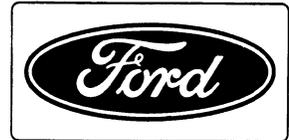


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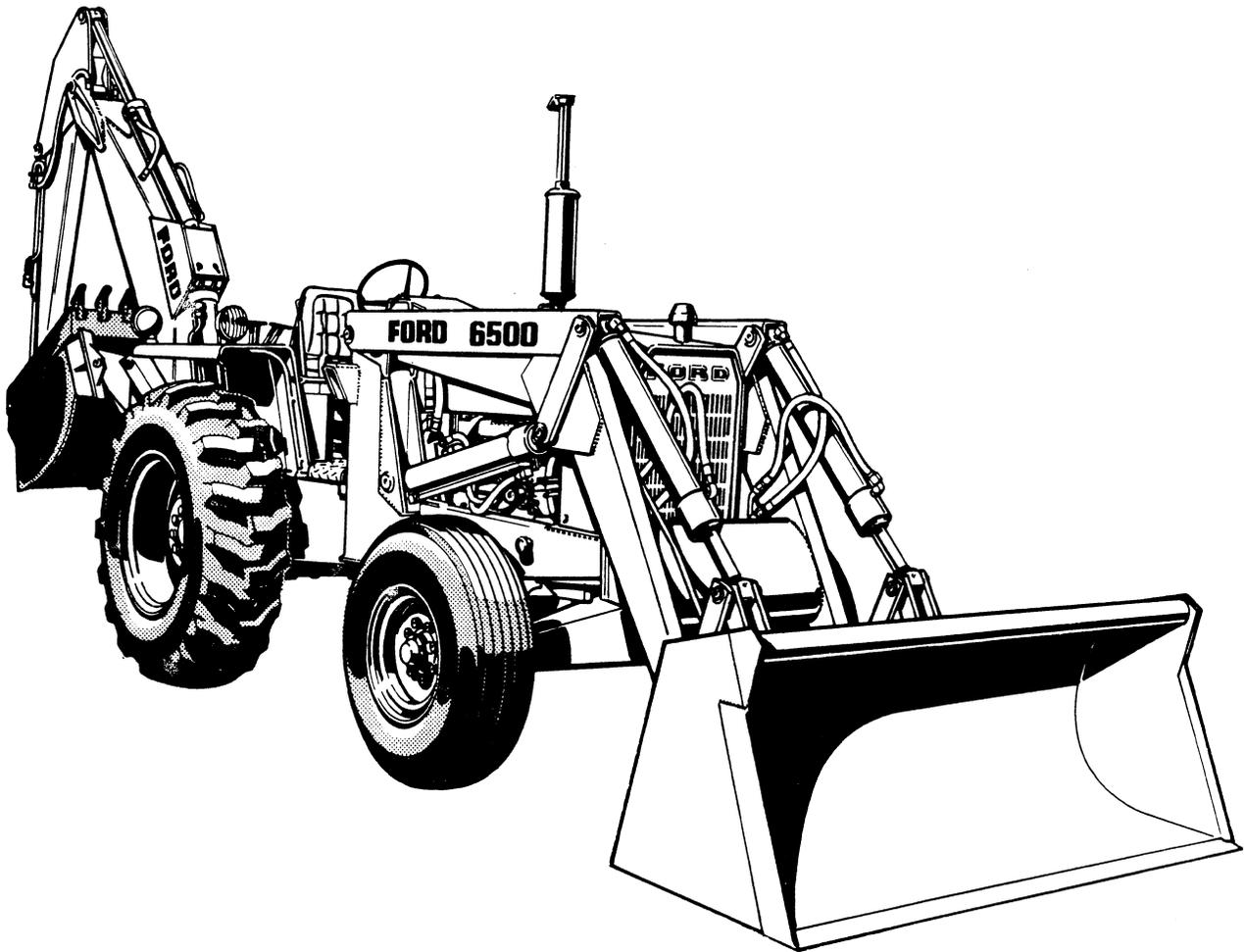


FORD

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Service Manual

Tractor - Loader - Backhoe 6500, 7500



Product: New Holland Ford 6500/7500 Tractor Loader Backhoe Service Repair Manual

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Part 1

ENGINES

Chapter 1

ENGINES AND LUBRICATING SYSTEM

Section		Page
1.	Description and Operation	1
2.	Cylinder Head, Valves, and Related Parts	4
3.	Engine Front Cover and Timing Gears	12
4.	Oil Pan Sump and Oil Pump	17
5.	Connecting Rods, Bearings, Pistons, Rings, and Cylinder Block	20
6.	Balancer, Main Bearings, Flywheel, and Crankshaft	30
7.	Camshaft	39

Chapter 2

TURBOCHARGER - FORD 7500

Section		Page
1.	Description and Operation	43
2.	Turbocharger Overhaul	44

Chapter 3

COOLING SYSTEM

Section		Page
1.	Description and Operation	53
2.	Radiator and Thermostat	54
3.	Water Pump	55

Chapter 4

TROUBLE SHOOTING, SPECIFICATIONS AND SPECIAL TOOLS

Section		Page
1.	Trouble Shooting	59
2.	Specifications	61
3.	Special Tools	69

Part 1

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7.	Camshaft	39

1. DESCRIPTION AND OPERATION

This part of the manual covers the diesel engines for the Ford 6500 and 7500 Tractors. The Ford 7500 diesel engine is similar to the Ford 6500 diesel engine but develops more power through use of a turbocharger along with different pistons, valves, connecting rods, and air cleaner.

This part of the manual deals with disassembly, inspection and repair, and the assembly of engines; the lubrication system and the cooling system.

Cylinder Head Assembly - Including Valve Train Components

The cylinder head assembly incorporates the valves, valve springs, and rotators. The valve rocker arm shaft assembly is bolted to the head. The intake and exhaust manifolds are bolted to the head. The intake manifold is on the right side from the rear of the engine, and the exhaust manifold is on the left side. The water outlet connection and thermostat are attached to the front of the cylinder head. Valve guides are an integral part of the cylinder head, and valves with oversize stems are available for service. Special replaceable cast alloy

valve seats are pressed into each valve port of the cylinder head. The exhaust valves are fitted with positive valve rotators. The Ford 6500 intake valves have umbrella-type seals while the Ford 7500 intake valves do not have seals.

Exhaust valves on both tractors have a square section O-ring seal.

Valve lash is maintained by self-locking adjusting screws. The camshaft is supported by five replaceable bearings. The camshaft is driven by the camshaft drive gear which is in mesh with the camshaft gear. Camshaft thrust is controlled by a plate secured to the block and located between the camshaft gear and the front journal of the camshaft.

The cylinder heads use six evenly spaced head bolts per cylinder. The fuel injectors are mounted outside the rocker cover.

The engine cylinder heads are designed with the face of the cylinder head flat. The combustion chambers are in the heads of the pistons.

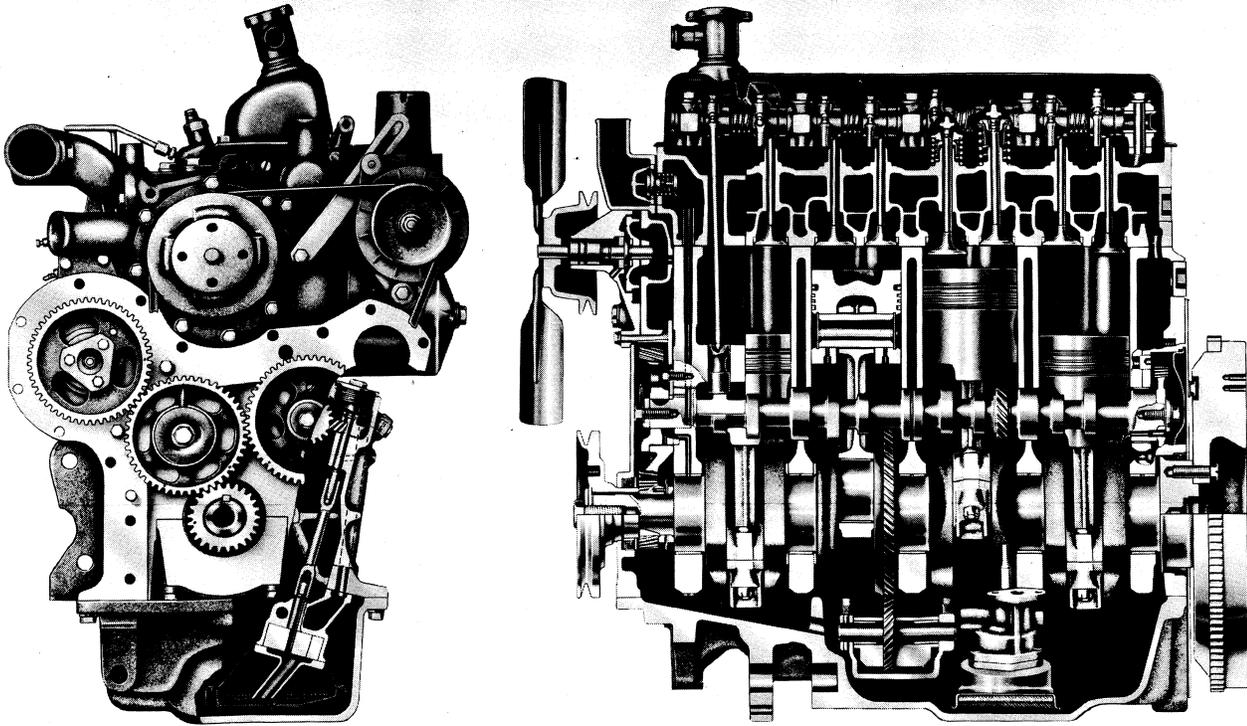


Figure 1
Four Cylinder Diesel Sectional View

Manifolds

The aluminum alloy intake and cast iron exhaust manifolds are on opposing sides of the cylinder head to provide better heat distribution in the head. Tractors can be equipped with exhaust manifolds for either horizontal or vertical exhaust systems. The intake manifolds are connected through tubing to the air cleaner and are provided with a tapped hole for installation of a thermostat or an ether cold starting aid kit.

NOTE: If cold start equipment is not installed, the plug assembled in the manifold should remain securely assembled at all times. Considerable damage to the cylinder bores could result from its absence. The cylinder bores can also be damaged by grit and other foreign matter passing through the air cleaner hose connections if they are not properly secured.

Cylinder Block Assembly

The cylinder block is alloy cast iron with heavy webbing and deep cylinder skirts. The block features full length water jackets, bored integral with the block, to cool the cylinders. Cylinder arrangement is vertical in-line with the cylinders numbered from 1 to 4, starting at the front of the block. The firing order is 1 - 3 - 4 - 2.

The oil pan sump is heavy cast iron. The cast iron pan is used as part of the attaching area for the front axle of the tractor. The oil pan is attached to the bottom of the cylinder block and is the sump for the lubrication system. The engine front cover is attached to the front engine adapter plate, forming a cover for the timing gears. The crankshaft gear is keyed and press fitted on the front of the crankshaft. The crankshaft gear drives the camshaft drive gear, which is attached to the front of the cylinder block. The camshaft drive gear drives the camshaft gear and the injection pump drive gear.

The camshaft gear is attached to the front of the camshaft by a bolt, lock washer, flat washer, and a spacer. The gear is keyed to the camshaft to maintain the position of the gear and drive the shaft. All the timing gears can be checked by observing the timing punch marks on the gears. The crankshaft is supported in the cylinder block by five main bearings. The bearing liners are copper-lead or aluminum-tin alloy with a flange-type thrust bearing liner to control crankshaft end play. The thrust bearing is the third intermediate. A slinger is machined to the rear of the crankshaft to direct oil away from the rear seal. The rear seal is a circular lip-type rubber seal that fits into a pocket machined into the cylinder block and rear main bearing cap. The cap has two composition side seals.

The engine is equipped with a dynamic balancer to smooth out engine vibrations. The balancer assembly consists of a housing attached to the bottom of the cylinder block containing a drive gear and a driven gear. The balancer is driven by a gear machined on the crankshaft, and the balancer gears are timed from the crankshaft balancer drive gear.

Diesel engines have trunk-type pistons with a continuous skirt around the entire piston. Each piston has three compression rings and one oil control ring, all of which are above the piston pin. Two ring kits are supplied for service. One kit has an expander for installation behind the third compression ring and the other kit does not.

The piston is connected to the crankshaft by a heavy I-beam connecting rod. The crankshaft end of the connecting rod has an insert-type copper-lead or aluminum-tin alloy bearing. The piston end of the connecting rod has a replaceable bronze bushing. The piston pin is a free-floating steel pin held in place in the piston by two snap rings (circlips).

Lubrication System

Oil from the oil pan sump is pumped through the pressure lubrication system by a rotor-type oil pump mounted on the bottom of the cylinder block and driven from a gear on the camshaft. The pump body incorporates a spring-loaded relief valve that limits the maximum pressure of the system. Oil relieved by the valve is directed back to the intake side of the pump.

Oil, after leaving the pump, passes through an external filter. Engines are equipped with a one-quart can type filter assembly with a replaceable cartridge. The filter incorporates a relief valve. The relief valve permits oil to bypass the filter if the filter becomes clogged, thereby maintaining oil to the engine at all times.

From the filter, the oil flows through a drilled passage in the block to the main oil gallery. The oil gallery is a drilled passage running the full length of the cylinder block which intersects the tappet chambers for lubrication of the tappets. The main oil gallery also supplies oil to the crankshaft main bearings through a drilled passage in the cylinder block, and from the main bearing journals through the crankshaft, to the connecting rod journals. Camshaft bearings are lubricated by drilled passages in the cylinder block from each main bearing.

The camshaft drive gear bushing is pressure-lubricated through a drilled passage from the front main bearing. The camshaft drive gear has a bushing which has spiral grooves to direct oil toward the outside of the gear, and on both sides of the gear. The gear has small oil passages machined on both sides which allows the oil to exhaust. The timing gears are splash-lubricated by oil from the tappet chamber and from the pressure-lubricated camshaft drive gear. The balancer is pressure lubricated through a drilled passage from the block intermediate thrust bearing web to the balancer housing. Oil flows through the balancer housing to the hollow balancer shafts and to the bushings in the balancer gears.

The Ford 6500 cylinder walls, pistons, and piston pins are splash lubricated by the crankshaft. An intermittent flow of oil is fed to the valve rocker arm shaft assembly through a drilled passage in the cylinder block at the No. 1 camshaft bearing, which indexes with a hole in the cylinder head. From the head, the oil flows up around the No.1 rocker arm support bolt to the rocker shaft. The oil from the shaft flows through drilled holes in each rocker arm to lubricate the valve end and the adjusting screw end of the rocker arm. Oil from the ball ends of the rocker arms flows down the push rods and assists in lubricating the tappets and push rods. Excess oil drains into the push rod chamber through the push rod holes in the cylinder head and then back to the oil pan sump through cored openings in the block.

2. CYLINDER HEAD, VALVES, AND RELATED PARTS

Cylinder Head

The cylinder head can be removed from the engine for service with the engine installed in the tractor. When removing the Ford 7500 cylinder head, first remove the turbocharger. For instructions, see Chapter 2, Part 1.

A. Removal

1. Remove the vertical muffler, if so equipped, and disconnect the main wiring harness from the hood panel assembly. Remove the hood panel assembly.
2. Remove the battery (Ford 6500). Remove the air cleaner assembly and related components. Remove the battery tray support bolts from the head (Ford 6500) and remove the radiator shell support. Disconnect the exhaust pipe from the exhaust manifold on units that are equipped with horizontal exhaust systems. Drain the radiator and cylinder block.

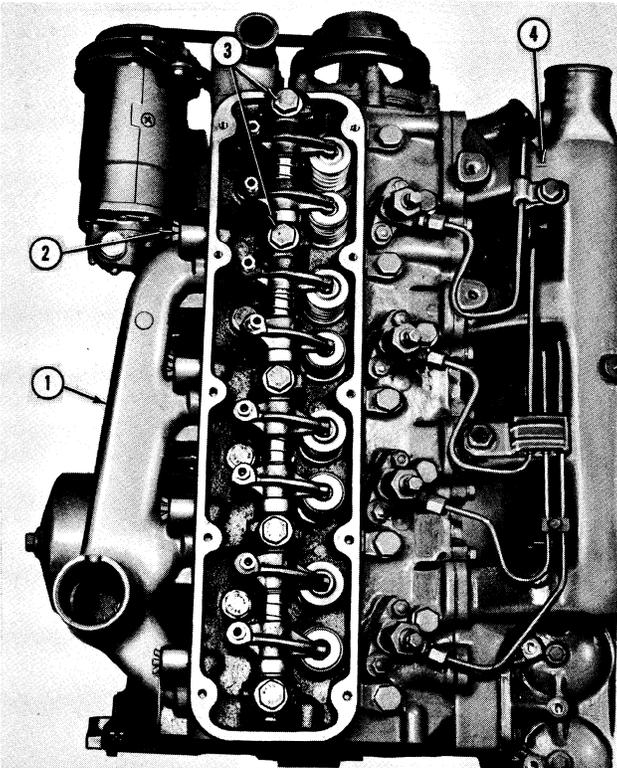


Figure 2
Engine with Rocker Arm Cover Removed

- | | |
|---------------------|------------------------|
| 1. Exhaust Manifold | 3. Cylinder Head Bolts |
| 2. Lock Tabs | 4. Intake Manifold |

3. Bend the lock tabs back, Figure 2, and remove the bolts that secure the exhaust manifold to the cylinder head.
4. Remove the exhaust manifold and metal gasket, Figure 2.
5. Remove the injector lines from the injection pump and from the injectors. Cap the exposed openings in the pump and in the injectors, and all tube ends to prevent the entry of dirt.
6. Disconnect cold start equipment where equipped.
7. Disconnect the air inlet hose at the clamp at the intake manifold.
8. Shut off the fuel at the tank (Ford 6500). Remove the fuel filter from the manifold by disconnecting the fuel lines and removing two bolts and flat washers and cap the openings.
9. Remove the bolts and lock washers that retain the intake manifold, Figure 2, to the cylinder head and remove the manifold and gasket.
10. Disconnect the ventilation tube from the rocker cover. Remove the bolts that attach the rocker arm cover to the cylinder head and remove the rocker arm cover and gasket.
11. Disconnect the injector leak-off line. Remove the two nuts from the studs that retain each injector, Figure 3, and remove each injector from its bore in the cylinder head. Be sure the area surrounding the injectors is clean. If the injectors can not be readily pulled by hand, it may be necessary to pry the injectors out.
12. Visually check the push rods for straightness before they are removed by rotating them with the valve closed. Loosen the bolts that retain the rocker shaft to the cylinder head, Figure 2, evenly and alternately until all tension has been relieved, and lift the rocker shaft assembly from the cylinder head.

NOTE: The rocker shaft retaining bolts should be left in place in the rocker shaft supports during removal. The bolts hold the rocker shaft assembly together; therefore, only remove the bolts when it is necessary to disassemble the rocker shaft.

13. Remove the valve push rods from their holes in the cylinder head and arrange them in a rack in the order in which they were removed.
14. Remove the remaining cylinder head attaching bolts and carefully lift the cylinder head from the block.

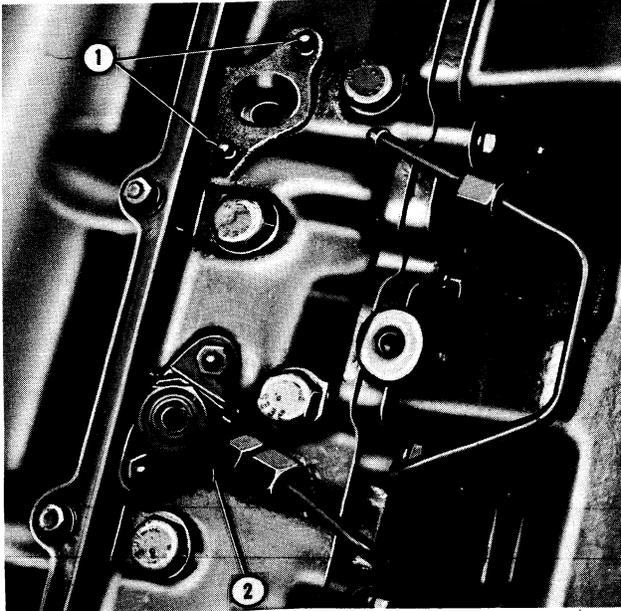


Figure 3
Engine Injector Removed

- 1. Injector Mounting Studs
- 2. Injector

B. Disassembly

1. Remove the two bolts that attach the water outlet connection to the cylinder head. Remove the connection, thermostat, and gasket, Figure 4.

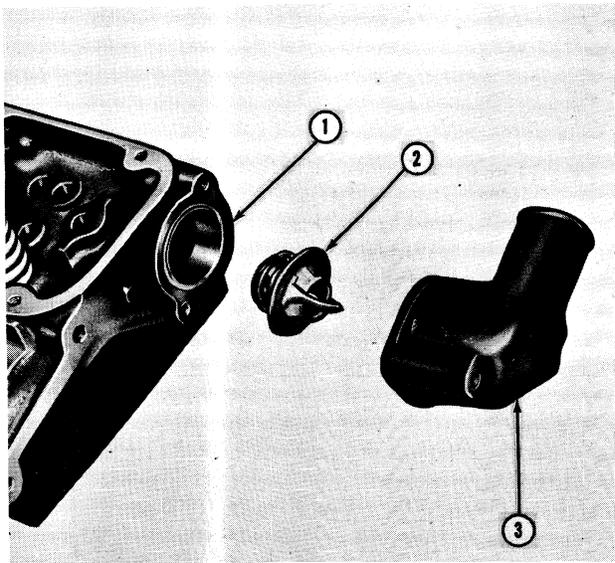


Figure 4
Engine Thermostat

- 1. Gasket
- 2. Thermostat
- 3. Coolant Outlet Connection

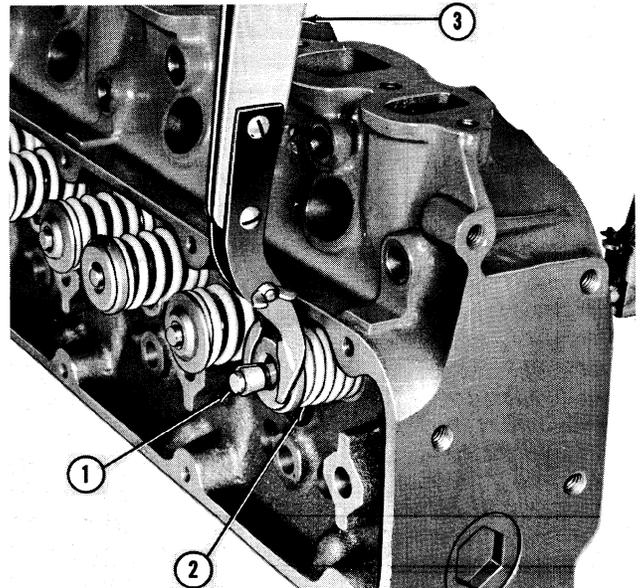


Figure 5
Removing Valves

- 1. Retainer Locks
- 2. Valve Spring
- 3. Valve Spring Compressor

2. Before removing the valves from the cylinder head, clean any carbon deposits from the area of the valve heads.
3. Position the valve spring compressor over the valve and spring, as shown in Figure 5, and compress the spring.

INTAKE VALVES: Remove the retainer locks, spring retainer, spring, and valve stem seal. The parts are shown in Figure 6.

EXHAUST VALVES: Remove the retainer locks, the seal from its groove, and the valve rotator and spring. The parts are shown in Figure 7.

4. Lift the valves from the cylinder head and place them in a numbered rack so they can be reinstalled in their respective guides. Keep the exhaust valve rotators with the valves from which they were removed.

C. Cleaning

1. After the valves are removed, clean the valve guide bores with a valve guide cleaning tool.
2. Remove all dirt, grit, and grease from the cylinder head with cleaning solvent.
3. Scrape all gasket surfaces clean. If necessary, soak the head gasket surface with paint remover to loosen the gasket material. Carefully scrape the gasket from the head, applying the paint remover as required.

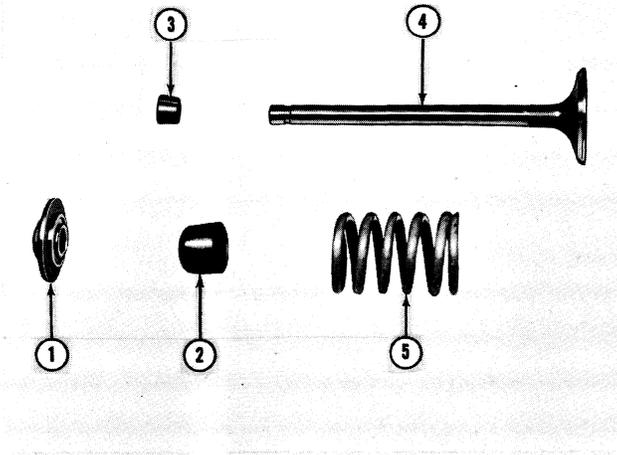


Figure 6
Intake Valve Assembly

- | | |
|-------------------|-----------------|
| 1. Retainer | 4. Intake Valve |
| 2. Seal | 5. Spring |
| 3. Retainer Locks | |



CAUTION: Be careful when working with paint remover, as it is highly combustible.

Be sure to remove any injector washers that may have remained in the bores.

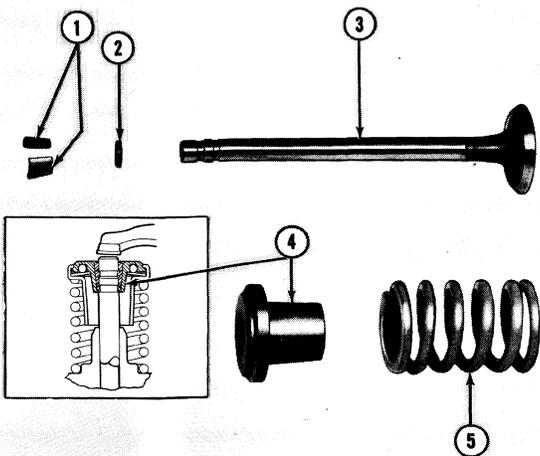


Figure 7
Exhaust Valve Assembly

- | | |
|-------------------|-----------------|
| 1. Retainer Locks | 4. Rotator |
| 2. Seal | 5. Valve Spring |
| 3. Exhaust Valve | |

D. Inspection and Repair

1. Inspect the cylinder head for cracks, nicks, or burrs. Install a new head if necessary. Remove all burrs or nicks from the gasket surface with an oil stone.
2. With a straight edge and feeler gauge, check the flatness of the cylinder head lengthwise, diagonally, and crosswise as shown in Figure 8. Specifications for flatness are 0.006 in. (0.15 mm) maximum overall or 0.003 in. (0.076 mm) in any six inches (152.40 mm).

NOTE: If the cylinder head face is not within flatness specification, it may be skimmed provided the depth from the top of the valve head to the cylinder head face after skimming is not less than 0.061 in. (1.55 mm).

3. If the head has been skimmed, check to determine whether the head bolts will bottom. To do this, place the cylinder head, less gasket, on the block and install and finger tighten all the head bolts (rocker arm shaft supports and washers should be used under the long bolts). Using a feeler gauge, check the clearance between the underside of the head bolts and the cylinder head rocker arm support. If the clearance is 0.010 in. (0.254 mm) or greater for any bolt, use a 1/2" X 13 UNC-2A thread tap and increase the tap depth. The head bolts should be marked so they are reinstalled in the hole in which they were checked.

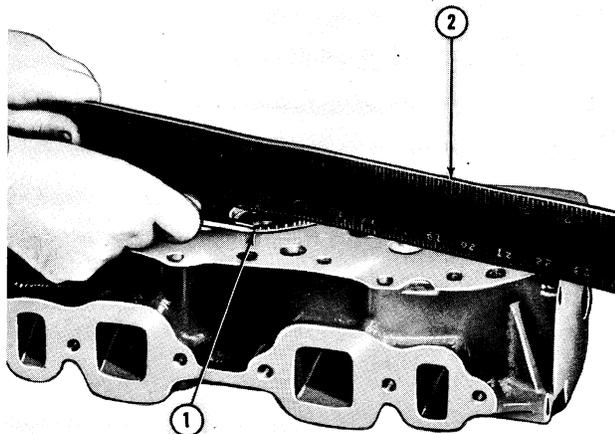


Figure 8
Measuring Cylinder Head Flatness

- | | |
|-----------------|------------------|
| 1. Feeler Gauge | 2. Straight Edge |
|-----------------|------------------|

IMPORTANT: Valve seat inserts of 0.010 in. (0.25 mm) and 0.020 in. (0.508 mm) oversize in diameter have been fitted to some cylinder heads in production. Heads having oversize inserts fitted are stamped with the following identification marking S010 OS and S020 OS on the exhaust manifold side of the cylinder head in line with the valve seat concerned.

4. The intake and exhaust valve ports in the cylinder head are equipped with removable valve seat inserts. Check the inserts for cracks, looseness, or excessive wear. If any of these conditions exist, remove the inserts and install new ones. See Table 1.
5. To install a larger insert than originally fitted, machine the counterbore for the seat in the cylinder head to the dimension shown in Table 1. The insert must be thoroughly chilled in dry ice before installation.
6. Measure the width of the valve seats, Figure 9, and reface the seats if they do not meet the specifications shown in Figures 11 and 12.
7. Measure the concentricity of the valve seat with a suitable gauge, Figure 10, or with Prussian Blue. If the seat runout exceeds 0.002 in. (0.0508 mm), reface the seat.

NOTE: Refacing the valve seat should be coordinated with refacing the valve face so the finished measurements will correspond to Figure 11.

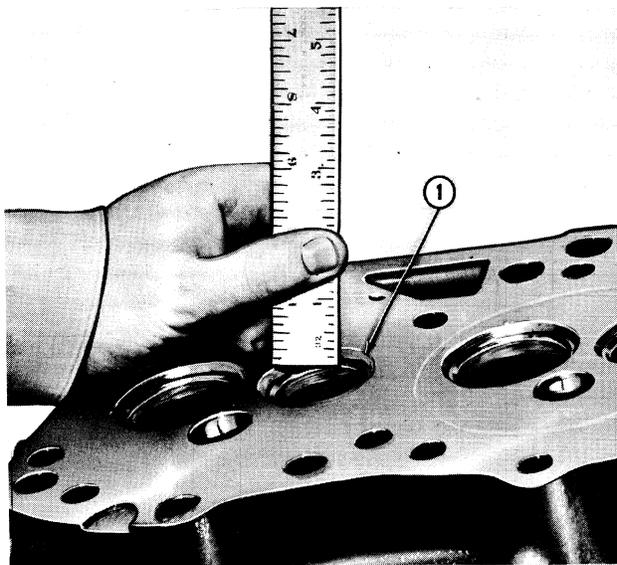


Figure 9
Measuring Valve Seat Width

1. Valve Seat

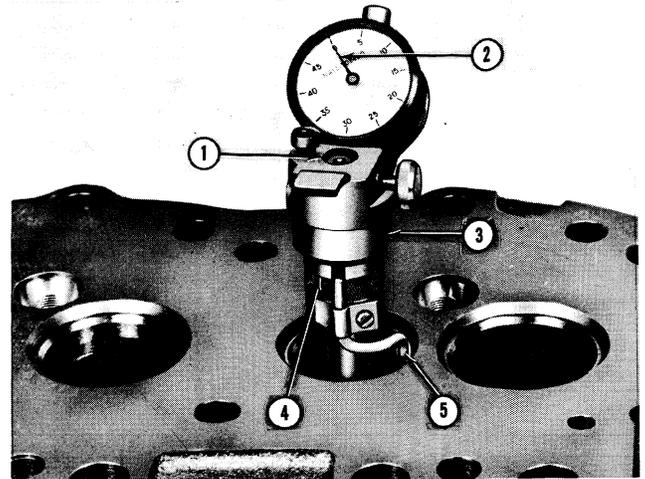


Figure 10
Checking Valve Seat Concentricity

- | | |
|-----------------------------------|--|
| 1. Tighten Pilot | 4. Rotate Sleeve Clockwise and Read Dial |
| 2. Set Dial at "0" | 5. Set Point to Ride on Valve Seat Face |
| 3. Valve Seat Concentricity Gauge | |

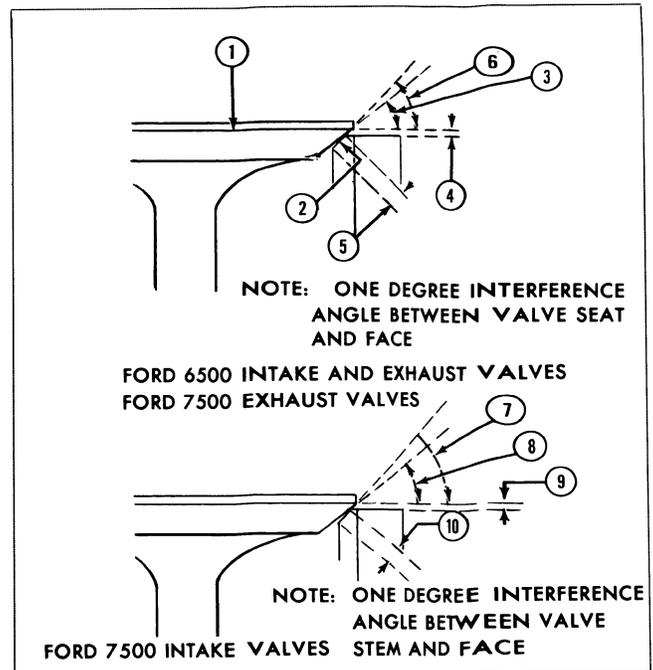


Figure 11
Valve Face and Seat Angles and Measurements

- | | |
|------------------------------------|-------------------------------------|
| 1. Valve Face | 6. Valve Seat Angle-45° |
| 2. Valve Seat | 7. Valve Seat Angle-30° |
| 3. Valve Face Angle-44° | 8. Valve Face Angle-29° |
| 4. 1/16 in. (1.59 mm) | 9. 1/16 in. (1.59 mm) |
| 5. Seat Width - 3/32 in. (2.38 mm) | 10. Seat Width - 3/32 in. (2.38 mm) |

Insert Oversize	Exhaust Valve Insert Counterbore Diameter In Cylinder Head	Intake Valve Seat Insert Counterbore Diameter In Cylinder Head
0.010 in. (0.254 mm)	1.607/1.608 in. (40.82/40.84 mm)	1.907/1.908 (43.44/43.46 mm)
0.020 in. (0.508 mm)	1.617/1.618 in. (41.07/41.10 mm)	1.917/1.918 (43.69/43.72 mm)
0.030 in. (0.762 mm)	1.627/1.628 in. (41.33/41.36 mm)	1.927/1.928 (43.95/43.97 mm)

Table 1

Remove only enough stock from the seat to clean up the pits and grooves, or to correct the seat runout. After refacing, the seat should measure 3/32 in. (2.38 mm) ± 1/64 in. (0.40 mm). If the refaced seat exceeds this width, narrow the seat by removing stock from the top or bottom of the seat. See Step 8. If the seat measures less than this width, widen the seat.

- Rotate a new or refaced valve lightly in the seat, using Prussian Blue. If the blue is transferred to the valve face 1/16 in. (1.59 mm) below the upper edge of the valve face, the contact is satisfactory. If the blue is transferred to the valve face above or below this point, raise or lower the seat as follows.

FORD 6500 INTAKE; FORD 6500 AND 7500 EXHAUST VALVES

Lower the valve seat by removing stock from the top of the seat with a 30° grinding wheel. Raise the seat by removing stock from the bottom of the seat with a 60° grinding wheel. See Figure 12.

FORD 7500 INTAKE VALVES

Lower the valve seat by removing stock from the top of the seat with a 15° grinding wheel. Raise the seat by removing stock from the bottom of the seat with a 45° grinding wheel. See Figure 12.

IMPORTANT: Some cylinder heads may have one or more 0.003 in. (.0762 mm) or 0.015 in. (0.381 mm) oversize valves and guides installed. The exhaust manifold side of the cylinder head opposite these valves will be stamped "03" or Y003 OS; "15" or Y015 OS as appropriate.

- Valve stem-to-guide clearance tolerances are as follows. Intake valves, 0.0010 - 0.0045 in. (0.0245 - 0.114 mm); exhaust valves, 0.0020 - 0.0055 in. (0.0508 - 0.139 mm).

Measure stem-to-guide clearance with a telescoping gauge and micrometer, Figure 13. If not within tolerances, or if excessive oil consumption is indicated, replace the affected guides.

Valves with oversize stems are available for service. If it is necessary to ream valve guides to install valves with oversize stems, use Valve Reamer Kit, SW502, and ream guides in steps, first using the small reamer and standard diameter pilot. The kit contains the following reamer and pilot combinations.

Reamer Diameter	Pilot Diameter
0.003 in. (0.0762 mm) oversize	Standard Diameter
0.015 in. (0.3810 mm) oversize	0.003 in. (0.0762 mm) oversize
0.030 in. (0.7620 mm) oversize	0.015 in. (0.3810 mm) oversize

NOTE: Always reface valve seats after reaming a valve guide.

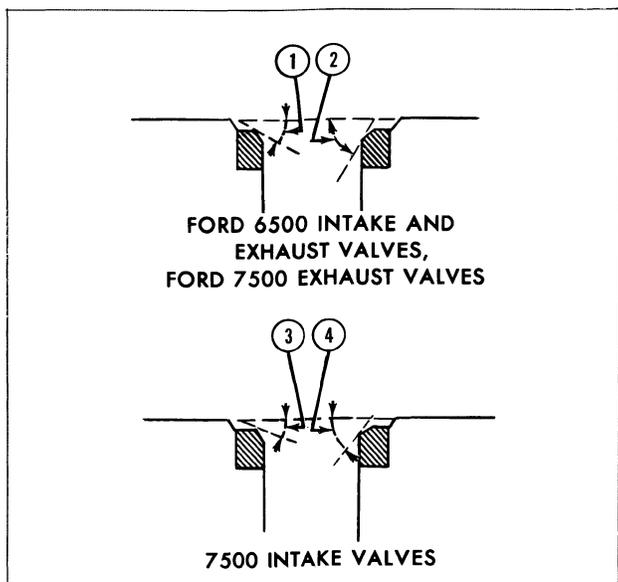


Figure 12 Dressing Valve Seats

- | | |
|--------|--------|
| 1. 30° | 3. 15° |
| 2. 60° | 4. 30° |

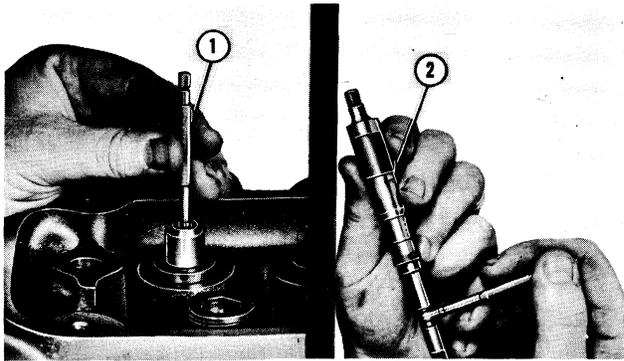


Figure 13
Measuring Valve Guide

1. Telescope Gauge 2. Micrometer

Valves and Push Rods

A. Inspection

NOTE: Ford 7500 intake valves do not have umbrella seals.

The critical inspection points of the valves are shown in Figure 14. Inspect the valve face and the edge of the valve head for pits, grooves, or other defects. Inspect the stem for a bent condition and the end of the stem for grooves or scores. Check the valve head for cracks, erosion, warpage, or burn. Minor defects such as small pits or grooves can be removed. Check the valve tip for pits or grooves and replace the valve if such a condition exists. Discard valves that are severely damaged.

Discard valve springs that show signs of erosion or rust. Check each valve spring for squareness, as shown in Figure 15. Discard valve springs that are out of square in excess of 1/16 in. (1.5873 mm).

Check specified free length and loaded height of the valve springs. Weak valve springs cause poor engine performance; therefore, if the pressure of any spring is below specification, install a new spring.

Check the valve spring retainer locks to be sure they are in good condition. Rotate the exhaust valve positive rotator to be sure it is not binding or excessively worn. Install new rotators if necessary.

Check the ends of the push rods for nicks, grooves, roughness, or excessive wear. If the push rods were not straight when checked in Step 12 of "Removal," or if any of the above wear conditions exist, install new rods. Do not attempt to straighten push rods.

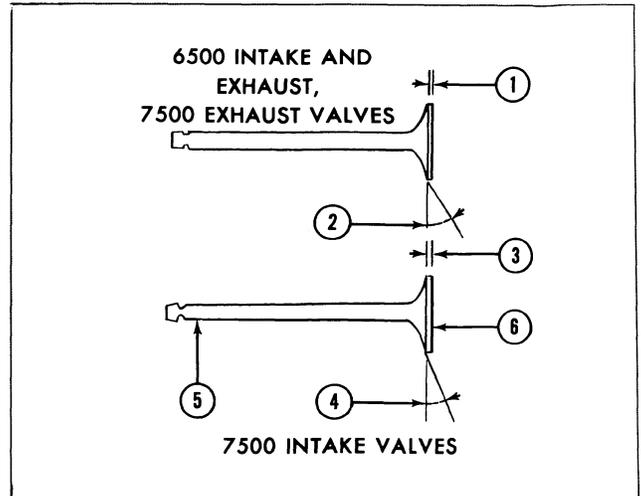


Figure 14
Critical Valve Measurements and Inspection Checks

- | | |
|------------------------------------|---|
| 1. 1/32 in. (0.7937 mm)
Minimum | 4. 29° |
| 2. 44° | 5. Check for Bent Stems
and Correct Diameter |
| 3. 1/16 in. (1.58 mm)
Minimum | 6. Check Maximum Valve
Face Runout |

B. Refacing Valves

The valve refacing operation should be closely coordinated with the valve seat refacing operation so the finished angle of the valve face is 1° less than the valve seat to provide an interference angle for better seating. Adjust the refacing tool to obtain a valve face angle of 44° or 29° as applicable. See Figure 11.

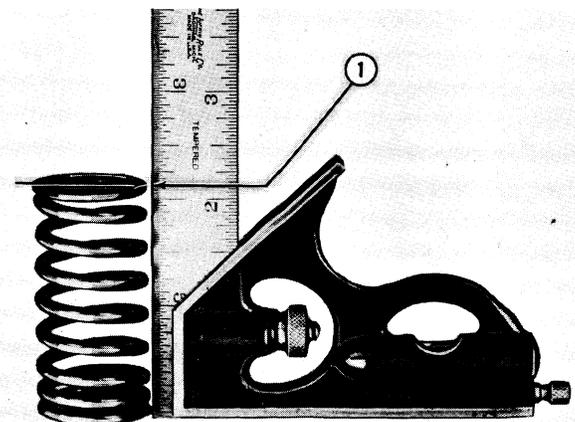


Figure 15
Checking Valve Spring Squareness

1. Not more than 1/16 in. (1.587 mm)

Remove only enough stock to clean up the pits and grooves. Check the edge of the valve head; if less than 1/32 in. (0.7937 mm) or 1/16 in. (1.58 mm) margin, install a new valve, Figure 14.

Remove all grooves or score marks from the valve tip, then chamfer as necessary. Do not remove more than 0.010 in. (0.2540 mm) from the tip.

Rocker Arms and Shaft

A. Disassembly

To disassemble the rocker shaft assembly, remove the bolts that attach the rocker shaft to the cylinder head from the rocker shaft supports, Figure 16.

B. Inspection

1. Inspect the rocker arm adjusting screws and the push rod ends of the rocker arms for stripped or worn threads.
2. Check the ball end of the screws for nicks, scratches, or excessive wear.
3. Check the rocker arm locating springs and spacers for breaks or damage.
4. Inspect the pad end of the rocker arm for roughness, grooves, or excessive wear. If any of the above conditions exist, install new parts.
5. Check the rocker arm and rocker shaft diameters. If the diameters are outside of specifications, page 63, install a new part. If the shaft meets specifications, clean it thoroughly in solvent. Make sure the oil passages are clean of obstructions.

C. Installation

1. Coat the rocker arm shaft with engine oil prior to assembly. Lubricate the valve pads on all rocker arms.
2. The rocker shaft has an identification groove at one end of the shaft. Position the mark upward and use this end as the front of the shaft, Figure 16. This puts the oil holes and grooves in the shaft facing down.
3. Start reassembly from the rear of the shaft by first positioning a rocker arm support with the notch on the support to the right of the shaft facing forward.
4. Be sure the springs and spacers are in their correct position, Figure 16, then proceed with the assembly.

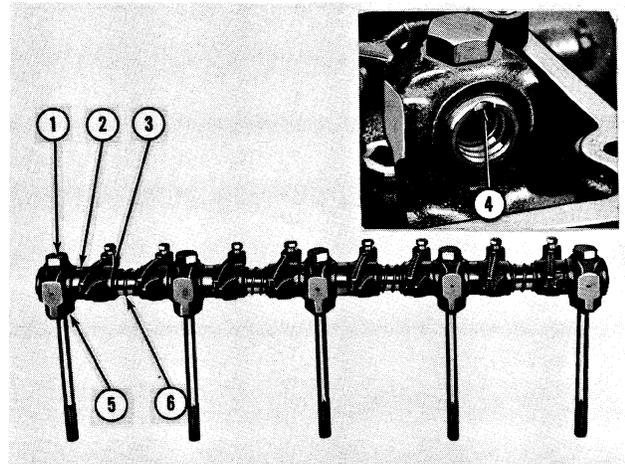


Figure 16
Rocker Arm Shaft

- | | |
|---------------|-----------------------------|
| 1. Bolt | 5. Rocker Arm Shaft Support |
| 2. Spacer | 6. Spring |
| 3. Rocker Arm | |
| 4. Notch | |

Cylinder Head

A. Assembly

1. Insert each valve in the guide bore from which it was removed and lap it in position to give an even seat around the valve. On completion of this operation remove the valve and carefully clean the valve seat and seat insert of any lapping compound.
2. Lubricate all moving parts with engine oil prior to installation. Refer to Figures 6 and 7 for reference to parts of the intake and exhaust valves.
3. Insert each valve in the guide bore from which it was removed or to which it was fitted. Position a new valve seal over each intake valve and guide.
4. Install the valve springs over the valve guides.
5. On intake valves, compress the springs and spring retainer as shown in Figure 5, and install the retainer locks. On exhaust valves, compress the spring and the valve rotator. Be sure to install the rotator onto the valve from which it was removed.
6. On exhaust valves install a new sealing ring into the second groove from the top of the valve stem and install the retainer locks.
7. Install the thermostat (spring end towards head) and water outlet connections, Figure 4, to the front of the cylinder head. Use a new gasket.
8. If service is required on the thermostat or water outlet, refer to Chapter 3, "COOLING SYSTEM."

B. Installation

1. Place a new head gasket on the cylinder block, then carefully position the cylinder head on the gasket. Two dowels are incorporated on the top of the cylinder block at opposite corners to aid in positioning the cylinder head and gasket.
2. Lubricate the cylinder head bolts and washers and install them finger tight.
3. Install the valve push rod, with cupped end up, in the holes in the cylinder head from which they were removed. Be sure the ball ends of the push rods are seated in the tappet sockets.
4. Position the rocker shaft assembly on the cylinder head, the long cylinder head bolts and washers in the respective holes. Refer to Figure 2. Make sure that the ball ends of the rocker arm adjusting screws are seated in the cupped end of the push rods.
5. Tighten the cylinder head bolts in the proper sequence, as shown in Figure 17. Tighten the bolts progressively in three steps; first to 90 lbs. ft. (12.42 kgm), then to 100 lbs. ft. (13.8 kgm), and finally to 110 lbs. ft. (15.2 kgm).

NOTE: The cylinder head bolts should be torqued only when the engine is cold.

6. Rotate the engine and set the preliminary valve lash, Figure 18, to the specified limits, page 62.
7. Install a new seat washer in each injector bore in the cylinder head. Position new cork seals over the injectors.
8. Install each injector into the cylinder head and over the two studs, as shown in Figure 3. Install the nut on each stud and tighten progressively to the specified torque, page 68.
9. Using new copper washers, install the injector leak-off line.
10. Install a new gasket and the intake manifold onto the cylinder head. Secure the manifold with the bolts and lock washers and tighten the bolts to the specified torque, page 68.
11. Attach the fuel filter to the manifold with two bolts and flat washers, and connect the fuel lines.
12. Connect the air intake hose to the intake manifold and secure with the clamp.
13. Connect the injector lines to the injection pump and to the injectors. Position the clamps on the injector lines in the same position from which they were removed.
14. Reconnect cold start equipment where equipped.

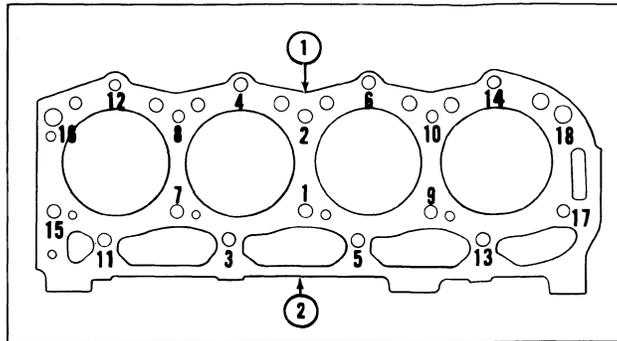


Figure 17
Cylinder Head Tightening Sequence

1. Intake Side 2. Exhaust Side

15. Position a new metal exhaust manifold gasket on the cylinder head and install the exhaust manifold, as shown in Figure 2. Use new lock tabs and tighten the bolts to the specified torque, page 68. Bend the lock tabs to retain the bolts.
16. If the tractor is equipped with a horizontal exhaust system, connect the exhaust pipe.
17. Connect the hose to the water outlet and secure it with the clamp.
18. Fill the radiator with coolant.
19. Install the battery tray on the Ford 6500 and radiator shell support. Install the battery and connect the battery leads.

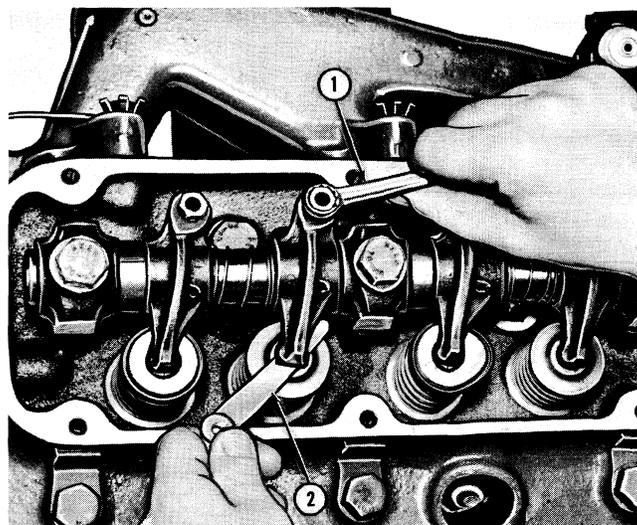


Figure 18
Adjusting Valve Lash

1. 1/2 in. (12.7 mm) Box End Wrench 2. Feeler Gauge

20. Bleed the fuel system as outlined in Part 2, "FUEL SYSTEM." Start the engine and make a final valve lash adjustment, page 11.

NOTE: Do not make valve lash adjustments when the engine is operating at above normal operating temperature.

21. Install the rocker cover, using a new gasket and tighten the bolts to the specified torque, page 68. Connect the ventilation tube.
22. Install the air cleaner and related parts.
23. Install the hood panel assemblies and reconnect the wiring harness to the hood clips. Install the muffler (vertical exhaust).

3. ENGINE FRONT COVER AND TIMING GEARS

Engine front cover and timing gears service operation can be performed after removing the radiator and oil cooler.

Crankshaft Pulley Removal

1. Remove the fan belt. Remove the bolt and washer from the crankshaft pulley, Figure 19, using Puller No. 518 and Shaft Protector No. 625-1, as shown in Figure 20. To use the puller for this purpose, 7/16 in. X 14 UNC bolts have to be used and the slots in the puller enlarged.
2. Check the pulley belt groove to be sure the surface is smooth and the flanges are not cracked or broken.

3. Check the shaft spacer in the area that contacts the front oil seal to be sure it is free of scratches or grooves that may cause oil leakage past the seal. Clean the seal contact surface with solvent and polish with crocus cloth prior to installation.

Front Cover Removal

1. Drain the engine oil, and remove the oil pan.
2. Remove the front cover-to-front engine plate bolts.
3. Remove the alternator front mounting bracket bolt.
4. Carefully pry the front cover off of the dowel pins and remove it.

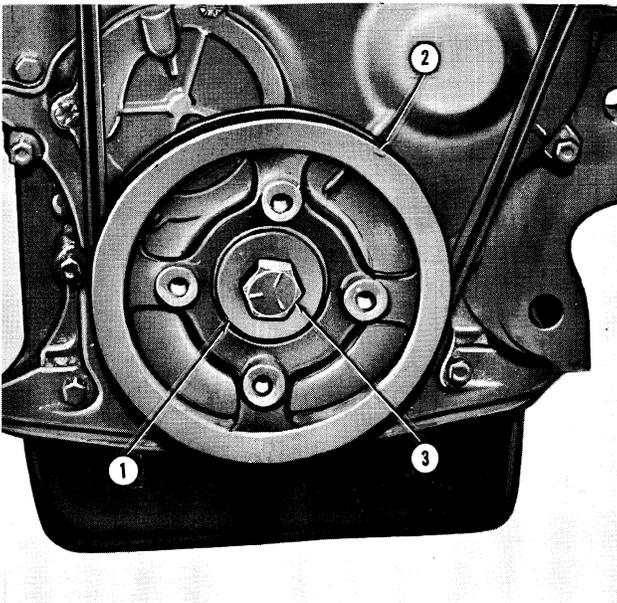


Figure 19
Crankshaft Pulley

- | | |
|----------------------|-------------------------------------|
| 1. Washer | 3. Crankshaft Pulley Retaining Bolt |
| 2. Crankshaft Pulley | |

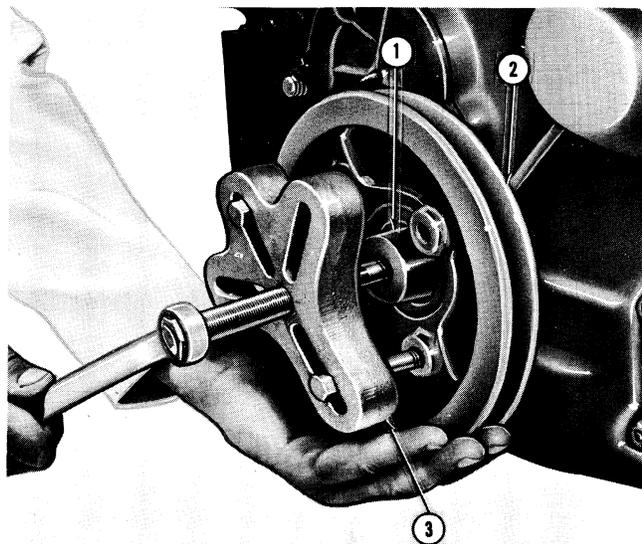


Figure 20
Removing Crankshaft Pulley

- | | |
|--------------------------|---------------|
| 1. 625-1 Shaft Protector | 3. 518 Puller |
| 2. Crankshaft Pulley | |

5. Remove the oil slinger.
6. Clean all the gasket material from the front cover and from the front engine plate.

Front Cover Crankshaft Seal Removal

The front cover oil seal should be removed and a new seal installed every time the front cover is removed.

1. Drive out the old oil seal and dust seal with a punch. Be careful not to damage the cover.
2. Thoroughly clean the seal bore in the cover.
3. Insert the dust seal in the seal bore before installing the oil seal. Coat the new oil seal with petroleum jelly and install the seal as shown in Figure 21. To install the seal, use Step Plate No. 630-16 and a driver handle. Drive the seal in until it is fully seated in the seal bore. Check after installation to be sure the spring is properly positioned in the seal.

Checking Timing Gear Backlash

1. The timing gears are shown in Figure 22. The gears are correctly assembled when the timing marks on the gear teeth line up, as shown in the illustration, with the No. 1 piston on T.D.C.
2. Check the backlash of the gears with a dial indicator or a feeler gauge, as shown in Figure 23.

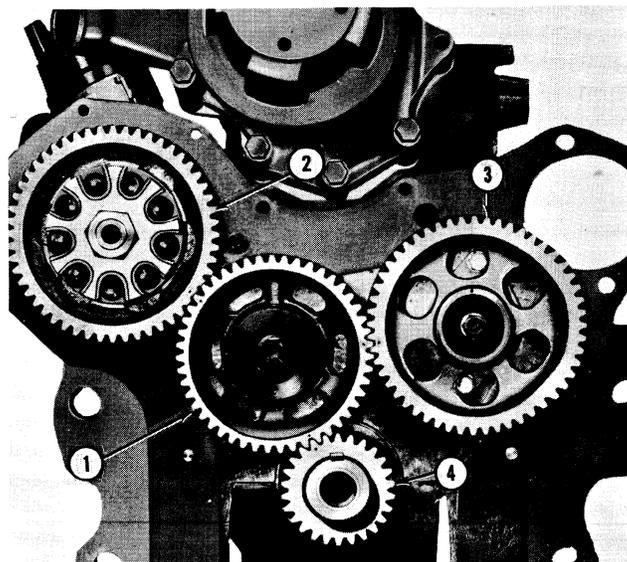


Figure 22
Timing Gears

- | | |
|------------------------------|--------------------|
| 1. Camshaft Drive Gear | 3. Camshaft Gear |
| 2. Injection Pump Drive Gear | 4. Crankshaft Gear |

3. Check between the camshaft drive gear and camshaft gear as shown, and also between the injection pump gear and camshaft drive gear. Also check between the crankshaft gear and camshaft gear.

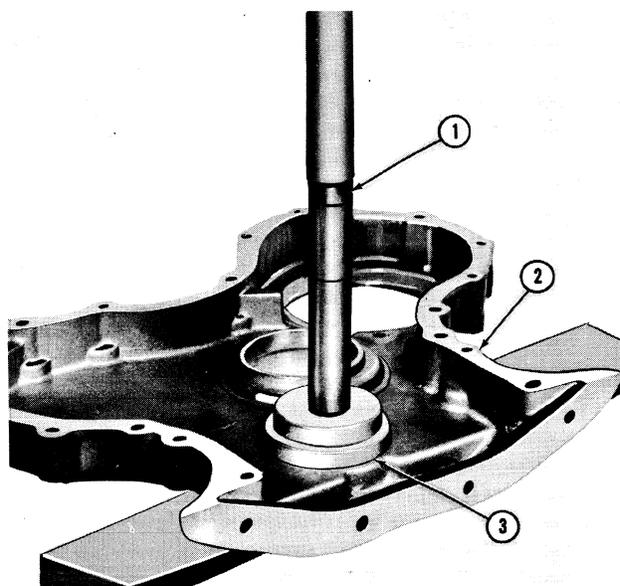


Figure 21
Installing Front Cover Oil Seal

- | | |
|-----------------------|----------------------|
| 1. Driver | 3. 630-16 Step Plate |
| 2. Engine Front Cover | |

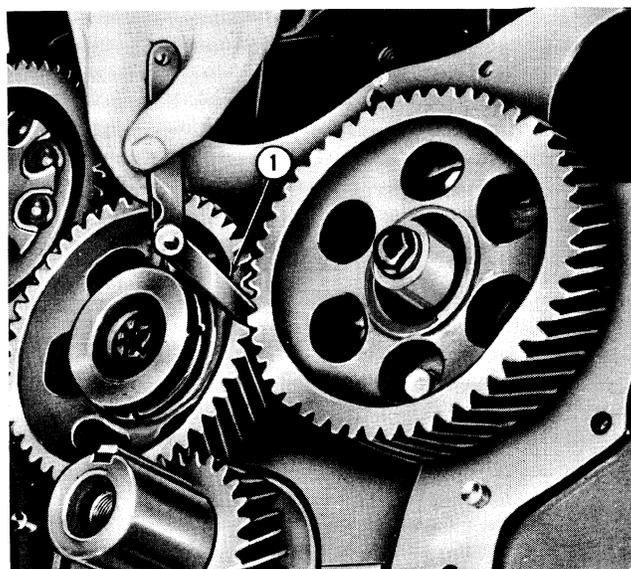


Figure 23
Checking Timing Gear Backlash

1. Feeler Gauge

4. Check the backlash at four equidistant points on the gears.
5. If the backlash is within specifications, page 63, the gears are suitable for reinstallation. If not, install new gears.

Injection Pump Drive Gear

A. Removal

Turn the crankshaft until the camshaft gear is in the approximate timed position, Figure 24.

Remove the three retaining bolts that retain the injection pump drive gear, Figure 24, to the pump adapter plate and remove the gear.

B. Cleaning and Inspection

1. Clean the gear in solvent.
2. Inspect gear teeth for scores, nicks, and the condition of the teeth contact pattern.
3. Use a carborundum stone to remove minor gear teeth imperfection. If gear teeth wear or damage is severe install a new gear.

C. Installation

1. Retime the engine before installing the injection pump. To do this remove the camshaft drive gear, place No. 1 piston at top dead center, and reinstall the camshaft drive gear in mesh and the timing marks aligned to the other gears as shown in Figures 22 and 24. Tighten the camshaft drive gear adapter bolt to the specified torque, page 68.
2. Install the new injection pump gear on the pump adapter plate, with the timing mark aligned.
3. Install the three bolts and tighten to the specified torque, page 68.

Camshaft Drive Gear and Adapter

A. Removal

1. Remove the self-locking bolt that retains the camshaft drive gear and adapter to the cylinder block, Figure 25.
2. Remove the adapter and camshaft drive gear, as shown in Figure 26.

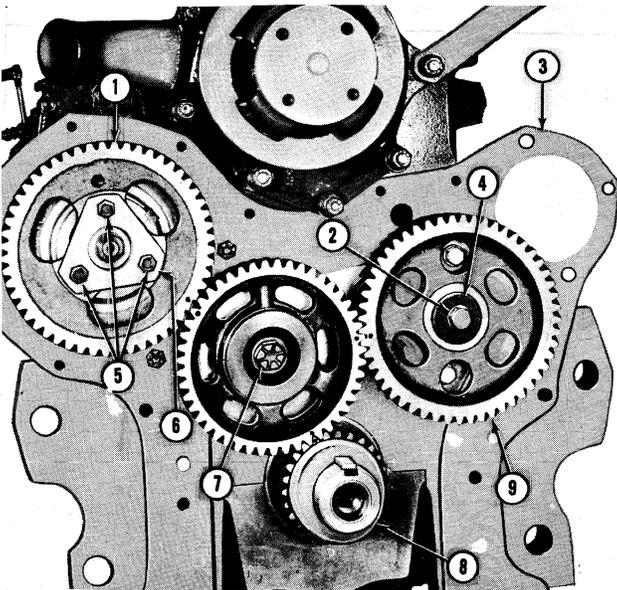


Figure 24
Engine Front Cover Removed

- | | |
|------------------------------|----------------------|
| 1. Injection Pump Drive Gear | 5. Attaching Bolts |
| 2. Retaining Bolt | 6. Adapter Plate |
| 3. Front Engine Plate | 7. Self Locking Bolt |
| 4. Washer | 8. Slinger |
| | 9. Camshaft Gear |

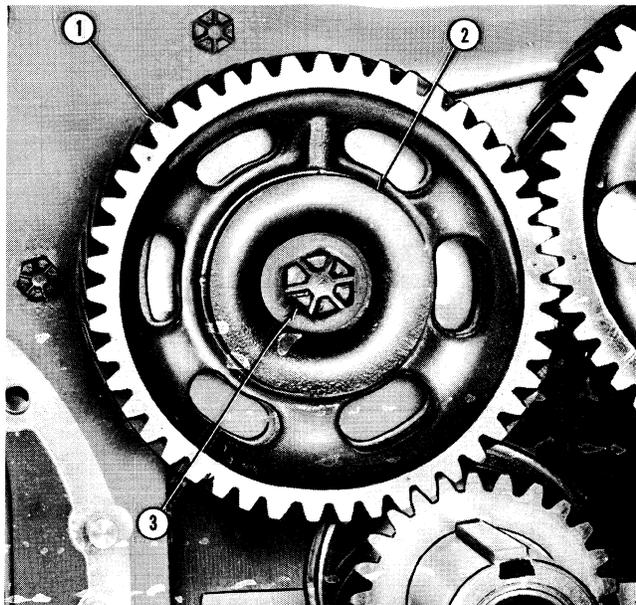


Figure 25
Camshaft Drive Gear

- | | |
|------------------------|----------------------|
| 1. Camshaft Drive Gear | 3. Self Locking Bolt |
| 2. Adapter | |

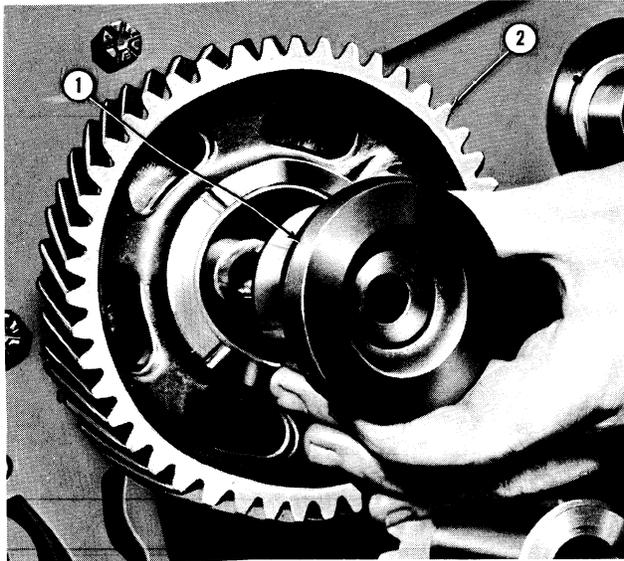


Figure 26
Removing Camshaft Drive Gear Adapter

1. Adapter
2. Camshaft Drive Gear

B. Cleaning and Inspection

1. Clean the gear and adapter in solvent.
2. Inspect gear teeth for scores, nicks, and the condition of the teeth contact pattern. Use a carborundum stone to remove minor gear teeth imperfections. If tooth wear or damage is severe install a new gear.
3. Check the adapter oil passage, Figure 27, to be sure that it is clear.
4. Inspect the camshaft drive gear bushing, Figure 27, for wear, nicks, or burrs, and install a new gear if any of these conditions exist.
5. If excessive backlash, page 63, existed in the gears when checked, install a new gear.

C. Installation

1. Install the gear and adapter in mesh with the timing marks aligned.
2. Install the adapter self-locking bolt and tighten the bolt to the specified torque, page 68. Check the end float as outlined on page 39, "CAMSHAFT - REMOVAL."

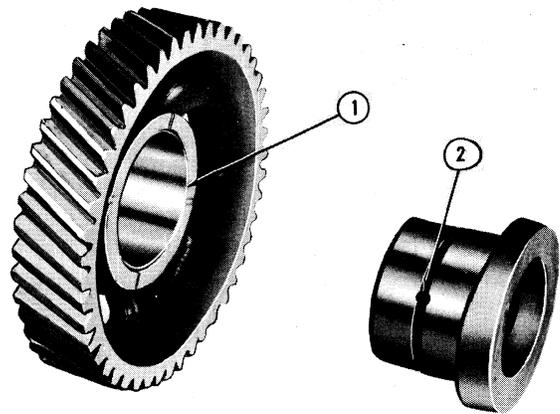


Figure 27
Camshaft Drive Gear and Adapter

1. Bushing
2. Oil Passage

Crankshaft Gear

The crankshaft gear should be removed only if it shows signs of wear or chipping.

A. Removal

Remove the crankshaft gear with Crankshaft Gear Remover-Replacer, No. SW 501 Insert SW 501-1, or Remover No. CPT 6040, as shown in Figure 28.

B. Cleaning and Inspection

1. Clean the gear in cleaning solvent.
2. Inspect the gear teeth for scores, nicks, and the condition of the teeth wear pattern.
3. Check the crankshaft keyway to be sure it is in good condition.
4. Check the key. If there is any evidence of distortion or chipping, use a new key when installing the gear. Install a new gear if any wear or damage is evident.

C. Installation

1. Drive the key into the keyway until it is seated.
2. Install the crankshaft gear with Crankshaft Gear Remover-Replacer No. SW 501 and Insert SW 501-1, or Replacer No. CT 6069, as shown in Figure 28.

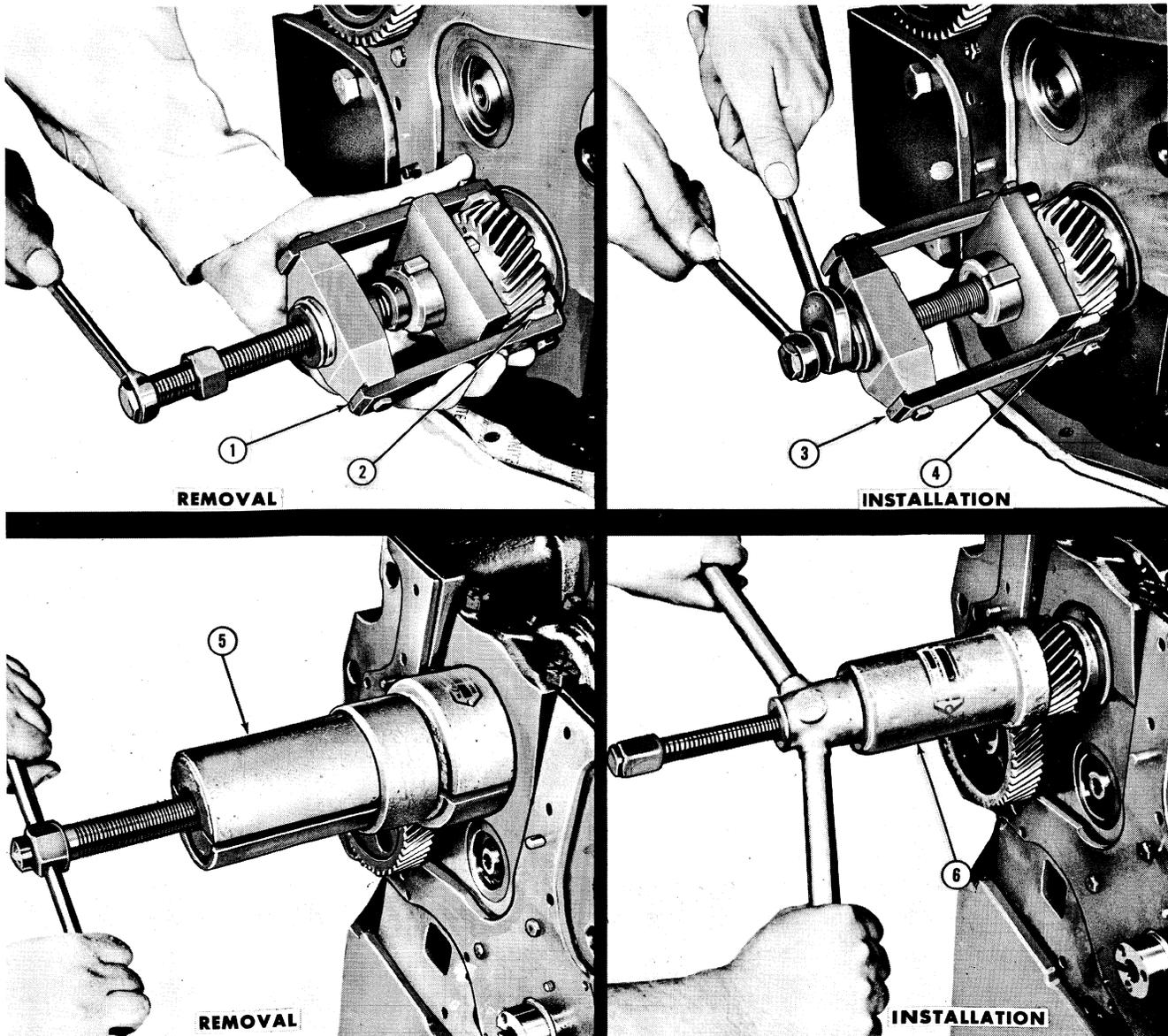


Figure 28
Removing and Installing Crankshaft Gear

1. Remover-Replacer SW 501
2. Insert SW 501-1
3. Remover-Replacer SW 501

4. Insert SW 501-1
5. Remover CPT 6040
6. Replacer CT 6069

Camshaft Gear

A. Removal

1. Remove the bolt and flat washer, as shown in Figure 24.
2. Remove the camshaft gear from the end of the shaft.

B. Cleaning and Inspection

1. Clean the gear in solvent.
2. Inspect gear teeth for scores, nicks, and the condition of the teeth wear pattern.

3. Check the keyway and key on the end of the camshaft. If the key is damaged in any way, install a new key before installing the gear. Use a carborundum stone to remove minor gear teeth imperfections. If tooth wear or damage is severe install a new gear.

C. Installation

1. Install the camshaft gear spacer.
2. Install the key in the camshaft keyway.
3. Install the camshaft gear with timing marks aligned. Install the flat washer, lock washer, and bolt, and tighten to the specified torque, page 68.

Timing the Gears

When removing and reinstalling any or all of the timing gears, be sure that the timing marks line up correctly, as shown in Figure 24. On all engines, the No. 1 piston must be at T.D.C. on the firing stroke, when the timing marks are aligned.

NOTE: The power steering pump drive gear does not require timing.

Front Cover Installation

1. Position a new gasket on the engine front adapter plate.

2. Install the oil slinger dish out, Figure 24.
3. Install the front cover, being sure the cover aligns with the dowel pins.
4. Install the front cover-to-front engine plate bolts and tighten to the specified torque, page 68.
5. Install the oil pan with a new gasket and tighten the bolts to the specified torque, page 68.
6. Install the alternator support front mounting bolt.
7. Refill the crankcase with the proper grade and quantity of oil.

Crankshaft Pulley Installation

1. Lubricate the crankshaft pulley spacer, align the keyway in the spacer with the crankshaft keyway and slide it back as far as it will go.
2. Lubricate the pulley hub and align the keyway in the pulley with the key in the end of the crankshaft. Tap the pulley onto the crankshaft.

NOTE: To install the pulley with longer hub, lubricate the hub internally and externally align the keyway in the pulley with the key in the end of the crankshaft. Tap the pulley onto the crankshaft.

3. Install the flat washer and bolt and tighten the bolt to the specified torque, page 68.

4. OIL PAN SUMP AND OIL PUMP

Oil Pan Sump

A. Removal

The sump can be removed by replacing the cylinder block-to-front support bolts one at a time with 8 inch (206.38 mm) long bolts. The purpose of these bolts is to allow the front support and radiator assembly to be eased forward about 1-1/2 in. (38.1 mm), permitting the removal of the sump front bolts.

1. Drain the engine oil, and remove the dipstick.
2. Support the tractor under the transmission with a jack, and the front support and radiator assembly with a hoist or crane.
3. Remove the hood.
4. Disconnect the radiator shell support.

5. Disconnect the steering linkage to enable the front axle to be moved away.
6. Remove the front and rear axle support pins and roll the front axle away.
7. Move the front axle support and radiator assembly forward to allow the front sump bolts and sump to be removed.

NOTE: Due to the weight of the oil pan sump, take care when removing it.

Using the above method it is not necessary to disconnect the radiator hoses, power steering, and cooler tubes.

B. Cleaning and Inspection

1. Scrape any dirt or metal particles from the inside of the oil pan sump.

2. Scrape all gasket material from the gasket surface.
3. Wash the oil pan sump in a solvent and dry thoroughly.
4. Check the pan for cracks, holes, damaged drain plug threads, or a nicked or warped gasket surface.
5. Repair any damage, or install a new pan if repairs cannot be made.

C. Installation

To install the oil pan sump to an engine assembled in a tractor, reverse the disassembly procedure on page 17, paying attention to the following points:

1. Be sure that the gasket surfaces on the oil pan and block are clean.
2. Position the gasket on the cylinder block and apply a thin film of gasket sealer on the gasket, front cover, and the oil pan.
3. Hold the oil pan in place against the block and install a bolt finger tight at each corner of the oil pan.

NOTE: Align the machined surface on the rear of the oilpan with the rear surface of the engine.

4. Install the remaining bolts and tighten the rear bolts first and then tighten from the middle outward in each direction to the specified torque, page 68.

NOTE: Assemble the front of the tractor to the engine. Install the two oil pan-to-transmission case attaching bolts. Refer to Part 8 of this manual.

5. Install the oil level dipstick, tighten the drain plug, and fill the crankcase with the proper grade and quantity of engine oil.
6. Operate the engine and check for oil leaks.

Oil Pump

A. Removal

1. Remove the oil pan sump, as outlined under "OIL PAN SUMP REMOVAL."
2. Remove the oil pump retaining bolts, Figure 29, and remove the oil pump and gasket. When the oil pump is removed, the intermediate shaft is loose and should be removed.
3. Remove the engine oil filter, and oil drain shield when installed to gain access to the oil pump drive gear and shaft cover, Figure 30. Remove the cover and extract the drive gear and shaft.

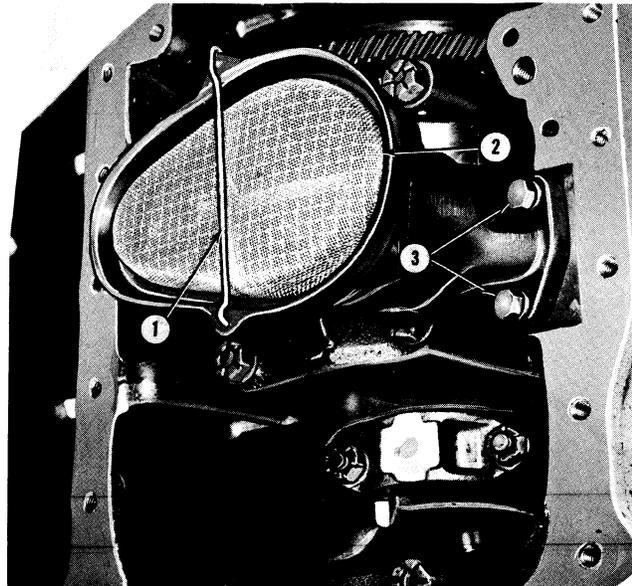


Figure 29
Oil Pump

- | | |
|---------------------------|-----------------------------|
| 1. Oil Pump Screen Spring | 3. Oil Pump Retaining Bolts |
| 2. Screen | |

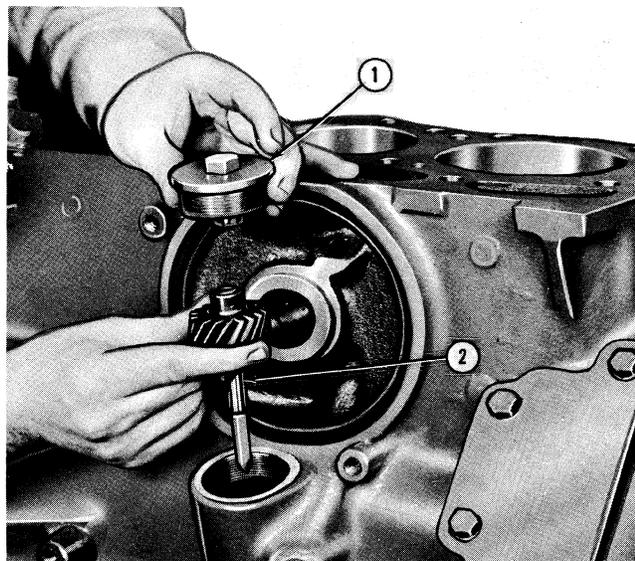


Figure 30
Removing Oil Pump Drive Gear

- | | |
|---------|-------------------------|
| 1. Stop | 2. Drive Gear and Shaft |
|---------|-------------------------|

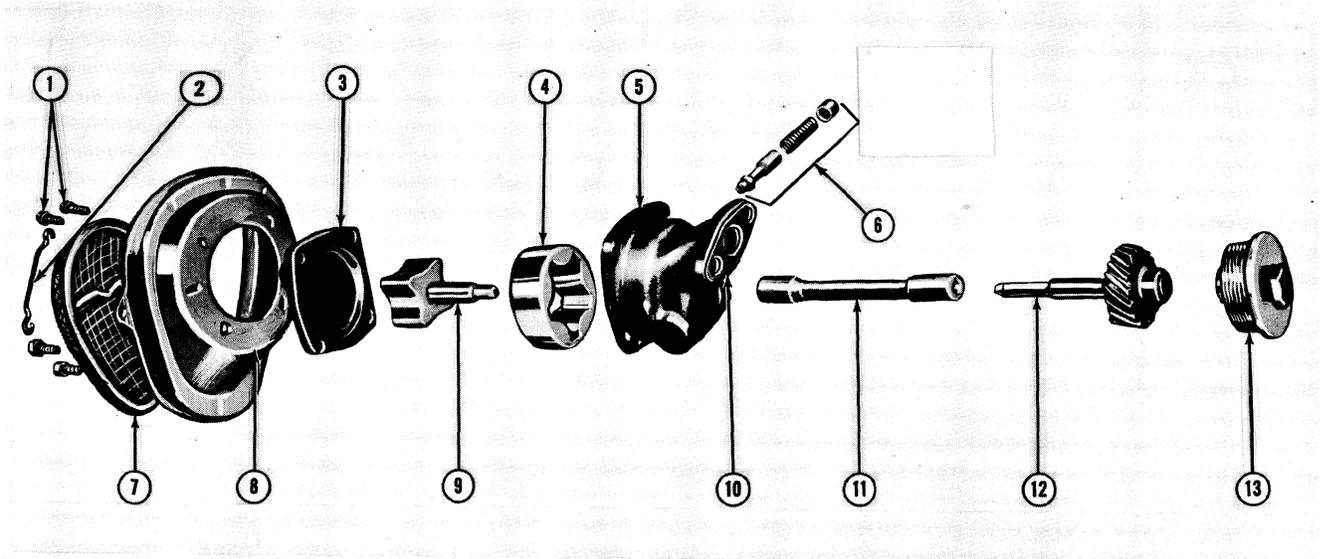


Figure 31
Oil Pump Disassembled

- | | | |
|--------------------|-----------------------------------|--------------------------|
| 1. Retaining Bolts | 6. Relief Valve Assembly | 10. Gasket |
| 2. Screen Spring | 7. Pump Screen | 11. Intermediate Shaft |
| 3. Pump Cover | 8. Screen Cover | 12. Drive Gear and Shaft |
| 4. Outer Rotor | 9. Inner Rotor and Shaft Assembly | 13. Stop |
| 5. Pump Housing | | |

B. Disassembly

1. Remove the oil pump screen spring and pump screen, Figure 29.
2. Remove the four capscrews and remove the screen cover and pump cover, Figure 31. Remove the rotor and shaft assembly.
3. Insert a self-tapping screw of the correct size into the hole in the relief valve plug and pull the plug out of the chamber. Remove the spring and relief valve, Figure 31.

C. Cleaning and Inspection

1. Wash all parts in solvent and dry thoroughly. Use a brush to clean the inside of the pump housing and the pressure relief valve chamber. Be sure all dirt and metal chips are removed.
2. Check the inside of the pump housing and the rotor and shaft assembly for excessive wear.
3. Check the inside face of the pump cover for wear or score marks. If these conditions exist, install a new cover.

4. With the rotor and shaft assembly installed in the pump body, place a straight edge over the rotor and shaft assembly and the pump body. Measure the clearance between the straight edge and the inner rotor and shaft assembly and between the straight edge and the outer rotor, Figure 32. If the measurement is not within specifications, see page 67, install a new rotor assembly.

NOTE: The shaft and rotor are serviced only as an assembly.

5. Measure the rotor-to-housing clearance by inserting feeler blades between the rotor and the housing. Take the measurements at four places, 90° apart. If the measurements are not within specifications, page 67, install a new rotor assembly. Remeasure clearances with the new rotor assembly in the pump housing. If the measurements are still not within specifications install a new pump housing.
6. Check the relief valve spring tension. If the spring tension is not within specifications, page 67, install a new spring.
7. Check the relief valve for score marks and be sure it is free to move within the bore; the valve should have two flats on each side at the location shown in Figure 33.

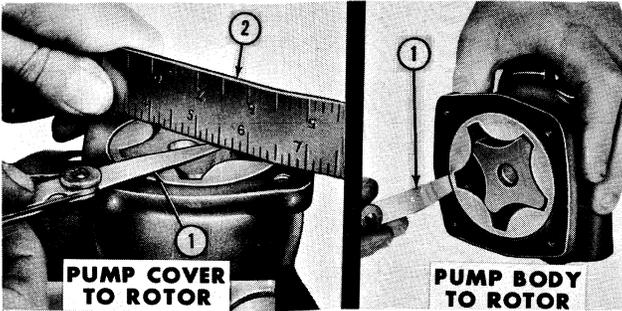


Figure 32
Checking Oil Pump Clearance

1. Feeler Gauge 2. Straight Edge

8. Check the oil pump drive gear for worn or broken teeth. If any of these conditions exist install a new drive gear and shaft assembly.
9. Check the intermediate drive shaft to be sure the hexagon socket ends are not excessively worn.

D. Assembly

The oil pump assembly is shown in Figure 31.

1. Oil all the parts thoroughly.
2. Install the oil pressure relief valve piston and spring, and drive in a new plug.
3. Install the rotor and shaft and outer race into the pump body. The rotor and shaft assembly and outer race are serviced as an assembly. One part should not be replaced without replacing the other.
4. Install the pump cover and screen cover together and tighten the four cap screws to the specified torque, page 68.
5. Install the screen assembly and secure it with the screen spring.

E. Installation

1. Prime the pump by filling the inlet port with clean engine oil. Rotate the pump shaft to distribute oil within the pump body.

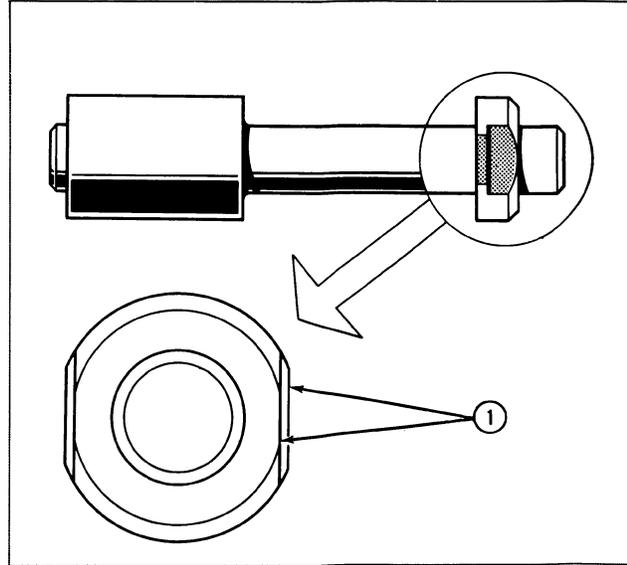


Figure 33
Relief Valve

1. Flats

2. Place the intermediate shaft on the rotor shaft and, using a new gasket, install the oil pump assembly on the cylinder block, Figure 29. Install the two mounting bolts and lock washers and tighten to the specified torque, page 68.
3. Install the pump drive gear and shaft, Figure 30. Install a new gear stop gasket and install the gear stop. Install the drain shield.
4. Install a new oil filter adapter if the adapter threads are damaged. Install a new oil filter cover gasket and the oil filter assembly.
5. Install the oil pan sump as outlined on page 18, under "OIL PAN SUMP INSTALLATION."

Engine Oil Filters: Refer to Part 10 of this manual for service information on the engine oil filter.

5. CONNECTING RODS, BEARINGS, PISTONS, RINGS, AND CYLINDER BLOCK

Piston and Connecting Rod Assembly

NOTE: Ford 7500 connecting rods have a drilled passage so oil can help cool the pistons. Ford 7500 connecting rod bearings are not interchangeable with Ford 6500 bearings. The following procedures apply to both Ford 6500 and 7500 engines.

A. Removal

1. Remove the cylinder head assembly as outlined on page 4, "CYLINDER HEAD REMOVAL."
2. Remove the oil pan sump and oil pump assembly as outlined on page 17, "OIL PAN SUMP REMOVAL" and page 18, "OIL PUMP REMOVAL."

3. Remove the balancer.
4. If necessary, remove the ridge from the top of each cylinder with a cylinder ridge reamer or a hand scraper, Figure 34. (Ridge removal is not necessary when reboring or if the old pistons are not to be used. However, it may be necessary to remove a ridge in order to remove an old piston.) When removing the cylinder ridge do not cut down into the ring travel more than 1/32 in. (0.793 mm). It is possible to cut so deeply into the cylinder wall and so far down into the ring travel that reboring, or the installation of a new engine block is necessary. Do not attempt to remove and reuse a piston from a cylinder with an excessive ridge. Forcing the piston past the ridge may break the lands on the piston or the rings.
5. Remove the nuts from the connecting rod bearing cap bolts of the piston that is at the bottom of its stroke. Remove the rod bearing cap and liner, Figure 35, from the rod. Push the piston and rod assembly away from the crank pin and remove the bearing liner from the rod. Push the rod and piston assembly out of the top of the cylinder, using the handle end of a hammer. Be careful not to scratch the crank pin or the cylinder. Turn the crankshaft to bring each piston to the bottom of its stroke and repeat this procedure. Keep the bearing caps and liners with their respective connecting rods.
6. Remove the piston rings from the pistons with a piston ring expander or other suitable means, as shown in Figure 36.

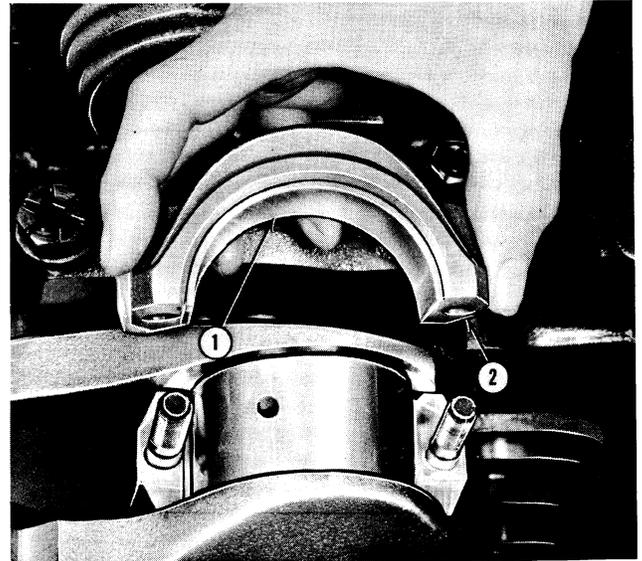


Figure 35
Removing the Rod Bearing Cap and Liner

- | | |
|------------------|--------------------|
| 1. Bearing Liner | 2. Rod Bearing Cap |
|------------------|--------------------|

B. Disassembly

1. Remove the piston pin snap ring (circlip) from each side of the piston and remove the pin.
2. Identify each piston to be sure it will be reassembled onto the rod from which it was removed.

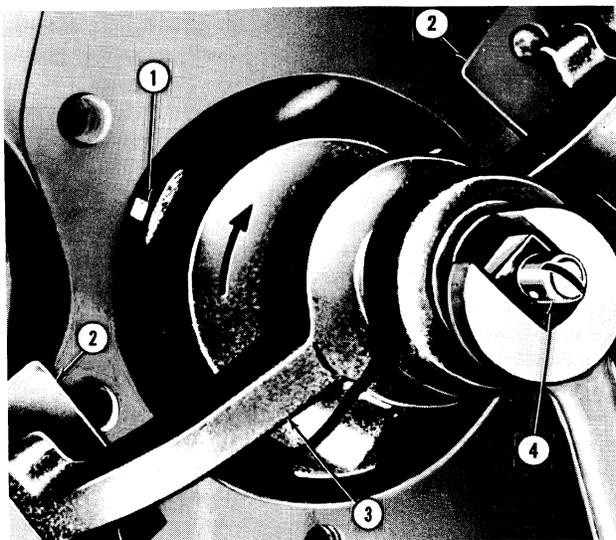


Figure 34
Removing Cylinder Ridge

- | | |
|-----------------|--------------------------|
| 1. Cutter Blade | 3. Cylinder Ridge Reamer |
| 2. Shoe | 4. Pilot Adjusting Screw |

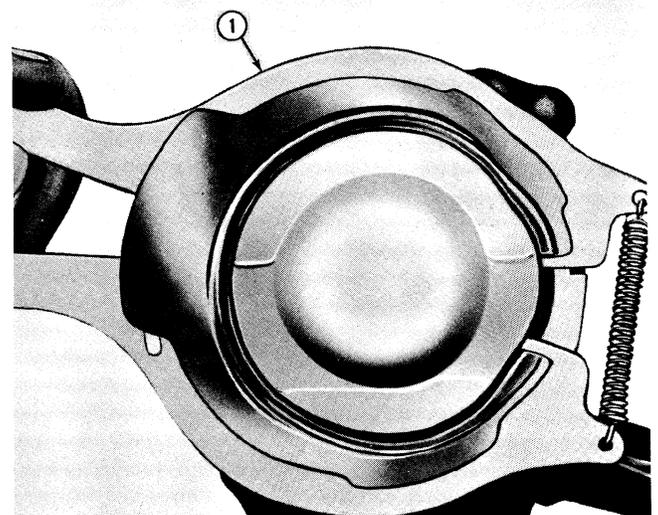


Figure 36
Removing Piston Ring with Ring Expander

- | |
|-------------------------|
| 1. Piston Ring Expander |
|-------------------------|

C. Cleaning

Clean the piston ring grooves with a piston ring groove cleaner, Figure 37. Be careful not to scratch or remove metal from the groove sides. Place the piston assembly in liquid cleaner, if available, to soften carbon and lead deposits. Clean the rod bore and the back of the connecting rod bearing liners thoroughly. Dry the parts with compressed air. Do not use a wire brush.

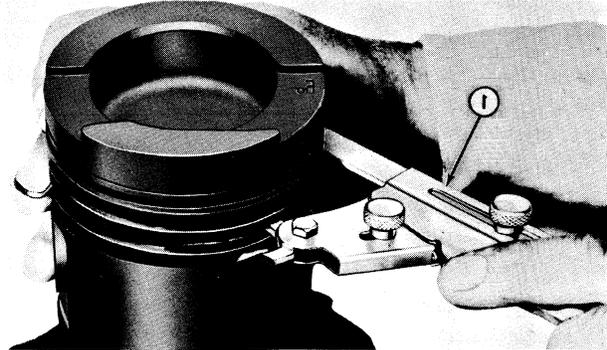


Figure 37
Cleaning Piston Ring Grooves

1. Piston Ring Groove Cleaner

D. Inspection

Connecting Rods

1. Inspect the connecting rods for signs of damage and the bearing bores for out-of-round and taper. If the bore exceeds the recommended limits, or is damaged, a new connecting rod should be installed.
2. Check the connecting rod nuts and bolts. Any part that shows signs of wear or damage should be replaced. Always use new connecting rod bearing cap nuts.
3. Check piston pin bushings for wear or damage. Measure outside diameter of piston pin and inside diameter of piston pin bushing. If bushing is damaged, or if the measurements indicate that a clearance between the bushing and the pin is not between 0.0005 - 0.0007 in. (0.0127 - 0.01778 mm) the bushings must be removed.

NOTE: If a new piston pin bushing is installed, it must be reamed to provide the clearance listed above.

4. A shiny surface on the pin boss side of the piston will usually indicate that a connecting rod is bent. Abnormal connecting rod bearing wear is also an indication of bent connecting rods. Twisted connecting rods will not create an easily identifiable wear pattern, but badly twisted rods will disturb the action of the entire piston assembly. Refer to "CONNECTING ROD ALIGNMENT."

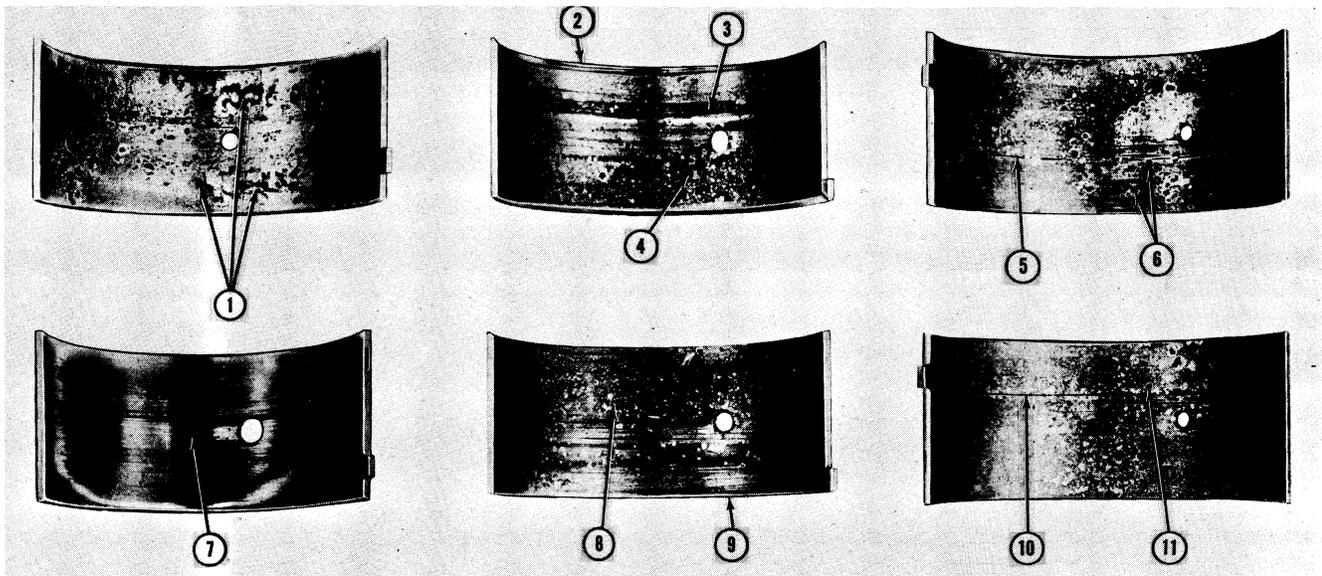


Figure 38
Typical Defective Bearings

- | | | |
|-----------------------|---------------------|-------------------|
| 1. Craters or Pockets | 5. Scratches | 9. Radii Ride |
| 2. Radii Ride | 6. Imbedded Dirt | 10. Scratches |
| 3. Scratches | 7. Overlay Worn Out | 11. Imbedded Dirt |
| 4. Dirt in Bearing | 8. Fatigue Failure | |

Connecting Rod Bearings

1. If the bearing liners are scored, have the flash overlay wiped out, show fatigue failure, or are badly scratched, as shown in Figure 38, install new bearing liners.
2. If the bearing liners appear to be serviceable, keep with their respective rods for reassembly in the engine. If the clearance exceeds the specified limits, page 64, new bearings must be installed. Undersize connecting rod bearings are available in 0.002 in. (0.0508 mm), 0.010 in. (0.254 mm), 0.020 in. (0.508 mm), 0.030 in. (0.762 mm), and 0.040 in. (1.016 mm) for service. If new bearings are required, follow the procedure covered on page 38.

Pistons

1. Inspect pistons for damage at the ring lands, skirts, and pin bosses. Check for separation of the top ring insert from the piston. Check for wear in the ring lands by using a new ring and a feeler gauge, as shown in Figure 39. The rings should have the clearances specified on page 66.
2. If the pistons have excessive skirt clearance, wavy ring lands, fractures, or damage from detonation, install new pistons.

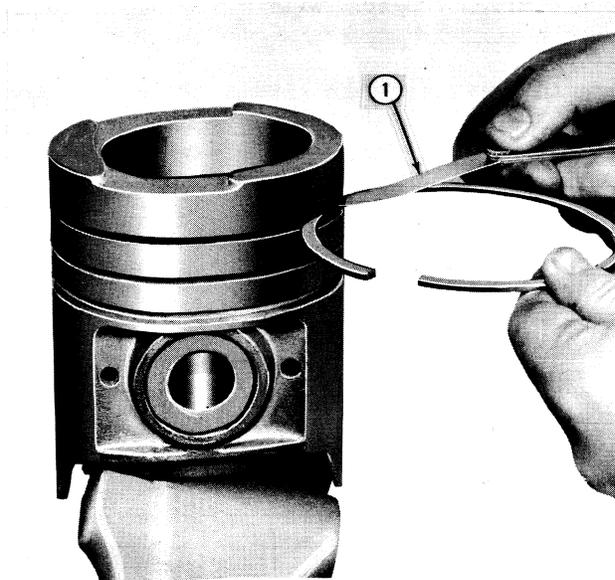


Figure 39
Checking Ring Side Clearance

1. Feeler Gauge

3. Piston pins having wear or damage should be discarded and new ones installed. Always use new piston pin snap rings (circlips).

Connecting Rod Alignment

1. Place each connecting rod in an alignment fixture, as shown in Figure 40.
2. If the connecting rod is twisted more than 0.0120 in. (0.3048 mm) or bent more than 0.0040 in. (0.1016 mm) install a new rod.

E. Repair

Connecting Rod Bushing

1. Remove the connecting rod bushing from the connecting rod with Driving Mandrel No. 815, Adapter No. T-809, and an arbor press, Figure 41.
2. Clean the connecting rod bore and make sure there are no burrs or scratches in the bore. Press a new bushing into the connecting rod, using the same bushing tool that was used for removal.
3. Using the hole in the top of the connecting rod as a guide, drill a 1/4 in. (6.350 mm) diameter hole in the bushing, Figure 42.
4. Using an expansion reamer, ream the bushing in the connecting rod to obtain the specified bushing-to-piston pin clearance, page 65. A spiral expansion reamer is recommended.

Fitting Pistons

1. Pistons are available in both standard and oversizes to fit all engines. New pistons should be installed if the clearance exceeds the specified limits, page 65.
2. The cylinder bores must be checked for taper and out-of-round before fitting a piston, as outlined on page 28. under "CYLINDER BLOCK INSPECTION."
3. Before installing a piston and new rings in a used block, remove the high polish on the cylinder wall to aid ring seating. This is done by passing a hone lightly through the cylinder bore a few times. Do not hone more than enough to rough up the polish. After honing, bores should be washed with hot water and detergent, then rinsed in cold water and dried thoroughly. The bores should then be oiled to prevent rusting.

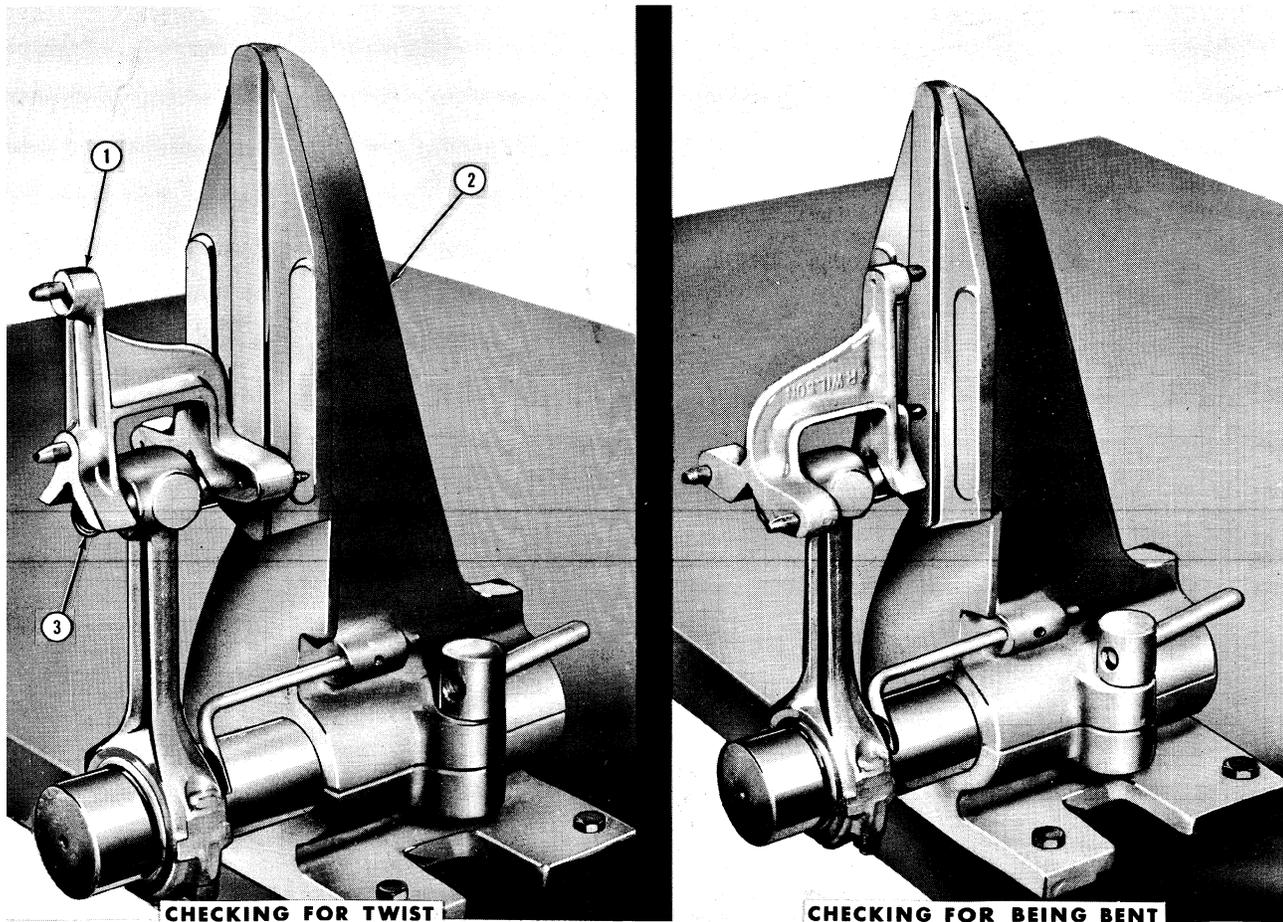


Figure 40
Connecting Rod Alignment

1. Alignment Gauge

2. Connecting Rod Aligner

3. Piston Pin

Using a bore gauge (or inside micrometer) check and record the cylinder bore diameter in a crosswise direction as shown in Figure 43.

With an outside micrometer, check and record the "W" diameter of the piston to be fitted, Figure 44.

Subtract the piston diameter from the bore diameter. The resultant figure should be within the clearance specification given on page 65.

If the resultant figure is greater than the clearance given in the specifications, page 65, try another piston. If none can be fitted, rebore the cylinder to the next oversize. If the clearance is less than specified, hone the bore until the desired clearance is obtained.

NOTE: Dimension "W" is not the point of largest diameter of the piston, but it is the datum from which bore clearances are calculated.

Fitting Piston Rings

1. Before installing new rings on a piston, the rings should be checked for proper ring gap. Each ring should be fitted and checked in the cylinder in which it is going to be used, and marked accordingly after the cylinders have been checked and reconditioned as required. Push the ring down into the cylinder bore to the lower unworn portion of the cylinder, using the head of a piston so that the ring is square with the cylinder wall.

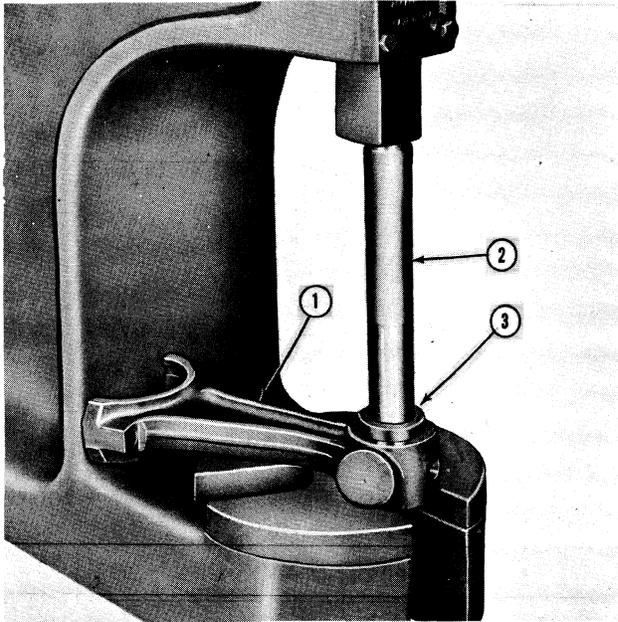


Figure 41
Removing and Installing
Connecting Rod Bushing

- 1. Connecting Rod
- 2. 815 Mandrel
- 3. T 809 Adapter

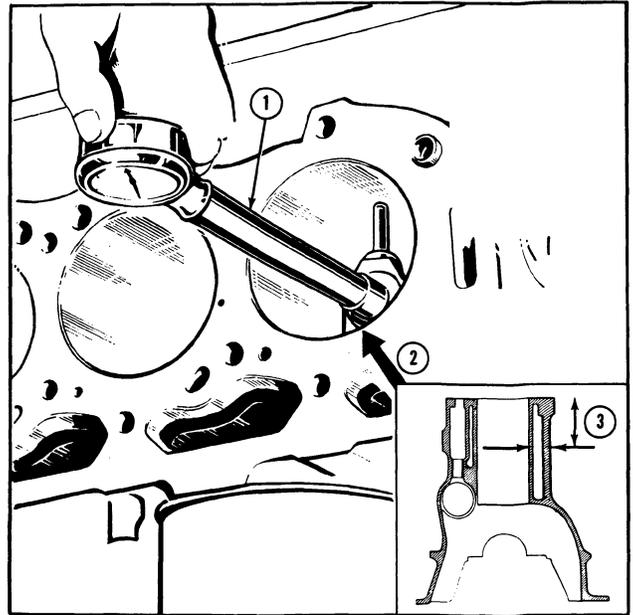


Figure 43
Cylinder Bore Grading Depth

- 1. Bore Gauge
- 2. Depth at which Measurement Should Be Taken
- 3. 2-3/4 in. (69.85 mm)

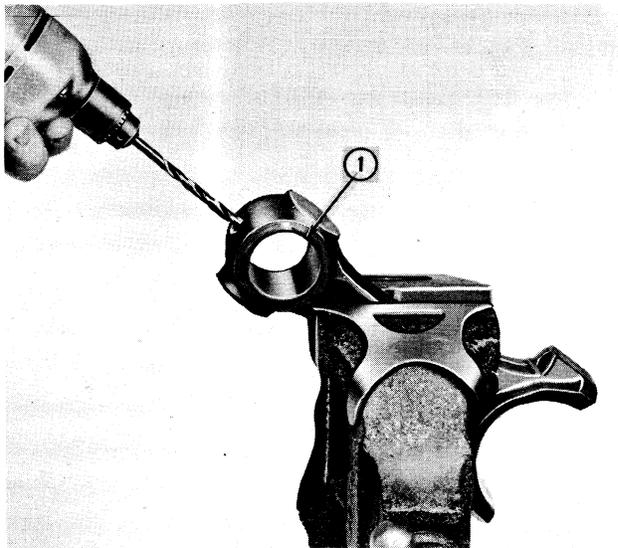


Figure 42
Drilling Connecting Rod Bushing

- 1. Connecting Rod Bushing

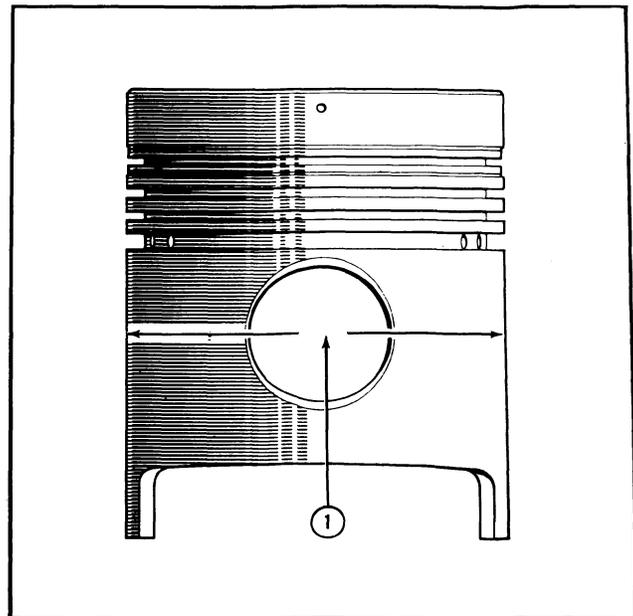


Figure 44
Piston Grading Diameter

- 1. Dimension W

PART 1 - ENGINES

NOTE: When positioning the piston ring inside the cylinder for checking ring gap, be very careful not to damage the ring or the cylinder bore.

2. Check the gap between the ends of the ring with a feeler gauge, Figure 45. The ring gap should be as specified on page 66. It is important that all rings have at least the minimum gap clearance to provide for the expansion that may occur when the engine warms up to operating temperatures; otherwise, the ring ends may butt together and cause scuffing, scoring, or ring breakage.
3. New rings should also be checked for side clearance in the grooves of the piston on which they are to be installed. This is done as outlined on page 23, under "PISTONS."

Installing Piston Rings

NOTE: When installing the piston rings, it is recommended that a piston ring expander be used as shown in Figure 36. This tool will prevent over-expansion of the ring, and will expand the ring to a true circle to avoid distortion. The rings supplied in Service Ring Kits differ from the standard size rings used in production. Because of differences the following points should be noted when installing new sets of rings, whether they be standard or oversize.

1. Diesel Production Piston Ring Set - comprises:
 - 3 Compression Rings
 - 1 Oil Control Ring
 - 1 Oil Control Ring Expander (Slotted)

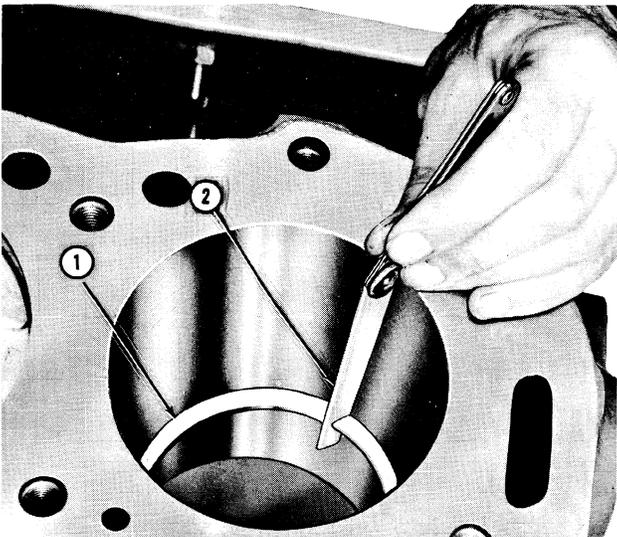


Figure 45
Checking Piston Ring Gap

TOP COMPRESSION RING

Ford 6500 - Bright chrome finish, non-stepped.
Ford 7500 - Bright, chrome finish, keystone tapered.

2nd COMPRESSION RING

Bright chrome finish, step on inside diameter. Assemble with step facing upwards.

3rd COMPRESSION RING

Dull black finish, step on inside diameter. Assemble with step facing upwards - no expander behind ring, Figure 46.

OIL CONTROL RING

Install either way upwards with slotted expander behind ring, Figure 46.

2. Service Type Set Comprises:

- 3 Compression Rings
- 1 Oil Control Ring
- 1 No. 3 Compression Ring Expander (Non-Slotted)
- 1 Oil Control Ring Expander (Slotted)

TOP COMPRESSION RING

Ford 6500 - Bright chrome finish, chamfer on inside diameter. Assemble with chamfer facing upwards.
Ford 7500 - Bright chrome finish, keystone tapered. Assemble either side up.

2nd COMPRESSION RING

Bright chrome finish, step on inside diameter. Assemble with step facing upwards.

3rd COMPRESSION RING

Dull black finish, step on outside diameter, facing down and non-slotted expander behind ring.

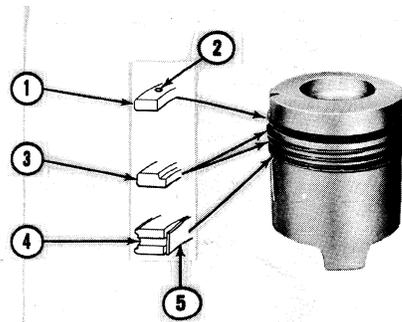


Figure 46
Fitting Piston Rings

1. Top Compression Ring
2. Top Identification Mark
3. Intermediate Compression Ring
4. Oil Control Ring
5. Hump-Type Expander