ENGINE MECHANICAL

CONTENTS OF THIS SECTION—SIX CYLINDER ENGINE

FOR CONTENTS OF V-8 ENGINE SEE PAGE 6-41

Engine Code	Horse-Power*	Trans. Type	Model	Application	Comp. Ratio 8.6	Comp. Ratio 10.5	Carb. 1-bbl.	Carb. 2-bbl.	Carb. 4-bbl.	Valve Spring Single	Valve Spring Two	Valve Spring H.D.	Spec. Lifter	Camshaft Ident. No. 3788506	Camshaft Ident. No. 537441	Distributor 1110293	Distributor 1111039	H.D. Clutch
80Z	140	SM	215	Standard	X		X			X				X		X		
84Z	140	SM	215	Taxi	X		X			X				X		X		X
				Spec. Equip.	X		X			X				X		X		X
				Trail. Prov.	X		X			X				X		X		X
88Y	140	Auto.	215	Standard	X		X			X				X		X		
92X	250	SM	326	Spec. Equip.	X			X			X				X		X	
94X	280	SM	326HO	Spec. Equip.		X			X			X	X		X		X	
96O	250	Auto.	326	Spec. Equip.	X			X			X				X		X	
97O	280	Auto.	326HO	Spec. Equip.		X			X			X			X		X	

Transmission Code
Z-Synchromesh (3 Speed) (215 Engine)
X-Synchromesh (3 Speed) (326 Engine)
Y-Automatic (215 Engine)
O-Automatic (326 Engine)

Fig. 6-1 Tempest Engine Chart

GENERAL DESCRIPTION

The Pontiac Tempest uses a 215 cubic inch, in-line, 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.

Two optional V-8 engines with 326 cubic inch displacement are available on special order. These engines have a 3-23/32" bore and 3-3/4" stroke. The compression ratios are 8.6:1 and 10.5:1.

Seven 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 cyl. 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.

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

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

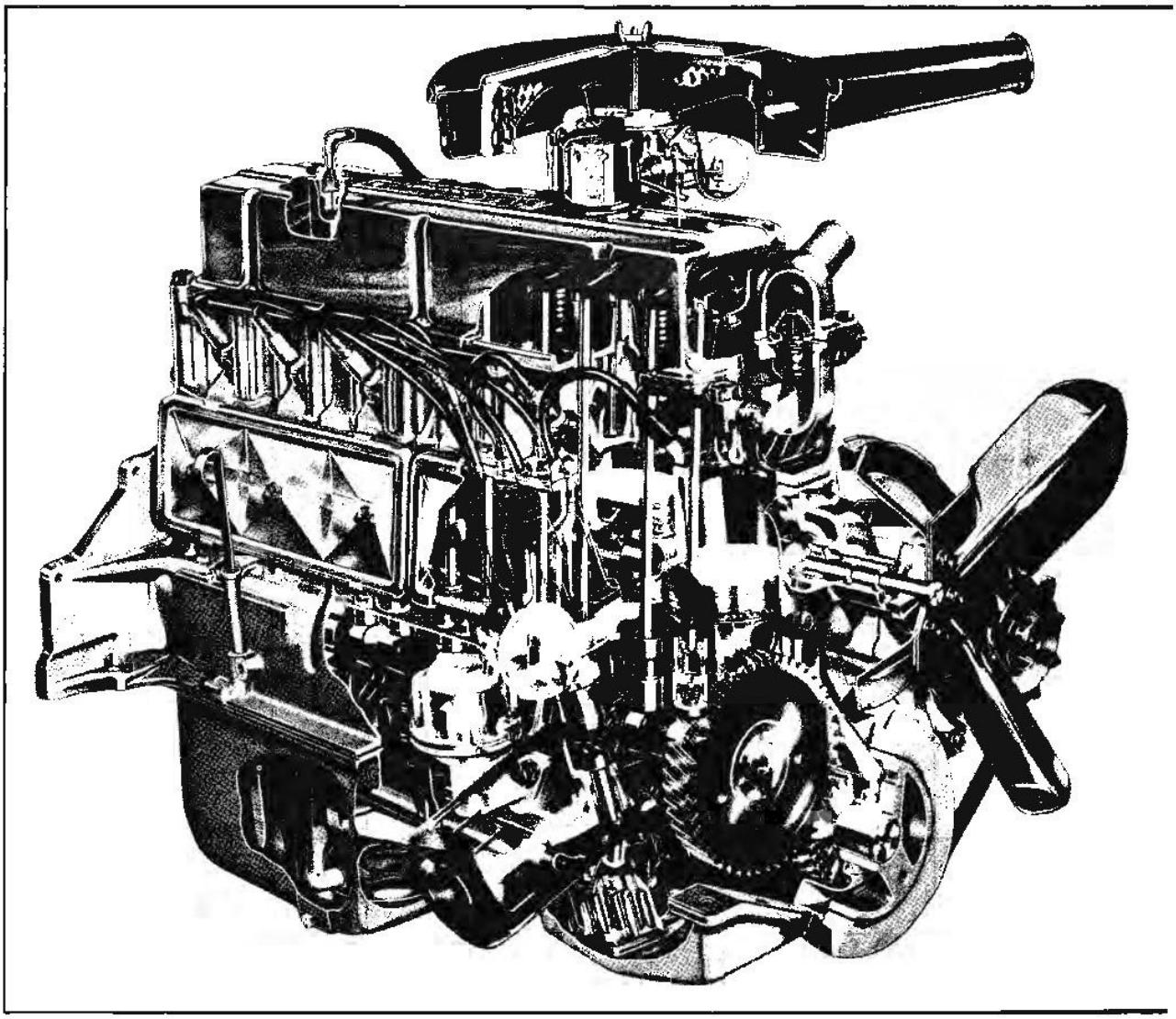

Fig. 6-2 Tempest 215 Cu. In. 6-Cyl. Engine

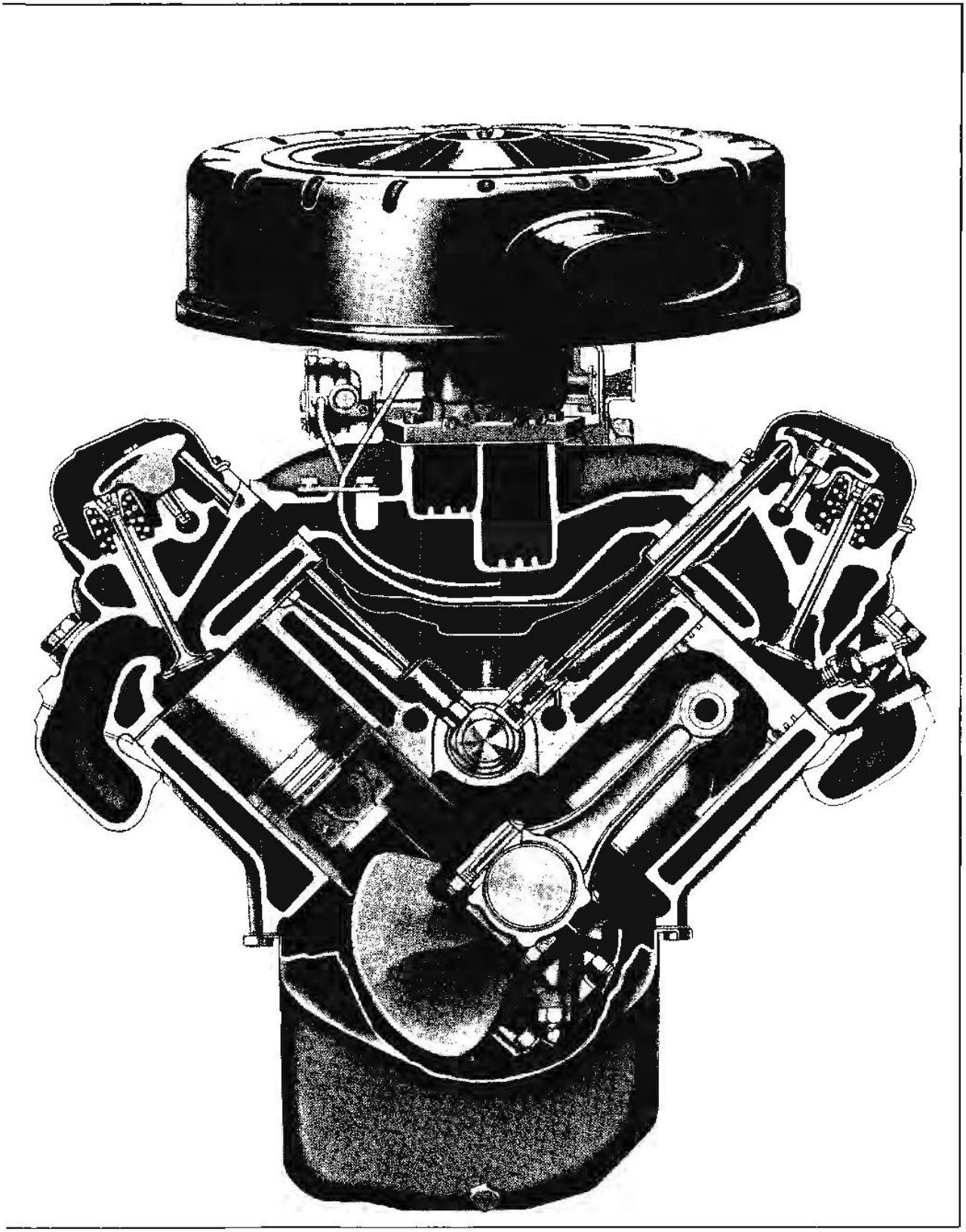

Fig. 6-3 Tempest 326 Cu. In. V-8 Engine

SIX CYLINDER ENGINE

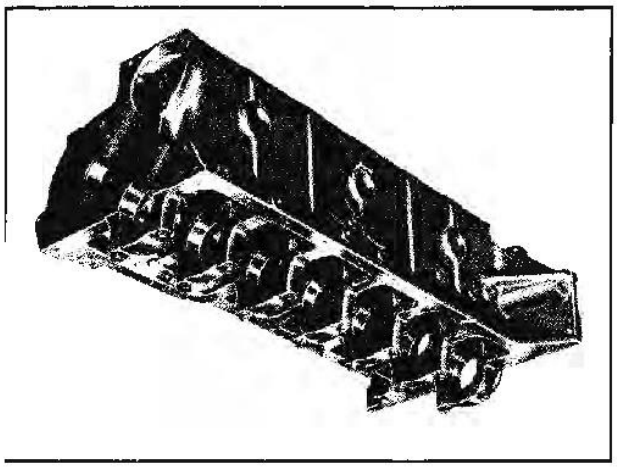

Fig. 6-4 Cylinder Block and Bearing Caps

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.

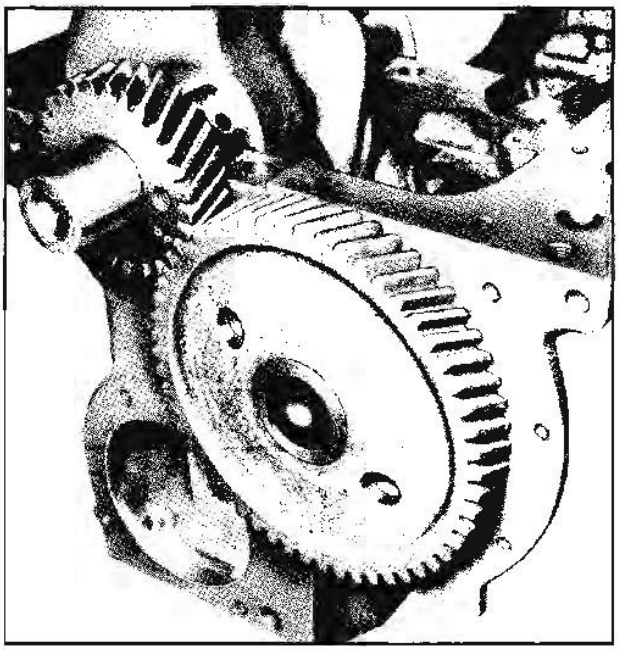

Fig. 6-5 Timing Gears

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.

CRANKSHAFT AND BEARINGS

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

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.

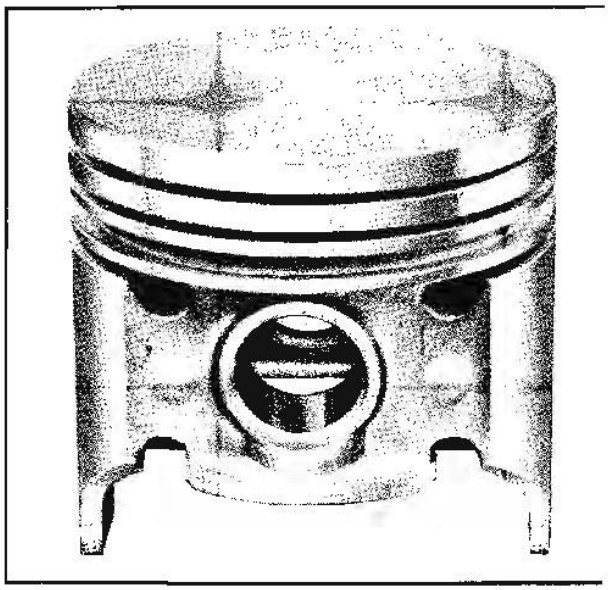

Fig. 6-6 Piston

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 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. 6-5.

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 and 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.

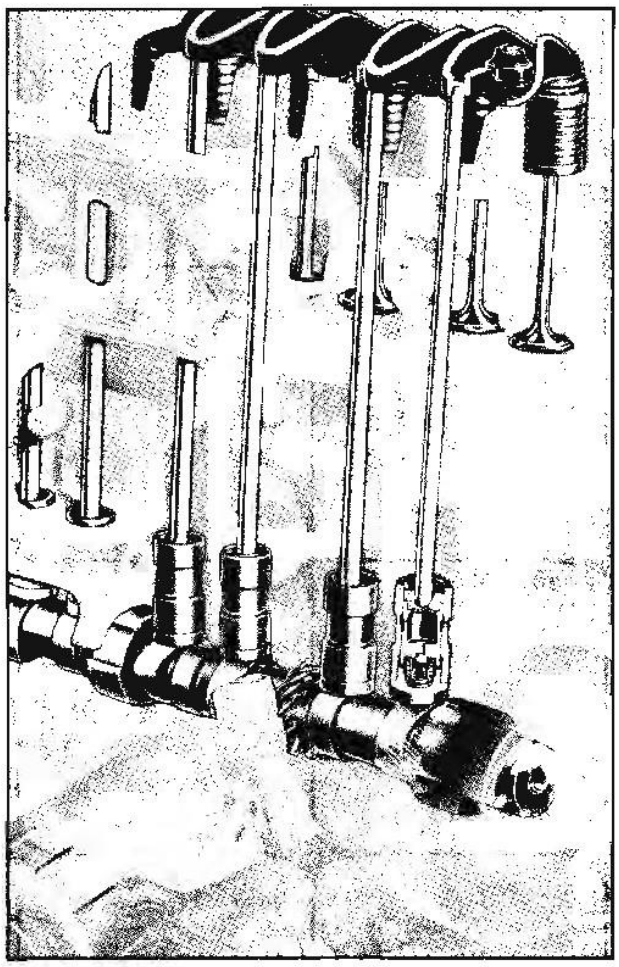

Fig. 6-7 Valve Train

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

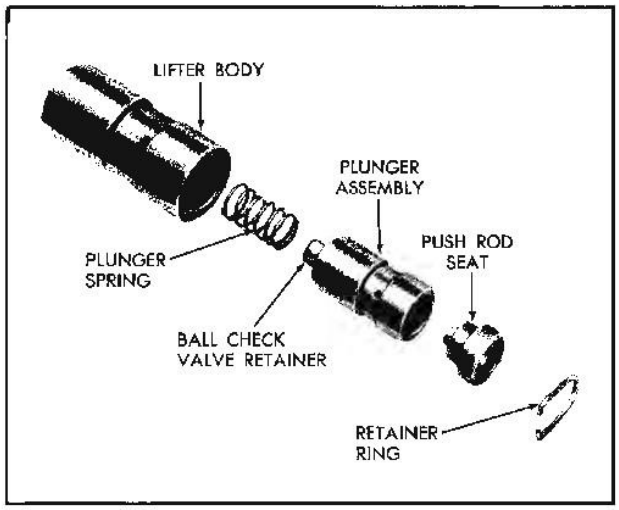

Fig. 6-8 Hydraulic Valve Lifter

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 6-15).

Oil is supplied to the lifter by the cylinder block oil gallery to replace that lost through leak down. 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 (Fig. 6-9)

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. 6-10). 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. 6-10).

EXHAUST SYSTEM

The four-port, cast iron exhaust manifold contains a heat riser valve. This thermostatically controlled

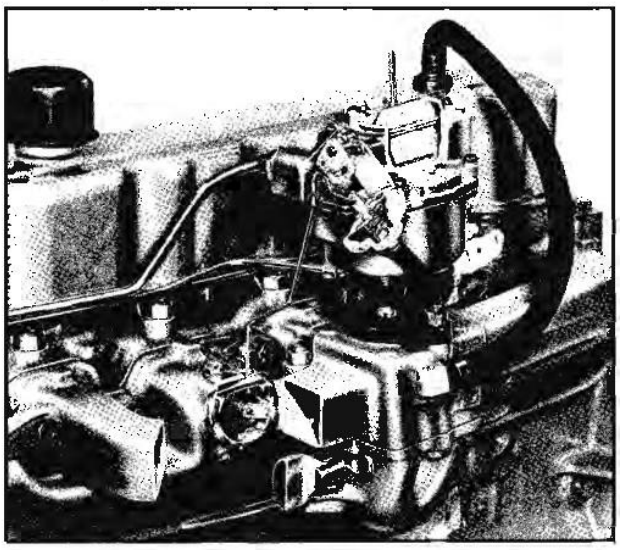

Fig. 6-9 Carburetor and Intake Manifold

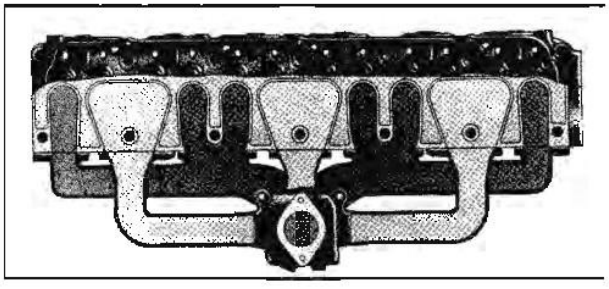

Fig. 6-10 Intake and Exhaust Manifolds

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 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. 6-11) 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°.

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 J-5763 (Fig. 6-12). 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.

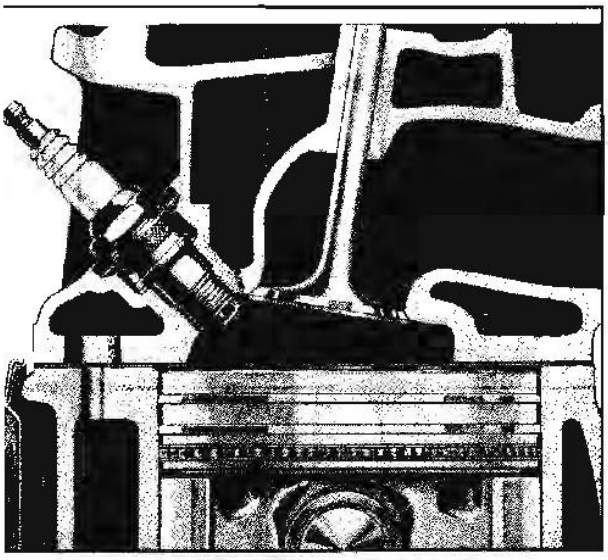

Fig. 6-11 Combustion Chamber

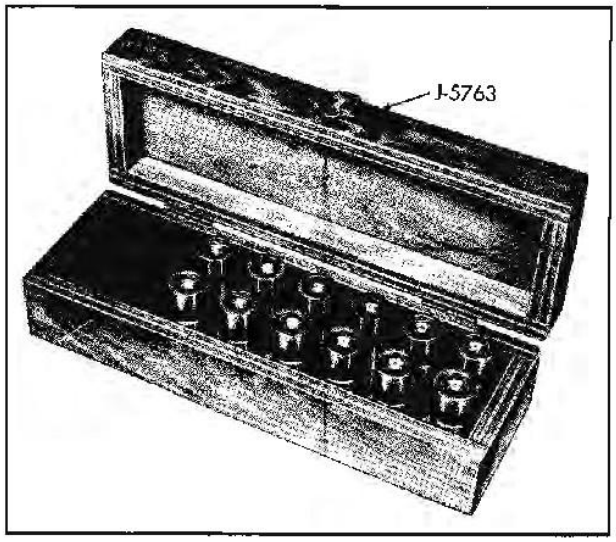

Fig. 6-12 Valve Lifter Storage Box

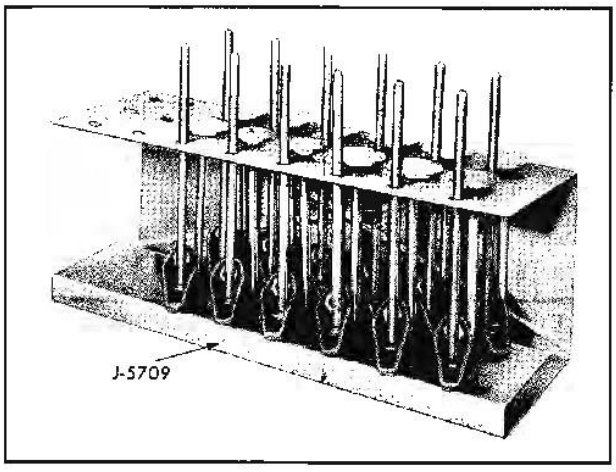

Fig. 6-13 Valve and Valve Train Holding Stand

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 storage box J-5763 and valves, push rods, rocker arms, balls and nuts in holding stand J-5709 (Fig. 6-13), 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-5821 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 ground 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.

PERIODIC SERVICE

There are no periodic services required on the mechanical portions of the engine. Periodic services

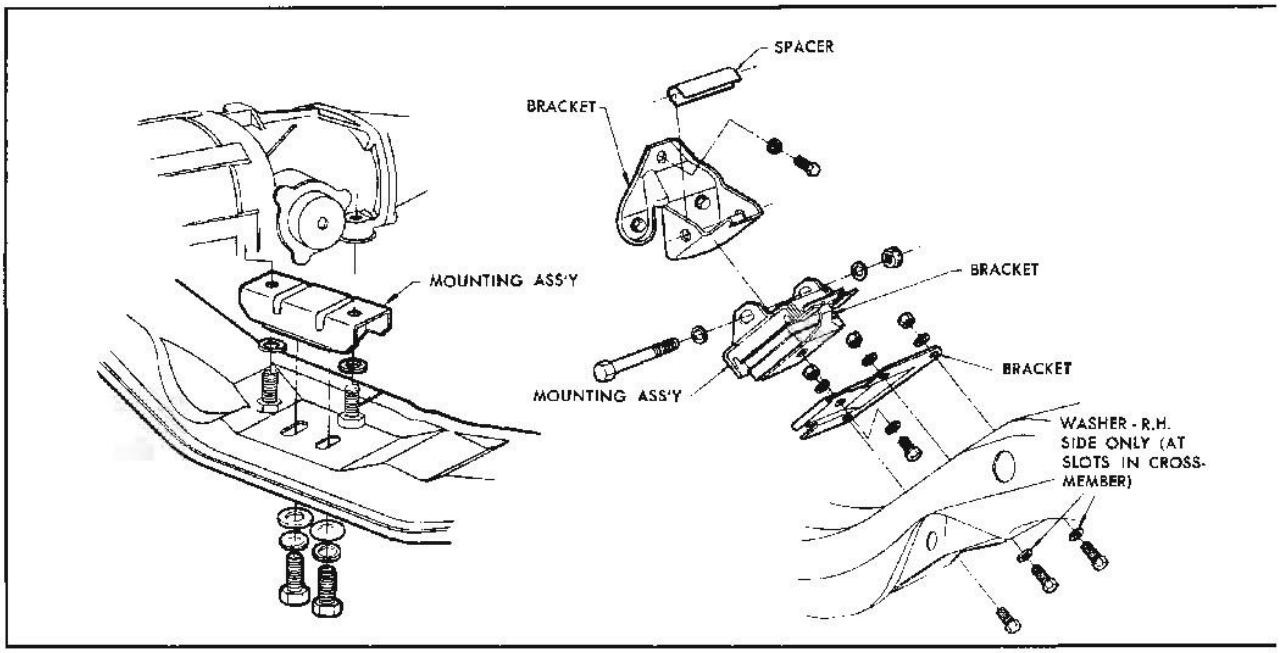

Fig. 6-14 Engine Insulators

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. 6-14)

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 25-35 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 25-35 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 25-35 lb. ft.

5. Lower engine and transmission into position.

6. Install cross member to insulator bolts and tighten to 25-35 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. Scribe alignment marks on hood around hood hinges and remove hood from hinges.

2. Raise vehicle on hoist.

3. Drain cooling system and crankcase.

4. Disconnect radiator hoses and heater hoses at engine attachment.

5. Disconnect battery cables at battery.

6. Remove radiator.

7. Remove air cleaner.

8. Disconnect coil, starter and generator wires, engine-to-body ground strap, oil pressure and engine temperature sender wires.

9. Disconnect gas tank line at fuel pump.

10. Disconnect accelerator control linkage at fire wall.

11. Disconnect exhaust pipe from manifold.

12. 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.

13. Remove drive shaft by removing rear universal joint U-bolts. Plug the end of the transmission extension housing.

14. Remove two lower transmission mounting bolts.

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

16. Loosen engine front mounting bolts.

17. Raise engine slightly and remove front engine mounting bolts, nuts and washers.

18. Free the transmission rear mounting from cross member.

19. 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.

2. Align and install rear mount bolts.

3. Install engine front mount bolts and remove lifting tool from engine.

4. Install drive shaft and U-bolts at rear U-joint.

5. 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.

ON AUTOMATIC TRANSMISSION MODELS:

a. Connect transmission control rod and throttle valve rod at transmission and adjust as outlined in TRANSMISSION SECTION.

b. Install transmission filler tube and dipstick.

6. Connect carburetor linkage.

7. Connect speedometer cable to driven gear at transmission.

8. Check transmission lubricant level. Fill if necessary.

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

10. Connect wire harness to temperature sending unit, oil pressure sending unit and coil primary terminal. Attach armature and field wires to generator.

11. Attach fuel line to fuel pump.

12. Attach wires and battery cable to starter solenoid.

13. Install radiator assembly.

14. Refill radiator and crankcase.

15. 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 bol

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 25-30 lb. ft. and end bolts to 15-20 lb. ft. (Fig. 6-15).

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.

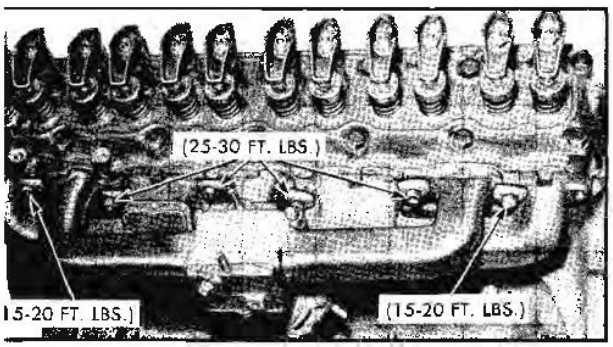

Fig. 6-15 Manifold Attaching Points

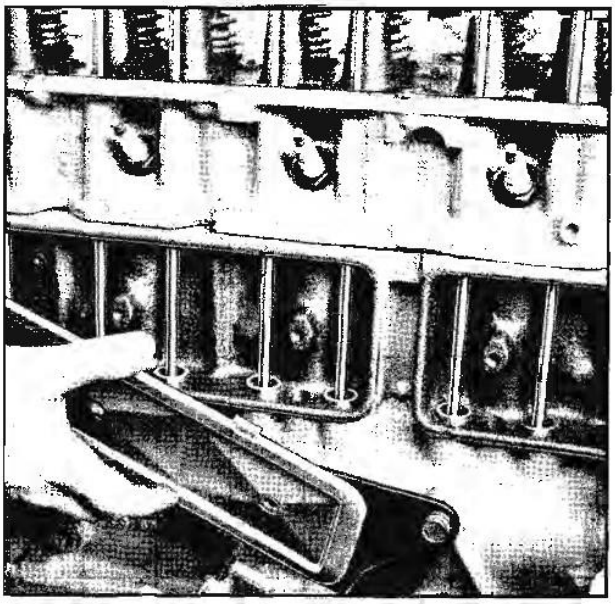

Fig. 6-16 Removing Push Rod Covers

VALVE SPRINGS, SHIELDS 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.

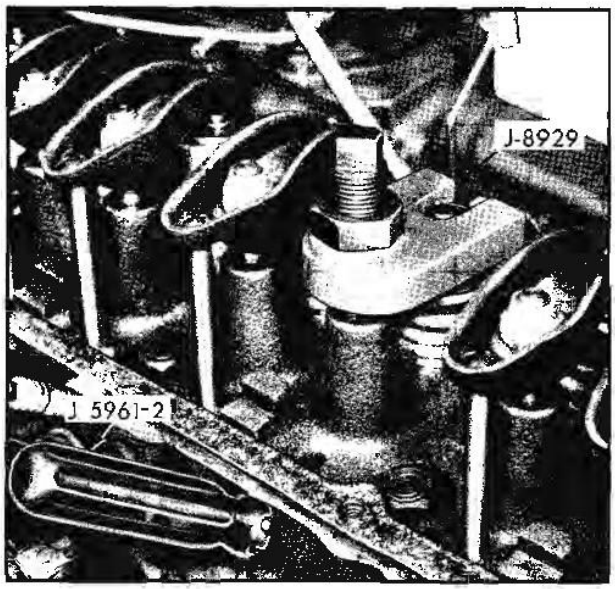

Fig. 6-17 Valve Spring Compressor Installed

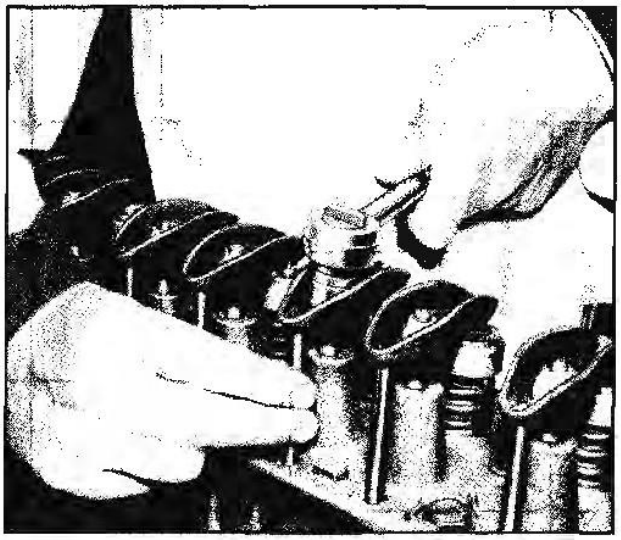

Fig. 6-18 Adjusting Valve Lifter Plunger Travel

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. 6-17). 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. 6-18).

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. 6-19) and store so that each push rod may be installed in original location.

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

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.

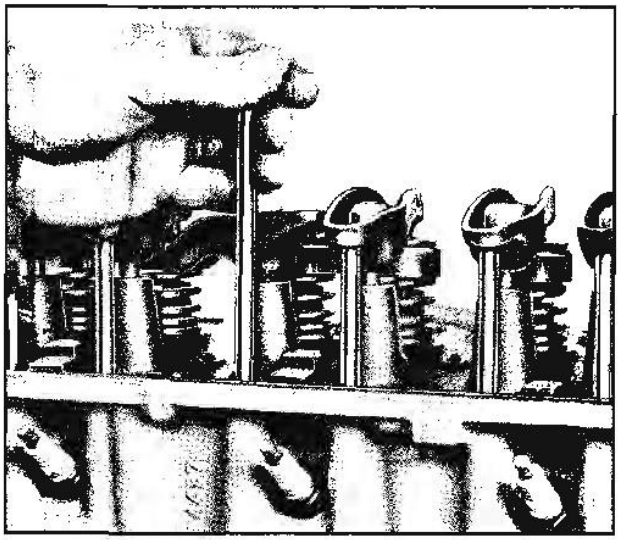

Fig. 6-19 Removing Push Rod

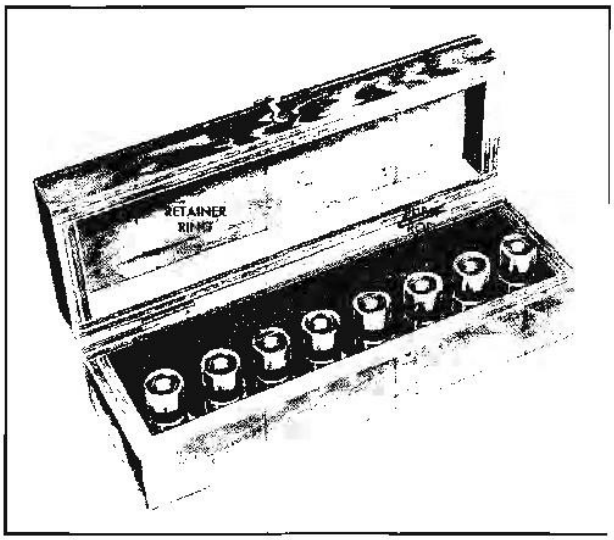

Fig. 6-20 Valve Lifter Storage Box

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.

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. 6-18).

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.

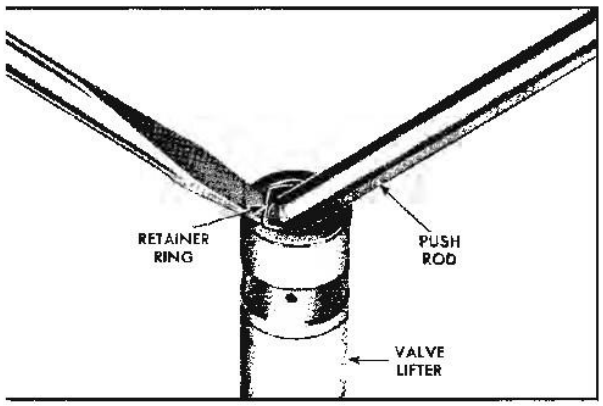

Fig. 6-21 Removing Push Rod Seat Retaining Ring

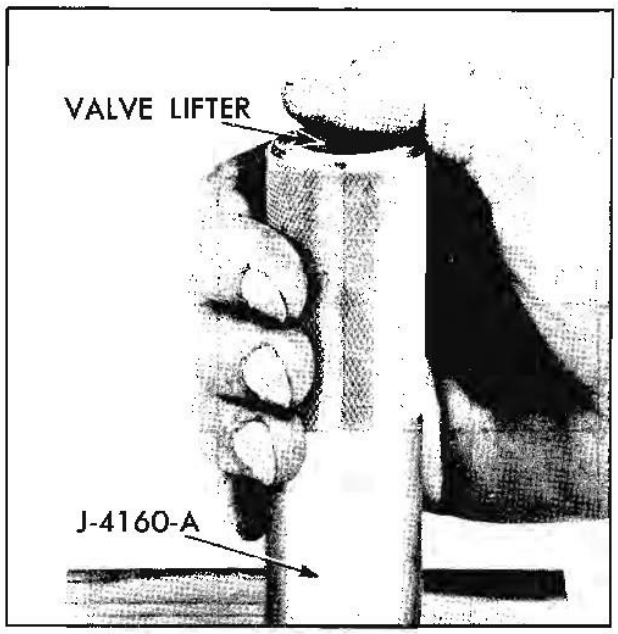

Fig. 6-22 Removing Stuck Plunger

Lifters should at all times be stored in a covered box (Fig. 6-20) 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. 6-21). 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. 6-22) 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.

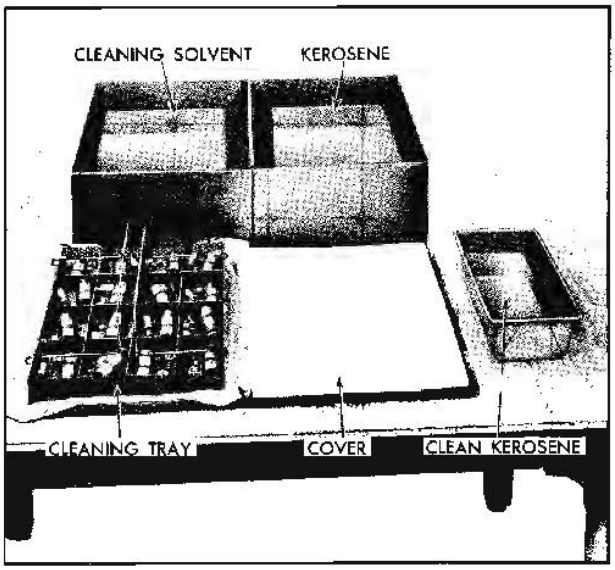

Fig. 6-23 Lifter Wash Tank and Tray

3. Drain oil out of lifter body and place all valve lifter parts in separate compartment of tray from wash tank J-5821 (Fig. 6-23).

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 brie period.

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

5. Wipe out tank cover and place tray of parts o cover in front of tank. A shop towel under tray an clean paper on remainder of cover will ensur 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 o body with a hard wiping action. A bristle brush ma 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 i each lifter is inspected and assembled after cleaning, but before proceeding to the next lifter.

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

8. Inspect lifter plunger. Using a magnifying glass, inspect the check ball seat for defects. Inspec outer surface of plunger for scratches or scores Small score marks with a rough, satiny finish wil cause the plunger to seize when hot but operat normally when cool. Defects in check ball seat o scores or scratches on outer surface of plunge which may be felt with a fingernail are causes fo replacing the lifter assembly. This rule does no apply to the slight edge which may sometimes b present where the lower end of plunger extends belo the ground inner surface of the body. This edge i not detrimental unless it is sharp or burred.

A blackened appearance is not a defective condi tion. Sometimes the discoloration serves to highlig slight grinder chatter marks and give the outer sur face of plunger a ridged or fluted appearance. Thi

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 6-24 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.

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.

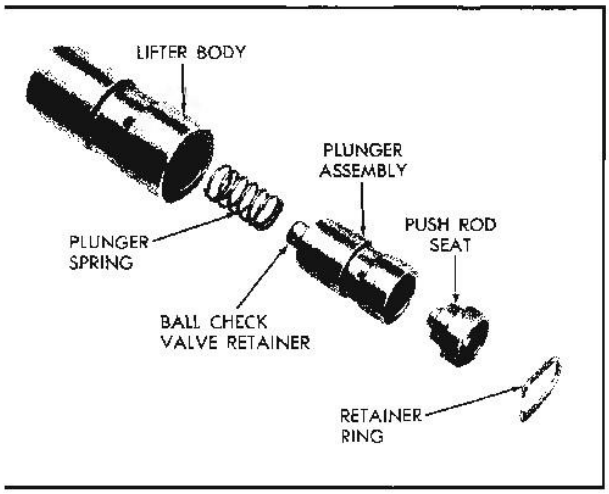

Fig. 6-24 Exploded View - Valve Lifter

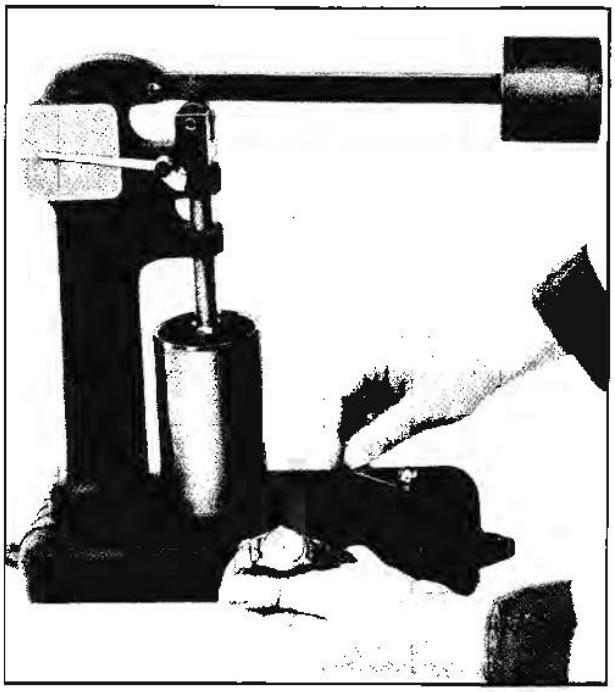

Fig. 6-25 Testing Leak Down Rate

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 lead down tester J-5790 (Fig. 6-25) 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.

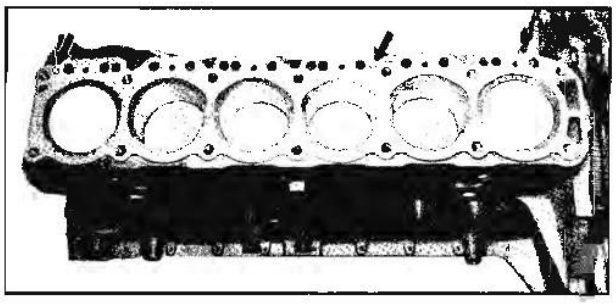

Fig. 6-26 Installing Head Gasket

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. 6-25). 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 manifolds 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.

REPLACE

1. Place a new cylinder head gasket in position over dowel pins in cylinder block (Fig. 6-26).

2. Carefully guide cylinder head into place over dowel pins and gasket (Fig. 6-27).

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 90 to 95 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. 6-18).

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.

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

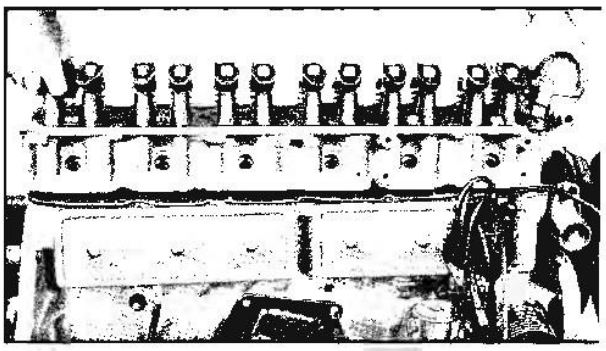

Fig. 6-27 Installing Cylinder Head

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. 6-28.

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 lbs. 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 cylinder head.

2. Remove rocker arm.

3. File two slots 3/32" to 1/8" deep on opposite sides or rocker arm stud (Fig. 6-29). Bottom of slots should be 1/2" from top of stud hole (Fig. 6-29).

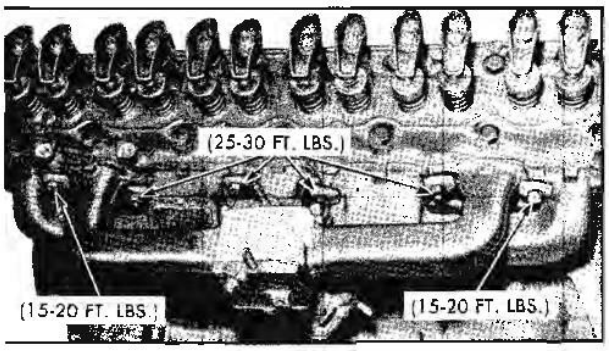

Fig. 6-28 Manifold Attaching Points

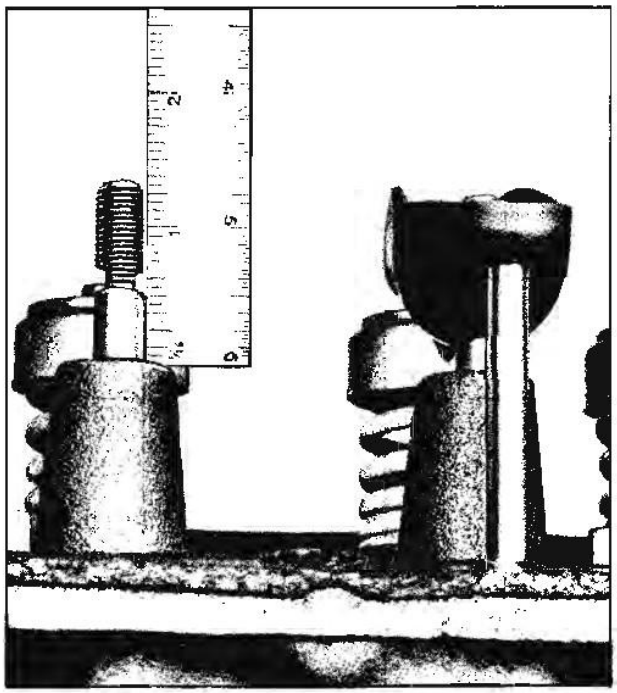

Fig. 6-29 Slots for Removing Rocker Arm Stud

4. Place washer J-6392-3 at bottom of rocker arm stud (Fig. 6-30).

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

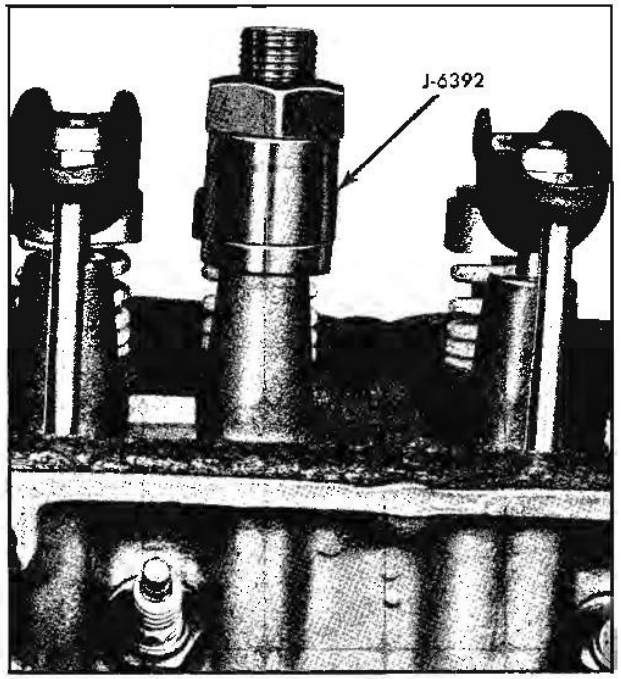

Fig. 6-30 Tool Installation for Removing Rocker Arm Stud

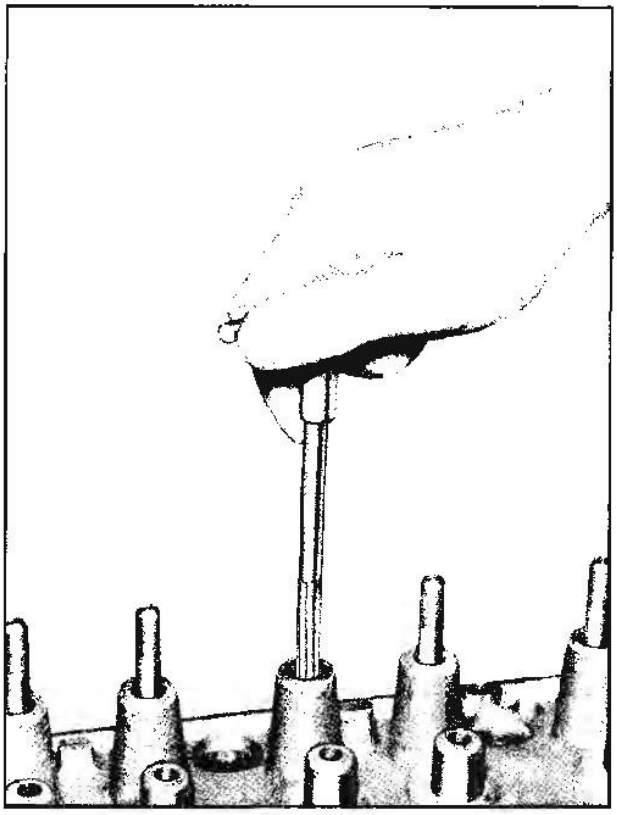

Fig. 6-31 Reaming Rocker Arm Stud Hole

6. Place spacer J-6392-2 over stud remover J-6392-1 (Fig. 6-30).

7. Thread 7/8" standard nut on stud remover and turn nut until stud is out of cylinder head (Fig. 6-30).

8. Ream rocker arm stud hole if oversize stud is to be used (Fig. 6-31).

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. 6-32).

3. Install cylinder head.

4. Install push rod and rocker arm.

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

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

7. Install spark plug.

8. Install rocker arm cover.

CYLINDER HEAD AND VALVES—RECONDITION

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

DISASSEMBLE

1. Remove the cylinder head and gasket as pre viously described. Place cylinder head on two block of wood to prevent damage.

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

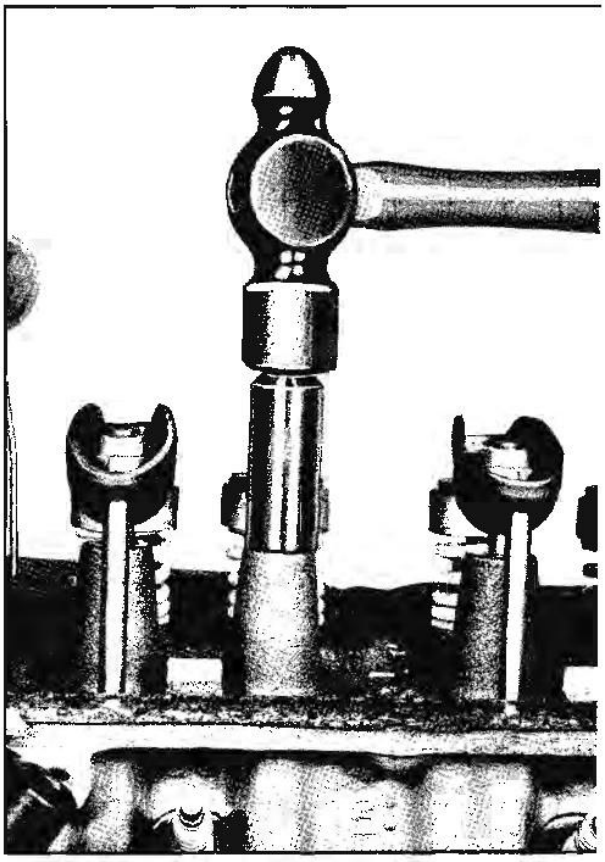

Fig. 6-32 Installing New Rocker Arm Stud

3. Using tool J-8929, compress the valve springs and remove valve keys. Remove spring caps, spring seats, oil seals, springs and spring dampers (Fig. 6-33).

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.

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

CLEAN AND INSPECT

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

2. Thoroughly clean the valve guides using tool J-8101 (Fig. 6-34).

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.

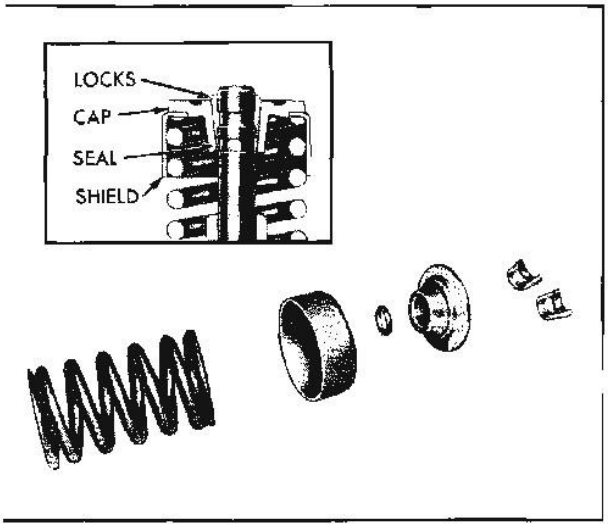

Fig. 6-33 Upper Valve Train Parts

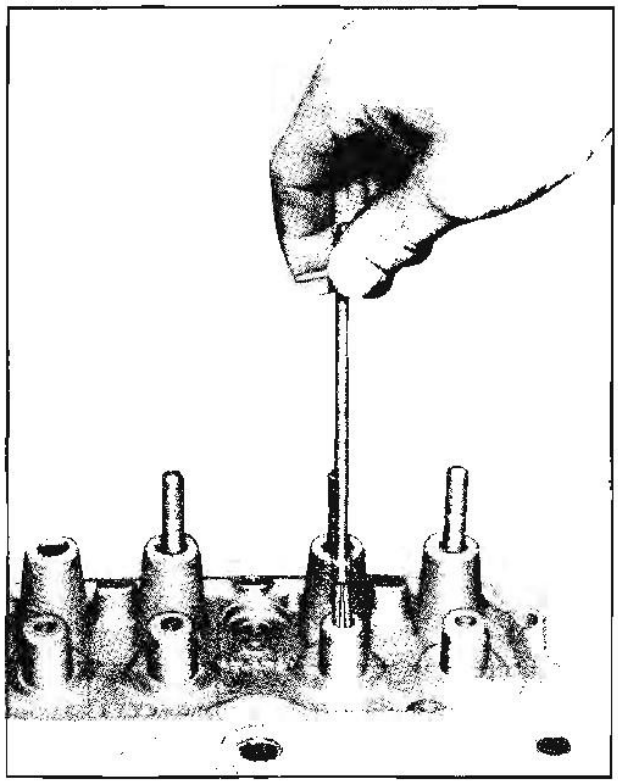

Fig. 6-34 Cleaning Valve Guide Bore

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

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. 6-35).

4. Check valve spring tension with suitable tester (Fig. 6-36).

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.

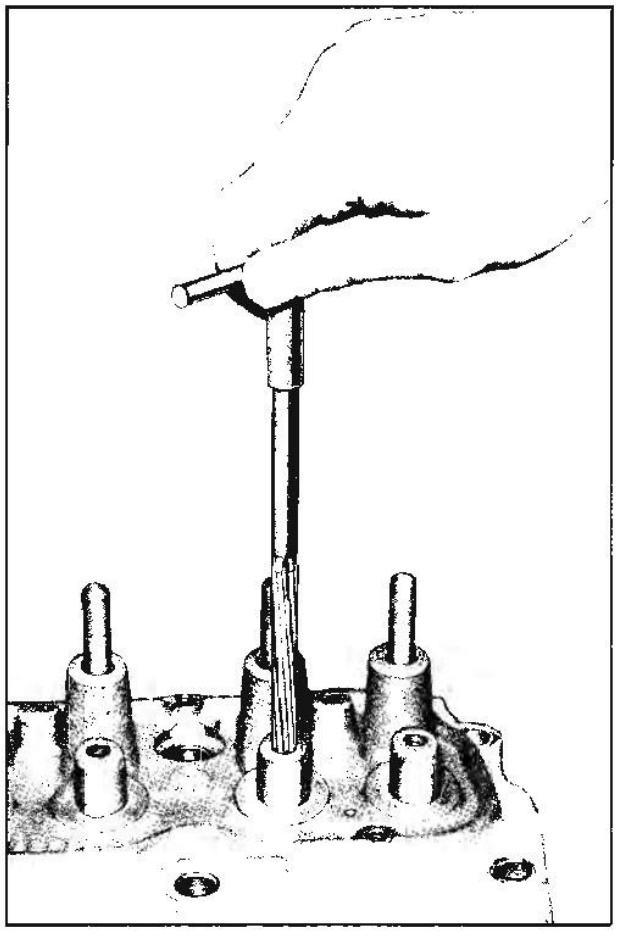

Fig. 6-35 Reaming Valve Guide Bore

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

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. 6-37).

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).

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.

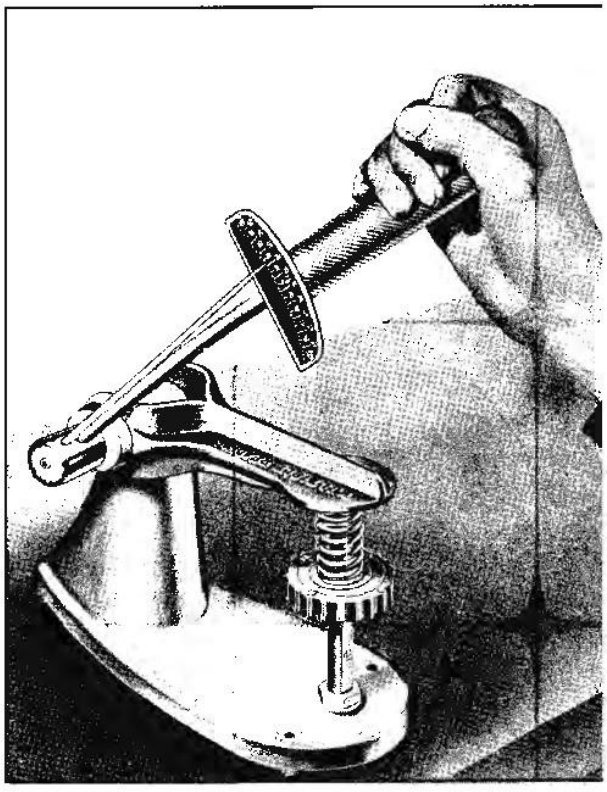

Fig. 6-36 Checking Valve Spring Tension

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 any 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. 6-38).

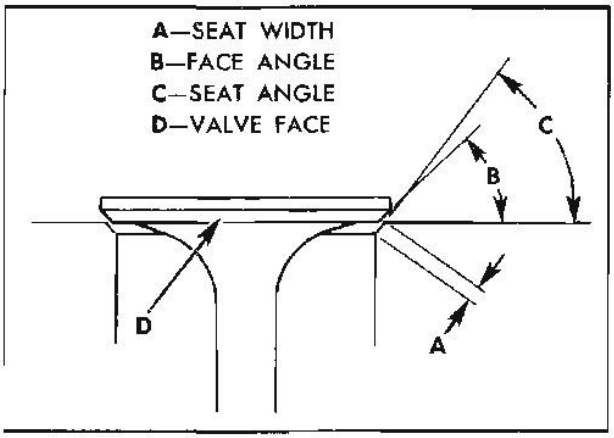

Fig. 6-37 Valve Seat and Face Angles

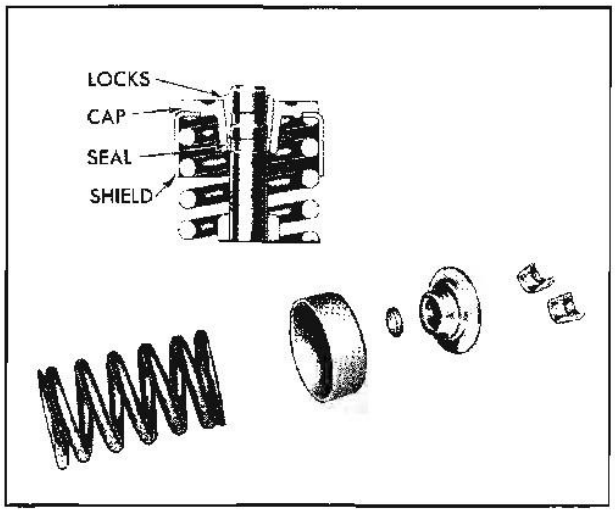

Fig. 6-38 Valve Installation

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 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. 6-39).

HARMONIC BALANCER—REMOVE AND REPLACE

REMOVE

1. Drain radiator and disconnect radiator hoses at radiator.

2. Remove fan and water pump pulley.

3. Remove radiator core and fan belt.

Fig. 6-39 Checking Valve Spring Installed Height

4. Install tool J-6978 to balancer and turn puller screw to remove balancer (Fig. 6-40). Then remove tool from balancer.

REPLACE

1. Coat front cover oil seal contact area of balancer with engine oil.

2. Attach balancer installer tool X-8792 (Fig. 6-41) to balancer (Fig. 6-42).

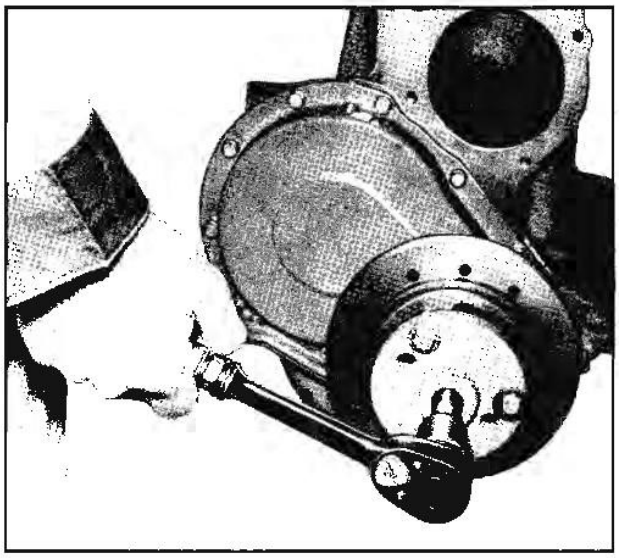

Fig. 6-40 Removing Harmonic Balancer

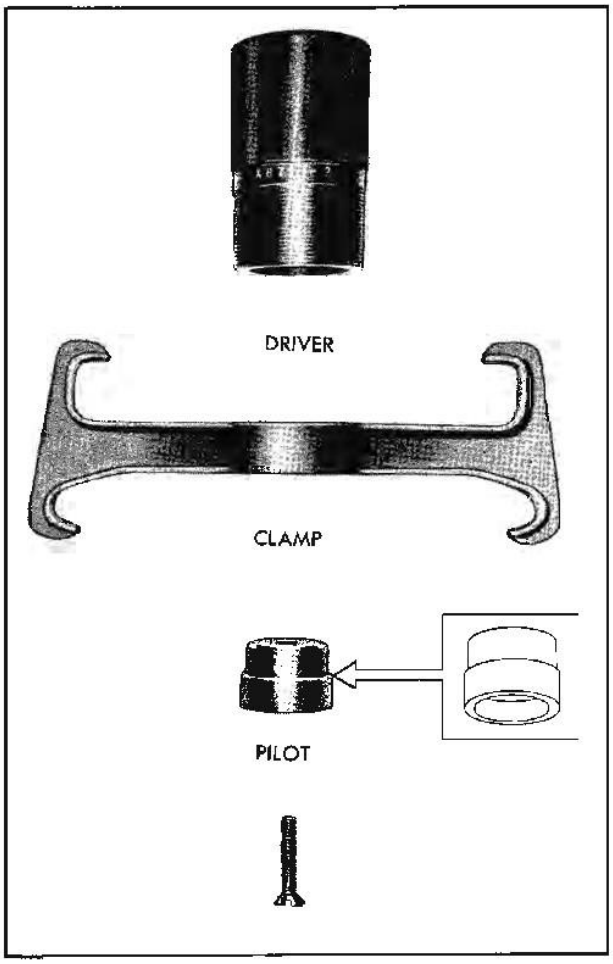

Fig. 6-41 Harmonic Balancer Installer

3. Position balancer on crankshaft and drive into position until it bottoms against crankshaft gear. Remove installer tool (Fig. 6-42).

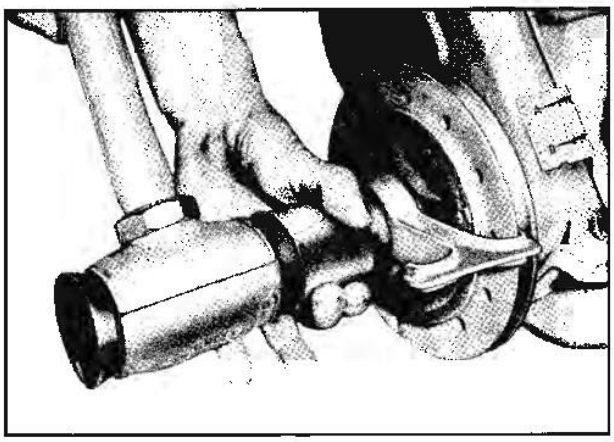

Fig. 6-42 Installing Harmonic Balancer

4. Install water pump pulley, fan and fan belt and adjust belt tension.

5. Install radiator core and connect radiator hoses.

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 cross member.

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. 6-43).

OIL NOZZLE - REPLACE

1. Remove nozzle with pliers (Fig. 6-44).

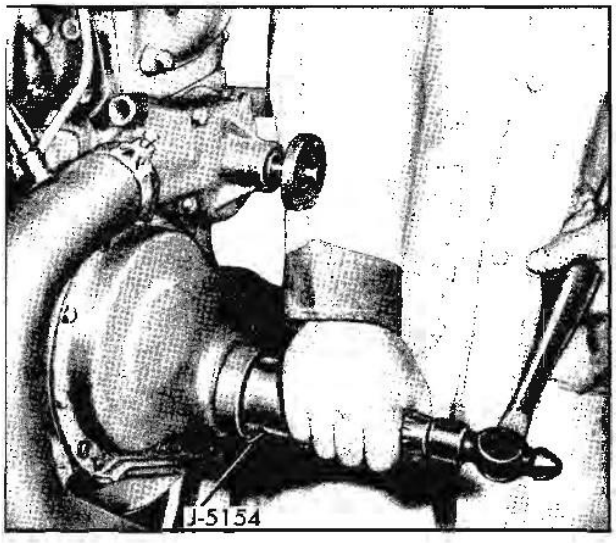

Fig. 6-43 Installing Timing Cover Oil Seal

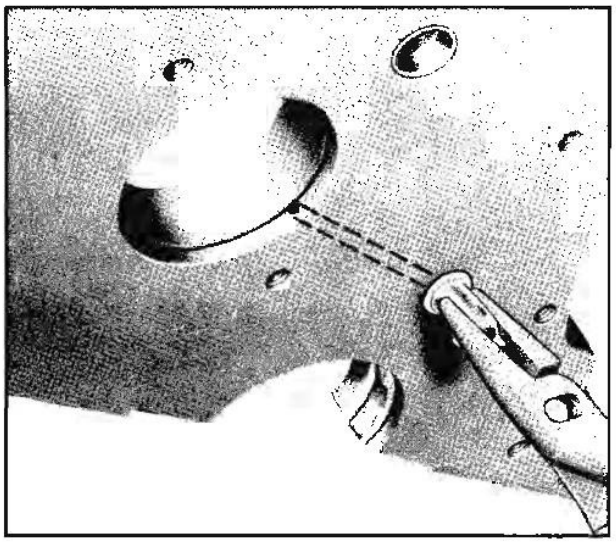

Fig. 6-44 Removing Timing Gear Oil Nozzle

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-0966 over end of crankshaft.

3. Coat the gasket with light grease and stick a new cover gasket in position on block with light grease.

4. Install cover over centering tool (Fig. 6-45) and install cover screws. Torque screws to 6 to 8 ft. lbs. Remove centering tool.

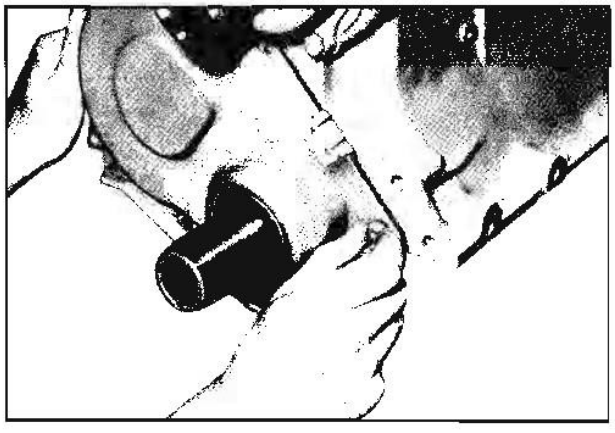

Fig. 6-45 Installing Timing Gear Cover

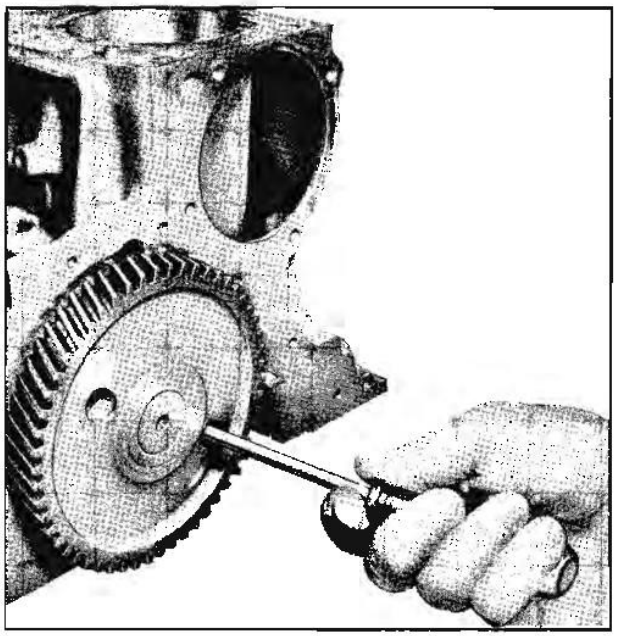

Fig. 6-46 Removing Camshaft Thrust Plate Screws

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.

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.

9. Remove the two camshaft thrust plate screws by working through holes in the camshaft gear (Fig. 6-46).

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. 6-47).

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

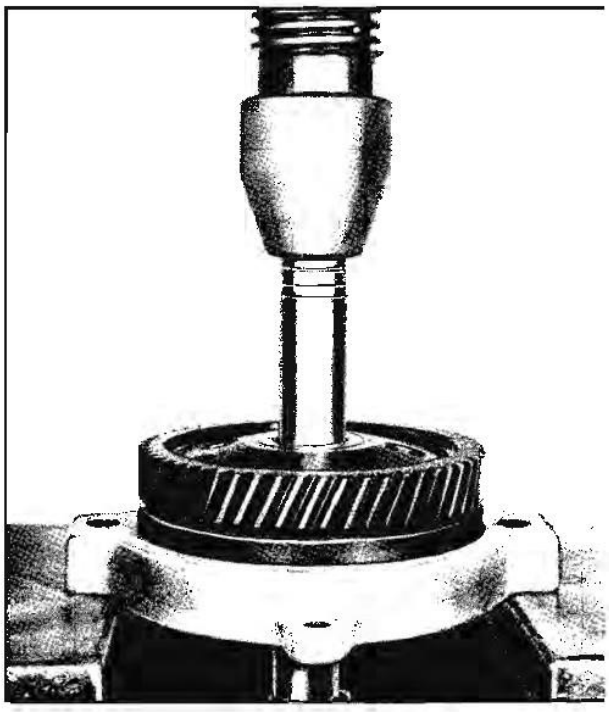

Fig. 6-47 Removing Camshaft Timing Gear

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. 6-48). 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. 6-49). 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.

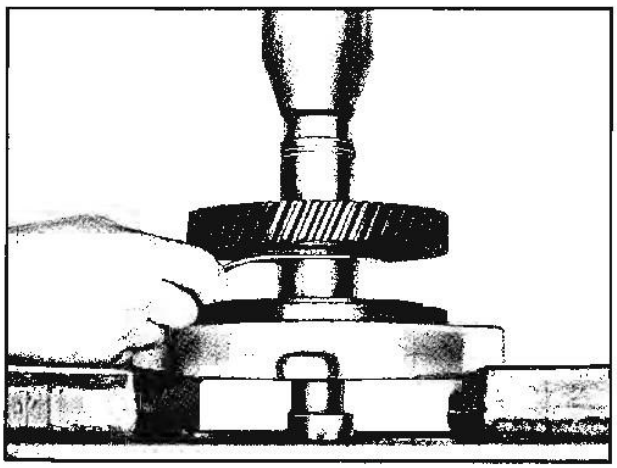

Fig. 6-48 Installing Camshaft Timing Gear and Checking Thrust Plate End Clearance

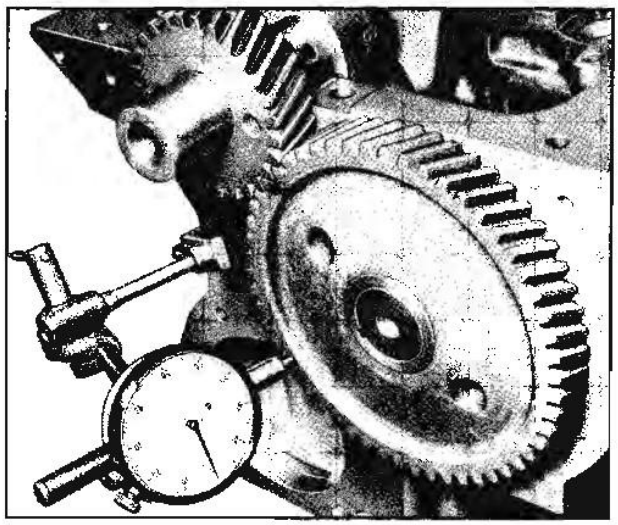

Fig. 6-49 Checking Camshaft Gear Runout

5. Check the backlash between the timing gear teeth with a dial indicator (Fig. 6-50). The backlash should not be less than .004" nor more than .006".

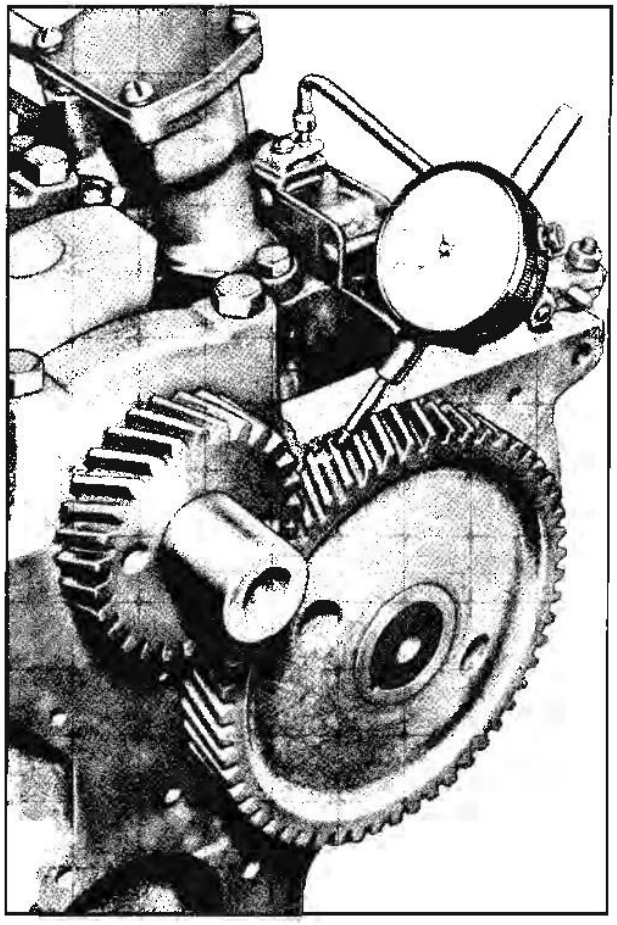

Fig. 6-50 Checking Camshaft Gear Backlash

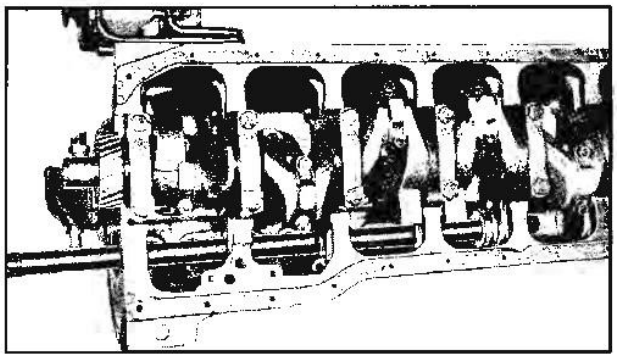

Fig. 6-51 Removing Center Camshaft Bearings

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.

9. Install valve lifters and push rods. Install side cover with a new gasket. Attach coil and wires. Then 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 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 one 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. 6-51).

REPLACE

1. Install each new bearing on tool.

2. Install bearings by reversing removal procedure.

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.

EPLACE

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 ips into holes provided in cover.

4. Install side gaskets on cylinder block using rease as a retainer. (Side gasket tabs index into otches of front seal -- Fig. 6-52).

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 ehicle. (See "Engine - Remove and Install").

IL PUMP—REMOVE AND REPLACE

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

2. Remove two flange mounting bolts and nut from longated number 6 main bearing cap bolt and remove pump and screen as an assembly (Fig. 6-53).

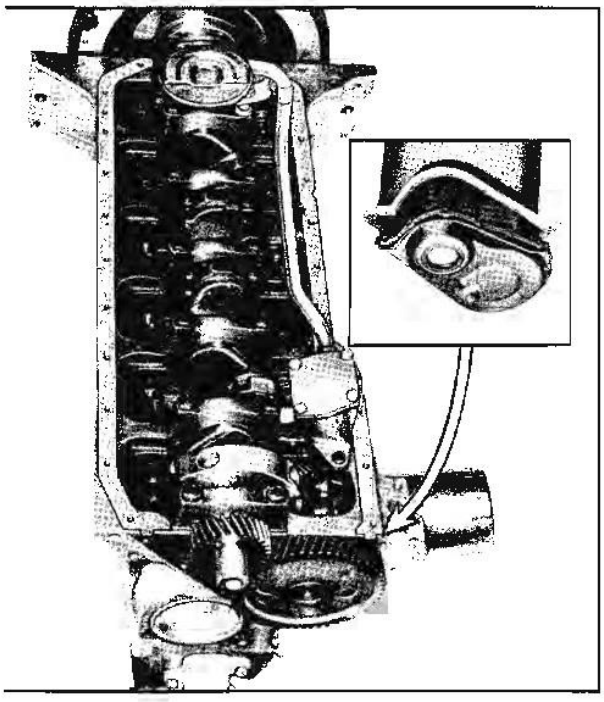

Fig. 6-52 Oil Pan Gaskets

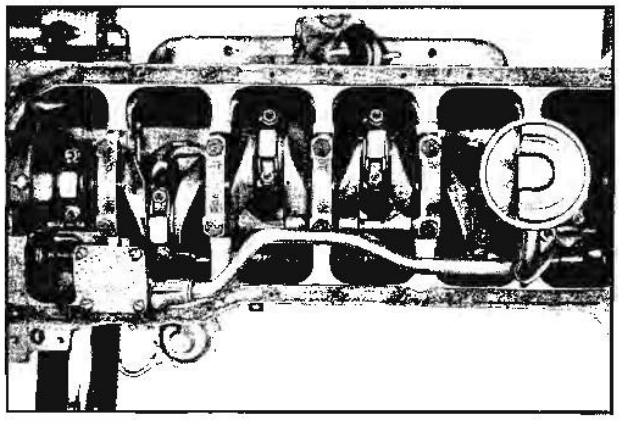

Fig. 6-53 Oil Pump Installed

3. Remove 4 cover attaching screws, cover, gasket, idler gear and drive gear and shaft (Fig. 6-54).

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.

INSPECT

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

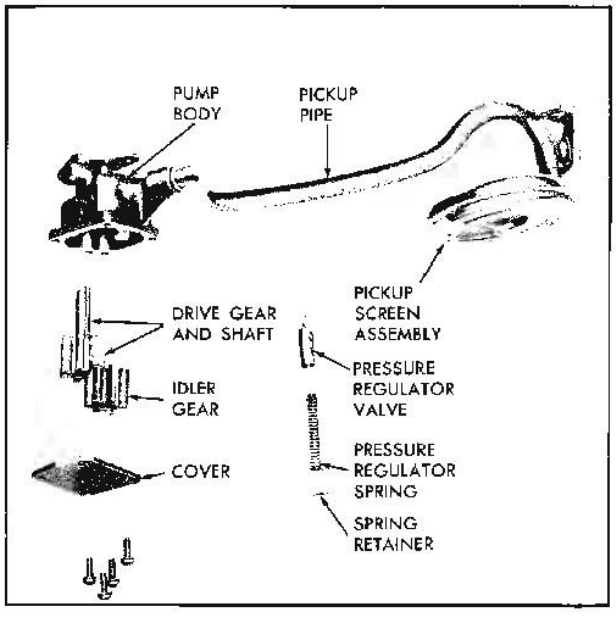

Fig. 6-54 Oil Pump - Exploded View

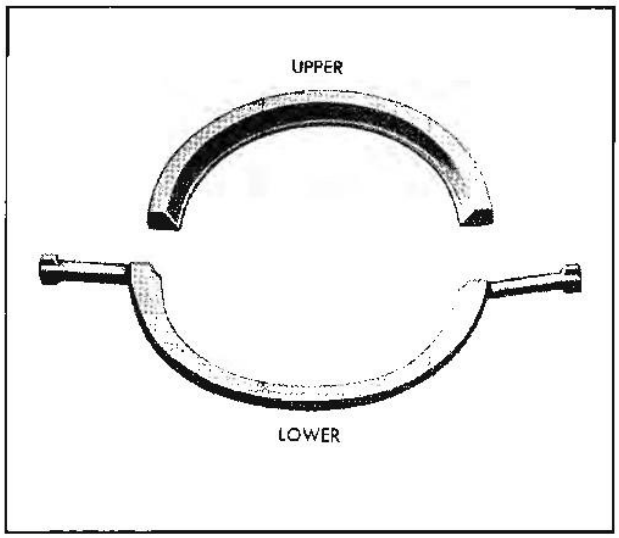

Fig. 6-55 Rear Main Bearing Oil Seal

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 wi distributor tang, then install oil pump to block pos tioning flange over distributor lower bushing. U no gasket. Tighten bolts 10-20 lb. ft.

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

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

REAR MAIN BEARING OIL SEAL— REMOVE AND REPLACE

The rear main bearing oil seal (Fig. 6-55) can b removed (both halves) without removal of th crankshaft.

NOTE: Always replace upper and lower seal a unit.

1. Drain coolant system and crankcase and remov engine from vehicle. (See "Engine - Remove ar Install").

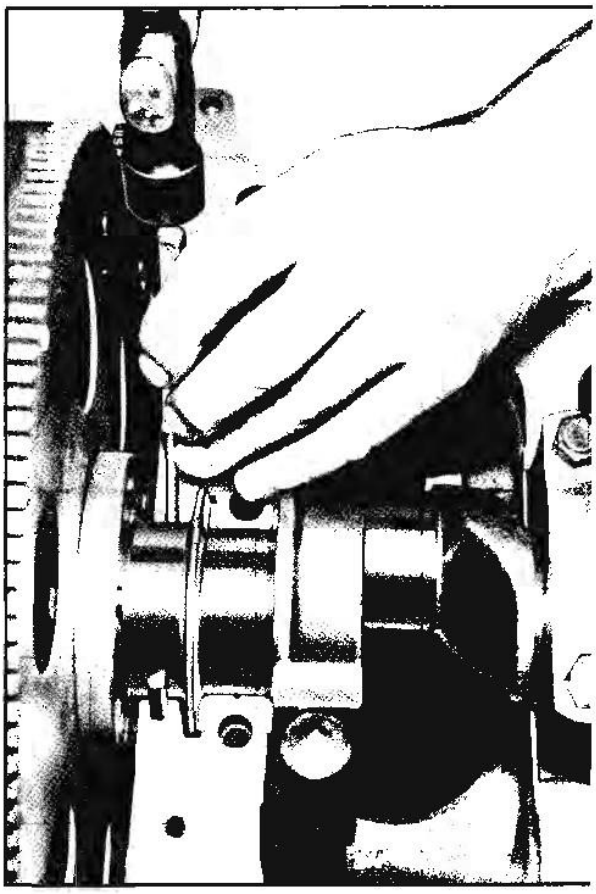

Fig. 6-56 Removing Oil Seal

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.

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. 6-56) until it protrudes far enough to be removed with pliers (Fig. 6-56). Push new seal into place.

7. Install bearing cap and torque bearing cap bolts 60-70 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. 6-57).

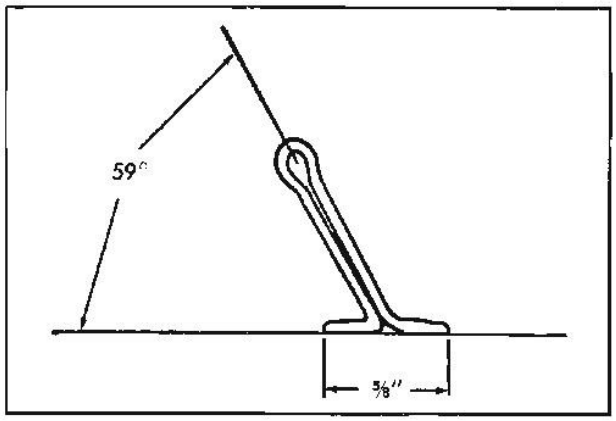

Fig. 6-57 Tool for Removing Upper Half of Main Bearing

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.

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.

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 60-70 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.

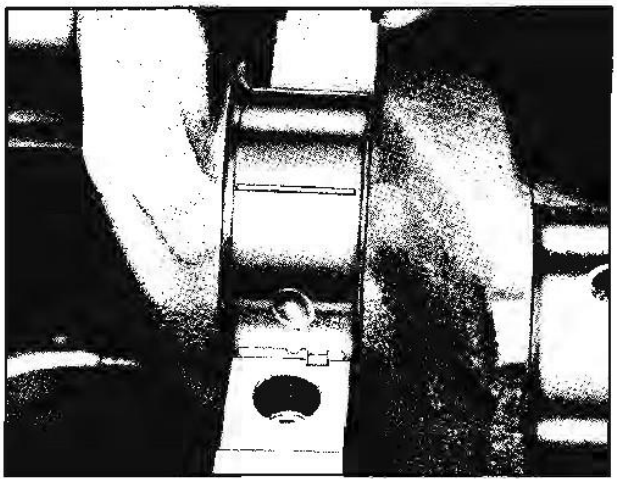

Fig. 6-58 Postigage on Journal

3. Place a piece of Plastigage the length of the bearing (parallel to the crankshaft) on the journal or bearing surface (Fig. 6-58). 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. 6-59). 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". 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

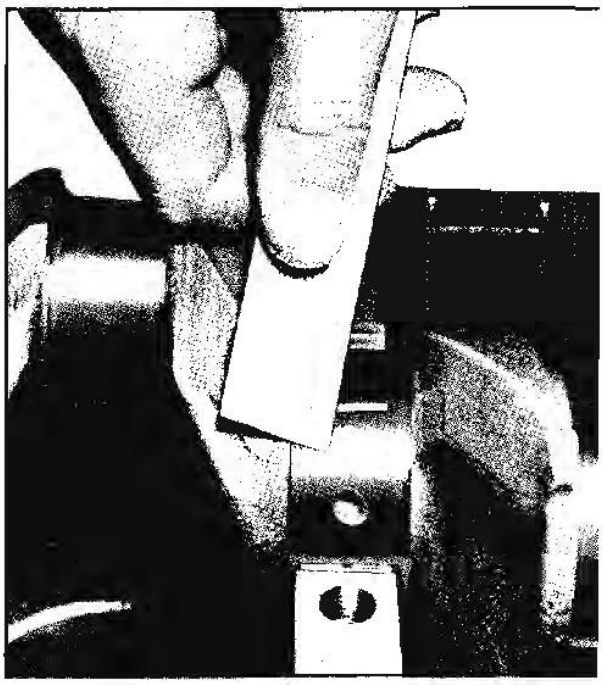

Fig. 6-59 Measure Plastigage

2. Place a piece of Plastigage the length of the earing (parallel to the crankshaft) on the crankpin r bearing surface (Fig. 6-60). Install the cap and ighten cap bolts to 30-35 lb. ft.

NOTE: Do not turn crankshaft with Plastigage in place.

3. Remove bearing cap and using Plastigage scale n envelope measure width of compressed Plastigage efore removing it from the crankpin or bearing Fig. 6-61). If the bearing clearance is between 0005" and .0025" the clearance is satisfactory. If he clearance is more than .0025" replace the bearng with the next size undersize bearing and recheck learance. Bearings are available in .001" and 002" undersize.

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

5. Check connecting rod end clearance between onnecting rod cap and side of crankpin (Fig. 6-62). learance should be .008" - .014". If clearance is nore than .014", replace connecting rod.

ONNECTING ROD AND PISTON ASSEMBLY— EMOVE AND REPLACE

EMOVE

1. Remove engine and transmission assembly from ehicle.

2. Remove transmission, clutch (SM) and starter rom engine and place engine on suitable stand.

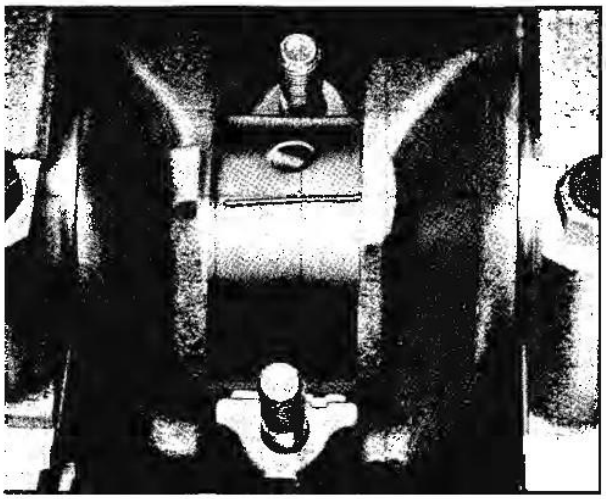

Fig. 6-60 Plastigage on Crankpin

Fig. 6-61 Measure Plastigage

3. Remove rocker arm cover.

4. Loosen rocker arm nuts, rotate rocker arms and remove push rods.

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.

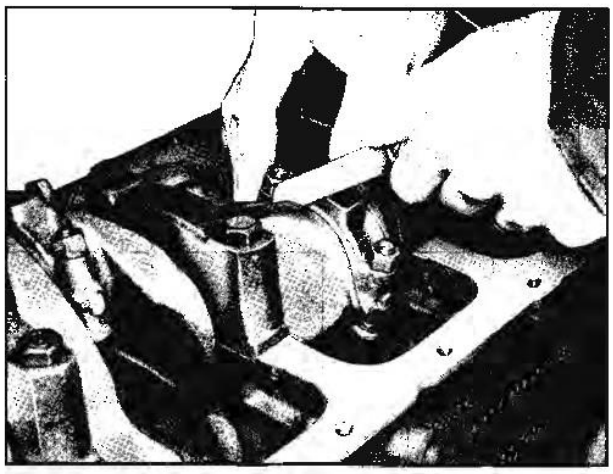

Fig. 6-62 Checking Connecting Rod Side Clearance

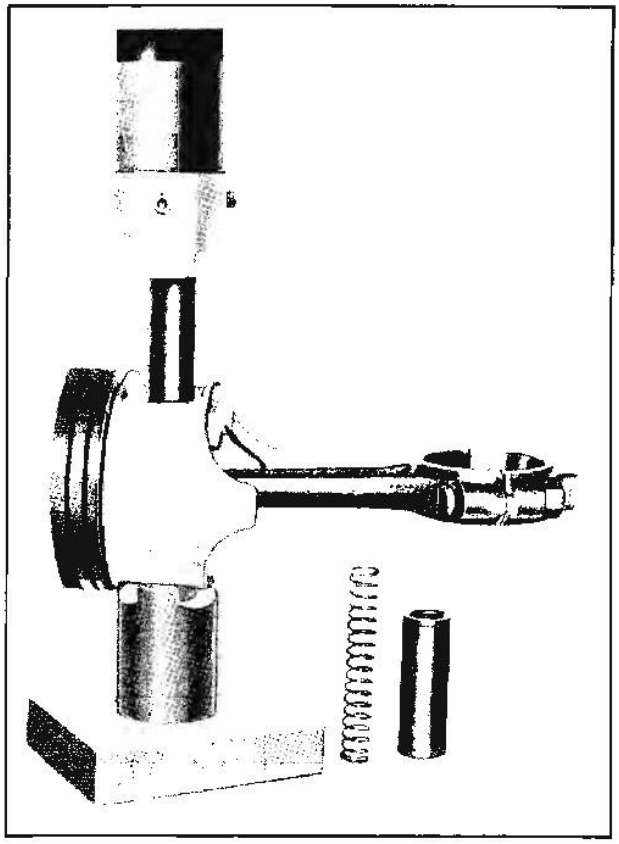

Fig. 6-63 Removing Piston Pin

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 prevent 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 in stalling tool J-9510 on piston pin.

3. Install piston and connecting rod assembly c support and place assembly in an arbor press (Fi 6-63). Press pin out of connecting rod.

4. Remove assembly from press and remove pis ton pin from support and remove tool from pistc and rod.

CONNECTING ROD AND PISTON - CLEAN AND INSPECT

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

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

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

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

PISTON PIN-FIT

Piston pins are a matched fit to the piston and a not available separately. Piston pins will not becor loose enough to cause a knock or tapping until aft very high mileage and in such cases a new pist and pin assembly should be installed. Pistons a pins are serviced as assemblies.

The piston pin fit in piston is .0003" to .000 loose with pin and bosses clean and dry.

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

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

CYLINDER BORES-INSPECT

Inspect cylinder bores for out-of-round or e cessive taper, with an accurate cylinder gau

-8087 or comparable, at top, middle and bottom of ore. (Fig. 6-65). Measure cylinder bore parallel nd at right angles to the center line of the engine to etermine out-of-round. Variation in measure from op to bottom of cylinder indicates the taper in the ylinder. Fig. 6-66 illustrates area in cylinder here normal wear occurs. If dimension "A" is arger than dimension "B" by .007", it indicates the ecessity of cylinder boring and installing new rings nd pistons. Cylinder bores can be measured by etting the cylinder gauge dial at zero in the cylinder t the point of desired measurement. Lock dial indicator at zero before removing from cylinder, and neasure across the gauge contact points with outside nicrometer, with the gauge at the same zero setting hen removed from the cylinder (Fig. 6-67).

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

IONING OR BORING

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

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

When boring always be sure the crankshaft is out f the way of the boring cutter when boring each

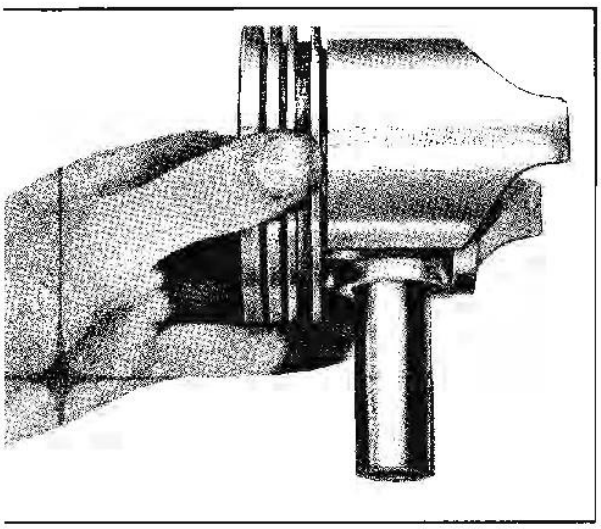

Fig. 6-64 Checking Piston Pin Fit

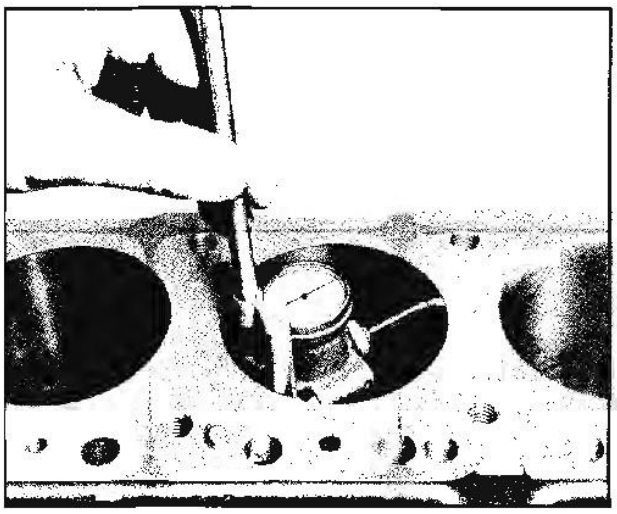

Fig. 6-65 Checking for Out-Of-Round and Taper

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 between pistons, rings, and cylinder bores is maintained.

By measuring the piston to be installed at the sizing points (Fig. 6-68) 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

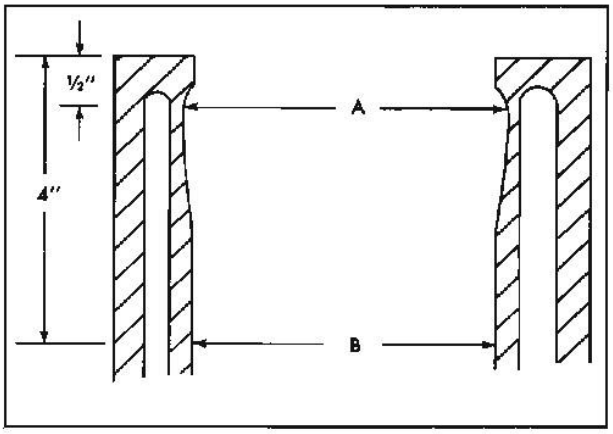

Fig. 6-66 Normal Cylinder Wear Pattern

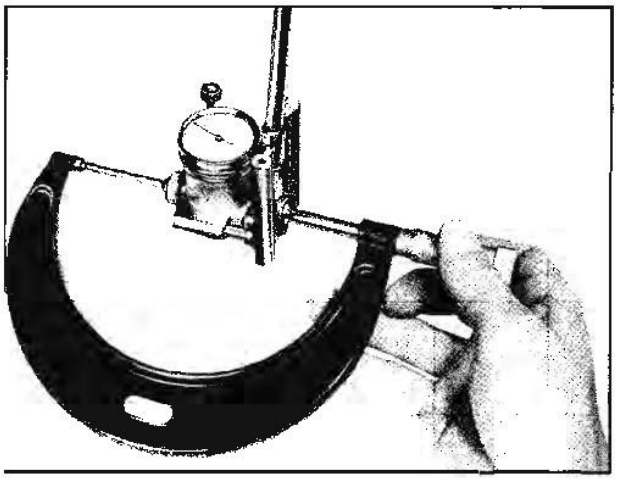

Fig. 6-67 Measuring Cylinder Gauge

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 i pistons are being replaced, reconditioning of bore and fitting of pistons should be closely coordinated

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

Using a cylinder checking gauge, measure the cyl inder bore crosswise of the block to find the smalles diameter. Record the smallest diameter of eac bore.

NOTE: When measuring cylinder bores and piston it is very important that the block and pistons b al room temperature. If any or all of the part are hotter or colder than normal room tempera ture, improper fitting will result.

Measure the piston skirt perpendicular to th piston pin boss (piston pin removed) and at the sizin point indicated in Fig. 6-69.

Make sure the micrometer is in full contac

As the pistons are measured they should b marked for size identification and the measurement recorded.

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

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

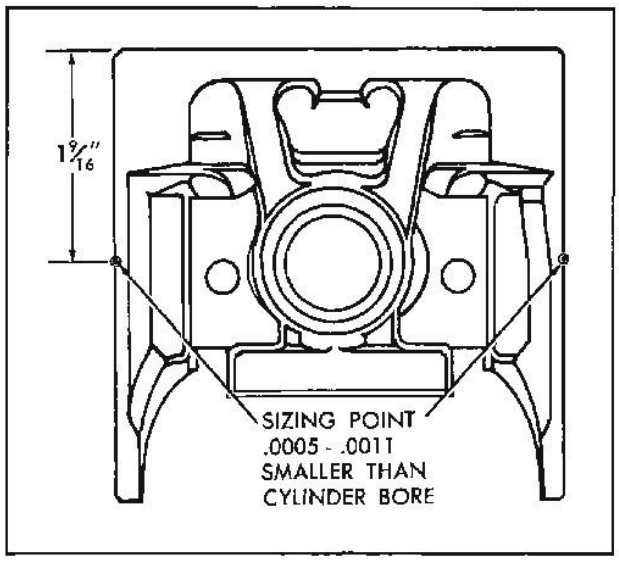

Fig. 6-68 Piston Sizing Points

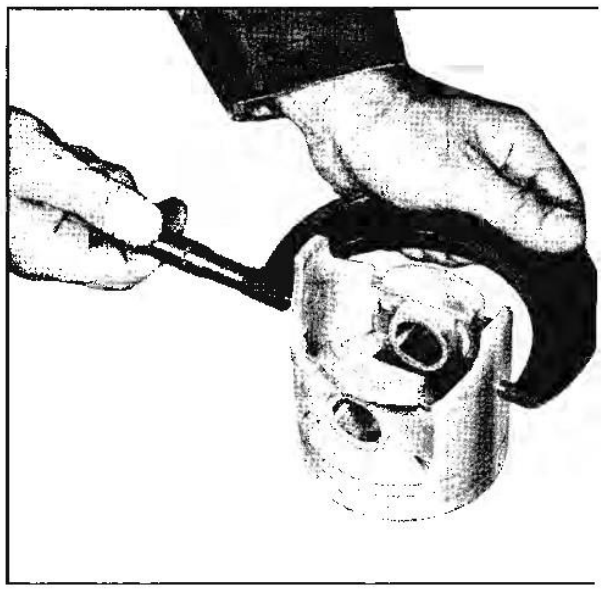

Fig. 6-69 Measuring Piston

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

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

ONNECTING ROD TO PISTON - ASSEMBLE

There is a notch cast in the top of all piston heads o facilitate proper installation. The piston assemblies should always be installed with the notch oward 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 op).

3. Install piston pin on installer and pilot spring nd pilot in support (Fig. 6-70). Use piston pin emoving and installing tool J-9510.

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

5. Place support on arbor press, start pin into osition and press on installer until pin pilot ottoms.

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

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

PISTON RINGS - REPLACE

1. Remove connecting rod and piston assembly (see "Connecting Rod and Piston Assembly - Remove nd 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

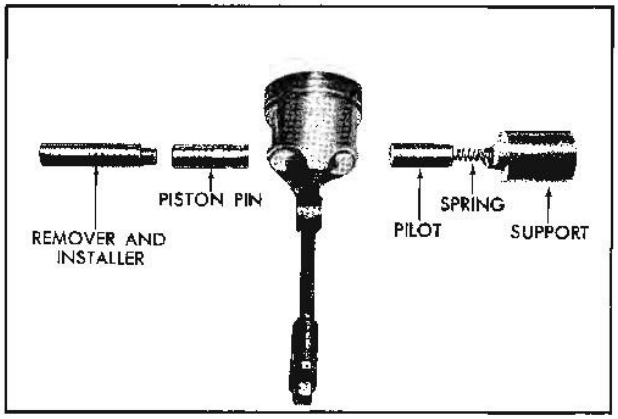

Fig. 6-70 Piston Pin Replacement

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 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.

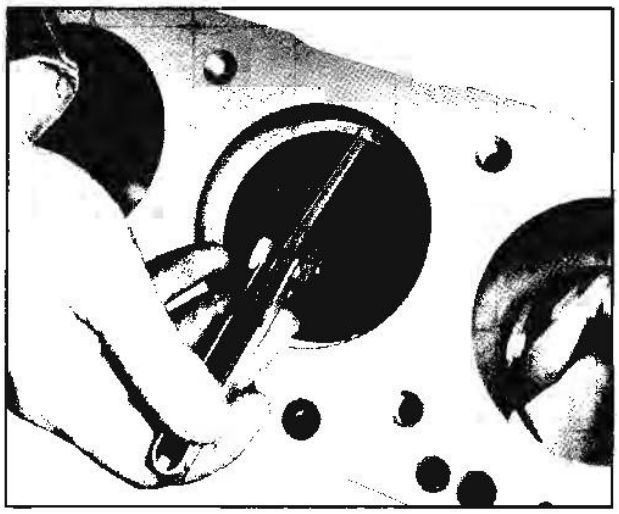

Fig. 6-71 Checking Ring Gap

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. 6-71). Gaps should be as follows:

Upper Compression Ring	.010" - .020"
Lower Compression Ring	.010" - .020"
Oil Ring	.015" - .055"

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 b necessary to alter ring gap by filing.

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

5. Measure side clearance of rings in ring groov (Fig. 6-72) as each ring is installed. Clearance wit new pistons and rings should be as follows:

Upper Compression Ring . . .	.0015" - .0030"
Lower Compression Ring . . .	.0015" - .0035"
Oil Control Ring	.0005" - .0055"

If side clearance is excessive, piston should b replaced.

CONNECTING ROD AND PISTON ASSEMBLY—REPLACE

1. Install connecting rod bolt guide set J-5239 o connecting rod bolts (Fig. 6-73).

2. Using a suitable piston ring compressor inse rod and piston assembly into cylinder so that not in top of piston is facing front of engine (Fig. 6-74

3. From beneath engine, pull connecting rod wi bearing into place against crankpin.

4. Remove guide set J-5239 and install bearin cap with oil groove facing camshaft. Tighten ca nuts to 30-35 lb. ft.

5. Install oil pan.

6. Install cylinder head, intake and exhaust mani fold as an assembly.

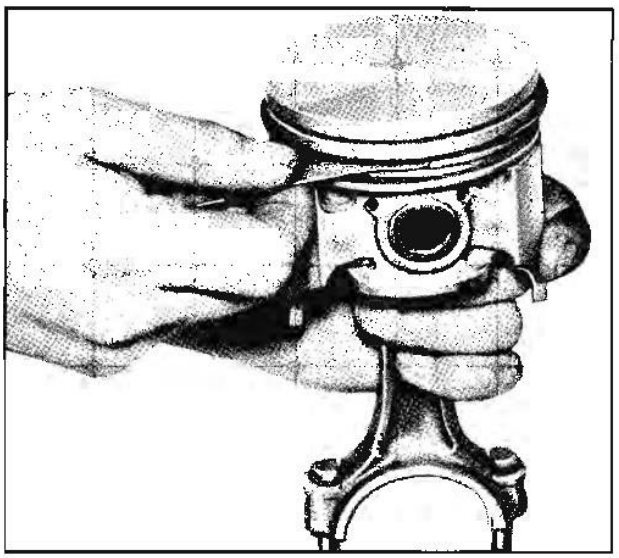

Fig. 6-72 Checking Side Clearance

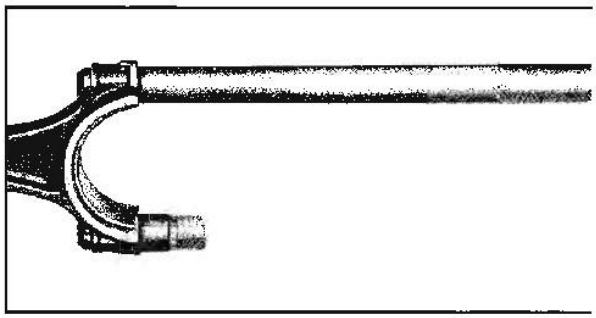

Fig. 6-73 Guide Tool J-5239 Installed

7. Connect fuel line and vacuum line to carburetor.

8. Install valve lifters.

9. Install coil and push rod covers.

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 o 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.

RANKSHAFT—REMOVE AND REPLACE

EMOVE

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

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

3. Mount engine on suitable stand.

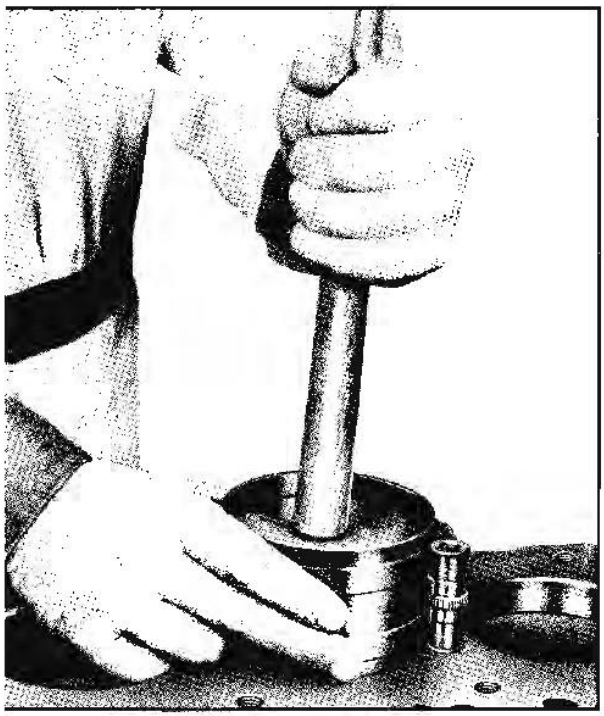

Fig. 6-74 Installing Piston in Cylinder

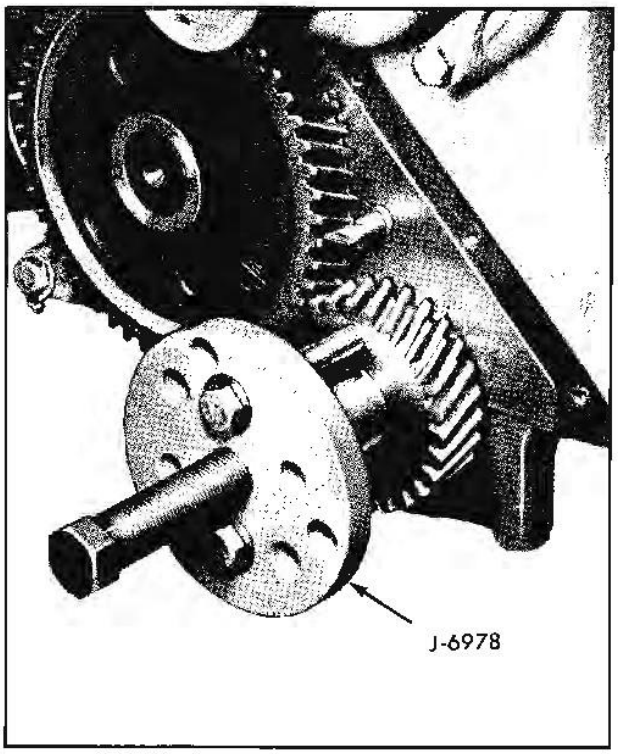

Fig. 6-75 Tool J-6978 Installed for Removing Crankshaft Timing Gear

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. 6-75).

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.

Fig. 6-76 Installing Crankshaft Timing Gear

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.

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

5. Tighten main bearing caps 60-70 lb. ft.

6. Tighten connecting rod bearing caps 30-35 lb. ft.

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

8. Install crankshaft timing gear with installer tool J-5154 (Fig. 6-76).

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

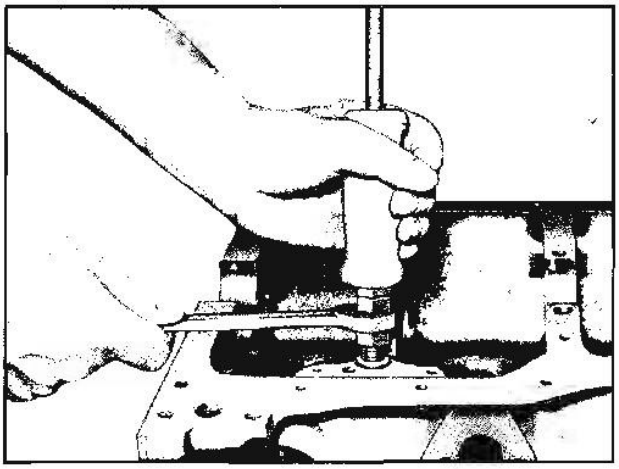

Fig. 6-77 Removing Distributor Lower Bushing

9. Install timing gear cover using new seal ar gaskets.

10. Install oil pump assembly and oil pan usir new rear seal in rear main bearing cap and ne front seal on timing gear cover. Press front se tips into holes in timing gear cover.

11. Coat front cover oil seal contact area balancer with oil and drive balancer into positic using balancer installer tool X-8792.

12. Install fan pulley and fan.

13. Install spark plugs.

14. Remove engine from stand.

15. Attach clutch (SM), transmission and start to engine.

16. Install complete assembly in vehicle.

DISTRIBUTOR LOWER BEARING— REMOVE AND REPLACE

The distributor lower bearing is a bronze bushi pressed into the lower side of the engine block. I upper inside diameter pilots the distributor shaft a the outside diameter extending below the block pilo the oil pump.

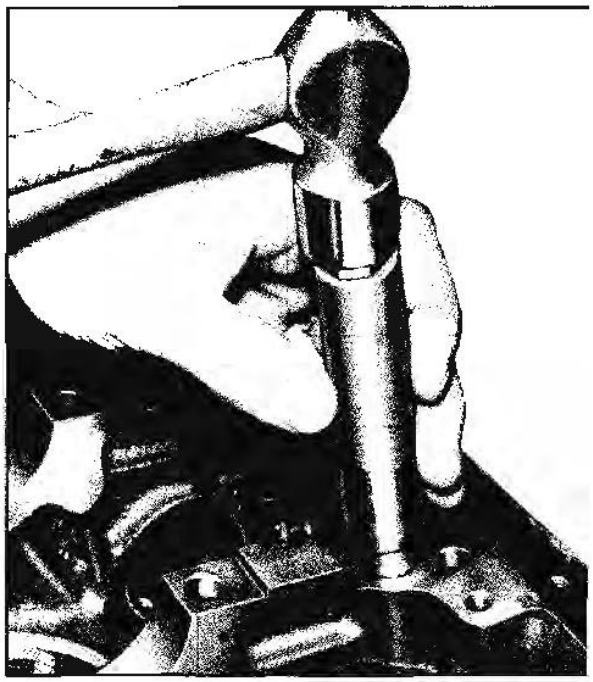

Fig. 6-78 Installing Distributor Lower Bushing

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. 6-77).

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. 6-78).

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 hold down 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 stand J-5709 and box J-5763 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.

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 undersize bearings if necessary.

4. Install oil pump over distributor lower bearing and bolt in place. Tighten 9 to 11 lb. ft.

5. Install camshaft with camshaft gear. Attach thrust plate with screws and tighten to 6-7-1/2 lb. ft.

6. Install crankshaft key and install crankshaft timing gear with timing marks aligned.

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-0966. Install cover screws and torque to 6-7-1/2 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 90-95 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 on cylinder (number one exhaust and intake valve lifter both on base circle of camshaft and timing mark o harmonic balancer indexed with top dead center mar on timing pad). Position new distributor to bloc gasket on block.

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

15. With camshaft of base circle for each cyl inder, tighten rocker arm nuts until all valve trai play is removed. Then tighten nut one additiona turn.

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

17. Install water pump.

18. Install generator mounting bracket.

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

20. Install generator and fan belt.

21. Install fuel pump and tighten bolts to 10-1 lb. ft.

22. Install oil pressure sending switch.

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

24. Install ground strap, dipstick tube and dipstic

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

26. Install engine, clutch (S-M) and transmissic as an assembly in vehicle.