GEARCASE

OIL PUMP (1976 AND EARLIER)

GENERAL

The oil feed and scavenger (oil return) pumps are gear-type pumps incorporated in one pump body with a check valve on the oil feed side. The feed section forces oil to the engine and the scavenging section returns oil to the tank.

The oil pump seldom needs servicing; therefore, before disassembling the pump for any repairs because of no oil pressure, be absolutely certain that all possible related malfunctions have been eliminated:

Check the level and condition of oil in the tank. If oil is diluted, pressure will be affected. In freezing weather, the oil feed line may clog with ice and sludge, preventing circulation of oil.

Check for a grounded oil pressure switch wire or faulty switch if oil indicator light fails to go out with engine running. See “ENGINE LUBRICATION.” for additional information.

Inspect the oil pump check valve. The check valve prevents the gravity flow of oil into the crankcase when the engine is not running and provides correct oil pressure for operation of the oil signal light switch. If the check valve is not seating correctly oil will bypass the valve and drain oil from the tank into the crankcase and on starting the engine, a considerable amount of accumulated oil will be blown through the crankcase breather pipe. If this condition exists, disassemble and inspect the check valve. See “DISASSEMBLING OIL PUMP CHECK VALVE.”

If no oil pressure or return oil is indicated at the oil tank (return line) when engine is running, or an excessive amount of oil is blown from the breather pipe, (after all other possible troubles have been eliminated, including inspection of the oil pump check valve), disassemble the oil pump for further inspection and repair. See “DISASSEMBLING OIL PUMP.”

When an oil pump has to be disassembled for repair, damage is usually caused by a foreign particle, such as a metal fragment, that has worked its way into the oil circulatory system. If this particle passes through the pump’s protective screening, damage will result when it enters the pump. Primarily, the damage consists of a sheared oil pump drive lock pin (18, Figure 3-25), broken retaining ring (7, Figure 3-25) or subsequent damage to gears and other parts.

DISASSEMBLING AND ASSEMBLING OIL PUMP CHECK VALVE (Figure 3-25)

Thoroughly clean exterior of pump in cleaning solvent before disassembly. Disconnect oil pressure switch wire and disassemble switch (1) from motorcycle. Remove oil pump nipple (2). Free check valve spring (3) and valve (4) from pump body.

CLEANING AND INSPECTING OIL PUMP CHECK VALVE (Figure 3-25)

Clean all parts in cleaning solvent. Blow out pump nipple (2) oil passage and the nipple valve spring guide. Examine the nipple for any damage that would bind or hinder the free operation of spring (3). Carefully examine the nipple threads for wear; if badly worn replace nipple.

Inspect spring (3) for breakage and rusted condition. Replace if worn or damaged. Free length of new check valve spring (3) is approximately 1.15/64 in.

Carefully inspect the oil pump check valve ball (4) for wear and rusted condition. Valve may have rings formed by action on valve seat. Valve balls not perfectly smooth and round should be replaced.

Using a light, inspect valve seat in pump body (16) for pits and for dirty condition. A small particle of foreign matter lodged on valve seat will prevent check valve ball from seating. If seat is only slightly damaged place check valve ball on seat and with a drift lightly tap against its seat to remove slight marks or pits. Replace pump body if valve seat is badly damaged. See “DISASSEMBLING OIL PUMP.”

ASSEMBLING OIL PUMP CHECK VALVE (Figure 3-25)

Assembly is essentially the reverse order of disassembly. Apply a light coating of oil to all moving parts. Make sure that check valve ball (4) is correctly seated and valve action is free. Be extremely careful to prevent dust, dirt or other foreign particles from getting on the parts when reassembling.

DISASSEMBLING OIL PUMP (Figure 3-25)

Because of interference from motorcycle frame it is necessary to remove engine to disassemble pump. First, remove the engine complete from the chassis and position on workbench. See “STRIPPING MOTORCYCLE FOR ENGINE REPAIR.”

NOTE

It is not necessary to remove valve tappets and valve tappet guides to service the oil pump.

The breather is a part of and drives the oil pump. When removing the oil pump, the breather will of course come out with it. Removing the pump does not require removing the circuit breaker, gearcase cover or removing timing gears. However, it must be remembered that in order to correctly time breather and to check oil pump alignment, it is necessary to remove these parts.

See Figure 3-25. Thoroughly clean exterior of pump with cleaning solvent before further disassembly. Remove the five crankcase stud nuts that secure the oil pump to the crankcase. Slip the pump off the studs as one unit. If difficult to remove, take a piece of brass and tap on breather sleeve that extends into gearcase compartment. To disassemble the check valve see “DISASSEMBLING OIL PUMP CHECK VALVE.”
Free the oil pump body plate (5) from pump body. Discard gasket (6). Remove split key (7), remove scavenger gears (8) and (9). Remove key (10). Free oil feed pump cover (11) and breather valve (19) as one assembly from pump body. Discard gasket (12). Free gears (13 and 14) from pump body. Pry oil seal (15) from pump body (16) and discard seal. Discard gasket (17).

With a punch remove lock pin (18) and free oil pump breather valve gear and shaft (19) from oil pump cover (11).

NOTE

Remove lock pin (18) only if inspection or replacement of shaft (19) and cover (11) is necessary.

Remove breather valve screen (20) from crankcase. Remove idler gear shaft (21) only if replacement is necessary. Shaft is a press fit.

CLEANING AND INSPECTING (Figure 3-25)

First clean all parts in cleaning solvent. Blow out all oil holes and passages with compressed air. Replace any parts that are worn or damaged.

Replace all gaskets (6, 12 and 17), lock pin (18) and oil pump seal (15) when reassembling. Be sure to always install new "factory made" gaskets. Never use "home made" gaskets because they are a specified thickness with holes especially located for oil passage.

Check gear side clearance as follows: When feed gears are inserted in pump body, gear faces should be no more than .0005 in. below to .0025 in. above body gasket surface.

Carefully examine the pump body (16) for any wear. See "CLEANING AND INSPECTING OIL PUMP CHECK VALVE."
Examine gears (8, 9, 13 and 14) and oil pump breather shaft (19) and idler gear shaft (21) for damage or wear. If the breather valve key (10) is excessively worn or loose on shaft or gear, replace with a new one. Inspect pump body plate (5) and cover (11). If they are worn or damaged, replace them. Examine breather valve (19) and oil pump cover for any wear or damage that might affect its operation. Insert breather valve (19) in oil pump cover (11). Make sure valve turns freely in cover and does not bind.

**ASSEMBLING OIL PUMP (Figure 3-25)**

Reassembly of the oil pump is essentially the reverse order of disassembly.

Apply a light coating of engine oil to all moving parts before assembling.

Reassemble check valve. See "ASSEMBLING OIL PUMP CHECK VALVE."

Position breather valve screen (20) in crankcase using grease to hold in place. Insert breather valve gear and shaft (19) in oil pump cover (11). Press a new drive lock pin (18) into breather valve shaft. Lock pins are often damaged when removed; therefore, install new ones when reassembling pump.

Press a new idler gear shaft (21) into pump body if the old one was removed. Place gears (13 and 14) in pump body and install a new gasket (12) being very careful to correctly align the oil holes of the gasket with the pump body. Use a non-hardening gasket sealer.

Install oil pump breather valve gear, shaft and cover assembly on pump body (16). Place a very thin strip of acetate (Scotch) tape over shaft lock ring groove to avoid damaging new oil seal (15). Install seal carefully over shaft with lip side facing pump body, then remove tape from shaft. Press seal into body counterbore flush with surface.

Install gear key (10) and gears (8 and 9). Install retaining keys (7) in breather valve shaft groove. Assemble a new gasket (6) in place using a non-hardening gasket sealer. (If gasket is exceptionally dry and curled up, soak in water for a few minutes to soften before applying gasket sealer.) Position oil pump body plate (5) and install assembled pump in place on engine crankcase studs. Snug up the oil pump stud nuts evenly. Then, working opposite one another, tighten to 100 in-lbs torque to ensure correct alignment of the oil pump.

Before installing gears on pinion shaft, make sure pump gears turn with little or no binding. While a very slight bind or drag is permissible, gears should turn freely as possible. Binding is caused by slight misalignment of pump. If there is more than just noticeable bind, loosen five mounting stud nuts and shift pump as needed by tapping lightly with a soft mallet. It will not be possible to determine before hand in which direction pump must be shifted and it may require several attempts from different angles before alignment is attained.

After the oil pump is completely assembled to the crankcase and correctly aligned, it is necessary to open gear case in order to time the breather valve. Disassemble timing gears, gearcase cover, circuit breaker and push rods; and time breather as described subsequently under Head-
Figure 3-26. Oil Pump - Exploded View (1977 and Later)

Do not remove seal, unless it is damaged and must be replaced.

Using external lock ring pliers, remove retaining ring (19) from groove in shaft (22). With ring (19) removed, slide gerotor set (20) off shaft (22).

Again using long-nosed pliers, pull pin (21) out of hole in shaft (22). Remove gear shaft (22) from body (24). Remove O-ring (10) from groove in body (24).

Remove check valve (11). Push out with a rod approximately 5/16 in. in diameter. This completes disassembly of the oil pump.
CLEANING AND INSPECTING (Figure 3-26)

Clean all parts in a cleaning solvent. Blow out holes and passages with compressed air. Check parts for fit, wear, and damage.

Check O-rings (7), (10), and (12) and make sure they are without irregularities and seal tightly when in place. Inspect seal (16) to see that it is not deformed or worn.

Inspect valve (11) to see that it is not clogged. The spring loaded cup inside the valve should be free to move and should return to its closed, seated position. If the valve is damaged in any way, the complete valve assembly must be replaced.

Check spring (17) and replace if fingers are broken off.

Inspect both gerotor sets, (13) and (20). Each set is made up of an inner and an outer piece. Mesh the two pieces together as shown in Figure 3-29 and check for wear using a feeler gauge. The maximum wear limit is .004 in.

If either of the bushings, (8) or (25), is scored, worn or otherwise damaged, it should be replaced. Pull the old one and replace with a new one. The bushing to shaft clearance is .0005 in.

Check teeth of gear on shaft (22). If any teeth are broken or worn replace the shaft assembly.

Inspect gasket (23). Replace if it is torn or damaged.

ASSEMBLING

Reassemble in reverse order of disassembly. In addition, however, the following steps should be performed.

Place feed (thin) gerotor in cover. Using a straight edge and feeler gauge as shown in Figure 3-28, measure the distance gerotor extends above cover surface. The dimension should be .001 in. to .011 in. If the dimension is less than .011 in., remove gerotor and invert cover on a piece of sandpaper on a flat surface (#280 grit to start and #400 grit to finish) and sand cover ridge evenly until desired dimension is obtained.

Using a micrometer, measure the thickness of the feed gerotors. If they are not the same thickness, replace them as a set. The feed gerotors must be the same height when placed in the cover. If not, the cover is warped and must be replaced.

Lightly oil all moving parts prior to assembly (Figure 3-26). Position fingers of spring (17) toward plate (15). Gasket (23) should be coated with a sealer when placed on body (24). Reinstall seal (16) into groove of plate (15) with lip of seal facing the feed section of pump. Tighten screws to 100 in-lbs torque.
PRIMING OIL PUMP (Figure 3-26)

Oil pump must be primed whenever oil lines have been removed or pump has been disassembled. Loosen oil pressure switch (26) while engine is running and allow about 3 oz. of oil to be forced out. Retighten switch and connect switch wire.

VALVE TAPPETS AND GUIDES

GENERAL

Tappets and tappet guides seldom require replacement. Primarily, they are only removed for the purpose of checking end play of the cam gears, when reassembling an engine.

DISASSEMBLING (Figure 3-30)

Clean all dirt from around crankcase and blow loose particles from the area with compressed air. Remove push rods. This procedure is covered under "REMOVING AND INSTALLING PUSH RODS," this section.

For 1976 and earlier models guides are press fit into crankcase (see "SPECIFICATIONS," this section). Remove tappet guide screw (1) and tappet adjusting screw (2) and slide

Tappet Guide Puller, Part No. 95724-57, in mating grooves of tappet guide (3). Before turning tappet guide (3) from crankcase, be sure cam gear is installed in case for tappet to butt against when using puller (see Figure 3-31). For 1977 and later models, remove tappet guide screw (1) and remove tappet guide (3). It may be necessary to remove cylinders to remove front and rear intake tappet guides. Mark valve tappets in some manner to identify them as to location.

It is good practice to reassemble valve tappets and valve tappet guides in the same place from which they were removed. This will ensure an even wear pattern between tappet, guide and cam surface.

CLEANING AND INSPECTING (Figure 3-30)

Clean all parts thoroughly in cleaning solvent and blow dry with compressed air. Inspect valve tappets for excessive clearance in guides. Valve tappets should be loose in tappet guides. Excessive tappet-guide clearance is serviced by fitting new tappet, and/or new guide. It is recommended practice to replace complete tappet when only the roller is excessively loose or badly worn; however, it is possible to replace tappet roller kit (6) individual parts. If this is done, roller must turn freely on needle bearings and have side play after new roller pin is securely riveted to tappet. See "SPECIFICATIONS."

If end of valve tappet adjusting screw is damaged, worn egg shaped or pitted from action of push rod, it should be replaced to ensure accurate tappet-valve stem adjustment.

Discard O-ring (5, Figure 3-30) and replace with a new one.

ASSEMBLING (Figure 3-30)

Assembly is essentially the reverse order of disassembly. Apply a light coat of oil to the tappet and in particular, the tappet roller assembly and O-ring. If tappet is not located correctly in guide, tappet roller will be crosswise to guide and cam, and serious damage may result when installed in crankcase.
Figure 3-30. Gearcase and Tappet - Exploded View

1. Tappet guide screw
2. Tappet screw with nut
3. Tappet guide
4. Tappet and roller
5. Tappet guide O-ring
6. Tappet roller kit
7. Rear cylinder exhaust cam gear
8. Rear cylinder intake cam gear
9. Front cylinder intake cam gear
10. Front cylinder exhaust cam gear
11. Cam gear plate (2)
12. Cam shaft washer - .005, .007 in.
13. Idler gear
15. Gearcase cover gasket
16. Flywheel shaft pinion gear
17. Oil pump drive gear
18. Cam gear needle roller bearing (4)
19. Rear exhaust cam gear shaft bushing
20. Cam gear and timer shaft bushing
21. Pinion gear shaft bushing
22. Front intake cam gear shaft bushing
23. Front exhaust cam gear shaft bushing
24. Idler gear shaft bushing (2)
25. Oil separator bushing
26. Crankcase oil strainer, retaining pin and gasket (1976 and earlier)
27. Gearcase cover bushing pin (7)
28. Idler gear shaft
29. Lockwasher (1977 and later)
30. Nut (1977 and later)
Pull tappet out to limit of travel and hold in place with a clip or other means to prevent tappet from dropping into crankcase when installing the assembly.

Insert new O-ring (5) on guide (3). Assemble adjusting screw and nut (2) in tappet (4) and then insert tappet into guide (3). Align screw holes in tappet guide with screw holes in crankcase and install assembly using a piece of tubing or a block of soft wood. Tappet guides are a soft malleable cast iron, therefore, be extremely careful not to damage the guide during installation. With screw (1) in place, recheck free movement of tappet in guide.

![Figure 3-31. Removing Tappet Guide (1976 and Earlier)](image)

GEARCASE COVER AND CAM GEARS

DISASSEMBLING (Figure 3-32 and Figure 3-33)

Thoroughly clean area around gearcase cover and tappets. Blow all loose dirt from crankcase with compressed air. Locase exhaust pipe port clamps (1) and muffler clamps and lower exhaust pipe free of gearcase cover. Remove footrest (2), gear shift foot lever (3), 1974 and earlier, and breather pipe (4). For models 1975 and later, remove footrest (2), along with rear brake foot lever (3A), and breather pipe (4). On 1970 models remove circuit breaker (5).

Remove push rods (7) as described in “REMOVING AND INSTALLING PUSH RODS.”

On 1971 models, remove two circuit breaker cover screws, cover and gasket. Remove circuit breaker cam assembly bolt, two circuit breaker hold down screws, lockwashers and washers or retainer and circuit breaker advance assembly. See “CIRCUIT BREAKER” Section 5.

Place a pan under gearcase to collect oil when cover is removed. Remove gearcase cover screws (8) and generator mounting screws (9). Free cover from crankcase. Cover is located on dowel pins which fit rather snugly. The cover must be worked off these pins carefully to avoid damage to joint faces. Do not pry off with screwdriver inserted between joint faces. Use a hammer and a block of wood, and tap lightly at the end where the cover projects beyond the gearcase. Note that oil tank vent hose is clamped to gearcase cover fitting and must be disconnected before cover can be completely removed from motorcycle.

Remove valve tappets and valve tappet guides only to establish correct cam gear end play. See “VALVE TAPPETS AND VALVE TAPPET GUIDES.” On 1970 models, pull clutch cable (9) forward (as positioned on motorcycle), at the same time press cable inward and down to free from gearcase cover.

Refer to Figure 3-30 and proceed as follows. Remove cam gears (7, 8, 9 and 10) and cam gear plates (11). (Cam gears are numbered on cam lobe from one to four, from the rear exhaust valve cam forward.) When cam gears are removed, note whether or not cam gears have thin steel spacing washers (12) on either end of cam gear shafts. If any of the cam gears mentioned have spacing washers, be sure the same ones are used on each shaft when reassembling if the same cam gears and case cover are used again.

![Figure 3-32. Removing Gearcase Cover (1970)](image)
result in noisy operation, often mistakenly attributed to the other timing gears.

Check cam gear needle roller bearings (18) and idler gear bushings (24) in right crankcase side and cam gear shaft and pinion gear shaft bushings (19, 20, 21, 22, 23 and 24) in gearcase cover for extent of wear. These bushings normally do not require replacement until an engine has run up extremely high mileage.

See “SPECIFICATIONS,” for clearance of cam gear shafts in cover bushings, pinion gear shaft in cover bushing and cam gear shafts in crankcase needle roller bearings.

When bushings are worn to the extent of increasing clearance to .001 in. or more over specified limits, they should be replaced, as the cam gears are likely to become very noisy with excessive clearance in the bushings. Examine the face of each bronze bushing flange for wear. If bushing flanges are badly worn replace bushings.

Examine cam gear plates (11) for excessive wear or damage. Replace, if necessary.

Oil separator bushing (25) should have 1/16 in. ± 1/64 in. running clearance with generator oil slinger. If clearance is too great, insert a thin washer between face of gear and oil slinger washer.

On 1976 and earlier models, inspect the crankcase oil strainer (26) to make sure it is not plugged with any foreign material.

REPLACING BEARINGS

The four cam gear needle roller bearings in the crankcase are a press fit and can be removed and installed without disassembling crankcase by using Tool, Part No. 95760-69 as shown in Figure 3-39. Use Tool, Part No. 97273-60, for installing cam gear needle roller bearings, always press on printed side of bearings, being extremely careful not to tip or misalign bearing in the case during the installing operation.

If inspection warrants replacement of either the cam gear or pinion gear bronze bushings in the gearcase cover, it first is necessary to separate the right and left crankcase sides and remove the flywheel assembly. See “CRANKCASE.”

To remove the six blind bushings from the gearcase cover and one blind bushing (idler gear) from the crankcase, use Puller, Part No. 95760-69 as shown in Figure 3-34.

Before pressing in new bushings, note location of original dowel pin holes for reference when drilling new holes. When drilling new holes, be sure to locate holes 1/8 in. or more from original dowel pin holes.

Use a smooth surfaced disc or plate slightly larger than flange when pressing bushing into position. Be sure bushing flanges are seated tight against gearcase cover and/or crankcase idler gear bushing.

After new bushings have been pressed in, they must be dowel pinned with cover bushing pins to prevent them from turning. Drill a hole with a number 31 drill, 9/32 in. deep, through bushing flange and into aluminum so when dowel pin is driven in and bottomed, its end will be slightly below face of bushing flange. Peen bushing around dowel pin hole to prevent pin from coming out.

Figure 3-33. Removing Gearcase Cover
(1971 and Later)

Free idler gear (13) with fiber washer (14) by lifting generator up and away from crankcase. Discard gasket (15). On 1976 and earlier models pinion gear (16) is a press fit on pinion shaft splines, remove with Pinion Gear Puller, Part No. 96830-51. On 1977 and later models, pinion gear is a slip fit. Remove nut (30) and lockwasher (29) and remove pinion gear from pinion shaft. Oil pump drive gear (spiral gear) (17) is located on splined shaft behind pinion gear. Remove slip gear which is a slip fit on splines.

CLEANING AND INSPECTING (Figure 3-30)

With cleaning solvent thoroughly scrub the gearcase cover and gears to remove any oil and carbon deposits. Blow out all gearcase cover oil passages and bushings with compressed air. Clean old gasket sealer from joint faces with cleaning solvent. Carefully examine timing gears for excessive wear by inserting gears in case cover. Check for looseness in bushings and for amount of lash between gears. If teeth are pitted, scored, cracked, chipped or if faces of teeth are worn, replace gears. Check the gear shafts for damage and pitted surfaces. Measure shafts and bushings with appropriate instruments to determine extent of wear. If any cams are found with rough or pitted surfaces, replace gear. The idler gear shaft (28) is a press fit in the gear and can be replaced, providing the gear is in good condition.

On 1976 and earlier models, check pinion gear (16) for press fit on pinion shaft. The slightest lash will usually re-
After all bronze bushings have been pressed in and dowel pinned, all but the idler gear bushings must be line-reamed.

Parts order bushings are furnished nearly to size so there is little stock to be removed when reaming bushing. When removing reamer, keep turning it to the right as it is being pulled out.

To ream idler gear bushings, use special Reamer, Part No. 94806-57. Carefully align and turn reamer into bushing until it bottoms.

To line-ream the 1-1/8 in. dia. rear intake camshaft bushing in the gearcase cover, insert special Reamer, Part No. 94803-37 or use late style Reamer, Part No. 94803-67 and insert through crankcase needle roller bearing. Reamer will be a close fit in needle roller bearing, providing alignment for reaming the gearcase cover bushing.

See Figure 3-35. Install gearcase cover, at same time starting cover bushing reamer in cover bushing. Turn reamer into crankcase and gearcase cover bushings until it bottoms in gearcase cover.

To line-ream the front exhaust, front intake and rear exhaust cam gear shaft bushings in the gearcase cover, assemble the cover to crankcase side. With cover bushing reamer removed, insert special Reamer, Part No. 94803-37 or use a standard 11/16 dia. hand reamer through needle roller bearing, into cover bushing and turn until it bottoms in case cover.

To line-ream the pinion gear shaft bushing, install gearcase cover. Insert steel pilot bushing into crankcase bearing race to guide reamer. Insert special Reamer, Part No. 94812-37A, through pilot bushing into pinion gear shaft bushing, and turn reamer until it bottoms in gearcase cover. Remove gearcase cover.

ASSEMBLING

1. Check end play of cam gears described below under "DETERMINING CORRECT CAM GEAR END PLAY."

2. For 1976 and earlier, retight the breather valve according to the instructions under "TIMING BREATHER VALVE."

3. Install the cam gears and assemble the gearcase cover in place. See "INSTALLING CAM GEARS AND GEARCASE COVER."

4. Install valve tappets and valve tappet guides (if they have been removed). See "VALVE TAPPETS AND VALVE TAPPET GUIDES."

5. Reassemble circuit breaker. See "CIRCUIT BREAKER."

Section 5.

6. Install push rods and adjust tappets as described in "CYLINDER HEAD."

7. Refer to Figure 3-32. Assemble breather pipe (4), gear shift foot lever (3), footrest (2), exhaust pipe port clamps (1) and muffler clamps.

DETERMINING CORRECT CAM GEAR END PLAY
(Figure 3-30)

Before final reassembly of the cam gears, correct cam gear end play must be established. Temporarily position the two cam gear plates (11), less shims, in the gearcase compartment. Position against crankcase with beveled side of holes for cam shaft facing outward toward cams. Install cam gears. Assemble the case cover with a new dry gasket and securely tighten screws to 8-10 ft-lbs torque (less generator bolts).
Turn the engine over until the number one cam gear lobe is facing up as viewed through the tappet guide hole in the crankcase. Using a long shank screwdriver, pry the cam gear towards the case cover. With a feeler gauge, measure the clearance (end play) between the cam shaft shoulder and the gear plate. Repeat this operation for remainder of cam gears.

If end play exceeds the maximum specification, add necessary number of .005 to .007 in. thickness steel shims (12) to obtain recommended running clearance. If more than 1 shim is required, equally divide shims on both ends of shaft. After adding shims, turn engine over to be sure cam gears turn freely.

TIMING BREATHER VALVE (1976 AND EARLIER)
(Figure 3-36)

1. Flywheel timing mark
2. Oil pump drive gear (spiral gear)
3. Pinion gear
4. Timing hole in breather sleeve gear

Figure 3-36. Timing Crankcase Breather (1976 and Earlier)

The breather must be retimed if disengaged from mating oil pump drive gear (spiral gear) on pinion shaft. To check breather timing proceed as follows:

Flywheel timing mark (1) should be exactly in center of timing inspection hole in left side of crankcase.

Oil pump drive gear (spiral gear) (2) is located on splined shaft behind pinion gear (3). Spiral gear is a slip fit on splines. A mark is cut on one side of spiral gear, which should face outward against pinion gear when assembled to shaft.

NOTE

Once breather valve is correctly timed, position of flywheel timing mark and breather valve timing mark, registered in slot of breather sleeve gear, can be disregarded when installing timing gears.

INSTALLING PINION GEAR (Figure 3-37)

On 1976 and earlier models, assemble spiral gear against shoulder on pinion shaft engaging breather sleeve gear tooth which will register timing hole in breather sleeve (4) in center of slot in breather bushing as shown. Install pinion gear using Gear Puller and Installer Tool as shown in Figure 3-37.

Figure 3-37. Installing Pinion Gear (1976 and Earlier)

Turn screw (1) on end of pinion shaft and tighten securely. Position gear locating collar (2) and body (3) on screw (1). Turn tool body to press gear into position until locating collar firmly contacts joint face of crankcase. This positions pinion gear outer face exactly 5/16 in. from gearcase joint face, the running position for the gear when case cover is in place.

On 1977 and later models, install pinion gear on shaft with timing marks aligned. Install lockwasher (29, Figure 3-30) and nut (30, Figure 3-30) and tighten to 50 ft-lbs torque.
INSTALLING CAM GEARS AND GEARCASE COVER (Figure 3-38)

Install plates (11, Figure 3-30) in case recess with beveled side of holes for cam shaft facing outward toward cam.

Lubricate cam gear shafts and position in crankcase with marks on gears 1, 2, 3, 4 and 5 in alignment as shown under Figure 3-38. Install idler gear (7) in crankcase with fiber washer (8) toward the cover side.

Position gearcase cover gasket on crankcase. Be sure to install a new factory-made gasket. Never use a homemade gasket as cover gasket has holes especially located for oil passages and if a hole is left out or put in wrong place, oiling system will not function normally.

Lubricate the cam gears with a liberal coating of engine oil. Carefully align cover and tap into position. Cover should slip into place easily and should never be forced or driven into place. Tighten all screws evenly to 8-10 ft-lbs torque, working opposite from one another. Install generator and gasket. Tilt generator back end down as it is inserted in gearcase opening to lift oil slinger over idler gear, and then up to mesh generator and idler gears. Turn engine over to make sure gears turn freely.

Figure 3-38. Timing Gears

Figure 3-39 Removing and Installing Cam Gear Needle Bearings in Crankcase
GENERAL

When rod bearings, pinion shaft bearings, or sprocket shaft bearings are in need of repair, the engine must be removed from the chassis as described in "STRIPPING MOTORCYCLE FOR ENGINE REPAIR." It is recommended procedure to check over and make repairs to cylinder heads, cylinders, gearcase and transmission at the same time.

CHECKING FLYWHEEL END PLAY

Before completely disassembling the crankcases, it is recommended procedure to check flywheel end play to determine amount of sprocket shaft bearing wear.

To check flywheel end play, remove cylinder heads, cylinders, front chain cover, gearcase cover and cam gears. Do not remove or loosen engine sprocket assembly. (See "DISASSEMBLING CRANKCASE").

Anchor dial indicator base firmly on right or left side of engine crankcase with indicator stem against end of pinion shaft or engine sprocket shaft nut. Rotate flywheels and at the same time, push and pull on pinion shaft reading travel of dial indicator in thousandths of an inch. If end play exceeds maximum specification limit as shown under "SPECIFICATIONS," sprocket shaft Timken bearing must be replaced. Also, see "CLEANING AND INSPECTION."

DISASSEMBLING CRANKCASE

To completely disassemble the crankcase, follow steps 1-13.
1. Remove cylinder heads as described in "CYLINDER HEAD."
2. Remove cylinders and pistons as described in "CYLINDER."
3. Remove clutch and clutch release as described in "CLUTCH." Section 4.
4. Remove the starter as described in "STARTER." Section 4.
5. Using Sprocket Shaft Extension Puller, Part No. 96015-56 for 1976 and earlier models and 96015-77 for 1977 and later models, remove sprocket shaft extension (1, Figure 3-40), as shown in Figure 3-40. For models equipped with a solid sprocket, use Claw Puller, Part No. 95635-46.
6. Remove tappets, tappet guides, circuit breaker or magnet, gearcase cover, cam gears and generator as described in "GEARCASE."
7. Remove the oil pump as described in "OIL PUMP."
8. See Figure 3-41. Free the tachometer drive unit from the right case and remove right crankcase bolts (1, 2, and 3) and stud nuts (4). Remove bolts (5), engine rear mount (6), bolts (7), and top center crankcase stud (8).
9. Check flywheel end play as described above.
10. See Figure 3-42. Remove snap ring (2) from pinion shaft with tip of screwdriver. Lift bearing washer (3) with bearings (4) and retainer (5) off pinion shaft.
11. Remove transmission as described in "CRANKCASE AND TRANSMISSION DISASSEMBLY PROCEDURE," Section 4.
12. See Figure 3-42. Mount flywheel and left case assembly on arbor press table supporting crankcase on parallel bars. Press on end of sprocket shaft with arbor press until flywheel assembly (6) is free from case. Do not drift or tap flywheel assembly from left case as flywheels may be knocked out of alignment.
13. This step applies to 1976 and earlier models. See Figure 3-42. If it is necessary to disassemble flywheels or remove Timken bearing from crankcase, free right bearing half (7) from sprocket shaft, using Sprocket Shaft Puller, Part No. 96015-52 for 1976 and earlier models and 96015-77 for 1977 and 1978 models, as shown in Figure 3-43. Secure pinion shaft between copper jaws in vise. Place hooked ends of puller halves behind bearing, and slip round holding collar over outside diameter, down to bearing end. Engage puller screw handle in puller slots and pull bearing off by tightening puller screw against sprocket shaft center.

If left bearing half is to be removed, first pry oil seal (8) from crankcase. Use a pointed instrument such as an old spoke that has one end sharpened to a point. Remove crankcase outer spring ring (9) from groove in case, by prying end with screwdriver and inserting thin screwdriver or knife blade between spring ring and case.
1. Crankcase mounting bolt 5/16 x 4-7/16 in.
2. Crankcase mounting bolt 5/16 x 4-1/16 in.
3. Crankcase mounting bolt 5/16 x 2-3/8 in. (3)
4. Crankcase rear mounting stud and locknut (3)
5. Engine rear mounting bolt and lockwasher (4)
6. Engine rear mount
7. Crankcase bolt (2)
8. Crankcase stud and locknut (center)
9. Crankcase

Figure 3-41. Crankcase - Exploded View

1. Sprocket shaft extension
2. Pinion shaft bearing snap ring (1976 & earlier)
3. Pinion shaft bearing washer (1976 & earlier)
4. Pinion shaft roller bearing (13) (1976 & earlier)
5. Pinion shaft roller bearing retainer (1976 & earlier)
6. Connecting rod and flywheel assembly
7. Sprocket shaft Timken bearing right half (1976 & earlier)
8. Sprocket shaft oil seal
9. Sprocket shaft bearing spring ring (outer) (1976 & earlier)
10. Sprocket shaft bearing spacer (1976 & earlier)
11. Sprocket shaft Timken bearing left half (1976 & earlier)
12. Sprocket shaft Timken bearing spacer (1976 & earlier)
13. Sprocket shaft Timken bearing outer race (1976 & earlier)
14. Pinion shaft bushing (1976 & earlier)
15. Pinion shaft bearing bushing screw (2)
16. Sprocket shaft bearing spring ring (inner) (1976 & earlier)
17. Pinion race (1977 & later)
18. Pinion bearing (1977 & later)
19. Sprocket right bearing (1977 & later)
20. Sprocket right outer race (1977 & later)
21. Spacer (1977 & later)
22. Lock ring (1977 & later)
23. Sprocket left outer race (1977 & later)
24. Sprocket left bearing (1977 & later)

Figure 3-42. Crankcase and Flywheel Assembly - Exploded View
Figure 3-43. Removing Bearing from Sprocket Shaft

Position left crankcase side on arbor press table, clutch side supported by parallel bars. Use right half of Timken bearing to press out sprocket shaft bearing spacer (10), bearing left half (11), spacer (12), and outer race (13).

13A. This step applies to 1977 and later models. See Figure 3-42. If it is necessary to remove either the pinion shaft bearing or sprocket shaft (Timken) bearing, proceed as follows:

Disassemble flywheel assembly and remove pinion and sprocket shafts. Remove pinion race (17) from pinion shaft and sprocket right bearing (19) from sprocket shaft using appropriately sized tubes to press them off using an arbor press.

Press out pinion bearing (18) from right crankcase half using a plug and press. Remove oil seal (8) from left crankcase half and remove sprocket shaft bearing (24). Remove both outer races (20) and (23) from left crankcase half by tapping them out from the opposite side. Pry out lock ring (22) from the groove in case.

FLYWHEELS

DISASSEMBLING (Figure 3-44)

Grip pinion shaft in copper vise jaws so shafts are in vertical position. Remove lock plate screw (1), lock plate (2), and crank pin nut (3), using crank pin and flywheel nut wrench, Part No. 96546-41. Strike left flywheel with soft metal mallet at about 90 degrees from crank pin hole on wheel periphery to loosen. Lift left flywheel (4) off crank pin.

Hold down bearing assembly with a short length of pipe or tubing so connecting rods (6) may be slipped off bearings. Move bearings (6). Hold together in set until bearings are fitted and refitted to crank pin.

Remove lock plate screw (7), lock plate (8), and gear shaft nut (9). Tap right flywheel (10) to loosen and lift off pinion shaft (11). Remove key (12) from shaft. Clamp crank pin in vise. Remove lock plate screw (13), lock plate (14), and crank pin nut (15). Tap flywheel to loosen and remove crank pin (16) and key (17).

Grip sprocket shaft in vise and remove lock plate screw (18), lock plate (19), and sprocket shaft lock nut (20). Tap flywheel to loosen and remove sprocket shaft (21). Remove key (22) from shaft.

CLEANING AND INSPECTING (Figure 3-44)

Wash all parts in solvent and blow out oil holes in pinion shaft, right flywheel and crank pin with compressed air. Examine crank pin for wear, grooving and pitting. If the surface is at all worn, replace with new pin. Examine flywheel washers (23 and 24). If either washer is worn and grooved, it should be replaced. A bad rod bearing is indicated when one washer is worn more than the other. Bearing should be replaced.

Examine connecting rod lower races. If the appear slightly grooved or shouldered where edge of bearing rollers ride, they may be lapped out and oversize bearing rollers installed. If they appear badly worn, grooved or pitted, new rods should be installed, preferably as an assembly with new bearings and crank pin. (See "LAPPING ROD BEARINGS.")

Examine pinion shaft and right crankcase bushing (see 14, Figure 3-42) for pitting, grooving, and gouging. A shaft that is worn must be replaced. If bushing is worn beyond repair, replace as described in "REPAIRING CRANKCASE."

Examine sprocket shaft bearing outer races for wear, grooving, pitting and powdered metal fragments. Examine bearing rollers for wear, pitting, grooving and scoring. The sprocket shaft Timken tapered roller bearings are manufactured in selectively fitted sets. If any part is unusable, the entire set must be replaced. See "CHECKING FLYWHEEL END PLAY."

REPLACING FLYWHEEL WASHERS (Figure 3-44)

Replace worn flywheel washers as follows:

Washer is a close fit in recess in flywheel and is secured originally by staking flywheel metal tight against the washer at several points. It is usually necessary to drill a small hole (1/8 in. or smaller) at the outer edge of the washer to permit getting a pointed tool underneath to pry it out. The hole is drilled only slightly deeper than the thickness of the washer to avoid removing more metal than necessary.

Before installing new washer, scrape outer edge of washer recess where metal was staked against it so new washer may seat fully against recess bottom. If washer does not seat fully, connecting rod will not have proper end play.

LAPPING CONNECTING ROD FACES (Figure 3-45)

Connecting rod lower races that are likely to clean up within the range of oversize bearing rollers and are otherwise in serviceable condition should be trued and sized with Connecting Rod Lapping Arbor, Part No. 96740-36.
Turn lapping arbor in lathe at 150 to 200 rpm. Adjust lap by means of adjusting nut to a snug but free fit in rod race. Clean lap before using, then apply fine lapping compound (No. 220 grit grinding compound mixed with oil) to lap. A loose lap will "bell mouth" bearing race so it must be kept just snug at all times. To avoid grooving or tapering lapped surface in rod, work rod back and forth the full length of the lap holding rod as near race as possible. Lap rods individually.

When rods are lapped true and all traces of pit marks or grooving are cleaned up, wash rods and blow dry. Surface should have a soft velvety appearance and be free of shiny spots.

Assemble crank pin nut with Flywheel Nut Wrench or torque wrench to foot-pound reading given in engine "SPECIFICATIONS."

FITTING ROD BEARINGS

Oversize rollers are available in .0002, .0004, .0006, .0008, .0010, .0015 and .0020 oversize.

There are two ways to determine oversize rollers to use. Each will result in properly fitted bearings if applied correctly.

1. Secure right flywheel in vise with pinion shaft down. Install any new set of oversize rollers to bearing races and position on crank pin. Slip rods over bearings. If they will not fit, it is obvious rollers are too large and a smaller size must be tried. If they fit and spin freely, install a larger set of rollers. Try various roller sizes until a slip fit is achieved. The rods will turn with a very slight drag. This is a plug fit. Determining running fit is merely a matter of subtracting one-half the desired running fit clearance (.0005 in.) from the roller size to find the running fit roller size.

It may be easier to gauge a plug fit as follows:

2. Fit any size rollers into races. Position bearings in rods. Support rods and bearings with left hand. Drop crank pin (not attached to flywheel) through crank pin hole. Plug fit has been achieved when crank pin will slide slowly through hole from its own weight. Running fit is then determined by subtracting one-half running clearance from oversize of rollers used to make plug fit.
ASSEMBLING FLYWHEELS (Figure 3-44)

After correct connecting rod bearing fit has been attained, clean and assemble parts as follows:

Wipe all tapers perfectly clean and free from oil. Install sprocket shaft (21) to left flywheel (4) and make sure key (22) is in position. See engine “SPECIFICATIONS” for proper torque. Assemble pinion shaft (11) and crank pin (16) to right flywheel making sure keys (12, 17) are in proper position. Install lock plates (8, 19). Tighten mounting screws (7, 18) to 20-24 in-lbs torque. If corners of nuts do not align with notches in lock plate, tighten (never loosen) shaft nuts to achieve alignment. Check to make sure oil passages through pinion shaft, right flywheel and crank pin are clean by blowing compressed air into hole near end of pinion shaft.

After correct connecting rod bearing fit has been attained, clean all parts and lubricate bearings with engine oil. Install connecting rods on crank pin bearing so female rod is to rear cylinder. Assemble key and sprocket shaft to left flywheel with sprocket shaft nut, lock plate and lock plate screw.

Position right flywheel assembly in vise. Wipe crank pin taper and crank pin hole in left flywheel clean and dry. Install left flywheel and tighten nut lightly. Hold steel straight edge along outer face of wheel rim at 90 degrees from crank pin (Figure 3-46). Tap outer rim of top wheel until rim faces of both wheels are in alignment. Tighten nut. Recheck with straight edge at frequent intervals. Use soft metal hammer to realign wheels. To prevent flywheel assembly from turning in vise while tightening nut, insert a rod 5 in. long and about 1/2 in. in diameter through holes in flywheels and between vise jaws so that rod bears against some part of the vise.

ASSEMBLING FLYWHEELS (Figure 3-44)

After correct connecting rod bearing fit has been attained, clean and assemble parts as follows:

Wipe all tapers perfectly clean and free from oil. Install sprocket shaft (21) to left flywheel (4) and make sure key (22) is in position. See engine “SPECIFICATIONS” for proper torque. Assemble pinion shaft (11) and crank pin (16) to right flywheel making sure keys (12, 17) are in proper position. Install lock plates (8, 19). Tighten mounting screws (7, 18) to 20-24 in-lbs torque. If corners of nuts do not align with notches in lock plate, tighten (never loosen) shaft nuts to achieve alignment. Check to make sure oil passages through pinion shaft, right flywheel and crank pin are clean by blowing compressed air into hole near end of pinion shaft.

After correct connecting rod bearing fit has been attained, clean all parts and lubricate bearings with engine oil. Install connecting rods on crank pin bearing so female rod is to rear cylinder. Assemble key and sprocket shaft to left flywheel with sprocket shaft nut, lock plate and lock plate screw.

Position right flywheel assembly in vise. Wipe crank pin taper and crank pin hole in left flywheel clean and dry. Install left flywheel and tighten nut lightly. Hold steel straight edge along outer face of wheel rim at 90 degrees from crank pin (Figure 3-46). Tap outer rim of top wheel until rim faces of both wheels are in alignment. Tighten nut. Recheck with straight edge at frequent intervals. Use soft metal hammer to realign wheels. To prevent flywheel assembly from turning in vise while tightening nut, insert a rod 5 in. long and about 1/2 in. in diameter through holes in flywheels and between vise jaws so that rod bears against some part of the vise.

If lower end race of one rod is found to be slightly larger than the other, select rollers to fit the larger rod race and lap smaller rod race to same size as larger race rather than fitting rollers of two sizes.

When rods are correctly fitted with required bearing clearance, extreme upper end of the male rod will have 3/64 in. side shake. All fitting and checking must be made with bearings, rods and crank pin free of oil and clean.

Fitting bearings tighter than described is likely to result in seizing and bearing damage when heat expands parts.

Check overall width of roller retainer assembly. It must be less than width of female rod end.
When wheels are both out of true as indicated in "B," a hardwood wedge is driven between the wheels opposite the crank pin and the rims near the crank pins moderately tapped with a mallet.

When wheels are out of true as indicated in "C," strike the rim of the wheel a firm blow at about 90 degrees from crank pin on high side.

When wheels are out of true in a combination of any of conditions shown, correct condition C first, then correct A and B.

The number of blows required and how hard they should be struck depends on how far shafts are out of true and how tight nuts are drawn. Remember that centers must be loosened slightly before striking flywheels. Making them too loose may result in damaged centers. Never strike wheels a hard blow near crank pin.

Readjust centers, revolve wheels and take reading from indicator. Repeat truing operation until indicators show run-out to be no more than .001 in. (each graduation on indicator is .002 in.).

If it is impossible to true wheels, look for a cracked flywheel, damaged or enlarged tapered hole, or a sprocket or pinion shaft worn out of round at surface where indicator reading is being taken.

When wheels are true, position in vise and draw crank pin nuts to 150 ft-lbs torque, using crank pin nut wrench or torque wrench. Check connecting rod sideplay with thickness gauge as shown in Figure 3-49. If it is greater than tolerance shown in engine "SPECIFICATIONS," draw up crank pin nuts until within tolerance. Insufficient play between rods and flywheel face is caused by one of following conditions:

1. Flywheels and crank pin assembled with oil on tapers and nuts over-tightened. Disassemble, clean, reassemble and recheck. It may be necessary to replace the flywheel.

2. New flywheel washers installed and not fully seated. Disassemble, inspect, and reset thrust washer. As last resort, grind down width of forked rod. Remove material evenly from both sides.
3. Taper holes enlarged as a result of having been taken apart several times. Replace wheel seating deepest.


If sides of forked rod are ground to get desired clearance, backs of bearing retainers must be ground down to remain narrower than width of female rod.

After rod sideway is checked and adjusted, tighten crank pin nut to 150 ft-lbs torque and install lock plate and screw. Check wheel trueness on truing device. Correct any run-out as above.

TRUING AND SIZING PINION SHAFT BEARINGS RACE

Before fitting new pinion shaft bearings, lap bearing race in crankcase to true and remove traces of wear at sides of roller paths. A smooth velvety finish should result. A race that is worn beyond limits of oversize bearing rollers must be replaced. See engine “SPECIFICATIONS,” for shaft fit in roller bearing.

To remove worn bearing race, remove two bearing bushing screws (15, Figure 3-42) from inside of right case and press out bearing race. Heat cases to 275°-300°F. Heating expands case and makes it possible to remove bearing race using less force. Press worn race out and new race in. New race must be lapped slightly to true and align with left case bearing, and to attain a size compatible with roller sizes available.

Lap bearing race by inserting guide sleeve (1, Figure 3-50), Part No. 96728-56, from inside of case, through complete Timken bearing assembly on sprocket side of crankcase. Turn nut finger tight on sleeve. See “ASSEMBLING CRANKCASE,” to install Timken bearing. This pilot will line up lapping arbor shaft through both bearing races so that an accurately lapped pinion shaft bearing race bore is obtained.

Temporarily assemble right and left cases with stud (8), bolts (3) and bolts (2, Figure 3-41). Securely tighten bolts to assure perfect alignment between left and right cases.

Insert crankcase main bearing lap (2, Figure 3-50) through pinion shaft bearing race and into guide sleeve in opposite race as shown in Figure 3-51.

Tighten arbor expansion collars using a length of 5/32 in. rod as spanner wrench until arbor begins to drag. Do not adjust arbor loose in bushing or bushing will “bell,” a condition where hole is larger at ends than it is in the center.

Withdraw arbor far enough to coat lightly with fine lapping compound. Do not apply a heavy coat. Reposition lap in bushing and turn handle at moderate hand speed. Work lap back and forth in bushing as it is revolved to avoid grooving and tapering.
At frequent intervals, remove lap from crankcase, wash and inspect bushing. Lapping is completed when entire bushing surface has a dull, satin finish rather than a glossy, smooth appearance. If necessary, flush off lap in cleaning solvent, air dry and apply fresh, light coat of fine lapping compound.

FITTING PINION SHAFT BEARING

The fitting of pinion shaft bearing is done in much the same way as fitting lower rod bearings (see "FITTING ROD BEARINGS"). A plug fit is first determined using proper instruments or, preferably, by trial and error using sets of various size rollers. Determine plug fit using pinion shaft that will be used on engine being overhauled, or spare shaft of exactly same size. When a plug fit has been found, pinion shaft will enter bearing slowly under its own weight, will turn with only a very light drag and will have no perceptible shake. A running fit is determined from a plug fit by subtracting one-half the desired running fit clearance from the size of the plug fit rollers.

Example:

Running fit clearance is .0005 to .0015 in. loose. See engine "SPECIFICATIONS." If a plug fit was achieved with .0006 in. oversize rollers, subtract one-half running fit clearance from plug fit roller oversize. Use figure representing minimum of tolerance span, .0005 in. One-half the minimum tolerance allowed (.00025 in.) subtracted from roller oversize equals .0005, therefore, .0004 in. oversize rollers should be used to produce a suitable running fit.

Oversize rollers are available in .0002, .0004, .0006, .0008 and .0010 in. sizes. Roller selection should therefore be made to nearest available even-numbered size. In the example above, it would be possible to arbitrarily decide upon .0008 in. as a running fit rather than the .0005 in. if desired. Final decision would rest largely upon intended use of motorcycle. For high speed work, the more free fit would be better, while the closer tolerance is suited to road use at average speeds. This consideration may be made in fitting all tolerances.

All fitting must be done with bearings that are clean and dry. Oiled surfaces will take up some clearance and give a false reading.

ASSEMBLING CRANKCASE (1976 AND EARLIER)

1. See Figure 3-42. If spring ring (16) has been removed, install a new one in left case. Position left case on arbor press, clutch side up. Press outer race (13) in case until it bottoms against ring (16).

2. See Figure 3-53. Position flywheel assembly in vise and grip pinion shaft between copper jaws. Install screw (1, Figure 3-52) and with a 1 in. I.D. x 3-1/2 in. long steel tube under drive (2, Figure 3-52). Install Timken bearing half (7, Figure 3-42) on sprocket shaft. Be sure bearing bottoms on shaft shoulder.

Figure 3-52. Sprocket Shaft Timken Bearing Assembling Tool

Figure 3-53. Installing Bearing (Right Half) and Spacer
If an arbor press is available, bearing may also be pressed on shaft with a 1 in. I.D. x 6 in. long steel tube. Be sure to use Flywheel Support Plate, Part No. 96137-52A, in between flywheel halves.

After pressing bearing tight against the flywheel, install bearing spacer (12, Figure 3-42) on sprocket shaft.

3. See Figure 3-54. With screw (1, Figure 3-52) installed on threaded end of sprocket shaft, place left crankcase (bearing race installed in case) over end of sprocket shaft, seating bearing race against Timken bearing half (7) and bearing spacer (12, Figure 3-42). Lubricate bearing with engine oil and insert Timken bearing left half (11, Figure 3-42) on screw (1, Figure 3-52) tapered end of bearing down.

NOTE

If Timken bearing left half (11, Figure 3-42) and outer spacer are already installed in case, simply position case over top of screw (1, Figure 3-52) until bearing is snug on sprocket shaft and proceed as follows.

Install bearing sleeve (3) over end of screw (1, Figure 3-52) with step-cut end of sleeve facing down as positioned on tool.

Start driver (2, Figure 3-52) on screw and turn driver down against bearing sleeve. Continue turning the driver clockwise until the two bearing halves are brought tight against spacer. Remove tools.

4. Insert screw (1) with driver (2) in small end of spacer sleeve (4, Figure 3-52). Position sprocket shaft bearing spacer (10, Figure 3-42) on flanged end of spacer sleeve (4) with notched side of spacer away from spacer sleeve (4). Position this assembly with spacer against crankcase outer bearing race as shown in Figure 3-55. Assemble screw and driver on sprocket shaft. Turn driver clockwise until spacer is tight against bearing outer race. Remove tools.

5. Install sprocket shaft oil seal (8), lip side of seal towards the spacer. Insert screw (1, Figure 3-52) through sleeve (4) and assemble on end of sprocket shaft. Install driver (2) and turn clockwise until seal is pressed into crankcase recess. Install sprocket shaft bearing spring ring (9). Align splines and start sprocket shaft extension (1, Figure 3-42) on end of sprocket shaft. Insert screw (1) through shaft extension and tighten on end of sprocket shaft. Turn driver (2) clockwise until extension bottoms against bearing inner race (see Figure 3-56).

6. See Figure 3-42. Install bearing assembly (4 and 5) and washer (3) on pinion shaft. Install new snap ring (2) in groove of pinion shaft.

Position right crankcase on arbor press and press pinion bearing (18) into case until it bottoms in recess. Install pinion race (17) onto pinion shaft using Bearing Guide Tool, Part No. 97080-77, as follows. Place assembled flywheel assembly on a press supported in the middle by Flywheel Support Plate, Part No. 96137-52A. Place pinion race (17) on outer end of pinion shaft and then press into place using Bearing Guide tool. When tool bottoms, pinion race (17) will be correctly positioned 0.31 inches from edge of shaft shoulder.
7. Reassemble transmission as described in "CRANKCASE AND TRANSMISSION ASSEMBLY PROCEDURE," Section 4.

8. Apply a coat of non-hardening gasket sealer to crankcase joint faces. Lubricate pinion shaft bearing with engine oil and assemble crankcase sides together.

9. See Figure 3-41. Remount crankcase in chassis using hardware shown in Figure.

10. Install transmission mainshaft sprocket as described in "TRANSMISSION," Section 4.

11. Install starter as described in "STARTER," Section 4.

12. Install clutch and clutch release as described in "CLUTCH," Section 4.

IMPORTANT

Be sure to refill transmission with oil as described in "LUBRICATION," Section 4.

13. Install oil pump as described in "OIL PUMP."

14. Install timing gears, gearcase cover, tappet guides, tappets, and generator as described in "GEARCASE."

15. Install cylinders and pistons as described in "CYLINDER."

16. Install circuit breaker and time engine as described in Section 5.

17. Install cylinder heads as described in "CYLINDER HEAD."

ASSEMBLING CRANKCASE
(1977 AND LATER)

1. Referring to Figure 3-42 replace lock ring (22) in groove in left crankcase half and then press both outer races (20 and 23) back in place against ring.

Press new sprocket right bearing (19) on sprocket shaft so that it bottoms on shaft shoulder using Bearing Installing Tool, Part No. 97081-54A. Use Bearing Sleeve, Part No. 97100-77, under driver to press the bearing into place.

2. Referring to Figure 3-42, install pinion bearing (18) and pinion race (17) as follows.

Position right crankcase on arbor press and press pinion bearing (18) into case until it bottoms in press. Install pinion race (17) onto pinion shaft using Bearing Guide Tool, Part No. 97080-77, as follows. Place assembled flywheel assembly on a press supported in the middle by Flywheel Support Plate, Part No. 96137-62A. Place pinion race (17) on outer end of pinion shaft and then press into place using Bearing Guide Tool. When tool bottoms, pinion race (17) will be correctly positioned 0.31 inches from edge of shaft shoulder.

3. After reassembling the bearing components, reinstall flywheel assembly into left crankcase half as shown in Figure 3-54 using Bearing Installing Tool, Part No. 97081-54A.

4. Perform steps 7 through 17 under "ASSEMBLING CRANKCASES (1976 AND EARLIER)."