WATEROUS

Overhaul Instructions

Form No.	Issue Date	Rev. Date
T–335	**11/91**	**05/29/98**

TMS Split Shaft Power Take–Off Overhaul Instructions

Waterous Company Since 1886
Subsidiary of American Cast Iron Pipe Company

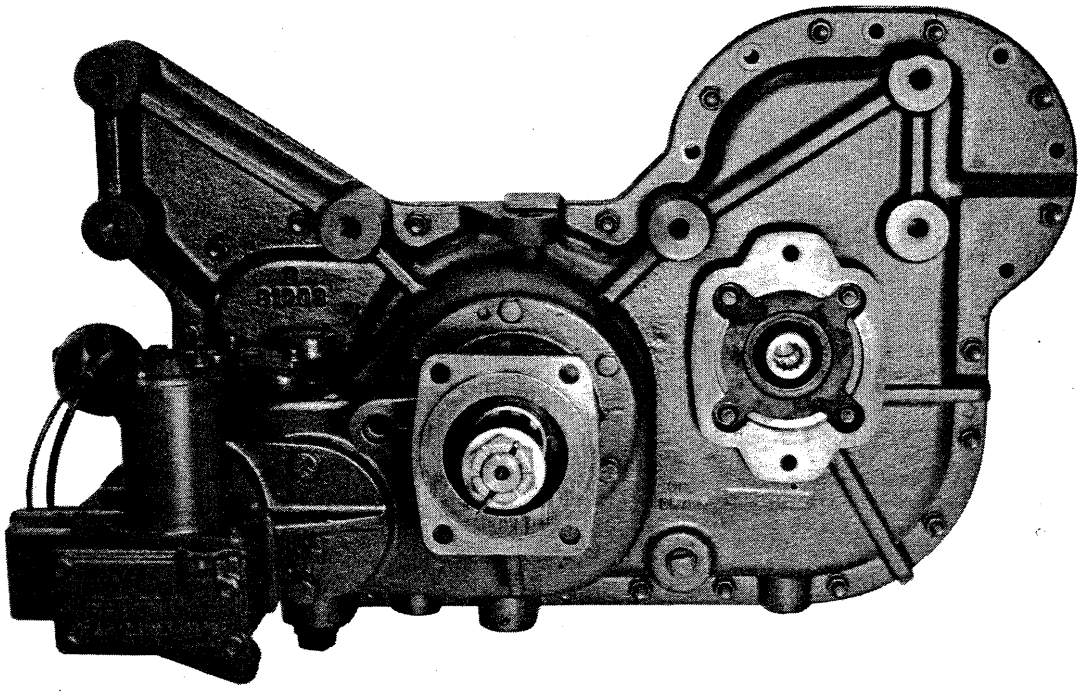
Printed in U.S.A.

INTRODUCTION

These instructions contain information for the overhaul, bench repair and maintenance of the Waterous TMS split shaft power take–off. The bench repair is performed after the PTO is removed from the chassis with the air compressor removed and either the hydraulic pump or the pump drive coupling removed.

REFERENCE NUMBERS

The text frequently uses "reference numbers" when discussing specific parts. These numbers correspond to parts on the illustrations and the Service Parts List included with the transmission manual.



REAR VIEW

DISASSEMBLY

1. Remove parking brake (if provided) as follows:
   a) Remove the cotter pin and locknut retaining the companion flange and brake drum to the coupling shaft.
   b) Pull companion flange and drum assembly off spline of coupling shaft.
   c) Disconnect linkage to brake operating arm. Remove bolts fastening brake assembly to coupling shaft housing and remove brake assembly.
2. Remove electric shift assembly and bracket. Do not lose the two adjusting screw retainers (T37) which are exposed when the bracket is removed.
3. Remove companion flanges or end yokes from drive and coupling shafts.
4. Remove speedometer driven gear sleeve (T82) and driven gear (T83) from coupling shaft housing (T10) if so equipped.
5. Remove coupling shaft housing (T10) and shims (T9). Tapped holes are provided in the housing for use of push off screws.

NOTE

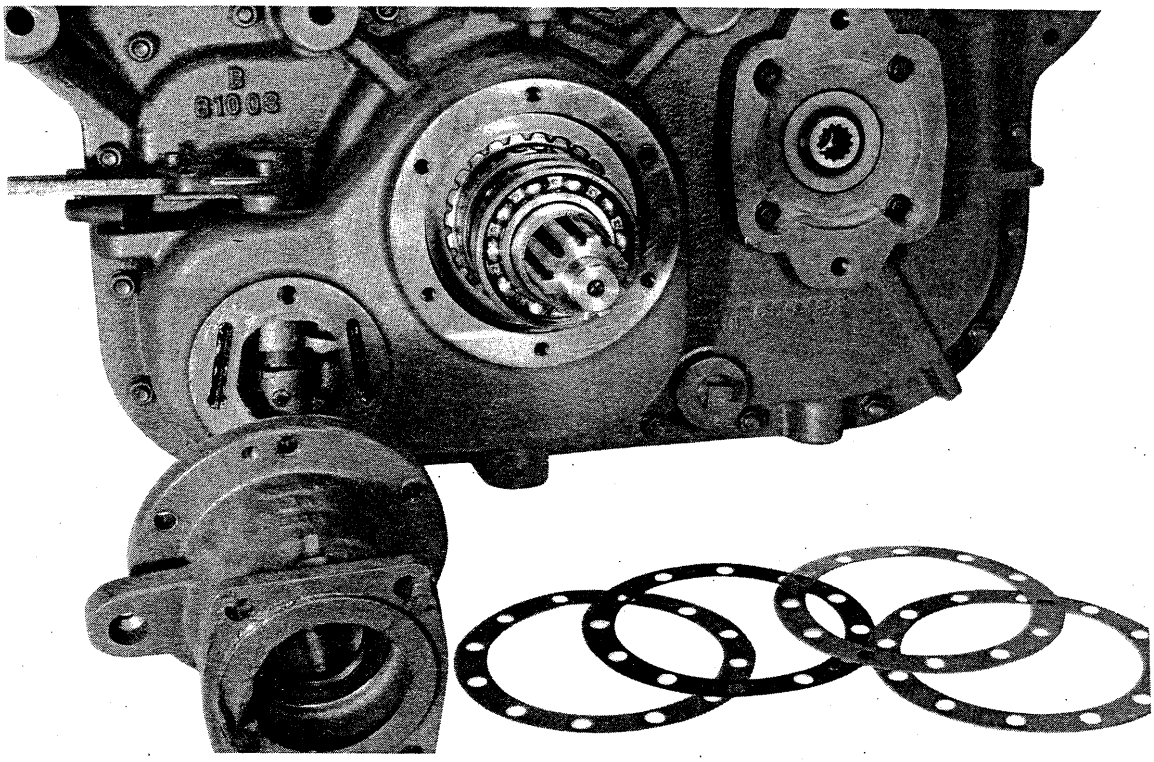
Coupling shaft (T76) and its associated parts may come off with housing (T10).

6. Remove the coupling shaft assembly if it did not come off when removing coupling shaft housing (T10).
7. Remove fasteners holding case halves (T1 and T3) together. Punch out alignment dowels (T75) between case halves.
8. Install push off screws in tapped holes in case half and separate rear case half from front half. The shifting mechanism and shift collar (T44) will come off with the rear case half.

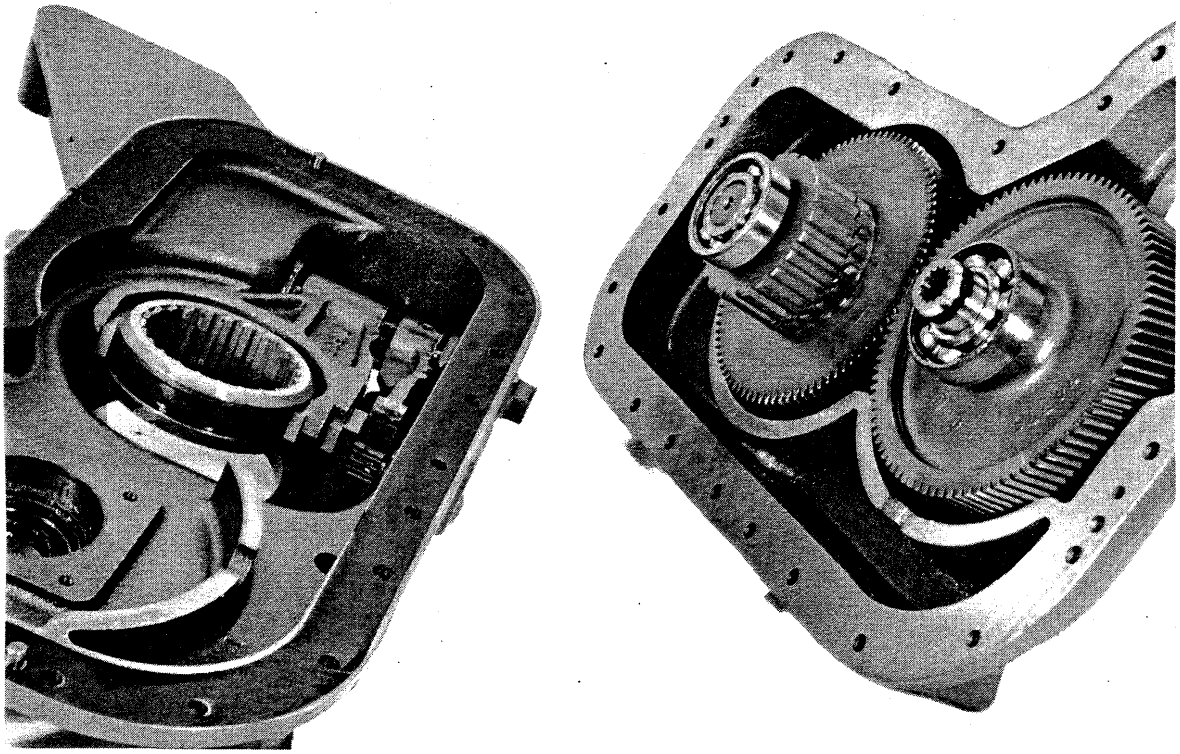
CAUTION

Shift collar may fall out of case half when halves are separated.

9. Withdraw drive shaft (T45), gear (T53) and associated parts as an assembly rearward, out of drive shaft housing and front case half.
10. Remove drive shaft housing (T51) from front half of case. Tapped holes are provided in the housing for use of push off screws.
11. Remove idler gear (T54), shaft (T55) and associated parts as an assembly from the case half it remains with.
12. Remove hydraulic pump adapter (T5) from rear case half and bearing cover (T56) from front case half. Remove O–ring (T57) from bearing cover and oil seal from adapter.
13. Remove oil seals (T14) from the coupling shaft and drive shaft housings.



Rear View
Coupling shaft housing and electric shift removed.

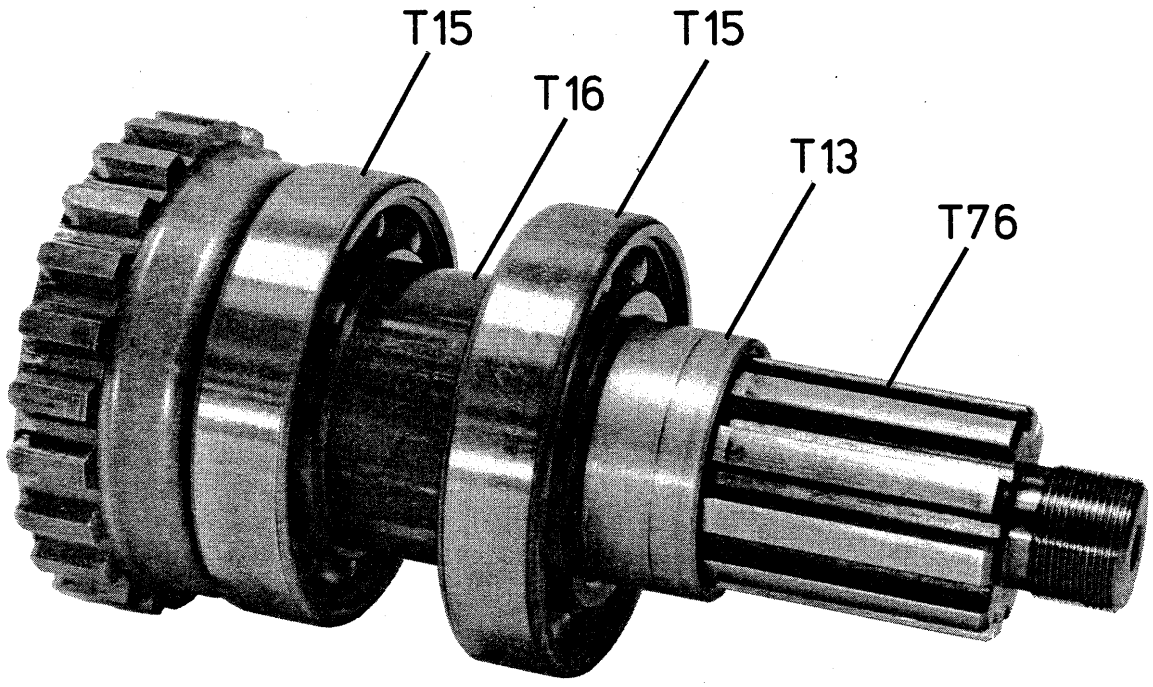


Case halves separated.

DISASSEMBLY OF COMPONENTS

COUPLING SHAFT ASSEMBLY

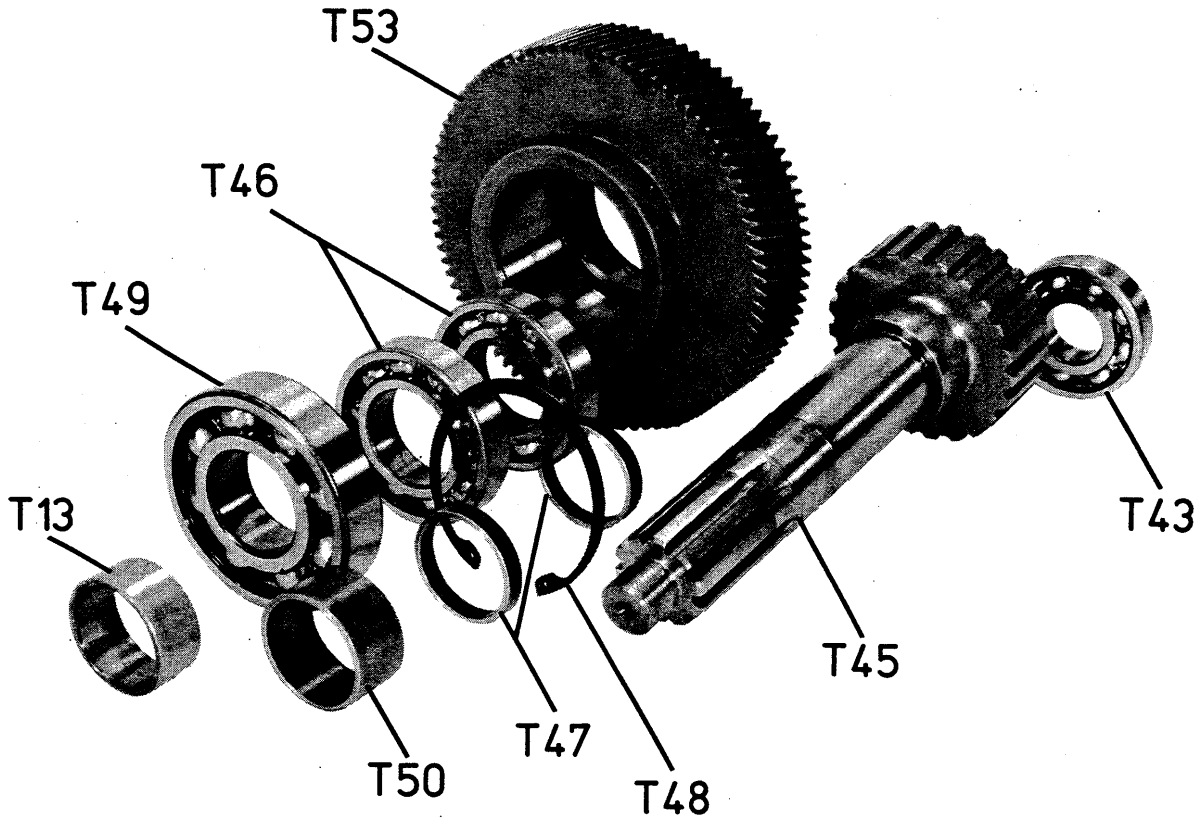
1. Pull outer bearing (T15) from shaft (T76); oil seal sleeve (T13) will come off with the bearing. Remove spacer (T16), if equipped with speedometer drive remove gear (T78), key (T80), and spacer (T79) pull inner bearings (T15) from shaft. Due to closeness of this bearing to hub end of shaft (T76), a split plate type puller may be necessary.
2. If pilot bearing (T43) remains in coupling shaft, tap out by using punch through the two access holes in the coupling shaft.



Coupling Shaft Assembly

DRIVE SHAFT ASSEMBLY

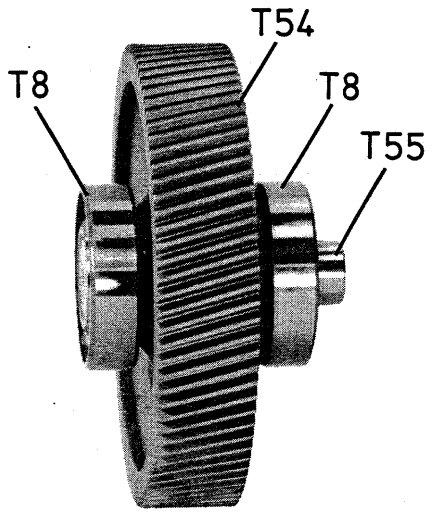
1. Set up shaft assembly in a press so it rests on face of drive gear (T53) with spline end of shaft (45) facing up.
2. Remove oil seal sleeve (T13) and spacer (T50).
3. Press shaft (T45) out of bearing (T49) and drive gear (T53). Bearings (T46) will remain with drive gear.
4. Remove snap ring (T48) from drive gear (T53). Remove bearings (T46) and inner spacer (T47) from the drive gear.



Drive Gear and Shaft Assembly

IDLER GEAR ASSEMBLY

1. Support idler gear (T54) on its face and press shaft (T55) out of the gear (T54) and one bearing (T8).
2. Remove key (T74).
3. Press shaft (T55) out of remaining bearing (T8).



SHIFT MECHANISM

Disassembly of shift mechanism is only necessary if the shift shoes, locking arm or sector gear are worn.

Remove the shift mechanism from rear case half (T3) as follows:

1. Drive out pin (T30) which fastens sector gear (T29) to shift shaft (T19).
2. Rotate or raise shift arm (T20) to disengage spring (T41) and spring housing (T40) from arm.

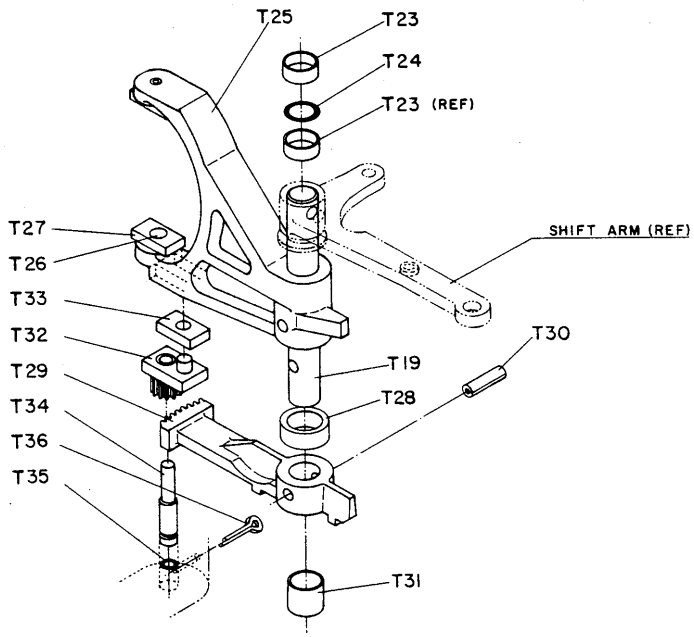
CAUTION

Catch spring (T41) as it becomes unloaded.

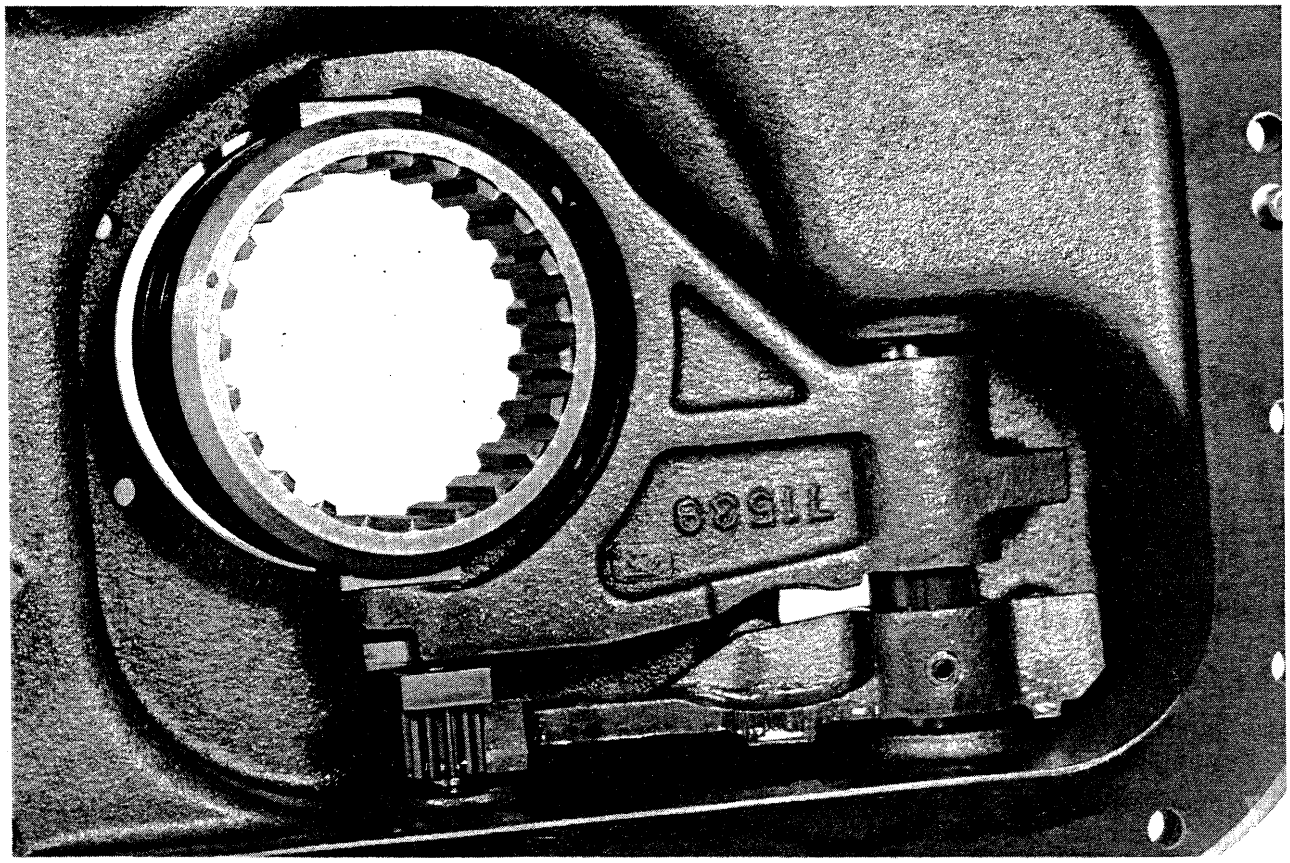
3. Remove shift shaft (T19) from case by pulling upward on shift arm (T20). All parts retained by the shaft will now be free of shaft and can be removed.

NOTE

Locking arm, shift shoe and pivot pin need only be removed if worn or damaged.



4. Remove locking arm (T32) and shift shoe (T33).
5. Drive out pin (T21) fastening shift shaft to shift arm.
6. Press bushings (T23) from case. O–ring (T24) will come out with bushings.
7. Remove pipe plug (T63) and press out bushing (T31).
8. Remove cotter pin (T36) and press out pivot pin (T34).



Internal view of shift mechanism in rear case half.

INSPECTION AND REPAIR

Check for the following:

Bent shift shaft

Bent shift fork

Worn shifter shoes

Loose shifter shoe studs

Damaged locking arm, sector gear, or bent pivot pin.

Worn gear teeth

Badly worn pointing on teeth of shift collar, and similar wear on teeth of drive or coupling shaft.

Worn or damaged oil seal sleeves

Before reassembly, make sure all reusable parts have been cleaned and are kept free of dirt during reassembly.

REASSEMBLY

INSTALLING BEARINGS

Keep reusable bearings covered and new bearings wrapped until they are to be installed. It is recommended that new ball bearings be installed during overhaul. Before pressing a ball bearing on a shaft, coat bearing bore with grease. Always apply force to the inner race of a ball bearing when pressing it on a shaft, and to the outer race if pressing bearing into a bore. Press on evenly with a piece of pipe or tube which just clears the shaft or the bore in a housing. Be sure shafts, bores, and pipe or tube used for pressing out bearings are clean before installing bearings.

INSTALLING OIL SEALS

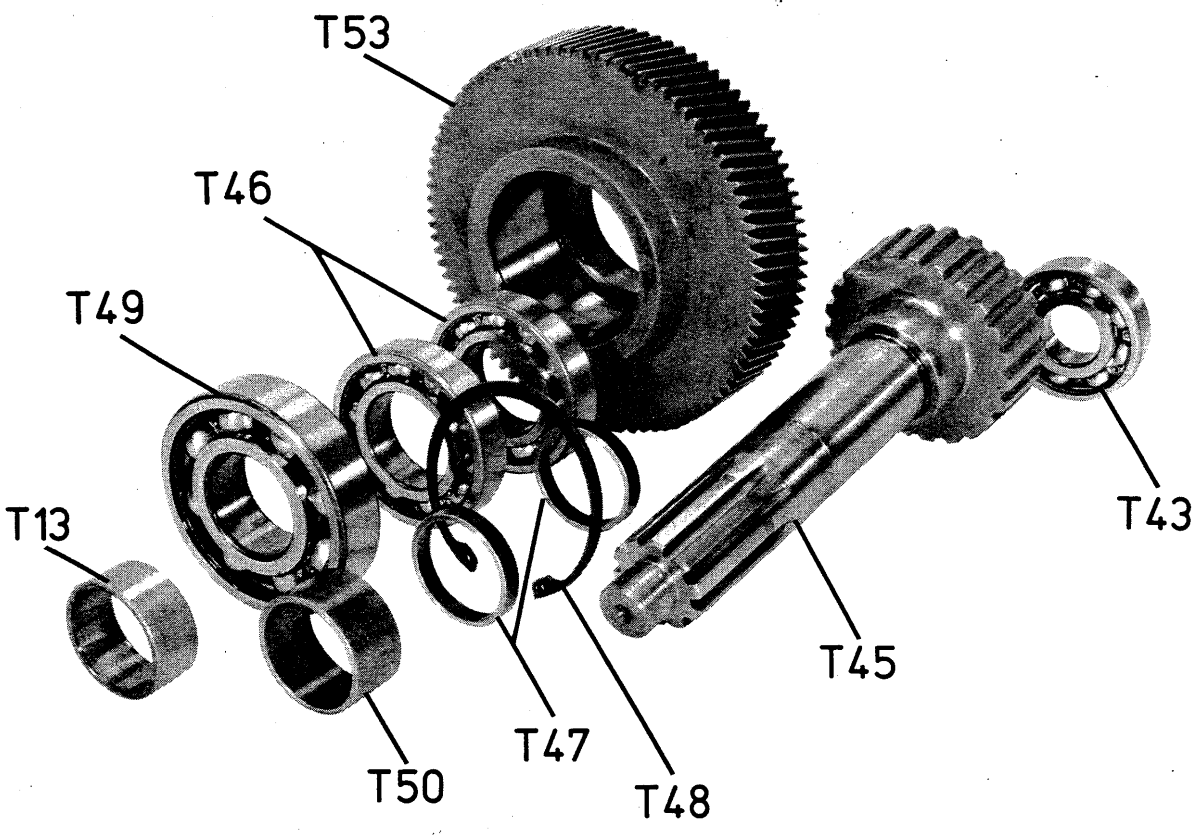
Before installing an oil seal in its housing, coat seal O.D. evenly with oil or grease. Be sure that seal, shaft, and housing are clean. Always install a seal with the seal lip facing in. Apply force to the outer edge of a seal, and press in evenly.

INSTALLING GASKETS

Remove all gasket material from case halves before installing new gaskets. If a gasket is awkward to hold in place while assembling a component, coat one of the mating flanges with grease and press the gasket into position against the flange. The grease will hold the gasket in place during reassembly.

DRIVE SHAFT ASSEMBLY

1. Install one (T46) bearing in drive gear (T53). Push bearing until it seats against shoulder in the gear.
2. Place spacer (T47) on inner race of bearing (T46).
3. Install outer bearing (T46) in gear (T53) trapping spacer (T47) between bearings.
4. Install snap ring (T48) in gear.
5. Stand drive shaft (T45) with spline end up. Slide gear assembly on drive shaft with snap ring end facing up. Make sure spacer between bearings in gear is centered as it passes over bearing journal on shaft.
6. Slide spacer (T47) over shaft and seat it against bearing (T46)
7. Press bearing (T49) onto shaft tight against spacer (T47).
8. Slide spacer (T50) over shaft against bearing (T49).
9. Press oil seal sleeve (T13) tight against spacer (T50).
10. Turn drive shaft assembly over so spline end is down and press on pilot bearing (T43).
11. Make sure drive gear spins free on its bearings and does not rub against drive shaft. Put this assembly aside to install in case later.



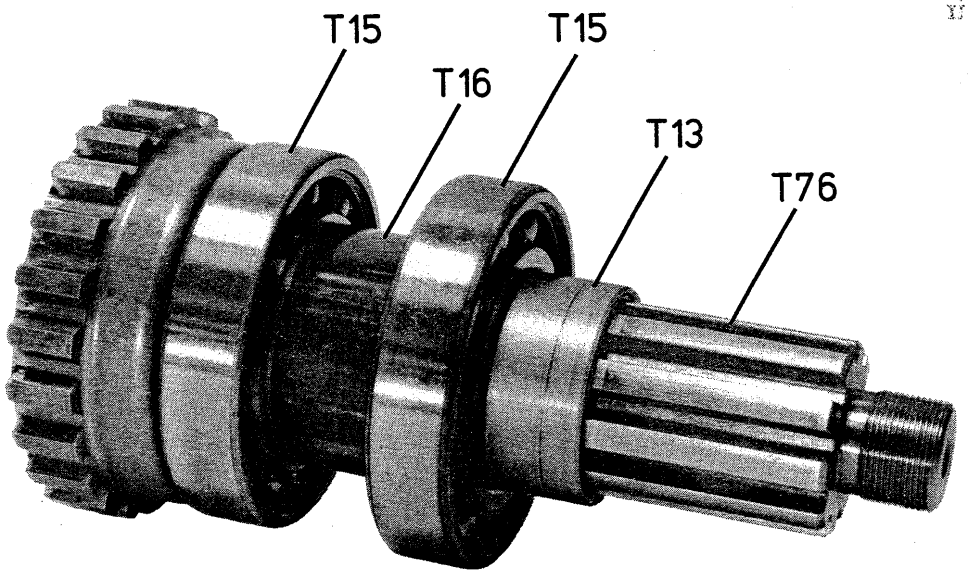
COUPLING SHAFT ASSEMBLY

1. Stand coupling shaft (T76) on table with spline end up.
2. Install inner bearing (T15) tight against shoulder on coupling shaft.
3. Slip spacer (T16), on coupling shaft (T76) up against bearing (T15).

NOTE

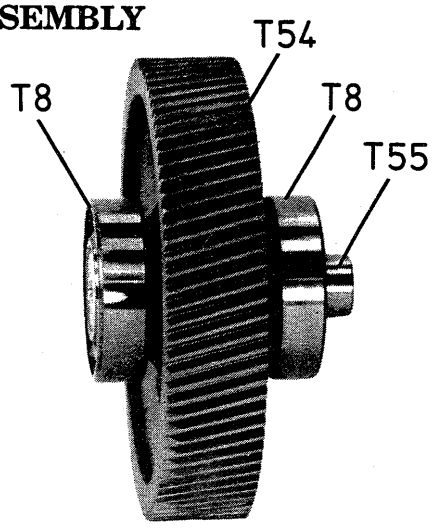
If equipped with speedometer drive, slip spacer (T79) on coupling shaft (T76), up against bearing (T15). Install Woodruff key (T80) and gear (T78).

4. Install outer bearing (T15) tight against spacer (T16) or gear (T78).
5. Install oil seal sleeve (T13) tight against bearing inner race.
6. Put this assembly aside for installation in the case later.



IDLER GEAR ASSEMBLY

1. Install key (T74) in keyway in shaft (T55).
2. Line up key (T74) in shaft (T55) with keyway in gear (T54). Press shaft (T55) into gear (T54) so that the slotted or internal spline end protrudes thru the gear (T54) at the long hub face of the gear.
3. Install bearings (T8) on shaft (T55).
4. Put this assembly aside for installation in the case later.



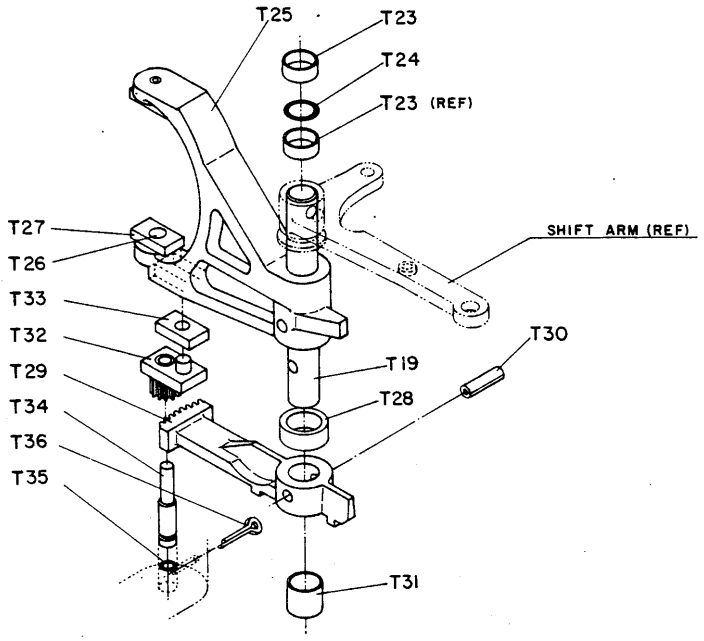
SHIFT MECHANISM

Reassemble shift mechanism in rear half of case (T3) as follows:

1. Install O–ring (T35) in groove in pivot pin (T34). Apply light coating of oil or grease to the O–ring. Press pivot pin (T34) into hole in bottom of case half (T3) until large end of pin clears 1/8 in. cotter pin hole in case.
2. Install cotter pin (T36) in cross hole in case and spread open split end of pin below pivot pin (T34).
3. Press bushing (T31) into lower hole of case. Press in from inside of case until bushing is flush with inside of case.
4. Press one bushing (T23) in upper hole in case. Press in a distance of 13/32 in. from top of casting to top of bushing. Install O–ring (T24) in same hole as bushing down to top of bushing. Press in second bushing (T23) after the O–ring until bushing contacts O–ring. The second bushing should be nearly flush with the case.
5. Place sector gear (T29) in case, with the hub end up, positioned with teeth centered and in line with pivot pin (T34) and the hole for the shift shaft directly above the shift shaft hole in the case.
6. Install locking arm (T32) on the pivot pin (T34) engaging its teeth with the center tooth of the sector gear (T29) while lining up the locking arm so that the pin end is pointed directly at the center of the shift shaft hole in the sector gear.
7. Slide shift shaft (T19) through lower shift shaft hole in the case into the sector gear (T29).
8. Install shoe (T33) on pin of locking arm (T32).

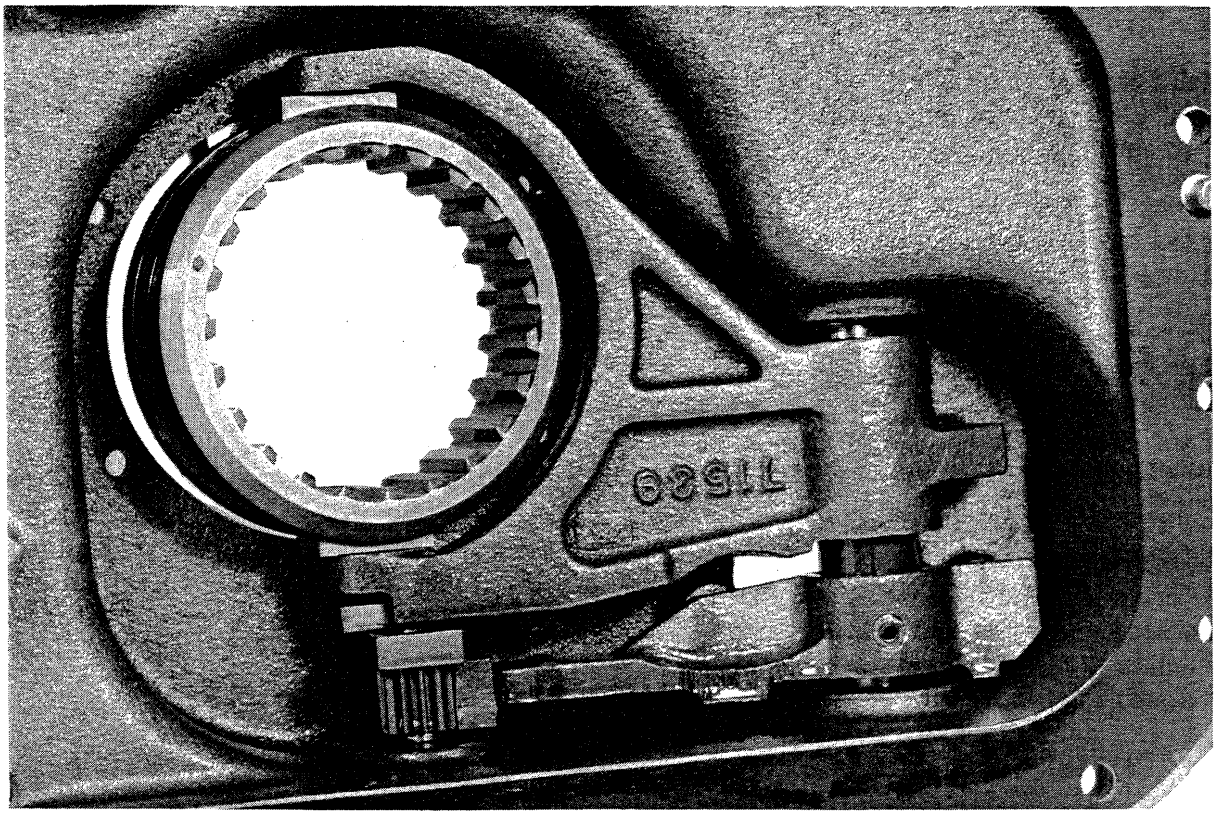
NOTE

Shifter shoe (T33) can be installed with counterbore at hole either up or down.



9. Install spacer (T28) over top of shift shaft (T19) and seat it against top side of sector gear (T29).
10. Position shift fork (T25) over shift shaft (T19); make sure slot in fork fits over shoe (T33). Slide shift shaft (T19) through spacer (T28) and shift fork (T25) and through bushings and O–ring in the upper shift shaft hole in the case.
11. The shift fork locking arm (T32) should now be centered and in line with the sector gear (T29). If they are not in line, withdraw shift shaft (T19) and reposition parts as stated above.
12. Line up holes in sector gear (T29) and shift shaft (T19), and install pin (T30).
13. With a punch in the hole in top of the shift shaft (T19), and locking arm (T32) centered with sector gear (T29), rotate shift shaft (T19) back and forth rotating the locking arm to the left 90 degrees and to the right 90 degrees from a centered position. It should not disengage from the teeth on the sector gear (T29). If necessary, remove shift shaft (T19) and reposition parts as stated above.

14. Install washer (T22) over top of shift shaft (T19).
15. Install pins (T39) in case and shift arm (T20), and slip spring housing (T40) over pin (T39) in the case.
16. Slide spring (T41) into spring housing (T40).
17. Position shift arm (T20) on shift shaft (T19) just enough to engage it with the shaft. Rotate both the shift arm (T20) and spring housing (T40) and compress spring (T41) until pin (T39) in the shift arm (T20) will engage in slot in spring housing (T40) and over end of compressed spring (T41). Line up holes in shift arm and shift shaft and install pin (T21).
18. Install adjusting screws (T38) and adjust them so movement of locking arm(T32) is slightly less than 90 degrees both directions from a centered position with the sector gear (T29).
19. Electric shift assembly.
    a) If unit does not incorporate an electric shift assembly, install adjusting screw retainers (T37) in slots in adjusting screws (T38). Install gasket (T18), manual shift indicator light bracket, if so equipped, and cover (T17) and fasten with capscrews.
    b. If equipped with electric shift, the electric shift assembly should not be installed until assembly of the case has been completed. The adjusting screw retainers (T37) will be installed when the electric shift unit is installed.



Internal Shift Mechanism in Rear Case Half

ASSEMBLY OF CASE HALVES AND SHAFT ASSEMBLIES

1. Install oil seal (T7) in adapter (T5).
2. Place gasket (T6) on pilot diameter of adapter (T5) and install adapter to the rear case half (T3) with fasteners (T86) or (T68) and (T65). Note the type of fastener depends on the style of the adapter (T5).
3. Support rear case half (T3) on suitable blocking so that inside of the case is up.
4. Install suitable additional blocking in bore in the case for the coupling shaft housing so that the top of the block protrudes about 1 inch into the case.
5. Install shift collar (T44) onto the shoes on the shift fork (T25) with the face of the collar (T44) with the large chamfered outside corner facing up.
6. Install the idler gear assembly in the case half (T3) seating the bearing (T8) in the bore in the case.
7. Position the drive shaft assembly in the case meshing the external teeth at the pilot bearing end with the internal teeth in the shift collar (T44) and the teeth on the drive gear (T53) with the idler gear (T54) the drive shaft being supported by the blocking at the pilot bearing end.
8. Position gasket (T2) on flange of rear case half (T3).
9. Position front case half (T1) above gasket (T2) and case half (T3) which is supported on blocking. Tap case half (T1) down making sure that the bearing (T8) on the idler gear shaft (T55) slides into the bore in case half (T1). Line up holes between case halves (T1) (T3). Install dowels (T75) and fasteners (T71), (T68) and (T73) tighten securely.
10. Install O–ring (T57) in cover (T56). Install cover to case (T1) and fasten securely with fasteners (T65), (T66) and (T68).
11. Install oil seal (T14) in the drive shaft housing (T51).
12. Position gasket (T9) on face of case half (T1).
13. Slide housing (T51) over the spline end of the drive shaft (T6) and onto bearing (T49) being careful not to damage the oil seal (T14). Line up holes and tap onto bearing (T49) until pilot diameter of housing (T51) begins to enter the bore in case half (T1). Install fasteners (T66), (T67) and (T68) and tighten securely.

NOTE

Fasteners (T67) with locking and sealing nylon inserts are used for the lower fasteners (those below the normal oil level).

14. Remove the case assembly from the blocking and rest it on the bottom of bolting flange of case halves allowing it to tip toward the drive shaft end. Block or otherwise support in this position. During this positioning, make sure the drive shaft is kept from sliding towards the shift collar.
15. Take previously assembled coupling shaft assembly and insert large end through bore in rear case half (T3) and onto bearing (T43) at end of drive shaft and tap on the end of the coupling shaft with a soft face hammer until coupling shaft assembly bottoms against bearing (T43).
16. Install oil seal (T14) in end of couping shaft housing (T10) and install bushing (T84) in the housing if equipped with speedometer drive.

NOTE

The drive line assembly was factory shimmed to limit the axial float of the drive line. If any of the drive line parts have been changed, it may be necessary to change the total thickness of shims (T9) between the coupling shaft housing (T10) and the transmission case. The shims are color coded for thickness as follows:

blue	**.005"**
aluminum	**.007"**
brown	**.010"**

The correct thickness of shims can be determined as follows:

A. Install coupling shaft housing (T10) with no shims between the housing and case. Tighten cap screws evenly to force drive line all the way forward. Do not overtighten causing bending or breakage of the coupling shaft housing.

B. Measure gap between housing and the case, and add 0.005 in. This will be the total thickness of shims needed to provide the recommended axial float of 0.005 in.

C. Remove coupling shaft housing from case after measuring gap.

NOTE

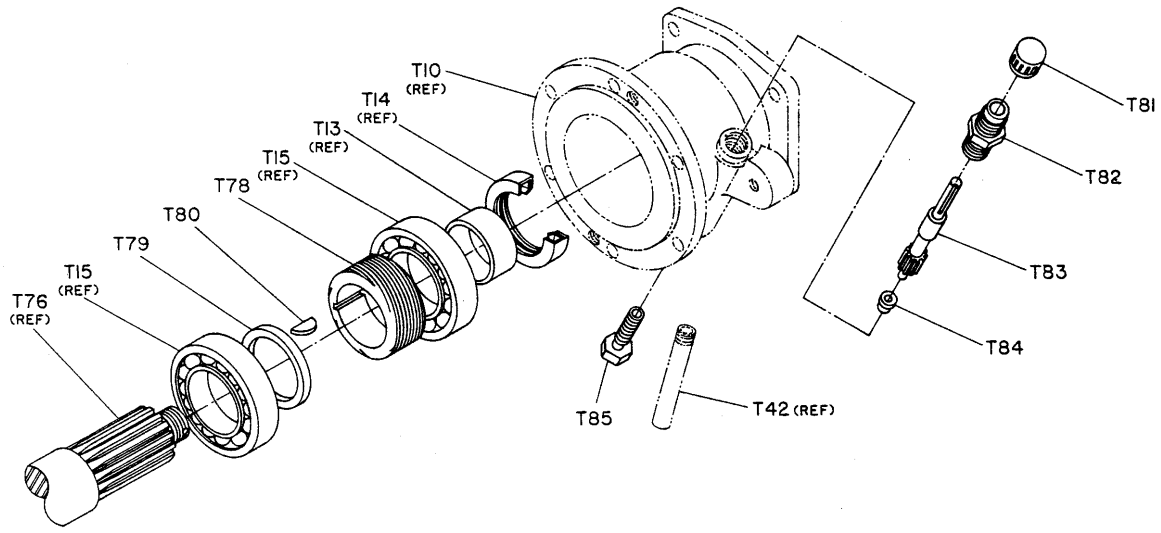
Field conditions may make it difficult to determine the correct amount of shims. If in doubt, add another 0.005 in. shims. No harm will result from a small amount of additional axial float but bearing life will be shortened if bearings are excessively preloaded.

17. Install correct amount of shims on the coupling shaft housing, or if all original parts are being reused, reinstall original shims or new shims of the same thickness (color) (T9) on coupling shaft housing (T10) applying a light coat of Permatex sealant between shims and on both faces of first and last shim. Install the housing over the bearings (T15) on the coupling shaft and tighten housing in case half (T3) with cap screws. Use the (T67) cap screws with the nylon seal in lower half of housing and (T65) screws in upper half.

REASSEMBLY OF MISCELLANEOUS PARTS

SPEEDOMETER DRIVE

1. Install gear (T83) in coupling shaft housing (T10) making sure it fits into bushing (T84) previously installed in the housing.
2. Install sleeve (T82) over end of gear (T83) and thread into housing (T10).



MISCELLANEOUS HARDWARE

1. Install pipe plug (T63) in tapped hole at lower end of shift shaft.
2. Install magnetic drain plug (T58).
3. Install street elbow (T60) and breather (T59).
4. Install oil level plug (T64).

REASSEMBLY OF ACCESSORIES TO THE TRANSMISSION

ELECTRIC SHIFT ASSEMBLY

1. Make sure adjusting screws (T38) are in place and adjusted, and adjusting screw retainer (T37) is installed in slot in end of each screw.
2. Position and bolt electric shift assembly into place making sure gasket (T56) is installed between shift assembly and face of the case (T3). Fasten in place with cap screws (T69).
3. Fasten pivot plate and cover to shift arm (T20) if these were removed.
4. Reconnect wiring and check for proper adjustment of indicator light switch if shift unit is so equipped.

NOTE

If chassis is equipped with an automatic transmission, indicator lights must be used.

Refer to separate instructions for adjustment of the shift switch. For detail of electric shift assembly, refer to separate Service Parts List.

BRAKE ASSEMBLY

1. If previously removed, reinstall the drain tube (T42) in hole in bottom of coupling shaft housing (T10).
2. Install and fasten brake assembly to coupling shaft housing (T10). Install related linkage and brake drum, and adjust brake. See separate instruction for brake installation, adjustment and maintenance.

COMPANION FLANGES

1. Slide companion flange or end yoke on the drive shaft (T76) up against the oil seal sleeve (T13).
2. Install washer (T11) and lock nut (T12); tighten nut securely. Make sure one slot in nut lines up with hole in end of drive shaft (T76). Install cotter pin (T52) and spread open split end of pin.
3. Repeat same installation procedure at coupling shaft end unless companion flange was previously installed at the time the brake assembly was installed.

LUBRICATION AND FINAL CHECK

Fill transmission to oil level plug hole with SAE 90# or SAE 85W–140 gear lube (approximately six (6) quarts required). Change oil every 6 months or 500 hours of operation.

1. Recheck fasteners for tightness.
2. Check for oil leaks.

After the PTO is reinstalled in the chassis:

1. Recheck shift mechanism for proper operation.
2. Test shift indicator light system (if equipped).
3. Inspect for damaged wires and connections. Repair as necessary.