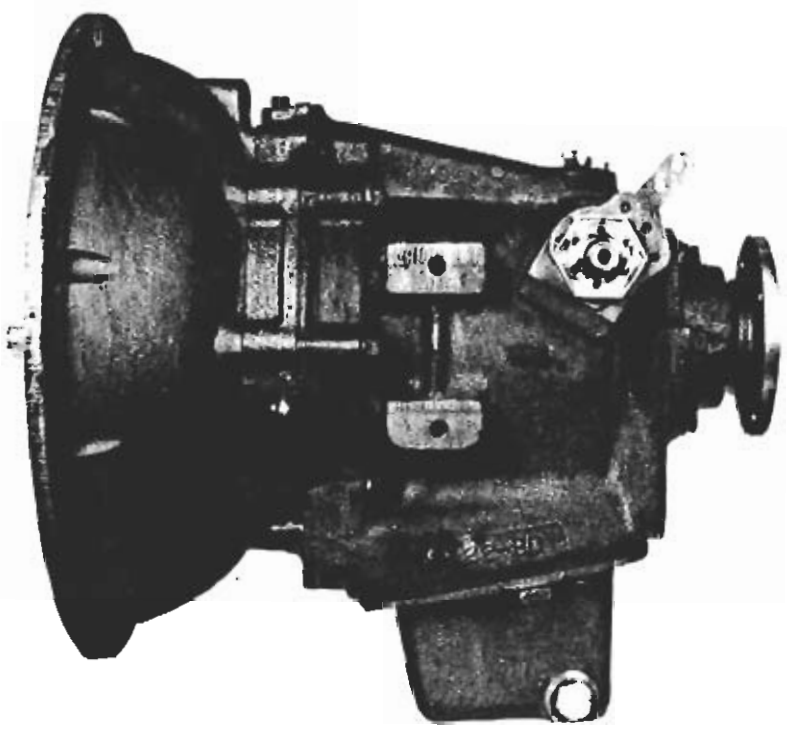
Price $2.50

T72 & 10-16 Velvet Shuttle Transmission Service Manual



TRANSMISSION DESCRIPTION

This manual covers the Velvet Shuttle industrial transmission Model 10-16. A 1.00:1.00 forward speed ratio, neutral, and a 1.10:1.00 reverse speed ratio are available from these forward and reversing units. A torque converter between engine and transmission permits stopping the vehicle in gear with the engine running.

These units consist of a planetary gear set, a multiple disc forward clutch, and a multiple disc reverse clutch. The input and output shafts are in line. Hydraulic pressure is provided by a crescent type pump driven at engine speed by converter drive lugs.

Oil from the pump is diverted to the pressure regulator and control valve. An optional converter relief valve is provided to prevent excessive converter pressure. Oil discharged from the converter relief valve is returned to transmission sump.

An inching valve is provided in some models to permit inching the vehicle in close quarters. When inching is not required, a dump valve replaces the inching valve. The dump valve permits stopping the vehicle without shifting to neutral. Moving the forward and reverse shift lever causes the oil to be diverted to the appropriate clutch for forward or reverse operation. The oil is blocked from feeding the clutches when neutral is selected and both clutches are exhausted to interrupt powerflow.

Warner Gear

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HYDRAULIC CIRCUIT DESCRIPTION

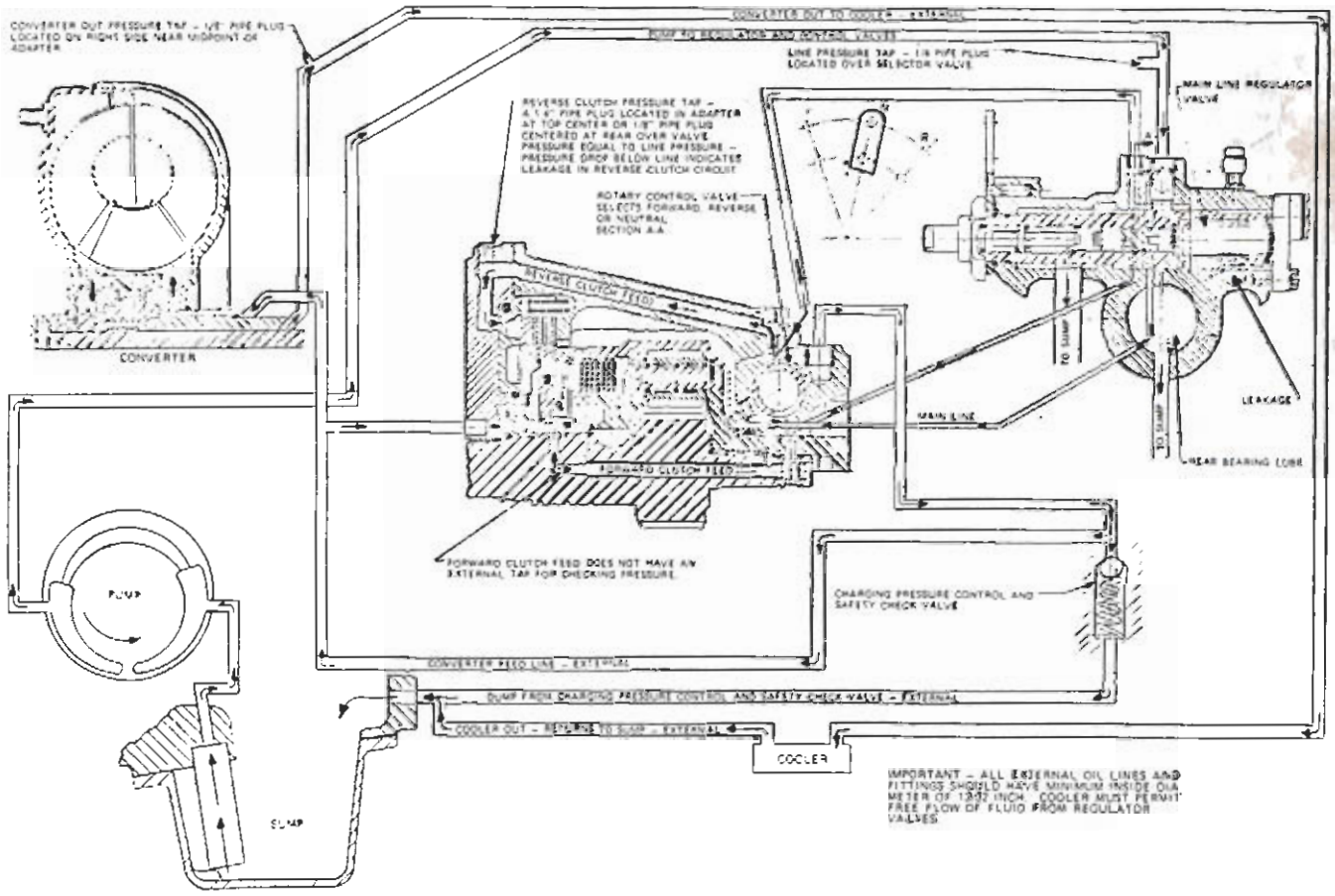
The crescent type pump is driven at engine speed by converter drive lugs. Hydraulic fluid leaving the pump is fed through adapter and case passages to end of regulator valve. A .091 to .098 inch (2.3-2.5 mm) orifice provides converter feed from line pressure circuit prior to opening of regulator valve. Additional oil is fed to converter after regulator valve opens.

The converter is fed through external tubing from a 3/8 inch pipe fitting located behind valve bore in case. A charging pressure relief valve is connected through a pipe tee into the converter feed circuit. The charging pressure relief valve opens any time converter feed pressure becomes excessive and the oil is returned to the transmission sump. Oil enters the converter between converter hub and stator support. Oil leaves converter between stator support and input shaft.

Oil leaving converter is fed by external plumbing to an external cooler. Oil from cooler is returned to transmission sump. Cooler return oil and oil dumped by the charging pressure relief valve are returned to sump by a common pipe tee.

Main line pressure is fed to the inching valve which can either block or regulate clutch feed pressure determined by inching valve plunger position. Clutch feed circuits are exhausted when the inching valve is in the blocking position.

Rotating the selector valve to forward or reverse position permits oil from the inching valve to be fed to the appropriate clutch. Clutches are exhausted when neutral is selected.



HYDRAULIC SCHEMATIC DIAGRAM

OPERATION

Starting the Engine

Prior to starting the engine, place selector in neutral for safety. A neutral safety switch (usually provided) permits starter operation only when neutral has been selected.

Shifting

Shifts from any selector position to any other selector position are permissible at any time and in any order when engine is operating at speeds less than 1500 rpm. An occasional shift made at 2100 engine rpm will not damage the unit. Shifts should be made, except in an emergency, when the engine is operating at the lowest feasible engine rpm.

Failure to exercise care in the selection of engine speeds at which shifts are made, or in the time interval between shifts, can result in damage to the transmission being caused by excessive heat caused by such abusive operation.

Neutral

Move the shift lever to the center position where the spring-loaded poppet ball enters the chamfered hole in the side of the shift lever to positively locate it in the neutral position. In this position, flow of pressurized oil to both clutches is blocked at the control valve and both clutches are exhausted to sump causing complete interruption of power through the transmission.

Forward

Move shift lever to a position aligned with the raised "F" on case where the spring-loaded poppet ball is exactly centered in the chamfered hole in the side of the lever. Oil at regulated pressure then flows through the rotary control valve, through case passages, output shaft, and into the forward clutch cylinder to apply the clutch. Piston movement and lever action of clutch spring forces the clutch plates together. The friction, or inner discs are secured to the clutch hub by internal teeth. The applied clutch locks the ring gear to the input shaft, causing the input shaft rotation to be transmitted directly to the output shaft.

Reverse

Move the shift lever to a position over the raised "R" on side of case where the spring-loaded ball is exactly centered in the chamfered hole in the side of the lever. Oil at regulated pressure then flows through the control valve, case and adapter passages, and into the reverse clutch cylinder. The stationary steel plates and friction plates are locked together and the inner teeth of the friction plates hold the ring gear. With the ring gear held and the sun gear on the input shaft operating at input shaft speed, the pinions in the compound planetary gear set rotate about their own axis and drive the carrier and output shaft in reverse at a 1.10:1.00 speed reduction ratio.

Inching

An inching valve or dump valve is provided depending upon the model. Fully depressing the inching pedal when either forward or reverse is selected will exhaust pressure from either clutch and cause transmission to stop. The vehicle may be eased in either forward or reverse direction by gradually releasing the inching pedal to give desired degree of slipping.

Dump Valve

The dump valve, when provided, permits clutch disengagement by exhausting pressure from the applied clutch. The dump valve does not permit inching.

MISCELLANEOUS SERVICE INFORMATION

Service Requirements

Modern hydraulic transmissions require good servicing if they are to function properly. Knowledge of all transmission components, oil cooler, cooler lines and connections, hydraulic circuit, and all external controls is necessary to insure dependable, economical, and trouble-free operation.

Good service starts with knowledge. The most important factor for good servicing is cleanliness. Hydraulic valves and transmission parts have very close tolerances. Small particles of dirt or lint will cause valves to stick or may cause damage to hydraulic sealing rings and surfaces of transmission components. Good service requires careful workmanship and a craftsman's attitude. Take nothing for granted and check everything.

Shift Linkage

Adjust and check linkage after making installation and at other times when transmission functioning indicates a need for linkage adjustment. Transmission will operate properly only if the shift lever is located with the ball poppet fully seated in the hole in the side of the shift lever.

Inching Valve Linkage Adjustment

The inching valve plunger has a .50 inch (1.27 cm.) total travel. The inching control should be adjusted to permit inching pedals to obtain full travel; however the inching valve stop should not be used to stop inching control movement. Adjust linkage to provide approximately .010 inch (.3 mm.) clearance before valve bottoms against stop in valve assembly.

Checking and Changing Fluid

The fluid level should be maintained between the low and full mark on the dipstick. Check fluid level when the vehicle is sitting on a level surface. Check oil level with engine idling at 500 to 1,000 rpm with the transmission in neutral and warm oil. Dexron and type A suffix A automatic transmission fluid and J.I.Case transmission and converter fluid are recommended.

Change oil after each 1,000 hours of operation. High operating temperature and severe service may cause more frequent changes to be required. Low oil levels should be reason to check for leakage from external fittings and around gaskets and oil seals.

NOTE: Overfilling will sometimes result in oil blowing out from breather.

Internal Leaks

Leakage may be caused by many factors. Look when checking for leaks, for broken sealing rings (cast iron or rubber), scratched surfaces, loose bolts, foreign particles between mating surfaces or surfaces which are not flat. Surfaces may be lapped to correct flatness. Damaged seals and sealing rings should be replaced. Torque loose bolts.

Checking Pressures

Check the various hydraulic oil pressures by installing suitable gages. Gages must be accurate to be of any value. Pressure depends on transmission model and varies with engine speed and transmission temperature. Obtain specific pressure recommendation for your particular application from the original equipment manufacturer.

A pressure 5 psi (.35 k Pa) below normal usually indicates leakage in the circuit being tested. Low pressure in all circuits indicates leakage in the portion of circuit common to all circuits, or a weak pump, stuck regulator valve, or restrictions in pump circuits.

10-16-442-002 TEST SPEC.

RPM	LINE PRSSURE WITH								CONVERTER PRESSURE			
	FORWARD SELECTED				REVERSE SELECTED				IN		OUT	
	Line Pressure		Clutch Pressure		Line Pressure		Clutch Pressure					
	psi	k Pa	psi	k Pa	psi	k Pa	psi	k Pa	psi	k Pa	psi	k Pa
600	45-60	310-414	40-60	276-414	60-80	414-552	58-80	400-552	1-30	7-207	0-10	0-69
1000	100-120	689-827	90-115	620-951	110-130	758-836	108-130	745-896	4-60	28-414	0-20	0-138
2000	125-145	862-1000	110-130	758-1427	120-140	827-965	115-140	793-965	10-90	69-620	0-30	0-207

Pressures given in chart are accurate for transmissions being tested at 120-130 F (49-54C).

DISASSEMBLY OF TRANSMISSION

Prepare for Disassembly

Sit transmission upright on a bench and remove converter housing bolts and housing from transmission. Loosen companion flange nut. Disassembly should not begin until the transmission has been drained and the transmission and work area have been thoroughly cleaned.

NOTE: A number in parenthesis following a part name refers to that part in the exploded view of the transmission.

Pump

Remove pump to adapter bolts (99) and pull pump straight forward from transmission. It may be necessary to tap pump with plastic hammer to free it from the gasket and snap fit. Never strike the pump bolt bosses as the pump bolts seal against face of boss.

Place pump on bench with converter support resting on bench and remove the flat head screw. Lower the housing and gears straight down to bench. Mark gears with a marking pencil so gears can be replaced with gear faces located as they were when removed.

Inspect gears for nicks, excessive wear, cracks or mutilation. Check drive gear bushing for wear. Stator support should be checked for face and journal wear. Check housing gear pockets for wear or other damage. Oil seals should always be replaced.

Pumps are only serviced as assemblies. The oil seal is the only pump part which can be purchased separately.

Adapter

Disconnect and remove the connector tube assembly and fittings.

Remove capscrews (91) from adapter and remove the adapter (90). The reverse clutch pressure plate (83) may stick to piston and should be caught to prevent damage. Use compressed air to force the reverse clutch piston (84) from the adapter. Remove the sealing rings from piston and adapter.

Inspect reverse clutch piston and adapter for wear, scoring and burrs. Replace all sealing rings which are found to be brittle or mutilated. It is suggested that all sealing rings and gaskets should always be discarded and replaced with new ones.

Reverse Clutch

Remove clutch pressure plate (83), pressure plate springs (82), dowel pins (22), and clutch plates.

Check clutch plates for wear, scoring, burrs and overheating. All plates should be flat. Springs should not be bent or mutilated and should all have approximately the same free height.

Forward Clutch and Drive Gear

Remove the thrust washer (76) from front face of clutch cylinder.

Pull drive gear and clutch assembly from case. Remove the thrust washer (28) from front face of pinion cage and output shaft.

Place drive gear and clutch assembly in a suitable fixture and remove the snap ring (78) from the groove in drive gear. Drive gear (30) and forward clutch hub can be pressed or a soft hammer may be used to drive these parts from the remaining clutch parts.

Remove the two cast iron sealing rings (61) from the drive gear.

The clutch hub (59) can be pressed from the drive gear after removing the snap ring (60) from groove in drive gear.

Remove the snap ring (79) and annular bearing from clutch cylinder bore.

Remove the ring gear snap ring (75) from the ring gear groove.

Place ring gear and clutch assembly front face down on a suitable ring or fixture, which will clear the outside diameter of forward clutch cylinder. Use a 2-1/4 inch (57.15 mm) diameter bar to press against the exposed clutch cylinder hub to press clutch cylinder and piston out of ring gear.

Remove clutch spring (69), snap rings and plates from ring gear.

Use compressed air to force the piston (72) from clutch cylinder. Remove the sealing rings from piston and clutch cylinder.

Inspect all clutch parts for wear, mutilation and scoring. Clutch friction and steel plates should be flat. All plates should not be damaged from heat or build-up. Check clutch spring for cracks.

Pinion Cage and Output Shaft

Remove companion flange nut, washers and companion flange from the output shaft.

Pull pinion cage and output shaft (25) forward out of case. Use a soft hammer when necessary to drive shaft out of annular bearing.

Bearing Retainer and Sleeve

Remove attaching bolts, bearing retainer (7) and bearing from rear face of transmission case. The oil seal may be pulled or pressed out of retainer. The annular bearing should be inspected in position and should only be removed when replacement is planned.

Worn or damaged needle bearings should be pressed from case rear bore and a new bearing should be carefully pressed into case using proper tools to keep bearing aligned while being pressed into position.

Control Valve and Spring

Remove the three hex head bolts with lockwashers, switch, cover, and gasket from transmission case.

Remove shift lever and associated parts. Pull valve assembly from transmission case bore.

WARNING

The valve spring is dangerous and snap ring (35) should only be removed when spring is properly retained in a special tool or by an arbor press.

Use suitable fixtures and tools to hold the valve assembly and compress the valve spring. Remove the snap ring and carefully release the spring. Remove spring retainer, spring and regulator valve from the forward and reverse valve.

Inspect valve for scratches or grooves. The spring should not be bent, damaged or broken. The regulator valve when washed and dried should slide freely inside of the forward and reverse valve bore.

Two spring pins must be driven from selector valve to permit inching valve plunger, spring and inching valve or dump valve to be removed.

Oil Baffle

Press down on front end of oil baffle, forcing baffle locating holes off of special bosses. The baffle can then be removed from case.

INSPECTION AND GENERAL INSTRUCTIONS

Tighten all bolts and screws evenly to the recommended torque.

Needle bearings, which are pressed into the case and into pinion cage and output shaft assembly, should be carefully inspected in position in mating part. Do not remove needle bearings unless inspection shows the need for replacement. Always press on end of bearing which has name or other miscellaneous markings.

Inspect needle bearings, ball bearings, and mating thrust faces or journals for scuffing, pits, or deforming of any nature. Replace all damaged parts.

Clutch plates should be flat. Plates, which have slipped, will show heat by discoloration and should be carefully inspected for wear and warpage. Replace clutch plates in sets of steel or friction, or both steel and friction, but not as single plates.

Gears should be checked for pitting or scuffing on teeth and pinion thrust washers should be inspected for wear. The oil fling, which is spun onto carrier, should be oil tight and secure.

Pumps are built to very close tolerances and gears are matched to pump housing at the factory; therefore, it is necessary to replace a complete pump assembly and not individual parts. Inspect pump gears for scratches, galling and wear.

It is wise to carefully check "O" rings and cast iron sealing rings before they are removed since information may be gained, which if analyzed may give the answer to a reason for a failure. A broken sealing ring permits leakage, which could cause clutches to slip and fail.

ASSEMBLY OF TRANSMISSION

Assemble Carrier & Output Shaft Into Case

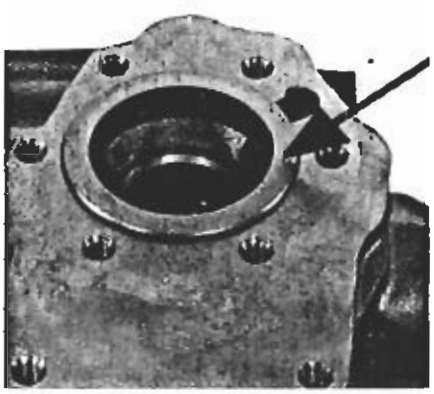


Figure 1 Sleeve in case.

STEP 1 Press sleeve (10) to bottom of case bore, figure 1.

STEP 2 Press a needle bearing (24) approximately 1/8 inch (3.2 mm) below flush with front face of bearing bore, figure 2.

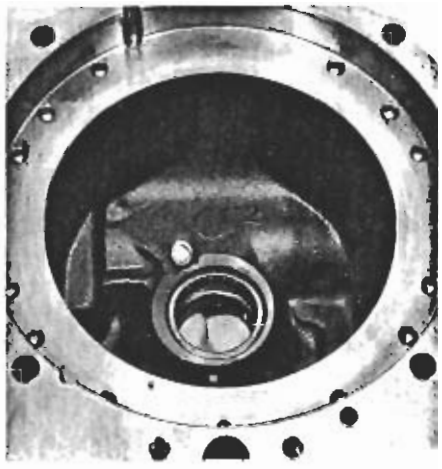


Figure 2 Needle bearing in case

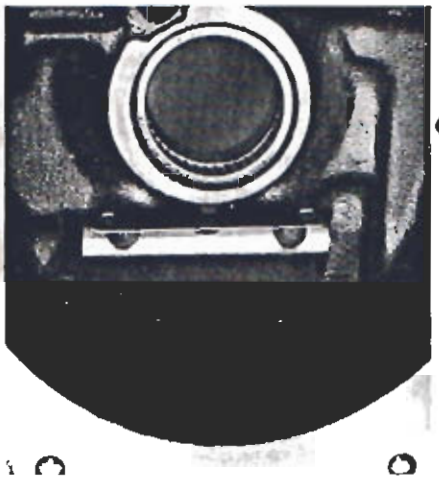


Figure 3 Install oil baffle

STEP 3 Position front center portion of baffle (53) above with outer tabs below boss at front of case then lift curved portion at rear to snap the two large holes in baffle over the spherical bosses at rear of case, figure 3.

STEP 4 Press the annular bearing (8) and oil seal (6) to bottom of their respective bore in bearing retainer. Assemble the gasket, bearing retainer, and six 7/16-14 x 1-1/4 hex head bolts to rear face of case, figure 4.

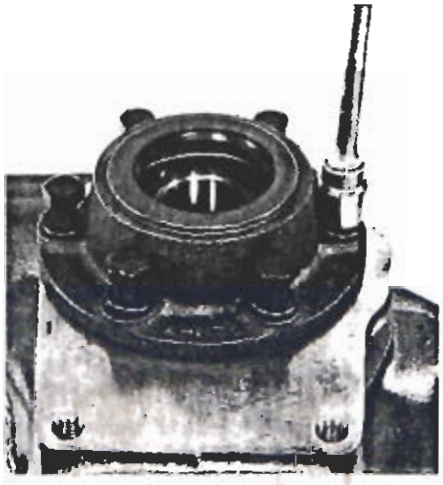


Figure 4 Assemble bearing retainer

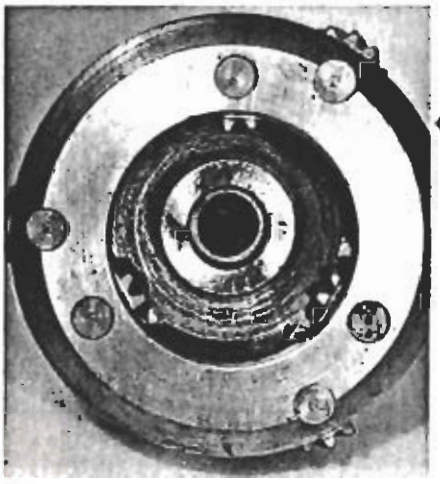


Figure 5 Assemble needle bearing

STEP 5 Press the needle bearing (27) into bore of carrier assembly. Front face of bearing should be .000-.280 inch (7.1 mm) below carrier bore face, figure 5.

STEP 6 Assemble a sealing ring into each of the two output shaft grooves behind carrier. Ring ends should be hooked together. Use petrolatum to lubricate rings, figure 6.

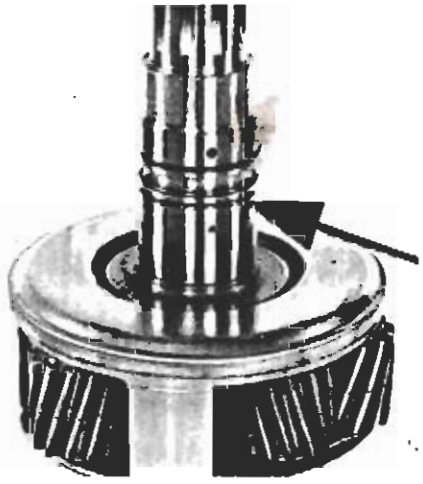


Figure 6 Assemble seal rings

Figure 7 Assemble companion flange

STEP 7 Assemble output shaft and carrier assembly into case. Rotate shaft to help start sealing rings into case bore.

STEP 8 Assemble companion flange, flat washer and output shaft nut. Use heavy permatex under flat washer to prevent oil seepage through shaft and flange spline, figure 7.

STEP 9 Use a fixture or suitable blocking to hold transmission front face up while completing remaining steps of transmission assembly.

Assemble Forward Clutch & Ring Gear

STEP 10 Place ring gear (62) on a bench with the external teeth located up. Be sure that all dirt has been cleaned from shoulder and splines of ring gear, figure 8.

Figure 8 Assemble pressure plate

STEP 11 Install pressure plate (64) with ground face located up in ring gear. Pressure plate should rest squarely on shoulder at bottom of internal spline, figure 8.

Figure 9 Assemble clutch plates

STEP 12 Assemble a friction plate (65) then alternating with steel and friction plates, assemble seven friction and six steel plates, figure 9.

STEP 13 Assemble the flat side of pressure plate (67) against the top friction plate in ring gear.

STEP 14 Assemble the clutch spring snap ring (68) against end of internal spline, figure 10. This snap ring does not assemble into a groove. *Note: The clutch spring snap ring should be from .090 inch to .093 inch (2.3-2.4 mm) thick and have a free diameter approximately 5-19/32 inches (14.21 cm).*

Figure 10 Assemble pressure plate

Figure 11 Assemble clutch spring

STEP 15 Assemble clutch spring (69) concave side down into ring gear. Center spring over snap ring, figure 11.

STEP 16 Assemble sealing ring (71) into clutch piston (72) groove and sealing ring (73) into clutch cylinder (74) hub groove. Lubricate and assemble piston into cylinder bore. Assemble clutch spring bearing ring (70) into groove on face of piston, figure 12.

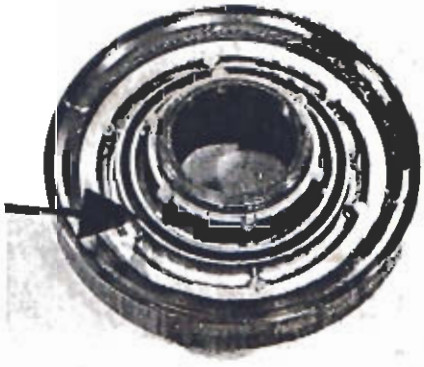


Figure 12 Spring bearing in groove

Figure 13 Press clutch cylinder into ring gear

STEP 17 Center the ring gear with clutch components assembled into it under an arbor press and press clutch piston and cylinder assembly into ring gear, figure 13. Assemble the snap ring (75) into groove above clutch cylinder. *Note: the ring gear snap ring is from .074-.078 inch (1.9 to 2.0 mm) thick and has a free diameter of approximately 5-7/8 inches (14.9 cm).*

STEP 18 Clutch assemblies use a selective snap ring which must be selected and installed between the pressure plate and ring gear web. Position clutch and ring gear on a bench with external teeth of ring gear resting on bench. Place a 10 pound weight on pressure plate to maintain load on clutch pack while a feeler gage is used to determine the clearance between pressure plate and ring gear web, figure 14.

Figure 14 Checking pack clearance

Select and install a snap ring, figure 15, to reduce this dimension (clutch pack clearance) to .011 to .046 inch (.3 to 1.2 mm). Two thin rings may be used to obtain proper pack clearnace. *Note: Selective snap rings have a free diameter of approximately 5-11/16 inches (14.55 cm). A color code has been used to help identify each ring as to thickness as charted below:*

Color	Thickness		Part No.	Total Pack Clearnace		Use Selective Snap Rings
	inch	mm		inch	mm	
Green	.059-.054	1.3-1.4	4768	.065-.088	1.7-2.2	4768
Orange	.074-.078	1.7-1.9	4768A	.089-.110	2.3-2.8	4768A
White	.096-.100	2.4-2.5	4768B	.111-.142	2.8-3.6	4768B
Green & Orange	.124-.132	3.0-3.3	4768 & 4768A	.143-.169	3.6-4.3	4768 & 4768A

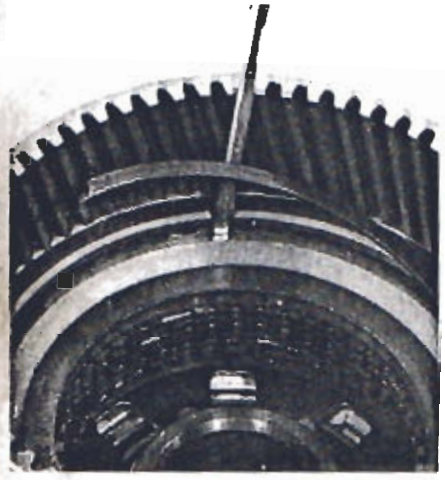


Figure 15 Assembling selective snap ring

Assemble Hub & Sealing Ring on Drive Gear

STEP 19 Assemble the woodruff key (29) into keyway provided in drive gear (30).

STEP 20 Assemble drive gear to clutch hub (59) aligning keyway and key as parts are pressed together under an arbor press, figure 16.

STEP 21 Assemble a snap ring (60) in drive gear groove in front of hub, figure 17.

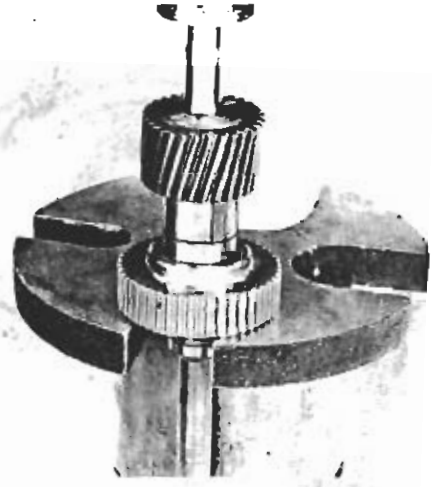


Figure 16 Press sun gear into clutch hub

Figure 17 Assemble snap ring

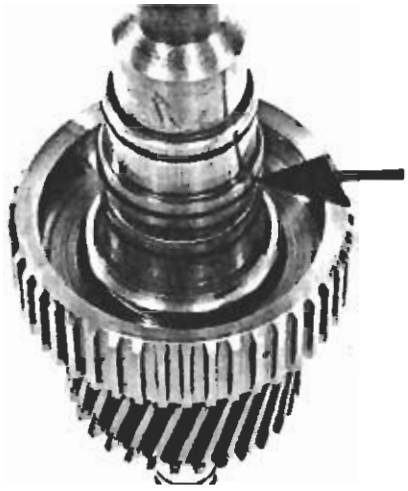


Figure 18 Rings in groove

STEP 22 Assemble two sealing rings in grooves of drive gear. Rings should be free in their grooves, figure 18.

Assemble Drive Gear to Ring Gear & Clutch Assembly

STEP 23 Align clutch hub teeth with clutch plate teeth as drive gear and hub are assembled into clutch and ring gear assembly. Then, position these parts under an arbor press with input shaft splines up and rear face of ring gear and gear resting on a flat surface and shaft extended down through a hole in the support plate.

STEP 24 Press the annular bearing (77) over shaft and into clutch cylinder hub bore.

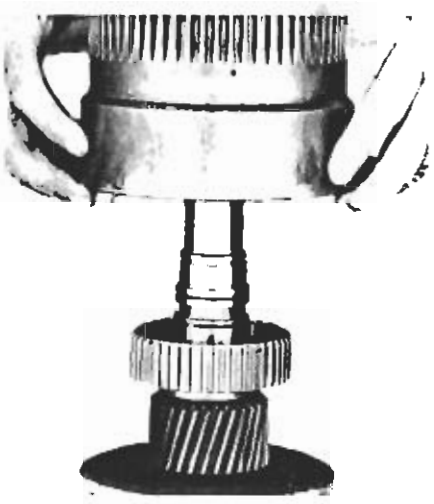


Figure 19 Assembling ring gear to sun gear and clutch hub

Figure 20 Assemble snap ring

STEP 25 Install a snap ring (78) in drive gear groove in front of bearing, figure 20.

STEP 26 Install a snap ring (79) in clutch cylinder hub in front of bearing, figure 21.

STEP 27 Assemble a thrust washer (28) against front face of planet carrier. Use petrolatum to hold washer in position during assembly.

STEP 28 Assemble the two sealing rings (26) in groove of drive gear shaft. Use petrolatum to hold rings in position. Do not use rings which have been cut or mutilated in any manner.

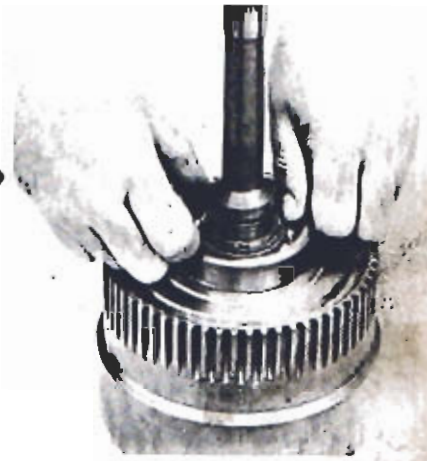


Figure 21 Assemble snap ring

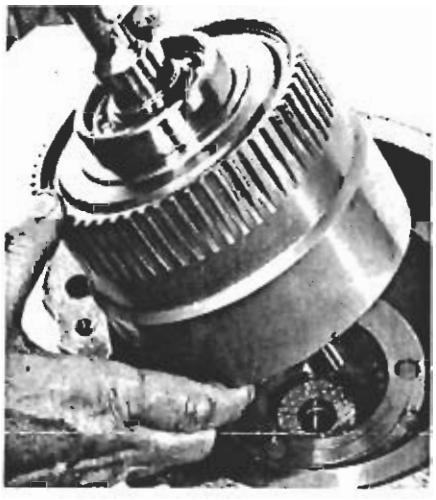


Figure 23 Reverse clutch parts assembled in case

STEP 29 Rotate clutch and drive gear assembly to engage gear teeth as the assembly is lowered into position in transmission, figure 22. Use care to prevent sealing ring damage.

STEP 30 Assemble the thrust washer (76) on face of clutch cylinder, figure 23.

Assemble Reverse Clutch

STEP 31 Assemble eleven pressure plate springs (82) in the holes provided in reverse clutch cavity.

STEP 32 Coat three dowel pins (22) with petrolatum and assemble in grooves provided in outer diameter of the reverse clutch cavity, figure 23.

STEP 33 Assemble a reverse clutch friction plate (80) over exposed splines of ring gear, figure 23.

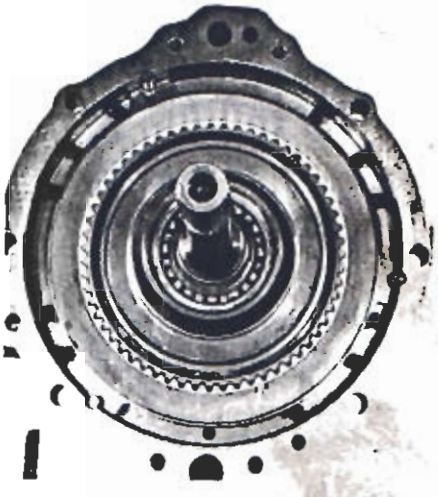


Figure 22 Assemble clutch pack

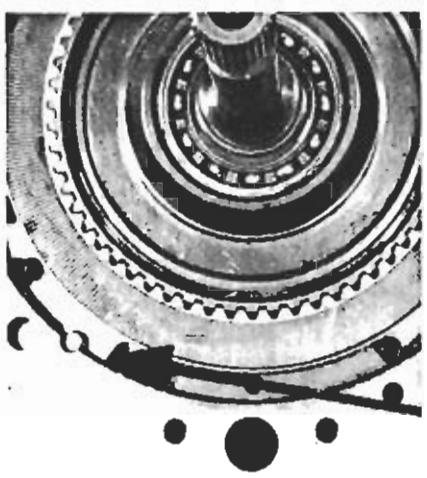


Figure 24 Location of odd lug

STEP 34 Assemble a steel reverse clutch plate (81) locating the odd shaped lug over a dowel which is located at lower left side of case, figure 24. Repeat steps 33 and 34 until three friction and two steel plates have been assembled.

STEP 35 Locate the holes down and align the cast V-slot of the reverse clutch pressure plate (83) with the large oil hole at the top of front face of the transmission case. Springs must engage holes in pressure plate which will be level when properly assembled, figure 25.

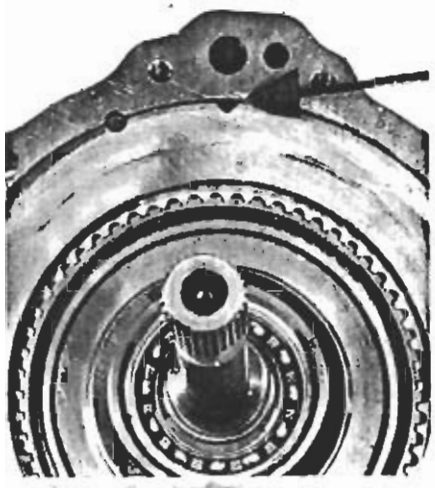


Figure 25 Location of cast V-slot

Assemble Reverse Clutch Piston Into Adapter

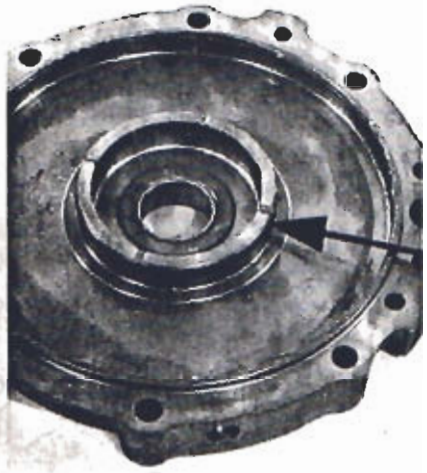


Figure 26 Assemble sealing ring in hub groove

STEP 36 Assemble clutch sealing ring (87) in adapter groove, figure 26.

STEP 37 Assemble a clutch seal ring (85) in reverse clutch piston (84) groove.

STEP 38 Lubricate sealing rings and assemble piston into adapter. A smooth screwdriver may be used to help start sealing rings into cylinder bore, figure 27.

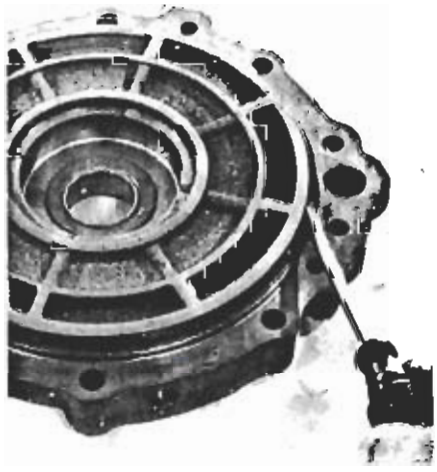


Figure 27 Assemble piston in cylinder

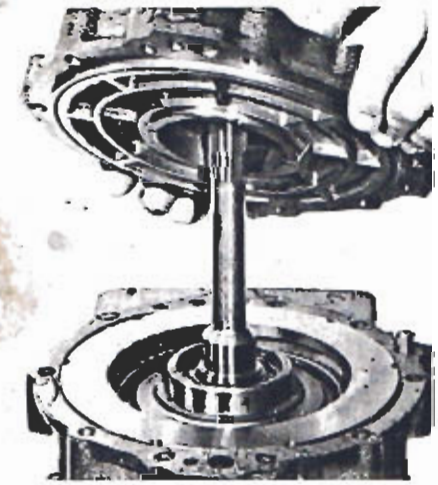


Figure 28 Lower adapter to case face

STEP 39 Assemble gasket to adapter face and lower gasket and adapter straight down over input shaft and rest on front face of case. Twisting the adapter will unseat pressure plate from springs and should be avoided, figure 28.

STEP 40 Assemble the four capscrews (91) and tighten evenly to recommended torque. Should the pressure plate bottom against dowels, it would be necessary to loosen the capscrews and shift adapter to cause the pressure plate to shift into alignment with dowels.

STEP 41 Press a new seal into and against bottom of pump bore, figure 29.

Figure 29 Pump components

Figure 30 Assembling pump

STEP 42 Use the marks made during disassembly to help locate gear faces as they were located before disassembly. A worn pump may look good but may still not deliver full output when operating at high temperature when hot oil becomes very thin. Clearance in excess of .0025 inch (.06 mm) between gear face and front face of pump housing or between gear and housing bore will usually result in a weak pump.

STEP 43 The pump parts are selected to obtain very close tolerances and for that reason, individual parts are not sold. Only complete pump assemblies and seals are serviced.

STEP 44 Lower the small end of stator down through gears and housing and rest stator support on bench, figure 30. Lift housing and gears up into contact with the stator support and replace the flat head screw, figure 30.

STEP 45 Check gears for free movement after the pump has been assembled. A cocked gear or small burr will sometimes lock the gears so that they cannot be turned in the housing. The pump should be disassembled to correct for any binding condition. Always lubricate pump gears with transmission fluid.

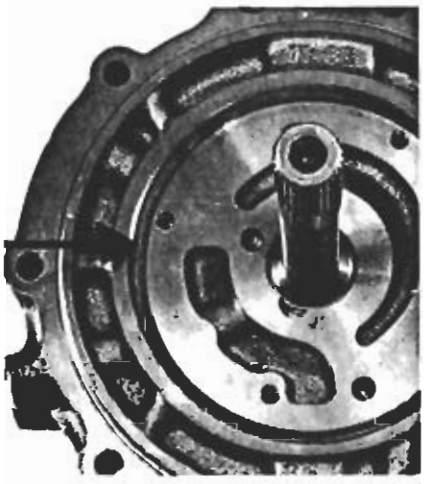


Figure 31 Pump gasket in position

STEP 46 Place a gasket on adapter face and align pump bolt holes to holes in adapter as pump is assembled over the input shaft and against adapter face, figure 31.

STEP 47 Two pump housing bolt bosses are higher than the other two. Use longer bolts in the holes with higher bosses. Use two 5/16-18 x 1-7/8 and two 5/16-18 x 1-3/4 inch hex head bolts to attach pump to adapter, figure 32.

STEP 48 Check transmission end play at this time to insure that it falls within the .011-.086 inch (0.28-2.18 mm) limits. Too much end play could indicate excessive wear which should be corrected or a thrust washer may have been left out.

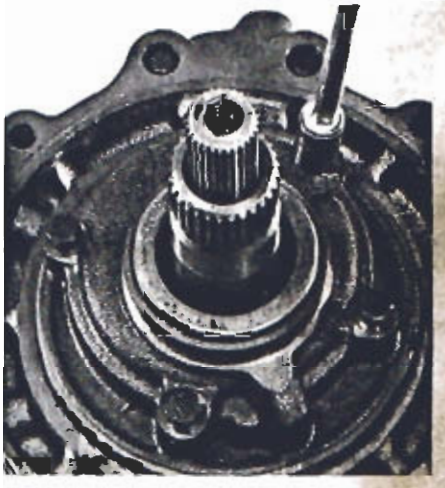


Figure 32 Assembling pump bolts

Assemble Screen and Oil Pan

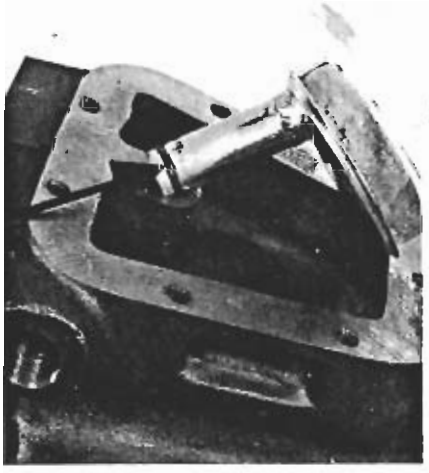


Figure 33 Assemble "O" ring and screen

STEP 49 Assemble an "O" ring in groove of oil screen tube and assemble tube into bore of case, figure 33.

STEP 50 Assemble a gasket and oil pan to case, figure 34.

STEP 51 Assemble the drain plug and gasket to oil pan.

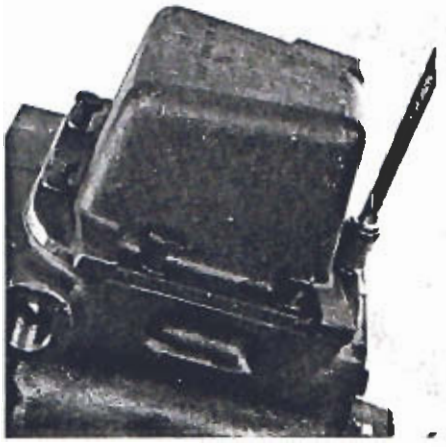


Figure 34 Assemble oil pan

Valve Assembly

STEP 52 Refer to figure 35 during valve body assembly. Wash and air dry all components of valve assembly. Do not use rags to wipe parts dry. Lint from rags can cause erratic valve action. The expansion plug should be seated tightly in bore of valve. Valves should move freely in their respective bores. Crocus cloth may be used to polish valves which are not free.

STEP 53 Assemble the regulator valve, spring, retainer and snap ring into bore of selector valve.

STEP 54 Use petrolatum to hold spring in valve as spring and valve are assembled into bore of selector valve.

STEP 55 Assemble a single spring or two springs if used into bore of selector valve.

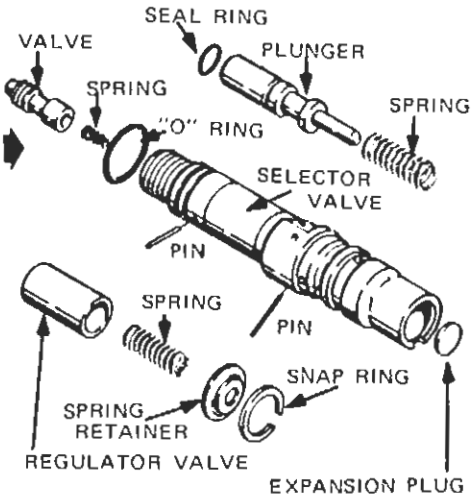


Figure 35 Valve components

STEP 56 Assemble the seal onto plunger, if used. Assemble a sleeve, figure 36, over vee seal to prevent seal damage and assemble plunger into valve body. The current seal and valve must be used together. An early type valve was used with an "O" ring seal. It is recommended that valves which were used with an "O" ring be replaced by the new valve which is used with the vee seal. *Note: Units which use an inching valve in place of the dump valve will be assembled as follows; Assemble plunger into valve bore. Press the oil seal over valve stem and into bore at end of valve.*

STEP 57 Push in on plunger and drive the two pins into selector valve.

STEP 58 Lubricate and assemble the "O" ring into groove at threaded end of selector valve.

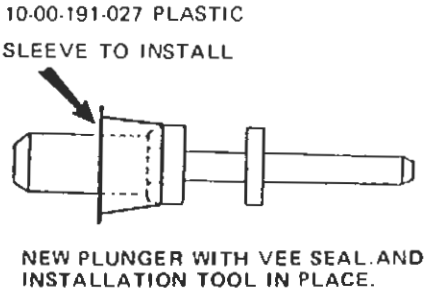


Figure 36 New valve and seal

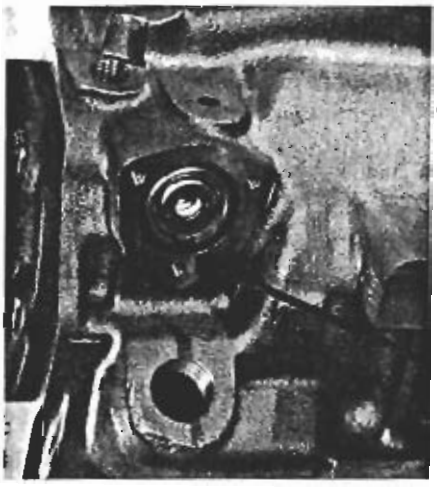


Figure 37 Locate notch down

STEP 59 Assemble valve assembly into case bore, locating notch on end of valve down, figure 37.

STEP 60 Assemble neutral switch cam plate, figure 38, engaging cam lug in notch of valve.

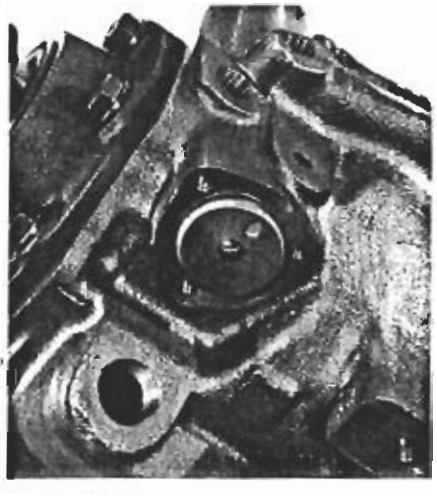


Figure 38 Assemble switch cam

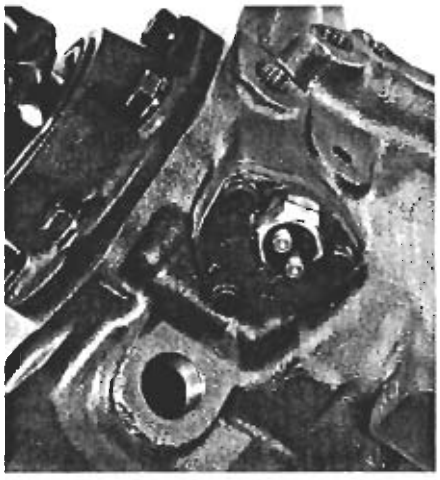


Figure 39 Neutral switch

STEP 61 Assemble gasket, valve cover, switch and 1/4-20 x 7/8 inch bolts and lockwashers to end of valve bore, figure 39.

STEP 62 Assemble retaining ring in the exposed groove of selector valve, figure 40.

CAUTION: The exposed valve plunger is easily bent or damaged. Do not permit valve to support transmission in any manner.

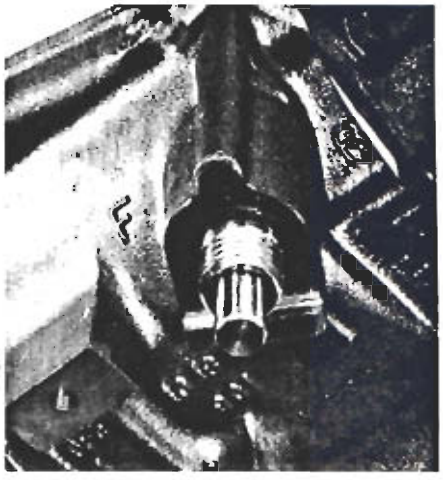


Figure 40 Retaining ring in groove

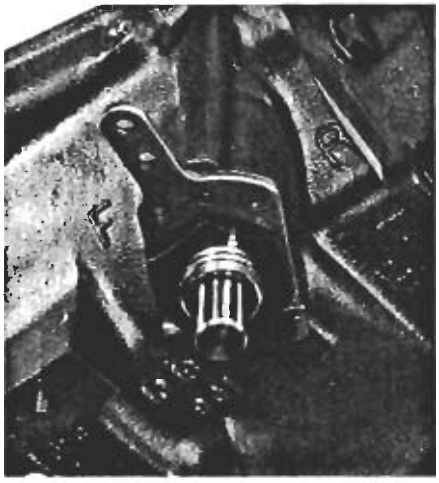


Figure 41 Selector lever in position

STEP 63 Assemble the poppet spring and ball, selector lever and nut or solenoid, figure 41. The nut is supplied for shipping purposes and is replaced by the solenoid when unit is to be installed in vehicle.

Different configurations have been used for external plumbing connections; therefore, replace all plumbing according to the position it was in originally. The usual method is to screw a 90° tubing fitting into the forward and reverse transmission adapter, screw a pipe nipple into transmission case outlet, screw the pipe tee into the nipple, screw a straight tubing connection into the tee and connect the tube between the tube connectors. A street ell is screwed into the open end of the tee and the check valve is screwed into the street ell.

INSTALLATION RECOMMENDATIONS

1) Flushing, regardless of how thoroughly done, can not remove all contamination from a converter. Welded converters can not be torn down for cleaning. Transmissions installed behind a dirty converter are sure to fail after a few hours of operation; therefore it is urgently suggested that new converters be installed where contamination has taken place.

2) Bell housings, which are found to be out of alignment more than the maximum allowable .010 inch (.25mm) limit for bore or face, should be correctly positioned and new oversize dowels then installed.

3) Check for the proper clearance of .080 to .120 inch (2.0-3.1mm) from the pump drive gear front face to the rear face of the converter hub. This should be checked only on new installations and when interchanging parts between installations or when problems indicate an interference.

4) Lubricate the converter hub and the pilot and install drive plate bolts, but do not tighten bolts until after the transmission is securely bolted into position and the pump bushing properly centers the converter.

5) It is wise to install two long dowel bolts, with the heads

removed and screw driver slots cut for installing with a screw driver, in the lower bell housing bolt holes. Slide the transmission forward on the bolts to prevent damaging the pump seal and bushing. Remove dowels after installing the two upper transmission bolts.

6) Cooler and cooler lines should have a minimum inside diameter of 13/32 inch (10.3mm) and be free of all restrictions, such as bent or pinched lines, which would restrict cooler flow. Be certain that the cooler and lines are not contaminated with dirt from a transmission failure or from careless handling. Dirty cooler lines will contaminate the oil which will in turn contaminate the transmission.

7) Transmission operating temperature should not exceed 230°F (110°C). On new installations or when it appears that this temperature is being exceeded, then a temperature check should be made.

8) Exact positioning of the shift lever with ball poppet fully engaging the chamfered hole in side of shift lever is necessary so that oil feed passages are fully opened. External linkage must always correctly position the shift lever in all poppet positions. The warranty is cancelled if the shift lever poppet spring and/or ball is permanently removed, or if linkage between remote control and transmission shift lever does not have sufficient travel in both directions.

9) Filling transmission cannot be completed without operating the engine to fill converter; however, before starting the engine, fill the transmission and be ready to add oil immediately after engine starts and maintain oil level above the L mark on the dipstick until both transmission and converter are filled. Do not overfill as oil level will raise as transmission temperature increases. Check oil level and adjust to full mark after operating temperature has been reached and after shifting a few times into all selector positions to be sure that converter and cooler lines are filled. The total capacity will be upwards of seven quarts.

TROUBLE SHOOTING

A trouble shooting chart is included in this manual and should be used to help solve problems.

A complete knowledge and understanding of the transmission, its functions, gear trains, hydraulic system and its adjustments should be acquired prior to any attempt to diagnose transmission problems. Once this knowledge is obtained, trouble shooting becomes a simple procedure of checking and correcting until the problem is solved.

Gauges are of no value unless they are accurate and should be checked periodically against a master gauge or a dead weight tester and should either be adjusted or discarded when found inaccurate.

Engine rock will sometimes cause shift linkage to be shifted. It is important that the shift lever be exactly positioned in each selector position. The ball poppet should be centered in the hole in the side of the lever at each position.

Oil level, pressure and all operational checks should be made with the transmission at operating temperature. Test data should be compared with data which is given for the model being tested.

Low pressure can be caused by leaks, stuck valves, low oil level, a faulty pump, restrictions such as a dirty oil screen and other conditions. High pressure is usually caused by a stuck regulator valve. A restricted exhaust could cause high pressure. No pressure could be caused by low oil level or no oil, a defective pump, broken pump drive tangs or a large leak.

Poor acceleration combined with a substantially reduced maximum speed, indicates that the stator one-way clutch has locked in the engaged condition. The stator will not rotate with the turbine and impeller; therefore, the fluid wheel phase of the converter performance cannot occur. This condition will cause overheating and although the stall speed will remain normal, the converter should be replaced.

A stall check determines the maximum speed that the engine can drive the converter when the converter turbine is held by applying the brakes with the transmission engaged in either forward or reverse. Do not stall longer than ten seconds without shifting to neutral to permit cooling. After a brief cooling period additional stalling is permissible.

Interputation of stall tests requires that engine condition be known. The engine should operate at full governed speed with neutral selected. The engine is developing full power when the stall speed equals the specified speed. Two to three hundred engine RPM below the specified stall speed usually indicates the need for engine tune-up.

A stall speed 600-700 RPM below normal indicates that the converter one-way clutch is not holding and the converter should be replaced. A high stall speed could indicate a slipping clutch or when a tinny sound coming from the converter is heard, the converter blading is defective.

Slipping clutches will usually squeal. A clutch which had slipped will sometimes overheat and the plates will weld together. Clutch plates which have welded together will not release and the transmission will be permanently engaged in either forward or reverse. Shifting the transmission for opposite direction will lock the vehicle and overload the engine.

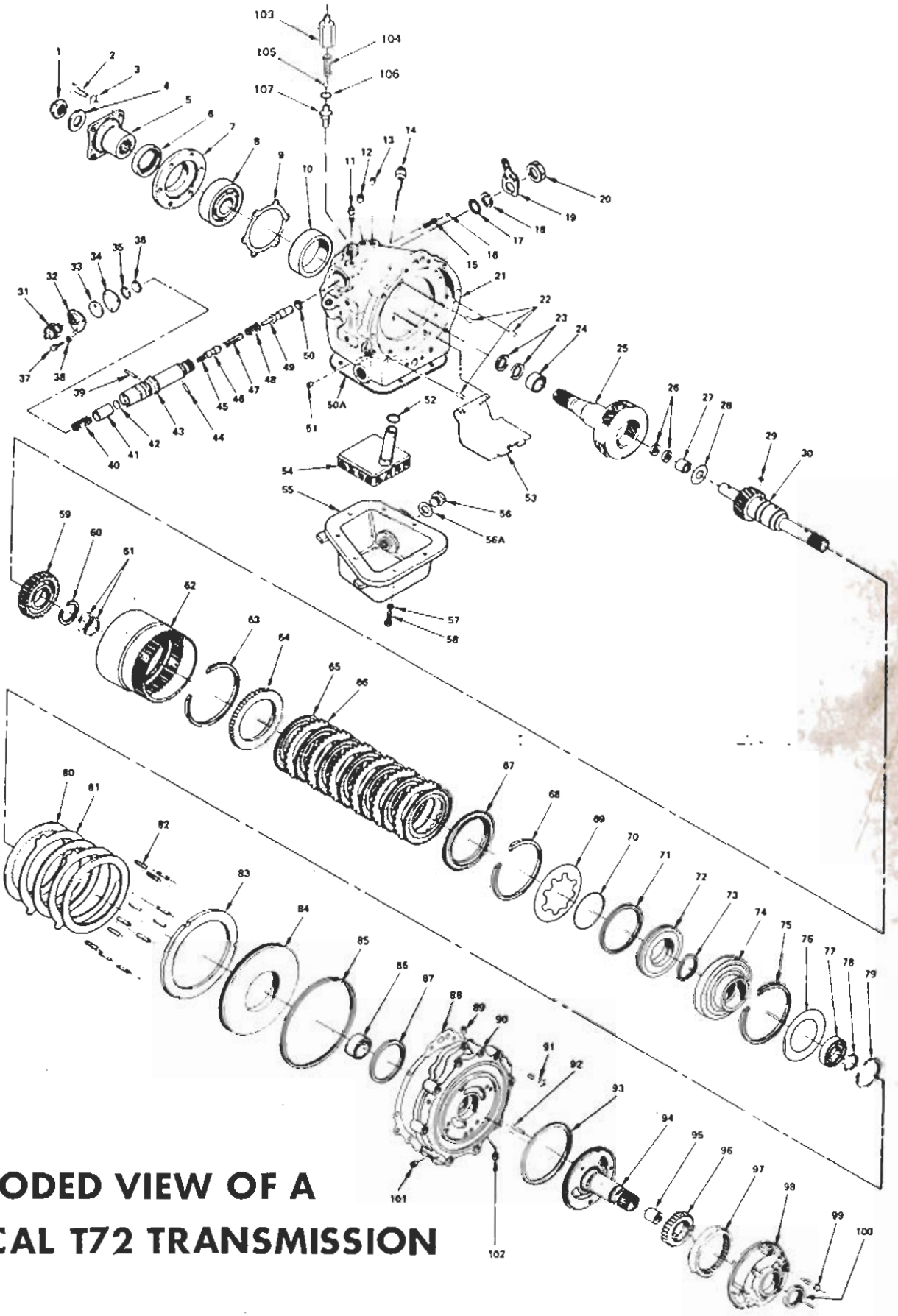
TROUBLE ANALYSIS CHART

PROBLEM	POSSIBLE CAUSE	CORRECTION
Noisy in Forward & Reverse	Misalignment of converter housing or converter with transmission or engine.	Align converter assembly and housing.
	Worn universal joints.	Inspect and service as necessary.
Noisy in Neutral Only	Worn bushings in pump assembly.	Inspect pump assembly and replace if necessary.
	Worn sprag or sprag races in converter assembly.	Replace converter assembly.
	Oil level low.	Fill to correct oil level.
Valve Buzz or Noise	Air in hydraulic system.	Running will remove air.
	Low oil level.	Add oil to full mark.
	Air leak on suction side of pump.	Find and repair.
	Restrictions in oil passages.	Remove restrictions.
	Restricted oil screen.	Clean and replace.
	Sticky valves or converter relief valve noisy.	Clean valve and add clean oil.
Transmission Overheating	Oil level low.	Fill to correct level.
	Cooler to small or restricted oil passages.	Cooler must be connected as shown in oil circuit diagram, figure 6. All external oil lines should have minimum inside diameter of 13/32 inch. Cooler must permit free flow of oil from regulator valves.
	Pump pressure low – worn or damaged pump.	Check transmission pressures at gauging outlets in accordance with oil circuit diagram. Inspect pump assembly if pressures are low. Replace pump assembly if worn or damaged.
	Converter sprag clutch worn and slipping.	Replace converter assembly.
Transmission Will Not Pull in Forward & Reverse	Converter drive lugs sheared or not engaged in pump.	Replace converter parts as necessary.
	Pump gears siezed and converter lugs sheared.	Replace pump assembly and converter parts.
	Insufficient oil in forward and reversing unit.	Fill to correct level.
Transmission Will Not Pull in Forward Only	Worn or broken sealing rings in forward clutch of forward and reversing unit.	Disassemble and inspect clutch assembly. Replace parts as necessary.
	Clutch plates worn or broken in forward clutch assembly.	
Transmission Will Not Pull in Reverse Only	Worn or broken sealing rings on reverse clutch piston. Broken or worn reverse clutch plates.	Disassemble and replace damaged or worn parts as necessary.

PARTS LIST

INDEX NO.		PART NAME
1		MAINSHAFT NUT
2		7/16-14 x 1-1/4 HEX HEAD BOLT
3		7/16 LOCKWASHER
4		MAINSHAFT WASHER
5		COMPANION FLANGE
6		OIL SEAL
7		BEARING RETAINER
8		BEARING
9		BEARING RETAINER GASKET
10		SLEEVE
11		BREATHER
12		3/8 DRYSEAL PLUG
13		1/8-27 DRYSEAL PLUG
14		DIPSTICK ASSEMBLY
15		POPPET SPRING
16		5/16 STEEL BALL
17		"O" RING
18		RETAINING RING
19		FORWARD & REVERSE SHIFT LEVER
20		LOCK NUT (1-1/8 x 7)
21		TRANS. CASE, PLUG & BEARING ASS'Y.
22		DOWEL PIN
23		SEALING RING
24		NEEDLE BEARING
25		CARRIER & OUTPUT SHAFT ASSEMBLY
26		SEALING RING
27		NEEDLE BEARING
28		CLUTCH HUB THRUST WASHER
29		WOODRUFF KEY
30		DRIVE GEAR ASSEMBLY
31		NEUTRAL SWITCH
32		VALVE COVER
33		SWITCH CAM
34		VALVE COVER GASKET
35		SNAP RING
36		VALVE SPRING RETAINER
37		1/4-20 x 7/8 HEX HEAD BOLT
38		1/4 LOCKWASHER
39		SPRING PIN
40		VALVE SPRING
41		PRESSURE REGULATOR VALVE
42		EXPANSION PLUG
43		FORWARD & REVERSE VALVE
44		SPRING PIN
45		INCHING VALVE SPRING
46		INCHING VALVE SPRING INCHING VALVE DUMP VALVE
47		INNER SPRING
48		OUTER SPRING OUTER SPRING
49		INCHING VALVE PLUNGER INCHING VALVE PLUNGER
50		OIL SEAL
51		OIL SEALING RING
52		1/8-27 DRYSEAL PLUG "O" RING
53		OIL BAFFLE
54		OIL SCREEN ASSEMBLY
55		OIL PAN
55A		OIL PAN GASKET
56		DRAIN PLUG
56A		DRAIN PLUG GASKET

INDEX NO.		PART NAME
57		3/8 LOCKWASHER
58		3/8-16 x 1 inch HEX HEAD BOLT
59		FORWARD CLUTCH HUB
60		SNAP RING
61		SEALING RING
62		RING GEAR
63		SELECTIVE SNAP RING
64		CLUTCH PRESSURE PLATE
65		CLUTCH INNER PLATE
66		CLUTCH PLATE (STEEL)
67		CLUTCH PRESSURE PLATE
68		CLUTCH SPRING SNAP RING
69		CLUTCH SPRING
70		CLUTCH SPRING BEARING RING
71		CLUTCH RING
72		FORWARD CLUTCH PISTON
73		"O" RING
74		FORWARD CLUTCH CYLINDER
75		RING GEAR SNAP RING
76		THRUST WASHER
77		BEARING
78		SNAP RING
79		SNAP RING
80		REVERSE CLUTCH PLATE
81		OUTER CLUTCH PLATE – STEEL
82		PRESSURE PLATE SPRING
83		REVERSE CLUTCH PRESSURE PLATE
84		REVERSE CLUTCH PISTON
85		SEALING RING
86		ADAPTER BUSHING
87		SEALING RING
88		CASE & ADAPTER GASKET
89		1/4 PIPE PLUG
90		FORWARD & REVERSE ADAPTER & BUSHING ASSEMBLY
91		3/8-16 x 1-1/4 CAPSCREW
92		No. 10-24 x 3/4 FLAT LEAD SCREW
93		PUMP GASKET
94		CONVERTER SUPPORT
95		CONVERTER SUPPORT BUSHING
96		PUMP DRIVE GEAR
97		PUMP DRIVEN GEAR
98		PUMP BODY
99		5/16-18 x 1-3/4 HEX HEAD BOLT 5/16-18 x 1-7/8 HEX HEAD BOLT
100		OIL SEAL
101		1/8-27 DRYSEAL PLUG
102		1/8-27 DRYSEAL PLUG
103		CHECK VALVE BODY
104		SPRING
105		STEEL BALL
106		"O"
107		SEAT



EXPLODED VIEW OF A TYPICAL T72 TRANSMISSION

BOLT TORQUE CHART

PART NUMBER	DESCRIPTION	BOLT TORQUE	
		POUNDS FT.	NEWTON METERS
4911	3/8-16 x 1-1/4 CAP SCREW	27-37	37-50
4775K	MAIN SHAFT NUT	75-85	102-115
3-A194	DRAIN PLUG	25-30	34-41
71-2A195	DIPSTICK ASSEMBLY	10-15	14-20
0000110533	No. 10-24 x 3/4 FLAT HEAD SCREW	25-35*	3-4
0000179796	1/4-20 x 7/8 HEX HEAD BOLT	8-11	11-15
0000179824	5/16-18 x 1-3/4 HEX HEAD BOLT	17-22	23-30
0000179825	5/16-18 x 1-7/8 HEX HEAD BOLT	17-22	23-30
0000179839	3/8-16 x 1 HEX HEAD BOLT	22-37	30-50
0000179860	7/16-14 x 1-1/4 HEX HEAD BOLT	42-50	57-68
0000444860	1/4 PIPE TEE	12-20	16-27
0000444866	3/8-18 DRYSEAL PLUG	17-27	23-37
0000444867	1/8-27 DRYSEAL PLUG	7-12	9-16
10-00-149-009	SHIFT LEVER NUT	15-25	20-34

*Pound inches

SPRING IDENTIFICATION CHART

PART NUMBER	WHERE USED	CHECK LOAD AT THIS HEIGHT						FREE LENGTH		MAXIMUM COMPRESSED HEIGHT		OUTSIDE DIAMETER		WIRE DIAMETER		ACTIVE COILS
		POUNDS		KILOGRAMS		HEIGHT										
		MIN.	MAX.	MIN.	MAX.	INCH	cm.	INCH	cm.	INCH	cm.	INCH	cm.	INCH	cm.	
5J-222	PLUNGER	2.7	2.84	1.17	1.29	.86	2.18	1.45	3.68	.68	1.73	.63	1.6	.05	.13	10.0
11-215	INCHING VALVE	.27	.36	.12	.16	.50	1.27	.63	1.59	–	–	.19	.48	.016	.04	7.5
11-223	INCHING VALVE	1.9	2.2	.86	.99	.45	1.15	.69	1.74	.35	.90	.18	.46	.023	.06	12
T11-238	PLUNGER	9.5	10.5	4.31	4.76	1.25	3.18	2.00	5.08	.63	1.6	.66	1.66	.063	.16	8
72N-272	REGULATOR VALVE	72	79	32.66	35.83	2.07	5.27	2.69	6.84	1.63	4.13	.78	1.98	.128	.33	11
T90A-42A	POPPET	8	10	3.63	4.59	.94	2.38	1.17	4.29	–	–	3.1	.79	–	–	
10-16-156-001	INCHING	12.35	13.65	5.60	6.19	1.63	4.13	2.95	5.12	1.60	4.05	5.11	1.3	.063	.16	7.5

BOLT TORQUE CHART

PART NUMBER	DESCRIPTION	BOLT TORQUE	
		POUNDS FT.	NEWTON METERS
4911	3/8-16 x 1-1/4 CAP SCREW	27-37	37-50
4775K	MAIN SHAFT NUT	75-85	102-115
3-A194	DRAIN PLUG	25-30	34-41
71-2A195	DIPSTICK ASSEMBLY	10-15	14-20
0000110533	No. 10-24 x 3/4 FLAT HEAD SCREW	25-35*	3-4
0000179796	1/4-20 x 7/8 HEX HEAD BOLT	8-11	11-15
0000179824	5/16-18 x 1-3/4 HEX HEAD BOLT	17-22	23-30
0000179825	5/16-18 x 1-7/8 HEX HEAD BOLT	17-22	23-30
0000179839	3/8-16 x 1 HEX HEAD BOLT	22-37	30-50
0000179860	7/16-14 x 1-1/4 HEX HEAD BOLT	42-50	57-68
0000444860	1/4 PIPE TEE	12-20	16-27
0000444866	3/8-18 DRYSEAL PLUG	17-27	23-37
0000444867	1/8-27 DRYSEAL PLUG	7-12	9-16
10-00-149-009	SHIFT LEVER NUT	15-25	20-34

*Pound inches

SPRING IDENTIFICATION CHART

PART NUMBER	WHERE USED	CHECK LOAD AT THIS HEIGHT						FREE LENGTH		MAXIMUM COMPRESSED HEIGHT		OUTSIDE DIAMETER		WIRE DIAMETER		ACTIVE COILS
		POUNDS		KILOGRAMS		HEIGHT										
		MIN.	MAX.	MIN.	MAX.	INCH	cm.	INCH	cm.	INCH	cm.	INCH	cm.	INCH	cm.	
5J-222	PLUNGER	2.7	2.84	1.17	1.29	.86	2.18	1.45	3.68	.68	1.73	.63	1.6	.05	.13	10.0
11-215	INCHING VALVE	.27	.36	.12	.16	.50	1.27	.63	1.59	–	–	.19	.48	.016	.04	7.5
11-223	INCHING VALVE	1.9	2,2	.86	.99	.45	1.15	.69	1.74	.35	.90	.18	.46	.023	.06	12
T11-238	PLUNGER	9.5	10.5	4.31	4.76	1.25	3.18	2.00	5.08	.63	1.6	.66	1.66	.063	.16	8
72N-272	REGULATOR VALVE	72	79	32.66	35.83	2.07	5.27	2.69	6.84	1.63	4.13	.78	1.98	.128	.33	11
T90A-42A	POPPET	8	10	3.63	4.59	.94	2.38	1.17	4.29	–	–	3.1	.79	–	–	
10-16-156-001	INCHING	12.35	13.65	5.60	6.19	1.63	4.13	2.95	5.12	1.60	4.05	5.11	1.3	.063	.16	7.5