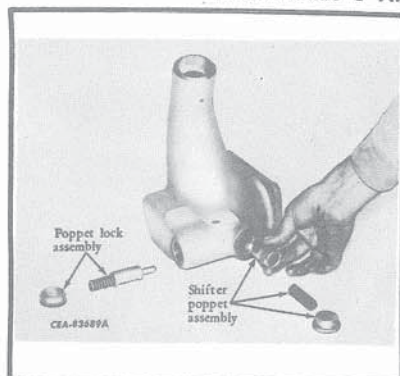


CONTENTS

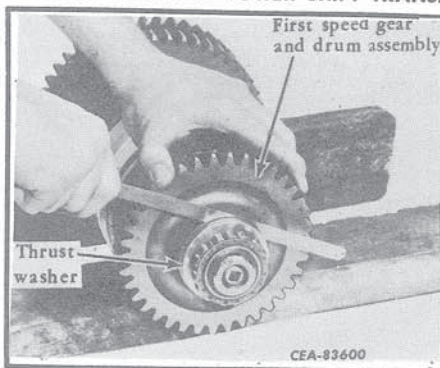
Paragraph		Page
1.	Description	1 to 6
2.	Specifications	6, 7
3.	Checking Mechanical Problems	8, 9
4.	Removal	9, 10
5.	Disassembly	10 to 25
6.	Inspection and Repair	25 to 27
7.	Reassembly	27 to 37
8.	Installation	37, 38
9.	Checking Transmission Oil Pressure	38, 39
MAIN REGULATING VALVE		
10.	Removal and Disassembly	40, 41
11.	Inspection and Repair	41
12.	Reassembly and Installation	41, 42
RANGE SELECTOR VALVE		
13.	Removal and Disassembly	43, 44
14.	Inspection and Repair	44
15.	Reassembly and Installation	44
PILOT CONTROL VALVE		
16.	Removal	45
17.	Disassembly	45, 46
18.	Inspection and Repair	46
19.	Reassembly	47, 48
20.	Installation	48
PRESSURE REGULATING BOOSTER VALVE		
21.	Removal	48
22.	Disassembly, Inspection and Repair, and Reassembly	48, 49
23.	Installation	49

TD-20 SERIES C AND 250 SERIES C LOADER POWER SHIFT TRANSMISSION SERVICE CHART

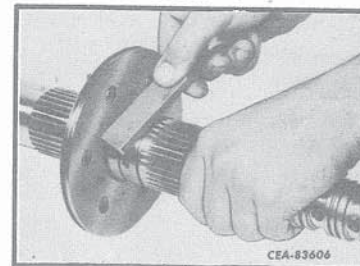


HI-LO SHIFTER LEVER SPRINGS

Free Length Inches	Test Length Inches	Test Load Pounds	No. of Coils
Poppet: 2	1 1/2	67	12 1/2
Poppet lock: 1 15/16	1 1/2	28-34	12

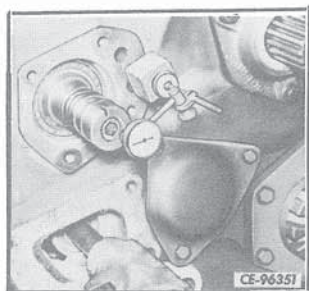


Clutch pack gear and drum assembly end play (Inch):
 New clutch pack assy..... .010-.030
 Used clutch pack assy..... .010-.040
 (Refer to manual text for instructions.)



CLUTCH SHAFT

Using an oilstone, remove any burrs that might damage sealing surfaces or increase wear to close tolerance parts.

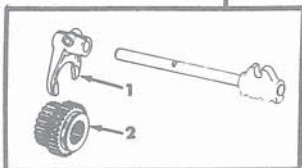


Reverse clutch shaft end play (Inch)..... .030-.040
 (Refer to manual text for instructions.)

HI-LO SHIFTER FORK AND DRIVING GEAR

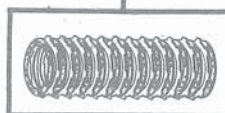
Inspect the hi-lo shifter fork fingers for misalignment or wear and the shifter fork slot in the driving gear for wear.

1. Width of shifter fork fingers (Inch). .365-.375
2. Width of slot in driving gear (Inch). .380-.390



CLUTCH PLATES

Inspect clutch plates for excessive wear and warpage.
 Minimum allowable thickness for internally splined bronze clutch plates (Inch)088



FIRST AND SECOND SPEED DRIVE GEAR AND THRUST WASHER

1. Inspect the first and second speed drive gear and drum assemblies for excessive wear or damage.
2. Thrust washer minimum allowable thickness (Inch):
 First speed drive gear..... .388
 Second speed drive gear..... .054

CE-96652

1. DESCRIPTION

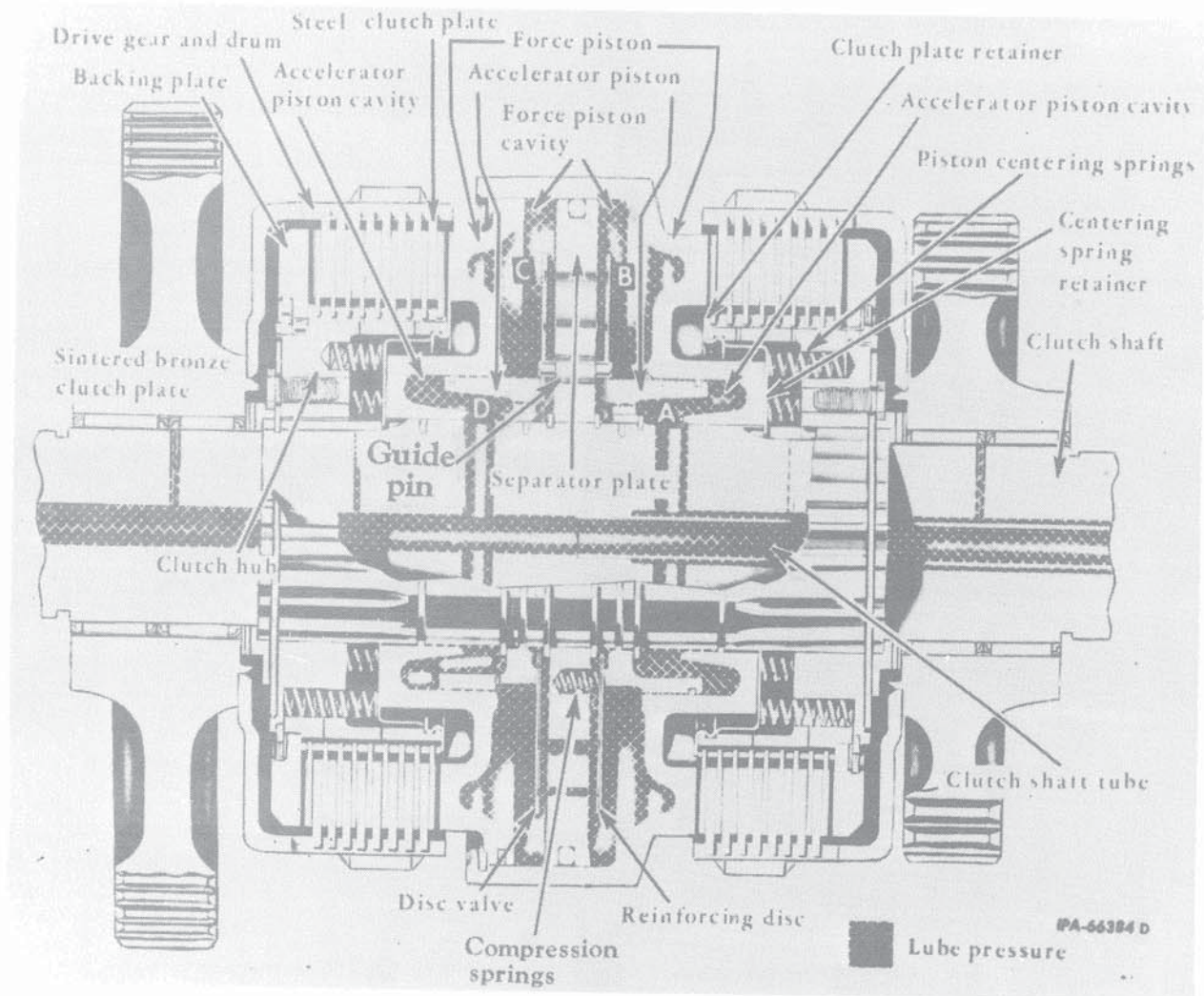
The power shift transmission is designed to provide high speed shifting by the use of hydraulic actuated clutches. The transmission has two forward and two reverse speeds in low range and two forward and two reverse speeds in high range. Shifting from one range to another is controlled by the hi-lo shifting lever (9, Illust. 5) mounted on the transmission front cover.

The transmission is coupled, by a universal joint, to the torque converter which is attached

to the flywheel on the engine. Gears are mounted on four shafts; the reverse clutch shaft, the forward clutch shaft, the spline shaft and the bevel pinion shaft.

The range selector valve is hydraulically controlled. The transmission gear selector lever aligns ports in a pilot control valve which directs oil to operate the spool type range selector valve used to select the various transmission gear ranges.

(Continued on next page)



Illust. 1
Flow of Oil Through Clutch in Neutral Position.

1. DESCRIPTION - ContinuedBevel Pinion Shaft

The shaft consists of the high and low range gears which are keyed to the shaft. The shaft is supported at the rear by a straight roller bearing and at the front by a double-row taper roller bearing. The pinion gear is splined to the rear of the pinion shaft and held in place with a nut. A shim pack is provided between the front bearing cage and the transmission case front cover for setting the cone center of the pinion and bevel gear.

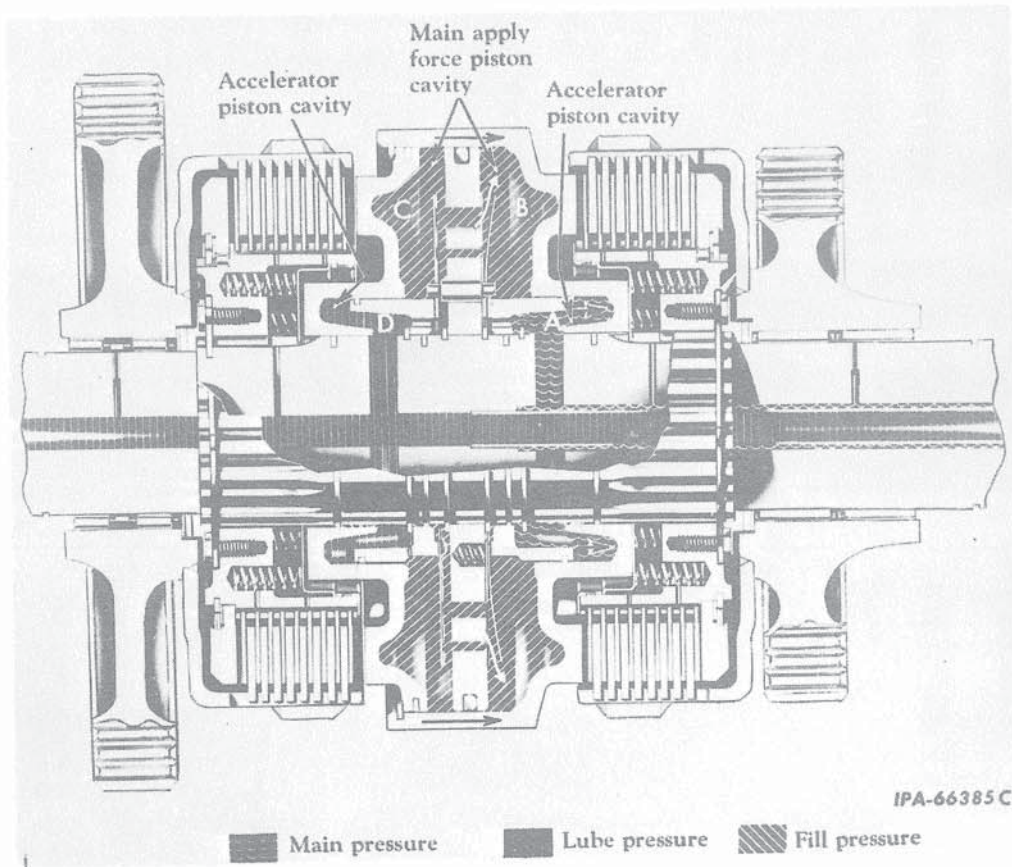
Spline Shaft

The spline shaft rotates on two straight roller bearings. The rear bearing is mounted in the transmission case and the front bearing is in the transmission cover. The first and second speed driven gears are held in position on the

spline shaft by snap rings and are in constant mesh with the first and second speed drive gears on the clutch shafts. The hi-lo driving gear slides freely on the shaft and drives the bevel pinion shaft when brought into mesh with either the high or low range driven gear by the use of the hi-lo shifting lever.

Forward and Reverse Clutch Shafts

The forward clutch shaft rotates on a straight roller bearing at the rear and a ball bearing at the front. The reverse clutch shaft has a straight roller bearing at each end. The reverse drive gear is keyed to the front of the forward clutch shaft and the reverse driven gear is keyed to the front of the reverse clutch shaft. Each shaft consists of first and second speed drive gears which ride on caged roller bearings and are welded to the dual hydraulic clutch pack assemblies.



Illust. 2
Flow of Oil Through Clutch in Travel Position.

Forward and Reverse Hydraulic
Clutch Operation

The hydraulic clutch is actually two clutches on a common shaft with a common apply force piston between them. The clutches allow the simple transfer of oil from the disengaged clutch into the cavity created by the engaging clutch. This allows a low volume of main pressure to actuate the clutch for high speed shifting.

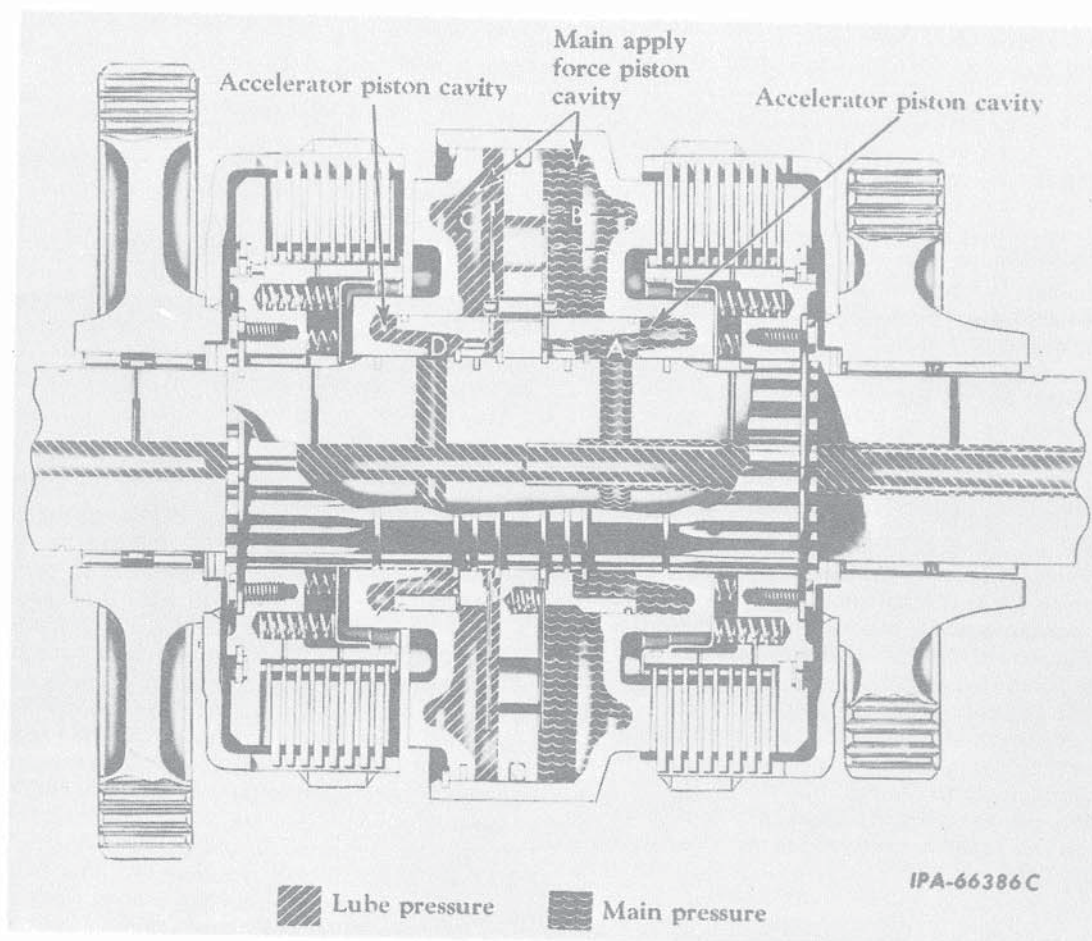
The heart of the clutch is contained in two pistons; the accelerator piston and the force piston. Pump oil volume is not needed to fill the applying clutch cavity and only a relatively low volume is needed to pressurize the clutch.

In neutral, all accelerator and force piston cavities are filled with oil at lube pressure (20-30 psi). A selector valve, located on the top of the transmission case, directs the oil to the accelerator piston cavities and, in

turn, to the force piston cavities. From this valve, oil is directed through the inside of a tube pressed in the clutch shaft and a cross drilled shaft hole and on the outside of the tube and through a cross drilled shaft hole to fill both clutch piston cavities. Once the pistons are filled with oil, they remain full under lube pressure. Other small cross drilled shaft holes furnish a constant supply of lube oil to the roller bearings beneath the drive gear and drum assemblies and to the clutch hubs for distribution through the clutch plates. In neutral, neither clutch is engaged; the drive gear and drum assemblies are free and no torque is transmitted through the clutch. (Illust. 1.)

Upon application of a clutch, main oil pressure (approximately 140-160 psi) is directed through the clutch shaft for the specific side of the

(Continued on next page)



Illust. 3
Flow of Oil Through Clutch in Engaged Position.

1. DESCRIPTION - ContinuedForward and Reverse Hydraulic
Clutch Operation - Continued

clutch desired and enters the accelerator piston cavity. In Illust. 2, main oil pressure enters the accelerator piston (A) through the cross drilled hole in the clutch shaft. During this phase, main pressure also lubricates the clutch plates and the roller bearings under the drive gear and drum assembly on the activated side.

NOTE: Lube oil pressure remains in the cavities (C and D) on the unapplied side and lubricates the clutch plates and roller bearings under the drive gear and drum assembly.

Oil entering the accelerator piston cavity (A) performs three functions: (1) Forces the accelerator piston, reinforcing disc and disc valve against the separator plate; (2) Forces the accelerator piston to push the guide pins against the opposite accelerator piston, positioning this piston, reinforcing disc and disc valve away from the separator plate; (3) Starts to move the force piston to the right. As a result, the force piston cavity (B) expands and the area in the opposite force piston cavity (C) contracts in an equal amount. At this time, oil in the non-applied force piston cavity (C) enters the holes in the separator plate, pushes open the disc valve and enters the applying force piston cavity (B). This fill pressure puts the clutch in its primary engagement position. Simultaneously, main oil pressure passes through the orifice in the applied accelerator piston and pressurizes the force piston cavity (B). When the force piston cavity is pressurized, the clutch is in its full engaged position. The reinforcing disc and disc valve in area "B" are now flat against the separator plate (Illust. 3).

When the transmission is returned to neutral, main pressure on the applied clutch is released and oil pressure in the disengaging clutch is regulated by the lube pressure system. An immediate pressure drop occurs within the disengaging accelerator piston cavity (A). Simultaneously, the compressed piston centering springs in the clutch hub return the common apply force piston to its axially centered position or neutral. Lubrication of all parts is now controlled by the lube pressure system.

If the selector valve on the transmission is positioned to direct main pressure into the left hand clutch instead of neutral, the right

hand clutch is disengaged and the left hand clutch is immediately applied.

NOTE: Compression springs located in bored holes in the separator plate are used to keep the reinforcing disc and disc valve on the unactivated side of the clutch pack assembly away from the separator plate. This allows for faster transfer of oil between the force piston cavities during the "travel phase" resulting in smoother clutch operation.

Gear Shifter Mechanism

The gearshift hand lever, located at the left hand side of the operator, is directly connected to the spool of the pilot control valve located within the control tower. This valve is connected through hoses to the range selector valve assembly on the top of the transmission case. Movement of the gearshift hand lever positions the pilot control valve spool to allow booster pressure oil to activate the spool (of the range selected) in the range selector valve assembly. Main pressure oil within the range selector valve assembly is then allowed to engage the side of the clutch pack selected (Illust. 4).

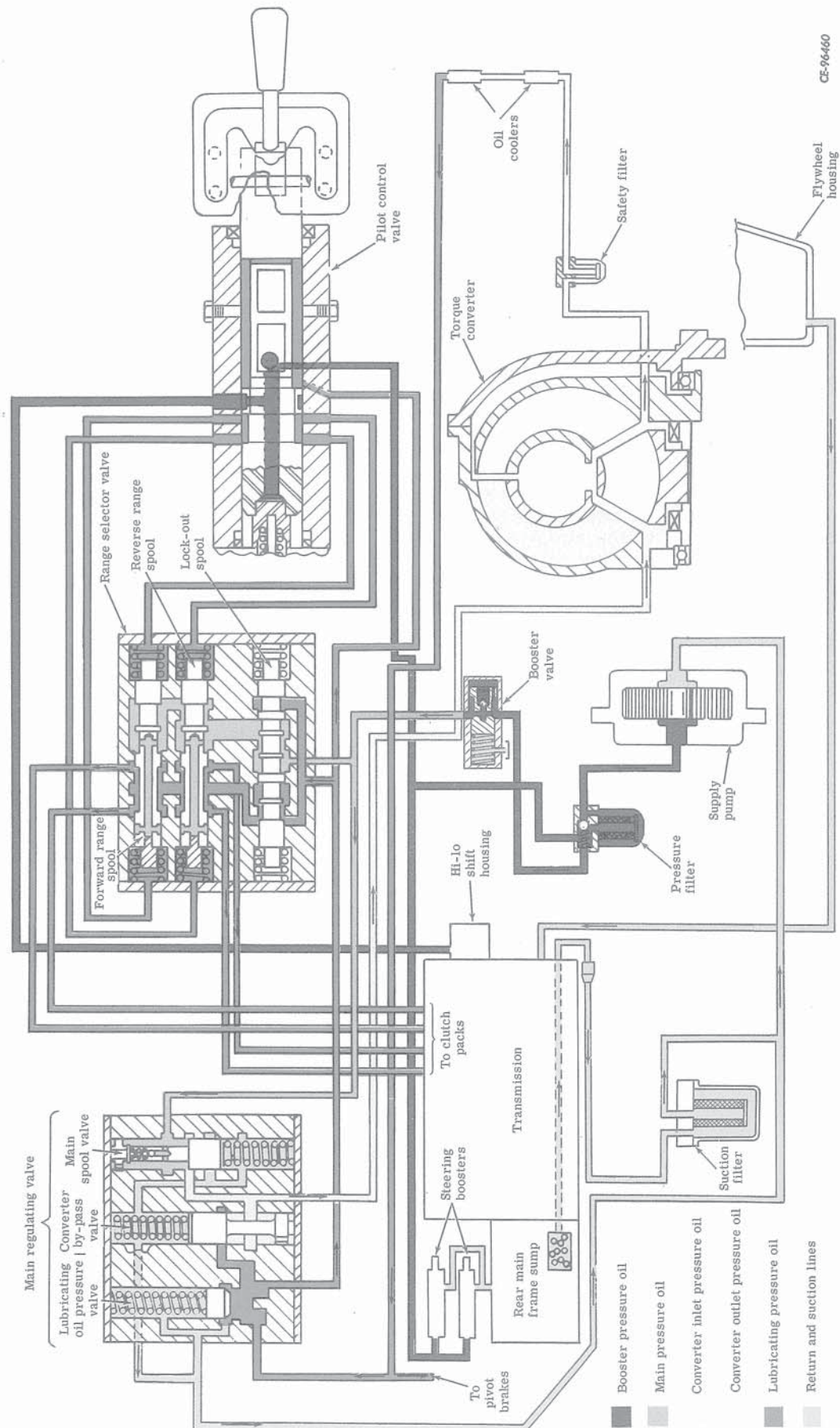
Hi-Lo Shift Lever

The hi-lo shifting lever (on the transmission cover) is held in position by a poppet lock in the hi-lo shifter housing. To shift from one range to another, the engine must be running and the gearshift lever must be in neutral position. At this time, the booster pressure oil from the pilot control valve is directed through a hose to the shifter housing. Here it releases the poppet lock from the hi-lo shifter poppet. (Illust. 4.)

Hydraulic Oil Flow (Illust. 4)

The rear main frame is the source of supply for the oil that enters the transmission, torque converter, steering boosters and pivot brakes. The oil is drawn through an oil intake pipe located at the bottom of the rear main frame and through the suction filter by the suction developed by the supply pump located in the right hand side of the torque converter. The oil on the output side of the pump passes through the pressure filter and, from here, is directed to the steering boosters, pressure regulating booster valve and the pilot control valve. The pressure in these lines is maintained between 200-230 psi by the booster valve. When this pressure is reached, the valve opens and allows the oil to enter the clutch pressure gauge and

(Continued on page 6)



Illust. 4
Hydraulic Oil Flow with Transmission in Neutral.

1. DESCRIPTION - Continued

Hydraulic Oil Flow (Illust. 4) - Continued

the main regulating valve and range selector valve assemblies.

NOTE: Refer to Section 8, "STEERING SYSTEM," for operation of the steering boosters.

MAIN REGULATING VALVE ASSEMBLY: When oil pressure at the main spool valve exceeds 160 psi, the valve opens and allows the oil to enter the torque converter. Oil pressure in the torque converter is maintained between 50 to 80 psi by the by-pass valve in the main regulating valve housing. The oil on the output side of the torque converter is directed through the oil coolers (mounted on the front of the radiator) and to the lubricating oil pressure valve in the main regulating valve housing. This oil cooler outlet oil along with any excess pressure oil from the converter by-pass valve is directed through drilled passages to the range selector valve assembly. The lubricating oil pressure valve maintains the pressure of this oil between 20-30 psi. When the pressure exceeds 30 psi, the lubricating oil pressure valve opens and the excess oil is returned to the suction side of the converter input pump through a hose. A hydraulic line connected to the top of the main regulating valve housing also directs the oil cooler outlet oil to the rear main frame for cooling the pivot brakes.

NOTE: For the flow of oil inside of the torque converter, refer to Section 6, "HYDRAULIC TORQUE CONVERTER."

RANGE SELECTOR VALVE ASSEMBLY: This assembly consists of a lock-out spool and two range spools which are hydraulically controlled. The lock-out spool is not utilized in this particular system and its ports in the valve housing are plugged. The lock-out spools only function in this system is to separate the lubricating pressure oil and the main pressure oil passages within the selector valve housing. Spool position within the housing is maintained by the centering spring at each end of the spool.

In "neutral," the range spools are centered in the housing by the springs and the equal oil pressure being exerted on each end of the spools. Under this condition, the oil from the lubricating oil pressure valve enters the openings not covered by the spool lands and, through internal passages, is directed to the transmission clutch shafts to provide lubrication for cooling the clutch plates. Under all conditions this lubricating pressure oil within the selector valve housing is also directed by a hose to the pilot control valve located inside the gear shifter tower. In "neutral," the main pressure oil within the range selector valve housing (oil received from the booster valve outlet) is kept from engaging the transmission clutch packs by the range spools.

PILOT CONTROL VALVE ASSEMBLY: This valve is manually operated by the gear selector hand lever. Booster pressure oil from the pressure filter outlet enters the center of the pilot control valve spool and exists through a cross drilled hole into the port of the valve housing to which it is aligned. Lubricating pressure oil from the range selector valve flows between the valve spool and the housing entering all ports not covered by the spool lands. This oil then exists through tubing and hoses to the ends of the range spools in the range selector valve assembly. In "neutral" the booster pressure oil is directed through an outlet hose to the lock in the hi-lo shift housing to allow movement of the shift lever. When the gear selector hand lever is placed in a speed range, the pilot control valve spool is positioned to allow the booster pressure oil to act upon the end of the range spool in the speed range selected. This pressure, being higher than the lubricating oil pressure at the opposite end of the spool, upsets the pressure balance and moves the spool. The main pressure oil within the range selector valve housing is then directed to the clutch shaft to engage the selected clutch pack (refer to "Forward and Reverse Hydraulic Clutch Operation" in this paragraph for the flow of oil after it enters the clutch shaft).

2. SPECIFICATIONS

Transmission

Type	Power shift
Number of forward speeds	2*
Number of reverse speeds	2*

*Actually four speeds when used in conjunction with the hi-lo shifting mechanism.

Forward and Reverse Clutch Packs

Number of internal splined clutch plates (sintered bronze)	18
Number of external splined clutch plates (steel)	16
Minimum allowable thickness for internally splined bronze clutch plates, inch088
Reverse clutch shaft end play, inch030 - .040
First speed drive gear thrust washer minimum allowable thickness, inch388
Second speed drive gear thrust washer minimum allowable thickness, inch054
Gear and drum assembly end play:	
New clutch pack assembly (inch)010 - .030
Used clutch pack assembly (inch)010 - .040

Hi-Lo Fork and Driving Gear

Width of slot in driving gear, inch380 - .390
Width of shifter fork fingers, inch365 - .375

Springs

	Free Length Inches	Test Length Inches	Test Load Pounds	Number of Coils
Main regulating valve:				
Main spool valve spring				
(internal)	59/64	21/32	3-1/2 - 4-1/2	12
By-pass valve spring (Approx.)	3-21/32	2-15/64	74-1/2 - 82-1/2	10-3/4
Main pressure regulating spring	3-21/64	2-5/32	121 - 134	10
Lube valve spring	4-1/8	2-13/64	13-1/2 - 15-1/2	15
Pilot control valve indexing springs	1-5/64	11/16	8-1/2	10
Range selector valve centering springs	1-11/64	1	20	6
Pressure regulating booster valve:				
Pressure regulating spring				
(inner)	3	2-5/32	40-3/4 - 45	13-1/2
Pressure regulating spring				
(outer)	3-11/32	2-5/32	121 - 134	10
Valve spool internal spring	59/64	21/32	3-1/2 - 4-1/2	12
Hi-lo shifter lever poppet spring	2	1-11/32	67	12-1/2
Poppet lock spring	1-15/16	1-1/2	28 - 34	12
Clutch pack separator plate com- pression springs				
Inner	11/16	3/8	4-1/2	9
Outer	1/2	3/8	8 - 9-1/2	6

Special Nut and Bolt Torque Data (Foot-Pounds)

(Torques given are for bolts and nuts lubricated with SAE-30 engine oil).

Bevel pinion shaft front nut	500 - 550
Bevel pinion shaft rear nut	500 - 550
Bevel pinion shaft front bearing retainer	300 - 350
Transmission pressure filter hold-down bolt	40 - 50
Safety filter mounting bolts	23 - 26
Suction filter mounting bolts	56 - 63
Range selector valve range spool plugs	5 - 7
Pilot control valve detent housing cap screws	19 - 21
Pilot control valve spool extension	5 - 7

NOTE: Except for the special torques shown, all bolts and nuts are to be given a standard torque. Refer to the "STANDARD TORQUE DATA CHART" in Section 1, "GENERAL."

3. CHECKING MECHANICAL PROBLEMS

PROBABLE CAUSE

REMEDY

Main Oil Pressure Gauge Shows Low or High Pressures

- | | |
|---|--|
| 1. Pressure gauge malfunction | Replace gauge. |
| 2. Plugged suction or pressure filter | Clean suction filter. Replace pressure filter element. |
| 3. Air leakage at suction filter | Tighten fittings or replace "O" rings. |
| 4. Faulty booster valve | Install pressure gauge at range selector valve and check booster pressure. If below specification, disassemble valve and replace parts as necessary. |
| 5. Main regulating valve spring malfunctioning | Remove and replace with new. |
| 6. Wrong number of washers at main regulating valve spring location | Refer to Par. 9 in this section. |
| 7. Binding of lube valve, by-pass valve or main pressure valve in regulator housing | Check valves. Install new valve body gasket. |
| 8. Charging pump malfunctioning | Replace pump. |

Low Oil Pressure When in Forward or Reverse Speed

- | | |
|---|--------------------------------------|
| 1. Contaminated or restricted oil lines | Clean or replace oil lines. |
| 2. Shims or "O" ring leaking at reverse clutch shaft manifold | Replace with new shims or "O" rings. |
| 3. Hook type seal rings on shaft leaking | Replace seal rings. |
| 4. Clutch piston seal ring leaking | Replace seal ring. |

Slow or Erratic Clutch Engagement

- | | |
|--|---|
| 1. Low oil level | Add oil to proper level. |
| 2. Clogged filters | Remove and clean suction and safety filters. Replace pressure filter element. |
| 3. Faulty hydraulic oil pump | Replace worn parts or replace pump. |
| 4. Internal oil leaks | Check for damaged or worn sealing rings in clutch packs. |
| 5. External oil leaks | Check all gaskets, lines and connections. |
| 6. Low main oil pressure | Clean main regulator valve and bore; check spring tension. |
| 7. Contaminated or restricted oil lines | Clean or replace oil lines. |
| 8. Binding of main pressure valve in regulator housing | Check valve. Install new valve body gasket. |

Noise in Transmission

- | | |
|--|--|
| 1. Bearings worn or broken. Worn drive gear and drum roller bearings | Install new. |
| 2. Foreign material in oil | Drain, flush and refill with clean oil. Clean suction and safety filters. Replace pressure filter element. |
| 3. Gears badly worn | Install new gears. |
| 4. Bevel gear and pinion not in proper mesh. | Adjust to proper clearance. |

High Oil Temperature

- | | |
|--|---|
| 1. Clogged oil cooler | Remove and clean. |
| 2. Improper tractor operation | Operate in correct range. |
| 3. Improper torque converter operation | Refer to "CHECKING MECHANICAL PROBLEMS" in Section 6. |
| 4. Low or high oil level | Add or drain to proper level. |

PROBABLE CAUSE

REMEDY

- | | |
|---|---|
| <p>5. Oil leakage</p> <p>6. Faulty hydraulic oil pump</p> <p>7. Temperature gauge malfunction</p> <p>8. Air entry into suction line</p> | <p>Check all gaskets, lines and connections and replace parts as necessary.</p> <p>Replace worn parts or replace pump.</p> <p>Replace gauge or sending unit.</p> <p>Replace "O" rings in system. Tighten connections.</p> |
|---|---|

4. REMOVAL

NOTE: It is suggested that Par. 3, "CHECKING MECHANICAL PROBLEMS" be reviewed and the pressure checks in Par. 9, "CHECKING TRANSMISSION OIL PRESSURE" be taken before removing the transmission. In this manner, hydraulic malfunctions can be pinpointed and corrected at time of teardown.



CAUTION: BE SURE THE BUCKET OR BLADE HAS BEEN LOWERED TO THE GROUND.

NOTE: When disconnecting hydraulic lines for any reason, they should be properly capped with the correct size plastic cap. If these caps are not available, tape or clean rubber corks may be used. Hydraulic openings must never be plugged with rags. This practice could easily introduce dirt or lint into critical hydraulic components of the machine. Tag all disconnected oil lines to facilitate easier installation.

1. Drain the rear main frame. Drain the equipment hydraulic system.
2. Remove the seat bottom cushion. Remove the mounting hardware and lift off the seat frame.
3. Disconnect the battery cables and remove the batteries and battery support.
4. Remove the side cover enclosing the equipment control valve on the RH fender. Reach in through the cover opening to remove the nuts and lock washers securing the two operating lever guides to the seat side sheet. Remove the guides and the two flat washers that are between the seat side sheet and operating lever. Disengage the operating lever from the brake pedal pawl and the opening in the seat front support and lift out the operating lever.

5. Remove the cap screws, lock washers, flat washers and nuts securing the seat front support to the seat support bar and seat side sheets and remove the seat front support.

6. Disconnect the decelerator pedal pick-up lever rod at the pedal by removing the cotter and end pin. Remove the platforms.

7. Disconnect any linkage necessary to facilitate removal of the platform support. Remove the cap screws and washers securing the platform support to the front frame and remove the support with linkage attached.

8. Disconnect and remove the steering booster return springs. Disconnect the steering booster valve operating rods and the steering brake pull rods at the steering levers.

9. Disconnect the hoses at the suction filter. Remove the cap screws and lock washers securing the seat support bar to the front frame and remove the support bar with suction filter and steering levers.

10. Disconnect the hydraulic lines at the pressure filter base. Remove the pressure filter assembly.

11. LOADER ONLY: Disconnect the inlet tube at the top of the equipment pump. Disconnect the rear of the inlet tube at the hose connection and remove the inlet tube.

- TD-20 SERIES C ONLY: Disconnect the equipment pump inlet and outlet lines at the pump. Disconnect the inlet tube at the connecting hose and remove the inlet tube.

12. Disconnect the three test connection tubes at the main regulating valve located on the transmission.

13. Remove the rear cover from the underside of the front frame.

(Continued on next page)

4. REMOVAL - Continued

14. LOADER ONLY: Disconnect the outlet line from the bottom of the equipment pump. Insert an eyebolt into one of the inlet tube mounting holes in the top of the pump and attach a hoist. Remove the pump mounting bolts and free the pump from the converter housing. Lower the pump until it rests in the front frame, and transfer the hoist sling to one of the pump mounting holes. Remove the eyebolt from the pump. Raise the pump out the top of the unit.

15. Remove the cap screws securing the universal joint to the converter output flange and the transmission drive yoke. Remove the universal joint. Slide the transmission drive yoke off the shaft.

NOTE: Before removing the cap screws securing the universal joint, wire or tape the bearing caps to prevent them from falling off the spider trunnions.

16. Disconnect all the necessary hydraulic lines between the converter housing and the transmission and oil cooler to facilitate converter removal.

17. Remove the two center cap screws and washers securing the supply pump inspection cover to the top of the converter housing and insert eyebolts for attaching a hoist. Place a slight tension on the hoist sling. Remove the cap screws and washers securing the converter housing to the flywheel housing. Move the converter back so the converter drive housing clears the flywheel housing and hoist the converter out of the unit. Cover the opening at the flywheel housing to prevent dirt and dust from entering.

18. Remove the cap screws and lock washers securing the hydraulic manifold to the control tower housing and allow the manifold with hoses attached to lay on the transmission. Discard the manifold mounting "O" rings.

19. LOADERS ONLY: Disconnect the equipment pump outlet rear tube at the control valve. Remove the mounting hardware securing the tube bracket on the transmission case and remove the tube.

20. Disconnect all the hoses and the tubing necessary at the main regulating valve and the transmission case to facilitate transmission removal.

21. Remove the cover from the rear of the unit directly below the diesel fuel and hydraulic oil tanks. Disconnect the operating rod from each of the steering boosters and remove the rods. Disconnect the steering brake pull rods at each of the bellcranks and remove the pull rods.

22. Push the brake pedal forward and lock with the locking pawl.

23. Remove one of the upper transmission cover-to-transmission case bolts and one of the bolts securing the main regulating valve to the top of the transmission case and attach a hoist. Remove the cap screws securing the transmission to the rear main frame and remove the transmission from the tractor.

24. Lower the transmission assembly on a bench with the shafts in a horizontal position and block the case on each side. It is also desirable to keep the hoist attached with a slight tension on the chain.

NOTE: Cover the opening in the main frame to prevent dirt and dust from entering.

25. Remove the main regulating valve and range selector valve assemblies from the transmission case. Disconnect the hose from the hi-lo shifter housing and remove the range selector valve with manifold and hoses attached.

5. DISASSEMBLY

Hi-Lo Shift Lever Assembly (Ref. Nos. Refer to Illust. 5)

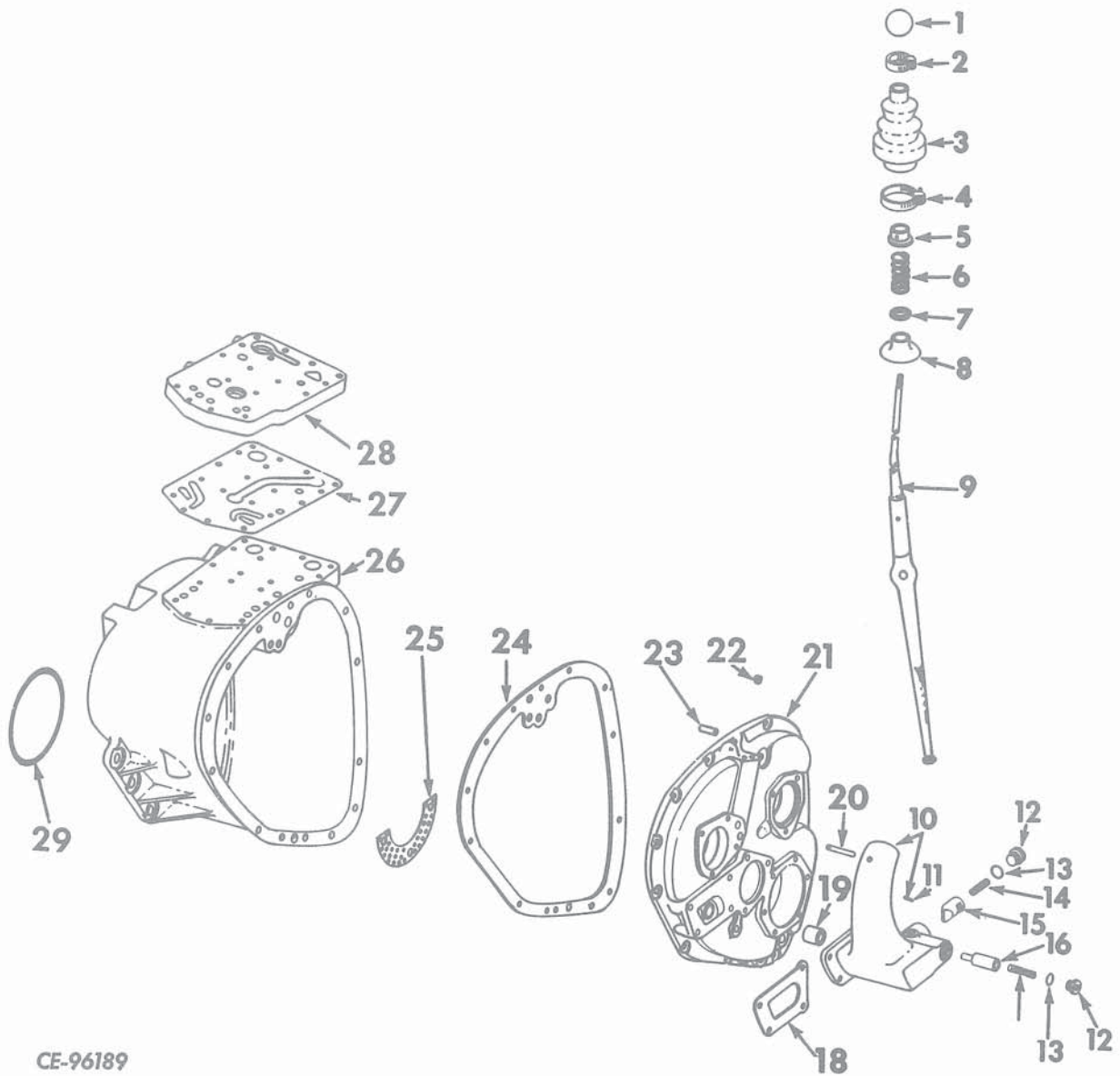
1. Remove the shift lever ball (1). Remove the upper and lower shift lever boot clamps and remove the boot (3).

2. Remove the rivet securing the spring stop (5) to the shift lever and remove the spring stop, spring (6), spring washer (7) and swivel cap (8) from the shift lever.

3. Remove the swivel shaft (20) securing the shift lever to the shifter housing and pull the lever (9) from the housing.

4. Remove the cap screws and washers securing the shifter housing (10) to the transmission cover and remove the housing and gasket (18).

(Continued on page 12)



CE-96189

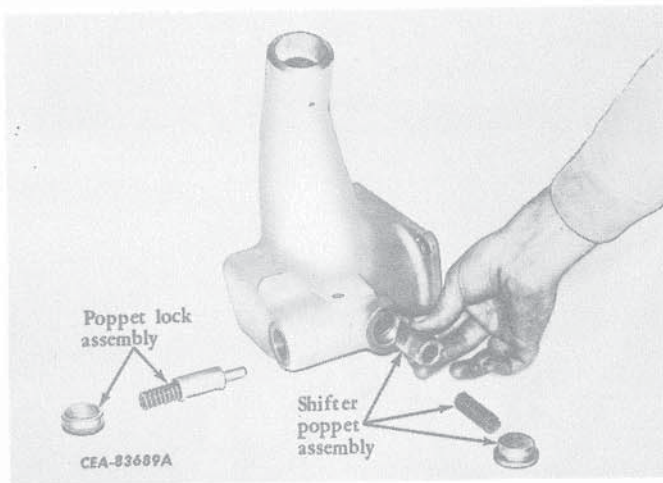
Illust. 5
Exploded View of Transmission Hi-Lo Shifting Lever and Linkage.

- | | | |
|-----------------------|-------------------------|-----------------------------|
| 1. Hand lever ball. | 11. Poppet guide pin. | 21. Transmission cover. |
| 2. Clamp. | 12. Plug. | 22. Plug. |
| 3. Boot. | 13. Gasket. | 23. Dowel pin. |
| 4. Clamp. | 14. Poppet spring. | 24. Gasket. |
| 5. Spring stop. | 15. Poppet. | 25. Oil screen. |
| 6. Spring. | 16. Poppet lock. | 26. Transmission case. |
| 7. Washer. | 17. Poppet lock spring. | 27. Gasket. |
| 8. Swivel cap. | 18. Gasket. | 28. Hydraulic valve spacer. |
| 9. Hi-lo shift lever. | 19. Bushing. | 29. Transmission case |
| 10. Lever housing. | 20. Swivel shaft. | "O" ring. |

5. DISASSEMBLY - Continued

Hi-Lo Shift Lever Assembly (Ref. Nos. Refer to Illust. 5) - Continued

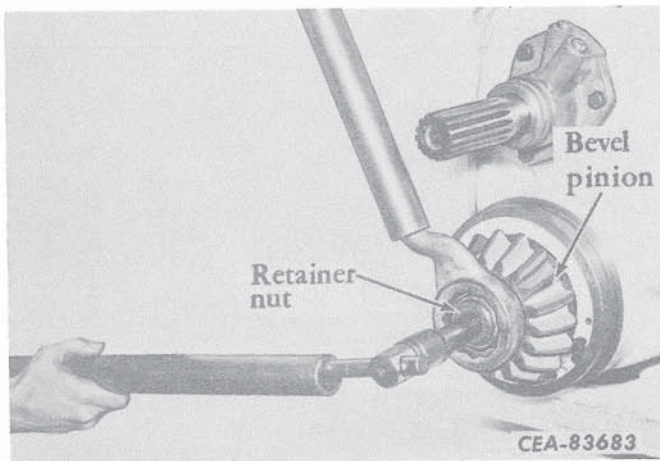
5. If desired, the shifter poppet (15), poppet lock (16) and springs (14) can be removed for inspection by removing the two pipe plugs (12) with gaskets (13) from the shifter housing (Illust. 6).



Illust. 6
Disassembling the Shift Lever Housing.

Transmission Case and Cover

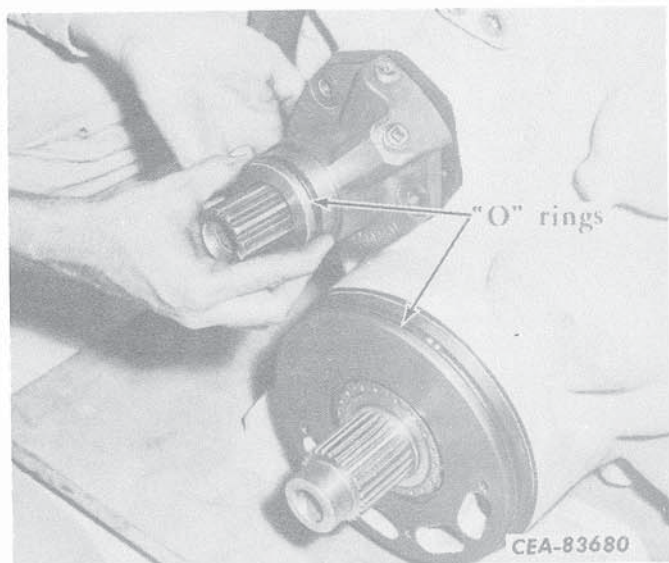
6. Insert a 3/4 inch drive in the end of the pinion shaft and remove the pinion shaft rear nut with a box-end wrench. With the aid of a puller, remove the bevel pinion from the shaft splines (Illust. 7).



Illust. 7
Removing the Bevel Pinion Rear Nut.

7. Remove the three cap screws and washers securing the forward clutch shaft hydraulic manifold to the rear of the transmission case. Remove the manifold with "O" rings and sealing rings. Remove the "O" ring from the rear of the transmission case (Illust. 8).

NOTE: The four hook type seal rings should be left in the clutch shaft to protect the ring grooves in the shaft during further disassembly.



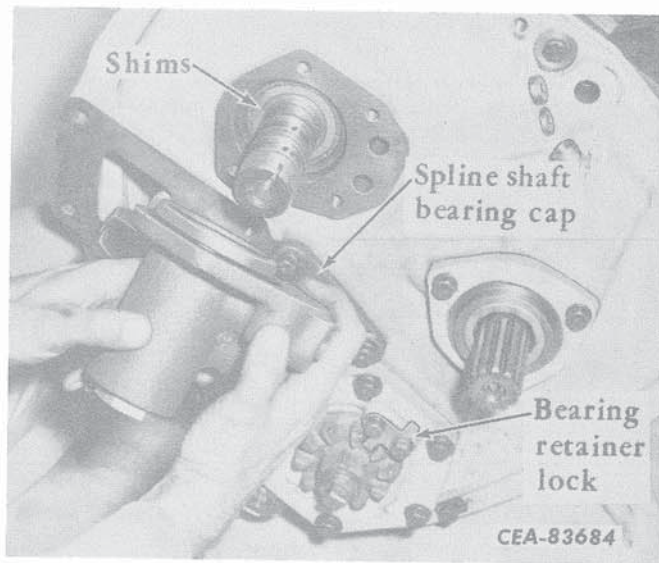
Illust. 8
Removing the Forward Clutch Shaft Hydraulic Manifold.

8. Remove the cap screws and washers securing the reverse clutch shaft manifold to the transmission cover and remove the manifold with rings (17 and 18, Illust. 25).

9. Remove the shims (16, Illust. 25) and keep them with the hydraulic manifold. The shims are used to obtain the clutch shaft end play (Illust. 9).

10. Remove the cap screws and washers securing the spline shaft bearing cap (Illust. 9) to the front cover and remove the cap with sealing ring.

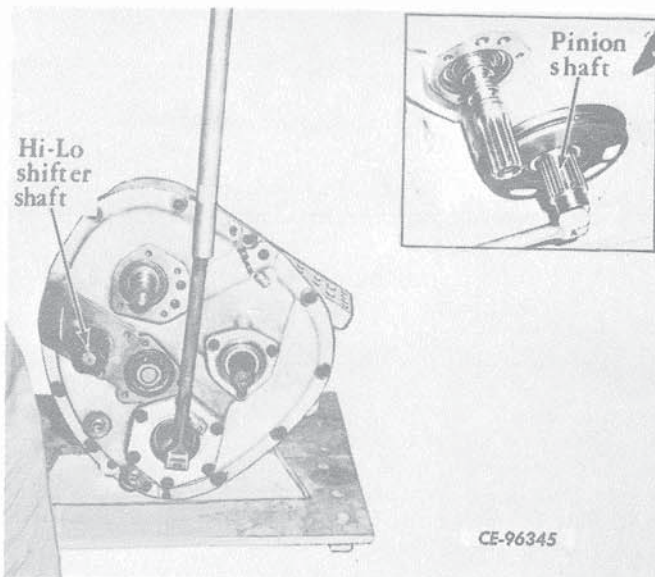
11. Remove the cap screws and washers securing the lock to the pinion shaft bearing cage and the bearing retainer. Remove the lock (Illust. 9).



Illust. 9
Removing the Reverse Clutch Shaft
Hydraulic Manifold.

12. Remove the bearing retainer using a 1-1/2 inch socket and a breaker bar. Remove the "O" ring from the bearing retainer.

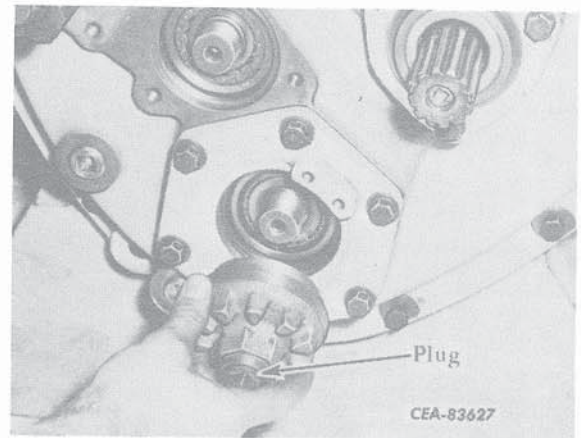
13. Place a 3/4 inch square drive breaker bar in the rear of the pinion shaft. Place an extension over the breaker bar handle to hold the



Illust. 10
Removing the Pinion Shaft Front Nut.

pinion shaft from turning while removing the pinion shaft front nut. Remove the front nut using a socket, breaker bar and extension (Illust. 10).

14. Reinstall the bearing retainer. It will be used later in disassembly to facilitate pinion shaft removal. Remove the plug with gasket from the retainer (Illust. 11).



Illust. 11
Installing the Pinion Shaft Front
Bearing Retainer.

15. Place the transmission in a TD-24 crawler tractor transmission stand or up on blocks with the transmission cover down and none of the shafts touching the floor.

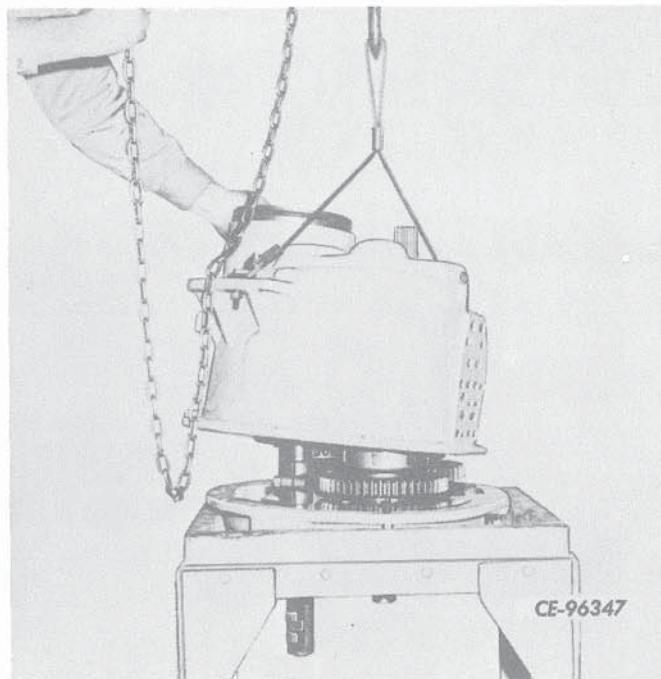
16. Remove the cap screws, washers and nuts securing the transmission case to the transmission cover and remove the case (Illust. 12). Remove the cover gasket. The rear bearing outer races on the four transmission shafts will remain in the case and can easily be removed if necessary. To remove the bevel pinion shaft rear bearing outer race from the case, it will first be necessary to remove the retaining snap ring.

NOTE: If the transmission case and cover will not separate easily, insert two puller screws in the holes provided in the cover until the case is free of the cover dowels.

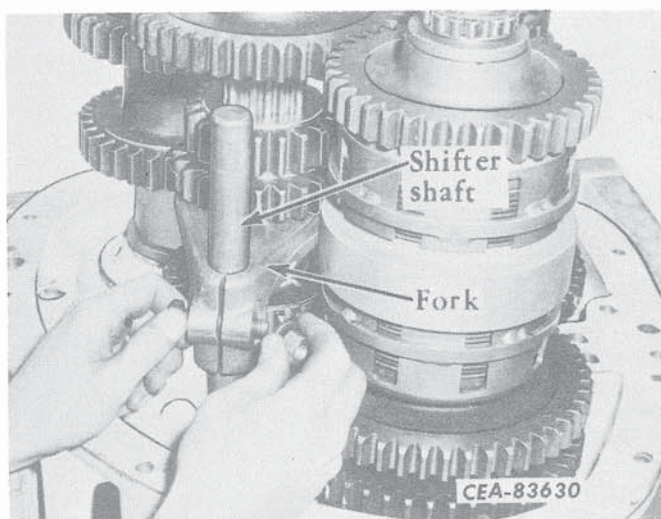
(Continued on next page)

5. DISASSEMBLY - Continued

Transmission Case and Cover - Continued



Illust. 12
Removing the Transmission Case.

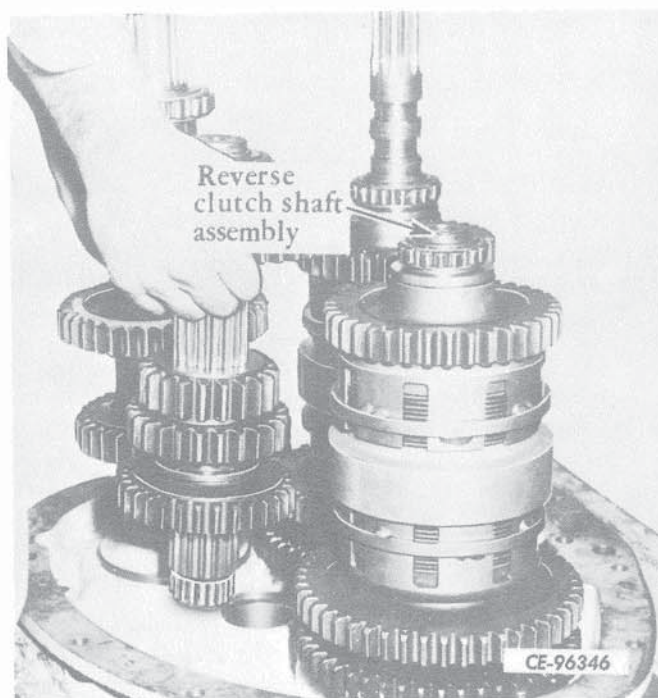


Illust. 13
Removing the Shifter Fork Lock Screw.

17. Remove the cap screw washer and nut securing the shifter shaft to the fork. Tap the shifter shaft out of the fork using a brass hammer. Remove the fork from the hi-lo drive gear collar (Illust. 13).

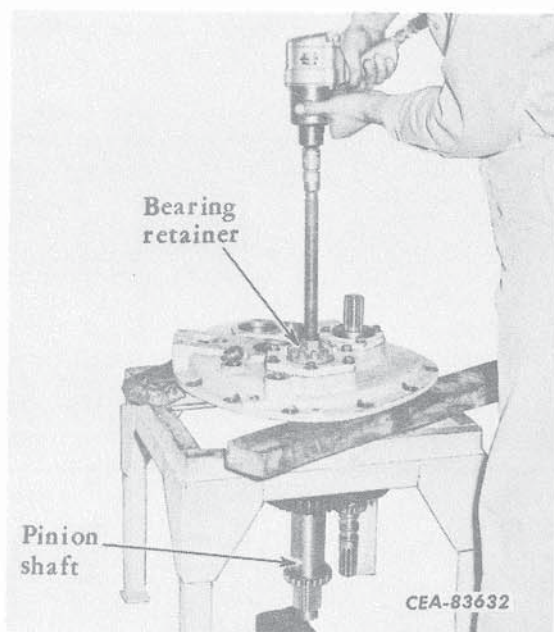
18. Lift the spline shaft from the front cover. Lift the reverse clutch shaft from the front cover. The front bearing outer races of these shafts will remain in the front cover (Illust. 14).

19. Place the front cover with the two remaining shafts in the stand or on blocks with the shafts extending down.



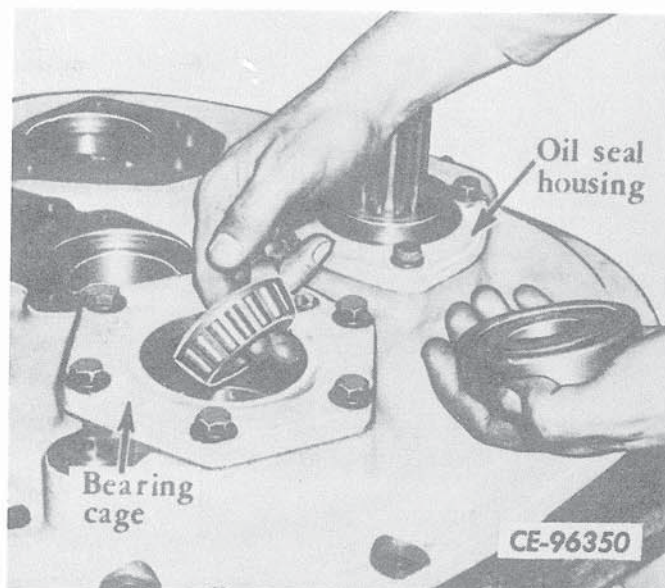
Illust. 14
Removing the Spline Shaft.

20. Screw a standard puller screw into the front bearing retainer until it bottoms on the pinion shaft. Use a socket and air wrench to push the shaft out of the front bearing assembly. Remove the bearing retainer (Illust. 15).



Illust. 15
Removing the Bevel Pinion Shaft.

21. Remove the pinion shaft front bearing assembly from the bearing cage. The bearing assembly consists of two taper roller bearings and a spacer (Illust. 16).



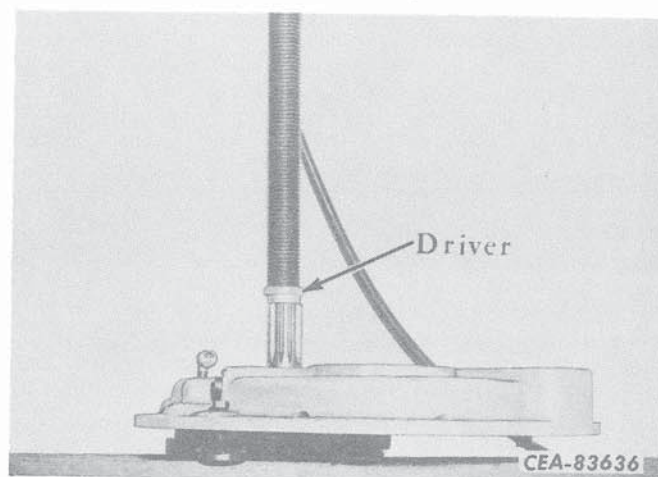
Illust. 16
Removing the Pinion Shaft Front
Bearing Assembly.

22. Remove the cap screws and lock washers securing the bearing cage (Illust. 16) to the front cover. The bearing cage is held in the front cover by the pressure of the "O" ring on its outside diameter and can be tapped out from the underside of the cover using a wooded block and hammer. Keep the shims that fit between the bearing cage and cover with the bearing cage to facilitate proper reassembly of the pinion shaft.

23. Remove the cap screws and washers securing the oil seal housing to the front cover and remove the housing with "O" ring (15, Illust. 24) and oil seal. Remove the snap ring (14, Illust. 24) from the shaft.

24. Support the shaft and cover assembly in a press on the reverse drive gear and press the shaft from the ball bearing. The gear will be partially pressed off as the shaft is freed from the bearing. Use a driver to protect the shaft (Illust. 17). If bearing replacement is necessary, reverse the cover in the press and press it out of the cover.

(Continued on next page)

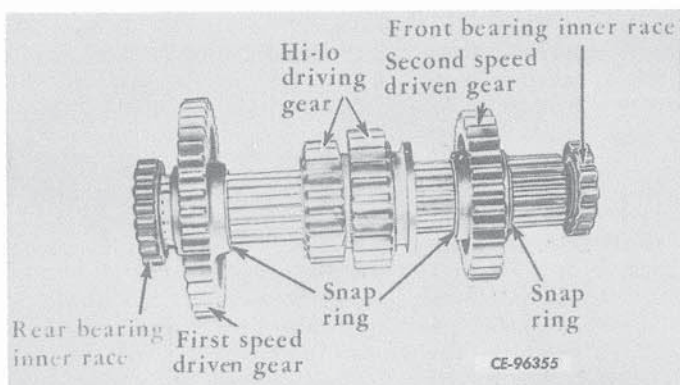


Illust. 17
Removing the Forward Clutch Shaft.

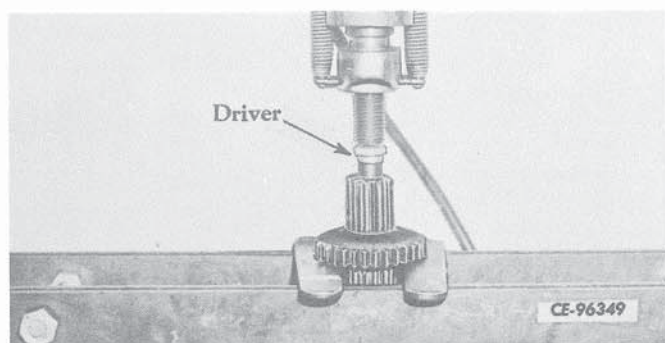
5. DISASSEMBLY - Continued

Spline Shaft
(Ref. Nos. Refer to Illust. 21)

25. Install a bearing split collar puller plate behind the front bearing inner race (Illust. 18). Support the shaft assembly in a press on the puller plate and press the shaft from the bearing inner race.



Illust. 18
Spline Shaft Assembly.



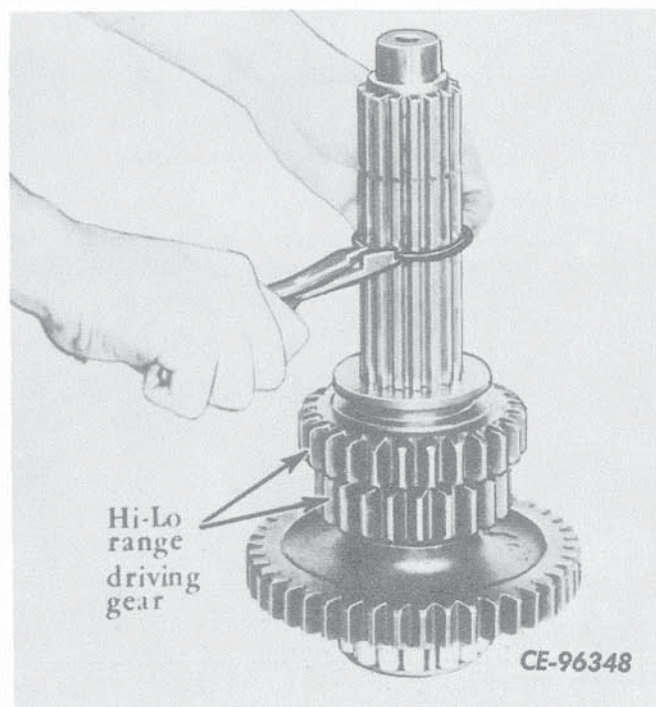
Illust. 19
Removing the Second Speed Driven Gear.

26. Remove the second speed driven gear outer snap ring (8) from the shaft.

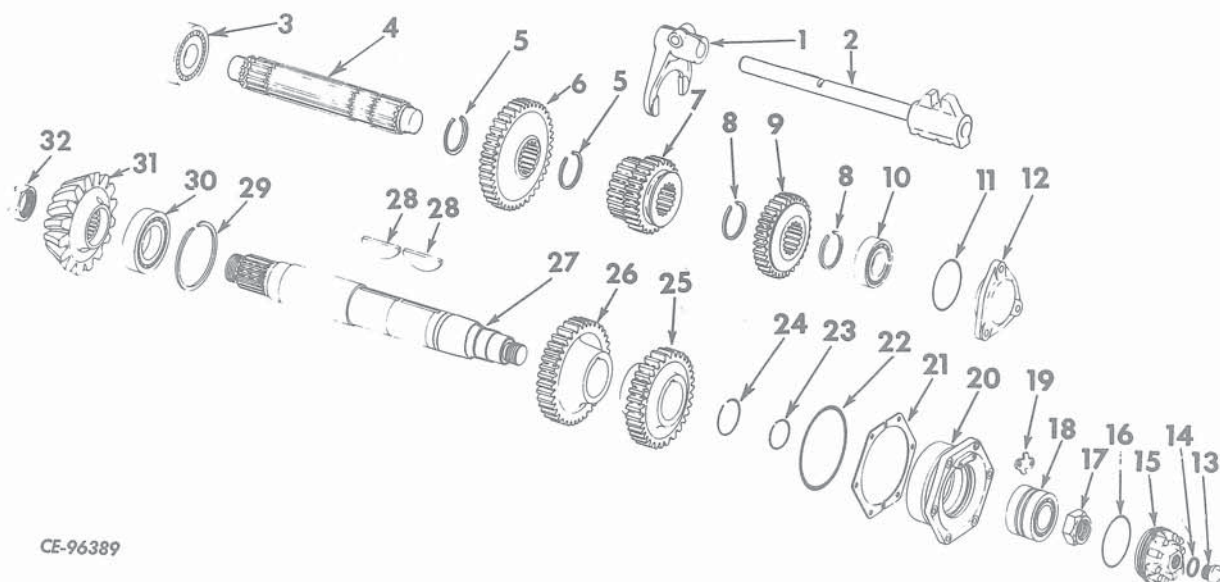
27. Support the shaft in a press under the second speed driven gear (9) and press the shaft from the gear (Illust. 19). Use a driver to protect the shaft.

28. Remove the second speed driven gear inner snap ring (8) and slide the hi-lo range driving gear (7) from the shaft (Illust. 20). Remove the first speed driven gear front snap ring (5), driven gear (6) and rear snap ring (5).

29. Install a bearing split collar puller plate behind the rear bearing inner race. Support the shaft in a press on the puller plate and press the shaft from the bearing inner race.



Illust. 20
Removing the Second Speed Driven Gear Inner Snap Ring.



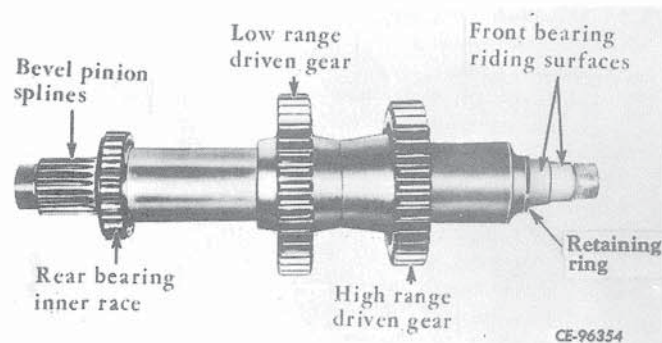
CE-96389

Illust. 21
Exploded View of Spline Shaft and Bevel Pinion Shaft.

- | | | |
|------------------------------|--------------------------------------|-----------------------------|
| 1. Hi-lo shifter fork. | 12. Bearing cap. | 22. Sealing ring. |
| 2. Hi-lo shifter shaft. | 13. Plug. | 23. Retaining ring. |
| 3. Rear bearing. | 14. Gasket. | 24. Retaining ring. |
| 4. Spline shaft. | 15. Front bearing retainer. | 25. High range driven gear. |
| 5. Snap ring. | 16. Sealing ring. | 26. Low range driven gear. |
| 6. First speed driven gear. | 17. Nut. | 27. Pinion shaft. |
| 7. Driving gear. | 18. Double-row taper roller bearing. | 28. Key. |
| 8. Snap ring. | 19. Lock. | 29. Snap ring. |
| 9. Second speed driven gear. | 20. Bearing cage. | 30. Rear bearing. |
| 10. Front bearing. | 21. Shim. | 31. Pinion. |
| 11. Sealing ring. | | 32. Nut. |

Pinion Shaft
(Ref. Nos. Refer to Illust. 21)

NOTE: If difficulty is encountered in removing the high or low range driven gears, use a torch on the gear hubs. Care must be taken that heat is uniform all around the hub and kept away from the gear bores or shaft. Do not heat to more than 400°F.



CE-96354

Illust. 22
Bevel Pinion Shaft Assembly.

(Continued on next page)

5. DISASSEMBLY - Continued

Pinion Shaft

(Ref. Nos. Refer to Illust. 21) - Continued

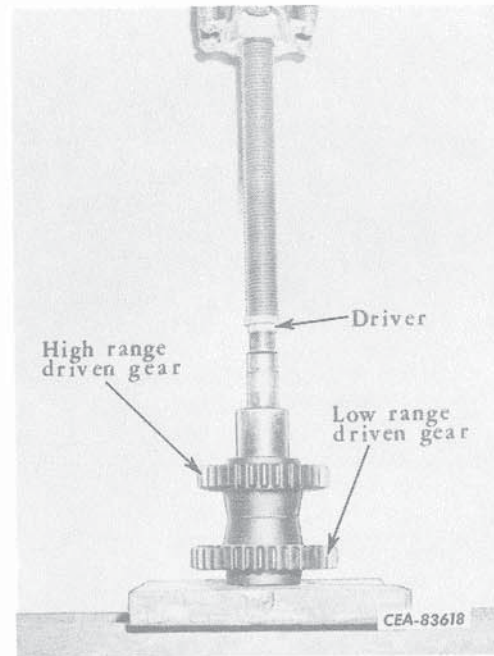
30. Place the shaft in a press supported by the low range driven gear (26). Remove the retaining ring (24) from the shaft groove located at the base of the high range driven gear. Press off both gears (25 and 26) in one operation. Remove the woodruff keys (28) (Illust. 23).

31. Install a bearing split collar puller plate behind the rear bearing inner race (Illust. 22). Support the shaft in a press on the puller plate and press the shaft from the bearing race.

Forward and Reverse Clutch Shafts

(Ref. Nos. Refer to Illust. 24 and 25)

NOTE: The following procedure covers the disassembling of either a forward or reverse clutch shaft. Whenever a difference in the disassembly of one clutch shaft from the other is required, both procedures are covered. Illustrations used to show disassembly are of the reverse clutch shaft; the forward clutch shaft would be similar.

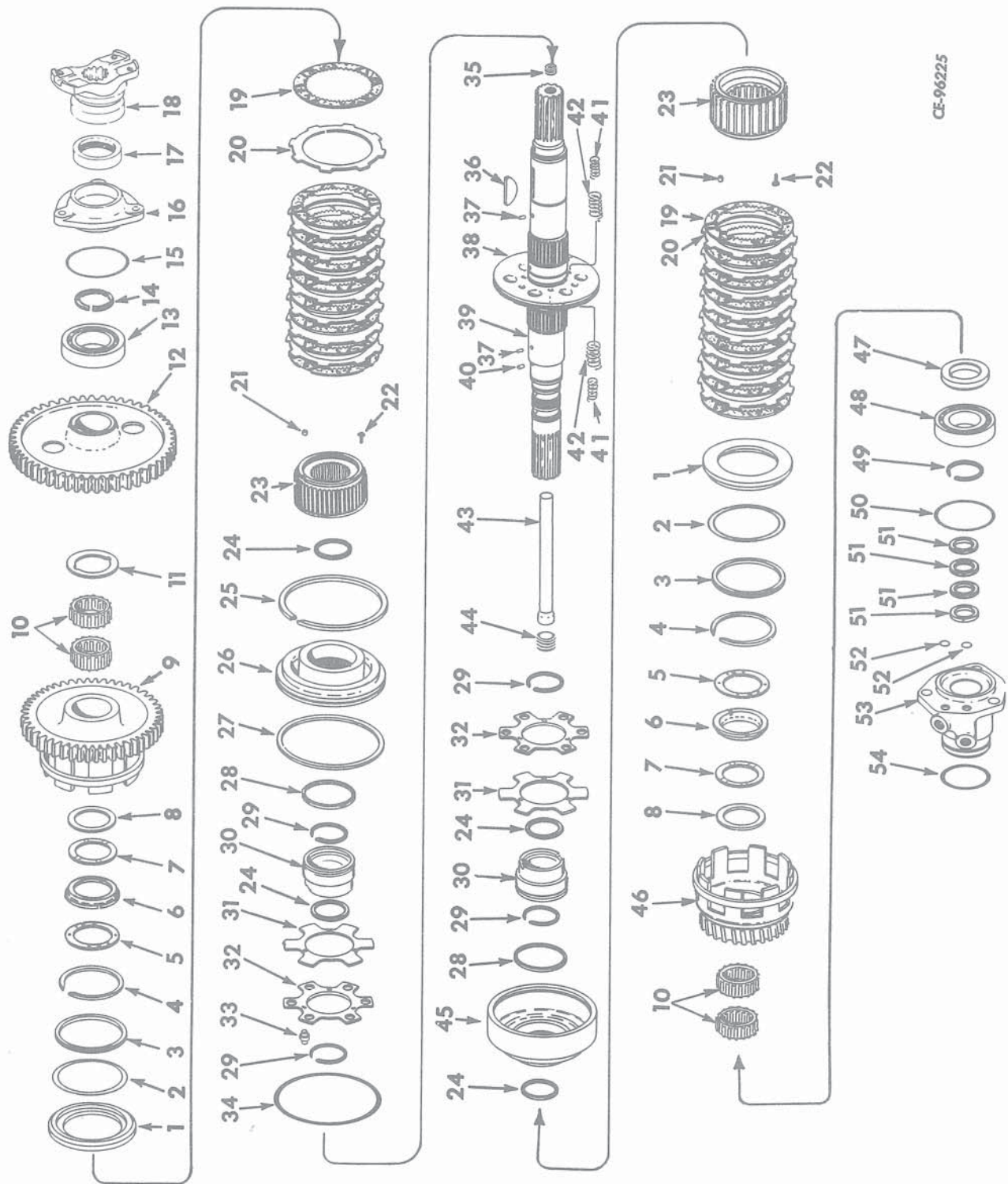


Illust. 23
Removing the High and Low Range
Driven Gears.

(Continued on page 21)

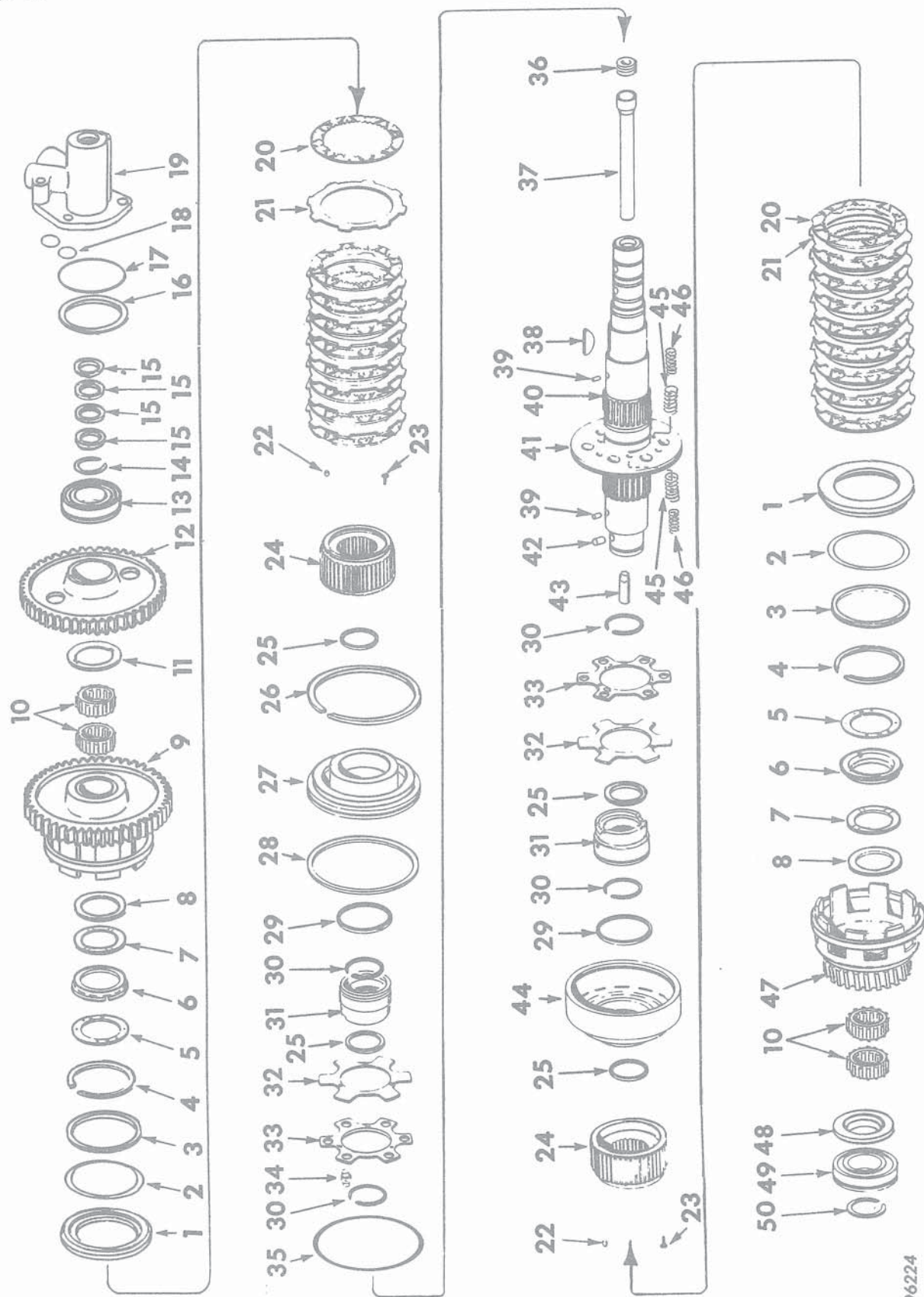
Legend for Illust. 24

- | | | |
|---|--------------------------|---|
| 1. Backing plate. | 19. Clutch plate. | 37. Spring pin. |
| 2. Snap ring retainer. | 20. Clutch plate. | 38. Separator plate. |
| 3. Snap ring. | 21. Dowel pin. | 39. Shaft. |
| 4. Snap ring. | 22. Cap screw. | 40. Dowel pin. |
| 5. Hub retainer. | 23. Clutch hub assembly. | 41. Compression spring (inner). |
| 6. Clutch spacer. | 24. Seal ring. | 42. Compression spring (outer). |
| 7. Thrust washer. | 25. Snap ring. | 43. Shaft tube. |
| 8. Washer spacer. | 26. Force piston. | 44. Plug. |
| 9. Second speed gear and drum assembly. | 27. Seal ring. | 45. Piston housing. |
| 10. Roller bearings. | 28. Seal ring. | 46. First speed gear and drum assembly. |
| 11. Thrust washer. | 29. Snap ring. | 47. Thrust washer. |
| 12. Reverse drive gear. | 30. Accelerating piston. | 48. Bearing. |
| 13. Bearing. | 31. Disc valve. | 49. Snap ring. |
| 14. Snap ring. | 32. Reinforcing disc. | 50. Sealing ring. |
| 15. "O" ring. | 33. Guide pin. | 51. Sealing rings. |
| 16. Housing. | 34. "O" ring. | 52. "O" ring. |
| 17. Lip type oil seal. | 35. Plug. | 53. Hydraulic manifold. |
| 18. Drive yoke. | 36. Key. | 54. Sealing ring. |



Illust. 24
Exploded View of Forward Clutch Shaft.

TRANSMISSION (POWER SHIFT)



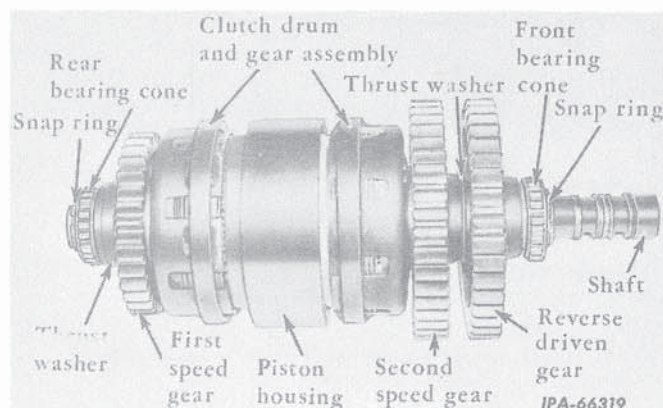
Illust. 25
Exploded View of Reverse Clutch Shaft.

CE-96224

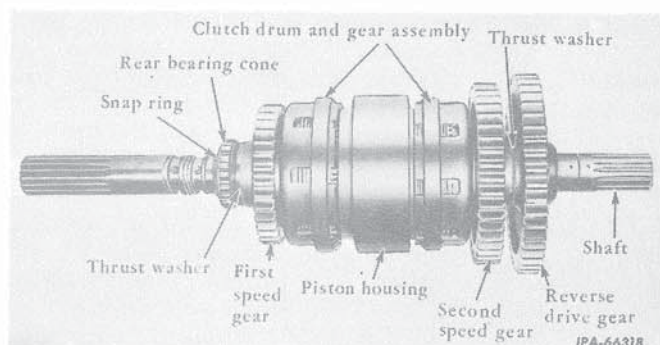
Legend for Illust. 25

- | | | |
|---|--------------------------|---|
| 1. Backing plate. | 17. Sealing ring. | 35. "O" ring. |
| 2. Snap ring retainer. | 18. "O" rings. | 36. Pipe plug. |
| 3. Snap ring. | 19. Hydraulic manifold. | 37. Shaft tube. |
| 4. Snap ring. | 20. Clutch plate. | 38. Key. |
| 5. Hub retainer. | 21. Clutch plate. | 39. Spring pin. |
| 6. Clutch spacer. | 22. Dowel pin. | 40. Shaft. |
| 7. Thrust washer. | 23. Cap screw. | 41. Separator plate. |
| 8. Washer spacer. | 24. Clutch hub assembly. | 42. Dowel pin. |
| 9. Second speed gear and drum assembly. | 25. Seal ring. | 43. Dowel pin. |
| 10. Roller bearing. | 26. Snap ring. | 44. Piston housing. |
| 11. Thrust washer. | 27. Force piston. | 45. Compression spring (outer). |
| 12. Reverse driven gear. | 28. Seal ring. | 46. Compression spring (inner). |
| 13. Bearing. | 29. Seal ring. | 47. First speed gear and drum assembly. |
| 14. Snap ring. | 30. Snap ring. | 48. Thrust washer. |
| 15. Sealing rings. | 31. Accelerating piston. | 49. Bearing. |
| 16. Shims. | 32. Disc valve. | 50. Snap ring. |
| | 33. Reinforcing disc. | |
| | 34. Guide pin. | |

5. DISASSEMBLY - Continued

Forward and Reverse Clutch Shafts (Ref. Nos.
Refer to Illust. 24 and 25) - Continued

Illust. 26
Reverse Clutch Shaft Assembly.

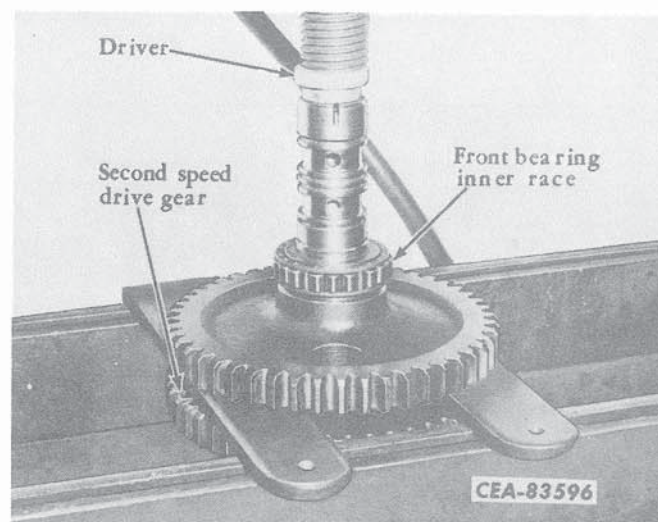


Illust. 27
Forward Clutch Shaft Assembly.

32. REVERSE CLUTCH SHAFT: Remove the front bearing snap ring (14). Support the shaft assembly on a press under the reverse driven gear (12) and press the shaft from the gear and inner race of the front bearing (13) (Illust. 28). Remove the gear key (38) from the shaft.

FORWARD CLUTCH SHAFT: Support the shaft assembly in a press under the reverse drive gear (12) and press the shaft from the gear. Remove the gear key (36).

(Continued on next page)

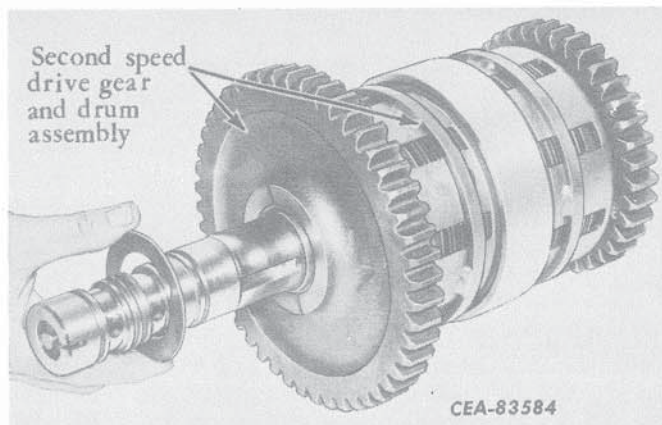


Illust. 28
Removing the Reverse Driven Gear.

5. DISASSEMBLY - Continued

Forward and Reverse Clutch Shafts (Ref. Nos.
Refer to Illust. 24 and 25) - Continued

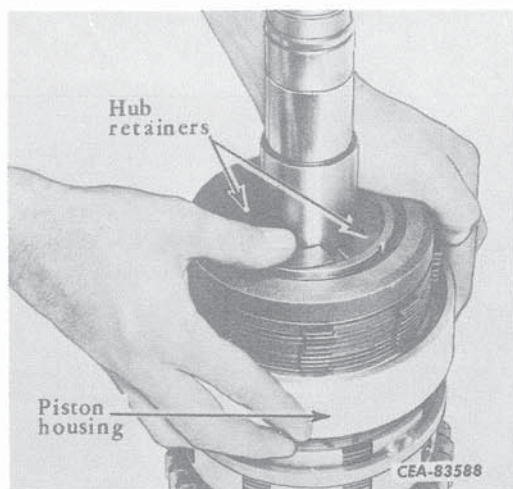
33. Remove the second speed drive gear thrust washer (11) from the clutch shaft. Slip the second speed drive gear and drum assembly (9) off the shaft (Illust. 29). Remove the two caged roller bearings (10).



Illust. 29
Removing the Second Speed Drive
Gear Thrust Washer.

34. Remove the spacer (8), thrust washer (7) and clutch spacer (6) from the shaft.

35. Remove the two cap screws (22 or 23) securing the retainer halves (5) to the clutch hub (23 or 24).

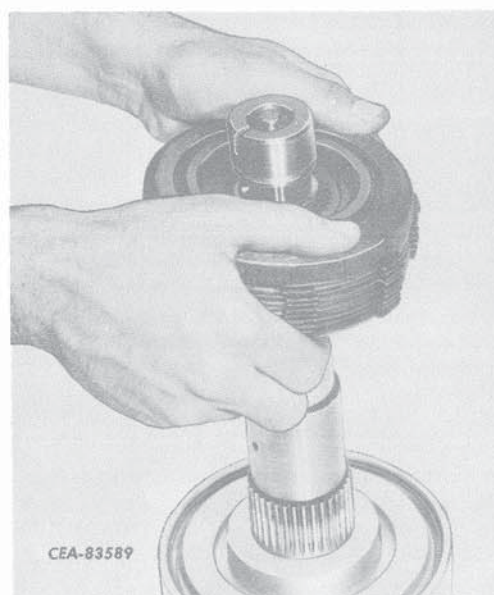


Illust. 30
Removing the Clutch Hub Retainers.

36. Remove the hub retainers (5). To free the retainers (5) from the shaft, grasp the end of the piston housing with the fingers and using the palms of the hands compress the hub assembly (Illust. 30).

37. Grasp the outside diameter of the steel clutch plates (20 or 21) and lift off the clutch hub assembly (Illust. 31).

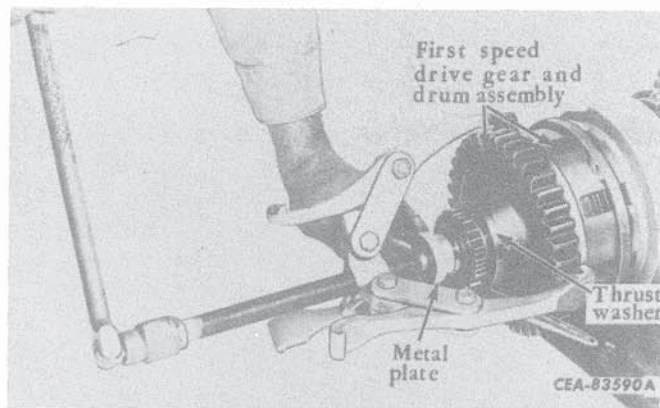
NOTE: The hub assembly must be lifted straight off. Be careful not to cock the hub (23 or 24) on the shaft splines as the return springs in the hub may become twisted.



Illust. 31
Removing the Clutch Hub Assembly.

38. Remove the rear bearing snap ring (49 or 50) from the clutch shaft. Install a three jaw puller to the first speed drive gear and drum assembly as shown in Illust. 32. The gear and drum assembly and the thrust washer are not tight on the shaft and will push the bearing inner race off the shaft. Remove the thrust washer (47 or 48) and the gear and drum assembly (46 or 47). Lift the caged roller bearings (10) from the clutch shaft. Remove the spacer (8), thrust washer (7) and the clutch spacer (6).

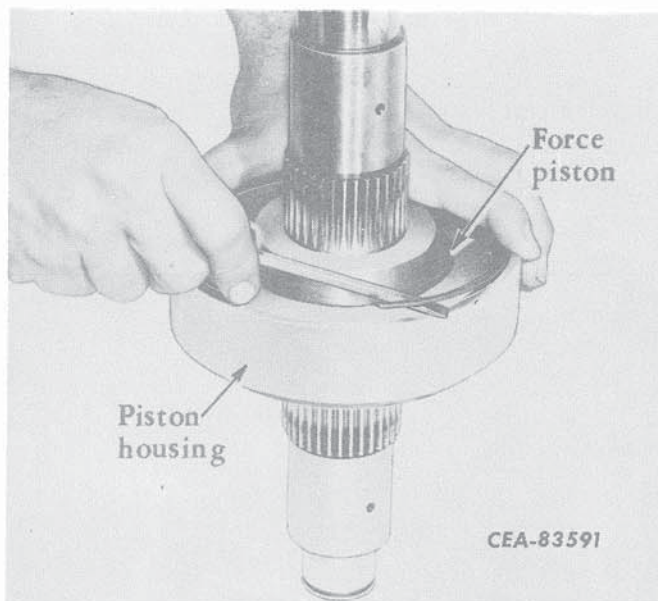
NOTE: Do not remove the bearing inner race with a bearing split collar puller plate as the bearing will be damaged. When pulling the bearing race from the shaft, place a flat metal plate between the puller screw and the end of the shaft.



Illust. 32
Removing the Rear Bearing Inner Race.

39. Place the shaft assembly on end so the remaining clutch hub assembly is up. Repeat steps 35 through 37 for removing the clutch hub assembly.

40. Place the shaft on end so the force piston (26 or 27) is up. Remove the internal snap ring (25 or 26) from the groove in the piston housing using a screwdriver or other suitable tool (Illust. 33).



Illust. 33
Removing the Force Piston Snap Ring.

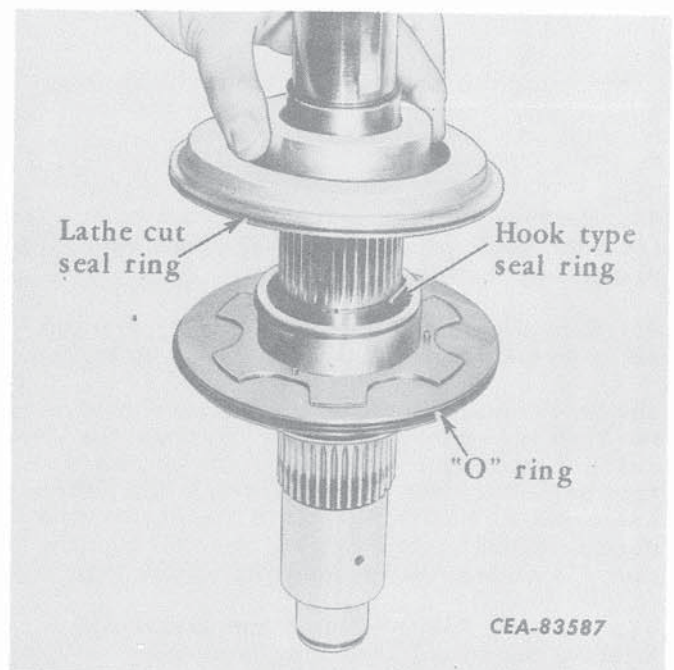
41. To prevent damaging the lathe cut seal ring (27 or 28) on the force piston and the "O" ring (34 or 35) on the separator plate when the piston housing is being removed, fill the snap ring groove in the piston housing. A piece of brazing rod can be rolled around in the groove to the approximate circumference of the force piston or an "O" ring of the exact diameter can be used to fill the snap ring groove.

Push the piston housing down off the force piston. If the housing is tight, tap around the outer diameter of the piston housing with a soft-faced hammer.

42. Lift off the force piston and remove the lathe cut seal ring. Remove the hook type seal ring from the shaft and the "O" ring from the separator plate (Illust. 34).

43. Push the accelerator piston away from the snap ring (29 or 30) and, using a pair of special snap ring pliers No. 1 020 441R1, remove the snap ring (Illust. 35). Remove the accelerator piston. Remove the seal ring (28 or 29) from the accelerator piston. Remove the hook type seal ring (24 or 25) from the clutch shaft.

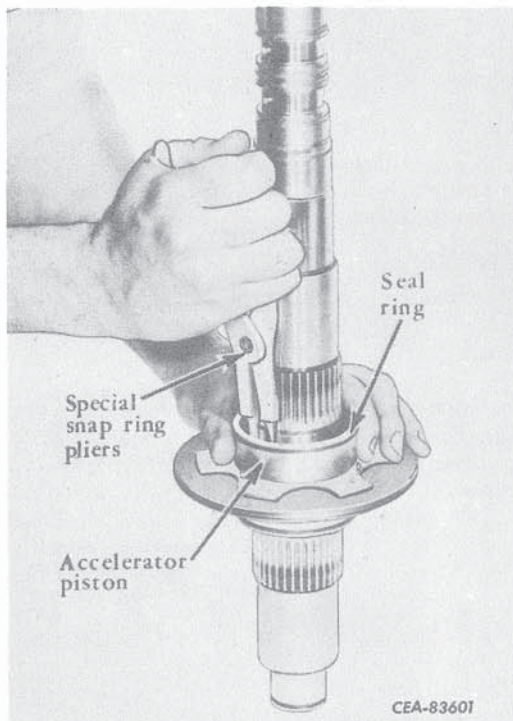
(Continued on next page)



Illust. 34
Removing the Force Piston.

5. DISASSEMBLY - Continued

Forward and Reverse Clutch Shafts (Ref. Nos.
Refer to Illust. 24 and 25) - Continued



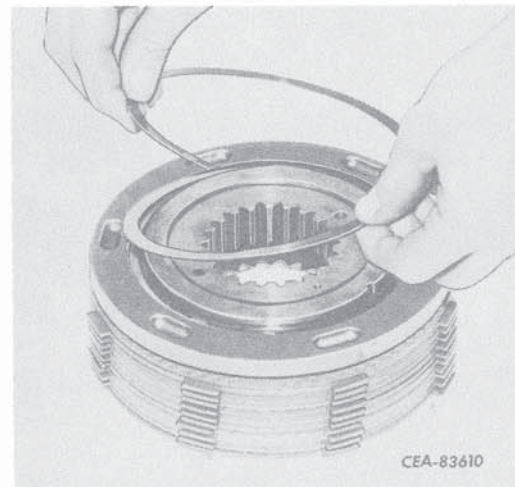
Illust. 35
Removing the Accelerator Piston Snap Ring.

44. Remove the disc valve and reinforcing disc from the guide pins (33 and 34) in the separator plate.

45. Remove the compression springs (41 and 42 or 45 and 46) from the separator plate.

46. Reverse the shaft on the bench. Remove the hook type seal ring (24 or 25) from the shaft. Remove the accelerator piston, hook type seal rings and the reinforcing disc, disc valve and springs in the same manner as was done previously. In addition, the three guide pins (33 or 34) will be removed at this time.

47. Disassemble the clutch hub assembly. Remove the spiral snap ring from the groove in the clutch backing plate. (Illust. 36.) Remove the external snap ring (4), retainer (2), backing plate (1) and the three dowel pins (21 or 22) from the clutch hub (Illust. 37 and 38). Keep the retainer or retainers (1A) with the hub assembly. The same retainers removed

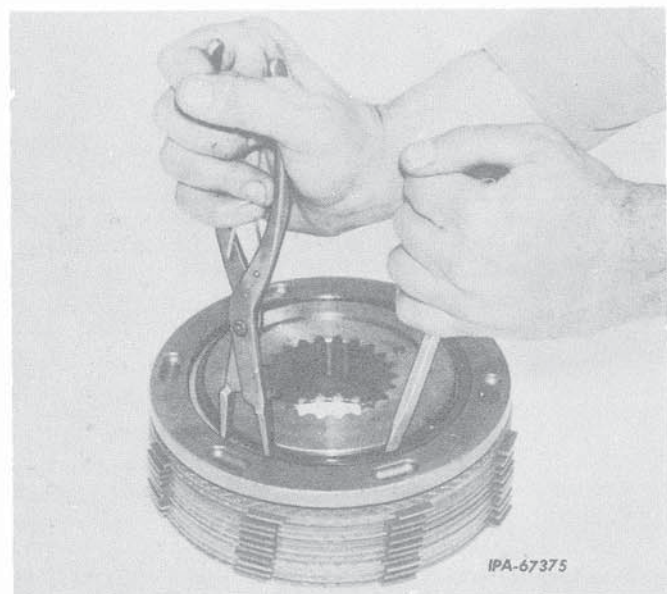


Illust. 36
Removing the Clutch Hub Spiral Snap Ring.

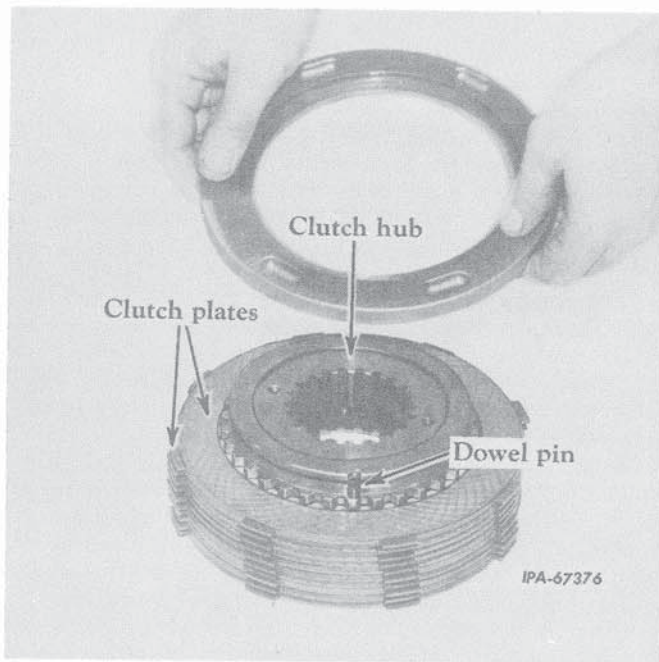
must be reinstalled to maintain the end gap established at the initial installation.

Alternately remove the internal splined clutch plates and externally tanged clutch plates from the clutch hub.

NOTE: No attempt should be made to remove the sheet metal retainers and springs contained on the inside of the clutch hub.



Illust. 37
Removing Clutch Hub External Snap Ring.



Illust. 38
Removing Clutch Hub Backing Plate.

48. Remove the four hook type seal rings (15 or 51) from the clutch shaft.

49. Do not remove the separator plate from the shaft unless it is damaged and a new plate is to be installed. The separator plate is thermally fitted on the shaft and must be removed by one of the following methods to prevent damaging the shaft.

In either of the following methods one of the snap rings next to the separator plate must first be removed.

a. With a hack saw, saw through the separator plate from the outer diameter through one of the six holes and to within approximately 1/16 to the inside diameter of the separator plate. Caution must be used to prevent the saw blade from marring the shaft. Place a chisel in the groove formed by the saw cut on the outer diameter of the separator plate. Using a hammer, drive the chisel down into the saw cut spreading and breaking the separator plate. This should spread the separator plate enough to be easily slipped off the shaft.

b. An alternate method of removing the separator plate is to heat the inside diameter with a torch until it expands enough

to be slipped off of the shaft. The torch flame must never touch the shaft and no attempt should be made to cut the separator plate from the shaft by using the torch.

6. INSPECTION AND REPAIR

1. Inspect all bearings for cracks, scores and wear. Replace if necessary. Soak in oil, wrap and cover until ready for assembly.

2. Inspect the gears for wear or chipped or broken teeth. Replace if wear is excessive or teeth are damaged.

3. Inspect the hi-lo shifter fork fingers for misalignment or wear and the shifter fork slot in the driving gear for wear. (Refer to Par. 2, "SPECIFICATIONS.")

4. Inspect the condition of the hi-lo shifter poppet and poppet lock springs. If they are not within specification as described in Par. 2, "SPECIFICATIONS," they must be replaced.

5. Inspect the splines on the spline shaft and the power take-off and universal joint coupling spline on the forward clutch shaft for wear. Replace shaft if wear is excessive. Slight burrs can be smoothed down with a stone.

6. Remove the plugs in the ends of the clutch shafts and flush all oil passages. Install the plugs. Be sure all lube holes are clean and free of obstruction. All parts of the clutch packs should be thoroughly cleaned and recoiled before assembly.

7. Inspect the first and second speed drive gear thrust washers for excessive wear (refer to Par. 2, "SPECIFICATIONS" for minimum allowable thickness).

8. Inspect the clutch hub assembly. Lubrication holes in the hub should be checked for possible contamination by foreign particles that could interfere with lubrication. The return springs should be checked visually to see if they are properly seated and not damaged. Push the spring plate down by hand and release to check spring fatigue and binding. Spring plate must return immediately upon release. If any components of the hub assembly are not functioning properly, replace the complete hub and backing plate assembly.

(Continued on next page)

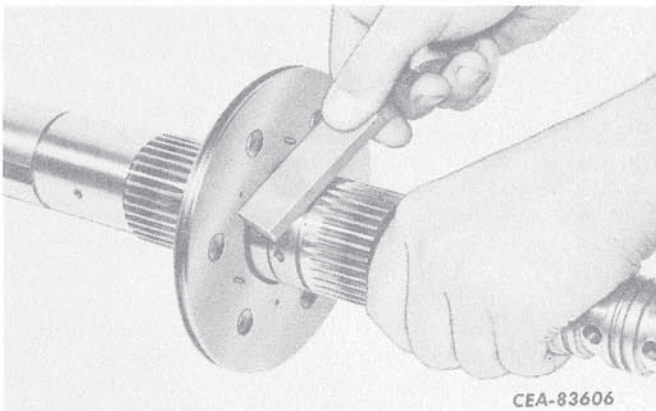
6. INSPECTION AND REPAIR - Continued

9. Inspect the "O" rings, sealing rings, reinforcing disc and disc valve of the forward and reverse clutch packs for wear or damage and replace parts as necessary.

NOTE: Do not mistake the loose appearance of the separator plate "O" ring as being stretched or deformed. It has been manufactured with a greater circumference than the separator plate.

10. Inspect the clutch plates for excessive wear or warpage and replace if necessary. (Refer to Par. 2, "SPECIFICATIONS" for wear tolerance of bronze clutch plates.)

11. Using an oil stone, remove any burrs that might damage sealing surfaces or increase wear to close tolerance parts (Illust. 39).



Illust. 39
Removing Burrs from Clutch Shaft.

12. Check the compression springs for damage and fatigue. If they do not fall within the tolerances given in Par. 2, "SPECIFICATIONS" they must be replaced.

13. Flush and clean all oil lines and the oil coolers to assure a clean hydraulic system.

14. If the oil seal used at the front of the forward clutch shaft needs replacement, refer to Par. 7, "REASSEMBLY" under "Transmission Case and Cover" for the proper method of installing a new oil seal.

Procedure for Servicing and Adjusting
Tapered Roller Bearings
(Ref. Letters Refer to Illust. 40)

The tapered roller bearings and spacer are furnished as a matched unit, so a definite procedure for adjustment of the tapered roller bearings, due to normal wear, must be followed.

1. Assemble the complete bearing assembly on a flat surface (surface plate).

2. Place a weight (20 pounds minimum) on top of bearing assembly as shown in Illust. 40. This will keep the rollers in alignment.

NOTE: Be sure to place parallels or spacers on the bearing, and then rest the weight on top of the parallels or spacers. This is done so the weight is free from touching the bearing cone or rollers and the proper thrust is given. The same must be done between the bottom surface of the bearing cup and the surface plate (Illust. 40). Bottom parallels must be of equal thickness.

3. Rotate the cones (C) to a minimum of four revolutions in each direction.

4. With the spacer (B) in place, set the dial indicator at zero. Check at three different points.

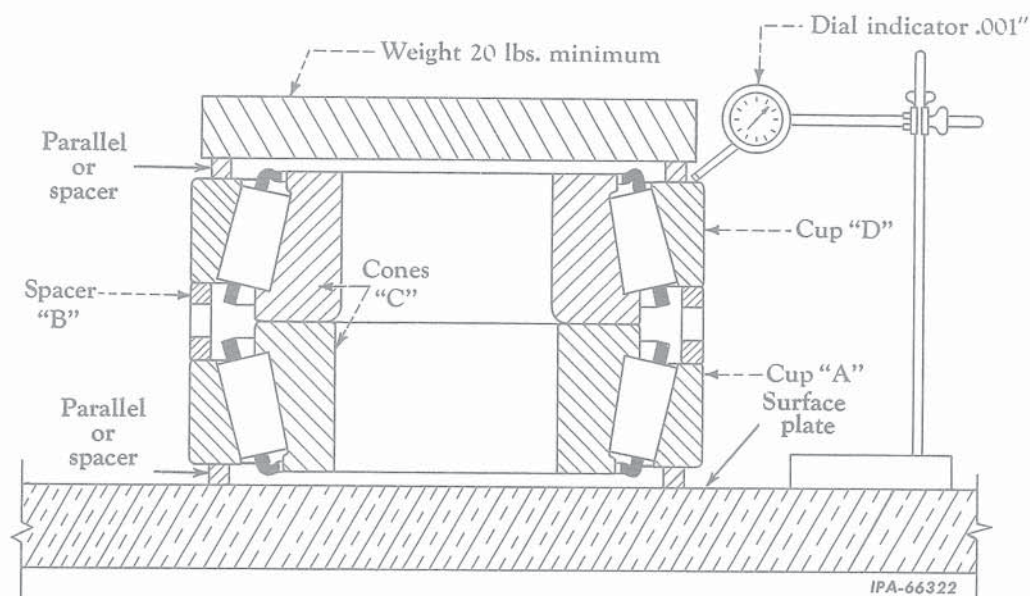
5. Slide the dial indicator off the cup (D) carefully. (Do not disturb the indicator reading.)

6. Remove the weight, parallels, cup (D) and spacer (B). Replace the cup (D), parallels and weight. (Do not replace the spacer (B).)

7. Repeat the rotation of the cones (C) and slide the dial indicator on the cup (D). Be careful to get an accurate reading from the dial indicator. Check at three different points.

8. The factory end play specification in a new bearing assembly is .008 .001 inch. If the reading on the dial indicator shows a greater drop than the maximum factory set end play (.008 .001 inch), grinding or lapping of the spacer (B) is necessary. The amount to be ground off of the spacer is the difference between the indicator reading and the factory set end play.

A bearing assembly that is heavily pitted or scored must not be salvaged.



Illust. 40
Adjustment of Tapered Roller Bearings.

7. REASSEMBLY

Forward and Reverse Clutch Shafts (Ref. Nos. Refer to Illust. 24 and 25)

NOTE: The inner races for the reverse clutch shaft front and rear bearings or forward clutch shaft rear bearing must be heated to 275°F for approximately 45 minutes before assembling on the shaft.

1. If the separator plate (38 or 41) was removed, install the new plate as follows.

Be sure one of the snap rings (29 or 30) is installed on the shaft. Heat the separator plate in oil to 350°F to 400°F for approximately 15 to 20 minutes. This should allow the separator plate to drop onto the clutch shaft flush against the snap ring. Install the other plate snap ring (29 or 30) and allow the plate to cool.

NOTE: Force must not be used at any time in attempting to install the separator plate. After the plate has cooled, it must be checked for warpage.

2. Be sure the pipe plugs (35 and 44) in both ends of the forward clutch shaft and plug (36)

in the front of the reverse clutch shaft are installed below or flush with end of shaft.

3. Place the shaft on end. Install an inner and outer compression spring (41 and 42 or 45 and 46) into each of the three spring bores in the separator plate.

4. Install the reinforcing disc (32 or 33) on the springs. Install the disc valve (31 or 32) on the reinforcing disc.

NOTE: The reinforcing disc is of heavier gauge metal and contains six oil passage holes. The reinforcing disc must be assembled next to the separator plate.

5. Install 2 hook type seal ring (24 or 25) on the shaft in the groove nearest the separator plate. Position the accelerator piston (30 or 31) over the clutch shaft until it is past the snap ring groove and install the snap ring (29 or 30). Install the hook type seal ring (28 or 29) on the accelerator piston (Illust. 35).

6. Place the shaft on a bench with the opposite end up. Install the guide pins (33 or 34) in the separator plate. Be sure to position the reinforcing disc and disc valve installed previously so the pins enter the openings provided in the disc and valve. Repeat Steps 3, 4 and 5.

(Continued on next page)

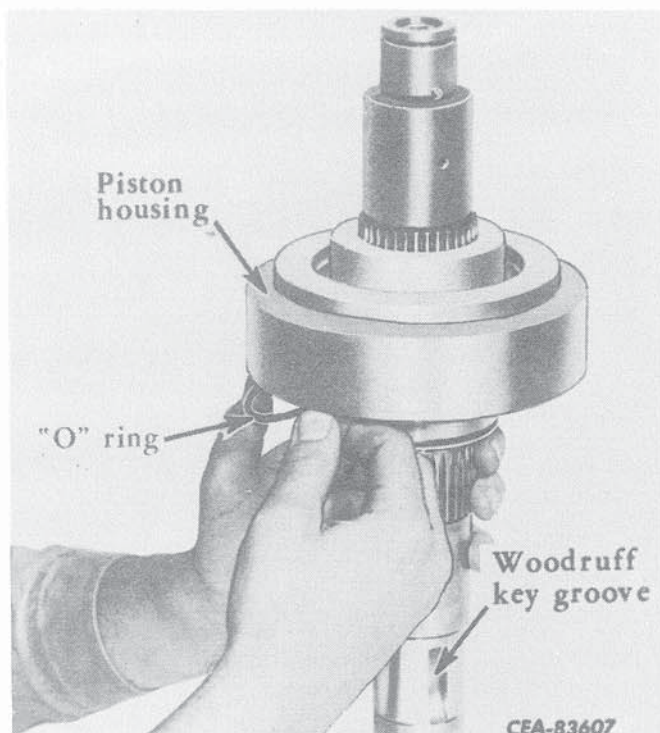
7. REASSEMBLY - Continued**Forward and Reverse Clutch Shafts (Ref. Nos.
Refer to Illust. 24 and 25) - Continued**

7. Place a hook type seal ring (24 or 25) in the clutch shaft groove near each accelerator piston (Illust. 34).

Place the "O" ring (34 or 35) into the groove on the separator plate and apply a low melting, non-fibrous grease around the "O" ring.

8. Remove the brazing rod or "O" ring (used in piston housing removal) from the snap ring groove in the piston housing. This groove does not have to be filled for installing the piston housing.

9. Place the clutch shaft on end so the woodruff key groove in the shaft is down. Position the piston housing (44 or 45) over the shaft until it contacts the separator plate "O" ring. Pull the excess of the "O" ring into a small loop in one area as shown in Illust. 41, positioning the rest of the "O" ring against the inside diameter of its groove. Allow the chamfer on the leading edge of the piston housing to cover as much of the "O" ring as possible and feed the excess loop of the "O" ring back into its groove. Push the piston housing over the "O" ring and the separator plate.

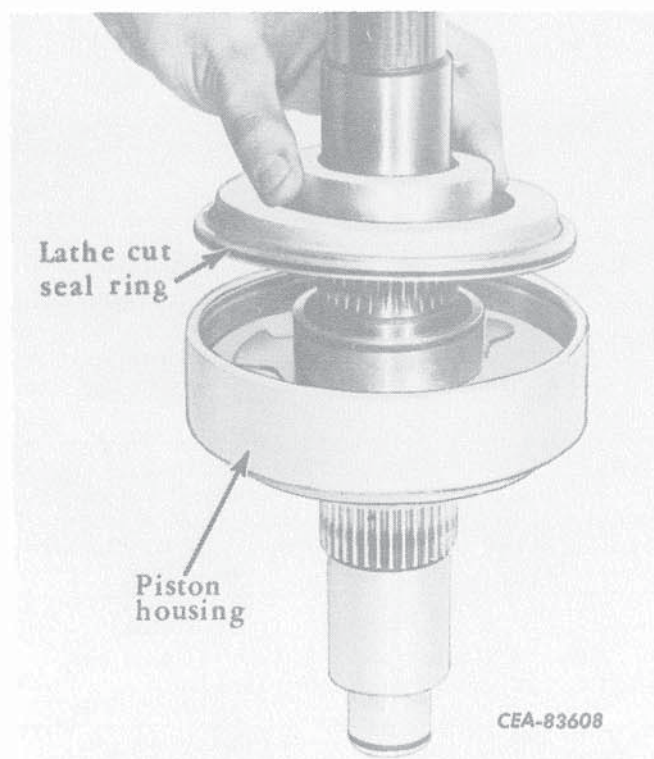


Illust. 41
Positioning "O" Ring for Piston
Housing Installation.

ISS-1523 (1-70)

NOTE: Do not force the piston housing into position. Allow the chamfer of the housing to compress the seal rings and move the housing slowly over the separator plate "O" ring. Rough handling of the housing can result in a broken seal ring or cut "O" ring.

10. Reverse the shaft assembly on the bench. Install the lathe cut seal ring (27 or 28) into the groove in the force piston (26 or 27). Position the force piston on the clutch shaft and engage it into the piston housing. Care must be taken to prevent damage to the lathe cut seal ring (Illust. 42).



Illust. 42
Installing the Force Piston.

As the force piston contacts the piston hook type sealing ring on the clutch shaft and accelerator piston, rotate the piston and allow the chamfer on the force piston to compress the sealing rings. Do not force the force piston over the sealing rings.

11. After the force piston has cleared the snap ring groove in the piston housing, install the snap ring (25 or 26) (Illust. 33).

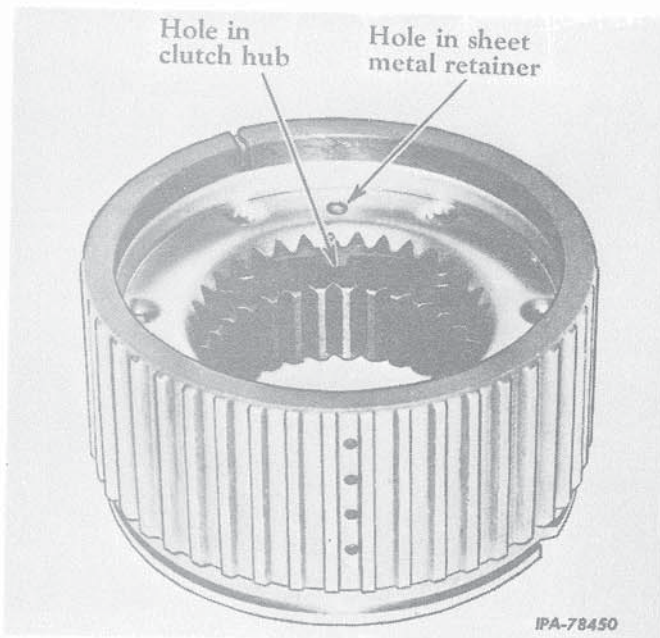
PRINTED IN UNITED STATES OF AMERICA

12. Alternately install one internally splined bronze clutch plate and one externally tanged steel clutch plate on the clutch hub (23 or 24).

NOTE: The bronze faced clutch plates must be thoroughly oiled (with same oil as used in the transmission) prior to assembling on the clutch hub. Because the sintered bronze facing is porous and absorbs oil, a light oiling with an oil can may not be sufficient. Whenever possible, the plates must be soaked, for at least two minutes, in a container of clean transmission oil. If facilities are not available for soaking, a heavy oiling on both surfaces may be sufficient.

13. Position the three dowel pins (21 or 22) into the hub. Install the clutch backing plate (1) over the hub with it properly indexed over the dowel pins (Illust. 38). Place the snap ring retainer or retainers (2) on the hub. Be sure to install the same thickness retainers that were removed. Install the snap ring (4) on the hub to secure the backing plate and install the internal spiral snap ring (3) into the groove in the backing plate (Illust. 36 and 37).

14. Be sure the small hole in the sheet metal retainer is in line with the through hole in the clutch hub (Illust. 43). Position the clutch hub assembly onto the shaft by properly splining the sheet metal retainer and hub splines to the clutch shaft splines (Illust. 31).



Illust. 43
Clutch Hub Assembly.

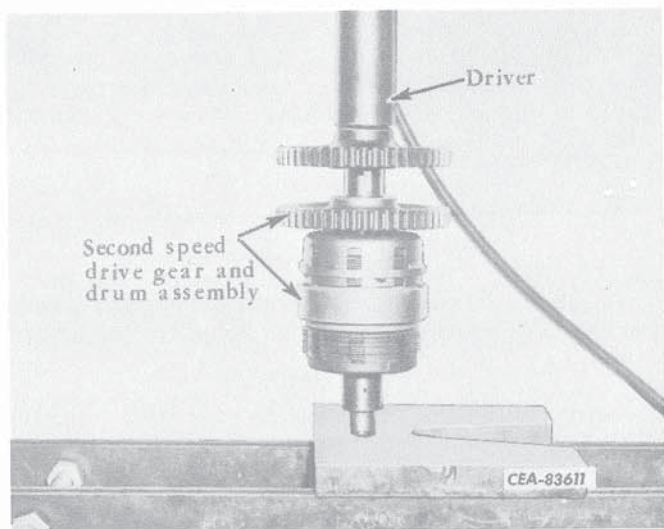
NOTE: When positioning the clutch hub assembly on the shaft, the splines of the retainer will engage the shaft splines first. The splines of the hub, which can be moved separately, may move slightly out of line with the shaft splines. If this happens, and the hub will not go down on the shaft, turn the hub very slightly in either direction until the splines engage. Do not turn the hub so the two holes (refer to Illust. 43) become misaligned. To do so will cock the springs, causing them to bind and even pop off their seats.

15. Compress the hub assembly to install the two clutch hub retainers (5) onto the shaft and secure them with the two cap screws (22 or 23).
16. Assemble and install the remaining clutch hub assembly as described in Steps 12 through 15.
17. Place the shaft on end so the woodruff key groove in the shaft is up.
18. Place the clutch spacer (6) against the clutch hub so the slots of the spacer fit over the flats of the cap screws (22 or 23). Install the thrust washer (7) and washer spacer (8) over the end of the shaft until they are up against the clutch spacer (6).
19. Install the two caged roller bearings (10) over the clutch shaft and against the washer spacer (8). Position the second speed gear and drum assembly (44 teeth) over the shaft, indexed on its outside diameter with the externally tanged clutch plates and flush with the spacer (8) on its inside diameter (Illust. 44).
20. Install the second speed gear thrust washer (11), and gear key (36 or 38) on the shaft.
21. Place the clutch shaft in a press as shown in Illust. 44 and press the reverse drive gear or the reverse driven gear (12) over the woodruff key.
- NOTE: The gear (12) must be installed with the long taper of the gear hub up.
22. **REVERSE CLUTCH SHAFT:** Install the heated inner race of the bearing (13) on the shaft and use the press to hold the inner race in position until it cools. Secure with the snap ring (14).

(Continued on next page)

7. REASSEMBLY - Continued

Forward and Reverse Clutch Shafts (Ref. Nos.
Refer to Illust. 24 and 25) - Continued



Illust. 44
Installing the Reverse Driven Gear.

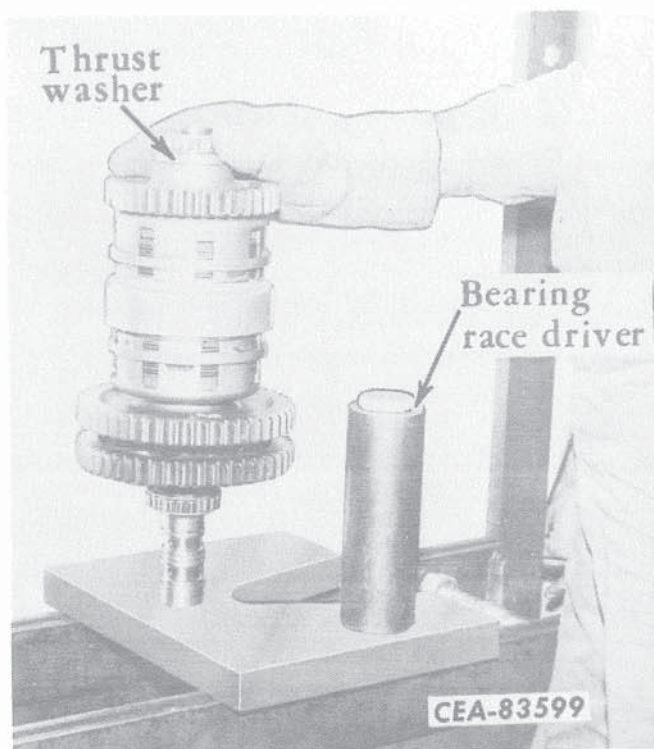
23. Place the shaft assembly on end so the reverse drive gear or reverse driven gear is down.

24. Position the clutch spacer (6) on the clutch hub so the slots of the spacer fit over the flats of the cap screws (22 or 23). Install the thrust washer (7) and washer spacer (8) over the end of the shaft until they are up against the clutch spacer (6).

25. Install the two caged roller bearings (10) over the clutch shaft and against the washer spacer (8). Position the first speed gear and drum assembly (33 teeth) over the shaft, indexed on its outside diameter with the externally tanged clutch plate and flush with the spacer (8) on its inside diameter.

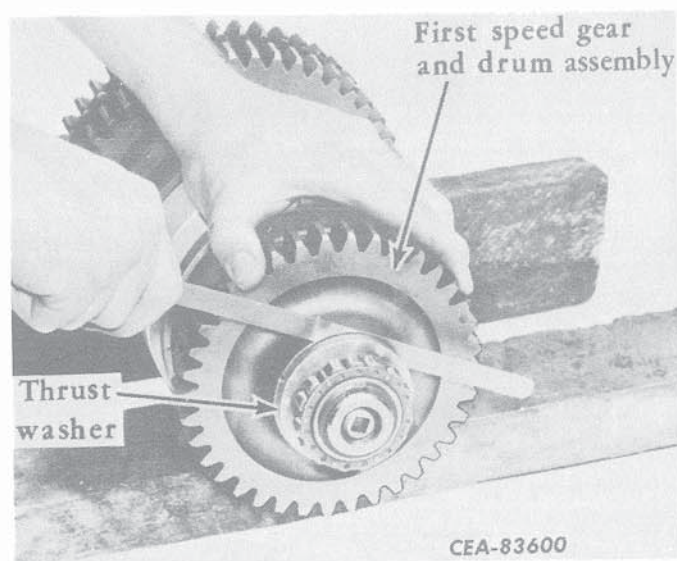
26. Install the thrust washer (47 or 48) on the shaft so the slot engages the dowel pin (40 or 42) (Illust. 45).

27. Install the heated inner race of the rear bearing (48 or 49) on the shaft and use the press to hold the inner race in position until it cools. Secure with snap ring (49 or 50) (Illust. 45).



Illust. 45
Installing the Rear Bearing Inner Race.

28. Check the gear and drum assembly end play. Move the gear and drum assembly away from the thrust washer (11, 47 or 48) as far as possible. Measure the clearance between the gear and thrust washer using a feeler gauge (Illust. 46). The clearance obtained must be



Illust. 46
Checking Gear and Drum Assembly End Play.

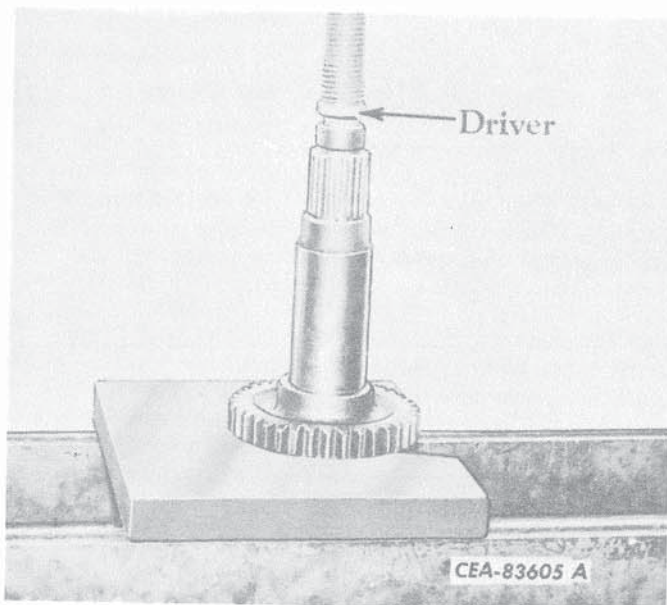
within the limits shown in Par. 2, "SPECIFICATIONS." Check the gear and drum assembly end play on the opposite side of the clutch shaft in the same manner. If the clearance obtained on either of the assemblies is above or below the specified clearance, the clutch shaft must be disassembled and the thrust washer, gear and drum assembly and clutch shaft inspected. Replace the part or parts necessary to bring the end play within the limit specified.

29. Install the hook type seal rings (15 or 51) in the grooves of the clutch shaft.

Pinion Shaft
(Ref. Nos. Refer to Illust. 21)

NOTE: Heat the inner race of the rear bearing to not more than 300°F and the driven gears to not more than 400°F before installing on the shaft.

30. Install the gear key (28) in the keyway closest to the spline. Position the low range driven gear (26) (gear with the larger outside diameter) in a press so the short taper of the gear hub is up. Place the shaft in the gear aligning the gear key with the keyway in the gear and press the shaft into the gear until the shaft shoulder bottoms on the gear (Illust. 47).

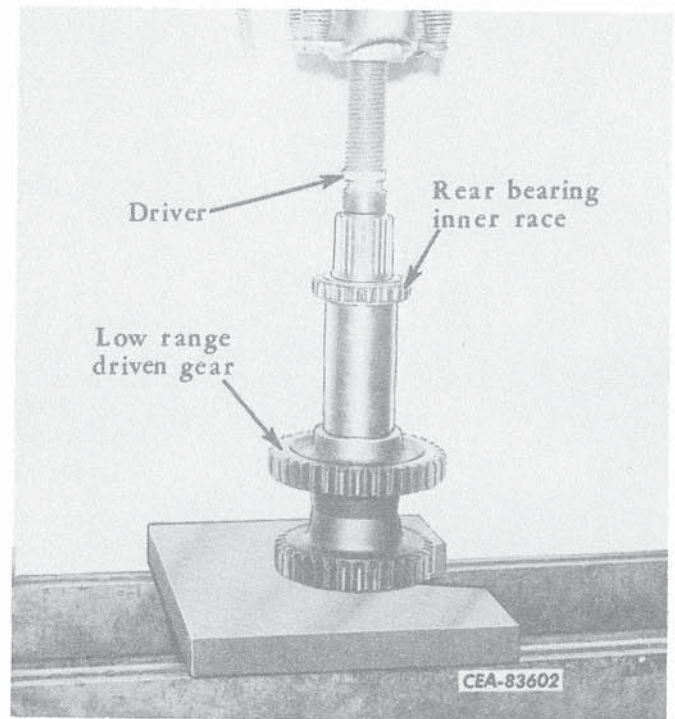


Illust. 47
Installing the Low Range Driven Gear.

31. Position the rear bearing inner race (Illust. 48) on the shaft. Press the inner race on the shaft and hold until it cools.

32. Install the remaining gear key (28). Position the high range driven gear (25) in the press so the long taper of the gear hub is up. Place the shaft in the gear aligning the key and keyway and press the shaft into the gear until the low range gear bottoms on the high range gear (Illust. 48).

33. Remove the assembly from the press. Install the retaining ring (24) in the shaft groove located at the base of the gear (25).



Illust. 48
Installing the High Range Driven Gear.

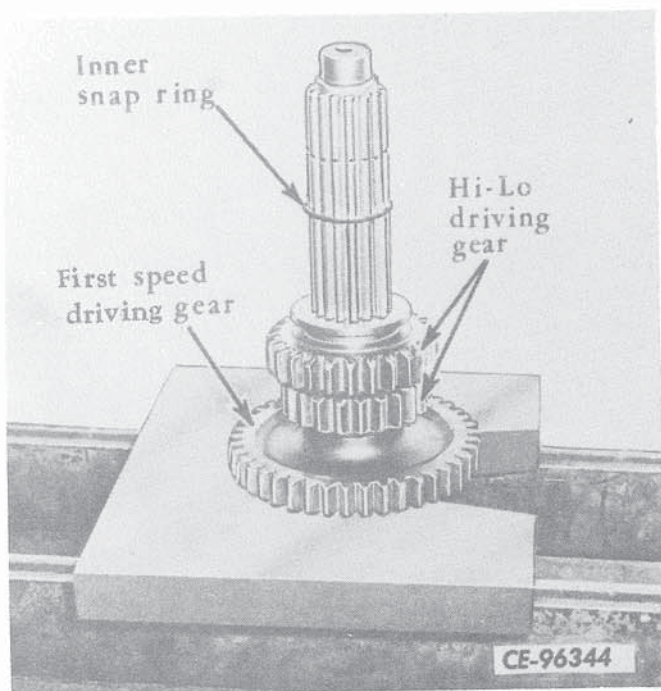
Spline Shaft
(Ref. Nos. Refer to Illust. 21)

NOTE: Heat the front and rear bearing inner races to not more than 300°F and the first and second speed driven gears to not more than 400°F before installing on the shaft.

(Continued on next page)

7. REASSEMBLY - Continued**Spline Shaft**
(Ref. Nos. Refer to Illust. 21) - Continued

34. Install the front snap ring (5) in the second snap ring groove from the rear of shaft (end of shaft with larger bearing riding surface). Place the first speed driven gear (6) (gear with larger outside diameter) in a press. Press the shaft (front end up) into the gear until the snap ring bottoms on the gear (Illust. 49).

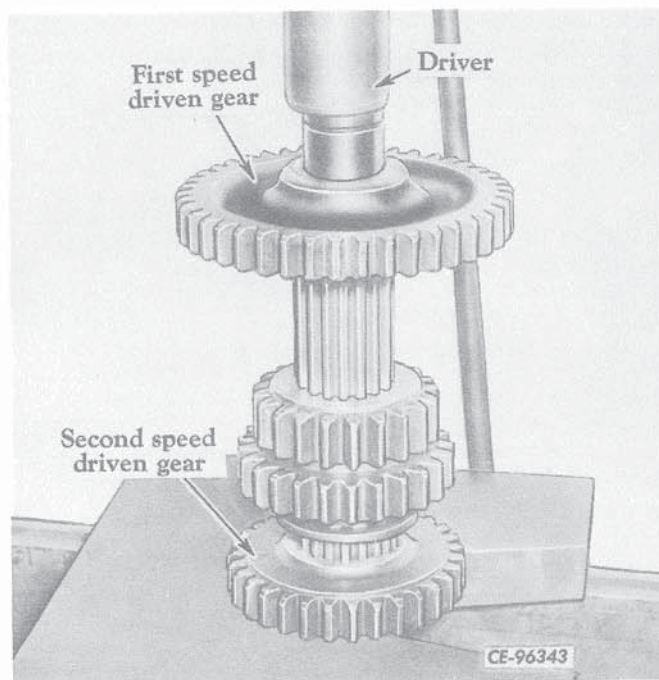


Illust. 49
Hi-Lo Speed Driving Gear Installed.

35. Install the hi-lo speed driving gear (7) so the shift collar is up. Install the second speed driven gear inner snap ring (8) (Illust. 49). Remove the shaft from the press and install the rear snap ring (5) next to the gear (6).

36. Place the second speed driven gear (9) in a press and press the shaft into the gear until the inner snap ring (Illust. 49) bottoms on the gear (Illust. 50). Install the outer snap ring (8).

37. Position the shaft in the press supported by the first speed driven gear. Press the front bearing inner race (Illust. 18) on the shaft until it bottoms and hold in place until it cools.



Illust. 50
Installing the Second Speed Driven Gear.

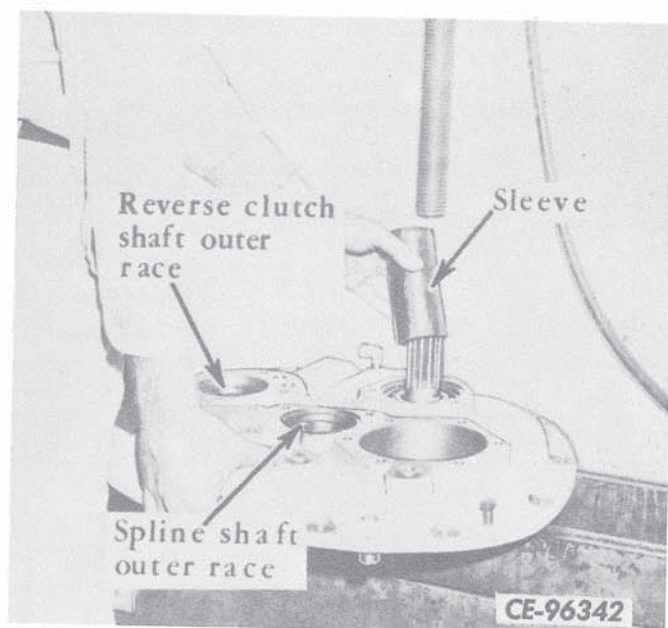
38. Reverse the shaft in the press and press on the rear bearing inner race (Illust. 18) until it bottoms on the shaft and hold in position until it cools.

Transmission Case and Cover

39. Install the reverse clutch shaft and the spline shaft rear bearing outer races into the transmission case until the lips of the bearing races bottom on the case shoulder. Install the pinion shaft rear bearing outer race into the case until it bottoms and secure with the internal snap ring (29, Illust. 21).

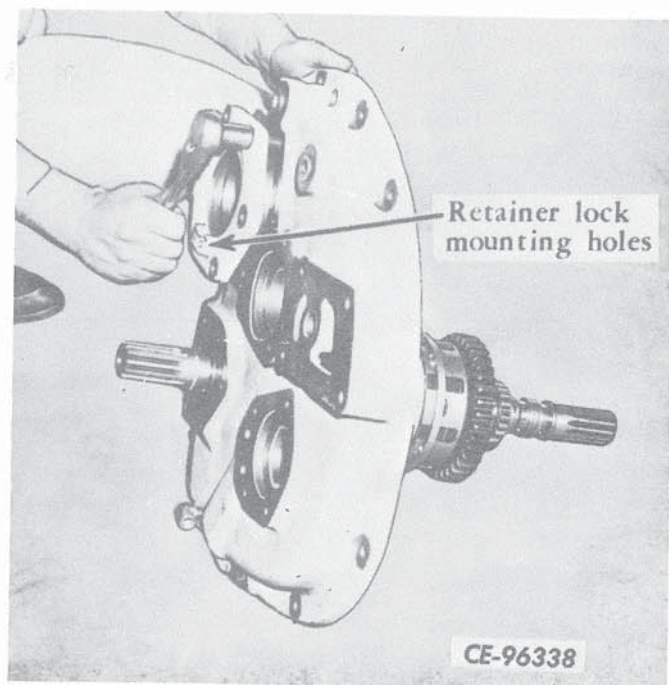
Install the hydraulic manifold (Illust. 12) to the transmission case and install the forward clutch shaft rear bearing outer race until the lip of the bearing race bottoms on the flange of the manifold. Remove the hydraulic manifold.

40. Both the ball bearing for the forward clutch shaft and the straight roller bearing outer race for the spline shaft should be pressed in the transmission front cover until they bottom against a shoulder in their respective bores. If the reverse clutch shaft outer race was removed, or if a new one is to be installed, it should be installed with the lip of the outer race facing up. Press it in until the lip is not more than 1/4 inch past the start of the bore. The proper distance will be adjusted later with the shims (Illust. 51).



Illust. 51
Installing the Forward Clutch Shaft.

41. Place the forward clutch shaft in a press and let the lower end of the shaft rest on blocks. Do NOT rest the clutch shaft on the



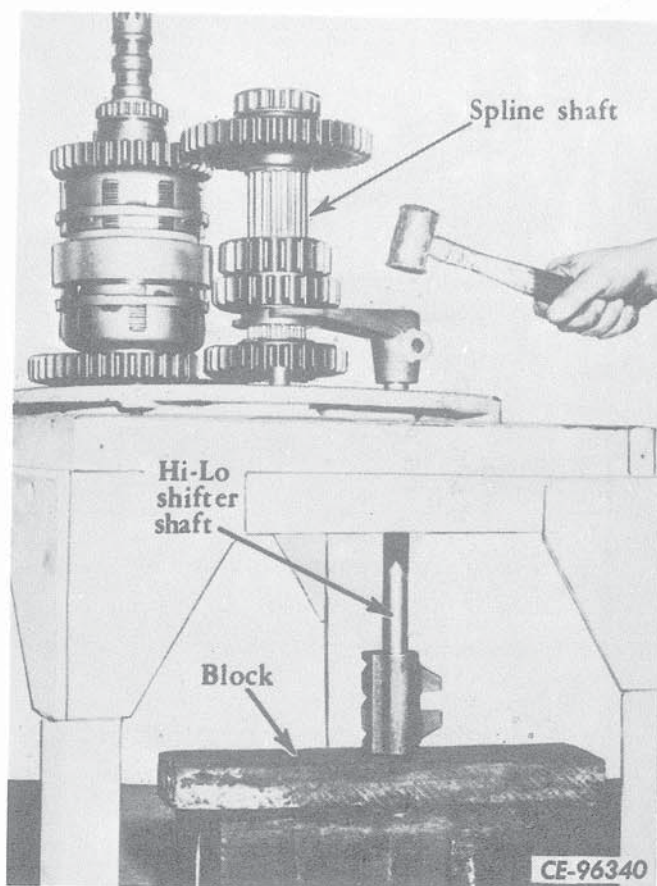
Illust. 52
Installing the Pinion Shaft Front Bearing Cage.

gears. Position the transmission front cover so the ball bearing is over the shaft. Then place a sleeve over the shaft that has an I.D. that will rest on the face of the inner race of the bearing. It should be deep enough to allow the bearing to be pressed all the way on the shaft before bottoming out. Support the transmission front cover by hand while the bearing is being pressed on the shaft. The bearing should bottom against the reverse drive gear. Then install the snap ring (14, Illust. 24) (Illust. 51).

42. Place the sealing ring on the bevel pinion shaft front bearing cage. Install the bearing cage with the two tapped holes for the retainer lock at the bottom (Illust. 52).

43. Place the front cover in the stand or on blocks so the forward clutch shaft is up. Set the spline shaft into the front cover (Illust. 53).

(Continued on next page)

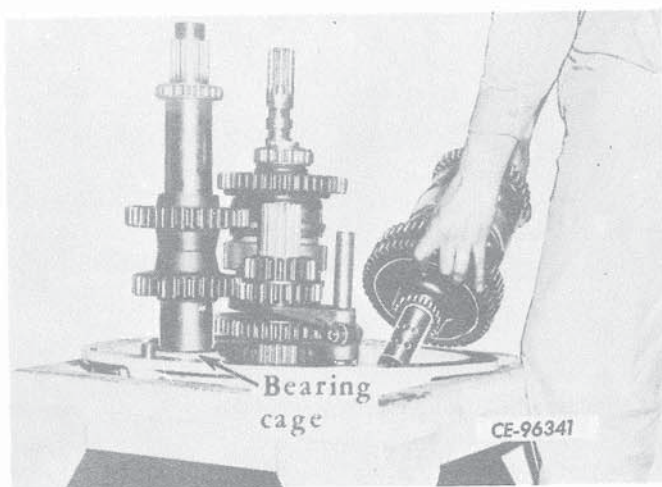


Illust. 53
Installing the Hi-Lo Shifter Shaft and Fork.

7. REASSEMBLY - Continued**Transmission Case and Cover - Continued**

44. Install the hi-lo shifter fork on the sliding gear with the long part of the fork hub facing toward the front cover. Slide the shifter shaft through the bushing in the front cover and through the shifter fork until the slot in the chart is in the center of the fork. Secure the fork to the shaft with a cap screw, washer and nut. If the shifter shaft is tight entering the fork, block the shaft and tap the fork into place (Illust. 53).

45. Be sure the retaining ring (23, Illust. 21) is in position on the front bearing riding surface of the pinion shaft. This retaining ring must be up against the shaft shoulder. Place the pinion shaft in position in the front cover. Use blocks under the shaft to keep it high enough to allow the rear bearing cup to seat on its cone when the case is installed. Install the reverse clutch shaft (Illust. 54).

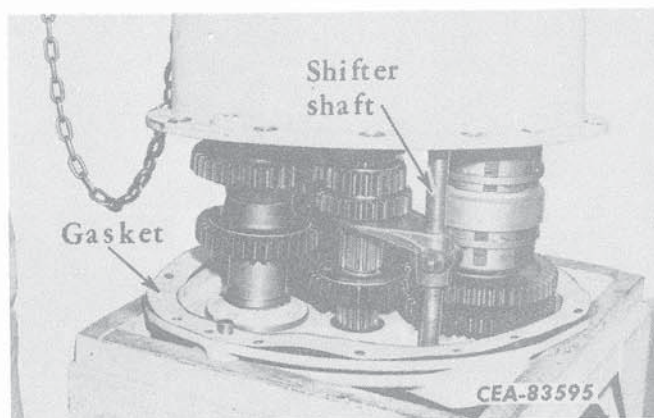


Illust. 54
Installing the Reverse Clutch Shaft.

NOTE: Remove the two pipe plugs in the rear of the case to provide a visual means for aligning the spline shaft and reverse clutch shaft rear bearing cones with their cups as the case is lowered into position. After the case is seated and secured, install the two pipe plugs.

46. Place a jack or blocks under the hi-lo shifter shaft to raise the shaft to its highest position (Illust. 53 and 55). Then install a new transmission cover gasket. Begin to lower the transmission case over the four shafts.

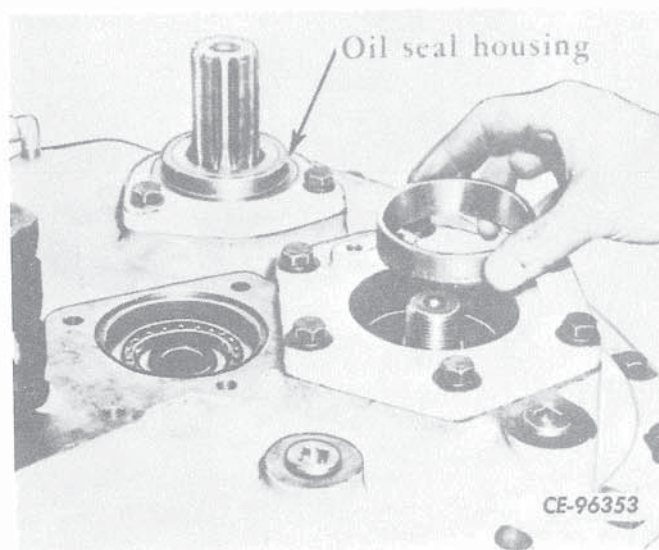
The case should be lowered so that the hi-lo shifter shaft starts into the hole provided for it in the transmission case. Then continue to lower the transmission case until it rests against the top of the shafts. Joggle the case until the rear bearings are properly seated (Illust. 55). Secure the case to the cover with cap screws, washers and nuts.



Illust. 55
Installing the Transmission Case.

47. Position the transmission in the stand or on blocks so the front cover is up.

48. Install the oil seal (17) into the rear of the housing (16) until it is flush with the housing rear face and the seal part number is toward the inside of the housing. Install the "O" ring on the housing (Illust. 24).



Illust. 56
Installing Pinion Shaft Front Bearing Inner Cup.

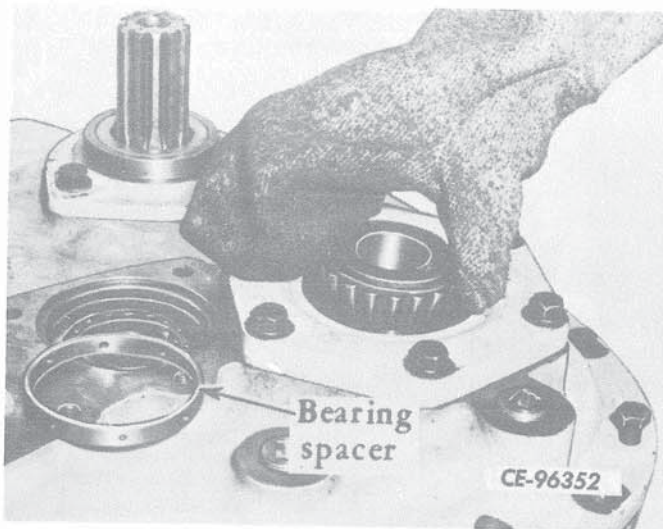
49. Install the oil seal housing with the seal and "O" ring over the forward clutch shaft and secure to the front cover (Illust. 56).

50. Place a jack or some blocks under the pinion shaft and raise the shaft the full length of its travel.

51. Heat the pinion shaft front bearing cones to not more than 250°F for approximately 15 minutes before installing.

52. Install the inner bearing cup of the pinion shaft front bearing into the bearing cage so the large diameter of the taper is up. Be sure the cup bottoms squarely in the cage (Illust. 56).

53. Install the front bearing inner cone (cone with the larger I.D.) on the pinion shaft so the large diameter of the taper is up. Place the bearing spacer on the inner cup (Illust. 57).



Illust. 57
Installing the Pinion Shaft Front Bearing Inner Cone.

54. Install the outer cone on the shaft (small diameter of the taper up) until it bottoms on the inner cone. Install the outer cup until it bottoms on its cone.

55. Install a new nut on the front of the bevel pinion shaft.

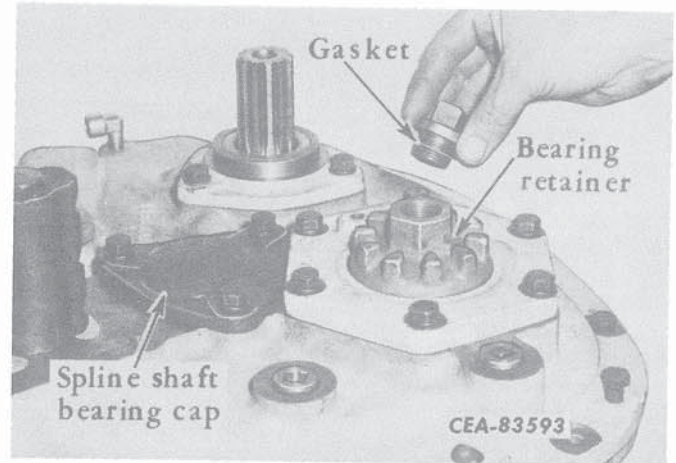
56. Place the transmission assembly on the bench so the shafts are horizontal with the bench.

57. Install a 3/4 inch square drive breaker bar with an extension in the rear of the pinion shaft to keep the shaft from turning and tighten the front nut. Refer to Par. 2, "SPECIFICATIONS" for the proper torque.

58. Place the sealing ring on the spline shaft bearing cap and secure the cap to the front cover (Illust. 58).

59. Place the sealing ring in the groove on the pinion shaft front bearing retainer. Then screw the retainer into the bearing cage until it stops. Use a socket and torque wrench and tighten the retainer to the torque specified in Par. 2, "SPECIFICATIONS" (Illust. 58).

60. Install the retainer plug with gasket on the retainer (Illust. 58).

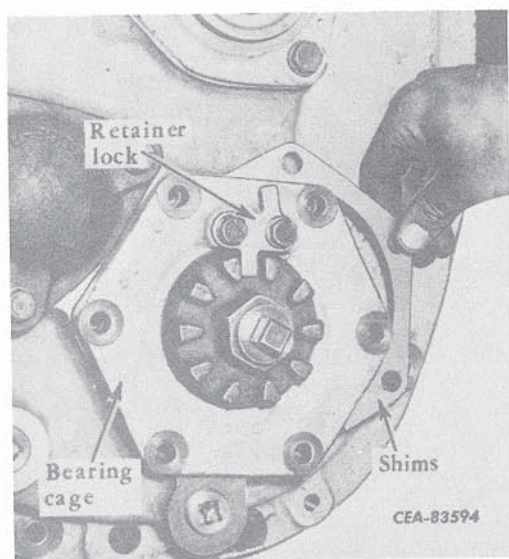


Illust. 58
Installing the Retainer Plug and Gasket.

61. Install the retainer lock. Then remove the cap screws securing the bearing cage and slide the split shims into place. The original shim thickness that was removed must be reinstalled (Illust. 59). Secure the cage to the transmission cover.

NOTE: If the pinion shaft front bearing, pinion shaft, bevel pinion and the drive bevel gear in the steering planetary are to be reused, it will not be necessary to check the pinion shaft end clearance as long as the original shims are installed. However, if a new or reworked bearing, new shaft, pinion or bevel gear is installed, adjust for end clearance after the transmission is installed. (Refer to "STEERING SYSTEM," Section 8.)

(Continued on next page)

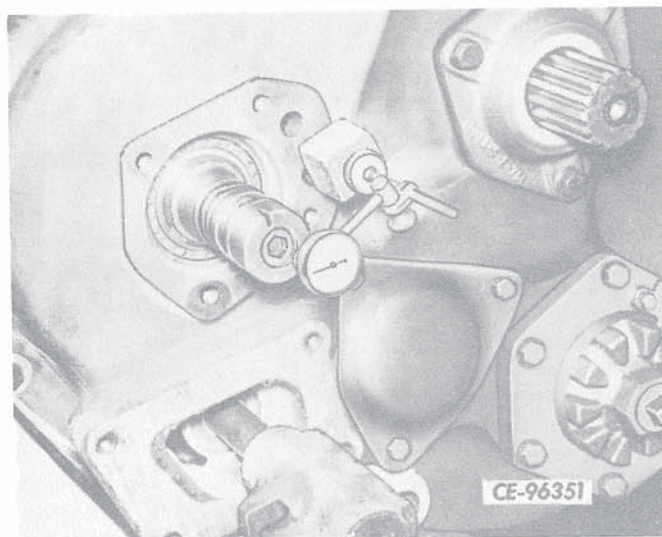
7. REASSEMBLY - Continued**Transmission Case and Cover - Continued**

Illust. 59
Installing the Pinion Shaft Front Bearing
Cage Shims.

62. If a new transmission case or cover has been installed or any reverse clutch shaft bearings or gears replaced, it will be necessary to check the end play in the reverse clutch shaft. If it was not necessary to replace any of these parts, using the original shims will result in the proper end play.

63. To check the reverse clutch shaft end play, push the clutch shaft in until the rear bearing cone bottoms in its cup. Secure the manifold (19, Illust. 25) to the front cover using standard torque. DO NOT install shims (16). Remove the manifold. Mount a dial indicator on the front cover, place the indicator pointer on the end of the shaft and set the indicator at zero (Illust. 60). Pull out on the shaft and take a reading. The difference between the proper end play (refer to Par. 2, "SPECIFICATIONS") and the indicator reading is the amount of shims to be used to obtain the proper end play.

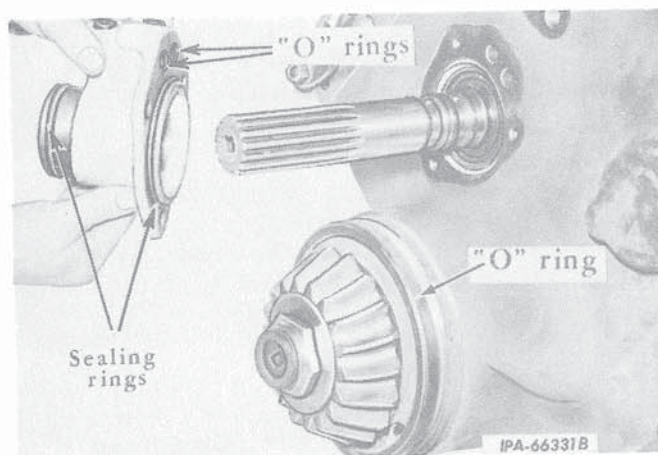
64. **REVERSE CLUTCH SHAFT:** Install the proper amount of shims against the front bearing cup. Be sure the "O" rings (18) and the sealing ring (17) are properly seated to the manifold (Illust. 25). Secure the manifold to the front cover. Be careful not to damage the sealing rings on the shaft as the manifold is passed over them (Illust. 9).



Illust. 60
Checking Reverse Clutch Shaft End Play.

65. Heat the bevel pinion gear to 400°F for one hour and place it on the splines of the bevel pinion shaft. Make sure the gear is pushed back against the inner race of the rear bearing while it is cooling. Do NOT put the new retainer nut on the shaft for 15 to 20 minutes or the plastic portion of the elastic nut will melt. When the nut is installed, tighten it to the specified torque given in Par. 2, "SPECIFICATIONS." To do this, the shaft should be held by the torque wrench. Turn the nut with an open-end wrench.

66. Be sure the "O" rings and sealing rings are properly seated in the forward clutch shaft manifold and carefully guide the manifold over the clutch shaft sealing rings. Secure the manifold to the transmission case (Illust. 61).



Illust. 61
Installing Forward Clutch Shaft Manifold.

67. Install the "O" ring on the rear of the transmission case (Illust. 61).

Hi-Lo Shift Lever Assembly
(Ref. Nos. Refer to Illust. 5)

68. Install the shifter poppet (15) and spring (14) in the shifter housing and secure with the pipe plug (12) and gasket (13). Place the poppet lock (16) in the shifter housing so it engages the poppet. Install the spring (14) and secure with pipe plug (12) and gasket (13) (Illust. 6).

69. Install the shifter housing and gasket (18) to the front cover (21) and secure with cap screws and washers.

70. Install the swivel cap (8), spring washer (7), spring (6) and spring stop (5) over the top of the shift lever and secure by installing a rivet through the shift lever and spring stop.

71. Insert the shift lever in the shifter housing (10) until you feel the lever (9) engage the slot of the shifter rod in the bottom of the housing. Secure the lever to the housing with the swivel shaft (20).

72. Place the shifter lever boot (3) over the top of the lever and secure with the clamps. Install the shift lever ball (1).

8. INSTALLATION

1. Remove the cover from the opening in the rear main frame. Apply a thin film of Molykote type "G" to both ends of the forward clutch shaft.

2. Install and secure the main regulating valve and range selector valve assemblies to the transmission case. Connect the inlet hose extending from the hydraulic manifold to the hi-lo shifter housing.

3. Be sure the "O" ring on the rear of the transmission case and sealing ring on the forward clutch shaft hydraulic manifold are properly seated (Illust. 61). Attach a hoist to one of the main regulating valve mounting holes and one of the upper transmission cover-to-transmission case mounting holes. Hoist the transmission into position and secure it to the rear main frame with the locking cap screws. Install the main regulating valve and transmission cover mounting bolts and washers.

4. Connect the steering brake pull rods at each of the bellcranks. Connect the operating rod to each of the steering boosters.

5. Connect the hoses and tubing to the main regulating valve and the transmission case that had to be removed to facilitate transmission removal.

6. **LOADERS ONLY:** Connect the equipment pump outlet rear tube at the control valve. Secure the tube mounting bracket to the top of the transmission case.

7. Install new "O" rings in the hydraulic manifold counterbores and secure the manifold to the bottom of the control tower.

8. Remove the covering from the flywheel housing. Connect a hoist to the converter housing as was done in removal and position the converter against the flywheel housing. Secure with the cap screws and washers and remove the hoist and eyebolts. Install the two center cap screws and washers in the supply pump inspection cover.

9. Connect the hydraulic lines between the converter, transmission and oil cooler that had to be disconnected to facilitate converter removal.

10. Install the transmission drive yoke (18, Illust. 24) on the splines of the forward clutch shaft. Secure the universal to the drive yoke and to the torque converter output flange.

◆ CAUTION: REMOVE THE WIRE OR TAPE USED TO KEEP THE BEARINGS FROM FALLING FROM THE SPIDER TRUNNIONS. IF INSTALLING A NEW SPIDER AND BEARING ASSEMBLY, REMOVE THE SOFT IRON STRAP ATTACHED TO THE BEARING CAPS. THIS WILL ELIMINATE THE POSSIBILITY OF THE STRAPS OR WIRE BREAKING LOOSE FROM THE CAPS AND CAUSING PERSONAL INJURY WHEN THE ENGINE IS RUNNING.

11. **LOADERS ONLY:** Position the equipment pump in the converter housing transferring the hoist sling as was done in removal and secure the pump with the mounting bolts. Connect the outlet line to the bottom of the pump.

12. Install the rear cover to the underside of the front frame.

13. Connect the three test connection tubes to the main regulating valve.

(Continued on next page)

8. INSTALLATION - Continued

14. Secure the pressure filter assembly to the front frame. Connect the hydraulic lines at the filter base.

15. LOADERS ONLY: Insert the rear of the equipment pump inlet tube into the hose connection and secure with hose clamps. Connect the front end of the tube at the top of the equipment pump with the clamp halves.

TD-20 SERIES C TRACTOR ONLY: Install and secure the inlet tube between the connecting hose and the equipment pump. Connect the outlet hose at the pump.

16. Position the seat support bar (with suction filter and steering levers attached) on the front frame mountings and secure with the cap screws and washers. Connect the hoses at the suction filter.

17. Connect the steering brake pull rods and the booster valve operating rods at the steering levers. Connect the steering booster return springs at the bellcranks and seat side sheets.

18. Position the platform support (with control linkage attached) between the front frame side members and secure to the front frame with the cap screws and washers. Connect the governor control linkage that had to be disconnected to facilitate removal of the platform support.

19. Install and secure the seat front support to the seat support bar and seat side sheets with the cap screws, lock washers, flat washers and nuts.

20. Install and secure the LH and RH front platforms. Connect the pick-up lever rod to the decelerator pedal with the end pin and cotter.

21. Position the brake pawl operating lever so it engages the brake pedal pawl and enters the opening in the seat front support. Install the two guides and two flat washers between the seat side sheet and the operating lever and secure the guides to the seat side sheet with the nuts and lock washers. Install the equipment control valve side cover on the RH fender.

22. Install the batteries and battery support. Connect the battery cables.

23. Install and secure the seat frame. Install the seat bottom cushion.

24. Be sure the drain plugs are installed. Fill the rear frame with the proper grade of oil as specified in the operator's manual. Fill and vent the equipment hydraulic system as described in the pertinent operator's manual.

CAUTION: BEFORE STARTING THE ENGINE, BE SURE ALL THE FLOOR PLATFORMS ARE IN PLACE. AS SOON AS THE ENGINE STARTS, OBSERVE THE TRANSMISSION CLUTCH OIL PRESSURE GAUGE ON THE DASH. IF THE NEEDLE MOVES RAPIDLY TO THE "DANGER AREA" SIDE, IMMEDIATELY TURN OFF THE ENGINE AND WAIT FOR PRESSURE TO SUBSIDE BEFORE DISCONNECTING ANY HOSES OR MAKING ANY INSPECTIONS.

25. Start the engine and check for leaks.

26. Perform the engine idle adjustments as described in Section 4, "ENGINE."

27. Check the oil pressures in the transmission as described in Par. 9, "CHECKING TRANSMISSION OIL PRESSURE."

28. Install the platforms.

29. Install the rear cover directly below the fuel tank at the rear of the unit.

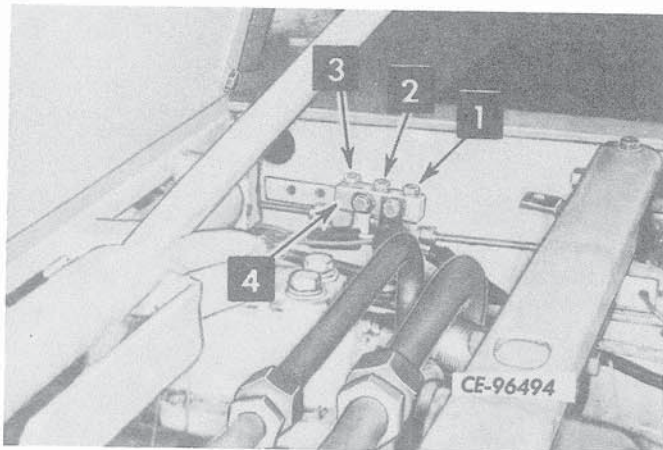
30. After one hour of operation, disassemble and clean the suction filter. Remove the pressure filter case and inspect the element. Replace the element if necessary.

9. CHECKING TRANSMISSION OIL PRESSURE
(Ref. Nos. Refer to Illust. 62)

CAUTION: THE FOLLOWING CHECKS MUST BE MADE BY TWO MEN. ONE MAN MUST BE AT THE CONTROLS WHILE THE OTHER DOES THE CHECKING. THE BRAKE PEDAL MUST BE APPLIED AND LOCKED AND THE MANUAL HI-LO SHIFT LEVER MUST BE IN THE "NEUTRAL" POSITION UNTIL ALL PRESSURE CHECKS HAVE BEEN COMPLETED AND THE ENGINE IS SHUT OFF.

NOTE: The following pressure checks should be performed with the engine running at full throttle (governor control hand lever all the way up in the ratchet) and oil at operating temperature.

Remove the rear platform to connect pressure gauges to the test connection block (Illust. 62).



Illust. 62
Transmission Oil Pressure Check Points.

- | | |
|--------------------------|------------------------------|
| 1. Clutch main pressure. | 3. Lubricating oil pressure. |
| 2. Converter by-pass. | 4. Test connection block. |

Main Pressure

Remove the pipe plug (1) and connect a 0 to 300 psi calibrated gauge in its place. Then with the engine running at full throttle, check the gauge readings with the transmission selector lever in low forward, high forward, low reverse and high reverse. If desired, also check gauge reading with selector lever in the neutral position.

Converter Inlet Pressure

Remove the pipe plug (2) from the test connection header block and install a 0 to 160 psi gauge. Start the engine and check pressure reading while shifting through the complete shift pattern as described previously under "Main Pressure." Converter inlet pressure should be from 50-80 psi in all positions except neutral where the pressure should be 70-110 psi. If the pressures are not within the specified range, refer to the following "DIAGNOSIS CHART."

Lubricating Oil Pressure

Remove the pipe plug (3) and install a 0 to 60 psi gauge. Start the engine and repeat the same checks as before. The lubrication pressure should be 20-30 psi in all positions. If the pressure is not in this range, refer to the following "DIAGNOSIS CHART."

DIAGNOSIS CHART

PROBLEM	POSSIBLE CAUSE
1. Low main pressure in all ranges	1. a. Low oil level. b. Dirty suction filter. c. Fatigued main spring. d. Broken main spool valve spring or spring pin. e. Faulty pressure regulating booster valve.
2. Low main pressure in both forward or both reverse positions only	2. a. Damaged separator plate "O" ring. b. Warped separator plate. c. Leaking clutch shaft tube.
3. Low main pressure in one-speed position only	3. a. Worn seal rings. b. Pipe plug in clutch shaft loose.
4. Low converter inlet pressure	4. a. Low main pressure (see 1). b. Worn seal rings in the converter. c. Fatigued by-pass valve.
5. High converter inlet pressure	5. a. Stuck by-pass valve. b. Plugged safety filter.
6. Low lube pressure	6. a. Low main pressure (see 1). b. Fatigued lube spring. c. Internal clutch pack leakage.
7. High lube pressure	7. a. Stuck lube valve.

TRANSMISSION (POWER SHIFT)

MAIN REGULATING VALVE

10. REMOVAL AND DISASSEMBLY (Ref. Nos. Refer to Illust. 63)

NOTE: Tag disconnected hoses and cap openings with a suitable plastic cap to prevent dust or dirt from entering. Never plug hydraulic openings with rags. If plastic caps are not available, use tape.

1. Remove the seat frame, batteries and battery support.
2. Disconnect the converter inlet hose and the oil cooler outlet hose at the main regulating valve. Disconnect the test connection block tubes and the pivot brake tube at the main regulating valve. Bend the tubes out of the way.
3. Remove the cap screws and washers securing the valve to the top of the transmission

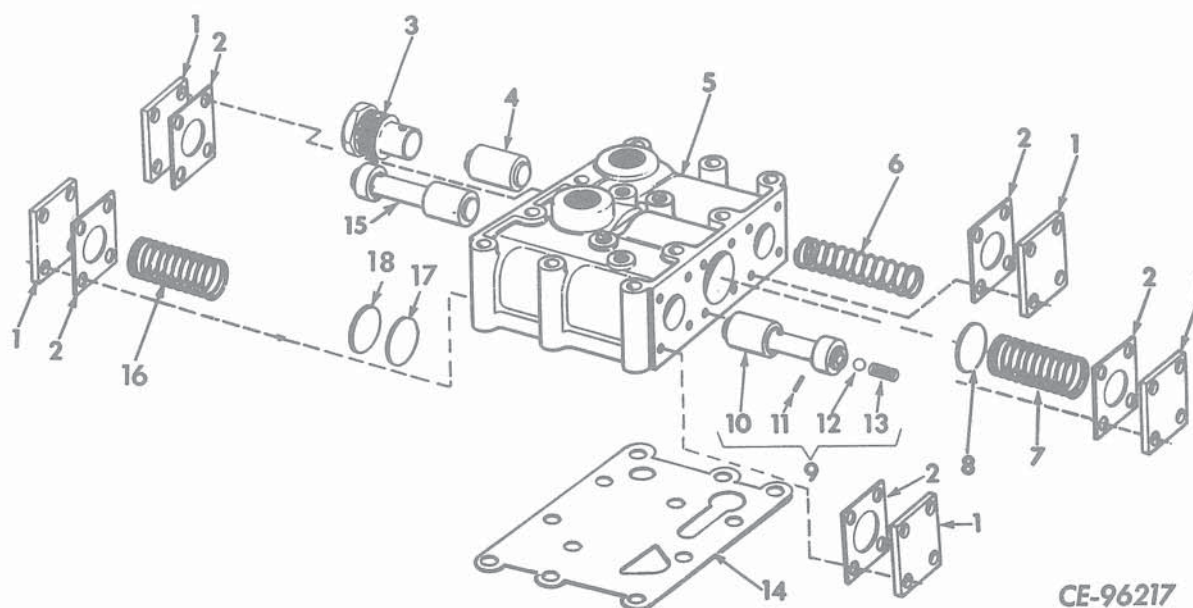
case and remove the valve assembly. Discard the mounting gasket (14).

4. Remove the valve cover (1) and gasket opposite the plug (3). Tip the valve body to remove the valve (4) and spring (6).

5. Remove the valve cover and gasket next to the plug (3) and remove the by-pass valve (15) from the valve body. Remove the plug (3) from the valve body.

6. Turn the valve body around and remove the valve cover and gasket from the spring end. Tilt the body and the spring (7) and washer (8) will slide out.

7. Remove the valve cover and gasket from the valve end of the body and tip the body to remove the valve assembly (9). To disassemble the valve, drive out the pin (11) and tip the valve down to allow the spring (13) and ball (12) to fall free of the valve (10).



CE-96217

Illust. 63
Exploded View of Main Regulating Valve Assembly.

- | | | |
|---|------------------------------------|--------------------------------------|
| 1. Valve cover. | 7. Valve spring. | 13. Main spool valve spring. |
| 2. Gasket. | 8. Spring washer. | 14. Gasket. |
| 3. Plug. | 9. Main regulating valve assembly. | 15. By-pass valve. |
| 4. Lubricating pressure regulating valve. | 10. Valve. | 16. Main pressure regulating spring. |
| 5. Valve body. | 11. Pin. | 17. Spring washer. |
| 6. Valve spring. | 12. Ball. | 18. Spring washer. |

MAIN REGULATING VALVE

8. Remove the remaining valve cover and gasket and lift out the main pressure regulating spring (16). Tip the valve body to remove the spring washers (17 and 18).

11. INSPECTION AND REPAIR

1. Clean all parts in a suitable cleaning solution and blow dry with compressed air. Be sure that all the oil passages in the valve body are free of foreign particles and dirt. Be sure the relief passage in the by-pass valve and the oil passages in the main regulating valve are clean and free of any obstruction.

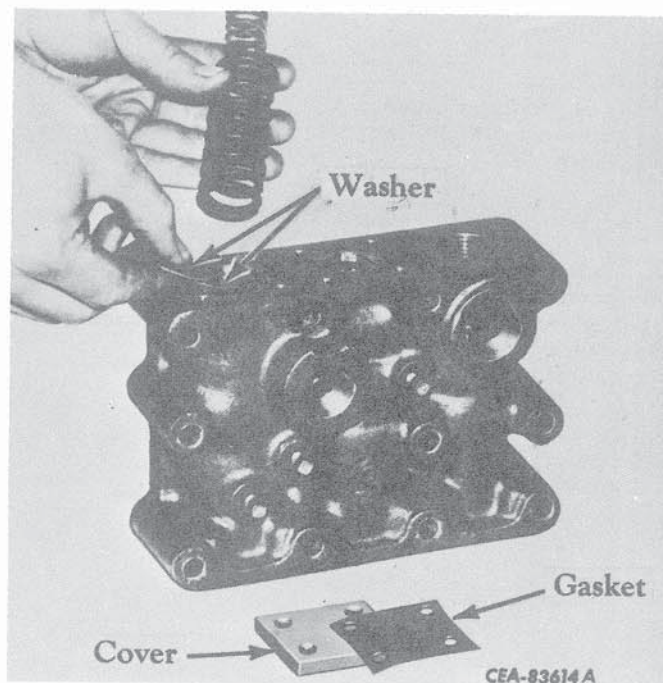
2. Inspect the parts for excessive wear and replace if necessary.

3. Inspect the condition of the valve springs. If they are not within the specifications as described in Par. 2, "SPECIFICATIONS," they must be replaced.

12. REASSEMBLY AND INSTALLATION
(Ref. Nos. Refer to Illust. 63)

NOTE: Use new gaskets and lubricate the valves and valve bores with transmission oil upon reassembly.

1. In the end bore, place the same amount of spring washers (17 and 18) that were removed.

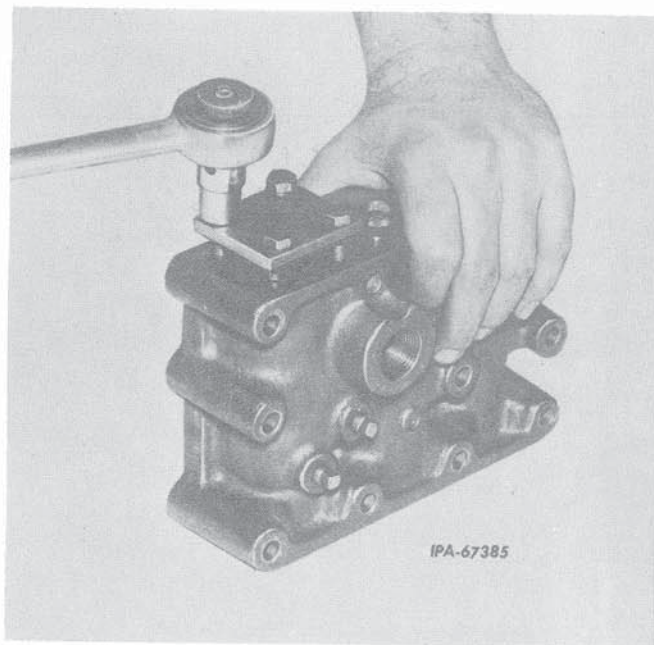


Illust. 64

Installing Main Valve Spring and Washers.

Be sure washers are not cocked and install the regulating spring (16). Install and secure the valve cover and gasket (Illust. 64).

NOTE: Because of the tension exerted by the spring (16) it will be necessary to use longer cap screws to tighten the cover (1) down until the regular cap screws can be installed (Illust. 65).



Illust. 65

Installing Main Valve Spring Cover and Gasket.

NOTE: If the main regulating valve assembly (9) was disassembled, insert the ball (12) and spring (13) into the opening in the valve (10) and secure with pin (11).

2. Turn the valve body over and install the main regulating valve assembly (9) in the other end of the bore so the end of the valve with the long land is started in first. Install the valve cover and gasket.

3. In the center bore, insert the washer (8) and after being sure the washer is not cocked, install the spring (7) on the washer and secure with the valve cover and gasket (Illust. 66).

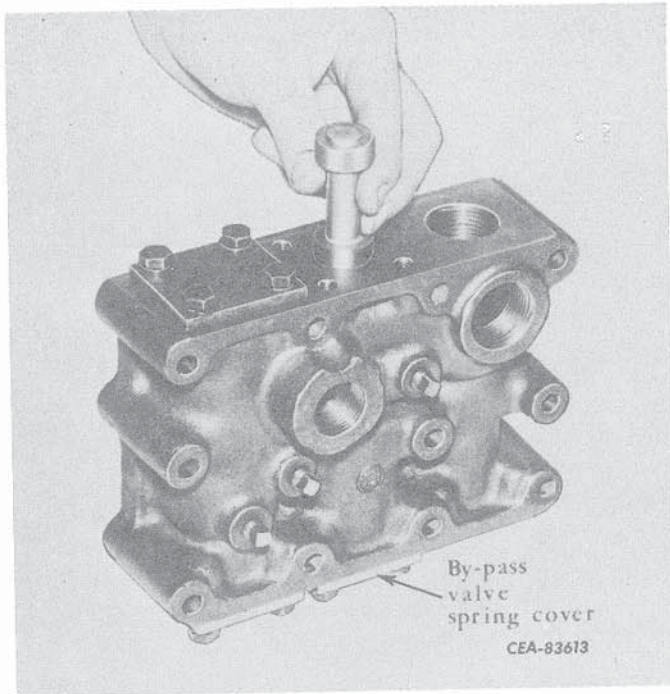
4. Turn the valve body over and in the other end of the center bore install the by-pass valve

(Continued on next page)

MAIN REGULATING VALVE

12. REASSEMBLY AND INSTALLATION
(Ref. Nos. Refer to Illust. 63) - Continued

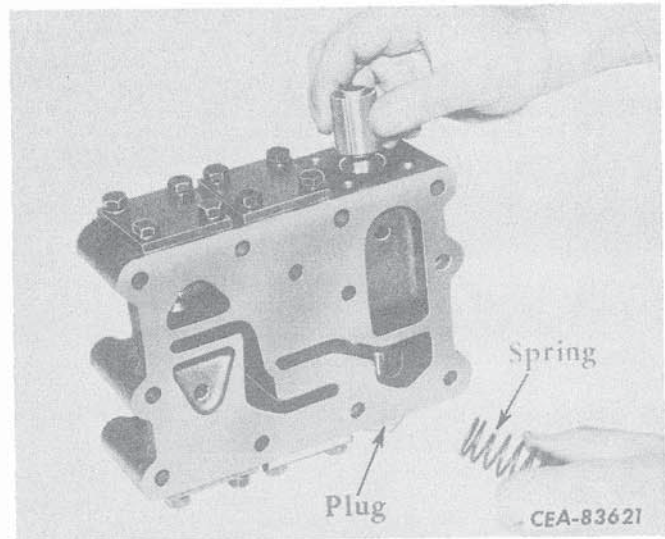
(15) so the end with the long land starts in first (Illust. 66). Install the valve cover and gasket.



Illust. 66
Installing the By-Pass Valve.

5. Install the plug (3) in the end bore, then turn the valve body over and insert the valve (4) and spring (6) into the valve body from the other end and secure with the valve cover and gasket (Illust. 67).

NOTE: The valve (4) can be installed with either end starting in the valve body first; but because of the design of the valve body bore, the valve must be installed from the side opposite the plug to prevent the possibility of marring the valve surface.



Illust. 67
Installing the Lubricating Pressure
Regulating Valve and Spring.

6. Position the valve body gasket (14) and valve body (5) on the hydraulic valve spacer (mounted on the transmission case) and secure with the cap screws and washers.

NOTE: Always tighten the cap screws in sequence from the center of the housing to the outside.

7. Connect the test connection block tubes and the pivot brake tube to the valve housing. Connect the oil cooler outlet hose and the converter inlet hose at the valve housing.

8. Install the batteries, battery support and seat frame.

RANGE SELECTOR VALVE

13. REMOVAL AND DISASSEMBLY
(Ref. Nos. Refer to Illust. 68)

NOTE: Tag disconnected hydraulic lines and cap hydraulic openings to prevent dirt or dust from entering.

1. Remove the seat frame, batteries and battery support.
2. Disconnect the hydraulic hoses at the range selector valve.
3. Remove the cap screws and washers securing the valve assembly to the top of the transmission case. Remove the valve assembly and discard the valve mounting "O" rings.

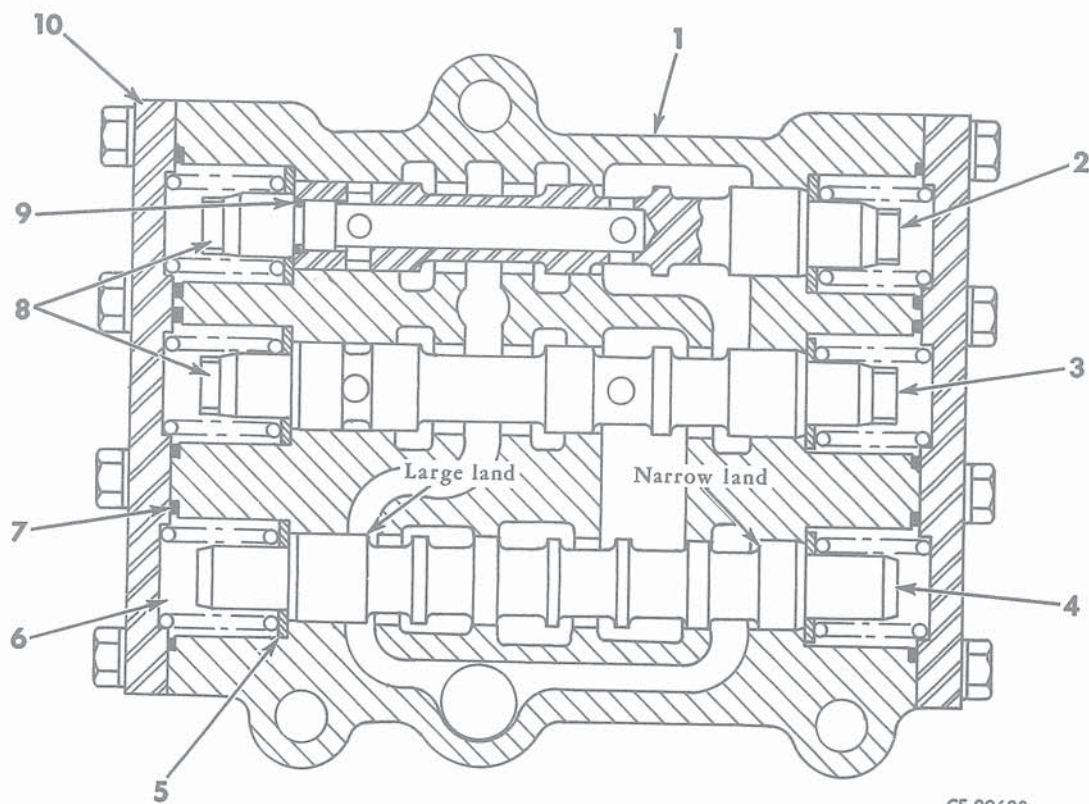
4. Remove the cap screws and lock washers securing the end cover (10) to the valve housing and remove the end cover.

5. Lift out the three spool centering springs (6) from the housing bore. Remove the three sealing rings (7) from the counterbore in the housing and discard them.

6. Tip the housing slightly to expose the valve spool ends and carefully pull each spool from the housing. Remove the spring retainer (5) from each spool.

7. Remove the end cover, sealing rings, centering springs and spring retainers from the opposite end of the housing in the same manner.

(Continued on next page)



CE-90638

Illust. 68
Range Selector Valve Cross Section.

- | | |
|-------------------------|-----------------------|
| 1. Valve housing. | 6. Centering spring. |
| 2. Forward valve spool. | 7. Sealing ring. |
| 3. Reverse valve spool. | 8. Spool plug. |
| 4. Lock-out spool. | 9. Plug sealing ring. |
| 5. Spring retainer. | 10. End cover. |

RANGE SELECTOR VALVE

13. REMOVAL AND DISASSEMBLY

(Ref. Nos. Refer to Illust. 68) - Continued

8. Unthread the spool plug (8) from the forward and the reverse valve spools. Remove the sealing ring (9) from the spool plug and discard it.

14. INSPECTION AND REPAIR

1. It is recommended that all new sealing rings be installed upon reassembly of the valve.

2. Clean all reusable parts in a suitable solvent and blow dry with compressed air. Be sure all drilled and cored passages are clean and free of obstruction.

3. Check all threads for damage. Repair damaged threads with a thread file or stone or replace part as necessary.

4. Inspect the valve spools for excessive wear and scratches. Inspect the bores in the housing for grooving and scratches. If a defect cannot be corrected by light polishing, the part must be replaced.

5. Inspect the condition of the valve spool centering springs. If they are damaged or do not fall within the specifications shown in Par. 2, "SPECIFICATIONS" they must be replaced.

15. REASSEMBLY AND INSTALLATION

(Ref. Nos. Refer to Illust. 68)

1. Place a new sealing ring (9) on each of the plugs (8) and thread the plugs into the forward and reverse spool ends using the torque given in Par. 2, "SPECIFICATIONS."

2. Place the housing (1) on end so the side with the cast letters, "R," "R1" and "F2" is up. Place a spring retainer (5) in each of the spool bores and a new sealing ring (7) in each of the counterbores.

3. Place a centering spring (6) in each bore and install the end cover (10) on the springs being sure each spring is seated properly in the end cover counterbores. Secure the end cover to the housing with the lock washers and cap screws.

4. Turn the housing over so the open bores are up. Lubricate the valve spools with the same type fluid used in the system and carefully install them into the housing until they bottom against the spring retainers (5).

The forward and reverse spools (2 and 3) are interchangeable and must be installed in the housing so the spool plug (8) is up. The lock-out spool (4) must be installed so the end with the large land is up.

5. Insert a spring retainer (5) over each of the spools being sure it bottoms in the bore. Install the sealing rings (7), centering springs (6) and end cover (10) as was done previously on the opposite side of the housing.

6. Install new mounting "O" rings in the spacer plate on the transmission case. Install and secure the valve assembly to the transmission.

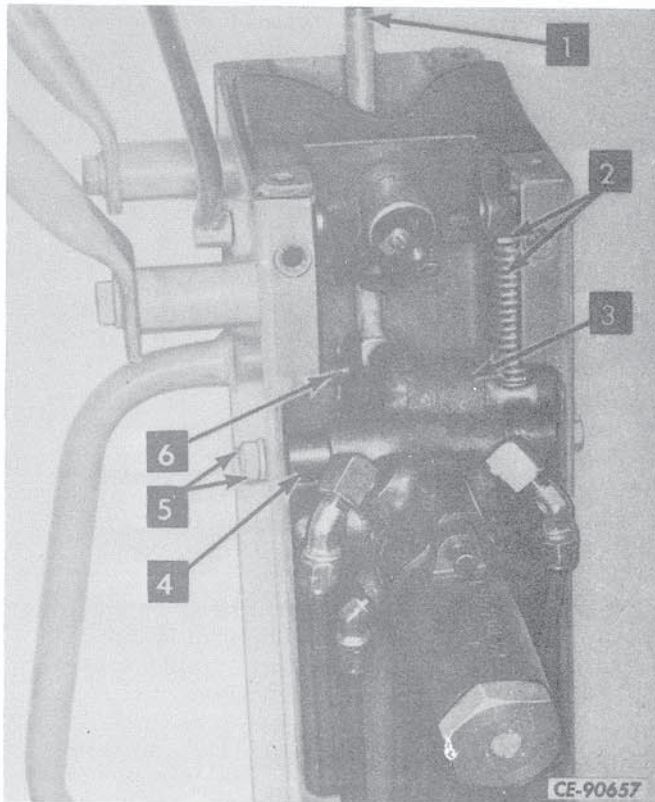
7. Connect the hydraulic hoses to the valve body. Install the battery support, batteries and seat frame.

PILOT CONTROL VALVE

16. REMOVAL

(Ref. Nos. Refer to Illust. 69)

1. Remove the seat frame and batteries.
2. Disconnect the starting switch cable harness coming from the bottom of the control tower.
3. Remove the two cap screws and lock washers securing the hydraulic manifold to the bottom of the control tower and allow the manifold with hoses to lay on the transmission. Discard the sealing rings in the manifold counterbores.
4. Unthread the handle from the control valve lever (1). Remove the four cap screws securing the lever gate to the housing and remove the gate. Remove the cap screws and lock washers securing the cover to the housing and remove the cover.



Illust. 69

Pilot Control Valve Disconnect Points.

1. Pilot control valve lever.
2. Safety lock mechanism.
3. Valve body.
4. Mounting spacer.
5. Mounting cap screws.
6. Valve lever end pin.

5. Remove the hardware securing the control tower housing to the seat LH side sheet and remove the housing assembly from the tractor.

6. Disconnect the hydraulic oil tubes at the bottom of the control tower housing.

7. Remove the cotter and end pin (6) securing the valve lever to the spool and remove the lever (1) from the housing.

8. Remove the four cap screws (5), washers, and spacers (4) securing the control valve body (3) to the housing. Maneuver the valve assembly to free it from the safety lock mechanism (2) and remove the valve with oil tubes attached. Remove the oil tubes from the valve body.

17. DISASSEMBLY

(Ref. Nos. Refer to Illust. 70)

1. Clamp the valve assembly in a vise with the spool (1) down. Only light pressure must be used and the valve body (6) protected from the vise jaws with a soft material to prevent damage.

2. Unscrew the cap (15) with filter (16) from the end of the housing.

3. Insert a brass rod into the housing (7) and slowly apply pressure on the indexing ball (13). When the indexing ball is free of the poppet balls (14), pull the sleeve (8) from the housing. Slowly release the pressure of the brass rod on the ball until the spring (12) is completely extended.

4. Remove the assembly from the vise. Tip the housing down to free the four poppet balls, indexing ball and spring.

5. Insert a drift in the spool eye and unthread the spool (1) from the spool extension (10) using finger pressure to hold the spool extension from turning. If necessary, place the assembly in the vise and apply pressure against the end of the spool extension to break the initial torque.

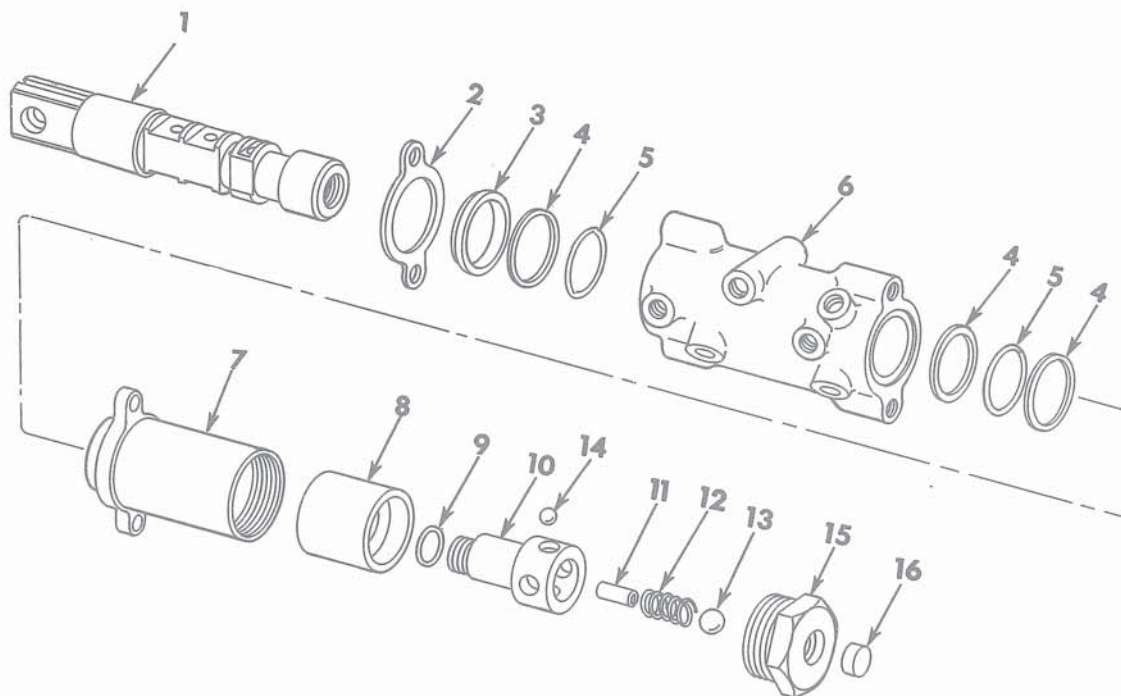
6. Remove the spool extension with pin (11) and sealing ring (9) from the housing bore. Discard the sealing ring. Slowly pull the spool (1) from the valve body (6).

(Continued on next page)

PILOT CONTROL VALVE

17. DISASSEMBLY

(Ref. Nos. Refer to Illust. 70) - Continued



CE-89097

Illust. 70
Exploded View of Pilot Control Valve.

- | | | | |
|-------------------|--------------------|----------------------|--------------------|
| 1. Spool. | 5. Sealing ring. | 9. Sealing ring. | 13. Indexing ball. |
| 2. Seal retainer. | 6. Valve body. | 10. Spool extension. | 14. Poppet ball. |
| 3. Wiper ring. | 7. Detent housing. | 11. Stop pin. | 15. Housing cap. |
| 4. Back-up ring. | 8. Detent sleeve. | 12. Indexing spring. | 16. Bronze filter. |

7. Remove the two cap screws securing the housing (7) to the valve body and separate the parts. Remove the sealing ring (5) and two back-up rings (4) from the valve body pilot bore. Discard the sealing ring and back-up rings.

8. Remove the two cap screws securing the retainer (2) to the valve body and remove the retainer.

9. Remove the wiper ring (3), back-up ring (4) and sealing ring (5) from their respective bores in the valve body. Discard the sealing ring and back-up ring.

18. INSPECTION AND REPAIR

1. It is recommended that all rubber rings be discarded and replaced with new ones.

2. Clean all parts in a suitable solvent and dry. Check all cored passages and oil ports to be sure they are clean and free of obstruction.

3. Check parts for excessive wear and damage such as cracks, deep scratches or defective threads. If an existing defect cannot be repaired, the part must be replaced.

4. Inspect the valve spool and body bore for excessive wear, scoring or scratches. If the part is excessively worn or if the defect cannot be corrected by light polishing, it must be replaced.

5. Check that the bronze filter in the bore of the detent housing cap is in good condition and is not loose. Check the condition of the indexing spring. If it is damaged or does not fall within the specifications given in Par. 2, "SPECIFICATIONS" it must be replaced.

PILOT CONTROL VALVE

19. REASSEMBLY

(Ref. Nos. Refer to Illust. 71)

NOTE: All sealing rings and the valve spool should be lightly lubricated with the same type fluid used in the system to facilitate ease of assembly.

1. Clamp the spool extension (12) in the vise with the spring bore up. If the stop pin (5) was removed, be sure to install the pin until it bottoms in the extension bore.
2. Place the spring (13) in the extension bore over the stop pin. Place a heavy coat of chassis lubricant on the end of the spring and in the poppet ball holes of the spool extension. Position the indexing ball (6) on the spring.
3. Place the detent sleeve (11) over a brass rod and hold both items with one hand. Push down on the indexing ball with the rod and install the four poppet balls (7) in the spool extension until they are approximately flush with the outside diameter. Keeping a constant pressure on the rod, lower the detent sleeve over

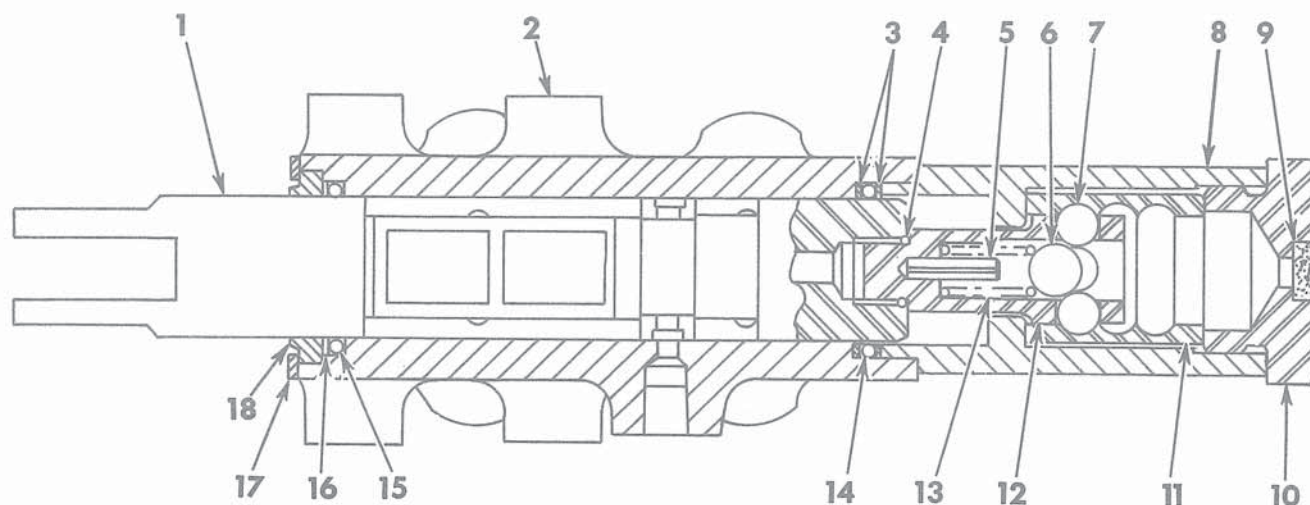
the spool extension and poppet balls. Release the pressure on the rod, allowing the indexing ball to move against the four poppet balls, causing them to move outward into the sleeve to lock the assembly in place. Spin the sleeve to be sure it is locked in place.

4. Remove the assembly from the vise and install a new sealing ring (4) in the groove provided on the spool extension.

5. Place the body (2) in the vise with the double counterbore end up. Install a new sealing ring (15) and back-up ring (16) in the smaller counterbore. The back-up ring must be installed so the concave side is against the sealing ring. Install the wiper ring (18) in the large counterbore and secure in position with the retainer (17) and two cap screws.

6. Reverse the body (2) in the vise so the single counterbore end is up. Install the two back-up rings (3) and sealing ring (14) until

(Continued on next page)



CE-90639

Illust. 71
Pilot Control Valve Cross Section.

- | | | |
|-------------------|----------------------|----------------------|
| 1. Spool. | 7. Poppet ball. | 13. Indexing spring. |
| 2. Body. | 8. Detent housing. | 14. Sealing ring. |
| 3. Back-up ring. | 9. Bronze filter. | 15. Sealing ring. |
| 4. Sealing ring. | 10. Housing cap. | 16. Back-up ring. |
| 5. Stop pin. | 11. Detent sleeve. | 17. Seal retainer. |
| 6. Indexing ball. | 12. Spool extension. | 18. Wiper ring. |

PILOT CONTROL VALVE

19. REASSEMBLY

(Ref. Nos. Refer to Illust. 71) - Continued

they bottom in the bore. The assembly is installed correctly when the sealing ring (3) is encircled by the concave portion of the two back-up rings.

7. Carefully pilot the detent housing (8) into the valve body. Secure the detent housing with the two mounting screws using the torque specified in Par. 2, "SPECIFICATIONS."

8. Insert the assembled spool extension and detent sleeve into the detent housing bore.

9. Carefully insert the spool (1) through the valve body until it contacts the spool extension. At this point, a brass rod of the proper diameter must be used to apply pressure on the end of the spool extension as the spool is threaded on the other end. Refer to Par. 2, "SPECIFICATIONS" for the proper torque.

10. Thread the cap (10) with bronze filter (9) into the end of the detent housing. Remove the assembly from the vise.

20. INSTALLATION

(Ref. Nos. Refer to Illust. 69)

1. Connect the oil tubes to the valve body (3). Position the valve body with tubes in the housing so the pivot shaft of the safety lock mechanism (2) enters the valve body bore. Secure the valve assembly in the housing with the four spacers (4), lock washers and cap screws (5).

2. Position the valve lever (1) in the housing and secure it to the valve spool with the cotter and end pin (6).

3. Connect the hydraulic oil tubes to the bottom of the control tower housing.

4. Position the control tower housing on the LH fender and secure it to the seat LH side sheet with the mounting hardware.

5. Install and secure the lever gate to the top of the housing. Install the lever handle.

6. Install new sealing rings in the hydraulic manifold counterbores and secure the manifold to the bottom of the control tower housing.

7. Connect the starting switch cable harness. Secure the cover to the control lever housing.

8. Install the batteries and seat frame.

PRESSURE REGULATING BOOSTER VALVE

21. REMOVAL

NOTE: Tag disconnected hoses and cap openings with a suitable plastic cap to prevent dust or dirt from entering. Never plug hydraulic openings with rags. If plastic caps are not available, use tape.

NOTE: The pressure regulating booster valve is secured to the left hand front frame below the pressure filter. This valve can be removed with the hydraulic hoses attached.

1. Remove the rear platform.

2. Disconnect the pressure filter outlet hose at the top of the filter base.

3. Disconnect the booster valve outlet hose at the transmission case, just below the main regulating valve and range selector valve hydraulic manifold.

4. Disconnect the booster valve drain hose at the booster valve and secure it in a vertical position.

5. Remove the two cap screws and washers securing the valve supports to the front frame to free the valve assembly with hydraulic hoses.

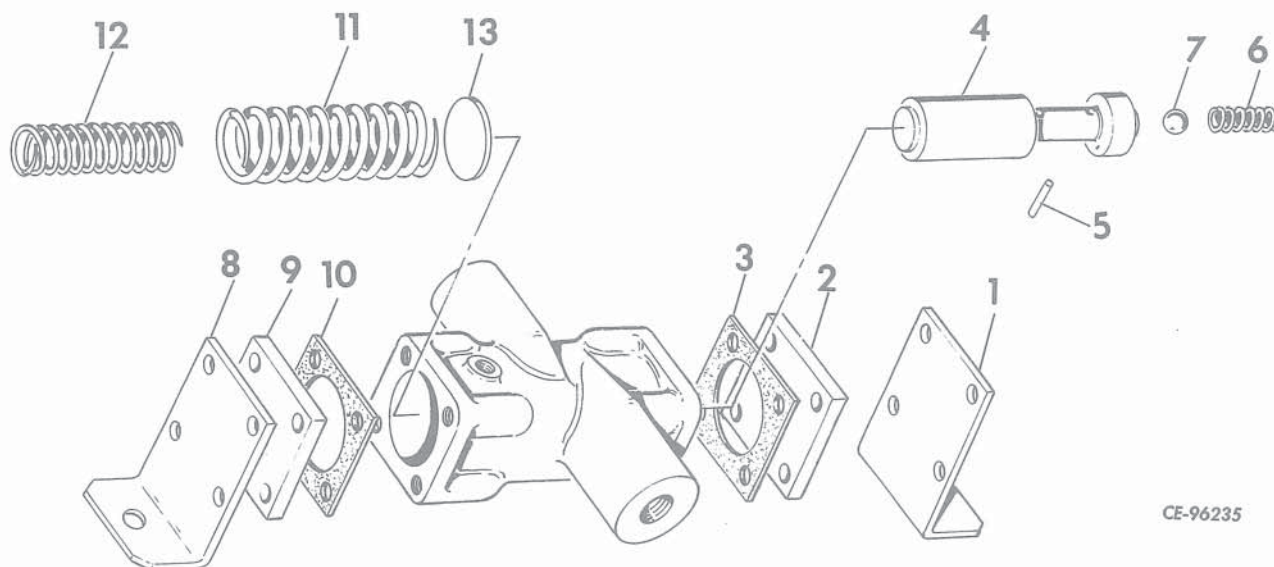
22. DISASSEMBLY, INSPECTION AND REPAIR, AND REASSEMBLY
(Refer to Illust. 72)

1. Disassemble in numerical order per Illust. 72.

2. Clean all parts in a suitable cleaning solution. Blow dry with compressed air. Be sure all oil passages in the valve housing and the main regulating valve spool (4) are clean and free of any obstruction. Check the springs for damage and correct tension (refer to Par. 2 "SPECIFICATIONS").

3. Assemble in the reverse order.

PRESSURE REGULATING BOOSTER VALVE



CE-96235

Illust. 72
Pressure Regulating Booster Valve Exploded View.

- | | |
|---------------------------------|---|
| 1. Valve assembly support. | 8. Valve assembly support. |
| 2. Valve cover. | 9. Valve cover. |
| 3. Cover gasket. | 10. Cover gasket. |
| 4. Main regulating valve spool. | 11. Pressure regulating spring (outer). |
| 5. Pin. | 12. Pressure regulating spring (inner). |
| 6. Valve spool internal spring. | 13. Spring washer. |
| 7. Ball. | |

NOTE: Use new gaskets and lubricate valve and valve bore with the same fluid as used in the system. Because of the tension exerted by the springs (11 and 12) it may be necessary to use longer cap screws to tighten the cover (9) until the regular cap screws can be installed.

23. INSTALLATION

1. Position the booster valve assembly in the machine with its two hydraulic hoses attached. Secure to the front frame with the cap screws and washers.

2. Connect the booster valve drain hose to the booster valve.

3. Connect the booster valve outlet hose at the top of the transmission case.

4. Connect the booster valve inlet hose (pressure filter outlet hose) to the top port in the filter base.

5. Install the rear platform.