VERSATILE

Ford

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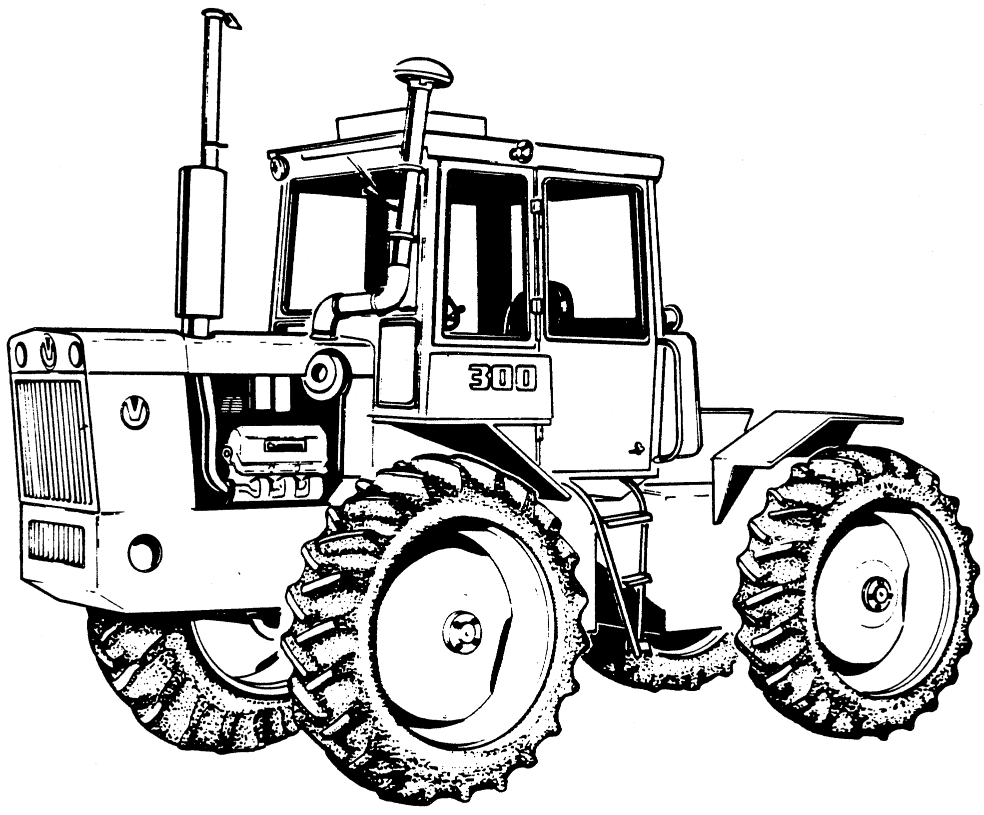
Service Manual

Hydro-Mechanical Transmission Tractor 300

1978



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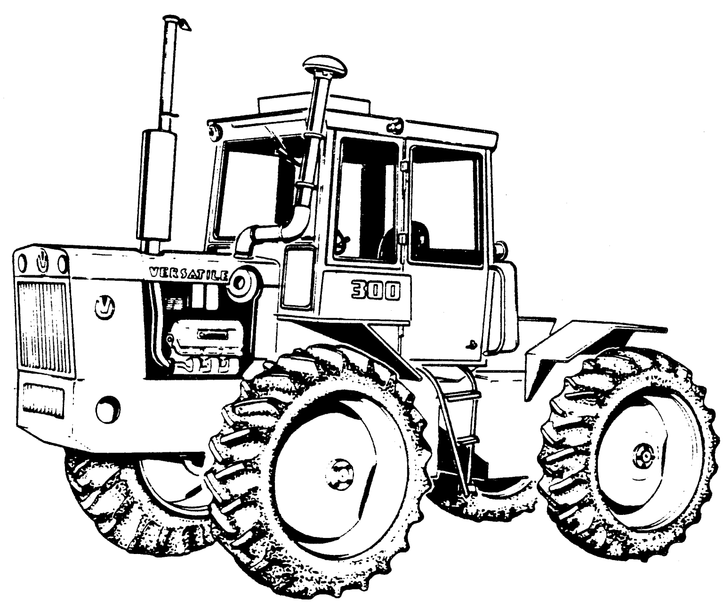
MODEL 300 TRACTOR

HYDRO-MECHANICAL TRANSMISSION

SERVICE



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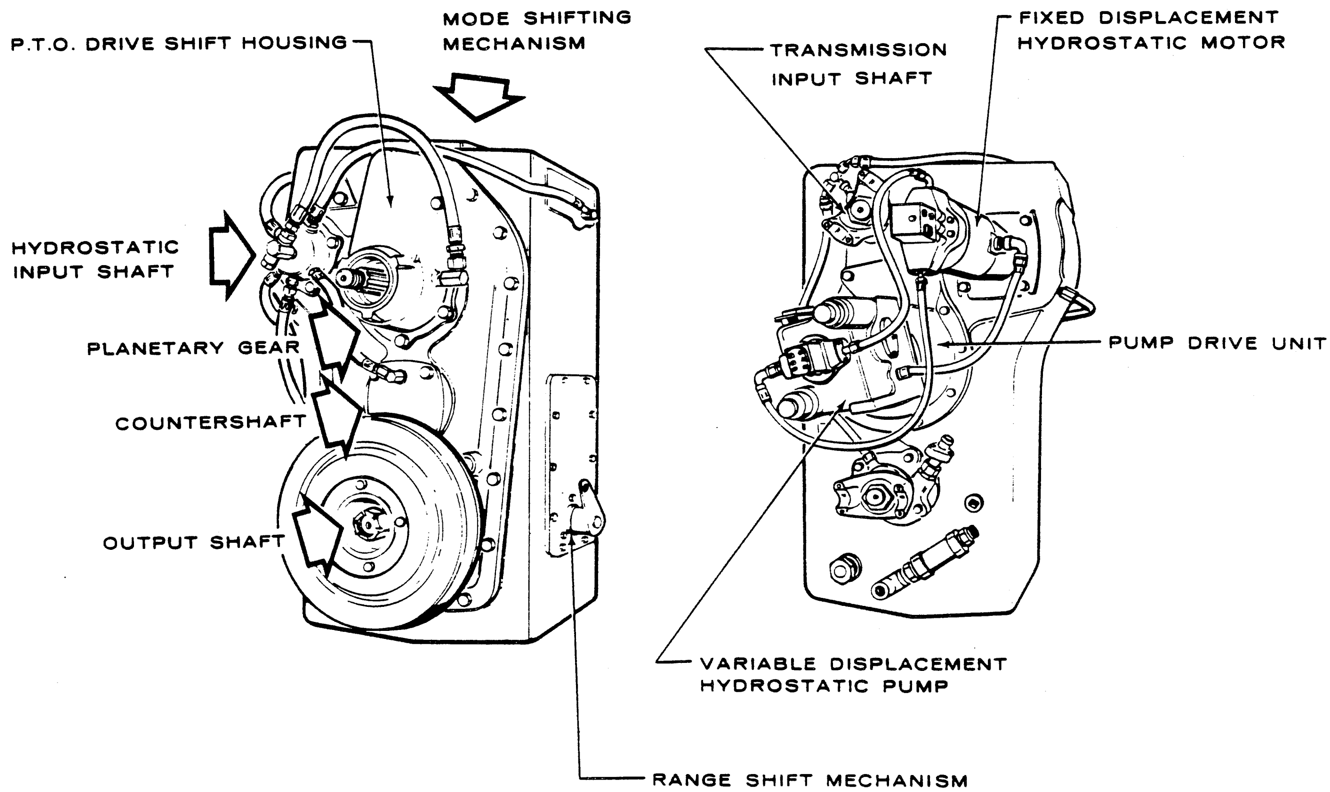
HYDRO-MECHANICAL TRANSMISSION - MODEL 300 TRACTOR



HYDRO-MECHANICAL TRANSMISSION
FIGURE 1.

INTRODUCTION

The service information contained herein is intended to be a guideline for overhaul and repair of the hydro-mechanical transmission used in the VERSATILE Model 300 Tractor.

This does not include information for removal of the transmission from the tractor nor re-installation after overhaul and repair.

GENERAL DESCRIPTION

The hydro-mechanical transmission is a combination gearbox consisting of a basic mechanical transmission conbined with a planetary gear and hydrostatic drive units. The transmission can be used in three modes each of which has a low and a high range. The modes and ranges are selected by using the control levers in the tractor cab. The relationship of Mode, Range and driving speed is shown in Table 1.

TABLE 1

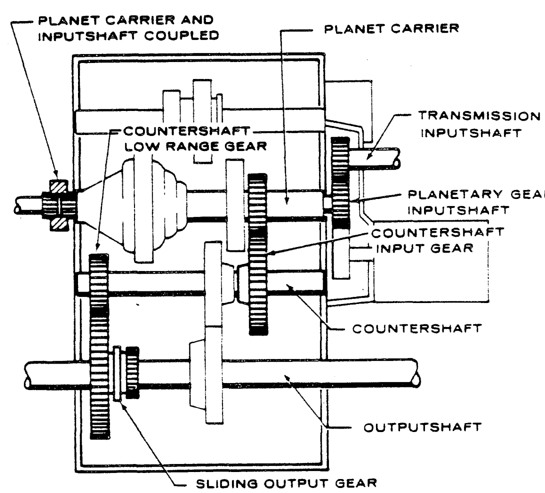
MODE	RANGE	SPEED
Road Gear	low high	9.7 mph 15.4 mph
Hydro-Mechanical	low high	1.9 to 4.8 mph 3 to 7.8 mph
Hydrostatic	low high	0 to 4.8 mph 0 to 7.8 mph
Reverse (Hydrostatic Only)	low high	0 to 4.8 mph 0 to 7.8 mph

OPERATION

ROAD GEAR MODE

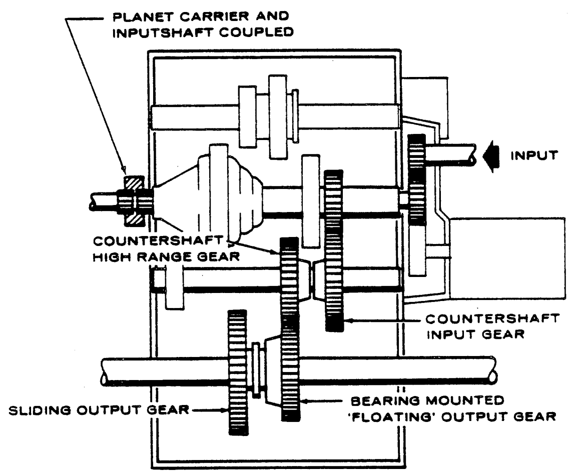
When road gear mode is selected, the transmission gears are in positions as shown in Figures 2 and 3, depending on which range is selected. With road gear mode selected, the planet carrier and planetary gear input shaft are coupled by means of the planet carrier and input shaft coupler and rotate as a single unit. In this mode, the power transfer through the transmission is purely mechanical.

With low range selected and the road gear in the low range position, (Ref. Figure 2), the power transfer is through the transmission input shaft, the planetary gear input shaft and planet carrier, thence through the countershaft input gear, the countershaft low range gear, and then through the output gear to the output shaft.



ROAD GEAR - LOW RANGE
FIGURE 2

When high range is selected (Ref. Figure 3), the output gear is moved along the splined output shaft to engage with the floating, bearing-mounted output gear. In this instance, the output from the countershaft input gear is via the countershaft high range gear and the sliding and floating output gears.

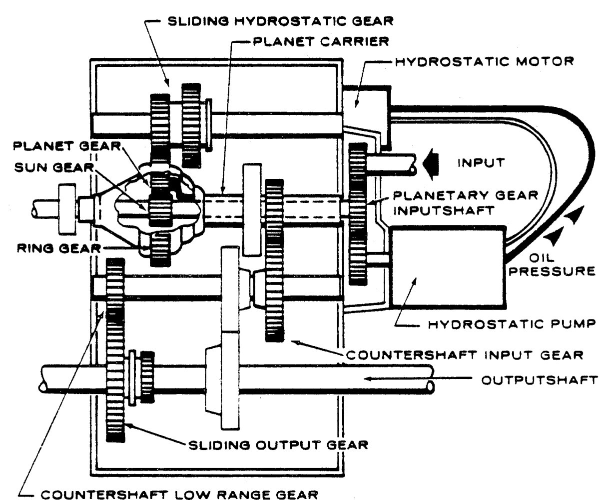


ROAD GEAR - HIGH RANGE
FIGURE 3

HYDRO-MECHANICAL MODE

When the hydro-mechanical mode is selected, the transmission gears are in positions as shown in Figures 4 and 5. Power is transferred through the combination of mechanical gearing assisted by the hydrostatic units consisting of a variable - displacement hydraulic pump and a fixed displacement motor which are both located on the exterior of the transmission box. Because of the variable - displacement hydraulic pump, the tractor speed at full throttle can be varied from 1.9 to 4.8 mph in low range and from 3.0 to 7.8 mph in high range.

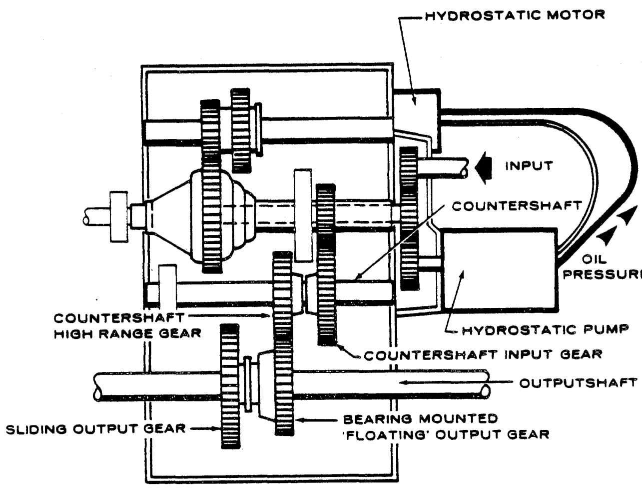
In the hydro-mechanical mode, the planet carrier and input shaft coupler is not engaged. In the hydro-mechanical mode, power input from the engine drives the sun gear which is mounted on the planetary gear input shaft, as well as the variable - displacement hydrostatic pump which delivers oil under high pressure for operation of the hydrostatic motor at a variable speed selected by the operator. The hydrostatic motor, in turn, transfers power through the sliding hydrostatic gear to the ring gear. Since the planet carrier and input shaft coupler is not engaged in this mode, the combined rotation of sun and ring gear transfers power through the planet gears and planet carrier to the countershaft input gear. With low range selected, power is then transferred from the sliding output gear to the output shaft. (Ref. Figure 4)



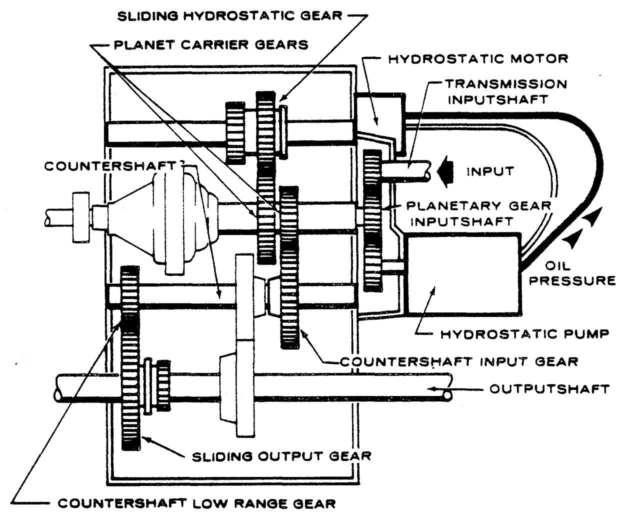
HYDRO-MECHANICAL - LOW RANGE
FIGURE 4

With high range selected, power transfer from the engine through to the countershaft is the same as for low range. From the countershaft, power is transferred through the countershaft high range gear, through the engaged floating output gear and sliding gear to the output shaft.

From the countershaft power is transferred through the countershaft low range gear and sliding output gear to the output shaft. With high range selected, power from the countershaft is transferred via the countershaft high range gear and the sliding and floating output gears to the output shaft.



HYDRO-MECHANICAL - HIGH RANGE
FIGURE 5

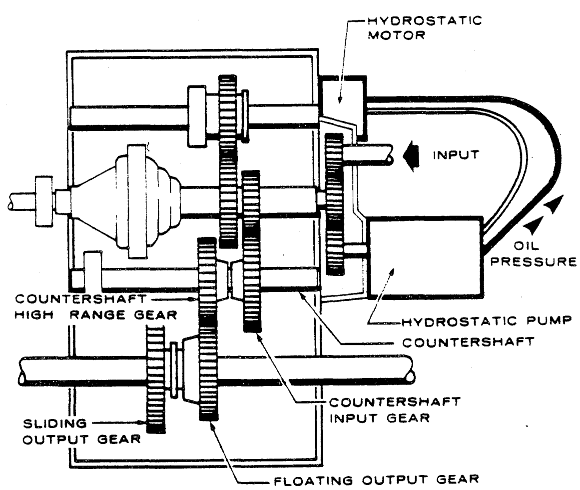


HYDROSTATIC - LOW RANGE
FIGURE 6

HYDROSTATIC MODE

When the hydrostatic mode is selected, power transmission is as shown in Figure 6 and 7 with the sliding hydrostatic gear being in mesh with the planet carrier gear. In this mode, the power input is via the hydrostatic units only and the output speed is variable from 0 to 4.8 mph in low range and 0 to 7.8 mph in high range.

With low range selected, the engine power input drives the variable - displacement hydrostatic pump which pumps oil under high pressure to the hydrostatic motor. From the hydrostatic motor, power is transferred via the sliding hydrostatic gear, planet carrier gears and countershaft.



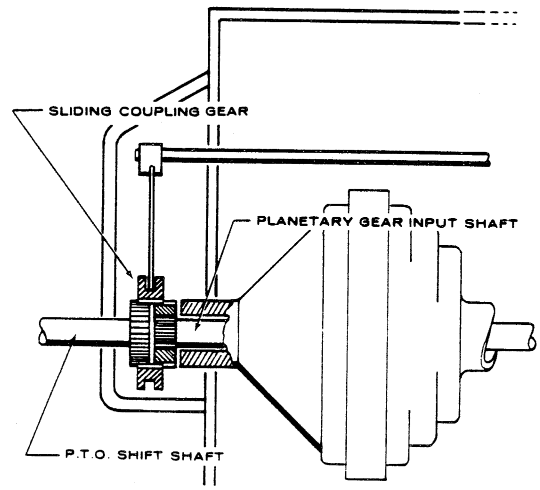
HYDROSTATIC - HIGH RANGE
FIGURE 7

REVERSE

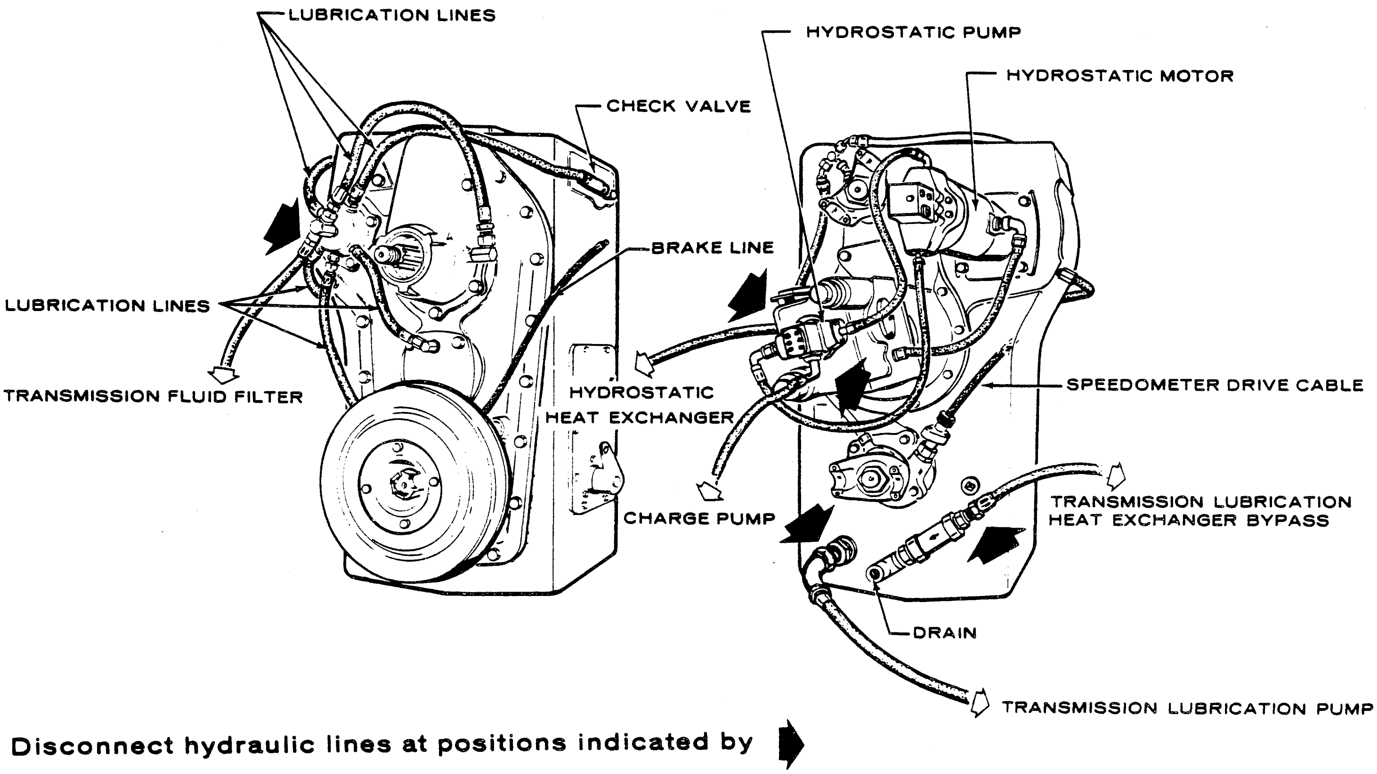
Reverse operation of the Model 300 tractor is only possible in hydrostatic mode. The gear engagement are as shown in Figures 6 and 7, but the oil flow from the hydrostatic pump to the hydrostatic motor is reversed.

POWER TAKE OFF

Power transfer from transmission to P.T.O. unit is possible in hydro-mechanical and hydrostatic mode as well as with mode shift lever in neutral, however, the P.T.O. is only 'Live' when hydrotatic mode is selected.
Power is transfered from the planetary gear input shaft, through the engaged sliding coupling gear, to the P.T.O. shift shaft. (Ref. Figure 8)



POWER TAKE OFF (P.T.O.)
FIGURE 8



TRANSMISSION OVERHAUL
FIGURE 9

TRANSMISSION OVERHAUL

OVERHAUL PREPARATION

Before removing transmission from tractor, ensure all transmission fluid is drained off. Disconnect external hydraulic lines as shown in Figure 9. Disconnect brake line, emergency brake linkage and speedometer drive cable. Disconnect gear selector linkages and drive shafts.

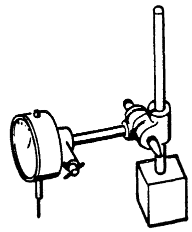
When transmission is out of tractor, dismantle remaining hydraulic lines (lubrication lines) from transmission, (See Figure 9). Remove hydrostatic pump and hydrostatic motor. Cover all open hydraulic fittings and hose connections to avoid fluid contamination.

SPECIAL TOOLS AND EQUIPMENT

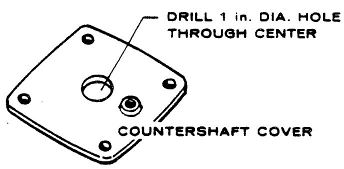
To do a complete overhaul of the Hydromechanical transmission, the following special tools and equipment should be available:

- One overhead hoist, minimum 800 lb. capacity,
- One intermediate size, three-legged universal gear puller,
- One 3/4 in. Dia. steel ball,
- One micrometer or dial indicator depth gauge, 0.000 to 0.500 in. rang

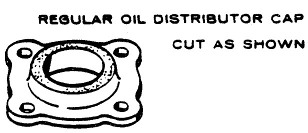
- One consol mounted dial indicator as shown below,



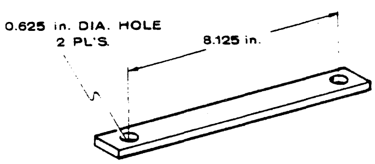
- A lifting rod or crowbar,
- One dummy cover for countershaft as shown below,



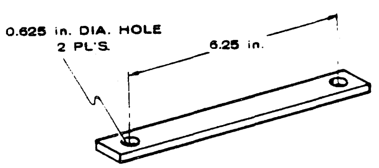
- One dummy oil distributor cap as shown below,



- A piece of flat bar 1/2 in. x 2 in. x 10-1/2 in., drilled as shown below,



- A piece of flat bar 1/2 in. x 1-1/2 in. x 8 in., drilled as shown below,



- Gasket adhesive - Permatex super '300' or equivalent.

DISASSEMBLY OF GEARBOX

To disassemble Gearbox, refer to Figure 10, sheet 1 through 3, and proceed as follows:

1. Disassemble top cover and mode shifting mechanism (1) by removing the 12 attaching bolts. Do not disassemble top cover any further at this stage. Remove and retain shift set spring and ball (24) and set screws (30). Also dismantle and retain shift set spring and ball (27).

2. Disassemble Pump Drive Unit (41) from Gearbox by removing attaching bolts. Remove and retain shims (42) if undamaged.

3. When Pump Drive Unit is removed, mount the large bar across Countershaft bearing housing to prevent the Countershaft from falling through when Gearbox is laid down.

4. Disassemble end yoke (35) only. Do not remove speedometer gear housing at this stage. It is needed to prevent output shaft from falling through when gearbox is turned.

5. Before proceeding further, turn or lay transmission down on suitable support, with side cover facing up as shown in Figure 10, sheet 1.

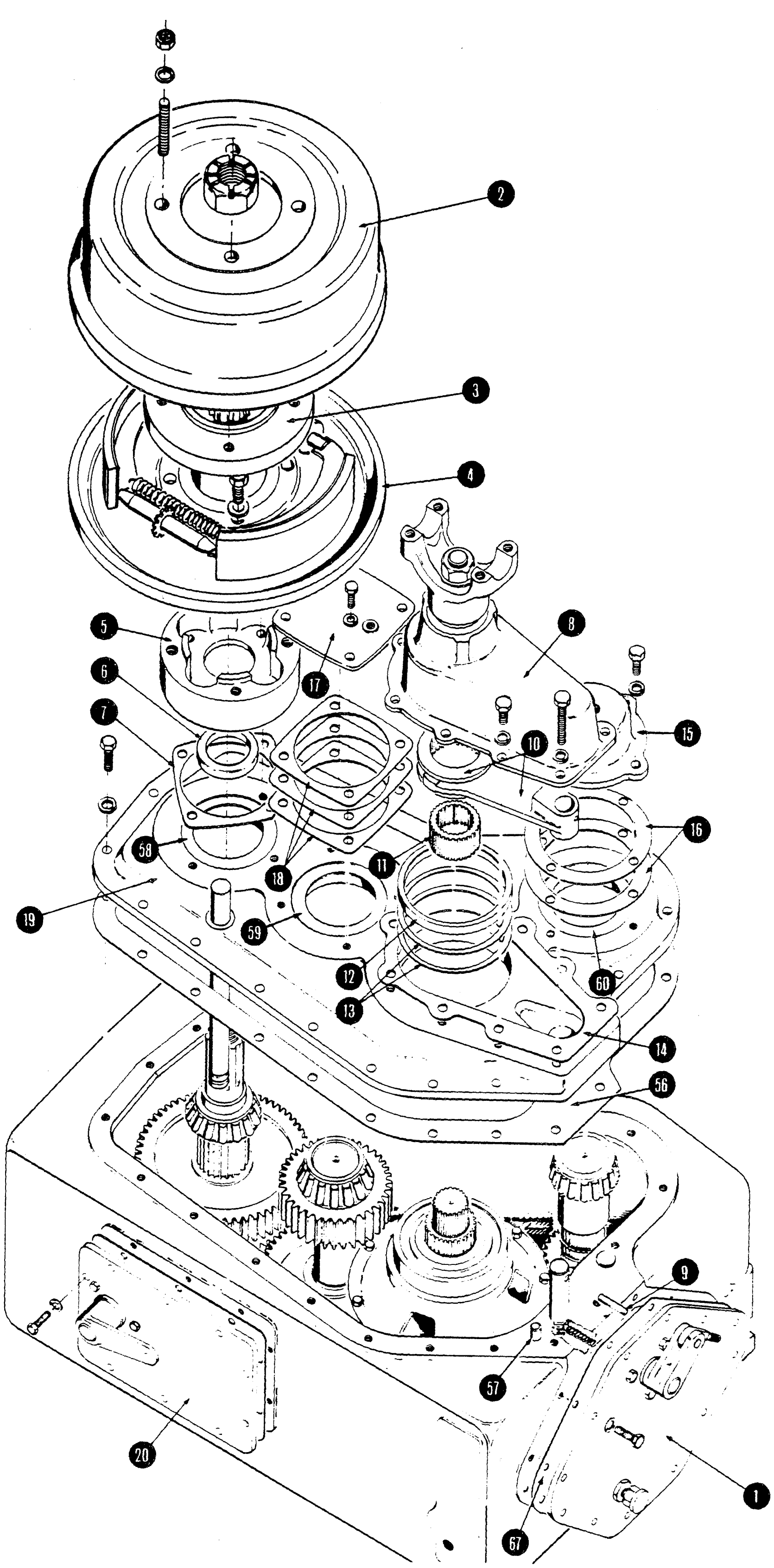
6. Remove brake drum (2), companion flange (3), and brake backing plate (4). Brake drum and companion flange can be removed as one unit by removing cotterpin and crown nut holding companion flange.

7. Remove bolts attaching spacer (5) to cover (19) and carefully slide spacer off output shaft in order not to damage oil seal (6) which is recessed into back of spacer. Remove gasket (7).

8. Remove P.T.O. drive shaft housing (8) by dismantling attaching bolts. Remove and retain housing shims (14).

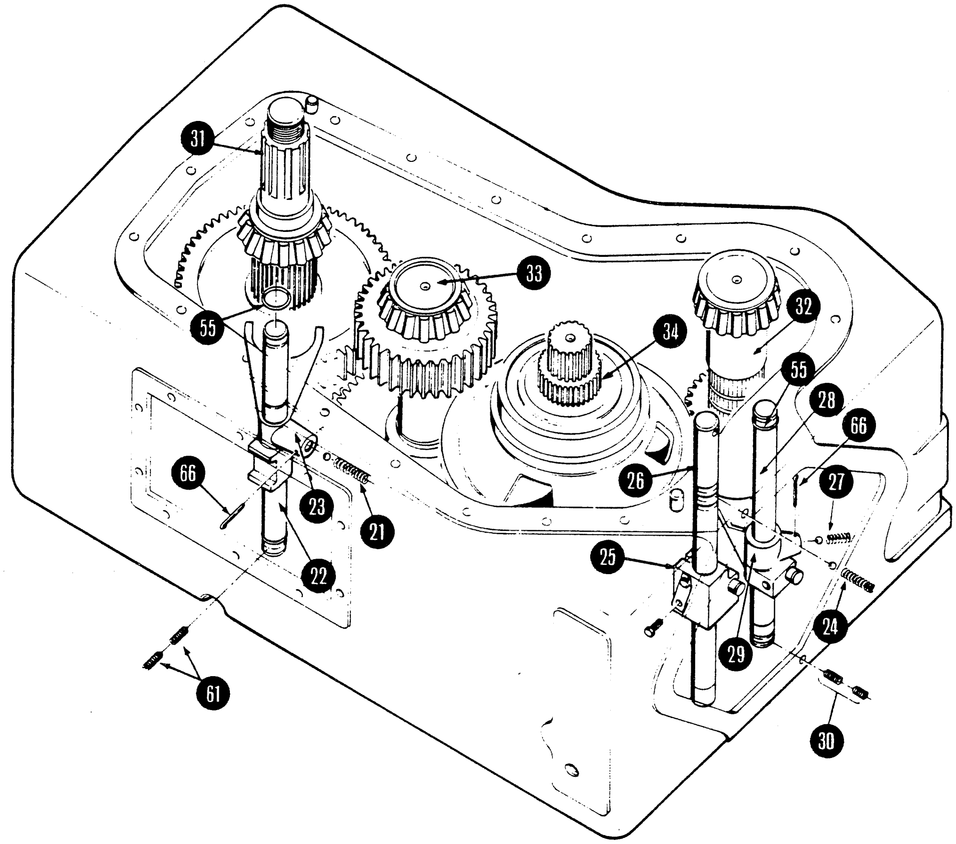
9. Knock out roll pin (9) and slide off shifting fork and coupling gear (10).

10. Carefully pry out spacer ring (12) and remove shims (13). Retain if undamaged.



1. Top Cover And Mode Shifting Mechanism
2. Brake Drum
3. Companion Flange
4. Brake Backing Plate
5. Spacer
6. Oil Seal
7. Gasket
8. P.T.O. Shift Shaft Housing
9. Roll Pin
10. Shifting Fork And Coupling Gear
11. Fixed Coupling Gear
12. Spacer Ring
13. Shims
14. Housing Shims
15. Oil Distributor Cap
16. Shims
17. Counter Shaft Cap
18. Shims
19. Side Cover
20. Range Shift Cover
56. Gasket
57. Dowel Pin
58. Bearing Race - Output Shaft
59. Bearing Race - Counter Shaft
60. Bearing Race - Hydrostatic Input Shaft
67. Top Cover Gasket

GEARBOX COMPONENTS
FIGURE 10 SHEET 1



21.	Shift Set Spring And Ball	30.	Set Screws
22.	Range Shifting Shaft	31.	Output Shaft Complete
23.	Range Shift Fork	32.	Hydrostatic Input Shaft Complete
24.	Shift Set Spring And Ball	33.	Countershaft Complete
25.	Shifting Block	34.	Planetary Gear Assembly
26.	P.T.O. Shifting Shaft	55.	O-Ring
27.	Shift Set Spring And Ball	61.	Setscrew
28.	Mode Shifting Shaft	66.	Cotterpin
29.	Mode Shifting Fork	68.	Cotterpin

GEARBOX COMPONENTS
FIGURE 10 SHEET 2

35. End Yoke

36. Speedometer Drive Gear

37. Speedometer Gear Housing

38. Oil Seal

39. Spacer

40. Shims

41. Pump Drive Unit

42. Shims

43. Support Washer

44. Bearing Outer Race

45. Retaining Ring

46. Bearing Outer Race

47. Check Valve

48. Street Tee

49. Wire Screen Oil Filter

50. End Yoke

51. Cap

52. O-Ring

53. Bearing Outer Race

54. Gasket

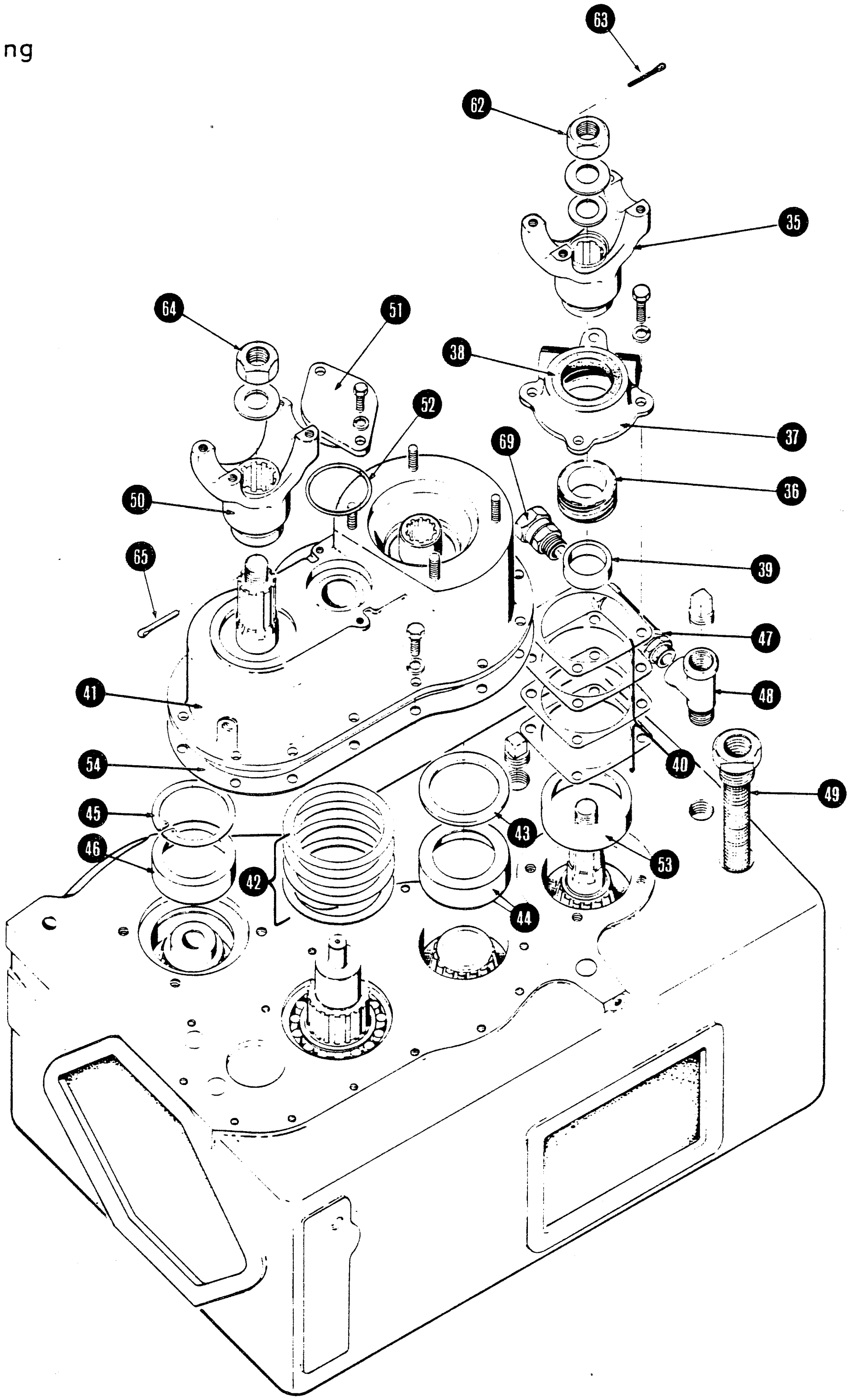
62. Nut

63. Cotterpin

64. Nut

65. Cotterpin

66. Swivel Adaptor



GEARBOX COMPONENTS
FIGURE 10 SHEET 3

11. Remove oil distributor cap (15) by removing attaching bolts. Retain shims (16) if undamaged.

12. Disassemble counter shaft cap (17) and shims (18) by removing the attaching bolts and retain undamaged shims.

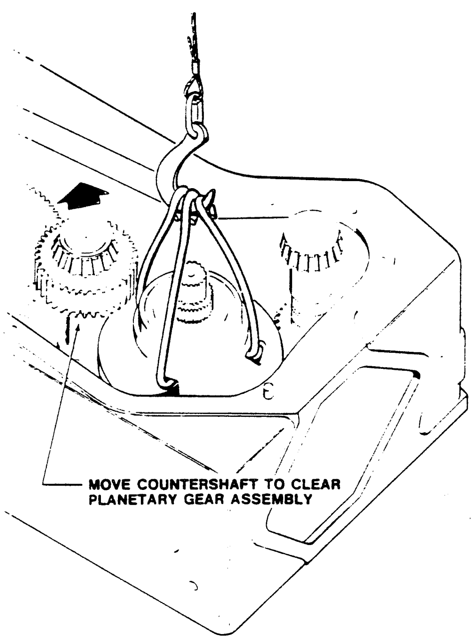
13. In order to simplify the removal of side cover (19), remove the two setscrews (61) and tap Range Shifting shaft out of hole in cover and into gearbox.

14. Remove attaching bolts and dismantle side cover (19) by inserting two 3 in. long bolts into threaded holes beside dowel holes in cover and alternately turn each bolt until cover is released from dowel pins (56). Do not remove dowel pins unless damaged or loose.

15. Remove bearing races (58,59 & 60) from side cover and label for reassembly.

16. Remove range shift cover (20) by removing attaching bolts. Do not disassemble range shift cover any further at this stage.

17. Attach a suitable lifting arrangement to planetary gear assembly as shown in Figure 11. Lift planetary



REMOVAL OF PLANETARY GEAR ASSEMBLY
FIGURE 11

gear assembly (34) slowly until the hydrostatic gear on the planet carrier touches the high range gear on the Countershaft (33). Support the Countershaft and continue lifting until bottom end of Countershaft is clear of housing. Move Countershaft backward until the touching gears are clear of each other and lift Planetary Gear Assembly out of Gearbox.

18. Carefully remove countershaft (33) and hydrostatic Input Shaft (32).

NOTE

When removing the hydrostatic input shaft it is necessary to lift the bottom end of shaft clear of housing and move the complete shaft backward until shifting fork (29) is off the hydrostatic gear.

19. Proceed to disassemble range shifting shaft (22) and shifting fork (23) by removing shift set spring and ball (21) which are held in position by a cotterpin.

20. Remove output shaft (31) carefully to prevent damage to oil seal (38) Ref. Sheet 3. When pulling out shaft, speedometer drive gear (36) and spacer (39) will slide off shaft and lay loose inside speedometer gear housing (37). Remove gear and spacer through bearing housing at this stage.

21. Mark orientation of shifting block (25) relative to shaft (26). This is important so that block will be reassembled in same position as before disassembly.

22. Disassembly P.T.O. shifting shaft (26) and shifting block by unscrewing clamping bolts on side of shifting block until shifting block can slide on shaft. Support shifting block and pull out shaft.

23. Dismantle mode shifting shaft (28) and mode shifting fork (29) by pushing shaft out until O-Rings are free of gearbox. Remove and retain O-Rings if undamaged and slide out shaft while supporting shifting fork

24. Turn Gearbox end-for-end so that Pump Drive side is facing up as shown on sheet 3. Remove end yoke (50) and cap (51). Retain O-Ring (52) if undamaged.

25. Remove previously installed bar from Countershaft bearing housing and retain support washer (43), bearing race (44), retaining ring (45) and bearing race (46). Label bearing races pertaining to respective shafts.

26. Remove speedometer gear housing (37) by removing the four attaching bolts. Retain shims (40) if undamaged. Remove bearing race (53) and label for reassembly. Do not remove oil seal (38) from speedometer gear housing at this stage.

27. Disassemble check valve (47) street tee (48) and wire screen filter (49). Discard wire screen filter if damaged.

INSPECTION OF GEARBOX COMPONENTS

1. Inspect the hydrostatic input shaft countershaft and output shaft, refer to Figure 12. Check bearings (items 1, 3, 5, 8, 11 and 13) visually for signs of wear and damage such as discoloration, restrictions when turning, and excessive play in roller mounting rings. Pull off bearings and replace parts if necessary.

2. Check needle bearings (18) by rotating gear (17). Rotation should be smooth and unrestricted without excessive play. Dismantle gear and replace needle bearing if performance is not satisfactory.

3. Inspect condition of gear teeth and splines on gears (2, 6, 7, 9, 12 and 17) and replace exceedingly worn or damaged gears.

4. Check splines and bearing surfaces on shafts (items 4, 10 and 20) for damage and replace as necessary. Check only those bearing surfaces where faulty bearings have been removed.

5. Inspect Top Cover and Mode Shifting mechanism for damage. (Ref. Figure 13) Check cam follower guides in shifting cam to ensure surfaces are smooth and free of obstructions.

6. Turn Shifting Lever (2) back and forth and check play of shaft (5) in hub (3). If hub is excessively worn, dismantle and replace.

7. Check rod end (9) and pin (8) for wear or damage and replace if necessary.

8. Check breather fitting (10) for clearance. Clean or replace as necessary.

9. Inspect range shift lever arm (15) for play in hub (13). If excessive play, disassemble and replace worn parts.

10. Inspect tip of lever arm (15) for wear or damage and replace if necessary.

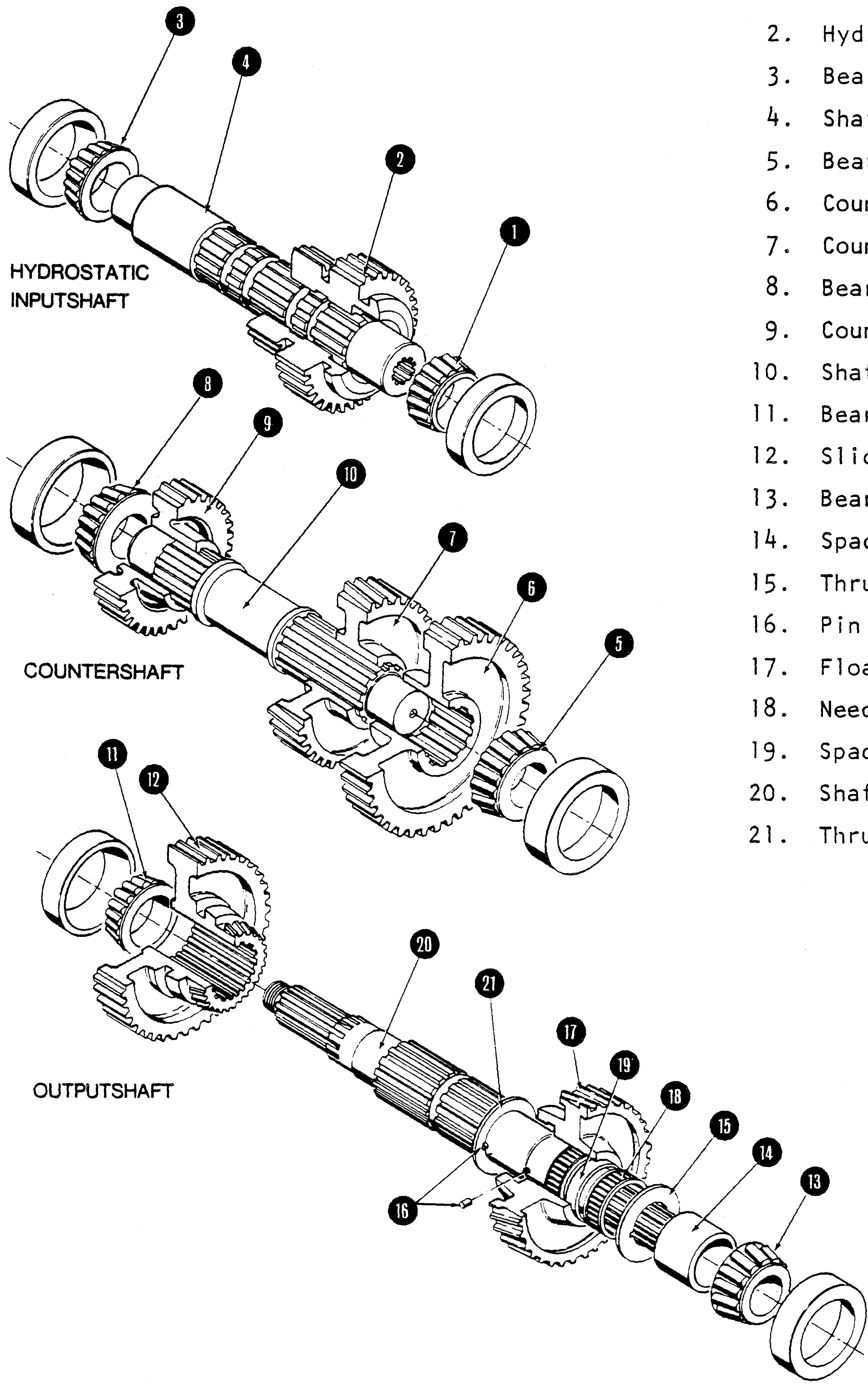
11. Inspect condition of oil seals, (6 and 38), Ref. Figure 10, and replace if necessary.

12. Inspect P.T.O. Shift shaft housing, see Figure 14, check conditions of teeth on shaft (3).

13. Inspect for oil leaks through oil seal (6) and replace as necessary.

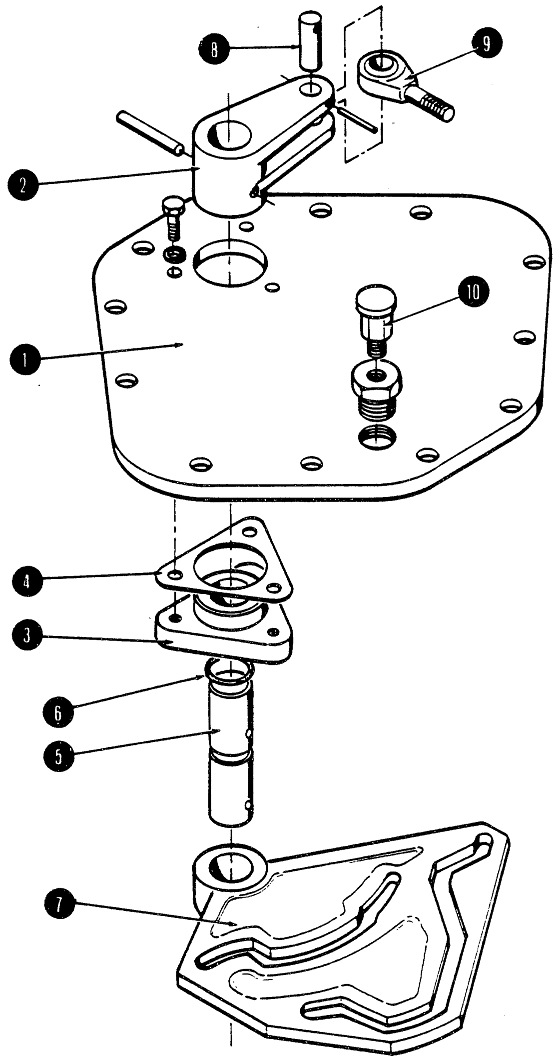
NOTE

It is necessary to dismantle Driveshaft housing as shown in Figure 13, in order to remove oil seal.



1. Bearing
2. Hydrostatic Input Gear
3. Bearing
4. Shaft
5. Bearing
6. Counter Input Gear
7. Counter High Range Gear
8. Bearing
9. Counter Low Range Gear
10. Shaft
11. Bearing
12. Sliding Output Gear
13. Bearing
14. Spacer
15. Thrust Washer
16. Pin
17. Floating Output Gear
18. Needle Bearing
19. Spacer
20. Shaft
21. Thrust Washer

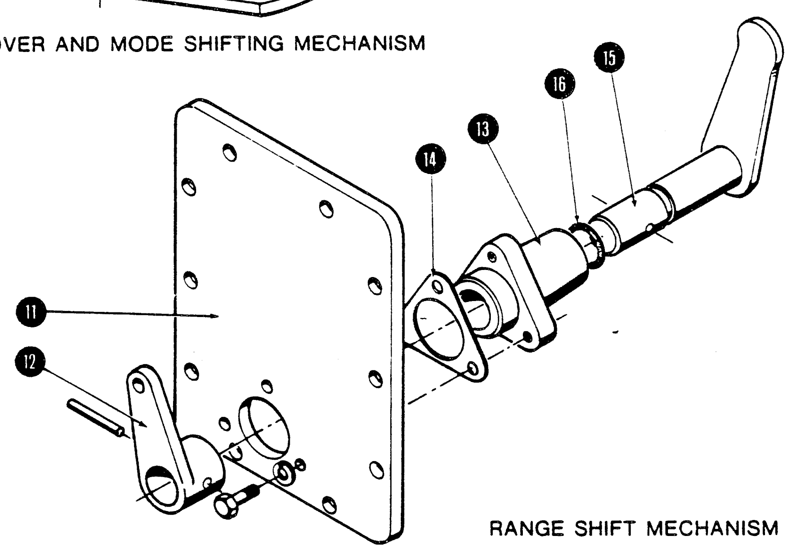
HYDROSTATIC INPUT SHAFT, COUNTERSHAFT AND OUTPUT SHAFT
FIGURE 12



TOP COVER AND MODE SHIFTING MECHANISM

1. Top Cover
2. Shifting Lever
3. Hub
4. Gasket
5. Shaft
6. O-Ring
7. Shifting Cam
8. Pivot Pin
9. Rod End
10. Breather Fitting

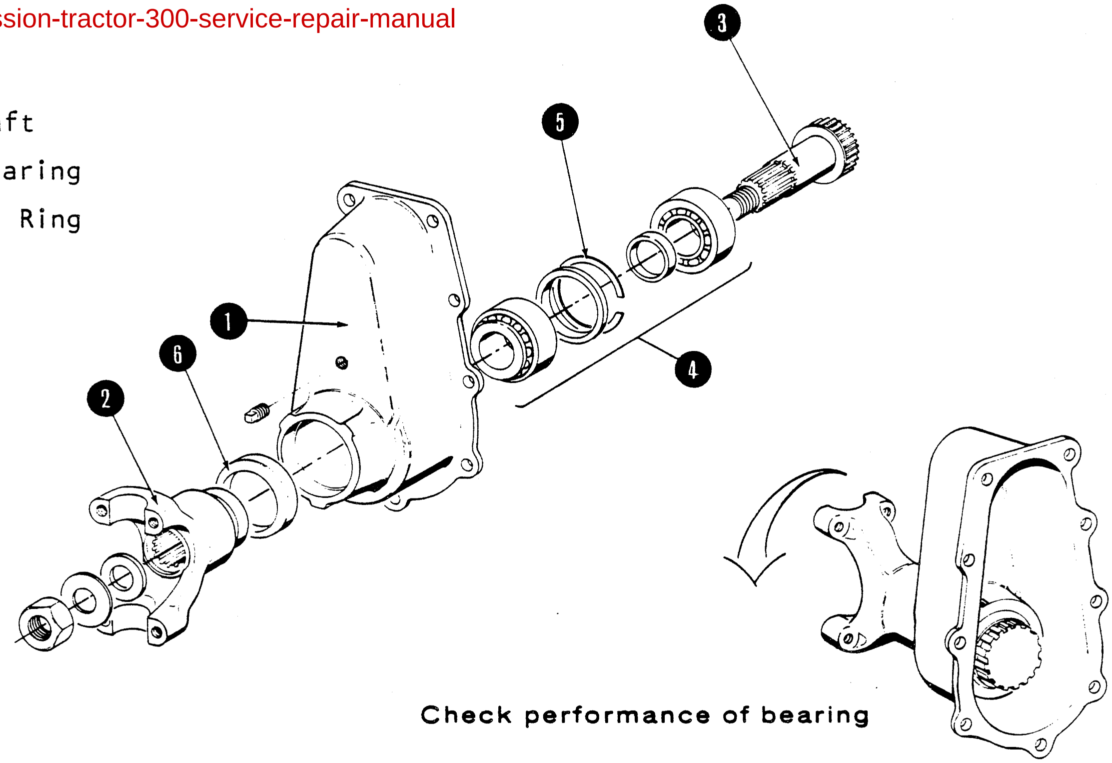
11. Range Shift Cover
12. Shifting Lever
13. Hub
14. Gasket
15. Lever Arm
16. O-Ring



RANGE SHIFT MECHANISM

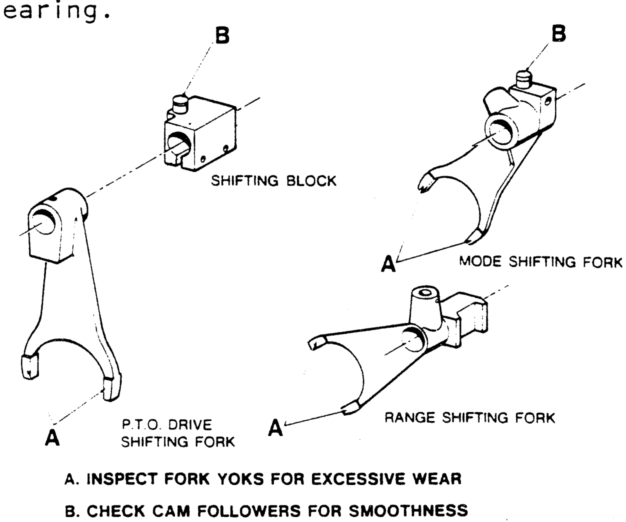
MODE AND RANGE SHIFTING MECHANISMS
FIGURE 13

1. Housing
2. End Yoke
3. Shift shaft
4. Double Bearing
5. Retaining Ring
6. Oil Seal



P.T.O. SHIFT SHAFT HOUSING
FIGURE 14

14. Rotate yoke and check performance of shift shaft bearing. If not satisfactory, disassemble shift shaft housing as shown in Figure 14 and replace bearing.



SHIFTING FORKS
FIGURE 15

15. Inspect shifting forks and cam followers, Ref. Figure 15. Replace shifting forks if yoke ends show excessive or uneven wear. Check cam follower surfaces for smoothness, excessively worn or damaged cam followers should be replaced.

16. Check all lubrication hoses for material fatigue or damage and inspect fittings for damaged thread. Test performance of check valve and replace if necessary.

17. Refer to subsection PLANETARY GEAR OVERHAUL for procedures and details regarding inspection and parts replacement of the Planetary Gear Assembly.

18. Refer to subsection PUMP DRIVE UNIT OVERHAUL for details regarding inspection and parts replacement of the Pump Drive Unit.