EIGHT CYLINDER ENGINE

(283 cu. in.)

INDEX

GENERAL DESCRIPTION

The standard 8-cylinder V-8 engine for 1200, 1600 and 1800 series passenger cars for 1961, is the Turbo-Fire 283 cubic inch V-8 engine, two barrel carburetor equipped, with a compression ratio of 8.5 to 1. Equipped with a single exhaust system, this engine is teamed with 3-speed, overdrive, Powerglide, or Turboglide transmission. Also available with these four transmissions is the optional 283 cubic inch V-8 engine with 4-barrel carburetor and a compression ratio of 9.5 to 1.

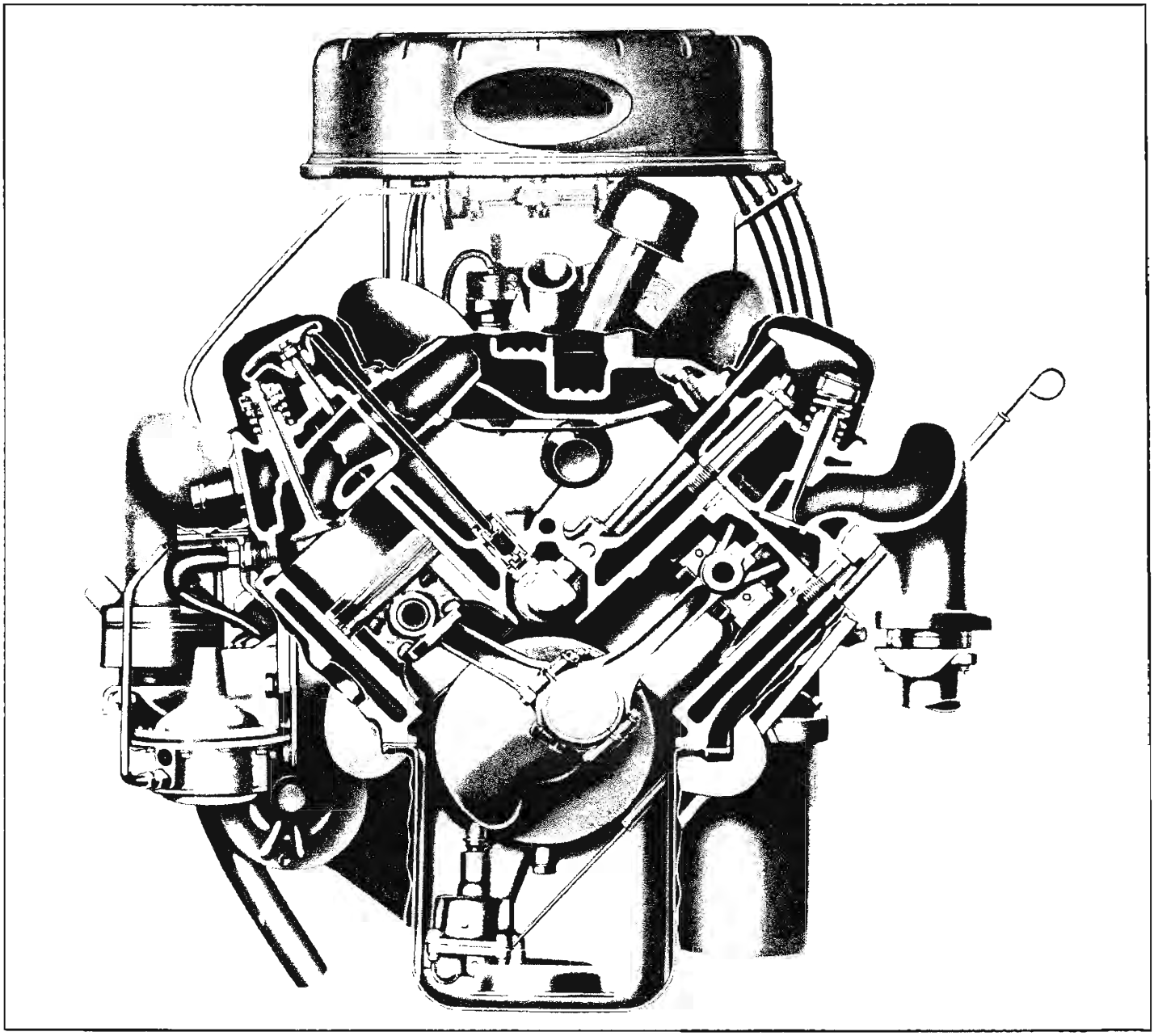


Fig. 55—Engine Cross-Section Across Crankshaft

MAINTENANCE AND ADJUSTMENTS

A routine inspection of items which should be checked at regular intervals is determined by the conditions under which the vehicle operates may vary.

ENGINE OIL

See "General Lubrication," Section 2.

ENGINE OIL LEVEL

The engine oil level should be maintained between the "Full" and "Add" marks on the oil level gauge. DO NOT OVERFILL. Refill capacity 4 quarts, with oil filter 5 quarts.

RADIATOR

See "Cooling System," in this section.

CYLINDER NUMBERING AND FIRING ORDER

The front of the engine in the installed position is the balancer end. Engine rotation as viewed from the front of the vehicle, is clockwise. Cylinders are numbered from the front of the engine. The left front cylinder is No. 1 and the right front cylinder is No. 2. Thus reading in order from the front, the left bank is numbered 1, 3, 5 and 7 and the right bank 2, 4, 6 and 8.

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

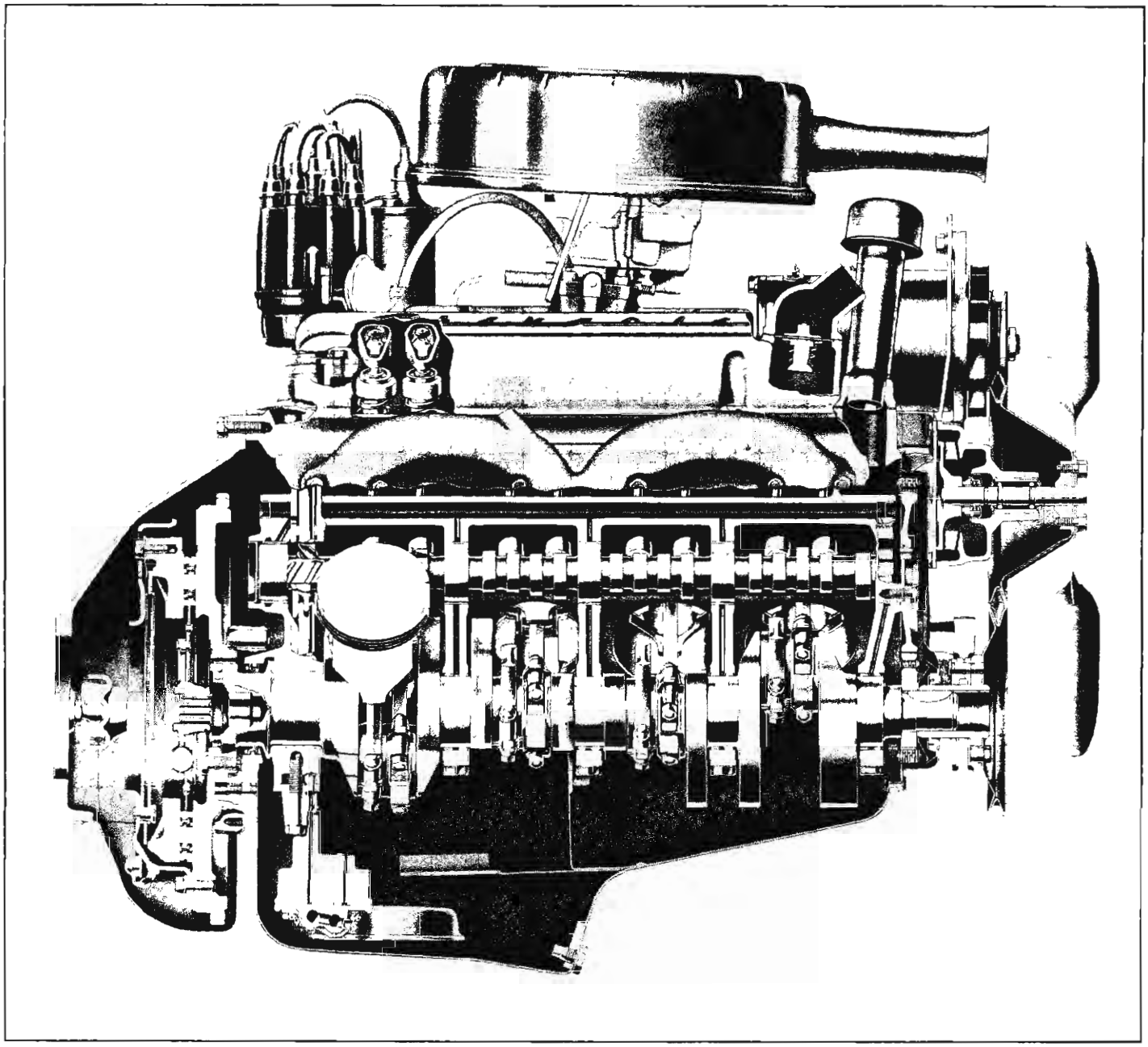


Fig. 56—Engine Cross-Section Along Crankshaft

IGNITION TIMING

See Section 7.

COMPRESSION CHECK

See Section 7.

CRANKCASE VENTILATION—STANDARD

The breather filter should be cleaned with a solvent every 2000 miles. After cleaning, oil the mesh with light engine oil.

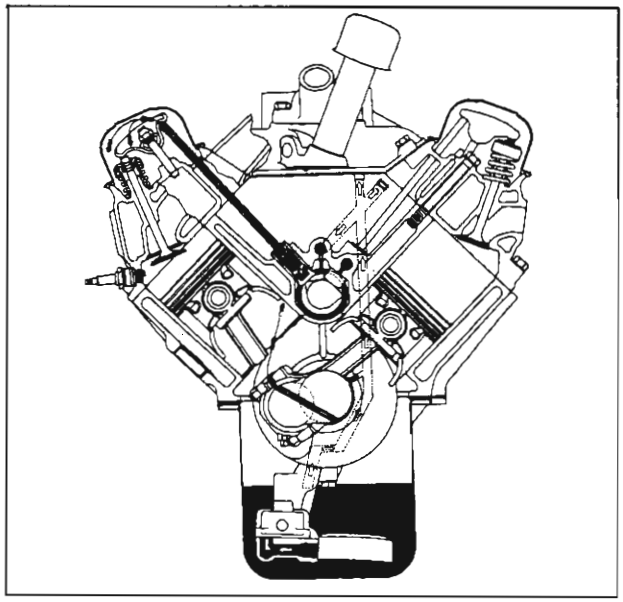
The road-draft tube seldom requires service.

CRANKCASE VENTILATION—POSITIVE

The positive crankcase ventilation system will operate effectively as long as normal maintenance is applied. Due to the nature of the materials carried by the ventilating system, the valve and pipe are subject to fouling with sludge and carbon formation.

At regular intervals of 10,000 miles or less, depending on operating conditions, the metering valve, the pipe running from the valve to the intake manifold and manifold fitting should be removed from the engine, disassembled and cleaned thoroughly.

NOTE: Under cold weather operating conditions, when vehicles are operated at slow



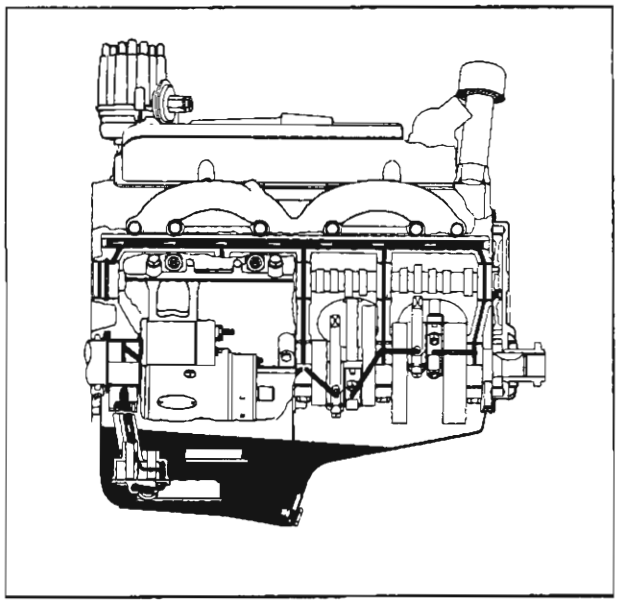


Fig. 57—Engine Lubrication

speeds with low engine temperatures, more rapid accumulations of harmful fumes may be present in the engine. Under these conditions of operation the valve and tube must be cleaned more frequently than specified above. However, no specific mileage recommendation can be made under these conditions. Frequency of cleaning must be dictated by experience.

VALVE LASH ADJUSTMENT—ENGINE RUNNING

The following procedure, performed with the engine running, supplements the valve lash adjustment as instructed under Service Operations—Valve Lash Adjustment.

1. After the engine has been normalized, remove valve covers and install a reworked valve cover (cut the top out of a used valve cover) and gasket, on cylinder heads to prevent oil from running out.
2. With the engine running at idle, back off valve rocker arm nuts (one at a time) until the valve rocker arm starts to clatter.
3. Turn rocker arm nut down until the clatter just stops; continue to turn nut down exactly 1 turn.

   NOTE: The engine will run rough for a few seconds until the lifter plunger adjusts to its normal operating position. Noisy lifters should be replaced.

4. Remove reworked covers, install new gaskets and valve covers.

AIR CLEANER AND CARBURETION

See "Fuel and Exhaust Systems," Section 10.

ENGINE ELECTRICAL SYSTEM COMPONENTS

See "Engine Electrical," Section 9.

ENGINE TUNE-UP

See "Engine Tune-Up," Section 7.

SERVICE OPERATIONS

CHECKING CAMSHAFT LOBE LIFT

NOTE: Procedure is similar to that used for checking valve timing. If improper valve operation is indicated, check the lift of each lobe in consecutive order and record the readings.

1. Remove valve rocker covers and gaskets.
2. Remove rocker arms and balls.
3. Attach Tool J-8520 to stud as shown in Figure 58.
4. Position clamp on Tool J-8520 as shown in Figure 58.
5. Position indicator with ball socket adapter on Tool J-8520 to push rod as shown in Figure 58.

   NOTE: Make sure push rod is in the lifter socket.

6. Rotate the crankshaft balancer slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.

7. Set dial indicator on zero, then rotate the damper slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is in the fully raised position.

   NOTE: Ground primary wire on coil, when cranking engine.

8. Compare the total lift recorded from the dial indicator Tool J-8520 with specifications.
9. Continue to rotate the engine until the indicator reads zero. This will be a check on the accuracy of the original indicator reading.
10. If camshaft readings for all lobes are within specifications, remove dial indicator assembly Tool J-8520 from cylinder head stud.
11. Install all push rods and valve rocker arms and balls. Adjust valves as outlined in this section.
12. Replace valve rocker covers and gaskets.

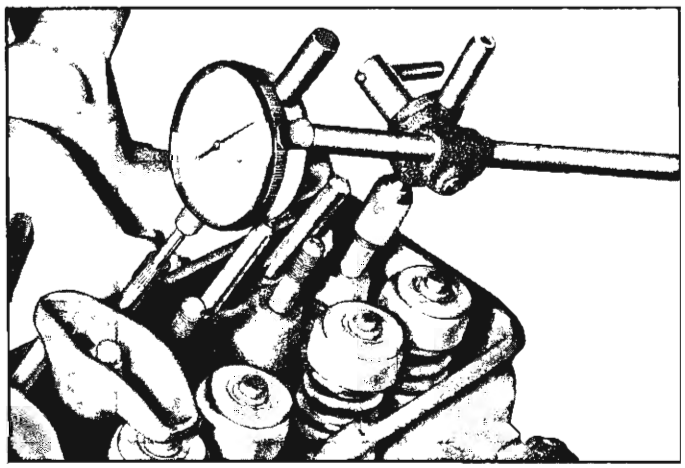


Fig. 58—Checking Camshaft Lobe Lift

CAMSHAFT—WEAR LIMIT

1961 283 Engine	Turbo-Fire	Super Turbo-Fire
	Inlet and Exhaust	Inlet and Exhaust
New	.222" ± .002"	.266" ± .002"
Worn	.217" $\pm \frac{.003"}{.002"}$	.261" $\pm \frac{.003"}{.002"}$

INTAKE MANIFOLD

Removal

1. Drain radiator, remove air cleaner, crankcase ventilator and by-pass cooling hose to water pump.
2. Disconnect carburetor linkage, fuel and vacuum lines, temperature sending unit and coil primary wires. Disconnect coil to distributor secondary wire. Remove distributor clamp and remove distributor.
3. Remove bolts attaching intake manifold to cylinder heads. Remove manifold and discard gaskets.

Installation

1. Clean gasket faces of manifold and cylinder heads.
2. Install intake manifold end gaskets on cylinder block. Coat ends of intake manifold side gaskets around water passages with a good gasket sealing compound and install on cylinder heads.
3. Install intake manifold and bolts and check for misalignment of manifold and gaskets, reposition if necessary. Tighten bolts a little at a time according to the sequence shown in Figure 59. Final torque should be 25-35 ft. lbs.

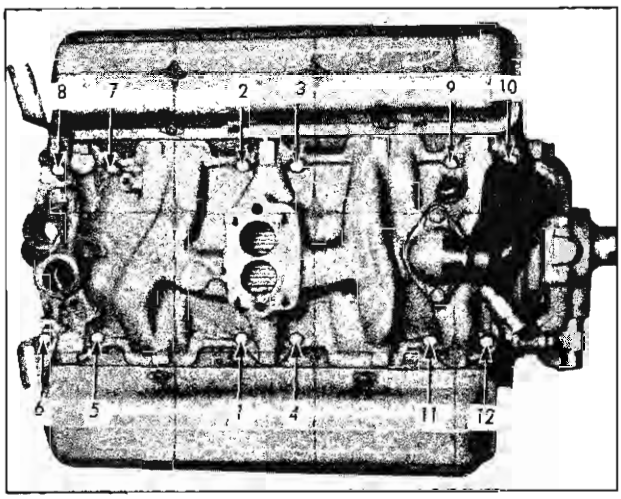


Fig. 59—Intake Manifold Bolt Torque Sequence

4. Install distributor and distributor holding clamp. Connect coil to distributor secondary wire and coil primary wire. Connect temperature sending unit wire, fuel and vacuum lines.
5. Connect all carburetor linkage and adjust as outlined in Section 10. Install carburetor air cleaner and crankcase ventilator.
6. Connect all radiator hoses and by-pass hose to thermostat housing.
7. Fill radiator, start engine and check for leaks. See Section 7 for ignition timing.

HYDRAULIC VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design, readjustments are not necessary, and servicing of the lifters require only that care and cleanliness be exercised in the handling of parts.

The easiest method for locating a noisy valve lifter is by use of a piece of garden hose approximately four feet in length. Place one end of the hose near the end of each intake and exhaust valve with the other end of the hose to the ear.

In this manner, the sound is localized making it easy to determine which lifter is at fault.

Another method is to place a finger on the face of

the valve spring retainer. If the lifter is not functioning properly, a distinct shock will be felt when the valve returns to its seat.

The general types of valve lifter noise are as follows:

1. *Hard Rapping Noise*—Usually caused by the plunger becoming tight in the bore of the lifter body to such an extent that the return spring can no longer push the plunger back up to working position. Probable causes are:
   a. Excessive varnish or carbon deposit causing abnormal stickiness.
   b. Galling or "pick-up" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedging between plunger and lifter body.
2. *Moderate Rapping Noise*—Probable causes are:
   a. Excessive high leakdown rate.
   b. Leaky check valve seat.
   c. Improper lash adjustment.
3. *General Noise Throughout the Valve Train*—This will, in almost all cases, be a definite indication of insufficient oil supply, or improper lash adjustment.
4. *Intermittent Clicking*—Probable causes are:
   a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.
   b. In rare cases, the ball itself may be out-of-round or have a flat spot.
   c. Improper Lash adjustment.

In most cases where noise exists in one or more lifters, all lifter units should be removed, cleaned in a solvent, reassembled, and reinstalled in the engine. If dirt, varnish, carbon, etc. is shown to exist in one unit, it more than likely exists in all the units, thus it would only be a matter of time before all lifters caused trouble.

In instances where parts are damaged, particularly the plunger or lifter body, the complete lifter unit should be replaced. However, in rare or emergency cases an Arkansas hard stone may be used to remove metal scratches or humps; and if after correcting, the plunger will operate freely in the lifter body, the parts may be thoroughly cleaned and the unit assembled and installed.

A few precautions to follow when servicing the valve lifter are:

1. Plungers are not interchangeable, they are a selective fit at the factory. Should a plunger or lifter body become damaged, it is necessary to replace the whole unit.
2. The plunger must be free in the lifter body. A simple test for this is to be sure the plunger will drop of its own weight in the body.
3. There must be no excessive leakdown and there must be no ball check valve leakage.

Valve Lifter

Removal

1. Remove rocker arm cover attaching screws with reinforcements and remove covers and gaskets.
2. Remove intake manifold as described in previous outline.
3. Back off rocker arm nuts until arms may be pivoted away from push rods. Remove push rods.
4. Remove hydraulic valve lifters.

NOTE: Valve lifters should be placed in a rack in their proper sequence so they can be installed in their same positions in the cylinder block.

Disassembly and Assembly

Refer to Figure 60 and 116.

1. Hold plunger down with a push rod and, using a small screwdriver or awl, remove push rod seat retainer.

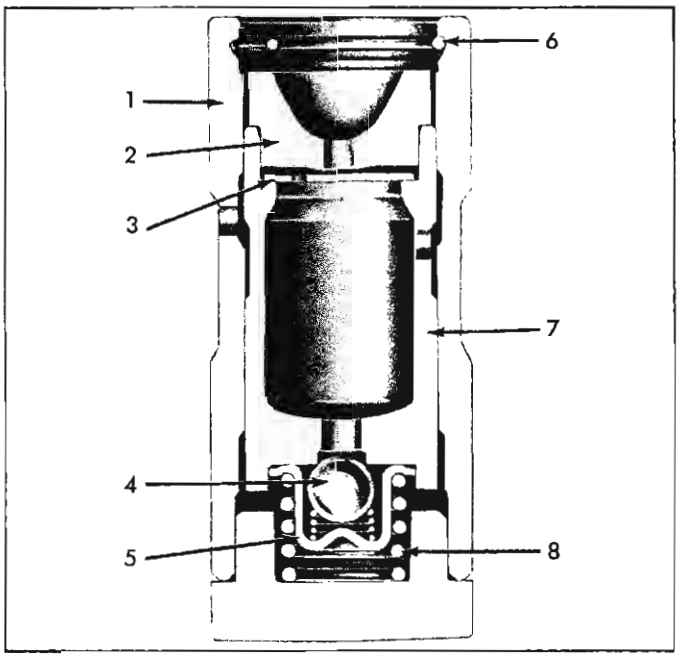


Fig. 60—Hydraulic Valve Lifter

1. Lifter Body
2. Push Rod Seat
3. Metering Valve
4. Check Ball
5. Ball Retainer
6. Push Rod Seat Retainer
7. Plunger
8. Plunger Spring

2. Remove push rod seat and metering valve, plunger and spring from lifter body.
3. Pull check valve ball retainer from plunger and remove ball and spring .
4. Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged, the entire lifter assembly should be replaced.

5. To reassemble the lifter:
   a. Place check ball on small hole in bottom of plunger.
   b. Insert check ball spring on seat in ball retainer and place retainer over ball so spring rests on ball. Carefully squeeze retainer and press into position in plunger.
   c. Place plunger spring over ball retainer and slide lifter body over spring and plunger.
   d. Install push rod seat and metering valve in open end of plunger, push plunger into body and install retainer.
6. Compress plunger to open oil holes and fill plunger with SAE 10 oil. Work plunger up and down and refill.

Installation

1. Install valve lifters.
2. Install intake manifold as described in this section.
3. Install push rods.
4. Pivot rocker arms to engage push rods and adjust valve lash.

VALVE LASH ADJUSTMENT

1. Adjust valve as follows:
   a. Crank engine until mark on harmonic balancer lines up with center or "0" mark on the timing tab fastened to the timing chain cover, with the engine in the Number 1 firing position. This may be determined by placing fingers on the number 1 cylinder valve as the mark on the balancer comes near the "O" mark on the front end cover. If the valves are not moving, the engine is in the number 1 firing position. If the valves move as the mark comes up to the timing tab, the engine is in number 6 firing position and should be turned over one more time to reach the number 1 position.
   b. Valve adjustment is made by backing off the adjusting nut (rocker arm stud nut) until there is play in the valve push rod and then tightened to just remove all push rod to rocker arm clearance. This may be determined by rotating push rod with fingers as the nut is tightened (fig. 61). When rod does not readily move in relation to the rocker arm, the clearance has been eliminated. The adjusting nut should then be tightened an additional 1 turn to place the hydraulic lifter plunger in the center of its travel. No other adjustment is required.
   c. With the engine in the number 1 firing position as determined above, the following valves may be adjusted.
      Exhaust—1,3,4,8
      Intake—1,2,5,7
   d. Crank the engine one revolution until the pointer "0" mark and harmonic balancer mark are again in alignment. This is number 6 firing position. With the engine in this position, the following valves may be adjusted.
      Exhaust—2,5,6,7
      Intake—3,4,6,8
2. Install rocker arm covers, using new gaskets, and tighten screws to 2½ ft. lbs., after determining that cover hole reinforcements are in place.
3. Start engine and check for oil leaks at rocker arm covers.

NOTE: If noisy, refer to valve lash adjustment —engine running.

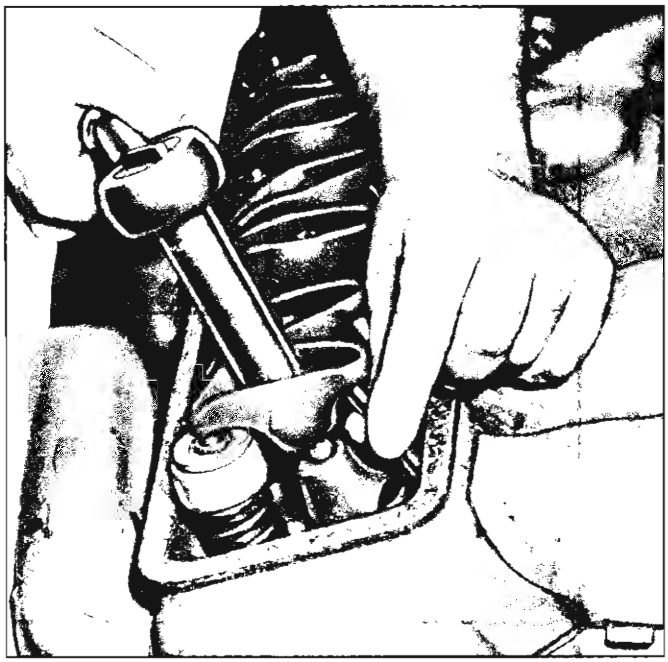


Fig. 61—Adjusting Valve Lash

EXHAUST MANIFOLDS

Removal

1. Remove exhaust manifold flange nuts and remove exhaust pipe and flange gasket.
2. Bend french lock ends to remove end bolts.
3. Remove center bolts and remove exhaust manifold.
4. Repeat Steps 1 through 3 for other exhaust manifold removal.

Installation

1. Clean mating surfaces and check manifold for cracks. Replace if manifold is cracked.
2. Install center bolts, french locks under end bolts and torque center bolts 25 to 35 ft. lbs., end bolts 15 to 20 ft. lbs. Bend end tabs of french locks against bolt head.
3. Clean mating surfaces and install exhaust manifold heat control valve, exhaust pipe and new gaskets.

CYLINDER HEAD AND VALVE CONDITIONING

The condition of the cylinder heads and valve mechanism, more than anything else, determines the power, performance and economy of a valve-in-head engine. Extreme care should be exercised when conditioning the cylinder heads and valves to maintain correct valve stem to guide clearance, correctly ground valves, valve seats of correct width and correct valve adjustment.

Removal

1. Drain radiator, engine block, remove air cleaner wing nut and remove air cleaner.
2. Disconnect throttle rod from carburetor. On Powerglide or Turboglide models, disconnect lower transmission throttle lever rod.
3. Disconnect fuel, vacuum and automatic choke lines from carburetor.
4. Disconnect coil primary wires. Disconnect coil to distributor secondary wire. Remove distributor clamp and remove distributor.
5. On over-drive equipped models, disconnect kickdown switch wires from switch.
6. Remove spark plug wires from spark plugs and remove plugs.
7. Remove water outlet hose and heater hose, if so equipped, from intake manifold.
8. Remove temperature indicator unit from intake manifold.
9. Remove bolts attaching intake manifold to cylinder heads. Remove manifold.
10. Remove fan belt.
11. Remove exhaust manifold to exhaust cross-over pipe stud nuts and allow cross-over pipe to drop for clearance. Remove exhaust manifold heat control valve from right bank exhaust manifold.
12. Disconnect generator field and armature wires from generator.
13. Remove exhaust manifold to cylinder head bolts and remove exhaust manifolds.
14. Remove choke heat tube and remove rocker arm covers.
15. Back off rocker arm nuts, pivot rocker arms to clear push rods and remove push rods. Be certain that push rod seats on solid lifters do not come out of lifters with push rods. Snap push rod lower end to one side before lifting, to break the push rod loose from the seat.
16. Remove cylinder head bolts, cylinder heads and gaskets.

Disassembly

1. Place cylinder head assembly on it side on a bench and, using Tool J-8062, compress valve spring and remove valve locks. Release tool and remove spring retainer, valve shield, spring and dampener and seal from stem. Repeat this operation on each valve (fig. 62).

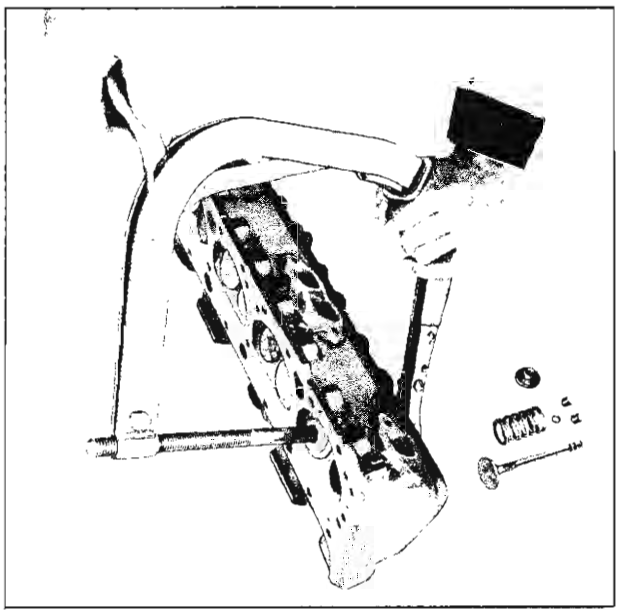


Fig. 62—Removing Valves

2. Remove valves from bottom of cylinder head and keep them in their proper sequence for inspection and assembly.
3. Remove rocker arm nuts, lift rocker arms off studs and remove pivots from rocker arms.

Cleaning

1. Clean all carbon from combustion chambers and valve ports using Tool J-8089 (fig. 63).

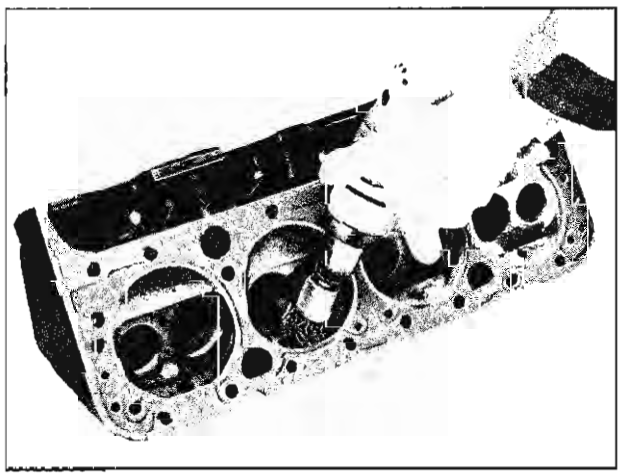


Fig. 63—Removing Carbon from Combustion Chambers

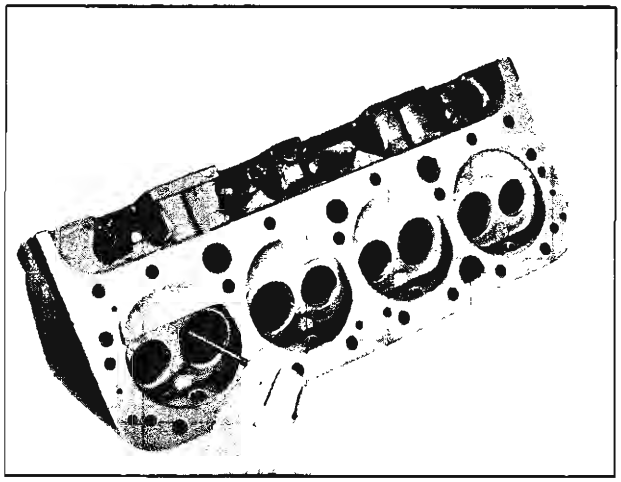


Fig. 64—Cleaning Valve Bores

2. Thoroughly clean the valve bores, using Tool J-8101 (fig. 64).
3. Clean all deposits from hollow push rods, inside and outside; disassemble, clean and reassemble all valve lifters.
4. Clean valve stems and heads on a buffing wheel.
5. Clean carbon deposits from pistons and cylinders.
6. Wash all parts in cleaning solvent and dry them thoroughly.

Inspection

1. Inspect the cylinder heads for cracks in the exhaust ports, combustion chambers, or external cracks to the water chamber.
2. Inspect the valves for burned heads, cracked faces or damaged stems.
3. Check fit of valve stems in their respective bores.

NOTE: Excessive valve to bore clearance may cause lack of power, oil consumption, rough idling and noisy valves. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness of operation.

Intake valve stem to bore clearance should be .001" to .003" while exhaust stem clearance should be .002" to .004". Valve stem clearance may be accurately determined by using a micrometer and a suitable telescope hole gauge. Check the diameter of the valve stem in three places; top, center and bottom. Insert telescope hole gauge in valve guide bore, measuring at the center. Subtract highest reading of valve stem diameter from valve guide bore center diameter to obtain valve to guide clearance. If clearance is not within .002" of above limits, use next oversize valve and ream valve bore to fit.

4. Check valve spring tension with Tool J-8056 (fig. 65).

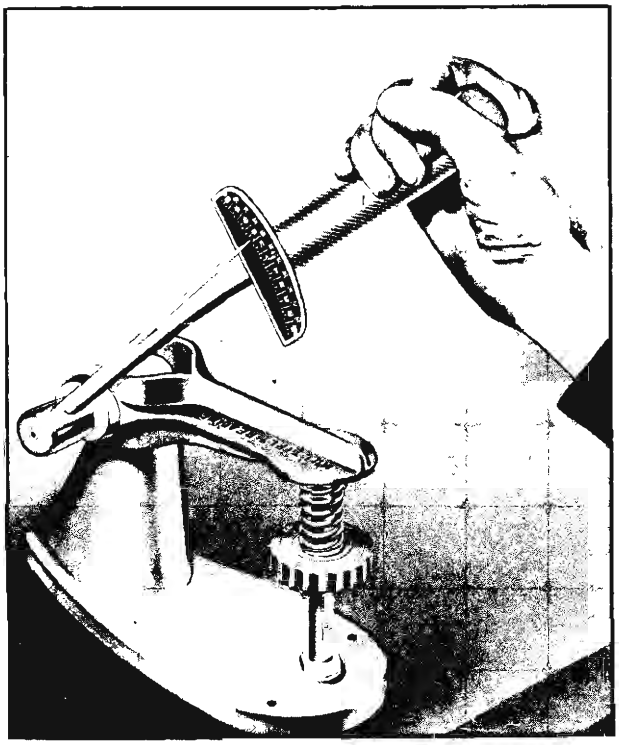


Fig. 65— Checking Valve Spring Tension

NOTE: Spring should be compressed to 1 45/64" at which height it should check 74.5 pounds. Weak springs affect power and economy and should be replaced if not within 10 lbs. of the above load without dampers.

5. Check valve lifters for free fit in block. The end that contacts the camshaft should be smooth. If this surface is worn or rough, the lifter should be replaced.

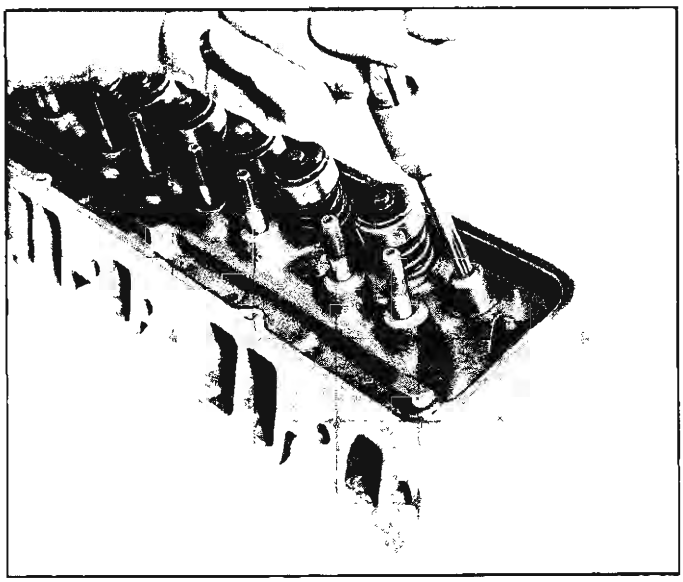


Fig. 66—Reaming Valve Bores

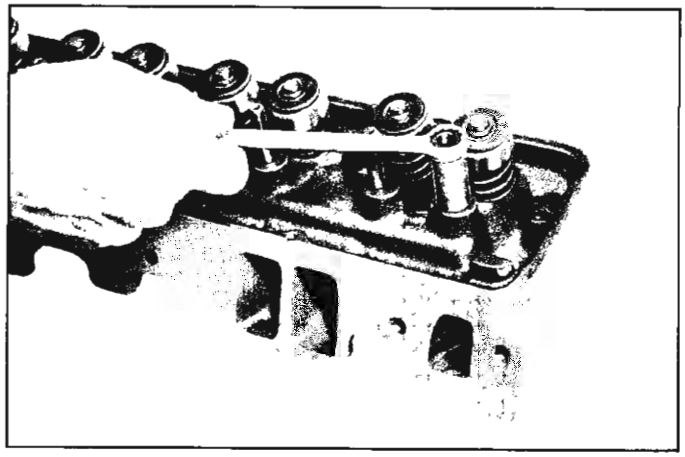


Fig. 67—Removing Valve Rocker Stud

Repairs

Valve Bores

Valves with oversize stems are available in the following sizes, .003", .015" and .030". Tool J-5830 may be used to ream the bores for new valves (fig. 66).

Rocker Arm Studs

Rocker arm studs that have damaged threads may be replaced with standard studs. If the studs are loose in the head, oversize studs, available in .003" or .013" oversize, may be installed after reaming the holes with Tool J-5715 reamer for .003" oversize and Tool J-6036 for .013" oversize.

1. Remove old stud by placing Tool J-5802-1 over the stud, installing nut and flat washer and removing stud by turning nut (fig. 67).
2. Ream hole for oversize stud, using Tool J-5715 for .003" oversize and Tool J-6036 for .013" oversize (fig. 68).

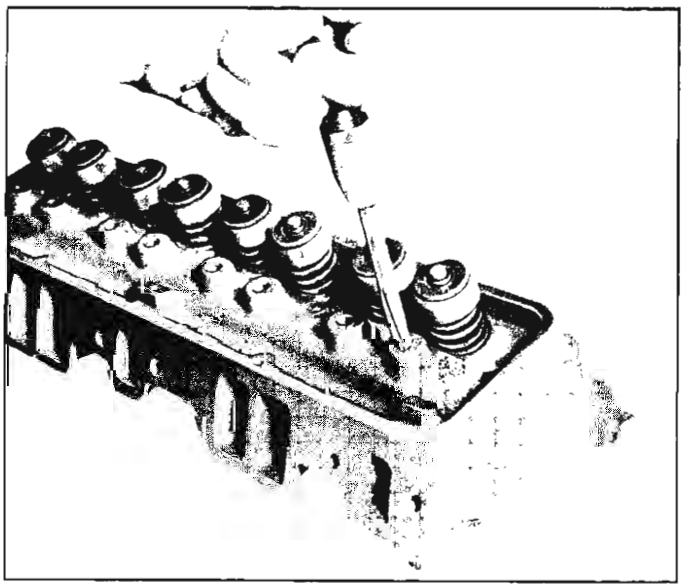


Fig. 68—Reaming Stud Hole

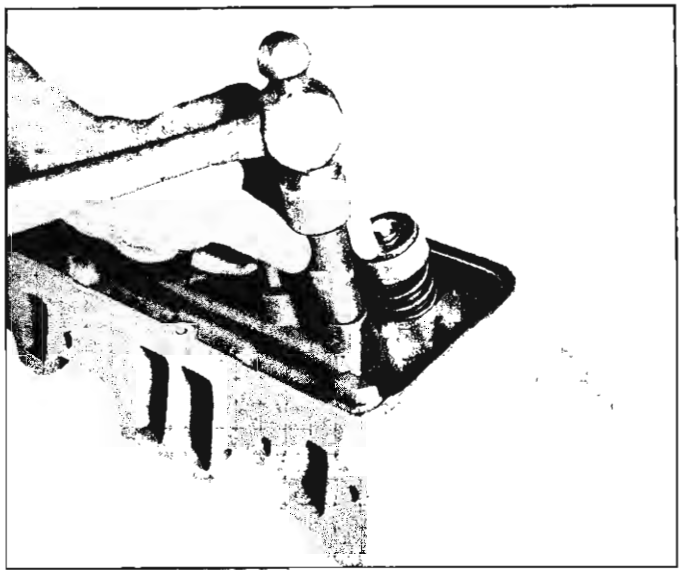


Fig. 69—Installing Valve Rocker Stud

3. Coat press-fit area of stud with hypoid axle lubricant. Install new stud, using Tool J-6880 as a guide. Gauge should bottom on head (fig. 69).

Reseating Valve Seats (Cylinder Head)

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for reseating valve seats; the recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Regardless of what type of equipment is used, however, it is essential that valve guides be free from carbon or dirt to insure proper centering of pilot in the guide.

Regardless of the methods used for seat repair, the final seat for the valves should be $\frac{1}{16}$" to $\frac{3}{32}$" for

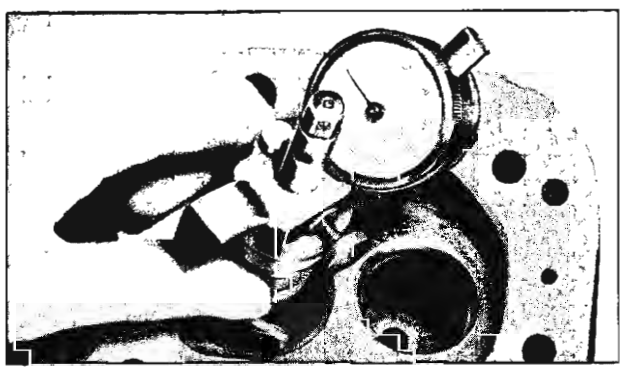


Fig. 70—Checking Valve Seat Concentricity

intake seats and exhaust seats. The seats should be concentric within .002" indicator reading (fig. 70).

Cylinder head seats should be 46°. Always dress stones to proper angle before grinding valve seats.

- If necessary, dress the valve refacing machine grinding wheel to make sure it is true and smooth.
- Set chuck angle at 45° mark for grinding both inlet and exhaust valves.
- Inlet and Exhaust valve to cylinder head angles are an interference fit as shown in Figure 71.

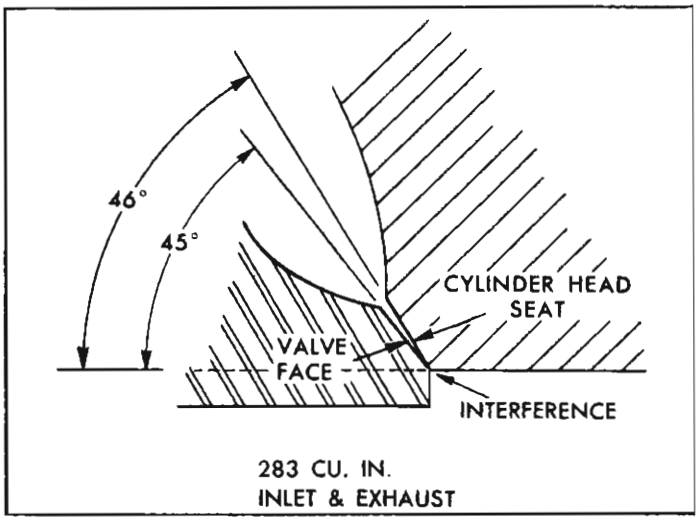


Fig. 71—Relation of Valve and Seat Angles

Assembly

1. Clean valves, valve seats, valve bores and cylinder heads thoroughly.
2. Insert the valve in the port and set the valve spring and damper in place with close coiled end of spring against cylinder head and install shield on spring.
3. Place rotator in position, if used, and install cap. Compress the spring with Tool J-8062 (fig. 62).
4. Install oil seal in lower groove on stem making sure seal is flat and not twisted in groove. Install valve locks and release compressor tool, making sure locks seat properly in upper groove on stem. Check each seal by placing a vacuum cup or similar device over end of valve stem and against cap to make sure no air leaks past cap. A vacuum cup can be made from a small ear syringe and a high voltage rubber shield such as (Sun Electric #1578), shown in Figure 72.
5. Assemble the remaining valves, valve springs, dampers, spring caps, shields, oil seals and valve locks in the cylinder heads in the same manner.

Valve Spring Installed Height

Check the installed height of the valve springs, using a narrow, thin scale to measure from the top of the shim, or spring seat, in the head to the top of the valve spring shield. If this is found in excess of $1^{23}/_{32}$", install a valve spring seat shim, approximately $1/16$" thick. At no time should the spring be shimmed to give an installed height of less than $1^{21}/_{32}$".

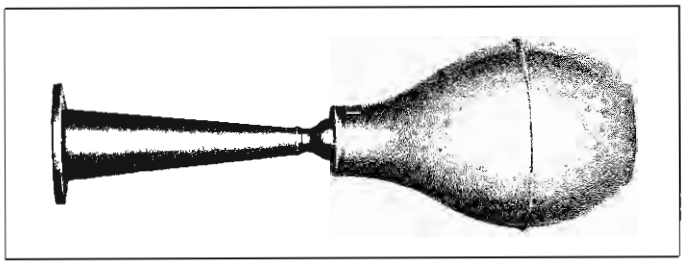


Fig. 72—Vacuum Cup

NOTE: If springs are to be changed with cylinder head installed, Tool J-5892 may be used to compress springs for removal or installation. Compressed air or a screwdriver, may be used to hold the valves in place, used through the spark plug hole.

Installation

1. Thoroughly clean out cylinder head bolt holes in the block and clean cylinder bolt threads. Then place new cylinder head gaskets in position on cylinder block. Use a good head gasket paste with these steel gaskets.
2. Place the cylinder head in position over the two dowel pins in the block.
3. Coat threads of all cylinder head bolts with a suitable oil and water thread sealing compound such as G. M. Perfect Seal or its equivalent.
4. Install bolts finger tight.

   NOTE: Two intermediate length bolts are used: one at No. 17 position and one at No. 14 position (fig. 73).

5. Tighten the cylinder head bolts a little at a time in the order shown (fig. 73). The final tightening torque should be 60-70 ft. lbs.

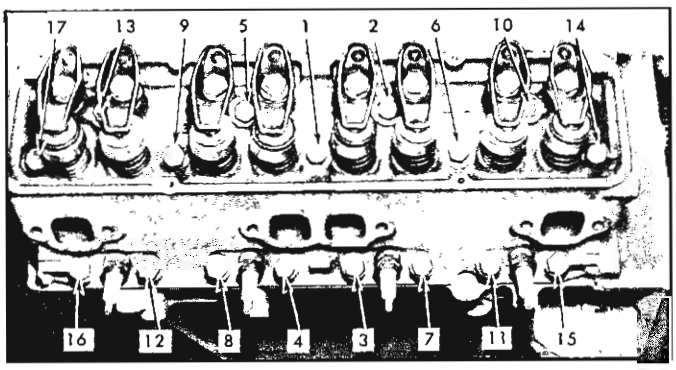


Fig. 73—Head Bolt Torque Sequence

6. Install 16 valve lifters and 16 push rods in their respective bores.
7. Insert pivots in valve rocker arms, install rocker arms over studs, and install nuts. Adjust valves, as outlined under "Valve Lash Adjustment."
8. Clean gasket faces of manifolds and cylinder heads.
9. Install intake manifold end gaskets on cylinder block. Coat ends of intake manifold side gaskets around water passage with a good gasket sealing compound and install on cylinder heads.
10. Install intake manifold bolts and check for misalignment of manifold and gaskets, reposition if necessary. Tighten finger tight. Tighten bolts a little at a time according to the sequence shown in Figure 59. Final torque should be 25-35 ft. lbs.
11. Install temperature indicator element in intake manifold.
12. Install radiator core to intake manifold hose.
13. Install exhaust manifolds and bolts. Tighten center bolts 25 to 35 ft. lbs. and install french locks under end bolts and tighten to 15-20 ft. lbs. torque.
14. Clean mating surfaces and install exhaust manifold heat control valve and exhaust cross-over pipe, using new gaskets and seals.
15. Clean all spark plugs with abrasive type cleaner, inspect for damage and set gap at .035" using a round feeler gauge.
16. Place new gaskets on plugs and install. Tighten to 20-25 ft. lbs.
17. Install distributor, distributor clamp and distributor and coil wiring. Roughly set timing, by adjusting for points just breaking with engine in number 1 firing position.
18. Connect spark plug wires to their respective terminals and install generator field and armature wires.
19. Connect throttle linkage.
20. Connect gasoline and vacuum lines to carburetor.
21. Clean and install air cleaner and crankcase ventilator.
22. Fill cooling system and check for leaks.
23. Normalize engine and re-torque cylinder head bolts (Refer to Figure 73).
24. Install rocker arm covers.
25. Check ignition timing as outlined in Section 7.

HARMONIC BALANCER

Removal

1. Drain radiator and disconnect radiator hoses, and necessary oil cooler lines.
2. Remove fan belt, fan and pulley.
3. Remove bolts from fan shroud and radiator.
4. Remove radiator core and shroud assembly.
5. Remove harmonic balancer pulley bolts and remove pulley or dual pulley (fig. 74).

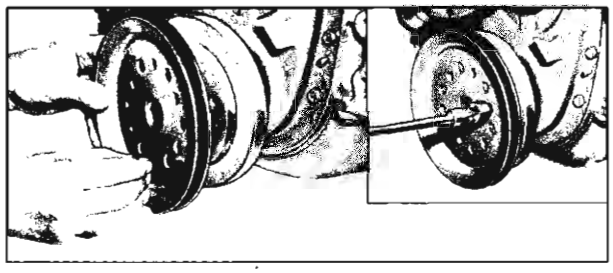


Fig. 74—Remove Crankshaft Pulley

6. Install Tool J-6978 to harmonic balancer and turn puller screw to remove balancer from crankshaft (fig. 75).
7. Remove tool from balancer.

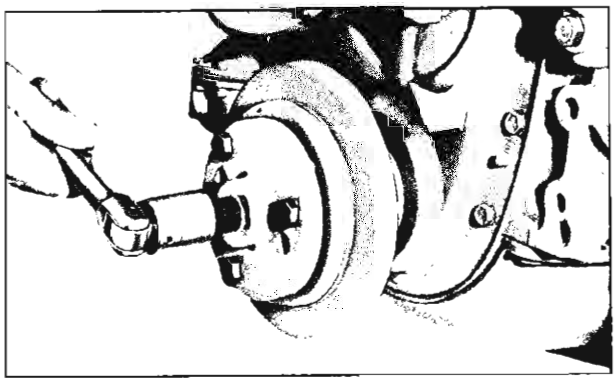


Fig. 75—Removing Balancer

Installation

1. Coat front cover seal contact on balancer with engine oil.
2. Position balancer on crankshaft aligning the key on the crankshaft with the keyway balancer.
3. Using Tool J-5590, drive balancer on crankshaft until the hub bottoms on the crankshaft timing sprocket (fig. 76).
4. Install crankshaft pulley on dual pulley (fig. 74).

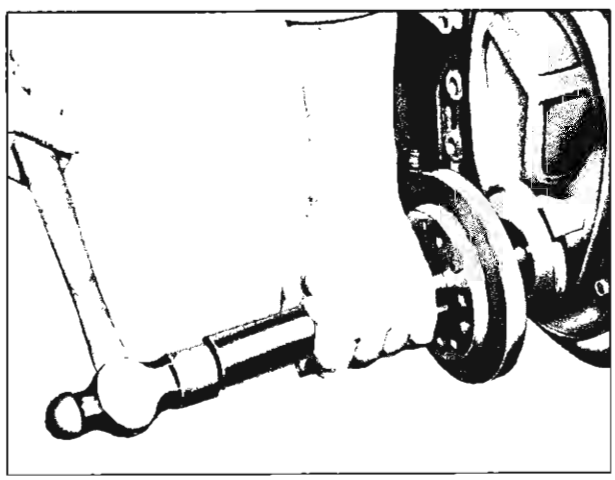


Fig. 76—Installing Harmonic Balancer

5. Install fan pulley, spacer and fan to water pump fan hub and tighten bolts securely.
6. Lay fan shroud over fan blade and lower radiator into place. Install radiator and shroud-to-radiator, retaining bolts.
7. Install fan belt and adjust as described in Section 7.
8. Install radiator hoses and oil cooler lines.
9. Fill cooling system, start engine and check for leaks.

CRANKCASE FRONT-END COVER

Removal

1. Remove harmonic balancer and radiator.
2. Remove oil pan.
3. Remove heater hose from water pump if so equipped. Remove water pump from cylinder block.
4. Remove crankcase front end cover attaching screws and remove front end cover and gaskets.

Repairs

Crankcase Front End Cover Oil Seal Replacement

1. Pry old seal out of cover from the front with a large screwdriver.

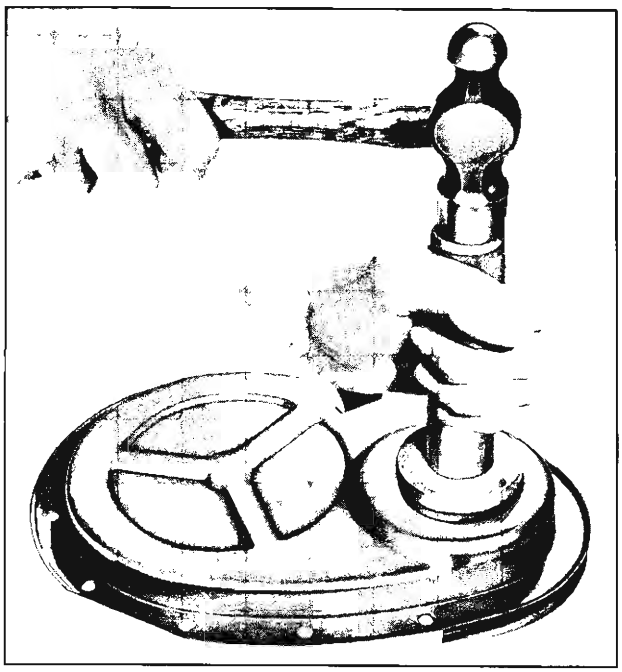


Fig. 77—Installing Oil Seal

2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J-996 (fig. 77).

CAUTION: Support cover at sealing area.

Installation

1. Make certain that cover mounting face and cylinder block front end plate face are clean and flat.
2. Make certain oil slinger is in place against crankshaft timing sprocket.
3. Coat the oil seal with light grease and, using a new cover gasket, install cover and gasket over dowel pins in cylinder block.
4. Install cover screws and tighten to 6-8 ft. lbs. torque.

NOTE: The preferred method for timing gear cover seal replacement, is to remove the cover and replace seal with Tool J-0995 as outlined above; however, an alternate method as outlined below may be used.

5. Remove harmonic balancer with Tool J-6978.
   a. Pry old seal out of cover from the front with a large screwdriver, being careful not to damage the seal surface on the crankshaft.
   b. Install new seal so that open end of seal is toward the inside of cover and drive it into position with a hollow piece of pipe.

TIMING CHAIN OR SPROCKET REPLACEMENT

1. Remove harmonic balancer and crankcase front end cover as previously described. Remove crankshaft oil slinger.
2. Crank engine until "0" marks on camshaft and crankshaft sprockets are in alignment (fig. 78).

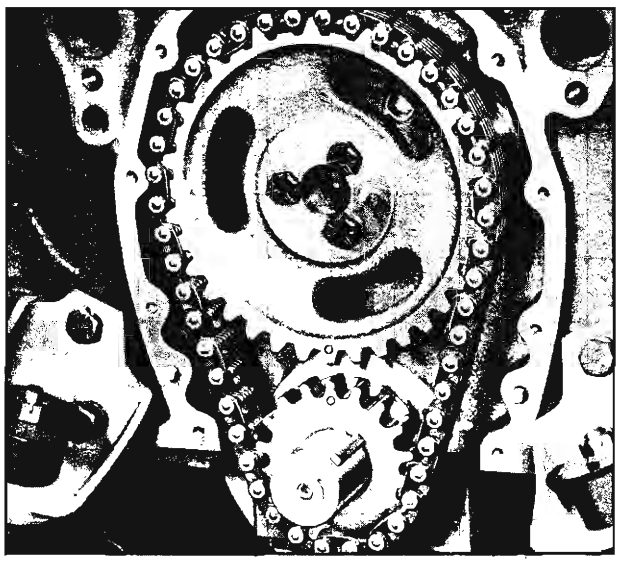


Fig. 78—Timing Sprocket "O" Marks

3. Remove three camshaft sprocket to camshaft bolts.
4. Remove camshaft sprocket and timing chain together. Sprocket is a light press fit on camshaft for approximately ⅛". If sprocket does not come off easily, a light blow with a plastic-faced ham-

mer on the lower edge of the camshaft sprocket should dislodge the sprocket.

5. If crankshaft sprocket is to be replaced, remove, using Tool J-5825. Install new sprocket, aligning key and keyway, using Tool J-5590.
6. Install timing chain on camshaft sprocket. Hold the sprocket vertical with the chain hanging below, and orient to align "0" marks on camshaft and crankshaft sprockets.
7. Align dowel in camshaft with dowel hole in camshaft sprocket and install sprocket on camshaft (fig. 79).

NOTE: Do not attempt to drive cam sprocket on shaft as welsh plug at rear of engine can be dislodged.

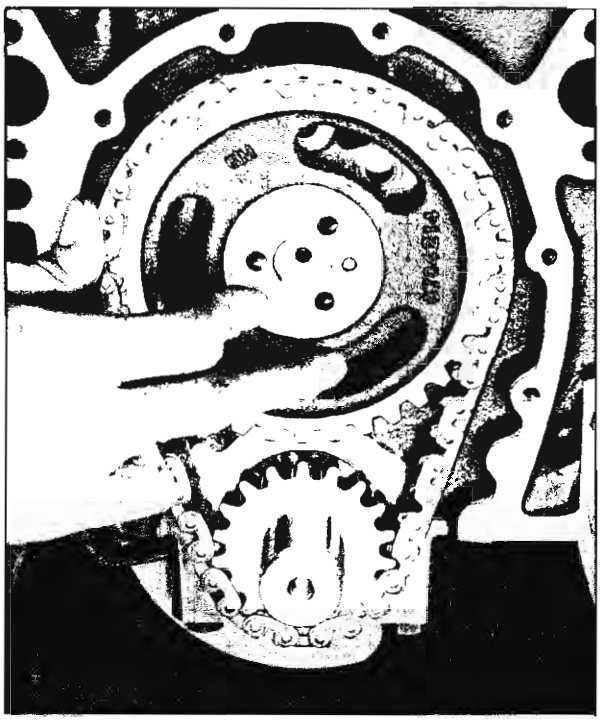


Fig. 79—Installation of Timing Chain

8. Draw camshaft sprocket onto camshaft, using the three mounting bolts. Tighten to 15-20 ft. lbs. torque.
9. Lubricate timing chain with engine oil.
10. Install crankcase front end cover and harmonic balancer as previously described.

CAMSHAFT

Removal

1. Remove valve lifters.
2. Remove fuel pump and fuel pump push rod as described in Section 10.
3. Remove grille assembly. See Front End Sheet Metal, Section 14.
4. Remove timing chain and camshaft sprocket as previously described.
5. Install two bolts, $\frac{5}{16}$"-18 x 4" in two of camshaft bolt holes. Remove camshaft from engine (fig. 80).

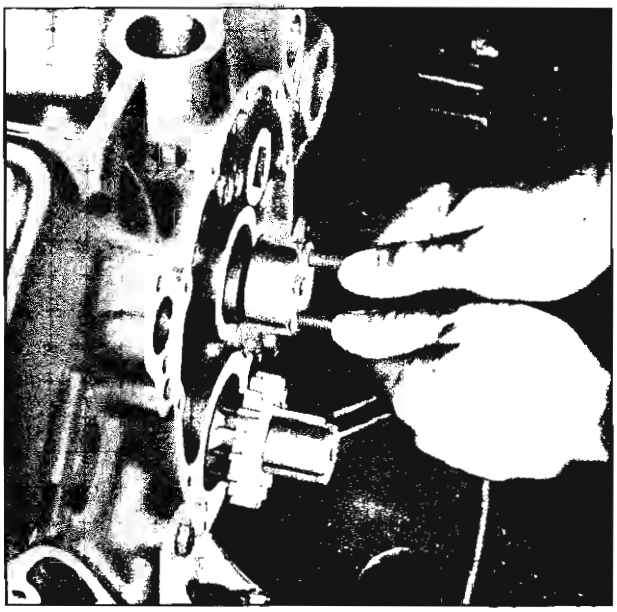


Fig. 80—Removing Camshaft

CAUTION: All camshaft journals are the same diameter and caution must be used in removing camshaft to avoid damage to bearing.

Inspection

The camshaft bearing journals are 1.8682"-1.8692" in diameter. The journals should be checked with a micrometer for an out-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.

The camshaft should also be checked for alignment. The best method is by use of "V" blocks and a dial indicator (fig. 81). The dial indicator will indicate the exact amount the camshaft is out of true. If it is out more than .002" dial indicator reading, the camshaft should be straightened. Examine the camshaft bearings and if any bearing needs replacement, replace all bearings.

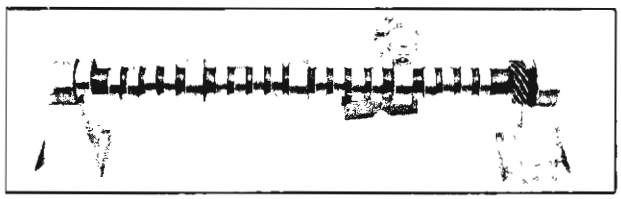


Fig. 81—Checking Camshaft Alignment

Installation

1. Install two bolts in camshaft, lubricate camshaft and install camshaft in engine. Remove bolts.

2. Install timing sprocket and chain as previously described.
3. Install crankcase front end cover and harmonic balancer as previously described.
4. Install grille assembly as described in *Front End Sheet Metal,* Section 14.
5. Install valve lifters, valve mechanism, intake manifold and distributor as described in this section.
6. Install fuel pump push rod, mounting plate and pump as described in Section 10.

CAMSHAFT BEARINGS

Removal

Camshaft bearings can be replaced while engine is disassembled for overhaul, or without complete disassembly of the engine. To replace bearings without complete disassembly remove the camshaft and crankshaft, leaving cylinder heads attached and pistons in place. Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Fasten connecting rods against sides of engine so they will not be in way while replacing camshaft bearings.

1. With camshaft removed, drive out expansion plug from cylinder block at the rear of the rear camshaft bearing, by driving it out from the inside.

   NOTE: This procedure is based on removal of the bearing nearest center of the engine first. With this method a minimum amount of turns is necessary to locate the Remover in position to remove next bearing.

2. Install nut on puller screw and turn to end of threads on puller screw using Tool J-6098.
3. Index pilot over screw with open end toward nut on puller screw.

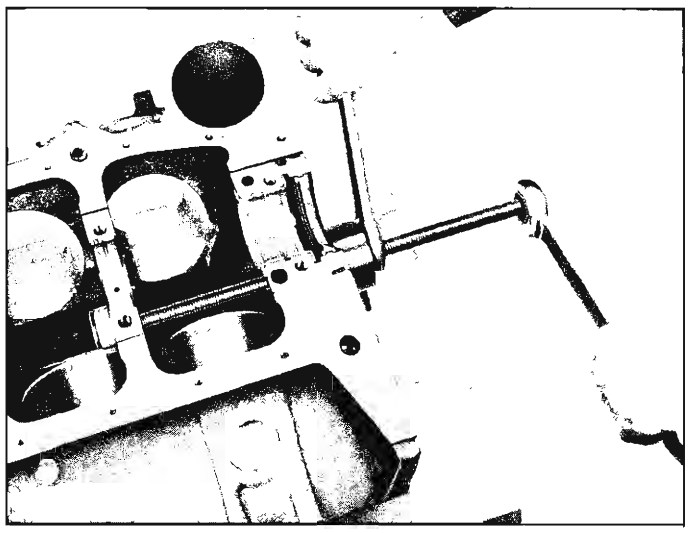


Fig. 82—Installing No. 4 Camshaft Bearing

4. Insert Remover with shoulder toward number three bearing, making sure a sufficient amount of threads are engaged on the puller.
5. Using two wrenches, hold screwshaft with one wrench while turning the front nut with the other wrench. After removing bearing from block, repeat operation for number two bearing.
6. Remove tool and reassemble tool to remove number four bearing from rear of engine.
7. Assemble remover on driver handle and remove front and rear bearing.

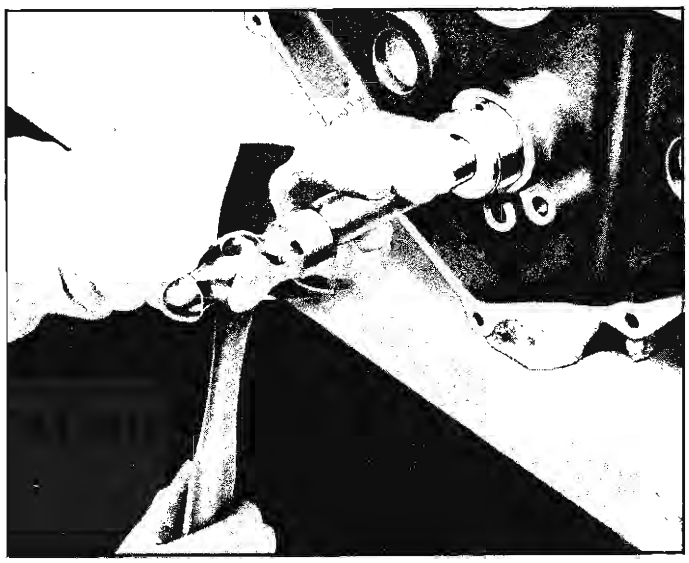


Fig. 83—Installing Rear Camshaft Bearing

Installation

Refer to Figures 82 and 83.

1. The number one or front camshaft bearing should be installed first. This bearing will act as a guide for the tool and center the number two and three bearing being pulled in place. Install the front bearing with bearing installer assembled to the drive handle, then drive bearing in.

   CAUTION: Align oil holes in bearing with oil holes in block before driving or pulling in place.

2. Install nut on puller screw and turn to end threads on puller screw.
3. Index pilot screw, with open end of pilot toward nut.
4. Index number three camshaft bearing on screw, then turn installer on screw with shoulder toward bearing making sure a sufficient amount of threads are engaged on the puller.
5. Turn nut on screw puller to exert pressure on pilot until bearing is installed.
6. Remove installer and repeat operation 4 and 5 for number two and four bearing.
7. Install rear bearing in same manner as number one bearing. Caution should be observed while

installing rear bearing due to smaller size of oil pressure holes in rear camshaft bearing. Improper alignment of rear camshaft bearing will result in restricted oil pressure to valve train.

8. Install a new camshaft end plug in back end of the cylinder block at the rear camshaft bearing.

NOTE: Plug should be installed flush to 1/32" deep to maintain level surface on rear of cylinder block.

OIL PAN

Removal

1. Raise front of vehicle and place on stand jacks or raise vehicle on a hoist.
2. Remove oil pan drain plug and drain crankcase oil.
3. Drain water and disconnect the radiator hoses at radiator.
4. Disconnect battery ground strap at engine.
5. Disconnect the clutch pedal push rod at clutch pedal control, intermediate lever and shaft (refer to Section 11).
6. Remove clutch pedal control, intermediate lever and shaft assembly at frame mounting bracket leaving shaft assembly attached to engine.
7. Remove carburetor fuel feed pipe at fuel pump. Remove fuel pump from engine.

NOTE: Hose connected from fuel pump to fuel tank feed pipe, need not be removed.

8. Remove accelerator control rod from accelerator control rod lever.
9. If power brake equipped, remove power brake vacuum hose at check valve on engine manifold.
10. If power steering equipped, move power steering pump to clear.
11. Remove transmission lower control rods at transmission shift levers.
12. Remove exhaust pipe flange to exhaust manifold nuts and gasket. Lower exhaust pipe and muffler assembly.
13. Remove oil filter.
14. Loosen transmission mounting bolts.
15. Remove nut, washer and long bolt from each front mounting.

NOTE: Turn crankshaft so that harmonic balancer key-way slot is at bottom of engine. This will index crankshaft counterweights so baffle in oil pan will clear.

16. Engine may be raised from below at harmonic balancer.

NOTE: Engine will have to be raised approximately 3" to clear frame crossmember for oil pan removal. Raise engine until transmission housing comes in contact with underbody toe pan. Note clearance at fan blade and shroud while lifting engine and adjust for clearance as required.

17. Remove oil pan bolts using a universal socket and long extension handle. Tilt oil pan, while removing.

NOTE: Removal of the oil pan with Turboglide transmission installed, is identical to the procedure above with one exception. Remove the transmission control lever cross-shaft at transmission shifter lever and shaft assembly.

Installation

1. Thoroughly clean all gasket sealing surfaces.
2. Install side gaskets on pan rails, using grease as a retainer. Rear end of side gaskets lap rear end gasket. Tuck front ends of side gaskets into gap between front end cover seal groove and cylinder block.
3. Install rear oil pan seal in groove in rear main bearing cap. Tuck ends into groove openings in cylinder block.
4. Install oil pan front seal in groove in front end cover, with ends butting side gaskets.
5. Install oil pan and pan to cylinder block bolts. Tighten bolts to 12-15 ft. lbs. torque.

OIL PUMP

The oil pump (fig. 84) has a baffle incorporated on the intake pipe and screw assembly (9) shown in Figure 84. This baffle is designed to eliminate pressure loss due to sudden surging stops.

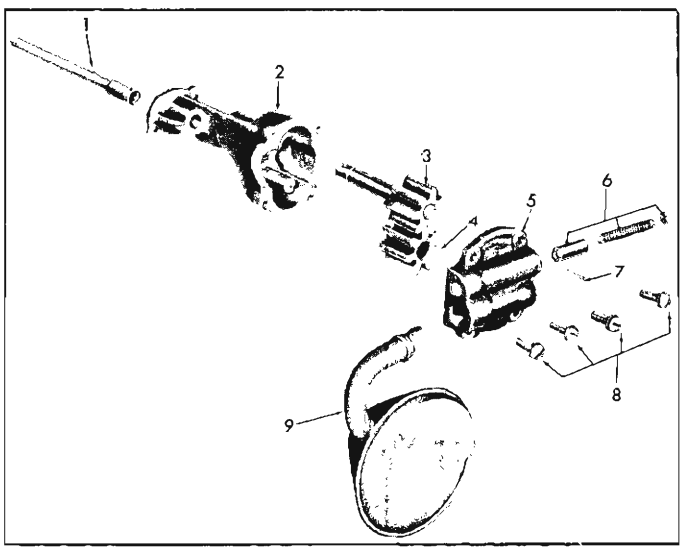


Fig. 84—Oil Pump Exploded

1. Shaft Extension
2. Pump Body
3. Drive Gear and Shaft
4. Idler Gear
5. Pump Cover
6. Regulator Valve
7. Retaining Pin
8. Screws
9. Intake Pipe and Screen

Removal and Disassembly

1. Remove oil pan.
2. Remove pump to rear main bearing cap bolt (fig. 85) and remove pump, extension shaft and collar.
3. Disconnect pump shaft from extension.
4. Remove pump cover attaching screws, cover, idler gear and drive gear and shaft.
5. Mount pump cover in a soft-jawed vise and pull pipe from cover (if screen or pipe needs replacing).
6. Wash all parts in cleaning solvent and dry by using compressed air, if available.

Inspection

Should any of the following conditions be found during inspection operations it is advisable to replace pump assembly.

1. Inspect pump body for cracks or excessive wear.
2. Inspect oil pump gears for excessive wear or damage. See specifications.
3. Check shaft for looseness or excessive wear of shaft in the housing.

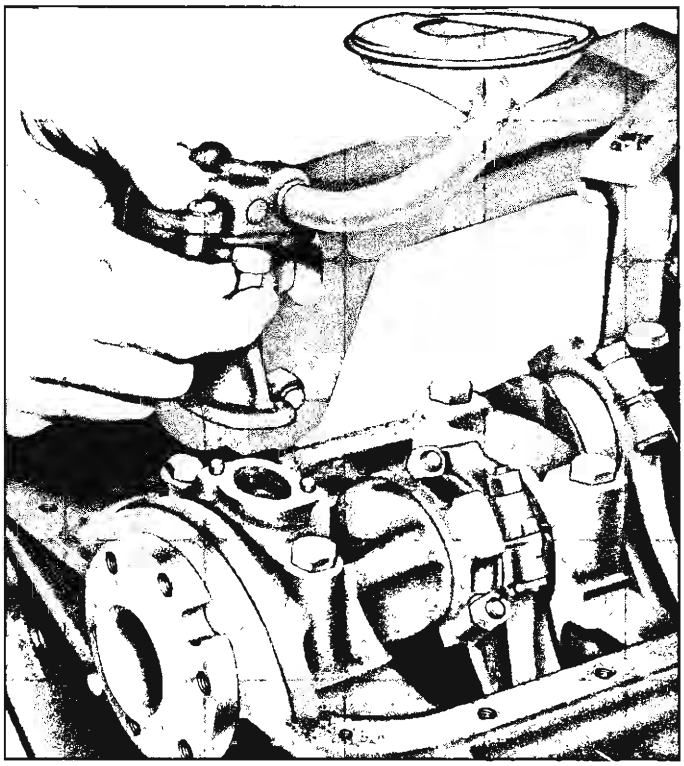


Fig. 85—Oil Pump Removal and Installation

4. Check inside of cover for wear (excessive end play) that would permit oil to leak past the ends of gear. See specifications.
5. Check the oil pick-up screen for damage to screen, by-pass valve or body. Check for oil in air chamber.

Assembly and Installation

1. Place drive gear and shaft in pump body.
2. Install idler gear so that smooth side of gear will be toward the cover.
3. Install pick-up screen and pipe in a vise and tap cover on with plastic hammer, be careful not to collapse suction tube (if screen or pipe was removed).

   NOTE: Be careful about shearing or twisting when driving cover on tube, air leakage could result.

4. Install cover and attaching screws. Tighten screws to 6 to 9 ft. lbs. and check to see that shaft turns freely.
5. Assemble collar end of extension shaft assembly over pump drive shaft, aligning tang of extension shaft with slot in end of pump drive shaft.
6. Assemble pump and extension shaft to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.

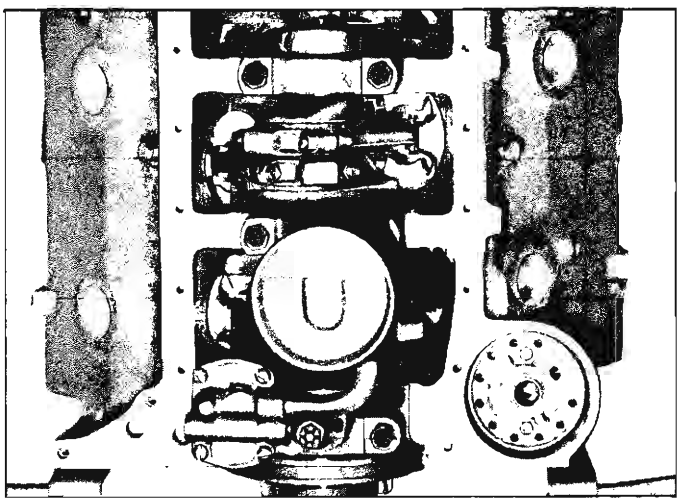


Fig. 86—Oil Pump Installed

7. Install pump to rear bearing cap bolt and tighten to 45 to 50 ft. lbs.

   NOTE: Install oil pump screen bottom edge parallel to oil pan rails as shown in Figure 86.

8. Install oil pan.

CONNECTING RODS, BEARINGS, PISTONS AND RINGS

Piston and Connecting Rod Removal

1. Remove oil pan and oil pump.
2. Remove cylinder heads or head, if only one piston assembly is being removed from one cylinder bank

3. Remove any ridge and/or deposits from the upper end of the cylinder bores with a ridge reamer.

   NOTE: Move piston to the bottom of its travel and place a cloth on top of piston to collect the cuttings.

4. After ridge and/or deposits are removed, turn crankshaft until piston is at the top of its stroke and carefully remove cloth with the cuttings.
5. Mark connecting Rod and Bearing Caps left bank 1, 3, 5 & 7. Right bank 2, 4, 6 & 8 from front to rear on same side as piston thrust.
6. Remove connecting rod journal bearing cap and install Tool J-6305, Connecting Rod Guide, set on studs as shown in Figure 87. Push piston assemblies out of top of cylinder block.

   NOTE: If tool interferes cut a 1¼" x 35/64" diameter relief at attaching end to clear bearing journal.

   NOTE: It will be necessary to turn the crankshaft slightly to disconnect some of the rods and to push them out of the cylinder.

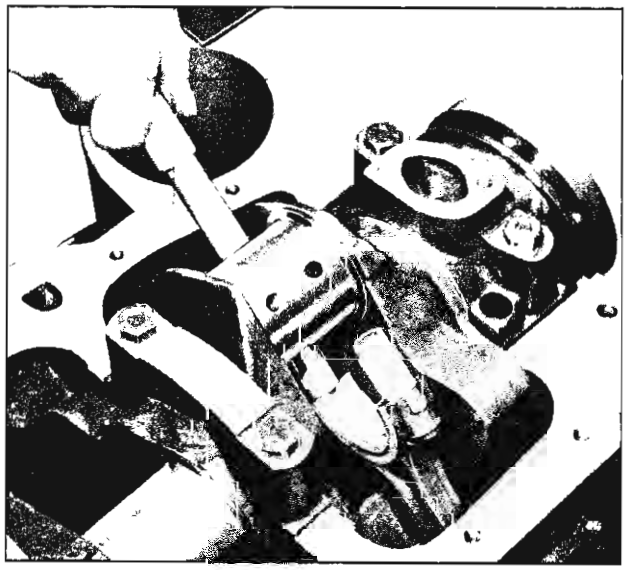


Fig. 87—Removing Piston Assemblies

7. Remove piston rings by expanding them and sliding them off the ends of the pistons. Tool J-8021 is available for this purpose.

Piston and Connecting Rod Disassembly

1. Install pilot on Tool J-5538 on adapter.

   NOTE: The tapered end of the support must be cut back at a smaller angle to the centerline of the support, to avoid breakage of the bottom piston ring land.

2. Install puller screw, with pilot, through piston and pin.

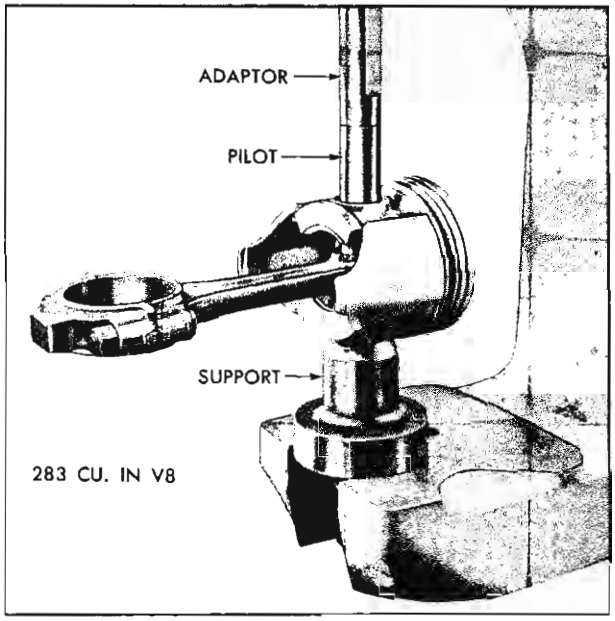


Fig. 88—Removing Piston Pin

3. Install support over threaded end of puller screw with small end of support against piston.
4. Install nut loosely on puller screw and place assembly in an arbor press as shown in Figure 88. Press pin out of connecting rod.
5. Remove assembly from press and remove puller nut, support and piston pin from puller screw.
6. Remove puller screw from piston and remove pilot from piston and connecting rod.
7. Remove connecting rod from piston.

Cylinder Block Inspection

1. Check the cylinder block for cracks in the cylinder walls, water jacket and main bearing webs.

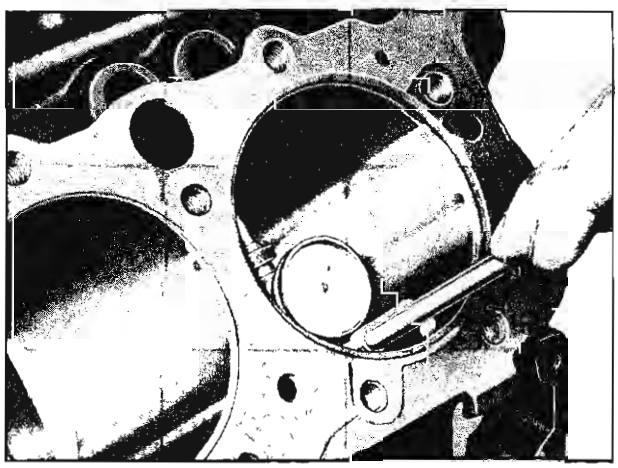


Fig. 89—Checking Cylinder Bores

2. Check the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator (fig. 89). Set the gauge so that the thrust pin must be forced in about ¼" to enter gauge in cylinder bore. Center gauge in cylinder and turn dial to "0." Carefully work gauge up and down cylinder to determine taper and turn it to different points around cylinder wall to determine the out-of-round condition. If cylinders were found to have more than .002 out-of-round, boring will be necessary.

Cylinder Conditioning

The performance of the following operations is contingent upon engine condition at time of repair.

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring and honing.

High limit standard size pistons are available for service use so that proper clearances can be obtained for slightly worn cylinder bores requiring only light honing to clean up the bores. There are four standard size pistons available for service installation. In addition, aluminum pistons are serviced in .020", .030" and .040" oversizes. If the cylinders were found to have less than .005" taper or wear they can be conditioned with a hone and fitted with the high limit standard size pistons. A cylinder bore of less than .005" wear or taper may not entirely clean up when fitted to a high limit piston. If it is desired to entirely clean up the bore in these cases, it will be necessary to rebore for an oversize piston. If more than .005" taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.

Cylinder Boring

1. Before using any type boring bar, the top of the cylinder block should be filed off to remove any dirt or burrs. This is very important. Otherwise, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.
2. The piston to be fitted should be checked with a micrometer, measuring at the center of the piston skirt and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston and honed to give a clearance of.0006" to .0010".
3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

Cylinder Honing and Piston Fitting

1. When the cylinders are to be honed only for use of standard high limit piston or for final finishing after they have been rebored to within .002" of the desired size, they should be finished with a hone. Rough stones may be used at first and fine stones for the final operation.
2. Follow the hone manufacturers recommendations for the procedure on the use of the hone and cleaning and lubrication during honing.
3. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.
4. Check fit of the aluminum pistons in the following manner.
   a. Invert the piston, skirt end up, and place a .0015" by ½" wide feeler ribbon, part of Tool J-5513 on the side of the piston 90° from the piston pin holes.
   b. Insert the feeler ribbon and inverted piston into the cylinder bore so that the center of the piston pin is flush with the top surface of the cylinder block. Keep the feeler ribbon straight up and down and keep the piston pin parallel with the crankshaft axis.
   c. Pull the feeler gauge straight up and out, noting at the same time the scale reading, which should be between 4 and 6 pounds (fig. 90).

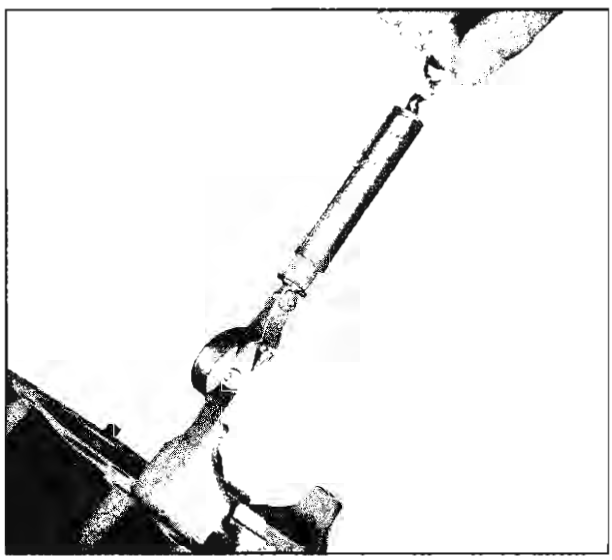


Fig. 90—Checking Piston Fit

   d. If the scale reading is greater than the maximum allowable pull, try another piston or lightly hone the cylinder bore to obtain the proper fit.
   e. Should the scale reading be less than the minimum allowable pull, try another piston, or if standard size, try a standard high limit piston. If proper fit cannot be obtained it will be necessary to rebore the cylinder to the next oversize piston.

f. Mark each piston after fitting to correspond with the cylinder to which it has been fitted. This will assure proper installation.

5. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

CAUTION: Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been bored to correct size as this type piston can be distorted through careless handling.

6. Thoroughly clean the cylinder bores and cooling holes at each cylinder with a small wire brush. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil. The bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

Checking Piston Pin Fit

Piston pins should be capable of supporting their own weight in either pin boss (fig. 91) when coated with light engine oil and at 60°F. Higher or lower temperatures will cause false indications. Pistons and pins are serviced as assemblies.

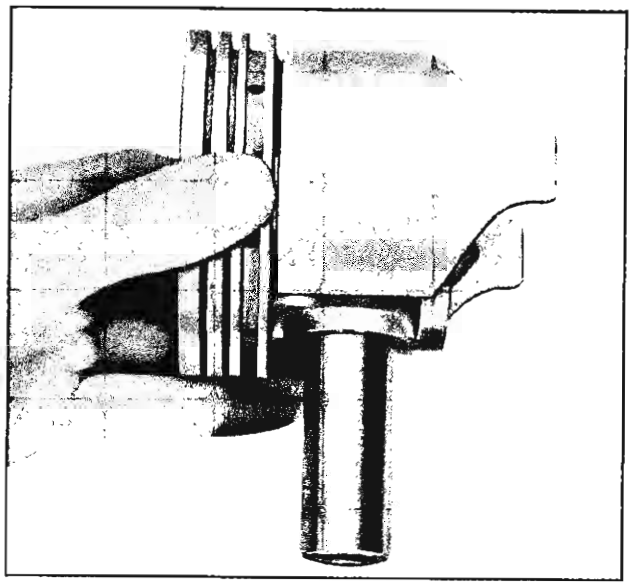


Fig. 91—Checking Piston Pin Fit

Piston and Connecting Rod Assembly

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.

2. Position connecting rod in its respective piston so that flange or heavy side of rod at the bearing end will be towards front of piston (cast depression in top of piston head) on 1, 3, 5 and 7 pistons, and the rod flange to the rear of the piston on 2, 4, 6 and 8 pistons.

3. Install piston pin on adapter and pilot on puller screw (fig. 92).

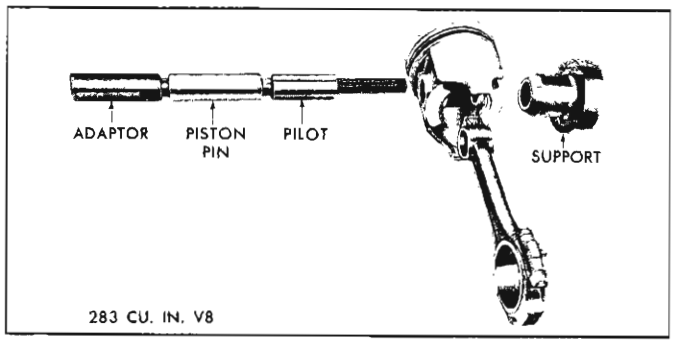


Fig. 92—Piston Pin Assembly Tool Layout

4. Install puller screw through piston and rod, indexing pilot through piston and rod.

5. Install support over threaded end of adapter with smaller diameter toward piston.

6. Install in arbor press and press piston pin in until pilot bottoms in support, properly positioning the pin in the rod.

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

Piston Rings

All compression rings in the V-8 engines are the deep section twist type.

This type compression ring takes its name, twist type, from its installed position which is cocked or twisted. It assumes and maintains this position for life because the I.D. is chamfered or stepped, making the ring unbalanced in cross section.

Compression ring for the upper ring has the chamfer, or step, at the upper edge. The second ring has the step at the lower edge.

All compression rings are marked with the letters "G.M." cast in the upper side of the ring. When installing compression rings, make sure the marked side is toward the top of the piston. The top ring is chromed for maximum life.

The oil control rings used are of the three piece type, consisting of two segments (rails) and a spacer.

Chevrolet piston rings are furnished in standard sizes as well as .020", .030" and .040" oversizes.

Piston Ring Installation

1. Select rings comparable in size to the piston being used.
2. Slip the ring in the cylinder bore; then using the head of a piston, press the ring down into the cylinder bore about two inches.

   NOTE: Using a piston in this way will place the ring square with the cylinder walls.

3. Check the space or gap between the ends of the ring with a feeler gauge (fig. 93).

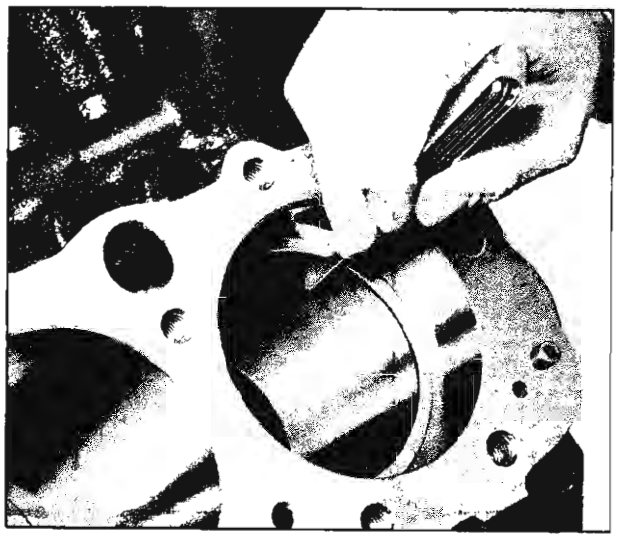


Fig. 93—Checking Ring Gap

4. If the gap between the ends of the ring is below specifications (see *Engine Specifications* in Section 16), remove the ring and try another for fit.
5. Fit each ring separately to the cylinder in which it is going to be used.

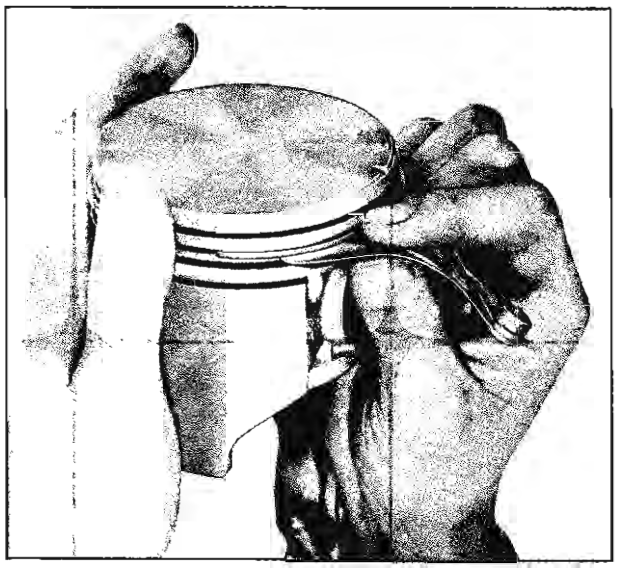


Fig. 94—Rolling Ring in Groove

6. New pistons, rings and cylinder bores wear considerably during seating and gaps widen quickly; however, engine operation will not become seriously affected if ring gaps do not become greater than $\frac{1}{32}$".
7. Carefully remove all particles of carbon from the ring grooves in the piston and inspect the grooves carefully for burrs or nicks that might cause the rings to hang up.
8. Slip the outer surface of the compression ring into the piston ring groove and roll the ring entirely around the groove to make sure that the ring is free and does not bind in the groove at any point (fig. 94). If binding occurs, the cause should be determined and removed by carefully dressing with a fine cut file. However, if the binding is caused by a distorted ring, install a new ring.
9. Install the oil ring spacer in the oil ring groove and position gap in line with piston hole. Hold spacer ends butted and install steel rail on top side of spacer. Position gap at least 1" to left of spacer gap, then install second rail on lower side of spacer. Position gap at least 1" to right of spacer gap.
10. Flex the oil ring assembly in its groove to make sure ring is free and does not bind in the groove at any point. If binding occurs, the cause should be determined and removed by carefully dressing with a fine cut file. However, if the binding is caused by a distorded ring, install a new ring.
11. Proper clearance of the piston ring in its piston ring groove is very important in maintaining engine performance and in preventing excessive oil consumption. Therefore, when fitting new rings, the clearances between the top and bottom surfaces of the ring grooves should be inspected (fig. 95). Refer to *Engine Specifications* in Section 16 for correct clearances.

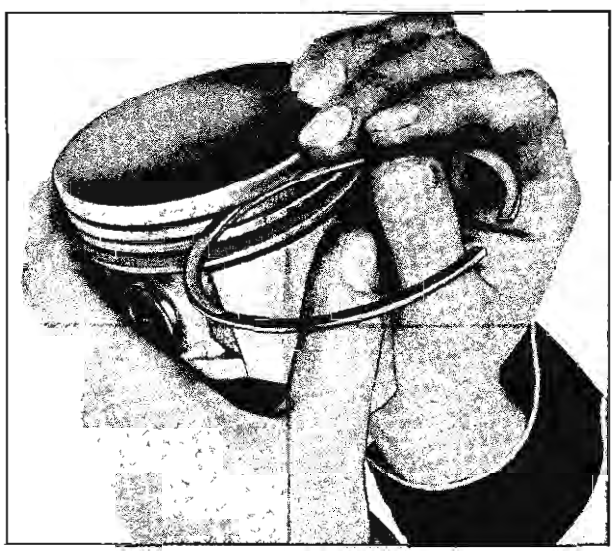


Fig. 95—Checking Groove Clearance

Piston and Connecting Rod Installation

NOTE: Be sure to install the pistons in the same cylinders from which they were fitted. Each connecting rod and bearing cap should be marked either 1, 3, 5 and 7 in the left bank and 2, 4, 6 and 8 in the right bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

1. Lightly coat pistons, rings and cylinder walls with light engine oil.
2. With bearing caps removed, install Tool J-6305 on bearing cap bolts.
3. Install each piston in its respective bore, using Tool J-6305 on each assembly. The side of the piston with the cast depression in the head should be to the front of the cylinder block. Use Tool J-8037 (fig. 96) to compress the rings for installation.

   Guide the connecting rod bearing into place on the crankshaft journals with the long detail of Tool J-6305 Connecting Rod Guide Set.

Fig. 96—Installing Piston Assemblies

4. Install the bearing caps and check the bearing clearance as described below.

Connecting Rod Bearing Clearance

Connecting rod bearing inserts are available in standard sizes and undersizes of .001", .002", .010" and .020". These bearings are not shimmed and when clearances become excessive the next undersize bearing insert should be used. DO NOT FILE ROD OR ROD CAPS.

1. Remove the connecting rod bearing cap.
2. Wipe bearing insert shell and crankpin clean of oil.
3. Place a piece of Plastigage the full width of the bearing or crankpin (parallel to the crankshaft) (fig. 97).

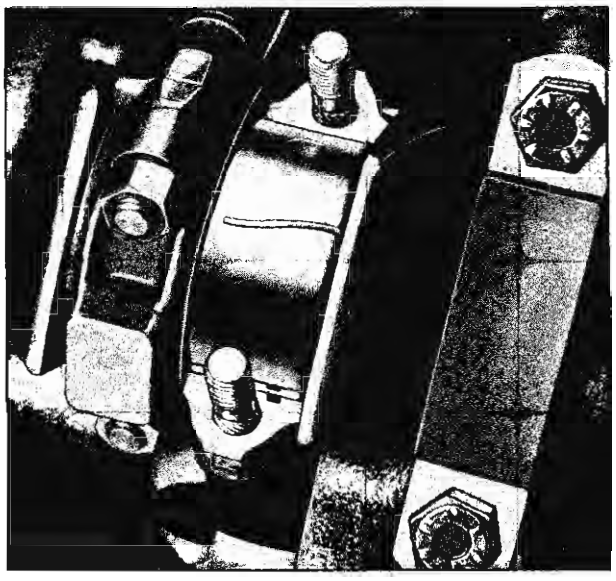


Fig. 97—Plastigage on Crankpin

4. Reinstall the bearing cap and evenly tighten the retaining bolts to 30-35 ft. lbs. torque.

   CAUTION: Do not turn crankshaft with the Plastigage installed.

5. Remove the bearing cap and without removing the Plastigage, check its width at the widest point with Plastigage scale (fig. 98).

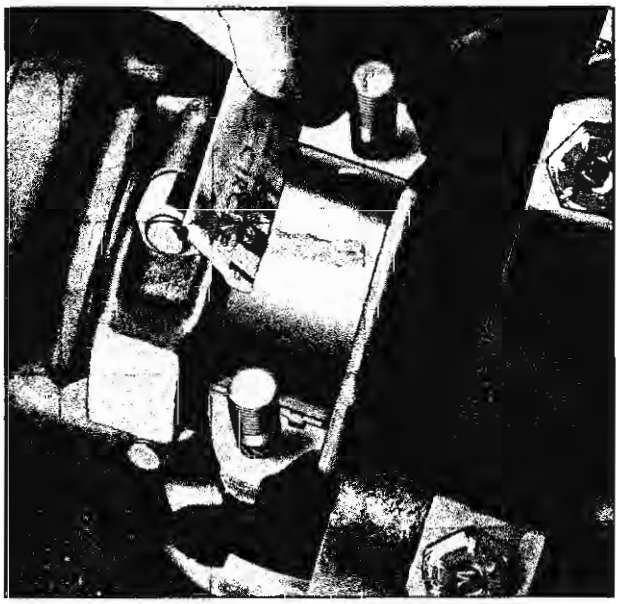


Fig. 98—Measuring Plastigage

NOTE: If the crankpin is out-of-round be sure to fit the bearing to the maximum diameter of the crankpin. If the flattened plastic is not uniform from end to end in its width, the crankpin or bearing is tapered, has a low spot or some other irregularity. Check the crankpin with a micrometer for taper if the flattened Plastigage indicates more than a .001" difference.

6. If the reading is not over .004" (worn), or .003" (new) or not less than .001" the fit is satisfactory. If, however, the clearances are not within these limits, replace the bearing with the proper undersize bearing.

NOTE: The insert bearing shells are not adjustable and no attempt should be made to adjust by filing the bearing caps.

7. Rotate the crankshaft after bearing adjustment to be sure the bearings are not too tight.
8. Check connecting rod clearance between upper half of connecting rod and side of crank pin. This clearance should be .008" to .014" with two rods on each crankpin of crankshaft (fig. 92).

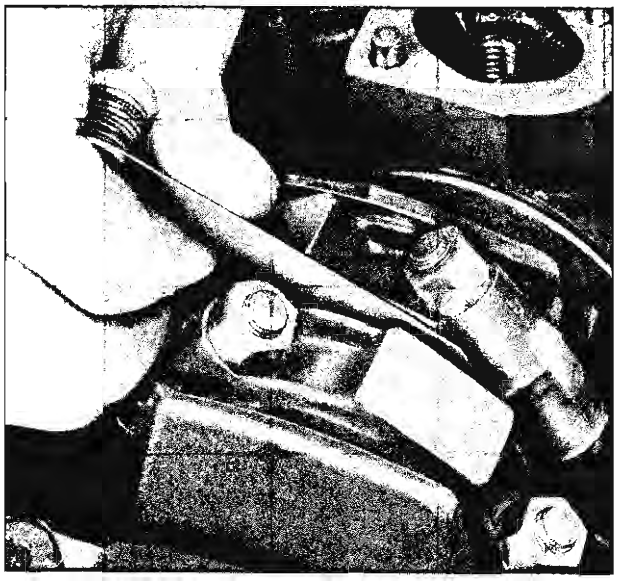


Fig. 99—Connecting Rod Side Clearance

CRANKSHAFT AND MAIN BEARINGS

Crankshaft

Removal

1. Drain the cooling system and the crankcase. Disconnect all radiator hoses.
2. Remove fan shroud, radiator, fan blade, spacer and pulley.
3. Remove engine from chassis and install on engine stand. If Tool J-5856 Stand is to be used, J-5831 Bracket set Adapter Kit will allow engine to be mounted securely.
4. Remove water pump, underpan, flywheel housing and flywheel.
5. Remove harmonic balancer and crankcase front end cover.
6. Remove camshaft sprocket and timing chain. Remove crankshaft oil slinger.
7. Remove crankshaft sprocket using Tool J-5825 (fig. 100).

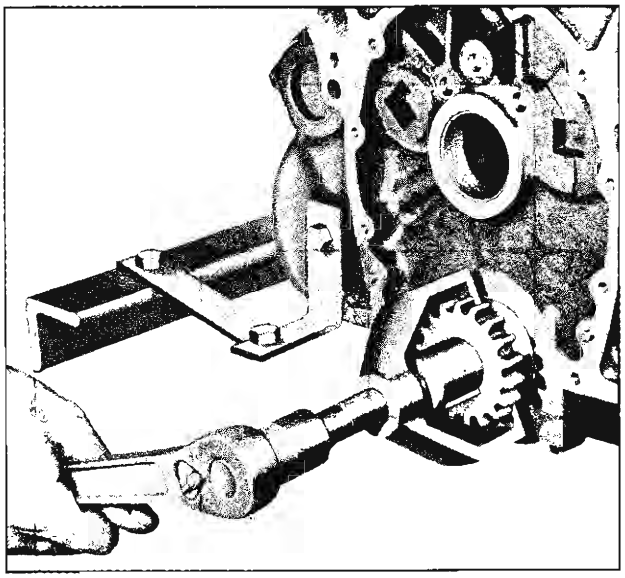


Fig. 100—Removing Crankshaft Sprocket

8. Remove oil pan and oil pump.
9. Make sure all bearing caps (main and connecting rods) are marked so they can be installed in their original locations. Remove connecting rod bearing caps, then push the piston and rod assemblies towards the heads.
10. Remove main bearing caps and carefully lift the crankshaft out of the cylinder block. Remove rear main bearing oil seal from cylinder block and rear main bearing cap following procedures outlined under *Rear Main Bearing Oil Seal.*
11. If new main and/or connecting rod bearings are to be installed, remove the main bearing inserts from the cylinder block and bearing caps, and/or connecting rod bearing inserts from the connecting rod and caps. Install new bearings following procedures outlined in this section.

Installation

NOTE: Be sure that all bearings and crankshaft journals are clean.

1. Install a new rear main bearing oil seal in cylinder block and rear main bearing cap.
2. Carefully lower the crankshaft into place. BE CAREFUL NOT TO DAMAGE THE BEARING SURFACES.
3. Check clearance of each main bearing following

procedure outlined under *Main Bearing Clearance* in this section. If the bearing clearances are satisfactory, apply a light coat of engine oil to the journals and bearings.

4. Install all bearing caps and bolts. Torque all main bearing cap bolts, except the rear main bearing 60 to 70 ft. lbs. When tightening rear main bearing cap, torque bolts 10 to 12 ft. lbs. first, then tap end of crankshaft rearward with a lead hammer (this will locate bearing cap and bearing). Then tap crankshaft forward (this will line up both upper and lower crankshaft bearing thrust surfaces). Proceed with final tightening of all main bearing cap bolts—60 to 70 ft. lbs. torque.
5. Check crankshaft end play by forcing the crankshaft to its extreme front position. Check at the front end of the rear main bearing with a feeler gauge (fig. 101). Clearance should be from .002″ to .006″ with a new bearing. If greater than a maximum .009″ clearance, the rear main bearing must be replaced.

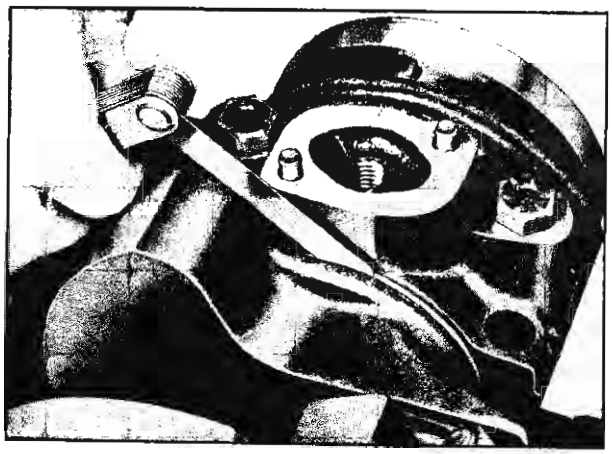


Fig. 101—Checking Crankshaft End Play

Main Bearings

Crankshaft main bearing service may be performed with the engine inverter and oil pan, spark plugs, oil pump and timing chain removed. The Plastigage method of measuring bearing clearance is recommended on both main and connecting rod bearings.

Bearing and Journal Inspection

In general, the lower half of the bearing shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can safely be assumed that the upper half is also satisfactory. If the lower half shows evidence of fatigue, distress, abrasion, erosion, scoring or the like, both upper and lower halves should be replaced. Never should one half be replaced without replacing the other half.

If the running clearance of a bearing is too great with the used inserts, it will be necessary to install both upper and lower bearing halves. Should this become necessary, the crankshaft journals should be checked with a micrometer for out-of-round, taper or undersize. If out-of-round more than .001″ or tapered, the shaft should be replaced or reconditioned. Check the crankshaft thrust faces at the rear main bearing for scoring or excessive wear. Experience has shown that clearance increase from wear in main bearings is not only due to bearing wear, but is also due in part to crankshaft journal wear.

Main Bearing Clearance

Plastigage consists of a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface. To obtain the most accurate results with Plastigage, certain precautions should be observed. If the engine is out of the chassis and upside down, the crankshaft will rest on the upper bearings and it can be assumed that the total clearance can be measured between the cap bearing and journal.

NOTE: To assure the proper seating of the crankshaft, the rear main bearing oil seal should be removed and all bearing cap bolts should be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

1. Starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of Plastigage the full width of the bearing (parallel to the crankshaft) on the journal (fig. 102).

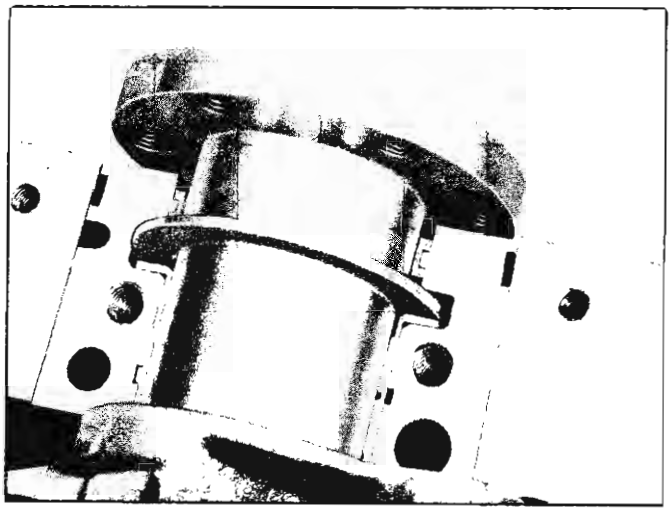


Fig. 102—Plastigage on Journal

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

3. Install the bearing cap and evenly tighten the retaining bolts to 60-70 lb. ft. torque.

4. Remove bearing cap. The flattened Plastigage will be found adhering to either the bearing shell or journal. On the edge of Plastigage packing envelope there is a graduated scale which is correlated in thousandths of an inch.

5. Without removing the Plastigage, check its compressed width (at the widest point) with the graduations on the Plastigage envelope (fig. 103).

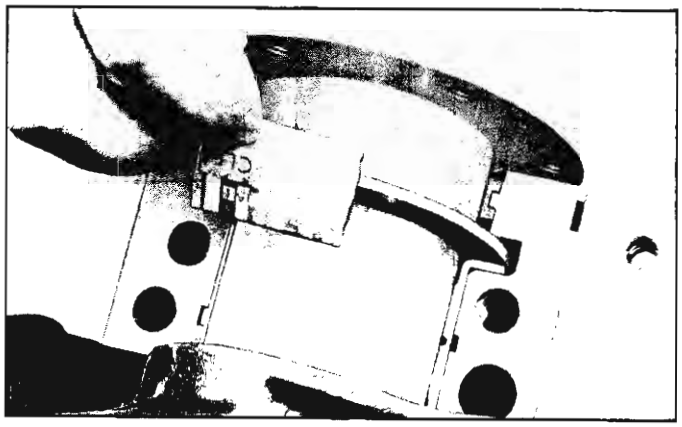


Fig. 103—Measuring Plastigage

NOTE: Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal be sure to fit to the maximum diameter of the journal. If the bearing is fitted to the minimum diameter of the journal and the journal is out-of-round .001" or more, interference between the bearing and journal will result in rapid bearing failure. If the flattened Plastigage tapers toward the middle or ends, there is a difference in clearance indicating a taper, low spot or other irregularity of the bearing or journal. Be sure to check the journal with a micrometer if the flattened Plastigage indicates more than .001" difference.

6. If the bearing clearance is not over .004" (worn) or .003" (new) or less than .001" the bearing insert is satisfactory. If the clearance is not within these limits replace the insert.

NOTE: If a new bearing cap is being installed and clearance is less than .001", check for burrs or nicks; if none are found then install shims as required.

7. A .002" undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.

NOTE: Bearings are available in standard sizes and .002", .010", .020" and .030" undersize.

8. Proceed to the next bearing. After all bearings have been checked rotate the crankshaft to see that there is no excessive drag.

9. Check the end play by forcing the crankshaft to its extreme front position. Check at the front end of the rear main bearing with a feeler gauge (fig. 101). This clearance should be from .002" to .006".

10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

Main Bearings—Replace

The main bearings used as service replacement are of high quality with close tolerances of fit and will not require line reaming on installations. The close dimensional tolerances assure an equalized bearing surface at all points on the crankshaft when replaced in sets.

1. Remove main bearing caps and connecting rod caps and lift crankshaft out of cylinder block. Push pistons to top of bores.

2. Inspect the crankshaft. All main bearings are ground to 2.2978"-2.2988", and crankpin journals to 1.999"-2.000".

   These dimensions should be checked with a micrometer for out-of-round, taper or undersize. If the journals exceed .001" out-of-round or taper the crankshaft should be replaced or reconditioned to an undersize figure that will enable the installation of undersize precision type bearings.

   The crankshaft should also be checked for runout. To perform this operation, support the crankshaft at the front and rear main bearing journals m "V" blocks and indicate the runout of both the rear intermediate and front intermediate journals, using a dial indicator. The runout limit of each of these journals is .002". If the runout exceeds .002" the crankshaft must be repaired or replaced.

3. Remove old bearing shells from cylinder block and caps.

4. Remove rear main bearing oil seal.

5. Install new bearing shells in the cylinder block and caps.

NOTE: Main bearing shells with oil holes are the upper halves of the bearing shells and are inserted between the crankshaft and cylinder block.

6. Carefully place the crankshaft in the bearings.

7. Install the bearing caps as previously outlined under *Crankshaft Installation.*

NOTE: The caps are marked with an arrow for identification purposes. The caps are to be installed with the arrows pointing to the front of the engine.

8. Check crankshaft end clearance as previously outlined.
9. Check main bearing clearance as previously outlined.
10. Install new rear bearing oil seal.
11. Install connecting rod bearings and caps.

Rear Main Bearing Oil Seal

Removal and Installation

The rear main bearing oil seal, shown in Figure 104, can be removed (both halfs) without removal of the crankshaft.

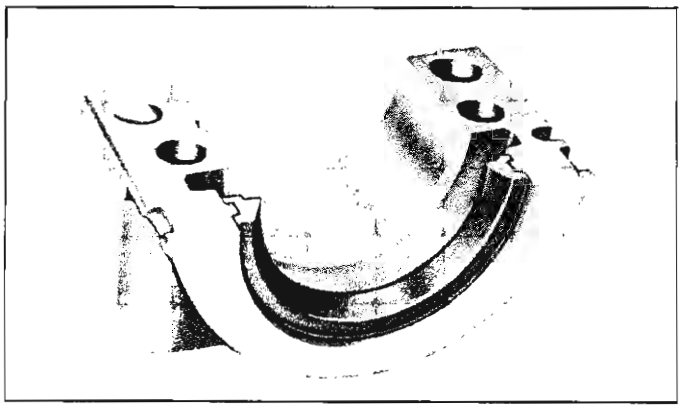


Fig. 104—Rear Main Bearing Seal

1. Drain crankcase and remove oil pan.
2. Remove rear bearing cap.
3. Remove oil seal from groove, prying from bottom, using a small screwdriver as shown in Figure 105.

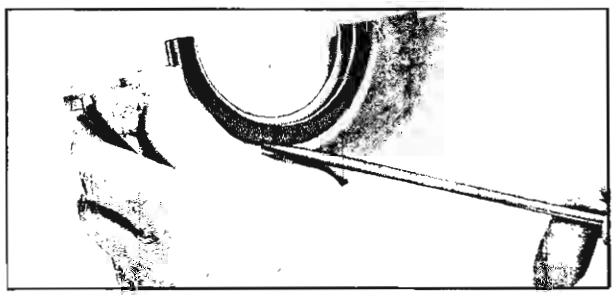


Fig. 105—Removing Seal from Cap

NOTE: Always clean crankshaft surface before installing a new seal.

4. Insert new seal well lubricated on lip only (keep oil off of parting line surface, this is treated with glue) with engine oil (lip facing toward the front of engine) with finger and thumb, roll seal in place, being careful not to cut bead on back of seal with seal tangs at parting line.

NOTE: Always replace upper and lower seal as a unit.

5. To replace the upper half of the seal, use a small hammer and tap a brass pin punch on one end of seal (fig. 106) until it protrudes far enough to be removed with pliers as shown in Figure 106.

NOTE: Be careful of seal retainer tang while inserting a new seal so that it doesn't cut the seal.

6. Insert a new seal well lubricated with engine oil in groove (keep oil off of parting line surface, this surface is treated with glue) gradually push with a hammer handle until seal is rolled into place. Install bearing cap and torque bearing cap bolts 60-70 ft. lbs.

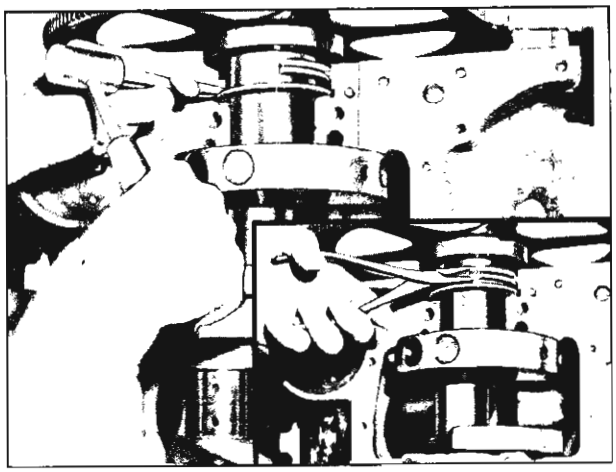


Fig. 106—Removing and Installing Oil Seal

OIL FILTER VALVE REPLACEMENT

Refer to *Oil Filter Valve Replacement* described under 348 cu. in. V-8 engine in this section.

ENGINE MOUNTINGS

Front engine mountings are of the non-adjustable type. Because of this, service is seldom required. Broken or deteriorated mounts should be replaced immediately because of the added strain thrown on other mounts and drive line components.

Front Mounts—Replace

1. Remove distributor cap.
2. Remove fuel pump and remove nut, bolt and washer at "B" (fig. 107) from mount.
3. Raise engine and remove three bolts and lockwashers at point "A" (fig. 107), bolts may be removed from bottom of vehicle with a universal socket wrench, using a long extension.

NOTE: Do not remove bolts at "C" location for engine mount removal (fig. 107).

4. Replace mounts and install bolts and lockwashers

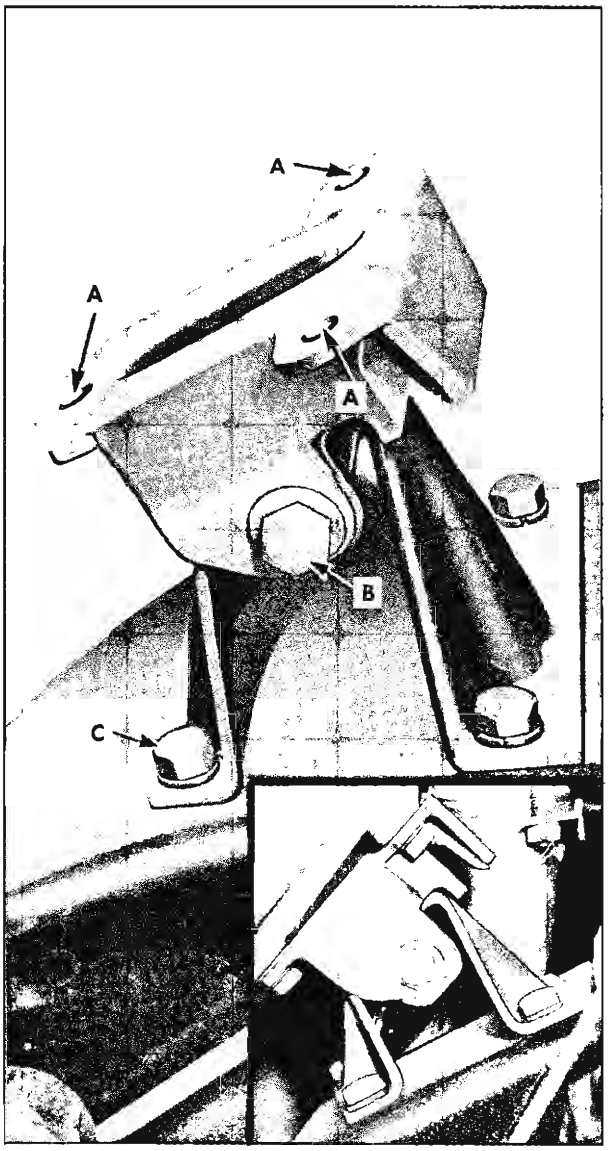


Fig. 107—Front Engine Mounts

at point "A" (fig. 107) and lower engine into place.

5. Replace long bolts, washers and locknuts as shown in Figure 107 inset.
6. Replace fuel pump.

ENGINE OVERHAUL

Removal from Vehicle

1. Drain cooling system, crankcase and transmission.
2. Scribe alignment marks on hood around hood hinges and remove hood from hinges.
3. Remove radiator hoses and heater hoses on models so equipped.
4. Remove battery and battery cables.
5. Remove fan shroud and radiator core bolts. On Powerglide or Turboglide models, remove and plug oil cooler lines. Remove radiator core and fan shroud.
6. Disconnect starter and generator wires, engine to body ground strap, oil pressure indicator wire at sending unit on block and coil primary lead at coil.
7. Remove temperature indicator element wire.
8. Remove oil filter assembly.
9. Remove air cleaner. Remove Air Conditioning if so equipped as outlined in Section 15.
10. Disconnect gasoline feed pipe from fuel pump and disconnect vacuum lines from intake manifold and fuel pump if so equipped.
11. Remove distributor cap. Remove Power-Steering if so equipped as outlined in Section 3.
12. Disconnect carburetor control rod from bell crank and T.V. lever on Transmission if Powerglide or Turboglide equipped.
13. Remove exhaust pipe flange nuts and lower exhaust pipes and mufflers.
14. Remove bolt from road draft tube. Remove road draft tube.
15. Remove exhaust cross-over pipe and manifold heat valve from right hand exhaust manifold.
16. Remove transmission control rods. On overdrive models, disconnect overdrive wires and cables.
17. Remove clutch control bell crank and control rods on conventional transmission models. On Powerglide or Turboglide models, remove oil filler tube and plug the opening.
18. Disconnect speedometer cable at transmission.
19. Remove propeller shaft as outlined in Section 5.
20. Install two eye bolts and spacers from Tool Kit J-4536-A in cylinder head bolt holes.
21. Raise engine slightly. Remove front mounting bolts (see figure 107). Remove transmission mounting block to frame cross-member bolts.
22. Remove the engine and transmission from the vehicle as a unit, tilting engine to clear core support.

Engine Disassembly

1. On all models equipped with a 3-speed transmission, proceed as follows:
   a. Remove flywheel underpan and extension and bolts attaching transmission to clutch housing. Remove transmission.

   NOTE: Support the transmission as the last mounting bolt is removed and as it is being pulled away from the engine to prevent damage to clutch disc.

b. Remove throwout bearing from clutch fork and remove fork by forcing it forward and toward the center of the vehicle.

c. Install Tool J-5824 to support clutch during disassembly. Loosen clutch to flywheel bolts a turn at a time (to prevent distortion of clutch cover) until the diaphragm spring pressure is released (fig. 108). Remove all bolts, pilot tool, cover assembly and disc.

d. Remove the flywheel and clutch housing.

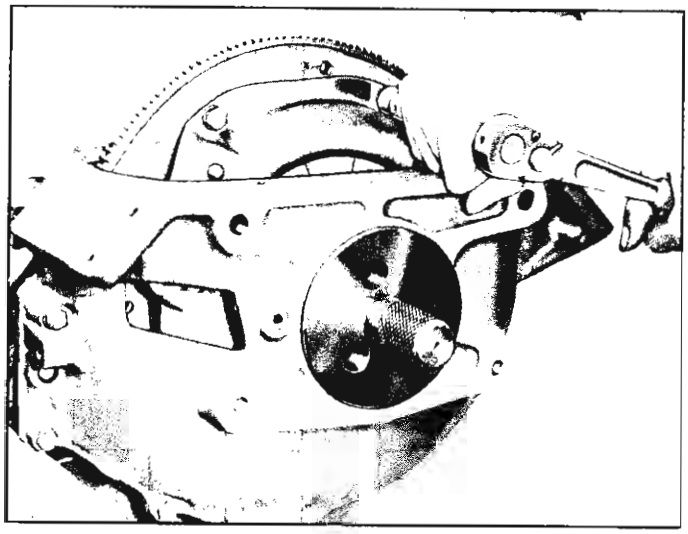


Fig. 108—Removing Clutch

2. On models equipped with an automatic transmission, remove transmission from engine. Refer to Section 13.
3. Remove generator from left bank exhaust manifold.
4. Remove exhaust manifold to cylinder head bolts and remove exhaust manifolds.
5. Install engine on stand. If Tool J-5856-02 universal stand is to be used, Tool J-8690-01 universal adapter will allow engine to be mounted securely. Tool J-4533A or Tool J-4533-5 if available can also be used with Tool J-5856-02 stand. Remove lifting hooks.
6. Disconnect fuel pump to carburetor pipe and remove fuel pump. Remove fuel pump mounting-plate and fuel pump push rod from cylinder block.
7. Remove carburetor. On Powerglide or Turboglide models, remove transmission throttle control upper rod from carburetor throttle lever.
8. Remove thermostat housing from intake manifold and remove thermostat. Remove water pump.
9. Remove intake manifold to cylinder head bolts and remove pipe clips, plug wire supports and intake manifold.
10. Remove spark plug wiring harness and spark plugs.
11. Remove rocker arm nuts, rocker arms and pivots, and remove push rods.
12. Remove cylinder head bolts, cylinder heads and discard gaskets.
13. Remove valve lifters.

    NOTE. Valve lifters should be placed in a rack in their proper sequence so they can be reinstalled in their same positions in the cylinder block.
14. Remove screw retaining crankcase inner ventilator body to cylinder block and remove ventilator body from cylinder block.

    CAUTION: Do not damage vent body.
15. Remove oil pan retaining bolts and screws and remove oil pan.
16. Install Tool J-6978 to harmonic balancer and turn puller screw to remove balancer from crankshaft. Remove tool from balancer.
17. Remove crankcase front end cover attaching screws and remove front end cover and gasket. Remove crankshaft oil slinger.
18. Remove three camshaft sprocket to camshaft bolts.
19. Remove camshaft sprocket and timing chain together. Sprocket is a light press fit on camshaft for approximately ⅛". If sprocket does not come off easily, a light blow with a plastic-faced hammer on the lower edge of the camshaft sprocket should dislodge the sprocket.
20. Remove crankshaft sprocket using Tool J-5825.
21. Install two bolts, $\frac{5}{16}$"-18 x 4" in two of camshaft bolt holes. Remove camshaft from engine.

    CAUTION: All camshaft journals are the same diameter and caution must be used in removing camshaft to avoid damage to bearings.
22. Remove oil pump to rear main bearing cap bolt and remove pump, extension shaft and collar.
23. Disconnect pump shaft from extension.
24. Remove pump cover attaching screws, cover, idler gear and drive gear and shaft.
25. Remove connecting rod journal bearing caps and install Tool J-6305 on studs. See Fig. 87. Push piston assemblies out of top of cylinder block. If piston rings strike ridge at top of cylinder, remove ridge to prevent damaging piston ring lands.

    NOTE: If tool interferes cut a 1 ¼" x ¾" diameter relief at attaching end to clear bearing journal.

    NOTE: It will be necessary to turn the crankshaft slightly to disconnect some of the rods and to push them out of the cylinder.

26. Remove piston rings by expanding them and sliding them off the ends of the pistons. Tool J-8021 is available for this purpose.
27. Remove main bearing caps and lift crankshaft out of cylinder block. Lift bearing shells out of block and caps.

CLUTCH HOUSING INSTALLATION, AND ALIGNMENT (Standard Transmissions)

1. Install clutch housing to cylinder block over dowel pins, install attaching bolts and tighten to 25 to 35 ft. lbs.
2. Install Tool J-2494 in one of the crankshaft flange bolt holes.
3. Install Dial Indicator and position to read bore runout of the housing (fig. 109). Check runout by rotating crankshaft. This runout should not exceed .008″.
4. Reposition the dial indicator to read face runout and rotate crankshaft. The maximum allowable runout is .010″.

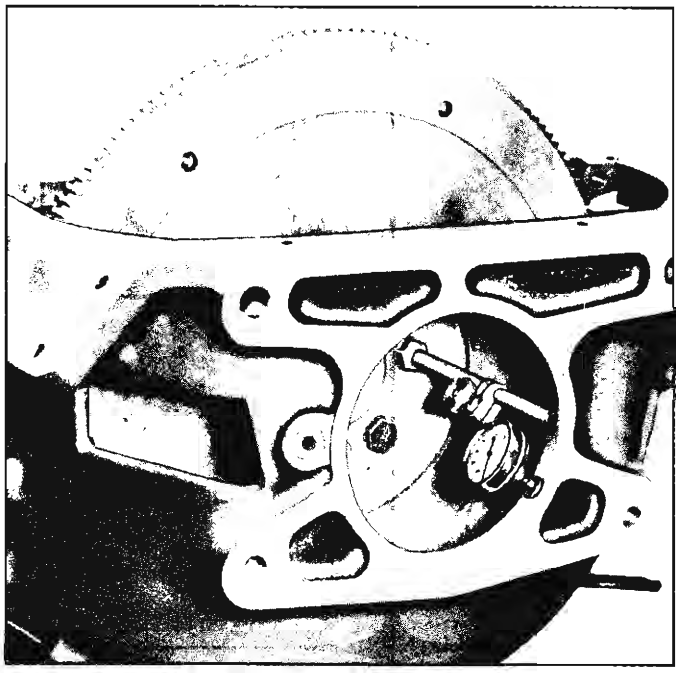


Fig. 109—Checking Bore Runout

5. If more runout is in excess of .008″ or if housing face parallelism exceeds .010″, remove indicator and the housing from engine block.
6. Remove the cylinder block to housing dowel pins.
7. Clean mating faces of housing and engine block and make certain there are no burrs or metal extrusion around dowel or bolt holes.
8. Install flywheel housing and tighten attaching bolts evenly to 25-35 ft. lbs. torque.
9. Mount indicator on indicator post and indicate flywheel housing face. Set indicator at zero at the six o'clock position and carefully check indicator readings at the 9, 12 and 2 o'clock positions. The runout limit is .010″.

   NOTE: Care should be exercised so that the indicator button is not on the edge of a bolt hole when the readings are taken.
10. If the face runout exceeds .010″, shim as necessary, using shim stock between the housing and block at the attaching bolt locations.
11. After the housing face has been brought within the .010″ limit with bolts tightened to 25-35 ft. lb. torque, reset indicator to read zero at the six o'clock position on the machined inside diameter of the flywheel housing bore.

    NOTE: Be careful that the indicator button is centered on the narrow machined flange and does not touch flange step.
12. Check indicator readings at the 9, 12 and 3 o'clock positions and, if the readings exceed the .008″ runout limits, loosen bolts slightly and tap housing with a soft hammer in required direction until runout is within limits. Tighten attaching bolts evenly to 25-35 ft. lbs. torque and recheck.
13. With housing in proper alignment, carefully ream dowel holes, using a $^{21}/_{32}$″ expansion reamer.
14. Blow out holes and then install special oversize dowels.
15. Recheck flywheel housing bore and the face to

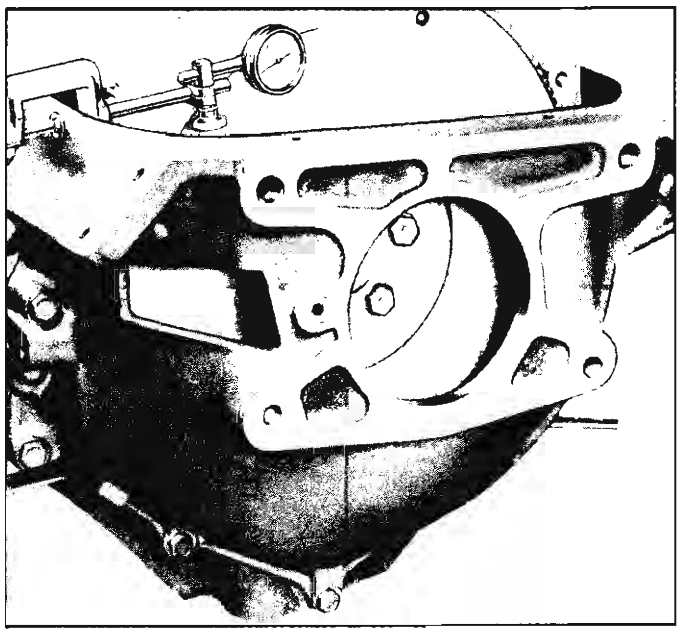


Fig. 110—Checking Flywheel Runout

make sure they still are within proper limits.

16. Remove indicator and attachments.

Flywheel Installation

1. Clean the mating flanges of flywheel and crankshaft carefully and make sure there are no burrs on either mounting face.
2. Place the flywheel in the clutch housing and position it so that the dowel in crankshaft flange will enter the hole in the flywheel.
3. Install the six bolts and lock washers.
4. Tighten bolts to 55-65 foot-pounds with a torque wrench.
5. Mount a dial indicator on the clutch or flywheel housing so that the button of the indicator will contact the machined surface of flywheel (fig. 110), and check the flywheel runout.
6. Runout should not exceed .008" on conventional, .005" on automatic. If excessive, remove flywheel and recheck for burrs or replace flywheel.

FLYWHEEL HOUSING INSTALLATION AND ALIGNMENT (Automatic Transmissions)

Install flywheel housing, front half. Tighten bolts to 45-55 ft. lbs. (See Transmission Section of this manual for alignment checks.)

Flywheel Balance Markings

Balance markings are incorporated on Engines and Automatic Transmissions to provide closer indexing of these components and improve Engine-transmission balance conditions.

Flywheel assemblies used with the Powerglide transmission have been changed to provide six transmission attaching holes instead of three.

The three holes have been added to permit more accurate indexing of the converter to flywheel. The actual attachment, however, will remain the same three bolt type.

All flywheels used with automatic transmissions will have a "white" paint mark on the outer rim on the transmission side to indicate "heavy" side of engine.

All automatic transmissions will have ¼ to ½" stripe of "Dykem Blue" across the ends of both converter cover and housing to denote the "light" side of the transmission.

These paint markings are to be aligned as closely as possible during assembly of transmission to engine to obtain best balance conditions.

Engine Assembly

The following engine assembly is to be performed after the crankshaft, connecting rods and pistons, clutch or flywheel housing and flywheel have been installed as previously outlined.

1. Install three new oil gallery plugs in front of cylinder block.
2. Assemble oil pump and extension shaft assembly to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.
3. Install oil pump to rear main bearing cap bolt and tighten to 45 to 50 ft. lbs.
4. Install two $\frac{5}{16}$-18 x 4" bolts in camshaft, lubricate camshaft and install camshaft in engine. Remove bolts.
5. Install crankshaft timing sprocket on crankshaft, aligning keyway with key installed in crankshaft. Drive in place, using a hammer and Tool J-5590.
6. Rotate crankshaft until "0" mark on crankshaft is up toward camshaft.
7. Install timing chain on camshaft sprocket. Hold the sprocket vertical with the chain hanging below, and orient to align "0" marks on camshaft and crankshaft sprockets.
8. Align dowel in camshaft with dowel hole in camshaft sprocket and install sprocket on camshaft.
9. Draw camshaft sprocket onto camshaft, using the three mounting bolts. Do not drive sprocket, as camshaft bore rear plug can be driven out of block. Tighten to 15-20 ft. lbs. torque.
10. Lubricate timing chain with engine oil.
11. Install crankshaft oil slinger on crankshaft.
12. Make certain that cover mounting face and cylinder block front end plate face are clean.
13. Coat the oil seal with light grease and, using a new cover gasket, install cover and gasket over dowel pins in cylinder block.
14. Install cover screws and tighten to 6-7½ ft. lb. torque.
15. Install hamonic balancer on crankshaft with a light coating of oil. Position harmonic balancer on crankshaft, aligning the key on the crankshaft with the keyway in the balancer.
16. Using Transmission Front Bearing Installer J-5590, drive balancer on crankshaft until the hub bottoms on the crankshaft timing sprocket.
17. Remove two capscrews from balancer.
18. Thoroughly clean all oil pan gasket sealing surfaces.
19. Install rear oil pan seal in groove in rear main bearing cap. Tuck ends into groove openings in cylinder block.
20. Install side gaskets on pan rails, using grease as a retainer. Rear ends lap end gasket. Tuck front

ends of side gaskets into gap between front end cover seal groove and cylinder block.

21. Install oil pan front seal in groove in front end cover, with ends butting side gaskets.
22. Install oil pan to cylinder block bolts. Tighten front and rear $\frac{5}{16}$" bolts to 12 to 15 ft. lbs., intermediate ¼" bolts should be tightened to 6-9 ft. lbs.
23. Install oil pan drain plug.
24. Install inner crankcase ventilator body to crankcase and install retaining screw. Use caution to avoid damage to vent body.
25. Install the valve lifters in same bores as removed.
26. Thoroughly clean out cylinder head bolt holes in the block and clean cylinder bolt threads. Then place new cylinder head gaskets in position on cylinder block. Use a good head gasket paste such as G. M. Perfect Seal Compound or its equivalent with these steel gaskets.
27. Place the cylinder heads in position over the two dowel pins in the block.
28. Coat threads of all cylinder head bolts with a suitable water and oil thread sealing compound such as G. M. Perfect Seal. These bolts protrude into the water passages and require compound to prevent rusting.
29. Install bolts finger tight.
30. Tighten the cylinder head bolts a little at a time in the order shown (fig. 73). The final tightening should be 60-70 ft. lbs.
31. Install 16 push rods in their respective bores.
32. Insert pivots in valve rocker arms, rocker arms over studs, and install nuts.
33. Clean gasket faces of intake manifold and cylinder heads.
34. Install intake manifold end gaskets on cylinder block. Coat ends of intake manifold side gaskets around water passages with a good gasket sealing compound such as G. M. Perfect Seal and install on cylinder heads.
35. Install intake manifold and bolts with pipe clips and plug wire supports in place. Tighten finger tight. Tighten bolts a little at a time according to the sequence shown in Figure 59. Final torque should be 25-35 ft. lbs.
36. Install thermostat, water outlet gasket and thermostat housing and tighten bolts to 18 to 23 ft. lbs. Install water pump. Tighten bolts to 25-35 ft. lbs.
37. Mount coil and install distributor. (See Section 9 "Engine-Electrical" for installation procedure.)
38. Attach coil wires to distributor.
39. Install rocker arm cover gaskets, covers and screws with reinforcements.
40. Clean all spark plugs with abrasive type cleaner, inspect for damage and set gap at .035" using a round feeler gauge.
41. Place new gaskets on plugs and install. Tighten to 20-25 ft. lbs.
42. Install plug wiring harness.

    CAUTION: Plug wire location is extremely important. Numbers formed in rubber support grommets show sequence.
43. Install carburetor. On Powerglide or Turboglide models, install transmission throttle control upper rod to carburetor.
44. Install automatic choke heat tube.
45. Install push rod, fuel pump mounting plate gasket, mounting plate, fuel pump. Mounting plate bolts should be tightened to 6 to 9 ft. lbs. Install fuel pump to carburetor feed pipe.
46. Install lift Tool J-4536. Engine may have to be removed from stand for following steps, depending on stand used.
47. Install exhaust manifolds and bolts. Tighten center bolts 25-35 ft. lbs. torque. Install french locks under end bolts and torque to 15-20 ft. lbs.
48. Install generator on left band of exhaust manifold.
49. On all STANDARD TRANSMISSION MODELS:
    a. Lubricate the clutch pilot bearing with a small amount of high melting point grease. Place the clutch disc and clutch cover assembly in position and install Tool J-5284.
    b. Turn the clutch cover until the "X" on the cover lines up with the "X" on the flywheel. Install the attaching bolts loosely and then tighten them a turn at a time to take up the spring pressure evenly and prevent clutch distortion. Tighten bolts to 25-30 ft. lbs. torque with a torque wrench and then remove pilot tool.
    c. Pack the clutch fork ball seat with a small amount of high melting point grease and snap the fork onto the ball with the end extending through opening in clutch housing.
    d. Install clutch throw-out bearing.
    e. Install transmission and tighten attaching bolts securely.
    f. Install flywheel underpan and extension.
50. On all POWERGLIDE TRANSMISSION MODELS:
    a. Remove Tool J-5384.
    b. Install transmission on flywheel housing and tighten attaching bolts securely.
    c. Install converter to flywheel bolts and tighten to 25 to 30 ft. lbs.
    d. Install flywheel housing cover and starting motor.
    e. Install crankcase breather road draft tube.
51. On all TURBOGLIDE TRANSMISSION MODELS:

a. Remove the two oil cooler plugs from right side of transmission assembly and apply approximately one thimble-full of petrolatum into each hole with caulking gun or any other suitable applicator. Reinstall plugs finger tight.
b. Put film of lubriplate in crankshaft bore which pilots converter cover.
c. Remove converter safety clamp. Make sure that converter has not slipped forward or it will be necessary to reengage converter pump drive tangs with slots in converter hub (see Section 13).
d. Align bolt holes in flywheel and converter.
e. Enter transmission case on dowels on engine and assemble one bolt on right side of center near top.
f. Assemble throttle bell crank bracket on left side of case and install two bolts holding case and bracket to engine.
g. Tighten transmission case to engine bolts.
h. Tighten flywheel to converter bolts to 25 to 30 ft. lbs.
i. Assemble vacuum hose to vacuum modulator on right side of transmission.
j. Assemble converter underpan.
k. Hook up throttle linkage.

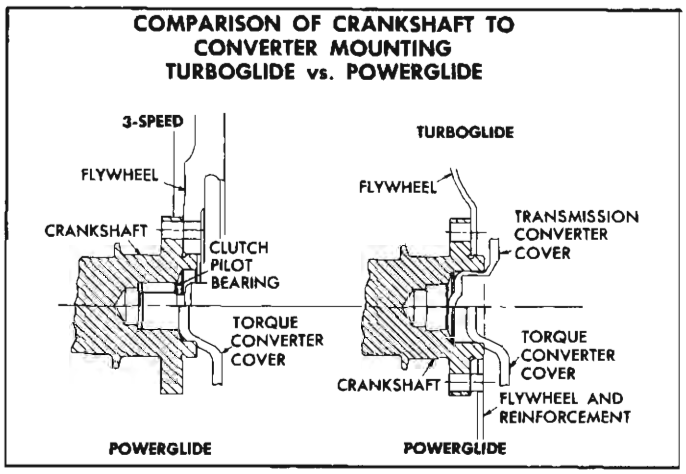


Fig. 111—Comparison of Crankshaft to Converter Mounting

Engine Installation to Vehicle

1. Install lift Tool J-4536-A.
2. Tilt and lower engine and transmission assembly into the chassis as a unit, guiding engine to align supports with frame.
3. Install front mounts, and tighten nuts (fig. 107).
4. Remove lifting attachments. Tighten transmission mounting bolts.
5. Install propeller shaft as outlined in Section 5.
6. On all STANDARD TRANSMISSION MODELS:
   a. Install clutch bell crank, connect clutch pedal adjusting link to clutch fork and adjust. See Section 11.
   b. Connect speedometer cable to speedometer driven gear.
   c. Connect transmission control rods to shifter levers on transmission side cover. Adjust control rods as outlined in Section 12.
   d. Check transmission lubricant level.
   e. If equipped with overdrive, connect associated wires and cables.
7. On all POWERGLIDE or TURBOGLIDE TRANSMISSION MODELS:
   a. Connect speedometer cable to speedometer driven gear.
   b. Connect transmission control rod to transmission control rod bell crank and adjust rod as outlined in Section 13.
   c. Install transmission filler tube and dip stick.
   d. Install transmission throttle control rod.
8. Install exhaust manifold heat control valve and gaskets and install exhaust cross-over pipe and packing.
9. Replace exhaust pipe to cross-over pipe and tighten attaching bolts securely.
10. Connect vacuum lines.
11. Connect wire to oil pressure sending unit and temperature sending unit on intake manifold.
12. Install air cleaner. Install "Air-Conditioning," on models so equipped as outlined in Section 15.

    NOTE: If oil bath cleaner is used, disassamble, clean, and refill before installing.
13. Attach generator and field wires to generator. On overdrive equipped models attach overdrive controls.
14. Attach gasoline line to fuel pump.
15. Install battery. Attach battery cable and voltage regulator wire to large terminal. Install wire to solenoid and install starter switch wire to small terminal and connect coil wire to coil.
16. Install fan pulley and fan blade. Install radiator core and fan shroud.
17. Install oil cooler lines on all Powerglide or Turboglide models, and connect radiator hoses.
18. Refill radiator and crankcase. On models equipped with power brakes install equipment as outlined in Section 6.
19. Install and adjust fan belt as outlined in Section 7.
20. Start engine and allow to run until properly normalized and check for leaks.
21. On all models with automatic transmission use Tool J-4264 and fill transmission as outlined in Section 13.
22. On Powerglide and Turboglide equipped cars, place selector lever in reverse and check linkage adjustment as outlined in Section 13.
23. Replace hood assembly, aligning previously scribed marks.