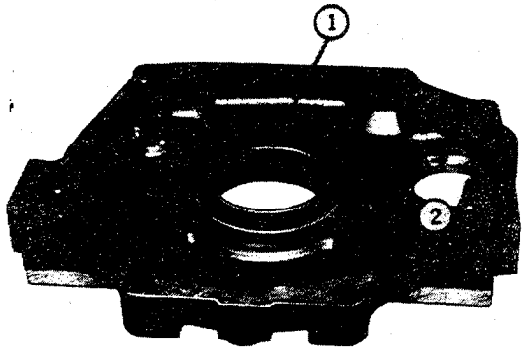
Remove old oil seal from flywheel housing.



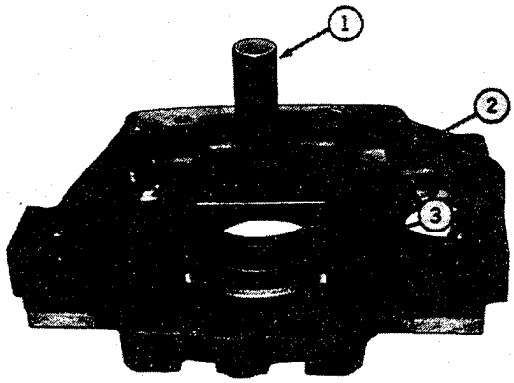
T46608N

1—JD-297-2 Pilot **2—Crankshaft Rear Oil Seal**

Fig. 21-Pilot and Oil Seal in Place

Place flywheel housing on a flat, even surface to install the oil seal.

Place JD-297-2 Pilot and oil seal in flywheel housing as shown in Fig. 21.



T46609N.

1—27489 Handle **3—Oil Seal**
2—JD-297-1 Driver

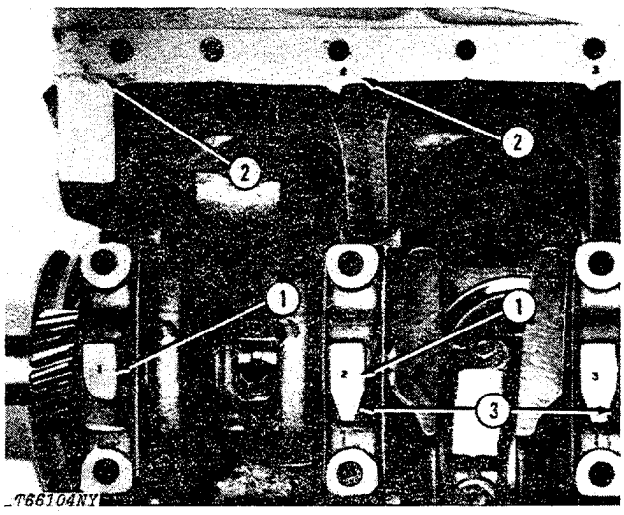
Fig. 22-Installing Crankshaft Rear Oil Seal

It is not necessary to use 27489 Handle with the JD-297-1 Driver to install the oil seal but it does help (Fig. 22).

Use a mallet to drive in the oil seal until the driver bottoms on the pilot.

Installation

Install main bearing caps with numbers corresponding to numbers in oil pan rail and to the same side as the numbers in the oil pan rail.



T66104NY

1—Number in Main Bearing Cap **3—Arrow**
2—Number in Oil Pan Rail

Fig. 23-Main Bearing Cap Positions

If numbers were stamped in main bearing caps (1, Fig. 23) at factory, install main bearing caps with numbers corresponding to numbers in oil pan rail (2). The "arrow" (3) machined on the main bearing cap number pad must point toward the cam shaft side of the cylinder block.

Install inserts with thrust faces in rear main bearing bore. Install plain inserts in other main bearing bores. Make sure that tangs on all inserts fit the locking grooves in the bores and that the oil holes in inserts line up with oil passages in the block.

Make sure bearing caps are installed on the mains from which they were removed by referring to identification marks made at the time of removal. Dip each main bearing cap screw in oil. Loosely install cap screws in main bearing caps until finger tight.

Align upper and lower thrust flanges on rear main bearings as follows: Tap the crankshaft to the rear to line up the front flanges. Then tap the crankshaft to the front to line up the rear flanges. Tighten main bearing cap screws to 85 lb-ft (11.752 kg-m).

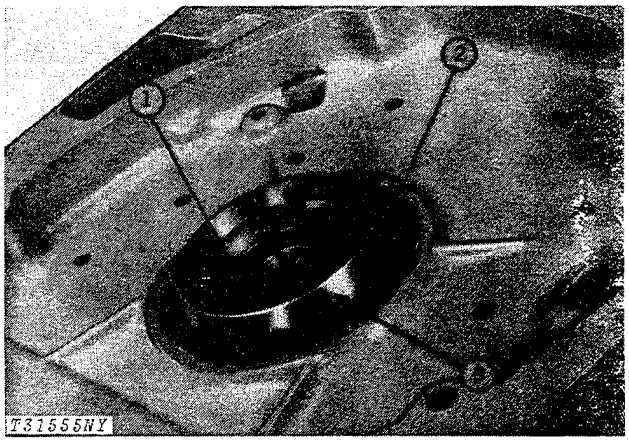
If crankshaft end play has not been checked with all repair parts installed, check it by method given on page 20-10-10. End play is 0.0020 to 0.0080 inch (0.0508 to 0.2032 mm). End play up to 0.0150 inch (0.3810 mm) is acceptable.

Position JD251-4 seal protector over rear of crankshaft and coat protector and wear ring with engine oil. Install flywheel housing on rear of engine. Be careful not to invert oil seal lip in flywheel housing. Tighten flywheel housing cap screws to 35 lb-ft (5 kg-m).

To facilitate installation of flywheel, screw two pilot studs into flywheel mounting screw holes in crankshaft.

NOTE: It is recommended that "D" grade cap screws be replaced with "F" grade cap screws and hardened washers.

Install cap screws. Tighten "D" grade cap screws to 85 lb-ft (12 kg-m). "F" grade cap screws to 120 lb-ft (18 kg-m).



1—Crankshaft **3—JD251-4**
2—Wear Ring

Fig. 24-Installing Flywheel Housing

Place crankshaft oil slinger over front end of crankshaft with inside diameter of slinger against front gear on crankshaft.

Install all other parts removed.

Install engine (See Group 5 of this section).

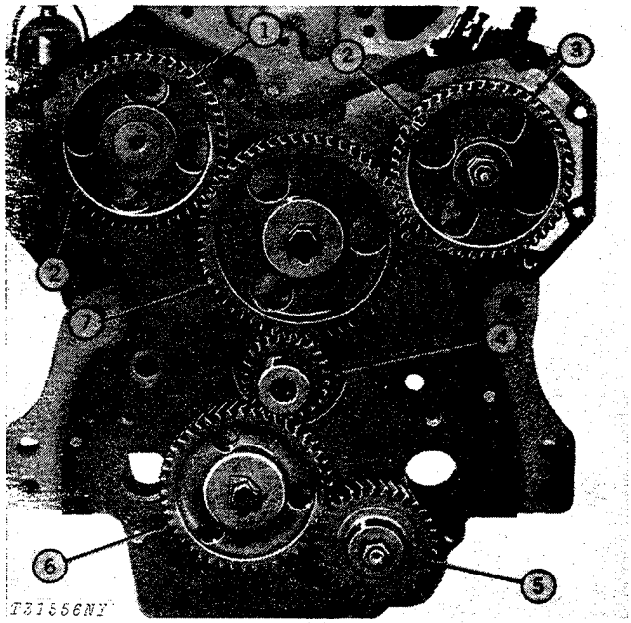
TIMING GEAR TRAIN

REMOVAL

To service gear train and related parts, with the exception of the crankshaft, engine normally need not be removed. If engine must be removed, see Group 5 of this Section.

Whenever an engine is being completely reconditioned or the crankshaft is being removed, the engine front plate with gear assemblies should be removed from the engine using the following steps:

1. Remove oil pressure regulating valve and timing gear cover.
2. Remove hex. nuts from the oil pump, drive gears and cap screws from upper and lower idler gears.
3. Remove upper and lower idler gears from engine front plate. Attach a puller to oil pump gear and pull gear from shaft. NEVER PRY GEAR FROM SHAFT.
4. Remove oil pump (Group 15).
5. On diesel engines, remove fuel injection pump and drive gear (Group 25). On gasoline engines, remove governor (Group 25).
6. Remove camshaft.



1—Camshaft Gear
2—Timing Mark
3—Injection Pump Gear (Diesel)
4—Crankshaft Gear
5—Oil Pump Gear
6—Lower Idler Gear
7—Upper Idler Gear

Fig. 25-Engine Timing Gear Train

REPAIR

For gear inspection and repair, refer to the section and group in the manual which covers the assemblies which the gears drive. The camshaft and crankshaft must be removed from the engine to replace their gears.

Checking Gear Train Backlash

Gear train noise can be an indication of excessive gear lash or damaged teeth. Check backlash before removing gears. Specified timing gear train backlash is as follows:

Gear	Backlash
Crankshaft to upper idler	0.0027 to 0.0116 in. (0.065 to 0.295 mm)
Upper idler to camshaft	0.0028 to 0.0135 in. (0.071 to 0.343 mm)
Upper idler to injection pump	0.0028 to 0.0135 in. (0.071 to 0.343 mm)
Crankshaft to lower idler	0.0027 to 0.0137 in. (0.069 to 0.348 mm)
Lower idler to oil pump	0.0016 to 0.0147 in. (0.043 to 0.373 mm)
Upper idler to governor	0.0023 to 0.0127 in. (0.058 to 0.323 mm)
Camshaft to distributor	0.0005 to 0.0075 in. (3.013 to 0.191 mm)

Replace gears as necessary.

Idler Gears

Be sure that oil hole in upper idler gear is open.

Check both idler gears for excessive end play. New part end play should be 0.0010 to 0.0070 inch (0.025 to 0.178 mm). A maximum 0.0150 inch (0.381 mm) end play is acceptable.

Measure I.D. of bushing and O.D. of shaft to determine oil clearance of 0.0015 to 0.0035 inch (0.038 to 0.089 mm). A maximum 0.0061 inch (0.1524 mm) clearance is acceptable. New bushing I.D. is 1.7520 to 1.7530 inches (44.501 to 44.526 mm). New shaft O.D. is 1.7495 to 1.7505 inches (44.437 to 44.463 mm).

If excessive wear or oil clearance is indicated, use JD-252 Bushing Driver to install new bushing flush with either side of gear.

If idler gear shaft replacement is necessary, press in new spring pins to 0.20 to 0.28 inch (5.1 to 7.1 mm) above shaft.

Front Plate and Timing Gear Cover

Never pry or press against timing gear cover with excessive force. The cover is cast aluminum alloy and might be sprung or warped.

On gasoline engines, inspect governor shaft bushing in timing gear cover for galling or excessive wear. Replace if necessary. Using tool JD-246, press in new bushing until flange on bushing contacts timing gear cover.

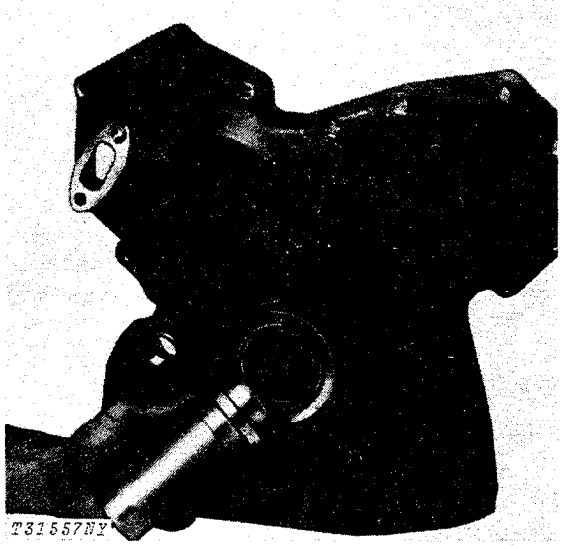


Fig. 26-Installing Oil Seal in Timing Gear Cover Using JD-250 Driver

If there is evidence of oil leakage on outside of timing gear cover, replace crankshaft front oil seal.

Coat outer surface of seal with joint sealing compound and inside surface with multi-purpose grease. Support the oil seal bore area of timing gear cover. Press in oil seal to bottom of bore with spring loaded lip facing inward using special JD-250 driver (Fig. 26).

INSTALLATION

Installing and Timing the Gear Train

The camshaft gear and injection pump gear must be timed to the crankshaft when they are installed. Install and time gear assemblies using the following steps:

1. Turn crankshaft until No. 1 piston is at top dead center (TDC) of its compression stroke. Remove timing hole cover and screw on flywheel housing. Reversing the screw, insert the smooth end into the flywheel housing bore. Rock the flywheel until the screw slides into hole in flywheel.

If engine is stripped, position crankshaft so that No. 1 (fan end) connecting rod journal is at its highest point toward the deck of the engine at this time. The keyway in the crankshaft front gear (not pulley keyway) should now point straight up toward the top of the engine.

Do not rotate crankshaft after "TDC" setting has been made.

2. Install camshaft.

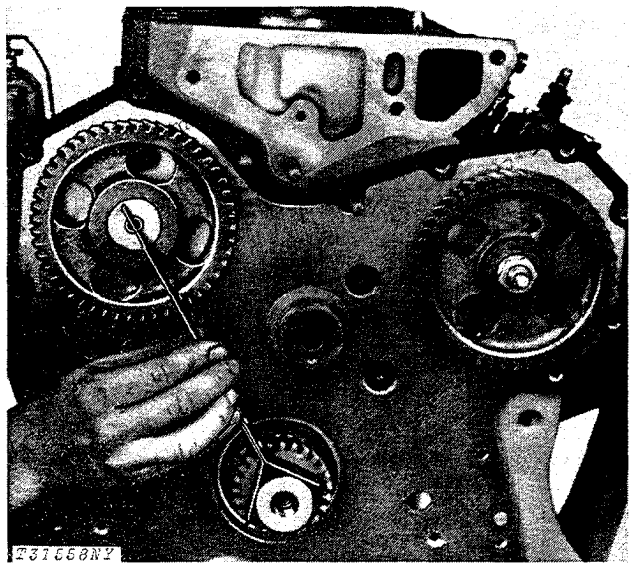


Fig. 27-Timing the Camshaft Gear with JD-254 Tool

With engine at "TDC," use special tool JD-254 to align the timing mark on the camshaft gear between centers of the crankshaft and camshaft (Fig. 27).

3. Install fuel injection pump and drive gear or governor (Group 25).

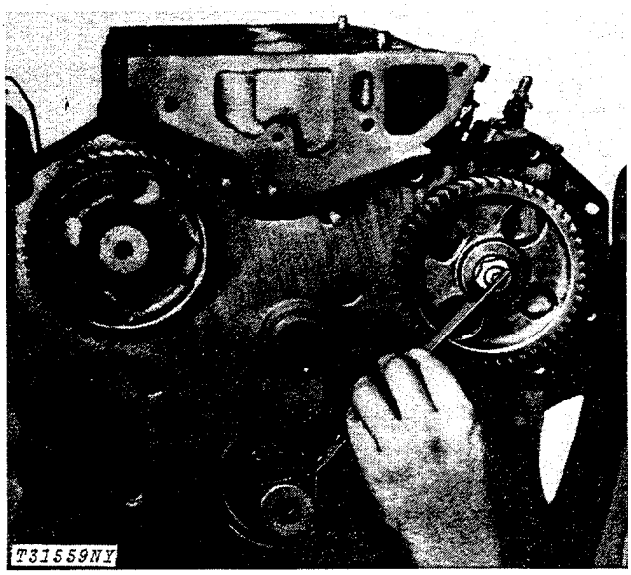


Fig. 28-Timing the Injection Pump Gear with JD-254 Tool

On diesel engines, with engine at "TDC," use special tool JD-254 to align the timing mark on the injection pump gear between centers of crankshaft and injection pump shaft (Fig. 28).

Use the timing mark on the injection pump drive gear which indicates the number of cylinders in the engine.

4. With camshaft and injection pump gear or governor installed and timed, carefully install upper idler gear into position using care not to rotate the timing gears. Be sure inner thrust washer and idler gear shaft are in place behind idler gear.

Install outer thrust washer, making sure holes in inner and outer thrust washers fit over spring pin or idler gear shaft. Install special washers and cap screw and tighten to 65 lb-ft (9 kg-m).

5. Install oil pump and drive gear (Group 15).

Tighten oil pump gear hex. nut 35 to 45 lb-ft (4.8 to 6.2 kg-m) after gears have been timed and lower idler gear installed so that gears may be restrained with a screwdriver. Then stake threads on shaft.

6. With oil pump gear installed, install lower idler gear into position, using care not to rotate any gears. Be sure inner thrust washer is in place on rear of idler gear shaft.

Install outer thrust washer, making sure holes in inner and outer thrust washers fit over spring pin in idler gear shaft. Install inner and outer special washers and cap screws and tighten to 95 lb-ft (13.1 kg-m).

After all gears are locked in place, recheck all timing marks with special tool JD-254, making sure that marks still align between the centers of the respective shafts and the center of the crankshaft with the engine at "TDC." Then remove timing screw from flywheel and install timing hole cover.

Final Installation

Apply a thin coat of high temperature grease to the inside lips of the front oil seal and install timing gear cover. Be careful not to invert lips of oil seal while installing cover.

Before installing gear cover on engine be sure that oil slinger is securely positioned over end of crankshaft with inside against gear. Also be sure oil pressure regulating valve and spring are in place under cover.

Group 15
ENGINE LUBRICATION SYSTEM

GENERAL INFORMATION

The engine lubrication system consists of the oil filter and oil pump.

The oil filter is mounted on the right side of the engine. It filters impurities out of the crankcase oil.

The engine oil pump is mounted in the oil pan. Oil enters the pump from the rear through the pump intake tube and is discharged at the oil outlet hole into an oil tube leading to the oil filter and an engine oil gallery.

A pressure regulating valve is located at the fan end of cylinder block in the oil gallery. Under normal conditions it is not necessary to adjust pressure but it can be done by adding or subtracting shims or adding a large aluminum washer behind the valve plug. When oil pressure is greater than the spring pressure, oil is bypassed to the crankcase and desired pressure is maintained.

OIL PUMP

Removal

Check engine oil pressure before removing pump (See Group 10, Section 70).

Drain oil from engine and remove oil pan.

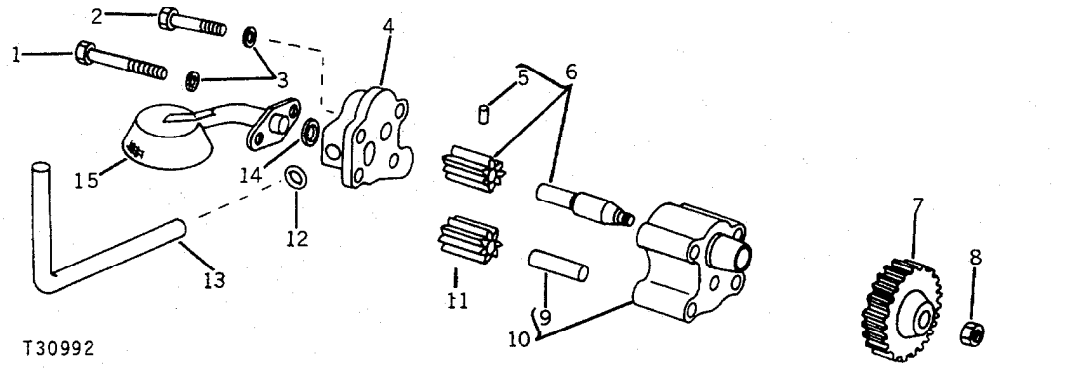
Remove cap screws holding pump to block.

Repair

Remove idler gear (11, Fig. 1) from idler shaft (19); then support housing and press out shaft.

Inspect pump housing surface which attaches to cover for rough burred or warped conditions. Replace if necessary.

Examine pump cover (4) mounting surface. A damaged cover must be replaced. The seal between cover and pump housing is dependent upon these two surfaces being perfectly flat and smooth.



1—Cap Screw (2 used)
2—Cap Screw (2 used)
3—Lock Washer (4 used)
4—Cover Assembly
5—Groove Pin
6—Drive Shaft with Gear and Pin
7—Drive Gear
8—Nut
9—Idler Shaft
10—Housing
11—Idler Gear
12—O-Ring
13—Outlet Tube
14—O-Ring
15—Oil Pump Intake

Fig. 1-Oil Pump

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