SECTION 8

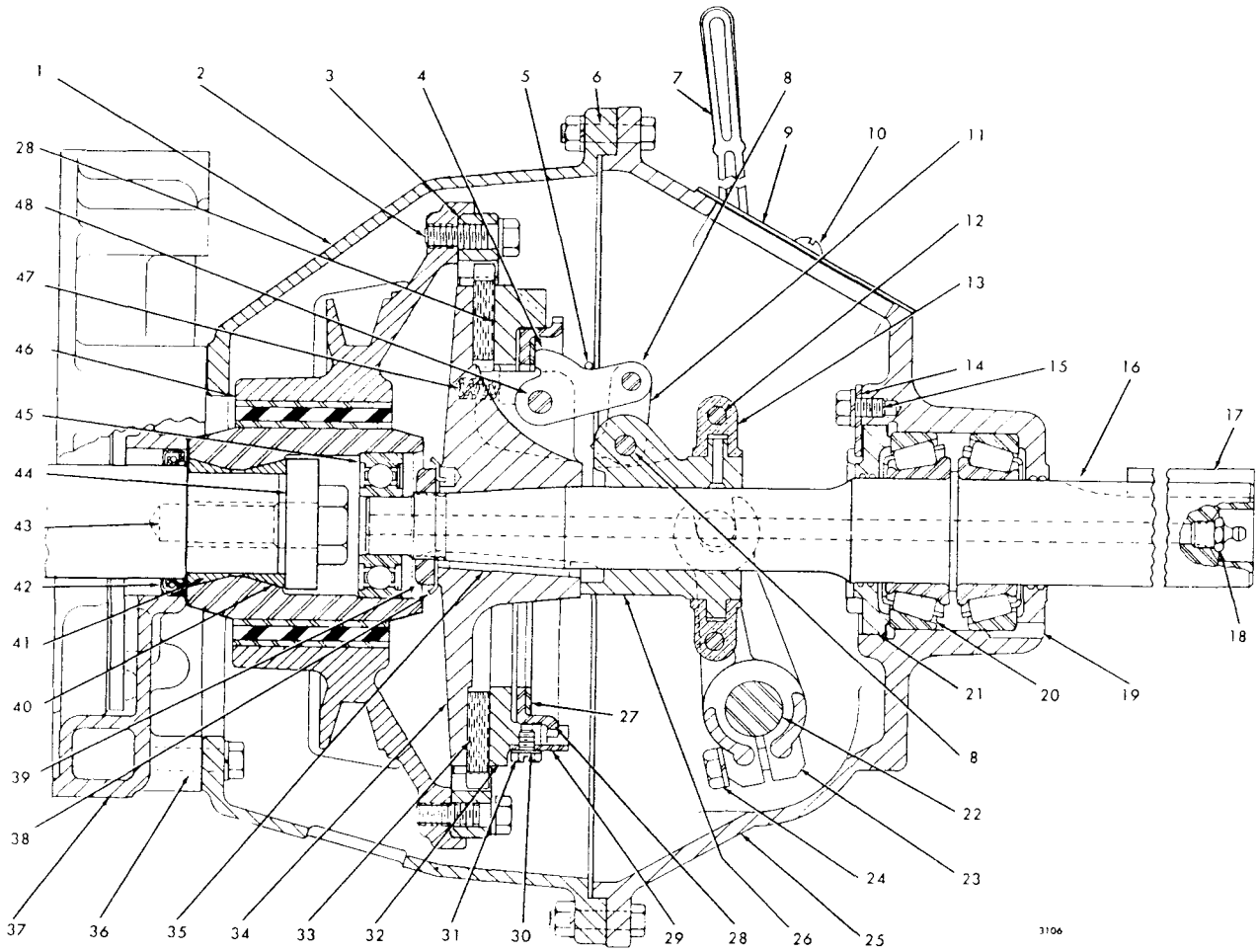
POWER TAKE-OFF - TORQMATIC CONVERTER

CONTENTS

*Note: For service and overhaul procedures covering Torqmatic Converters, refer to Allison 200-300 Series Torqmatic Converter Service Manual - Form SA 1099.

POWER TAKE-OFF - DIRECT DRIVE (Front And Rear Mounted)

The front and the rear power take-off units are basically similar in design, varying in clutch size to meet the requirements of a particular application.



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1. Adaptor--Power Take-Off
2. Bolt--Clutch Driving Ring
3. Ring--Clutch Driving
4. Lever--Clutch Release
5. Spring--Clutch Release Lever
6. Bolt--Clutch Housing
7. Lever--Clutch Hand
8. Pin--Release Lever Link
9. Cover--Inspection Hole
10. Screw--Cover
11. Link--Release Lever
12. Bolt--Release Collar
13. Collar--Clutch Release
14. Lock Plate--Bearing Retainer
15. Bolt--Lock Plate
16. Shaft--Clutch Drive
17. Key--Drive Shaft
18. Fitting--Grease
19. Bearing Assy.--Roller (Outer)
20. Bearing Assy.--Roller (Inner)
21. Retainer--Bearing
22. Shaft--Clutch Release
23. Yoke--Clutch Release
24. Bolt--Yoke Clamping
25. Housing--Clutch
26. Sleeve--Clutch Release
27. Plate--Adjusting Ring Wear
28. Ring--Clutch Adjusting
29. Lock--Clutch Adjusting Ring Spring
30. Lock Washer
31. Screw
32. Plate--Clutch Pressure (Inner)
33. Clutch Facing
34. Plate--Clutch Pressure (Outer)
35. Key--Drive Shaft
36. Bolt--Adaptor
37. Cover (Lower)--Engine Front
38. Lock Washer
39. Nut--Drive Shaft
40. Cone (Front)
41. Cone (Rear)
42. Oil Seal--Crankshaft (Front)
43. Bolt
44. Washer
45. Bearing--Clutch
46. Adaptor--Clutch Drive
47. Spring--Pressure Plate Separator
48. Pin--Clutch Release Lever

Fig. 1 - Front End Power Take-Off and Drive Assembly (8 Inch Diameter Clutch)

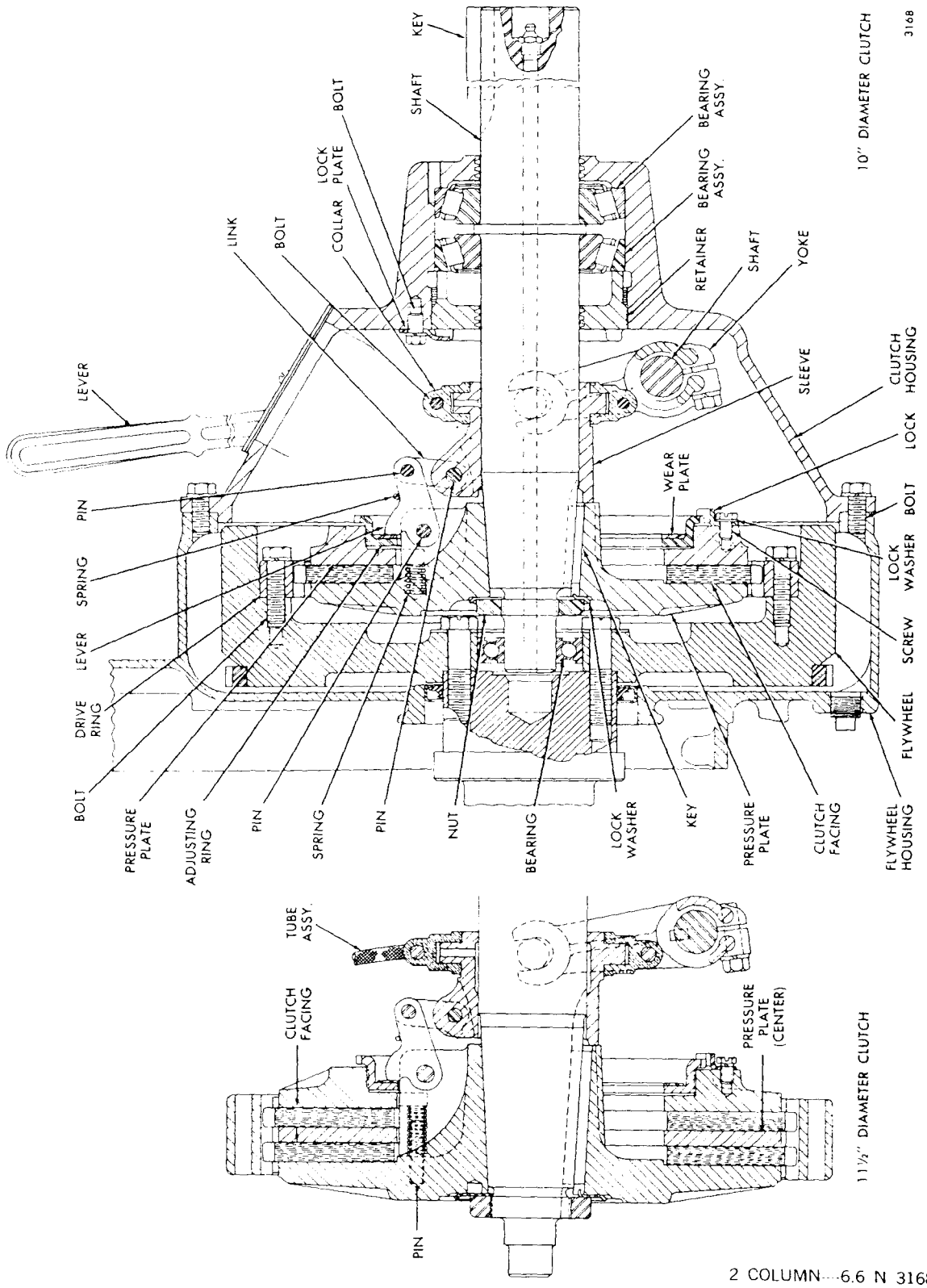


Fig. 2 - Rear Power Take-Off Assembly

The direct drive power take-off unit is attached to either an adaptor (front power take-off) or the flywheel housing (rear power take-off). The clutch mechanism in the current 8" diameter clutch front power take-off consists of a one-piece dry disc clutch facing (33), Fig. 1. Formerly a three-piece clutch facing was used. The rear mounted power take-offs have either a 10" diameter single or a 11-1/2" diameter double-plate clutch. The clutch mechanism in the 10" diameter clutch consists of a three-piece dry disc clutch facing (Fig. 2). The clutch mechanism in the 11-1/2" diameter clutch consists of two one-piece dry disc clutch facings; formerly it consisted of two three-piece facings.

The forward end of the drive shaft is supported by a single-row ball bearing in the flywheel (Fig. 2) or the clutch drive adaptor (46), Fig. 1. The outer end of the drive shaft is supported by two tapered roller bearings in the clutch housing.

The tapered roller bearings absorb the greatest portion of the thrust and radial load on the drive shaft. An adjustable bearing retainer provides a means of adjusting the tapered roller bearings.

A driving ring, attached to the flywheel or the clutch drive adaptor, drives the power take-off.

Operation

When the hand lever (7) is moved toward the engine, the yoke (23) moves the release sleeve (26) toward the clutch. This movement forces the outer ends of the links (11) away from the axis of rotation causing the levers (4) to contact the face of the adjusting ring (28), which locks the clutch facings (33) between the outer and inner pressure plates (34) and (32). Thus, the power of the engine is transmitted to the drive shaft (16).

When the hand lever (7) is moved away from the engine, the yoke (23) moves the clutch release sleeve (26) away from the clutch, and the springs (47) and (5) return the pressure plate (32) to its released position. Thus, pressure between the pressure plates and clutch facings is relieved, permitting the pressure plates and the clutch drive shaft to cease rotating. Since the clutch facings have external teeth and mesh with the teeth in the inner diameter of the driving ring (3) which is bolted to the flywheel or the clutch drive adaptor, the clutch facings continue to rotate while the engine is running.

Lubrication

The clutch release shaft, clutch release sleeve collar and all bearings are lubricated with grease. Refer to *Lubrication and Preventive Maintenance* in Section 15.1.

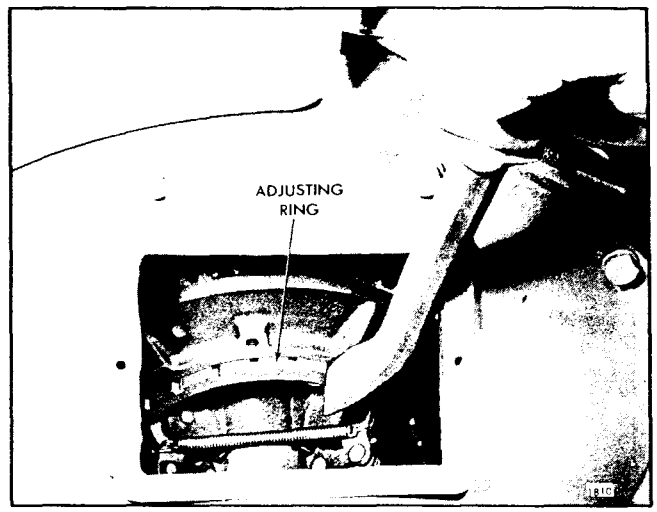


Fig. 3 - Adjusting 8, 10 or 11-1/2 Inch Diameter Power Take-Off Clutch

Clutch Adjustment

These instructions refer to field adjustment for clutch facing wear. Frequency of adjustment depends upon the amount and nature of the load. To ensure longest facing life and best clutch performance, the clutch should be adjusted before slippage occurs.

When the clutch is properly adjusted, a heavy pressure is required at the outer end of the hand lever to move the throwout linkage to the "over center" or locked position.

Adjust 8", 10" and 11-1/2" diameter clutches as follows:

1. Disengage the clutch with the hand lever.

2. Remove the inspection hole cover to expose the clutch adjusting ring.

3. Rotate the clutch, if necessary, to bring the clutch adjusting ring lock within reach.

4. Remove the clutch adjusting ring spring lock screw and lock from the inner clutch pressure plate and adjusting ring. Then, while holding the clutch drive shaft from turning, turn the clutch adjusting ring counterclockwise as shown in Fig. 3 and tighten the clutch until the desired pressure on the outer end of the hand lever, or at the clutch release shaft (Fig. 4) is obtained.

5. When the clutch is properly adjusted, the approximate pressure required at the outer end of the hand lever to engage the various diameter clutches is

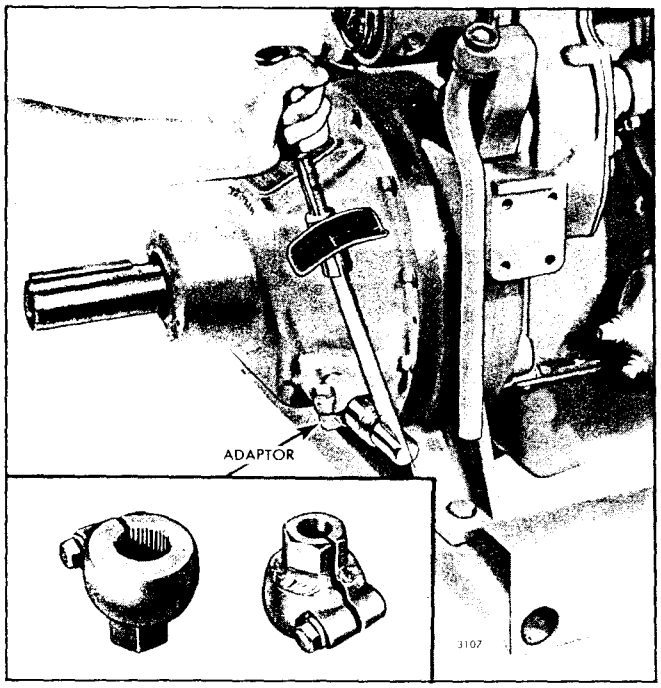


Fig. 4 - Checking Power Take-Off Clutch Adjustment with a Torque Wrench and an Adaptor

shown in the following table. These specifications apply only to the hand lever which is furnished with the power take-off. A suitable spring scale may be used to check the pounds pressure required to engage the clutch.

Clutch Dia.	Hand Lever Length	Pressure Lbs.
8"	15-1/2"	55
10"	15-1/2"	80
11-1/2"	20"	65

However, the most accurate method of checking the clutch adjustment is shown in Fig. 4. To fabricate an adaptor, saw the serrated end off of a clutch hand lever and weld a 1-1/8" nut (across the hex) on it as shown in Fig. 4. Then saw a slot through the nut.

When checking the clutch adjustment with a torque wrench, engage the clutch slowly, noting the torque just before the clutch engages (goes over center). The specified torque is shown in the following table.

Clutch Diameter	Torque Lb-Ft
8"	56-63
10"	88-94
11-1/2"	94-100

6. Install the clutch adjusting ring spring lock. Be sure that the ends of the spring lock register with the notches in the adjusting ring.

7. Install the inspection hole cover.

Replace Clutch Facings

Replace the clutch facings when they become worn to the extent that the clutch adjustment, to prevent slippage, cannot be made with the adjusting ring. When the power take-off assembly is removed from the engine or is being reconditioned, check the clutch facings for wear, burning or scoring. If the clutch facings are burned, scored or worn to or near the minimum facing thickness shown in the following table, they must be replaced.

Clutch Size	Facing Thickness New	Max. Allow. Wear	Min. Thickness of Facing
8"	3/8"	1/8"	1/4"
10"	7/16"	1/8"	5/16"
11-1/2"	7/16"	1/8"	5/16"

The clutch facings on the current 8" diameter single-plate clutch and the 11-1/2" diameter double-plate clutch consists of one piece. When replacing the one-piece clutch facing, the clutch must be removed from the clutch drive shaft and the clutch disassembled. The former 8" diameter single-plate and the 11-1/2" diameter double-plate clutches consisted of three pieces and did not require clutch removal and disassembly. The 10" diameter single-plate clutch facing still consists of three pieces.

The current 8" and 11-1/2" diameter one-piece replacement clutch facings are marked at three places on the side of the facing so they may be cut into three pieces with a 1/8" thick saw to facilitate replacement of the facing (rear mounted power take-offs only) without removing and disassembling the clutch each time a replacement is made.

NOTE: The current one-piece clutch facing should be used on the front mounted power take-off.

Replace the clutch facings in the current 8" diameter single-plate and the 11-1/2" diameter double-plate clutches as follows:

1. Remove the power take-off assembly from the engine as outlined under *Remove Power Take-Off.*

2. Remove the clutch assembly from the clutch drive shaft as outlined under *Disassemble Power Take-Off.*

3. Disassemble the clutch as outlined under *Disassemble Power Take-Off.*

4. Assemble the clutch as outlined under *Assemble Power Take-Off.*

5. Install the clutch assembly on the clutch drive shaft as outlined under *Assemble Power Take-Off.*

6. Attach the power take-off assembly to the engine as outlined under *Attach Power Take-Off to Engine.*

7. Adjust the power take-off clutch as outlined under *Clutch Adjustment.*

8. Install the inspection hole cover.

Replace the three-piece clutch facings in the former 8" diameter single-plate, 11-1/2" diameter double-plate and the 10" diameter single-plate clutches as follows:

1. Remove the power take-off from the engine as outlined under *Remove Power Take-Off.*

2. Disengage the clutch with the hand lever and the clutch facings will automatically fall out from between the pressure plates.

3. Remove the inspection hole cover to expose the clutch adjusting ring and linkage.

4. Rotate the clutch, if necessary, to bring the clutch adjusting ring lock within reach.

5. Remove the clutch adjusting ring spring lock screw and lock from the inner clutch pressure plate and adjusting ring. On the former clutches, the clutch adjusting ring spring lock did not require removal.

6. While holding the clutch drive shaft to prevent the clutch from turning, back off the adjusting ring by turning it clockwise just enough to permit the new clutch facings to be inserted and locked in position between the pressure plates.

7. Support the power take-off in a vertical position with the clutch assembly up on wood blocks; or, screw two eyebolts in the tapped holes in the flange or the clutch housing and use a rope sling and chain hoist to support the power take-off.

8. Insert the new clutch facings between the pressure plates and center them.

9. Remove the clutch driving ring from the flywheel or the clutch drive adaptor at the front of the engine.

10. Support the clutch driving ring by placing two strips of wood across the top face of the clutch housing, next to the clutch facing, that are just thick enough to permit the driving ring to center over the clutch facings.

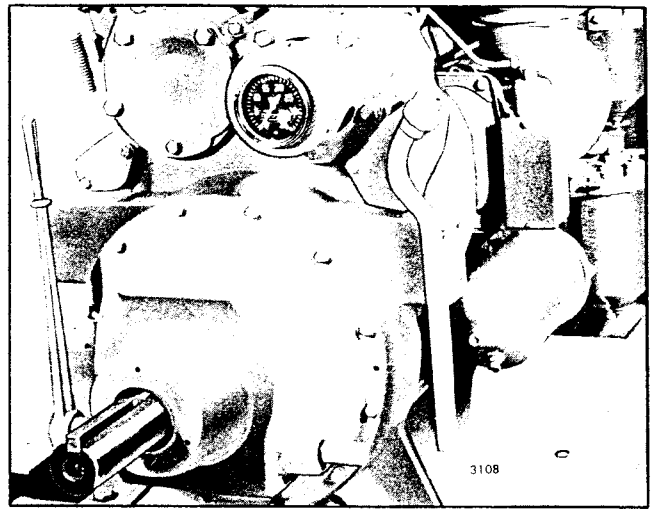


Fig. 5 - Power Take-Off Mounting (Rear)

11. Place the clutch driving ring over the clutch facing, with the teeth in the driving ring in mesh with the teeth of the clutch facings, and locate the driving ring centrally relative to the pressure plates.

> **NOTE:** If the driving ring is not properly located, the clutch cannot be assembled to the flywheel or the clutch drive adaptor because the teeth of the clutch facings will not enter the teeth of the driving ring even though the clutch drive shaft enters the pilot bearing.

12. Engage the clutch with the hand lever and lock the clutch facings between the pressure plates. If the clutch facings are still free to move, disengage the clutch and turn the adjusting ring counterclockwise just enough to lock the clutch facings in place when the clutch is engaged. *Do not disengage the clutch until the power take-off assembly is attached to the engine.*

13. Remove the clutch driving ring from the clutch facing and attach it to the flywheel or the clutch drive adaptor at the front of the engine with bolts and lock washers. Tighten the 3/8"-16 bolts to 30-35 lb-ft torque.

14. Attach the power take-off assembly to the engine as outlined under *Attach Power Take-Off to Engine.*

15. Adjust the power take-off clutch as outlined under *Clutch Adjustment.*

16. Install the inspection hole cover.

Remove Power Take-Off from Engine

If replacement of the clutch facings or reconditioning of the direct drive power take-off assembly becomes

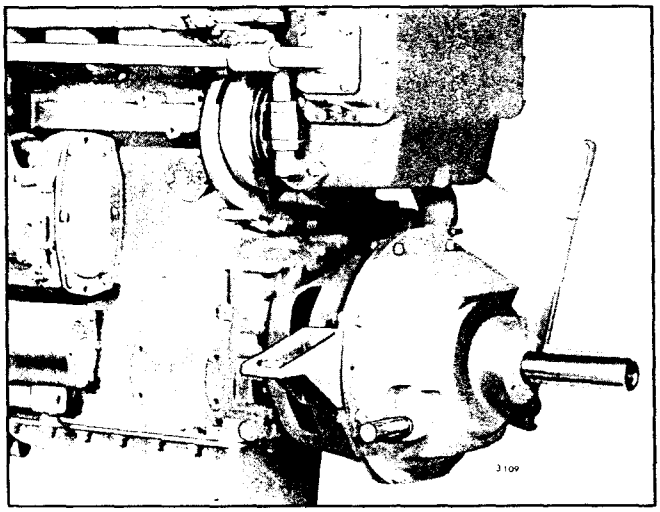


Fig. 6 - Power Take-Off Mounting (Front)

necessary, it must be disconnected and removed from the engine.

With the power take-off disconnected from its driven mechanism, refer to Fig. 5 or 6 and remove the power take-off as follows:

1. Remove the engine accessories, as required, to permit removal of the power take-off.

2. Remove the pulley and key from the drive shaft.

3. Support the weight of the power take-off assembly with a rope sling and chain hoist as shown in Fig. 7. Engage the clutch with the hand lever to hold the clutch facings in place.

4. Refer to Fig. 5 or 6, then remove the bolts and lock washers securing the power take-off assembly to the flywheel housing or bolts, lock washers and nuts to the front end power take-off adaptor.

5. Screw two of the clutch housing attaching bolts into the tapped holes provided in the flange of the clutch housing and push the power take-off assembly away from the flyweel housing or the front end power take-off adaptor. Pull the power take-off assembly straight back away from the engine.

> **NOTE:** Do not permit the outer end of the unit to tip down when being removed from the engine or the clutch pilot bearing may be damaged.

6. If necessary, remove the clutch driving ring from the flywheel on rear mounted or the clutch drive adaptor on front mounted power take-off units.

7. For removal of the front mounted power take-off adaptor, refer to *Remove Power Take-Off Adaptor* in Section 8.1.4.

DISASSEMBLE POWER TAKE-OFF

With the power take-off assembly removed from the engine, it may be disassembled as outlined below:

Remove Clutch Assembly from Clutch Drive Shaft

1. Remove the inspection hole cover and gasket to expose the adjusting ring and linkage.

2. On the 11-1/2" diameter double-plate clutch power take-off unit, hold the outer end of the flexible grease tube from turning (inside the clutch housing) and remove the flexible tube retaining nut. Then pull the outer end of the grease tube inside of the clutch housing and remove the opposite end from the release sleeve collar.

3. Support the power take-off assembly on wood blocks with the clutch drive shaft in a horizontal position. Then bend the edge of the lock washer up off the flat side of the clutch drive shaft nut.

4. Disengage the clutch with the hand lever. On the 10" diameter and the former 8" diameter single and 11-1/2" diameter double-plate clutches equipped with the three-piece clutch facing, the clutch facing will drop out from between the pressure plates.

5. Refer to Fig. 1 or 2 and slide the clutch release

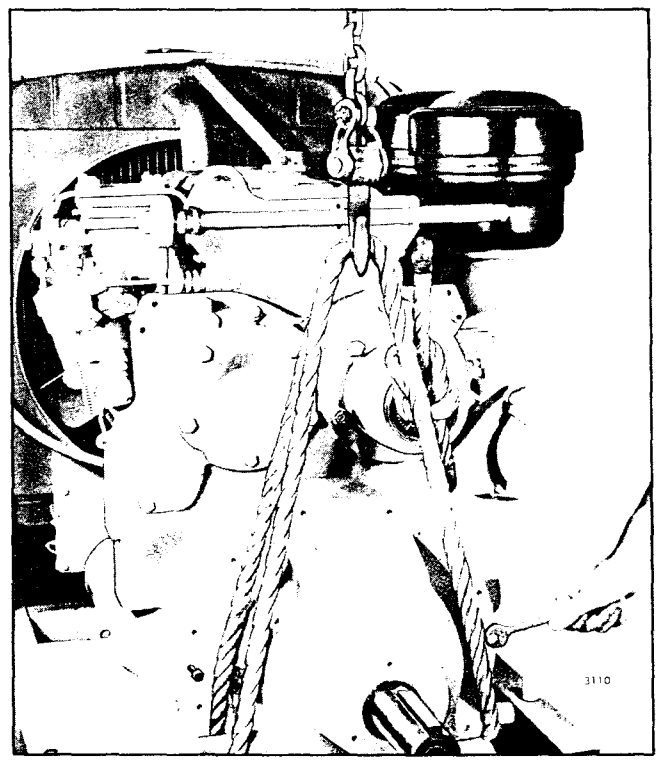


Fig. 7 - Removing Power Take-Off

lever spring (5) off of the clutch release levers and against the release sleeve collar.

6. Refer to Figs. 1, 2 and 12 and remove the retaining rings from the pins (8); then remove the pins from the links.

7. Install the key in the keyway of the clutch drive shaft. Attach a chain wrench to the drive shaft as shown in Fig. 8 to prevent the drive shaft from turning. Then remove the nut and lock washer from the shaft.

CAUTION: Be sure and place the teeth of the chain wrench on top of the key to prevent damage to the drive shaft while holding the drive shaft from turning. If the key or the drive shaft is damaged and cannot be cleaned up, they must be replaced.

8. Place pry bars behind the inner clutch pressure plate as shown in Fig. 9. While exerting pressure on the outer ends of the pry bars, loosen the clutch assembly from the tapered shaft and key with a brass drift and hammer as shown in Fig. 9.

9. Remove the clutch assembly from the clutch drive shaft and place it on a bench with the forward face down.

10. Remove the chain wrench from the clutch drive shaft.

11. Remove the clutch retaining key from the clutch drive shaft.

12. Slide the clutch release sleeve and release sleeve collar assembly off the clutch drive shaft.

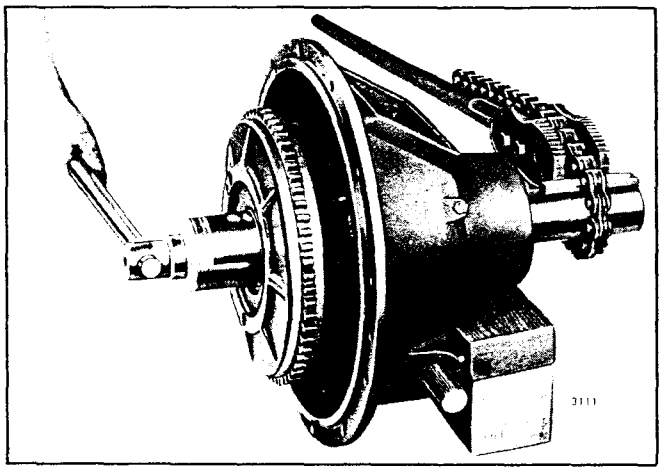


Fig. 8 - Removing Clutch Drive Shaft Nut

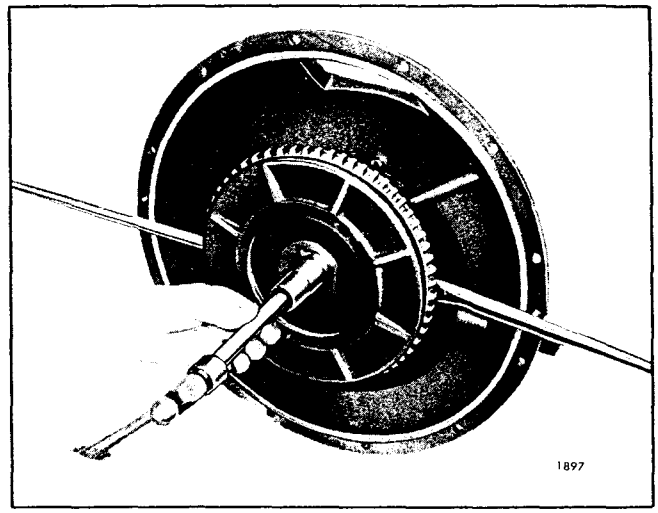


Fig. 9 - Removing Clutch Assembly from Clutch Drive Shaft

Remove Clutch Release Shaft and Yoke from Clutch Housing

1. Loosen the hand lever attaching bolt, then slide the hand lever off of the clutch release shaft.

2. Refer to Fig. 1 or 2 and remove the two clutch release yoke bolts (24) and lock washers from the clutch release yoke (23).

3. Slide the clutch release yoke to the right or left and the clutch release shaft in the opposite direction until the two Woodruff keys are free from the clutch release yoke.

4. Remove the two Woodruff keys from the clutch release shaft; then withdraw the clutch release shaft from the clutch housing and release yoke.

Remove Clutch Drive Shaft from Clutch Housing

With the clutch assembly removed from the clutch drive shaft, refer to Fig. 1 or 2 and remove the clutch drive shaft from the clutch housing as follows:

1. Remove the key from the pulley end of the clutch drive shaft, if not previously removed.

2. Remove the bearing retainer lock plate bolt (15), lock washer and bearing retainer lock plate (14) from the inside of the clutch housing.

3. Remove the bearing retainer (21) from the clutch housing by turning the retainer counterclockwise.

4. Pull the clutch drive shaft and roller bearing cones and one bearing cup from the clutch housing. If the

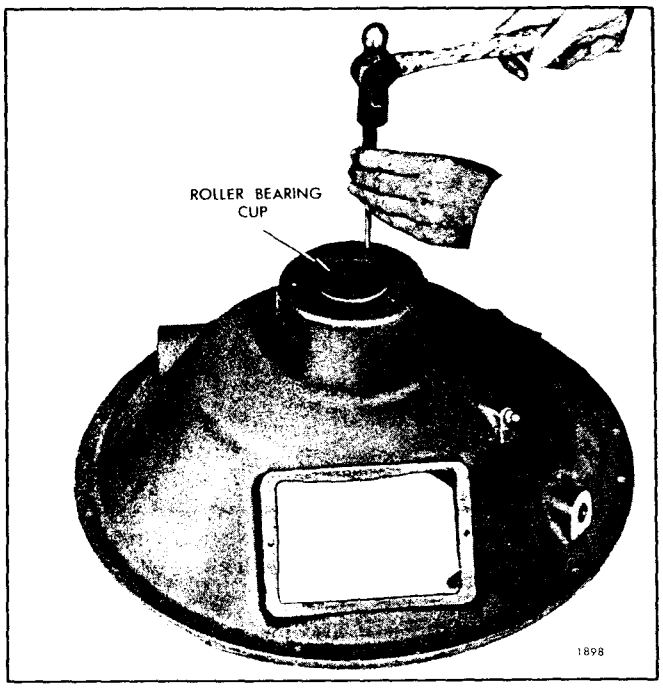


Fig. 10 - Removing Roller Bearing Cup from Housing

bearing cones or cup tend to stick in the clutch housing, tap on the outer end of the clutch drive shaft lightly with a plastic hammer to loosen the bearing cup.

5. The bearing cup of the rear roller bearing cone will remain in the clutch housing when the clutch drive shaft is removed from the clutch housing. It may be removed by inserting a punch in the holes provided at the rear of the clutch housing and tapping the punch alternately at three points as shown in Fig. 10. Do not cock the bearing cup when removing it.

6. If necessary, remove the clutch release sleeve collar grease fitting cover on the side of the clutch housing (8" and 10" diameter clutch power take-offs).

7. Wash the roller bearing cups and cones thoroughly in clean fuel oil, dry them with compressed air and examine them for wear, corrosion or rough spots. If the bearings are unsatisfactory for further use, remove them from the clutch drive shaft.

Remove Roller Bearing Cones from Clutch Drive Shaft

The roller bearing cones may be removed from the clutch drive shaft as follows:

1. Place two split plates (inset in Fig. 11) between the bearing cones; then support the clutch drive shaft and split plates on two steel supports on the bed of the arbor press as shown in Fig. 11.

2. Place wood blocks under the lower end of the clutch drive shaft to prevent the drive shaft from falling and being damaged when it is pressed from the bearing.

3. With the ram of the press resting on the end of the drive shaft, press the shaft out of the roller bearing cone.

4. Reverse the clutch drive shaft on the bed of the press and remove the second bearing cone in the same manner.

Disassemble Clutch

Refer to Figs. 1, 2 and 12 and proceed as follows:

1. Remove the retaining rings (2) from the pins (48) that connect the release levers (4) to the bosses on the outer clutch pressure plate (34). Remove the pins and levers from the outer pressure plate.

2. Remove the clutch adjusting ring spring lock retaining screw (31), lock washer and spring lock (29) from the inner clutch pressure plate (32).

3. On the current 8", 10" and 11-1/2" diameter clutches, remove the clutch adjusting ring wear plate (27) from inside the adjusting ring.

4. Remove the clutch adjusting ring (28) by turning it counterclockwise out of the inner clutch pressure plate.

5. Lift the inner clutch pressure plate straight up off the bosses on the outer clutch pressure plate (34).

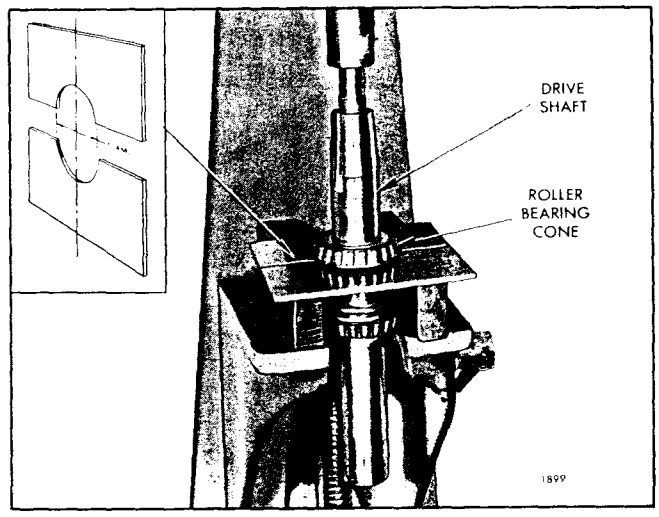


Fig. 11 - Removing Roller Bearing Cone from Clutch Drive Shaft

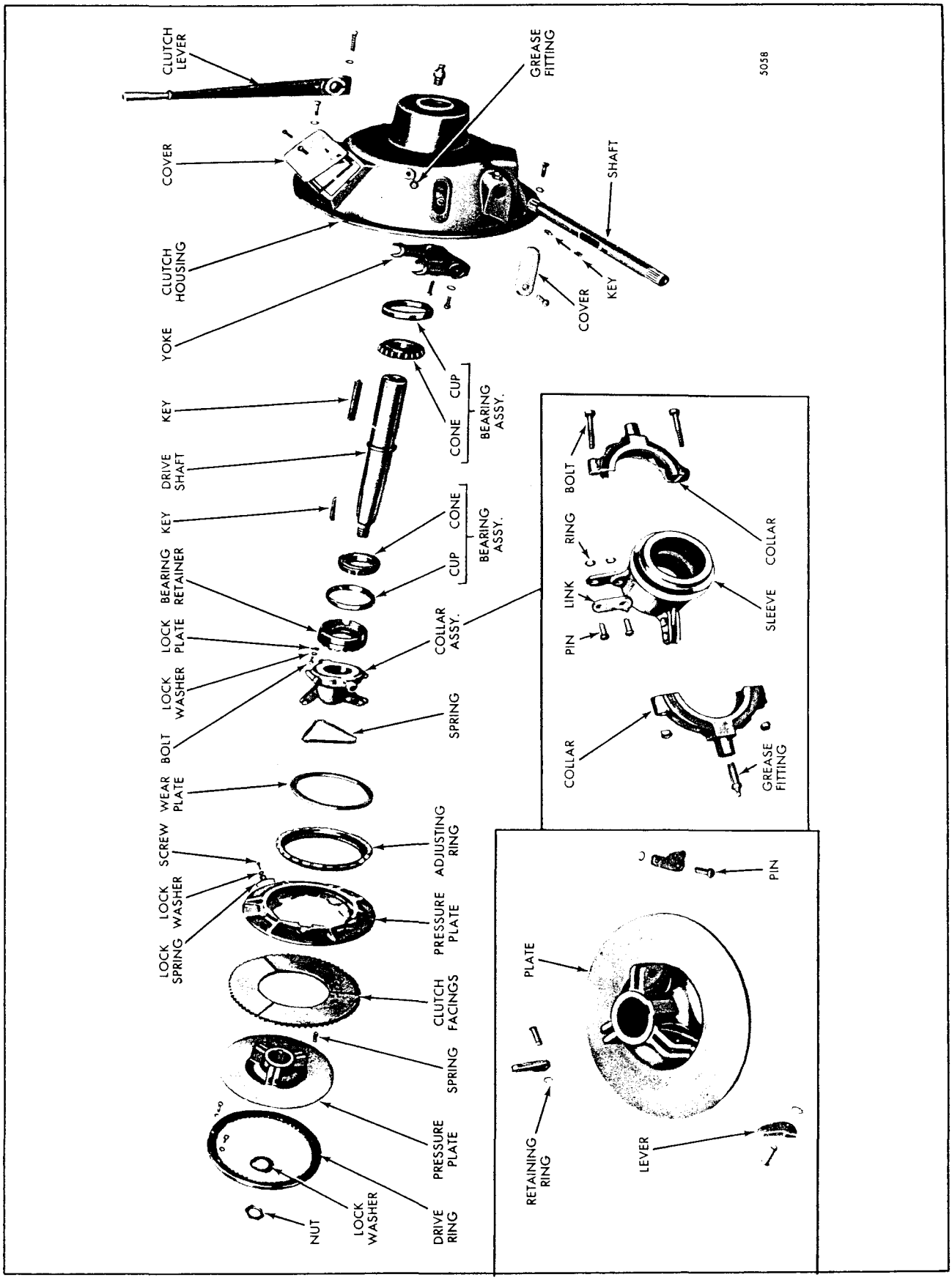


Fig. 12 - Rear Power Take-Off Details and Relative Location of Parts (10 Inch Diameter Clutch Shown)

6. Remove the one-piece clutch facing from the outer clutch pressure plate (8" diameter clutch).

On the 11-1/2" diameter double-plate clutch assembly, remove the one-piece clutch facing from the center pressure plate. Lift the center clutch pressure plate straight off the bosses on the outer pressure plate, then remove the second one-piece clutch facing.

7. Remove the three clutch pressure plate separator springs (47) from the holes (or pins in the 11-1/2" diameter double-plate clutch) in the outer clutch pressure plate.

8. If necessary, on the 11-1/2" diameter double-plate clutch, remove the clutch pressure plate separator spring roll pin (Fig. 2) with a pair of pliers.

9. Remove the clutch release lever spring (5) as an assembly from the clutch release sleeve.

10. Matchmark both halves of the release sleeve collar (13) to assure that they will be assembled in the same position.

11. Remove the two nuts from the bolts (12) securing the two halves of the collar (13) together, then remove the collar from the release sleeve (26).

12. Remove the retaining rings from the pins (8) that connect the links (11) to the release sleeve (26). Remove the pins and links from the release sleeve.

13. If necessary, remove the grease fitting (Fig. 12) from the end of the release sleeve collar trunnion (8" and 10" diameter clutches).

Remove Clutch Drive Shaft Pilot Bearing

If the clutch pilot bearing is worn or damaged, it may be removed as follows:

1. On the front mounted power take-off, remove the pilot bearing from the clutch drive adaptor with slide hammer J 5901-1 and remover adaptor J 5901-2.

2. On the rear mounted power take-offs, remove the pilot bearing from the flywheel as follows:

a. Remove the six flywheel attaching bolts and the bearing retainer or scuff plate, then reinstall one of the attaching bolts to hold the flywheel on the crankshaft.

CAUTION: When removing or installing the flywheel attaching bolts, hold the flywheel firmly against the crankshaft by hand to prevent it from slipping off the end of the crankshaft. The flywheel is NOT doweled to the crankshaft.

b. Remove the pilot bearing from the flywheel with slide hammer J 5901-1 and remover adaptor J 5901-2.

INSPECTION

Wash all of the power take-off parts, except the clutch facings or shielded bearings, in clean fuel oil and dry them with compressed air. *Shielded bearings must not be washed;* dirt may be washed in and the cleaning fluid could not be entirely removed from the bearing.

Examine the ball and roller bearings for corrosion and pitting. Lubricate each bearing with light engine oil; then, while holding the inner race or cone from turning, revolve the outer race or cup slowly by hand and check for rough spots.

Examine the clutch facing for wear, burning or scoring. Also check the teeth for wear or damage and measure the thickness of the facing. Replace the clutch facing if the teeth are worn or damaged, or if the facing is badly burned, scored or worn to the approximate worn thickness shown in the chart under *Replace Clutch Facings.*

Inspect the friction surfaces of the inner, center and outer clutch pressure plates; they should be flat, smooth and free from cracks or heat checks. Also examine the drive bosses, the keyway in the outer pressure plate, the adjusting ring threads and the notches in the inner pressure plate.

Examine all of the release levers, link pins and pin holes in the links, release levers, release sleeve and pressure plate for wear.

On the current clutch adjusting ring, inspect the wear plate and the threads for wear. If the wear plate is worn excessively, reverse the plate. If both sides of the plate are worn excessively, replace it.

NOTE: On the current 8", 10" and 11-1/2" diameter clutches, the wear plate is loose in the adjusting ring.

On the former clutch adjusting ring, inspect the face of the ring where the release levers make contact and the threads for wear. If worn excessively, replace the adjusting ring.

Inspect the fingers of the former adjusting ring lock for wear. If worn excessively or damaged, it must be replaced with the current lock.

Check for weak and broken pressure plate separator springs. Refer to the following table for the spring specifications. Then check the spring load with spring tester J 9666.

PRESSURE PLATE SEPARATOR SPRING CHART

Clutch Size	Approx. Free Length	Approx. O.D.	Force Exerted by Spring*
8"	7/8"	3/8"	12-15 lbs at 5/8" length
10"	1-1/16"	7/16"	15-20 lbs at 13/16" length
11-1/2"	2"	21/64"	15-20 lbs at 1-3/16" length

*Springs should be replaced when force exerted is less than lowest pressure specified at length indicated.

Examine the wear surface of the clutch release sleeve collar and the mating surface on the release sleeve.

Inspect the mating surface of the clutch release yoke fingers and mating trunnions on the release sleeve collar for wear.

Inspect the keyways in the clutch drive shaft. If the shaft is excessively peened or damaged so that the keys have a tendency to "roll", the drive shaft must be replaced.

Replace all of the power take-off parts that are excessively worn or damaged.

ASSEMBLE POWER TAKE-OFF

With all of the power take-off parts cleaned and inspected and necessary parts on hand, the power take-off may be reassembled,as outlined below.

Assemble Clutches

Refer to Figs. 1, 2 and 12 and proceed as follows:

1. Place the outer pressure plate (Fig. 13) on a bench with the hub end of the pressure plate up.

2. If removed (on the 11-1/2" diameter double-plate clutch), install the pressure plate separator spring roll pins in the holes in the outer pressure plate by driving them straight into the plate until they bottom.

3. Place the pressure plate separator springs in the holes (or on the pins in the 11-1/2" diameter double-plate clutch) in the outer pressure plate.

4. On the 8" diameter clutch, place the one-piece clutch facing on top of the pressure plate.

5. If a one-piece clutch facing is used on the 11-1/2" diameter clutch, place the clutch facing on top of the pressure plate, followed by the center pressure plate and the second one-piece clutch facing.

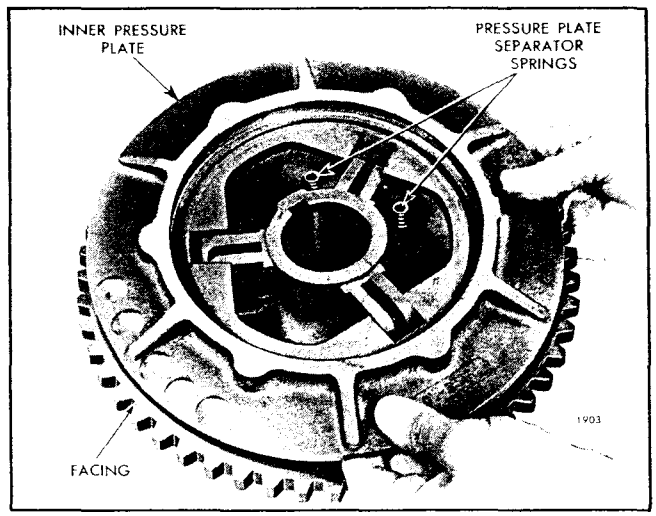


Fig. 13 - Installing Inner Pressure Plate With Springs and Clutch Facing in Plate

NOTE: On the 10" diameter clutch and the former 11-1/2" diameter clutch using a three-piece clutch facing, install the clutch facings after the clutch has been assembled.

6. With the notches in the inner pressure plate aligned with the bosses on the outer pressure plate, place the inner pressure plate over the bosses and rest it on the three pressure plate separator springs.

7. Lubricate the threads of the clutch adjusting ring (28) lightly with engine oil, then thread the adjusting ring into the inner pressure plate until it bottoms.

8. On the current 8", 10" and 11-1/2" diameter clutches, place the clutch adjusting ring wear plate in the cavity in the adjusting ring (Fig. 1 or 2).

The clutch adjusting ring wear plate was not used on the former 8", 10" and 11-1/2" diameter clutches.

9. Install the clutch release levers as shown in Fig. 14.

10. Align the holes in the clutch release levers and the pressure plate; insert the clutch release lever pins through the holes and secure them in place with the retaining rings.

NOTE: Be sure the retaining rings are securely locked in the groove in the release lever pins.

11. Lubricate the inside diameter of the clutch release sleeve collar sparingly with an all purpose grease such as Shell Alvania No. 2, or equivalent. Note the matchmarks previously placed on the collar, then place

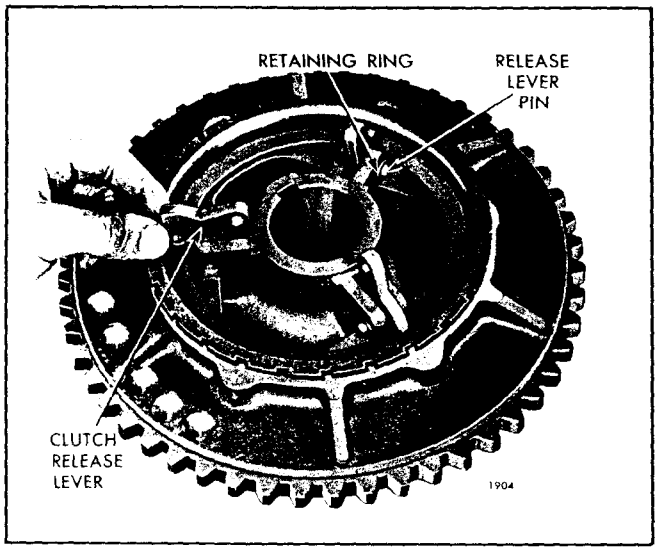


Fig. 14 - Installing Clutch Release Lever

the two halves of the collar over the shoulder on the clutch release sleeve and secure it in place with two bolts and nuts. Rotate the collar on the sleeve to be sure it rotates freely. If necessary, loosen the nuts and tap the edge of the collar lightly with a plastic hammer to free it up, then retighten the nuts.

12. If removed, install the grease fitting (Fig. 12) in the end of clutch release sleeve collar trunnion (8" and 10" diameter clutches).

13. Place the clutch release lever spring (5) over the end of the clutch release sleeve and against the clutch release sleeve collar.

14. Note the position of the stop on the clutch release lever links (11), Fig. 1 or 2. Then attach a pair of release lever links to each ear on the clutch release sleeve with link pins (8) and retaining rings.

NOTE: Be sure the retaining rings are securely locked in the groove in the link pins (8).

15. Place the clutch release sleeve on top of the clutch pressure plates with each pair of release lever links (11) astride the release levers (4). Then connect the release lever links to the release levers with the pins (8) and the retaining rings.

NOTE: Be sure the retaining rings are securely locked in the groove in the link pins.

16. Slide the clutch release lever spring (5) over the end of the release lever links and into place on the clutch release levers (4) as shown in Fig. 1 or 2.

17. On the 10" diameter single-plate clutch, insert the three-piece clutch facing in between the inner and outer clutch pressure plates and center them.

If a three-piece clutch facing is being used on the 11-1/2" diameter double-plate clutch, insert the center two sets of clutch facings in between the pressure plates, with the teeth of both sets of clutch facings in alignment.

18. Lock the clutch facing between the inner and outer pressure plates as follows:

a. With the clutch assembly resting on a bench, forward face down, turn the clutch adjusting ring counterclockwise until the inner pressure plate almost contacts the clutch facing.

b. Place the clutch driving ring over the clutch facing with the teeth in the driving ring in mesh with the teeth on the clutch facing. Then position the driving ring centrally relative to the pressure plates.

NOTE: If the driving ring is not properly located, the clutch cannot be assembled to the flywheel or the clutch drive adaptor because the teeth of the clutch facing will not enter the teeth of the driving ring even though the clutch drive shaft enters the pilot bearing.

c. Lock the clutch facing between the pressure plates by applying pressure on the outer end of the clutch release sleeve and collar assembly. If the clutch facing is still free to move, disengage the clutch and turn the adjusting ring counterclockwise just enough to lock the clutch facing in place when the clutch is engaged. *The clutch must now be kept engaged until the power take-off is assembled and attached to the engine.*

19. Remove the clutch driving ring from the clutch facing and attach it to the flywheel, or the clutch drive adaptor at the front end of the engine, with bolts and lock washers. Tighten the 3/8" -16 bolts to 30-35 lb-ft torque.

20. Attach the adjusting ring spring lock (29) to the inner pressure plate with a bolt (31) and lock washer. Be sure the ends of the spring lock are in the notches in the adjusting ring.

Install Roller Bearing Cones on Clutch Drive Shaft

If the roller bearing cones (Fig. 12) were removed from the clutch drive shaft (16), install them as follows:

1. Lubricate the inside diameter of the roller bearing cone with engine oil; then start the bearing cone straight on the drive shaft with the wide face of the race facing the shoulder on the drive shaft (Fig. 15).

2. Place a steel ring approximately 1/4" thick over the end of the shaft and rest it on the inner race of the bearing cone.

CAUTION: The steel ring must bear against the inner race of the bearing cone. Do not allow any pressure to be applied against the roller bearing cage or the bearing cone will be damaged.

3. Support the clutch drive shaft, bearing cone and steel ring on the bed of an arbor press with split plates under the steel ring as shown in Fig. 15. Then press the drive shaft straight into the bearing cone until the inner race is tight against the shoulder on the shaft.

4. Install the second roller bearing cone on the clutch drive shaft in the same manner.

Install Clutch Drive Shaft in Clutch Housing

With the roller bearing cones installed on the clutch drive shaft, install the shaft as follows:

1. Support the clutch housing on a wood block with the forward (bell) side of the housing up.

2. If removed, lubricate the outside diameter of the rear roller bearing cup with engine oil; then start it straight into the bearing bore in the clutch housing with the tapered inner diameter of the cup facing up.

3. Place a hard wood block (1" O.D. x 15" long) on the top edge of the bearing cup, then use a hammer to tap the bearing cup down in the clutch housing by tapping it alternately at several places.

CAUTION: Do not allow any wood chips off of the wood block to get under the bearing cup.

4. Support the clutch housing on wood blocks in a horizontal position.

5. Lubricate the roller bearing cones with light engine oil; then insert the outer end of the clutch drive shaft through the bearing bore from the forward side of the clutch housing until the bearing cone contacts the bearing cup.

6. Lubricate the outside diameter of the front roller bearing cup with engine oil. Place the cup over the forward end of the clutch drive shaft with the tapered inner diameter of the cup facing the bearing cone.

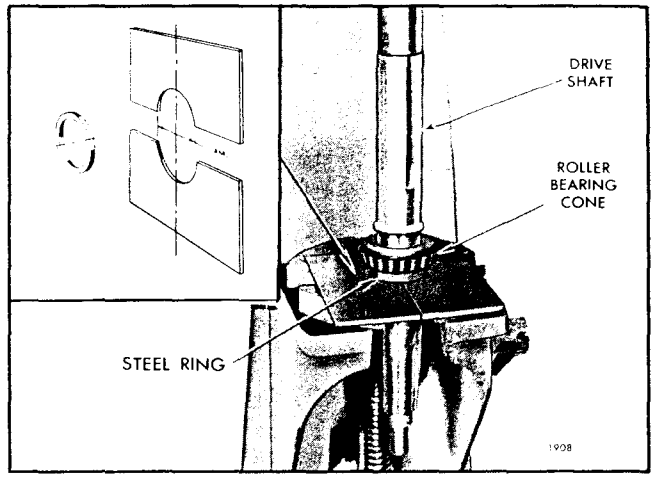


Fig. 15 - Installing Roller Bearing Cones On Clutch Drive Shaft

7. Start the roller bearing cup straight in the bearing bore of the clutch housing. Then tap the cup in against the rollers of the bearing cone by tapping alternately around the cup with a hard wood block and hammer.

8. Lubricate the threads of the roller bearing retainer (21) with engine oil. Place the retainer over the forward end of the drive shaft with the notches in the end of the retainer facing the forward end of the shaft.

9. Thread the bearing retainer into the bearing bore until it is against the bearing cup. Tighten the bearing retainer while rotating the drive shaft until the bearing retainer is tight and the bearing cups are seated. When the bearing cups are seated, it will be noted by the increased effort required to rotate the drive shaft.

10. Back the bearing retainer out 2 or 3 notches.

11. Support the clutch housing and shaft assembly on wood blocks with the outer end of the clutch drive shaft up. Then tap on the outer end of the drive shaft with a plastic hammer to force the roller bearing cup down until the bearing cup seats on the bearing retainer.

Clutch Drive Shaft End Play Adjustment

To check the end play in the clutch drive shaft bearing, the power take-off must be removed from the engine and the clutch assembly removed from the drive shaft to be checked correctly. If the clutch drive shaft and bearing assembly has just been installed in the clutch housing, the end play in the drive shaft

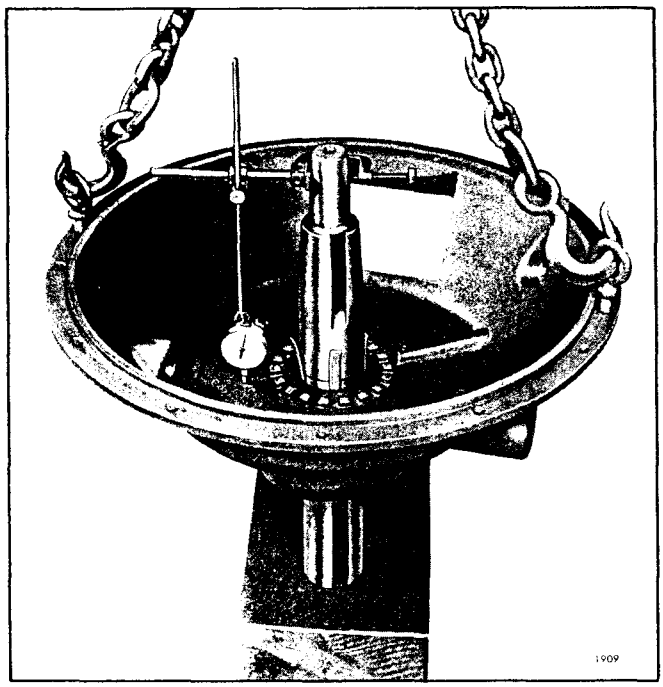


Fig. 16 - Checking Clutch Drive Shaft End Play

bearing must be checked before the clutch is attached to the drive shaft.

Servicing personnel should read the instructions on the clutch housing name plate. Instructions on the name plates are correct for the particular power take-off to which they are attached. If an occasion occurs that a unit does not have the clutch drive shaft end play listed on the clutch housing name plate, the bearing should be adjusted in accordance with the recommendations listed in the following table.

Clutch Sizes	End Play
8", 10" and 11-1/2"	.004" to .006"

With the clutch drive shaft and bearing assembly installed in the clutch housing, the clutch drive shaft bearing end play may be checked as follows:

1. Support the clutch housing with a sling and chain hoist with the drive (pulley) end of the shaft down as shown in Fig. 16.

2. Lower the clutch housing until the end of the drive shaft rests on the wood block.

3. Insert four pieces of shim stock, which are the same thickness, between the bearing retainer and the drive shaft as shown in Fig. 16.

4. Attach a dial indicator to the pilot bearing end of the drive shaft, then position the indicator as shown in Fig. 16. Set the dial indicator at zero.

5. Lift the clutch housing and drive shaft assembly from the wood block.

6. Tap lightly on the pilot bearing end of the drive shaft to move the drive shaft and bearing outer cone assembly against the outer roller bearing cup.

7. Note the reading on the dial indicator. The dial indicator will show the amount of end play in the clutch drive shaft bearing.

8. Lower the clutch housing until the end of the drive shaft rests on the wood block and the weight of the housing is off of the chain hoist.

9. Tap lightly on the inner side of the clutch housing alternately around the bearing retainer to be sure the inner roller bearing cone rests against the bearing cup. The dial indicator should read zero.

10. If necessary, turn the bearing retainer clockwise to decrease or counterclockwise to increase the drive shaft bearing end play.

11. Repeat the above steps to make sure the readings are correct, then install the bearing retainer lock plate, lock washer and bolt.

12. Remove the shim stock and the dial indicator.

13. Support the clutch housing and drive shaft assembly on wood blocks in a horizontal position.

14. Refer to *Lubrication* and fill the roller bearing cavity through the grease fitting, above the bearing, with a grease gun until the grease just starts to seep out around the clutch drive shaft at the bearing retainer or at the rear of the clutch housing.

> **NOTE:** Rotate the clutch drive shaft when filling the bearing cavity to be sure the bearing cavity is full of grease.

Install Clutch Release Shaft and Yoke in Clutch Housing

With the clutch drive shaft and bearings installed in the clutch housing, install the clutch release shaft and yoke in the clutch housing as follows:

1. Squirt engine oil in the clutch release shaft holes in the clutch housing.

2. Slide the clutch release shaft (22) through one of the holes in the side of the clutch housing. Position the clutch release yoke (23) in front of the release shaft inside of the clutch housing so that the heads of the

clamping bolts (24) will face the forward end of the clutch housing (Fig. 1 or 2). Slide the release shaft through the release yoke and through the hole in the opposite side of the clutch housing.

3. Move the release yoke to one side of the clutch housing to expose the two keyways in the shaft. Then install the two Woodruff keys in the release shaft.

4. Align the keyways in the release yoke with the Woodruff keys in the release shaft; then move the release yoke over the keys until it is centrally located in the clutch housing and each end of the release shaft extends an equal distance outside of the clutch housing.

5. Install the two clamp bolts (24) and lock washers and tighten the bolts to 30-35 lb-ft torque.

Install Clutch Assembly on Clutch Drive Shaft

1. Support the clutch housing and drive shaft assembly on wood blocks with the clutch drive shaft in a horizontal position and the inspection hole in the clutch housing facing up.

2. Lubricate the inside diameter of the clutch release sleeve with engine oil. Then start the clutch assembly over the tapered end of the clutch drive shaft with the keyway in the hub of the outer pressure plate in line with the keyway in the clutch drive shaft. Position the clutch release sleeve collar so that the grease fitting in the end of the release sleeve collar trunnion faces the opening in the side of the clutch housing; then guide the fingers of the release yoke over the trunnions on the release sleeve collar as shown in Fig. 17.

On the 11-1/2" diameter clutch, position the clutch release sleeve collar so the tapped hole in the collar faces the flexible grease tube hole in the side of the clutch housing.

CAUTION: The clutch release sleeve is a close fit on the drive shaft and must be started straight over the clutch drive shaft to prevent any bind between the release sleeve and the drive shaft.

3. Slide the clutch assembly back on the clutch drive shaft until it is tight against the taper on the drive shaft, then insert the key (35) in the keyway and tap it into place with a punch and a hammer.

4. Place the lock washer (38) on the drive shaft and against the outer pressure plate with the tang on the inner diameter of the lock washer in the keyway in the pressure plate.

5. Install the clutch drive shaft nut (39).

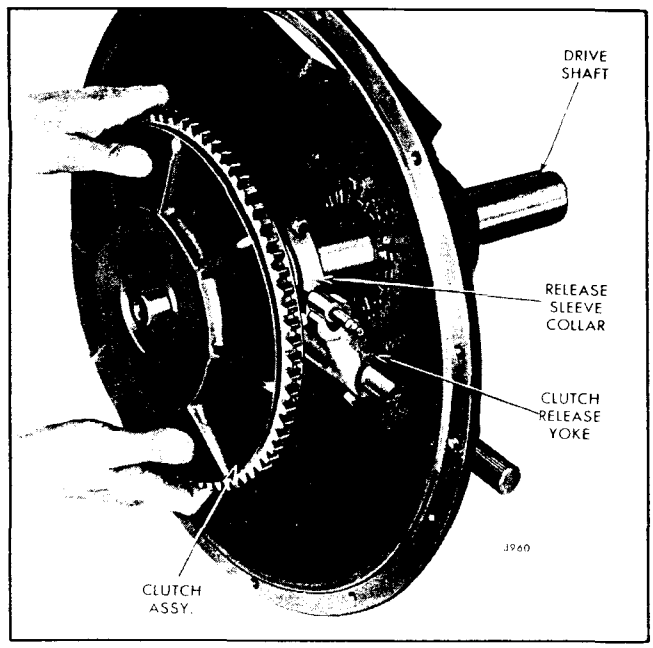


Fig. 17 - Installing Clutch Assembly

6. Install the key in the keyway of the clutch drive shaft. Attach a chain wrench to the drive shaft as shown in Fig. 8 to prevent the drive shaft from turning.

CAUTION: Be sure and place the teeth of the chain wrench on top of the key to prevent damage to the drive shaft while holding the drive shaft from turning. If the key or the shaft is damaged and cannot be cleaned up, they must be replaced.

7. Tighten the clutch drive shaft nut to the torque specified in the following table. Then bend the edge of the lock washer over against the flat side of the nut.

Clutch Size	Nut Size	Lb-Ft Torque
8"	1-1/8"-12	165-170
10"	1-5/16"-12	175-180
11-1/2"	1-3/4"-10	225-230

8. On the 11-1/2" diameter double-plate clutch power take-off unit thread the small end of the flexible grease tube in the hole in the side of the clutch release sleeve collar. Then insert the opposite end of the tube through the hole in the side of the clutch housing and install the tube retaining nut. Tighten the retaining nut while holding the tube nut inside the clutch housing from turning. Install the grease fitting in the tube, if it was removed.

9. Attach the inspection hole cover and gasket to the clutch housing.

10. If removed, install the clutch release sleeve collar grease fitting cover on the side of the clutch housing (8" and 10" diameter clutch power take-offs).

11. For installation of the front mounted power take-off adaptor (1), refer to *Install Power Take-Off Adaptor* in Section 8.1.4.

Install Clutch Drive Shaft Pilot Bearing

If removed, install the clutch pilot bearing (45) in the clutch drive adaptor (46) or the flywheel (Fig. 1 or 2) as follows:

1. On the front mounted power take-off, lubricate the outside diameter of the pilot bearing with engine oil. Start the bearing, shielded side of bearing facing out, straight into the clutch drive adaptor, then drive the bearing into and against the shoulder in the adaptor with a bearing driver.

2. On the rear mounted power take-offs, with the flywheel attached to crankshaft with one bolt, install the pilot bearing as follows:

a. Lubricate the outside diameter of the pilot bearing with engine oil. Start the bearing, shielded side of bearing facing out, straight into the flywheel, then drive the bearing into and flush with the rear face of the flywheel with a bearing driver or tool J 3154-04 with suitable plates.

NOTE: The clutch drive shaft pilot bearing used on the 11-1/2" diameter clutch power take-off is a prelubricated bearing and is shielded on both sides. When installing this bearing, the numbered side of the bearing should face the rear (finished) face of the flywheel.

b. While holding the flywheel in place on the crankshaft by hand, remove the one flywheel attaching bolt. Then place the bearing retainer (scuff plate) against the flywheel and align the bolts holes in the retainer with the holes in the flywheel. Install the six flywheel attaching bolts and tighten them to the specified torque.

CAUTION: When removing or installing the flywheel attaching bolts, the flywheel must be held firmly against the crankshaft to prevent it from slipping off the end of the crankshaft. The flywheel is NOT doweled to the crankshaft.

ATTACH POWER TAKE-OFF TO ENGINE

With the power take-off assembled, attach it to the engine as follows:

1. If not previously installed, attach the clutch driving ring to the flywheel or the clutch drive adaptor with bolts and lock washers. Tighten the bolts to 30-35 lb-ft torque.

2. Support the power take-off assembly with a rope sling and chain hoist as shown in Fig. 7, then position the power take-off assembly at the rear of the flywheel housing, or the adaptor at the front end of the engine, with the clutch drive shaft in line with the pilot bearing in the flywheel or the clutch drive adaptor.

3. Push the power take-off forward and guide the forward end of the drive shaft straight into the clutch pilot bearing (45), Fig. 1 or 2, and engage the teeth on the outer diameter of the clutch facings (26) with the teeth in the inner diameter of the driving ring (3).

4. Guide the pilot on the clutch housing straight into the flywheel housing or the front end adaptor opening, then install the clutch housing to the flywheel housing with bolts and lock washers, or to the adaptor with bolts, lock washers and nuts. Tighten the bolts and nuts to 30-35 lb-ft torque.

5. Remove the chain hoist and the rope sling.

6. Install the clutch control hand lever (7) on the clutch release shaft (22) and secure it in place with a bolt and lock washer.

CAUTION: The thrust load on the clutch release sleeve collar should be kept at an absolute minimum. Therefore, the hand lever should be positioned on the shaft as near the 12 o'clock or 6 o'clock position as possible. The 9 and 3 o'clock positions are to be avoided.

7. Install all of the accessories on the engine that were removed.

8. Install the key and pulley on the clutch drive shaft.

9. Refer to *Lubrication* and lubricate the clutch release sleeve collar, clutch levers and linkage.

10. Before applying the load and with the clutch released, rotate the drive shaft by hand to be sure it rotates freely.

11. Refer to *Clutch Adjustment* and adjust the power take-off clutch as described for the clutch size being used.

FRONT POWER TAKE-OFF ADAPTOR AND DRIVE MECHANISM

The front power take-off adaptor and drive mechanism (Fig. 1) consists of an adaptor which is bolted to the lower engine front cover, a clutch drive adaptor mounted on the front end of the crankshaft and a clutch driving ring.

The clutch drive adaptor is secured to the crankshaft with two cones, a washer and bolt. The clutch drive ring is bolted to the clutch drive adaptor. The forward end of the clutch drive shaft is supported by a pilot ball bearing in the clutch drive adaptor assembly.

Remove Power Take-Off Adaptor and Drive Mechanism

When removal of the front end power take-off adaptor or drive mechanism becomes necessary, they may be removed as follows:

1. Refer to *Remove Power Take-Off From Engine* in Section 8.1 for removal of the power take-off assembly.

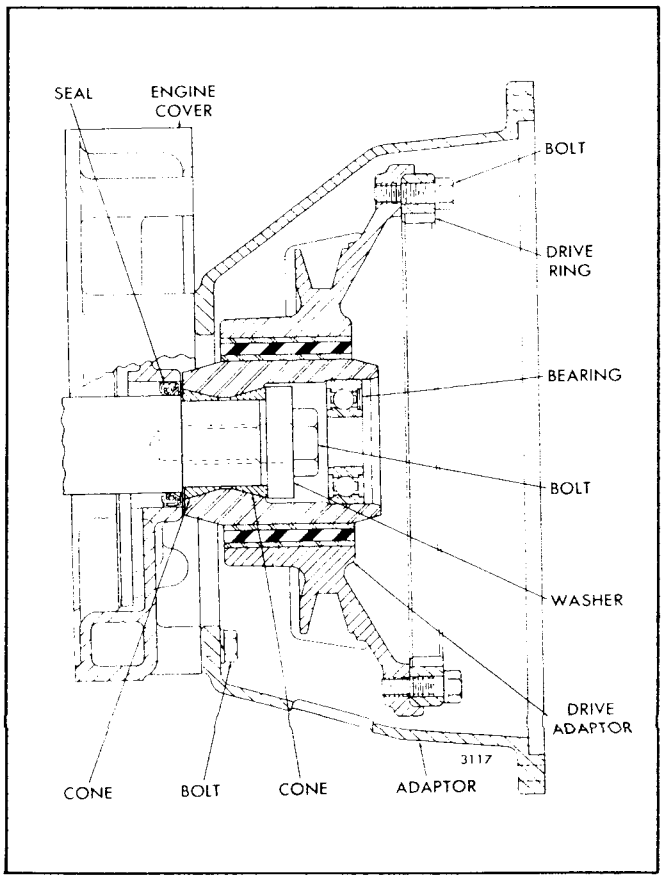


Fig. 1 - Front Power Take-Off Adaptor and Drive Mechanism

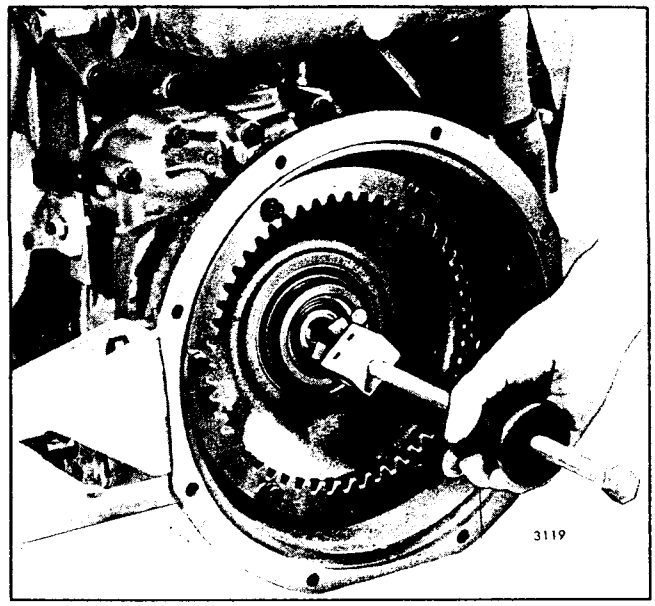


Fig. 2 - Removing Clutch Drive Shaft Pilot Bearing From Clutch Drive Adaptor

2. If used, loosen the bilge pump or the generator drive belt, then disconnect the belt by removing the connecting pins and remove the belt from the accessory drive pulley and bilge pump or generator pulley.

CAUTION: Use care not to lose the two-piece connecting pin after it has been removed.

3. Remove the clutch drive shaft pilot bearing from the clutch drive adaptor with slide hammer J 5901-1 and remover adaptor J 5901-2 as shown in Fig. 2.

4. Remove the clutch drive adaptor to crankshaft bolt and washer securing the drive adaptor to the crankshaft.

5. Use a wood block and hammer as shown in Fig. 3 to loosen the clutch drive adaptor from the crankshaft.

6. Insert the blade of a screw driver in the slot in the front cone to expand it, then withdraw it from the crankshaft.

7. Slide the clutch drive adaptor assembly from the crankshaft.

8. If necessary, slide the inner cone off the end of the crankshaft.

9. Remove the bolts and lock washers securing the front engine supports to the engine base.

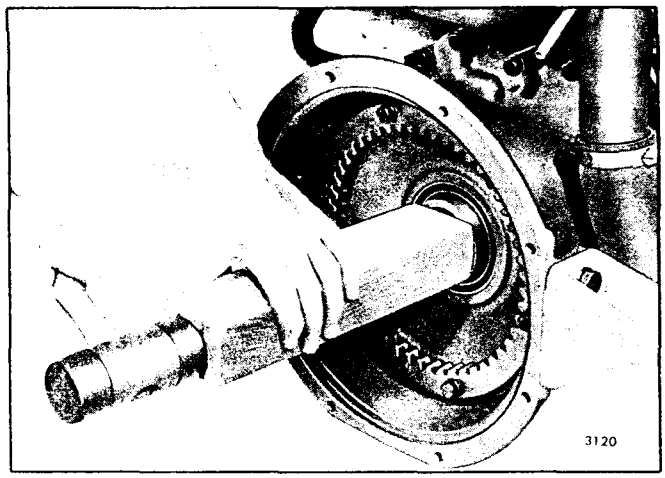


Fig. 3 - Loosening Clutch Drive Adaptor

10. Attach a suitable lifting sling and chain hoist to the front engine lifter bracket. Then lift the front end of the engine just enough to free the supports from the base.

11. Remove the six bolts and lock washers securing the power take-off adaptor to the engine front cover (Fig. 5).

12. Install a 3/8" -16 x 6" pilot stud in two of the attaching bolt holes, diametrically opposite each other to support the adaptor.

13. While supporting the front end of the power take-off adaptor, tap alternately against the back side of the engine supports with a plastic hammer to free the adaptor from the end plate and dowel pins in the engine front cover. Then slide the adaptor off of the pilot studs and crankshaft, being careful not to damage the oil seal.

Inspection

Wash all of the parts, except the shielded bearing, in clean fuel oil and dry them with compressed air. *Shielded bearings must not be washed*; dirt may be washed in and the cleaning fluid could not be entirely removed from the bearing.

Examine the clutch pilot ball bearing for corrosion or pitting. Lubricate the bearing with light engine oil; then, while holding the bearing inner race from turning, revolve the outer race slowly by hand. Replace the bearing if it is defective.

Inspect the clutch drive adaptor to make sure the rubber is firmly bonded to the metal at each end of the drive adaptor assembly. If the clutch drive adaptor has been exposed to fuel oil, lubricating oil or excessive heat, the rubber may have become loosened. In this event, the clutch drive adaptor assembly must be replaced.

Install Power Take-Off Adaptor and Drive Mechanism

Refer to Figs. 1 and 4 and proceed as follows:

1. Install a 3/8" -16 x 6" pilot stud in two of the attaching bolt holes, diametrically opposite each other, to support the adaptor.

2. Place the power take-off adaptor over the crankshaft and guide the pilot studs into the bolt holes of the adaptor. Then slide the adaptor back over the pilot studs and dowel pins and against the engine front cover.

3. Refer to Fig. 5 and install the six bolts and lock washers. Tighten the 3/8" -16 bolts to 30-35 lb-ft torque and the 7/16" -14 bolts to 46-50 lb-ft torque.

4. If removed, place the clutch drive adaptor hub rear cone over the end of the crankshaft with the tapered end of the cone facing the front end of the crankshaft, then slide the cone back against the shoulder on the crankshaft.

5. Place the clutch drive adaptor assembly over the end of the crankshaft and against the taper on the rear cone.

6. Place the front cone over the end of the crankshaft with the tapered end of the cone facing the adaptor hub. Insert the blade of a screw driver in the slot in the cone to expand it, then slide the cone straight forward until the taper on the cone contacts the taper on the adaptor hub. Remove the screw driver.

7. Place the washer on the clutch drive adaptor to crankshaft bolt and thread the bolt in the crankshaft. Tighten the 3/4" -16 bolt (In-Line and 6V engines) to 200-220 lb-ft torque; tighten the 1" -14 bolt (8V and 12V engines) to 290-310 lb-ft torque.

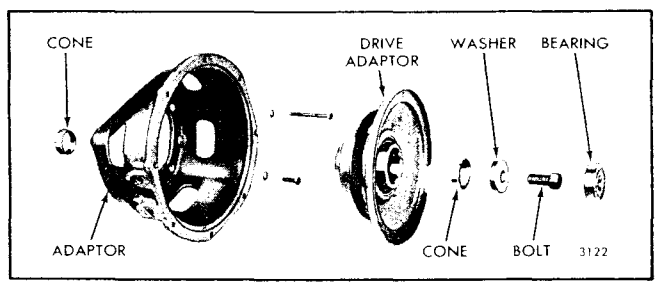


Fig. 4 - Front Power Take-Off Adaptor and Drive Details and Relative Location of Parts

8. If removed, attach the clutch driving ring to the clutch drive adaptor with bolts and lock washers. Tighten the bolts to 30-35 lb-ft torque.

9. Install the clutch drive shaft pilot bearing in the clutch drive adaptor as follows:

a. Lubricate the outside diameter of the pilot bearing with engine oil.

b. Start the bearing, shielded side facing out, straight into the clutch drive adaptor, then drive the bearing straight into and against the shoulder in the adaptor with a bearing driver, or use a round bar as shown in Fig. 6.

NOTE: The round bar used to drive the bearing in should be slightly smaller than the outside diameter of the bearing and flat on the end.

10. Lower the front end of the engine so the front engine supports rest on the engine base, then install

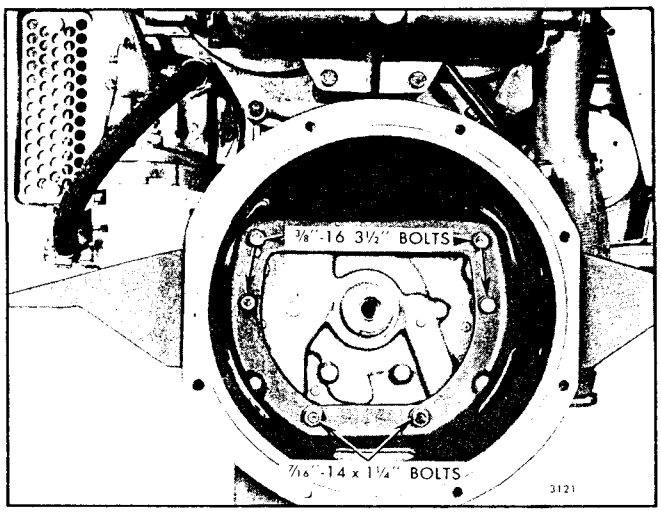


Fig. 5 - Location of Power Take-Off Adaptor to Engine Bolts

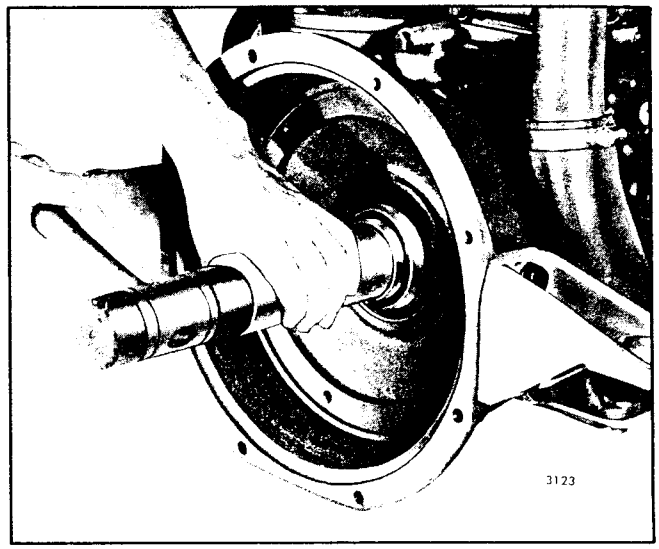


Fig. 6 - Installing Clutch Drive Shaft Pilot Bearing in Clutch Drive Adaptor

the bolts and lock washers securing the front engine supports to the engine base. Tighten the bolts securely.

11. Remove the chain hoist and sling from the engine.

12. If used, insert one end of the drive belt through the opening in the side of the adaptor, over the accessory drive pulley, back out the adjacent hole in the side of the adaptor, over the bilge pump or generator pulley and connect the ends of the belt with the connecting pin. Then adjust the belt tension.

CAUTION: Use care not to lose the two piece connecting pin; also, be sure the pin is rotated to its locked position.

13. Refer to *Attach Power Take-Off To Engine* in Section 8.1 for the installation of the power take-off assembly.

SHOP NOTES - TROUBLE SHOOTING - SPECIFICATIONS - SERVICE TOOLS

SHOP NOTES

CONNECTING A REMOTE MOUNTED TRANSMISSION TO A 4 or 6V-53 ENGINE

When connecting a remote mounted transmission to an engine equipped with a rear power take-off adaptor housing assembly (support bearing), Fig. 1, the inner oil seal in the power take-off housing must be in contact with the straight portion of the adaptor shaft.

Also the distance between the rear face of the power take-off housing and the rear face of the adaptor shaft must not exceed the following:

Engine	Dimension A
4-53	1.54" Min. - 1.80" Max.
6V-53	2.14" Min. - 2.40" Max.

NOTE: The above dimensions not to be used with drive shafts having a slip joint.

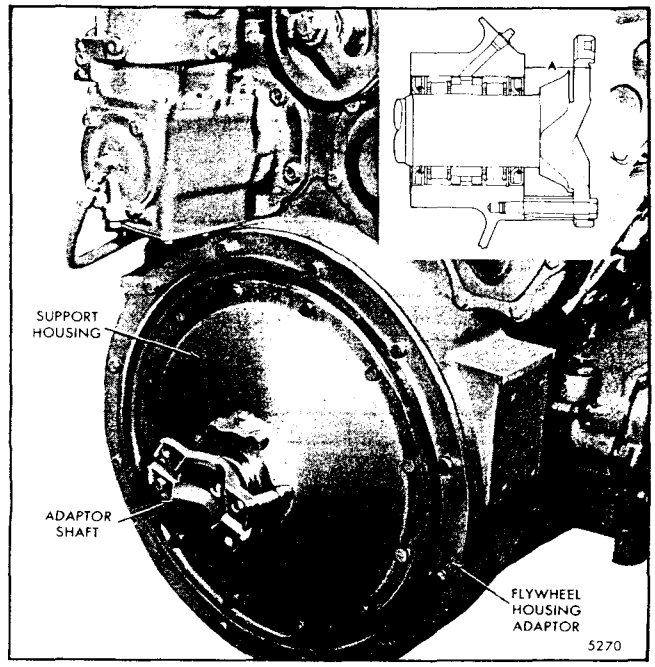
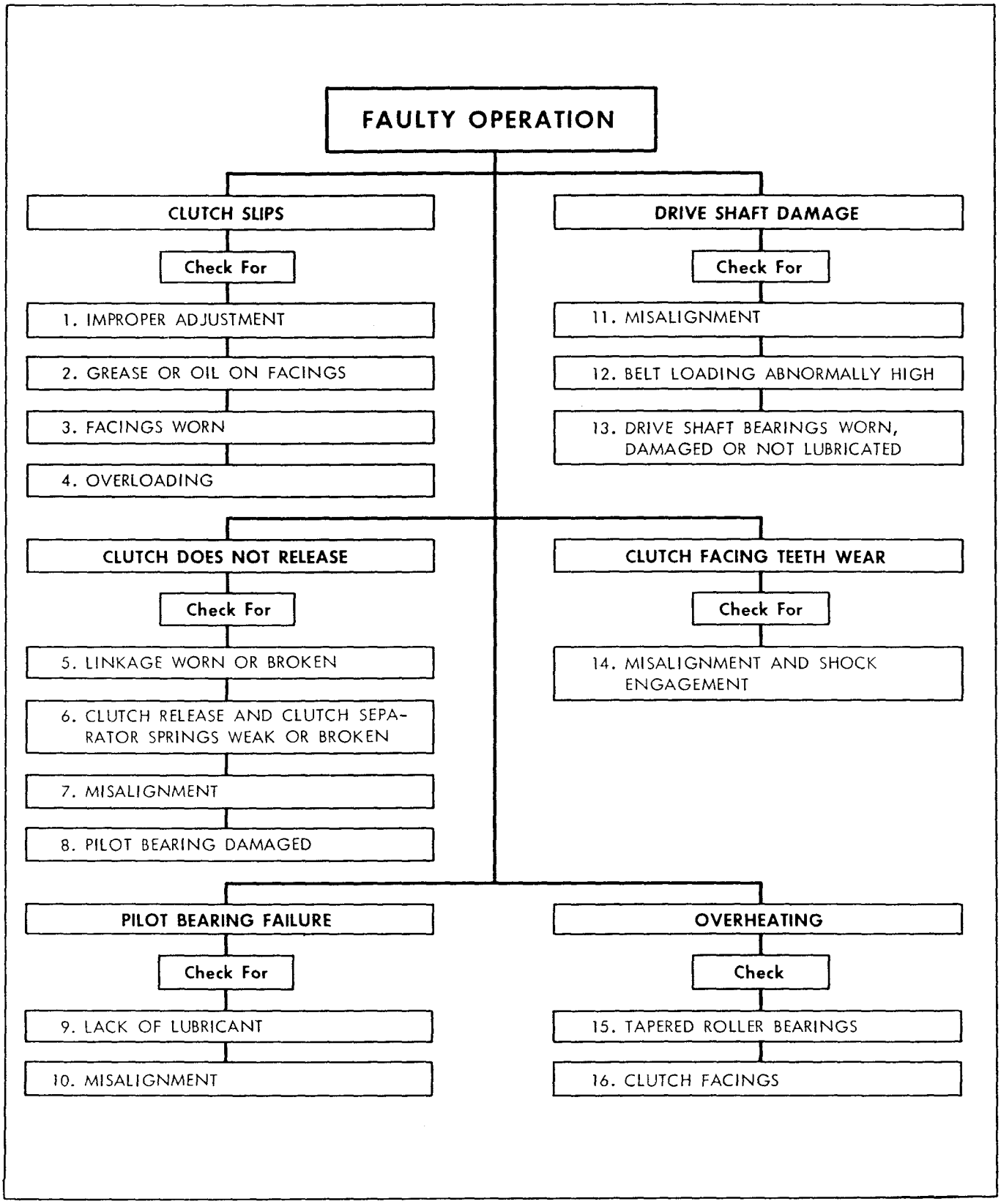


Fig. 1 - Typical Engine with Power Take-Off Adaptor Housing

TROUBLE SHOOTING

POWER TAKE-OFF



FAULTY OPERATION (Cont'd).

SUGGESTED REMEDY

1. Adjust the clutch as outlined under *Clutch Adjustment* in Section 8.1.

2. Disassemble the clutch and remove any excessive grease or oil from the clutch operating linkage. Remove all grease and oil from the pressure plates and facings. Replace clutch facings which are badly saturated.

3. Measure the thickness of the clutch facings. Replace clutch facings worn to the minimum thickness shown in the chart under *Replace Clutch Facings* in Section 8.1.

4. Check the installation and reduce the operating load on the unit as much as practical, also the shock loads and unnecessary belt loading should be reduced to a minimum. If necessary, install a power take-off assembly with a higher capacity clutch.

5. When the clutch operating linkage is badly worn or broken and the clutch is adjusted as in Step 1, the clutch may not disengage. Replace worn or broken linkage.

6. Broken or weak clutch release springs or clutch separator springs may cause the clutch to drag. Disassemble the clutch and replace the defective springs.

7. Misalignment is caused by overloading the clutch drive shaft, shock loads or the runout and out-of-round condition of the flywheel housing face and bore. Inspect the installation and determine whether the load on the clutch drive shaft is excessive; refer to Step 4. The out-of-round (concentricity) and runout of a flywheel housing can be checked as outlined in Section 1.5.

8. Damage to the clutch drive shaft pilot bearing is usually the result of misalignment (Step 7), lack of lubricant (Step 9), or incorrect adjustment of the tapered roller bearings.

Adjust the clutch drive shaft tapered roller bearings after disassembling the power take-off and cleaning the bearings. Lubricate the bearings with engine oil.

Then reinstall the clutch drive shaft and bearings and adjust the drive shaft end play as outlined under *Clutch Drive Shaft End Play Adjustment* in Section 8.1. Complete the assembly of the power take-off and lubricate the tapered roller bearings with an all purpose grease such as Shell Alvania No. 2, or equivalent (see Step 15).

9. The clutch drive shaft pilot bearing may fail from lack of lubricant. Remove the bearing from the flywheel or the clutch drive adaptor and check the lubricant. Refer to *Lubrication* in Section 8.1.

To prolong the life of the clutch pilot bearing in an application where the power take-off is in continuous operation 8 hours or more a day, it is recommended that the engine be run at idle speed for at least 5 minutes each work shift with the power take-off disengaged. This will permit the grease to work its way into the pilot bearing.

10. Overloaded clutch drive shaft pilot bearing may fail. This condition may be corrected by referring to Step 7.

11. The clutch drive shaft may be damaged by misalignment (refer to Step 7).

12. Abnormally high belt load may cause damage to the clutch drive shaft (refer to Step 4).

13. Clutch drive shaft bearings that are badly worn or damaged may damage the drive shaft. Replace all worn bearings and properly adjust the direct drive clutch drive shaft end play.

14. Misalignment and shock engagement will place undue wear on the teeth of clutch facings and result in rapid wear (refer to Step 7).

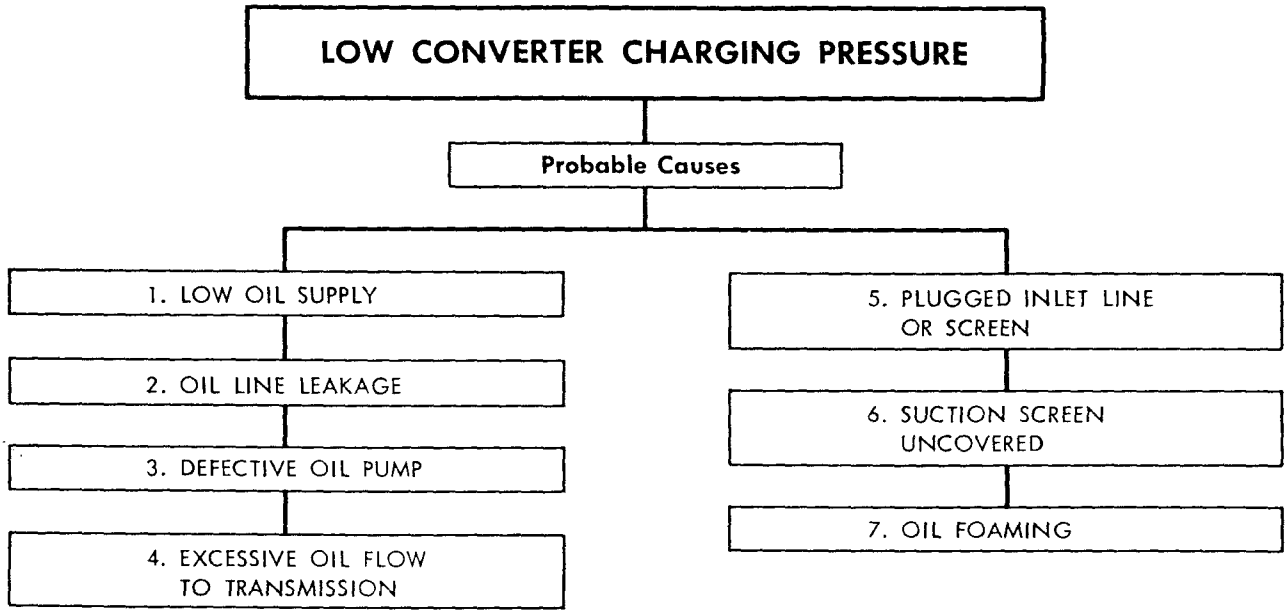
15. If the clutch drive shaft tapered roller bearings show evidence of overheating, replace the bearings. Abnormal overheating results from incorrect lubricating procedure or improper lubricant. Excessive side load or incorrect shaft end play can also be contributing factors. Lubricate the bearings with an all purpose grease such as Shell Alvania No. 2, or equivalent. Properly lubricated bearings will have a small ridge of grease on the drive shaft next to the clutch housing.

16. If inspection of the clutch facings reveals evidence of overheating, it is the result of clutch slippage. Refer to Step 1 to correct this condition.

TROUBLE SHOOTING

TORQMATIC CONVERTER

Chart 1



SUGGESTED REMEDY

1. Add oil. Refer to the *Lubrication and Preventive Maintenance Chart* in Section 15.1.

2. Check for air leaks in the suction lines and oil leaks in the pressure lines.

3. Check for wear in the oil pump. Check for high stall speed (refer to the specific Torqmatic Converter Service Manual).

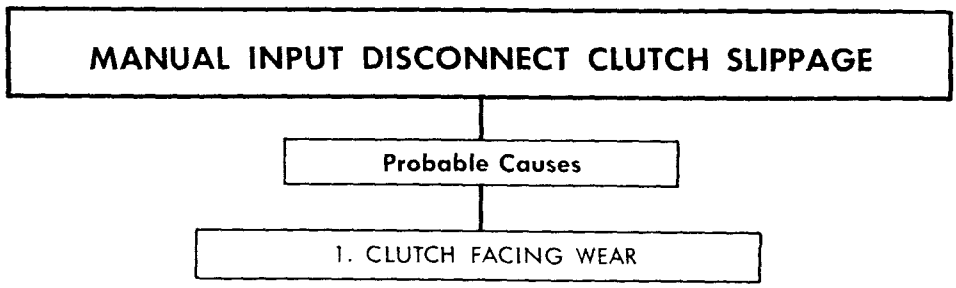
4. Check the operation of the selector valve; check the valve, by-pass valve and transmission driven pump (Series 400 through 900 converters).

5. Check the inlet line and screen. Clean them if necessary (Series 400 through 900 converters).

6. Check the oil level or check for improper installation of the suction screen (Series 400 through 600 converters).

7. Check to be sure the oil return line is below the oil level in the sump.

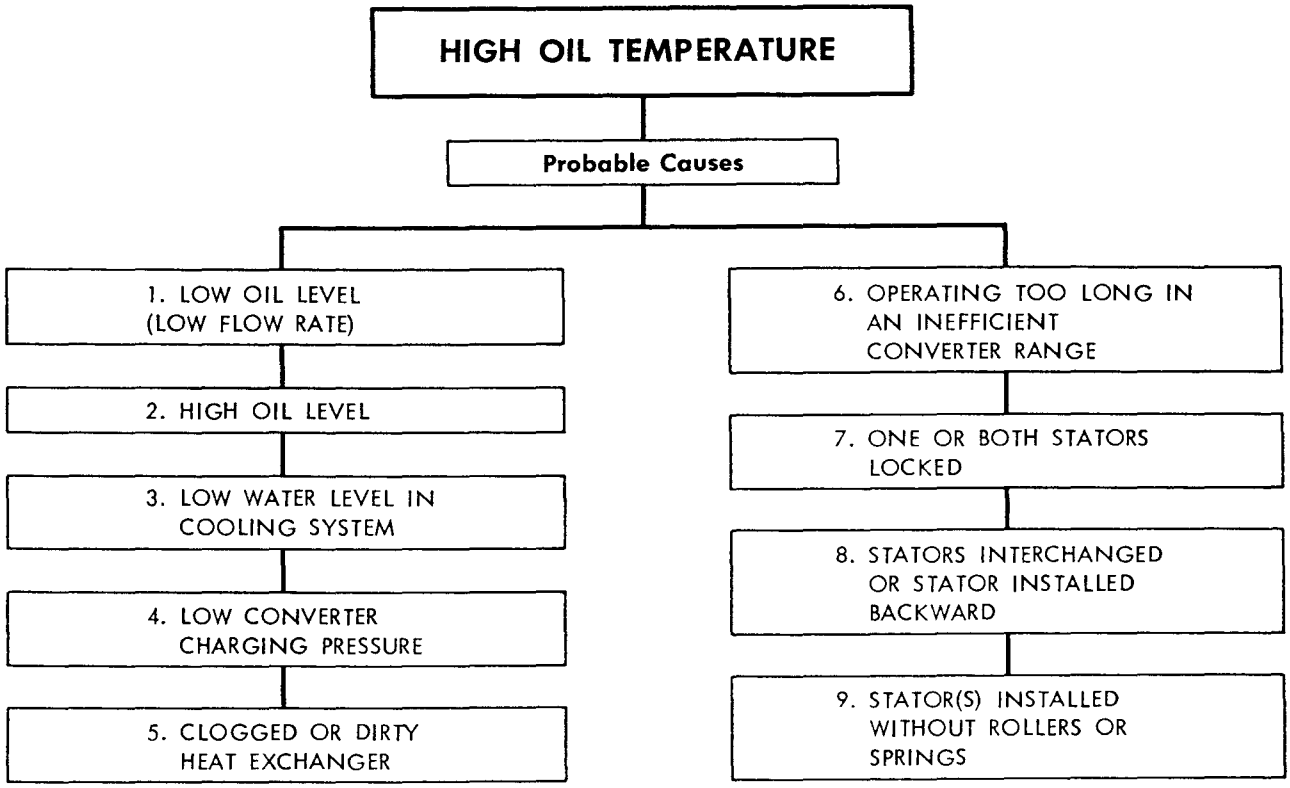
Chart 2



SUGGESTED REMEDY

1. Adjust the clutch.

Chart 3



SUGGESTED REMEDY

1. Add oil. Refer to the *Lubrication and Preventive Maintenance Chart* in Section 15.1.

2. Drain the oil to the proper level.

3. Add water. Check for leaks.

4. Refer to Chart 1.

5. Clean or replace the heat exchanger as necessary.

6. Readjust the work cycle to allow operation in an efficient converter range.

7. Check for the low maximum speed of the operating equipment.

The maximum converter "OUT" oil temperature is 250°F.

If it should become necessary to check for locked stator(s) by observing the temperature drop rate, increase the converter "OUT" temperature to 230°F. by stalling the converter output shaft at full throttle. Release the converter output shaft and immediately check the rate of temperature drop with no load on the converter and a maximum input rpm. The temperature should start to drop after 15 seconds.

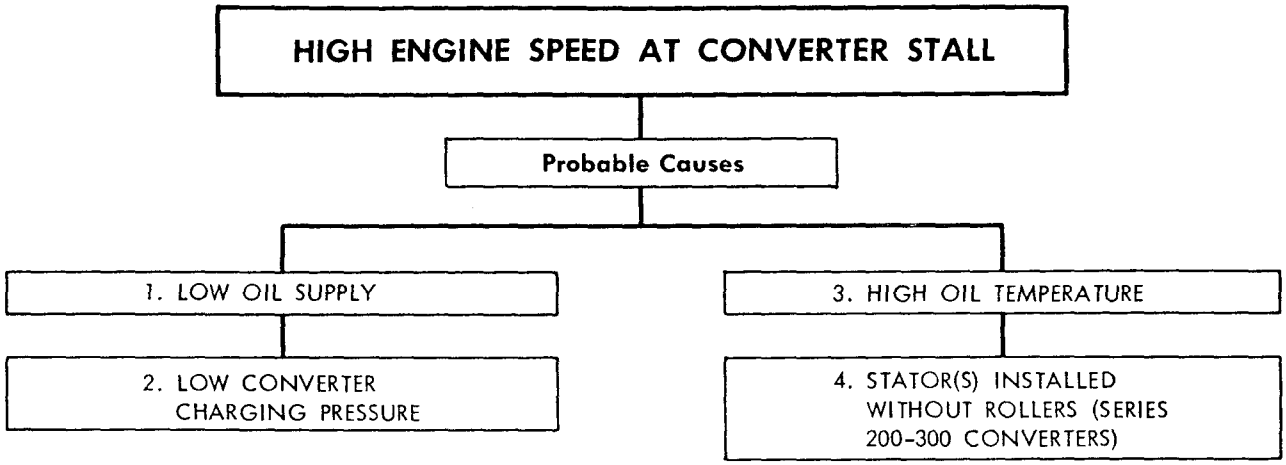
A slow temperature drop rate may indicate locked stator(s). A rapid temperature drop rate indicates a normal stator operation.

8. Check for lack of power at converter stall. Refer to Chart 1.

Disassemble the converter and check the stators (refer to the specific Torqmatic Converter Service Manual).

9. Disassemble the converter and install the missing parts (see Item 4 in Charts 4 and 5).

Chart 4



SUGGESTED REMEDY

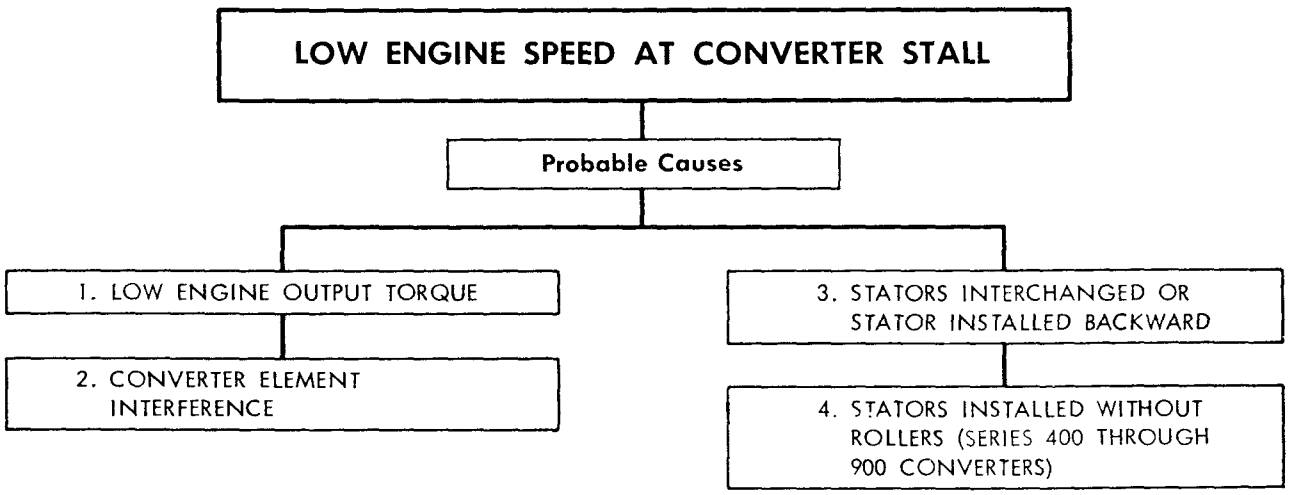
1. Add oil. Refer to the *Lubrication and Preventive Maintenance Chart* in Section 15.1.

2. Refer to Chart 1.

3. Refer to Chart 3.

4. Disassemble the converter and install the rollers (refer to the specific Torqmatic Converter Service Manual).

Chart 5



SUGGESTED REMEDY

1. Tune the engine and check the output.

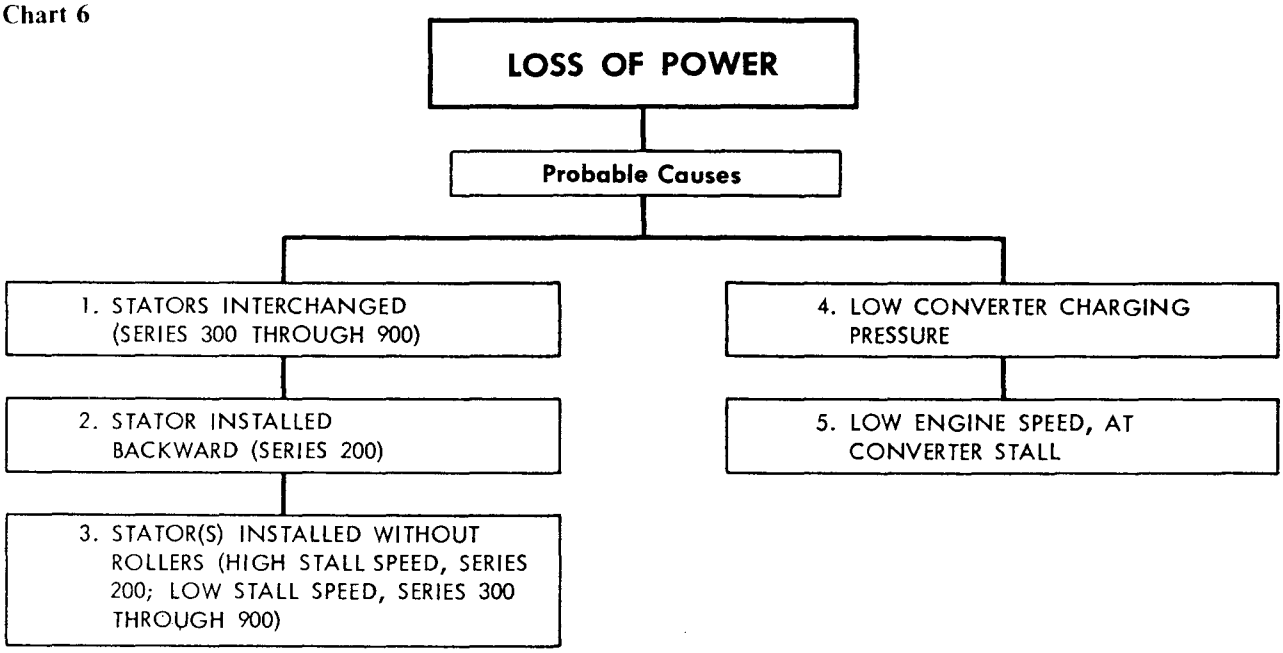
2. Check for noise at stall. Overhaul the converter if necessary.

3. Check for a lack of power at converter stall (see the specific Torqmatic Converter Service Manual).

Disassemble the converter and check the stators.

4. Disassemble the converter and install the rollers.

Chart 6



SUGGESTED REMEDY

1. Check for a lack of power at stall (see the specific Torqmatic Converter Service Manual).

Disassemble the converter and check the stators.

2. Check for a lack of power at stall.

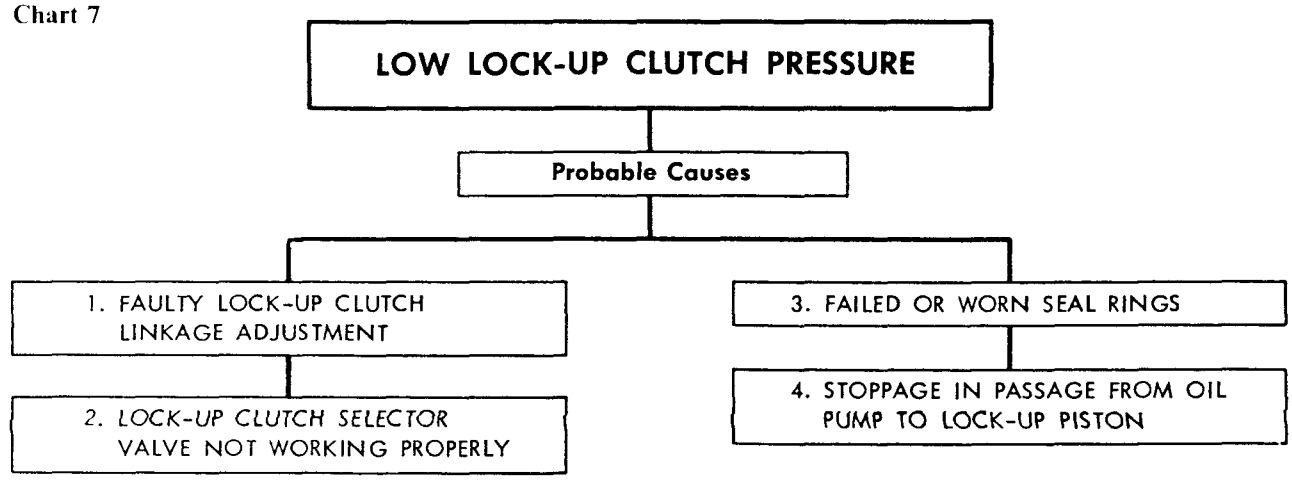
Disassemble the converter and check the stator.

3. Disassemble the converter and install the rollers.

4. Refer to Chart 1.

5. Refer to Chart 5.

Chart 7



SUGGESTED REMEDY

1. Adjust the linkage.

2. Remove the charging oil pump cover and check the clutch selector valve.

3. Disassemble the converter. Replace the failed or worn seal rings.

4. Disassemble the converter and clean the passage. Inspect the converter for dirt.

SPECIFICATIONS

STANDARD BOLT AND NUT TORQUE SPECIFICATIONS

THREAD SIZE	TORQUE (lb-ft)	THREAD SIZE	TORQUE (lb-ft)
1/4 -20	7-9	9/16-12	90-100
1/4 -28	8-10	9/16-18	107-117
5/16-18	13-17	5/8 -11	137-147
5/16-24	15-19	5/8 -18	168-178
3/8 -16	30-35	3/4 -10	240-250
3/8 -24	35-39	3/4 -16	290-300
7/16-14	46-50	7/8 - 9	410-420
7/16-20	57-61	7/8 -14	475-485
1/2 -13	71-75	1 - 8	580-590
1/2 -20	83-93	1 -14	685-695

EXCEPTIONS TO STANDARD BOLT AND NUT TORQUE SPECIFICATIONS

APPLICATION	THREAD SIZE	TORQUE (lb-ft)
Flywheel bolts	1/2 -20	110-220
Crankshaft end bolt (in-line and 6V engines)	3/4 -16	200-220
Crankshaft end bolt (in-line engines with cone mounted pulleys not stamped with letter (A)	3/4 -16	290-310
Crankshaft end bolt (8V engines)	1 -14	290-310
Clutch-to-drive shaft nut (8" dia.)	1-1/8 -12	165-170
Clutch-to-drive shaft nut (10" dia.)	1-5/16-12	175-180
Clutch-to-drive shaft nut (11-1/2" dia.)	1-3/4 -10	225-230

SERVICE TOOLS

TOOL NAME	TOOL NO.
Oil seal remover and installer tool set	J 3154-04
Slide hammer and puller set	J 5901
Hammer and shaft	J 5901-1
Flywheel pilot bearing remover adaptor	J 5901-2
Spring tester	J 9666