



## TRANSMISSION (POWER SHIFT)

Section 7A  
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### 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 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.

#### Bevel 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 by a nut.

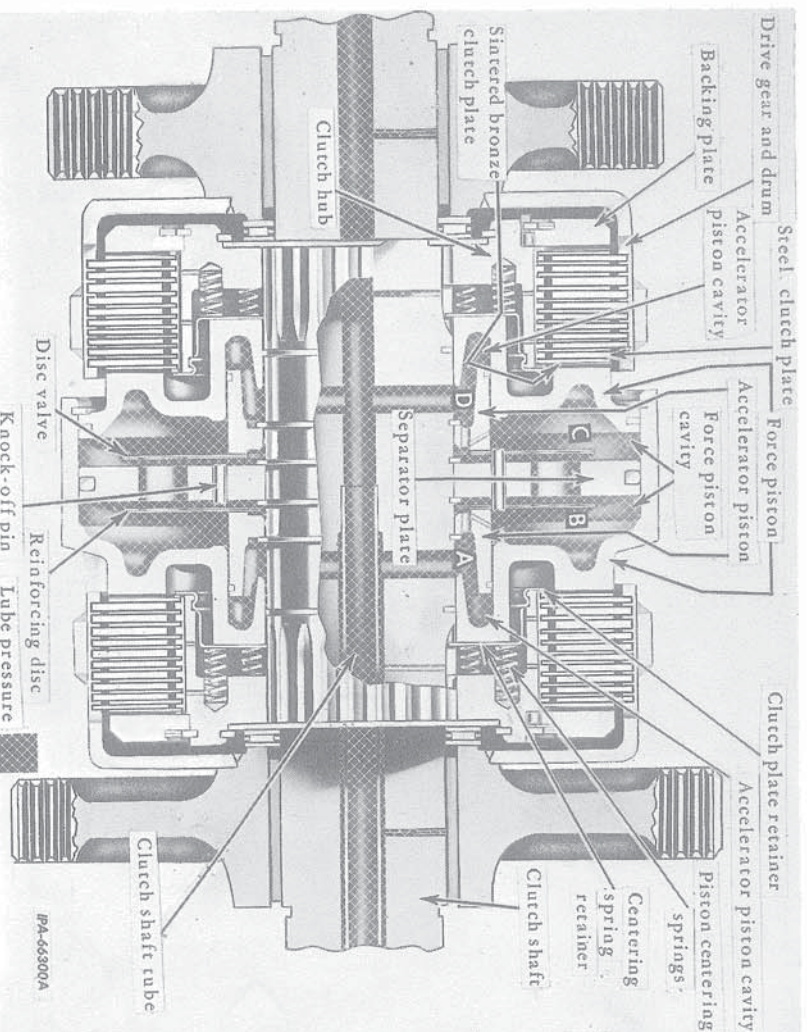
The spline shaft rotates on two straight roller bearings. The rear bearing is mounted in the transmission case and the front bearing is in the transmission cover. The first and second speed driven gears are held in position on the spline shaft by snap rings and are in constant mesh with the first and 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 the high or low range driven gear by the use of the hi-lo shifting lever.

#### Spline Shaft

#### 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 bushings and are welded to the dual hydraulic clutch pack assemblies.

(Continued on next page.)



Flow of Oil Through Clutch in Neutral Position.

Illustr. 1





## 1. DESCRIPTION - Continued

### 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.

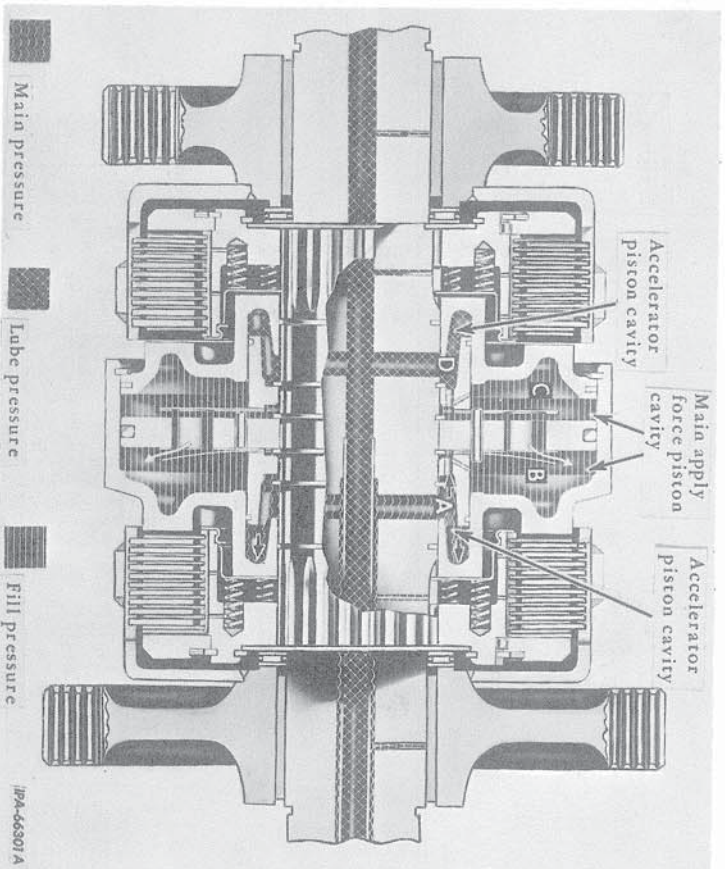
In neutral, all accelerator and force piston cavities are filled with oil at lube pressure (10 to 25 psi). A selector valve, located on the top of the transmission case, directs the oil to the accelerator piston cavities and, in turn, to the force piston cavities. From this valve, oil is directed through 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 bushings 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 (approx. 200 to 230 psi) is directed through the clutch shaft for the specific side of the 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 bushing 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 bushing 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 knock-off



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





dowel 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.

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 of 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.

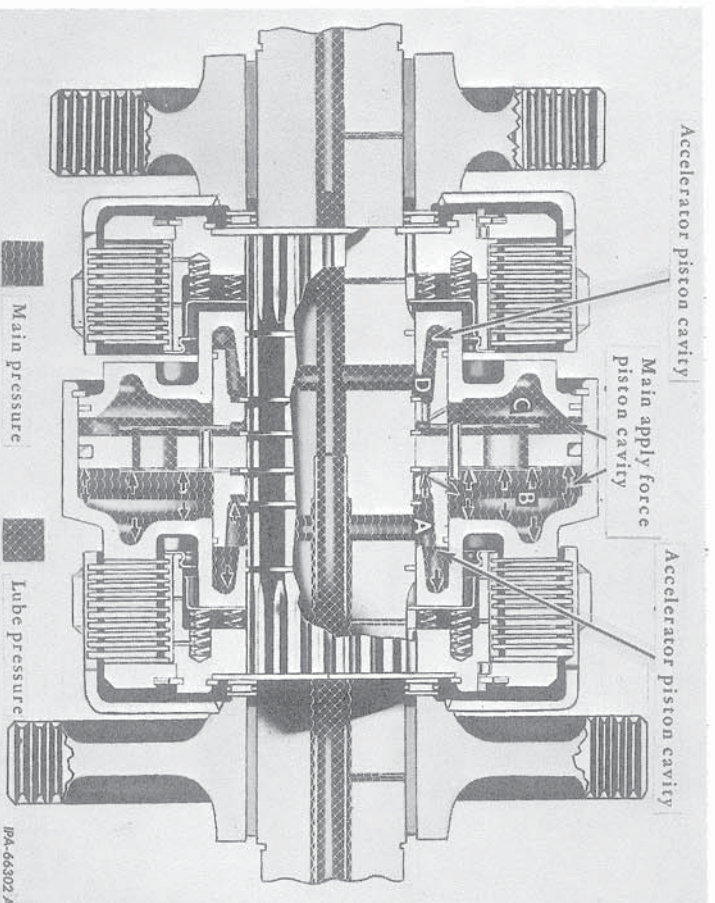
#### Gear Shifter Mechanism

The gearshift lever, located on the left hand side of the operator, is connected through linkage to the range selector valve assembly on the top of the transmission case. Movement of the gearshift lever, positions the selector valve to allow main oil pressure to engage the side of the clutch desired. (Illust. 4.)

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).

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

(Continued on next page.)



Illust. 3

Flow of Oil Through Clutch in Engaged Position.



TRANSMISSION (POWER SHIFT)



1. DESCRIPTION - Continued

Gear Shifter Mechanism - Continued

and the gear shift lever must be in neutral position. At this time, main oil pressure from the pump passes through a drilled hole in the selector valve and through an oil line 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 oil supply for the transmission and 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, by the suction developed by the pump located in the right hand side of the torque converter. The oil leaves the pump at approximately 200 to 230 psi and enters the pressure filter and the hydraulic valve spacer (not shown) on top of the transmission case. From here, the oil is directed through drilled passages to the main regulator valve in the main regulating valve assembly to the selector valve and to the steering boosters. (Refer to Section 8 "STEERING SYSTEM" for operation of the steering boosters.)

Through drilled passages in the main regulating valve assembly, hydraulic valve spacer and transmission case, oil, at lubricating pressure (10 to 25 psi), fills the selector valve and transmission clutch shafts for lubrication of the transmission clutches. This pressure is

maintained by the oil passing through the by-pass valve in the main regulating valve housing and also by the return oil from the oil cooler. When this pressure is over 25 psi, the lubricating valve opens and the excess oil is returned to the suction side of the oil pump. When the selector valve is in the neutral position, as shown in Illust. 4, the main oil pressure from the pump is directed through an outlet hose to the hi-lo shift lever lock and hydraulic decelerator valve. When the selector valve is moved to any other position, main oil pressure is directed to the clutch shaft to engage the clutch desired. (Refer to "Forward and Reverse Hydraulic Clutch Operation" in this paragraph.)

When oil pump pressure at the main regulating valve exceeds 230 psi, the main regulating 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 regulator housing. When this pressure exceeds 80 psi, the by-pass valve opens and allows the excess oil to be returned to the suction side of the pump or to be used for transmission clutch lubrication. The oil on the output side of the torque converter enters the air cooled oil cooler and is returned to the suction side of the oil pump through the lubricating oil valve or is directed to the selector valve for clutch lubrication if the pressure at the valve is under 25 psi.

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

2. SPECIFICATIONS

Transmission

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

Forward and Reverse Clutch Packs

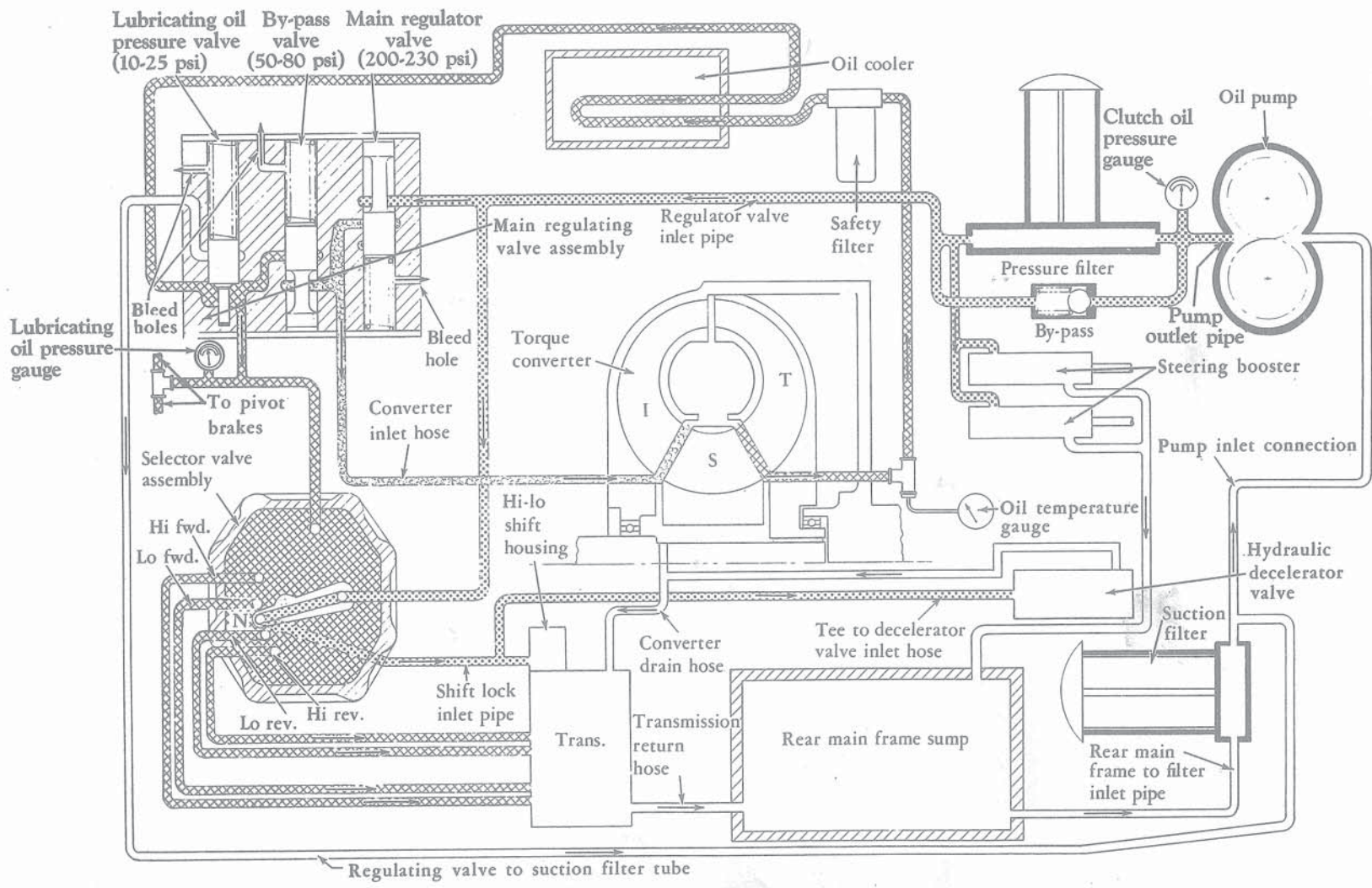
Number of internal splined clutch plates (sintered bronze):

Forward clutch pack . . . . .	26
Reverse clutch pack . . . . .	22

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

(Continued on page 6)





- Return and suction lines
- By-pass valve pressure
- Main oil pressure (200-230 psi)
- Lubricating oil pressure (10-25 psi)
- (approximately 40psi from converter outlet-to-safety filter)

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Illust. 4  
Hydraulic Oil Flow Diagram.



# TRANSMISSION (POWER SHIFT)



## 2. SPECIFICATIONS - Continued

### Forward and Reverse Clutch Packs - Continued

Number of external splined clutch plates (steel):

Forward clutch pack	24
Reverse clutch pack	20
Minimum allowable thickness for internally splined bronze clutch plates, inch	0.050
Reverse clutch shaft end play, inch	0.030 - 0.040
Second speed drive gear thrust washer minimum allowable thickness, inch	0.054
First speed drive gear thrust washer minimum allowable thickness, inch	0.338
First and second speed drive gear bushing inside diameters (assembled in gear), inches	2.003 - 2.005
First and second speed drive gear bushing maximum allowable running clearance, inch	0.009
Gear and drum assembly end play:	
New clutch pack assemblies (inch)	0.010 - 0.030
Used clutch pack assemblies (inch)	0.010 - 0.040

### Hi-Lo Shifter Fork and Driving Gear

Width of slot in driving gear, inch	0.380 - 0.390
Width of shifter fork fingers, inch	0.365 - 0.375

### 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 to 4-1/2	12
By-pass valve spring	3-23/64	2-3/16	63 ± 6	10
Main regulating spring (outer)	3-21/64	2-5/32	121 to 134	10
Pressure regulating spring (inner)	3	2-5/32	43	13-1/2
Lube valve spring	4-1/8	2-13/64	13-1/2 to 15-1/2	15
Range selector valve:				
Detent spring	1-3/8	57/64	15-17	10
Wiper spring	15/16	11/16	3-4	5
Hi-lo shifter lever poppet spring and poppet lock spring	2	1-11/32	67	12-1/2

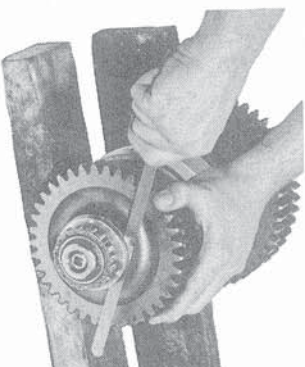
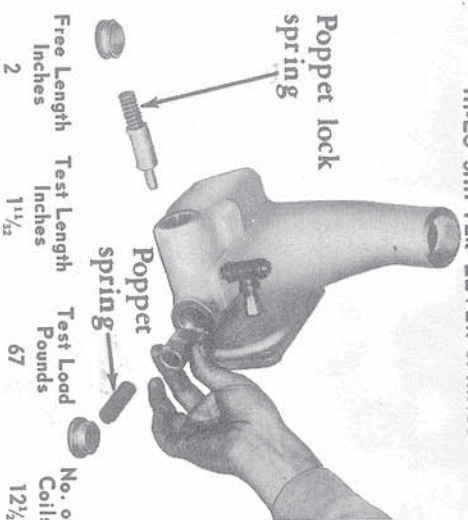
### Special Nut and Bolt Torque Data (Foot-Pounds) (Torques given are for bolts and nuts lubricated with SAE-30 engine oil)

Spline shaft nut	500 to 550
Bevel pinion shaft front nut	500 to 550
Bevel pinion shaft rear nut	500 to 550
Bevel pinion shaft front bearing retainer	300 to 350
Transmission pressure filter hold-down bolt	65 to 75
Safety filter mounting bolts	23 to 26
Suction filter mounting bolts:	
3/8 inch	23 to 26
1/2 inch	56 to 63
Pressure filter hold-down bolt	55 maximum

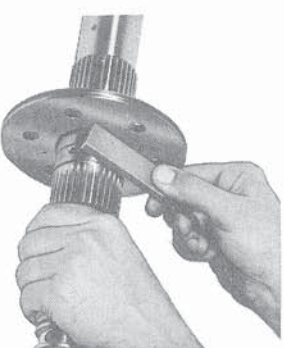




# HI-LO SHIFTER LEVER SPRINGS

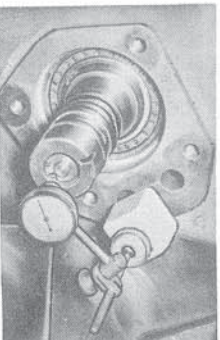


Clutch pack gear and drum assembly end play (Inch):  
New clutch pack assy. .... .010-.030  
Used clutch pack assy. .... .010-.040  
(Refer to manual text for instructions.)

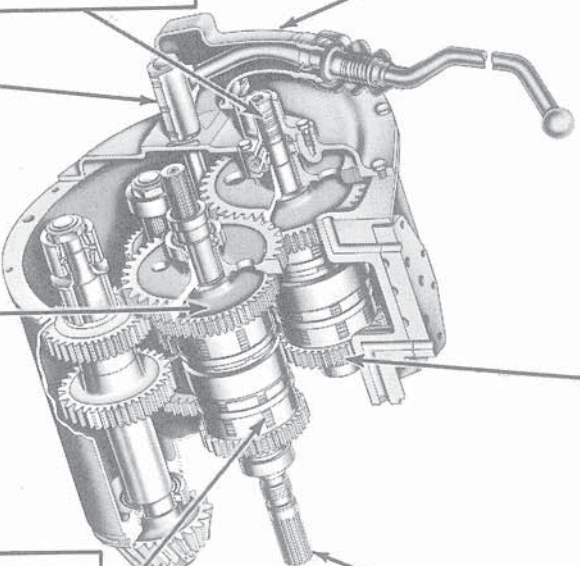


## CLUTCH SHAFT

Using an oil stone, 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.)



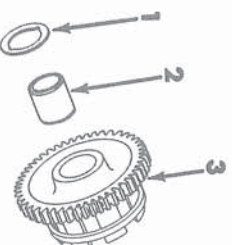
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## CLUTCH PLATES

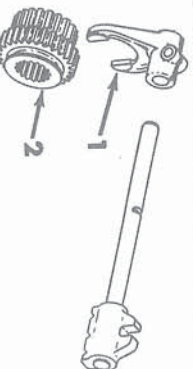
Inspect clutch plates for excessive wear and warpage.  
Minimum allowable thickness for internally splined bronze clutch plates (Inch) ... .050

## FIRST AND SECOND SPEED DRIVE GEAR, BUSHING AND THRUST WASHER



1. Inspect the first and second speed drive gear and drum assemblies for excessive wear or damage.
2. First and second speed drive gear bushing: Inside diameter (assembled in gear (Inches) ... 2.003-2.005 Maximum allowable running clearance (Inch) ... .009
3. Thrust washer minimum allowable thickness (Inch).  
First speed drive gear ... .338  
Second speed drive gear ... .054

## 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







3. CHECKING MECHANICAL PROBLEMS

PROBABLE CAUSE	REMEDY
<u>Slow or Erratic Clutch Engagement</u>	
1. Low oil level . . . . .	Add oil to proper level.
2. Clogged filter . . . . .	Remove and clean 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. Range selector valve linkage improperly adjusted . . . . .	Adjust linkage.
<u>Noise in Transmission</u>	
1. Bearings worn or broken . . . . .	Install new bearings.
2. Foreign material in oil . . . . .	Drain, flush and refill with clean oil.
3. Gears badly worn . . . . .	Install new gears.
4. Bevel gear and pinion not in proper mesh . . . . .	Adjust to proper clearance.
<u>High Oil Temperature</u>	
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.
5. Oil leakage . . . . .	Check all gaskets, lines and connections and replace parts as necessary.
6. Faulty thermo by-pass valve (if equipped) . . . . .	Discard valve assembly. Refer to instructions in paragraph 6, "INSPECTION AND REPAIR."
7. Faulty hydraulic oil pump . . . . .	Replace worn parts or replace pump.





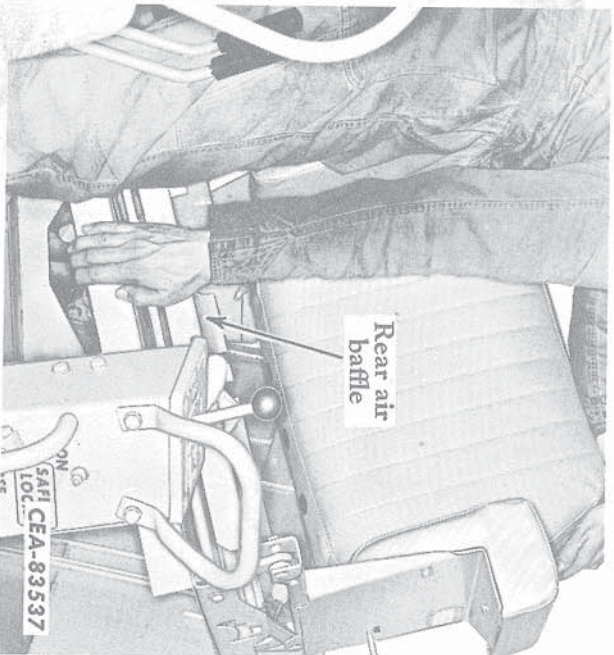
#### 4. REMOVAL



**CAUTION:** Be sure the bucket or blade has been lowered to the ground.

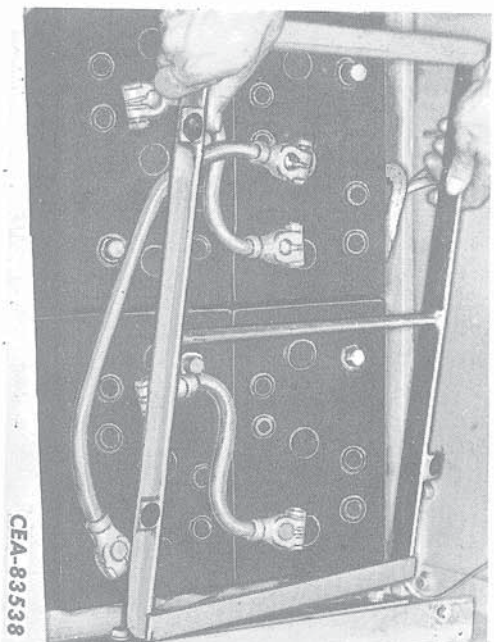
**NOTE:** Disconnected hydraulic lines must be capped with the correct size plastic cap. If caps are not available, use tape or rubber stoppers. Openings must never be plugged with rags. This practice could introduce dirt or lint into critical hydraulic components.

1. Remove the plug in the underside of the rear frame and allow the oil to drain completely.
2. **MODEL 175 LOADER ONLY:** Drain the bucket hydraulic system by removing the plug in the bottom of the hydraulic tank on the right hand fender.
3. Remove the seat bottom cushion. Remove the four cap screws and lockwashers securing the seat frame to the seat side sheets. Lift off the seat frame with bottom and rear air baffles (Illust. 5).



Illust. 5  
Removing the Seat Frame.

4. Disconnect the battery cables at one end in such a manner so each battery can be removed independently. Remove the four cap screws, flat washers and lock washers securing the battery support bracket and remove the bracket. Mark the batteries to assure installation in the same location and remove the four batteries (Illust. 6).



Illust. 6  
Removing Battery Support Top Bracket.

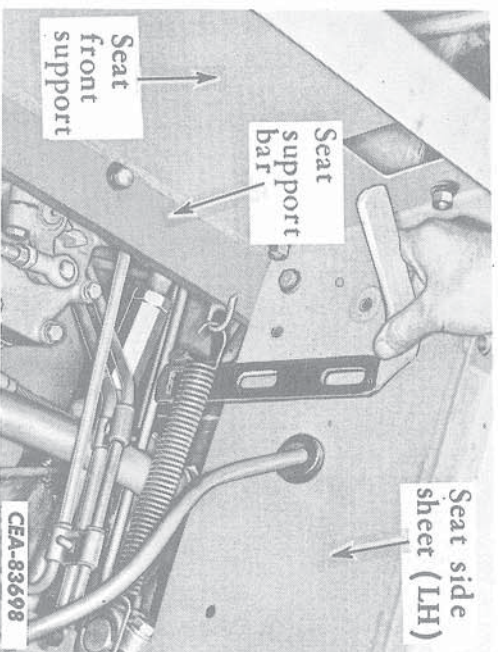
5. Remove the two cap screws, flat washers and lock washers securing the battery bottom bracket to the seat support bar. Remove the two cap screws, lockwashers and nuts securing the bracket at the rear to the seat side sheets and remove the bracket.
6. Remove the side cover enclosing the equipment control valve on the RH fender. Reach in through the cover opening to remove the nuts and lockwashers 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 (Illust. 7).



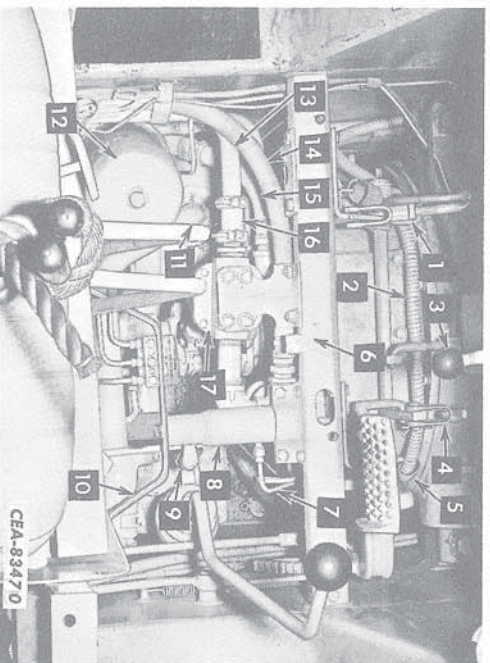


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Illust. 7  
Removing the Brake Pawl Operating Lever.

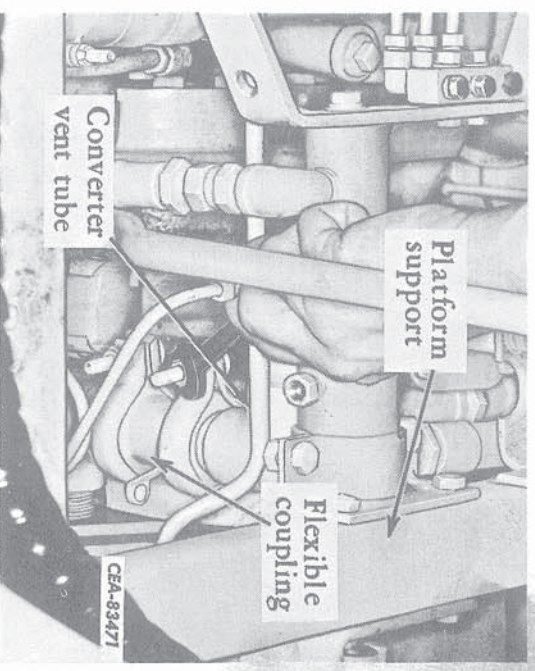


Illust. 8  
Platform Support Disconnect Points.

1. Decelerator pedal adjustable clevis.
2. Cranking motor cable.
3. Adjustable clevis.
4. Control rod clevis.
5. Spring clip.
6. Platform support.
7. Drain tube.
8. Decelerator cylinder.
9. Decelerator cylinder inlet hose.
10. Seat support bar bracket.
11. Equipment pump inlet tube.
12. Pressure filter.
13. Suction filter inlet tube.
14. Regulator drain hose.
15. Pressure filter inlet hose.
16. Flexible coupling.
17. Suction filter.

7. Remove the cap screws, lockwashers, flat washers and nuts securing the seat front support to the seat support bar and seat side sheets and remove the front support (Illust. 7).
8. Disconnect the decelerator pedal adjustable clevis at the pedal by removing the cotter and end pin. Remove the LH, front platform with decelerator pedal. Remove the RH, front platform. Remove the rear platform (snap on type).
9. Tie back the steering levers with a heavy rope.

10. Remove the platform support (Illust. 8):
  - (a) Disconnect the governor control rear rod clevis (4) at the cross shaft by removing the end pin and cotter.
  - (b) Disconnect the drain tube (7) and the inlet hose (9) at the decelerator cylinder (8).
  - (c) Disconnect the drain tube (7) at the converter and remove the tube.
  - (d) Remove the bolt, lockwasher and flat washer securing the decelerator cylinder to the seat support bar bracket (10).
  - (e) Remove the clamp on the suction filter side of the flexible coupling (16). Loosen the clamp on the filter inlet tube side of the coupling and pull the coupling sleeve onto the inlet tube (13).

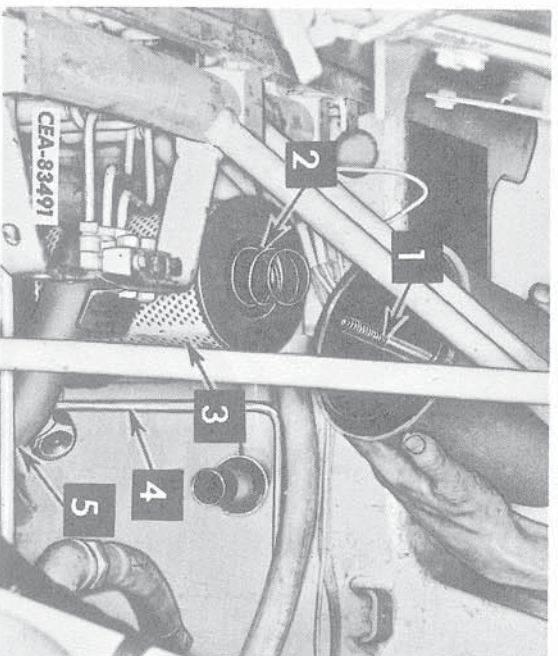


Illust. 9  
Loosening Flexible Coupling Clamp.





#### 4. REMOVAL - Continued



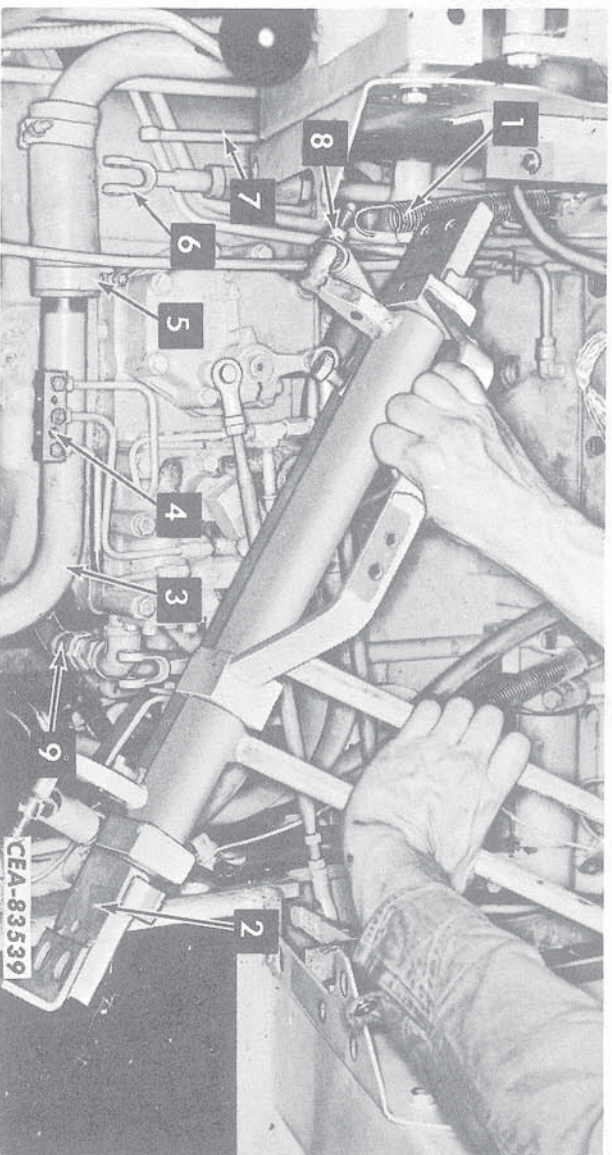
Illust. 10  
Removing the Pressure Filter Case.

1. Hold-down bolt.
2. Filter spring.
3. Filter element.
4. Clutch pressure gauge tube.
5. Equipment pump inlet tube.

- (f) Loosen the upper clamp on the flexible coupling below the platform support and lower the clamp onto the coupling (Illust. 9).
- (g) Remove the cotter and end pin securing the adjustable clevis (3) to the bellcrank.
- (h) Disconnect the regulator drain hose (14) at the converter elbow.
- (i) Remove the cap screw, lockwasher and flat washer securing the platform support on each side to the front frame. Remove the support with suction filter, decelerator cylinder and control linkage attached.

11. Remove the rope holding the steering levers. Unhread the pressure filter hold-down bolt securing the filter case to the base and remove the case with bolt. Lift the spring and element from the base (Illust. 10).

12. Remove the steering levers. Disconnect the two booster springs (1) at the seat support bar (2). Remove the cotter securing each of the booster operating rods (7) to the steering lever pivot arms (8) and disengage the rods from the pivot arms. Remove the cotter and end pin securing the pull rod clevis (6) at each of the steering levers. Remove the two nuts, lockwashers and cap screws securing the test



Illust. 11  
Removing the Seat Support Bar with Steering Levers.

1. Booster spring.
2. Seat Support bar.
3. Equipment pump inlet tube.
4. Test connection block (if equipped).
5. Hose clamp.
6. Pull rod.
7. Booster operating rod.
8. Steering lever pivot arm.
9. Pressure filter outlet hose.





## TRANSMISSION (POWER SHIFT)

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connection block (4) (if equipped) to the seat support bar. Remove the four cap screws and lockwashers securing the seat support bar to the front frame and remove the support bar with steering levers (Illustr. 11).

NOTE: On RH side of seat support bar, remove the bolts securing the support bar to the mounting bracket instead of the bolts holding the bracket to the front frame. There are also flat washers used for mounting here.

13. MODEL 175 LOADER ONLY: Remove the cap screws, lockwashers and clamp halves securing the equipment pump inlet tube (5, Illustr. 10) to the top of the pump. Loosen the nut on the clamp (5, Illustr. 11) securing the other end of the tube to the connecting hose and remove the tube.

14. Disconnect the clutch pressure gauge tube (4, Illustr. 10) at the pressure filter base (main regulating valve on earlier units) and at the other end from the front tube connection above the engine rear mounting. Remove the bolt and clamp securing the tube and electrical cables to the side of the front frame and remove the tube.

15. Remove the bolt and clamp securing the hydraulic hoses to the inner face of the front frame on the LH side of the unit near the seat support bar mounting. This will enable the filter base to be maneuvered more freely to facilitate removal of the equipment pump and/or torque converter.

16. Disconnect the pressure filter inlet hose at the filter base.

17. Remove the four bolts and lockwashers securing the filter base to the front frame and allow the base to lay in the frame. Disconnect the pressure filter outlet hose (9, Illustr. 11) at the side of the transmission case.

18. Remove the lockwire and cap screws securing the universal joint to the converter and transmission yokes. Use a screwdriver to free the bearing caps from the transmission yoke and remove the caps from the trunion. Hold the universal joint and bottom bearing cap (to prevent cap from falling off of trunion) and pull the assembly free of the converter yoke. Lift out the universal.

19. Remove the rear cover in the underside of the front frame. Disconnect the transmission-to-flywheel housing hose at the transmission cover.

20. MODEL 175 LOADER ONLY: Remove the cap screws, lockwashers and clamp halves securing the equipment pump outlet hose at the bottom of the pump and at the pressure tube and remove the hose.

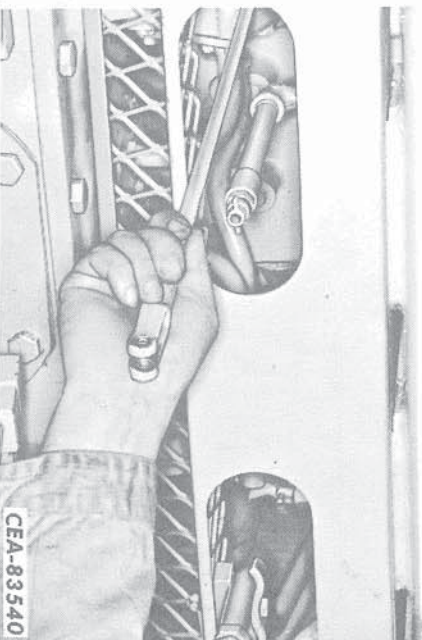
21. MODEL 175 LOADER ONLY: Insert an eyebolt into one of the inlet tube mounting holes in the equipment pump and attach a hoist. Remove the two pump mounting bolts and free the pump from the converter housing. Lower the pump until it rests on the front frame and transfer the hoist sling to one of the pump mounting holes. Remove the eyebolt from the pump.

Raise the pump out the top of the unit. As the pump is being lifted out it will be necessary to maneuver the pressure filter base to the rear as far as possible and then down under the pump. It also may be necessary to turn the pressure filter inlet hose and converter inlet hose elbows to clear the pump. If the elbows are to be turned, mark them to the converter housing to assure installation in the same position for connecting hoses.

22. Loosen the jam nut on the back side of the turnbuckle on each of the pull rods (long) and unthread the turnbuckles with short pull rods (Illustr. 13).

23. Disconnect the booster operating rods at each of the steering boosters by removing the cotter and end pin and remove the rods through the openings in cover under the fuel tank (Illustr. 12).

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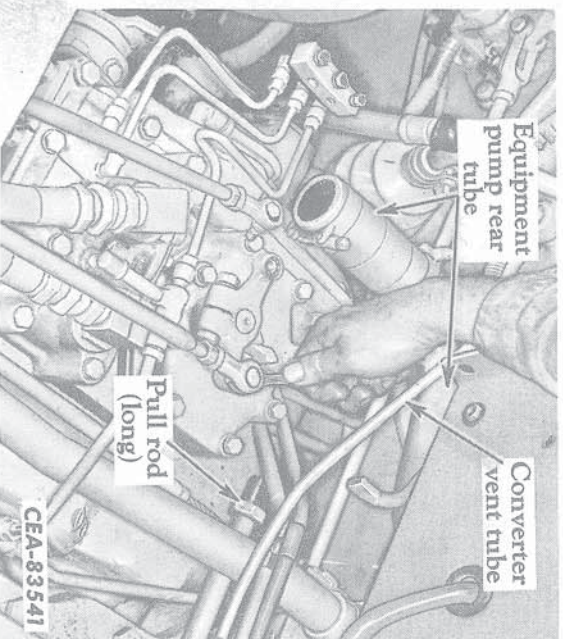
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Illustr. 12  
Removing the Booster Operating Rod.



**4. REMOVAL - Continued**

24. Disconnect the converter vent tube at the converter housing and bend it up and behind the hi-lo shift lever of the transmission being careful not to kink the tube (Illustr. 13).
25. Disconnect the transmission lower rods at the selector valve lever and tie the rods up out of the way to the LH seat side sheet. (Illustr. 13).

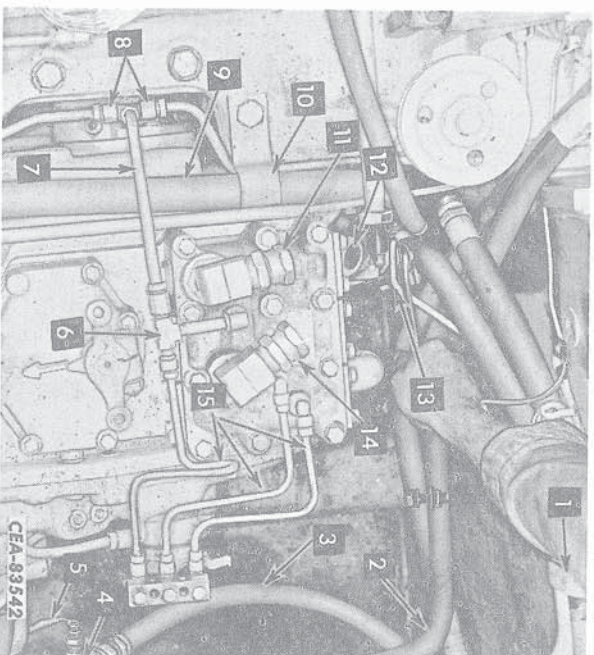


Illustr. 13

Disconnecting Transmission Lower Rods.

26. MODEL 175 LOADER ONLY: Disconnect the equipment pump rear tube (Illustr. 13) at the hydraulic tank and remove the tube.
27. Disconnect the regulator drain hose at the elbow (12). This end of hose does not have a swivel connection but the hose can be turned out of the elbow or the clamp (1) can be removed and the hose removed with the transmission (Illustr. 14).

28. Disconnect the converter inlet hose (2) at the converter and at the regulator connection (14) and remove the hose. Disconnect the oil cooler outlet hose at its connection (11) on the regulator valve and move the hose out of the way (Illustr. 14).
29. MODEL 175 LOADER ONLY: Remove the cap screw, nut and lockwasher securing the equipment pump pressure tube (9) to the support bracket (13). Remove the bolt securing the bracket (13) to the front frame and remove the bracket. Disconnect the pressure tube (9) at the control valve and remove the clamp (10) so the tube can be moved out of the way to clear the transmission (Illustr. 14).



Illustr. 14

Removing Loader Equipment Pump Pressure Tube Support Bolt.

1. Hose clamp.
2. Converter inlet hose.
3. Safety filter inlet hose.
4. Reducing tee.
5. Sending unit cable.
6. Tee.
7. Pivot brake oil tube.
8. Nuts.
9. Equipment pump pressure tube.
10. Clamp.
11. Oil cooler outlet hose connection.
12. Regulator drain elbow.
13. Support bracket.
14. Converter inlet hose connection.
15. Test block tubes (if equipped).



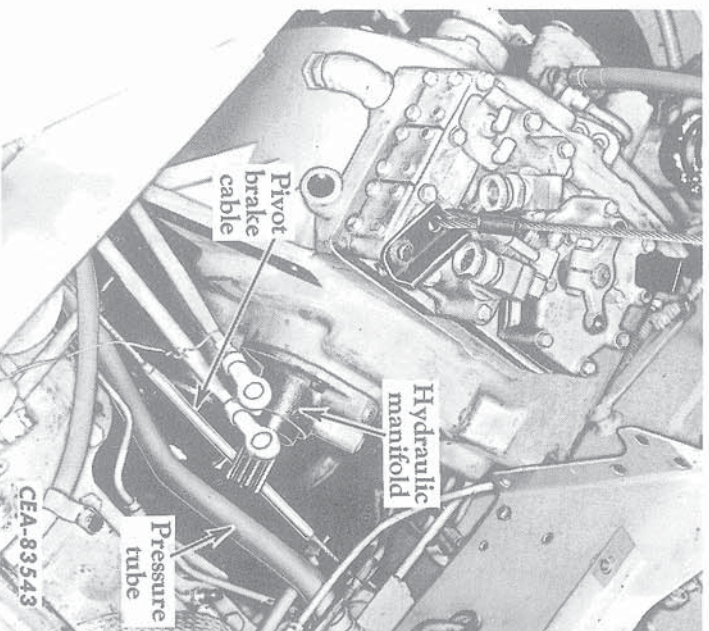


## TRANSMISSION (POWER SHIFT)

Section 7A  
Page 13

30. Disconnect the tube (7) at the tee (6). Loosen the nuts (8) so the tube (7) can be swung back out of the way. If equipped, disconnect the tubes (15) at the regulator valve and remove the tubes with test connection block (Illustr. 14).
31. Disconnect the converter oil temperature sending unit cable (5) at the tee (4) and face the cable from the clip on the converter housing mounting bolt (Illustr. 14).
32. Disconnect the safety filter inlet hose (3) at the converter. Mark the reducing tee (4) to the converter housing to assure installation in the same position and remove the tee and connecting nipple from the housing. It will first be necessary to remove the hose adapter from the tee to allow the tee to be turned out of the housing (Illustr. 14).
33. Loosen the clamp on the flexible coupling sleeve and remove the sleeve, gasket and retainer assembly and clamp from the suction filter nipple on the RH side of the converter housing.
34. Attach a hoist and remove the torque converter as described in section 6, "HYDRAULIC TORQUE CONVERTER."
35. Push the brake pedal forward and lock in place with the locking pawl.
36. Remove one of the upper transmission case-to-transmission cover bolts and one of the bolts securing the main regulating valve to the transmission case and connect a hoist. Remove the nuts from the studs securing the transmission to the rear frame and remove the transmission from the tractor. It may be necessary to use a pry bar between the rear frame and hydraulic manifold to push the transmission free of the studs. (Illustr. 15.)

NOTE: As the transmission assembly is lifted out, it will have to be maneuvered to clear the pivot brake cable and the suction filter inlet tube at the LH side of the front frame. On loader machines, it will also have to clear the equipment pump pressure tube (Illustr. 15).



Illustr. 15  
Removing the Transmission.

37. 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.
38. Slide the drive yoke from the forward clutch shaft splines.
39. Cover the rear frame and flywheel housing openings to prevent dirt and dust from entering.





5. DISASSEMBLY



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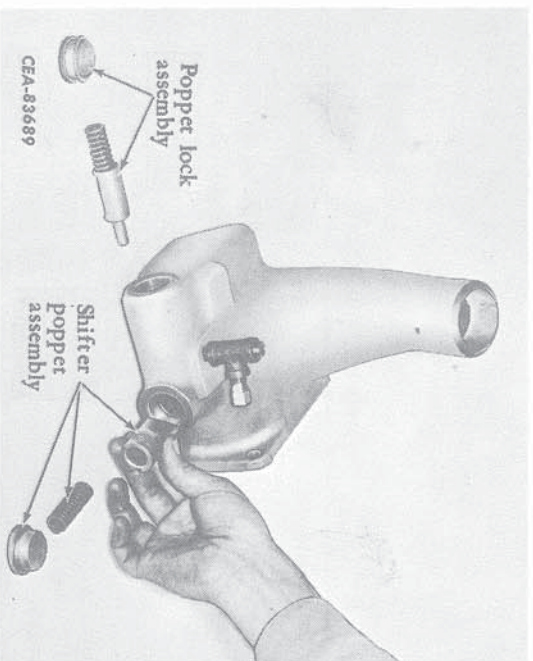
Illustr. 16  
Exploded View of Transmission Hi-Lo Shifting Lever and Linkage.

- |                       |                        |                                       |
|-----------------------|------------------------|---------------------------------------|
| 1. Hand lever ball.   | 13. Gasket.            | 25. Bushing.                          |
| 2. Clamp.             | 14. Spring.            | 26. Swivel shaft.                     |
| 3. Boot.              | 15. Poppet.            | 27. Transmission cover.               |
| 4. Clamp.             | 16. Poppet lock.       | 28. Plug.                             |
| 5. Spring stop.       | 17. Shifter lock tube. | 29. Dowel pin.                        |
| 6. Spring.            | 18. Nut.               | 30. Gasket.                           |
| 7. Washer.            | 19. Elbow.             | 31. Oil screen.                       |
| 8. Swivel cap.        | 20. Nut.               | 32. Transmission case.                |
| 9. Hi-lo shift lever. | 21. Connector.         | 33. Gasket.                           |
| 10. Lever housing.    | 22. Tee.               | 34. Hydraulic valve spacer.           |
| 11. Poppet guide pin. | 23. Nipple.            | 35. Transmission case lower "O" ring. |
| 12. Plug.             | 24. Gasket.            |                                       |



### Hi-lo Shift Lever Assembly (Ref. Nos. Refer to Illust. 16)

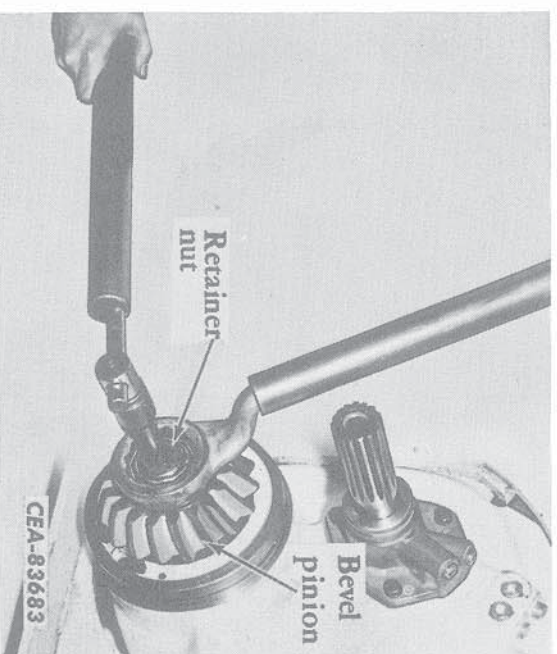
1. Disconnect the shifter lock tube (17) from the hi-lo shifter housing (10) and transmission cover (27) and remove the tube.
2. Remove the shift lever ball (11). Remove the upper and lower shift lever boot clamps and remove the boot (3).
3. Remove the rivet securing the spring stop (5) to the shift lever and remove the spring stop, spring (6), spring washer (7) and swivel cap (8) from the shift lever.
4. Remove the swivel shaft (26) securing the shift lever to the shifter housing and pull the lever (9) from the housing.
5. Remove the cap screws and washers securing the shifter housing (10) to the transmission cover and remove the housing and gasket (24).
6. 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. 17).



Illust. 17  
Disassembling the Shift Lever Housing.

### Transmission Case and Cover

7. 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. 18.)



Illust. 18  
Removing the Bevel Pinion Rear Nut.

8. 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. 19.)

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.

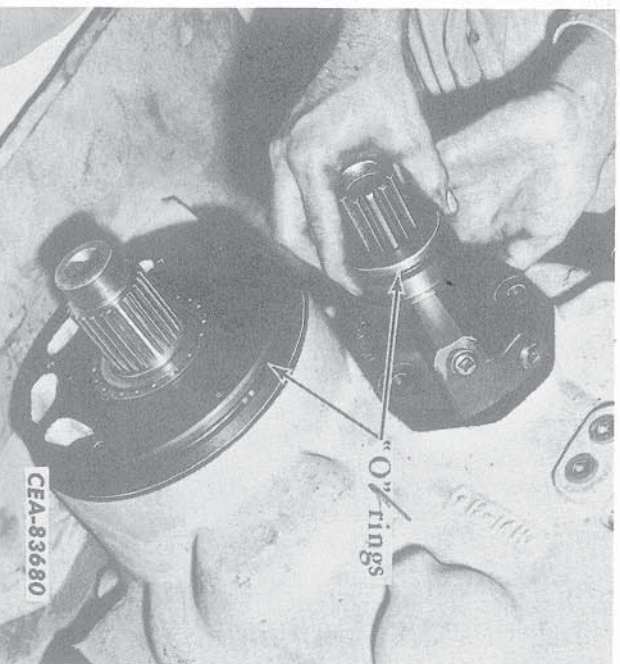
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## 5. DISASSEMBLY - Continued

### Transmission Case and Cover - Continued

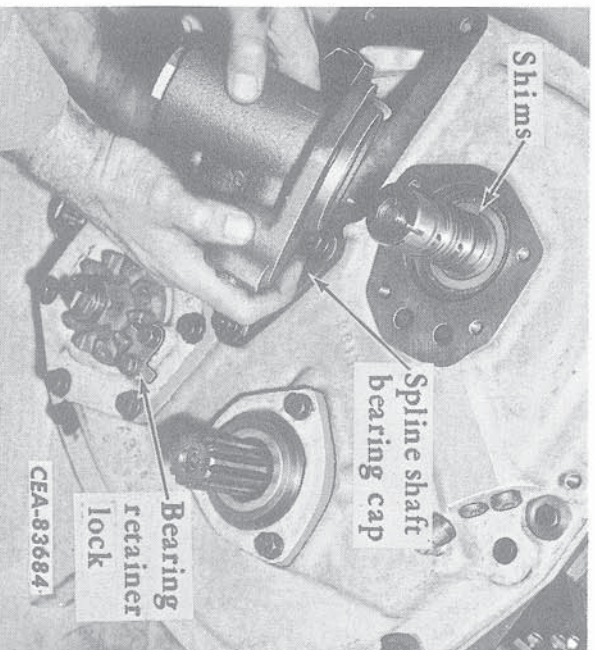


Illust. 19  
Removing the Forward Clutch Shaft  
Hydraulic Manifold.

9. Remove the cap screws and washers securing the reverse clutch shaft manifold to the transmission cover and remove the manifold. Remove the shims and keep them with the hydraulic manifold. The shims are used to obtain the clutch shaft end play. (Illust. 20.)

NOTE: Earlier transmissions have shims installed between the hydraulic manifold and front cover. Later transmissions have shims between the hydraulic manifold flange and front bearing cup as shown in Illust. 20. Also on the later transmissions "O" rings (17A) and a sealing ring (18A) are used with the manifold to seal off the oil passages (Illust. 39).

10. Remove the cap screws and washers securing the spline shaft bearing cap (Illust. 20) to the front cover and remove the cap with sealing ring.



Illust. 20  
Removing the Reverse Clutch Shaft  
Hydraulic Manifold.

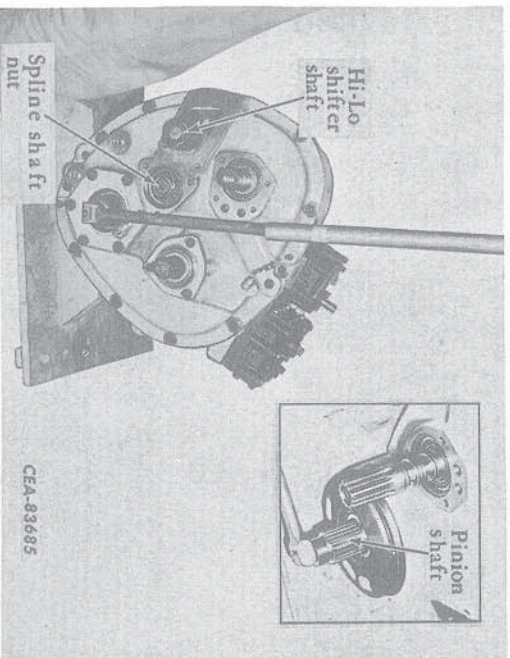
11. Remove the cap screws and washers securing the lock to the pinion shaft bearing cage and the bearing retainer. Remove the lock (Illust. 20).

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

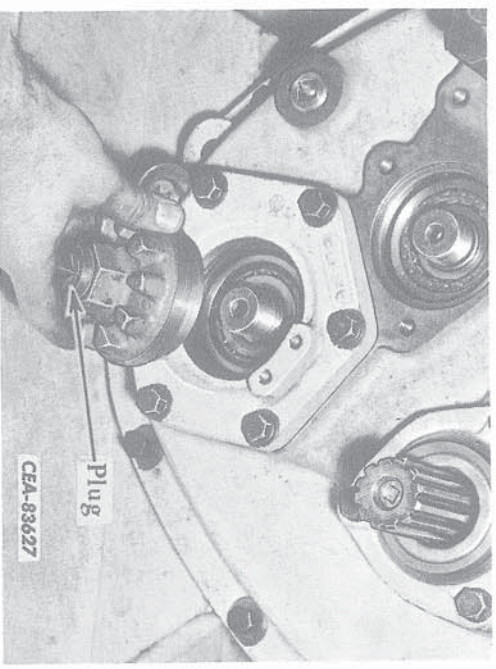
13. Place a 3/4 inch square drive breaker bar in the rear of the pinion shaft. Place an extension over the breaker bar handle to hold the pinion shaft from turning while removing the pinion shaft front nut. Remove the front nut using a socket, breaker bar and extension (Illust. 21).

To remove the spline shaft nut (Illust. 21), hold the bevel pinion shaft as described previously. Place the high and low gear in mesh with the low range driven gear on the bevel pinion shaft by pushing the hi-lo shifter shaft in against the transmission front cover. This will keep the spline shaft from turning as the nut is loosened with a socket, breaker bar and extension.



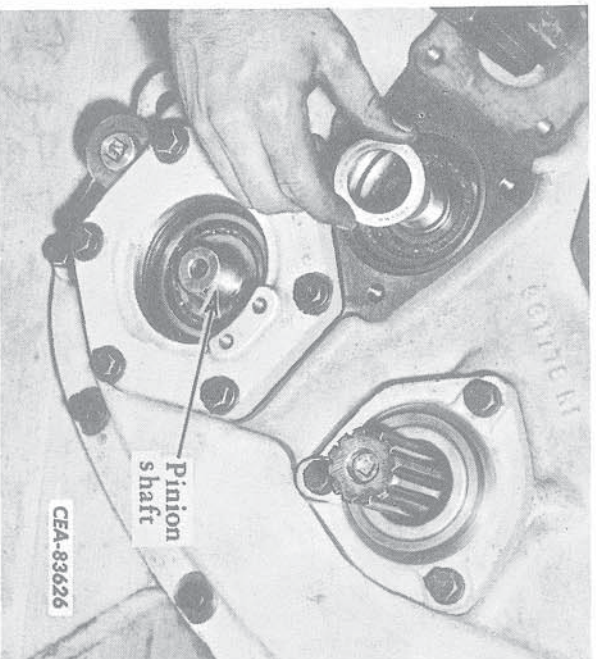


Illust. 21  
Removing the Pinion Shaft Front Nut.



Illust. 23  
Installing the Pinion Shaft Front  
Bearing Retainer.

14. Remove the spline shaft front bearing plate. This plate is part of the bearing and is not serviced separately (Illust. 22).



Illust. 22  
Removing the Spline Shaft Front Bearing Plate.

15. Re-install the bearing retainer. It will be used later in disassembly to facilitate pinion shaft removal. Remove the plug with gasket from the retainer (Illust. 23).

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

17. Remove the cap screws, washers and nuts securing the transmission case to the transmission cover and remove the case. (Illust. 24) 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.

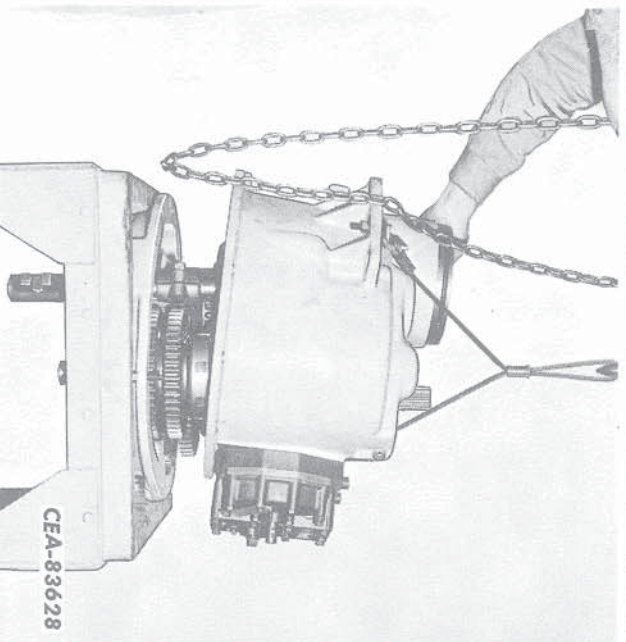
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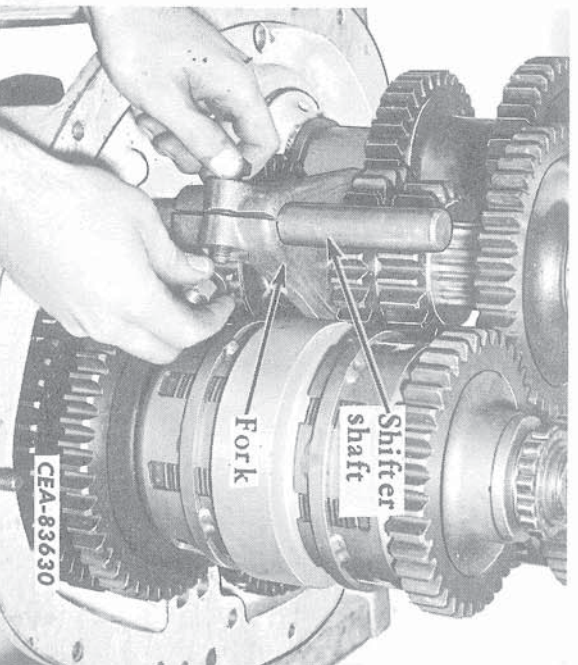
## 5. DISASSEMBLY - Continued

### Transmission Case and Cover - Continued



Illust. 24

Removing the Transmission Case.

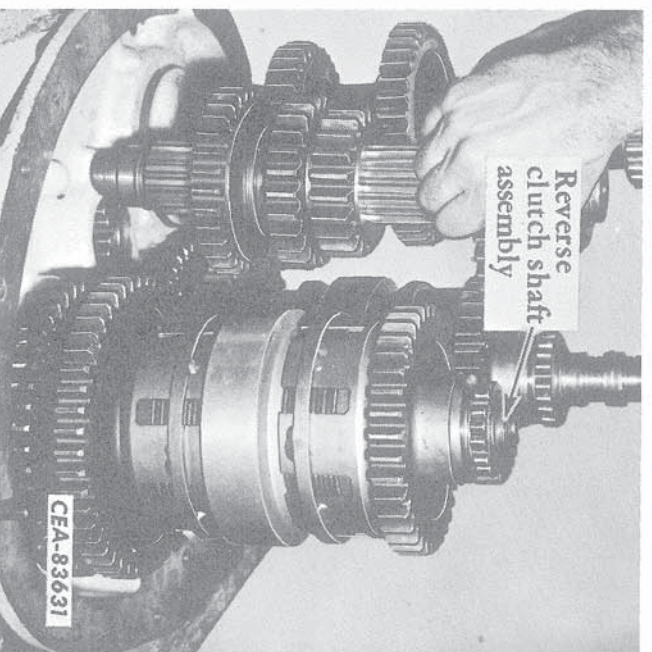


Illust. 25

Removing the Shifter Fork Lock Screw.

18. 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. 25).

19. 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. 26).

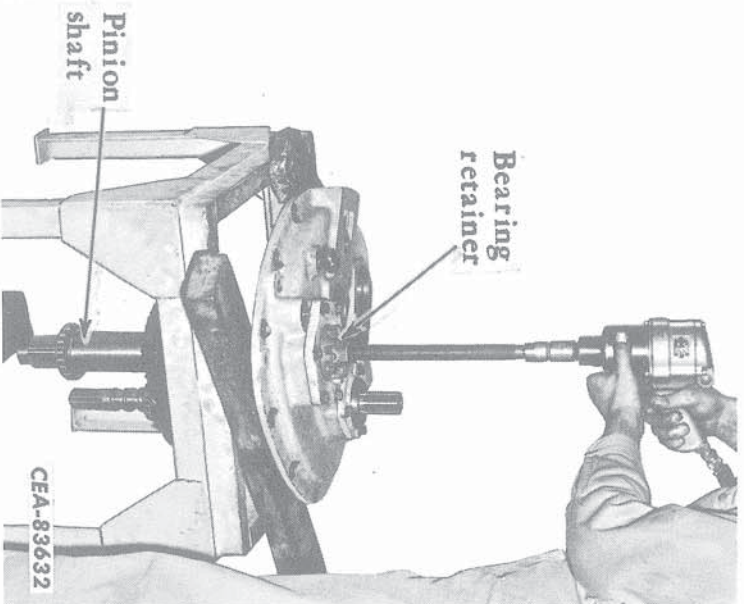


Illust. 26

Removing the Spline Shaft.

20. Place the front cover with the two remaining shafts in the stand or on blocks with the shafts extending down. 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. 27).

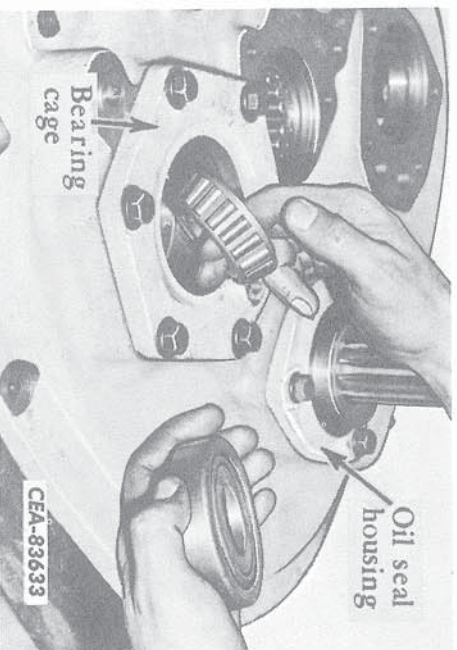




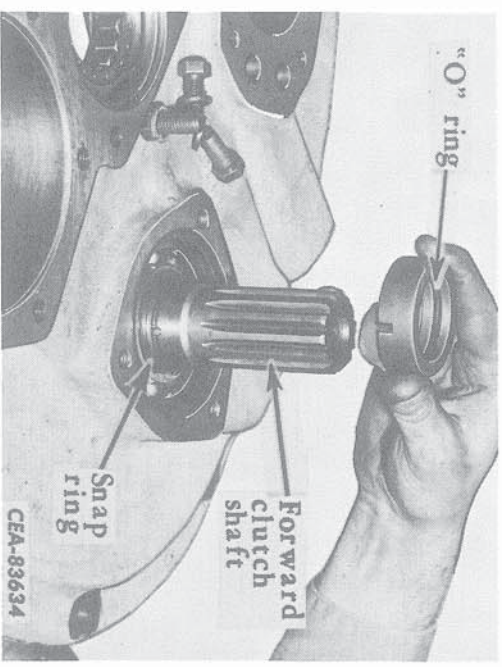
Illust. 27  
Removing the Bevel Pinion Shaft.

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. 28).

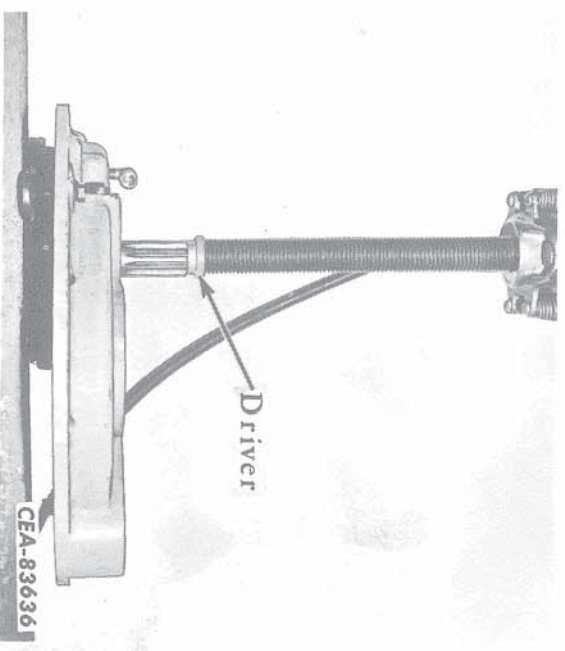
22. Remove the cap screws and lockwashers securing the bearing cage (Illust. 28) to the front cover. The bearing cage is held in the



Illust. 28  
Removing the Pinion Shaft Front  
Bearing Assembly.



Illust. 29  
Removing the Forward Clutch Shaft  
Oil Seal Rotor.



Illust. 30  
Removing the Forward Clutch Shaft.

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.

(Continued on next page)





## 5. DISASSEMBLY - Continued

### Transmission Case and Cover - Continued

23. Remove the cap screws and washers securing the oil seal housing (Illust. 28) to the front cover and remove the housing with sealing ring and oil seal stator from the forward clutch shaft. Remove the oil seal rotor from the shaft. Remove the snap ring from the shaft (Illust. 29).

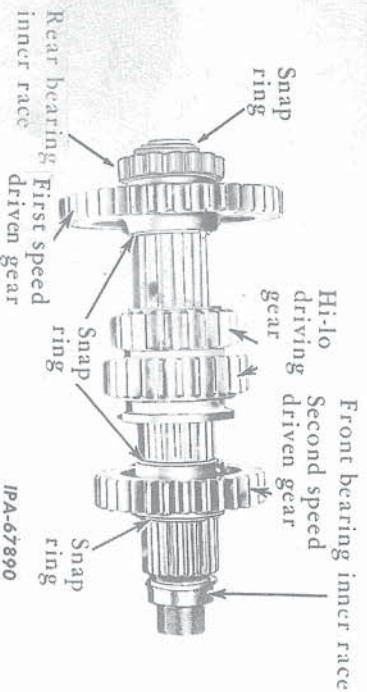
24. Support the shaft and cover assembly in a press on the reverse drive gear and press the shaft from the ball bearing. The gear will be partially pressed off as the shaft is freed from the bearing. Use a driver to protect the shaft (Illust. 30). If bearing replacement is necessary, reverse the cover in the press and press it out of the cover.

### Spline Shaft (Ref. Nos. Refer to Illust. 35)

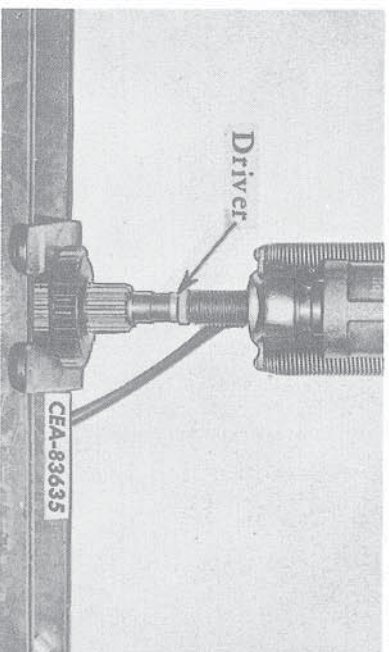
25. Install a bearing split collar puller plate behind the front bearing inner race (Illust. 31). Support the shaft assembly in a press on the puller plate and press the shaft from the bearing inner race.

26. Remove the second speed driven gear outer snap ring (9) and the rear bearing snap ring (3) from the shaft.

27. Support the shaft in a press under the second speed driven gear (10) and press the shaft from the gear (Illust. 32). Use a driver to protect the shaft.



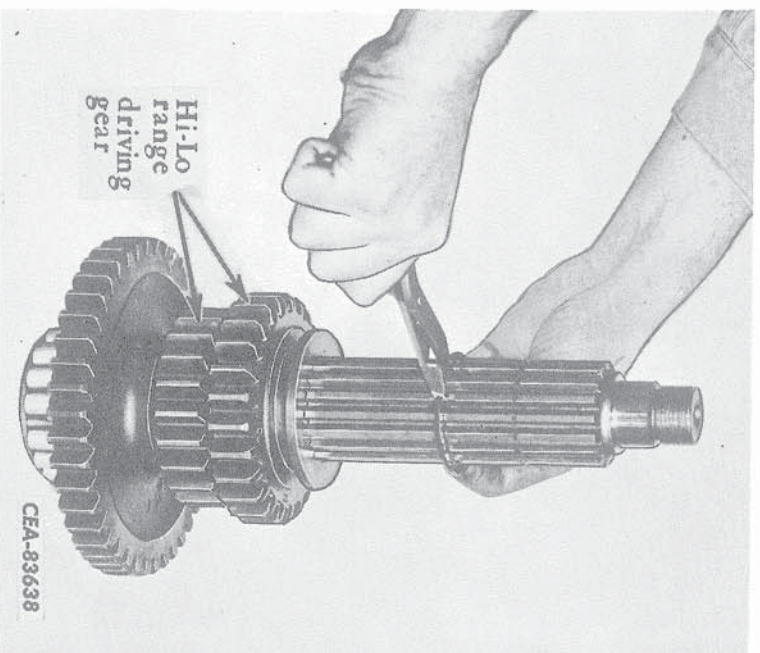
Illust. 31  
Spline Shaft Assembly.



Illust. 32  
Removing the Second Speed Driven Gear.

28. Remove the second speed driven gear inner snap ring (9) and slide the hi-lo range driving gear (8) from the shaft (Illust. 33).

29. Position the shaft in a press supported by the first speed driven gear (6) and press the shaft (using a driver) from the gear and inner race of the bearing (4) (Illust. 34).

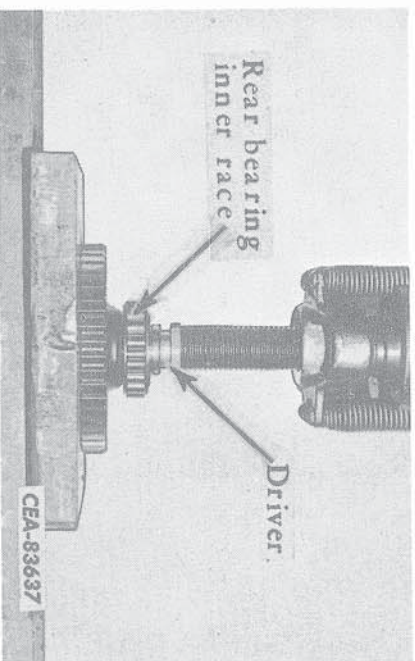


Illust. 33  
Removing the Second Speed Driven Gear Inner Snap Ring.



## TRANSMISSION (POWER SHIFT)

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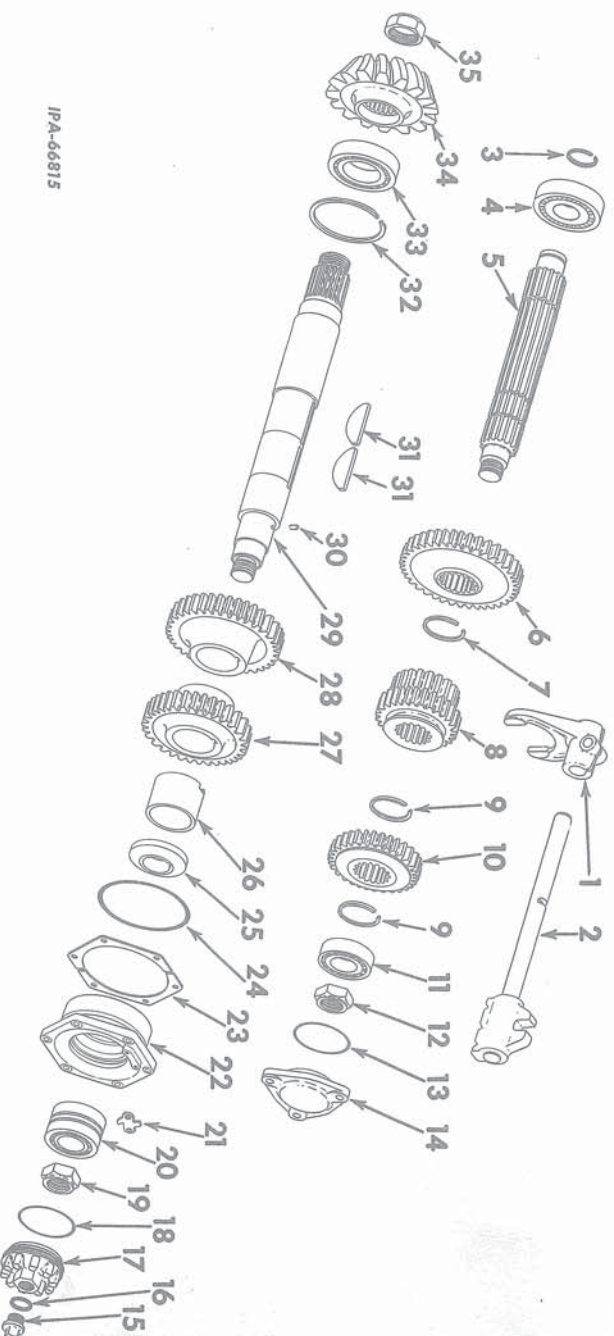


Illust. 34  
Removing the First Speed Driven Gear  
and Bearing Race.

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.

Pinion Shaft  
(Ref. Nos. Refer to Illust. 35)

(Continued on next page)



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Illust. 35  
Exploded View of Spline Shaft and Bevel Pinion Shaft.

- |                               |                                      |                             |
|-------------------------------|--------------------------------------|-----------------------------|
| 1. Hi-lo shifter fork.        | 13. Sealing ring.                    | 24. Sealing ring.           |
| 2. Hi-lo shifter shaft.       | 14. Bearing cap.                     | 25. Front spacer.           |
| 3. Snap ring.                 | 15. Plug.                            | 26. Rear spacer.            |
| 4. Rear bearing.              | 16. Gasket.                          | 27. High range driven gear. |
| 5. Spline shaft.              | 17. Front bearing retainer.          | 28. Low range driven gear.  |
| 6. First speed driven gear.   | 18. Sealing ring.                    | 29. Pinion shaft.           |
| 7. Snap ring.                 | 19. Nut.                             | 30. Locating pin.           |
| 8. Driving gear.              | 20. Double-row taper roller bearing. | 31. Key.                    |
| 9. Snap ring.                 | 21. Lock.                            | 32. Snap ring.              |
| 10. Second speed driven gear. | 22. Bearing cage.                    | 33. Rear bearing.           |
| 11. Front bearing.            | 23. Shims.                           | 34. Pinion.                 |
| 12. Nut.                      |                                      | 35. Nut.                    |

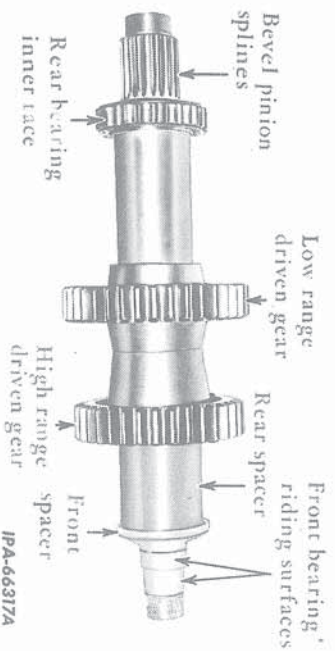




## 5. DISASSEMBLY - Continued

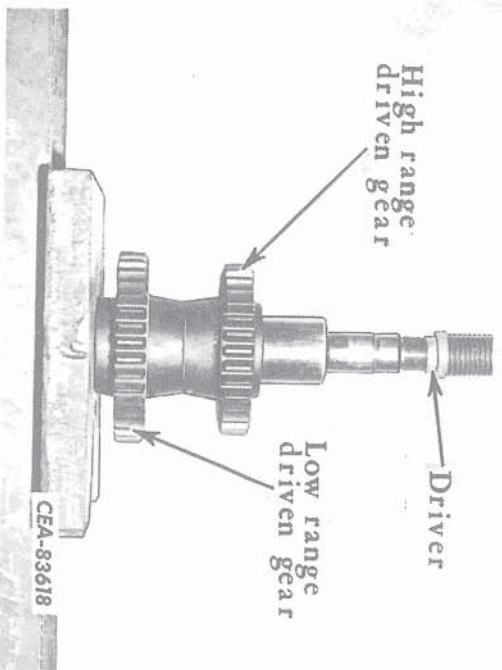
### Pinion Shaft - Continued (Ref. Nos. Refer to Illust. 35)

30. Slide the two spacers (25 and 26) from the shaft. Place the shaft in a press supported by the low range driven gear (28) and press off both gears (27 and 28) in one operation. Remove the woodruff keys (31) (Illust. 37).



### Illust. 36 Bevel Pinion Shaft Assembly.

31. Install a bearing split collar puller plate behind the rear bearing inner race (Illust. 36). Support the shaft in a press on the puller plate and press the shaft from the bearing race.



Illust. 37

Removing the High and Low Range Driven Gears.

### Forward and Reverse Clutch Shafts (Ref. Nos. Refer to Illust. 38 and 39)

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 on the reverse clutch shaft; the forward clutch shaft would be similar.

32. **REVERSE CLUTCH SHAFT:** Remove the rear bearing snap ring (13). Support the shaft assembly on a press under the reverse driven gear (11) and press the shaft from the gear and inner race of the front bearing (12) (Illust. 42). Remove the gear key (41) 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 (40). Remove the snap ring (11) from the clutch shaft.

33. Remove the second speed drive gear thrust washer (10) from clutch shaft. Slip the second speed drive gear and drum assembly (8) off the shaft (Illust. 43).

34. Remove the two bearing spacers (6) and the thrust bearing (7) (Illust. 44).

35. Remove the internal snap ring from the groove in the clutch hub (22A or 25A) which secures the two clutch hub retainers (4) (Illust. 45).

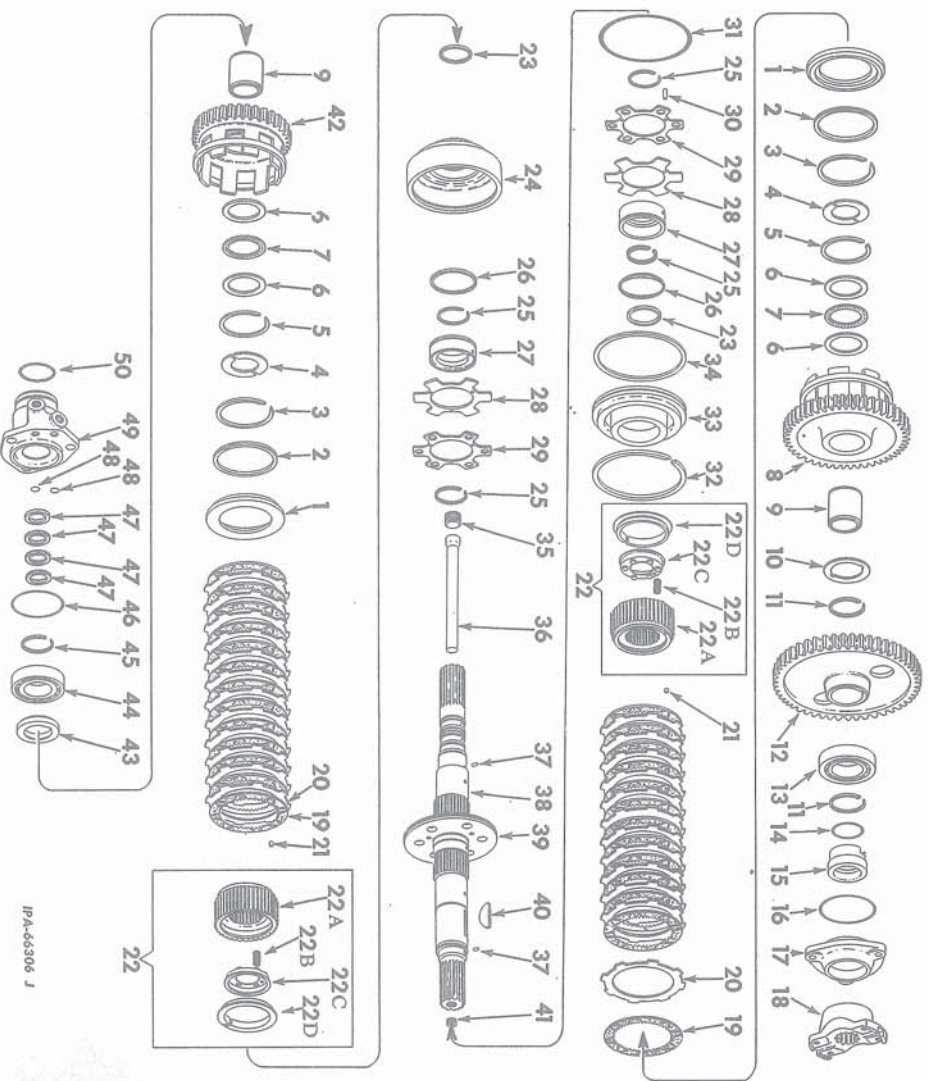
36. Remove the hub retainers (4). To free the retainers (4) from the shaft, grasp the end of the piston housing with the fingers and using the palms of the hands compress the hub assembly (22 or 25) (Illust. 46).

(Continued on page 25)



# TRANSMISSION (POWER SHIFT)

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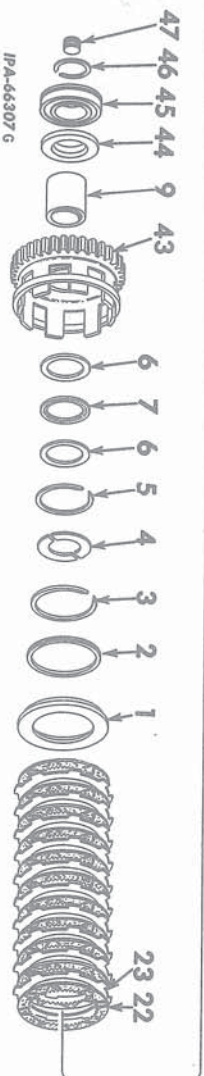
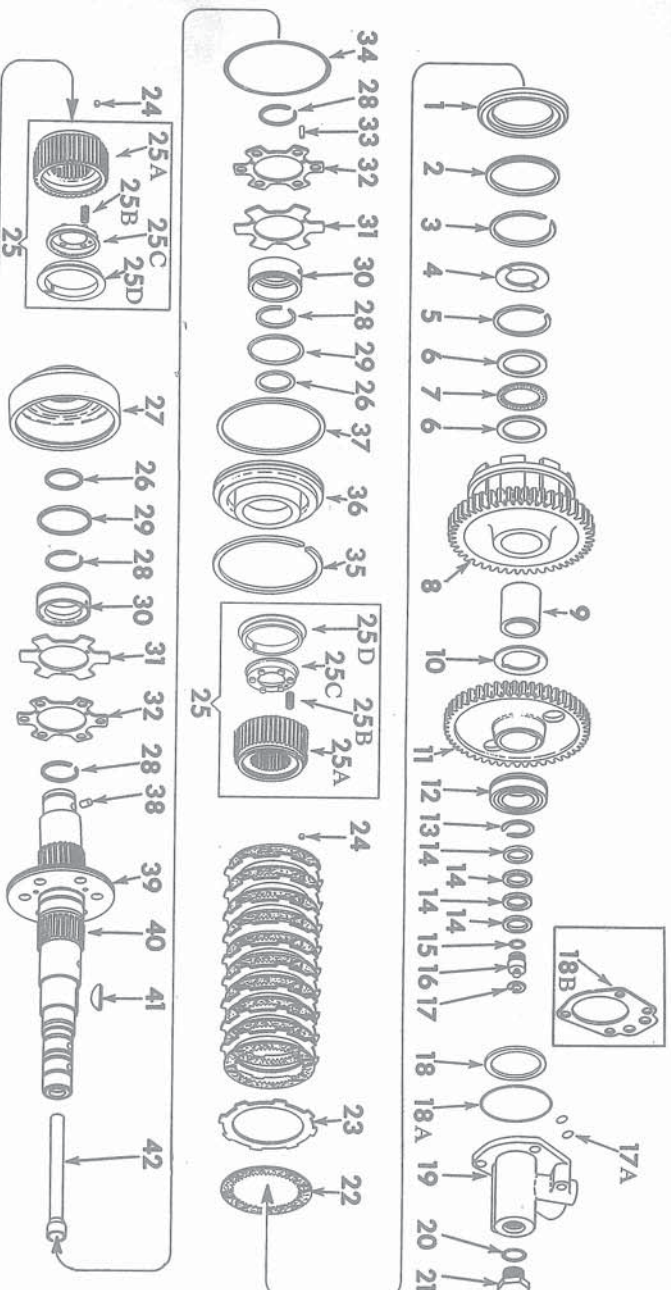


Illust. 38  
Exploded View of Forward Clutch Shaft.

- |   |                          |                          |   |
|---|--------------------------|--------------------------|---|
| 1. Backing plate.                       | 14. "O" ring.            | 24. Piston housing.      | 38. Shaft.                              |
| 2. Snap ring.                           | 15. Seal.                | 25. Snap ring.           | 39. Separator plate.                    |
| 3. Snap ring.                           | 16. "O" ring.            | 26. Sealing ring.        | 40. Key.                                |
| 4. Hub retainer.                        | 17. Housing.             | 27. Accelerating piston. | 41. Plug.                               |
| 5. Snap ring.                           | 18. Drive yoke.          | 28. Disc valve.          | 42. First speed gear and drum assembly. |
| 6. Spacer.                              | 19. Clutch plate.        | 29. Reinforcing disc.    | 43. Thrust washer.                      |
| 7. Thrust bearing.                      | 20. Clutch plate.        | 30. Dowel pin.           | 44. Bearing.                            |
| 8. Second speed gear and drum assembly. | 21. Dowel pin.           | 31. Snap ring.           | 45. Snap ring.                          |
| 9. Bushing.                             | 22. Clutch hub assembly. | 32. Force piston.        | 46. Sealing ring.                       |
| 10. Thrust washer.                      | 22A. Hub.                | 33. Force piston.        | 47. Sealing rings.                      |
| 11. Snap ring.                          | 22B. Return spring.      | 34. Sealing ring.        | 48. "O" ring.                           |
| 12. Reverse drive gear.                 | 22C. Spring retainer.    | 35. Plug.                | 49. Hydraulic manifold.                 |
| 13. Bearing.                            | 22D. Plate retainer.     | 36. Shaft tube.          | 50. "O" ring.                           |
|   | 23. Sealing ring.        | 37. Dowel pin.           |   |



# TRANSMISSION (POWER SHIFT)

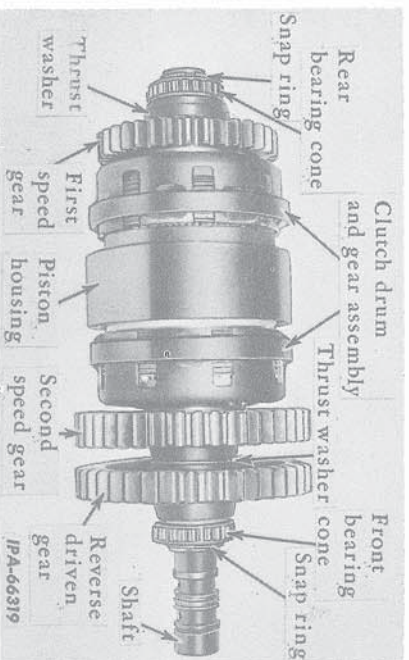


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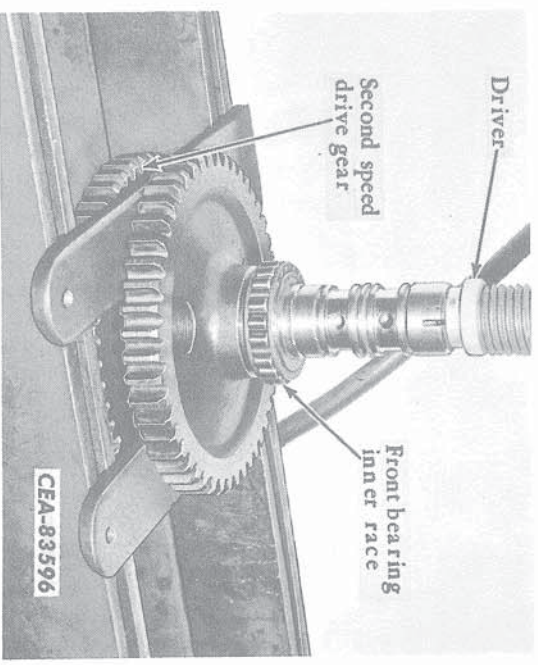
Illust. 39  
Exploded View of Reverse Clutch Shaft.

1. Backing plate.
2. Snap ring.
3. Snap ring.
4. Hub retainer.
5. Snap ring.
6. Spacer.
7. Thrust bearing.
8. Second speed gear and drum assembly.
9. Bushing.
10. Thrust washer.
11. Reverse driven gear.
12. Bearing.
13. Snap ring.
14. Sealing rings.
15. "O" ring.
16. Tachometer drive plug.
17. Snap ring.
- 17A. "O" rings.
18. Shims.
- 18A. Sealing ring.
19. Hydraulic manifold.
20. Gasket.
21. Plug.
22. Clutch plate.
23. Clutch plate.
24. Dowel pin.
25. Clutch hub assembly.
- 25A. Hub.
- 25B. Return spring.
- 25C. Spring retainer.
- 25D. Plate retainer.
26. Sealing ring.
27. Piston housing.
28. Snap ring.
29. Sealing ring.
30. Accelerating piston.
31. Disc valve.
32. Reinforcing disc.
33. Dowel pin.
34. "O" ring.
35. Snap ring.
36. Force piston.
37. Sealing ring.
38. Dowel pin.
39. Separator plate.
40. Shaft.
41. Key.
42. Shaft tube.
43. First speed gear and drum assembly.
44. Thrust washer.
45. Bearing.
46. Snap ring.
47. Plug.

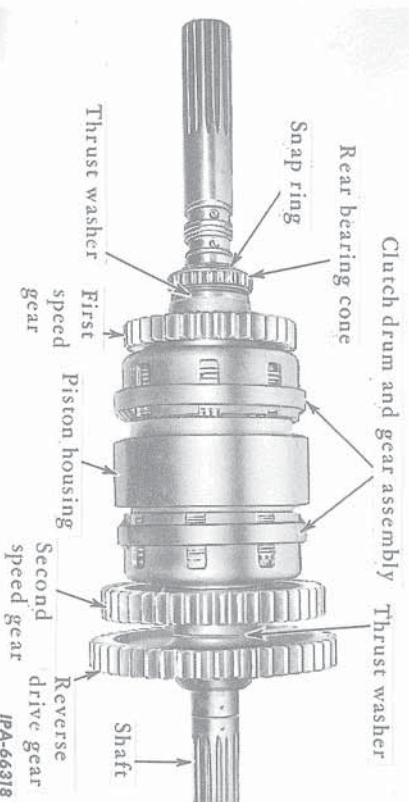


**5. DISASSEMBLY - Continued****Forward and Reverse Clutch Shafts - Continued**  
**(Ref. Nos. Refer to Illust. 38 and 39)**

**Illust. 40**  
**Reverse Clutch Shaft Assembly.**



**Illust. 42**  
**Removing the Reverse Driven Gear.**



**Illust. 41**  
**Forward Clutch Shaft Assembly.**

37. Grasp the outside diameter of the steel clutch plates (20 or 23) and lift off the clutch hub assembly (Illust. 47).

**NOTE:** The hub assembly must be lifted straight off. Be careful not to cock the hub (22A or 25A) on the shaft splines as the return springs in the hub may become twisted.

38. Remove the rear bearing snap ring (45 or 46) from the clutch shaft. Install a three jaw puller to the first speed drive gear and drum assembly as shown in Illust. 48. 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, gear and drum assembly, spacers (6) and thrust bearing (7) from the shaft.

(Continued on next page)

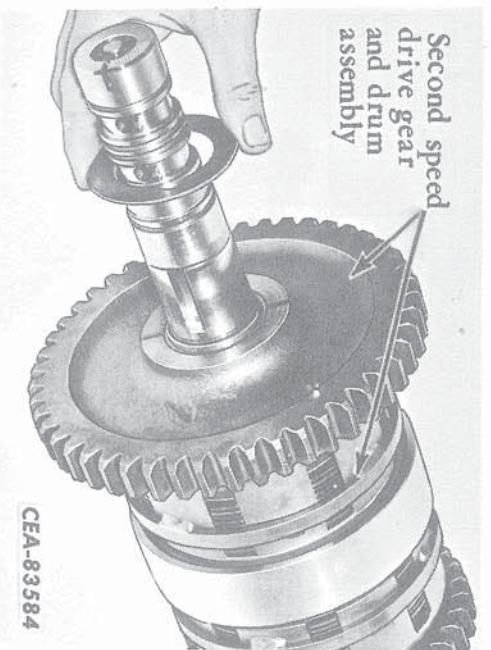




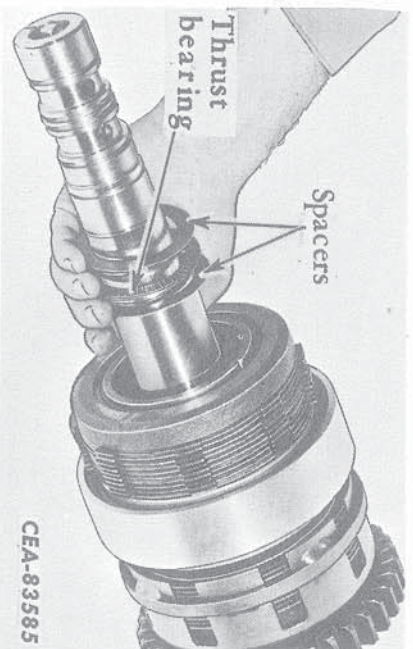
## 5. DISASSEMBLY - Continued

### Forward and Reverse Clutch Shafts - Continued (Ref. Nos. Refer to Illust. 38 and 39)

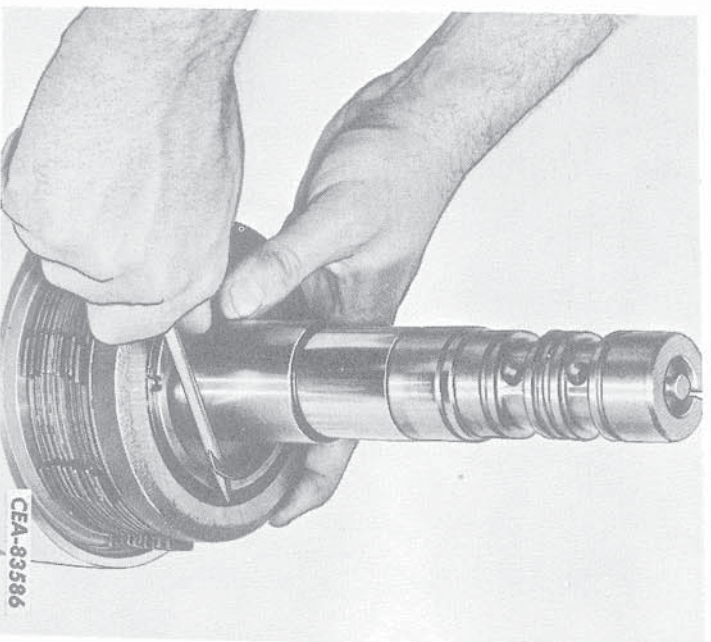
NOTE: Do not remove the bearing inner race with a bearing split collar puller plate as the bearing will be damaged. When pulling the bearing race from the shaft, place a flat metal plate between the puller screw and the end of the shaft.



Illust. 43  
Removing the Second Speed Drive  
Gear Thrust Washer.



Illust. 44  
Removing the Thrust Bearing and Spacers.



Illust. 45  
Removing the Clutch Hub Retaining  
Snap Ring.

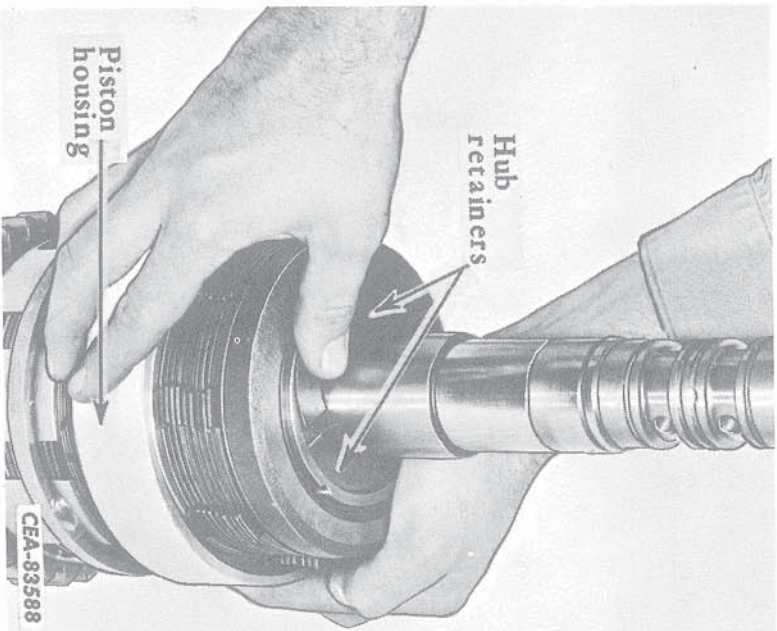
39. Place the shaft assembly on end as the remaining clutch hub assembly is up. Repeat steps 35 through 37 for removing the clutch hub assembly.

40. Place the shaft on end so the force piston (33 or 36) is up. Remove the internal snap ring (32 or 35) from the groove in the piston housing using a screwdriver or other suitable tool (Illust. 49).

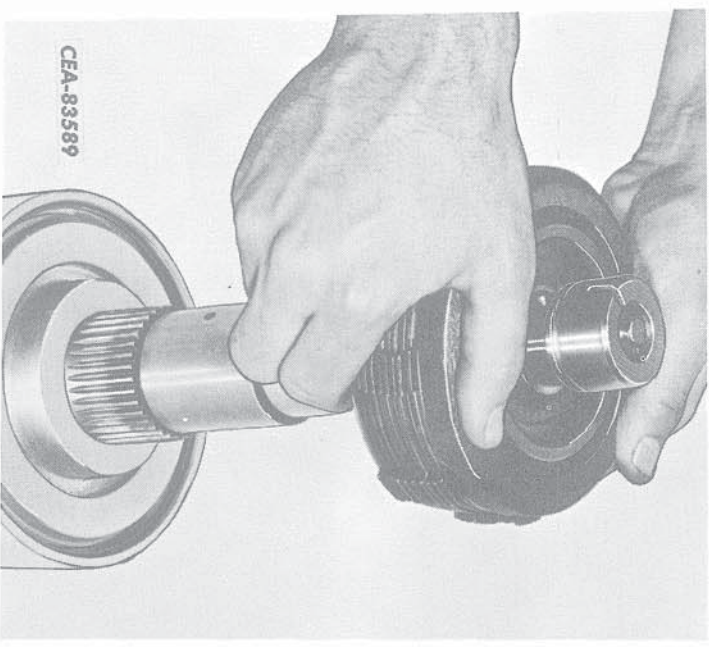
41. To prevent damaging the lathe cut seal ring (34 or 37) on the force piston and the "O" ring (31 or 34) on the separator plate when the piston housing is being removed, fill the snap ring groove in the piston housing. A piece of brazing rod can be rolled around in the groove to the approximate circumference 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.





Illust. 46  
Removing the Clutch Hub Retainers.



Illust. 47  
Removing the Clutch Hub Assembly.

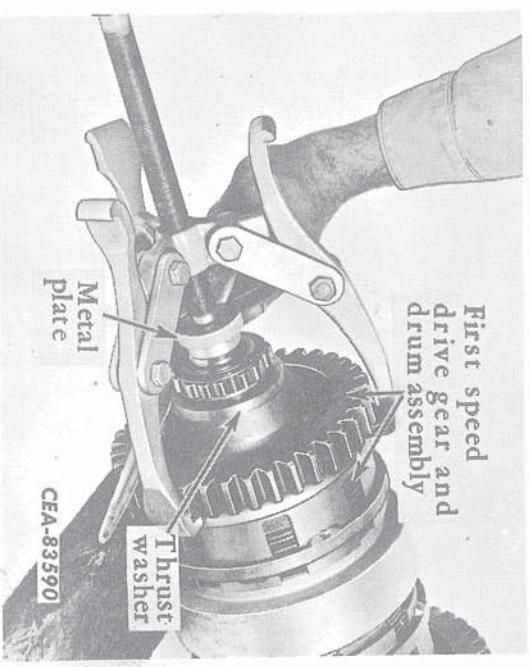
42. Lift off the force piston and remove the lathé cut seal ring. Remove the hook type seal ring from the shaft and "O" ring from the separator plate (Illust. 50).

43. Push the accelerator piston away from the snap ring (25 or 28) and, using a pair of special snap ring pliers No. 1 020 441R1, remove the snap ring (Illust. 51). Remove the accelerator piston. Remove the seal ring (26 or 29) from the accelerator piston.

44. Remove the disc valve and reinforcing disc from the guide pins in the separator plate. Then remove the three knock-off dowel pins from the separator plate (Illust. 52).

NOTE: The guide pins are swaged to the separator plate and are not serviced separately.

(Continued on page 29)



Illust. 48  
Removing the Rear Bearing Inner Race.





**5. DISASSEMBLY - Continued**

Forward and Reverse Clutch Shafts - Continued  
(Ref. Nos. Refer to Illust. 38 and 39)



Illust. 49  
Removing the Force Piston Snap Ring.



Illust. 51  
Removing the Accelerator Piston Snap Ring.



Illust. 50  
Removing the Force Piston.



Illust. 52  
Removing the Disc Valve and Reinforcing Disc.



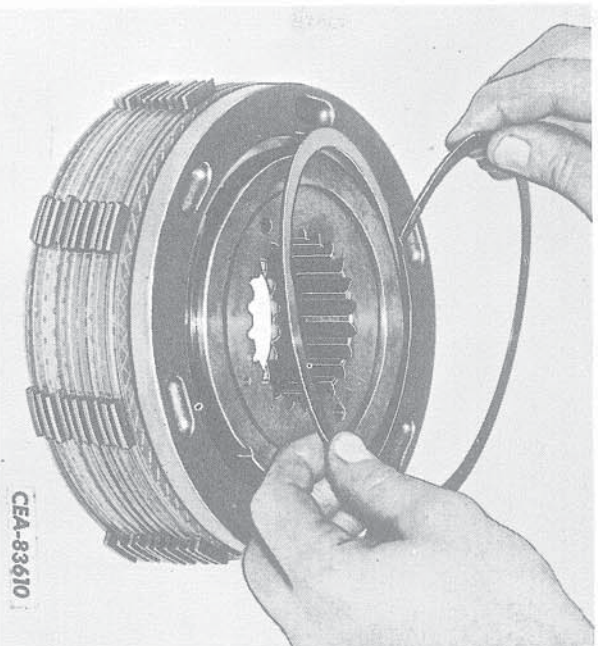


45. Reverse the shaft on the bench. Remove the hook type seal ring (23 or 26) from the shaft. Remove the accelerator piston and the reinforcing disc and disc valve in the same manner as was done previously.

46. Disassemble the clutch hub assembly. Remove the spiral snap ring from the groove in the clutch backing plate (Illust. 53). Remove the external snap ring and remove the backing plate (1) and the dowel pin (21 or 24) from the clutch hub. (Illust. 54 and 55.)

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

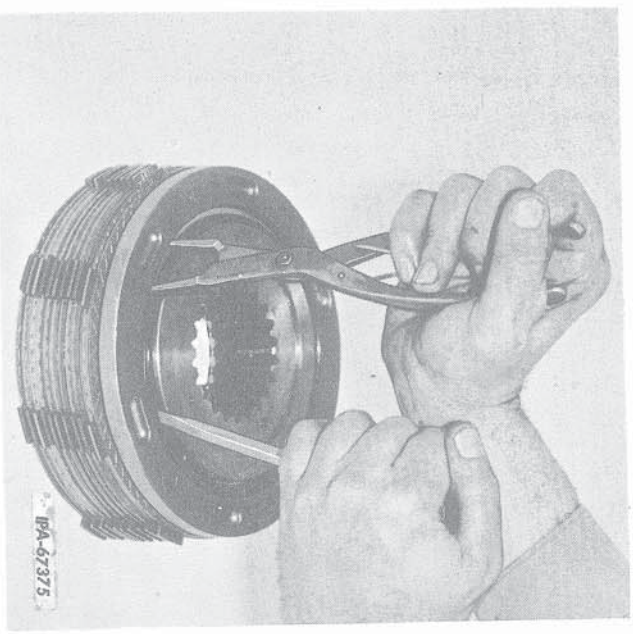
**NOTE:** No attempt should be made to remove the sheet metal retainers and springs contained on the inside of the clutch hub.



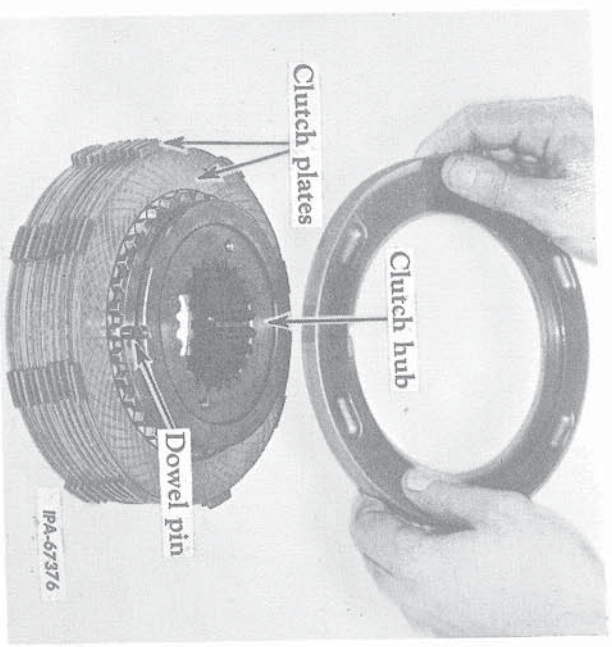
Illust. 53  
Removing the Clutch Hub Spiral Snap Ring.

47. Remove the four hook type seal rings (14 or 47) from the clutch shaft.

48. 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.



Illust. 54  
Removing Clutch Hub External Snap Ring.



Illust. 55  
Removing Clutch Hub Backing Plate.

(Continued on next page)



## TRANSMISSION (POWER SHIFT)

### 5. DISASSEMBLY - Continued

#### Forward and Reverse Clutch Shaft - Continued (Ref. Nos. Refer to Illust. 38 and 39)

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 shafts 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 reoiled before assembly.

Remove the snap ring securing the tachometer drive plug in the end of the reverse clutch shaft. Remove the drive plug and inspect the "O" ring. Reinstall the drive plug with "O" ring and secure with the snap ring.

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 (22, Illust. 38) and (25, Illust. 39). 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 component of the hub assembly is not functioning properly, replace the complete hub assembly.

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.

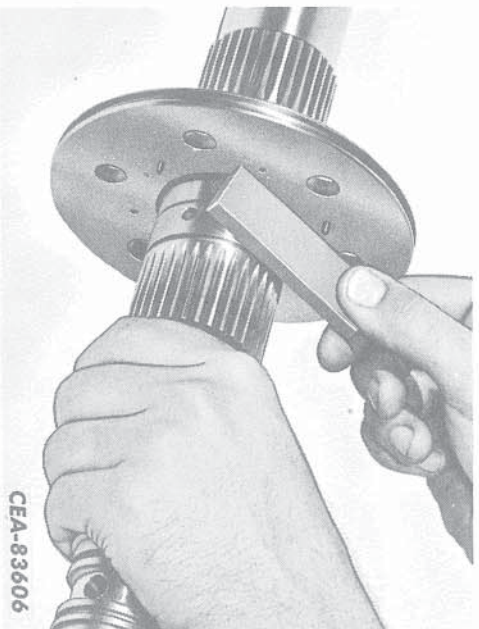
NOTE: Do not mistake the loose appearance of the separator plate "O" ring as being stretched or deformed. It has been manufactured with a greater circumference than the separator plate.





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).

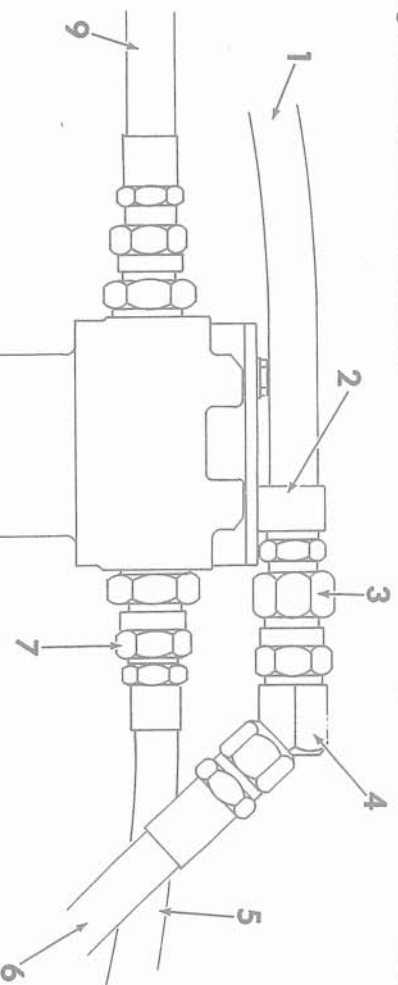
11. Using an oil stone, remove any burrs that might damage sealing surfaces or increase wear to close tolerance parts (Illust. 56).



12. Inspect the first and second speed drive gear bushings for scoring or excessive wear. Measure the shaft O.D. where the bushing rides and the bushing I.D. Subtract the shaft dimension from the bushing dimension to obtain the running clearance. If the running clearance exceeds that shown in Par. 2, "SPECIFICATIONS" the bushing should be replaced. If the bushing needs replacement, install a new bushing as follows:
- (a) Check the drive gear bore for scoring or galling. Check that the leading chamfer of the gear is free of burrs, nicks and sharp edges.
  - (b) Lubricate bushing O.D. or gear bore with engine oil before pressing bushing into place.
  - (c) Press bushing into place until end of bushing is 0.030 inch below the edge of the gear hub thrust surface (opposite to clutch drum).
  - (d) Check bushing I.D. (refer to Par 2, "SPECIFICATIONS.")

Illust. 56  
Removing Burrs from Clutch Shaft.

(Continued on next page)



Illust. 57  
Hydraulic Hose Connections without Thermo By-Pass Valve.

- 1. Regulator valve inlet hose.
- 2. Hose clamp (308 576R1).
- 3. Hose adapter (606 291C91).
- 4. Elbow (296 406R91).
- 5. Oil cooler inlet hose.
- 6. Oil cooler outlet hose.
- 7. Hose adapter (336 182R1).
- 8. Safety filter.
- 9. Converter-to-safety filter inlet hose.



## TRANSMISSION (POWER SHIFT)

### 6. INSPECTION AND REPAIR - Continued

13. The thermo by-pass valve is unnecessary in the hydraulic system of the torque converter and transmission and it is suggested that it be removed. Remove and add parts as follows to operate the hydraulic system without a thermo by-pass valve (refer to Illust. 57 and legend for new parts.)

(a) Disconnect the two oil cooler hoses and the regulator valve inlet hose at the by-pass valve housing.

(b) Remove the by-pass valve housing and valve assembly with plug, nipple and adapter from the nipple in the safety filter base. Remove the nipple from the base. Discard these parts.

(c) Install the new adapter (7) into the safety filter and connect the oil cooler inlet hose (5).

(d) Place the new clamp (2) on the regulator inlet hose (1) and install the new adapter (3) to the hose. Install the new elbow (4) on the oil cooler outlet hose (6) and connect the elbow to the adapter. Secure the clamp (2) to the safety filter mounting bracket.

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 handling and installing a new oil seal.

### Procedure for Servicing and Adjusting Tapered Roller Bearings

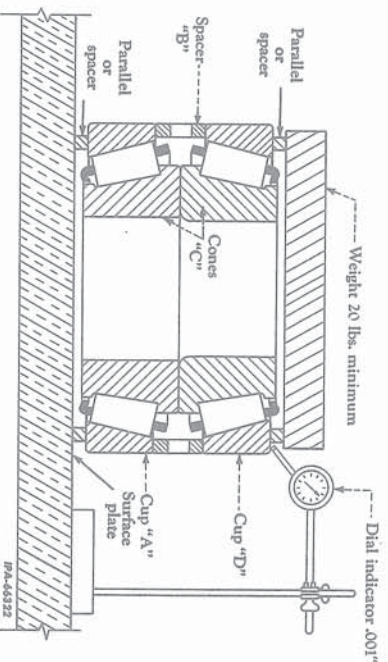
(Ref. Nos. Refer to Illust. 58)

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. 58. 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. 58). Bottom parallels must be of equal thickness.



Illust. 58  
Adjustment of Tapered Roller Bearings.

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  $0.008 \pm 0.001$  inch. If the reading on the dial indicator shows a greater drop than the maximum factory set end play ( $0.008 \pm 0.001$  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.

## 7. REASSEMBLY

### Forward and Reverse Clutch Shaft (Ref. Nos. Refer to Illust. 38 and 39)

NOTE: The inner races for the reverse clutch shaft front and rear bearings or forward clutch shaft rear bearing must be heated to  $275^{\circ}\text{F}$  for approximately 45 minutes before assembling on the shaft.

1. If the separator plate (39) was removed, install the new plate as follows. Three guide pins (Illust. 52) are pressed and wedged into the separator plate and should extend an equal distance on both sides of the plate.

Be sure one of the snap rings (25 or 28) is installed on the shaft. Heat the separator plate in oil to  $350^{\circ}\text{F}$  to  $400^{\circ}\text{F}$  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 (25 or 28) 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 41) in both ends of the forward clutch shaft and plug (47) in the rear of the reverse clutch shaft are installed properly (0.06 inch to flush). Be sure the tachometer drive plug (16) with "O" ring (15) has been installed and is held securely in the front of the reverse clutch shaft with an internal snap ring (17).

3. Place the shaft on end. Install the reinforcing disc (29 or 32) and disc valve (28 or 31) over the guide pins in the separator plate.

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 (Illust. 52).

4. Position the accelerator piston (27 or 30) over the clutch shaft until it is past the snap ring groove and install the snap ring (25 or 28). Install the hook type seal ring (26 or 29) on the accelerator piston (Illust. 51).

5. Place the shaft on a bench with the opposite end up. Install the pins (30 or 33) in the separator plate (39). Repeat Steps 3 and 4.

6. Place a hook type seal ring (23 or 26) in the clutch shaft groove near each accelerator piston (Illust. 50).

7. Place the "O" ring (31 or 34) 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 (24 or 27) over the shaft until it contacts the separator plate "O" ring.

(Continued on next page)



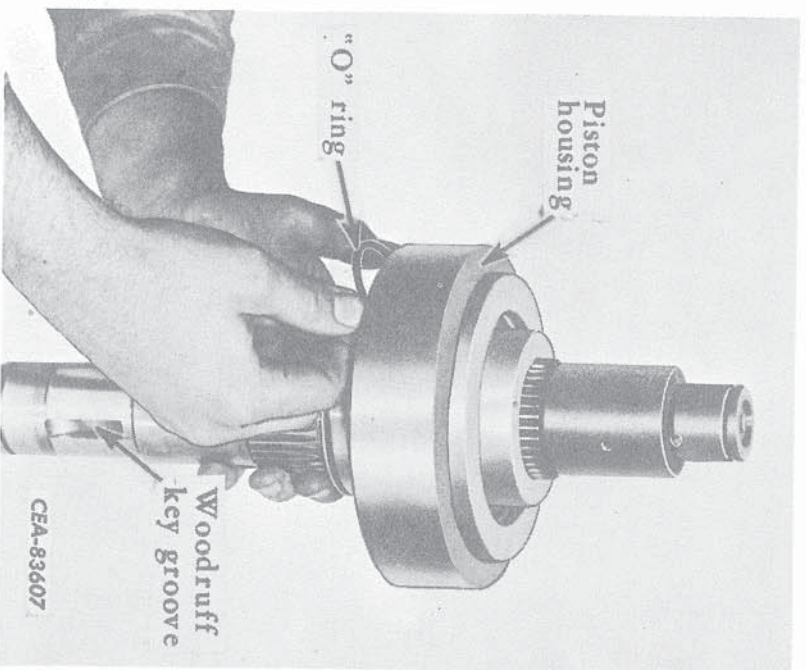


## 7. REASSEMBLY - Continued

### Forward and Reverse Clutch Shaft - Continued (Ref. Nos. Refer to Illust. 38 and 39)

Pull the excess of the "O" ring into a small loop in one area as shown in Illust. 59, 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.

**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.

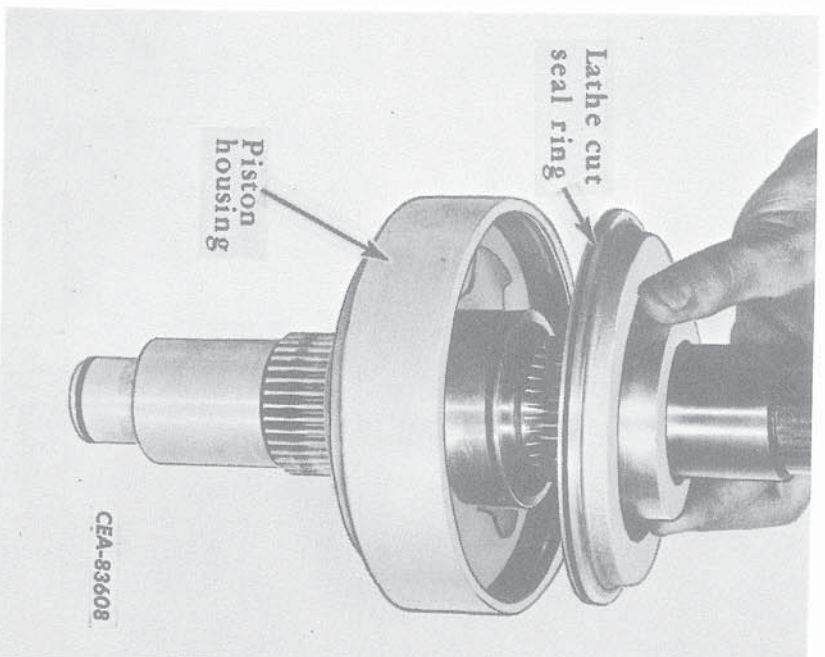


Illust. 59  
Positioning "O" Ring for Piston  
Housing Installation.

10. Reverse the shaft assembly on the bench. Install the lathe cut "O" ring (34 or 37) into the groove in the force piston (33 or 36). 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 "O" ring. (Illust. 60.)

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 (32 or 35) (Illust. 49).



Illust. 60  
Installing the Force Piston.

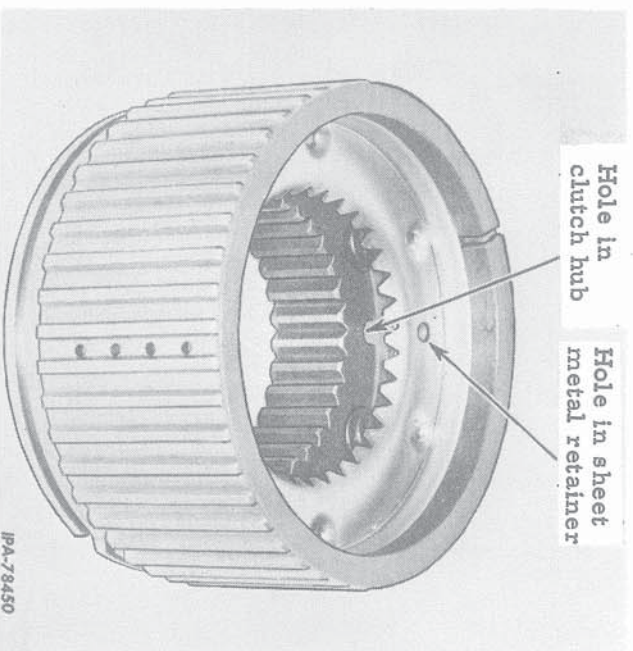




12. Alternately install one internally splined bronze clutch plate and one externally tanged steel clutch plate on the clutch hub (22A or 25A).

**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 dowel pin (21 or 24) into the hub. Install the clutch backing plate (1) over the hub with it properly indexed over the dowel pin. (Illustr. 55.) Install the snap ring (3) on the hub to secure the backing plate and install the internal spiral snap ring (2) into the groove in the backing plate (Illustr. 53 and 54).



Illustr. 61  
Clutch Hub Assembly.

14. Be sure the small hole in the sheet metal retainer is in line with the through hole in the clutch hub (Illustr. 61). Position the clutch hub assembly onto the shaft by properly splining the sheet metal retainer and hub splines to the clutch shaft splines (Illustr. 47).

**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 Illustr. 61) 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 (4) onto the shaft and secure them by installing the internal snap ring (5) into the clutch hub (Illustr. 46).
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. Install the spacer (6), thrust bearing (7) and then the other spacer (6) on the shaft (Illustr. 44).
19. Position the second speed gear and drum assembly (48 teeth) with bushing over the shaft, indexed on its outside diameter with the externally tanged clutch plates and flush with the spacer (6) on its inside diameter (Illustr. 62).
20. FORWARD CLUTCH SHAFT: Install the second speed gear thrust washer (10), snap ring (11) and gear key (40) on the shaft.

**REVERSE CLUTCH SHAFT:** Install the second speed gear thrust washer (10) and gear key (41) on the shaft.

21. Place the clutch shaft in a press as shown in Illustr. 62 and press the reverse drive gear (12) or the reverse driven gear (11) over the woodruff key.

**NOTE:** The gear (11 or 12) must be installed with the long taper of the gear hub up.

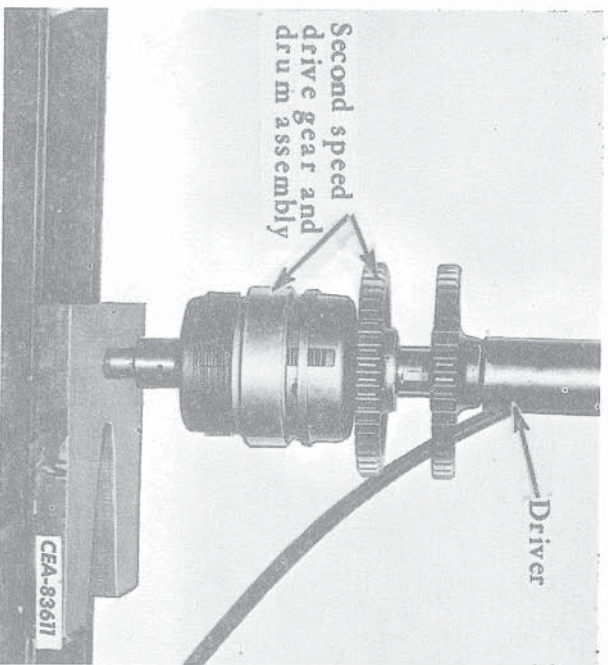
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## 7. REASSEMBLY - Continued

### Forward and Reverse Clutch Shaft - Continued (Ref. Nos. Refer to Illust. 38 and 39)



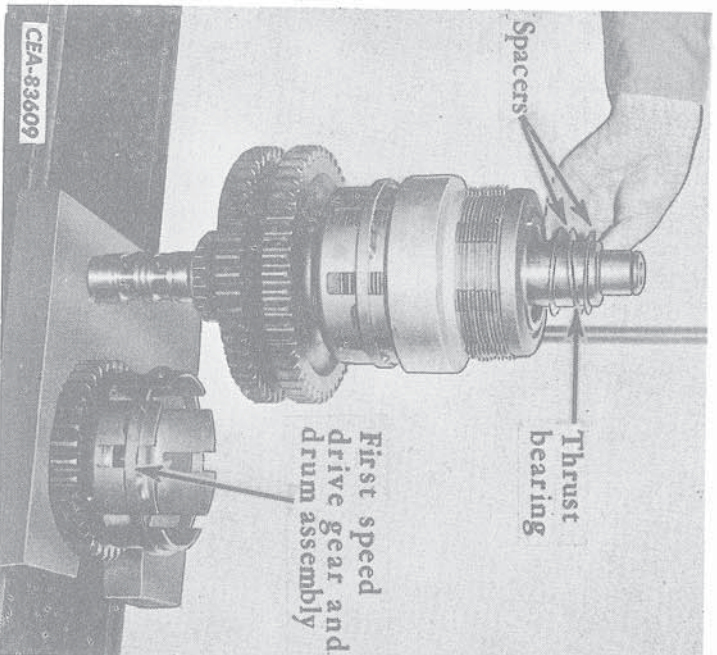
Illust. 62  
Installing the Reverse Driven Gear.

22. **REVERSE CLUTCH SHAFT:** Install the heated inner race of the bearing (12) on the shaft and use the press to hold the inner race in position until it cools. Secure with the snap ring (13).

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

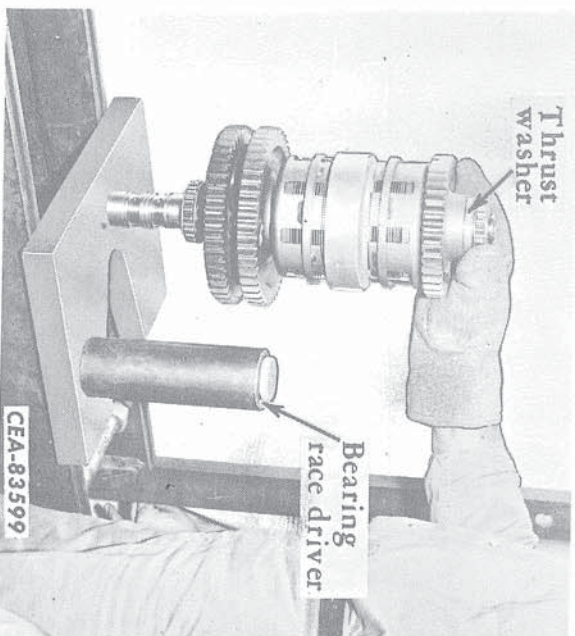
24. Install a bearing spacer (6) over the end of the shaft until it is up against the clutch hub retainers (4). Install the thrust bearing (7) next to the bearing spacer and install the second bearing spacer (6) on the thrust bearing. (Illust. 63.)

25. Position the first speed gear and drum assembly (42 or 43) with bushing over the shaft, indexed on its outside diameter with the externally tanged clutch plates and flush with bearing spacer on its inside diameter. (Illust. 63.)



Illust. 63  
Installing the Drive Gear Spacers  
and Thrust Bearing.

26. Install the thrust washer (43 or 44) on the shaft so the slot engages the dowel pin (37 or 38). (Illust. 64.)



Illust. 64  
Installing the Rear Bearing Inner Race.

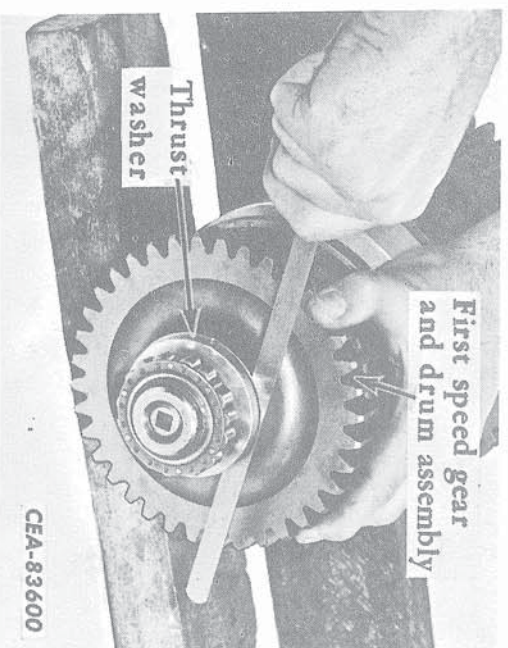




27. Install the heated inner race of the rear bearing (44 or 45) on the shaft and use the press to hold the inner race in position until it cools. Secure with snap ring (45 or 46). (Illustr. 64.)

28. Check the gear and drum assembly end play. Move the gear and drum assembly away from the thrust washer (10, 43 or 44) as far as possible. Measure the clearance between the gear and thrust washer using a feeler gauge. (Illustr. 65.) The clearance obtained must be 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 (14 or 47) in the grooves of the clutch shaft.

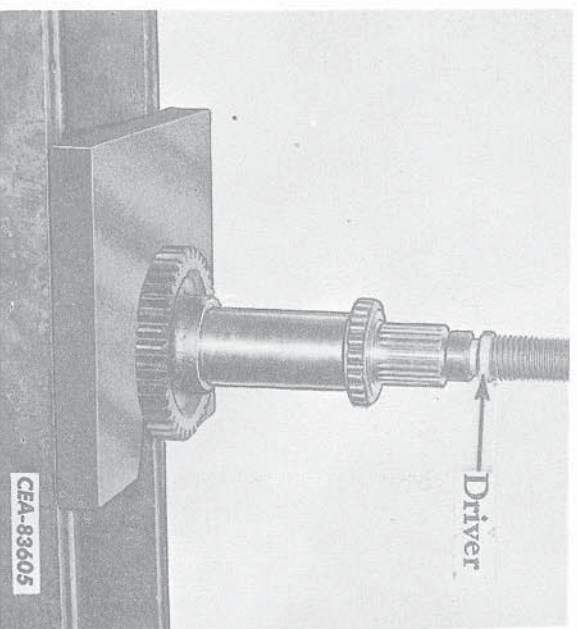


Illustr. 65  
Checking Gear and Drum Assembly  
End Play.

Pinion Shaft  
(Ref. Nos. Refer to Illustr. 35)

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 (31) in the keyway closest to the spline. Position the low range driven gear (28) (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 (Illustr. 66).



Illustr. 66  
Installing the Low Range Driven Gear.

31. Position the rear bearing inner race (Illustr. 67) on the shaft. Press the inner race on the shaft and hold until it cools.

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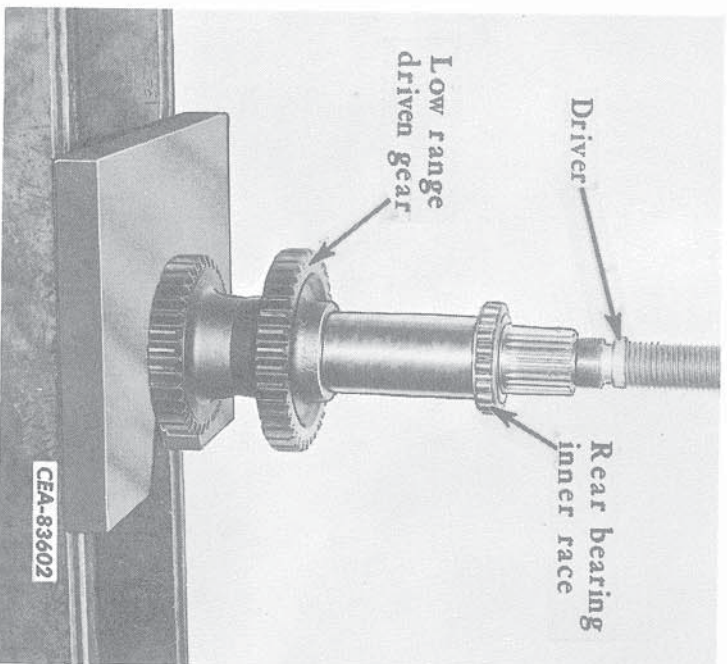




## 7. REASSEMBLY - Continued

### Pinion Shaft - Continued (Ref. Nos. Refer to Illust. 35)

32. Install the remaining gear key (31). Position the high range driven gear (27) 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. 67).



Illust. 67  
Installing the High Range Driven Gear.

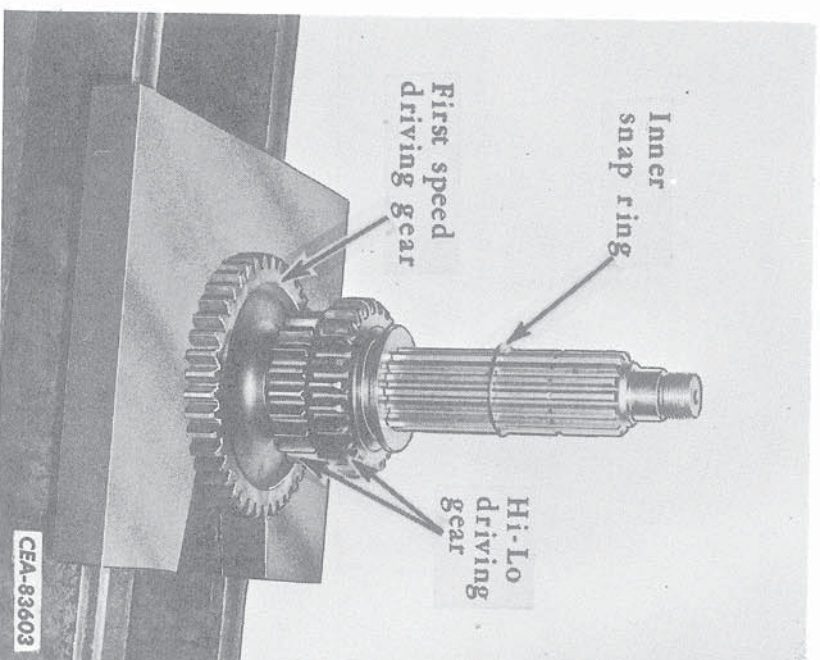
33. Install the rear spacer (26) on the shaft until the slot in the spacer engages the high range gear key. Install the front spacer (25) over the locating pin (30) in the shaft. (Illust. 36.)

### Spline Shaft (Ref. Nos. Refer to Illust. 35)

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.

34. Install the snap ring (7) in the groove farthest from the threaded end of shaft. Place the first speed driven gear (6) (gear with larger outside diameter) in a press. Press the shaft (threaded end up) into the gear until the snap ring bottoms on the gear (Illust. 68).

35. Install the hi-lo speed driving gear (8) so the shift collar is up. Install the second speed driven gear inner snap ring (9) (Illust. 68).

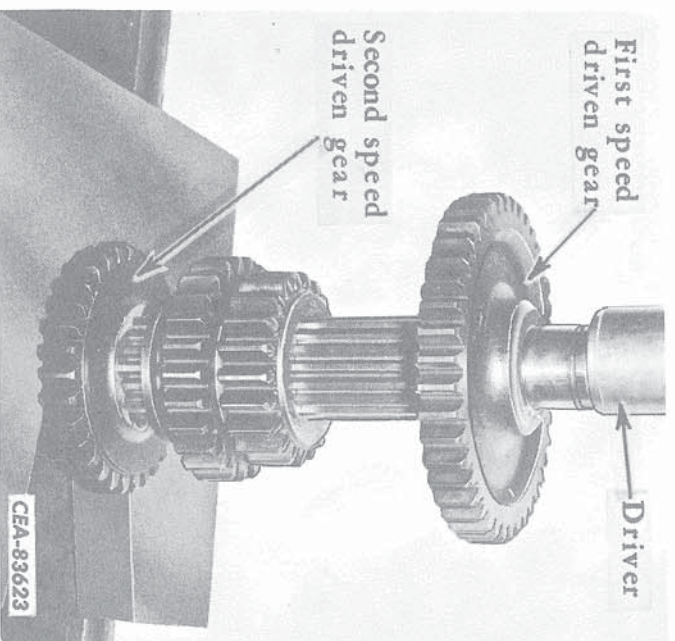


Illust. 68  
Hi-Lo Speed Driving Gear Installed.





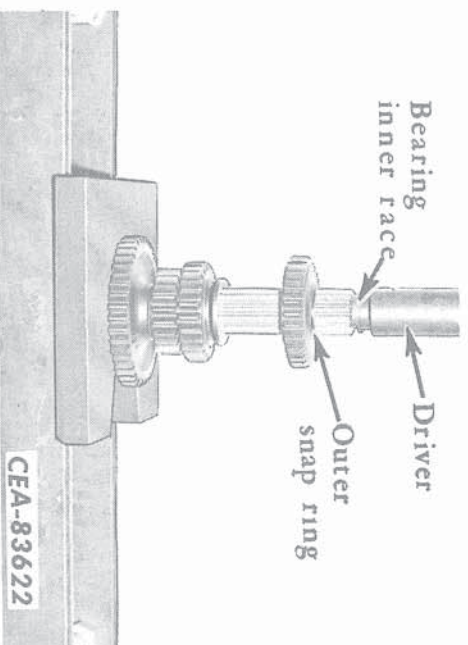
36. Place the second speed driven gear (10) in a press and press the shaft into the gear until the inner snap ring (Illustr. 68) bottoms on the gear (Illustr. 69). Install the outer snap ring (9) (Illustr. 70).



Illustr. 69  
Installing the Second Speed Driven Gear.

37. Position the shaft in the press supported by the first speed driven gear. Press the front bearing inner race on the shaft (lip of race down) until it bottoms and hold in place until it cools (Illustr. 70).

38. Reverse the shaft in the press and press on the rear bearing inner race until it bottoms on the first speed driven gear and hold in position until it cools. Secure the bearing race with the snap ring (3).



Illustr. 70  
Installing Front Bearing Inner Race.

39. Install the reverse clutch shaft and the spline shaft rear bearing outer races into the case until it bottoms and secure with the internal snap ring (32, Illustr. 35).

#### Transmission Case and Cover

- Install the hydraulic manifold (Illustr. 19) 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. (Illustr. 71.)

(Continued on next page)

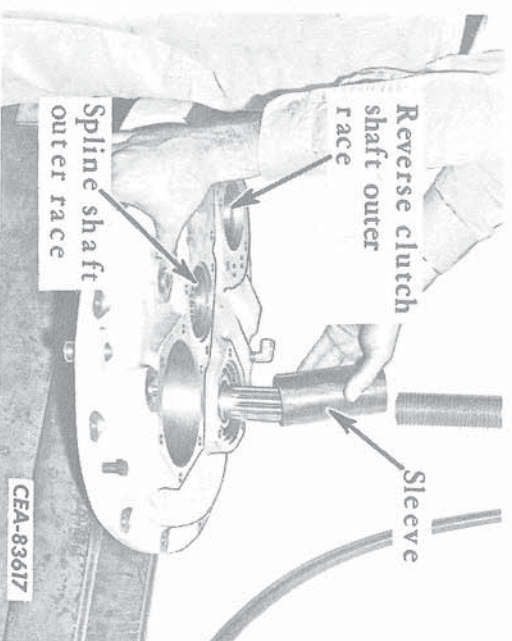




## 7. REASSEMBLY - Continued

### Transmission Case and Cover - Continued

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 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 (11, Illust. 38). (Illust. 71.)

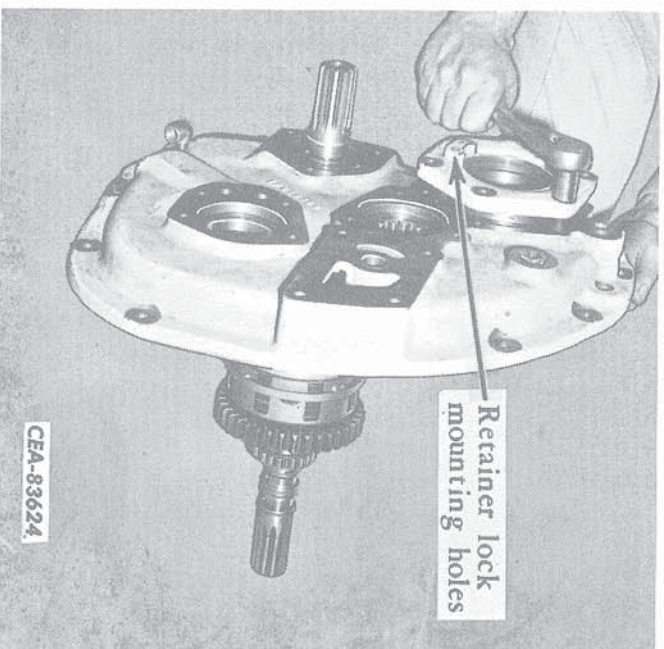


Illust. 71

Installing the Forward Clutch Shaft.

42. Place the "O" 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. 72.)

43. Place the front cover in the stand or on blocks as the forward clutch shaft is up. Set the spline shaft into the front cover (Illust. 73).



Illust. 72

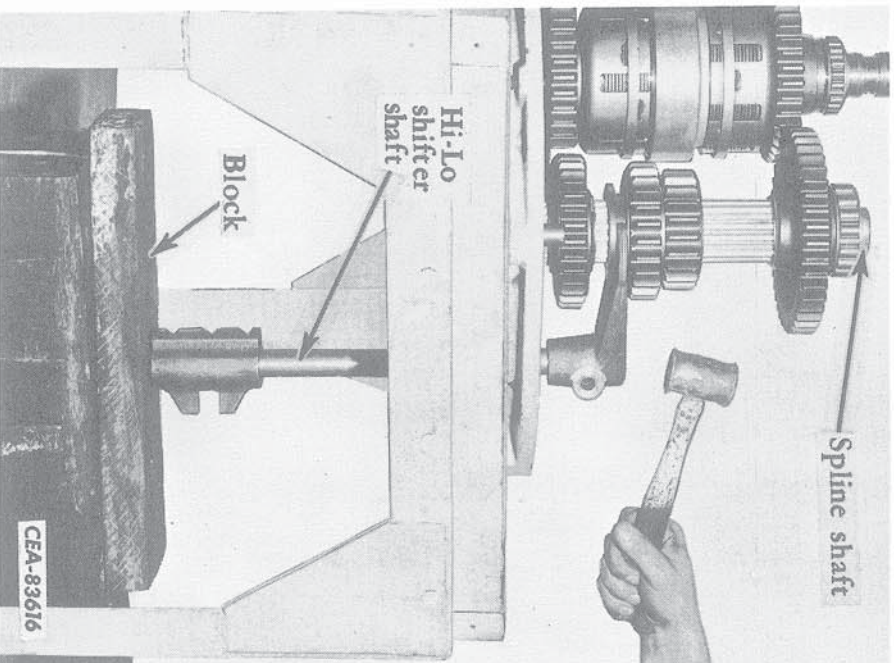
Installing the Pinion Shaft  
Front Bearing Cage.

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 shaft 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. 73).

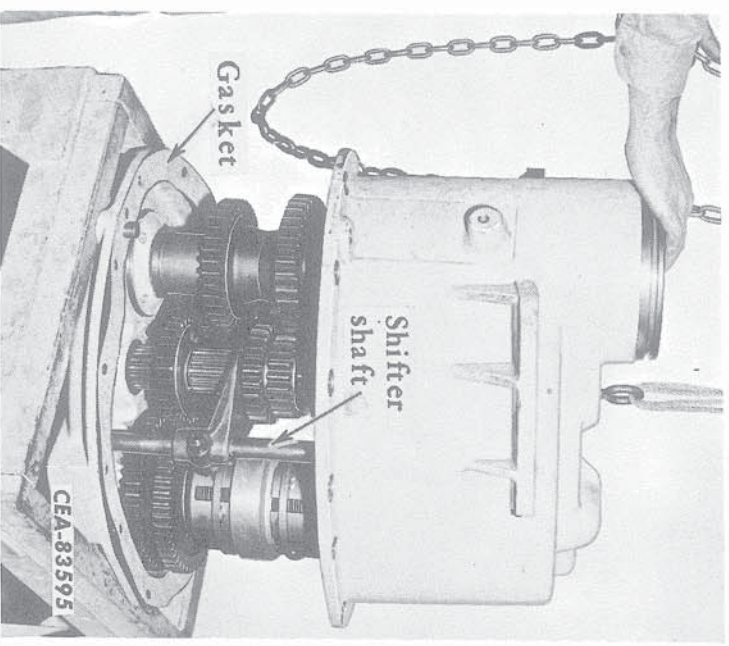
45. Set the pinion shaft in the front cover allowing the front spacer to rest on the bearing cage. Install the reverse clutch shaft (Illust. 74).

46. Place a jack or blocks under the hi-lo shifter shaft to raise the shaft to its highest position. (Illust. 73 and 75.) 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

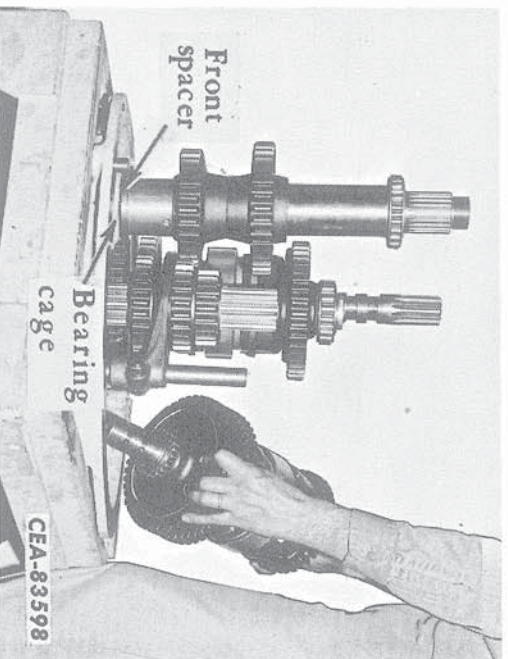




Illust. 73  
Installing the Hi-Lo Shifter  
Shaft and Fork.



lower the transmission case until it rests against the top of the shafts. Joggle the case until the rear bearings are properly seated. (Illust. 75.) Secure the case to the cover with cap screw, washers and nuts.



Illust. 74  
Installing the Reverse Clutch Shaft.

Illust. 75  
Installing the Transmission Case.

47. Position the transmission in the stand or on blocks so the front cover is up.
48. FORWARD CLUTCH SHAFT ONLY: If the oil seal (15, Illust. 38) needed replacement, the following method of handling the new Cartriseal type oil seal must be used:
- A. Do not remove the seal from its box until ready to install.
  - B. Be extremely careful not to nick either seal face.
  - C. Clean seal faces just prior to their contacting each other.

(Continued on next page)





## 7. REASSEMBLY - Continued

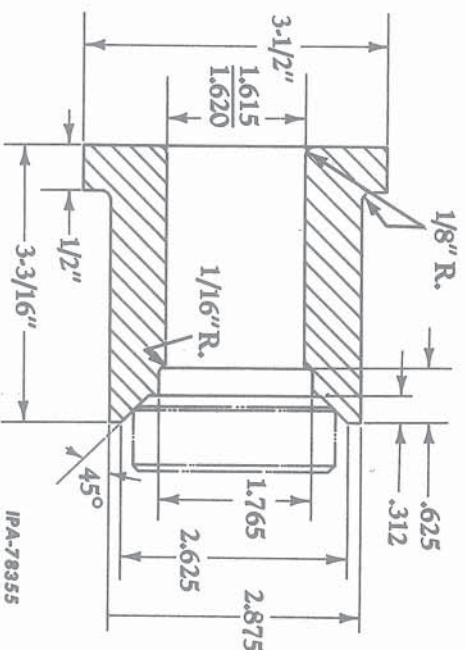
### Transmission Case and Cover - Continued

1. It is usually easier to clean these faces when they are dry.
2. Seal rotor face is coated with Molykote to permit a few minutes running until the oil can reach the seal faces. Some of this is likely to rub off during the final cleaning.
3. Clean rags should be used to wipe the seal faces. The paper pads in the seal box are often the cleanest available in your service shop so these will suffice. If oil is used to wipe the seal faces, it must be clean and be kept in a closed container.
4. Subsequent assembly procedures following the installation of the seal rotor may cause chips or dirt to fall onto the rotor seal face. Step C above is therefore very important.
- D. The oil seal should remain square to the bore within 0.010 per inch.

E. When pressing the seal stator into the housing (17, Illust. 38) the back of the stator must be fully supported (minimum support would be where only 50 percent of the stator contacts the assembly tool). The assembly tool shown in Illust. 76 can be constructed for installing the seal stator.

Be sure the seal stator is installed in the housing (17, Illust. 38) so the bronze lip will face toward the seal rotor in operation. Install the oil seal rotor with "O" ring (14, Illust. 38) on the clutch shaft being sure to engage the slot in the rotor with the locating pin (37, Illust. 38).

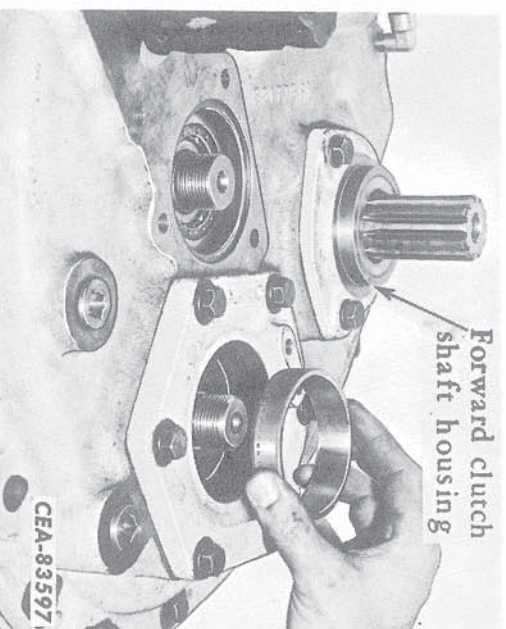
49. Install the forward clutch shaft housing with the seal stator and "O" ring (16, Illust. 38) over the forward clutch shaft and secure to the front cover (Illust. 77).



Illust. 76  
Forward Clutch Shaft Oil Seal  
Assembly Tool.

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.



Illust. 77  
Installing Pinion Shaft Front  
Bearing Inner Cup.

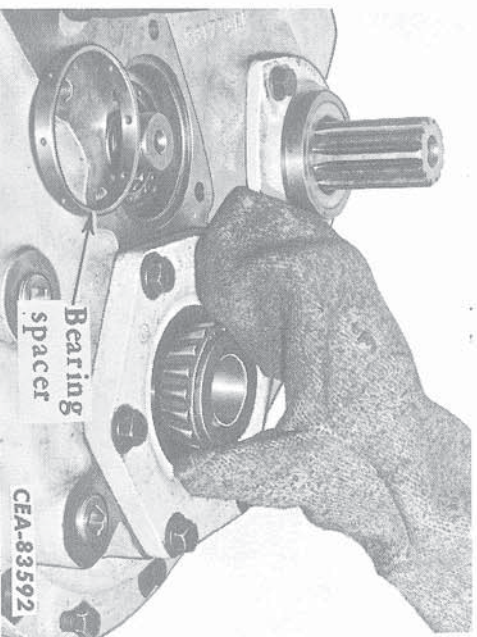




52. Install the inner bearing cup of the pinion shaft front bearing into the bearing cage so the large diameter of the taper is up. Be sure the cup bottoms squarely in the cage. (Illustr. 77.)

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 (Illustr. 78).

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.



Illustr. 78  
Installing the Pinion Shaft Front  
Bearing Inner Cone.

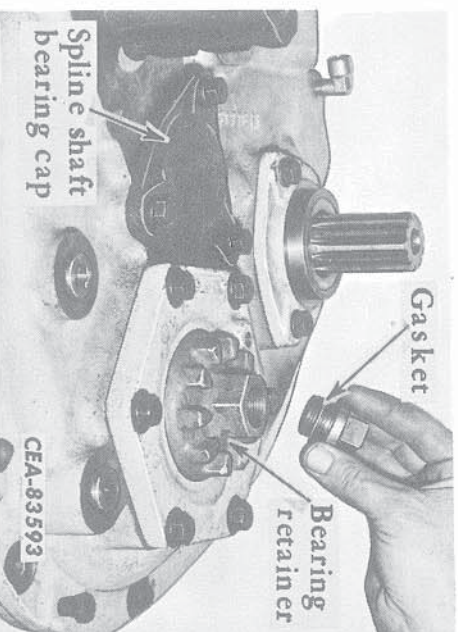
55. Install the front bearing plate (Illustr. 22) and a new nut on the spline shaft. Install a new nut on the front of the bevel pinion shaft.

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. Then tighten the spline shaft front nut while keeping the pinion shaft from turning. (Illustr. 22.) Refer to Par. 2, "SPECIFICATIONS" for the proper torque.

NOTE: If the spline shaft turns when tightening the front nut, the hi-lo range driving gear is in neutral and should be moved into either high or low range.

58. Place the sealing ring on the spline shaft bearing cap and secure the cap to the front cover (Illustr. 79).



Illustr. 79  
Installing the Retainer  
Plug and Gasket.

59. Place the sealing ring on the pinion shaft front bearing retainer against the first shoulder from the end of the retainer. Do not place the sealing ring against the second shoulder where the threads begin. 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." (Illustr. 79.)

60. Install the retainer plug with gasket on the retainer (Illustr. 79).

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. (Illustr. 80.)

(Continued on next page)

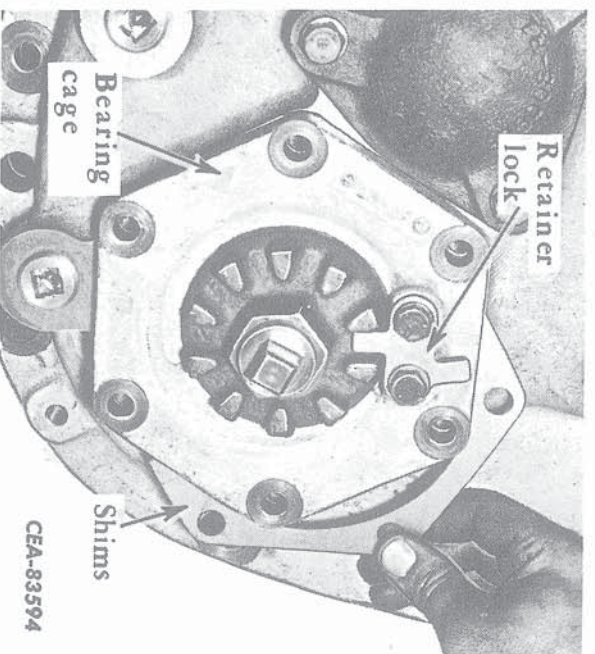




## 7. REASSEMBLY - Continued

### Transmission Case and Cover - Continued

NOTE: If the pinion shaft front bearing, pinion shaft, bevel pinion and the drive bevel gear in the steering planetary are to be re-used, 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 and backlash after the transmission is installed. (Refer to "STEERING SYSTEM," Section 8.)



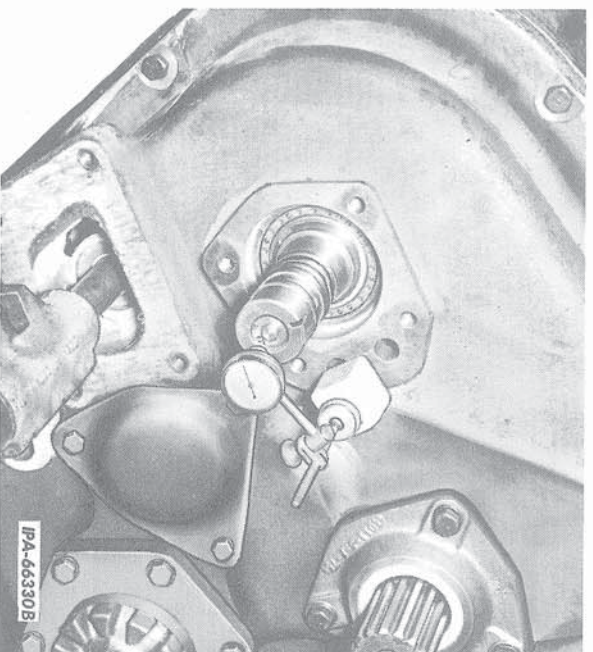
Illust. 80  
Installing the Pinion Shaft Front  
Bearing Cage Shims.

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. Check the reverse clutch shaft end play.

A. TRANSMISSIONS WITH SHIMS BETWEEN FRONT COVER AND HYDRAULIC MANIFOLD: Push the clutch shaft in until the rear bearing cone bottoms in the bearing cup. Place shims totaling approximately 0.060 inch over the end of the reverse clutch shaft and secure the clutch shaft manifold (19, Illust. 39) to the front cover using standard torque. Remove the clutch shaft manifold and shims. Mount the base of a dial indicator on the front cover, place the indicator pointer on the end of the clutch shaft and set the indicator at zero (Illust. 81). Pull out on the clutch 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 removed from the shim pack. Using the remaining shims should obtain the proper reverse clutch shaft end play.

B. TRANSMISSION WITH SHIMS BETWEEN FRONT BEARING CUP AND MANIFOLD FLANGE: Push the clutch shaft in until the rear bearing cone bottoms in its cup. Secure the manifold (19, Illust. 39) to the front cover using standard torque.



Illust. 81  
Checking Reverse Clutch Shaft End Play.





Do NOT install shims (18, Illust. 39). 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. 81). 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 on the hydraulic manifold or against the front bearing cup (depending on transmission model). On later models be sure the "O" rings (17A) and the sealing ring (18A) are properly seated to the manifold (Illust. 39). 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. 20.)

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, "SPECIFICA-

TIONS." To do this, the shaft should be held by the torque wrench. Turn the nut with an open-end wrench.

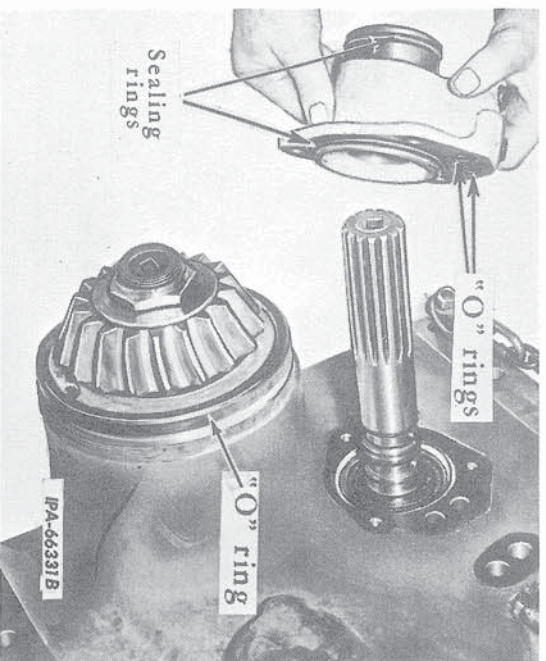
66. Be sure the "O" rings and sealing rings are properly seated in the forward clutch shaft manifold and carefully guide the manifold over the clutch shaft sealing rings. Secure the manifold to the transmission case. (Illust. 82.)

67. Install the "O" ring on the rear of the transmission case (Illust. 82).

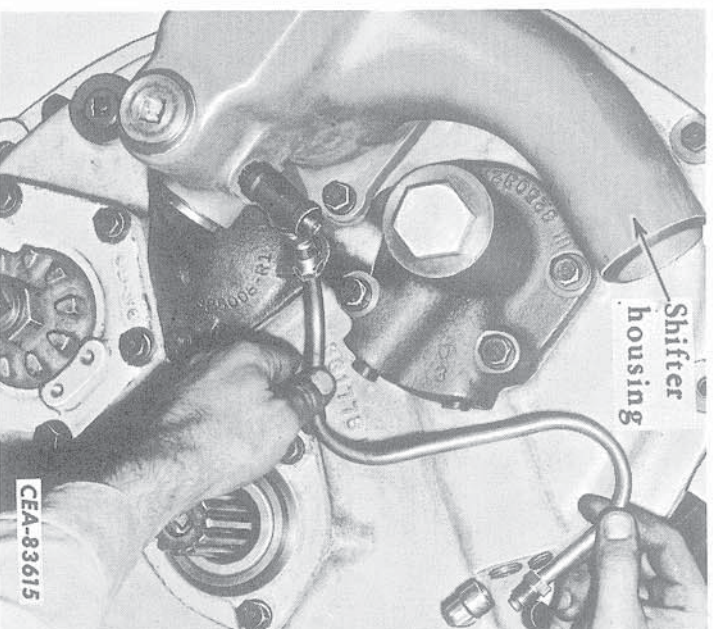
**Hi-Lo Shift Lever Assembly**  
(Ref. Nos. Refer to Illust. 16)

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. 17.)

(Continued on next page)



Illust. 82  
Installing Forward Clutch  
Shaft Manifold.



Illust. 83  
Installing the Shifter Lock Tube.



## TRANSMISSION (POWER SHIFT)



### 7. REASSEMBLY - Continued

#### Hi-Lo Shift Lever Assembly - Continued (Ref. Nos. Refer to Illust. 16)

69. Install the shifter housing and gasket (24) to the front cover (27) and secure with cap screws and washers. (Illust. 83.)
70. Connect the shifter lock tube (17) to the hi-lo shifter housing and to the top of the transmission cover. (Illust. 83.)
71. 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.
72. 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 (26).
73. 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. Slide the drive yoke (18, Illust. 38) onto the forward clutch shaft splines.
2. Remove the cover from the opening in the rear main frame and flywheel housing.
3. Be sure the "O" ring on the rear of the transmission case and the sealing ring on the forward clutch shaft hydraulic manifold are properly seated. (Illust. 82.) Molykote the splines at each end of the forward clutch shaft. Attach a hoist to one of the main regulating valve mounting holes and one of the upper transmission cover-to-transmission case mounting holes. (Illust. 15.) Hoist the transmission into position on the rear main frame studs and secure with nuts. Install the main regulating valve and transmission cover mounting bolts and washers.

4. Attach a hoist and install the torque converter as described in section 6, "HYDRAULIC TORQUE CONVERTER."

5. Position the flexible coupling sleeve with the retainer and gasket assembly and clamp on the section filter nipple on the RH side of the torque converter housing. Do not tighten the clamp at this time.
6. Install the reducing tee (4) with connecting nipple on the converter housing until tight. Continue to turn in until the aligning marks made in the removal are aligned. Install the hose adapter in the reducing tee and connect the safety filter inlet hose (3) (Illust. 14).

7. Slip the converter oil temperature sending unit cable (5) through the clip on the converter housing mounting bolt and connect it to the sending unit on the tee (4) (Illust. 14).

8. MODEL 175 LOADER ONLY: Lower the equipment pump into position, repositioning the hoist sling as was done in removal and secure to the converter housing with the two mounting bolts. Be sure to maneuver the pressure filter base as the pump is being lowered so the base is above the pump when the pump is secured. If the pressure filter inlet hose and the converter inlet hose elbows were turned, they must be positioned so the marks made in removal are aligned.

9. Position the universal joint assembly and secure to the torque converter output flange and transmission drive yoke. Tape the bearing caps to the trunnion to keep them from falling until the mounting bolts are installed.



**CAUTION:** If installing a new universal joint, remove the soft iron strap attached to the bearing caps. This will eliminate the possibility of the straps breaking loose and causing personal injury when the engine is running.

10. MODEL 175 LOADER ONLY: Connect the equipment pump pressure tube (9) at the





## TRANSMISSION (POWER SHIFT)

Section 7A  
Page 47

control valve. Secure the bracket (13) to the front frame. Secure the tube (9) to the bracket with the cap screw, nut and washer. Install the clamp (10) (Illust. 14). Working through the rear cover opening in the bottom of the rear frame, connect the equipment pump outlet hose to the pump and pressure tube with the cap screws, lock washers and clamp halves.

NOTE: Be sure the "O" ring in each end of the hose is properly seated and in good condition before making the connection.

11. Working through the rear cover opening in the bottom of the rear frame, connect the transmission-to-flywheel housing hose at the transmission front cover. Install and secure the rear cover.

12. Turn the regulator drain hose into the elbow (12) and tighten the bolt securing the clamp (1) to the front frame (Illust. 14).

13. Connect the pressure filter outlet hose (9, Illust. 11) to the elbow in the side of the transmission case. Secure the filter base to the front frame with the four bolts and lockwashers. The front lower mounting bolts also secure the clamp for the converter inlet hose (2, Illust. 14). Secure this hose to the torque converter.

14. Connect the pressure filter inlet hose to the filter base.

15. MODEL 175 LOADER ONLY: Connect the equipment pump rear tube (Illust. 13) at the hydraulic tank. Install the equipment pump inlet tube (5, Illust. 10) to the connecting hose on the rear tube and tighten the hose clamp (5, Illust. 11). Be sure the "O" ring in the other end of the inlet tube is properly seated and in good condition and secure to the top of the pump with the cap screws, lockwashers and clamp halves.

16. Connect the clutch pressure gauge tube (4, Illust. 10) at the pressure filter base (main regulating valve on earlier units) and at the other end to the front tube connection above the engine rear mounting. Secure the tube and electrical cables to the side of the front frame with the clamp.

17. Connect the converter inlet hose at the regulator connection (14) and the oil cooler outlet hose at the regulator connection (11) (Illust. 14). Place these hoses along with the steering booster hose in the clamp on the inner face of the front frame on the LH side of the unit near the seat support bar mounting. Secure the clamp with the mounting bolt.

18. Connect the tube (7) to the tee (6) and tighten the nuts (8). If equipped, connect the tube (15) with test connection block to the regulator valve (Illust. 14).

19. Connect the transmission lower rods at the selector valve lever (Illust. 13).

20. Connect the torque converter vent tube at the converter housing. Check for kinks in the tube (Illust. 13).

21. Insert the booster operating rods through the openings in the cover under the fuel tank (Illust. 12) and connect the rods to the steering boosters with the end pin and cotter.

22. Thread the pull rods (short) with turn-buckles onto the pull rods (long) (Illust. 13).

23. Install the steering levers. Position the seat support bar with steering levers on the mounting pads of the front frame and secure with the cap screws, lockwashers and flat washers. The front mounting cap screw on the LH side also holds a clip for securing electrical wiring. Secure the test connection block (4) (if equipped) to the seat support bar with the two cap screws, lockwashers and nuts. Secure the pull rod clevis (6) to each of the steering levers with the end pin and cotter (Illust. 11).

Place the steering booster operating rod (7) on each of the steering lever pivot arms (8) and secure with the cotter. Position the two booster springs (1) on the hooks of the bell-cranks (connected to front of steering boosters) and using brake pliers or other suitable tool, connect the other end of the springs to the welded clips on the seat support bar (Illust. 11).

24. Position the element and spring on the pressure filter base. Be sure the "O" ring on the hold-down bolt and in the filter case are in place and in good condition and secure the filter case to the base (Illust. 10).

(Continued on next page)





## 8. INSTALLATION - Continued

25. Install the platform support (Illustr. 8).
  - (a) Position the support (with suction filter, decelerator cylinder and control linkage attached on the mounting pads of the front frame and secure with the cap screws, lockwashers and flat washers.
  - (b) Connect the regulator drain hose (14) to the converter.
  - (c) Secure the adjustable clevis (3) to the bellcrank with the end pin and cotter.
  - (d) Secure the flexible coupling (Illustr. 9) to the suction filter upper and lower nipples (refer to section 1, "GENERAL," for the proper method of installing a flexible coupling.)
  - (e) Secure the flexible coupling (16) between the suction filter and filter inlet tube following procedure in step (d).
  - (f) Secure the decelerator cylinder to the seat support bar bracket (10) with the bolt, lockwasher and flat washer.
  - (g) Connect the decelerator drain tube (7) to the converter and decelerator cylinder (8). Connect the cylinder inlet hose (9) at the cylinder (8).
  - (h) Connect the governor control rear rod clevis (4) at the crossshaft with the end pin and cotter.
26. Secure the seat front support to the seat support bar and seat side sheets with the cap screws, lockwashers, flat washers and nuts (Illustr. 7).
27. Install and secure the LH and RH front platforms. Connect the adjustable clevis to the decelerator pedal with the end pin and cotter.
28. Check that the transmission gear selector hand lever and linkage is in proper adjustment (refer to Par. 9, "SELECTOR HAND LEVER ADJUSTMENTS AND STALL TORQUE CHECK.")
29. Position the brake pawl operating lever so it engages the brake pedal pawl and enters the opening in the seat front support (Illustr. 7). 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 lockwashers. Install the equipment control valve side cover on the RH fender.
30. Position the battery bottom bracket. Secure the bracket at the front to seat support bar with the two cap screws, flat washers and lockwashers. Secure the bracket at the rear to the seat side sheets with the cap screws, lockwashers and nuts. The rear mounting cap screw on the LH side also holds a clip for the rear light cable.
31. Install the batteries in their original locations using the markings made in removal. Install and secure the battery support top bracket. Connect the battery cables.
32. Position the seat frame with bottom and rear air baffles (Illustr. 5). Secure the seat frame to the seat side sheets with the four cap screws and lockwashers. Install the seat bottom cushion.
33. Be sure the drain plug is installed and fill the rear frame with the proper grade of oil as specified in the operator's manual.
34. MODEL 175 LOADER ONLY: Fill and vent the equipment hydraulic system as described in the pertinent instruction manual.
35. Start the engine and check for leaks.
36. Perform the engine idle adjustments as described in section 4, "ENGINE."
37. Perform the "Stall Torque Check" as described in Par. 9, "SELECTOR HAND LEVER ADJUSTMENTS AND STALL TORQUE CHECK."
38. Check the oil pressures in the transmission as described in Par. 10, "CHECKING TRANSMISSION OIL PRESSURE."
39. Install the quick disconnect platform.





## **9. SELECTOR HAND LEVER ADJUSTMENTS AND STALL TORQUE CHECK**

**(Refer to Illust. 87)**



**CAUTION:** The engine must never be running while the hand lever adjustments are being made.

**NOTE:** To arrive at the proper hand lever adjustment, the linkage must be adjusted in the following sequence.

1. Place the hand lever in neutral. Insert a 5/16 inch diameter rod (approximately nine inches long) through the holes provided in the front and rear of the selector controls housing (Illust. 85 and 87). If this can be accomplished, remove the rod and move the hand lever through all positions to feel if the detent ball (in the range selector valve) fully engages in each of the positions and that there is no pressure on the hand lever when it is in the second speed forward and reverse positions. If this can be accomplished, the hand lever linkage should be in proper adjustment and the "Stall Torque Check" following should be performed. If one of the preceding operations could not be accomplished, continue as follows.

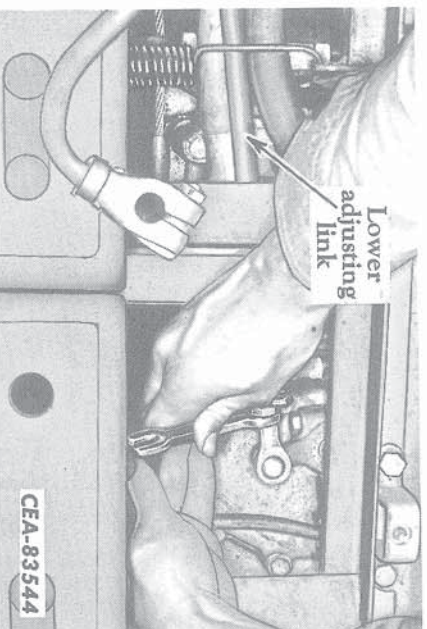
### **Selector Hand Lever Adjustment**

2. Remove the seat bottom cushion, seat frame, battery support top bracket and the two front batteries. Remove the lower access hole cover plate from the side of the selector controls housing.
3. Place the hand lever in neutral. Be sure the selector lever, keyed to the selector valve shaft, is in the neutral position (pointer on selector lever aligned with fixed indicator). Refer to insert in Illust. 87.

**NOTE:** Later range selector valves are equipped with a cast raised "arrow" and the letter "N" on the valve cover in place of the fixed indicator. On these units the selector lever pointer and the "arrow" are aligned with the valve in the "neutral" detent.

4. Disconnect the upper adjusting link ball joints at the lower bellcranks. Loosen the jam nuts at each end of the lower adjusting links (Illust. 84).

**NOTE:** The upper and lower adjusting links have a left hand thread on one end and a right hand thread on the other. If links were removed from the controls housing, they must be installed with the left hand threads in the position shown in Illust. 87.



**Illust. 84**  
**Loosening Lower Adjusting Link Jam**  
**Nut at the Range**  
**Selector Valve.**

5. Rotate the lower adjusting links until a 5/16 inch diameter rod (approximately nine inches long) can be inserted through the holes provided in the front and rear walls of the controls housing and the two lower rod bellcranks (Illust. 85). This rod must not be removed until all adjustments are performed. Tighten the jam nuts at each end of the lower adjusting links.

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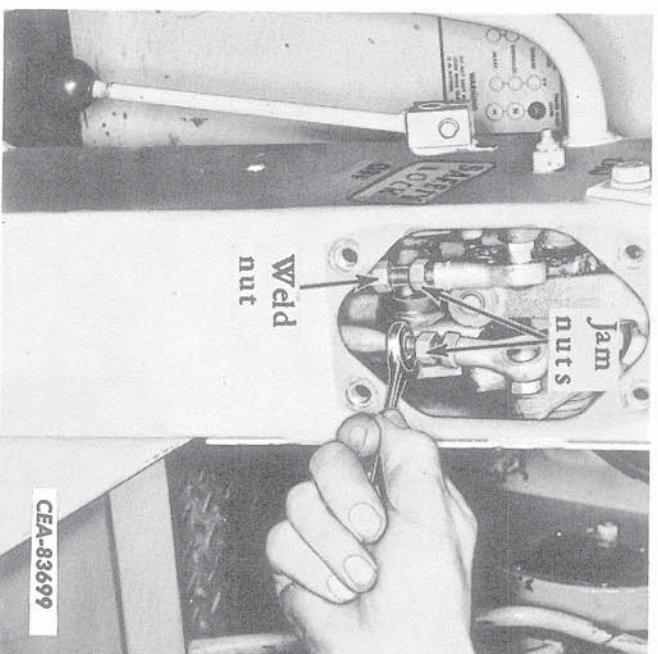




## 9. SELECTOR HAND LEVER ADJUSTMENTS AND STALL TORQUE CHECK - Continued (Refer to Illust. 87)

### Selector Hand Lever Adjustment - Continued

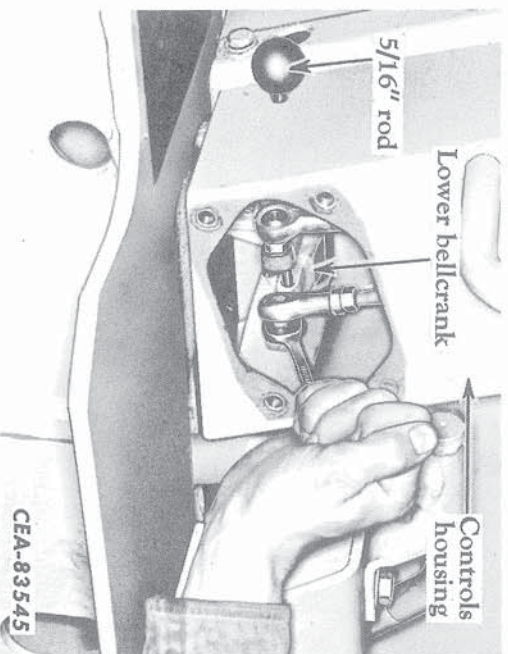
6. With the aligning rod still in position, connect the upper links to the lower bellcranks (Illust. 85). If they cannot be connected, remove the upper access hole cover plate from the rear of the controls housing and loosen the jam nuts at each end of the upper links. Use the weld nut at the top of the links and turn the links until they can be connected at the lower bellcranks (Illust. 86). Tighten the jam nuts at each end of the upper links.



Illust. 86  
Turning Upper Adjusting Links to  
Connect at Lower Bellcranks.

8. Move the hand lever through all the positions and feel if the detent ball (in the range selector valve) fully engages in each of the positions. If the hand lever strikes the back of the shifting gate in the second speed reverse or forward positions before the detent ball fully engages (pressure on lever) readjust as follows:

- (a) Place the hand lever in the neutral position.
- (b) Insert the 5/16 inch diameter rod through the controls housing and bellcranks.
- (c) Disconnect the upper adjusting link (for the side hand lever touches gate) at the lower bellcrank. Loosen the jam nut and turn the clevis (one turn) to lengthen the link. Reconnect clevis to the bellcrank and tighten jam nut.
- (d) Remove the 5/16 inch rod and move the hand lever through all positions to check for proper indexing of the ball poppet in the range selector valve.



Illust. 85  
Securing Upper Adjusting Link  
to Lower Bellcrank.

7. Remove the 5/16 inch diameter rod from the controls housing. It should come out freely without binding.





## TRANSMISSION (POWER SHIFT)

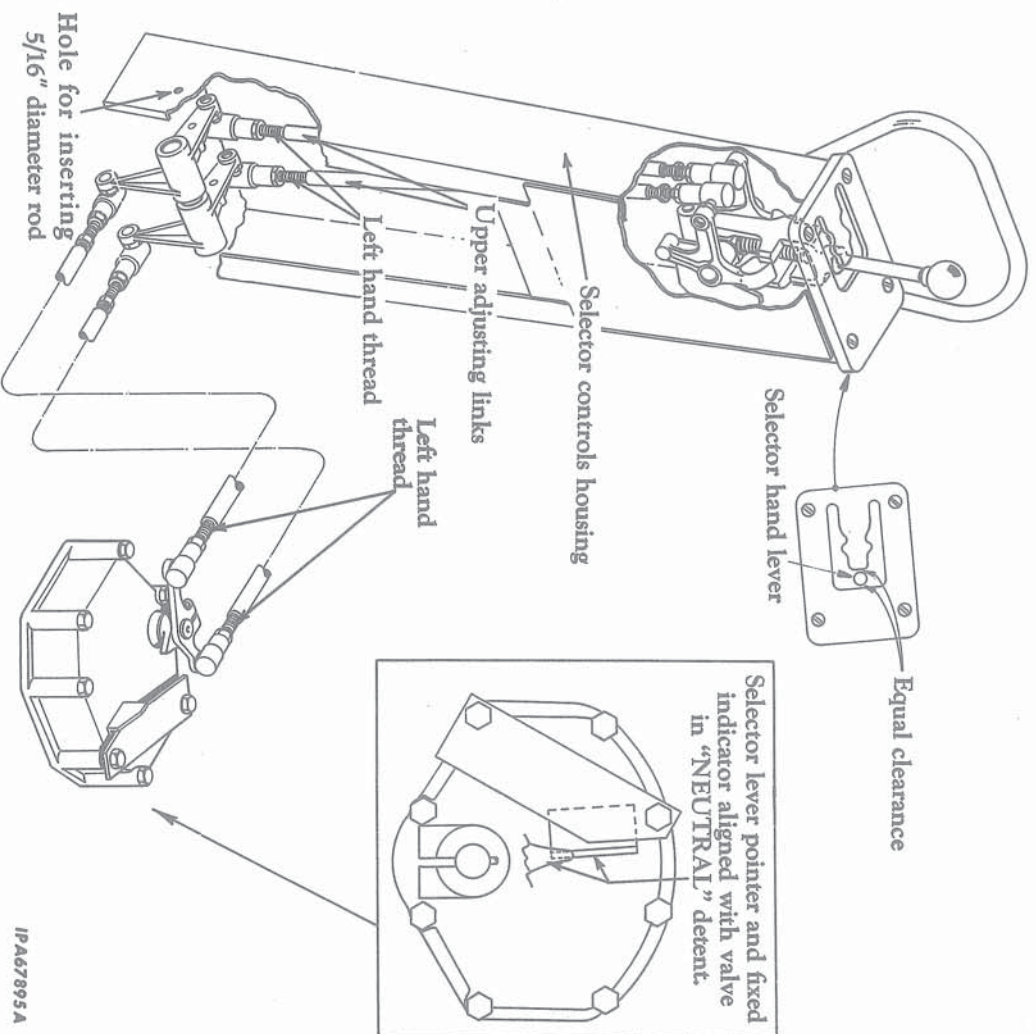
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Page 51

### Stall Torque Check

**CAUTION:** EXTREME CAUTION MUST BE USED WHEN FOLLOWING THE STALL TORQUE CHECK PROCEDURE OUTLINED BELOW. ALL PERSONNEL EXCEPT OPERATOR SHOULD BE AWAY FROM THE TRACTOR AND ALL TOOLS AND MATERIAL AWAY FROM TRACKS.

9. Adjust brake pedal as outlined in Section 8.
10. Check transmission oil level.
11. Fully apply and lock the brake pedal.
12. Remove the rear platform (snap on type).
13. Install the batteries, battery support top bracket, seat frame and bottom cushions.

(Continued on next page)



Illust. 87  
Selector Hand Lever Adjustment Points.





## 9. SELECTOR HAND LEVER ADJUSTMENTS AND STALL TORQUE CHECK - Continued

(Refer to Illust. 87)

### Stall Torque Check - Continued

14. Start engine.
15. Place the hi-lo shift lever in hi range.
16. Place governor hand control in fully open (High Idle) position.
17. Shift transmission into each of the four speed ranges stopping momentarily in each range, while observing the universal joint. The universal joint should stop rotating in each range almost instantaneously (within one second).
18. If the universal joint continues to rotate or stops gradually, readjust the gear shift linkage and repeat Step 17.
19. If after readjusting linkage Step 18 still exists, the transmission is malfunctioning internally and a transmission oil pressure check should be made as outlined in Par. 10.
20. Secure the upper and lower access hole cover plates to the controls housing. Install the rear platform.

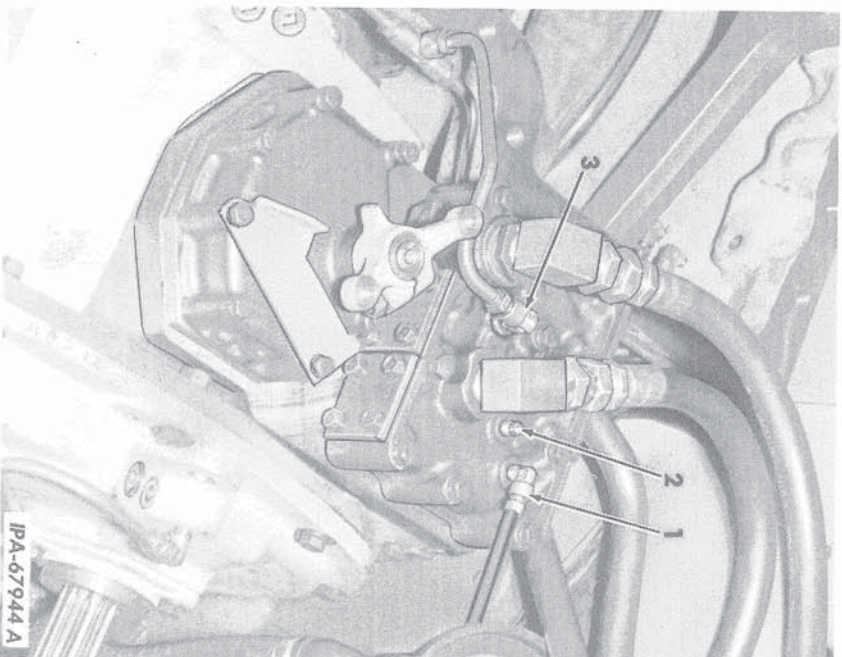
## 10. CHECKING TRANSMISSION OIL PRESSURE

(Ref. Nos. Refer to Illust. 88 and 89)



**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).



**Illust. 88**  
**Transmission Oil Pressure Check Points.**  
**(Transmission Without Test Connected**  
**Header Block.)**

1. Clutch oil pressure tube (main pressure).
2. Converter by-pass.
3. Pivot brake oil line (tube pressure).

On units equipped with a test connection block (Illust. 89) only the quick disconnect platform has to be removed to connect pressure gauges. If not equipped with a test connection block, the seat frame will have to be removed and the batteries moved to connect pressure gauges at the main regulator valve (Illust. 88).





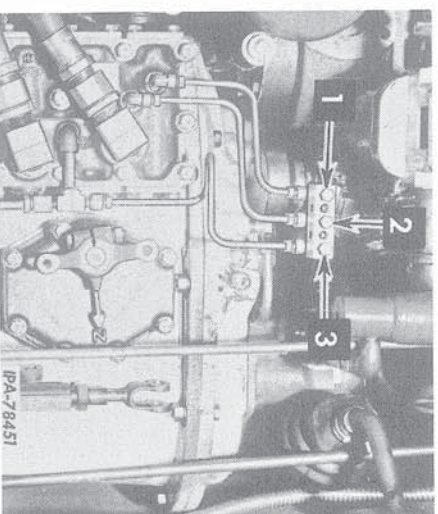
### Main Pressure

Disconnect the clutch oil pressure tube (1) or 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 reading with the transmission selector lever in low forward, high forward, low reverse and high reverse. On MODEL 175 loader, also check gauge reading with selector lever in "fast idle" position.

The main pressure should be 200-230 psi in each position. If the main pressure does not fall within the psi range, refer to the following "DIAGNOSIS CHART." If main pressure is still too low, add washers (8 or 19) between the main regulating valve (10) and springs (16 and 17) as required to bring pressure up to 200-230 psi. DO NOT USE MORE THAN A TOTAL OF FOUR WASHERS. (Illustr. 90.)

### Converter By-Pass Pressure

Remove the pipe plug (2) from the main regulating valve (Illustr. 88) or from the test connection header block (Illustr. 89) and install a 0 to 100 psi gauge. Start the engine and check pressure reading while shifting through the complete shift pattern as described previously under "Main Pressure." By-pass pressure should be from 50 to 80 psi in all positions except "fast idle" where the pressure should be 60 to 90 psi. If the pressures are not within the specified range, refer to the following "DIAGNOSIS CHART."



Illustr. 89  
Transmission Oil Pressure Check Points.  
(Transmission With Test Connection  
Header Block.)

1. Clutch oil pressure tube (main pressure).
2. Converter by-pass.
3. Pivot brake oil line (tube pressure).

### Lubricating Oil Pressure

Disconnect the pivot brake oil lever (3) or 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 10 to 25 psi in all positions. If the pressure is not in this range, refer to the following "DIAGNOSIS CHART."

(Continued on next page)



TRANSMISSION (POWER SHIFT)



10. CHECKING TRANSMISSION OIL  
PRESSURE - Continued

(Ref. Nos. Refer to Illust. 88 and 89)

DIAGNOSIS CHART

<u>PROBLEM</u>	<u>POSSIBLE CAUSE</u>
1. Low main pressure in all speed ranges . . . . .	1. a. Low oil level. b. Dirty suction filter. c. Fatigued main spring. d. Broken main spool valve spring or spring pin. e. Worn selector valve wiper. f. Worn selector valve shaft seal ring.
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 by-pass pressure . . . . .	4. a. Low main pressure (refer to Step 1). b. Worn seal rings in the converter. c. Fatigued by-pass valve.
5. High converter by-pass pressure . . . . .	5. a. Stuck by-pass valve. b. Plugged safety filter.
6. Low lube pressure . . . . .	6. a. Low main pressure (see Step 1). b. Fatigued lube spring. c. Internal clutch pack leakage.
7. High lube pressure . . . . .	7. a. Stuck lube valve.





## TRANSMISSION (POWER SHIFT)

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### MAIN REGULATING VALVE

#### 11. REMOVAL AND DISASSEMBLY

(Ref. Nos. Refer to Illust. 90)

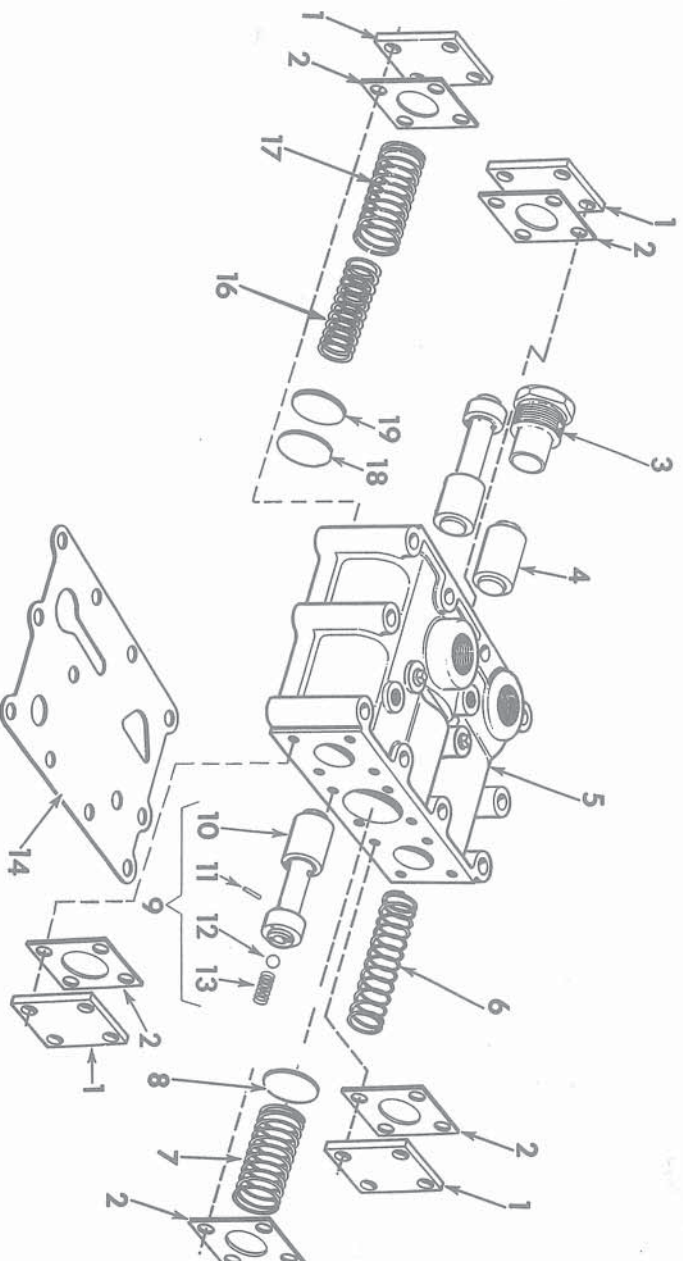
1. Remove the seat frame, batteries and the seat support bar with steering levers (refer to Par. 4, "REMOVAL" of transmission).
2. Disconnect the selector hand lever lower adjusting links at the range selector valve and move them out of the way. Disconnect all the hydraulic oil lines at the main regulating valve. Tag lines for proper installation and cap openings to prevent dust or dirt from entering.

3. Remove the cap screws and washers securing the valve body (5) to the top of the transmission case and remove the valve assembly and 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.

(Continued on next page)



IPA-66252 E

Illust. 90

Exploded View of Main Regulating Valve Assembly.

- |   |                                    |  |
|---|------------------------------------|--|
| 1. Valve cover.                           | 8. Spring washer.                  | 14. Gasket.                                  |
| 2. Gasket.                                | 9. Main regulating valve assembly. | 15. By-pass valve.                           |
| 3. Plug.                                  | 10. Valve.                         | 16. Main pressure regulating spring (inner). |
| 4. Lubricating pressure regulating valve. | 11. Pin.                           | 17. Main regulator valve                     |
| 5. Valve body.                            | 12. Ball.                          | 18. Spring washer.                           |
| 6. Valve spring.                          | 13. Main spool valve spring.       | 19. Spring washer.                           |
| 7. Valve spring.                          |                                    |  |



MAIN REGULATING VALVE

**11. REMOVAL AND DISASSEMBLY - Continued**  
(Ref. Nos. Refer to Illust. 90)

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).
8. Remove the remaining valve cover and gasket and lift out the main regulating valve springs (16 and 17). Tip the valve body to remove the spring washers (18 and 19).

**12. INSPECTION AND REPAIR**

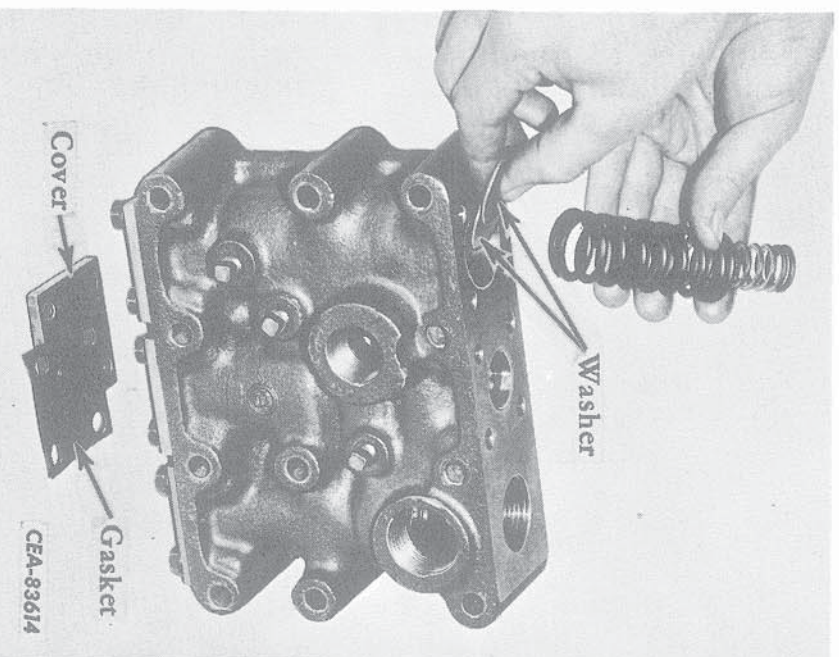
1. Clean all parts in a suitable cleaning solution and blow dry with compressed air. Be sure that all the oil passages in the valve body are free of foreign particles and dirt. Be sure the relief passage in the by-pass valve and the oil passages in the main regulating valve are clean and free of any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

**13. REASSEMBLY AND INSTALLATION**  
(Ref. Nos. Refer to Illust. 90)

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 (18 and 19) that were removed. Be sure washers are not cocked and install the inner regulating spring (16) and main regulating valve spring (17). Install and secure the valve cover and gasket. (Illust. 91.)

NOTE: Because of the tension exerted by the spring assemblies (16 and 17) it will be necessary to use longer cap screws to tighten the cover (1) down until the regular cap screws can be installed. (Illust. 92.)



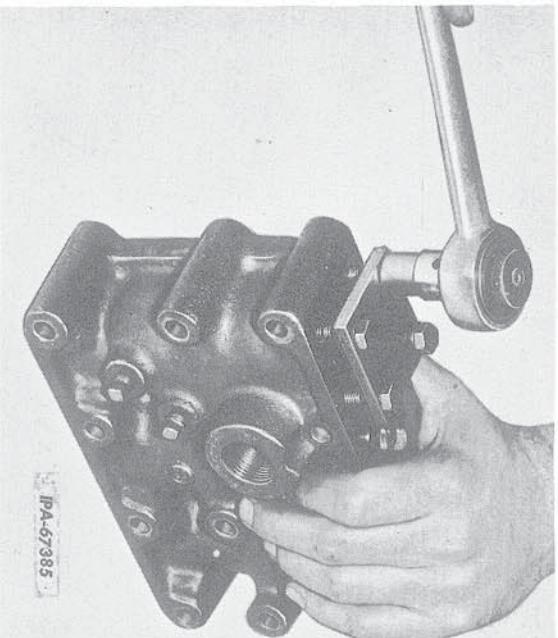
Illust. 91  
Installing Main Valve Springs and Washers.

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).



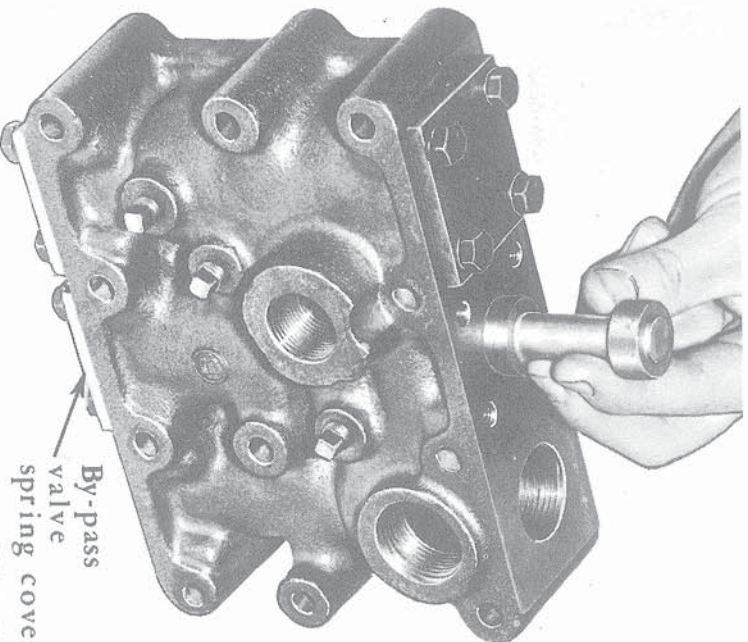


## MAIN REGULATING VALVE

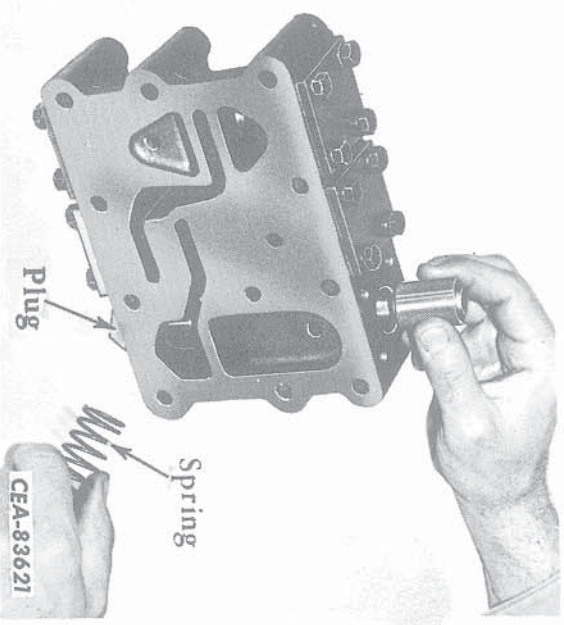


Illust. 92  
Installing Main Valve Spring  
Cover and Gasket.

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. 93).
4. Turn the valve body over and in the other end of the center bore install the by-pass valve (15) so the end with the long land starts in first (Illust. 93). Install the valve cover and gasket.
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. 94).



Illust. 93  
Installing the By-Pass Valve.



Illust. 94  
Installing the Lubricating Pressure  
Regulating Valve and Spring.

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.

(Continued on next page)

# TRANSMISSION (POWER SHIFT)



## MAIN REGULATING VALVE

### 13. REASSEMBLY AND INSTALLATION - Continued (Ref. Nos. Refer to Illust. 90)

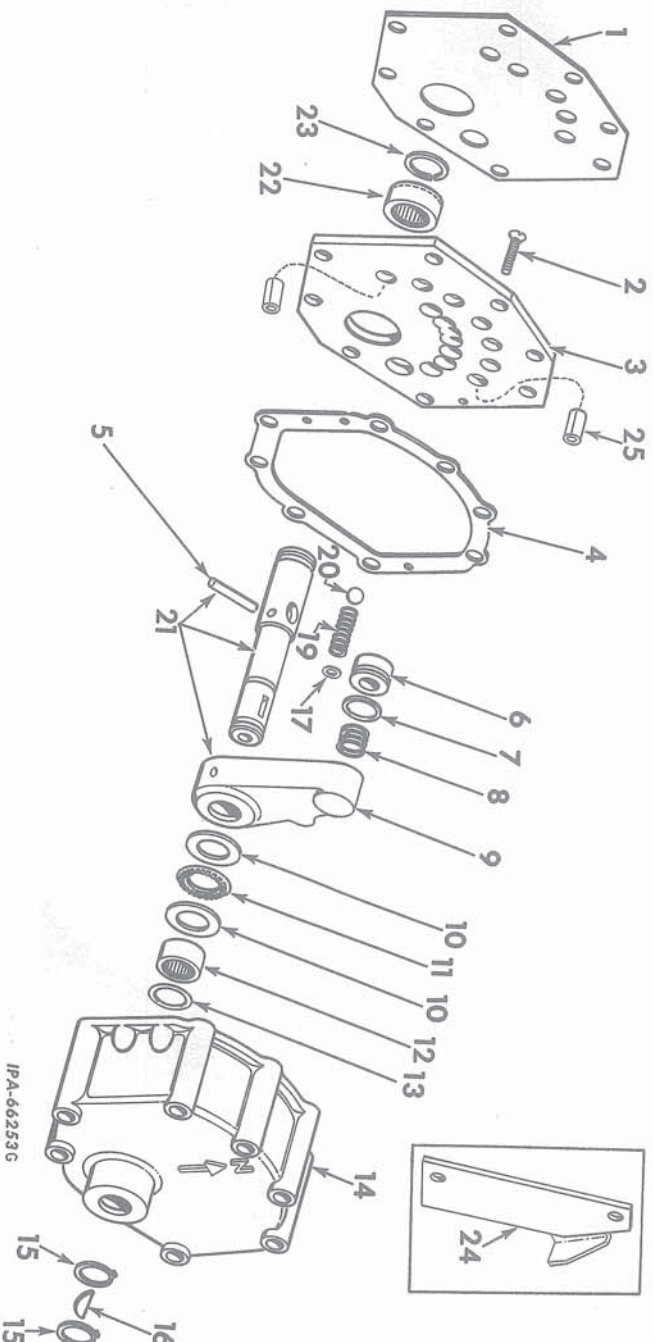
NOTE: Always tighten the cap screws in sequence from the center of the housing to the outside.

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.

7. Connect the hydraulic oil lines to the valve body. Connect the selector hand lever lower adjusting links to the range selector valve.

8. Install the seat support bar with steering levers. Install the batteries and the seat frame (refer to Par. 8, "INSTALLATION" of the transmission).

## RANGE SELECTOR VALVE



Illust. 95  
Exploded View of Range Selector Valve Assembly.

- |                  |                     |                               |
|------------------|---------------------|-------------------------------|
| 1. Plate gasket. | 9. Valve.           | 17. Spring retainer.          |
| 2. Cap screw.    | 10. Thrust washer.  | 19. Spring.                   |
| 3. Plate.        | 11. Thrust bearing. | 20. Detent ball.              |
| 4. Cover gasket. | 12. Bearing.        | 21. Shaft and valve assembly. |
| 5. Dowel.        | 13. Seal ring.      | 22. Bearing.                  |
| 6. Wiper.        | 14. Valve cover.    | 23. Seal ring.                |
| 7. Seal ring.    | 15. Snap ring.      | 24. Fixed indicator.          |
| 8. Wiper spring. | 16. Key.            | 25. Roll pin.                 |



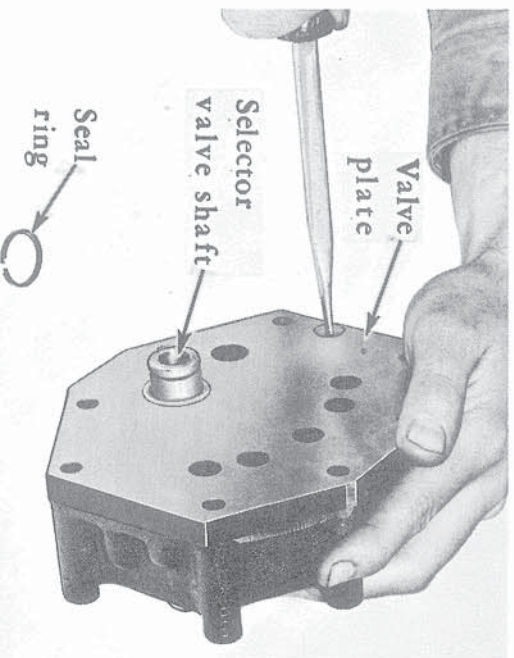


RANGE SELECTOR VALVE

**14. REMOVAL AND DISASSEMBLY**

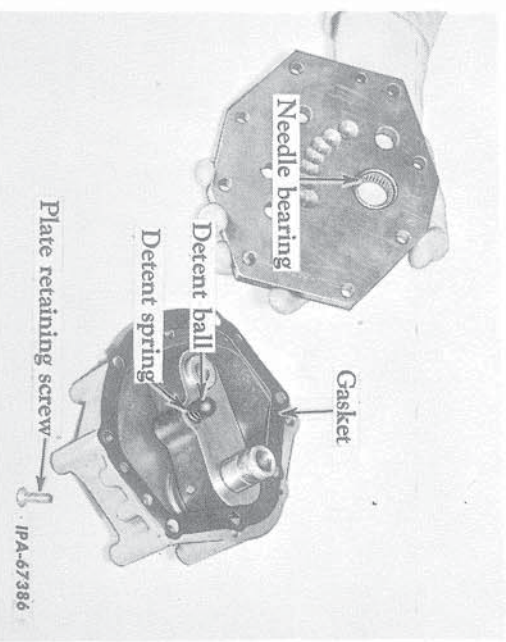
(Ref. Nos. Refer to Illust. 95)

1. Remove the rear platform (snap on type).
2. Remove the seat frame and batteries.
3. Disconnect the selector hand lever lower adjusting links from the selector lever on the shaft assembly (21). Remove the cap screws and washers securing the valve assembly to the transmission case and remove the assembly, fixed indicator (if equipped) and gasket (1).
4. Remove the cap screw, nut and washer from the selector lever. Remove the upper snap ring (15) and remove the selector lever from the shaft (21).
5. Remove the woodruff key (16) and the lower snap ring (15) from the shaft.
6. Remove the seal ring (23) from the selector valve shaft. Then remove the screw (2) securing the plate (3) to the valve cover (Illust. 96).
7. Separate the valve plate and cover and discard the gasket (4). If the needle bearing (22) needs replacement, it can easily be pressed from the plate (Illust. 97).



CEA-83619

Illust. 96  
Removing the Valve Plate  
Mounting Screw.

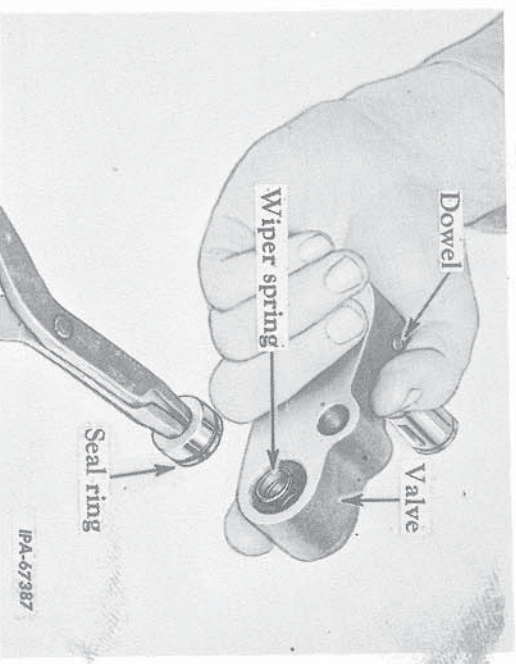


IPA-67386

Illust. 97  
Removing the Valve Plate.

8. Remove the detent ball (20), spring (19) and spring retainer (17) from the valve (9). (Illust. 97.)

(Continued on next page)



IPA-67387

Illust. 98  
Removing the Valve Wiper.

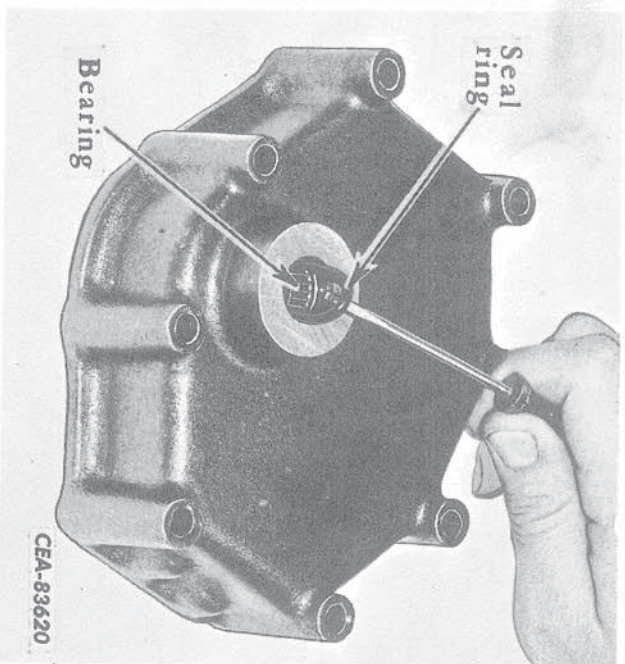
## TRANSMISSION (POWER SHIFT)



### RANGE SELECTOR VALVE

#### 14. REMOVAL AND DISASSEMBLY - Continued (Ref. Nos. Refer to Illust. 95)

9. Lift out or lightly tap out the shaft assembly (21) from the cover (14).
10. Remove the thrust washers (10) and bearing (11) from the shaft.
11. Remove the valve wiper (6) and wiper spring (8) from the valve and pull the seal ring (7) from the wiper (Illust. 98).
12. Use a screwdriver to remove the seal ring (13) from the valve cover (Illust. 99).
13. If the bearing (12) in the cover needs replacement, use a standard type puller to remove it (Illust. 99).



Illust. 99  
Removing Valve Cover Seal Ring.

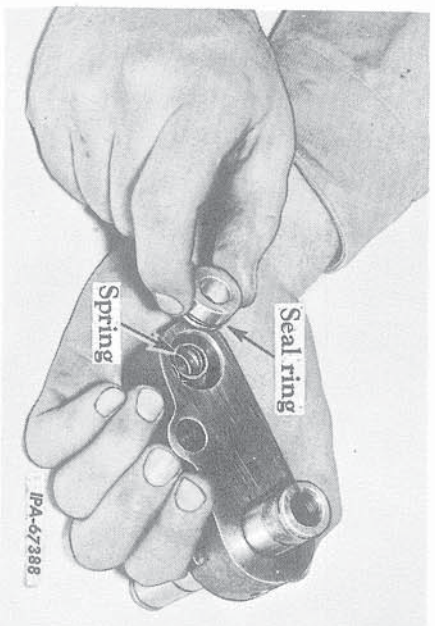
NOTE: Do not disassemble the shaft assembly (21). If either the shaft or valve (9) is damaged, a new shaft assembly (21) must be installed.

#### 15. INSPECTION AND REPAIR

1. Clean all parts in a suitable cleaning solution and blow dry with compressed air. Be sure the oil passages in the shaft and valve are clean and free of any obstruction.
2. Inspect the bearings and thrust washers for excessive wear, nicks or cracks and replace if necessary.
3. Replace all gaskets and seal rings.

#### 16. REASSEMBLY AND INSTALLATION (Ref. Nos. Refer to Illust. 95)

1. Place the seal ring (13) in the bore of the cover (14) and press in the bearing (12) flush with the cover bore. Press only on the flat numbered side of the bearing. (Illust. 99.)
2. Place the seal ring (7) on wiper (6). Install the spring (8) into the bore of the valve (9) and place the wiper on the spring with the seal ring (7) closest to the spring. (Illust. 100.)



Illust. 100  
Installing Valve Wiper and Spring  
into Selector Valve.





RANGE SELECTOR VALVE

3. Install one thrust washer (10); then install the bearing (11) and the other thrust washer (10) on the shaft. Insert the shaft and valve assembly into the cover until the lower snap ring groove in the shaft is uncovered and install the snap ring (15).
4. Lay the spring retainer (17) in the bore of the valve (9). Place the spring (19) and the detent ball (20) on the retainer. (Illust. 97.)
5. If it was removed, press the bearing (22) into the valve plate (3), allowing the bearing to extend 0.08 inch beyond the bottom side of the plate. Install the gasket (4) on the cover. Be sure not to install the gasket upside down covering the tapped screw hole.
6. Install the plate (3) on the cover and gasket, compressing the springs in the valve (9). Secure the plate to the cover with the cap screw (2). Install the seal ring (23) and key (16) on the shaft. (Illust. 96.)
7. Install the selector lever on the shaft (21) until the upper snap ring (15) can be installed. Install the selector lever cap screw, nut and washer.
8. Position the gasket (1) on the spacer on the top of the transmission case. Position the valve assembly on the gasket.
9. Place the fixed indicator (24, if equipped) on the valve cover (14) so that the raised flange is in line with the arrow on the cover.
10. Secure the valve assembly with the cap screws and washers.
11. Connect the selector hand lever lower adjusting links to the selector lever.
12. Install the batteries and seat frame.
13. Install the rear platform (snap on type).