SHOP MANUAL

FORD

SERIES 6000

INDEX (By Starting Paragraph)

there is a measurable clearance (0.002-0.004) or end gap between the end of the exhaust valve stem and the inside floor of the cap when the open end of the cap just contacts the spring keeper or horseshoe as shown. Desired end gaps should be checked and if necessary adjusted each time the valves are reseated.

One of the simpler methods of checking is as follows: From a strip of 0.010 flat shim stock, cut a $\frac{3}{16}$-inch diameter disc. Lay this disc, which must be flat, on inside floor of rotator cap and install valve lock or keeper on valve stem. Now, while simultaneously pressing downward on valve lock and upward on rotator cap, measure with a feeler gage the gap between cap and valve lock. If gap measures anywhere between 0.006 and 0.008, it is within desired limits. If gap is less than 0.006, grind or lap open end face of cap; if more than 0.008, grind end of valve stem, however do not remove more than 0.010 from end of valve stem.

VALVE TAPPETS

All Models

31. Intake and exhaust valve tappet gap should be set to 0.015 when engine is at operating temperature.

The 0.4989-0.4995 diameter mushroom type tappets are available in standard size only and operate directly in the cylinder block bores with a clearance of 0.0005-0.0021. To remove the tappets, it is first necessary to remove the camshaft as outlined in paragraph 36.

ROCKER ARMS

All Models

32. Remove hood and fuel tank. Remove tappet cover. Remove oil inlet and outlet tubes from rocker arm supports. If grommet is missing from lower end of rear (inlet) oil tube, it can usually be "fished" out with a wire; if not, remove engine side plate and extract the grommet. Remove the cap screws which retain rocker arm supports to cylinder head and lift off rocker arms and shaft assembly.

All of the rocker arms are identical and interchangeable in the same type engine. The 0.780 - 0.781 diameter rocker arm shaft should have a clearance of 0.002-0.004 in the rocker arms. Renew rocker arms and/or shaft if clearance exceeds 0.007.

If I. D. of rocker arm shaft requires cleaning, drill a hole in one end plug and use a long rod inserted through hole to bump out plug on opposite end. The remaining plug can now be bumped out.

When reassembling rocker arm assembly, refer to Fig. FO27 to see the location of the different size spacers which are used on the diesel models. Wide spacers are 0.165 thick; narrow spacers are 0.0085 thick.

When reassembling rocker arm shaft to cylinder head, tighten the rocker arm support cap screws to a torque of 45-55 ft.-lbs. When installing the rocker arm oil lines, install new grommet on lower end of the rear oil line and be sure grommet is seated in the counter-bore in the cylinder block. Adjust the intake and exhaust tappet gap to 0.015 when engine is at operating temperature.

TIMING GEAR COVER

All Models

NOTE: Early engines are fitted with a vibration dampener which can be removed from the crankshaft with little or no difficulty. Late engines have vibration dampeners which are a press fit on the crankshaft. To remove the vibration dampener from late engines, use two cap screws threaded into dampener and OTC puller number 518, or its equivalent. When reinstalling dampener, align index marks of dampener and crankshaft and using a $\frac{5}{8}$ x 1¾-inch cap screw and washer, force dampener about half way on splines, then remove the 1¾-inch cap screw, install the original retaining cap screw ($\frac{5}{8}$ x 1¼-inch) and tighten cap screw to a torque of 45-55 ft.-lbs.

33. To remove the timing gear cover, first remove the hood front side panels, lower baffles and lower splash plate, then drain radiator and remove lower radiator hose. Loosen fan bracket and generator adjusting strap and remove fan belt and both generator belts. Exhaust accumulator pressure by actuating brakes or cycling the hydraulic lift. Disconnect power steering pump pressure line at control valve, remove pump by-pass line, then unbolt and remove power steering pump. Disconnect lines from hydraulic system unload valve, then unbolt and remove the engine front support, hydraulic pump and unload valve as a unit. Remove crankshaft pulley (vibration dampener). On non-diesel models, disconnect linkage from governor arm. On all models, unbolt timing gear cover from engine and oil pan, separate oil pan gasket from cover and remove cover.

Crankshaft front oil seal can be renewed at this time. For information on non-diesel governor and related parts, refer to paragraph 69.

Reinstall by reversing removal procedure and tighten cover retaining cap screws to 9-12 ft.-lbs. torque. BE SURE to mate timing (punch) marks of crankshaft pulley and crankshaft and torque retaining cap screw to 45-55 ft.-lbs.

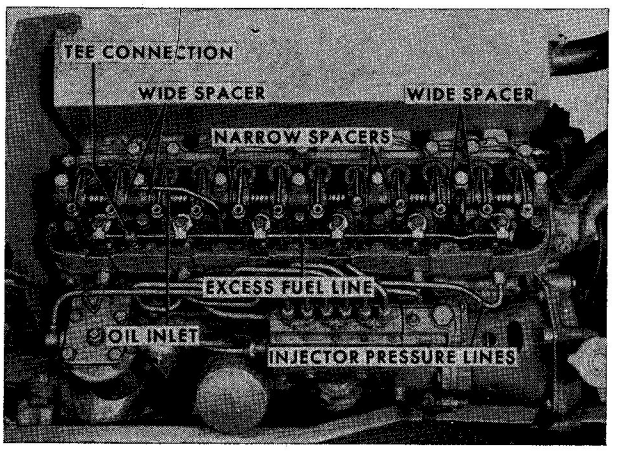

Fig. FO27 — When reassembling rocker arm assembly on diesel engines be sure spacers are located as shown.

TIMING GEARS

All Models

34. **CAMSHAFT GEAR.** To remove the camshaft gear, first remove the timing gear cover as outlined in paragraph 33, then prior to removing camshaft gear, check camshaft end play by measuring between gear hub and thrust plate. Normal camshaft end play is 0.003 - 0.007 and if the clearance exceeds 0.007, renew thrust plate during reassembly.

Remove snap ring which retains camshaft gear to camshaft, then using a suitable puller, pull gear from shaft.

far enough to pass through spray holes. Rotate pin vise without applying undue pressure.

The valve seats are cleaned by inserting the small end of a valve seat scraper into the nozzle and rotating. Then reverse the scraper and clean the upper chamfer with the large end. See Fig. FO41. The annular groove in top of the nozzle and the pressure chamber are cleaned by using (rotating) the pressure chamber tool as shown in Fig. FO42.

With the above cleaning accomplished, back flush nozzle and needle by installing the reverse flushing adapter on the injector tester and positioning the nozzle and valve in adapter, tip end first. Secure with the knurled nut and rotate the needle in the nozzle while flushing to make sure it is free. After nozzle is back flushed, the seat can be polished by using a small amount of tallow on the end of a polishing stick and rotating the nozzle as shown in Fig. FO43.

If the leak-back test time was greater than 45 seconds (paragraph 60), or if the valve is sticking slightly, correction can be made by remating the needle and nozzle assembly. This is accomplished by using a polishing compound (Kent-Moore No. J8537-28) consisting of tallow and a small amount of very fine lapping compound and proceeding as follows: Hold needle in a chuck and polish same using a piece of felt coated with a very small amount of the above mentioned special compound; or, place the nozzle in the chuck of a drill having a maximum speed of not more than 450 rpm; then, apply a small amount of special compound on the needle valve and insert same in nozzle body. Turn nozzle to lap and be sure to hold needle up off the pressure chamber shoulder during operation to avoid damage to needle. See Fig. FO44. Care should be taken to see that lapping compound does not damage the needle seat. Back flush and clean assembly.

Before assembly, rinse all parts in clean fuel oil or calibrating fluid and install while still wet. The injector inlet adapter normally does not need to be removed. However, if adapter is removed, use a new copper washer when reinstalling. Position the nozzle and needle valve on injector body and make sure dowel pins in body are correctly located in nozzle as shown in Fig. FO45. Install the nozzle retaining nut and torque to 50 ft-lbs. Note: Place injectors in holding fixture to torque nut. Install the spindle, spring, upper spring disc and spring adjusting nut. Tighten the adjusting nut until pressure from spring is felt. Connect the injector to the nozzle tester and adjust opening pressure to 2700-2800 psi. Use a new copper gasket and install cap nut. Recheck nozzle opening pressure to see that it has not changed.

Retest the injector as outlined in paragraphs 57 through 60, and if the injector fails to pass the tests, renew the nozzle and needle.

NOTE: If injectors are to be stored, it is recommended that they be cleaned in calibrating fluid prior to storage. Fuel oil tends to separate and allow the lapped surfaces to score. Storage periods of more than thirty days may result in the necessity of disassembling and cleaning injectors in order to obtain satisfactory performance.

INJECTION PUMP

Diesel Models

The fuel injection pump is a self-contained unit which includes the engine governor and components for metering and delivering fuel to the injectors. Pump is mounted on right side of engine and is driven from engine camshaft gear. Other than renewing the unit as a complete assembly, the only service requirements are timing and the adjustment of the engine high and low idle speed.

63. **TIMING.** The diesel engine is timed to 26 degrees BTDC. To time the injection pump remove starting motor on early models, or remove access plate in engine rear cover plate on later models (Fig. FO45A), turn the crankshaft in the direction of normal rotation until the number one pis-

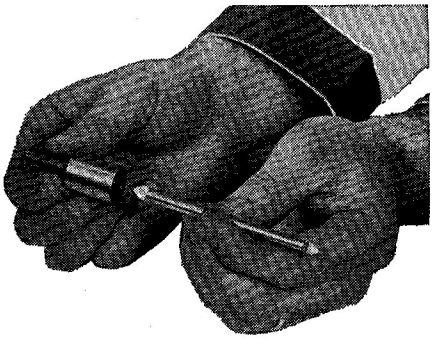

Fig. FO41 — Valve seat and upper chamfer are cleaned by using scraper as shown. Refer to text.

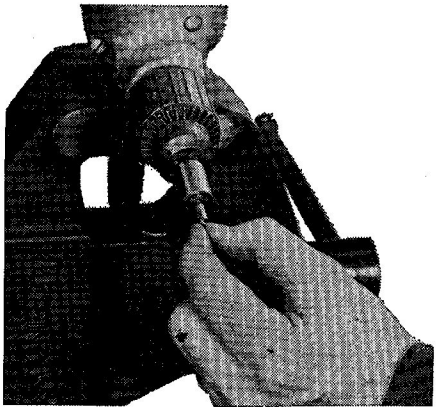

Fig. FO44 — Needle and nozzle assembly can be remated by using an electric drill and polishing compound as shown. Refer to text.

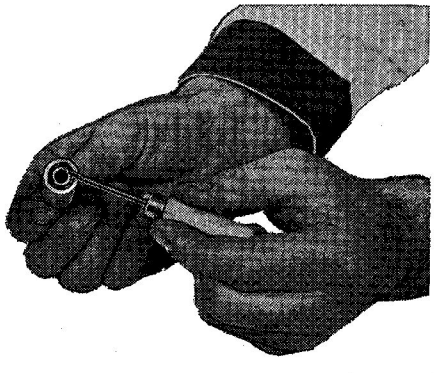

Fig. FO42—Clean annular groove in top of nozzle by using pressure chamber tool as shown.

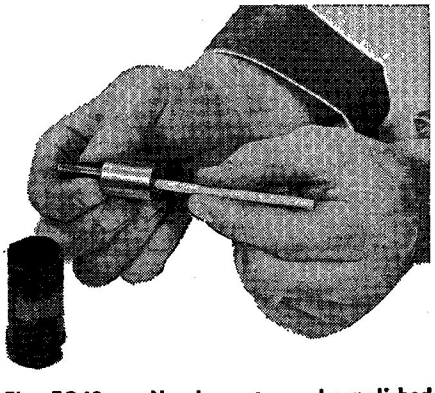

Fig. FO43 — Nozzle seat can be polished by using a small amount of tallow on a polishing stick and rotating nozzle as shown.

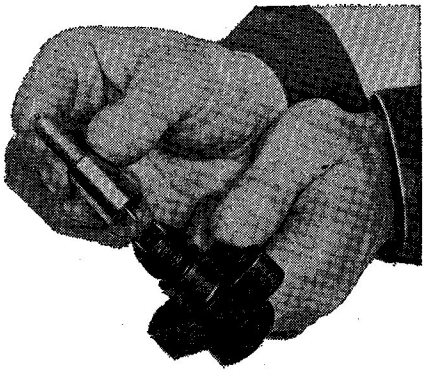

Fig. FO45 — When positioning nozzle and needle on body be sure that body dowel pins are correctely aligned in nozzle.

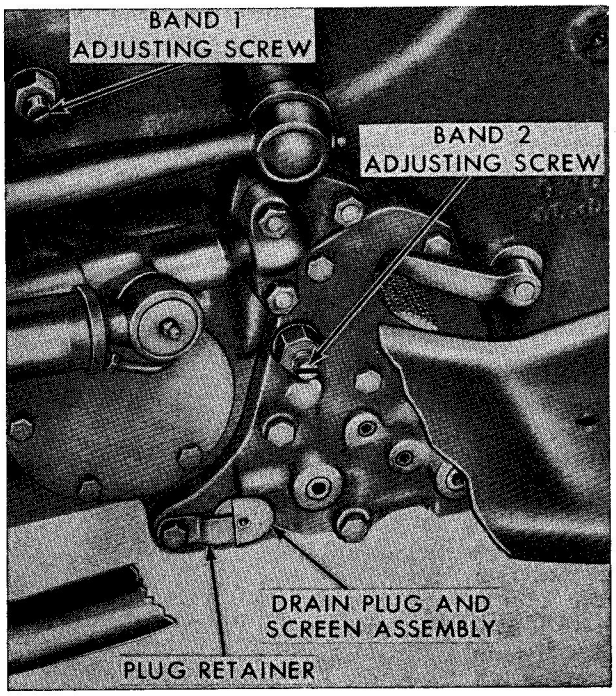

Fig. FO64 — Band 1 and Band 2 adjusting screws are located on left side of transmission as shown on this view of early type transmission.

Band No. 3: With engine running at 800 rpm, shift selector lever to fifth speed position, hold adjusting screw and back-off lock nut at least two full turns. Tighten the adjusting screw to a torque of 5-10 ft.-lbs. as shown in Fig. FO63, then back-off screw exactly ¾-turn, move speed selector to Park position, and tighten lock nut to a torque of 20-25 ft.-lbs.

NOTE: It may not be possible to reach the 5-10 ft.-lb. torque value on Band 3 adjusting screw without killing the engine; if so, tighten adjusting screw until engine begins to pull down, then back-off screw ¾-turn.

98. **SELECTOR ADJUSTMENT.** For positive identification of speed selections, the individual speed indications on the dial should always be positioned directly under the pointers. Adjustment for wear or misalignment can be made as follows:

Remove the selector shaft cover, move the selector lever to the park position and loosen the shaft nut. Move the dial to proper alignment and retighten nut. See Fig. FO65 for an exploded view of the selector assembly.

TROUBLE SHOOTING

All Models

99. **OPERATIONAL CHECK.** If the system adjustments outlined in the previous section fail to correct transmission malfunctions, the next step in trouble diagnosis would be an operational check. To perform this check, the traction coupling must first be engaged.

Start engine and set the engine speed at 800 rpm. Put the transmission in neutral by depressing the inching pedal, shift the selector lever into each speed position in turn and gradually release the inching pedal. Note the reaction in each speed position for later reference to the diagnosis guide. When the inching pedal is released, one of five conditions will prevail.

(1) The tractor will operate in an incorrect speed ratio.
(2) The tractor will go to neutral.
(3) The tractor will go to park.
(4) The tractor will lock up (stall engine).
(5) The transmission will operate properly in that control position.

A diagnosis guide in paragraph 102 outlines the probable causes of malfunction if indicated abnormal patterns are encountered in the operational check.

100. **TORQUE LIMITING CLUTCH.** A torque limiting clutch is installed in the engine flywheel and functions as an overload clutch to prevent damage to the engine or transmission in the event a transmission lockup occurs. Slippage of the torque limiting clutch under normal loads will cause an interruption or lowering of transmission pump flow and system pressure and a lockup may occur. A defective torque limiting clutch is to be suspected if the transmission malfunction exists only under extremely heavy loads, especially in the higher speed ranges and the transmission operates properly when shifted to a lower speed range.

To check the torque limiting clutch, start the engine and bring the tractor up to operating temperature. Shift the selector lever into 10th position, increase the engine speed to 1500 rpm and firmly apply both brakes. If the tractor forward motion can be halted without stalling the engine the torque limiting clutch will need to be renewed as outlined in paragraph 111.

101. **PRESSURE CHECKS.** Leakage in any of the clutches or servos will only occur when that unit is activated. To check the various units for leakage, first disengage traction coupling, insert a 0-300 psi pressure gage (or gages) in servos 1, 2 and 3 and proceed as follows:

Operate engine at 800 rpm, move selector through all gear positions and note gear positions where low pressure readings occur. Completely de-

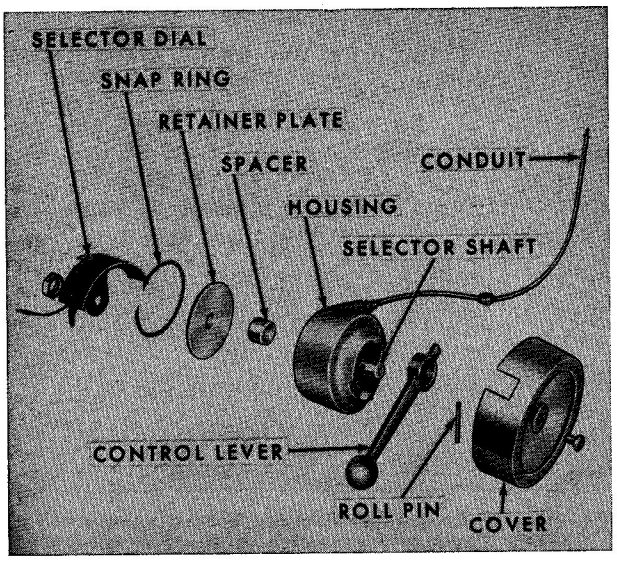

Fig. FO65 — Exploded view showing component parts of speed selector assembly.

Before removal of the distributor, Band No. 3, Servo 3 actuating pin and lever, Servo 3 adjusting screw, the interlock cover and the two servo hydraulic fluid tubes must be removed as follows:

To remove Band No. 3, manually compress band while holding adjusting strut and actuating strut and remove band and the two struts. See Fig. FO88.

To remove Servo 3 actuating pin and lever, first remove Servo 2 and 3 retaining nuts and flat washers, retainer bolt and pin retainer from the right side of the transmission housing as shown in Fig. FO89 and remove the actuating pin and lever from the inside as an assembly. Remove Servo 3 adjusting screw by threading it out the inside of the housing.

Remove Band 2 adjusting screw lock nut and washer and completely loosen the adjusting screw. Remove the eight interlock cover attaching bolts and slide the cover off evenly to avoid damage to the interlock valve on Servo 3 piston (Fig. FO90). Loosen, but do not remove, the four distributor retaining bolts, and remove the two servo hydraulic fulid tubes by pulling with a twisting motion as shown in the inset of Fig. FO90.

Disconnect the pto hydraulic fluid line fitting from the distributor. Move the ground speed pto shifter fork toward the rear and pivot it up out of the way, then remove the distributor, Clutch No. 1, "B" ring gear and "B" carrier from the housing as an assembly as shown in Fig. FO91.

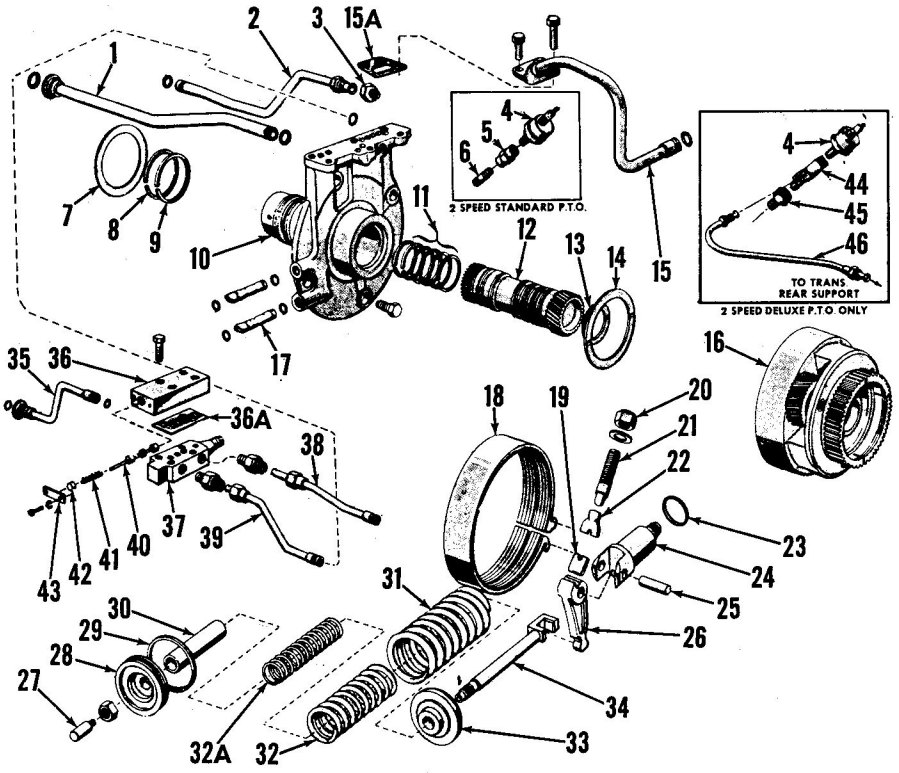

Fig. FO86—Exploded view of distributor, "C" carrier, No. 3 band assembly, direct drive shuttle valve and related parts.

1. Pump pressure line
2. Pto pressure line
3. Connector
4. Pressure switch
5. Adapter
6. Nipple
7. Thrust washer (selective)
8. Seal ring
9. Seal ring
10. Oil distributor
11. Sealing rings
12. "C" sun gear shaft
13. Thrust washer
14. Thrust washer
15. Outlet tube
15A. Gasket
16. "C" carrier
17. Servo oil tubes
18. No. 3 band
19. Actuating strut
21. Adjusting screw
22. Adjusting strut
23. "O" ring
24. Actuating pin
25. Pin
26. No. 3 lever
27. Interlock valve
28. Servo piston
29. "O" ring
30. Sleeve
31. Outer spring
32. Center spring
32A. Inner spring
33. Retainer
34. Piston rod
35. Direct drive clutch oil tube
36. Valve body (direct drive clutch)
36A. Gasket
37. Valve support
38. No. 1 servo tube
39. Valve inlet tube
40. Valve
41. Spring
42. Seat
43. Plate
44. Tee
45. Adapter
46. PTO oil tube

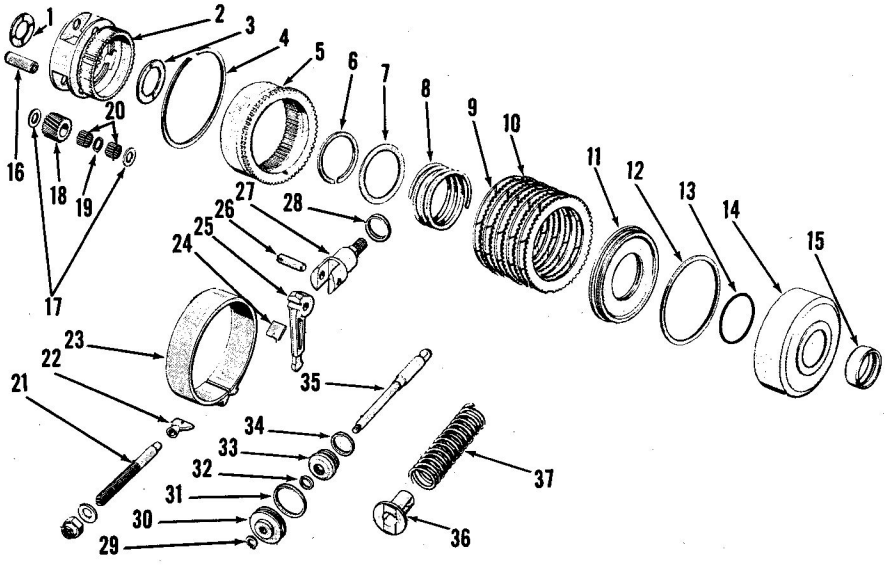

Fig. FO87—Exploded view of "B" carrier, No. 1 clutch, No. 2 band and related parts. Bushing (15) and planetary gear assembly (items 16 through 20) are not available separately.

1. Thrust washer
2. "B" carrier
3. Thrust washer
4. Snap ring
5. "B" ring gear
6. Snap ring
7. Spring seat
8. Clutch spring
9. Bronze plate
10. Steel plate
11. Piston
12. Piston seal
13. "O" ring
14. No. 1 clutch housing
15. Bushing
16. Pinion shaft
17. Washer
18. Pinion
19. Spacer
20. Needle bearings
21. Adjusting screw
22. Adjusting strut
23. No. 2 band
24. Actuating strut
25. Actuating lever
26. Pin
27. Actuating pin
28. "O" ring
29. Snap ring
30. Servo piston
31. "O" ring
32. "O" rng
33. Guide
34. "O" ring
35. Piston rod
36. Retainer
37. Servo spring

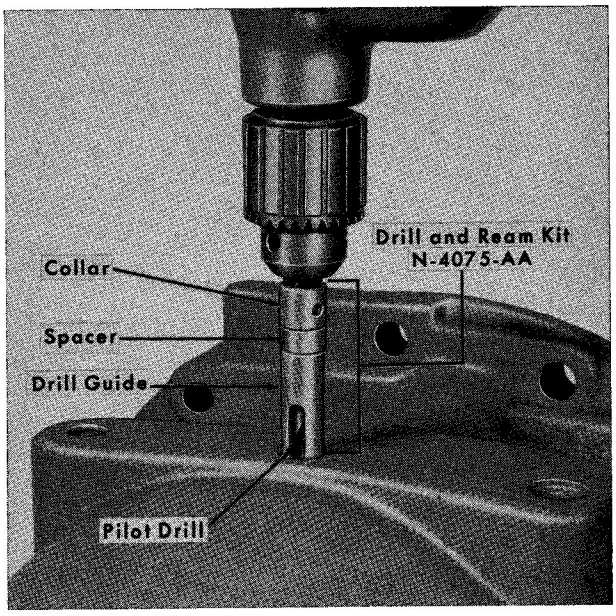

Fig. FO111 — View showing installation of drill and ream kit. Refer to text.

BRAKES

The wet type, hydraulically operated power brakes receive their pressurized operating fluid from the hydraulic system and are controlled by individual, foot operated control valves.

All Models

134. **ADJUSTMENT.** No provision is made for adjusting brakes. However, the brake pedal rods are fitted with a clevis so that pedal height can be equalized and simultaneous brake application accomplished.

135. **R&R AND OVERHAUL BRAKES.** To service brakes, first remove rear axle and housing assembly as outlined in paragraph 130. Remove differential bearing retainer from inner end of axle housing, then remove snap ring (Fig. FO112) from inner side of retainer. Place retainer, piston side down, on wood blocks as shown in Fig. FO113, apply compressed air to hydraulic port and force piston from retainer.

NOTE: On tractors prior to serial number 15939, differential bearing retainer was fitted with a separate brake cylinder as shown in Fig. FO-112. On tractors serial number 15939 and up, the brake cylinder is an integral part of the differential bearing retainer.

On early models, the cylinder may, or may not, be removed when compressed air is applied to remove piston. If cylinder remains in the retainer, it can be removed as follows: Drill and tap three ¼-inch holes, 120 degrees apart and $\frac{9}{16}$-inch deep, in the exposed edge of the piston. Drill three matching holes in a steel plate and attach steel plate to cylinder with ¼-inch cap screws. Invert retainer and press cylinder from retainer.

Refer to Fig. FO108 and remove snap ring (17), spacer (14), spring (13), shim (15) (Series 6000 only), pressure plate (12), brake disc (11) and shaft (18). Remove retaining bolt (9) and nut (10), then pull brake housing (8) from axle housing.

Clean all parts in a suitable solvent and inspect. Renew parts showing undue wear or damage. Linings on brake disc (11) are bonded and are not available separately; however, a new disc and lining assembly is available which can be riveted to hub.

Use all new "O" rings and back-up washers and reassemble components by reversing the disassembly procedure. Torque retaining bolt (9) to 40-50 ft.-lbs. Shim (15) (series 6000 only) is installed with beveled edge toward spring (13).

NOTE: Beginning with the Commander 6000 series tractors, the brake housing (8) has been redesigned and shim (15) is no longer used. This also requires that the brake disc be installed with hub toward center frame rather than toward outer end of axle as it is on the series 6000 tractors.

After brake assembly is installed in axle housing (series 6000 only) be sure clearance between spacer (14) and spring (13) is within limits of 0.028-0.033. If clearance exceeds 0.033, install additional shim, or shims (15). Reinstall axle and housing assembly on center frame.

136. **BRAKE CONTROL VALVE.** To remove the brake control valve, first actuate hydraulic system or brakes to relieve pressure, remove operators platform, then disconnect hy-

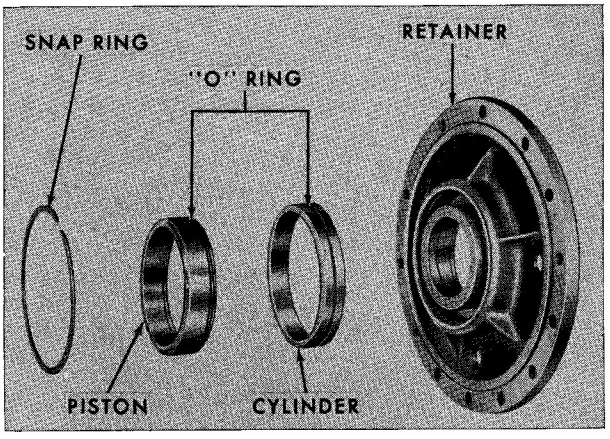

Fig. FO112 — Differential bearing retainer with brake piston and cylinder removed; early production unit is shown. Cylinder is not removable on late production models.

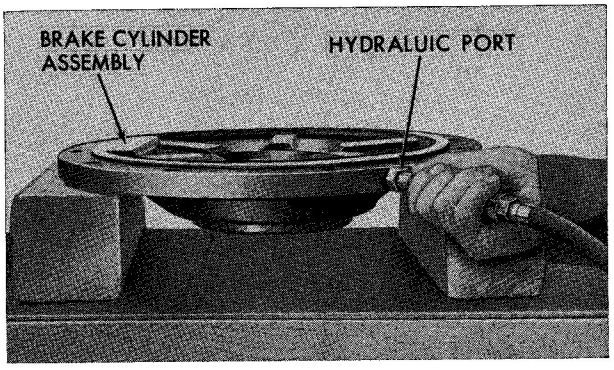

Fig. FO113 — Remove brake piston with compressed air as shown.