

ENGINE MECHANICAL

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GENERAL DESCRIPTION

The Pontiac Tempest uses a 215 cubic inch, inline, overhead valve six-cylinder engine as standard equipment. This engine has a 3-3/4" bore and 3-1/4" stroke. The compression ratio of this engine is 8.6:1.

Four optional V-8 engines are available on special order, two having 326 cubic inch displacement with 3-23/32" bore and 3-3/4" stroke. The compression

ratios are 9.2:1 and 10.5:1. Two 389 cubic inch displacement engines available on the G.T.O. have a 4-1/16" bore and 3-3/4" stroke. These engines have a compression ratio of 10.75:1.

Seventeen different engine combinations are available. These combinations and their usage are shown on the engine chart (Fig. 6-1).

Engine identification is facilitated by a number-letter code stamped below the production engine

number. By referring to the identification code and Fig. 6-1, each engine may be readily identified. The engine code for 6-cylinder engines is stamped on the distributor mounting pad at the right side of block. On V-8 engines the code is stamped on the block in front of the right bank of cylinders.

pivot rocker arm construction, harmonic balancer, hydraulic lifters, aluminum pistons, straight valve guides, superior crankcase ventilation and lubrication systems, and large displacement combined with high compression ratio for most favorable performance and economy.

The V-8 engine (Figs. 6-2 and 6-3) features a completely machined combustion chamber. Both the 6-cylinder and V-8 engines have overhead valves, ball

Detailed descriptions of cooling, crankcase ventilation, and the lubrication system are given in ENGINE COOLING AND LUBRICATION, Section 6A.

HORSEPOWER	ENGINE CODE	DISP. CUIN.	TYPE TRANS.	USAGE	MODEL APPLICATION							COMPRESSION RATIO					CARBURETOR				VALVE SPRINGS			CAM - SHAFT	DIST. MODEL			H.D. CLUTCH SPEC.	CLOSED PCV VALVE (USED IN CALIF. ONLY)										
					33-35-37	GTO	TAXI	POLICE	7:2:1	8:6:1	9:2:1	10:5:1	10:7.5:1	1 BBL	2 BBL	4 BBL	3-2 BBL	SINGLE	STD. TWO	H.D. TWO	3789506	537441	9779067		9779068	110328	111054			111097									
140	ZK	215	5M	Standard	x																																		
140	ZR	215		Optional	x					x								x																					
125	ZD	215		Export	x				x																														
140	ZS	215		Standard	x																																		
140	Z5	215		Optional	x																																		
140	ZN	215		Optional	x																																		
360	WS	389		Optional	x																																		
335	WT	389		Standard	x																																		
250	WP	326		Optional	x																																		
285	WR	326 H.O.		Optional	x																																		
125	ZE	215		Auto.	Export	x																																	
140	ZL	215	Optional		x																																		
140	ZM	215	Optional		x																																		
360	YR	389	Optional		x																																		
335	Y5	389	Optional		x																																		
250	YN	326	Optional		x																																		
250	YN	326	Optional		x																																		
285	YP	326 H.O.	Optional		x																																		

Fig. 6-1 Tempest Engine Chart

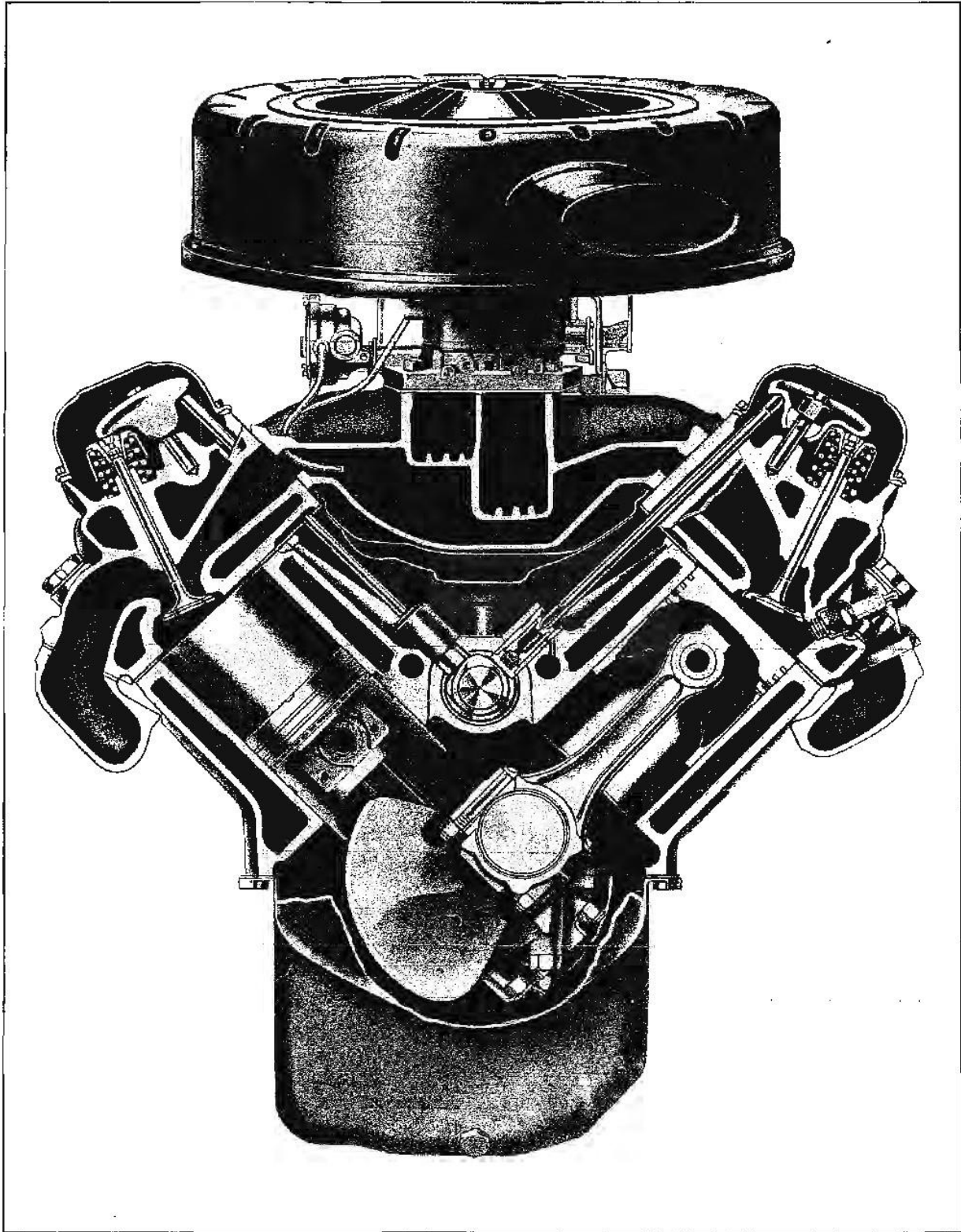


Fig. 6-3 Tempest 326 Cu. In. V-8 Engine

SIX CYLINDER ENGINE

GENERAL DESCRIPTION

CYLINDER BLOCK

The cast iron cylinder block has one vertical row of six cylinders numbered from front to rear, 1 through 6. Seven main bearings support the crankshaft (Fig. 6-4). Bearing caps fit in recesses in the block which assure accurate alignment and facilitate assembly.

Cylinders are completely encircled by coolant jackets. For details of engine cooling system, see ENGINE COOLING AND LUBRICATION.

CYLINDER HEADS

The cast iron cylinder head provides a compression ratio of 8.6:1.

Two large coolant ports at the rear end of the cylinder head provide coolant to passages beneath each spark plug. Coolant surrounds each spark plug mounting and valve seat. Coolant returns to the water pump through an outlet at the front of the cylinder head.

Oil is fed through hollow push rods to the upper valve train for superior lubrication.

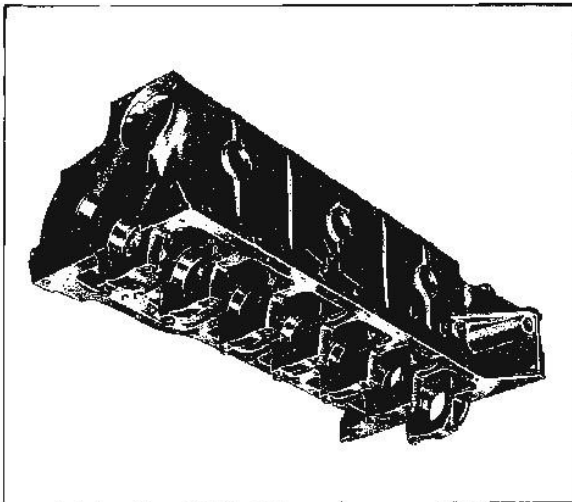


Fig. 6-4 Cylinder Block and Bearing Caps

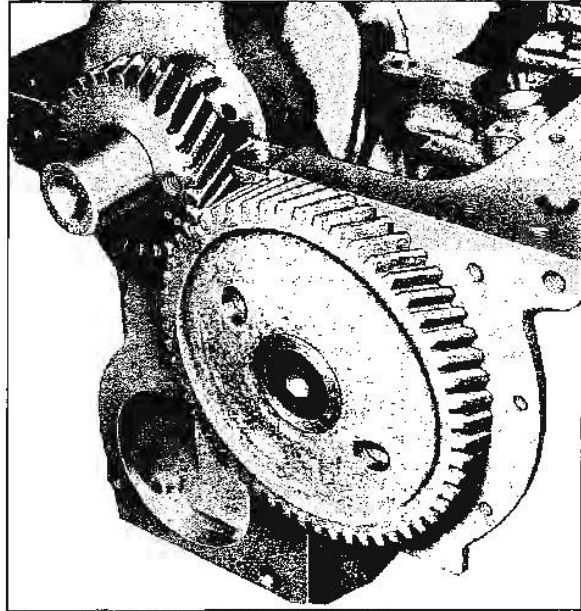


Fig. 6-5 Timing Gears

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron and is supported by seven main bearings.

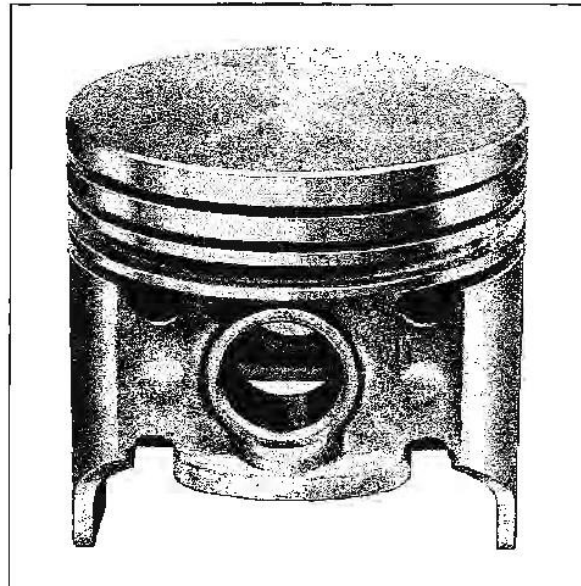


Fig. 6-6 Piston

Main bearings are lubricated from oil holes which intersect the main oil gallery which runs parallel to the cylinder bores along the right side of the block.

A rubber floated harmonic balancer on the forward end of the crankshaft dampens any engine torsional vibrations.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by four bearings and is gear driven. A steel crankshaft gear drives the camshaft through a bakelite fabric composition gear with steel hub (Fig. 6-5).

Cam lobes are ground, hardened and tapered with the high side toward the rear. This coupled

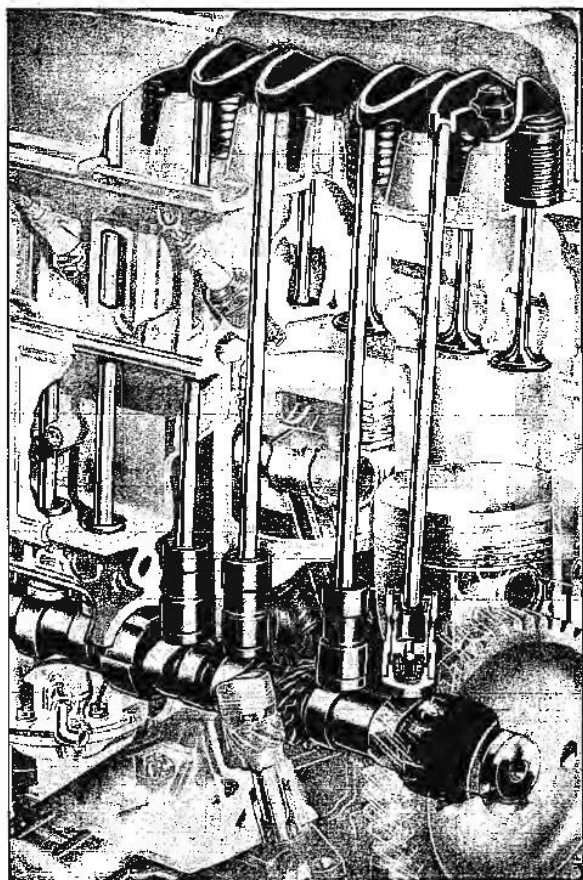


Fig. 6-7 Valve Train

with a spherical face on the lifter causes valve lifters to rotate.

Camshaft bearings are lubricated through oil holes which intersect the main gallery. The main gallery runs parallel to the cylinder bores along the right side of the block.

PISTONS AND CONNECTING RODS

The pistons are aluminum alloy, tin plated, with steel struts to control expansion and give added strength (Fig. 6-6). Pistons are cam ground so that the diameter across the thrust faces is larger than the diameter fore and aft of the engine. The steel struts force expansion and contraction to occur to the front and rear and thus provides a constant diameter across the thrust faces. Two compression rings and one oil control ring are used, all of which are located above the piston pin.

All pistons are flat on top as shown in Fig. 6-6.

Piston pins are offset 1/16" toward thrust side (right-hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. This feature provides quieter engine operation. Pins are hardened steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just prior to full bearing load.

VALVE TRAIN

A very simple ball pivot-type train is used (Fig. 6-7). Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker-arm ball is retained by a nut.

The maximum in durability is assured by the use of carbo-nitrided, stamped steel rocker arms. In addition all friction points to the valve train are positively lubricated.

The cylinder head has straight valve guides cast integrally (Fig. 6-7). External shields are used on both intake and exhaust valves to reduce the amount of oil splashed against stems. Valve stem seals are used on exhaust, as well as intake, valves to prevent oil from entering the valve guides.

A single valve spring is used.

HYDRAULIC VALVE LIFTERS

Hydraulic valve lifters are used to keep all parts of the valve train in constant contact.

The hydraulic lifter assembly (Fig. 6-8) includes: the cast iron body which rides in the cylinder block boss, the plunger, push rod seat, metering valve, plunger spring, ball check valve, ball check valve retainer, and retainer ring.

The hydraulic valve lifter functions as follows: when the lifter is riding on the low point of the cam, the plunger spring keeps the plunger and push rod seat in contact with the push rod.

When the lifter body begins to ride up the cam lobe, the ball check valve cuts off the transfer of oil from the reservoir below the plunger. The plunger and lifter body then rise as a unit, pushing up the push rod and opening the valve.

As the lifter body rides down the other side of the cam, the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the push rod. The ball check valve will then move off its seat and the lifter reservoir will remain full.

During operation a small amount of oil leaks out of the lifter between the plunger and body. A controlled amount of leakage is important to provide continuous adjustment of the plunger position within the lifter. This leakage is called "leak down" and must be within certain limits to provide correct operation (see page 6-16).

Oil is supplied to the lifter by the cylinder block oil gallery to replace that lost through leak down.

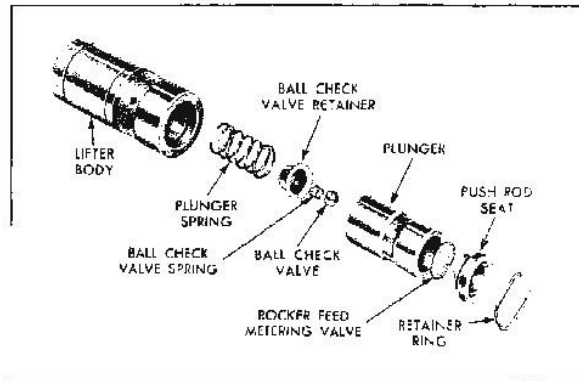


Fig. 6-8 Hydraulic Valve Lifter

The annular groove around the outside of the lifter body indexes with the passage drilled from the gallery to the lifter boss. Oil then enters the lifter from this groove and passes into the plunger cavity. From the plunger cavity, oil under pressure is also fed up the push rod to lubricate the friction area between the upper end of the push rod and the rocker arm and other upper valve train contact points.

FUEL DISTRIBUTION SYSTEM

A single-barrel carburetor with an automatic choke provides fuel to the intake manifold.

The intake manifold is positioned directly above the exhaust manifold (Fig. 6-9). This design allows hot exhaust to heat the cool, incoming fuel mixture.

The side-by-side location of the intake valves and side-by-side location of the exhaust valves along with joined parts permit the use of a three-port intake manifold and four-port exhaust manifold (Fig. 6-9).

EXHAUST SYSTEM

The four-port, cast iron exhaust manifold contains a heat riser valve. This thermostatically controlled valve is located above the manifold to exhaust pipe outlet. When the engine is cold, this valve closes, blocking the exhaust outlet; thus causing the hot exhaust to warm the stove beneath the carburetor. The fuel mixture is warmed by passing above through

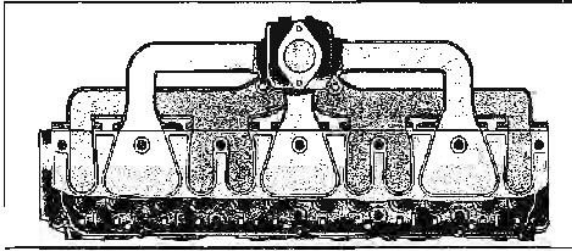


Fig. 6-9 Intake and Exhaust Manifolds

the stove. The heat riser valve opens as the engine warms up.

COMBUSTION CHAMBERS

Combustion chambers are cast to insure uniform shape for all cylinders. Spark plugs are located near intake valves for maximum power and to properly fire economically lean mixtures.

The contoured wedge shape of the combustion chamber (Fig. 6-10) minimizes the possibility of detonation, facilitates breathing and provides swirling turbulence for smooth, complete combustion.

Intake valves are large and have 46° seat angles to further provide easy breathing for high combustion efficiency. Exhaust valve seat angle is also 46° .

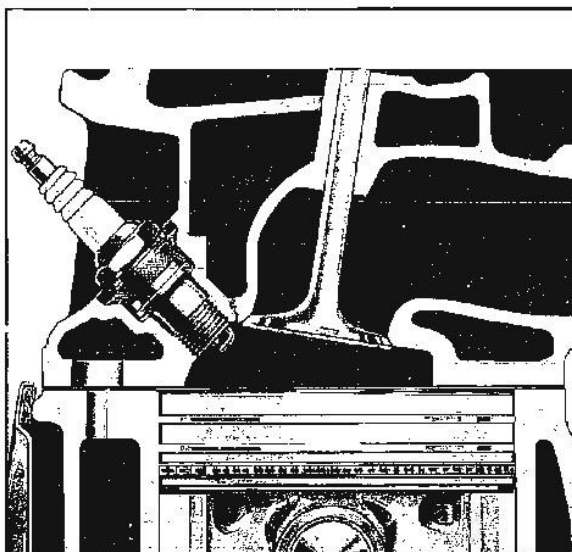


Fig. 6-10 Combustion Chamber

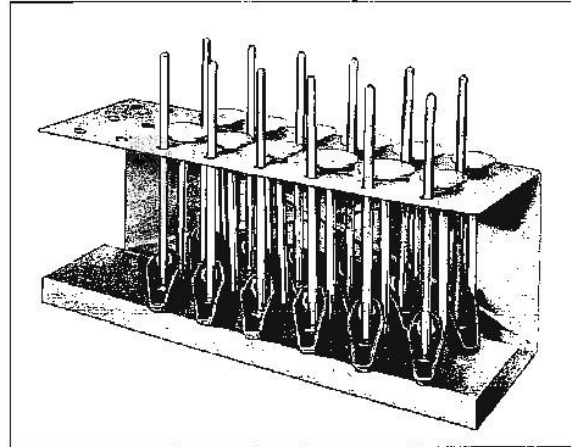


Fig. 6-11 Valve and Valve Train Holding Stand

GENERAL INFORMATION ON ENGINE SERVICE

Cleanliness is a primary factor when servicing the engine. The slightest particle of dirt that finds its way into a hydraulic lifter may cause a malfunction.

Since any dirt which may enter the oil galleries or passages in the engine could eventually get to a lifter, cleanliness should be exercised when any part of the engine is removed or disassembled. When a cylinder head is removed for any purpose, it is necessary to remove the push rod cover. This exposes the lifters to any dirt which may fall from the upper portion of the block or which may be carried in the air. Thus, it is wise to cover the lifter galleries until ready to reassemble the engine.

When lifters are removed for any reason, they should immediately be placed in order in valve lifter storage box. This is important for two reasons. First, it is the easiest way to keep lifters clean. Second, lifters should always be replaced in the same bosses from which they were removed.

Valves, valve lifters, push rods, rocker arms, rocker arm balls, and rocker arm ball nuts should always be kept in sets and returned to their original positions. These parts will tend to mate as the engine operates and will provide more satisfactory operation when kept together. By storing lifters in

a storage box and valves, push rods, rocker arms, balls and nuts in a holding stand (Fig. 6-11), whenever they are removed, they can easily be kept in sets for identification during assembly. In addition to keeping the parts in sets, the push rods should be replaced with the same end up. In other words, the same end will contact the rocker arm as before the engine was disassembled. The upper end can usually be identified by the polished surface which contacts the rocker arm. Push rods will also be polished somewhat in the area where the rod passes through the head.

When hydraulic valve lifters are disassembled, the various parts of each lifter must be kept together. This is especially important since the lifter body and plunger are selectively fitted. The use of the special tray included with cleaning tank J-5621 will aid in keeping the parts of each lifter together when lifters are being serviced.

When raising or supporting the engine for any reason, do not use a jack under the oil pan or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, the result would be a telegraphed noise which would be difficult to trace.

It should be kept in mind, while working on the engine, that the twelve-volt electrical system is capable of violent and damaging short circuits.

When performing any work where electrical terminals could possibly be grounded, the positive cable of the battery should be disconnected.

Any time the carburetor or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

In the mechanical procedures described in this section, generally, no references will be made to the removal of optional equipment such as power steering pump, air conditioning compressor, etc.

Should it become necessary to remove any such item to perform other service, refer to the appropriate section of the manual for specific information.

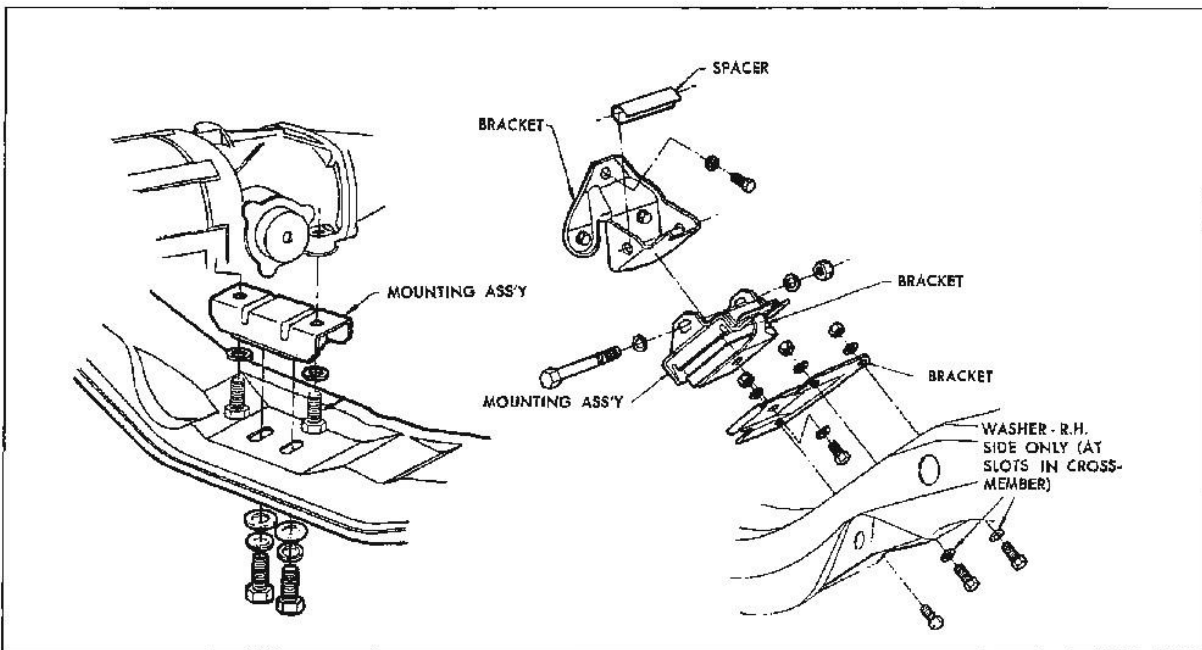


Fig. 6-12 Engine Insulators

PERIODIC SERVICE

There are no periodic services required on the mechanical portions of the engine. Periodic services connected with the engine consist of tune-up, lubrication, replacing oil filter, fuel filter, etc. Procedures and recommendations for these services will be found in appropriate sections of this book.

SERVICE OPERATIONS ON CAR

ENGINE INSULATORS— REMOVE AND REPLACE (Fig. 6-12)

FRONT INSULATORS

1. Remove cross member to rear insulator bolts.
2. Support engine with suitable lifting equipment.
3. Remove insulator to engine bracket through bolts.
4. Raise engine approximately 1" above front insulators.
5. Remove front insulator by unscrewing frame bracket to insulator bolt and lifting insulator from bolt.
6. Install new insulator.
7. Drop front of engine into position and install insulator to engine bracket bolts. Tighten nuts to 30 ± 5 lb. ft.
8. Raise engine at rear to allow rear insulator to reposition.
9. Lower engine and transmission assembly so that rear insulator rests on cross member.
10. Install cross member to insulator bolts and tighten to 30 ± 5 lb. ft.

REAR INSULATOR

1. Remove cross member to rear insulator bolts.
2. Raise rear of engine and transmission with suitable lifting equipment.
3. Remove insulator to transmission housing bolts.
4. Replace insulator and install insulator to transmission housing bolts. Tighten to 30 ± 5 lb. ft.
5. Lower engine and transmission into position.
6. Install cross member to insulator bolts and tighten to 30 ± 5 lb. ft.

DRIVE BELTS—ADJUST

Engine fan and accessory drive belts may be adjusted by use of the Burroughs Belt Tension Gauge. Section 6-A gives the correct specifications for both methods.

ENGINE—REMOVE AND INSTALL

REMOVE

1. Disconnect battery cables at battery.
2. Drain cooling system.
3. Scribe alignment marks on hood around hood hinges and remove hood from hinges.
4. Disconnect coil, starter and generator wires, engine-to-body ground strap, oil pressure and engine temperature sender wires.
5. Remove air cleaner.
6. Disconnect radiator hoses and heater hoses at engine attachment.

7. Remove radiator.
8. Remove engine fan and pulley.
9. Disconnect accelerator control linkage.
10. Raise vehicle on hoist and drain crankcase.
11. Remove drive shaft by removing rear universal joint U-bolts. Plug the end of the transmission extension housing.

12. Remove four lower transmission mounting bolts.

NOTE: Transmission mount will fall loose when engine is removed.

13. Disconnect speedometer cable and transmission control rod linkage lower ends.

14. Disconnect clutch cross shaft bracket at frame and disconnect clutch push rod, spring and pedal linkage. On models with automatic transmission, remove transmission oil filler tube and plug opening and disconnect vacuum modulator line and downshift switch wire.

15. Disconnect exhaust pipe from manifold.

16. Remove starter.

17. Disconnect gas tank line at fuel pump.

18. Loosen engine front mounting bolts.

19. Lower vehicle.

20. Remove the engine and transmission as a unit from the vehicle using suitable lifting equipment.

INSTALL

1. Install engine lifting equipment to engine and lower engine and transmission into chassis as a unit guiding engine to align front engine mounts with frame bracket, then remove engine lifting equipment.

2. Raise vehicle on hoist.
3. Align and install rear mount bolts.
4. Install engine front mount bolts.
5. Install drive shaft and U-bolts at rear U-joint.
6. Make the connections necessary for the type of transmission.

ON MANUAL TRANSMISSION MODELS:

- a. Install clutch cross shaft on ball socket at block and bolt bracket to frame rail. Connect pedal and clutch fork push rods. Install return spring from clutch fork to left engine mount.

- b. Connect transmission control rods to shifter levers on transmission side cover. Adjust control rods as outlined in TRANSMISSION SECTION.

- c. Check transmission lubricant level.

ON AUTOMATIC TRANSMISSION MODELS:

- a. Connect transmission vacuum modulator line and downshift switch wire.

- b. Install transmission filler tube and dipstick.

7. Install starter.

8. Connect speedometer cable to driven gear at transmission and transmission control linkage.

9. Carefully connect exhaust pipe to manifold and tighten securely.

10. Attach fuel line to fuel pump.

11. Lower vehicle.

12. Connect wire harness to temperature sending unit, oil pressure sending unit and coil primary

terminal. Attach armature and field wires to generator.

13. Connect carburetor linkage.

14. Attach wires and battery cable to starter solenoid.

15. Install engine fan and pulley.

16. Install radiator assembly.

17. Refill radiator and crankcase.

18. Check transmission lubricant lever. Fill if necessary.

19. Install hood assembly, aligning previously scribed marks.

INTAKE AND EXHAUST MANIFOLDS OR GASKETS— REMOVE AND REPLACE

REMOVE

1. Remove air cleaner wing nut and air cleaner.
2. Disconnect both throttle rods at bell crank and remove throttle return spring.
3. Disconnect fuel and vacuum lines from carburetor. Disconnect thermostatic coil rod at carburetor.
4. Remove carburetor for manifold replacement.
5. Disconnect exhaust pipe at manifold flange.
6. Remove manifold to head attaching bolts and clamps and remove manifolds as an assembly.

REPLACE

1. Clean gasket flanges on cylinder head and manifolds.
2. Check for cracks on manifold castings.

3. If necessary to replace either intake or exhaust manifold, separate them by removing 1 attaching bolt and 2 nuts at center of assembly. Reassemble manifolds using new gasket. Tighten finger tight and torque 15 ± 30 lb. ft. after assembly to cylinder head.

4. Position new gaskets over manifold end studs on head and carefully install the manifold in position, making sure the gaskets are in place.

5. Install bolts and clamp while holding manifold in place with one hand.

6. Tighten center clamp bolts to 35 ± 5 lb. ft. and end bolts to 20 ± 5 lb. ft. (Fig. 6-13).

7. Connect exhaust pipe to manifold using a new packing seal.

8. Reverse Steps 1-4 of Removal to complete installation procedure.

PUSH ROD COVER OR GASKET— REMOVE AND REPLACE

REMOVE

1. Loosen coil to block attaching screw and rotate coil upwards for clearance.
2. Remove push rod cover screws and remove cover.

REPLACE

1. Place new gasket in push rod cover.
2. Install cover to block.
3. Return coil to original position and tighten attaching screw.

VALVE SPRINGS, SHIELD OR SEALS— REMOVE AND REPLACE

REMOVE

1. Remove rocker arm cover.
2. Remove rocker arm.
3. Remove spark plug from cylinder of valves to be serviced.

4. After removing rocker arm, thread valve spring compressor stud J-8929-1 on rocker arm stud. Compress valve spring using compressor J-8927-4 and nut J-8929-2 while holding valve up with valve holder J-5961-2 (Fig. 6-14). Remove valve spring retainer cup locks and then remove valve spring compressor, valve spring retainer cup shield and valve stem seal.

5. Remove valve springs.

REPLACE

1. Install any new parts by reversing removal procedures 2-5.

NOTE: Install spark plug after removing valve train play.

2. With lifter on base circle of camshaft, turn rocker arm down until valve train play is removed. Turn nut down one additional turn (Fig. 6-15).

3. Install rocker arm cover.

PUSH ROD OR VALVE LIFTER— REMOVE AND REPLACE

REMOVE

1. Remove rocker arm cover.

2. Loosen rocker arm and rotate it for clearance from push rod.

3. Remove push rod (Fig. 6-16) and store so that each push rod may be installed in original location.

If hydraulic valve lifters are to be removed, proceed as follows:

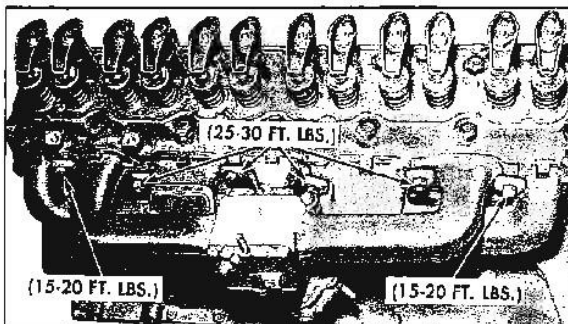


Fig. 6-13 Manifold Attaching Points

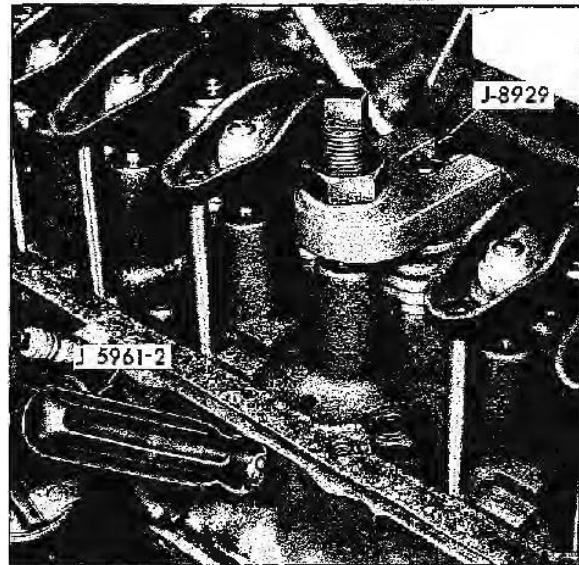


Fig. 6-14 Valve Spring Compressor installed

4. Remove spark plug from cylinder of valve train being serviced.

5. Disconnect distributor primary lead.

6. Loosen coil mounting screw and rotate coil upwards.

7. Remove push rod covers.

8. Remove lifter. Hydraulic valve lifter remover J-3049 may facilitate removal of lifter. Store lifters so that they can be installed in exactly the same location.

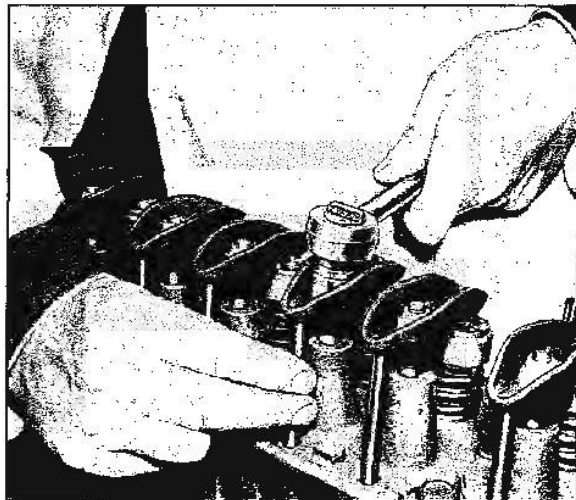


Fig. 6-15 Adjusting Valve Lifter Plunger Travel

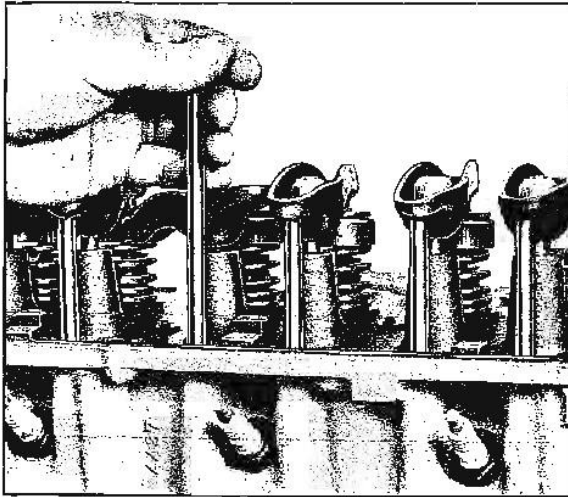


Fig. 6-16 Removing Push Rod

NOTE: If new lifter is to be installed, be sure to remove all sealer coating from inside of new lifter and check leak-down rate.

1. Place lifter in original lifter boss.
2. Replace push rod exactly as removed.
3. Position rocker arm or push rod.
4. With lifter on base circle of camshaft, tighten rocker arm nut until valve train play is removed. Turn nut down one additional turn (Fig. 6-15).
5. Install spark plug.
6. Install rocker arm cover.

HYDRAULIC VALVE LIFTERS—RECONDITION

NOTE: Because of the important part hydraulic valve lifters play in the operation of an engine and the close tolerances to which they are manufactured, proper handling, and above all, cleanliness, cannot be overstressed when servicing these parts.

New lifters are serviced as individual units packaged with a plastic coating. Leave the coating on until ready to check leak-down rate. It is not necessary to remove the oil from new lifters prior to checking leak-down rate since special leak-down oil is already in new lifters.

Wash tank and tray, J-5821, is recommended for cleaning valve lifters. This tank should be used only for valve lifters and should be kept covered when not in use. All servicing should be done in an area removed from grinders or other sources of dust and foreign material.

Lifters should at all times be stored in a covered box which will aid in keeping them clean. The lifter box should be kept dry and as free of oil as possible.

VALVE LIFTER—DISASSEMBLE

1. Remove push rod seat retainer ring by holding seat down with push rod while dislodging spring from lifter body with a pointed tool (Fig. 6-17).

NOTE: It may be necessary to unseat lifter ball, using plunger unloader, J-5097, before plunger can be pushed down.

2. Invert lifter and allow push rod seat and plunger to slide out of body. If plunger sticks in body, place lifter in large end of hydraulic valve lifter plunger remover, J-4160-A, with push rod end of lifter downward. Hold tool firmly in hand with thumb over lifter body and sharply strike tool against a block of wood (Fig. 6-18) until plunger falls out.

NOTE: It may be necessary to soak a lifter having a stuck plunger in cleaning solvent for several minutes in order to remove the plunger.

3. Drain oil out of lifter body and place all valve lifter parts in separate compartment of tray from wash tank J-5821 (Fig. 6-19).

CAUTION: Valve lifter body and plunger are selectively fitted and must not be interchanged with parts of other lifters. Keeping all parts of lifters together will also aid in trouble diagnosis.)

VALVE LIFTER—CLEAN AND INSPECT

Wash tank, J-5821, is recommended for cleaning valve lifter parts. This tank consists of two chambers, a tray and a cover. One chamber is for cleaning solvent and the other is for kerosene. Whenever the tank is not being used (and when parts are soaking), the cover should be closed.

1. Before placing tray of parts in cleaning solvent, first immerse it in kerosene chamber to remove

as much engine oil as possible. (This reduces contamination of solvent, thus prolonging its useful life.)

2. Submerge tray in cleaning solvent and allow to soak for approximately one hour. More time may be required, depending on varnish condition and effectiveness of solvent. Light agitation of tray in solvent at 10-15 minute intervals will hasten cleaning action.

3. After varnish has dissolved or has been sufficiently softened to permit removal by wiping, suspend tray above solvent, utilizing hooks on tray handles. Allow tray and parts to drain for a brief period.

4. Rinse tray of parts in kerosene chamber to cut solvent and to avoid injury to hands (from solvent).

5. Wipe out tank cover and place tray of parts on cover in front of tank. A shop towel under tray and clean paper on remainder of cover will ensure cleanliness.

6. Working on one lifter at a time and using clean, lint-free cloths, thoroughly wipe off lifter parts. Clean plunger and external and internal surfaces of body with a hard wiping action. A bristle brush may be used to clean internal surface of lifter body.

CAUTION: Do not use wire brush or sand paper, as these may damage machined surfaces.

NOTE: Absolute cleanliness can be assured if each lifter is inspected and assembled after cleaning, but before proceeding to the next lifter.

7. Inspect lifter body. Both inner and outer surfaces of lifter body should be inspected for scoring. Lifter assembly should be replaced if body is roughly scored, grooved, or galled. Inspect cam contact surface on lower end of lifter body. Replace lifter assembly if this surface is excessively worn, galled or otherwise damaged.

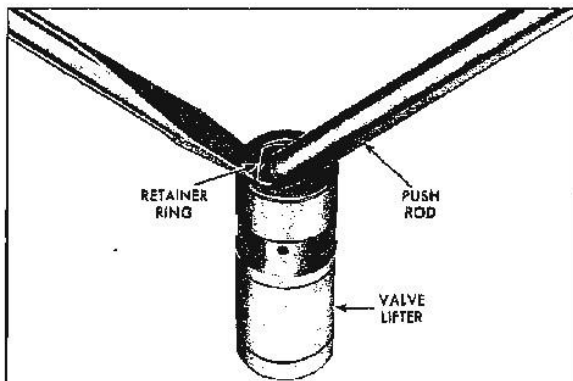


Fig. 6-17 Removing Push Rod Seat Retaining Ring

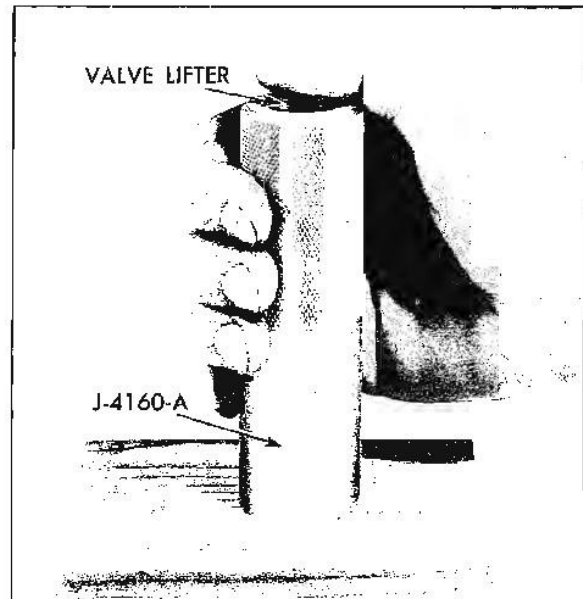


Fig. 6-18 Removing Stuck Plunger

8. Inspect lifter plunger. Using a magnifying glass, inspect the check ball seat for defects. Inspect outer surface of plunger for scratches or scores. Small score marks with a rough, satiny finish will cause the plunger to seize when hot but operate normally when cool. Defects in check ball seat or scores or scratches on outer surface of plunger which may be felt with a fingernail are causes for replacing the lifter assembly. This rule does not apply to the slight edge which may sometimes be

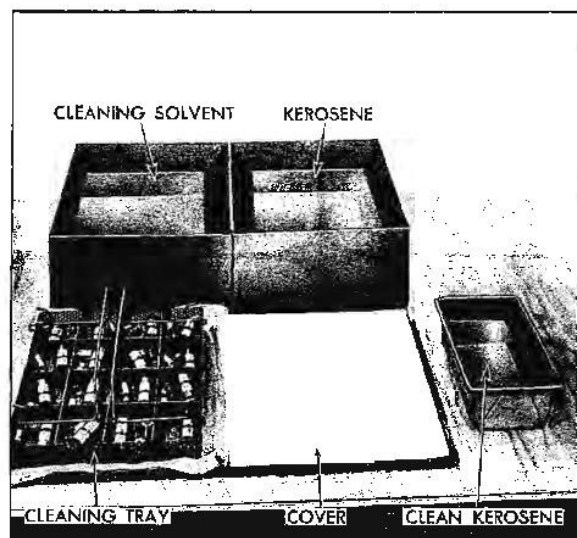


Fig. 6-19 Lifter Wash Tank and Tray

present where the lower end of plunger extends below the ground inner surface of the body. This edge is not detrimental unless it is sharp or burred.

A blackened appearance is not a defective condition. Sometimes the discoloration serves to highlight slight grinder chatter marks and give the outer surface of plunger a ridged or fluted appearance. This condition will not cause improper operation, therefore, it may be disregarded.

9. Inspect push rod seat for roughness and to insure that hole in center is open.

10. Inspect valve lifter ball. Carefully examine ball for nicks, embedded material or other defects which would prevent proper seating. Such defects may cause intermittently noisy lifter operation. Also inspect plunger face of ball retainer for excessive wear.

VALVE LIFTER—ASSEMBLE

NOTE: All parts must be absolutely clean when assembling a hydraulic lifter. Since lint and dust may adhere to parts, they should not be blown off with air or wiped with cloths. All parts should be rinsed in clean kerosene and assembled without drying. A small container with clean kerosene (separate from cleaning tank) should be used for each set of lifters being overhauled.

Figure 6-20 shows the relative position of component parts of valve lifters. The recommended procedure for assembly is given in the following steps.

1. Rinse plunger spring and ball retainer and position retainer in spring.

2. Rinse lifter ball and place in retainer.

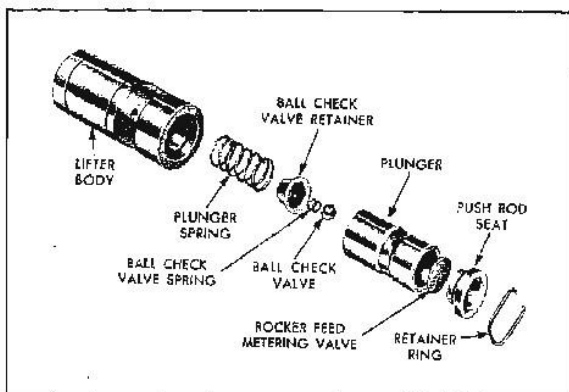


Fig. 6-20 Exploded View - Valve Lifter

3. Rinse plunger and place on retainer so that seat on plunger mates with ball.

4. Invert plunger with parts assembled thus far and after rinsing lifter body, install body over spring and plunger.

5. Place lifter body on clean paper, rinse and install push rod seat and retainer ring.

6. After lifter has been assembled, place in lifter box and close lid to preserve cleanliness.

VALVE LIFTER TEST LEAK-DOWN RATE

After all lifters have been assembled, the leak-down rate must be checked before they are installed in the engine. Valve lifter leak-down tester, J-5790, (Fig. 6-21), is designed to test leak-down rate of lifters to determine whether or not they are within specified limits. As with previous service operations concerned with lifters, cleanliness is paramount. The tester cup, and ram should be thoroughly cleaned, and testing should be done in an area free of dust and dirt. The testing procedure is described in the following steps:

1. Fill tester cup to approximately one inch from top with special fluid which is available from tester manufacturer.

2. Swing weight arm up out of the way, raise ram, and position lifter into boss in center of tester cup.

3. Adjust ram (with weight arm clear of ram) so that the pointer is positioned on the set line (marked "S"). Tighten jam nut to maintain setting.

4. Operate lifter through full travel of plunger by pumping weight arm to fill lifter with test fluid and force out air. (Lifter must be completely submerged at all times.) Continue pumping for several strokes after definite resistance is detected.

5. Raise weight arm to allow plunger spring to expand fully; lower arm onto ram and commence turning crank slowly (1 revolution every 2 seconds).

Time indicator travel from lower line (first line above set line) to line marked .094 or 3/32", while still rotating cup with crank (Fig. 6-21). Lifter is satisfactory if rate is between 12 and 65 seconds.

CYLINDER HEAD OR GASKET-- REMOVE AND REPLACE

REMOVE

1. Drain cooling system and remove air cleaner.
2. Disconnect accelerator pedal rod at bell crank on manifold and fuel and vacuum lines at carburetor.
3. Disconnect exhaust pipe at manifold flange, then remove manifold bolts and clamps and remove manifold and carburetor as an assembly.
4. Remove fuel and vacuum line retaining clip from water outlet and disconnect wire harness from temperature sending unit and coil, leaving harness clear of clips on rocker arm cover.
5. Disconnect radiator hose at water outlet housing and battery ground strap at cylinder head.
6. Disconnect wires and remove spark plugs. Disconnect coil to distributor primary wire lead at coil and remove coil.
7. Remove rocker arm cover. Back off rocker arm nuts, pivot rocker arms to clear push rods and remove push rods.
8. Remove the cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

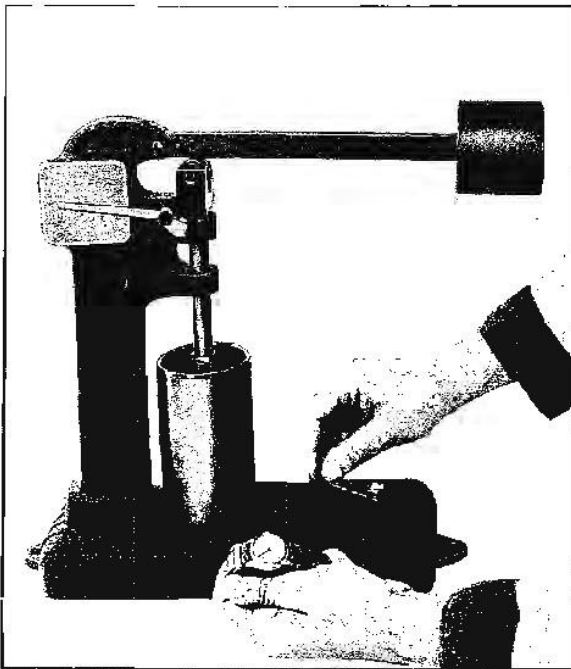


Fig. 6-21 Testing Leak-Down Rate

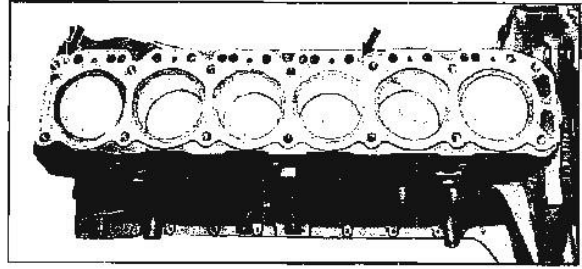


Fig. 6-22 Installing Head Gasket

REPLACE

1. Place a new cylinder head gasket in position over dowel pins in cylinder block (Fig. 6-22).
2. Carefully guide cylinder head into place over dowel pins and gasket (Fig. 6-23).
3. Coat threads of cylinder head bolts with sealing compound, install and run them down to the block.
4. Tighten the cylinder head a little at a time with a torque wrench. Tighten center bolts and then end bolts. The final torque should be 95 ± 5 ft. lbs.
5. Install valve push rods down through openings in the cylinder head and seat them in lifter sockets.
6. Install rocker arms, balls and nuts and tighten rocker arm nuts until all push rod play is taken up (Fig. 6-15).
7. Install thermostat housing, thermostat and water outlet using new gaskets and connect radiator hose.
8. Install temperature sending switch and tighten to 15-20 ft. lbs.
9. Clean all spark plugs with abrasive-type cleaner, inspect for damage and set the gap at .035" using a wire gauge.

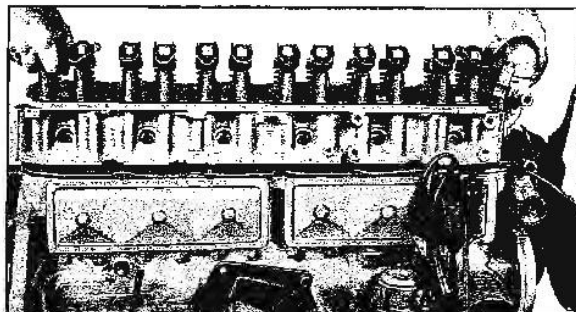


Fig. 6-23 Installing Cylinder Head

10. Install coil, then connect temperature sending unit and coil primary wires, and connect battery ground cable at cylinder head.

11. Clean manifold gasket surfaces and install new gasket over manifold studs. Position manifold and slide it into place over the studs, making sure it seats against the gasket. Install bolts and clamps and tighten as shown in Fig. 6-24.

12. Connect throttle linkage and adjust as shown in Section 6B.

13. Connect fuel and vacuum lines to carburetor and install lines in clip at water outlet.

14. Fill cooling system and check for leaks.

15. With lifter on base circle of camshaft, tighten rocker arm nut until valve train play is removed. Tighten nuts one more turn.

16. Install spark plugs and tighten to 20-25 lb. ft.

17. Install rocker arm cover and position wiring harness in clips on cover.

18. Clean and install air cleaner.

ROCKER ARM STUDS—REMOVE AND REPLACE

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" oversize, may be installed after reaming the holes with tool J-5715 for .003" oversize.

REMOVE

1. Remove rocker arm cover.
2. Remove rocker arm.
3. File two slots $3/32''$ to $1/8''$ deep on opposite sides of rocker arm stud (Fig. 6-25). Bottom of slots should be $1/2''$ from top of stud hole (Fig. 6-25).
4. Place washer J-6392-3 at bottom of rocker arm stud (Fig. 6-26).

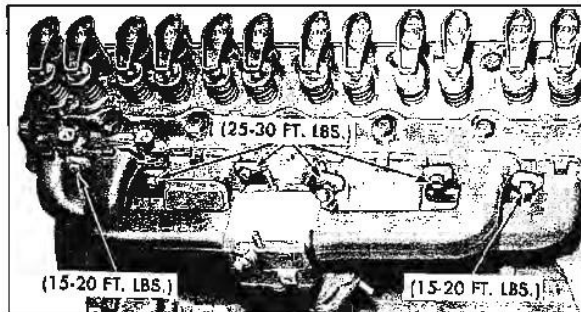


Fig. 6-24 Manifold Attaching Points

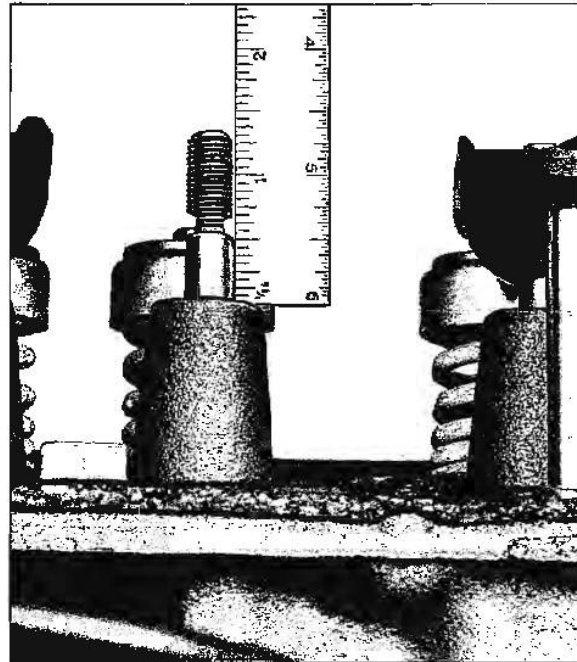


Fig. 6-25 Slots for Removing Rocker Arm Stud

5. Position rocker arm stud remover J-6392-1 on stud and tighten screws securely with $5/32''$ allen wrench.

6. Place spacer J-6392-2 over stud remover J-6392-1 (Fig. 6-26).

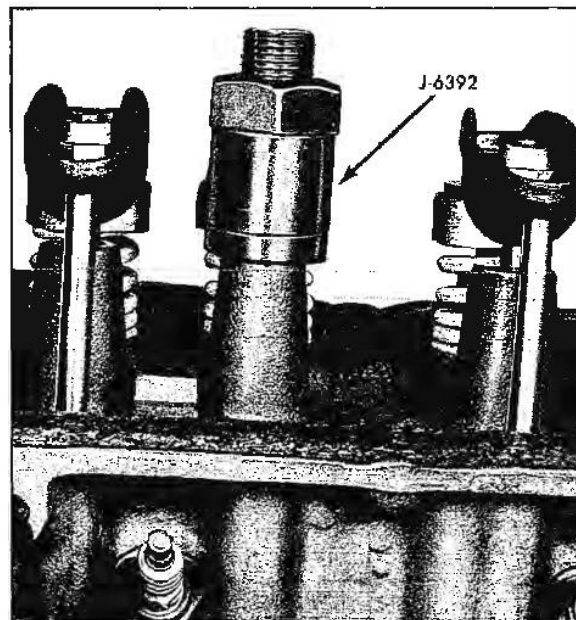


Fig. 6-26 Tool Installation for Removing Rocker Arm Stud

7. Thread 7/8" standard nut on stud remover and turn nut until stud is out of cylinder head (Fig. 6-26).

8. Ream rocker arm stud hole if oversize stud is to be used (Fig. 6-27).

REPLACE

1. Coat press-fit area of stud with hypoid axle lubricant.

2. Install new stud, using tool J-6880. Tool should bottom on head (Fig. 6-28).

3. Install push rod and rocker arm.

4. Remove spark plug from cylinder of valve train being serviced.

5. With lifter on base circle of camshaft tighten rocker arm nut until all valve train play is removed. Tighten nut one additional turn.

6. Install spark plug.

7. Install rocker arm cover.

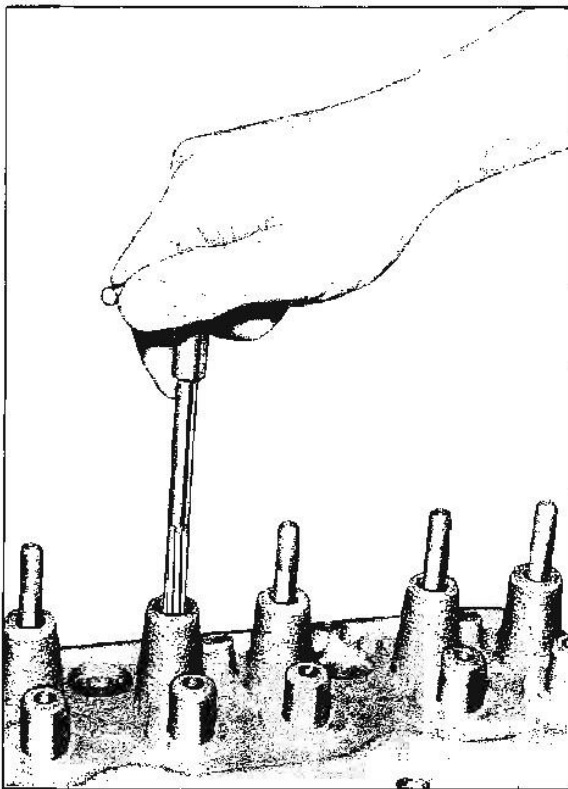


Fig. 6-27 Reaming Rocker Arm Stud Hole

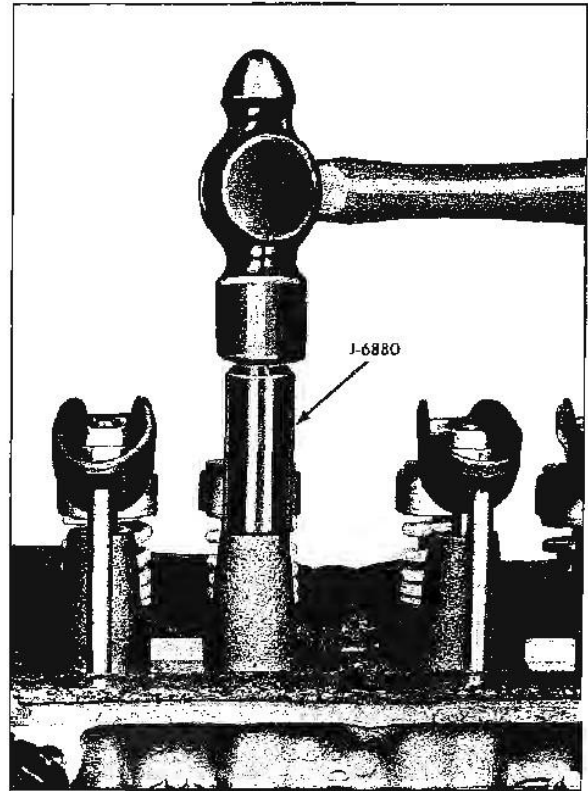


Fig. 6-28 Installing New Rocker Arm Stud

CYLINDER HEAD AND VALVES—RECONDITION

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

DISASSEMBLE

1. Remove the cylinder head and gasket as previously described. Place cylinder head on two blocks of wood to prevent damage.

2. Remove rocker arm nuts, ball seats and rocker arms.

3. Using tool J-8062, compress the valve springs and remove valve keys. Remove spring caps, spring seats, oil seals, springs and spring dampers (Fig. 6-29).

4. Remove valves from bottom of cylinder head and place them in a rack in their proper sequence so they can be assembled in their original positions.

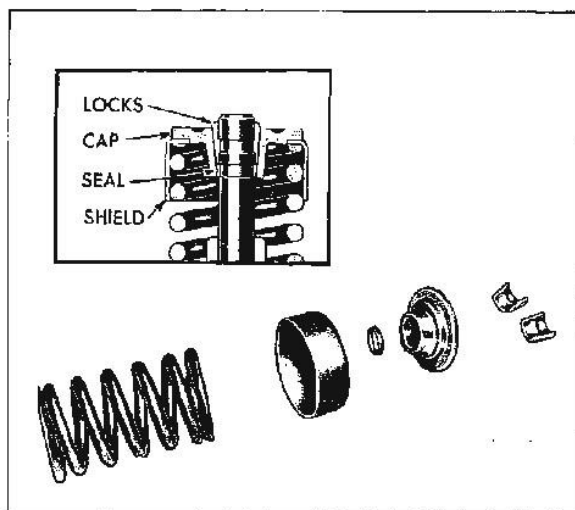


Fig. 6-29 Upper Valve Train Parts

5. Remove water outlet and thermostat, then remove thermostat housing.

CLEAN AND INSPECT

1. Clean all carbon from combustion chambers and valve ports.

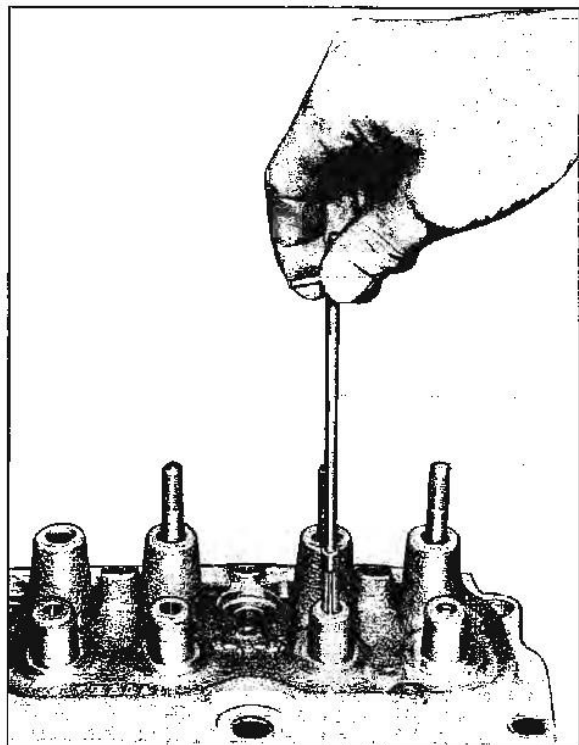


Fig. 6-30 Cleaning Valve Guide Bore

2. Thoroughly clean the valve guides using tool J-8101 (Fig. 6-30).

3. Clean all carbon and sludge from push rods and rocker arms.

4. Clean valve stems and heads on a buffing wheel.

5. Clean carbon deposits from head gasket mating surfaces.

6. Wash all parts in cleaning solvent and dry them thoroughly.

7. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the water chamber.

8. Inspect the valves for burned heads, cracked faces or damaged stems.

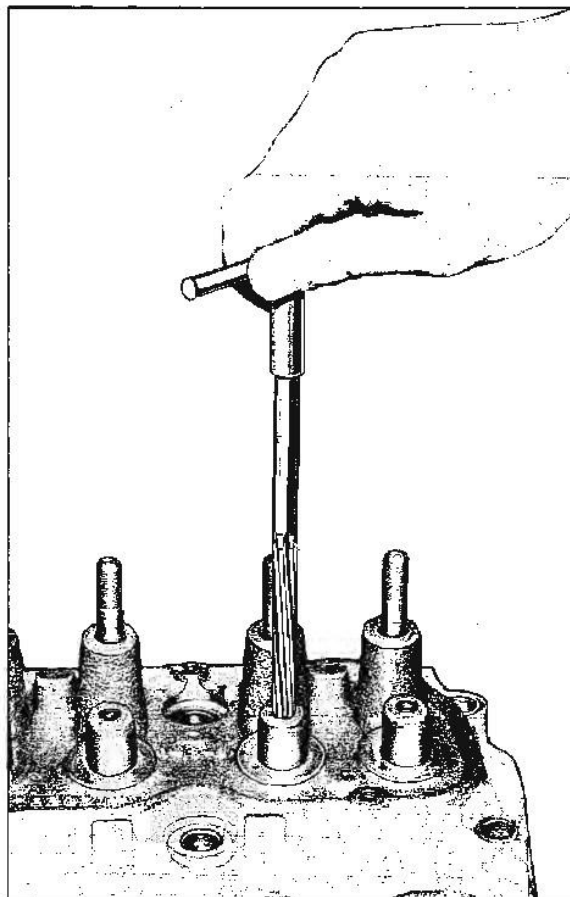


Fig. 6-31 Reaming Valve Guide Bore

9. Check fit of valve stems in their respective bores.

NOTE: Excessive valve stem to bore clearance will cause lack of power, rough idling and noisy valves, and may cause valve breakage. 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". 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 valve guide clearance. If clearance is not within limits, use next oversize valve and ream bore to fit using suitable reamer of tool J-7049 (Fig. 6-31).

10. Check valve spring tension with suitable tester (Fig. 6-32).

NOTE: Springs should be compressed to 1-21/32" at which height it should check 84-92 pounds. Weak springs affect power and economy and should be replaced if below 70 pounds.

11. 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.

VALVE GUIDE BORE - RECONDITION

Valves with .003" oversize stems are available for inlet and exhaust valves. Use the 3/8" diameter reamer sizes, which are: J-8814, Standard and J-5830-1, .003" Oversize.

VALVES AND SEATS—RECONDITION

1. Reface valves and seats as follows:

Valves should be ground on a special bench grinder designed specifically for this purpose and built by a reputable manufacturer. Valve seats should be ground with reputable power grinding equipment having stones of the correct seat angle and a suitable pilot which pilots in the valve stem guide. To ensure positive sealing of the valve face to its seat, the grinding stones should be carefully refaced before any grinding is done.

Intake and exhaust valve seat angle is 46° . Intake and exhaust valve face angle is 45° . This will provide hairline contact between valve and seat to provide positive sealing and reduce build-up of deposits on seating surfaces (Fig. 6-33).

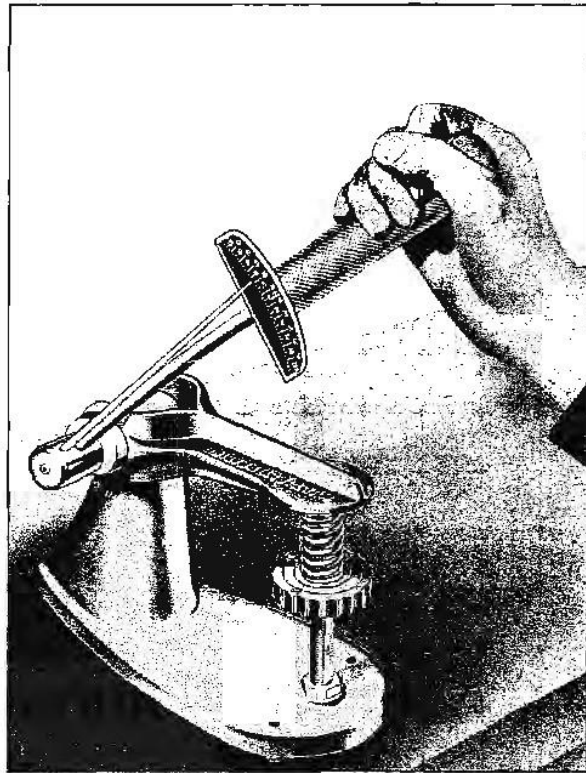


Fig. 6-32 Checking Valve Spring Tension

DO NOT USE REFACING EQUIPMENT EXCESSIVELY; only enough material should be removed to true up surfaces and remove pits. The valve head will run hotter as its thickness is diminished; therefore, if valve face cannot be cleaned up without grinding to point where outside diameter of valve has a sharp edge, the valve should be replaced. Whenever it is necessary to replace a valve, the new valve should be of the same stem diameter as the valve removed (unless the valve guide is reamed to provide proper fit).

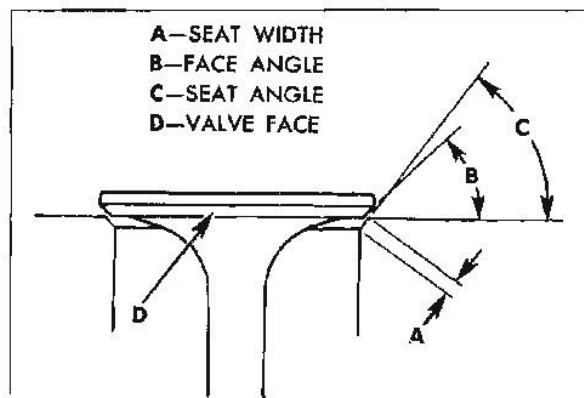


Fig. 6-33 Valve Seat and Face Angles

Width of exhaust valve seats should be $1/16''$ to $3/32''$. Intake valve seats should be $1/32''$ to $1/16''$ wide. If seat width is excessive, it should be narrowed by grinding with a flat stone. This is the only method that should be used to narrow the seat.

2. Check concentricity of valve seat and valve guide. Concentricity of valve seat and valve guide can be checked by using a suitable dial indicator or prussian blue. When using a dial indicator, total runout should not exceed $.002''$.

When prussian blue is used, a light coat should be applied to the face of the valve only and the valve rotated in its seat. If blue appears all the way around the valve seat, the valve seat and the valve guide are concentric with one another.

3. Check concentricity of valve stem and face of valve. After cleaning prussian blue from valve and seat, lightly coat valve seat with prussian blue again and rotate valve in guide. If blue appears all the way around the valve, the valve stem and valve face are concentric with one another.

NOTE: Both tests in steps 2 and 3 are necessary to insure proper valve seating.

IMPORTANT: If it is necessary to grind and pit from rocker arm end of valve stem, feed end squarely against grinding wheel. Only the extreme end of the valve stem is hardened to resist wear. Do not grind end excessively.

ASSEMBLE

1. Starting with No. 1 cylinder, place the exhaust valve in the port and place the valve spring and cap in position. Place spring and rotator on exhaust valves. Then using suitable spring compressor, compress the spring and install the oil seal and valve keys. See that the seal is flat and not twisted in the valve stem groove and that the keys seat properly in the valve stem groove (Fig. 6-29).

NOTE: Place valve springs in position with the closed coil end toward the cylinder head.

2. Assemble the remaining valves, valve springs, shields, spring caps, oil seals and valve locks in the cylinder head. Check seals by placing a vacuum cup over valve stem and cap, squeeze vacuum cup to make sure no oil leaks past oil seal.

3. Install cylinder head as previously described.

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



Fig. 6-34 Checking Valve Spring Installed Height

of $1-23/32''$, install a valve spring seat shim approximately $1/16''$ thick above the spring seating surface in the head. At no time should the spring be shimmed to give an installed height of less than $1-21/32''$ (Fig. 6-34).

HARMONIC BALANCER—REMOVE AND REPLACE

REMOVE

1. Drain radiator and disconnect radiator hoses at radiator.

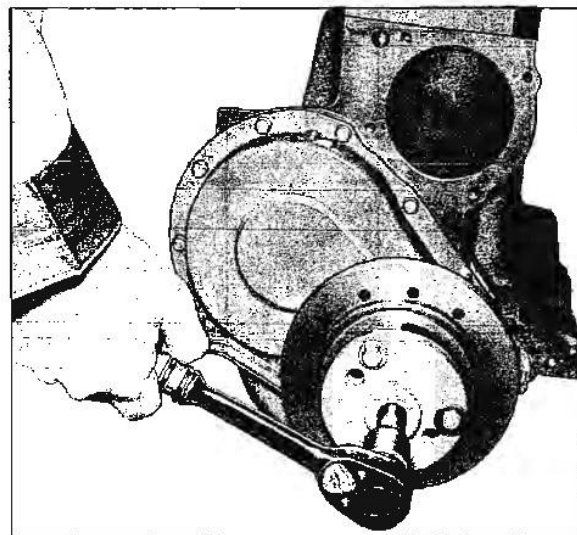


Fig. 6-35 Removing Harmonic Balancer

2. Remove fan and water pump pulley.
3. Remove radiator core and fan belt.
4. Install tool J-6978 to balancer and turn puller screw to remove balancer (Fig. 6-35). Then remove tool from balancer.

REPLACE

1. Coat front cover oil seal contact area of balancer with engine oil.
2. Attach balancer installer tool J-8792 (Fig. 6-41) to balancer (Fig. 6-37).
3. Position balancer on crankshaft and drive into position until it bottoms against crankshaft gear. Remove installer tool (Fig. 6-37).
4. Install water pump pulley, fan and fan belt and adjust belt tension.
5. Install radiator core and connect radiator hoses.

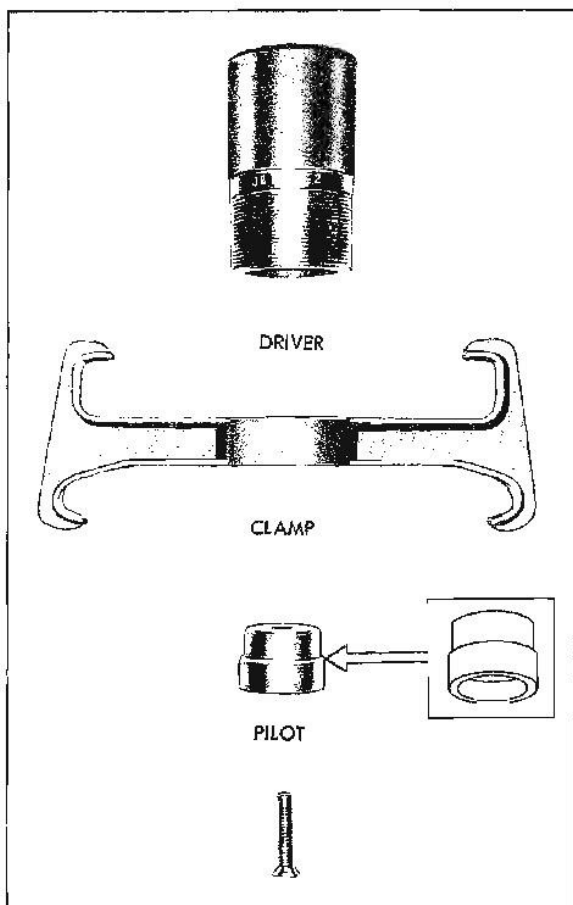


Fig. 6-36 Harmonic Balancer Installer

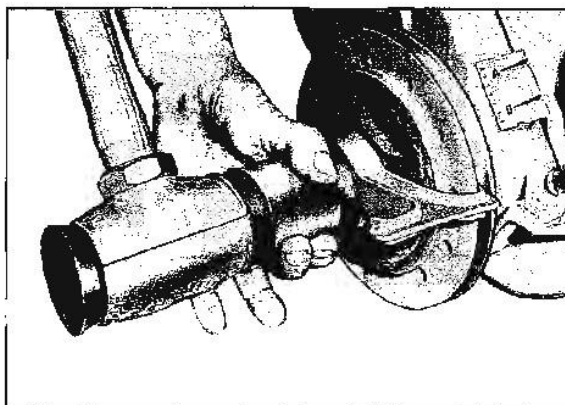


Fig. 6-37 Installing Harmonic Balancer

6. Fill cooling system and check for leaks.

TIMING GEAR COVER—REMOVE AND REPLACE

REMOVE

1. Remove harmonic balancer as previously described.
2. Loosen oil pan bolts and let oil pan rest against front crossmember.
3. Remove timing gear cover attaching screws and remove cover and gasket.

OIL SEAL - REPLACE

(Seal can also be replaced with timing gear cover installed.)

1. After removing harmonic balancer, pry seal out of timing gear cover with a large screwdriver.
2. Install new lip seal with lip toward inside of cover and drive it into position with tool J-5154 (Fig. 6-38).

OIL NOZZLE - REPLACE

1. Remove nozzle with pliers (Fig. 6-39).
2. Drive new nozzle in place using a suitable light plastic or rubber hammer.

REPLACE

1. Clean gasket surfaces on block and cover.
2. Install centering tool J-21742 over end of crankshaft.
3. Coat the gasket with light grease and stick a new cover gasket in position on block with light grease.

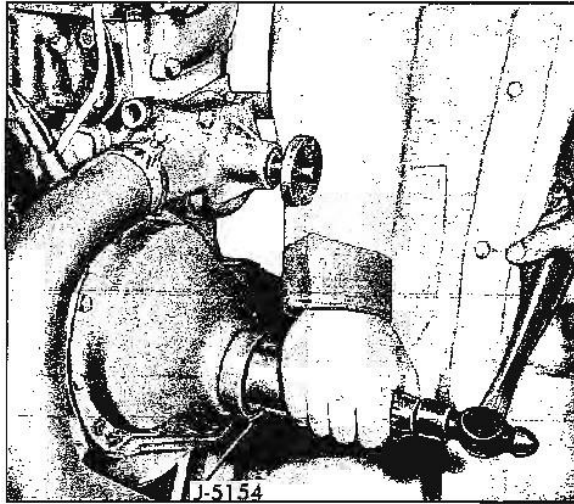


Fig. 6-38 Installing Timing Cover Oil Seal

4. Install cover over centering tool (Fig. 6-40) and install cover screws. Torque screws to 8 to 8 ft. lbs. Remove centering tool.

NOTE: It is important that centering gauge be used to align cover, so that harmonic balancer installation will not damage seal, and to position seal to seal evenly around balancer hub surface.

5. Move oil pan into position and tighten bolts.

6. Install harmonic balancer as previously described.

CAMSHAFT—REMOVE AND REPLACE

REMOVE

1. Drain crankcase and radiator.

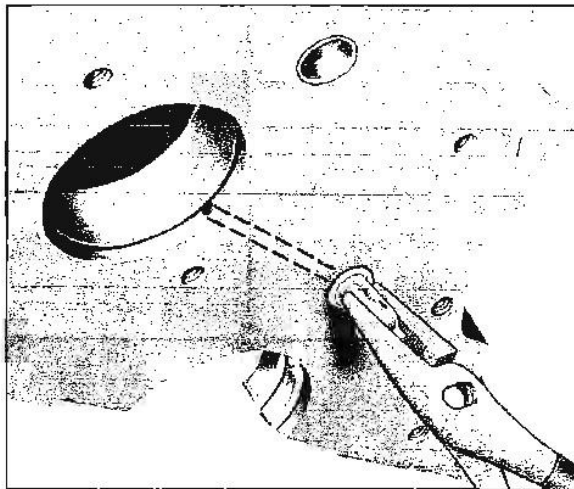


Fig. 6-39 Removing Timing Gear Oil Nozzle

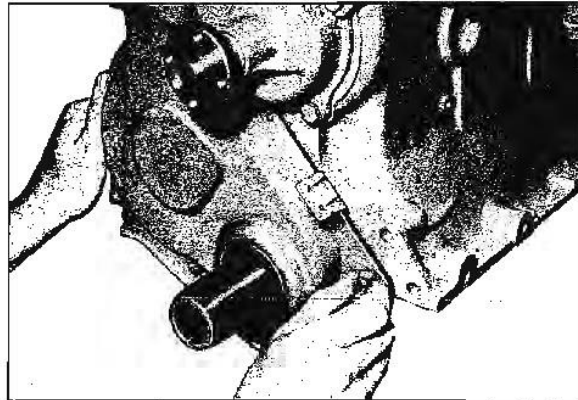


Fig. 6-40 Installing Timing Gear Cover

2. Remove radiator as described under "Engine Cooling," in Section 6-A.

3. Remove fan and water pump pulley.

4. Remove grille assembly. See FRONT END SHEET METAL, Section 10.

5. Remove valve cover and gasket, loosen valve rocker arm nuts and pivot rocker arms clear of push rods.

6. Remove distributor, fuel pump and spark plugs.

7. Remove coil, push rod covers and gasket. Remove push rod and valve lifters. Remove spark plugs.

8. Remove harmonic balancer using tool J-6978. Loosen oil pan bolts and allow oil pan to drop away from timing gear cover. Remove timing gear cover.

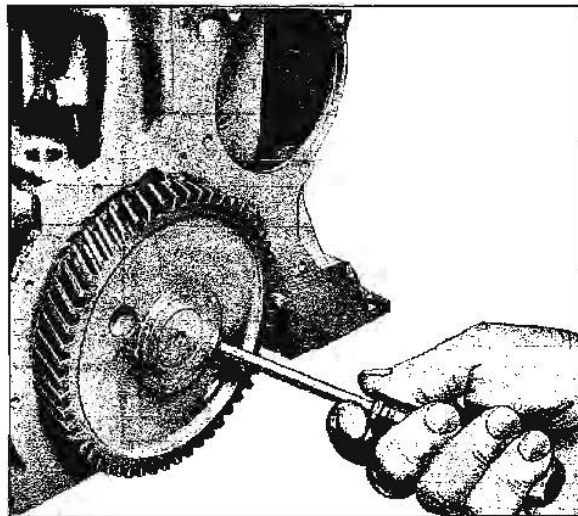


Fig. 6-41 Removing Camshaft Thrust Plate Screws

9. Remove the two camshaft thrust plate screws by working through holes in the camshaft gear (Fig. 6-41).

10. Remove the camshaft and gear assembly by pulling it out through the front of the block.

NOTE: Support shaft carefully when removing so as not to damage camshaft bearings.

DISASSEMBLE

1. If the gear must be removed from the shaft, use press plate J-6547 inside J-6407-2 on press.

2. Place tools on table of a press. Place the camshaft through the opening in the tools. Press shaft out of gear using socket or other suitable tool (Fig. 6-42).

CAUTION: Thrust plate must be so positioned that woodruff key in shaft does not damage it when the shaft is pressed out of gear.

ASSEMBLE

To assemble camshaft gear, thrust plate and gear spacer ring to camshaft, proceed as follows:

1. Firmly support shaft at back of front journal in an arbor press using press plates J-9156 in J-6407-2.

2. Place gear spacer ring and thrust plate over end of shaft, and install woodruff key in shaft keyway.

3. Install camshaft gear and press it onto the shaft until it bottoms against the gear spacer ring. Use a socket or other suitable tool. The end clearance of the thrust plate should be .001" to .005" (Fig. 6-43). If less than .001", the spacer ring should be replaced. If more than .005", the thrust plate should be replaced.

REPLACE

1. Install the camshaft assembly in the engine block, being careful not to damage bearings or cams.

2. Turn crankshaft and camshaft so that the valve timing marks on the gear teeth will line up. Push camshaft into position. Install camshaft thrust plate to block screws and tighten 5-8 ft. lbs.

3. Check camshaft and crankshaft gear runout with a dial indicator (Fig. 6-44). The camshaft gear runout should not exceed .004" and the crankshaft gear runout should not exceed .003".

4. If gear runout is excessive, the gear will have to be removed and any burrs cleaned from the shaft or the gear replaced.

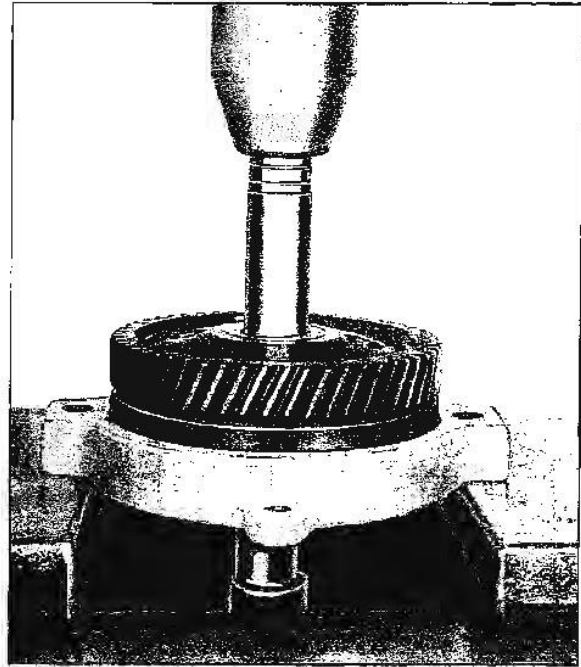


Fig. 6-42 Removing Camshaft Timing Gear

5. Check the backlash between the timing gear teeth with a dial indicator (Fig. 6-45). The backlash should not be less than .004" nor more than .006".

6. Install timing gear cover and gasket. Move oil pan up into position and tighten oil pan bolts.

7. Install harmonic balancer, using harmonic balancer installer tool J-8792.

8. Line up keyway in balancer with key on crankshaft and drive balancer onto shaft until it bottoms against crankshaft gear, using tool J-5590.

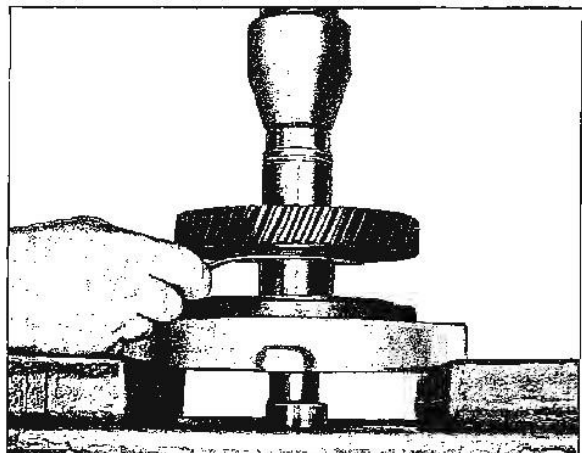


Fig. 6-43 Installing Camshaft Timing Gear and Checking Thrust Plate End Clearance

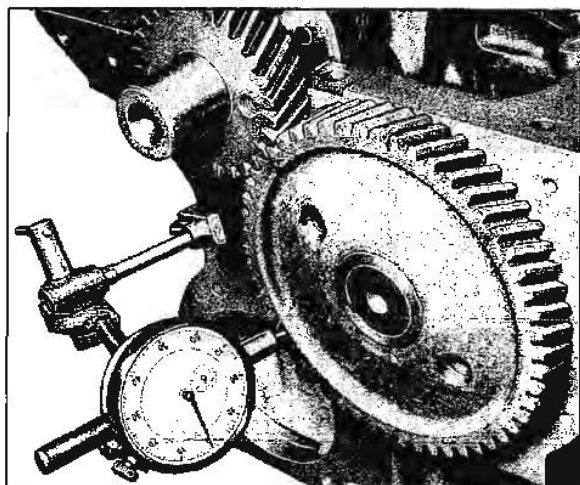


Fig. 6-44 Checking Camshaft Gear Runout

9. Install valve lifters and push rods. Install side cover with a new gasket. Attach coil and wires. Then install distributor as follows:

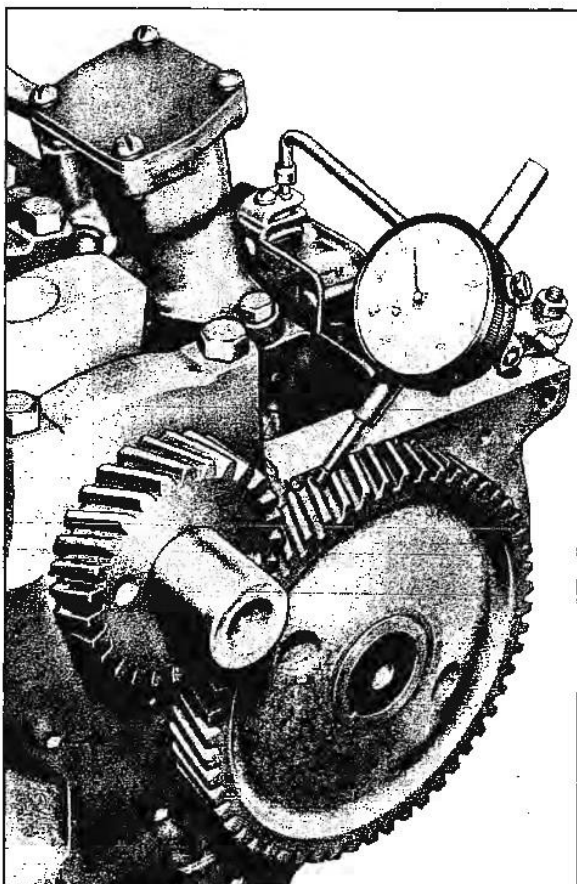


Fig. 6-45 Checking Camshaft Gear Backlash

Turn crankshaft to firing position of number one cylinder (number one exhaust and intake valve lifters both on base circle of camshaft and timing mark on harmonic balancer indexed with top dead center mark on timing pad). Position new distributor to block gasket on block.

Install distributor so that vacuum diaphragm faces the front of the engine and rotor arm points toward number on cylinder spark plug contact. It will also be necessary to turn oil pump drive shaft so it will index with distributor shaft.

10. Install fuel pump.

11. Pivot rocker arms over push rods. With lifters on base circle of camshaft, tighten rocker arm nut until all valve train play is removed. Tighten nut one additional turn.

12. Install spark plugs.

13. Add oil to engine. Install water pump pulley and fan belt and adjust using tension gauge.

14. Install the radiator as described under "Engine Cooling," in Section 6A and fill cooling system.

15. Install grille assembly. See FRONT END SHEET METAL, Section 10.

16. Add cooling solution to radiator, start engine and check for leaks.

17. Check and adjust timing.

CAMSHAFT BEARINGS—REMOVE AND REPLACE

REMOVE

Camshaft bearings can be replaced while the engine is disassembled for overhaul, or without complete disassembly of the engine after camshaft and flywheel have been removed.

1. With camshaft and flywheel removed, drive out expansion plug from rear cam bearing by driving from inside.

2. Use Tool J-21473-1 to drive out front bearing toward rear and rear bearing toward front.

3. Install extension J-21054 on installer J-21473-1 and drive center two bearings out toward rear (Fig. 6-46).

REPLACE

1. Install each new bearing on tool.

2. Install bearings reversing removal procedure.

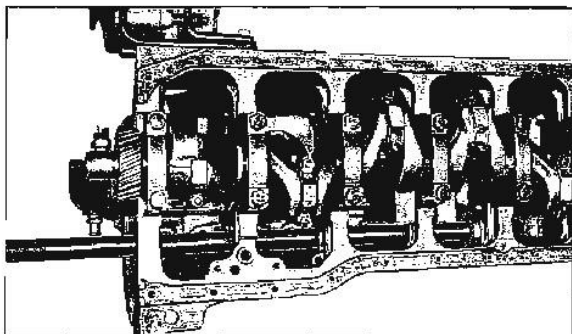


Fig. 6-46 Removing Center Camshaft Bearings

NOTE: The front bearing must be driven approximately 1/8" behind front of cylinder block to uncover oil hole to timing gear oil nozzle. Align bearing oiling holes with block oiling holes and install new expansion plug.

OIL PAN—REMOVE AND REPLACE

REMOVE

1. Drain cooling system and crankcase and remove engine and transmission as an assembly from vehicle. (See "ENGINE - REMOVE AND INSTALL").

2. Remove oil pan bolts, oil pan, oil pan gaskets and end seals.

REPLACE

1. Thoroughly clean all gasket sealing surfaces.

2. Install rear seal in rear main bearing cap.

3. Install front seal on timing gear cover pressing tips into holes provided in cover.

4. Install side gaskets on cylinder block using grease as a retainer. (Side gasket tabs index into notches of front seal -- Fig. 6-47).

5. Install oil pan.

NOTE: Screws into timing gear cover should be installed last. They are installed at an angle and holes line up after rest of pan bolts are snugged up.

6. Install engine and transmission assembly in vehicle. (See "ENGINE - REMOVE AND INSTALL").

OIL PUMP—REMOVE AND REPLACE

1. Drain oil and remove oil pan as previously outlined.

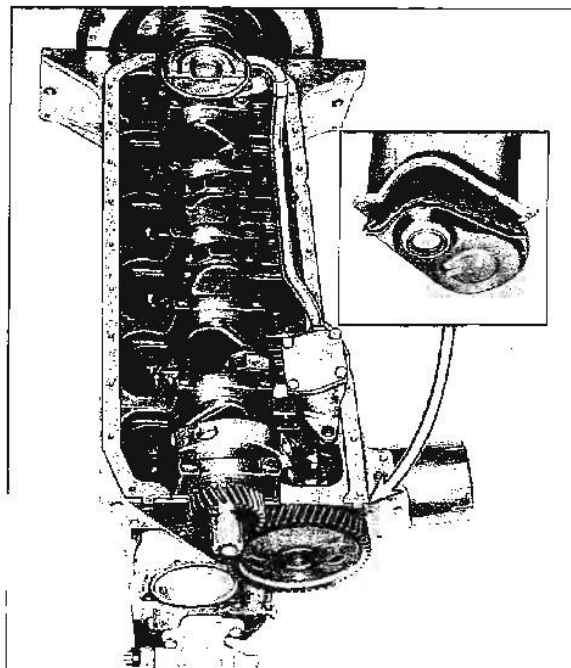


Fig. 6-47 Oil Pan Gaskets

2. Remove two flange mounting bolts and nut from elongated number 6 main bearing cap bolt and remove pump and screen as an assembly (Fig. 6-48).

3. Remove 4 cover attaching screws, cover, gasket, idler gear and drive gear and shaft (Fig. 6-49).

4. Remove pressure regulator valve and valve parts.

5. Wash all parts in cleaning solvent and dry using compressed air.

CAUTION: Do not disturb oil pickup pipe on screen or body. This pipe is located at assembly.

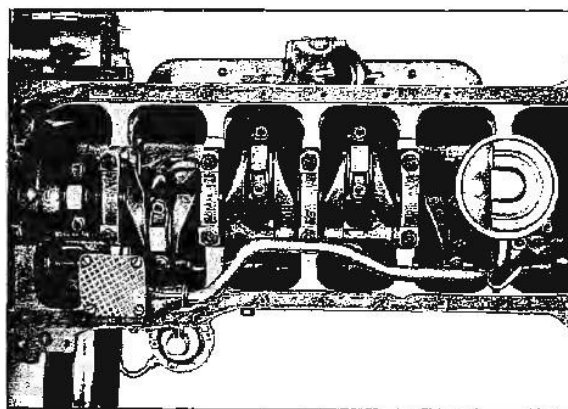


Fig. 6-48 Oil Pump Installed

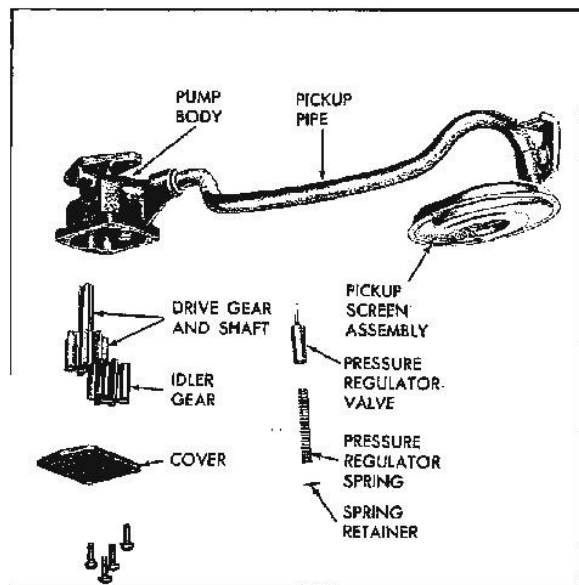


Fig. 6-49 Oil Pump - Exploded View

INSPECT

Should any of the following conditions be found during inspection operations, the pump assembly should be replaced.

1. Inspect pump body for cracks or excessive wear.
2. Inspect oil pump gears for excessive wear or damage.
3. Check shaft for looseness in the housing.
4. Check inside of cover for wear that would permit oil to leak past the ends of gears.
5. Check the oil pick-up screen for damage to screen, or relief grommet.
6. Check pressure regulator valve plunger for fit in body.

REPLACE

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 a new gasket to assure correct end clearance of the gears.
4. Install cover and attaching screws. Tighten screws 5 to 8 lb. ft. torque and check to see that shaft turns freely.

5. Install regulator valve plunger, spring, retainer and pin and install oil line to pump body loosely.

6. Align oil pump drive shaft slot to match with distributor tang, then install oil pump to block positioning flange over distributor lower bushing. Use no gasket. Tighten bolts 15 ± 5 lb. ft.

NOTE: Oil pump should slide easily into place. If not, remove and relocate slot or locate other problem.

7. Install oil pan using new gaskets and seals as outlined under Oil Pan Installation.

**REAR MAIN BEARING OIL SEAL—
REMOVE AND REPLACE**

The rear main bearing oil seal (Fig. 6-50) can be removed (both halves) without removal of the crankshaft.

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

1. Drain coolant system and crankcase and remove engine from vehicle. (See "ENGINE - REMOVE AND INSTALL").

2. Remove transmission, clutch (SM), and starter from engine, install engine on suitable stand and remove oil pan.

3. Remove rear bearing cap.

4. Remove oil seal from groove, prying from bottom, using a small screwdriver.

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

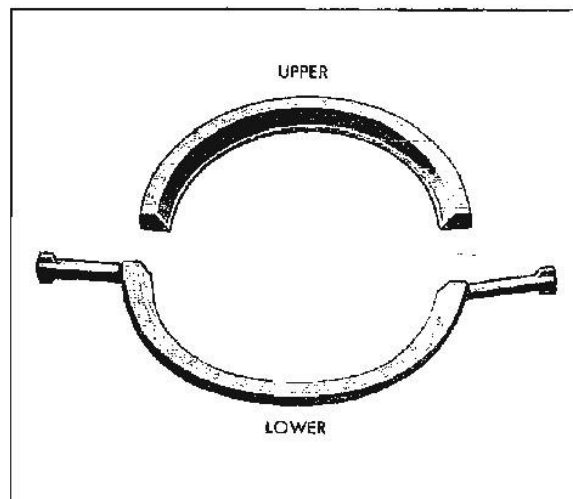


Fig. 6-50 Rear Main Bearing Oil Seal

5. Insert a new seal well lubricated with engine oil in bearing cap 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.

6. To replace the upper half of the seal, use a small hammer and brass pin punch to tap one end of oil seal (Fig. 6-51) until it protrudes far enough to be removed with pliers. Push new seal into place.

7. Install bearing cap and torque bearing cap bolts 65 ± 5 ft. lbs.

8. Install oil pan.

9. Install engine in vehicle and fill crankcase and cooling system. (See "ENGINE - REMOVE AND INSTALL").

MAIN BEARINGS—REMOVE AND REPLACE

The main bearings are of the precision insert type and do not utilize shims for adjustment. If the clearances are found to be excessive, a new standard or undersize bearing insert, both upper and lower halves, will be required.

REMOVE

1. Remove engine and transmission assembly from vehicle. Remove transmission from engine and place engine on suitable stand.

2. Remove oil pan.

3. Remove cap on main bearing requiring replacement and remove bearing from shell.

NOTE: It may be necessary to remove oil pump when removing number 6 main bearing cap.

4. Install a main bearing shell removing and installing tool such as KMO-734 in the oil hole in the crankshaft.

NOTE: If such a tool is not available, a cotter pin may be bent as required to do the job (Fig. 6-52).

5. Rotate the crankshaft clockwise as viewed from front of engine. This will roll upper bearing shell out of engine.

REPLACE

1. Oil new upper bearing shell and insert plain (unnotched) end of shell between crankshaft and indented or notched side. Rotate the bearing into place.

2. Install new bearing shell in bearing cap.

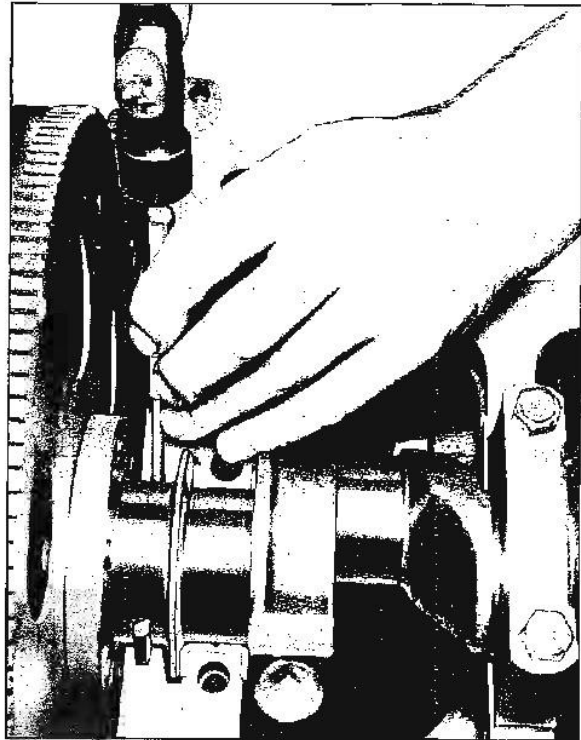


Fig. 6-51 Removing Oil Seal

3. Check bearing clearance using Plastigage method as outlined below.

4. Install oil pan using new gaskets and seals.

5. Remove engine from stand.

6. Install transmission to engine.

7. Install engine and transmission assembly in vehicle.

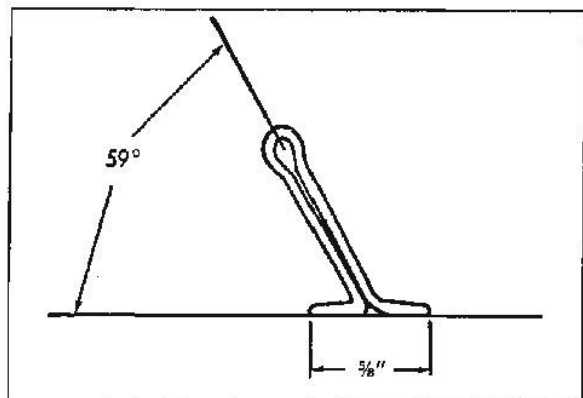


Fig. 6-52 Tool for Removing Upper Half of Main Bearing

PLASTIGAGE METHOD OF DETERMINING MAIN BEARING CLEARANCE

1. Place a .002" brass shim between the crankshaft journal and the lower bearing in each bearing cap next to the one being checked. Tighten all cap bolts to 65 ± 5 lbs. ft. This causes the crankshaft to be forced against the upper bearing and insures an accurate measurement of the total clearance.

2. Remove the bearing cap of the bearing to be checked. Wipe the bearing and the journal free of oil.

3. Place a piece of Plastigage, the length of the bearing (parallel to the crankshaft), on the journal or bearing surface (Fig. 6-53). Install the cap and tighten cap bolts to proper torque.

NOTE: Do not turn crankshaft with Plastigage in place.

4. Remove bearing cap and using Plastigage scale on envelope measure width of compressed Plastigage before removing it from the bearing or journal (Fig. 6-54). If the bearing clearance is between .0005" and .0025", the clearance is satisfactory. If the clearance is more than .0025", replace the bearing with the next undersize bearing and recheck clearance. Bearings are available in standard size .001" and .002" undersize.

5. Install a new rear main bearing oil seal in the cylinder block and main bearing cap if the rear main bearing was checked and/or replaced.

CONNECTING ROD BEARINGS— REMOVE AND REPLACE

Connecting rod bearing inserts are available in standard size and undersizes of .001" and .002".

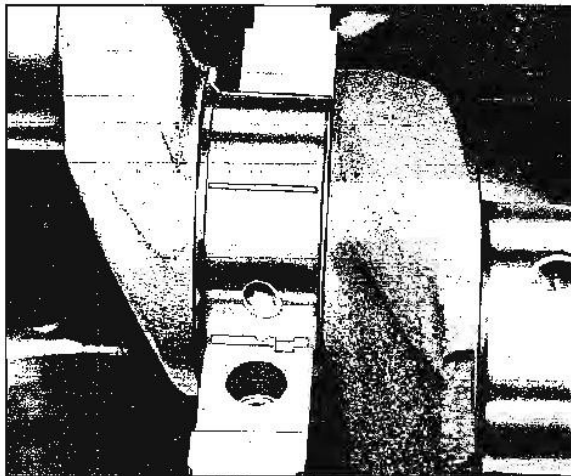


Fig. 6-53 Plastigage on Journal

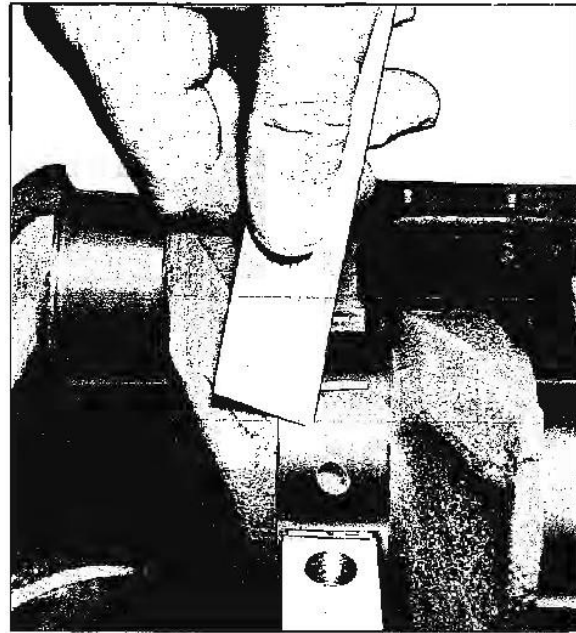


Fig. 6-54 Measure Plastigage

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.**

REMOVE

1. Remove engine and transmission assembly from vehicle. Remove transmission clutch (SM) and starter from engine and place engine on suitable stand.

2. Remove oil pan.

3. Rotate crankshaft as necessary to bring crankpin carrying bearing to be replaced straight toward bottom of block.

4. Remove bearing cap.

5. Install connecting rod bolt guide set J-5239 on connecting rod bolts. Push piston and rod assembly up far enough to remove upper bearing.

6. Remove bearings from cap and rod.

7. Inspect crankpin for damage, out-of-round and taper.

REPLACE

1. Reassemble cap and rod with new bearings and check clearance with Plastigage as outlined below.

2. Install oil pan using new gaskets and seals.
3. Remove engine from stand.
4. Install transmission on engine.
5. Install transmission and engine assembly in vehicle.

PLASTIGAGE METHOD OF DETERMINING CONNECTING ROD BEARING CLEARANCE

1. Remove the cap of the bearing to be checked. Wipe the bearing and the crankpin free of oil.
2. Place a piece of Plastigage, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface (Fig. 6-55). Install the cap and tighten cap bolts to 33 ± 2 lb. ft.

NOTE: Do not turn crankshaft with Plastigage in place.

3. Remove bearing cap and using Plastigage scale on envelope measure width of compressed Plastigage before removing it from the crankpin or bearing (Fig. 6-56). If the bearing clearance is between .0005" and .0025", the clearance is satisfactory. If the clearance is more than .0025", replace the bearing with the next size undersize bearing and recheck clearance. Bearings are available in .001", and .002" undersize.

4. Rotate the crankshaft after bearing adjustment to be sure bearings are not tight.

5. Check connecting rod end clearance between connecting rod cap and side of crankpin (Fig. 6-57). Clearance should be .008" - .014". If clearance is more than .014", replace connecting rod.

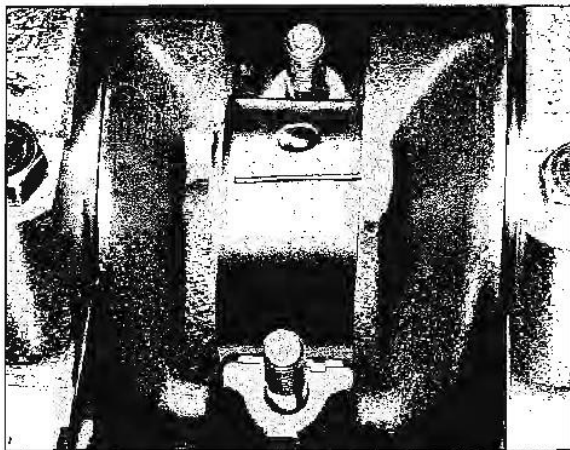


Fig. 6-55 Plastigage on Crankpin



Fig. 6-56 Measure Plastigage

CONNECTING ROD AND PISTON ASSEMBLY—REMOVE AND REPLACE

REMOVE

1. Remove engine and transmission assembly from vehicle.
2. Remove transmission, clutch (SM) and starter from engine and place engine on suitable stand.
3. Remove rocker arm cover.
4. Loosen rocker arm nuts, rotate rocker arms and remove push rods.

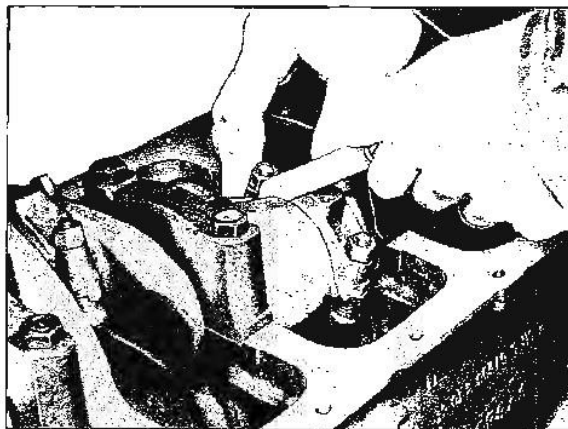


Fig. 6-57 Checking Connecting Rod Side Clearance

5. Remove coil and push rod covers.
6. Remove valve lifters.
7. Disconnect fuel line and vacuum line at carburetor.
8. Remove cylinder head, intake and exhaust manifolds as an assembly. Remove spark plugs.
9. Remove oil pan.
10. Check connecting rod and piston for cylinder number identification and if necessary, mark them.
11. Remove bearing cap and install connecting rod bolt guide set J-5239.
12. Carefully remove connecting rod and piston assembly by pushing out with knurled handle of long guide.

CONNECTING ROD AND PISTON DISASSEMBLE

NOTE: Use care at all times when handling and servicing connecting rods and pistons. To pre-

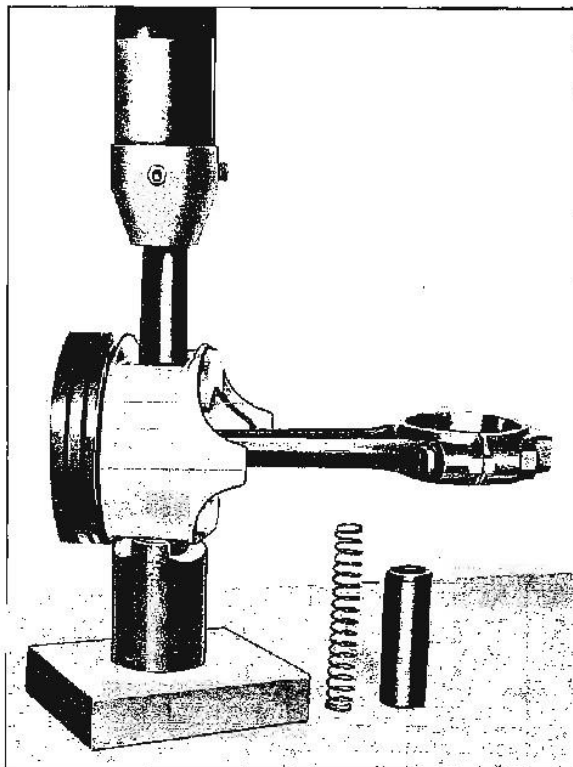


Fig. 6-58 Removing Piston Pin

vent possible damage to these units, do not clamp rod or piston in vise since they may become distorted. Do not allow pistons to strike against one another, against hard objects or bench surfaces, since distortion of piston contour or nicks in the soft aluminum material may result.

1. Remove piston rings using suitable piston ring remover.
2. Install pilot of piston pin removing and installing tool J-9510 on piston pin.

3. Install piston and connecting rod assembly on support and place assembly in an arbor press (Fig. 6-58). Press pin out of connecting rod.

4. Remove assembly from press and remove piston pin from support and remove tool from piston and rod.

CONNECTING ROD AND PISTON - CLEAN AND INSPECT

1. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tools and solvent.

2. Clean piston pin, rod, cap, bolts and nuts in suitable solvent. Reinstall cap on connecting rod to assure against subsequent mixing of caps and connecting rods.

3. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; and scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

4. Inspect piston pin for scoring, roughness, or uneven wear and proper fit.

PISTON PIN-FIT

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 mileage and in such cases a new piston and pin assembly should be installed. Pistons and pins are serviced as assemblies.

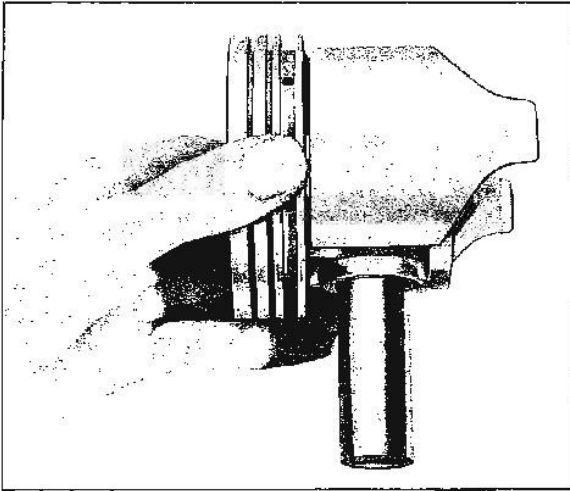


Fig. 6-59 Checking Piston Pin Fit

The piston pin fit in piston is .0003" to .0005" loose with pin and bosses clean and dry.

NOTE: Piston and pin must be at room temperature when checking fit and pin must be able to fall from piston by its own weight (Fig. 6-64).

5. Inspect bearing shells to see that they are serviceable. Fit of bearings should be checked when engine is being assembled.

CYLINDER BORES-INSPECT

Inspect cylinder bores for out-of-round or excessive taper, with an accurate cylinder gauge J-8087 or comparable, at top, middle and bottom of bore. (Fig. 6-60). Measure cylinder bore parallel and at right angles to the centerline of the engine to determine out-of-round. Variation in measure

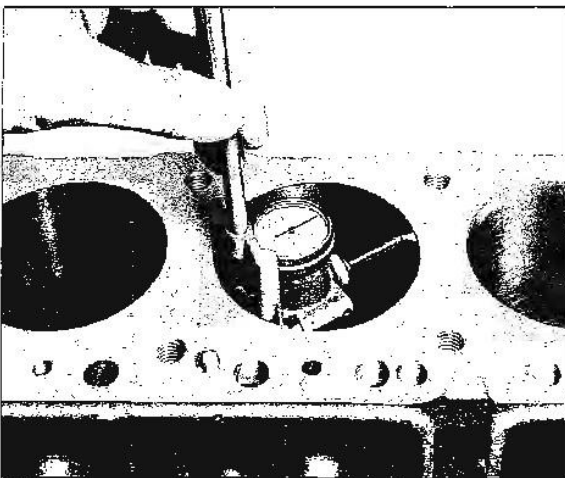


Fig. 6-60 Checking for Out-Of-Round and Taper

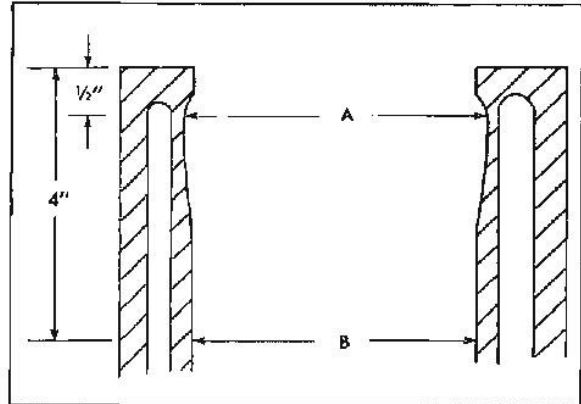


Fig. 6-61 Normal Cylinder Wear Pattern

from top to bottom of cylinder indicates the taper in the cylinder. Fig. 6-61 illustrates area in cylinder where normal wear occurs. If dimension "A" is larger than dimension "B" by .007", it indicates the necessity of cylinder boring and installing new rings and pistons. Cylinder bores can be measured by setting the cylinder gauge dial at zero in the cylinder at the point of desired measurement. Lock dial indicator at zero before removing from cylinder, and measure across the gauge contact points with outside micrometer, with the gauge at the same zero setting when removed from the cylinder (Fig. 6-62).

Fine vertical scratches made by ring ends will not cause excessive oil consumption, therefore, honing to remove is unnecessary.

HONING OR BORING

If a piston in excess of .005" oversize is to be installed, the cylinder should be bored, rather than honed, to effect a true bore.

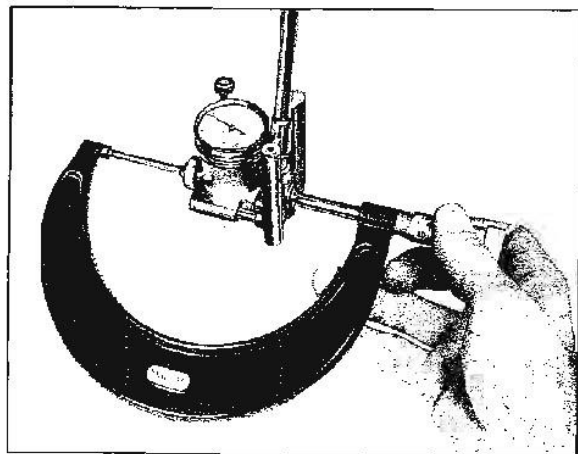


Fig. 6-62 Measuring Cylinder Gauge

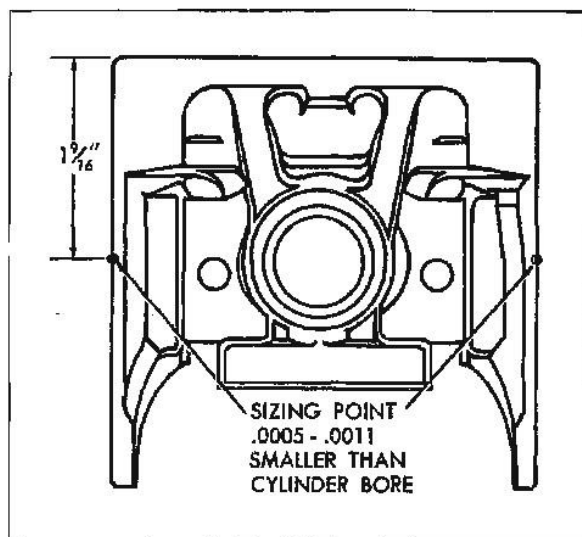


Fig. 6-63 Piston Sizing Points

When honing to eliminate the possibility of honing taper into the cylinder when installing .005" oversize; full strokes of the hone in cylinder should be made in addition to checking measurement at top, middle and bottom of bore repeatedly.

When boring, always be sure the crankshaft is out of the way of the boring cutter when boring each cylinder. Crankshaft bearings and other internal parts must be covered or taped to protect them during boring or honing operation. When taking the final cut with a boring bar, leave .001" on the diameter for finish honing to give the required piston to cylinder clearance specifications.

NOTE: Honing or boring operation must be done under close supervision so that specified clearance

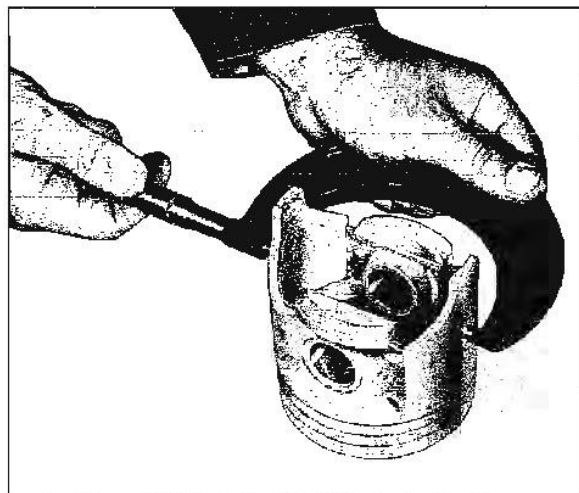


Fig. 6-64 Measuring Piston

between pistons, rings, and cylinder bores is maintained.

By measuring the piston to be installed at the sizing points (Fig. 6-63) and adding the mean of the clearance specification, the finish hone cylinder measurement can be determined. It is important that both the block and piston be measured at normal room temperature, 60° - 90°F.

After final honing and before the piston is checked for fit; each cylinder bore must be thoroughly cleaned. Use soapy water solution and wipe dry to remove all traces of abrasive. If all traces of abrasive are not removed, rapid wear of new rings and piston will result.

Intermixing different size pistons has no effect on engine balance as all Pontiac pistons from standard size, up to .030" oversize, weigh exactly the same. Pontiac does not recommend boring beyond .010" during warranty period so that if necessary, engine can be serviced at high mileage without cylinder block replacement.

PISTON - FIT AND REPLACE

Pistons should be fitted in the bores by actually measuring the fit. Clearance between the piston and the cylinder bore should be .0005" to .0011".

If cylinder bores have been reconditioned, or if pistons are being replaced, reconditioning of bores and fitting of pistons should be closely coordinated.

If bore has been honed, it should be washed thoroughly with hot, soapy water and a stiff bristle brush.

Using a cylinder checking gauge, measure the cylinder bore crosswise of the block to find the smallest diameter. Record the smallest diameter of each bore.

NOTE: When measuring cylinder bores and pistons, it is very important that the block and pistons be at room temperature. If any or all of the parts are hotter or colder than normal room temperature, improper fitting will result.

Measure the piston skirt perpendicular to the piston pin boss (piston pin removed) and at the sizing point indicated in Fig. 6-64.

Make sure the micrometer is in full contact.

As the pistons are measured they should be marked for size identification and the measurements recorded.

If there is excessive clearance between a cylinder bore and the piston which was installed in that bore, a new piston should be used.

New pistons are serviced in standard size and .005", .010", .020" and .030" oversize.

NOTE: Since these are nominal or basic sizes, it is important that new pistons be measured to ensure proper fit. All new pistons are serviced with selectively fitted piston pins.

After all measurements have been made, match the new pistons with the cylinders where they will fit with proper clearance. Honing of cylinder bore may be necessary to effect a proper fit. When properly mated, mark the pistons with the cylinder numbers they fit so they will not become mixed.

CONNECTING ROD TO PISTON - ASSEMBLE

There is a notch cast in the top of all piston heads to facilitate proper installation. The piston assemblies should always be installed with the notch toward the front of the engine.

1. Lubricate piston pin holes in piston and connecting rod lightly with graphite lubricant.

2. Position connecting rod in its respective piston so that flange or heavy side of rod at bearing end will be toward front of engine (cast slot in piston top).

3. Install piston pin on installer and pilot spring and pilot in support (Fig. 6-65). Use piston pin removing and installing tool J-9510.

4. Install piston and rod on support, indexing pilot through piston and rod.

5. Place support on arbor press, start pin into position and press on installer until pin pilot bottoms.

6. Remove installer and support assembly from piston and connecting rod assembly.

7. Check piston pin for freedom of movement in piston bore.

PISTON RINGS - REPLACE

1. Remove connecting rod and piston assembly (See "CONNECTING ROD AND PISTON ASSEMBLY - REMOVE AND REPLACE" in this section).

2. Clean carbon, varnish, and gum from piston surfaces, including underside of piston head. Clean ring grooves, and oil holes in oil ring groove, using suitable cleaning tools and solvent.

3. Carefully examine piston for rough or scored bearing surfaces; cracks in skirt or head; cracked, broken, or worn ring lands; scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

4. Inspect bearing shells to see that they are serviceable. Fit of bearings should be checked when engine is being assembled.

5. Inspect cylinder bores for out-of-round or excessive taper. If bores show excessive out-of-round or taper, or if cylinder walls are badly scored, scratched or worn beyond specified limits, the cylinder block should be rebored and new pistons and rings installed.

PISTON RINGS - INSTALL

Two compression rings and one 3-piece oil control ring, all above the piston pin, are used on pistons for both standard and premium fuel engines. The top compression rings are taper faced and also have either a step or a chamfer on the inside diameter of the top side. The top compression ring is chrome plated. The lower compression ring may have a step.

Always install compression rings with the side marked with letters "GM" toward the top of the piston.

New rings are serviced for the standard size pistons, and for .005", .010", .020", and .030" oversize pistons. When selecting rings be sure they match the size of the piston on which they are to be installed, i.e. standard rings for standard pistons, .010" oversize rings for .010" oversize

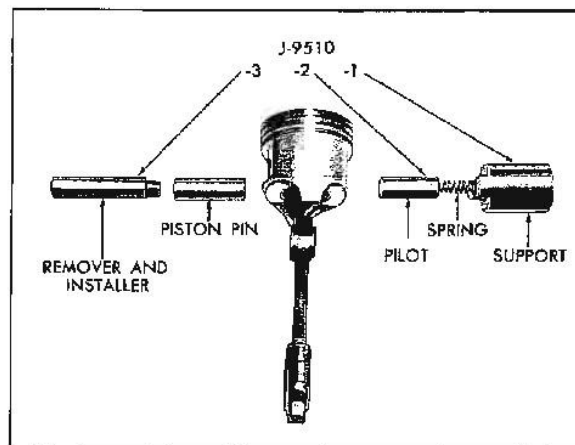


Fig. 6-65 Piston Pin Replacement

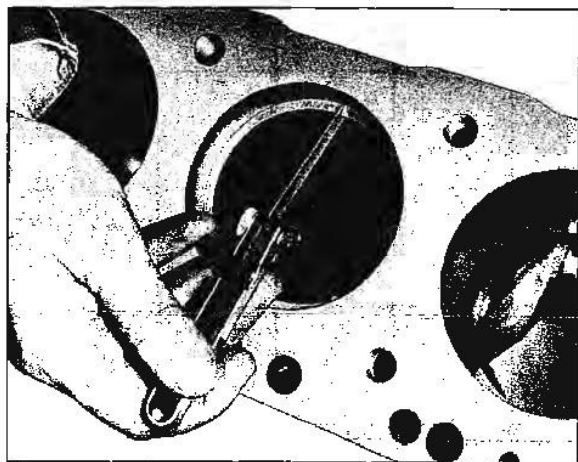


Fig. 6-66 Checking Ring Gap

pistons, etc. Ring gap and side clearance should be checked while installing rings as follows:

1. Check pistons to see that ring grooves and oil return holes have been properly cleaned.
2. Place ring down at the bottom of the ring traveled part of the cylinder bore in which it will be used. Square ring in bore by pushing it into position with head of piston.
3. Measure gap between ends of ring with feeler gauge (Fig. 6-66). Gaps should be as follows:

Upper Compression Ring010" - .020"
Lower Compression Ring010" - .020"
Oil Ring015" - .055"

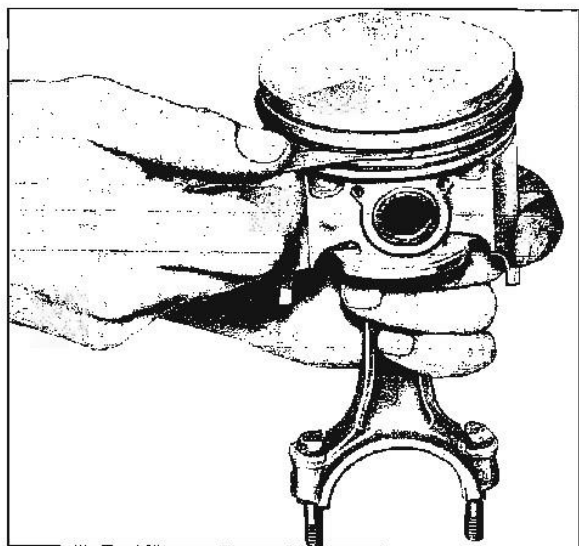


Fig. 6-67 Checking Side Clearance

Incorrect ring gap indicates that wrong size rings are being used. If rings are selected according to the size of the bore (standard .005", oversize, etc.) they should have the proper gap. It should not be necessary to alter ring gap by filing.

4. Install rings on piston, using suitable ring installing tool, such as J-7135, to prevent breakage or fracture of rings, or damage to pistons.

5. Measure side clearance of rings in ring groove (Fig. 6-67) as each ring is installed. Clearance with new pistons and rings should be as follows:

Upper Compression Ring0015" - .0030"
Lower Compression Ring0015" - .0035"
Oil Control Ring0005" - .0055"

If side clearance is excessive, piston should be replaced.

CONNECTING ROD AND PISTON ASSEMBLY—REPLACE

1. Install connecting rod bolt guide set J-5239 on connecting rod bolts (Fig. 6-68).
2. Using a suitable piston ring compressor insert rod and piston assembly into cylinder so that notch in top of piston is facing front of engine (Fig. 6-69).
3. From beneath engine, pull connecting rod with bearing into place against crankpin.
4. Remove guide set J-5239 and install bearing cap with oil groove facing camshaft. Tighten cap nuts to 33 ± 2 lb. ft.
5. Install oil pan.
6. Install cylinder head, intake and exhaust manifold as an assembly.
7. Connect fuel line and vacuum line to carburetor.
8. Install valve lifters.
9. Install coil and push rod covers.

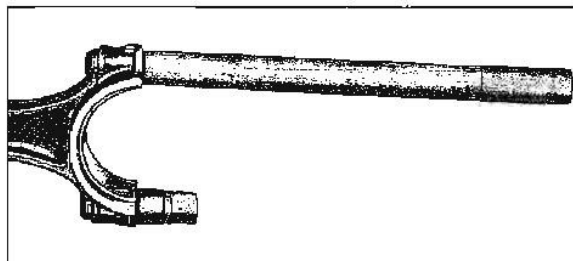


Fig. 6-68 Guide Tool J-5239 Installed

10. Install push rods, move rocker arms into position and tighten rocker arm nuts.

11. Remove engine from stand.

12. Install transmission, clutch (SM) and starter to engine and install complete assembly in vehicle.

13. With lifter on base circle of camshaft, tighten rocker arm nut until all valve train play is removed. Tighten nut one additional turn.

14. Install spark plugs.

15. Install rocker arm cover.

CRANKSHAFT—REMOVE AND REPLACE

REMOVE

1. Remove engine and transmission as an assembly from vehicle.

2. Remove transmission, clutch (SM) and starter from engine.

3. Mount engine on suitable stand.

4. Remove spark plugs.

5. Remove fan and fan pulley.

6. Remove harmonic balancer using tool J-6978.

7. Remove oil pan and oil pump assembly.

8. Remove timing gear cover.

9. Remove crankshaft timing gear with tool J-6978 (Fig. 6-70).

10. Remove connecting rod bearing caps with bearings and identify each for reinstallation.

11. Push connecting rod and piston assemblies away from crankshaft.

12. Remove main bearing caps with bearings and identify for reinstallation.

13. Remove crankshaft.

REPLACE

1. With upper bearings installed position crankshaft in block.

2. Install main bearing caps (with lower bearings), but do not tighten cap bolts.

3. Pull connecting rods (with upper bearings installed) and pistons into place.

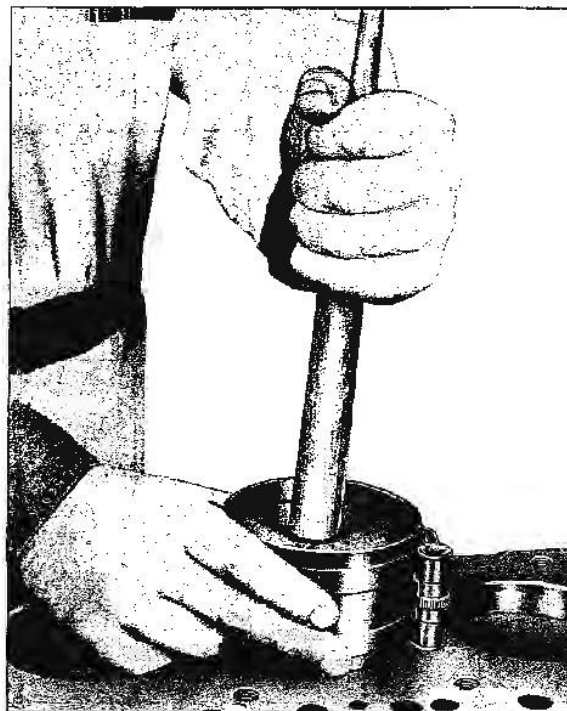


Fig. 6-69 Installing Piston in Cylinder

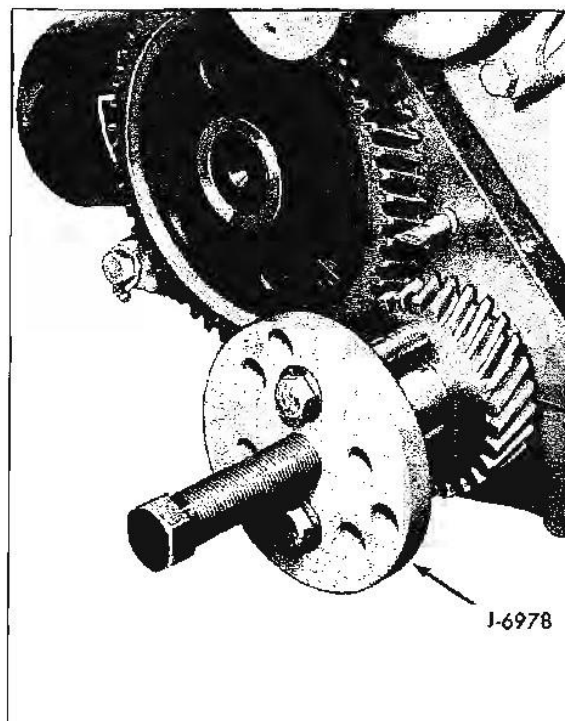


Fig. 6-70 Tool J-6978 Installed for Removing Crankshaft Timing Gear

4. Install rod bearing caps (with bearings), but do not tighten nuts.

5. With rubber mallet hit both ends of crankshaft to center thrust bearing.

6. Tighten main bearing caps 65 ± 5 lb. ft.

7. Tighten connecting rod bearing caps 33 ± 2 lb. ft.

8. Install key from old crankshaft keyway in new crankshaft.

9. Install crankshaft timing gear with installer tool J-5154 (Fig. 6-71).

IMPORTANT: ALIGN TIMING MARKS ON TIMING GEARS BY ROTATING CRANKSHAFT IF NECESSARY.

10. Install timing gear cover using new seal and gaskets.

11. Install oil pump assembly and oil pan using new rear seal in rear main bearing cap and new front seal on timing gear cover. Press front seal tips into holes in timing gear cover.

12. Coat front cover oil seal contact area of balancer with oil and drive balancer into position using balancer installer tool J-8792.

13. Install fan pulley and fan.

14. Install spark plugs.

15. Remove engine from stand.

16. Attach clutch (SM), transmission and starter to engine.

17. Install complete assembly in vehicle.

DISTRIBUTOR LOWER BEARING— REMOVE AND REPLACE

The distributor lower bearing is a bronze bushing pressed into the lower side of the engine block. Its upper inside diameter pilots the distributor shaft

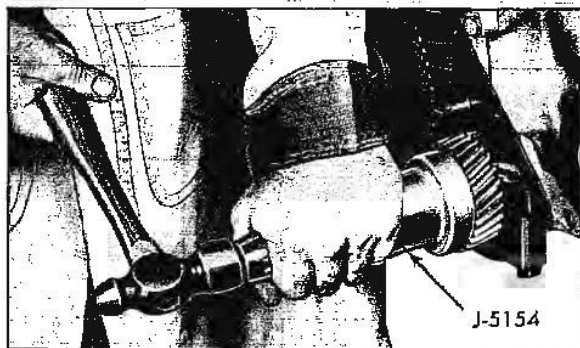


Fig. 6-71 Installing Crankshaft Timing Gear

and the outside diameter extending below the block pilots the oil pump.

The lower bushing will ordinarily require only a clearance or wear check during engine overhaul. When distributor shaft-to-bushing clearance exceeds .0035", the bushing should be replaced as follows with oil pump and distributor removed.

REMOVE

1. Install tool J-9534 into bushing and using a slide hammer, remove the bushing (Fig. 6-72). ...

2. Clean bushing bore in block and check for burrs or damage.

REPLACE

1. Using tool J-9535 with driver-bolt in driver handle or other suitable tool, install new bushing (Fig. 6-73).

FITTED BLOCK ASSEMBLY—REPLACE

Fitted block assembly contains pistons, rings, pins, camshaft bearings, main bearings, oil filter by-pass valve and distributor lower bearing.

DISASSEMBLE

1. Remove engine and transmission as an assembly from vehicle.

2. Remove transmission, clutch (SM) and starter from engine.

3. Install engine in suitable stand.

4. Remove ground strap and dipstick.

5. Disconnect spark plug wires and primary wire at coil.

6. Remove distributor holddown clamp and vacuum advance line and remove distributor and base gasket.

7. Remove spark plugs and coil.

8. Disconnect fuel line at fuel pump and remove fuel pump.

9. Remove push rod cover, retaining screws, their gaskets, covers and cover gaskets.

10. Remove oil pressure sending switch, oil filter and oil filter connector.

11. Disconnect fuel and vacuum lines at carburetor.

12. Remove the lines by sliding them from the retaining clip at the cylinder head water outlet.

13. Remove generator mounting bolts, generator, fan belt and generator mounting bracket.
14. Remove fan and water pump pulley.
15. Remove water pump.
16. Remove harmonic balancer with tool J-6978.
17. Remove timing gear cover.
18. Remove crankshaft timing gear with tool J-6978 and remove crankshaft key.
19. Remove rocker arm cover.
20. Loosen and rotate rocker arms.
21. Remove push rods and valve lifters and store in a stand and suitable box in numerical order.
22. Remove cylinder head, intake and exhaust manifolds as an assembly.
23. Remove two camshaft thrust plate screws through holes in the camshaft gear and remove camshaft through the front of the block.
24. Remove starter.
25. Remove oil pan.
26. Remove oil pump and dipstick tube.
27. Remove crankshaft.
28. Remove all connecting rod and piston assemblies and identify each connecting rod according to cylinder from which it was removed.
29. Remove connecting rods from pistons.
30. Remove old block from stand and mount new block on stand.
31. Remove new piston and pin assemblies from new block and identify each according to cylinder from which it was removed.

This completes disassembly for partial engine replacement. Use new gaskets and pay special attention to torque requirements.

ASSEMBLE

1. Assemble old connecting rods to new piston and pin assemblies according to cylinders from which they were removed.
2. Install connecting rod and piston assemblies in proper cylinders.
3. Install crankshaft.

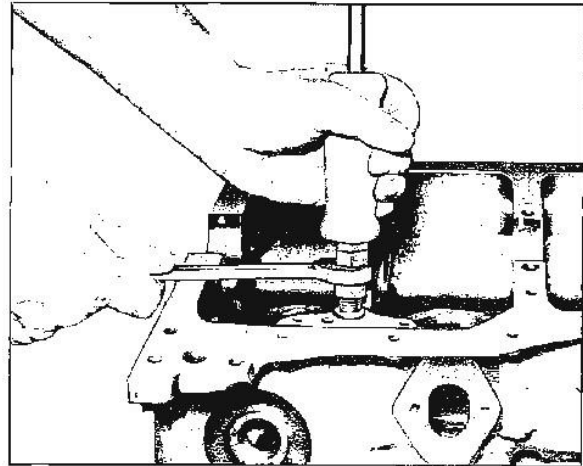


Fig. 6-72 Removing Distributor Lower Bushing

NOTE: New fitted block contains fitted upper main bearings and standard lower main bearings. It is necessary to check crankshaft to bearing clearance with Plastigage when installing the crankshaft. Replace main bearings with under-size bearings if necessary.

4. Install oil pump over distributor lower bearing and bolt in place. Tighten 15 ± 5 lb. ft.
5. Install camshaft with camshaft gear. Attach thrust plate with screws and tighten to $6-7\frac{1}{2}$ lb. ft.
6. Install crankshaft key and install crankshaft timing gear with timing marks aligned.

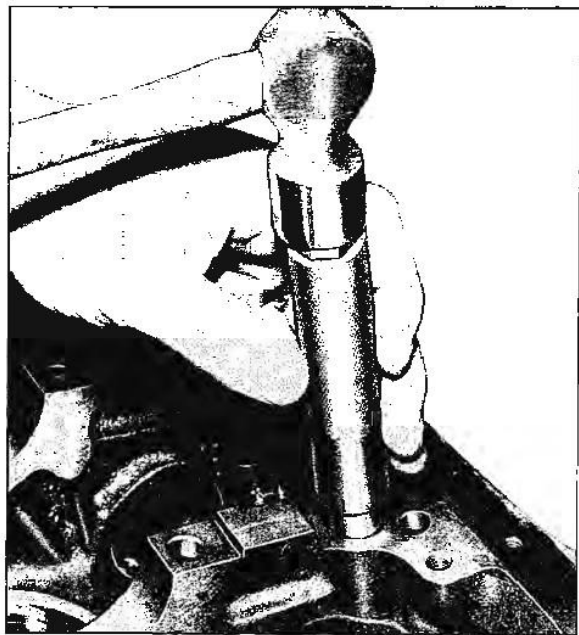


Fig. 6-73 Installing Distributor Lower Bushing

7. Install timing gear cover oil seal in cover with tool J-5154.

8. Install timing gear cover gasket on block with grease and install cover over centering tool J-21742. Install cover screws and torque to 7 ± 1 lb. ft. Remove centering tool.

9. Install harmonic balancer.

10. Install oil pan with new gaskets and seals.

11. Install starter.

12. Install cylinder head, intake and exhaust manifolds as an assembly. Torque cylinder head bolts to 95 ± 5 lb. ft. Use new cylinder head gasket.

13. Install valve lifters, push rods and push rod covers.

14. Install distributor as follows:

Turn crankshaft to firing position of number one cylinder (number one exhaust and intake valve lifters both on base circle of camshaft and timing mark of harmonic balancer indexed with top dead center mark on timing pad). Position new distributor to block gasket on block.

Install distributor so that vacuum diaphragm faces the front of the engine and rotor arm points toward number one cylinder spark plug contact. It will also be necessary to turn oil pump drive shaft so it will index with distributor shaft.

15. With camshaft of base circle for each cylinder, tighten rocker arm nuts until all valve train play is removed. Then tighten nut one additional turn.

16. Install spark plugs, coil, distributor cap and high tension wires.

17. Install water pump.

18. Install generator mounting bracket.

19. Install fan and fan pulley. Tighten bolts 5-6 lb. ft.

20. Install generator and fan belt.

21. Install fuel pump and tighten bolts to 10-15 lb. ft.

22. Install oil pressure sending switch.

23. Install vacuum and fuel lines and connect them to the fuel pump, distributor and carburetor.

24. Install ground strap, dipstick tube and dipstick.

25. Remove engine from stand and install flywheel, clutch (SM), transmission, and starter. Tighten flywheel to crankshaft bolts 50-65 lb. ft.

26. Install engine, clutch (SM) and transmission as an assembly in vehicle.