GROUP 21 — TRANSMISSIONS
SECTION 0 — INDEX

SPEEDOMETER PINION CHART

Axle Ratio	Engine	Transmission	Tyre Size	Pinion Tooth Number	
				Drive	Driven
3.545:1	2,0ℓ	Auto-BW35	165SR x 13, AR78S x 13 A78L x 13, BR70S x 13	5	15
3.545:1	2,0ℓ	Auto-MA904A	195/70HR x 14, DR70H x 14	13	37
3.545:1	2,0ℓ	Manual early — (5 spd. M.M.C.) late —	195/70HR x 14, DR70H x 14 195/70HR x 14, DR70H x 14	5 8	16 25
3.909:1	1,6ℓ; 1,85ℓ; 2,0ℓ	Manual (4 spd. M.M.C.)	165SR x 13, AR78S x 13 A78L x 13, BR70S x 13	5	17
3.891:1	1,6ℓ; 1,85ℓ; 2,0ℓ	Manual (4 spd. M.M.C.)	165SR x 13, AR78S x 13 A78L x 13, BR70S x 13	5	17
3.891:1	2,0ℓ	Manual early — (5 spd. M.M.C.) late —	165SR x 13, AR78S x 13 A78L x 13, BR70S x 13	5 8	17 27
3.891:1	2,0ℓ	Manual (4 spd. B.W.)	165SR x 13, AR78S x 13 A78L x 13, BR70S x 13	7	25
3.42:1	2,0ℓ	Auto-BW35 (Short Ext./Hsg.)	165SR x 13; AR78S x 13 A78L x 13, BR70S x 13	5	15
3.42:1	2,0ℓ	Auto-BW35 (Long Ext./Hsg.)	165SR x 13, AR78S x 13 A78L x 13, BR70S x 13	7	21
3.42:1	2,6ℓ	Auto-BW35 (Long Ext./Hsg.)	185/70HR x 14, BR70H x 14	7	20

SERVICE BULLETIN REFERENCE

DATE	NUMBER	SUBJECT	CHANGES

SERVICE DIAGNOSIS — MANUAL TRANSMISSIONS

Condition	Possible Cause	Correction
HARD SHIFTING	(a) Incorrect clutch adjustment.	(a) Adjust clutch.
	(b) Synchronizer clutch sleeve damaged.	(b) Replace damaged parts.
	(c) Synchronizer spring improperly installed.	(c) Install correctly.
	(d) Broken or worn synchronizer blocker rings.	(d) Replace faulty parts.
	(e) Incorrect lubricant or low lubricant level.	(e) Fill to level with correct grade of lubricant.
TRANSMISSION NOISES	(a) Loose transmission.	(a) Tighten transmission.
	(b) Worn or damaged gears.	(b) Replace faulty components.
	(c) Worn or damaged bearings.	(c) Replace faulty components.
	(d) Incorrect lubricant or low lubricant level.	(d) Fill to level with correct grade of lubricant.
TRANSMISSION JUMPS OUT OF GEAR	(a) Synchronizers worn.	(a) Replace faulty components.
	(b) Incorrect or damaged interlock detent spring and/or loose detent screw.	(b) Replace faulty components.
	(c) Bent main shaft.	(c) Replace faulty components.
	(d) Worn or damaged bearings on input or output shaft.	(d) Replace faulty components.

SECTION 4A — TRANSMISSION FOUR SPEED SYNCHROMESH

BORG WARNER — MODEL 0505

SPECIFICATIONS

GEAR RATIO

First	3.65:1
Second	1.97:1
Third	1.37:1
Fourth	1.00:1
Reverse	3.66:1

LUBRICANTS

Type	S.A.E. 30 Engine Oil
Capacity	2,3 litres (4.0 pints)

INPUT SHAFT

Front Diameter	14,97 to 14,99 mm (0.589 to 0.590")
Inside Diameter Needle Bearing Area	30,48 to 30,50 mm (1.200 to 1.201")
Oil Seal Area Diameter	28,55 to 28,60 mm (1.124 to 1.126")
Input Gear Snap Ring Thickness	2,18 to 2,24 mm (0.086 to 0.088") 2,26 to 2,31 mm (0.089 to 0.091") 2,34 to 2,39 mm (0.092 to 0.094") 2,41 to 2,46 mm (0.095 to 0.097")
Input Bearing End Play	0 to 0,1 mm (0 to 0.004")

MAIN SHAFT

Front Diameter	19,36 to 19,38 mm (0.762 to 0.763")
First Gear Diameter	34,99 to 35,00 mm (1.377 to 1.378")
Second Gear Diameter	40,63 to 40,64 mm (1.599 to 1.600")
Third Gear Diameter	34,94 to 34,95 mm (1.375 to 1.376")
End Play	0 to 0,1 mm (0 to 0.004")
Rear Bearing Snap Ring Thickness	2,18 to 2,24 mm (0.086 to 0.088") 2,26 to 2,31 mm (0.089 to 0.091") 2,34 to 2,39 mm (0.092 to 0.094") 2,41 to 2,46 mm (0.095 to 0.097")
Third Speed Gear	
— Internal Diameter	34,99 to 35,00 mm (1.377 to 1.378")
— End Play	0,13 to 0,52 mm (0.005 to 0.020")
Second Speed Gear	
— Internal Diameter	40,68 to 40,70 mm (1.602 to 1.603")
— End Play	0,16 to 0,40 mm (0.006 to 0.016")
First Speed Gear	
— Internal Diameter	40,01 to 40,02 mm (1.575 to 1.576")
— End Play	0,15 to 0,74 mm (0.006 to 0.029")
1st and 2nd Synchronizer hub snap ring thickness (Selective to maintain 2nd gear end float)	2,16 to 2,21 mm (0.085 to 0.087") 2,24 to 2,29 mm (0.088 to 0.090") 2,31 to 2,36 mm (0.091 to 0.093") 2,39 to 2,41 mm (0.094 to 0.096")

COMPONENT DIMENSIONS

Gear 1st speed width	40,32 to 40,38 mm (1.587 to 1.590")
Synchro. Hub 1st and 2nd — width to 1st speed thrust face	15,34 to 15,39 mm (0.604 to 0.606")
Synchro. Hub 1st and 2nd — width from 2nd gear thrust face to snap ring thrust face	22,48 to 22,58 mm (0.885 to 0.889")
Gear 2nd speed width	38,18 to 38,26 mm (1.503 to 1.506")
Gear 3rd speed width	39,42 to 39,50 mm (1.552 to 1.555")
Synchro. Hub 3rd and 4th width	22,48 to 22,58 mm (0.885 to 0.889")
Number of rollers in cluster gear bore	2 sets of 19 rollers
Number of rollers in maindrive pocket bore	14
Number of cluster gear needle roller thrust washers	4
Number of cluster gear thrust washers	2

GEAR SELECTOR ASSEMBLY

Detent Spring

— Free Length	26,42 mm (1.040")
— Load	2,5 to 3,0 kg (5.5 to 7.0 lbs.)

SPECIAL TOOLS

Clutch plate aligning tool	E6M16
Gearshift lever ball seat spanner	E21M21
Bearing puller	ST15032-1 and adaptors ST15033-1 or E6673
Remover/replacer gearshift rail pin	E21C20
Adaptor (use with tool E21C20 above)	E21M20
Installer front oil seal	E21A29
Remover extension housing oil seal	E6604
Replacer extension housing oil seal	E21M15
Remover/replacer extension housing bush	E21M11

TORQUE SPECIFICATIONS

Clutch housing to cylinder block	34 to 47 Nm
Reverse light switch	20 to 27 Nm
Maindrive cover bolts	27 to 34 Nm
Clutch housing bolts	40 to 54 Nm
Top cover bolts	9 to 12 Nm
Extension housing bolts	40 to 54 Nm
Gearshift lever ball seat	20 to 24 Nm

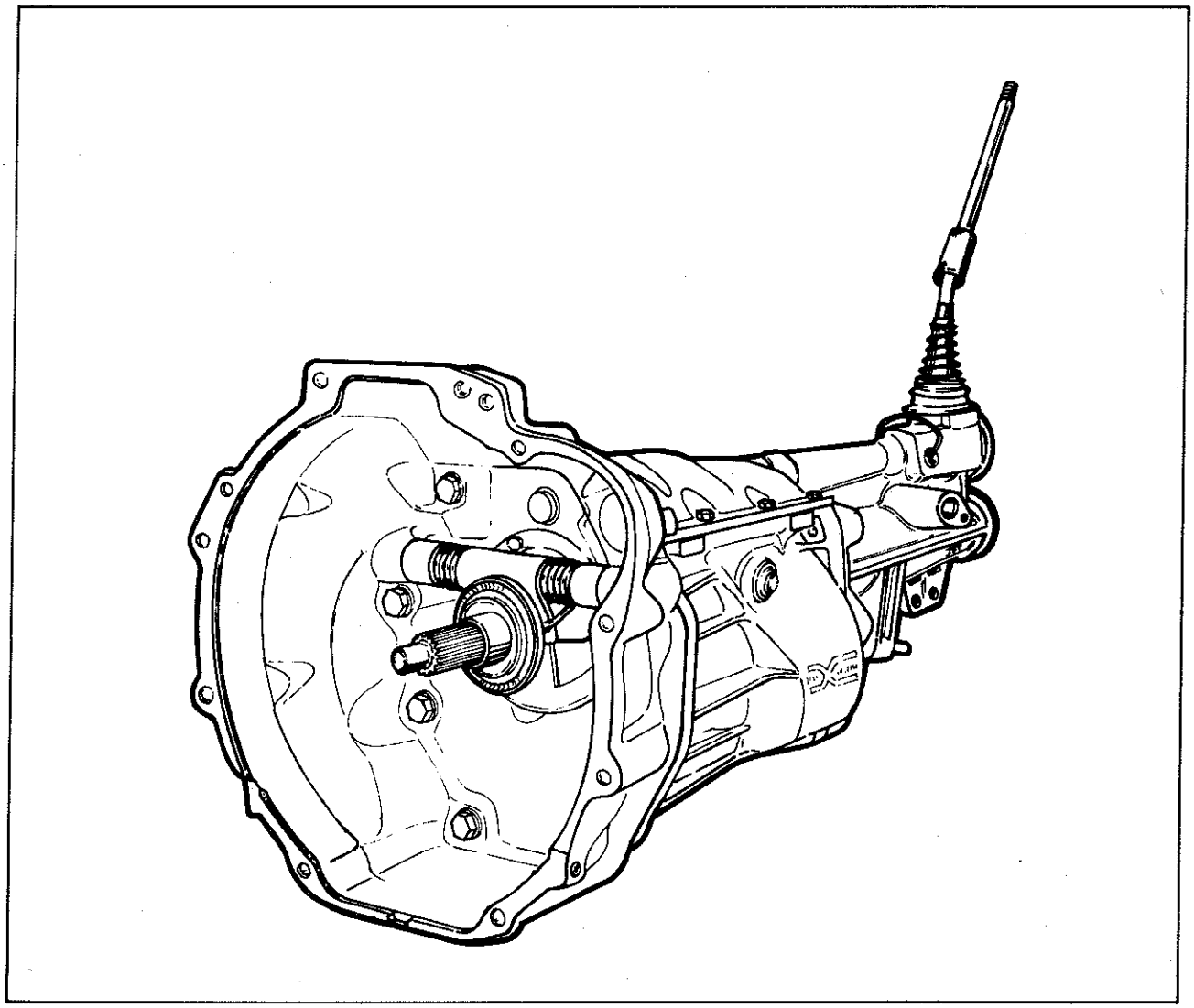


Fig. 1—Borg-Warner Model 0505 manual transmission

GENERAL INFORMATION

The transmission is a four-speed fully synchronized type using three strut synchronizers which give rapid silent gear changes. All forward gears are helical to give smooth operation. Reverse gear is of the spur type.

The first/second, and third/fourth gear synchronizers are keyed to the output shaft (mainshaft) and permit clutching to the required gear which is in constant mesh with the cluster gear. The first, second and third gears, when not engaged by the synchronizer sleeve splines, are free to rotate on the mainshaft. It is important to maintain the running clearances specified or seizure may result owing to expansion of the components.

The hubs of the synchronizer assemblies are splined to the mainshaft and fitted with three shifting plates which fit into slots in the hub. The shift plates fit into three recesses in the bronze blocking ring which fits over the taper cone on the gear.

The blocking rings have clutch teeth similar to those on the gears. When a forward gear is to be engaged, the synchronizer sleeve carrying with it the shift plates, moves over the hub bringing the shift plates into contact with the back face of the recesses in the blocking ring. When synchronization takes place the blocking ring indexes so that the sleeve can slide over the shift plates and engage the gear clutch teeth. To engage reverse gear, the reverse idler gear is moved by the reverse idler lever into mesh with the cluster gear reverse step and the combined first speed synchronizer sleeve and reverse sliding gear, with the drive being transferred to the output shaft (mainshaft) through the first and second hub.

The cluster gear runs on two rows of needle roller bearings, the maindrive gear and the mainshaft on ball bearings, the reverse idler is bushed and runs on the reverse idler shaft and the second and third gears run directly on the mainshaft. The first speed gear runs on a caged needle roller bearing. The mainshaft is also supported by a set of rollers in the

maindrive gear and rear end splines are located in the propeller shaft slip yoke which runs in a bushing in the gearcase exetension housing. The speedometer gear is located on the mainshaft by 2 snap rings and is driven by a steel ball.

The interlock mechanism consists of an interlock spool, which is a sliding fit on the gearshift rail, and is located by its circular flange in the case cover. Shifts are effected by a pin pressed into the rail which moves longitudinally through a slot in the interlock spool. This pin can be rotated to pick up the required groove in the respective fork arms. The rotational movement causes the interlock spool flange to be rotated into the groove in the fork arms not required, thus preventing the forks not in line with the shifting pin to be locked in position by the flange. The gearshift rail has three grooves in it corresponding to each gear and neutral. A detent pin is forced into the grooves by a spring which must be overcome by a force applied to the gearshift lever before a gear change can be made.

The reverse light switch is located in the gearshift housing, and is actuated by rotating a flat milled on the operating rod away from the reverse light switch. This rotation takes place as reverse gear is selected.

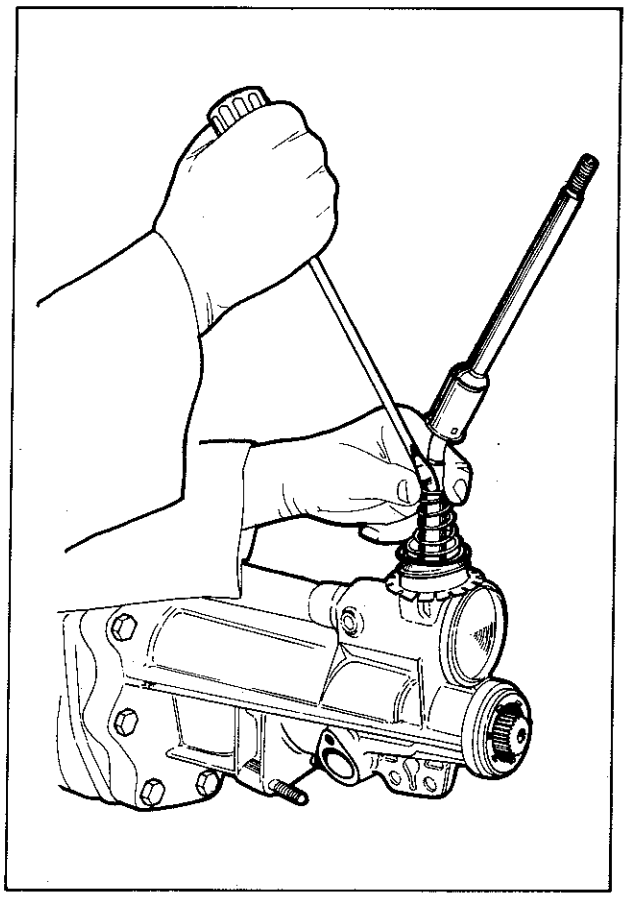


Fig. 2—Removing conical spring retainer

TRANSMISSION REMOVAL

(1) Disconnect the battery ground (negative) lead.

(2) Drain the lubricant from the transmission.

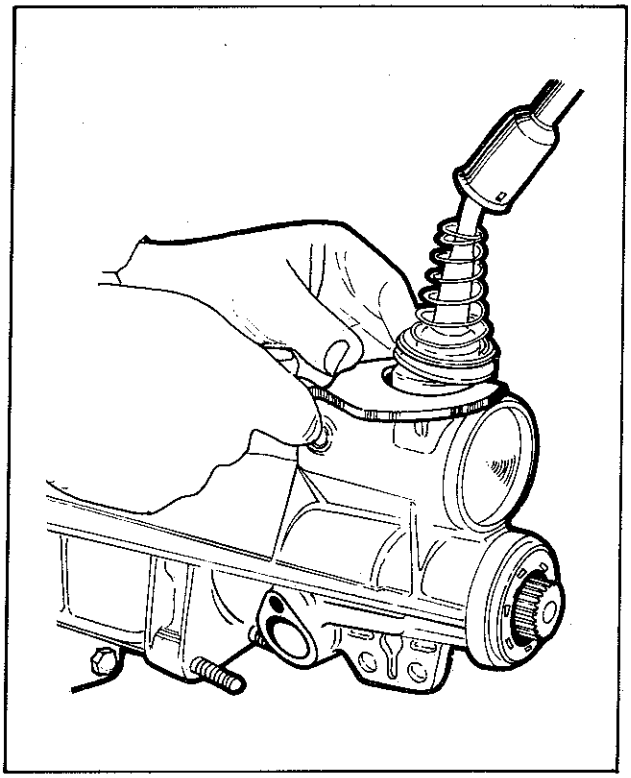


Fig. 3—Removing gear lever assembly

(3) Remove the starter motor.

(4) Remove propeller shaft, back-up light switch leads and speedometer cable.

(5) Disconnect the clutch cable.

(6) Remove the clutch housing cover.

(7) From inside the vehicle, remove vehicle console, dust seal and gearshift knob. It is possible to remove the gearlever from beneath the vehicle allowing it to "hang" in the gearlever boot.

(8) Using a screwdriver, remove gearshift lever conical spring upper retainer, Fig. 2.

(9) Unlock all the bent tabs on the nylon pivot ball seat.

(10) Raise the conical spring, spring seat and spherical washer up the gearshift lever.

(11) Using tool E21M21 on the flats of the pivot ball seat, unscrew the seat and remove the gear lever assembly from the extension housing, Fig. 3.

NOTE: The gear lever should be placed in the second gear position prior to removal.

(12) Support the rear of the engine with a suitable jack and remove the rear crossmember.

(13) Remove the bolts attaching the transmission to the engine and remove the transmission.

NOTE: Care must be taken to slide the transmission straight back off the clutch assembly to avoid damage to the clutch or input shaft assembly.

TRANSMISSION INSTALLATION

Install the transmission by reversing the removal procedure, noting the following:

(1) When installing the transmission do not allow it to hang on the clutch assembly.

(2) Tighten all bolts to the specified torque.

(3) Ensure the clutch housing cover is not damaged or bent.

(4) Adjust the clutch as specified in Group 6.

(5) When installing the gear lever, place the selector rod in the second gear position, and ensure that dust and dirt do not enter the selector mechanism.

(6) Assemble the gearshift lever assembly into the gearshift housing, screw down the nylon ball seat. Secure by bending a tab against the rib on the side of the housing.

NOTE: Coat gear lever with a general purpose grease before assembly.

(7) Press down the conical spring and spring seat and fit the upper retaining clip to the gear lever.

(8) Install the gear lever dust boot securely onto the body flange.

(9) Fill the transmission with the correct grade and quantity of lubricant.

TRANSMISSION DISASSEMBLY

(1) For the removal of clutch control lever shaft and arm, refer Group 6 — Clutch.

(2) Remove the two plastic cup plugs from the rear of extension housing.

(3) Using a pin punch, remove the roll pin connecting the gearshift link and the gearshift rail, Fig. 4. Remove the reverse light switch.

(4) Remove the extension housing, if necessary tap it lightly with a soft hammer to free it from the case.

(5) Remove the clutch housing.

(6) Remove the top cover assembly.

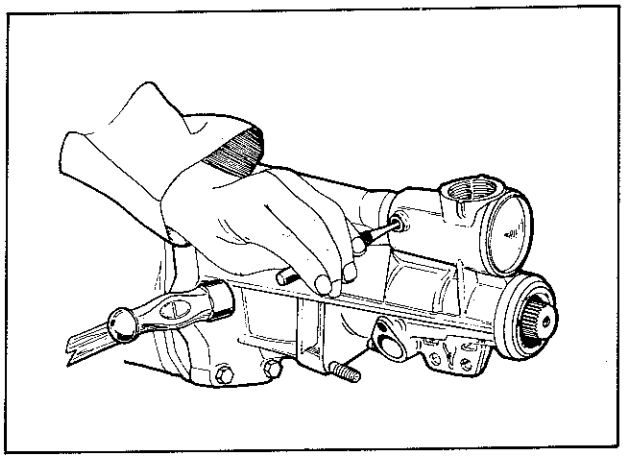


Fig. 4—Removing roll pin

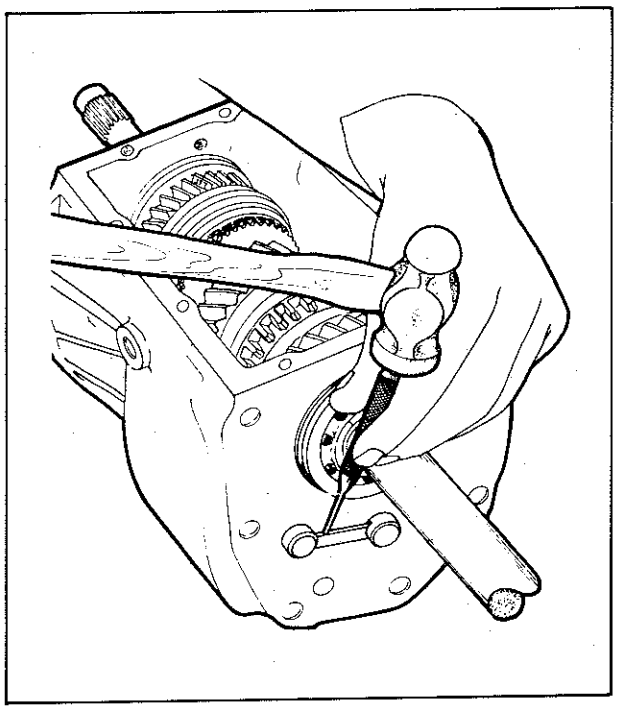


Fig. 5—Removing locking plate

(7) Remove the inner snap ring from the reverse lever shaft, push the reverse lever shaft through the case and remove the reverse lever, reverse gear fork and torsion spring.

(8) Remove the front bearing retainer.

(9) Use a soft drift to knock the countershaft partly through from the front of the gearbox case to allow the lock plate to be removed, Fig. 5.

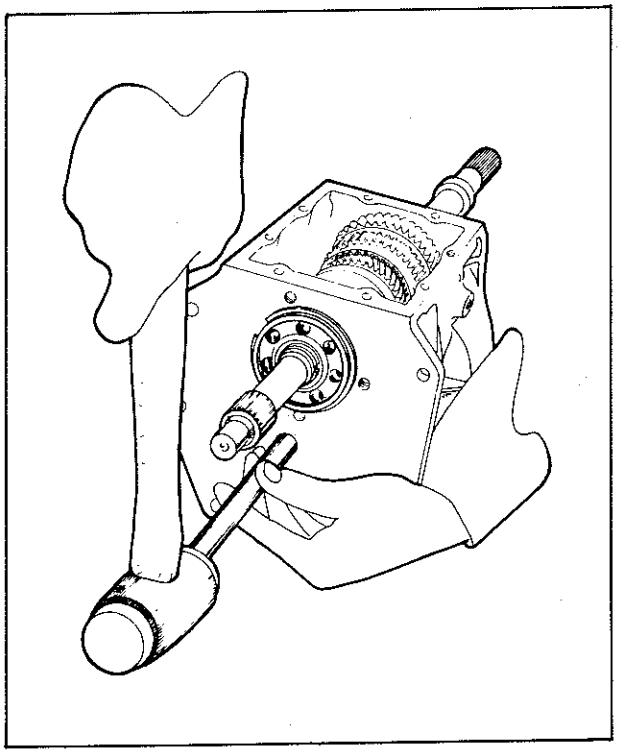


Fig. 6—Removing countershaft

(5) Press on the rear end of the mainshaft to remove the rear bearing, first speed gear thrust washer and caged roller bearing.

NOTE: Special tool ST15032-1 and adaptors ST15033-1 that grip in the bearing snap ring groove can also be used in this application, Fig. 14.

CAUTION: Do not press on the front face of second speed gear at this stage as damage to the mainshaft will result. A snap ring that is hidden when the mainshaft is assembled holds the second speed gear and first and second synchronizer in place on the mainshaft.

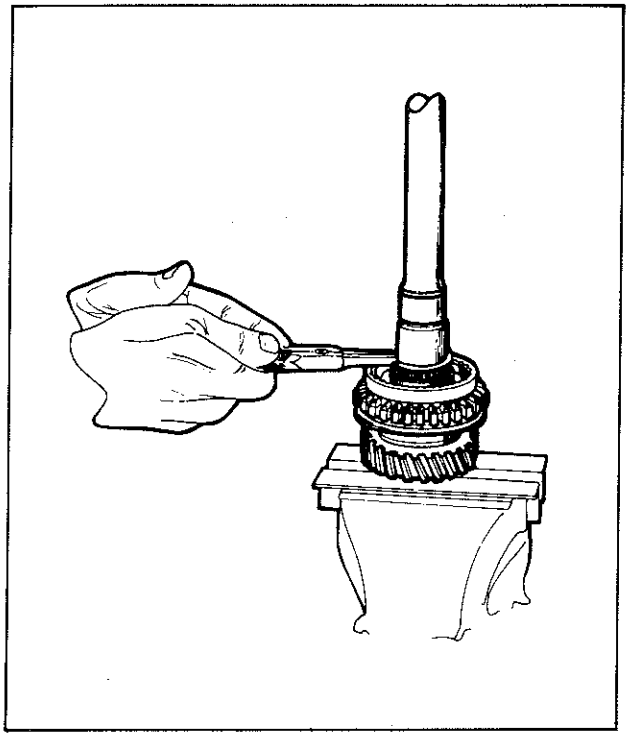


Fig. 15—Removing first/second synchronizer hub snap ring

(6) Remove first and second synchronizer hub snap ring from the mainshaft, Fig. 15.

(7) Remove the first and second synchronizer inner hub and reverse sliding gear, the second speed gear and blocker ring by supporting the front face of the second speed gear and pressing on the rear end of the mainshaft.

CAUTION: (a) When pressing on the front face of the second speed gear always ensure that the faces of the second speed gear, the end of the mainshaft and the blocks mounted on the press are square to each other.
(b) Do not press on the thrust face flange of the mainshaft.

(8) Slide the third and fourth synchronizer sleeve from the synchronizer hub and remove the springs and shift plates.

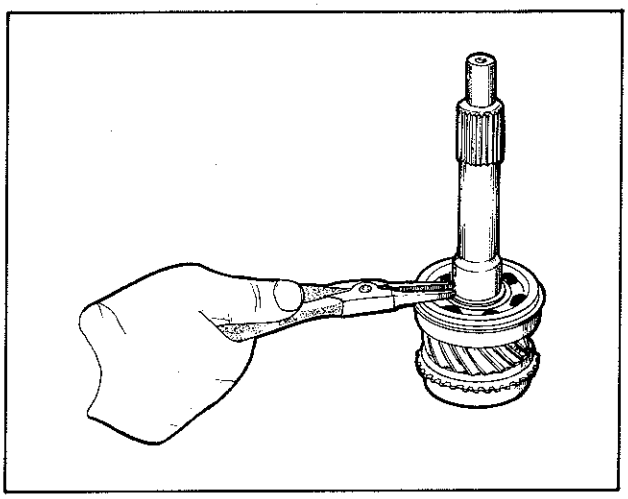


Fig. 16—Removing maindrive gear snap ring

(9) Slide the first and second speed synchronizer sleeve from the synchronizer hub and remove the springs and shift plates.

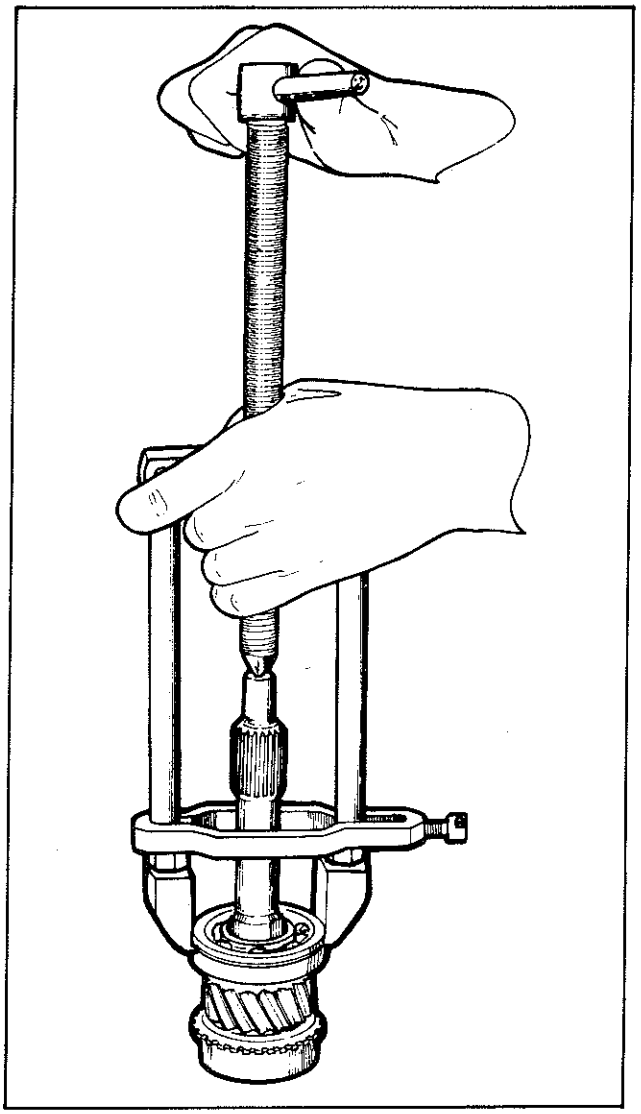


Fig. 17—Removing maindrive gear bearing

Countershaft

(1) Remove the dummy shaft and cluster gear thrust washers.

(2) Remove the needle rollers, needle roller thrust washers and countershaft spacer.

NOTE: Check specifications for numbers of needle rollers and thrust washers in cluster gear bore.

Maindrive Gear

(1) Remove the needle rollers from the bore of the gear.

(2) Remove the snap ring from the shank of the gear, Fig. 16.

(3) Remove the maindrive gear bearing, Fig. 17.

Gearshift Cover Disassembly

(1) Remove the detent screw, detent spring and detent pin.

(2) Tap on the rear end of the gearshift rail to remove the metal cup plug.

(3) Rotate the gearshift rail and move it forward so that the operating pin is free of the interlock spool.

(4) Using basic tool E21C20 in conjunction with adaptor pin E21M20, remove the operating pin, Fig. 18.

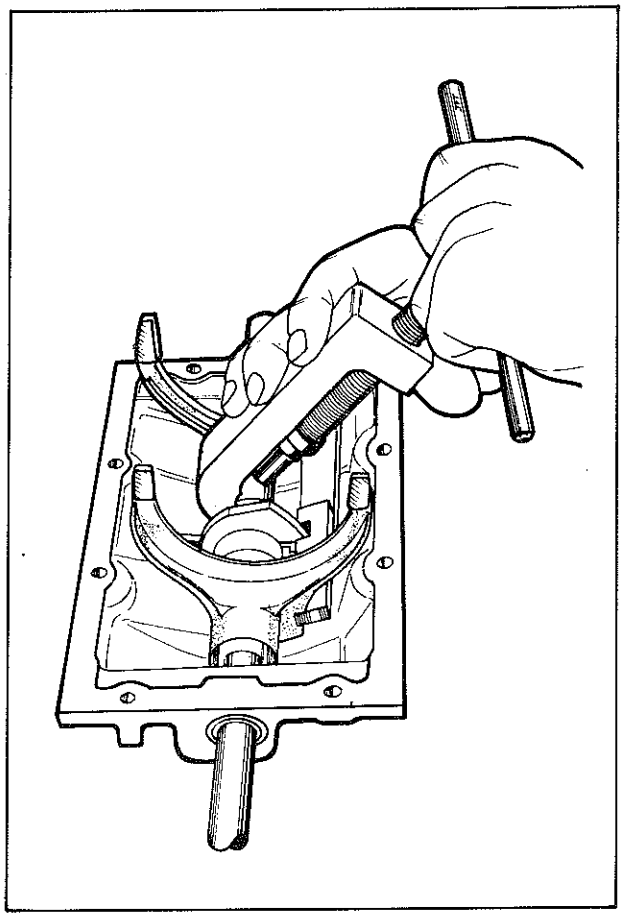


Fig. 18—Removing operating pin

CAUTION: (a) Do not use the adaptor pin supplied with base tool E21C20.
(b) Note that the gearshift rail must be rotated to a position that prevents the operating pin from being pressed into, and therefore damaging the cover.

(5) Withdraw the gearshift rail completely and remove the gearshift forks and the interlock spool.

Extension Housing

(1) Remove the reverse light switch.

(2) Remove the cup plug in the rear of the housing.

(3) Remove the gearshift link and plastic gear lever damping block.

Cleaning and Inspection

Clean all parts in a suitable solvent and blow dry with compressed air.

NOTE: Do not spin bearings with compressed air. The bearings should be immersed in clean solvent and rotated by hand until clean. A bearing that is spun by air is likely to score due to absence of lubrication.
Lubricate the clean bearings with light oil and turn by hand to test for roughness, looseness or wear. Test the fit of the bearings on their respective shaft and in the bores.

Case

Check the transmission case and extension housing for cracks and damage.

Mainshaft

Check the mainshaft for worn or damaged gear mounting areas and splines. Check bushing, spigot and gear mounting diameters to specifications.

Input Shaft

Check the flywheel spigot area outside diameter and the mainshaft spigot bearing area inside diameter for wear or damage.

Inspect the synchronizer gear and cone for rough or damaged surfaces and for worn or damaged teeth.

Inspect the helical gear for worn or damaged teeth.

Inspect the clutch plate splines for damage, wear, looseness and sliding condition with the clutch plate.

Gears

Inspect the helical gear and clutch gear for worn or damaged teeth.

Inspect the cone surface for wear or damage.

Check the gear inside diameter and the front and rear surface of each gear for wear or damage.

Synchronizer Rings

Inspect the ring tooth surface for damage and also its gear contact surface for excessive or uneven wear.

Synchronizer Hub and Sleeve

Assemble the synchronizer sleeves and hubs so that the longer protrusion of the inner hub is at the opposite end to the outer sleeve selector groove. Check that the hub slides smoothly in the sleeve.

Check both ends of the hub for damage and the sleeve grooves for wear.

NOTE: If either the hub or the sleeve require replacement due to damage or wear, both the hub and sleeve must be replaced as an assembly.

Cluster Gear and Shaft

Inspect each gear for damage, wear and any other tooth surface failure.

Check the front and rear thrust washer surfaces for wear and damage.

Check cluster gear shaft for wear.

Reverse Idler Gears and Shaft

Check each gear for cracked, damaged or worn teeth and both ends of each gear for wear or damage.

Check shaft for wear.

Selection Mechanism

Check the clearances between the fork and the fork groove on the synchronizer sleeve.

Check the shift rail for bend and the interlock plunger slot for wear.

Check the clearance between the gear selector and shift rail selector.

Gear Lever Assembly

Check the stop plate groove for wear, the gear lever to control lever rubber inserts for permanent strain, the spring for permanent set and the fulcrum for wear of the sliding section.

Check the control lever stopper, the nylon bushing at the lower end of the gear lever and the rubber dust boot for damage.

TRANSMISSION ASSEMBLY

Sub-Assemblies

Mainshaft

Assemble the first and second synchronizer assembly as follows:—

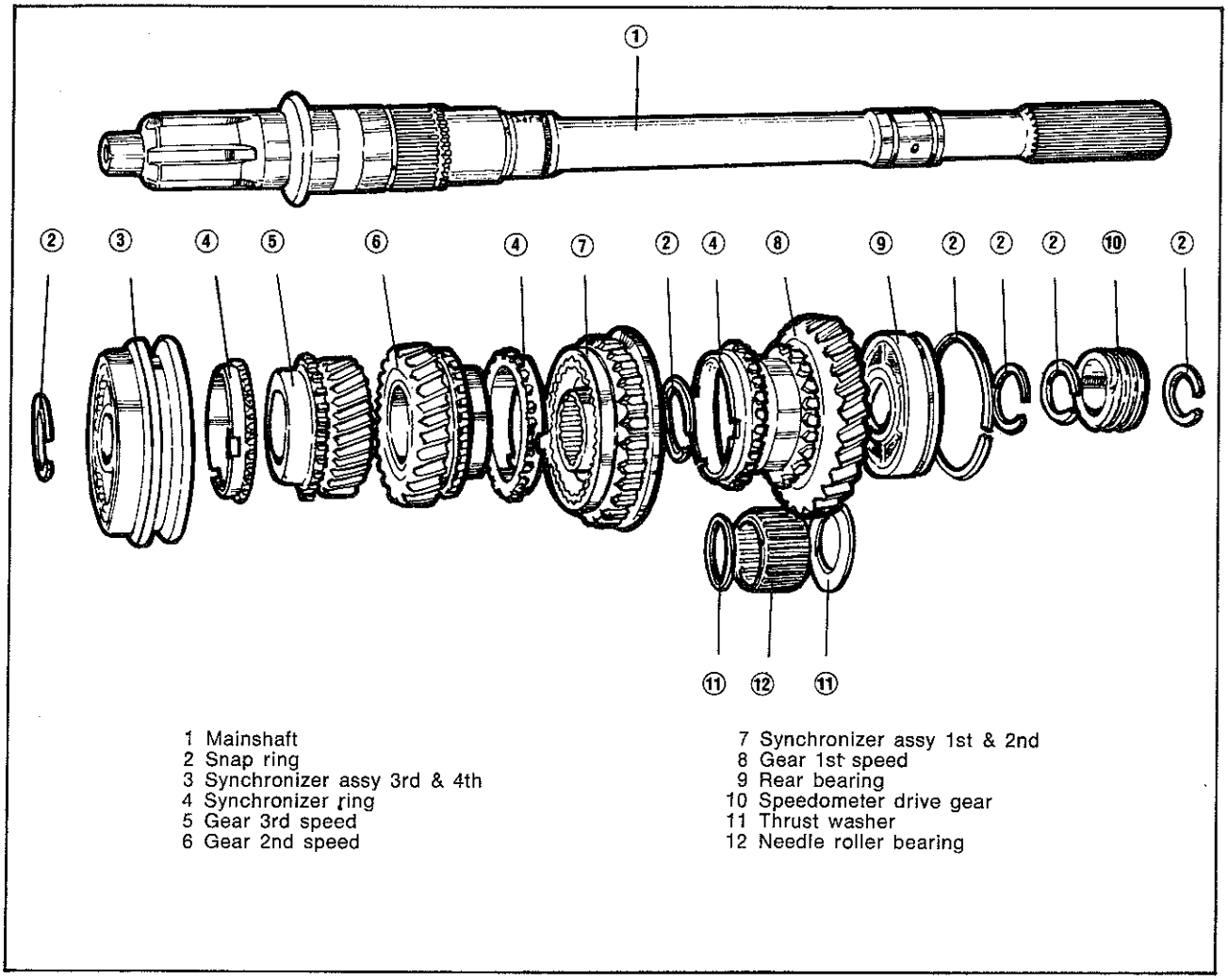


Fig. 19—Mainshaft disassembled view

(1) Lubricate the synchronizer sleeve and reverse gear and fit to the inner hub with the sleeve selector groove and the inner hub spline protrusion at opposite ends.

(2) Slide the sleeve across the hub until three shift plates can be fitted into the slots in the inner hub.

(3) Install the two synchronizer springs under the shift plates behind the pads, with the long lug of each spring in the same shift plate.

NOTE: The spring tangs should locate on opposite sides of the same shift plate so that the spring openings do not line up.

(4) The third and fourth speed synchronizer assembly is assembled in the same way as the first and second speed synchronizer assembly.

(5) Lubricate the second speed bore and fit with the blocker ring to the mainshaft.

NOTE: Slots in the blocker rings should be 8,76 to 9,14 mm (0.345 to 0.360") wide.

(6) Install the first and second speed synchronizer assembly to the mainshaft with the selector groove towards the front of the mainshaft.

(7) Assemble snap ring, selecting the snap ring to keep the synchronizer hub end float to within specifications.

(8) Fit "small" needle roller thrust washer and caged needle roller (lubricated). Lubricate the bore of the first speed gear and with blocker ring fitted, slide over the needle roller. Fit the "large" needle thrust washer.

(9) Install the mainshaft bearing and snap ring, selecting the snap ring to keep the end float within specifications. **Do not** install the snap ring to the outside diameter of the mainshaft bearing.

(10) Lubricate the third speed bore and install it with blocker ring to the mainshaft.

(11) Lubricate the third and fourth speed synchronizer assembly and install it to the mainshaft with the inner hub spline protrusion to the front of the mainshaft. Install a snap ring to the mainshaft.

(12) Check all gears as specified in disassembly procedure to ensure correct end float.

(13) Move the third and fourth speed synchronizer sleeve to engage third gear and the first and second synchronizer sleeve to engage second gear. The mainshaft is now completely assembled ready for assembly into case.

Countershaft

Assemble the cluster gear, dummy countershaft and bearings as follows:—

(1) Insert the dummy countershaft into the cluster gear, insert the tubular countershaft spacer and install a cluster gear needle roller thrust washer into each end of the gear. Fit one set of 19 needle rollers to each end of the cluster gear, Fig. 20.

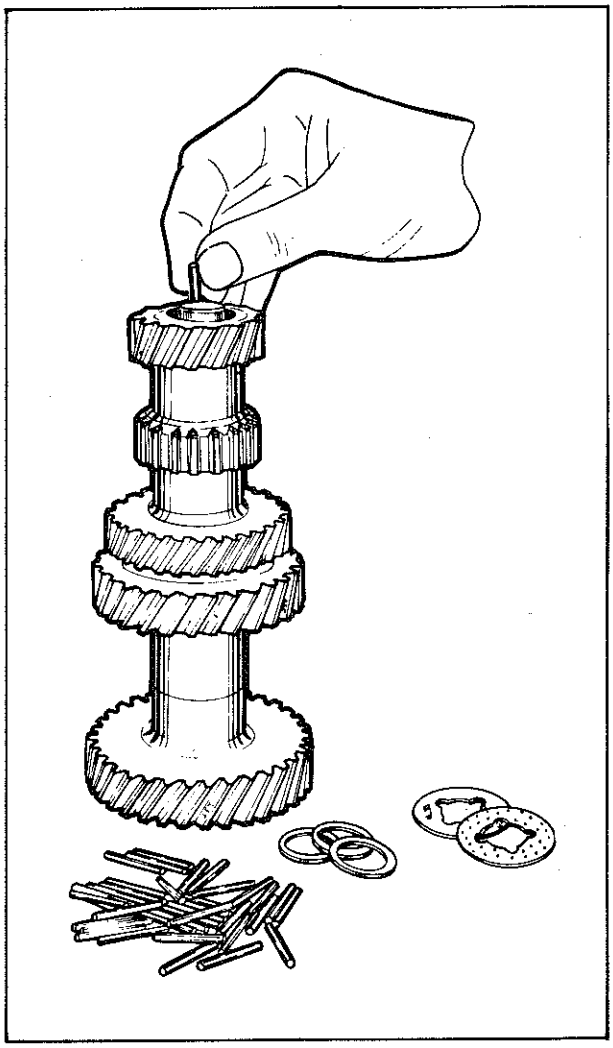


Fig. 20—Cluster gear assembly

(2) Install a needle roller thrust washer at each end of the dummy countershaft, together with a bi-metal thrust washer at each end of the cluster gear.

NOTE: Ensure that the tang in the bi-metal thrust washer sits in the slot in the case, and that the bronze side of the washer is in contact with the cluster gear. These washers may be retained on the cluster gear with grease.

Maindrive Gear

(1) Fit the maindrive gear bearing, selecting a snap ring to keep end float within specifications.

(2) Fit the fourth speed synchronizer blocker ring to the maindrive gear.

(3) Install 14 needle roller bearings into the maindrive gear, retain with grease.

Top Cover Assembly

(1) Install a new gearshift rail oil seal into the top cover.

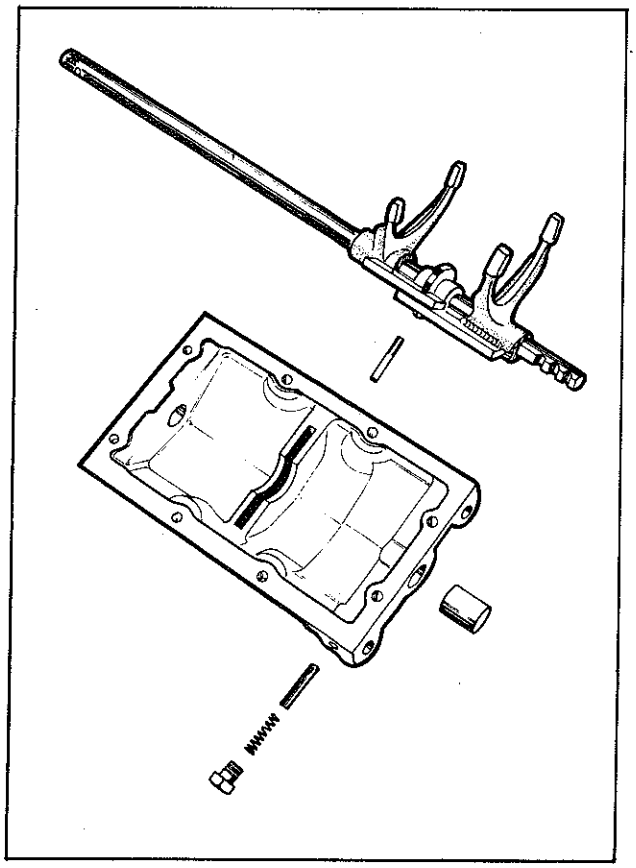


Fig. 21—Top cover assembly

(2) Insert the gearshift rail into the top cover taking care not to damage the oil seal. Fit the gearshift forks and interlock spool with the operating lug of the first/second gear lift fork located **above** the lug of the third/fourth fork.

(3) Slide the gearshift rail forward until the operating pin hole is clear of the interlock spool. With the detent flats facing upward fit the gearshift operating pin using basic tool E21C20 in conjunction with adaptor pin E21M20.

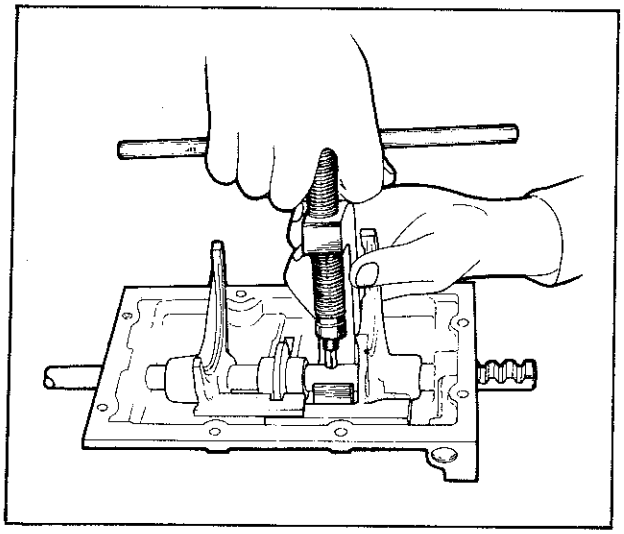


Fig. 22—Installing gearshift operating pin

NOTE: DO NOT use the adaptor pin supplied with base tool E21C20. Ensure pin flats are parallel to shaft centreline.

(4) Slide the gearshift rail back until the gearshift operating pin is in line with the flange of the interlock spool and rotate the rail until the rail detents are in line with the detent holes.

(5) Fit the detent pin, detent spring and detent screw.

(6) Fit the metal cap plug to the front of the top cover in the gearshift rail hole, use jointing compound to seal.

Sub-Assembly Installation

(1) Fit the reverse idler gear and bush assembly to the reverse idler shaft with the taper on the idler gear teeth towards the front of the case. The shaft must be inserted with the locking plate groove at the rear of the case and in the correct location relative to the cluster gear countershaft locking plate groove.

(2) Lower the cluster gear assembly into the bottom of the gearcase, ensuring that the tangs of the thrust washers enter the grooves of the case.

(3) Slide the reverse idler gear forward, lower the mainshaft assembly into the case and locate the bearing in the case bore. Tap the front of the mainshaft assembly with a soft hammer, until the mainshaft bearing snap ring can be assembled to locate on the rear face of the case.

(4) Install the maindrive gear assembly and fourth speed blocker ring into the case from the front. Fit the maindrive gear bearing outside diameter snap ring and tap the end of the maindrive gear with a soft hammer until the snap ring abuts the front of the case. Take care not to dislodge the maindrive gear rollers.

(5) If removed, press a new bearing retainer oil seal to the bearing retainer, tool E21A29 is suitable for this job. Coat the oil seal outside diameter with a light coat of gasket cement.

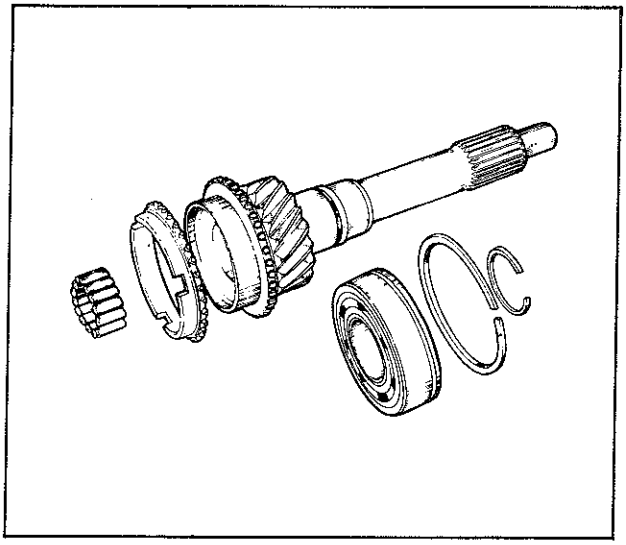


Fig. 23—Exploded view maindrive gear assembly

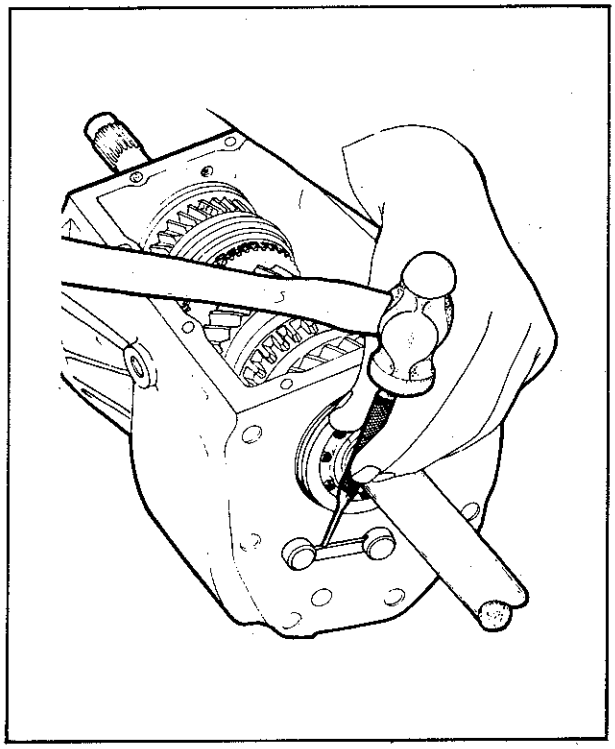


Fig. 24—Fitting lock plate

(6) Use a light coating of gasket cement to position the bearing retainer gasket and install the bearing retainer with 3 bolts, tightening to the specified torque. Coat the threads of the bolts with jointing compound.

(7) Bring the cluster gear into mesh by carefully turning the gear case upside down and allowing the cluster gear to drop into place. It may be necessary to rotate the maindrive gear to ensure proper meshing.

(8) Using the countershaft, drive out the dummy shaft through the front of the case until the locking plate slot in the countershaft is flush with the rear face of the case. The slots in the countershaft and the reverse idler must be parallel and adjacent.

(9) Install the locking plate to the countershaft and reverse idler shaft, tapping to bring the plate against the case.

NOTE: It is imperative when rebuilding a transmission that the lock plate is positioned completely within the retaining webs of the extension housing. This can be checked by placing the extension housing over the mainshaft and ensuring that the face of the extension housing sits squarely and flush against the main case face.

(10) Place reverse lever, reverse fork and torsion spring in position. Fit a new "O" ring and the outer snap ring to the reverse lever shaft and slide shaft assembly through the hole in the case. Fit the inner snap ring to the reverse lever shaft. Ensure correct fitment of torsion spring so that reverse lever returns to neutral position.

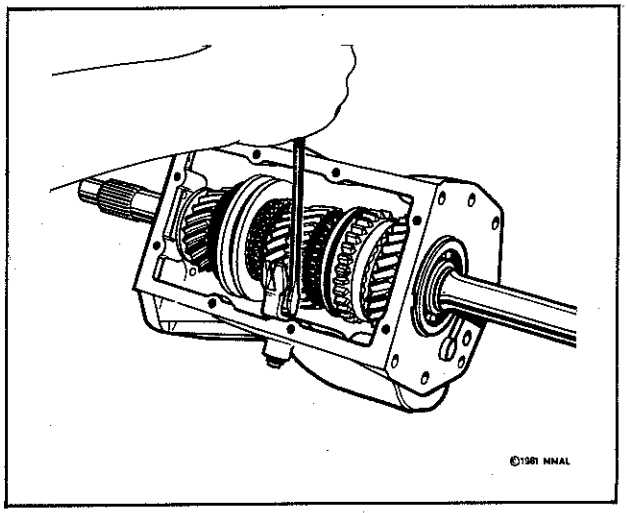


Fig. 25—Pressing reverse lever snap ring into place

(11) Operate the reverse lever by hand to ensure correct movement of the reverse idler gear.

(12) Slide the first and second synchronizer sleeve into the second gear position.

(13) Apply a continuous bead of RTV liquid gasket to the cover face.

(14) Place the top cover assembly (also in second gear position) in position and tighten top cover bolts finger tight.

(15) Install the clutch housing and tighten the 8 clutch housing bolts to the specified torque.

(16) Tighten the top cover bolts to the specified torque.

(17) Install the speedometer drive gear, drive ball and 2 snap rings to the mainshaft.

(18) If necessary install a new bush in the extension housing end as detailed later in this section.

Apply a 1,5 mm diameter bead of silastic RTV 732 or GE Silmate around the seal area at the rear of the top cover. Fill the bottom of the reverse light switch pocket with molybdenum disulphide grease.

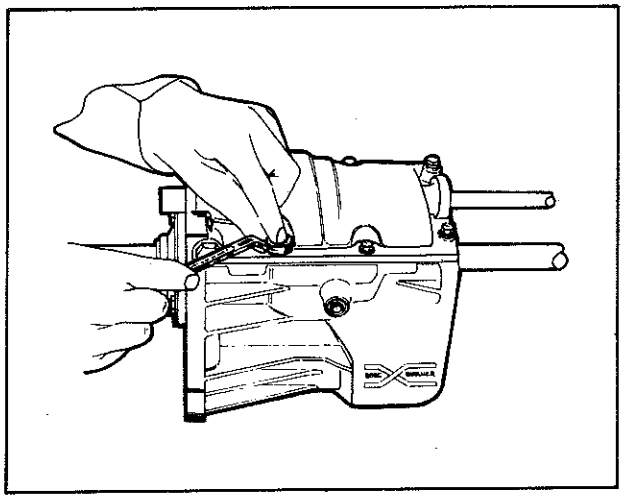


Fig. 26—Installing top cover

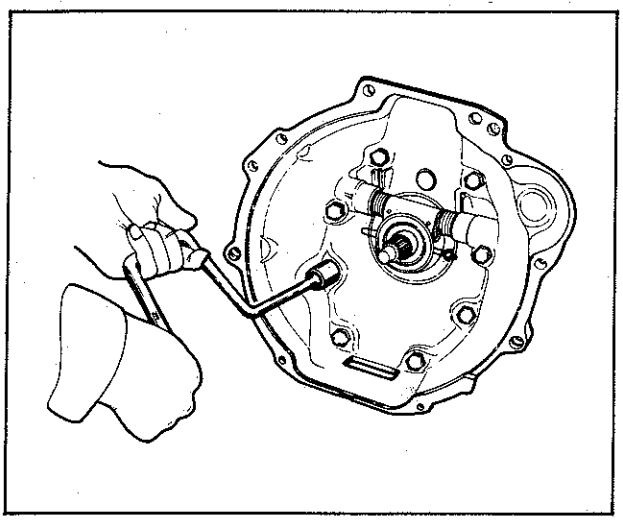


Fig. 27—Refilling clutch housing bolts

(19) Place a suitable protector over the mainshaft splines to prevent damage to the extension housing oil seal and bush whilst installing the extension housing.

(20) Use a light coating of gasket cement to position the extension housing gasket to the gearbox housing mating face. Install the extension housing with six bolts and lock washers and tighten to the specified torque.

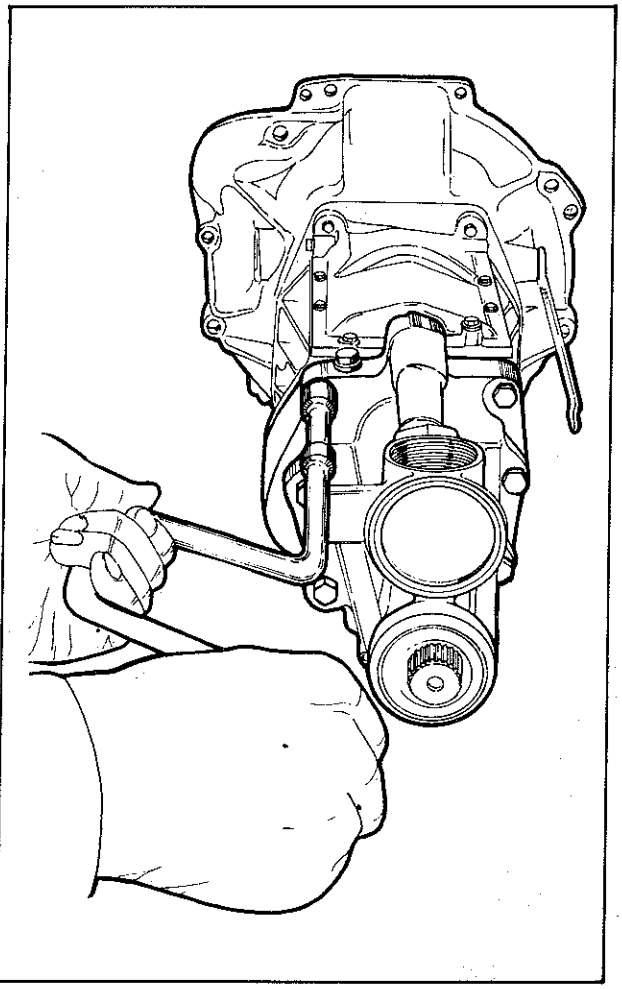


Fig. 28—Fitting extension housing

(21) Fit the reverse light switch to the housing and tighten to the specified torque.

(22) Assemble the gearshift link and plastic gear-lever damper block and place in the gearshift housing over the end of the gearshift rail.

(23) Press the roll pin into the gearshift link, using the holes provided in the gearshift housing, to connect the rail and the gearshift link.

(24) Fit the 2 plastic cup plugs and spring clip to the roll pin assembly holes in the gearshift housing.

(25) Fit a new metal cup plug to the housing, ensuring that the bottom of the plug is abutting the machined shoulder of the housing. Centre punch the cup plug flange in three equally spaced locations to further retain the cup plug.

(26) Fit the gear lever assembly and select each gear position in turn. Rotate input shaft to ensure correct operation of all gears and shift mechanism. Remove gear lever assembly before fitting transmission to vehicle.

NOTE: The gear lever fork should be coated in a general purpose grease before final fitment.

Extension Housing Yoke Seal Replacement

(1) Disconnect propellor shaft at rear universal joint. Carefully pull shaft yoke out of extension housing.

CAUTION: Be careful not to scratch or nick ground surface on sliding spline yoke during removal or installation of the shaft assembly.

(2) Remove the extension housing yoke seal using tool E6604.

(3) Position the new seal in opening of extension housing and drive it into the housing using tool E21M15.

(4) Carefully refit propellor shaft.

Extension Housing Bush Replacement

(1) Remove the extension housing as described in sections Transmission Removal and Transmission Disassembly.

(2) Remove the yoke seal.

NOTE: Support the housing over the edge of a bench to avoid damage to the dowel in the end of the housing.

(3) Using the long end of tool E21M11, drive out the bush, using a press or a plastic or hide faced hammer.

(4) Thoroughly clean out the housing.

(5) Locate the new bush on the short end of tool E21M11. **Ensure the oil hole in the bush lines up with the groove in the bottom of the housing** and drive in the new bush.

(6) Fit a new yoke seal and refit extension housing by reversing disassembly procedure.

SECTION 4B — TRANSMISSION FOUR SPEED SYNCHROMESH (KM110)

SPECIFICATIONS

GEAR RATIO

First	3.525:1
Second	2.193:1
Third	1.442:1
Fourth	1.000:1
Reverse	3.867:1

LUBRICANTS

Type	S.A.E. 80 Gear Oil
Capacity	1,7 litres (3.0 pts.)

INPUT SHAFT

Front Diameter	15,0 mm (0.5906")
Inside Diameter Needle Bearing Area	26,0 mm (1.0236")
Oil Seal Area Diameter	25,0 mm (0.9843")
End Play	0 to 0,06 mm (0 to 0.002")
Input Gear Snap Ring Thickness	2,30 mm (0.091") White
	2,35 mm (0.093") None
	2,40 mm (0.094") Red
	2,45 mm (0.096") Blue
	2,50 mm (0.098") Yellow
Input Bearing End Play	0 to 0,1 mm (0 to 0.004")
Bearing Spacer Thickness	0,84 mm (0.033") Black
	0,93 mm (0.037") None
	1,02 mm (0.040") Red
	1,11 mm (0.044') White
	1,20 mm (0.047") Yellow
	1,29 mm (0.051") Blue
	1,38 mm (0.054") Green

CLUSTER GEAR

Shaft Diameter	18,145 mm (0.7144")
Shaft Bend (Max.)	0,02 mm (0.0008")
Bearing Surface Inside Diameter	24,53 mm (0.9657")
End Play	0,05 to 0,18 mm (0.002 to 0.007")
Rear Thrust Washer Thickness	2,040 mm (0.080") A
	2,110 mm (0.083") B
	2,145 mm (0.084") F
	2,180 mm (0.086") C
	2,215 mm (0.087") G
	2,250 mm (0.089") D
	2,330 mm (0.092") E

REVERSE IDLER GEAR

Gear Ring Inside Diameter	20,0 mm (0.7874")
Shaft Diameter	16,0 mm (0.6299")
End Play	0,05 to 0,30 mm (0.002" to 0.012")
Rear Thrust Washer Thickness	1,790 mm (0.070") None
	1,980 mm (0.078") A
	2,075 mm (0.082") E
	2,170 mm (0.085") B
	2,265 mm (0.089") F
	2,360 mm (0.093") C
	2,550 mm (0.100") D

MAIN SHAFT

Front Diameter	20,0 mm (0.7874")
First Gear Diameter	30,0 mm (1.1811")
Second — Third Gear Diameter	35,0 mm (1.3780")
First Gear Spacer Bushing Diameter	37,0 mm (1.4567")
End Play	0 to 0,15 mm (0 to 0.006")
Rear Bearing Snap Ring Thickness	1,44 mm (0.057") None 1,53 mm (0.060") Red 1,62 mm (0.064") White 1,71 mm (0.067") Yellow 1,80 mm (0.071") Blue
Synchronizer Ring to Gear Gap (Min.)	0,8 mm (0.032")
Third, Fourth Synchronizer Sleeve	
— Width of Fork Groove	5,0 mm (0.1969")
— Fork to Groove Clearance	0,1 to 0,3 mm (0.004" to 0.012")
Third Speed Gear	
— Internal Diameter	40,0 mm (1.5748")
— End Play	0,03 to 0,19 mm (0.001" to 0.007")
Third, Fourth Synchronizer Hub	
— End Play	0 to 0,08 mm (0 to 0.003")
— Snap Ring Thickness	2,15 mm (0.085") None 2,22 mm (0.087") Yellow 2,29 mm (0.090") Green 2,36 mm (0.093") Blue
Second Speed Gear	
— Internal Diameter	40,0 mm (1.5748")
— End Play	0,03 to 0,19 mm (0.001" to 0.007")
First, Second Synchronizer Sleeve	
— Width of Fork Groove	5,0 mm (0.1969")
— Fork to Groove Clearance	0,1 to 0,3 mm (0.004" to 0.012")
First Speed Gear	
— Internal Diameter	42,0 mm (1.6535")
— End Play	0,03 to 0,19 mm (0.001" to 0.007")
Reverse Gear	
— Width of Fork Groove	5,0 mm (0.1969")
— Fork to Groove Clearance	0,1 to 0,3 mm (0.004" to 0.012")

GEAR SELECTOR ASSEMBLY

Shift Rail Bend	0,04 mm (0.0016") max.
First, Second Selector	
— Change Lever Groove Width	12,0 mm (0.4724")
— Change Lever Clearance	0,1 to 0,3 mm (0.004" to 0.012")
Reverse Detent Spring	
— Free Length	31,4 mm (1.236")
— Load	4 kg/27,7 mm (8.8 lbs./1.091")
Forward Detent Spring	
— Free Length	18,9 mm (0.744")
— Load	4 kg/15,2 mm (8.8 lbs./0.598")

SPECIAL TOOLS

E21M10	Front Oil Seal Installer
E21M10B	Installer Extension Housing Oil Seal
E21M15	Front Bearing Installer
E21M15B	Wrench Main Shaft Nut
E21M20	Bearing Puller

TORQUE SPECIFICATIONS

	Nm	lbs./ft.	lbs./in.
Back-up lamp switch	30	22	
Bottom cover attaching bolts	9	7	84
Clutch cable bracket bolts	11	8	96
Drain plug	58	43	
Gear lever housing bolts	7	5	60
Idler shaft set screw	7	5	60
Main shaft lock nut	49-98	36-72	
Oil filter plug	34	25	
Transmission mounting bolts	41	30	

GENERAL INFORMATION

The transmission is a four-speed fully synchronized type using four strut type synchronizers. All forward gears are helical cut and in constant mesh to give smooth quiet operation.

Reverse gear is of a spur type and is splined to the rear of the main shaft.

The one piece alloy case has a removable bottom cover for access to the internal components.

The forward speed synchronizers are splined to the main shaft and permit clutching to the respective speed gears, which are in constant mesh with the cluster gear. The first, second and third speed gears when not engaged by the synchronizer sleeve splines, are free to rotate on the main shaft. It is important to maintain running clearances specified or seizure may result owing to expansion of the components.

The inner hubs of the synchronizer assemblies are splined to the mainshaft, and fitted with three shifting plates, which fit into slots in the inner hubs. The plates are located by two circular synchronizer springs between the inner hubs and the synchronizer sleeves, which are splined to the inner hubs. The shift plates fit into three recesses in the bronze blocker rings, which fit over the tapered cones of the gears. The blocker rings have clutch teeth similar to those on the gears.

When a forward speed gear is to be engaged, the synchro sleeve, carrying with it the shaft plates, moves over the inner hub bringing the shift plates into contact with the back face of the recesses in the blocker ring. There is sufficient lateral clearance for the shift plates in the blocker ring recesses to allow the blocker ring clutch teeth to move out of line with the splines on the inner hub, due to the frictional drag of the blocker ring tapers on the gear cones. This prevents the synchronizer sleeve from moving over the blocker ring teeth until such time as the gear and the blocker ring are rotating at the same speed. When this occurs the shift pads centralize in the blocker ring recesses, the synchronizer sleeve clutch teeth move over the clutch teeth of the blocker ring and engage the clutch teeth of the gear.

To engage reverse gear, the gear located behind the rear main shaft bearing, is moved into mesh with the reverse idler gear, drive being transfered to the main shaft through the splined reverse gear.

The cluster gear runs on two rows of roller bearings, the input shaft and main shaft on ball bearings, the reverse idler on needle bearings and the first, second and third speed gears on needle bearings. The main shaft is also supportd by a set of needle rollers in the input shaft.

The interlock mechanism consists of interlock pins located between the shift rails, which prevent the engagement of two gears simultaneously. Detent balls and springs are located onto each shift rail providing a load which must be overcome by a force applied to the gearshift lever before a gear change can be made.

TRANSMISSION REMOVAL

(1) Disconnect the battery ground (negative) lead.
(2) Drain the lubricant from the transmission.
(3) Remove the starter motor.
(4) Remove propeller shaft, back-up light switch leads and speedometer cable.
(5) From inside the vehicle, remove the gear lever boot retaining plate and screws and remove the bolts attaching the gear lever to the extension housing.

NOTE: The gear lever should be placed in the second gear position prior to removal.

(6) Disconnect the clutch cable.
(7) Remove the clutch housing cover.
(8) Support the rear of the engine with a suitable jack and remove the rear cross member.
(9) Remove the bolts attaching the transmission to the engine and remove the transmission.

NOTE: Care must be taken to slide the transmission straight back off the clutch assembly to avoid damage to the clutch or input shaft assembly.

TRANSMISSION INSTALLATION

Install the transmission by reversing the removal procedure, noting the following:

(1) When installing the transmission do not allow it to hang on the clutch assembly.
(2) Tighten all bolts to the specified torque.
(3) Ensure the clutch housing cover is not damaged or bent.
(4) Adjust the clutch as specified in Group 6.

(5) When installing gear lever, place the selector rod in the second speed position, and ensure that dust and dirt does not enter the selector mechanism.

(6) Install the gear lever dust boot securely onto the body flange.

(7) Fill the transmission with the correct grade and quantity of lubricant.

TRANSMISSION DISASSEMBLY

(1) For removal of the clutch control lever shaft and arm, refer Group 6 Clutch.

(2) Remove the speedometer locking plate and then the speedometer driven gear assembly.

(3) Remove the back-up lamp switch and remove the ball, taking care not to lose it.

(4) Remove the extension housing, if necessary tap it lightly with a soft hammer to free it from the case.

(5) Lay the transmission upside down and remove the bottom cover.

(6) Remove the snap ring retaining the speedometer drive gear and remove the gear and drive ball.

(7) Remove the input shaft bearing retainer, if necessary tap it lightly with a soft hammer to aid removal.

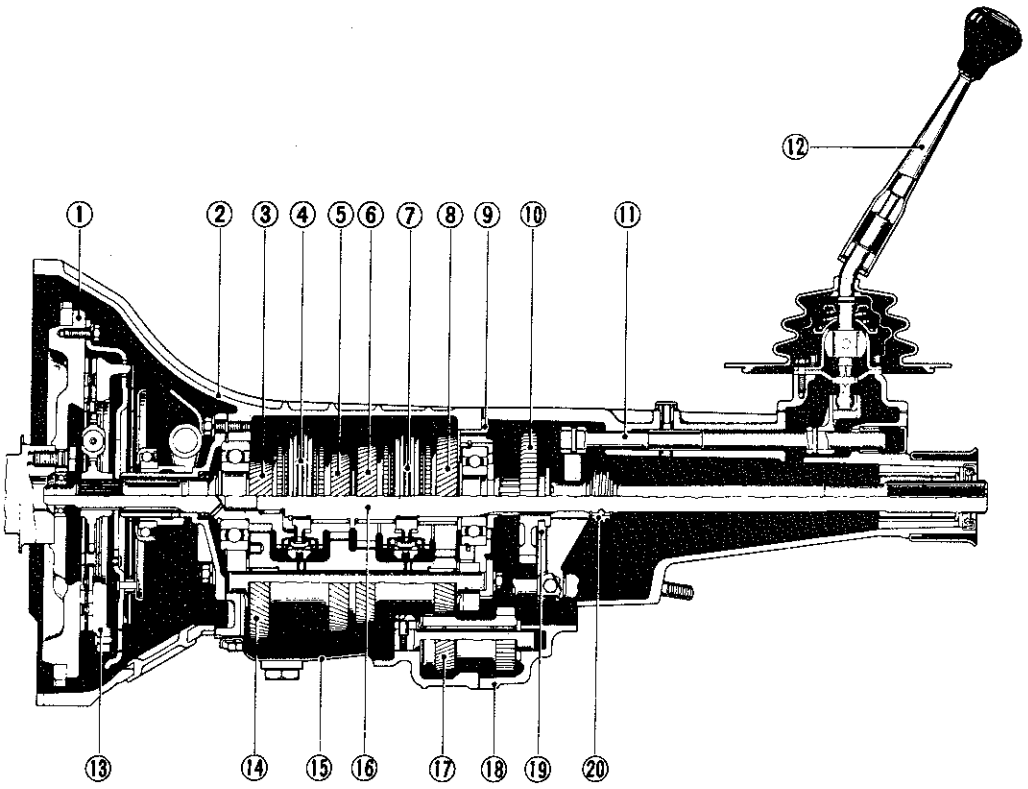
(8) Remove the cluster gear retainer.

(9) Withdraw the cluster gear shaft through the rear of the case and remove the cluster gear, needle rollers, spacers and thrust washers.

(10) Remove the reverse idler rear thrust washer, gear, needle bearings, spacer and front thrust washer from the shaft.

(11) Remove the reverse idler gear shaft locking bolt and withdraw the shaft from the rear of the case.

(12) Remove the three plugs from the right hand side of the case and remove the springs and balls keeping them in order.



1 Flywheel
2 Transmission case
3 Main drive gear
4 Synchronizer sleeve (for third-fourth speed)
5 Third-speed gear
6 Second-speed gear
7 Synchronizer sleeve (for first-second speeds)
8 First-speed gear
9 Rear bearing retainer
10 Reverse gear
11 Control shaft
12 Gearshift lever assembly
13 Pressure plate assembly
14 Cluster gear
15 Bottom cover
16 Mainshaft
17 Reverse idler gear
18 Extension housing
19 Shift fork (reverse)
20 Speedometer drive gear

Fig. 1—Sectioned view of manual transmission

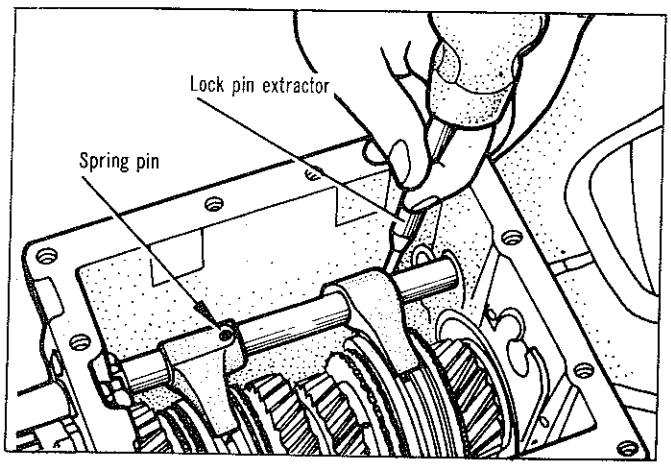


Fig. 2—Removing roll pins

(13) Remove the reverse gear, reverse shift rail and fork.

(14) Remove the shift rail and fork roll pins using a 5 mm (3/16") punch.

(15) Withdraw each shift rail and selector towards the rear of the case and remove the shift fork. The shift rail and selector should not be disassembled.

NOTE: When removing shift rails care must be taken not to drop the inter lock plungers located in the transmission case.

(16) Withdraw the main shaft assembly rearwards off the rear bearing retainer and remove the synchronizer ring and main shaft spigot needle bearings.

(17) Using snap ring pliers, remove the rear bearing retainer from the bearing.

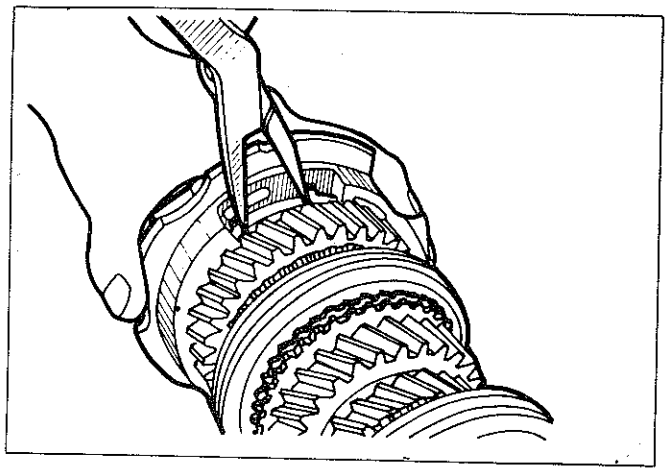


Fig. 3—Removing bearing retainer

(18) Remove the lock nut.

(19) Holding the main shaft assembly, tap the rear end of the shaft on a wooden block to remove the rear bearing.

(20) Remove the spacer, first gear, needle bearing, spacer bushing, synchronizer ring, first-second speed synchronizer assembly, synchronizer ring, second speed gear and needle bearing.

(21) Remove the snap ring from the front end of the main shaft and remove the third-top speed synchronizer assembly, synchronizer ring, third speed gear and needle bearing.

(22) Disassemble each synchronizer assembly into the sleeve, hub, springs and shift plates. All the parts are identical except the hubs, but they should be assembled in the position from which they were removed.

(23) Withdraw the input shaft assembly from the front of the case.

(24) Remove the snap ring and using a suitable puller remove the input shaft bearing, Fig. 5.

(25) Using a parallel punch remove the shift control shaft roll pin, Fig. 6.

(26) Remove the return spring and shift control shaft.

(27) Disassemble the control lever assembly into the central housing, stopper plate and lever assembly.

INSPECTION

After cleaning, inspect all parts for wear or damage, replacing or repairing faulty components.

Case

Check the transmission case and extension housing for cracks and damage.

Main Shaft

Check the main shaft for worn or damaged gear mounting areas and splines. Check bushing, spigot and gear mounting diameters to specification.

Input Shaft

Check the flywheel spigot area outside diameter and the mainshaft spigot bearing area inside diameter for wear or damage.

Inspect the synchronizer gear and cone for rough or damaged contact surfaces and for worn or damaged teeth.

Inspect the helical gear for worn or damaged teeth.

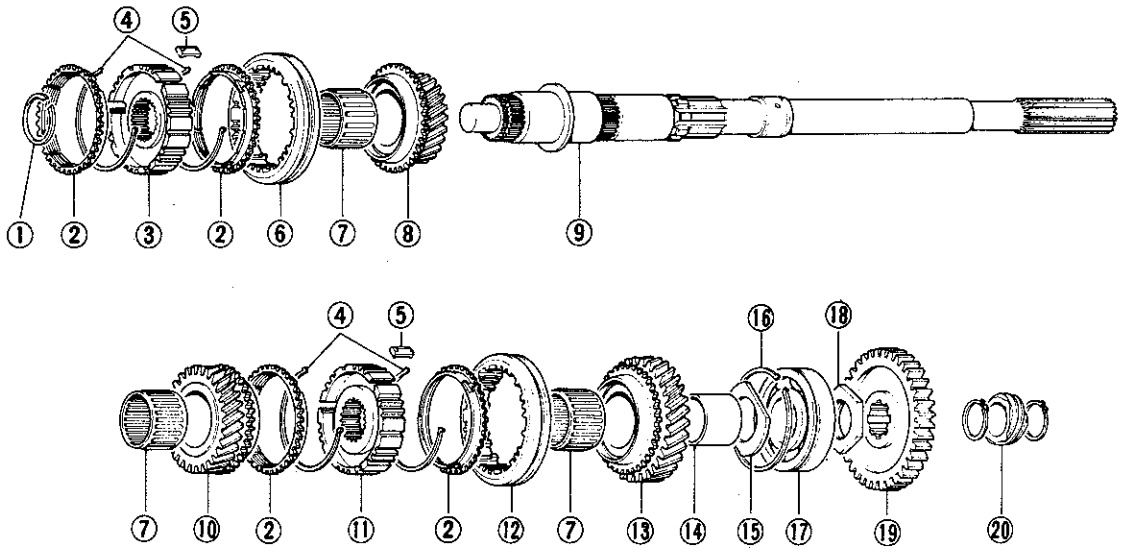
Inspect the clutch plate splines for damage, wear, looseness and sliding condition with the clutch plate.

Gears

Inspect the helical gear and clutch gear for worn or damaged teeth.

Inspect the cone surface for wear or damage.

Check the gear inside diameter and the front and rear surface of each gear for wear or damage.



1 Snap ring
2 Synchronizer ring
3 Synchronizer hub (3rd-4th speeds)
4 Synchronizer spring
5 Synchronizer shift plate
6 Synchronizer sleeve (3rd-4th speeds)
7 Needle bearing
8 3rd-speed gear
9 Mainshaft
10 2nd-speed gear
11 Synchronizer hub (1st-2nd speeds)
12 Synchronizer sleeve (1st-2nd speeds)
13 Low-speed gear
14 Spacer bushing
15 Spacer
16 Snap ring
17 Ball bearing
18 Lock nut
19 Reverse gear
20 Speedometer drive gear

Fig. 4—Main shaft disassembled view

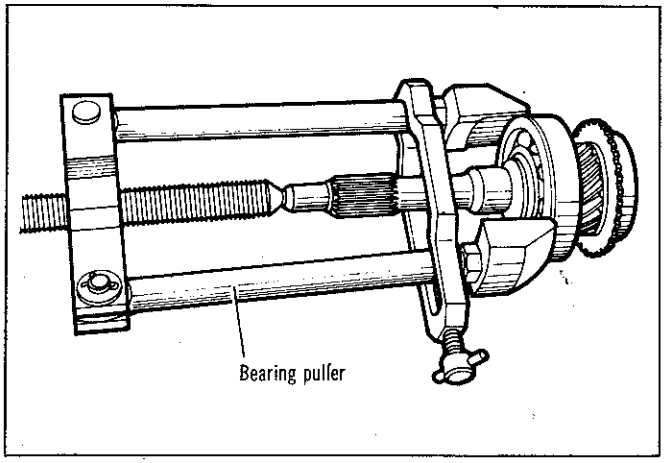


Fig. 5—Removing input shaft bearing

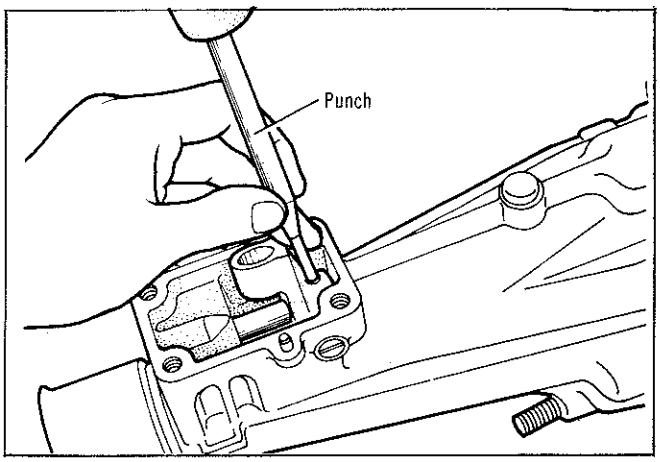


Fig. 6—Removing shift control shaft roll pin

Synchronizer Ring

Inspect the ring tooth surface for damage and also its gear contact surface for excessive or uneven wear.

Check the ring to gear gap 'A' (Fig. 7), and replace ring if the gap is less than the specified limit.

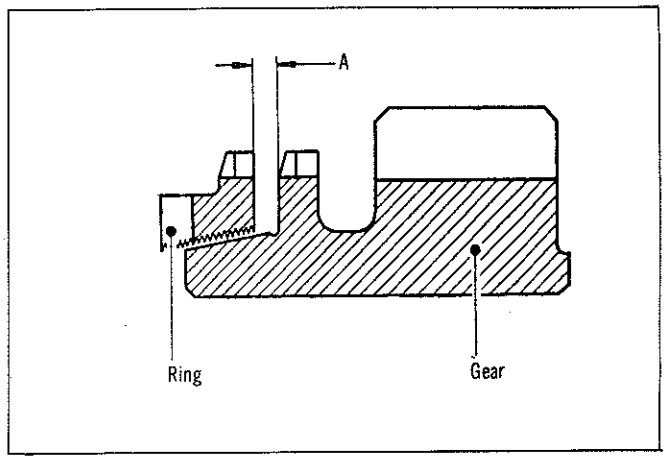


Fig. 7—Synchronizer ring to gear gap

Synchronizer Hub and Sleeve

Assemble the synchronizer sleeve and hub checking that the hub slides smoothly within the sleeve.

Check both ends of the hub for damage and the sleeve grooves for wear.

NOTE: If either the hub or the sleeve require replacement due to damage or wear, both the hub and sleeve must be replaced as an assembly.

Synchronizer Shift Plates and Springs

Inspect the shift plates for excessive wear, especially around the central projection and for any other defects.

Inspect the springs for deterioration and breakage.

Cluster Gear and Shaft

Inspect each gear for damage, wear and any other tooth surface failure.

Check the front and rear thrust washer surfaces and the internal needle roller bearings contact surface for wear and damage.

Check the cluster gear shaft for wear and bend.

Reverse Idler Gears and Shaft

Check each gear for cracked, damaged or worn teeth and both ends of each gear for wear or damage.

Check the shaft for wear and bend.

Install the front gear onto the splined end of the rear gear and check for looseness and sliding motion of the front gear on the spline.

Selection Mechanism

Check the clearances between the fork and the fork groove on the synchronizer sleeve.

Check the shift rails for bend and the interlock plunger slot for wear.

Check the clearance between the gear selector lever and shift rail selector.

Needle Bearings and Ball Bearings

Check the ball bearings for noise and smoothness when rotated.

Check the needle bearing cages for damage and deformation.

NOTE: Do not spin bearings with compressed air as the lack of lubricant will damage the bearings.

Interlock Plungers, Detent Balls and Springs

Check the plunger and ball surfaces for excessive damage.

Check each spring for breakage and wear.

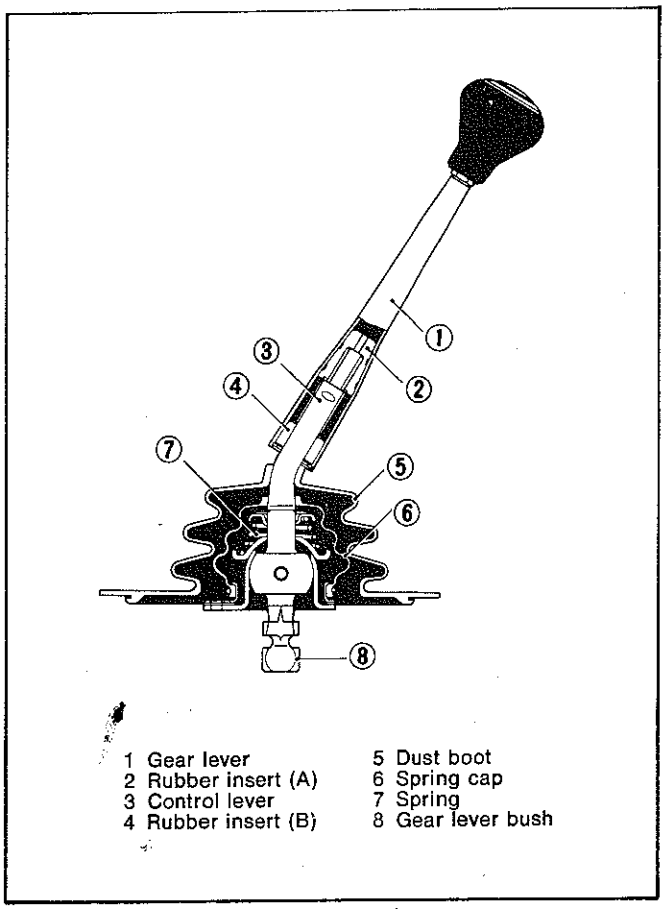


Fig. 8—Cross section of gear lever assembly

Gear Lever Assembly

Check the stop plate groove for wear, the gear lever to control lever rubber inserts for permanent strain, the spring for permanent set and the fulcrum for wear of the sliding section. Check the control lever stopper, the nylon bushing at the lower end of the gear lever, and the rubber dust boot for wear or damage.

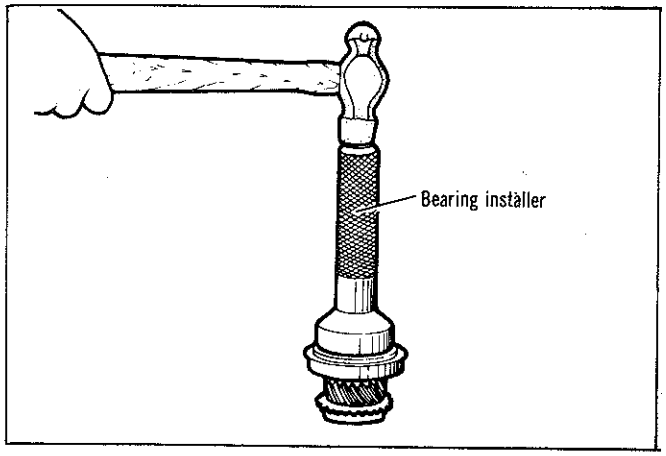


Fig. 9—Installing input shaft bearing

TRANSMISSION ASSEMBLY

When assembling the transmission the following procedures should be observed:

- **All old seals, gaskets and roll pins should be replaced with new ones.**
- **All parts should be cleaned thoroughly and lubricated prior to installation.**
- **Lip type oil seals should be filled with grease.**

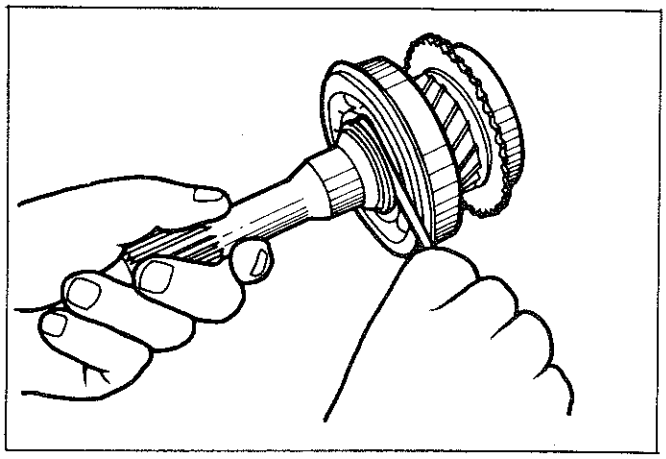


Fig. 10—Checking bearing end play

(1) Using a suitable tool install the input shaft bearing and then install a suitable thickness snap ring to retain the bearing end play within specifications.

(2) Assemble the synchronizer sleeves, hubs, shift plates and springs in the order they were removed. Position the open ends of the synchronizer springs away from each other i.e. so that the gaps are not in the same hub segment, Fig. 11.

(3) Install the needle bearing and third speed gear onto the front of the main shaft.

(4) Install the synchronizer ring and third-fourth speed synchronizer assembly onto the main shaft and install a suitable thickness snap ring to retain the end play within specification.

(5) Install the needle bearing and second speed gear onto the rear of the main shaft.

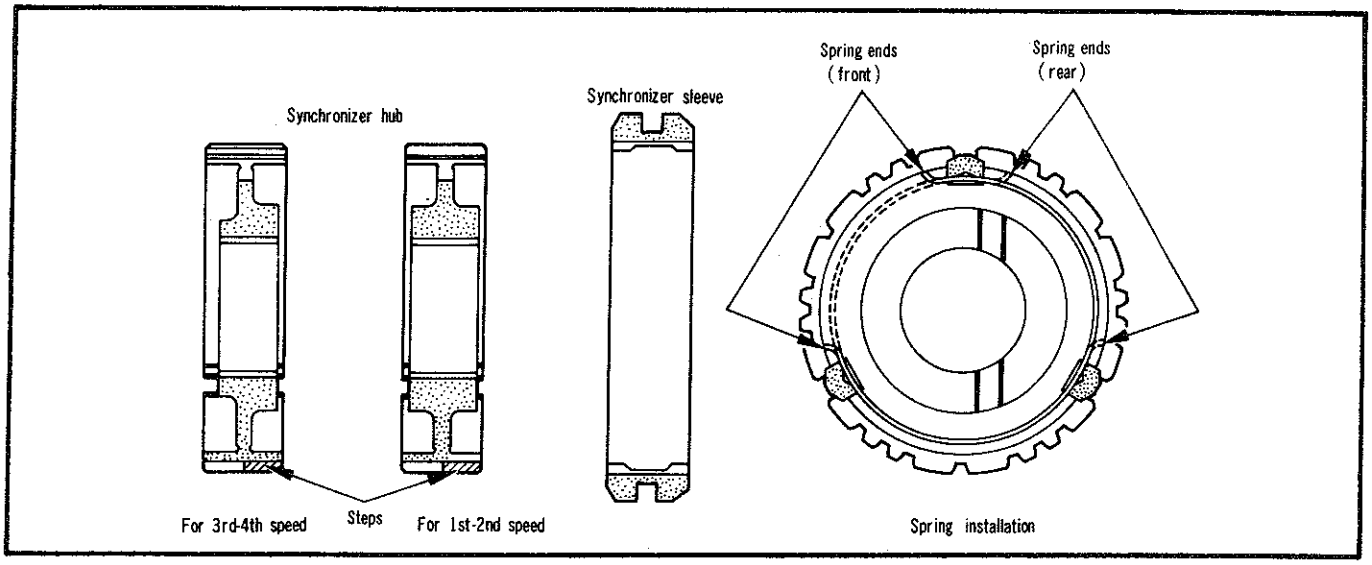


Fig. 11—Synchronizer and spring location

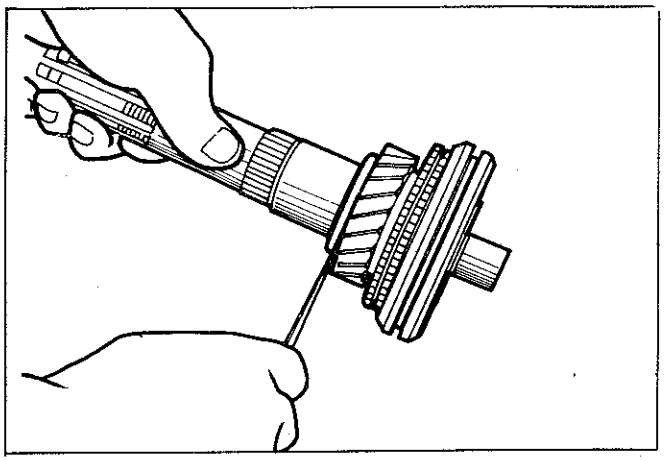


Fig. 12—Checking third gear end play

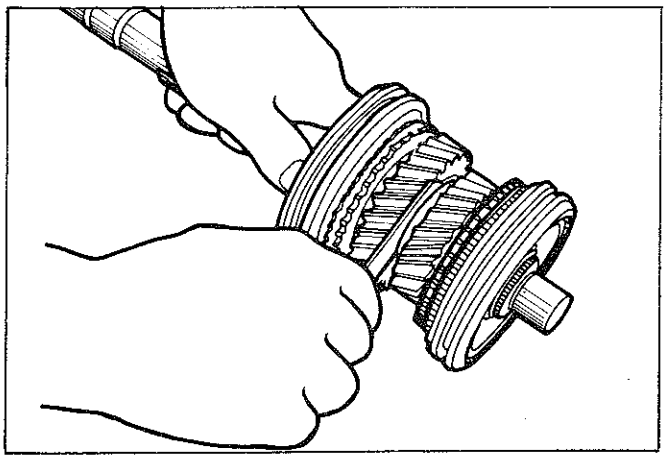


Fig. 14—Checking second gear end play

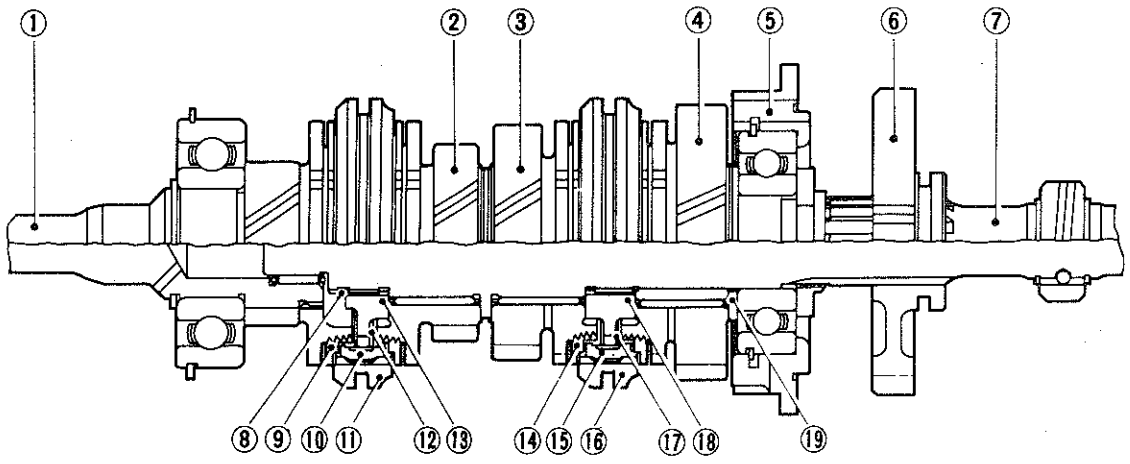
(6) Install the synchronizer ring and first-second speed synchronizer assembly onto the main shaft.

(7) With the synchronizer assembly forced forward, check the second speed gear end play.

(8) Install the first speed gear bushing, needle bearing, synchronizer ring, gear and spacer washer. With this assembly forced forward check the first speed gear end play.

NOTE: The spacer must be installed with the identification mark 'I' towards the rear main shaft bearing.

(9) Using a suitable tool install the main shaft bearing. Install and tighten the lock nut to the specified torque. Lock the nut to the key-way in the mainshaft by staking the nut with a suitable drift.



1 Input shaft
2 Third speed gear
3 Second speed gear
4 First speed gear
5 Rear bearing retainer
6 Reverse gear
7 Mainshaft
8 Snap ring
9 Synchronizer ring
10 Synchronizer shift plate
11 Synchronizer sleeve
12 Synchronizer spring
13 Synchronizer hub (third-fourth)
14 Synchronizer ring
15 Synchronizer shift plate
16 Synchronizer sleeve
17 Synchronizer spring
18 Synchronizer hub (first-second)
19 Spacer

Fig. 13—Cross section of main shaft assembly

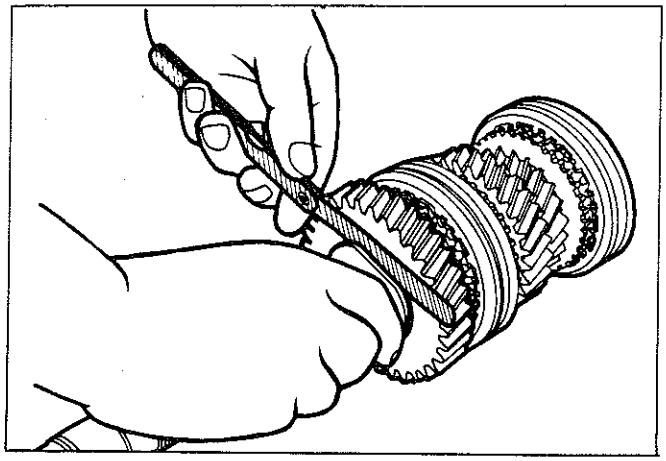


Fig. 15—Checking first gear end play

(10) Install the rear bearing retainer snap ring and fit the retainer onto the bearing ensuring the bearing end play (snap ring to bearing retainer play) is within specification.

If it is difficult to check the end play, select the thickest snap ring, if it is too thick to fit the bearing groove or leaves no end play, fit the next thinner snap-ring.

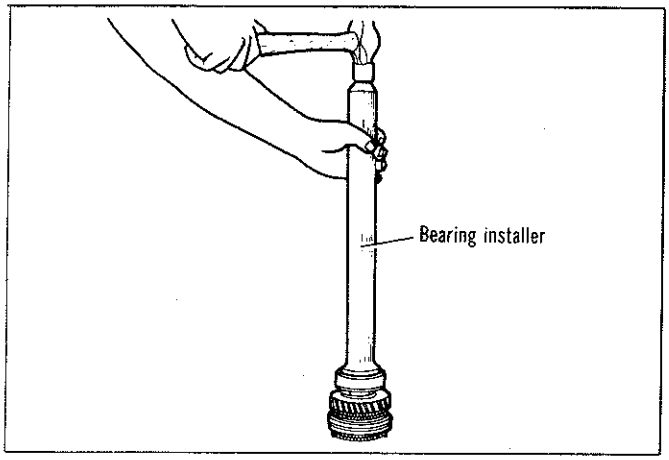


Fig. 16—Installing main shaft bearing

(11) Install the input shaft into the case.

(12) Install the input shaft needle bearing applying grease to the bearing prior to installation.

(13) Install the fourth speed synchronizer ring to the input shaft gear cone.

(14) Install the mainshaft assembly into the case through the rear and position it into mesh with the input shaft.

(15) Install each shift fork onto the appropriate groove of the synchronizer assembly. Holding the forks in position, install the third-fourth speed shift rail assembly into the case and through each shift fork.

(16) Install the interlock plunger into the case through the rear bore, and push the plunger into its hole by using a screw driver through the top opening of the case.

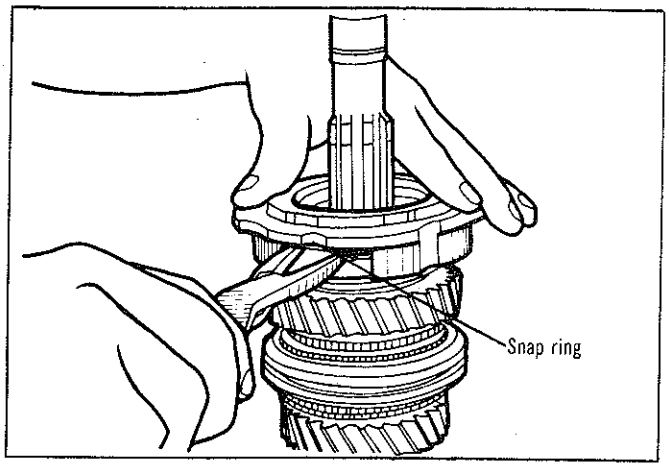


Fig. 17—Installing bearing retainer

(17) Install the first-second speed shift rail into place and align both shift forks with the holes in the shift rails. Fix the forks in position on the rails using new roll pins.

NOTE: The roll pins must be installed with the gaps aligned with the shift rail centre line.

(18) Install the second interlock plunger.

(19) Install the reverse gear onto the main shaft and position the reverse gear fork into the gear groove. Fit the distance piece onto the shift rail and install the assembled shift rail into the case.

(20) Install the detent balls and springs with the tapered end of the spring towards the ball. The long spring is fitted to the reverse (lower) shift rail.

(21) Apply sealant to the plugs and tighten the plugs until they are flush with the case surface.

(22) Install the reverse idler gear shaft, tighten the lock bolt and secure the bolt with the locking tab.

(23) Install the front thrust washer, needle bearing, distance piece and needle bearing onto the shaft.

(24) Install both reverse idler gears.

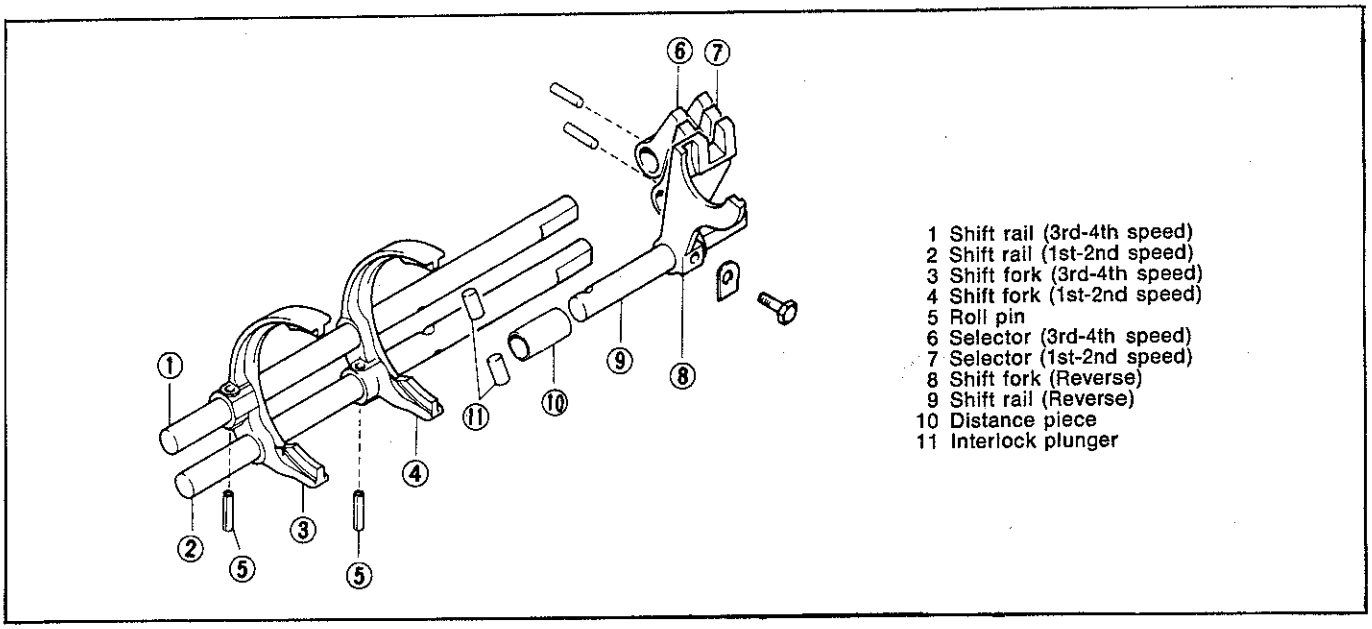


Fig. 18—Gear selector assembly

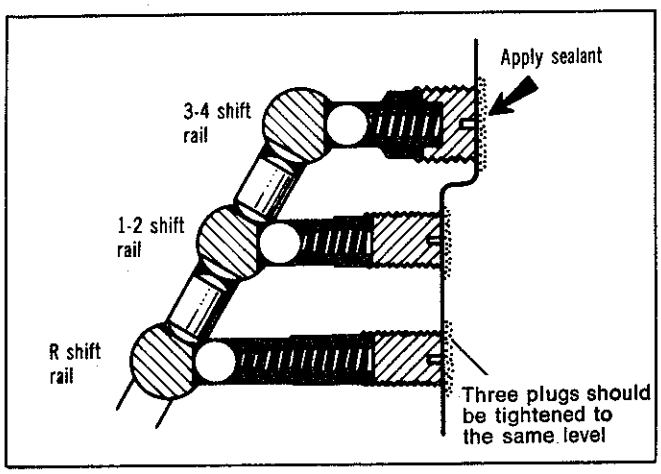


Fig. 19—Detent ball, spring and plug location

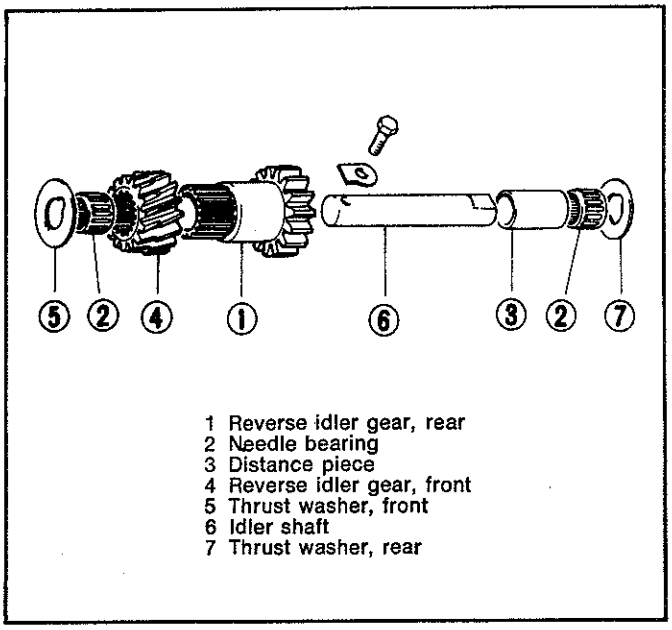


Fig. 20—Reverse idler gear assembly

(25) Select and install the rear thrust washer using the following procedure:

(a) Measure the distance between the rear surface of the case and the rear end of the rear reverse idler gear, Fig. 21.

(b) Measure the depth from the end of the extension housing to the thrust face of the idler gear shaft hole.

The thickness of the washer is determined by (b) + 0.1 mm (0.004") (thickness of extension housing gasket) — (a) — reverse idler gear specified end play.

(26) Temporarily install the cluster gear, thrust washers and shaft and measure the end play of the cluster gear. If the end play is not within specification, replace the rear thrust washer with a suitable thickness washer, Fig. 22.

(27) Install the needle rollers and the bearing spacers in the front and rear cluster gear bores. Applying grease to the rollers will assist in holding them in position. The spacers are installed on the outside of the rollers, Fig. 23.

(28) Attach the front and rear thrust washers to the cluster gear with grease.

(29) Carefully position the assembled cluster gear into the case, ensuring the thrust washer tongue fits into the case groove.

(30) Install the cluster gear shaft from the rear of the case, ensuring the thrust washers and needle rollers are correctly positioned.

(31) Install the cluster gear shaft stopper plate.

(32) Install a new input shaft seal onto the bearing retainer, fill the seal lip with grease.

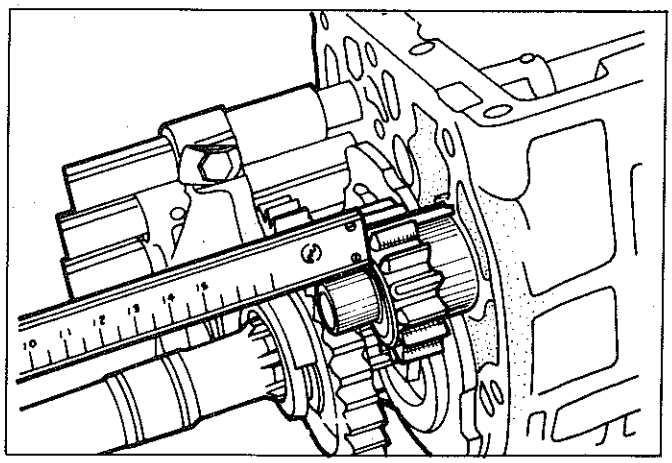


Fig. 21—Measuring idler gear distance from case

(33) Prior to installing the bearing retainer check the dimensions A and B, Fig. 25, and adjust the retainer-to-bearing clearance to specifications as follows:

Shim size = B + 0.3 mm (0.012") (gasket thickness) — A.

(34) Install the bearing retainer with a new gasket and the correct size bearing shim.

(35) Install the speedometer gear, drive ball and snap ring to the main shaft.

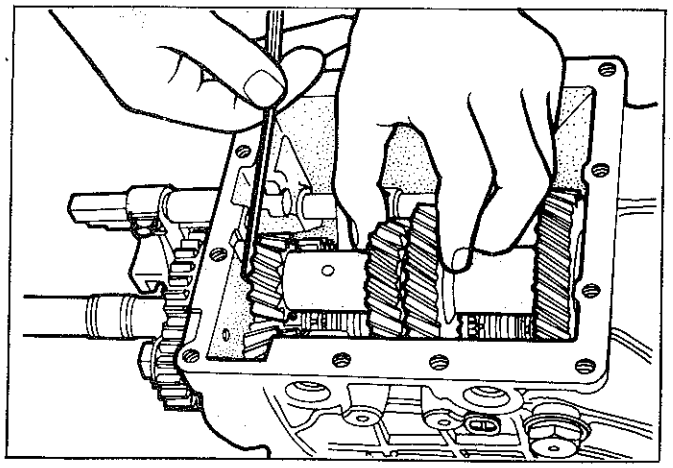


Fig. 22—Checking cluster gear end play

(36) Install the extension housing with a new gasket applying sealer to the gasket and bolts.

(37) Install the ball in the back-up light switch hole and install the switch. Apply sealant to the thread of the switch prior to installation.

(38) Install the speedometer driven gear to the housing and secure the bolt with the locking tab.

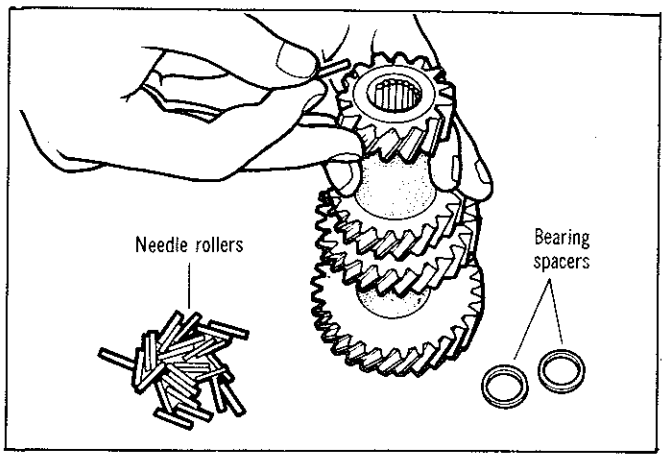


Fig. 23—Installing needle rollers

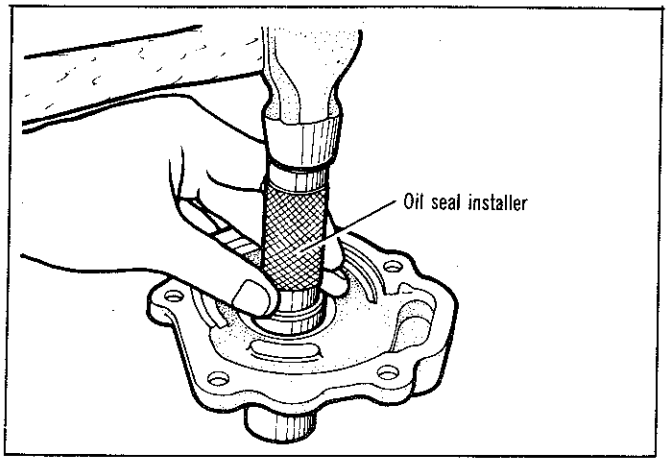


Fig. 24—Installing bearing retainer seal

(39) Install the transmission bottom cover tightening the bolts to the specified torque in a criss-cross manner.

(40) For installation of clutch lever refer to Group 6 Clutch.

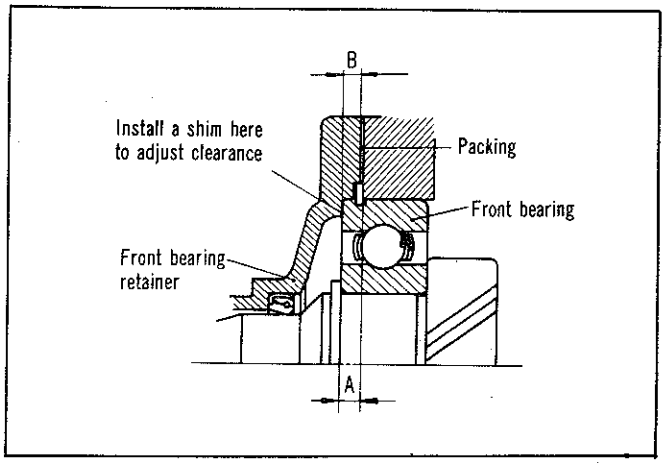


Fig. 25—Front bearing retainer clearance adjustment

SECTION 5A — TRANSMISSION FIVE SPEED SYNCHROMESH (KM132) ASTRON ENGINE

SPECIFICATIONS

GEAR RATIO

First	3.369:1
Second	2.035:1
Third	1.360:1
Fourth	1.000:1
Fifth	0.856:1
Reverse	3.635:1

LUBRICANT

Type	SAE 80 Gear Oil
Capacity	2.3 litres (4.0 pts.)

INPUT SHAFT

Front Diameter	15,0 mm (0.5906")
Inside Diameter Needle Bearing Area	26,0 mm (1.0236")
Oil Seal Area Diameter	25,0 mm (0.9843")
End Play	0 to 0,06 mm (0 to 0.002")
Input Gear Snap Ring Thickness	2,30 mm (0.091") White
	2,35 mm (0.093") None
	2,40 mm (0.094") Red
	2,45 mm (0.096") Blue
	2,50 mm (0.098") Yellow
Input Bearing End Play	0 to 0,1 mm (0 to 0.004")
Bearing Spacer Thickness	0,84 mm (0.033") Black
	0,93 mm (0.037") None
	1,02 mm (0.040") Red
	1,11 mm (0.044") White
	1,20 mm (0.047") Yellow
	1,29 mm (0.051") Blue
	1,38 mm (0.054") Green

CLUSTER GEAR

Shaft Diameter	25,0 mm (0.9843")

REVERSE IDLER GEAR

Inside Diameter	20,0 mm (0.7874")
Shaft Diameter	16,0 mm (0.6299")
End Play	0,12 to 0,28 mm (0,005" to 0,011")

MAIN SHAFT

Front Diameter	20,0 mm (0.7874")
First Gear Diameter	35,0 mm (1.3780")
Second Gear Diameter	43,0 mm (1.6929")
Third Gear Diameter	35,0 mm (1.3780")
Fifth Gear Diameter	30,0 mm (1.1811")
First Gear Spacer Bushing Diameter	43,0 mm (1.6929")
Fifth Gear Spacing Bushing Diameter	35,0 mm (1.3780")
Main Shaft Bend (Max.)	0,02 mm (0.0008")
Synchronizer Ring to Gear Gap (Min.)	0,8 mm (0.032")

Third/Fourth Synchronizer Sleeve	
— Width of Fork Groove	5,0 mm (0.1969")
— Fork to Groove Clearance	0,1 to 0,3 mm (0.004" to 0.012")
Third Speed Gear	
— Internal Diameter	40,0 mm (1.5748")
— End Play	0,04 to 0,20 mm (0.002" to 0.008")
Third/Fourth Synchronizer Hub	
— End Play	0 to 0,08 mm (0 to 0.003")
— Snap Ring Thickness	2,15 mm (0.085") None 2,22 mm (0.087") Yellow 2,29 mm (0.090") Green 2,36 mm (0.093") White
Second Speed Gear	
— Internal Diameter	48,0 mm (1.8897")
— End Play	0,04 to 0,20 mm (0.002" to 0.008")
First/Second Synchronizer Sleeve	
— Width of Fork Groove	5,0 mm (0.1969")
— Fork to Groove Clearance	0,1 to 0,3 mm (0.004" to 0.012")
First Speed Gear	
— Internal Diameter	48,0 mm (1.8897")
— End Play	0,04 to 0,20 mm (0.002" to 0.008")
Fifth Speed Gear	
— Internal Diameter	40,0 mm (1.5784")
— End Play	0,1 to 0,25 mm (0.004" to 0.010")

GEAR SELECTOR ASSEMBLY

Shift Rail Bend (Max.)	0,04 mm (0.0016")
Detent Spring	
— Free Length	18,9 mm (0.744")
— Load	4,0 kg/15,2 mm (8.8 lbs./0.5984")
Neutral Return Spring	
— Free Length	41,6 mm (1.638")
— Load	4,0 kg/31,6 mm (8.8 lbs./1.244")
Resistance Spring	
— Free Length (Up to trans. 5C39060)	27,7 mm (1.091")
— Free Length (From trans. 5C39061)	33,7 mm (1.327")
— Load	6,3 kg/22,5 mm (13.9 lbs./0.886")

SPECIAL TOOLS

E21A29	Front Oil Seal Installer
E21M15	Front Bearing Installer
E21M20	Bearing Puller
E21A22	Cluster Bearing Puller

TORQUE SPECIFICATIONS

	Nm	lbs./ft.	lbs./in.
Back-up lamp switch	30	22	
Bottom cover attaching bolts	9	7	84
Clutch cable bracket bolts	11	8	96
Cluster gear lock nut	69-98	51-72	
Drain plug	58	43	
Gear lever housing bolts	7	5	60
Idler shaft lock nut	20-58	15-43	
Main shaft lock nut	98-127	72-94	
Oil filler plug	34	25	
Transmission mounting bolts	41	30	

GENERAL INFORMATION

The transmission is a five speed fully synchronized type using five strut type synchronizers. All forward gears are helical cut and in constant mesh to give smooth quiet operation.

Reverse gear is a spur type and is splined to the rear of the main shaft through the fifth gear synchronizer hub.

The one piece alloy case has a removable bottom cover for gaining access to the internal components.

The forward speed synchronizers are splined to the mainshaft and permit clutching to the respective speed gears which are in constant mesh with the cluster gear.

The first, second, third and fifth speed gears, when not engaged by the synchronizer sleeve splines, are free to rotate on the mainshaft. It is important to maintain running clearances specified or seizure may result owing to expansion of components.

The inner hubs of the synchronizer assemblies are splined to the mainshaft and fitted with three shifting plates which fit into slots in the inner hub. The plates are located by two circular synchronizer springs between the inner hub and synchronizer sleeves, which are splined to the inner hubs. The shift plates fit into three recesses in the bronze blocker rings which fit over the tapered cones of the gears. The blocker rings have clutch teeth similar to those on the gears.

When a forward speed gear is to be engaged, the synchronizer sleeve, carrying with it the shift plates, moves over the inner hub, bringing the shift plates into contact with the back face of the recesses in the blocker ring. There is sufficient lateral clearance for the shift plates in the blocker ring recesses to allow the blocker ring clutch teeth to move out of line with the splines on the inner hub, due to the frictional drag of the blocker ring tapers on the gear cones. This prevents the synchronizer sleeve from moving over the blocker ring teeth until such time as the gear and the blocker ring are rotating at the same speed. When this occurs the shift pads centralize in the blocker ring recesses, the synchronizer sleeve clutch teeth move over the clutch teeth of the blocker ring and engage the clutch teeth of the gear.

To engage reverse gear, the reverse gear located on the fifth speed gear synchronizer sleeve is moved into mesh with the reverse idler gear, the drive being transferred to the main shaft through the fifth speed gear synchronizer hub.

The cluster gear runs on three bearings, a needle roller at the front, a twin row roller bearing in the centre and a single row roller at the rear. The input shaft runs on one single row roller bearing and the mainshaft on one single row roller and one double row roller bearing. The first, second, third and fifth forward gears, the reverse idler gear and the input shaft to mainshaft support all run on needle bearings.

The interlock mechanism consists of interlock pins located between the shift rails, which prevent the engagement of two gears simultaneously. Detent balls and springs are located onto each shift rail providing a load, which must be overcome by a force applied to the gearshift lever before a gear change can be made.

TRANSMISSION REMOVAL

(1) Disconnect the battery ground (negative) lead.
(2) Drain the lubricant from the transmission.
(3) Remove the starter motor.
(4) Remove the propeller shaft, back-up light switch leads and speedometer cable.
(5) From inside the vehicle, remove the gear lever boot retaining plate and screws and remove the bolts attaching the gear lever to the extension housing.

NOTE: The gear lever should be placed in the first speed position prior to removal.

(6) Disconnect the clutch cable.
(7) Remove the clutch housing cover.
(8) Support the rear of the engine with a suitable jack and remove the rear crossmembers.
(9) Remove the bolts attaching the transmission to the engine and remove the transmission.

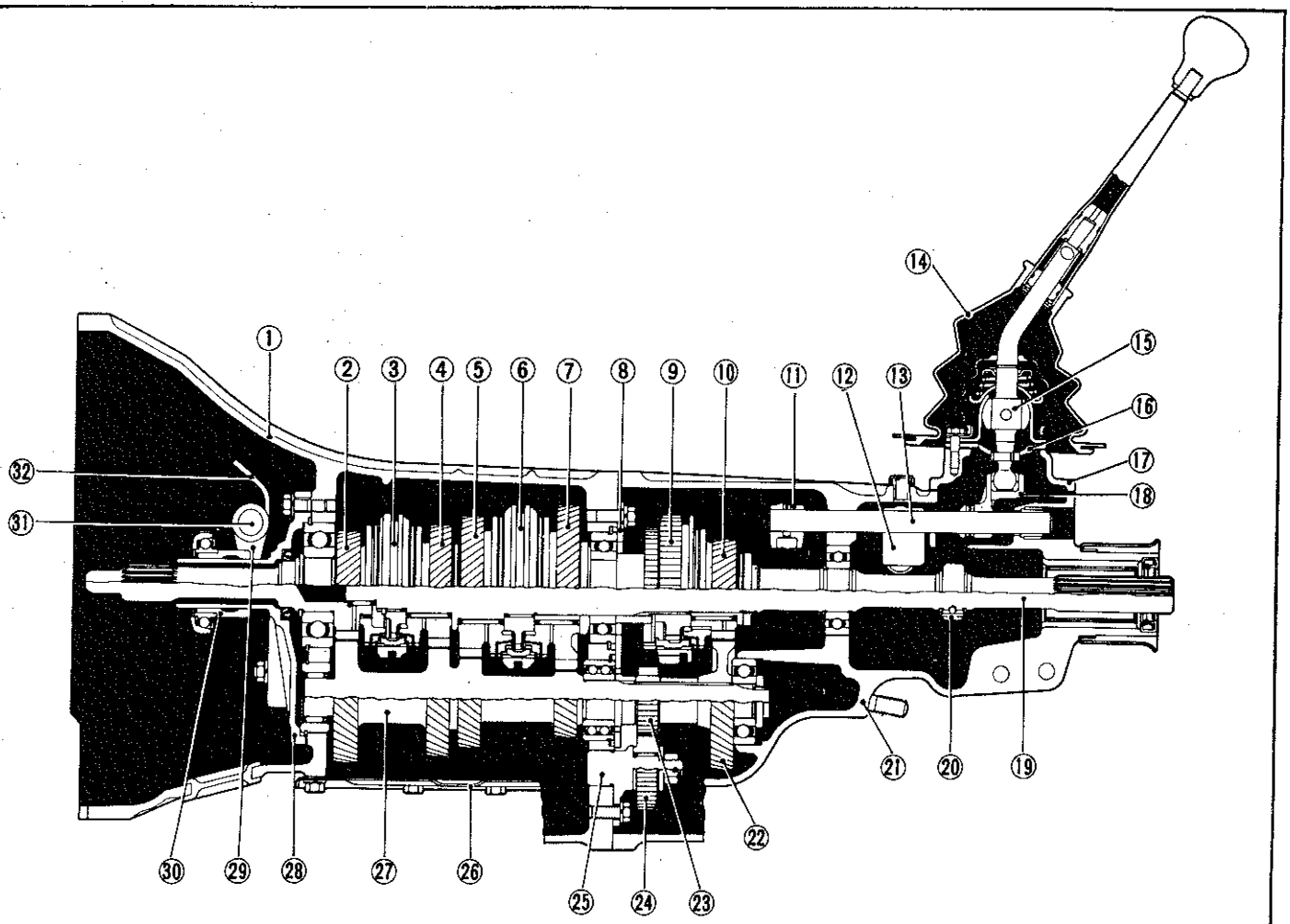
NOTE: Care must be taken to slide the transmission straight back off the clutch assembly to avoid damaging the clutch or input shaft assembly.

TRANSMISSION INSTALLATION

Install the transmission by reversing the removal procedure noting the following:
(1) When installing the transmission do not allow it to hang on the clutch assembly.
(2) Tighten all bolts to the specified torque.
(3) Ensure the clutch housing cover is not damaged or bent.
(4) Adjust the clutch as specified in Group 6.
(5) When installing gear lever, place the selector rod in the first speed position, and ensure that dust and dirt does not enter the selector mechanism.
(6) Install the gear lever dust boot securely onto the body flange.
(7) Fill the transmission with the correct grade and quantity of first grade lubricant.

TRANSMISSION DISASSEMBLY

(1) Remove the transmission case bottom cover.
(2) Remove the back-up light switch, being careful not to loose the steel ball.
(3) Remove the speedometer pinion retaining bracket and pull out the pinion assembly. Remove the extension housing bolts.
(4) Back off the neutral return plunger plug and move the change shifter down to the left, this will enable the extension housing to be removed from the transmission case.



1. Transmission case
2. Input drive gear
3. Synchronizer assy (3-4 speed)
4. 3rd Speed gear
5. 2nd Speed gear
6. Synchronizer assy (1-2 speed)
7. 1st Speed gear
8. Rear bearing retainer
9. Synchronizer assy (5 speed)
10. 5th Speed gear
11. Shift control rod selector
12. Neutral return finger
13. Control shaft
14. Gear lever boot
15. Gear lever assy
16. Stopper plate
17. Gear lever housing
18. Control shaft shifter
19. Mainshaft
20. Speedometer drive gear
21. Extension housing
22. Cluster gear, 5th speed gear
23. Cluster gear, reverse gear
24. Reverse idler gear
25. Reverse idler gear shaft
26. Bottom cover
27. Cluster gear
28. Front bearing retainer
29. Clutch shift arm
30. Release bearing carrier
31. Clutch control shaft
32. Return spring

Fig. 1—Sectional view of five speed transmission

(5) Remove the speedometer drive gear snap ring and remove the gear and drive ball.

NOTE: On later transmissions the speedometer drive gear is a machined part of the mainshaft.

(6) Remove the mainshaft rear bearing snap ring and remove the bearing.

(7) Remove the three detent spring plugs, and remove the springs and balls.

(8) Using a 5,0 mm (3/16") parallel punch remove the 1st-2nd and 3rd-4th shift fork roll pins. Remove the 3rd-4th selector shaft through the rear of the transmission case.

(9) Using a 5,0 mm (3/16") parallel punch remove the 5th-reverse shift fork roll pin and then remove the selector shaft and shift fork.

(10) Release the mainshaft nut locking tab and remove the nut. Double engaging reverse and second gear will assist when loosening the nut.

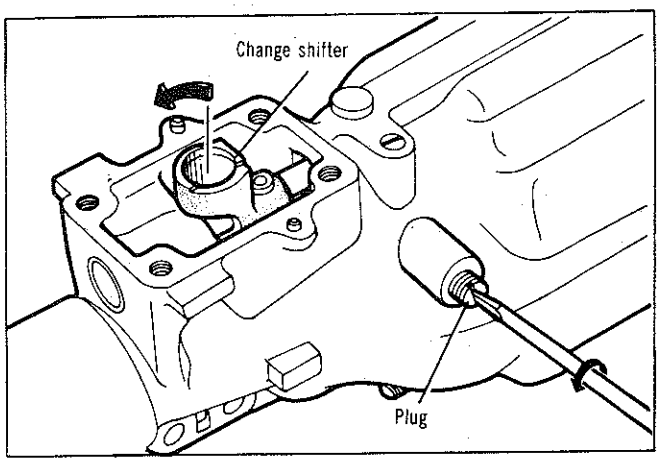


Fig. 2—Removing extension housing (early model)

(11) Remove the fifth speed cluster gear locking nut.

(12) Using a universal puller, remove the fifth speed cluster gear and bearing together. Remove the shift rail at the same time, then remove the spacer and reverse gear.

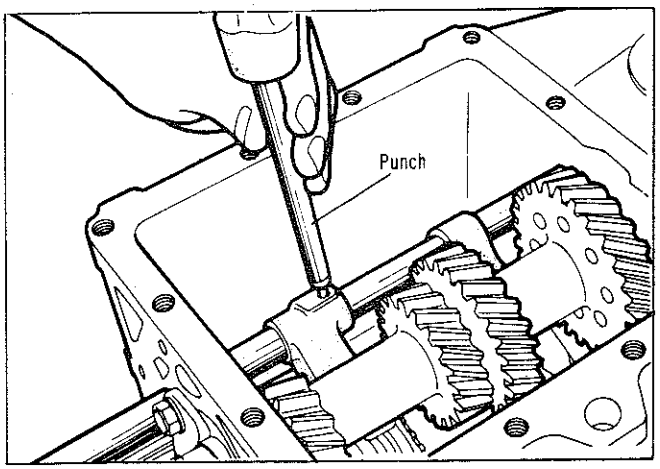


Fig. 3—Removing the shift fork roll pin

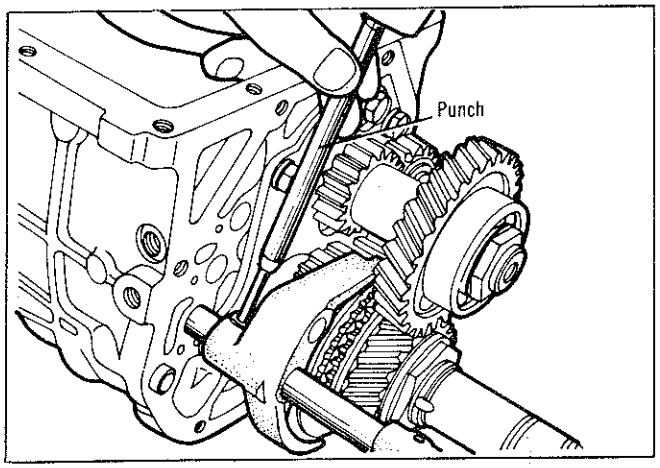


Fig. 4—Removing 5th-reverse shift fork roll pin

(13) Remove the interlock plungers and shift forks from the case.

(14) Remove the fifth speed gear and sleeve from the main shaft, then remove the synchronizer assembly and spacer.

(15) Remove the reverse idler gear split pin and nut and then remove the reverse idler gear.

(16) Remove the rear bearing retainers.

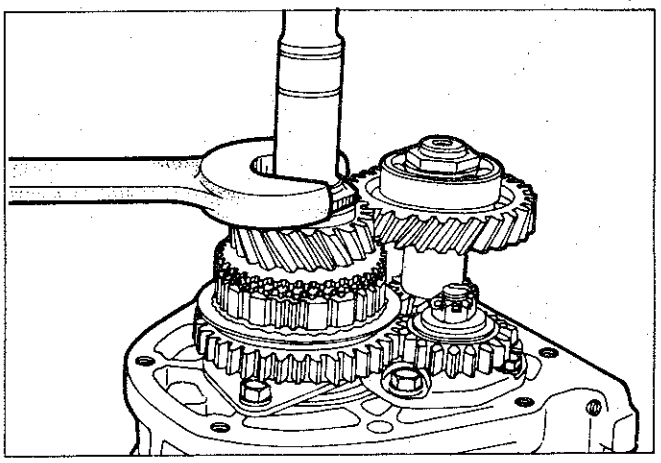


Fig. 5—Releasing mainshaft lock nut

(17) Using a suitable soft drift, drive the reverse idler gear shaft through the rear of the transmission case.

(18) Remove the clutch actuating mechanism as described in Group 6 Clutch.

(19) Remove the front bearing retainer by tapping with a suitable drift through the shift rail case holes.

(20) With the cluster gear pressed towards the rear of the transmission case remove the rear bearing snap ring.

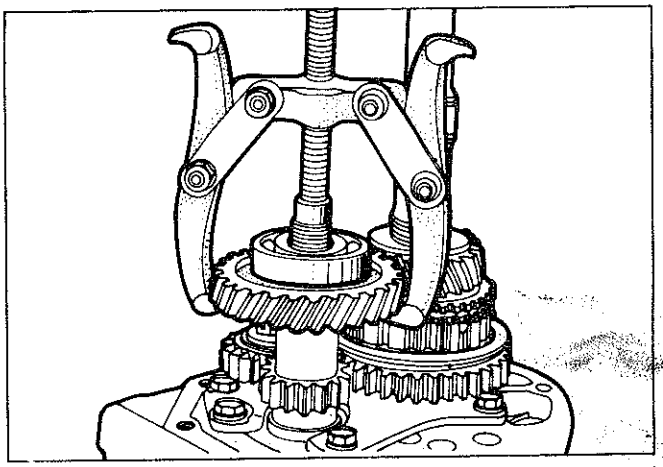


Fig. 6—Removing 5th speed cluster gear and bearing

(21) Remove the cluster gear rear bearing using Tool No. E21A22.

(22) Remove the cluster gear front bearing snap ring and remove the bearing using Tool No. E21A22.

(23) Remove the cluster gear.

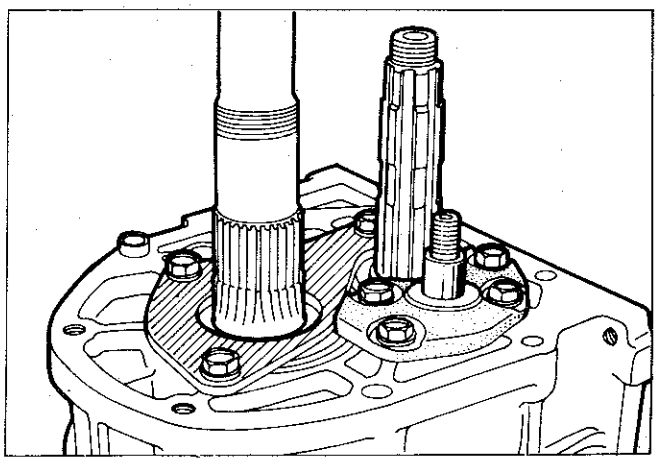


Fig. 7—Rear bearing retainers

(24) Remove the input shaft from the front of the transmission case and remove the two snap rings retaining the bearing. Remove the bearing from the input shaft using Tool No. E21M20.

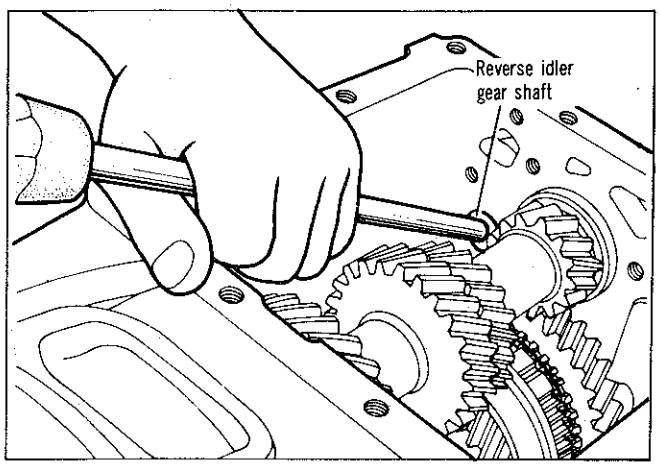


Fig. 8—Removing reverse idler gear shaft

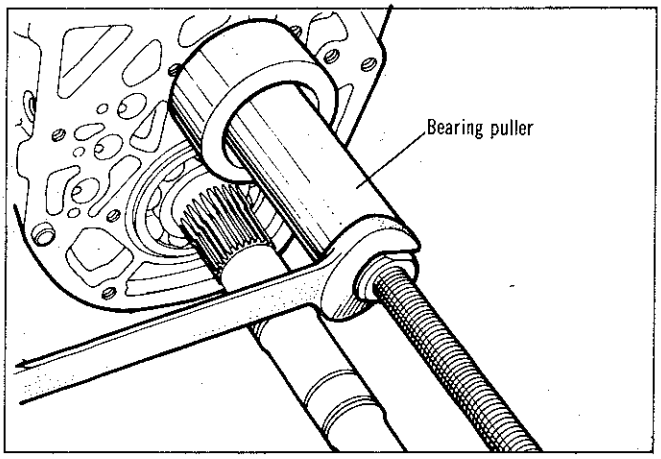


Fig. 9—Removing cluster gear rear bearing

(25) Remove the main shaft centre bearing snap ring and remove the bearing.

(26) Remove the main shaft assembly from the case.

(27) Remove the first speed gear, the first-second speed synchronizer and the second speed gear from the rear of the main shaft.

(28) Remove the snap ring from the forward end of the mainshaft, then remove the third-fourth speed synchronizer and the third speed gear.

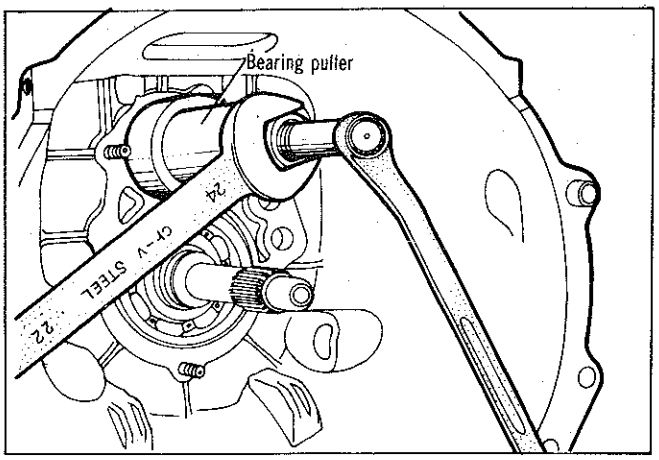


Fig. 10—Removing cluster gear front bearing

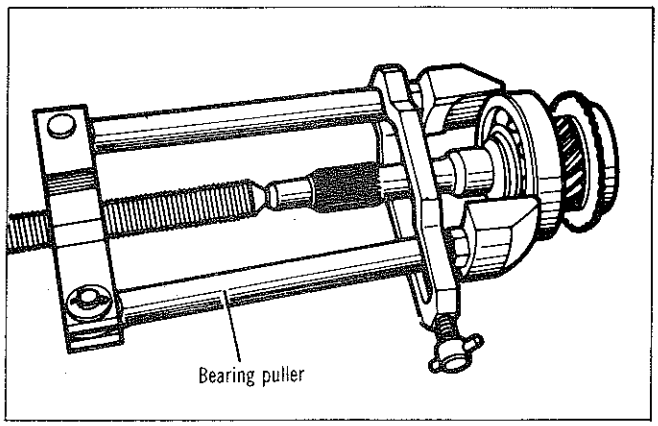


Fig. 11—Removing the input shaft bearing

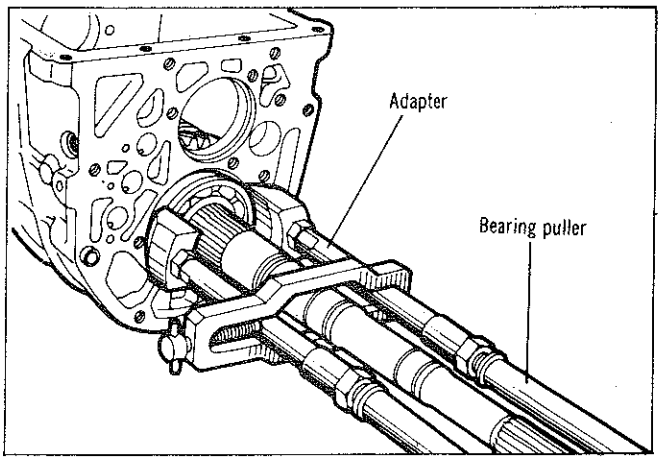


Fig. 12—Removing main shaft centre bearing

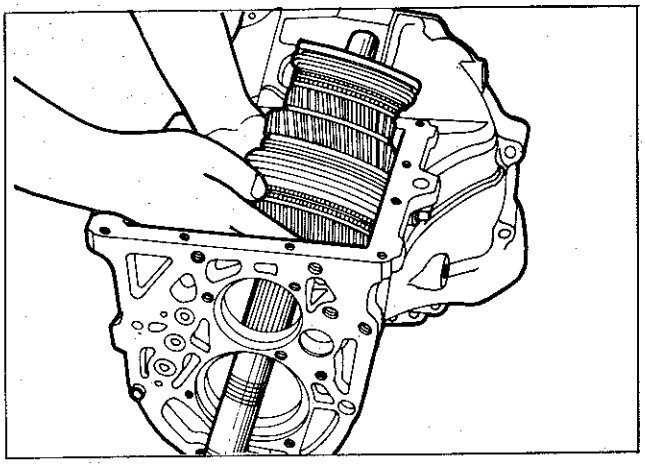


Fig. 13—Removing mainshaft assembly

(29) Release the speedometer driven gear locking tab, then remove the gear.

(30) Remove the neutral return and resistance plugs, springs and plungers.

NOTE: Later transmissions from serial number 5C39061 feature a larger extension housing cover. The larger cover retains the resistance spring in these transmissions.

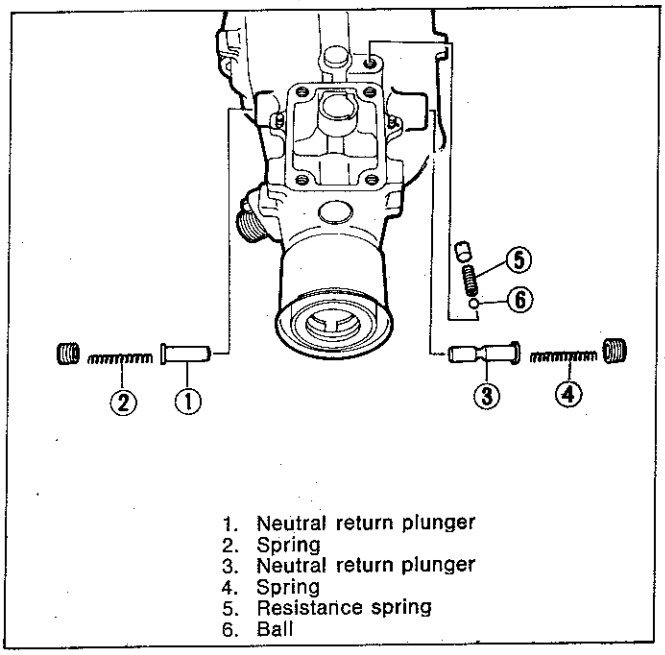


Fig. 14—Neutral return and resistance plunger assembly (early model)

(31) Remove the control shaft shifter roll pin using a 5,0 mm (3/16") punch. Remove the control shaft and shifter being careful not to bend the control shaft.

INSPECTION

After cleaning, inspect all parts for wear or damage, replacing or repairing faulty components.

Case and Extension Housing

Check the case and extension housing for cracks, damage and wear.

Mainshaft

Check the mainshaft for worn or damaged gear mounting areas and splines. Check the spacer bushing for worn or damaged outside diameter.

Input Shaft

Check the flywheel spigot area outside diameter and the mainshaft spigot bearing area inside diameter for wear or damage.

Inspect the synchronizer gear and cone for rough or damaged contact surfaces and for worn or damaged teeth.

Inspect the helical gear for worn or damaged teeth.

Inspect the clutch splines for damage, wear, looseness and sliding condition with the clutch plate.

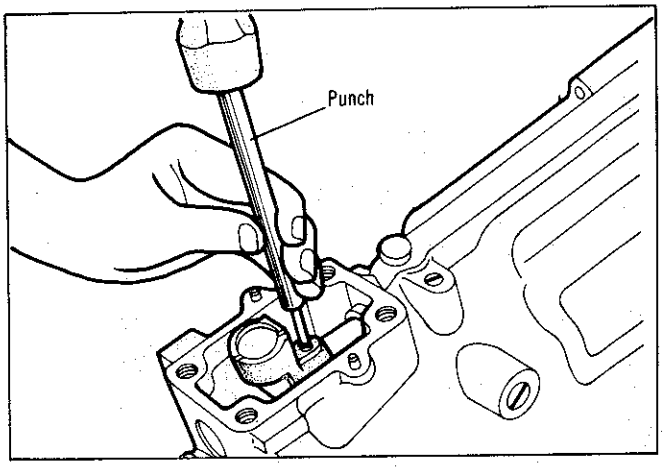


Fig. 15—Removing control shaft roll pin

Gears

Inspect the helical gear and clutch gear for worn or damaged teeth.

Inspect the cone surface for wear or damage.

Check the gear inside diameter and the front and rear surface of each gear for wear or damage.

Synchronizer Ring

Inspect the ring tooth surface for damage and also its gear contact surface for excessive or uneven wear.

Check the ring to gear gap 'A' (Fig. 16) and replace the ring if the gap is less than the specified limit.

Synchronizer Hub and Sleeve

Assemble the hub and sleeve checking that the hub slides smoothly within the sleeve.

Check both ends of the hub for damage and the sleeve grooves for wear.

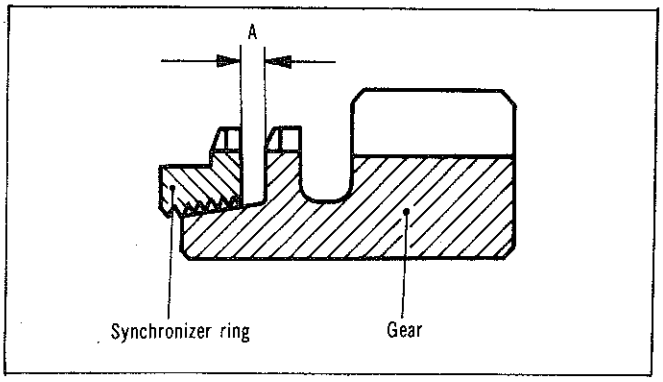


Fig. 16—Synchronizer ring to gear gap

NOTE: If either the hub or sleeve require replacement due to damage or wear both the hub and sleeve must be replaced as an assembly.

Synchronizer Shift Plates and Springs

Inspect the shift plates for excessive wear, especially around the central projection and for any other defects. Inspect the springs for deterioration and breakage.

Reverse Idler Gear Shift

Check the shaft diameter for wear and damage.

Needle Bearings and Ball Bearings

Check the ball bearings for noise and smoothness when rotated and for wear and damage.

Check the needle bearings for damaged roller surfaces and for damaged or deformed cages. Assemble the bearings onto the shaft and its mating gear, checking for smoothness and quietness when rotated.

NOTE: Do not spin bearings with compressed air as the lack of lubricant will damage the bearings.

Selector Mechanism

Check the clearance between the fork and fork groove on the synchronizer sleeve.

Check the shift rails for bend and the interlock plunger slot for wear.

Check the clearance between the gear selector lever and shift rail selector.

Interlock Plungers, Detent Balls and Springs

Check the plunger and ball surfaces for excessive wear or damage.

Check each spring for breakage and wear.

Neutral Return Plunger and Spring

Check the plunger and resistance ball for wear and damage.

Check the return spring and resistance spring for wear or breakage.

Gear Lever Assembly

Check the stop plate groove for wear, the gear lever to control lever rubber inserts for permanent strain, the spring for permanent set and the fulcrum for wear of the sliding section. Check the control lever stopper, the nylon bushing at the lower end of the gear lever and the rubber dust boot for wear or damage.

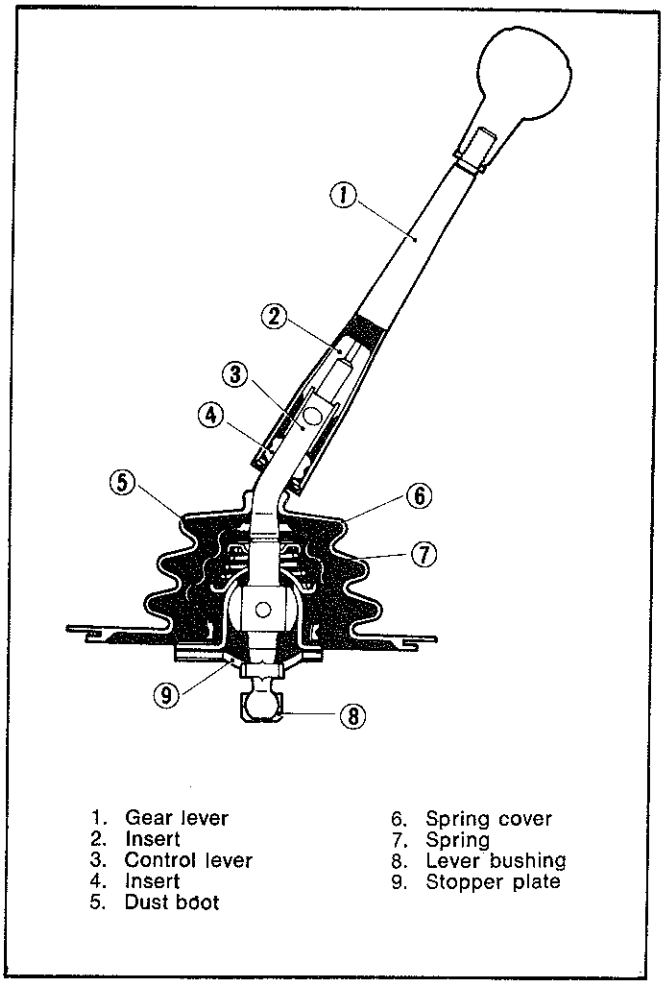


Fig. 17—Cross section of gear lever assembly

TRANSMISSION ASSEMBLY

When assembling the transmission the following procedures should be observed.

- **All old seals, gaskets and roll pins should be replaced with new ones.**
- **All parts should be cleaned thoroughly and lubricated prior to installation.**
- **The sealing surface of lip type oil seals should be smeared with grease prior to installation.**

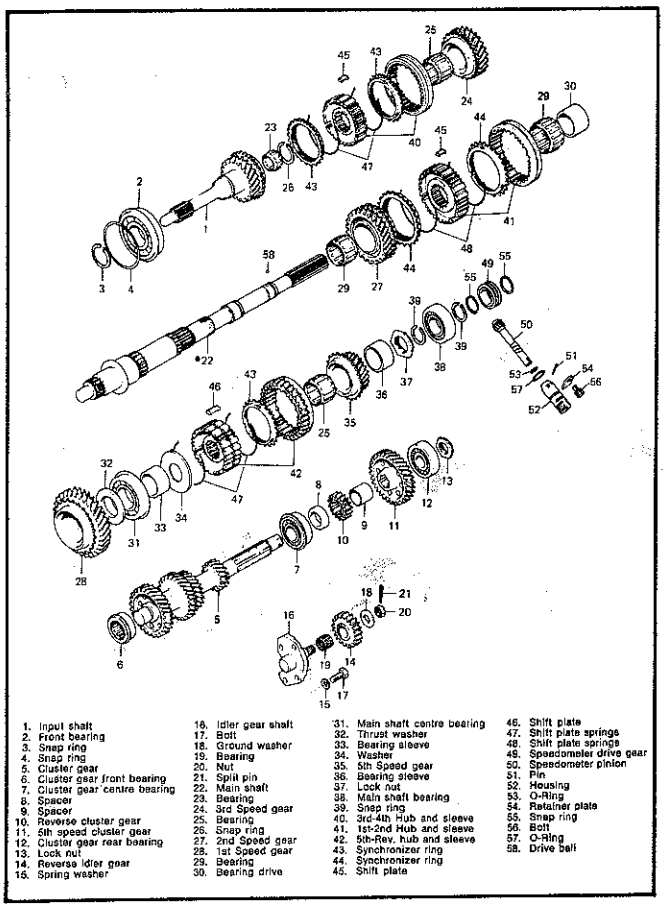


Fig. 18—Transmission components (early model)

(1) Using a suitable tool install the input shaft bearing and then install a suitable thickness snap ring to retain the bearing end play within specifications.

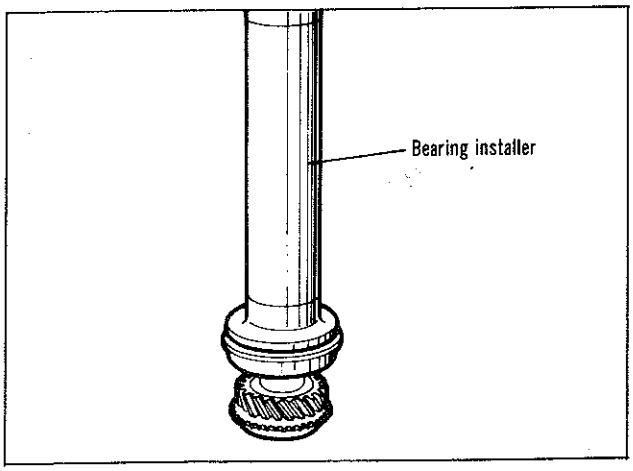


Fig. 19—Installing input shaft bearing

(2) Assemble the 3-4 speed and 1-2 speed synchronizer sleeves, hubs, shift plates and springs in the order they were removed. Position the open ends of the synchronizer springs away from each other, i.e. so that the gaps are not in the same segment (Fig. 24).

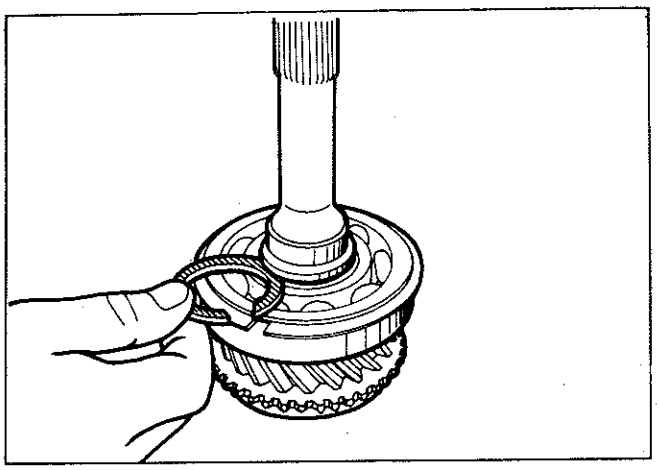


Fig. 20—Selecting suitable thickness snap ring

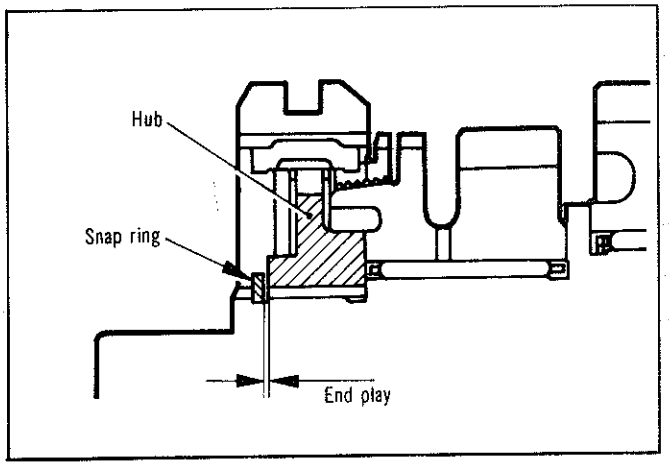


Fig. 21—Checking synchronizer hub end play

(3) Install the needle bearing and third speed gear onto the front of the mainshaft.

(4) Install the synchronizer ring and third-fourth speed synchronizer assembly onto the mainshaft, ensuring the assembly is positioned the correct way, refer Fig. 24.

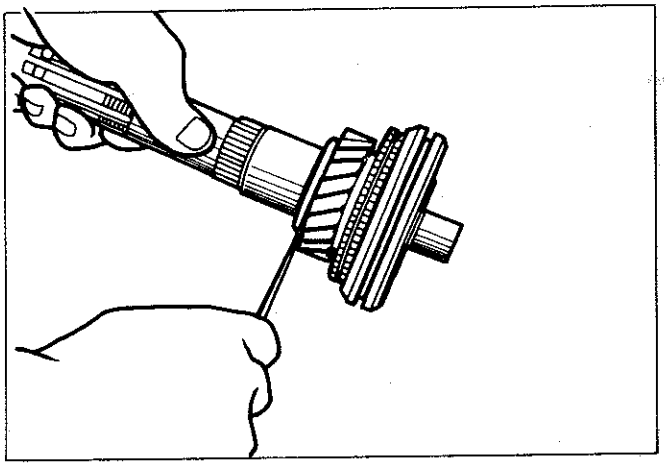
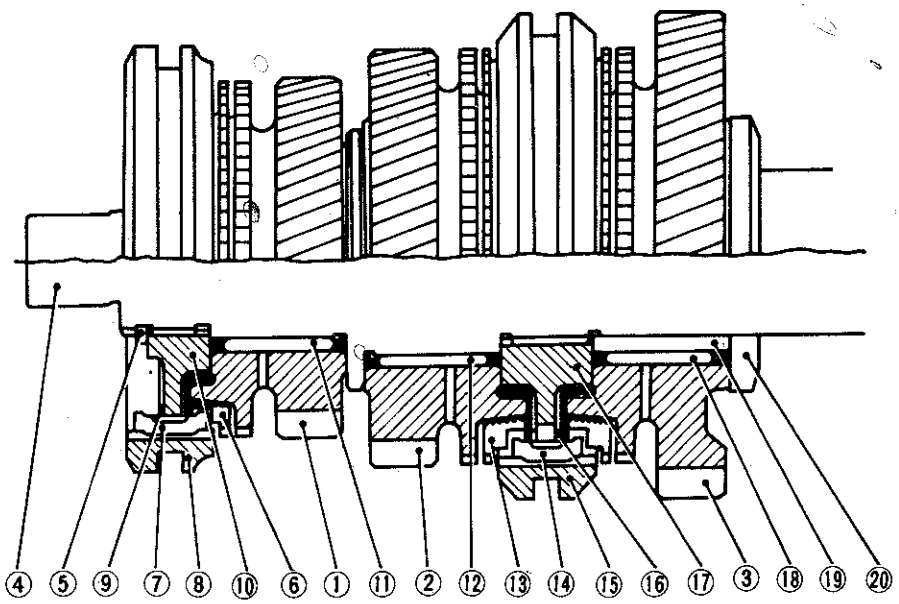


Fig. 22—Checking third speed gear end play



1. 3rd Speed gear
2. 2nd Speed gear
3. 1st Speed gear
4. Mainshaft
5. Snap ring
6. Synchronizer ring (3-4 speed)
7. Shift plate
8. Synchronizer sleeve (3-4 speed)
9. Synchronizer spring (3-4 speed)
10. Synchronizer hub (3-4 speed)
11. Needle bearing (3rd speed gear)
12. Needle bearing (2nd speed gear)
13. Synchronizer ring (1-2 speed)
14. Shift plate
15. Synchronizer sleeve (1-2 speed)
16. Synchronizer spring (1-2 speed)
17. Synchronizer hub (1-2 speed)
18. Needle bearing (1st speed gear)
19. 1st gear bearing sleeve
20. Bearing spacer

Fig. 23—Mainshaft assembly

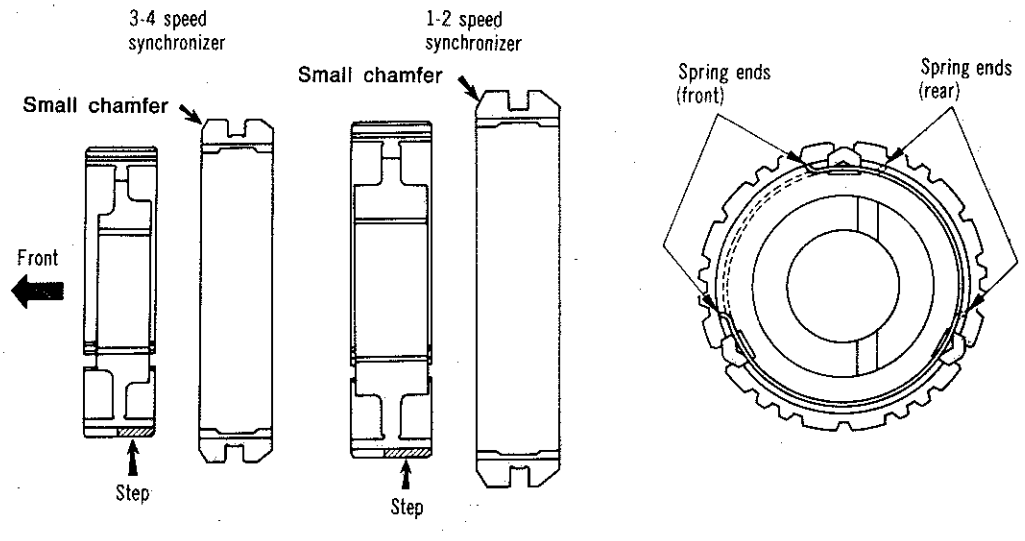


Fig. 24—Synchronizer identification and spring location

(5) Select a suitable thickness snap ring to retain the end play within specification.

(6) Check the third speed gear end play.

(7) Install the needle bearing and second speed gear onto the rear of the main shaft.

(8) Install the synchronizer ring and first-second speed synchronizer assembly onto the mainshaft.

(9) With the synchronizer assembly forced forward, check the second speed gear end play.

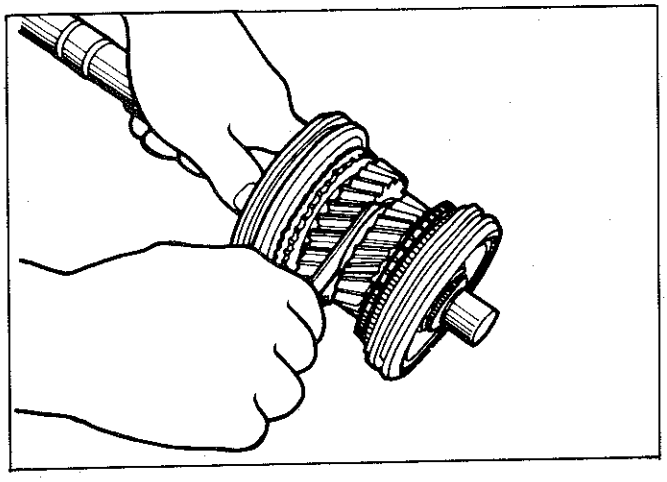


Fig. 25—Checking second gear end play

(10) Install the first speed gear bushing, needle bearing, synchronizer ring, gear and spacer. With this assembly forced forward check the first speed gear end play.

(11) Install the assembled mainshaft assembly into the transmission case. Holding the forward end of the mainshaft assembly, install the mainshaft centre bearing using a suitable tool.

NOTE: Ensure the double line mark on the inner race faces the rear of the transmission.

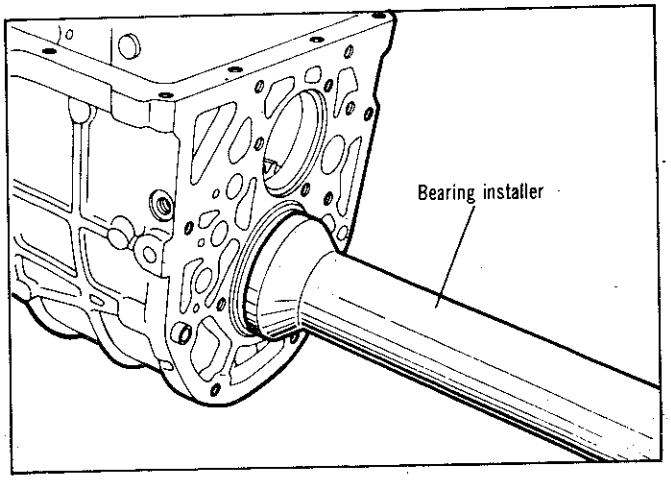


Fig. 26—Installing mainshaft centre bearing

(12) Install the input shaft needle bearing and synchronizer ring, then install the shaft into the front of the case. Lightly smear the input shaft clutch splines with a suitable grease.

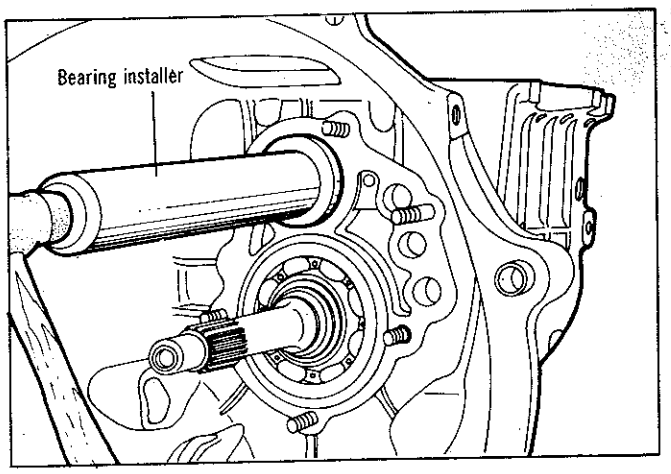


Fig. 27—Installing cluster gear front bearing

(13) Install the cluster gear into the case and with the snap ring fitted to the cluster gear front needle bearing, drive the bearing into the case using a suitable installer on the outer race.

(14) Install the snap ring onto the cluster gear rear bearing and using a suitable installing tool that applies driving force on the outer race of the bearing, install the bearing.

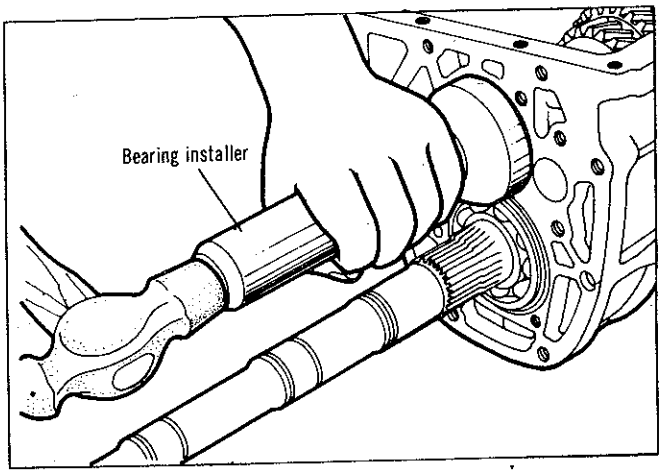


Fig. 28—Installing cluster gear rear bearing

(15) Replace the input shaft bearing retainer seal and apply grease to the seal lip.

(16) Install the input shaft bearing retainer selecting a suitable thickness spacer to maintain the clearance 'C' (Fig. 30) within specification.

(17) Install the mainshaft rear bearing retainer.

(18) Install the reverse idler gear shaft assembly using the shaft retaining bolts as guides.

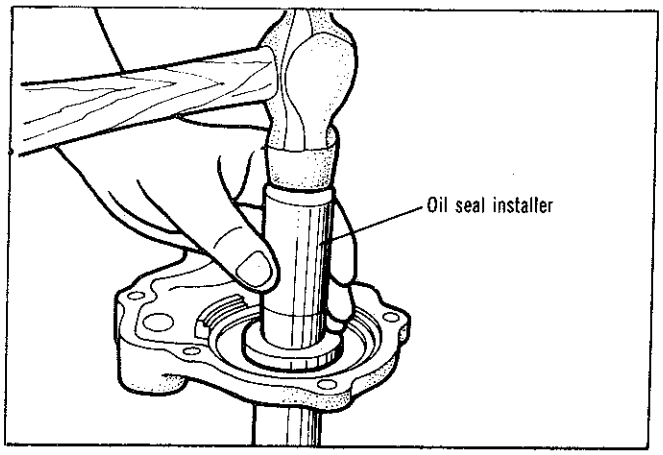


Fig. 29—Installing bearing retainer seal

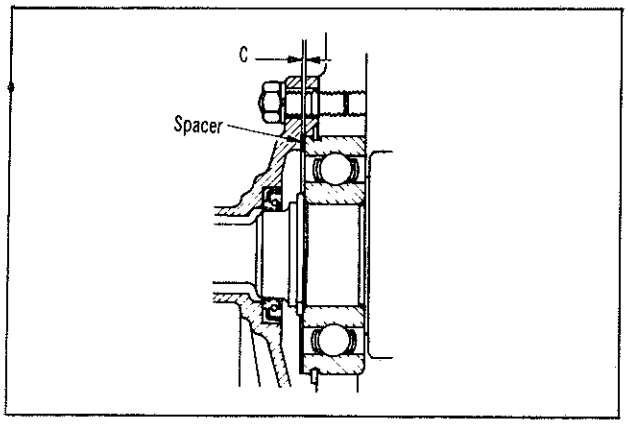


Fig. 30—Input shaft bearing retainer clearance

(19) Install the reverse idler gear needle bearing, gear and thrust washer. The washer must be installed with the ground side facing the gear.

(20) Install the locknut, maintaining the idler gear end play to specification and then fit the locknut and shift pin.

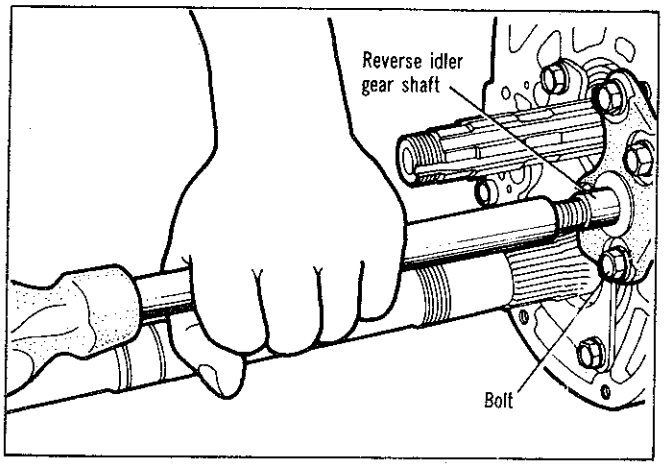


Fig. 31—Installing reverse idler gear shaft

(21) Assemble the fifth speed gear synchronizer hub, sleeve and shifter plates as shown in Fig. 33. The springs must be installed in the same manner as the 1-2 and 3-4 synchronizer assemblies, refer Fig. 24.

(22) Install in the following order the spacer, stop plate, fifth speed synchronizer assembly, bearing sleeve, needle bearing, synchronizer ring and the fifth speed gear, onto the mainshaft.

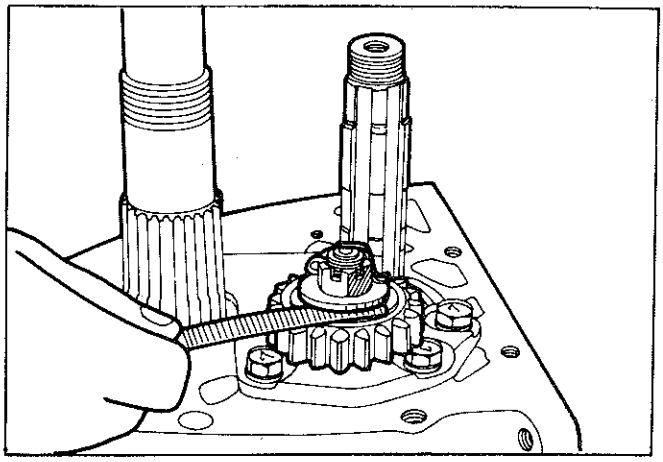


Fig. 32—Checking reverse idler gear end play

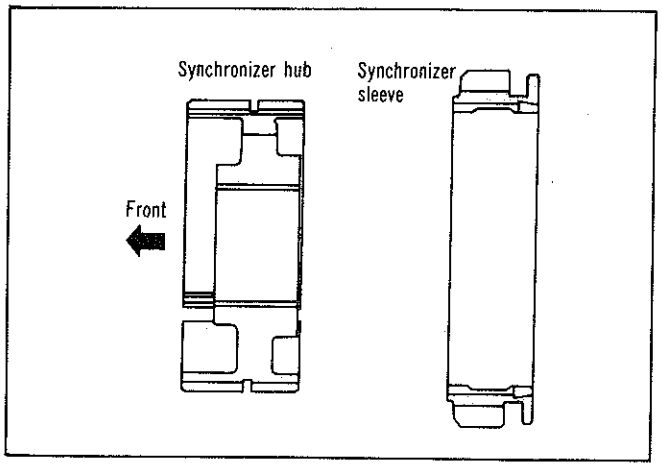


Fig. 33—Fifth gear synchronizer assembly

(23) Install and tighten the mainshaft lock nut to the specified torque and check fifth gear end float. Lock the nut to the mainshaft, in the notch provided.

(24) Install the 3-4 and 1-2 shift forks into their respective synchronizer sleeves. Insert each shift rail from the rear of the case and install the interlock plungers between the shaft rails. Lock the shift forks and rails with the roll pins.

(25) Install the spacer, reverse gear, spacer, fifth gear and bearing onto the cluster gear shaft. Tighten the locknut to the specified torque, then lock the nut to the shaft in the notch provided.

NOTE: The roll pins must be installed with the gaps aligned with the shift rail centre line.

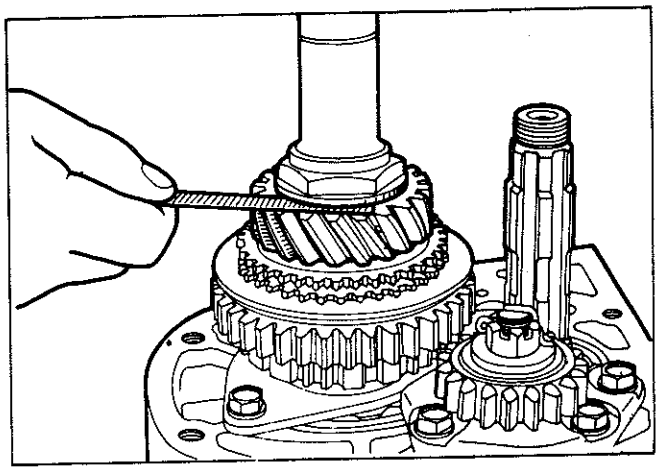


Fig. 34—Checking fifth gear end play

(26) Install the detent balls and springs into each shift rail, then install each plug 6 mm (0.240") below the surface of the transmission case, refer Fig. 35. Seal the plug head with sealant.

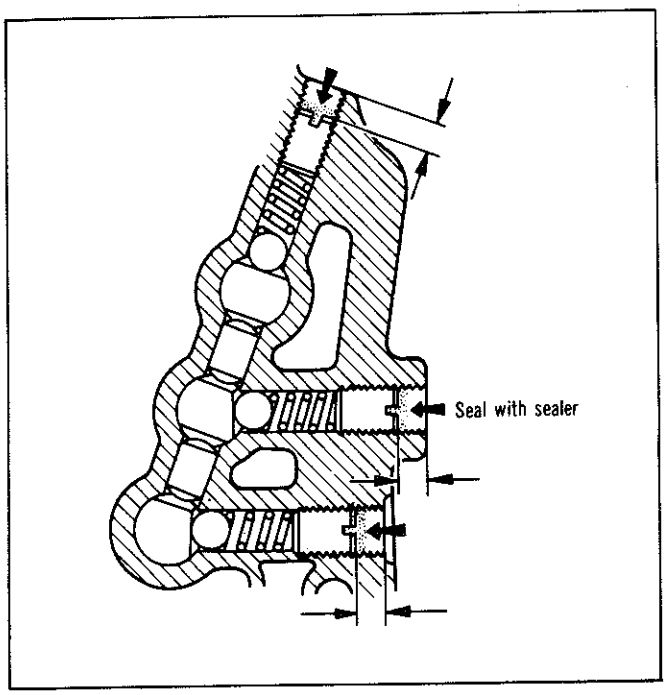


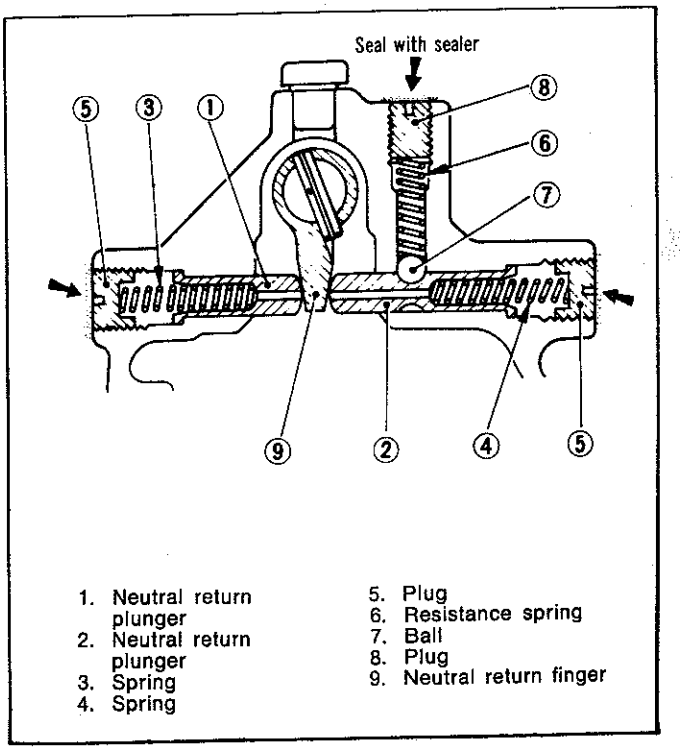
Fig. 35—Detent balls, springs and plugs

(27) Install the main shaft rear bearing.

(28) Install the speedometer drive gear, ball and snap ring (early transmission).

(29) Install the control shaft and shifter to the extension housing.

(30) Apply sealer to both sides of the extension housing gasket and fit gasket to the case.



1. Neutral return plunger
2. Neutral return plunger
3. Spring
4. Spring
5. Plug
6. Resistance spring
7. Ball
8. Plug
9. Neutral return finger

Fig. 36—Neutral return and resistance spring assembly (early transmission)

(31) Install the extension housing to the transmission case, moving the control shaft shifter fully to the left while installing the housing. Ensure the forward end of the control shaft selector fits snugly into the shift rail lugs.

(32) Apply sealant to the extension housing bolt threads, install bolts tightening them to the specified torque.

(33) Install the neutral return plungers, springs and the resistance spring and ball. Tighten each plug until its top is flush with the housing surface. Apply sealer to the head of the plug.

NOTE: Later transmissions from serial number 5C39061 feature a larger extension housing cover. The larger cover retains the resistance spring in these transmissions.

(34) Apply sealant to the outside surface of the speedometer driven gear sleeve and insert the gear into extension housing. Install the locking plate and bolt.

(35) Install the back-up lamp switch and steel ball, applying sealer to the switch threads.

(36) Install the transmission case bottom cover tightening the attaching bolts to the specified torque.

NOTE: Do not over-tighten the bolts otherwise the gasket will crush, resulting in oil leakage.

(37) Install the clutch actuating mechanism as described in Group 6 Clutch.

SECTION 10 — SERVICE DIAGNOSIS — TORQUEFLITE

GENERAL

Automatic transmission malfunctions may be caused by four general conditions: poor engine performance, improper adjustments, hydraulic malfunctions, and mechanical malfunctions. Diagnosis of these problems should always begin by checking the easily accessible variables: fluid level and condition, manual linkage adjustment, and throttle linkage adjustment. Then perform a road test to determine whether the problem has been corrected or that more diagnosis is necessary. If the problem exists after the preliminary tests and corrections are completed, hydraulic pressure tests should be performed.

Fluid Level

Before removing the dipstick, wipe all dirt off the protective cap and top of the filler tube.

Since the torque converter fills more slowly in the "P" Park position, place the selector lever in "N" Neutral to be sure that the fluid level check is accurate. The engine should be running at idle speed. The fluid should be at normal operating temperature, approximately 97°C (175°F). The fluid level is correct if it is between the "Full" and "Add" marks on the dipstick.

Low fluid level can cause a variety of conditions because it allows the pump to take in air along with the fluid. As in any hydraulic system, air bubbles make the fluid spongy, therefore, pressures will be low and build up slowly.

Improper filling can also raise the fluid level too high. When the transmission has too much fluid, the gears churn up foam and cause the same conditions which occur with a low fluid level.

In either case, the air bubbles can cause over-heating, fluid oxidation and varnish which can interfere with normal valve, clutch and servo operation. Foaming can also result in fluid escaping from the transmission vent where it may be mistaken for a leak.

Fluid Condition

Along with fluid level, it is important to check the condition of the fluid. When the fluid smells burned, and is contaminated with metal or friction material particles, a complete transmission overhaul is needed.

If the fluid appears milky, it may be contaminated with water. This condition is not common, but it is possible. Since engine coolant attacks O — rings, seals, clutches and bands, a complete overhaul is necessary. If this condition is found, ensure that the reason for coolant leakage into the transmission fluid is rectified. Check for a leak in the transmission oil cooler in the lower tank of the radiator by disconnecting the fluid lines and applying air pressure to the cooler — no more than 354 kPa (50 p.s.i.). If a leak exists, air will bubble up through the coolant in the radiator.

Be sure to examine the fluid on the dipstick closely. If there is any doubt about its condition, drain out a sample for a double check.

After the fluid has been checked, seat the dipstick fully to seal out water and dirt.

Manual Linkage

Normal operation of the neutral safety switch provides a quick check to confirm proper manual linkage adjustment.

Move the selector lever slowly upward until it clicks into the "P" Park notch in the selector gate. If the starter will operate the "P" position is correct.

After checking "P" position move the selector slowly toward "N" Neutral position until the lever drops at the end of the "N" stop in the selector gate. If the starter will also operate at this point the manual linkage is properly adjusted. If adjustment is required, refer to "Gearshift Linkage Adjustment".

Throttle Linkage

The throttle linkage adjustment is very important to proper transmission operation. This adjustment positions a valve which controls shift speed, shift quality and part throttle down shift sensitivity. If the setting is too short, early shifts and slippage between shifts may occur. If the setting is too long, shifts may be delayed and part throttle down shifts may be very sensitive.

Refer to "Linkage Adjustment".

Road Test

Prior to performing a road test, be certain that the fluid level and condition, and control linkage adjustments have been checked.

During the road test, concentrate your thoughts on what the clutches and bands are doing, rather than the control valves and hydraulic circuits.

The transmission should be operated in each position to check for slipping and any variation in shifting. Note whether the shifts are harsh or spongy and check the speeds where the upshifts and downshifts occur. Approximate shift speeds for the various modes of operation are shown in the "Automatic Shift Speeds and Governor Pressure" chart.

Observe closely for slipping or engine speed flare-up. Slipping or flare-up in any gear usually indicates clutch, band or over-running clutch problems. If the condition is far advanced, an overhaul will probably be necessary to restore normal operation.

In most cases, the clutch or band that is slipping can be determined by noting the transmission operation in all selector positions and by comparing which internal units are applied in those positions. The "Elements in Use Chart" provides a basis for road test analysis.

By observing that the rear clutch is applied in both the "D" first gear and "1" first gear positions, but that the over-running clutch is applied in "D" first and the low and reverse band is applied in "1" first, if the transmission slips in "D" range first gear but does not slip in "1" first gear, the over-running clutch must be the unit that is slipping. Similarly, if the transmission slips in any two forward gears, the rear clutch is the slipping unit.

Using the same procedure, the rear clutch and front clutch are applied in "D" third gear. If the transmission slips in third gear, either the front clutch or the rear clutch is slipping. By selecting another gear which does not use one of those units, the unit which is slipping can be determined. If the transmission also slips in reverse, the front clutch is slipping. If the transmission does not slip in reverse, the rear clutch is slipping.

This process of elimination can be used to detect any unit which slips and to confirm proper operation of good units. However, although road test analysis can usually diagnose slipping units, the actual cause of the malfunction usually cannot be decided. Practically any condition can be caused by leaking hydraulic circuits or sticking valves.

Therefore, unless the condition is obvious, like no drive in "D" range first gear only, the transmission should never be disassembled until hydraulic pressure tests have been performed. For hydraulic pressure tests refer to "Service in Vehicle Section".

CONVERTER STALL TEST

WARNING: During test let no one stand in front of vehicle.

The stall test consists of determining the engine speed obtained at full throttle in "D" position. This tests checks the torque converter stator clutch operation, and the holding ability of the transmission clutches. The transmission oil level should be checked and the engine brought to normal operating temperature before stall operation. **Both the parking and service brakes must be fully applied and front wheels blocked while making this test.**

Do not hold the throttle open any longer than is necessary to obtain a maximum engine speed reading, **and never longer than five seconds at a time.** If more than one stall check is required, operate the engine at approximately 1,000 rpm in neutral for 20 seconds to cool the transmission fluid between runs. If engine speed exceeds the maximum limits shown, release the accelerator immediately since transmission clutch slippage is indicated.

Stall Speed Above Specification

If stall speed exceeds the maximum specified in specification chart by more than 200 rpm, transmission clutch slippage is indicated. Follow the transmission oil pressure and air pressure checks outlined in "Service in Vehicle" section to determine the cause of slippage.

Stall Speed Below Specification

Low stall speeds **with a properly tuned engine** indicate torque converter stator clutch problems. A road test will be necessary to identify the exact problem.

If stall speeds are 250-350 rpm below specification, and the vehicle operates properly at highway speeds, but has poor through-gear acceleration, the stator over-running clutch is slipping.

If stall speed and acceleration are normal, but abnormally high throttle opening is required to maintain highway speeds, the stator clutch has seized.

Both of these stator defects require replacement of the torque converter.

Noise

A whining or siren-like noise due to fluid flow is normal during stall operation with some converters; however, loud metallic noises from loose parts or interference within the assembly indicate a defective torque converter. To confirm that the noise originates within the converter, operate the vehicle at light throttle in "D" and "N" on a hoist and listen under the transmission bell housing.

ELEMENTS IN USE AT EACH POSITION OF THE SELECTOR LEVER

Lever Position	Gear Ratio	Start Safety	Parking Sprag	Clutches			Bands	
				Front	Rear	Over Running	(Kickdown) Front	(Low-Rev.) Rear
P—PARK		X	X					
R—REVERSE	2.21			X				X
N—NEUTRAL		X						
D—DRIVE								
First	2.45				X	X		
Second	1.45				X		X	
Direct	1.00			X	X			
2—SECOND								
First	2.45				X	X		
Second	1.45				X		X	
1—LOW (First)	2.45				X			X

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
HARSH ENGAGEMENT IN D, 1, 2 AND R	(a) Engine idle speed too high.	(a) Adjust engine idle speed to specifications. Re-adjust throttle linkage.
	(b) Hydraulic pressures too high or low.	(b) Inspect fluid level, then perform hydraulic pressure tests and adjust to specifications.
	(c) Low-reverse band out of adjustment.	(c) Adjust low-reverse band.
	(d) Valve body malfunction or leakage.	(d) Perform pressure tests to determine cause and correct as required.
	(e) Accumulator sticking, broken rings or spring.	(e) Inspect accumulator for sticking, broken rings or spring. Repair as required.
	(f) Low-reverse servo, band or linkage malfunction.	(f) Inspect servo for damaged seals, binding linkage or faulty band lining. Repair as required.
	(g) Worn or faulty front and/or rear clutch.	(g) Disassemble and inspect clutch. Repair or replace as required.
DELAYED ENGAGEMENT IN D, 1, 2 AND R	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Incorrect gearshift control linkage adjustment.	(b) Adjust control linkage.
	(c) Hydraulic pressures too high or low.	(c) Perform hydraulic pressure tests and adjust to specifications.
	(d) Oil filter clogged.	(d) Replace oil filter.
	(e) Valve body malfunction or leakage.	(e) Perform pressure tests to determine cause and correct as required.
	(f) Accumulator sticking, broken rings or spring.	(f) Inspect accumulator for sticking, broken rings or spring. Repair as required.
	(g) Clutches or servos sticking or not operating.	(g) Remove valve body assembly and perform air pressure tests. Repair as required.
	(h) Faulty oil pump.	(h) Perform hydraulic pressure tests, Adjust and repair as required.
	(i) Worn or faulty front and/or rear clutch.	(i) Disassemble and inspect clutch. Repair or replace as required.
	(j) Worn or broken input shaft and/or reaction shaft support seal rings.	(j) Inspect and replace seal rings as required, also inspect respective bores for wear. Replace parts as required.
	(k) Aerated fluid.	(k) Inspect for air leakage into pump suction passages.
	(l) Engine idle speed too low.	(l) Adjust idle speed to specifications and readjust transmission throttle linkage.
RUNAWAY OR HARSH UPSHIFT AND 3-2 KICKDOWN	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Incorrect throttle linkage adjustment.	(b) Adjust throttle linkage.
	(c) Hydraulic pressures too high or low.	(c) Perform hydraulic pressure tests and adjust to specifications.
	(d) Kickdown band out of adjustment.	(d) Adjust kickdown band.
	(e) Valve body malfunction or leakage.	(e) Perform pressure tests to determine cause and correct as required.
	(f) Governor malfunction.	(f) Inspect governor and repair as required.
	(g) Accumulator sticking, broken rings or spring.	(g) Inspect accumulator for sticking, broken rings or spring. Repair as required.
	(h) Clutches or servos sticking or not operating.	(h) Remove valve body assembly and perform air pressure tests. Repair as required.
	(i) Kickdown servo, band or linkage malfunction.	(i) Inspect servo for sticking, broken seal rings, binding linkage or faulty band lining. Repair as required.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
	(j) Worn or faulty front clutch.	(j) Disassemble and inspect clutch. Repair or replace as required.
	(k) Worn or broken input shaft and/or reaction shaft support seal rings.	(k) Inspect and replace seal rings as required, also inspect respective bores for wear. Replace parts as required.
NO UPSHIFT	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Incorrect throttle linkage adjustment.	(b) Adjust throttle linkage.
	(c) Kickdown band out of adjustment.	(c) Adjust kickdown band.
	(d) Hydraulic pressures too high or low.	(d) Perform hydraulic pressure tests and adjust to specifications.
	(e) Governor sticking or leaking.	(e) Remove and clean governor. Replace parts if necessary.
	(f) Valve body malfunction or leakage.	(f) Perform pressure tests to determine cause and correct as required.
	(g) Clutches or servos sticking or not operating.	(g) Remove valve body assembly and perform air pressure tests. Repair as required.
	(h) Faulty oil pump.	(h) Perform hydraulic pressure tests, adjust or repair as required.
	(i) Kickdown servo, band or linkage malfunction.	(i) Inspect servo for sticking, broken seal rings, binding linkage or faulty band lining. Repair as required.
	(j) Worn or faulty front clutch.	(j) Disassemble and inspect clutch. Repair or replace as required.
	(k) Worn or broken input shaft and/or reaction shaft support seal rings.	(k) Inspect and replace seal rings as required, also inspect respective bores for wear. Replace parts as required.
NO KICKDOWN OR NORMAL DOWNSHIFT	(a) Incorrect throttle linkage adjustment.	(a) Adjust throttle linkage.
	(b) Incorrect gearshift control linkage adjustment.	(b) Adjust control linkage.
	(c) Kickdown band out of adjustment.	(c) Adjust kickdown band.
	(d) Hydraulic pressures too high or low.	(d) Perform hydraulic pressure tests and adjust to specifications.
	(e) Governor sticking or leaking.	(e) Remove and clean governor. Replace parts if necessary.
	(f) Valve body malfunction or leakage.	(f) Perform pressure tests to determine cause and correct as required.
	(g) Clutches or servos sticking or not operating.	(g) Remove valve body assembly and perform air pressure tests. Repair as required.
	(h) Kickdown servo, band or linkage malfunction.	(h) Inspect servo for sticking, broken seal rings, binding linkage or faulty band lining. Repair as required.
	(i) Overrunning clutch not holding.	(i) Disassemble transmission and repair overrunning clutch as required.
SHIFTS ERRATIC	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Aerated fluid.	(b) Inspect for air leakage into pump suction passages.
	(c) Incorrect throttle linkage adjustment.	(c) Adjust throttle linkage.
	(d) Incorrect gearshift control linkage adjustment.	(d) Adjust control linkage.
	(e) Hydraulic pressures too high or low.	(e) Perform hydraulic pressure tests and adjust to specifications.
	(f) Governor sticking or leaking.	(f) Remove and clean governor. Replace parts if necessary.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
	(g) Oil filter clogged.	(g) Replace oil filter.
	(h) Valve body malfunction or leakage.	(h) Perform pressure tests to determine cause and correct as required.
	(i) Clutches or servos sticking or not operating.	(i) Remove valve body assembly and perform air pressure tests. Repair as required.
	(j) Faulty oil pump.	(j) Perform hydraulic pressure tests, adjust or repair as required.
	(k) Worn or broken input shaft and/or reaction shaft support seal rings.	(k) Inspect and replace seal rings as required, also inspect respective bores for wear. Replace parts as required.
SLIPS IN FORWARD DRIVE POSITIONS	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Aerated fluid.	(b) Inspect for air leakage into pump suction passages.
	(c) Incorrect throttle linkage adjustment.	(c) Adjust throttle linkage.
	(d) Incorrect gearshift control linkage adjustment.	(d) Adjust control linkage.
	(e) Hydraulic pressures too low.	(e) Perform hydraulic pressure tests and adjust to specifications.
	(f) Valve body malfunction or leakage.	(f) Perform pressure tests to determine cause and correct as required.
	(g) Accumulator sticking, broken rings or spring.	(g) Inspect accumulator for sticking, broken rings or spring. Repair as required.
	(h) Clutches or servos sticking or not operating.	(h) Remove valve body assembly and perform air pressure tests. Repair as required.
	(i) Worn or faulty front and/or rear clutch.	(i) Disassemble and inspect clutch. Repair or replace as required.
	(j) Overrunning clutch not holding.	(j) Disassemble transmission and repair overrunning clutch as required.
	(k) Worn or broken input shaft and/or reaction shaft support seal rings.	(k) Inspect and replace seal rings as required, also inspect respective bores for wear. Replace parts as required.
	(l) Engine idle speed too low.	(l) Adjust idle speed to specifications and readjust transmission throttle rod.
SLIPS IN REVERSE ONLY	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Aerated fluid.	(b) Inspect for air leakage into pump suction passages.
	(c) Incorrect gearshift control linkage adjustment.	(c) Adjust control linkage.
	(d) Hydraulic pressures too high or low.	(d) Perform hydraulic pressure tests and adjust to specifications.
	(e) Low-reverse band out of adjustment.	(e) Adjust low-reverse band.
	(f) Valve body malfunction or leakage.	(f) Perform pressure tests to determine cause and correct as required.
	(g) Front clutch or rear servo, sticking or not operating.	(g) Remove valve body assembly and perform air pressure tests. Repair as required.
	(h) Low-reverse servo, band or linkage malfunction.	(h) Inspect servo for damaged seals, binding linkage or faulty band lining. Repair as required.
	(i) Faulty oil pump.	(i) Perform hydraulic pressure tests, adjust or repair as required.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
	(j) Engine idle speed too low.	(j) Adjust idle speed to specifications and readjust transmission throttle rod.
SLIPS IN ALL POSITIONS	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Hydraulic pressures too low.	(b) Perform hydraulic pressure tests and adjust to specifications.
	(c) Valve body malfunction or leakage.	(c) Perform pressure tests to determine cause and correct as required.
	(d) Faulty oil pump.	(d) Perform hydraulic pressure tests, adjust or replace as required.
	(e) Clutches or servos sticking or not operating.	(e) Remove valve body assembly and perform air pressure tests. Repair as required.
	(f) Engine idle speed too low.	(f) Adjust idle speed to specifications and readjust transmission throttle rod.
	(g) Worn or broken input shaft and/or reaction shaft support seal rings.	(g) Inspect and replace seal rings as required, also inspect respective bores for wear. Replace parts as required.
NO DRIVE IN ANY POSITION	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Hydraulic pressures too low.	(b) Perform hydraulic pressure tests and adjust to specifications.
	(c) Oil filter clogged.	(c) Replace oil filter.
	(d) Valve body malfunction or leakage.	(d) Perform pressure tests to determine cause and correct as required.
	(e) Faulty oil pump.	(e) Perform pressure tests to determine cause and correct as required.
	(f) Clutches or servos sticking or not operating	(f) Remove valve body assembly and perform air pressure tests. Repair as required.
NO DRIVE IN FORWARD DRIVE POSITIONS	(a) Hydraulic pressures too low.	(a) Perform hydraulic pressure tests and adjust to specifications.
	(b) Valve body malfunction or leakage.	(b) Perform pressure tests to determine cause and correct as required.
	(c) Clutches or servos, sticking or not operating.	(c) Remove valve body assembly and perform air pressure tests. Repair as required.
	(d) Worn or faulty rear clutch.	(d) Disassemble and inspect clutch. Repair or replace as required.
	(e) Overrunning clutch not holding.	(e) Disassemble transmission and repair overrunning clutch as required.
	(f) Worn or broken input shaft and/or reaction shaft support seal rings.	(f) Inspect and replace seal rings as required, also inspect respective bores for wear. Replace parts as required.
NO DRIVE IN REVERSE	(a) Incorrect gearshift control linkage adjustment.	(a) Adjust control linkage.
	(b) Hydraulic pressures too low.	(b) Perform hydraulic pressure tests and adjust to specifications.
	(c) Low-reverse band out of adjustment.	(c) Adjust low-reverse band.
	(d) Valve body malfunction or leakage.	(d) Perform pressure tests to determine cause and correct as required.
	(e) Front clutch or rear servo, sticking or not operating.	(e) Remove valve body assembly and perform air pressure tests. Repair as required.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
	(f) Low-reverse servo, band or linkage malfunction.	(f) Inspect servo for damaged seals, binding linkage or faulty band lining. Repair as required.
	(g) Worn or faulty front clutch.	(g) Disassemble and inspect clutch. Repair or replace as required.
DRIVES IN NEUTRAL	(a) Incorrect gearshift control linkage adjustment.	(a) Adjust control linkage.
	(b) Valve body malfunction or leakage.	(b) Perform pressure tests to determine cause and correct as required.
	(c) Rear clutch dragging.	(c) Inspect clutch and repair as required.
DRAGS OR LOCKS	(a) Kickdown band out of adjustment.	(a) Adjust kickdown band.
	(b) Low-reverse band out of adjustment.	(b) Adjust low-reverse band.
	(c) Kickdown and/or low-reverse servo, band, linkage malfunction.	(c) Inspect servo for sticking, broken seal rings, binding linkage or faulty band lining. Repair as required.
	(d) Front and/or rear clutch faulty.	(d) Disassemble and inspect clutch. Repair or replace as required.
	(e) Planetary gear sets broken or seized.	(e) Inspect condition of planetary gear sets and replace as required.
	(f) Overrunning clutch worn, broken or seized.	(f) Inspect condition of overrunning clutch and replace parts as required.
GRATING, SCRAPING GROWLING NOISE	(a) Kickdown band out of adjustment.	(a) Adjust kickdown band.
	(b) Low-reverse band out of adjustment.	(b) Adjust low-reverse band.
	(c) Output shaft bearing and/or bushing damaged.	(c) Remove extension housing and replace bearing and/or bushing.
	(d) Governor support binding or broken seal rings.	(d) Inspect conditions of governor support and repair as required.
	(e) Oil pump scored or binding.	(e) Inspect condition of pump and repair as required.
	(f) Front and/or rear clutch faulty.	(f) Disassemble and inspect clutch. Repair or replace as required.
	(g) Planetary gear sets broken or seized.	(g) Inspect condition of planetary gear sets and replace as required.
	(h) Overrunning clutch worn, broken or seized.	(h) Inspect condition of overrunning clutch and replace parts as required.
BUZZING NOISE	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Pump sucking air.	(b) Inspect pump for nicks or burrs on mating surfaces, porous casting, and/or excessive rotor clearance. Replace parts as required.
	(c) Valve body malfunction.	(c) Remove and recondition valve body assembly.
	(d) Overrunning clutch inner race damaged.	(d) Inspect and repair clutch as required.
HARD TO FILL, OIL BLOWS OUT FILLER TUBE	(a) High fluid level.	(a) Drain fluid to correct level.
	(b) Breather clogged.	(b) Inspect and clean breather vent opening in oil pump housing.
	(c) Oil filter clogged.	(c) Replace oil filter.
	(d) Aerated fluid.	(d) Inspect for air leakage into pump suction passage.
OIL LEAKAGE	(a) Speedometer Adaptor.	(a) Replace rubber "O" ring seal. Inspect for bore porosity.
	(b) Speedometer Drive Pinion Seal	(b) Replace rubber seal.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
	(c) Oil Pan Gasket.	(c) Can often be stopped by tightening bolts to proper torque 17 Nm (150 lbs. in.).If necessary, replace gasket. Inspect oil pan gasket mounting face for flatness. CAUTION: Do not overtorque pan bolts.
	(d) Fluid Filler Tube.	(d) Replace "O" ring seal. Inspect for tube damage, and bore porosity.
	(e) Fluid Lines and Fittings.	(e) If leakage cannot be stopped by tightening a fitting, replace the defective part.
	(f) Manual Control Lever.	(f) Replace either or both the manual lever or throttle lever shaft seal.
	(g) Pipe Plugs.	(g) Torque to specified torque. If leak persists, replace plug.
	(h) Rear Extension Seal.	(h) Check for O.D. Bore damage and replace seal.
	(i) Rear Bearing Access Plate.	(i) Replace gasket.
	(j) Extension Bolts.	(j) Replace bolt.
	(k) Extension Gasket.	(k) Replace gasket and check for sealing surface damage on case and extension.
	(l) Kickdown Band Adjusting Screw.	(l) Apply sealer.
	(m) Neutral Switch.	(m) Replace switch and/or gasket.
	(n) Fluid Leakage in Converter Housing area.	(n) See section on Fluid Leakage.
TRANSMISSION OVERHEATS	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Kickdown band adjustment too tight.	(b) Adjust kickdown band.
	(c) Low-reverse band adjustment too tight.	(c) Adjust low-reverse band.
	(d) Faulty oil pump.	(d) Inspect transmission cooling system, clean and repair as required.
	(e) Cracked or restricted oil cooler line or fitting.	(e) Inspect, repair or replace as required.
	(f) Faulty oil pump.	(f) Inspect pump for incorrect clearance, repair as required.
	(g) Insufficient clutch plate clearance in front and/or rear clutches.	(g) Measure clutch plate clearance and correct with proper size snap ring.
STARTER WILL NOT ENERGIZE IN NEUTRAL OR PARK	(a) Incorrect gearshift control linkage adjustment.	(a) Adjust control linkage.
	(b) Faulty neutral starting switch.	(b) Test operation of switch with a test lamp. Replace if required.
	(c) Broken lead to neutral switch.	(c) Inspect lead and test with a test lamp. Repair broken lead.

SERVICE DIAGNOSIS — BORG WARNER AUTOMATIC TRANSMISSION

(Model 35)

Condition	Possible Cause	Correction
NO FORWARD DRIVE	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Linkage adjustment incorrect.	(b) Adjust linkage.
	(c) Transmission throttle cable adjustment incorrect.	(c) Adjust cable to specifications.
	(d) Valve body malfunction.	(d) Clean and check valve body.
	(e) Front clutch and/or seal rings leaking.	(e) Check and replace faulty components.
	(f) Output shaft plug leaking.	(f) Replace plug.
	(g) Over-running clutch slipping ("D" or "2" selected).	(g) Repair or replace clutch components.
	(h) Planetary gear set damaged.	(h) Replace planetary gear set.
	(i) Torque converter faulty.	(i) Repair or replace torque converter.
	(j) Oil pump or drive tangs damaged.	(j) Replace faulty components.
NO REVERSE DRIVE	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Manual linkage adjustment incorrect.	(b) Adjust linkage.
	(c) Rear band and/or throttle cable adjustment incorrect.	(c) Adjust band and/or throttle cable to specifications.
	(d) Rear servo and or tube leaking.	(d) Replace faulty components.
	(e) Rear clutch tube leaking.	(e) Repair or replace faulty components.
	(f) Valve body malfunction.	(f) Clean and check valve body.
	(g) Rear clutch and/or seal rings leaking.	(g) Check and replace faulty components.
	(h) Rear band faulty.	(h) Replace faulty component.
HARSH ENGAGEMENT IN D, 1, 2 AND R.	(a) Engine idle speed to high.	(a) Adjust engine idle speed to specifications. Re-adjust throttle linkage.
	(b) Transmission throttle cable adjustment incorrect.	(b) Adjust throttle cable to specifications.
	(c) Valve body malfunction.	(c) Clean and check valve body.
	(d) Front/rear clutch faulty.	(d) Repair or replace clutch assemblies.
DELAYED ENGAGEMENT IN D, 1, 2 AND R	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Transmission throttle cable adjustment incorrect.	(b) Adjust cable to specifications.
	(c) Manual linkage adjustment incorrect.	(c) Adjust linkage.
	(d) Oil strainer blocked.	(d) Unblock strainer and clean transmission oil pan.
	(e) Rear servo/tubes leaking.	(e) Repair or replace faulty components.
	(f) Rear clutch tube leaking.	(f) Repair or replace faulty components.
	(g) Valve body malfunction.	(g) Clean and check valve body.
	(h) Pump tubes leaking.	(h) Replace faulty components.
	(i) Front clutch/seal rings leaking.	(i) Replace faulty components.
	(j) Output shaft plug leaking.	(j) Replace plug.
	(k) Rear clutch/seal rings leaking.	(k) Replace faulty components.
NO NEUTRAL (DRIVES IN NEUTRAL)	(a) Manual linkage adjustment incorrect.	(a) Adjust linkage.
	(b) Valve body screws loose.	(b) Tighten valve body screws to specifications.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
NO UPSHIFT 1 - 2	(a) Manual linkage adjustment incorrect.	(a) Adjust linkage.
	(b) Governor valve malfunction.	(b) Repair or replace governor valve.
	(c) Front band adjustment incorrect.	(c) Adjust band to specifications.
	(d) Front servo/tubes leaking.	(d) Replace faulty components.
	(e) Valve body malfunction.	(e) Clean and check valve body.
	(f) Front band faulty.	(f) Replace faulty components.
NO UPSHIFT 2 - 3	(a) Manual linkage adjustment incorrect.	(a) Adjust linkage.
	(b) Governor valve malfunction.	(b) Repair or replace governor valve.
	(c) Rear clutch/tubes leaking.	(c) Replace faulty components.
	(d) Front servo/tubes leaking.	(d) Replace faulty components.
	(e) Valve body malfunction.	(e) Clean and check valve body.
	(f) Rear clutch/sealing ring leaking.	(f) Check and replace faulty components.
HARSH SHIFT QUALITY 1 - 2	(a) Transmission throttle cable adjustment incorrect.	(a) Adjust cable to specifications.
	(b) Front band adjustment incorrect.	(b) Adjust band to specifications.
	(c) Valve body malfunction.	(c) Clean and check valve body.
	(d) Governor valve malfunction.	(d) Repair or replace governor valve.
HARSH SHIFT QUALITY 2 - 3	(a) Transmission throttle cable adjustment incorrect.	(a) Adjust cable to specifications.
	(b) Front servo malfunction.	(b) Repair or replace faulty parts.
	(c) Valve body malfunction.	(c) Clean and check valve body.
HARSH SHIFT QUALITY 3 - 2	(a) Transmission throttle cable adjustment incorrect.	(a) Adjust cable to specifications.
	(b) Valve body malfunction.	(b) Clean and check valve body.
HARSH SHIFT QUALITY 2 - 1	(a) Engine idle speed incorrect.	(a) Adjust engine idle speed and adjust throttle cable to specifications.
	(b) Transmission throttle cable adjustment incorrect.	(b) Adjust cable to specifications.
	(c) Over-running clutch malfunction	(c) Repair or replace faulty components.
INCORRECT SHIFT SPEEDS	(a) Throttle adjustment incorrect.	(a) Check for full throttle at carburettor.
	(b) Transmission throttle cable adjustment incorrect.	(b) Adjust cable to specifications.
	(c) Valve body malfunction.	(c) Clean and check valve body.
	(d) Governor valve malfunction.	(d) Repair or replace governor valve.
	(e) Front servo assembly/tubes leaking.	(e) Repair or replace faulty parts.
	(f) Rear clutch assembly/tubes leaking.	(f) Repair or replace faulty parts.
NO KICKDOWN	(a) Throttle adjustment incorrect.	(a) Check for full throttle at carburettor.
	(b) Transmission throttle cable adjustment incorrect.	(b) Adjust cable to specifications.
	(c) Valve body malfunction.	(c) Clean and check valve body.
	(d) Kickdown band adjustment incorrect.	(d) Adjust band to specifications.

SERVICE DIAGNOSIS

Condition	Possible cause	Correction
SLIPPAGE ON BREAKAWAY	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Manual control linkage adjustment incorrect.	(b) Adjust linkage.
	(c) Transmission throttle cable adjustment incorrect.	(c) Adjust cable to specifications.
	(d) Valve body malfunction.	(d) Clean and check valve body.
	(e) Front clutch assembly and/or seal rings leaking.	(e) Replace faulty components.
	(f) Output shaft plug leaking.	(f) Replace plug.
	(g) Over-running clutch malfunction.	(g) Repair or replace faulty components.
	(h) Torque converter malfunction.	(h) Repair or replace torque converter.
SLIPPAGE 1 - 2 SHIFT	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Transmission throttle cable adjustment incorrect.	(b) Adjust cable to specifications.
	(c) Manual control linkage adjustment incorrect.	(c) Adjust linkage.
	(d) Front band adjustment incorrect.	(d) Adjust band to specifications.
	(e) Front servo assembly and or tubes leaking.	(e) Replace faulty components.
	(f) Valve body malfunction.	(f) Clean and check valve body.
	(g) Front band malfunction.	(g) Replace faulty components.
SLIPPAGE 2 - 3 SHIFT	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Manual control linkage adjustment incorrect.	(b) Adjust linkage.
	(c) Transmission throttle cable adjustment incorrect.	(c) Adjust cable to specifications.
	(d) Rear clutch assembly and/or tubes leaking.	(d) Replace faulty components.
	(e) Valve body malfunction.	(e) Clean and check valve body.
	(f) Rear clutch assembly and/or seal rings leaking.	(f) Replace faulty components.
SLIP "1" SELECTED	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Manual control linkage adjustment incorrect.	(b) Adjust linkage.
	(c) Transmission throttle cable adjustment incorrect.	(c) Adjust cable to specifications.
	(d) Rear band adjustment incorrect.	(d) Adjust band to specifications.
	(e) Rear servo and/or tubes leaking.	(e) Replace faulty components.
	(f) Valve body malfunction.	(f) Clean and check valve body.
	(g) Front clutch assembly and/or seal rings leaking.	(g) Replace faulty components.
	(h) Output shaft plug leaking.	(h) Replace plug.
	(i) Rear band malfunction.	(i) Replace faulty components.
SLIP "R" SELECTED	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Manual control linkage adjustment incorrect.	(b) Adjust linkage.
	(c) Transmission throttle cable adjustment incorrect.	(c) Adjust cable to specifications.
	(d) Rear band adjustment incorrect.	(d) Adjust band to specifications.
	(e) Rear servo assembly and/or tubes leaking.	(e) Replace faulty components.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
	(f) Valve body malfunction.	(f) Clean and check valve body.
	(g) Rear clutch assembly and/or seal rings leaking.	(g) Replace faulty components.
	(h) Rear band malfunction.	(h) Replace faulty components.
UPSHIFT "1" SELECTED	(a) Manual control linkage adjustment incorrect.	(a) Adjust linkage to specifications.
	(b) Valve body malfunction.	(b) Clean and check valve body.
DELAYED DOWN SHIFT "2" SELECTED	(a) Manual control linkage adjustment incorrect.	(a) Adjust linkage.
	(b) Governor valve malfunction	(b) Repair or replace governor valve.
	(c) Front servo assembly and/or tubes leaking.	(c) Replace faulty components.
	(d) Valve body malfunction.	(d) Clean and check valve body.
DELAYED DOWN SHIFT "1" SELECTED	(a) Manual control linkage adjustment incorrect.	(a) Adjust linkage.
	(b) Governor valve malfunction.	(b) Repair or replace governor valve.
	(c) Rear servo and/or tube leaking.	(c) Replace faulty components.
	(d) Valve body malfunction.	(d) Clean and check valve body.
PARK NOT HOLDING VEHICLE	(a) Manual control linkage. adjustment incorrect.	(a) Adjust linkage.
	(b) Park pawl operating mechanism malfunction.	(b) Replace faulty components.
INCORRECT STARTER/ REVERSE LAMP OPERATION	(a) Manual control linkage adjustment incorrect.	(a) Adjust linkage.
	(b) Mounting screws loose.	(b) Tighten screws.
	(c) Faulty connections or switch.	(c) Replace faulty components.
OVERHEATING	(a) Low fluid level.	(a) Refill to correct level with "Dexron"® II type Automatic Transmission Fluid.
	(b) Torque converter faulty.	(b) Repair or replace torque converter.
	(c) Heat exchanger or pipes/tubes blocked.	(c) Unblock or replace faulty components.
	(d) Faulty cooling system.	(d) Repair cooling system.

SECTION 11 — TORQUEFLITE AUTOMATIC TRANSMISSION

(Model MA904 A)

NOTE: Part numbers of transmission assemblies are subject to change during a model. It is therefore important to identify the transmission being serviced by the number stamped on the left hand side oil pan flange. When ordering parts it is essential to quote transmission part number as well as all of the numbers on the vehicle certification plate attached to the plenum chamber.

SPECIFICATIONS

Transmission Model	MA904 A Torqueflite
Part Number Identification	4028427/4058851/4130795/4130174
Type	Automatic Three Speed with Torque Converter
Torque Converter Diameter	241 mm (9½")
Engine Application	Astron 2,0 litre
Cooling Method	Water — Heat Exchanger
Lubrication	
Pump	Rotor Type
Fluid Type	Dexron® II "B" Classification
Fluid Capacity	6,4 litres (11.20 pints)
Stall Speed (r.p.m.)	
Transmission Number—4028427	2,200 to 2,650
Transmission Number—4058851/4130795/4130174	1,950 to 2,400
Gear Ratios—	
1—Low	2.45:1
2—Second	1.45:1
D—Drive	1.00:1
R—Reverse	2.21:1
Pump Clearances—	
Outer Rotor to Case Bore	0,10 to 0,20 mm (0.004 to 0.008")
Outer to Inner Tip	0,13 to 0,25 mm (0.005 to 0.010")
End Clearance — Rotors	0,03 to 0,08 mm (0.001 to 0.003")
Gear Train End Play	0,03 to 1,20 mm (0.001 to 0.047")
Input Shaft End Play	0,41 to 1,50 mm (0.016 to 0.059")
Snap Rings—	
Rear Clutch Snap Ring (Selective)	1,52 to 1,57 mm (0.060 to 0.062")
	1,73 to 1,78 mm (0.068 to 0.070")
	1,93 to 1,98 mm (0.076 to 0.078")
Output Shaft (Forward End)	1,02 to 1,12 mm (0.040 to 0.044")
	1,22 to 1,32 mm (0.048 to 0.052")
	1,50 to 1,65 mm (0.059 to 0.065")
Front Clutch—	
Number of Discs	3
Number of Plates	3
Number of Springs	1
Rear Clutch—	
Number of Discs	3
Number of Plates	2
Clutch Plate Clearance—	
Front Clutch	1,70 to 3,40 mm (0.067 to 0.134")
Rear Clutch	0,81 to 1,40 mm (0.032 to 0.055")
Band Adjustments—	
Kickdown (Front) Turns* (4028427 Trans.)	3
(4028851/4130795/4130174 Trans.)	3½
Low-Reverse (Internal) Turns**	7,5

*Back off from 8 Nm (72 lbs. in.) "Direct application" or 5 Nm (48 lbs. in.) with adaptor E1295.

**Back off from 4,5 Nm (41 lbs. in.) "Direct application"

Thrust Washers—		
Reaction Shaft Support to Front Clutch Retainer	# 1	1,55 to 1,60 mm (0.061 to 0.063")
Front Clutch to Rear Clutch	# 2	1,55 to 1,60 mm (0.061 to 0.063")
Input Shaft to Output Shaft	# 3	Selective 1,32 to 1,37 mm (0.052 to 0.054") Natural 1,73 to 1,78 mm (0.068 to 0.070") Red 2,11 to 2,16 mm (0.083 to 0.085") Green
Front Annulus Support to Front Carrier	# 4	3,07 to 3,18 mm (0.121 to 0.125")
Driving Shell to Front Annulus	# 5	1,22 to 1,27 mm (0.048 to 0.050")
Front Carrier to Driving Shell Thrust Plate	# 6	1,22 to 1,27 mm (0.048 to 0.050")
Driving Shell Thrust Plate	# 7	1,27 to 1,32 mm (0.050 to 0.052")
	# 8	1,27 to 1,32 mm (0.050 to 0.052")
Rear Carrier to Driving Shell	# 9	1,22 to 1,27 mm (0.048 to 0.050")
Rear Annulus Support to Rear Carrier	# 10	1,22 to 1,27 mm (0.048 to 0.050")

AUTOMATIC SHIFT SPEED AND GOVERNOR PRESSURE CHART

Transmission	MA904 A
Axle Ratio	3.545:1

CONDITION:	Approx. Road Speed in km/h
Throttle Closed:	
1-2 Upshift	15-23
2-3 Upshift	23-31
*3-1 Downshift	13-21
Throttle Wide Open:	
1-2 Upshift	56-72
2-3 Upshift	105-122
Kickdown Range:	
3-2 Downshift	84-109
3-1 Downshift	40-55
Governor Pressure:	
100 kPa (15 p.s.i.)	32-34
345 kPa (50 p.s.i.)	56-64
520 kPa (75 p.s.i.)	84-92

*Governor pressure should be from zero to 10 kPa (1.5 p.s.i.) at stand-still or downshift may not occur.

SPECIAL TOOLS

MA-904-A	TOOL DESCRIPTION
E3C10C	Remover — extension housing yoke seal
E21C 5B	Stand — valve body
E21C 5C	Stand — transmission
E21C 5D	Transmission repair stand adaptor
E21C 15A	Installer — detent ball
E21C 25C	Torque convertor flushing tool
E21C 30	Compressor — front clutch piston spring
E21C 35B	Studs — pilot
E21C 35C	Studs — pilot
E21C 35D	Remover — front oil pump and reaction shaft support
E21C 35E	Aligning tool — front pump
E21C 35F	Installer — front pump seal
E21C 35G	Remover — front pump seal
E21C 35H	Assembly tool — front pump to reaction shaft support
E21C 45B	Installer — Speedometer drive adaptor inner oil seal
E21C 50C	Installer — extension housing yoke seal
E21C 50E	Remover and Installer — extension housing sliding yoke bushing
E21C 55	Gauge — throttle pressure adjustment
E21C 60	Transmission bushing kit
E21C 65	Gauge — low pressure
E21C 65A	Gauge — high pressure
E0092	Compressor engine valve spring (for servo removal)
E1295	Adaptor — transmission band adjuster (use with torque wrench)

TORQUE SPECIFICATIONS

	Nm	(lbs. ft.)	(lbs. in.)
Cooler line fitting	13		110
Cooler line union nut	10		85
Converter drive plate to crankshaft bolt	127-136	94-101	
Converter drive plate to torque converter bolt	45-51	33-38	
Converter cover plate to housing bolt	6		40
Extension housing to transmission case bolt	33	24	
Extension housing to insulator mounting bolt	24-34	18-25	
Governor body to support bolt	11		100
Kickdown band adjusting screw lock nut	47	35	
Kickdown lever shaft plug	17		150
Oil filler tube bracket bolt	17		150
Oil pan bolt	17		150
Oil pump housing to transmission case bolt	20		175
Output shaft support bolt	17		150
Over-running clutch cam set screw	13		110
Pressure test take-off plug	13		110
Reaction shaft support to oil pump bolt	19		160
Reverse band adjusting screw lock nut	40	30	
Speedometer drive clamp screw	13		110
Transmission to engine bolt	42-54	31-40	
Valve body screw	4		35
Valve body to transmission case bolt	13		110
Throttle valve shaft lever clamp bolt	10		90

GENERAL INFORMATION

The transmission combines a torque converter and a fully-automatic 3-speed gear system. The converter housing and transmission case are an integral aluminium casting. The transmission consists of two multiple disc clutches, an over-running clutch, two servos and bands, and two planetary gear sets to provide three forward ratios and a reverse ratio. The common sun gear of the planetary gear sets is connected to the front clutch by a driving shell which is splined to the sun gear and to the front clutch retainer. The hydraulic system consists of an oil pump, and a single valve body which contains all of the valves except the governor valve.

Venting of the transmission is accomplished by a passage through the upper part of the oil pump housing.

The torque converter is attached to the crankshaft through a flexible driving plate. Cooling of the converter is accomplished by circulating the transmission fluid through an oil-to-water type cooler, located in the radiator lower tank. The torque converter assembly is a sealed unit which cannot be disassembled.

The transmission fluid is filtered by an internal "Dacron Type" filter attached to the lower side of the valve body assembly.

Engine torque is transmitted to the torque converter then, through the input shaft to the multiple disc clutches in the transmission. The power flow depends on the application of the clutches and bands.

NOTE: When replacing parts, refer to the part number stamped on the left of the transmission oil pan flange.

HYDRAULIC CONTROL SYSTEM

The hydraulic control circuits (Figs. 2 to 10) show the position of the various valves with colour coded passages to indicate those under hydraulic pressure for all operations of the transmission.

The hydraulic control system makes the transmission fully automatic, and has four important functions to perform. In a general way, the components of any automatic control system may be grouped into the following basic groups.

The pressure supply system, the pressure regulating valves, the flow control valves, and the clutches and band servos.

Taking each of these basic groups or systems in turn, the control system may be described as follows:

Pressure Supply System

The pressure supply system consists of an oil pump driven by the engine through the torque converter. The single front pump furnishes pressure for all the hydraulic and lubrication requirements.

Pressure Regulating Valves

The pressure regulating valves consist of a regulator valve which controls line pressure at a value dependent on throttle opening.

The torque converter control valve maintains torque converter operating pressure and transmission lubricating pressure.

The governor valve transmits regulated pressure to the transmission (in conjunction with vehicle speed) to control upshift and downshift speeds.

The throttle valve transmits regulated pressure to the transmission (in conjunction with throttle position) to control upshift and downshift speeds.

Flow Control Valves

The manual valve provides the different transmission drive ranges as selected by the vehicle operator.

The 1-2 shift valve automatically shifts the transmission from low to second or from second to low depending on the vehicle operation.

The 2-3 shift valve automatically shifts the transmission from second to direct or from direct to second depending on the vehicle operation.

The kickdown valve makes possible a forced downshift from direct to second-second to breakaway or direct to breakaway (depending on vehicle speed) by depressing the accelerator pedal past the detent "feel" near wide open throttle.

The throttle pressure plug at the end of the 2-3 shift valve, provides a 3-2 downshift with varying throttle openings depending upon vehicle speed.

The shuttle valve has two separate functions and performs each independently of the other. The first is that of providing fast release of the kickdown band, and smooth front clutch engagement when the driver makes a "lift-foot" upshift from second to direct. The second function of the shuttle valve is to regulate the application of the kickdown servo and band when making direct to second kickdowns.

Clutches, Band Servos and Accumulator

The front and rear clutch pistons, and both servo pistons are moved hydraulically to engage the clutches and apply the bands. The pistons are released by spring tension when hydraulic pressure is released. On the 2-3 upshift, the kickdown servo piston is released by spring tension and hydraulic pressure.

The accumulator controls the hydraulic pressure on the apply side of the kickdown servo during the 1-2 shift; thereby, cushioning the kickdown band application at any throttle position.

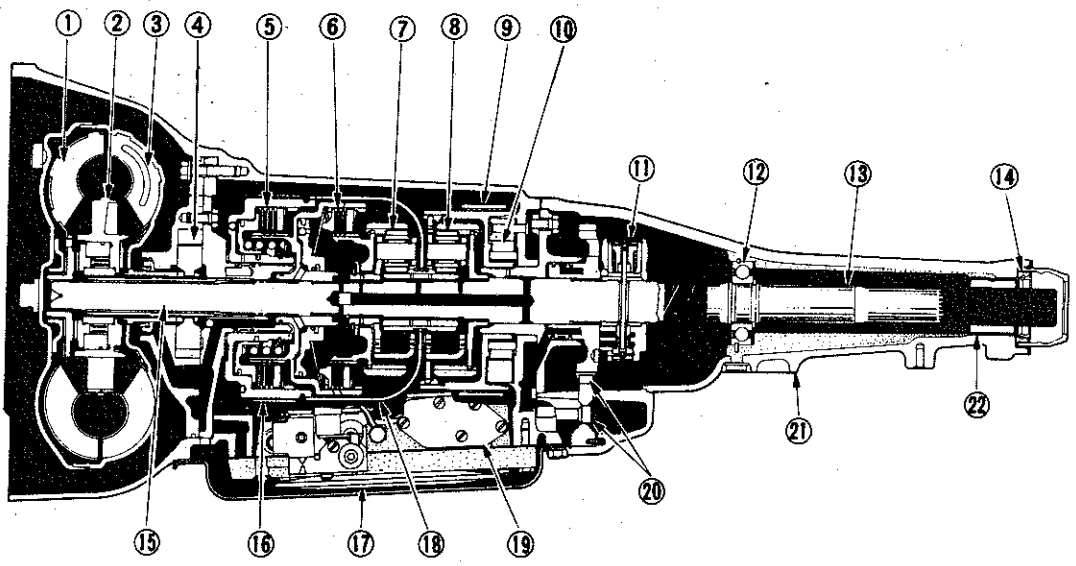
Starting the Engine

The engine will start with the selector lever in either the P (park) or N (neutral) positions. As a safety precaution when starting in the N (neutral) position, apply the parking or foot brake. **The Torqueflite transmission will not permit starting the engine by pushing or towing.**

Towing Vehicle

Transmission Inoperative: Tow the vehicle with a rear end pickup or remove the propeller shaft.

Transmission Operating Properly: The vehicle may be towed safely in N (neutral) with rear wheels on the ground at a speed not to exceed 50 km/h. **If the vehicle is to be towed for extended distances, it should be done with a rear end pickup or the propeller shaft removed.** Because the transmission receives lubrication only when the engine is running, **it is good practice to always tow a disabled vehicle with a rear end pickup** or remove the propeller shaft.



1 Turbine
2 Stator
3 Impeller
4 Oil pump
5 Front clutch
6 Rear clutch
7 Front planetary gear set
8 Rear planetary gear set
9 Low and reverse band
10 Overrunning clutch
11 Governor
12 Bearing
13 Output shaft
14 Seal
15 Input shaft
16 Kickdown band
17 Oil filter
18 Sun gear driving shell
19 Valve body
20 Parking lock assembly
21 Extension housing
22 Bushing

Fig. 1—Torqueflite transmission assembly

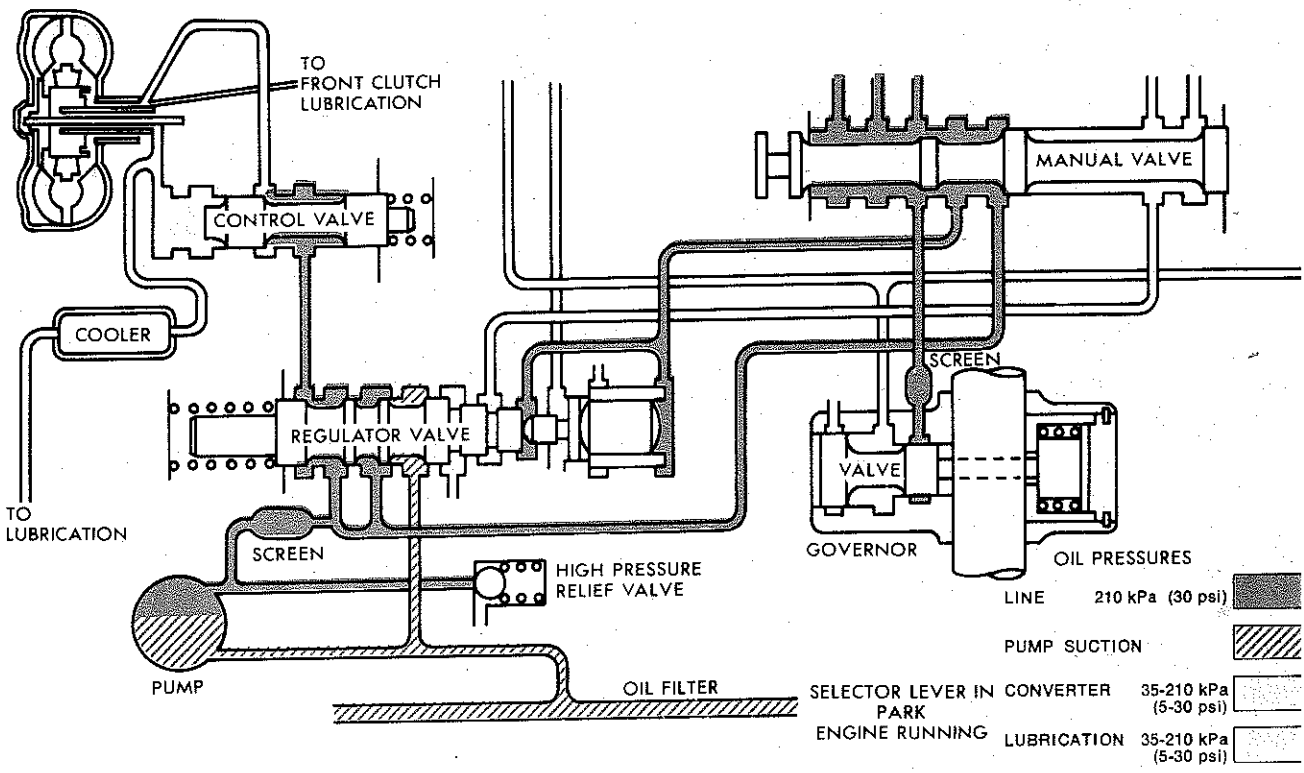


Fig. 2—Park (MA904 A)

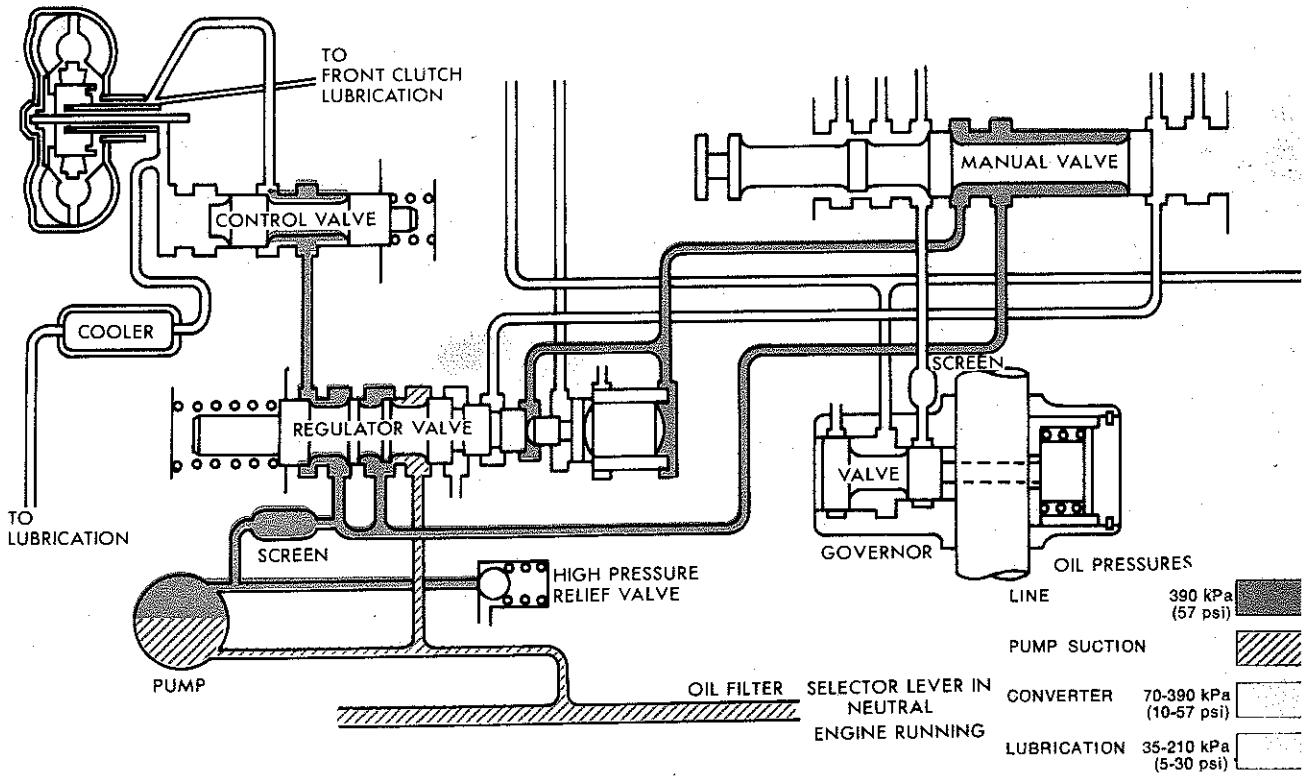


Fig. 2A—Neutral (MA904 A)

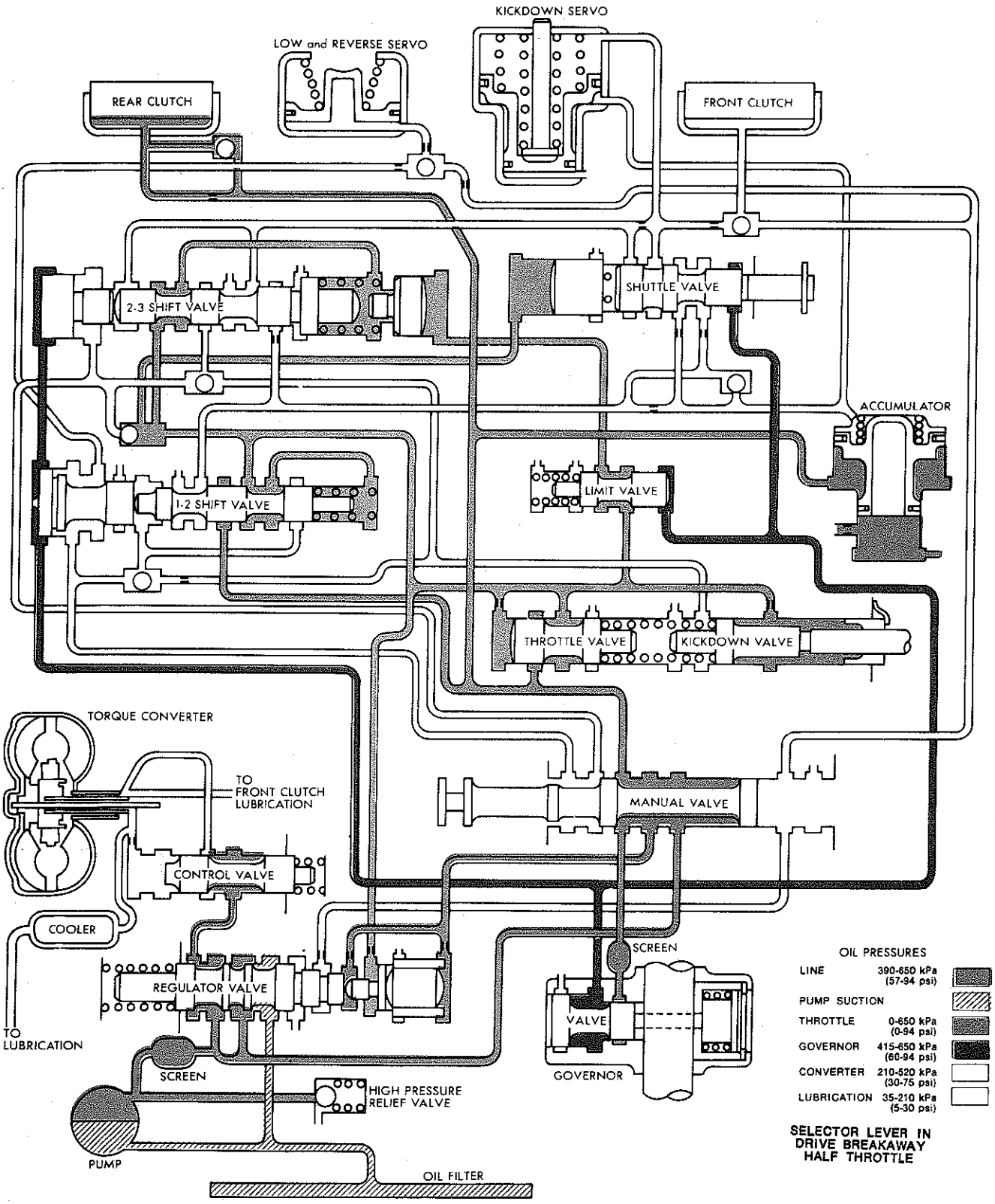


Fig. 3—Drive selected, low (breakaway) (MA904 A)

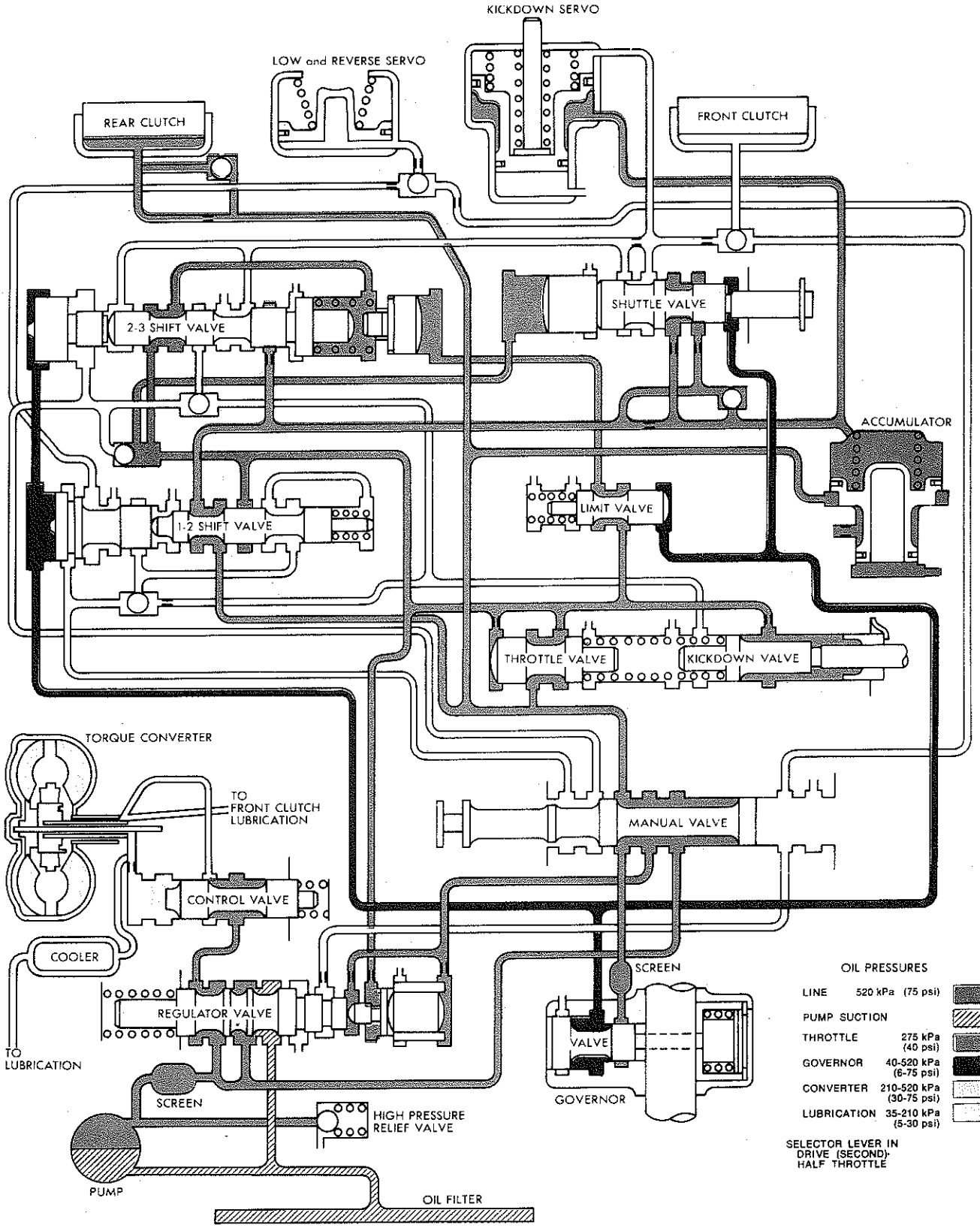


Fig. 4—Drive selected, second speed (MA904 A)

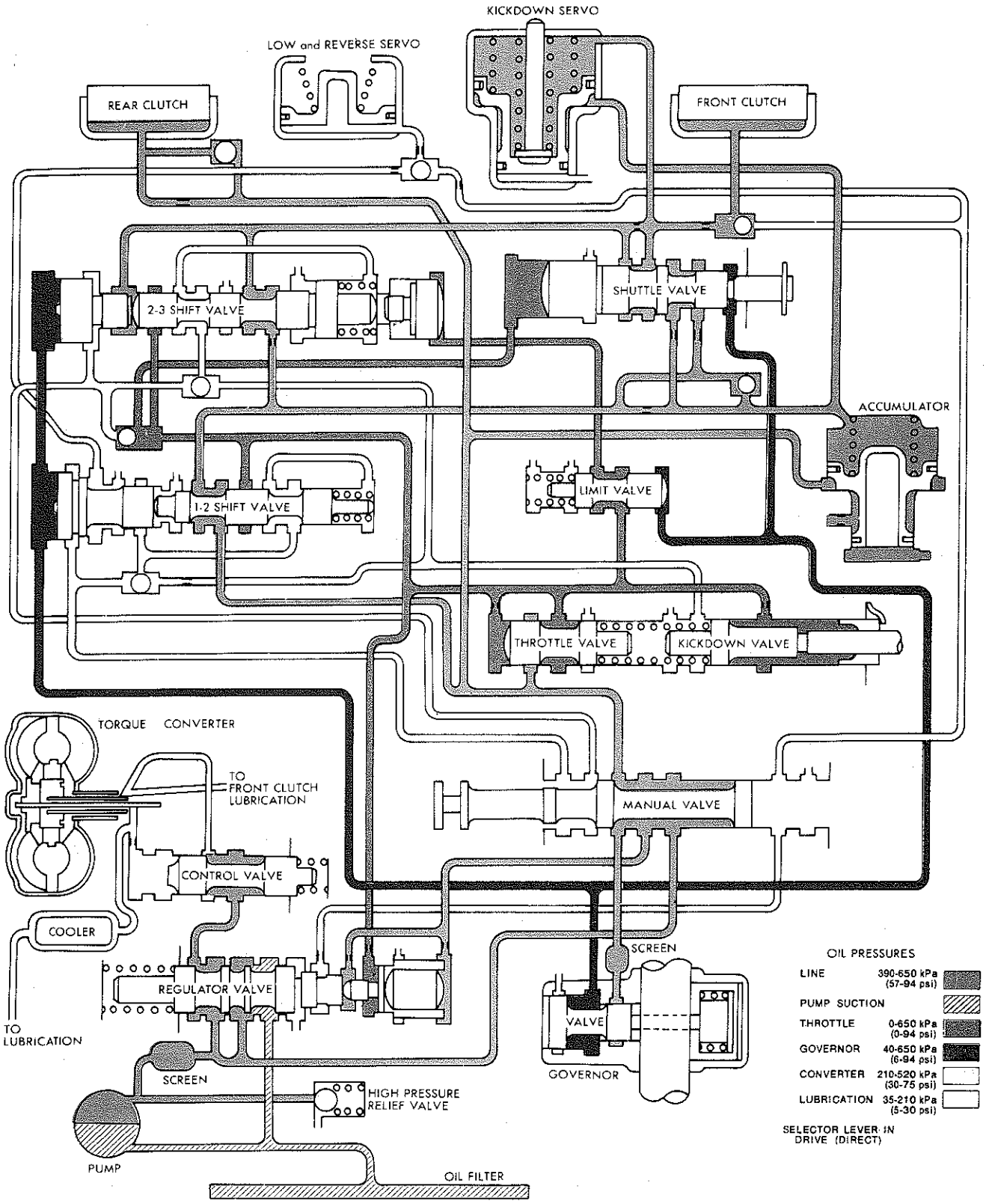


Fig. 5—Drive direct (MA904 A)

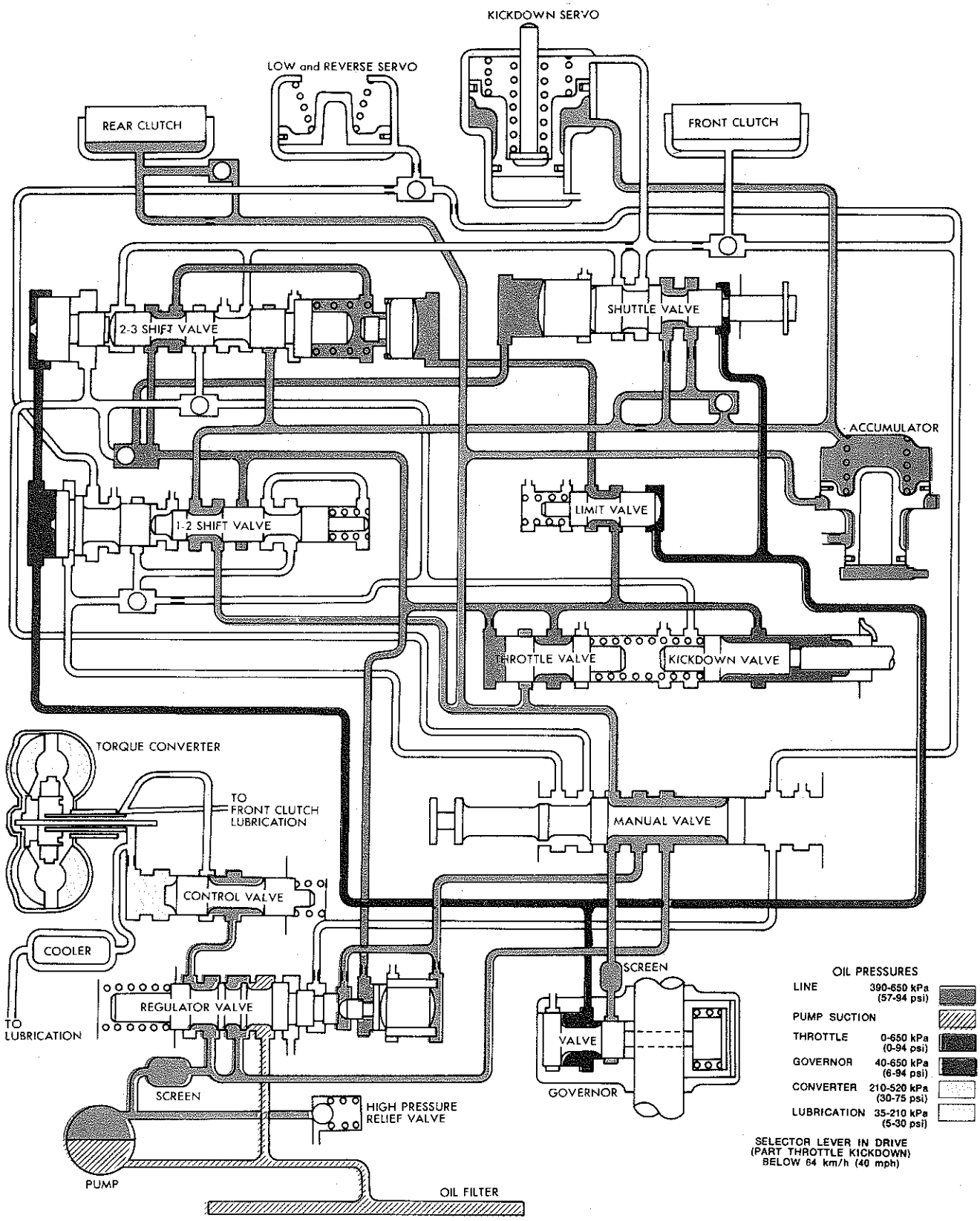


Fig. 6—Drive, part throttle kickdown (MA904 A)

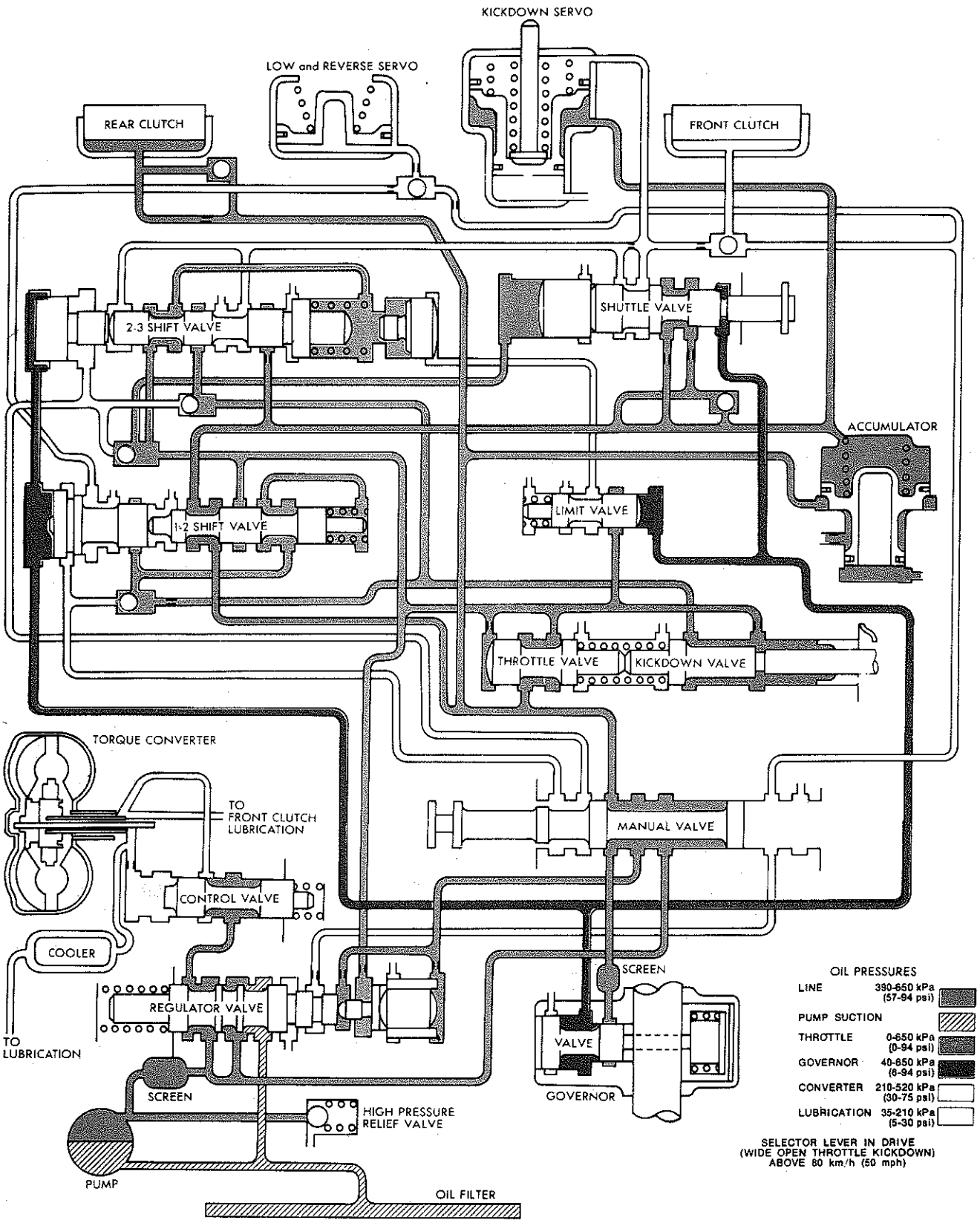


Fig. 7—Drive, full throttle kickdown (MA904 A)

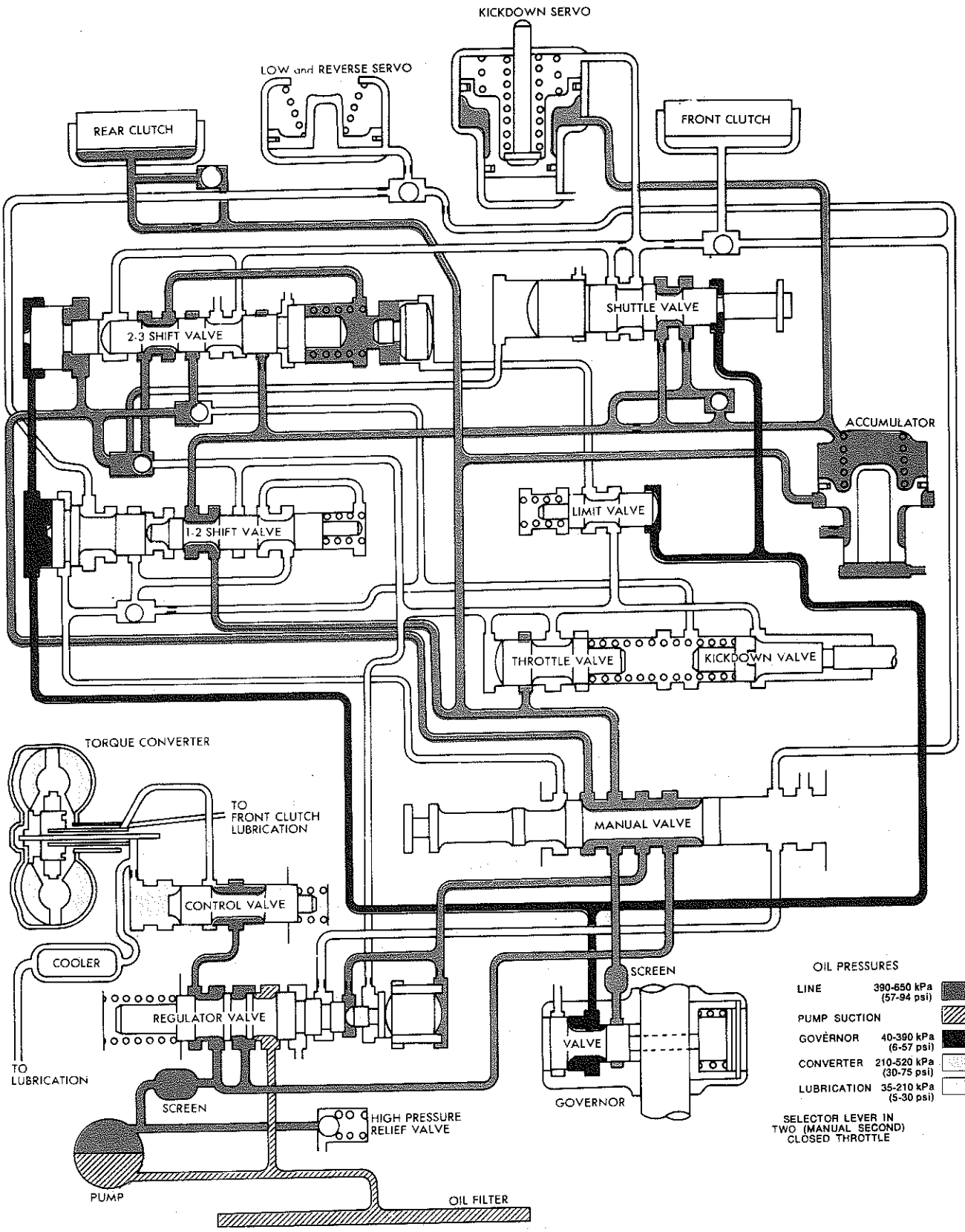


Fig. 8—Selector lever in two (MA904 A)

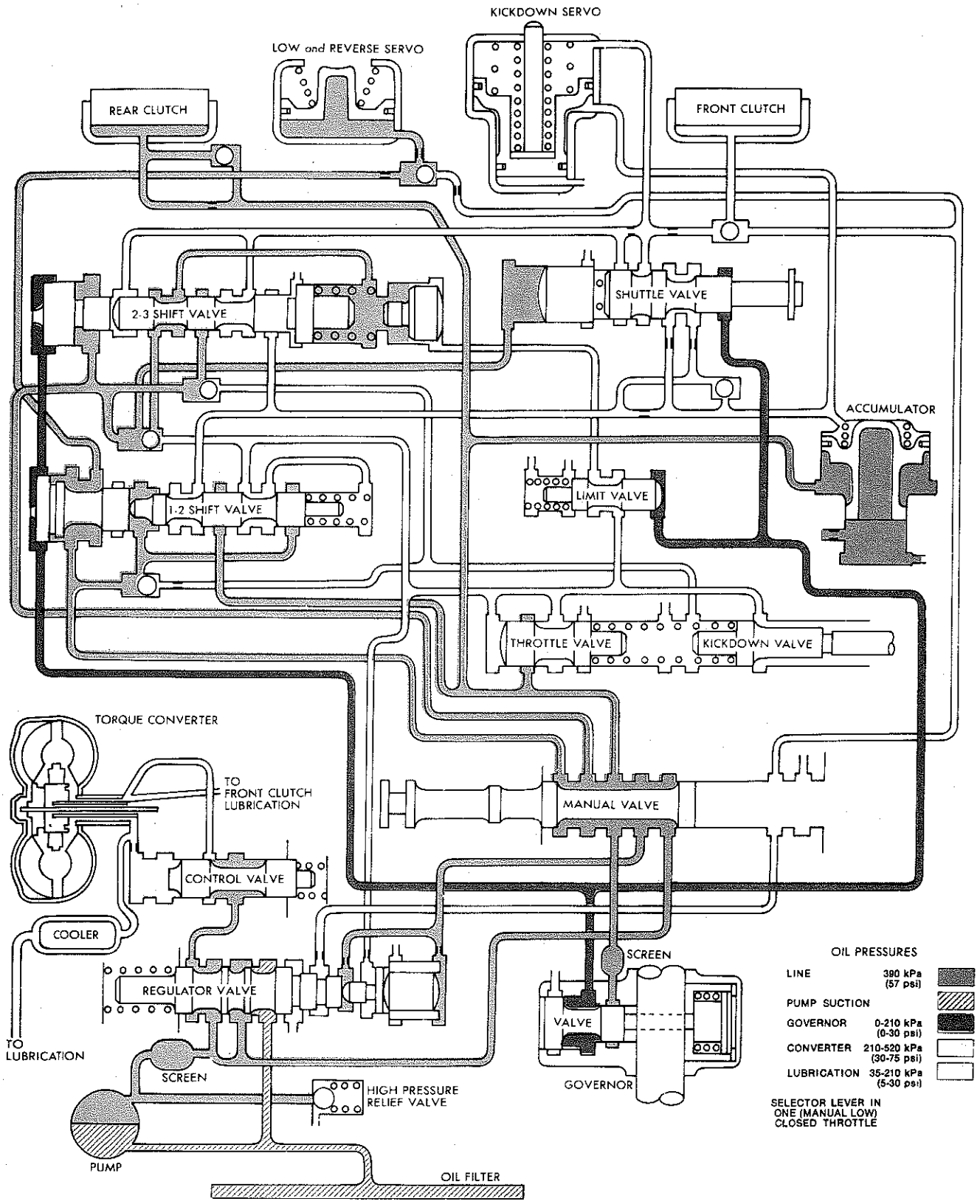


Fig. 9—Selector lever in one (MA904 A)

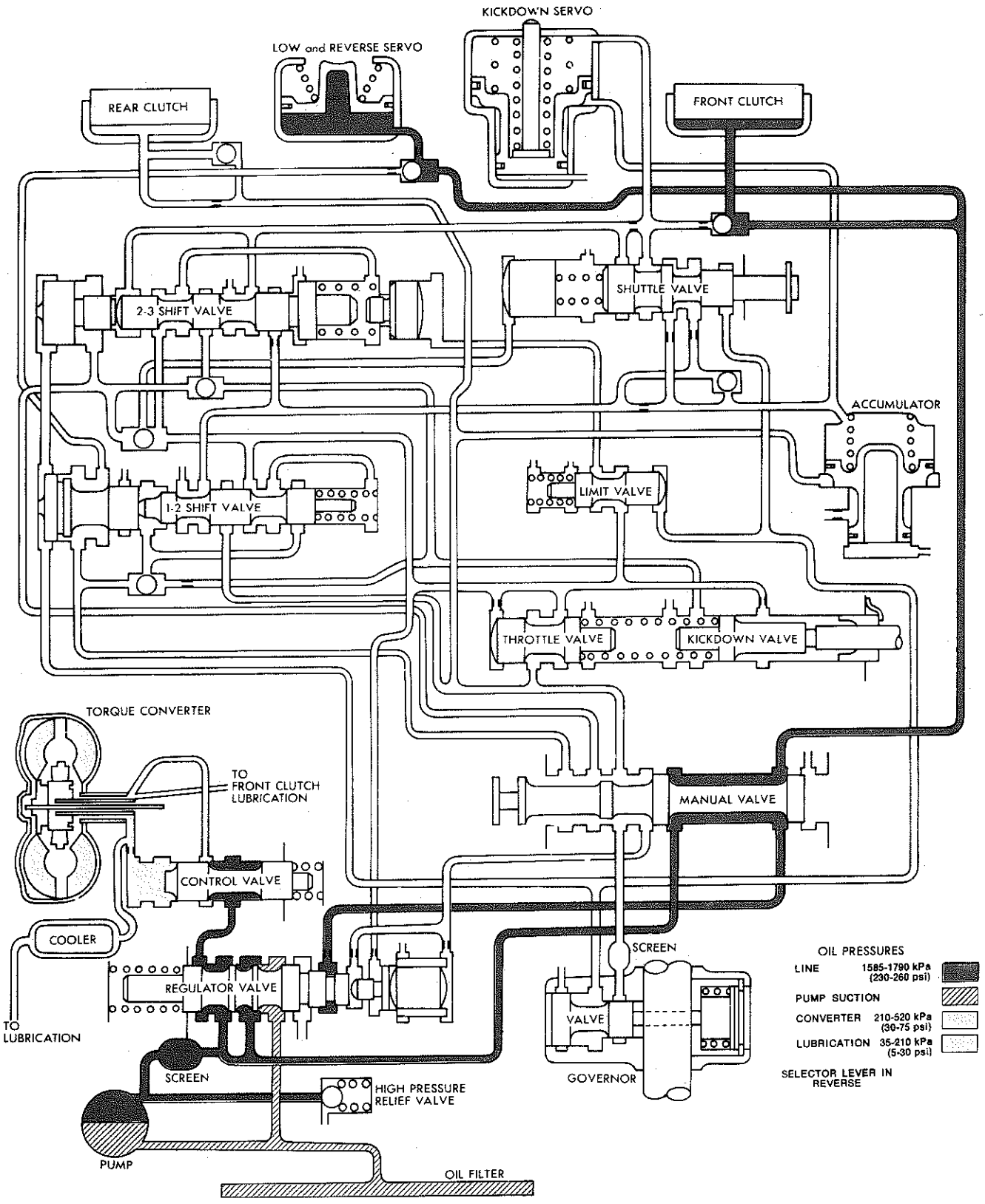


Fig. 10—Reverse (MA904 A)

SERVICE PROCEDURES

Service in Vehicle

Various transmission components can be removed for repairs without removing the transmission from the vehicle. The removal, reconditioning and installation procedures for these components are covered here.

Aluminium Thread Repair

Damaged or worn threads in the aluminium transmission case and valve body can be repaired by the use of Heli-Coils. Essentially, this repair consists of drilling out the worn or damaged threads, tapping the hole with a special Heli-Coil Tap, and installing a Heli-Coil Insert into the tapped hole. This brings the hole back to its original thread size.

Some thread drag may occur in screwing a bolt into the installed Heli-Coil insert. Therefore, a torque reading should be taken of the thread drag with a torque wrench and added to the specified bolt torque, so that all bolts securing a particular part will be tightened to the same torque.

BAND ADJUSTMENTS

Kickdown Band

The kickdown band adjusting screw is located on the left side of the transmission case (Fig. 11).

(1) Loosen lock nut and back off approximately five turns. Test adjusting screw for free turning in the transmission case.

(2) Using Nm (lbs. in.) torque wrench tighten band adjusting screw to specifications.

(3) Back off the adjusting screw as listed in specifications. Hold adjusting screw in this position and tighten lock nut to specification.

Low and Reverse Band

(1) Raise vehicle, drain transmission fluid and remove the oil pan.

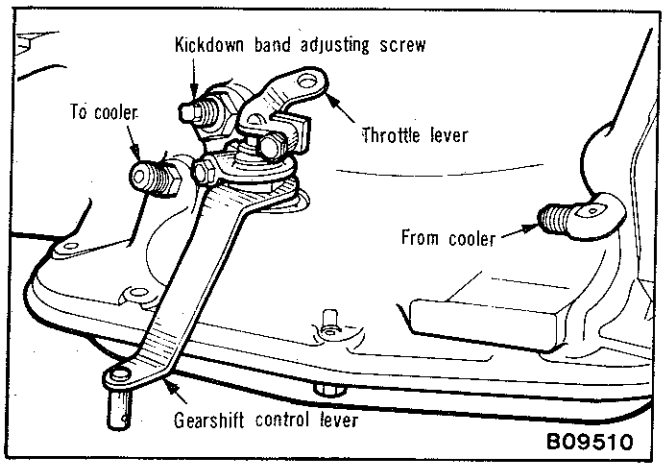


Fig. 11—External controls and adjustments

(2) Loosen adjusting screw lock nut and back off nut approximately five turns (Fig. 12). Test adjusting screw for free turning in the lever.

(3) Using Nm (lbs. in.) torque wrench tighten band adjusting screw to specifications.

(4) Back off adjusting screw as listed in specifications. Hold adjusting screw in this position and tighten lock nut to specification.

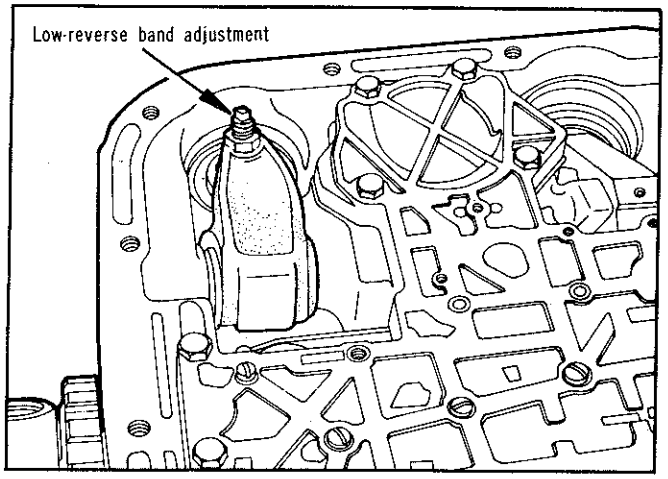


Fig. 12—Low-Reverse band adjustment

(5) Re-install oil pan using a new gasket. Tighten oil pan bolts to specification.

(6) Fill transmission with Automatic Transmission fluid. (See specifications for the recommended fluid).

HYDRAULIC PRESSURE TESTS

Before performing pressure tests, be certain that fluid level and condition, and control linkage adjustments have been checked and approved. Fluid must be at operating temperature 65 to 95°C (150 to 200°F).

Install an engine tachometer, raise vehicle on hoist which allows rear wheels to turn, and position tachometer so it can be read under the vehicle.

Disconnect throttle rod and shift rod from transmission lever so they can be controlled under the vehicle.

Attach two 0 to 700 kPa (0 to 100 p.s.i.) gauges Tool E21C65 to ports required for test being conducted. A 0 to 2500 kPa (0 to 300 p.s.i.) gauge Tool E21C65A is required for "reverse" pressure test at rear servo.

Test port locations are shown in (Fig. 13 and 14).

Test One (Selector in "1")

This tests pump output, pressure regulation, and condition of rear clutch and rear servo hydraulic circuits.

(1) Attach gauges to "line" and "rear servo" ports.

(2) Operate engine at 1000 r.p.m. for test.

(3) Move selector lever on transmission all the way rearward ("1" position).

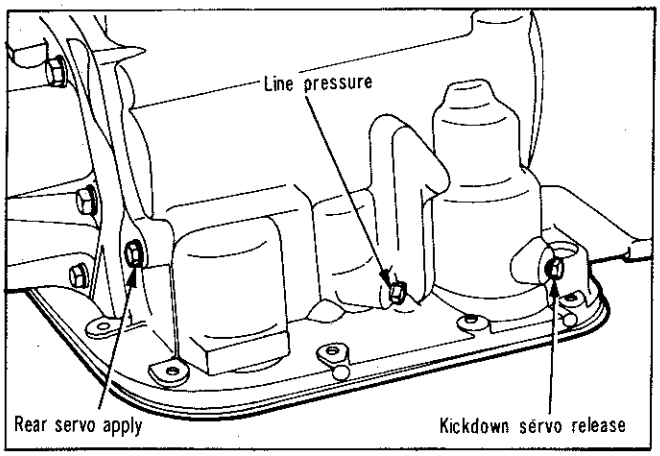


Fig. 13—Pressure test locations (right side of case)

(4) Read pressures on both gauges as throttle lever on transmission is moved from full rearward position to full forward position.

(5) Line pressure should read 372 to 413 kPa (54 to 60 p.s.i.) with throttle lever rearward and gradually increase, as lever is moved forward, to 620 to 662 kPa (90 to 96 p.s.i.).

(6) Rear servo pressure should read the same as line pressure within 21 kPa (3 p.s.i.).

Test Two (Selector in "2")

This tests pump output, pressure regulation, and condition of rear clutch and lubrication hydraulic circuits.

(1) Attach gauge to "line pressure" port and "tee" into rear cooler line fitting to read "lubrication" pressure.

(2) Operate engine at 1000 r.p.m. for test.

(3) Move selector lever on transmission one "detent" forward from full rearward position. This is selector "2" position.

(4) Read pressures on both gauges as throttle lever on transmission is moved from full rearward position to full forward position.

(5) Line pressure should read 372 to 413 kPa (54 to 60 p.s.i.) with throttle lever rearward and gradually increase, as lever is moved forward, to 620 to 662 kPa (90 to 96 p.s.i.).

(6) Lubrication pressure should be 34 to 103 kPa (5 to 15 p.s.i.) with lever rearward and 69 to 207 kPa (10 to 30 p.s.i.) with lever forward.

Test Three (Selector in "D")

This tests pump output, pressure regulation, and condition of rear clutch and front clutch hydraulic circuits.

(1) Attach gauges to "line" and "front servo release" ports.

(2) Operate engine at 1600 r.p.m. for test.

(3) Move selector lever on transmission two "detents" forward from full rearward position. This is selector "D" position.

(4) Read pressures on both gauges as throttle lever on transmission is moved from full rearward position to full forward position.

(5) Line pressure should read 372 to 413 kPa (54 to 60 p.s.i.) with throttle lever rearward and gradually increase, as lever is moved forward.

(6) Front servo release is pressurized only in direct drive and should be same as line pressure within 21 kPa (3 p.s.i.) up to downshift point.

Test Four (Selector in Reverse)

This tests for leakage into rear servo, due to case porosity, which can cause reverse band burn out.

(1) Attach 0 to 2500 kPa (0 to 300 p.s.i.) gauge Tool E21C65A to "rear servo apply" port.

(2) Operate engine at 1600 r.p.m. for test.

(3) Move selector lever on transmission four "detents" forward from full rearward position. This is selector "R" position.

(4) Rear servo pressure should read 1590 to 1790 kPa (230 to 260 p.s.i.).

(5) This tests pump output, pressure regulation, and condition of front clutch and rear servo hydraulic circuits.

(6) Move selector lever on transmission to "D" position to check that rear servo pressure drops to zero.

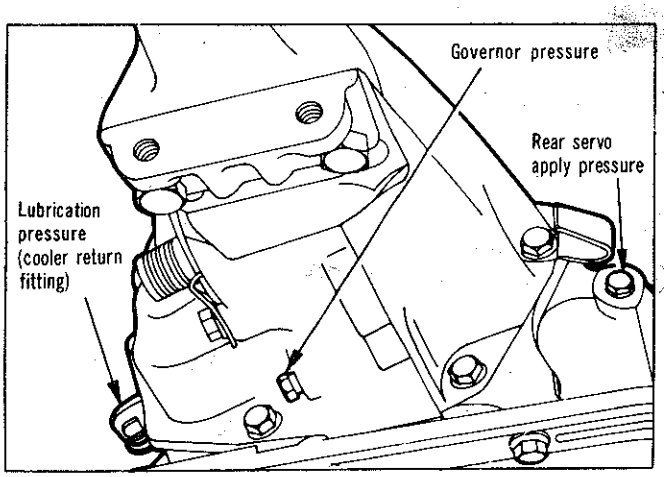


Fig. 14—Pressure test locations (rear end of case)

Test Result Indications

(1) If proper line pressure, minimum to maximum, is found in any one test, the pump and pressure regulator are working properly.

(2) Low pressure in "D, 1 and 2" but correct pressure in "R" indicates rear clutch circuit leakage.

(3) Low pressure in "R and 1" but correct pressure in "L" indicates front clutch circuit leakage.

(4) Low pressure in "R and L" but correct pressure in "2" indicates rear servo circuit leakage.

(5) Low line pressure in all positions indicates a defective pump, a clogged filter or a stuck pressure regulator valve.

Governor Pressure

Test only if transmission shifts at wrong vehicle speeds when throttle rod is correctly adjusted.

(1) Connect a 0 to 700 kPa (0 to 100 p.s.i.) pressure gauge, Tool E21C65 to governor pressure take-off point, located at lower left side of extension near the mounting flange (Fig. 14).

(2) Governor pressures should fall within the limits given in the "Governor Pressure Chart".

If governor pressures are incorrect at the given vehicle speeds, the governor valve and/or weights are probably sticking. **The governor pressure should respond smoothly to changes in km/h and should return to 0 to 10 kPa (0 to 1½ p.s.i.) when vehicle is stopped. High pressure at stand still (above 14 kPa) (2 p.s.i.) will prevent the transmission from downshifting.**

Throttle Pressure

No gauge port is provided for the throttle pressure. Incorrect throttle pressure should only be suspected if part throttle up-shift speeds are either delayed or occur too early in relation to vehicle speeds. Engine runaway on either up shifts or down shifts can also be an indicator of incorrect (low) throttle pressure setting.

CAUTION: In no case should throttle pressure be adjusted until the transmission throttle linkage adjustment has been verified to be correct.

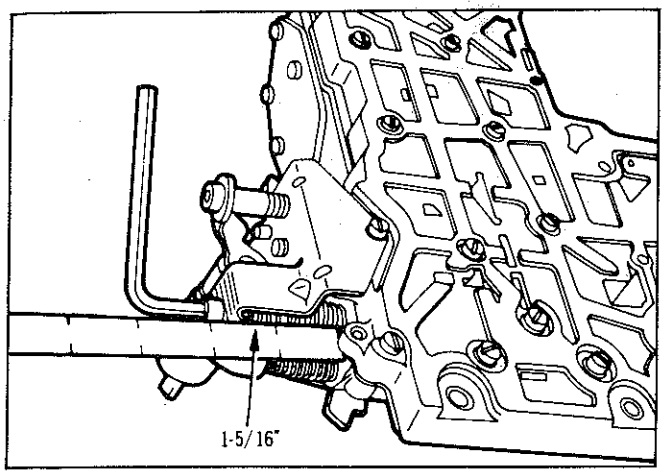


Fig. 15—Line pressure adjustment

HYDRAULIC CONTROL PRESSURE ADJUSTMENTS

Line Pressure

An incorrect throttle pressure setting will cause incorrect line pressure readings even though line pressure adjustment is correct. Always inspect and correct throttle pressure adjustment before adjusting the line pressure.

If line pressure is not correct, it will be necessary to remove valve body assembly to perform the adjustment unless a modified Allen Key is used.

The approximate adjustment is 33 mm (1-5/16"), measured from valve body to inner edge of adjusting nut (Fig. 15). However, due to manufacturing tolerances, the adjustment can be varied to obtain specified line pressure.

The adjusting screw may be turned with an Allen wrench. One complete turn of adjusting screw changes closed throttle line pressure approximately 11.5 kPa (1-2/3 p.s.i.). Turning adjusting screw counter-clockwise increases pressure, and clockwise decreases pressure.

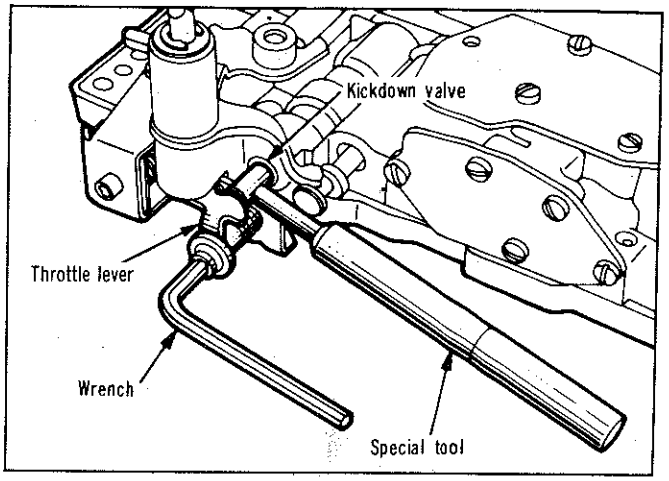


Fig. 16—Throttle pressure adjustment

Throttle Pressure

Throttle pressures cannot be tested accurately; therefore, the adjustment should be measured if a malfunction is evident.

(1) Remove valve body assembly from transmission to perform adjustment.

(2) Loosen throttle lever stop screw lock nut and back off approximately five turns (Fig. 16).

(3) Insert gauge pin of Tool E21C55 between the throttle lever cam and kickdown valve.

(4) By pushing in on tool, compress kickdown valve against its spring so throttle valve is completely bottomed inside the valve body.

(5) As force is being exerted to compress spring, tighten throttle lever stop screw finger tight against throttle lever tang with throttle lever cam touching tool and the throttle valve bottomed. **Be sure adjustment is made with spring fully compressed and valve bottomed in the valve body.**

(6) Remove tool and tighten stop screw lock nut securely.

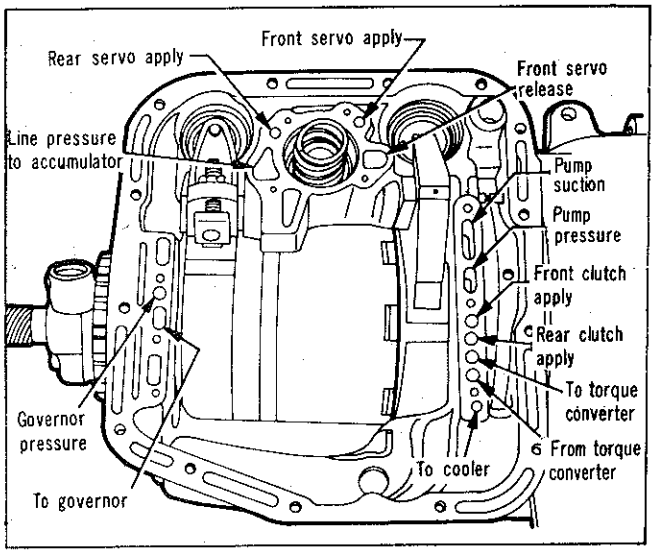


Fig. 17—Air pressure tests

AIR PRESSURE TESTS

A "NO DRIVE" condition might exist even with correct fluid pressure, because of inoperative clutches or bands. The inoperative units, clutches, bands and servos can be located through a series of tests by substituting air pressure for fluid pressure (Fig. 17).

The front and rear clutches, kickdown servo, and low-reverse servo may be tested by applying air pressure to their respective passages after the valve body assembly has been removed. To make air pressure tests, proceed as follows:

CAUTION: Compressed air supply must be free of all dirt or moisture. Use a pressure of 200-700 kPa (30 to 100 p.s.i.).

Front Clutch

Apply air pressure to front clutch "apply" passages and listen for a dull "thud" which indicates that front clutch is operating. Hold air pressure on for a few seconds and inspect system for excessive oil leaks.

Rear Clutch

Apply air pressure to rear clutch "apply" passage and listen for a dull "thud" which indicates that the rear clutch is operating. Also inspect for excessive oil leaks. **If a dull "thud" cannot be heard in the clutches, place finger tips on clutch housing and again apply air pressure. Movement of piston can be felt as the clutch is applied.**

Kickdown Servo (Front)

Direct air pressure into front servo "apply" passage. Operation of servo is indicated by a tightening of rear band. Spring tension on servo piston should release the band.

Low and Reverse Servo (Rear)

Direct air pressure into rear servo "apply" passage. Operation of servo is indicated by a tightening of rear band. Spring tension on servo piston should release the band.

If clutches and servos operate properly, no upshift or erratic shift conditions indicate that malfunctions exist in the valve body.

Governor

Governor operating failures can generally be diagnosed by a road test or hydraulic pressure test. Refer to "Hydraulic Pressure Tests."

SPEEDOMETER PINION

Removal and Installation

Rear axle gear ratio and tyre size determines pinion gear size requirements.

(1) Remove bolt and retainer securing speedometer pinion adapter in the extension housing (Fig. 18).

(2) With cable housing connected, carefully work adapter and pinion out of the extension housing.

(3) If transmission fluid is found in cable housing, replace seal in the adapter (Fig. 19). Start seal and retainer ring in the adapter, then push them into adapter with Tool E21C45B until tool bottoms (Fig. 20).

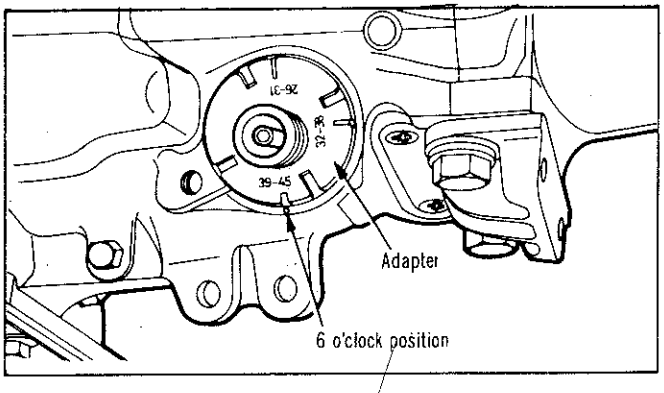


Fig. 18—Speedometer pinion and adapter installed (Retainer removed for view)

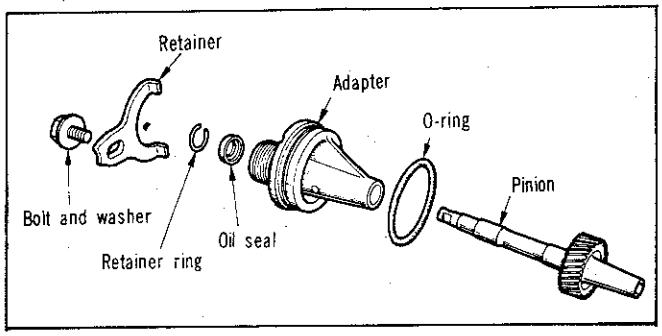


Fig. 19—Speedometer drive—disassembled

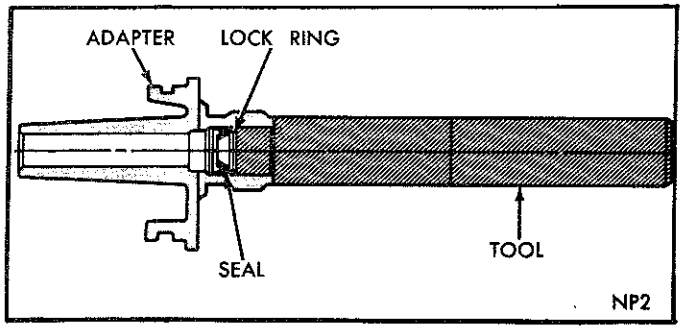


Fig. 20—Installing speedometer pinion seal

CAUTION: Before installing pinion and adapter assembly make sure adapter flange and its mating area on extension housing are perfectly clean. Dirt or sand will cause mis-alignment resulting in speedometer pinion gear noise.

(4) Note number of gear teeth and install speedometer pinion gear into adapter (Fig. 19).

(5) Rotate the speedometer pinion gear and adapter assembly so that the number on the adapter, corresponding to the number of teeth on the gear, is in the 6 o'clock position as the assembly is installed (Fig. 18).

(6) Install retainer and bolt, with retainer tangs in adapter positioning slots. Tap adapter firmly into the extension housing and tighten retainer bolt to specification.

EXTENSION HOUSING BUSHING AND OUTPUT SHAFT BEARING

Removal

(1) Mark parts for reassembly then disconnect propeller shaft. Carefully pull shaft assembly out of the extension housing.

(2) Remove speedometer pinion and adapter assembly (Fig. 18). Drain approximately 2 litres (3 pints) of fluid from the transmission.

(3) Remove bolts securing extension housing to the crossmember. Raise transmission slightly with service jack, then remove centre crossmember/s and support assembly.

(4) Remove extension housing to transmission bolts.

IMPORTANT: In removing or installing extension housing (step 5), the gearshift lever must be in "1" (low) position. This positions parking lock control rod rearward so it can be disengaged or engaged with the parking lock sprag.

(5) Remove access plate and gasket from extension housing. Spread large snap ring from output shaft bearing (Fig. 21).

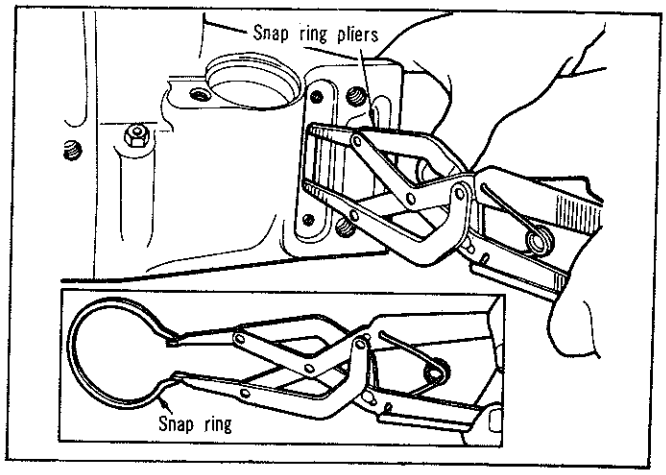


Fig. 21—Removing or installing extension housing

(6) With snap ring spread as far as possible, carefully tap extension housing off the output shaft bearing. Carefully pull extension housing rearward, to remove parking lock control rod knob past the parking sprag, then remove the housing.

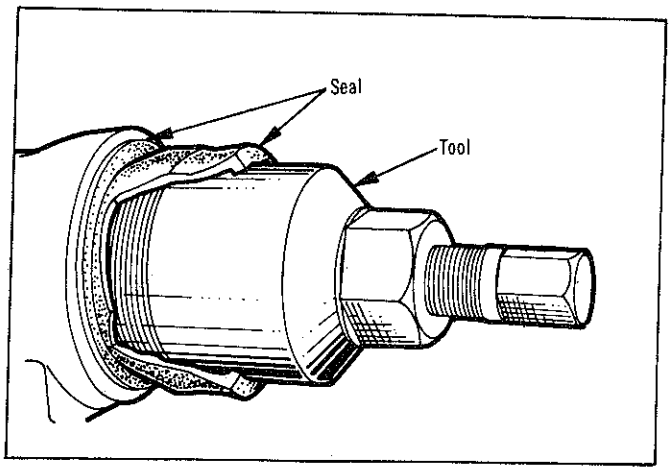


Fig. 22—Removing extension housing yoke seal

Bushing Replacement

(1) Remove oil seal with Tool E3C10C (Fig. 22).

(2) Press or drive out bushing with Tool E21C50E (Fig. 23).

(3) Slide a new bushing on installing end of Tool E21C50E. Align oil hole in bushing with oil slot in the housing, then press or drive bushing into place.

(4) Position a new seal in opening of the extension housing and drive it into housing with Tool E21C50C (Fig. 24).

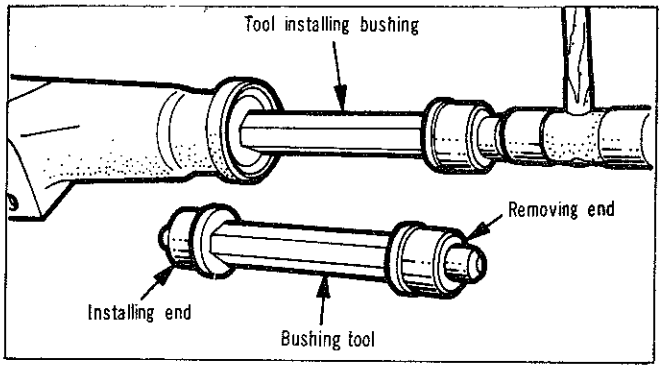


Fig. 23—Replacing extension housing bushing

Bearing Replacement

(1) Using heavy duty snap ring pliers remove output shaft bearing rear snap ring and remove bearing from the shaft (Fig. 25).

(2) Install a new bearing on shaft with outer race ring groove toward front (Fig. 25), then install rear snap ring.

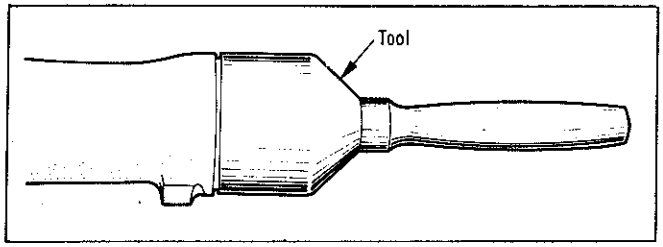


Fig. 24—Installing extension housing yoke seal

Installation

(1) Place a new extension housing gasket on the transmission case. Position output shaft bearing retaining snap ring in extension housing. Slide extension housing on output shaft guiding the parking lock control rod knob past the parking sprag. While spreading large snap ring in housing (Fig. 21), carefully tap housing into place, then release the snap ring. Make sure snap ring is fully seated in bearing outer race ring groove.

(2) Install and tighten extension housing bolts to specification.

(3) Install gasket and access plate on the extension housing.

(4) Install centre crossmember's and rear mount assembly. Tighten retaining bolts.

Lower transmission, install extension housing to support bolts and tighten to specification.

(5) Install the speedometer pinion and adapter.

(6) Carefully guide front universal joint yoke into extension housing and on the output shaft splines. Align marks made at removal and refit propeller shaft.

(7) Add fluid to transmission to bring up to proper level.

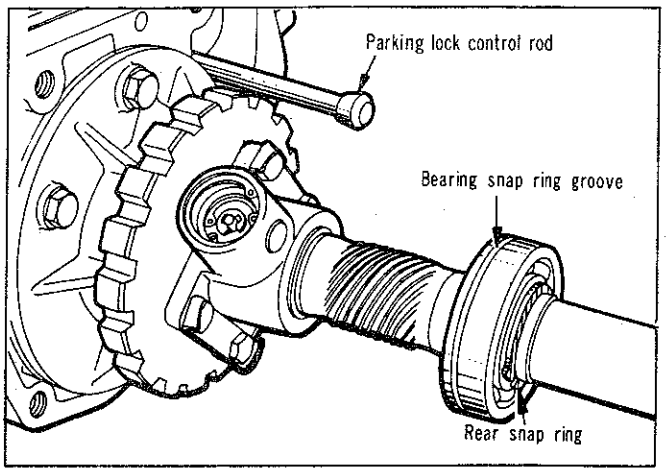


Fig. 25—Output shaft bearing

GOVERNOR AND PARKING GEAR

Removal

(1) Remove extension housing and output shaft bearing.

(2) Carefully pry snap ring from weight end of governor valve shaft (Fig. 26). Slide valve and shaft assembly out of governor body.

(3) Remove large snap ring from weight end of governor body, lift out governor weight assembly.

(4) Remove snap ring from inside governor weight, remove inner weight and spring from the outer weight. Figure 27 shows a disassembled view of the governor assembly.

(5) Remove snap ring from behind governor body, then slide governor and support assembly off the output shaft. If necessary remove the four bolts and separate governor body and screen from the support.

Cleaning and Inspection

Inspect all parts for burrs and wear. Inspect inner weight for free movement in outer weight, and outer weight for free movement in governor body. Inspect valve for free movement in governor body. The weights and valve should fall freely in the bores when clean and dry. Rough surfaces may be removed with crocus cloth.

Inspect governor weight spring for distortion. Inspect lugs on support gear for broken edges or other damage. Thoroughly clean all governor parts in clean solvent and test for free movement before assembly.

Assembly

Assemble governor weights and spring, and secure with snap ring inside of large governor weight. Place weight assembly in governor body and install snap ring.

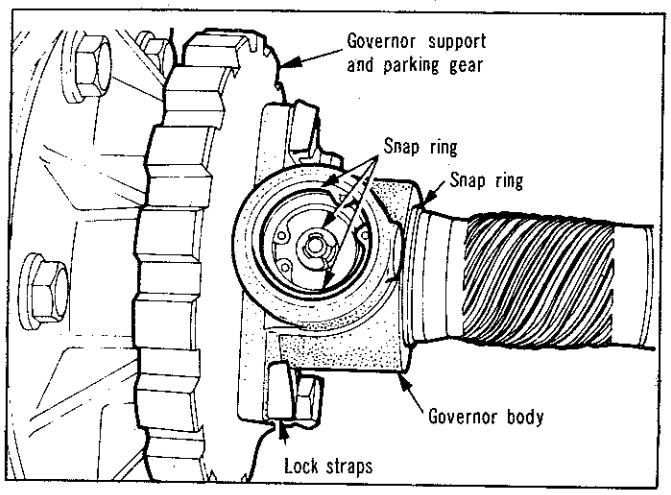


Fig. 26—Governor shaft and weight snap rings

Installation

(1) Assemble governor body and screen to the support (if disassembled) and tighten bolts finger tight. Make sure oil passage of governor body aligns with passage in the support.

(2) Position support and governor assembly on the output shaft. Align assembly so valve shaft hole in governor body aligns with hole in the output shaft, then slide assembly into place. Install snap ring behind governor body (Fig. 26). Tighten the body to support bolts to specification. Bend ends of lock straps over both heads.

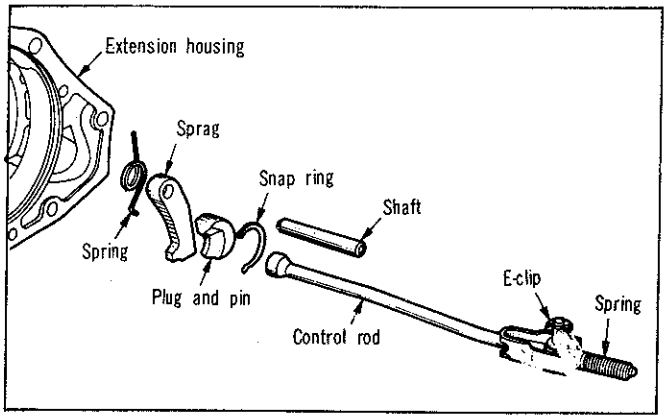


Fig. 27—Governor assembly

(3) Assemble governor weights and spring, and secure with snap ring inside of large governor weight. Place weight assembly in governor body and install snap ring.

(4) Place governor valve on the valve shaft, insert assembly into the body and through governor weights. Install valve shaft retaining snap ring. Inspect valve and weight assembly for free-movement after installation.

NOTE: Ensure valve shaft snap rings are positioned at the outer extremities of the locating grooves.

(5) Install output shaft bearing and extension housing.

PARKING LOCK COMPONENTS

Removal

(1) Remove extension housing.

(2) Slide shaft out of extension housing to remove the parking sprag and spring (Fig. 28). Remove snap ring and slide the reaction plug and pin assembly out of the housing.

(3) To replace the parking lock control rod, refer to "Valve Body—Removal and Installation."

Inspection

Inspect sprag shaft for scores and free movement in the housing and sprag. Inspect sprag, and control rod springs for distortion and tension. Inspect square lug on sprag for broken edges, also lugs on parking gear for damage. Inspect knob on end of control rod for nicks, burrs and free turning.

Assembly

(1) Install reaction plug and pin assembly in the housing and secure with snap ring (Fig. 28).

(2) Position sprag and spring in housing and insert the shaft. Make sure square lug on sprag is toward parking gear, and spring is positioned so it moves sprag away from the gear.

(3) Install extension housing.

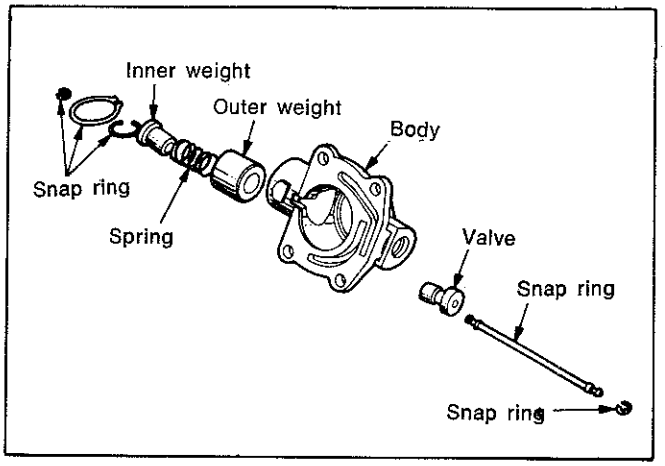


Fig. 28—Parking lock components

VALVE BODY ASSEMBLY AND ACCUMULATOR PISTON

Removal

(1) Raise vehicle on a hoist.

(2) Loosen oil pan bolts, tap the pan to break it loose allowing fluid to drain, then remove oil pan.

(3) Disconnect throttle and gearshift linkage from levers on the transmission. Loosen clamp bolts and remove the levers.

(4) Place a drain pan under transmission, then remove the hex-head valve body to transmission case bolts. Hold valve body in position while removing the bolts.

(5) While lowering valve body down out of transmission case, pull it forward out of the case. If necessary, rotate propeller shaft to align parking gear and sprag to permit knob on end of control rod to pass the sprag.

(6) Remove accumulator piston and spring from transmission case. Inspect piston for nicks, scores and wear. Inspect spring for distortion. Inspect ring for freedom in piston grooves and wear or breakage. Replace parts as required.

(7) If valve body manual lever shaft seal requires replacement, drive it out of the case with a punch.

(8) Drive a new seal into the case with a suitable size socket and hammer (Fig. 29).

NOTE: This seal can be replaced without removing the valve body from transmission by using a small screwdriver to pry seal out of its bore. Be careful not to scratch manual lever shaft or the seal bore in transmission.

Servicing the valve body assembly is outlined under "Recondition Sub-Assemblies".

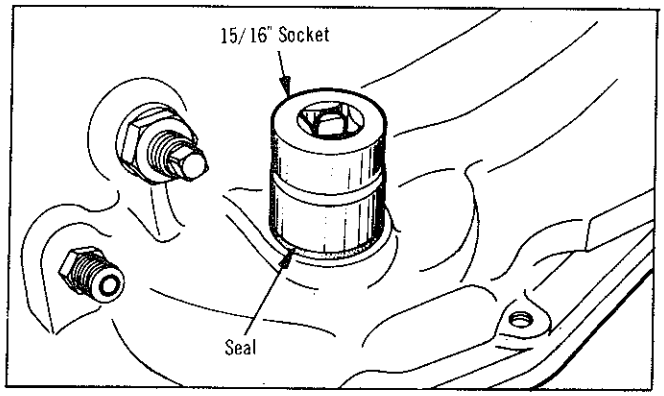


Fig. 29—Installing valve body manual lever shaft oil seal

Installation

(1) Install accumulator piston in the transmission case.

(2) Position accumulator spring on the valve body.

(3) Place valve body manual lever in **LOW** position. Insert parking rod through opening in rear of case with knob positioned against the plug and sprag (rotate propeller shaft if necessary). Position valve body in the case, install retaining bolts finger tight.

(4) Place manual lever in the neutral position. Snug bolts down evenly, then tighten to specification.

(5) Install gearshift lever and tighten clamp bolt. Check lever shaft for binding in the case by moving lever through all detent positions. If binding exists, loosen valve body bolts and re-align.

(6) Make sure throttle shaft seal is in place, then install flat washer, lever and tighten the clamp bolt. Connect throttle and gearshift linkage and adjust as required.

(7) Install oil pan, using a new gasket. Add transmission fluid to bring it up to proper lever.

SERVICE OUT OF VEHICLE

Transmission and Converter Removal

NOTE: The transmission and converter must be removed as an assembly; otherwise the converter drive plate, pump bushing and oil seal will be damaged. The drive plate will not support a load; therefore none of the weight of the transmission should be allowed to rest on the plate during removal.

(1) Connect a remote control starter switch to starter solenoid and position switch so engine can be rotated from under the vehicle.

(2) Disconnect primary wire from the ignition coil.

(3) Remove cover plate from in front of converter to provide access to the converter mounting bolts.

(4) Mark converter and drive plate to aid in reassembly. The crankshaft flange bolt circle, inner and outer circle of holes in drive plate, and tapped holes in front face of converter all have one hole offset so these parts will be installed in original position. This maintains the balance of engine and converter.

(5) Rotate engine with remote control switch to locate converter to drive plate bolts at "6 o'clock" position. Remove the bolt, rotate engine with switch and remove remaining bolts.

NOTE: Do not rotate converter or drive plate by prying with a screw driver or similar tool as the drive plate might become distorted. Also, starter should never be engaged if drive plate is not attached to converter with at least one bolt or if transmission case to engine bolts have been loosened.

(6) Disconnect negative (ground) cable from the battery.

(7) Remove the starting motor assembly.

(8) Disconnect gearshift rod from the transmission lever.

(9) Disconnect throttle rod from throttle lever on the transmission.

(10) Disconnect oil cooler lines and remove oil filler tube. Disconnect the speedometer cable.

(11) Mark parts for reassembly then disconnect propeller shaft. Carefully pull shaft assembly out of the extension housing.

(12) Remove rear mount to extension housing bolts.

(13) Install engine support fixture, and raise the engine slightly.

(14) Remove crossmember attaching bolts and remove crossmember.

(15) Place a transmission service jack under transmission to support the assembly.

(16) Attach a small "C" clamp to edge of bell housing to hold converter in place during removal of the transmission.

(17) Remove the bell housing retaining bolts. Carefully work transmission rearward off engine block dowels and disengage converter hub from end of the crankshaft.

(18) Lower transmission jack and remove transmission and converter assembly.

(19) To remove converter assembly, remove "C" clamp from edge of bell housing, then carefully slide assembly out of the transmission.

TORQUE CONVERTER FLUSHING

When a transmission failure has contaminated the fluid, the torque converter should be flushed to insure that metal particles or sludged oil are not later transferred back into the reconditioned transmission. Also flush and blow out the oil cooler and its lines.

MACHINE FLUSHING

Machine cleaning is recommended; using the type which rotates the converter while pumping cleaning fluid through it. The machine automatically adds timed blasts of compressed air to the cleaning fluid as it enters the converter, providing thorough cleaning.

PUMP OIL SEAL

Replacement

The pump oil seal can be replaced without removing pump and reaction shaft support assembly from the transmission case.

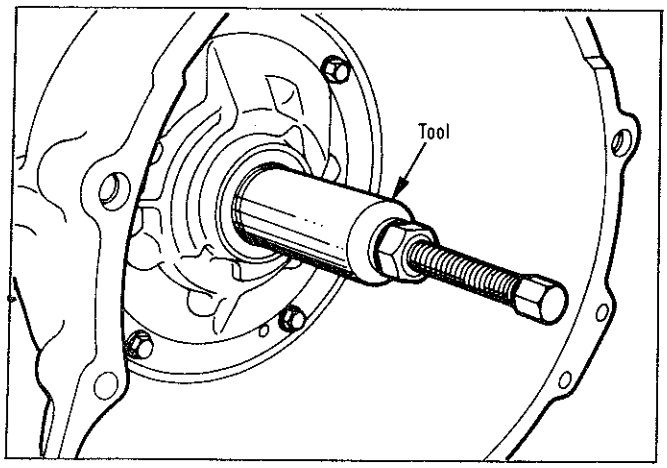


Fig. 30—Removing pump oil seal

(1) Screw seal remover Tool E21C35G into seal (Fig. 30), then tighten screw portion of tool to withdraw the seal.

(2) To install a new seal, place seal in opening of the pump housing (lip side facing inward). Using Tool E21C35F, drive seal into housing until tool bottoms (Fig. 31).

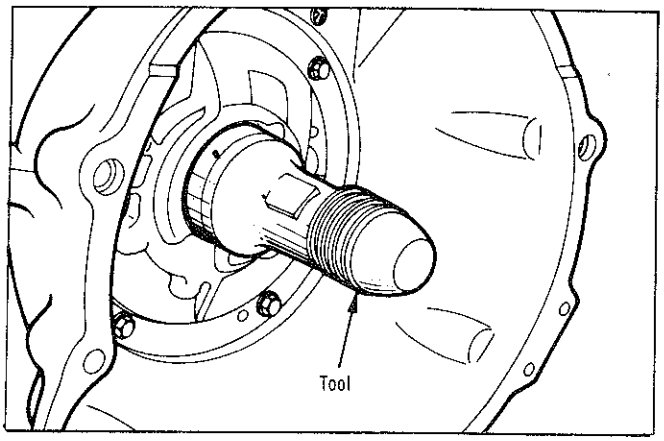


Fig. 31—Installing pump oil seal

DISASSEMBLY — SUB-ASSEMBLY REMOVAL

Prior to removing any transmission sub-assemblies, plug all openings and thoroughly clean exterior of the unit, preferably by steam. Cleanliness through entire disassembly and assembly cannot be over-emphasized. When disassembling, each part should be washed in a suitable solvent, then dried by compressed air. **Do not wipe parts with shop towels.** All mating surfaces in the transmission are accurately machined; therefore, careful handling of parts must be exercised to avoid nicks or burrs.

Drive Train End Play

Measuring drive train end play before disassembly will usually indicate when a thrust washer change is required, (except when major parts are replaced).

(1) Attach a dial indicator to transmission bell housing with its plunger seated against end of input shaft (Fig. 32).

Move input shaft in and out to obtain end play reading. For end play refer specifications.

(2) Record indicator reading for reference when reassembling the transmission.

Oil Pan

(1) Place transmission assembly in repair stand, Tool E21C5C (Fig. 33).

(2) Unscrew oil pan bolts and remove oil pan and gasket.

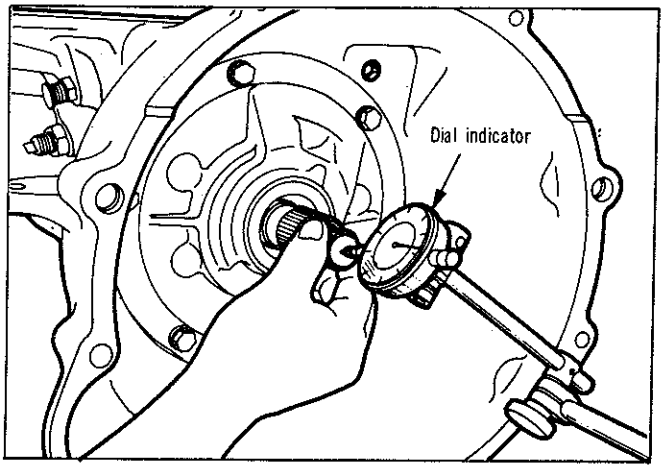


Fig. 32—Measuring input shaft end play

Valve Body Assembly

(1) Loosen clamp bolts and remove throttle and gearshift levers from the transmission.
(2) Remove the hex-head valve body to transmission bolts.
(3) While lifting valve body upward out of transmission case, disconnect parking lock rod as described under Parking Lock Components.

Accumulator Piston and Spring

(1) Lift spring off accumulator piston and withdraw piston from the case.

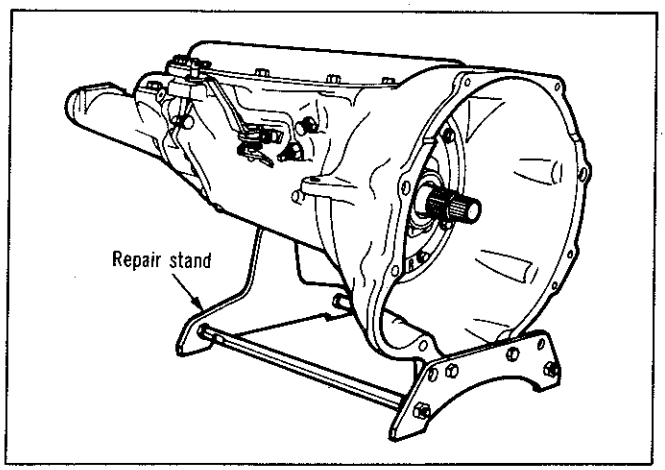


Fig. 33—Transmission installed in repair stand

Extension Housing and Output Shaft Bearing

(1) Remove speedometer pinion and adapter assembly.
(2) Remove extension housing to transmission bolts. Remove access plate and gasket from bottom or side of the extension housing mounting pad. Spread large snap ring from the output shaft bearing with snap ring pliers (Fig. 21).

With snap ring spread as far as possible, carefully tap extension housing off the output shaft and bearing.
(3) Using heavy duty snap ring pliers, remove output shaft bearing rear snap ring. Remove bearing from shaft.

Governor and Support.

(1) Carefully pry snap ring from weight end of governor valve shaft (Fig. 26). Slide valve and shaft assembly out of the governor body.
(2) Remove snap ring from behind governor body, then slide governor body and support assembly off the output shaft.

Oil Pump and Reaction Shaft Support

(1) **Tighten front band adjusting screw until band is tight on front clutch retainer.** This prevents clutch retainer from coming out with pump which might cause unnecessary damage to the clutches.
(2) Remove oil pump housing retaining bolts.
(3) Attach Tool E21C35D to pump housing flange, (Fig. 34), in threaded holes in the flange.
(4) Bump outward evenly with the two "knocker weights" to withdraw pump and reaction shaft support assembly from the case.

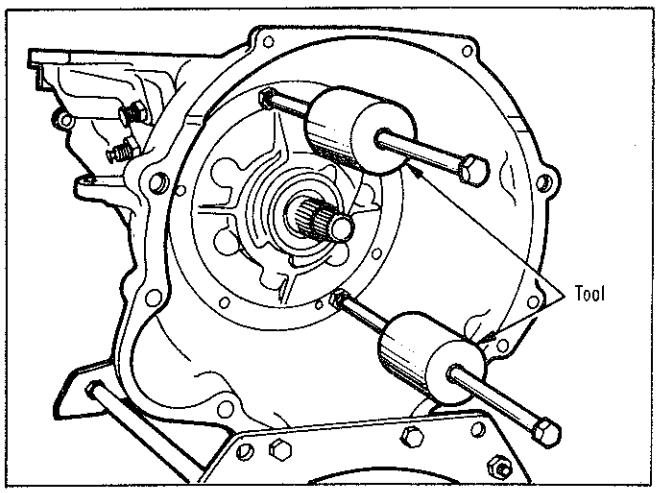


Fig. 34—Removing pump and reaction shaft support assembly

Front Band and Front Clutch

(1) Loosen front band adjuster, remove band strut and slide band out of the case.
(2) Slide front clutch assembly out of the case.

Input Shaft and Rear Clutch

(1) Grasp input shaft, and slide input shaft and rear clutch assembly out of the case.

NOTE: Be careful not to lose thrust washer located between rear end of input shaft and forward end of the output shaft.

Planetary Gear Assemblies, Sun Gear and Driving Shell

(1) While supporting output shaft and driving shell, carefully slide assembly forward and out through the case.

NOTE: Be very careful not to damage ground surfaces on output shaft during removal.

Rear Band and Low-Reverse Drum

(1) Remove low-reverse drum, then loosen rear band adjuster, remove band strut and link, then remove band from the case.

Over-running Clutch

(1) Note position of over-running clutch rollers and springs before disassembly to assist in reassembly.

(2) Carefully slide out clutch hub and remove rollers and springs. **If the over-running clutch cam and/or roller spring retainer are found damaged or worn, refer to Para "Over-running clutch replacement".**

Kickdown Servo (Front)

(1) Compress kickdown servo spring by using engine valve spring compressor, Tool E0092, then remove snap ring.

(2) Remove rod guide, springs and piston rod from the case. Be careful not to damage piston rod or guide during removal.

(3) Withdraw piston from the transmission case. (See Fig. 62).

Low and Reverse Servo (Rear)

(1) Compress low and reverse servo piston spring by using engine valve spring compressor, Tool E0092, then remove the snap ring.

(2) Remove spring retainer, spring, and servo piston and plug assembly from the case.

RECONDITIONING SUB-ASSEMBLIES

The following procedures cover disassembly, inspection, repair, and assembly of sub-assemblies as removed from the transmission.

Heli-Coil inserts are recommended for repairing damaged, stripped or worn threads in aluminium parts.

Pre-sized service bushings are available for replacement for most bushings in the transmission. The two bushings in sun gear are not serviced because of the low cost of sun gear assembly. If bushings are found worn or scored, they should be replaced as outlined in the following reconditioning procedures.

The bushing replacement tools listed by "SP" numbers are part of Tool Kit E21C60.

The use of crocus cloth is permissible where necessary, providing it is used carefully. When used on valves, use extreme care to avoid rounding off the sharp edges. The sharp edge is vitally important to this type of valve. Sharp edges prevent dirt and foreign matter from getting between the valve and body, thus reducing possibility of sticking. When it becomes necessary to recondition transmission, and vehicle has seen considerable usage, install new seal rings on parts requiring their usage. **Coat each part with "DEXRON"®II type Automatic Transmission Fluid during assembly.**

VALVE BODY DISASSEMBLY

NOTE: Never clamp any portion of valve body or transfer plate in a vice. Any slight distortion of the aluminium body or transfer plate will result in sticking valves, excessive leakage or both. When removing or installing valves or plugs, slide them in or out carefully. Do not use force.

Filter, Transfer Plate, and Pressure Regulators

(1) Place valve body assembly on repair stand, Tool E21C5B. Remove three screws from fluid filter and lift off the filter.

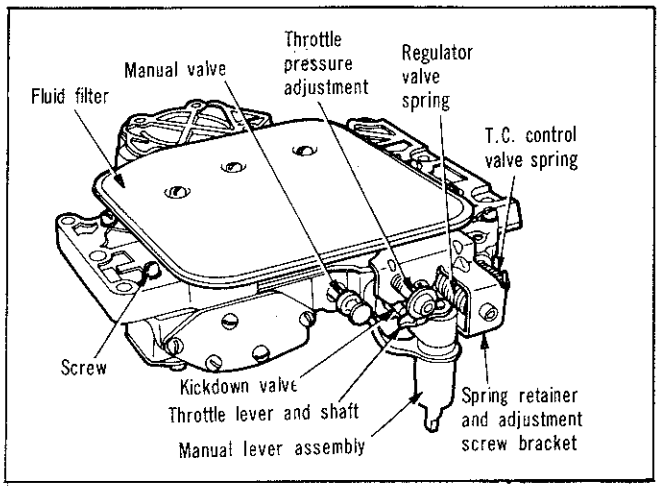


Fig. 35—Valve body assembly

(2) Remove top and bottom screws from spring retainer and adjustment screw bracket.

(3) **Hold spring retainer firmly against spring force while removing last retaining screw from side of valve body.**

(4) Remove spring retainer, with line and throttle pressure adjusting screws **(do not disturb setting)** and the line pressure and torque converter regulator springs.

(5) Slide torque converter and line pressure valves out of their bores.

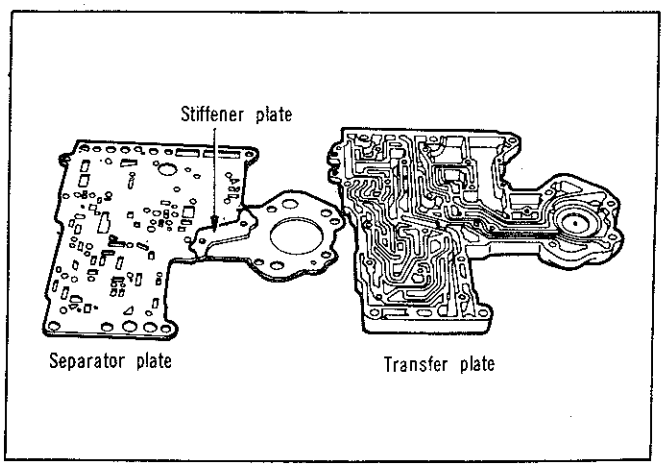


Fig. 36—Transfer and separator plate

(6) Remove transfer plate retaining screws and lift off transfer plate and separator plate assembly.
(7) Remove screws from stiffener and separator plate and separate parts for cleaning (Fig. 36).
(8) Remove rear clutch ball check valve from transfer plate and regulator valve screen from separator plate for cleaning.
(9) Remove the balls and springs from valve body shown in (Fig. 37).

NOTE: Tag all springs as they are removed for reassembly identification.

NOTE: Later model transmissions are not fitted with a high pressure relief ball (3/8").

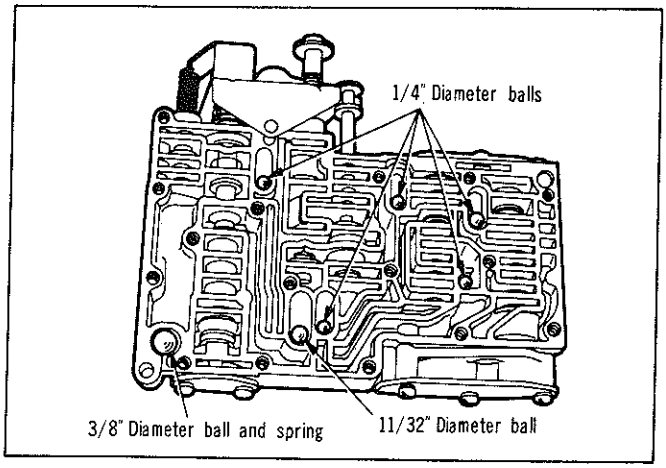


Fig. 37—Steel ball locations

Shuttle Valves and Governor Plugs

(1) Turn valve body over (Fig. 38) and remove shuttle valve cover plate.
(2) Remove governor plug end plate (Fig. 40) and slide out the shuttle valve throttle plug and spring, the 1-2 shift valve governor plug and the 2-3 shift valve governor plug.
(3) Remove shuttle valve "E" clip and slide shuttle valve out of its bore.
(4) Remove "E" clip and park control rod from manual lever.

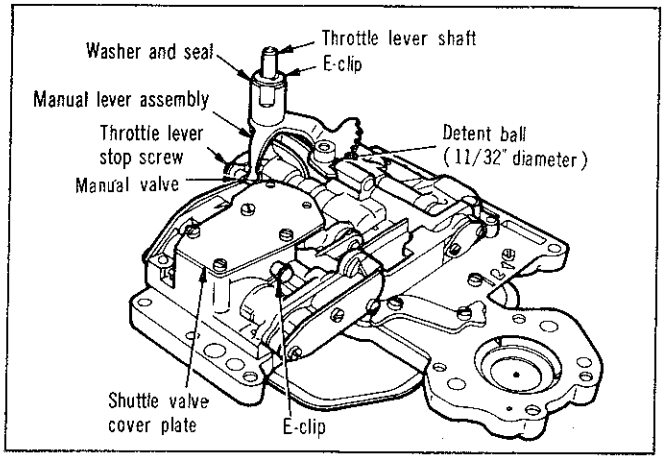


Fig. 38—Valve body controls

Manual and Throttle Leaver

(1) Remove E-clip and washer from throttle lever shaft (Fig. 39). Remove any burrs from shaft, then while holding manual lever detent ball and spring in their bore with Tool E21C15A or similar tool, slide manual lever off the throttle shaft. Remove the detent ball and spring.
(2) Slide manual valve out of its bore.
(3) Slide out the kickdown detent, kickdown valve, throttle valve spring and the throttle valve.

Shift Valves and Regulator Valve Pressure Sensing Plugs

(1) Remove the line pressure regulator valve end plate (Fig. 41) and slide out the regulator valve sleeve, line pressure plug, and throttle pressure plug.

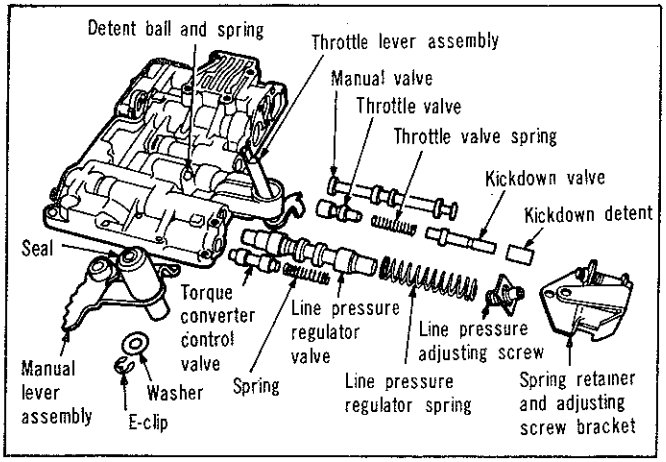


Fig. 39—Pressure regulators and manual control

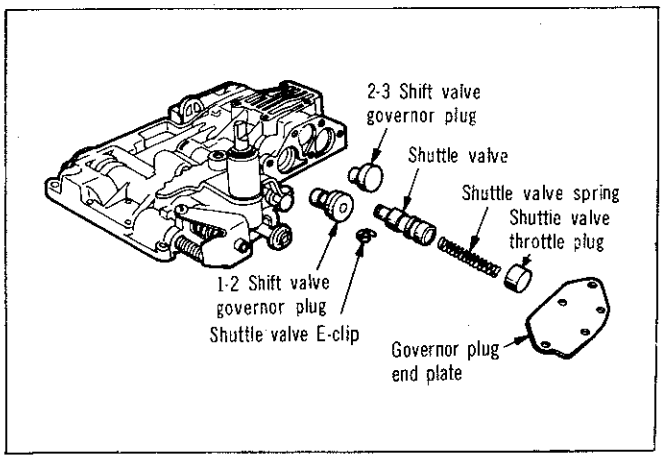


Fig. 40—Shuttle valve and governor plugs

(2) Remove shift valve end plate.

(3) Remove the shift valve springs and slide both shift valves from their bores.

VALVE BODY REASSEMBLY

Shift Valves and Regulator Valve Pressure Sensing Plugs (Fig. 41)

(1) Slide shift valves and springs into proper valve body bores.

(2) Install end plate on valve body. Tighten screws to specification.

(3) Install throttle pressure plug, line pressure plug and sleeve, then fasten end plate to valve body.

Manual Leaver and Throttle Leaver (Fig. 39)

(1) Install throttle valve, throttle valve spring, kickdown valve and kickdown detent.

(2) Slide manual valve into its bore.

(3) Install throttle lever and shaft on valve body (Fig. 39). Insert detent spring and ball in its bore in valve body. Depress ball and spring with Tool E21C15A (Fig. 42) or similar tool and slide manual lever over throttle shaft so that it engages manual valve and detent ball. Install seal, retaining washer and E-clip on throttle shaft.

Shuttle Valve and Governor Plugs (Fig. 40)

(1) Place 1-2 and 2-3 shift valve governor plugs in their respective bores.

(2) Install shuttle valve, spring and shuttle valve throttle plug.

(3) Install governor plug end plate and tighten the five retaining screws.

(4) Install E-clip on end of shuttle valve.

(5) Install shuttle valve cover plate and tighten the four retaining screws.

Filter, Transfer Plate, and Pressure Regulators

(1) Install the balls and springs in valve body as shown in (Fig. 37).

(2) Install rear clutch ball check valve in transfer plate and regulator valve screen in separator plate (Fig. 36).

(3) Install screws in stiffener and separator plate (Fig. 36).

(4) Place transfer plate assembly on valve body. Be careful to align filter screen and the spring loaded ball as the 17 shorter screws are installed finger tight (3 longer screws are for oil filter).

(5) Starting at the centre and working outward, tighten screws to specification.

(6) Slide torque converter and line pressure valves and springs into their bores.

(7) Install pressure adjusting screw and bracket assembly on the springs and fasten with one screw for now. Use screw which goes into side of valve body. This screw is to be tightened first, after starting the top and bottom screws.

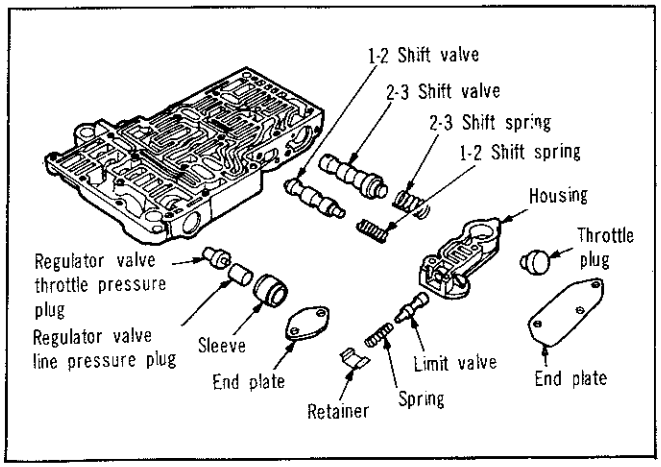


Fig. 41—Shift valves and pressure regulator valve plugs

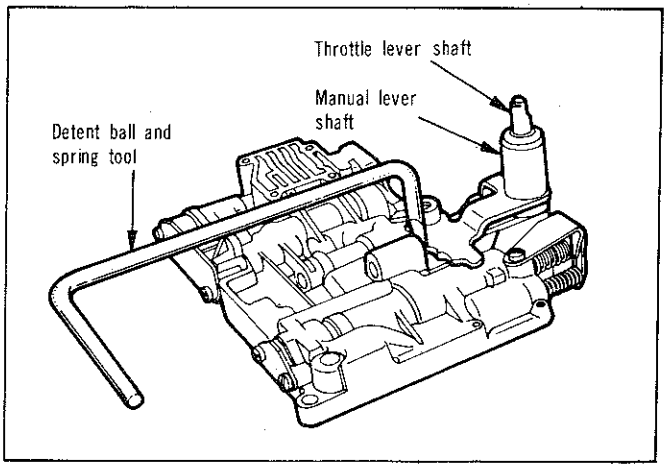


Fig. 42—Installing detent ball, spring and control levers

(8) Install oil filter and tighten.
(9) After valve body has been serviced and completely assembled, measure throttle and line pressure adjustments. However, if pressures were satisfactory prior to disassembly, use original settings.
(10) Install parking lock rod and "E" clip retainer to manual lever.

ACCUMULATOR PISTON AND SPRING

Inspection

Inspect seal rings for wear and make sure they turn freely in piston grooves. It is not necessary to remove rings unless conditions warrant. Inspect piston for nicks, burrs, scores and wear. Inspect piston spring for distortion. Replace parts as required.

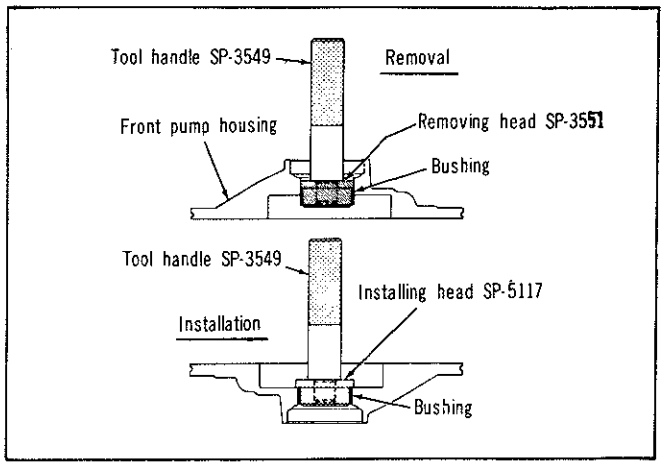


Fig. 44—Replacing pump bushing

OIL PUMP AND REACTION SHAFT SUPPORT

Disassembly

Figure 43 shows the oil pump and reaction shaft support disassembled.
(1) Remove bolts from rear side of reaction shaft support and lift support off the pump.
(2) Remove rubber seal ring from pump body flange.
(3) Drive out oil seal with a blunt punch.

Inspection

Inspect interlocking seal rings (Fig. 43) on reaction shaft support for wear or broken locks, make sure they turn freely in the grooves. Seal rings have to be removed to allow clearance for No. 1 thrust washer removal and installation. Inspect front clutch piston retainer to reaction shaft support thrust washer for wear. Washer thickness should be as specified, replace if necessary. Inspect machined surfaces on pump body and reaction shaft support for nicks and burrs. Inspect pump body and reaction shaft support bushings for wear or scores. Inspect pump rotors for scoring or pitting. With rotors cleaned and installed in pump body, place a straight edge across face of rotors and pump body. Use a feeler gauge to measure clearance between edge and face of rotors. Clearances should be as specified. Also, measure rotor tip clearance between inner and outer rotor teeth and outer rotor to oil pump body clearance.

Pump Bushing Replacement

(1) Place pump housing (seal face down) on a smooth firm surface.
(2) Place removing head, Tool SP-3551 in bushing and install handle, Tool SP-3549 in the removing head (Fig. 44).
(3) Drive bushing straight down and out of pump housing bore. Be careful not to cock tool in the bore.
(4) Position new bushing on installing head. Tool SP-5117.
(5) With pump housing on a smooth clean surface, start bushing and installing head in the bushing bore. Install handle, Tool SP-3549 in the installing head (Fig. 44).

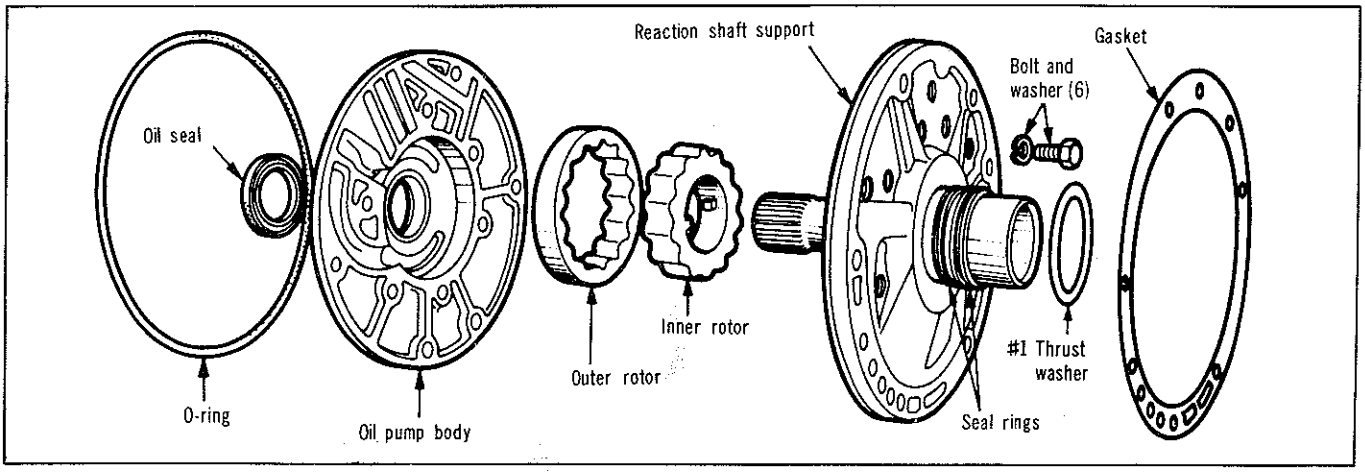


Fig. 43—Oil pump and reaction shaft support disassembled

(6) Drive bushing into housing until tool bottoms in the pump cavity. Be careful not to cock tool during installation.

(7) Stake bushing in place by using a blunt punch or similar tool (Fig. 45). A gentle tap at each stake slot location will suffice.

(8) Using a narrow-bladed knife or similar tool, remove high points or burrs around staked area (Fig. 45). Do not use a file or similar tool that will remove more metal than is necessary.

Reaction Shaft Bushing Replacement

In case of a reaction shaft bushing failure, always inspect the support for wear from the input shaft seal ring lands. If worn or grooved, replace support assembly.

(1) Assemble remover Tool SP-5324, cup Tool SP-3633, and hex nut Tool SP-1191 (Fig. 46).

NOTE: Do not clamp any part of reaction shaft or support in a vice.

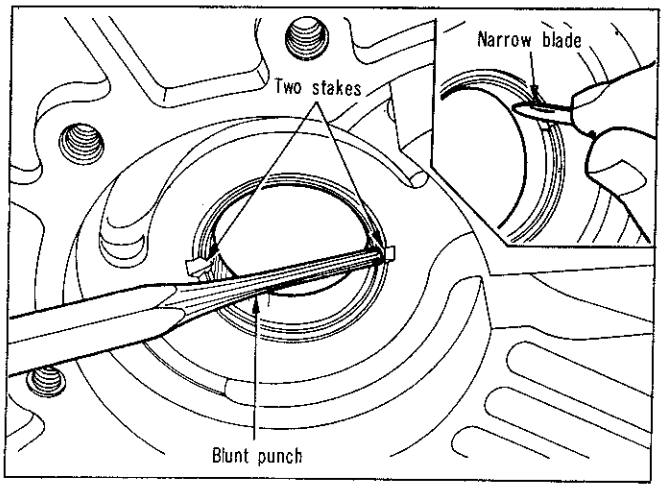


Fig. 45—Staking pump bushing

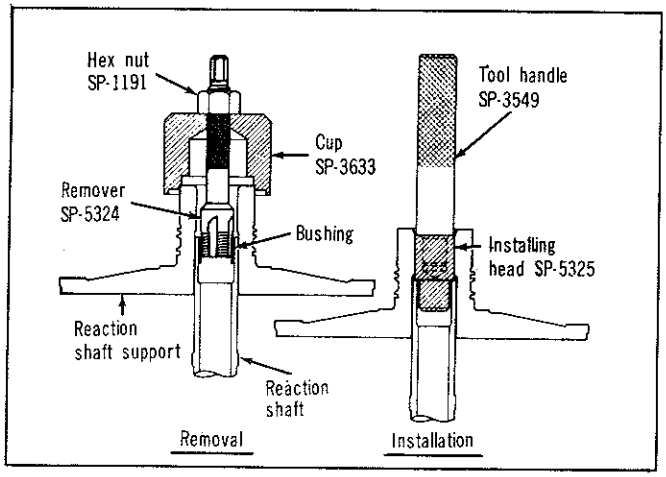


Fig. 46—Replacing reaction shaft bushing

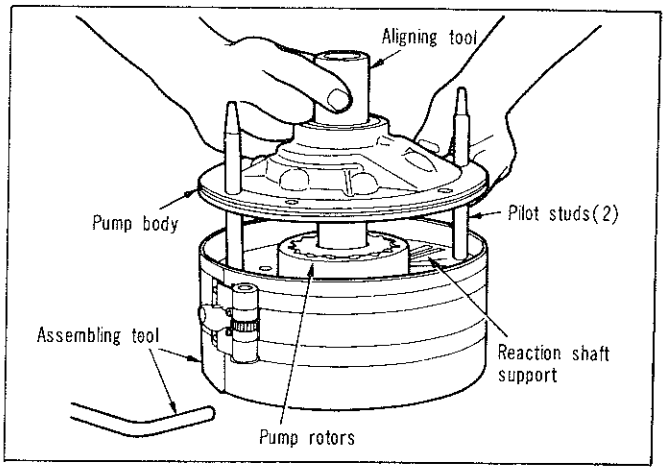


Fig. 47—Assembling pump and reaction shaft support

(2) With cup held firmly against reaction shaft, thread remover into bushing as far as possible by hand.

(3) Using a wrench, screw remover into bushing 3 to 4 additional turns to firmly engage threads in the bushing.

(4) Turn hex nut down against cup to pull bushing from reaction shaft. Thoroughly clean reaction shaft to remove chips made by remover threads.

(5) Lightly grip bushing in a vice or with pliers and back tool out of the bushing. Be careful not to damage threads on bushing remover.

(6) Slide a new bushing on installing head Tool SP-5325, and start them in the bore of reaction shaft (Fig. 46).

(7) Support reaction shaft upright on a clean smooth surface and install handle Tool SP-3549 in installing head. Drive bushing into the shaft until tool bottoms.

(8) Thoroughly clean reaction shaft support assembly before installation.

Assembly

(1) Place reaction shaft support in assembling Tool E21C35H, with hub of support and tool resting on a smooth **flat** surface bench (Fig. 47). Screw two pilot studs, Tool E21C35B into threaded holes of reaction shaft support flange.

(2) Assemble and place rotors in centre of the support (Fig. 47).

(3) Lower pump body over the pilot studs, insert Tool E21C35E through pump body and engage pump inner rotor. Rotate the rotors with tool to enter rotors in pump body, then with pump body firm against reaction shaft support, tighten clamping tool securely.

(4) Invert pump and reaction shaft support assembly with clamping tool intact. Install support to pump body bolts and tighten to specification. Remove clamping tool, pilot studs and rotor alignment tool.

(5) Place a new oil seal in opening of pump housing (lip of seal facing inward). Using Tool E21C35F, drive seal into housing until tool bottoms.

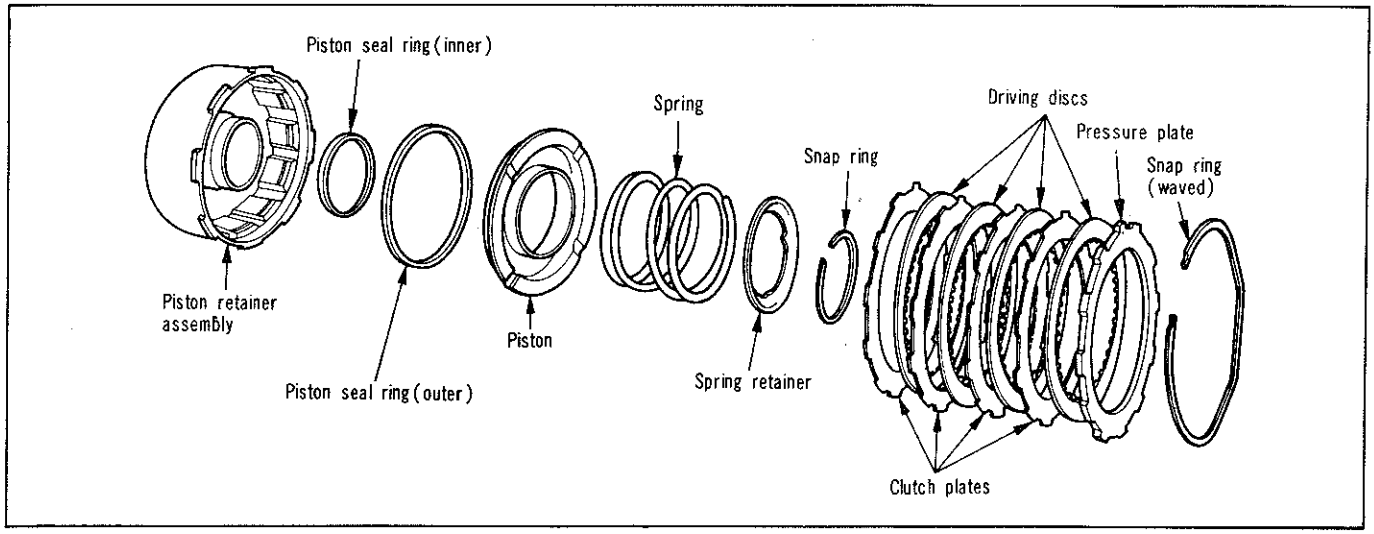


Fig. 48—Front clutch disassembled

FRONT CLUTCH

Disassembly

Figure 48 shows a disassembled view of the front clutch assembly.

(1) Remove large waved snap ring that secures pressure plate in the clutch piston retainer. Lift pressure plate and clutch plates out of the retainer.

(2) Install compressor Tool E21C30C over piston spring retainer (Fig. 49). Compress spring and remove snap ring, then slowly release tool until spring retainer is free of the hub. Remove tool, retainer and spring.

(3) Invert clutch retainer assembly and bump it on a wood block to remove the piston. Remove seal rings from the piston and clutch retainer hub.

Inspection

Inspect facing material on all driving discs. Replace discs that are charred, glazed or heavily pitted. Discs should be replaced if they show evidence of material flaking off or if facing material can be scraped off easily. Inspect driving disc splines for wear or other damage. Inspect steel plate and pressure plate surfaces for burning, scoring or damaged driving lugs. Replace if necessary.

Inspect steel plate lug grooves in clutch retainer for smooth surfaces, plates must travel freely in grooves. Inspect band contacting surface on clutch retainers for scores, **the contact surface should be protected from damage during disassembly and handling.** Note ball check in clutch retainer, make sure ball moves freely. Inspect piston seal ring surfaces in clutch retainer for nicks or deep scratches, light scratches will not interfere with sealing of neoprene rings. Inspect clutch retainer inner bore surface for wear from reaction shaft support seal rings. Inspect clutch retainer bushing for wear or scores.

Inspect bore of piston for score marks, if light, remove with crocus cloth. Inspect seal ring grooves for nicks and burrs. Inspect neoprene seal rings for deterioration, wear and hardness. Inspect piston spring, retainer and snap ring for distortion.

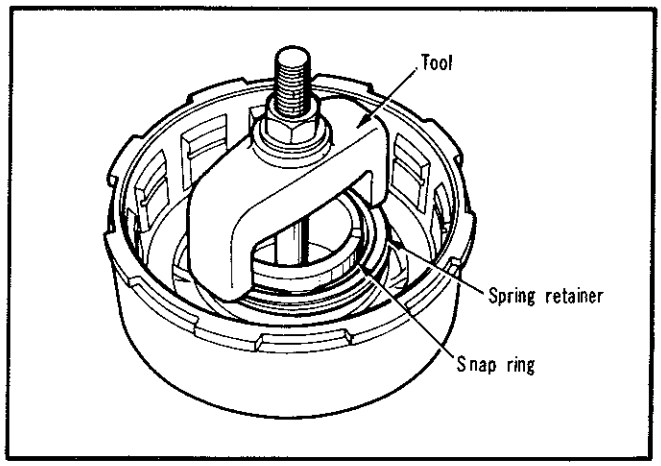


Fig. 49—Removing or installing front clutch spring retainer snap ring

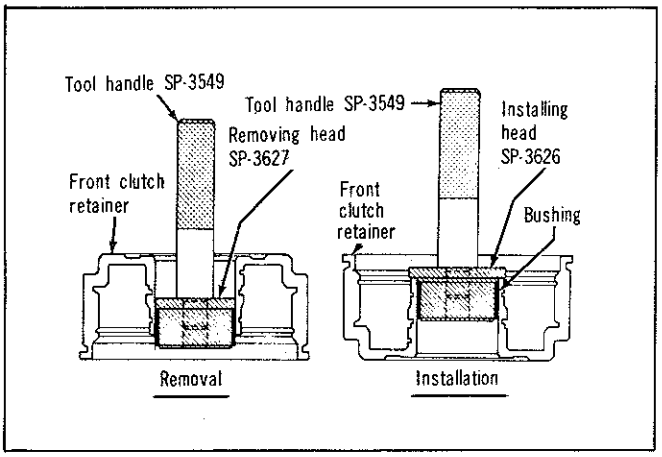


Fig. 50—Replacing front clutch retainer bushing

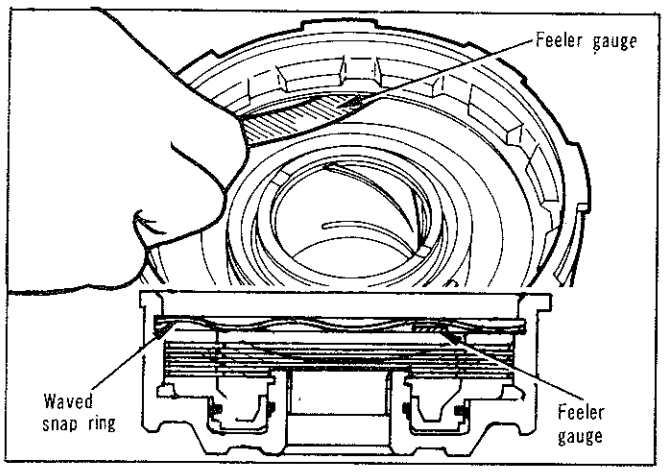


Fig. 51—Measuring front clutch plate clearance

Front Clutch Retainer Bushing Replacement

(1) Lay clutch retainer (open end down) on a clean smooth surface and place removing head Tool SP-3627 in the bushing (Fig. 50). Install handle Tool SP-3549 in removing head.

(2) Drive bushing straight down and out of clutch retainer bore. Be careful not to cock tool in the bore.

(3) Lay clutch retainer (open end up) on a clean smooth surface. Slide a new bushing on installing head Tool SP-3626, and start them in clutch retainer bore (Fig. 50).

(4) Install handle Tool SP-3549 in installing head. Drive bushing into clutch retainer until tool bottoms.

(5) Thoroughly clean clutch retainer before assembly and installation.

Assembly

(1) Lubricate and install inner seal ring on hub of clutch retainer. Make sure lip of seal faces down and is properly seated in the groove (Fig. 48).

(2) Lubricate and install outer seal ring on clutch piston, with lip of seal toward bottom of clutch retainer. Place piston assembly in retainer and, with a twisting motion, seat piston in bottom of retainer.

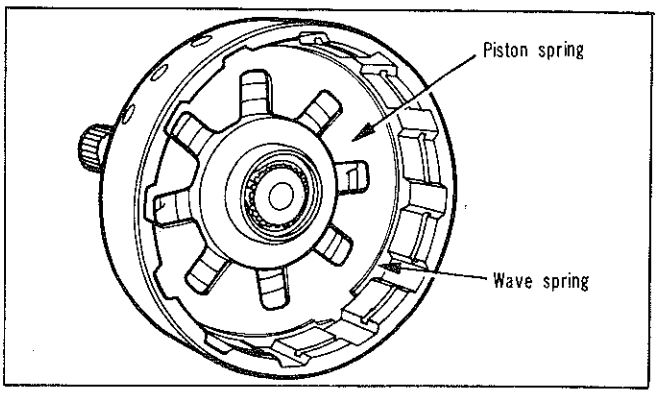


Fig. 53—Installing rear clutch spring, spacer ring and wave spring

(3) Place spring on piston hub and position spring retainer and snap ring on the spring. Compress spring with Tool E21C30C (Fig. 49), and seat snap ring in hub groove. Remove compressor tool.

(4) Lubricate all clutch plates, install one steel plate followed by a lined plate until all plates are installed. Install pressure plate and waved snap ring. Make sure snap ring is properly seated.

(5) With front clutch completely assembled insert a feeler gauge between pressure plate and snap ring (Fig. 51), refer to specifications for clearances.

REAR CLUTCH

Disassembly

Figure 52 shows a disassembled view of the rear clutch assembly.

(1) Remove large selective snap ring that secures pressure plate in clutch piston retainer. Lift pressure plate, clutch plates, and inner pressure plate out of the retainer.

(2) Carefully pry one end of wave spring out of its groove in clutch retainer, then remove wave spring, spacer ring and clutch piston spring.

(3) Invert clutch piston retainer assembly and bump it on a wood block to remove piston. Remove seals from piston.

(4) If necessary, remove snap ring and press input shaft from piston retainer.

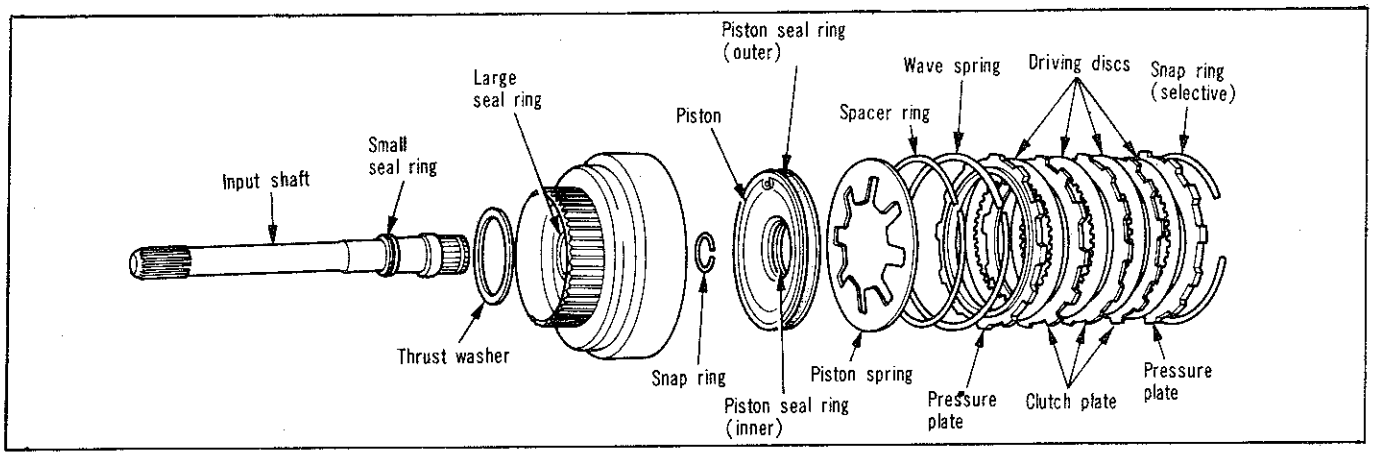


Fig. 52—Rear clutch — disassembled

Inspection

Inspect facing material on all driving discs. Replace discs that are charred, glazed or heavily pitted. Discs should also be replaced if they show evidence of material flaking off or if facing material can be scraped off easily. Inspect driving disc splines for wear or other damage. Inspect steel plate and pressure plate surface for burning, scoring or damaged driving lugs. Replace if necessary. Inspect plates and discs for flatness, they must not be warped or cone-shaped.

Inspect steel plate lug grooves in clutch retainer for smooth surfaces, plates must travel freely in the grooves. Note ball check in clutch retainer, make sure ball moves freely. Inspect seal ring surfaces in clutch retainer for nicks or deep scratches, light scratches will not interfere with sealing of the neoprene rings. Inspect neoprene seal rings for deterioration, wear and hardness. Inspect piston spring, wave spring, and spacer for distortion or breakage.

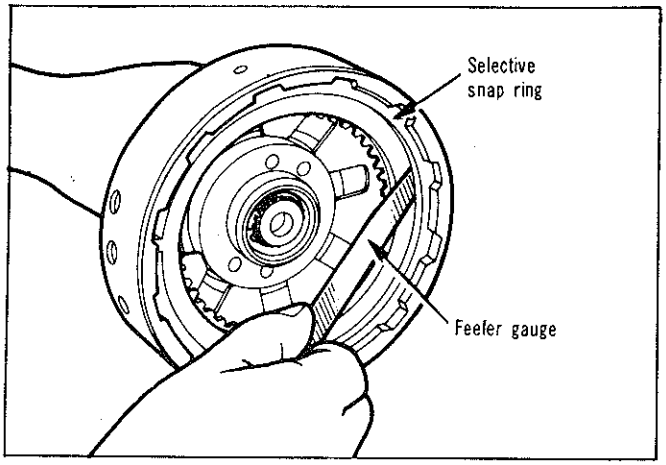


Fig. 54—Measuring rear clutch plate clearance

Inspect interlocking seal rings (Fig. 52) on input shaft and piston retainer for wear or broken locks, make sure they turn freely in the grooves. Do not remove rings unless conditions warrant. Inspect rear clutch to front clutch thrust washer for wear. Washer thickness should be as specified, replace if necessary.

Assembly

(1) If removed, press input shaft into piston retainer and install snap ring.

(2) Lubricate and install inner and outer seal rings on clutch piston. Make sure lip of seals face toward head of clutch retainer, and are properly seated in piston grooves (Fig. 52).

(3) Place piston assembly in retainer and, with a twisting motion, seat piston in bottom of retainer.

(4) Place clutch piston spring and spacer ring on top of piston in clutch retainer, make sure spring and spacer ring are positioned in the retainer recess. Start one end of wave spring in retainer groove (Fig. 52), then progressively push or tap spring into place making sure it is fully seated in the groove.

(5) Install inner pressure plate in clutch retainer with raised portion of plate resting on the spring.

(6) Lubricate all clutch plates, install one lined plate followed by a steel plate until all plates are installed. Install outer pressure plate and selective snap ring.

(7) Measure rear clutch plate clearance by having an assistant press down firmly on outer pressure plate, then insert a feeler gauge between the plate and snap ring (Fig. 54).

The clearance should be as specified. If not, install a snap ring of proper thickness to obtain specified clearance. Low limit clearance is desirable.

NOTE: Rear clutch plate clearance is very important in obtaining proper clutch operation. Clearance can be adjusted by the use of various thickness outer snap ring. Refer specifications.

PLANETARY GEAR TRAIN

End Play

Measure end play of planetary gear assemblies, sun gear and driving shell before removing these parts from output shaft. With assembly in an upright position, push rear annulus gear support downward on the output shaft. Insert a feeler gauge between rear annulus gear support hub and shoulder on output shaft (Fig. 56). If clearance exceeds specifications, replace thrust washers and/or necessary parts.

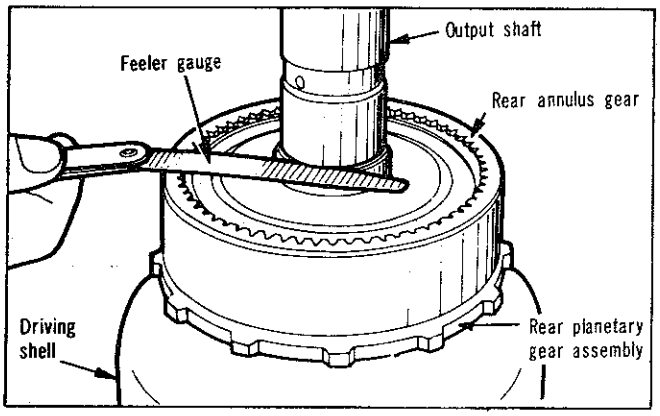


Fig. 55—Measuring end play of planetary gear

Disassembly

(1) Remove selective thrust washer No. 3 from forward end of output shaft (Fig. 56).

(2) Remove selective snap ring from forward end of output shaft, then slide front planetary assembly off the shaft.

(3) Remove snap ring and thrust washer No. 4 from forward hub of front planetary gear assembly, slide front annulus gear and support off planetary gear set. Remove thrust washer No. 5 from front side of planetary gear set. Remove thrust washer No. 6 from rear side of planetary gear assembly. If necessary, remove snap ring from front of annulus gear to separate support from annulus gear.

(4) Slide sun gear, driving shell and rear planetary assembly off the output shaft.

(5) Lift sun gear and driving shell off rear planetary assembly. Remove snap ring and thrust plate No. 8 from sun gear (rear side of driving shell). Slide sun gear out of driving shell, and remove snap ring and thrust plate No. 7 from opposite end of sun gear if necessary.

(6) Remove thrust washer No. 9 from forward side of rear planetary assembly and remove planetary gear set from rear annulus gear. Remove thrust washer No. 10 from rear side of planetary assembly. If necessary, remove snap ring from rear of annulus gear to separate support from the annulus gear.

Inspection

Inspect bearing surfaces on output shaft for nicks, burrs, scores or other damage. Light scratches, small nicks or burrs can be removed with crocus cloth or a fine stone. Inspect speedometer drive gear for any nicks or burrs, and remove with a sharp edged stone. Make sure all oil passages in shaft are open and clean.

Inspect bushings in sun gear for wear or scores, replace sun-gear assembly, if bushings are damaged. Inspect all thrust washers for wear and scores, replace if damaged or worn below specifications. Inspect thrust faces of planetary gear carriers for wear, scores or other damage, replace as required. Inspect planetary gear carrier for cracks and pinions for broken or worn gear teeth, and for broken pinion shaft lock pins. Inspect annulus gear and driving gear teeth for damage. Replace distorted lock rings.

Assembly

Refer to Fig. 56 for parts reference.

(1) Place rear annulus gear support in annulus gear and install snap ring.

(2) Position thrust washer No. 10 on rear side of rear planetary gear assembly and install in rear annulus gear. Install thrust washer No. 9 on front side of rear planetary gear assembly.

(3) Insert output shaft in rear opening of rear annulus gear. Carefully work shaft through annulus gear support and planetary gear assembly. Make sure shaft splines are fully engaged in splines of annulus gear support.

(4) Install thrust plate No. 7 and snap ring on one end of sun gear. Insert sun gear through front side of driving shell, install thrust plate No. 8 and snap ring.

(5) Carefully slide driving shell and sun gear assembly on the output shaft, engaging sun gear teeth with rear planetary pinion teeth.

(6) Place front annulus gear support in the annulus gear and install snap ring.

(7) Position thrust washer No. 5 on front side of front planetary gear assembly. Position front planetary gear assembly in front annulus gear, place No. 4 thrust washer over planetary gear assembly hub and install snap ring. Position No. 6 thrust washer on rear side of planetary gear assembly.

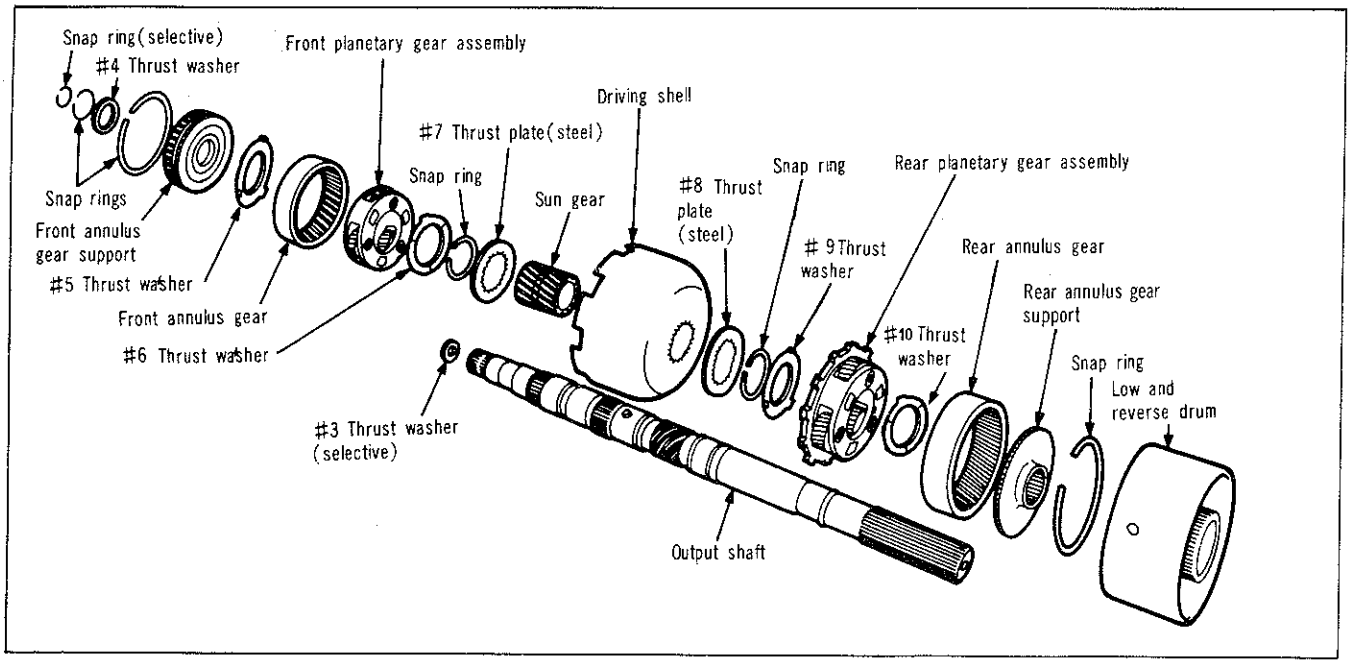


Fig. 56—Planetary gear train and output shaft disassembled

(8) Carefully work front planetary and annulus gear assembly on output shaft, meshing planetary pinions with sun gear teeth.

(9) With all components properly positioned, install selective snap ring on front end of output shaft. Re-measure end play of the assembly.

NOTE: The clearance can be adjusted by the use of various thickness snap rings. Refer specifications.

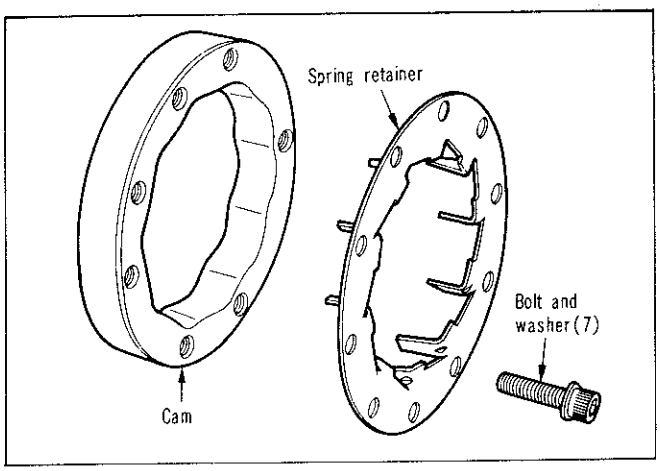


Fig. 57—Overrunning clutch service replacement cam

OVER-RUNNING CLUTCH

Inspection

Inspect clutch rollers for smooth round surfaces, they must be free of flat spots and chipped edges. Inspect roller contacting surfaces in the cam and race for brinelling. Inspect roller springs for distortion, wear or other damage.

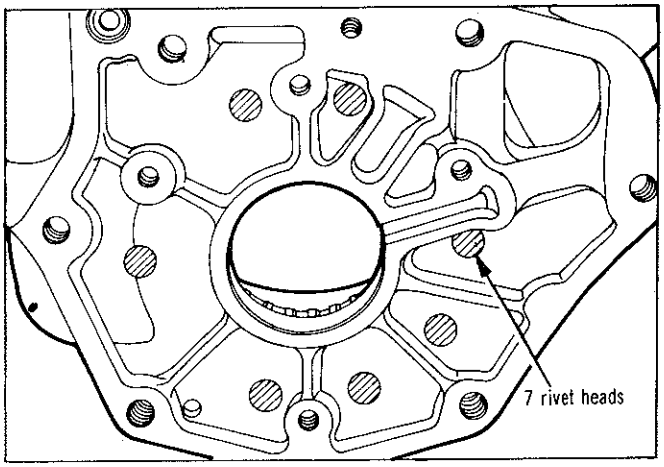


Fig. 58—Centre punch rivet heads

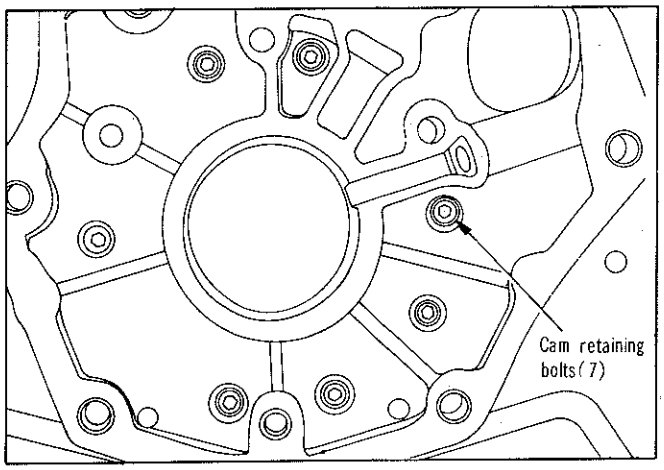


Fig. 59—Cam retaining bolts installed

Over-running Clutch Cam Replacement

If over-running clutch cam or spring retainer are found damaged, they can be replaced with a service replacement cam, spring retainer, and retaining bolts (Fig. 57).

The service parts are retained in the case with bolts instead of rivets. To install, proceed as follows:

(1) Remove four bolts securing output shaft support to rear of transmission case. Drive support rearward out of the case with a wood block and hammer.

(2) Centre punch the rivets **exactly** in centre of each rivet head (Fig. 58).

(3) Drill through each rivet head with a 9.60 mm (3/8") drill. **Be careful not to drill into the transmission case.** Chip off rivet heads with a small chisel, then drive rivets and cam from the case with a blunt punch of proper size.

(4) Carefully enlarge rivet holes in the case with a 6.70 mm (17/64") drill. Remove all chips and foreign matter from the case, make sure cam area is free of chips and burrs.

(5) To install, position cam and roller spring retainer in the case. Align cam bolt holes with holes in the case, then thread all seven retaining bolt and washer assemblies into cam a few turns. The cone washers must be installed so inner diameter is coned toward the bolt head (Fig. 59).

(6) Tap cam firmly into the case if necessary. Draw retaining bolts down evenly, then tighten to specification.

(7) Screw two pilot studs, Tool E21C35C, into the case (Fig. 60). Position support over the pilot studs, and tap it firmly into the case with a soft faced hammer.

KICK-DOWN SERVO AND BAND

Disassembly

Compress servo by using engine valve spring compressor Tool E0092, then remove snap ring. Remove piston rod guide, spring, piston rod and piston.

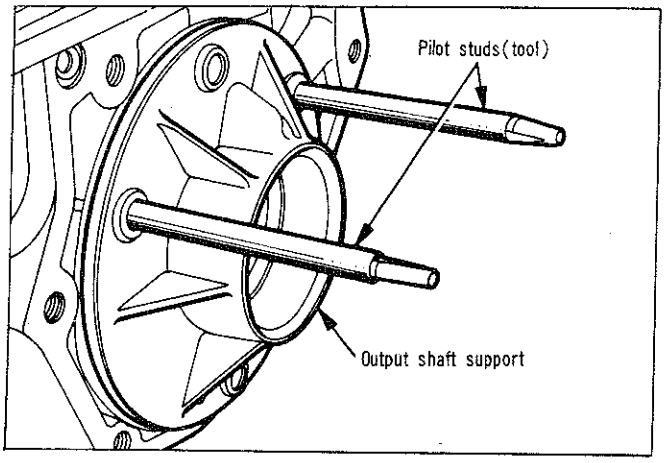


Fig. 60—Installing output shaft support

Inspection

See Fig. 62 for parts reference.

Inspect piston and guide seal rings for wear, and make sure they turn freely in the grooves. It is not necessary to remove seal rings unless conditions warrant. Inspect piston for nicks, burrs, scores and wear. Inspect piston bore in the case for scores or other damage. Inspect fit of guide on piston rod. Inspect piston spring for distortion.

Inspect band lining for wear and bond of lining to the band. Inspect lining for black burn marks, glazing, non-uniform wear pattern and flaking. If lining is worn so grooves are not visible at ends or any portion of the bands, replace the band. Inspect band for distortion or cracked ends.

Assembly

(1) Carefully push servo piston into the case bore. Install piston rod, spring and guide.

(2) Compress kickdown servo spring by using compressor Tool E0092, then install snap ring.

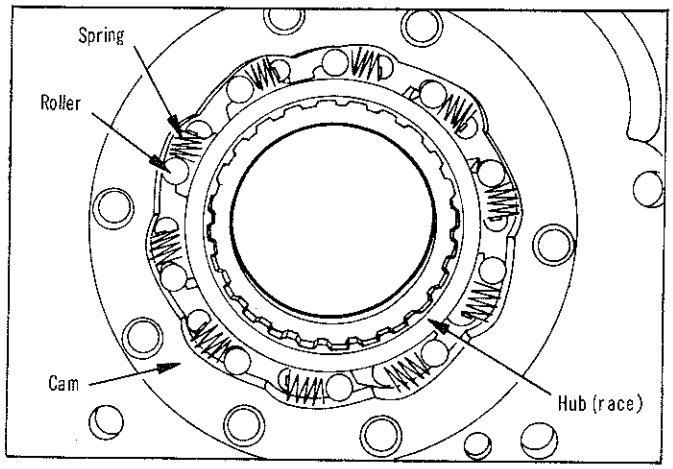


Fig. 61—Over-running clutch

LOW-REVERSE SERVO AND BAND

Disassembly

(1) Remove snap ring from piston and remove the piston plug and spring (Fig. 63).

Inspection

Inspect seal for deterioration, wear and hardness. Inspect piston and piston plug for nicks, burrs, scores and wear; piston plug must operate freely in the piston. Inspect piston bore in the case for scores or other damage. Inspect springs for distortion.

Inspect band lining for wear and bond of lining to the band. If lining is worn so grooves are not visible at ends or any portion of the band, replace the band. Inspect band for distortion or cracked ends.

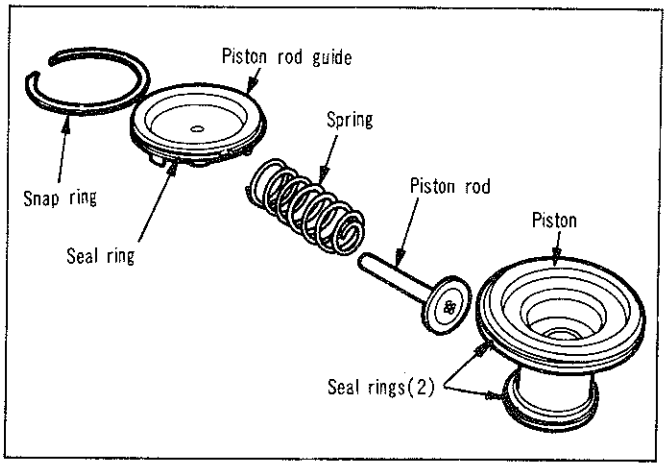


Fig. 62—Kickdown servo

Assembly

(1) Lubricate and insert piston plug and spring in the piston, and secure with snap ring.

ASSEMBLY — SUB-ASSEMBLY INSTALLATION

The assembly procedures given here include installation of sub-assemblies in the transmission case and adjusting drive train end play. Do not use force to assemble mating parts. If parts do not assemble freely, investigate the cause and correct the trouble before proceeding with assembly procedures. Always use new gaskets during assembly operations.

NOTE: Use only "Dexron"® II type Automatic Transmission Fluid to lubricate transmission parts during assembly.

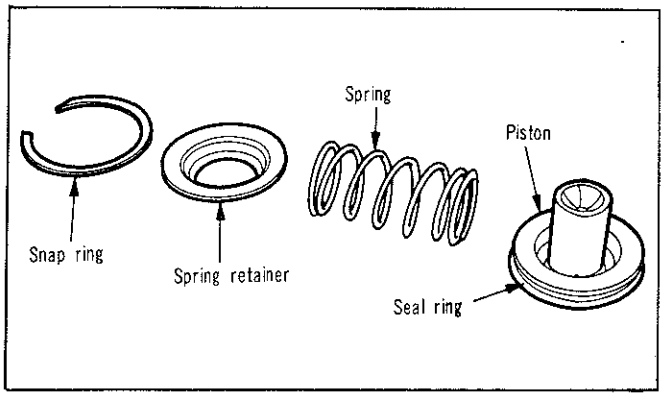


Fig. 63—Low and reverse servo

Over-running Clutch

(1) With transmission case in an upright position, insert clutch hub inside the cam. Install over-running clutch rollers and springs exactly as shown in Fig. 61.

Low-Reverse Servo and Band

(1) Carefully work servo piston assembly into the case with a twisting motion. Place spring, retainer and snap ring over the piston (Fig. 63).

(2) Compress low and reverse servo piston spring by using engine valve spring compressor Tool E0092, then install snap ring.

(3) Position rear band in the case, install short strut, then connect long link and anchor to the band (Fig. 64). Screw in band adjuster just enough to hold strut in place. Install low-reverse drum.

NOTE: Be sure long link and anchor assembly is installed to provide running clearance for the low and reverse drum.

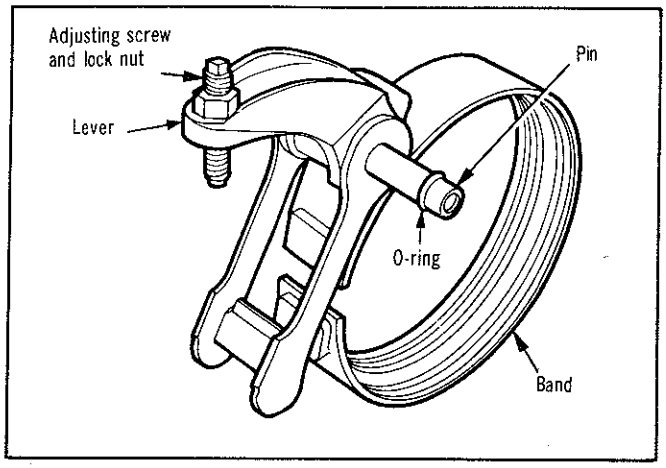


Fig. 64—Low-reverse band and linkage

Planetary Gear Assemblies, Sun Gear, and Driving Shell

(1) While supporting assembly in the case, insert output shaft through rear support. Carefully work assembly rearward, engaging rear planetary carrier lugs into low-reverse drum slots.

NOTE: Be very careful not to damage ground surfaces on output shaft during installation.

Front and Rear Clutch Assemblies

The front and rear clutches, front band, oil pump and reaction shaft support are more easily installed with transmission in an upright position.

One method to support transmission is outlined in Steps 1 and 2.

(1) Cut a 90 mm (3½") diameter hole in a bench, in the end of a small oil drum or a large wooden box strong enough to support transmission. Cut or file notches at edge of the 90 mm (3½") hole so output shaft support will fit and lay flat in the hole.

(2) Carefully insert output shaft into hole to support the transmission upright, with its weight resting on flange of the output shaft support.

(3) Apply a coat of grease to selective thrust washer (Fig. 56) and install washer on front end of the output shaft. If drive train end play was not within specifications (refer specifications for tolerance) when tested before disassembly, replace thrust washer with one of proper thickness.

For selective washers available see specifications.

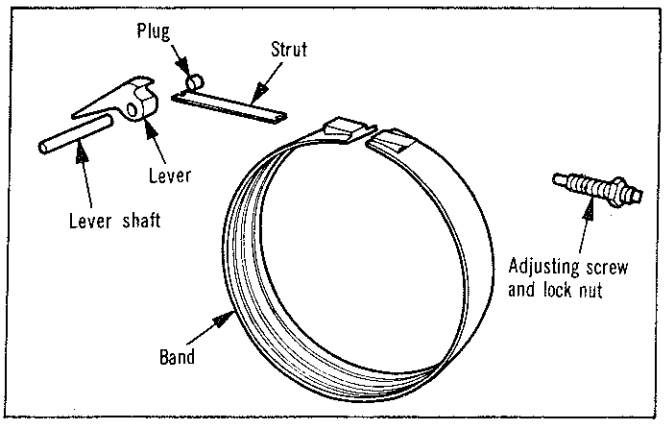


Fig. 65—Kickdown band and linkage

(4) Align front clutch plate inner splines, and place assembly in position on the rear clutch. Make sure front clutch plate splines are fully engaged on rear clutch splines.

(5) Align rear clutch plate inner splines, grasp input shaft and lower the two clutch assemblies into the transmission case.

(6) Carefully work clutch assemblies in a circular motion to engage rear clutch splines over splines on front annulus gear. Make sure front clutch drive lugs are fully engaged in slots in the driving shell.

Front Band

Figure 65 shows a disassembled view of the kickdown band assembly.

(1) Slide band over front clutch assembly.

(2) Install band strut, screw in adjuster just enough to hold strut and anchor in place.

Oil Pump and Reaction Shaft Support

If difficulty was encountered in removing pump assembly due to an exceptionally tight fit in the case, it may be necessary to expand the case with heat during pump installation. Using a suitable heat lamp, heat the case in area of pump for a few minutes prior to installing pump and reaction shaft support assembly.

Install thrust washer on reaction shaft support hub (Fig. 43).

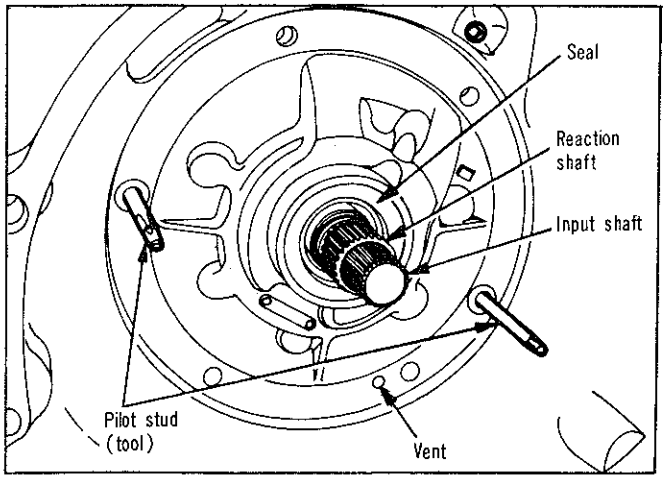


Fig. 66—Installing pump and reaction shaft support

(1) Screw two pilot studs, Tool E21C35C in pump opening in the case (Fig. 66). Install a new gasket over the pilot studs.

(2) Place a new rubber seal in the groove on outer flange of pump housing. Make sure seal ring is not twisted. Coat seal ring with grease for easy installation.

(3) Install pump assembly in the case; tap it lightly with a soft mallet, if necessary. Fit four pump bolts and remove pilot studs, install remaining bolts and snug down evenly.

Rotate input and output shafts to see if any binding exists, then tighten bolts to specification. Check shafts again for free rotation.

(4) Adjust both bands as described in Band Adjustment.

Governor and Support

(1) Position support and governor body assembly on the output shaft. Align assembly so governor valve shaft hole in governor body aligns with hole in output shaft, then slide assembly into place. Install snap ring behind the governor body (Fig. 26). Tighten body to support bolts to specification. Bend ends of lock straps against bolt heads.

(2) Place governor valve on valve shaft, insert assembly into body and through governor weights. Install valve shaft retaining snap ring.

Output Shaft Bearing and Extension Housing

(1) Install bearing on shaft with its outer race ring groove facing forward (Fig. 25). Press or tap bearing tight against shoulder, then install rear snap ring.

(2) Place a new extension housing gasket on the transmission case.

(3) Position output shaft bearing retaining snap ring in the extension housing and spread snap ring as far as possible (Fig. 21).

(4) Carefully tap extension housing into place. Make sure snap ring is fully seated in bearing retaining groove.

(5) Install and tighten extension housing bolts to specification.

(6) Install gasket, plate and screws on bottom of extension housing mounting pad.

(7) Install speedometer pinion and adapter assembly.

NOTE: Measure input shaft end play and correct if necessary.

Valve Body Assembly and Accumulator Piston

(1) Place valve body manual lever in low position to move parking rod to rear position.

(2) Use screw driver to push park sprag into engagement with parking gear, turning output shaft to verify engagement. This will allow "knob" on end of parking rod to move past the sprag as valve body is installed.

(3) Install accumulator piston in the transmission case (Fig. 67).

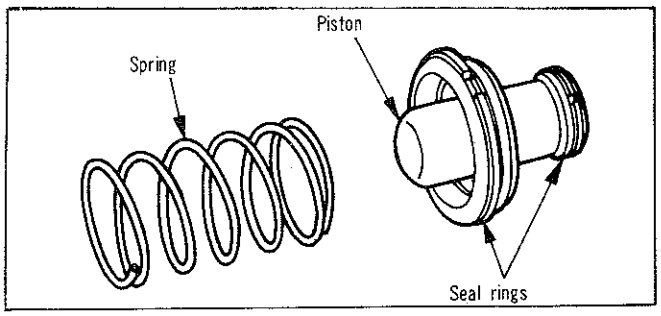


Fig. 67—Accumulator piston and spring

(4) Position accumulator spring between piston and valve body.

(5) Place valve body in position, working park rod through opening and past sprag. Install retaining bolts finger tight.

(6) Snug bolts down evenly, then tighten to specification.

(7) Install gearshift lever and tighten clamp bolt. Check lever shaft for binding in the case by moving lever through all detent positions. If binding exists, loosen valve body bolts and re-align.

(8) Make sure throttle shaft seal is in place, then install flat washer and throttle lever and tighten the clamp bolt.

(9) Install oil pan and a new gasket.

TRANSMISSION, CONVERTER AND DRIVE PLATE INSTALLATION

NOTE: The transmission and converter must be installed as an assembly; otherwise the converter drive plate, pump bushing, and oil seal will be damaged. The drive plate will not support a load; therefore, none of the weight of transmission should be allowed to rest on the plate during installation.

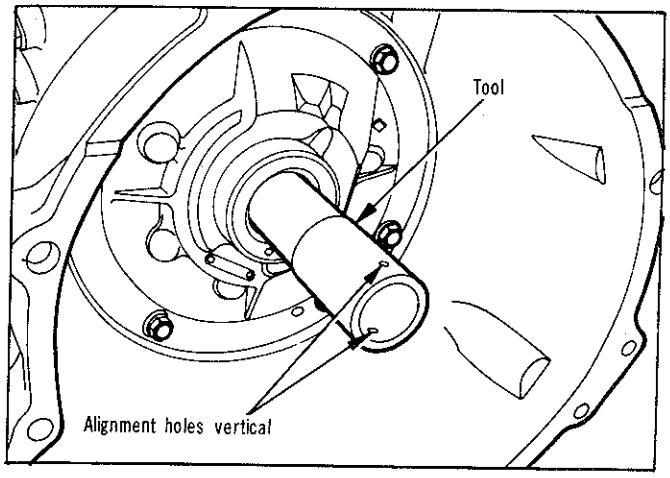


Fig. 68—Aligning pump rotors

(1) Rotate pump rotors with Tool E21C35E until the two small holes in handle are vertical (Fig. 68).

(2) Carefully slide converter assembly over input shaft and reaction shaft. Make sure converter impeller shaft slots are also vertical and fully engage pump inner rotor lugs.

Test for full engagement by placing a straight edge on face of the case (Fig. 68). The surface of converter front cover lug should be at least 12 mm (½") to rear of straight edge when converter is pushed all the way into the transmission.

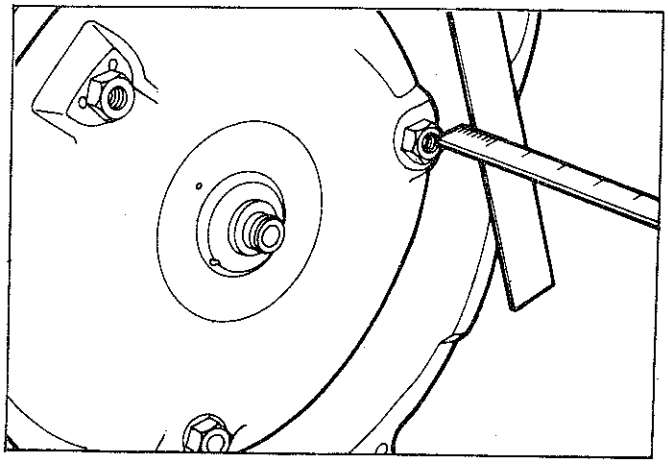


Fig. 69—Measuring converter for full engagement in transmission

(3) Attach a small "C" clamp to edge of converter housing to hold converter in place during transmission installation.

(4) Inspect converter drive plate for distortion or cracks and replace if necessary. Torque drive plate to crankshaft bolts to specified torque.

(5) Coat converter hub hole in crankshaft with wheel bearing grease. Place transmission and converter assembly on a service jack and position assembly under vehicle for installation. Raise or tilt as necessary until transmission is aligned with engine.

NOTE: When Drive Plate replacement has been necessary, make sure both transmission dowel pins are in engine block and they are protruding far enough to hold transmission in alignment.

(6) Rotate converter so mark on converter (made during removal) will align with mark on drive plate. Carefully work transmission assembly forward over engine block dowels with converter hub entering the crankshaft opening.

(7) After transmission is in position, install bell housing bolts and tighten to specified torque.

(8) Install and tighten the drive plate to converter bolts to specified torque.

(9) Install starting motor and connect battery ground cable.

(10) Install crossmember and tighten attaching bolts.

(11) Lower transmission so extension housing is aligned and rests on rear mount. Install bolts and tighten.

(12) Connect gearshift rod to the transmission lever.

(13) Carefully guide sliding yoke into extension housing and on the output shaft splines. Align marks made at removal then connect propeller shaft.

(14) Connect oil cooler lines, and install oil filler tube. Connect the speedometer cable.

(15) Connect throttle rod to the transmission throttle lever.

(16) Install cover plate in front of the converter assembly.

(17) Refill transmission with "Dexron" ® II type Automatic Transmission Fluid as specified.

(18) Adjust throttle and gearshift linkage.

FLUID LEAKAGE — TRANSMISSION CONVERTER HOUSING AREA

(1) Check for source of leakage.

Since fluid leakage at or around the converter area may originate from an engine oil leak, the area should be examined closely. Factory fill fluid is dyed red and, therefore, can be distinguished from engine oil.

(2) Prior to removing the transmission, perform the following checks:

When leakage is determined to originate from the transmission, check fluid level prior to removal of the transmission and torque converter.

High oil level can result in oil leakage out the vent located at the top of the front pump housing. If the fluid level is high, adjust to proper level.

After performing these two operations, re-check for leakage. If a leak persists, perform the following operation on the vehicle to determine whether it is the **converter or transmission** that is leaking.

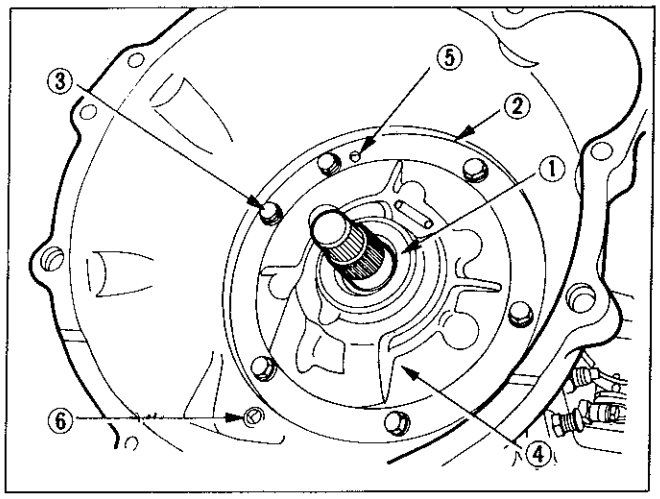


Fig. 70—Transmission converter area

LEAKAGE TEST PROBE

(1) Remove converter housing dust shield.

(2) Position vehicle with front lower than back so that accumulated fluid in converter housing will drain out.

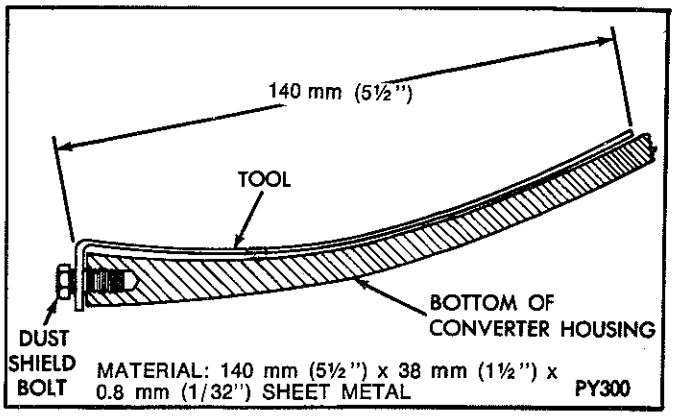


Fig. 71—Leak locating test probe tool

Wipe bottom inside of converter housing as dry as possible. A solvent spray followed by compressed air drying is preferable.

(3) Fabricate and fasten test probe (Fig. 71) securely to convenient dust shield bolt hole. Make certain converter is cleared by test probe. Tool must be clean and dry.

(4) Run engine at approximately 2,500 r.p.m. with transmission in neutral, for about 2 minutes. Transmission must be at operating temperature.

(5) Stop engine and carefully remove tool.

(6) If upper surface of test probe is dry, there is no converter leak. A path of fluid across probe indicates a converter leak. Oil leaking under the probe is coming from the transmission converter area (Fig. 70).

(7) Remove transmission and torque converter assembly from vehicle for further investigation. The fluid should be drained from the transmission and converter. Re-install oil pan (with new gasket), tightening to specified torque.

Possible sources of transmission converter area fluid leakage shown in (Fig. 70) are:

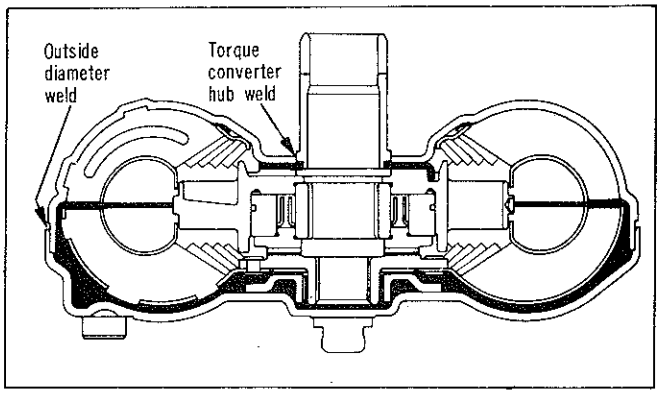


Fig. 72—Torque converter cross section

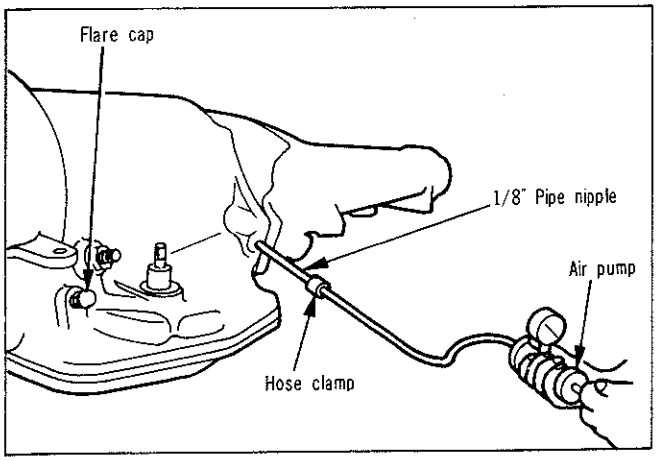


Fig. 73—Pressurizing transmission

(1) Converter Hub Seal.
  (a) Seal lip cut, check converter hub finish.
  (b) Bushing moved and/or worn.
  (c) Oil return hole in front pump housing plugged or omitted.
  (d) Seal worn out (high kilometreage cars).

(2) Fluid leakage at the outside diameter from pump housing O-ring seal.

(3) Fluid leakage at the front pump to case bolts.

(4) Fluid leakage due to case or front pump housing porosity.

(5) Oil leakage out the vent.

(6) Kickdown lever shaft access plug.

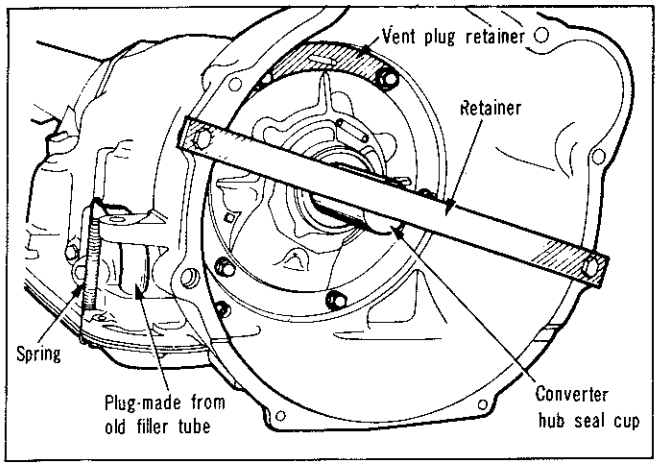


Fig. 74—Transmission prepared for test

Converter Leakage

Possible sources of converter leakage are:

(a) Torque converter weld leaks at the outside diameter (peripheral) weld.

(b) Front pump hub weld.

(c) Crankshaft pilot weld.

These leaks appear at the outside diameter of the converter on the engine side.

AIR PRESSURE TEST OF TRANSMISSION

Fabricate equipment needed for test as shown in (Figs. 75 through 77).

The transmission should be prepared for pressure test as follows after removal of the torque converter.

(1) Install filler tube bore plug, propeller shaft yoke (tie in with cord or wire), flared tube fitting cap (on front cooler line fitting), and pipe nipple (in case at rear cooler line fitting) (Fig. 73 and 74).

(2) Remove necessary front pump housing bolts. Install vent plug (rubber stopper), and vent plug retainer preferably using longer bolts than those removed.

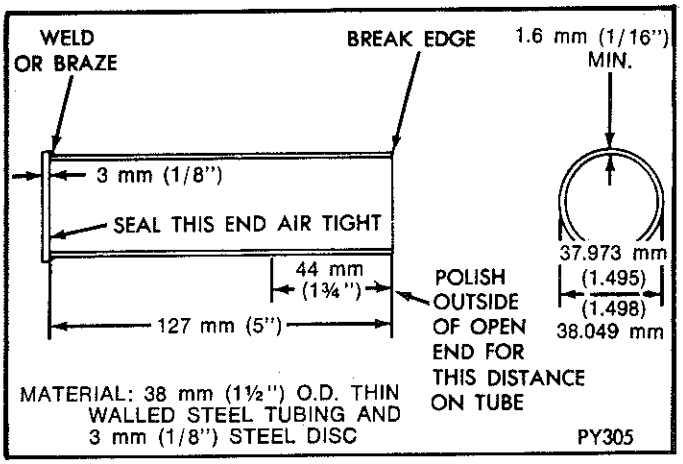


Fig. 75—Converter hub seal cup

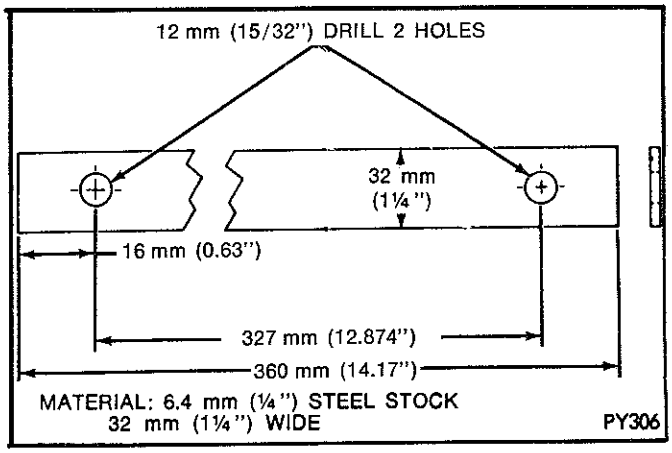


Fig. 76—Hub seal cup retaining strap

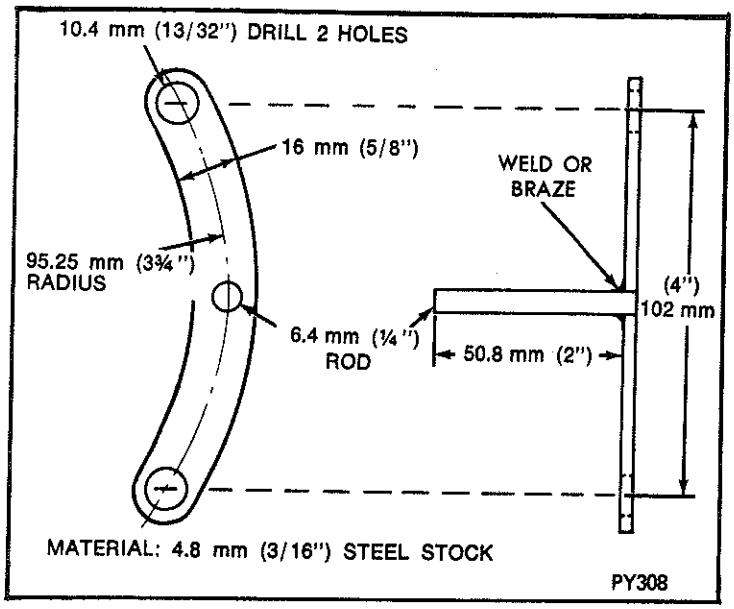


Fig. 77—Vent plug retainer

(3) With rotary motion, install converter hub seal cup over input shaft, and through the converter hub seal until the cup bottoms against the pump rotor lugs. Secure with cup retainer strap (Fig. 74), using converter housing to engine block retaining bolts.

(4) Attach and clamp hose from nozzle of Tool E7C15 to pipe nipple, which is in the rear cooler line fitting position in case (Fig. 73).

(5) Pressurize the transmission using Tool E7C15 until the pressure gauge reads 55 kPa (8 p.s.i.). Position transmission so that pump housing and case front may be covered with soapy solution or water. Leaks are sometimes caused by porosity in the case or pump housing.

If a leak source is located, that part and all associated seals and gaskets should be replaced with new parts.

NOTE: Do not, under any circumstances, pressurize a transmission to more than 69 kPa (10 p.s.i.).