SECTION 6

CRANKSHAFT ASSEMBLY AND ACCESSORY DRIVE GEAR TRAIN

CRANKSHAFT ASSEMBLY AND ACCESSORY DRIVE GEAR TRAIN

GENERAL

The crankshaft assembly is made up of the crankshaft, main bearings and caps, thrust collar, torsional damper, and the accessory drive gear. Although the accessory drive gear is part of the crankshaft assembly, it will be described as part of the accessory drive gear train.

The accessory drive gear train provides power from the crankshaft to drive the oil pumps, water pumps and the governor.

CRANKSHAFT

DESCRIPTION

The crankshaft, Fig. 6-1, is a drop forging of carbon steel material with induction hardened main and crankpin journals. On 8 and 12-cylinder engines, the crankshaft is a one piece forging. On 16 and 20-cylinder engines, the crankshaft is made up of two sections whose flanges are bolted together. Counterweights are provided to give stable operation and all crankshafts are dynamically balanced. Drilled oil passages provide for lubrication of the main bearings as shown in Fig. 6-2.

Crankshafts with bolt-on accessory drive stubshafts are available for 12, 16, and 20-cylinder engines.

Refer to "Accessory Drive Gear" for removal and installation of stubshaft.

MAINTENANCE

INSPECTION

Whenever the main or connecting rod bearings are removed, the crankshaft journals should be inspected. Check for scoring and cracks, and signs of distress, as

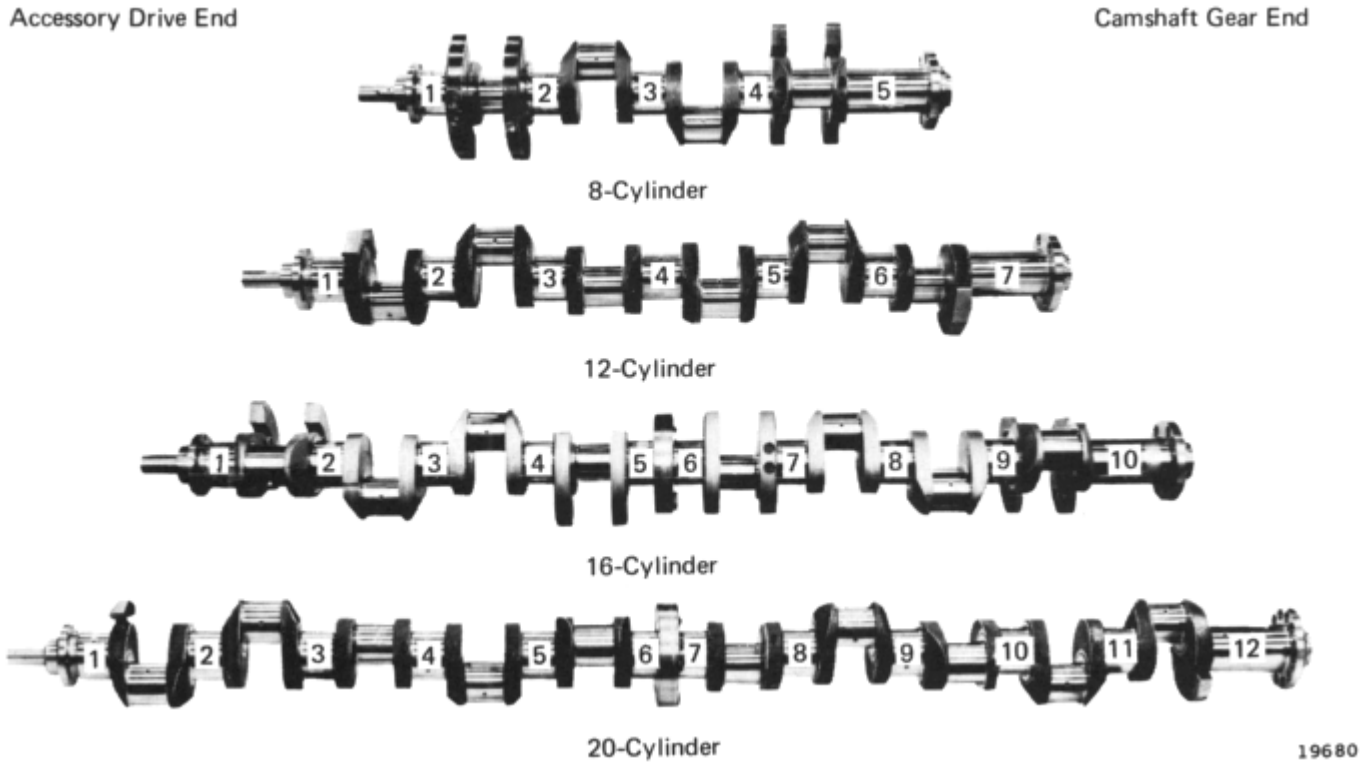


Fig. 6-1 - Engine Crankshaft

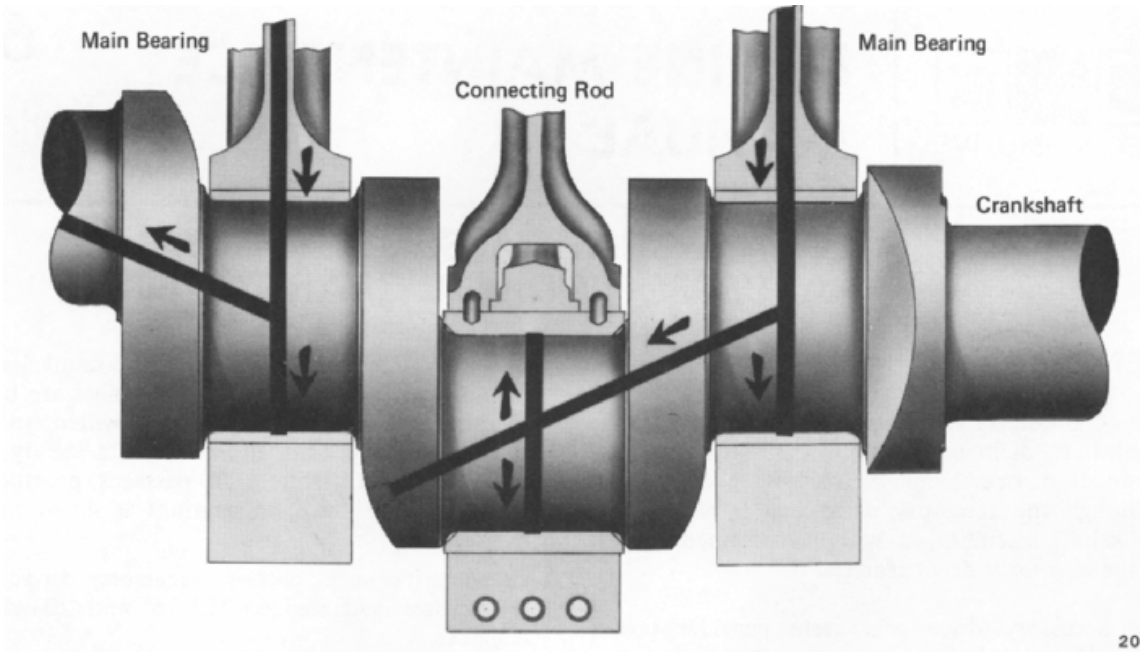


Fig. 6-2 - Crankshaft Oil Passages

will generally be evidenced first in the bearings. When the crankshaft is removed from the engine, it should be visually and dimensionally inspected, and magnaflux inspected if possible.

The journals of the crankshaft are induction hardened. Excessive heat resulting from lack of lubrication, insufficient bearing clearance, or other causes will usually produce thermal cracks on the journal. Damaged crankshafts can usually be reconditioned at EMD to re-establish journal size and condition to use standard size bearings. In some instances, crankshafts may have to be reground requiring the use of undersize bearings.

Attempts to grind crankshafts in the field have proven unsuccessful, as during the regrinding process, the depth of the induction hardened zone must be checked, and when necessary, rehardened. This requires special induction hardening equipment. It is therefore recommended that the crankshaft be returned for grinding. To aid identification, reground crankshafts with undersize journals or oversize thrust bearings will have this information stamped on the same cheek as the serial number.

INSTALLATION

1. Aply the main bearings to the "A" frame bores and to the bearing caps, lining up the bearing tangs.

NOTE: See "Main Bearings" for qualification of bearings.

2. Ispect the crankshaft and be sure it is clean. Oil the crankshaft journals and main bearing shells, using clean oil.

3. Pace the thrust collars in their respective "A" frame counterbores, as shown in Fig. 6-3.

4. Pace the crankshaft in the "A" frame bearing shells and apply the two end and two center (16 & 20-cyl.) bearing caps to hold the crankshaft in place. Check that the studs, nut seats, and washers are lubricated with Texaco Threadtex No. 2303 and secure the caps. Tighten the nuts until they contact the bearing caps.

5. Rmove the hoist or crane hooks.
6. Aply the remaining bearing shells and caps. Manually tighten the nuts until hardened washers are seated on bearing cap.

7. Uing a power wrench, all nuts are torqued to 475-542 N-m (350-400 ft-lbs). After all nuts have been tightened to this torque, final torque nuts to 1 017 N-m (750 ft-lbs). Do NOT overtorque.

NOTE: No one nut on any one cap should be torqued to 1 017 N-m (750 ft-lbs) until all nuts on that cap have been torqued to 475-542 N-m (350-400 ft-lbs).

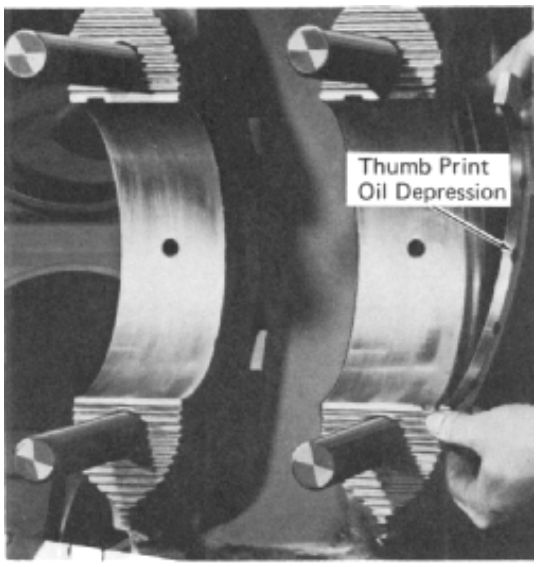


Fig. 6-3 - Applying Thrust Collar (16 & 20-Cyl.)

MAIN BEARINGS

DESCRIPTION

The main bearing shells, Fig. 6-4, are precision type steel-backed lead-bronze, with a thin layer of lead-tin. Tangs in the bearings locate them in the proper axial position and prevent bearing turning. Upper and lower bearing shell halves are not interchangeable.

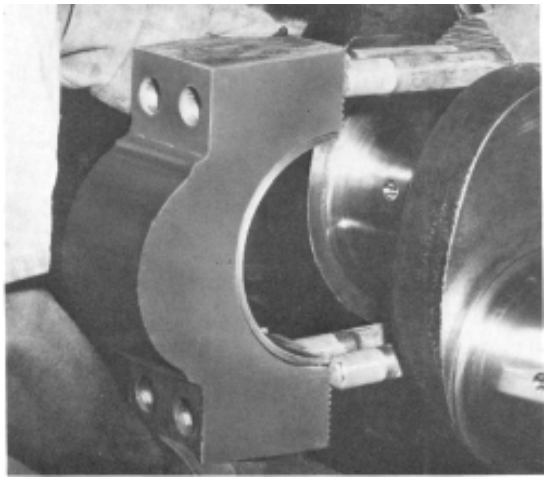


Fig. 6-4 - Main Bearing Shell And Cap

Lower main bearing shells have two tangs on each side which fit into the main bearing cap. Upper main bearing shells have one tang which fits into a groove on the right side of the "A" frame bore. Upper shells can be rotated out, in a direction opposite to normal crankshaft rotation, when the lower bearing and cap are removed.

MAINTENANCE

SCHEDULED RENEWAL

Lower main bearings should be renewed at the intervals specified in the Scheduled Maintenance Program. Upper main bearings need not be removed when lower main bearings are renewed unless the lower bearings show definite signs of distress. Upper main bearings may be changed out individually as required, not in sets.

INSPECTION

UPPER MAIN BEARINGS

Inspection of upper main bearings is not recommended; however once the upper main bearings are removed, they should not be reinstalled.

LOWER MAIN BEARINGS

Lower main bearing inspection should be performed only when necessary as an element of risk is involved whenever main bearings are disturbed.

1. he lower main bearings should be inspected when abnormal conditions are observed in the engine, such as contamination of lube oil due to dilution with fuel or water, or the presence of foreign material in the lube oil filters, screens, or engine oil pan.

2. Lower main bearings need not be inspected in routine service, but should be renewed at the intervals specified in the Scheduled Maintenance Program.

INSPECTION SAMPLE

Unless evidence is present calling for other action, inspection of main bearings should be limited to the following "selected" lower bearings, which experience has shown to be the most critical. See Fig. 6-1 for main bearing numbering location.

Number Of Cylinders	Bearing Number To Be Inspected
8	2,4
12	2,6
16	2,6,9
20	2,5,8,11

DISQUALIFICATION CRITERIA

All lower main bearings are to be renewed if any one lower main bearing is disqualified at any one of the "selected" bearing locations indicated above, or at any additional locations inspected for other reasons.

The following numbered paragraphs give examples of conditions requiring renewal of all lower main bearings.

1. Any one bearing shows evidence of overheat. An overheat condition results in flowing of the overlay, and discoloration of exposed bronze. (An upper main bearing is to be renewed when the corresponding lower bearing shows evidence of overheat.)

2. Any one bearing shows a milky white color on the overlay. (This is evidence of an extremely thin overlay and indicates water contamination.)

3. Any one bearing has an area of wear-exposed bronze 3.18 mm (1/8") or more wide running along either edge, or if two or more bearings have any exposed bronze.

NOTE: The lead-tin overlay on the bearings must be present to provide an adequate safety margin against temporary marginal lubrication or corrosive conditions. Exposed bronze in healed dirt cuts does not affect bearing operation, but exposed bronze due to wear does cause a bearing to lose its protection against temporary marginal lubrication conditions.

4. Exposed bronze due to isolated abnormal wear or overlay flaking.

5. Severe fretting along the mating edge of the upper and lower bearing. (The corresponding upper bearing should be renewed at any location exhibiting severe fretting, and bearing cap serrations inspected for possible damage.)

6. Severe dirt scratches or dirt impregnation resulting in an abrasive surface.

CAUTION: Dirt impregnation or scratches are evidence that bearing oil is not properly filtered. The filtration system should be checked, and scheduled pressure monitoring of lube oil filter condition established.

INSPECTION PROCEDURE

A visual inspection is made by dropping the main bearing cap, with the bearing in it, low enough to make the inspection without removing the cap from the studs or the bearing from the cap. Removal of a reusable main bearing from the cap may result in improper reseating. Bearing removal also allows the possibility of replacing the bearing in a reversed position or at the wrong journal location. Either condition can lead to early failure. In addition, removal of the cap from the studs involves the risk of damage by dropping and the risk of replacing the cap backwards.

If a reusable bearing is inadvertently removed from the cap during inspection, perform the following:

1. Determine the previous bearing position by matching the wear patterns on the cap bore and the back of the bearing. If this cannot be done, a new bearing should be installed. This is the only case where a lower main bearing may be renewed independently.
2. When previous position is determined, mark a mud pocket to identify right or left bank side.
3. Thoroughly clean the bearing back and cap bore. Remove any raised material in fretted areas. High spots may distort the bearing and cause premature failure.
4. Thoroughly clean the cap and "A" frame serrations before assembly.

REMOVAL AND APPLICATION

Lower main bearings are to be removed with the bearing caps, and new bearings installed in the caps before the caps are reapplied. It is recommended practice to install new bearings with the part numbers towards the accessory end of the engine. A main bearing cap application and removal tool is available for removal and application of main bearing caps.

All upper main bearings, except No. 5 on 8-cylinder engines, No. 7 on 12-cylinder engines, Nos. 5 and 6 on 16-cylinder engines, and Nos. 6 and 7 on 20-cylinder engines, Fig. 6-1, are removed by inserting the upper main bearing shell remover into the journal oil passage and rotating the crankshaft opposite to the normal direction of rotation. Upper main bearings on journals without oil holes or which are fretted (or welded) to the "A" frame bore can be removed by using upper bearing removal tool.

New upper main bearings are to be fitted by hand between the crankshaft and steel bore. If the bearings can not be hand fitted, the reason must be found and corrected. The engine may have to be removed and the crankcase remanufactured.

To apply the main bearings, see the instructions for installation of crankshaft.

SPECIAL PROCEDURES FOR OVERHEATED BEARINGS

If an overheat condition is detected, all lower main bearings are to be renewed. Upper main bearings are to be renewed only at the overheat locations. In addition to routine cleanup of main bearing caps and "A" frame serrations, perform the following:

1. Measure main bearing cap serration spacing, using serration gauge. If the gap is closed in more than 0.51 mm (.020") from nominal (dial indicator on gauge set to zero with master bar), the engine should be removed and the crankcase remanufactured.

2. If new upper main bearings can not be hand fitted between the crankshaft and the steel bore, the reason must be found and corrected. The engine may have to be removed and the crankcase remanufactured.

3. If crankcase inspections proved satisfactory and new bearings are installed, perform a "feel over" check after the break-in run. The main bearing caps should be lowered on the studs at the locations where the overheat was detected, and a bearing inspection made.

4. Bearing inspection should be repeated at the overheat locations at the end of one month of operation, and at the end of three months of operation.

THRUST COLLAR

DESCRIPTION

The two thrust collars, Fig. 6-5, are solid bronze and are semicircular in shape. One face of each collar has "thumb print" oil depressions to ensure adequate lubrication. They are placed in the counterbore of each center bearing"A" frame and are held in position by the bearing caps. Their purpose is to limit the longitudinal movement of the crankshaft.

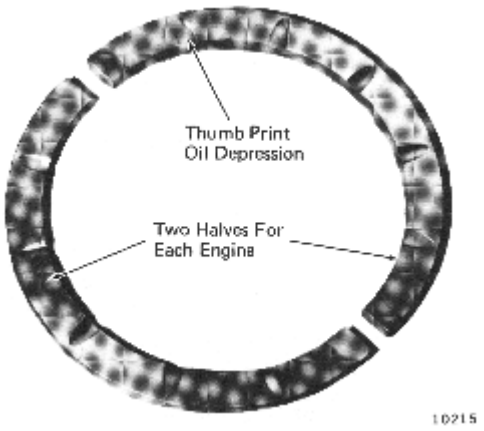


Fig. 6-5 - Crankshaft Thrust Collars

The thrust surfaces are lubricated by main bearing leak-off oil and are installed with their "thumb print" oil depressions away from the "A" frame in which they are placed.

MAINTENANCE

Thrust collars which exceed clearance limit should be replaced.

GEAR TYPE TORSIONAL DAMPER

DESCRIPTION

The gear type damper, Fig. 6-6, is a hydraulic paddle wheel device which absorbs torsional vibrations of the crankshaft by forcing engine lubrication oil through narrow passages in the damper. The damper consists of a spider, with external spur teeth, an intermediate ring, with internal spur teeth, and two outer side plates secured with bolts and nuts. A continuous circulation of oil is provided to the damper through an oil passage in the crankshaft.

Oil flows from the chamber in the center of the damper through radial holes, beginning in the spider hub and ending at the fillet radius at the base of each tooth. The passages contain a narrowed section at the spider hub to provide an oil flow restriction. The spider is designed so that each tooth is directly supplied with oil. An auxiliary circumferential oil groove is machined into each side face of the spider to supply oil for the rubbing surfaces between the spider and outer plate. These grooves are supplied by means of passages connecting the grooves of the radial holes.

The intermediate ring is ground on both sides to a uniform thickness, slightly thicker than the spider.

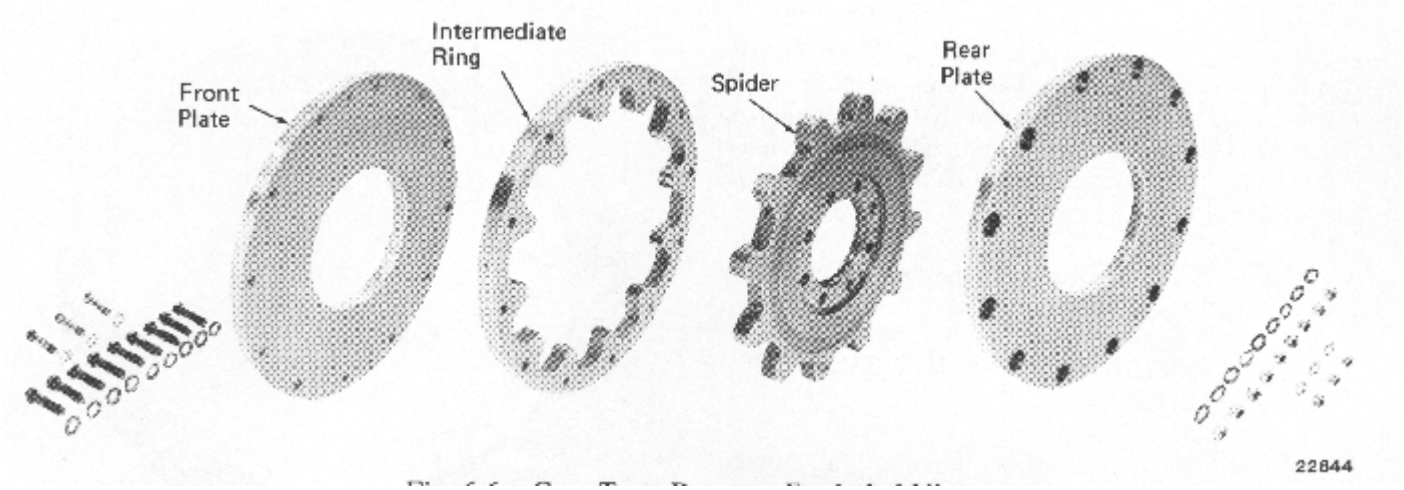


Fig. 6-6 -- Gear Type Damper, Exploded View

This difference in thickness provides the axial clearance necessary for proper oil passage. In addition, clearance between the intermediate ring and the spider is provided to allow the ring to "float" on the oil film generated at the tips of the spider teeth.

Four vent holes are drilled through the rim of the intermediate ring to relieve oil pressure and readjust the ring to a central position when it becomes displaced. The holes, which are equally spaced around the ring, are normally covered by the tips of the spider teeth. However, oil is permitted to vent when the intermediate ring becomes displaced and the spider teeth no longer cover the holes; thereby reducing pressure. The higher pressure on the opposite side of each tooth then prevails and restores the intermediate ring to its correct position. This design is used to prevent sudden bumping of the teeth.

Two identical outer side plates are secured to the intermediate ring by means of through bolts. The inner faces of the plates (adjacent to the spider) are covered with oil which flows through the clearance between the spider and the outer plates and drains to the crankcase.

MAINTENANCE

The damper requires no maintenance other than inspection at the time of normal overhaul. However, the damper should be checked for free movement at intervals specified in the applicable Scheduled Maintenance Program. This check can be performed by removing the rear handhole cover and rotating the damper about 10° in each direction by pressing against the inner plate. If the damper cannot be moved, it should be removed and disassembled.

DISASSEMBLY

1. Scribe a line across the outer plate, intermediate ring, and outer plate. Also mark the relationship of the spider to the outer plate. These marks will be used during reassembly of the unit.
2. Using 1-1/8" thinwall sockets, remove nine 3/4" bolts, washers and nuts from damper.
3. Using 15/16" thinwall sockets, remove three 5/8" bolts, washers and nuts from damper.
4. Remove front plate, intermediate ring, and spider from rear plate.

INSPECTION

1. Inspect four vent holes in intermediate ring for sludge or other obstructions. Remove debris using wire or thin metal rod.
2. Clean oil holes in spider with wire or thin metal rod.
3. Clean all components with fuel oil and examine all surfaces for excessive scratching or scoring.

ASSEMBLY

1. Place front plate with stamped serial number and part number facing down.
2. Apply a liberal coating of engine oil to all contact surfaces between the spider and the intermediate ring, and the inner and outer plates.
3. Place spider on front plate with stamped "FRONT" facing down, and align scribe mark on spider to line on front plate.

4. Place intermediate ring on front plate so internal teeth mesh with teeth of spider and scribe mark on ring is aligned with mark on front plate.

5. Position rear plate on intermediate ring and align scribe marks.

6. Apply Texaco Threadtex No. 2303 to threads of three 5/8" body bolts and install bolts and washers in 5/8" holes of rear plate, intermediate ring, and front plate.

7. Install 5/8" washers and nuts and torque to 203 N-m (150 ft-lbs).

8. Apply Texaco Threadtex No. 2303 to threads of nine 3/4" bolts and install bolts and washers in remaining holes of rear plate and secure with washers and nuts torqued to 325 N-m (240 ft-lbs).

INSTALLATION

Install damper on crankshaft with side of spider stamped "FRONT" facing away from engine. A "0" stamped above one of the mounting holes is to be applied in line with the number one crank pin. Apply Texaco Threadtex No. 2303 to mounting bolt threads and install eight mounting bolts and hardened washers. Torque to specified value.

ACCESSORY DRIVE GEAR TRAIN

DESCRIPTION

The accessory drive gear train, Fig. 6-7, is located at the front of the engine, and provides power from the crankshaft to drive the oil pumps, water pumps, and the governor.

The gear train consists of the accessory drive gear, scavenging oil pump gear, main lube oil pump gear, right and left hand water pump gears, and the governor drive gear.

MAINTENANCE

Unless a complete engine disassembly is being undertaken it is unlikely that the entire gear train would be removed from the engine at one time. The water pumps, oil pumps, and governor drive assembly can be removed from the gear train as individual units. Removal of the accessory drive gear or the governor drive gear requires removal and realignment of the accessory drive housing.

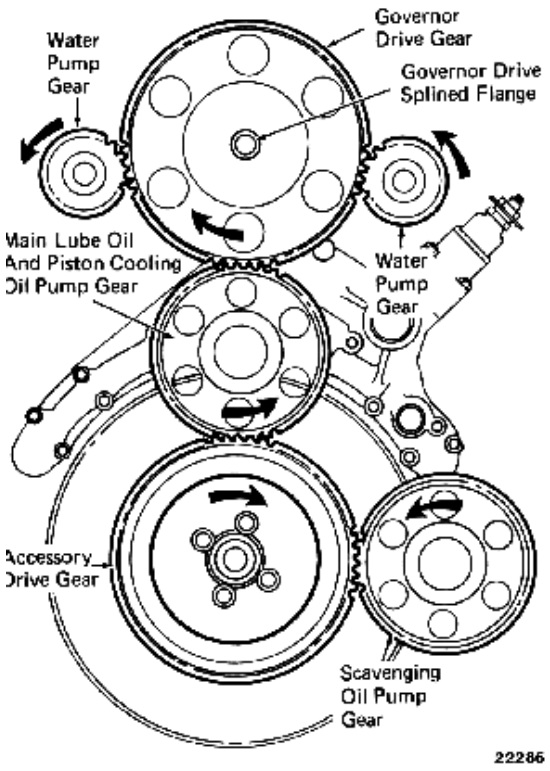


Fig. 6-7 - Accessory Drive Gear Train

ACCESSORY DRIVE GEAR

DESCRIPTION

The coil spring design accessory drive gear, Fig. 6-8, damps the transmission of crankshaft torsional vibrations to the accessory gear train. The accessory drive gear meshes directly with and provides the drive for the lube oil scavenging pump and the main lube oil and piston cooling oil pump.

MAINTENANCE

The accessory drive gear should be removed and inspected at the time of a complete engine overhaul. The accessory drive gear requires very little maintenance. At inspection intervals, it should be disassembled for inspection of parts.

Parts which show obvious damage should be replaced.

REMOVAL

The following removal procedures apply to gears mounted on standard crankshafts and to gears mounted on bolt-on stubshafts.

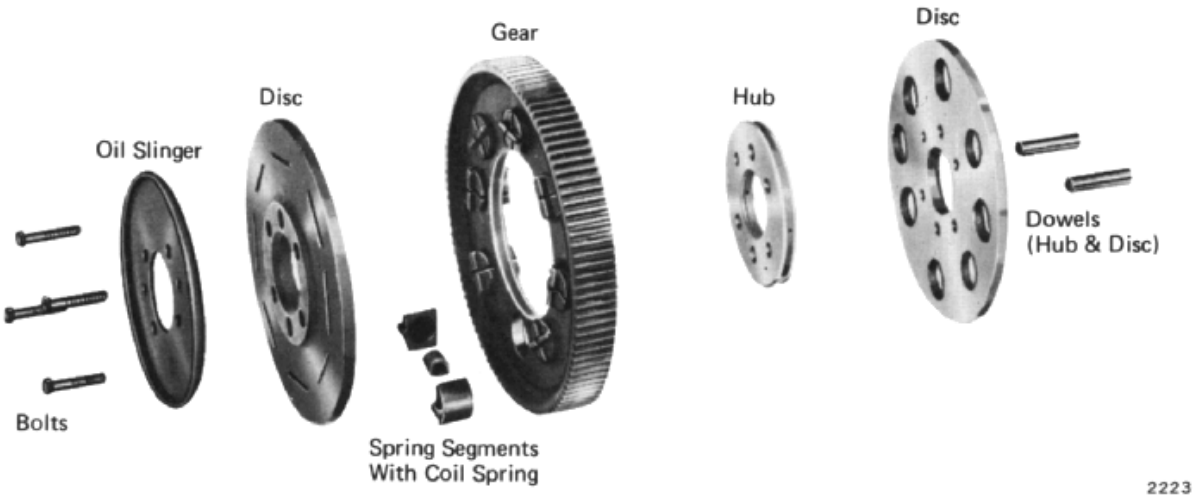


Fig. 6-8 - Accessory Drive Gear, Exploded View

STANDARD CRANKSHAFT

1. Remove four accessory drive gear mounting bolts and hardened washers securing gear to crankshaft.
2. Remove oil slinger.
3. Remove gear from crankshaft. BOLT-ON

STUBSHAFT

WARNING: Accessory drive gear mounting bolts also secure bolt-on stubshaft to crankshaft. Prior to removal of mounting bolts, apply blocking or secure gear and stubshaft with holding device.

1. Remove four oil slinger mounting bolts and remove oil slinger from gear.
2. Remove six spline head mounting bolts and hardened washers securing gear and stubshaft to crankshaft.
3. Remove gear and stubshaft from crankshaft.

BOLT-ON STUBSHAFT WITH IDENTIFICATION GROOVE

NOTE: Current configuration of stubshaft has a 1/8" wide groove on the face of the small end of the taper. This stubshaft is mounted to the crankshaft with two 1/2"-13 retention bolts which allows removal and application of the accessory drive gear and crankshaft damper without removing the stubshaft from the crankshaf't.

1. Remove four oil slinger mounting bolts and remove oil slinger from gear.
2. Remove six spline head mounting bolts and hardened washers securing gear to stubshaft.
3. Remove gear from stubshaft.

GEAR

The gear should be inspected for rough or scored surfaces on the gear teeth, and magnaflux inspected. If wear in excess of maximum limit occurs on the drive side of holes, the gear should be reversed. The serial number side of the gear is placed adjacent to the oil slinger at original installation. To identify the drive side when gear is reversed, the original serial number should be ground off and restamped on the opposite side.

The maximum bore diameter is permissible, provided that the hub to gear clearance does not exceed the maximum limit. (This bore may be chrome plated and reground to new dimension.)

HUB

A hub having a 190.436 mm (7.4975") diameter may be used if the maximum hub to gear clearance is not exceeded.

DISC

The disc may be re-used providing the spring segment bores do not exceed maximum diameter and are otherwise in good condition.

SPRING SEGMENTS

Spring segments should be marked, prior to dis-assembly, as to their relative position in the gear.

Wear should be checked on the right-hand segment half (viewed at 12 o'clock position) where the segment contacts the gear bore when driving the gear. If wear at this point exceeds maximum limit, the segment half should be replaced.

When reassembling spring segments, re-locate the segment, originally on the driven side, to the drive side, and place the replacement segment at the driven side of the gear.

SPRINGS

Springs may be re-used providing a pre-load exists at assembly of the spring and segments in the gear.

PHOSPHATE TREATMENT

It is recommended that the gear, hub, discs, and segments be phosphate treated before reassembly.

ASSEMBLY

Before reassembling the drive gear, be sure all parts are clean and well lubricated. Place the slotted disc on the bench with the slots facing down, and apply the gear over the disc. Align the holes in the gear and disc. Place a coil spring between two segments, and with the tabs down, and the assembly pressed together, start it into the gear. Drive the assembly all the way down, using a rawhide mallet, until the tabs enter the slot in the disc. Repeat this operation for the remaining spring assemblies. After they are in place, install the hub in the gear bore, and the remaining spring assemblies. After they are in place, install the hub in the gear bore, and apply the top disc. Line up the dowel holes in both discs and hub, and apply the dowels. A snug dowel fit should be maintained by reaming, and if necessary, applying oversize dowels. A bolt and nut should be used to clamp the assembly together until it is applied to a crankshaft.

INSTALLATION

The following procedures apply to crankshaft mounted gears and to bolt-on stubshaft mounted gears.

CRANKSHAFT MOUNTED

1. Install accessory drive gear on crankshaft and align mounting holes with holes in crankshaft.

2. Install oil slinger and align mounting holes with holes in gear.

3. Lubricate four mounting bolts with Texaco Threadtex No. 2303. Install bolts and hardened washers and torque to specified value.

BOLT-ON STUBSHAFT MOUNTED

1. Place gear on stubshaft and align mounting holes.

2. Place gear and stubshaft against crankshaft and align mounting holes of stubshaft to crankshaft.

3. Lubricate six spline head mounting bolts with Texaco Threadtex No. 2303. Install bolts and hardened washers and torque to specified value.

4. Secure oil slinger to gear with four mounting bolts and torque to 33 N-m (24 ft-lbs).

BOLT-ON STUBSHAFT WITH IDENTIFICATION GROOVE MOUNTED

1. If stubshaft has not been installed, align stubshaft retention bolt holes with holes in crankshaft and secure stubshaft to crankshaft with two 1/2"-13 bolts torqued to specified value.

2. Place gear on stubshaft and align mounting holes.

3. Lubricate six spline head mounting bolts with Texaco Threadtex No. 2303. Install bolts and hardened washers and torque to specified value.

4. Secure oil slinger to gear with four mounting bolts and torque to 33 N-m (24 ft-lbs).

GOVERNOR DRIVE GEAR AND STUBSHAFT

DESCRIPTION

The governor drive gear is mounted on the governor drive stubshaft, Fig. 6-9, and is driven by the main lube oil and piston cooling pump gear. The governor drive gear is used to drive the right and left bank water pumps and the governor drive assembly.

MAINTENANCE

The governor drive gear and stubshaft require no maintenance other than inspection at the time of normal overhaul.

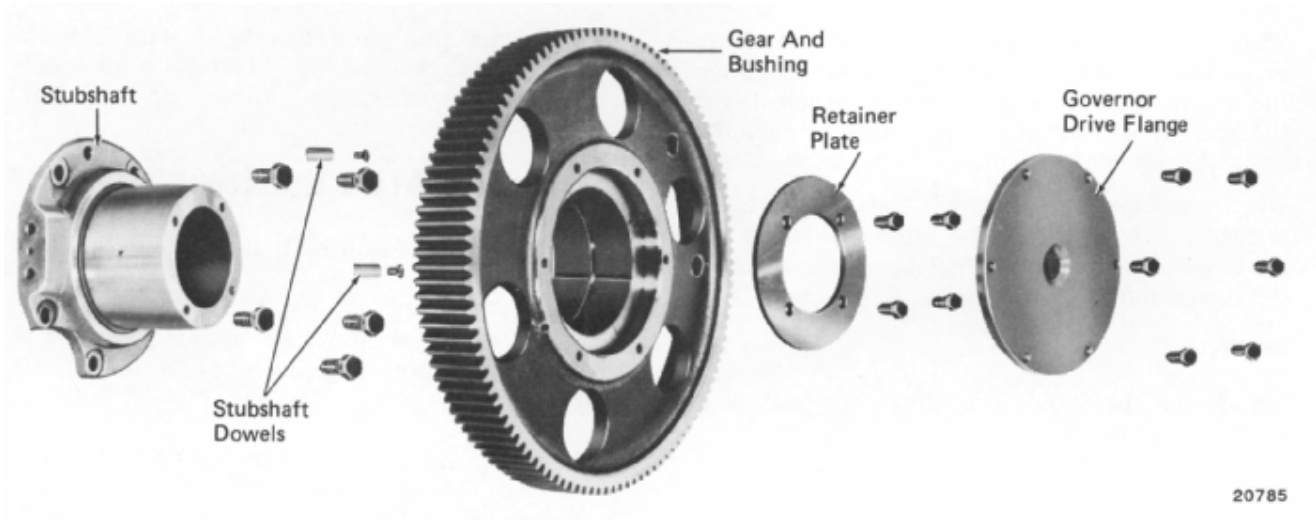


Fig. 6-9 - Governor Drive Gear And Stubshaft

Inspect gear teeth for fatigue indications, cracks, pits or other evidence of failure. If possible, a magnatlux inspection should be performed. Inspect the gear bushings and stubshaft for gouges or other damage and ensure that stubshaft oil passage is not plugged.

INSTALLATION

1. Position stubshaft on crankcase with oil inlet on left side.

2. Secure stubshaft to crankcase using four 1/2"-20 hex head drilled bolts. Do not torque bolts at this time.

3. Apply governor drive gear assembly to stubshaft.

4. Place "dummy" main lube oil pump gear on top of accessory drive gear with teeth meshed with accessory drive gear and governor drive gear.

5. Raise or lower governor drive gear stubshaft until backlash between governor drive and main lube oil pump gear is 0.41-0.81 mm (.016"-.032").

NOTE: Since the "dummy" oil pump gear is resting on the accessory drive gear with zero backlash, the backlash between the "dummy" gear and the governor drive gear is twice the normal requirement of 0.20-0.41 mm (.008"-.016").

6. Remove "dummy" gear and governor drive gear.

7. Tighten governor drive stubshaft bolts to 102 N-m (75 ft-lbs).

8. Ream the two dowel holes in the governor drive stubshaft with a 0.494" tapered reamer and a 0.4998" ± 0.0002" bottoming reamer, being sure to use cutting oil.

NOTE: If the dowel holes in governor drive stubshaft do not align with holes in crankcase, drill and ream for oversize dowels as required to produce full circumference fit. See parts catalog for listing of oversize dowels.

9. Use an air hose to blow chips and oil out of the dowel holes, and insert 1/4"-28 bolts approximately 6.35 mm (1/4") into the dowel pins.

10. Place dowels in dowel holes in the stubshaft and drive into the crankcase end plate.

11. Torque the dowel bolts to 23 N-m (17 ft-lbs) and lockwire stubshaft mounting bolts and dowel bolts in groups of three or less.

12. Apply gasket between oil jumper and oil passage on stubshaft. Secure oil line to stubshaft using two 3/8"-24 hex head drilled bolts and torque to 47 N-m (35 ft-lbs). Lockwire mounting bolts.

13. Apply governor drive gear to stubshaft.

14. Install retainer plate and secure to stubshaft using four 3/8"-24 hex head bolts torqued to 47 N-m (35 ft-lbs).

15. Lockwire retainer plate mounting bolts.

16. Apply governor drive flange to governor drive gear and secure with six 3/8"-24 hex head drilled bolts torqued to 47 N-m (35 ft-lbs).

17. Lockwire flange bolts to two groups of three bolts each.

ACCESSORY DRIVE HOUSING APPLICATION AND ALIGNMENT

The following procedure is provided to properly align the accessory drive housing to the accessory drive and governor drive assemblies for subsequent application of the water and lube oil pumps.

1. Apply sealing compound to accessory drive housing mounting flange, and apply gasket.

2. Place mounting bolts and washers in housing mounting holes.

3. Using holding fixture (File 758) and a suitable lifting device, position housing to crankcase and secure with one mounting bolt on each side of housing, Fig. 6-10.

4. Remove holding fixture from housing.

5. Hand-tighten all mounting bolts.

6. Apply left-hand water pump alignment gauge (File 761) to left pump opening in housing so that gauge gear teeth mesh with governor drive gear, Fig. 6-11.

7. Apply right-hand water pump alignment gauge (File 762) to right pump opening in housing so that gauge gear teeth mesh with governor drive gear.

8. Apply oil pump alignment gauge (File 763) to the main lube oil pump opening in housing so that gauge gear teeth mesh with accessory drive gear. This same gauge is used to align the housing to the governor drive gear.

9. Apply another oil pump alignment gauge (File 763) to scavenging oil pump opening in housing so that gauge gear teeth mesh with accessory drive gear.

10. Position jacking tool (File 759) over the end of the accessory drive shaft until the adjusting nuts are in line with the accessory drive opening, Fig. 6-11.

    Movement of the vertical adjusting nuts will affect the gauge readings of the governor drive gear and the accessory drive gear that are taken by the alignment gauge applied to the main lube oil pump opening.

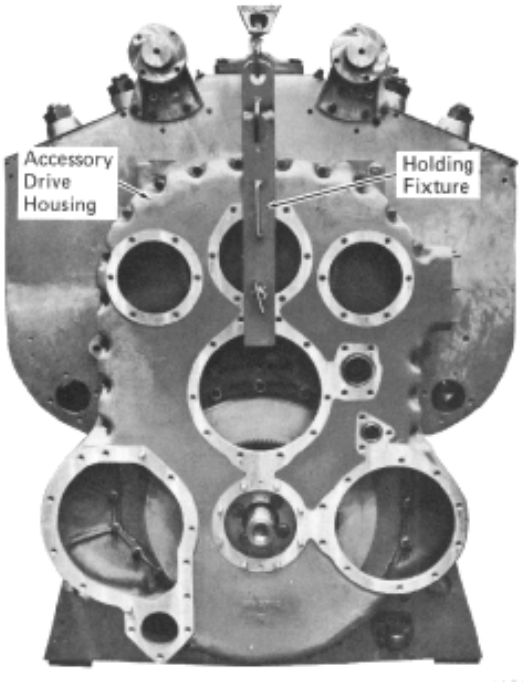


Fig. 6-10 - Accessory Drive Housing Positioning

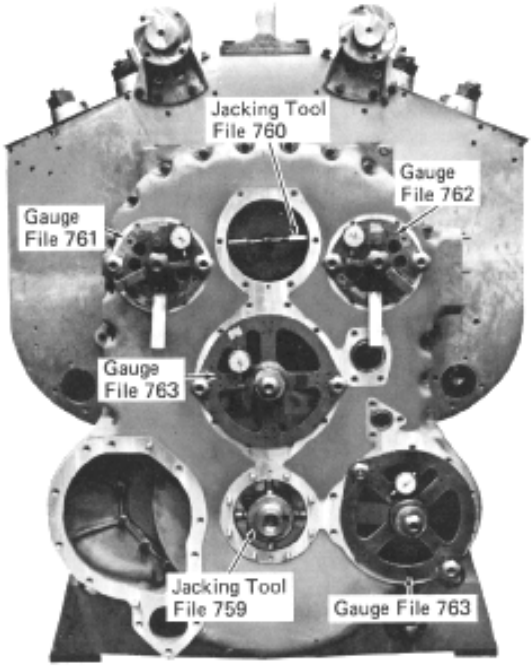


Fig. 6-11 - Accessory Drive Housing Alignment

Movement of the horizontal adjusting nuts will affect the gauge reading of the accessory drive gear which is taken by the alignment gauge applied to the scavenging oil pump opening.

11. Insert spline end of jacking tool (File 760) into splines of the governor drive gear flange until the adjusting nuts are in line with the governor drive opening. Adjusting nuts should be in a horizontal position, Fig. 6-11. Movement of the adjusting nuts affects the gauge readings of the governor drive gear which are taken by the alignment gauges mounted at the water pump openings.

12. Adjust both jacking tools until all four gauges indicate within 0.20-0.41 mm (.008"-.016") clearance between the gauge gears and the engine-mounted gears.

13. Disengage the gear of the alignment gauge mounted in the main lube oil pump opening from the accessory drive gear and rotate approximately 180° to mesh with the governor drive gear. Recheck all gauge indications of 0.20-0.41 mm (.008"-.016") clearance.

14. Tighten four mounting bolts, preferably one on each side, and one at top and bottom.

15. Remove both jacking tools from housing.

16. Check all alignment gauges. If all indications are within 0.20-0.41 mm (.008"-.016"), tighten remaining housing mounting bolts to 88 N-m (65 ft-lbs).

RING GEAR AND COUPLING DISC (FLYWHEEL)

DESCRIPTION

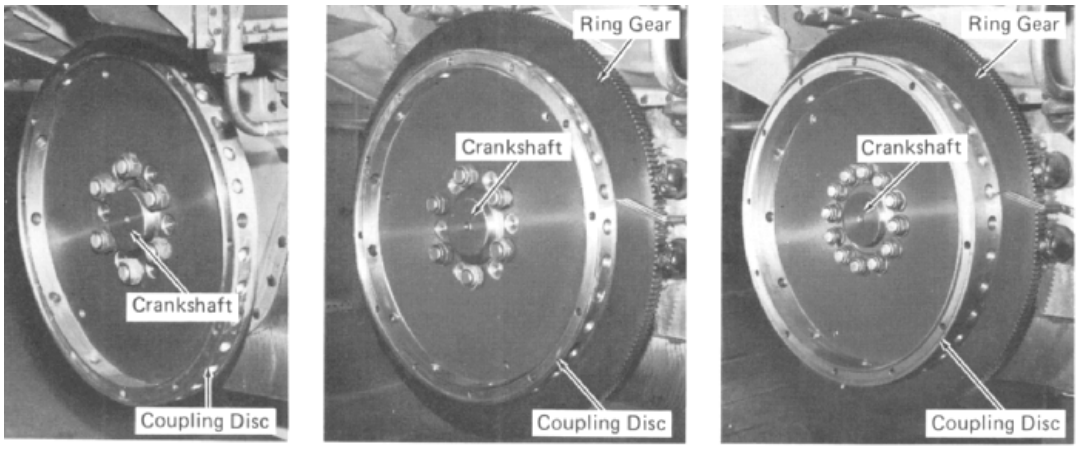
The ring gear, Fig. 6-12, is used on engines equipped with starting motors. Engaging the teeth on the ring gear rotates the crankshaft for engine starting or selects a crankshaft position when using an engine turning gear device. The ring gear pilots on the engine side of the coupling disc and is bolted to the coupling disc.

The coupling disc serves as the coupling between the engine crankshaft and the driven shaft. Degree and top dead center markings are stamped on the outer rim of the coupling disc. Holes are also provided around the circumference of the rim for insertion of a turning bar to manually rotate the crankshaft.

MAINTENANCE

Inspect the engine coupling disc for cracks or damaged surfaces. Also inspect the coupling disc to crankshaft bolt holes for elongation or fretting at the bolt head mating surface. If the surface is fretted the area may be spotfaced up to 1.59 mm (1/16") deep as long as the minimum disc thickness is maintained. See Service Data for limits.

Engine to generator coupling discs should be re-qualified whenever the engine or the generator assembly is removed. Maximum trouble free performance of the engine-generator coupling can best be ensured by careful magnetic particle inspection of both discs prior to their reuse. This inspection is particulary important if it is known that the coupling has been subjected to unusual stress.



8 & 12-Cyl. (w/DC Gen.) 12-Cyl. w/AC Gen. & 16-Cyl. 20-Cyl.

Fig. 6-12 - Ring Gear And Coupling Disc Installations

Engine coupling discs of the same type are interchangeable, providing top dead center pointer location on the engines is the same. The serrated coupling is assembled without using body bound bolts and for this reason has no reamed holes. All rim bolts are the same size. The coupling disc should be applied to the crankshaft with the small "O" marks on the coupling disc and the crankshaft coinciding. This will position the coupling with the pointer at the 0° mark on the rim when the No. 1 piston is at TDC.

Apply Texaco Threadtex No. 2303 to engine coupling bolts and tighten bolts to a torque value of 2440 N-m (1800 ft-lbs) on the 8, 12, and 16-cylinder engines and 1830 N-m (1350 ft-lbs) on the 20-cylinder engine. Tighten the rim bolts uniformly (to avoid cocking the coupling on the serrations) to a torque value of 400 N-m (295 ft-lbs). The gap between the coupling halves at the rim bolts should not be less than minimum after the rim bolts have been properly torqued.

CAUTION: The coupling bolts must be applied with the chamfered side of the head placed adjacent to the crankshaft fillet.

Face runout and rim eccentricity should be checked after installation of coupling disc to crankshaft, and with crankshaft positioned to avoid thrust interference. Eccentricity of rim outside diameter and runout on rim face should not exceed maximum indicator reading listed in Service Data.

ACCESSORY DRIVE COUPLING

DESCRIPTION

The accessory drive coupling assembly, Fig. 6-13, is bolted and keyed to the tapered front end of the crankshaft to provide a power takeoff connection for components driven from the front of the engine. In some applications, the coupling is bolted to a tapered stubshaft.

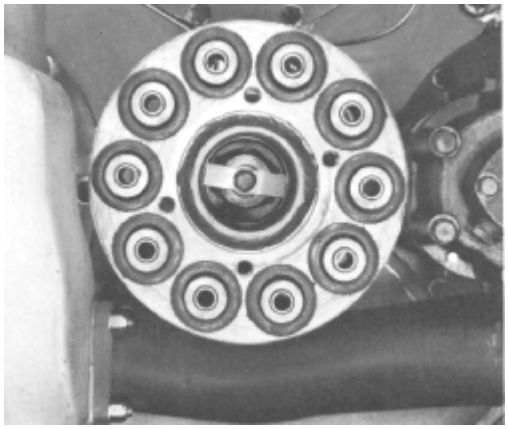


Fig. 6-13 - Accessory Drive Coupling

MAINTENANCE

The accessory drive coupling does not require any routine maintenance. However, replacement of the rubber center-bonded joints may be required or desired. See the applicable Maintenance Instruction for replacement of rubber joints.

COUPLING APPLICATION

If the coupling has been removed, it is essential that the proper application procedure is used to avoid severe damage to the crankshaft of either the driven unit or the engine.

1. Prior to mounting the coupling on the crankshaft (stubshaft), inspect the two tapered surfaces to ensure the mating surfaces are free of nicks or burrs. Use aluminum oxide cloth of a 180J grit to clean the tapered surfaces and the crankshaft key slot.
2. Hand fit 2-1/2" key so it is tight in the engine crankshaft key slot. Tap the key in the slot so the end of the key is flush with the end of the crankshaft.

NOTE: If the key slides in the keyway, scrap the key.

3. Fit the coupling flange on the shaft, making sure that the key remains flush with the end of the shaft.
4. Lubricate the threads on the retaining bolt and both sides of the washer with Texaco Threadtex. Torque the retaining bolt to 136 N-m (100 ft-lbs).
5. Attach a dial indicator to the coupling with the button of the indicator on the accessory housing or on one of the studs at the coupling seal. Zero the indicator.
6. Torque the retaining bolt to 678 N-m (500 ft-lbs) and record the advance, measured to the nearest thousandth. Failure to obtain a reading within the limits given in the Service Data is usually caused by imperfections found on one of the tapered surfaces or within the keyway. These surfaces should be free of all nicks or burrs.
7. Install the lock spring, lockwasher, and 1/2"-20 bolt in the head of the retaining bolt and torque to 88 N-m (65 ft-lbs).
8. With a dial indicator button resting on the outside diameter of the coupling flange, record the T.I.R. of the rim to be sure it does not exceed the limits given in the Service Data.

SERVICE DATA
CRANKSHAFT ASSEMBLY AND ACCESSORY DRIVE GEAR TRAIN

REFERENCES

Alignment of locomotive rotating equipment . . . . . M.l. 1753

SPECIFICATIONS

Clearance and dimensional limits listed below are defined as follows:

1. New limits are those to which new parts are manufactured. (Drawing tolerances.)

2. Minimum, maximum, and tolerance measurements are provided as service limits. At time of rebuild or any time unscheduled maintenance is performed, the service limits should not be exceeded. Engine components within these limits may be reused with the assurance that they will perform satisfactorily until the next scheduled overhaul.

Crankshaft	
Diameter, main journal -	
New	190.45-190.50 mm (7.498"-7.500")
Min.	190.411 mm (7.4965")
Diameter, crankpin journal -	
New	165.05-165.10 mm (6.498"-6.500")
Min.	165.011 mm (6.4965")
Clearance (diametric main bearings to crankshaft) -	
New	0.190-0.368 mm (.0075"-.0145")
Max.	0.521 mm (.0205")
Thrust Bearing Clearance -	
(8 & 12-Cyl.) -	
New	0.20-0.38 mm (.008"-.015")
Max.	0.76 mm (.030")
(16 & 20-Cyl.) -	
New	0.20-0.46 mm (.008"-.018")
Max.	0.76 mm (.030")
Thrust Bearing Collar Thickness -	
8, 16 & 20-Cyl.	9.35-9.37 mm (.368"-.369")
12-Cyl.	22.07-22.10 mm (.869"-.870")
Accessory End Gear Train	
Backlash (all drive gears) -	
New	0.20-0.41 mm (.008"-.016")
Max.	0.64 mm (.025")
Accessory Drive Gear	
Hub to gear clearance -	
New	0.038-0.08 mm (.0015"-.003")
Max.	0.089 mm (.0035")
Diameter of gear spring segment holes - New -	
(8 & 12-Cyl.)	50.95-51.05 mm (2.006"-2.010")
(16 & 20-Cyl.)	62.05-62.15 mm (2.443"-2.447")
Wear on drive side of gear -- Max. . . .	0.02 mm (.001 ")

Gear bore diameter -	
New	190.50-190.53 mm (7.50"-7.501 ")
Max.	190.55 mm (7.502")
(If hub to gear maximum clearance is not exceeded)	
Hub outside diameter - Min.	190.436 mm (7.4975")
(If hub to gear maximum clearance is not exceeded)	
Disc spring segment bore -- Max.	
(8 & 12-Cyl.)	51.08 mm (2.011 ")
(16 & 20-Cyl.)	62.18 mm (2.448")
Spring segment wear (right half as viewed from 12 o'clock position) - Max.	0.02 mm (.001 ")
Governor Drive Gear	
Governor drive gear to stubshaft clearance	
New	0.08-0.15 mm (.003"-.006")
Max.	0.20 mm (.008")
Thrust clearance	
New	0.15-0.36 mm (.006"-.014")
Max.	0.51 mm (.020")
Flexible Coupling	
Crankshaft pilot diameter - Max.	203.264 mm (8.0025")
Mounting bolt hole diameter - Max.	45.212 mm (1.780")
Thickness at mounting bolt holes - Min.	17.462 mm (.6875")
Clearance between coupling discs at rim bolts, after bolts are torqued -- Min.	0.038 mm (.0015")
Coupling face runout -- Max.	0.25 mm (.010") T.I.R.
Coupling rim eccentricity -- Max.	0.13 mm (.005") T.I.R.
Accessory Drive Coupling	
Coupling advance -- coupling-to-stubshaft	1.27-11.52 mm (.050"-.060")
Coupling rim runout - Max.	0.25 mm (.010") T.I.R.

EQUIPMENT LIST

	Part No.
Upper main bearing shell remover	8055837
Sealing compound gasket (1 pt.)	8178639
Thread lubricant (5 gal.)	8307731
Pinion and flange remover	8309742
Main bearing cap application and removal tool	8487487
Upper main bearing removal tool	8488833
Adapter nipple	8496555
Serration gauge	9081052
Accessory drive housing holding fixture	File 758
Accessory drive housing jacking fixture	File 759

SERVICE DATA
CRANKSHAFT ASSEMBLY AND
ACCESSORY DRIVE GEAR TRAIN