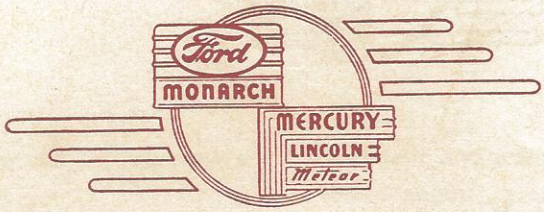
Master
REPAIR MANUAL



ENGINE

This manual applies to the models listed below.

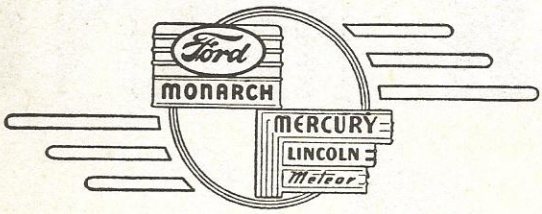
FORD CARS								
METEOR CARS								
MERCURY CARS								
MONARCH CARS								
LINCOLN CARS		—	—	—	1952			
LINCOLN COSMOPOLITAN		—	—	—	1952			
TRUCKS								
F-190 & M-190	F-7 & M-7	1949	1950	1951	1952			
F-215 & M-215	F-8 & M-8	1949	1950	1951	1952			

MANUAL NUMBER SE 384A

SECTION NUMBER TWELVE

Ford Motor Company of Canada
LIMITED

PRICE 35 CENTS



To all Automotive Repair Men:

This Master Repair Manual contains complete repair and overhaul information on Ford of Canada Products starting with 1949 models.

You will note that seven spaces are provided on the cover to indicate the models and years to which it applies.

When a new model is released to which this publication is applicable, you will be advised accordingly so that you may enter the appropriate model year in the space provided on the cover. This system will enable you to maintain up-to-date repair information for all models and years.

These manuals have been prepared to provide useful information to those engaged in the field of automotive repair. It is our hope that they will prove to be of considerable use to you, and we shall welcome your comments or suggestions at any time.

SERVICE DEPARTMENT

FORD MOTOR COMPANY OF CANADA,
Limited

279 Cubic Inch and 317 Cubic Inch Truck Engines

In the 1952 truck line, we have two entirely new engines. These are as follows:

Series 7—279 cu. in. displacement O.H.V. engine having a 3.56″ bore and a 3.5″ stroke.
Model Symbol—EAL.

Series 8—317 cu. in. displacement O.H.V. engine having a 3.8″ bore and a 3.5″ stroke.
Model Symbol—EAM.

Repair and maintenance operations are performed on either engine in exactly the same manner. The parts used in these engines are interchangeable with the following exceptions: cylinder block, pistons and rings, piston pins, carburetor, governor, and cylinder heads.

The location of externally mounted parts of the engine can be noted in figs. 1 and 2.

Complete repair procedures given below are supplemented with illustrations.

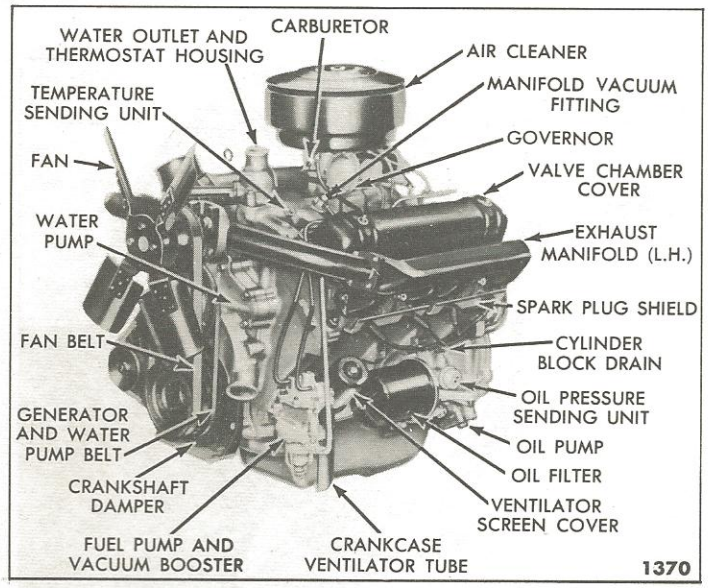


Fig. 1—EAM or EAL Series Engine (Left Hand View)

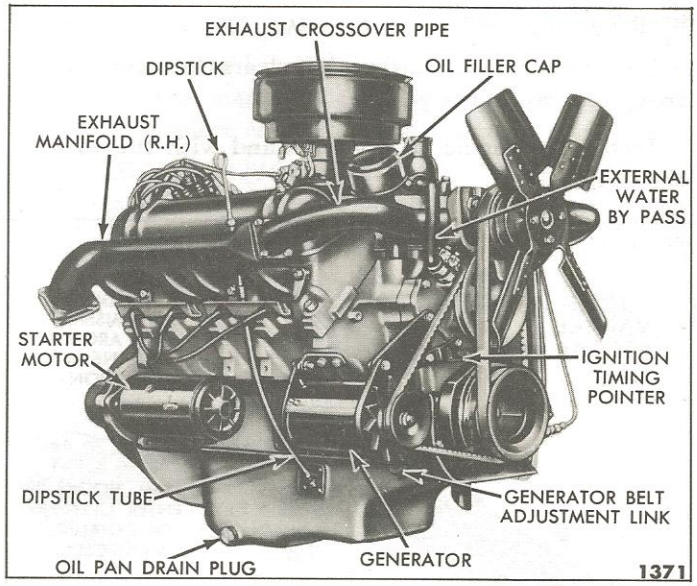


Fig. 2—EAM or EAL Series Engine (Right Hand View)

1. ENGINE REMOVAL AND INSTALLATION

The procedure given below will apply for either the Series 7 or the Series 8 truck engine.

a. Removal.

Disconnect the battery ground strap to avoid short circuits. Shut off the tank valve in the fuel line under the cab. Drain the cooling system. Remove the hood.

Disconnect the oil pressure sender wire. Disconnect the radiator hose at the engine. Disconnect the heater

hose at the engine and slide them out of the support clamp on the right hand apron. Remove the fan assembly. Remove the radiator.

Disconnect the generator wires at the generator, the starter cable at the starter, the engine temperature sending unit wire, and the oil pressure sending unit wire.

Remove the high tension wire and the coil primary wire at the distributor. Disconnect the choke wire, hand throttle, and accelerator rod and spring at the carburetor.

Disconnect the flexible inlet line at the fuel pump. Disconnect the windshield wiper hose and the brake vacuum booster hose.

Disconnect the muffler inlet pipe and pull the pipe away from the manifold.

Remove the screws retaining the flywheel housing to the engine. Place a jack under the transmission.

Remove the lock wire and the two engine rear mounting nuts. Remove the cotter pins and retaining nuts from the engine front mounts.

Install the lifting sling (fig. 3) and carefully lift the engine with a portable floor crane. Raise the engine enough to clear the frame front crossmember. Raise the transmission jack until it supports the transmission to keep this alignment.

Pull the engine forward until it clears the transmission, then lift it out of the vehicle.

Install the engine on a work stand with the adaptor shown in fig. 4.

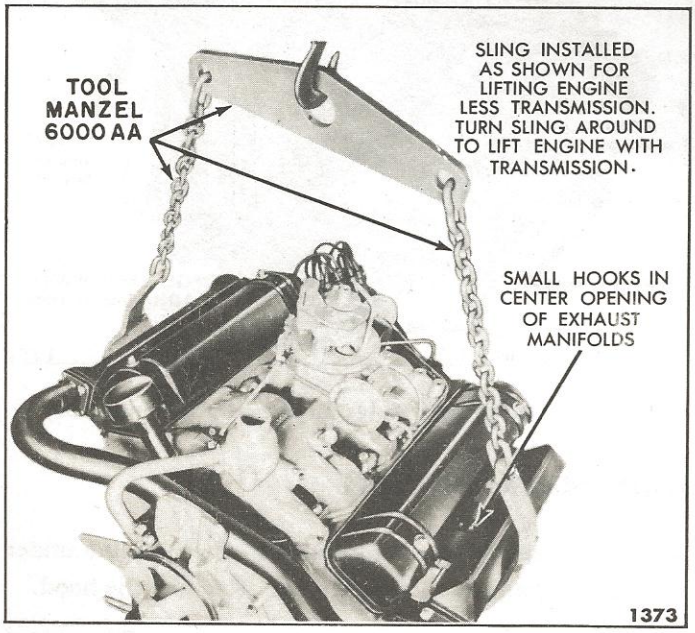


Fig. 3—Engine Lifting Sling

b. Installation.

Align the front support mounts in the frame crossmember.

Remove the engine from the work stand with the lifting sling and crane. Lower the engine carefully in the frame, aligning it with the transmission shaft. Slide the clutch over the transmission shaft. If necessary, turn the crankshaft to align the shaft splines with the clutch disc splines. Install the screws retaining the flywheel housing to the block.

Lower the engine on the front mounts, install the washers, nuts, and cotter pins. Install the rear mount bolts and nuts. Install the lock wire. Install the clutch equalizer shaft clevis pin and cotter pin. Check the clutch free play. Adjust, if necessary.

Connect the muffler inlet pipe. Connect the throttle linkage, hand throttle, and choke wire. Connect the vacuum hose and the flexible fuel line to the pump. Connect the vacuum brake booster hose if the truck has booster brakes.

Connect the generator wires, the engine temperature sending unit wire, the oil pressure sending unit wire, the ignition primary and secondary wire, and the starter cable.

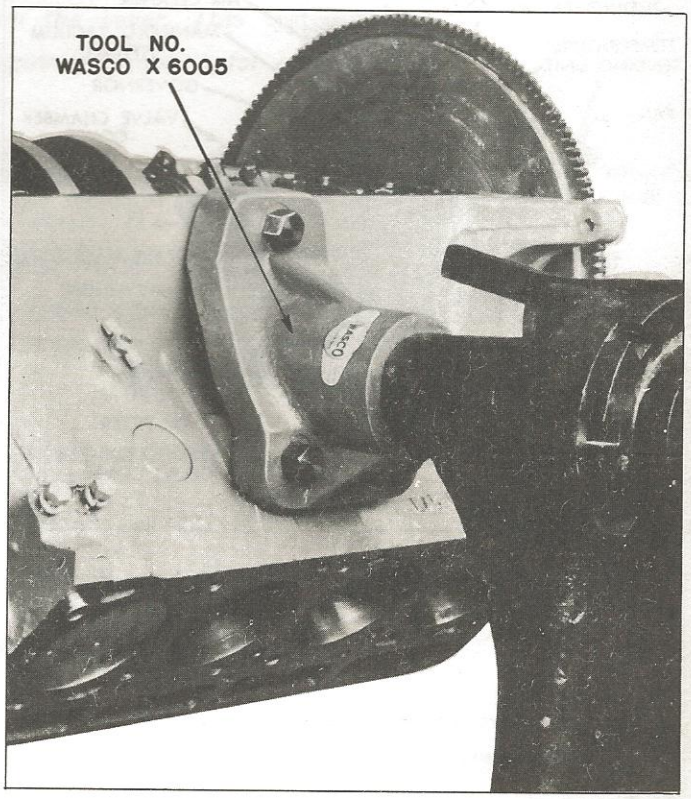


Fig. 4—Install Engine on Work Stand

Install the two springs, washers, nuts, and cotter pins on the radiator support bolts. Connect the radiator hose. Slide the heater hose through the supports on the compartment side and install the hose on the engine.

Connect the hood hinges with the two bolts. Fill the cooling system. Turn on the fuel tank valve under the cab. Connect the battery ground strap. Fill the crankcase with the proper grade and quantity of engine oil.

Run the engine until it is thoroughly warmed up, and check for coolant and oil leaks.

2. MANIFOLDS

Procedures for removal, cleaning and inspection, and installation of intake and exhaust manifolds are presented below.

a. Intake Manifold.

The intake manifold is bolted to the cylinder heads and straddles the centre portion of the block. The manifold and carburetor can be removed as an assembly.

(1) *REMOVAL.* Remove the air cleaner. Disconnect the throttle linkage, choke wire, carburetor fuel line, distributor vacuum line, and governor vacuum lines. Disconnect the vacuum booster line at the manifold fitting. Disconnect the engine temperature sending unit wire.

Remove the water by-pass flange screws from the outlet elbow. Remove the manifold retaining screws and the four clamps and lift the manifold and gaskets from the block. The manifold is illustrated in fig. 5.

(2) *CLEANING AND INSPECTION.* Wash the grease and oil accumulation from the outside of the manifold.

Inspect the manifold for cracks and warped gasket surfaces. Replace warped or cracked manifold. Be sure the gasket surfaces of the manifold are free from nicks, burrs, or bad scratches.

(3) *INSTALLATION.* Install the manifold with new gaskets and align the bolt holes in the gaskets and manifold with the cylinder head tapped holes. Install the manifold retaining screws (the four centre screws use the clamps to bear against the manifold flanges) and torque the screws to 23-28 foot-pounds tightening from the centre of the manifold outward in each direction.

Install the water by-pass screws. Connect the engine temperature sending unit wire. Connect the vacuum booster line, the distributor vacuum line, the carburetor fuel line, and governor vacuum line. Connect the choke wire and the throttle linkage. Install the air cleaner.

b. Exhaust Manifolds.

Do not remove manifolds when they are hot or they may warp and make reassembly difficult.

(1) *REMOVAL.* Disconnect the crossover pipe from both manifolds. Disconnect the muffler inlet pipe from the right-hand manifold. Remove the oil dipstick and tube. Remove the screws, flatwashers, and manifolds. The manifolds are shown in fig. 6.

(2) *CLEANING AND INSPECTION.* Clean the gasket surfaces of the manifolds.

Inspect the manifolds for cracks or warped gasket surfaces. Replace cracked or badly warped manifolds.

(3) *INSTALLATION.* Coat the mating surfaces of the manifold with a light amount of graphite grease. Hold the manifold and gaskets against the head and

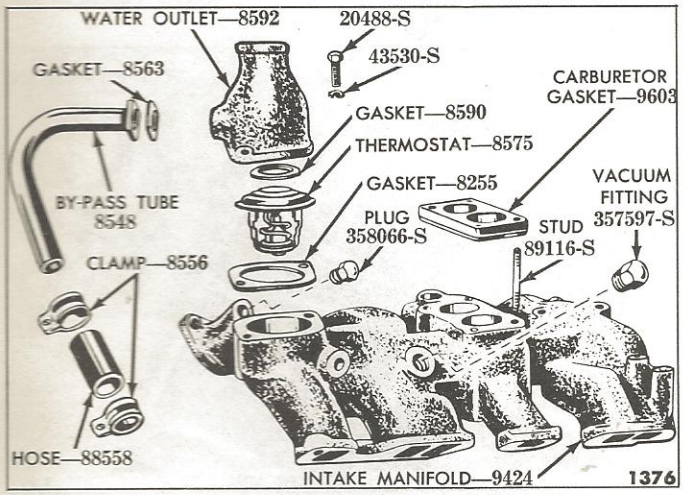


Fig. 5—Intake Manifold

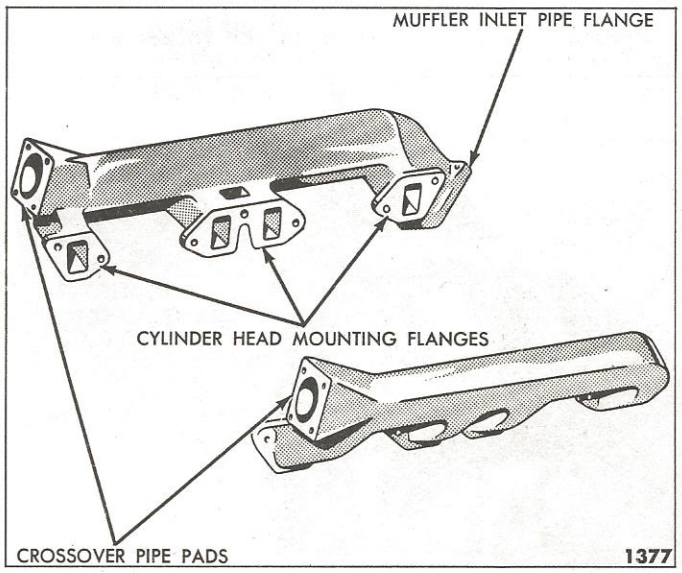


Fig. 6—Exhaust Manifolds

install the washers and retaining bolts. Torque the bolts to 23-28 foot-pounds from the centre to the ends. Install the crossover pipe gaskets. Place the crossover pipe on the manifold studs and install the retaining nuts. Torque the nuts to 23-28 foot-pounds. Install the muffler inlet pipe.

3. CYLINDER HEADS

The cylinder head contains the valves and rocker mechanism. The intake manifold straddles the cylinder block and is bolted directly to the heads. Procedures given here cover only the removal, cleaning and inspection, and installation of the head. Disassembly of the cylinder head is covered under "Valves and Valve Mechanism" later in this chapter.

The left and right hand cylinder heads (except rocker assembly) are interchangeable provided a water outlet plug is removed from one end of the head and a new plug installed in the other end. Cylinder heads serviced to the field will not have the water outlet plug installed so they can be used for either right or left-hand installations.

The plug is installed in the rear water passage of either cylinder head by using the tool shown in fig. 7. Be sure to apply a light coat of water resistant sealer to the sealing surface of the plug before it is installed.

a. Removal.

Drain the cooling system. Clean the outside of the valve chamber cover. Remove the cover. Disconnect the muffler cross over pipe and remove the exhaust manifold. Remove the intake manifold. Clean the outside of the tappet chamber cover and remove the cover. Disconnect the spark plug wires.

NOTE: *On the right-hand cylinder head remove the ignition harness bracket from the rear corner of the head. Remove the oil dipstick and tube from the crank case. On vehicles equipped with air brakes, remove the air compressor.*

Release the spring tension on the rocker arms and remove the push rods (fig. 8). Be sure to identify the rods so they can be replaced in the same place from which they were removed.

NOTE: *The two end push rods can be left in place and removed after the head is removed.*

Remove the cylinder head bolts. Install the cylinder head holding fixture using the four long screws from the intake manifold to secure the brackets to the head. Lift the cylinder head off the block. Do not pry between the head and block. Remove the head gasket.

b. Cleaning.

Remove carbon deposits from the combustion chambers and valve heads with a scraper and a wire brush. Be careful not to scratch the gasket surface of the head. Clean rust and dirt from the water passages.

c. Inspection.

Check the head for cracks and warped gasket surfaces. Check to see that all water passages are open. Make sure the gasket surfaces of both head and block are free from projections or scratches. Smooth off any projections or scratches with an oil stone.

d. Installation.

Install the head gasket over the cylinder dowels and pilot studs as shown in fig. 9.

Apply cylinder head gasket sealer (8M-19554) to both sides of the gasket.

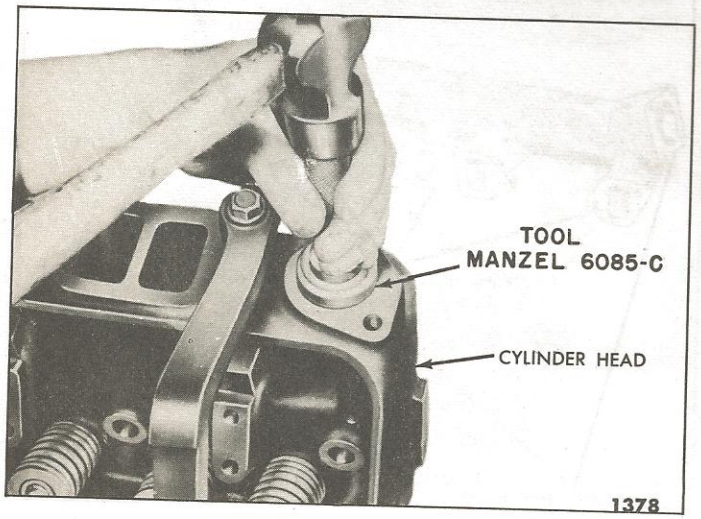


Fig. 7—Installing Cylinder Head Water Outlet Plug

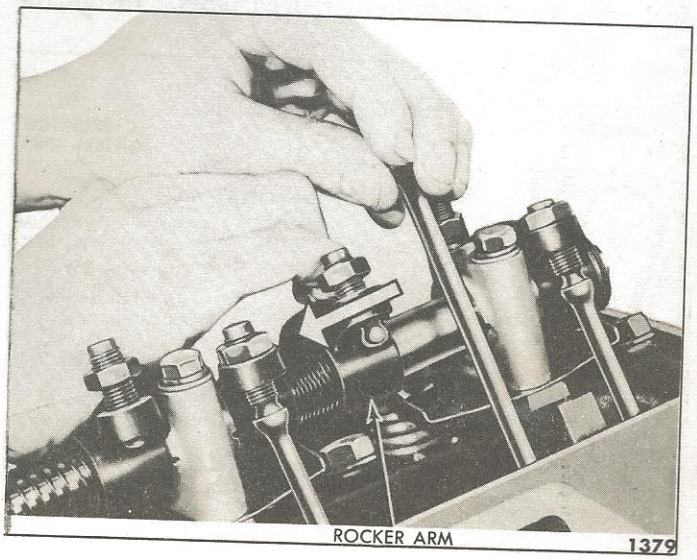


Fig. 8—Removing Push Rods

Slide the cylinder head over the pilot studs in the cylinder block guiding the end push rods through the head. Remove the cylinder head fixture brackets, and the pilot studs. Coat the cylinder head bolt threads with water resistant sealer, install the bolts, and tighten them in the order shown in fig. 10 to 80-90 foot-pounds. Install the push rods centring them in the tappets and the ball end of the rocker lever screws. Adjust the valve lash (cold setting) to 0.010 inch (intake) and 0.020 inch (exhaust). Install the tappet chamber cover with a new gasket cemented to the cover. Tighten the nuts to 6-8 foot-pounds. Install the intake manifold using new gaskets. Install the exhaust manifold and reconnect the exhaust cross over pipe, making sure that the thermostat is in the right-hand side of the pipe. Connect the radiator hose.

NOTE: *On the right-hand head, install the ignition harness bracket and the oil dipstick and tube.*

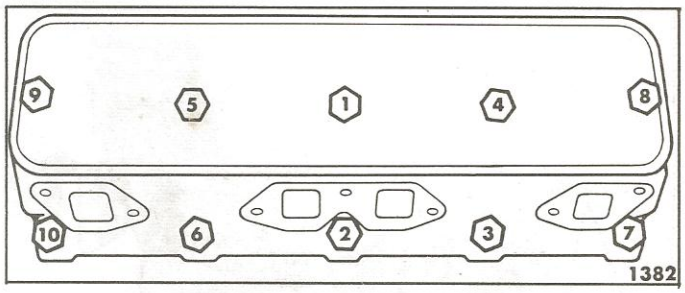


Fig. 10—Cylinder Head Bolt Tightening Sequence

Connect the spark plug wires. Run the engine until it is thoroughly warmed up and recheck the valve lash with the engine at idle. The valve lash (hot setting) should be 0.012 inch (intake) and 0.018 inch (exhaust). Install the valve chamber cover using a new gasket cemented to the cover and tighten the nuts to 6-8 foot-pounds.

4. VALVES, VALVE MECHANISM, AND VALVE LASH ADJUSTMENT

Procedures covering repair and replacement of valves and valve mechanism and the adjustment of valve lash are given here. The procedures include cylinder head disassembly.

Valve guides are an integral part of the cylinder head. Valves with 0.003, 0.015 and 0.030 inch oversize stems are available for service when the valve guides become worn or scored.

a. Cylinder Head Disassembly.

Remove the valve chamber cover. Remove the intake and exhaust manifolds. Remove the rocker shaft bracket screws and remove the shaft assembly from the head. Remove the oil baffle plates. Pull the drain line from the end bracket. Remove the push rods identifying each rod with the rocker arm from which it was removed. Install the cylinder head holding fixture brackets and remove the cylinder head. The head is shown mounted in the holding fixture in fig. 11.

Remove the cotter pins at each end of the rocker arm shaft and remove the flat washers, spring washers, and plugs. Slide the rocker arms, springs, and brackets off the shaft. Be sure to identify the parts so they can be installed in their original position. The rocker mechanism is shown disassembled in fig. 12.

Remove the exhaust valve stem caps identifying the caps so they can be replaced on the same valve. Clean the carbon out of the combustion chamber. Compress the valve springs with the tool shown in fig. 13, remove the valve stem locks, and release the springs. Remove the intake valve sleeve, spring retainer, and spring. Remove and discard the intake valve seal and remove the valve. Remove the exhaust valve spring retainer, spring, and valve. Identify all valve parts so they can be re-

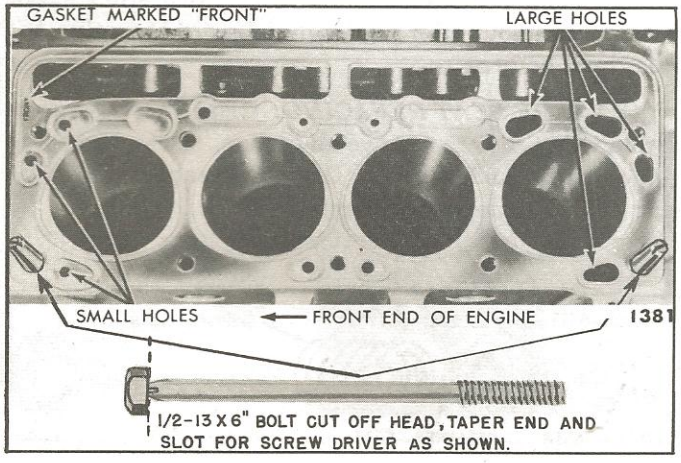


Fig. 9—Cylinder Head Gasket and Pilot Studs Installed

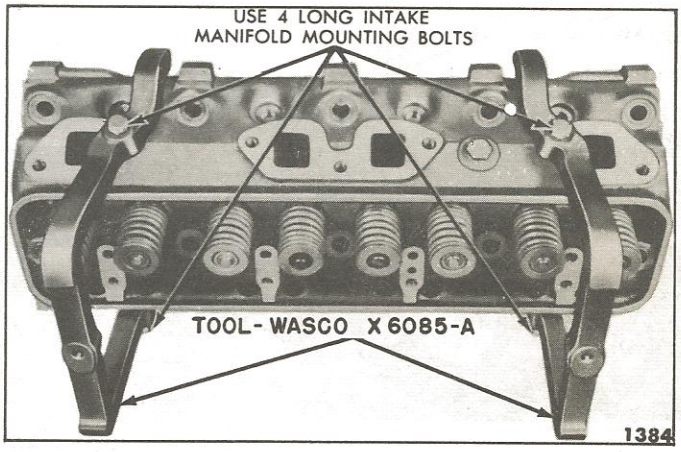


Fig. 11—Cylinder Head Holding Fixture

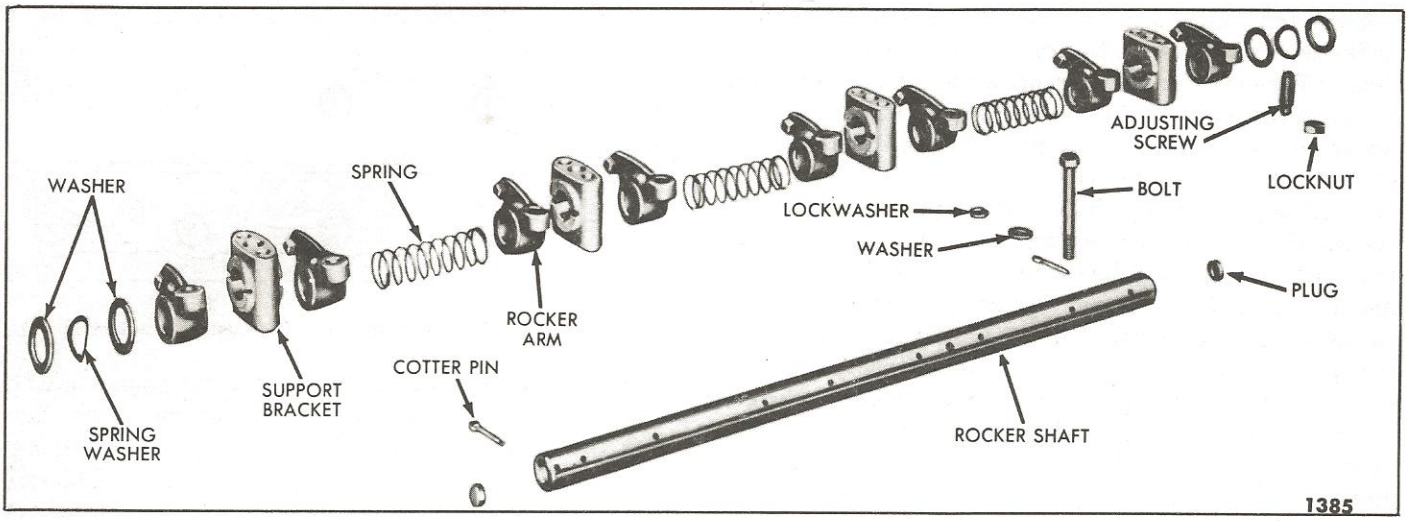


Fig. 12—Rocker Mechanism—Disassembled

placed in the same position from which they were removed.

b. Valves and Valve Seats.

A rotatable valve (fig. 14) is used for the intake and a free type valve (fig. 15) is used for exhaust. The exhaust valve seat has a hardened insert to increase seat life. Intake valve seats do not have inserts.

After regrinding valves and seats or installing new valves, the valve and seat should be lightly lapped to form a good seal. Use a medium grade lapping compound.

(1) *VALVE CLEANING AND INSPECTION.* Scrape or wire brush carbon off the head and stem of the valve. Remove varnish from the valve stem. Check the valve for a burned or warped head or a bent or scored stem. Discard any defective valves.

(2) *VALVE GUIDE INSPECTION AND REPAIR.* Measure the valve guide diameter (fig. 16) and the valve stem diameter. If the clearance is more than 0.004 inch for the intake or more than 0.005 inch for the exhaust valve, ream out the guide for the next oversize valve. Use the piloted reamer shown in fig. 17. Be sure to clean the guide and valve port thoroughly after reaming.

NOTE: *The valve guide reamers are piloted to fit a standard guide bore (0.003 inch oversize reamer); 0.003 inch oversize bore (0.015 inch oversize reamer); and a 0.015 inch oversize bore (0.030 inch oversize reamer). Be sure to use the reamers in sequence when reaming from standard to 0.015 inch or 0.030 inch oversize bores.*

(3) *REFACING VALVES.* Grind the valve face at 45° angle on a valve grinder as shown in fig. 18. Grind off only enough stock to remove pits or grooves from the valve face. If the edge of the valve head is less than $\frac{1}{32}$ inch thick after grinding, replace the valve.

Grind the valve stem ends if they are scored or grooved. Do not remove more than 0.010 inch from the end of the valve stem. Check the valve face runout. If it exceeds 0.002 inch, regrind the valve. If it still exceeds 0.002 inch runout after regrinding, discard the valve, the stem may be bent.

(4) *VALVE SEAT REFACING.* Clean the valve seats with a wire brush to remove all carbon. Clean the valve guides with a guide cleaner. Grind the seats with a valve seat grinder removing only enough stock to clean up pits or grooves. If the valve seat width is more than 0.070-

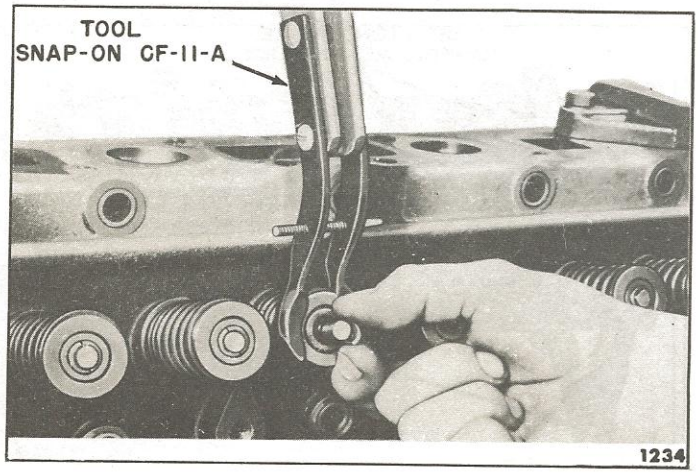


Fig. 13—Removing or Installing Valve Locks

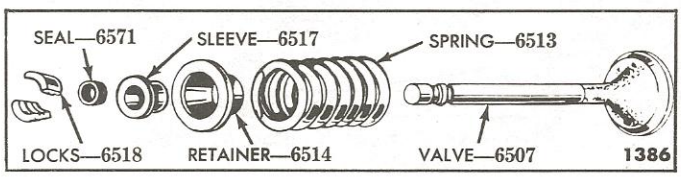


Fig. 14—Intake Valve and Related Parts

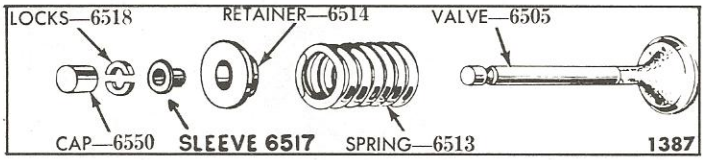


Fig. 15—Exhaust Valve and Related Parts

0.080 inch (intake) or 0.095-0.105 (exhaust) after grinding, remove stock from the top and bottom edge to reduce the width (figs. 19 and 20). Keep the seat as near to the centre of the valve face as possible. Use a 30° angle wheel to remove stock from the bottom and a 60° angle wheel to remove it from the top of the seat.

Check the valve seat runout with an indicator as shown in fig. 21. The seat runout should not exceed 0.003 inch.

(5) *TEST VALVE SPRING PRESSURE.* Check the valve spring pressure with the tool shown in fig. 22. The springs should exert a minimum pressure of 58 lbs. when compressed to a length of 1.8 inches or 120 lbs. when compressed to a length of 1.47 inches.

c. Rocker Arm, Shaft, and Push Rod.

Check the rocker arm to shaft clearance. If the clearance is excessive, replace worn parts. Replace any rocker arm adjustment screws or lock nuts that have stripped threads. Replace any adjusting screws that have nicks or scratches in the ball ends.

Check the push rods between ball and cup centres with a dial indicator on the centre of the rod. If the total indicator runout exceeds 0.020 inch, discard the rod. Do not attempt to straighten push rods. Check the ball end and socket end to make sure they are smooth. Replace push rods with nicked or scratched ends.

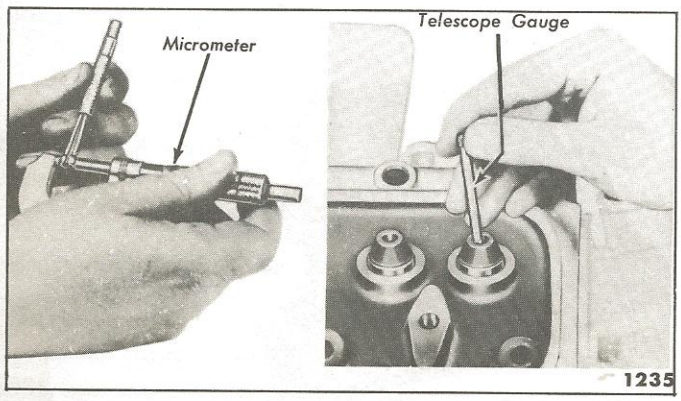


Fig. 16—Measuring Valve Guide

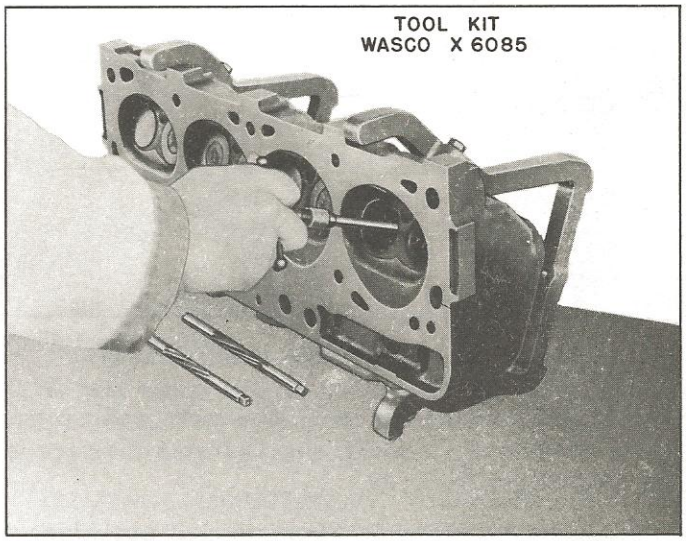


Fig. 17—Reaming Valve Guide

NOTE: *A rough check for bent push rods can be made while they are installed in the engine by rotating them (valve closed) and observing the runout. If any runout is observed, be sure to check the rod between centres as described above.*

d. Cylinder Head Assembly.

Oil all moving parts with engine oil. Be sure the oil plugs are installed in each end of the rocker shaft. The plug should be installed cup side out. Do not peen the plugs tight, they should be a loose fit in the shaft to permit air bleed when the shaft fills with oil. Install a flat

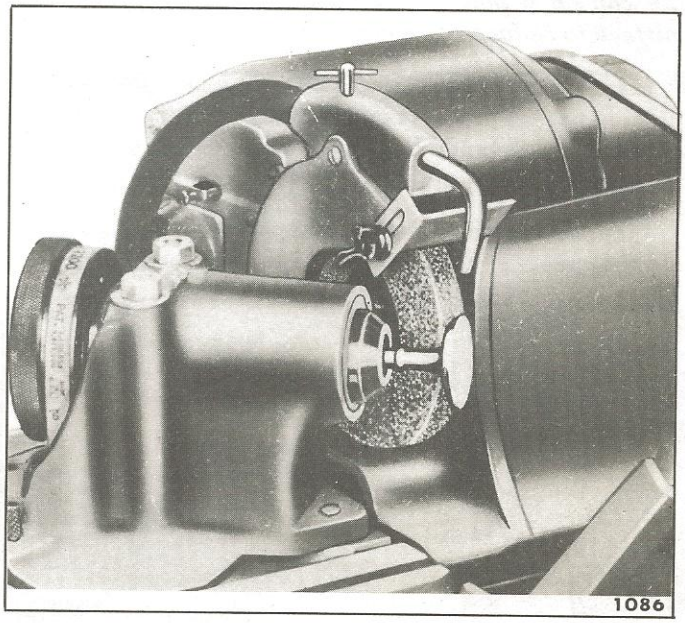


Fig. 18—Valve Refacing

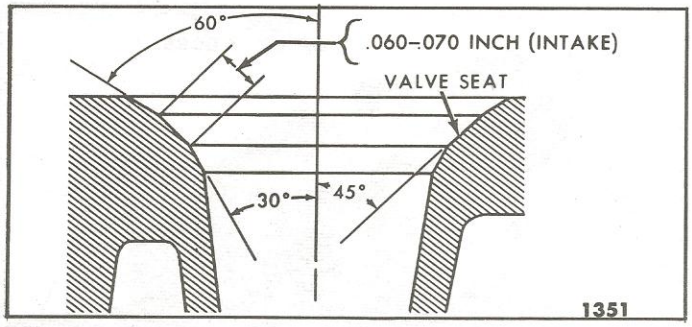


Fig. 19—Correct Valve Seat Width (Intake)

washer, spring washer, another flat washer, and a cotter pin in one end of the rocker shaft. Install the parts in the order shown in fig. 12.

Install a valve in the port from which it was removed or to which it was fitted. On intake valves, install the spring with the closed coil against the head. Install the spring seat and sleeve. Compress the valve spring and install the valve stem seal and the locks (fig. 13). On exhaust valves, install the spring with the closed coil against the head and install the spring seat. Compress the valve and install the locks.

NOTE: *The exhaust free valve design requires a clearance of 0.0002-0.004 inch between the end of the valve stem and the inside of the cap (fig. 23) so the cap can carry the valve spring pressure permitting the valve to rotate. The clearance can be measured before the valve is installed with the micrometer tool shown in fig. 24. If the clearance is less than 0.0002 inch, grind off the end of the valve stem to provide the proper clearance. If the clearance is greater than 0.004 inch, lap the open end of the cap on a piece of fine emery paper on a smooth surface to reduce the clearance.*

Install the cylinder head on the engine. Remove the holding fixture brackets and the guide studs. Install the cylinder head bolts and tighten them to 80-90 foot-pounds in proper sequence.

Install the push rods in their proper location and install the exhaust valve caps. Lay the oil baffle plates on

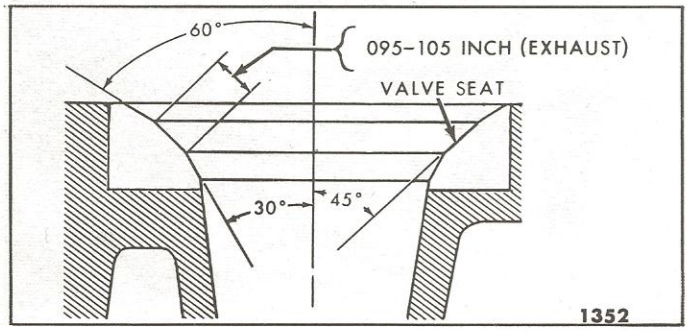


Fig. 20—Correct Valve Seat Width (Exhaust)

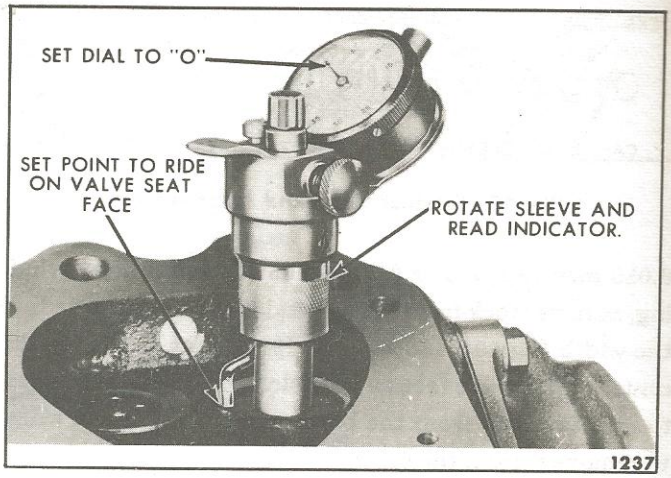


Fig. 21—Checking Valve Seat Runout

the head. Place the rocker assembly on the plates and install the bracket retaining screws. Be sure to install the oil drain line on the same end bracket from which it was removed.

CAUTION: *Be sure the rocker shaft supporting brackets are not upside down when the assembly is installed. There is a 0.020 inch difference in bracket height when reversed. Tightening the screws with the brackets reversed can result in a broken shaft.*

Tighten the bracket retaining nuts on the studs. Install the manifolds.

Make a preliminary valve lash adjustment. Fill the cooling system and run the engine until it is thoroughly warmed up. Recheck the valve lash, adjusting the lash

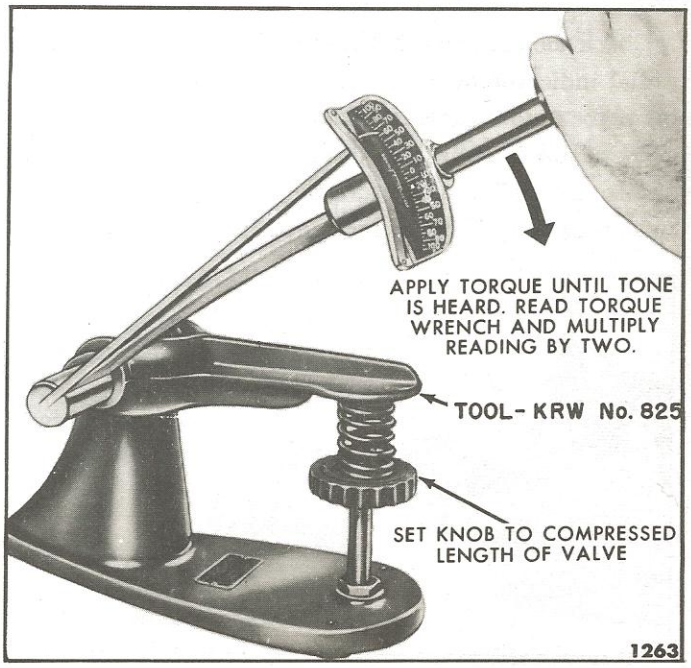


Fig. 22—Checking Valve Spring Pressure

if necessary. Install the valve chamber cover with a new cover gasket cemented to the cover only. Tighten cover nuts to 6-8 foot-pounds.

e. Valve Lash Adjustment.

Valve lash is adjusted by means of a set screw and lock nut on the push rod end of the rocker arm. If the cylinder head or the rocker mechanism has been removed and reinstalled, it will be necessary to make a preliminary adjustment before starting the engine. If the valve lash adjustment is made for the purpose of engine tune up, omit step (1) and proceed with step (2) below.

(1) *PRELIMINARY ADJUSTMENT.* Remove the valve chamber cover. Rotate the crankshaft until No. 1 piston is near top centre at the end of the compression stroke.

NOTE: *No. 1 piston is near T.C. compression stroke when both of its valves are closed and the timing mark on the damper is in line with the pointer.*

Check the intake valve lash with a 0.010 inch feeler gauge (fig. 25). Loosen the lock nut and adjust the screw until 0.010 inch clearance is obtained. Tighten the lock nut without moving the screw. Torque the nut to 30-35 foot-pounds. Check the exhaust valve lash with a 0.020 inch feeler gauge.

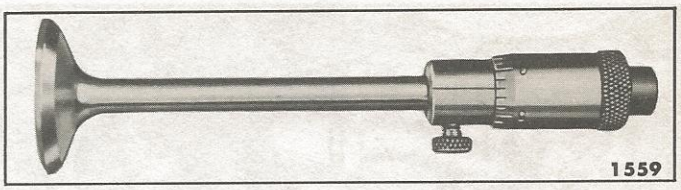


Fig. 24—Measuring Valve to Cap Clearance

Repeat the procedure for each set of valves, turning the crankshaft ¼ turn while checking the valves in the firing order (1-5-4-8-6-3-7-2).

(2) *FINAL ADJUSTMENT.* Run the engine until it is thoroughly warmed up. Check the valve lash with the engine idling. The valve lash setting (hot) is 0.012 inch for the intake, and 0.018 inch for the exhaust.

Replace the valve chamber cover with a new gasket cemented to the cover only. Torque the cover nuts to 8-10 foot-pounds. Do not exceed the 10 foot-pounds limit or the cover will be distorted.

5. OIL PAN, OIL FILTER, OIL PUMP AND PRESSURE RELIEF VALVE

The oil pump is externally mounted in the lower left-hand corner of the engine, and is driven by an intermediate shaft which fits into a slot in the distributor drive shaft. The pump uses an external inlet tube to pick up the oil from the oil pan (fig. 26). The oil inlet screen and tube assembly is bolted to the inside of the oil pan by two slotted head screws. The oil pan is sealed to the cylinder block by a one-piece cork gasket and the pan is retained by 21 slotted head screws. The oil filter is mounted to the block by means of a right angle adaptor. Both the adaptor and the filter must have a good seal to prevent oil leakage since the entire output of the pump flows through the filter before it is delivered to the oil lines in the block.

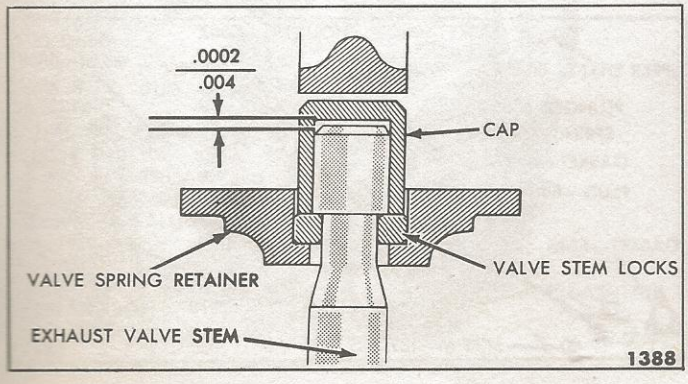


Fig. 23—Exhaust Free Valve Clearances

a. Oil Pan.

Removal, cleaning, inspection, and installation procedures are given under descriptive headings below. The oil pan is illustrated in fig. 27.

(1) *REMOVAL.* Drain the crankcase. Remove the three slotted head screws retaining the oil pump inlet tube to the oil pan and remove the oil inlet line from the

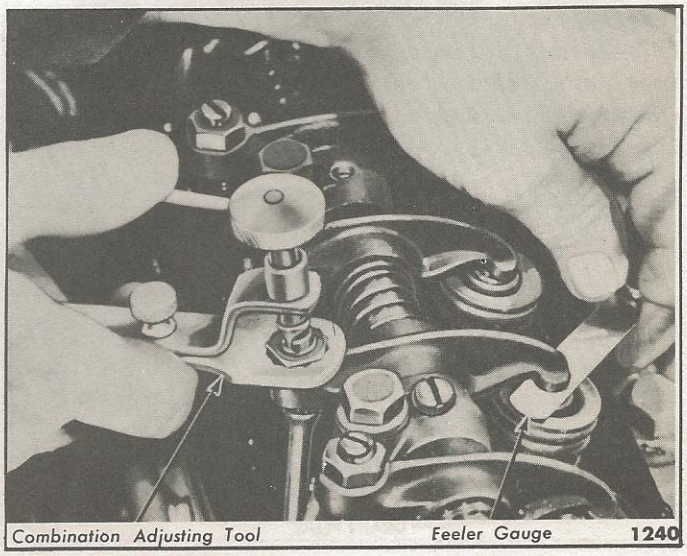


Fig. 25—Checking Valve Lash

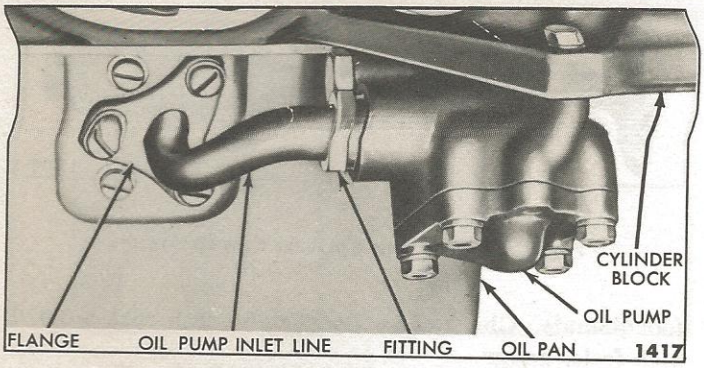


Fig. 26—Oil Pump and Inlet Tube

pump. Remove the cap screw retaining the oil dip stick tube to the manifold and remove the dip stick and tube. Remove the screws retaining the oil pan to the block and remove the pan. If it is necessary to remove the oil pump inlet tube and screen assembly, remove the two screws on the outside of the oil pan and remove the assembly and gasket and the neoprene seal ring.

(2) *CLEANING.* Wash the pan in solvent and dry it thoroughly. Brush any dirt or metal particles from the inside of the pan. Scrape off old gasket material from the gasket surface of the pan.

(3) *INSPECTION.* Check the pan for cracks, holes, damaged drain plug threads, or warping of the gasket surface. Repair any cracks or holes or replace the pan if repairs cannot be made.

(4) *INSTALLATION.* Tie a new gasket to the oil pan with string through the bolt holes in opposite corners of the pan. Hold the pan in place and install two of the retaining screws, and tighten the screws from the centre to the ends using a large screwdriver. Recheck the screws to make sure none have loosened. Install the oil dip stick tube and secure the retaining tab to the exhaust manifold. Install the oil dip stick. Install the oil pump inlet tube and seal in the pump. Do not tighten the fitting at this time. Place a new gasket between the oil line flange and the pan and install and tighten the three screws.

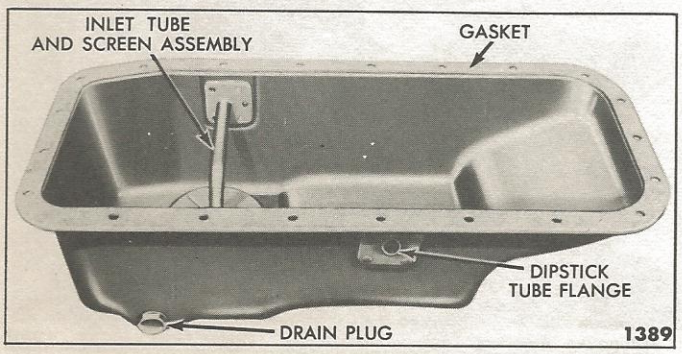


Fig. 27—Oil Pan

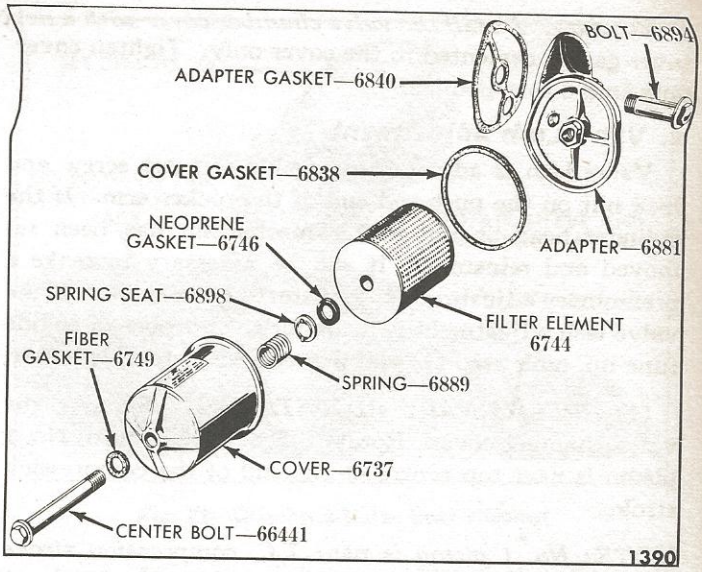


Fig. 28—Oil Filter—Disassembled

Tighten the oil line fitting in the pump to 10-12 foot-pounds.

b. Oil Filter.

The full-flow type oil filter purifies the entire output of the pump before the oil enters the lubrication system of the engine. A built in by-pass provides oil to the system in case the filter element becomes clogged. The by-pass is located in the hollow centre bolt and consists of a spring loaded valve. When the element is clean and oil will flow through it, the pressure difference between the inner and outer faces of the valve is not great enough to overcome the spring pressure behind the valve. When the element is dirty and will not permit a sufficient flow of oil, the pressure on the inner face of the valve drops, and the pressure difference between the valve faces is enough to cause the valve to open. Oil by-passes the element, maintaining a supply to the lubrication system.

(1) *REMOVAL.* Place a pan on the floor directly under the filter. Remove the filter centre bolt and remove the filter assembly and gasket from the adaptor.

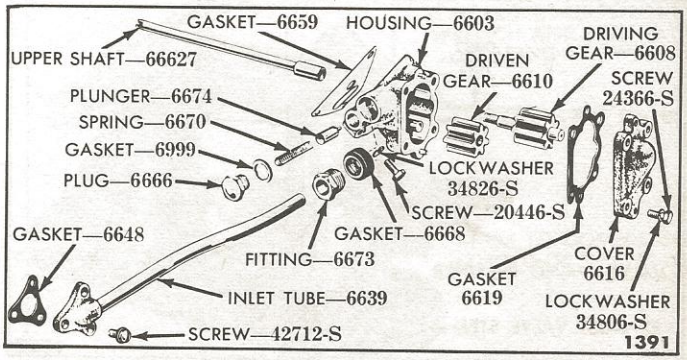


Fig. 29—Oil Pump—Disassembled

(2) *DISASSEMBLY.* Remove the filter element, neoprene gasket, spring and seat, and remove the centre bolt and fiber gasket from the cover. The oil filter is shown disassembled in fig. 28.

(3) *CLEANING.* Wash all parts in solvent and dry them thoroughly. Make sure all the openings in the centre bolt are clean.

(4) *ASSEMBLY.* Install a new fiber gasket on the centre bolt and place the bolt through the filter housing. Install the spring and spring seat assembly on the bolt, making sure the seat tangs are engaged in the spring. Install a new neoprene gasket and filter element over the centre bolt.

(5) *INSTALLATION.* Install a new gasket in the bracket recess. Place the filter assembly in position and thread the centre bolt into the adaptor finger tight. Rotate the filter assembly slightly in each direction to make sure the filter housing seats evenly on the gasket. Tighten the centre bolt to 20-25 foot-pounds.

NOTE: *Be sure to check the oil filter housing with the engine warmed up and operating at a fast idle so that no oil leaks past the housing gasket or around the centre bolt gasket.*

c. Oil Pump and Pressure Relief Valve.

A gear type pump is used to supply oil to the bearings of the engine. The oil pressure relief valve is mounted in the pump housing. The pump is driven by an intermediate shaft from the distributor drive gear.

(1) *REMOVAL.* Remove the pump inlet tube. Remove the three cap screws and lock washers securing the pump body to the block. Remove the pump and gasket and the intermediate shaft if it comes out with the pump.

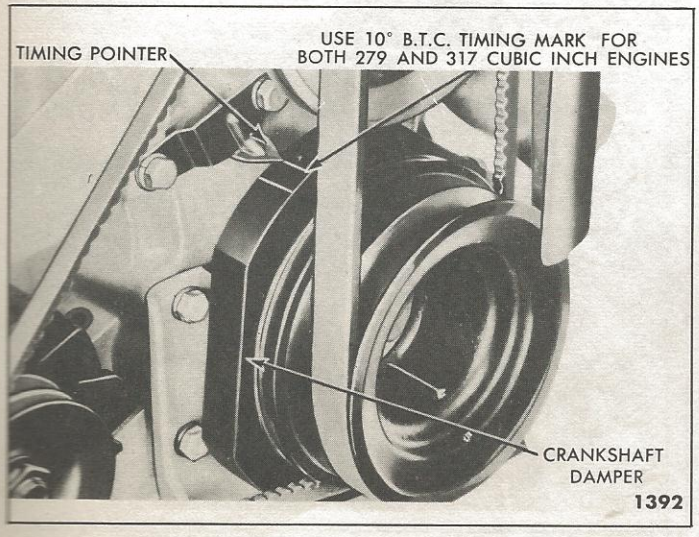


Fig. 30—Damper and Pulley

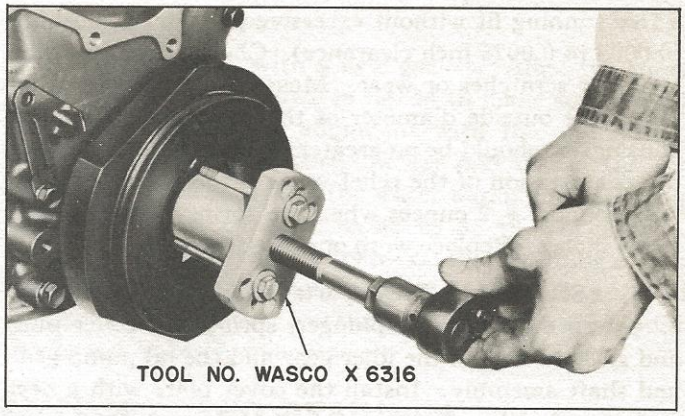


Fig. 31—Removing Damper

(2) *DISASSEMBLY.* Remove the four cap screws retaining the pump cover to the pump body. Remove the cover plate and gasket. Do not tap the pump drive shaft to drive the cover off the pump body. Remove the oil pump gear and shaft assembly and oil pump idler gear. Remove the oil pressure relief plug gasket, spring and plunger. A disassembled view of the oil pump is shown in fig. 29.

(3) *CLEANING.* Wash all parts in solvent and dry them thoroughly. Brush out the inside of the pump housing to make sure no dirt remains. Remove all old gasket material from the pump body.

(4) *INSPECTION.* Check the pump housing for cracks or excessive wear. The pump shaft should have

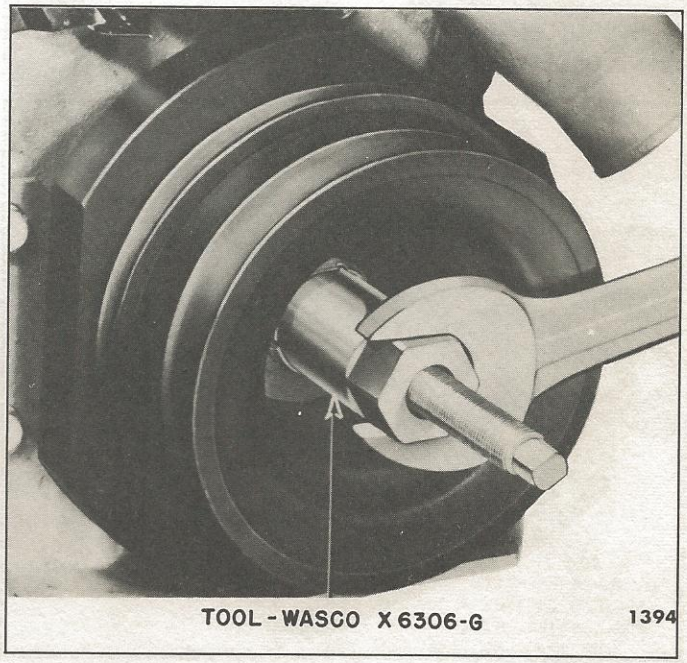


Fig. 32—Installing Damper

a free running fit without excessive play in the bushing (0.0005 to 0.0025 inch clearance). Check the pump gear teeth for scratches or wear. Measure the clearance between the outside diameter of the gears and the pump housing. It should be no greater than 0.005 inch. Check the compression of the relief valve spring. It should be 7.83 pounds $\pm$ 2 ounces when the spring is compressed to 1.4 inches. Replace worn or defective parts.

(5) *ASSEMBLY.* Oil all parts thoroughly. Install the oil pressure relief valve plunger, spring and cover plug and gasket. Install the idler gear and the oil pump gear and shaft assembly. Install the cover plate with a new gasket and tighten the cover plate screws to 8-10 foot-pounds.

(6) *INSTALLATION.* Insert the oil pump intermediate shaft in the cylinder block and rotate it slightly until it engages the distributor shaft. Note the position of the tang in the extension shaft and set the tang in the oil pump shaft so that it will engage with the slot. Place the pump housing in position on the block with a new gasket, install the three retaining screws, and tighten them to 15-20 foot-pounds.

CAUTION: *Do not use sealing compound on the gaskets. Do not attempt to force the pump in position if it will not seat against the block. The tang on the pump driving shaft may be out of alignment with the tang in the intermediate shaft. Realign the tang if necessary.*

6. CRANKSHAFT DAMPER

The engine is equipped with a damper and pulley (fig. 30) which is keyed to the crankshaft and retained with a capscrew and washer. Two threaded bolt holes are provided in the damper to facilitate its removal.

a. Removal.

Remove the radiator. Remove the generator and fan belts. Remove the retaining bolt and washer from the end of the crankshaft. Install the damper removing tool and pull the damper from the crankshaft (fig. 31).

b. Installation.

Lubricate the crankshaft with a white lead and oil mixture. Line up the damper keyway with the key in the crankshaft and start the damper on the shaft. Do not hammer the damper to start it on the shaft. Press the damper on the shaft as shown in fig. 32. Install the damper retaining bolt and washer and tighten the bolt to 55-60 foot-pounds. Install the generator and the fan belts and adjust the tension. Install the radiator.

7. CYLINDER FRONT COVER

The cylinder front cover is a one piece casting which contains the crankshaft front oil seal. The water pump is mounted in the front cover. The engine front support also is retained by the front cover retaining screws.

a. Removal.

Drain the crankcase and remove the oil pan. Support the front of the engine on a jack. Remove the engine front support nuts and raise the front of the engine enough so the front support bracket clears the front

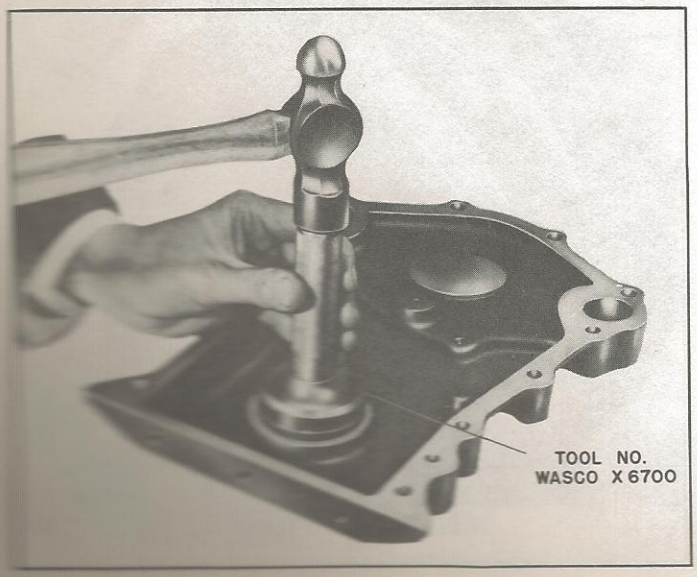


Fig. 33—Installing Oil Seal

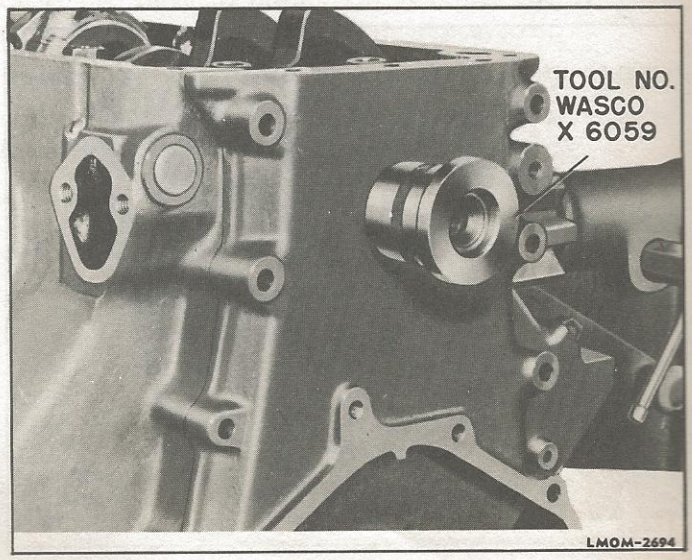


Fig. 34—Aligning Front Cover

mount bolts. Remove the screws retaining the front support bracket and the cover to the block. Remove the bracket, front cover, and gasket.

b. Front Oil Seal Replacement.

Drive out the old seal with a pin punch. Clean the seal recess thoroughly. Coat a new seal with grease and install the seal with the tool shown in fig. 33, driving it into the recess until it bottoms. Check the seal spring after the seal has been installed to be sure it is in the proper position in the seal.

c. Installation.

Install the cover with a new gasket. Align the front cover with the tool shown in fig. 34 to make sure the oil seal will be in proper alignment with the crankshaft. Position the front support bracket and install the six lower cover bolts. Install the water pump and retaining bolts. Tighten all cover bolts to 35-40 foot-pounds. Install the crankshaft damper. Lower the front of the engine and install the front support nuts. Install the oil pan with a new gasket. Fill the crankcase with the proper grade and quantity of engine oil.

8. CAMSHAFT SPROCKET, CAMSHAFT, AND BEARINGS

The camshaft is driven by means of a timing chain connecting the camshaft sprocket to the crankshaft sprocket. The camshaft and related parts are shown in fig. 35.

a. Camshaft Sprocket and Timing Chain.

The camshaft sprocket is bolted to the camshaft. It can be placed on the shaft in only one position since the bolt holes are unequally spaced.

(1) *INSPECTION.* Check the wear on the timing chain by taking up the slack on the driving side of the chain and then measuring the outward deflection of the slack side of the chain (fig. 36). Total outward deflection should not exceed ½ inch.

Replace a camshaft sprocket with broken or chipped teeth. If the timing chain slack is excessive, replace the sprockets and timing chain.

(2) *REMOVAL.* Remove the damper and cylinder front cover. Align the timing marks as shown in fig. 37. Bend down the retaining tabs on the lockplate and remove the three cap screws retaining the sprocket to the camshaft. Slide the sprocket off the camshaft and remove the chain and sprocket.

(3) *INSTALLATION.* Be sure the notch on the camshaft hub is aligned with the timing mark on the crankshaft sprocket as shown in fig. 38. Place the camshaft sprocket in the timing chain and place the chain over the crankshaft sprocket with the timing mark on the crankshaft sprocket and the timing mark on the camshaft sprocket aligned as shown in fig. 37.

Install a new lock plate and the three cap screws and tighten the cap screws to 15-18 foot-pounds. Bend the tabs on the lock plate against the screw heads. Install the cylinder front cover and the damper.

b. Camshaft.

The camshaft is supported by five insert type bearings in the cylinder block. End thrust of the camshaft is controlled by oil pressure against the end of a thrust piston in the forward end of the camshaft (fig. 39). The piston bears against a boss on the inside of the front cover.

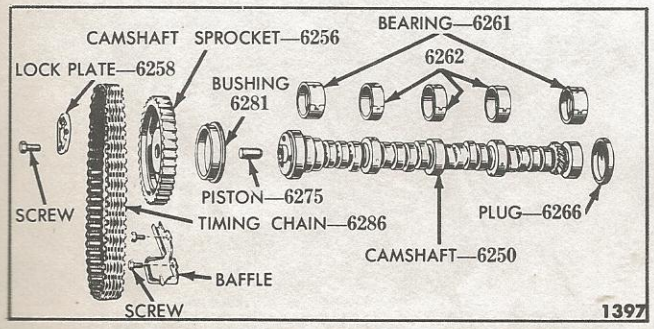


Fig. 35—Camshaft and Related Parts

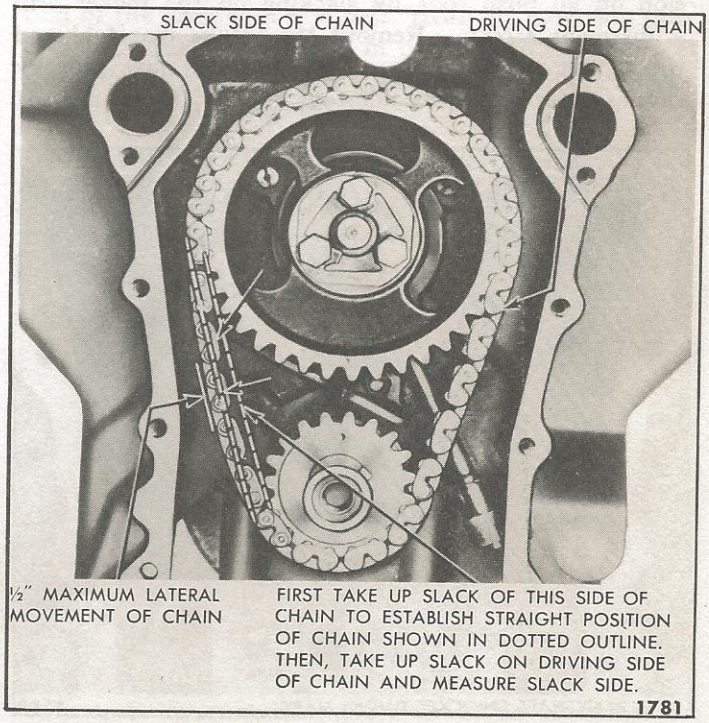


Fig. 36—Checking Timing Chain Deflection

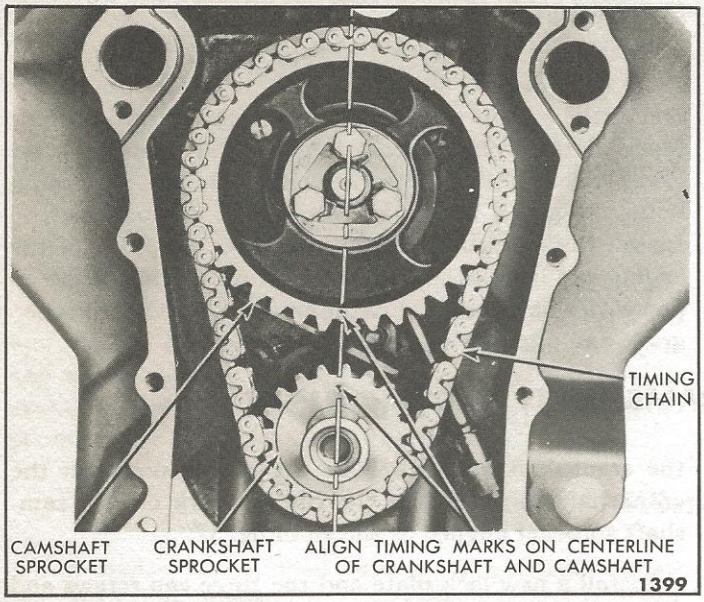


Fig. 37—Aligning Camshaft Sprocket

It will be necessary to replace the camshaft when the lobes are worn to such an extent that the valve lift is less than 0.338 inch (intake and exhaust). Check valve lift with a dial indicator as shown in fig. 40. Valve lash should be zero during this check.

(1) *REMOVAL.* Remove the crankshaft damper and cylinder front cover. Remove the timing sprocket and chain. Remove the fuel pump. Remove the distributor. Remove the valve chamber covers and release the tension on all push rods by slacking off the rocker arm adjustment screws. Remove the intake manifold and the tappet chamber cover. Remove the push rods by sliding the rocker arms sideways against the springs. It

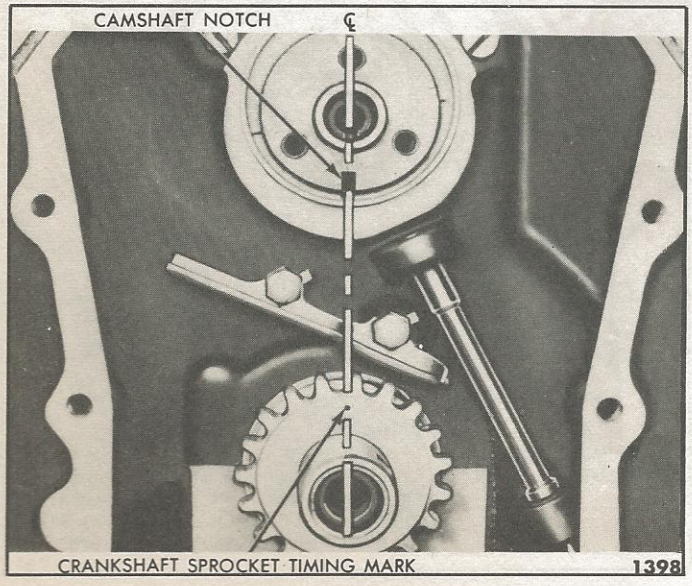


Fig. 38—Aligning Camshaft Notch

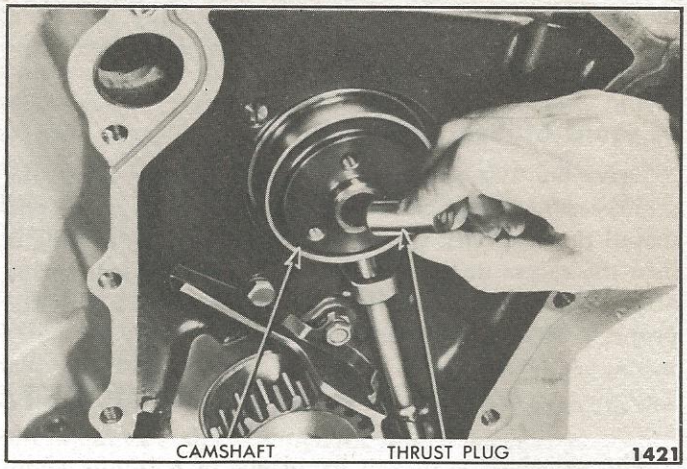


Fig. 39—Camshaft Thrust Plunger

will be necessary to remove the cotter pins and washers at each end of the rocker mechanism to move the end rocker arms far enough to pull the end push rods out. Remove the tappets. Keep the push rods and tappets in order so they can be replaced in their original position. Remove the fuel pump push rod, the camshaft thrust plunger and the eccentric collar. Carefully slide the camshaft out of the block. Be careful that the cam lobes do not gouge the bearing surfaces.

(2) *INSPECTION.* Check the journals for scratches or grooves. Measure the journals for wear and out of round. Replace the camshaft if the journals are more than 0.001 inch out of round or less than 1.924 inches in diameter. Measure the camshaft front bearing. The difference between the bearing and journal (amount of clearance) should be not more than 0.005 inch for a used camshaft and bearings. If the front journal to bearing clearance is excessive, it can be assumed that all bearings are worn and need replacement.

(3) *INSTALLATION.* Slide the camshaft carefully in through the bearings. Oil the tappets and slide them into place. Install the push rods. Install the eccentric collar (with the shoulder out, if the collar is equipped

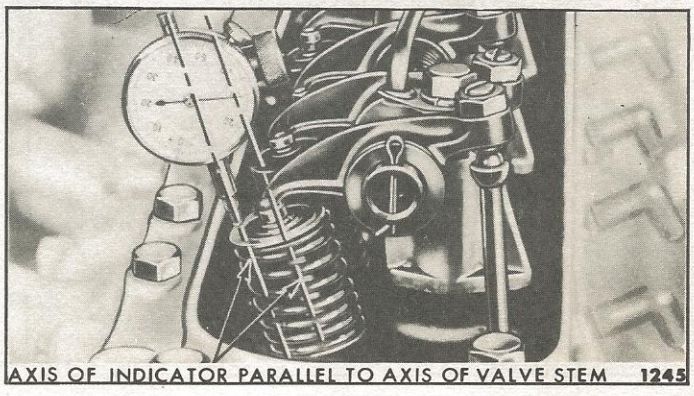


Fig. 40—Checking Valve Lift

with a shoulder). Install the fuel pump push rod. Install the sprocket making sure the camshaft, sprocket, and the timing chain are properly aligned with the crankshaft sprocket. Install the camshaft thrust plunger with the rounded end out. Install the cylinder front cover and the crankshaft damper. Adjust the valve lash. Install the valve chamber covers. Install the tappet chamber cover. Install the intake manifold. Install the fuel pump. Install the distributor and adjust the initial timing.

c. Camshaft Bearing Replacement.

Remove the engine and mount it on a work stand. Remove the flywheel, crankshaft, and the camshaft.

(1) *REMOVAL.* Remove the plug at the camshaft rear bearing bore by drilling a ½ inch hole through the plug and pulling it with a pilot bearing remover. Use the bearing replacement tool shown in fig. 41 to pull the bearings out of the cylinder block. A special adapter is used with the tool to pull the bearings through the block bore.

(2) *INSTALLATION.* The same tool shown in fig. 41 is used to install the bearings. A bearing adapter with a larger flange is used to pull the bearing in the end of the cylinder block. Be sure to align the oil holes in the camshaft bearings with the oiling holes in the cylinder block when the bearings are installed. After all the bearings are installed, install the camshaft rear bearing bore plug as shown in fig. 42. Coat the new plug with water resistant sealer before installing it. Install the camshaft, the crankshaft, and the flywheel. Install the engine.

9. FLYWHEEL, CRANKSHAFT, AND BEARINGS

The crankshaft is supported by five main bearings. The centre bearing controls end thrust in the crankshaft. The crankshaft has drilled passages to provide pressure lubrication to the connecting rod bearings. The crankshaft and related parts are shown in fig. 43.

a. Flywheel.

The flywheel is piloted on a shoulder and is retained on the crankshaft flange by six bolts. The flywheel can only be bolted on in one position because the bolt holes are not equally spaced.

(1) *INSPECTION.* Check flywheel runout with the dial indicator as shown in fig. 44. The runout should not exceed 0.005 inch. If the runout is in excess of this figure it will be necessary to remove the flywheel and check the mounting surfaces for nicks or dirt. Remount the flywheel and torque all screws evenly to 75-85 foot-pounds. Recheck the runout. If the runout is still excessive, machine the flywheel face to true it.

(2) *REMOVAL.* Remove the engine and mount it on a work stand. Remove the clutch housing and clutch pressure plate assembly. Remove the starter motor. Remove the six cap screws retaining the flywheel to the crankshaft flange and pull the flywheel from the crankshaft.

(3) *RING GEAR REPLACEMENT.* Drill a hole nearly through the ring gear and cut the remaining portion of the gear with a chisel. Heat the new ring gear evenly to 360° F., place it in position on the flywheel and allow it to cool. The ring gear runout should not exceed 0.010 inch (fig. 45).

(4) *INSTALLATION.* Line up the holes in the flywheel with the tapped holes in the crankshaft flange.

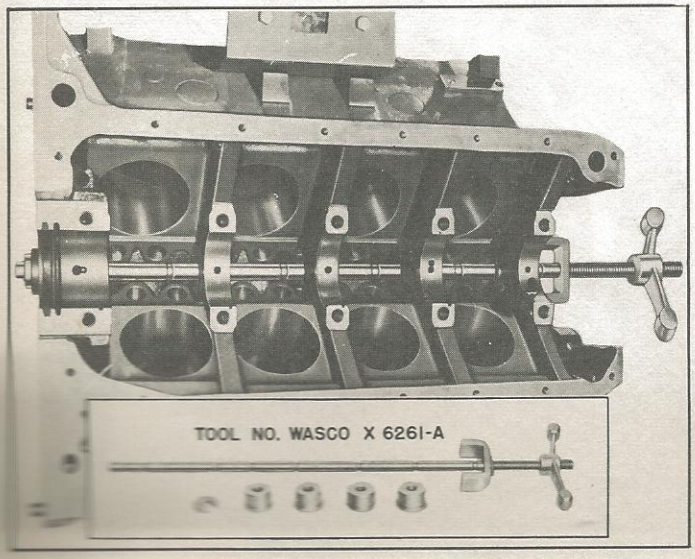


Fig. 41—Removing or Replacing Cam Bearings

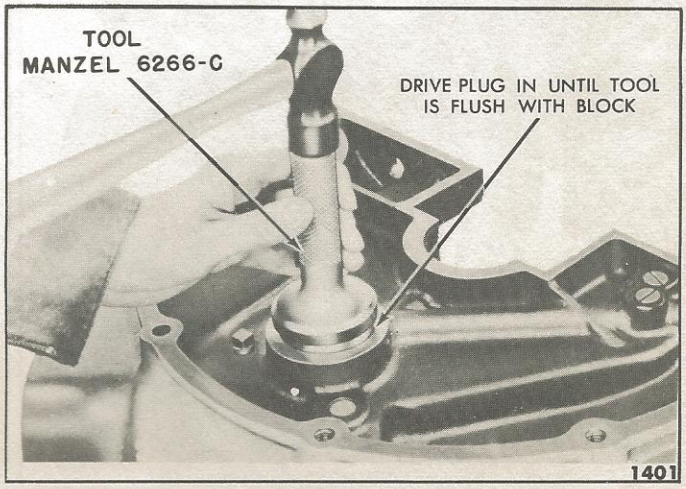


Fig. 42—Installing Camshaft Rear Bearing Bore Plug

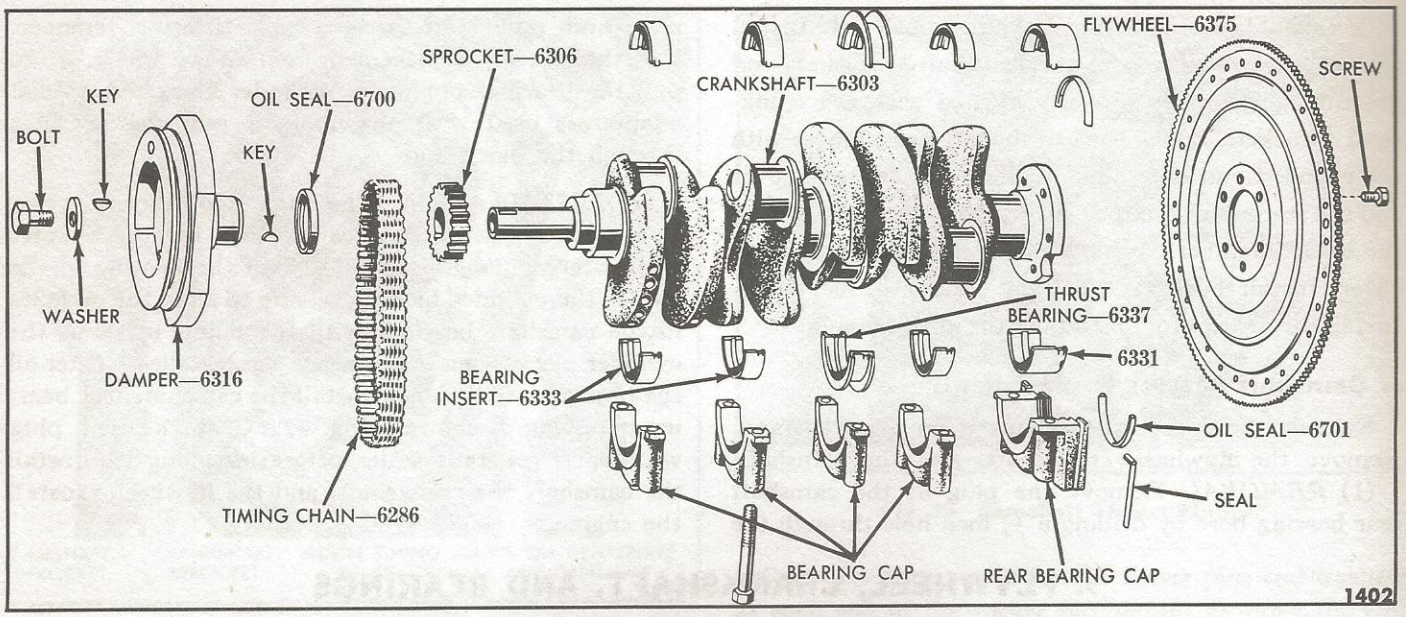


Fig. 43—Crankshaft and Related Parts

Start the flywheel on the flange and install the six bolts. Pull the flywheel up with two bolts diametrically opposite. Tighten all bolts to 75-85 foot-pounds. Align the clutch disc and install the clutch pressure plate and the clutch housing. Install the engine.

b. Crankshaft.

The crankshaft is made of cast nodular iron with intergral counterweights and is statically and dynamically balanced. No sludge pockets are used in the new crankshaft. The full flow oil filter eliminates the need for sludge pockets.

(1) *REMOVAL.* Remove the engine from the vehicle and mount it on an engine workstand. Drain the oil. Remove the crankshaft damper and engine front cover. Remove the spark plugs. Remove the timing chain. Remove the clutch housing, clutch pressure plate assembly, and flywheel. Remove the oil pan. Remove the connecting rod bearing caps and push the piston and rod assemblies up against the head. Remove the main bearing bolts and bearing caps, and lift the crankshaft out of the cylinder block. Do not damage the thrust bearing surfaces. Mark all parts so they can be installed in their original position.

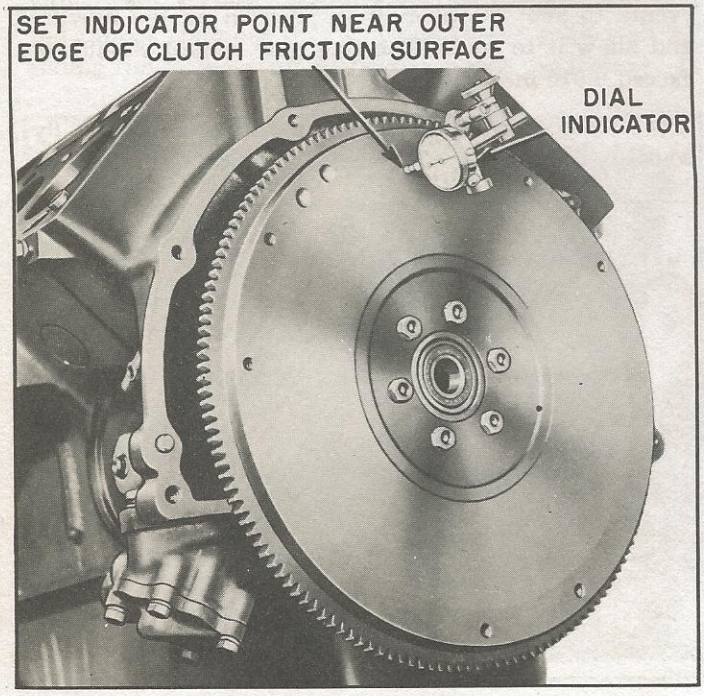


Fig. 44—Check Flywheel Runout

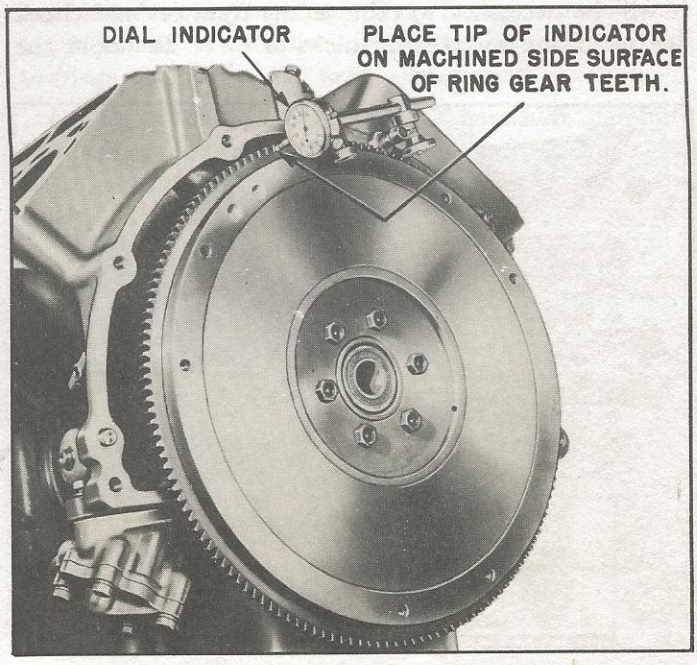


Fig. 45—Checking Ring Gear Runout

(2) *INSPECTION.* Examine the shaft for cracks. Grooved or scored bearing or crankpin journals will cause bearing failure. Regrind the journals to the next undersize if they are grooved. Light scratches on the journals can be removed with a hone and polished with No. 320 grit polishing paper.

(3) *MEASURING JOURNALS.* Measure each journal at a minimum of four places to determine size, out of round, and taper. Journals that are out of round more than 0.0015 inch or have more than 0.001 inch taper should be reground.

(4) *REGRINDING CRANKSHAFT.* If it is necessary to regrind the crankshaft, select the next undersize bearing and regrind the journal to obtain 0.0005 to 0.0021 inch clearance between the shaft and bearings. If it is necessary to regrind the journal more than 0.030 inch, discard the crankshaft.

(5) *INSTALLATION.* Be sure that all bearings and crankshaft journals are clean. Apply a light coat of engine oil to the crankshaft journals and the bearing inserts. Carefully lay the crankshaft in the bearings. Do not damage the thrust bearing surfaces. Install the main bearing caps with the bolts finger tight. Pry the crankshaft forward to align the thrust bearing faces. Tighten the bolts to 120-130 foot-pounds.

NOTE: *Be sure to use the procedure under Par. "c Main Bearings" when replacing the rear main bearing.*

Install the timing chain, cylinder front cover, and the crankshaft damper. Install the oil pan with a new gasket.

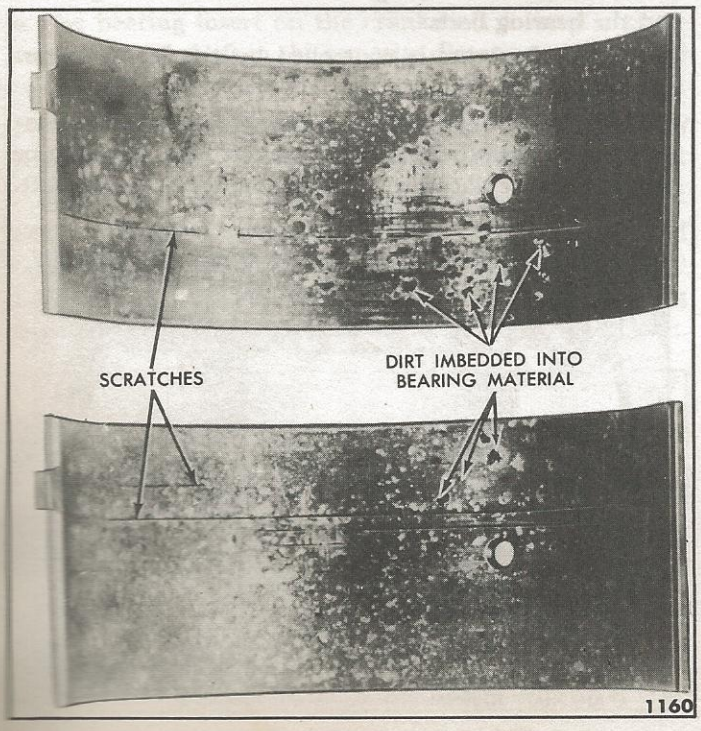


Fig. 46—Bearing Scratched by Dirt

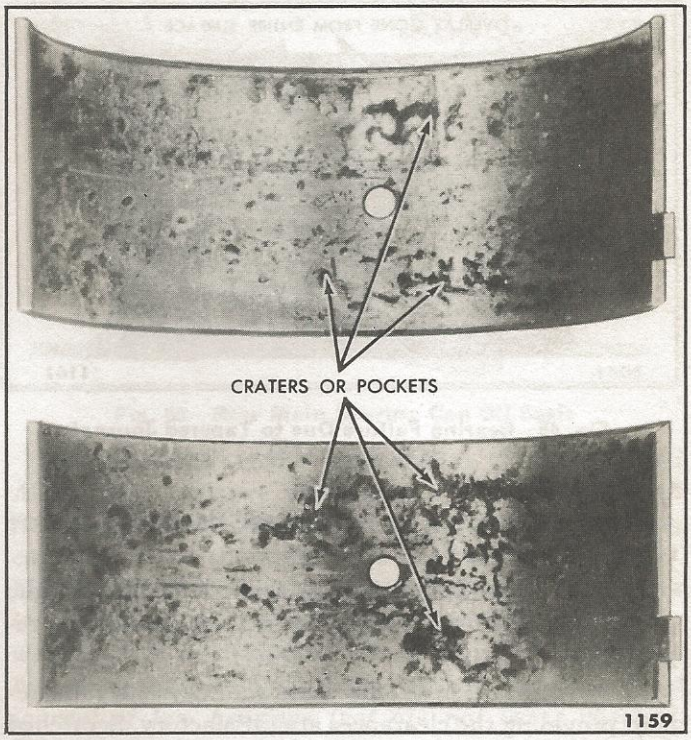


Fig. 47—Fatigue Failure of Bearing

Install the flywheel, align the clutch disc, and install the clutch pressure plate assembly, and the clutch housing. Pull the piston and connecting rod assemblies against the crankshaft and install the bearing inserts and caps. Install the spark plugs. Install the engine in the vehicle. Fill the crankcase with the proper grade and amount of oil.

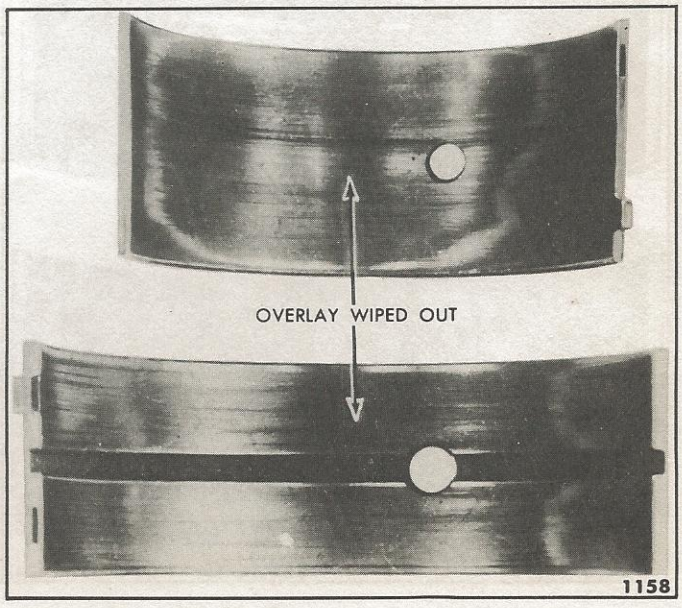


Fig. 48—Bearing Failure Due to Lack of Oil

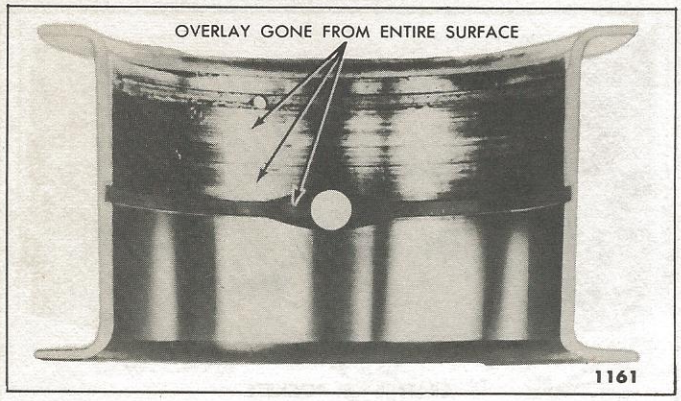


Fig. 49—Bearing Failure Due to Tapered Journal

c. Main Bearings.

The main bearings are copper-lead steel backed insert type.

Main bearing inserts that are scratched, show fatigue pockets, or have the overlay wiped out, should be replaced.

A bearing that has only light scratches may be reused providing the clearances are satisfactory. Scratched bearings are shown in fig. 46. Fatigue failure can be recognized by the breaking away of the bearing overlay material (fig. 47). Figure 48 shows two bearings with the overlay wiped out.

NOTE: *Any engine that has experienced rod or piston failure must have all the oil passages thoroughly cleaned before rebuilding the engine.*



Fig. 50—Bearing Showing Radius Ride

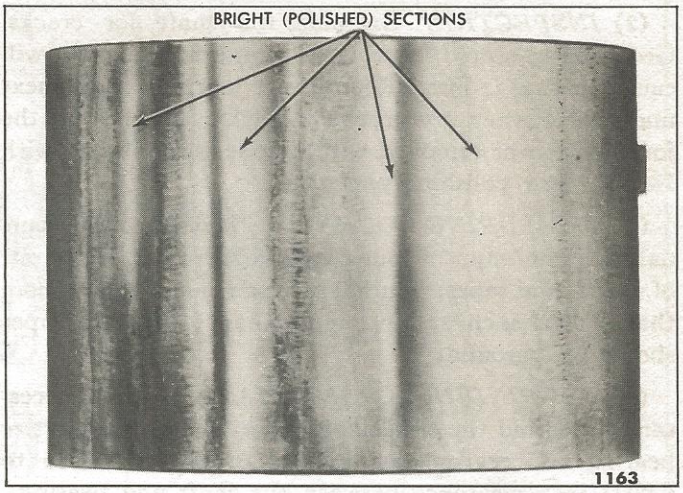


Fig. 51—Bearing Showing Bright Spots Due to Improper Seating

A bearing showing signs of excessive wear on one side of the bearing half (fig. 49) indicates a tapered bearing journal. The journal should be reground to the next undersize to remove the taper and undersize bearings fitted. Similarly, bearings showing excessive wear at the centre or end of the bearing around the circumference (fig. 50) indicate high spots on the bearing journal which should be corrected before the engine is rebuilt.

Bearing that shows bright sections across the back of the bearing (fig. 51) indicates that the bearings have been loose in the bore either because of an undersize outside diameter or because of the bearing bore being too large. Bearings showing bright spots on the bearing surface indicate dirt lodged between the bearing insert and the bearing bore.

Crankshaft thrust is controlled by the No. 3 (intermediate) bearing flanges.

If the crankshaft has been removed, the bearing inserts can be easily replaced. However the inserts can be removed and replaced without removing the crankshaft.

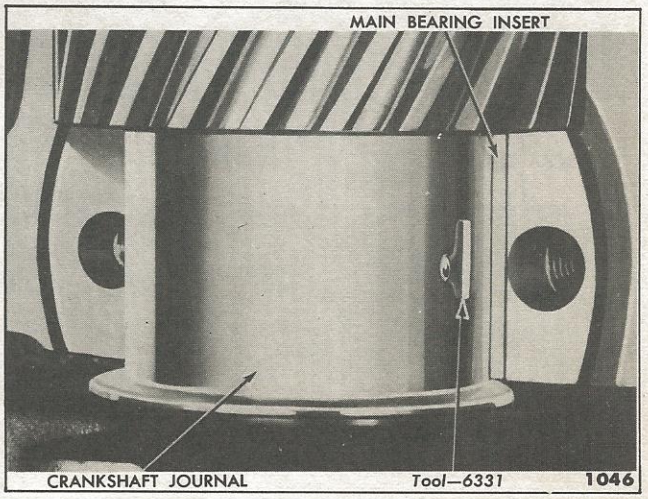


Fig. 52—Removing Main Bearing Insert

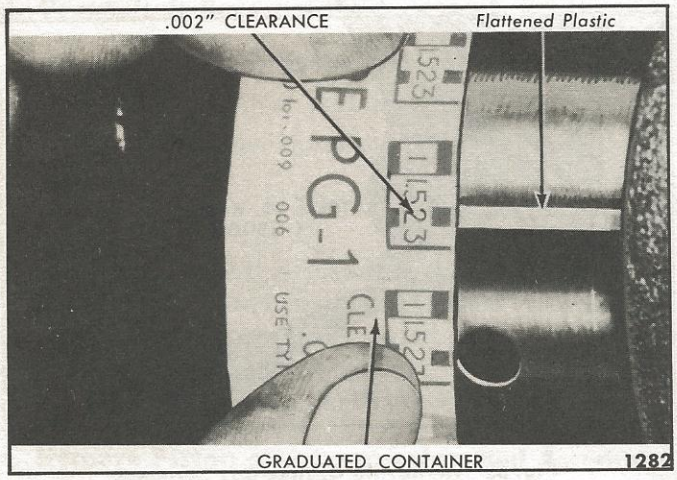


Fig. 53—Measuring Flattened Plastigage

NOTE: *Special care must be taken when installing the rear main bearing cap to prevent oil leakage past the two sets of seals. Use the procedure presented under "(4) Replacing Rear Oil Seals" when the cap is installed.*

The bearings can be replaced when the crankshaft is removed or they can be replaced without removing the crankshaft as described under "(1) Replacement Without Removing Crankshaft," below.

(1) *REPLACEMENT WITHOUT REMOVING CRANKSHAFT.* When using this procedure replace one bearing at a time leaving the other bearings securely fastened. Remove the bearing cap and the insert. Install the bearing removing tool as shown in fig. 52. Rotate the crankshaft to slide the bearing out of the block. Install a new bearing insert on the crankshaft journal and rotate the crankshaft in the opposite direction to that used for removal to replace the insert.

NOTE: *Be sure the notch end of the bearing is placed correctly so that it will seat when rotated into position.*

Install the new bearing insert in the cap, oil the crankshaft journal with engine oil and install the cap and insert. Tighten the main bearing cap bolts to 120-130 foot-pounds. Repeat the procedure for the remaining bearings if they need replacement. Install the oil pan.

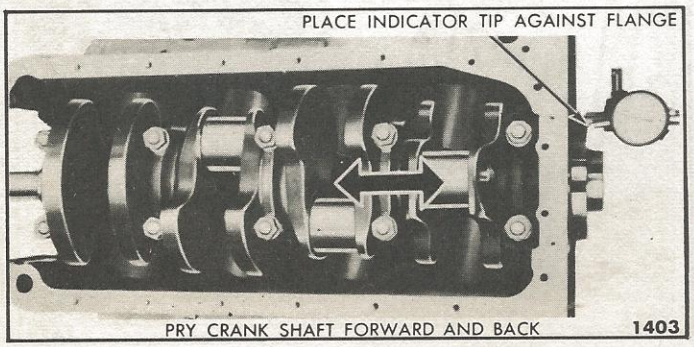


Fig. 54—Checking Crankshaft End Thrust

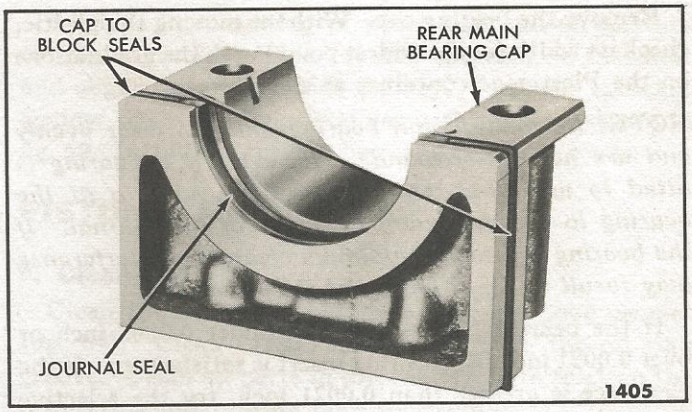


Fig. 55—Rear Main Bearing Cap Oil Seals

(2) *FITTING MAIN BEARINGS (PLASTIGAGE METHOD).* Remove the bearing cap and wipe the oil from the bearing and journal. Keep the other bearing caps tight while checking the fit of a bearing.

NOTE: *If the bearing fit is checked while the engine is in the vehicle, it will be necessary to support the weight of the crankshaft. The shaft can be supported by placing a thin rubber pad between the cap insert and journal of two bearings that are not being checked. Tighten these bearing caps enough to hold the crankshaft up against the block half of the main bearing inserts.*

Place a piece of Plastigage the full width of the bearing on the bearing insert (or in the bearing cap.)

Install the bearing cap and torque the retaining bolts to 120-130 foot-pounds.

CAUTION: *Do not turn the crankshaft while the Plastigage is between the bearing and the journal.*

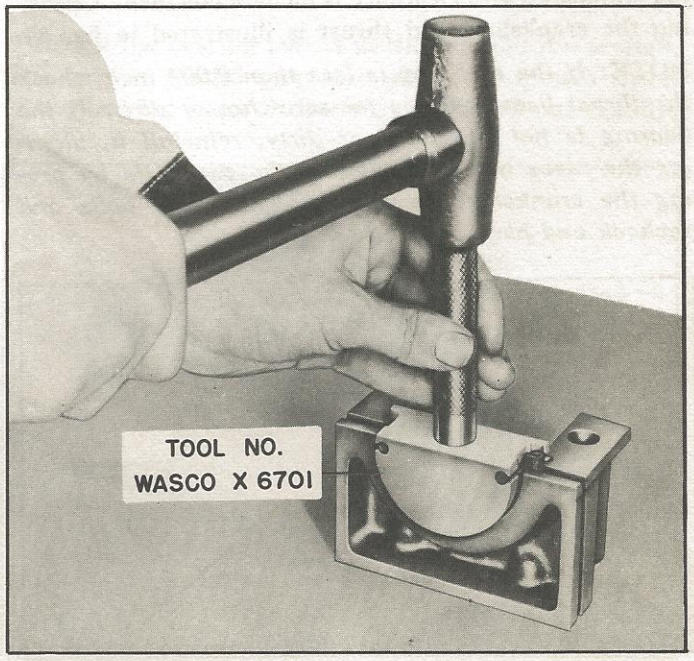


Fig. 56—Form and Cut Oil Seal

Remove the bearing cap. Without moving the plastic, check its width (at the widest point) with the graduations on the Plastigage container as shown in fig. 53.

NOTE: *Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is fitted to an out-of-round journal, be sure to fit the bearing to the maximum diameter of the journal. If the bearing is fitted to minimum clearance, interference may result in rapid failure of the bearing.*

If the bearing clearance is not under 0.0005 inch or over 0.0021 inch, the bearing insert is satisfactory. If the clearance is greater than 0.0021 inch, try the selective fit standard bearing to bring the clearance within the 0.0005-0.0021 inch limit. If the selective fit bearings do not bring the clearance within limits, it will be necessary to regrind the crankshaft journals for use with the next undersize bearing.

NOTE: *If the flattened plastic is not uniform in width from end to end, the journal or bearing is probably tapered. Be sure to check the journal with micrometers if the flattened plastic indicates more than 0.001 inch taper.*

(3) *CHECKING CRANKSHAFT END THRUST.* To check the crankshaft end play, push the crankshaft toward the rear of the engine. Place a dial indicator against the crankshaft flange, keeping the indicator axis parallel to the crankshaft axis. Set the dial to zero, pry the shaft forward, and read the indicator.

If the dial indicator shows more than 0.008 inch end play, the main thrust bearing insert should be replaced with a new insert to take up the thrust. The manufacturing crankshaft end clearance is 0.004-0.008 inch. Checking the crankshaft end thrust is illustrated in fig. 54.

NOTE: *If the end play is less than 0.004 inch, check the thrust bearing faces for scratches or dirt. If the bearing is not scratched or dirty, reinstall it, aligning the faces before tightening the cap bolts by prying the crankshaft forward. Tighten cap bolts and recheck end play.*

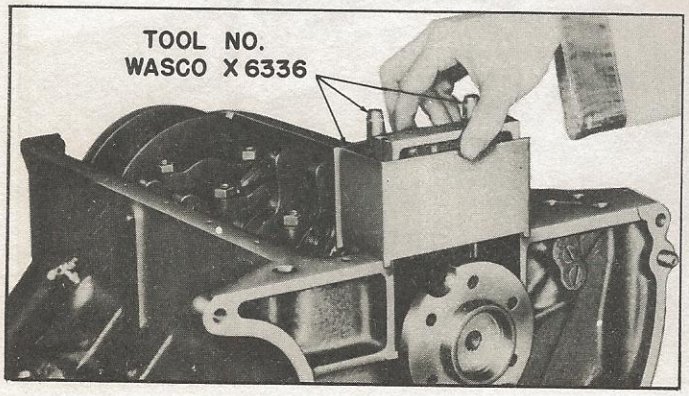


Fig. 57—Install Bearing Cap

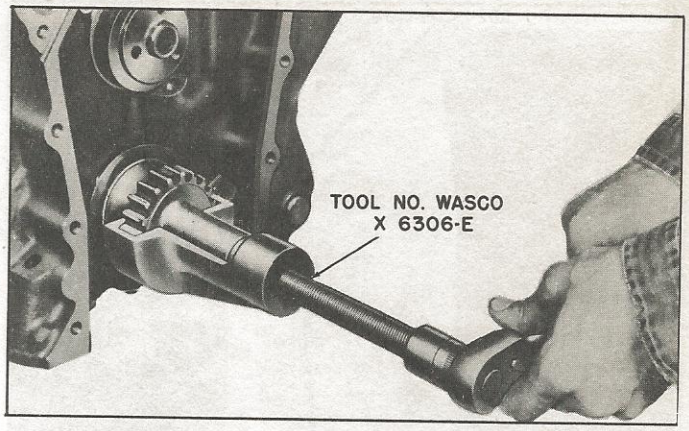


Fig. 58—Removing Crankshaft Sprocket

(4) *REPLACING REAR MAIN BEARING OIL SEALS.* Remove the crankshaft. Remove the bearing insert from the rear bearing cap and block. The rear main bearing cap oil seals are shown in fig. 55. Remove the old sealing material and clean the seal grooves in the bearing cap and the cylinder block bearing bore. Install new journal seals in the cap as shown in fig. 56 and cut the seals to the proper length. Use the same tool to form and cut the seal in the cylinder block bearing bore.

Install the bearing cap to block seals and press them into the groove. Lubricate the seals with grease to reduce friction. Install the crankshaft and insert the bearing cap guide studs into the cap bolt holes in the block. Install the bearing inserts. Install the bearing cap with the tool shown in fig. 57.

NOTE: *Be sure to press the bearing all the way home to insure proper sealing of the bearing cap to cylinder block seals.*

Install the bearing cap bolts. Cut off the cap to block seals allowing approximately 0.080 inch to project below the oil pan gasket surface of the block. Install the engine.

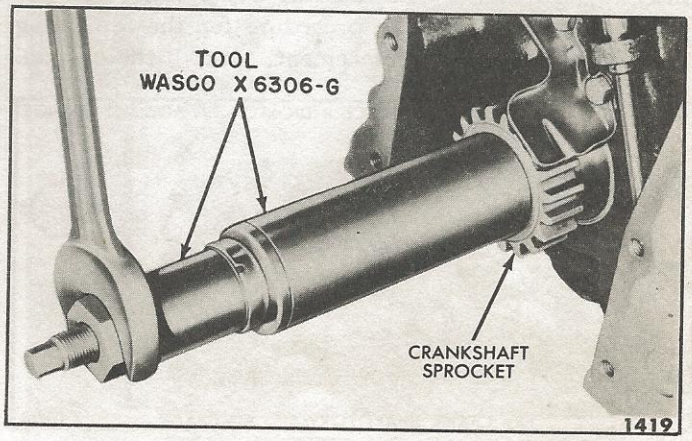


Fig. 59—Installing Crankshaft Sprocket

d. Crankshaft Sprocket Replacement.

If it is necessary to remove the crankshaft sprocket, remove the front cover and timing chain. Pull the sprocket with the tool shown in fig. 58.

Apply a light coating of white lead and oil mixture to the crankshaft. Slide the new sprocket on the shaft and align the keyway with the key. Press the sprocket against the crankshaft shoulder with the tool shown in fig. 59. Install the timing chain and the front cover.

10. CONNECTING RODS, PISTONS, AND RINGS

Four ring, slipper type pistons are used in this engine. The two oil rings are installed in a single groove in the piston. The pistons are the autothermic cam ground type in which the expansion is controlled to prevent loose piston fitting when the engine is cold.

a. Remove Piston and Connecting Rod Assembly.

Remove the oil pan. Remove the cylinder heads. Before removing the piston assemblies check for a ridge at the top of the cylinder bore formed by piston ring wear. If a ridge is present it will be necessary to remove it with a ridge cutter shown in fig. 60, to prevent piston ring breakage and groove damage. Clean carbon from the piston and cylinder bore before removing pistons.

Remove the connecting rod pal nuts and the connecting rod nuts. Pull the cap off the rod and push the connecting rod and piston assembly up through the cylinder bore.

b. Disassembly.

Remove the piston rings with the tool shown in fig. 61. Remove the piston pin retaining clips and push the pin out of the piston and rod. If the piston assembly has been in long use and the pin has become "varnished" it may be necessary to drive the pin out with the tool shown in fig. 62. A disassembled view of the piston and connecting rod is shown in fig. 63.

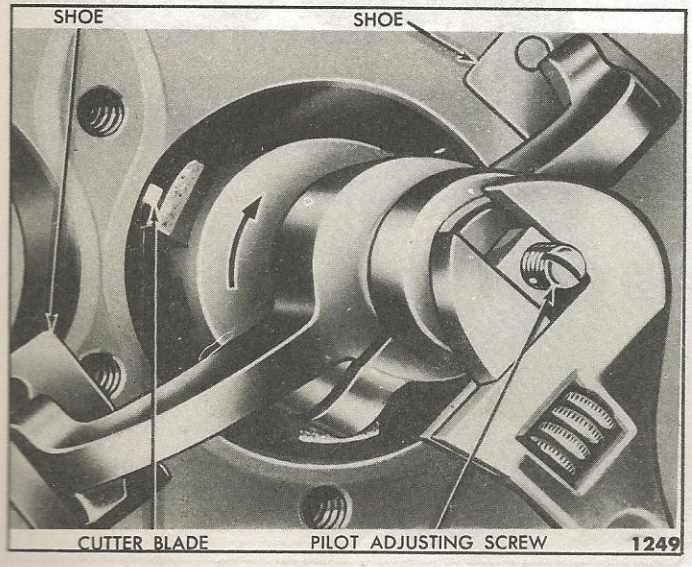


Fig. 60—Removing Cylinder Ridge (Typical)

c. Cleaning.

Clean the piston ring grooves with a groove cleaner (fig. 64). Clean carbon and sludge from the oil ring groove. Clean all parts in solvent. Be sure to clean the connecting rod bearing bore thoroughly.

d. Inspection of Piston and Connecting Rod Assemblies.

Connecting rods with deep nicks, signs of fractures, scored bore, or bore out of round more than 0.002 inch should be replaced.

Use a new piston pin to check the piston pin bushing in the connecting rod for wear. The pin should have a 0.0002 inch to 0.0004 inch clearance in the rod bushing. If the new pin falls through the bore by its own weight, replace the connecting rod or install an oversize piston pin.

Connecting rods with twists or bends should be realigned. Check every connecting rod assembly for alignment on a fixture after fitting the piston pins (fig. 65).

(1) *CONNECTING ROD BEARINGS.* Replace bearing inserts that are scored, have the overlay wiped out, show fatigue failure, or are badly scratched (fig. 46 through 51).

Install the bearing inserts in the cap and rod section. The bearing should snap into place and remain there. If the bearing slides in freely and will fall out readily,

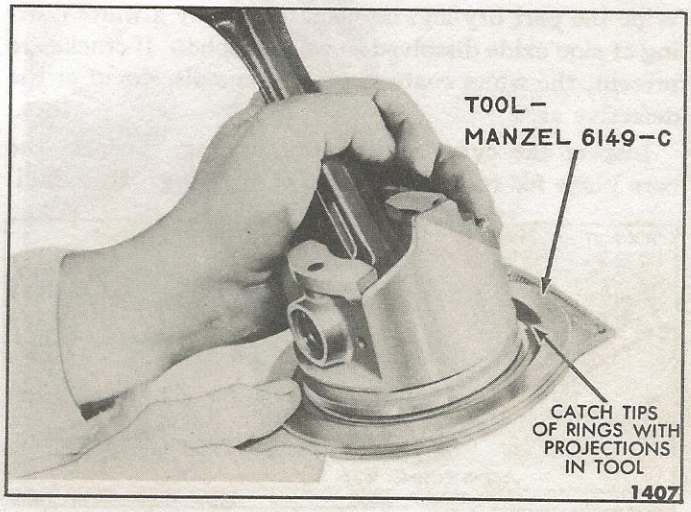


Fig. 61—Removing Rings

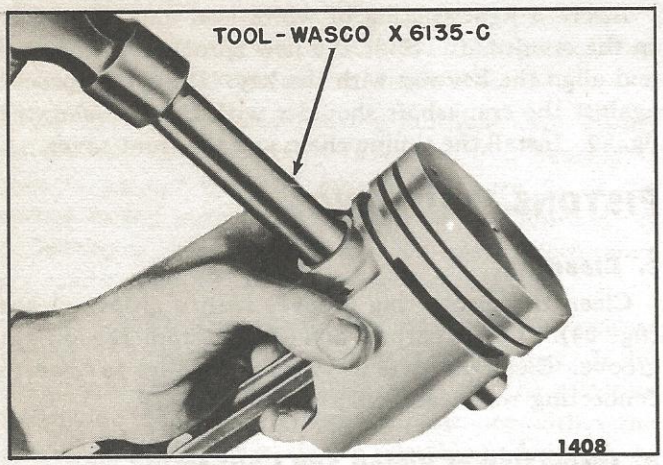


Fig. 62—Removing Piston Pin

the bearing has lost its spread and should be replaced. Check the inside edge of the bearing at the parting line for sharp burrs. Remove the burrs if any are apparent. The parting edges of the bearings should be free of dirt or other foreign particles.

(2) *PISTONS.* Inspect pistons for fractures at the ring lands, skirt and pin bosses. Replace pistons showing signs of wavy ring lands, fractures, or damage from detonation. Spongy eroded areas near the edge of the piston top are caused by detonation. In some instances holes are also burned through the piston top. Replace any pistons that show excessive skirt clearance or ring groove wear.

(3) *PISTON PINS.* Replace piston pins showing signs of fractures or etching. Piston pins that show wear or fit loose in the piston or rod bushing should be replaced. Replace all piston pin retainers.

(4) *CYLINDER BLOCK.* Make a thorough check for cracks. Minute cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light motor oil. Wipe the part dry and immediately apply a white coating of zinc oxide dissolved in wood alcohol. If cracks are present, the white coating will become discolored at the defective area.

Inspect the cylinder bores for scoring. Inspect the core plugs for rust at the edge of the plug. Rust indicates leakage. If leakage is indicated, remove the plug by drilling a ½ inch hole through it and using the pilot bearing remover to pull it out. Replace with a new plug. Always use a sealer when installing new plugs or leakage may result.

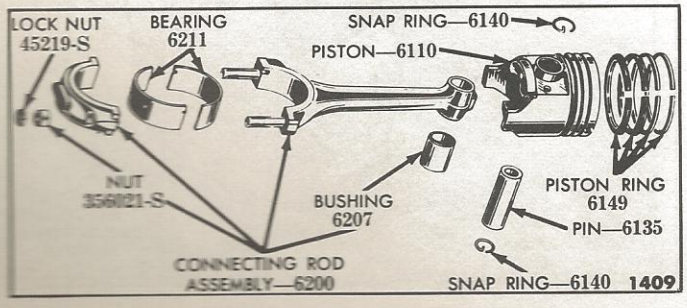


Fig. 63—Piston and Connecting Rod—Disassembled

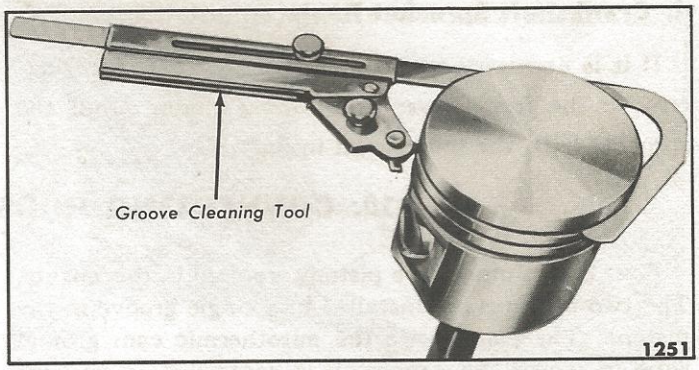


Fig. 64—Cleaning Ring Grooves

Check the cylinder bore for taper, out of round, and wear. Use a cylinder bore gauge, telescope gauge, or inside micrometers. Only experienced personnel should be permitted to take these measurements.



Fig. 65—Check Connecting Rod Alignment

Record measurements taken lengthwise and crosswise at the top and bottom of the ring travel in the bore as follows:

Lengthwise of the block, measure and record as "A" the diameter of the cylinder at the top of the cylinder where the greatest ring wear occurs. Also lengthwise of the block, measure and record as "B" the cylinder diameter at the bottom of the piston skirt travel.

Crosswise of the block, measure and record as "C" the diameter at the top of the cylinder at the greatest wear point. Measure and record as "D" the diameter at the bottom of cylinder bore, also crosswise of the block.

Reading "A" compared to reading "B" and reading "C" compared to reading "D" indicates cylinder taper. If the taper is greater than 0.015 inch the cylinder must be rebored and honed for the next oversize piston.

Reading "A" compared to reading "C" and reading "B" compared to reading "D" indicates whether or not the cylinder is out of round. If the out of round exceeds 0.003 inch, the cylinders must be rebored and honed for the next oversize pistons.

Measuring the cylinder bore with a telescope gauge is illustrated in fig. 66.

e. Fitting Pistons.

Proper assembly tolerances of pistons are required if satisfactory engine operation is to be obtained. Cylinder bores must be checked for taper and out of round condition before fitting a piston.

Before installing a piston and new rings in a used block, remove the high polish on the cylinder wall to aid ring seating by passing a cylinder bore glaze remover through the cylinder bore a few times. Make sure that oiled rags are placed to catch the hone dust and that the cylinder bore and crankcase are thoroughly cleaned before installing the piston.

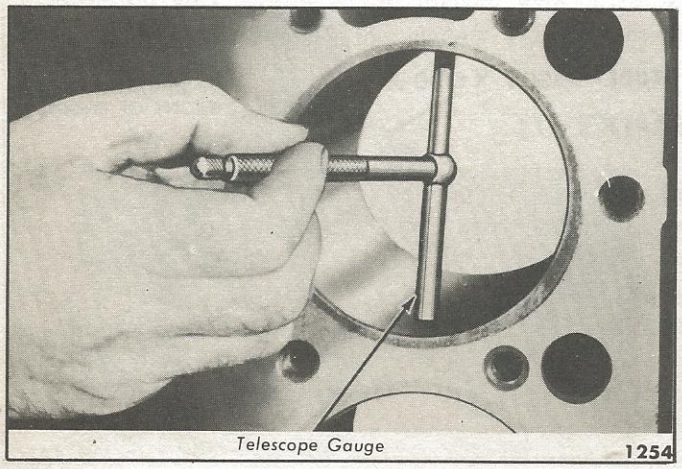


Fig. 66—Measuring Cylinder Bore (Typical)

Table 1—Piston Fitting Specifications

Fit New Piston In New Bore		Fit New Piston In Used Bore		Fit Used Piston In Used Bore	
Gauge Thickness (Inches)	Pounds Pull	Gauge Thickness (Inches)	Pounds Pull	Gauge Thickness (Inches)	Pounds Pull
0.0015	6-12	0.002	6-12	0.003	6-12

To fit a new piston in a new bore, use the tool shown in fig. 67 with the correct feeler ribbon thickness as given in Table 1.

Position the feeler ribbon on the side of the piston 90° from the piston pin hole. Invert the piston, then push the piston in the cylinder so the end is about ¾ inch below the top of the block. Keep the piston pin bore parallel with the camshaft. Pull out the feeler gauge while noting the reading (fig. 67).

The pull limits for new pistons and used pistons in new or used bores is given in Table 1. If the reading is high, check the piston for nicks or scratches.

If the scale reading is still greater than the maximum allowable pull, try another piston or hone the cylinder bore to obtain the proper fit. If the scale reading is less than the minimum allowable pull, try another piston. If none can be fitted, rebore all cylinders to next oversize.

f. Boring Cylinder Block.

To assure maximum engine performance and balance of the reciprocating parts of the engine, all cylinders must be bored to the same size even though only one cylinder requires reboring and the others are within tolerance. Manufacturers recommendations on how to use boring equipment should be followed and the work performed only by experienced personnel.

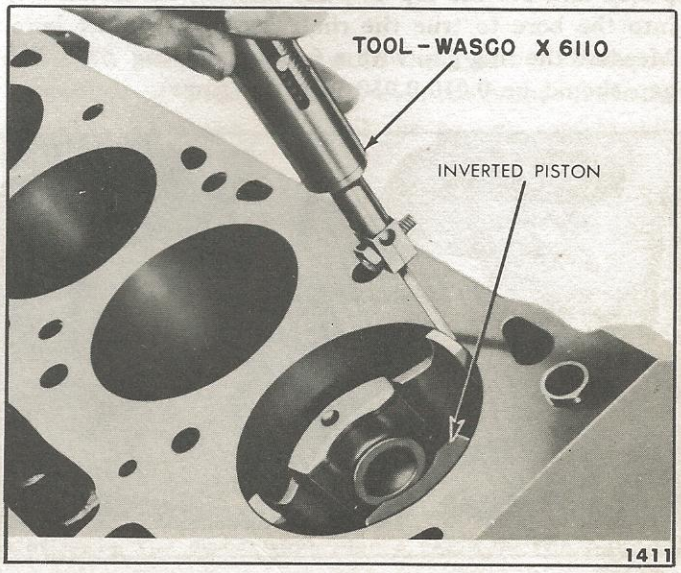


Fig. 67—Fitting Piston

Bore the cylinder with the most wear first to determine the proper oversize. If the cylinders will not clean up at 0.060 inch oversize, the block must be replaced.

When reboring the cylinders allow 0.0015 inch stock for honing to a final finish. Fit the pistons as described previously.

CAUTION: *Thoroughly clean the block to remove all particles of abrasive after the honing operation.*

g. Fitting Piston Pins.

Check the piston pin fit in the piston. Piston pins must be a hand-push fit in the piston pin bore at normal room temperature (70° F.).

If the oversize piston pins are to be used, or if the piston pins are too tight, use an expansion type piston pin reamer. Place the reamer in a vise and revolve the piston around the reamer.

Set the reamer to the size of the piston bore, then expand reamer very slightly and trial ream the bore in the piston using a pilot sleeve of the nearest size to maintain alignment of the piston pin bores.

CAUTION: *Take a very light cut.*

Check the reamed hole size using a new piston pin as a gauge. If the bore is small, expand the reamer slightly and make another trial cut, then repeat the procedure outlined until a piston pin fit is obtained.

Similarly ream all the pistons in which pins need to be fitted, checking each with the pin to be used in the piston. Repeat above procedure for fitting the pins to the connecting rod bushings.

h. Fitting Piston Rings.

Install the piston ring in the cylinder bore. Invert the piston and use the top to push the ring about half way into the bore to true the ring with the cylinder bore. Measure the ring gap with a feeler gauge (fig. 68). The gap should be 0.010-0.050 inch (all rings).

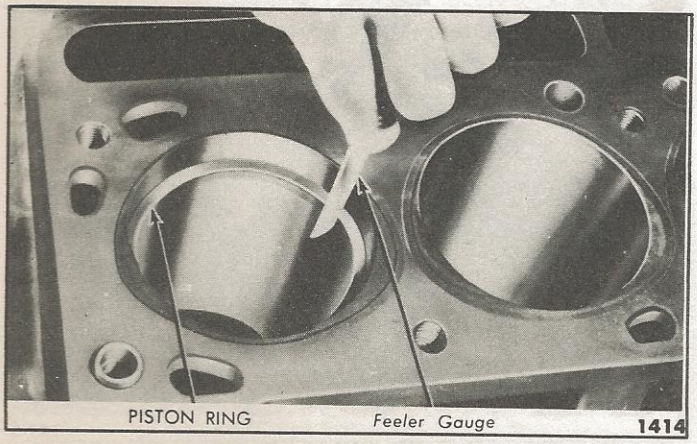


Fig. 68—Checking Ring End Gap

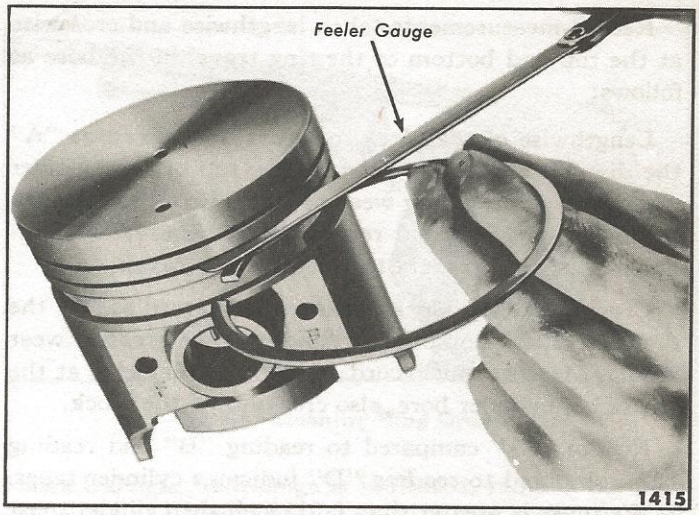


Fig. 69—Checking Ring Clearance

After the rings have been fitted in the cylinder bore, they should be immediately installed on the piston or identified with the piston and cylinder bore in which they are to be installed.

Check the ring to groove clearance on the proper piston for the cylinder as shown in fig. 69.

The rings should have the following clearance:

Ring	Clearance in Piston Groove (Inch)
Top Compression	0.0015 - 0.0030
2nd Compression	0.0010 - 0.0030
Oil Rings	0.0015 - 0.0035

CAUTION: *If the side clearance is not within limits check the ring grooves in the piston. Do not attempt to remove any stock from rings.*

Three different type rings are available in sets for service: the standard ring, the expander ring, and the steel section ring.

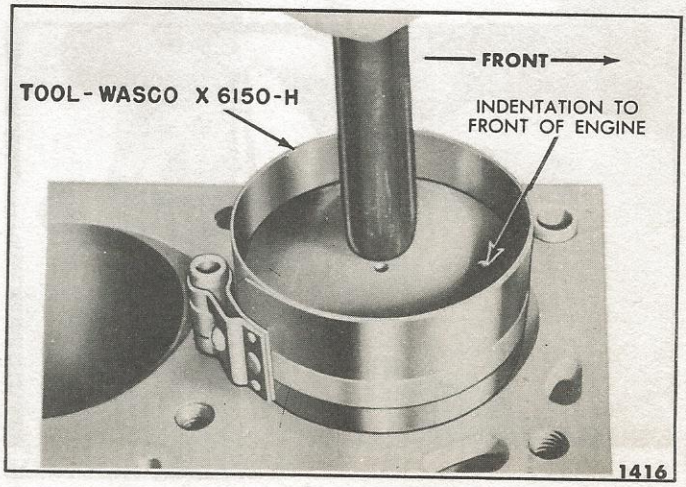


Fig. 70—Installing Piston

The standard (snap type) is designed for use in a new engine or whenever the block is rebored and new pistons installed.

The expander type is designed for use if the taper of the cylinder bore does not exceed 0.006 inch or whenever an oil consumption condition is encountered.

The steel section type ring should be used in cylinders where the taper of the cylinder bore is between 0.006 and 0.015 inch or for excessive oil consumption conditions when the cylinder bore is not to be honed. The bores should have the glaze removed.

i. Fitting Connecting Rod Bearings (Plastigage Method).

Place a piece of Plastigage the length of the insert in the cap bearing insert. Install the cap and tighten to 45-50 foot-pounds.

NOTE: *Do not turn the crankshaft with Plastigage in place.*

Remove the bearing cap and use the Plastigage scale to measure the width of the flattened piece of plastic at the widest point.

NOTE: *If the crankpin is out-of-round, be sure to fit the bearing to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter of the crankpin with minimum clearance of 0.0005 inch and the crankpin is out of round 0.0005 or more, interferences will result in rapid failure of the bearing.*

If reading is not over 0.0021 inch or not less than 0.0005 inch, the fit is satisfactory. If the clearance is greater than 0.0021 inch, try another selective fit bearing to bring the clearance within the 0.0021 inch limit. If the clearance is still excessive, regrind the crankshaft and fit undersize bearing inserts.

NOTE: *If the flattened plastic is not uniform from end to end in its width, the journal or bearing is tapered. Be sure to check the journal with micrometers for taper if the flattened plastic indicates more than 0.001 inch difference.*

Rotate the crankshaft after the bearing is installed to be sure the bearing is not too tight.

j. Assembly.

Lubricate all parts with engine oil. Install the piston pin through the piston and rod and install the pin retainers at each end of the pin in the piston. Install the piston rings as shown in fig. 61. Position the ring gaps 120° apart. Install the insert bearings in the connecting rod and the connecting rod cap.

k. Installation.

Oil the piston rings, piston, connecting rod bearings, and cylinder walls with light engine oil. Install the piston ring compressor on the piston and insert the piston in the cylinder with the indentation toward the front of the engine. Be sure to install pistons in the same cylinder from which they were removed or to which they were fitted. If a new piston and connecting rod is to be installed be sure to stamp the cylinder number on the connecting rod and connecting rod cap so the numbers will face the outside of the engine when the assembly is installed. Push the piston into the cylinder as shown in fig. 70.

Be careful not to damage the crank pin journals with the connecting rod bolts when the piston is pushed all the way into the cylinder bore. Install the connecting rod cap and install the connecting rod cap bolts. Tighten the nuts to 45-50 foot-pounds. Install the connecting rod pal nuts and tighten them to 3-3½ foot-pounds (or finger tight plus ⅓ turn). Check connecting rod side clearance with a feeler gauge all the way around the crankpin. Total side clearance (both rods installed) should be 0.006-0.014 inch.

Install the oil pan. Install the cylinder heads and manifolds. Fill the crankcase with the proper grade and quantity of engine oil. Fill the cooling system with coolant.

11. EXHAUST SYSTEM

The exhaust system consists of a muffler, exhaust inlet pipe, exhaust outlet pipe, and the crossover pipe.

NOTE: *After replacing a muffler, inlet pipe, or outlet pipe, it is advisable to loosen all the frame attaching bracket clamps to relieve twisting strains and then retighten the clamps.*

The exhaust system is shown in fig. 71.

a. Muffler Replacement.

Loosen the inlet and the outlet pipe clamps. Remove the clamp support retaining bolts and slide the clamps away from the muffler. Pull the outlet pipe out of the muffler. Pull the muffler off the inlet pipe.

To install the muffler, place it in position on the inlet pipe. Install the outlet pipe and slide the clamps over the muffler. Install the clamp support retaining bolts and tighten the clamps.

b. Outlet Pipe Replacement.

Loosen the outlet pipe clamp and pull the pipe out of the muffler. To install, slide the pipe into the muffler and tighten the clamp.

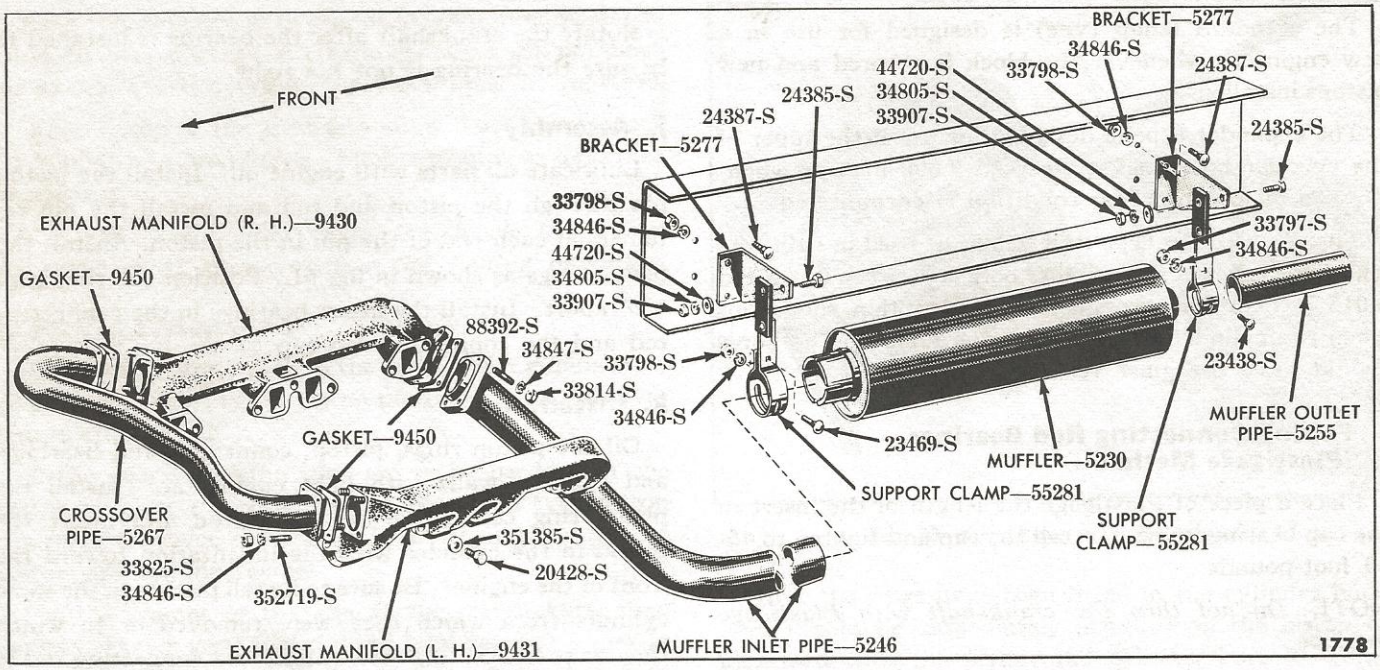


Fig. 71—Truck Exhaust System

c. Inlet Pipe Replacement.

Remove the nuts and lockwashers retaining the inlet pipe to the exhaust manifold flange, pull the pipe away from the flange, and remove and discard the gasket. Loosen the inlet pipe clamp and pull the pipe out of the muffler.

To install, slide the pipe into the muffler. Install a new gasket over the manifold flange studs, install the inlet pipe flange on the studs, and secure it with the lockwashers and nuts. Tighten the nuts to 23-28 foot-pounds. Tighten the inlet pipe clamp.

d. Crossover Pipe Replacement.

The crossover pipe contains a duckbill type thermostat to control the exhaust gas during engine warm-up. The thermostat is located in the crossover-pipe on the side entering the right-hand manifold.

NOTE: *On trucks equipped with air brakes, it will be necessary to remove the air compressor.*

(1) *REMOVAL.* Remove the nuts and lockwashers retaining the pipe to each manifold. Remove the left-hand manifold. Remove the crossover pipe and gaskets.

(2) *INSTALLATION.* Install new gaskets over the manifold studs. Position the crossover pipe on the right-hand manifold and install the left-hand manifold. Install the lockwashers and nuts retaining the crossover pipe and tighten the nuts.

12. WATER PUMPS

A single water pump is used on the engine. The pump bearings are self-lubricated. Service kits are available for repairing the pumps.

The pump is mounted into a recess in the cylinder front cover. It is driven by the generator and water pump belt.

(1) *REMOVAL.* Drain the cooling system. Disconnect the lower radiator hose and heater hose. Remove the fan and fan belt. Remove the generator belt. Remove the bolts retaining the pump to the cover and remove the pump and gasket.

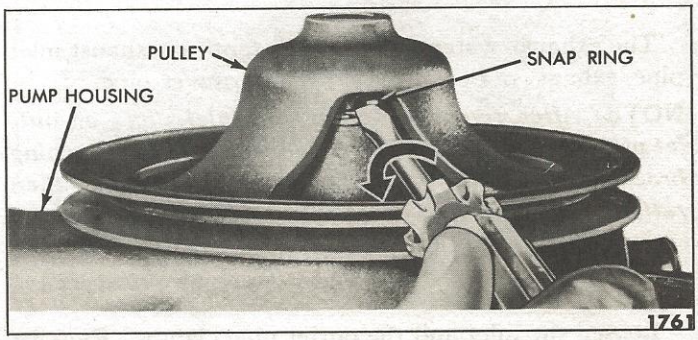


Fig. 72—Removing Snap Ring

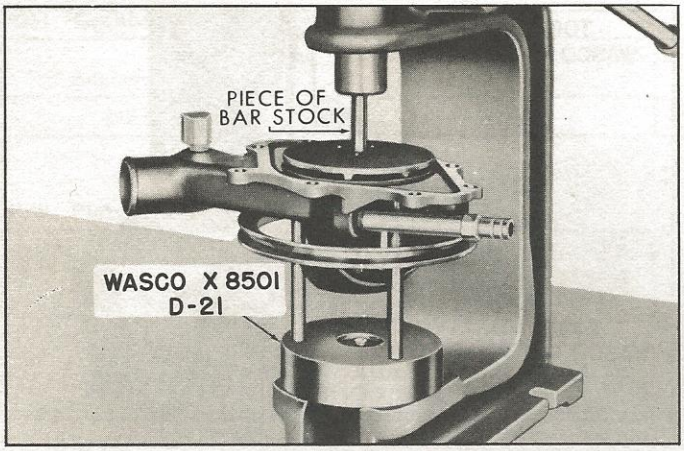


Fig. 73—Pressing Out Shaft and Pulley from Impeller

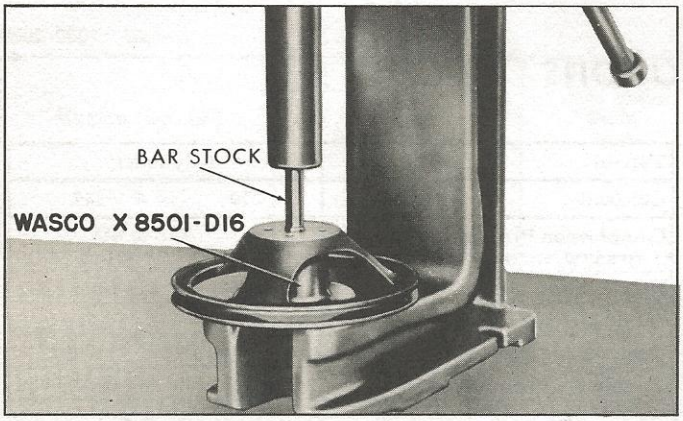


Fig. 74—Pressing Shaft Out of Pulley

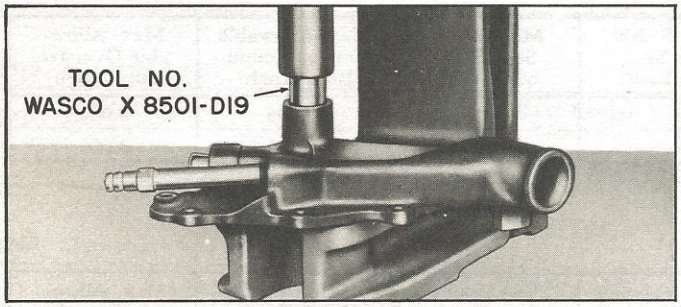


Fig. 75—Removing Pump Seal

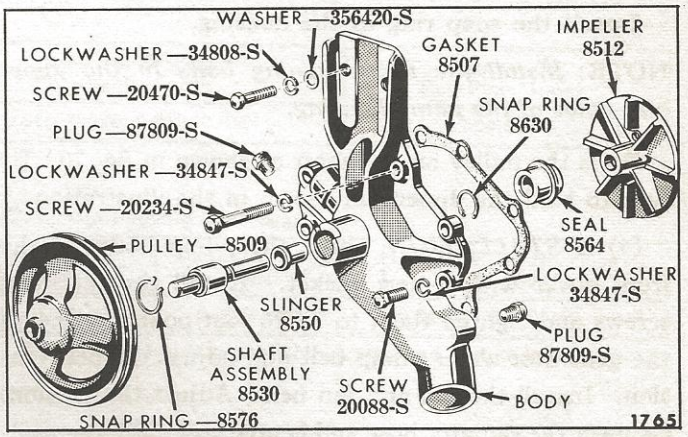


Fig. 76—Water Pump—Disassembled

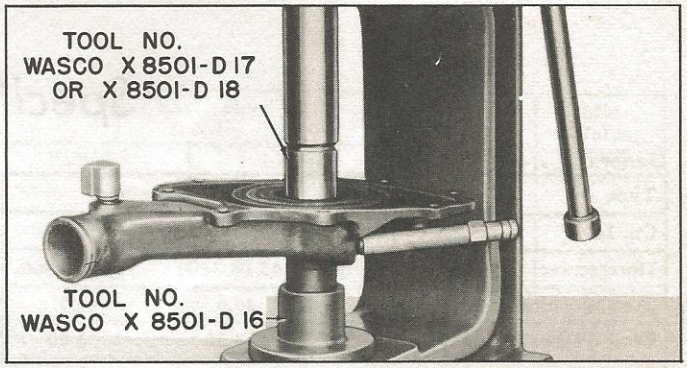


Fig. 77—Install Pump Seal

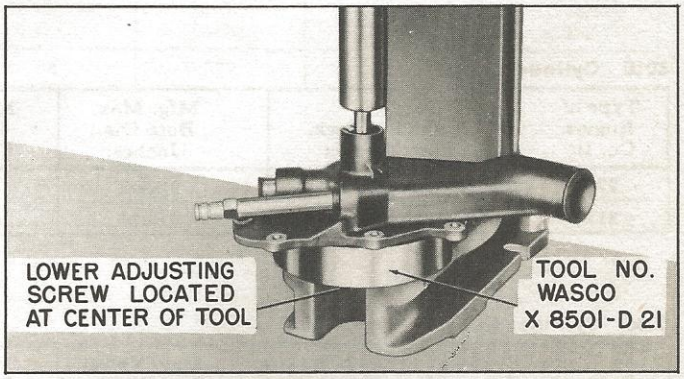


Fig. 78—Pressing Shaft into Impeller

NOTE: *Two of the retaining bolts will remain in the pump housing because they do not clear the pulley. Note the position of these bolts and be sure to install them in this position when the pump is reassembled.*

(2) *DISASSEMBLY.* Pry out the snap ring retaining the shaft in the housing (fig. 72). Press the shaft and pulley out of the impeller and housing (fig. 73.)

Remove the snap ring from the shaft and press the shaft out of the pulley (fig. 74.) Press out the pump seal (fig. 75).

A disassembled view of the pump is shown in fig. 76.

(3) *ASSEMBLY.* Install a new seal in the pump housing (fig. 77) and press the shaft and bearing into the pump housing.

Press the shaft into the impeller as shown in fig. 78. The impeller to body clearance should be 0.025-0.035 inch after pressing the impeller on the shaft.

Tighten the set screw in the bottom of the fixture plate until it just touches the end of the shaft. Do not lift the pump body off the fixture plate.

Install the snap ring in the housing.

NOTE: *Install the two retaining bolts in the upper bolt holes of the pump housing.*

Press the pulley on the shaft as shown in fig. 79. Be sure to hold the dimension shown in the illustration.

(4) *INSTALLATION.* Place the pump body on the front cover with a new gasket. Install the retaining screws and tighten them to 23-28 foot-pounds. Install the generator-water pump belt and adjust the belt tension. Install the fan and fan belt. Adjust the tension. Connect the radiator hose and heater hose. Fill the cooling system.

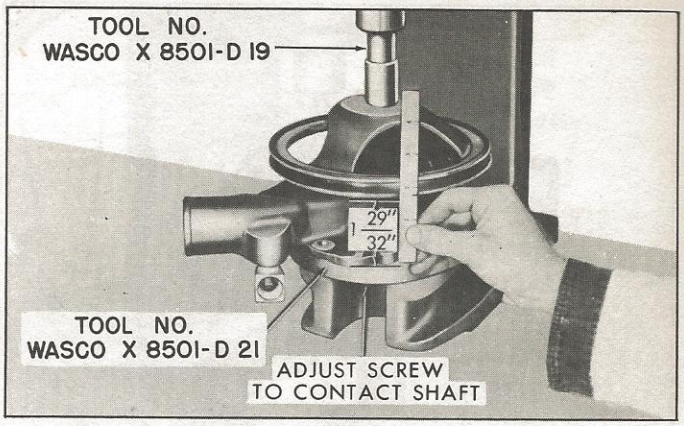


Fig. 79—Pressing Pulley on Shaft

Specifications

General

Type	8-Cylinder	
Cu. In.	279	317
Horsepower	145 @ 3800	155 @ 3900
Taxable Horsepower	40.6	46.2
Bore (Inches)	3.56	3.80
Stroke (Inches)	3.50	3.50
Piston Displacement (cubic inches)	279	317.5

Type	8-Cylinder	
Cu. In.	279	317
Compression Pressure @ Sea Level (p.s.i. @ r.p.m.)	115 @ 90	115 @ 90
Firing Order	1-5-4-8-6-3-7-2	1-5-4-8-6-3-7-2
Oil Capacity (Qts.)	7.5	7.5
Compression Ratio	7.0:1	7.0:1
Torque Ft. Lbs. @ RPM	244 @ 19-2100	284 @ 17-2000

6010 Cylinder Block

Type of Engine Cu. In.	Cylinder Block Part Number	Mfg. Max. Bore Dia. (Inches)	Max. Width Valve Seat Face (Inch)	Max. Valve Seat Run-out (Inch)	Max. Allowable Out-of-Round Bore (Inch)	Max. Allowable Oversize Bore (Inch)
279	EAL-6010	3.5645	—	—	0.0005	0.060
317	EAD-6010	3.8024	—	—	0.0005	0.060

6085 Cylinder Head

Engine Cu. In.	Part No.	Max. Valve Seat Width Intake (Inch)	Max. Valve Seat Width Exhaust (Inch)	Max. Valve Seat Run-out (Inch)	Mfg. Max. Valve Guide Bore (Inch)	Max. Allowable Oversize Guide (Inch)
279	EAL-6085	0.070	0.105	0.003	0.344	0.030
317	EAM-6085	0.070	0.105	0.003	0.344	0.030

6108 Piston Assemblies

Engine Cu. In.	Fitting New Piston in New Bore		Fitting New Piston in Used Bore		Fitting Used Piston in Used Bore	
	*Gauge Thickness (Inches)	Pounds Pull	*Gauge Thickness (Inches)	Pounds Pull	*Gauge Thickness (Inches)	Pounds Pull
279 & 317	0.0015	6-12	0.002	6-12	0.003	6-12

*Use ½ inch wide feeler gauge.

6200 Connecting Rod

Engine—Cu. In.	Side Clearance Total (Inches)
279 & 317	0.006-0.0014

Note: Allowable bend in connecting rod-0.0005 per inch. Allowable twist in connecting rod is 0.0015 per inch.

6331 Crankshaft Main Bearings

Engine—Cu. In.	Journal Clearance (Inch)	Undersize Bearings Available (Inch)	Crankshaft End Play (Inch)
279 & 317	0.0008-0.0026	0.010, 0.020, 0.030, 0.040	0.004-0.008

6149 Piston Rings

Engine Cu. In.	Clearance in Piston Grooves (Inch)			End Gap of Ring in Cylinder Bore (Inch)	
	Top Rings	Second Rings	Lower Rings	Compression Rings	Oil Rings
279 & 317	0.0015-0.0030	0.0010-0.0030	0.0015-0.0030	0.010-0.050	0.010-0.050

6211 Connecting Rod Bearings

Engine (Cu. In.)	Journal Clearance (Inch)	Undersize Bearings Available (Inch)
279 & 317	0.0004-0.0020	0.010, 0.020, 0.030, 0.040

Selective fit bearings available in standard and undersize.

6375 Flywheel

Max. Runout—Flywheel Face . . . . . 0.005 in.
Max. Runout—Ring Gear . . . . . 0.010 in.
Max. Depth of Refacing . . . . . 0.045 in.

6505-6507 Valves

Engine (Cu. In.)	Valve Part Number	Max. Clearance Valve Stem Guide (Inch)	Valve Lash (Hot) (Inch)				Mfg. Min. Stem Diameter (Inch)	Min. Valve Head Thickness (Inch)
			Exhaust		Intake			
			Min.	Max.	Min.	Max.		
279 & 317	EAM-6505-E	0.0030	0.018	0.018	—	—	0.3410	1/32
279 & 317	EAM-6507-E	0.0025	—	—	0.012	0.012	0.3415	1/32

Valve Timing

Engine (Cu. In.)	Intake			Exhaust		
	Lash (Inch)	Opens (Degrees B.T.C.)	Closes (Degrees A.B.C.)	Lash (Inch)	Opens (Degrees B.B.C.)	Closes (Degrees A.T.C)
279 & 317	0.010	18	58	0.020	56	20

6513 Valve Spring

Engine (Cu. In.)	Part No.	Test Length (Inches)	Pressure (Pounds)
279 & 317	EAD-6513-A	1.80	64-70

6250 Camshaft

Engine (Cu. In.)	Camshaft Part Number	†Max. Allowable Runout (Inch)	Min. Valve Lift. (Inch)*		Wear Limit Camshaft Journals (Inches)	End Play (Inch)
			Intake	Exhaust		
279 & 317	EAM-6250-C	0.005	0.338	0.338	—	**

† Centre journal runout with end journals supported. * Zero valve lash. ** End thrust controlled by plunger in camshaft.

6600 Oil Pump

Measurement	279 & 317
Max. Clearance Housing and Shaft (Inch)	0.0029
Max. Clearance Oil Pump Driven Gear and Shaft (Inch)	0.005
Max. Allowable Clearance Gear to Housing (Inch)	0.005
Relief Valve Spring Pressure (Lbs. @ Inches Length)	7.8 @ 1.40

Lincoln Engine

1952

The engine introduced in the 1952 Lincoln is a 90° V type, 8 cylinder, valve-in-head engine, and has a displacement of 317.5 cubic inches, with a 3.800″ bore and a 3.500″ stroke. The compression ratio is 7.5-1.

Repair and maintenance operations are performed on this engine in much the same manner as those given in the foregoing part, Section I (EAL and EAM truck engine). The major engineering changes are shown in

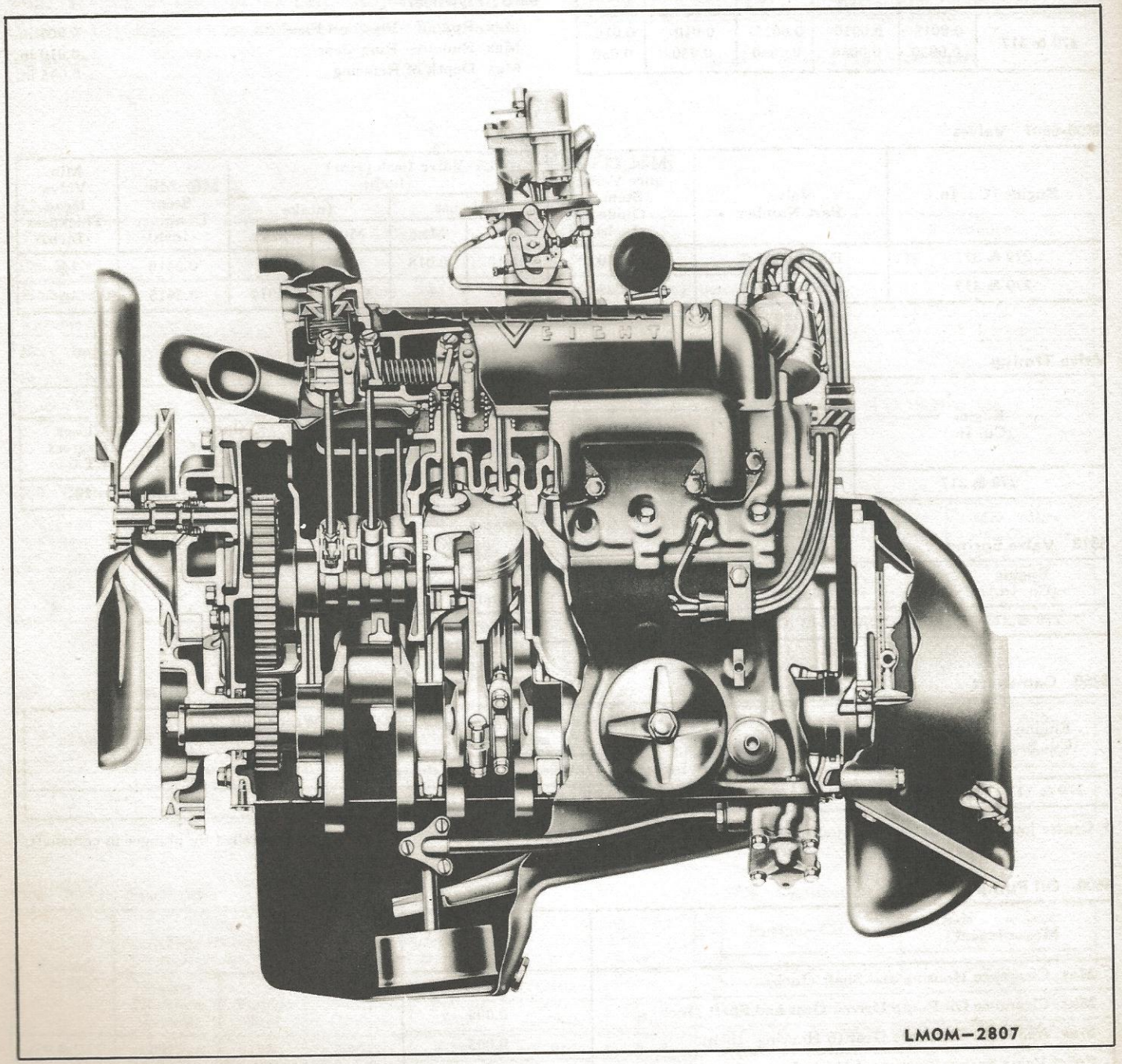


Fig. 80—Longitudinal Section of Engine

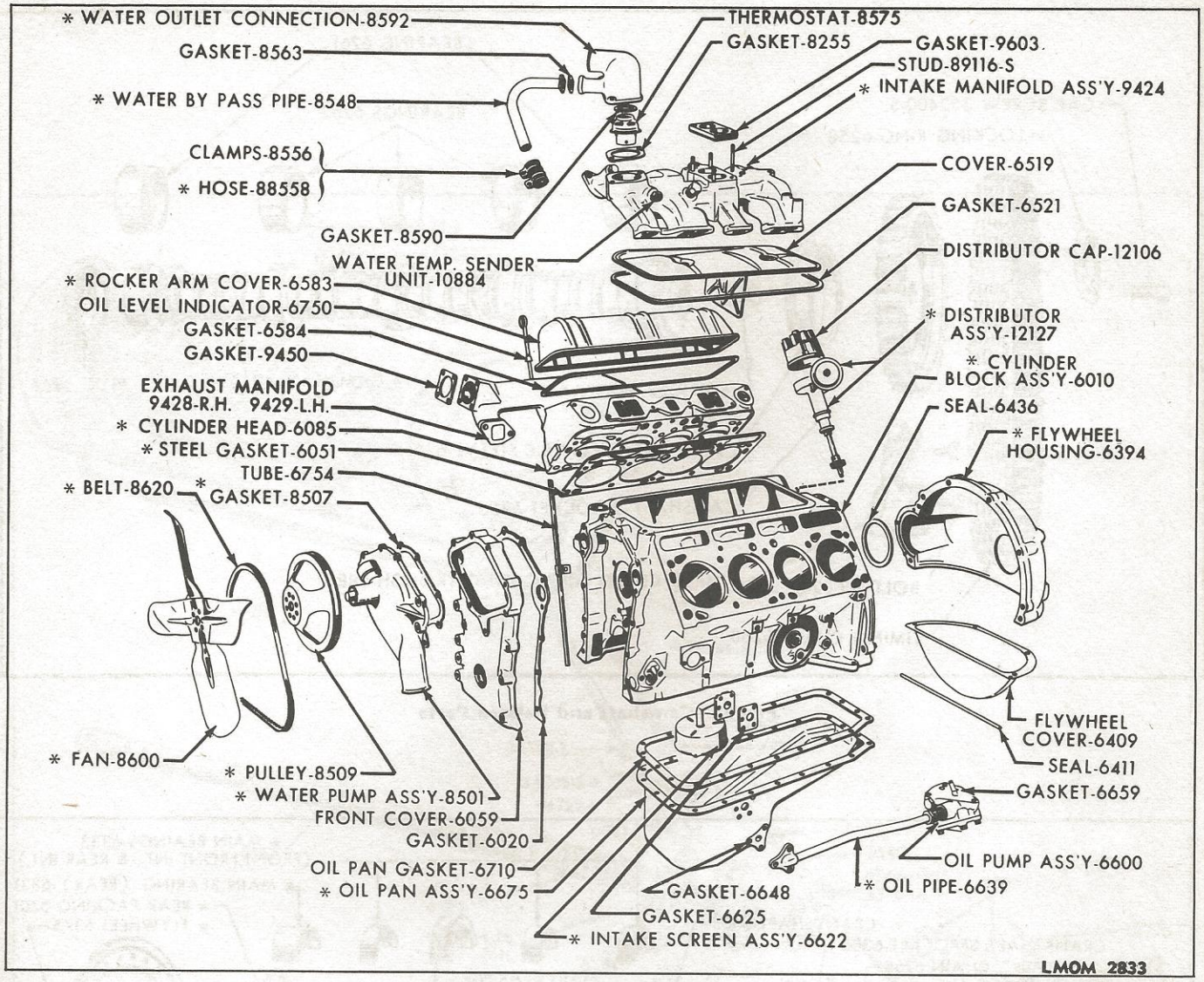


Fig. 81—Cylinder Block and Related Parts

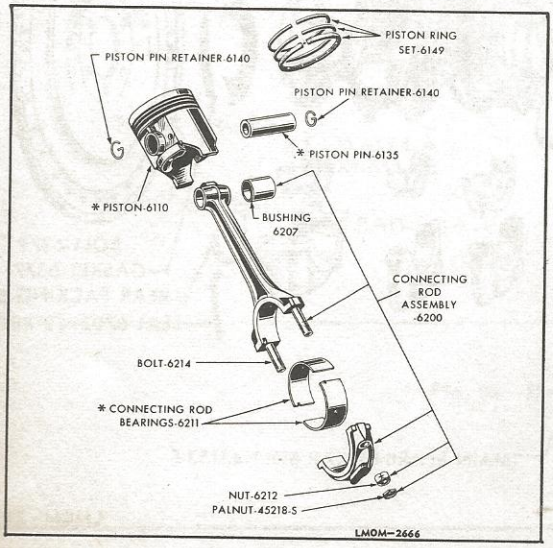


Fig. 82—Piston and Connecting Rod Assembly

figures 81, 82, 83, 84 and 85. All parts which are designed specifically for Lincoln are preceded by an asterisk. Parts not so identified are common to both the truck and Lincoln engine.

Figure 81 above illustrates the cylinder block and related parts. Those parts peculiar to the Lincoln engine are marked with an asterisk and parts not so marked are common to the EAL, EAM and Lincoln engines.

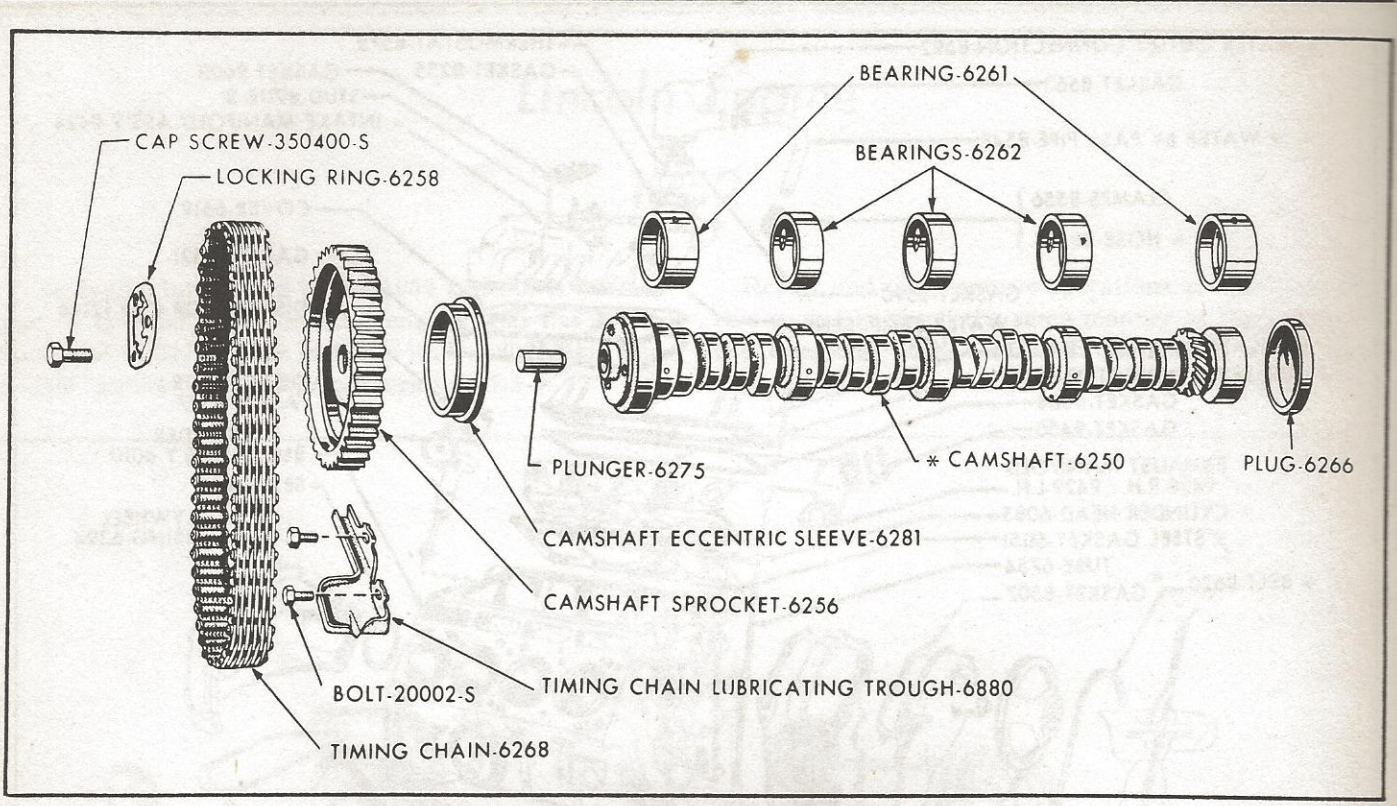


Fig. 83—Camshaft and Related Parts

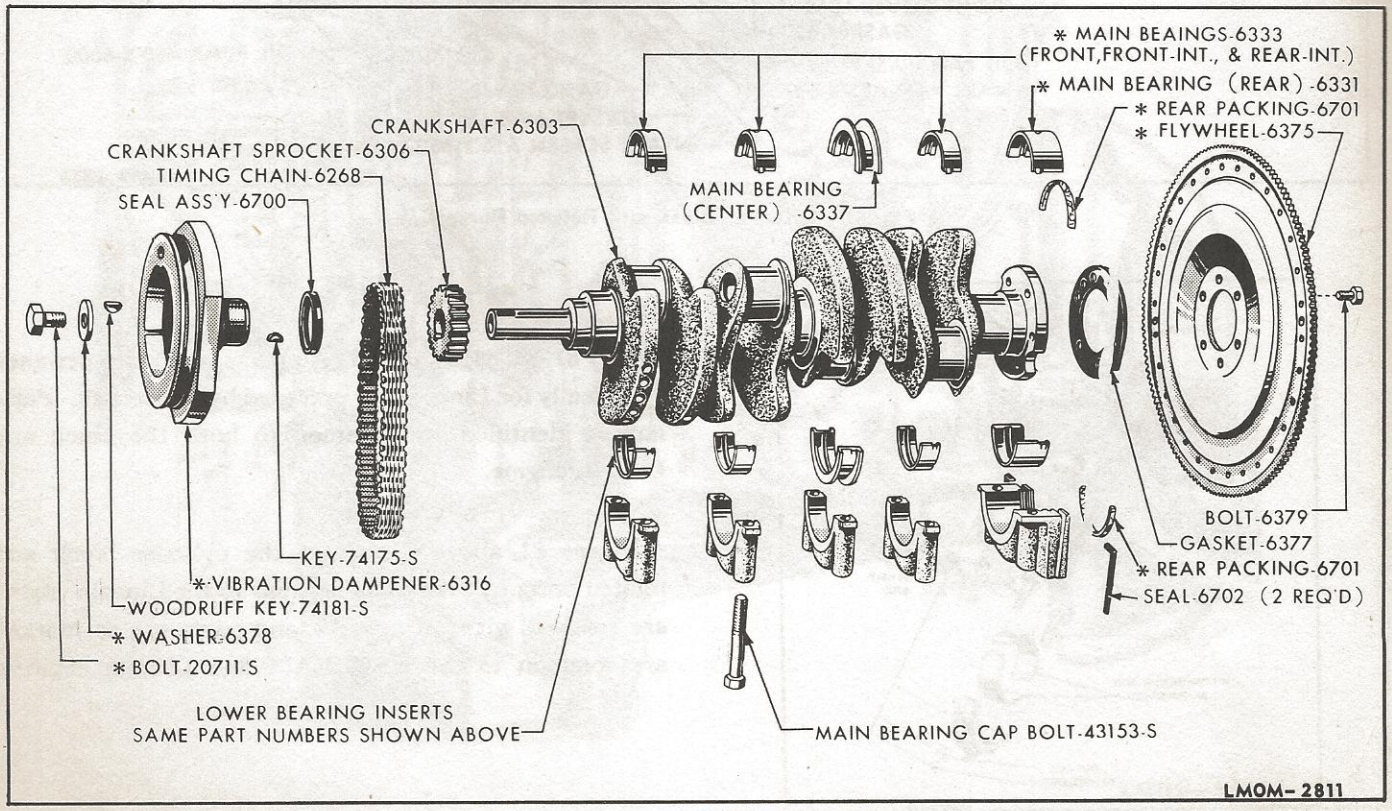


Fig. 84—Crankshaft and Related Parts

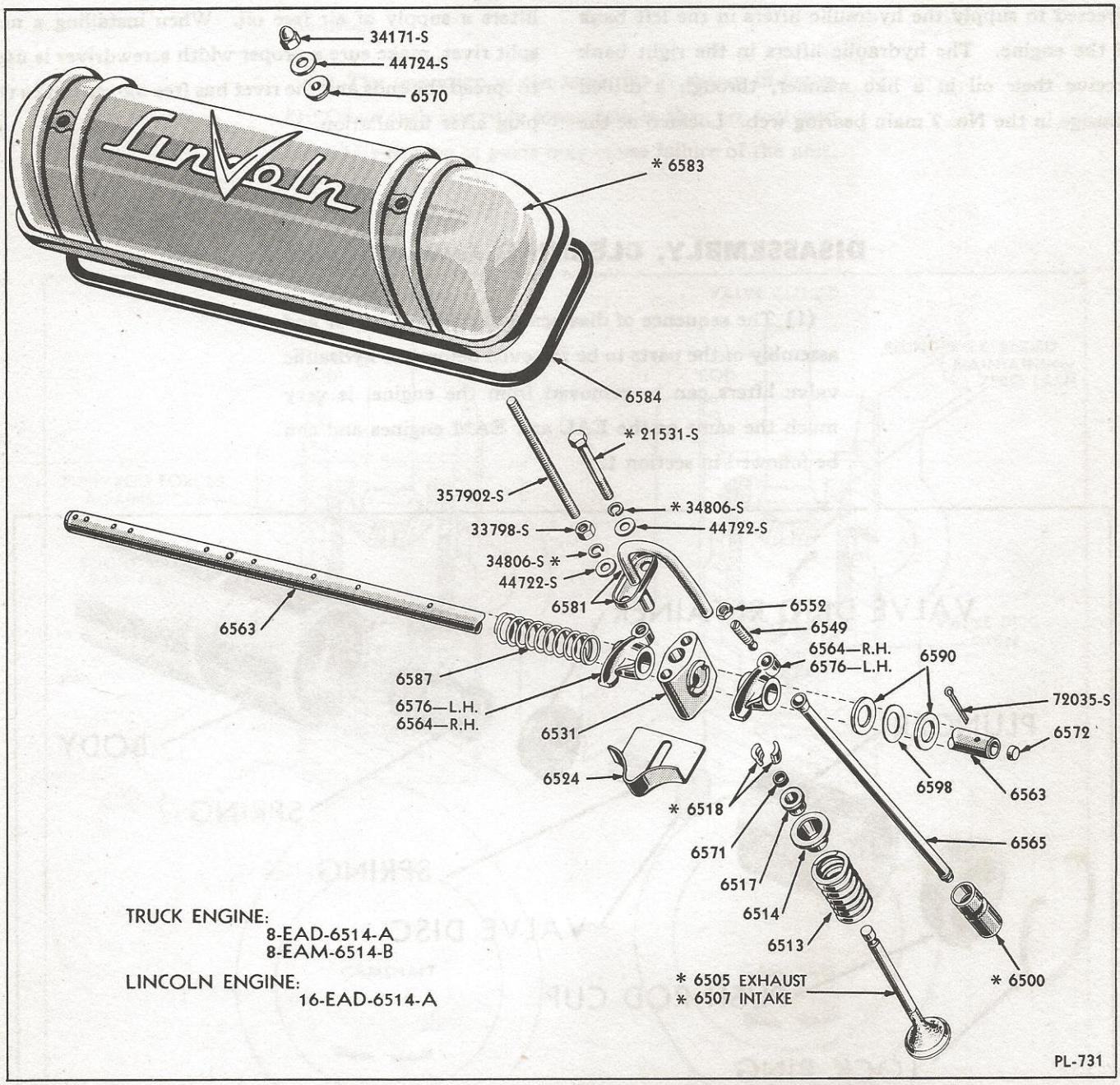


Fig. 85—Rocker Arm and Related Parts

HYDRAULIC VALVE LIFTER ASSEMBLIES

The valve lifters used in the Lincoln engine are of the hydraulic type. See fig. 86. Through a drilled passage in the No. 1 main bearing web, oil under pressure is directed to supply the hydraulic lifters in the left bank of the engine. The hydraulic lifters in the right bank receive their oil in a like manner, through a drilled passage in the No. 2 main bearing web. Located at the front end of each hydraulic lifter oil passage, is a drilled vent plug. This plug contains a rivet which vents the plug and allows air in the line to escape, assuring the lifters a supply of air free oil. When installing a new split rivet, make sure a proper width screwdriver is used to spread the ends and the rivet has free movement in the plug after installation.

DISASSEMBLY, CLEANING AND ASSEMBLY

(1) The sequence of disassembly, cleaning, repair and assembly of the parts to be removed before the hydraulic valve lifters can be removed from the engine, is very much the same as the EAL and EAM engines and can be followed in section 1.

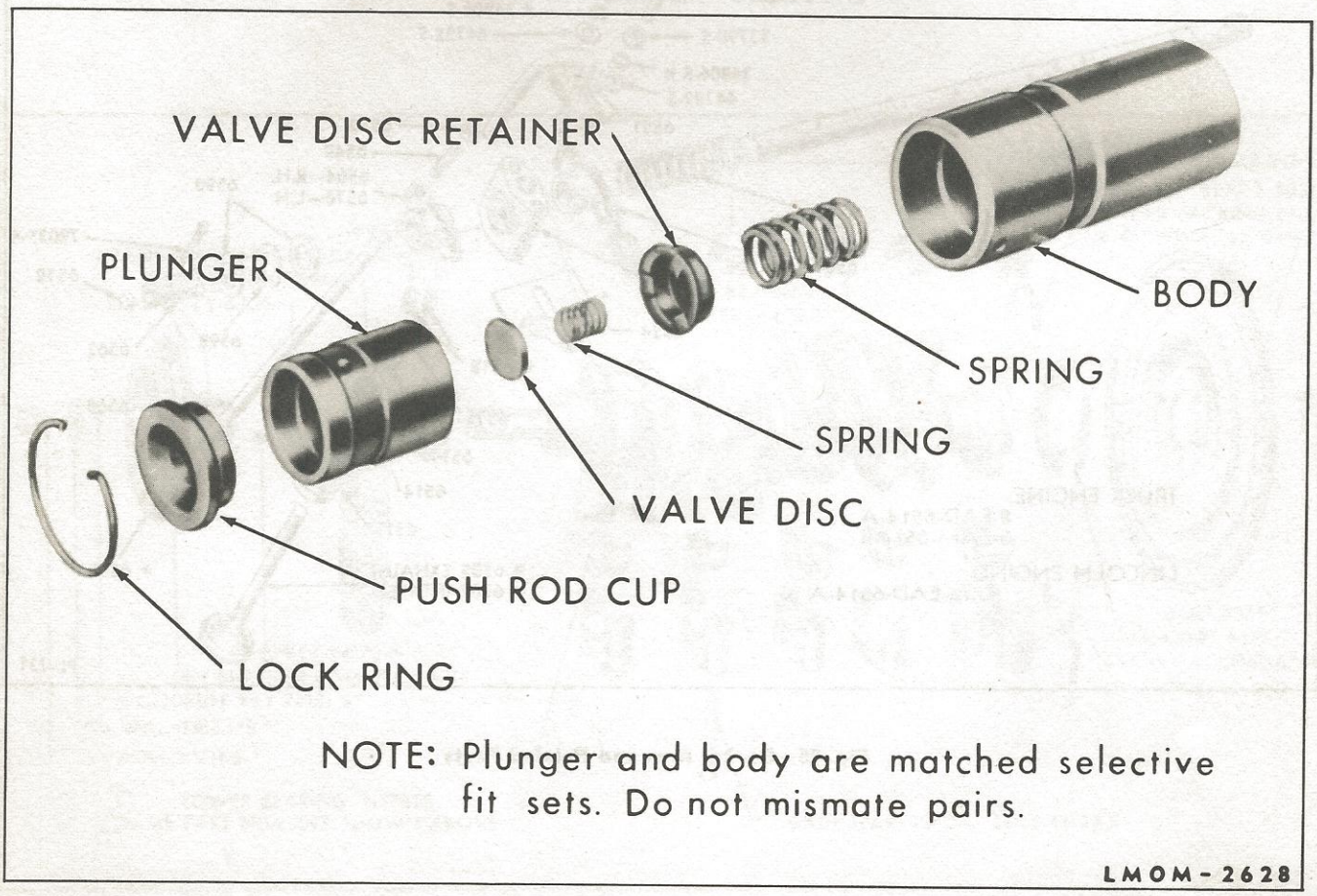


Fig. 86—Hydraulic Lifter Assembly—Disassembled

(2) Remove hydraulic lifters. Keep these in order of removal so they may be installed in their original bores if inspection reveals satisfactory performance. If lifters have a tendency to stick, a hook made from stiff wire may be inserted into one of the two holes near the top of the lifter.

(3) The operation of the assembly is shown in figure 87. Clean each assembly separately as they are matched sets. Mis-mating of parts may cause failure of the unit.

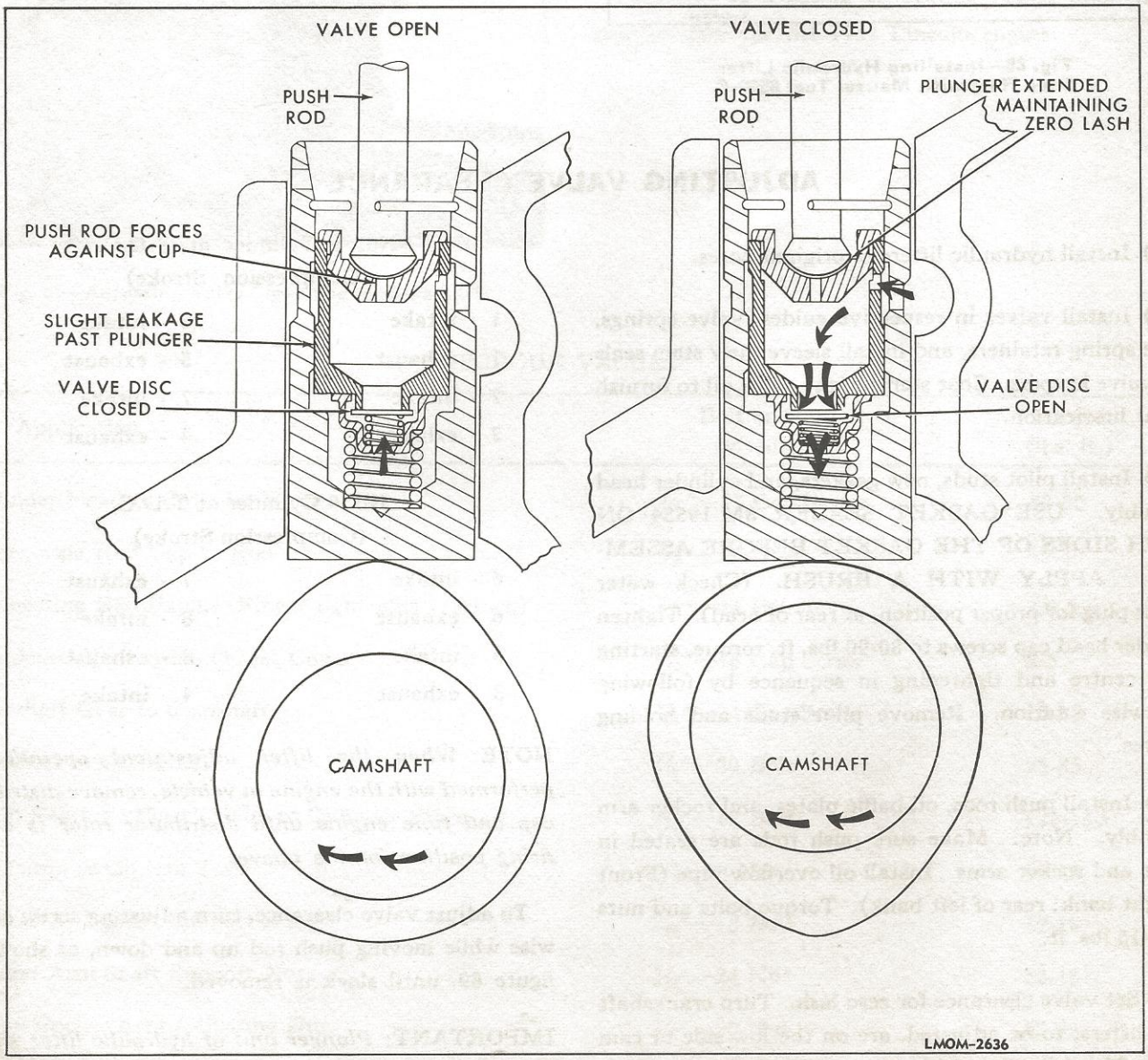


Fig. 87—Hydraulic Lifter Operation—Cross Section

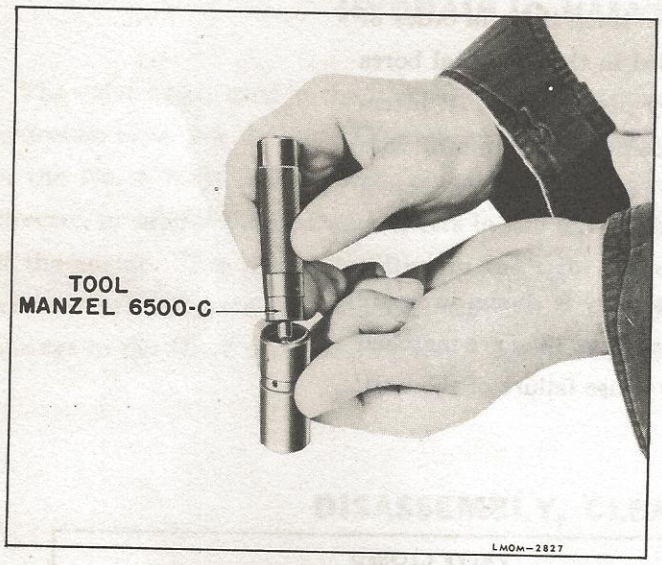


Fig. 88—Installing Hydraulic Lifter Snap Ring with Manzel Tool 6500-C

After thoroughly cleaning and inspecting the parts, place the push rod seat upside down on a clean cloth. Place plunger unit on push rod seat, then valve disc assembly and finally the spring. Place body over parts and pick assembly up (still upside down) and push assemblies up into body. Using Tool Manzel 6500-C, install lock ring in place. See figure 88.

If the above mentioned tool is not available, use a drift of some soft material so that the body of the lifter will not be scratched or damaged.

ADJUSTING VALVE CLEARANCE

(1) Install hydraulic lifters in original bores.

(2) Install valves in respective guides, valve springs, valve spring retainers, and install sleeve, new stem seals and valve keepers. Coat stems with engine oil to furnish initial lubrication.

(3) Install pilot studs, new gaskets, and cylinder head assembly. USE GASKET SEALER 8M-19554 ON BOTH SIDES OF THE GASKET BEFORE ASSEMBLY. APPLY WITH A BRUSH. (Check water jacket plug for proper position, at rear of head). Tighten cylinder head cap screws to 80-90 lbs. ft. torque, starting from centre and tightening in sequence by following clockwise rotation. Remove pilot studs and holding fixtures.

(4) Install push rods, oil baffle plates, and rocker arm assembly. Note: Make sure push rods are seated in lifters and rocker arms. Install oil overflow pipe (Front of right bank; rear of left bank). Torque bolts and nuts to 12-15 lbs. ft.

(5) Set valve clearance for zero lash. Turn crankshaft until lifters, to be adjusted, are on the low side of cam lobe. The following table shows which lifters are in position for adjustment with—

No. 1 Cylinder at T.D.C.
(Compression Stroke)

1 - intake	5 - intake
1 - exhaust	5 - exhaust
2 - intake	7 - intake
2 - exhaust	4 - exhaust

No. 6 Cylinder at T.D.C.
(Compression Stroke)

6 - intake	7 - exhaust
6 - exhaust	8 - intake
3 - intake	8 - exhaust
3 - exhaust	4 - intake

NOTE: *When the lifter adjustment operation is performed with the engine in vehicle, remove distributor cap and tune engine until distributor rotor is at the firing position for the above.*

To adjust valve clearance, turn adjusting screw clockwise while moving push rod up and down, as shown in figure 89, until slack is removed.

IMPORTANT: *Plunger unit of hydraulic lifter should NOT be forced down into lifter body during this operation.*

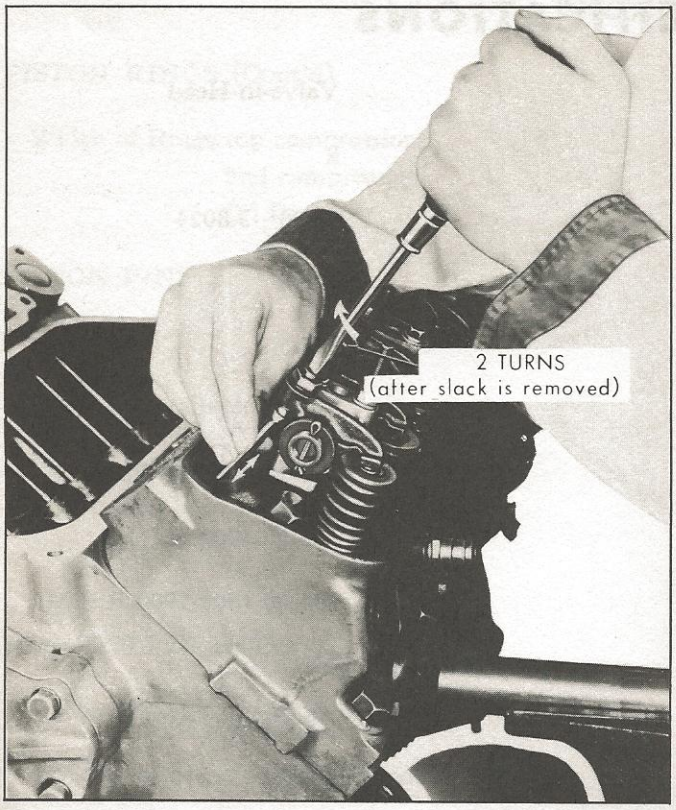


Fig. 89—Adjusting Valve Clearance for Zero Lash

Now that only the slack is removed, turn adjusting screw clockwise an additional two (2) turns. Hold adjusting screw and tighten lock nut to 30-35 lbs.ft. torque. Repeat until all are adjusted.

NOTE: *If lifter is noisy during operation, adjustment can be varied by turning adjusting screw ±¼ turn from original 2 turn setting.*

Follow on with the assembly of the remaining parts of the engine in the proper sequence as laid out in section 1-EAL and EAM engines.

Following is a listing of Torque values and engine specifications for the 1952 Lincoln engine.

TORQUE VALUES

Application	Bolt or Nut Specified	Torque (lbs. ft.)
Cylinder Head to Cylinder Block	½"—13 Cap Screw	80-90
Connecting Rod Cap to Rod	⅜"—24 Nut	45-50
Connecting Rod Palnut (Finger tight plus 1/3 turn)	⅜"—24 Palnut	3.0-3.5
Crankcase Ventilation Outlet Cover	5/16"—18 Cap Screw	3-5
Camshaft Gear to Camshaft	5/16"—24 Cap Screw	15-18
Flywheel to Crankshaft	7/16"—20 Bolt	75-85
Main Bearing "Place" Bolts to Cylinder Block	9/16"—12 Bolt	120-130
Oil Pump to Oil Pan Tube	1"—18 Nut	10-12
Rocker Arm Shaft Support Bolts	5/16"—18 Bolt	12-15
Rocker Arm Shaft Support Nuts	5/16"—24 Nut	12-15
Valve Rocker Arm Adjusting Nut	7/16"—20 Nut	30-35
Spark Plugs (Cast Iron Head)		24-30

ENGINE SPECIFICATIONS

Type	Valve-in-Head
Number of Cylinders	8
Bore	3.800—3.8024
Stroke	3.500
Piston Displacement—Cu. In.	317.5
Compression Ratio	7.5
Compression Pressure lbs./sq. in. (cranking R.P.M.)	110-120 @ 120 R.P.M.
Maximum B.H.P. @ R.P.M.	160 @ 3900 R.P.M.
Maximum Torque lbs. ft. @ R.P.M.	284 @ 1600-1900 R.P.M.
Taxable Horsepower	46.2
Firing Order	1-5-4-8-6-3-7-2
CYLINDERS	
Cylinder Bore	
Rebore if taper exceeds	.006
Rebore if out-of-round-exceeds	.003
PISTONS	
Oversizes available	.005″, .020″, .030″ and .040″
Ring groove width	
top compression	.0795″—.0805″
2nd compression	.079″—.080″
Oil Ring	.188″—.189″
Piston Clearance (Centre Skirt)	.0007″—.0013″
PISTON RINGS	
Side clearance in Groove	
top compression	.0015—.0030
2nd compression	.0010—.0025
Oil Ring	.0015—.0030
Ring Gap	
Compression	.010—.020
Oil Ring	.010—.020
Ring Gap Spacing	120°

SPECIFICATIONS

PISTON RINGS (Cont'd)	
Width of Rings top compression	.0775″—.0780″
2nd compression	.0775″—.0780″
Oil Ring	.186″—.1865″
PISTON PINS	
Diameter	.912″—.9123″
Oversizes available	.001—.002
Clearance	
In piston	.0001—.0003 loose
In rod	.0003—.0004 loose
	(Select for light thumb press fit)
CONNECTING RODS	
Inside diameter of piston pin bushing (Standard)	.9123″—.9126″
Side clearance on crankpin (2 rods)	.006—.014
CONNECTING ROD BEARINGS	
Clearance on Crankpin	Select for .0004—.0020
Undersizes available	.010″, .020″, .030″ and .040″
CRANKSHAFT	
Number of bearings	5
Bearing Journal Diameters	
Front	2.6235″—2.6243″
Front—Intermediate	2.6235″—2.6243″
Center	2.6235″—2.6243″
Rear—Intermediate	2.6235″—2.6243″
Rear	2.6235″—2.6243″
	Service
End Play	.004″—.008″ (Max. .012″)
Thrust taken	Centre main (No. 3)
Crankpin diameter	2.2482″—2.2490″
CRANKSHAFT MAIN BEARING	
Clearance	.0008—.0026
Undersize bearings available	.010″, .020″, .030″, .040″

SPECIFICATIONS

CAMSHAFT

Number of bearings	5
Camshaft journal diameter	
Front	2.1240—2.1250
Front—Intermediate	2.1240—2.1250
Centre	2.1240—2.1250
Rear—Intermediate	2.1240—2.1250
Rear	2.1240—2.1250
Maximum runout	.005 T.I.R.
Camshaft end play	Zero—Restrained by Oil Pressure
Camshaft Eccentric Sleeve Clearance	.006″

CAMSHAFT BEARINGS

Bearing Clearance	.0013″—.0028″
Undersize Available	.015″

VALVES

Valve Clearance	Zero when lifters are filled
Valve lift (intake)	.333
Valve lift (exhaust)	.333
Valve seat angle	45°
Seat width (in Head)	.060—.070
Seat runout limit (total indicator reading)	.002
Valve stem diameter	
Intake (Std.)	.3415—.3425
Exhaust (Std.)	.3410—.3420
Oversizes available	.003—.015—.030
Stem clearance in guide	
Intake	Select for .0010—.0020
Exhaust	Select for .0015—.0025
Valve face runout (Total indicator Reading)	.0025
Valve face angle	45°

SPECIFICATIONS

VALVE SPRINGS	
Free length (inches)	Approx. 2.21
Tension in pounds	
Compressed to 1.80″	57-67
Compressed to 1.47″	120-147
VALVE TIMING	
Intake Opens	18° BTC
Intake Closes	58° ABC
Exhaust Opens	56° BBC
Exhaust Closes	20° ATC
VALVE LIFTER	
Type	Hydraulic
Clearance in block	Select for .0005—.0020 (Service Max. .003″)
Diameter	.8740—.8745
FLYWHEEL	
Back lash between flywheel ring gear and starter motor	.015—.025
Runout of face at mtg. surface of torus cover (after assembled to crank) (Total Ind. Reading)	.008
OIL PUMP	
Type	Gear
Drive shaft clearance (upper)	.0015—.0030 Loose
Drive shaft clearance (in cover)	.0010—.0030
Driven shaft clearance	.0020—.0030 Loose
Relief valve clearance	.0020—.0040 Loose
Tension of relief valve spring	9.82# @ 1.71″ Length
ROCKER ARM	
Clearance to rocker shaft	Service .002″—.004″ (Max. .007″)

337 Cubic Inch Truck Engine

Series 7 and 8

1949-51

The 337 cu. in 8-cylinder engine has a bore of 3½ inches, a stroke of 4⅜ inches, and is rated at 145 horse power. This engine is used in Series 7 (190) and 8 (215) trucks. 1949 and early 1950 engines are shown in figures 90 and 91.

Several changes in the external appearance were made in the late 1950 and 1951 engines. Of these changes, the fan design, ignition cable brackets, addition of the external water by-pass tubes, oil filter tubes, and location of the oil filter are shown in figs. 92 and 93.

Complete procedures for the overhaul and repair of the 337 cubic inch 8 cylinder truck engine are given below. The necessary operations are presented in the written text and supplemented with illustrations. Specially designed tools are fully illustrated to aid you in learning their use easily and quickly. Pay particular attention to the notes, cautions, and examples accompanying the written procedures. They contain time saving and material saving hints and suggestions.

Always install new gaskets when overhauling an engine.

Procedures for removal, cleaning, inspection, and installation of the exhaust and intake manifolds are presented below.

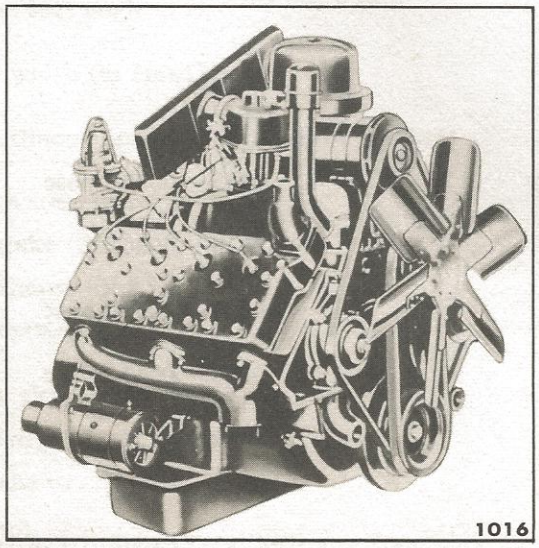


Fig. 90—1949 and Early 1950 8EQ Engine (¾ Front View)

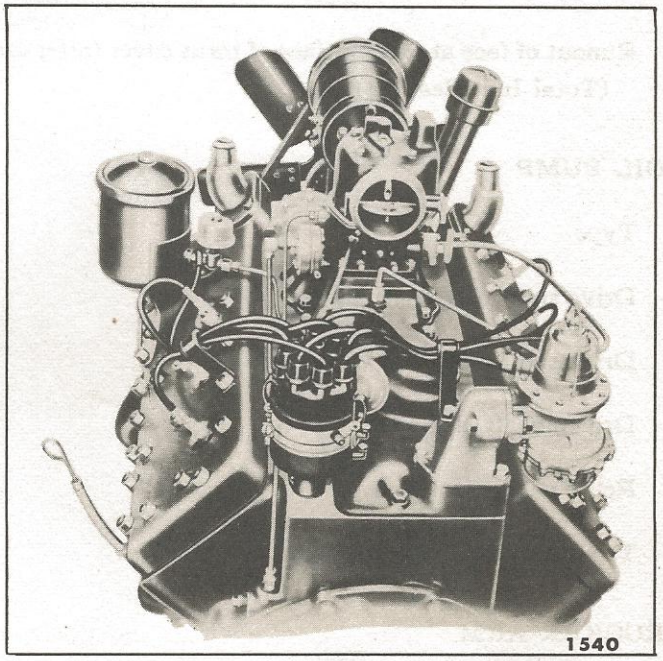


Fig. 91—1949 and Early 1950 8EQ Engine (Rear View)

1. MANIFOLDS

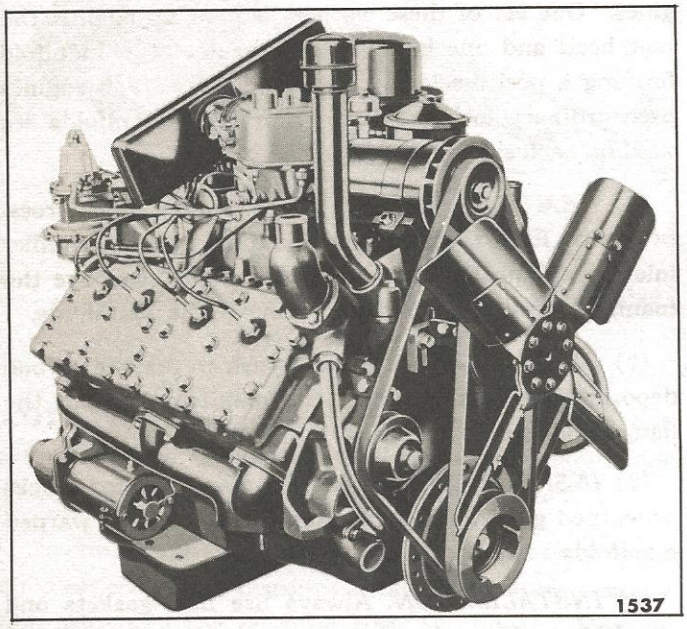


Fig. 92—Late 1950 and 1951 8EQ Engine (¾ Front View)

a. Intake Manifold.

The intake manifold can be removed from the cylinder block without removing the oil filter, carburetor or fuel pump (Fig. 94). If it is necessary to repair any accessories, you may remove the accessories before you remove the manifold.

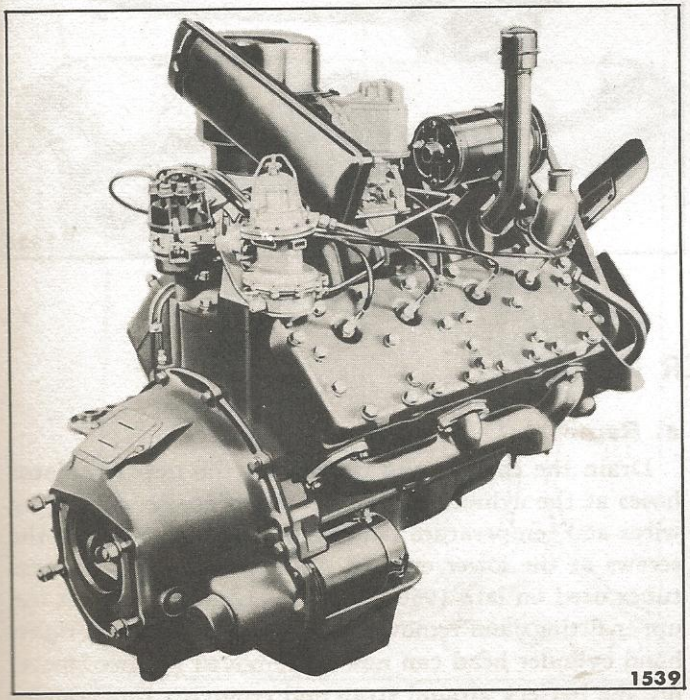


Fig. 93—Late 1950 and 1951 8EQ Engine (¾ Rear View)

(1) *REMOVAL.* Remove the air cleaner and oil filter lines. Disconnect the generator wires, oil pressure sending unit wire, and temperature sending unit wires at both heads. Disconnect the throttle linkage, choke wire, vacuum booster hose, and the flexible fuel line. Disconnect the spark plug wires, ignition wire brackets, and remove the ignition wires, brackets, and distributor cap from the engine. Disconnect the distributor diaphragm vacuum line at the distributor. Disconnect the governor vacuum lines at the distributor and remove the distributor assembly. Remove the generator belt and generator. Loosen the road draft tube clamp at the elbow. Remove the intake manifold retaining bolts and lift the manifold from the engine.

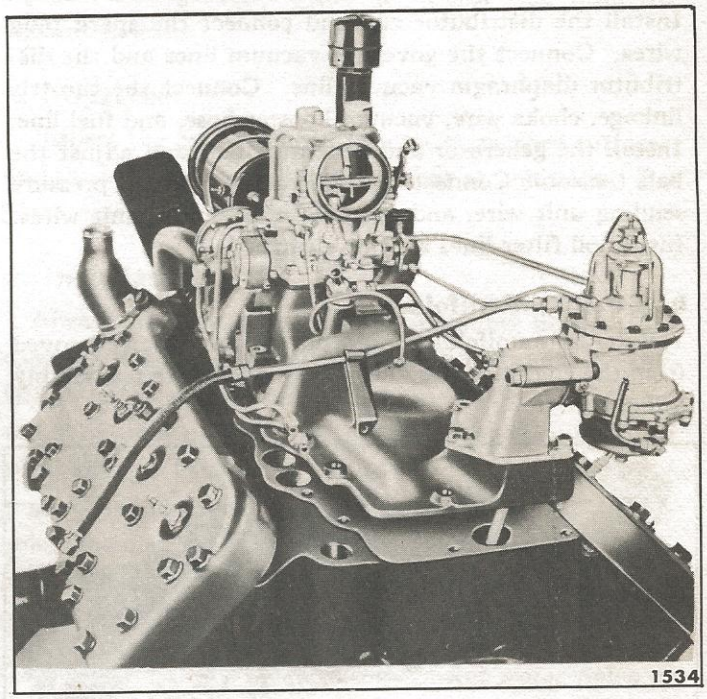


Fig. 94—Intake Manifold Removal

The remaining engine accessories are removed as follows: Remove the fuel line between the fuel pump and carburetor. Remove the vacuum line between the vacuum pump and vacuum booster fitting. Remove the fuel pump, oil filter, and carburetor. Remove the road draft ventilation elbow, oil filter tube, and windshield wiper fitting. Figure 95 shows the intake manifold stripped of all engine accessories.

(2) *CLEANING.* Brush out rust and dirt from the inside of the manifold. Clean oil and grease accumulation from the outside.

(3) *INSPECTION.* Inspect the manifold for cracks and warped gasket surfaces. Replace the manifold if it is cracked or warped. Replace studs with stripped

threads. Check the vacuum booster fitting threads in the manifold.

(4) *INSTALLATION.* Position a new gasket on the block. Align the manifold on the gasket and install one bolt at each end finger tight. If the manifold is disassembled, install the engine as follows: Install vacuum booster fitting, oil filler tube, and road draft tube elbow. Install the carburetor, oil filter, and fuel pump. Install the vacuum line between the vacuum pump and vacuum booster fitting. Install the fuel line between fuel pump and carburetor.

With the above engine accessories in place, install the ignition wire brackets (with ignition wires and distributor cap). Install the manifold retaining bolts and tighten them to 25-30 foot-pounds torque. Tighten the road draft tube clamp. Install the distributor assembly. Install the distributor cap and connect the spark plug wires. Connect the governor vacuum lines and the distributor diaphragm vacuum line. Connect the throttle linkage, choke wire, vacuum booster hose, and fuel line. Install the generator and generator belt and adjust the belt tension. Connect the generator wires, oil pressure sending unit wire, and temperature sending unit wires. Install oil filter lines and air cleaner.

b. Exhaust Manifold.

Exhaust manifolds should not be hot when removed from the engine or they may warp and make reassembly difficult.

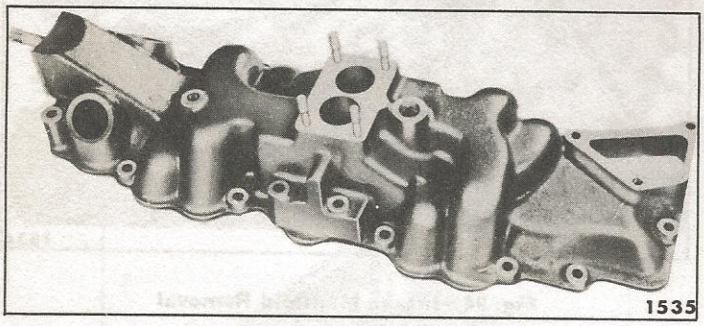


Fig. 95—Intake Manifold

Four ear type washers are used to lock the exhaust manifold bolts into place on late 1950 and 1951 engines. One ear of these washers is bent up against the bolt head and one is bent down against the manifold forming a positive lock. 1949 and early 1950 engines used ordinary lock washers. Individual manifolds are used on each side of the engine (fig. 96).

(1) *REMOVAL.* Disconnect the muffler inlet crossover pipe from the left hand manifold and the muffler inlet pipe from the right hand manifold. Remove the manifold retaining bolts and remove the manifolds.

(2) *CLEANING.* Use a wire brush to remove carbon deposits from the inside of the manifold. Clean the flange and gasket surfaces.

(3) *INSPECTION.* Inspect the manifolds for cracks or warped gasket surfaces. Replace cracked or warped manifolds.

(4) *INSTALLATION.* Always use new gaskets and new lock washers when installing the manifolds. Hold the manifold in place and install the retaining bolts. Tighten the retaining bolts to 25-30 foot-pounds torque. Secure the bolts with the retaining washers. Connect the muffler inlet crossover pipe to the left hand manifold.

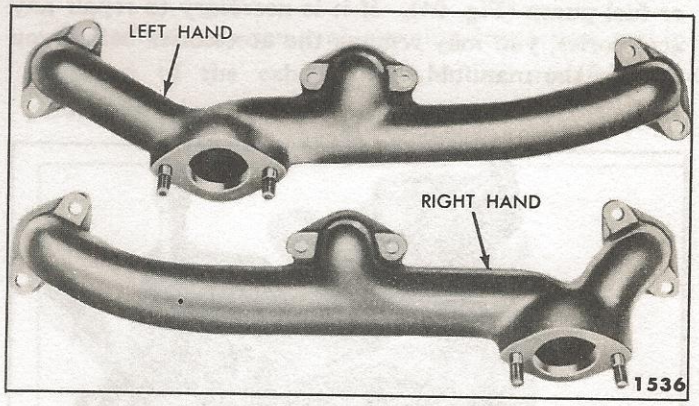


Fig. 96—Exhaust Manifolds

2. CYLINDER HEADS

A complete procedure for the removal, cleaning, inspection, and installation of cylinder heads is given below. The heads are so designed that the coolant enters the rear of the head and flows toward the front. This flow must not be obstructed or inadequate cooling will result.

External water by-pass tubes have been added to late 1950 and 1951 engines to assure even heat control.

An 8EQ engine cylinder head is shown in fig. 97.

a. Removal.

Drain the coolant and disconnect the upper radiator hoses at the cylinder heads. Disconnect the spark plug wires and temperature sending unit wires. Remove the screws at the lower ends of the external water by-pass tubes used on late 1950 and 1951 engines. Loosen the upper fittings and remove the by-pass tubes. The right-hand cylinder head can now be removed by disconnecting the battery ground strap and removing the cylinder head bolts.

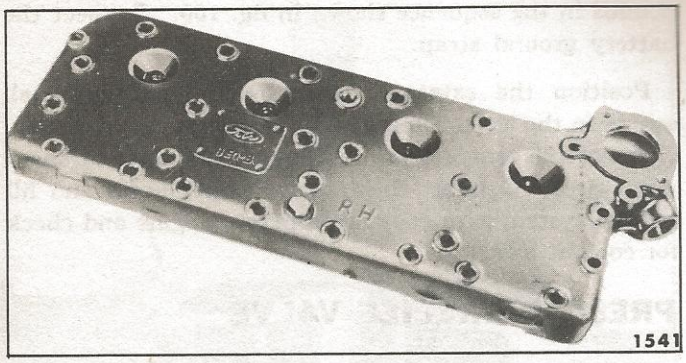


Fig. 97—Cylinder Head

NOTE: *The fuel pump to carburetor vacuum line interferes with removal of the head bolt directly below it. Loosen this bolt and remove it with the head.*

To remove the left-hand cylinder head, first remove the air cleaner. Then disconnect the oil pressure sending unit wire and the oil filter lines (at filter). Remove the cylinder head bolts and cylinder head. The air cleaner support will come off with the left hand cylinder head.

b. Cleaning.

Remove any cabon deposits from the inside of the head by brushing and scraping. Be careful not to scratch the gasket surfaces of the cylinder head when removing old pieces of gasket. Clean all dirt or rust from the coolant holes.

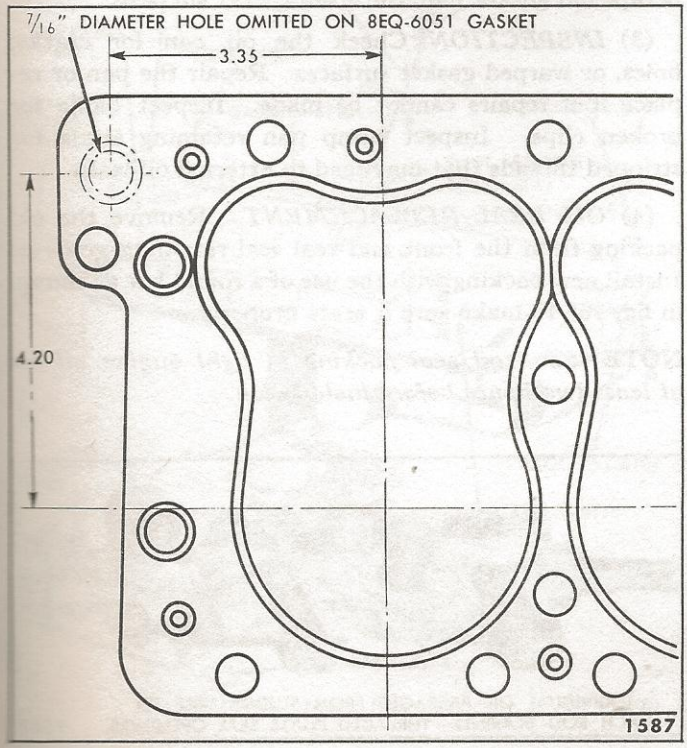


Fig. 98—Cylinder Head Gasket

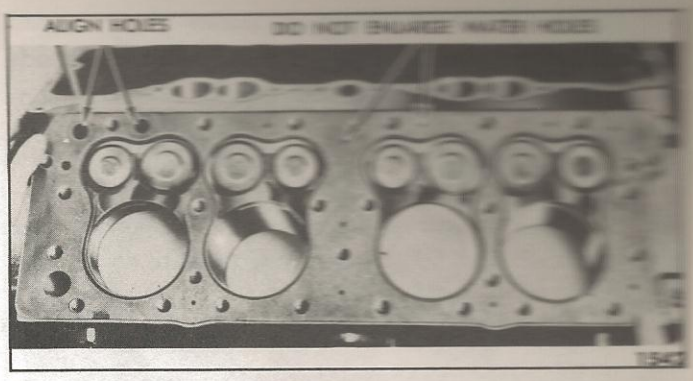


Fig. 99—Cylinder Head Gasket Installation

c. Inspection.

Inspect the cylinder head for cracks, warped surfaces, and raised projections that may occur at bolt holes. Replace cracked or warped heads.

d. Installation.

Always use new gaskets when installing heads. Use cylinder head gaskets OEL-6051 or 8EL-6051-D (fig. 98) on engines which are *not* equipped with the external water by-pass tube and 8EQ-6051 on engines equipped with external water by-pass tubes. The 8EQ-6051 gasket does not have the 7/16 inch internal water by-pass hole shown in fig. 98. Align the water passages with those in both the cylinder head and the cylinder block to insure free water passage.

CAUTION: *Do not enlarge any gasket water holes or overheating of the rear cylinder may result.*

Correct gasket installation is shown in fig. 99.

Place the left-hand cylinder head and gasket on the block. Install one bolt at each end of the head to align

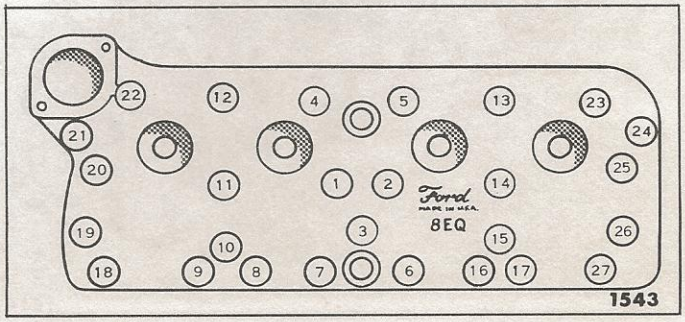


Fig. 100—Cylinder Head Bolt Tightening Sequence

and hold it in the proper position. Install the air cleaner support and torque the head bolts to 65-70 foot-pounds in the sequence shown in fig. 100. Install oil filter. Connect the oil filter lines, oil pressure sending unit wire, and generator wires.

Place the right-hand cylinder head and gasket on the block. Install head bolts and torque them to 65-70 foot-pounds in the sequence shown in fig. 100. Connect the battery ground strap.

Position the external water by-pass tubes, install screws in the lower flanges and tighten the upper fitting. Connect the temperature sending unit wires and spark plug wires. Connect the radiator upper hoses and fill cooling system with coolant. Operate engine and check for coolant leaks.

3. OIL PAN, OIL PUMP, AND PRESSURE RELIEF VALVE

The oil pressure system used in the 8EQ engine is illustrated in fig. 101. After leaving the pump, the oil divides into two paths. In one line the oil flows through the filter and returns to the crankcase. The other line carries the oil to all tappet assemblies. The oil flows from the tappets to the camshaft bearings and then to the crankshaft main bearings through passages in the block. Drilled oil passages through the crankshaft (fig. 102 conduct the oil to the connecting rod bearings. The oil then lubricates the cylinder walls through connecting rod squirt holes and drips back to the crankcase.

A cylinder block oil relief valve located in the forward end of the valve chamber holds the pressure in the hydraulic lifters at 15 P.S.I. (fig. 103). Exhaust oil from this valve flows into the timing gears and returns to the crankcase.

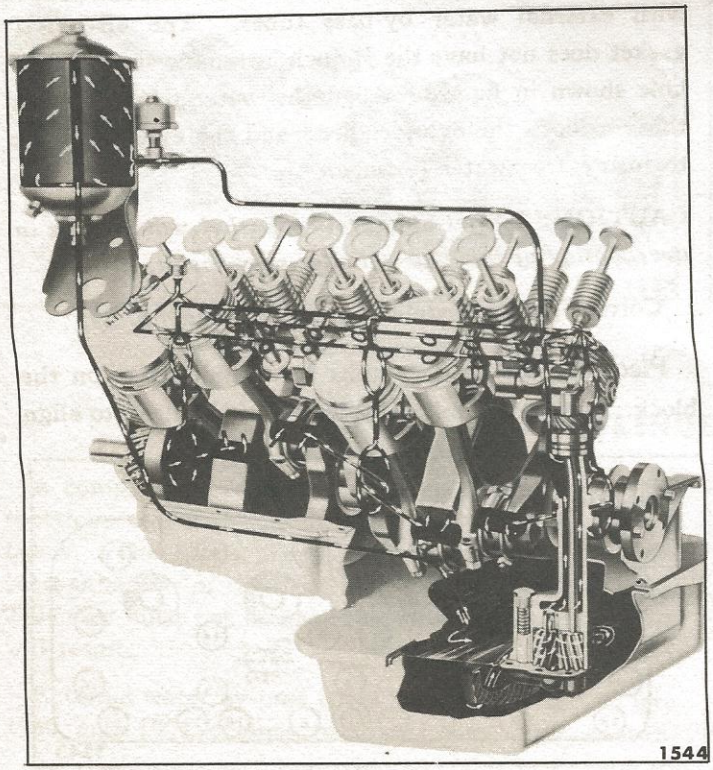


Fig. 101—Oil Pressure System

a. Oil Pan.

The procedure for removing, cleaning, inspecting, and installing the oil pan is described below. A sump pan on the oil pan makes the oil pump accessible for service without removing the oil pan. Fig. 104 shows an exploded view of the oil pan assembly.

(1) *REMOVAL.* Drain the crankcase. Remove the engine dust pan. Disconnect the muffler inlet pipe at both exhaust manifolds and the lower inlet pipe. Disconnect the starter cable at the starter motor and remove the starter motor. Remove the sump pan and the four bottom clutch housing to engine rear plate bolts. Remove the baffle (fig. 105) between the sump pan and oil pan. Remove the oil pan dip stick and tube. Remove the oil pan screws and lower the oil pan from the engine.

(2) *CLEANING.* Wash the pan in a solvent. Remove any dirt or metal particles from the inside of the pan. Scrape old gasket material from gasket surfaces.

(3) *INSPECTION.* Check the oil pan for cracks, holes, or warped gasket surfaces. Repair the pan or replace it if repairs cannot be made. Inspect baffle for broken clips. Inspect sump pan retaining studs for stripped threads that may lead to external oil leaks.

(4) *OIL SEAL REPLACEMENT.* Remove the old packing from the front and real seal retaining grooves. Install new packing with the use of a round bar as shown in fig. 106 to make sure it seats properly.

NOTE: *Soak oil seal packing in light engine oil for at least two hours before installation.*

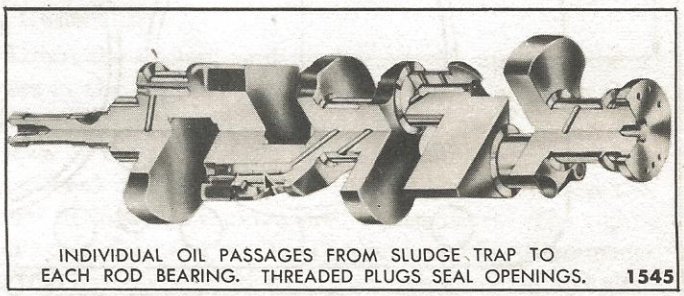


Fig. 102—Crankshaft Oil Passages

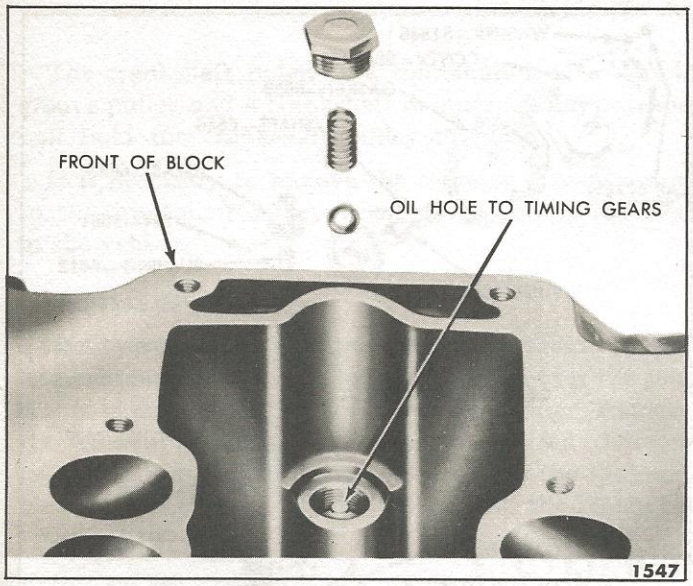


Fig. 103—Oil Pressure Relief Valve

(5) *INSTALLATION.* Use new oil pan gaskets. Tie each gasket to the pan through two bolt holes. Hold the pan in place against the cylinder block and install two screws (finger tight) in each side of the pan. Remove the string ties, install the remaining screws, and tighten them to 15-18 foot-pounds torque. Install the oil pan dip stick tube and dip stick. Install the engine oil pan baffle. Install the sump pan with a new gasket. Install the clutch housing to engine rear plate bolts. Install the starter and connect starter cable. Connect the muffler inlet pipe to the exhaust manifolds. Install the engine dust pan. Fill the crankcase with the proper amount and grade of oil.

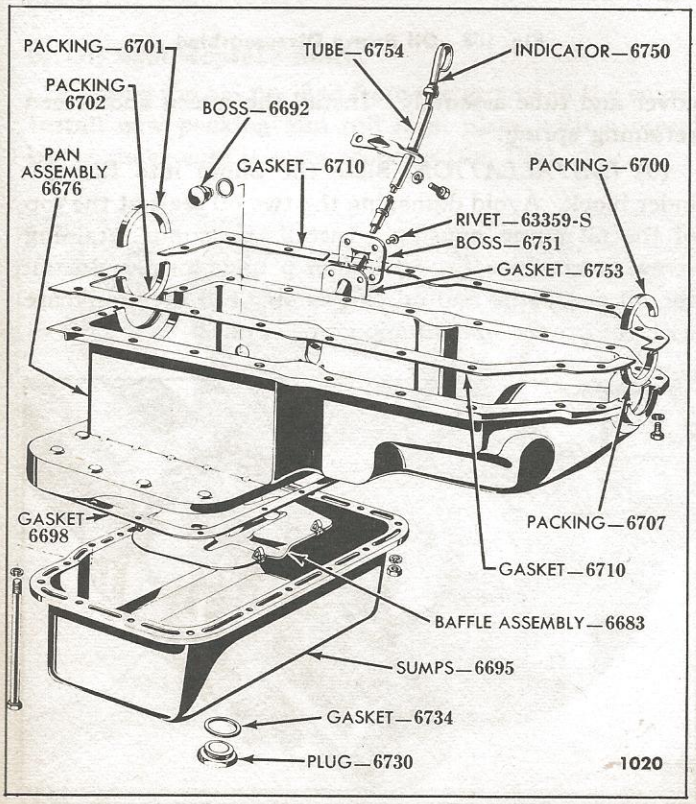


Fig. 104—Engine Oil Pan

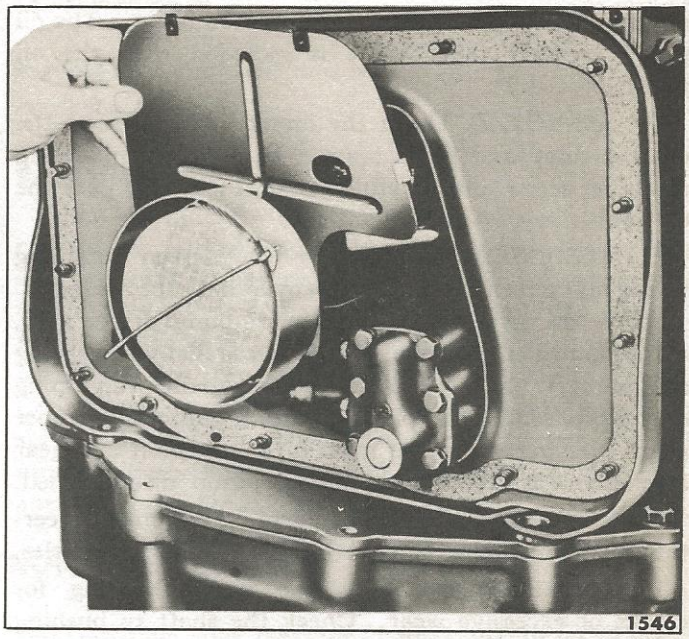


Fig. 105—Removing Engine Oil Pan Baffle

b. Oil Pump and Oil Pressure Relief Valve.

The oil pump (fig. 107) is mounted inside the oil pan at the rear of the engine. The oil pump pressure relief valve is mounted in the oil pump housing. Removal of the oil pan sump makes the oil pump accessible for service.

Oil pump removal, disassembly, cleaning, inspection,

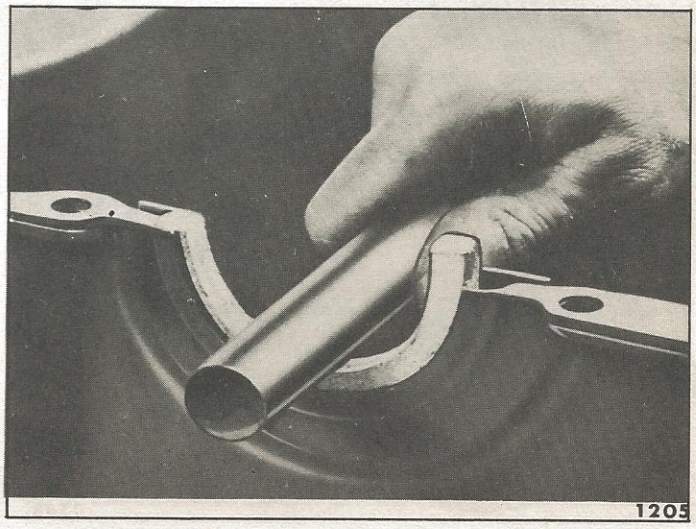


Fig. 106—"Rolling In" Oil Seal Packing

assembly, and installation are presented below. The oil pump pressure relief valve is included with the oil pump procedure.

(1) *REMOVAL.* Drain the crankcase. Remove the oil pan sump and baffle plate. Remove the oil pump retaining screw and carefully guide the pump past the oil pan.

(2) *DISASSEMBLY.* Remove the screen retaining spring and screen. Remove the cover and tube assembly. Remove the oil pump cover plate, oil pump driven gear, oil pump driven gear stud, oil pressure relief valve spring and plunger. Remove the oil pressure relief valve plug and gasket. Drive the pin from the oil pump shaft upper gear. Remove the upper gear, oil pump shaft and gear assembly. Fig. 108 shows the oil pump disassembled.

(3) *CLEANING.* Wash all parts in solvent. Be certain the pump and screen are free of any foreign particles.

(4) *INSPECTION.* Check the pump housing for cracks or excessive wear. Check the shaft to bushing clearance (0.0005 to 0.0025 inch). Check the pump gear teeth for wear. Pump gear to body clearance should measure no greater than 0.005 inch.

Check the oil pressure relief valve spring compression. It should be 12.42 pounds $\pm$ 2 ounces when the spring is compressed to 2.18 inches. Check the condition of the oil seals.

(5) *ASSEMBLY.* Coat all moving parts with engine oil. Slide the gear and shaft assembly into the housing. Install the oil pump shaft upper gear on the pump shaft, tap the pin into place, and peen both ends.

NOTE: *When a new gear and shaft assembly is used, it is necessary to drill the retaining pin hole in the shaft. Set the end clearance (fig. 109) to 0.016 inch and use a number 30 (0.1285) inch drill for the retaining pin hole.*

Install the oil pressure relief valve spring and plunger, driven gear stud, driven gear and cover plate. Torque the cover plate screws to 7-10 foot-pounds. Install the oil pressure relief valve plug with a gasket. Attach the cover and tube assembly. Install the screen and screen retaining spring.

(6) *INSTALLATION.* Slide the pump into the cylinder block. Avoid damaging the two oil seals at the top of the oil pump housing. Install the pump retaining screw and tighten it to 10-15 foot-pounds torque. Install the oil pan baffle and oil pan sump. Fill the crankcase with the proper amount and grade of oil.

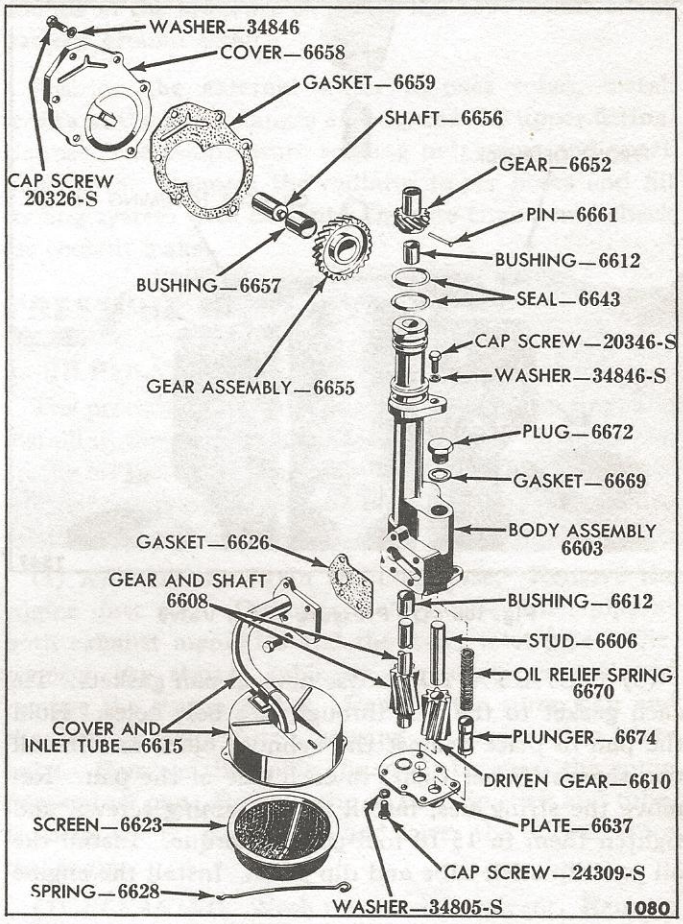


Fig. 108—Oil Pump Disassembled

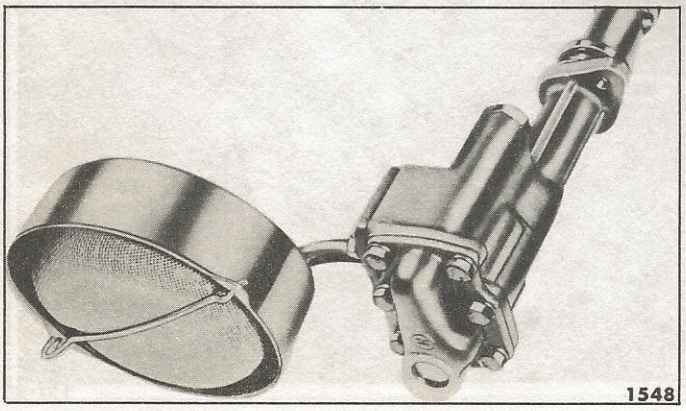


Fig. 107—Oil Pump and Screen Assembly

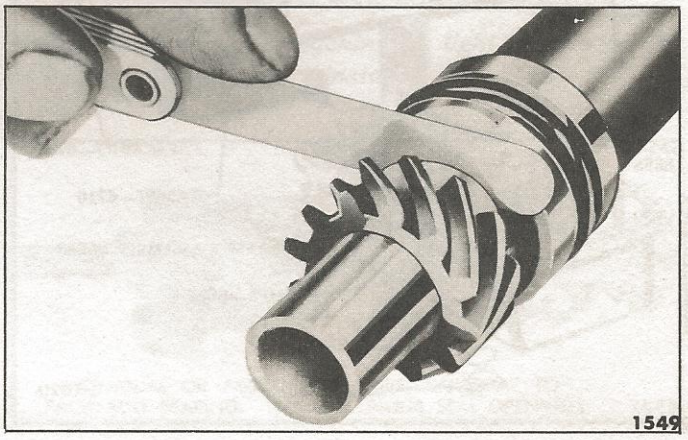


Fig. 109—Oil Pump End Clearance

4. CRANKSHAFT DAMPER

The crankshaft pulley is a combination of a double groove pulley and a crankshaft damper. A keyway and bolt hold the crankshaft pulley in place.

It is necessary to remove the radiator to gain access to the crankshaft pulley when the engine is installed in the vehicle.

a. Removal.

Drain the radiator. Remove the upper radiator hoses and cylinder head to radiator pipe. Disconnect the generator wires and accelerator retarding spring. Remove the fan belt, generator belt, generator and fan. Disconnect the lower radiator hoses and remove the radiator. Remove the pulley retaining bolt, install the pulley removing tool (fig. 110) and remove the pulley from the crankshaft.

b. Installation.

Align the pulley with the keyway and start it on the crankshaft. Install the pulley replacing tool (fig. 111) and press the pulley on the crankshaft. Remove the tool and install the crankshaft retaining bolt and washer. Install the radiator. Connect the lower radiator hoses. Install the fan, generator, generator belt, and fan belt. Connect the generator wires and the accelerator retarding spring. Install the cylinder head to radiator pipes and upper radiator hoses. Fill the cooling system with coolant and check for leaks.

5. CYLINDER FRONT COVER

The upper half of the front oil seal is retained in the engine front cover. The cover is made of cast iron and has a pointer pressed into the forward side for timing the engine.

a. Removal.

Disconnect the generator wires and accelerator retracting spring. Remove the fan belt, generator belt, generator, and fan. Remove the road draft tube. Remove the front cover.

b. Oil Seal Replacement.

Remove the old packing from the groove in the cover. Install new packing and roll it in place with a round bar to make sure it seats properly (fig. 106).

NOTE: *Soak new packing in light engine oil at least two hours before installation.*

c. Installation.

Position the lower edge of the cover first, tap the cover with a soft faced hammer until it seats in the block and install the cover retaining screws. Tighten the screws to 15-18 foot-pounds torque.

CAUTION: *The oil pan gasket may be damaged if the cover plate is not properly installed.*

Install the road draft tube. Install the fan, generator belt, and fan belt. Connect the generator wires and accelerator retracting spring.

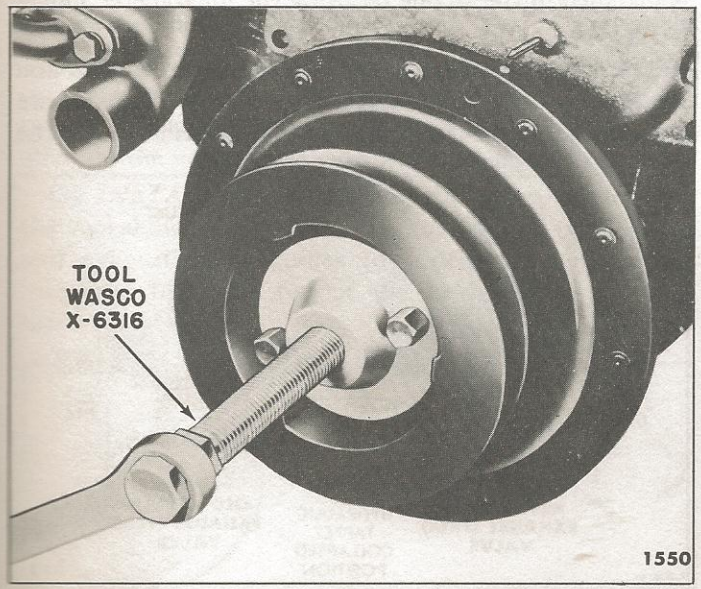


Fig. 110— Removing Crankshaft Pulley

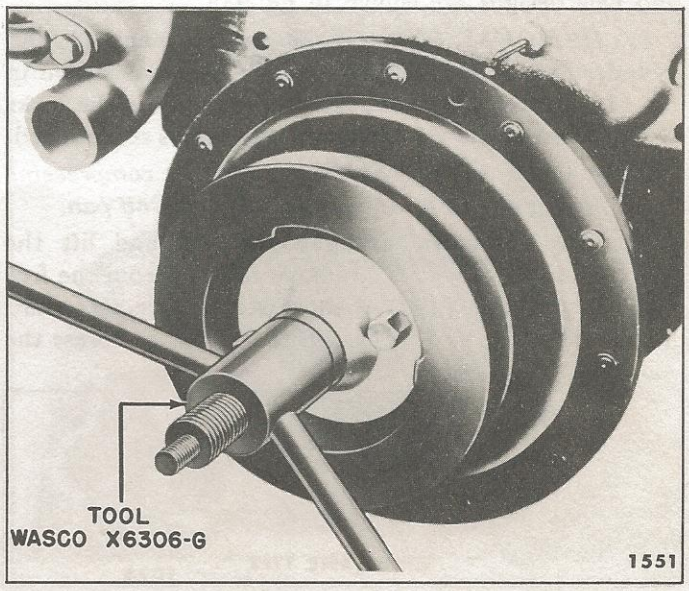


Fig. 111—Installing Crankshaft Pulley

6. VALVES, VALVE GUIDES, HYDRAULIC LIFTERS, AND TAPPETS

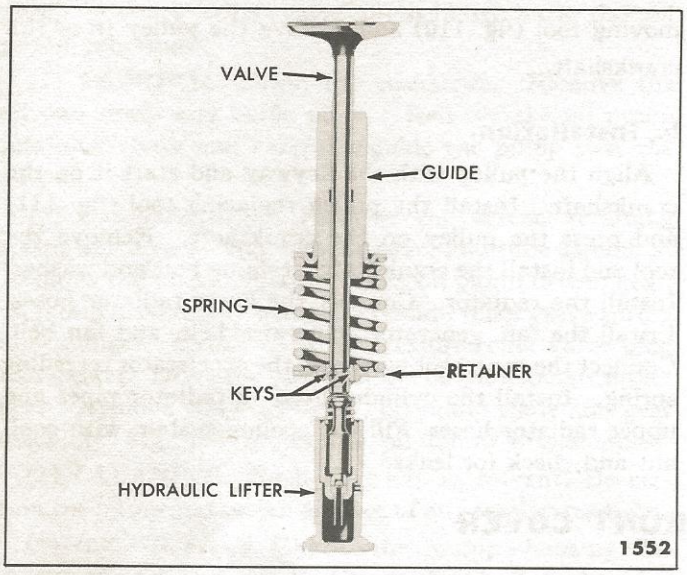


Fig. 112—Valve and Hydraulic Lifter

Early 1949 engines are equipped with hydraulic valve lifters. A cutaway view of the valve and hydraulic lifter assembly is shown in fig. 112. Adjustable type tappets (fig. 113) are used in late 1949, 1950, and 1951 engines.

a. Valves.

Intake and exhaust valves (fig. 114) are not interchangeable. Each valve should be marked or put in a rack so they can be installed in the same valve port from which they are removed.

Exhaust free valves are installed in engines starting in February 1949. A change in the cap, valve, and retainer design was made in April, 1950. Both the old and new designs are shown in fig. 115.

(1) *REMOVAL.* Remove the intake manifold and cylinder heads. Compress the valve spring as shown in fig. 118 and remove the locks. In most cases the locks will fall free of the valve when the spring is compressed.

NOTE: *Cover oil passage holes before compressing valve spring or the locks may fall into the oil pan.*

Remove the valve spring compressor and lift the valve from the guide. To remove the cap from the free valve installation insert a short stem valve (standard length valve cut to 3 inches) in the guide, compress the

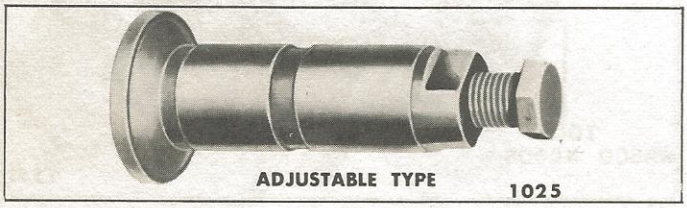


Fig. 113—Adjustable Type Tappet

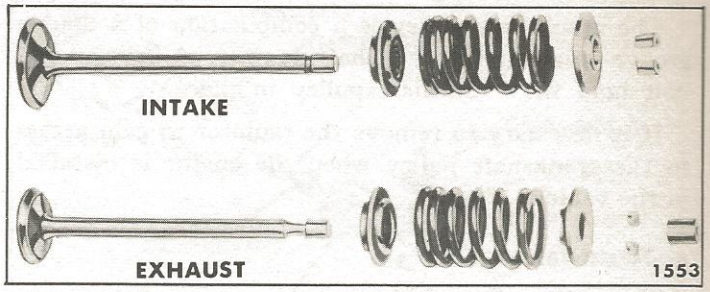


Fig. 114—Valves, Springs, and Retainers

valve spring and remove the cap. Remove the compressing tool and short valve. Remove the valve spring and retainers.

(2) *INSTALLATION.* Install the retainers and springs. Install the exhaust free valve caps using the compressing tool and short stem valve. Successful free valve operation depends on the clearance between the end of the valve stem and the inside of the cap. Fig. 115 illustrates the free type valve installation and the proper clearances.

CAUTION: *If the cap inside depth is too shallow or the length between the face of the undercut and the end of the valve stem is too long, the cap will not lift the spring pressure from the valve and consequently the valve will not rotate. On the other hand, if the cap depth is too deep or the length between the face of the undercut and the valve stem end is too short, the clearance will be excessive, resulting in a high wear rate between cap and keys and possible valve breakage.*

The exhaust free valve to cap clearance of 0.0002-0.004 inch can be measured accurately before the valve is installed in the engine by using the micrometer shown in fig. 116.

The clearance between the end of the valve stem and the inside of the cap can be checked after the parts are assembled in the engine. Rotate the crankshaft until the

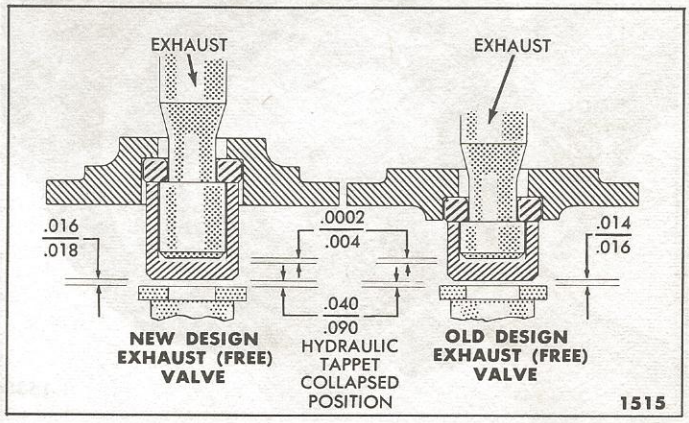


Fig. 115—Exhaust Free Type Valve Installation

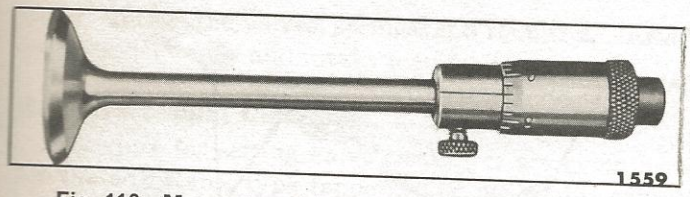


Fig. 116—Measuring Exhaust Valve to Cap Clearance

valve is off the seat and can be rotated freely by thumb and forefinger in the lifted position. In this free position the actual clearance can be measured. Locate an indicator on the valve head and note the reading while the valve is pushed in and pulled out. This clearance can be 0.0002 inch (providing the value turns freely) but not over 0.004 inch maximum vertical movement. If the vertical movement exceeds 0.004 inch, polish the open end of the cap with a piece of fine emery cloth to bring the vertical movement of the valve to specified clearance. If the vertical movement is less than the specified amount (.0002 inch) grind off the end of the valve stem to provide the proper clearance.

An exhaust valve locking kit 8EQ 6534 (fig. 117) is available for replacing the locks, cap, and lower spring retainer.

Install the intake and exhaust valve locks as shown in figs. 118 and 119. Install the intake manifold and cylinder heads.

b. Guides.

Valve guides are the pressed-in type. Damage to the guide and block is avoided by using special tools when replacing guides.

(1) *INSPECTION.* Measure the valve guide inside diameter. The difference between the valve stem diameter and the guide inside diameter should not exceed 0.0037 inch. Replace guides that show excessive wear or are bellmouthed.

(2) *REMOVAL.* Remove the intake manifold and cylinder heads. Remove the valves, springs, and retainers. Remove the adjusting screw from the tappet. Remove the valve guide with the tool shown in fig. 120

(3) *INSTALLATION.* Install the valve guide with the tool shown in fig. 121. This tool installs both intake and exhaust valve guides to a depth of 1.28 inches measured from the top of the guide to the cylinder block surface.

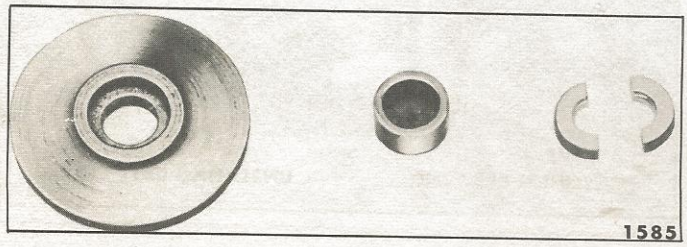


Fig. 117—Exhaust Valve Locking Kit

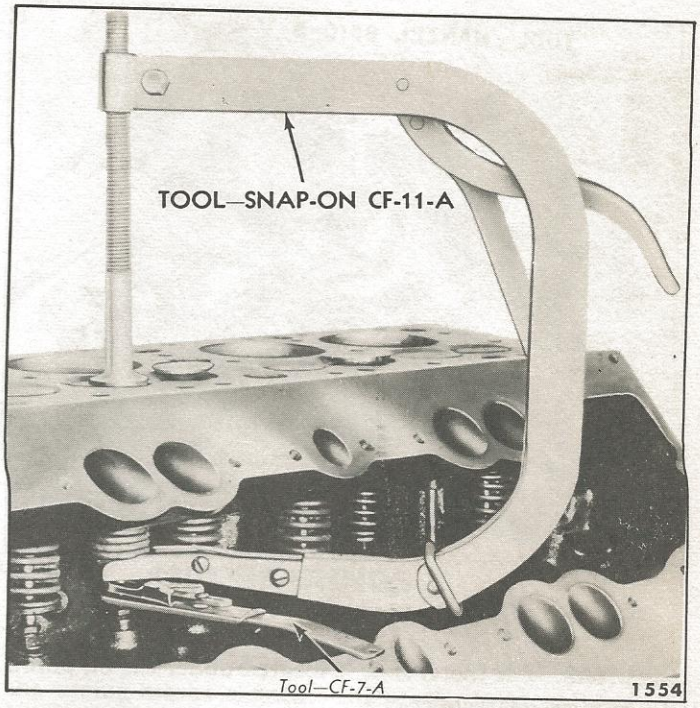


Fig. 118—Installing Intake Valve Locks

Install the valves, springs, and retainers. Install the intake manifold and cylinder heads.

c. Hydraulic Lifter.

Auxiliary oil lines are used to supply oil to the valve lifters from the engine lubricating system. The oil pressure to the lifters is reduced by passing the oil through the metering hole at the point of entry into the auxiliary oil lines. This restriction in combination with the oil pressure relief valve at the forward end of the valve chamber reduces the pressure for proper operation of

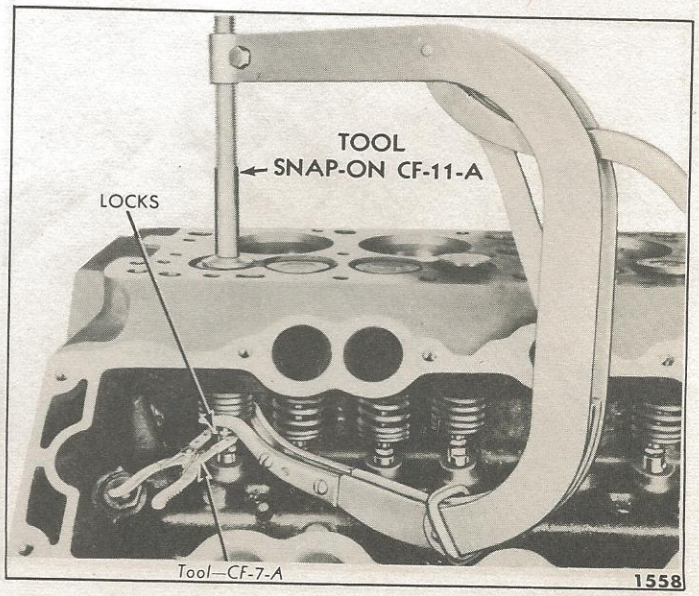


Fig. 119—Installing Exhaust Valve Locks



Fig. 120—Removing Valve Guide

the lifters. The meter hole is located under the oil pump drive idler gear cover.

To remove the hydraulic lifter body, it is necessary to remove the camshaft. To remove only the hydraulic cylinder assembly, it is necessary to remove only the valve. Fig. 122 shows the hydraulic lifter disassembled.

(1) *REMOVAL.* Remove the cylinder heads and intake manifold. Remove the valves, springs, and retainers. Lift the plunger and cylinder assembly from the lifter body.

NOTE: *The plunger and cylinder assembly should slide freely from the lifter body. If an excessive deposit of sludge or dirt prevents it from being so, it is necessary to remove the camshaft and remove the entire hydraulic lifter.*

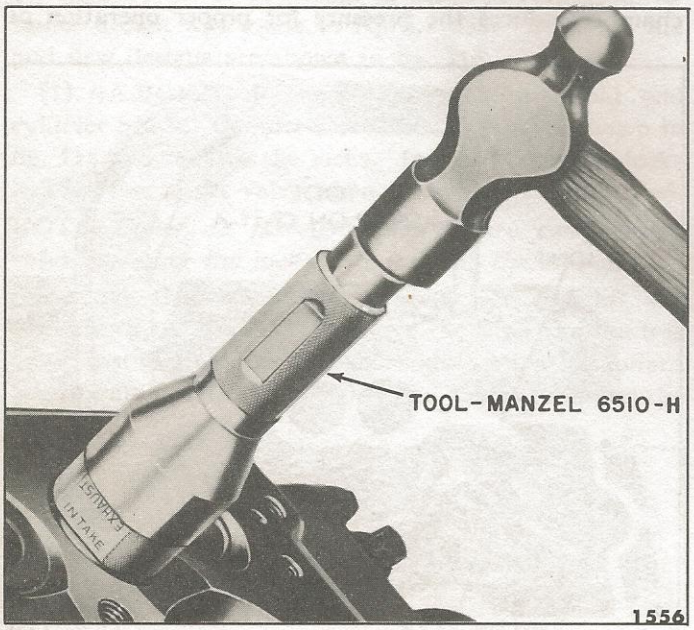


Fig. 121—Installing Valve Guide

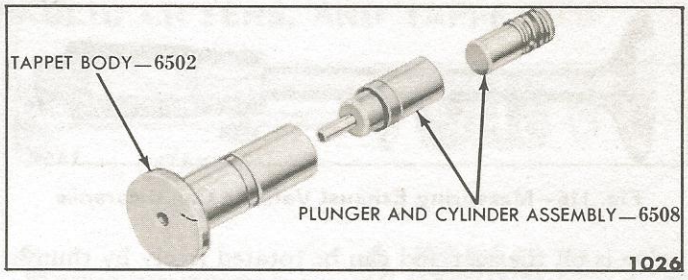


Fig. 122—Hydraulic Valve Lifter Disassembled

Immerse the lifter in solvent and wash until the cylinder and body separate. Disengage the spring by twisting the plunger and spring clockwise and pulling outward simultaneously. Bleed the hydraulic lifter by inserting a wooden stick in the oil inlet hole (fig. 123) to unseat the ball check valve and allow the oil to drain. If the plunger cannot be removed after bleeding, discard the unit.

NOTE: *Do not interchange hydraulic lifter parts. The plunger and cylinder are matched to a selective fit at time of assembly.*

(2) *CLEANING.* Wash all parts thoroughly with solvent and dry immediately with compressed air.

(3) *INSPECTION.* Examine the plunger for scored surfaces and check for a free fit between cylinder and plunger. Inspect the body for wear, pits, and scores. Replace defective parts. Test for free movement of the ball check valve (fig. 123).

(4) *LIFTER TEST.* Push the plunger into the cylinder quickly then release the pressure. If the plunger rises, the unit is operative (fig. 123).

(5) *INSTALLATION.* Install the plunger in the cylinder and the cylinder in the body. If the lifters were removed, install the valve lifter and camshaft in the

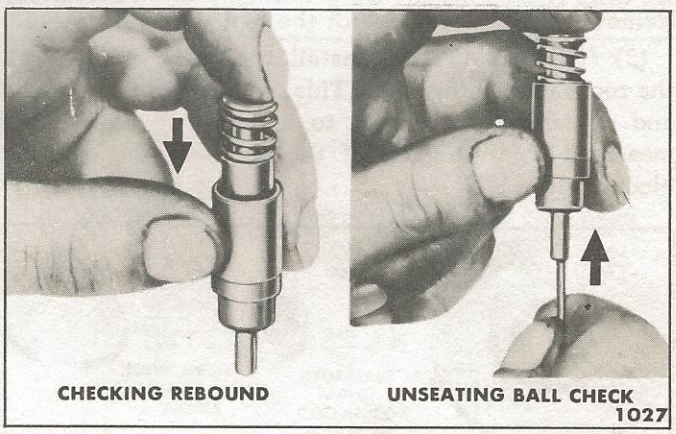


Fig. 123—Testing Hydraulic Lifter

block. Install the valves, springs, and retainers. Install the cylinder heads and intake manifold.

d. Valve Tappet Clearance.

Procedure for setting valve clearances are given here for the adjustable type tappet. The adjustable tappet has a self-locking screw. The hydraulic lifter is self-adjusting and it is only necessary to check the clearance.

(1) *ADJUSTABLE TYPE TAPPET.* Remove the intake manifold to make tappet adjustments. Valve clearance is set as shown in fig. 124 when the engine is cold. The valve clearance should be:

	1949 and Early 1950	Late 1950 and 1951
Intake	0.010-0.012 inch	0.010-0.012 inch
Exhaust	0.014-0.016 inch	0.016-0.018 inch

(2) *HYDRAULIC VALVE LIFTER.* Remove the intake manifold. Rotate the crankshaft until the lifter is on the heel of the cam. Compress the plunger to the bottom of its stroke and check the valve stem to plunger clearance. This clearance should be 0.040-0.090 inch.

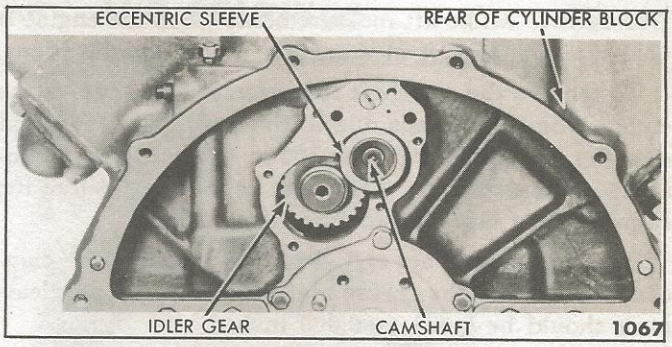


Fig. 125—Fuel Pump Eccentric Sleeve Location

7. CAMSHAFT GEAR, CAMSHAFT, AND BEARINGS

Procedures for removal and installation of the camshaft gear, camshaft, and camshaft bearings are given below. The camshaft gear can be removed with the engine in the truck. To remove the camshaft or replace the camshaft bearings it is necessary to remove the engine.

a. Camshaft Gear Replacement.

The camshaft gear is an aluminum bolt-on type. The bolt holes are spaced irregularly so the gear cannot be installed improperly. Four bolts hold the gear to the camshaft flange.

(1) *REMOVAL.* Disconnect the generator wires and accelerator retracting spring. Remove the fan belt, generator belt, generator, and fan. Remove the road draft tube and front cover. Remove camshaft gear retaining bolts, locking ring, and camshaft gear.

(2) *INSPECTION.* Check the gear for cracks and chipped teeth. Check the backlash. If backlash is excessive, replace the gear with an oversize gear. Gears are available in 0.006 and 0.012 inch oversizes.

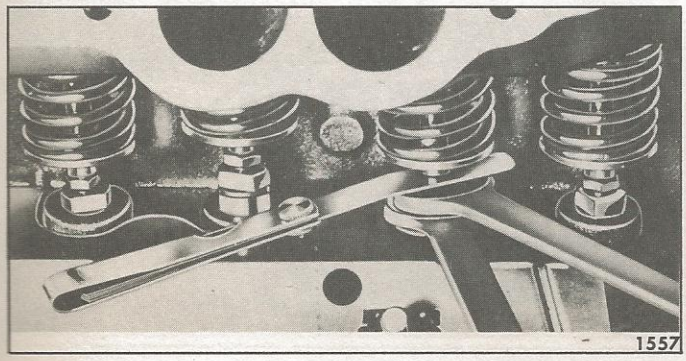


Fig. 124—Setting Valve Clearance

(3) *INSTALLATION.* Install the camshaft gear with the timing marks aligned. Install the lock ring and retaining bolts. Tighten the bolts to 15-18 foot-pounds torque. Bend the lock ring tabs against the head of each bolt. Install the engine front cover. Tighten the bolts to 15-18 foot-pounds torque. Install the road draft tube. Install the fan, generator, generator belt, and fan belt. Connect the generator wires and accelerator retracting spring.

b. Camshaft Replacement.

It will be necessary to replace the camshaft when the cam lobes are worn to such an extent that the valve lift is less than 0.3375 inch for old design exhaust free valves (fig. 115), and 0.3315 inch for the new design exhaust

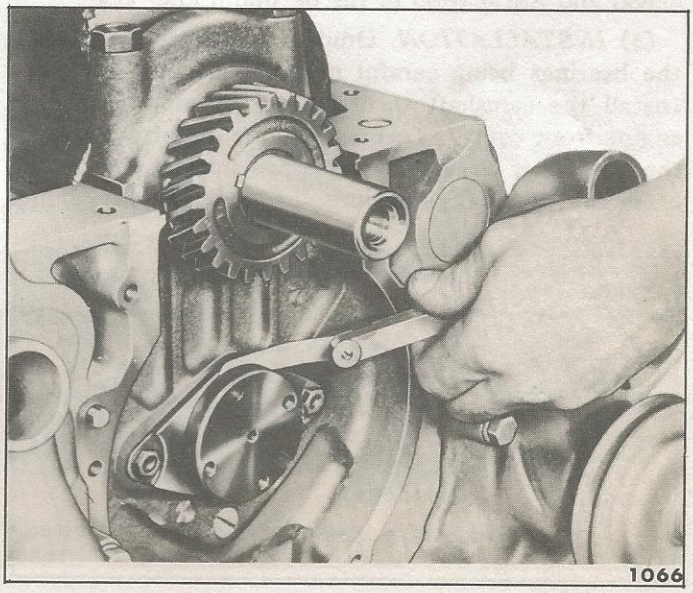


Fig. 126—Checking Camshaft End Clearance

free valves. Make lift measurements when the engine is cold and the tappet clearance is within specifications.

To remove the camshaft it is necessary to remove the engine from the chassis due to the eccentric sleeve that operates the fuel pump push rod at the rear of the camshaft. This sleeve (fig. 125) must be removed before the camshaft can be removed from the engine.

Check the camshaft end clearance between the camshaft flange and the thrust plate (fig. 126). This clearance should be 0.003 to 0.006 inch.

(1) *REMOVAL.* Remove the engine from the chassis. Remove the cylinder heads and intake manifold. Remove the valve assemblies or block the valves in the open position. Remove the flywheel housing, clutch pressure plate assembly and disc, and flywheel. Remove the oil pump drive cover and fuel pump eccentric sleeve. Invert the engine so the tappets will fall away from the camshaft, or with the engine upright, pull the tappets away from the camshaft and hold them in place with rubber bands. Remove the engine front cover, camshaft gear and camshaft thrust plate. Turn the camshaft away from the oil pump idler gear, and remove the camshaft from the engine. Fig. 127 shows the camshaft and related parts disassembled.

CAUTION: *Exercise care to avoid gouging the camshaft bearings with the cam lobes when removing the camshaft.*

(2) *INSPECTION.* Inspect the camshaft journal surfaces for grooves or scratches. Chech the camshaft runout by setting the end journals in "V" blocks and using a dial indicator on the center journal. Runout should not exceed 0.005 inch. Inspect the oil pump drive gear and oil pump idler gear for worn, chipped, or broken teeth. Replace gears if worn or broken. Figure 128 shows removal and installation of the oil pump idler gear.

(3) *INSTALLATION.* Guide the camshaft through the bearings being careful not to gouge the bearings. Install the camshaft thrust plate, camshaft gear and engine front cover. Turn the engine upright or release the tappets if the engine remained upright during the camshaft removal procedure. Install the fuel pump eccentric sleeve and oil pump drive cover. Install the flywheel, clutch pressure plate assembly and disc, and flywheel housing. Tighten the flywheel bolts to 75-85 foot-pounds torque. Install valve assemblies or remove blocks from under the valve heads. Install the cylinder heads and intake manifold. Tighten the cylinder head bolts to 65-70 foot-pounds torque and the intake manifold bolts to 25-30 foot-pounds torque. Install the engine in the chassis.

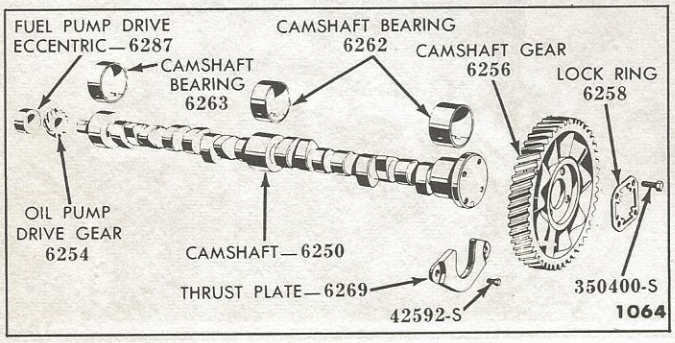


Fig. 127—Camshaft and Related Parts

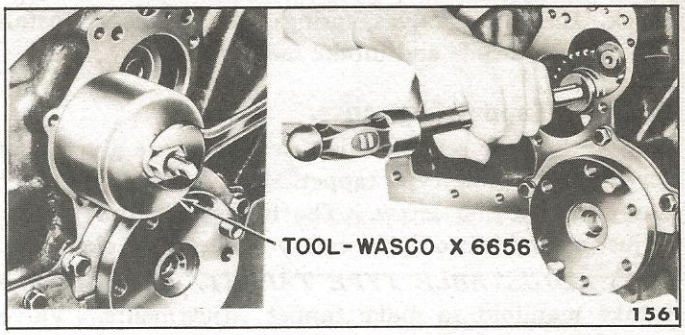


Fig. 128—Oil Pump Idler Gear

c. Camshaft Bearing Replacement.

Under normal usage the camshaft bearings will not need replacement. They should be replaced if they have been damaged due to lack of lubrication or worn because of severe usage. It is necessary to remove the engine from the chassis and then disassemble it to gain access to the camshaft bearings.

(1) *REMOVAL.* Remove the shaft, oil pan, and oil pump. Disconnect the connecting rods and remove the piston and rod assemblies. Remove the main bearing caps and crankshaft. Remove the tappets. Tap the bearings out as shown in fig. 129.

(2) *INSTALLATION.* Replace the new bearings with the tool shown in fig. 129. Install the tappets, crankshaft, and main bearing caps. Tighten the main bearing bolts to 120-130 foot-pounds torque. Install the piston and rod assemblies. Fasten the connecting rods to the crankshaft. Tighten the connecting rod nuts to 52-60 foot-pounds torque. Install the oil pump, oil pan, and camshaft.

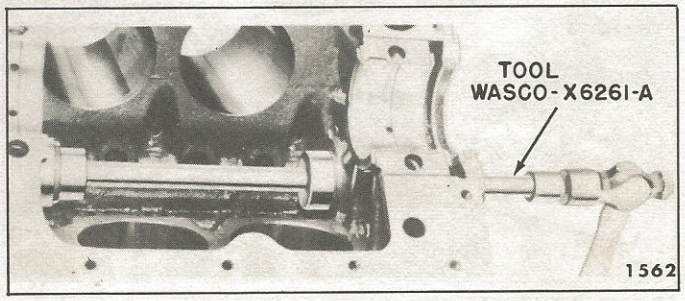


Fig. 129—Replacing Camshaft Bearings

8. FLYWHEEL, CRANKSHAFT, AND BEARINGS

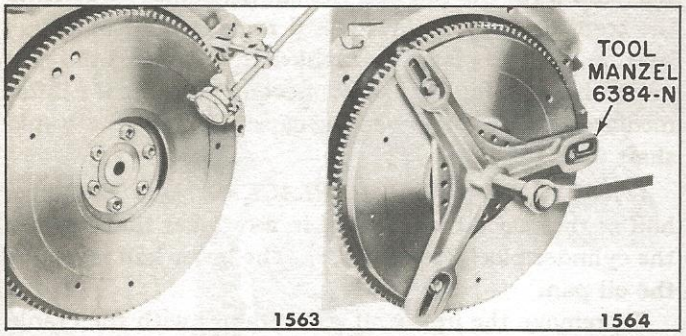


Fig. 130—Checking Flywheel Runout

Fig. 131—Removing Flywheel

The procedures given in this section cover the removal, inspection, repair and installation of the crankshaft, rear oil seal, main bearings, crankshaft gear, and flywheel.

a. Flywheel.

The flywheel is mounted on the crankshaft rear flange. The rear face of the flywheel has a friction surface for clutch plate engagement. The starter ring gear is shrunk to the flywheel and can be removed by relieving the fit.

(1) *INSPECTION.* Check the flywheel runout (fig. 130). The runout should not exceed 0.005 inch. If the runout is excessive, remove the flywheel and check the crankshaft flange runout. If the flange is at fault replace the crankshaft. Replace or machine the flywheel if the crankshaft flange runs true.

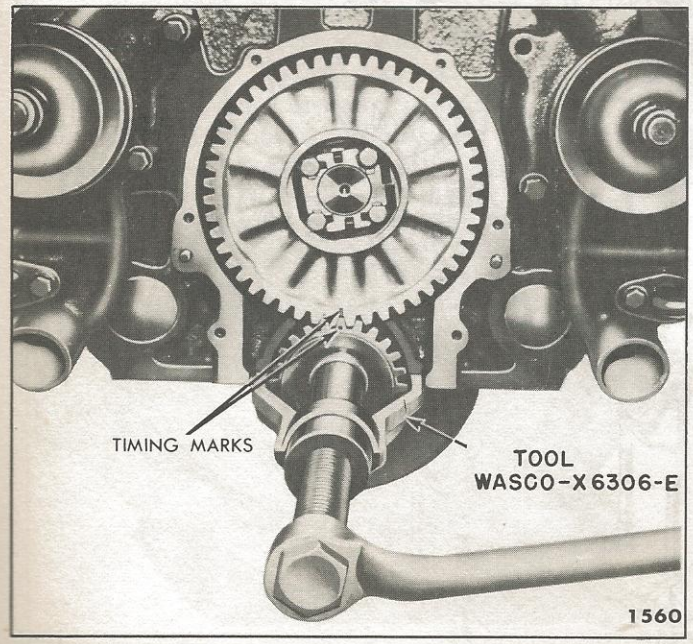


Fig. 132—Removing Crankshaft Gear

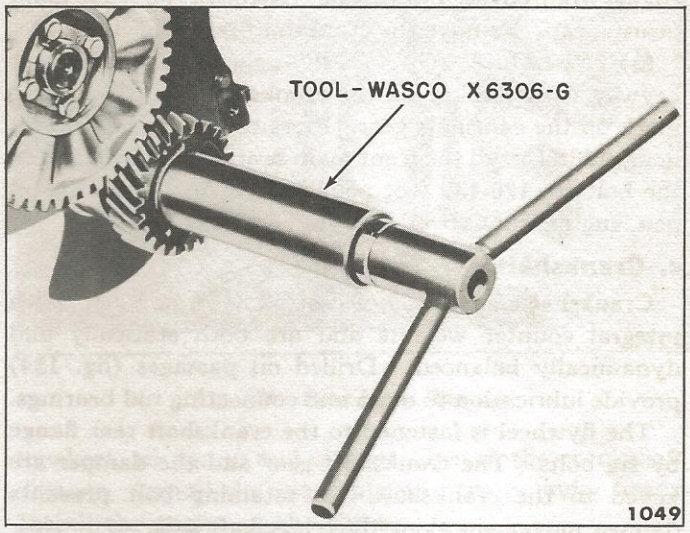


Fig. 133—Installing Crankshaft Gear

Inspect the flywheel ring gear for cracks and worn, chipped, or broken teeth. Check the ring gear runout. If the runout exceeds 0.010 inch, replace the ring gear.

(2) *REMOVAL.* Remove the engine from the chassis. Remove the starter, flywheel housing, and clutch pressure plate and disc. Remove the flywheel retaining bolts and locking ring. Pull the flywheel as shown in fig. 131.

(3) *INSTALLATION.* Align the flywheel on the dowel pins, install the locking ring, and install the bolts. Torque the bolts to 75-85 foot-pounds. Install the clutch pressure plate assembly and disc. Tighten the bolts to 15-18 foot-pounds. Install the flywheel housing and tighten the bolts to 45-50 foot-pounds torque. Install the starter and tighten the starter bolts to 15-20 foot-pounds torque.

b. Crankshaft Gear.

The crankshaft gear is pressed on the crankshaft and keyed in place. A timing mark on one tooth of this gear is used in conjunction with the camshaft gear timing mark for timing the engine. These timing marks are shown in fig. 132

(1) *INSPECTION.* Check the gear for worn, chipped, or broken teeth and replace if necessary.

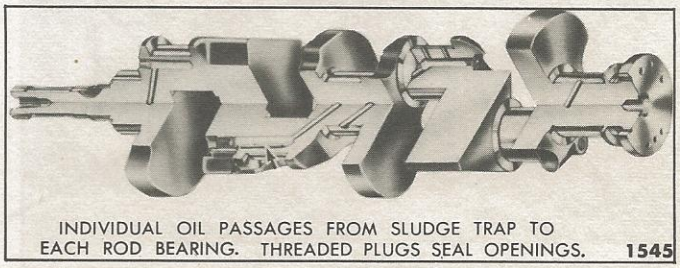


Fig. 134—Crankshaft Oil Passages

(2) *REMOVAL.* Remove the crankshaft damper, engine front cover, and oil pan. Remove the front main bearing cap. Remove the crankshaft gear (fig. 132).

(3) *INSTALLATION.* Align the crankshaft gear keyway with the key on the crankshaft and the timing mark on the camshaft gear. Press the gear on as shown in fig. 133. Install the front main bearing cap and tighten the bolts to 120-130 foot-pounds torque. Install the oil pan, engine front cover, and crankshaft damper.

c. Crankshaft.

Crankshafts are made of cast alloy forging steel with integral counter weights and are both statically and dynamically balanced. Drilled oil passages (fig. 134) provide lubrication to main and connecting rod bearings.

The flywheel is fastened to the crankshaft rear flange by six bolts. The crankshaft gear and the damper are keyed to the crankshaft. A retaining bolt prevents damper movement along the crankshaft axis.

Procedures for crankshaft removal, repair, and installation are given here. Fig. 135 shows the crankshaft and its related parts.

(1) *REMOVAL.* Remove the engine from the chassis and mount it on an engine work stand. Remove the spark plugs from the cylinder heads. Remove the oil pan, oil pump, flywheel and engine rear plate. Remove the crankshaft damper, engine front cover, and oil slinger. Invert the engine. Disconnect the connecting rods and push the rod and piston assemblies away from the crankshaft. Disconnect and remove the front main bearing cap. Remove the crankshaft gear with the gear puller shown in fig. 132. Disconnect and remove the intermediate and rear main bearing caps. Remove the crankshaft from the block.

(2) *REAR OIL SEAL REPLACEMENT.* The upper half of the rear oil seal is held in a retainer that bolts to the cylinder block rear surface. The lower half is held in the oil pan.

To remove the upper oil seal retainer with the crankshaft in place, it is necessary to remove the engine from the chassis and remove the oil pan, flywheel, engine rear plate, and oil pump drive cover. Remove the retainer by rotating it around the crankshaft as shown in fig. 136. Remove the packing and clean the retainer groove. It is not necessary to remove the oil pump drive cover if the crankshaft is removed.

NOTE: *Soak new packing in engine oil for at least two hours before installing.*

"Roll" the new packing into the retainer groove (fig. 137) and check to see that the packing ends come flush with the retainer ends. Incorrect packing length may result in oil leaking from the flywheel housing.

Rotate the retainer around the crankshaft into place.

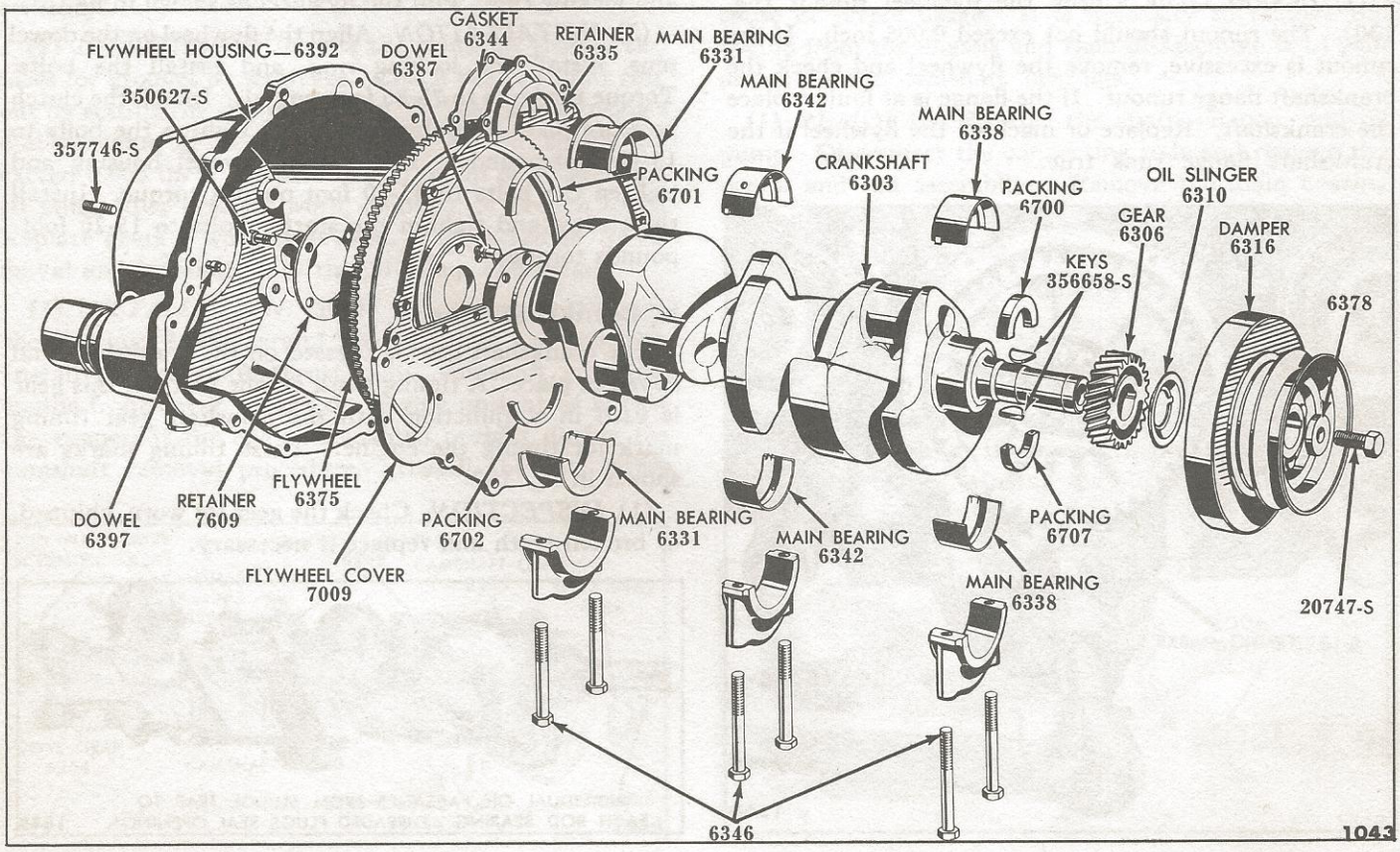


Fig. 135—Crankshaft and Related Parts

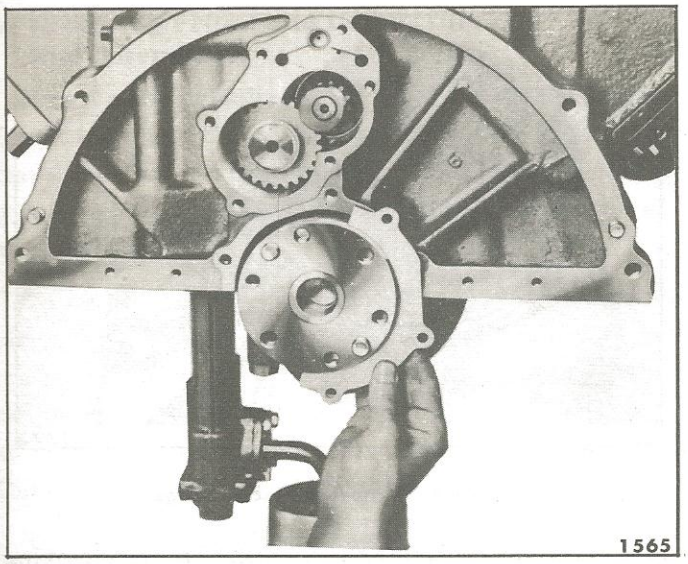


Fig. 136—Removing Rear Oil Seal Retainer

Install the retainer bolts and tighten them to 5-8 foot-pounds torque. Install the oil pump drive cover and tighten the bolts to 7-10 foot-pounds torque. Install the engine rear plate and tighten the bolts to 50-60 foot-pounds torque. Install the flywheel and oil pan. Install the engine in the chassis.

(3) *INSTALLATION.* Install the crankshaft gear on the crankshaft. With the engine inverted on the work stand, lay the crankshaft in place on the upper main bearings.

NOTE: *Be sure the timing marks on the timing gears are aligned.*

Install the main bearing caps and tighten the bolts to 120-130 foot-pounds torque. Fasten the connecting rods to the crankshaft. Tighten connecting rod nuts to 52-60 foot-pounds torque. Install the oil slinger and engine front cover. Position the engine rear plate and install and torque the bolts to 50-60 foot-pounds. Install the flywheel, oil pump, and oil pan. Install the crankshaft damper. Install the spark plugs in the cylinder heads. Install the engine in the chassis.

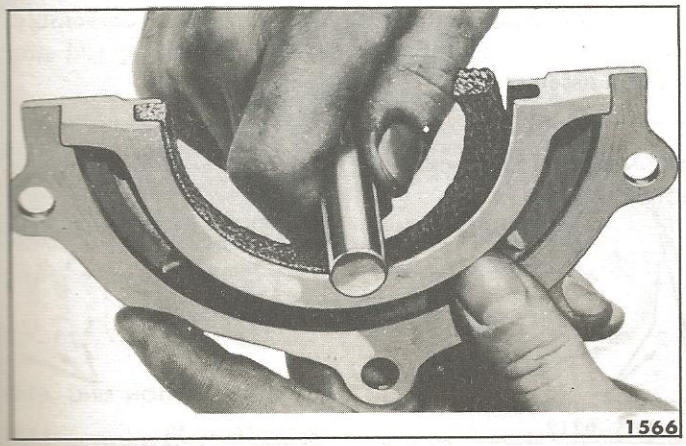


Fig. 137—"Rolling" Packing Into Retainer Groove

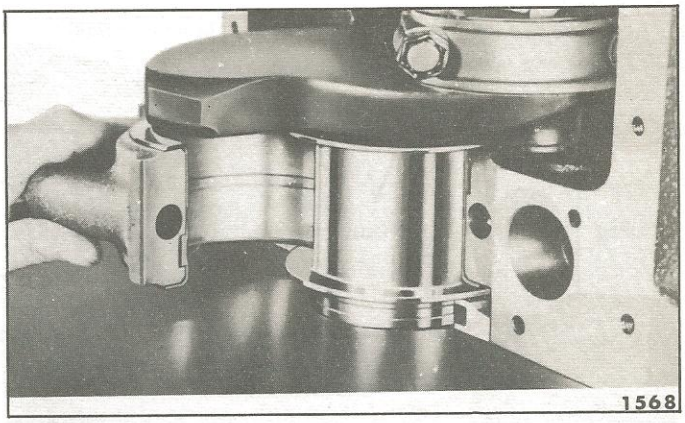


Fig. 138—Rear Main Bearing

d. Main Bearing Replacement.

The main bearing inserts are held in place by indentations on the end of the inserts which locate themselves in the machined notches in the cylinder block and cap.

Main bearings have a copper-lead overlay on a steel back. If this overlay becomes damaged, the insert should be replaced.

The rear main bearing has flanges that control crankshaft end play. Excessive crankshaft end play (over 0.008 inch) requires replacement of the rear main bearing. Fig. 138 shows the rear main bearing insert location in both bearing cap and block. The indentations prevent the bearings from rotating with the crankshaft. Crankshaft longitudinal thrust is transmitted through the bearing flange to the cylinder block.

Main bearing inserts are easily accessible when the crankshaft has been removed. The procedure for removing and installing the bearings with the crankshaft in the engine is given below.

(1) *REPLACEMENT WITHOUT REMOVING CRANKSHAFT.* Remove the oil pan and oil pump.

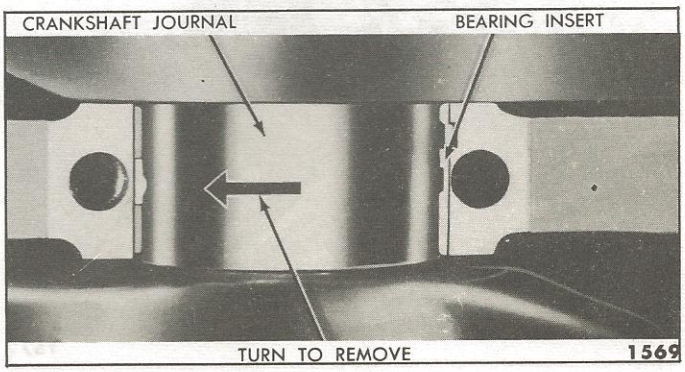


Fig. 139—Removing Main Bearing

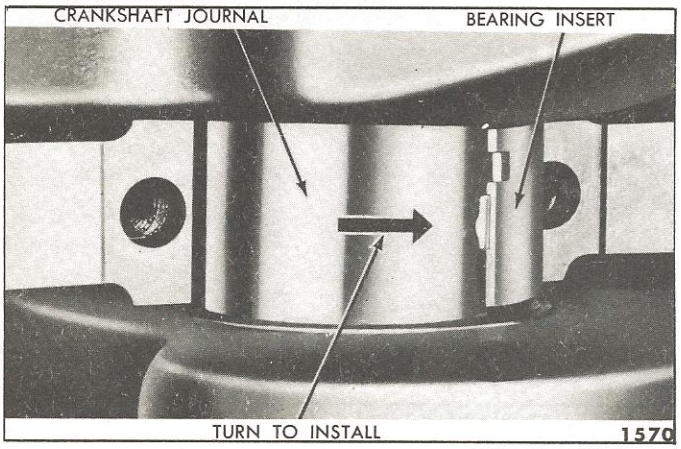


Fig. 140—Installing Main Bearing

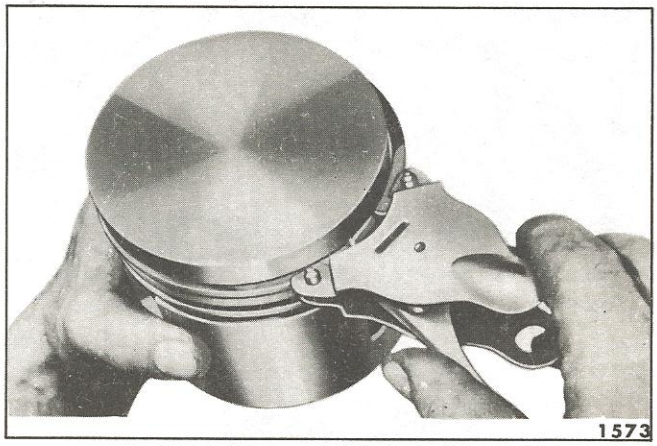


Fig. 142—Removing Piston Rings

Remove one bearing cap; leave the other two tight. Insert the bearing removing tool in the crankshaft oil hole and rotate the crankshaft so the removing tool presses on the plain end of the bearing (fig. 139). Continue rotating the crankshaft until the bearing is displaced.

Coat the new bearing with a film of engine oil. Start the plain end of the bearing between the crankshaft journal and the block. Rotate the crankshaft so the removing tool presses against the indented end of the bearing (fig. 140). Continue rotating the crankshaft until the bearing seats.

Install the bearing cap and torque the bolts to 120-130 foot-pounds. Replace the two remaining bearings in the same manner. Install the oil pump and oil pan.

9. PISTON AND CONNECTING ROD ASSEMBLIES

Engines made in 1949 and early 1950 are equipped with 4-ring split skirt aluminum pistons. Late 1950 and 1951 engines use a 3-ring solid skirt aluminum piston with controlled expansion.

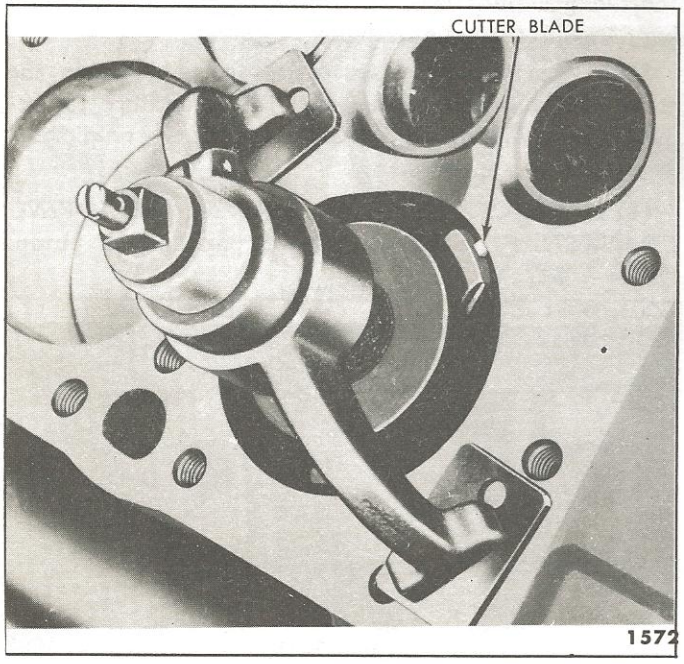


Fig. 141—Removing Ridge From Cylinder

The piston pin is held in place with a clip retainer at each end. A notch is provided in the piston at the top of the retainer groove to facilitate retainer removal.

The connecting rod has oil squirt holes for increased piston lubrication. Oil from the crankshaft oil hole passes through the hole in the connecting rod bearing, through the connecting rod squirt holes, and is squirted on the cylinder wall.

The connecting rod bolts are integral with the rod. Lock nuts prevent the connecting rod nuts from vibrating loose.

The following procedures cover removal, disassembly, assembly, and installation of the connecting rod and piston assemblies.

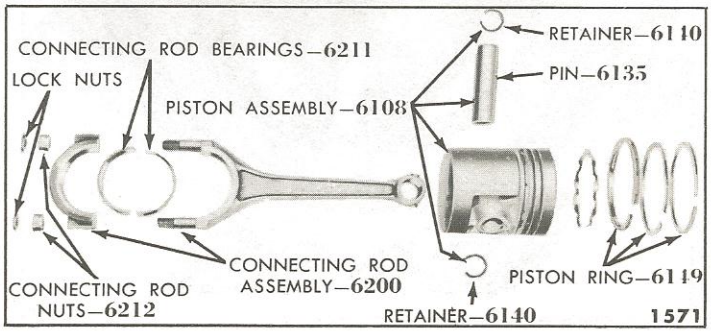


Fig. 143—Connecting Rod and Piston, Disassembled

a. Removing Piston and Connecting Rod Assemblies.

Remove the cylinder heads, oil pan, and oil pump. Check the top of the cylinder bore above the piston ring travel area for a ridge. It any appreciable ridge exists, it must be cut away before removing the piston and rod assembly.

To remove the ridge, rotate the crankshaft until the piston is at the bottom of the cylinder. Place a cloth on the piston to catch the ridge cutter chips. Install the ridge cutter, set the cutting tool just below the ridge (not more than 1/32 inch) and adjust it to the cylinder bore size. Cut the ridge away by rotating the cutter (fig. 141).

Turn the crankshaft to bring the piston to the top of the cylinder and carefully remove the cloth and chips. Turn the crankshaft until the piston is at the bottom of the stroke. Remove the lock and retaining nuts, bearing cap, and bearing. Push the rod assembly away from the crankshaft and remove it from top of the cylinder bore. It the connecting rod bearings are to be used again, mark them to correspond with the cylinder from which they are removed.

b. Disassembly.

Spread the rings (fig. 142) and remove them from the piston. Rotate the piston pin retainer until the opening is toward the bottom of the piston or away from the notch. Use needle nose pliers or a screwdriver, cover the retainer with a cloth, and pry the retainer out. The cloth will catch the retainer as it springs from the groove. Use a brass drift to remove the piston pin from the piston. Where the piston pin is very tight, heat the piston in hot water, then press the pin out.

Figure 143 shows the connecting rod and piston disassembled.

c. Assembly.

Oil the piston pin and press it into the piston and connecting rod bushing. Install the retainers at each end of the piston pin. Install the piston rings. Space the rings so the gaps are equidistant around the piston.

d. Installation.

Turn the crankpin to the bottom of the stroke. Cover the cylinder wall with engine oil. Start the piston and connecting rod assembly into the cylinder with the cylinder identification number (stamped on the connecting rod) away from the camshaft. Compress the rings (fig. 144) and tap the piston into the cylinder. Guide the connecting rod onto the crankpin so the bearing surfaces do not get marred. Install the connecting rod bearing inserts and bearing cap with the cylinder identification number corresponding to the connecting rod (fig. 145). Install the connecting rod nuts and tighten them to 52-60 foot-pounds. Tighten the lock nuts to 4-5 foot-pounds torque. Install the oil pump, oil pan, and cylinder heads.

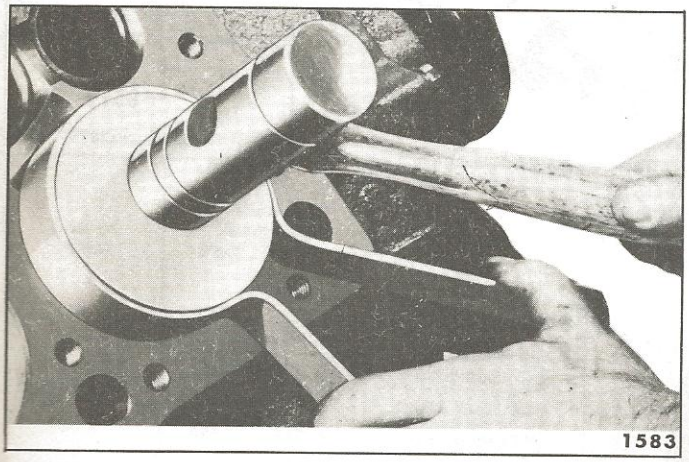


Fig. 144—Installing Piston In Cylinder

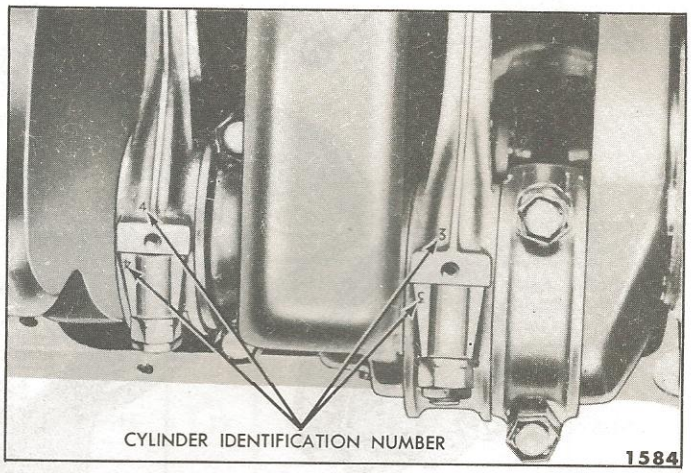


Fig. 145—Connecting Rod and Cap Installation

10. WATER PUMPS

When water pump difficulty is experienced, it is not necessary to replace the entire assembly as a water pump repair kit is available for service. Whenever a pump is disassembled, the impeller, slinger, seal, bearing, shaft, or shaft and bearing assembly should always be replaced.

Repair Procedure.

(1) *REMOVAL.* Drain the radiator. Remove the fan and generator belts. Remove the radiator to water pump hose. Support the weight of the engine on a jack and remove the water pump to engine support screws. Remove the cap screws securing the pump to the cylinder block. Remove the pump and gasket.

(2) *DISASSEMBLY.* Remove the pulley with a suitable puller. Remove the bearing retainer. Press the impeller off the shaft by pressing the shaft and bearing through the front end of the housing. Press the seal out of the impeller end of the housing. A disassembled view of the pump is shown in fig. 146.

(3) *ASSEMBLY.* Press a new seal into the housing with the carbon washer toward the impeller. Install the slinger with the flange toward the impeller. Press the shaft and bearing in from the front end of the pump.

CAUTION: *Apply pressure to the bearing outer race only, not the shaft.*

Install the bearing retainer. Press the pulley on the shaft. Be sure to support the opposite end of the shaft. Press the impeller on the shaft. Be sure to maintain a clearance of 0.030-0.040 inch between the impeller blade and the housing.

(4) *INSTALLATION.* Use a new gasket and install the pump and gasket on the cylinder block. Install the retaining screws and tighten them to 25-28 foot-pounds torque. Install the water pump to engine support screws. Remove the support from under the engine.

Install the radiator hose, fill the cooling system and check for leaks. Install and adjust the fan and generator belts. Run the engine until it is warmed up and check for leaks at the gasket and at the radiator hose.

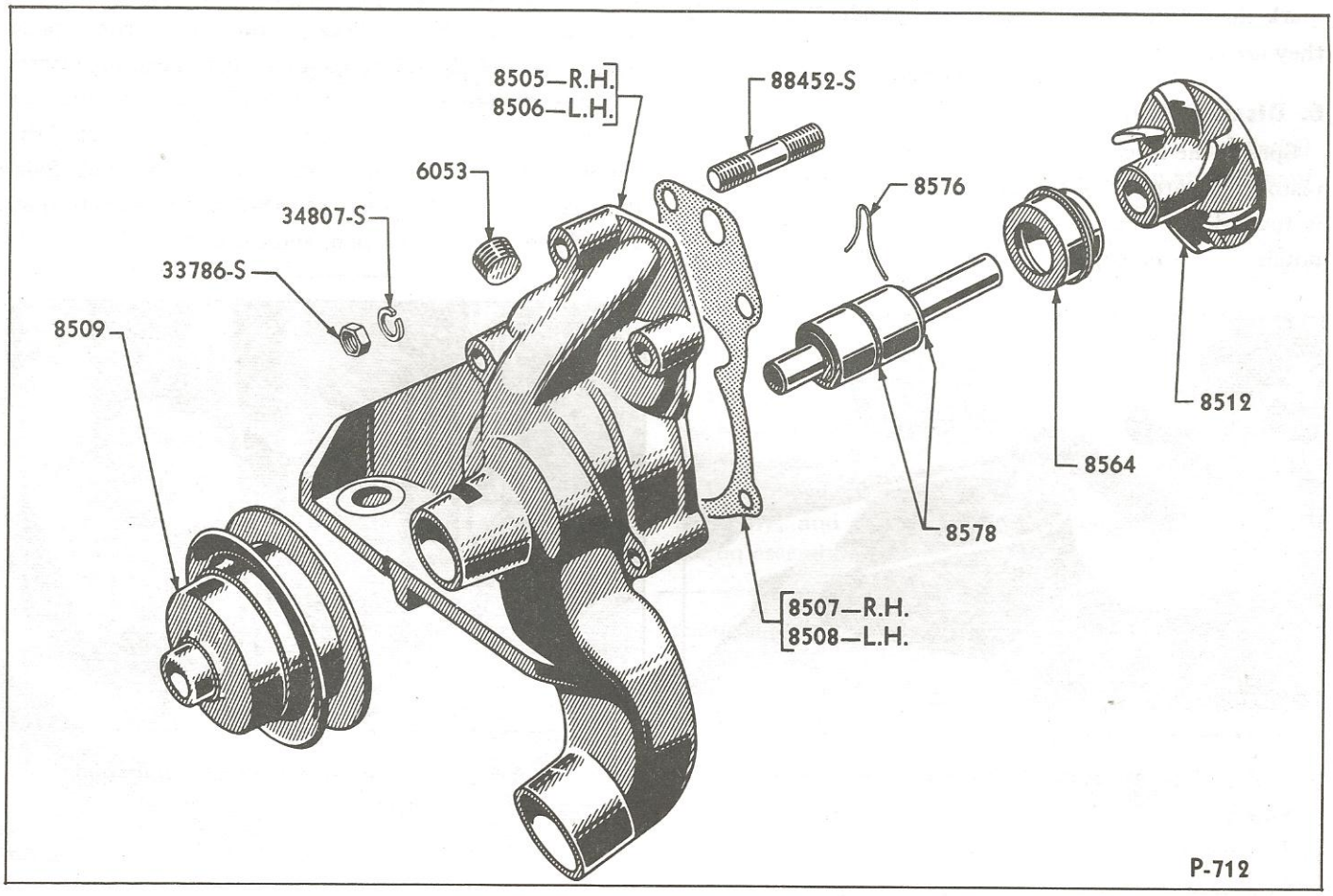


Fig. 146 EQ Engine Water Pump Disassembled

SPECIFICATIONS

General

Horsepower	145 @ 3600 RPM
Taxable Horsepower	39.2
Bore (Inches)	3.50
Stroke (Inches)	4.375
Piston Displacement (cubic inches)	337

Compression Pressure @ Sea Level (p.s.i. @ r.p.m.)	
Firing Order	
Oil Capacity (Qts.)*	
Compression Ratio	
Torque Ft. Lbs. @ RPM	

* 8 Qts. with Oil Filter

6010 Cylinder Block

Year of Engine	Cylinder Block Part Number	Mfg. Max. Bore Dia. (Inches)	Max. Width Valve Seat Face (Inches)	Max. Valve Seat Run-out (Inches)	Max. Allowable Out-of-round Bore (Inches)	Max. Allowable Oversize Bore (Inches)
1949-50-51	8EL-6010-B	3.502	0.065-0.080	0.005	0.0005	0.050

6505-6507 Valves

Year of Engine	Valve Part Number	Mfg. Clearance Valve Stem to Guide (Inches)	*Mfg. Valve Stem to Push Rod Clearance (Inches)				Mfg. Min. Stem Diameter (Inches)	Min. Valve Head Thickness (Inches)
			Exhaust		Intake			
			Min.	Max.	Min.	Max.		
E (Early 1949)	8EQ-6505-A	0.0022-0.0037	0.014	0.016			0.3410	1/32
E (Late 1949 and Early 1950)	8EQ-6505-B	0.0022-0.0037	0.014	0.016			0.3405	1/32
E (Late 1950 and 1951)	8EQ-6505-C	0.0022-0.0037	0.016	0.018			0.3405	1/32
E (Early 1949)	8EL-6507-A	0.0022-0.0037			0.010	0.012	0.3412	1/32
E	8EL-6507-B	**0.0022-0.0037			0.010	0.012	0.3412	1/32
E (Late 1949, 1950 and 1951)	8EL-6507	0.0015-0.0030			0.010	0.012	0.3412	1/32

*Set clearance when engine is cold.
**Valve head diameter 0.070 inch oversize.
All valves have 45° seat angle.

6108 Piston Assemblies

Year of Engine	Piston Assembly Part Number	Type of Piston	Piston Skirt Diameter Limits (Inches)	Fitting New Piston in New Bore		Fitting New Piston in Used Bore		Fitting Used Piston in Used Bore	
				*Gauge Thickness (Inches)	Pounds Pull	*Gauge Thickness (Inches)	Pounds Pull	*Gauge Thickness (Inches)	Pounds Pull
(Late 1950 and 1951)	8MTH 6108-G	Standard	3.3989-3.5009	0.0015	5-10	0.002	5-10	0.003	5-10
	8MTH 6108-H	0.0025 inch O.S.	3.5014-3.5034						
	8MTH 6108-J	0.020 inch O.S.	3.5189-3.5209						
	8MTH 6108-K	0.030 inch O.S.	3.5289-3.5309						
	8MTH 6108-L	0.040 inch O.S.	3.5389-3.5409						
(1949 and early 1950)	8EQ 6108-A	Standard	3.4989-3.5009	0.0015	5-10	0.002	5-10	0.003	5-10
	8EQ 6108-C	0.020 inch O.S.	3.5189-3.5209						
	8EQ 6108-D	0.030 inch O.S.	3.5289-3.5309						
	8EQ 6108-E	0.040 inch O.S.	3.5389-3.5409						

*Use ½ inch wide feeler gauge.

6135 *Piston Pins

Type of Engine	Part Number	Mfg. Clearance in Piston (Inches)	Wear Limit Clearance in Piston (Inches)	Mfg. Clearance in Connecting Rod Bushings (Inches)
E	8EL-6135-B and C	0.0001-0.0004	0.0007	0.0002-0.0005

*Fit pins at 70° F.

Valve Springs

Type of Engine	Valve Spring Part Number	Test Length (Inches)	Pressure (Pounds)
E	8EL-6513	1.68	62 to 68

Valve Timing

Engine	Intake Opens (Degrees) B.T.C.	Intake Closes (Degrees) A.B.C.	Exhaust Opens (Degrees) B.B.C.	Exhaust Closes (Degrees) A.T.C.
E	14	45	50	9

6500 Valve Push Rods

Type of Engine	Valve Push Rod Part Number	Mfg. Clearance in Block (Inches)	Mfg. Minimum Push Rod Diameter (Inches)
E	8EQ-6500-A	0.0002-0.0012	0.7178

6306 Crankshaft Gear

Type of Engine	Crankshaft Gear Part Number	Max. Gear Face Runout (Inches)
E	1GA 6306-B	0.0015

6251 Camshaft

Type of Engine	Camshaft Part Number	†Max. Allowable Runout (Inches)	Min. Valve Lift. (Inches)		Wear Limit Camshaft Journals (Inches)	End Play (Inches)
			Intake	Exhaust		
E	8EQ-6251	0.005	0.360	0.360	1.924	0.003-0.006

†Center journal runout with end journals supported.

6256 Camshaft Gear

Type of Engine	Part Number	Back Lash Between Timing Gears (Inches)	Max. Gear Face Runout (Inches)
E	1GA 6256-A and B	0.002-0.003	0.002

6262-6263 Camshaft Bearings

Type of Engine	Part Number	Mfg. Max. Inside Dia. (Inches)	Clearance New Camshaft and Bearings (Inches)
E	8EL 6262-C and D	1.9285	0.0013-0.0023

6149 Piston Rings

Engine	Clearance in Piston Grooves (Inches)			End Gap of Ring in Cylinder Bore (Inches)		Oversizes Available for Service (Inches)	When Bore Taper Does Not Exceed 0.006 Inch	When Bore Taper Is Between 0.006 and 0.015 Inches
	Top Rings	Second Rings	Lower Rings	Compression Rings	Oil Rings			
E (Late 1950 and 1951)	0.0030	0.0025	0.0030	0.047	0.047	0.040, 0.060	Use expander type rings	Use steel section type rings
E (1949 and Early 1950)	0.002-0.0035	0.0015-0.0035	0.0015-0.0030	0.007-0.047	0.007 0.047	0.020, 0.030, 0.040, 0.060	Use expander type rings	Use steel section type rings

6200 Connecting Rod

Type of Engine	Connecting Rod Part Number	Mfg. Max. Diameter Crankpin End (Inches)	Mfg. Dia. Piston Pin Bushing (Inches)	Mfg. Side Clearance Total (Inches)	Max. Out-of-Round Bore (Inches)
E	8EL-6200	2.5520	0.8506	0.006-0.014	0.002

Note: Allowable bend or twist in connecting rod is 0.002 inch as checked on connecting rod aligner.

6211 Connecting Rod Bearings

Type of Engine	Connecting Rod Bearing Part Number	Undersize Bearings Available (Inches)	Mfg. Crankpin Clearance (Inches)	Bearing Crush Clearance (Inches)
E	8EQ-6211	0.010, 0.020, 0.030, 0.040	0.0005-0.0025	0.001-0.003

6303 Crankshaft

Type of Engine	Crankshaft Part Number	*Mfg. Main Journal Diameter (Inches)	Mfg. Crankpin Journal Diameter (Inches)	Mfg. Crankshaft End Play (Inches)
E	8EQ 6303	†2.8729-2.8740	2.3991-2.4000	0.004-0.008

†Front and Center journals. Rear journal—2.8724-2.8735.

*Max. allowable journal taper 0.001 inch.

Max. allowable out-of-round journals 0.0015 inch.

6331 Rear Main Bearings

Type of Engine	Bearing Part Number	Nominal Size	Bearing Thickness (Inches)	Crankshaft Diameter (Inches)	Mfg. Clearance Between Bearing and Shaft (Inches)
E	8EL 6331-A	Standard	0.095/0.0958	2.8730/2.8735	0.0004-0.0029
	8EL 6331-B	0.002 inch U/S	0.0963/0.0968	2.8710/2.8715	
	8EL 6331-C	0.010 inch U/S	0.1003/0.1008	2.8630/2.8635	
	8EL 6331-D	0.020 inch U/S	0.1053/0.1058	2.8530/2.8535	
	8EL 6331-E	0.030 inch U/S	0.1103/0.1108	2.8430/2.8435	
	8EL 6331-F	0.040 inch U/S	0.1153/0.1158	2.8330/2.8335	

6338 Front Main Bearings

Type of Engine	Bearing Part Number	Nominal Size	Bearing Thickness (Inches)	Crankshaft Diameter (Inches)	Mfg. Clearance Between Bearing and Shaft (Inches)
E	8EL 6338-A	Standard	0.0953/0.0958	2.8735/2.8740	0.0004-0.0029
	8EL 6338-B	0.002 inch U/S	0.0963/0.0968	2.8715/2.8720	
	8EL 6338-C	0.010 inch U/S	0.1003/0.1008	2.8635/2.8640	
	8EL 6338-D	0.020 inch U/S	0.1053/0.1058	2.8535/2.8540	
	8EL 6338-E	0.030 inch U/S	0.1103/0.1108	2.8435/2.8440	
	8EL 6338-F	0.040 inch U/S	0.1153/0.1158	2.8335/2.8384	

6342 Intermediate Main Bearings

Type of Engine	Bearing Part Number	Nominal Size	Bearing Thickness (Inches)	Crankshaft Diameter (Inches)	Mfg. Clearance Between Bearing and Shaft (Inches)
E	8EL 6342-A	Standard	0.0953/0.0958	2.8735/2.8740	0.0004-0.0029
	8EL 6342-B	0.002 inch U/S	0.0963/0.0968	2.8715/2.8720	
	8EL 6342-C	0.010 inch U/S	0.1003/0.1008	2.8635/2.8640	
	8EL 6342-D	0.020 inch U/S	0.1053/0.1058	2.8535/2.8540	
	8EL 6342-E	0.030 inch U/S	0.1103/0.1108	2.8435/2.8440	
	8EL 6342-F	0.040 inch U/S	0.1153/0.1158	2.8335/2.8340	

6375 Flywheel

Type of Engine	Flywheel Part Number	Max. Allowable Runout (Inches)	Max. Depth Cut for Refacing (Inches)	Max. Allowable Ring Gear Runout (Inches)
E	8EQ 6375	0.005	0.045	0.010

6600 Oil Pump

Measurement	Dimension (Inches)
Mfg. Max. Body Inside Diameter (Inches)	2.2175
Mfg. Clearance Bushing and Shaft	0.0005-0.0025
Backlash Between Oil Pump and Camshaft Gears	0.003-0.005
Mfg. Clearance Oil Pump Driven Gear and Shaft	0.002-0.0035
Max. Allowable Clearance Between Driven Gear and Housing	0.005
Relief Valve Spring Pressure	12.42 Lbs. ± 8 Ounces @ 2.18 Inches

Torque Limits

Part	Torque (Foot-Pounds)
Main bearing bolts	120-130
Cylinder head bolts	65-70
Oil pan to cylinder block	15-18
Flywheel bolts	75-85

Part	Torque (Foot-Pounds)
Exhaust manifold	25-30
Intake manifold	25-30
Oil pump to cylinder block	10-15
Oil pump cover plate	7-10
Oil filter to cylinder block or head	25-30
Cylinder front cover	15-18
Water pump	30-35
Water outlet elbow	20-25
Fuel pump	23-28
Rear oil seal retainer	5-8
Clean out plate to oil pan	5-10
Generator bracket	55-60
Camshaft gear	15-18
Pressure plate assembly	15-18
Rear plate to block	50-60
Clutch housing to transmission	40-50
Clutch housing to block	45-50
Starter to engine rear plate	15-20
Damper to crankshaft	120-130
Conn. rod nuts	52-60