

Fig. 12—Intake and Exhaust Valves

(3) When refacing valve seats, it is important that the correct size valve guide pilot be used for re-seating stones. A true and complete surface must be obtained.

(4) Measure the concentricity of the valve seat using valve seat dial indicator No. 13725. The total runout should not exceed .003 inch (total indicator reading).

(5) Check valve seat with Prussion blue to determine where valve contacts the seat. To do this, coat valve seat lightly with Prussian blue then set valve in place. Rotate valve with light pressure. If blue is transferred to center of valve face, the contact is satisfactory. If blue is transferred to top edge of valve face, lower the valve seat with a 30 degree stone. If blue is transferred to bottom edge of valve face raise valve seat with a 60 degree stone.

(6) When seat is properly positioned the width of intake seats should be 1/16 to 3/32 inch. The width of exhaust seats should be 3/64 to 1/16 inch.

(7) If valves or seats are reground, check valve stem height with Tool C-3746. If valve is too long, grind off the tip until length is within limits.

Testing Valve Springs (Fig. 13)

(1) Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example: the compressed length of the spring to be tested is 1-5/16 inches. Turn the table of Tool C-647 until surface is in line with the 1-5/16 inch mark on threaded stud and zero mark to the front. Place spring over stud on table and lift the compressing lever to set the tone device. Pull on torque wrench until ping is heard. Take the reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at the test length. Fractional measurements are indi-

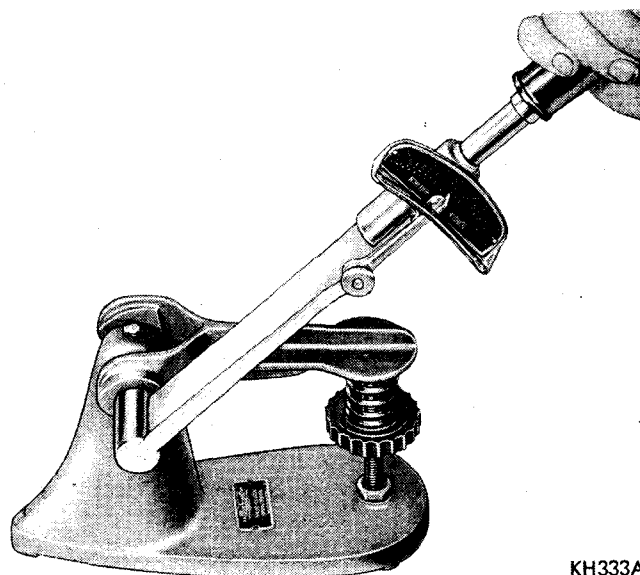


Fig. 13—Testing Valve Springs

“Specifications” to obtain specified height and allowable tensions. Discard springs that do not met specifications.

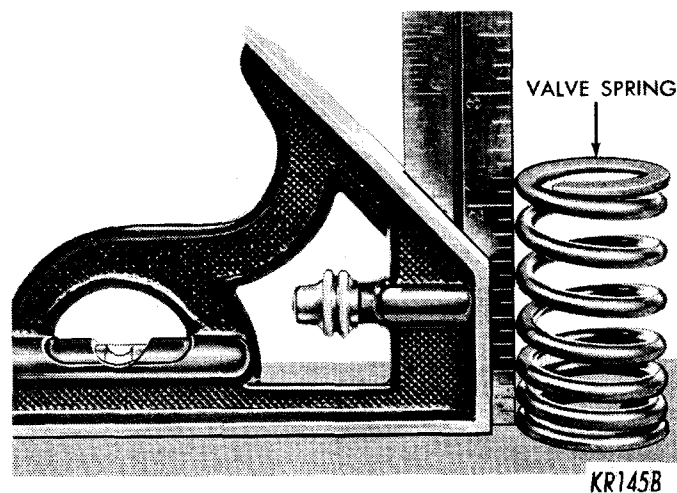
(2) Inspect each valve spring for squareness with a steel square and surface plate, as shown in (Fig. 14). Test spring from both ends. If spring is more than 1/16 inch out-of-square, install a new spring.

Installation

(1) Lubricate valve stems and insert them in cylinder head.

(2) Install new cup seals on all valve stems, (long seal on intake valve and short seal on exhaust valve) and other valve guides (Figs. 15 and 16). Install valve springs and retainers.

(3) Compress valve springs with Tool C-3422A, install locks and release tool. **If valves and/or seats are reground, measure the installed height of springs. Make sure measurement is taken from the bottom of**



the spring seat in cylinder head to the bottom surface of spring retainer. (If spacers are installed, measure from the top of spacer.) If height is greater than 1-11/16 inches, install a 1/16 inch spacer in the head counterbore to bring spring height back to normal 1-5/8 to 1-11/16 inches.

When exhaust valves are equipped with positive type rotators, the proper installed spring height is 1-33/64 to 1-37/64 inches.

Replacing Valve Stem Shields or Valve Springs, Cylinder Head Not Removed

- (1) Set engine basic timing to TDC and remove Air Cleaner.
- (2) Remove cylinder head covers and spark plugs.
- (3) Remove coil wire from distributor and secure to good ground to prevent engine from starting.
- (4) Using suitable tool, turn engine so the number 1 piston is at Top Dead Center on the compression stroke.
- (5) Remove rocker arms with rocker shaft and install a dummy shaft. (The rocker arms should not be disturbed and left on shaft).
- (6) With air hose attached to adapter tool C-3907 installed in number 1 spark plug hole, apply 90 to 100 psi air pressure.
- (7) Using Tool C-3906 or C-4228 compress valve spring and remove retainer valve locks and valve spring.
- (8) Install cup shields on the exhaust valve stem and position down against valve guides.
- (9) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. **Do Not Force** seal against top of guide. When installing the valve retainer locks, compress the spring **only enough** to install the locks.
- (10) Follow the same procedure on the remaining 5 cylinders using the firing order sequence 1-5-3-6-2-4. **Make sure piston in cylinder is at TDC on the valve spring that is being removed.**
- (11) Remove adaptor Tool 3907.
- (12) Remove dummy shaft and install rocker shaft

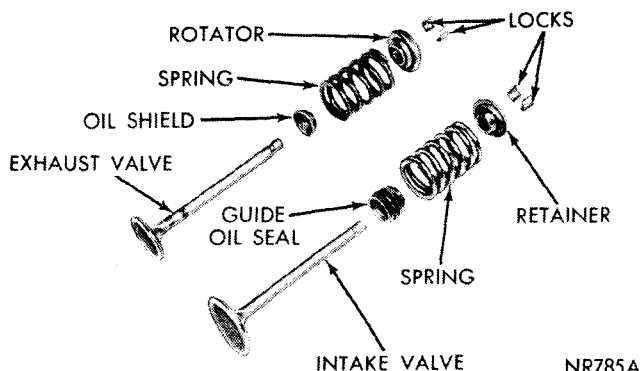


Fig. 15—Valve Assemblies

with rocker arms.

- (13) Install covers and coil wire to distributor.
- (14) Install air cleaner.
- (15) Road test vehicle.

VALVE TIMING

(1) Rotate crankshaft until No. 6 exhaust valve is closing and No. 6 intake valve is opening. Install dial indicator so that the indicator pointer contacts the valve spring retainer on No. 1 intake valve parallel to the axis of the valve stem.

(2) Turn No. 1 intake adjusting screw in one complete turn to remove lash. Adjust dial indicator to zero. Rotate crankshaft clockwise (normal running direction) until valve has lifted .029 inch. The timing of the crankshaft pulley should now read from 12 degrees before top dead center to top read center. Readjust lash.

(3) If reading is not within the specified limits:

- (a) Check sprocket index marks.
- (b) Inspect timing chain for wear.
- (c) Check accuracy of "O" mark on timing indicator.

TIMING CHAIN COVER, OIL SEAL AND CHAIN

Cover Removal

- (1) Drain cooling system.
- (2) Remove radiator and fan.
- (3) Install Tool C-3732A and pull vibration damper assembly off end of crankshaft (Fig. 17).
- (4) Loosen oil pan bolts to allow clearance and remove the chain case cover and gasket.

Measuring Timing Chain for Stretch

- (1) Place a scale next to the timing chain so that any movement of the chain may be measured.
- (2) Place a torque wrench and socket over the camshaft sprocket lock bolt and apply torque in the direction of crankshaft rotation to take up slack; 30

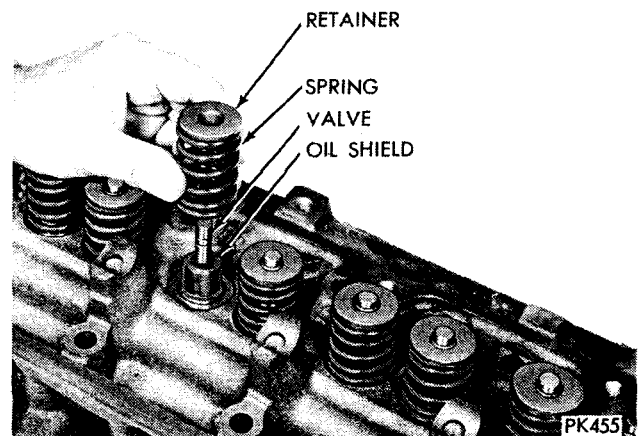


Fig. 16—Installing Valves and Cup Seals

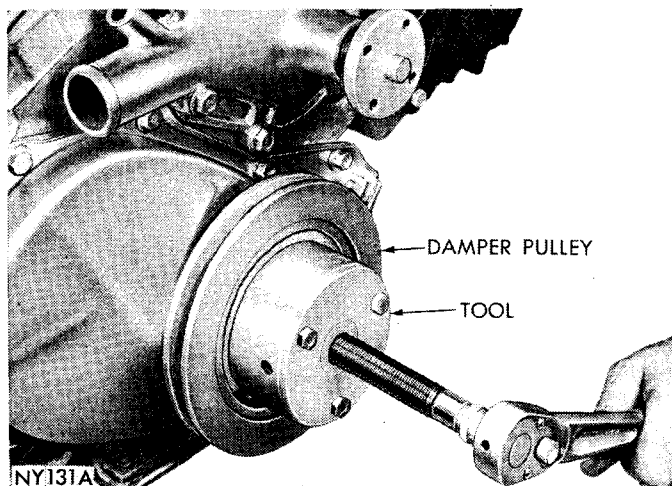


Fig. 17—Removing Vibration Damper Assembly

foot-pounds (cylinder head installed) or 15 foot-pounds (cylinder head removed). **With torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block the crankcase to prevent rotation.**

(3) Holding a scale with dimensional reading even with the edge of a chain link, apply torque in the reverse direction 30 foot-pounds (cylinder head installed) or 15 foot-pounds (cylinder head removed) and note the amount of chain movement (Fig. 18).

(4) If chain movement exceeds 3/16 inch, install a new timing chain.

(5) If chain is not satisfactory, remove camshaft sprocket attaching bolt and remove timing chain with camshaft sprocket.

(6) Turn crankshaft to line up the centerline of camshaft and crankshaft with the timing mark on crankshaft sprocket.

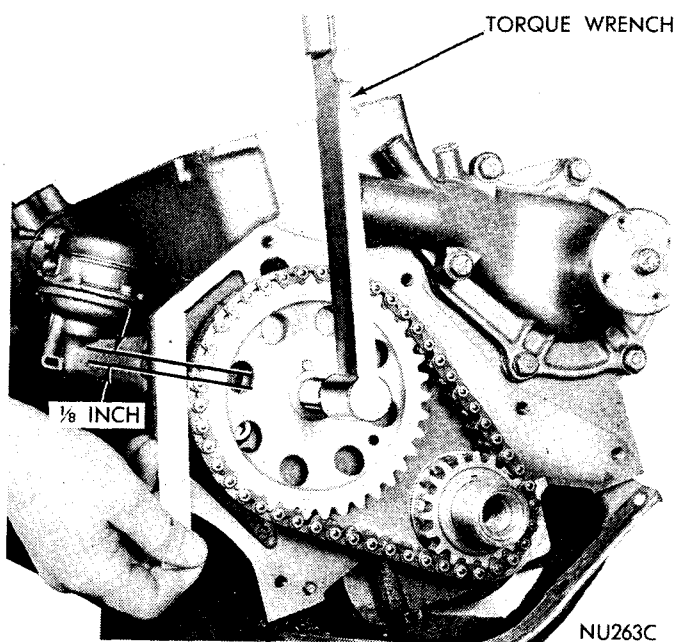


Fig. 18—Measuring Timing Chain Stretch

(7) Install camshaft sprocket and timing chain.

(8) Line up timing marks on the sprockets with the centerline of crankshaft and camshaft (Fig. 19).

(9) Tighten camshaft sprocket lock bolt to 35 foot-pounds.

Oil Seal Removal (Cover Removed)

(1) Using a drift and hammer tap lightly at several places around the seal case to deform the oil seal case inward.

(2) Engage the seal case with vise grips. Twist and pull on the vise grips at several places around the seal case for removal.

(3) Insert installing screw through installing plate. Part of Tool C-3506.

(4) Insert installing screw with plate through the seal opening (inside of chain case cover facing up).

(5) Place seal in the cover opening, with seal lips down. Place the seal installing plate into the new seal, with protective recess toward lip of seal retainer, Tool SP-5598, part of Tool C-3506.

(6) Install flat washer and nut on installing screw, hold screw and tighten the nut.

(7) Seal is properly installed when tool is tight against face of cover.

Cover Installation

(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.

(2) Using a new gasket carefully install chain case cover to avoid damaging oil pan gasket. Tighten chain case cover capscrews to 30 foot-pounds first then tighten oil pan capscrews to 200 inch-pounds.

(3) Lubricate seal lip with lubriplate, position vibration damper hub slot on key in crankshaft, and slide on crankshaft.

(4) Place installing tool, part of Puller set Tool C-3688 in position and press vibration damper on crankshaft (Fig. 20).

Oil Seal Timing Chain Cover Not Removed

With cover in place and seal removed by the use of suitable tool being careful not to damage seal surface or cover. Install new seal by installing threaded shaft

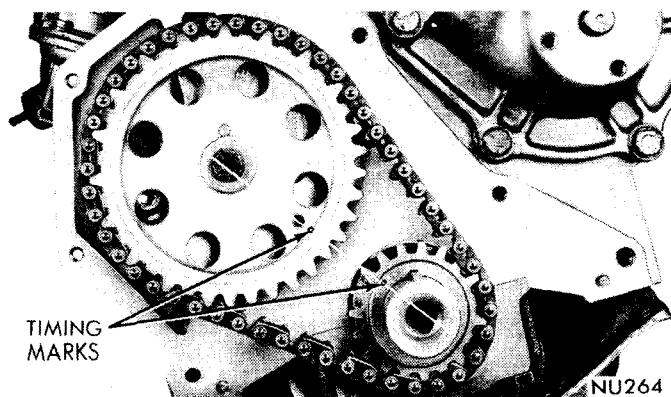


Fig. 19—Alignment of Timing Marks

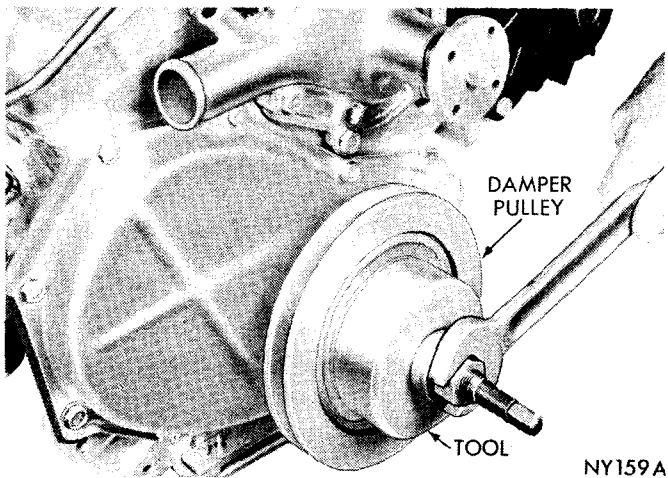


Fig. 20—Installing Vibration Damper Assembly

part of tool C-4251 into threads in front end of crankshaft. Place seal in opening with seal spring in and over seal place the installing adapter with thrust bearing and nut on shaft. Tighten nut until tool is flush with timing chain cover.

CAMSHAFT

The camshaft has an integral oil pump and distributor drive gear and fuel pump eccentric (Fig. 21).

Rearward camshaft thrust is taken by the rear face of the camshaft sprocket hub, bearing directly on the front of the cylinder block, eliminating the need for a thrust plate.

The helical oil pump distributor drive gear and camshaft lobe taper both tend to produce only a rearward thrust.

Removal

- (1) Remove tappets using Tool C-4129.
- (2) Remove timing sprockets, distributor and oil pump.
- (3) Remove fuel pump.
- (4) Install a long bolt into the front of camshaft to facilitate removal of the camshaft; remove crank-

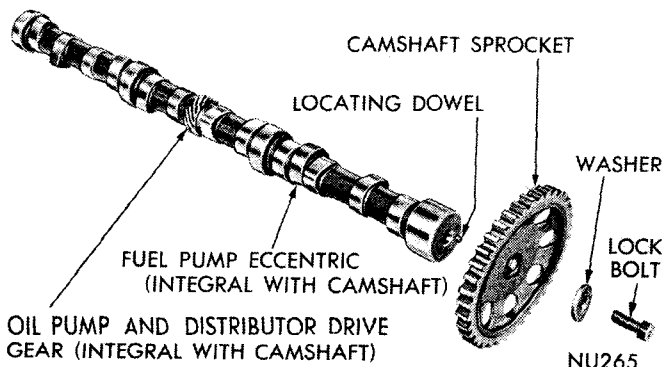


Fig. 21—Camshaft and Sprocket Assembly

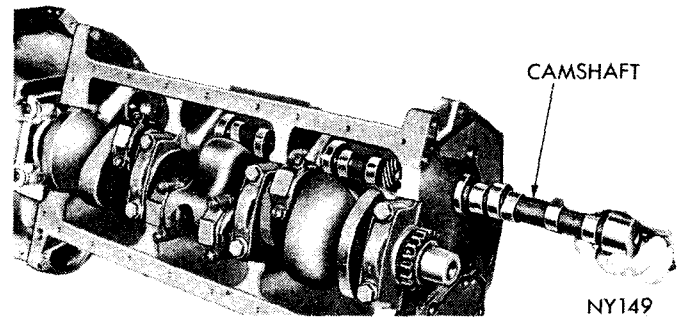


Fig. 22—Installing Camshaft

shaft, being careful not to damage cam bearings with the cam lobes.

Installation

- (1) Lubricate camshaft lobes and camshaft bearing journals and insert camshaft in cylinder block (Fig. 22).

Whenever an engine has been rebuilt and/or a new camshaft and/or new tappets have been installed, add one pint of Chrysler Crankcase Conditioner Part Number 3419130 or equivalent to engine oil to aid in break-in. The oil mixture should be left in engine for a minimum of 500 miles, and drained at the next normal oil change.

All of the tappet faces must be inspected for crown with a straight edge. If any negative crown (dish) is observed, tappet must be replaced. The tappet must have a definite crown. Each tappet must be reinstalled in the same position from which it was removed. New tappets must be used if a new camshaft is installed.

Installation of Distributor

Before installing the distributor, time the engine as follows:

The distributor rotates clockwise.

- (1) Rotate crankshaft until the mark on outer edge of crankshaft pulley is in line with the "O" (TDC) mark on the timing chain case cover (Fig. 23). No. 1,

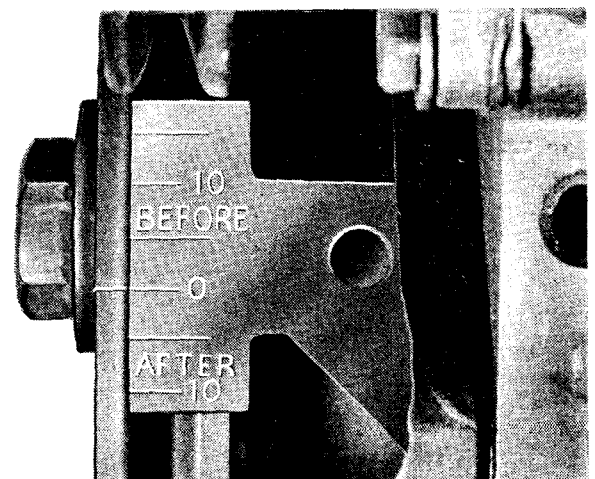


Fig. 23—Timing Indicator

cyl. compression stroke (both valves closed).

(2) With distributor "O" rings in position, hold the distributor over mounting pad.

(3) Turn the rotor to point forward, corresponding to 4 o'clock.

(4) Install distributor so that with distributor fully seated on the engine, the gear has spiraled to bring the rotor to a 5 o'clock position. (Fig. 24).

(5) Turn the housing until rotor is under No. 1 cap tower.

(6) Install hold down bolt and connect the primary wire.

(7) Adjust timing to specifications, using a timing light, then re-connect the vacuum line.

CAMSHAFT BEARINGS (Engine Removed from Vehicle)

Removal

(1) With camshaft removed, drive out rear cam bearing welch plug.

(2) Install proper size adapters and horse shoe washers (part of Tool C-3132A) at the back of each bearing shell and drive out all bearing shells (Fig. 25).

Installation

(1) Install new camshaft bearings with Tool C-3132A by sliding the new camshaft bearing shell over the proper adapter.

(2) Position bearing in tool. Install horseshoe lock and drive the bearing shell into place. **The camshaft bearing oil hole or holes must be in exact alignment with drilled oil passage or passages from the main bearing.**

(3) Install remaining shells in like manner. Install

No. 1 camshaft bearing 3/32 inch inward from front face of the cylinder block.

(4) Apply sealer 3837795 or equivalent, to a new cap plug and install at the rear of camshaft. **Be sure this plug does not leak.**

CYLINDER BLOCK

Oversized Cylinder Bores

Whenever it is necessary to machine cylinder bores .020 oversize all bores shall be oversized. Engines will be identified with a letter "A" stamped on the engine serial pad. See specifications for oversized and under-sized machined parts.

Piston Removal

(1) Remove the top ridge of cylinder bores using Tool C-3012 before removing pistons from cylinder block. **Keep tops of the pistons covered during this operation.**

(2) Pistons and connecting rods must be removed from top of cylinder block. Rotate crankshaft so that each connecting rod is centered in the cylinder bore.

(3) Remove connecting rod cap.

(4) Install Tool C-3221 on one connecting rod bolt and protector over the other bolt. Push each piston and rod assembly out of cylinder bore. Be careful not to nick crankshaft journals.

(5) Install bearing caps on mating rods.

Cleaning and Inspection

(1) Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

(2) If new core plugs are installed, coat edges of plug and core hole with Number 3837795 Sealer or equivalent. Drive the core plug in so that the rim lies at least 1/64" below the lead-in chamfer.

(3) Examine block for cracks or fractures.

Cylinder Bore Inspection

The cylinder walls should be tested for out-of-round and taper with Tool C-119. If the cylinder

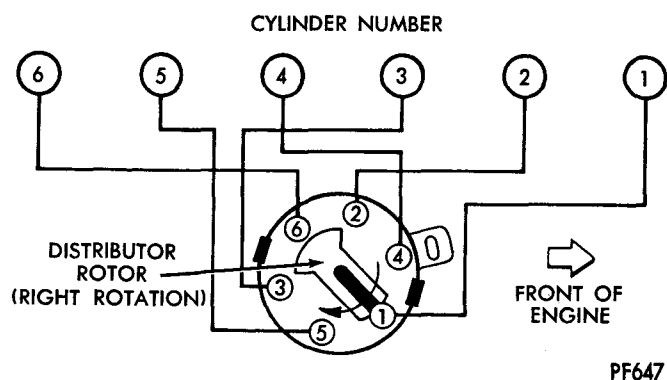


Fig. 24—Distributor With Rotor Positioned Under No. 1 Tower of Cap

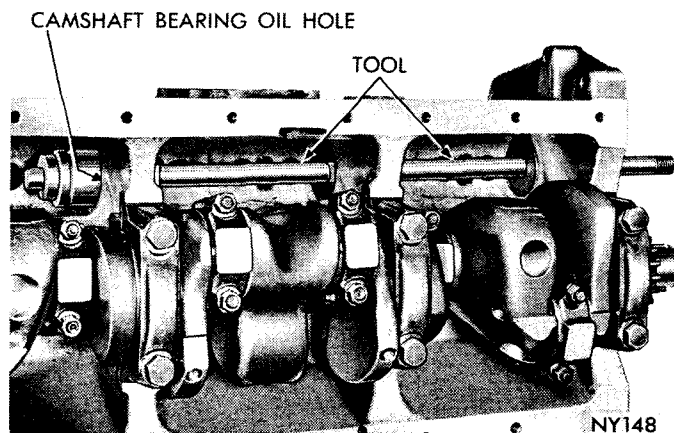


Fig. 25—Removing Camshaft Bearings

bores show more than .005" out-of-round, or a taper of more than .010" or if the cylinder walls are badly scuffed or scored, the cylinder block should be re-bored and honed, and new oversize pistons and rings fitted. Whatever type of boring equipment is used, boring and honing operation should be closely coordinated with the fitting of pistons and rings in order that specified clearance may be maintained.

Honing Cylinder Bores

Before honing, stuff plenty of clean rags under the bores, over the crankshaft to keep abrasive materials from entering crankcase area.

(1) Used carefully, the cylinder bore resizing hone Tool C-823, equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round as well as removing light scuffing, scoring or scratches. Usually a few strokes will clean up a bore and maintain the required limits.

(2) Deglazing of the cylinder walls may be done using a cylinder surfacing hone, Tool C-3501, equipped with 280 grit stones (C-3501-3810). If the cylinder bore is straight and round 20-60 strokes depending on the bore condition will be sufficient to provide a satisfactory surface. Inspect cylinder walls after each 20 strokes. Using honing oil C-3501-3880 or a light honing oil available from a major oil distributor. **Do not use engine or transmission oil, mineral spirits or kerosene.**

(3) Honing should be done by moving hone up and down fast enough to get a cross hatch pattern. When hone marks intersect at 50-60 degrees, cross hatch angle is most satisfactory for proper seating of rings. (Fig. 26).

(4) After honing, it is necessary that block be cleaned again to remove all traces of abrasives.

CAUTION: Be sure all abrasives are removed from engine parts after honing. It is recommended that a

solution of soap and water be used with a brush and the parts then thoroughly dried. The bore can be considered clean when it can be wiped clean with a white cloth and cloth remains clean. Oil bores after cleaning to prevent rusting.

PISTONS, PINS AND RINGS

The pistons are cam ground so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. The expansion forces the pin bosses away from each other, and the piston assumes a more round shape. Inspect pistons for taper and elliptical shape before they are fitted into cylinder bores (Fig. 27).

Finished Pistons

All pistons are machined to the same weight in grams, regardless of oversize, to maintain piston balance. For cylinder bores which have been honed or re-bored, all service pistons include pins and are available in standard and .020 inch oversizes.

Fitting Pistons

The piston and cylinder wall must be clean and dry. Specified clearance between the piston and cylinder wall is .0005 to .0015 inch.

(1) Pistons and cylinder bores should be measured at normal room temperature, 70 degrees F.

(2) Measure piston diameter at the top of skirt 90 degrees to piston pin axis.

(3) Measure cylinder bores halfway down cylinder bore and transverse to engine crankcase center line.

Fitting Rings

(1) Measure piston ring gap about two inches from the bottom of the cylinder bore in which it is to be fitted. (An inverted piston can be used to push rings

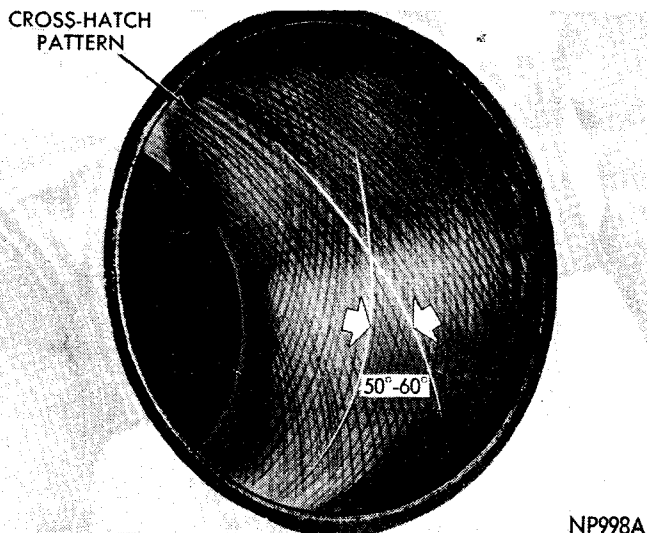
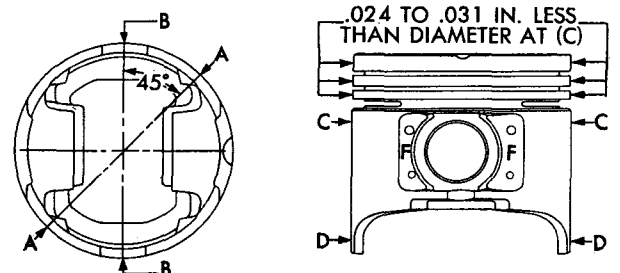


Fig. 26—Cross Hatch Pattern



THE ELLIPTICAL SHAPE OF THE PISTON SKIRT SHOULD BE .008 TO .010 IN. LESS AT DIAMETER (A) THAN ACROSS THE THRUST FACES AT DIAMETER (B). MEASUREMENT IS MADE $\frac{1}{8}$ IN. BELOW LOWER RING GROOVE

DIAMETERS AT (C) AND (D) CAN BE EQUAL OR DIAMETER AT (D) CAN BE .002 IN. GREATER THAN (C)

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Fig. 27—Piston Measurements

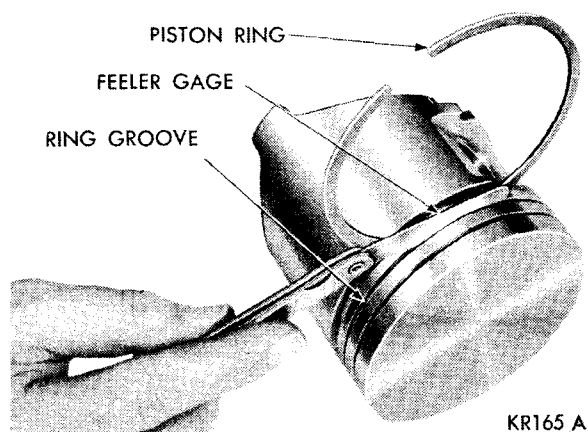


Fig. 28—Measuring Piston Ring Side Clearance

down to insure positioning rings squarely in cylinder bore.)

(2) Insert feeler stock in the gap. Ring gap should be .010 to .020 inch for compression rings and .015 to .055 inch for oil ring steel rails in standard size bores. Maximum gap in .005 inch o/s bores should be .060 inch for compression rings and .070 inch for oil ring steel rails.

(3) Measure side clearance between piston ring and ring land, (Fig. 28).

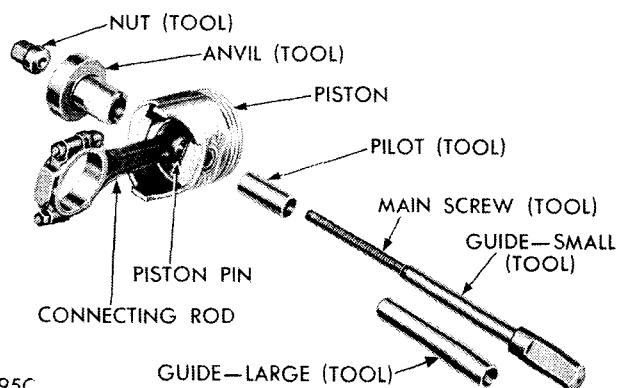
Clearance should be .0015 to .003 inch for top compression ring and intermediate ring.

(4) Starting with oil ring expander, place expander ring in lower ring groove and install oil control ring using instructions in package. Steel rail service oil ring should be free in groove, but should not exceed .005 inch side clearance.

(5) Install compression rings in middle and top grooves, using ring installer, Tool C-3805 or C-4184. Be sure the mark "TOP" on each compression ring is to the top of piston.

Piston Pin Removal

(1) Arrange Tool C-3724 parts for removal of piston pin (Fig. 29).



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Fig. 29—Tool Arrangement for Removing Piston Pin

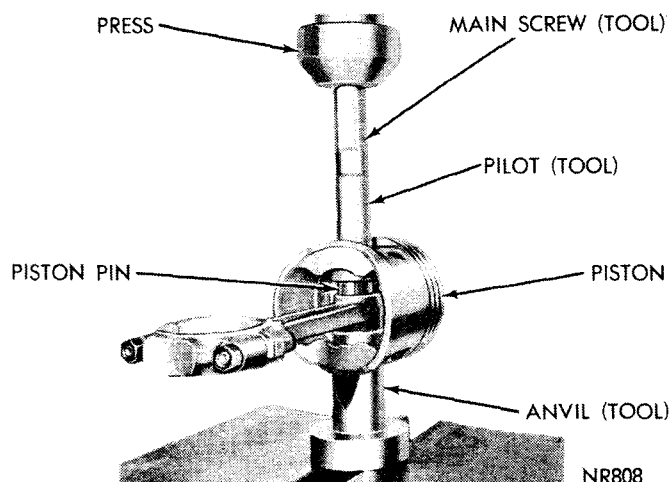


Fig. 30—Removing Piston Pin

(2) Install pilot on main screw.

(3) Install screw through piston pin.

(4) Install anvil over threaded pin of main screw with small end of anvil against piston boss. **Be sure spring is removed from anvil.**

(5) Install nut loosely on main screw and place assembly on the press (Fig. 30). Press piston out of connecting rod.

When the pin falls free from connecting rod, stop the press to prevent damage to bottom of anvil.

(6) Remove tool from piston

Installation

(1) Measure piston pin fit in the piston. It should be a sliding fit in piston at 70 degrees F. Piston pins are supplied in standard sizes only.

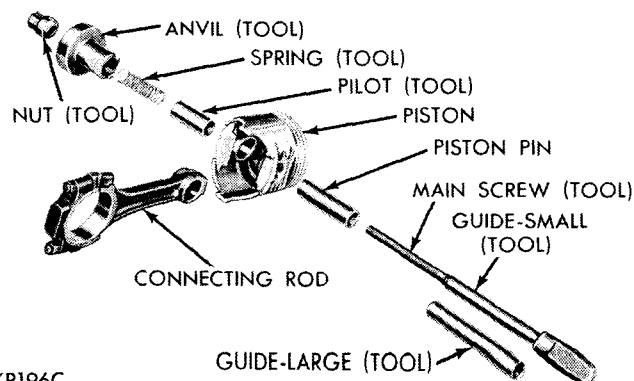
(2) Lubricate piston pin holes in piston and connecting rod.

(3) Arrange tool parts for installation of piston pin (Fig. 31).

(4) Install spring inside the pilot and install spring and pilot in the anvil.

(5) Install piston pin over main screw.

(6) Place piston, with "Notch Front" up, over the pilot so that pilot extends through piston pin holes.



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Fig. 31—Tool Arrangement for Installing Piston Pin

(7) Position connecting rod over the pilot which extends through piston hole. **The oil hole in connecting rod must point in the direction shown in (Fig. 32), with a forged crankshaft, and toward the front of the engine with a cast crankshaft (Fig. 33).**

(8) Install main screw and piston pin in piston then install nut on main screw to hold assembly together. Place assembly on a press (Fig. 34).

(9) Press piston pin in the piston until pin bottoms on pilot, properly positioning pin in connecting rod.

(10) Remove tool and arrange tool parts and piston assembly in the same manner, as shown in (Fig 34) for measuring pin fit.

(11) Place assembly in a vise (Fig. 35).

(12) Attach torque wrench to nut and test torque up to 15 foot-pounds. If connecting rod moves downward on the piston pin, reject this connecting rod and piston pin combination. Install a new connecting rod and repeat the installation and testing procedure.

If the connecting rod does not move under 15 foot-pounds, piston and connecting rod interference is satisfactory.

(13) Remove tool.

CRANKSHAFT IDENTIFICATION

A Maltese Cross stamped on the engine numbering pad on right side of block, on top boss directly behind coil indicates that engine is equipped with a crankshaft which had one or more connecting rods and/or

main bearing journals finished .001 inch undersize. The position of the undersize journal or journals is stamped on the center counterweight of crankshaft.

A Maltese Cross with an X indicates that all connecting rods and/or main bearing journals are .010 inch undersize.

Connecting rod journals will be identified by the letter "R" and main bearing journals by the letter "M". For example "M-1" indicates that No. 1 main bearing is .001 inch undersize.

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

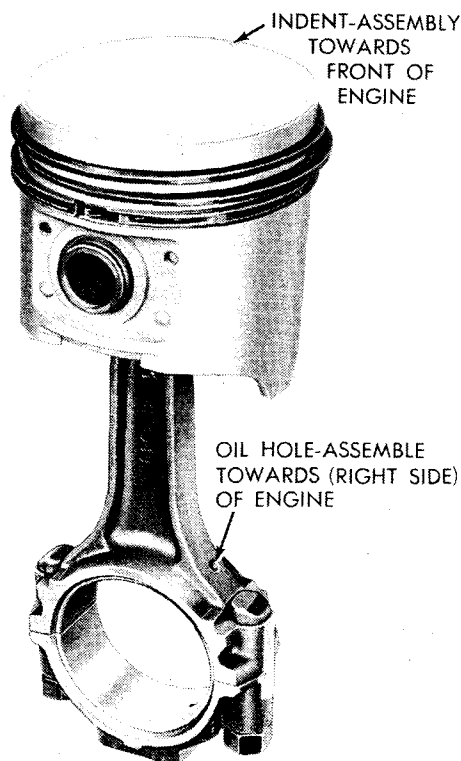
CONNECTING RODS

Installing Connecting Rod Bearings

(1) Install connecting rod bearings so small formed tang fits into machined groove in connecting rod.

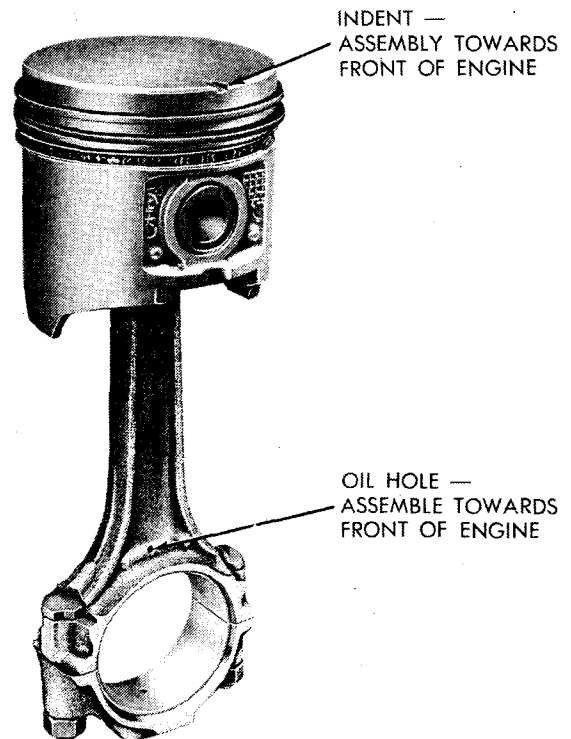
(2) The limits of taper or out-of-round on any crankshaft journal should be held to .001 inch. Bearings are available in standard .001, .002, .003, .010 and .012 inch undersize.

(3) Install bearings in pairs. **Do not use a new bearing with an old bearing. Do not file rods or bearing caps.**



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Fig. 32—Positioning of Connecting Rod Oil Hole



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**Fig. 33—Position of Connecting Rod Oil Hole
(Cast Iron Crankshaft)**

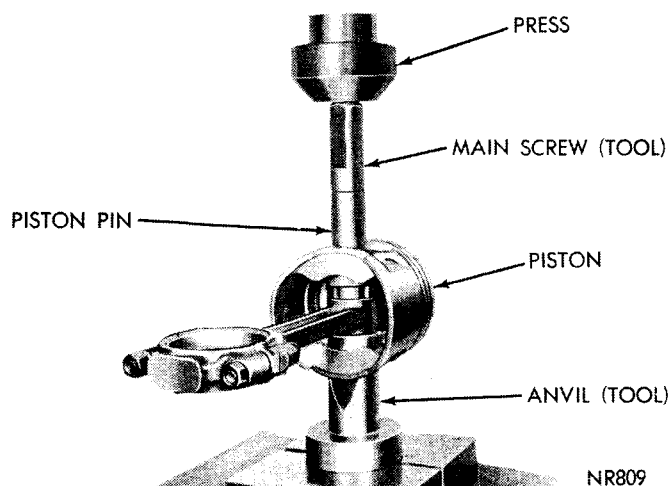


Fig. 34—Installing Piston Pin

MEASURING CONNECTING ROD BEARING CLEARANCE

Shim Stock Method

(1) Smooth the edges of a 1/2 x 3/4 inch piece of brass shim stock, .001 inch thickness.

(2) Oil and place between the bearing and connecting rod journal.

(3) Install bearing cap and tighten to 45 foot-pounds.

(4) Turn connecting rod 1/4 turn in each direction. A slight drag should be felt which indicates clearance is satisfactory. Correct clearance is from .0005 to .0015 inch.

(5) Side play should be from .006 to .012 inch.

Plastic-Gage Method

(1) Wipe journal clean.

(2) Place a strip of Plastic-Gage across full width of

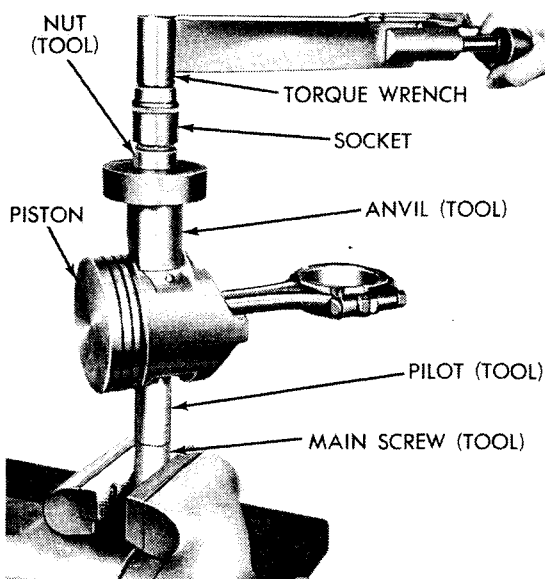


Fig. 35—Testing Fit of Piston Pin in Connecting Rod

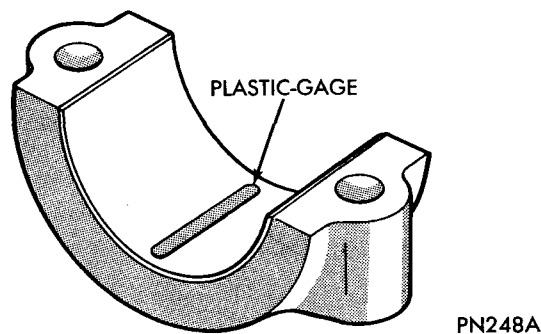


Fig. 36—Plastic-Gage Placed in Lower Shell

lower insert at the center of bearing cap (Fig. 36).

(3) Install bearing cap to connecting rod and tighten retaining nuts to 45 foot-pounds torque.

(4) Remove bearing cap and determine amount of clearance by measuring the width of the compressed Plastic-Gage with the scale furnished (Fig. 37).

(5) New bearings should be installed if bearing clearance is not within specifications. Excessive taper indicates that a new or reground crankshaft is required.

INSTALLING PISTON AND CONNECTING ROD ASSEMBLY

(1) Compression ring gaps should be located on the left side of the engine and staggered about 60 degrees apart. Neither gap should line up with oil ring gaps.

(2) Rotate oil ring expander so that ends are at right side of engine. Rotate steel rails so that gaps are approximately opposite and positioned above piston pin holes.

(3) Immerse piston head and rings in clean engine oil. Slide the ring compressor, Tool C-385, over the piston and tighten with special wrench (part of Tool C-385). **Position of rings must not change during this operation.**

(4) The notch on top of piston must point toward front of engine so that squirt hole in connecting rod is toward right side of engine with a forged crankshaft and toward front of engine with a cast crankshaft.

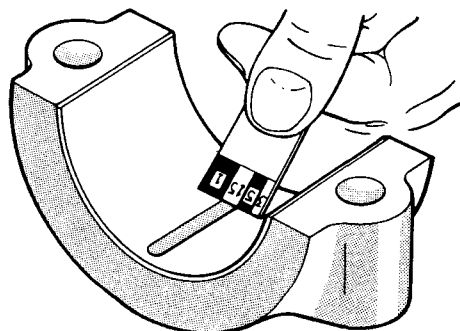


Fig. 37—Clearance Measurement

(5) Screw connecting rod bolt protector (part of Tool C-3221) on one rod bolt, and insert rod and piston into cylinder bore. Rotate crankshaft so that connecting rod journal is on the center of cylinder bore.

(6) Attach puller part of Tool C-3221 on other bolt, and guide rod over the crankshaft journal (Fig. 39). Be careful not to nick connecting rod journals.

(7) Tap piston down in cylinder bore, using handle of a hammer. At the same time, guide connecting rod into position on crankshaft journal.

(8) Install rod caps, tighten nuts to 45 foot-pounds.

CRANKSHAFT MAIN JOURNALS

Crankshaft journals should be inspected for excessive wear, taper and scoring. Limits of taper or out-of-round on any crankshaft journal should be held to .001 inch. Journal grinding should not exceed .012 inch under the standard journal diameter. Do not grind thrust faces of No. 3 main bearing. Do not nick connecting rod or main bearing journal fillets (Fig. 38). After regrinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CRANKSHAFT MAIN BEARINGS

The NOs. 1, 2 and 4 lower main bearings are interchangeable (Fig. 40). The NOs. 2 and 4 upper main bearings are interchangeable.

The NO. 1 upper main bearing is **not interchangeable** and is **chamfered** on the tab side for timing chain oiling and can be identified by a red marking on the edge of the bearing. Upper main bearings are grooved and lower main bearings are plain and are

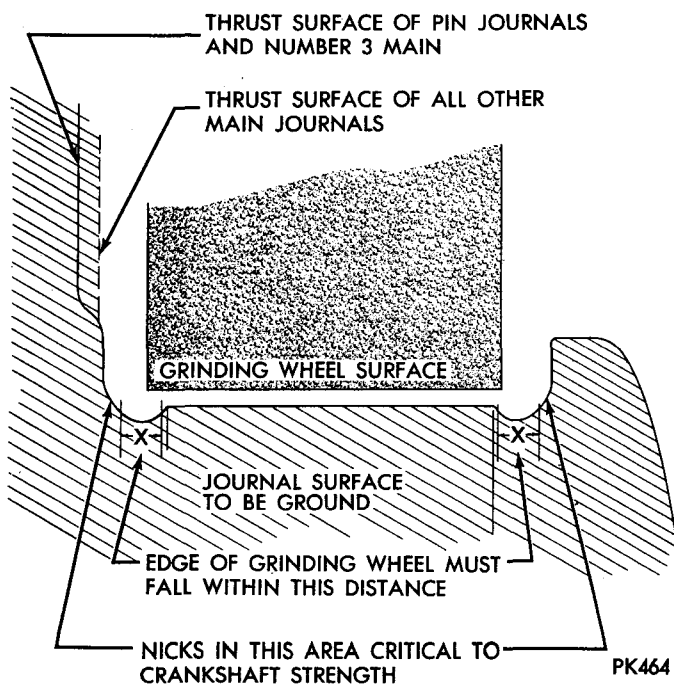


Fig. 38—Crankshaft Pin and Main Journal Grinding

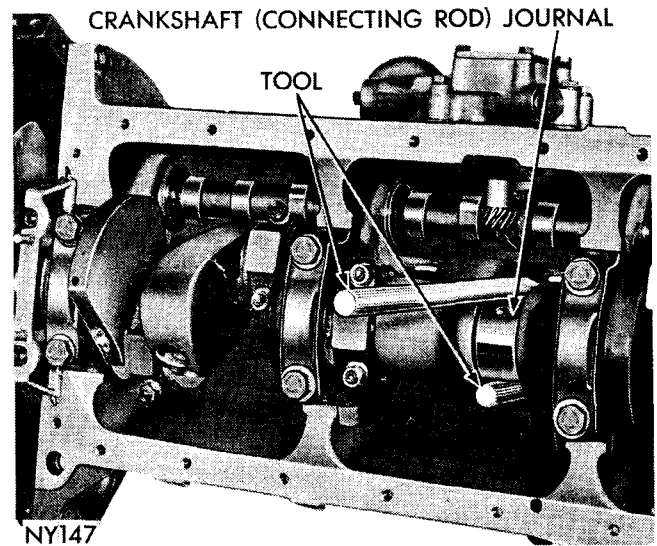


Fig. 39—Removing and Installing Connecting Rod

not interchangeable. The NO. 3 upper and lower main bearings are flanged to carry the crankshaft thrust loads and are **not interchangeable** with any other main bearings in the engine. Bearings that are **not badly worn, scored or pitted** should be **reinstalled in the same bearing bore**.

The bearing caps are not interchangeable and the numbers should be marked at removal to insure correct assembly. Bearings are available in standard and the following undersizes, .001, .002, .003, .010 and .012 inch. Never install an undersize bearing that will reduce the clearance below specifications.

Removal

(1) Remove oil pan and inspect the bearing cap identifying numbers.

(2) Remove bearing caps one at a time. Remove

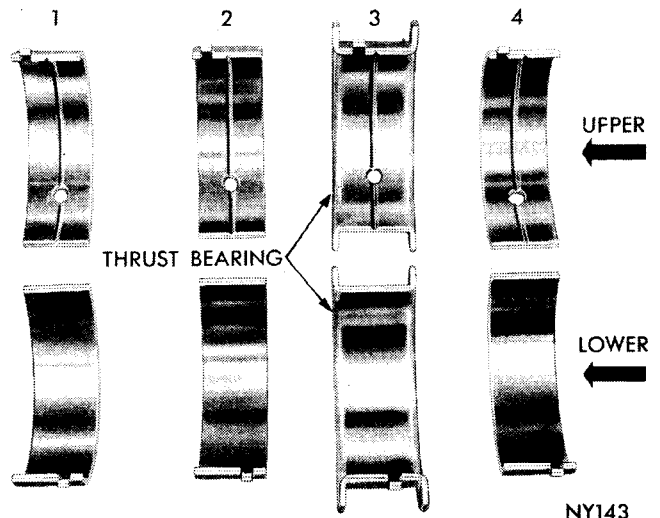


Fig. 40—Main Bearing Identification

upper bearing by inserting Tool C-3059 (Fig. 41) into oil hole on crankshaft.

(3) Slowly rotate crankshaft clockwise, forcing out upper bearings.

MEASURING MAIN BEARING CLEARANCE

Shim Stock Method

(1) Smooth the edges of a 1/2 x 3/4 inch piece of brass shim stock, .001 inch thickness.

(2) Lubricate main bearing journals and position shim stock across center main journals.

(3) Install bearing in center main bearing cap, **bearing tang in groove on cap**, lubricate bearing and seat cap on block. Tighten bolts to 85 foot-pounds.

(4) If a slight drag is felt as the crankshaft is rotated, not over 1/4 turn in either direction the clearance is .001 inch or less and is considered satisfactory.

If however, no drag is felt, the bearing is too large or if the crankshaft cannot be rotated, the bearing is too small and should be replaced with the correct size.

It is permissible to use one .001 inch undersize bearing shell with one standard bearing shell, or one .002 inch undersize bearing shell with one .001 inch undersize shell. Always use the smaller diameter bearing half as the upper. Do not use a new bearing with a used bearing and never use an upper bearing half more than .001 inch smaller than the lower bearing half.

(5) Fit remaining bearings in same manner.

(6) Measure crankshaft end play to .002-.007 inch. If end play is more than .007 inch, install a new center bearing.

Plastic-Gage Method

NOTE: Check clearance one bearing at a time.

(1) Support weight of crankshaft with a jack or

stand placed under counterweight adjacent to main bearing being checked.

NOTE: When servicing No. 1 main bearing, support crankshaft at vibration damper. All other bearings must remain tightened.

(2) Remove main bearing cap and insert.

(3) Clean insert and exposed portion of crankshaft journal.

(4) Place strip of Plastic-Gage across full width of bearing insert (Fig. 36).

(5) Install bearing cap and tighten bolts to 85 foot-pounds torque.

(6) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastic-Gage with furnished scale (Fig. 37).

(7) New bearings should be installed if bearing clearance is not within specifications. Excessive taper indicates that a new or reground crankshaft is required.

REAR MAIN BEARING OIL SEALS

Service seals are of split rubber type composition. The seals make it possible to replace the upper rear seal without removing the crankshaft. **The seal must be used as an upper and lower set and cannot be combined with the rope seal.**

(1) With oil pan removed, remove rear seal retainer and rear main bearing cap.

(2) Remove lower rope oil seal by prying from the side with a small screw driver (Fig. 42).

(3) Remove upper rope seal by turning in Tool C-4148 into the end of the seal, being careful not to damage to the crankshaft (Fig. 43). Pull the seal out with the tool while rotating the crankshaft.

CAUTION: Always wipe crankshaft surface clean, then oil lightly before installing a new seal.

(4) Oil seal lip lightly with engine oil.

(5) Hold seal (with paint stripe to the rear) tightly against crankshaft with thumb to make sure that the

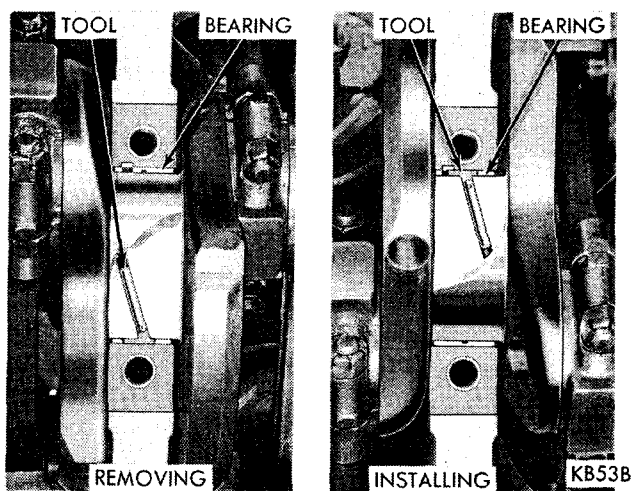


Fig. 41—Removing or Installing Upper Main Bearing

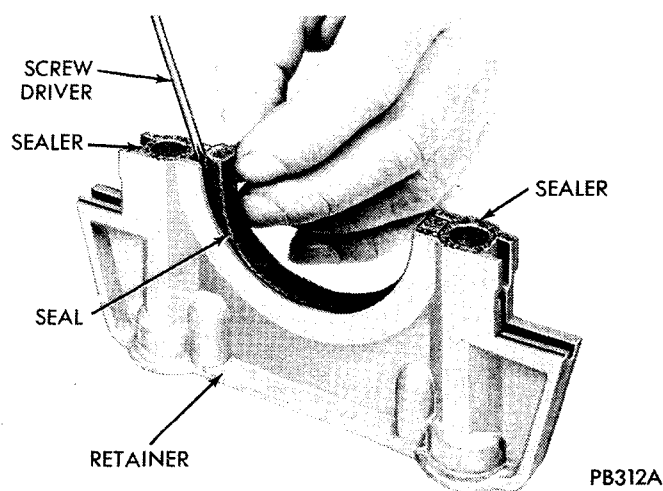


Fig. 42—Removing Lower Oil Seal From Retainer

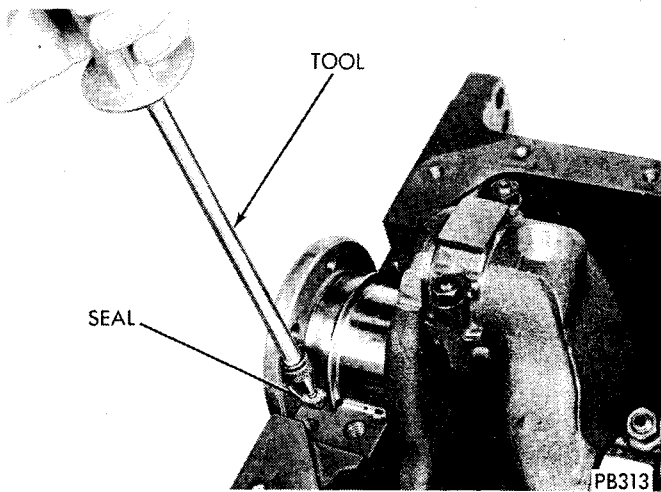


Fig. 43—Removing Upper Oil Seal With Tool C-4148

sharp edge of the groove, in the block does not shave or nick the back of the seal, install seal in the block groove. Rotate the crankshaft, if necessary, while sliding seal into groove. **Care must be exercised not to damage the seal lip.**

(6) Install other half of the seal into the lower seal retainer with paint stripe to rear.

(7) Install rear main bearing cap, tighten to 85 foot-pounds.

(8) Install lower seal retainer, tighten to 30 foot-pounds. **Do not use sealer or cement on seal ends or lip.** Apply small amount of gasket sealer to bottom of seal retainer, both sides (Fig. 42).

OIL PAN

Removal

- (1) Disconnect battery and remove oil dip stick.
- (2) Raise vehicle on hoist and drain oil.
- (3) Remove retainer nut from left motor support.
- (4) Set floor stand or jack under vibration damper and raise left side of engine about 1 inch for sufficient clearance to remove oil pan.
- (5) Turn front wheels to extreme right to obtain maximum clearance of the center link.
- (6) Remove oil pan bolts and remove oil pan.

Installation

- (1) Install oil pick up tube and screen. Turn in pipe until it begins to tighten in the block, continue tightening until the screen is positioned (Fig. 45). Hold a steel rule against the flat surface inside block and measure from the edge of the rule to the edge of oil screen. The measurement should be 1-1/8 inches with the screen properly positioned. The screen must

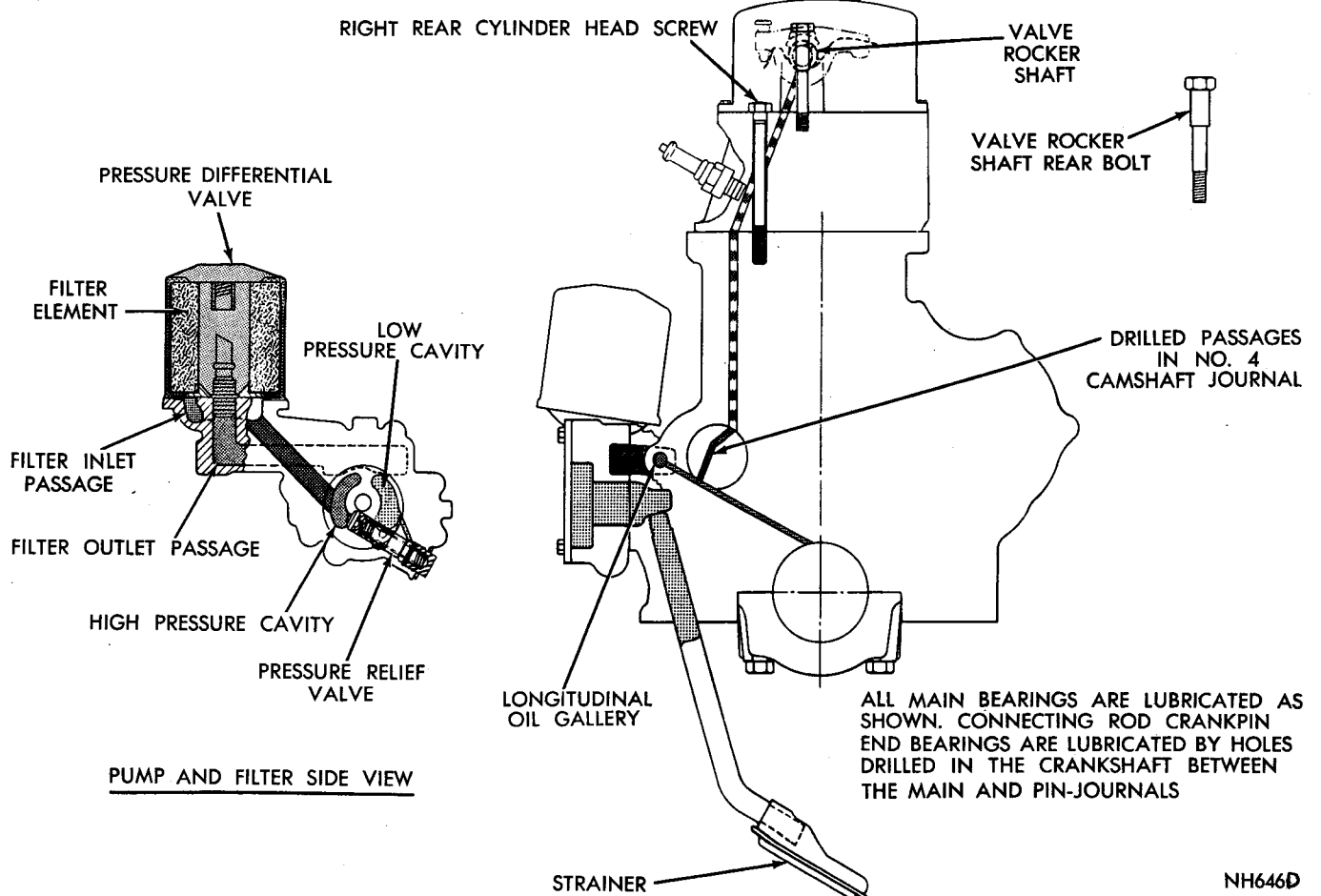


Fig. 44—Engine Oiling System

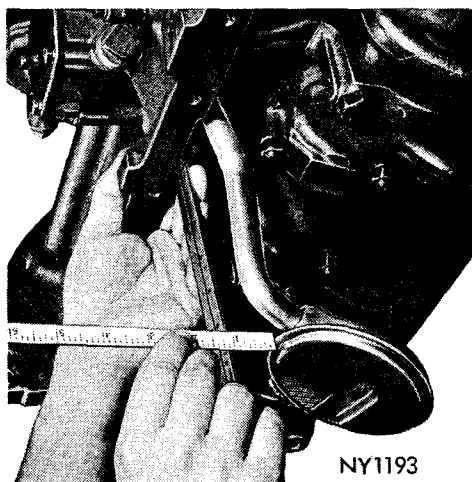


Fig. 45—Positioning Oil Pick-up Tube and Screen

be an interference with the bottom of the oil pan.

(2) Using new gaskets and seals, install oil pan, use care when positioning pan as to be sure pick up tube assembly clears the baffle in lower portion of pan. Tighten attaching screws to 200 inch-pounds.

(3) Lower engine and install motor support retainer nut.

(4) Lower vehicle, install dipstick, fill with proper grade and quantity of motor oil.

OIL PUMP

Removal

(1) Remove oil pump attaching bolts and remove pump and filter assembly from side of engine.

Disassembly (Fig. 46)

(1) Remove the pump cover and seal ring.

(2) Press off drive gear. Support the gear to keep load off of aluminum body.

(3) Remove pump rotor and shaft and lift out pump rotor.

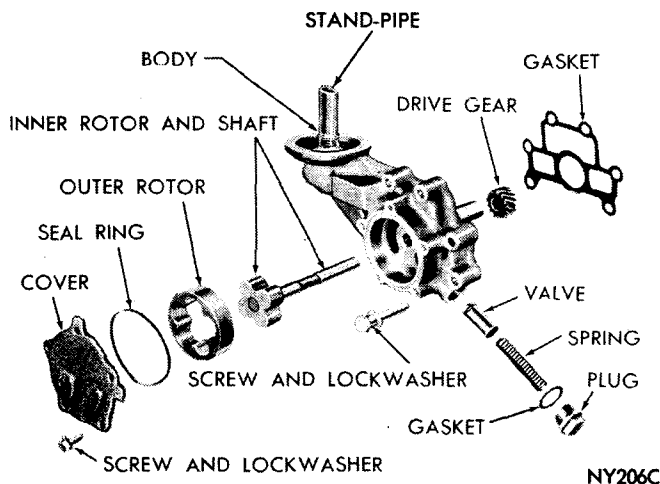


Fig. 46—Oil Pump (Disassembled View)

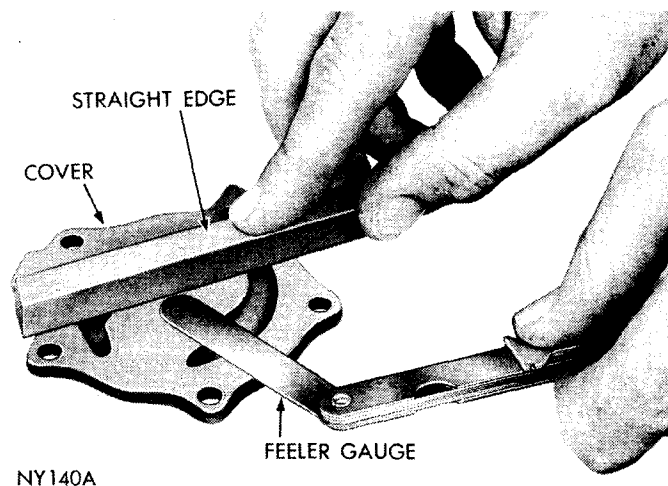


Fig. 47—Measuring Oil Pump Cover Flatness

(4) Remove oil pressure relief valve plug and lift out spring and plunger (Fig. 46).

Inspection

(1) Clean all parts thoroughly. Mating face of oil pump cover should be smooth. Replace cover if it is scratched or grooved.

(2) Lay a straightedge across the oil pump cover surface (Fig. 47). If a .0015 feeler gauge can be inserted between cover and straightedge, cover should be replaced.

(3) Measure diameter and thickness of outer rotor. If outer rotor length measures less than .649 inch (Fig. 48) and the diameter less than 2.469 inches, replace outer rotor.

(4) If inner rotor length measures less than .649 inch (Fig. 49), replace inner rotor.

(5) Install outer rotor into pump body, pressing to one side with fingers and measure clearance between outer rotor and pump body (Fig. 50). If measurement is more than .014 inch, replace oil pump body.

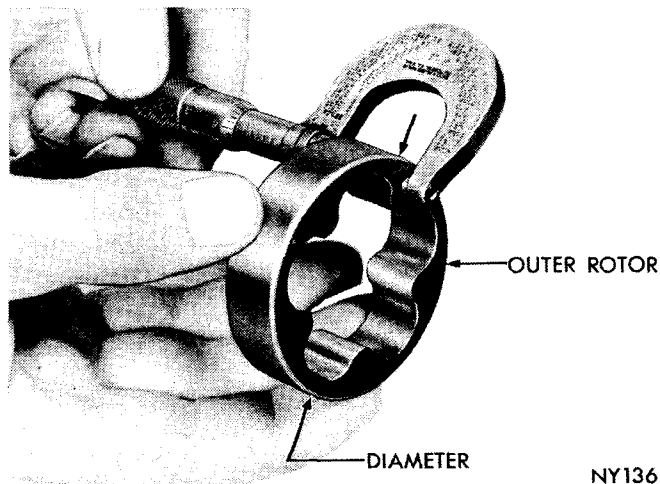
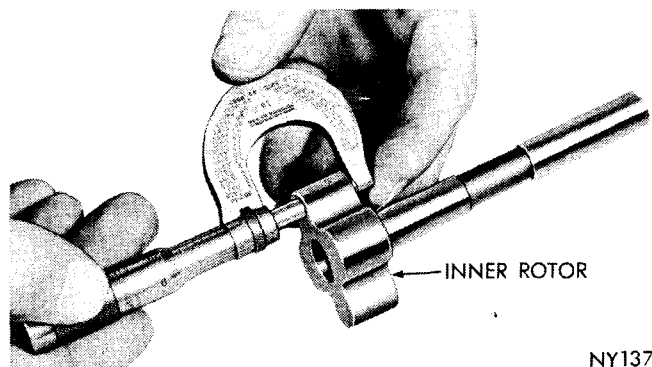


Fig. 48—Measuring Outer Rotor Thickness



NY137

Fig. 49—Measuring Inner Rotor Thickness

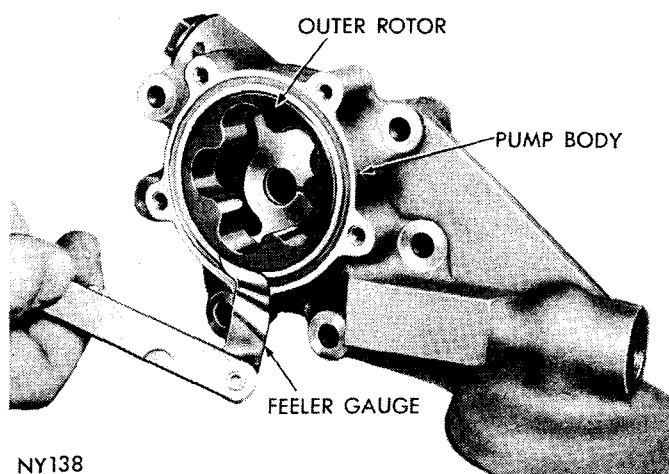
(6) Install inner rotor into pump body and place a straightedge across face between bolt holes (Fig 51). If a feeler gauge of more than .004 inch can be inserted between the rotors and straightedge, replace pump body.

(7) If clearance between inner rotor and outer rotor (Fig. 52) is more than .010 inch, replace inner and outer rotors.

(8) Inspect oil pump relief valve plunger for scoring and for free operation in its bore. Small scores may be removed with 400 grit wet or dry paper.

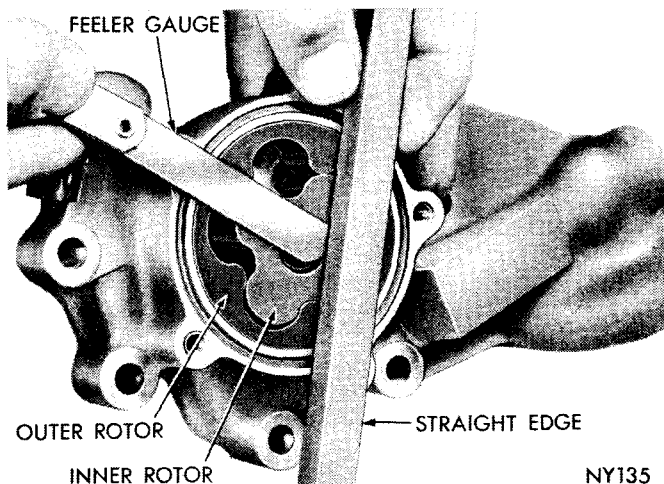
(9) The relief valve spring has a free length of 2-1/4 inches and should test 22.3 to 23.3 lbs. when compressed to 1-19/32 inch. Discard spring that fails to meet specifications.

(10) If oil pressure is low, inspect for worn bear-



NY138

Fig. 50—Measuring Outer Rotor Clearance



NY135

Fig. 51—Measuring Clearance Over Rotors

ings, or look for other causes of possible loss of pressure.

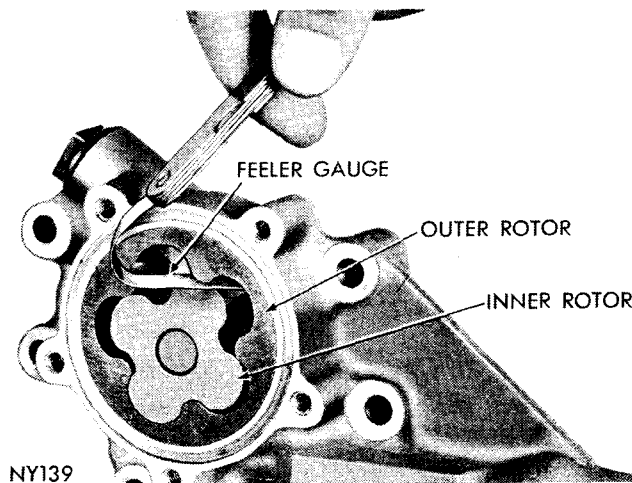
Installation

(1) Install new oil seal rings between cover and body. Tighten attaching bolts to 95 inch-pounds.

(2) Install the oil pump on engine. Tighten attaching bolts to 200 inch-pounds.

OIL FILTER

The oil filter should be replaced every second oil change.



NY139

Fig. 52—Measuring Clearance Between Rotors

318-360 CUBIC INCH ENGINE

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SERVICE PROCEDURES

CHECKING OPERATION OF EXHAUST VALVE ROTATORS

Before an engine is disassembled for valve grinding or major repair work, the performance of the exhaust valve position rotators should be checked if so equipped.

(1) With engine in vehicle, remove cylinder head covers.

(2) Observe exhaust valve rotation with the engine running at 1000 and 3000 R.P.M. the valve should rotate at uniform and constant speeds. There is generally a large difference in rotation speeds between 1000 and 3000 R.P.M.

(3) Rotators which do not appear to function properly should be replaced.

ENGINE ASSEMBLY

Removal

(1) Drain coolant from radiator and cylinder block.

(2) Disconnect battery cables and remove battery.

(3) Scribe hood hinge outlines on hood and remove hood.

(4) If equipped with air conditioning, discharge the system. Disconnect compressor lines. Cap all openings as soon as they are disconnected to keep moisture or dirt out of the system.

(5) Disconnect electrical connections at alternator, ignition coil, temperature and oil pressure sending units (oil gauge line if so equipped) starter relay-to-solenoid wires and engine to body ground.

(6) Remove air cleaner and carburetor. Install engine lifting fixture to carburetor flange on intake manifold.

(7) Remove distributor cap, rotor and spark plug wires.

(8) Disconnect flexible fuel line to fuel pump and cap line.

(9) Disconnect radiator and heater hoses (oil cooler lines if so equipped). Remove fan, spacer (or fluid drive) and radiator. **Caution: To prevent silicone fluid from draining into fan drive bearing and ruining the grease, do not place drive unit with shaft pointing downward.**

(10) Raise vehicle on a hoist and install engine support fixture tool C-3487A to support rear of engine.

(11) Disconnect exhaust pipes at manifolds, propeller shaft, wires, linkage, cable and oil cooler lines at the transmission if so equipped.

(12) Remove engine rear support crossmember and remove transmission from vehicle.

(13) Lower vehicle and attach a chain hoist or hydro-crane to fixture eyebolt.

(14) Remove front motor mount insulator top stud nuts and washers. Raise engine with lifting equipment and work engine out of chassis.

(15) Place engine in repair stand Tool C-3167 and adapter C-3662 for disassembly, using transmission bolts.

Installation

(1) Install engine lifting fixture to carburetor flange studs on intake manifold.

(2) Attach a chain hoist or hydro-crane to fixture eyebolt.

(3) Remove engine from repair stand and lower engine carefully until engine is positioned in chassis with front motor mount studs in place (Fig. 1).

(4) Install engine support fixture Tool C-3487A (if removed from chassis) to support rear of engine. Remove hydro-crane.

(5) Raise vehicle on hoist.

(6) Install transmission and engine rear support cross-member. Remove engine support fixture Tool C-3487A. (Fig. 2).

(7) Connect propeller shaft, wires, linkage, cables, exhaust pipes to manifolds, (oil cooler lines and transmission filler tube is so equipped.)

(8) Lower vehicle, install compressor if equipped with air conditioning.

(9) Install radiator, fan shroud, hoses and oil cooler lines.

(10) Install rotor, distributor cap and spark plug wires. Connect electrical connections at ignition coil, alternator, temperature and oil pressure sending units (oil gauge line if so equipped) starter relay-to-solenoid and engine to body ground.

(11) Remove engine lifting fixture from cylinder head. Uncap flexible fuel line and install to fuel pump.

(12) Install battery, close all drain cocks and fill cooling system.

(13) Fill engine crankcase and transmission as necessary. Refer to "Lubrication" Group 0, for quantities and lubricants. Inspect the entire system for leaks and correct as necessary.

Whenever an engine has been rebuilt and/or a new camshaft and/or new tappets have been installed, add one pint of Chrysler Crankcase Conditioner Part Number 3419130 or equivalent to engine oil to aid in break-in. The oil mixture should be left in engine for a minimum of 500 miles, and drained at the next normal oil change.

(14) Start engine and run until normal operating temperature is reached.

(15) Inspect ignition timing (with vacuum advance line removed) and adjust carburetor as necessary.

(16) Refer to "Air Conditioning" Group 24 on proper procedure for charging the system if so equipped.

(17) Adjust accelerator and transmission linkages. Road test vehicle.

Engine Removal Without Removing Automatic Transmission

(1) Scribe hood hinge outlines on hood and remove hood.

(2) Drain cooling system and remove battery and carburetor air cleaner.

(3) Remove radiator and heater hoses and remove radiator. Set fan shroud aside.

(4) Discharge air conditioning, refer to Group 24 Air Conditioning for service procedures if so equipped.

(5) Remove vacuum lines, distributor cap and wiring.

(6) Remove carburetor, linkage, starter wires and oil pressure wire.

(7) Remove air conditioning hoses and power steering hoses if so equipped.

(8) Remove starter motor, alternator, charcoal canister and horns.

(9) Remove exhaust pipe at manifold.

(10) Remove bell housing bolts and inspection plate. Attach "C" clamp on front bottom of transmission torque converter housing to prevent torque converter from coming out.

(11) Remove torque converter drive plate bolts from torque converter drive plate. Mark converter and drive plate to aid in reassembly.

(12) Support transmission with transmission stand tool number C-3201-A in its normal position relative to the vehicle. This will assure that the torque converter will remain in proper position in the transmission housing.

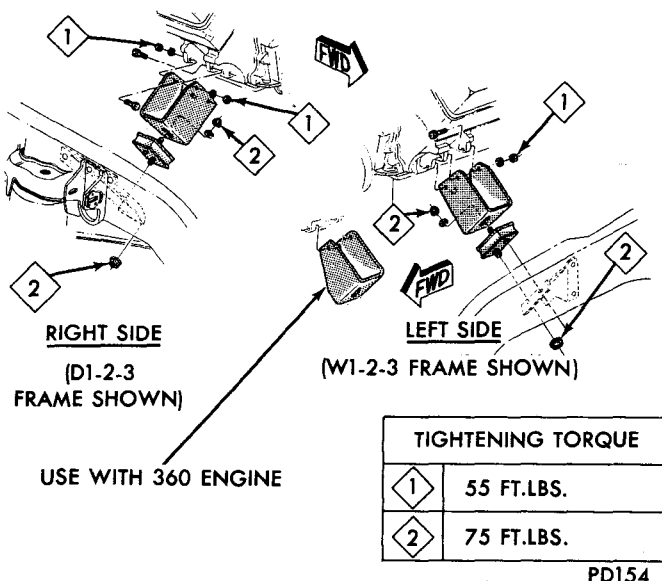


Fig. 1—Engine Mounts—Front—318-360 Cubic Inch Engine Models D100-200-300 and W100-200-300

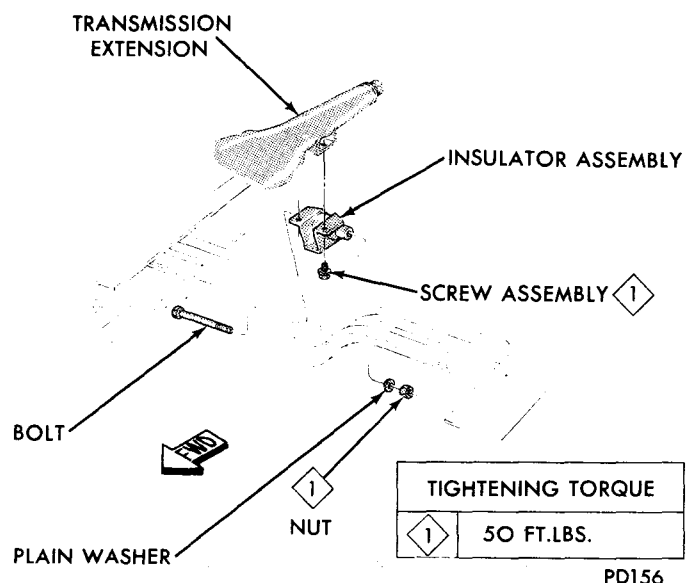


Fig. 2—Engine Mount—Rear—Models D100-200-300 and W100-200-300

9-28 ENGINE—318-360 CUBIC INCH

- (13) Disconnect the engine from the torque converter drive plate.
- (14) Install engine lifting fixture. Attach a chain hoist to fixture eyebolt.
- (15) Remove engine front mount bolts.
- (16) Remove engine from engine compartment and install in engine repair stand.

Installation

- (1) Remove engine from repair stand and install in engine compartment.
- (2) Install torque converter drive plate bolts and front end mounts.
- (3) Install bell housing bolts. Remove "C" clamp and install inspection plate. Remove stand from transmission.
- (4) Remove engine lifting fixture and install carburetor and lines.
- (5) Install starter motor, alternator, charcoal canister and lines.
- (6) Install vacuum lines, distributor cap and wiring.
- (7) Install exhaust pipe.
- (8) Connect carburetor linkage and wiring to engine.
- (9) Install radiator, radiator hoses and heater hoses.
- (10) Set fan shroud in position. Fill cooling system full.
- (11) Install battery and carburetor air cleaner. Connect vacuum hose, power steering hoses, if so equipped.
- (12) Install air conditioning equipment and charge air conditioning. Refer to Group 24 Air Conditioning for service.
- (13) Warm engine and adjust.
- (14) Install hood and line up.
- (15) Road test vehicle.

ROCKER ARMS AND SHAFT ASSEMBLIES

Assembly and Installation

If the rocker arm assemblies are disassembled for cleaning or replacement, refer to Figure 3 for rocker arm identification, and Figure 4 for positioning on the shaft. Some exhaust rocker arms have a ground out section on the under side.

Install rocker arm and shaft assemblies with notch on end of rocker shaft pointing to center line of engine and toward front of engine on the left bank, and to the rear on the right bank, making sure to install the long stamped steel retainers in the number two and four positions. Tighten to 200 inch-pounds. (Fig. 4).

CYLINDER HEADS

The chrome alloy cast iron cylinder heads shown in (Fig. 5) are held in place by 10 bolts. The spark

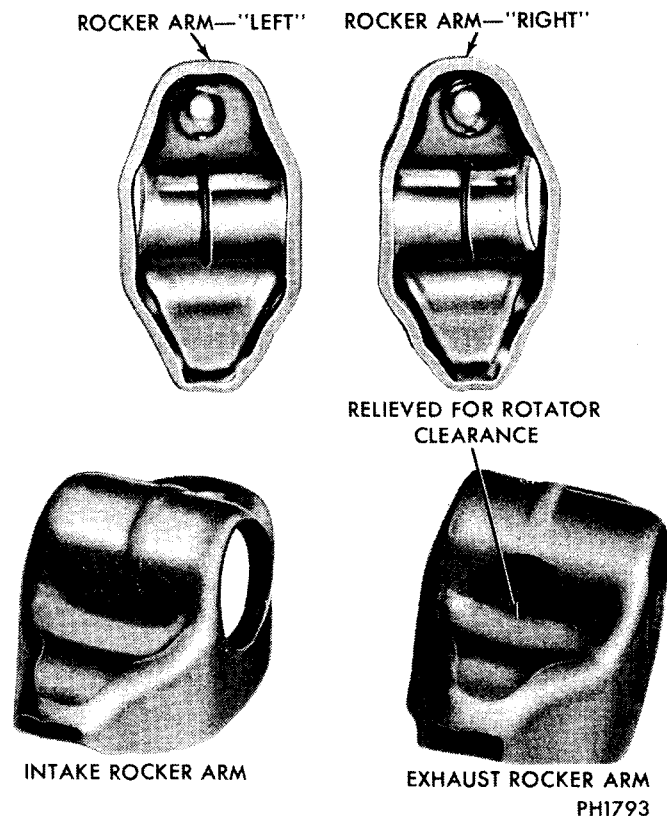


Fig. 3—Intake and Exhaust Rocker Arm Identification
plugs are located in peak of the wedge between the valves.

Removal

- (1) Drain cooling system and disconnect battery ground cable.
- (2) Remove alternator, carburetor air cleaner and fuel line.
- (3) Disconnect accelerator linkage.
- (4) Remove vacuum control hose between carburetor and distributor.
- (5) Remove distributor cap and wires.
- (6) Disconnect coil wires, heat indicator sending unit wire, heater hoses and by-pass hose.
- (7) Remove closed ventilation system, evaporative control system and cylinder head covers.

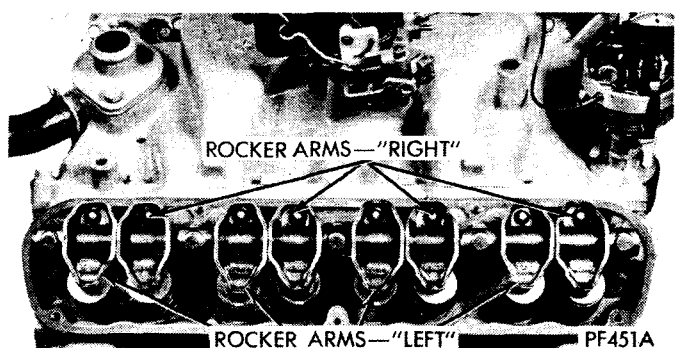
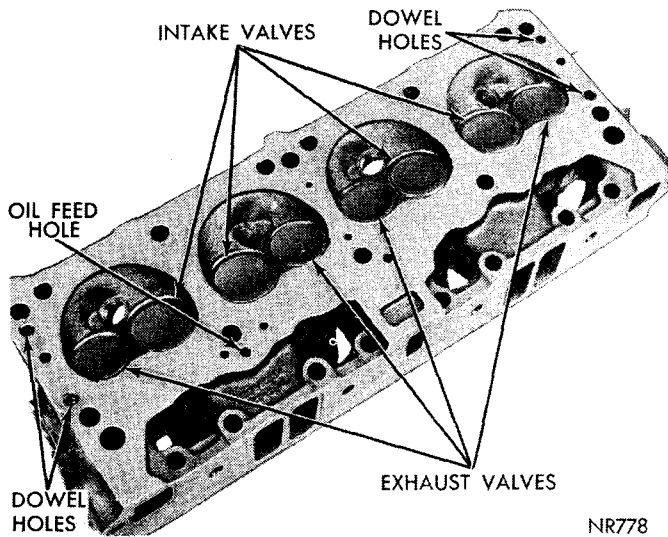


Fig. 4—Proper Rocker Arm Location on Shaft



NR778

Fig. 5—Cylinder Head Assembly

- (8) Remove intake manifold, ignition coil and carburetor as an assembly.
- (9) Remove exhaust manifolds.
- (10) Remove rocker arms and shaft assemblies. Remove push rods and **identify to insure installation in original location.**
- (11) Remove the 10 head bolts from each cylinder head and remove cylinder heads.
- (12) Place cylinder heads in holding fixture Tool C-3626. Remove spark plugs.

Installation

- (1) Clean all gasket surfaces of cylinder block, cylinder heads and remove all burrs.
- (2) Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out of flatness exceeds .00075 times the span length in any direction; either replace head or lightly machine the head gasket surface. As an example, if a 12 inch span is .004 in. out of flat, allowable is $12 \times .00075 = .009$ in. Head is OK.

The cylinder head surface finish should be 70-180 micro-inches.

- (3) Coat new gaskets lightly with number 3419115 Sealer and install on cylinder block.

- (4) Remove cylinder heads from holding fixtures Tool C-3626 and place heads on engine.

- (5) Install cylinder head bolts. Starting at top center, tighten all cylinder head bolts to 50 foot-pounds in sequence, as shown in (Fig. 6). Repeat procedure, retighten all cylinder head bolts to 95 foot-pounds **on all engines.**

- (6) Inspect push rods and replace worn or bent rods.

- (7) Install push rods, rocker arm and shaft assemblies with the "NOTCH" on the end of rockershaft pointing to centerline of engine and toward front of

engine on the left bank and to the rear on right bank, making sure to install the long stamped steel retainers in the number two and four positions, tighten to 210 inch-pounds.

- (8) Cut the three inch strip of sealer material into four equal parts and install under cylinder head gasket lock tabs. **Do not use sealer or cement.**

- (9) Position rubber seals over rails at front and rear of cylinder block. Center hole in seals must engage dowel pins and end holes locked in tangs of head gasket.

- (10) Coat intake manifold side gaskets lightly with number 3419115 sealer or equivalent. Install gaskets with the bead down.

- (11) Carefully lower intake manifold into position on the cylinder block and cylinder heads. After intake manifold is in place, **inspect to make sure seals are in place.**

- (12) Install the twelve attaching cap screws "Finger Tight." Tighten cap screws one through four to 25 foot-pounds, in the tightening sequence shown in (Fig. 7), then retighten cap screws one through four to 35 foot-pounds and follow by retightening the remaining cap screws to 35 foot-pounds in sequence shown.

- (13) Install exhaust manifolds, tighten to 30 foot-pounds.

- (14) Adjust spark plugs to .035 inch gap and install the plugs tightening to specifications.

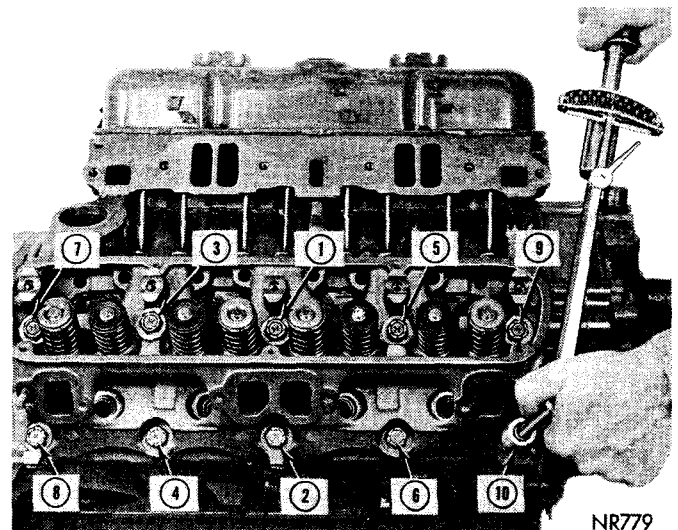
- (15) Install coil wires, heat indicator sending unit wire, heater hoses and by-pass hose.

- (16) Install vacuum control hose between carburetor and distributor.

- (17) Install accelerator linkage and adjust as necessary.

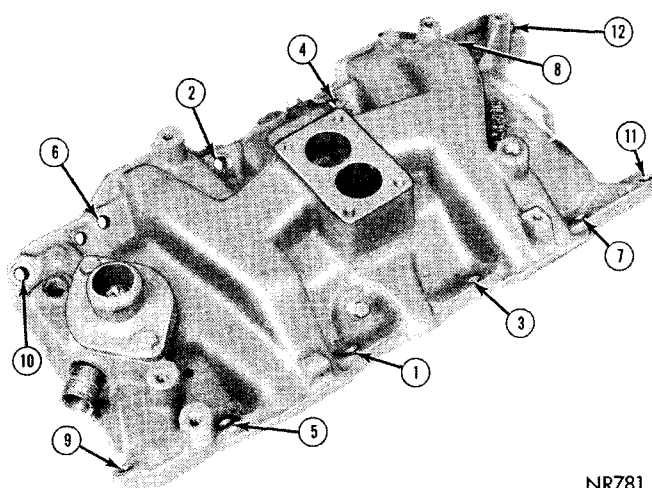
- (18) Install distributor cap and wires.

- (19) Install fuel line, alternator and drive belt. Tighten alternator mounting bolt to 30 foot-pounds



NR779

Fig. 6—Cylinder Head Tightening Sequence



NR781

Fig. 7—Intake Manifold Tightening Sequence

and adjusting strap bolt to 200 inch-pounds.

(20) Place new cylinder head cover gaskets in position and install cylinder head covers. Tighten to 40 inch-pounds.

(21) Install closed crankcase ventilation system and evaporative control system.

(22) Fill cooling system and install battery ground cable.

VALVES AND VALVE SPRINGS

The valves are arranged in line in the cylinder heads and inclined 18 degrees. The rocker shaft support and the valve guides are cast integral with the heads.

Removal

(1) With cylinder head removed, compress valve springs using Tool C-3422A, as shown in (Fig. 8).

(2) Remove valve retaining locks, valve spring retainers, valve stem cup seals and valve springs.

(3) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to

the valve guide. Identify valves to insure installation in original location.

Valve Inspection

(1) Clean valves thoroughly and discard burned, warped and cracked valves.

(2) Measure valve stems for wear. New intake valve stem diameter should measure .372 to .373 inch and exhaust valve stem diameter should measure .371 to .372 inch. If wear exceeds .002 inch, replace valve.

(3) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

(4) Measure valve stem guide clearance as follows:

(a) Install sleeve Tool C-3973 over valve stem (Fig. 9) and install valve. The special sleeve places the valve at the correct height for checking with a dial indicator.

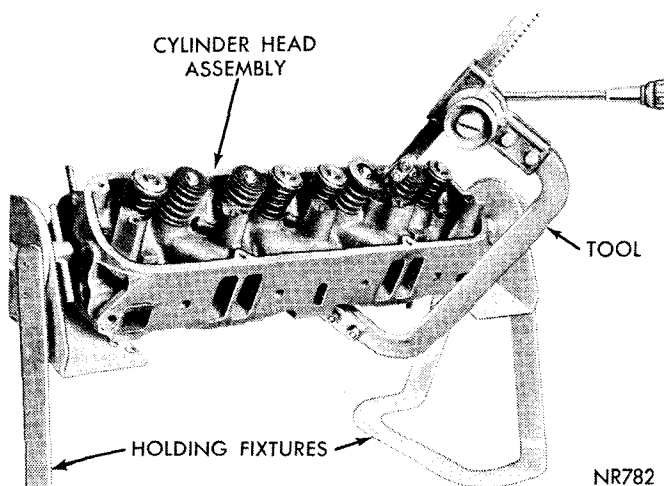
(b) Attach dial indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 10).

(c) Move valve to and from the indicator. The total dial indicator reading should not exceed .017 inch. Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

(5) Service valves with oversize stems are available in .005, .015 and .030 inch oversize. Reamers to accommodate the oversize valve stem are as follows:

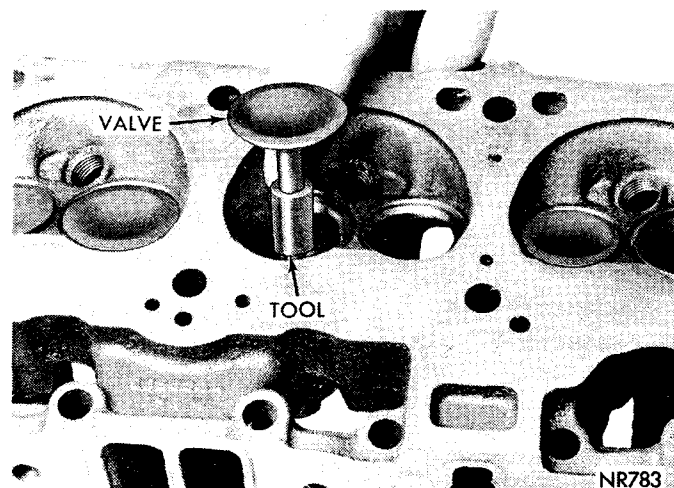
Reamer Tool Number	Reamer Oversize	Valve Guide Size
C-3433	.005 in.	.379-.380 in.
C-3430	.015 in.	.389-.390 in.
C-3427	.030 in.	.404-.405 in.

(6) Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Do not attempt to ream the valve guides from standard directly to .030 inch. Use step procedure of .005, .015 and .030 inch so the valve guides may be reamed true in relation to the valve seat.**



NR782

Fig. 8—Compressing Valve Spring



NR783

Fig. 9—Installing Valve and Tool C-3973

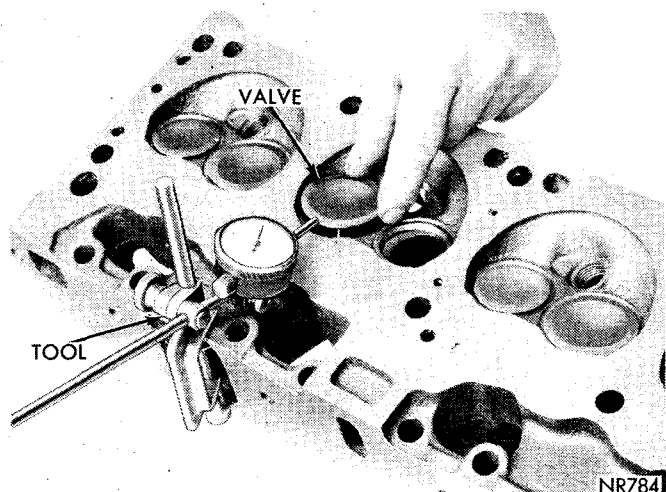


Fig. 10—Measuring Valve Guide Wear

Refacing Valves and Valve Seats

(1) The intake and exhaust valve seats and intake valve face have a 45 degree angle. The exhaust valve face has a 43 degree angle. The valve face and valve seat angles are shown in Figure 11.

(2) Inspect the remaining margin after the valves are refaced (Fig. 12). Valves with less than 3/64 inch margin should be discarded.

(3) When refacing valve seats, it is important that the correct size valve guide pilot be used for re-seating stones. A true and complete surface must be obtained.

(4) Measure the concentricity of valve seat using dial indicator No. 13725. Total runout should not exceed .002 inch (total indicator reading).

(5) Check the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat lightly with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to top edge of valve face, lower valve seat with a 30 degrees stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60 degrees stone.

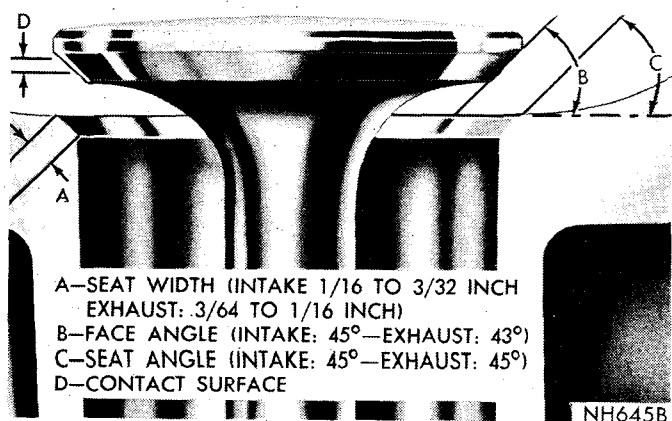


Fig. 11—Valve Face and Seat Angle

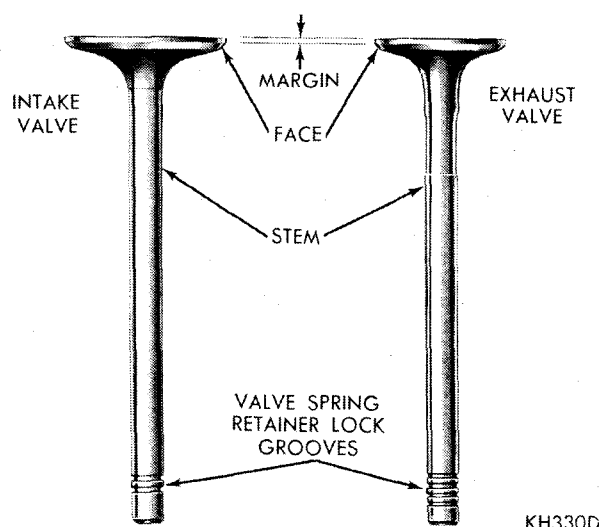


Fig. 12—Intake and Exhaust Valves

(6) 318-1, 360 Cubic Inch Engine, when seat is properly positioned the width of intake seats should be 1/16 to 3/32 inch. The width of the exhaust seats should be 3/64 to 1/16 inch.

318-3, 360-3 Cubic Inch Engine, the width of intake seats should be 5/64 to 7/64 inch. The width of exhaust seats should be 3/32 to 7/64 inch.

Testing Valve Springs (Fig. 13)

(1) Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example the compression length of the spring to be tested is 1-5/16 inches. Turn table of Tool C-647 until surface is in line with the 1-5/16 inch mark on the threaded stud and the zero mark to the front. Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at test.

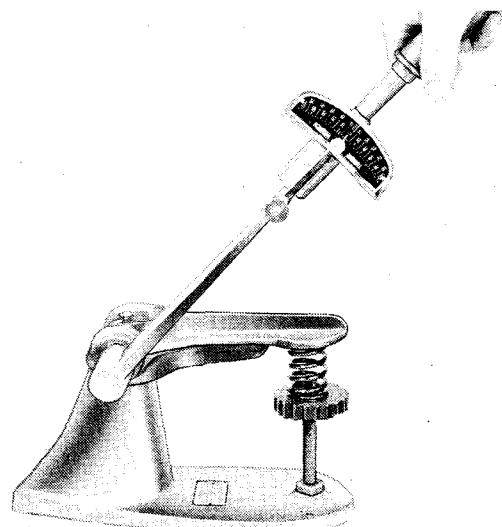


Fig. 13—Testing Valve Springs

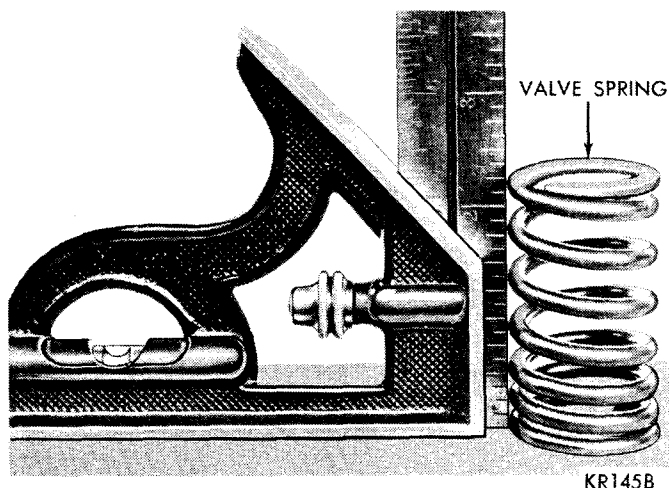


Fig. 14—Inspecting Valve Spring Squareness

length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

(2) Inspect each valve spring for squareness with a steel square and surface plate, test springs from both ends (Fig. 14).

If the spring is more than $1/16$ inch out of square, install a new spring.

Installation (Fig. 15)

(1) Coat valve stems with lubrication oil and insert them in cylinder head.

(2) If valves or seats are reground, check valve stem height with Tool C-3968 (Fig. 16). If valve is too long, grind off the tip until length is within limits.

NOTE: If engine is equipped with rotators, DO NOT grind valve stem.

(3) Install new cup seats on all valve stems and over valve guides (Fig. 17). Install valve springs and retainers.

(4) Compress valve springs with Tool C-3422A, install locks and release tool. If valves and/or seats are reground, measure the installed height of springs, make sure measurement is taken from bottom of spring seat in cylinder head to the bottom of spring

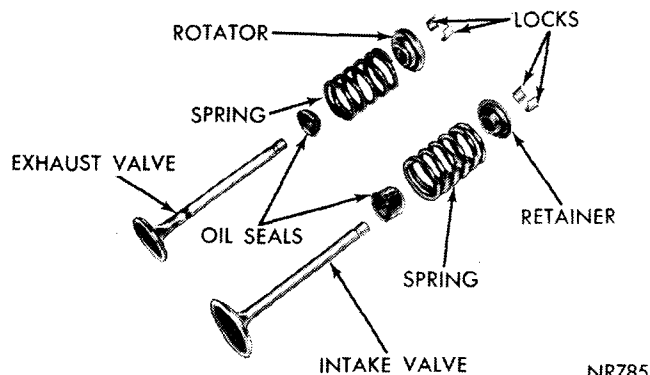


Fig. 15—Valve Assemblies (Disassembled View)

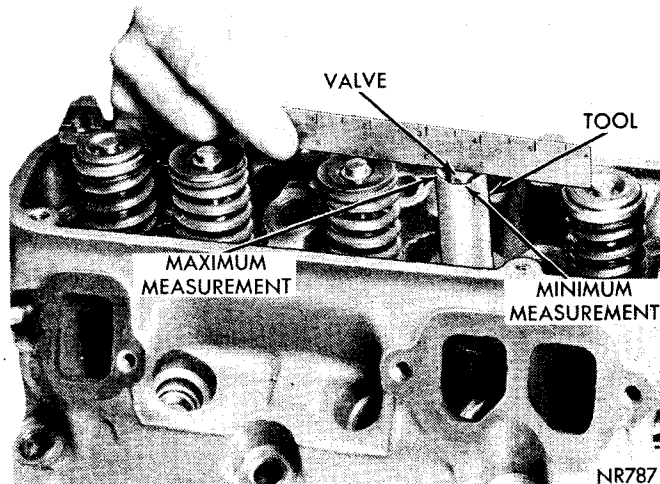


Fig. 16—Measuring Valve Stem Length

retainer (if spacers are installed, measure from the top of spacer). If height is greater than $1-11/16$ inches, install a $1/16$ inch spacer in head counterbore to bring spring height back to normal $1-5/8$ inches to $1-11/16$ inches.

318-3 Cubic Inch Engine, exhaust valves equipped with positive type rotators, the proper installed spring height is $1-15/32$ to $1-17/32$ inches.

Replacing Valve Stem Shields or Valve Springs, Cylinder Head Not Removed

(1) Set engine basic timing to TDC and remove Air Cleaner.

(2) Remove cylinder head covers and spark plugs.

(3) Remove coil wire from distributor and secure to good ground to prevent engine from starting.

(4) Using suitable socket and flex handle at crankshaft pulley retaining screw, turn engine so the number 1 piston is at Top Dead Center on the compression stroke.

(5) Remove rocker arms with rocker shaft and install a dummy shaft. (The rocker arms should not be disturbed and left on shaft).

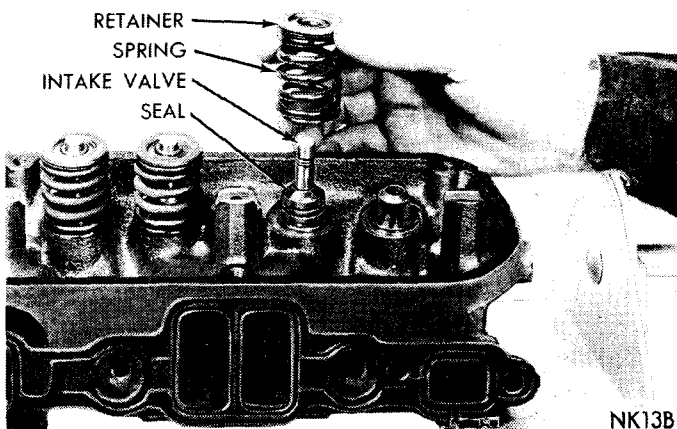


Fig. 17—Installing Valves, Cup Seats, Springs and Retainer

(6) With air hose attached to adapter tool C-3907 installed in number 1 spark plug hole, apply 90 to 100 psi air pressure.

(7) Using Tool C-3906 or C-4228 compress valve spring and remove retainer valve locks and valve spring.

(8) Install cup shields on the exhaust valve stem and position down against valve guides.

(9) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. **Do Not Force** seal against top of guide. When installing the valve retainer locks, compress the spring **only enough** to install the locks.

(10) Follow the same procedure on the remaining 7 cylinders using the firing order sequence 1-8-4-3-6-5-7-2. **Make sure piston in cylinder is at TDC on the valve spring that is being removed.**

(11) Remove adapter Tool 3907.

(12) Remove dummy shaft and install rocker shaft with rocker arms.

(13) Install covers and coil wire to distributor.

(14) Install air cleaner.

(15) Road test vehicle.

HYDRAULIC TAPPETS

Preliminary to Checking the Hydraulic Tappets

Before disassembling any part of the engine to correct tappet noise, read the oil pressure at the GAUGE. (Install a reliable gauge at pressure sending unit if vehicle has no oil pressure gauge) and check the oil level in the oil pan. The pressure should be between 30 and 80 pounds at 2000 R.P.M. The oil level in the pan should never be above the "full" mark on the dipstick, or below the "add oil" mark. Either of these two conditions could be responsible for noisy tappets.

Oil Level Too High

If oil level is above the "full" mark on dipstick, it is possible for the connecting rods to dip into the oil while engine is running and create foam. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

Oil Level Too Low

Low oil level may allow pump to take in air which, when fed to the tappets, causes them to lose length and allows valves to seat noisily. Any leaks on intake side of pump through which air can be drawn will create the same tappet action. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than one tappet will be noisy. When oil level and leaks have been corrected, engine should be operated at fast idle for sufficient time to

allow all of the air inside of the tappets to be bled out.

Tappet Noise Diagnosis

(1) To determine source of tappet noise, operate engine at idle with cylinder head covers removed.

(2) Feel each valve spring or rocker arm to detect noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on the valve spring. If noise is not appreciably reduced, it can be assumed the noise is in the tappet. Inspect the rocker arm push rod sockets and push rod ends for wear.

(3) Valve tappet noise ranges from light noise to a heavy click. A light noise is usually caused by excessive leakdown around the unit plunger which will necessitate replacing the tappet, or by the plunger partially sticking in the tappet body cylinder. A heavy click is caused either by a tappet check valve not seating, or by foreign particles becoming wedged between the plunger and the tappet body, causing the plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between the valve stem and rocker arm as valve closes. In either case, tappet assembly should be removed for inspection and cleaning.

Tappet Removal

(1) The tappets can be removed without removing cylinder heads by following this recommended procedure: Remove cylinder head covers.

(2) Remove rocker arms and shaft assembly.

(3) Remove push rods and **identify to insure installation in original location.**

(4) Remove intake manifold.

(5) Slide Tool C-4129 through opening in cylinder head and seat tool firmly in the head of tappet.

(6) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, **identify to insure installation in original location.**

CAUTION: The plunger and tappet bodies are not interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tappet at a time to avoid mixing of parts. Mixed parts are not compatible. Do not disassemble a tappet on a dirty work bench.

Disassembly (Fig. 18)

(1) Pry out plunger retainer spring clip.

(2) Clean varnish deposits from inside of tappet body above plunger cap.

(3) Invert tappet body and remove plunger cap, plunger, flat check valve, or ball check valve spring, check valve retainer and plunger spring.

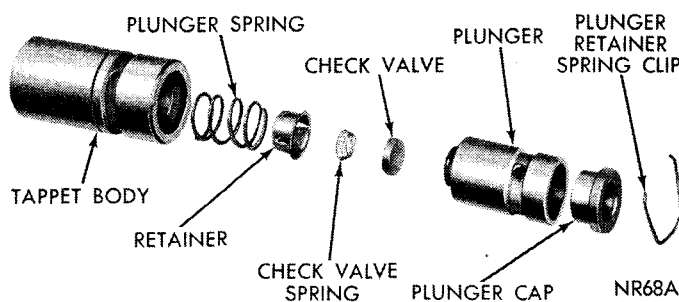


Fig. 18—Hydraulic Tappet (Disassembled View)

Cleaning and Assembly

- (1) Clean all tappet parts in a solvent that will remove all varnish and carbon.
- (2) Replace tappets that are unfit for further service with new assemblies.
- (3) If plunger shows signs of scoring or wear and valve is pitted, or if valve seat on end of plunger indicates any condition that would prevent valve from seating, install a new tappet assembly.
- (4) Assemble tappets (Fig. 18).

Testing

- (1) Fill a pan with clean kerosene.
- (2) Remove cap from plunger and plunger from tappet body.
- (3) Fill tappet body with kerosene and install plunger.
- (4) Unseat check valve with a brass rod to permit complete installation of plunger. Replace cap.
- (5) Hold tappet in an upright position and insert lower jaw of pliers, Tool C-3160, in the groove of tappet body (Fig. 19).
- (6) Engage jaw of pliers and top of tappet plunger. Test leakdown by compressing the pliers. If plunger collapses almost instantly as pressure is applied, disassemble tappet, clean and test again (Fig. 19).
- (7) If tappet still does not operate satisfactorily after cleaning, install a new tappet assembly.

If the tappet or bore in cylinder block is scored,

scuffed, or shows signs of sticking, ream the bore to next oversize.

Installation

- (1) Lubricate tappets.
- (2) Install tappets and push rods in their original positions.
- (3) Install intake manifold, using new gaskets.
- (4) Install rocker arm and shaft assembly.
- (5) Start and operate engine. Warm up to normal operating temperature.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

VALVE TIMING

- (1) Turn crankshaft until the No. 6 exhaust valve is closing and No. 6 intake valve is opening.
- (2) Insert a 1/4 inch spacer between rocker arm pad and stem tip of NO. 1 intake valve (second valve on the left bank).
- (3) Install a dial indicator so plunger contacts valve spring retainer as nearly perpendicular as possible.
- (4) Allow spring load to bleed tappet down giving in effect a solid tappet. Zero the indicator.
- (5) Rotate crankshaft clockwise (normal running direction) until the valve has lifted .010 inch for 318 cubic inch engines, .020 inch for 360 cubic inch engine.

CAUTION: Do not turn crankshaft any further clockwise as valve spring might bottom and result in serious damage.

The timing of the crankshaft pulley should now read from 10 degrees before top dead center to 2 degrees after top dead center. Remove spacer.

- (6) If reading is not within specified limits:
 - (a) Check sprocket index marks.
 - (b) Inspect timing chain for wear.
 - (c) Check accuracy of DC mark on timing indicator.

TIMING CHAIN COVER, OIL SEAL AND CHAIN

Cover Removal

- (1) Drain cooling system and remove radiator, fan belt and water pump assembly.
- (2) Remove pulley from vibration damper and bolt and washer securing vibration damper on crankshaft.
- (3) Install Tool C-3688 and pull vibration damper from end of crankshaft (Fig. 20).
- (4) Remove fuel lines and fuel pump.
- (5) Loosen oil pan bolts and remove the front bolt at each side.
- (6) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

Measuring Timing Chain for Stretch

- (1) Place a scale next to timing chain so that any

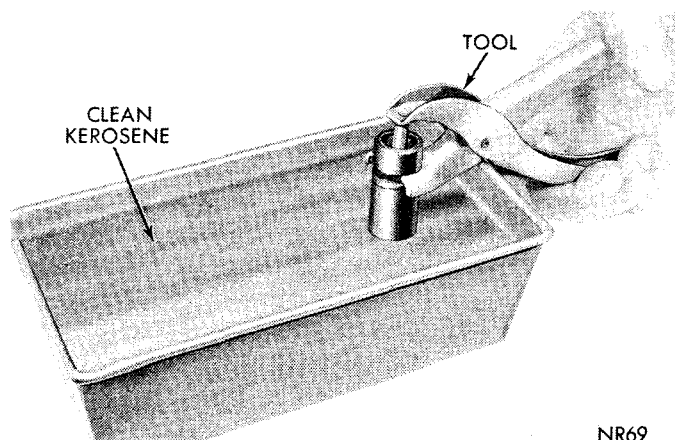


Fig. 19—Testing Tappet Using Tool C-3160

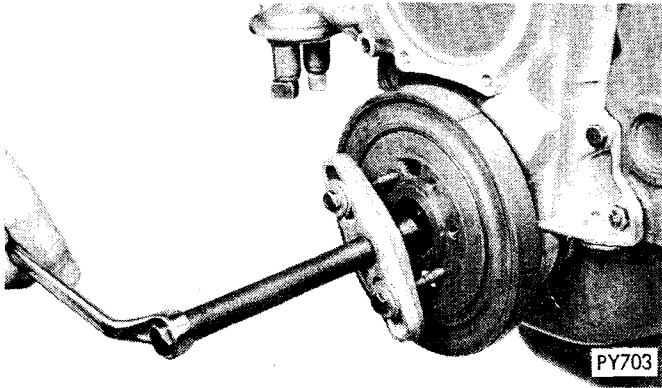


Fig. 20—Removing Vibration Damper Assembly 318 Cubic Inch Shown (Typical)

movement of chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt and apply torque in direction of crankshaft rotation to take up slack; 30 foot-pounds (with cylinder head installed) or 15 foot-pounds (cylinder heads removed). **With a torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block crankshaft to prevent rotation.**

(3) Holding a scale with dimensional reading even with edge of a chain link, apply torque in the reverse direction 30 foot-pounds (with cylinder heads installed) or 15 foot-pounds (cylinder heads removed) and note amount of chain movement (Fig. 21).

(4) Install a new timing chain, if its movement exceeds 1/8 inch.

(5) If chain is not satisfactory, remove camshaft sprocket attaching cup washer, fuel pump eccentric and remove timing chain with crankshaft and camshaft sprockets.

When installing timing chain, use Tool C-3509 to prevent camshaft from contacting the welch plug in the rear of engine block. Remove distributor and oil pump-distributor drive gear. Locate tool against rear side of cam gear and attach tool with distributor retainer plate bolt (Fig. 22).

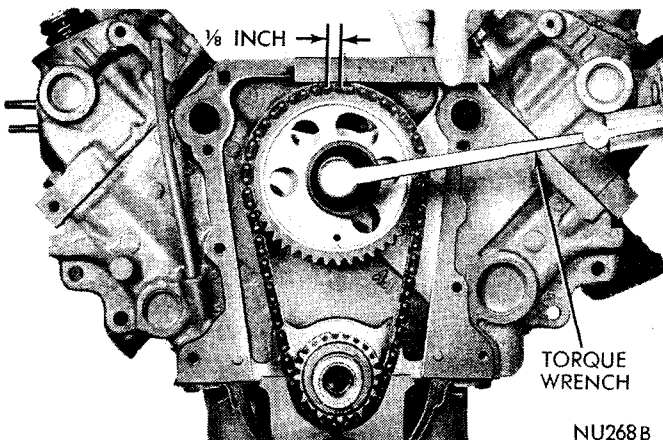


Fig. 21—Measuring Timing Chain Stretch

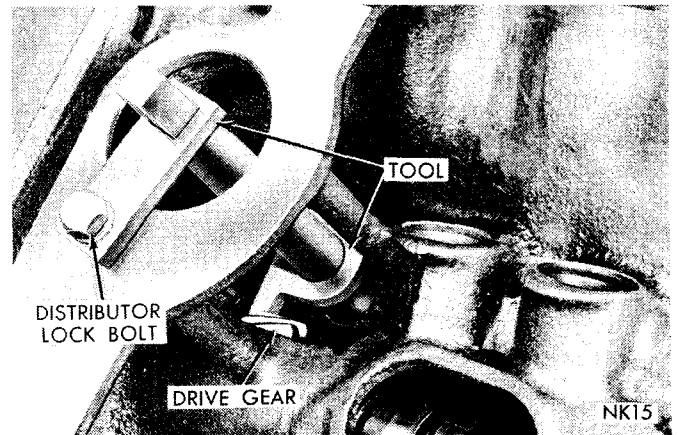


Fig. 22—Camshaft Holding Tool C-3509

(6) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(7) Place timing chain around both sprockets.

(8) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(9) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(10) Slide both sprockets evenly over their respective shafts and use a straight edge to check alignment of timing marks (Fig. 23).

(11) Install the fuel pump eccentric, cup washer, and camshaft bolt. Tighten bolt to 35 foot-pounds.

(12) Check camshaft for .002 to .006 inch end play with a new thrust plate and up to .010 inch end play with a used thrust plate. If not within these limits install a new thrust plate.

Oil Seal Removal (Cover Removed)

(1) Using a drift and hammer tap lightly at several places around the seal case to deform the oil seal case inward.

(2) Engage the seal case with vise grips. Twist and pull on the vise grips at several places around the seal case for removal.

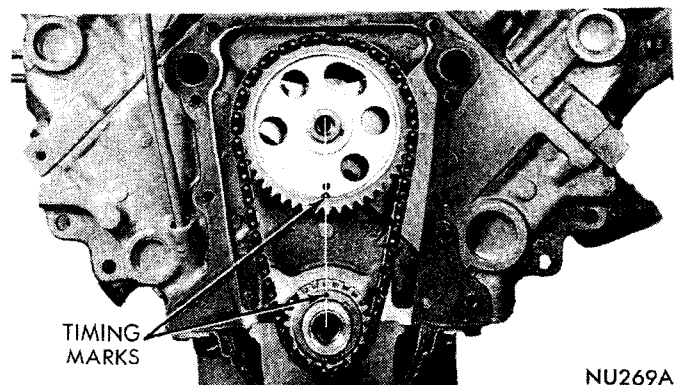


Fig. 23—Alignment of Timing Marks

(3) Insert installing screw through installing plate. Part of Tool C-3506.

(4) Insert installing screw with plate through the seal opening (inside of chain case cover facing up).

(5) Place seal in the cover opening, with seal lips down. Place the seal installing plate into the new seal, with protective recess toward lip of seal retainer, Tool SP-5598, part of Tool C-3506.

(6) Install flat washer and nut on installing screw, hold screw and tighten the nut.

(7) Seal is properly installed when seal case is tight against face of cover. Try to insert a .0015 inch feeler gauge between seal case and cover. If the seal is installed properly, the feeler gauge cannot be inserted. Seal must be fully bottomed in case (Fig. 24).

Cover Installation

(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.

(2) Using a new gasket carefully install chain case cover to avoid damaging oil pan gasket. Tighten chain case cover capscrews to 30 foot-pounds first then tighten oil pan capscrews to 200 inch-pounds.

(3) Lubricate seal lip with lubriplate, position vibration damper hub slot on key in crankshaft, and slide on crankshaft.

(4) Place installing tool, part of Puller set Tool C-3688 in position and press vibration damper on crankshaft (Fig. 25).

(5) Install vibration damper retainer bolt with washer and tighten to 135 foot-pounds.

(6) Position pulley on vibration damper and attach with bolts and lockwashers. Tighten to 200 inch-pounds.

(7) Install fuel pump and fuel lines.

(8) Install water pump and housing assembly using new gaskets. Tighten bolts to 30 foot-pounds.

(9) Install power steering pump.

(10) Install radiator, fan and belt, hoses and close drains.

(11) Fill cooling system.

(12) With timing indicator on "0" install distribu-

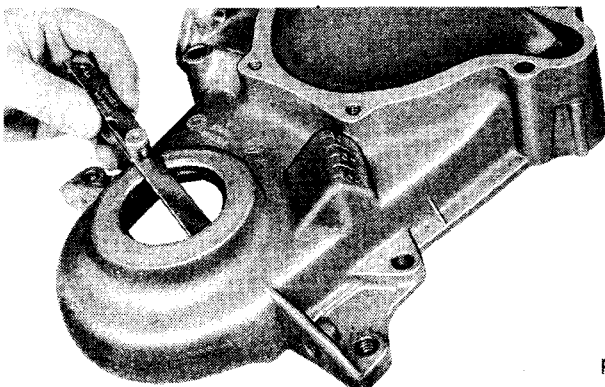


Fig. 24—Inspecting Seal for Proper Seating

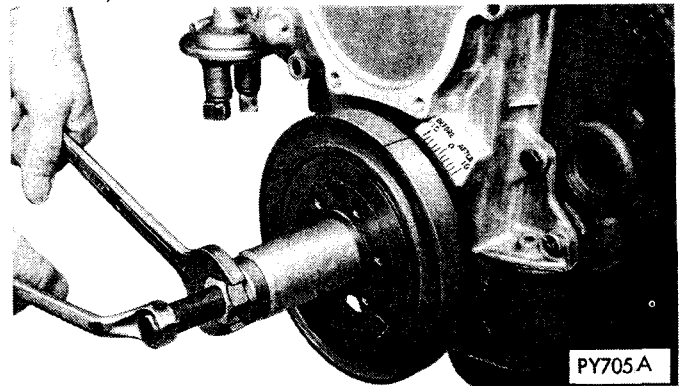


Fig. 25—Installing Vibration Damper Assembly

tor drive gear with slot pointing to the first intake manifold bolt on left side of engine (Fig. 26).

CAMSHAFT

(Engine Removed from Vehicle)

The camshaft has an integral oil pump and distributor drive gear and a bolt on fuel pump eccentric, as shown in (Fig. 27). With engine in repair stand C-3167 and adapter C-3662. Remove intake manifold, cylinder head covers, timing case cover and timing chain.

(1) Remove rocker arm and shaft assemblies.

(2) Remove push rods and tappets; identify so each part will be replaced in its original location.

(3) Remove distributor and lift out the oil pump and distributor drive shaft.

(4) Remove camshaft thrust plate, **note location of oil tab.**

(5) Install a long bolt into front of camshaft to facilitate removal of the camshaft; remove camshaft, being careful not to damage cam bearings with the cam lobes.

Installation

(1) Lubricate camshaft lobes and camshaft bearing

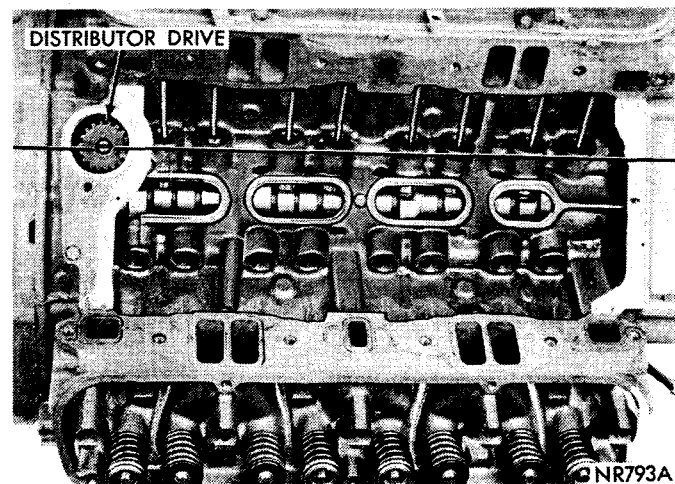


Fig. 26—Position of Distributor Drive Gear

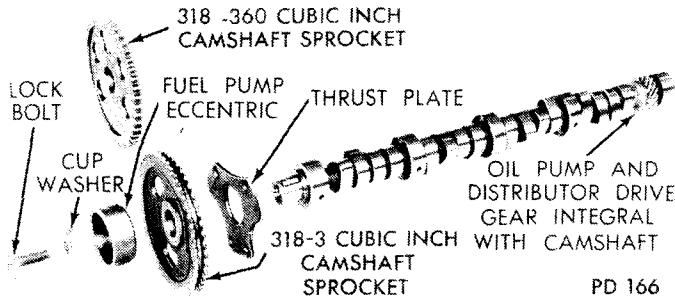


Fig. 27—Camshaft and Sprocket Assembly (Disassembled View)

journals and insert the camshaft to within 2 inches of its final position in cylinder block.

(2) Install Tool C-3509 with tongue back of distributor drive gear, (Fig. 22).

(3) Hold tool in position with distributor lock plate screw. This tool will restrict camshaft from being pushed in too far and prevent knocking out the welch plug in rear of cylinder block. **Tool should remain installed until the camshaft and crankshaft sprockets and timing chain have been installed.**

(4) Install camshaft thrust plate and chain oil tab with three screws as shown in (Fig. 28). **Make sure tang enters lower right hole in thrust plate.** Tighten to 210 inch-pounds.

(5) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(6) Place timing chain around both sprockets.

(7) Turn crankshaft and camshaft to line up with

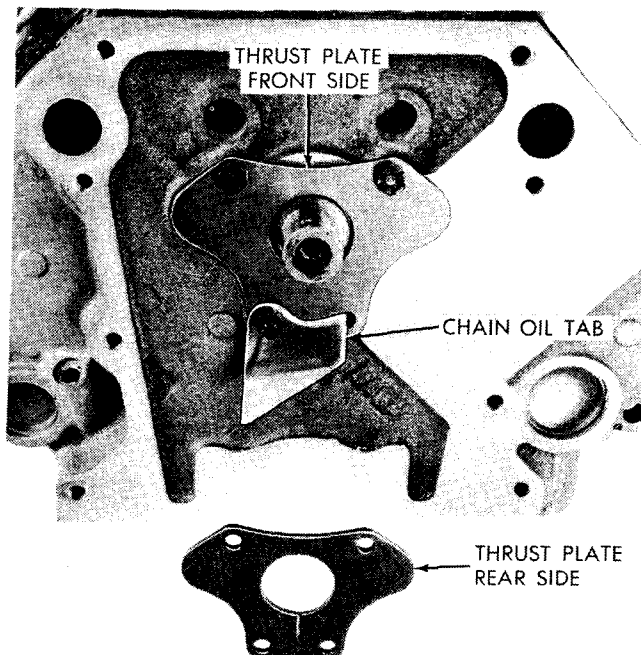


Fig. 28—Timing Chain Oil Tab Installation

keyway location in crankshaft sprocket and in camshaft sprocket.

(8) Lift sprockets and chain (keep sprockets tight against the chain in position as described).

(9) Slide both sprockets evenly over their respective shafts and use a straight edge to check alignment of timing marks (Fig. 23).

(10) Install the fuel pump eccentric, cup washer, and camshaft bolt. Tighten bolt to 35 foot-pounds.

(11) Measure camshaft end play. Refer to Specifications for proper clearance. If not within limits install a new thrust plate.

Whenever an engine has been rebuilt and/or a new camshaft and/or new tappets have been installed, add one pint of Chrysler Crankcase Conditioner Part Number 3419130 or equivalent to engine oil to aid in break-in. The oil mixture should be left in engine for a minimum of 500 miles, and drained at the next normal oil change.

All of the tappet faces must be inspected for crown with a straight-edge. If any negative crown (dish) is observed, tappet must be replaced. Each tappet must be reinstalled in the same position from which it was removed. New tappets must be used if a new camshaft is installed.

CAMSHAFT BEARINGS

(Engine Removed from Vehicle)

Removal

(1) With engine completely disassembled, drive out rear cam bearing welch plug.

(2) Install proper size adapters and horse shoe washers (part of Tool C-3132A) at back of each bearing shell to be removed and drive out bearing shells, (Fig. 29).

Installation

(1) Install new camshaft bearings with Tool C-3132A by sliding the new camshaft bearing shell over proper adapter.

(2) Position rear bearing in the tool. Install horse

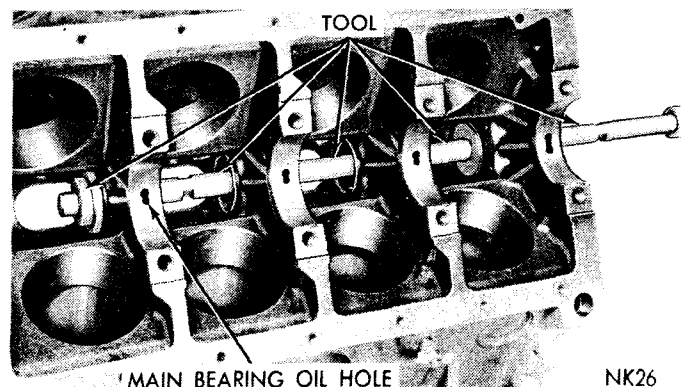


Fig. 29—Removing Camshaft Bearings

shoe lock and by reversing removal procedure, carefully drive bearing shell into place.

(3) Install remaining bearings in the same manner.

Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearings. Also, Number two bearing must index with the oil passage to the left cylinder head and Number four bearing must index with the oil passage to the right cylinder head. If the camshaft bearing shell oil holes are not in exact alignment, remove and install them correctly. Coat core hole with sealer 3837795 or equivalent. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

DISTRIBUTOR DRIVE SHAFT BUSHING

Removal

(1) Insert Tool C-3052 into old bushing and thread down until a tight fit is obtained, (Fig. 30).

(2) Hold puller screw and tighten puller nut until bushing is removed.

Installation

(1) Slide new bushing over burnishing end of Tool C-3053 and insert the tool and bushing into the bore.

(2) Drive bushing and tool into position, using a hammer (Fig. 31).

(3) As the burnisher is pulled through the bushing by tightening the puller nut, the bushing is expanded tight in block and burnished to correct size (Fig. 32).

Do not ream this bushing.

Distributor Timing

Before installing the distributor and oil pump drive shaft, time engine as follows:

(1) Rotate crankshaft until No. 1 cylinder is at top dead center on the firing stroke.

(2) When in this position, the straight line on vibration damper should be under ("O") on the timing indicator.

(3) Coat shaft and drive gear with engine oil. Install the shaft so that after gear spirals into place, it will index with the oil pump shaft, so slot in top of

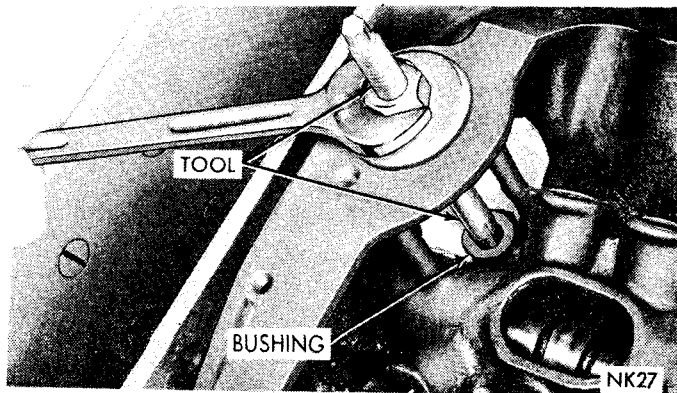


Fig. 30—Removing Distributor Drive Shaft Bushing

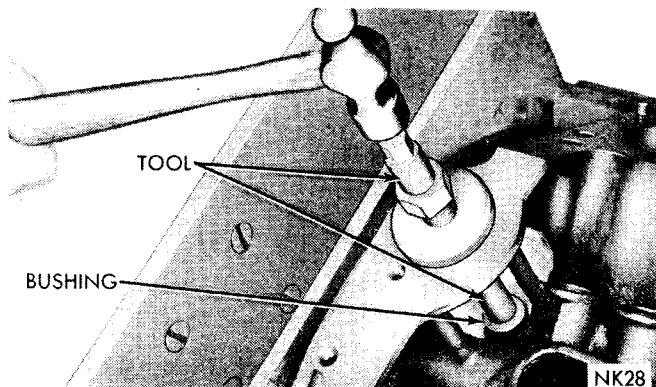


Fig. 31—Installing Distributor Drive Shaft Bushing

drive gear will point in a direction parallel to the centerline of the crankshaft. (Fig. 26).

Installation of Distributor

(1) Hold the distributor over the mounting pad on cylinder block with vacuum chamber pointing toward right of engine.

(2) Turn rotor until it points forward and to approximate location of No. 1 tower terminal in distributor cap.

(3) Place distributor gasket in position.

(4) Lower the distributor and engage the shaft in the slot of distributor drive shaft gear.

(5) Install hold down clamp.

CYLINDER BLOCK

Oversized Cylinder Bores

Whenever it is necessary to machine cylinder bores .020 oversize all bores shall be oversized. Engines will be identified with a letter "A" stamped on the engine serial pad. See specifications for oversized and undersized machined parts.

Piston Removal

(1) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from

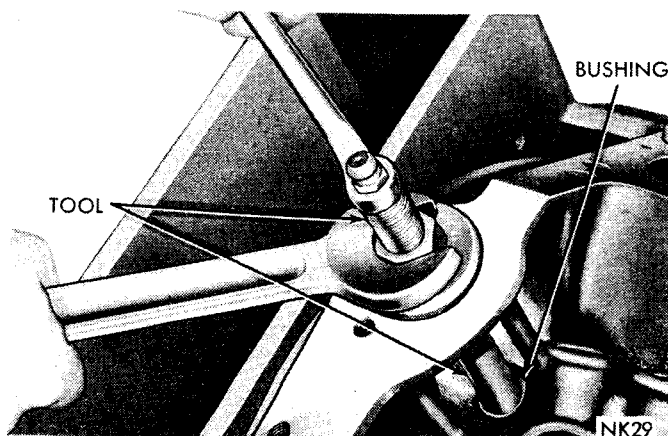


Fig. 32—Burnishing Distributor Drive Shaft Bushing

cylinder block. **Be sure to keep tops of pistons covered during this operation. Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so that each connecting rod is centered in cylinder bore.**

(2) Inspect connecting rods and connecting rod caps for cylinder identification. Identify them if necessary.

(3) Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts. Push each piston and rod assembly out of cylinder bore. **Be careful not to nick crankshaft journals.**

(4) After removal, install bearing cap on the mating rod.

Cleaning and Inspection

(1) Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

(2) If new core plugs are installed, coat edges of plug and core hole with Number 1057794 Sealer or equivalent. Drive the core plug in so that the rim lies at least 1/64 in. below the lead-in chamfer.

(3) Examine block for cracks or fractures.

Cylinder Bore Inspection

The cylinder walls should be checked for out-of-round and taper with Tool C-119. If the cylinder bores show more than .005 in. out-of-round, or a taper of more than .010 in., or if the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed, and new pistons and rings fitted. Whatever type of boring equipment is used, boring and honing operation should be closely coordinated with the fitting of pistons and rings in order that specified clearances may be maintained.

Honing Cylinder Bores

Before honing, stuff plenty of clean rags under the bores, over the crankshaft to keep abrasive materials from entering crankcase area.

(1) Used carefully, the cylinder bore resizing hone C-823 equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round as well as removing light scuffing, scoring or scratches. Usually a few strokes will clean up a bore and maintain the required limits.

(2) Deglazing of the cylinder walls may be done using a cylinder surfacing hone. Tool C-3501, equipped with 280 grit stones (C-3501-3810) if the cylinder bore is straight and round, 20-60 strokes depending on the bore condition will be sufficient to provide satisfactory surface. Inspect cylinder walls after each 20 strokes. Use honing oil C-3501-3880 or a light honing oil available from major oil distributors. **Do not use engine or transmission oil, mineral spirits or kerosene.**

(3) Honing should be done by moving the hone up and down fast enough to get a cross-hatch pattern. When hone marks intersect at 50-60 degrees, the cross hatch angle is most satisfactory for proper seating of rings (Fig. 33).

(4) After honing, it is necessary that the block be cleaned again to remove all traces of abrasives.

CAUTION: Be sure all abrasives are removed from engine parts after honing. It is recommended that a solution of soap and water be used with a brush and the parts then thoroughly dried. The bore can be considered clean when it can be wiped clean with a white cloth and cloth remains clean. Oil the bores after cleaning to prevent rusting.

PISTONS, PINS AND RINGS

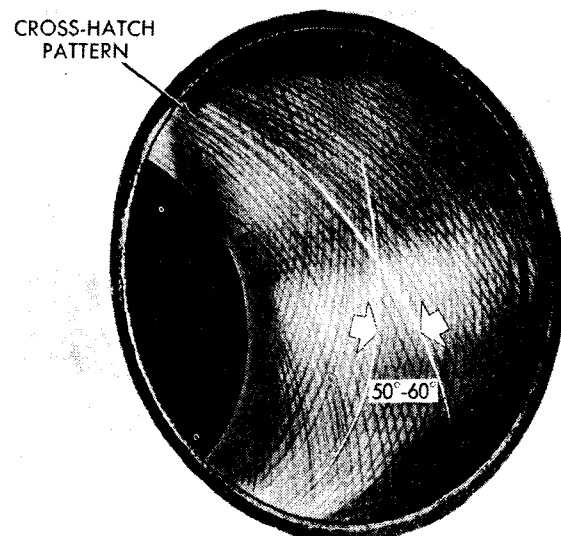
The pistons are cam ground so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, thus, causing the piston to assume a more nearly round shape. It is important that pistons be checked for taper and elliptical shape before they are fitted into the cylinder bore (Figs. 34 and 35).

Finished Pistons

All pistons are machined to the same weight in grams, regardless of oversize to maintain piston balance. For cylinder bores which have been honed or rebored new pistons are supplied with properly fitted pins, available in standard and .020 inch oversize.

Fitting Pistons

Piston and cylinder wall must be clean and dry. Specified clearance between the piston and the cylinder wall is .0005 to .0015 inch.



NP998A

Fig. 33—Cross Hatch Pattern

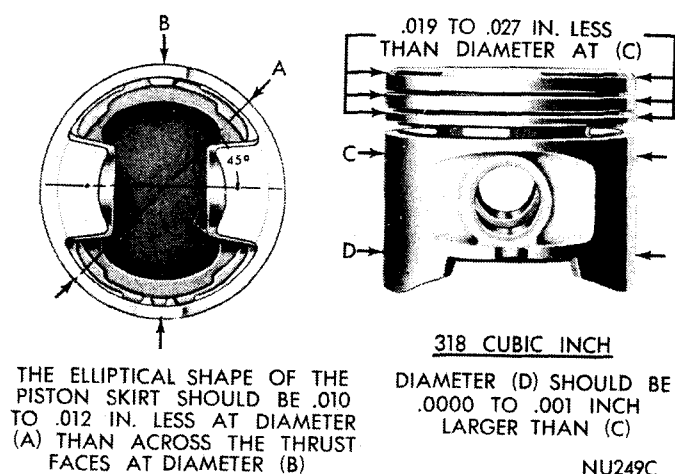


Fig. 34—318 Cubic Inch Piston Measurements

Piston diameter should be measured at the top of skirt 90 degrees to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 70 degrees F.

Piston Pins

On all 318-1 and 360 engines, the piston pin rotates in the piston only, and is retained only by the interference fit of the piston pin in the connecting rod. No locks are used in the piston to retain the piston pin.

Tool C-4158 is required to remove and install the piston pin; the pilot and anvil in the chart below is also required, and used with Tool C-4158.

Engine	Pilot Tool No.	Anvil Tool No.
318-1	C-4200-3	C-4200-1
318-3	C-4200-2	C-4200-1
360	SP-5523	SP-5520

Piston Pin Removal

(1) Select appropriate pilot and anvil shown in chart for use with Tool C-4158.

(2) Arrange Tool C-4158 parts for removal of piston pin, (Fig. 36).

(3) Install pilot on main screw.

(4) Install main screw through piston pin.

(5) Install anvil over threaded end of main screw with small end of anvil against piston boss. Be sure spring is removed from anvil.

(6) Install nut loosely on main screw and place assembly on a press, (Fig. 37).

(7) Press piston pin out of connecting rod. **When pin falls free from connecting rod, stop press to prevent damage to bottom of anvil.**

(8) Remove tool from piston.

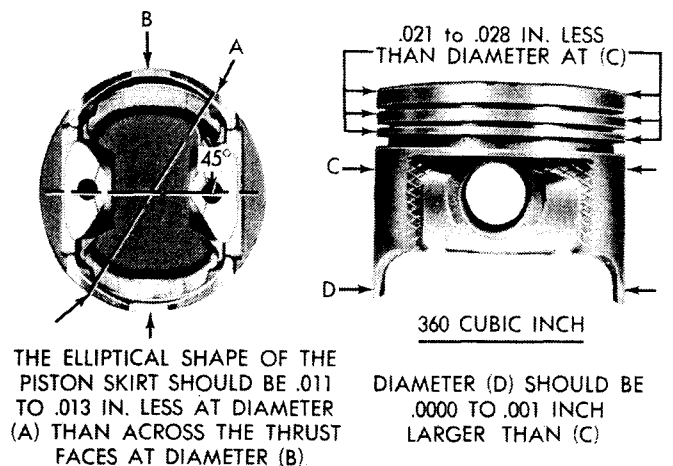


Fig. 35—360 Cubic Inch Piston Measurement

Piston Pin Installation

(1) Test piston pin fit in the piston. It should be a sliding fit in the piston at 70 degrees F. **Piston pins are supplied in standard sizes only.**

(2) Lubricate piston pin holes in the piston and connecting rod.

(3) Select appropriate pilot and anvil shown in chart for use with Tool C-4158.

(4) Arrange Tool C-4158 parts for installation of piston pin (Fig. 38).

(5) Install spring inside the pilot and install spring and pilot in the anvil. Install piston pin over main screw.

(6) Place piston, with "front" up, over the pilot so pilot extends through piston pin hole.

(7) Position connecting rod over the pilot which extends through piston pin hole.

Assemble rods to pistons of the right cylinder bank (2, 4, 6, and 8) with indent on piston head opposite to the larger chamfer on the large bore end of connecting rod. Assemble rods to pistons of the left cylinder bank (1, 3, 5, and 7) with indent on piston head on the same side as the large chamfer on the

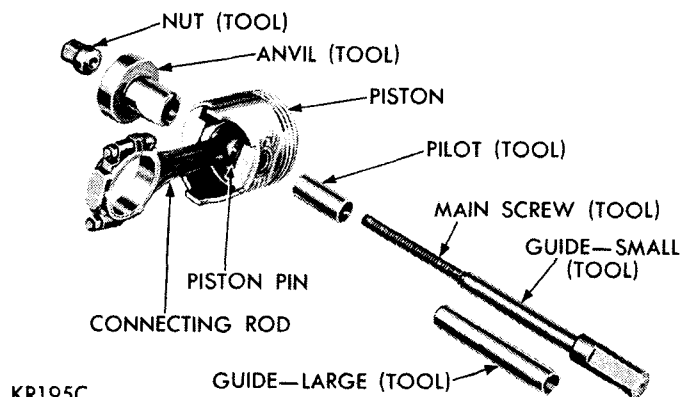


Fig. 36—Arrangement of Tool C-4158 For Removing Piston Pin

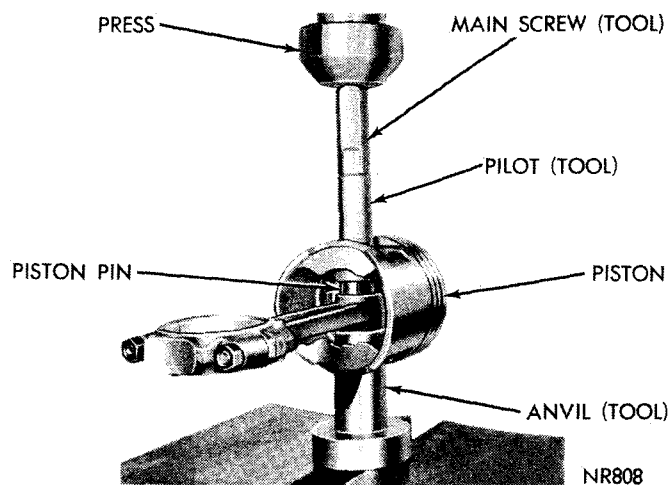


Fig. 37—Removing Piston Pin With Tool C-4158

large bore end of the connecting rod.

(8) Install main screw and piston pin in piston, (Fig. 38).

(9) Install nut on puller screw to hold assembly together. Place assembly on a press (Fig. 39).

(10) Press piston pin in until pin "bottoms" on the pilot. This will position pin in connecting rod.

(11) To measure pin fit, remove tool and arrange tool parts and piston assembly as shown in (Fig. 36).

(12) Place assembly in a vise (Fig. 40).

(13) Attach torque wrench to nut and tighten up to 15 foot-pounds. If the connecting rod moves downward on piston pin, reject this connecting rod and piston pin combination. Obtain a connecting rod with proper small end bore diameter and repeat the installation and tightening procedure.

(14) If connecting rod does not move under 15 foot-pounds, interference fit of piston pin in connecting rod is satisfactory.

Fitting Rings

(1) Measure piston ring gap about two inches from bottom of cylinder bore in which it is to be fitted (An inverted piston can be used to push the rings down to

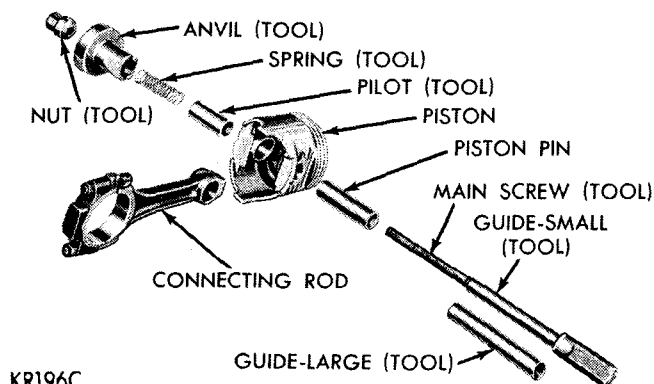


Fig. 38—Arrangement of Tool C-4158 For Installing Piston Pin

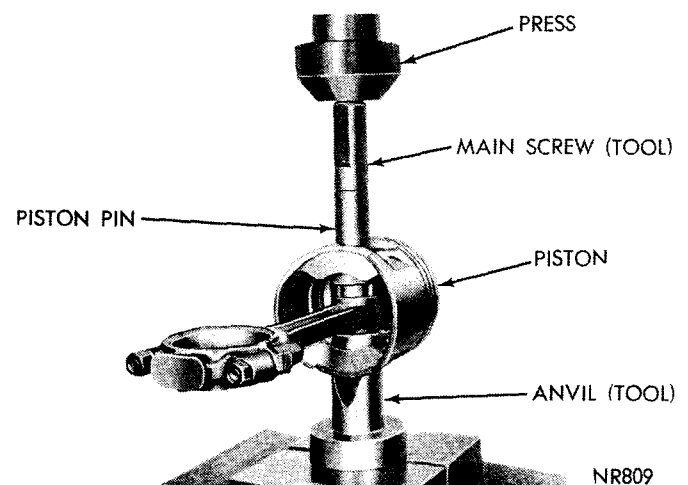


Fig. 39—Installing Piston Pin With Tool C-4158

insure positioning rings squarely in the cylinder bore before measuring).

(2) Insert feeler stock in the gap. The ring gap should be between .010 and .020 inch for compression rings and .015 to .055 inch for oil ring steel rails in standard size bores (for new service rings). Maximum gap in .005 inch O/S bores should be .060 inch for compression rings and .070 inch for oil ring steel rails.

(3) Measure side clearance between piston ring and ring land (Fig. 41). Clearance should be .0015 to .003 inch for the top compression ring and the intermediate ring. Steel rail service oil ring should be free in groove, but should not exceed .005 inch side clearance.

(4) On 318 or 360 Cubic Inch Engine, the keys on the spacer expander must be inserted into the hole in the oil ring groove over the piston pin front boss (Fig. 42).

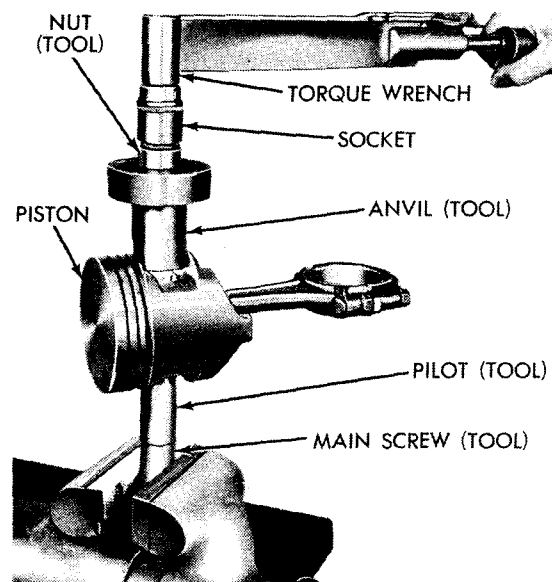


Fig. 40—Testing Piston Pin Fit in Connecting Rod

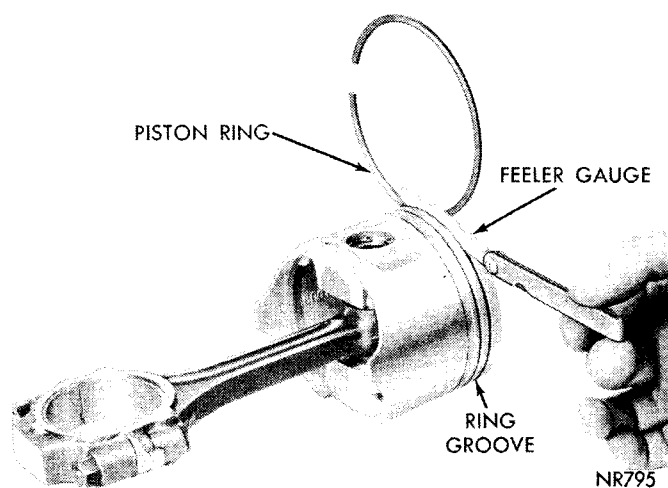
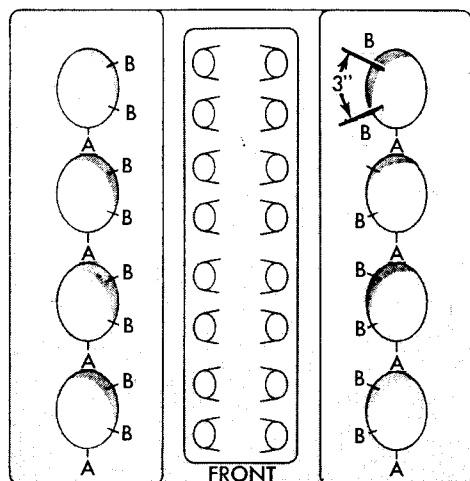


Fig. 41—Measuring Piston Ring Side Clearance

(5) Install compression rings in middle and top grooves use ring installer Tool C-3586 or C-4184 for 318 cubic inch engine, Tool C-3562 or C-4184 for 360 cubic inch engine. **Be sure the mark "Top" on each compression ring is to the top of piston when ring is installed.**



A-EXPANDER GAPS

B-RAIL GAPS

IF YOU HAVE FOLLOWED THE INSTRUCTIONS, THE RING WILL BE IN THIS POSITION ON THE PISTON.

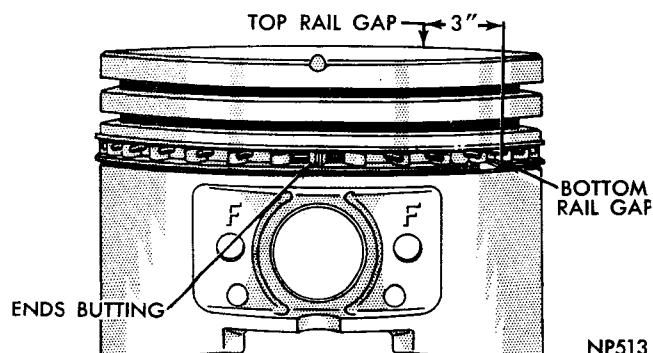


Fig. 42—Proper Oil Ring Installation

CRANKSHAFT IDENTIFICATION

A crankshaft which has one or more connecting rod or main bearing journals undersize will be steel stamped on the milled flat on the No. 8 crankshaft counterweight (Fig. 43).

Undersize Journal	Identification Stamp
.001 inch	R1-R2-R3 or R4
.010 inch	RX
.001 inch	M1-M2-M3-M4 or M5
.010 inch	MX

A crankshaft which has .010 inch undersize journals will have all rod journals; all main journals or both.

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

CONNECTING RODS

Installation of Connecting Rod Bearings

Fit all rods on one bank until completed. Do not alternate from one bank to another, because when the rods are assembled to pistons correctly, they are not interchangeable from one bank to another.

The bearing caps are not interchangeable and should be marked at removal to insure correct assembly.

Each bearing cap has a small "V" groove across the parting face. When installing the lower bearing shell, make certain that the "V" groove in the shell is in line with the "V" groove in the cap. This provides lubrication of the cylinder wall in the opposite bank.

The bearing shells must be installed so that the tangs are in the machined groove in the rods and caps.

Limits of taper or out-of-round on any crankshaft journals should be held to .001 inch. Bearings are available in .001, .002, .003, .010 and .012 inch undersize. **Install the bearings in pairs. Do not use a new bearing half with an old bearing half. Do not file the rods or bearing caps.**

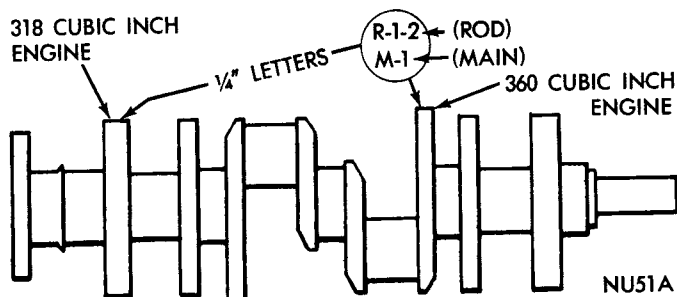


Fig. 43—Showing Location of Internal Marking of No. 8 Counterweight

MEASURING CONNECTING ROD BEARING CLEARANCE

Shim Stock Method

(1) (a) **On 318-1 or 360 Cubic Inch Engine**, place an oiled .001 inch brass shim stock (1/2 inch wide and 3/4 inch long) between the bearing and connecting rod journal.

(b) **On 318-3 Cubic Inch Engine** with tri-metal bearings, use an oiled .002 inch brass shim stock (1/2 inch wide and 3/4 inch long) between the bearing and connecting rod journal.

(2) Install bearing cap and tighten to 45 foot-pounds.

(3) Turn crankshaft 1/4 turn in each direction. A slight drag should be felt which indicates clearance is satisfactory. **318-1 or 360 Cubic Inch Engine** correct clearance is from .0002 to .0022 inch; **318-3 Cubic Inch Engine** with tri-metal bearings correct clearance is from .001 to .002 inch.

(4) Side play should be from .006 to .014 inch (two rods).

Plastic-Gage Method

(1) Wipe journal clean.

(2) Place a strip of Plastic-Gage across full width of lower insert at the center of bearing cap (Fig. 44).

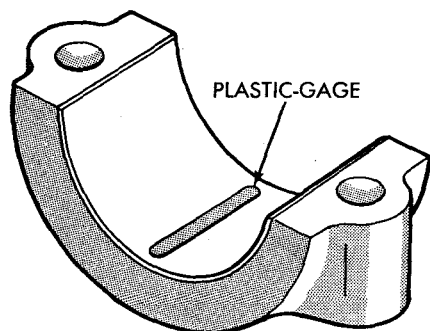
(3) Install bearing cap to connecting rod and tighten retaining nuts to 45 foot-pounds torque.

(4) Remove bearing cap and determine amount of clearance by measuring the width of the compressed Plastic-Gage with the scale furnished (Fig. 45).

(5) New bearings should be installed if bearing clearance is not within specifications. Excessive taper indicates that a new or reground crankshaft is required.

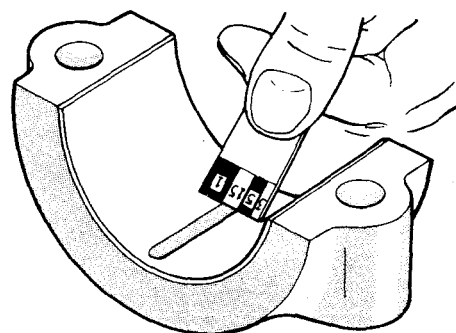
INSTALLING PISTON AND CONNECTING ROD ASSEMBLY

(1) Before installing pistons, and connecting rod assemblies into the bore, be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.



PN248A

Fig. 44—Plastic-Gage Placed in Lower Shell



PN249

Fig. 45—Clearance Measurement

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 42).

(3) Immerse the piston head and rings in clean engine oil, slide the ring compressor, Tool C-385, over the piston and tighten with the special wrench (part of Tool C-385). **Be sure position of rings does not change during this operation.**

(4) Install connecting rod bolt protectors on rod bolts, the long protector should be installed on the numbered side of the connecting rod.

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal (Fig. 46).

(6) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on crankshaft journal.

(7) The notch or groove on top of piston must be pointing toward front of engine and the larger chamfer of the connecting rod bore must be installed toward crankshaft journal fillet.

(8) Install rod caps, tighten nuts to 45 foot-pounds.

Whenever an engine has been rebuilt and/or a new camshaft and/or new tappets have been installed, add one pint of Chrysler Crankcase Conditioner Part Number 3419130 or equivalent to engine oil to aid in break-in. The oil mixture should be left in engine for a minimum of 500 miles, and drained at the next normal oil change.

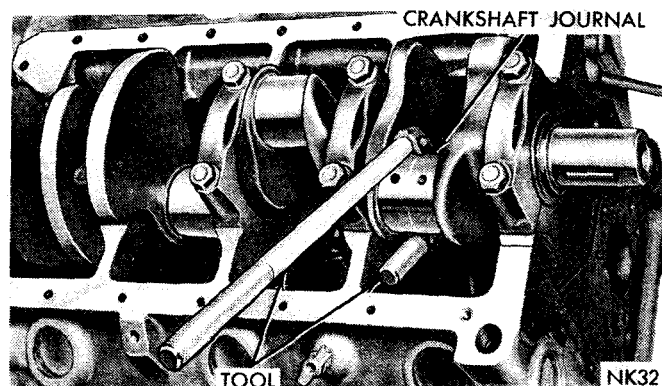


Fig. 46—Removing or Installing Connecting Rod

CRANKSHAFT MAIN JOURNALS

The crankshaft journals should be checked for excessive wear, taper and scoring. Limits of taper or out-of-round on any crankshaft journals should be held to .001 inch. Journal grinding should not exceed .012 inch under the standard journal diameter. Do NOT grind thrust faces of Number 3 main bearing. Do NOT nick crank pin or main bearing fillets. After re-grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CAUTION: Journal grinding and polishing of nodular cast iron crankshaft journals is much more critical than forged steel crankshafts. It is absolutely essential that final polishing be in the direction of normal rotation with 320 or 400 grit paper.

CRANKSHAFT MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to insure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of 1, 2 and 4 are interchangeable. Upper main bearing halves of 1, 2 and 4 are interchangeable.

Upper and lower Number 3 bearing halves are flanged to carry the crankshaft thrust loads and are NOT interchangeable with any other bearing halves in the engine (Fig. 47). Bearing shells are available in standard and the following undersizes: .001, .002, .003, .010 and .012 inch. Never install an undersize bearing shell that will reduce clearance below specifications.

Removal

(1) Remove oil pan and identify bearing caps before removal.

(2) Remove bearing caps one at a time. Remove upper half of bearing by inserting Tool C-3059 (Fig. 48) into the oil hole of crankshaft.

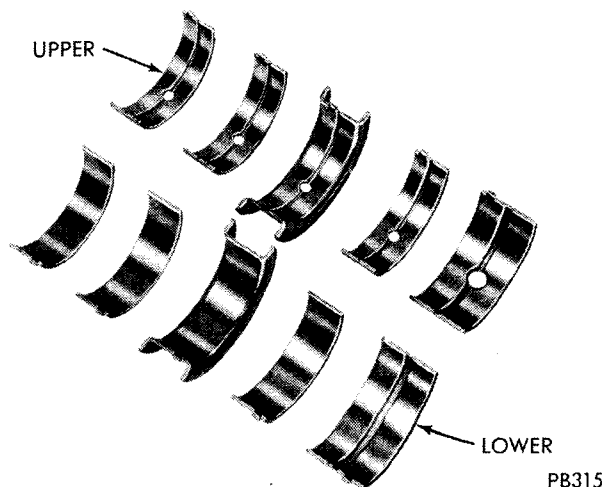


Fig. 47—Main Bearing Identification

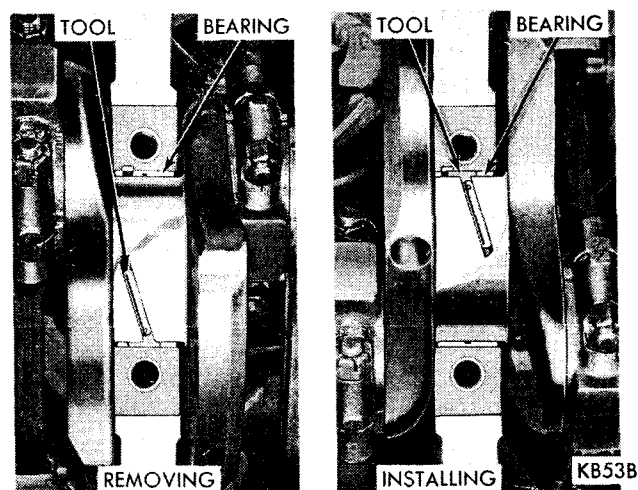


Fig. 48—Removing or Installing Upper Main Bearing

(3) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

Installation

Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Tool C-3059 into oil hole of crankshaft (Fig. 48).

(2) Slowly rotate crankshaft counter-clockwise sliding the bearing into position. Remove Tool C-3059.

MEASURING MAIN BEARING CLEARANCE

Shim Stock Method

(1) Smooth edges of a 1/2 x 3/4 inch piece of brass shim stock, .001 inch thickness.

(2) Install bearing in center main bearing cap, bearing tang in groove in cap, lubricate bearing and bolts, position shim stock across the bearing, install cap, tighten bolts to 85 foot-pounds.

(3) If a slight drag is felt as crankshaft is turned (moved no more than 1/4 turn in either direction), clearance is .001 inch or less and is considered satisfactory.

If, however, no drag is felt, the bearing is too large or crankshaft cannot be rotated, bearing is too small and should be replaced with the correct size.

(4) Measure crankshaft end play .002 to .007 inch. If end play is less than .002 inch or more than .007 inch, install a new number 3 main bearing.

(5) Fit remaining bearings in same manner.

It is permissible to use one .001 inch undersize bearing shell with one standard bearing shell or one .002 inch undersize bearing shell with one .001 inch undersize shell. Always use the smaller diameter bearing half as the upper. Never use an upper bearing half more than .001 inch smaller than the lower

bearing half and never use a new bearing half with a used bearing half.

Plastic-Gage Method

NOTE: Check clearance one bearing at a time.

(1) Support weight of crankshaft with a jack or stand placed under counterweight adjacent to main bearing being checked.

NOTE: When serving No. 1 main bearing, support crankshaft at vibration damper. All other bearings must remain tightened.

(2) Remove main bearing cap and insert.

(3) Clean insert and exposed portion of crankshaft journal.

(4) Place strip of Plastic-Gage across full width of bearing insert (Fig. 44).

(5) Install bearing cap and tighten bolts to 85 foot-pounds torque.

(6) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastic-Gage with furnished scale (Fig. 45).

(7) New bearings should be installed if bearing clearance is not within specifications. Excessive taper indicates that a new or reground crankshaft is required.

REAR MAIN BEARING OIL SEALS

Service seals are of split rubber type composition. The seals make it possible to replace the upper rear seal without removing the crankshaft. **The seal must be used as a complete upper and lower set.**

(1) With the oil pan and oil pump removed, remove the rear main bearing cap.

(2) Remove lower rope oil seal by prying from the side with a small screw driver.

(3) Remove upper rope oil seal by screwing Tool C-4148 into the end of the seal, being careful not to damage the crankshaft (Fig. 49). Pull the seal out with the tool while rotating the crankshaft.

CAUTION: Always wipe crankshaft surface clean, then oil lightly before installing a new seal.

(4) (318 engines only) Insert cap seals into slots in bearing cap. Seal with yellow paint goes into right side with bearing cap in engine position. Install seals with narrow sealing edge up. Be certain that edge of cap seals line up exactly with shoulder in bearing cap, (Fig. 50). If this is not done oil leakage will occur. Install seal edge toward inside of shoulder. Pull outward on small end of seal until edge lines up with shoulder.

(5) Lightly oil lips of crankshaft seals.

(6) Rotate half seal into cylinder block with paint stripe toward rear. **Be careful** not to shave or cut outer surface of seal.

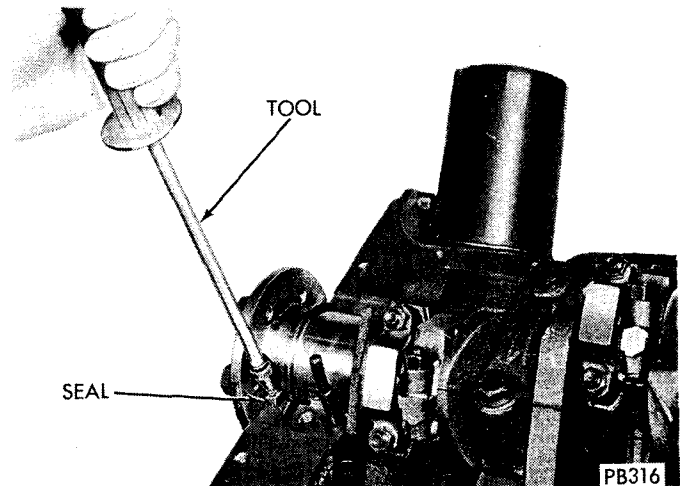


Fig. 49—Removing Upper Oil Seal with Tool C-4148

(7) Place the other half seal in bearing cap with paint stripe toward rear.

(8) (360 cu. in. engine only) Apply 4026070 or equivalent sealer adjacent to rubber seal (Fig. 51). Assemble bearing cap to block immediately after applying sealer. Torque to 85 foot pounds.

(9) (318 cu. in. engines) Assemble bearing cap to cylinder block. Torque to 85 foot pounds.

OIL PAN

Removal

(1) Remove oil dipstick, disconnect battery.

(2) Raise vehicle on hoist, drain oil pan.

(3) Remove oil pan attaching bolts and pan.

Installation—318-360

(1) Inspect alignment of oil strainer. Bottom of strainer must be parallel with the machined surface of the cylinder block. Bottom of strainer must touch bottom of oil pan with 1/16 to 1/8 inch interference desirable.

(2) Clean oil pan gasket surface and mating surface of block. Inspect pan rail for distortion and flatten if necessary.

(3) Using a new pan gasket set, add drop of sealer 4026070 or equivalent at corners of rubber and cork. **Be sure notches on side gaskets are installed as**

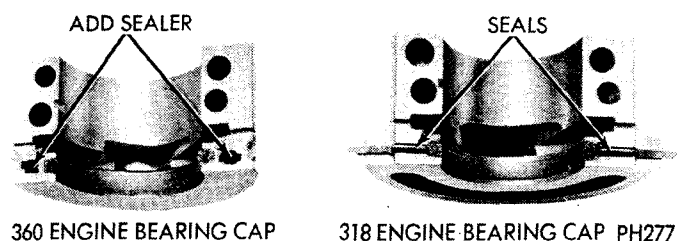


Fig. 50—Rear Main Bearing Cap

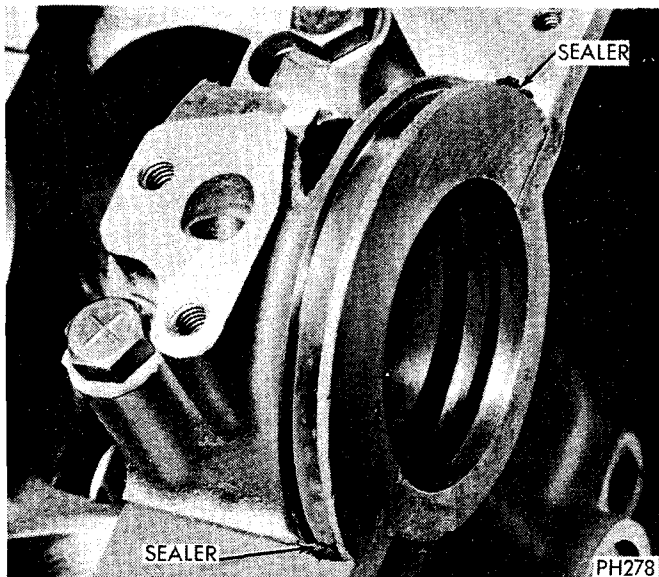


Fig. 51—Oil Pan End Seal at Rear Bearing

shown in Fig. 53 on 360 cubic inch engines.

(4) Install oil pan and torque screws to 200 inch pounds.

(5) Lower vehicle, install dipstick, fill with proper

grade and quantity of motor oil, connect battery ground cable.

OIL PUMP

It is necessary to remove the oil pan, and remove the oil pump from the rear main bearing cap to service the oil pump (Fig. 52.)

Disassembly

(1) To remove the relief valve, proceed as follows:

(a) Remove cotter pin, drill a 1/8 inch hole into the relief valve cap and insert a self-threading sheet metal screw into cap.

(b) Clamp screw into a vise and while supporting oil pump, remove cap by tapping pump body using a soft hammer. Discard cap and remove spring and relief valve (Fig. 54).

(2) Remove oil pump cover bolts and lockwashers, and lift off cover.

(3) Remove pump rotor and shaft, and lift out outer rotor.

(4) Wash all parts in a suitable solvent and inspect carefully for damage or wear (Fig. 55).

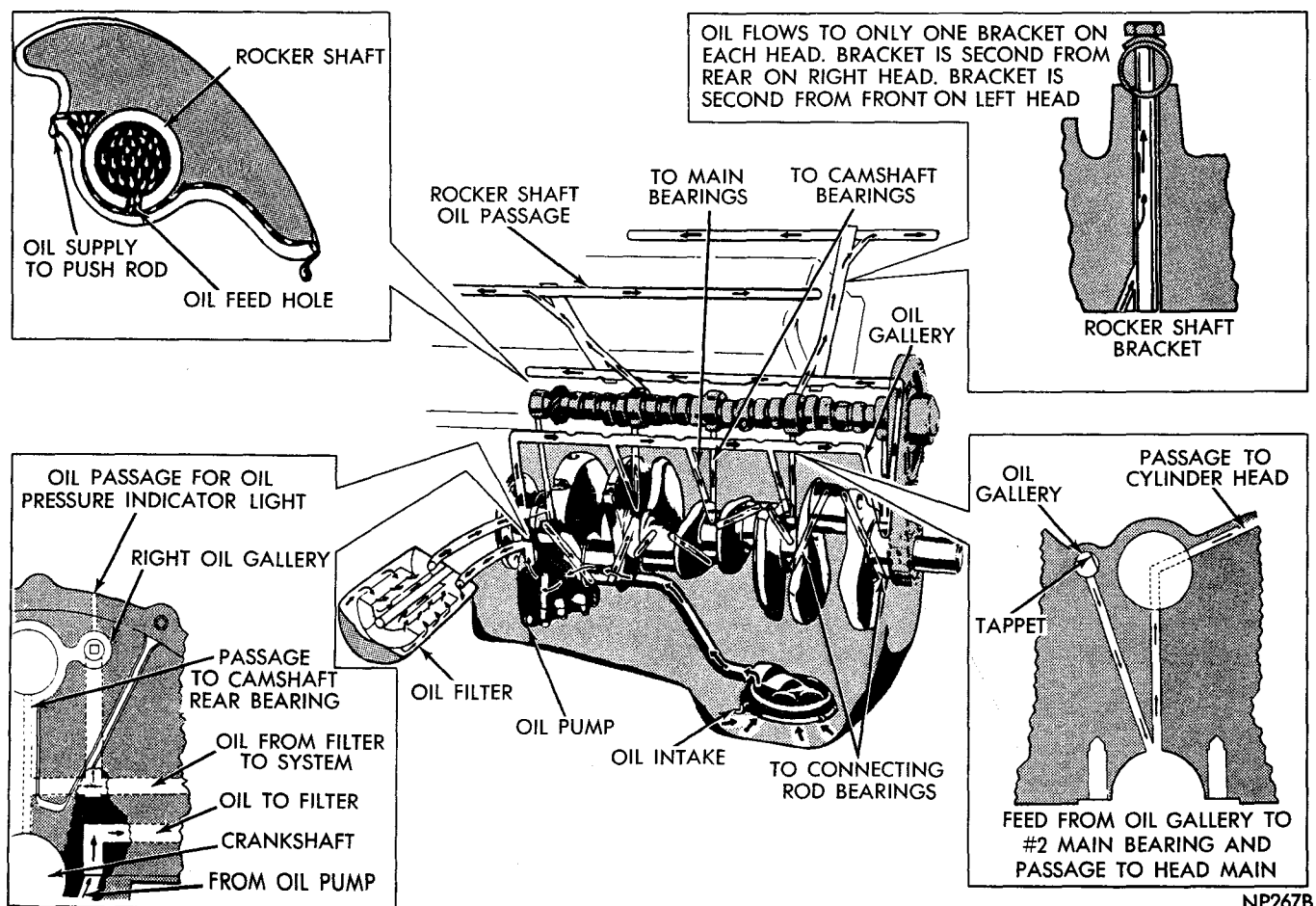


Fig. 52—Engine Oil System

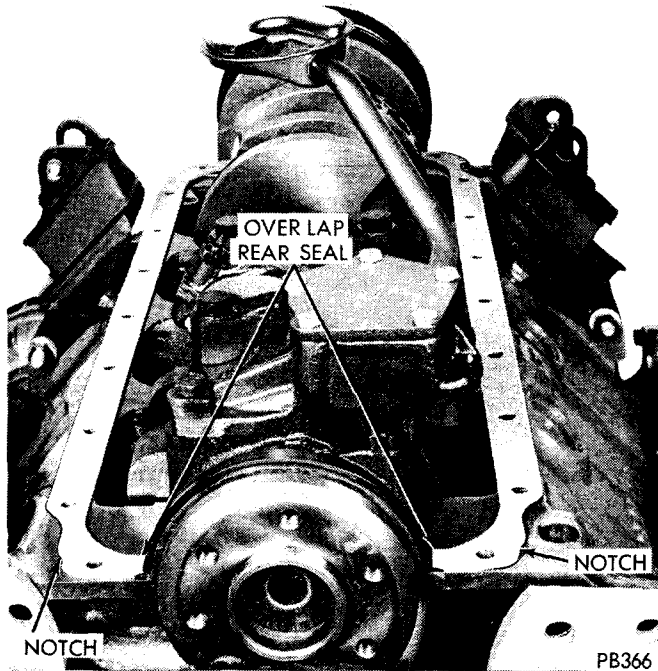


Fig. 53—Oil Pan Gaskets and Rear Seal Installation

Inspection and Repair

- (1) Clean all parts thoroughly. Mating surface of the oil pump cover should be smooth. Replace pump assembly if cover is scratched or grooved.
- (2) Lay a straight edge across the pump cover surface (Fig. 56). If a .0015 inch feeler gauge can be inserted between cover and straight edge, pump assembly should be replaced.
- (3) Measure thickness and diameter of outer rotor. If outer rotor thickness measures .825 inch or less on 318 engine, or .943 on 360 engine (Fig. 57) or the diameter is 2.469 inches or less, replace outer rotor.
- (4) If inner rotor measures .825 or less on 318 engine, or .943 on 360 engine, replace inner rotor and shaft assembly (Fig. 58).
- (5) Slide outer rotor into pump body, press to one

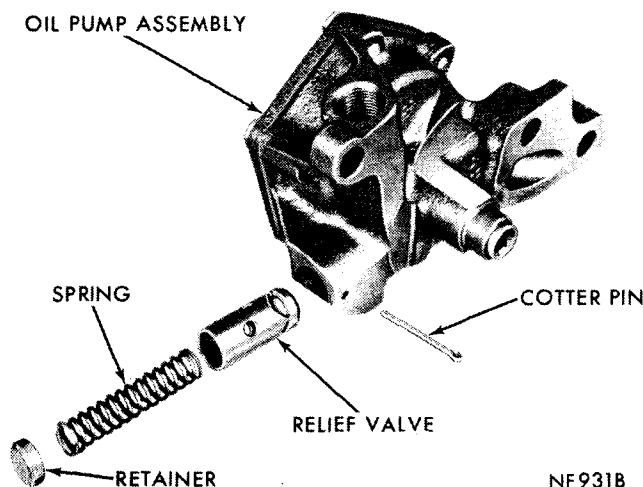


Fig. 54—Relief Valve, Spring and Retainer (Removed)

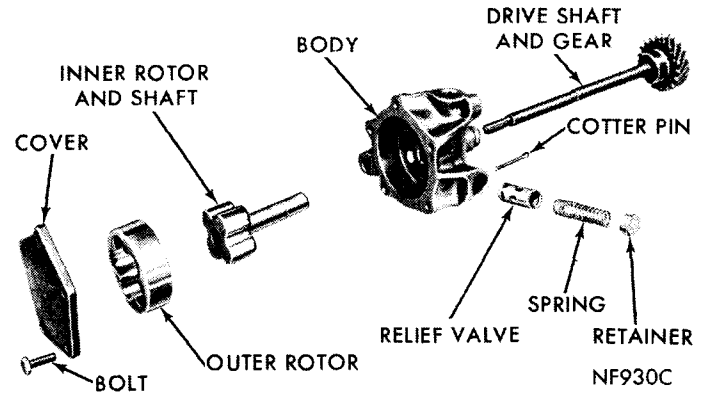


Fig. 55—Oil Pump Assembly (Disassembled View)

side with fingers and measure clearance between rotor and pump body (Fig. 59). If measurement is .014 inch or more, replace oil pump assembly.

(6) Install inner rotor and shaft into pump body. If clearance between inner and outer rotors (Fig. 60) is .010 inch or more, replace shaft and both rotors.

(7) Place a straight edge across the face of the pump, between bolt holes. If a feeler gauge of .004 inch or more can be inserted between rotors and the straight edge, replace pump assembly (Fig. 61).

(8) Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

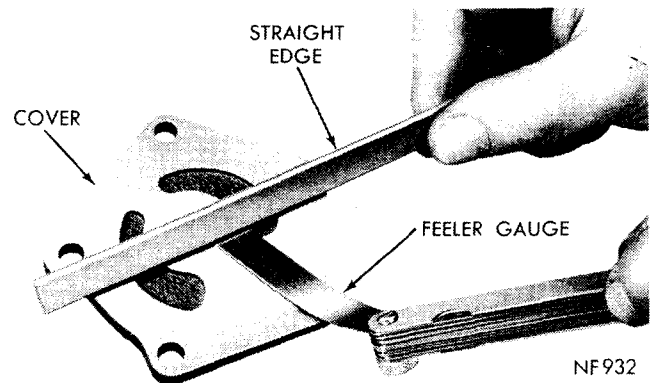


Fig. 56—Measuring Oil Pump Cover Flatness

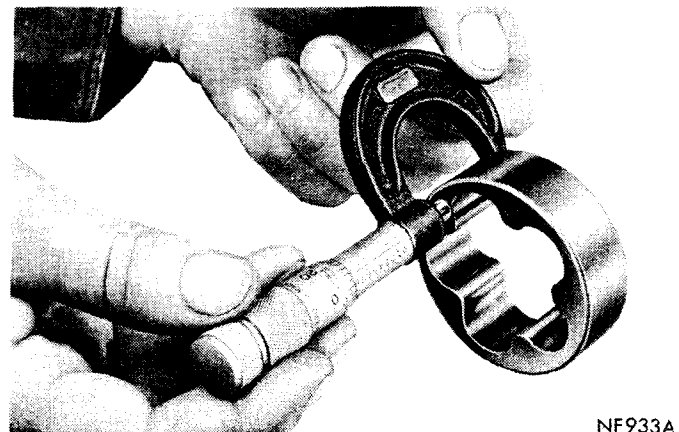
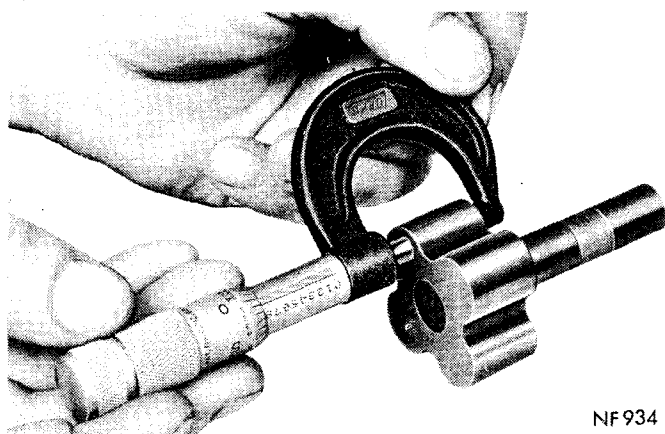


Fig. 57—Measuring Outer Rotor Thickness



NF934

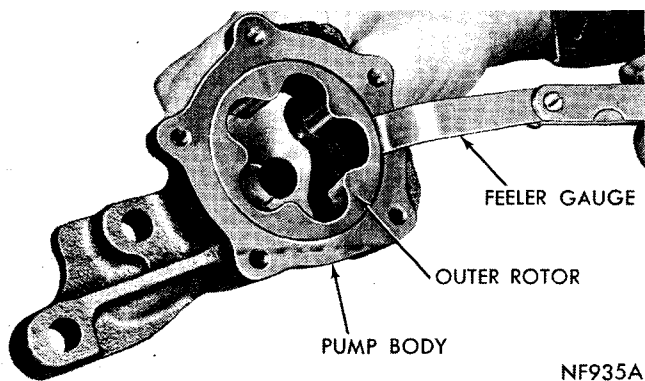
Fig. 58—Measuring Inner Rotor Thickness

(9) The relief valve spring has a free length of 2-1/32 to 2-3/64 inch and should test between 16.2 and 17.2 pounds when compressed to 1-11/32 inch. Replace spring that fails to meet specifications. (Fig. 62).

(10) If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

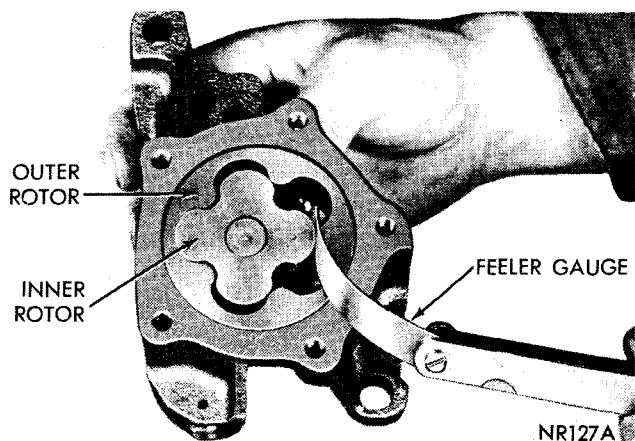
Oil Pump Assembly and Installation

- (1) Assemble pump, using new parts as required.
- (2) Tighten cover bolts to 95 inch-pounds.



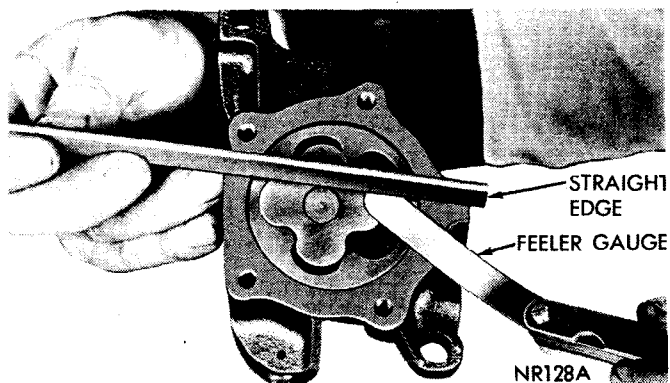
NF935A

Fig. 59—Measuring Outer Rotor Clearance



NR127A

Fig. 60—Measuring Clearance Between Rotors



NR128A

Fig. 61—Measuring Clearance Over Rotors

(3) Prime oil pump before installation by filling rotor cavity with engine oil.

(4) Install oil pump on engine. Tighten attaching bolts to 30 foot-pounds.

Servicing Oil Pressure Relief Valve

It is necessary to remove the oil pan, and remove oil pump from rear main bearing cap to service the pressure relief valve.

To remove the relief valve, proceed as follows:

(1) Remove cotter pin, drill a 1/8 inch hole in the relief valve cap and insert a self-threading sheet metal screw into cap.

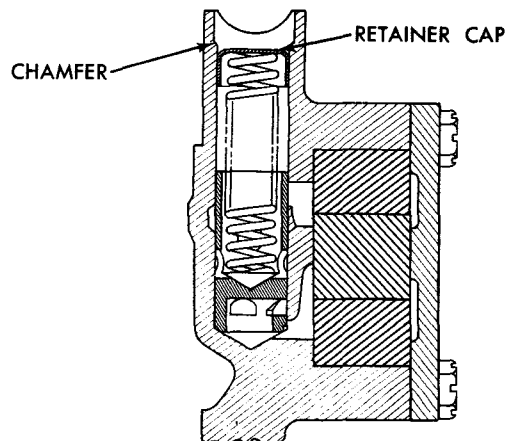
(2) Clamp screw into a vise and while supporting oil pump, remove cap by tapping pump body using a soft hammer. Discard cap.

(3) Remove spring and plunger.

(4) Clean parts thoroughly. Inspect oil pump relief valve for scoring and free operation in its bore. Small scores may be removed with 400 grit wet or dry paper providing extreme care is used not to round off the sharp edge portion of the valve.

(5) The relief valve spring has a free length of 2-1/32 to 2-3/64 inch and should test 16.2 to 17.2 lbs. when compressed to 1-11/32 inch. Discard springs that fails to meet specifications.

(6) Install the relief valve, spring a new retainer



NP565A

Fig. 62—Proper Retainer Cap Installation

cap. (Spring seats inside retainer cap). Press retainer in housing so that top of retainer cap is within the relief valve bore diameter as shown in Figure 61. Install cotter pin.

OIL FILTER

The oil filter should be replaced to coincide with every second oil change.

(1) Using Tool C-4065, unscrew filter from base and discard.

(2) Wipe base clean.

(3) Screw new filter on the base until gasket on filter contacts base.

(4) To obtain an effective seal, tighten filter by hand the additional number of turns **indicated on the replacement filter**. Start engine and inspect for leaks.

361-413 CUBIC INCH ENGINE

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SERVICE PROCEDURES

Checking Operation of Exhaust Valve Rotators

Before an engine is disassembled for valve grinding or major repair work, the performance of the exhaust valve positive rotators should be checked.

(1) With engine in vehicle, remove cylinder head covers.

(2) Observe exhaust valve rotation with engine running at 1000 and 3000 rpm. the valve should rotate at uniform and constant speeds. There is generally a large difference in rotation speeds between 1000 and 3000 rpm.

(3) Rotators which do not appear to function properly should be replaced.

ENGINE ASSEMBLY

Removal

(1) Drain cooling system.

It may be necessary to remove the oil filters from the engine.

On models 500-800 the grille and support assembly may be removed as an assembly. Refer to the body section for removal.

(2) Remove all coolant hoses and fuel lines.

(3) Disconnect all electrical connections.

(4) Disconnect tie rods at engine firewall.

(5) Remove bolts at radiator yoke.

(6) Remove radiator.

(7) Remove transmission short shaft.

(8) Remove transmission.

(9) Remove carburetor air cleaner and carburetor.

(10) Install engine lifting fixture on intake manifold.

(11) Attach hydro-crane lifting hook to engine lifting fixture eyebolt.

(12) Remove rear engine mounting bolts at both sides of flywheel housing. **On models 500 and 600 studs and nuts are used. On 800 models bolts are used.**

(13) Remove nuts from front engine mounting at front center of engine.

(14) Lift engine out of chassis with hydro-crane.

(15) Install engine on repair stand.

Installation

(1) Attach hydro-crane lifting hook to engine lifting fixture eyebolt and remove engine from repair stand.

(2) Lower engine into chassis until rear engine mountings line up with bolt holes in both sides of flywheel housing.

(3) Install engine rear mounting bolts.

On models 500 and 600, tighten nuts to 70 foot pounds and on 800 models 75 foot pounds.

(4) Install engine front mounting bolts.

- (5) Remove hydro-crane lifting hook and engine lifting fixture from engine.
- (6) Install carburetor and air cleaner.
- (7) Install transmission.
- (8) Install transmission short shaft.
- (9) Install radiator.
- (10) Connect radiator yoke hold down.
- (11) Connect tie rod brackets at engine firewall and adjust as necessary.
- (12) Connect all electrical connections.
- (13) Install coolant hoses and fuel lines and oil filters (if removed).
- (14) Fill cooling system and test for leaks.

ROCKER ARM AND SHAFT ASSEMBLY

The rocker arms are of stamped steel and are arranged on one rocker arm shaft, per cylinder head. The push rod angularity tends to force the pairs of rocker arms toward each other where oilite spacers carry the side thrust at the rocker arms. The rocker shaft is held in place by bolts and stamped steel retainers attached to the five brackets on the cylinder head.

Removal

- (1) Remove cylinder head cover and gasket.
- (2) Remove bolts that attach rocker arm assemblies to cylinder head.
- (3) Remove rocker arms and shaft as an assembly.
- (4) If rocker arm assemblies have been disassembled for cleaning, inspection, or replacement, refer to (Fig. 1) for proper reassembly.

Installation

Install rocker shafts so that the 3/16 inch dia. rocker arm lubrication holes point downward into the rocker arm and so that the 15 degree angle of these holes (Fig. 2) point toward valve end of rocker arms.

The 15 degree angle of the rocker arm lubrication holes is determined from the center line of the bolt holes through the shaft which are used to attach the shaft assembly to the cylinder head.

- (1) Install rocker arms and shaft assembly making sure to install the long stamped steel retainers in the number two and four positions.
- (2) Tighten bolts to 25 foot-pounds.
- (3) Clean cylinder head cover gasket surface. Inspect cover for distortion and straighten if necessary.
- (4) Clean head rail if necessary. Install cylinder head cover and tighten to 40 inch-pounds.

CYLINDER HEADS

The chrome alloy cast iron cylinder heads (Fig. 3) are held in place by 17 head bolts on each cylinder head. The spark plugs enter cylinder head vertically

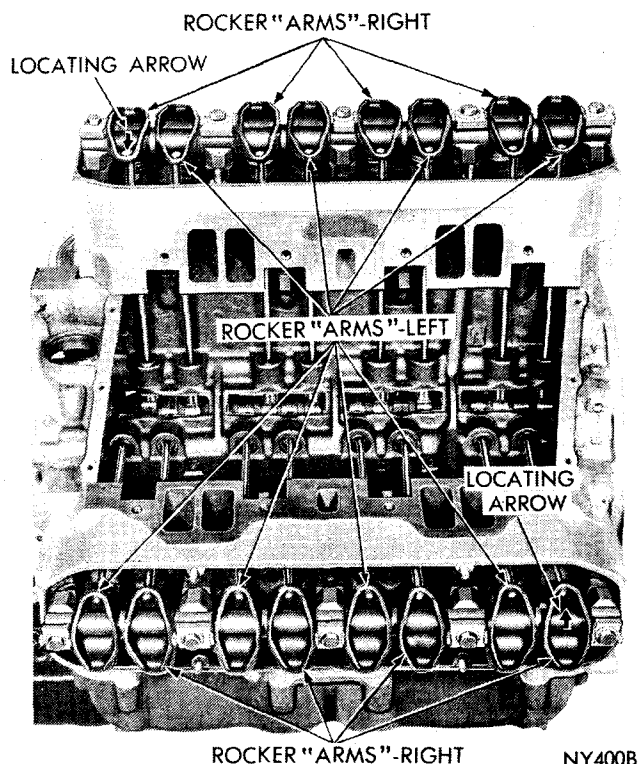


Fig. 1—Rocker Arms Installed (Typical)

and are located at outer edge of combustion chambers.

Removal

- (1) Drain cooling system and remove battery.
- (2) Remove alternator.
- (3) Remove air compressor (if so equipped).
- (4) Remove carburetor air cleaner.
- (5) Remove coolant hoses and fuel lines.
- (6) Disconnect accelerator linkage and wiring.
- (7) Remove vacuum control tube from carburetor and distributor.
- (8) Remove distributor cap and cables as an assembly.
- (9) Disconnect primary wire and remove distributor.
- (10) Remove governor assembly.
- (11) Remove crankcase ventilation system.
- (12) Remove spark plugs.
- (13) Remove intake manifold and carburetor as an assembly.
- (14) Remove tappet chamber cover.
- (15) Remove bolts that secure water pump housing to each cylinder head.
- (16) Remove exhaust manifolds.

Tag center bolts for replacement in the same hole. Inspect all bolts for burned out or failed Ny-Lock Plugs. Replace damaged bolts. Ny-Lock bolts are used to prevent coolant seepage.

- (17) Remove rocker arms and shaft assemblies.

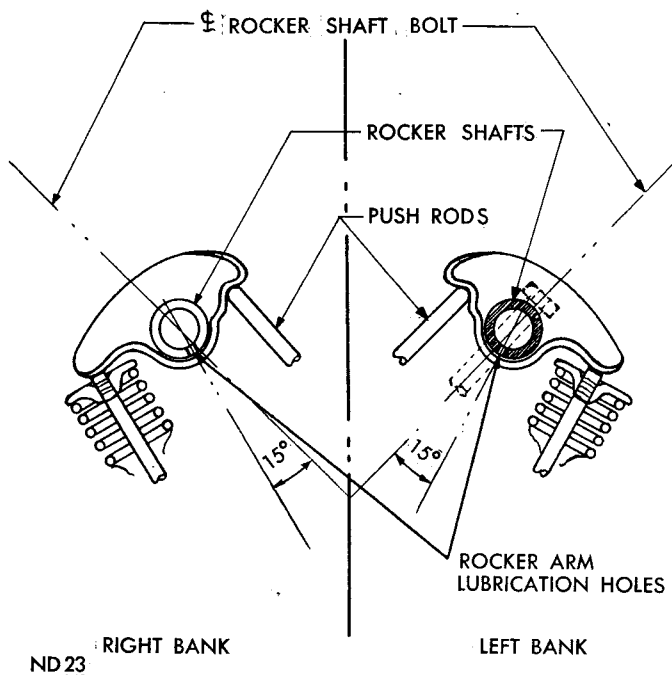


Fig. 2—Rocker Arm Lubrication Holes

(18) Remove push rods and identify to insure installation in original location.

(19) Remove cylinder heads from engine.

(20) Place cylinder heads in holding fixture, Tool C-3626.

Installation

(1) Clean gasket surfaces of cylinder block, cylinder head and remove all burrs.

(2) Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out of flatness exceeds .00075 times the span length in any direction; either replace head or lightly machine the head gas-

ket surface. As an example, if a 12 inch span is .004 inches out of flat, allowable is $12 \times .00075 = .009$ inches. Head is OK.

The cylinder head surface finish should be 70-180 micro-inches.

(3) Coat new gaskets with number 1057794 Sealer and install on cylinder block.

(4) Remove cylinder heads from holding fixtures, Tool C-3626 and place heads on cylinder block.

(5) Install cylinder head bolts. Starting at top center, tighten all cylinder head bolts to 50 foot-pounds in sequence, as shown in (Fig. 4).

(6) Repeat the procedure, retightening all cylinder head bolts to 70 foot-pounds. **Do not retighten cylinder head bolts after engine has been operated when embossed steel head gaskets are used.**

(7) Inspect for worn or bent push rods and replace if necessary.

(8) Place aligning rod on cylinder head (Fig. 5). Install push rods in hydraulic tappets.

(9) Install rocker arm and shaft assembly starting each push rod into its respective rocker arm socket making sure to install the long stamped steel retainers in the number two and four positions. Tighten bolts to 25 foot-pounds.

(10) Install cylinder head cover gaskets and covers and tighten to 40 inch-pounds.

(11) Install new exhaust manifold gaskets and exhaust manifolds and tighten bolts to 30 foot-pounds. Be sure center bolt is inserted in same place.

(12) Adjust spark plugs to .035 inch gap.

(13) Install spark plugs and tighten to 30 foot-pounds.

(14) Be sure tappet chamber cover gasket is positioned so the 1/8 inch bleed hole at the crossover is on the right side of the engine. Tighten bolts to 9 foot-pounds.

(15) Install intake manifold and carburetor as an assembly and tighten bolts to 40 foot-pounds.

(16) Install bolts that secure water pump housing to each cylinder head.

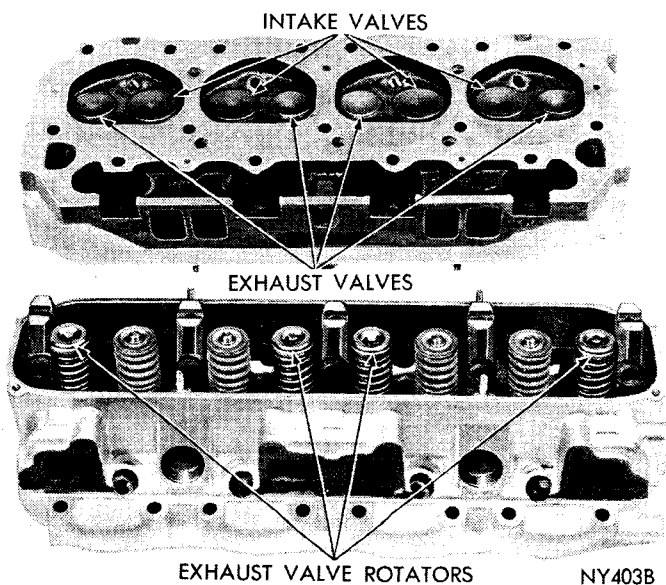


Fig. 3—Cylinder Head Assemblies

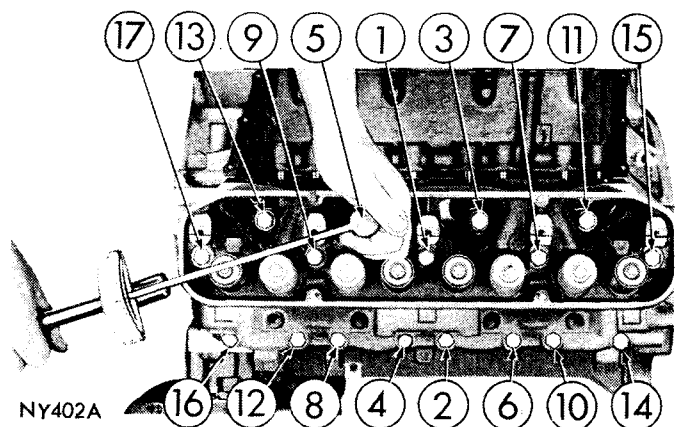


Fig. 4—Cylinder Head Tightening Sequence

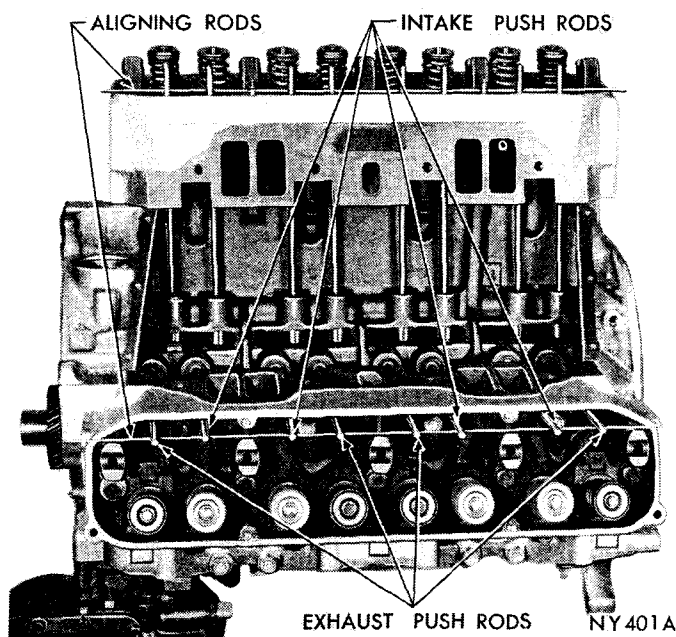


Fig. 5—Push Rods Installed

- (17) Install governor assembly and distributor.
- (18) Install distributor cap and cables.
- (19) Connect accelerator linkage and electrical wiring.
- (20) Install vacuum tube from carburetor to distributor.
- (21) Install coolant hoses and fuel lines and carburetor air cleaner.
- (22) Install crankcase ventilation system.
- (23) Install alternator and tighten alternator bracket bolts to 50 foot-pounds and alternator pivot nut to 30 foot-pounds.
- (24) Install air compressor (if so equipped).
- (25) Adjust belt tensions.
- (26) Fill cooling system and install battery.
- (27) Bleed air from water pump housing by opening drain cock.

VALVES AND VALVE SPRINGS

Valves are arranged in line in cylinder heads and inclined 30 degrees outward from vertical. Intake and exhaust valves operate in replaceable guides. Intake valves are solid stem. Exhaust valves are sodium-filled and are equipped with positive rotators.

Removal

- (1) With cylinder head removed, compress valve springs using Tool C-3422A.
- (2) Remove valve retaining locks, valve spring retainer.
- (3) Remove intake valve stem cup seals and valve springs.
- (4) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to

the valve guide. Identify valves to insure installation in original location.

Valve Inspection

- (1) Clean valves thoroughly, and discard burned, warped and cracked valves.
- (2) Measure valve stems for wear. Intake valve stem diameter should measure .372 to .373 inch and exhaust valve stem diameter should measure .433 to .434 inch. If wear exceeds .002 inch, replace valve.
- (3) Remove carbon and varnish deposits from inside of valve guides, with a reliable guide cleaner.
- (4) Measure valve stem guide clearance as follows: Install sleeve Tool C-3973 on intake and Tool C-3726 on exhaust, over valve stem, (Fig. 6) and install valve. The special sleeve places valve at correct height for checking with a dial indicator.
- (5) Attach dial indicator Tool C-3339 to cylinder head and set it at right angle of the valve stem being measured (Fig. 7).
- (6) Move valve to and from indicator. The total dial indicator reading should not exceed .016 inch on intake valves and .018 inch on exhaust valves.
- (7) Replace guides if dial indicator reading is excessive or if stems are scuffed or scored. Use Tool C-3159 for Intake Valve Guide, for Exhaust Valve Guide use DD-915.

Refacing Valves and Valve Seats

- (1) The intake and exhaust valve faces have a 45 degree angle. Always inspect the remaining margin after the valves are refaced (Fig. 8). Valves with less than 1/32 inch margin should be discarded.
- (2) The angle of both valve and seat should be identical. When refacing valve seats, it is important the correct size valve guide pilot be used for re-seating stones. A true and complete surface must be obtained.
- (3) Measure the concentricity of the valve seat using valve seat dial indicator No. 13725. The total

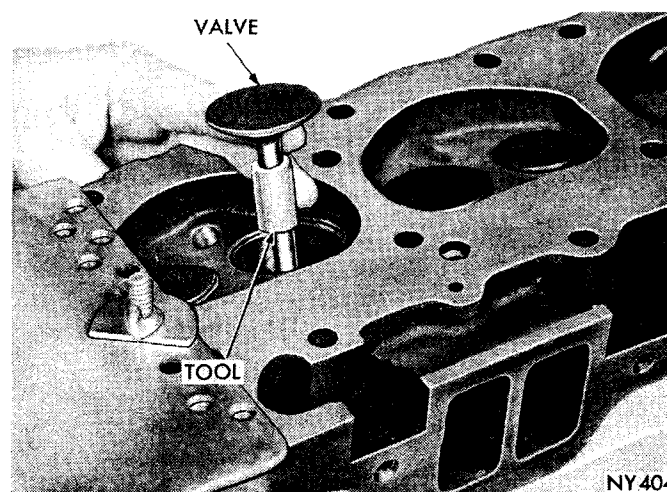


Fig. 6—Installing Valve and Tool

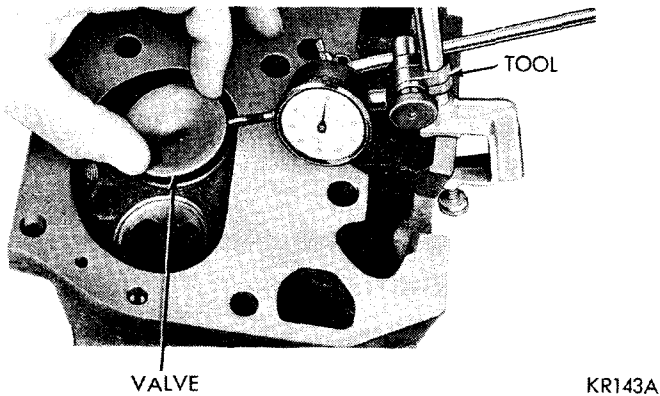


Fig. 7—Measuring Valve Guide Wear

runout should not exceed .002 inch (total indicator reading).

(4) Check valve seat with Prussian blue to determine where valve contacts the seat. To do this, coat valve seat lightly with Prussian blue then set valve in place. Rotate valve with light pressure. If the blue is transferred to center of valve face, the contact is satisfactory. If the blue is transferred to top edge of valve face, lower valve seat with a 30 degree stone. If the blue is transferred to bottom edge of valve face raise valve seat with a 60 degree stone.

(5) When seat is properly positioned the width of intake seats should be $1/16$ to $3/32$ inch. The width of exhaust seats should be $3/32$ to $7/64$ inches.

(6) When valves and seats are reground, the position of valve in cylinder head is changed, shortening the operating length of hydraulic tappet. This means the plunger is operating closer to its bottomed position, and less clearance is available for thermal expansion of valve mechanism during high speed driving. The design of valve mechanism includes a safety factor to allow for a limited amount of wear, and refacing of valves and seals.

(7) To insure that limits have not been exceeded, the dimension from valve spring seat in head to valve

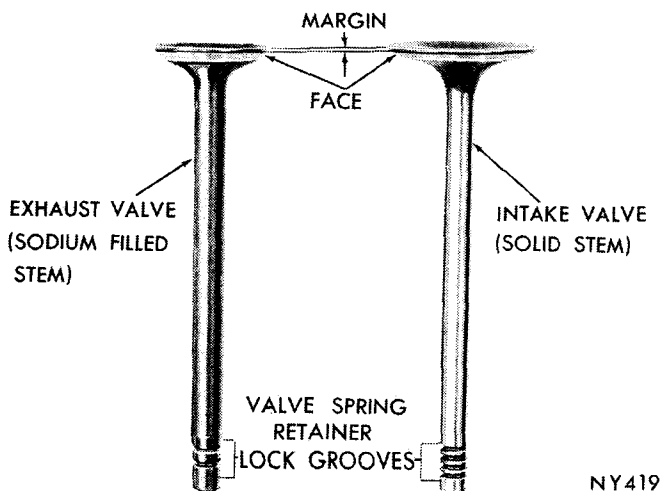


Fig. 8—Intake and Exhaust Valves

tip should be measured with Gauge, Tool C-3648, (Fig. 9).

(8) The end of the cylindrical gauge and the bottom of slotted area represent the maximum and minimum allowable extension of valve stem tip beyond the spring seat. If tip exceeds maximum, grind stem tip to within gauge limits. Clean tappets if tip grinding is required.

Testing Valve Springs (Fig. 10)

(1) Whenever valves are removed for inspection, reconditioning or replacement, the valve springs should be tested. As an example, the compressed length of the spring to be tested is $1-15/32$ inches. Turn the table of Tool C-647 until the surface is in line with the $1-15/32$ inch mark on the threaded stud and the zero mark to the front. Place the spring over the stud on the table and lift the compressing lever to set the tone device. Pull on the torque wrench until a ping is heard. Take the reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at the test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tension. Discard the springs that do not meet specifications.

(2) Inspect each valve spring for squareness at both ends with a steel square and surface plate (Fig. 11).

(3) If the spring is more than $1/16$ inch out of square, install a new spring.

Installation (Fig. 12)

- (1) Coat valve stems with lubricating oil.
- (2) Insert them in position in cylinder head.
- (3) Install new cup seals on intake valve stem and over valve guides, (Fig. 13).
- (4) Install valve spring and retainers (Figs. 13 and 14).

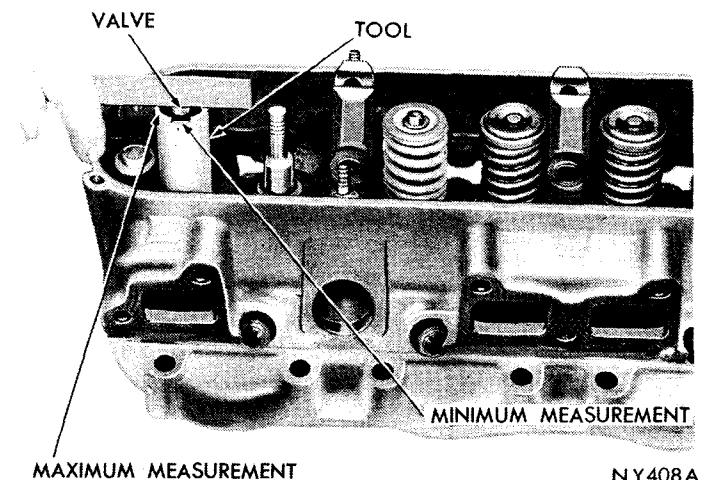
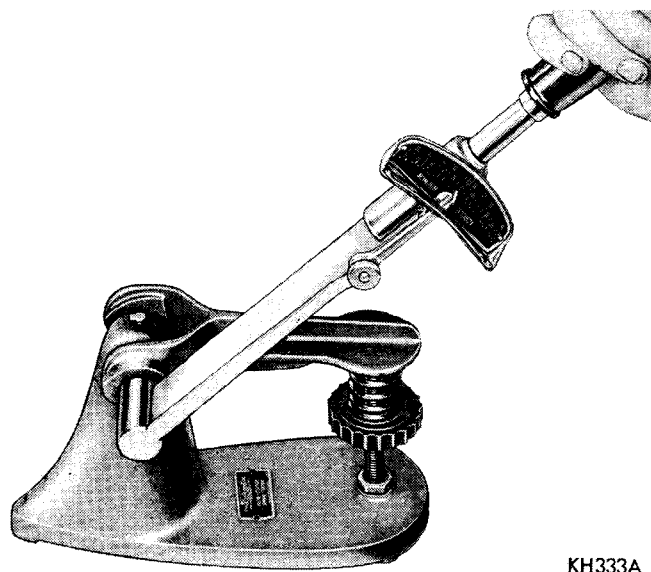


Fig. 9—Measuring Valve Stem Length



KH333A

Fig. 10—Testing Valve Springs

(5) Compress valve springs with Tool C-3422A. Install locks and release tool.

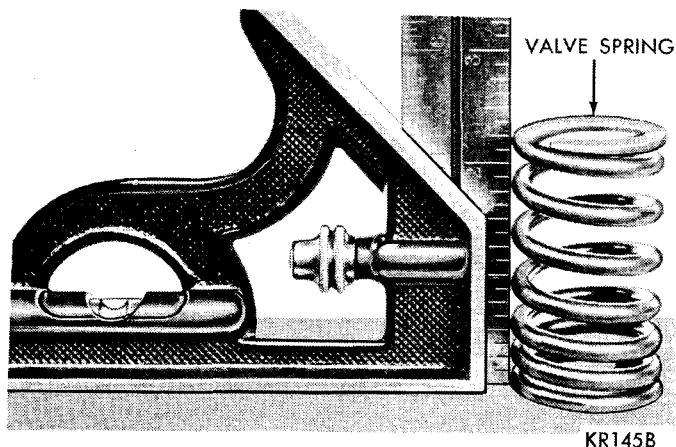
If the valves and/or seats are reground, measure the installed height of springs. Make sure measurement is taken from the bottom of the spring seat in cylinder head to the bottom surface of spring retainer. (If spacers are installed, measure from the top of spacer). If height is greater than 1-57/64 inches for intake valve springs or 1-49/64 inches for exhaust valve springs, install a 1/16 inch spacer in head counterbore to bring spring height back to normal 1-53/64 to 1-57/64 inch for intake or 1-45/64 to 1-49/64 inches for exhaust.

Replacing Valve Stem Shields or Valve Springs, Cylinder Head Not Removed

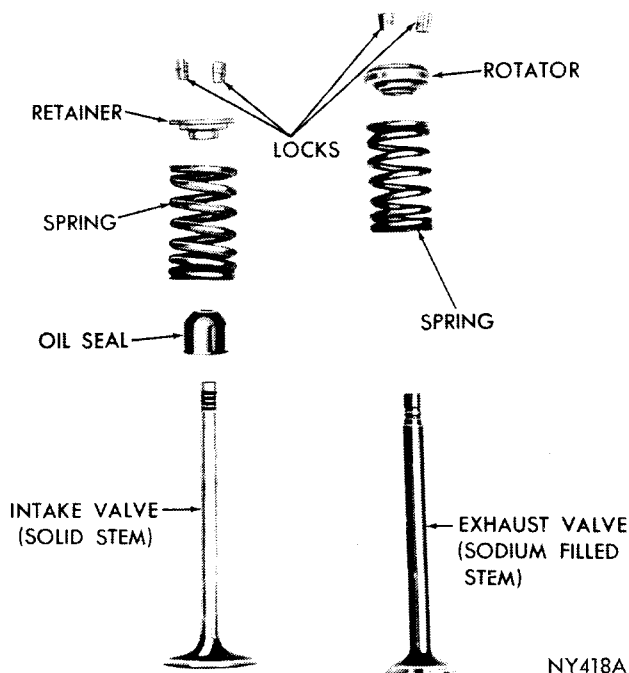
(1) Set engine basic timing to TDC and remove Air Cleaner.

(2) Remove cylinder head covers and spark plugs.

(3) Remove coil wire from distributor and secure



KR145B

Fig. 11—Inspecting Valve Spring Squareness

NY418A

Fig. 12—Valve Assembly (Disassembled View)

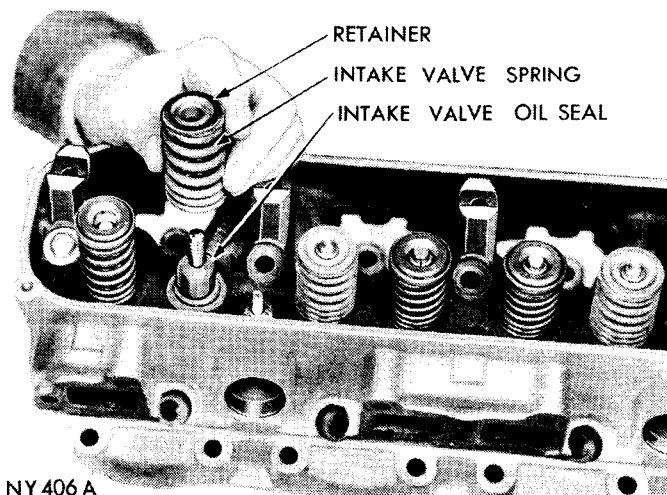
to good ground to prevent engine from starting.

(4) Using suitable socket and flex handle at crankshaft pulley retaining screw, turn engine so the number 1 piston is at Top Dead Center on the compression stroke.

(5) Remove rocker arms with rocker shaft and install a dummy shaft. (The rocker arms should not be disturbed and left on shaft).

(6) With air hose attached to adapter tool C-3907 installed in number 1 spark plug hole, apply 90 to 100 psi air pressure.

(7) Using Tool C-3906 or C-4228 compress valve spring and remove retainer valve locks and valve spring.



NY 406 A

Fig. 13—Installing Intake Valve, Cup Seal, Valve Spring and Retainer

(8) Install cup shields on the exhaust valve stem and position down against valve guides.

(9) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. **Do Not Force** seal against top of guide. When installing the valve retainer locks, compress the spring **only enough** to install the locks.

(10) Follow the same procedure on the remaining 7 cylinders using the firing order sequence 1-8-4-3-6-5-7-2. **Make sure piston in cylinder is at TDC on the valve spring that is being removed.**

(11) Remove adaptor Tool 3907.

(12) Remove dummy shaft and install rocker shaft with rocker arms.

(13) Install covers and coil wire to distributor.

(14) Install air cleaner.

(15) Road test vehicle.

HYDRAULIC TAPPETS

Preliminary to Checking Hydraulic Tappets

Before disassembling any part of engine to correct tappet noise, read the oil pressure at gauge and check the oil level in the oil pan. The pressure should be between 30 and 80 pounds at 2000 RPM. The oil level in the pan should never be above "Full" mark on dip stick, or below "add oil" mark. Either of these two conditions could be responsible for noisy tappets.

Oil Level Too High

If oil level is above "full" mark on dipstick, it is possible for the connecting rods to dip into oil while the engine is running and create foam. Foam in the oil pan would be fed to the hydraulic tappets by the oil pump causing them to go flat and allow the valves to seat noisily.

Oil Level Too Low

Low oil level may allow the oil pump to take in air which, when fed to tappets, causes them to lose

length and allow the valves to seat noisily. Any leaks on intake side of the pump through which air can be drawn will create the same tappet action. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than one tappet will be noisy. When oil level and leaks have been corrected, the engine should be operated at fast idle for sufficient time to allow all of air inside of tappets to be bled out.

Tappet Noises

To determine the source of tappet noise, operate the engine at idle with the cylinder head covers removed. Feel each valve spring or rocker arm to detect the noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on valve spring. Inspect rocker arm push rod sockets and push rod ends for wear. If noise is not appreciably reduced, it can be assumed the noise is in the tappet.

Valve tappet noise ranges from a light noise to a heavy click. A light noise is usually caused by excessive leakdown around the unit plunger which will necessitate replacing tappet, or by the plunger partially sticking in the tappet body cylinder. A heavy click is caused either by a tappet check valve not seating, or by foreign particles becoming wedged between the plunger and tappet body, causing plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between valve stem and rocker arm as valve closes. In either case, the tappet assembly should be removed for inspection and cleaning.

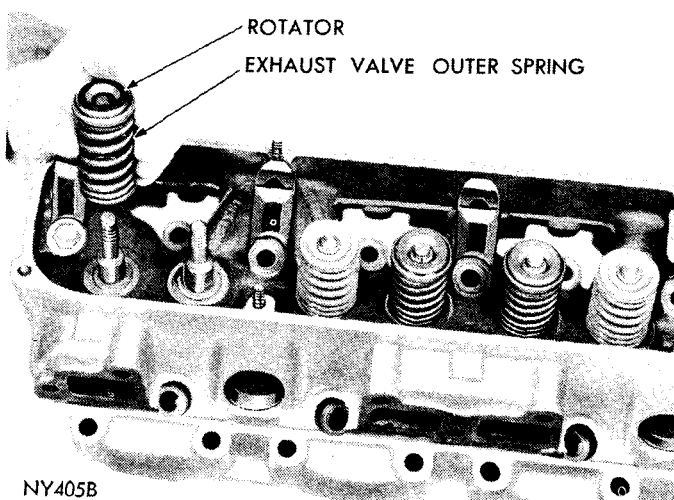
Removal of Tappets

Tappets can be removed without removing the cylinder head or intake manifold.

- (1) Remove cylinder head covers.
- (2) Remove rocker arms and shaft assembly.
- (3) Remove push rods and **identify to insure installation in original position.**
- (4) Slide puller Tool C-4129 through push rod opening in cylinder head and seat tool firmly in head of tappet.
- (5) Pull tappet out of bore with a twisting motion, (Fig. 15). If all tappets are to be removed, **identify tappets to insure installation in original location.**

A diamond shaped marking stamped on the engine numbering pad indicates that some tappet bodies are .008 inch oversize.

CAUTION: Do not disassemble a tappet on a dirty work bench. The plunger and tappet bodies are not



NY405B
Fig. 14—Installing Exhaust Valve, Inner Spring, Outer Spring and Rotator

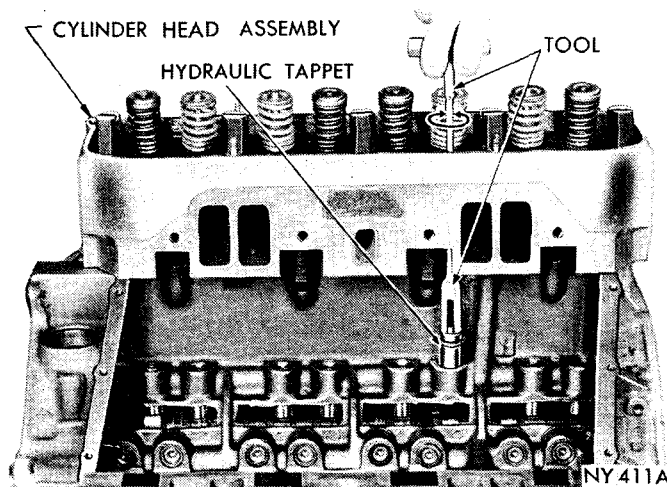


Fig. 15—Removing Hydraulic Tappet

interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tappet at a time to avoid mixing of parts.

Disassembly (Fig. 16)

- (1) Pry out plunger retainer spring clip.
- (2) Clean varnish deposits from inside of tappet body above plunger cap.
- (3) Invert tappet body and remove plunger cap, plunger, ball or flat check valve, check valve spring, check valve retainer and plunger spring.

Cleaning and Inspection

- (1) Clean all tappet parts in a solvent that will remove all varnish and carbon.
- (2) Replace tappets that are unfit for further service with new assemblies.
- (3) Assemble tappets, (Fig. 16).

Inspection

- (1) If tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream bore to next oversize.
- (2) If plunger shows signs of scoring or wear and valve is pitted, or if valve seat on end of plunger indicates any condition that would prevent valve from seating, install a new tappet assembly.

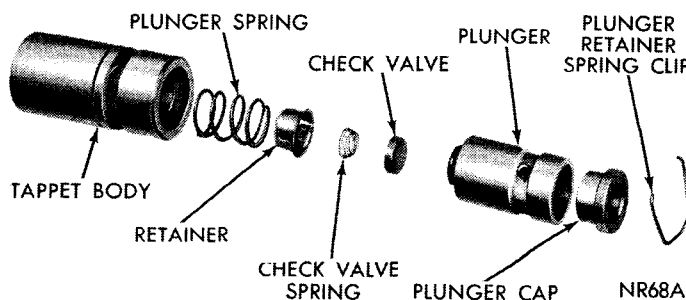


Fig. 16—Hydraulic Tappet (Disassembled View)

Testing

- (1) Fill a pan with clean kerosene.
 - (2) Remove cap from plunger and completely submerge tappet in an upright position.
 - (3) Allow tappet to fill with kerosene, and replace the cap.
 - (4) Hold tappet in an upright position and insert lower jaw of pliers, Tool C-3160, in groove of tappet body (Fig. 17).
 - (5) Engage jaw of pliers with top of tappet plunger.
 - (6) Check leakdown by compressing pliers. If plunger collapses almost instantly as pressure is applied, disassemble tappet, clean and test again.
- If tappet still does not operate satisfactorily after cleaning, install a new tappet assembly.

Installation

- (1) Lubricate tappets.
- (2) Install tappets and push rods in their original positions.
- (3) Install rocker arms and shaft assembly.
- (4) Start engine. Warm up to normal operating temperature.

To prevent damage to valve mechanism, the engine must not be run above fast idle until all of hydraulic tappets have filled with oil and have become quiet.

VALVE TIMING

- (1) Check accuracy of the TDC mark on the indicator plate by bringing the number one piston to TDC by means of an indicator placed in the spark plug openings.
- (2) Rotate crankshaft clockwise (normal running direction) until NO. 1 intake is fully open. Install a dial indicator on NO. 1 exhaust valve so that the indicator pointer contacts the spring retainer as near to 90 degree angle as possible.
- (3) Insert a 1/4" spacer between rocker arm and stem of NO. 1 exhaust valve. Allow spring load to bleed tappet down giving, in effect, a solid tappet.

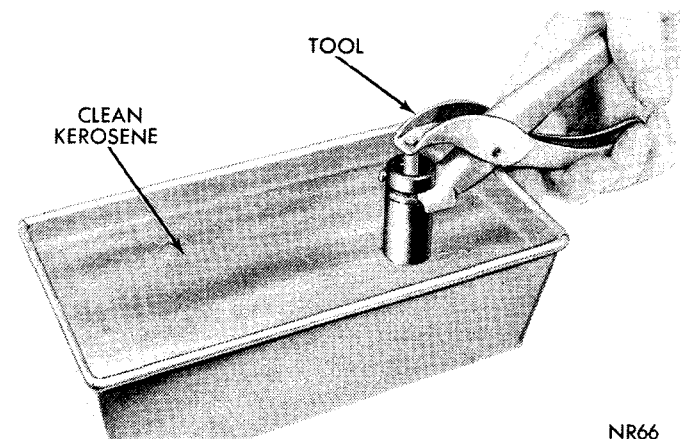


Fig. 17—Testing Hydraulic Tappet

(4) Reset dial indicator to zero. Rotate crankshaft counter-clockwise (opposite to normal running direction) until exhaust valve has lifted the amount shown in the following chart.

361-4, 413-3048 inch

(5) The timing marks should now read from 12 degrees before TDC to TDC. If reading is over the specified limits, check timing gear marks and timing chain wear.

(6) After timing has been checked, turn crankshaft clockwise (normal running direction) until tappet is back down to valve closed position. Remove spacer from between rocker arm and valve stem.

TIMING CHAIN COVER, OIL SEAL AND CHAIN

Cover Removal

- (1) Drain cooling system.
- (2) Remove radiator.
- (3) Remove water pump and housing assembly.
- (4) Remove bolt holding vibration damper on crankshaft.
- (5) Remove two of the pulley bolts, install Tool C-3688, and pull damper assembly off end of crankshaft. **Remove air cleaner, jack up engine.**
- (6) Remove front engine mount.
- (7) Remove the two front pan bolts.
- (8) Remove chain case cover and gasket using extreme caution to avoid damaging oil pan gasket.

Measuring Timing Chain for Stretch

- (1) Place a scale next to the timing chain so any movement of the chain may be measured.
- (2) Place a torque wrench and socket over camshaft sprocket attaching bolt and apply torque in the direction of crankshaft rotation to take up slack; 30 foot-pounds (with cylinder heads installed) or 15 foot-pounds (cylinder heads removed).

With torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block crankshaft to prevent rotation.

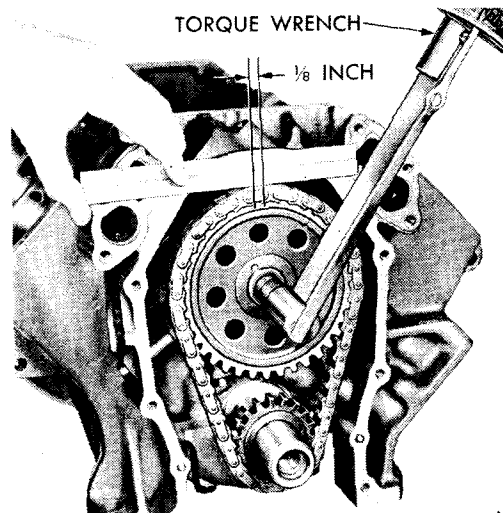
(3) Holding a scale with dimensional reading even with edge of a chain link, apply torque in the reverse direction 30 foot-pounds (with cylinder heads installed) or 15 foot-pounds (cylinder heads removed), and note amount of chain movement (Fig. 18).

(4) Install a new timing chain, if its movement exceeds $3/16$ inch.

(5) If chain is satisfactory, slide crankshaft oil slinger over shaft and up against sprocket (flange away from sprocket).

(6) If chain is not satisfactory, remove camshaft sprocket attaching bolts and remove timing chain with crankshaft and camshaft sprockets.

When installing timing chain, use Tool C-3509 to prevent camshaft from contacting the welch plug in the rear of engine block. Remove distributor and oil pump-distributor drive gear. Locate tool against rear



KR151B

Fig. 18—Measuring Timing Chain Stretch (Typical)
side of cam gear and attach tool with distributor retainer plate bolt (Fig. 19).

(7) Place camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft sprocket bores.

(8) Place timing chain around both sprockets.

(9) Turn crankshaft and camshaft to line up with keyway location on crankshaft sprocket and dowel holes in camshaft sprocket.

(10) Lift sprockets and chain (keep sprockets tight against chain in position as described).

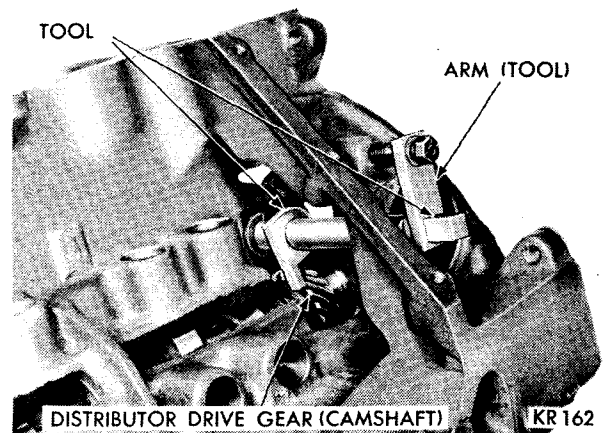
(11) Slide both sprockets evenly over their respective shafts.

(12) Use a straight edge to measure alignment of timing marks (Fig. 20).

(13) Install camshaft sprocket bolts and tighten to 40 foot-pounds.

Oil Seal Removal (Cover Removed)

(1) Using a drift and hammer tap lightly at several places around the seal case to deform the oil seal case inward.



KR 162

Fig. 19—Camshaft Holding Tool C-3509

(2) Engage the seal case with vise grips. Twist and pull on the vise grips at several places around the seal case for removal.

(3) Insert installing screw through the installing plate, part of Tool C-3506.

(4) Insert installing screw with the plate through seal opening (inside of chain case cover facing up).

(5) Place seal in cover opening, with seal lips down. Place seal installing plate into the new seal, with protective recess toward lip of seal retainer Tool SP-5598, part of Tool C-3506.

(6) Install flat washer and nut on installer screw, hold screw and tighten nut.

(7) The seal is properly installed when the seal case is tight against face of cover. Try to insert a .0015 inch feeler gauge between the case and the cover. If the seal is installed properly, feeler gauge cannot be inserted. Seal must be fully bottomed in cover (Fig. 21).

Cover Installation

(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.

(2) Using a new gasket slide chain case cover over locating dowels. Install and tighten upper four 5/16 inch bolts to 200 inch-pounds.

(3) Install front engine mount using lower four holes. Be sure to use Special Hardened Bolts with Bellville Washers. Tighten to 40 foot-pounds.

(4) Lubricate seal lip with lubriplate, place damper hub slot on key in crankshaft, and slide vibration damper on crankshaft.

(5) Place installing tool part of Tool C-3688 in position and press damper on the crankshaft.

(6) Install damper retainer washer and bolt. Tighten to 135 foot-pounds.

(7) Install the two pulley retainer lockwashers and bolts. Tighten to 200 inch-pounds.

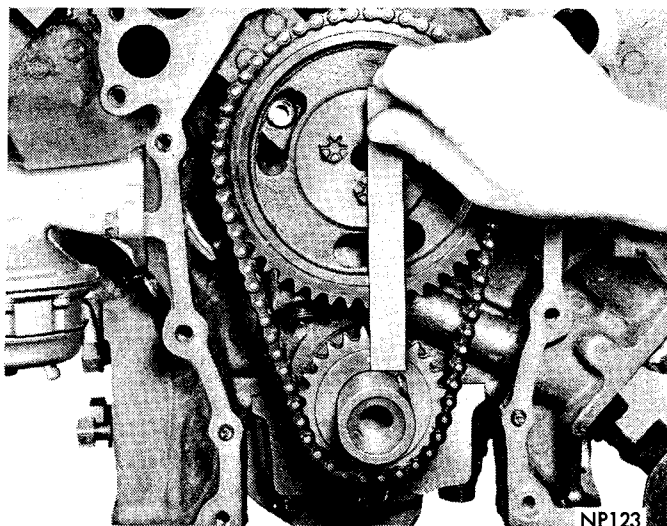


Fig. 20—Alignment of Timing Marks

(8) Use new gaskets, install water pump and housing assembly. Tighten to 30 foot-pounds. Adjust belt tension.

(9) Install radiator, fill cooling system and inspect for leaks. Correct as necessary. Install air cleaner.

CAMSHAFT

The camshaft has an integral oil pump and distributor drive gear and fuel pump eccentric.

Rear camshaft thrust is taken by rear face of the aluminum camshaft sprocket hub, bearing directly on the front of the cylinder block, eliminating the need for a thrust plate. The helical oil pump and distributor drive gear and camshaft lobe taper both tend to produce only a rearward thrust.

Removal

(1) With tappets, timing chain and sprockets removed, remove distributor and governor assembly.

(2) Lift out oil pump distributor drive shaft.

(3) Remove fuel pump to allow push rod to drop away from cam eccentric.

(4) Remove camshaft, being careful not to damage cam bearings with cam lobes.

Installation

(1) Lubricate camshaft lobes and camshaft bearing journals.

(2) Insert camshaft to within 2 inches of its final position in cylinder block.

(3) Modify Tool C-3509 by grinding off index lug holding upper arm on tool and rotate arm 180 degrees.

(4) Install Tool C-3509 in place of distributor drive gear and shaft (Fig. 19).

(5) Hold tool in position with distributor lock plate screw. This tool will restrict camshaft from being pushed in too far and prevent knocking out the welch plug in rear of cylinder block. The tool should remain installed until camshaft and crankshaft gear have been installed.

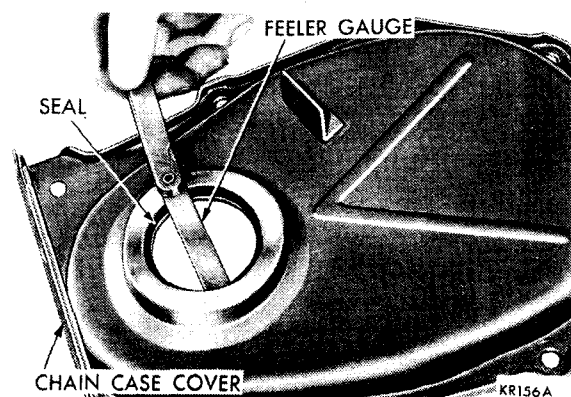


Fig. 21—Inspecting Seal for Proper Seating

DISTRIBUTOR DRIVE SHAFT BUSHING

Removal

- (1) Insert Tool C-3052 into old bushing and thread down until a tight fit is obtained.
- (2) Hold puller screw and tighten puller nut until bushing is removed (Fig. 22).

Installation

- (1) Slide new bushing over burnishing end of Tool C-3053.
- (2) Insert tool and bushing into bore. Drive bushing and tool into position, using a soft hammer (Fig. 23).
- (4) As burnisher is pulled through bushing by tightening puller nut, bushing is expanded tight in block and burnished to correct size (Fig. 24). DO NOT REAM THIS BUSHING.

Distributor Timing

Before installing governor assembly and distributor and oil pump drive shaft, time engine as follows:

- (1) Rotate crankshaft until No. 1 cylinder is at top dead center on firing stroke.
- (2) When in this position, the straight line on vibration damper should be under ("O") on the timing indicator.
- (3) Coat shaft and drive gear with engine oil.
- (4) Install shaft so that after gear spirals into place, it will index with oil pump shaft, so that the slot in top of drive gear will be parallel with center line of crankshaft, and offset in direction (Fig. 25).

Installation of Governor Assembly and Distributor

- (1) Hold distributor over mounting pad with the vacuum chamber pointing toward center of engine.
- (2) Turn rotor until it points forward and to the approximate location of the no. 1 tower terminal in the distributor cap (Fig. 26).
- (3) Place distributor "O" Ring in position.
- (4) Lower distributor and engage shaft in slot of distributor drive shaft gear.
- (5) Install hold down clamp.

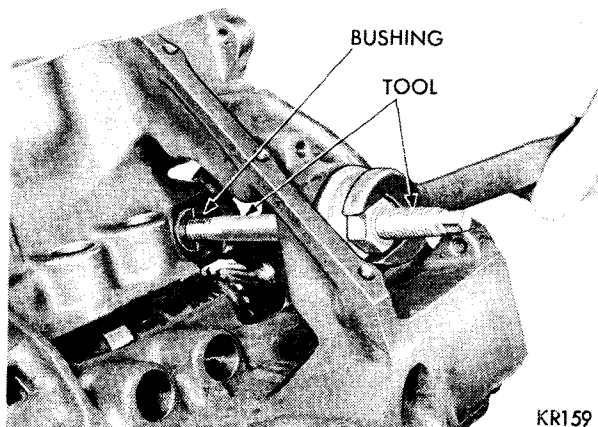


Fig. 22—Removing Distributor Drive Shaft Bushing

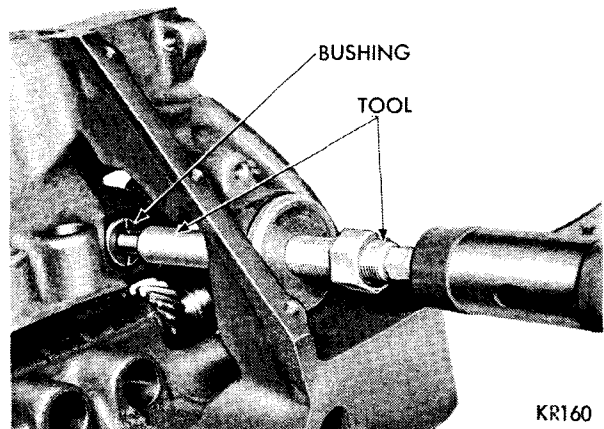


Fig. 23—Installing Distributor Drive Shaft Bushing

Whenever an engine has been rebuilt and/or camshaft and/or new tappets have been installed, add one pint of Chrysler Crankcase Conditioner Part Number 3419130 or equivalent to engine oil to aid in break-in. The oil mixture should be left in engine for a minimum of 500 miles, and drained at the next normal oil change.

Whenever the camshaft is replaced, all of the tappet faces must be inspected for crown with a straight-edge. If any negative crown (dish) is observed, the tappet must be replaced.

CAMSHAFT BEARINGS

(Engine Removed from Vehicle)

Removal

- (1) With engine completely disassembled, drive out rear cam bearing welch plug.
- (2) Install proper size adapters and horse shoe washers (part of Tool C-3132A) at back to each bearing shell to be removed and drive out bearing shells.

Installation

- (1) Install new camshaft bearings with Tool C-3132A by sliding new camshaft bearing shell over proper adapter.

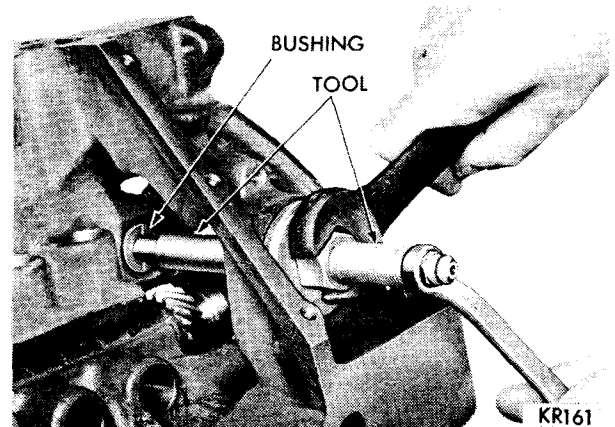


Fig. 24—Burnishing Distributor Drive Shaft Bushing

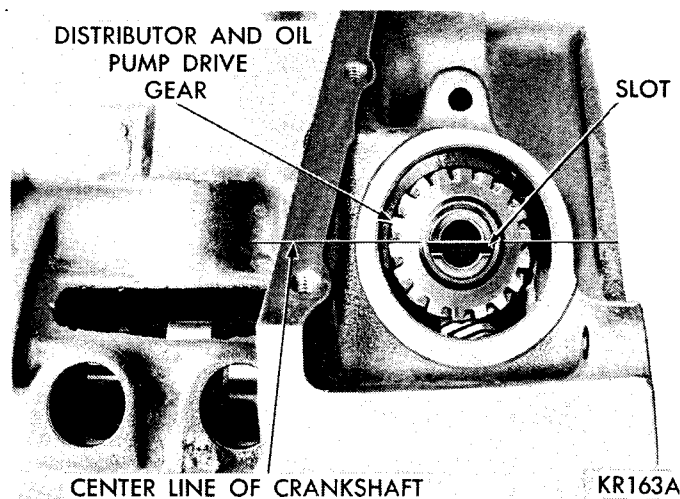


Fig. 25—Distributor Drive Gear Installation

(2) Position bearing in tool. Install horse shoe lock and by reversing removal procedure, carefully drive bearing shell into place.

(3) Install remaining shells in like manner.

Install the No. 1 camshaft bearing 1/32" inward from front face of the cylinder block.

(4) The oil holes in camshaft bearings and cylinder block must be in exact alignment to insure proper lubrication.

(5) Camshaft bearing index can be checked after installation by inserting a pencil flashlight in the bearing shell. The camshaft bearing oil hole should be perfectly aligned with the drilled oil passage from the main bearing.

(6) Another oil hole in the camshaft bearings should be visible by looking down on the left bank oil hole above and between No. 6 and No. 8 cylinders to No. 4 camshaft bearings and on the right bank above and between No. 5 and 7 cylinders to No. 4 camshaft bearings.

(7) If camshaft bearing shell oil holes are not in exact alignment, remove and reinstall them correctly.

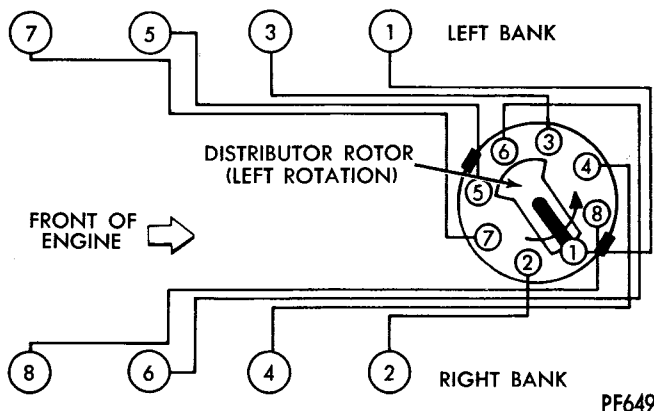


Fig. 26—Distributor with Rotor Positioned Under No. 1 Tower of Cap

(8) Apply sealer 3837795 or equivalent to cup plug core. Install a new cup plug at rear of camshaft. **Be sure this plug does not leak.**

CYLINDER BLOCK

The chrome alloy-cast iron block is of the deep block design. Its sides extend three inches below crankshaft center line.

Oversized Cylinder Bores

Whenever it is necessary to machine cylinder bores .020 oversize all bores shall be oversized. Engines will be identified with a letter "A" stamped on the engine serial pad. See specifications for oversized and undersized machined parts.

Piston Removal

(1) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.**

The pistons and connecting rods must be removed from the top of the cylinder block. When removing piston and connecting rod assemblies from the engine, rotate the crankshaft so each connecting rod is centered in cylinder bore.

(2) Inspect connecting rods and connecting rod caps for cylinder identification. Identify them if necessary.

(3) Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts. Push each piston and rod assembly out of cylinder bore. **Be careful not to nick crankshaft journals.**

(4) After removal, install the corresponding bearing cap on the rod.

Cleaning and Inspection

(1) Clean cylinder block thoroughly and inspect all core hole plugs for evidence of leaking.

(2) If new core plugs are installed coat edges of plug and core hole with Number 1057794 Sealer or equivalent. Drive the core plug in so that the rim lies at least 1/64" below the lead-in chamfer.

(3) Examine block for cracks or fractures.

Cylinder Bore Inspection

The cylinder walls should be checked for out-of-round and taper with Tool C-119. If cylinder bores show more than .005" out-of-round, or a taper of more than .010" or if cylinder walls are badly scuffed or scored, cylinder block should be rebored and honed, and new pistons and rings fitted. Whatever type of boring equipment is used, boring and honing operation should be closely coordinated with the fitting of pistons and rings in order that specified clearance may be maintained.

Honing Cylinder Bores

Before honing, stuff plenty of clean rags under the

bores, over crankshaft to keep abrasive materials from entering crankcase area.

(1) Used carefully, the cylinder bore resizing hone C-823, equipped with 220 grit stones and 390 extensions necessary for 413 cubic inch engines and honing oil C-3501-3880, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round as well as removing light scuffing, scoring or scratches. Usually a few strokes will clean up a bore and maintain the required limits.

(2) Deglazing of cylinder walls may be done using a cylinder surfacing hone. Tool C-3501 equipped with 280 grit stones (C-3501-3810). 20-60 strokes depending on the bore condition will be sufficient to provide a satisfactory surface. Inspect cylinder walls after each 20 strokes. Use honing oil C-3501-3880 or a light honing oil available from major oil distributors. **Do not use engine or transmission oil, mineral spirits or kerosene.**

(3) Honing should be done by moving hone up and down fast enough to get a cross-hatch pattern. When hone marks intersect at 60 degrees, cross hatch angle is most satisfactory for properly seating rings (Fig. 27).

(4) After honing, it is necessary that the block be cleaned again to remove all traces of abrasives.

CAUTION—Be sure all abrasives are removed from engine parts after honing. It is recommended that a solution of soap and water be used with a brush and the parts then thoroughly dried. The bore can be considered clean when it can be wiped clean with a white cloth and cloth remains clean. Oil bores after cleaning to prevent rusting.

PISTONS, PINS AND RINGS

Pistons

The pistons are cam ground so that the diameter at the pin boss is less than its diameter across the thrust

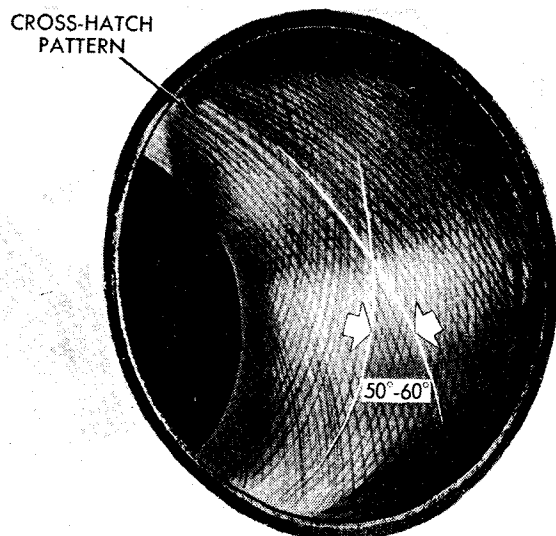


Fig. 27—Cross Hatch Pattern

face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, thus causing the piston to assume a more nearly round shape. It is important that old or new pistons be measured for taper and elliptical shape before they are fitted into the cylinder bore.

Finished Pistons

All pistons are machined to the same weight in grams, regardless of oversize so piston balance can be maintained. For cylinder bores which have been honed or rebored, all service pistons include pins and are available in standard and the following oversizes: .005, .020, .040 and .060 inch.

Fitting Pistons

(1) The piston and cylinder wall must be clean and dry. **Pistons and cylinder bores should be measured at normal room temperature of 70°F.**

(2) **Measure the piston diameter 90 degrees to the piston pin bore.** The specified clearance between the piston and cylinder wall also the location on the piston to be measured is as follows:

	Clearance	Location
361 C.I.D.	.005 to .0015 inch	Top of Skirt
413 C.I.D.	.002 to .003 inch	Piston Pin Center Line

(3) The cylinder bores should be measured halfway down the cylinder bores and transverse to the engine crankshaft centerline.

Fitting Rings

(1) Measure piston ring gap about two inches from bottom of cylinder bore in which it is to be fitted.

(2) An inverted piston can be used to push rings down to insure positioning rings squarely in cylinder bore before measuring.

(3) Insert feeler stock in gap.

(4) The ring gap should be between .013 to .025 inch. This measurement is the same for all rings.

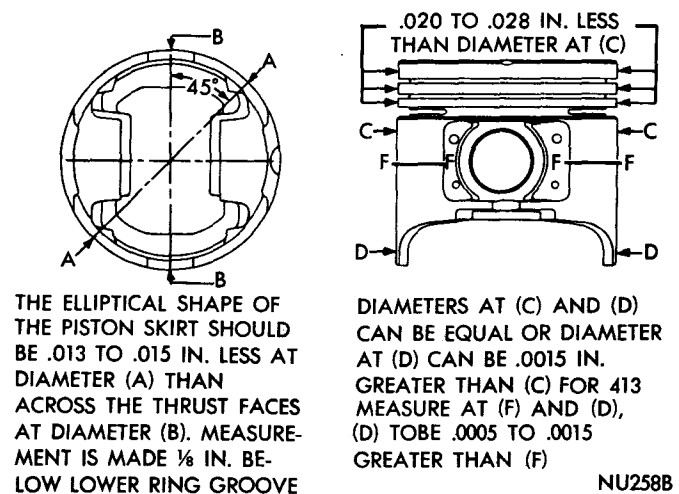


Fig. 28—Piston Measurements

(5) Measure side clearance between piston ring and ring groove.

(6) The clearance should be .0025 to .004 inch for top compression ring, .0025 to .004 inch for intermediate ring, and .001 to .003 inch for cast iron oil control ring. Compression ring for 413 CID is .001 to .023.

(7) Starting with the oil ring expander, place expander ring in lower ring groove and install oil control ring using instructions in package.

(8) Install compression rings in middle and top grooves so side marked "Top" is up.

(9) Use ring installer, Tool C-3628 for the 361 cubic inch engine, and Tool C-3671 for the 413 cubic inch engine or C-4184 for both engines.

Piston Pin Removal

(1) Arrange Tool C-3684 parts for removal of piston pin (Fig. 29).

(2) Install pilot on main screw.

(3) Install the screw through piston pin.

(4) Install anvil over threaded end of main screw with small end of anvil against piston boss.

(5) Install nut loosely on main screw and place assembly on a press (Fig. 30).

When pin falls free from connecting rod, stop press to prevent damage to bottom of anvil.

(6) Remove tool from piston.

Installation

(1) Test piston pin fit in the piston. It should be a sliding fit in the piston at 70 degrees F. Piston pins are supplied in standard sizes only.

(2) Lubricate piston pin holes in the piston and connecting rod.

(3) Arrange Tool C-3684 parts for installation of piston pin (Fig. 31).

(4) Install spring inside the pilot and install spring and pilot in the anvil. Install piston pin over main screw.

(5) Place piston, with "front" up, over the pilot so pilot extends through piston pin hole.

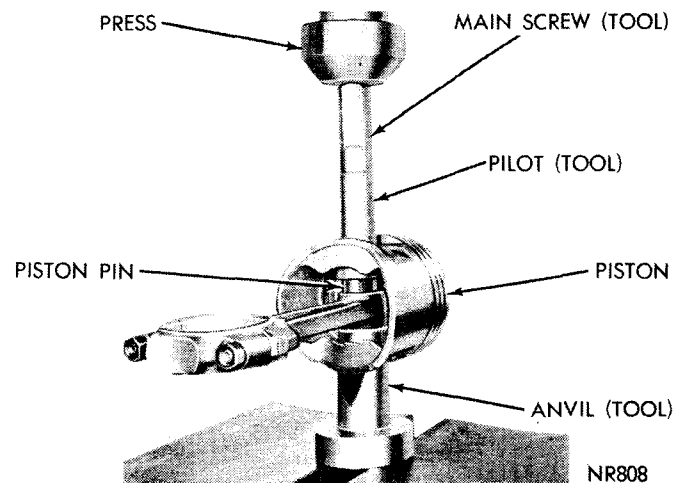


Fig. 30—Removing Piston Pin

(6) Position connecting rod over the pilot which extends through piston pin hole.

Assemble rods to pistons of the right cylinder bank (2, 4, 6, and 8) with indent on piston head opposite to the larger chamfer on the large bore end of connecting rod. Assemble rods to pistons of the left cylinder bank (1, 3, 5, and 7) with indent on piston head on the same side as the larger chamfer on the large bore end of the connecting rod.

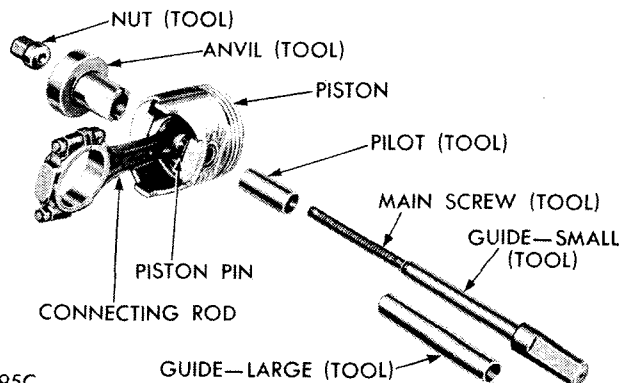
(7) Install main screw and piston pin in piston, then install nut on puller screw to hold assembly together. Place assembly on a press (Fig. 32).

(8) Press piston pin in until piston pin "bottoms" on the pilot. This will position pin in connecting rod.

(9) Remove tool and arrange tool parts and piston assembly in same manner as shown in (Fig. 29) for measuring pin fit.

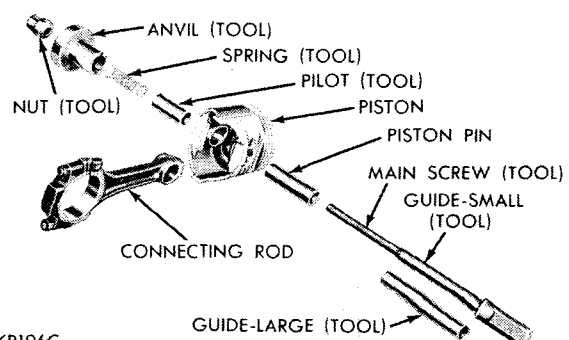
(10) Place assembly in a vise (Fig. 33).

(11) Attach torque wrench to nut and tighten up to 15 foot-pounds. If the connecting rod moves downward on piston pin, reject this connecting rod and piston pin combination. Obtain a connecting rod with proper small end bore diameter and repeat the installation and tightening procedure.



KR195C

Fig. 29—Tool Arrangement for Removing Piston Pin



KR196C

Fig. 31—Tool Arrangement for Installing Piston Pin

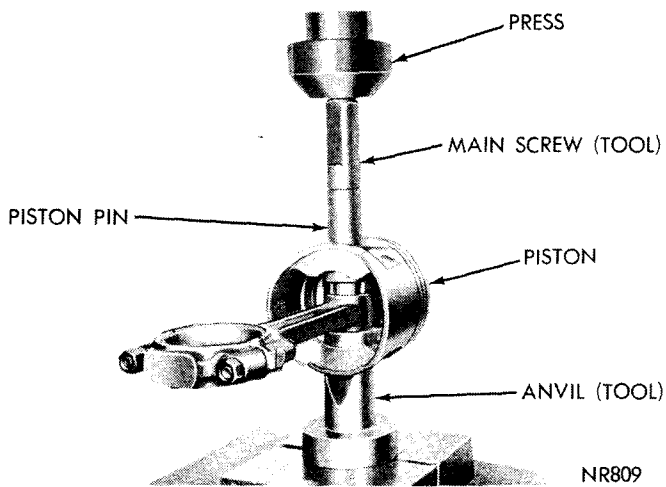


Fig. 32—Installing Piston Pin

(12) If connecting rod does not move under 15 foot-pounds, piston pin and connecting rod interference is satisfactory, remove tool.

CRANKSHAFT IDENTIFICATION

IMPORTANT: A Maltese Cross stamped on the engine numbering pad (Fig. 34) indicates that engine is equipped with a crankshaft which has one or more connecting rods and/or main bearing journal finished .001 inch undersize. The position of the undersize journal or journals is stamped on a machine surface of the NO. 3 counterweight (Fig. 35). A Maltese Cross with an X indicates .010 inch undersize journals.

The connecting rod journals are identified by the letter "R" and main bearing journals by the letter "M." For example "M-1" indicates that NO. 1 main bearing is .001 inch undersize.

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new

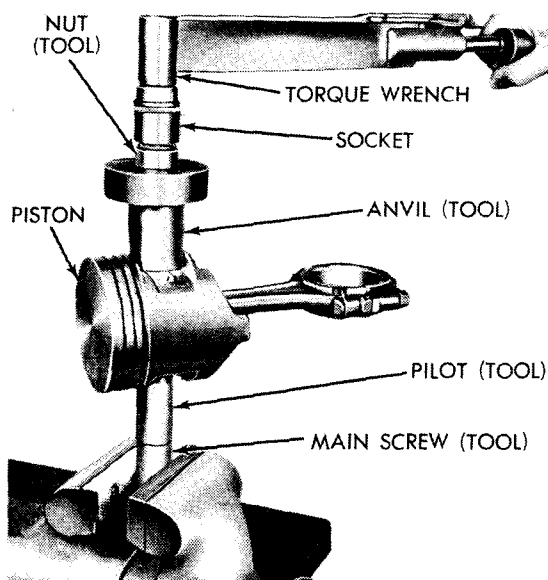


Fig. 33—Testing Fit of Piston Pin in Connecting Rod

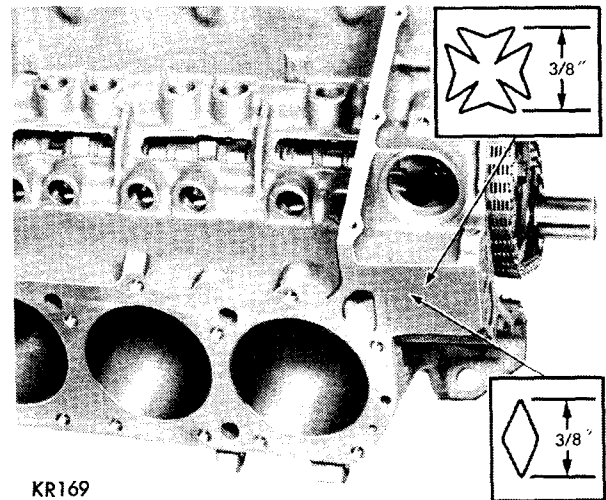


Fig. 34—Showing Location of External Engine Numbering Pad

bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

CONNECTING RODS

Installation of Connecting Rod Bearings

Fit all rods on one bank until complete. Do not alternate from one bank to another, because when rods are assembled to the pistons correctly, they are not interchangeable from one bank to another.

Each bearing cap has a small "V" groove across parting face. When installing the lower bearing shell, make certain "V" groove in shell is in line with "V" groove in cap. This allows lubrication of the cylinder wall. The bearings should always be installed so that the small formed tang fits into the machined grooves of the rods. The end clearance should be from .009 to .017 inch (two rods).

Limits of taper or out-of-round on any crankshaft journals should be held to a maximum of .001 inch.

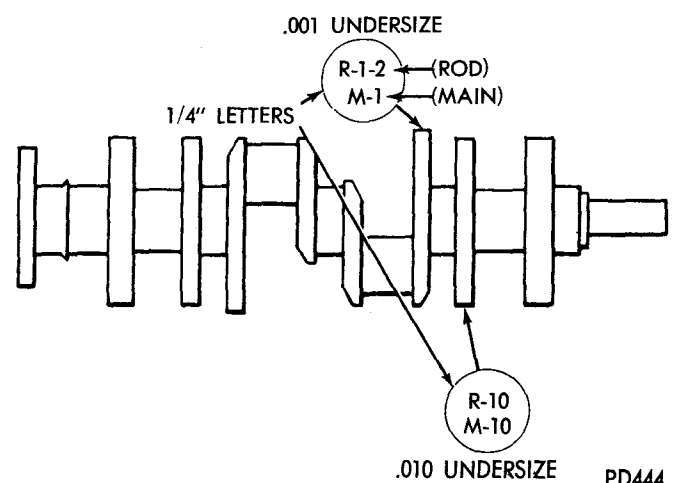


Fig. 35—Showing Location of Internal Marking of Counterweight

Bearings are available in .001, .002, .003, .010 and .012 inch undersize.

Install the bearings in pairs. Do not use a new bearing half with an old bearing half. Do not file the rods or bearing caps.

MEASURE CONNECTING ROD BEARING CLEARANCE

Shim Stock Method

(1) Place an oiled .001 inch brass shim stock (1/2 inch wide and 3/4 inch long) between bearing and connecting rod journal.

(2) Install bearing cap and tighten to 45 foot-pounds.

(3) Turn connecting rod 1/4 turn in each direction. A slight drag should be felt which indicates clearance is satisfactory. Correct clearance is from .001 to .002 inch.

(4) The side play should be from .009 to .017 inch.

Plastic Gage Method

(1) Wipe journal clean.

(2) Place a strip of Plastic Gage across full width of lower insert at the center of bearing cap (Fig. 36).

(3) Install bearing cap to connecting rod and tighten retaining nuts to 45 foot-pounds torque.

(4) Remove bearing cap and determine amount of clearance by measuring the width of the compressed Plastic Gage with the scale furnished (Fig. 37).

(5) New bearings should be installed if bearing clearance is not within specifications. Excessive taper indicates that a new or reground crankshaft is required.

INSTALLING PISTON AND CONNECTING ROD ASSEMBLY

(1) Before installing pistons, rods, and rod assemblies in the bore, be sure that the compression ring gaps are staggered so that neither are in line with oil ring rail gaps.

(2) The oil ring expander ends should be positioned toward the outside of the "V" of the engine.

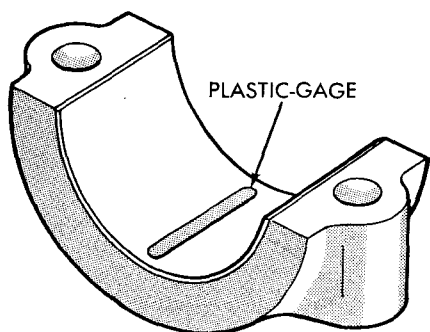


Fig. 36—Plastic Gage Placed in Lower Shell

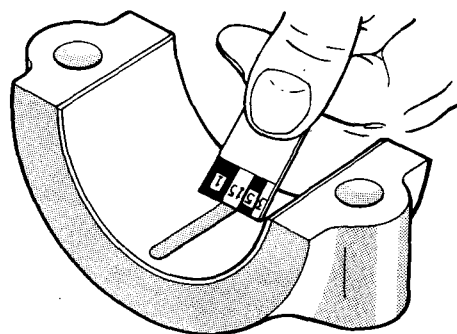


Fig. 37—Clearance Measurement

The oil ring rail gaps should be positioned opposite each other and above the piston pin holes.

(3) Immerse piston head and rings in clean engine oil, slide ring compressor, Tool C-385, over the piston and tighten with special wrench (part of Tool C-385).

(4) Be sure the position of rings does not change during this operation. Screw connecting rod bolt protector on one rod bolt, and insert rod and piston into cylinder bore.

Rotate crankshaft so connecting rod journal is on center of cylinder bore.

(5) Attach puller part of tool on the other bolt, and guide the rod over crankshaft journal (Fig. 38).

(6) Tap piston down in cylinder bore, using handle of a hammer. At the same time, guide connecting rod into position on crankpin journal.

(7) The notch or groove on top of piston must be pointing toward front of engine and larger chamfer of connecting rod bore must be installed toward crank pin journal fillet.

(8) Install rod caps, tighten nuts to 45 foot-pounds.

Whenever an engine has been rebuilt and/or a new camshaft and/or new tappets have been installed, add one pint of Chrysler Crankcase Conditioner Part Number 3419130 or equivalent to engine oil to aid in break-in. The oil mixture should be left in engine for a minimum of 500 miles, and drained at the next normal oil change.

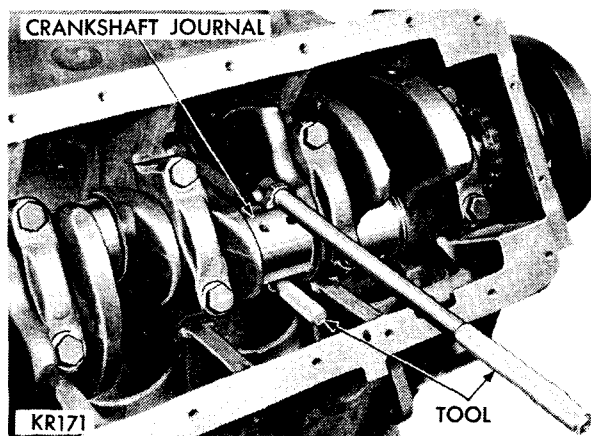


Fig. 38—Install Connecting Rod

CRANKSHAFT MAIN JOURNALS

The crankshaft journals should be checked for excessive wear, taper and scoring. Journal grinding should not exceed .012 inch under the standard journal diameter. DO NOT grind the thrust faces of No. 3 main bearing. DO NOT nick the crankpin or main bearing fillets. After regrinding, remove the rough edges from crankshaft oil holes and clean out all oil passages.

CRANKSHAFT MAIN BEARINGS

New lower main bearing halves of numbers 1, 2, 4 and 5 are interchangeable, as shown in (Fig. 39). New upper main bearing halves of numbers 2, 4 and 5 are interchangeable. Upper and lower bearing halves are not interchangeable because the upper bearings have an oil hole.

The No. 1 upper bearing is not interchangeable and is chamfered on tab side for timing chain oiling and can be identified by a red marking on the edge of the bearing.

The upper and lower No. 3 bearing halves are flanged to carry the crankshaft thrust loads and are not interchangeable with any other bearing halves in the engine. **Bearings that are not badly worn or pitted must be reinstalled in the same position.**

The bearing caps are not interchangeable and should be marked at removal to insure correct assembly. Bearing shells are available in standard and the following undersizes: .001, .002, .003, .010 and .012 inch. Never install an undersize bearing shell that will reduce the clearance below specifications.

Removal

- (1) Remove oil pan.
- (2) Mark bearing caps before removal.
- (3) Remove bearing caps one at a time. Remove upper half of bearing by inserting Tool C-3059 (Fig. 40) into oil hole of crankshaft.

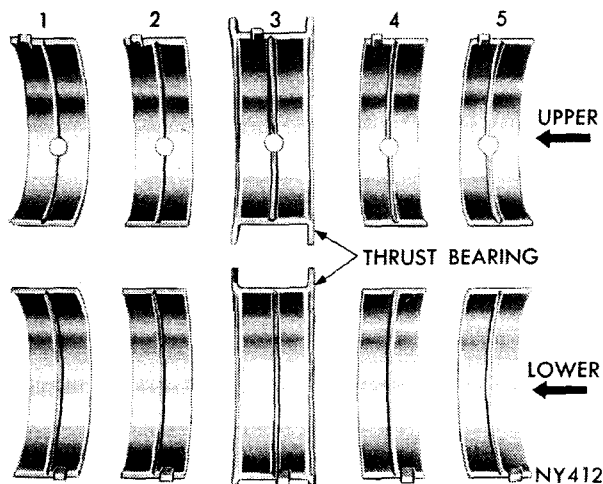


Fig. 39—Main Bearing Identification

- (4) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

Installation

Only one main bearing should be selectively fitted while all other main bearing caps are properly torqued.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

- (1) Start bearing in place, and insert Tool C-3059 into oil hole of crankshaft (Fig. 40).
- (2) Slowly rotate crankshaft counter-clockwise sliding the bearing into position. Remove Tool C-3059.

MEASURING MAIN BEARING CLEARANCE

Shim Stock Method

- (1) Smooth edges of a 1/2 x 3/4 inch piece of brass shim stock, .001 inch thickness.

- (2) Install bearing in center main bearing cap, bearing tang in groove in cap, lubricate bearing and position shim stock across the bearing, install cap, tighten bolts to 85 foot-pounds.

- (3) If a slight drag is felt as crankshaft is turned (moved no more than 1/4 turn in either direction), clearance is .001 inch or less and is considered satisfactory.

If, however, no drag is felt, the bearing is too large or crankshaft cannot be rotated, bearing is too small and should be replaced with the correct size.

- (4) Measure crankshaft end play .002 to .007 inch. If end play is less than .002 inch or more than .007 inch, install a new number 3 main bearing.

- (5) Fit remaining bearings in same manner.

It is permissible to use one .001 inch undersize bearing shell with one standard bearing shell or one .002 inch undersize bearing shell with one .001 inch undersize shell. **Always use the smaller diameter bearing half as the upper. Never use an upper bearing half more than .001 inch smaller than the lower**

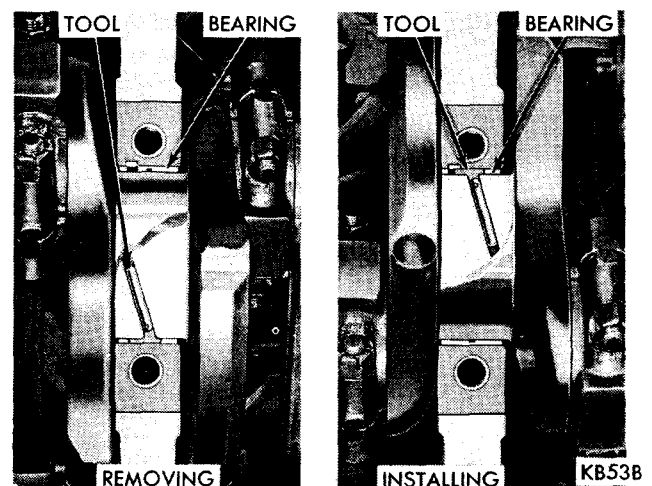


Fig. 40—Removing or Installing Upper Main Bearings

bearing half and never use a new bearing half with a used bearing half.

Plastic Gage Method

NOTE: Check clearance one bearing at a time.

(1) Support weight of crankshaft with a jack or stand placed under counterweight adjacent to main bearing being checked.

NOTE: When servicing No. 1 main bearing, support crankshaft at vibration damper. All other bearings must remain tightened.

(2) Remove main bearing cap and insert.

(3) Clean insert and exposed portion of crankshaft journal.

(4) Place strip of Plastic Gage across full width of bearing insert (Fig. 36).

(5) Install bearing cap and tighten bolts to 85 foot-pounds torque.

(6) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastic Gage with furnished scale (Fig. 37).

(7) New bearings should be installed if bearing clearance is not within specifications. Excessive taper indicates that a new or reground crankshaft is required.

REAR MAIN BEARING OIL SEALS

Service seals are of split rubber type composition. The seals make it possible to replace the upper rear seal without removing the crankshaft. The seal must be used as an upper and lower set and cannot be combined with the rope seal.

(1) With oil pan removed, remove rear seal retainer and rear main bearing cap.

(2) Remove lower rope oil seal by prying from the side with a small screwdriver.

(3) Remove upper rope seal by turning in Tool C-4148 into the end of the seal, being careful not to damage the crankshaft (Fig. 41). Pull the seal out with the tool while rotating the crankshaft.

CAUTION: Always wipe crankshaft surface clean, then oil lightly before installing a new seal.

(4) Oil seal lip lightly with engine oil.

(5) Hold seal (with paint stripe to the rear) tightly against crankshaft with thumb to make sure that the sharp edge of the groove, in the block does not shave or nick the back of the seal, install seal in the block groove. Rotate the crankshaft, if necessary, while sliding seal into groove. **Care must be exercised not to damage the sealing lip.**

(6) Install other half of the seal into the lower seal retainer with paint stripe to rear.

(7) Install rear main bearing cap, tighten to 85 foot-pounds. **Do not use sealer or cement on seal ends or lip.**

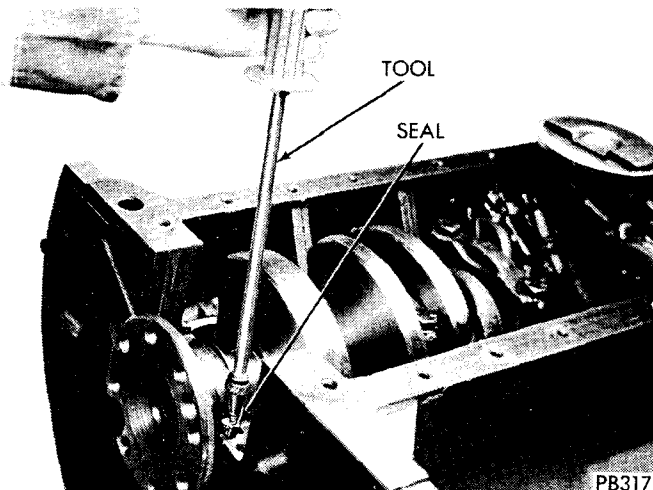


Fig. 41—Removing Upper Oil Seal with Tool C-4148

Side Seals Installation

Perform the following operations as rapidly as possible. These side seals are made from a material that expands quickly when oiled.

(1) Apply mineral spirits or diesel fuel to the side seals.

(2) Install seals immediately in the seal retainer grooves.

(3) Install seal retainer and tighten screws to 30 foot-pounds.

Failure to pre-oil the seals will result in an oil leak.

OIL PAN

Removal

(1) Remove oil dipstick, disconnect battery.

(2) Raise vehicle on hoist, drain oil pan. If equipped with air compressor, remove oil return line from side of oil pan.

(3) Remove oil pan attaching bolts and pan.

Installation

(1) Inspect alignment of oil strainer. Bottom of strainer must be parallel with the machined surface of the cylinder block. Bottom of strainer must touch bottom of oil pan with 1/16 to 1/8 inch interference desirable.

(2) Clean oil pan gasket surface and mating surface of block. Inspect pan rail for distortion and flatten if necessary.

(3) Using a new pan gasket, install oil pan and torque screws to 200 inch pounds. Install compressor oil return line if so equipped.

(4) Lower vehicle, install dipstick, fill with proper grade and quantity of motor oil, connect battery ground cable.

ENGINE OILING

The engine oil system consists of an externally mounted rotor type oil pump and oil filter. Oil is

forced by the oil pump to a series of oil passages in the engine.

Models D600, 800 and S600 are equipped with a two quart full-flow filter (Fig. 42).

On models which utilize an air compressor, lubrication of the compressor is obtained through an oil line coming from the rear of the cylinder block. The oil returns to the engine oil sump from the compressor through a large external drain line which attaches to the left side of the oil pan.

It is important upon repair or replacement of the governor or air compressor that their oil lines be correctly installed.

OIL PUMP

Removal

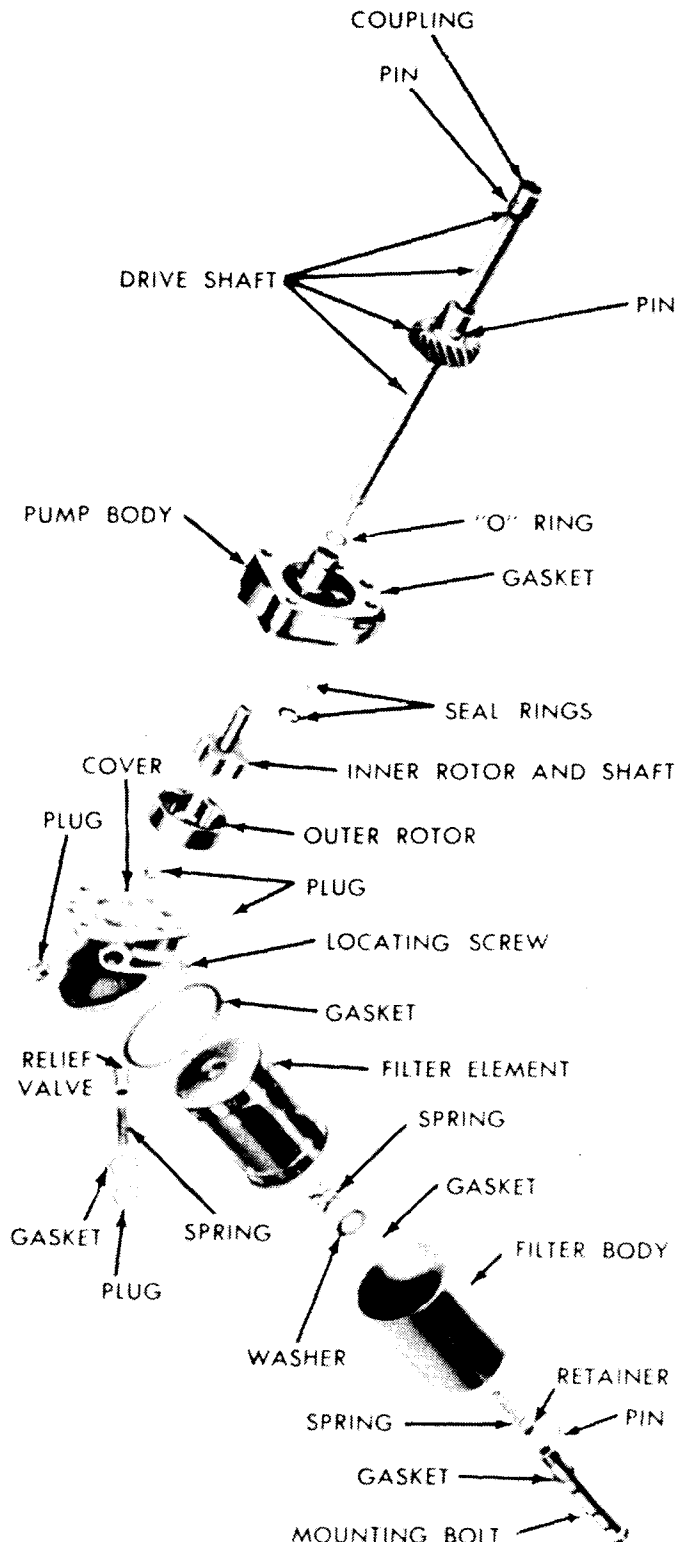
- (1) Remove oil pump attaching bolts.
- (2) Remove pump and filter assembly from bottom side of the engine.

Disassembly

- (1) Remove filter body and element from oil pump.
- (2) Remove filter base and oil seal ring.
- (3) Remove pump rotor and shaft and lift out outer pump rotor.
- (4) Remove oil pressure relief valve plug and lift out spring and plunger.

Inspection

- (1) Clean all parts thoroughly. Mating face of oil pump cover should be smooth. Replace cover if it is scratched or grooved.
- (2) Lay a straightedge across the oil pump cover surface (Fig. 43). If a .0015 feeler gauge can be inserted between cover and straightedge, cover should be replaced.
- (3) Measure diameter and thickness of outer rotor. If outer rotor length measures less than .943 inch (Fig. 44) and the diameter less than 2.469 inches, replace outer rotor.
- (4) If inner rotor length measures less than .942 inch (Fig. 45), replace inner rotor.
- (5) Install outer rotor into pump body, pressing to one side with fingers and measure clearance between outer rotor and pump body (Fig. 46). If measurement is more than .014 inch, replace oil pump body.
- (6) Install inner rotor into pump body and place a straightedge across the face between bolt holes (Fig. 47). If a feeler gauge of more than .004 inch can be inserted between the rotors and straightedge, replace pump body.
- (7) If clearance between inner rotor and outer rotor (Fig. 48) is more than .010 inch, replace inner and outer rotors.
- (8) Inspect oil pump relief valve plunger for scoring and for free operation in its bore. Small scores



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Fig. 42—Oil Pump and Filter Assembly (Disassembled View)

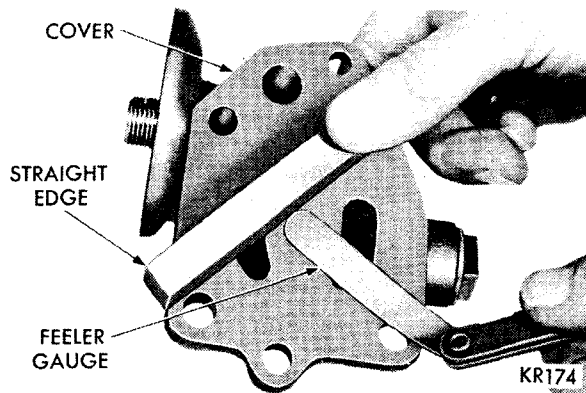


Fig. 43—Measuring Oil Pump Cover Flatness

may be removed with 400 grit wet or dry paper.

(9) The relief valve spring has a free length of 2-

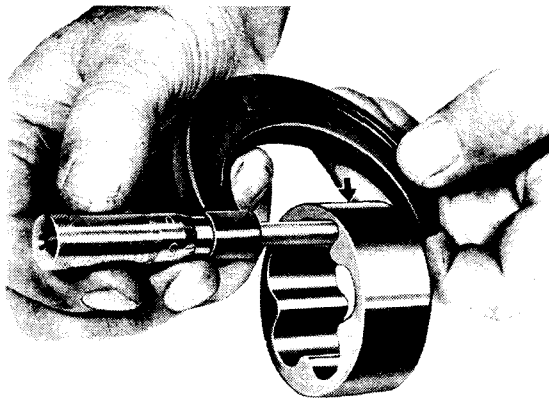


Fig. 44—Measuring Outer Rotor Thickness

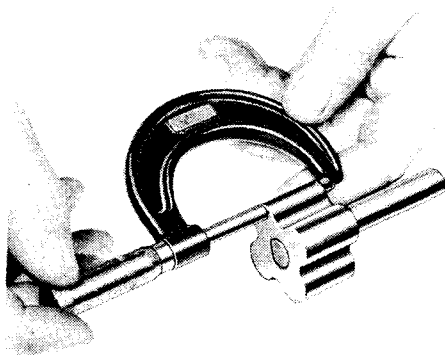


Fig. 45—Measuring Inner Rotor Thickness

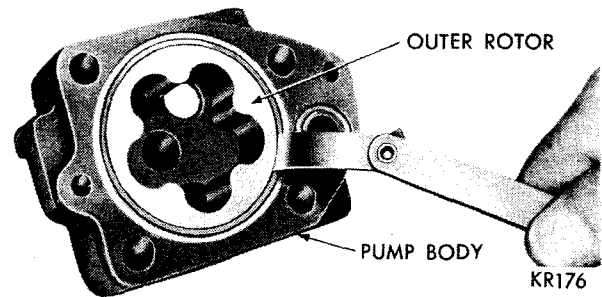


Fig. 46—Measuring Outer Rotor Clearance

1/4 inches and should test 22.3 to 23.3 lbs. when compressed to 1-19/32 inch. Discard spring that fails to meet specifications.

(10) If oil pressure is low, inspect for worn bearings, or look for other causes of possible loss of pressure.

Installation

When assembling oil pump, be sure to use new oil seal rings between filter base and body. Tighten the attaching bolts to 30 foot-pounds.

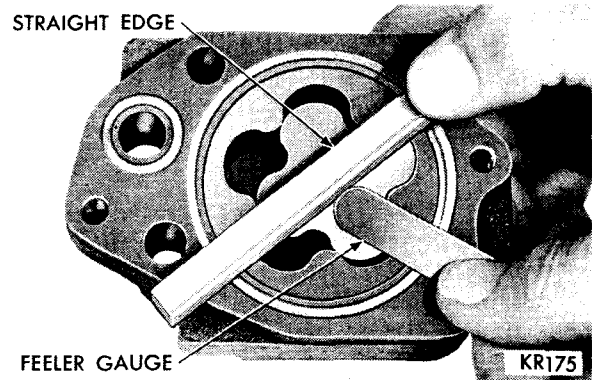


Fig. 47—Measuring Clearance Over Rotors

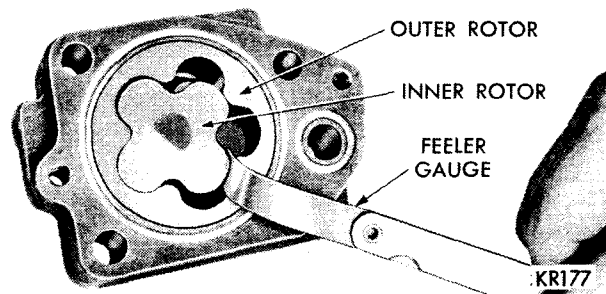


Fig. 48—Measuring Clearance Between Rotors

400-440 CUBIC INCH ENGINE

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SERVICE PROCEDURES

ENGINE ASSEMBLY

Removal

- (1) Drain coolant from radiator and cylinder block.
- (2) Disconnect battery cables and remove battery.
- (3) Scribe hood hinge outlines on hood and remove hood.
- (4) If equipped with air conditioning, discharge the system. Disconnect compressor lines. Cap all openings as soon as they are disconnected to keep moisture or dirt out of the system.
- (5) Disconnect electrical connections at alternator, ignition coil, temperature and oil pressure sending units (oil gauge line if so equipped) starter relay-to-solenoid wires and engine to body ground.
- (6) Remove air cleaner and carburetor. Install engine lifting fixture to carburetor flange on intake manifold.
- (7) Remove distributor cap, rotor and spark plug wires.
- (8) Disconnect flexible fuel line to fuel pump and cap line.
- (9) Disconnect radiator and heater hoses (oil cooler lines if so equipped). Remove fan, spacer (or fluid drive) and radiator. **Caution: To prevent silicone fluid from draining into fan drive bearing and ruining the grease, do not place drive unit with shaft pointing downward.**
- (10) Raise vehicle on a hoist and install engine support fixture Tool C-3487A to support rear of engine.
- (11) Disconnect exhaust pipes at manifolds, propeller shaft, wires, linkage, cable and oil cooler lines at the transmission if so equipped.
- (12) Remove engine rear support crossmember and remove transmission from vehicle.
- (13) Lower vehicle and attach a chain hoist or hydro-crane to fixture eyebolt.

(14) Remove front motor mount insulator top stud nuts and washers. Raise engine with lifting equipment and work engine out of chassis.

(15) Place engine in repair stand Tool C-3167 and adapter C-3662 for disassembly, using transmission bolts.

Installation

- (1) Install engine lifting fixture to carburetor flange studs on intake manifold.
- (2) Attach a chain hoist or hydro-crane to fixture eyebolt.
- (3) Remove engine from repair stand and lower engine carefully until engine is positioned in chassis with front motor mount studs in place (Fig. 1).
- (4) Install engine support fixture Tool C-3487A (if

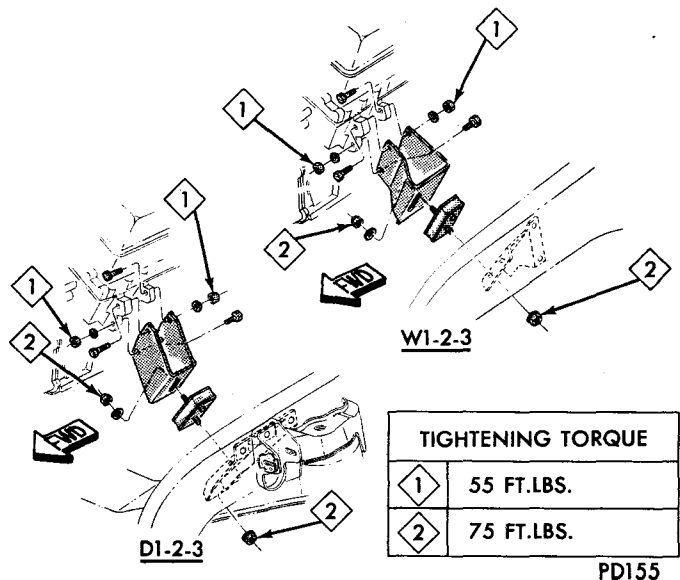


Fig. 1—Engine Mounts—Front—440 Cubic Inch Engine Models D100-200-300 and W100-200-300

removed from chassis) to support rear of engine. Remove hydro-crane.

(5) Raise vehicle on hoist.

(6) Install transmission and engine rear support crossmember. Remove engine support fixture Tool C-3487A. (Fig. 2).

(7) Connect propeller shaft, wires, linkage, cables, exhaust pipes to manifolds, (oil cooler lines and transmission filler tube if so equipped.)

(8) Lower vehicle, install compressor if equipped with air conditioning.

(9) Install radiator, fan shroud, hoses and oil cooler lines.

(10) Install rotor, distributor cap and spark plug wires. Connect electrical connections at ignition coil, alternator, temperature and oil pressure sending units (oil gauge line if so equipped) starter relay-to-solenoid and engine to body ground.

(11) Remove engine lifting fixture from cylinder head. Uncap flexible fuel line and install to fuel pump.

(12) Install battery, close all drain cocks and fill cooling system.

(13) Fill engine crankcase and transmission as necessary. Refer to "Lubrication" Group 0, for quantities and lubricants. Inspect the entire system for leaks and correct as necessary.

Whenever an engine has been rebuilt and/or a new camshaft and/or new tappets have been installed, add one pint of Chrysler Crankcase Conditioner Part Number 3419130 or equivalent to engine oil to aid in breakin. The oil mixture should be left in engine for minimum of 500 miles, and drained at the next normal oil change.

(14) Start engine and run until normal operating temperature is reached.

(15) Inspect ignition timing (with vacuum advance

line removed) and adjust carburetor as necessary.

(16) Refer to "Air Conditioning" Group 24 on proper procedure for charging the system if so equipped.

(17) Adjust accelerator and transmission linkages. Road test vehicle.

Engine Removal Without Removing Automatic Transmission

(1) Scribe hood hinge outlines on hood and remove hood.

(2) Drain cooling system and remove battery and carburetor air cleaner.

(3) Remove radiator and heater hoses and remove radiator. Set fan shroud aside.

(4) Discharge air conditioning, refer to Group 24 Air Conditioning for service procedures if so equipped.

(5) Remove vacuum lines, distributor cap and wiring.

(6) Remove carburetor, linkage, starter wires and oil pressure wire.

(7) Remove air conditioning hoses and power steering hoses if so equipped.

(8) Remove starter motor, alternator, charcoal canister and horns.

(9) Remove exhaust pipe at manifold.

(10) Remove bell housing bolts and inspection plate. Attach "C" clamp on front bottom of transmission torque converter housing to prevent torque converter from coming out.

(11) Remove torque converter drive plate bolts from torque converter drive plate. Mark converter and drive plate to aid in reassembly.

(12) Support transmission with transmission stand tool number C-3201-A in its normal position relative to the vehicle. This will assure that the torque converter will remain in proper position in the transmission housing.

(13) Disconnect the engine from the torque converter drive plate.

(14) Install engine lifting fixture. Attach a chain hoist to fixture eyebolt.

(15) Remove engine front mount bolts.

(16) Remove engine from engine compartment and install in engine repair stand.

Installation

(1) Remove engine from repair stand and install in engine compartment.

(2) Install torque converter drive plate bolts and front end mounts.

(3) Install bell housing bolts. Remove "C" clamp and install inspection plate. Remove stand from transmission.

(4) Remove engine lifting fixture and install carburetor and lines.

(5) Install starter motor, alternator, charcoal canister and lines.

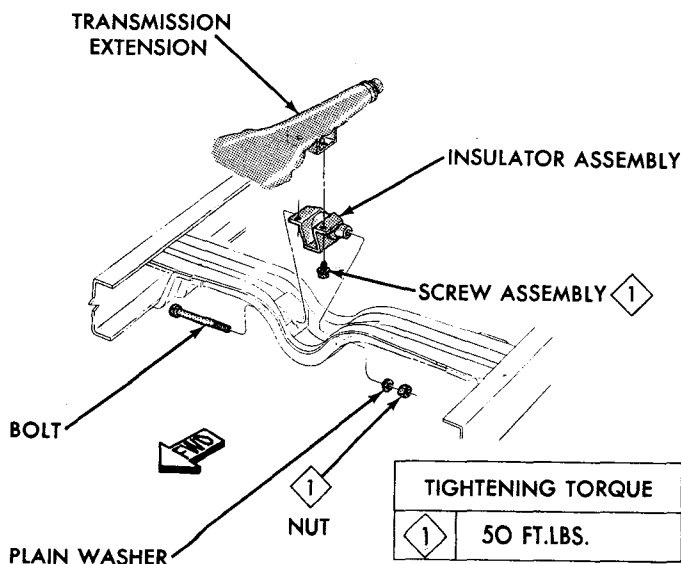


Fig. 2—Engine Mount-Rear-Models D100-200-300

- (6) Install vacuum lines, distributor cap and wiring.
- (7) Install exhaust pipe.
- (8) Connect carburetor linkage and wiring to engine.
- (9) Install radiator, radiator hoses and heater hoses.
- (10) Set fan shroud in position. Fill cooling system full.
- (11) Install battery and carburetor air cleaner. Connect vacuum hose, power steering hoses, if so equipped.
- (12) Install air conditioning equipment and charge air conditioning. Refer to Group 24 Air Conditioning for service.
- (13) Warm engine and adjust.
- (14) Install hood and line up.
- (15) Road test vehicle.

ROCKER ARMS AND SHAFT ASSEMBLY

The rocker arms are of stamped steel and are arranged on one rocker arm shaft, per cylinder head. The push rod angularity tends to force the pairs of rocker arms toward each other where oilite spacers carry the side thrust at each rocker arm. The rocker shaft is held in place by bolts and stamped steel retainers attached to the five brackets on the cylinder head.

Removal

- (1) Remove cylinder head cover and gasket.
- (2) Remove rocker shaft bolts and retainers and remove rocker arms and shaft assembly.
- (3) If rocker arm assemblies have been disassembled for cleaning, inspection, or replacement, refer to (Fig. 3) for proper reassembly.

Installation

- (1) Install rocker arms and shaft assembly making sure to install the long stamped steel retainers in the number two and four positions.
- (2) Install rocker shafts so that 3/16 inch diameter rocker arm lubrication holes point downward into the rocker arm, so that the 15 degree angle of these holes point outward towards the valve end of the rocker

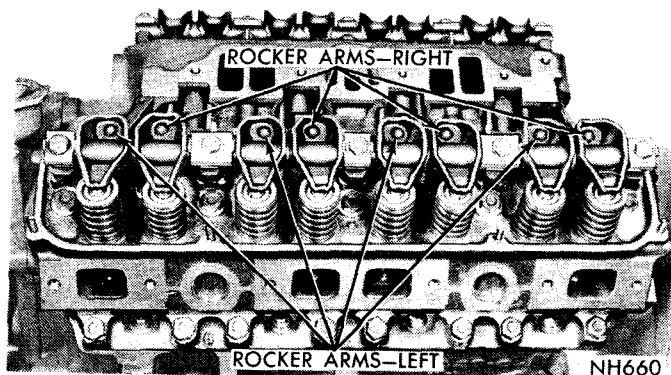


Fig. 3—Rocker Arm Assemblies Installed

arms, (Fig. 4). This is necessary to provide proper lubrication to the rocker assemblies.

The 15 degrees angle of the rocker arm lubrication holes is determined from the center line of the bolt holes through the shaft which are used to attach the shaft assembly to the cylinder head.

- (3) Tighten rocker shaft bolts to 25 foot-pounds.
- (4) Clean cylinder head cover gasket surface. Inspect cover for distortion and straighten if necessary.
- (5) Clean cylinder head rails. Place new cylinder head cover gasket in position and install cylinder head covers. Tighten to 40 inch-pounds.
- (6) Install closed crankcase ventilation system and evaporation control system.

CYLINDER HEADS

The chrome alloy cast iron cylinder heads are held in place by 17 bolts. The spark plugs enter the cylinder head horizontally and are located at the wedge of the combustion chambers.

Removal

- (1) Drain cooling system. Remove air cleaner.
- (2) Remove alternator, carburetor fuel line and accelerator linkage and air pump if so equipped.
- (3) Remove closed ventilation system and evaporation control system.
- (4) Remove vacuum control tube at carburetor and distributor.
- (5) Disconnect distributor cap, coil wires and heater hose.
- (6) Disconnect heat indicator sending unit wire.
- (7) Remove spark plugs.

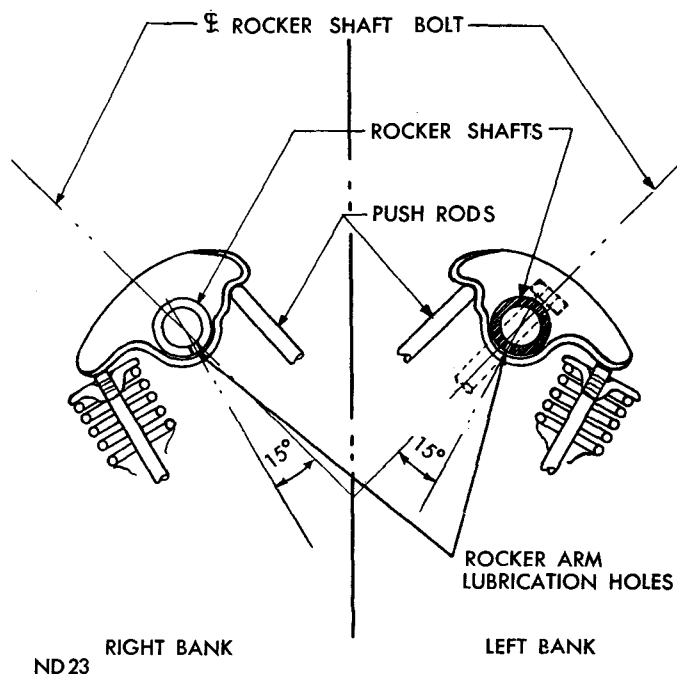


Fig. 4—Rocker Arm Lubrication Holes

- (8) Remove intake manifold, ignition coil and carburetor as an assembly.
- (9) Remove tappet chamber cover.
- (10) Remove cylinder head covers and gaskets.
- (11) Remove exhaust manifolds.
- (12) Remove rocker arm and shaft assemblies. Remove push rods and **identify to insure installation in original location.**
- (13) Remove the 17 head bolts from each cylinder head and remove cylinder heads.
- (14) Place cylinder head in holding fixture Tool C-3626.

Installation

- (1) Clean gasket surfaces of the cylinder block, cylinder heads and remove all burrs.
- (2) Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out of flatness exceeds .0075 times the span length in any direction; either replace head or lightly machine the head gasket surface. As an example, if a 12 inch span is .004 inches out of flat, allowable is $12 \times .00075 = .009$ inches. Head is OK.
- The cylinder head surface finish should be 70-180 micro-inches.
- (3) Coat new gaskets lightly with a suitable sealer, Chrysler Number 1057794 or equivalent. Install gaskets and cylinder heads.
- (4) Install cylinder head bolts. Starting at top center, tighten all cylinder head bolts to 40 foot-pounds in sequence (Fig. 5).
- Repeat the procedure, tightening all heads bolts to 70 foot-pounds. **Do not retighten cylinder head bolts after the engine has been operated when embossed steel head gaskets are used.**
- (5) Inspect push rods and replace any worn or bent rods.

- (6) Install push rods in the tappets maintaining alignment, using rod, (Fig. 6).
- (7) Install rocker arm and shaft assembly starting each push rod into its respective rocker arm socket making sure to install the long stamped steel re-

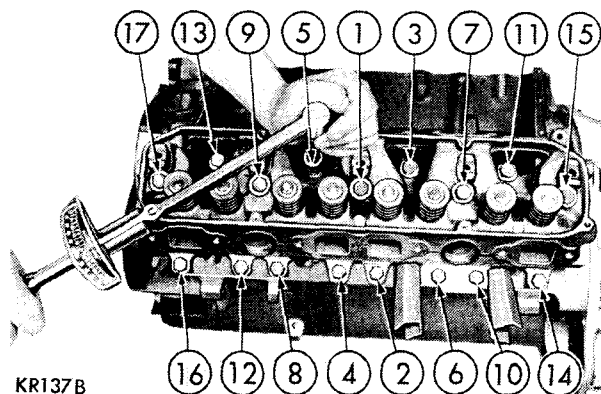


Fig. 5—Cylinder Head Tightening Sequence

tainers in the number two and four positions, **tighten bolts to 25 foot-pounds.**

- (8) Place new cylinder head cover gasket in position and install cylinder head covers. Tighten nuts to 40 inch-pounds.
- (9) Install new exhaust manifold gaskets and exhaust manifolds and tighten nuts to 30 foot-pounds.
- (10) Adjust spark plugs to .035 inch gap and install plugs, tighten plugs to 30 foot-pounds.
- (11) Install a new tappet chamber cover and tighten end bolts to 9 foot-pounds.
- (12) Install intake manifold carburetor and ignition coil as an assembly and tighten manifold bolts to 40 foot-pounds.
- (13) Install distributor cap. Connect the coil wire, heat indicator sending unit wire, accelerator linkage, spark plug cables and insulators.
- (14) Install carburetor fuel line, alternator (with air pump bracket if so equipped). Adjust belt tensions and tighten pivot and mounting bolts to 30 foot-pounds and adjusting strap bolt to 200 inch-pounds.
- (15) Install vacuum hose at carburetor and distributor.
- (16) Install closed ventilation system and evaporation control system.
- (17) Install carburetor air cleaner and fill cooling system.

VALVES AND VALVE SPRINGS

Valves are arranged in-line in the cylinder heads and inclined 30 degrees outward from vertical. The intake and exhaust valves operate in guides that are cast integral with the heads.

Removal

- (1) With cylinder head removed, compress valve springs, using Tool C-3422A, (Fig. 7).
- (2) Remove valve retaining locks, valve spring retainers, valve stem cup seals and valve springs.

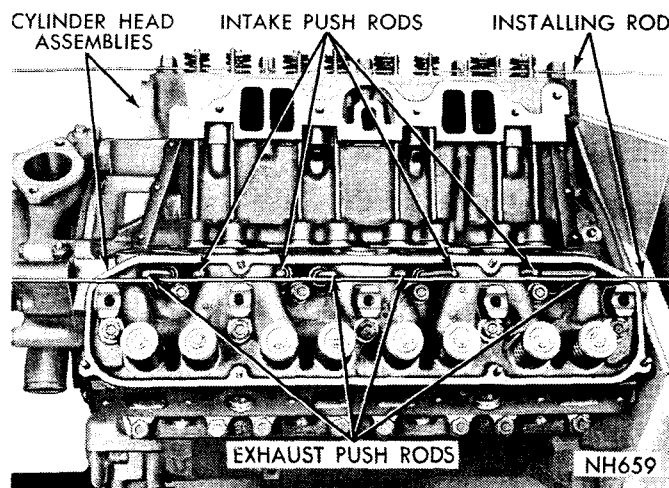


Fig. 6—Push Rods Installed

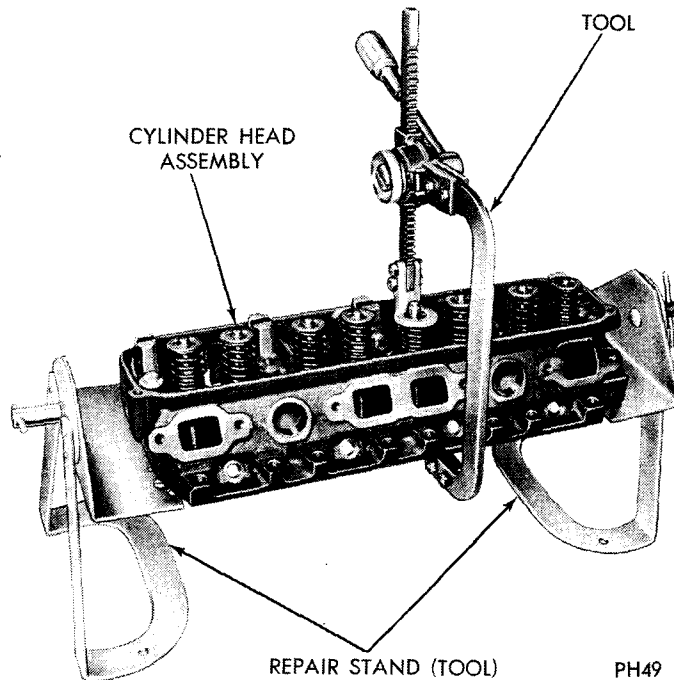


Fig. 7—Compressing Valve Spring

(3) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guide. **Identify valves to insure installation in original location.**

Valve Inspection

(1) Clean valves thoroughly, and discard any burned, warped, or cracked valves.

(2) Measure valve stems for wear. Refer to specifications for proper size. If wear exceeds .002 inch, replace the valve.

(3) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

(4) Measure valve stem guide clearance as follows: Install sleeve Tool C-3973 over valve stem (Fig. 8) and install valve.

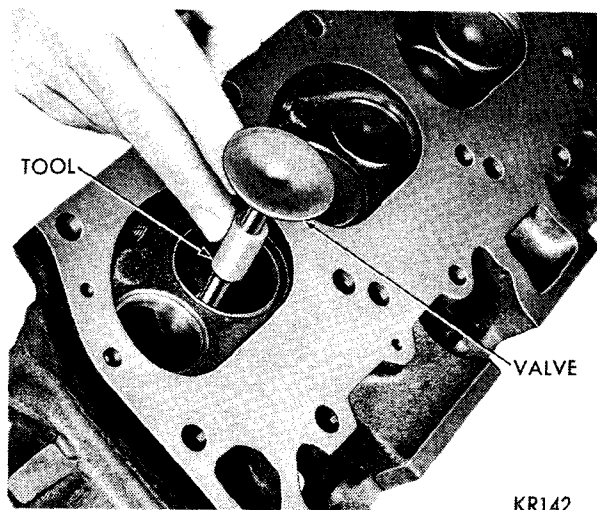


Fig. 8—Installing Valve and Tool C-3973

(5) The special sleeve places the valve at the correct height for measuring with a dial indicator. Attach dial indicator Tool C-3339 to the cylinder head and set it at a right angle to the valve stem being measured (Fig. 9).

(6) Move valve to and from the indicator. Total dial indicator reading should not exceed .017 inch. If the dial indicator reading is excessive or if the stems are scored or worn excessively, ream the guides for new valves with oversize stems.

(7) Service valves with oversize stems are available in .005, .015 and .030 inch oversize, the oversize valve stem are as follows:

Reamer Tool Number	Reamer Oversize	Valve Guide Size
C-3433	.005 in.	.379-.380 in.
C-3430	.015 in.	.389-.390 in.
C-3427	.030 in.	.404-.405 in.

(8) Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Do not attempt to ream the valve guides from standard directly to .030 inch. Use step procedure of .005, .015 and .030 inch so the valve guides may be reamed true in relation to the valve seat.**

Refacing Valves and Valve Seats

The intake and exhaust valve faces have a 45 degree angle. Always inspect the remaining valve margin after the valves are refaced (Fig. 10). Valves with less than 3/64 inch margin should be discarded.

(1) The angle of both the valve and seat should be identical. When refacing valve seats, it is important the correct size valve guide pilot be used for re-seating stones. A true and complete valve seat surface must be obtained.

(2) Inspect valve seat with Prussian blue to determine where valve contacts seat. To do this, coat valve seat lightly with Prussian blue, then set valve in place. Rotate valve with light pressure. If the blue is transferred to the center of the valve face, the contact is satisfactory. If the blue is transferred to the top edge of the valve face, lower the valve seat with a 30 degree stone. If the blue is transferred to the bot-

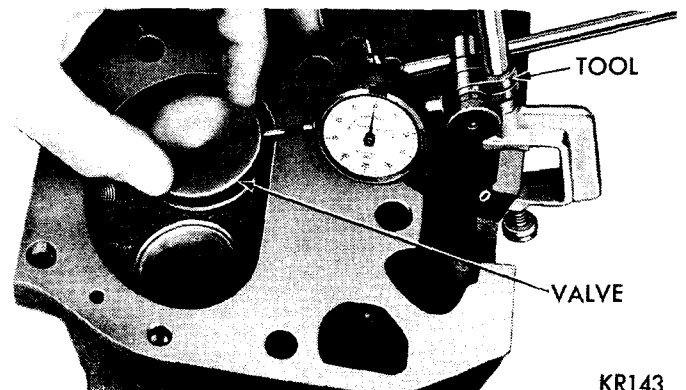


Fig. 9—Measuring Valve Guide Wear

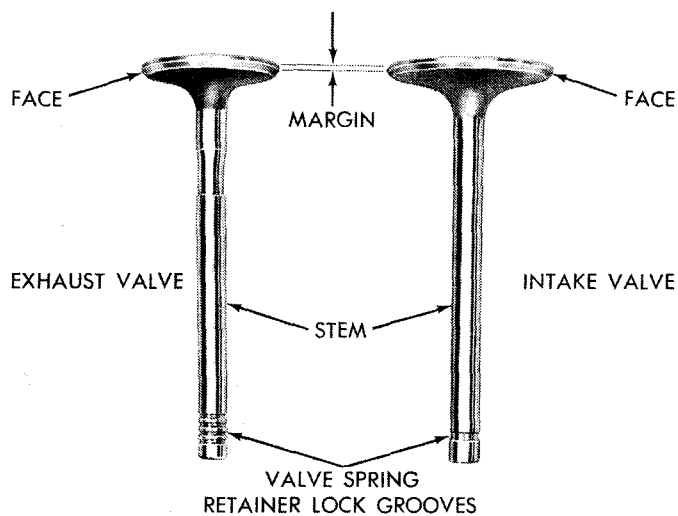


Fig. 10—Intake and Exhaust Valves

tom edge of the valve face raise the valve seat with a 60 degree stone.

(3) When the seat is properly positioned the width of the intake seats should be $1/16$ to $3/32$ inch. The width of the exhaust seats should be $3/64$ to $1/16$ inch.

(4) Measure the concentricity of the valve seat using dial indicator No. 13725. The total runout should not exceed .003 inch (total indicator reading).

(5) When valves and seats are reground, the position of the valve in the cylinder head is changed, shortening the operating length of the hydraulic tappet. This means that the plunger is operating closer to its "bottomed" position, and less clearance is available for thermal expansion of the valve mechanism during high speed driving.

(6) The design of the valve mechanism includes a safety factor to allow for a limited amount of wear, and the refacing of the valves and seats.

(7) To insure that limits have not been exceeded, the dimension from valve spring seat in the head to the valve tip should be measured with gauge, Tool C-3648 (Fig. 11).

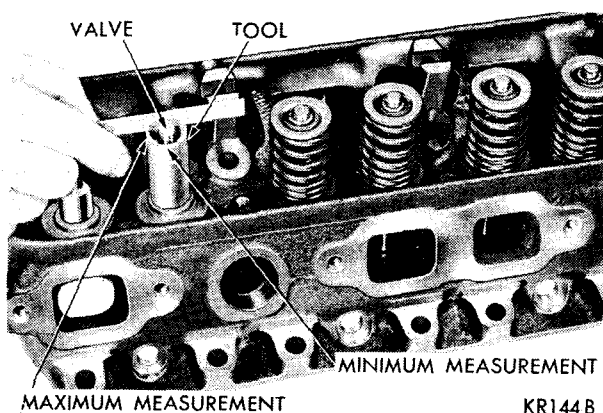


Fig. 11—Measuring Valve Stem Length

(8) The end of the cylindrical gauge and the bottom of slotted area represent the maximum and minimum allowable extension of the valve stem tip beyond the spring seat.

(9) If the tip exceeds the maximum, grind stem tip to within gauge limits. Clean tappets if tip grinding is required.

Testing the Valve Springs (Fig. 12)

(1) Whenever valves are removed for inspection, reconditioning or replacement, the valve springs should be tested. As an example, the compressed length of the spring to be tested is $1-15/32$ inches. Turn the table of Tool C-647 until the surface is in line with the $1-15/32$ inch mark on the threaded stud and the zero mark to the front. Place the spring over the stud on the table and lift the compressing lever to set the tone device. Pull on the torque wrench until a ping is heard. Take the reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at the test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tension. Discard the springs that do not meet specifications.

(2) Inspect each valve spring for squareness at both ends with a steel square and surface plate (Fig. 13).

(3) If the spring is more than $1/16$ inch out of square, install a new spring.

Installation

(1) Coat valve stems with lubricating oil and insert them in position in cylinder head.

(2) Install new cup seals on the intake and exhaust valve stems and over valve guides (Figs. 14 and 15) and install valve springs and retainers.

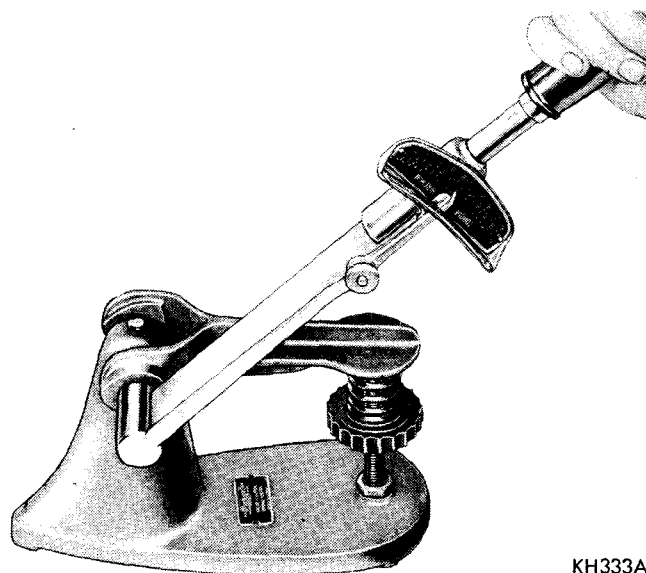


Fig. 12—Testing Valve Spring

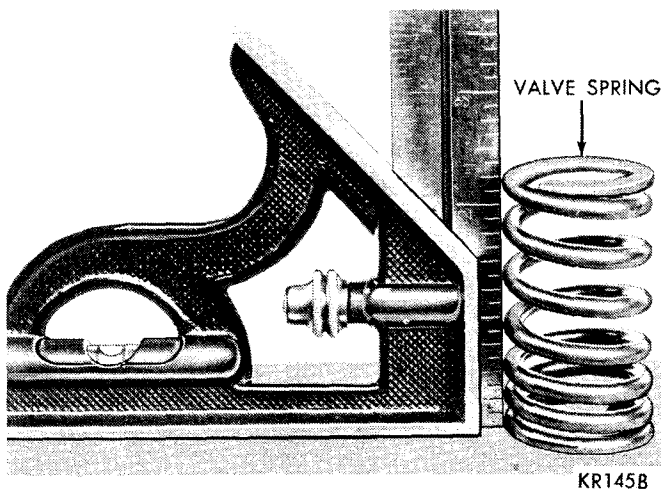


Fig. 13—Inspecting Valve Spring Squareness

(3) Compress valve springs with Tool C-3422A. Install locks and release tool.

If valves and/or seats are reground, measure installed height of the springs. Make sure measurement is taken from the bottom of spring seat in cylinder head to bottom surface of spring retainer. If the height is greater than 1-57/64 inches, install a 1/16 inch spacer in the head counterbore to bring the spring height back to normal 1-53/64 to 1-57/64 inch. (If spacers are installed, measure from the top of the spacer.)

Replacing Valve Stem Shields or Valve Springs, Cylinder Head Not Removed

(1) Set engine basic timing to TDC and remove Air Cleaner.

(2) Remove cylinder head covers and spark plugs.

(3) Remove coil wire from distributor and secure to good ground to prevent engine from starting.

(4) Using suitable socket and flex handle at crankshaft pulley retaining screw, turn engine so the num-

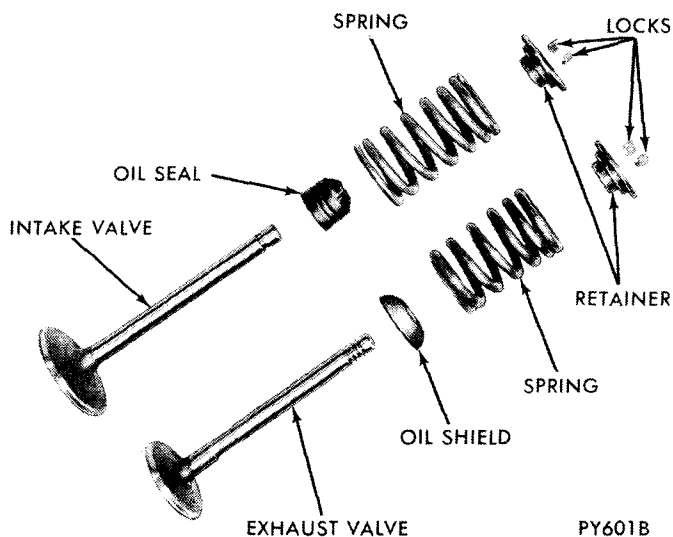


Fig. 14—Valve Assembly (Disassembled View)

ber 1 piston is at Top Dead Center on the compression stroke.

(5) Remove rocker arms with rocker shaft and install a dummy shaft. (The rocker arms should not be disturbed and left on shaft).

(6) With air hose attached to adapter tool C-3907 installed in number 1 spark plug hole, apply 90 to 100 psi air pressure.

(7) Using Tool C-3906 or C-4228 compress valve spring and remove retainer valve locks and valve spring.

(8) Install cup shields on the exhaust valve stem and position down against valve guides.

(9) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as a guide. **Do Not Force** seal against top of guide. When installing the valve retainer locks, compress the spring **only enough** to install the locks.

(10) Follow the same procedure on the remaining 7 cylinders using the firing order sequence 1-8-4-3-6-5-7-2. **Make sure piston in cylinder is at TDC on the valve spring that is being removed.**

(11) Remove adapter Tool 3907.

(12) Remove dummy shaft and install rocker shaft with rocker arms.

(13) Install covers and coil wire to distributor.

(14) Install air cleaner.

(15) Road test vehicle.

HYDRAULIC TAPPETS

Preliminary to Checking the Hydraulic Tappets

(1) Before disassembling any part of the engine to correct tappet noise, read the oil pressure at the gauge (Install a reliable gauge at pressure sending unit if vehicle has no oil pressure gauge). Check the oil level in the oil pan. The pressure should be between 30 and 80 pounds at 2000 R.P.M.

(2) The oil level in the pan should never be above the "full" mark on dipstick, or below the "add oil"

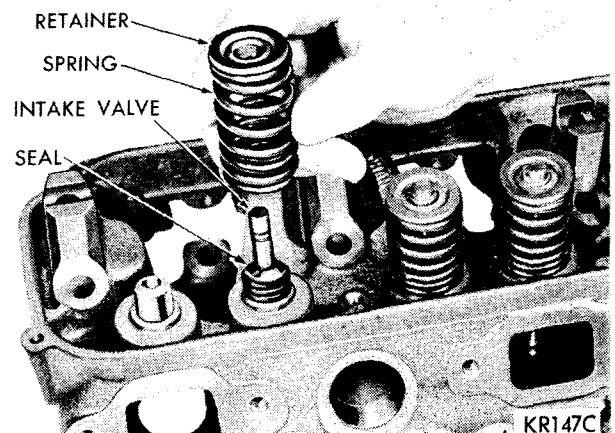


Fig. 15—Installing Valve, Spring, Cup Seal and Retainer

mark. Either of those two conditions could be responsible for noisy tappets.

Oil Level Too High

If oil level is above the "full" mark on dipstick, it is possible for the connecting rods to dip into the oil while engine is running and create foam. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

Oil Level Too Low

Low oil level may allow oil pump to take in air which, when fed to the tappets, causes them to lose length and allow valves to seat noisily. Any leaks on intake side of pump through which air can be drawn will create the same tappet action. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than one tappet will be noisy. When oil level and leaks have been corrected, engine should be operated at fast idle for sufficient time to allow all of the air inside of the tappets to bleed out.

Tappet Noise Diagnosis

(1) To determine source of tappet noise, operate engine at idle with cylinder head covers removed.

(2) Feel each valve spring or rocker arm to detect noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on the valve spring. If noise is not appreciably reduced, it can be assumed the noise is in the tappet. Inspect the rocker arm push rod sockets and push rods ends for wear.

(3) Valve tappet noise ranges from light noise to a heavy click. A light noise is usually caused by excessive leakdown around the unit plunger which will necessitate replacing the tappet, or by the plunger partially sticking in the tappet body cylinder. A heavy click is caused either by a tappet check valve not seating, or by foreign particles becoming wedged between the plunger and the tappet body, causing the plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between the valve stem and rocker arm as valve closes. In either case, tappet assembly should be removed for inspection and clearing.

Tappet Removal

The tappet can be removed without removing the intake manifold or cylinder heads by following this recommended procedure:

- (1) Remove cylinder head covers.
- (2) Remove rocker arms and shaft assembly.
- (3) Remove push rods and **identify to insure installation in original location.**

(4) Slide Tool C-4129 through push rod opening in cylinder head and seat tool firmly in the head of tappet.

(5) Pull tappet out of bore with a twisting motion. If all tappets are to be removed, **identify tappets to insure installation in original location.**

A diamond shaped marking stamped on the engine numbering pad indicates that some tappet bodies are .008 inch oversize.

CAUTION: The plunger and tappet bodies are not interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tappet at a time to avoid mixing of parts. Mixed parts are not compatible. Do not disassemble a tappet on a dirty work bench.

Disassembly (Fig. 16)

- (1) Pry out plunger retainer spring clip.
- (2) Clean varnish deposits from inside of tappet body above plunger cap.
- (3) Invert tappet body and remove plunger cap, plunger, check valve, check valve spring, check valve retainer and plunger spring. Check valve may be flat or ball.

Cleaning and Assembly

- (1) Clean all tappet parts in a solvent that will remove all varnish and carbon.
- (2) Replace tappets that are unfit for further service with new assemblies.
- (3) If plunger shows signs of scoring or wear and valve is pitted, or if valve seat on end of plunger indicates any condition that would prevent valve from seating, install a new tappet assembly.
- (4) Assemble tappets (Fig. 16).

Testing

- (1) Fill a pan with clean kerosene.
- (2) Remove cap from plunger and plunger from tappet body.
- (3) Fill tappet body with kerosene and install plunger.
- (4) Unseat check valve with a brass rod to permit complete installation of plunger. Replace cap.
- (5) Hold tappet in an upright position and insert

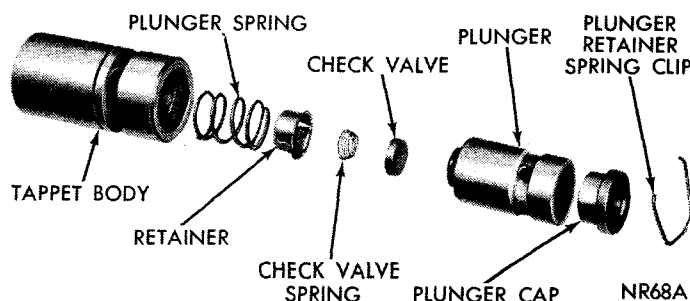


Fig. 16—Hydraulic Tappet Assembly (Disassembled View)

lower jaw of pliers, Tool C-3160, in the groove of tappet body (Fig. 17).

(6) Engage jaw of pliers with top of tappet plunger. Test leakdown by compressing the pliers. If plunger collapses almost instantly as pressure is applied, disassemble tappet, clean and test again (Fig. 17).

(7) If tappet still does not operate satisfactorily after cleaning, install a new tappet assembly.

If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize.

Installation

(1) Lubricate tappets.

(2) Install tappets and push rods in their original positions.

(3) Install rocker arm and shaft assembly.

(4) Start and operate engine. Warm up to normal operating temperature.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

VALVE TIMING (All Models)

(1) Turn crankshaft until NO. 6 exhaust valve is closing and NO. 6 intake valve is opening.

(2) Insert a 1/4 inch spacer between rocker arm pad and stem tip of NO. 1 intake valve (second valve on the left bank).

(3) Install a dial indicator so plunger contacts valve spring retainer as nearly perpendicular as possible.

(4) Allow spring load to bleed tappet down giving in effect a solid tappet. Zero the indicator.

(5) Turn the crankshaft clockwise (normal running direction) until intake valve has lifted .025 inch with 260-268 degrees camshaft. See specifications for engine application. The timing on the timing indicator, located on the chain case cover, should read from 10 degrees BTDC to 2 degrees ATDC. If the reading is

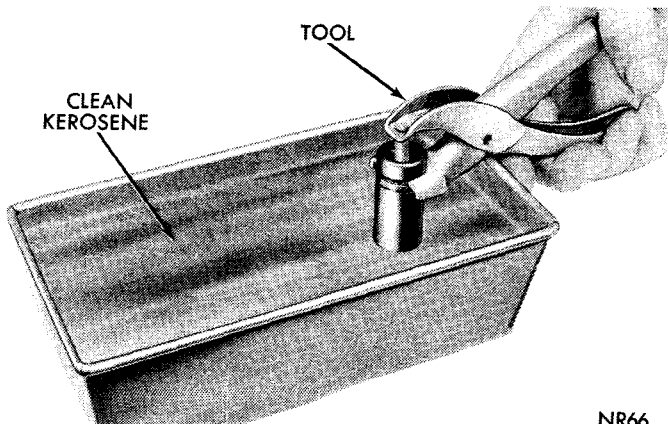


Fig. 17—Testing Tappet Using Tool C-3160

not within specified limits: Inspect timing sprocket index marks, inspect timing chain for wear, and determine accuracy of the DC mark on timing indicator. Turn crankshaft counterclockwise until valve is closed and remove the indicator and spacer.

CAUTION: Do not turn crankshaft any further clockwise, as the valve spring might bottom and result in serious damage.

TIMING CHAIN COVER, OIL SEAL AND CHAIN

Cover Removal

(1) Drain cooling system and remove radiator and water pump assembly.

(2) Remove crankshaft vibration damper attaching bolt.

(3) Remove two of the pulley bolts, install Tool C-3688, and pull damper assembly off end of crankshaft (Fig. 18).

(4) Remove chain cover and gasket.

Measuring Timing Chain for Stretch

(1) Place a scale next to the timing chain so any movement of the chain may be measured.

(2) Place a torque wrench and socket over camshaft sprocket attaching bolt and apply torque in the direction of crankshaft rotation to take up slack; 30 foot-pounds (with cylinder heads installed) or 15 foot-pounds (cylinder heads removed). **With torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block crankshaft to prevent rotation.**

(3) Holding a scale with dimensional reading even with edge of a chain link, apply torque in the reverse direction 30 foot-pounds with cylinder heads installed) or 15 foot-pounds (cylinder heads removed), and note amount of chain movement (Fig. 19).

(4) Install a new timing chain, if its movement exceeds 3/16 inch.

(5) If chain is not satisfactory, remove camshaft sprocket attaching bolt and remove timing chain with crankshaft and camshaft sprockets.

When installing timing chain, use Tool C-3509 to prevent camshaft from contacting the welch plug in

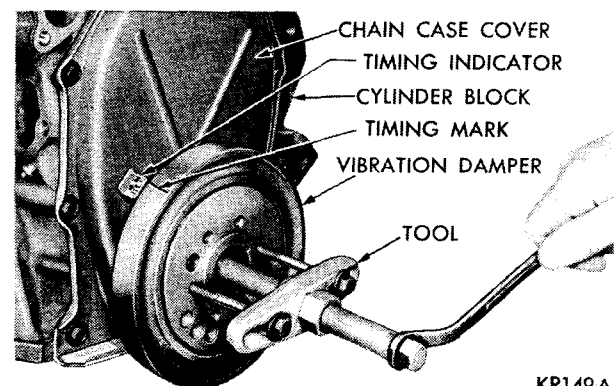
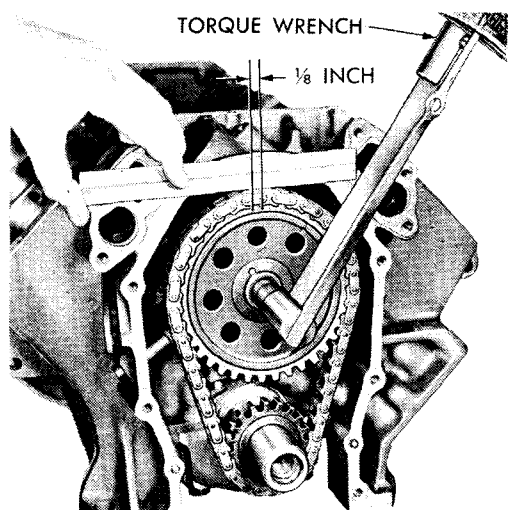


Fig. 18—Removing Vibration Damper Assembly



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Fig. 19—Measuring Timing Chain Stretch

the rear of engine block. Remove distributor and oil pump-distributor drive gear. Locate tool against rear side of cam gear and attach tool with distributor retainer plate bolt (Fig. 20).

(6) Place camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft sprocket bores.

(7) Place timing chain around both sprockets.

(8) Turn crankshaft and camshaft to line up with keyway location on crankshaft sprocket and dowel hole in camshaft sprocket.

(9) Lift sprockets and chain (keep sprockets tight against chain in position as described).

(10) Slide both sprockets evenly over their respective shafts.

(11) Use a straight edge to measure alignment of timing marks (Fig. 21).

(12) Install washer and camshaft sprocket bolt, tighten to 50 foot-pounds. Check to be sure that rear face of aluminum camshaft sprocket is flush with end of camshaft.

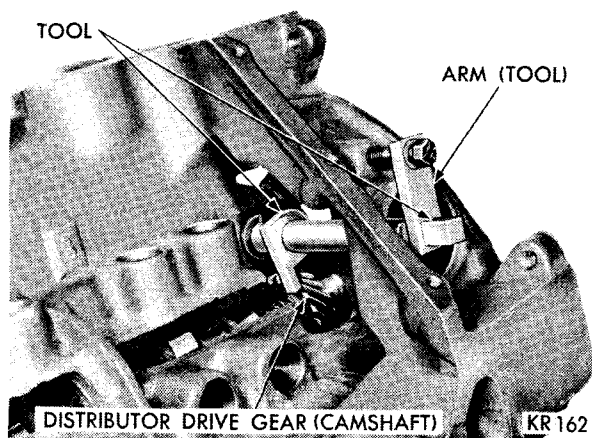
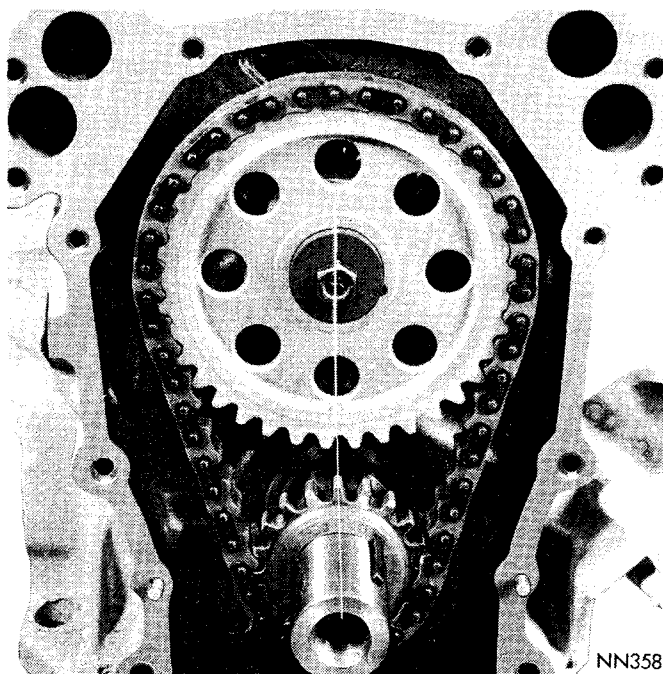


Fig. 20—Camshaft Holding Tool C-3509



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Fig. 21—Alignment of Timing Marks

Oil Seal Removal (Cover Removed)

(1) Using a drift and hammer tap lightly at several places around the seal case to deform the oil seal case inward.

(2) Engage the seal case with vise grips. Twist and pull on the vise grips at several places around the seal case for removal.

(3) Insert installing screw through the installing plate, part of Tool C-3506.

(4) Insert installing screw with the plate through seal opening (inside of chain case cover facing up).

(5) Place seal in cover opening, with seal lips down. Place seal installing plate into the new seal, with protective recess toward lip of seal retainer Tool SP-5598, part of Tool C-3506.

(6) Install flat washer and nut on installer screw, hold screw and tighten nut.

(7) The seal is properly installed when the seal case is tight against face of cover. Try to insert a .0015 inch feeler gauge between the case and the cover. If the seal is installed properly, feeler gauge cannot be inserted. Seal must be fully bottomed in cover (Fig. 22).

Cover Installation

(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs.

(2) Using a new gasket slide chain case cover over locating dowels. Install and tighten bolts to 15 foot-pounds.

(3) Lubricate seal lip with lubriplate, place damper hub slot on key in crankshaft, and slide vibration damper on crankshaft.

(4) Place installing tool, part of Tool C-3688 in

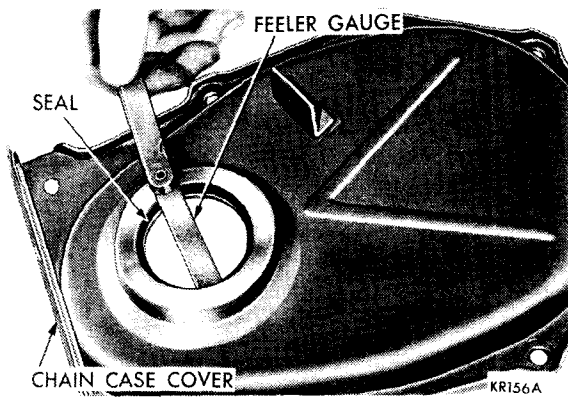


Fig. 22—Inspecting Seal for Proper Seating

position and press damper on the crankshaft (Fig. 23).

(5) Install damper retainer washer and bolt. Tighten to 135 foot-pounds.

(6) Slide belt pulley over shaft and attach with bolts and lockwashers. Tighten bolts to 200 inch-pounds.

Whenever an engine has been rebuilt and/or a new camshaft and/or new tappets have been installed, add one pint of Chrysler Crankcase Conditioner Part Number 3419130 or equivalent to engine oil to aid in break-in. The oil mixture should be left in engine for a minimum of 500 miles, and drained at the next normal oil change.

CAMSHAFT

The camshaft has an integral oil pump and distributor drive gear and fuel pump eccentric (Fig. 24).

The rearward camshaft thrust is taken by the rear face of the aluminum camshaft sprocket hub, bearing directly on the front of cylinder block, eliminating need for a thrust plate. The helix of the oil pump and distributor drive gear and camshaft lobe taper both tend to provide a rearward thrust.

Removal

(1) With tappets and the timing chain and sprockets removed, remove distributor and lift out oil pump and distributor drive shaft.

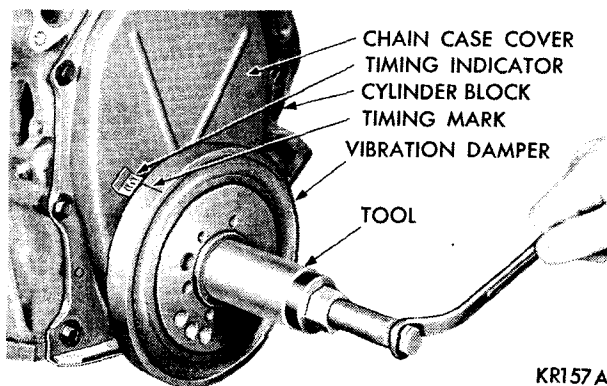


Fig. 23—Installing Vibration Damper Assembly

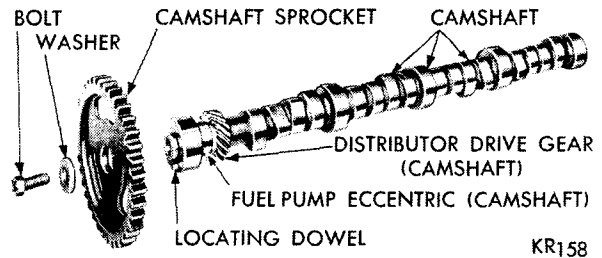


Fig. 24—Camshaft and Sprocket Assembly (Disassembled View)

(2) Remove fuel pump to allow fuel pump push rod to drop away from cam eccentric.

(3) Remove camshaft, being careful not to damage camshaft bearings with cam lobes.

Installation

(1) Lubricate camshaft lobes and camshaft bearing journals and insert camshaft to within 2 inches of its final position in cylinder block.

(2) Modify Tool C-3509 by grinding off index lug holding the upper arm on the tool and rotate arm 180 degrees.

(3) Install Tool C-3509 in place of distributor drive gear and shaft, as shown in (Fig. 20).

(4) Hold tool in position with distributor lock plate screw. This tool will restrict camshaft from being pushed in too far and prevent knocking out the welch plug in the rear of cylinder block.

The tool should remain installed until camshaft and crankshaft sprockets and timing chain have been installed.

Whenever camshaft is replaced, all of the tappet faces must be inspected for crown with a straight edge. If any contact surface is dished or worn, tappet must be replaced.

CAMSHAFT BEARINGS

(Engine Removed from Vehicle)

Removal

(1) With engine completely disassembled, drive out camshaft rear bearing welch plug.

(2) Install proper size adapters and horse shoe washers (part of Tool C-3132A) at the back of each bearing to be removed and drive out bearings (Fig. 25).

Installation

(1) Install new camshaft bearings with Tool C-3132A. Place new camshaft bearing over proper adapter.

(2) Position bearing in the tool. Install the horse shoe lock and by reversing removal procedure, carefully drive bearing into place.

(3) Install remaining bearings in like manner.

Install the NO. 1 camshaft bearing 1/32 inch inward from the front face of cylinder block.

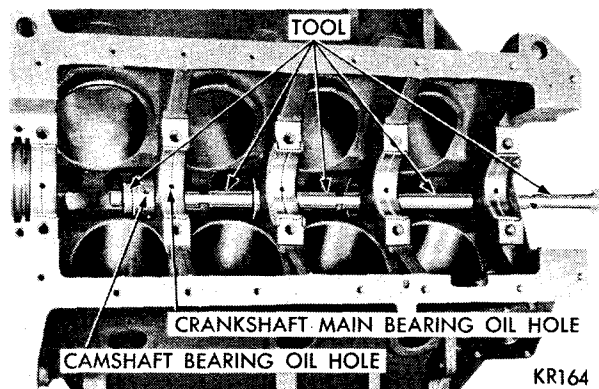


Fig. 25—Removing Camshaft Bearing

The oil holes in camshaft bearings and the cylinder block must be in exact register to insure proper lubrication (Fig. 25).

The camshaft bearing index can be inspected after installation by inserting a pencil flashlight in the bearing. The camshaft bearing oil hole should be perfectly aligned with the drilled oil passage from the main bearing. Other oil holes in the camshaft bearings should be visible by looking down on the left bank oil hole above and between NO. 6 and NO. 8 cylinders to NO. 4 camshaft bearing and on the right bank above and between NO. 5 and 7 cylinders to NO. 4 camshaft bearings. If camshaft bearing oil holes are not in exact register, remove and reinstall them correctly. Coat core plug hole with sealer 3837795 or equivalent. Install a new core plug at rear of camshaft. **Be sure this plug does not leak.**

DISTRIBUTOR DRIVE SHAFT BUSHING

Removal

(1) Insert Tool C-3052 into the old bushing and thread down until a tight fit is obtained (Fig. 26).

(2) Hold remover screw and tighten nut until bushing is removed.

Installation

(1) Slide a new bushing over burnishing end of

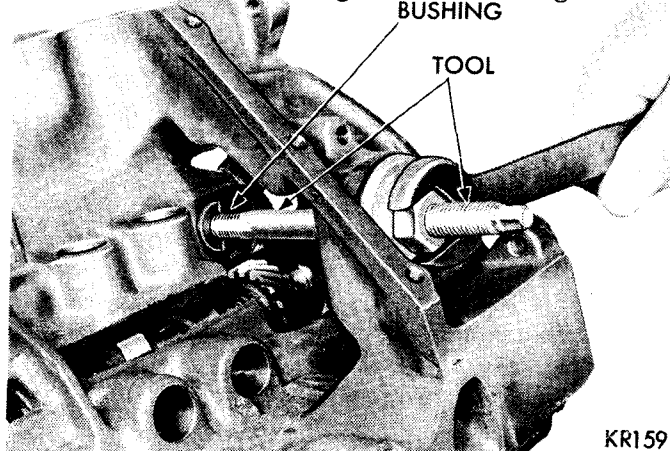


Fig. 26—Removing Distributor Drive Shaft

Tool C-3053 and insert tool bushing into the bore.

(2) Drive bushing and tool into position, using a hammer (Fig. 27).

(3) As the burnisher is pulled through the bushing by tightening remover nut, the bushing is expanded tight in the block and burnished to correct size (Fig. 28). **DO NOT REAM THIS BUSHING.**

Distributor Timing

Before installing distributor and oil pump drive shaft, time the engine as follows:

(1) Rotate crankshaft until NO. 1 cylinder is at top dead center on the firing stroke.

(2) When in this position, the straight line on the vibration damper should be under "O" on timing indicator.

(3) Coat shaft and drive gear with engine oil. Install the shaft so that after gear spirals into place, it will index with the oil pump shaft, so slot in top of drive gear will be parallel with center line of crankshaft (Fig. 29).

Installation of Distributor

(1) Hold distributor over mounting pad on cylinder block with vacuum chamber pointing toward center of engine.

(2) Turn rotor until it points forward and to approximate location of No. 1 tower terminal in the distributor cap.

(3) Place distributor "O" ring in position.

(4) Lower the distributor and engage the shaft in the slot of distributor drive shaft gear.

(5) Install and tighten hold down clamp.

CYLINDER BLOCK

The cylinder block is of the deep block design which eliminates the need for a torque converter housing adapter plate. Its side extends three inches below the crankshaft center line.

Oversized Cylinder Bores

Whenever it is necessary to machine cylinder bores

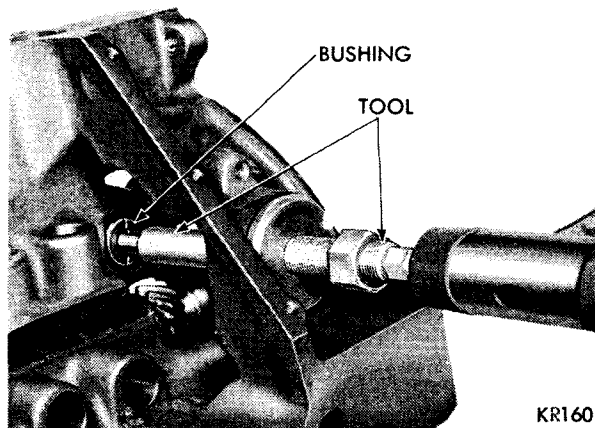


Fig. 27—Installing Distributor Drive Shaft Bushing

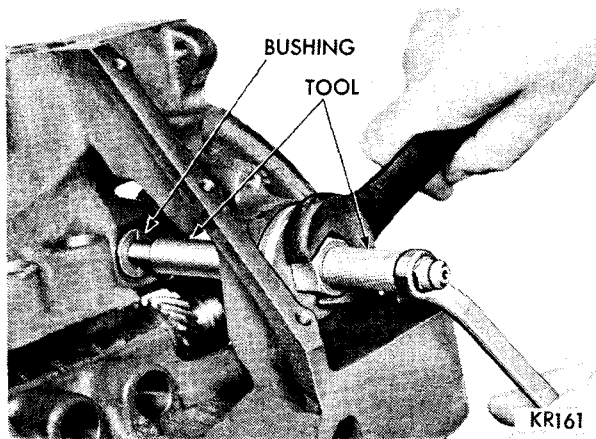


Fig. 28—Burnishing Distributor Drive Shaft Bushing

.020 oversize all bores shall be oversized. Engines will be identified with a letter "A" stamped on the engine serial pad. See specifications for oversized and under-sized machined parts.

Piston Removal

(1) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.**

The pistons and connecting rods must be removed from the top of the cylinder block. When removing piston and connecting rod assemblies from the engine, rotate the crankshaft so each connecting rod is centered in cylinder bore.

(2) Inspect connecting rods and connecting rod caps for cylinder identification. Identify them if necessary.

(3) Remove connecting rod cap. Install connecting rod bolt guide set on connecting rod bolts. Push each piston and rod assembly out of cylinder bore. **Be careful not to nick crankshaft journals.**

(4) Install bearing caps on mating rods.

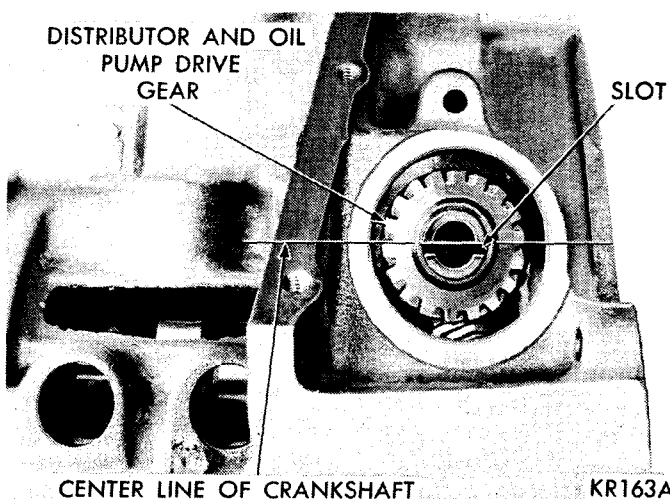


Fig. 29—Distributor Drive Gear Installed

Cleaning and Inspection

(1) Clean cylinder block thoroughly and inspect all core hole plugs for evidence of leaking.

(2) If new core plugs are installed, coat edges of plug and core hole with Number 1057794 Sealer or equivalent. Drive the core plug in so that the rim lies at least 1/64 inch below the lead-in chamfer.

(3) Examine block for cracks or fractures.

Cylinder Bore Inspection

The cylinder walls should be measured for out-of-round and taper with Tool C-119. If the cylinder bores show more than .005 inches out-of-round, or a taper of more than .010 inches or if the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed, and new pistons and rings fitted. Whatever type of boring equipment is used, boring and honing operation should be closely coordinated with the fitting of pistons and rings in order that specified clearance may be maintained.

Honing Cylinder Bores

Before honing, stuff plenty of clean rags under the bores, over the crankshaft to keep the abrasive materials from entering the crankcase area.

(1) Used carefully, the cylinder bore resizing hone C-823 equipped with 220 grit stones and 390 extensions necessary with 400 cubic inch engines is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round as well as removing light scuffing, scoring or scratches. Usually, a few strokes will clean up a bore and maintain the required limits.

(2) Deglazing of the cylinder walls must be done using a cylinder surfacing hone, Tool C-3501, equipped with 280 grit stones (3501-3810) if the cylinder bore is straight and round. 20 to 60 strokes depending on the bore condition will be sufficient to provide a satisfactory surface. Inspect cylinder walls after each 20 strokes. Using honing oil C-3501-3880 or a light honing oil available from major oil distributors. **Do not use engine or transmission oil, mineral oil or kerosene.**

(3) Honing should be done by moving the hone up and down fast enough to get a cross-hatch pattern. When hone marks intersect at 50-60 degrees, cross hatch angle is most satisfactory for proper seating of rings (Fig. 30).

(4) After honing, it is necessary that the block be cleaned again to remove all traces of abrasives. Wash cylinder block and crankshaft thoroughly.

CAUTION: Be sure all abrasives are removed from the engine parts after honing. It is recommended that a solution of soap and water be used with a brush and the parts then thoroughly dried. The bore can be considered clean when it can be wiped clean with a white cloth and the cloth remains clean. Oil bores after cleaning to prevent rust.

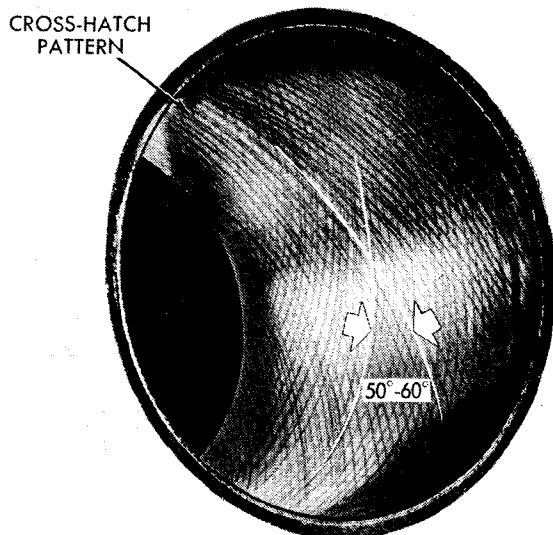


Fig. 30—Cross Hatch Pattern

PISTONS, PINS AND RINGS

Pistons

The pistons are cam ground so that the diameter at the pin boss is less than its diameter across the thrust face. This allows for expansion under normal operating conditions. Under operating temperatures, expansion forces the pin bosses away from each other, thus causing the piston to assume a more nearly round shape. It is important that old or new pistons be measured for taper and elliptical shape before they are fitted into the cylinder bore (Fig. 31).

Finished Pistons

All pistons are machined to the same weight in grams, regardless of oversize so piston balance can be maintained. For cylinder bores which have been honed or rebored, pistons are available in standard and the following oversize: .020 inch.

Fitting Pistons

Pistons and cylinder wall must be clean and dry.

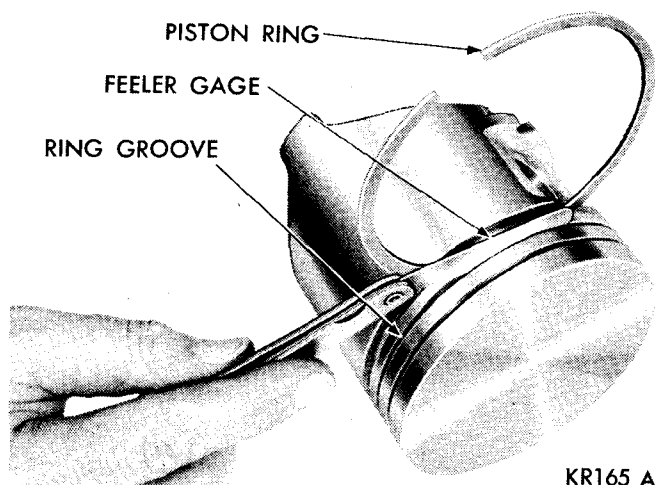


Fig. 31—Piston Measurements

Specified clearance between the piston and the cylinder wall is .0003 to .0013 inch.

Piston diameter should be measured at the top of skirt 90 degrees to piston pin axis. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line.

Pistons and cylinder bores should be measured at normal room temperature, 70 degrees F.

All service pistons include pins, and are available in standard and the following oversize: .020 inch.

Fitting Rings

(1) Measure piston ring gap about two inches from bottom of cylinder bore in which it is to be fitted. (An inverted piston can be used to push rings down to insure positioning rings squarely in cylinder bore before measuring.)

(2) Insert feeler stock in the gap. Ring gap should be between .013 to .023 inch for the compression rings and .015 to .055 inch for the oil ring steel rails in standard size bores. Maximum gap on .005 inch O/S bores should be .060 inch for compression rings and .070 inch for the oil ring steel rails.

(3) Measure side clearance between piston ring and ring groove (Fig. 32). Clearance should be .0015 to .003 inches for the top compression ring and intermediate ring. Steel rail service oil ring should be free in groove, but should not exceed .008 inch side clearance.

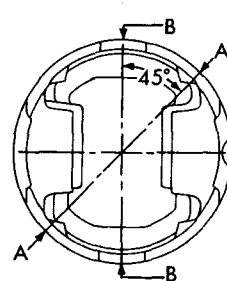
(4) Install the three piece oil ring in lower ring groove using instructions in ring package.

(5) Install compression rings in middle and top groove as shown in instruction sheet. Be sure the mark "top" on each compression ring faces top of piston.

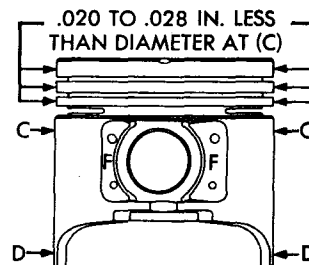
(6) For the two top rings use ring installer Tool C-4184 for the 440 cubic inch engine.

Piston Pin Removal

(1) Arrange Tool C-3684 parts, using pilot SP-3022 for removal of piston pin (Fig. 33).



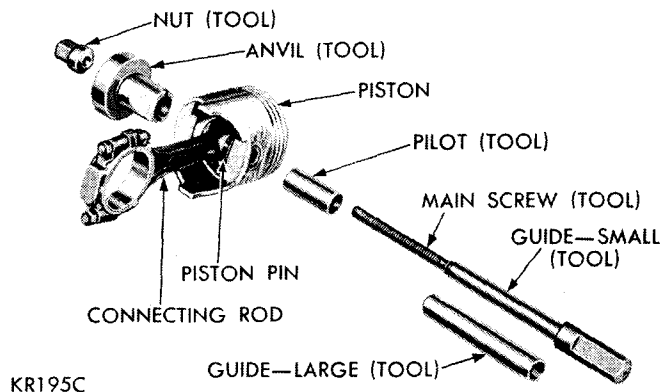
THE ELLIPTICAL SHAPE OF THE PISTON SKIRT SHOULD BE .013 TO .015 IN. LESS AT DIAMETER (A) THAN ACROSS THE THRUST FACES AT DIAMETER (B). MEASUREMENT IS MADE 1/8 IN. BELOW LOWER RING GROOVE



DIAMETERS AT (C) AND (D) CAN BE EQUAL OR DIAMETER AT (D) CAN BE .0015 IN. GREATER THAN (C)

Fig. 32—Measuring Piston Ring Clearance

NU258A



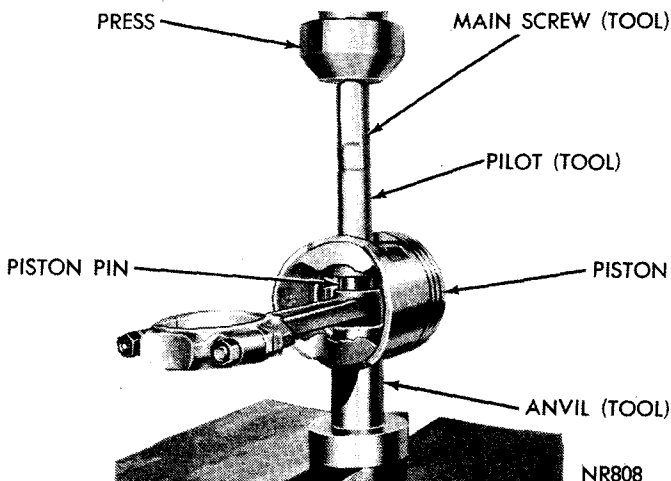
KR195C

Fig. 33—Tool Arrangement for Removing Piston Pin

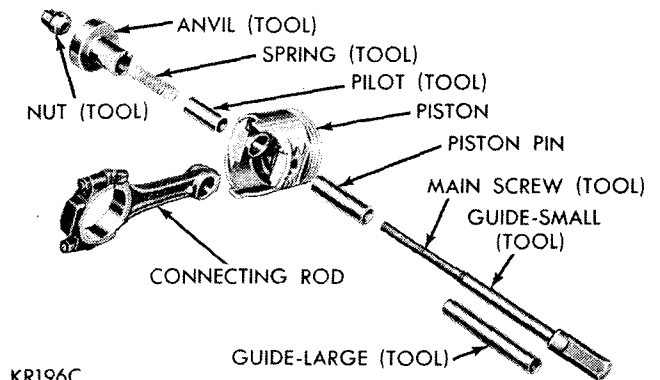
- (2) Install pilot on main screw.
 - (3) Install main screw through piston pin.
 - (4) Install anvil over threaded end of main screw with small end of anvil against piston boss. **Be sure spring is removed from anvil.**
 - (5) Install nut loosely on main screw and place assembly on a press, (Fig. 34).
 - (6) Press piston pin out of connecting rod.
- When pin falls free from connecting rod, stop press to prevent damage to bottom of anvil.**
- (7) Remove tool from piston.

Installation

- (1) Test piston pin fit in the piston. It should be a sliding fit in the piston at 70 degrees F. Piston pins are supplied in standard sizes only.
- (2) Lubricate piston pin holes in the piston and connecting rod.
- (3) Arrange Tool C-3684 parts, **using pilot SP-3022** for installation of piston pin (Fig. 35).
- (4) Install spring inside the pilot and install spring and pilot in the anvil. Install piston pin over main screw.
- (5) Place piston, with "front" up, over the pilot so



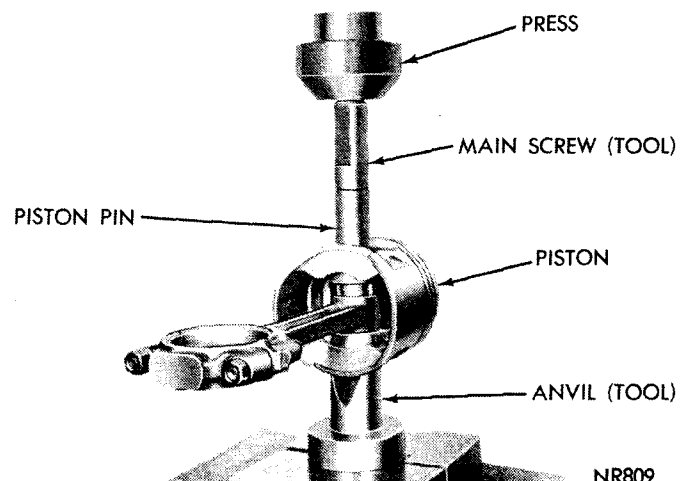
NR808

Fig. 34—Removing Piston Pin

KR196C

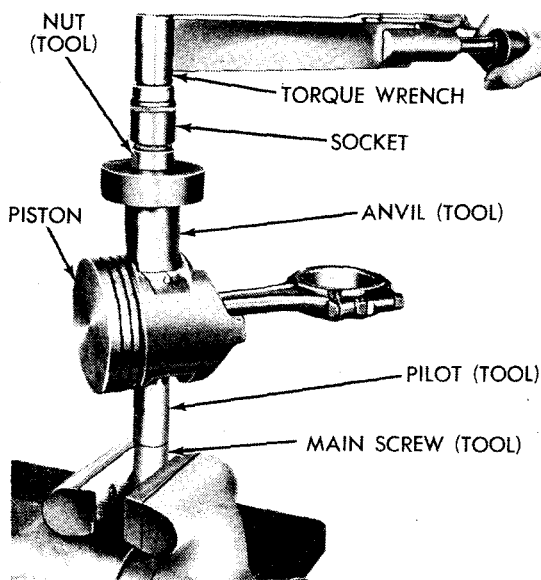
Fig. 35—Tool Arrangement for Installing Piston Pin

- pilot extends through piston pin hole.
 - (6) Position connecting rod over the pilot which extends through piston pin hole.
- Assemble rods to pistons of the right cylinder bank (2, 4, 6, and 8,) with indent on piston head opposite to the larger chamfer on the large bore end of connecting rod. Assemble rods to pistons of the left cylinder bank (1, 3, 5, and 7) with indent on piston head on the same side as the large chamfer on the large bore end of the connecting rod.**
- (7) Install main screw and piston pin in piston, (Fig. 35).
 - (8) Install nut on puller screw to hold assembly together. Place assembly on a press (Fig. 36).
 - (9) Press piston pin in until piston pin "bottoms" on the pilot. This will position pin in connecting rod.
 - (10) Remove tool and arrange tool parts and piston assembly in same manner as shown in (Fig. 37) for measuring pin fit.
 - (11) Place assembly in a vise (Fig. 37).
 - (12) Attach torque wrench to nut and tighten up to 15 foot-pounds. If the connecting rod moves downward on piston pin, reject this connecting rod and piston pin combination. Obtain a connecting rod with



NR809

Fig. 36—Installing Piston Pin



NR810

Fig. 37—Testing Fit of Piston Pin in Connecting Rod

proper small end bore diameter and repeat the installation and tightening procedure.

(13) If connecting rod does not move under 15 foot-pounds, piston pin and connecting rod interference is satisfactory, remove tool.

CRANKSHAFT IDENTIFICATION

Forged Or Cast

400 cubic inch engines are built with a cast crankshaft for automatic transmissions and forged crankshaft for manual transmissions. 440 cubic inch engines will have cast crankshafts for automatic and manual transmissions.

The cast crankshaft requires a different vibration damper and torque converter than the forged crankshaft. Severe engine vibration will result with inter-mixing of these components.

The cast crankshaft engines are identified by a letter "E" stamped on engine numbering pad (Fig. 38) following the built date (Example H440-0810E).

The cast crankshaft has clean sharp edges at counter-weights whereas the forged crankshaft does not.

When it is necessary to replace a crankshaft first determine the type of crankshaft forged or cast the engine was built with.

IMPORTANT: A Maltese Cross stamped on the engine numbering pad (Fig. 38) indicates that engine is equipped with a crankshaft which has one or more connecting rods and/or main bearings journal finished .001 inch undersize. The position of the undersize journal or journals is stamped on a machine surface of the NO. 3 counterweight (Fig. 39).

The connecting rod journals are identified by the letter "R" and main bearing journals by the letter

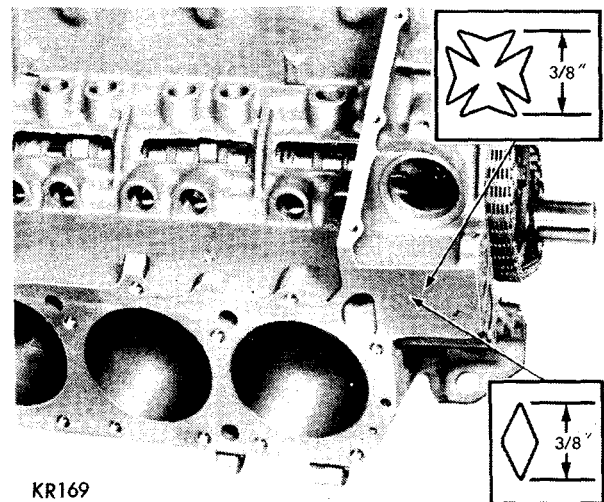


Fig. 38—Showing Location of External Engine Numbering

"M". For example, "M-1" indicates that NO. 1 main bearing is .001 inch undersize.

A Maltese Cross with an X indicates all rod or main journals are finished .010 inch undersize and the No. 2 counterweight will be stamped R-10 to indicate rod or M-10 for main journals.

When a crankshaft is replaced, all main and connecting rod bearings should be replaced with new bearings. Therefore, selective fitting of the bearings is not required when a crankshaft and bearings are replaced.

CONNECTING RODS

Installation of Connecting Rod Bearings

Fit all rods on one bank until complete. Do not alternate from one bank to another, because when rods are assembled to the pistons correctly, they are not interchangeable from one bank to another.

Each bearing cap has a small "V" groove across

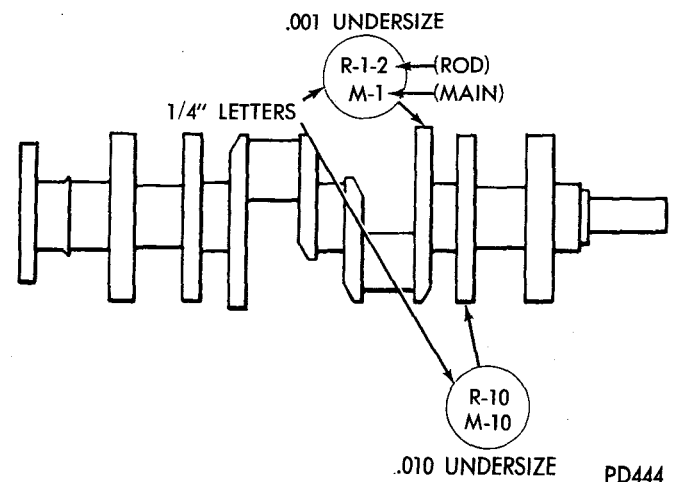


Fig. 39—Showing Location of Internal Marking of Counterweight

parting face. When installing the lower bearing shell, make certain "V" groove in shell is in line with "V" groove in cap. This allows lubrication of the cylinder wall. The bearings should always be installed so that the small formed tang fits into the machined grooves of the rods. The end clearance should be from .009 to .017 inch (two rods).

Limits of taper or out-of-round on any crankshaft journals should be held to a maximum of .001 inch. Bearings are available in .001, .002, .003, .010 and .012 inch undersize.

Install the bearings in pairs. Do not use a new bearing half with an old bearing half. Do not file the rods or bearing caps.

MEASURING CONNECTING ROD BEARING CLEARANCE

Shim Stock Method

(1) Place an oiled .001 inch brass shim stock (1/2 inch wide and 3/4 inch long) between the bearing and connecting rod journal.

(2) Install bearing cap and tighten to 45 foot-pounds.

(3) Turn crankshaft 1/4 turn in each direction. A slight drag should be felt which indicates clearance is satisfactory. Correct clearance is from .0005 to .002 inch.

(4) Side play should be from .009 to .017 inch (two rods.)

Plastic Gage Method

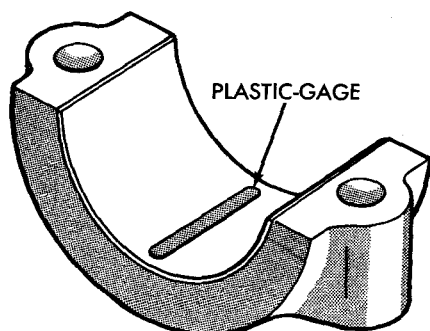
(1) Wipe journal clean.

(2) Place a strip of Plastic Gage across full width of lower insert at the center of bearing cap (Fig. 40).

(3) Install bearing cap to connecting rod and tighten retaining nuts to 45 foot-pounds torque.

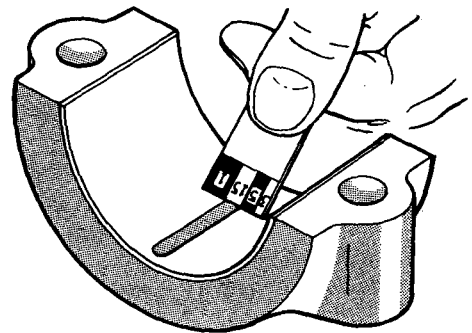
(4) Remove bearing cap and determine amount of clearance by measuring the width of the compressed Plastic Gage with the scale furnished (Fig. 41).

(5) New bearings should be installed if bearing clearance is not within specifications. Excessive taper indicates that a new or reground crankshaft is required.



PN248A

Fig. 40—Plastic Gage Placed in Lower Shell



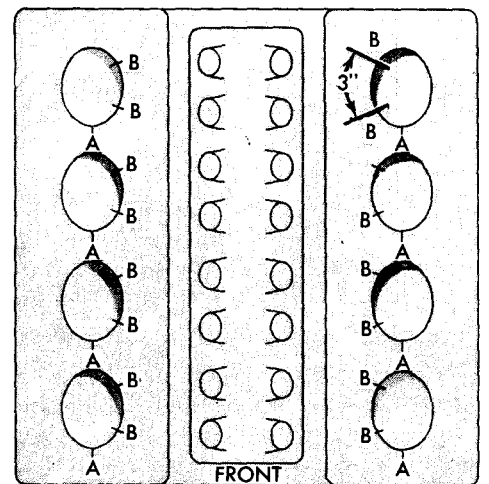
PN249

Fig. 41—Clearance Measurement

INSTALLING PISTON AND CONNECTING ROD ASSEMBLY

(1) Before installing pistons, rods, and rod assemblies in the bore, be sure that the compression ring gaps are staggered so that neither are in line with oil ring rail gaps.

(2) The oil ring expander ends should be positioned toward the outside of the "V" of the engine. The oil ring rail gaps should be positioned opposite each other and above the piston pin holes (Fig. 42).

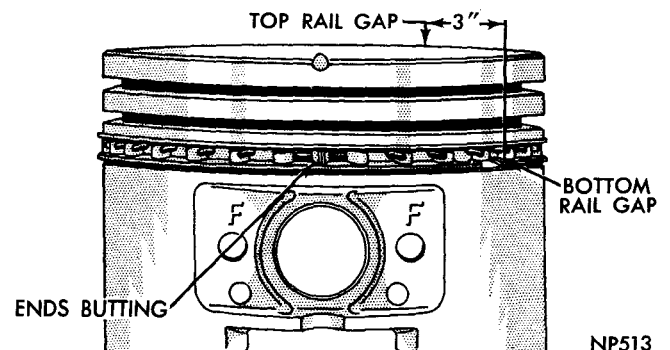


TOP VIEW OF BLOCK

A-EXPANDER GAPS

B-RAIL GAPS

IF YOU HAVE FOLLOWED THE INSTRUCTIONS, THE RING WILL BE IN THIS POSITION ON THE PISTON



NP513

Fig. 42—Proper Oil Ring Installation

(3) Immerse piston head and rings in clean engine oil, slide ring compressor, Tool C-385, over the piston and tighten with special wrench (part of Tool C-385). **Be sure position of rings does not change during this operation.**

(4) Install connecting rod bolt protectors on rod bolts, the long protector should be installed on the numbered side of the connecting rod.

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal (Fig. 43).

(6) Tap piston down in cylinder bore, using handle of a hammer. At the same time, guide connecting rod into position on crankpin journal.

(7) The notch or groove on top of piston must be pointing toward front of engine and larger chamfer of connecting rod bore must be installed toward crank pin journal fillet.

(8) Install rod caps, tighten nuts to 45 foot-pounds.

Whenever an engine has been rebuilt and/or a new camshaft and/or new tappets have been installed, add one pint of Chrysler Crankcase Conditioner Part Number 3419130 or equivalent to engine oil to aid in break-in. The oil mixture should be left in engine for a minimum of 500 miles, and drained at the next normal oil change.

CRANKSHAFT MAIN JOURNALS

Crankshaft main bearing journals should be inspected for excessive wear, taper and scoring. Journal grinding should not exceed .012 inch under the standard journal diameter. **DO NOT** grind the thrust faces of the NO. 3 bearing. Do not nick crankpin or main bearing fillets. After regrinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CAUTION: Journal grinding and polishing of nodular cast iron crankshaft journals is much more critical than forged steel crankshafts.

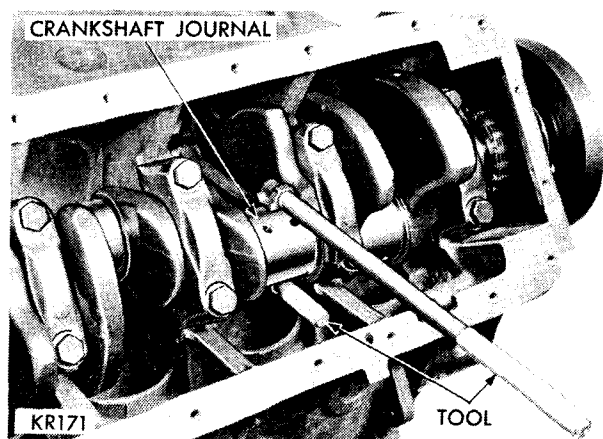


Fig. 43—Installing Connecting Rod

It is absolutely essential that final polishing be in the direction of normal rotation with 320 or 400 grit paper.

CRANKSHAFT MAIN BEARINGS

New lower main bearing halves Numbers 1, 2, 4 and 5 are interchangeable (Fig. 44). New upper main bearing halves Numbers 2, 4 and 5 are also interchangeable. Upper and lower bearing halves are not interchangeable because upper bearing has an oil hole and lower does not. Upper and lower bearings are grooved.

The NO. 1 upper main bearing **IS NOT INTERCHANGEABLE AND IS CHAMFERED** on the tab side for timing chain oiling and can be identified by a red marking on edge of bearing.

Upper and lower NO. 3 bearings are flanged to carry the crankshaft thrust loads and are **not interchangeable with any other bearings in the engine.**

Bearings that are not badly worn or pitted must be reinstalled in the same position.

Bearing caps are not interchangeable and should be marked at removal to insure correct assembly. Bearings are available in standard and the following undersizes: .001, .002, .003, .010, .011 and .012 inch. Do not install an undersize bearing that will reduce clearance below specifications.

Removal

(1) Remove oil pan and identify bearing caps before removal.

(2) Remove bearing caps one at a time. Remove upper half of bearing by inserting Tool C-3059 (Fig. 45) into oil hole of crankshaft.

(3) Slowly rotate crankshaft clockwise, forcing out upper half of bearing.

Installation

Only one main bearing should be selectively fitted

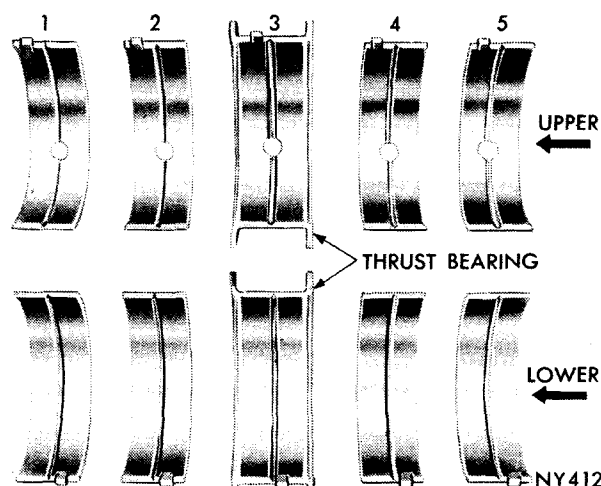


Fig. 44—Main Bearing Identification

while all other main bearing caps are properly torqued.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Tool C-3059 into oil hole of crankshaft (Fig. 45).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Tool C-3059.

MEASURING MAIN BEARING CLEARANCE

Shim Stock Method

(1) Smooth edges of a 1/2 x 3/4 inch piece of brass shim stock, .001 inch thickness.

(2) Install bearing in center main bearing cap, bearing tang in groove in cap, lubricate bearing and position shim stock across the bearing, install cap, tighten bolts to 85 foot-pounds.

(3) If a slight drag is felt as crankshaft is turned (moved no more than 1/4 turn in either direction), clearance is .001 inch or less and is considered satisfactory.

If, however, no drag is felt, the bearing is too large or crankshaft cannot be rotated, bearing is too small and should be replaced with the correct size.

(4) Measure crankshaft end play .002 to .009 inch. If end play is less than .002 inch or more than .009 inch, install a new number 3 main bearing.

(5) Fit remaining bearings in same manner.

It is permissible to use an .001 inch undersize bearing shell with one standard bearing shell or one .002 inch undersize bearing shell with one .001 inch undersize shell. **Always use the smaller diameter bearing half as the upper. Never use an upper bearing half more than .001 inch smaller than the lower bearing half and never use a new bearing half with a used bearing half.**

Plastic Gage Method

NOTE: Check clearance one bearing at a time.

(1) Support weight of crankshaft with a jack or

stand placed under counterweight adjacent to main bearing being checked.

NOTE: When servicing No. 1 main bearing, support crankshaft at vibration damper. All other bearings must remain tightened.

(2) Remove main bearing cap and insert.

(3) Clean insert and exposed portion of crankshaft journal.

(4) Place strip of Plastic Gage across full width of bearing insert (Fig. 40).

(5) Install bearing cap and tighten bolts to 85 foot-pounds torque.

(6) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastic Gage with furnished scale (Fig. 41).

(7) New bearings should be installed if bearing clearance is not within specifications. Excessive taper indicates that a new or reground crankshaft is required.

REAR MAIN BEARING OIL SEALS

Service seals are of split rubber type composition. The seals make it possible to replace the upper rear seal without removing the crankshaft. **The seal must be used as an upper and lower set and cannot be combined with the rope seal.**

(1) With oil pan removed, remove rear seal retainer and rear main bearing cap.

(2) Remove lower rope oil seal by prying from the side with a small screwdriver.

(3) Remove upper rope seal by turning in Tool C-4148 into the end of the seal, being careful not to damage the crankshaft (Fig. 46). Pull the seal out with the tool while rotating the crankshaft.

CAUTION: Always wipe crankshaft surface clean, then oil lightly before installing a new seal.

(4) Oil seal lip lightly with engine oil.

(5) Hold seal (with paint stripe to the rear) tightly against crankshaft with thumb to make sure that the

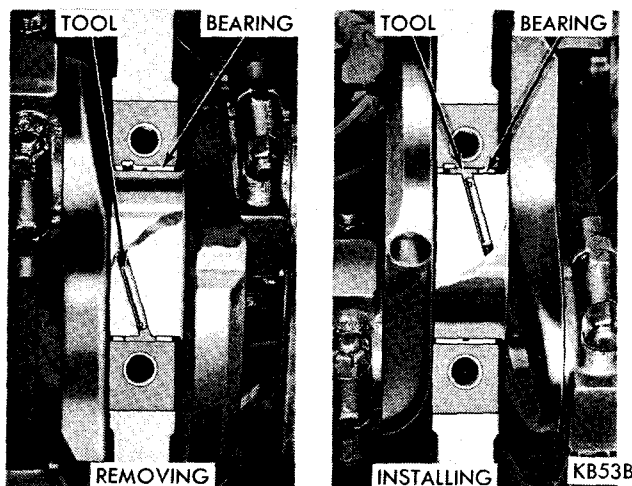


Fig. 45—Removing or Installing Upper Main Bearing

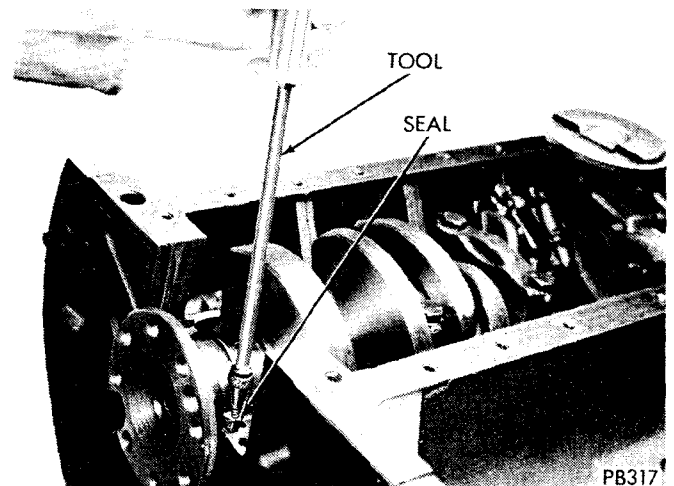


Fig. 46—Removing Upper Oil Seal with Tool C-4148