

# John Deere 336, 346, and 466 Baler Drives



## TECHNICAL MANUAL John Deere 336, 346, and 466 Baler Drives

TM1114 (01MAY75) English

**TM1114 (01MAY75)**

LITHO IN U.S.A.  
ENGLISH





# 336, 346 AND 466 BALER DRIVES

Technical Manual  
TM-1114 (May-75)

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### FOR YOUR CONVENIENCE

*Vertical lines appear in the margins of these pages. These lines identify new material and revised information that affects specifications, procedures, and other important instructions.*

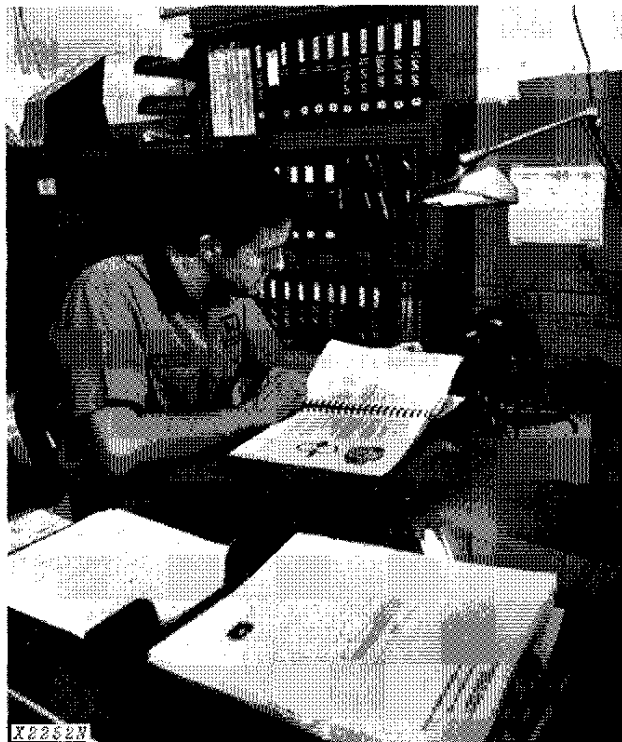
*All information, illustrations and specifications contained in this technical manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.*

#### **SI(International System) Units of Measure**

Metric equivalents have been included, where applicable, throughout this technical manual.

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## INTRODUCTION



Use FOS Manuals for Reference

This technical manual is part of a twin concept of service:

- **FOS Manuals — for reference**
- **Technical Manuals — for actual service**

The two kinds of manuals work as a team to give you both the general background and technical details of shop service.

*Fundamentals of Service (FOS) Manuals* cover basic theory of operation, *fundamentals* of trouble shooting, *general* maintenance, and *basic* types of failures and their causes. FOS Manuals are for training new people and for reference by experienced technicians.

*Technical Manuals* are concise service guides for a *specific* machine. Technical Manuals are on-the-job guides containing only the vital information needed by an experienced technician.



When a service technician should refer to a FOS Manual for more information, a FOS symbol like the one at the left is used in the TM to identify the reference.



Use Technical Manuals for Actual Service

Some features of this technical manual:

- *Table of contents at front of manual*
- *Exploded views showing parts relationship*
- *Photos showing service techniques*
- *Specifications grouped for easy reference*

This technical manual was planned and written for you — a service technician. Keep it in a permanent binder in the shop where it is handy. Refer to it whenever in doubt about correct service procedures or specifications.

Using the technical manual as a guide will reduce error and costly delay. It will also assure you the best in finished service work.



This safety alert symbol identifies important safety messages in this manual. When you see this symbol, be alert to the possibility of personal injury and carefully read the message that follows.

## GENERAL

Power is transmitted from the tractor through the powerline to a gear case which drives the baler plungerhead and pickup. A roller chain from the input shaft on the front of the gear case drives the knottter and feeder finger drive shaft. The drive shaft drives a set of cluster gears which drive the knotters. On the 336 or 346 balers, a shaft off the cluster gears drives the auger through a V-belt. On the 466 Baler, a shaft off the cluster gears drives the auger through a chain, with a slip clutch for auger drive protection. A chain from the drive shaft drives the feeder fingers.

An overrunning clutch, located in the slip clutch on the input shaft of the gear case, protects the tractor PTO from damage.

When servicing baler drives, pay particular attention to the tractor-baler hookup geometry, Figs. 1, 2 and 3.

Unequal angles occur if the tractor drawbar is not set for the proper length relative to the PTO operating speed. The tractor hookup U-joints must operate at equal angles whether turning a corner or passing over uneven terrain. If the equal angles are not maintained, the following problems could occur:

1. Premature failure of the powerline components.
2. Excessive noise and vibration



For basic theory of power transmitted with a tractor PTO hookup, see FOS manual 40 — POWER TRAINS.

The proper hookup dimensions are illustrated by Figs. 1, 2 and 3. Use Fig. 1 for a 336 or 346 Baler using hitch straps, Fig. 2 for a 336 or 346 Baler with an equal angle hitch, or Fig. 3 for a 466 Baler.

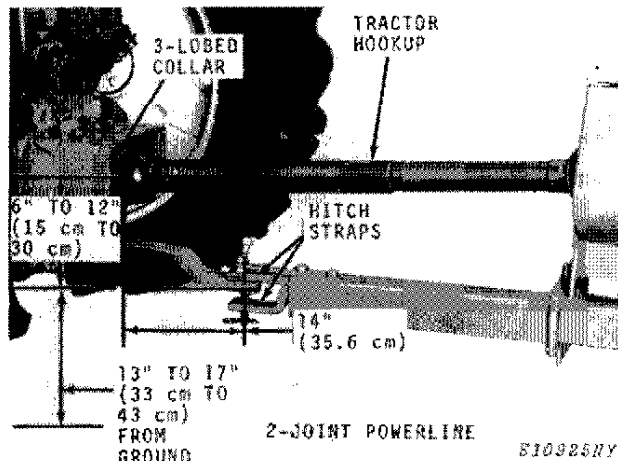


Fig. 1—Hookup Dimensions for Hitch Straps

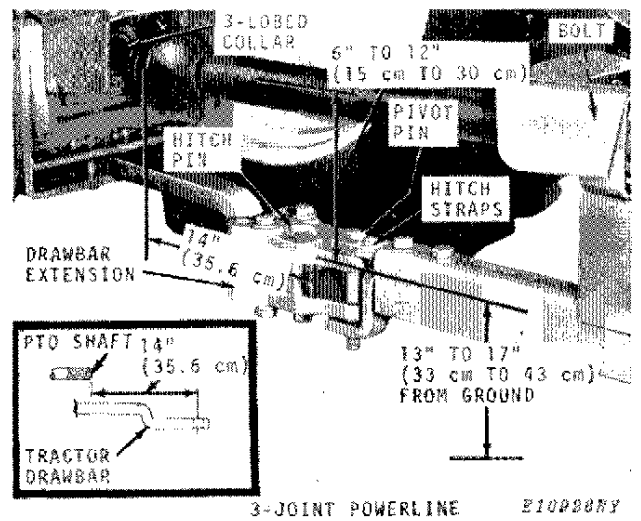
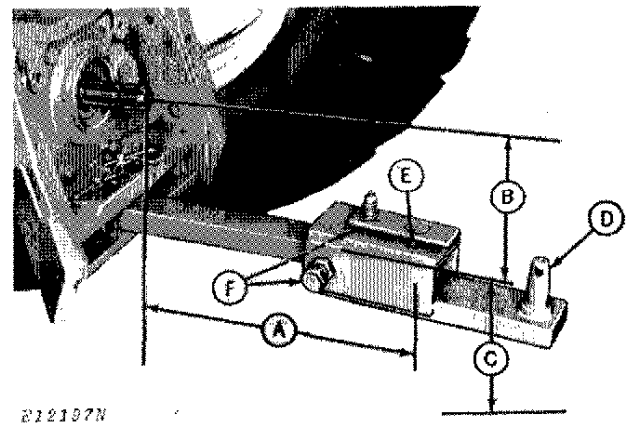


Fig. 2—Hookup Dimensions for an Equal Angle Hitch



- A—14" (35.6 cm)
- B—6-12" (15.2-30.5 cm)
- C—13-17" (33.0-43.2 cm)
- D—Equal Angle Hitch
- E—Hitch Pin
- F—Adjusting Bolts

Fig. 3—Hookup Dimensions of 466 Baler

## LUBRICATION

Gear cases can operate efficiently only if clean lubricants are used. Use clean containers to handle all lubricants. Store them in an area protected from dust, moisture, and other contamination.



For more information on lubricants, refer to FOS Manual 50 — GENERAL INFORMATION.

Fill the gear case to the check plug with SAE 90-140 API-GL5 Gear Lubricant. The capacity of the gear case is 1 U.S. gallon (3.79 l).

## OVERRUNNING CLUTCH AND SLIP CLUTCH (336 and 346 BALER)

### GENERAL INFORMATION

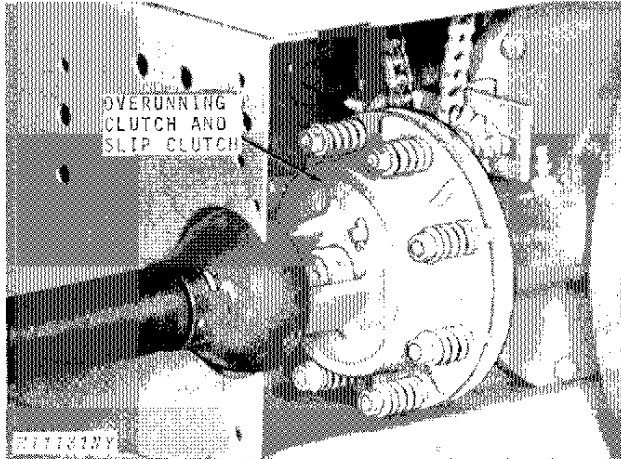


Fig. 1—Overrunning Clutch and Slip Clutch

The slip clutch in the main drive helps protect the baler from undue stress resulting from high starting torques, material too heavy, obstacles lodging between knives, etc.

### REMOVAL

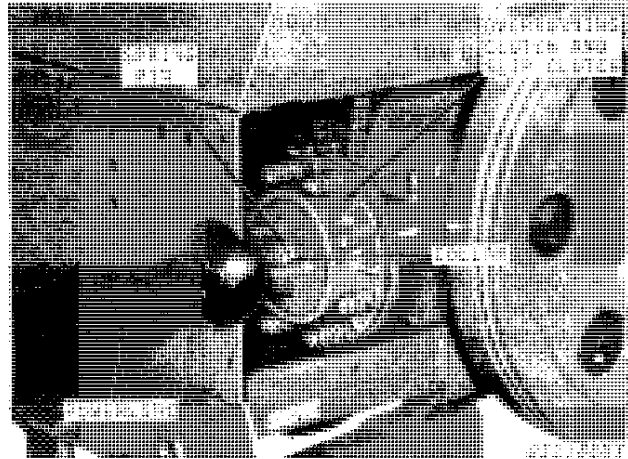
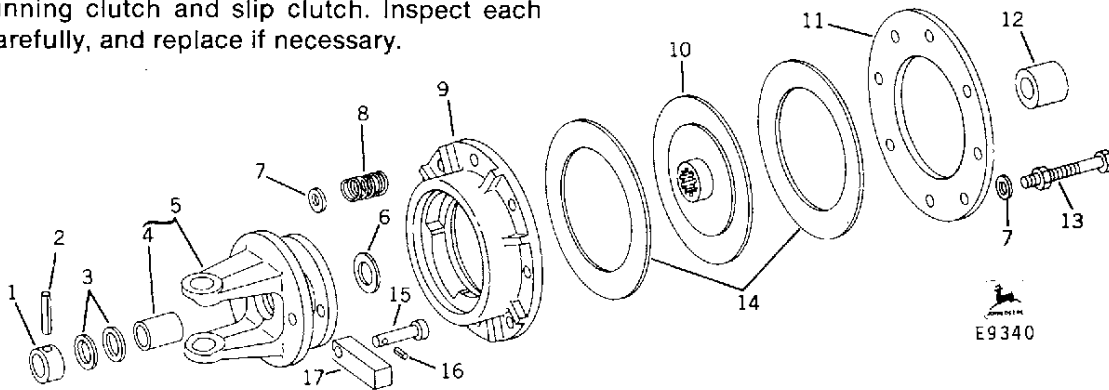


Fig. 2 — Removing Overrunning Clutch and Slip Clutch

Remove spring pin and collar from input shaft. Slide powerline forward until hub slips free of input shaft. Slide slip clutch off input shaft.

### REPAIR

Refer to Fig. 3 to disassemble and assemble overrunning clutch and slip clutch. Inspect each part carefully, and replace if necessary.



- |   |   |   |
|---|---|---|
| <ul style="list-style-type: none"> <li>1—Retainer collar</li> <li>2—Spring pin</li> <li>3—Thrust washer (2 used)</li> <li>4—Bushing</li> <li>5—Clutch yoke</li> <li>6—Thrust washer (2 used)</li> </ul> | <ul style="list-style-type: none"> <li>7—Flat washer (16 used)</li> <li>8—Spring (8 used)</li> <li>9—Overrunning clutch hub</li> <li>10—Clutch hub</li> <li>11—Pressure plate</li> <li>12—Spacer</li> </ul> | <ul style="list-style-type: none"> <li>13—Cap screw (8 used)</li> <li>14—Clutch facing (2 used)</li> <li>15—Drilled pin</li> <li>16—Spring pin</li> <li>17—Clutch pawl</li> </ul> |
|---|---|---|

Fig. 3—Exploded View of Overrunning Clutch and Slip Clutch

## INSTALLATION

Refer to Fig. 4 to install slip clutch onto input shaft.

3. Place yoke (A) on shaft. Put two .025-inch hardened washers (B) with collar (C) on shaft. Stick a punch in the hole of the collar to locate the yoke. Pull slip clutch (D) forward. Check clearance (E) between spacer (G) and slip clutch hub. Remove yoke and add required number of .060-inch hardened washers (F) between rear of yoke and slip clutch to take up slack (E). Replace yoke (A), two .025-inch washers (B) and collar (C) on shaft and attach with spring pin. See Note 1.

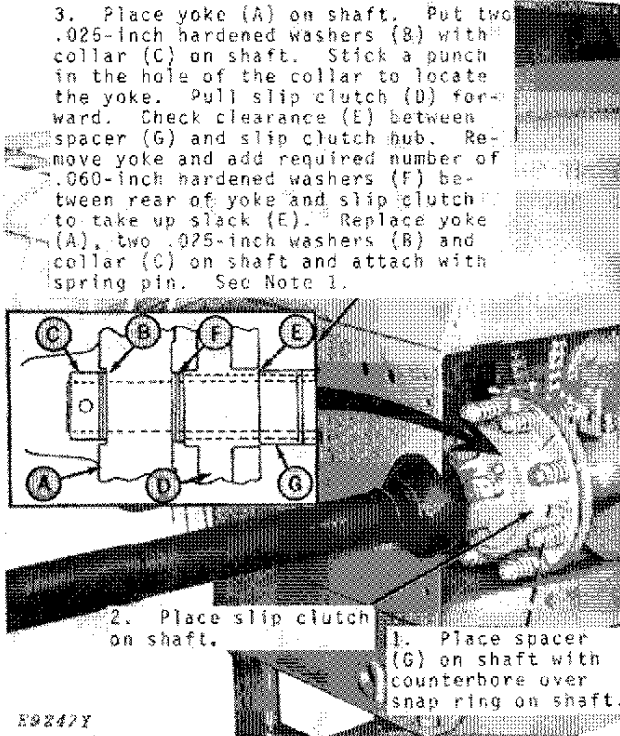


Fig. 4—Installing Overrunning Clutch and Slip Clutch on Input Shaft

**NOTE 1: IMPORTANT:** Washers must be placed between rear of yoke and slip clutch, not between spacer and slip clutch hub where clearance is measured.

## ADJUSTMENTS

The clutch must slip at a torque of 400 to 500 ft-lbs (542 to 678 Nm) on 336 Balers or 475 to 575 ft-lbs (644 to 780 Nm) on 346 Balers.

Check the clutch by blocking the movement of the plungerhead and using a 10-foot (3.05 m) lever attached to the slip clutch. On 336 Balers, the clutch must slip when 40 to 50 lbs (178 to 222 N) of force is exerted on the lever. On 346 Balers, the clutch must slip when 47 to 58 lbs (209 to 258 N) of force is exerted on the lever. If the clutch does not slip in this range, tighten or loosen the clutch spring bolts.

**NOTE:** When checking torque on baler with 3-joint powerline it may be easier to use torque wrench on hex. powerline. To check, remove PTO hookup and place torque wrench on front of hex. powerline shaft.

After checking the torque, check the length of the clutch springs. The spring length must be between 1-19/32 to 1-21/32 inches (40.5 to 42.1 mm) on 336 Balers or 1-17/32 to 1-18/32 inches (38.9 to 40.5 mm) on 346 Balers.

## OVERRUNNING CLUTCH AND SLIP CLUTCH (466 BALER)

### GENERAL INFORMATION

The slip clutch in the main drive helps protect the baler from undue stress resulting from high starting torques, material too heavy, obstacles lodging between knives, etc.

A—Spring Pin  
 B—Collar  
 C—Powerline

D—Overrunning Clutch and Slip Clutch

(Legend for Fig. 1)

### REMOVAL

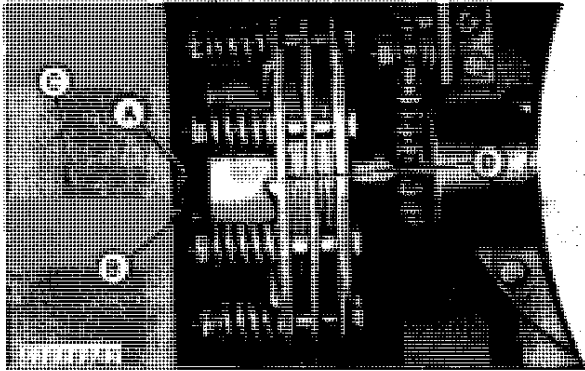
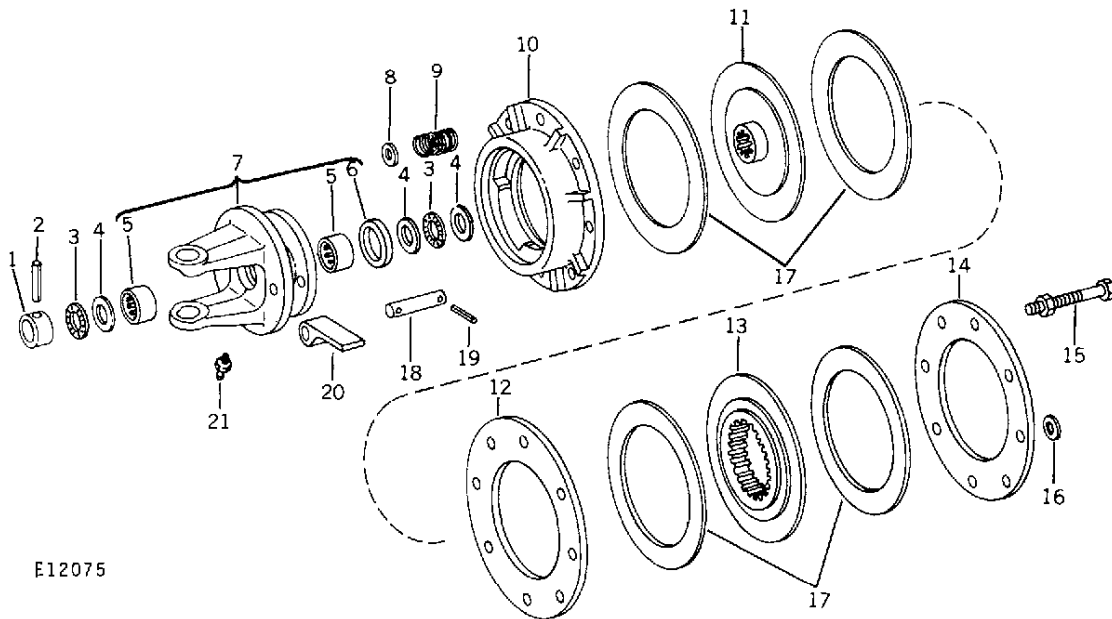


Fig. 1—Overrunning Clutch and Slip Clutch Removal

Remove spring pin (A) and collar (B) from input shaft. Slide powerline forward until hub slips free of input shaft. Slide slip clutch off input shaft.

### REPAIR

Refer to Fig. 2 to disassemble and assemble overrunning clutch and slip clutch. Inspect each part carefully and replace if necessary.



E12075

1—Retainer Collar  
 2—Spring Pin  
 3—Thrust Bearing (2 used)  
 4—Thrust Washer (3 used)  
 5—Needle Bearing (2 used)

6—Oil Seal  
 7—Clutch Yoke  
 8—Flat Washer (8 used)  
 9—Spring (8 used)  
 10—Clutch

11—Inner Hub  
 12—Pressure Plate  
 13—Outer Hub  
 14—Pressure Plate  
 15—Cap Screw (8 used)  
 Lock Nut

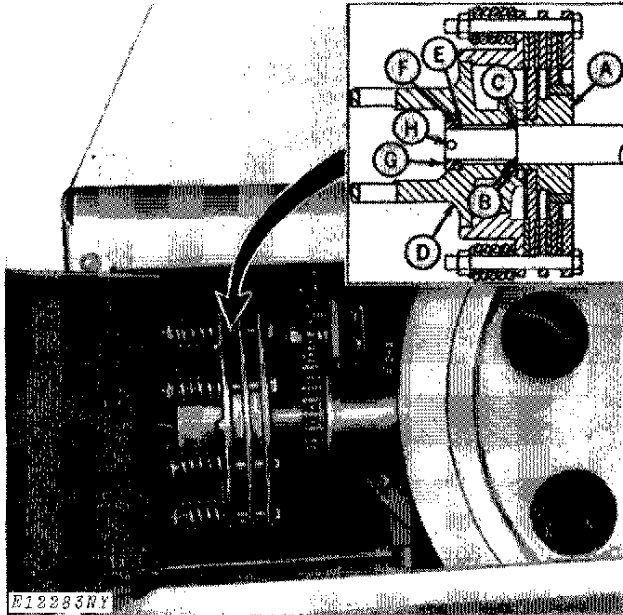
16—Flat Washer (use as required)  
 17—Clutch Facing (4 used)  
 18—Drilled Pin (2 used)  
 19—Spring Pin (4 used)  
 20—Clutch Pawl (2 used)  
 21—Grease Fitting

Fig. 2—Exploded View of Overrunning Clutch and Slip Clutch



### INSTALLATION

Refer to Fig. 3 to install slip clutch onto input shaft.



- |                  |                  |
|------------------|------------------|
| A—Slip Clutch    | E—Washer         |
| B—Washer         | F—Thrust Bearing |
| C—Thrust Bearing | G—Collar         |
| D—Yoke           | H—Spring Pin     |

Fig. 3—Installing Overrunning Clutch and Slip Clutch on Input Shaft

Slide slip clutch (A) onto shaft.

Place one .090" hardened washer (B), thrust bearing (C) and another .090" washer (B) on shaft.

Slide yoke (D) onto shaft.

Place one .090" hardened washer (E) on shaft. Slide thrust bearing (F) onto shaft.

Place collar (G) on shaft and secure with spring pin (H).

### ADJUSTMENTS

The slip clutch must slip at a torque of 700 to 800 ft-lbs (949 to 1085 Nm).

Check the clutch by blocking the movement of the plungerhead and using a torque wrench on the hex powerline. To check, remove PTO hookup and place torque wrench on front of hex powerline shaft. The clutch must slip at 700 to 800 ft-lbs (949 to 1085 Nm) torque.

After checking torque, check the length of the clutch springs. The spring length must be 1-23/32 inches (43.7 mm) when proper torque is obtained.

## GEAR CASE

### GENERAL INFORMATION

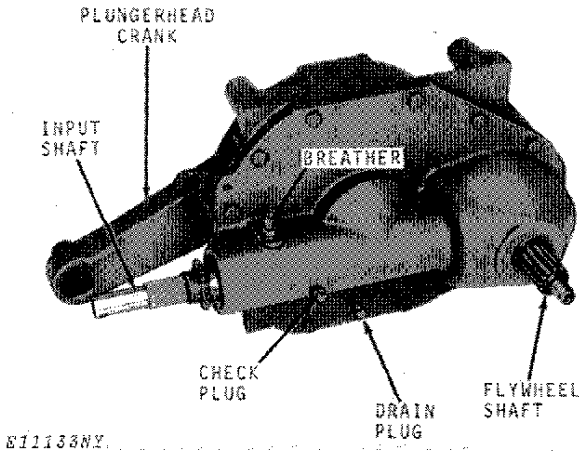


Fig. 1—Gear Case

The gear case transmits power from the powershaft around a 90-degree corner to the plungerhead and pickup. The feeder drive shaft is chaindriven from the input shaft. There are six bearings and three oil seals in the gear case.

### DIAGNOSING MALFUNCTIONS



Refer to FOS Manual 40 — POWER TRAINS for more information about diagnosing malfunctions of gear cases.

|         |                |
|---------|----------------|
| Problem | Possible Cause |
|---------|----------------|

#### Gear Case Noisy

- Lack of lubricant.
- Loose bearings.
- Gears not meshing properly.
- Excessive backlash.
- Gears binding.

#### Gear Case Excessively Hot

- Lack of lubricant.
- Gears binding.
- Defective bearings.
- Improperly installed bearing caps.

#### Leaking Oil

- Defective oil seals.
- Too much lubricant in gear case.
- Hardware not properly torqued.

### REMOVAL

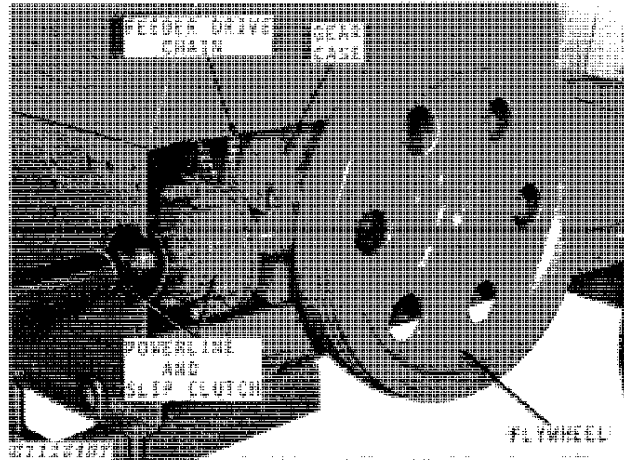


Fig. 2—Removing the Gear Case

Remove powerline and slip clutch from front input shaft, page 4 or 6.

Remove feeder drive chain.

Remove three machine screws from flywheel nut shield and remove shield (336 or 346 Balers). Remove slotted nut from flywheel shaft. Attach hoist or other lifting device to flywheel and remove flywheel from gear case.

Remove cap screws from pitman end of plungerhead crank.

Remove cap screws that hold gear case to baler and remove gear case.

## REPAIR

### Disassembly

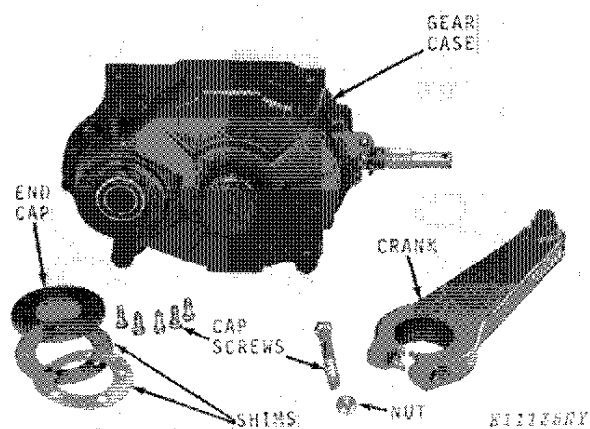


Fig. 3—Removing Flywheel Shaft End Cap and Crank

Remove cap screw and nut from plungerhead crank and remove crank from crankshaft.

Remove cap screws and end cap from gear case. Keep shims so they can be used in adjusting the rolling torque of the flywheel shaft.

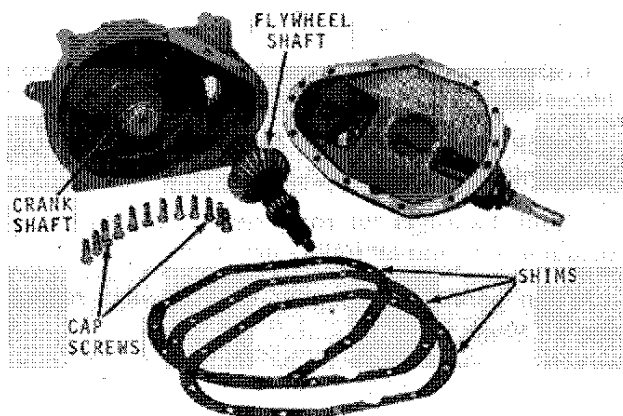


Fig. 4—Separating Gear Halves and Removing Flywheel Shaft and Crankshaft

Remove twelve cap screws and separate the gear case halves.

**IMPORTANT: Do not let shafts fall when separating gear case halves.**

Remove flywheel shaft and crankshaft from gear case housing.

Keep shims so they can be used when adjusting crankshaft bearing torque.

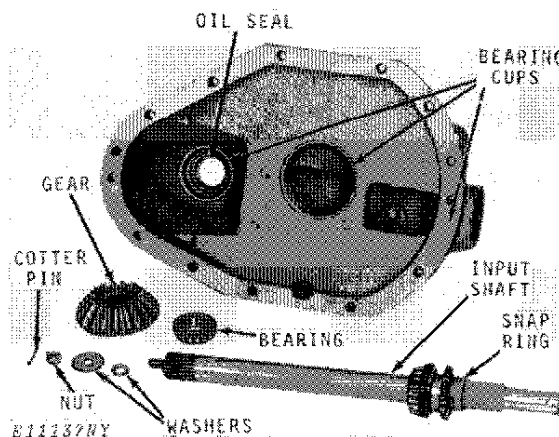


Fig. 5—Removing Input Shaft

On 336 or 346 Balers, remove cotter pin and slotted nut. On 466 Balers, remove stake nut. Slide gear and bearing off rear of shaft. Pull input shaft from front of gear case half.

With shafts out of case, check bearing cups for damage. If not damaged, do not remove bearing cups from case.

Remove flywheel shaft oil seal from gear case.

Remove snap ring from front of input shaft and slide sprocket, spacer and oil seal from shaft. Press bearing off shaft.

## REPAIR — Continued

## Disassembly — Continued

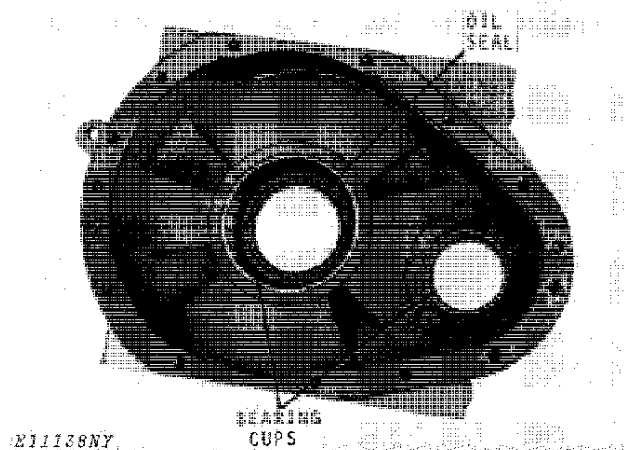


Fig. 6—Checking Bearing Cups

Remove crankshaft oil seal.

Check bearing cups for damage. If not damaged, do not remove bearing cups from case.

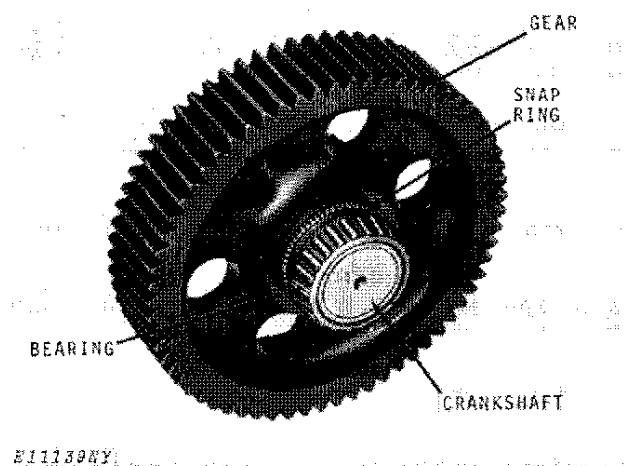


Fig. 7—Removing Crankshaft Bearings and Gear

Remove snap ring from crankshaft. Press gear and bearing off crankshaft. Press second bearing off front end of crankshaft.

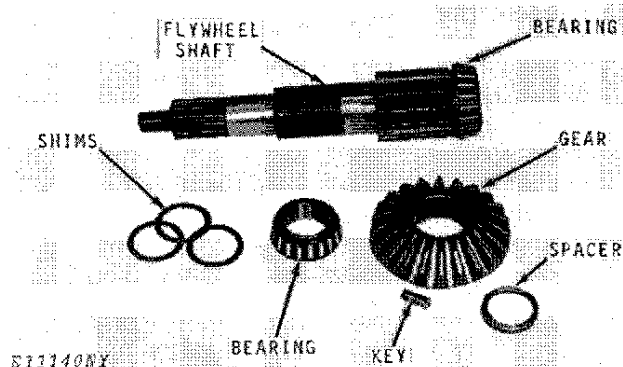


Fig. 8—Removing Gear, Bearings and Shims from Flywheel Shaft

Pressing against bottom of gear, remove gear, shims, spacer and bearing from flywheel shaft.

Check bearing at rear of shaft for damage. If not damaged, do not remove bearing from shaft. Removing bearing from shaft will damage bearing.

## Inspection

Wash all parts thoroughly in a clean solvent and dry. Clean all oil out of gear case.

Inspect all parts for wear or damage. Replace if necessary.

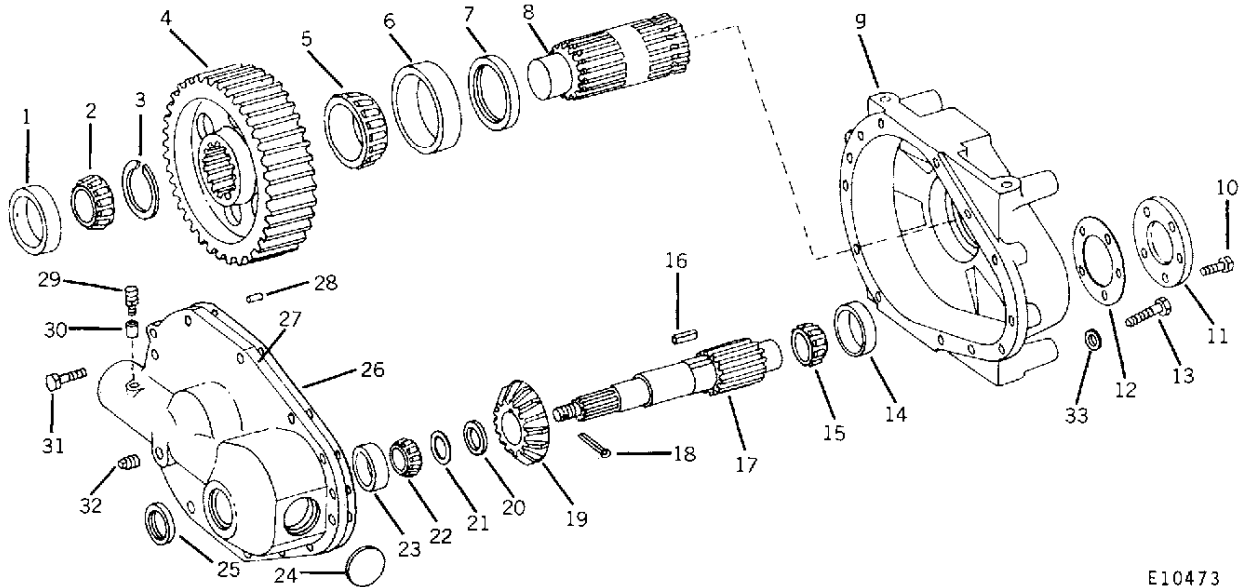
Check the bevel gears for irregular wear patterns, nicks, broken teeth, etc.

Check bearings for roughness. Be certain they rotate freely, and all rollers are in place.

When servicing the gear case, always replace the oil seals.

### Assembly

Refer to Figs. 9, 10 and 11 to help assemble the gear case. Use illustrations and procedures directly following these exploded views to adjust gear backlash and bearing preload.



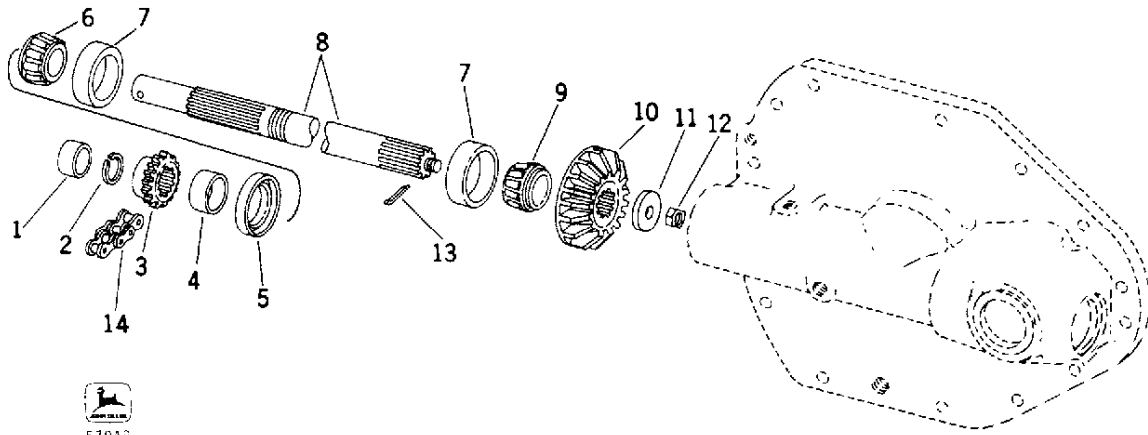
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- |   |  |  |
|---|--|--|
| <p>1—Bearing cup<br/>                 2—Bearing cone<br/>                 3—Snap ring<br/>                 4—Crank gear<br/>                 5—Bearing cone<br/>                 6—Bearing cup<br/>                 7—Oil seal<br/>                 8—Crankshaft<br/>                 9—R. H. half of gear case with cups<br/>                 10—Cap screw (5 used)<br/>                 11—End cap<br/>                 12—0.020" (0.51 mm) Shim<br/>                 0.0075" (0.20 mm) Shim<br/>                 0.005" (0.13 mm) Shim</p> | <p>13—Cap screw<br/>                 14—Bearing cup<br/>                 15—Bearing cone<br/>                 16—Key<br/>                 17—Flywheel shaft<br/>                 18—Cotter pin<br/>                 19—Bevel gear<br/>                 20—Spacer<br/>                 21—0.005" (0.13 mm) Shim<br/>                 0.007" (0.20 mm) Shim<br/>                 0.020" (0.51 mm) Shim</p> | <p>22—Bearing cone<br/>                 23—Bearing cup<br/>                 24—Expansion plug<br/>                 25—Main seal<br/>                 26—0.005" (0.13 mm) Shim<br/>                 0.0075" (0.20 mm) Shim<br/>                 0.020" (0.51 mm) Shim<br/>                 27—L. H. half of gear case with cups<br/>                 28—Dowel pin<br/>                 29—Atmospheric vent<br/>                 30—Bushing<br/>                 31—Cap screw (12 used)<br/>                 32—Pipe plug<br/>                 33—Flat washer (4 used)</p> |
|---|--|--|

Fig. 9—Exploded View of Flywheel Shaft and Crankshaft

**REPAIR — Continued**

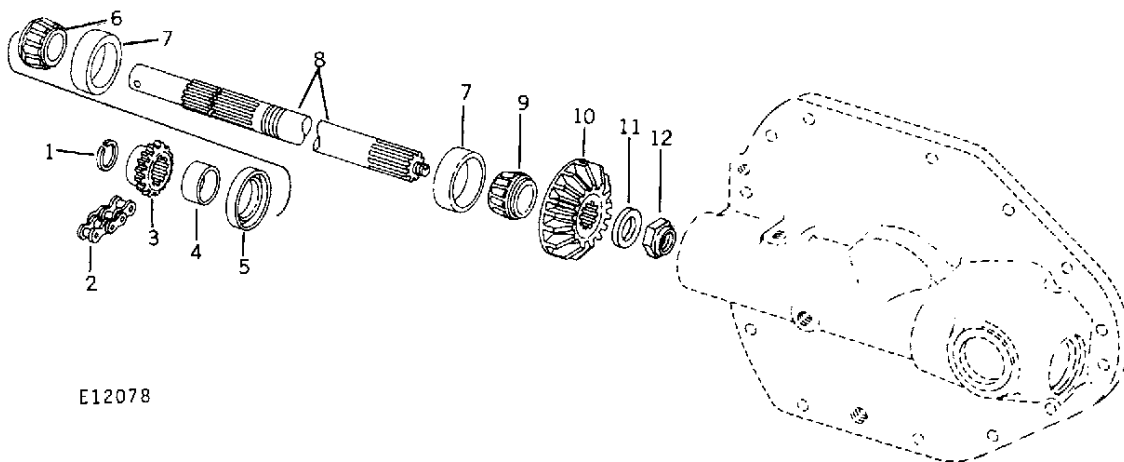
**Assembly — Continued**



  
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- |                        |                      |
|------------------------|----------------------|
| 1—Spacer               | 8—Feeder drive shaft |
| 2—Snap ring            | 9—Bearing cone       |
| 3—Drive sprocket       | 10—Bevel gear        |
| 4—Spacer               | 11—Special washer    |
| 5—Oil seal             | 12—Slotted nut       |
| 6—Bearing cone         | 13—Cotter pin        |
| 7—Bearing cup (2 used) | 14—Roller chain      |

Fig. 10—Exploded View of Input Shaft (336 and 346 Balers)



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- |                  |                        |
|------------------|------------------------|
| 1—Snap ring      | 7—Bearing cup (2 used) |
| 2—Roller chain   | 8—Feeder drive shaft   |
| 3—Drive sprocket | 9—Bearing cone         |
| 4—Spacer         | 10—Bevel gear          |
| 5—Oil seal       | 11—Thrust washer       |
| 6—Bearing cone   | 12—Stake nut           |

Fig. 11—Exploded View of Input Shaft (466 Baler)

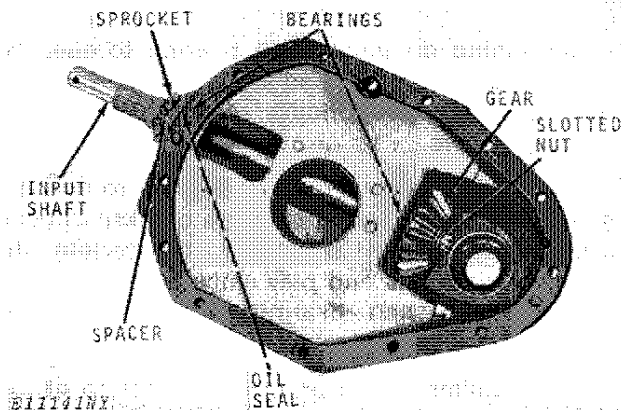


Fig. 12—Installing Input Shaft

Press bearing on front of input shaft.

Slide input shaft into left-hand half of gear case.

Place new oil seal on front of input shaft.

**IMPORTANT: Do not press seal into gear case at this time.**

Place spacer and chain sprocket on front of input shaft and secure with snap ring.

Place bearing and gear on rear of input shaft.

On 336 or 346 Baler, place washers on rear of shaft and attach slotted nut. On 466 Baler, place washers on rear of shaft and attach stake nut. Check rolling torque at front of shaft. Proper torque is 5 to 15 in-lbs (0.56 to 1.69 Nm), excluding seal drag. Record the torque reading, because it is used in determining crankshaft bearing torque.

*NOTE: Be sure snap ring is seated in the groove before checking rolling torque.*

On 336 or 346 Balers, secure slotted nut with cotter pin. On 466 Baler, stake the nut with a rounded punch into the keyway slot.

**IMPORTANT: Do not use a sharp punch or damage to the nut will occur.**

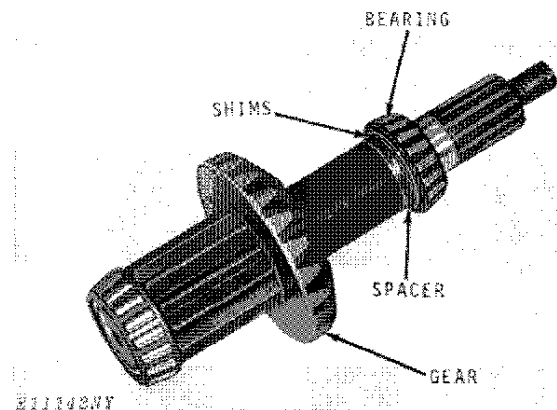


Fig. 13—Installing Gear and Bearings on Flywheel Shaft

If bearing on end of flywheel shaft has been damaged, press new bearing onto shaft.

Press gear, with key in slot, onto shaft with rear of gear pressed solid against spur gear of flywheel shaft.

Place spacer on shaft with chamfer toward the shoulder of the shaft.

Install shims between the spacer and the bearing to obtain .005 to .015-inch (0.13 to 0.38 mm) backlash between the bevel gears.

Press bearing onto flywheel shaft.

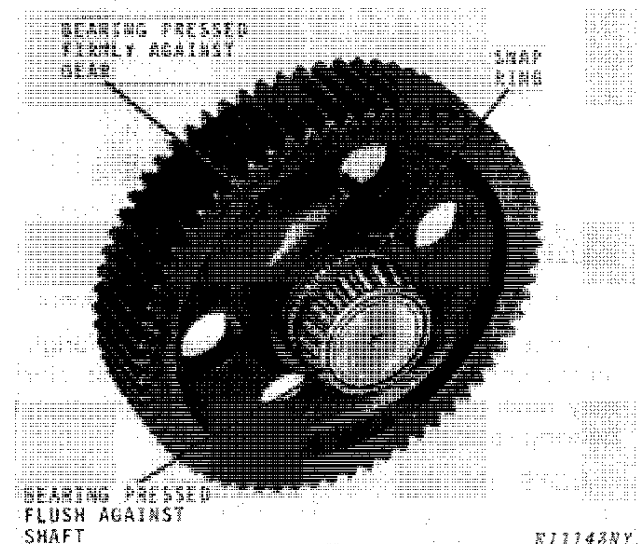


Fig. 14—Installing Gear and Bearings on Crankshaft

Place gear on crankshaft and secure with snap ring.

Press outer bearing on crankshaft until firm against gear.

Press inner bearing on crankshaft until flush with end of shaft.

**REPAIR — Continued**

**Assembly — Continued**

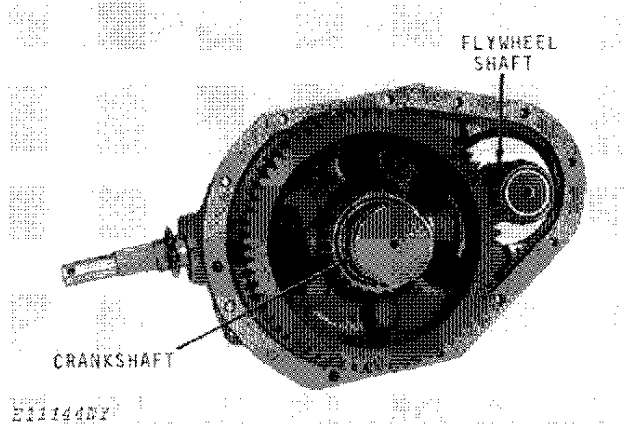


Fig. 15—Installing Flywheel Shaft and Crankshaft

Place flywheel shaft into gear case.

Place crankshaft into gear case to match gears on crankshaft with gears on flywheel shaft.

Apply Permatex No. 2 to gear case edge.

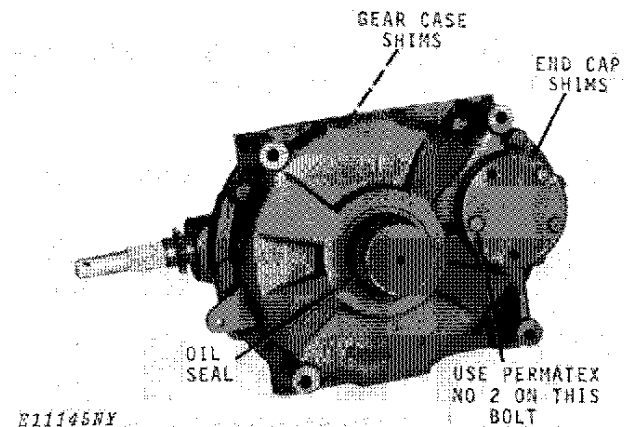


Fig. 16—Adjusting Rolling Torque on Crankshaft Bearings

Bring gear case halves together with original shims between the halves. (More or less shims may have to be used to obtain proper crankshaft bearing rolling torque.)

*NOTE: Use only three cap screws to hold gear case halves together while determining shim pack thickness to obtain correct torque.*

Proper crankshaft bearing torque depends on input shaft bearing torque which should be between 5 and 15 in-lbs (0.56 to 1.69 Nm).

Depending on input shaft bearing torque, determined on page 13, read across the chart below to find the corresponding range of crankshaft bearing torque.

Use a “C” clamp on the crankshaft to which a scale may be hooked to measure crankshaft bearing torque. When shimming, be certain the flywheel shaft has end play since any preload on the flywheel shaft bearings would affect the crankshaft bearing torque reading.

Select shims of the proper thickness to obtain the proper range of crankshaft bearing torque (from chart) depending on the input shaft bearing torque.

| INPUT SHAFT BEARING TORQUE |      | CRANKSHAFT BEARING TORQUE |              |
|----------------------------|------|---------------------------|--------------|
| In-lbs                     | Nm   | In-lbs                    | Nm           |
| 5                          | 0.56 | 134 to 164                | 15.1 to 18.5 |
| 6                          | 0.68 | 141 to 171                | 15.9 to 19.3 |
| 7                          | 0.79 | 147 to 177                | 16.6 to 20.0 |
| 8                          | 0.90 | 154 to 184                | 17.4 to 20.9 |
| 9                          | 1.02 | 161 to 191                | 18.2 to 21.6 |
| 10                         | 1.13 | 169 to 199                | 19.1 to 22.5 |
| 11                         | 1.24 | 175 to 205                | 19.8 to 23.2 |
| 12                         | 1.36 | 182 to 212                | 20.6 to 23.9 |
| 13                         | 1.47 | 189 to 219                | 21.3 to 24.7 |
| 14                         | 1.58 | 196 to 226                | 22.1 to 25.5 |
| 15                         | 1.69 | 202 to 232                | 22.8 to 26.2 |

After selecting the proper shim pack, apply Permatex No. 2 on outside shim before bolting case together. Bolt gear case halves together using twelve cap screws and tighten to 80 ft-lbs (108.5 Nm) torque.

Shim between end cap and gear case to obtain a torque increase from 25 to 75 in-lbs (28.2 to 84.7 Nm).

*NOTE: Use three bolts to hold end cap in place until proper torque is obtained.*

**IMPORTANT: The torque reading must be taken at the crankshaft.**

Bolt end cap to gear case using five cap screws. Tighten cap screws to 80 ft-lbs (108.5 Nm) torque.

Press crankshaft oil seal into gear case.

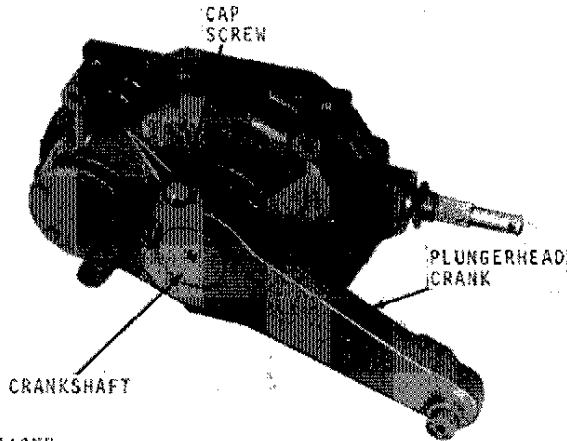
Press flywheel shaft oil seal into gear case.

Press input shaft oil seal into gear case.



Install seals with lip facing in. Use seal sleeves to protect the seals from the sharp edges of the splines on the shafts. Lubricate the seal lip.

Fill gear case with SAE 90-140 API-GL5 Gear Lubricant. The capacity is 1 U.S. gallon (3.79 l).



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Fig. 17—Installing Plungerhead Crank

Place plungerhead crank on crankshaft.

**NOTE:** Match teeth on crank with a new set of teeth on crankshaft.

Secure with cap screw and nut.

## INSTALLATION

Reverse the removal procedure to install the gear case.

When reinstalling flywheel it may be necessary to replace shear arm if excessive wear is evident.

## SPECIFICATIONS AND TORQUE VALUES

### OVERRUNNING CLUTCH AND SLIP CLUTCH

| Item                      | Measurement         | Specification   |
|---------------------------|---------------------|---|
| Slip Clutch .....         | Slip Torque .....   | 336 Balers:<br>400 to 500 ft-lbs (542 to 678 Nm)<br>346 Balers:<br>475 to 575 ft-lbs (644 to 780 Nm)<br>466 Balers:<br>700 to 800 ft-lbs (949 to 1085 Nm)           |
| Slip Clutch Springs ..... | Spring Length ..... | 336 Balers:<br>1-19/32 to 1-21/32 inches (40.5 to 42.1 mm)<br>346 Balers:<br>1-17/32 to 1-19/32 inches (38.9 to 40.5 mm)<br>466 Balers:<br>1-23/32 inches (43.7 mm) |

### GEAR CASE

| Item   | Measurement          | Specification   |                            |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
|--|----------------------|---|----------------------------|--|---------------------------|--|--------|----|--------|----|---|------|------------|--------------|---|------|------------|--------------|---|------|------------|--------------|---|------|------------|--------------|---|------|------------|--------------|----|------|------------|--------------|----|------|------------|--------------|----|------|------------|--------------|----|------|------------|--------------|----|------|------------|--------------|----|------|------------|--------------|
| Input shaft .....                              | Rolling torque ..... | 5 to 15 in-lbs (0.56 to 1.69 Nm)  |                            |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| Bevel gears .....                              | Backlash .....       | .005 to .015 in. (0.127 to 0.381 mm)  |                            |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| Crankshaft (less flywheel shaft end cap) ..... | Rolling torque ..... | <table border="0" style="margin: auto;"> <thead> <tr> <th colspan="2" style="text-align: center;">INPUT SHAFT BEARING TORQUE</th> <th colspan="2" style="text-align: center;">CRANKSHAFT BEARING TORQUE</th> </tr> <tr> <th style="text-align: center;">In-lbs</th> <th style="text-align: center;">Nm</th> <th style="text-align: center;">In-lbs</th> <th style="text-align: center;">Nm</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">5</td><td style="text-align: center;">0.56</td><td style="text-align: center;">134 to 164</td><td style="text-align: center;">15.1 to 18.5</td></tr> <tr><td style="text-align: center;">6</td><td style="text-align: center;">0.68</td><td style="text-align: center;">141 to 171</td><td style="text-align: center;">15.9 to 19.3</td></tr> <tr><td style="text-align: center;">7</td><td style="text-align: center;">0.79</td><td style="text-align: center;">147 to 177</td><td style="text-align: center;">16.6 to 20.0</td></tr> <tr><td style="text-align: center;">8</td><td style="text-align: center;">0.90</td><td style="text-align: center;">154 to 184</td><td style="text-align: center;">17.4 to 20.9</td></tr> <tr><td style="text-align: center;">9</td><td style="text-align: center;">1.02</td><td style="text-align: center;">161 to 191</td><td style="text-align: center;">18.2 to 21.6</td></tr> <tr><td style="text-align: center;">10</td><td style="text-align: center;">1.13</td><td style="text-align: center;">169 to 199</td><td style="text-align: center;">19.1 to 22.5</td></tr> <tr><td style="text-align: center;">11</td><td style="text-align: center;">1.24</td><td style="text-align: center;">175 to 205</td><td style="text-align: center;">19.8 to 23.2</td></tr> <tr><td style="text-align: center;">12</td><td style="text-align: center;">1.36</td><td style="text-align: center;">182 to 212</td><td style="text-align: center;">20.6 to 23.9</td></tr> <tr><td style="text-align: center;">13</td><td style="text-align: center;">1.47</td><td style="text-align: center;">189 to 219</td><td style="text-align: center;">21.3 to 24.7</td></tr> <tr><td style="text-align: center;">14</td><td style="text-align: center;">1.58</td><td style="text-align: center;">196 to 226</td><td style="text-align: center;">22.1 to 25.5</td></tr> <tr><td style="text-align: center;">15</td><td style="text-align: center;">1.69</td><td style="text-align: center;">202 to 232</td><td style="text-align: center;">22.8 to 26.2</td></tr> </tbody> </table> | INPUT SHAFT BEARING TORQUE |  | CRANKSHAFT BEARING TORQUE |  | In-lbs | Nm | In-lbs | Nm | 5 | 0.56 | 134 to 164 | 15.1 to 18.5 | 6 | 0.68 | 141 to 171 | 15.9 to 19.3 | 7 | 0.79 | 147 to 177 | 16.6 to 20.0 | 8 | 0.90 | 154 to 184 | 17.4 to 20.9 | 9 | 1.02 | 161 to 191 | 18.2 to 21.6 | 10 | 1.13 | 169 to 199 | 19.1 to 22.5 | 11 | 1.24 | 175 to 205 | 19.8 to 23.2 | 12 | 1.36 | 182 to 212 | 20.6 to 23.9 | 13 | 1.47 | 189 to 219 | 21.3 to 24.7 | 14 | 1.58 | 196 to 226 | 22.1 to 25.5 | 15 | 1.69 | 202 to 232 | 22.8 to 26.2 |
| INPUT SHAFT BEARING TORQUE                     |                      | CRANKSHAFT BEARING TORQUE   |                            |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| In-lbs   | Nm                   | In-lbs  | Nm                         |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| 5  | 0.56                 | 134 to 164  | 15.1 to 18.5               |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| 6  | 0.68                 | 141 to 171  | 15.9 to 19.3               |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| 7  | 0.79                 | 147 to 177  | 16.6 to 20.0               |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| 8  | 0.90                 | 154 to 184  | 17.4 to 20.9               |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| 9  | 1.02                 | 161 to 191  | 18.2 to 21.6               |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| 10   | 1.13                 | 169 to 199  | 19.1 to 22.5               |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| 11   | 1.24                 | 175 to 205  | 19.8 to 23.2               |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| 12   | 1.36                 | 182 to 212  | 20.6 to 23.9               |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| 13   | 1.47                 | 189 to 219  | 21.3 to 24.7               |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| 14   | 1.58                 | 196 to 226  | 22.1 to 25.5               |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| 15   | 1.69                 | 202 to 232  | 22.8 to 26.2               |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |
| Flywheel shaft .....                           | Rolling torque ..... | Increase crankshaft torque by 25 to 75 in-lbs (2.8 to 8.5 Nm)   |                            |  |                           |  |        |    |        |    |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |   |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |    |      |            |              |

### TORQUE VALUES

| Item                                    | Torque  |
|---|---|
| Cap screws between case halves .....    | 70 to 90 ft-lbs (95 to 122 Nm)                |
| End cap-to-case cap screws .....        | 70 to 90 ft-lbs (95 to 122 Nm)                |
| Flywheel nut .....                      | 100 ft-lbs (135.6 Nm), then next castellation |
| Bale case-to-gear case cap screws ..... | 160 to 180 ft-lbs (217 to 244 Nm)             |

