ENGINE MECHANICAL

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GENERAL DESCRIPTION

The engine used in all 1954 series Cadillacs is of the 90° overhead valve V-8 type. It has a bore of 3-13/16 inches and a stroke of 3-5/8 inches, giving a piston displacement of 331 cubic inches. The engine has a compression ratio of 8.25 to 1 and develops 230 horsepower at 4400 R.P.M. A side view of the engine is shown in Fig. 10-1.

The crankshaft is supported by five main bearing which use shell type, steel backed babbitt inserts. End thrust is taken by the rear main bearing. The six counterweights used are integral with the crankshaft. The engine is equipped with a harmonic balancer.

Connecting rods for opposite cylinders are carried side by side on the same crankpin. The shell type connecting rod bearings are made of steel backed aluminum.

ENGINE MECHANICAL

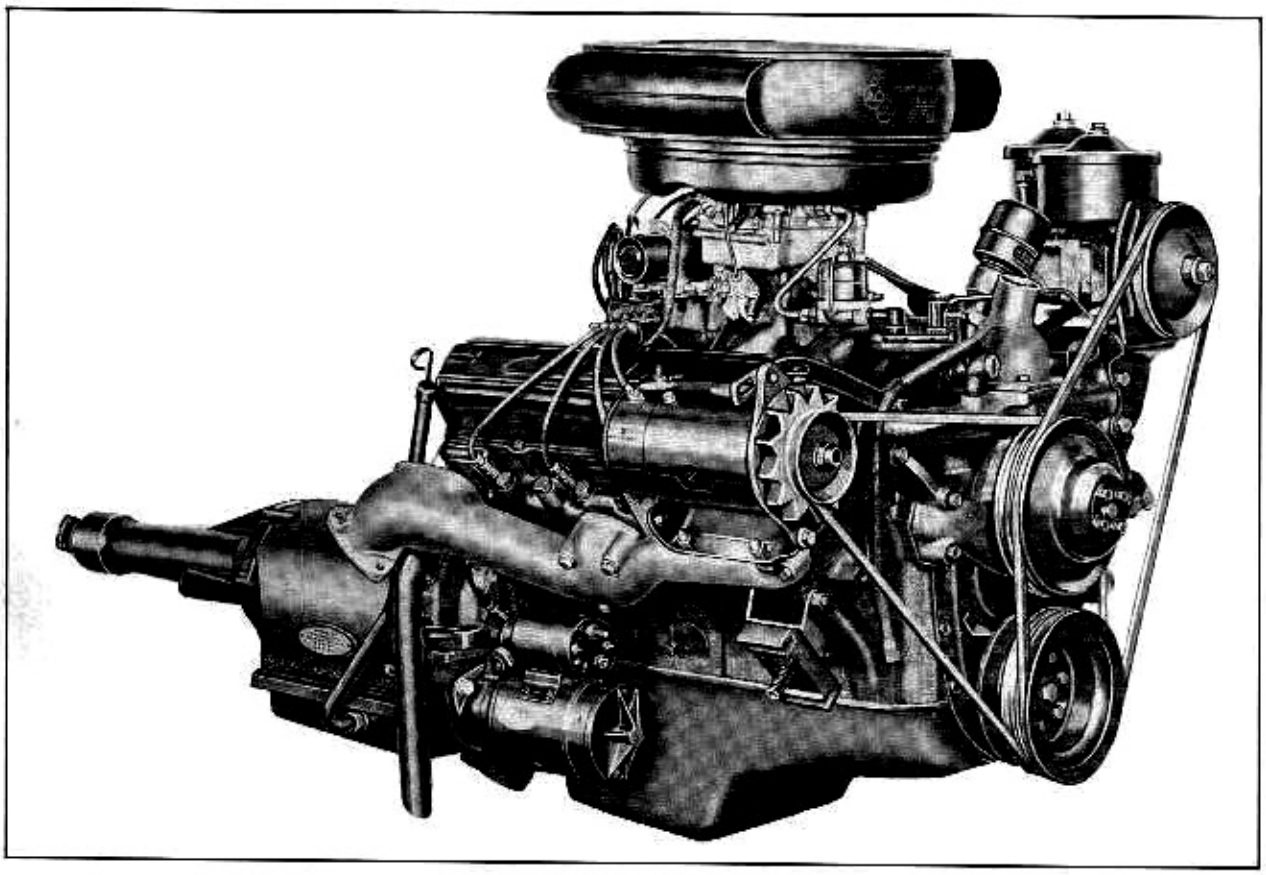


Fig. 10-1 Engine Side View

Cast aluminum pistons with a tin coating are used in the engine. The slipper type pistons are cut away at the skirt below the piston pin to allow for clearance between the crankshaft counterweights and piston skirt when the piston is at the bottom of its stroke.

The piston pins are press fitted into the connecting rods. Holes drilled from the piston skirt into the piston pin bores direct oil from the cylinder walls to the piston pin to assure adequate lubrication.

A chain driven camshaft is supported by five bearings. Wide camshaft lobes allow a minimum of lobe wear. Both the crankshaft and camshaft sprockets have a punched locating mark for correct valve timing when installing the timing chain.

The camshaft gear is cast as an integral part of the camshaft and meshes with the distributor drive gear which is an integral part of the distributor. Fig. 10-2. The distributor drive shaft, rotating in a COUNTERCLOCKWISE direction when viewed from above, drives the oil pump and vacuum pump. The vacuum pump is attached to the underside of the oil pump and is driven by a hexagonal drive shaft between the two pumps.

Hydraulic valve lifters are used to maintain zero clearance throughout the valve train. This arrangement assures quiet operation and eliminates the necessity for valve tappet adjustments. The lifters operate in guide holes drilled in the cylinder block. The valve lifter plunger and lifter body are in matched pairs. The push rods ride in cups in the lifters and extend up through openings in the cylinder block and cylinder head to the rocker arm. An engine cross section showing the valve operating mechanism is illustrated in Fig. 10-3.

ENGINE LUBRICATING SYSTEM -- The oil pump is mounted on the rear main bearing cap. Oil enters the pump through a screened intake, Fig. 10-4, which floats on the oil thereby drawing off only the cleaner surface oil.

Oil is forced by the pump through the main bearing cap to the vertical oil header which first feeds the rear main bearing, Fig. 10-4. The rear connecting rod journal is lubricated by oil from the rear main bearing through a drilled hole in the crankshaft.

The vertical oil header is intersected by the right longitudinal header, through which a portion of the

oil is forced. The rest of the oil continues up the vertical header to a connecting header to the left longitudinal header. The upper end of the vertical header is plugged with a pipe plug.

From the connecting header oil flows through a hole to the rear camshaft bearing. The oil pressure signal switch is screwed into the upper end of this connecting header.

The longitudinal headers feed several important points as the oil flows from the rear to the front of the engine. One by-pass is upward through the cylinder block and cylinder head to the rocker arm shaft. Another by-pass is through drilled passages to the hydraulic lifters.

The center main bearing is lubricated by oil from the right longitudinal header through a hole drilled to the bearing. This oil also flows through drilled holes in the crankshaft to the two adjacent connecting rod journals and from the main bearing to the center camshaft bearing through a drilled hole in the block.

Oil which flows through the right longitudinal header through a drilled hole lubricates the front main bearing. The front camshaft bearing is lubricated by oil through a drilled hole from the main bearing to the camshaft. The front connecting rod journal is also lubricated through a drilled hole in the crankshaft.

The hydraulic valve lifter bodies on the left bank, the two intermediate main bearings, and all adjacent connecting rod bearings are lubricated by oil which flows through the left longitudinal header. The two intermediate camshaft bearings are lubricated through drilled holes from the intermediate main-bearings.

The oil pump drive shaft is lubricated by oil which flows through a drilled hole from the rear main bearing.

At the front end of the left longitudinal header is a vertical header that extends upward through the cylinder block and cylinder head to the left rocker arm shaft. The rocker shafts are plugged at both ends to prevent loss of oil pressure. There are two holes in the rocker shaft at each rocker arm. One hole is at the bottom of the shaft, intersecting a 45° groove which distributes the oil evenly under the loaded area of each rocker arm. The other hole is slightly mis-matched with an angular passage in the rocker arm. This misalignment acts as a metering device to prevent excess oil being supplied to the upper end of the rocker arm. This angular passage in the rocker arm intersects a vertical passage which lubricates the push rod seat and provides an exit for oil to the top surface of the rocker arm, where it flows slowly to the valve end of the arm and lubricates the valve tip at this point.

Oil from the cylinder heads drains back to the crankcase through either the front or rear holes in each cylinder head and matching holes in the block leading directly to the crankcase. Excess oil in the valve lifter compartment returns to the crankcase through a drilled hole at the rear of the compartment on the right side.

A drilled and tapped hole at the top of the left cylinder block near the oil filler housing intersects the header which lubricates the left rocker arms. Another drilled and tapped hole in the oil filler housing is provided for the oil filter outlet line. Oil from this line lubricates the fuel pump linkage and fuel pump eccentric.

CRANKCASE VENTILATION SYSTEM -- The crankcase ventilating system provides positive air circulation through the crankcase at road speeds. With the system, air enters the crankcase through the oil filler cap. This cap is fitted with a copper mesh air filter which filters the dust out of the air entering the crankcase, Fig. 10-5. Air is drawn down through the timing gear compartment into the crankcase at the crankshaft level. Air and any contaminating vapors then pass up into the valve lifter compartment through an opening in the rear of the cylinder block between the lower part of the crankcase and valve lifter compartment.

The air then circulates toward the front of the valve lifter compartment and is drawn out through the valve lifter compartment cover channel to the ventilating pipe at the rear of the cover. This pipe extends below the rear of the engine into the air-stream which creates a vacuum, causing circulation of air through the crankcase.

SERVICE INFORMATION

(1) Torque Tightness

The proper torque tightness of the attaching bolts and screws of various engine parts is very important on all 1954 engines to avoid both overtightening and under-tightening with possible distortion and permanent injury of parts.

A torque wrench should always be used on the various engine bolts so that they can be accurately tightened according to the torque tightness specifications, which are given on page 10-36.

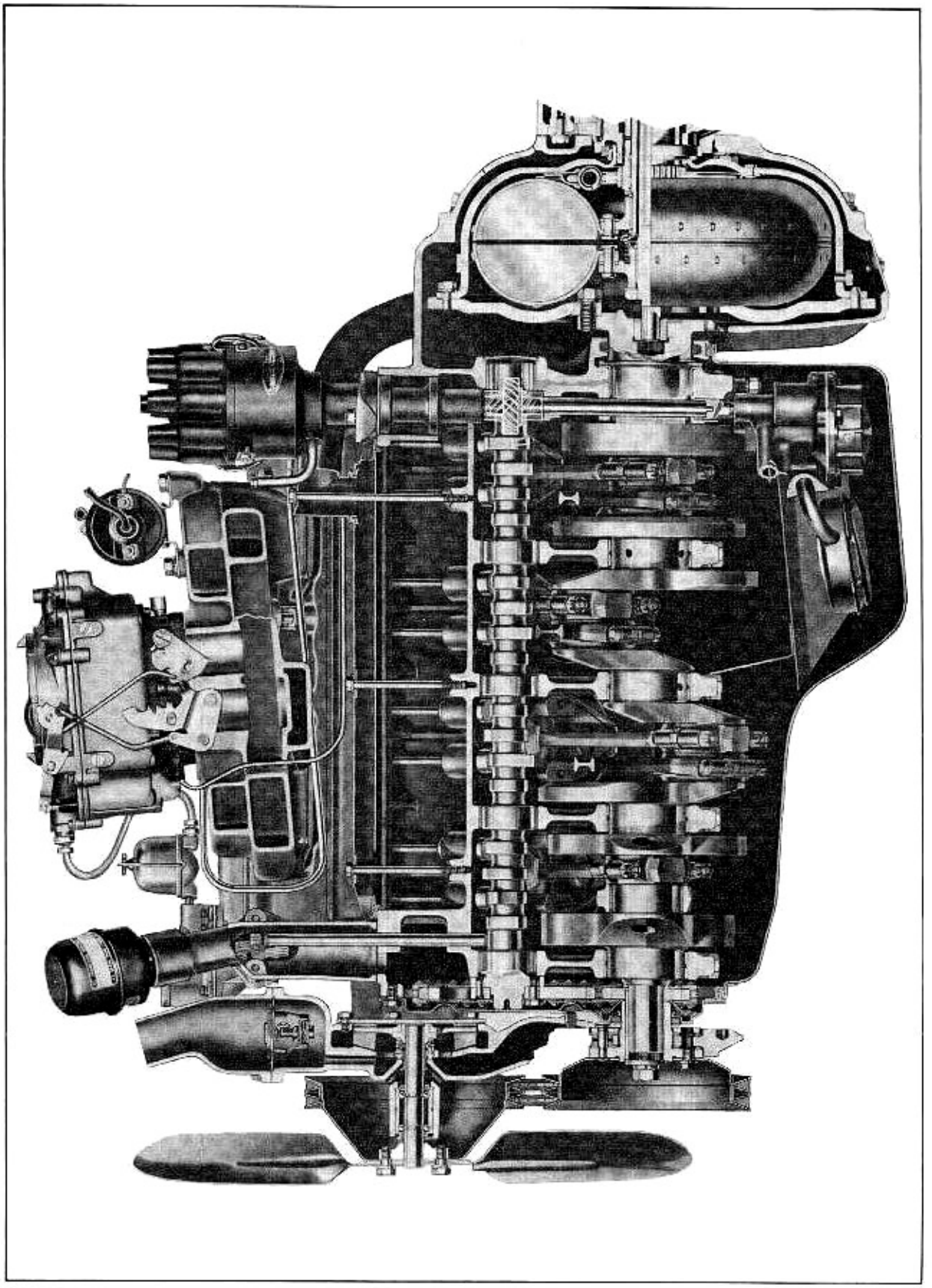


Fig. 10-2 Engine Longitudinal Section

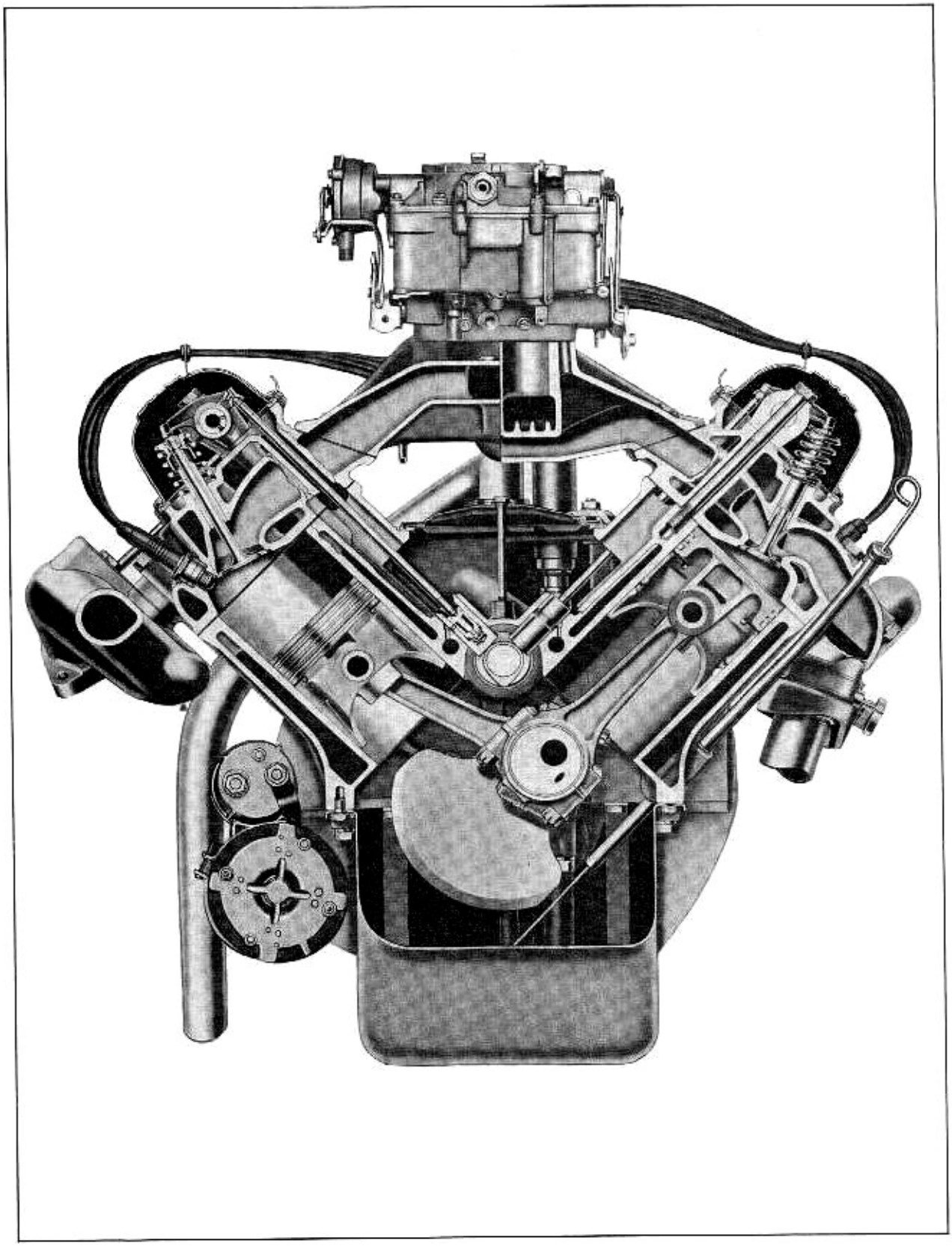


Fig. 10-3 Engine Transverse Section

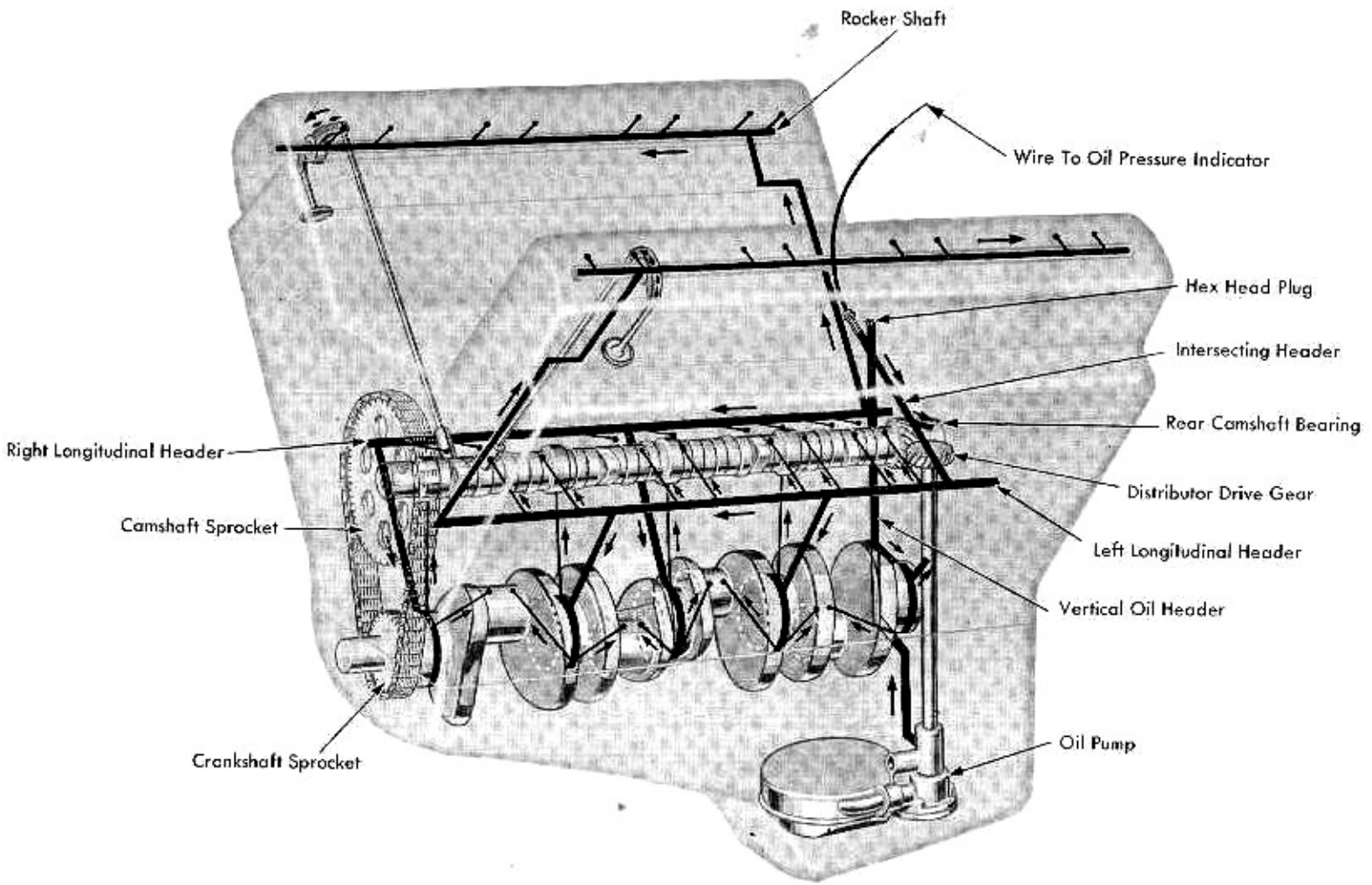


Fig. 10-4 Engine Lubricating System

(2) Cylinder Numbering

Cylinder numbering is by arrangement, rather than by firing order.

The left front cylinder is number one on all 1954 Series engines and the right front cylinder is number two.

The cylinders in the left block are odd numbered (1, 3, 5, and 7); those in the right block are even numbered (2, 4, 6, and 8).

The firing order is 1, 8, 4, 3, 6, 5, 7, 2.

(3) Removal of Cylinder Head

NOTE: Removal procedure will vary, depending on whether or not the car is equipped with Air Conditioning.

1. When removing the right cylinder head, on cars equipped with Air Conditioning, remove compressor, mounting brackets, and refrigeration lines as described in Section 16a, Note 10.

2. Drain radiator.

3. Remove oil line from oil filter inlet to block and oil line from oil filter to oil filler housing if left cylinder head is to be removed.

4. Remove oil filter and power steering assembly with mounting brackets from cylinder head if left cylinder head is to be removed.

5. Remove two cap screws from water pump flange at cylinder head.

6. Remove generator if right cylinder head is to be removed.

7. Remove carburetor air cleaner.

8. Remove fuel line from carburetor to fuel pump.

9. Remove ground strap screw from rear of cylinder head at cowl.

10. If left cylinder head is to be removed, disconnect water temperature gauge wire. If right cylinder head is to be removed, remove windshield wiper pipe clamp.

11. Remove vacuum advance line from front of carburetor to vacuum advance on distributor.

12. Disconnect hose from intake manifold vacuum pipe.

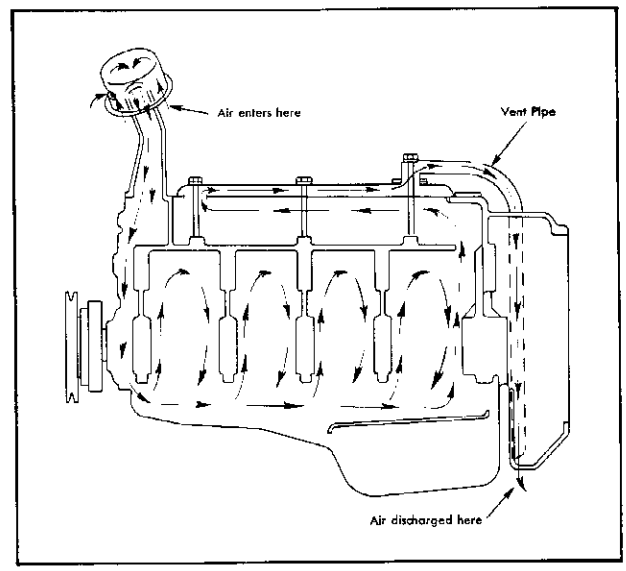


Fig. 10-5 Engine Ventilating System

13. Disconnect ignition coil high tension wire and primary wire at distributor.

14. Disconnect black resistor wire from porcelain resistor at coil.

15. On cars equipped with Hydro-Vac power brakes, disconnect vacuum hose from intake manifold pipe.

16. Disconnect transmission throttle rod at carburetor throttle lever.

17. Disconnect throttle control linkage at carburetor throttle lever.

18. Remove coil and secondary wiring mounting bracket, remove rocker arm cover screws, disconnect spark plug wires at plugs, and unsnap spring clips from sides of distributor cap.

19. Disconnect heater hose from water pump flange at thermostatic valve if right cylinder head is to be removed or at water pump flange if left cylinder head is to be removed.

20. Remove rocker arm covers, secondary wiring, and distributor cap as an assembly.

21. Remove four screws and four nuts which hold intake manifold to cylinder heads. Lifting manifold slightly upward and toward left of car to avoid fuel filter, remove manifold with carburetor and choke heater pipe.

22. Remove exhaust pipe to manifold screws.

23. Remove four cylinder head cap screws which hold rocker arm assembly to cylinder head and remove rocker arm assembly.

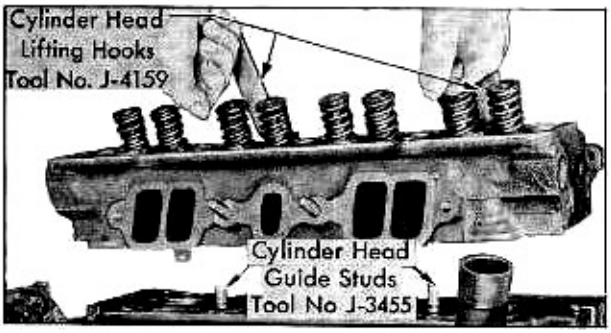


Fig. 10-6 Removing and Installing Cylinder Head

24. Remove push rods through openings in cylinder head.

25. Remove remaining cylinder head cap screws.

26. Remove first and third spark plugs from cylinder head and install Cylinder Head Lifting Hooks, Tool No. J-4159, in spark plug holes.

27. Lift cylinder head off dowels and remove from engine, Fig. 10-6.

(4) Disassembly of Cylinder Head Assembly

1. Remove spark plugs.

2. Place cylinder head (upside down) in cylinder Head Holding Stand, Tool No. J-3064.

3. Place Holding Strap, J-3064-6, over valve heads to hold them in place while compressing springs, and clamp in place on head with the thumb screw provided.

4. Invert head and place valve spring compressing bar over valve stem, Fig. 10-7.

5. Using foot stirrup, compress valve spring and remove valve keepers.

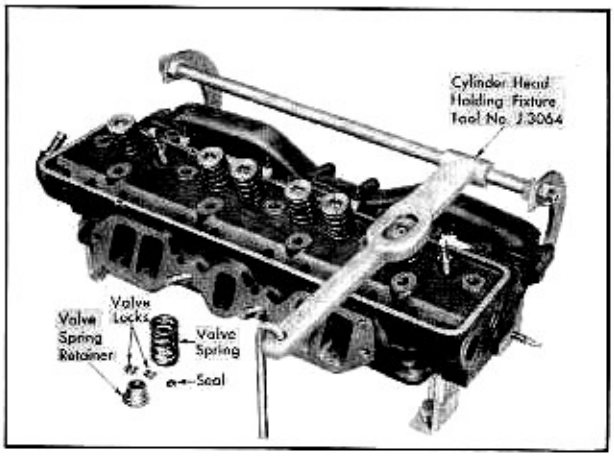


Fig. 10-7 Removing Valve Springs

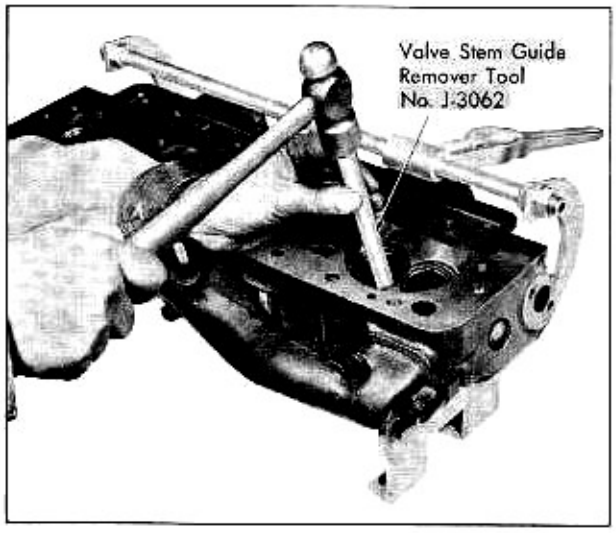


Fig. 10-8 Removing Valve Guides

6. Release bar and remove valve spring retainer, spring and rubber seal from lower groove in valve stem.

7. Invert head in stand, remove Holding Strap, and remove valves from head, being sure to keep them in order so that they can be reinstalled in the same position.

8. If it is necessary to remove valve guides because of excessive clearance between valve stem and valve guide as measured in Note 5, drive out valve guides from bottom side of cylinder head using Valve Stem Guide Remover, Tool No. J-3062, as shown in Fig. 10-8.

(5) Reconditioning Valves and Seats

Valve reconditioning, normally, is required much less frequently in engines having hydraulic valve silencers. When this work is done, the close limits given in the engine specifications, Page 10-34, must be maintained.

Check valve stem to guide clearance, using a 1/16" wide strip of .005" brass shim stock on a "no-go" basis. Bend the end of shim and hang in end of valve guide, with tab extended toward push rod side of head.

Shim should not extend more than 1/4" into guide. If valve stem will enter guide, clearance is excessive and guide and valve should be replaced to prevent excessive oil consumption and improper seating of valves.

Check concentricty of all valve seats. This should be within .004" total, as measured with dial indicator and a solid, slightly tapered, pilot which has a slight bind in the valve guide when installed.

CAUTION: A pilot of the correct size must be used. Do not attempt to drive pilot into guide. Pilots with adjustable diameters to fit various sized guides are not recommended.

Grind valves to within .001" indicator reading, if concentricity, seat width, or full contact is not indicated or when new valves and guides have been installed.

Check seat width and location on valve to insure proper heat dissipation and prevent build-up of carbon on seats. The desirable seat width depends a great deal upon conditions of operation. Cars operated at moderate or slow speeds in city driving should have a valve seat width of 3/64" to 1/16". For cars driven a great deal at high speeds, the seat width should be 1/16" to 3/32" to insure adequate cooling.

Valve seats should be cut so that there is no more than 1/32" from outer edge of seat to edge of flange on valve head, to allow heat to escape and to provide maximum life for newly ground valves.

New valve heads have a seat angle of 44°, to provide a hair line contact between the head of the valve and the valve seat in the cylinder head which assures good seating of the valve and less chance of burning the valve head due to exhaust gas leakage. Servicemen may, however, reface valves at a 45° angle.

New valves, when lapped in should not have more than 1/64 inch contact (due to 1° difference in angle). Grinding of valves by hand with a grinding compound is not recommended. Use only precision equipment for valves and seat reconditioning, and follow equipment manufacturer's recommendations.

(6) Assembly of Cylinder Head

a. Installation of Valve Guides

1. Position Valve Stem Guide Installer, Tool No. J-3066, through plate and slide Valve Guide Adapter, Tool No. J-3066-4, on installer pilot, Fig. 10-9.

2. Slide valve guide on installer pilot and lubricate outer surface of guide.

CAUTION: Be sure end of valve guide with longest chamfer enters bore first, pointing toward rocker arm side of head.

3. Drive guide into head until shoulder on installer contacts plate on cylinder head. The flat side of the Valve Guide plate rests on the cylinder head, while the notched portion, which acts as a stop for the driving tool, is toward the top.

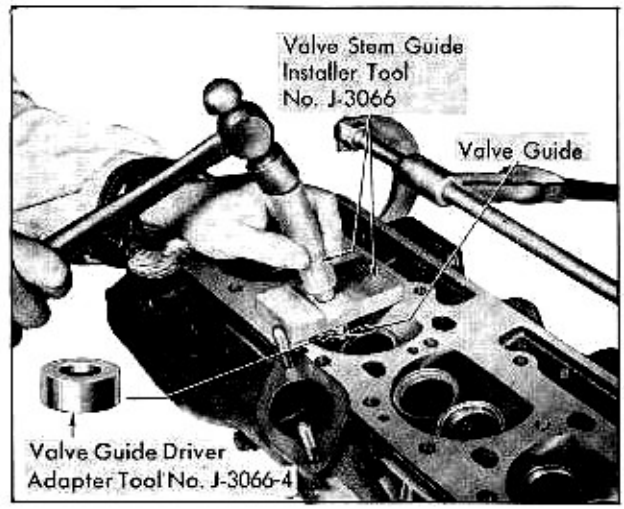


Fig. 10-9 Installing Valve Guides

b. Installation of Valves

1. Install all valves in their respective guides and install Holding Strap, J-3064-6, over valve heads to hold them in place when installing springs.

2. Place cylinder head in Holding Fixture, right side up.

3. Place spring over valve, being sure bottom of spring is in recess in head.

4. Place spring retainer over valve and spring.

5. Place the "thimble" over the valve stem with the tapered portion seated in the valve spring retainer.

6. Using the stirrup, compress the valve spring and then remove the "thimble."

7. Install new rubber seal in lower groove in valve stem (closest to valve head), being sure seal is properly seated.

8. Install valve keepers in position and release tension on foot stirrup.

NOTE: Check to see if oil seal has been installed properly by striking ends of valve stems to seat valve keepers. Compress a suction cup over the spring retainer and valve stem to test for leakage past the seal. If the oil seal is installed properly, the vacuum cup will stick to the spring retainer. If there is no suction, it is an indication of a leaking seal, and the parts must be disassembled and a new seal installed.

9. Install all other valve springs in a like manner.

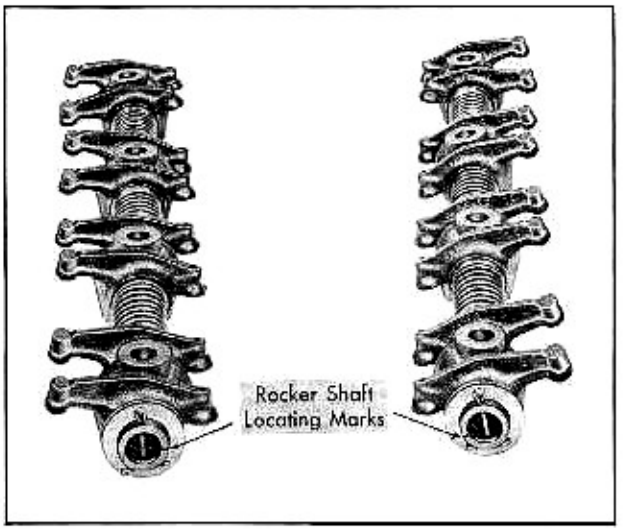


Fig. 10-10 Rocker Arm Locating Marks

c. Installation of Spark Plugs

1. Install spark plugs and copper gaskets in cylinder head.

2. Tighten plugs to 20-25 foot pounds torque.

(7) Installation of Cylinder Head

1. If exhaust manifold was removed from cylinder head, install new gaskets and install manifold cap screws. Tighten screws to 25-30 foot pounds torque.

2. Apply a coat of Cadillac Perfect Seal Gasket Paste to both sides of cylinder head gasket.

CAUTION: Extreme care must be used when installing cylinder head gaskets to assure freedom from dirt particles between the gasket and the cylinder block or head. Any foreign material may cause water or compression leaks. Blow out cylinder head passages and wipe machined surfaces of cylinder head and block clean.

3. Install Cylinder Head Guide Studs, Tool No. J-3455, (Fig. 10-6), in cylinder head bolt holes at each end of block.

4. Install gasket over studs and dowels in block with side stamped "TOP" facing upward.

5. Using Cylinder Head Lifter Tool No. J-4159, install cylinder head in position over guide studs and dowels.

6. Remove Guide Studs using removing tool provided with set.

7. Install cylinder head cap screws in lower and center rows and tighten finger tight.

8. Install push rods through openings in cylinder head with double grooved end of push rod up.

CAUTION: Bottoms of push rods must be seated in hydraulic valve lifter cups.

9. Install rocker arm assembly in position on cylinder head with notches on each end of rocker arm shaft pointing downward and toward center of engine, Fig. 10-10, and rocker arm brackets with larger machined surface next to head.

10. Tighten all cylinder head cap screws to 65-70 foot pounds torque, starting from center row and working outward and toward each end. Do not install oil filter bracket cap screw.

11. Install exhaust pipe to manifold, using new gasket. Tighten screws to 15-20 foot pounds torque for right side and 30-35 foot pounds torque for left side.

12. Install intake manifold gaskets in position over locating dowels.

13. Install intake manifold and carburetor, avoiding fuel filter, and being sure manifold is positioned correctly over locating dowels.

NOTE: When installing intake manifold, be sure choke heater pipe enters hole in heater stove in exhaust manifold before intake manifold is all the way down in position.

14. Install four cap screws and four nuts and washers which hold intake manifold to cylinder heads, placing windshield wiper vacuum pipe clamp between screws and manifold. Tighten all screws to 25-30 foot pounds torque.

15. Connect windshield wiper hose to vacuum line from intake manifold.

16. Connect throttle control linkage to carburetor throttle lever and adjust as explained in Section 13 Note 4.

17. Connect transmission throttle rod to carburetor throttle lever.

18. Install rocker arm covers, secondary wiring and distributor cap assembly.

19. Install spark plugs that have been removed.

20. Install coil and secondary wiring mounting bracket, install rocker arm cover screws, connect spark plug wires to spark plugs, and install distributor cap.

21. Connect heater hose at thermostatic valve if right cylinder head was removed or at water pump flange if left cylinder head was removed.

22. On cars equipped with Hydro-Vac power brakes, connect vacuum line to intake manifold pipe.

23. Connect black resistor wire from porcelain resistor to coil.

24. Connect ignition coil high tension wire and primary wire to distributor.

25. Install vacuum advance line from front of carburetor to vacuum advance on distributor.

26. If left cylinder head was removed, connect water temperature gauge wire, if right cylinder head was removed, install windshield wiper vacuum pipe clamp.

27. Connect ground strap at rear of cylinder head to cowl with screw.

28. Install fuel line between carburetor and fuel filter.

29. Install generator as described in Section 11, Note 21, if right cylinder head was removed. Adjust fan belt tension as described in Section 11, Note 21.

30. Install two cap screws through water pump flange and new gasket to cylinder head.

31. Install carburetor air cleaner.

32. Install oil filter and power steering assembly on cylinder head with remaining cap screw. Tighten to 65-70 foot pounds torque.

33. Install oil line from oil filter outlet to oil filler housing and oil line from block to oil filter inlet.

34. Fill cooling system and add a can of "Du Pont Sealer" if permanent type anti-freeze is to be used. Check for leaks after running engine ten minutes.

35. On cars equipped with Air Conditioning, install the compressor, brackets and refrigeration lines as described in Section 16a, Note 13, if right cylinder head was removed.

(8) Noisy Operation of Valve Lifters

Noisy operation of valve lifters may be due to:

1. Incorrect oil level in crankcase - Oil level should never be above, nor more than a quart below, "full" mark on indicator. If level is too high, foaming may result. If too low, air may enter pump inlet. In either case, noisy valve action may result.

2. Improper oil pressure-If valve action is noisy after the oil is hot, it may be due to low oil pressure.

Low pressure usually results from a leak in the oiling system, a stuck or improperly operating oil pressure relief valve, scored parts, worn bearings, worn oil pump gears, or poor operation of oil pump.

3. Weak valve lifters springs - These can cause noisy valve operation by causing sluggish plunger movement in the cylinder. To check these springs, disassemble plunger assembly, clean thoroughly and reassemble. Check pressure to compress spring dry.

If pressure required to compress spring .35 inch is less than 6-1/2 pounds, the assembly should be replaced.

4. Dirty, worn, or scored valve lifter parts - A recurring tap or click, synchronized with valve action, indicates trouble in a single lifter assembly, which should be disassembled and checked for:

a. Dirt or foreign particles, which can be removed after disassembly by wiping with a soft cloth and washing in kerosene.

b. Varnish or heavy sludge material, which can be removed by the use of a proper solvent.

NOTE: The engine oil pan should always be removed and cleaned when dirt has been responsible for sticking. The oil passages from the header to the lifter bores should also be cleaned thoroughly by blowing out with kerosene and air.

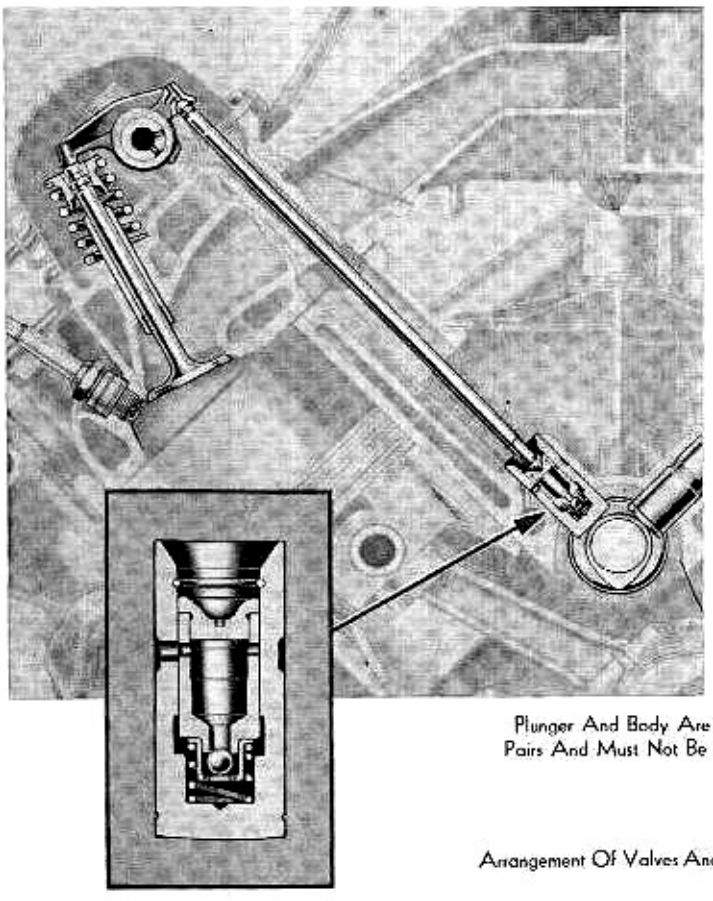
b. Pitting and scoring of surfaces, which may result from gritty particles, excessive wear, poor grade oil, or damage during installation. This condition requires replacement of the complete unit.

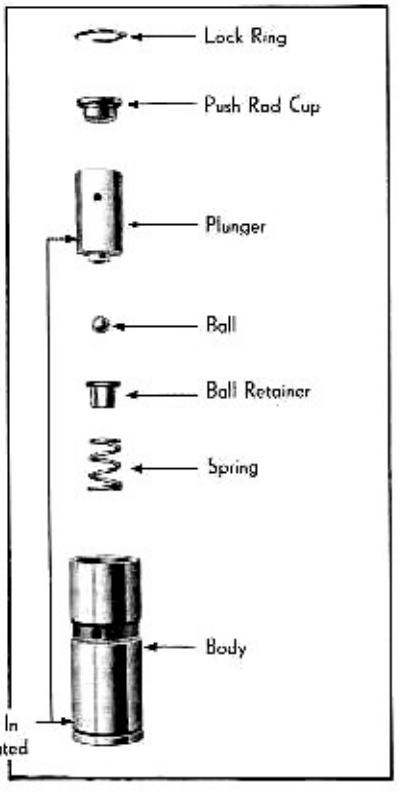
c. Incorrect clearance between cylinder and plunger, usually caused by mismating of parts. These parts are carefully fitted in manufacture and are not interchangeable, Fig. 10-11.

5. Lifters that do not turn in their bores. Scoring surface flakings or excessive wear on the bottom of the lifter may prevent the lifters from turning in their bores.

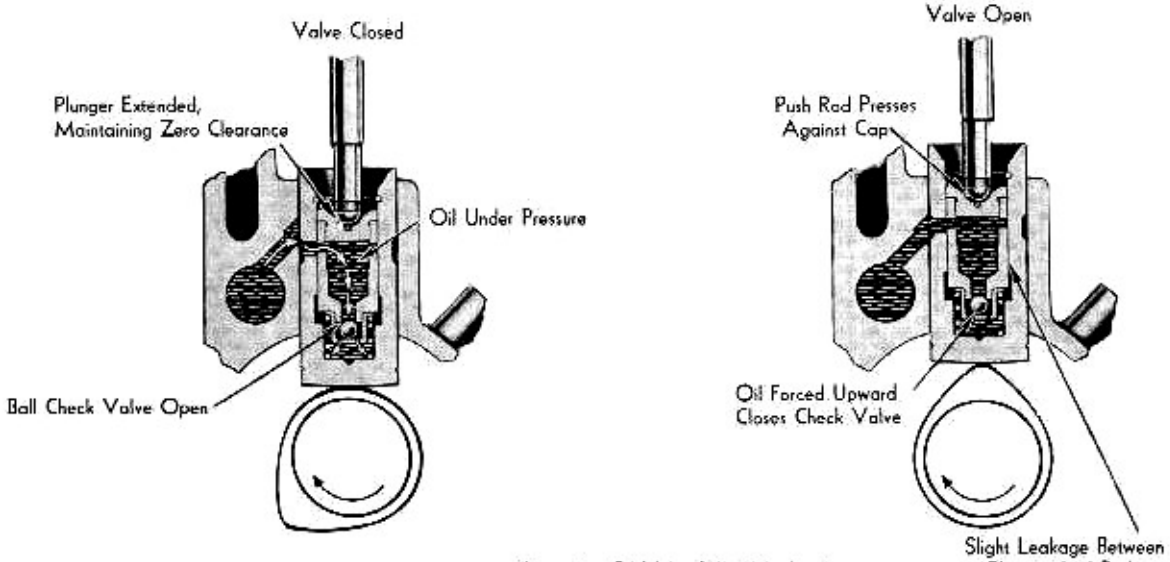
6. Excessive wear on either end of rocker arm or at rocker shaft.

ENGINE MECHANICAL





Arrangement Of Valves And Valve Lifters



Operation Of Valve Lifter Mechanism

Fig. 10-11 Valve Lifter Mechanism

7. Worn valve stems or push rods.

8. Worn camshaft lobes.

(9) Checking Valve Lifter Leak Down Rate

The Valve Lifter Leak Down Rate Tester, Tool No. J-3074, is used to obtain a comparison of the leak down rates of hydraulic valve lifters without removing them from the engine. This tool employs a simple principle whereby a feeler gauge of a given thickness is placed between the rocker arm and the valve stem, thus causing the valve spring pressure to force oil out of the lifter. To bring more uniformity to this test of leak down, a spring, attached to the tool and compressed against the valve spring retainer, ejects the feeler gauge when the lifter has leaked down enough to allow the valve to seat, thereby removing valve spring pressure from the feeler gauge. By noting the length of time required by each lifter to leak down the thickness of the feeler gauge, the faulty lifter or lifters can be easily located.

The following procedure is to be used when checking with this tool:

1. Remove heater hoses from clips on rocker arm covers.

2. If car is equipped with Hydro-Vac power brakes, disconnect vacuum hose at intake manifold.

3. If car is equipped with Air Conditioning, remove rear bracket and loosen generator.

4. Remove black resistor wire from porcelain resistor at coil.

5. Remove distributor cap, coil, and rocker arm covers as an assembly.

6. Set timing mark "C" on harmonic balancer to pointer and observe position of distributor rotor. Check each lifter as outlined in the following table:

Rotor at No. 1 firing position (pointing toward rear of engine) Check:

1 Intake	5 Intake
1 Exhaust	6 Intake
2 Intake	6 Exhaust
2 Exhaust	7 Intake
3 Exhaust	8 Intake
4 Exhaust	8 Exhaust

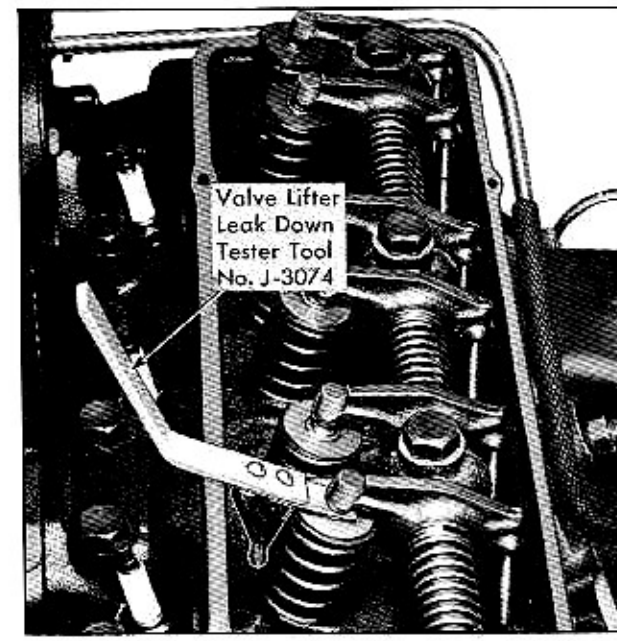


Fig. 10-12 Checking Valve Lifter Leak Down

Rotor at No. 6 firing position (pointing toward front of engine) Check:

3 Intake	5 Exhaust
4 Intake	7 Exhaust

9. Insert feeler gauge of tool between valve stem and rocker arm and at the same time compress tool "pop-out" spring against valve spring retainer, Fig. 10-12.

NOTE: The tool should be installed as quickly as possible to eliminate any unnecessary lifter leak down.

10. Note the interval of time during which the tool is held in place by valve spring pressure.

It will be found through this test that the noisy lifter or lifters will have the shortest leak down time.

(10) Removal of Valve Lifters

1. Remove heater hoses from clips on rocker arm covers.

2. Remove rocker arm covers as described in Note 3, Steps 1-4, 6, 7.

3. Remove intake manifold as described in Note 3, Steps 6-21.

4. Remove three valve compartment cover screws.

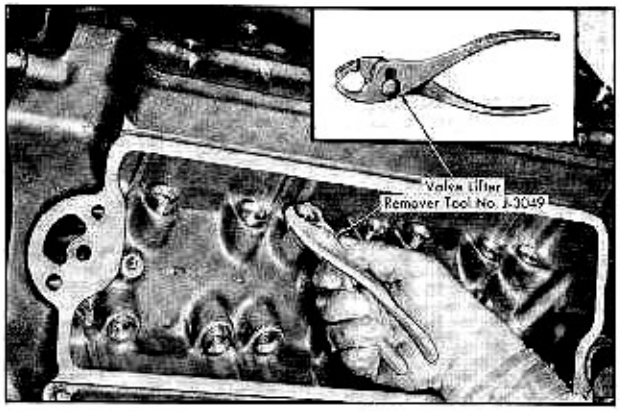


Fig. 10-13 Removing Valve Lifters

5. Loosen engine ventilator pipe clamp screw at flywheel housing, remove long ventilator pipe screw at valve compartment cover and remove cover.

6. Remove rocker arm assemblies as explained in Note 3, Step 23.

NOTE: When only one or two lifters are to be removed, it is not necessary to remove the complete rocker arm assembly. Compress the valve spring, slide the rocker arm over and remove the push rod.

7. Remove push rods.

8. Using Valve Lifter Remover, Tool No. J-3049, remove lifters from engine (Fig. 10-13), keeping them in order so they can be reinstalled in the same bore from which they were removed.

NOTE: Rotate the lifter back and forth while lifting to remove any varnish from the base of the lifter.

(11) Disassembly and Assembly of Valve Lifters

a. Disassembly

1. Press down on center of valve lifter push rod cup.

2. Using a pointed tool, remove lock wire from groove while holding cup down.

3. Invert lifter and slide out push rod cup, plunger, ball retainer and spring.

NOTE: If plunger is stuck in lifter body, place lifter, push rod end down, in Valve Lifter Plunger Remover, Tool No. J-4160, Fig. 10-14. Holding tool firmly in hand with thumb over lifter body, strike tool sharply on block of wood or wooden bench until plunger falls out of body.

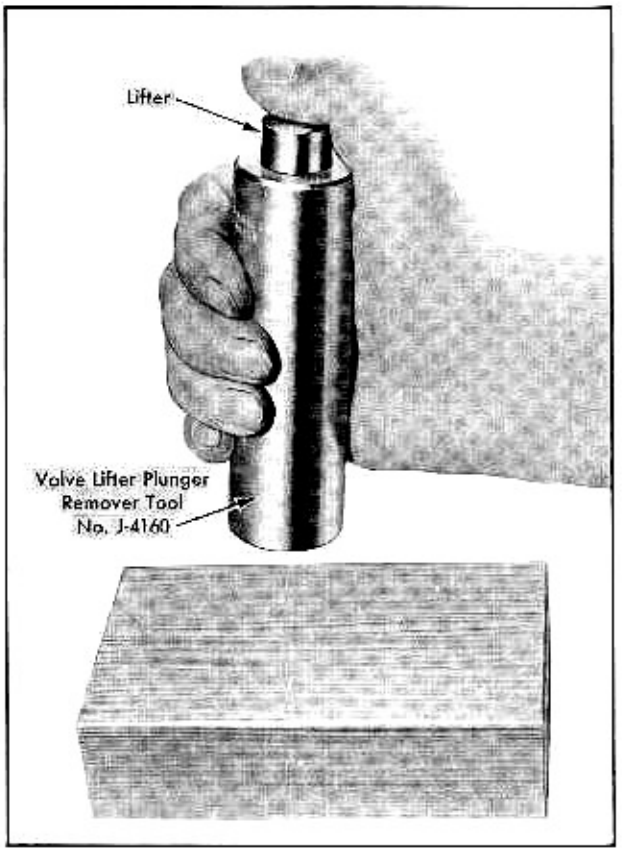


Fig. 10-14 Removing Stuck Plungers From Body

b. Assembly

1. Place ball on its seat in lower end of plunger while holding plunger up-side down.

2. Position ball retainer and spring over ball and end of plunger.

3. Lower lifter body over plunger assembly.

4. Turn assembly right side up and fill plunger with clean engine oil.

5. Jiggle ball with small piece of wire until oil drains out of plunger into body and trapped air is released from body.

6. Refill plunger with oil, place push rod cup on plunger, and position lock wire over cup.

7. Press lock wire into groove with Valve Lifter Lock Wire Installer, Tool No. J-2730, Fig. 10-15.

(12) Installation of Valve Lifters

1. Install lifters in cylinder block in same bores from which they were removed.

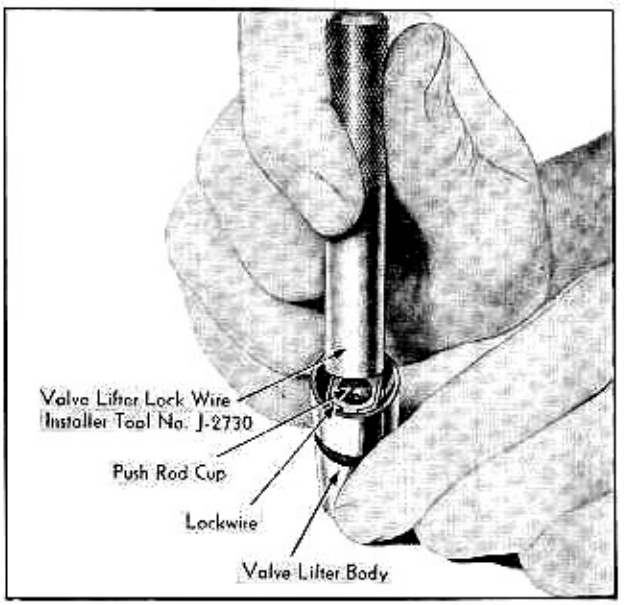


Fig. 10-15 Installing Valve Lifter Lock Wire

2. Install push rods through openings in cylinder head, with double grooved end of push rod at top, and bottom end in push rod cup.

3. Install rocker arm assemblies on cylinder heads, being sure rocker arms are correctly seated over push rods and push rods are correctly seated in their lifter cups.

CAUTION: Be sure all rocker shaft brackets are right side up, or the rocker shaft may be sprung out of alignment when the cap screws are tightened down.

4. Tighten rocker shaft screws to 65-70 foot pounds torque and recheck torque of all cylinder head cap screws which should also be tightened to 65-70 foot pounds.

5. Install valve lifter compartment cover and install front and center screws.

6. Place engine ventilator pipe over opening in valve cover, being sure cork gasket on pipe is in position, install long screw and tighten clamp screw at flywheel housing.

7. Tighten all valve compartment cover screws.

8. Tighten ventilator pipe bracket bolt at flywheel housing to 15-18 foot pounds torque.

9. Install intake manifold as described in Note 7, Step 12-17.

10. Install rocker arm cover assembly as described in Note 7, Steps 18, 20.

11. Connect black resistor wire from porcelain resistor at coil.

12. Replace heater hoses in rocker arm cover clips.

13. If car is equipped with Hydro-Vac power brakes, connect vacuum line at intake manifold.

(13) Vacuum Pump Test

1. Make sure windshield wipers operate satisfactorily with all lines connected.

NOTE: Wiper action should be checked on a wet windshield.

2. Disconnect vacuum pump hose leading from crankcase at check valve on cowl.

3. Connect vacuum gage to vacuum pump hose and start engine. If the vacuum pump is operating properly, the vacuum gage will show a minimum of 20 inches of mercury at sea level at 3600 R.P.M. engine speed.

4. If the vacuum gage does not show this reading the vacuum pump is defective or there is a leak in the vacuum lines.

5. If the vacuum does not increase after tightening vacuum connections, replace vacuum pump as explained in Note 16.

(14) Removal and Installation of Engine Oil Pan

a. Removal

1. Remove oil level indicator.

2. Remove starter motor assembly and place on frame side bar.

3. Remove idler arm support screws and lower support from frame side bar.

4. Remove oil pan screws and nuts which hold pan to cylinder block, and remove oil pan.

5. Remove gaskets from sides of pan, rear main bearing cap, and front cover.

b. Installation

1. Install new cork seals in rear main bearing cap and in front cover, being sure ends of gaskets are in the recess provided for them.

2. Cement pan gaskets to both sides of pan, being sure holes in gasket line up with holes in pan.

3. Place a small amount of chassis grease on each of the four corners of the pan gasket which hang over the front and rear cutouts, which will permit the pan gasket to slide over the corks and insure a good seal.

4. Place pan in position on bottom surface of cylinder block over the four studs, and install nuts and washers loosely.

5. Install remaining 16 screws and tighten screws and nuts in rotation, to 7 to 10 ft. lbs. torque.

6. Install idler arm support in position on frame side bar and install screws.

7. Install starter assembly.

8. Install oil level indicator.

(15) Removal and Disassembly of Vacuum Pump

a. Removal

1. Drain engine oil and remove oil pan, Note 14.

2. Remove oil pan baffle.

3. Disconnect vacuum line at engine block.

4. Remove six screws that hold vacuum pump to oil pump and remove vacuum pump with the oil pump idler gear.

WARNING: The oil pump idler gear may fall out when the vacuum pump is removed.

5. Remove hexagonal drive shaft.

6. Remove vacuum line from vacuum pump.

b. Disassembly

1. Remove two screws that hold plate to vacuum pump and remove plate from dowels.

2. Turn pump open side downward and shake out rotor assembly into hand.

3. Remove vanes and spring from rotor.

(16) Inspection, Assembly, and Installation of Vacuum Pump

a. Inspection

1. Inspect inside of pump body for excessive scoring.

2. Inspect cover plate as explained in Note 18, Step 6.

b. Assembly

CAUTION: Parts must be free from foreign matter before installation. Foreign particles caught between the rotor and pump body may cause the shaft to break.

1. Install spring and vanes in rotor.

2. Compress vanes and install rotor in pump body.

3. Position plate on doweled pump body so that hole in plate lines up with hexagonal hole in rotor.

4. Install two screws in cover plate.

c. Installation

1. Install vacuum line to vacuum pump.

2. Replace hexagonal drive shaft in vacuum pump.

3. Replace idler gear in oil pump and install vacuum pump below oil pump with six screws.

4. Connect vacuum line to engine block.

5. Install oil pan baffle.

6. Install oil pan.

(17) Removal and Disassembly of Oil Pump

NOTE: Oil pump should not be removed unless absolutely necessary because installation requires removal of the distributor to properly align the oil pump.

a. Removal

1. Drain engine oil and remove oil pan.

2. Remove oil pan baffle.

3. Disconnect vacuum line at engine block.

4. Remove two nuts holding oil pump to rear main bearing cap and remove oil pump, vacuum pump, oil float and screen assembly.

CAUTION: After removing the oil pump, the oil pump drive shaft is loose and free to drop out and should be removed.

b. Disassembly

1. Remove cotter pin holding oil float to pump and remove float.

2. Remove cotter pin holding oil pressure regulator valve and spring in body, and remove valve and spring.

CAUTION: Be careful not to lose retainer when removing cotter pin.

3. Remove six screws holding vacuum pump to oil pump and remove vacuum pump with vacuum line.

4. Slide idler gear off idler shaft in pump.

5. Remove pin from collar on end of drive shaft and press collar off shaft.

6. Slide oil pan drive gear out of pump body.

(18) Inspection, Assembly, and Installation of Oil Pump

a. Inspection

1. Inspect strainer screen for dirt and clean thoroughly.

2. Inspect float for leaks.

3. Inspect oil pressure regulator valve for nicks, and burrs which might cause leaks or binding in pump body.

4. Check free length of spring which should be approximately 2-25/64 inches. Compressed to 1-13/32 inches, pressure should be 5-3/4 to 6-1/4 pounds.

5. Inspect drive gear and idler gear for nicks and burrs.

6. Inspect vacuum pump cover plate for wear and dress down on surface plate.

b. Assembly

1. Install oil pump drive gear in oil pump body.

2. Press collar on end of shaft and install lock pin.

3. Slide idler gear into pump body, meshing gear with drive gear.

4. Place vacuum pump assembly with hexagonal drive shaft under oil pump and install six screws.

5. Slide oil pressure regulator valve into pump body.

6. Compress assembly and install cotter pin.

7. Slide oil pump strainer into opening in pump body and install locking pin.

CAUTION: Be sure strainer is installed so that screen is facing cover of oil pump.

c. Installation

1. Install oil pump assembly over studs, guiding vacuum line into fitting in engine block.

2. Install two nuts and lock washers and tighten to 25-30 foot pounds torque.

3. Install oil pan as explained in Note 14.

(19) Removal of Connecting Rods and Pistons

Connecting rod and piston assemblies are removed from above on all 1954 series engines. Connecting rod caps are removed by removing the self locking connecting rod nuts and sliding the caps down off the connecting rod bolts, Fig. 10-16. Install Connecting Rod Guide Studs, Tool No. J-3224, on connecting rod bolts to guide rod out of

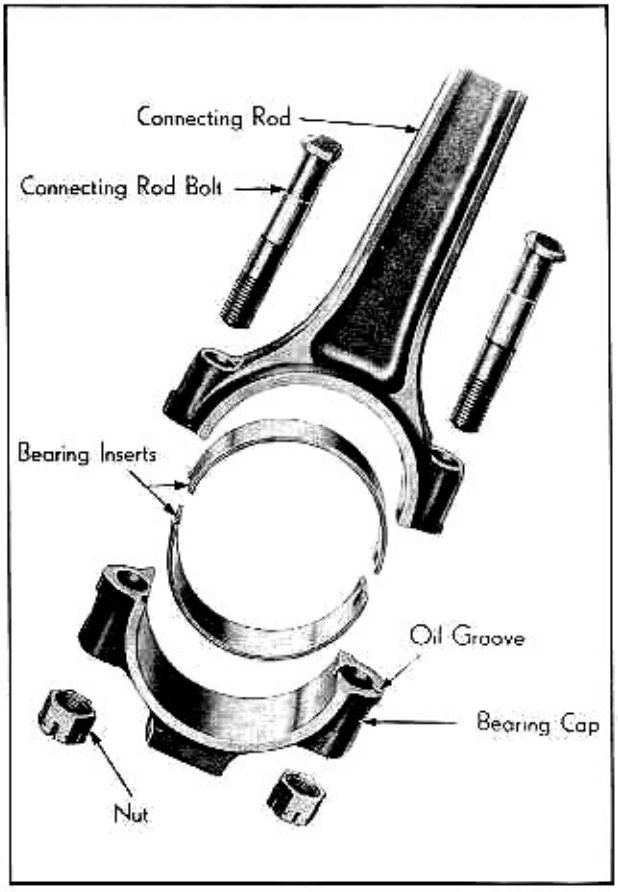


Fig. 10-16 Connecting Rod and Bearing Assembly

bore without nicking or scratching bore. Clean out carbon from top of cylinder bore and ream ridges if necessary to prevent breakage of piston ring lands. Push the connecting rod and piston assembly up until the piston rings are out of the bore and remove piston and connecting rod assembly from the engine.

CAUTION: Do not nick lower edge of bore when pushing rod up.

(20) Replacement of Connecting Rod Bearings

Connecting rod bearings are of the steel-backed aluminum shell type. Bearings worn beyond .0045 inch can be replaced without removing the rod assembly by removing the cap and replacing upper and lower halves. The clearance between the connecting rod bearing and the crankshaft can be measured by the use of a "Plastigauge," as follows:

1. Remove bearing cap and wipe oil from crankshaft journal and bearing insert.

2. With crank pin at approximately bottom dead center, place a piece of Plastigauge in the center of cap.

3. Reinstall bearing cap. Tighten to 40-45 foot pounds torque.

4. Remove bearing cap and determine bearing clearance by comparing the width of the flattened Plastigauge, at its widest point, with the graduation on the Plastigauge container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch, Fig. 10-17. If this clearance is greater than .0045 inch, replace the bearing.

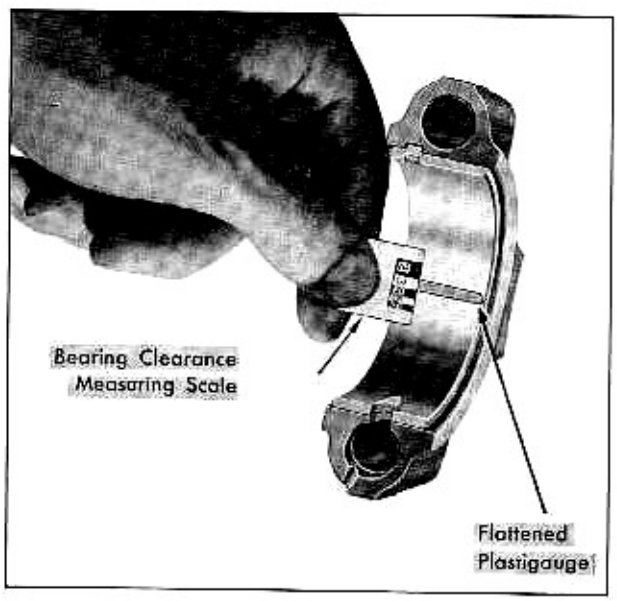


Fig. 10-17 Checking Bearing Clearance

(21) Replacement of Main Bearings

Shell type main bearings of steel-backed aluminum are used. The front four bearings are interchangeable journal to journal, and upper and lower halves are also interchangeable. Crankshaft end thrust is taken by the rear main bearing. Bearings worn more than .005 inch should be replaced. Bearing wear can best be measured by use of the Plastiguage, as explained in Note 20. When one main bearing is being checked, the other four caps should be tight, unless the engine is upside down.

To replace the main bearing:

1. Remove cap and take out worn shell.

NOTE: Each bearing cap is numbered on the left side starting from the front. Do not mismatch these caps or turn them around because they are individually matched when the cylinder block is machined. Casting numbers on the caps are read from the rear of engine.

2. Rotate crankshaft in clockwise direction to turn upper shell out of crankcase, using a flattened cotter pin in the oil passage hole in the shaft to contact the shell and force it out.

3. Place new upper half of main bearing on crankshaft journal, with locating lug in correct position, and rotate shaft to turn it into place with cotter pin.

4. Remove cotter pin, install lower half of main bearing in cap and install cap.

CAUTION: Always clean crankcase thoroughly before installing new main or connecting rod bearings.

(22) Replacement of Piston Rings

Each piston has two compression rings and one oil ring. The top compression ring is made of chrome plated rolled steel. The other two rings are cast iron.

The chamfered face of the compression ring should be installed toward the top of the piston.

When replacing piston rings, install the re-ring sets that have the chrome top compression ring and expanders behind the oil ring. If the re-ring set is to be installed in new or low mileage bores, it is not necessary to install the oil ring expander, Fig. 10-18.

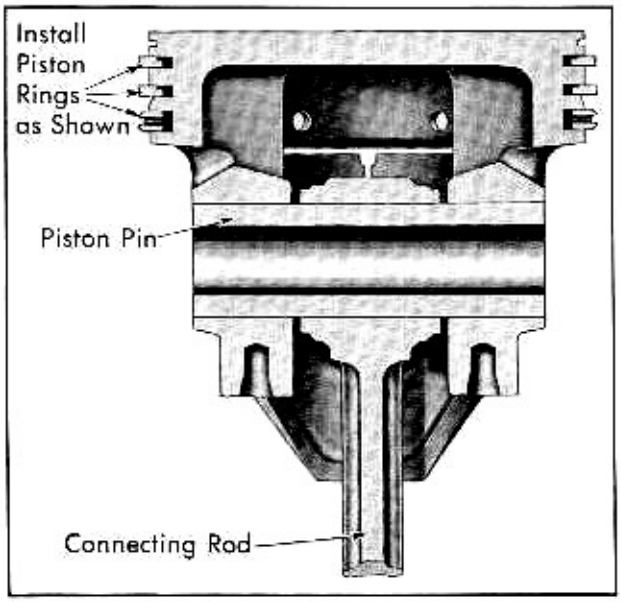


Fig. 10-18 Piston Cross Section

1. Place ring in area of cylinder where piston ring will travel. Be sure ring is square with cylinder bore.

2. Gap between ring ends should be .010" - .020".

3. With ring on piston, clearance between top face of piston ring and ring land should be .0017"-.0035".

(23) Removal and Installation of Piston Pins

a. Removal

1. Install pilot of Piston Pin Removing and Installing Tool, No. J-3848, on puller screw.

2. Install puller screw, with pilot, through piston and pin from side of piston stamped "REAR".

3. Install support over puller screw with small end of support against piston opposite from "REAR" on piston casting.

4. Install nut loosely on puller screw and place assembly in an arbor press, as shown in Fig. 10-19.

5. Press piston pin out of piston and rod assembly.

6. Remove assembly from press and remove puller nut, support, and piston pin from puller screw.

7. Remove puller screw from piston and remove pilot from piston connecting rod.

8. Remove connecting rod from piston.

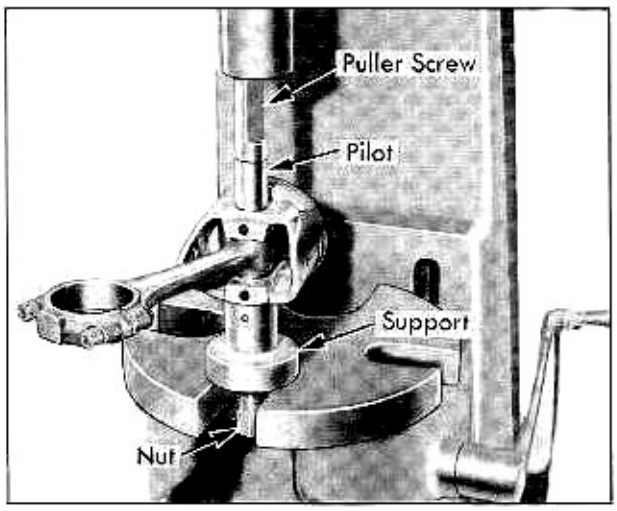


Fig. 10-19 Removing Piston Pin

b. Installation

1. Lubricate piston pin holes to facilitate installation of pin.

2. Position connecting rod in its respective piston so that when assembly is installed in engine the side of piston stamped "REAR" is toward the rear of the engine and numbers on lower end of the rod are down, Fig. 10-20. Numbers 1, 3, 5, 7, are in the left bank and 2, 4, 6, 8 are in the right bank.

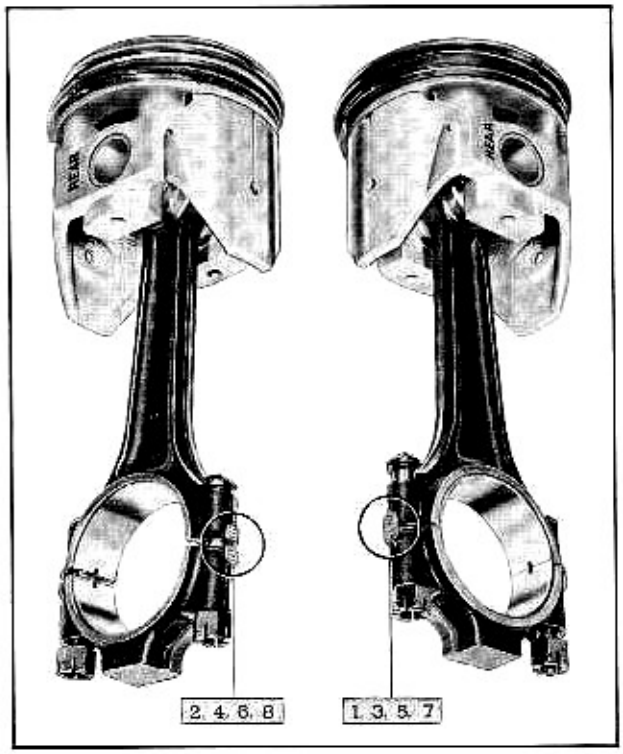


Fig. 10-20 Assembly of Connecting Rods to Piston

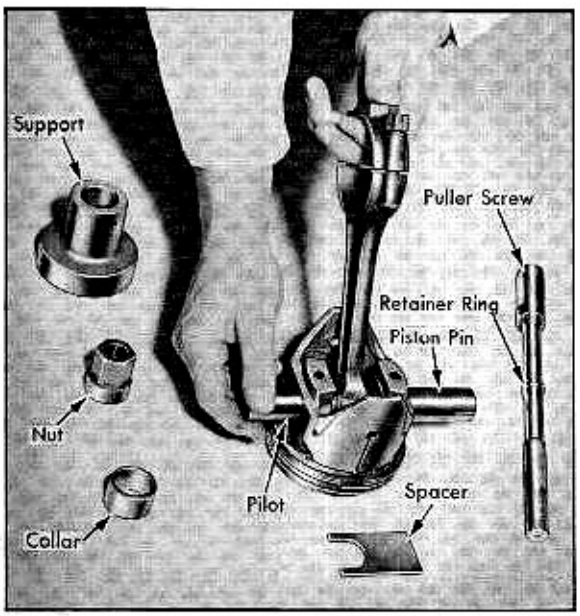


Fig. 10-21 Installing Pilot and Pin in Piston and Rod

3. Install pilot through piston and rod, Fig. 10-21.

4. Lubricate piston pin and insert it in piston pin hole on side of piston marked "REAR" Fig. 10-21.

5. Install puller screw through piston pin and pilot from side of piston marked "REAR", Fig. 10-22.

6. Insert spacer between connecting rod and piston until it is seated on the pilot.

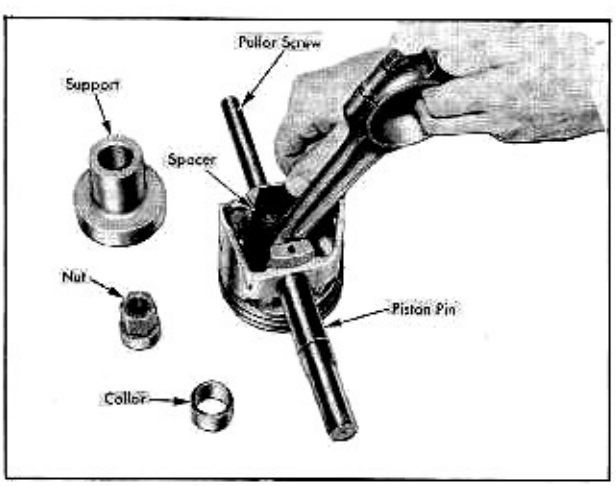


Fig. 10-22 Installing Puller Screw and Spacer

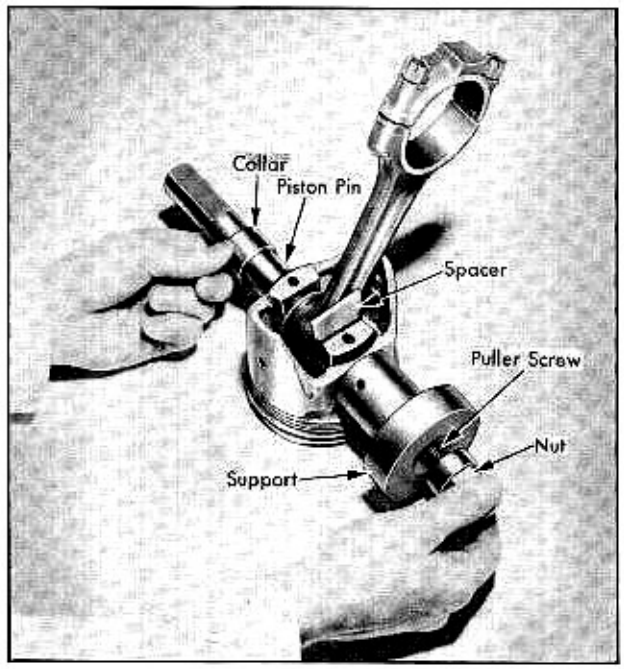


Fig. 10-23 Installing Collar, Support and Puller Nut

NOTE: The spacer must be installed between the piston and the rod on the side opposite that stamped "REAR", Fig. 10-22.

7. Install support over puller screw with smaller diameter toward piston, opposite that stamped "REAR", Fig. 10-23.

8. Install nut on puller screw and tighten with torque wrench to start piston pin into connecting rod, Fig. 10-24.

CAUTION: If pin can be started into connecting rod with less than 15 ft. lbs. minimum torque, the press fit between piston pin and rod is insufficient and either the piston and pin assembly or connecting rod must be replaced.

9. Install collar over piston pin, Fig. 10-24.

10. Press puller screw down until top of pin is level with top of collar.

11. Remove collar and spacer.

NOTE: The piston pin will now project slightly from rod and this pin should be guided into the piston pin boss next to the support by hand to assure correct alignment.

12. Press piston pin in until pilot bottoms in support, properly positioning the pin in the rod, Fig. 10-24.

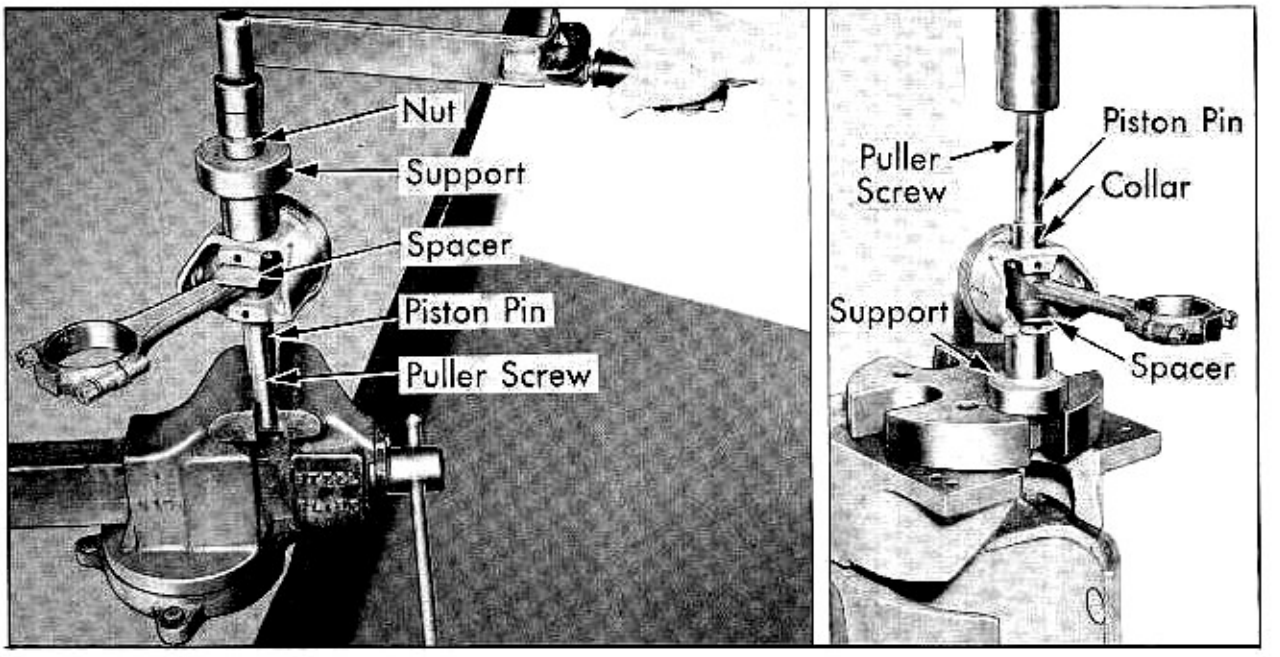


Fig. 10-24 Installing Piston Pin in Piston and Connecting Rod

NOTE: Piston pins are a match fit to the piston and are not available separately. Piston pins will not become loose enough to cause a knock or tapping until after very high mileages and in such cases a new piston and pin assembly should be installed.

(24) Measuring Piston Clearance

Piston should be measured for size 1/8" below the upper cross slot and at right angles to piston pin. Cylinders should be measured 1-1/4" from the top, crosswise to the cylinder block.

The clearance should be .0007" to .0011" in this position at 70° F. Subtract .0001" from measurement for every 6° above 70° F.

At the Factory, a system of letters stamped on the top face of the block, either to the right or left of each cylinder bore, denotes the cylinder sizes as shown below:

Letter	Cylinder Sizes	Piston Sizes
A	3.8125-3.8127	3.8116-3.8118
B	3.8127-3.8129	3.8118-3.8120
C	3.8129-3.8131	3.8120-3.8122
D	3.8131-3.8133	3.8122-3.8124
E	3.8133-3.8135	3.8124-3.8126
H	3.8135-3.8137	3.8126-3.8128
J	3.8137-3.8139	3.8128-3.8130
K	3.8139-3.8141	3.8130-3.8132
L	3.8141-3.8143	3.8132-3.8134
M	3.8143-3.8145	3.8134-3.8136

The chart indicates ten cylinder sizes for the size range of .002". There are twenty sizes, however, as each letter is either "+" or "-". If the letter is stamped to the left of the cylinder, it is "-". If letter is stamped to the right of cylinder, it is "+". This makes it possible to maintain the clearance of .0020-.0022", as formerly stated. For service use, pistons are furnished in the "L" or "M" code sizes only.

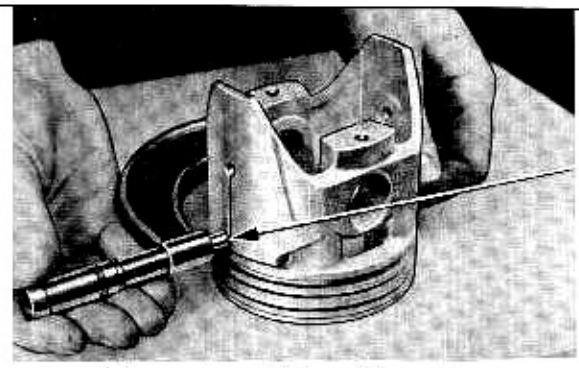
If a double letter ("AA") appears either to the left or right of the cylinder it indicates that the cylinder has been bored to .010" over the diameter indicated by the letter in the chart. For example, a cylinder with the letters "CC" stamped on the block to the left of the cylinder would have a diameter of 3.8129" + .010" or 3.8229" and a piston diameter of 3.8214".

Replacement pistons are furnished by the Factory Parts Department in the following sizes:

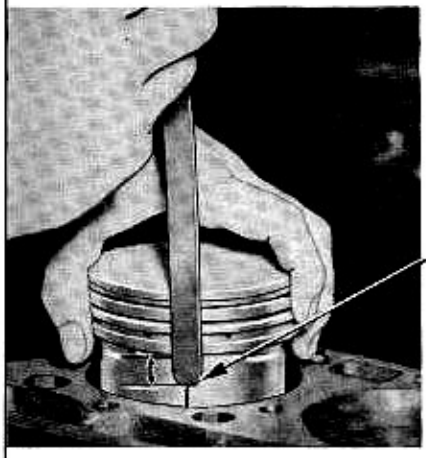
Standard
.010" oversize
.020" oversize
.030" oversize

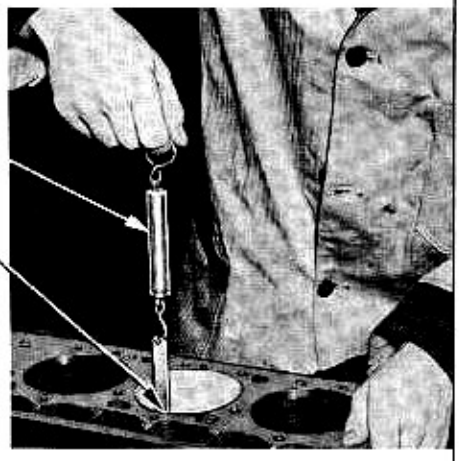
Piston diameters, as given in the specification table, can be measured with a large micrometer, as shown in Fig. 10-25.

Before ordering pistons for replacement, it is extremely important to determine the size of the cylinder bores by actual measurement. Actual measurement at the time of replacement is the only certain way to avoid errors in ordering.



Measuring Piston Diameter





Fitting Pistons to Cylinder Bores

Fig. 10-25 Piston Measurements

There are two methods of measuring piston clearance: with a micrometer or with ribbon feeler gauges. Both of these two methods are explained in detail, as follows:

a. Micrometer Measurements

The equipment required consists of a 3" to 4" outside micrometer and an inside micrometer of the same size. The outside micrometer must be adjusted to turn freely, so that it can be adjusted up to the piston with a very light turning effort on the screw. If it is adjusted to get a frictional feel over the piston, it will show several tenths of a thousandth smaller than its actual size. With practice, fractional thousandths can be checked.

The inside micrometer for measuring the cylinders must be provided with an extension handle and adjusted so the screw turns sufficiently tight to retain its setting while checking the cylinder at the different points to be measured.

The direct readings shown on the inside micrometer should not be taken as the cylinder sizes. After obtaining a light feel on the inside micrometer when one end of the bar contacts the exact center of the cylinder as it is being oscillated in a vertical plane, remove the micrometer and measure its length with the outside micrometer. This should be done, holding one end against the anvil of the outside micrometer and adjusting the screw, until the same feel is obtained as was felt in measuring the piston.

By this method, if the two micrometers do not agree in readings, no error will result in arriving at the actual net clearance of the piston in the cylinder at any point.

In measuring the pistons, it will be noted the upper end of the skirt is always the smallest. All aluminum pistons are ground tapered on the skirt to make the piston .0012"-.0021" larger at the open end. Thus, if the clearance were .002" at the upper end and the skirt tapered .002", there would be no clearance at the bottom, or if the cylinder were .0005" smaller at the bottom, the piston would be in confliction .0005".

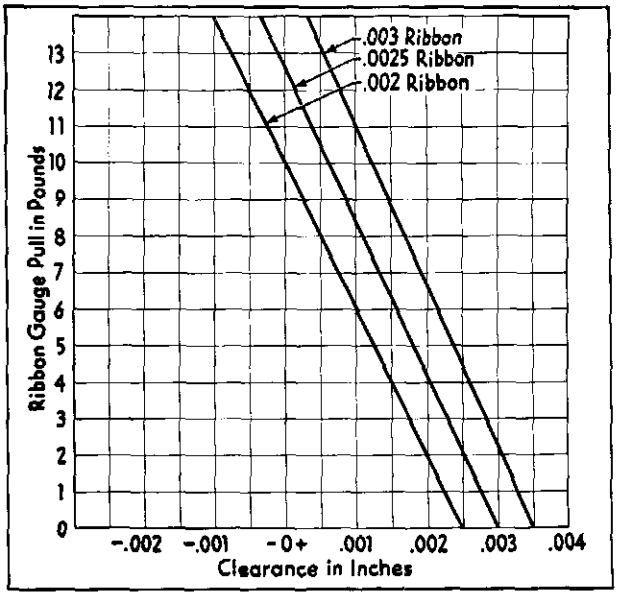


Fig. 10-26 Piston Clearance Chart

The piston skirt is sufficiently flexible so that it will contract to overcome this confliction just as piston rings contract to fit the cylinder.

The above conditions are perfectly normal and are necessary for long life and quietness of piston action. No undue friction or scoring will result, due to the flexibility designed into the casting and the oval shape of the skirt.

b. *Feeler Gauge Measurements*

Where no micrometers are available to measure piston clearance, the use of a feeler ribbon gauge will serve satisfactorily, as there is a definite relation between feeler gauge pull in pounds and micrometer clearance in thousandths of inches, as shown in Fig. 10-26, which is set up for .002", .0025", and .003" feeler gauge thicknesses.

Feeler ribbon gauges for this purpose must be considered as precision tools and if rusted or wrinkled are unfit for use. The most convenient length is about 8", with a cotter pin soldered on one end to hook onto the pull scale. In addition, the lower ends should be rounded and any frayed edges honed to prevent possible scratching of the cylinder and incorrect scale readings. Extreme cleanliness and a little lubrication is also necessary for accurate results.

In order to obtain the piston clearance at the upper end of the skirt, it is necessary to insert the piston into its extreme upper position, along with the ribbon, which must be kept located over the vertical slot and not in excess of 1/2" below the upper end of the skirt, as illustrated in Fig. 10-25. It is advisable to mark the ribbon adjacent to the piston head, so that its proper location on the piston can be maintained. It is helpful in getting the ribbon started into the cylinder along with the piston to use both thumbs to spring the piston inward.

Feeler gauges may also be used for measuring taper in cylinder, as follows:

Using a ribbon which gives between 2 and 6 pounds pull, insert the ribbon with the piston, open end down into the cylinder about one inch, taking the resulting pull at this point and in intervals of each two inches downward, until the open end of the piston is 1/8" below the bottom of the cylinder. By keeping a record of results the clearance difference can be read from the chart.

Checking the clearance with feeler ribbon gauges should not be attempted without help on the under side of the engine to push back the piston when required and to prevent it from being damaged if it should fall through the cylinder.

The clearances will become approximately .0005" greater at the upper end of the skirt, within a few hundred miles of operation, and remain so until increased due to normal wear. The initial increase of .0005" should not be mistaken as misfitting or rapid wear as this condition is due to normalizing of the piston casting. If this did not occur, it would be necessary to fit the piston with .0005" more clearance.

(25) Reconditioning Cylinder Bores

Worn cylinder bores can be reconditioned by reboring and honing in the service station. Several precautions are necessary, however, to assure a perfect fit between piston and cylinder. Take special note of the following:

1. Use the proper grit stone. When honing cylinders with only a few thousandths to be removed, a medium 300 to 400 grit stone will serve for both roughing and finishing. Where considerable stock is to be removed, however, 150 grit stones are best for roughing. To obtain the best results, the cylinders should be round and straight within .0007" and, in addition, free from chatter marks and dug-in spots from the hone.

Fast wearing hones are not recommended, due to the loss of time in keeping them tight and the undue amount of loose abrasive material which may remain in the engine. It is possible to obtain free cutting hones sufficiently hard that wear is negligible.

2. Guard against heat. The most troublesome problem in honing is from the heat generated, which causes the cylinders to expand, giving errors in fitting.

This can be overcome as follows: Use a steady small stream of filtered or fresh clean kerosene on the hone. Dry honing is not recommended, as the cylinder surface may become charged with abrasive and wear the rings out in a short time.

Use a means of driving the hone which controls the speed at 150 R.P.M., or lower, to keep down the heat. A slow speed air drill gives the best control.

Start honing at the lower or unworn end of the cylinder to prevent tapering the hones. Set the hones tight, and keep an up-and-down motion about one second apart for each stroke. Retighten the hone frequently. As the small end is enlarged, the stroke can be increased until the up-and-down motion covers the whole cylinder. It is advisable to reverse the stone holders occasionally to prevent tapering of the stones. As soon as the cylinder warms a little, start honing on another which is not adjacent to the warm one.

As the heat generated is greatest toward the upper side of V-engines and toward the center of the cylinder, this point is liable to be the smallest when the cylinder has cooled. If this condition exists, it may be necessary to rehone at this point. The cylinder limits given are for the whole length of the cylinder, and if the .0007" allowable taper should occur within the ring travel, the ring life will be short.

3. Do not hone too much. It is usual for the greatest wear in the cylinder to occur at the upper end of the upper ring travel, which therefore is the last point in the cylinders to clean up. Providing these spots are not in excess of 1/2" wide when the cylinders are finished for the smallest oversize, it is advisable to allow the condition to remain, rather than go to the expense of honing to the next oversize, as the condition will have very little effect on ring life or performance.

4. Make accurate measurements. Inasmuch as aluminum expands and contracts at approximately two times the rate of iron, it is necessary to correct the clearance results found, if the room temperature is much above or below 70°F. The correction following is for the difference between the expansion of aluminum and iron or steel; therefore, no consideration should be given to cylinder temperature or the tools used for measuring, other than that they be at approximately the same temperature as the pistons when measured. The temperature correction for piston size at other than 70°F is as follows:

Subtract .0001" from micrometer reading for each 6° above 70°F.

Add .0001" to micrometer reading for each 6° below 70°F.

If ribbon gauges are being used, the corrections are:

Subtract .4 lb. for each 6° above 70°F. before referring to chart.

Add .4 lb. for each 6° below 70°F. before referring to chart.

5. Remove all traces of abrasive from engine. Prior to the honing operation tape the crankpins tightly. Following the honing, wash down the cylinders, crankcase, and shaft to remove all abrasive material. This should be repeated at least three times, using a fresh supply each time. Do not use a wiping cloth or an air gun. Remove and clean crankshaft thrust bearing, as these surfaces are sufficiently exposed that abrasive material may have gotten on them.

6. Install proper engine oil. The principle requirements of the best oil for breaking-in rehoned engines are that it should be light, 10-W grade, and sold by a reputable refiner. New cylinder and ring surfaces are less liable to scuff or scratch with such a lubricant.

In addition, a 2-1/2% mixture of this lubricant with the fuel is suggested for the first 200 miles, which is in the ratio of one pint per five gallons of fuel. Do not just pour the oil into the fuel tank, as it will settle around the fuel pipe and cause smoke, hard starting, and stalling. The oil must be diluted and stirred into three times as much fuel as oil used, before adding oil to the fuel supply in the tank. Once the oil is diluted as directed, it will blend and not settle out in the tank.

(26) Connecting Rod Alignment

When connecting rod and piston assemblies are removed from an engine, the wear pattern on the piston skirts should be symmetrical on each side of the vertical slots. Bent or misaligned connecting rods will cause an off angle wear pattern. If this condition exists, the piston, pin, and rod assembly should be replaced. Do not attempt to straighten Cadillac precision connecting rods as field methods are not accurate.

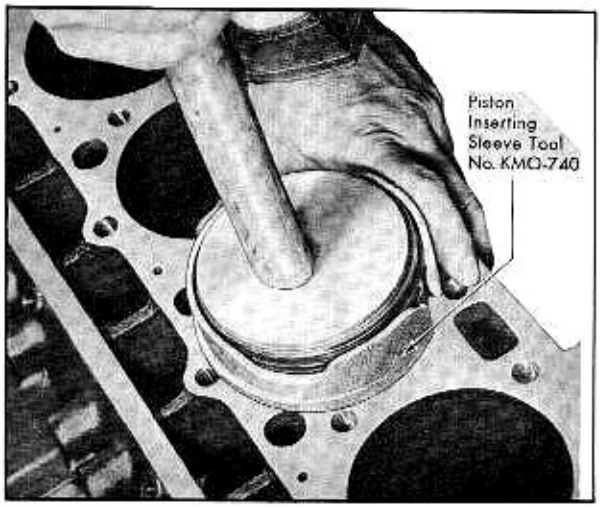


Fig. 10-27 Installing Piston in Cylinder Bore

(27) Installation of Piston and Connecting Rod Assemblies

1. Install piston and rod in cylinder bore with "REAR" on piston toward rear of engine, using Piston Inserting Sleeve, Tool No. KMO-740, Fig. 10-27.

CAUTION: Extreme care must be exercised when installing pistons and rods to be sure rod is lined up with crankshaft journal and does not stick or bind on counterweights.

2. Pull piston and connecting rod down into position on the crankshaft.

3. Install connecting rod cap and bearing over connecting rod bolts, being sure numbered side of cap is on same side as numbered side of rod.

NOTE: Re-check to see that the numbered side of connecting rod on No. 1, 3, 5, and 7 rods are on left side of engine and No. 2, 4, 6 and 8 are on right side of engine and that the rods are on the proper crank pins.

4. Install new self locking nuts and tighten to 40-45 ft. lbs. torque.

5. Repeat this operation for the other seven connecting rods.

(28) Replacement of Rear Main Bearing Oil Seal

Installation of a new rear main bearing oil seal requires use of Rear Main Bearing Oil Seal Compressor, Tool No. J-3048. After crankshaft has been removed from engine and worn packing taken out, proceed as follows:

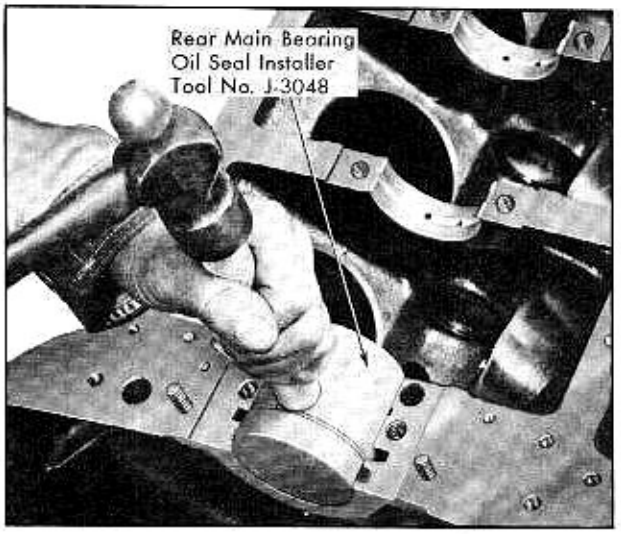


Fig. 10-28 Installing Rear Main Bearing Oil Seal

1. Remove rear main bearing.

2. Install a length of new packing in groove in crankcase and press up into place, using Rear Main Bearing Oil Seal Compressor, Tool No. J-3048, and a hammer, as shown in Fig. 10-28.

3. With tool held in position, cut off each end of packing flush with bearing edge, using a sharp knife, Fig. 10-29.

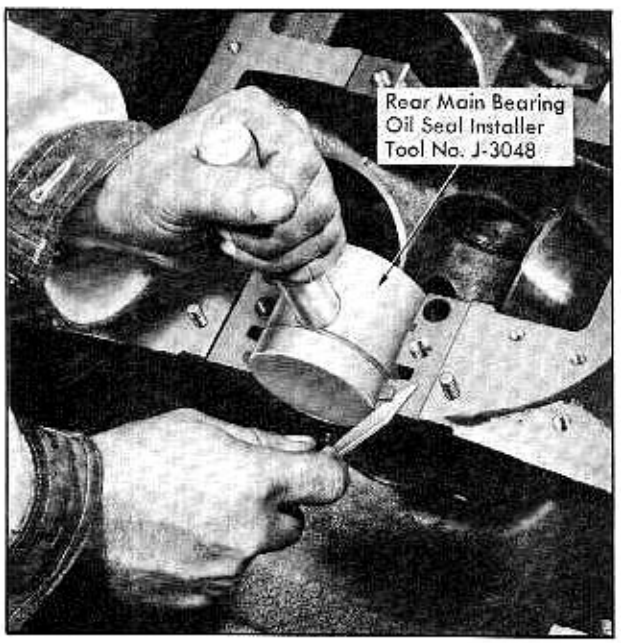


Fig. 10-29 Cutting Rear Main Bearing Oil Seal

4. Repeat operation in bearing cap. An arbor press or vise will provide the best means of forcing the packing into place and holding it while trimming.

(29) Removal of Timing Chain and Sprockets

1. Remove water pump, Section 13, Note 18.

2. Remove engine oil pan, Note 14.

3. Remove crankshaft pulley and harmonic balancer assembly.

4. Remove engine front cover.

5. Remove two cap screws and lock washers which hold sprocket to camshaft.

6. Remove sprocket with chain from camshaft.

7. Remove crankshaft sprocket.

(30) Removal of Camshaft

1. Remove hood lock plate support.

2. Remove Air Conditioning condenser as explained in Section 16a, Note 21, if car is so equipped.

3. Remove radiator core, Section 13, Note 16-a.

4. Remove timing chain and sprockets, as explained in Note 29.

5. Remove valve lifters, Note 10.

6. Remove distributor, Section 11, Note 12a.

7. Slide camshaft forward carefully until it is out of engine.

CAUTION: Extreme care should be exercised to keep the cam lobes from scratching the camshaft bushings.

(31) Checking Camshaft

The camshaft, on all 1954-Series cars, is made of cast iron and must be handled with particular care to avoid damage.

If the shaft is accidentally dropped, it may be sprung out of alignment, or the cam lobe surfaces may be damaged enough to cause erratic valve action or worn lifters and result in unsatisfactory engine performance.

Whenever the camshaft is removed, it should be checked for proper alignment. To make this inspection, the camshaft should be placed on "Vee" blocks at the front and rear bearing journals, or on centers, on a surface plate. A dial indicator should be mounted so that it is directly over the centerline of the camshaft with the pointer touching the shaft.

Set the dial indicator to read zero on the heel of No. 1 cam lobe and then check the heel of each cam lobe for a full 180° of rotation. If any discrepancy greater than .0015" total indicator reading on any particular cam heel is discovered, the camshaft should be replaced.

The runout of each of the bearing journals should also be checked. If more than .0015" total indicator reading runout is discovered, the camshaft is sprung out of alignment and should be replaced.

(32) Removal of Camshaft Bearings

1. Install puller collet of Camshaft Bearing Removing and Installing Tool No. J-3063 in No. 5 bearing, Fig. 10-30.

NOTE: Install a rubber band over both collet fingers next to thumb screw, to hold fingers while installing collet.

2. Tighten thumb screw and check to see that fingers are securely behind No. 5 bearing.

3. Install arbors "B", "C", and "E" in bearing Nos. 1, 2, and 3, respectively with large diameter of arbors toward rear of block.

4. Slide shaft through all three arbors and through No. 4 bearing.

5. Holding pilot "D" (which is used as an arbor in the removal operation) behind No. 4 bearing, slide shaft through pilot "D".

CAUTION: Be sure sharp corner on pilot "D" outside diameter is toward No. 4 bearing.

6. Thread shaft into puller collet in No. 5 bearing.

7. Slide bridge over front of shaft, with legs of bridge toward front face of block.

8. Slide flat washer on front end of shaft and install puller nut loosely.

9. Place a 3/4" open-end wrench over section of shaft on flats, which are between bridge and block. This keeps shaft from turning during the pulling operation.

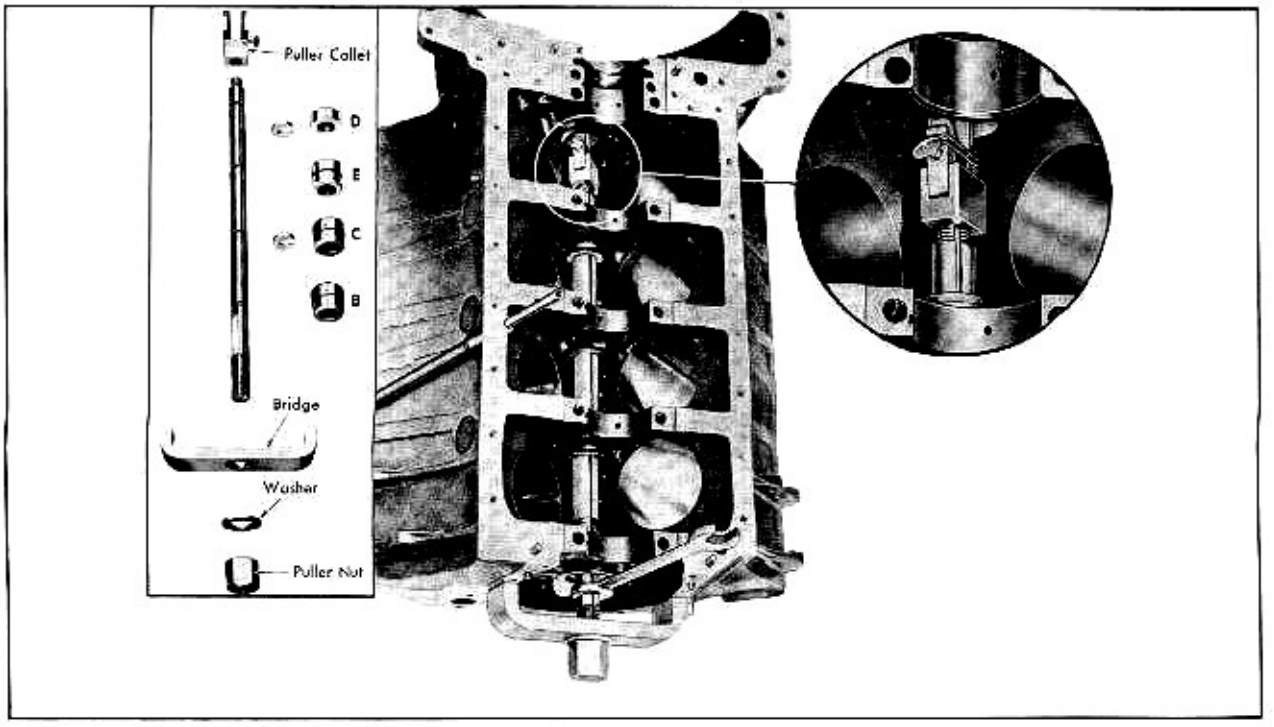


Fig. 10-30 Removing Camshaft Bushings

10. Install a C washer in slot in shaft behind pilot "D".

11. Tighten puller nut until No. 4 and 5 bearings are removed.

12. Remove puller collet and No. 5 bearing from rear end of shaft.

13. Loosen puller nut and slide shaft rearward until C washer can be removed from behind pilot "D"

14. Install C washers behind arbors "B", "C", and "E" respectively (bearings 1, 2 and 3).

15. Tighten puller nut until bearings No. 1, 2 and 3 are removed.

16. Remove puller nut from end of shaft.

17. Remove all pieces of the Camshaft Bearing Removing and Installing Tool and all bearings from cylinder block.

(33) Installation of Camshaft Bearings

1. Install camshaft bearings on arbors "A", "B," "C," E," AND "F" respectively, making sure that the oil holes in the camshaft bearings are centered over the spring loaded steel balls in the arbors.

2. Hold arbor "B" in position between No. 1 and 2 bearing bores and slide shaft through No. 1 bearing bore, through arbor "B," and through No. 2 bearing bore, Fig. 10-31.

NOTE: Arbor "B" must be positioned so that bearing is toward rear of cylinder block.

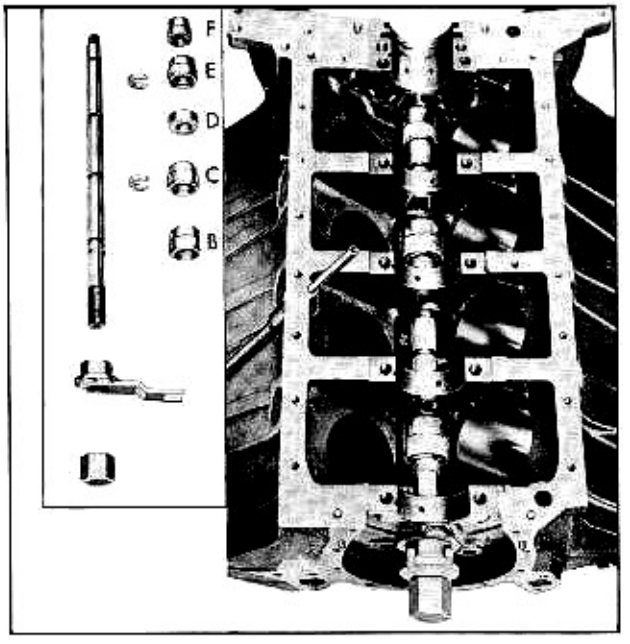


Fig. 10-31 Installing Camshaft Bushings

3. Install arbor "C" on shaft and in No. 2 bearing bore, making sure that the bearing is facing the No. 3 bearing bore.

4. Install pilot "D" in No. 3 bearing bore and slide shaft through pilot "D".

5. Position arbor "E" between No. 3 and 4 bearing bores and slide shaft through arbor, being sure arbor "E" is positioned so that the bearing faces rear of block.

6. Position arbor "F" between bearing bores No. 4 and 5 and slide shaft into arbor, being sure bearing on arbor is toward rear of block.

7. Slide arbor "A" over front end of the shaft, making sure that the grooved end of locating arm is centered over front end of the crankshaft. Fig. 10-31.

8. Install C washer in front of arbor "E" and slide shaft toward the rear until C washer is seated in the recess in arbor "E".

9. Thread driving cap nut on front of shaft until it bottoms on the shaft.

10. Make sure that pilot "D" is in No. 3 bearing bore and that large diameter of arbor "C" is in No. 2 bearing bore. These pilot the shaft in the cylinder block.

11. Using a hammer, drive the cap nut in until the large flange on arbor "A" contacts the front of the block. This will install camshaft bearings No's. 1, 4, and 5 (on arbors, "A," "E," and "F") simultaneously.

CAUTION: Make sure driving cap nut does not back off while driving bearings.

12. Slide shaft forward about 1/2", until the C washer is out of the recess in arbor "E" and remove C washer.

13. Slide arbor "C" out of No. 2 bearing bore and back in front of No. 3 bearing bore.

14. Install C washers in grooves in shaft in front of arbors "B" and "C."

15. With the C washers in place, slide the shaft rearward until the C washers are in the recesses of arbors "B" and "C."

16. Using a hammer, drive the driving cap nut in until it contacts arbor "A." This will install bearings No. 2 and No. 3 simultaneously.

CAUTION: Make sure driving cap nut does not back off when driving bearings.

17. Remove all pieces of the Camshaft Bearing Removing and Installing Tool from the cylinder block.

18. Bend a small piece of wire and place in oil hole in each bearing, to see that holes are lined up with oil holes in cylinder block.

(34) Installation of Camshaft

1. Lower camshaft into position between radiator grille and engine and guide it carefully into cylinder block.

CAUTION: Extreme care should be exercised to avoid nicking or scratching camshaft bearings.

2. Install timing chain and sprockets as explained in Note 35, Steps 1 through 10.

3. Install radiator core, Section 13, Note 16b.

4. Install condenser as explained in Section 16a, Note 21, if car is equipped with Air Conditioning.

5. Install hood lock plate support.

6. Install generator and compressor drive belts as explained in Section 11, Note 21, if car is equipped with Air Conditioning.

7. Install power steering drive belt as described in Section 7, Note 15.

8. Install distributor as explained in Section 11, Note 13b.

9. Install hydraulic valve lifters, Note 12.

(35) Installation of Timing Chain and Sprockets

1. Install crankshaft sprocket over crankshaft key.

2. Install camshaft sprocket in timing chain with timing mark toward the front.

3. Place chain over crankshaft sprocket and line up timing marks on both sprockets, Fig. 10-32.

4. Hold camshaft sprocket in position against end of camshaft and press sprocket on camshaft, being sure dowel on camshaft is lined up with dowel hole in sprocket.

5. Install 2 cap screws and lockwashers to hold sprocket to camshaft.

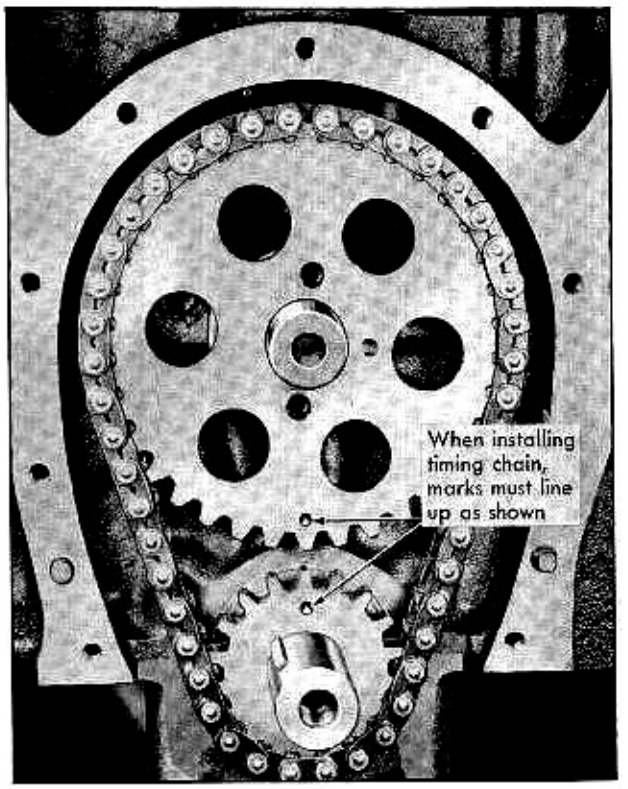


Fig. 10-32 Timing Gear Locating Marks

6. Install new front cover gasket and install cover over locating dowels on block.

7. Install 9 cap screws which hold cover to block and tighten to 10-12 foot pounds torque.

8. Install engine oil pan, Note 14.

9. Install crankshaft pulley.

10. Install water pump, Section 13, Note 21.

(36) Removal of Crankshaft (Engine in Car)

1. Raise car and install stands under car at all four wheels.

2. Remove timing chain and sprockets, Note 29.

3. Remove flywheel, Note 38.

4. Remove oil pan baffle and oil pump, Note 17.

5. Remove steering gear idler arm from right frame side bar and lower steering linkage to floor.

6. Remove spark plugs.

7. Disconnect connecting rods and push piston assemblies up into cylinder bores so that crankshaft can be removed without interfering with rods.

8. Remove front and rear main bearing caps.

9. Support crankshaft at front and rear and remove three intermediate bearing caps.

10. Lower crankshaft from engine.

(37) Installation of Crankshaft (Engine in Car)

1. Raise crankshaft into position and support in place while installing main bearing caps (See Note 21, Step 3), using a new rear main bearing oil seal as explained in Note 28.

2. Lubricate crank pins and pull connecting rod and piston assemblies down toward crankshaft.

3. Install connecting rod caps on crankshaft as described in Note 20.

4. Install camshaft sprocket, timing chain, and timing case cover, Note 35.

5. Install crankshaft pulley.

6. Install water pump using new gaskets, Section 13, Note 21.

7. Connect steering gear idler arm to right frame side bar.

8. Install oil pump, Note 18c.

9. Install flywheel, Note 39.

(38) Removal of Flywheel

1. Raise car 8 inches from floor and place stands under car at all four wheels.

2. Remove transmission, as described in Note 10.

3. Remove flywheel to crankshaft bolts.

4. Remove flywheel and gasket from crankshaft.

(39) Inspection and Installation of Flywheel

a. Inspection

1. Inspect all starter teeth on flywheel and clean up all burred teeth, using a fine file.

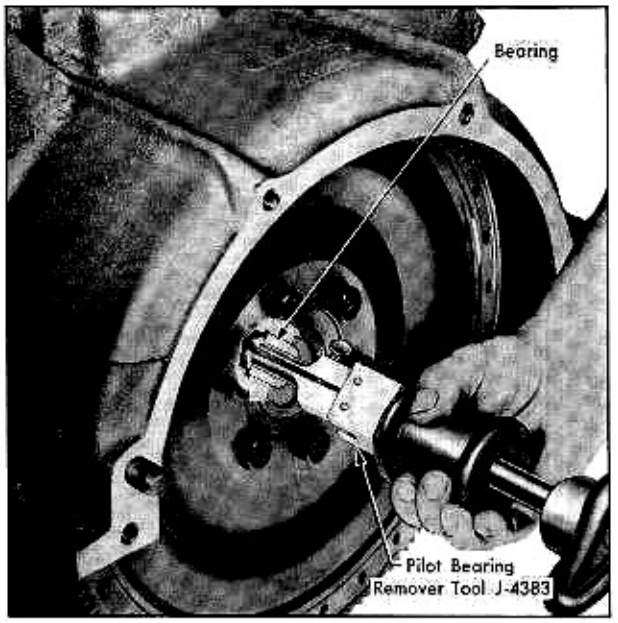


Fig. 10-33 Removing Crankshaft Pilot Bearing

2. Inspect flywheel cover attaching screw holes for stripped threads.

3. Inspect face of flywheel which contacts flywheel cover gasket for nicks or burrs which might cause leaks.

4. Inspect face of flywheel which contacts crankshaft for nicks or burrs which might cause leaks.

b. Installation

1. Place metal gasket on rear of crankshaft and position flywheel over dowel on end of shaft.

2. Dip the six mounting screws in sealer and install, tightening them to 80-85 foot pounds.

3. Install transmission as explained in Section 14, Note 36.

4. Raise car off stands, remove stands, and lower car to floor.

(40) Removal and Installation of Crankshaft Pilot Bearing

a. Removal

1. Remove transmission as described in Section 14, Note 10.

2. Install Pilot Bearing Remover, Tool No. J-4383, in bearing, being sure fingers of collet are behind bearing.

3. Tighten thumb screw to secure collet in bearing and remove bearing by tapping slide hammer against head of tool, Fig. 10-33.

b. Installation

1. Install new pilot bearing on Crankshaft Pilot Bearing Tool, No. J-2985.

2. Position bearing in line with its bore in crankshaft and drive the bearing into the shaft until the flange of tool touches the crankshaft face, Fig. 10-34.

3. Install transmission as described in Note 36.

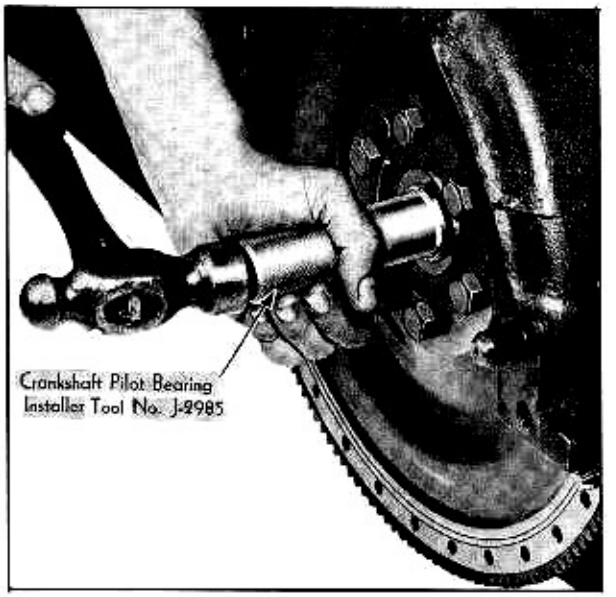


Fig. 10-34 Installing Crankshaft Pilot Bearing

(41) Engine Support Mountings

The engines on all 1954 series Cadillac cars are supported in the chassis; at three points - on each side of the crankcase toward the front of the engine and at the transmission extension housing in the rear. The front engine mountings are supported directly on the frame at an angle, and the rear engine mounting is on a bracket bolted to the frame X member. All supports are equipped with rubber cushions to eliminate vibration and road shocks.

It is important, when attaching the engine mountings to engine and frame, that the nuts and bolts be tightened to the proper torque, as follows:

Nut - Front Support - Cushion to Engine - 25 to 30 ft. lbs.

Nut - Front Motor Support Stud - 80 to 90 ft. lbs.

Engine Rear Support Cushion - 50 to 55 ft. lbs.

Rear Support Cushion to Cross Member - 50 to 60 ft. lbs.

Nut - Cross Member - Engine Rear Support - 25 to 30 ft. lbs.

NOTE: The rear support cushion should be a smooth, push fit in the retainer.

(42) Removal of Engine (with Transmission) from Car

1. Drain cooling system, crankcase, and transmission.

2. Remove hood top panel. Section 4, Note 2.

3. Disconnect battery cables.

4. Disconnect wires from generator.

5. Remove upper and lower radiator hoses.

6. Remove radiator core.

7. Disconnect power steering pump to valve body hoses at pump and install caps on fittings to prevent oil leakage.

8. Disconnect refrigerant lines as explained in Section 16a, Note 10a, on cars equipped with Air Conditioning.

9. Disconnect all heater hoses at water pump. Remove right heater hose from thermostatic valve.

10. Disconnect power brake vacuum line (on cars so equipped) at intake manifold.

11. Remove carburetor air cleaner, disconnect carburetor linkage and fittings and remove carburetor.

12. Disconnect flexible fuel line at fuel pump and remove line from clips.

13. Disconnect ground straps, primary wire at distributor, oil pressure and cooling system temperature switch wires.

14. Disconnect yellow and black wires at porcelain resistor.

15. Disconnect windshield wiper vacuum hoses at manifold line and vacuum pump line.

16. Raise front of car and install stands.

17. Disconnect propeller shaft at rear axle and remove assembly from car by sliding front yoke out of transmission extension housing.

18. Remove transmission linkage slush deflector.

19. Disconnect speedometer cable and shift linkage at transmission.

20. Remove starter from engine.

21. Disconnect front motor supports at frame.

22. Disconnect exhaust pipes from exhaust manifolds.

23. Remove idler arm support screws from frame and lower idler arm and steering connecting link.

24. Loosen hand brake cable at relay.

25. Remove stands from front of car and lower car to floor.

26. Install a rope or chain around intake manifold and attach to chain fall or hoist above engine.

27. Take up slack on rope or chain.

28. Disconnect and remove rear engine support bracket from frame and extension housing.

29. Lift engine, with transmission, out of car.

30. Remove transmission from engine if so desired.

(43) Installation of Engine and Transmission in Car

1. Install transmission on engine.

2. Lower engine and transmission into car, guiding engine so that extension housing will be in position in frame cross member.

3. Guide front engine support studs into holes in frame.

4. Raise car and install rear engine support on extension housing and frame.

5. Lower car and remove rope or chain from intake manifold.

6. Connect left heater hoses to water pump and right heater hose at thermostatic valve.

7. Connect windshield wiper vacuum hoses to manifold vacuum line and vacuum pump line.

8. Connect yellow and black wires to porcelain resistor.

9. Connect ground straps, primary wire to distributor, oil pressure and cooling system temperature switch wires.

10. Connect flexible fuel line to fuel pump.

11. Install carburetor, connect carburetor linkages and fittings and install carburetor air cleaner.

12. Connect power brake vacuum line (on cars so equipped) at intake manifold.

13. Install radiator core.

14. Install upper and lower radiator hoses.

15. Connect refrigerant lines as explained in Section 16a, Note 13b, on cars equipped with Air Conditioning.

16. Connect power steering pump to valve body hoses and fill tank to proper level with Hydra-Matic Transmission fluid.

17. Connect wires to generator.

18. Install hood top panel and align to cowl and fenders.

19. Connect battery cables.

20. Raise front of car and install stands.

21. Connect speedometer cable and shift linkage at transmission.

22. Install transmission linkage slush deflector.

23. Install starter on engine.

24. Using new gaskets, connect right and left exhaust pipes to manifolds.

25. Adjust hand brake cable at relay.

26. Install idler arm support in position on right frame side bar.

27. Tighten front engine support nuts to 80-90 foot pounds torque.

28. Fill cooling system, crankcase, and transmission.

29. Adjust throttle control linkage, as explained in Section 14, Note 4.

30. Set ignition timing and check operation of car.

OTHER NOTES AND REFERENCES

SPECIAL TOOLS

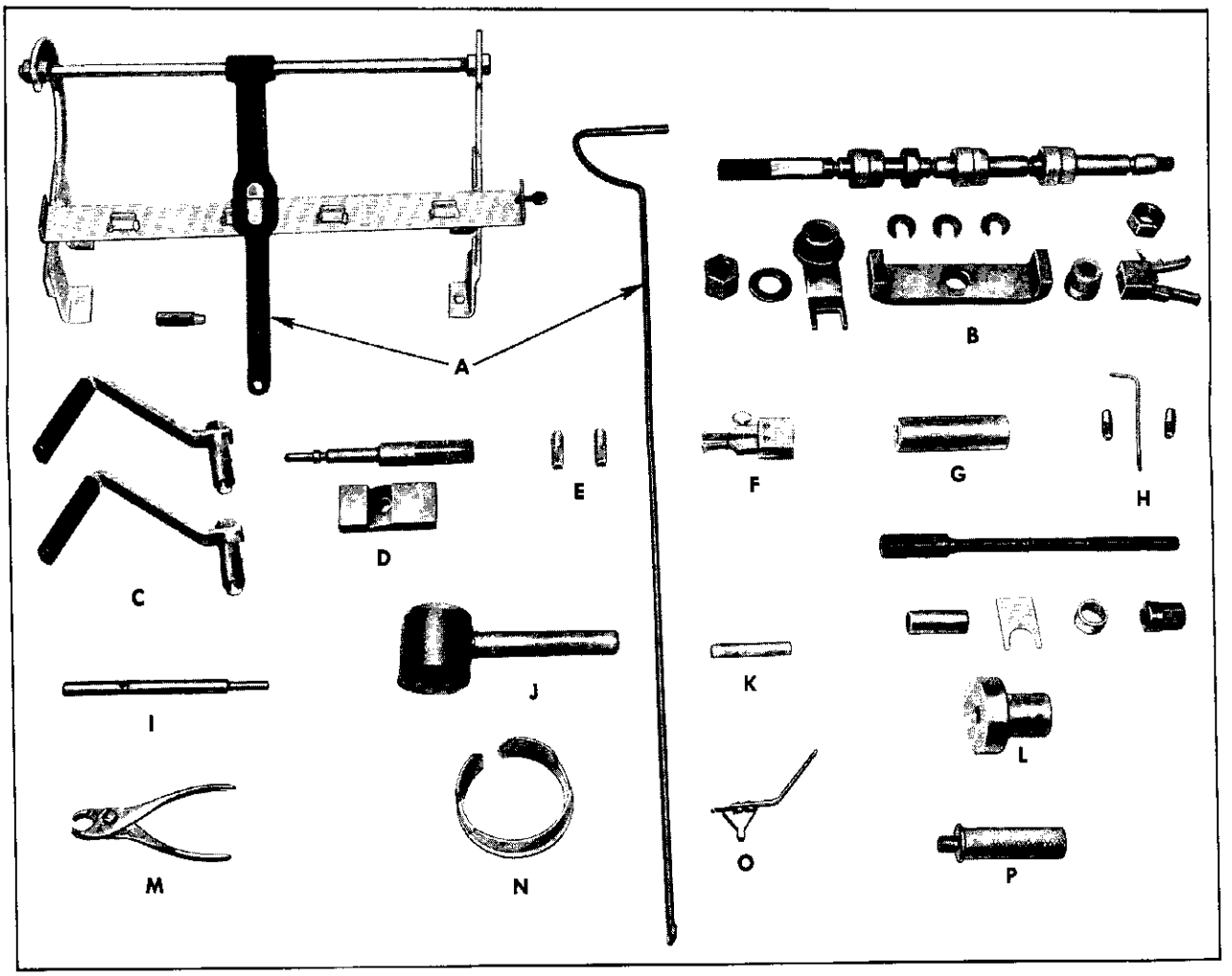


Fig. 10-35 Engine Mechanical Special Tools

Key	Tool No.	Name	Key	Tool No.	Name
A	J-3064	Cylinder Head Holder and Valve Spring Compressor.	H	J-3455	Cylinder Head Guide Stud Set.
B	J-3063	Camshaft Bearing Remover and Replacer Set.	I	J-3062	Valve Stem Guide Remover.
			J	J-3048-A	Rear Main Bearing Oil Seal Installer.
C	J-4159	Cylinder Head Removing Handles.	K	J-2730	Valve Lifter Lock Ring Installer.
D	J-3066-A	Valve Stem Guide Installer Set.	L	J-3049	Valve Lifter Remover.
			M	KMO-740	Piston Ring Compressor.
E	J-3224	Connecting Rod Bolt Guide Set.	N	J-3074	Valve Lifter Leak Down Tester
F	J-4383	Crankshaft pilot Bearing Puller (used with Slide Hammer J-2619-A)	O	J-2985	Crankshaft Pilot Bearing Installer.
G	J-4160	Hydraulic Valve Lifter Remover.	P	J-3848	Piston Pin Remover and Installer Set.

ENGINE MECHANICAL

SPECIFICATIONS

Subject and Remarks	All Series
Bore	3-13/16"
Stroke	3-5/8"
Compression pressure --	
At cranking speed (throttle open)	150 p.s.i.
At 1000 R.P.M.	203 p.s.i.
Compression ratio	8.25 to 1
Horsepower --	
Rated (taxable)	46.5
Developed at 4400 R.P.M.	230
Piston displacement	331 Cu. In.
Points of suspension	3
Torque, at 2700 R.P.M.	330 ft. lbs.
VALVES, EXHAUST	
Clearance between stem and guide --	
New limits	.0010-.0025"
Worn limits, not over	.005"
Clearance between lifter body and crankcase	.0010-.0023"
Head diameter, overall	1.562"
Lift	.365"
Seat Angle	44°
Seat width in head	.050"-.068"
Seat eccentricity, not over (total indicator reading)	.004"
Length overall	4-21/32"
Stem, diameter	.3415-.3420"
VALVES, INLET	
Clearance between stem and guide --	
New limits	.0010-.0025"
Worn limits, not over	.005"
Clearance between lifter body and crankcase	.0010-.0023"
Head diameter, overall	1.750"
Lift	.365"
Seat angle	44°
Seat width in head	.050-.068"
Seat eccentricity, not over (total indicator reading)	.004"
Stem, length overall	4.628-4.650"
Stem, diameter	.3415-.3425"
VALVE SPRINGS	
Free length	1.968"
Pressure in Pounds -- Compressed to 1.696" (valve closed)	61
Compressed to 1.326" (valve open)	140
ROCKER SHAFT ASSEMBLY	
Clearance between arm and shaft--	
New Limits	.0007-.0022"
Worn limits	.003"
Clearance between shaft and bracket	.0002-.0017"
Shaft diameter	.8108-.8113"
Diameter of hole in arm	.812-.813"
Short Spring (Center)	
Free length	3-63/64"
Pressure in pounds (when compressed to 1.844")	10-1/2-12
Long spring (end)	
Free length	4-31/32"
Pressure in pounds (when compressed to 2.219")	10-1/2-12
VALVE TIMING (Without ramp)	
Intake opens	22° B.T.D.C.
Intake closes	67° A.B.D.C.
Exhaust opens	63° B.B.D.C.
Exhaust closes	27° A.T.D.C.
CONNECTING RODS	
Bearing material	Moraine Durex
Clearance between bearing and shaft --	
New limits	.0005-.0020"
Worn limits, not over	.0045"
Diameter lower end, without bearing	2.3740-2.3745"
Length, center to center	6-5/8"
End play of rods on crank pin	.008-.014"
PISTON RINGS	
Clearance between rings and sides of grooves in piston --	
Compression rings	.0017-.0035"
Oil rings	.0008-.0026"
Gap between ends in 3.8125" cylinder --	
Compression rings	.010-.020"
Oil rings	.010-.020"
Number of compression rings	2
Number of oil rings	1
Width of compression rings	5/64"
Width of oil rings	3/16"
Width of oil ring slot	.064"
Diameter at bottom of groove	
Oil rings	3.405-3.410"
Compression rings	3.405-3.410"
Maximum wall thickness	
Oil rings	.150"
Compression rings	.184"
PISTON PINS	
Clearance between pin and piston--	
New limits	.00005 to .0001" at 70 F.

SPECIFICATIONS (Cont'd)

Subject and Remarks	All Series
Pin length	3-3/32"
Pin diameter	1.000
PISTONS AND CYLINDERS	
Cylinder bore out round (new or reground limit) Not over	.0005"
Taper, not over	.0007"
Cylinder bore, standard	3.8125-3.8145"
Cylinder sizes (as indicated by letters stamped on top face of block)	

Letter	Cylinder Sizes	Piston Sizes
A	3.8125-3.8127	3.8110-3.8112
B	3.8127-3.8129	3.8112-3.8114
C	3.8129-3.8131	3.8114-3.8116
D	3.8131-3.8133	3.8116-3.8118
E	3.8133-3.8135	3.8118-3.8120
H	3.8135-3.8137	3.8120-3.8122
J	3.8137-3.8139	3.8122-2.8124
K	3.8139-3.8141	3.8124-3.8126
L	3.8141-3.8143	3.8126-3.8128
M	3.8143-3.8145	3.8128-3.8130

Piston material	Aluminum Alloy
Piston skirt diameter-standard	3.8110-3.8140"
Piston skirt diameter-oversize--	
.010" oversize	3.8210-3.8230"
.020" oversize	3.8310-2.8330"
.030" oversize	3.8410-3.8430"
Piston skirt top clearance	.0015"
Piston skirt bottom clearance	.000"
Piston top land diameter -- Standard	3.779-3.782"
Piston top land clearance	.0305-.0355"
OIL PUMP	
Backlash between drive gears	.008-.012"
Clearance between pump body and drive shaft --	
New limits	.0010-.0025"
Worn limits, not over	.005"
Clearance between pump body and gears --	
New limits	.003-.005"
Worn limits, not over	.006"
End play in pump gears --	
New limits	.001-.004"
Worn limits, not over	.006"
Oil Pump type	Helical gear
VACUUM PUMP	
Clearances --	
Vane to cover plate	.002-.005"
Rotor to cover plate	.004-.007"
Socket to cover plate	.0144-.0324"
Socket to rotor face	.0104-.0254"
Rotor to shaft	.0010-.0023"
Rotor to depression in body cavity	.0005-.0034"
CRANKSHAFT AND MAIN BEARINGS	
Clearance, main bearings --	
New limits	.0008-.0025"
Worn limits, not over	.005"
Main bearing caps --	
Bolt thread diameter	1/2"
Main bearing journal, diameter	2-1/2"
Main bearing journals, out-of-round, not over	.00025"
Main bearing journal length --	
Front	.907"
Intermediate	.907"
Rear	1.622"
Main Bearings, material	Moraine Durex
Crankpin diameter	2.2488-2.2493"
Crankpin out-of-round, not over	.00025"
End play in crankshaft --	
New limits	.001-.005"
Worn limits	.010"
OIL PRESSURE REGULATOR	
Clearance between valve plunger and housing --	
New limits	.0020-.0035"
Worn limits, not over	.005"
Normal pressure to 30	
M.P.H. (min)	30-35 lbs.
Idle (average)	15 lbs.
Spring --	
Free length (approx.)	2-27/64"
Pressure at 1-7/16"	4.3-4.8 lbs.
Valve opens at	30 lbs.
CHAINS	
Camshaft chain --	
Adjustment	None
Length	23"
Make	Link Belt
Number of links	46
Pitch	.500"
Width	11/16"
CAMSHAFT	
Bearing Clearance --	
New limits	.001-.0022"
Worn limits, not over	.004"
Bearing out-of-round, not over	.002"
Number of bearings	5

ENGINE MECHANICAL

TORQUE TIGHTNESS

Location	Size	Ft. Lbs. Min.	Ft. Lbs. Max.
Camshaft sprocket screws	5/16-18	15	18
Connecting rod nuts	3/8-24	40	45
Cylinder head screws	7/16-14	65	70
Engine, rear support cushion	7/16-14	50	55
Engine, rear support, cushion to cross member bolt	7/16-20	50	60
Engine, rear support, cross member nut	3/8-24	25	30
Exhaust manifold to cylinder head	3/8-16	25	30
Fan blade assembly to flange	5/16-24	15	20
Flywheel to crankshaft	7/16-20	80	85
Flywheel housing plate--lower	1/4-20	10	12
Flywheel housing to crankcase	7/16-14	45	50
Flywheel housing to crankcase--lower	3/8-16	25	30
Flywheel housing to cover--lower	7/16-14	45	50
Front motor support stud nut	1/2-20	80	90
Front support cushion to engine nut	3/8-24	25	30
Harmonic balancer to crankshaft	1/2-20	60	65
Intake manifold to cylinder head	3/8-16	25	30
Intake manifold to cylinder head nut	3/8-24	25	30
Main bearing caps to crankcase	1/2-13	90	100
Oil filler support to crankcase	5/16-18	15	18
Oil pan baffle to crankcase	5/16-18	15	18
Oil pan to crankcase screw	5/16-18	10	12
Oil pan to crankcase nut	5/16-24	15	18
Oil pan drain plug	Special	25	30
Oil pump cover to body	1/4-20	10	12
Oil pump to rear bearing cap nut	3/8-24	25	30
Pulley to balancer hub	5/16-18	15	18
Rocker arm cover to cylinder head	1/4-20	20	25 in. lbs.
Temperature indicator thermal unit	1/2 pipe	35	40
Valve compartment cover to crankcase	1/4-20	20	30 in. lbs.
Valve lifter compartment vent pipe	1/4-20	20	30 in. lbs.

OTHER NOTES AND REFERENCES