GROUP 7

TRANSMISSION

CLUTCH

CONTENTS

DESCRIPTION AND OPERATION

CLUTCH PEDAL MECHANISM

GT Only

The pedal lever pivots on a tubular steel shaft and operates the clutch release yoke thru a sheathed cable attached directly to the upper end of the pedal lever. Pedal return is accomplished thru the cable by the clutch yoke return spring at the transmission. The pedal return stop is a nonadjustable rubber bumper inserted through the upper end of the pedal leverjust below the cable attaching point. The clutch cable is sheathed in woven steel and weather protected by a plastic and fabric covering. An eyelet is wedged on the upper end and fits over a formed hook on the upper end of the pedal. The lower end is provided with a swedged ball stud arrangement that slips into a slot in the clutch release lever. See Figure 7A-6.

Opel 1900 and Manta

The pedal lever pivots on a tubular steel shaft and operates the clutch release yoke through a sheathed cable attached directly to the upper end of the pedal lever. Pedal return is accomplished through a spring attached to the pedal below the pivot shaft and to the pedal assembly mounting bracket at the bulkhead. Clutch actuation works without pedal-free travel and a warning device is provided which actuates an indicator lamp in the instrument panel indicating necessity of clutch adjustment. The clutch cable is sheathed in woven steel and weather protected by a plastic fabric covering. An eyelet is wedged on the upper end and fits over a formed hook on the upper end of the pedal. The lower end is provided with a wedged ball stud arrangement that slips into a slot in the clutch release lever. See Figure 7A-7.

Clutch Mechanism

The clutch assembly is enclosed in the bell housing.

The clutch release bearing and release fork are of conventional design, with the fork pivoting on a ball stud located opposite the control cable attaching point. The bearing flange tits over two vertical pins which are riveted to and extend into the eye of the yoke.

The clutch pressure plate is similar in design to the Buick Century pressure plate. A radially slotted diaphragm pivoting on two steel wire rings is retained to the clutch cover by eight rivets. The clutch driven member is a 6-3/4 inches diameter single plate dry disc with torsional damper springs and spring leaves between facings to cushion application. Dampener springs in clutch disc assembly are preloaded.

DIAGNOSIS

CLUTCH TROUBLE DIAGNOSIS

Condition	Possible Cause	Correction
Fails to release (pedal pressed to floor - shift lever does not move freely in and out of "Reverse" gear.	1. Improper cable adjustment.	1. Adjust cable.
	2. Faulty pilot bearing.	2. Replace bearing.
	3. Faulty driven plate.	3. Replace driven plate.
	4. Yoke off ball stud.	4. Install properly.
	5. Clutch driven plate hub binding on main drive gear spline.	5. Repair or replace main drive gear.
Slipping	1. Improper adjustment (no lash).	1. Adjust cable.
	2. Oil-soaked driven plate.	2. Install new driven plate and correct oil leak at its source.
	3. Worn facing or facing torn from driven plate.	3. Replace driven plate.
	4. Warped pressure plate or flywheel.	4. Replace same.
	5. Weak diaphragm spring.	5. Replace cover assembly.
	6. Driven plate not seated in.	6. Make 20-50 normal starts.
	7. Driven plate overheated.	7. Allow to cool - check lash.
Grabbing	1. Oil on facing or burned or glazed facings.	1. Repair oil leak and install new driven plate.
	2. Worn splines on main drive gear.	2. Replace transmission main drive gear.
	3. Loose engine mountings.	3. Tighten or replace mountings.
	4. Warped pressure plate or flywheel.	4. Replace pressure plate or flywheel.
	5. Burned or smeared resin on flywheel or pressure plate.	5. Sand off if superficial, replace burned or heat checked parts.

Condition	Possible Cause	Correction
Rattling - Transmission Click	1. Yoke loose on ball stud in bearing groove.	1. Check ball stud and retaining spring and replace if necessary.
	2. Oil in driven plate damper.	2. Replace driven plate.
	3. Driven plate damper spring failure.	3. Replace driven plate,
Throw-out bearing noise with clutch fully engaged.	1. Improper adjustment.	1. Adjust cable.
	2. Throw-out bearing binding on transmission bearing retainer.	2. Clean, relubricate, check for burrs, nicks, etc.
	3. Insufficient tension between yoke and ball stud.	3. Replace yoke.
	4. Yoke improperly installed.	4. Install properly.
	5. Weak linkage return spring.	5. Replace spring.
Noisy	1. Worn throw-out bearing.	1. Replace bearing.
	2. Fork off ball stud (heavy clicking).	2. Install properly.
Pedal stays on floor when disengaged.	1. Bind in cable.	1. Lubricate and free up cable.
	2. Spring weak in pressure plate.	2. Replace
	3. Weak linkage return spring.	3. Replace
High Pedal Effort	1. Bind in cable.	1. Lubricate and free up cable.
	2. Driven plate worn.	2. Replace driven plate.
Clutch facings worn near rivets.	1. Normal wear.	1. Replace driven plate assembly only, and readjust clutch pedal and cable.
Pressure plate assembly friction surface badly scored or rough.	1. Improper clutch pedal lash causing pressure plate to come in contact with rivets.	1. If roughness can be smoothed with fine emery cloth, do not replace pressure plate assembly; if it cannot, replace the pressure plate and driven plate assembly. Adjust clutch.

Condition	Possible Cause	Correction
Heat-blued driven plate and pressure plate assembly.	1. Improper pedal adjustment.	1. Replace only driven plate, and adjust clutch pedal and cable.
Grab and chatter with oil present on clutch assembly.	1. Oil leak.	1. Correct oil leakage, clean pressure plate in solvent, replace driven plate and adjust pedal lash.

MAINTENANCE AND ADJUSTMENTS

CLUTCH LASH ADJUSTMENT

GT

Pedal lash, free pedal travel must be adjusted occasionally to compensate for normal wear of the clutch facings. As the driven plate wears thinner, pedal lash decreases. Adjust clutch pedal free travel only with ball stud located on right side of clutch housing if cable length is not to be changed. To adjust pedal lash proceed as follows:

1. Loosen lock nut on ball stud end located to the right of the transmission on the clutch housing. Position ball stud so that the outer end protrudes 3/4 inches out of housing and finger tighten lock nut. See Figures 7A-1 and 7A-6.

2. Adjust ball stud, pivoting clutch release fork, to obtain 3/4 to 1-1/4 inches pedal lash, free pedal. See Figure 7A-6.

Opel 1900 and Manta

The clutch actuation works without clutch pedal free travel. A readjustment of the clutch is only required if the indicator lamp at the instrument panel lights up.

In synchronism with the gradual wear of the clutch linings the clutch pedal travels from its basic adjustment position upwards, *i.e.,* towards driver. If the clutch lining wear has reached such an extent that the clutch pedal rests against switch, the indicator lamp at the instrument panel lights up.

This is an indication that the clutch pedal position has to be corrected to ensure proper clutch operation.

To ensure proper clutch operation, observe the following adjustment instructions.. For all adjustment dimensions, refer to Figure 7A-7.

1. If the parking brake is provided with an indicator lamp, the parking brake has to be disengaged, otherwise the same indicator lamp as for the clutch lights up.

2. Carry out adjustment only with ball stud on clutch housing whereby the distance (Item 20, Figure 7A-7) between clutch housing contacting surface and clutch release lever has to be adjusted in the rear to 4 1/4 inches.

Clutch Control Cable Adjustment(Only on Installation of a New Clutch Disc or Bowden Control Wire)

GT

1. Adjust ball stud so that outer end protrudes approximately 3/4 inches out of clutch housing.

2. Adjust distance between release lever and clutch housing face at eye for control cable to approximately 4 1/4 inches. See Figure 7A-6. Hold cable in this position and place E-ring two grooves ahead of washer on rubber grommet. Clutch pedal free travel is now between 3/4 and 1 1/4 inches and clutch release bearing has proper clearance from pressure plate.

Opel 1900 and Manta

1. Adjust ball stud on clutch housing to basic dimension of approximately 3/4 inch. With lower end of bowden control wire unhooked, push clutch release lever towards the front so that the clutch release bearing rests against clutch spring. Now, adjust ball stud so that the dimension (Item 20, Figure 7A-7) between clutch housing contacting surface and clutch release lever amounts in the rear to 4 1/4 inches.

2. Pull reattached bowden control wire out of dash panel so that clutch pedal rests against switch (indicator lamp lights up).

3. In this position, install lockwasher at upper control wire attachment three grooves towards the front, thereby completing control wire adjustment.

MAJOR REPAIR

CLUTCH REMOVAL AND INSTALLATION

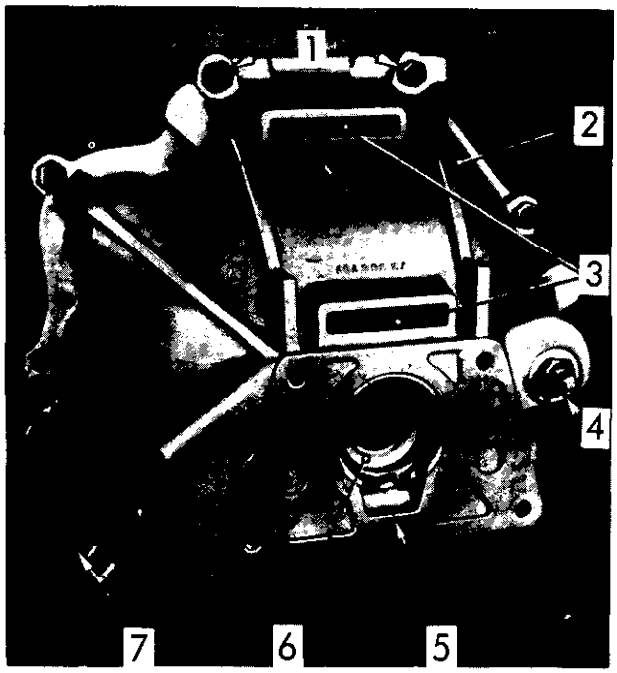
Remove Clutch

1. Remove transmission. Refer to Manual Transmission for removal procedure.

2. Remove bolts from engine support **brackets,** both sides. Let brackets hang by front bolts.

3. Remove flywheel cover pan.

4. Remove flywheel housing to engine attaching bolts and pry housing from locating pins. See Figure 7A-1.

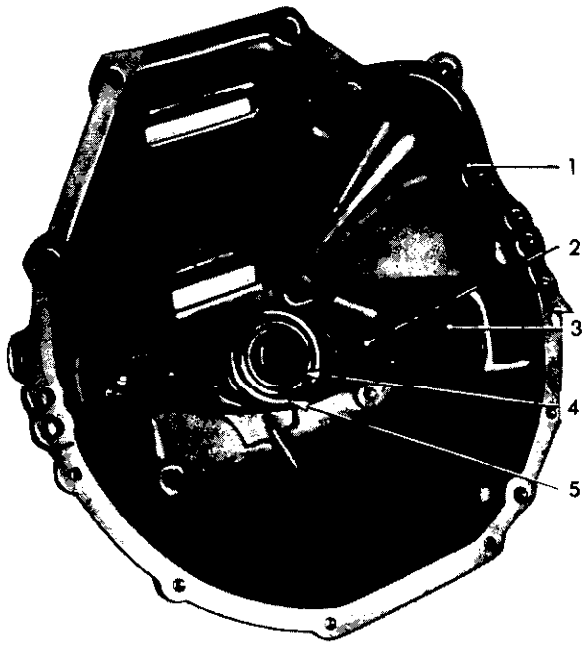


1. UPPER ATTACHING BOLTS
2. FLYWHEEL HOUSING
3. VENT HOLES
4. CLUTCH RELEASE LEVER BALL STUD AND LOCK NUT
5. RECESS IN FLYWHEEL HOUSING
6. CLUTCH RELEASE BEARING SLEEVE
7. CLUTCH RELEASE LEVER AND BOOT

7A-1

Figure 7A-1

5. To remove release bearing from clutch fork, slide lever off ball stud against spring action. Remove ball stud lock nut and remove stud from housing. See Figure 7A-2.



1. FLYWHEEL HOUSING
2. CLUTCH RELEASE LEVER
3. RELEASE LEVER BOOT
4. RELEASE BEARING SLEEVE
5. CLUTCH RELEASE BEARING

7A-2

Figure 7A-2

6. If assembly marks on clutch assembly and flywheel have **become** indistinct, renew with paint or centerpunch.

7. Loosen clutch cover to flywheel attaching bolts one turn at a time to avoid bending of clutch cover flange until spring pressure is released.

8. Support the pressure plate and cover assembly while removing last bolt, then remove pressure plate and clutch driven plate assemblies. Clutch cover, spring, and pressure plate must not be disassembled. If necessary, replace complete assembly.

Inspection of Clutch

Wash all metal parts of clutch, except release bearing and driven plate, in suitable cleaning solution to remove dirt and grease. Soaking release bearing in cleaning solution would permit solution to seep into bearing and destroy the lubricant. Soaking driven plate in cleaning solution would damage the facings.

1. *Flywheel and Pressure Plate*

Examine friction surfaces of flywheel and pressure plate for scoring or roughness. Slight roughness may be smoothed with fine emery cloth, but if surface is deeply scored or grooved the part should be replaced.

2. *Clutch Driven Plate*

Inspect driven plate for condition of facings, loose rivets, broken or very loose torsional springs.

If facings are worn down near rivets or are oily, the plate assembly should be replaced. A very slight amount of oil on clutch facings will cause clutch grab and chatter. A large amount of oil on facings will cause slippage. Removal of oil by solvents or by buffing is not practical since oil will continue to bleed from facing material when hot.

When oil is found on driven plate facings, examine transmission drainback hole, pilot bushing, engine rear main bearing and other points of possible oil leakage.

Test the fit of driven plate hub on transmission main drive gear for an easy sliding fit.

Regardless of whether the old plate or a new one is to be installed, the plate should be checked for run-out. Lateral run-out measured at disc circumference should not exceed .016 inch.

3. *Bearings*

Inspect clutch release bearing for scoring or excessive wear on front contact face. Test for roughness of balls and races by pressing and turning front race slowly. Inspect main drive gear pilot bushing in crankshaft. If bushing is rough or worn it should be replaced. If replacement is necessary, remove bearing with Tool J-21718 and Slide Hammer J-7004-1. Install new bearing using J-21706. See Figure 7A-3 for removal procedure and Figure 7A-4 for installation.

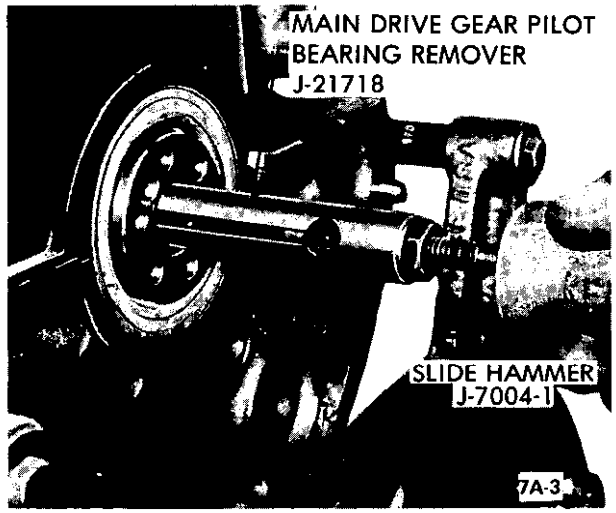


Figure *JA-3*

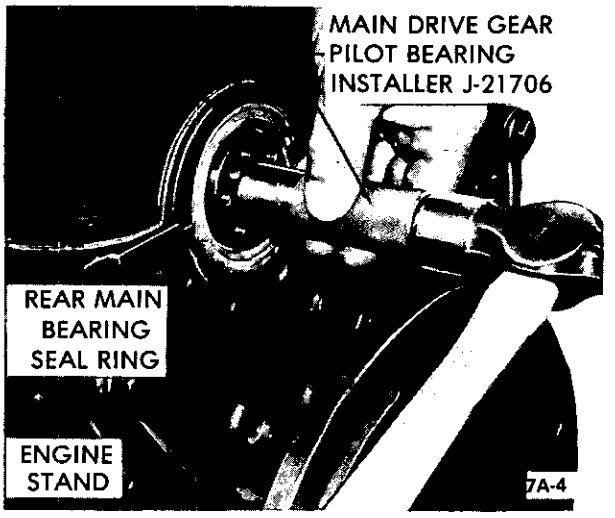


Figure *JA-4*

Installation of Clutch

1. Index alignment marks on clutch assembly and flywheel. Place driven plate on pressure plate with long end of splined hub facing ***forward*** toward the flywheel. See Figure 7A-5.

2. Insert alignment Tool J-22934 through clutch cover and driven plate.

3. Hold complete assembly against flywheel while inserting end of Tool J-22934 into pilot bearing in crankshaft.

4. Index the alignment marks and install four (4) clutch cover to flywheel bolts finger tight. Complete torquing bolts alternately and evenly one at a time.

5. Torque attaching bolts to 36 lb.ft. and remove alignment tool.

6. Install release bearing.

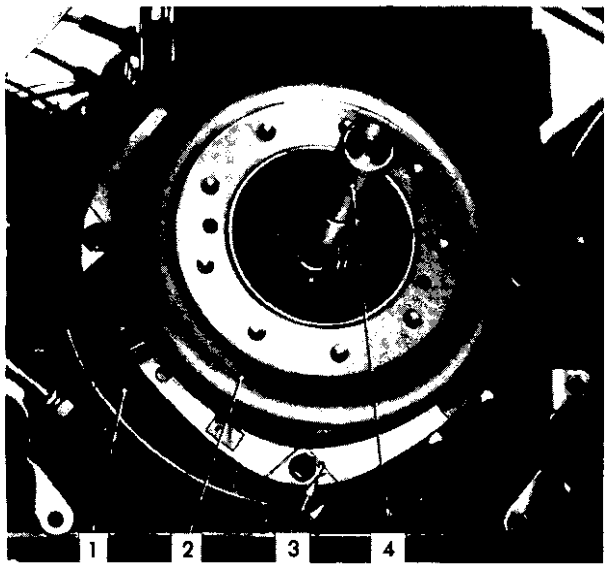
7. Install flywheel housing and torque lower bolts to 36 lb.ft.

8. Install flywheel housing lower cover.

9. Install clutch return spring and control cable.

10. Install transmission. See Manual Transmission Section for procedure.

11. Adjust clutch control cable. Refer to paragraph 7A-3.



1. FLYWHEEL
2. CLUTCH ASSEMBLY
3. ASSEMBLY MARKS
4. CLUTCH ALIGNING ARBOR J-22934

7A-5

Figure 7A-5 Clutch Installation

CLUTCH CONTROL CABLE REMOVAL AND INSTALLATION
(SEE FIGURE 7A.6 OR 7A-7)

If a new cable was installed or the cable adjustment was changed during an operation, x-adjust cable afterwards.

Removal

1. Disconnect return spring and cable with ball end from release lever. Slide control cable out of eye in clutch housing.

2. With a screwdriver, pry E-ring out of groove in control cable, at tirewall, and disconnect cable from clutch pedal.

3. Pull cable out of retainer on dash panel and remove washers and rubber grommet.

Installation

1. Slide control cable ball end through eye in clutch housing. Connect to lever and (on GT) install return spring.

2. Replace washers and rubber grommet, slide cable through retainer on dash panel, and connect to clutch pedal. To adjust, refer back to Clutch Adjustment paragraph c or d.

SPECIFICATIONS

GENERAL SPECIFICATIONS

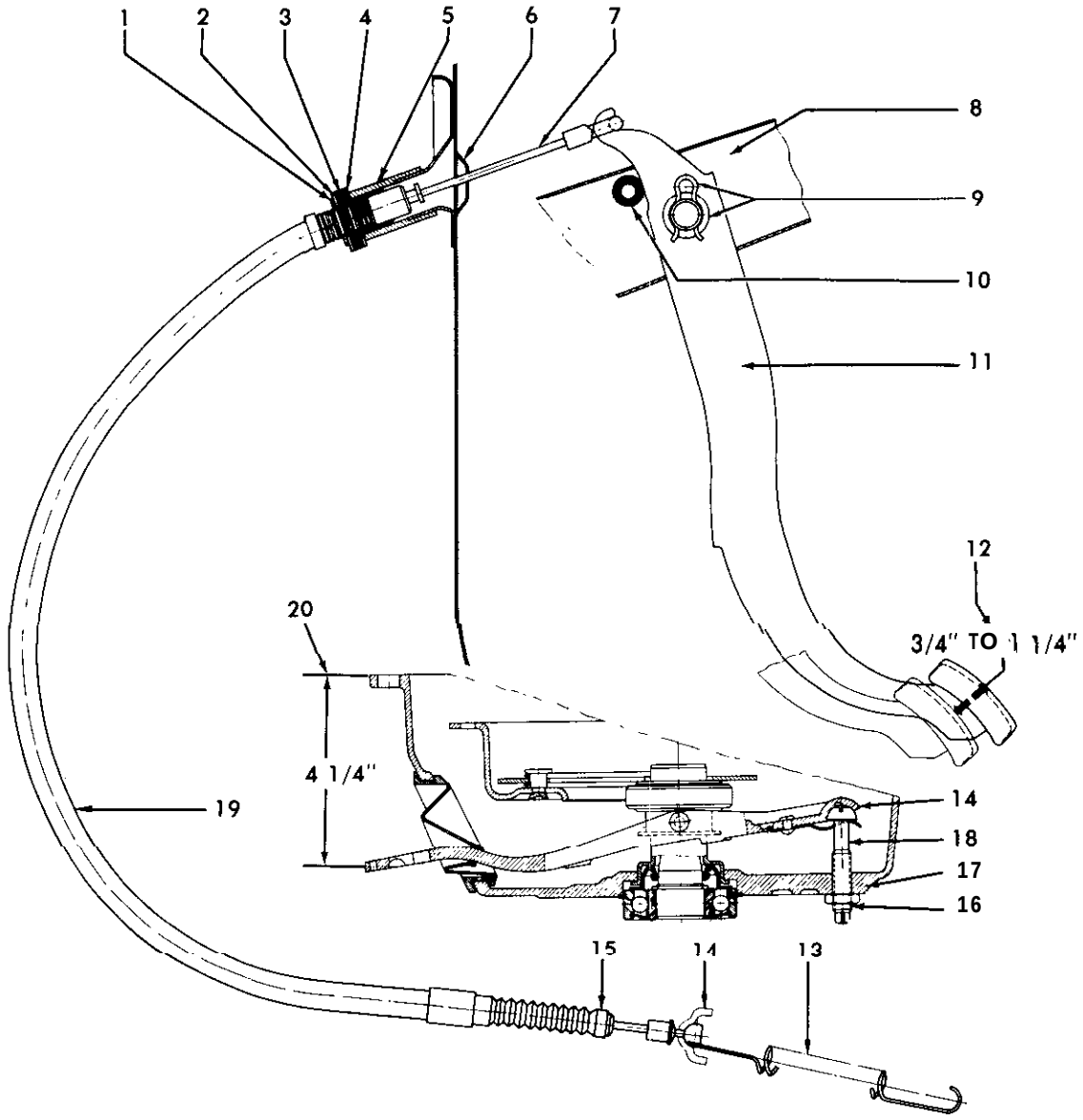
E-1

Clutch Specifications

Type	Single Plate - Dry Disc
Pedal Lash - 3/4" to 1-1/4"	
Driven Plate Diameter	6-3/4"
Driven Plate Facings	Woven Asbestos
Number of Facings	2
Facing Attachment	Riveted
Vibration Dampening	4 Torsional Springs

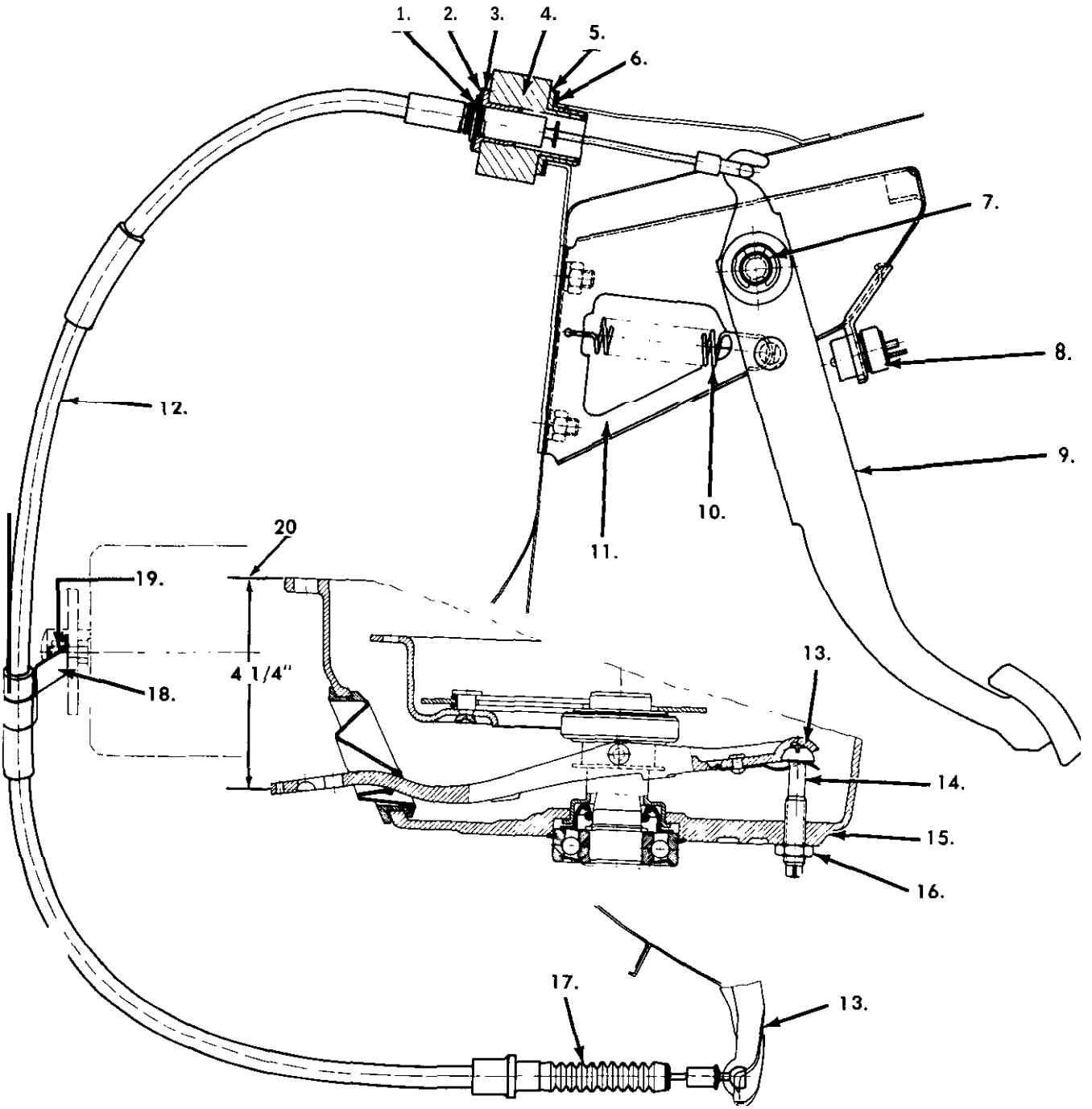
Bolt Tightening Specifications

Part	Location	Torque Lbs.Ft.
Bolt	Flywheel to Crankshaft	43
Bolt	Clutch Cover to Flywheel	36
Bolt	Transmission to Clutch Housing	32.36
Bolt	Starter to Clutch Housing	40
Nut	Support to Clutch Housing	4
Bolt	Intake and Exhaust Manifold to Cylinder Head	33



1. E-RING
2. WASHER
3. RUBBER GROMMET
4. WASHER
5. SLEEVE
6. DASH PANEL
7. BOWDEN CONTROL CABLE
8. BRACKET
9. WASHER, HAIRPIN CLIP
10. RUBBER STOP
11. CLUTCH PEDAL
12. CLUTCH PEDAL FREE TRAVEL- 3/4" TO 1 1/4"
13. RETURN SPRING
14. RELEASE LEVER
15. RUBBER BELLOWS
16. BALL STUD LOCK NUT
17. CLUTCH HOUSING
18. BALL STUD
19. BOWDEN CONTROL CABLE
20. DISTANCE BETWEEN RELEASE LEVER AND CLUTCH HOUSING

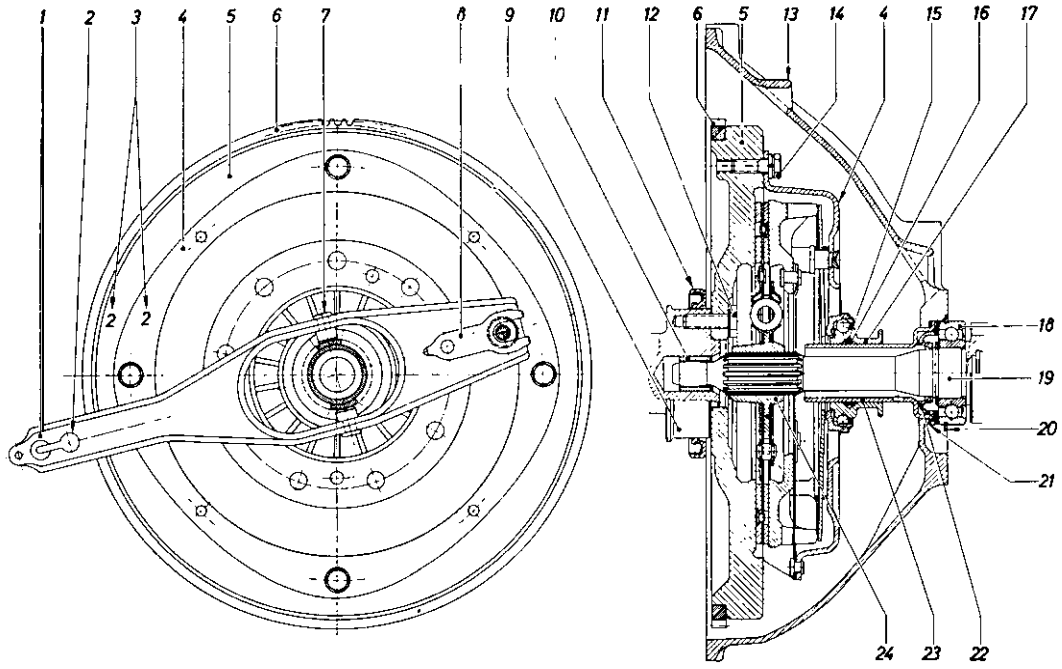
Figure 7A-6 Clutch Pedal Lash - GT Model



1. "E" RING
2. WASHER
3. RUBBER GROMMET
4. CLUTCH OPERATING DAMPER
5. GROMMET
6. WASHER
7. "E" RING
8. ADJUSTMENT SWITCH
9. CLUTCH PEDAL
10. RETURN SPRING
11. BRACKET
12. CABLE
13. RELEASE LEVER
14. BALL STUD
15. CLUTCH HOUSING
16. BALL STUD LOCK NUT
17. RUBBER BELLOWS
18. CABLE SUPPORT BRACKET
19. NUT, CABLE SUPPORT BRACKET
20. DISTANCE BETWEEN RELEASE LEVER AND CLUTCH HOUSING

JA-7

Figure *JA-7* Clutch Pedal Adjustment - Opel 1900 and Manta



Arrangement Of Clutch

1 Clutch release lever

2 Slot in lever for control cable boll end

3 Assembly marks

4 Clutch assembly

5 Flywheel

6 Flywheel ring gear

7 Thrust pin

8 Retaining spring

9 Crankshaft

10 Clutch gear pilot bushing

11 Oil seal

12 Flywheel bolt

13 Clutch housing

14 Clutch assy. bolt, lockwasher

15 Hollow space under felt ring filled with molybdenum disulfide paste

16 Felt ring

17 Clutch release bearing

18 Clutch gear ball bearing

19 Clutch gear

20 Snap ring

21 Paper gasket

22 Clutch gear oil seal

23 Clutch release bearing sleeve

24 Clutch disc, long end of hub facing forward.

Figure 7A-8 Arrangement of Clutch

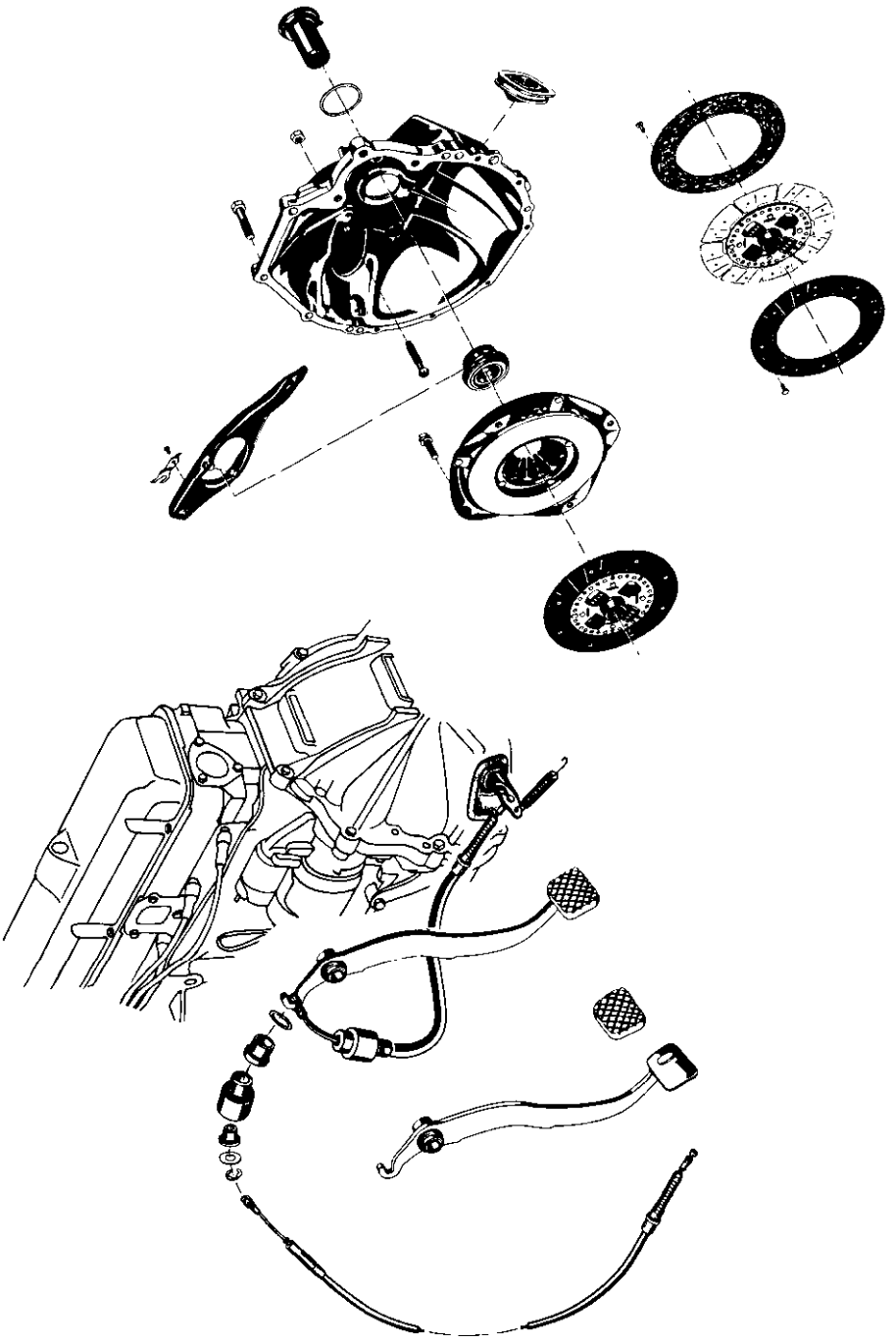


Figure 7A-9 Exploded View of Clutch Pedal and Housing

MANUAL TRANSMISSION

CONTENTS

POWER FLOW

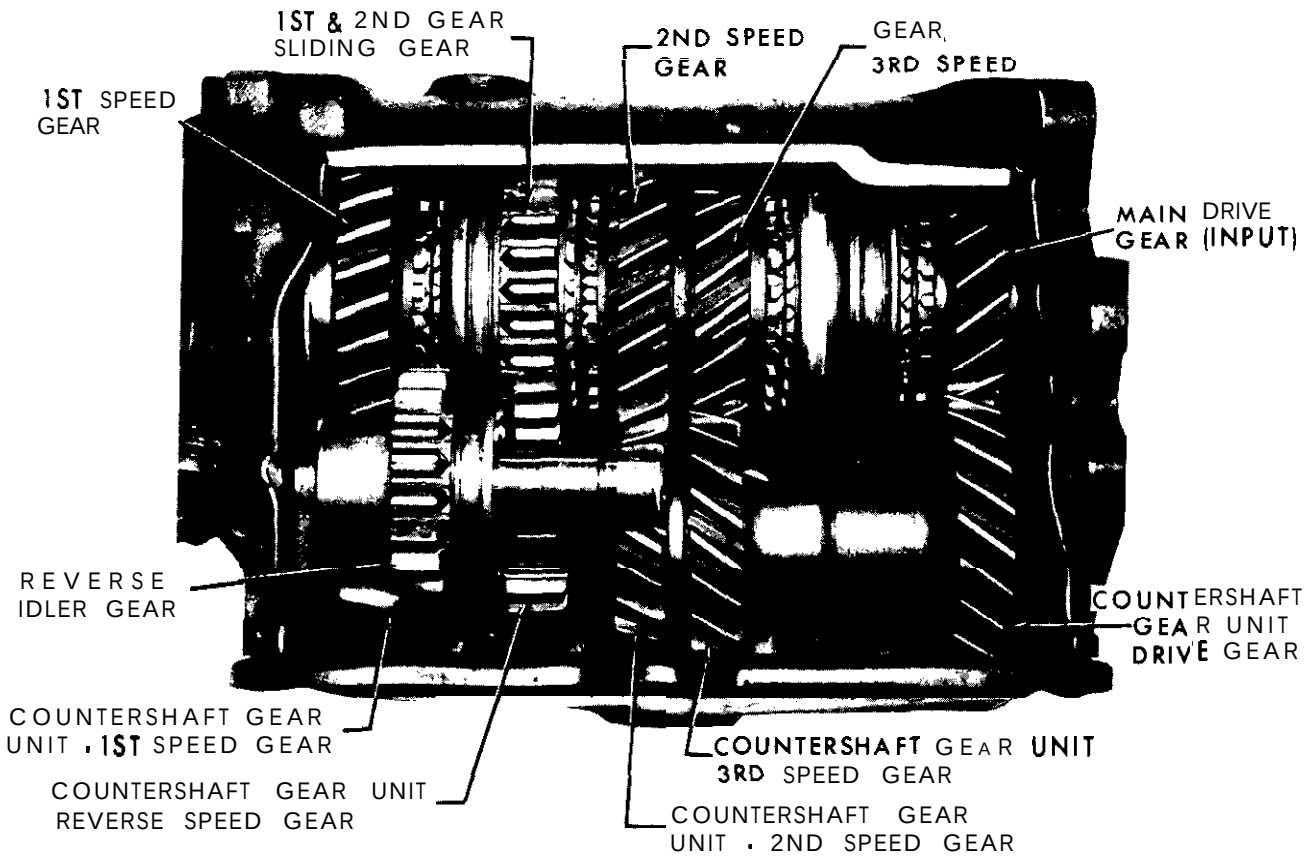
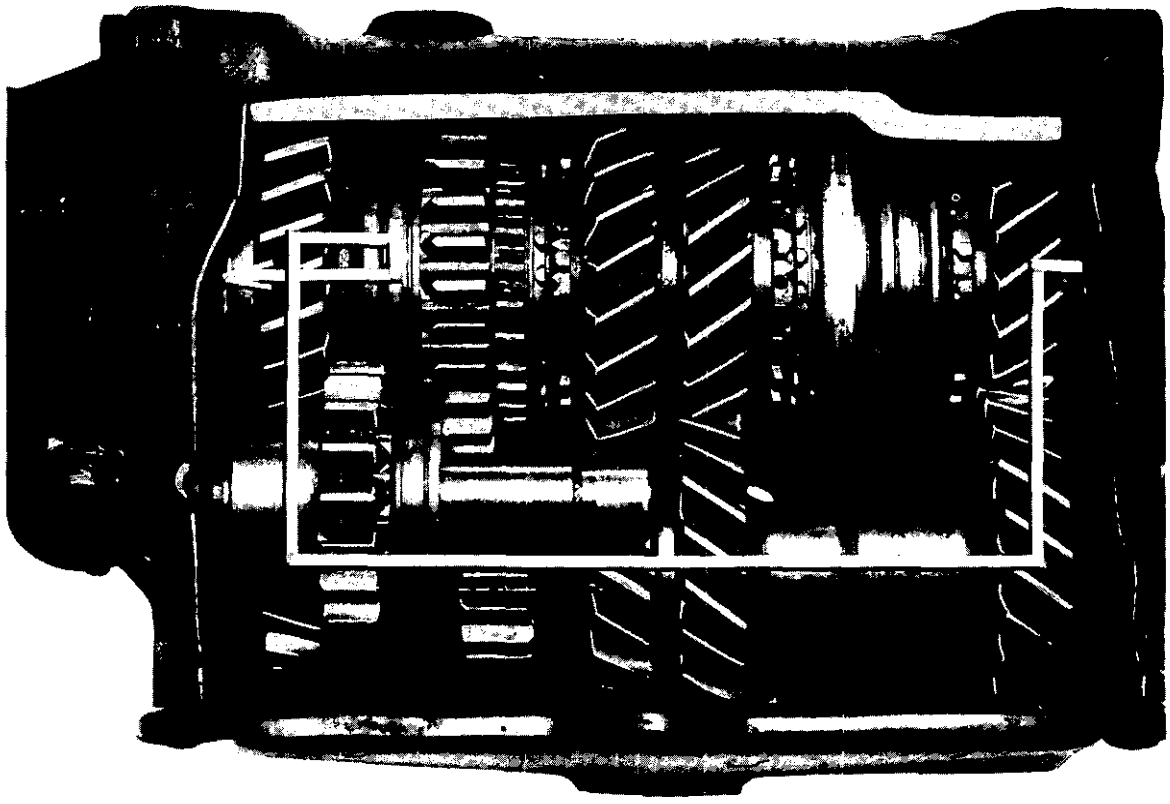


Figure 7B-1

Neutral Position

The countershaft gear unit and the mainshaft lst, 2nd, and 3rd speed gears are all idling in "Neutral" position. The reverse idler gear is not engaged or in mesh with any gear and, therefore, it is idle.



POWER FLOW - 1st SPEED

MAIN DRIVE GEAR (INPUT)
COUNTERSHAFT GEAR UNIT 1st SPEED GEAR
1 st SPEED GEAR
1st AND 2nd GEAR SLIDING GEAR
1st AND 2nd SPEED SLIDING GEAR GUIDE UNIT
COUNTERSHAFT GEAR UNIT DRIVE GEAR
1st SPEED GEAR
1st AND 2nd GEAR SLIDING GEAR
1st AND 2nd SPEED SLIDING GEAR GUIDE UNIT
MAINSHAFT (OUTPUT)

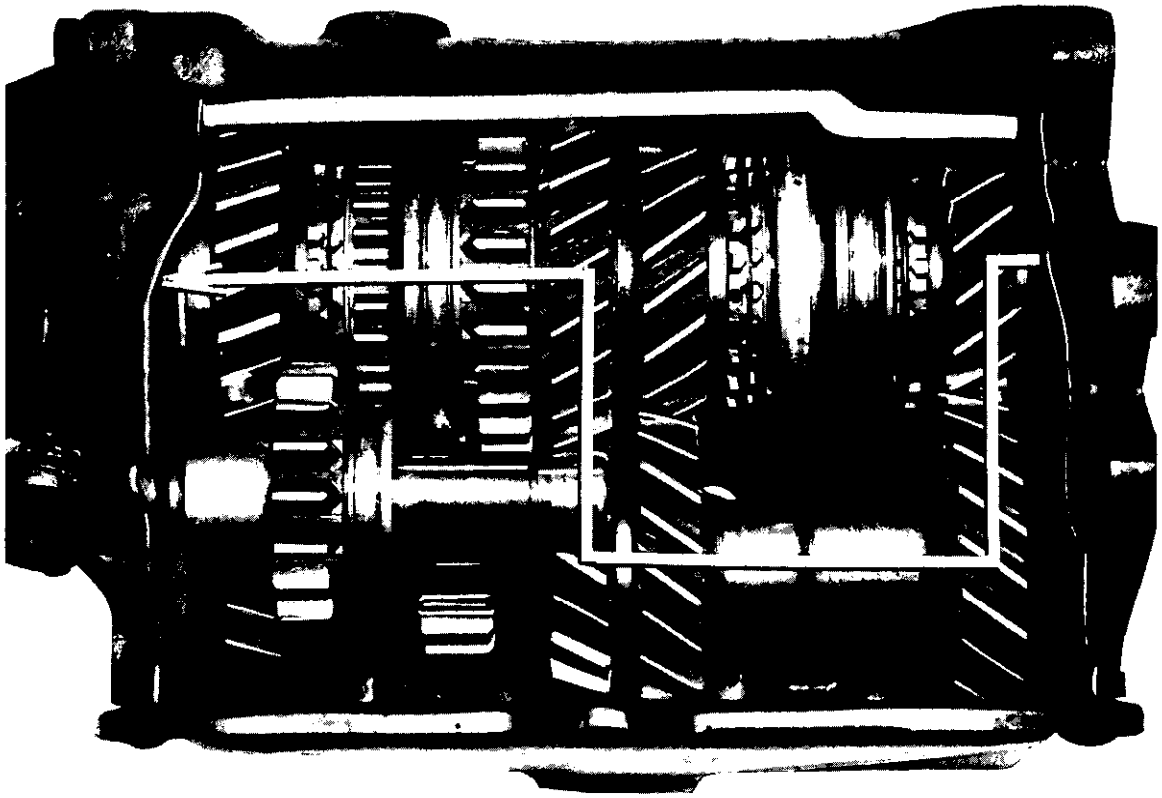
7B-2

Figure 7B-2

First Speed

After synchronizing the speeds of the mainshaft and the 1st speed gear, the 1st and 2nd gear sliding gear shifts to the rear of the transmission and locks the 1st speed gear to the mainshaft through the 1st and 2nd speed sliding gear guide unit. This 1st and 2nd speed sliding gear guide unit is internally splined to the 1st and 2nd gear sliding gear and is externally splined to the mainshaft. Both the **3rd** speed gear and the 2nd speed gear are idling. The reverse idler gear is *not* engaged with any gear and, therefore, it is idle.

With a 1st speed gear ratio of 3.428:1, the main drive gear (input) must turn 3.428 revolutions for every one revolution of the main shaft (output).



POWER FLOW. 2nd SPEED

MAIN DRIVE GEAR (INPUT)
COUNTERSHAFT GEAR UNIT 2nd SPEED GEAR
2nd SPEED GEAR
1st AND 2nd GEAR SLIDING GEAR
1st AND 2nd SPEED SLIDING GEAR GUIDE UNIT
COUNTERSHAFT GEAR UNIT DRIVE GEAR
2nd SPEED GEAR
1st AND 2nd GEAR SLIDING GEAR
1st AND 2nd SPEED SLIDING GEAR GUIDE UNIT
MAINSHAFT (OUTPUT)

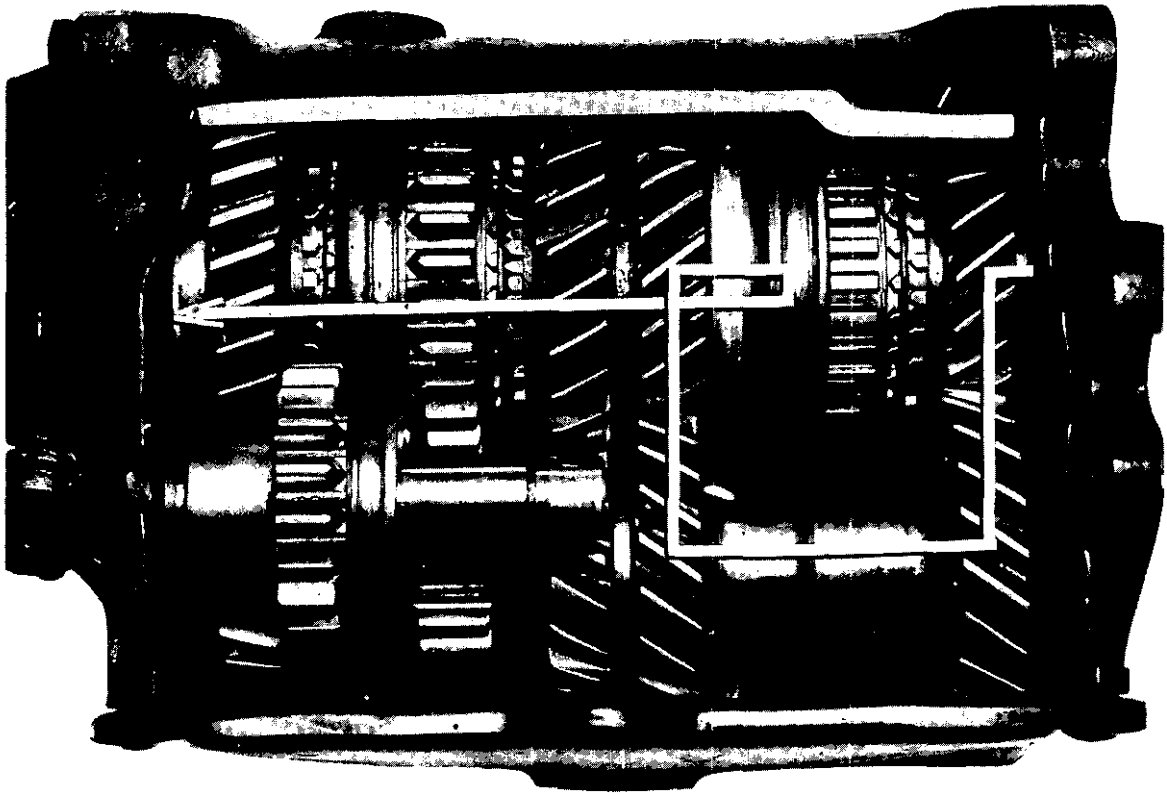
7B-3

Figure 7B-3

Second Speed

After synchronizing the speeds of the mainshaft and the 2nd speed gear, the 1st and 2nd gear sliding gear shifts toward the front of the transmission and locks the 2nd speed gear to the mainshaft through the 1st and 2nd speed sliding gear guide unit. This 1st and 2nd speed sliding gear guide unit is internally splined to the 1st and 2nd gear sliding gear and is externally splined to the mainshaft. Both the 3rd speed gear and the 1st speed gear are idling. The reverse idler gear is not engaged with any gear and, therefore, it is idle.

With a 2nd speed gear ratio of 2.156:1, the main drive gear (input) must turn 2.156 revolutions for every one revolution of the mainshaft (output).



POWER FLOW - 3rd SPEED

MAIN DRIVE GEAR (INPUT)
COUNTERSHAFT GEAR UNIT 3rd SPEED GEAR
3rd SPEED GEAR
GEAR SHIFTER SLEEVE
GEAR SHIFTER SLEEVE CARRIER
COUNTERSHAFT GEAR UNIT GEAR DRIVE
3rd SPEED GEAR
GEAR SHIFTER SLEEVE
GEAR SHIFTER SLEEVE CARRIER
MAIN SHAFT (OUTPUT)

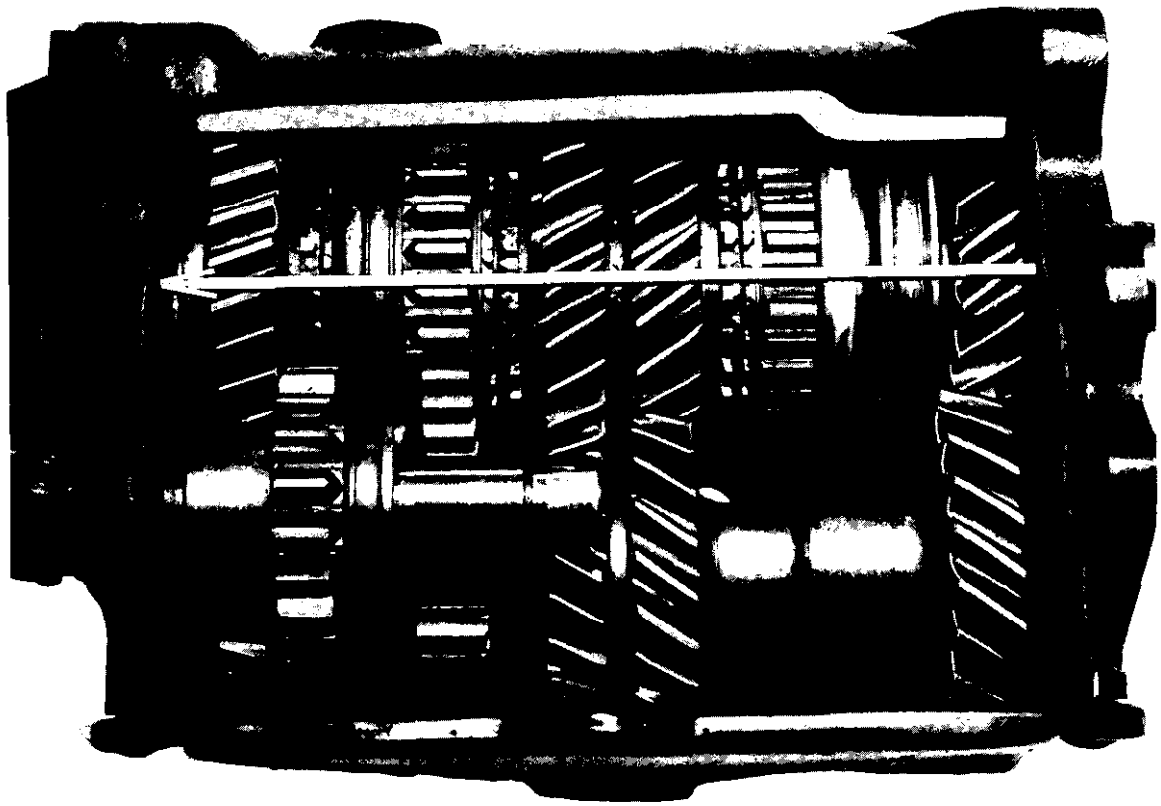
7B-4

Figure 7B-4

Third Speed

After synchronizing the speeds of the mainshaft and the 3rd speed gear, the gear shifter sleeve shifts to the rear of the transmission and locks the 3rd speed gear to the mainshaft through the gear shifter sleeve carrier. This gear shifter sleeve carrier is internally splined to the gear shifter sleeve and is externally splined to the mainshaft. Both the 1st speed gear and the 2nd speed gear are idling. The reverse idler gear is *not* engaged with any gear and, therefore, it is idle.

With a 3rd speed gear ratio of 1.366:1, the main drive gear (input) must turn 1.366 revolutions for every one revolution of the mainshaft (output).



POWER FLOW - 4th SPEED

MAIN DRIVE GEAR (INPUT)
GEAR SHIFTER SLEEVE
GEAR SHIFTER SLEEVE CARRIER
GEAR SHIFTER SLEEVE
GEAR SHIFTER SLEEVE CARRIER
MAIN SHAFT (OUTPUT)

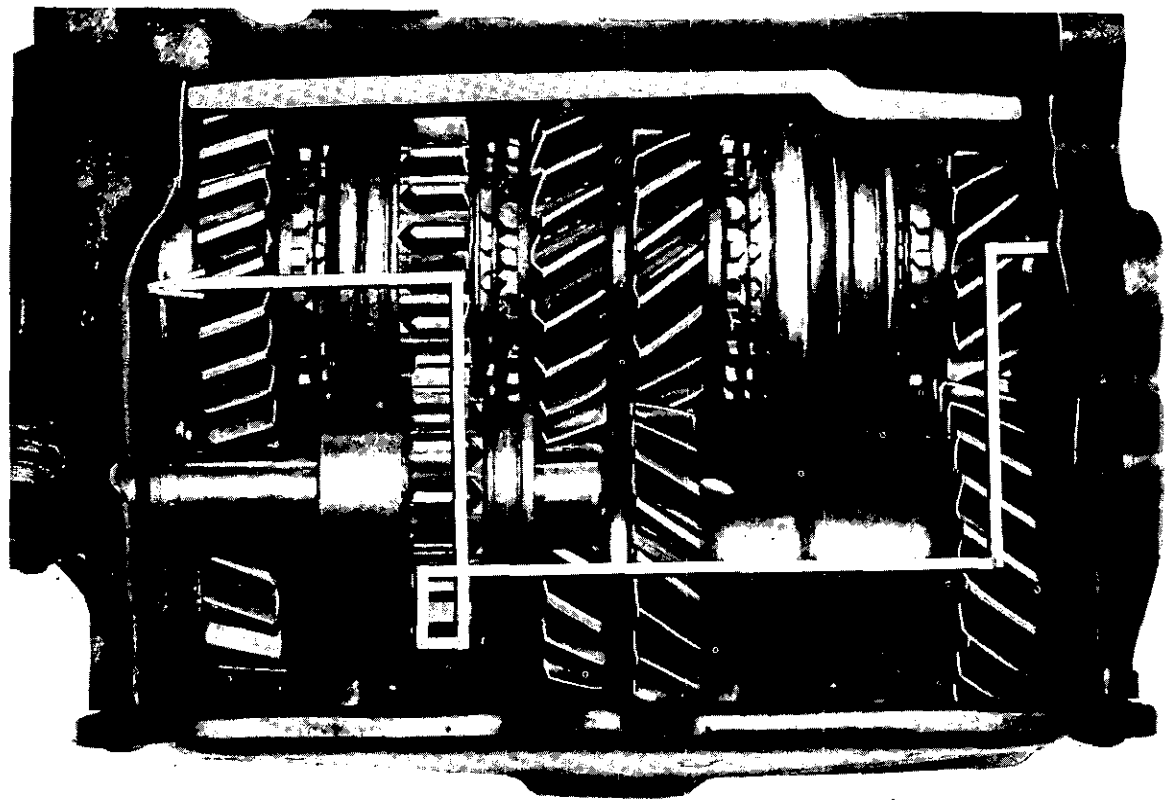
7B-5

Figure 7B-5

Fourth Speed

After synchronizing speeds of the main drive gear and mainshaft, the gear shifter sleeve shifts forward and locks the main drive gear to the mainshaft through the gear shifter sleeve carrier. This carrier is internally splined to the gear shifter sleeve and is externally splined to the mainshaft. The 3rd speed gear, 2nd speed gear, and the 1st speed gear are all idling. The reverse idler gear is *not* engaged with any gear and, therefore, it is idle.

With a 4th speed gear ratio of 1.000: 1, the main drive gear (input) must turn 1.000 revolutions for every one revolution of the mainshaft (output).



POWER FLOW - REVERSE SPEED

MAIN DRIVE GEAR (INPUT)
COUNTERSHAFT GEAR UNIT REVERSE SPEED GEAR
REVERSE IDLER GEAR
1st AND 2nd GEAR SLIDING GEAR
1st AND 2nd SPEED SLIDING GEAR GUIDE UNIT
COUNTERSHAFT GEAR UNIT DRIVE GEAR
REVERSE IDLER GEAR
1st AND 2nd GEAR SLIDING GEAR
1st AND 2nd SPEED SLIDING GEAR GUIDE UNIT
MAINSHAFT (OUTPUT)

7B-6

Figure 7B-6

Reverse Speed

Through the engagement of the reverse idler gear with the 1st and 2nd gear sliding gear (mainshaft) and the countershaft gear unit reverse speed gear, the drive is bridged between the countershaft gear unit and the mainshaft through the guide unit. The direction of the mainshaft is reversed. The guide unit is located between the 1st and 2nd gear sliding gear and the mainshaft. The guide unit is internally splined to the 1st and 2nd gear sliding gear, and it is externally splined to the mainshaft. The 3rd speed gear, 2nd speed gear, and the 1st speed gear are all idling. With a reverse **speed** gear ratio of -3.3 17: 1, the main drive gear (input) must turn 3.317 revolutions for every one revolution of the mainshaft (output). The "-" sign indicates that the direction of rotation of the mainshaft is opposite that of the main drive gear.

DIAGNOSIS

MANUAL TRANSMISSION DIAGNOSIS

Condition	Possible Cause
Noisy in Forward Speeds	1) Low lubricant level. 2) Incorrect lubricant. 3) Transmission misaligned or loose. 4) Front main bearing worn or damaged. 5) Mainshaft bearing worn or damaged. 6) Countergear or bearings worn or damaged, 7) Main drive gear worn or damaged. 8) Synchronizers worn or damaged.
Noisy in "Reverse"	1) Reverse sliding gear or shaft, worn or damaged
Hard Shifting	1) Clutch improperly adjusted. 2) Shift shafts, or forks worn. 3) Incorrect lubricant. 4) Synchronizers worn or broken.
Jumping Out of Gear	1) Partial engagement of gear. 2) Transmission misaligned or loose. 3) Worn pilot bearing. 4) End play in main drive gear (bearing retainer loose or broken, loose or worn bearings on main drive gear and mainshaft). 5) Worn clutch teeth on main drive gear and/or worn clutch teeth on synchronizer sleeve. 6) Worn or broken blocking rings. 7) Bent mainshaft.
Sticking in Gear	1) Clutch not releasing fully. 2) Low lubricant level. 3) Incorrect lubrication. 4) Defective (tight) main drive gear pilot bearing. 5) Frozen blocking ring on main drive gear cone. 6) Burred or battered teeth on synchronizer sleeve and/or main drive gear.

MAINTENANCE AND ADJUSTMENTS

ADJUSTING REVERSE GEARSHIFT BLOCKER

1. Engage second speed.

2. Adjust selector ring (a) so that ball on lower end of shift finger has an equal clearance on both sides when seated into the transmission case extension bolt hole. See Figure 7B-7.

3. Back off selector ring an additional 1/4 of a turn and tighten lock nut (B). See Figure 7B-7.

SERVICING GEARSHIFT LEVER

Removal

1. Unscrew console from floor panel, on small console remove three (3) attaching screws, on large console remove four (4) attaching screws. The fourth screw is accessible after removal of the ash tray. See Figure 7B-8.

2. Remove rubber bellows from cover plate and from below unbutton protective cap arranged around intermediate shift lever.

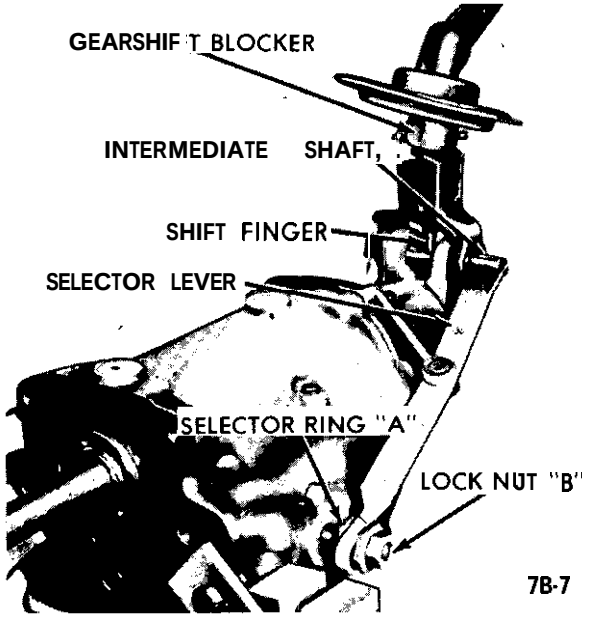


Figure 7B-7 **Reverse Gearshift Blocker Adjustment**

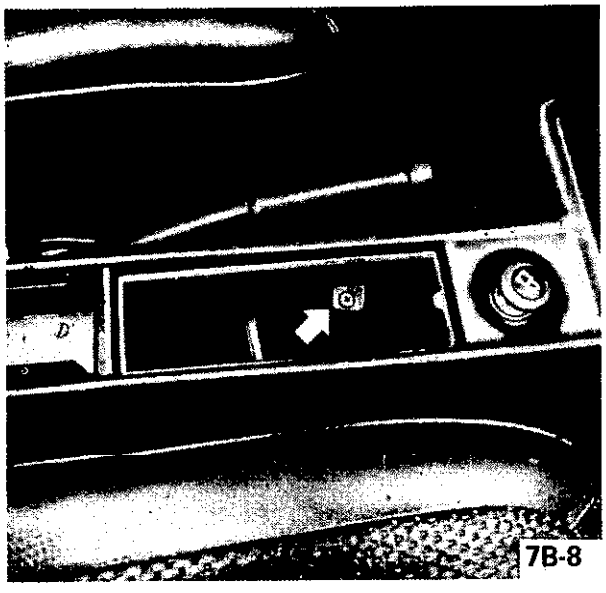


Figure 7B-8

3. Unhook tension spring of gearshift lever and, after removal of retaining washer, push pivot pin out of intermediate shift lever. See Figure 7B-10.

Installation

1. Prior to installation, grease support and spherical end of shift finger with protective grease.

2. Replace lever, pivot pin, retaining washer, and tension spring. Reposition protective cap and bellows and button cap from below. Replace console.

3. In Figure 7B-11, distance A = 8.07".

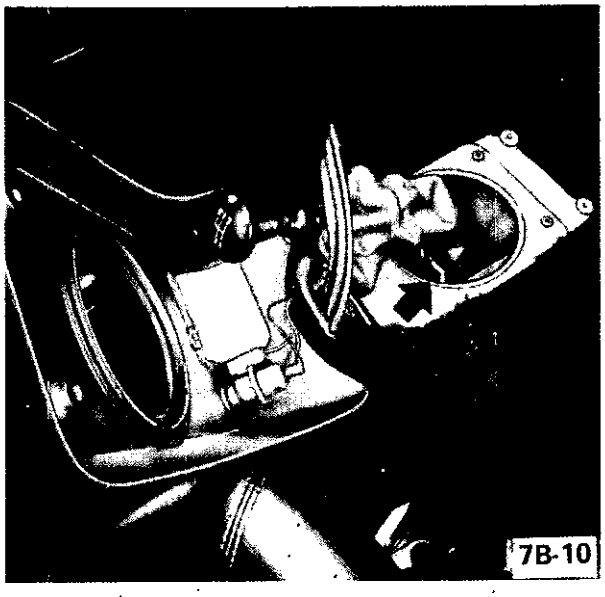


Figure 7B-10

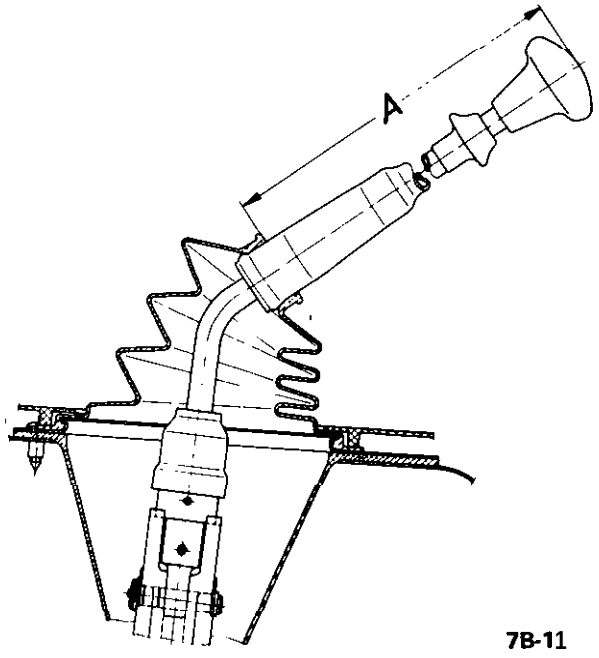


Figure 7B-11

4. After installation, check as to whether pull ring can be lifted up approximately .04 to .08", whereby the stop sleeve must still rest against intermediate shift lever. Otherwise, loosen threaded pin for Bowden control wire attachment. See Figure 7B- 12. Adjust distance B = free travel = by lifting up pull ring, and retighten threaded pin. See Figure 7B- 13.

REPLACING BOWDEN CONTROL WIRE IN GEARSHIFT LEVER

1. Remove gearshift lever.

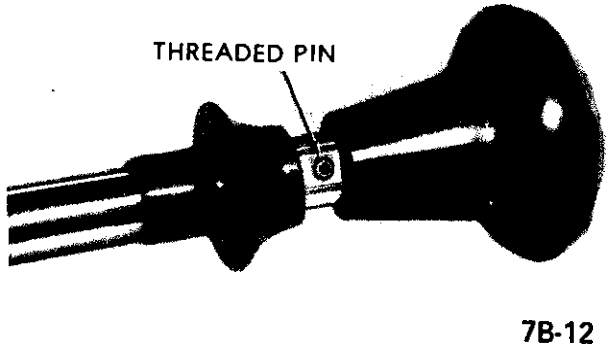


Figure 78-l 2

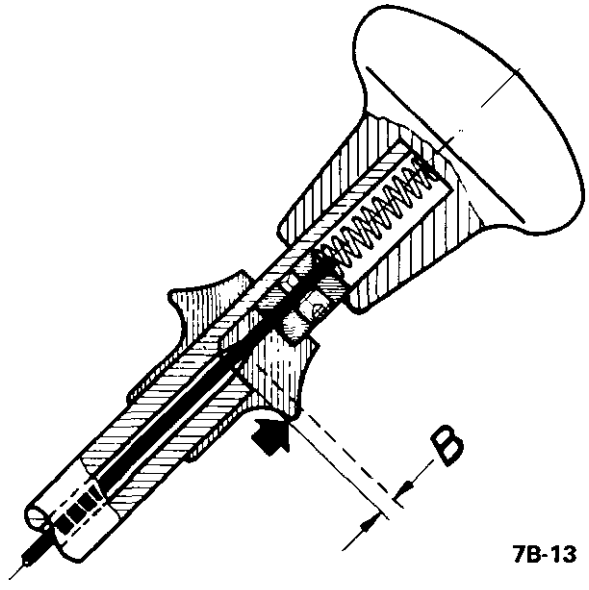


Figure 7B-13

2. Knock off gearshift lever button and loosen threaded pin for Bowden control wire attachment. See Figure 7B-12.

3. Drive spiral pin and clamping sleeve out of shift finger tube and stop sleeve. See Figure 7B-14.

4. Remove shift finger and pull Bowden control wire, together with thrust spring, out of gearshift lever.

5. Oil sliding surface of stop sleeve on shift finger tube with clutch oil.

6. After installation of thrust spring, attach new Bowden control wire first with clamping sleeve. When doing this, the cutout of stop sleeve in installation position shows to the left. The spiral pins must not protrude on either side.

7. Clamp tight Bowden control wire with threaded pin. Prior to tightening, pull ring must rest on gearshift lever tube and clamping block on pull ring.

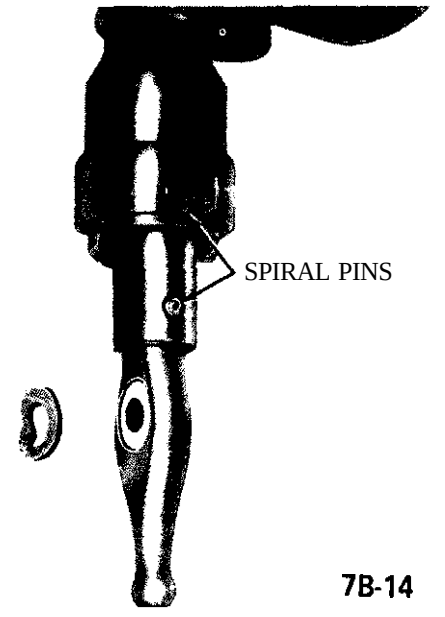


Figure 71-14

8. Heat up new gearshift lever knob in boiling water to 176 degrees F. and push it onto lever tube. Observe distance A = .3", see Figure 7B-15. The gearshift lever tube end is provided with transverse grooves for which reason the old button can no longer be used.

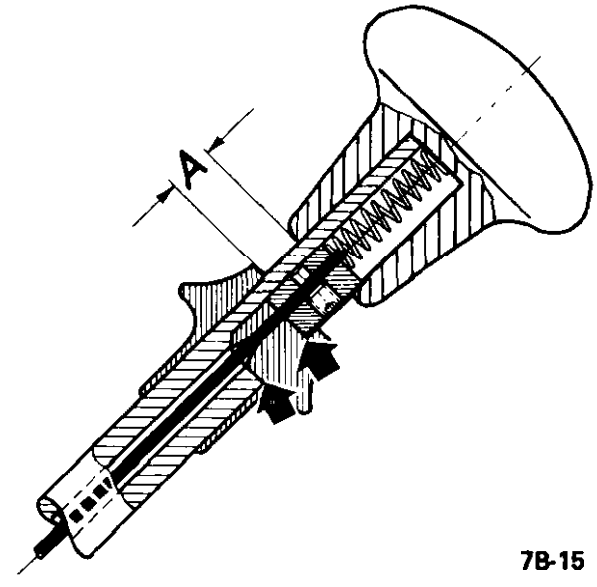


Figure 7B-15

9. Attach shift finger with spiral pin and install gearshift lever.

REPLACING GEARSHIFT LEVER BELLOWS

1. Remove gearshift lever.

2. Knock off gearshift lever button and pull off bellows over pull ring.

3. Install new bellows. Adhere to distance A ▪ 8.07". See Figure 7B-1 1.

4. Heat up new gearshift lever knob in boiling water to 176 degrees F. and push it onto gearshift lever tube. Adhere to distance A .3", see Figure 7B-15. The gearshift lever tube end is provided with transverse grooves for which reason the old button cannot be reused. Install gearshift lever.

REPLACING RUBBER DAMPENING PARTS IN GEARSHIFT LEVER

1. Remove gearshift lever.

2. Knock off gearshift lever button and loosen threaded pin for Bowden control wire attachment.

3. Remove lower snap ring from gearshift lever tube and pull tube off shift finger.

4. Take off and replace rubber dampening parts.

5. After installation of tube, tighten Bowden control wire with threaded pin. Prior to tightening, pull ring must rest on gearshift lever tube and clamping block on pull ring. See Figure 7B-15.

6. Heat up new gearshift lever knob in boiling water to 176 degrees F. and push it onto gearshift lever tube. Adhere to distance A ▪ .3", see Figure 7B-15. The gearshift lever tube end is provided with transverse grooves for which reason the old button cannot be reused.

7. Install gearshift lever.

MAJOR REPAIR

TRANSMISSION REMOVAL

1. Remove air cleaner. Remove throttle rod from carburetor and rear support and disconnect battery.

2. Remove screws from fan shroud.

3. Remove gearshift lever (refer to paragraph on servicing gearshift lever).

4. Support car with frame or wheel stands in the front or frame stands in the rear.

5. Loosen front exhaust pipe to manifold flange.

6. Remove clutch cable from fork by pushing fork to disengage the clutch and unsnap cable from slot.

7. Disconnect both wires from backup lamp switch.

8. Disconnect speedometer cable from transmission case extension housing.

9. Unhook parking brake cable return spring and remove cable adjusting nut, equalizer, and spacer. See Figure 7B-16.

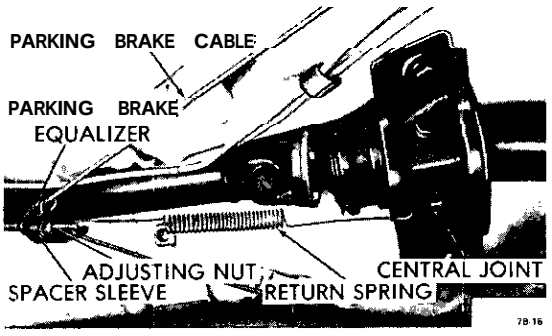


Figure 7B-16 Parking Brake Equalizer and Return Spring

9. Disconnect drive shaft at central joint and remove as follows: See Figure 7B-16.

a. Disconnect parking brake cable equalizer from rod.

b. Mark the mating parts of U-Joint and the drive pinion extension shaft flange.

c. Loosen bolt locks and remove bolts or nuts.

d. Work propeller shaft slightly forward, lower rear end of shaft and slide assembly rearward. Remove thrust spring.

e. Install a plug in the rear of the transmission to prevent loss of lubricant.

10. Remove rear engine mount bolts and lower transmission as far as possible.

11. Remove transmission case to clutch housing attaching bolts and remove transmission.

INSTALLATION OF TRANSMISSION WITH ENGINE IN CAR

1. Make certain main drive gear splines are clean and dry. Also, make certain the transmission is in Neutral so that the main drive gear splines may be indexed when making the installation.

2. Install transmission and support weight while installing transmission case to clutch housing bolts.

3. Install rear engine mount.

4. Install propeller shaft, align, and tighten U-Joint to pinion flange U-Bolt nuts and torque to 11 lb. ft.

5. Attach clutch cable.

6. Perform clutch lash adjustment. See Clutch, Sections A and B for adjustment procedure.

7. After overhaul of transmission, refill with 2-1/2 pints of SAE 80 or SO-90 multi-purpose gear lubricant.

REMOVING AND INSTALLING SPEEDO DRIVEN GEAR (WITH TRANSMISSION REMOVED)

Removing Speedo Driven Gear Assembly

1. Use wrench to unscrew speedo angular drive holding nut and remove speedo angular drive.

2. With Special Tool J-22926 and Slide Hammer J-7004-1, remove speedo driven gear lock pin which retains speedo driven gear assembly in transmission case extension housing.

3. Using Special Tool J-22929 and Slide Hammer J-7004-1, remove speedo driven gear assembly. Tool J-2292? screws onto the speedo driven gear guide making it possible to remove the guide and assembly without damage to the transmission case extension housing.

Installation of Speedo Driven Gear Assembly

1. Using Special Tool J-22929 install speedo driven gear assembly into transmission case extension housing. It may be necessary to tap lightly on tool J-22929 when installing assembly. Be sure speedo driven gear lock pin hole on guide lines up with hole in transmission case extension housing. Also, rotate mainshaft at output end when inserting speedo driven gear assembly to insure that driven gear meshes properly with speedo drive gear on mainshaft.

2. Install speedo driven gear lock pin into transmission case extension housing by tapping pin lightly.

3. Install speedo angular drive by tightening speedo angular drive to holding nut.

REPLACING BUSHING IN SELECTOR LEVER (TRANSMISSION AND GEARSHIFT LINKAGE REMOVED)

Removal

1. Remove snap ring from bushing. See Figure 7B-17.

2. Using a suitable brass drift drive out bushing from snap ring side. See Figure 7B-19.

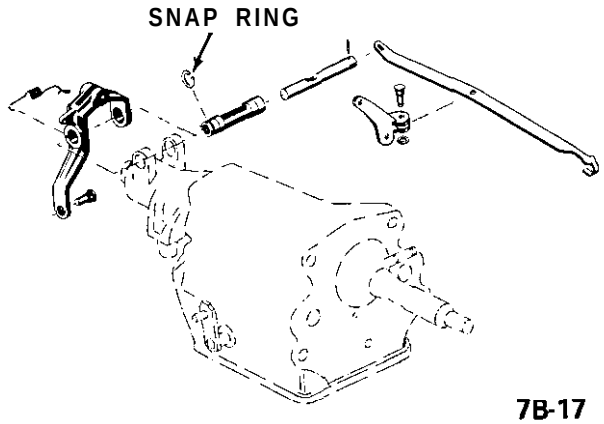


Figure 7B-17 Snap Ring on Selector Intermediate Lever Bushing

Figure 7B-19 Removing Bushing From Selector Intermediate Lever

Installation

1. Using a suitable tool drive in bushing up to stop. Install bushing in opposite direction of removal with the cutout in the bushing facing upwards. See Figure 7B-19.

2. Install snap ring onto bushing.

TRANSMISSION DISASSEMBLY

Maintain the respective positions of all mating parts during overhaul.

Removing Shifter Shaft

1. Remove cotter pins that secure each end of shifter shaft. See Figure 7B-20.

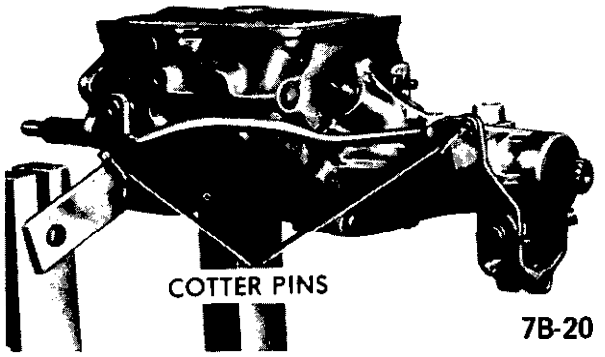


Figure 7B-20 Cotter Pin Locations on Shifter Shaft

2. Remove shifter shaft with washer and spring washer at each end.

Removing Selector Lever

1. With punch, drive out pin securing selector lever to transmission case extension bolt. See Figure 7B-21.

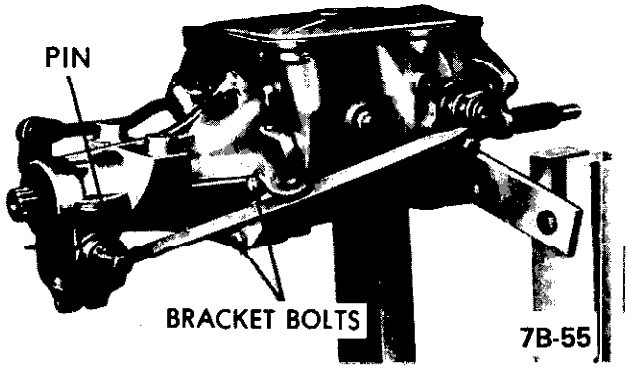


Figure 7B-21 Pin and Bracket Securing Selector Lever to Intermediate Shaft and Rear Bearing Retainer

2. Remove the two (2) bolts and spring washers from the transmission case extension housing which secure selector lever bracket. See Figure 7B-2 1.

3. Remove selector lever and bracket. Selector lever will just slip off selector ring.

4. Remove lock nut and selector ring.

5. Remove transmission case extension bolt. See Figure 7B-21.

Removing Transmission Case Cover

1. Remove ten (10) transmission case cover bolts, cover, and gasket.

2. Invert transmission to drain oil.

Removing Countergear

1. Remove remaining three transmission case extension housing to case attaching bolts and spring washers.

2. Turn transmission case extension housing until gear unit countershaft is exposed. See Figure 7B-22.

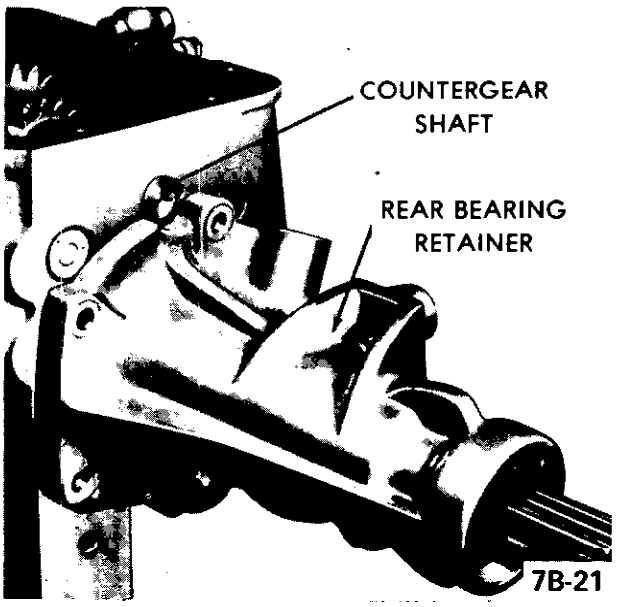


Figure 7B-22 Position of Rear Bearing So Countergear Can Be Removed

3. From the front of the transmission, using Special Tool J-2291 1, drive out shaft. Ensure that lock ball is not lost. See Figure 7B-23.

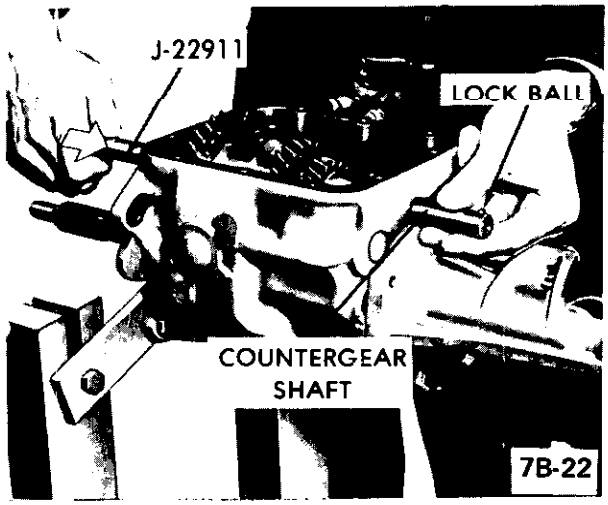


Figure 7B-23 Removing Countergear Shaft

4. With Special Tool J-2291 1 inserted, take counter-shaft gear unit out of transmission case. Remove both thrust washers.

Removing Selector Shaft and Intermediate Levers

1. Drive out reverse intermediate lever bedding bolt and remove reverse speed shifter intermediate lever. See Figure 7B-24.

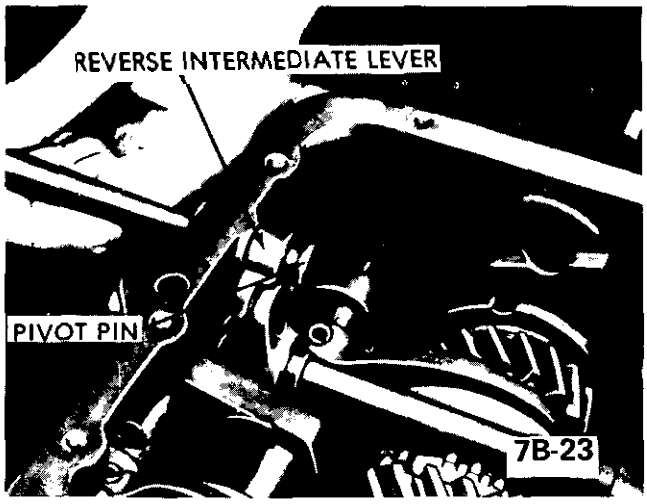


Figure 7B-24 Driving Out Reverse Intermediate Lever Pin

2. To remove all pins, use a 1/8 inch pin punch. Turn the selector shaft so that lock pins are in vertical position. First, drive lock pins out of third and fourth speed intermediate lever and then out of first and second speed intermediate lever. See Figure 7B-25.

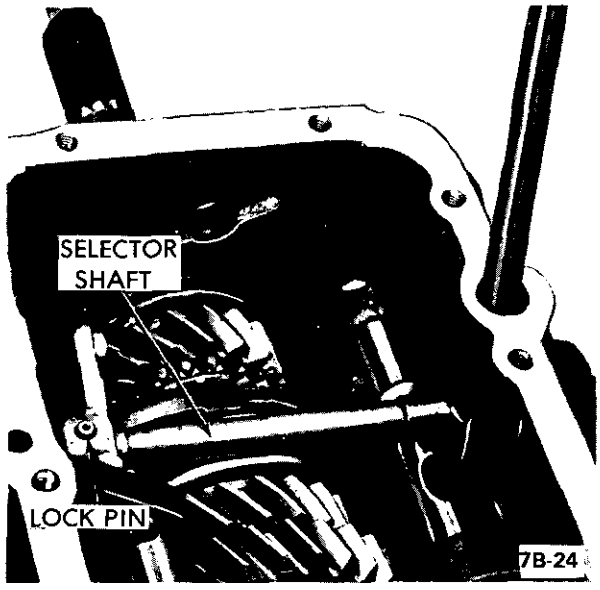


Figure 7B-25 Removing Lock Pins from Selector Shaft

3. Push selector shaft out of case and remove intermediate levers.

4. With screwdriver, pry out selector shaft oil seals on transmission case.

Removing First and Second Gear Shifter Shaft, Yoke, and Cam

1. Pull out both lock ball plugs using Tool J- 21715 with Slide Hammer J-7004-1. Remove thrust springs.

2. With transmission in first gear, drive lock pins out of shifter yokes and shifter shaft cam. See Figure 7B-26.

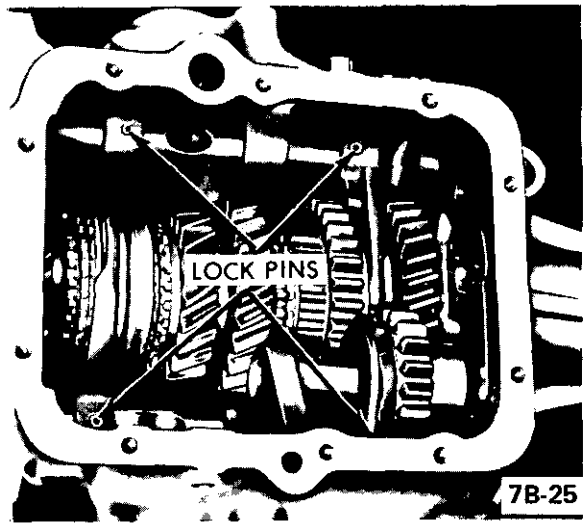


Figure 7B-26 Position of Lock Pins for Shifter Forks and Selector Dogs

3. Turn extension housing until shifter shaft is exposed. From the rear of transmission, drive out first and second speed shifter shaft. Use suitable brass drift. See Figure 7B-27.

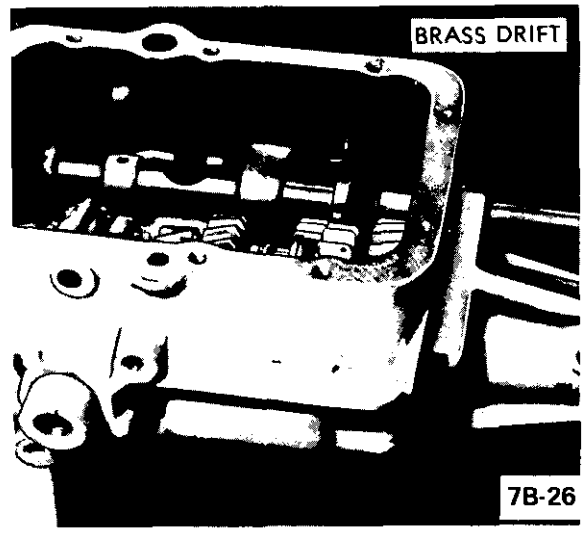


Figure 7B-27 Removing Shifter Shafts

4. Remove both first and second speed shifter yoke and shifter shaft cam.

Removing Main Drive Gear and Mainshaft Assembly

1. From front of transmission, pull main drive gear and needle bearing out of transmission. (May be necessary to rock main drive gear.)

2. From rear of transmission, pull mainshaft assembly and transmission case extension housing out of transmission. Gear shifter sleeve will be pulled off gear shifter sleeve carrier by the third and fourth speed shifter yoke. Remove sleeve from yoke and keep sleeve with mainshaft assembly. (Make sure third and fourth speed shoes are not lost.)

Removing **Third and Fourth Gear Shifter Shaft.**

1. With main shaft assembly out of transmission case, drive third and fourth gear shifter shaft out through hole in front of case with brass drift from rear of transmission through mainshaft assembly hole in case.

2. Remove third and fourth speed yoke.

Removing Reverse Gear Shifter Shaft and Reverse Idler Gear

1. Using a brass drift and from the front of the transmission, drive out reverse gear shifter shaft and plug. See Figure 7B-28. The reverse speed shifter yoke will remain in transmission case.

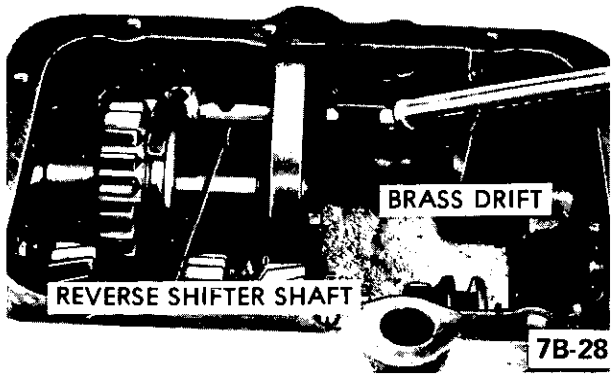


Figure 7B-28 Removing Reverse Shifter Shaft

2. With Special Tool J-22923 push reverse idler gear shaft from front toward the rear. Ensure that lock ball is not lost. See Figure 7B-29.

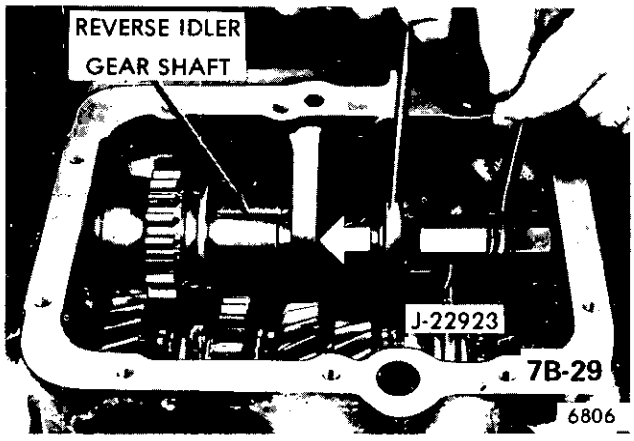


Figure 7B-29 Removing Reverse Idler Gear Shaft

3. Take shaft, reverse idler gear and reverse speed shifter yoke out of transmission case.

Disassembling Mainshaft Assembly

1. Remove mainshaft bearing snap ring from transmission case extension housing groove and remove mainshaft assembly from housing. See Figure 7B-30.

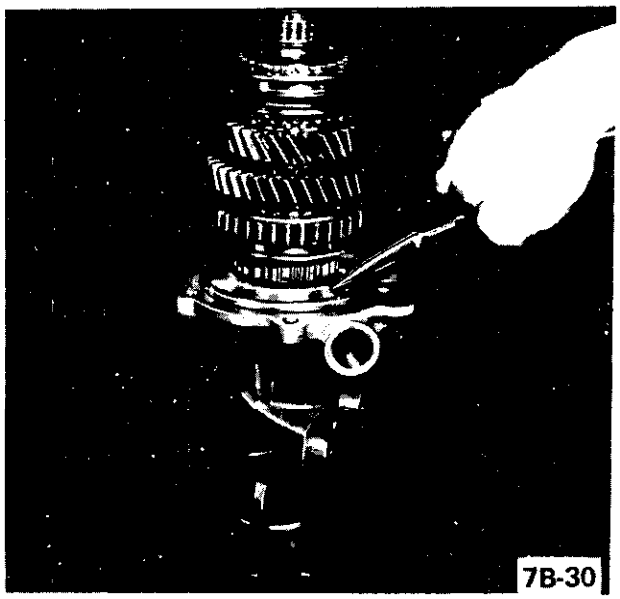


Figure 7B-30 Removing Snap Ring From Rear Bearing Retainer

2. Remove loose parts such as mainshaft needle bearing, mainshaft front ring, synchronizer cover, gear shifter sleeve, shoes, and front synchronizer spring. The gear shifter sleeve carrier and the first and second speed sliding gear guide unit and their respective gear shifter sleeve and first and second gear sliding gear are selected assemblies and should be kept together as originally assembled. See Figure 7B- 31.

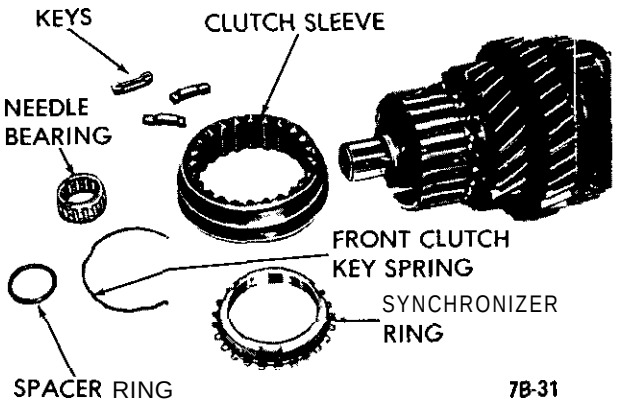


Figure 7B-31

3. Remove snap ring from in front of clutch hub. See Figure 7B-32.

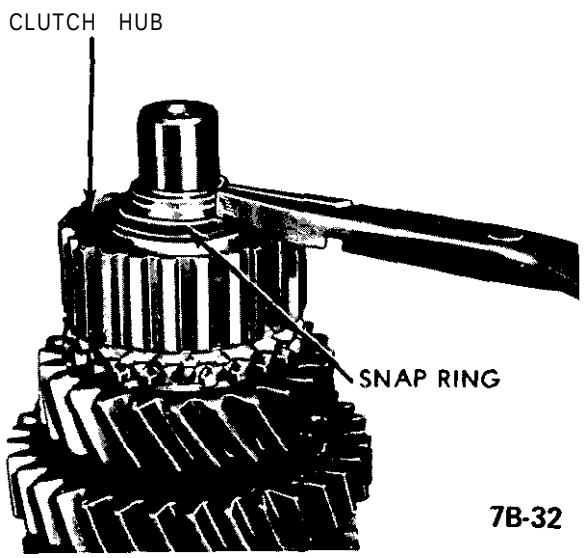


Figure 7B-32 Removing Snap Ring In Front of Clutch Hub

4. Using Tru-arc pliers, remove snap ring behind speedometer drive gear. See Figure 7B-33. Remove speedo drive gear spring washer and speedo drive worm gear.

5. Remove drive gear lock ball from mainshaft. See Figure 7B-34.

6. Press mainshaft inner bearing from mainshaft using Special Tool J-21684, Press Plate, as shown in Figure 7B-35 and then, by hand, remove all loose parts such as mainshaft washer, transmission case extension housing snap ring, first speed gear, first speed needle bearing, synchonrizer cover, first and second gear sliding gear, shoes, and rear synchronizer spring, See Figure 7B-37.

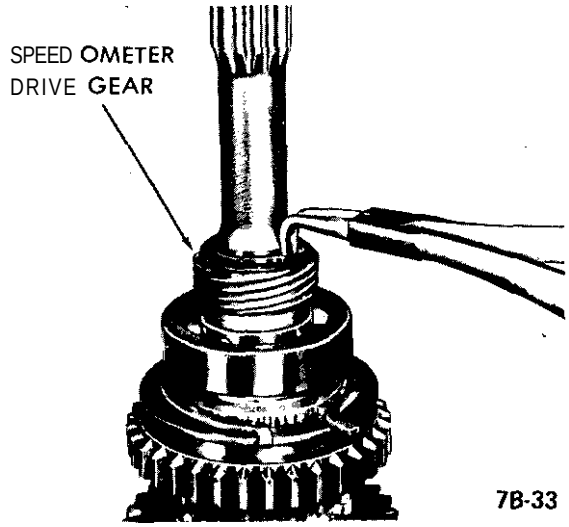


Figure 7B-33 Removing Snap Ring Behind Speedometer Drive Gear

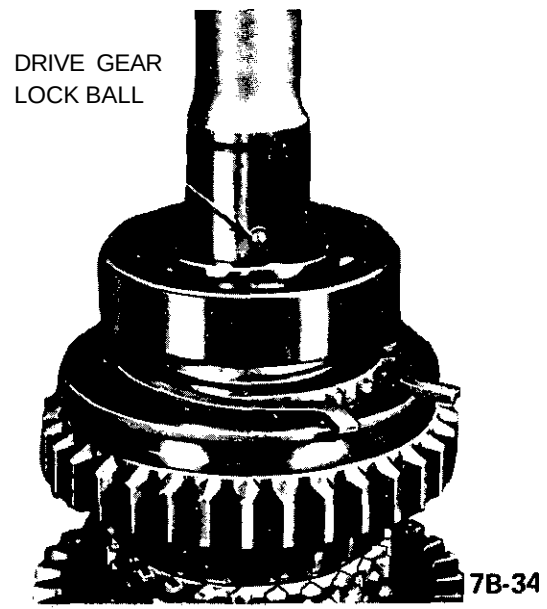


Figure 7B-34 Speedo Drive Gear Lock Ball on Mainshaft

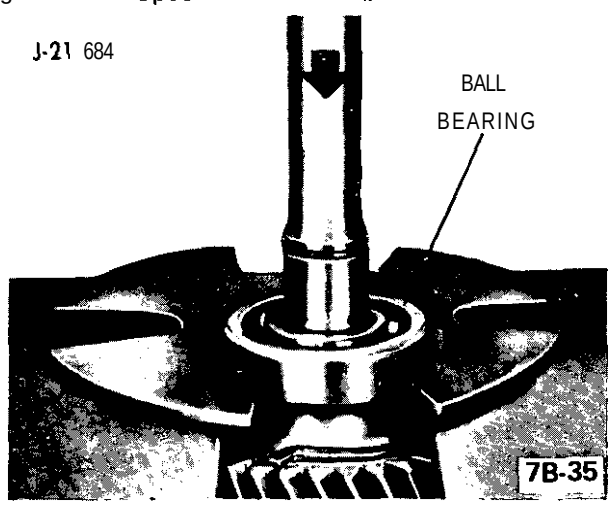


Figure 7B-35 Removing Rear Bearing From Mainshaft

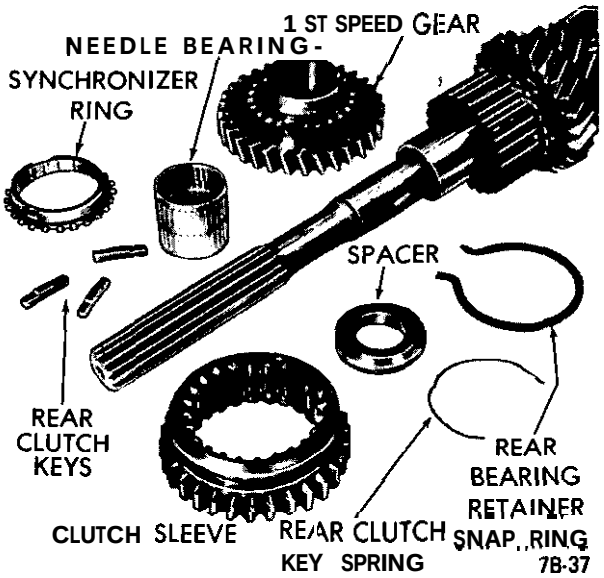


Figure 70-37

7. With Special Tool J-21684, Press Plate, located below third speed gear, press out gear shifter sleeve carrier. See Figure 7B-38.

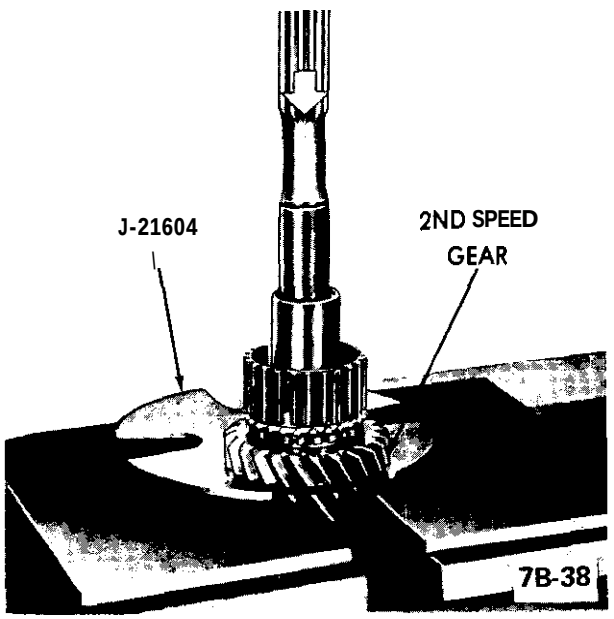


Figure 7B-38 Pressing Off Large Clutch Hub and Needle Bearing Inner Sleeve

8. With Special Tool J-21684, Press Plate, located below **second** speed gear, press out gear shifter sleeve carrier. See Figure 7B-39.

TRANSMISSION REASSEMBLY

A. Assembling Mainshaft

1. From front of the mainshaft install third speed gear onto mainshaft. Gear must turn freely on mainshaft.

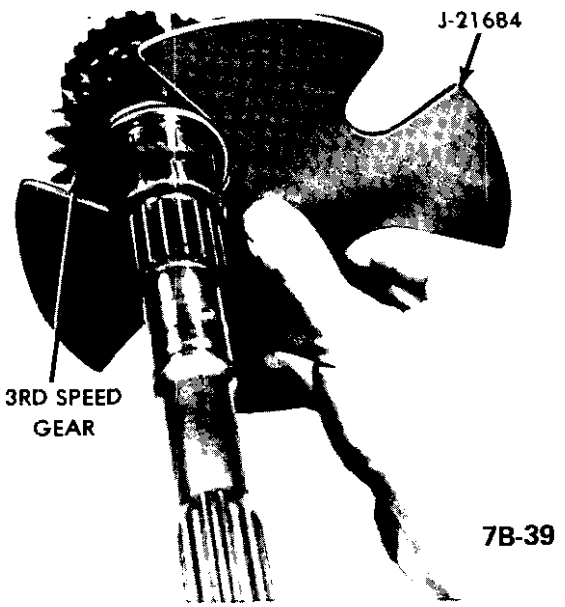


Figure 7B-39 Pressing Off Small Clutch Hub

2. Install third speed synchronizer cover onto third speed gear cone.

3. Install rear synchronizer spring into rear side of gear shifter sleeve carrier so that hooked spring end rests in one of the slots.

4. Using Press Plate J-21684, press gear shifter sleeve carrier onto mainshaft so that original tooth contact is obtained. The rear side of gear shifter sleeve carrier with installed spring should be toward third speed gear. This rear side of carrier is recessed more than front side to allow carrier to be pressed almost flush with synchronizer cover. See Figure 7B-40.

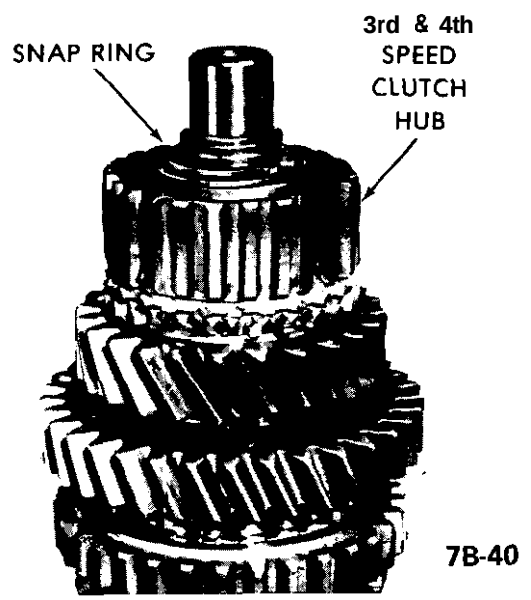


Figure 7B-40 Securing Third and Fourth Speed Clutch Hub on Mainshaft With Snap Ring

5. Using external snap ring pliers, secure gear shifter sleeve carrier on mainshaft with snap ring. See Figure 7B-40.

6. From rear of mainshaft, slide second speed gear onto mainshaft. Gear must turn freely on mainshaft. See Figure 7B-41.

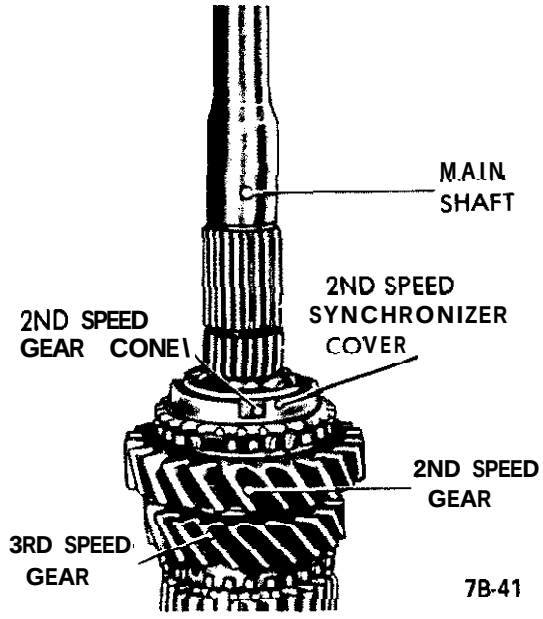


Figure 7B-41 Second Speed Gear and Synchronizer Ring Installed

7. Place second speed synchronizer cover onto second speed gear cone. See Figure 7B-41.

8. Install both synchronizer springs into first and second speed sliding gear guide unit so that hooks of both springs rest in the same guide unit shoe slot and the other spring ends are positioned opposite to each other. See Figure 7B-42.

9. Press first and second speed sliding gear guide unit onto mainshaft so that the original tooth contact is obtained.

10. Using Tool J-22913, press first speed gear needle bearing inner sleeve onto mainshaft.

11. Using Tool J-22913, install first and second speed shoes (long style) and install first and second gear sliding gear (forked groove to rear) onto first and second speed sliding gear guide unit.

12. Slide first speed gear needle bearing, synchronizer cover, first speed gear, mainshaft washer (chamfer toward rear), and mainshaft bearing snap ring onto mainshaft.

13. Press on mainshaft inner bearing using Tool J-22913. See Figure 7B-43.

Figure 7B-42 Both Clutch Key Springs Installed

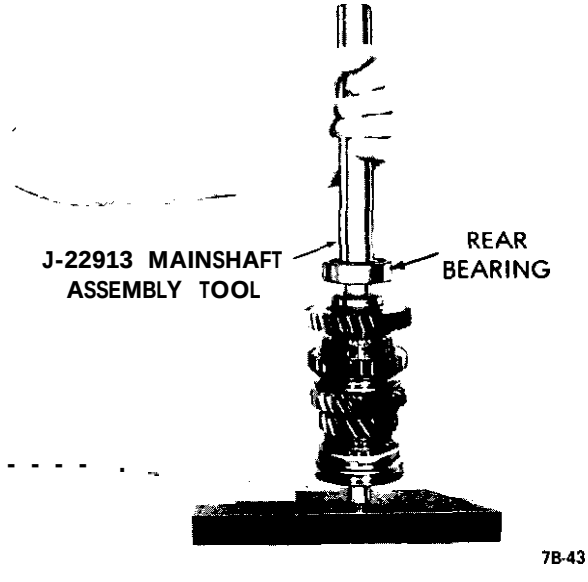


Figure 7B-43 Pressing on Rear Bearing Using Tool J-22913

14. Insert lock ball in place in mainshaft and place speedo drive worm gear and speedo drive gear spring washer on mainshaft. Secure with speedo drive gear snap ring.

15. Place mainshaft assembly into transmission case extension housing up to its stop. Secure with mainshaft bearing snap ring. See Figure 7B-44.

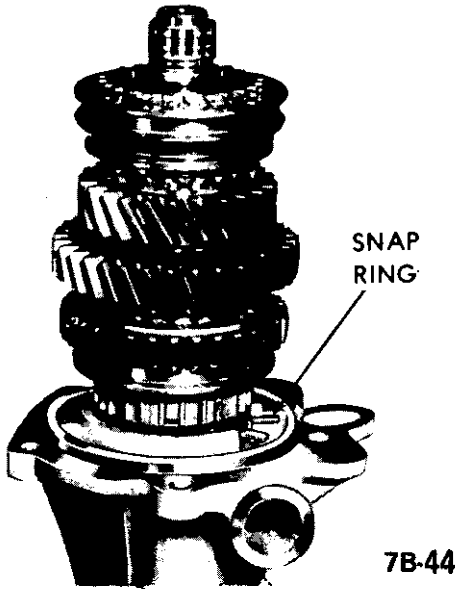


Figure 7B-44 Mainshaft Assembly Secured Into Rear Bearing Retainer by Snap Ring

16. Place front synchronizer spring in the gear shifter sleeve carrier. Install (3) third and fourth speed shoes (short design) and gear shifter sleeve over gear shifter sleeve carrier along with synchronizer cover. Arrows on shoes point toward rear of mainshaft. Gear shifter sleeve yoke groove should be toward front.

17. With sealer, install new gasket onto transmission case extension housing.

Installing Reverse Idler Gear and Reverse Gear Shifter Shaft

1. Inspect shafts carefully for burrs, and remove with emery cloth. Burrs on shifter shaft will prevent easy installation of shifter yoke. Lightly oil with transmission oil prior to installation. Place lock ball into reverse idler gear shaft and push shaft through hole in rear of case and on through reverse idler gear which should have groove end toward front. See Figure 7B-46.

Continue to drive reverse idler gear shaft forward with plastic hammer until rear end of shaft is flush with rear case face.

2. Position reverse speed shifter yoke in groove of reverse idler gear and install reverse gear shifter shaft from rear of case with notches up, pushing it through reverse speed shifter yoke. See Figure 7B-47.

3. Install spiral pin to secure yoke to shifter shaft and drive plug into hole in rear of case.

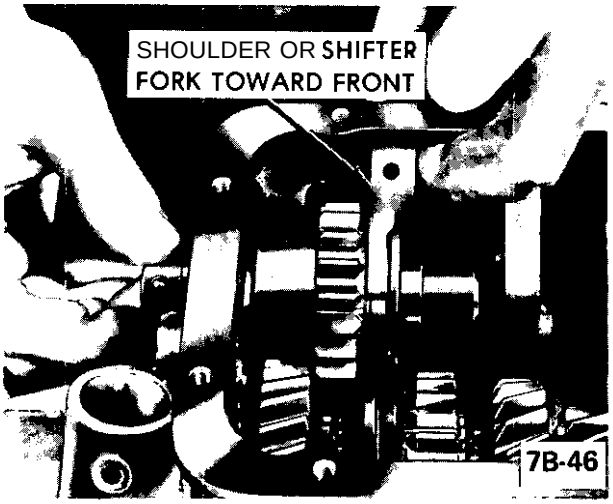


Figure 7B-46 Installing Reverse Shifter Fork

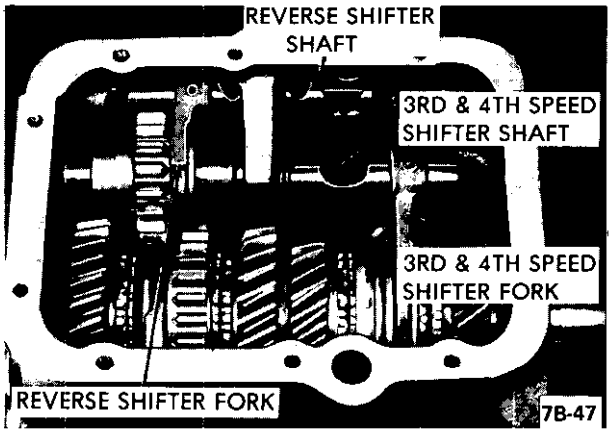


Figure 7B-47 Third and Fourth Speed Shifter Shaft Installed

Installing Mainshaft Assembly and Main Drive Gear

1. Slide mainshaft assembly into transmission case from rear.

2. From the front, slide mainshaft front ring and the mainshaft needle bearing onto the mainshaft. See Figure 7B-48.

3. Install main drive gear through front of transmission case until main drive (standard part) snap ring is flush with case.

Installing Third and Fourth Gear Shifter Shaft

1. Position third and fourth speed yoke onto gear shifter sleeve. See Figure 7B-47.

2. Insert third and fourth gear shifter shaft through hole in front of case with notches down, pushing it through third and fourth speed yoke. Third and

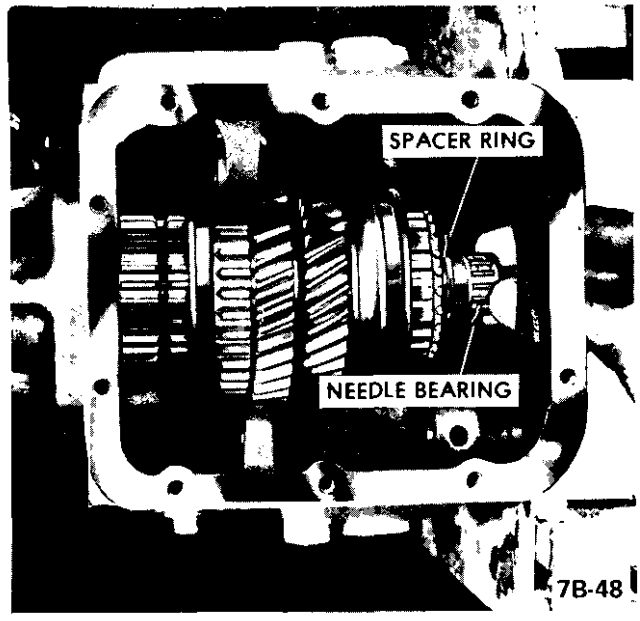


Figure 7B-48 Installing Spacer Ring and Needle Bearing Onto Mainshaft

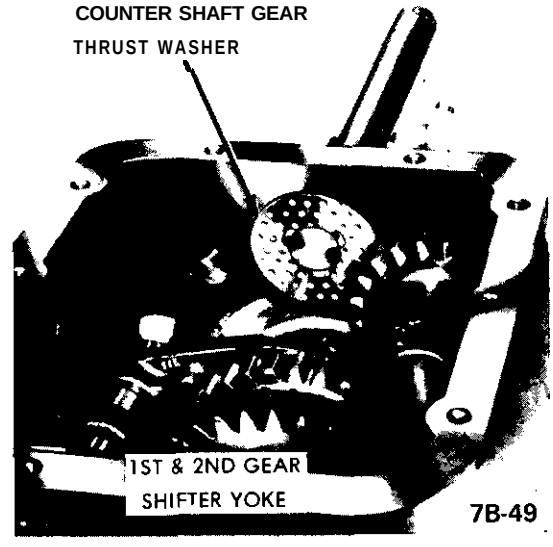


Figure 7B-49 Countergear Thrust Washers Installed

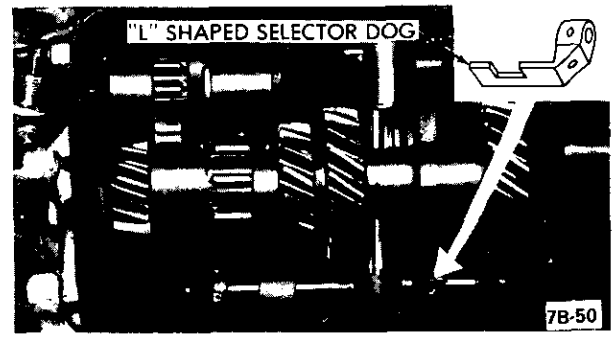


Figure 7B-50 Position of "L" Shaped Selector Dog

fourth speed yoke should be positioned with rounded notch at shaft hole portion of yoke toward rear. See Figure 7B- 47.

3. Install spiral pin, allowing 1/16″ to 5/64″ of pin to protrude.

Installing First and Second Gear Shifter Shaft

1. Inspect shifter shaft carefully for burrs, and remove with emery cloth. Burrs on shifter shaft will prevent easy installation of shifter yoke and cam. Lightly oil with transmission oil prior to installation. Insert first and second gear shifter shaft through hole in rear of case with three notches down and toward rear of transmission, pushing shaft first through first and second gear shifter yoke, which should be positioned on first and second gear sliding gear with shoulder toward front of case. To position first and second gear shifter yoke on first and second gear sliding gear, push reverse idler gear forward, engaging the idler gear with the first and second gear sliding gear. This will make room for positioning first and second gear shifter yoke. See Figure 7B-49.

2. Continue to drive first and second gear shifter shaft through shifter shaft cam, which should be positioned as shown in Figure 7B-50.

3. Install spiral pins to secure shifter yoke and shifter shaft cam to first and second gear shifter shaft.

Installing Selector Shaft

1. Inspect selector shaft carefully for burrs, and remove with emery cloth. Burrs on shaft will prevent easy installation of intermediate levers. Lightly oil with transmission oil prior to installation. Insert new selector shaft oil seals in holes on both sides of transmission case and insert selector shaft into case and through third, fourth, and reverse intermediate lever. Third, fourth, and reverse intermediate lever should be positioned on selector shaft, as shown in Figure 7B-51.

2. Continue to push selector shaft through first and second intermediate lever and through other side of case. First and second intermediate lever should be positioned on selector shaft, as shown in Figure 7B-52. Selector shaft is rotated counterclockwise (when looking from lever end of selector shaft) from working position to have spiral pin holes in shaft vertical and in line with pin holes in intermediate levers. To rotate selector shaft in this manner, the reverse gear shifter shaft and its reverse speed shifter yoke must be pushed rearward so that the reverse idler gear is against rear of case.

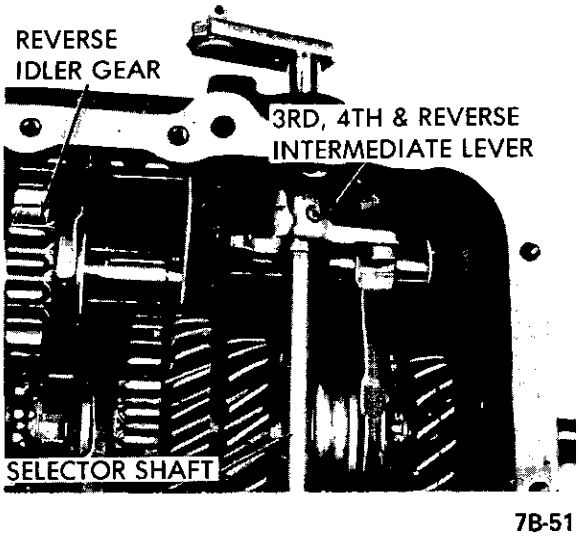


Figure 7B-5 1 Position of Third, Fourth, and Reverse Intermediate Lever on Selector Shaft

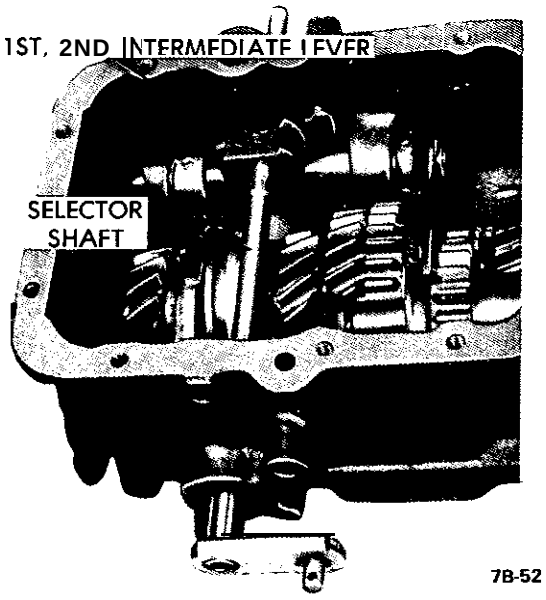


Figure 7B-52 Position of First and Second Intermediate Lever on Selector Shaft

3. Install spiral pins to secure both intermediate levers to the selector shaft. Spiral pins should not be flush with lever surface, but rather should extend up between 1/16 and 5/64 inches.

Installing Reverse Speed Shifter Intermediate Lever and Interlock Balls, Springs, and Plugs

1. Engage reverse speed shifter intermediate lever with third, fourth, and reverse intermediate lever **and also** in slot in reverse gear shifter shaft, and install bedding bolt through reverse speed shifter intermediate lever and into case. Reverse speed shifter intermediate lever end play on bolt should be between .004 and .012 inches.

2. Insert both interlock balls and then springs, and drive both interlock plugs into case holes until they bottom in interlock plug hole seats. Grooves in plugs will be showing.

Installing Countershaft Gear Unit

1. Coat thrust washers with ball and roller bearing grease and stick to transmission case. Lugs of thrust washers must fit into transmission case slots. See Figure 7B-49.

2. Turn transmission case extension housing until gear unit countershaft bore is completely exposed.

3. Place lock ball into shaft and from the rear of the transmission insert shaft so that thrust washer is held in position. Hold opposite thrust washer in position by using a short drift.

4. Insert countershaft gear unit into transmission case. Be sure all needle bearings and both needle bearing washers are in place.

5. Insert gear unit countershaft into gear unit and drive shaft into transmission case while driving out Special Tool J-2291 1. Pay attention to lock ball. See Figure 7B-53.

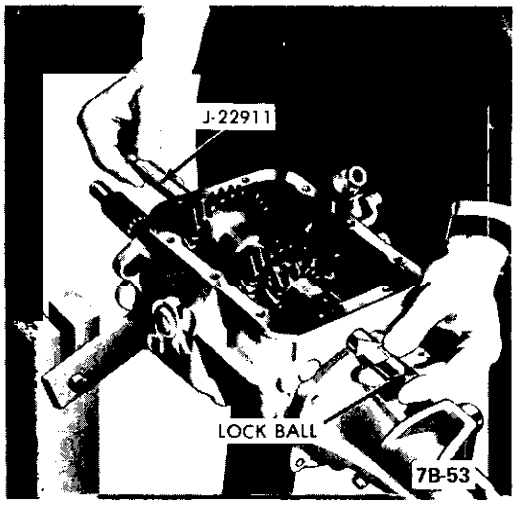


Figure 7B-53 Installing Countergear Shaft

Installing Transmission Case Extension Housing

1. Align transmission case extension housing and gasket and torque (3) bolts with spring washers to 21 lb. ft.

Installing Gearshift Interlock Ball and Gearshift Thrust Spring

1. Install gearshift interlock ball into top transmission bore and then install gearshift thrust spring.

Installing Transmission Case Cover

1. Install case cover gasket, cover, and tighten screws.

Installing Gearshift Linkages

1. Install selector ring and lock nut onto selector shaft.

2. Holding selector lever and support in place, torque (2) bracket bolts and spring washers to 14.5 lb. ft. See Figure 7B-55.

3. Install pin securing selector lever to transmission case extension bolt.

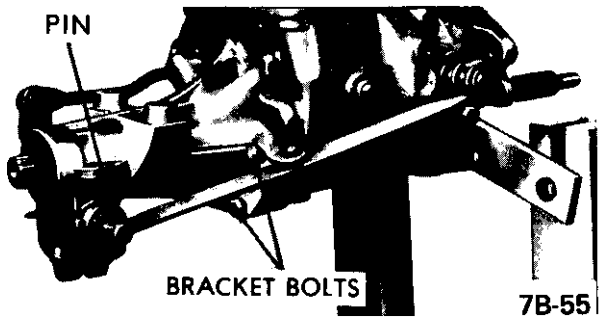


Figure 7B-55 Pin and Bracket Securing Selector Lever to Intermediate Shaft and Bearing Retainer

4. Install shifter shaft with spring washers on inside of shifter shaft ends and flat washers on outside of shaft.

5. Secure each end of shifter shaft and washers with new cotter pins.

SPECIFICATIONS

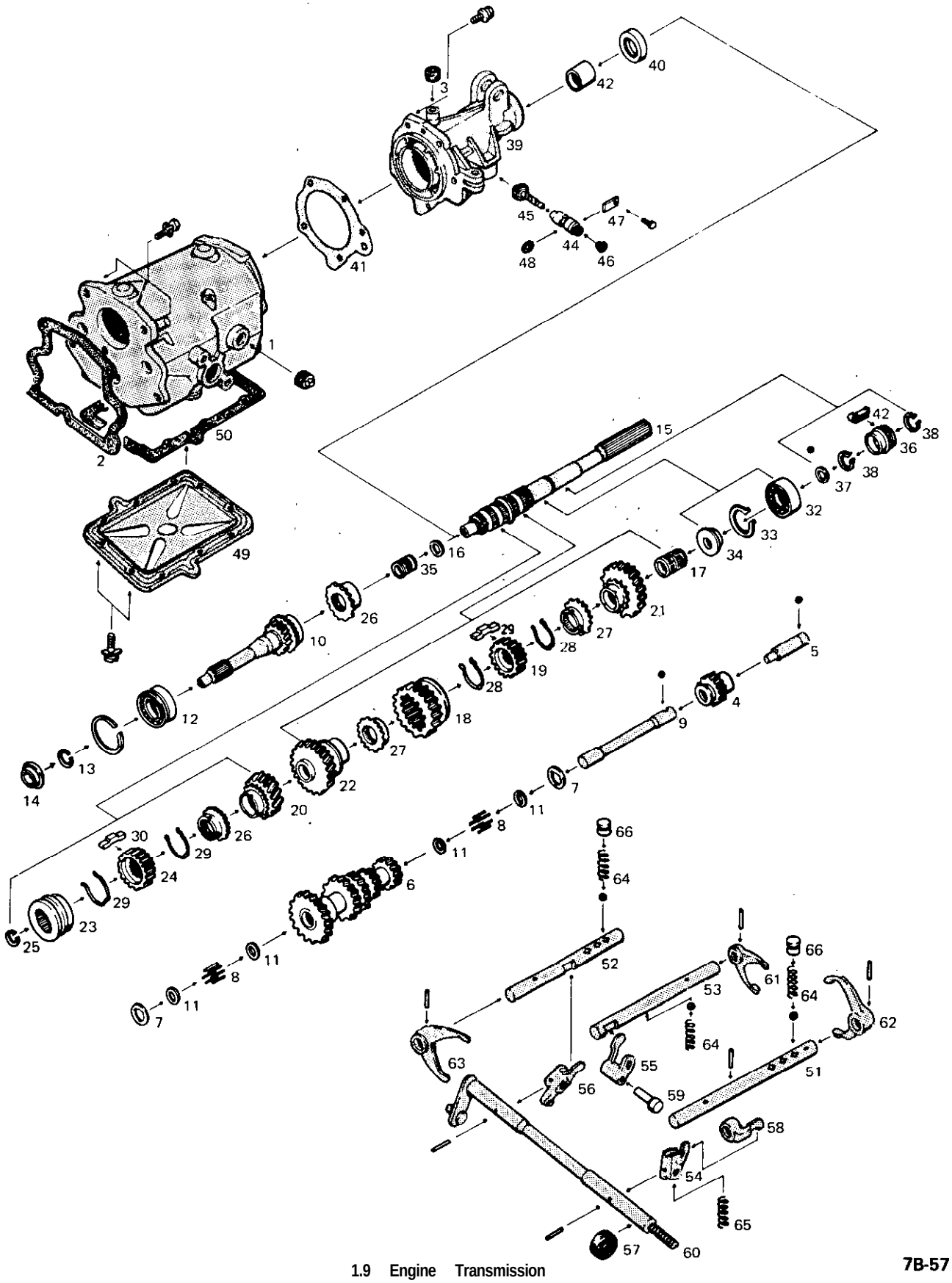
TRANSMISSION SPECIFICATIONS

General Specifications

Type	Manual Shift 4 Speeds Forward - 1 Reverse
Synchronization	Fully Synchronized All Forward Speeds
Gear Ratios:	
1st Gear	3.428
2nd Gear	2.156
3rd Gear	1.366
4th Gear	1.000
Reverse	3.317
Lubricant Capacity	2.5 pints
Lubricant Type	SAE 80 or SO-90 Multi-Purpose Gear Lubricant

Torquing Specifications

Part	Location	Torque Lbs.Ft.
Bolt	Transmission to Flywheel	32-36
Bolt	(3) Rear Bearing Retainer to Transmission Case (M8x25)	21
Bolt	(2) Rear Bearing Retainer to Transmission Case (M8x30)	14.5
Bolt	Rear Engine Mount to Underbody	22



1.9 Engine Transmission

7B-57

Figure 7B-57 Exploded View of Manual Transmission

1 Case, Transmission
2 Gasket, Trans. Case to Clutch Housing
3 Cap, Ventilator
4 Gear, W/Bushings, Reverse Idler
5 Shaft, Reverse Idler Gear
6 Cluster Gear, Countershaft
7 Washer, Trans. Counter Gear Thrust
8 Roller. Trans. Counter Gear Bearing
9 Countershaft. Cluster Gear
10 Gear, Main Drive
11 Spacer Ring, Trans. Counter Gear Bearing Roller
12 Bearing, Trans. Main Shaft Pilot
13 Ring, Trans. Main Drive Gear Ball Bearing Lock
14 Seal Ring, Main Drive Gear to Clutch
15 Shaft, Main
16 Ring, Trans. Main Shaft Snap Front
17 Needle Bearing, 1st Speed Gear on Main Shaft
18 Sliding Gear, 1st and 2nd Speed
19 Guide Unit, 1st and 2nd Speeding Sliding Gear
20 Gear. 3rd Speed
21 Gear, 1 st Speed
22 Gear, 2nd Speed
23 Sleeve, Trans. Gear Shifter
24 Carrier, Trans. Gear Shifter Sleeve
25 Snap Ring, Trans. Gear Shifter Sleeve
26 Cone, Trans. 3rd and 4th Speed Syncronizer
27 Cone, Trans. 1st and 2nd Speed Syncronizer
28 Spring, Syncronizer (1st and 2nd Speed)
29 Spring, Syncronizer
30 Shoe, 1st and 2nd Speed Shifter
31 Shoe, 3rd and 4th Speed Shifter
32 Bearing, Trans. Main Shaft R.R.
33 Snap Ring, Trans. Main Shaft Ball Bearings
34 Washer, Main Shaft Between Inner Ball Bearing and 1st Speed Gear
35 Bearing, Trans. Main Shaft Needle - Right
36 Gear, Speedometer Drive
37 Washer, Speedo Drive Gear
38 Ring, Speedo Drive Gear Snap
39 Retainer, R.R. Bearing
40 Oil Seal, Trans. R.R.
41 Gasket, R.R. Bearing Retainer
42 Bushing. Trans. Main Shaft - R.R.
43 Clip, Speedo Gear
44 Guide, Speedo Drive
45 Gear, Speedo Driven
46 Seal, Speedo - Shaft Sleeve
47 Bracket, Speedo and Guide on Trans.
48 Seal Ring, Speedo Drive Guide
49 Cover, Trans. Case
50 Gasket, Trans. Case Cover
51 Shifter Shaft, 1st and 2nd Speed
52 Shifter Shaft, 3rd and 4th Speed
53 Shaft, Reverse Speed Shifter
54 Intermediate Lever, 1st and 2nd Speed Shifter
55 Lever, Reverse Shifter Intermediate
56 Lever, Intermediate 3rd. 4th and Reverse
57 Seal, Shifter Shaft Oil in Trans.
58 Cam. on Shifter Shaft
59 Shifter Shaft, Intermediate Lever Reverse
60 Shaft, W/Lever and Bolt, in Trans.
61 Fork (Yoke), Reverse Speed Shifter
62 Yoke, Trans. Shifter (1st and Reverse)
63 Fork (Yoke), Trans. 2nd and 3rd Speed
64 Spring, Trans. Gearshift Interlock Thrust
65 Detent Spring, Reverse Speed Gearshift Interlock
66 Plug, Gearshift Interlock Detent

AUTOMATIC TRANSMISSION

CONTENTS

DESCRIPTION AND OPERATION

DESCRIPTION

The Opel Three-Speed Automatic is a fully automatic unit utilizing a torque converter and a Ravigneaux planetary gear set, with three multiple disc clutches and a single band to provide three forward speeds and reverse. See Figure 7C-71. Automatic upshifts and downshifts are controlled by road speed, engine vacuum and an accelerator pedal connection to the transmission.

Figure 7C-1 Quadrant In Park Position - Opel 1900 and Manta

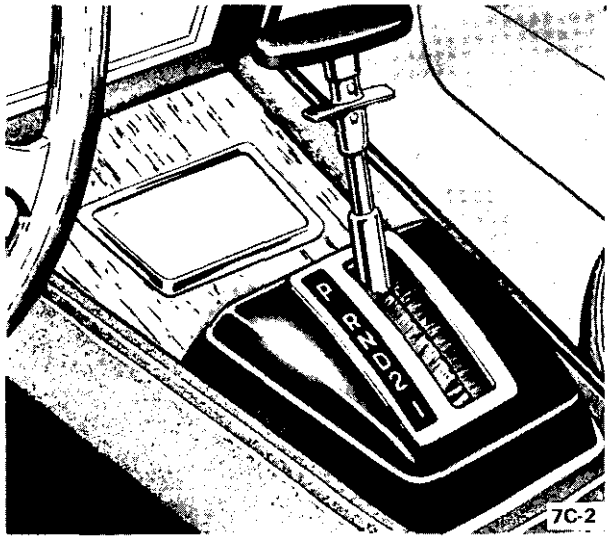


Figure 7C-2 Quadrant in Park Position - GT Models

The **quadrant** has **six positions indicated in the** following order: (Opel 1900 and Manta) P,R,N,D,S, and L (Figure 7C-1); and (GT) P,R,N,D,2, and 1 (Figure 7C- 2).

P - Park position enables the transmission output shaft to be locked - thus preventing the vehicle from roling either forward or backward. Because the output shaft is mechanically locked by a parking pawl anchored in the extension housing, the park position should not be selected until the vehicle has come to a stop. The engine may be started in the Park position.

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

N - Neutral position enables the engine to be started and operated without driving the vehicle.

D - Drive range is used for all normal driving conditions and maximum economy and has three gear ratios. Downshifts are available for passing by depressing the accelerator partially at lower car speeds and through the "detent" at higher car speeds.

S or 2 - Second range adds new performance for hilly terrain. It has the same starting ratio as Drive range, but prevents the transmission from shifting above second gear to retain second gear for acceleration or engine braking as desired. Second range can be selected at any vehicle speed, but should not be used above the speed shown in the Owner's Manual. This is to prevent over-speeding the engine. The transmission will shift to second gear immediately and remain in second until the vehicle speed or the throttle position is changed to obtain first gear operation in the same manner as in Drive range.

L or 1 - Lo range can be selected at any vehicle speed, but should not be used above the speed shown in the Owner's Manual. The transmission will shift to low (1st) gear immediately and remain in 1st gear regardless of vehicle speed or throttle position. This is particularly beneficial for maintaining maximum engine braking.

PRINCIPLES OF OPERATION

Torque Converter

The torque converter acts as a coupling to transmit engine torque, through oil, to the transmission power train. It also multiplies the torque from the engine under certain conditions of input and output speed.

The torque converter used in the Opel three speed automatic transmission consists of three basic elements: the pump (driving member), the turbine (driven or output member) and the stator (reaction member). See Figure 7C-3. The converter cover is welded to the pump to seal all three members in an oil tilled housing.

Whenever the engine is running, the converter pump turns at engine speed and acts as a centrifugal pump, picking up oil at its center, adding energy, and discharging the oil at its outer rim between the blades. The shape of the converter pump shells and blades cause the oil to leave the pump spinning in a clockwise direction toward the blades of the turbine. As there is no mechanical connection **between** converter pump and turbine, the oil is the only driving force and strikes the blades of the turbine, transferring the

Figure 7C-3 Torque Converter Assembly

energy of the oil to the turbine. See Figure 7C-1. The driven member, or turbine is splined to the transmission input shaft to transmit turbine torque to the transmission gear train.

When the engine is idling, the converter pump is being driven slowly. The energy of the oil leaving the pump is very low, therefore there is very little torque imparted to the turbine. For this reason, the engine can idle and the car will have little or no tendancy to "Creep."

As the throttle is opened and pump speed increases, the force of the oil leaving the pump increases and the resultant torque is absorbed by the turbine.

After the oil has imparted its force to the turbine member, oil leaving the turbine follows the contour of the turbine blades so that it leaves the turbine spinning counterclockwise. Since the turbine member has absorbed the energy required to reverse the direction of the oil, the turbine now has greater force or torque than is being delivered by the engine, and the process of torque multiplication has begun.

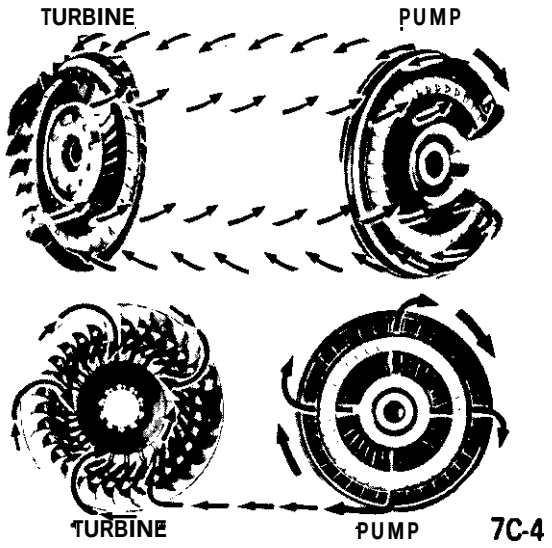


Figure 7C-4 Oil Flow Without Stator

If the counterclockwise spinning oil were allowed to return directly to the converter pump, the oil would strike the inner section of the pump blades in a direction that would hinder its rotation, cancelling out any gains in torque that have been obtained. To prevent this, a stator assembly is added, and is located between the converter pump and turbine. See Figure 7C-5.

The stator redirects the oil returning to the pump member of the converter and changes its direction of rotation to that of the pump. Since the direction of the oil leaving the stator is not opposing the rotation of the pump, the energy or torque of the engine is added to the oil as it passes through the pump and the entire cycle repeats. See Figure 7C-6.

The force of the returning oil from the turbine tends to rotate the stator in a counterclockwise direction, the stator is mounted on a one-way or roller clutch which allows it to turn clockwise but not counterclockwise. Therefore, at low turbine speeds, the returning oil from the turbine striking the stator blades in a counterclockwise direction causes the roller clutch to "lockup," and prevent the stator from turning.

As the turbine speed increases, the direction of the oil leaving the turbine changes and flows against the stator blades in a clockwise direction. Since the stator would now be hindering the smooth flow of returning oil to the pump, the roller clutch releases, and the stator rotates freely on its shaft. With this condition, the stator becomes ineffective and no further multiplication of engine torque is produced within the converter. At this point the converter acts

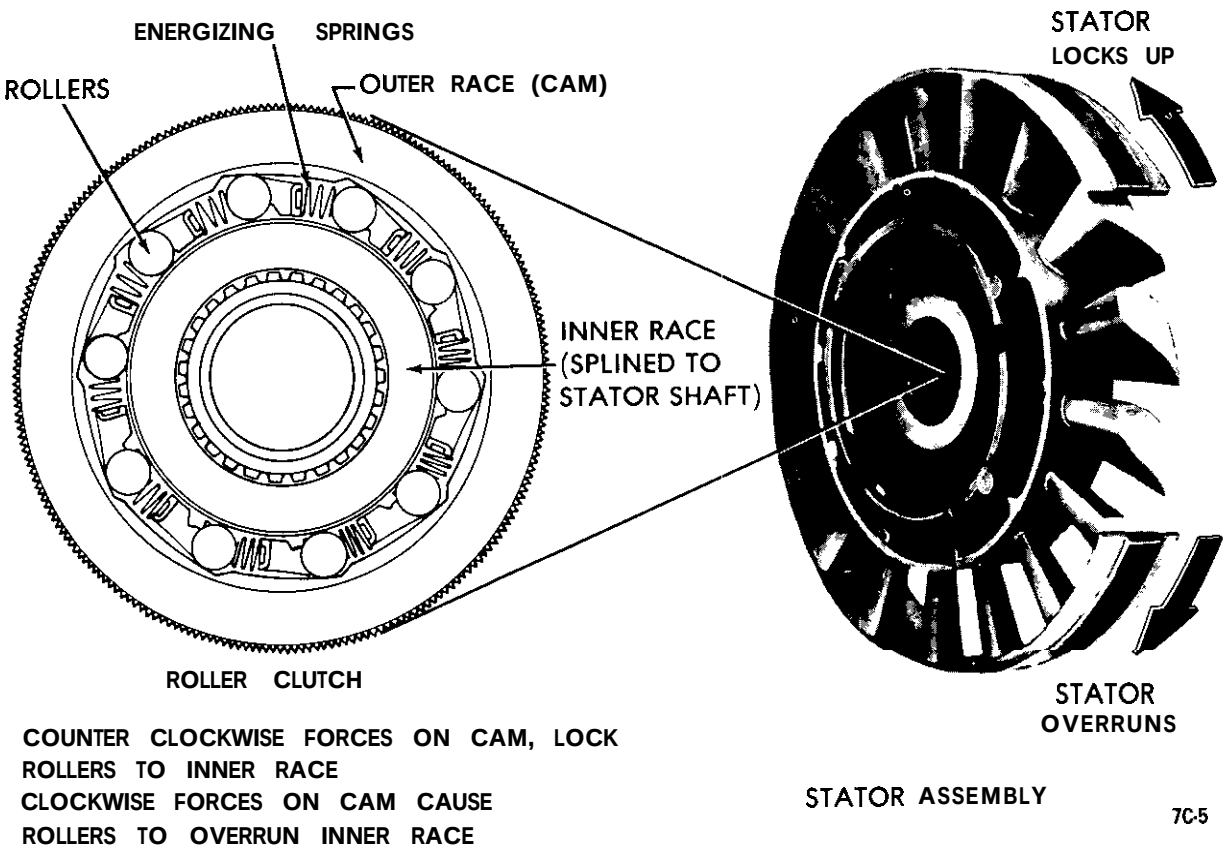


Figure 7C-5 Roller Clutch And Stator Assembly

as a fluid coupling, since both the converter pump and turbine are turning at the same speed, or at a 1:1 ratio.

The torque converter and input shaft actually form a simple transmission in themselves, however, since the requirements of an automobile transmission are greater, some means of providing additional torque, neutral and reverse, are required. For this reason a gear set is added behind the torque converter.

Planetary Gears

Planetary gears are used in automatic transmissions as the basic means of multiplying the twisting force or torque from the engine. They are so named because of their physical arrangement and are used because they permit constant mesh operation, cannot clash, operate in a minimum of space and distribute the load over several gears. The simplest planetary gear set consists of a center or sun gear, internal or ring gear and a planetary gears called planetary pinions. See Figure 7C-9. The sun gear meshes with the planetary pinions which rotate freely on their shafts attached to the planetary carrier. The ring gear surrounds the assembly and meshes with the planetary pinions. Power flow through the planetary gear set is accomplished by applying power to one member, holding another member thus making it a reaction member and obtaining the transmitted power from the third member, which can result in any of the following conditions:

1. Increase torque with a proportional decrease in output speed.

2. Increase speed with a proportional decrease of output torque.

3. Reverse direction of rotation.

4. Act as a direct connection for direct drive.

The gear set used in the Opel Three Speed Automatic transmission is known as a Ravigneaux planetary

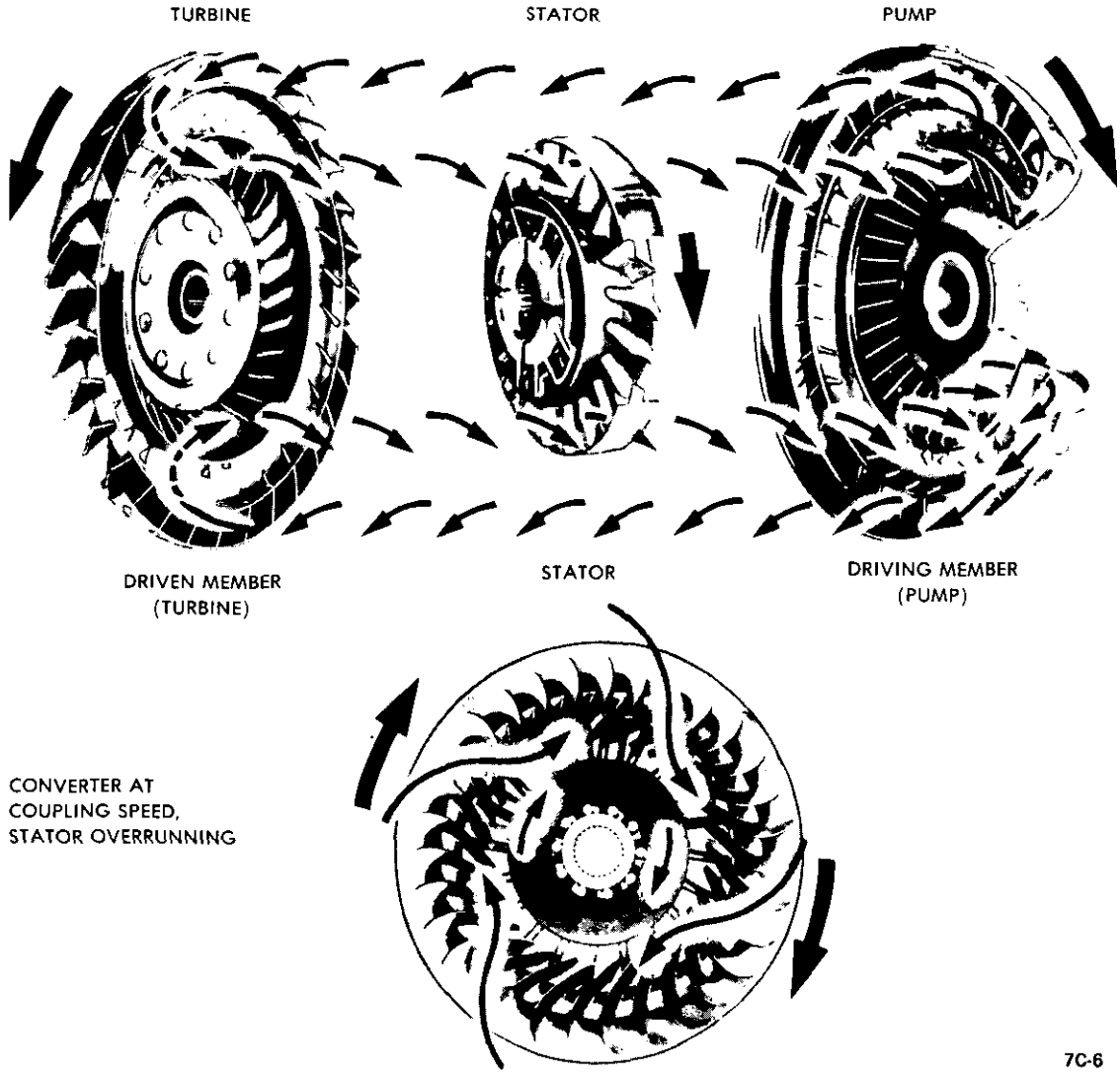


Figure 7C-6 Oil Flow With Stator Active

gear set and utilizes two sets of planetary pinions in one planet carrier, two sun gears and one ring gear. See Figure 7C-8.

The short planetary pinions are in constant mesh with both the input (front) sun gear and the long planetary pinions. The long planetary pinions are in constant mesh with the reaction (rear) sun gear, the short planetary pinions and the ring gear.

In the first gear the reaction (rear) sun gear is held stationary. The input (front) sun gear rotates in a clockwise direction (when viewed from the front) turning the short planet pinions counterclockwise and the long planet pinions clockwise. The long planet pinions turn the ring gear clockwise and walk around the held reaction (rear) sun gear driving the planet carrier and output shaft assembly in a clockwise direction. See Figure 7C-10.

In second gear the reaction (rear) sun gear is again held stationary. The ring gear is the input and is driven in a clockwise direction turning the long planet pinions clockwise which walk around the stationary reaction (rear) sun gear, driving the planet

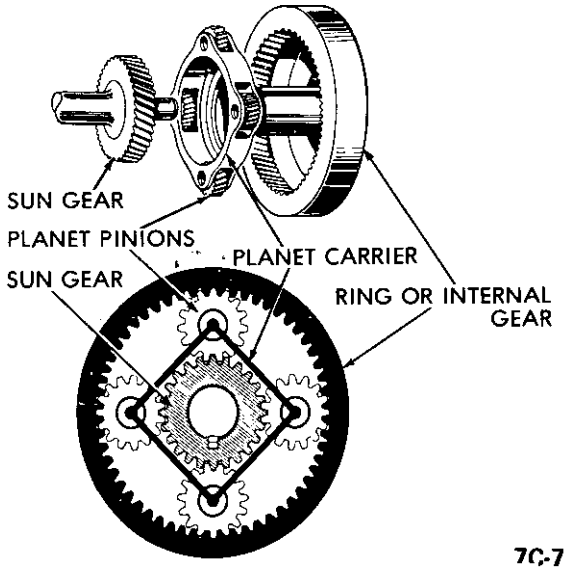


Figure 7C-7 Planetary Gears

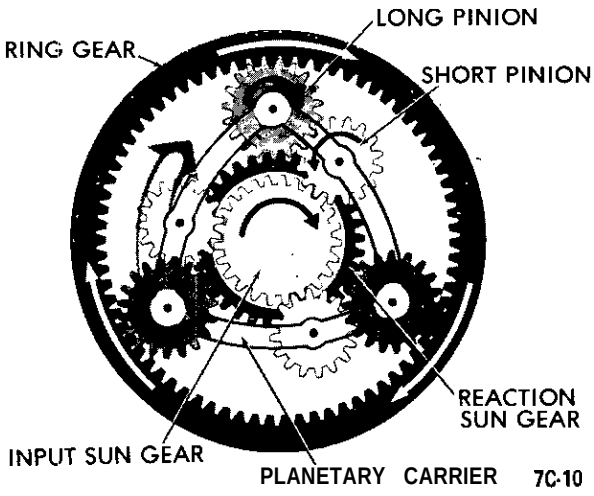


Figure 7C-10 First Gear

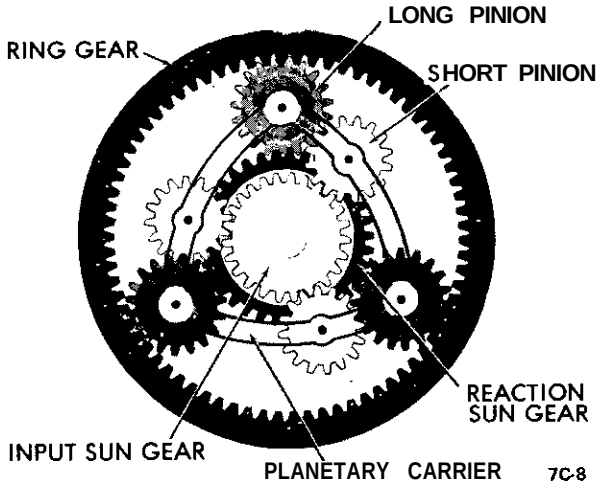


Figure 7C-8 Ravigneaux Planetary Gears

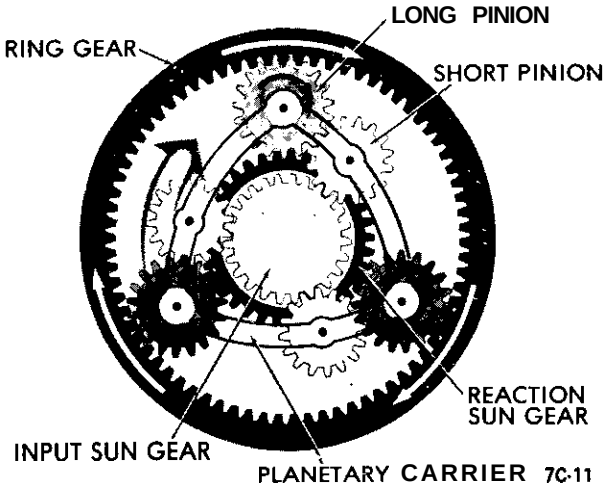


Figure 7C-11 Second Gear

carrier assembly and output shaft in a clockwise direction. See Figure 7C-11.

In the third gear, the ring gear is driven in a clockwise direction and the input (front) sun gear is also driven in the same direction. The long and short planetary pinions cannot rotate on their shafts in this situation, thus causing the planetary carrier, output shaft and gears to rotate clockwise as a solid unit to provide direct drive. See Figure 7C-12.

In reverse, the ring gear is held and the input (front) sun gear is driven in a clockwise direction. This causes the short planet pinions to turn counterclockwise, turning the long planetary pinions clockwise. The pinions then walk around the inside of the stationary ring gear, driving the planet carrier assembly and output shaft in a counterclockwise direction. See Figure 7C-13.

In order to provide the necessary input and reaction functions to produce the various ranges, the Opel

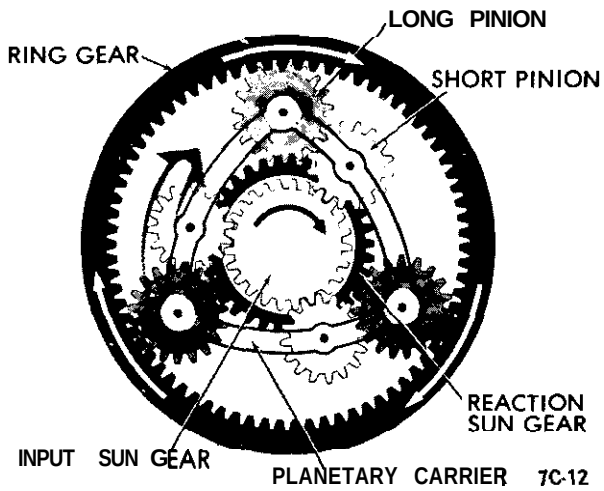


Figure 7C-12 Third Gear

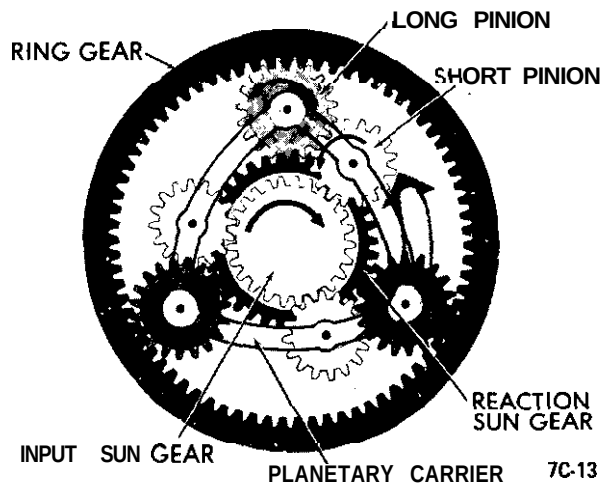


Figure 7C-13 Reverse

Three Speed automatic transmission has three disc clutches, a band and a sprag (overrunning) clutch.

Disc Clutch

A disc clutch serves to connect or disconnect a rotating member with another rotating member or a stationary member. A clutch of this type can have one or more discs or plates depending on the desired capacity.

A disc clutch consists of drive plates, driven plates, a hub and a drum or housing (depending on whether the rotating member is being clutched to another rotating member or a stationary member). The method of apply in an automatic transmission is a hydraulic piston.

One set of plates is lined with friction material and the other plates are steel. Whether the plates are designated as "drive" or "driven" plates depends on the power flow through the clutch.

One set of plates is splined to the drum or housing. With the piston in the released position, the hub with its plates are free to rotate relative to the drum or housing. When hydraulic pressure is applied behind the piston, the piston forces the drive and driven plates together, thus causing the hub to rotate with the drum or remain stationary with the housing. See Figure 7C- 12.

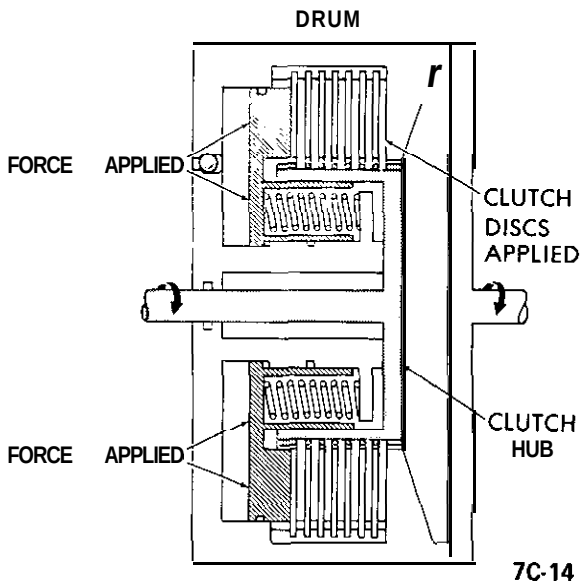


Figure 7C-14 Clutch Applied

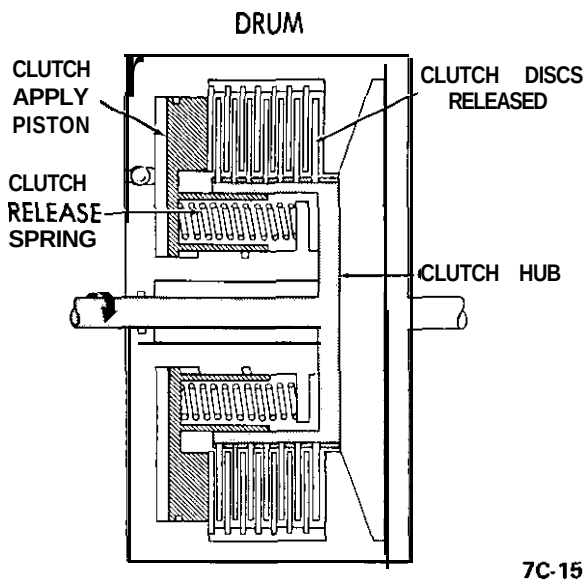


Figure 7C-15 Clutch Released

The clutch is released by exhausting the oil from behind the piston. The release springs push the piston to the released position, thereby removing the force from the plates. See Figure 7C-16.

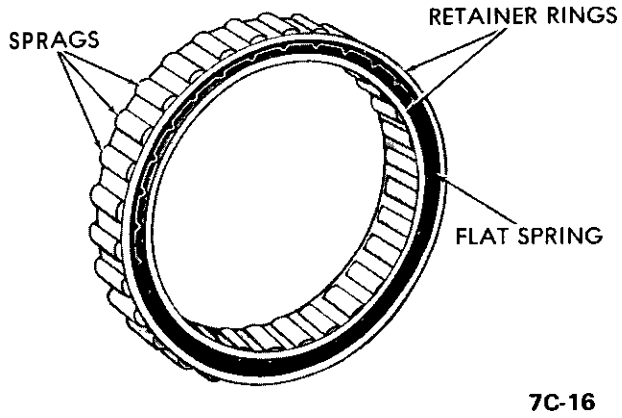


Figure 7C-16 Sprag Cage Assembly

Sprag Clutch

A sprag clutch is an overrunning clutch which allows rotation in one direction only and consists of an inner race, an outer race and the sprag assembly.

The sprag assembly itself consists of sprags, retainer rings and a spring. See Figure 7C- 16. The sprags are mounted at intervals between the two concentric retaining rings. The spring is located between the rings and surrounds the 'narrow portion of the sprags.

One diagonal dimension of each sprag is greater than the distance between the inner and outer race, while the other diagonal is less. See Figure 7C-17. This causes the sprags to wedge and prevent rotation in one direction, and to allow free rotation in the opposite direction.

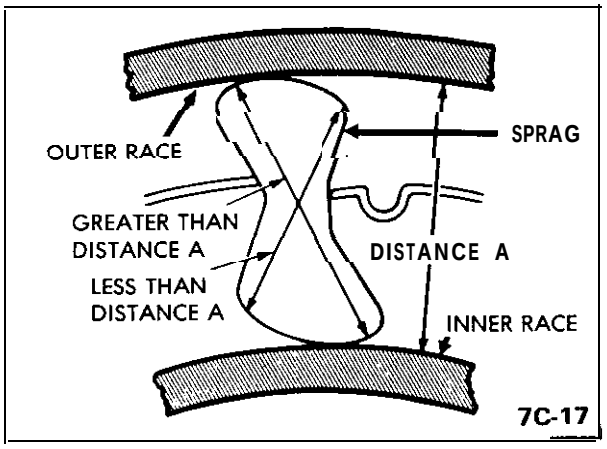


Figure 7C-17 Sprag Operational Schematic

Band

A band is used to hold one planetary member stationary with relation to the other planetary members. See Figure 7C-19. The band is connected to the transmission **case (stationary** anchor) and is operated by a servo piston. One band is used in the Opel Three: Speed Automatic Transmission and holds the **reaction sun gear** and drum **stationary** in first and second gear.

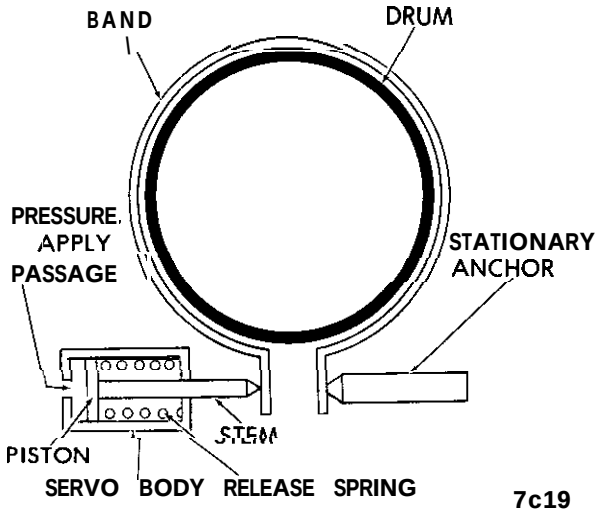


Figure 7C-19 Band Application

COMPONENT OPERATION AND LOCATION

The power flow and principles of operation of the Opel Three Speed Automatic Transmission power train are most easily understood when each unit is considered separately with a part by part build up of the unit.

The torque converter is connected to the engine by means of a flex plate which is bolted directly to the engine crankshaft and to the converter cover. The converter cover is welded to the converter pump member which provides a direct connection of the engine to the converter. The converter pump hub tits **into** the transmission oil pump driving the oil pump whenever the engine is operating. See Figure 7C-20.

The input shaft is splined into the hub of the turbine, delivering the converter's output torque to the transmission gear train. See Figure 7C-21.

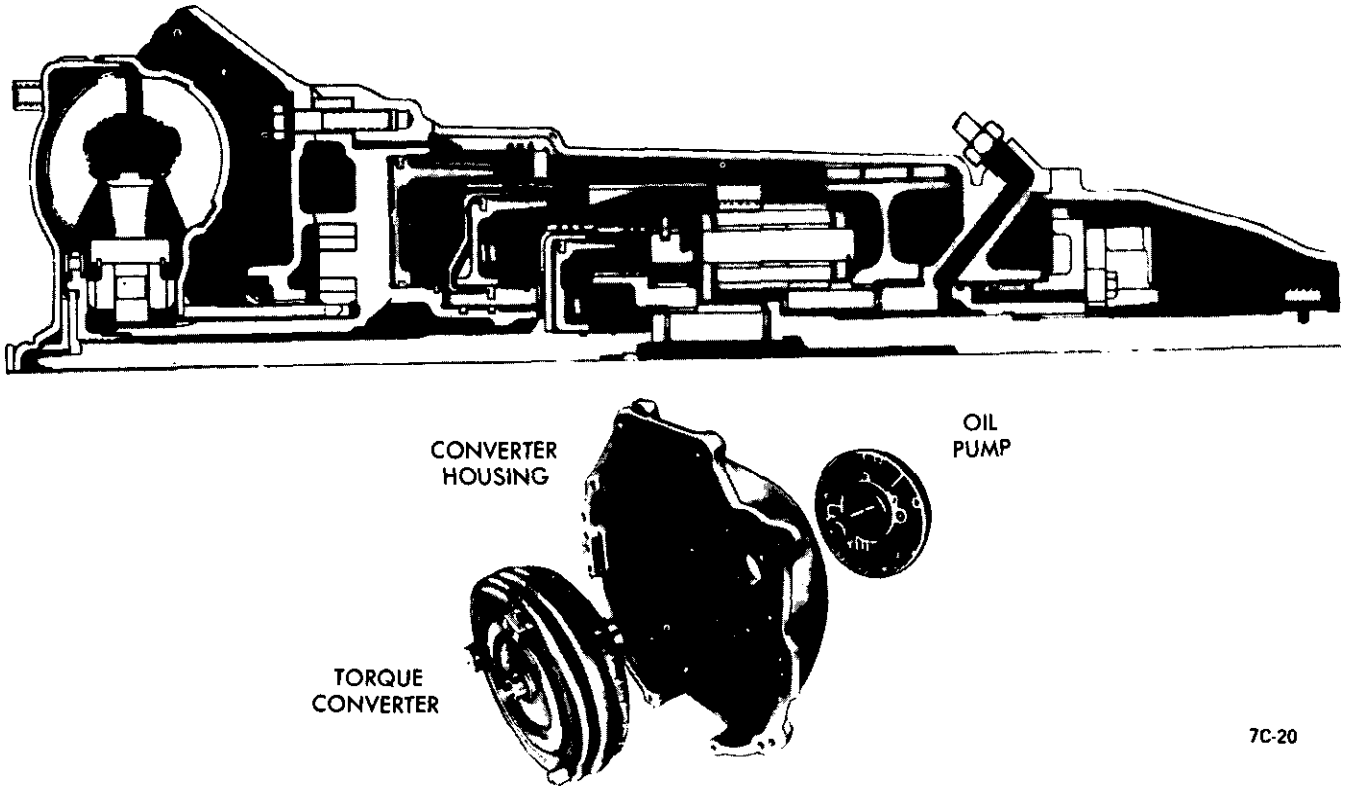
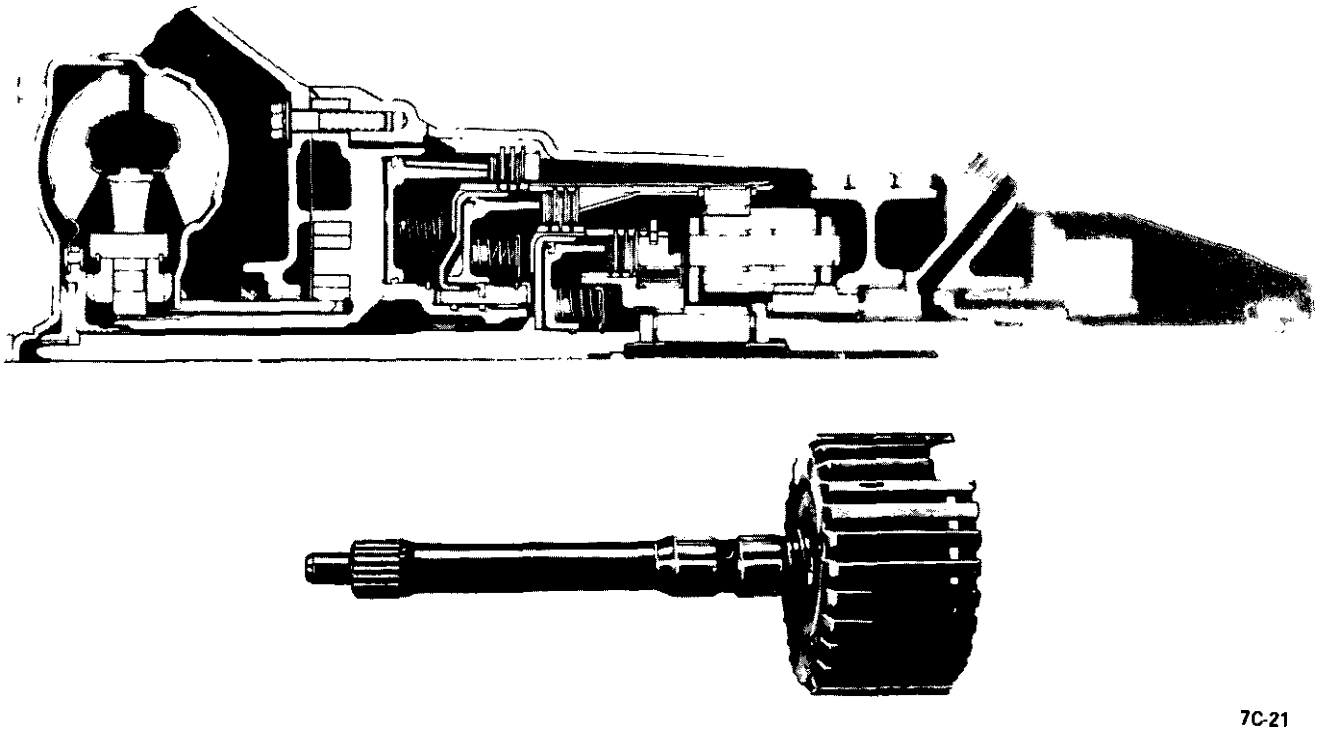


Figure 7C-20 Converter. Converter Housing And oil Pump



INPUT SHAFT AND THIRD CLUTCH DRUM

Figure 7C-21 Input Shaft And 3rd Clutch Drum

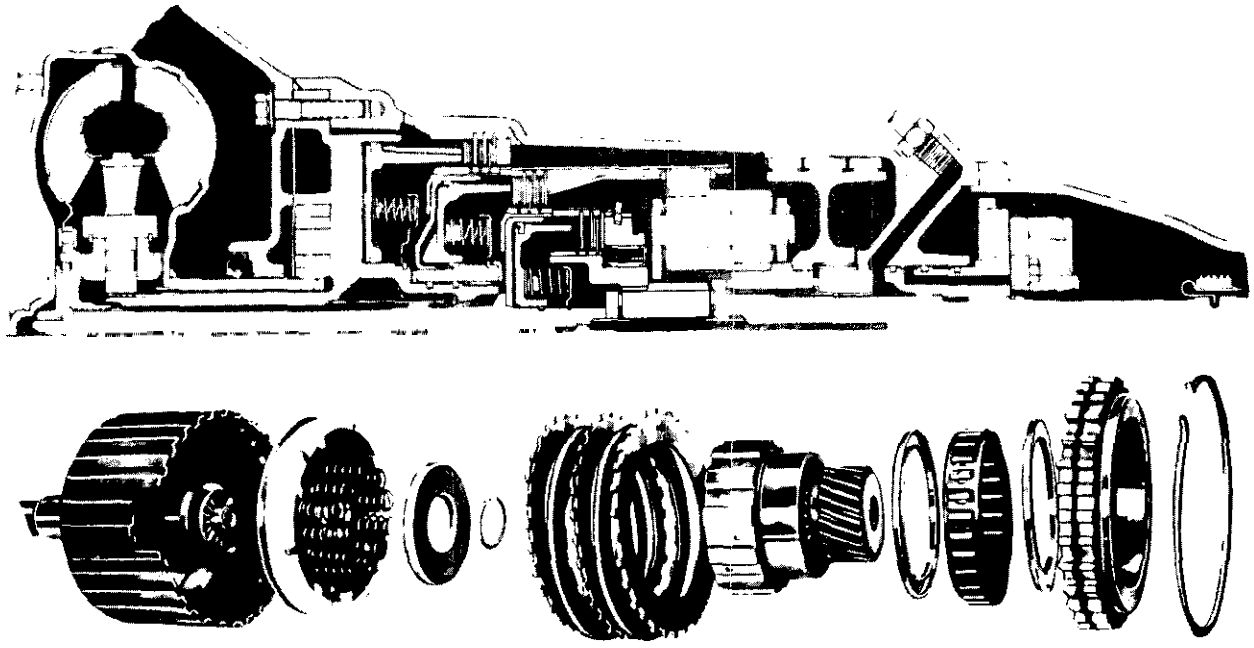


Figure 7C-22 Third Clutch Drum, Piston and Springs, Clutch Plates, Input Sun Gear. Sprag Race And Retainer Assembly

The stator shaft is an integral part of the transmission oil pump and supports the stator assembly at the inner race of the roller clutch assembly.

The input shaft is welded to the third clutch drum. The sprag outer race is splined to the third clutch drum and the inner race is splined to the input sun gear. See Figure 7C-22.

The second clutch assembly is supported by the oil pump hub. The second clutch composition plates are splined to the outside of the third clutch drum, making the third clutch drum the hub for the second clutch. The ring gear is splined to the second clutch drum. See Figure 7C-23.

The reverse clutch piston assembly is housed on the back side of the oil pump body. The reverse clutch steel plates are splined to the transmission case and the composition plates are splined to the outside of the second clutch drum. See Figure 7C-24. The reverse clutch serves to hold the 2nd clutch drum and ring gear stationary in reverse range.

The ring gear surrounds the planetary carrier and the teeth mesh with the front portion of the long pinions. The reaction sun gear is pressed into the reaction sun gear drum. See Figure 7C-25. The low band *is* wrapped around the *reaction sun gear* drum to function as the holding member for the reaction sun gear.

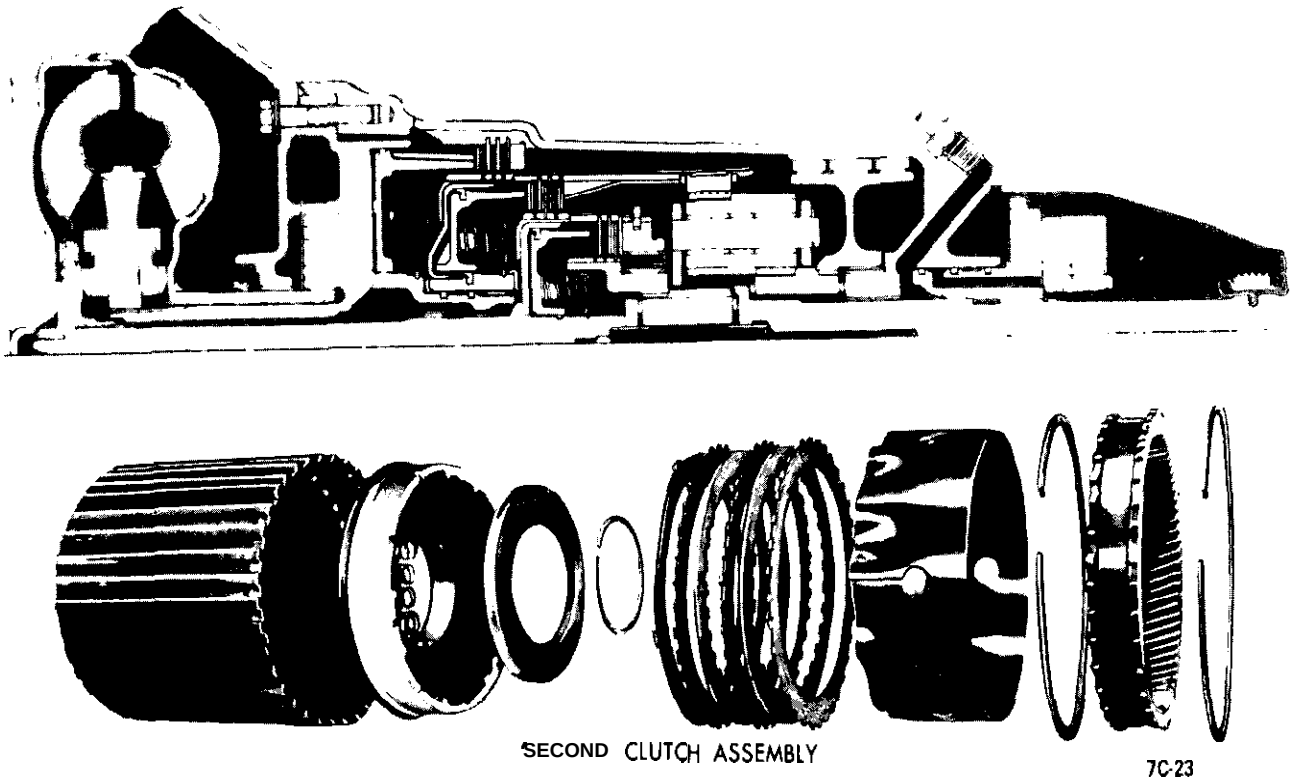


Figure 7C-23 Second Clutch Drum. Piston, Springs, Clutch Plates, Spacer And Ring Gear

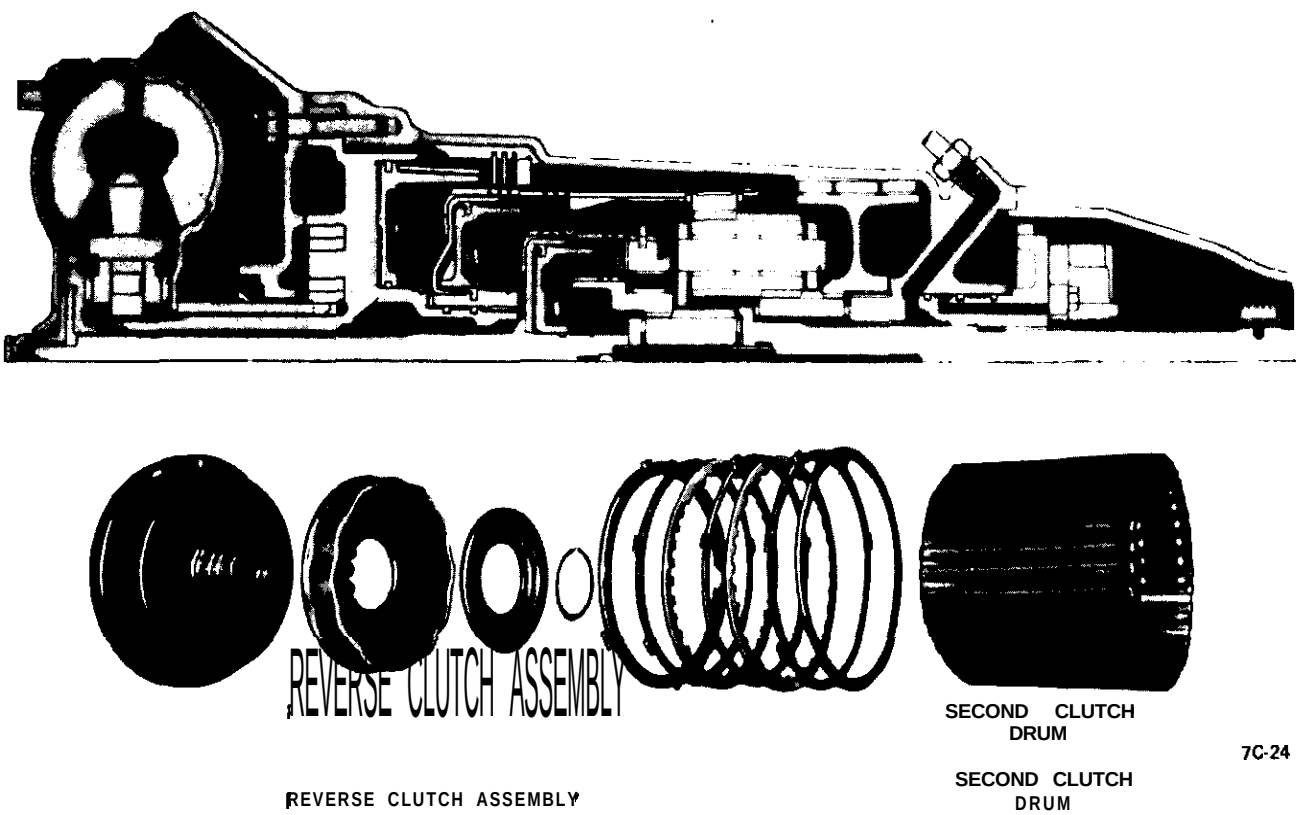


Figure 7C-24 Oil Pump. Reverse Clutch Piston, Springs, Clutch Plates and Second Clutch Drum

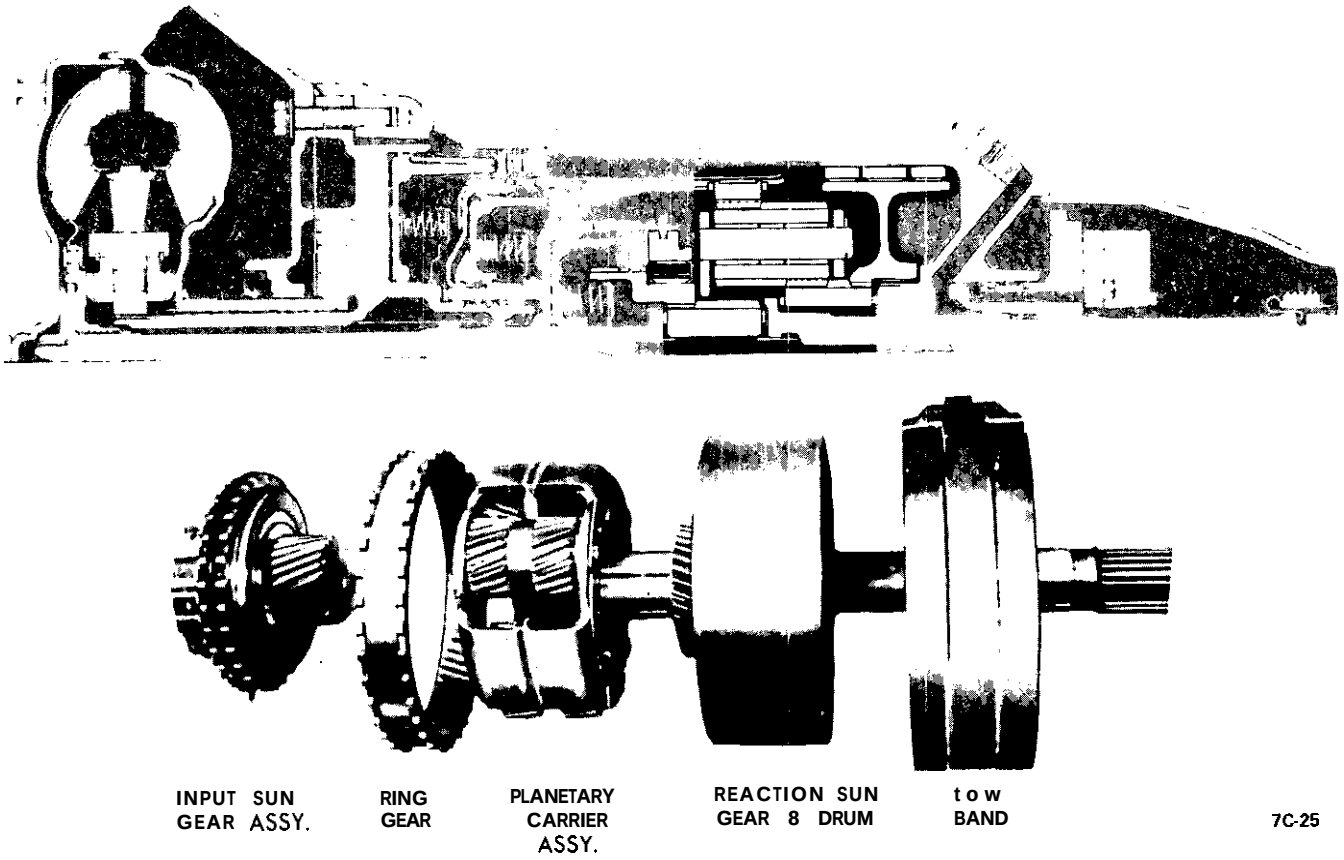


Figure 7C-25 Planetary Gears

The planetary pinion shafts which support the planetary pinions are secured to the planetary carrier by means of a lock plate at the rear of the planetary carrier preventing the pinion shafts from rotating or working loose. The lock plate is secured to the carrier by screws.

The planetary carrier is welded to the output shaft, therefore, the directional movement of the carrier delivers the transmission's torque to the output shaft.

The governor hub is splined to, and driven by, the output shaft. See Figure 7C-26. A governor body is bolted to the governor hub. The speedometer drive gear is also driven by the output shaft, and is secured to the shaft by a retaining clip.

MECHANICAL OPERATION

The following information describes how engine torque is transmitted through the Opel Three Speed automatic transmission for each selected position on the quadrant. In every case, with the engine running, torque is transmitted via the flex plate and converter cover to the pump member of the converter. The converter is always tilled with oil from the transmission's oil pump, and the converter pump member transmits the torque through oil to the driven member of the converter. Power to the transmission is then transmitted via the input shaft and third clutch drum. See Figures 7C-48 through 7C-52.

HYDRAULIC CONTROL UNITS AND VALVES

Previously, the mechanical aspects of the transmission operation have been described, including reference to various clutches and the low band being applied. The following describes, in detail, the hydraulic system that applies the clutches and band, and which controls the manually selected and automatic shifts.

A hydraulic pressure system requires a source of clean hydraulic fluid and a pump to pressurize the fluid. Opel Three Speed Automatic transmission uses a gear type pump which draws oil through a screen located in the sump. See Figure 7C-29. Since the pump drive gear is keyed to the converter pump hub, it turns whenever the engine is operating and turns the driven gear, which causes the oil to be lifted from

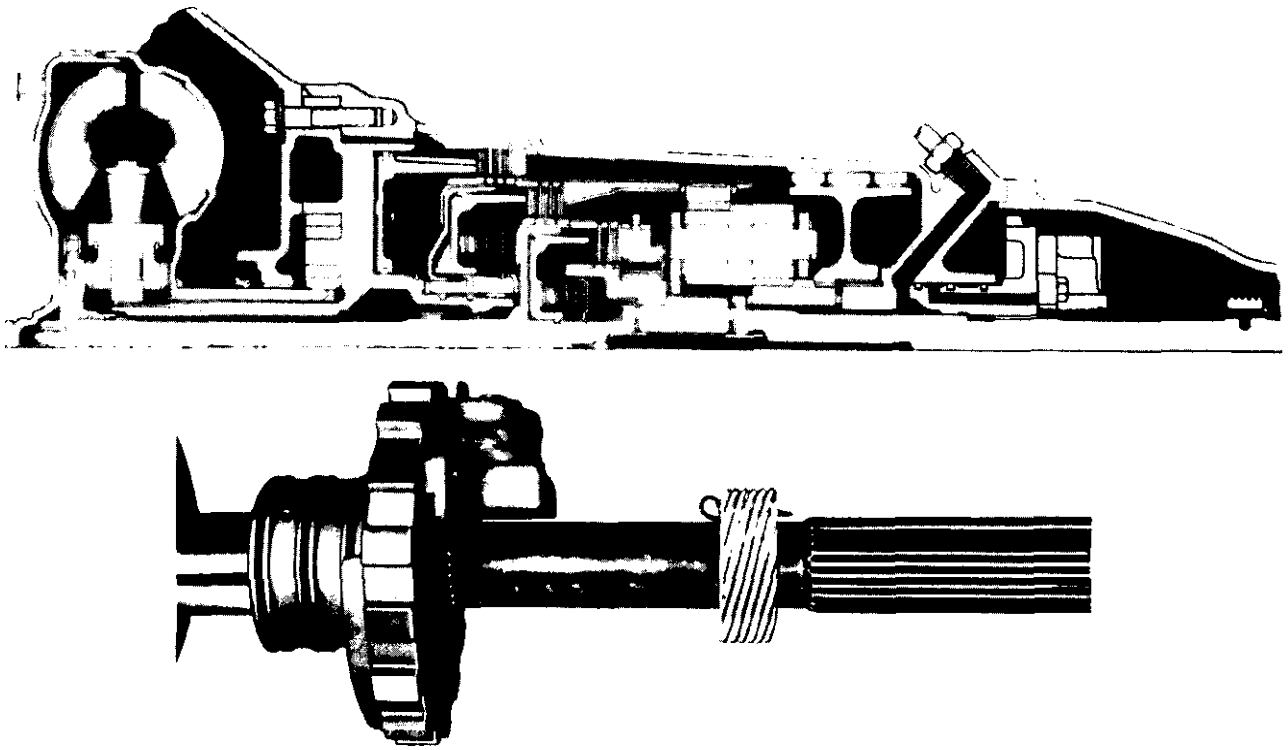


Figure 7C-26 Governor Assembly And Speedometer Drive Gear

the sump. The oil is carried past the crescent section of the pump, beyond which the gear teeth begin to come together, pressurizing the oil as it is squeezed from between the gear teeth. The pressurized oil is then delivered through the pump outlet to the hydraulic control system.

If the vehicle has not been operated for a while, the oil in the pump cavity tends to drain and leak back to the sump. With the pump cavity filled with air, the pump cannot develop enough suction to lift the oil from the sump. For this reason, a priming valve is located in the pump pressure passage. As the air in the pump is compressed by the gears, it is forced out through the bleed orifice in the priming valve and into the exhausted cavity behind the reverse piston. This permits the pump to prime and draw oil from the sump. As soon as the hydraulic pressure reaches 15 P.S.I. the valve is forced over closing off the bleed orifice.

In the hydraulic control circuit, there are four major types of control elements. These categories along with the specific items are listed below.

A. Pressure regulating valves.

1. Main pressure regulator valve.
2. Modulator valve.

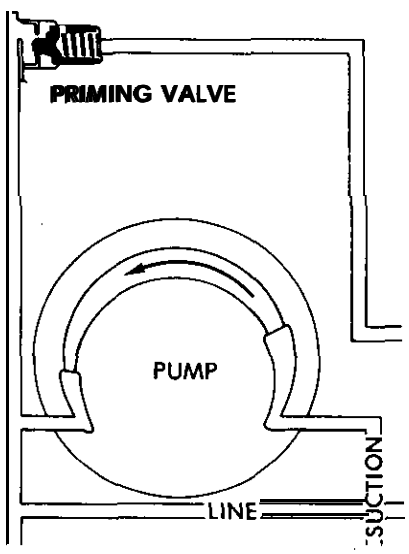


Figure 7C-29 Oil Pump and Priming Valve

3. Detent pressure regulator valve.

4. 1 - 2 Accumulator valve.

5. Governor.

B. Selector valves (manually and hydraulically controlled).

1. Manual valve.

2. Detent valve.

3. 1 - 2 Shift valve.

4. 2 - 3 Shift valve.

5. 3 - 2 Downshift control valve.

6. Manual low and reverse control valve.

7. Boost control valve.

C. Timing Valves.

1. Low speed downshift timing valve.

2. High speed downshift timing valve.

3. Second clutch orifice valve.

D. Accumulators.

1. 1 - 2 Accumulator.

2. Low servo piston.

Main Pressure Regulator Valve

Oil pressure from the pump is delivered to the "line" port of the main regulator valve. See Figure 7C-30. The port is connected through a damping orifice, to the regulator port at the end of the regulator valve. As the pressure in this port increases, it moves the valve against the spring force until the second spool of the. valve just opens to the "line" port. This permits the pump pressure to be by- passed into the pump suction passage. Therefore, the valve will regulate at a fixed minimum pressure as determined by the spring force, and all excess pump delivery will be by-passed back into the pump suction passage.

In moving from the "bottomed" to the regulating position, the valve also opens line pressure to the converter feed passage. This oil is directed to and through the converter, through the oil cooler, to the gear box lubrication system, then back to the sump.

In order to provide the required capacity in the band and clutches, it is desirable to have a variable line pressure that will increase with engine torque. This

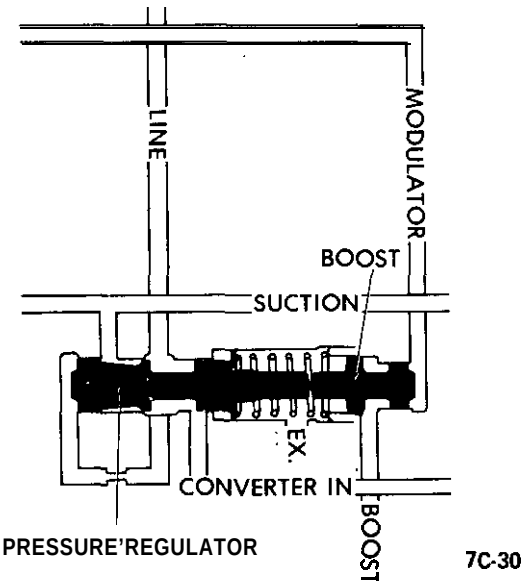


Figure 7C-30 Pressure Regulator Valve

is accomplished by introducing a "modulator" pressure on the end of the boost valve. The force of the boost valve acts against the end of the regulator valve and increases the line pressure above the base pressure as established by the spring force. By introducing line pressure to the stepped area between the spools of the boost valve, an additional pressure increase over and above that described above is obtained.

The regulated line pressure is then fed to:

Manual valve.

Modulator valve

Detent pressure regulator valve

Modulator Valve and Vacuum Modulator

Line pressure is directed to the second port of the modulator valve. See Figure 7C-31. This pressure passes between the spools of the valve and into the modulator port. The modulator port is connected to the regulating port at the end of the valve through a damping orifice. As the pressure in the regulating port increases, it moves the valve outward against the spring force of the modulator assembly until the end spool just closes the line port. If excess pressure has built up in the regulating port the valve will continue to move till the second spool just opens to the exhaust port. In other words, the valve tends to regulate between the line and exhaust ports.

Even though the modulator spring force may be constant, thereby causing the modulator valve to regulate at a fixed pressure, the pressure requirements

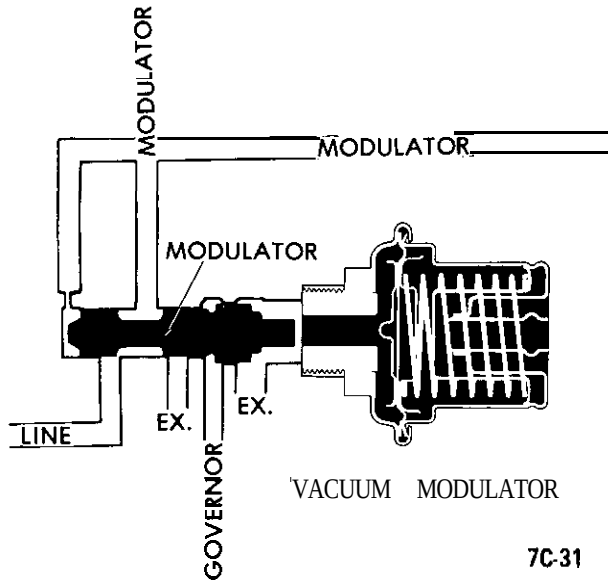


Figure 7C-31 Vacuum Modulator and Modulator Valve

decrease as car speed increases. For this reason, governor pressure (which is a function of car speed) is directed to the area between the two different diameter spools at the outboard end of the valve. As governor pressure increases, it creates an outward force on the modulator valve and in effect reduces the spring force of the modulator assembly.

The modulator assembly consists of two chambers separated by a diaphragm. The chamber toward the valve is open to atmosphere and the other chamber is connected to engine vacuum. The vacuum chamber also contains a spring. When there is no vacuum (o" of mercury), the full spring force bears against the diaphragm and is transmitted to the valve through a plunger. This is the spring force which establishes the regulated pressure of the modulator valve. As the vacuum in the outer chamber increases, an outward force is created on the diaphragm which cancels out some of the spring force. This continues up to 16" of vacuum, at which point the diaphragm force cancels out the spring force and the modulator pressure becomes zero.

In summary, the following indicates the function of the total modulator system in combination with the pressure regulator system.

In addition, higher car speeds will produce a somewhat lower modulator and line pressure for any given vacuum by virtue of the governor pressure acting on the modulator valve.

Engine Torque	Vacuum	Modulator Pressure	Line
Low	High	Low	LOW
High	Low	High	High

Modulator pressure is then directed to:

Pressure regulator boost valve.

1 - 2-Shift control.

2 - 3-Shift control valve by way of the 3 - 2 control valve.

Detent Valve.

1 - 2 Accumulator Valve.

Low Speed Downshift Timing Valve.

Detent Pressure Regulator Valve

The regulating action of the Detent Pressure Regulator Valve is essentially the same as for the Modulator Valve, except that it regulates a constant pressure. See Figure 7C-32. The feed port, regulating port and exhaust port all function in the same manner as the Modulator Valve. Since the force set up by the pressure in the regulating port acts only against a fixed spring force, the resulting detent pressure is constant. The detent regulator pressure is directed to the Detent Valve and to the Manual Low and Reverse Control Valve.

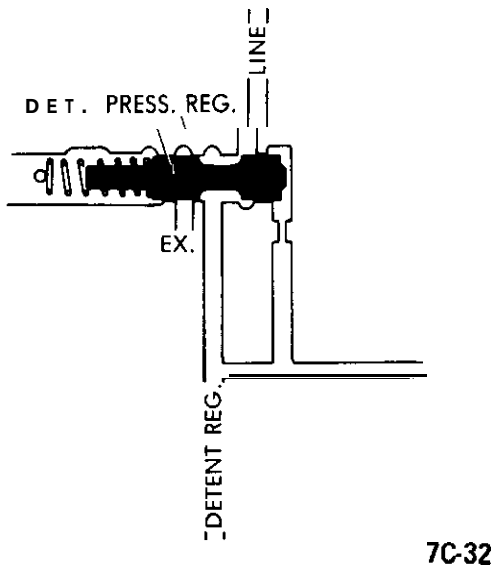


Figure 7C-32 Detent Pressure Regulator Valve

1-2 Accumulator Valve

The 1 2 Accumulator Valve, Figure 7C-33, is used to establish a desired pressure to ultimately control the rate of apply of the second clutch during a 1 to 2 upshift. Here again, the regulating action is essentially the same as for the Modulator Valve or Detent Pressure Regulator Valve.

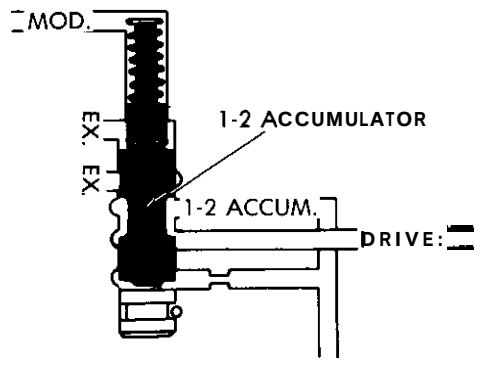


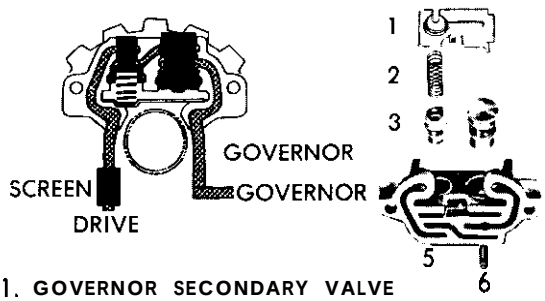
Figure 7C-33 1 • 2 Accumulator Valve

The ports and spools operate as previously described. However, for increased engine torque, it is necessary to increase the accumulator pressure. This is accomplished by introducing modulator pressure to the small end of the 1-2 accumulator valve. As the modulator pressure increases, it adds to the spring force and increases the l-2 accumulator pressure.

The 1-2 accumulator pressure is fed to the bottom (spring loaded side) of the 1-2 accumulator piston.

Governor

The Governor is **mounted** on the output shaft and contains two interconnected regulating valves See Figure 7C-34. Its purpose is to supply an oil pressure



1. GOVERNOR SECONDARY VALVE SPRING RETAINER
2. GOVERNOR SECONDARY VALVE SPRING
3. GOVERNOR SECONDARY VALVE
4. GOVERNOR PRIMARY VALVE
5. GOVERNOR BODY
6. ROLL PIN

Figure 7C-34 Governor Assembly

that is a function of output shaft or car speed. Line pressure is supplied to the governor from the Manual Valve (to be covered later). The governor operates on the principle of centrifugal force. That is, as an object spins off center at changing speeds, its outward force is a function of the rotating speed.

Line pressure is directed to the outer-most port of the secondary valve. The secondary spring holds the **valve** in **an** outward **position** so that the outer spool of the valve is open to "line". As the line pressure builds up between the spools, it exerts a force on the larger diameter inner spool to start counteracting the spring. When the hydraulic force is large enough, it moves the valve inward against the spring force until the outer spool closes the line port. If the pressure between the spools still creates a force larger than the spring force, the valve will continue to move inward until the excess pressure opens to the exhaust port. The valve then regulates between the line and exhaust port.

A fixed governor pressure in the secondary valve has now been established with no rotation of the output shaft. As the governor begins to rotate, the outward force (due to the weight of the secondary valve) is added to the force of the spring. Therefore, as the speed increases, the outward force and in turn the secondary valve pressure increases.

The secondary valve pressure is directed to the feed port of the primary valve. With no rotation of the governor, the pressure acts against the large inner spool and forces it to open to the exhaust port. Since there is no spring force on the primary valve, it will continue to keep the feed port closed and the exhaust port open. The final governor pressure is then zero. As the governor begins to rotate, the weight of the primary valve creates an outward force working against the oil pressure. The pressure in the primary valve port now increases as a function of speed. This continues up to the speed where the outward force finally holds the primary valve outward, keeping the feed port open.

In summary, at zero speed, the governor pressure is zero. As the speed increases, the governor pressure will increase as dictated by the primary valve until the speed is great enough to hold the primary valve all the way out. At speeds above this point, the governor pressure is established by the secondary valve.

Governor pressure is then directed to:

Modulator Valve.

1 • Two Shift Valve.

2 • Three Shift Valve.

3 High Speed Downshift Timing Valve.

Manual Valve

The manual valve is mechanically connected to the shift lever. Its function is to direct hydraulic pressure to the various circuits to establish the base hydraulic range of the transmission.

Line pressure is fed to the manual valve. See Figure 7C-35. In "Park" and "Neutral", the valve seals line pressure from entering any of the circuits. At the same time all circuits are open to exhaust so that the transmission remains in a neutral condition.

In "Reverse", line pressure is directed to the reverse clutch piston, boost control valve and the reverse and manual control valve. All other manual control circuits are open to exhaust.

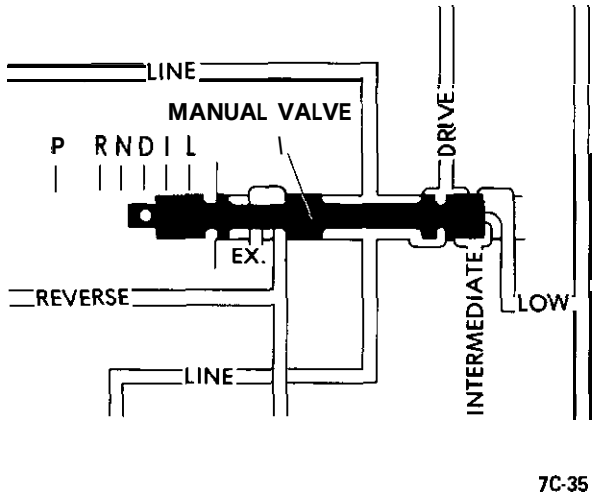


Figure 7C-35 Manual Valve

In "Drive" the manual valve directs oil to the governor, I - 2 shift valve, 1 2 accumulator valve, and to the apply side of the low servo piston by way of the high speed downshift timing valve. The "Reverse", "Second", and "Low" ports are exhausted.

In "Second" the "Drive" circuits remain pressurized. In addition, pressure is supplied to the boost control valve and to the 2 - 3 shift valve. The "Reverse" and "Low" ports are exhausted.

In "Low", pressure is supplied to the 1 - 2 shift valve and to the reverse and manual control valve in addition to the circuits already pressurized in "Drive" and "Second". The "Reverse" port is exhausted.

Detent Valve

The function of the detent valve is to cause the transmission to shift to a lower gear for additional performance when the accelerator is depressed all the way.

The detent valve is mechanically connected to the throttle linkage. A spring holds the detent valve in a retracted position. See Figure 7C-37. Two pressures, "detent regulator" and "modulator", are supplied to the detent valve.

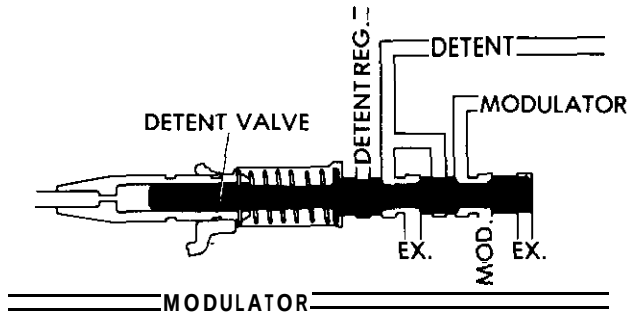


Figure 7C-37 Detent Valve

In the retracted or "part throttle" position, the detent valve directs modulator pressure to the 1 2 and 2 3 shift control valves and to the 3 2 control valve. In the "through detent" or full throttle position, modulator pressure is blocked and the passages previously receiving modulator pressure now receive detent regulator pressure. In this position, detent regulator pressure is also supplied to additional ports of the 1 - 2 and 2 3 shift control valves and the 3 2 control valve.

1 2 Shift Valve

The 1 - 2 Shift and Shift Control Valves determine whether the transmission is in first or second gear. See Figure 7C-38. With the shift valve bottomed in its bore, the valve blocks "Drive" or line pressure and the second clutch is open to exhaust. The valve is held in this position by a spring and any modulator pressure that may be acting against the two end spools of the 1 - 2 shift control valve.

As the car speed and governor pressure increase, a force is developed on the end of the shift valve. When this force is great enough to overcome the spring and the force of the 1 2 shift control valve, the shift valve moves, closing the exhaust and opening the line pressure port to the second clutch port.

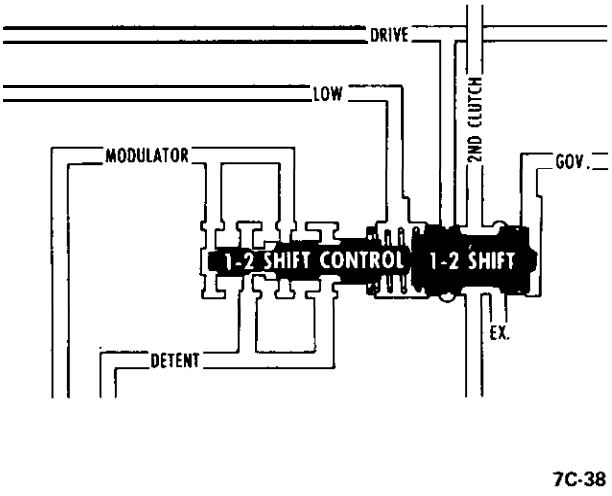


Figure 7C-38 1 2 Shift Valve

To prevent a "hunting" condition of the shift valve, modulator pressure supply to the second spool of control valve is cut off as the shift valve opens line pressure to the second clutch. The oil in this pocket is exhausted out through the detent passage. An additional force keeping the valve in an "upshifted" position is obtained by line pressure acting on the larger diameter second spool of the shift valve. Because of this, even though the governor pressure might be maintained at a constant pressure after the valve upshifts, a higher modulator pressure is required to cause the valve to downshift.

If the accelerator is depressed to the point where the detent spring force is felt, the vacuum will drop and the modulator pressure will increase. If the spring force plus the modulator pressure acting against the end spool of the shift control valve is great enough to overcome the governor and line pressure acting on the shift valve, a "part throttle" forced downshift will occur. If not, the transmission will remain in the higher gear.

If the accelerator is depressed through the detent, the detent valve supplies detent regulator pressure to all three spools of the shift control valve, a higher downshifting force is obtained as compared to the part throttle condition. Because of this, a "through detent" forced downshift can be obtained at a speed higher than for the "part throttle" condition. However, there is still a limiting speed at which a "through detent" forced downshift will occur.

If the selector lever is placed in "Manual Low", line pressure is supplied directly to the spring pocket between the valves. Since line pressure can never be less than governor pressure, the force established by line pressure on the shift valve plus the spring force will move the shift valve to a downshifted position regardless of car speed.

2 3 **Shift** Valve and 3 - 2 Control Valve

The function and operation of the 2 3 Shift and Shift Control Valves is the same as for the 1 2 valve except as described below. See Figure 7C-39.

The downshifted position establishes "second" gear, and the upshifted position establishes "third" or "high" gear.

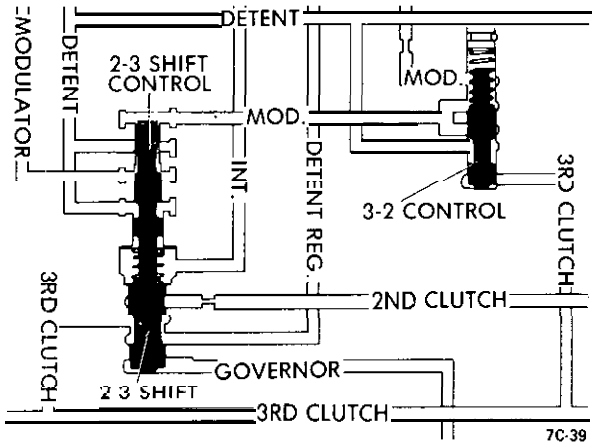


Figure 7C-39 2 3 Shift Valve and 3 2 Control Valve

Modulator pressure is supplied to the end spool of the 2 - 3 control valve through the 3 - 2 control valve. When the shift valve moves to the upshifted position, line pressure is introduced to the third clutch circuit. The third clutch circuit also directs pressure to the end spool of the 3 - 2 control valve.

At light throttle conditions, third clutch pressure acting on the end of the 3 - 2 control valve moves the valve against the spring and the force established by the modulator pressure. This exhausts the modulator pressure from behind the end spool of the 2 - 3 control valve and the spring is the only remaining force acting on the shift valve to produce a downshift. In this condition, it is not possible to obtain a "part throttle" forced downshift.

If the accelerator is depressed far enough to cause a substantial drop in vacuum, the increased modulator pressure on the 3 - 2 control valve plus the spring will overcome the force of the third clutch pressure. This feeds modulator pressure back to the 2 - 3 control valve and a "part throttle" forced downshift will occur. As with the 1 2 shift valve, there is a limiting speed at which this can occur.

When the selector lever is placed in "Second", line pressure is directed to the spring pocket between the 2 - 3 Shift and Shift Control Valves and the shift

valve will be held in downshifted, or second gear, condition regardless of car speed.

Manual Low and Reverse Control Valve

As described in the text on "Mechanical Operation", the third clutch is applied in manual "Low" and in "Reverse" to prevent a free wheeling condition. In "Drive" range third gear, third clutch pressure is also directed to the release side of the low servo (to be covered later). This is the pressure which causes the low band to release during a 2-3 upshift. However, in manual low, the band must remain applied even though the third clutch is on.

The above conditions are achieved by routing third clutch pressure to the release side of the low servo through the manual low and reverse control valve. See Figure 7C-40. In "Drive" range, the spring holds the valve in its "bottomed" position and permits the third clutch pressure to be directed to the servo release circuit.

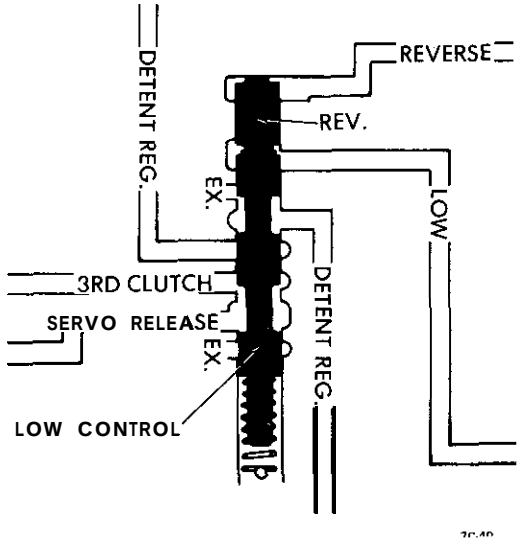


Figure 7C-40 Manual Low and Reverse Control Valve

When the selector lever is placed in manual "Low", line pressure is introduced between the manual low and reverse control valves. This forces the low control valve over against the spring. In this position, third clutch pressure is cut off from servo release and servo release is opened to exhaust. The third clutch exhaust passage is now open to detent regulator pressure which applies the third clutch since the shift valve is in the "downshifted" position. Because the servo release passage is open to exhaust, the low band will remain applied.

When the selector lever is placed in "Reverse," line pressure acts on the end of the reverse control valve and forces the low control valve into the same position as in manual "Low". This causes the third clutch to be applied.

Boost Control Valve

To obtain the required pressure increase previously described for "Second" "Low" and "Reverse", line pressure is introduced to the stepped area between the two spools of the pressure regulator boost valve. In "Second" or "Low", some means has to be provided to prevent the pressure to the boost valve from being exhausted through the reverse passage. It is also necessary to prevent reverse pressure from being exhausted through the intermediate passage when in "Reverse".

The boost control valve consists of a steel ball in a flow and pressure sensitive chamber. See Figure 7C-41. Where the reverse passage is pressurized. the pressure and flow seat the ball against the intermediate passage and the pressure is directed to the boost passage. In "Second" or manual "Low", the ball is seated against the reverse passage and the pressure is directed to the boost passage.

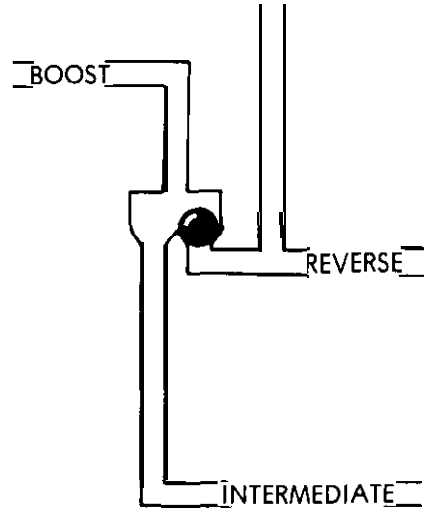
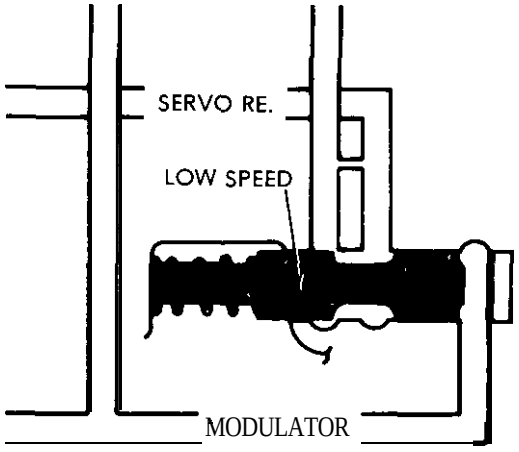


Figure 7C-4 1 Boost Control Valve

Low Speed Downshift Timing Valve

When the vehicle is coasting to a stop, and a 3-2 downshift takes place, it is necessary to delay the application of the band while the third clutch is being released. This is accomplished by directing the servo release pressure through the coast downshift timing valve. See Figure 7C-42.



7C-42

Figure 7C-42 Low Speed Downshift Timing Valve

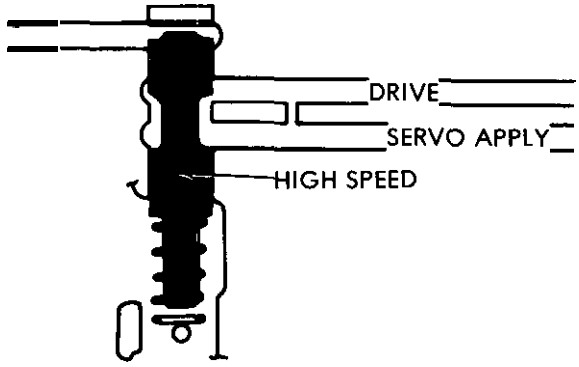


Figure 7C-43 High Speed Downshift Timing Valve

During a "coast" condition, the vacuum is high and the modulator pressure is zero. The spring holds the timing valve in a bottomed position and the servo release pressure is exhausted through a restricting orifice, thus delaying the apply of the servo.

During a "power on" 3-2 downshift at lower car speeds, the servo must be applied rapidly. During such a shift, the vacuum will be somewhat lower and the resulting modulator pressure will force the valve over against the spring. This provides an unrestricted passage for servo release, thus permitting rapid apply of the servo.

High Speed Downshift Timing Valve

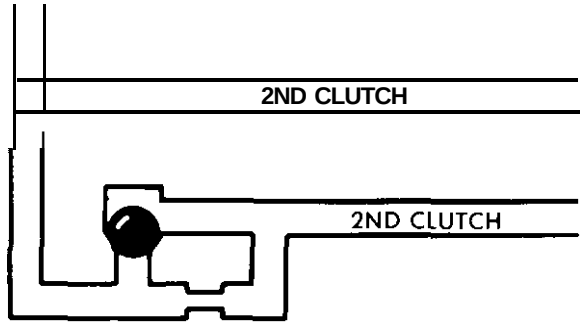
When a 3-2 downshift is "forced" at high car speeds, the application of the band must be delayed. Servo apply pressure is directed through the high speed downshift timing valve. See Figure 7C-43.

The timing valve is held in a bottomed position by the spring at lower car speeds. This permits an unrestricted flow for servo apply. At higher car speeds, approximately 25 to 35 MPH, (depending on axle ratio and engine), governor pressure forces the valve over against the spring. This closes off the direct feed to servo apply and the feed is controlled by a fixed orifice.

While it may outwardly appear that the functions of the two downshift timing valves are contradictory, whether or not the application of the band is delayed during a 3-2 downshift is a combined function of car speed and throttle position.

Second Clutch Orifice Valve

For reasons of shift timing, it is necessary to have different restricting orifice sizes for the feed and exhaust of the second clutch. This is accomplished by introducing a "one way" ball check in the second clutch circuit. See Figure 7C-44.



7C-44

Figure 7C-44 Second Clutch Orifice Valve

When the second clutch is being applied, the apply pressure seats the ball and the feed is directed through a single orifice. During the release of the clutch, the ball is unseated and the clutch can exhaust at a faster rate through the two orifices.

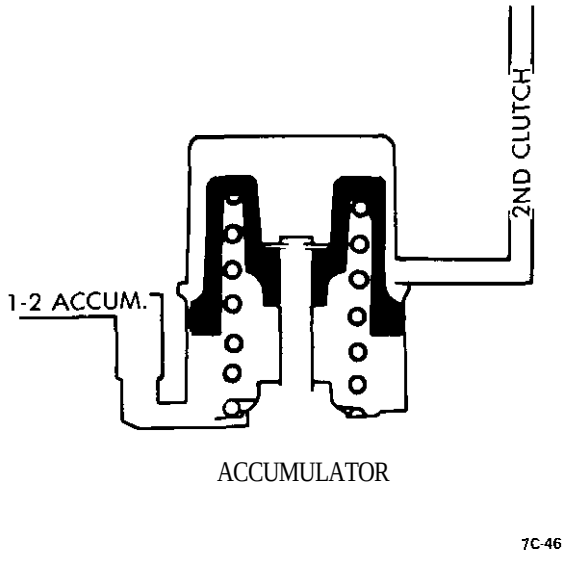


Figure 7C-46 1-2 Accumulator

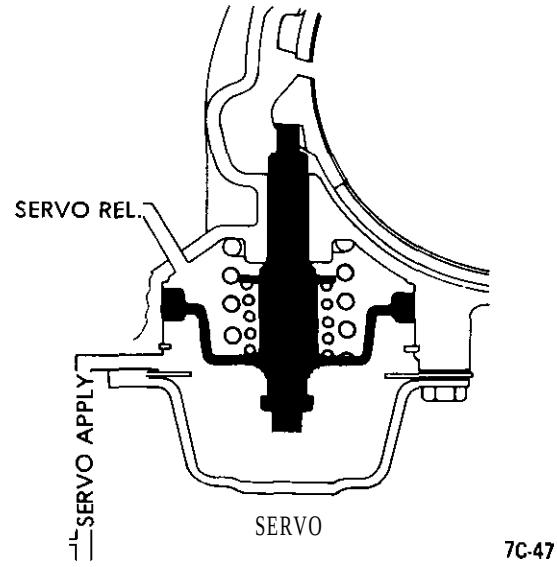


Figure 7C-47 Low Servo

1-2 Accumulator

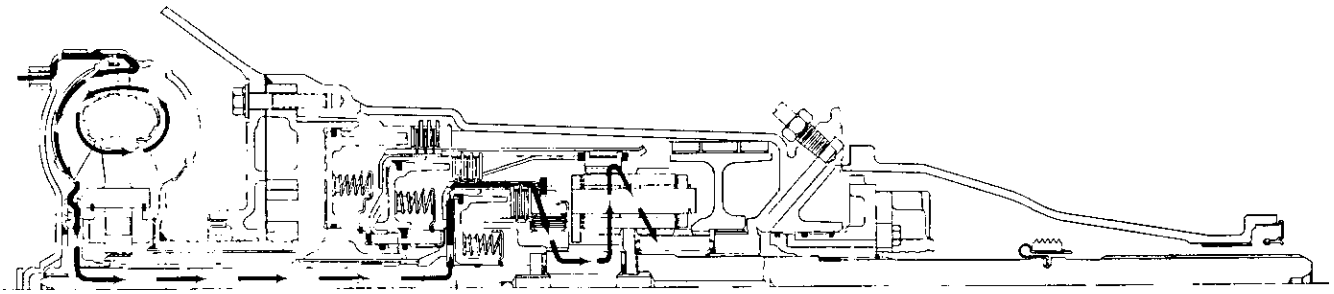
In order to obtain a smooth 1-2 upshift, it is necessary to control the rate of pressure build-up in the second clutch. This is accomplished by introducing a hydraulic modulator in the clutch circuit. Prior to the second clutch being applied, the spring holds the accumulator piston in an upward position. When line pressure is introduced to the second clutch circuit by way of the 1-2 shift valve, the pressure in the second clutch will be permitted to build up rapidly until the clutch pressure acting on the accumulator piston is sufficient to overcome the accumulator spring. As the clutch pressure increases on the top side of the accumulator piston, the piston will start to move against the spring force until the piston is forced all the way down. This provides a time delay for the apply of the second clutch before the pressure reaches its maximum value. When upshifts are made at heavier throttle, it is necessary to increase the pressure at which this time delay occurs. This is accomplished by introducing a vacuum sensitive pressure from the 1-2 accumulator valve to the bottom side of the accumulator piston. This pressure assists the spring and the clutch pressure will have to build up to a higher value before the accumulator piston will move. See Figure 7C-46.

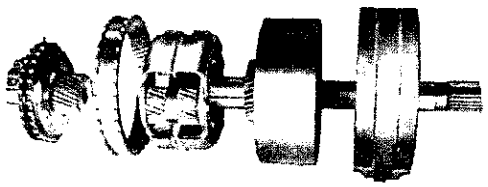
Low Servo

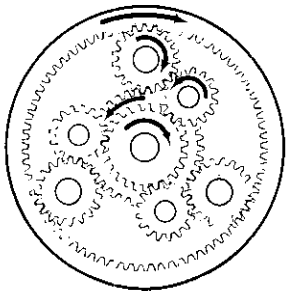
The low servo provides a dual function. See Figure 7C-47. It is the means by which the band is applied and it provides an accumulator action for the third clutch during a 2-3 upshift.

In first and second gear, servo apply pressure acting on the bottom side of the low servo piston moves the piston against the spring force and applies the band. During a 2-3 upshift, third clutch pressure is introduced to the top side of the servo piston. When third clutch pressure, acting on the top side of the piston and assisted by the servo release spring, is sufficient to overcome the servo apply force, the servo will move downward. This removes the apply force from the band and the band will release while the clutch is being applied. During the downward movement of the piston, a time interval occurs which cushions the apply of the third clutch in the same manner that the 1-2 accumulator cushions the apply of the second clutch. It is because of this accumulator action that the band adjustment is so critical. The main function of the band adjustment is to control the servo release spring load rather than to control band clearance.

a. NEUTRAL & PARK · ENGINE RUNNING







Neutral · Engine Running

Reverse Clutch. Released

Third Clutch · Released

Second Clutch. Released

Low Band . Released

Sprag · Locked

In neutral, the low band and all clutches are released. With this condition, no member of the planetary gear set is held and there is no reaction member. All gears are free to rotate around their own axis and no torque is transmitted to the planet carrier assembly and output shaft.

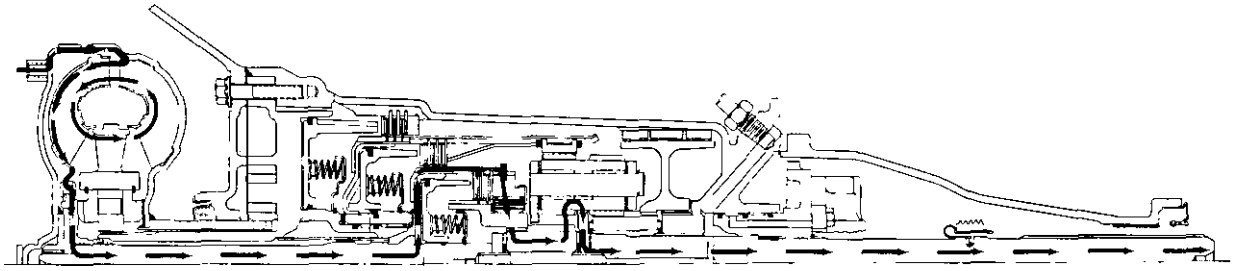
Park · Engine Running

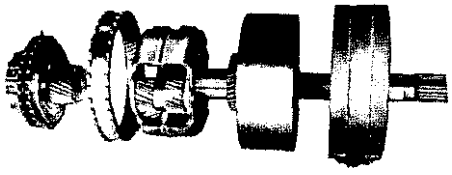
The same power flow conditions in the neutral position are in effect in the park position. Additionally, mechanical linkage actuates a parking pawl which engages with the splines in the periphery of the governor assembly. Since the governor assembly is splinad to the output shaft, the parking pawl holds the output shaft locked to the extension, preventing the vehicle from rolling.

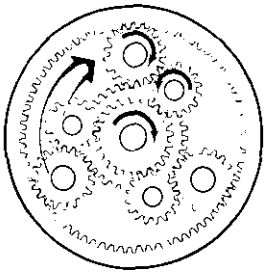
7C-48

Figure 7C-48 Neutral and Park Engine Running

b. DRIVE RANGE . FIRST GEAR







Drive Range . First Gear

Reverse Clutch Released

Third Clutch. Released

Second Clutch. Released

Low Band - Applied

Sprag Locked

In Drive Range - First Gear, the low band is applied and all clutches are released.

The low band holds the reaction sun gear and drum stationary, which serves as the reaction member of the planetary gear set in first gear. The input shaft drives the third clutch drum in a clockwise direction, which turns the sprag race and retainer assembly clockwise. The sprags wedge and drive the input sun gear.

The power is then transmitted through the gear set to the output shaft as outlined in "Principles of Operation". The ratio in first gear is 2.40:1.

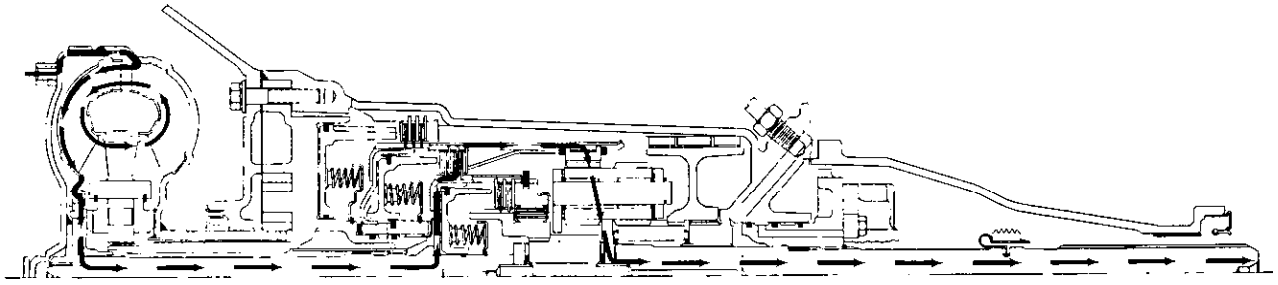
Low Range

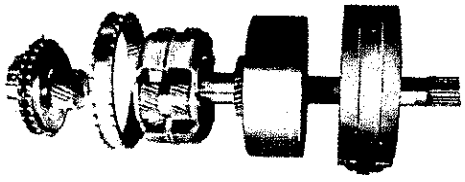
In Low Range, the third clutch is applied together with the low band. The input power flow is exactly the same as drive range first gear except that the third clutch is engaged and prevents the sprag from overrunning, thus providing engine braking when coasting in Low Range.

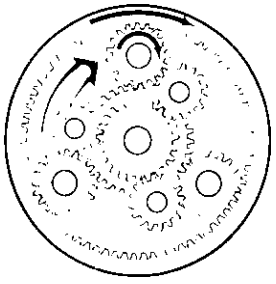
7C-49

Figure 7C-49 Drive Range First Gear

c. DRIVE RANGE. SECONO GEAR







Drive Range . Second Gear

Reverse Clutch · Released — **Third Clutch · Released**

Second Clutch -Applied — **Low Band -Applied**

Sprag · Overrunning

In Drive Range. Second Gear, the low band and second clutch are applied.

The input shaft drives the third clutch drum and the second clutch composition plates. When the second clutch piston is applied, the rotating second clutch composition plates are locked to the second clutch steel plates. Since the second clutch drum is now rotating in a clockwise direction, the ring gear is driven clockwise. As described in "Principles of Operation", the carrier is driven in a clockwise direction. The long planet pinions also drive the short planet pinions, which drive the input sun gear clockwise, causing the sprag assembly to overrun. The ratio is 1.48:1.

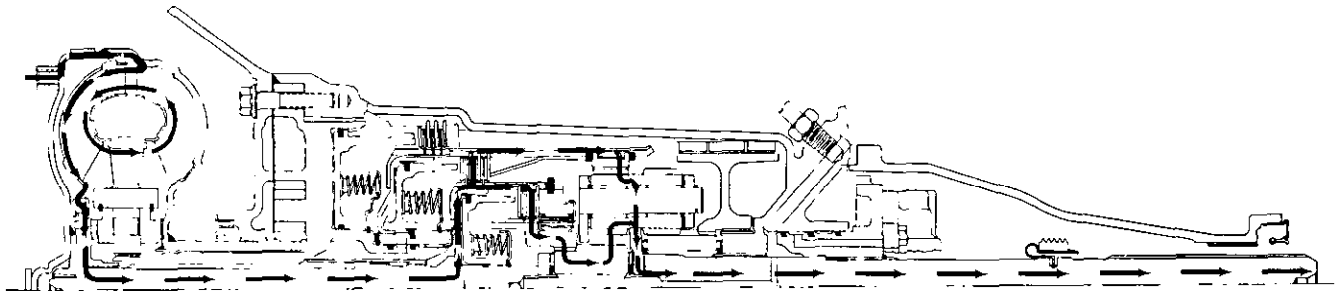
second Range

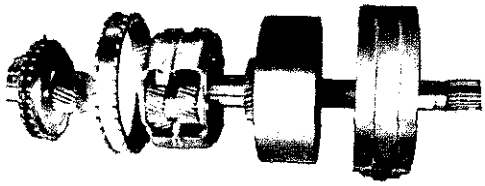
In Second Range, the Power flow is exactly the same as drive range · second gear.

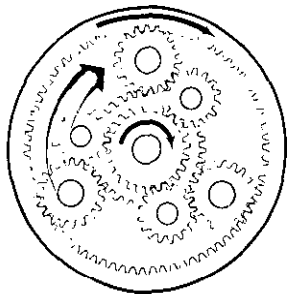
7c50

Figure 7C-50 Drive Range · Second Gear

d. DRIVE RANGE · THIRD GEAR







Drive Range · Third Gear

Reverse Clutch · Released — **Third Clutch -Applied**

Second Clutch. Applied — **Low Band · Released**

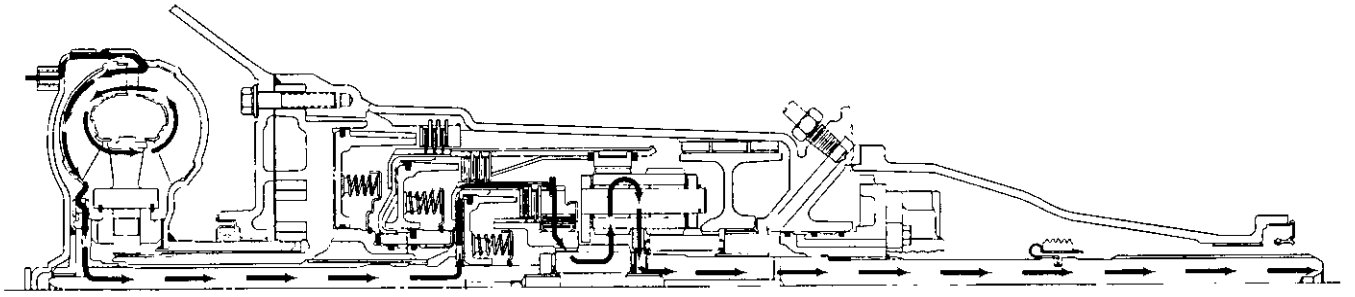
Sprag . Locked

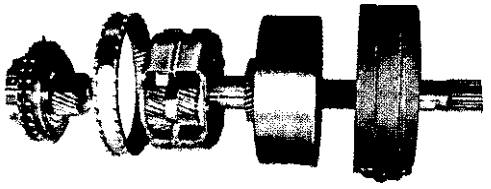
In Drive Range · Third Gear, the low band is released and both the second and third clutches are applied.

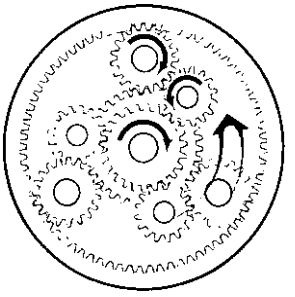
In this condition, the ring gear is locked o the input sun gear. With two planetary members connected in this manner, the entire planetary system will rotate as a solid unit and provide a direct drive with a ratio of 1 to 1. The input is split between the ring gear end input sun, and the rarrier is the output member.

Figure 7C-5 1 Drive Range Third Gear

e. REVERSE RANGE







Third Clutch -Applied

Low Band - Released

HYDRAULIC OPERATION

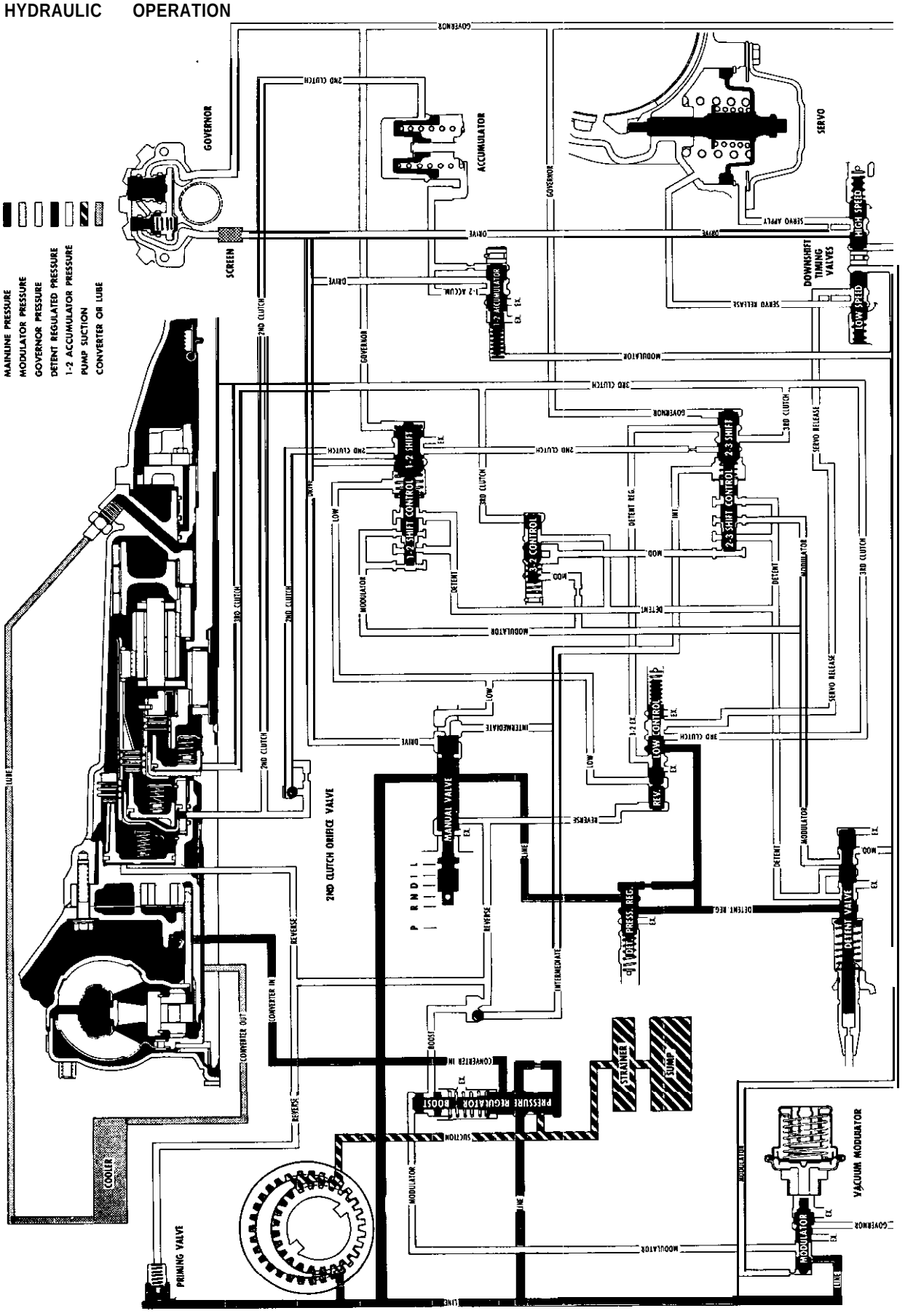


Figure 7C-53 - Transmission Oil Flow

7C-53

a. Operation of Controls in Neutral Engine Running

Reverse Clutch Released	Third Clutch Released
Second Clutch Released	Low Band Released
Sprag Locked	

Whenever the engine is running with the selector lever in Neutral, oil is pulled from the sump into the oil pump and is dispensed from the pump under pressure. The pressurized line oil if directed to the priming valve which bleeds off the air. Line oil is directed to the vacuum modulator valve, to the pressure regulator valve and to the manual valve. The converter is fed through the pressure regulator valve, the return oil from the converter being directed through the cooler and back into the transmission's lubricating system.

Line oil directed to the vacuum modulator valve becomes regulated to modulator oil and acts on the pressure regulator boost valve, the low speed downshift timing valve, the 1 2 accumulator valve, and the detent valve. The modulator oil passes through the detent valve to act on the 1 2 shift control valve, the 3 2 control valve and the 2 3 shift control valve. Line oil passes through the manual valve, and is regulated et the detent pressure regulator valve before being directed to the Reverse and Low control valve.

Summary

The converter is filled. the clutches and low band are released. The transmission is in Neutral.

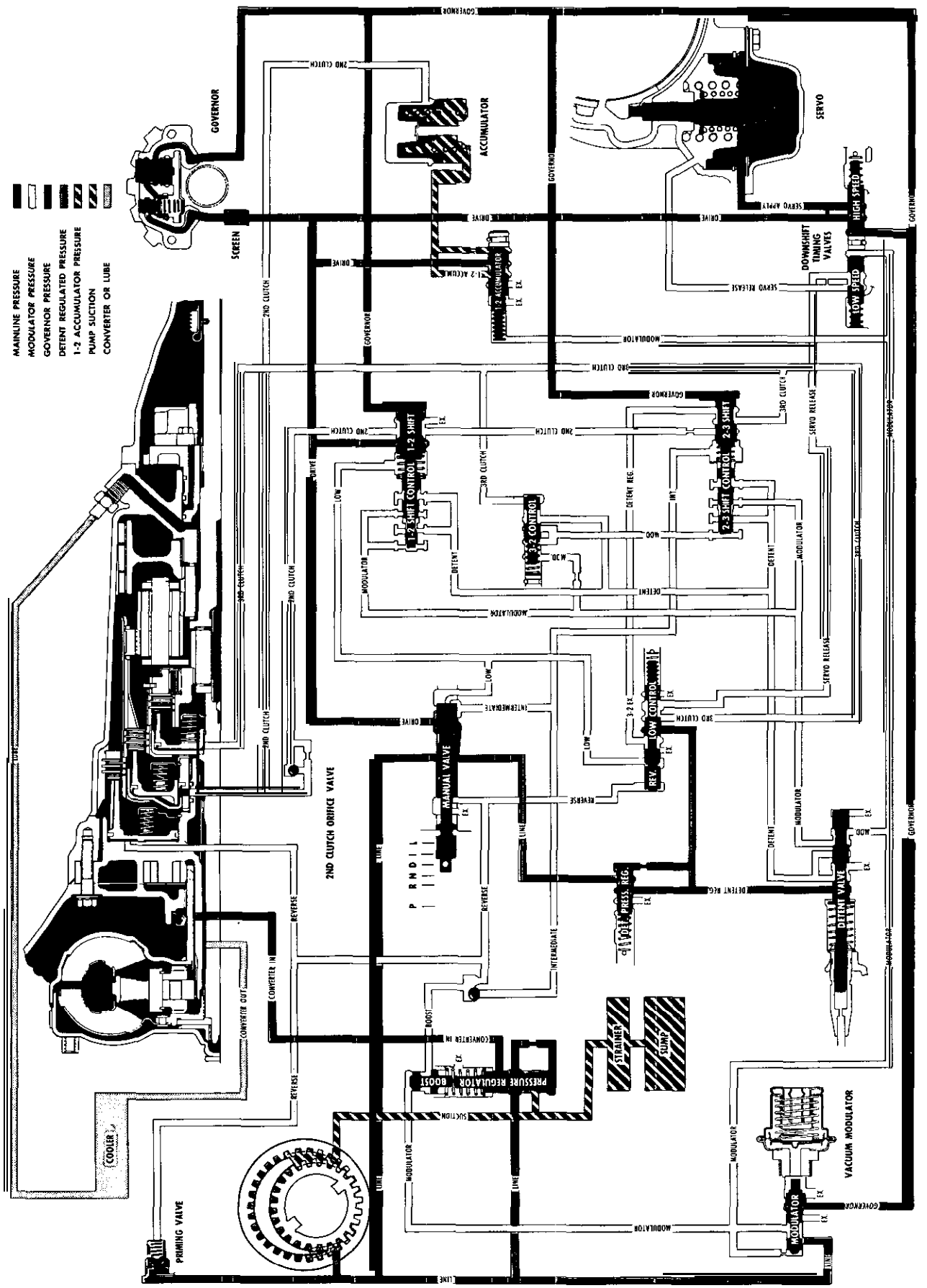


Figure 7C-56 - Transmission Oil Flow - Drive Range, First Gear

7C-56

b. Operation of Controls in Drive Range - First Gear

Reverse Clutch - Released

Third Clutch - Released

Second Clutch - Released

Low Band - Applied

Sprag - Locked

When the selector lever is moved to the "Drive" position on the quadrant, the manual valve is positioned to allow line oil to enter the drive circuit and is directed to the 1 - 2 shift valve, the governor, the 1 - 2 shift valve, the governor, the 1 - 2 accumulator valve and the high speed downshift timing valve.

The drive oil directed to the 1 - 2 accumulator valve is regulated and directed to fill the bottom portion of the accumulator. The drive oil also passes through and orifice at the high speed downshift timing valve and passes through the valve to apply the low band servo.

Drive oil at the governor is regulated to a variable pressure which increases with vehicle speed and acts on the ends of the 1 - 2, 2 - 3 shift valves, high speed downshift timing valve, and the vacuum modulator valve.

Summary

The clutches are off, the low band is applied, the transmission is in drive range - first gear.

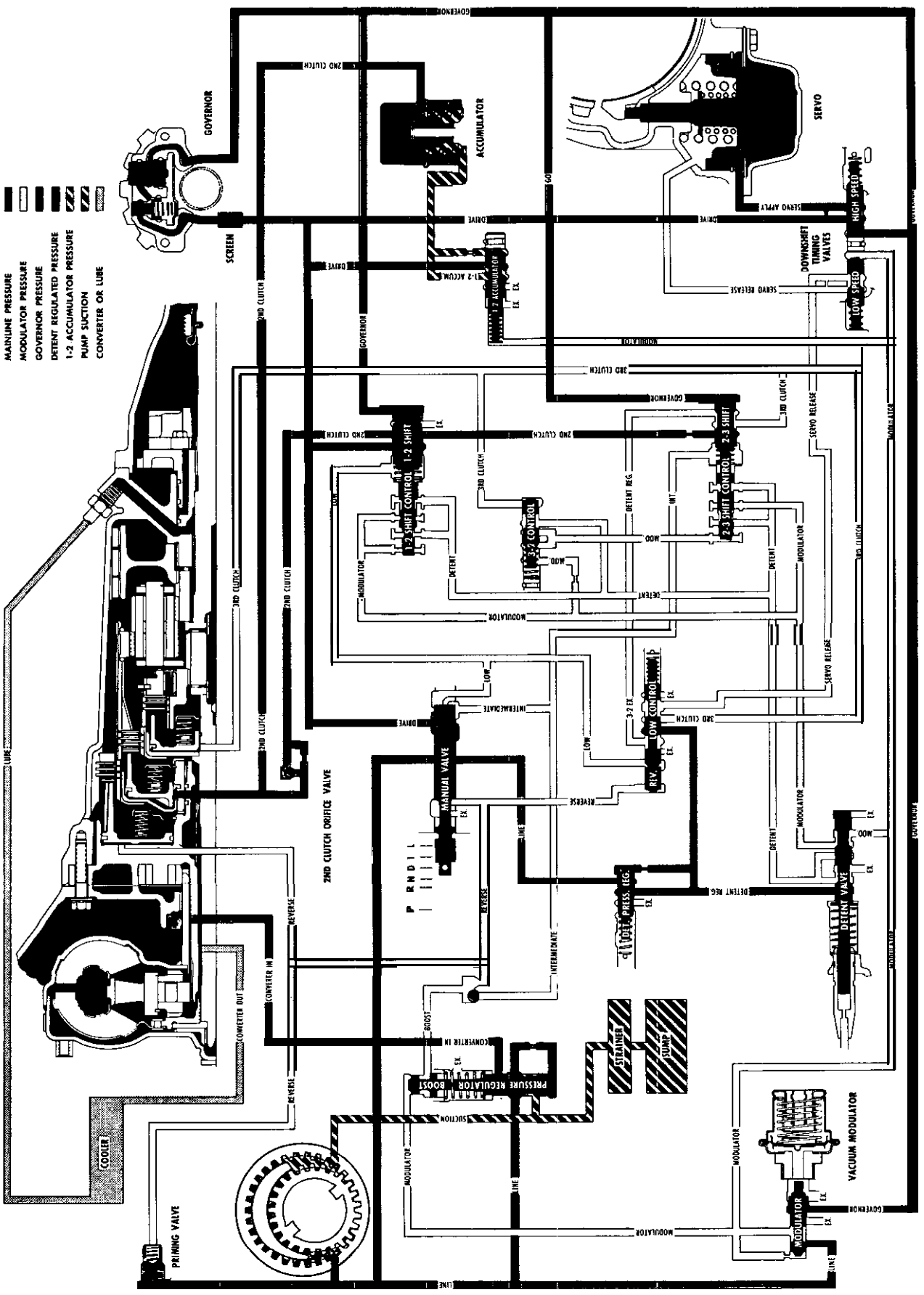


Figure 7C-58 - Transmission Oil Flow - Drive Range, Second Gear

c. Operation of Controls in Drive Range Second Gear

Reverse Clutch Released	Third Clutch Released
Second Clutch Applied	Low Band Applied

Sprag Over Running

As the vehicle increases speed. the governor allows more drive oil to pass through, and this increased pressure, acting on the end of the 1 2 shift valve, overcomes the 1 2 shift valve spring pressure and allows drive oil to pass through the valve to feed the second clutch oil passages.

Second clutch oil passes through the second clutch orifice control valve, seating the ball and is metered to the second clutch piston to begin to apply the second clutch, while portion of the oil is directed to the accumulator. As the upper portion of the accumulator fills with second clutch oil. it overcomes the lesser pressure of 1 2 accumulator oil and spring at the bottom of the accumulator piston. forcing the piston downward. The upper portion of the accumulator is now filled, allowing full oil pressure to the second clutch piston far the final apply. The accumulator, therefore, acts as a reservoir to produce a damping effect for a smooth second clutch apply and the 1 2 shift.

Second clutch oil from the 1 2 shift valve is simultaneously directed to the 2 3 shift valve to be used as the oil source for the 2 3 shift.

Summary

The second clutch is on, the band is on, the transmission is in drive range - second gear.

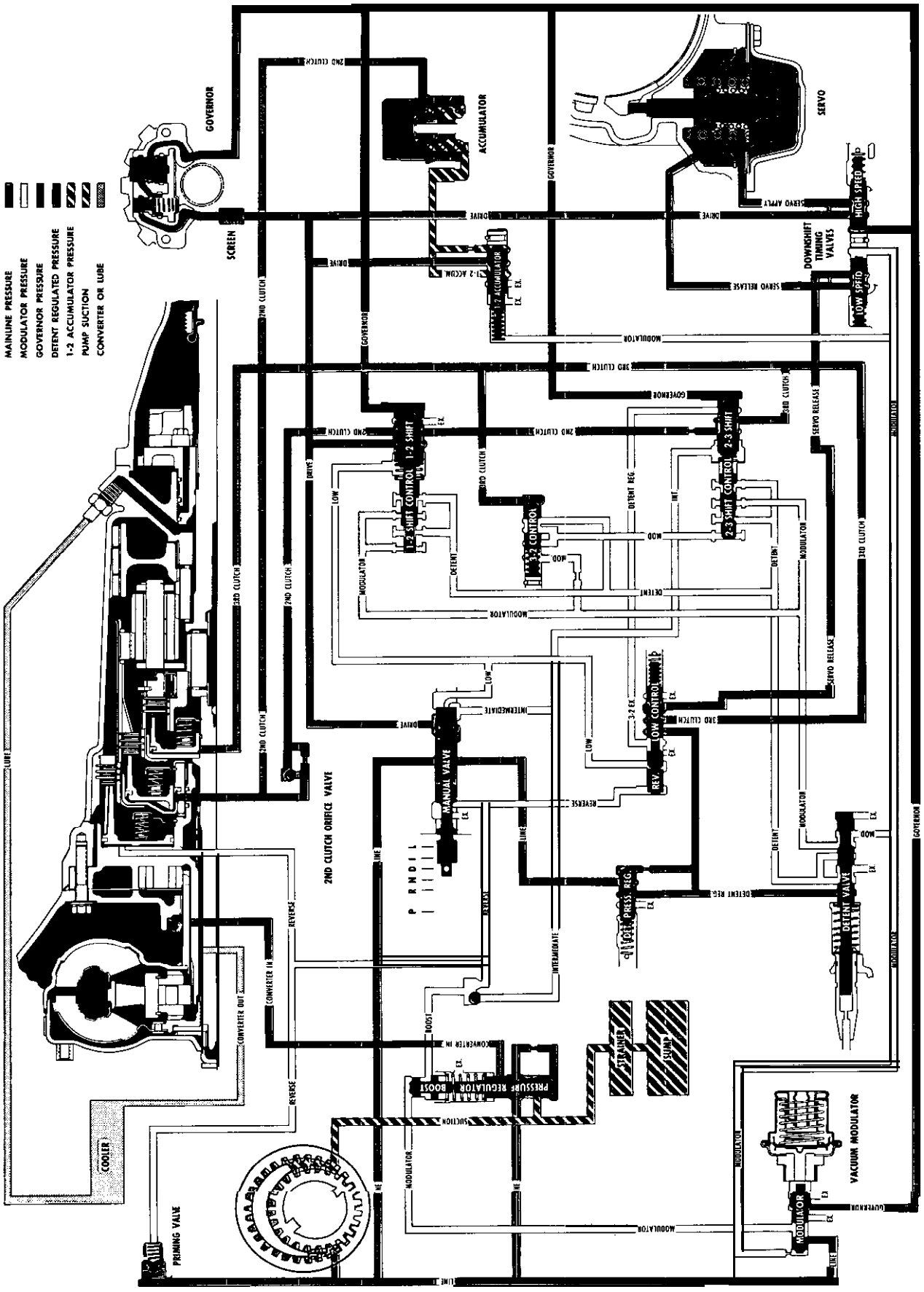


Figure 7C-60 - Transmission Oil Flow - Drive Range, Third Gear

7C60

d. Operation of Controls in Drive Range Third Gear

Reverse Clutch Released — Third Clutch-Applied

Second Clutchs Applied — Low Band Released

Sprag Locked

As vehicle speed increases. the governor allows more oil to pass through to act against the wring at the 2 3 shift valve. This allows the second clutch oil at the 2 3 shift valve to be released and pan through the valve as third clutch oil, directed to the third clutch piston to apply third clutch. At the same time, third clutch oil is directed to the 3 2 control valve. acting against the spring and modulator oil. cutting off modulator oil pressure to the 2 - 3 shift control valve. Third control oil also is directed to the Reverse and Law control valve and passes through the valve as servo release oil to the low speed downshift timing valve. The low speed downshift timing valve is held open against the spring by increased modulator oil pressure. The oil passes through the valve and is directed to the top of the low band servo, to act with the servo piston spring and force the servo piston downward. releasing the low band.

Summary

The second clutch is on, the third clutch is on, the band is released. The transmission is in drive range third gear

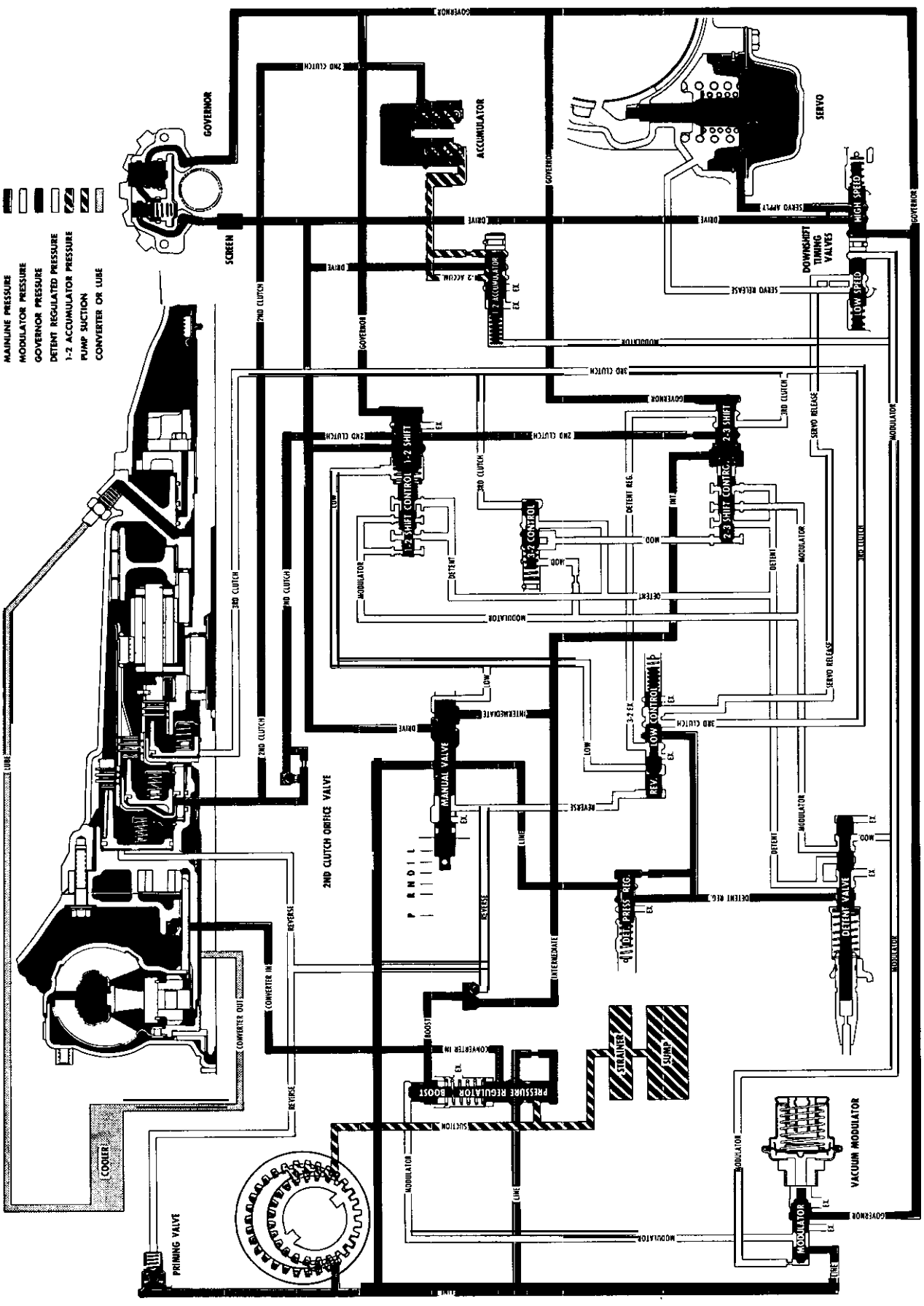


Figure 7C-62 Flow, Second Range, Second Gear

7C-62

e. Operation of Controls in Second Range Second Gear

Reverse Clutch Re eased

Third Clutch Released

Seconds Clutch Applied

Low Band Applied

Sprag Over Running

The selector lever is moved to the Intermediate position an the quadrant. the manual valve is positioned to allow drive oil and Intermediate oil to pan through the valve. Intermediate oil is directed to the pressure regulator boost control cavity, seating the check ball at the reverse passage. Intermediate oil is then directed to the pressure regulator valve downward to increase the oil pressure in the circuit. At the same time. the inter. mediate oil from the manual valve is directed lo the 2 3 shift valve train closing off the supply of third clutch oil in the circuit, which is exhausted through the Reverse and Low control valve.

Summary

With third clutch oil exhausted. the third clutch is off, the second clutch is an, the low band servo is applied. The transmission is in second Range Second Gear.

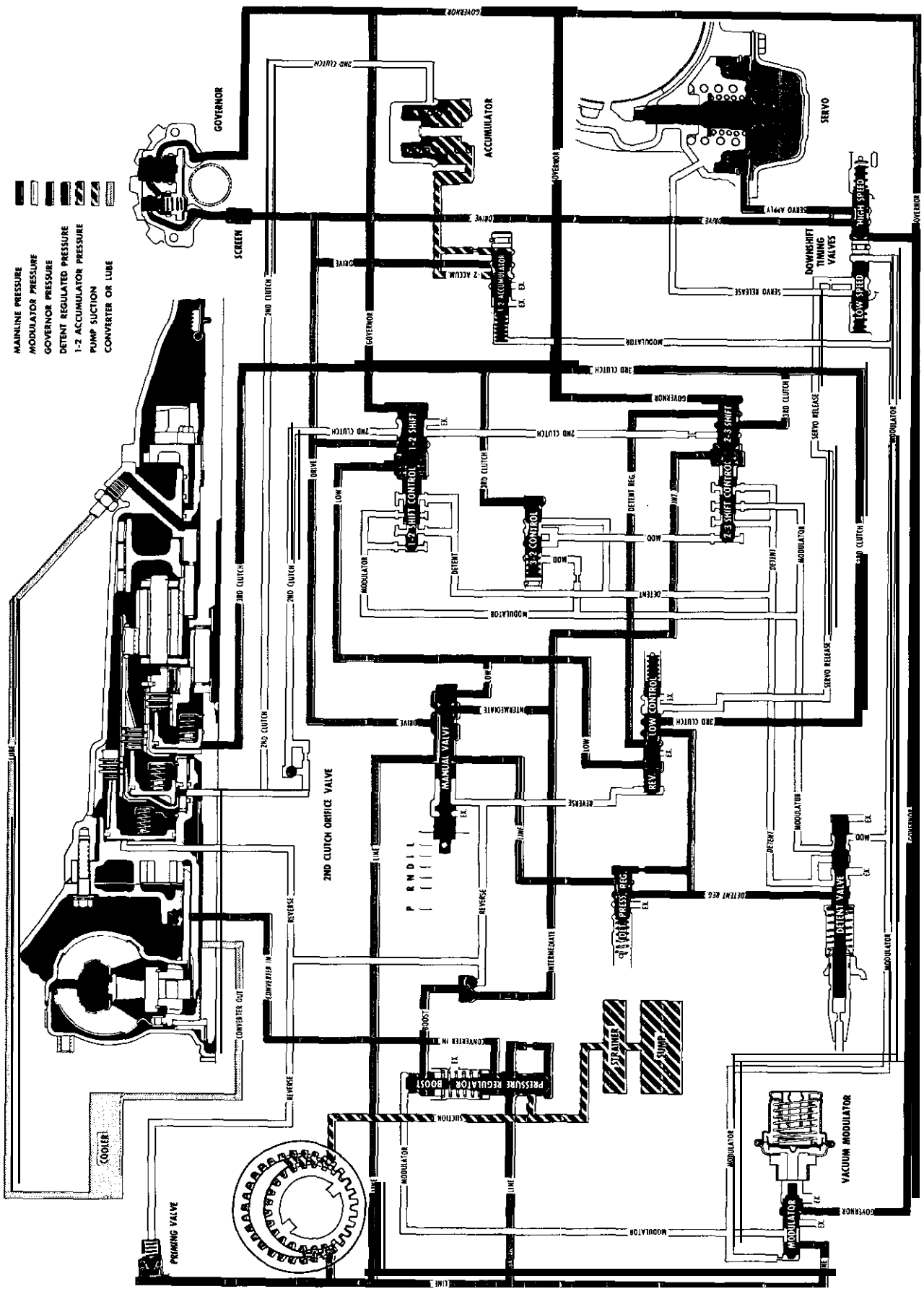


Figure 7C-65 - Transmission Oil Flow, 1st Range, 1st Gear

7C-65

f. Operation of Controls in Low Range First Gear

Reverse Clutch Released **Third Clutch Applied**

Second Clutch Released **Low Band Applied**

Sprag **Locked**

When the selector lever is moved to the low position on the quadrant. the manual valve is positioned to allow drive oil, intermediate oil and low oil to pass through the valve. Low oil is directed to the 1 2 shift valve train which acts with the 1 2 shift valve spring against governor oil pressure to close off drive oil from passing into the second clutch passage. At the same time, low oil is directed to the Reverse and Low control valve and acts against the spring to allow detent regulated oil at the Reverse and Law control valve to flow to the 2 3 shift valve, which is bottomed in its bore by intermediate oil pressure and the valve spring. The detent oil passes through the 2 3 shift valve and into the third clutch oil passages to apply the third clutch and to close off modulator oil pressure from the 3-2 control valve to the 2 3 shift control valve. Third control oil is also directed to the Reverse and Law control valve, which is held open against its spring by low oil pressure. and closes off the source of supply to the servo release passage, to allow the servo to apply the low band. Intermediate oil seats the check ball at the Reverse passage at the pressure regulator boost valve cavity and continues to the pressure regulator valve to increase oil pressure in the circuit.

Summary

The third clutch in on, the band is on. The transmission is in Low Range First Gear

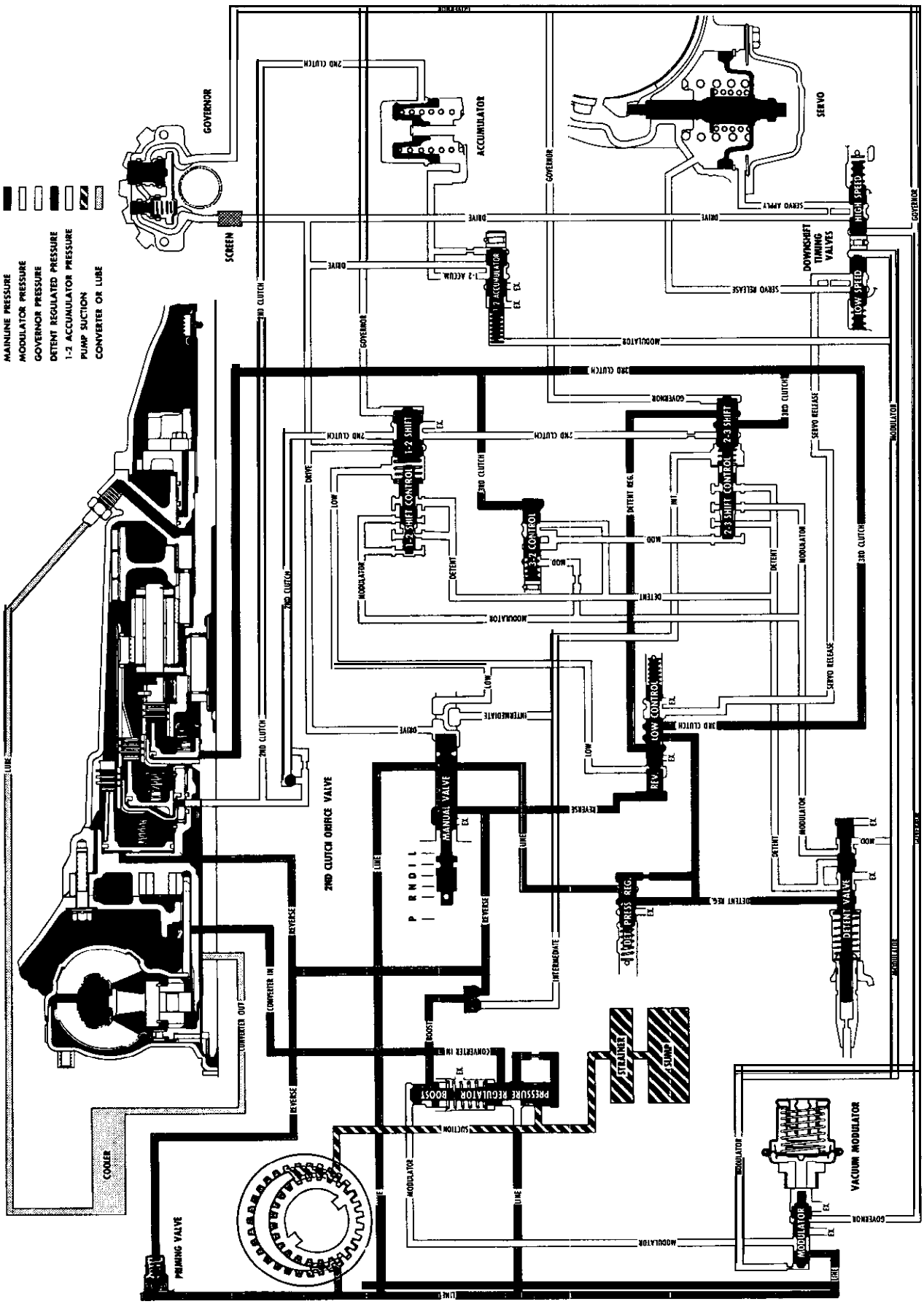


Figure 7C-67 Transmission Oil Flow, Reverse

7C-67

g. Operation of Controls in Reverse

Reverse Clutch -Applied	Third Clutch. Applied
Second Clutch Released	Low Band · Released
Sprag Locked	

When the selector lever is moved to the Reverse position on the quadrant, the manual valve is positioned to allow Reverse oil to pass through the manual valve into the Reverse oil passage. The reverse oil applies the reverse clutch. and a portion is directed to the priming valve which acts as a damper until the line is filled. to effect a smooth and firm apply of the reverse clutch. At the same time, reverse oil is directed to the pressure regulator boost control valve cavity to seat the check ball and prevent reverse oil passing into the intermediate oil passage. It is then directed to the pressure regulator boost valve forcing

Reverse oil is also directed to act on the end of the Reverse and Law control valve against the spring to allow detent regulated oil to pass through the valve to the 2 3 shift valve. The detent regulated oil passes through the 2 3 shift valve and into the third clutch oil passages to apply the third clutch. The third clutch oil also acts on the end of the 3 2 control valve against the spring and modulator oil pressure, closing off the supply of modulator oil to the 2 3 shift control valve. Third clutch oil at the reverse and low control valve is closed off from passing through the valve, and into the servo release passage.

Summary

The reverse clutch is cm and the third clutch is on. The transmission is in Reverse Range.

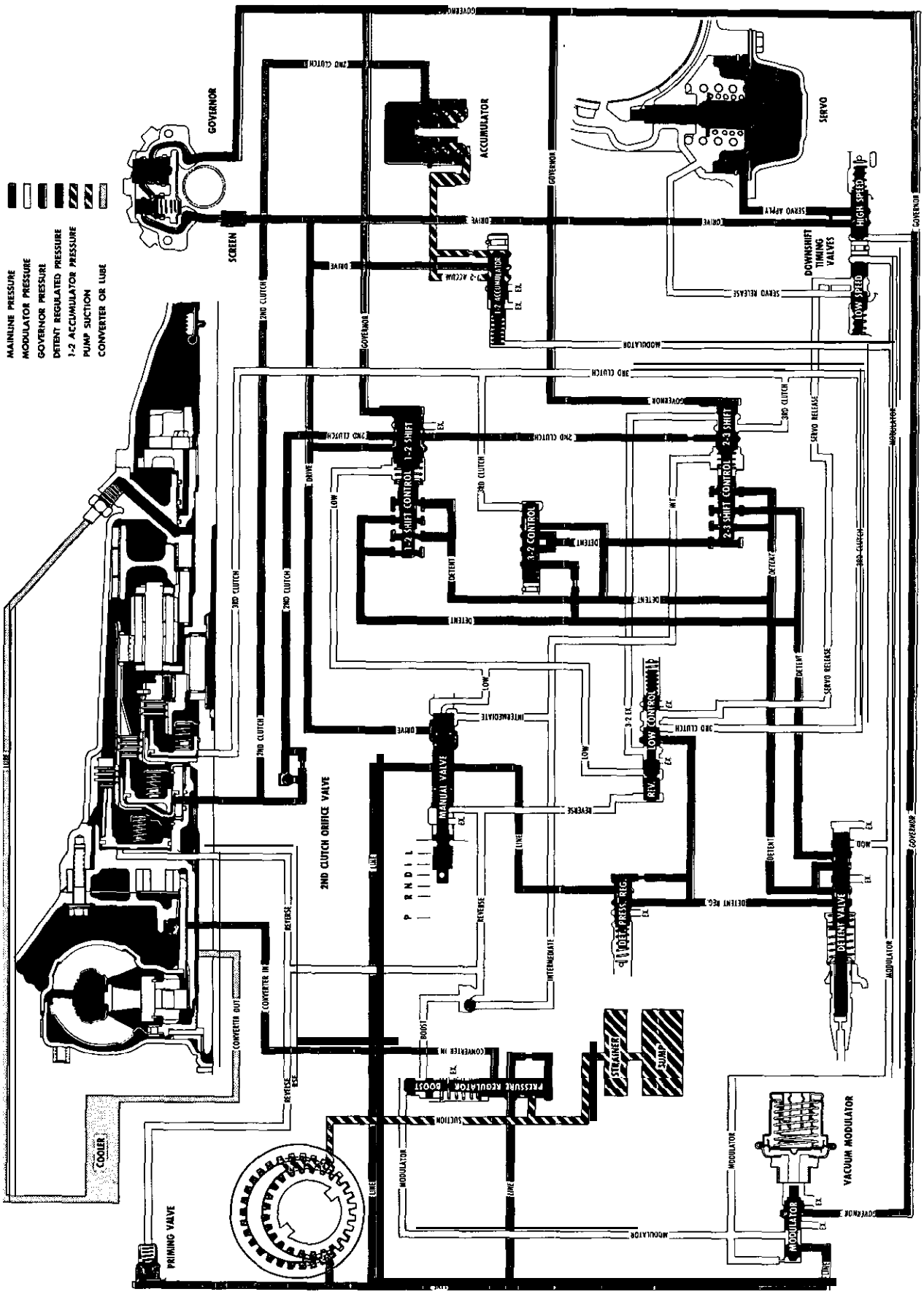


Figure 7C-69 - Transmission Oil Flow, Detent Downshift

7C-69

h. Operation of Controls during Detent Downshift Valves in Second Gear Position

Reverse Clutch Released

Third Clutch Released

Second Clutch Applied

Low Band Applied

Sprag Over Running

With the selector in the Drive position. detent downshifts ore possible by fully depressing the accelerator pedal. This causes the mechanical linkage to the detent valve to move the detent valve, cutting off moduahor oil to the 3 2 control valve, the 1 2 shift control valve, the 1 2 accumulator valve and the 2 • 3 shift control valve.

The mechanical linkage holding the detent valve open allows the detent regulated oil to pass into the detent oil passage and is directed to the 2 3 shift control valve, acting against the spring and governor oil pressure. It is also directed to the 3 2 control valve, acting against the spring, allowing detent oil to pass through the valve and act on the end of the 2 3 shift control valve to keep the valve bottomed in its bore against governor oil pressure. Second clutch oil et the 2 3 shift valve is closed off from passing into the third clutch passages by the detent oil pressure holding the 2 3 shift valve bottomed in its bore.

Summary

The second clutch is on, the low band is on. The valves are in second gear position under detent conditions.

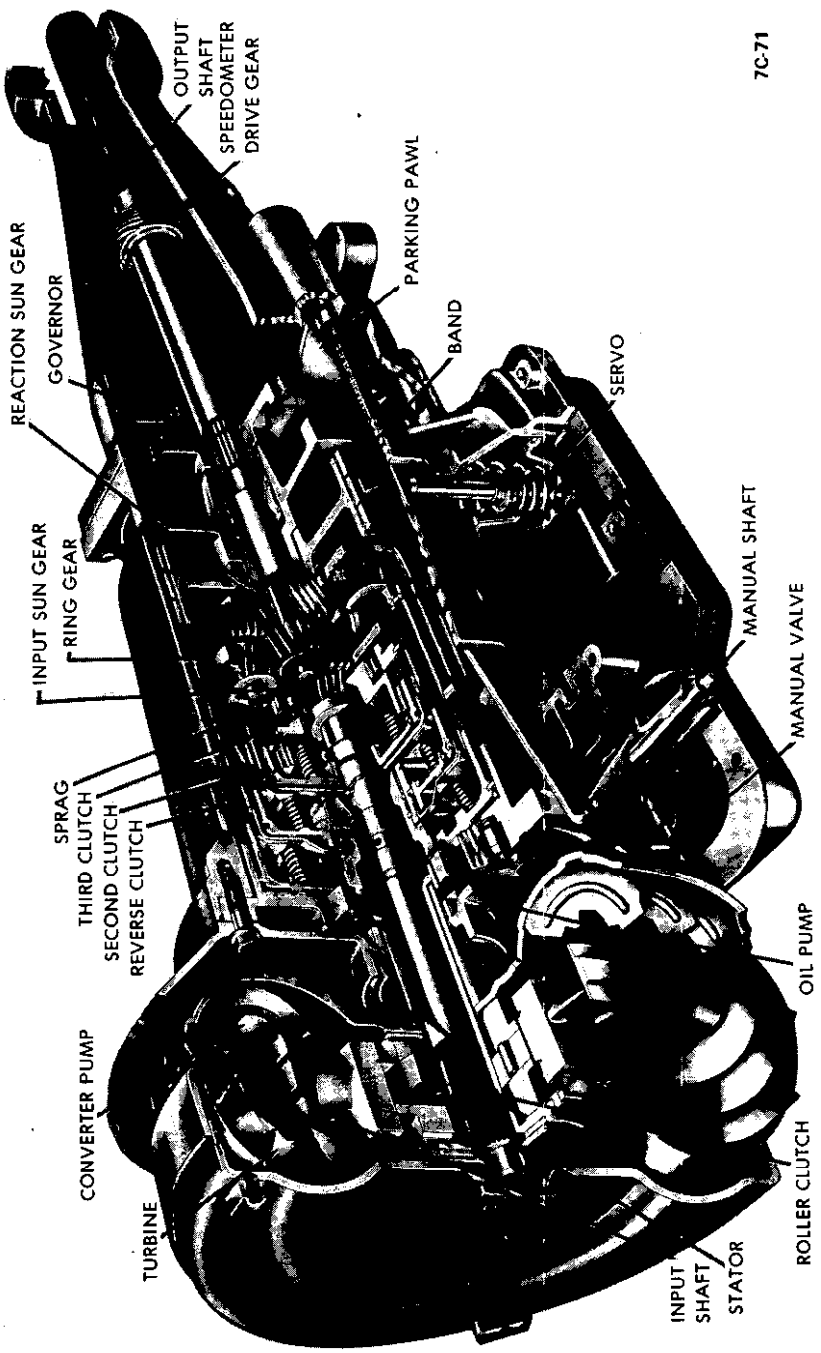


Figure 7C-71 of

DIAGNOSIS

SEQUENCE

1. Check and correct oil level. Refer to Specifications for checking and refill procedures.

2. Check and correct vacuum line and fittings.

3. Check and correct manual linkage.

4. Road test car using all selective ranges, noting when discrepancies in operation occur.

5. If engine performances indicates an engine tuneup is required, this should be performed before road testing is completed or transmission correction attempted. Poor engine performance can result in rough shifting or other malfunctions.

CHECKING PROCEDURES

Before diagnosis of any transmission complaint is attempted, there must be an understanding of oil checking procedure and what appearance the oil should have. Many times a transmission malfunction can be traced to low oil level, improper reading of dipstick, or oil appearances; therefore, a careful analysis of the condition of oil and the level may eliminate needless repairs.

When checking oil level in the Opel Three Speed Automatic Transmission, the procedure outlined in Specifications should be followed to obtain the most accurate reading.

Also when the dipstick is removed, it should be noted whether the oil is devoid of air bubbles or not. Oil with air bubbles gives an indication of an air leak in the suction lines, which can cause erractic operation and slippage. Water in the oil imparts a milky, pink cast to the oil and can cause spewing.

EXTERNAL OIL LEAKS

Determining source of oil leak

Before attempting to correct an oil leak, the actual source of the leak must be determined. In many cases, the source of the leak can be deceiving due to "wind flow" around the engine and transmission. The suspected area should be wiped clear of all oil before inspecting for the source of the leak. Red dye is used in the transmission oil at the assembly plant and will indicate if the oil leak is from the transmission.

The use of a "Black Light" to locate the point at which the oil is leaking is helpful. Comparing the oil from the leak to that on the engine or transmission dipstick, when viewed by Black Light, will determine the source of the leak-engine or transmission.

Oil leaks around the engine and transmission are generally carried toward the rear of the car by air stream. For example, a transmission oil filler tube to case leak will sometimes appear as a leak at the rear of the transmission. In determining the source of a leak, proceed as follows:

1. Degrease underside of transmission.

2. Road test to get unit at operating temperature.

3. Inspect for leak with engine running.

4. With engine off, check for oil leaks due to the raised oil level caused by drain back.

Case Porosity Repair

Opel Three-Speed Automatic Transmission external oil leaks caused by case porosity can be successfully repaired with the transmission in the car by using the following recommended procedures:

1. Road test and bring the transmission to operating temperature, approximately 180 degrees F.

2. Raise car on a hoist or jack stand, engine running, and locate source of oil leak. Check for oil leaks in low, drive, and reverse.

3. Shut engine off and thoroughly clean area to be repaired with a suitable cleaning solvent and a brush- air dry. A clean, dry soldering acid brush can be used to clean the area and also to apply the epoxy cement.

4. Using instructions of the manufacturer, mix a sufficient amount of epoxy, BUICK Group 0.423, Part No. 1360016, or equivalent, to make the repair. Observe cautions of manufacturer in handling.

5. While the transmission case is still HOT, apply the epoxy to the area to be repaired. Make certain the area to be repaired is fully covered.

6. Allow cement to cure for 3 hours before starting engine.

7. Road test and check for leaks.

AUTOMATIC TRANSMISSION TROUBLE DIAGNOSIS CHART

Condition	Cause
Concerns Transmission Oil	
1. Low oil level.	a) Oil coming out of oil tiller tube. b) External oil leak. c) Failed vacuum modulator.
2. Oil coming out of oil filler tube.	a) Oil level too high. b) Coolant in transmission oil. c) External vent clogged with mud. d) Leak in oil pump suction circuit.
3. External oil leaks in the area of the torque converter housing.	a) Leaking torque converter. b) Converter housing seal. c) Sealing washers under converter housing to case bolts. d) Sealing washers under converter housing to pump bolts. e) Converter housing to case seal. f) Loose attaching bolts on front of transmission.
4. External oil leaks in the area of transmission case and extension.	a) Shifter shaft seal. b) Extension seal. c) Oil pan gasket. d) Extension to case gasket. e) Vacuum modulator gasket. f) Drain plug gasket. g) Cooler line fittings. h) Oil tiller tube seal ring. i) Detent cable seal ring. j) Line pressure gauge connection.
5. Low oil pressure.	a) Low oil level. b) Clogged suction screen. c) Leak in oil pump suction circuit. d) Leak in oil pressure circuit. e) Priming valve stuck. f) Pressure regulator valve malfunction. g) Sealing ball in valve body dropped out.
6. High oil pressure.	a) Modulator vacuum line leaky or interuupted. b) Failed vacuum modulator. c) Leak in any part of engine or accessory vacuum system. d) Pressure regulator valve malfunction.
7. Excessrive smoke coming from exhaust.	a) Failed vacuum modulator. b) Oil from vent valve or leak on hot exhaust pipe.

Condition	Cause
Starting	
1. No **starting in any** drive range.	a) Low oil level. b) Clogged suction screen. c) Manual valve linkage or inner transmission selector lever disconnected. d) Input shaft broken. e) Pressure regulator valve stuck in open position. f) Failed oil pump.
2. No starting in any drive range for a time. Driving possible only after repeatedly moving selector lever to and fro.	Manual valve position does not coincide with valve body channels: a) Selector lever shaft retaining pin dropped out. b) Connecting rod to manual valve shifting. c) Selector lever shaft nut loose.
3. No starting after shifting lever from "P" to "D", "S", or "L" (inadequate engine acceleration).	a) Parking pawl does not disengage.
4. Sudden starting only after increase of engine RPM.	a) Band servo piston jamming. b) Low oil level. c) Oil pump defective. d) Oil screen missing. e) Sealing ball in valve body dropped out
5. Heavy jerking when starting.	a) Low oil pressure. b) Wrong modulator valve. c) Pressure regulator valve stuck. d) Sealing ball in valve body dropped out.
6. No starting in "D" or "S" range, but in "L" and "R" range.	a) Input sprag installed backwards. b) Input sprag failure.
7. No starting in "D" or "S" and "L" (proper driving in "R"; see also point 9).	a) Band worn, does not grip. b) Band servo piston jamming. c) Excessive leak in band servo. d) Parking pawl does not disengage.

Condition	Cause
8. No starting in "R" range (proper driving in all other ranges).	a) Reverse clutch failure.
9. Drive in selector lever position "N".	a) Inadequate selector lever linkage. b) Planetary gear set broken. c) Improper adjustment of band.
Gear Change	
1. No l-2 upshift in "D" and "S" (transmission remains in 1st gear at all speeds).	a) Governor valves stuck. b) 1-2 shift valve stuck in 1st gear position. c) Seal rings (oil pump hub) leaky. d) Large leak in governor pressure circuit. e) Governor screen clogged.
2. No 2-3 upshift in "D" (transmission remains in 2nd gear at all speeds).	a) 2-3 shift valve stuck. b) Large leak in governor pressure circuit.
3. Upshifts in "D" and "S" only at full throttle.	a) Failed vacuum modulator. b) Modulator vacuum line leaky or interrupted. c) Leak in any part of engine or accessory vacuum system. d) Detent valve or cable stuck.
4. Upshifts in "D" and "S" only at part throttle (no detent upshift).	a) Detent pressure regulator valve stuck. b) Detent cable broken or misadjusted.
5. Driving only in 1st gear of "D" and "S" range (transmission blocks in 2nd gear and "R").	a) "L" and "R" control valve stuck in "L" or "R" position.
6. No part throttle 3-2 downshift at low vehicle speeds.	a) 3-2 downshift control valve stuck.
7. No forced downshift.	a) Detent cable broken or improperly adjusted. b) Detent pressure regulator valve stuck.

Condition	Cause
8. After full throttle upshifting transmission shifts immediately into lower gear upon easing off accelerator pedal.	a) Detent valve stuck in open position, b) Detent cable stuck. c) Modulator vacuum line interrupted.
9. At higher speeds, transmission shifts into lower gear.	a) Retaining pin of selector lever shaft in transmission dropped out. b) Loose connection of selector lever linkage to manual valve. c) Pressure loss at governor.
10. Hard disengagement of selector lever from "P" position.	a) Steel guide bushing of parking pawl actuating rod missing. b) Manual selector lever stuck.
Shifts 1. Slipping 1-2 upshifts (engine flares).	a) Low oil pressure. b) Sealing ball in valve body dropped out. c) Second clutch piston seals leaking. d) Second clutch piston centrifugal ball stuck open. e) Second clutch piston cracked or broken. f) Second clutch plates worn. g) Seal rings of oil pump hub leaky.
2. Slipping 2-3 upshifts (engine flares).	a) Low oil pressure. b) Band adjustment loose. c) Third clutch piston seals leaking. d) Third clutch piston centrifugal ball stuck open. e) Third clutch piston cracked or broken. f) Wear of input shaft bushing. g) Sealing ball in valve body dropped out
3. Abrupt l-2 upshift.	a) High oil pressure. b) l-2 accumulator valve stuck. c) Spring cushion of second clutch broken, d) Second gear ball valve missing.
4. Abrupt 2-3 upshift.	a) High oil pressure **b)** Incorrect band adjustment.
5. Abrupt 3-2 detent downshift at high speed.	a) High speed downshift valve stuck open. b) Band adjustment.

Condition	Cause
6. Abrupt 3-2 coast downshift.	a) Low speed downshift timing valve stuck open.
7. Flare on high speed forced downshift.	a) Low oil pressure. b) Band adjustment loose
8. Flare on low speed forced downshift.	a) Low oil pressure. b) Band adjustment loose. c) High speed downshift timing valve stuck in closed position. d) Sprag race does not grip on 3-1 down shifting
Engine Braking	
1. No engine braking in "L" range.	a) Selector lever linkage improperly adjusted. b) Manual low control valve stuck.
2. No engine braking in "S" range.	a) Selector lever linkage improperly adjusted.
3. No park.	a) Selector lever linkage improperly adjusted. b) Parking lock actuator spring. c) Parking pawl. d) Governor hub.
Noises	
1. Excessive noises in all drive ranges.	a) Too much backlash between sun gear and planetary gears. b) Lock plate on planetary carrier loose. c) Thrust bearing defective. d) Bearing bushings worn. e) Excessive transmission axial play. f) Unhooked parking paw1 spring contacts governor hub. g) Converter balancing weights loose. h) Converter housing attaching bolt loose and contacting converter.
2. Screaching noise when starting.	a) Converter failure.
3. Short vibrating, hissing noise shortly before 1-2 upshift.	a) Dampening cushion of reverse clutch wearing into transmission case.
Abrasive	
1. Excessive amount of iron dust (can be picked up by magnet in oil pan).	a) Oil pump. b) Governor hub. c) Second clutch hub
2. Excessive amount of aluminum dust (cannot be picked up by magnet) in oil pan.	a) Thrust face in case. b) Rear bore of case. c) Stator thrust washer - check converter end clearance.

HYDRAULIC PRESSURE CHECK SHIFT POINTS

SPECIFICATIONS HYDRAULIC PRESSURE CHECKS

SHIFT POINTS

MODEL	OPERATING CONDITIONS	SHIFT POINTS (M.P.H. APPROX.)						DRIVE RANGE	
		D 1-2	D 2-3	D 3-2	D 2-1	S 1-2	S 2-1	L. M.P.H.	S M.P.H.
1900 & MANTA	Min. Throttle Valve Opening	12-15	15-18	14-16	11-13	12-15	10-12		
	Detent Touch	42-47	56-61	34-40	19-22	42-47	17-20		
	Through Detent	40-46	65-71	58-64	32-38	40-46	25-33		
	Top Speed							43	68
	Detent Downshift Possible Below Approx:			56-62	31-37		25-31		
G.T.	Min. Throttle Valve Opening	12-14	16-18	14-16	12-13	12-14	10-12		
	Detent Touch	42-47	56-61	45-50	20-21	42-47	18-19		
	Through Detent	40-46	65-71	58-65	32-39	40-46	24-33		
	Top Speed							43	68
	Detent Downshift Possible Below Approx:			59	34		34		

NOTE: ON REPLACING PLUG, TOROUE TO 6.7 LEFT.

4. After pressure gage and hose is install&, replace rear crossmember and side bolts and proceed with pressure checking procedure.

NOTE: PRESSURES ARE OFF OF THE SERVO APPLY.

D _____ 65
s _____ 65
L _____ 80

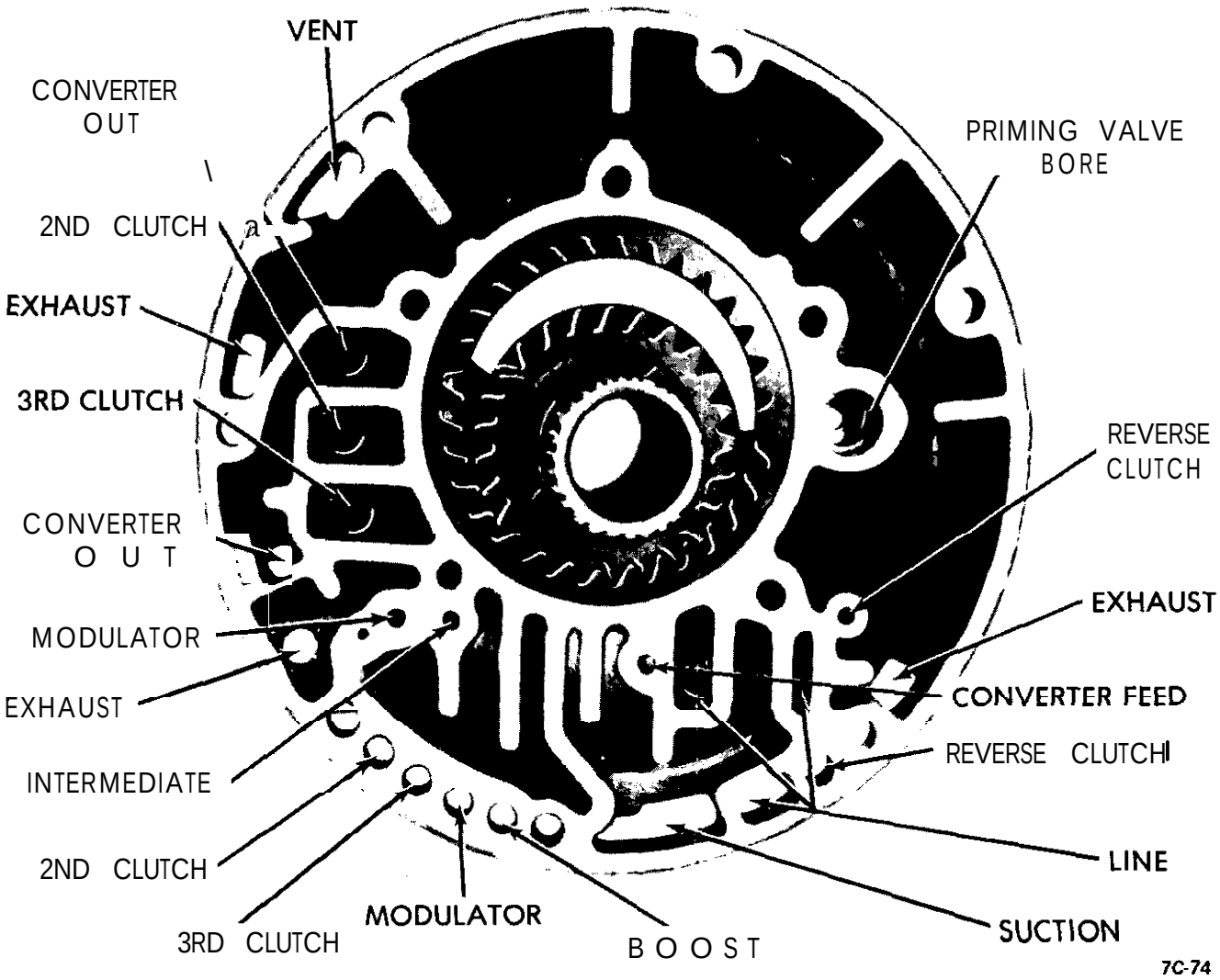


Figure 7C-74 Oil Pump Passages

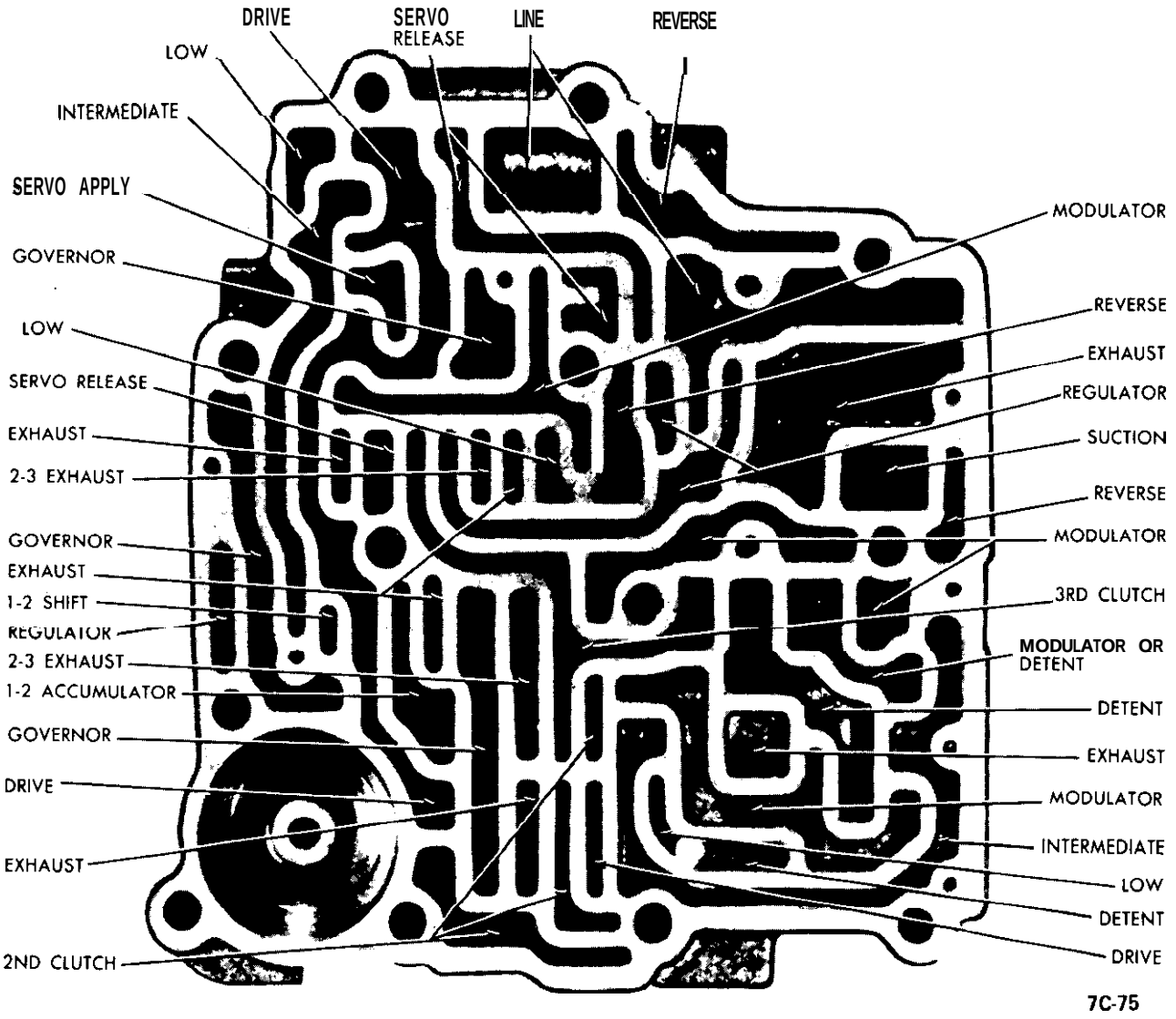


Figure 7C75 Valve Body Top

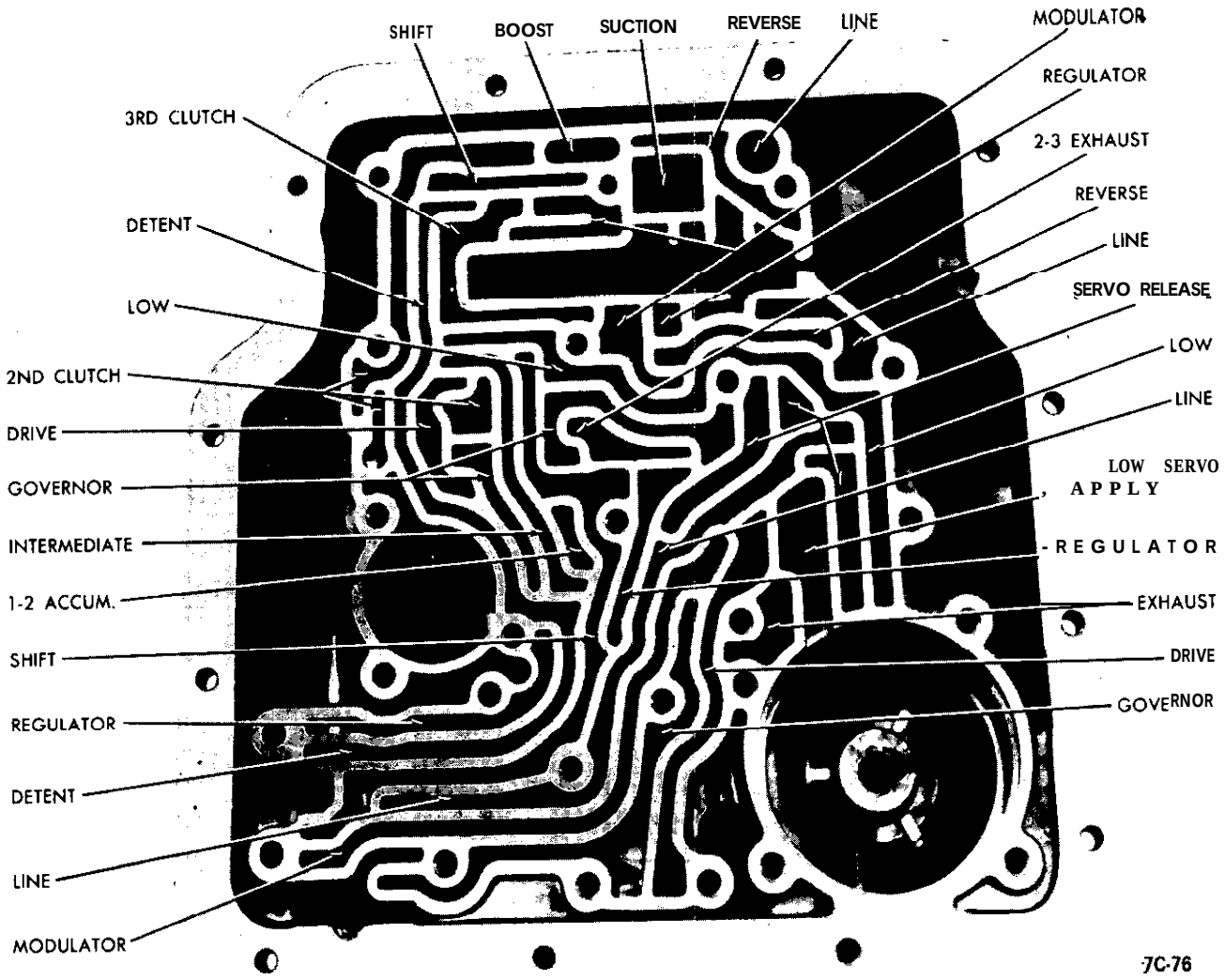


Figure 7C-76 Case Bottom

MAINTENANCE AND ADJUSTMENTS

DETENT CABLE REPLACEMENT AND ADJUSTMENT

The reliability of the detent bowden control cable is greatly dependent upon the proper adjustment of the wire whenever installation is being made. It is important to remember that the free end of the wire is not kinked, as individual strands will break due to the continuous bending during operation. To avoid this situation, it is important that the bowden control cable be properly installed. Although replacement and adjustment procedures on various models are identical, the location of the upper, or throttle, end of the detent cable may vary. For proper model identification, see Figures 7C-61, 7C-62, 7C-63, and 7C-64.

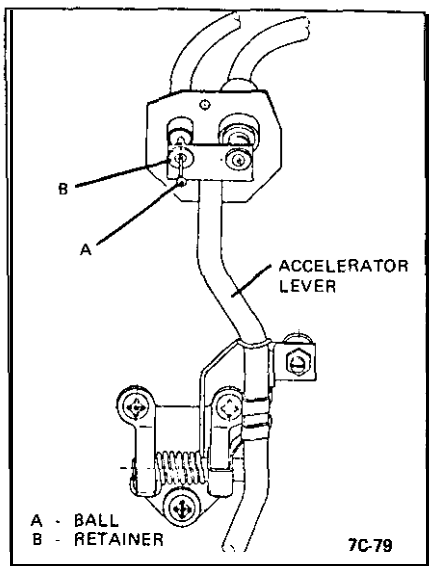


Figure *JC-79* Opel 1900 and Manta

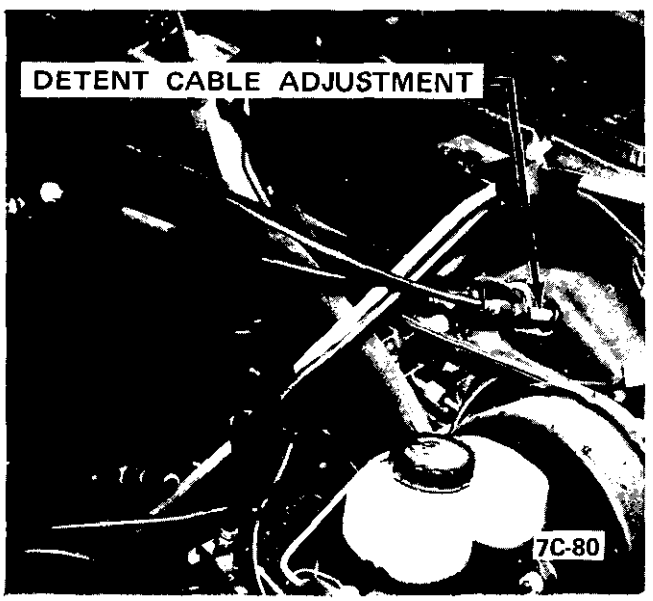


Figure 7C-80 Opel 1900 and Manta

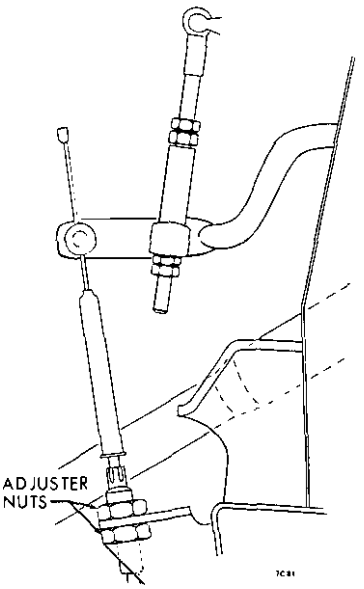


Figure *JC-81* GT Models

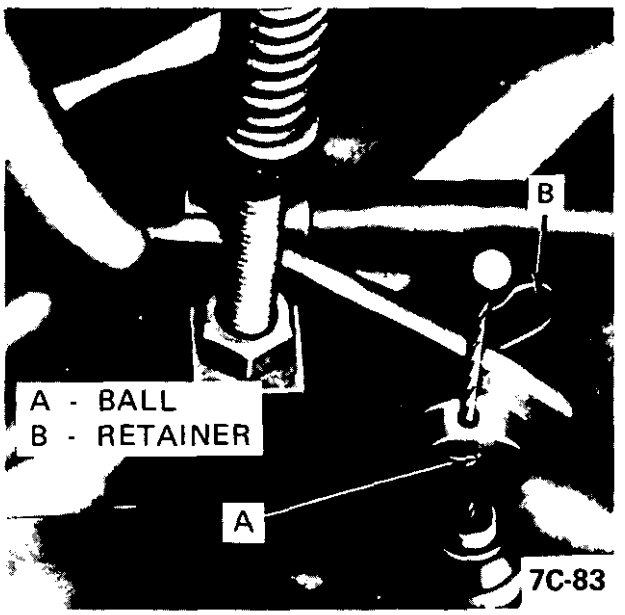


Figure *JC-93* GT Models

Removal

1. Detach retainer at detent cable to accelerator linkage.

2. Loosen rear transmission crossmember from body and remove right side bolt. See Figure 7C-84, Callout "A"

3. Insert block of wood between floor pan and right rear corner of transmission to expose detent cable bracket at transmission. See Figure 7C-85.

4. Unscrew detent cable connecting retainer from transmission and pull cable out of transmission. See Figure 7C-86.

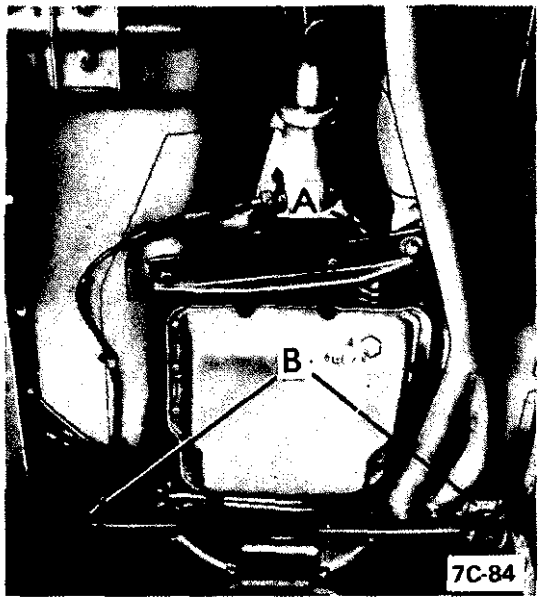


Figure 7C-84

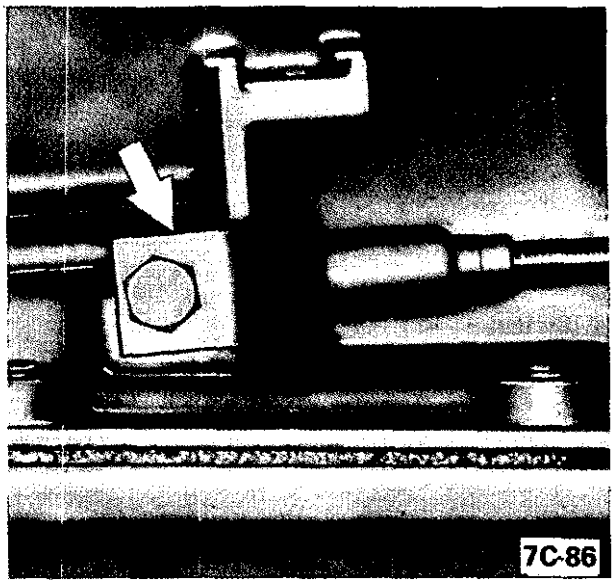


Figure 7C-86

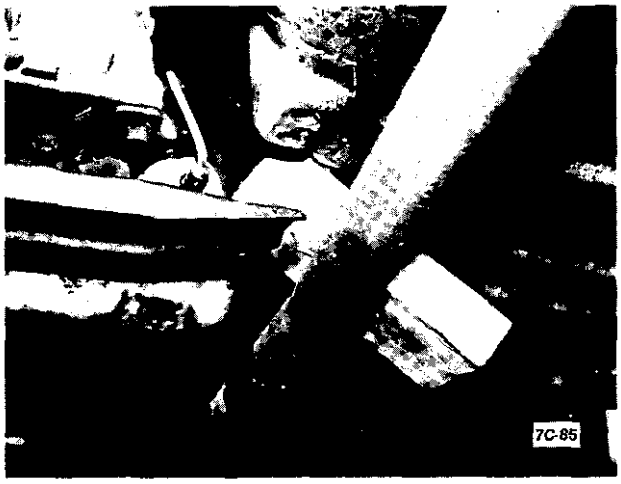


Figure 7C-85

5. Unhook detent cable from detent valve. See Figure 7C-87.

6. Pry detent cable pipe out of retainers.

7. Unscrew upper and lower adjuster nuts and remove detent cable (on Manta models, loosen lock nut and screw adjuster out of bulkhead).

Installation

1. Route cable and place in retainers,

2. Place cable in upper bracket and install upper **and** lower adjuster nuts and retainer (on Manta models, screw adjuster into bulkhead).

3. Hook detent cable to valve and install retainer.

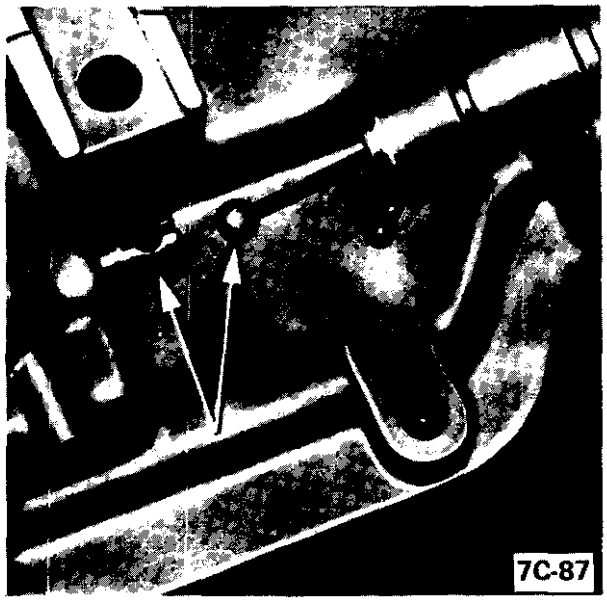


Figure 7C-87

Adjustment

Before carrying out any adjustment to the detent cable, it is essential that the throttle control linkage is correctly adjusted so that full throttle opening is obtained at the carburetor.

After the throttle control linkage has been set, the adjustment for the detent cable may be checked as follows:

1. Position accelerator to full throttle (pedal is *not* fully depressed at full throttle) and loosen and tighten upper and lower adjuster nuts of detent cable

(on Manta models, turn adjuster) until ball end of cable rests firmly against lever.

2. At this point, measure length of exposed detent inner cable. Depress accelerator pedal *fully,* and again measure inner cable. If correctly adjusted, detent cable should move approximately 3/8 inch.

Servicing Selector Lever

1. Unscrew console from floor panel, on small console remove three (3) attaching screws and on large console remove four (4) screws. The fourth screw is accessible after removal of ash tray. See Figure 7C-*88.*

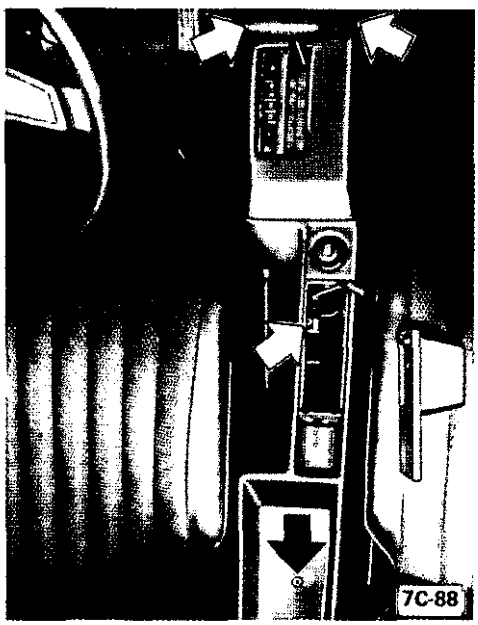


Figure 7C-88

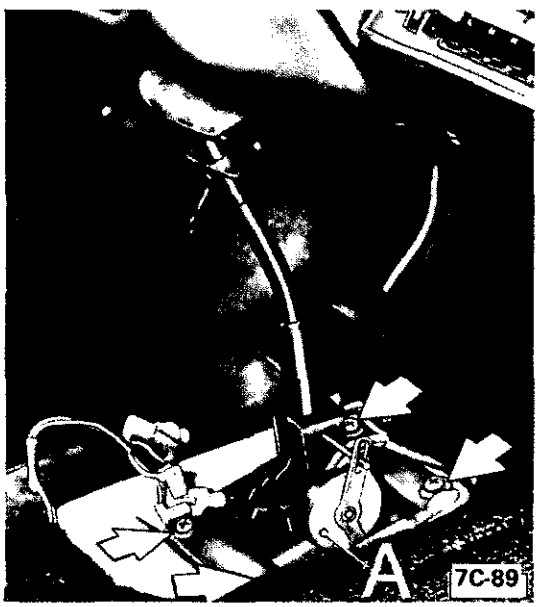


Figure 7C-89

2. Unplug cigar lighter and lamps from console and remove console.

3. From below vehicle, remove selector rod from intermediate selector lever.

4. Remove neutral start switch (A) and remove support housing attaching bolts. See Figure 7C-89.

5. Remove support housing and, from the underside of support housing, remove three (3) support attaching bolts. See Figure 7C-90.

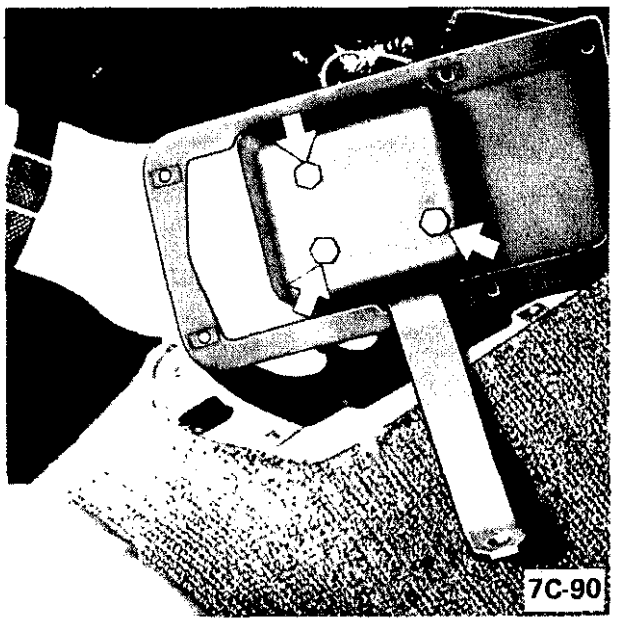


Figure 7C-90

6. Remove intermediate selector lever (B) from shaft and remove assembly from support housing. See Fig*ure* 7C-92.

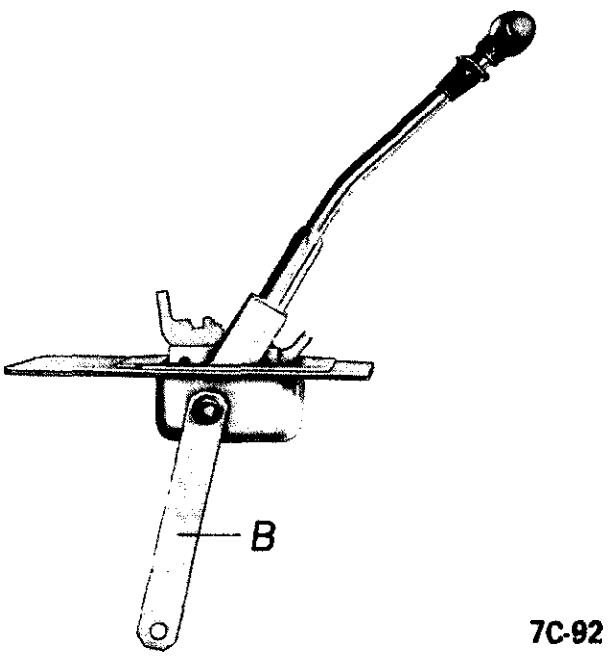


Figure 7C-92

7. Drive out retaining pin and shaft and remove selector detent. See Figure 7C-93.

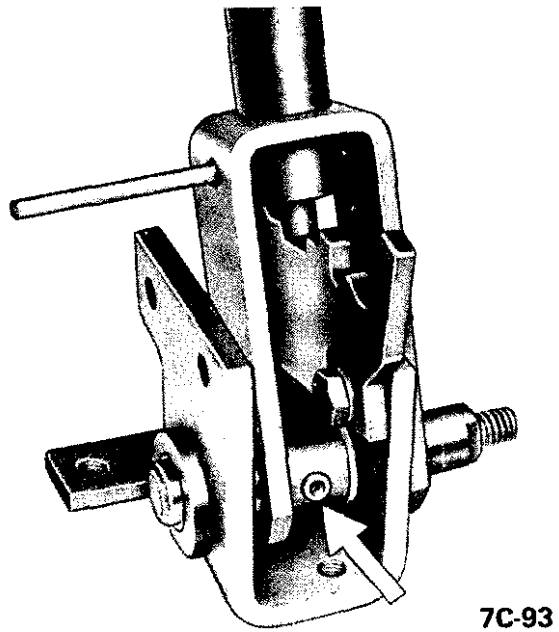


Figure 7C-93

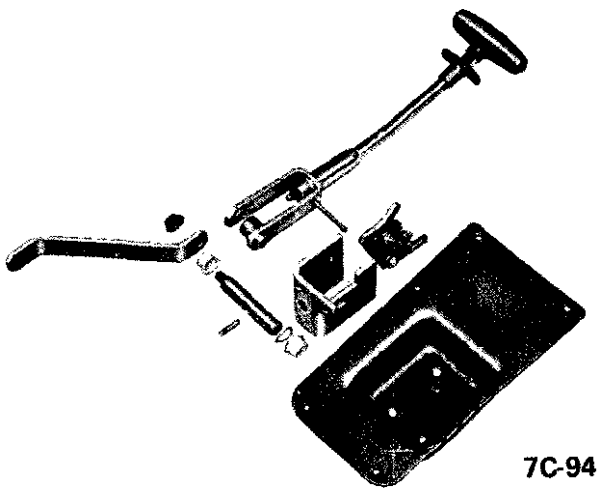


Figure 7C-94 - Exploded View of Selector Lever

8. To replace bowden cable in selector lever, knock off selector handle, remove screws from clamping piece and pull knob.

9. Remove pull knob and bowden cable, taking care not to lose lock bolt bushing, thrust springs, 'and washer.

10. Place thrust spring, bushing, washer, and thrust spring onto new bowden cable, in that order, and insert cable into selector lever.

1 I. Slide pull onto selector lever and clamping piece onto cable.

12. Heat up new selector lever handle in water to 176 degrees F. and push onto selector lever.

13. Set dimension between pull knob and selector lever handle at .4 inch and tighten set screws.

14. Lubricate selector lever detent and shaft. Install detent, align selector lever with support, install shaft, and drive in new retaining pin.

15. Install assembly to support housing and install intermediate selector lever.

16. Install assembly to vehicle and install neutral start switch.

17. Install console lights and cigar lighter connections to console and install console to vehicle.

18. Lubricate and connect selector rod to intermediate selector lever and adjust according to Figure 7C-198.

MAJOR REPAIR

REMOVAL AND INSTALLATION OF AUTOMATIC TRANSMISSION

Removal - Opel 1900 and Manta

1. Disconnect battery.

2. Remove dipstick.

3. Remove screws from fan shroud.

4. Remove 2 upper starter bolts.

5. Raise car and provide support for front and rear and drain oil.

6. Remove bolts from engine support brackets, both sides. Let brackets hang by front bolts. See Figure 7C-105.

7. Remove flywheel cover pan.

8. Remove exhaust pipe from manifold and unhook rubber tailpipe suspension.

9. Remove drive shaft. Do not misplace thrust spring in spline.

10. Disconnect cooler lines at flexible hoses.

II. Detach both stabilizer supports from crossmember to body supports and loosen stabilizer bolts in lower control arms. See Figure 7C-84, Callout "B".

12. Place suitable jack under transmission and remove transmission support bolts.

13. Lower transmission enough to remove detent cable and modulator vacuum line.

14. Remove speedometer cable.

15. Remove selector lever.

16. Mark flywheel and converter for reassembly in same position, and remove converter to flywheel bolts. See Figure 7C-106.

17. Remove converter housing to engine bolts and tiller tube.

18. Pry transmission loose from engine.

19. Keep rear of transmission lower than front to prevent converter from falling and install converter holding fixture J-21366. Lower transmission and move to bench.

Installation. Opel 1900 and Manta

1. Assemble transmission to suitable jack and raise transmission into position. Rotate converter to permit coupling of fly wheel and converter with original relationship. Remove J-21366.

2. Install tiller tube and converter housing to engine block bolts. Torque to 35 lb. ft. DO NOT over torque.

3. Install flywheel to converter bolts. Torque to 30 lb. ft.

4. Install detent cable to transmission.

5. Connect oil cooler lines.

6. Install lower bolt on starter. Torque to 40 lb. ft.

7. Connect shift linkage to transmission.

8. Connect modulator line.

9. Connect speedometer cable.

10. Install transmission support.

11. Install drive shaft. Torque U-Bolts to 18 lb. ft.

12. Install flywheel cover pan. Torque to 15 lb. ft.

13. Install engine support brackets.

14. Reconnect exhaust system.

15. Attach stabilizer supports and tighten stabilizer bolts in lower control arms.

16. Lower car.

17. Install starter bolts. Torque to 40 lb. ft.

18. Reconnect battery.

19. Fill tranamission with fluid as described in Specifications. Check selector lever and detent cable adjustment.

Removal GT

1. Disconnect battery.

2. Remove dipstick.

3. Pull throttle control rod off ball pin.

4. Remove screws from fan shroud.

5. Raise car and provide support for front and rear.

6. Remove heat protection shield from right side to make room for exhaust pipe removal.

Figure 7C-95

7. Detach exhaust pipe from manifold flange.

8. Unhook damper rings on front muffler and tail pipe from brackets on body floor panel. Place exhaust pipe assembly onto rear axle. See Figure 7C-96.

9. Remove propeller shaft. Make sure that spring in front universal joint does not get lost.

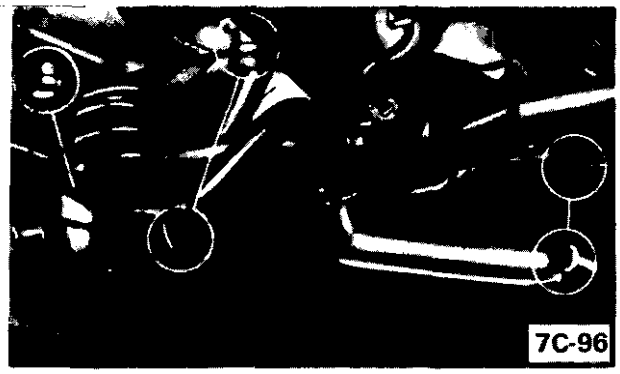


Figure 7C-96

10. Detach rear engine support from transmission crossmember. See Figure 7C-97.

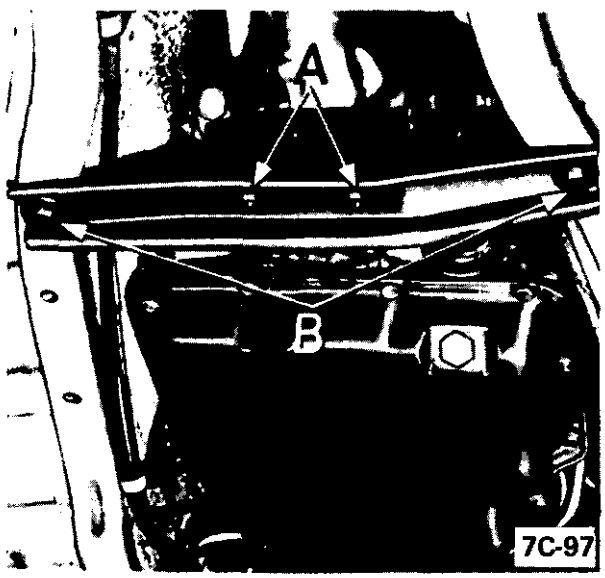


Figure 7C-97

11. Support transmission below oil pan with a suitable jack.

12. Unscrew transmission crossmember from side members. See Figure 7C-97.

13. Lower transmission as far as possible,

14. Drain transmission oil.

15. Detach selector rod from ball pin of the outer transmission selector lever on right transmission side. See Figure 7C-98.

16. Unscrew oil cooler pipes from transmission counter holding with a second wrench. Then plug oil cooler pipes. See Figures 7C-99 and 7C-101.

Figure 7C-98

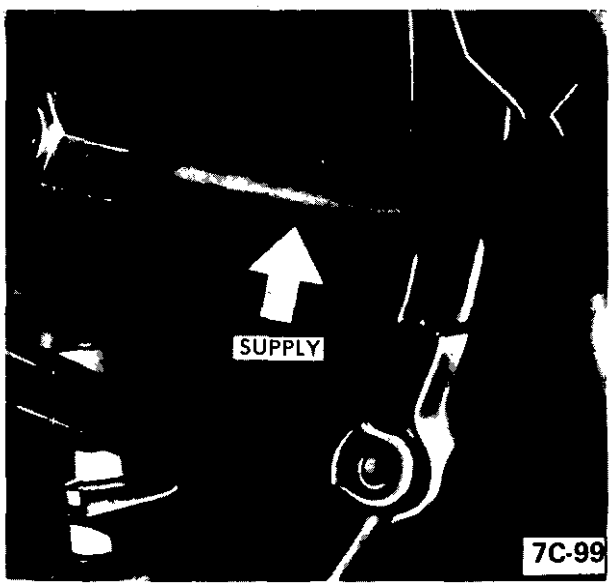


Figure 7C-99

17. Pull modulator line off diaphragm.

18. Unscrew detent cable retainer from transmission, pull cable out of transmission, and unhook from detent valve. See Figures 7C-102, 7C-103, and 7C-104.

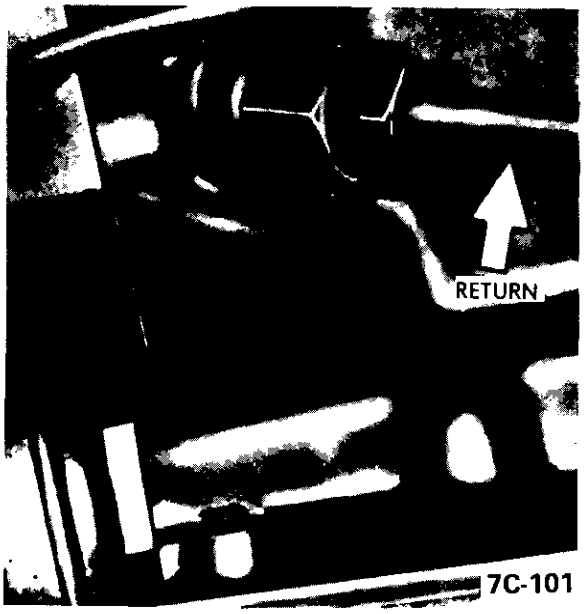


Figure 7C-101

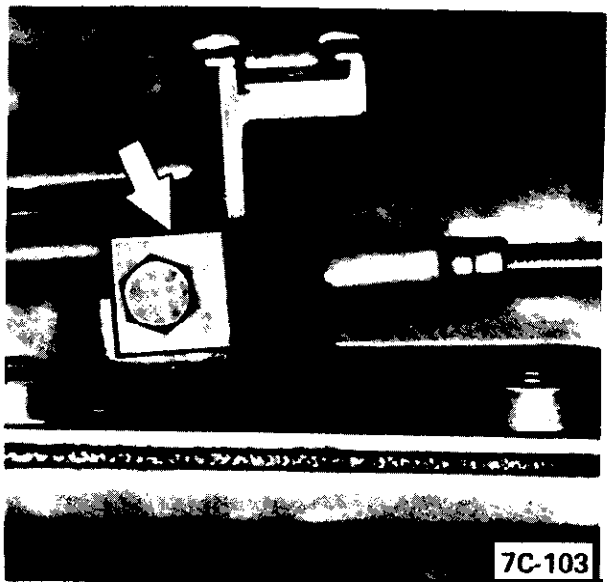


Figure 7C-103

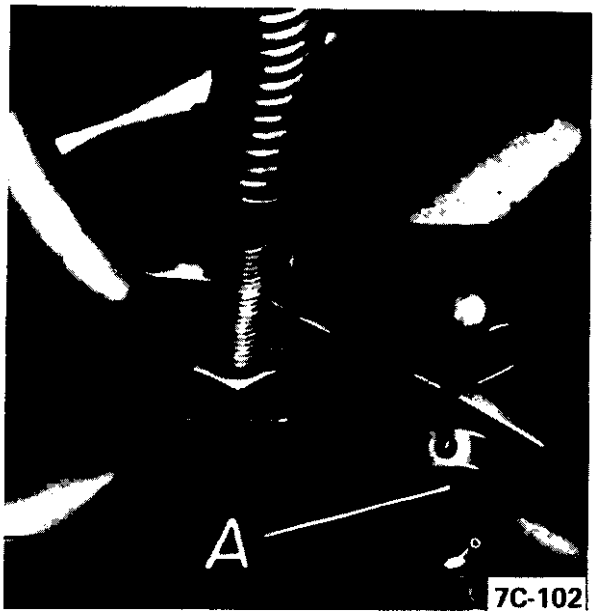


Figure 7C-102

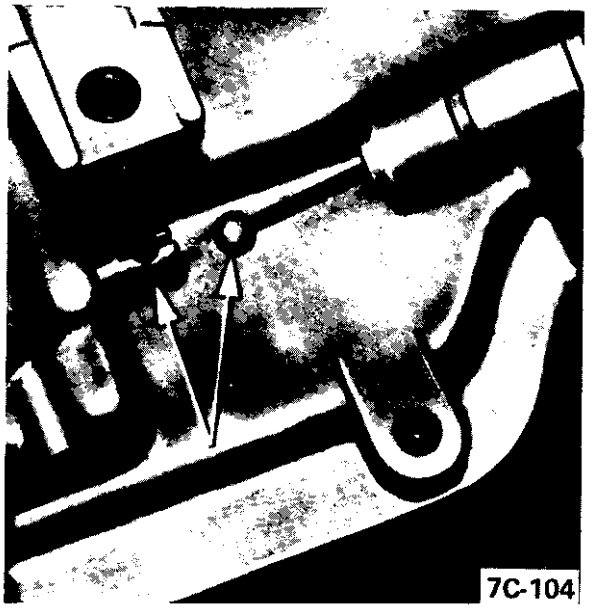


Figure 7C-104

19. Pry detent cable and oil cooler pipes out of retainers on transmission oil pan.

20. Unscrew **speedometer cable and pull it out of** speedometer driven gear housing.

21. On both engine sides unscrew engine support brackets from torque converter housing. Slacken' front attaching bolt only. See Figure 7C-105.

22. Remove torque converter housing cover plate.

23. Mark flex plate and converter for reassembly in same position.

24. Unscrew the three torque converter to flex plate attaching bolts. See Figure 7C-106.

25. Pry transmission loose from engine.

26. Move transmission rearward to provide clearance between converter and flex plate to install converter holding tool J-21366. Lower transmission and move to bench.

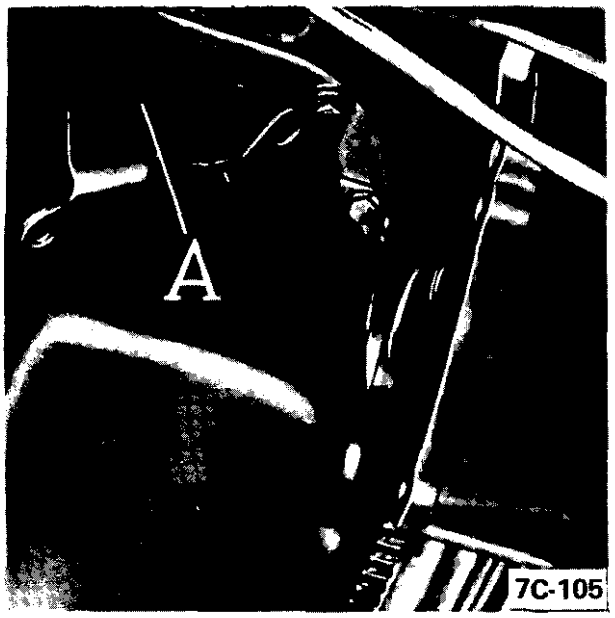


Figure 7C-105

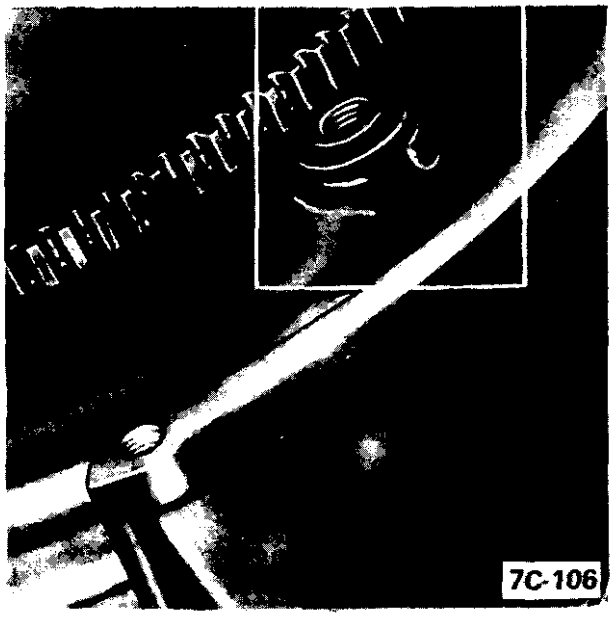


Figure 7C-106

Installation **GT**

1. Assemble transmission to suitable jack and raise into position. Rotate converter to permit coupling with flywheel in original relationship. Remove holding fixture.

2. Install tiller tube and converter housing to engine bolts. Torque to 35 lb.ft.

3. Install flywheel to converter bolts. Torque to 30 lb.ft.

4. Install detent cable.

5. Connect oil cooler lines.

6. Install lower bolt on starter. Torque to 40 lb.ft.

7. Connect modulator line.

8. Connect speedometer cable.

9. Connect shift linkage.

10. Install transmission support.

11. Install drive shaft. Torque U-bolts to 18 lb.ft.

12. Install flywheel cover pan.

13. Reconnect exhaust system and heat shield.

14. Install engine support brackets.

15. Lower car,

16. Install starter bolts, Torque to 40 lb.ft.

17. Connect battery.

18. Fill transmission with fluid, as described in Specifications. Check selector lever and detent cable adjustment.

DISASSEMBLY, INSPECTION AND REASSEMBLY

Transmission Installation Into Holding Fixture

I. Remove transmission tiller tube.

2. With transmission on cradle of portable jack, remove converter assembly by pulling straight out. Converter contains a large amount of oil.

3. Install holding fixture, J-8763-01, on transmission.

4. Install holding fixture and transmission into holding **base** tool J-3289-20 with bottom pan up. See Figure 7C-107. **Do** not overtighten.

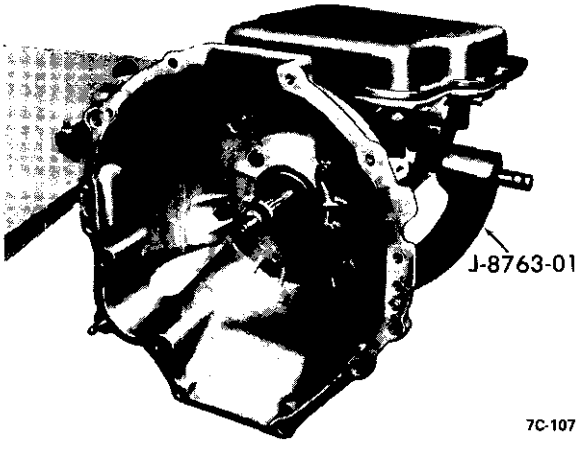


Figure 7C-107

Converter Housing Oil Seal

With transmission on portable jack and converter removed, converter housing oil seal may be removed without disassembling transmission using tool J-23129, and slide hammer J-7004.

2. Using tool J-23129 remove oil seal with slide hammer.

3. Install new oil seal using installer J-21359.

Removal of Oil Pan

This operation can be performed with transmission in vehicle.

1. Remove the twelve oil pan attaching bolts.

2. Remove oil pan and gasket. See Figure 7C-108.

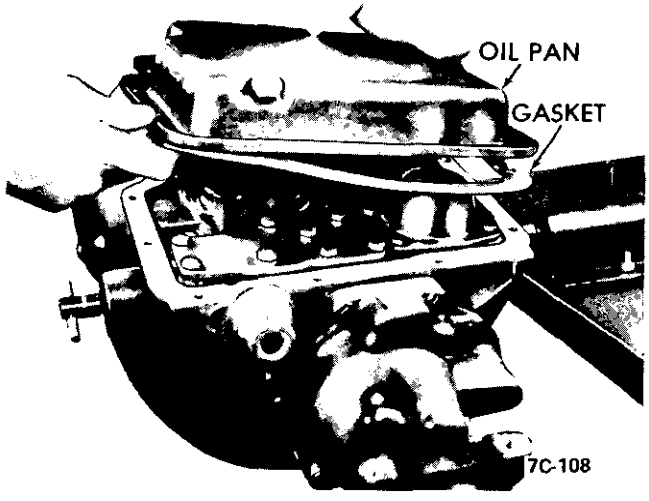


Figure 7C-108

REMOVAL OF VALVE BODY

8 Removal of Valve Body

This operation can be performed with transmission in vehicle

1. Remove the manual detent roller and spring, retained by two bolts. See Figure 7C-110.

2. Remove the three attaching bolts holding the strainer assembly to the valve body and remove. Discard gasket.

3. Remove the eight bolts from transfer plate reinforcement and remove reinforcement. See Figure 7C-111.

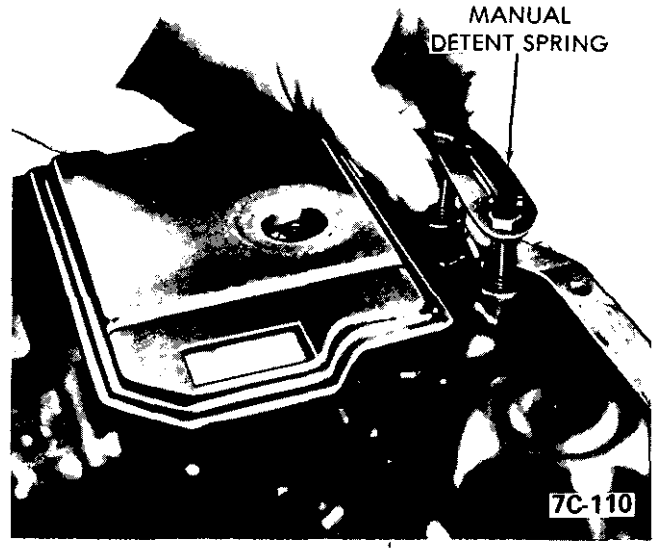


Figure 7C-110

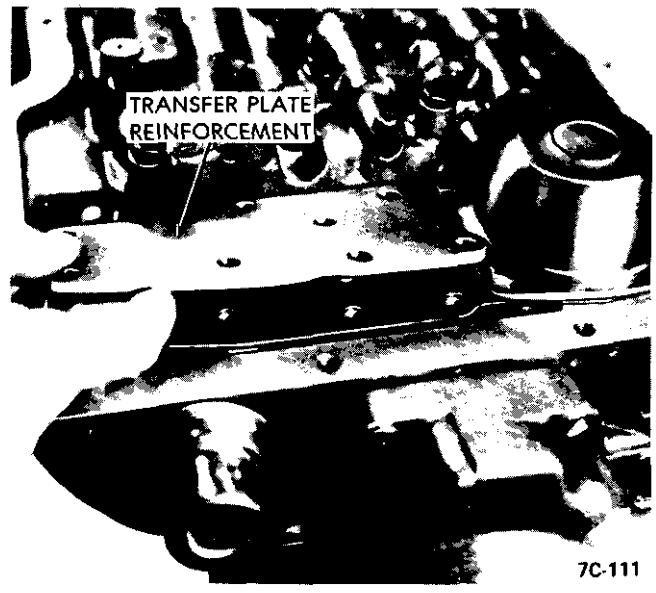


Figure 7C-111

4. Remove the four servo cover attaching bolts and remove servo cover and gasket. See Figure 7C-112.

5. Remove remaining eight bolts attaching valve body to case. Carefully remove valve body with gasket and transfer plate. See Figure 7C-113.

Care must be taken so that manual valve and manual valve link "A" are not damaged or lost during removal of valve body from the case.

Figure 7C-1 12

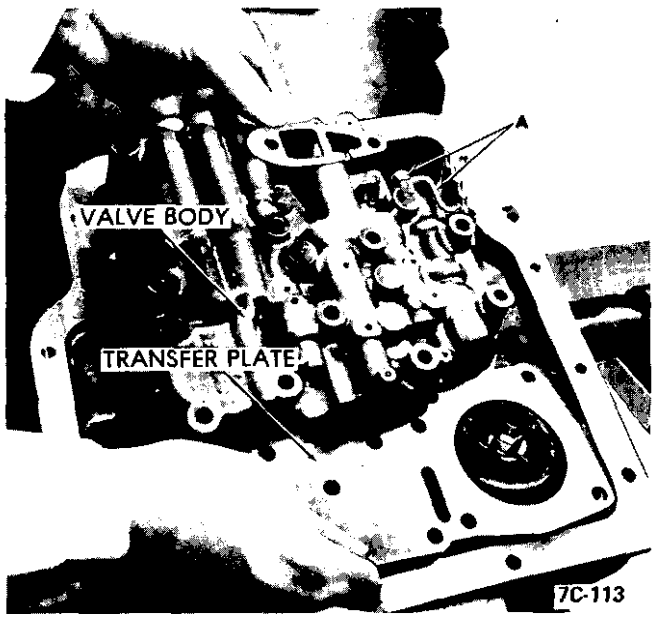


Figure 7C-1 13

6. Remove the two check balls located in the oil passages in the transmission case. See Figure 7C-114. Location of these check balls must be noted so that they are installed correctly.

Removal of Servo Piston

This operation can be performed with transmission in vehicle

1. Compress servo piston using servo piston compressor tool J-23075.

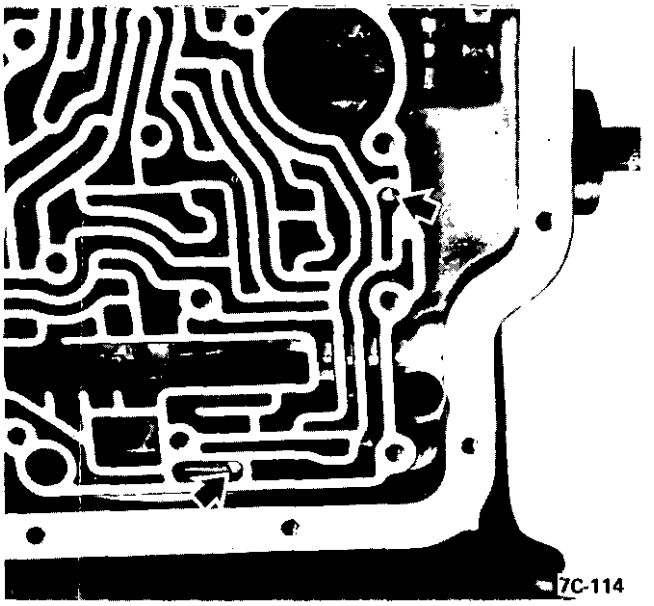


Figure 7C-1 14

2. Using pliers, remove servo piston snap ring. See Figure 7C-1 15.

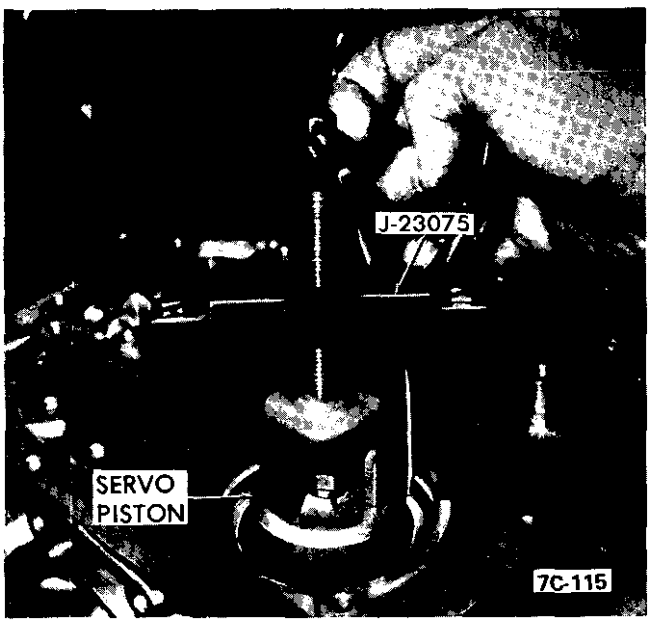


Figure 7C-1 15

3. Loosen servo piston compressor tool J-23075 slowly as servo is under high spring tension. Remove tool and servo piston assembly. See Figure 7C-116.

Removal of Selector Lever and Shaft

Note at this point that the selector lever (on GT models only) is on the opposite side from all other models, and that the selector shaft passes through the case. See Figures 7C-117 and 7C-118. Note also

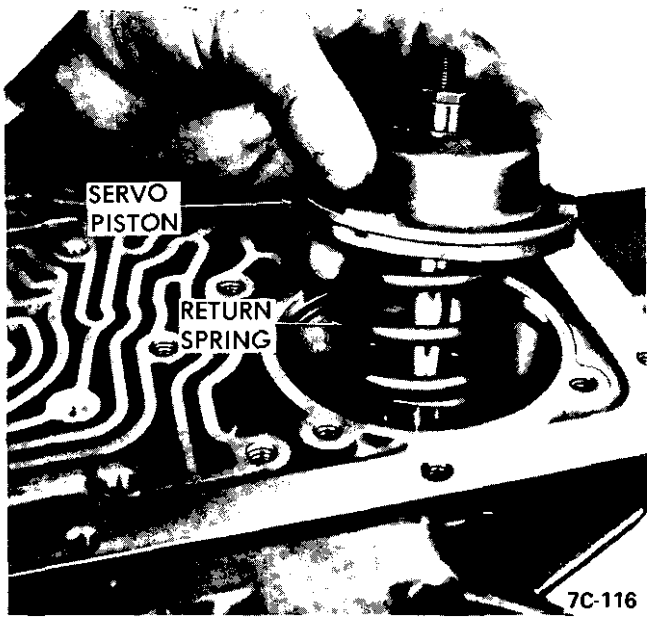


Figure 7C-116

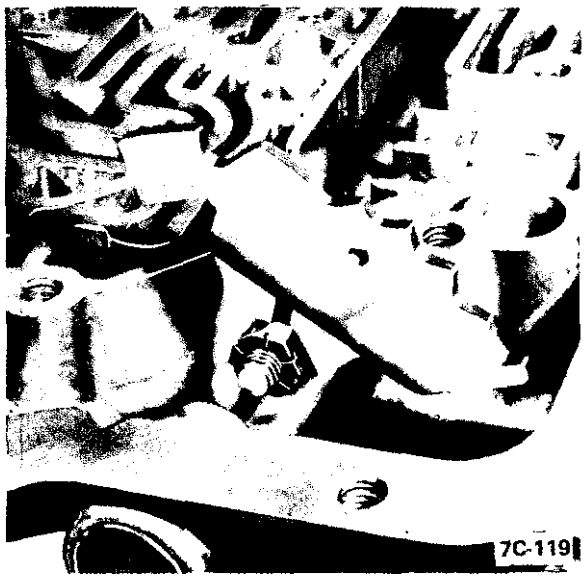


Figure 7C-118 GT Models

Figure 7C-117 GT Models

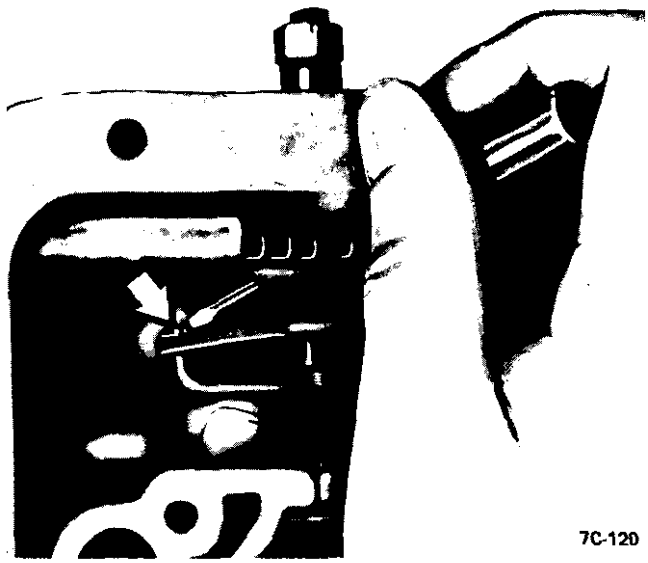


Figure 7C-119

that one case services both models and is machined to accept selector lever on either side with the unused hole being plugged.

1. Remove retaining ring From parking actuator rod to selector inner lever. See Figure 7C-119.

2. Remove selector inner lever locking nut from selector lever shaft.

3. Remove selector inner lever from selector lever shaft.

4. Remove selector lever shaft spring pin by pulling upwards with small pliers.

5. Remove selector lever shaft. See Figure 7C-120.

6. Remove selector lever shaft oil seal and discard.

Removal of Modulator Assembly

This operation can be performed with transmission in vehicle using tool J-23 100.

1. Remove vacuum modulator From transmission case. See Figure 7C-94. Care should be taken not to lose the modulator plunger.

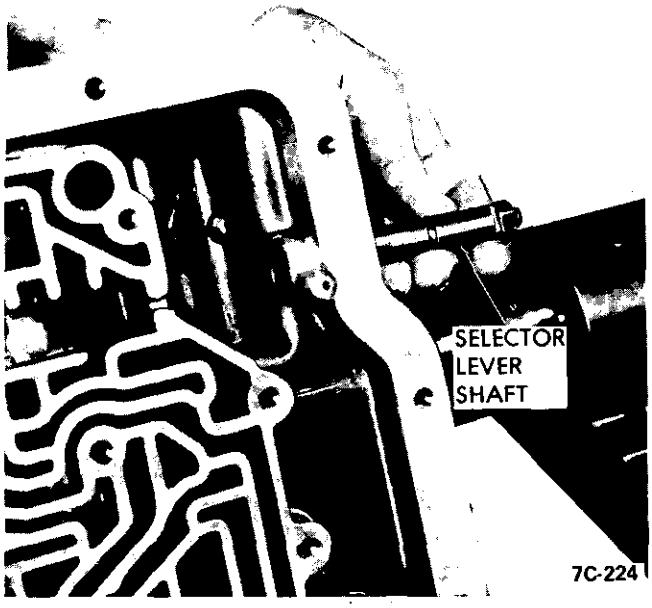


Figure 7C-120

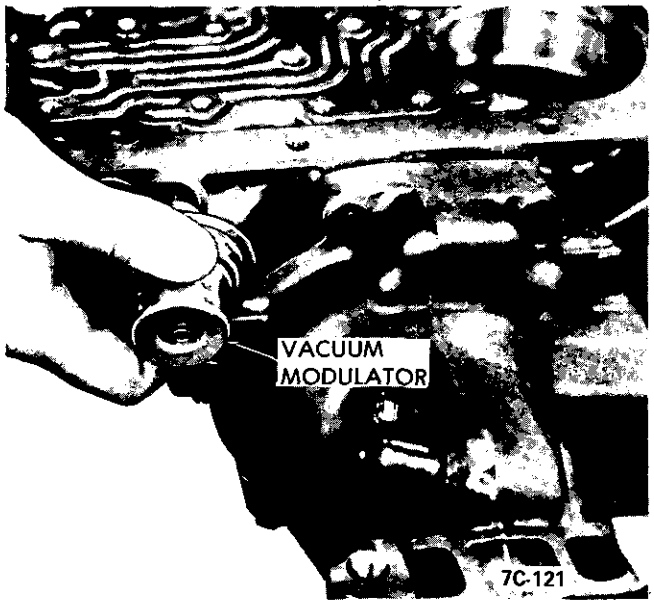


Figure 7C-12 1

2. Remove modulator valve and sleeve from transmission case.

Removal of Detent Valve Assembly

This operation can be performed with transmission in vehicle

1. Remove spring pin by pulling upward with pliers.

2. Lightly tap detent valve assembly from front of case and remove detent valve, sleeve, spring, and spring seat from rear of case. See Figure 7C-122.

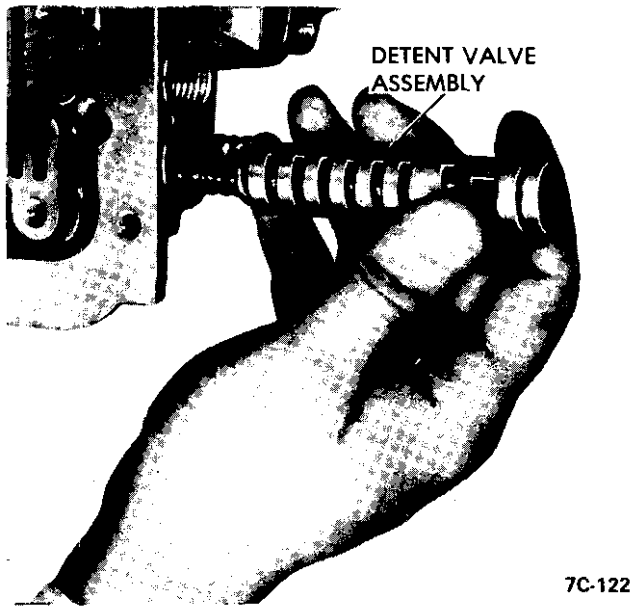


Figure 7C-122

Removal of Extension Housing

This operation can be performed with transmission in vehicle

1. Remove bolt holding speedometer driven gear housing retainer and carefully remove retainer and pull speedometer driven gear assembly from extension housing. See Figure 7C-123.

Figure 7C- 123

2. Remove the seven attaching bolts from extension housing to case.

3. Remove extension housing and gasket. See Figure 7C- 124.

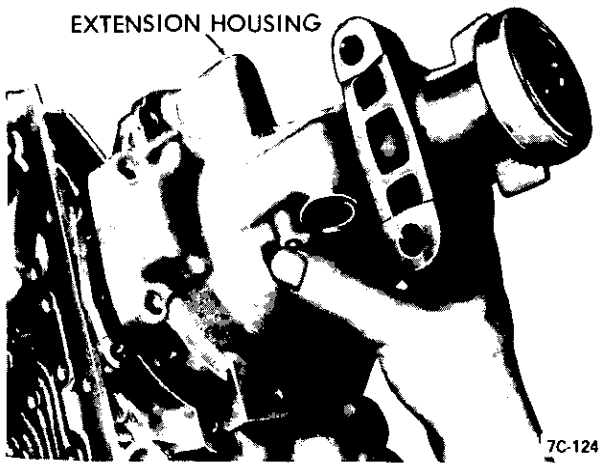


Figure 7C-124

4. Remove parking pawl actuator rod from transmission case.

Removal of Speedometer Drive Gear, Governor Body and Governor Hub

1. Depress speedometer drive gear retaining clip and remove speedometer drive gear by sliding off output shaft. See Figure 7C-125.

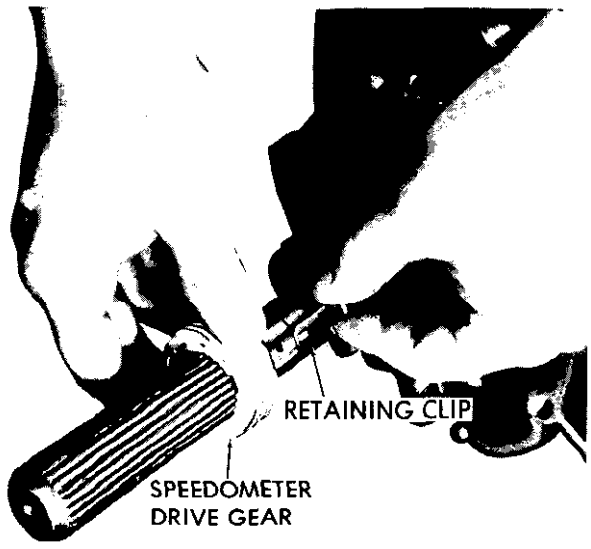


Figure 7C-125

2. Remove the four (4) attaching bolts from the governor body and remove governor and gasket. See Figure 7C-126.

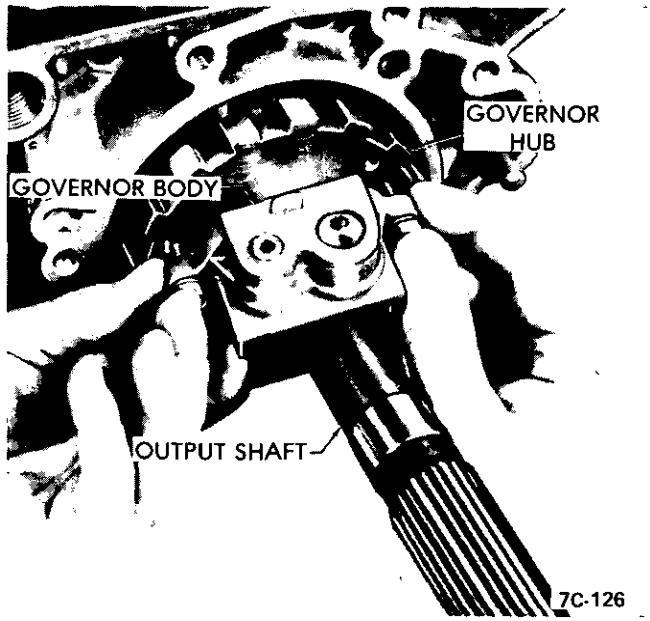


Figure 7C-126

3. Remove governor hub snap ring from output shaft using snap ring pliers, such as J-8059. See Figure 7C-128.

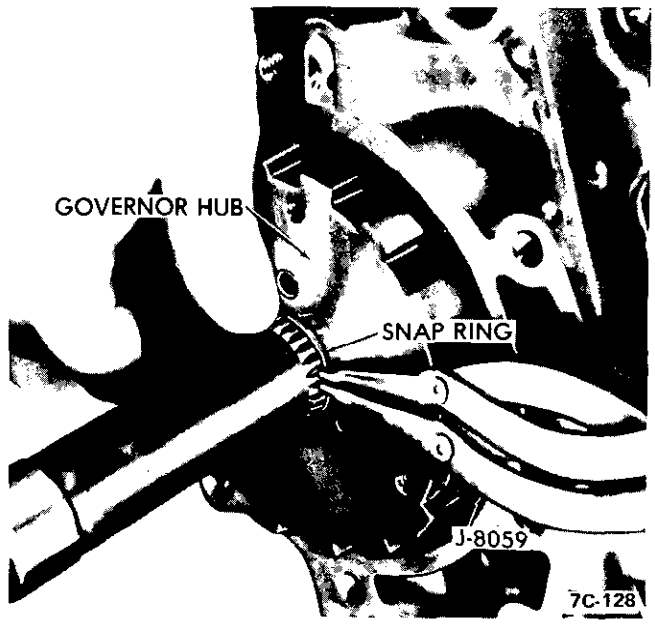


Figure 7C-128

4. Slide governor hub off the output shaft

Removal of Converter Housing, Oil Pump, Reverse and Second Clutch Assembly

1. Turn transmission in holding fixture so that converter housing is facing up.

2. Remove the seven converter housing attaching

bolts which are the outer bolts in the housing. See Figure 7C-129.

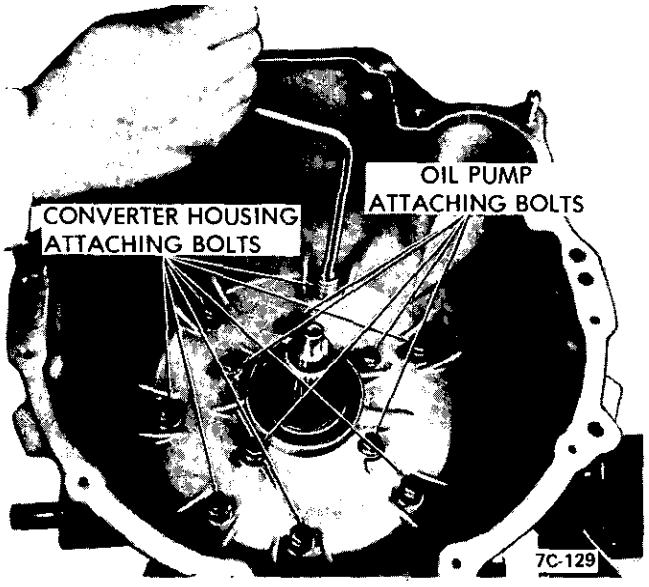


Figure 7C-129

3. Remove **converter** housing with oil pump, reverse and second clutch assemblies. Do not lose selective thrust washer. See Figure 7C-130. Second clutch assembly may remain in case. If so, remove with reverse clutch plates.

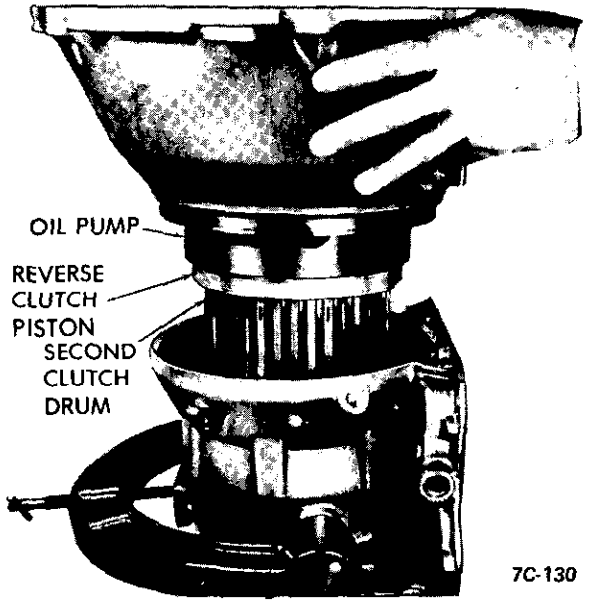


Figure 7C-130

4. Remove reverse clutch plates from transmission case, See Figure 7C-131.

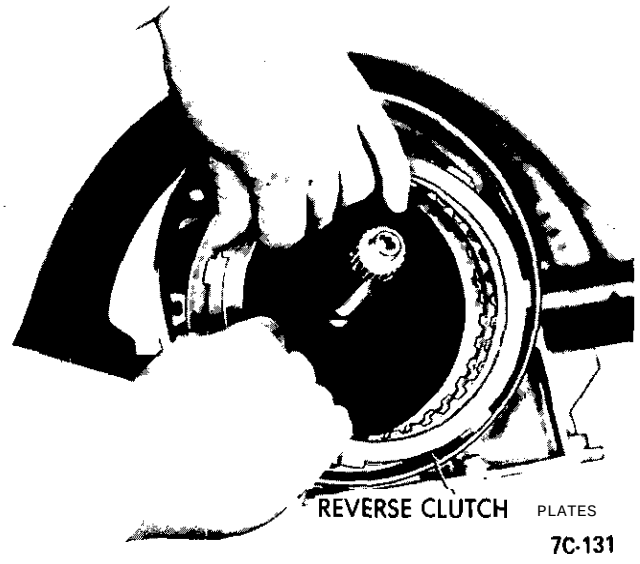


Figure 7C-13 1

Removal of Third Clutch Assembly. Planetary Carrier Assembly, Reaction Sun Gear and Drum Assembly and Low Band

1. Remove third clutch assembly. See Figure 7C-132.

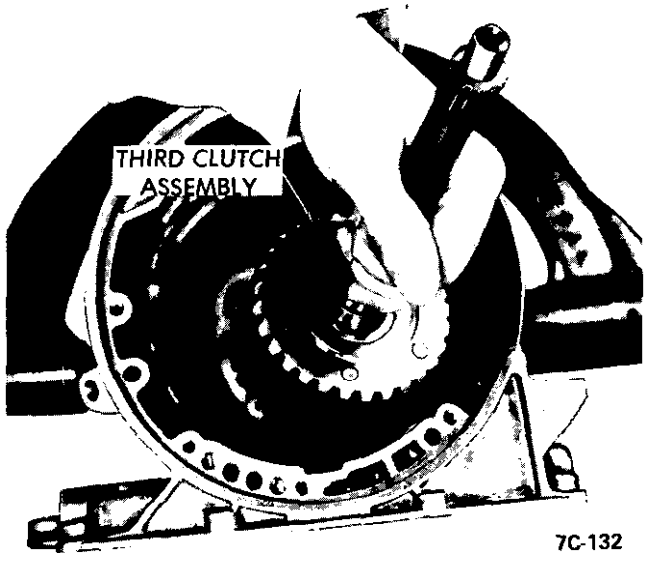


Figure 7C-132

2. Remove planetary carrier and output shaft by sliding out through front of case. See Figure 7C-133. Care should be taken not to lose the needle thrust bearing and race in the planetary carrier assembly.

3. Remove reaction sun gear and drum with needle

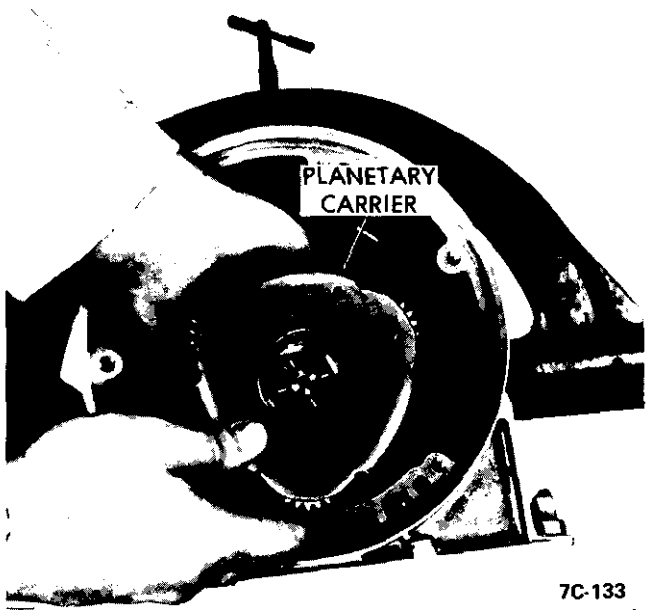


Figure 7C-133

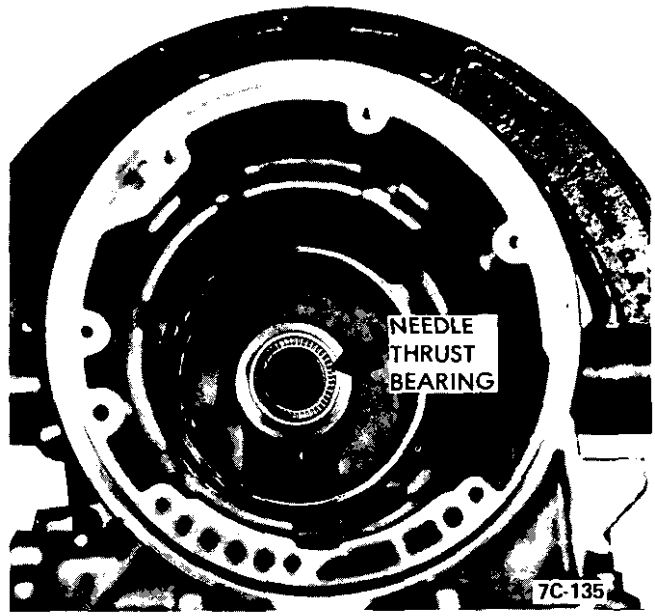


Figure 7C-135

thrust bearing and race from case by pulling straight out. See Figure 7C-134.

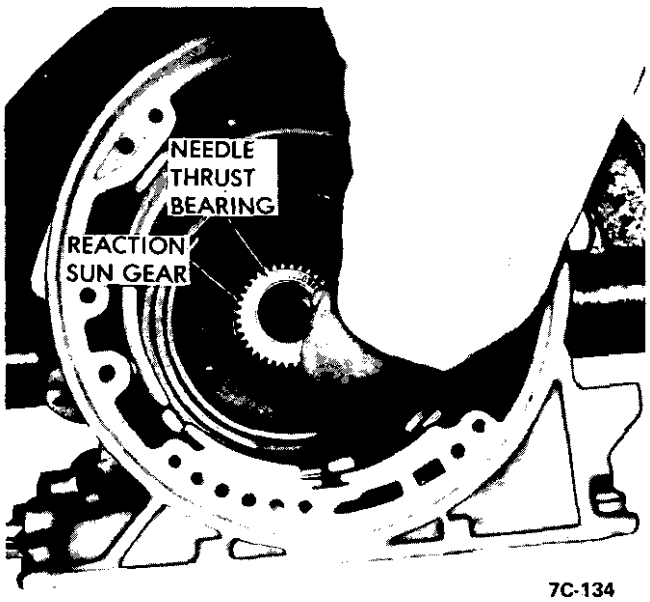


Figure 7C-134

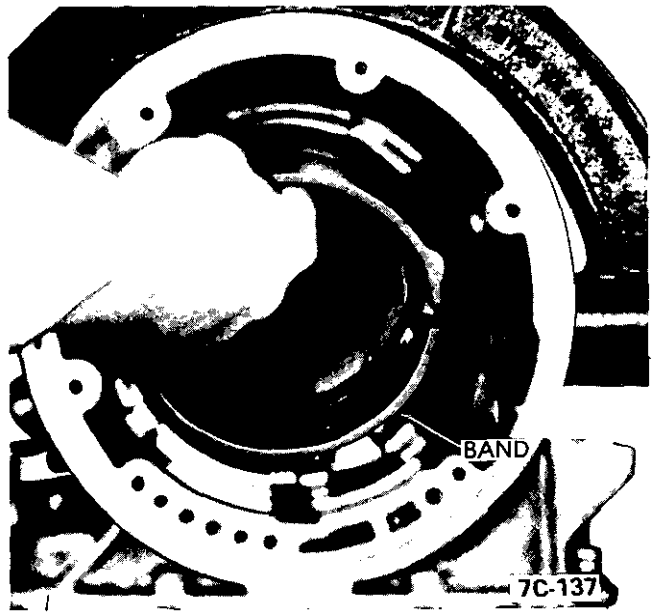


Figure 7C-137

4. Remove needle thrust bearing and race from rear of case. See Figure 7C-135.

5. Remove low band by slightly compressing band and pulling straight out. See Figure 7C-137.

6. If necessary to remove case vent, install new case vent. Do not attempt to reinstall old vent.

Disassembly, Inspection and Reassembly of Converter Housing, Oil Pump and Reverse Clutch

1. Remove second clutch assembly from oil pump shaft. See Figure 7C-138.

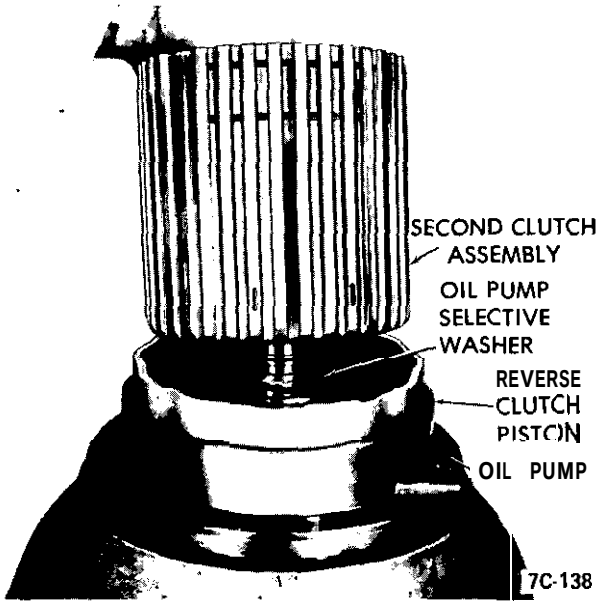


Figure 7C-138

2. Remove selective washer from oil pump shaft. See Figure 7C-138.

3. Remove the oil pump outer oil seal and discard. See Figure 7C-139.

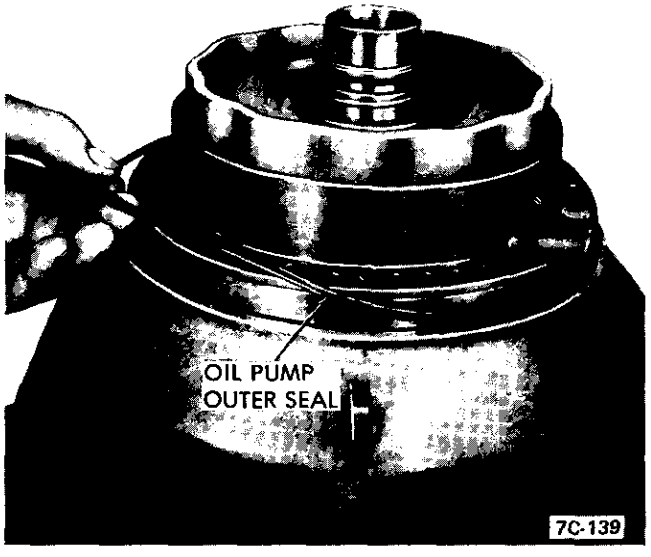


Figure 7C-139

4. Remove the five bolts holding the converter housing to the oil pump.

5. Remove the converter housing. See Figure 7C-140.

6. Remove oil pump wear plate "A". See Figure 7C-140.

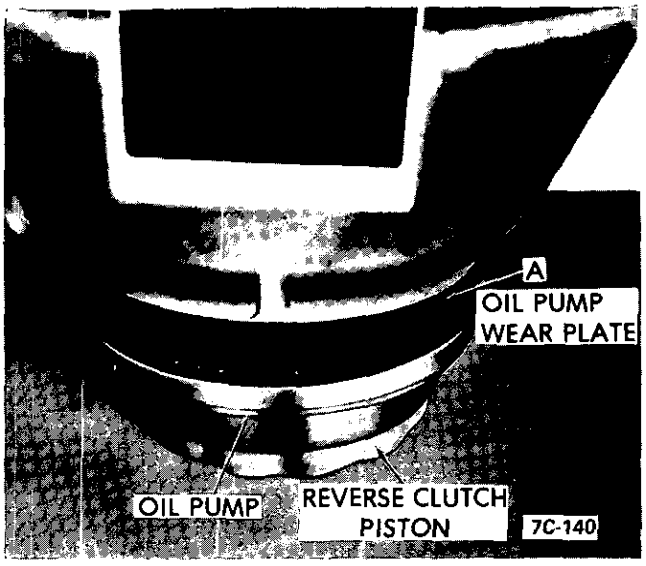


Figure 7C-140

7. Inspect front face of converter housing for oil leak. See Figure 7C-141. If problem is diagnosed as a front seal leak (presence of red oil coming from bottom of converter housing), remove front oil seal.

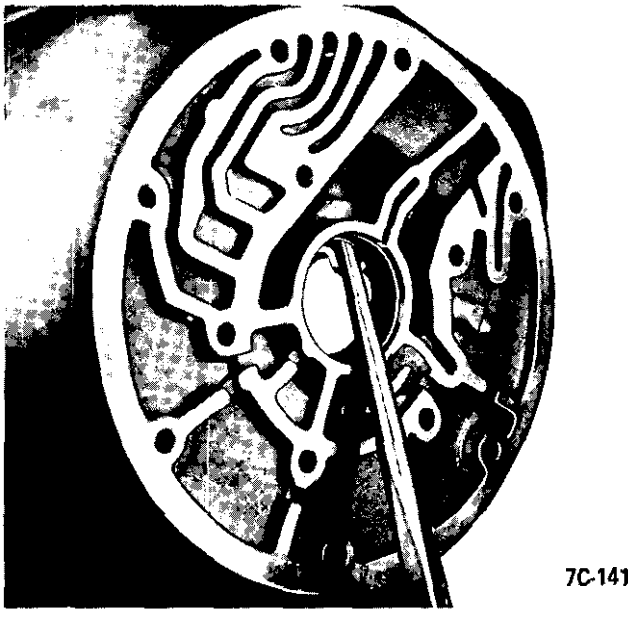


Figure 7C-141

8. Inspect converter housing bushing. If worn, remove bushing using tool J-21465-17 with drive handle J-8092 from converter **side** of housing.

9. Clean converter housing thoroughly. Install converter housing bushing flush with front face of housing using tool J-21465-17 with driver handle J- 8092. See Figure 7C-142.

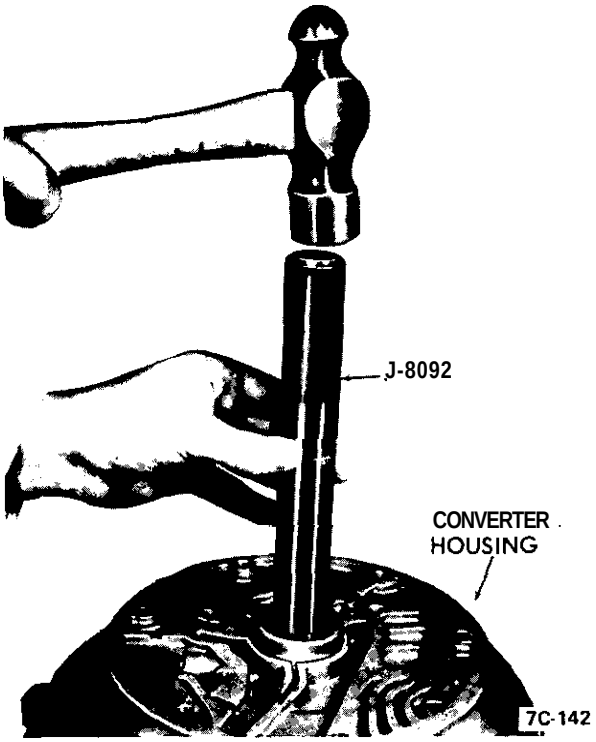


Figure 7C-142

10. Install new converter housing oil seal using tool J-21359. See Figure 7C-143.

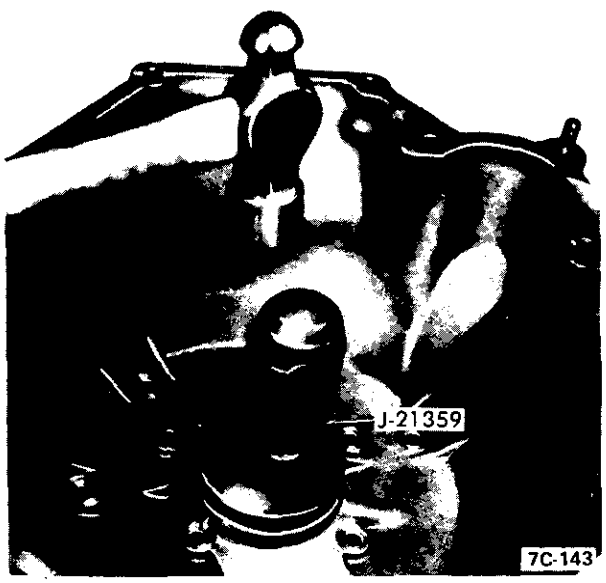


Figure 7C-143

11. Check converter pump hub for nicks, burrs or damage which could have caused oil seal to leak or have worn bushing. Remove nicks and burrs.

12. Mark relative location of oil pump gears and remove oil pump gears. See Figure 7C-144.

Figure 7C-144

13. Using compressor tool J-2590-12 with adapter J-21420-1 on reverse clutch retaining seat, compress clutch return springs. See Figure 7C-146.

14. Remove snap ring using snap ring pliers such as J- 8059. See Figure 7C-146.

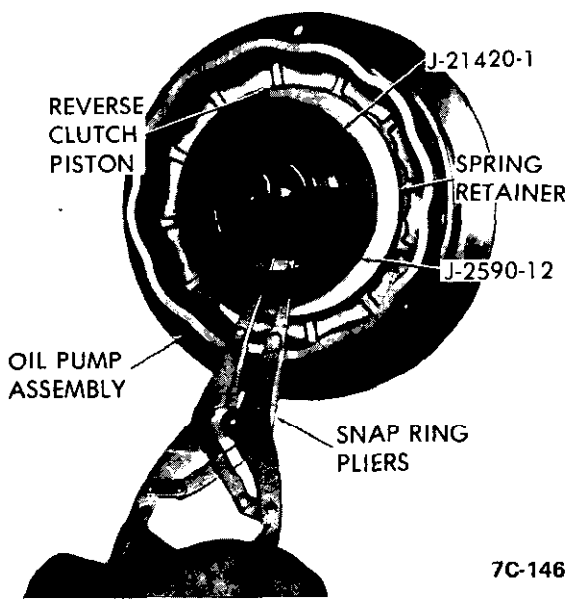
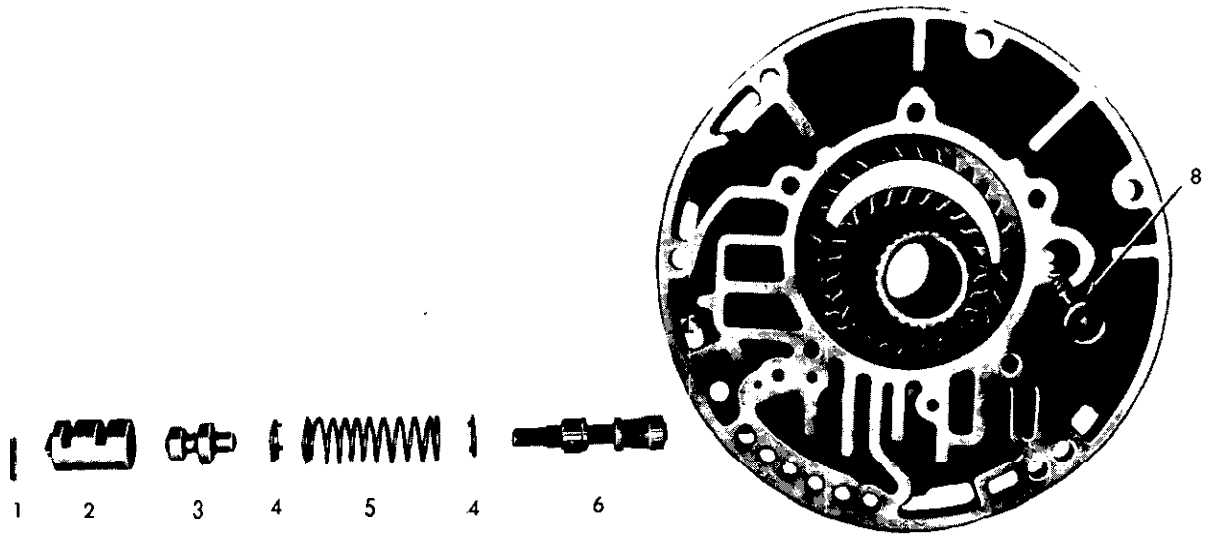


Figure 7C-146

15. Loosen compressor tool J-2590-12 and remove reverse clutch retaining ring and 24 reverse clutch springs.



1. RETAINING PIN
2. PRESSURE REGULATOR BOOST VALVE SLEEVE
3. PRESSURE REGULATOR BOOST VALVE
4. PRESSURE REGULATOR VALVE SPRING SEAT
5. PRESSURE REGULATOR VALVE SPRING
6. PRESSURE REGULATOR VALVE
7. OIL PUMP BODY
8. OIL PUMP PRIMING VALVE, SPRING & SPRING SEAT

7C-147

16. Remove reverse clutch piston.

17. Remove priming valve from oil pump body by lightly tapping with a drift through the hole at the rear of oil pump. (Only if diagnosis requires removal or if excessive dirt has passed through transmission.)

18. Pressure regulator and boost valve may be removed by using a pari of wire cutters to remove the retaining pin. Due to the difficulty of removing the retaining pin, it is not recommended that the pressure regulator valve and boost valve be disassembled during overhaul, unless it was determined by oil pressure checks to have been malfunctioning prior to tear down.

19. Remove pressure regulator boost valve sleeve, spring, pressure regulator valve and two washers. See Figure 7C-147.

20. Inspect and if necessary replace the oil pump hub bushing by threading a 3/4" standard pipe tap such as tool J-23130-5 into bushing. See Figure 7C-148.

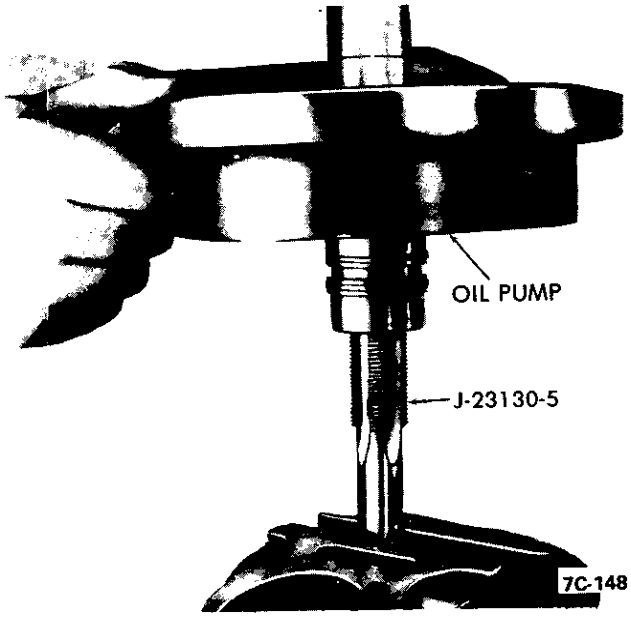


Figure 7C-148

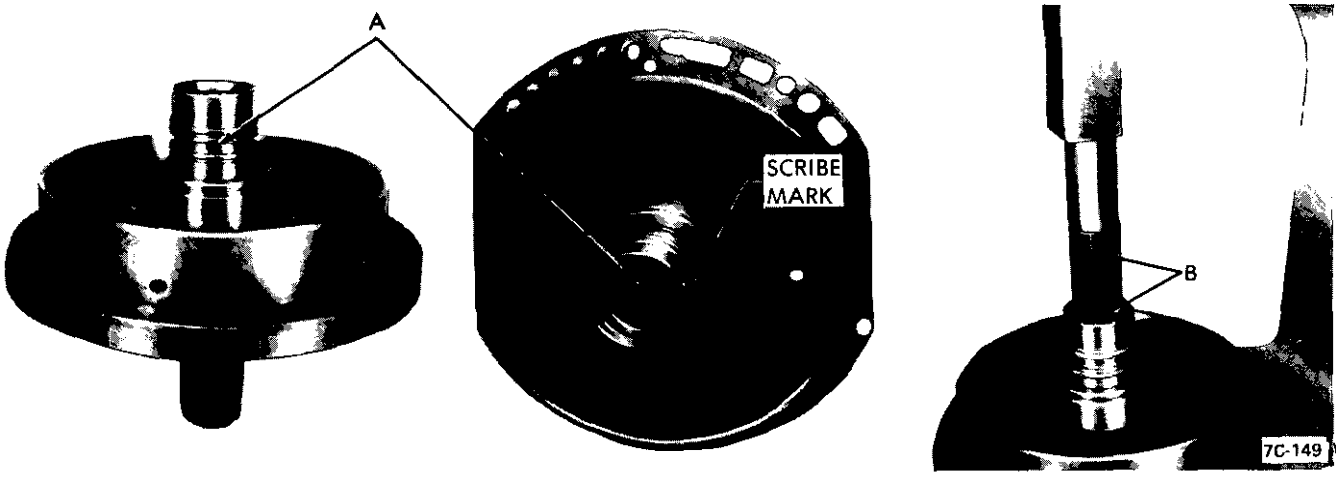


Figure 7C-149

21. Using a drift on tap, press out oil pump bushing with arbor press. Use rag or cloth to protect oil pump face.

22. Install new oil pump hub bushing with arbor press using tool J-23130-1. See Figure 7C-149. Clean pump body, including all holes and pockets thoroughly. With oil pump shaft hole "A" facing downward, scribe an aligning mark on oil pump shaft inner diameter at the center of the oil groove to the right of hole "A". Scribe mark on outer edge of bushing through the centers of the small and large drilled holes "B". Place bushing into oil pump shaft with small hole up, and align scribe marks on bushing with those made in oil pump shaft. Use arbor press to drive bushing into oil pump shaft until seated in the bore. Care must be taken so that bushing is pressed in straight, using the scribe marks as a guide until firmly seated.

23. Inspect and thoroughly clean the pressure regulator and priming valve assemblies. Immerse all valves in transmission fluid before installing in bores.

24. Install pressure regulator valve in oil pump body bore. See Figure 7C-150.

25. Install pressure regulator valve, two spring seats, spring, boost valve and sleeve in oil pump body bore.

26. Depress pressure regulator boost valve sleeve until backend lines up with pin hole and insert pin to secure.

27. Install priming valve assembly from front face of pump. Priming valve retainer should be pressed in flush with surface of oil pump body. See Figure 7C-151.

28. Inspect oil pump hub oil seal rings. Replace if damaged or side wear is noted. See Figure 7C-152.

29. Inspect reverse clutch piston for damage, Replace if necessary.

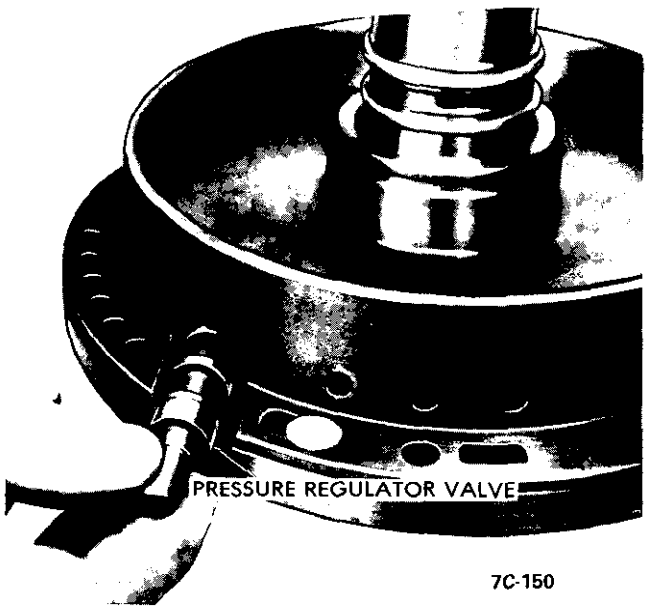


Figure 7C-150

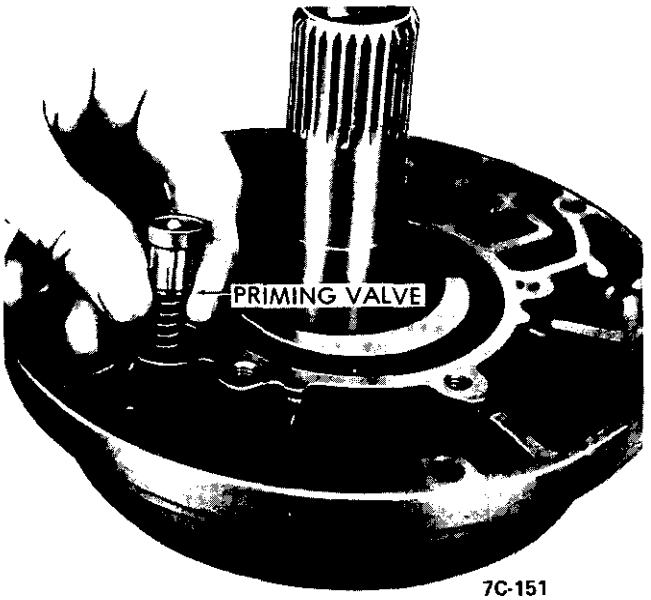


Figure 7C-151

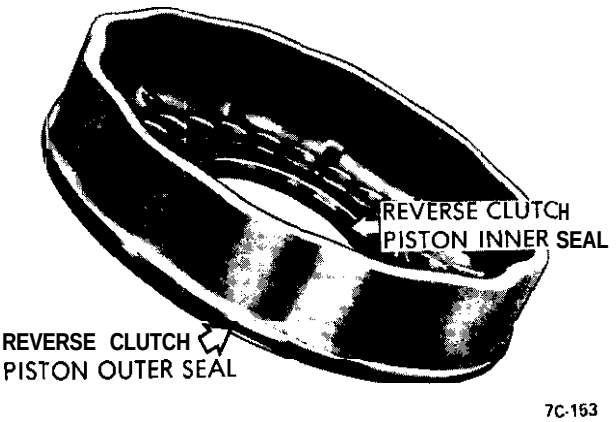


Figure 7C-153

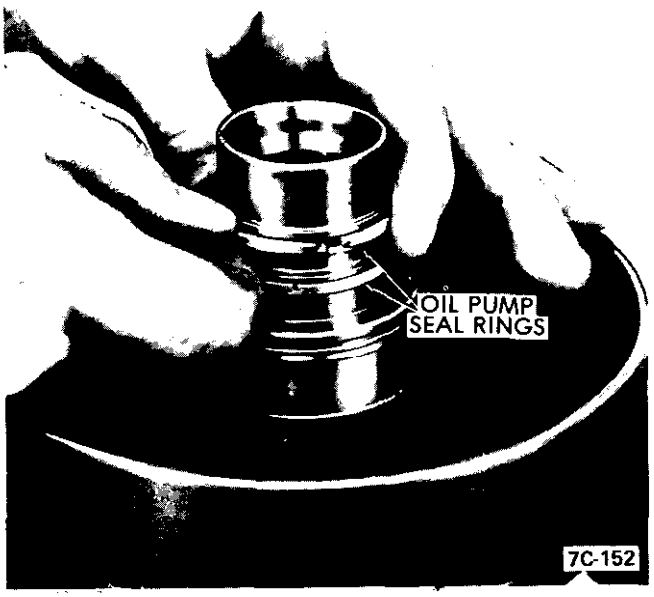


Figure 7C-152

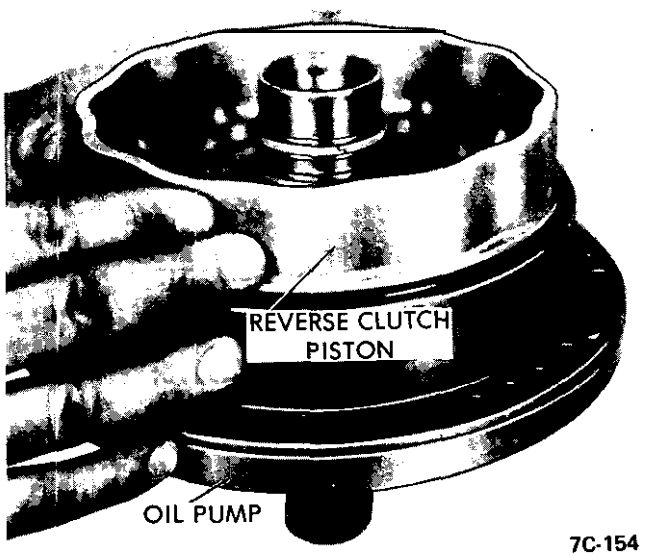


Figure 7C-154

30. Install new oil seals on reverse clutch piston. See Figure 7C-153.

31. Install reverse clutch piston onto rear face of oil pump using liberal amount of transmission fluid. See Figure 7C-154.

32. Inspect reverse clutch piston springs. Evidence of extreme heat or burning in the area of the clutch may have caused the springs to take a heat set and would justify replacement of the springs.

33. Install the twenty-four reverse clutch piston return springs.

34. Install retaining seat.

35. Compress return springs using second and reverse clutch piston spring compressor tool J-2590-12 with adapter J-21420-1. Care should be taken not to damage retainer should retainer catch in snap ring groove. See Figure 7C-155.

36. Install snap ring using snap ring pliers such as J-8059. See Figure 7C-155. Do not air check reverse clutch as the clutch is not complete and damage to the return spring retaining seat may occur.

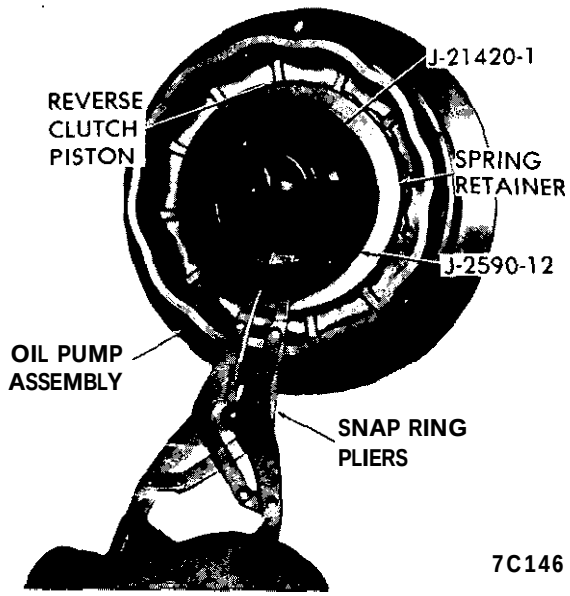


Figure 7C.155

37. Turn oil pump and reverse clutch assembly so that oil pump face is facing up.

38. Install oil pump gears using the location mark made before disassembly.

39. Check the end clearance of both gears to the oil pump face. Clearance should be between .0005 to .0035. See Figure 7C-156.

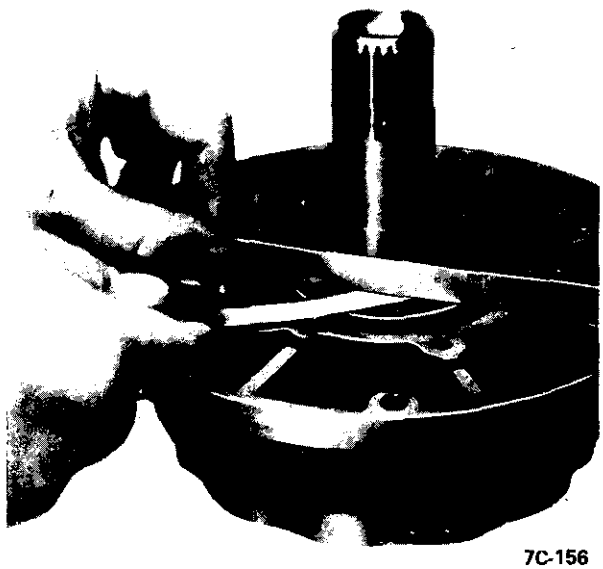


Figure 7C-156

41. Replace the oil pump assembly if the end clearance is not within specifications.

Disassembly, Inspection and Reassembly of Second Clutch

1. Remove ring gear retaining ring from second clutch drum. See Figure X-157.

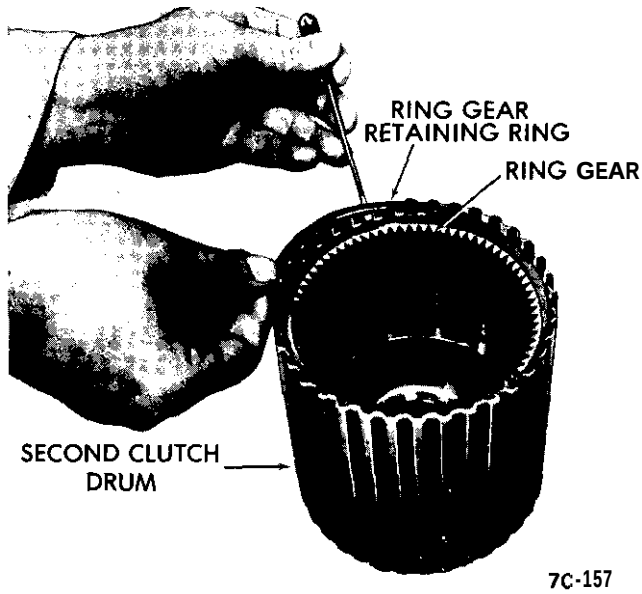


Figure 7C-157

2. Remove ring gear. See Figure 7C-158.

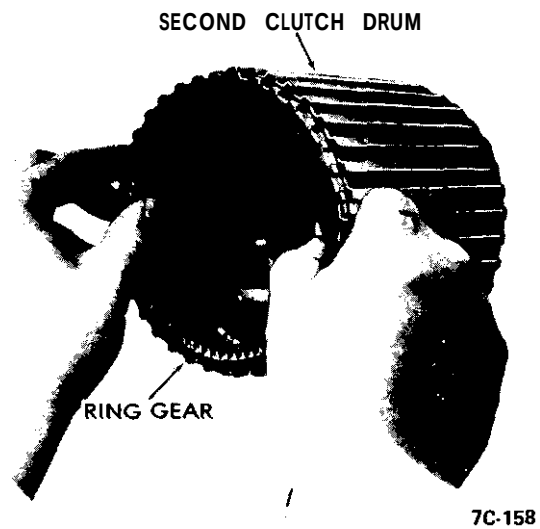


Figure 7C-158

3. Remove second clutch spacer plate retaining ring.

4. Remove second clutch spacer plate. See Figure 7C- 159.

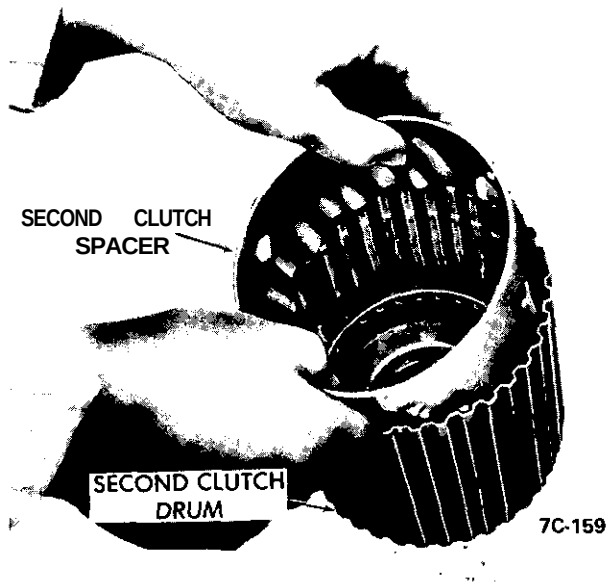


Figure 7C-159

5. Remove second clutch steel and composition plates. The plates should be kept in the same sequence as they were installed in the clutch. See Figure 7C- 160.

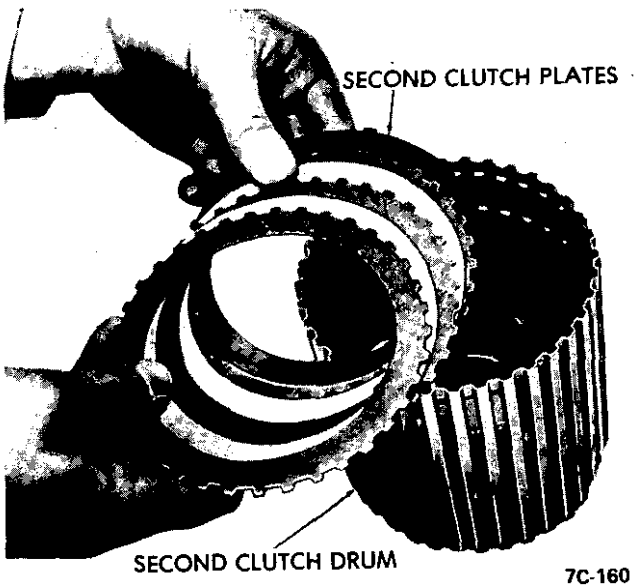


Figure 7C-160

6. Remove second clutch assembly to third clutch assembly bronze thrust washer. See Figure 7C-161.

7. Install second and reverse clutch spring compressor tool J-2590-12 with adapter J-21420-1 on second clutch piston return spring retainer and compress second clutch piston return springs.

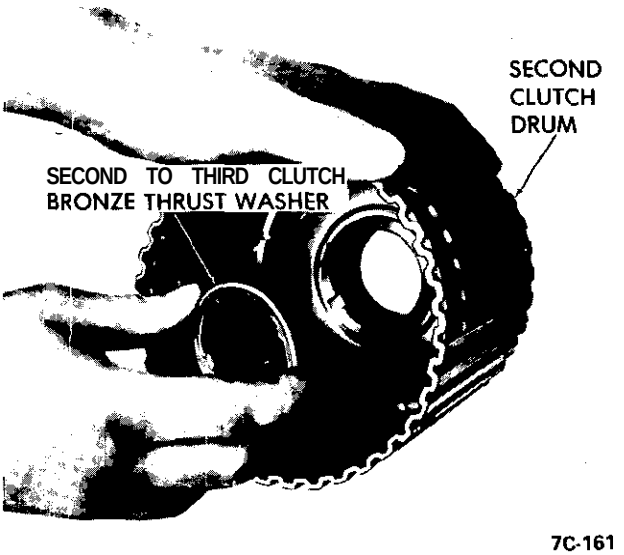


Figure 7C-161

8. Remove snap ring using snap ring pliers such as J- 8059. See Figure 7C-162.

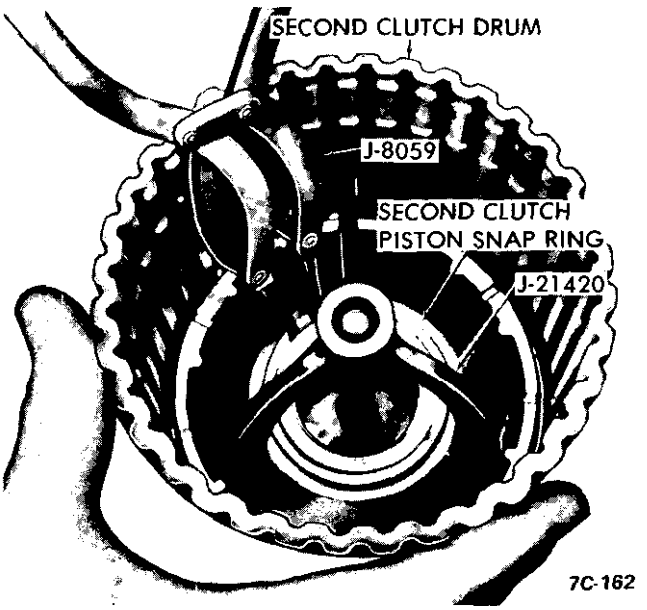


Figure 7C-162

9. Remove second clutch retaining seat and 22 return springs.

10. Remove second clutch piston.

11. Inspect second clutch piston. See Figure 7C-163. If piston is damaged or if check ball falls out upon inspection, replace piston. Install two new piston lip seals.

12. Inspect the piston return springs. Evidence of extreme heat or burning in the area of the clutch may have caused the springs to take a heat set and would justify replacement of the springs.

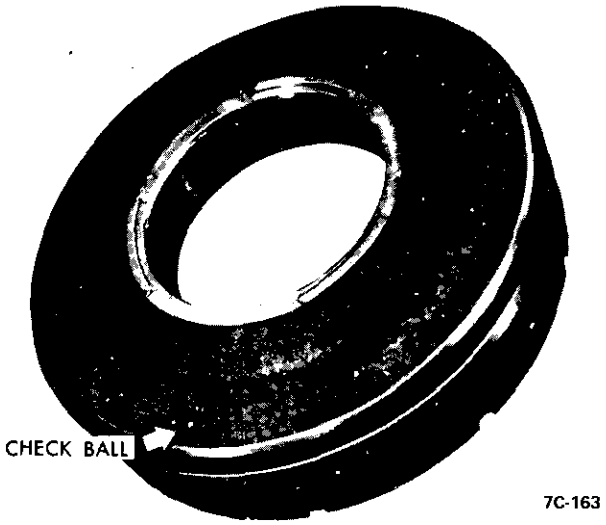


Figure 7C-163

13. Inspect second clutch hub bushing for scoring or wear.

14. If necessary, remove second clutch hub bushing using remover and installer J-23130-6 with driver handle J-8092. See Figure 7C-164.

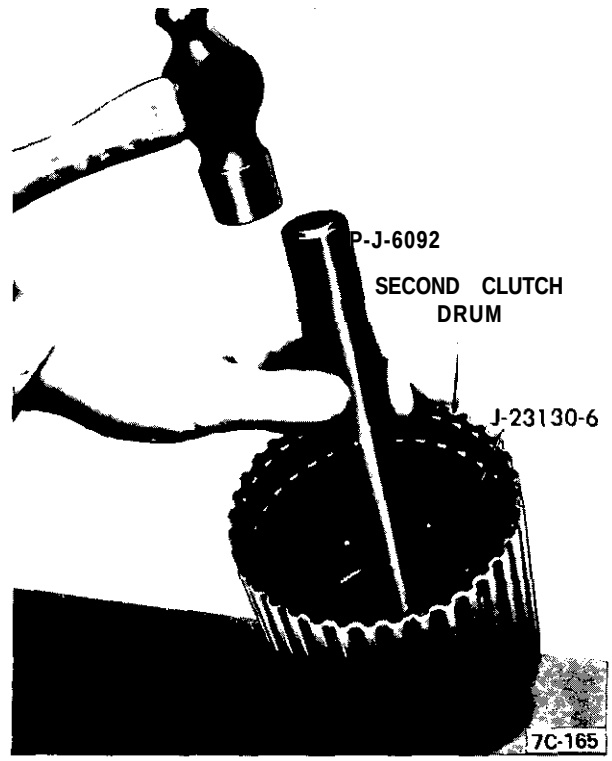


Figure 7C-164

15. Clean in solvent to remove any foreign matter. Install new second clutch hub bushing using tool J-23 130-6 and driver handle J-8092. Bushing must be driven in until tool bottoms on bench. See Figure 7C-164.

16. To install second clutch piston into second clutch drum, use installer tool J-23080 so as not to damage lip seal. See Figure 7C-165. Use liberal amount of transmission fluid for ease of installation and *to* prevent seal damage.

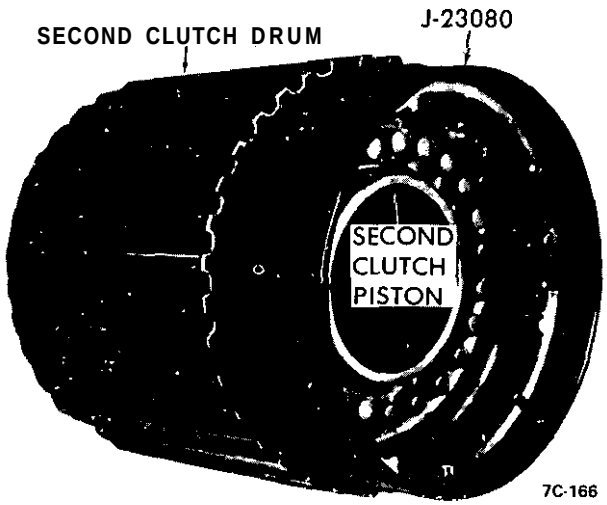


Figure 7C-165

17. Remove second clutch piston and seal installer J-23080.

18. Install 22 springs and retaining seat on second clutch piston.

19. Using spring compressor tool J-2590-12 with adapter J-21420-1 on retaining seat, compress second clutch piston return springs. Care should be taken so that retainer does not catch in snap ring groove and damage retainer.

20. Install snap ring with snap ring pliers such as J-8059.

21. Install bronze thrust washer so that the tang seats in the slot of the second clutch hub. Secure with petroleum jelly (unmedicated).

22. Inspect condition of composition and steel plates. ***Do not diagnose a composition drive plate by color.***

A. Dry composition plates with compressed air and inspect the composition surface for:

1. Pitting and flaking

2. Wear

3. Glazing

4. Cracking

5. Charring

6. Chips or metal particles imbedded in lining

If a composition drive plates exhibits any of the above conditions, replacement is required.

B. Wipe steel plates dry and check for heat discoloration. If the surface is smooth and an even color smear is indicated, the plates should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plates must be replaced.

23. Install second clutch plates into second clutch drum with cushion plate (wave washer) first, then steel plate, composition plate, steel plate, etc. Use liberal amount of transmission fluid. See Figure 7C-166.

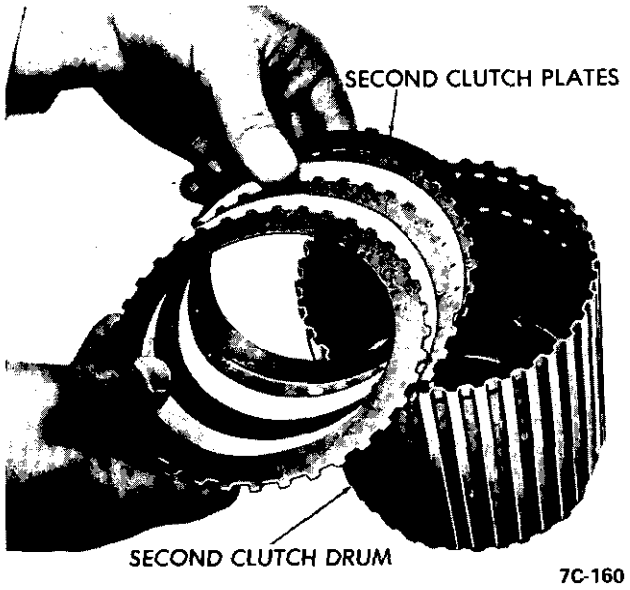


Figure 7C-166

24. Install second clutch spacer plate into second clutch drum. If necessary, expand spacer plate with screw driver until ends of spacer are evenly butted together seating tightly into drum. See Figure 7C-159.

25. Install second clutch spacer retaining ring

26. Install ring gear into second clutch drum.

27. Install ring gear retaining ring.

28. Air check second clutch assembly. See Figure 7C-167.

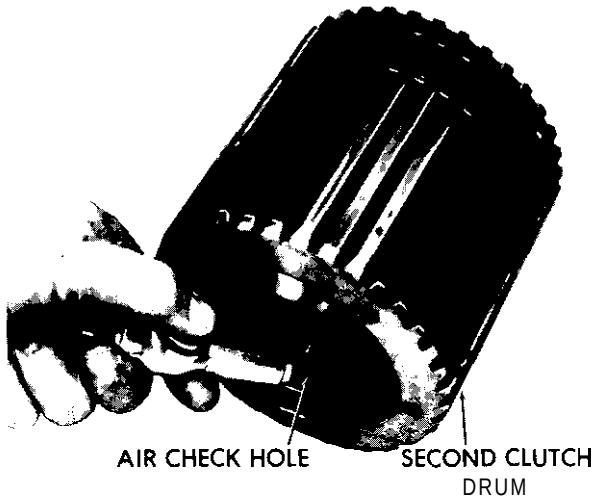


Figure 7C-167

Disassembly, Inspection and Reassembly of Third Clutch

1. Compress third clutch sprag race and retainer assembly retaining ring, and remove assembly from third clutch drum. See Figure 7C-168. Third clutch hub and input sun gear assembly will be removed at the same time.

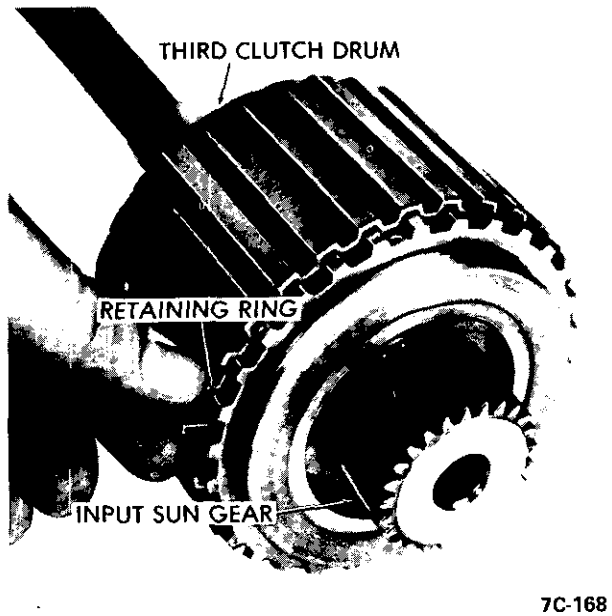


Figure 7C-168

2. Remove input sprag race and retainer assembly from third clutch hub and input sun gear assembly. See Figure 7C-169.

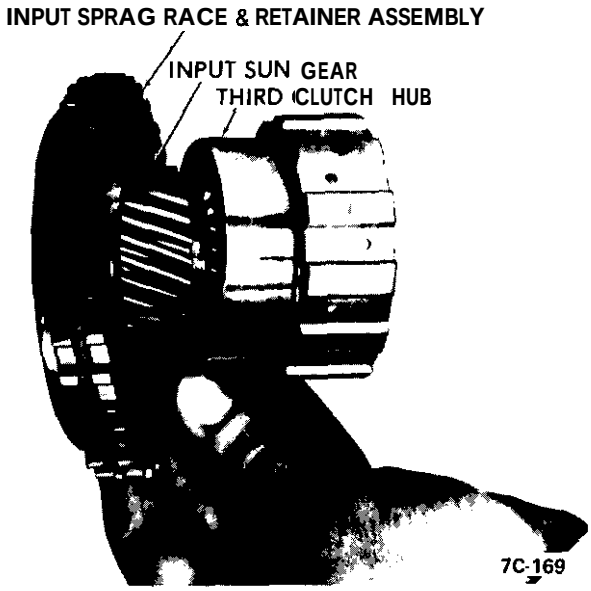


Figure 7C-169

3. Push sprag assembly and retaining rings from sprag race and retainer. See Figure 7C-170.

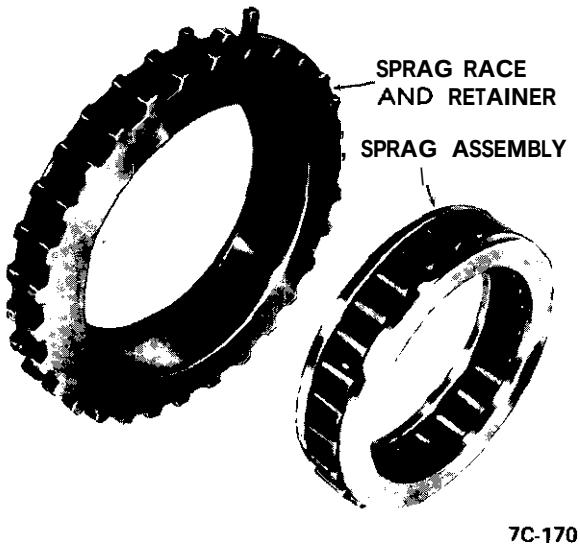


Figure 7C-170

4. Remove third clutch plates from third clutch drum. See Figure 7C-171. The plates should be kept in the same sequence as they were installed in the clutch.

5. Remove input shaft thrust washer and needle thrust bearing. See Figure 7C-171.

6. Using compressor tool J-23075 on third clutch piston retaining seat, compress third clutch piston return springs using arbor press.

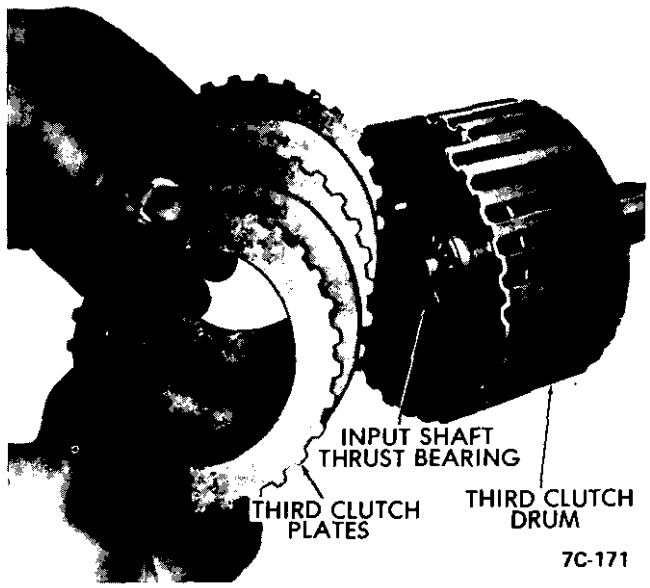


Figure 7C-171

7. Remove snap ring using snap ring pliers such as J- 8059. See Figure 7C-172.

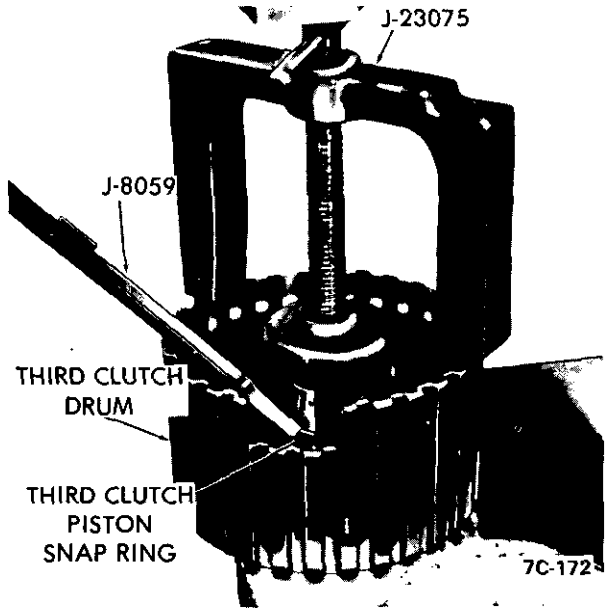


Figure 7C-172

8. Remove the retaining seat and 12 return springs.

9. Remove third clutch piston from third clutch drum. See Figure 7C-174.

10. Inspect third clutch piston return springs. have caused the springs to take a heat set and would justify replacement of the springs.

11. Inspect check ball in third clutch piston. If ball is missing or falls out upon inspection or piston is

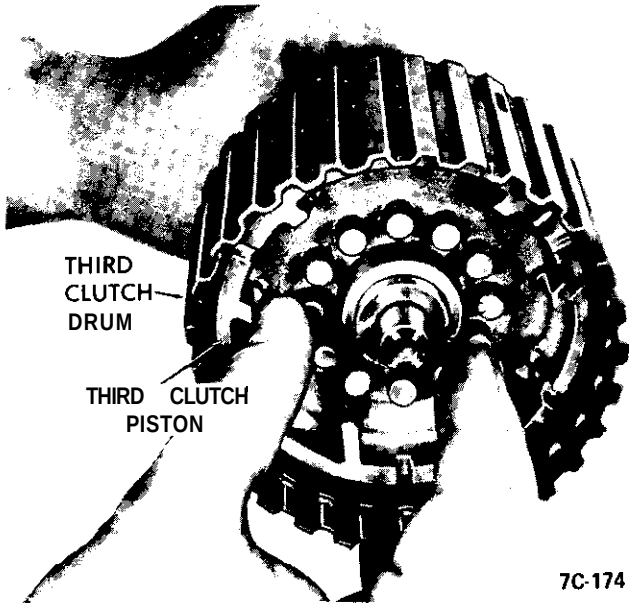


Figure 7C-174

damaged, replace piston. Install new lip seal on piston. See Figure 7C-175.

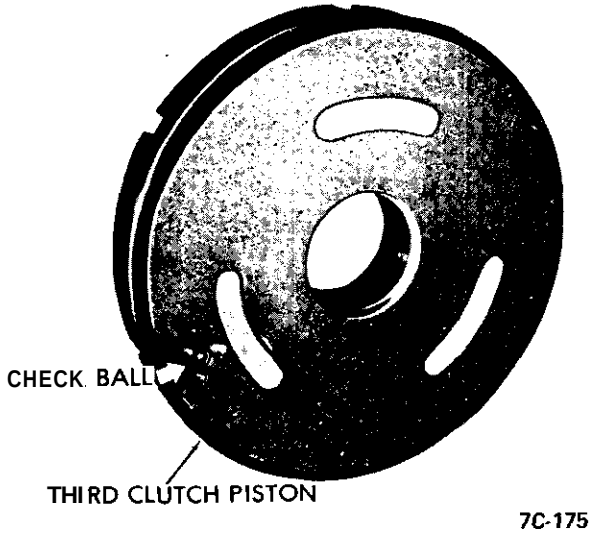


Figure 7C-175

12. Install new oil lip seal on input shaft inside of third clutch drum. See Figure 7C-176.

13. Inspect steel thrust washer on front face of third clutch drum. Replace if scored or damaged. See Figure 7C-177.

14. Install third clutch piston into third clutch drum using a .020 music wire crimped into a piece of copper tubing and a liberal amount of transmission fluid

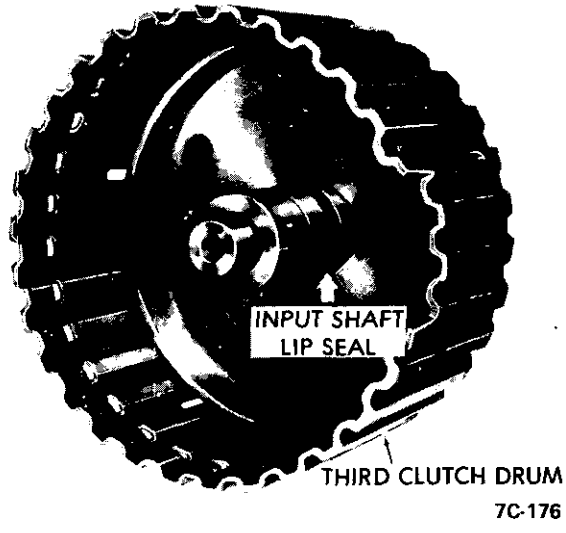


Figure 7C-176

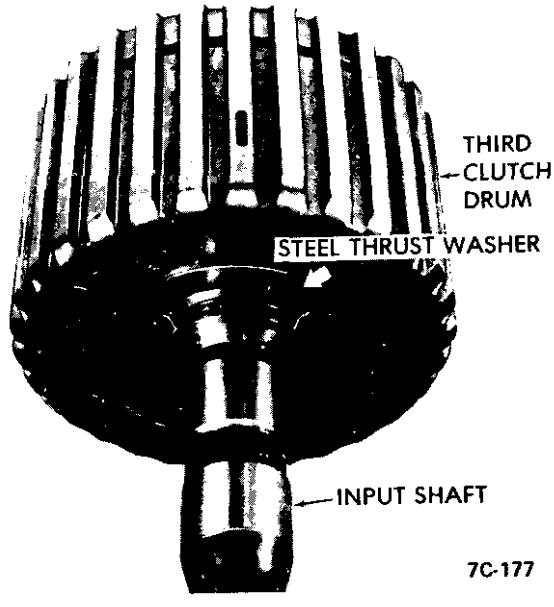


Figure 7C-177

so that lip seal is not damaged upon installation. See Figure 7C-178.

15. Install the 12 third clutch piston return springs onto piston.

16. Install retaining seat.

17. Using compressor tool J-23075 on retaining seat, compress piston return springs. Care must be taken so that retaining seat does not catch in snap ring groove and damage retainer.

18. Install snap ring using snap ring pliers such as J-8059.

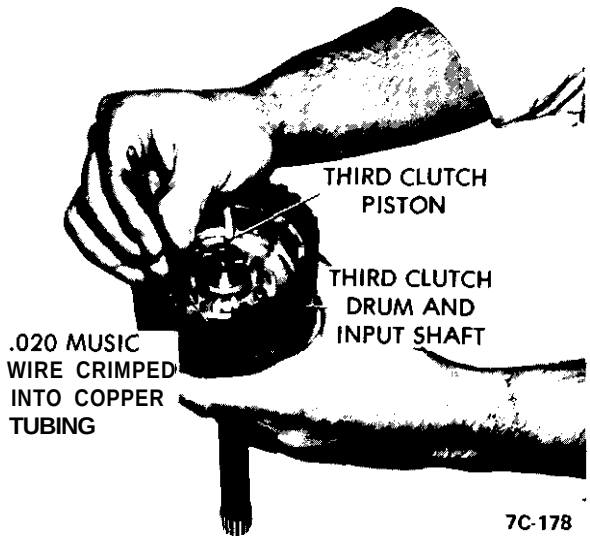


Figure 7C-178

19. Inspect condition of the third clutch composition and steel plates. ***Do not diagnose a composition drive plate by color,***

A. Dry composition plates with compressed air and inspect the composition surface for:

1. Pitting and flaking
2. Wear
3. Glazing
4. Cracking
5. Charring
6. Chips or metal particles imbedded in lining

If a composition drive plate exhibits any of the above conditions, replacement is required.

B. Wipe steel plates dry and check for heat discoloration. If the surface is smooth and an even color smear is indicated, the plates should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plates must be replaced.

20. Install third clutch plates into third clutch drum beginning with a steel plate, composition plate, steel plate, composition plate, etc. Use a liberal amount of transmission fluid.

21. Inspect thrust washer and needle thrust bearing for damage. Replace if necessary.

22. Install thrust washer and bearing onto input shaft. Secure with petroleum jelly (unmedicated).

23. Inspect sprag assembly for wear, damage or sprags that freely fall out of cage. Inspect input sun gear for chipped or nicked teeth or abnormal wear. Replace part if necessary.

24. Install sprag onto third clutch hub with groove on sprag cage outer diameter toward input sun gear. See Figure 7C-179.

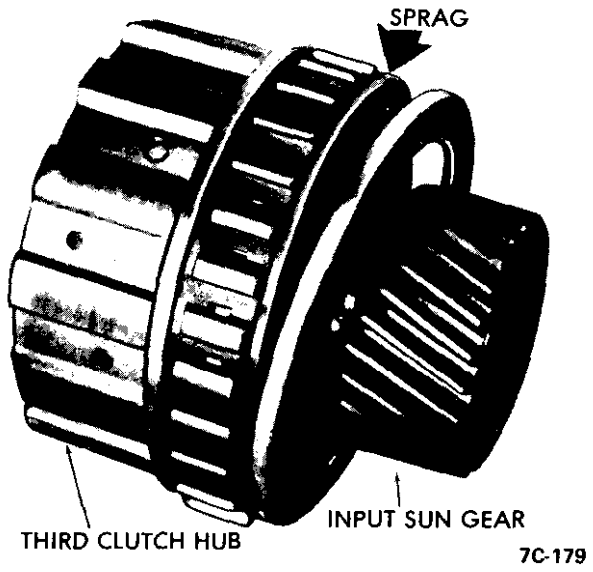


Figure 7C-179

25. Install sprag race and retainer assembly over sprag assembly. Holding input sun gear with left hand, sprag race and retainer assembly should "lock up" when turned with right hand in a clockwise direction and should rotate freely when turned counterclockwise. See Figure 7C-180.

Figure 7C-180

26. Align third clutch composition plates and install third clutch hub to index with the third clutch plate splines. Input sprag, race, and retainer assembly must also spline into third clutch drum. See Figure 7C-181.

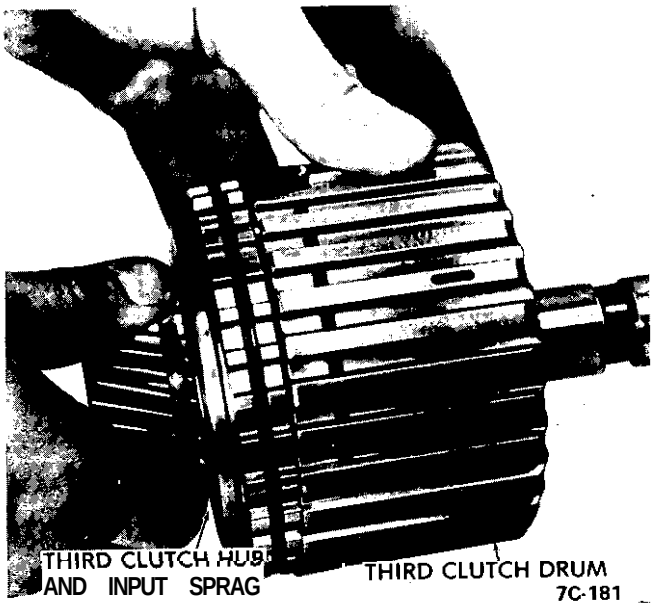


Figure 7C-181

27. Compress retaining ring and seat input sprag race assembly into third clutch drum.

28. Air check the 3rd clutch piston assembly. See Figure 7C-183.

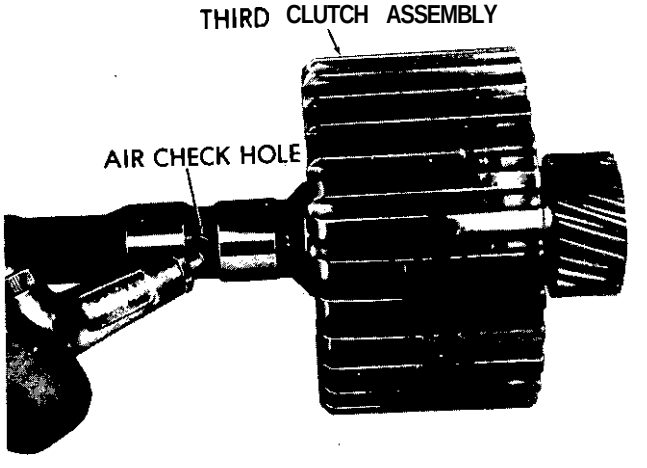


Figure 7C-183

Disassembly, Inspection and Reassembly of Palentary Carrier

1. Inspect the planetary carrier and output shaft for distortion or damage.

2. Inspect the planetary pinions for excessive wear or damage, such as chipped teeth.

3. Check the end clearance of all planetary pinions with feeler gauge at points "A" "B". Clearance should be between .005" and .035". See Figure 7C-184.

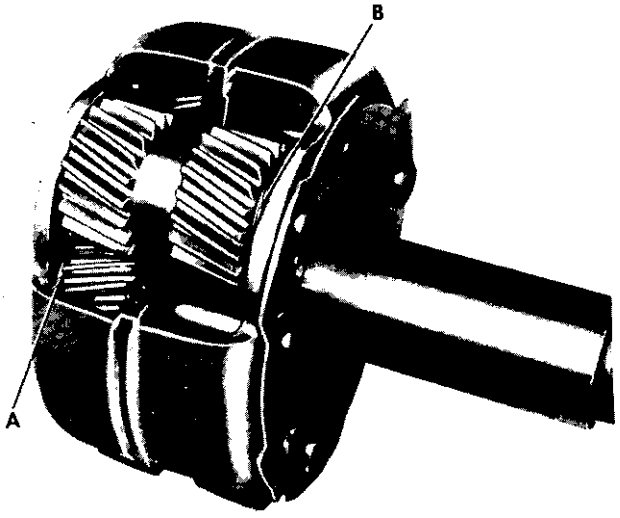


Figure 7C-184

4. Replace entire assembly if damage or excessive wear is noted.

5. Tighten planetary carrier lock plate retaining screws to 20-35 lbs. in.

Disassembly, Inspection and Reassembly of Reaction Sun Gear and Drum

1. Inspect reaction sun gear for chipped or nicked teeth and inspect sun gear for scoring. If necessary, replace entire assembly.

2. Inspect reaction sun gear, drum, and bushing.

3. If necessary to replace bushing, use a chisel such as tool J-8400-1. Remove bushing from sun gear drum at bushing joint. See Figure 7C-185.

4. Thoroughly clean drum. Install new bushing using installer tool J-23130-2 with driver handle J- 8092. Bushing should be installed flush with rear face of sun gear drum hub. See Figure 7C-186.

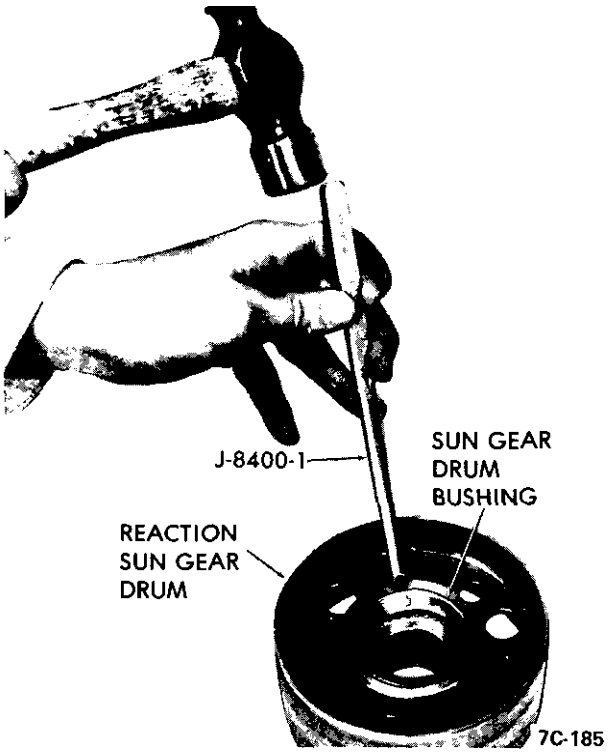


Figure 7C-185

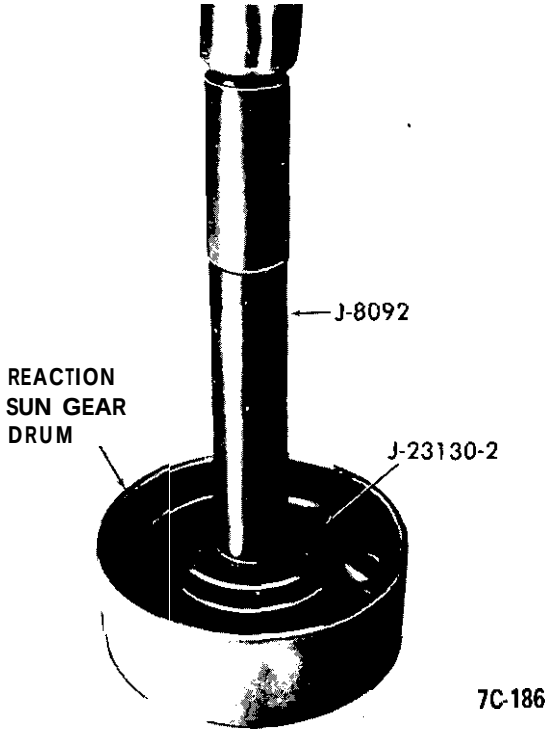


Figure 7C-186

Disassembly. Inspection and Reassembly of Governor Body

1. Depress secondary valve spring with small screw driver and remove secondary valve spring retainer. See Figure 7C-187.

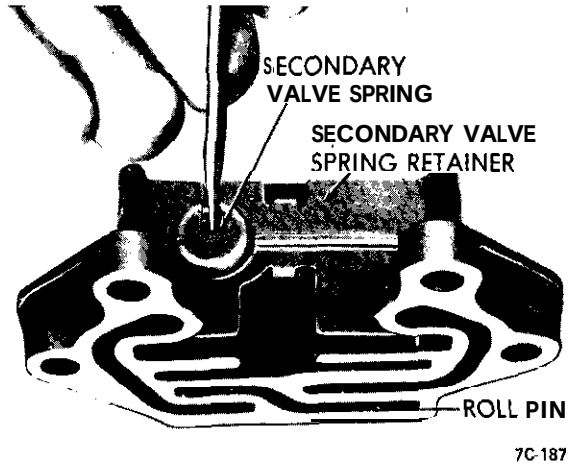
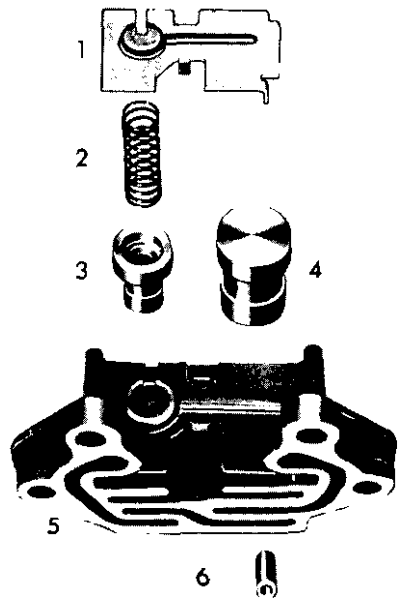


Figure 7C-187

2. Remove secondary valve spring, secondary valve, primary valve, and roll pin from governor body. See Figure 7C-188.



1. GOVERNOR SECONDARY VALVE SPRING RETAINER
2. GOVERNOR SECONDARY VALVE SPRING
3. GOVERNOR SECONDARY VALVE
4. GOVERNOR PRIMARY VALVE
5. GOVERNOR BODY
6. ROLL PIN

Figure 7C-188 Governor Body Exploded View

3. Inspect the primary and secondary valve for nicks, burrs, etc. If necessary, use crocus cloth to remove small burrs. Do not remove the sharp edges of the valve since these edges perform a cleaning action with the valve bore.

4. Inspect the secondary valve spring for distortion or breakage.

5. Clean in solvent, air clean, and blow out all oil passages. Inspect all oil passages, valve bores for nicks, burrs or varnish in governor body. Replace if necessary.

6. Install roll pin flush to .010" below the front face.

7. Install primary valve in governor placing the small portion of the valve in first. Use liberal amount of transmission fluid. There is no spring for the primary valve.

8. Install secondary valve with small spool portion of valve in first.

9. Install secondary valve spring.

10. Depress secondary valve spring with small screw driver and install retainer.

Disassembly, Inspection and Reassembly of Governor Hub

1. Inspect the three oil seal rings. See Figure 7C-189.

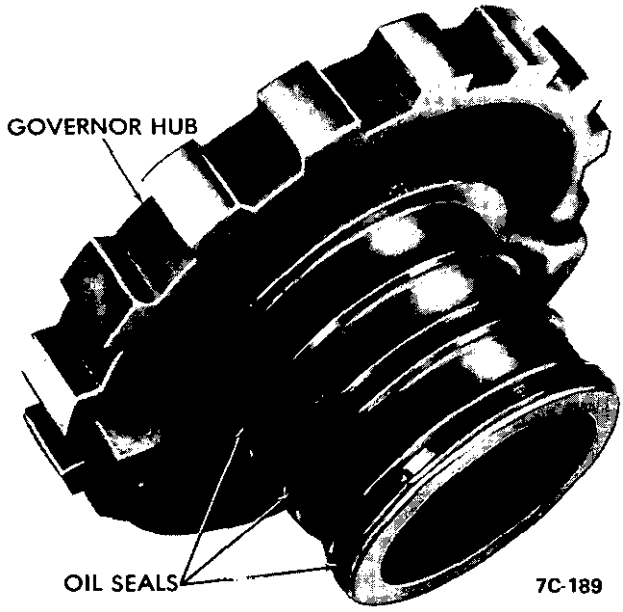


Figure 7C-189

2. Remove governor hub oil screen. Inspect screen and clean with solvent and air dry. Replace if necessary. See Figure 7C-191.

3. Install oil screen flush to governor hub.

4. Inspect governor hub splines for cracks or chipped teeth in splines. Replace governor hub if required.

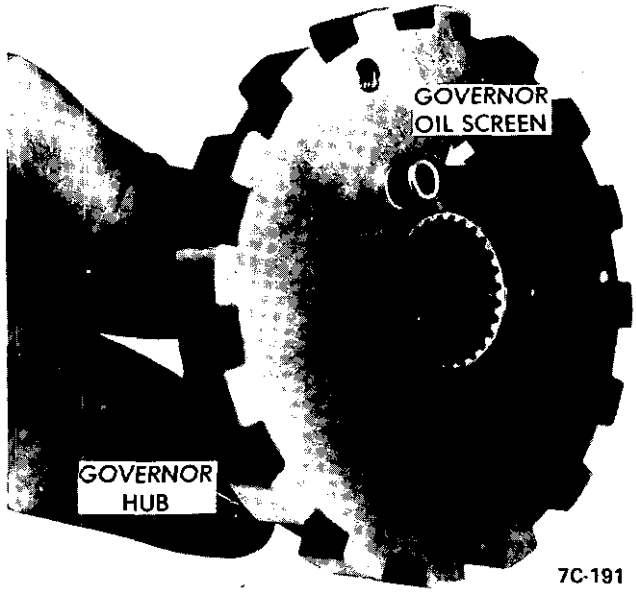


Figure 7C-191

Disassembly, Inspection end Reassembly of Extension Housing

1. Inspect extension housing for damage. Replace housing if necessary.

2. Inspect parking pawl and spring for damage. Replace if necessary.

3. If lubricant **leakage was noted** prior to removal of U-Joint from extension housing, extension housing rear seal should be replaced.

4. Use screw driver to pry out extension housing seal.

5. Inspect extension housing bushing. If worn, scored or damaged, bushing can be removed with remover and installer tool J-21424-9 used with driver handle J- 8092. See Figure 7C-192.

6. Clean extension housing of dirt and foreign matter. Install new extension housing bushing using remover/installer tool J-21424-9 with driver handle J- 8092. Bushing must be installed flush to shoulder of extension housing. See Figure 7C-192.

7. Install new extension housing seal using installer tool J-21426. See Figure 7C-193.

Disassembly, Inspection and Reassembly of Servo Piston

1. Remove servo piston apply rod

2. Holding servo piston sleeve at flat portion of sleeve with wrench, loosen the adjusting bolt lock nut and remove. See Figure 7C-194.

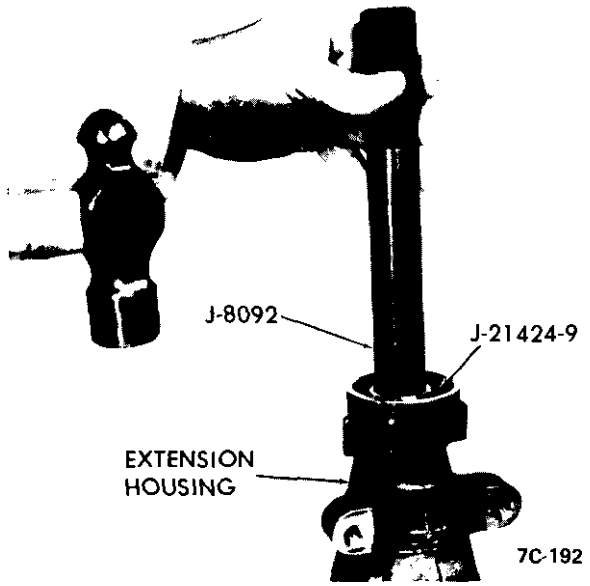


Fig 7C-192

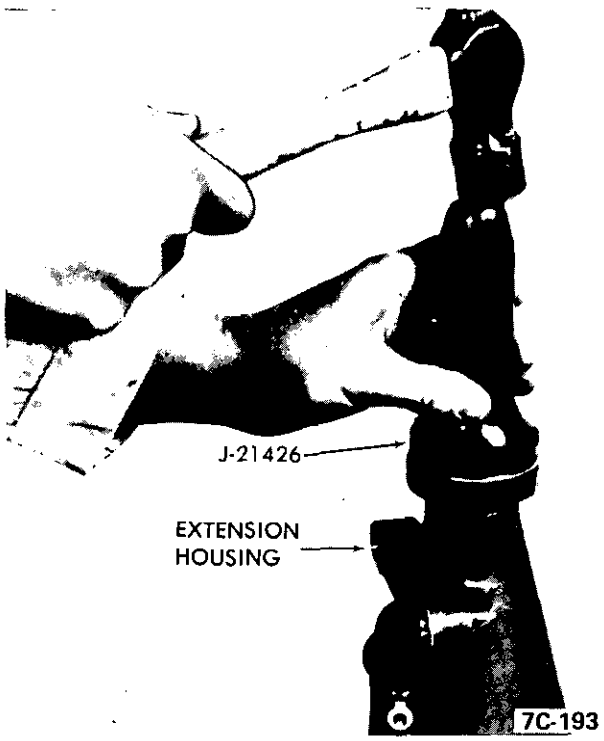


Figure 7C-193

3. Depress servo piston sleeve and remove piston sleeve retaining ring.

4. Push sleeve through piston and remove cushion spring and spring retainer.

5. Remove servo piston ring

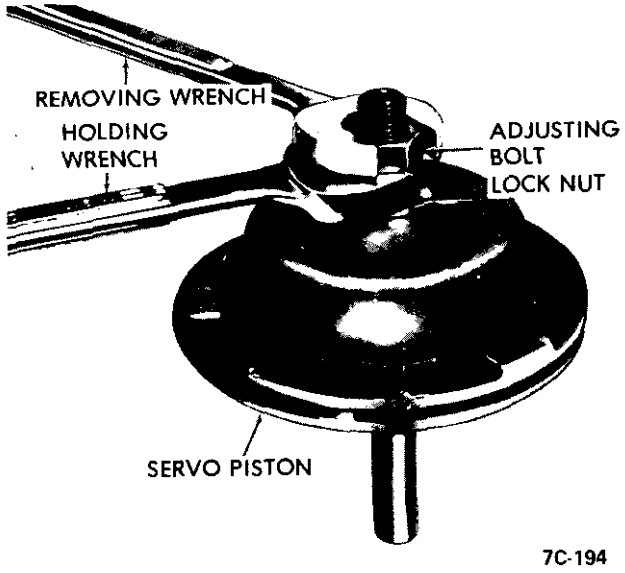


Figure 7C-194

6. Inspect cushion spring, adjusting bolt, and piston sleeve for damage. Inspect piston for damage and piston ring for side wear, replace if necessary.

7. Reassemble servo piston, reversing disassembly procedure.

Disassembly, Inspection and Reassembly of Valve Body

1. Remove the manual valve and manual valve link from the valve body.

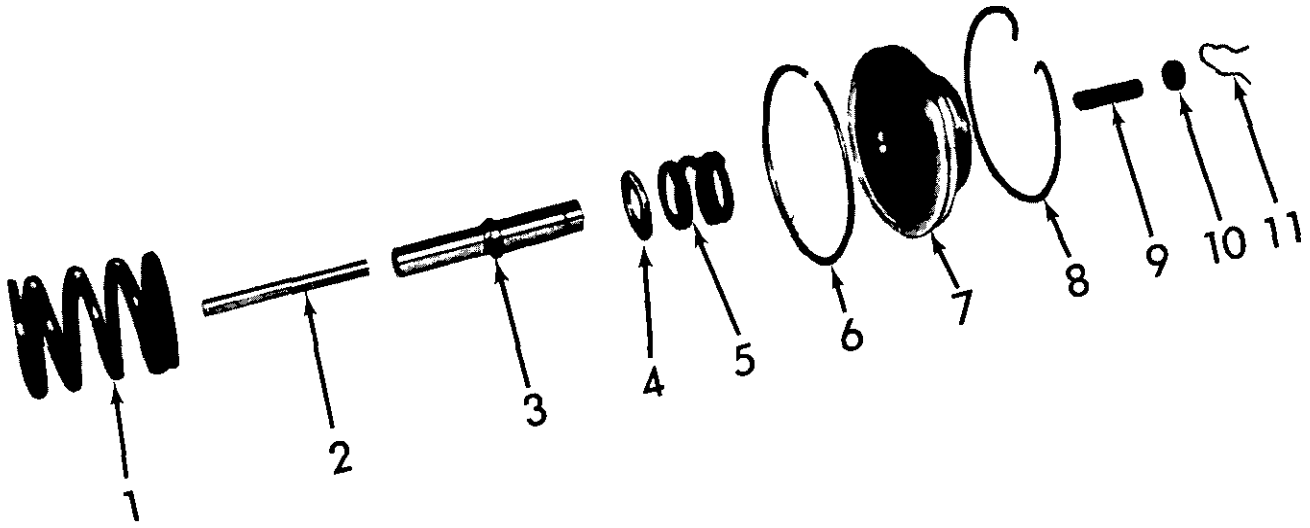
2. Turn the valve body so that the transfer plate is facing upward and remove the two bolts holding the transfer plate to the valve body. See Figure 7C-196.

3. Remove transfer plate and gasket.

4. Using small C-clamp on valve body, compress accumulator piston.

5. Remove the accumulator piston retaining ring with screw driver. See Figure 7C-198.

6. Carefully loosen C-clamp as accumulator piston is under spring tension.



1. SERVO PISTON RETURN SPRING
2. SERVO PISTON APPLY ROD
3. SERVO PISTON ADJUSTING SLEEVE
4. SERVO PISTON CUSHION SPRING SEAT
5. SERVO PISTON CUSHION SPRING
6. SERVO PISTON RING
7. SERVO PISTON
8. SERVO PISTON RETAINING RING
9. SERVO PISTON ADJUSTING BOLT
10. SERVO PISTON ADJUSTING BOLT NUT
11. SERVO PISTON RETAINER

7C-195

Figure 7C-195 Servo Piston - Exploded View

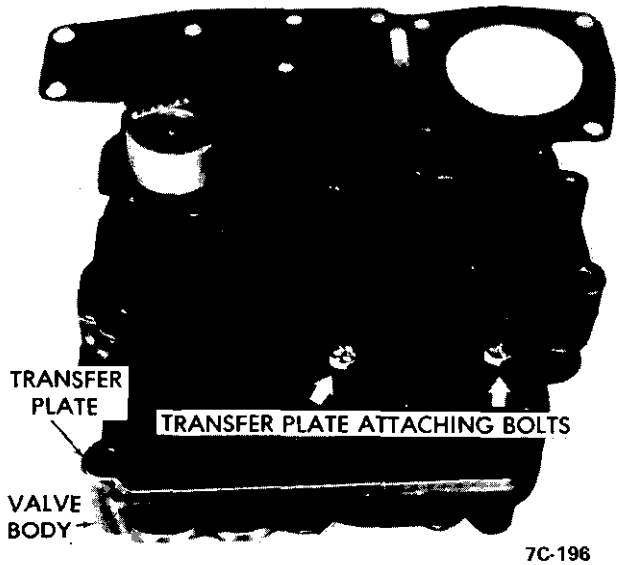


Figure 7C-196

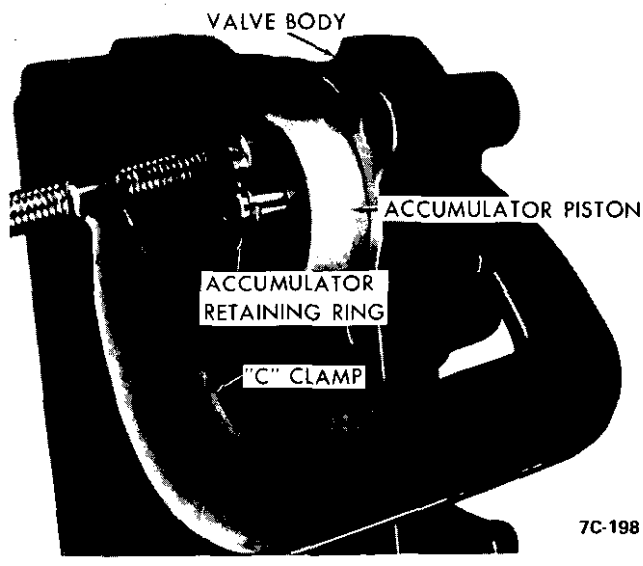


Figure 7C-198

7. Remove accumulator piston, oil ring, and spring. See Figure 7C-200.

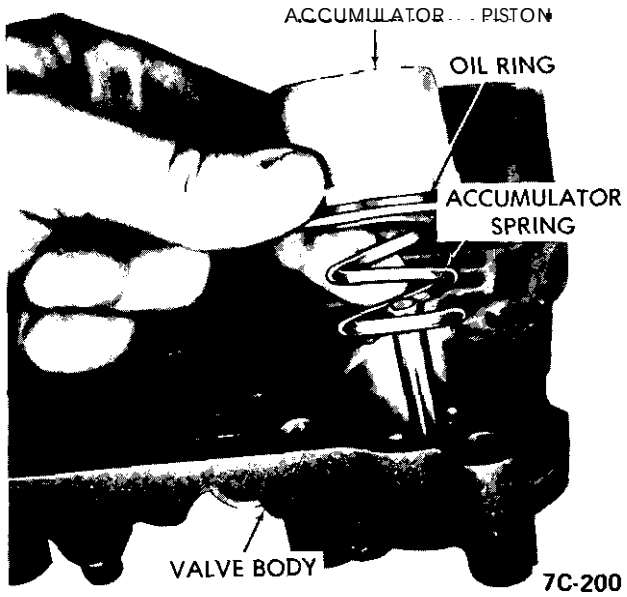


Figure 7C-200

8. Inspect accumulator oil ring for damage or edge wear and piston for damage. Replace if necessary. For steps 9 through 21 refer to Figure 7C-201.

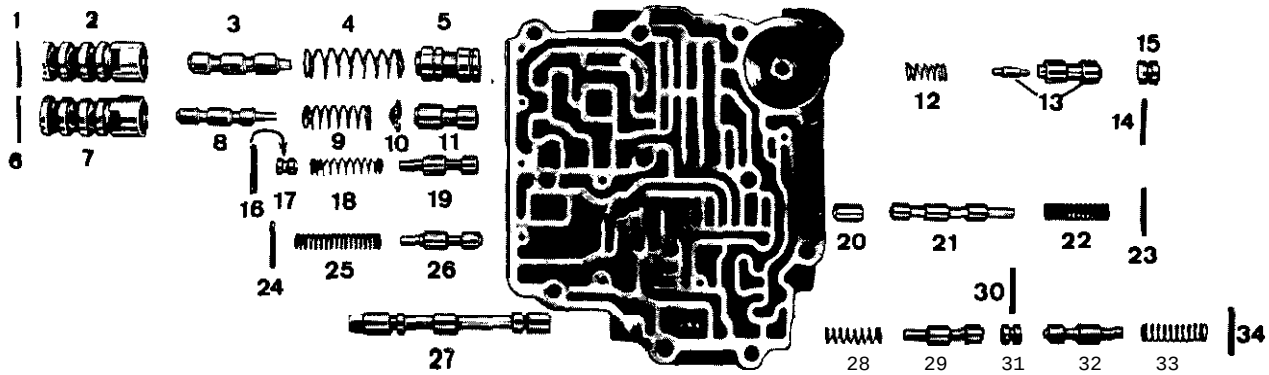
9. Remove 1-2 Shift control valve retaining pin, 1-2 shift control valve sleeve, control valve, 1-2 shift valve spring and valve. It may be necessary to remove burrs in valve body bore made by retaining pin prior to removal of the sleeves and valves.

10. Remove the 2-3 Shift control valve retaining pin and sleeve. Also, remove the 2-3 shift control valve, spring seat, spring and 2-3 shift valve.

11. Remove the 3-2 control valve retaining pin and plug. Remoye 3-2 control valve spring and control valve.

12. Remove the detent pressure regulator valve retaining pin, spring, and detent pressure regulator valve.

13. Remove the high speed downshift timing valve retaining pin and spring and remove valve.



1. RETAINING PIN
2. 1-2 SHIFT CONTROL VALVE SLEEVE
3. 1-2 SHIFT CONTROL VALVE
4. 1-2 SHIFT CONTROL VALVE SPRING
5. 1-2 SHIFT VALVE
6. RETAINING PIN
7. 2-3 SHIFT CONTROL VALVE SLEEVE
8. 2-3 SHIFT CONTROL VALVE
9. 2-3 SHIFT CONTROL VALVE SPRING
10. 2-3 SHIFT CONTROL VALVE SPRING SEAT
11. 2-3 SHIFT VALVE
12. 1-2 ACCUMULATOR VALVE SPRING
13. 1-2 ACCUMULATOR VALVE
14. RETAINING PIN
15. 1-2 ACCUMULATOR VALVE PLUG
16. RETAINING PIN
17. 3-2 CONTROL VALVE PLUG
18. 3-2 CONTROL VALVE SPRING
19. 3-2 CONTROL VALVE
20. REVERSE CONTROL VALVE
21. MANUAL LOW CONTROL VALVE
22. MANUAL LOW CONTROL VALVE SPRING
23. RETAINING PIN
24. RETAINING PIN
25. DETENT PRESSURE REGULATOR VALVE SPRING
26. DETENT PRESSURE REGULATOR VALVE
27. MANUAL VALVE
28. LOW SPEED DOWNSHIFT TIMING VALVE SPRING
29. LOW SPEED DOWNSHIFT TIMING VALVE
30. RETAINING PIN
31. TIMING AND CONTROL VALVE PLUG
32. HIGH SPEED DOWNSHIFT TIMING VALVE
33. HIGH SPEED DOWNSHIFT TIMING VALVE SPRING
34. RETAINING PIN

7C-201

Figure 7C-201 Valve Body - Exploded View

14. Remove the downshift timing valve plug retaining pin and remove downshift timing valve plug. Remove the low speed downshift timing valve and spring.

15. Remove the manual low and reverse control valve retaining pin. Remove the spring and the manual low control valve and the reverse control valve.

16. Remove the l-2 accumulator valve retaining pin and remove the l-2 accumulator valve plug, l-2 accumulator valve and spring.

17. A clean work area which is free of dirt and dust should be used to inspect, clean and install the valves in the valve body. Handle valve components with clean hands and tools. Since most valve failures are caused initially by dirt or other foreign matter preventing a valve from functioning properly, a thorough cleaning of all the components with a cleaning solvent is essential. Do not use paraffin to clean out the valve body passages and valve bore. Compressed air may be used to blow out the passages.

18. Inspect each valve for free movement in its respective bore in the valve body. If necessary, use crocus cloth to remove small burrs on a valve. Do not remove the sharp edges of the valves as these edges perform a cleaning action within the bore.

19. Inspect the valve springs for distortion or collapsed coils. Replace the entire valve body assembly if any parts are damaged.

20. Inspect the transfer plate for dents or distortion. Replace transfer plate if necessary.

21. Reassemble the valves, springs, plugs and retaining pins in their proper location and order into the valve body using a liberal amount of transmission fluid. See the spring data chart which includes the spring identification sizes in the event springs have been disarranged.

SPRING IDENTIFICATION CHART

Location	Application	Free Height	Outer Diameter
Pump	Pressure Regulator Valve	2.756	.760
Pump	Priming Valve	1.043	.320
Valve Body	1.2 Shift Valve	2.467	.720
Valve Body	2-3 Shift Valve	1.769	.700
Valve Body	Detent Pressure Regulator Valve	1.625	,474
Valve Body	High-Speed Timing Valve	1.349	.406
Valve Body	Low-Speed Timing Valve	1.380	,406
Valve Body	Reverse and Low Control Valve	1.343	.406
Case	Detent Valve	2.569	.675
Valve Body	1-2 Accumulator Valve	1.072	.520
Valve Body	3-2 Control Valve	1.853	.406
Gov. Body	Secondary Governor Valve	1.317	.406
Valve Body	Accumulator Piston	1.917	1.224
Case	Servo Return	2.240	1.850
Servo	Servo Cushion	1.039	1.267
Clutch Pack	Clutch Return (All)	1.050	.424

22. Install spring and accumulator piston in valve body.

23. Compress accumulator piston with C-clamp and install retaining ring.

24. Install new valve body gasket.

25. Bolt the transfer plate and gasket to the valve body. Torque to 6-8 lbs. ft.

Disassembly, Inspection and Reassembly of Case

1. Inspect case for damage. See Figure 7C-202.

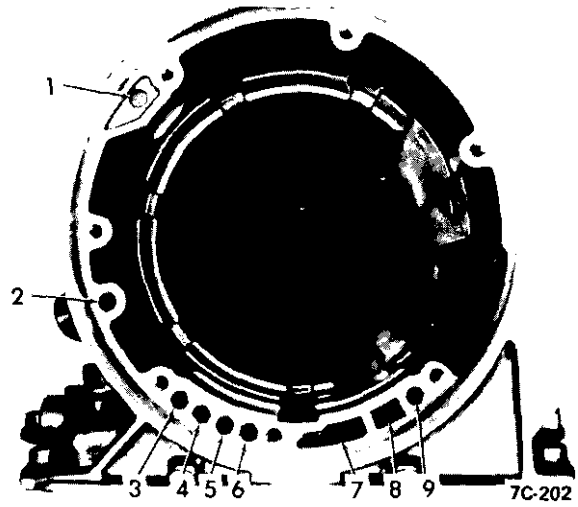
2. Inspect and clean oil passages with cleaning solvent and air.

3. Check for good retention of band anchor pins.

4. Inspect all threaded holes for thread damage.

5. Inspect detent valve and modulator valve bores for scratches or scoring.

6. Inspect case bushing inside of case at rear. If damaged, remove bushing with remover and installer tool J-23 130-3 and driver handle J-8092. See Figure 7C-203.



1. CASE VENT
2. CONVERTER OUT
3. 2ND CLUTCH
4. 3RD CLUTCH
5. MODULATOR
6. BOOST
7. SUCTION
8. LINE
9. REVERSE

Figure 7C-202 Case Front View Oil Passage Identification

7. Inspect reaction sun gear drum bushing sleeve inside case at rear for scoring. If necessary, replace sleeve before installing rear case bushing.

8. Remove sleeve by grinding. Care must be used in order that aluminum case is not damaged when grinding sleeve.

9. Install new sleeve using installer tool J-23130-7 and driver handle J-8092.

10. Install new case bushing using remover and installer tool J-23130-3 and driver handle J-8092. Bushing should be installed flush with case at rear. See Figure 7C-203.

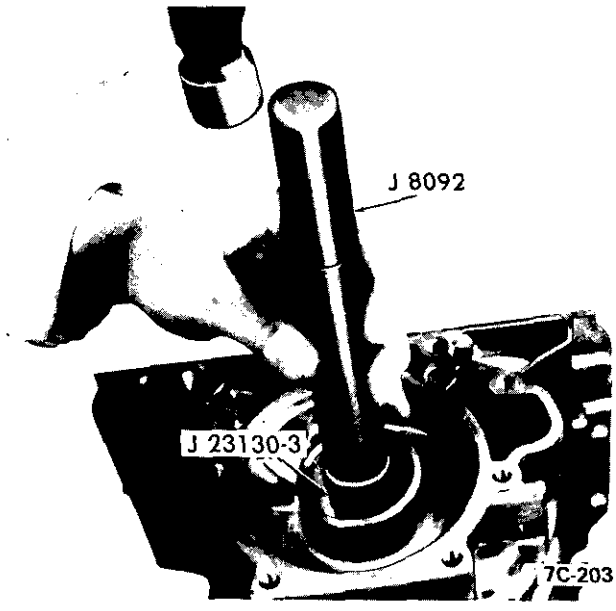


Figure 7C-203

1. Drain Converter. If clutch disc material or foreign matter has been found while draining converter,
replace entire converter assembly as it can not be cleaned properly.

2. Air check converter for leaks using converter checking tool J-21369. Install tool and tighten. Apply 80 psi air pressure to tool. See Figure 7C-204.

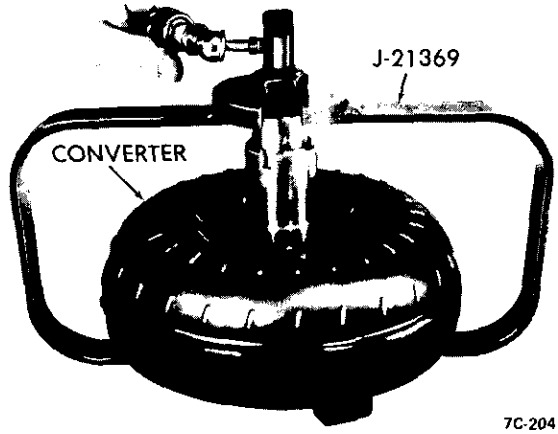


Figure 7C-204

3. Submerge in water and check for leaks.

4. Check converter hub surfaces for scoring or wear.

Installation of Selector Lever and Shaft

1. Install new selector lever shaft oil seal in case. Insert selector lever shaft through case from outside. Care should be exercised so that oil seal is not damaged. See Figure 7C-206.

2. Insert spring pin in case to secure selector lever shaft.

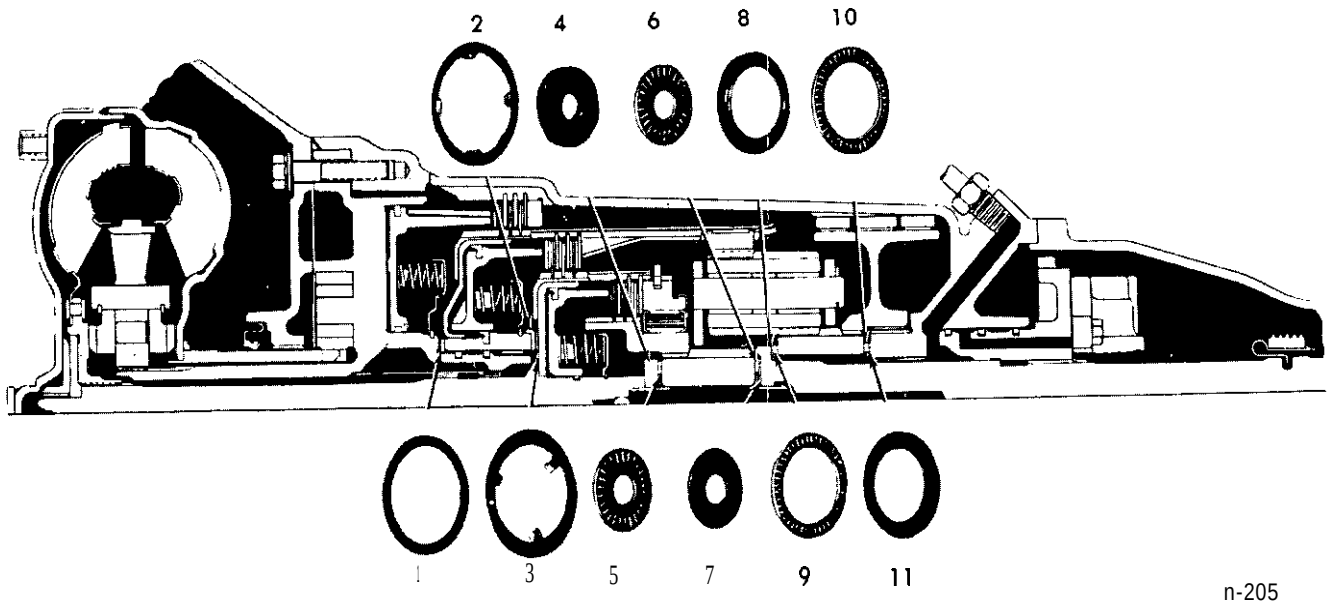
3. Guide selector lever over shaft and secure with lock nut.

4. Insert parking pawl actuator rod from front of the case and through hole in case at rear. See Figure 7C-207.

5. Install parking pawl actuator rod retaining ring.

Installation of Low Band

1. Turn transmission case so that front of case is upward.



1. CLUTCH ASSEMBLY THRUST WASHER
2. 2ND CLUTCH ASSEMBLY TO 3RD CLUTCH ASSEMBLY BRONZE THRUST WASHER
3. 2ND CLUTCH ASSEMBLY TO 3RD CLUTCH ASSEMBLY STEEL THRUST WASHER
4. INPUT SHAFT TO SUN GEAR THRUST WASHER
5. INPUT SUN GEAR ASSEMBLY BEARING
6. INPUT SUN GEAR ASSEMBLY BEARING
7. INPUT SUN GEAR ASSEMBLY TO PLANETARY CARRIER ASSEMBLY WASHER
9. REACTION SUN GEAR BEARING ASSEMBLY
10. REACTION SUN GEAR 8 BEARING ASSEMBLY
11. REACTION SUN GEAR & DRUM ASSEMBLY THRUST WASHER

Figure 7C-205 Location of Bearings And Washers

2. Inspect band for cracks, flaking, burring or looseness. Replace if required.

3. Place band in case and locate band onto the anchor pins in case. See Figure 7C-208.

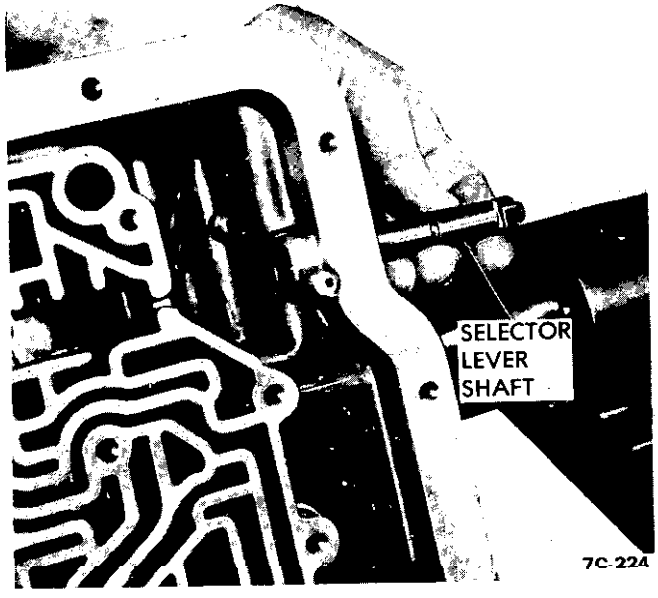


Figure 7C-206

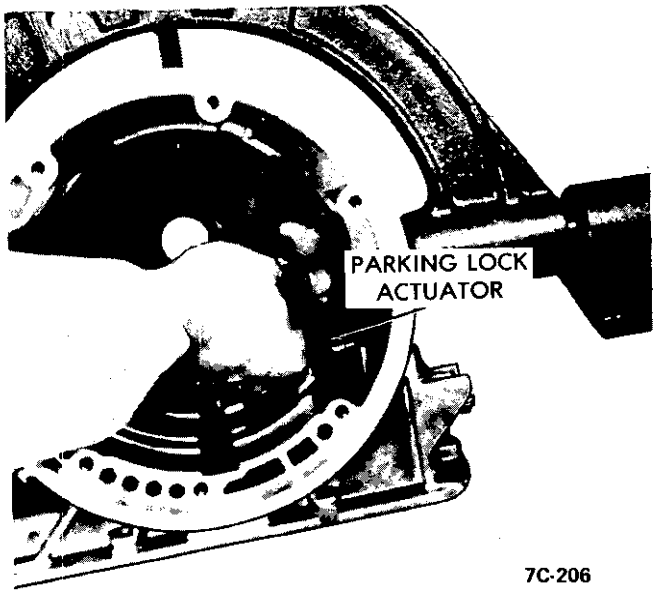


Figure 7C-207

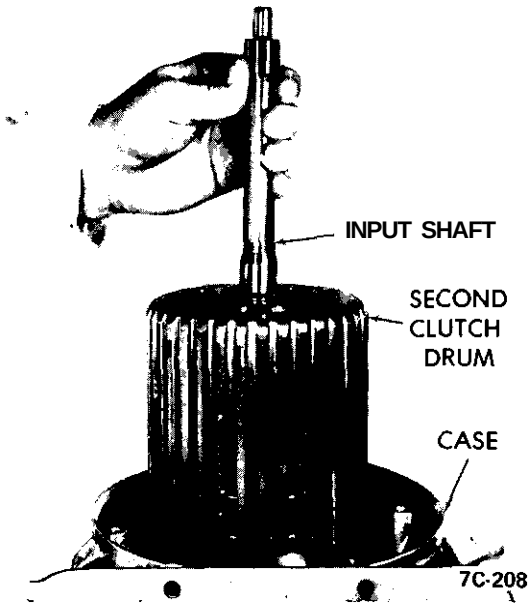


Figure 7C-208

1. Place needle thrust bearing race on rear of case around the case bushing. Secure with petroleum jelly (unmedicated).

2. Place needle thrust bearing on race. See Figure 7C-209. Secure with petroleum jelly (unmedicated).

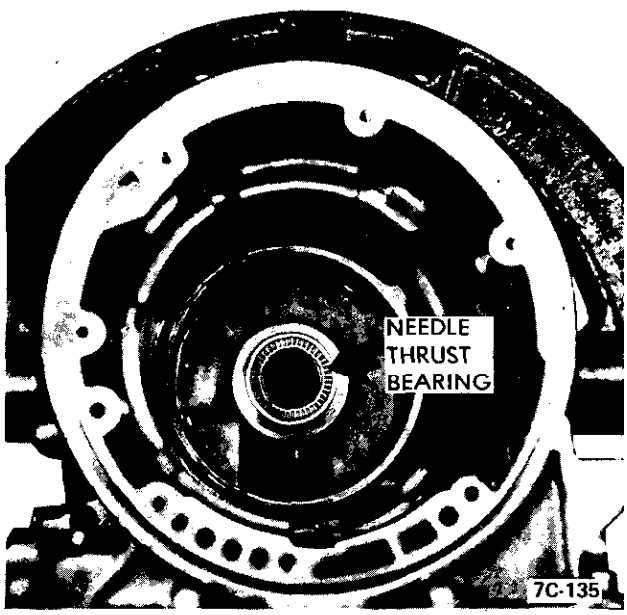


Figure 7C-209

3. Insert reaction sun gear and drum into band with reaction sun gear facing upward.

4. Place needle bearing on first then race on front face of reaction sun gear. See Figure 7C-210. Secure with petroleum jelly (unmedicated).

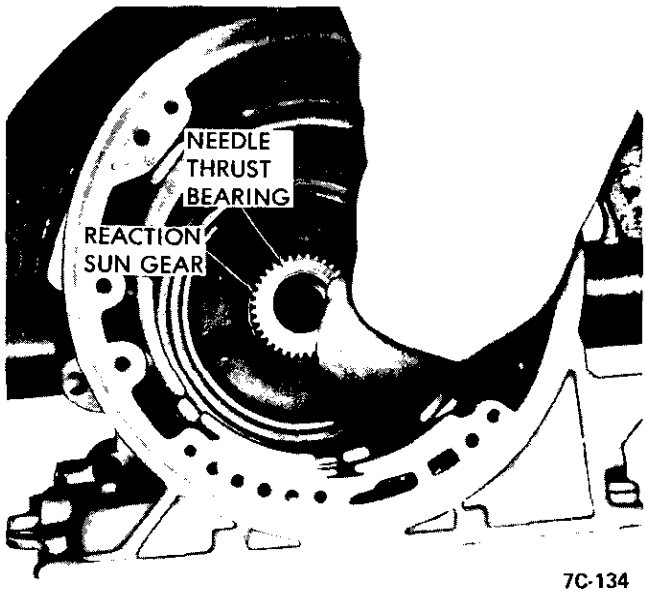


Figure 7C-210

Installation of Output Shaft and Planetary Carrier

1. Install input sun gear to planetary carrier washer and bearing into carrier. Secure with petroleum jelly (unmedicated).

2. Insert output shaft and planetary carrier assembly from front of case to spline with reaction sun gear. See Figure 7C-211.

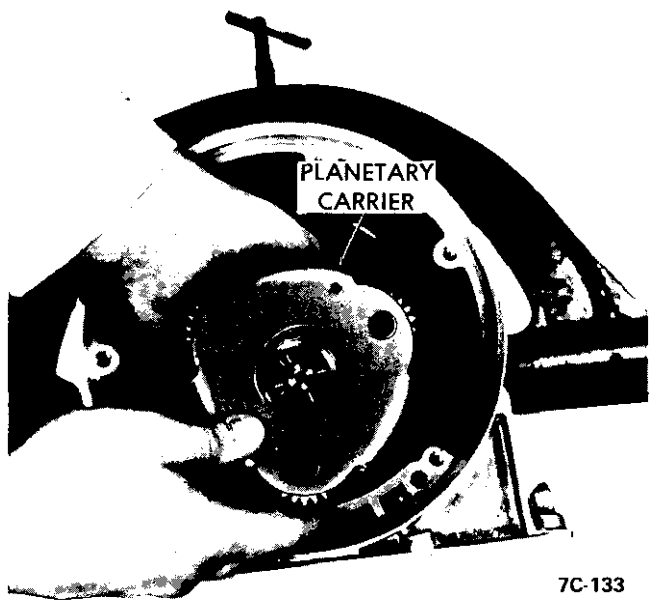


Figure 7C-211

Installation of 2nd and 3rd Clutch Assemblies Into Case

1. With second clutch assembly on bench, align second clutch drive plates in second clutch drum.

2. Insert third clutch drum and input shaft through top of second clutch drum seating third clutch drum splines into the second clutch plate splines. See Figure 7C- 212.

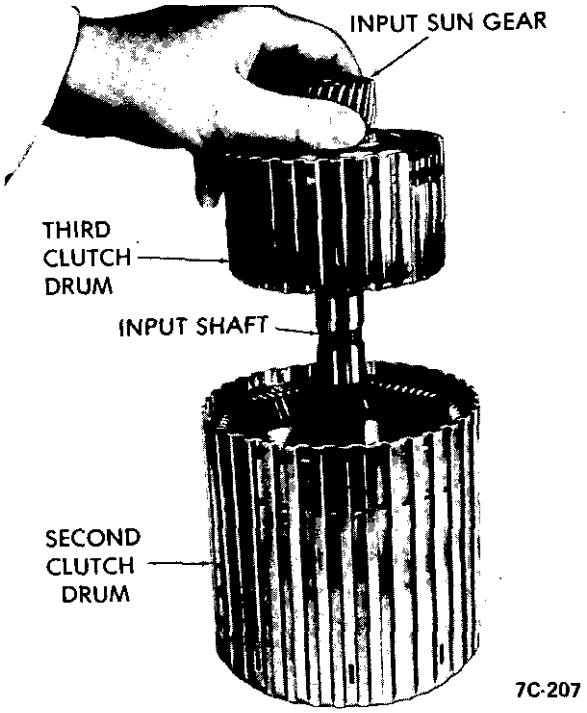


Figure 7C-2 12

3. Holding second and third clutch assemblies by the input shaft, lower into transmission case, indexing ring gear in second clutch drum with long planetary pinion gear teeth. See Figure 7C-213.

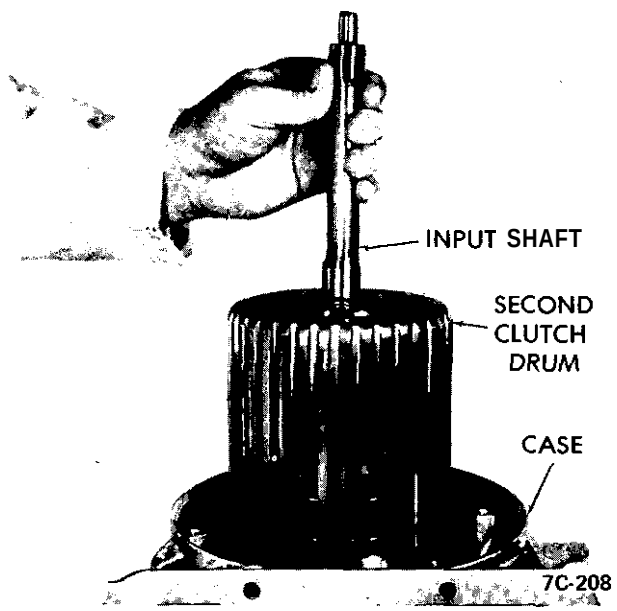


Figure 7C-213

Installation of Reverse Clutch

1. Inspect condition of the composition and steel plates. ***Do not diagnose a composition drive plate by color.***

A. Dry composition plates with compressed air and inspect the composition surface for:

1. Pitting and flaking
2. Wear
3. Glazing
4. Cracking
5. Charring
6. Chips or metal particles imbedded in lining

If a composition drive plate exhibits any of the above conditions, replacement is required.

B. Wipe steel plates dry and check for heat discoloration. If the surface is smooth and an even color smear is indicated, the plates should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plates must be replaced.

2. Install the steel reaction plate into the case. See Figure 7C-214.

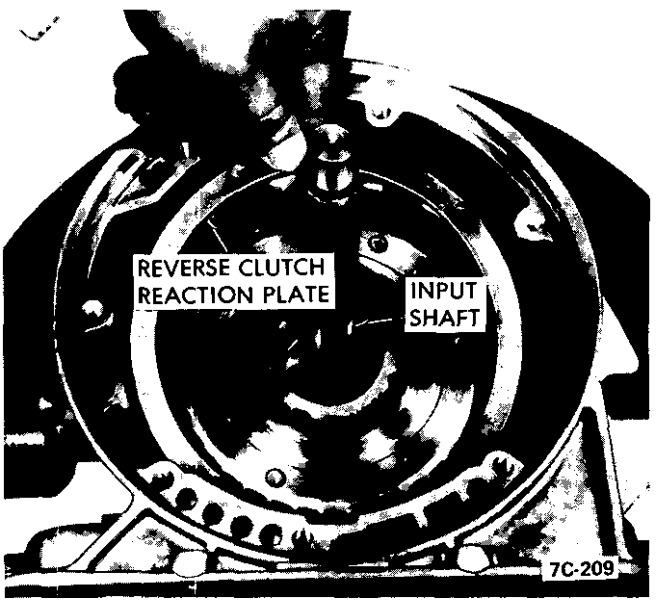


Figure 7C-2 14

3. Install reverse clutch steel plate, composition plate, steel plate, composition plate, etc., into case. Use a liberal amount of transmission fluid.

4. Install reverse clutch cushion plate (wave washer) into case.

Determining Selective Washer Size

1. Place gauging tool J-23085 on case flange and against input shaft. See Figure 7C-215.

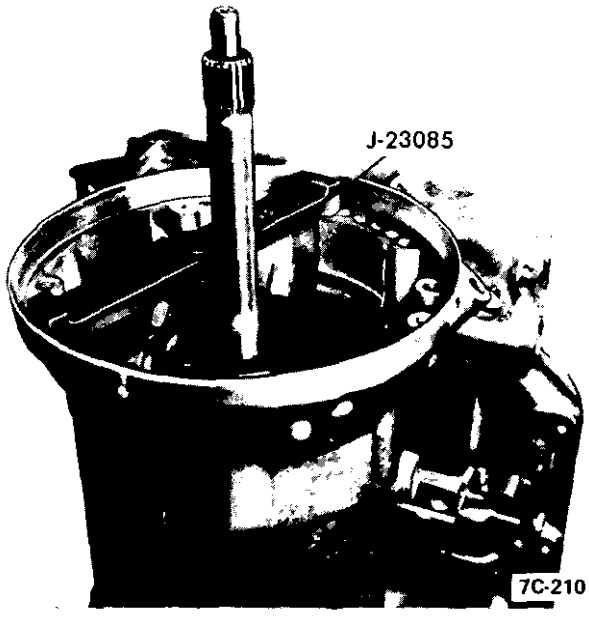


Figure 7C-2 15

2. Loosen thumb screw on tool to allow inner shaft to drop on second clutch drum hub.

3. Tighten thumb screw and remove tool J-23085.

4. Place selective washer removed from transmission against inner shaft of tool J-23085. Selective washer should be flush with top face of shaft. If not flush, select next larger or smaller washer until correct size is obtained. The washer selected should be exactly flush or slightly below inner shaft for correct end play in transmission. Selective washer removed from transmission may be oil soaked and discolored.

Color ID	Thickness
Yellow	.070-.074
Blue	.076-.080
Red	.081-.085
Brown	.086-.090
Green	.091-.095
Black	.097-.101

Installation of Converter Housing, Oil Pump and Reverse Clutch Assembly

1. Install oil pump wear plate onto oil pump.

2. Insert guide pin into oil pump for alignment of converter housing and lower housing onto pump.

3. Install new oil seal washers on converter housing to oil pump bolts, and loosely install bolts into converter housing.

4. Use converter housing to oil pump aligning tool J-23082 to align converter housing to pump. See Figure 7C-216. Tool should bottom on oil pump gear.

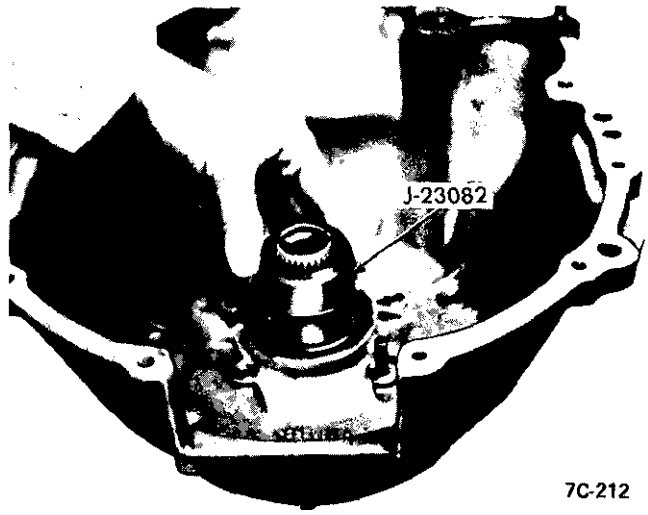


Figure 7C-2 16

5. Tighten the five bolts. Torque to 13-17 Ibs. ft. and remove aligning tool l-23082.

6. Install new converter housing to case rubber oil seal.

7. Install new pump flange gasket.

8. Place selective washer, previously determined, onto the oil pump shaft and retain with petroleum jelly (unmedicated).

9. Install two guide pins in case and lower converter housing and oil pump into case. See Figure 7C-217.

10. Bolt converter housing to case using new oil seal washers on all seven bolts. Torque to 13-17 lbs. ft.

I I. Check for correct assembly by turning input shaft by hand.

Installation of Governor Assembly

1. Turn case so that bottom of transmission is facing upward.

2. Slide governor hub along output shaft and seat

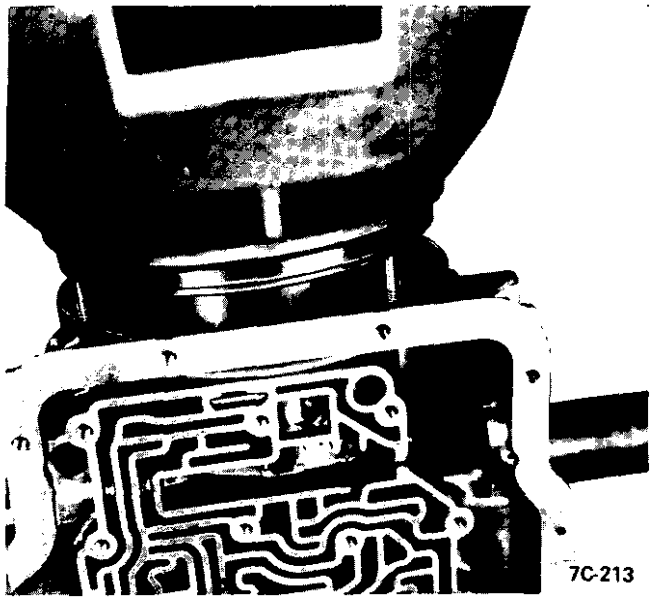


Figure 7C-217

into case. See Figure 7C-218. Use liberal amount of transmission fluid on oil seal rings.

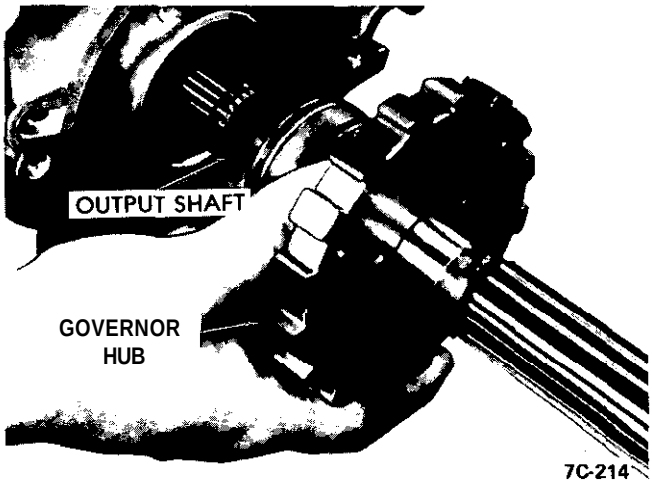


Figure 7C-218

3. Install snap ring over output shaft using snap ring pliers such as J-8059. See Figure 7C-219.

4. Install new governor body gasket.

5. Bolt governor body to governor hub. Torque to 6-8 lbs. ft. The two governor valves should move freely after governor body is torqued.

6. Install speedometer drive gear retaining clip into output shaft. See Figure 7C-220.

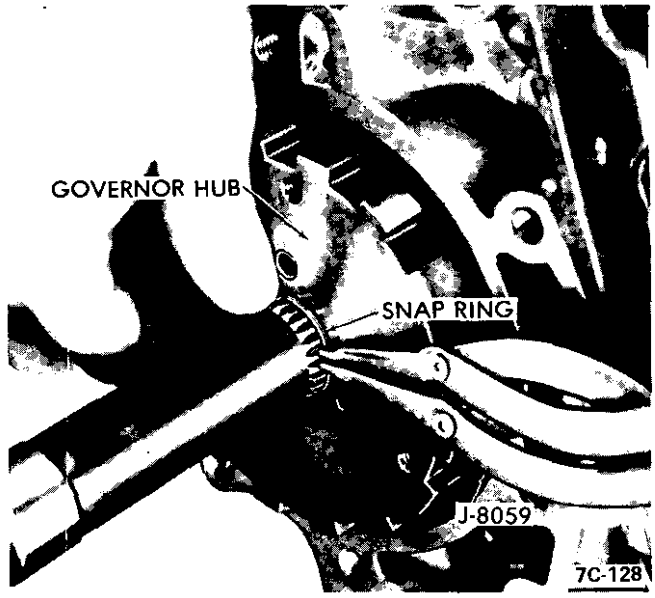


Figure 7C-219

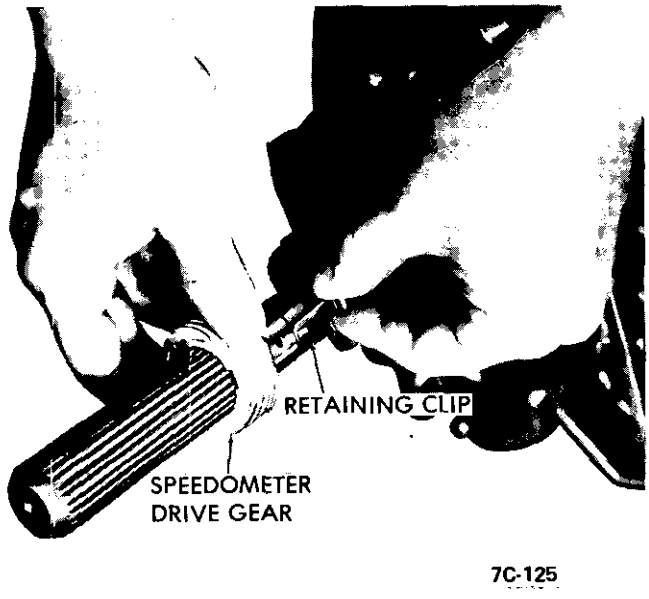


Figure 7C-220

7. While depressing retaining clip, slide speedometer gear over output shaft and install gear and retaining clip.

Installation of Extension Housing

1. Install new extension housing gasket.

2. Slide extension housing over output shaft and align holes.

3. Align parking pawl shaft into extension housing.

4. Bolt extension housing to rear of case. Torque to 20-30 lbs. ft. See Figure 7C-221.

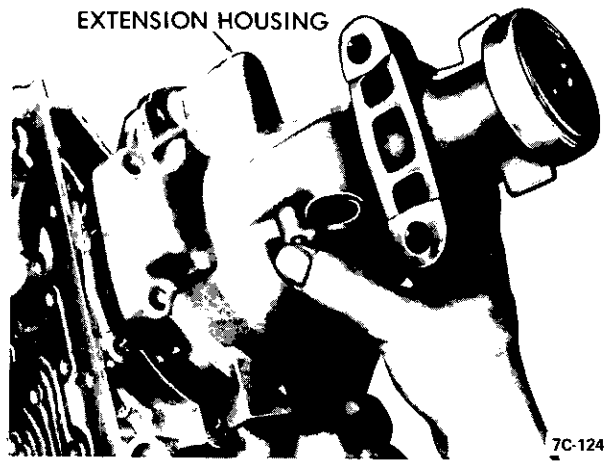


Figure 7C-22 1

Installation of Speedometer Driven Gear

1. Install speedometer driven gear and housing into extension housing. See Figure 7C-222.

Figure 7C-222

2. Install **speedometer** driven gear housing retainer into slot provided in speedometer driven gear housing. Bolt retainer to extension housing. Torque to 6-8 lbs. ft. See Figure 7C-223.

Installation of Detent Valve, Modulator Valve, Modulator Assembly

1. Inspect detent valve sleeve oil seal and replace if necessary.

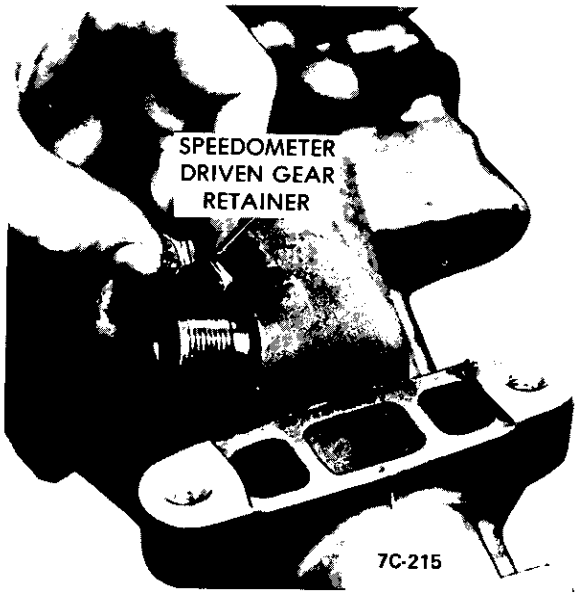


Figure 7C-223

2. Install detent valve, sleeve, **spring,** and **spring seat** into case bore using liberal **amount** of **transmission** fluid.

3. Depress detent valve spring and insert spring pin to secure detent valve assembly. Detent valve sleeve must be installed with slots facing oil pan. Care should be taken so that spring pin is inserted into the groove provided in sleeve and not into one of the oil passage slots in the sleeve.

4. Install modulator valve and sleeve into case with small end of modulator valve first.

5. Using new modulator assembly gasket, install plunger and thread modulator into case and tighten to 12-15 lbs. ft. using tool J-23100. See Figure 7C-224.

Installation and Adjustment of Servo

Adjustment of servo can be performed with **trans-**mission in vehicle.

1. Install servo apply rod, spring and piston into case, using liberal amount of transmission fluid.

2. Compress servo piston spring using compressor tool J-23075, lightly tapping servo piston while compressing until piston is seated to avoid damage to the oil seal ring.

3. Install servo retaining ring. See Figure 7C-225. Remove compressor tool J-23075.

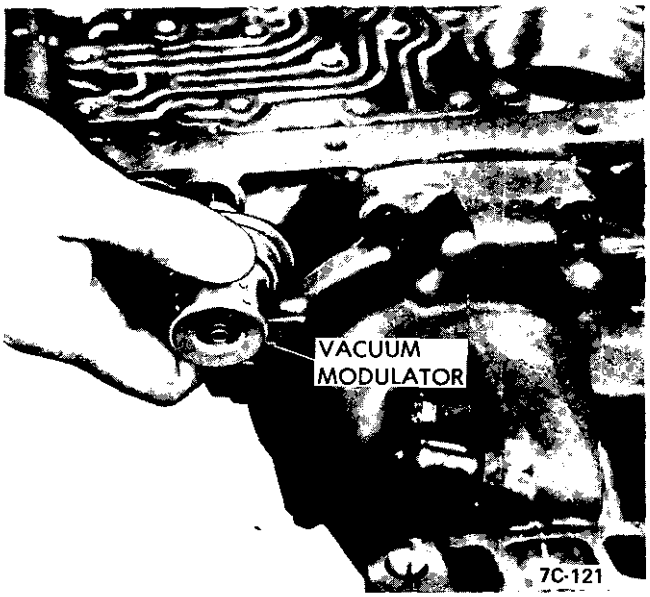


Figure 7C-224

Figure 7C-225

4. Using 3/16" hex head wrench on servo adjusting bolt, adjust servo apply rod by tightening adjusting bolt to 40 lbs. in. Back off bolt five (5) turns. *exactly. See* Figure 7C-226.

5. Tighten lock nut holding adjusting bolt and sleeve firm with hex head wrench. See Figure 7C-227.

installation of Valve Body

1. Install steel balls in oil passages in case. See Figure 7C-228.

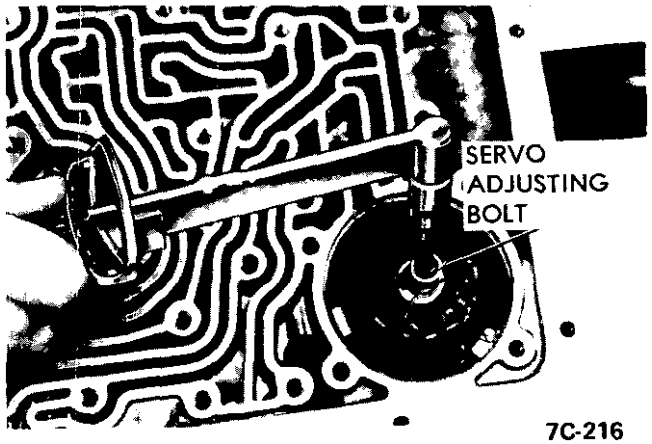


Figure 7C-226

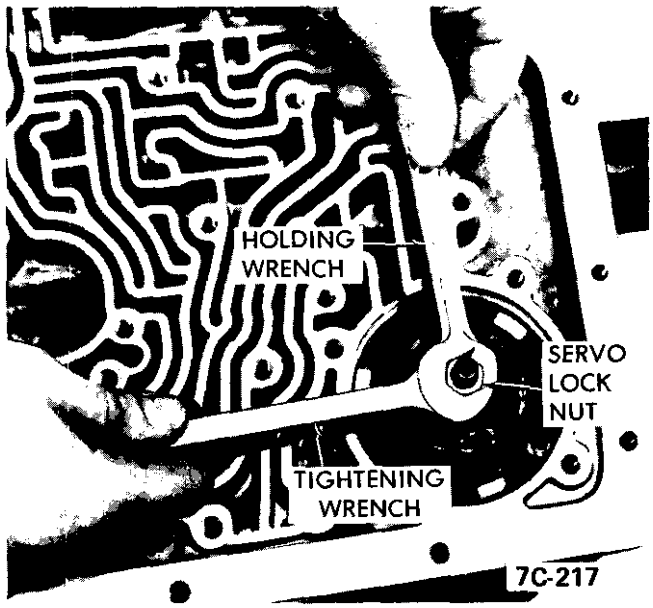


Figure 7C-227

2. Install new case to transfer plate **gasket.**

3. Locate guide pins in transmission case for correct alignment of valve body and transfer plate. See Figure 7C-229.

4. Install manual valve into valve body bore using liberal amount of transmission fluid.

5. Install long side of manual valve link pin into manual valve. See Figure 7C-230.

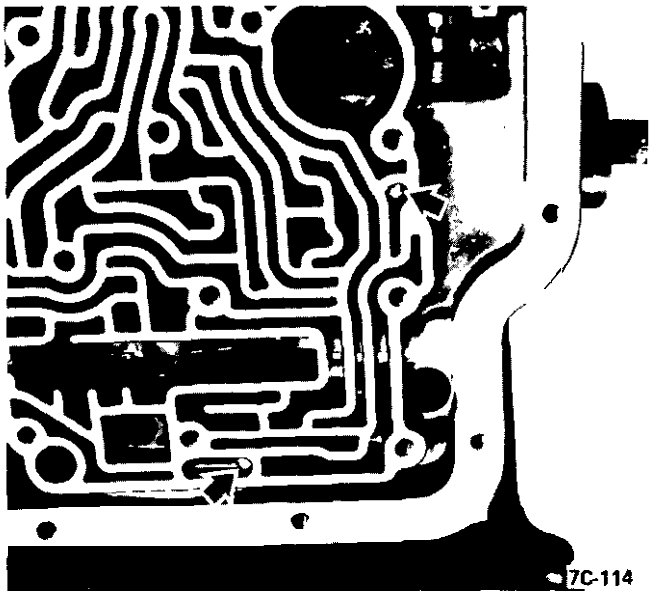


Figure 7C-228

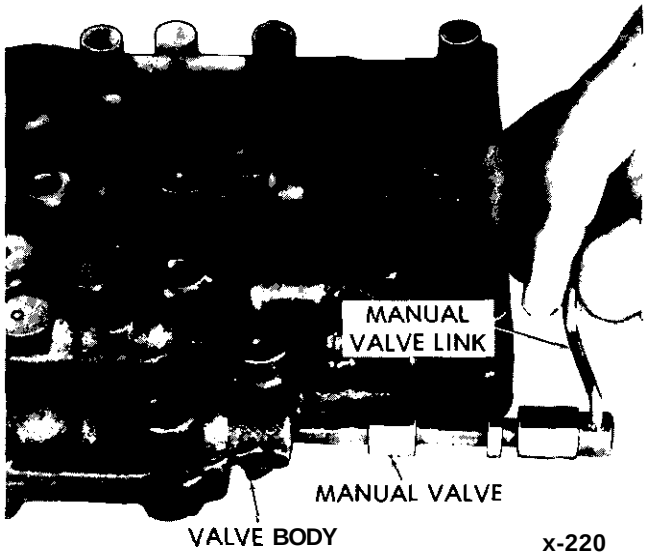


Figure 7C-230

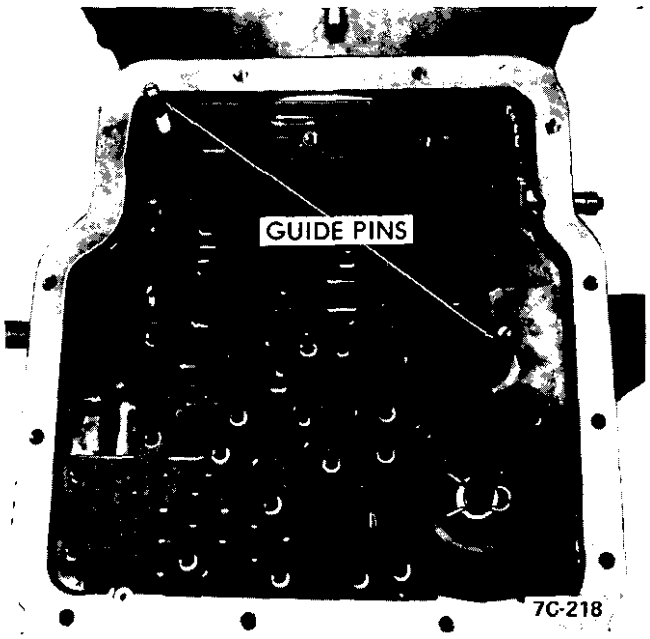


Figure 7C-229

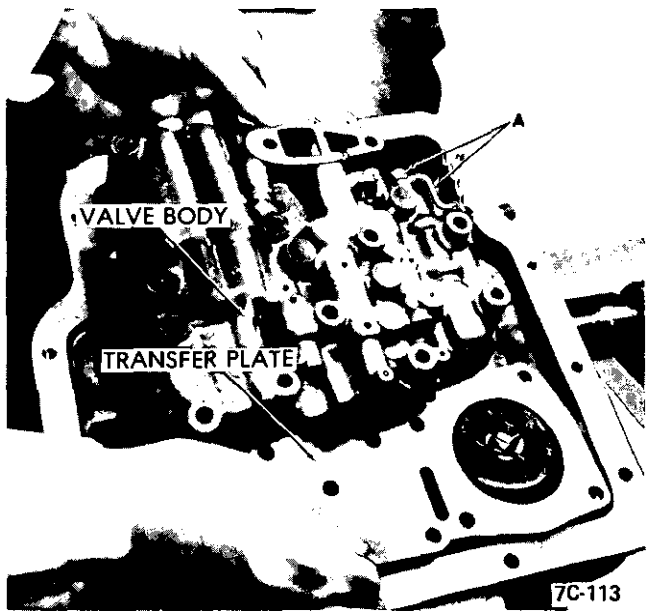


Figure 7C-231

6. Install small end of manual valve link "A" into selector lever and install valve body and transfer plate assembly over guide pins. See Figure 7C-23 1.

7. Install selector lever roller spring and retainer. Torque to 13-15 lbs. ft. The valve body bolts should be torqued starting in the center of the valve body and working outward. Torque to 13-15 lbs. Ft.

8. Install reinforcement plate to case. Torque to 13-15 lbs. ft.

9. Inspect oil strainer. If foreign matter is present, install new strainer.

10. Install oil strainer assembly using new gasket. Torque to 13-15 Ibs. ft.

11. Install new servo cover gasket.

12. Install servo cover. Torque to 17-19 lbs. ft.

Installation of Oil Pan and Gasket

1. Install new oil pan gasket.

2. Bolt oil pan to transmission case. Torque to 7-9 lbs. ft.

Torque Converter

1. Place transmission on portable jack

2. Slide torque converter over stator shaft and input shaft.

3. Be sure that converter pump hub keyway is seated into oil pump drive lugs and the distance "A" is .20" to .28". See Figure 7C-232.

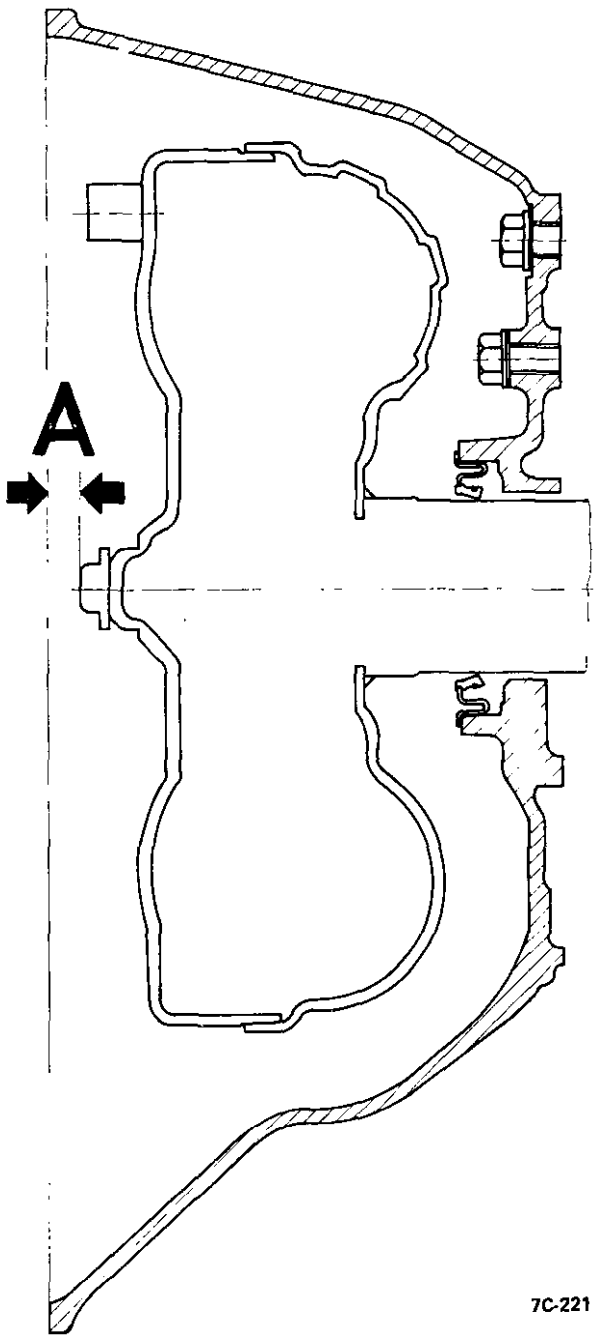


Figure 7C-232

4. Rotate converter to check for free movement.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Opel Three-Speed Automatic Transmission Fluid Recommendations

Use DEXRON Automatic Transmission Fluid *only* in all 1972 model Opel Automatic Transmissions (GM part No. 1050568-69-70 or any other fluid having DEXRON identifications).

DEXRON is an especially formulated automatic transmission fluid designed to improve transmission operation.

The oil pan should be drained and the strainer replaced every 24,000 miles and fresh fluid added to obtain the proper level on the dipstick. See subparagraph 2 for proper refill procedures. For cars subjected to heavy city traffic during hot weather, or in commercial use, when the engine is regularly idled for long periods, the oil pan should be drained and the strainer replaced every 12,000 miles.

1. ***Checking and Adding Fluid***

The Opel three-speed automatic is designed to operate at the full mark on the dipstick at normal operating temperature (180 degrees F.) and should be checked under these conditions. The normal operating temperature is obtained only after at least 15 miles of highway type driving or the equivalent of city driving.

Fluid level should be checked at every engine oil change. ***The "Full" and "Add" marks on the transmission dipstick indicate one (1) pint difference.*** To determine proper fluid level, proceed as follows:

To determine proper level, proceed as follows:

1. With manual control lever in Park position start engine. DO NOT RACE ENGINE. Move manual control lever through each range.

2. Immediately check fluid level with selector lever in Park, ***engine running,*** and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick should be at the "FULL" mark.

3. If additional fluid is required, add fluid to the "FULL" mark on the dipstick.

If the vehicle cannot be driven sufficiently to bring the transmission to operating temperature and it

becomes necessary to check the fluid level, the transmission may be checked at room temperature (70 degrees F.) as follows:

1. With manual control lever in Park position start engine. DO NOT RACE ENGINE. Move manual control lever through each range.

2. lmmediately check fluid level with selector lever in Park, engine running, and vehicle on LEVEL surface.

At this point, when a reading is made, fluid level on the dipstick should be 1/4" below the "ADD" mark.

3. If additional fluid is required add fluid to bring level to 1/4" below the "ADD" mark on the dipstick.

If transmission fluid level is correctly established at 70 degrees F. it will appear at the "FULL" mark on the dipstick when the transmission reaches normal operating temperature (180 degrees F.) The fluid level is set 1/4" below the "ADD" mark on the dipstick to allow for expansion of the fluid which occurs as transmission temperatures rise to normal operating temperature of 180 degrees F.

Do not overfill, as foaming and loss of fluid through the vent pipe might occur as fluid heats up. If fluid is too low especially when cold, complete loss of drive may result which can cause transmission failure.

2. ***Draining oil pan and replacing strainer assembly.***

(a) Raise car on hoist or *place on jack stands,* and provide container to collect draining fluid.

(b) Remove oil pan and gasket. Discard gasket.

(c) Drain fluid from oil pan. Clean pan with solvent and dry thoroughly with clean compressed air.

(d) Remove strainer assembly, strainer gasket and discard.

(e) Install new oil strainer gasket. Install new strainer assembly.

(f) Install new gasket on oil pan and install pan. Tighten attaching bolts to 7-10 lb. ft.

(g) Lower car and add approximately three (3) pints of transmission fluid through filler tube.

(h) With manual control lever in Park position, start engine. DO NOT RACE ENGINE. Move manual control lever through each range.

(i) Immediately check fluid level with selector lever in Park, engine running, and vehicle on LEVEL surface.

(j) Add additional fluid to bring level to 1/4" below the "ADD" mark on the dipstick. Do not overfill.

3. ***Adding Fluid to Fill Dry Transmission and Converter Assembly***

The fluid capacity of the Opel Three Speed Automatic transmission and converter assembly is approximately 10-1/2 pints, but correct level is determined by the mark on the dipstick rather than by amount added. In cases of transmission overhaul, when a complete fill is required, including a new converter proceed as follows:

(a) Add approximately 10-1/2 pints of transmission fluid through tiller tube.

The converter should be replaced on any major failure, such as a clutch or gearset, and an excessive amount of foreign material is indicated in the pan. If installation of a new converter is not required add approximately five (5) pints of transmission fluid.

(b) With manual control lever in Park position start engine and run at 1000 RPM. DO NOT RACE ENGINE. Move manual control lever through each range.

(c) Immediately check fluid level with selector lever *in* Park, engine running, and vehicle on LEVEL surface.

(d) Add additional fluid to bring level to 1/4" below the "ADD" mark on the dipstick. Do not overfill.

Opel Three Speed Automatic Transmission Towing Instructions

If an Opel equipped with an automatic transmission must be towed, the following precautions must be observed:

The car may be towed safely on its rear wheels with the shift lever in neutral position at speeds of 35 miles per hour or less under most conditions.

However, the drive shaft must be disconnected or the car towed on its front wheels if:

a. Tow **speeds** in excess of 35 mph are necessary.

b. Car must be towed for extended distances (over 50 miles).

c. Transmission is not operating properly.

If car is towed on its front wheels, the steering wheel

should be secured to keep the front wheels in a straight-ahead position.

Rocking Car

If it becomes necessary to rock the car to free it from sand,. mud, or snow, move the selector lever from "D" to "R" in a repeat pattern while simultaneously applying moderate pressure to the accelerator. Do not race engine. Avoid spinning wheels when trying to free the car.

Model Designations

Trans. Model	converter Assembly Information	Reverse Clutch Plates Required	2nd Gear Clutch Plates Required	3rd Gear Clutch Plates Required
Opel 1900 OG GT QH	Green Dot of Paint	Drive 3 (Composition Faced) Driven (Steel) 4 Waved 1 Pressure 1	Drive 3 (Composition Faced) Driven (Steel) 4 Waved 1 Pressure 1	Drive 3 (Composition Faced) Driven (Steel) 4 Waved. 1 Pressure 1

Bolt Torque Specifications

Location	Torque Lb.Ft.	Thread Size
Oil Pan to Case	7-10	5/16-18
Transfer Plate to Valve Body	6-8	1/6-20
Reinforcement Plate to Case	13.15	5/16-18
Valve Body to Case	13.15	5/16-18
Servo Cover to Case	16-19	5/16-18
Modulator Assembly	12-15	
Converter Housing to Oil Pump	13.17	5/16-18
Converter Housing to Case	22.26	5/16-18
Selector Lever Jam Nut	8-I 1	
Governor Body to Governor	6-8	1/4-20
Extension Housing to Case	20.30	3/8-16
Servo Adjusting Bolt Lock Nut	12.15	
Planetary Carrier Lock Plate	20.35	
Oil Pressure Check Plug	5-7	
Flex Plate to Crankshaft	36-51	
Converter to Flex Plate	38.42	
Converter Housing to Cylinder Block	38.42	
intermediate Selector Lever to Console Selector Lever Shaft	18.20	
Rear Engine Support to Transmission Case Extension	18.22	
Outer Transmission Selector Lever to Transmission Selector Lever Shaft	13.16	
Oil Cooler Line Connector	10-13	
Oil Cooler Line to Connector	1 I-15	
Oil Cooler Line to Oil Cooler Hose	1 I-15	
Oil Cooler Hose to Oil Cooler	11.15	

F. OPEL AUTOMATIC TRANSMISSION LINKAGE ADJUSTMENT

1. REMOVE LOCK CLIP
2. PLACE SELECTOR LEVER IN "L" OR "I" POSITION
3. PLACE TRANSMISSION SHIFT LEVER IN "L" OR "1" POSITION
4. ADJUST CONTROL ROD (ALLOWING IT TO FIT OVER PIN IN LOWER SELECTOR LEVER FREELY)
5. INSTALL LOCK CLIP

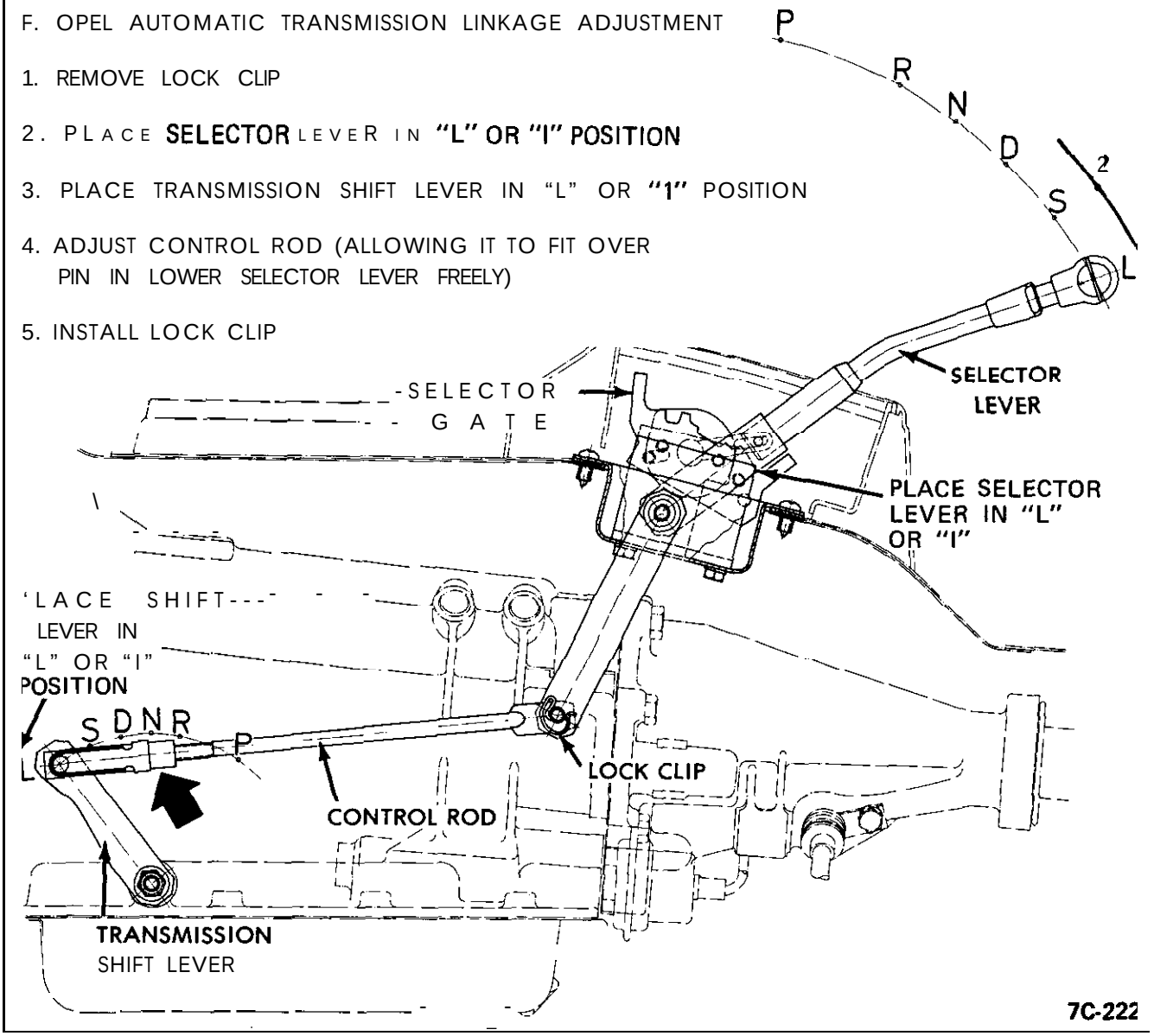


Figure 7C-233 Adjusting Selector Lever

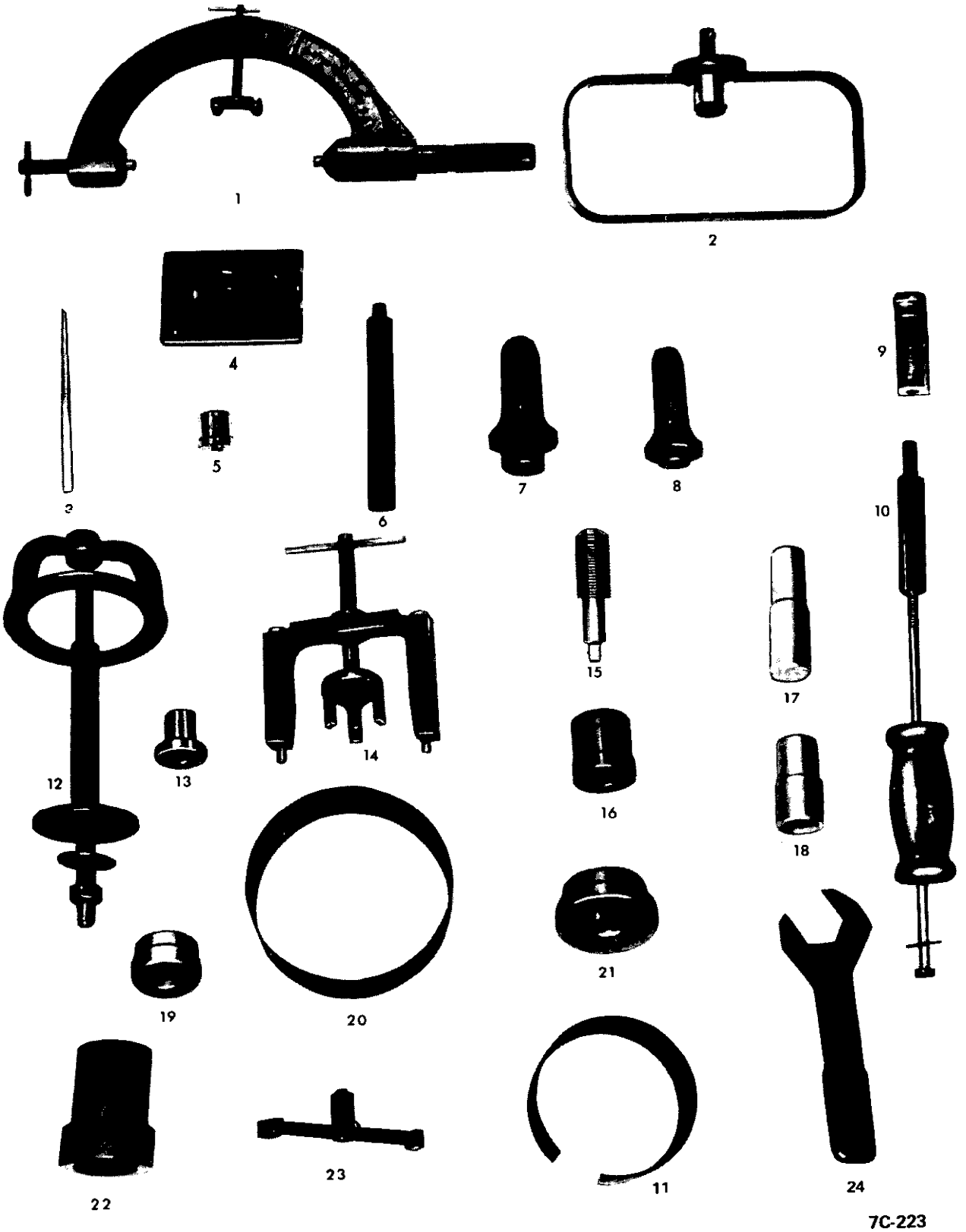


Figure 7C-234 Special Tools - Automatic Transmission

SPECIAL TOOLS

1.	J-8763-01	Transmission Holding Fixture
2.	J-21369	**Converter** Leak Test Fixture
3.	J-8400-1	Cape Chisel
4.	J-3289-20	Holding Fixture Base
5.	J-23130-3	Rear Case Bushing Remover and Installer
6.	J-8092	Driver Handle
7.	J-21359	Converter Housing Oil Seal Installer
8.	J-21426	Extension Housing Oil Seal Installer
9.	J-23129	Converter Housing Seal Remover ▪ Without Disassembling Transmission (Use With J-7004)
10.	J-7004	Slide Hammer
11.	J-2590-12	2nd and Reverse Clutch Piston Spring Compressor
12.	J-21420-1	Clutch Piston Compressor Adapter
13.	J-23130-7	Reaction Sun Gear Drum Bushing Sleeve Installer
14.	J-23075	Servo and 3rd Clutch Piston Spring Compressor
15.	J-23 130-S	Oil Pump Bushing Remover
16.	J-231306	2nd Clutch Drum Bushing Remover and Installer
17.	J-23130-1	Oil Pump Bushing Installer
18.	J-21424-9	Extension Housing Bushing Remover and Installer (Use with J-8092 Driver Handle)
19.	J-21465-17	Converter Housing Bushing Remover and Installer (Use With J-8092)
20.	J-23080	2nd Clutch Piston Seal Installer
21.	J-23 130-2	Reaction Sun Gear Drum Bushing Installer
22.	J-23082	Converter to Oil Pump Alignment Tool
23.	J-23085	Oil Pump to 2nd Clutch Drum Gauging Tool
24.	J-23 100	Vacuum Modulator Wrench

J-7004-1
SLIDE HAMMER

J-2291 3
MAIN SHAFT ASSEMBLY TOOL

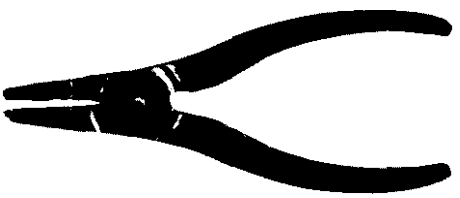
J-22929
SPEEDOMETER DRIVEN GEAR
REMOVER AND INSTALLER

J-22922
TRANSMISSION CASE EXTENSION
HOUSING SEAL INSTALLER

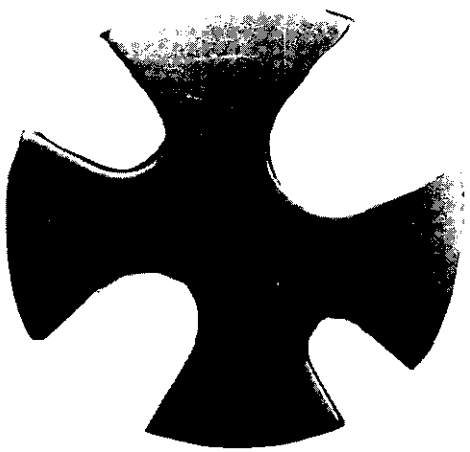
J-22926
SPEEDOMETER DRIVEN
GEAR PIN REMOVER

J-21715
DETENT PIN PLUG REMOVER

J-22934
CLUTCH PLATE ALIGNING ARBOR



TRU-ARC PLIERS



J-21 684
BEARING PRESS PLATE

J-22923
REVERSE IDLER SHAFT REMOVER

J-2291 1
NEEDLE BEARING LOADER

7B-56

Figure 7C-235 Special Tools. Manual Transmission