EIGHT CYLINDER ENGINE (V-8)

ENERAL DESCRIPTION

Two optional V-8 engines (Fig. 6-79), with 326 ubic inch displacement are available on special rder. These engines have a 3-23/32" bore and -3/4" stroke. The compression ratios are 8.6:1 and 0.5:1.

CYLINDER BLOCK

The cylinder block has two banks of four cylinders each, cast at 90° to each other. Left bank cylinders are numbered 1-3-5-7 and right bank cylinders are numbered 2-4-6-8.

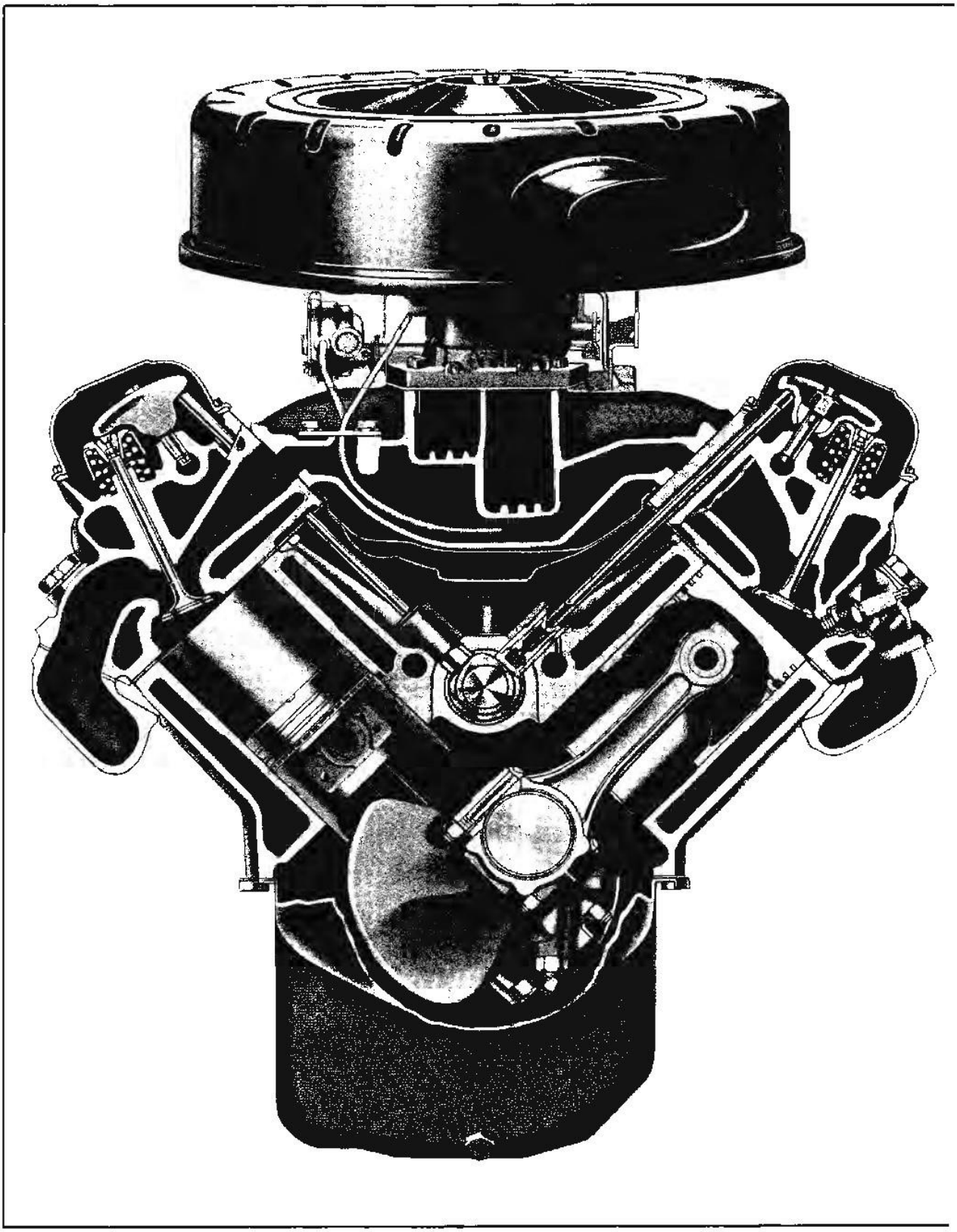

Fig. 6-79 Tempest 326 Cu. In. V-8 Engine

The left bank is set slightly behind the right bank. This provides room for mounting the fuel pump in front of the engine on the left side where it receives direct cooling from the fan (Fig. 6-79). Also, it permits a shorter fuel line. Both these factors minimize the possibility of vapor lock. This arrangement of cylinders also provides for mounting the alternator on the right side. This location is advantageous since it places the most severe turn on the belt on the slack, or lowest tension side, of the belt.

All main bearing caps are doweled to the cylinder block to assure accurate alignment and facilitate assembly (Figs. 6-80, 6-81).

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

CYLINDER HEADS

Left and right cylinder heads are identical. The same casting is used for both heads.

Different heads are used on 8.6:1 and 10.5:1 compression ratio engines.

Valve seats are completely surrounded by water and each head has an oil gallery which feeds oil to the rocker arm studs to provide lubrication of the upper valve train parts.

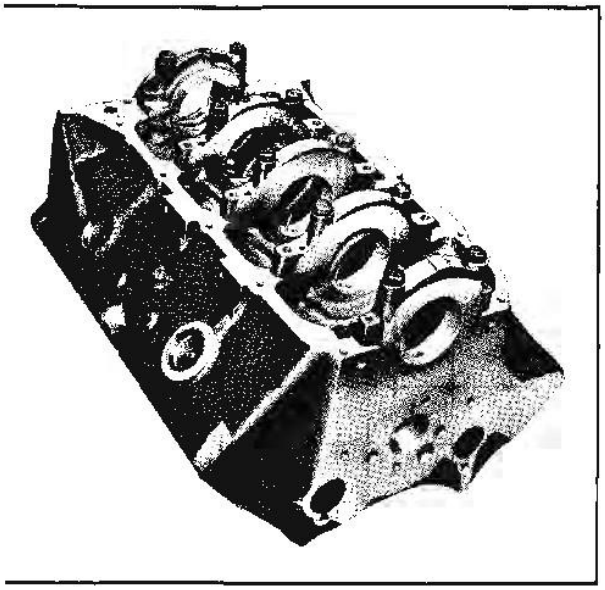

Fig. 6-80 Cylinder Block and Bearing Caps

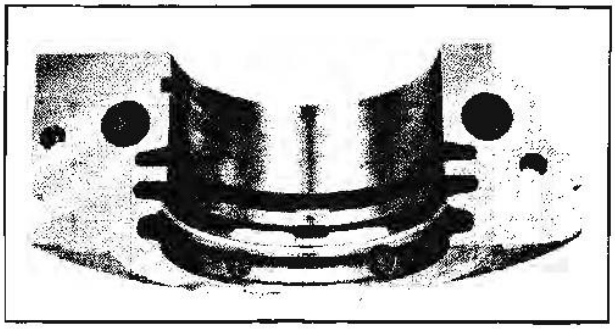

Fig. 6-81 Rear Main Bearing Cap

Cylinder head casting date is located at the right front corner of the right head and the left rear corner of the left head.

CRANKSHAFT AND BEARINGS

The crankshaft is cast pearlitic malleable iron and is supported by five main bearings. The rear main bearing shells have two oil grooves. The rear oil groove has three oil drain holes evenly spaced. The front four upper and lower shells are not interchangeable, due to omission of an oil groove in lower half. Torsional vibration is dampened by the harmonic balancer mounted on the front end of the crankshaft.

The rear main bearing is sealed by a packing seated in a chamfered groove in the block and bearing cap (Fig. 6-81). A slinger on the crankshaft in front of the seal and the drain groove in the rear main bearing prevent an excess of oil from getting to the seal.

Slots are cast in the cylinder block and cap seal groove to prevent seal rotation.

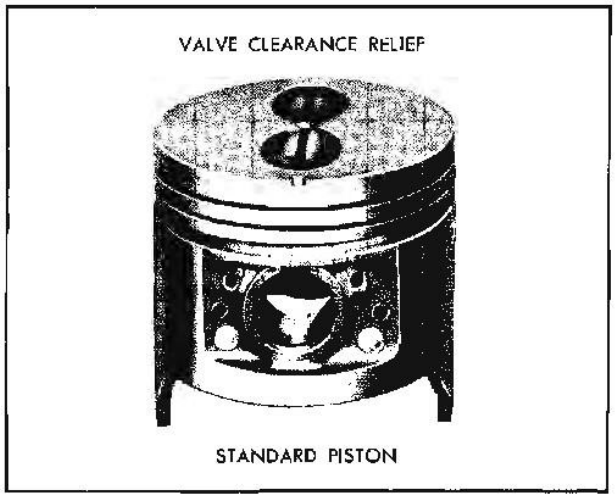

Fig. 6-82 Piston

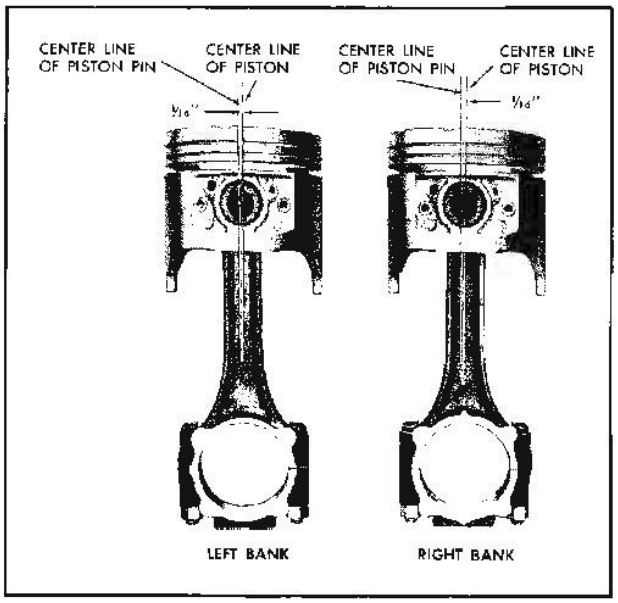

Fig. 6-83 Connecting Rod and Piston Assembly

CAMSHAFT AND DRIVE

The camshaft is cast from alloy iron. 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. The camshaft is supported by five bearings.

A 7/8" wide, 60 link timing chain is used to drive the camshaft. The 42 tooth camshaft drive sprocket is made from cyanide hardened, cast alloy iron, while the 21 tooth crankshaft sprocket is made from case hardened steel.

PISTONS AND CONNECTING RODS

The pistons are aluminum alloy, tin plated, with steel struts to control expansion and give added strength (Fig. 6-82). Pistons are cam ground so that the diameter across the thrust face is larger than the diameter fore and aft of the engine. The steel struts give assurance that the piston will expand front to rear and that the thrust diameter will not change. Two compression rings and one oil control ring are used, all of which are located above the piston pin.

The top of the piston has a relief machined into the head for valve clearance.

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 (Fig. 6-83). 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.

A lubrication groove between the connecting rod and cap directs a jet of oil onto the opposite cylinder wall to lubricate the piston and rings and to provide splash for lubricating the piston pins.

VALVE TRAIN

A very simple ball pivot type valve train is used (Fig. 6-84). Motion is transmitted from the camshaft through the hydraulic lifter and push rod to

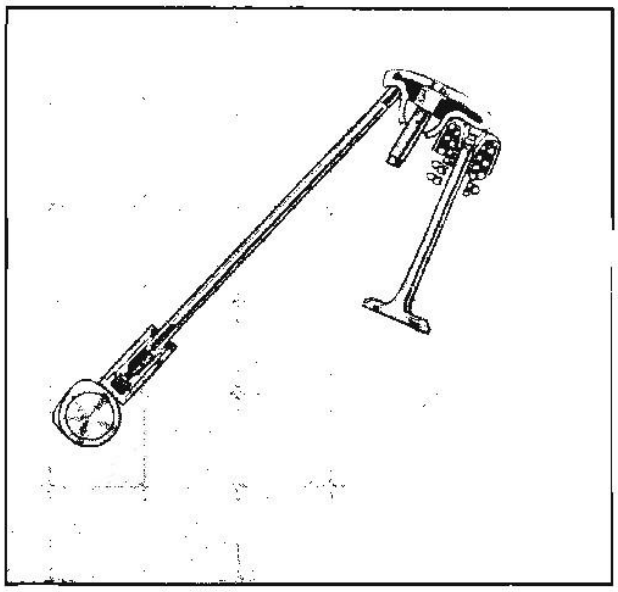

Fig. 6-84 Valve Train

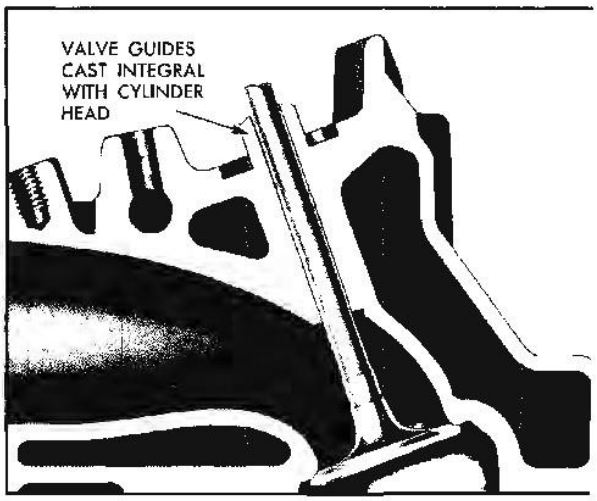

Fig. 6-85 Intake Valve Guide

he rocker arm. The rocker arm pivots on its ball nd transmits the camshaft motion to the valve. The ·ocker arm ball is retained by a nut which locks igainst a chamfer on the stud.

The maximum in durability is assured by the use of cyanide-hardened stamped steel rocker arms. In ddition all friction points to the valve train are iositively lubricated.

The cylinder head has straight valve guides cast ntegral (Fig. 6-85). External shields are used on ioth intake and exhaust valves to reduce the amount f oil splashed against stems. Valve stem seals are sed on exhaust as well as intake valves to prevent il from entering the valve guides.

Inner and outer valve springs are used on all ngines.

HYDRAULIC VALVE LIFTERS

Hydraulic lifters are used to keep all parts of the alve train in constant contact. In other words each ifter is an automatic adjuster maintaining zero lash nder all conditions. This insures precision valve iming and silent operation, increases valve life, nd eliminates the need for tappet adjustment.

The hydraulic lifter assembly (Fig. 6-86) includes: he cast iron body which rides in the cylinder block

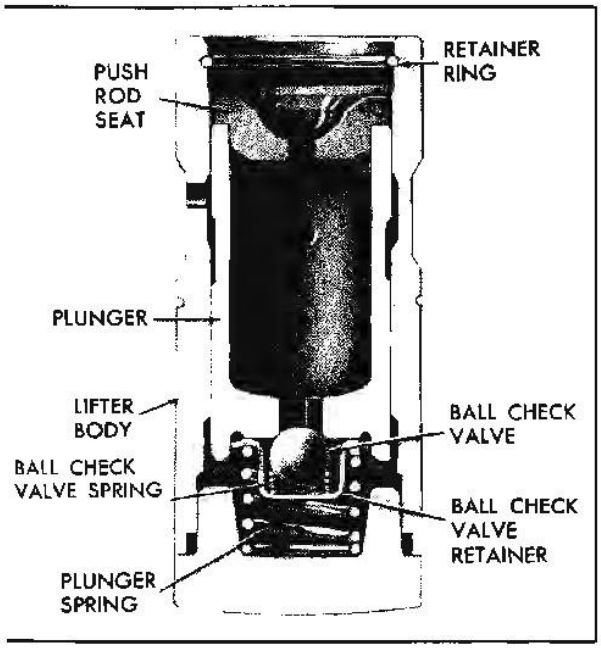

Fig. 6-86 Sectional View Valve Lifter Assembly

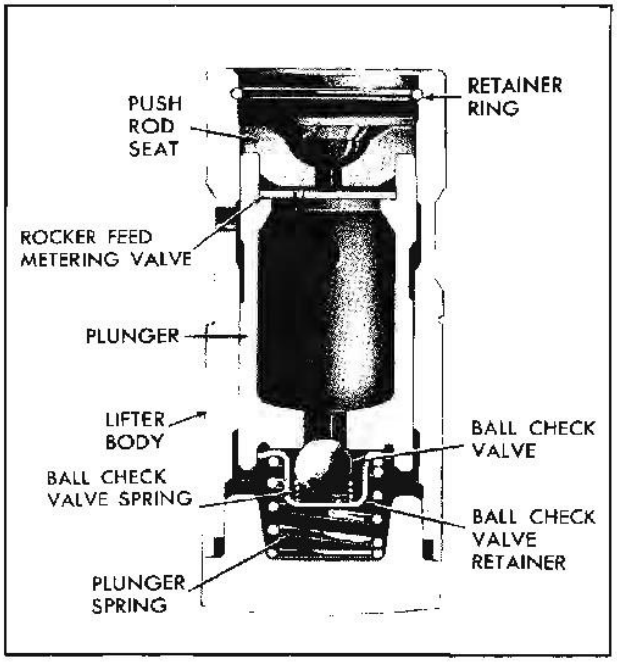

Fig. 6-87 Sectional View - Valve Lifter - 326 H.O. with Synchromesh

boss, the plunger, push rod seat, 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.

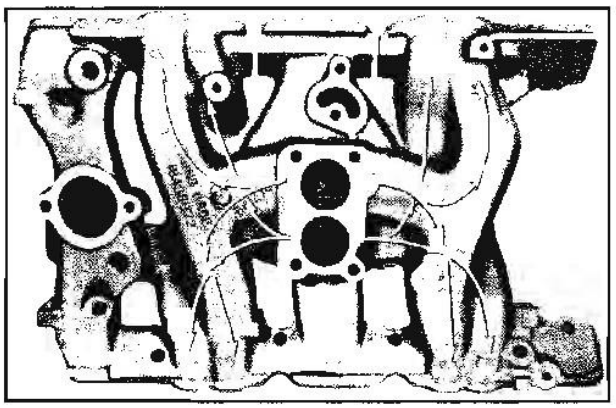

Fig. 6-88 Intake Manifold - Two Barrel Carburetor

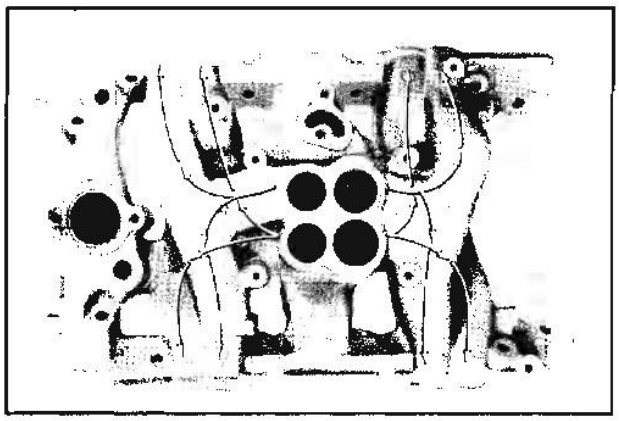

Fig. 6-89 Intake Manifold - Four Barrel Carburetor

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.

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.

A special hydraulic valve lifter is used in 326 H.O. engines with synchromesh transmission (Fig. 6-87). This special lifter incorporates a spring loaded check ball to allow higher engine RPM.

FUEL DISTRIBUTION SYSTEM

The intake manifold is designed to provide fuel passages which are short and practically equal in length. With the two barrel carburetor each throat of the carburetor feeds four cylinders as shown in Fig. 6-88. The intake manifold used with the four barrel carburetor is fundamentally the same as wit the two barrel but has four openings to index with th carburetor throats. With the four barrel carbureto the two throats on the right side feed four cylinder and the two throats on the left side feed four cyl inders (Fig. 6-89).

A stove is included in the intake manifold sur rounding the risers which lead to the carburetor When the engine is cold, exhaust gases from th right bank of cylinders pass through a passage i the intake manifold to circulate around and heat th stove. The fuel-air mixture passing from the carbu retor to the cylinders is thereby pre-heated to th desired temperature for proper combustion.

EXHAUST SYSTEM

Two cast iron exhaust manifolds are used, one fc each bank of cylinders. A one-piece Y-shaped ex haust pipe assembly is used to direct exhaust gase from each exhaust manifold to the muffler and tail pipe. A thermostatically controlled valve in the ou let of the right exhaust manifold blocks the passag of exhaust gases out of this manifold when the engir is cold. Exhaust from the cylinders on the right bar will then pass through the intake manifold exhau crossover passage and out the left cylinder head ar exhaust manifold.

In passing through the intake manifold crossove passage, the hot gases serve to heat the intake man fold stove.

COMBUSTION CHAMBERS

Combustion chambers are completely machined insure accurate volume control and uniform snap

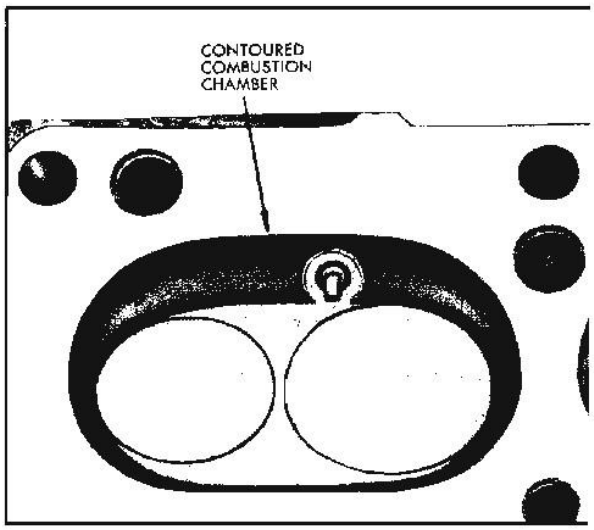

Fig. 6-90 Combustion Chamber

or 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. 6-90) minimizes the possibility of detonation, facilitates breathing and provides swirling turbulence for smooth, complete combustion.

Intake valves are large and have 30° seat angles to further provide easy breathing for high combustion efficiency. Exhaust valve seat angle is 45°.

ERIAL NUMBERS

The manufacturer's engine identification number is located on a machined pad on the front of the right-hand bank of the block (Fig. 6-91).

This number is used for production control purposes during manufacture. The production engine number should be included on AFAs or PI Reports concerning the engine.

GENERAL INFORMATION ON ENGINE SERVICE

Cleanliness is a primary factor when servicing the V-8 engine. The slightest particle of dirt that finds its way into a hydraulic lifter may cause a malfunction.

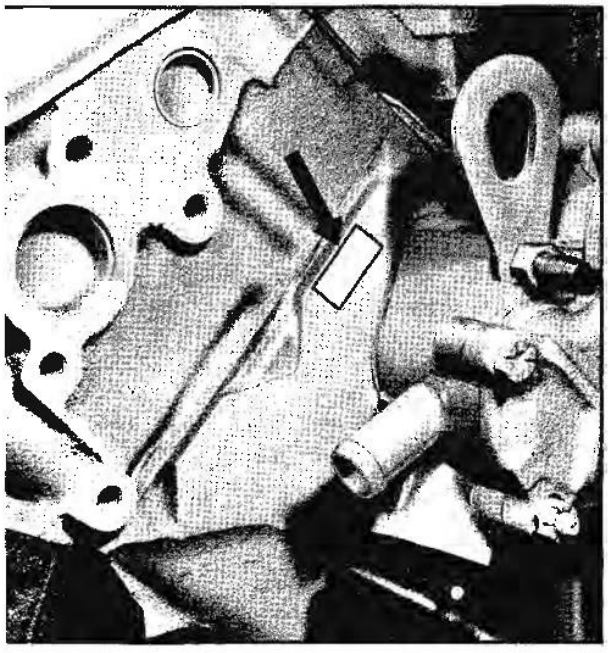

Fig. 6-91 Engine Number Location

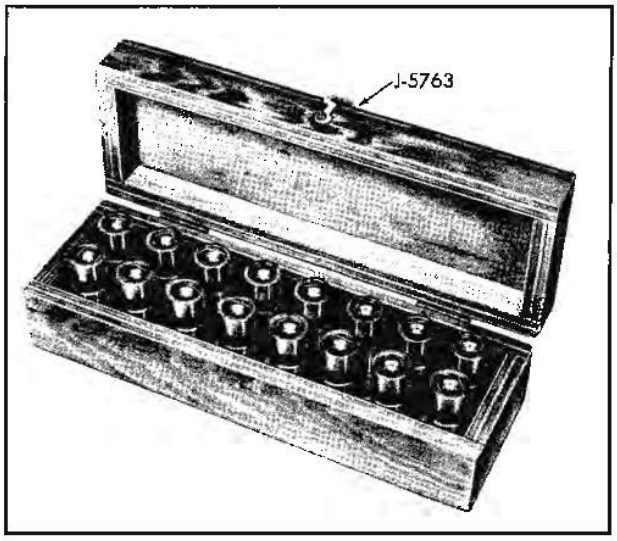

Fig. 6-92 Valve Lifter Storage Box

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. 6-92). This is important for two reasons. First, it is the easiest way to keep

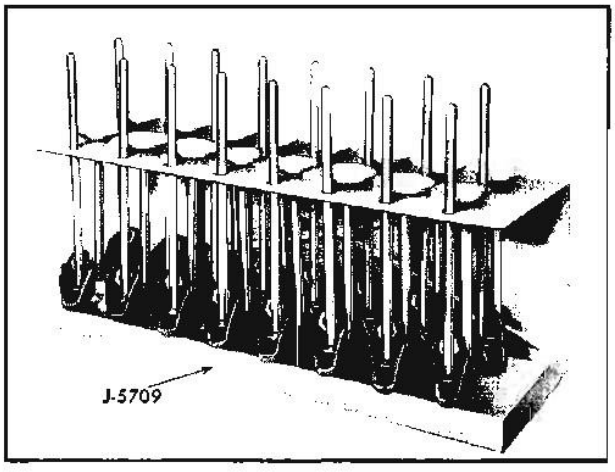

Fig. 6-93 Valve and Valve Train Holding Stand

lifters clean. Second, lifters should always be replaced in the same bosses from which they were removed.

Valves, valve lifters, push rods, rocker arms, rocker arm balls, and rocker arm ball nuts should always be kept in sets and returned to their original positions. These parts will tend to mate as the engine operates and will provide more satisfactory operation when kept together. By storing lifters in storage box J-5763 and valves, push rods, rocker arms, balls and nuts in holding stand J-5709 (Fig. 6-93) 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.

Cylinder head screws should be installed without thread sealer of any kind.

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, jacking against the oil pan may cause it to be bent against the pump. The result would be a telegraphed noise which would be difficult to trace. The crankshaft pulley is sheet steel and will not support engine weight.

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 terminal could possibly be grounded, the ground cable of the battery should be disconnected.

CAUTION: Never reverse battery leads, even for an instant, as reverse polarity current flow will damage diodes in the generator.

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 in the cylinder and cause extensive damage when the engine is started.

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

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

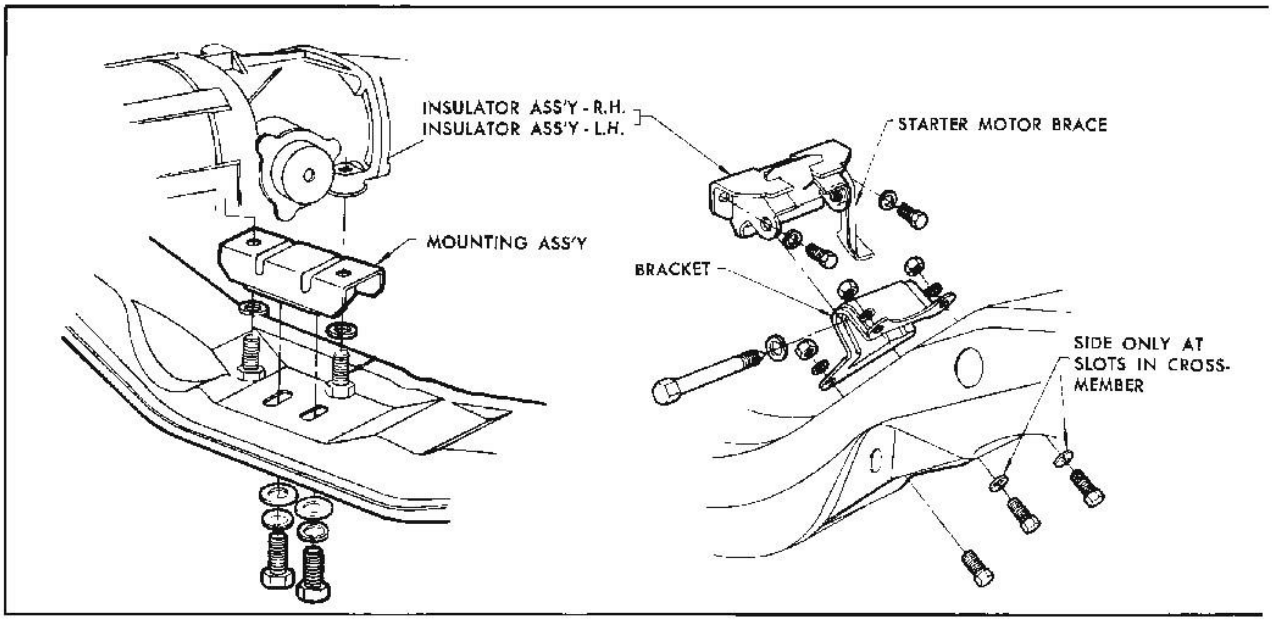

Fig. 6-94 Engine Insulators

PERIODIC SERVICE

There are no periodic services required on the mechanical portions of the engine. Periodic services connected with the engine consist of tune-up, lubrication, replacing oil filter, 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. 6-94)

FRONT INSULATORS

1. Raise hood and, using suitable engine lifting equipment, take weight of engine off front insulators.

NOTE: Disconnect battery ground strap before raising engine. When the engine is raised the starting motor solenoid terminals may contact the steering gear which could energize the starting motor if the ground cable is not disconnected.

2. Loosen rear insulator by removing cross member to insulator bolts and raise rear of engine.

3. Remove bolts which fasten front insulators to frame bracket.

4. Raise engine just clear of insulators.

5. Remove insulator to engine bolts and remove insulators.

6. Position new insulators against engine and install attaching bolts and washers. Tighten to 40-55 lb. ft. torque.

7. Lower engine.

8. Install frame bracket to insulator bolts with lockwashers and tighten to 25-35 lb. ft. torque.

9. Lower rear of engine and transmission so that rear insulator positions on cross member. Install two cross members to insulator bolts and washers and tighten to 25-35 lb. ft. torque.

REAR INSULATOR

1. Remove two cross member to insulator bolts.

2. With suitable engine lifting equipment raise engine at rear to provide clearance for removing insulator to transmission housing bolts.

3. Remove two insulator to transmission bolts and remove insulator.

4. Install new insulator and two insulator to transmission housing bolts and washers and tighten to 25-35 lb. ft. torque.

5. Lower rear of engine and transmission so that insulator positions above cross member.

6. Install two cross members to insulator bolts with washers and tighten to 25-35 lb. ft. torque.

ENGINE—REMOVE FROM VEHICLE

1. Drain coolant and engine oil.

2. Remove hood. SEE CHASSIS SHEET METAL CHECK.

3. Remove engine ground wire.

4. Remove air cleaner and disconnect throttle and transmission linkage.

5. On cars with power steering remove power steering pump belt and pump from mounting bracket, leaving hoses connected. Place pump in a position where it will not become damaged when engine is removed.

6. Remove upper and lower radiator hose and disconnect heater hoses from intake manifold and timing chain cover and remove from cylinder head clamp. On TempesTorque equipped cars remove inlet and outlet oil lines from radiator. Remove oil pressure warning light wire from switch terminal at filter. Remove automatic transmission cooler line clamps at front cross member.

7. Remove fuel pump inlet line.

8. Remove vacuum lines.

9. Remove terminal from thermogage unit on intake manifold, disconnect coil positive lead at coil, disconnect generator to regulator wires from generator, release from clip retaining to valve cover and pull clear of engine.

10. Remove battery ground from cylinder head and disconnect starter and solenoid at left fender skirt terminal. Open starter cable clip at front cross member and remove cable from clip.

11. Remove radiator and fan.

12. Loosen muffler and tail pipe supports, then disconnect exhaust pipe from each exhaust manifold. Wire exhaust pipe to engine rear support cross member.

13. Remove gear shift manual linkage at transmission.

14. Disconnect linkage from clutch release fork and remove clutch control countershaft bracket from flywheel housing (synchromesh equipped cars).

15. Remove speedometer cable at transmission.

16. Remove propeller shaft drive line assembly and insert splined plug on transmission output shaft.

17. With chain and overhead hoist raise engine and transmission assembly slightly to remove weight from engine insulators. Disconnect insulators from frame.

18. Remove engine and transmission as an assembly by lifting forward and upward.

ENGINE—INSTALL IN VEHICLE

1. Assemble clutch and transmission to engine.

2. Install rear insulator on transmission extension and install front insulators to engine. Tighten rear insulator to transmission extension bolts 25-35 lb. ft. and front insulators to engine bolts 40-55 lb. ft.

3. Using suitable engine lifting equipment, carefully lower engine, clutch (SM) and transmission assembly into position in vehicle. Fasten front insulators to frame bracket with thru bolts and tighten nuts to 25-35 lb. ft. Fasten rear insulator to cross member and tighten bolts to 25-35 lb. ft.

4. Install propeller shaft.

5. On synchromesh models, connect clutch linkage. See Engine Clutch Section.

6. Connect gearshift manual linkage to transmission.

7. Connect exhaust pipe assembly to exhaust manifolds.

8. Install starter and solenoid leads to left fender skirt terminal.

9. Install starter cable in clip and install clip to front cross member.

10. Install radiator.

11. Connect regulator to generator wires, routing through clips along right rocker arm cover. Connect coil positive lead and connect leads to thermogauge terminal.

12. Connect power brake vacuum hose to check valve to carburetor pipe, if car is so equipped

13. Connect fuel inlet line to fuel pump and connect oil pressure sending unit lead.

14. Connect upper and lower radiator hoses and heater hoses. Install heater hoses in cylinder head clamp.

15. On cars equipped with automatic transmission install cooler line clamps to front cross member and connect lines to radiator.

16. Install vacuum line to carburetor.

17. Install power steering pump and belt and adjust belt tension if car is so equipped.

18. Connect throttle linkage and install carburetor air cleaner.

19. Install battery cable and connect battery cable to posts.

CAUTION: Never reverse battery leads even for an instant, as reverse polarity current flow will damage diodes in generator.

20. Install ground wire.

21. Install hood.

22. Fill cooling system and crankcase.

23. Adjust ignition timing, carburetor and transmission linkage if necessary.

MANIFOLDS—VALVE TRAINS—CYLINDER HEADS

RIGHT SIDE EXHAUST MANIFOLD OR GASKET—REMOVE AND REPLACE

REMOVE

1. Disconnect exhaust pipe from manifold.

2. Straighten tabs on manifold front and rear individual bolt locks and remove manifold attaching bolts, manifold, and gasket.

NOTE: Locks are used on the front and rear pairs of bolts only.

REPLACE

1. Thoroughly clean gasket surfaces of cylinder head and exhaust manifold. Check condition of heat control valve and related parts.

2. Replace exhaust manifold and new gasket. Use new individual manifold bolt locks on front and rear pairs of bolts.

NOTE: Place manifold outlet in position over end of exhaust pipe but do not permit weight of manifold to rest on exhaust pipe. Since the end holes of the gasket are slotted, installation of gasket may be simplified by first installing the manifold using only the front and rear bolts to retain manifold. Allow clearance of about 3/16" between cylinder head and exhaust manifold. After inserting the gasket between head and manifold, the remaining bolts may be installed.

3. Tighten all bolts evenly and securely to 20-35 lb. ft. torque. Bend tab of screw locks against bolt heads.

NOTE: Be sure tabs are bent against sides of bolt heads, not on top of bolt heads.

4. Attach exhaust pipe to manifold with bolts and tighten to 25-35 lb. ft.

LEFT SIDE EXHAUST MANIFOLD OR GASKET—REMOVE AND REPLACE

REMOVE

1. Remove generator belt and remove generator and mounting bracket as an assembly.

2. Disconnect exhaust pipe from manifold.

3. Straighten tabs on manifold individual bolt locks. (Tabs can be straightened from beneath car by using long handled screwdriver.)

NOTE: Locks are used on front and rear pairs of bolts only.

4. Remove manifold attaching bolts and remove manifold.

REPLACE

1. Thoroughly clean gasket surfaces of cylinder head and exhaust manifold.

2. Place manifold in position against cylinder head and install two end bolts, finger tight.

3. Slide gasket between manifold and cylinder head.

4. Install remaining bolts and new bolt locks.

5. Tighten all bolts evenly and securely to 20-35 lb. ft. torque. Bend tabs of bolt lock against bolt heads.

6. Attach exhaust pipe to manifold and tighten to 25-35 lb. ft. torque.

INTAKE MANIFOLD OR GASKET—REMOVE AND REPLACE

REMOVE

1. Drain water from radiator and from each side of cylinder block.

NOTE: Most of the water can be drained from the block through the radiator drain by raising rear end of car approximately 15 to 18 inches off the floor.

2. Remove air cleaner.

3. Remove upper radiator hose.

NOTE: If condition of hose does not warrant replacing with new hose, possible damage to hose and clamps can be reduced by leaving hose attached to water outlet. In this case water outlet may be disconnected from manifold and moved out of way.

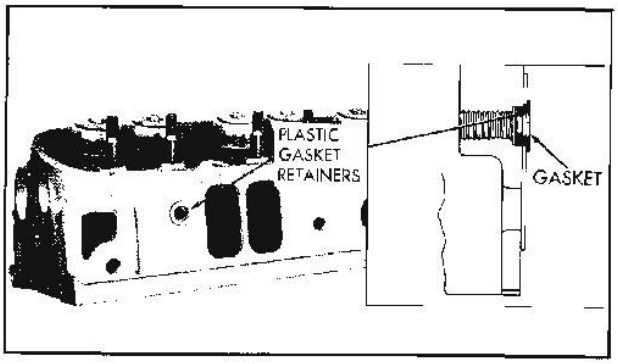

Fig. 6-95 Installing Intake Manifold Gasket

4. Disconnect heater hose from fitting.

5. Disconnect wire from thermogauge unit.

6. Remove two spark plug wire brackets from manifold.

7. On cars equipped with power brakes, remove power brake vacuum pipe from carburetor.

8. Disconnect distributor to carburetor vacuum hose.

9. Disconnect fuel line connecting carburetor and fuel pump.

10. Disconnect crankcase vent hose from intake manifold.

11. Disconnect throttle rod from carburetor.

12. Remove screws retaining throttle control bracket assembly.

13. Remove intake manifold retaining bolts and nuts, and remove manifold and gaskets.

NOTE: Make certain "O" ring seal between intake manifold and timing chain cover is retained and installed during assembly if not damaged.

REPLACE

NOTE: When a new manifold is to be installed, transfer carburetor, water outlet, thermostat, heater hose fitting and thermogauge fitting. Use new gaskets on those units requiring gaskets and new "O" ring seal between manifold and timing chain cover.

1. Install new gaskets on cylinder heads, positioning them with plastic retainers (Fig. 6-95).

2. Install intake manifold on engine.

3. Install "O" ring seal.

4. Install cap bolts and nuts loosely.

5. Position throttle control bracket assembly or manifold and install cap bolts.

6. Tighten timing chain cover to intake manifold bolt until both units are metal to metal (10-20 lb. ft. torque).

7. Tighten all nuts and bolts evenly to 40-45 lb. ft. torque.

8. Connect throttle rod to carburetor.

9. On cars equipped with power brakes, install vacuum pipe to carburetor.

10. Install fuel pipe connecting carburetor to fuel pump.

11. Install crankcase vent hose to intake manifold fitting.

12. Connect heater hose to fitting.

13. Install upper radiator hose.

14. Connect wire to thermogauge unit terminal.

15. Install vacuum hose connecting distributor vacuum advance unit to carburetor.

16. Install spark plug wire bracket.

17. Replace air cleaner.

18. Close drain plug and fill radiator to proper level.

19. Check automatic transmission linkage adjustments.

PUSH ROD COVER OR GASKET— REMOVE AND REPLACE

REMOVE

1. Remove intake manifold, retaining "O" ring seal.

2. Remove crankcase ventilator hose.

3. Remove screws from push rod cover and remove cover.

REPLACE

1. Cement new gasket on push rod cover.

2. Replace push rod cover and tighten screws to 5 lb. ft. torque.

3. Replace positive crankcase ventilation hose.

4. Install intake manifold and "O" ring seal.

VALVE SPRINGS, SHIELD OR SEAL— REMOVE AND REPLACE

REMOVE

1. Remove rocker arm cover, spark plug and distributor cap. (Remove rear generator bracket on right side.)

2. Remove rocker arm.

3. After removing rocker arm, thread valve spring compressor stud J-8929-1 on rocker arm stud and compress valve spring using compressor J-6384-1 and nut J-8929-2 while holding valve up with valve holder J-5961-2 (Fig. 6-96). Remove valve spring retainer cup locks and then remove valve spring compressor, valve spring retainer cup shield and valve stem seal.

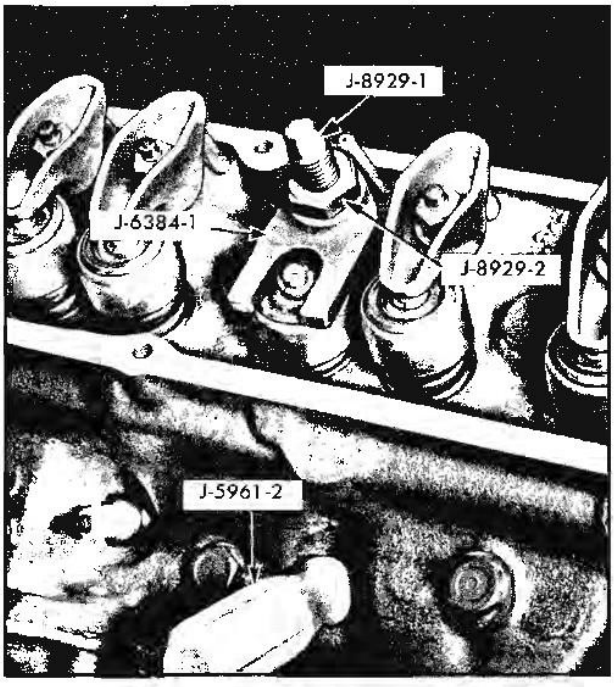

Fig. 6-96 Valve Spring Compressed

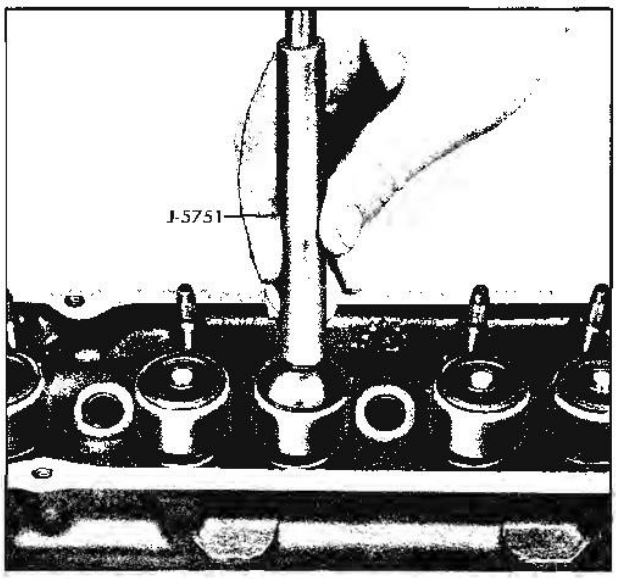

Fig. 6-97 Checking Valve Stem Seal

REPLACE

1. Install new part or parts, compress springs with valve spring compressor J-6384-1 and nut J-8929-2 (while holding valve up with holder J-5961-2), install valve stem seal and retainer cup locks. Remove spring compressor and valve holder, then test valve stem seal using suction cup end of tool J-5751 (Fig. 6-97).

2. Install rocker arm, tighten rocker arm ball retaining nut to 15-25 lb. ft. torque.

3. Replace rocker arm cover, spark plug, distributor cap and connect spark plug wire.

PUSH ROD AND VALVE LIFTER— REMOVE AND REPLACE

REMOVE

1. Remove intake manifold, retaining "O" ring seal.

2. Remove push rod cover.

3. Remove rocker arm cover.

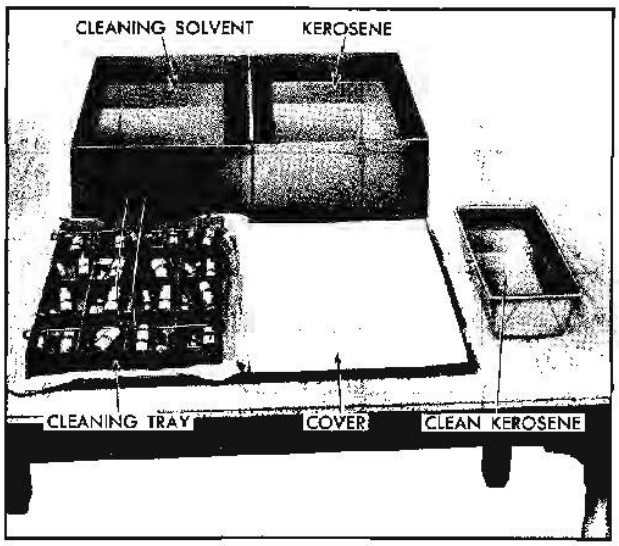

Fig. 6-98 Lifter Wash Tank and Tray J-5821

4. Loosen rocker arm ball nut and move rocker arm off push rod.

5. Remove push rod.

6. Before removing standard lifter that is suspected of having a stuck plunger, it can be tested using lifter plunger unloader J-5097. To check lifter, insert pin of unloader tool through hole in push rod seat and push down on tool. Pin will unseat ball, and tool will move push rod seat and plunger down. If lifter plunger is stuck, it will be impossible to move push rod seat down.

NOTE: In order to unseat the ball in special 326 H.O. Synchromesh lifters it is necessary to remove the retaining clip, push rod seat and orifice plate before using plunger unloader J-5097.

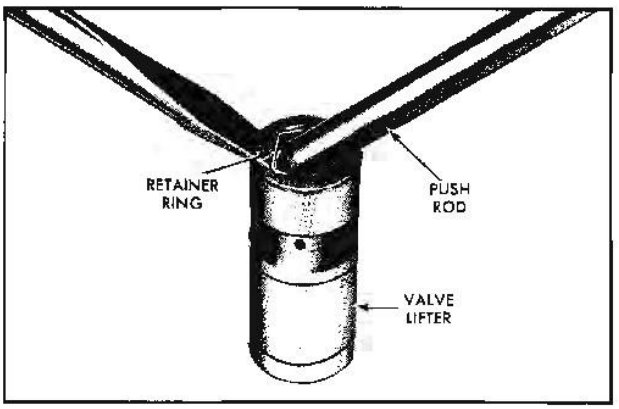

Fig. 6-99 Removing Push Rod Seat Retainer Ring

7. Remove lifter. Hydraulic valve lifter remove J-3049 may facilitate removal of lifter.

NOTE: If more than one lifter is to be replaced store push rods in stand J-5709 and lifters i lifter box J-5763 so they can be re-installed i exactly the same place and position. See GENERA INFORMATION ON ENGINE SERVICE.

REPLACE

NOTE: If new lifter is to be installed, be sure t remove all sealer coating from inside of new lifte and check leakdown rate. See page

1. Place new lifter in lifter boss.

2. Replace push rod exactly as removed (same en against rocker arm).

3. Position rocker arm on push rod and tighte rocker arm ball retaining nut to 15-25 lb. ft. torque

4. Replace rocker arm cover.

5. Inspect condition of push rod cover gasket an replace if necessary; replace push rod cover an tighten screws to 2-6 lb. ft. torque.

6. Replace intake manifold using new gaskets an replace "O" ring seal.

VALVE LIFTER - RECONDITION

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

New lifters are serviced as individual units pack aged with a plastic coating. Leaving the coating c until ready to check leakdown rate. It is not neces sary to remove the oil from new lifters prior t checking leakdown rate since special leakdown o is already in new lifters.

Wash tank and tray J-5821 (Fig. 6-98) is recom mended for cleaning valve lifters. This tank shoul be used only for valve lifters and should be kep covered when not in use. All servicing should b done in an area removed from grinders or othe sources of dust and foreign material.

Lifters should at all times be stored in a covere box (Fig. 6-92) which will aid in keeping them clea The lifter box should be kept dry and as free of o 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. 6-99).

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 the tool against a block of wood (Fig. 6-100) until plunger falls out.

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

3. Drain oil out of lifter body and place all valve lifter parts in separate compartment of tray from wash tank J-5821 (Fig. 6-98).

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

VALVE LIFTER - CLEAN AND INSPECT

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

1. Before placing tray of parts in cleaning solvent, first immerse it in kerosene chamber to remove as much engine oil as possible. (This reduces contamination of solvent, thus prolonging its useful life.)

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

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

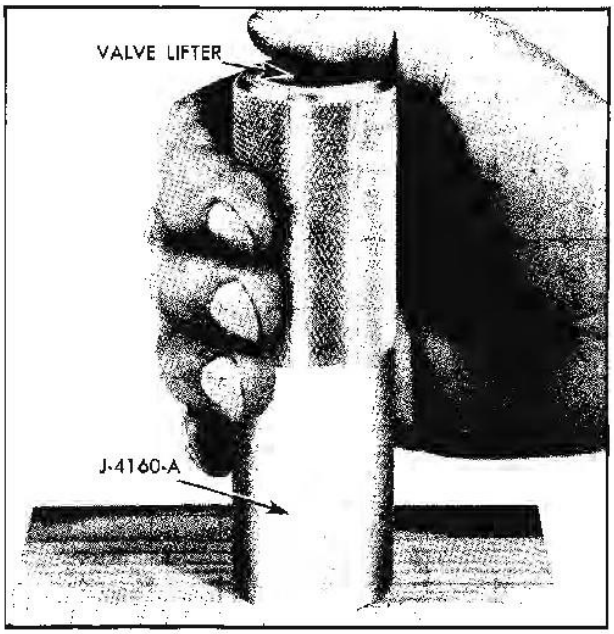

Fig. 6-100 Removing Stuck Plunger With J-4160-A

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

5. Wipe out tank cover and place tray of parts on cover in front of tank (Fig. 6-98). A shop towel under tray and clean paper on remainder of cover will enhance cleanliness.

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

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

CAUTION: Do not use wire brush or sand paper, since damage to machined surface is likely.

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

8. Inspect lifter plunger. Using a magnifying glass, inspect the check ball seat for defects. Inspect outer surface of plunger for scratches or scores. Small score marks with a rough, satiny finish will cause

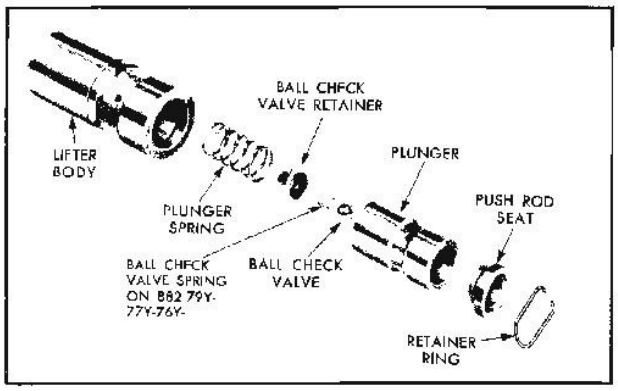

Fig. 6-101 Exploded View - Valve Lifter

the plunger to seize when hot but operate normally when cool. Defects in check ball seat or scores or scratches on outer surface of plunger which may be felt with a fingernail are causes for replacing the lifter assembly. This rule does not apply to the slight edge which may sometimes be present where the lower end of plunger extends below the ground inner surface of the body. This edge is not detrimental unless it is sharp or burred.

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

9. Inspect push rod seat. Inspect push rod seat for roughness and make sure that hole in center is open.

10. Inspect valve lifter ball. Carefully examine ball for nicks, imbedded material or other defects

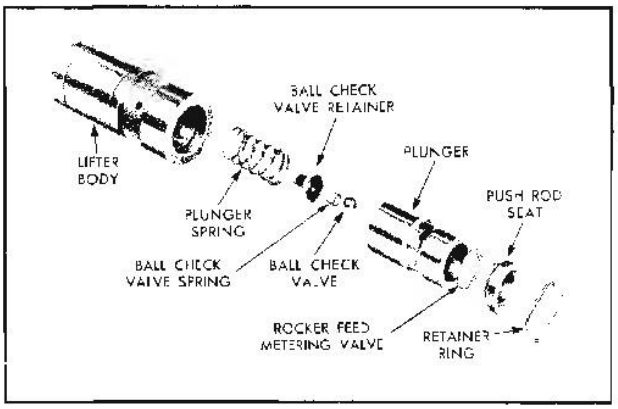

Fig. 6-102 Exploded View - 326 H.O. with Synchromesh Valve Lifter

which would prevent proper seating. Such defect may cause intermittently noisy lifter operation. Als inspect plunger face of ball retainer for excessiv wear.

VALVE LIFTER - ASSEMBLE

NOTE: All parts must be absolutely clean whe assembling a hydraulic lifter. Since lint and dus may adhere to parts they should not be blown o with air or wiped with cloths. All parts shoul be rinsed in clean kerosene and assembled withou drying. A small container with clean kerosen (separate from cleaning tank) should be used fo each set of lifters being overhauled.

Figures 6-101 and 6-102 show the relative positi of component parts of valve lifters. The recom mended procedure for assembly is given in th following steps.

1. Rinse plunger spring and ball retainer and po sition retainer in spring.

2. Rinse lifter ball and place in retainer.

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

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

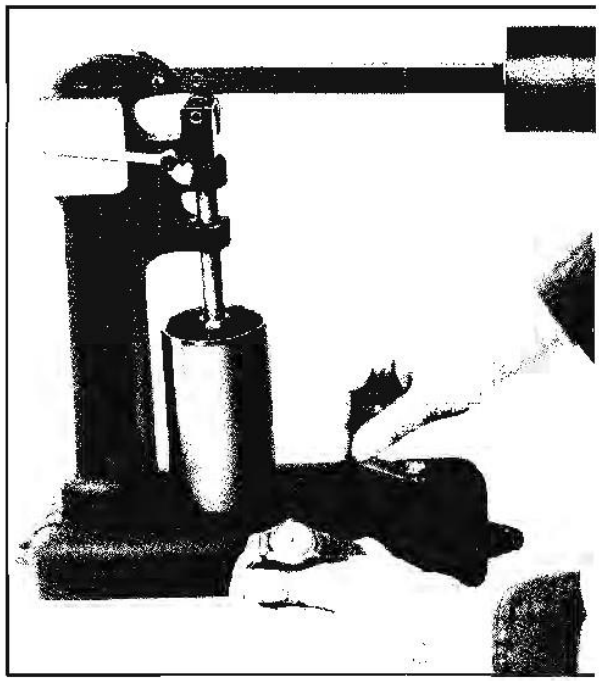

Fig. 6-103 Testing Leak-Down Rate

5. Place orifice feed plate in plunger (326 H.O. SM).

6. Place lifter body on clean paper; rinse and install push rod seat and retainer ring.

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

TEST VALVE LIFTER LEAKDOWN RATE

After all lifters have been assembled, the leakdown rate must be checked before they are installed in the engine. Valve lifter leakdown tester J-5790 (Fig. 6-103) is designed to test leakdown rate of lifters to determine whether or not they are within specified limits. As with previous service operations concerned with lifters, cleanliness is important. 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 your lifter tester dealer.

NOTE: No other type fluid is recommended.

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

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

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

5. Raise weight arm to allow plunger spring to expand fully; lower arm onto ram and commence turning crank slowly (1 revolution every 2 seconds). Time indicator travel from lower line (first line above set line) to line marked .125 or 1/8", while still rotating cup with crank (Fig. 6-103). Lifter is satisfactory if rate is between 12 and 60 seconds.

A doubtful lifter should be tested three or four times. Disassemble, inspect, and re-test doubtful lifters. If leakdown still is not within specifications, replace lifter.

6. After each lifter is tested, replace in lifter box to ensure cleanliness. Leave lifters in box until ready for installation in cylinder block.

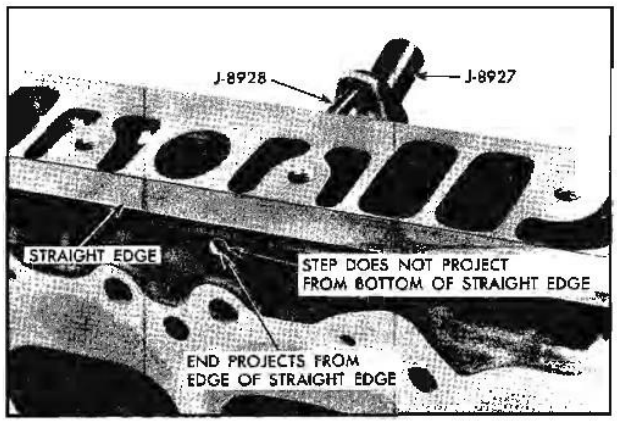

Fig. 6-104 Position of Gauge J-8928 When Stud is Properly Installed

7. When all lifters have been tested, empty cup, clean, and place cover over tester to maintain its cleanliness.

CYLINDER HEAD OR GASKET— REMOVE AND REPLACE

REMOVE

1. Remove intake manifold, push rod cover, and rocker arm cover.

2. Loosen all rocker arm retaining nuts and move rocker arms off push rods.

3. Remove push rods and place in support stand J-5709 so they can be replaced in exact position from which they were removed. See GENERAL INFORMATION ON ENGINE SERVICE.

4. Remove exhaust crossover pipe to manifold attaching bolts.

5. Remove battery ground strap and engine ground strap on left head or engine ground strap and Hydra-Matic oil level indicator tube bracket on right head.

6. Remove cylinder head bolts (dowel pins will hold head in place) and remove head with exhaust manifold attached using lifting hooks J-4266.

CAUTION: Extreme care should be taken when handling or storing cylinder heads as the rocker arm studs are hardened and may crack if struck.

NOTE: If left head is being removed, it will be necessary to raise head off dowel pins, move it forward, and "jockey" the head in order to clear the power steering and power brake equipment if car is so equipped.

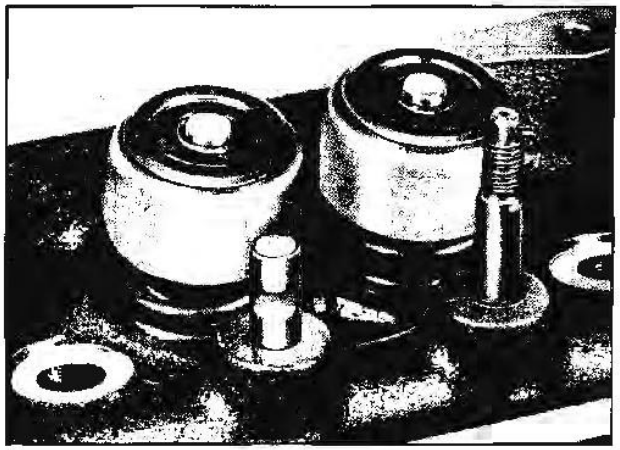

Fig. 6-105 Slots Filed in Rocker Arm Stud

7. Remove cylinder head gasket.

REPLACE

NOTE: Right and left cylinder heads are the same. New heads are complete with rocker arm studs, and all plugs.

When installing new head, transfer all serviceable parts to new head using new seals on intake and exhaust manifold valve stems, and new exhaust manifold gasket. Install new intake manifold gasket plastic retainers. Clamp straight edge into position as shown in Fig. 6-104 and check rocker arm position with valve train gauge J-8928.

1. Remove straight edge from cylinder head and thoroughly clean gasket surfaces of head and block. Place new gasket on block, and replace cylinder head.

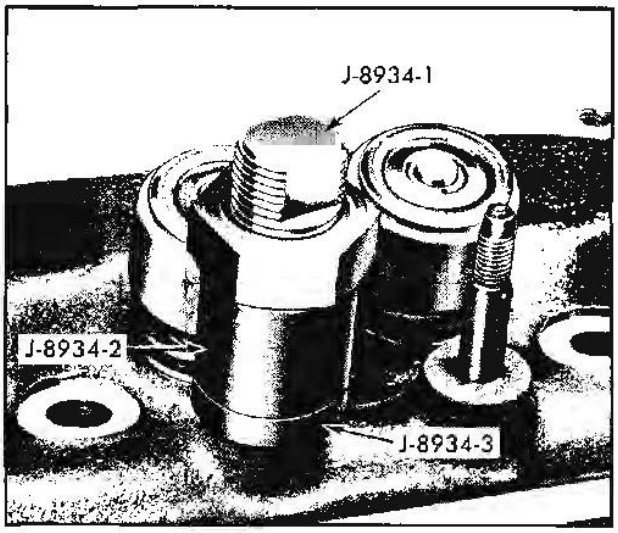

Fig. 6-106 Tool J-8934 Positioned to Remove Rocker Arm Stud

2. Start all bolts in threads.

NOTE: Bolts are three different lengths. Whe inserted in proper holes all bolts will project a equal distance from head. Do not use sealer o any kind on threads.

3. Tighten bolts evenly to 85-100 lb. ft. torque

4. Install push rods in same location from whic they were removed and with the same end up agains rocker arm.

5. Reposition rocker arms and tighten rocker arn ball retaining nuts to 15-25 lb. ft. torque.

6. Replace rocker arm cover and tighten screws t 5 lb. ft. torque.

7. Replace push rod cover and tighten screws t 5 lb. ft. torque.

8. Replace battery ground strap and engine groun strap on left head or engine ground strap and auto matic transmission oil level indicator tube bracke on right head. Also, replace the engine oil level in dicator on right side.

9. Replace intake manifold using new gaskets

ROCKER ARM STUDS—REMOVE AND REPLACE

(Rocker arm studs are replaceable providing press of two tons capacity or more is available.

NOTE: Both standard and .003" oversize stud are available. If stud has become loose, replac with .003" oversize stud and install accordin to steps 7 through 19. If replacing stud that i broken or because of faulty threads or oil hole use standard size stud and install according t steps 8 through 19.

1. Remove cylinder head from engine.

2. With rocker arm removed, file two slots 3/32 to 1/8" deep on opposite sides of rocker arm stu (Fig. 6-105). Top of slots should be 1/4" to 3/8 below thread travel.

3. Place washer at bottom of rocker arm stud

4. Position rocker arm stud remover J-8934 o rocker arm stud and tighten screws securely wit 5/32" allen wrench.

5. Place spacer over stud remover J-8934.

6. Thread 7/8" standard nut on stud remover and turn nut until rocker arm stud is out of cylinder head (Fig. 6-106).

7. Remove plugs (Fig. 6-105) from ends of cylinder head oil gallery and thoroughly clean out metal deposits and foreign matter from oil gallery (head must be right side up so foreign material will not lodge in or around studs).

8. Position rocker arm on new rocker arm stud and place rocker arm stud installer J-8927 on stud in place of rocker arm ball.

9. Coat rocker arm stud with white lead and oil and with cylinder head mounted in press on tool J-5712, so studs are vertical, position new stud with rocker arm and rocker arm stud installer over hole in head (Fig. 6-109).

10. Carefully press stud into head until it is in about half way (7/16").

11. Clamp straight edge on cylinder head as shown in Fig. 6-109 and position valve train gauge J-8928 in push rod hole so that it seats properly in the rocker arm.

12. With valve seated, slowly press rocker arm stud into cylinder head (Fig. 6-106) until gauge projects about midway between the end of the gauge and the step with respect to the straight edge as shown in Fig. 6-104.

13. Remove rocker arm stud installer J-8927, rocker arm and ball and straight edge.

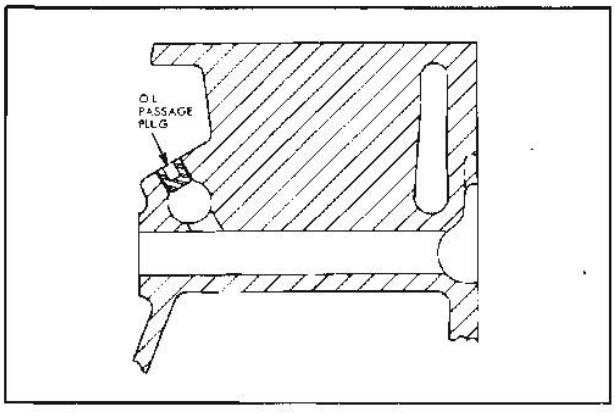

Fig. 6-107 Cylinder Head Oil Passage Plug

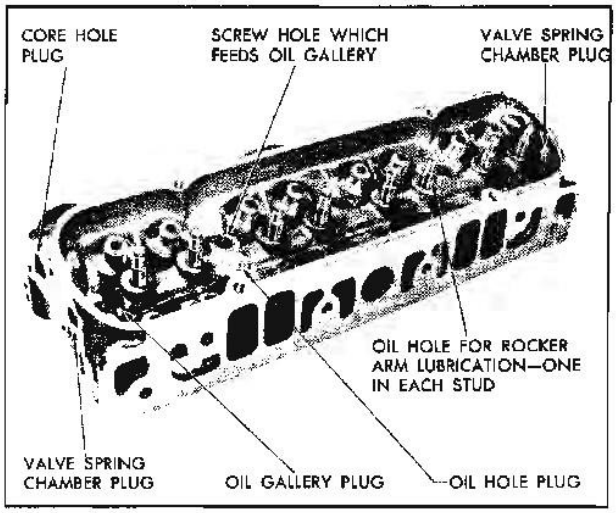

Fig. 6-108 Cylinder Head Passage Identification

14. Blow air through hole in new stud to ensure that the passage is not restricted.

15. Blow air through oil gallery to remove any foreign matter.

16. Replace plugs in ends of oil gallery (Fig. 6-107).

17. Check oil passages from oil gallery to all studs. See CYLINDER HEAD AND VALVES - CLEAN AND INSPECT.

18. Install rocker arm and ball and install nut loosely.

19. Replace cylinder head.

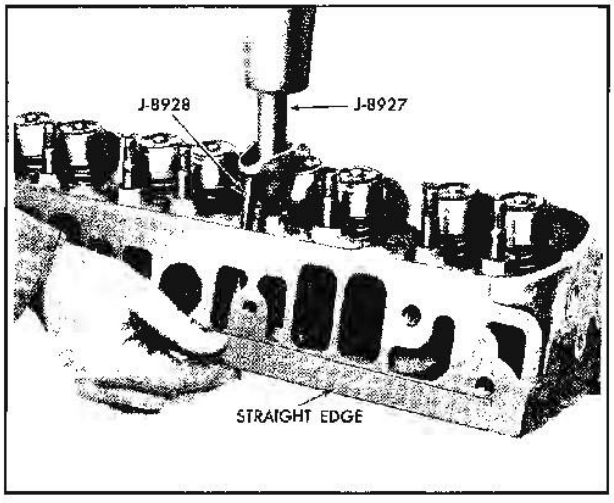

Fig. 6-109 Pressing in New Rocker Arm Stud

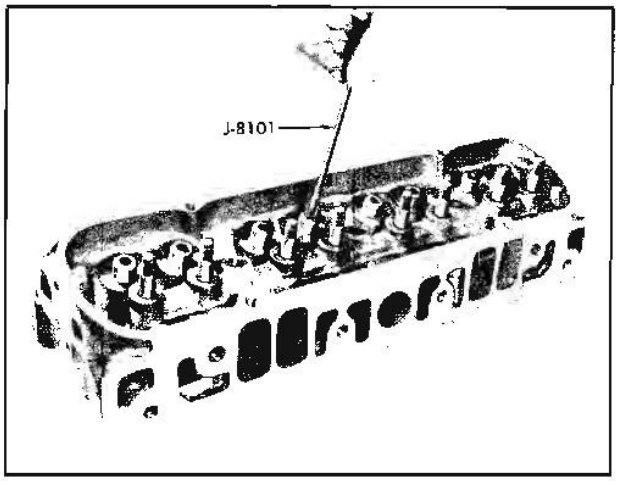

Fig. 6-110 Cleaning Valve Guide With J-8101

CYLINDER HEAD AND VALVES—RECONDITION

CYLINDER HEAD AND VALVES

DISASSEMBLE

1. Remove valve spring retainer cup locks (keepers), valve stem oil seals, valve spring retainer cups, valve stem shields, valve springs, and valves, using valve spring compressor J-8929. Valve stem oil seals must be discarded and replaced with new seals any time they are removed.

2. Place valves in valve and valve train holding stand J-5709.

CYLINDER HEAD AND VALVES - CLEAN AND INSPECT

Efficient engine performance depends to a great degree upon the condition of engine valves. Close inspection of intake valves is especially important as excessive clearance of valve stems in guides will permit oil to be pulled into the combustion chamber causing fouled spark plugs and clogged piston rings. Oil deposited on valve heads will carbonize and burn causing valves to leak with resultant loss of engine power. Therefore, valves must operate properly and if inspection discloses any malfunction of valves, the trouble must be corrected to avoid future damage to valves or related engine parts.

1. Inspect valves and seats to determine condition before cleaning. Also check oil and water passage plugs for evidence of leakage (Fig. 6-107).

2. Clean valves thoroughly to remove deposit from head and stem.

3. Clean and inspect cylinder head as follows

a. Clean carbon deposits from combustio chambers and all sludge or foreign matter fro other areas of cylinder head. If a scraper or wir brush is used for cleaning, use care to preven damage to valve seats.

CAUTION: To prevent damage to valve seat it i good practice to keep wire brush well away fro seat.

b. Clean cylinder head thoroughly using suitabl cleaning equipment.

c. Check oil passages from oil gallery throug rocker arm studs. A simple test can be mad using a rubber hose and smoke. Block lower en of cylinder head screw hole which feeds oil galler (Fig. 6.107) and blow smoke in top end of hol through rubber hose. Smoke should come out hol in each stud.

4. Clean valve guides thoroughly using valve guid cleaner J-8101 (Fig. 6-110).

5. Visually inspect valve guides for evidence c wear, especially the end toward the spring seat. I a guide is scored or galled, install valve with prope oversize stem according to procedure on page 6-

6. Clean valve springs and inspect to see that the meet specifications.

7. Clean push rods and thoroughly clean out oi passage through center of rod. Inspect to see tha the rod is straight.

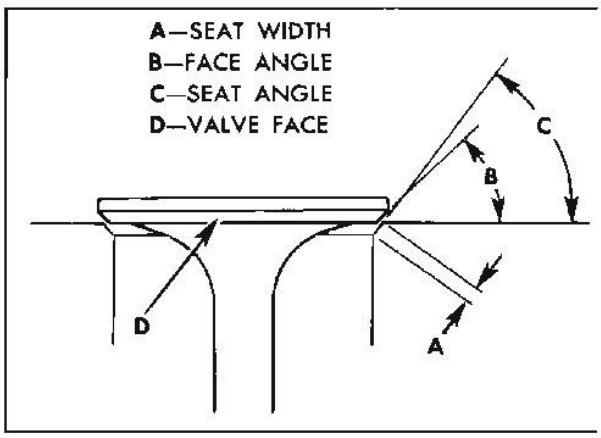

Fig. 6-111 Valve Seat and Face Angles

8. Clean rocker arms and rocker arm balls, and visually inspect for evidence of wear.

9. Clean spark plugs as outlined in ELECTRICAL SECTION.

10. Clean and inspect valve lifters.

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 valve seat angle is 30°, exhaust valve seat angle is 45°. Intake valve face angle is 29° and exhaust valve face angle is 44°. This will provide hairline contact between valve and seat to provide positive sealing and reduce build-up of deposits on seating surfaces (Fig. 6-111).

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" (.048"-.070). Intake valve seat should be between

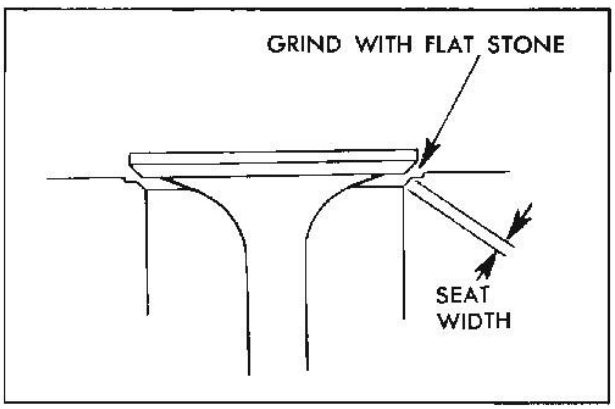

Fig. 6-112 Valve Seat After Grinding With Flat Stone

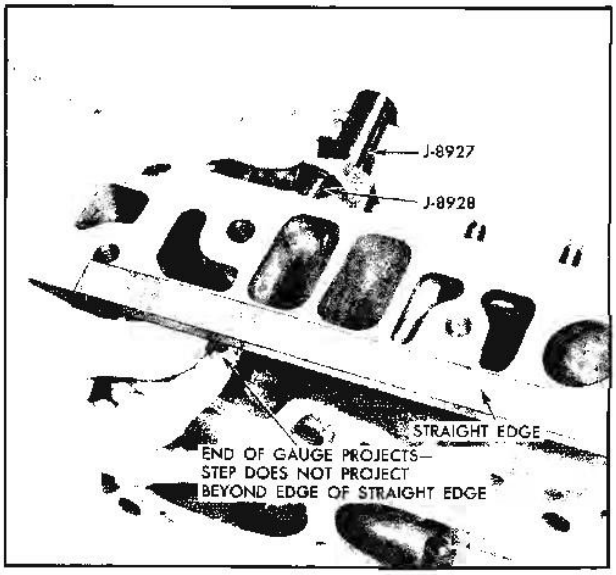

Fig. 6-113 Checking Length of Valve Stem with J-8928

3/64" and 1/16" (.045"-.071"). If seat width is excessive it should be narrowed by grinding with a flat stone (Fig. 6-112). This is the only method that should be used to narrow the seat.

NOTE: Lapping of valve seats is not required or recommended.

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 prussion 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 again with prussian blue 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.

4. Check and correct length of valve stem using valve train gauge J-8928 as follows:

a. Position rocker arm on stud and hold in place using rocker arm stud installer J-8927. Slip

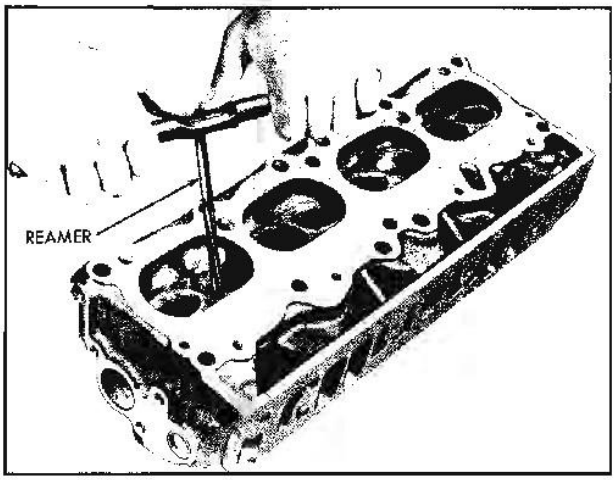

Fig. 6-114 Fitting Valve Stem to Guide

valve into place and hold it against valve seat. While holding rocker arm and valve in position securely, insert valve train gauge J-8928 through push rod hole and seat snugly in push rod seat of rocker arm (Fig. 6-113). With all parts seated, step end of gauge should be at least flush with gasket face of head, but should not project past the step on the gauge.

b. If gauge projects too far, indicating that the valve stem is too long, grind the tip of the valve stem as necessary to make the gauge index properly.

CAUTION: When grinding valve stem, be very careful not to overheat it. Overheating will soften the hardened stem causing rapid wear.

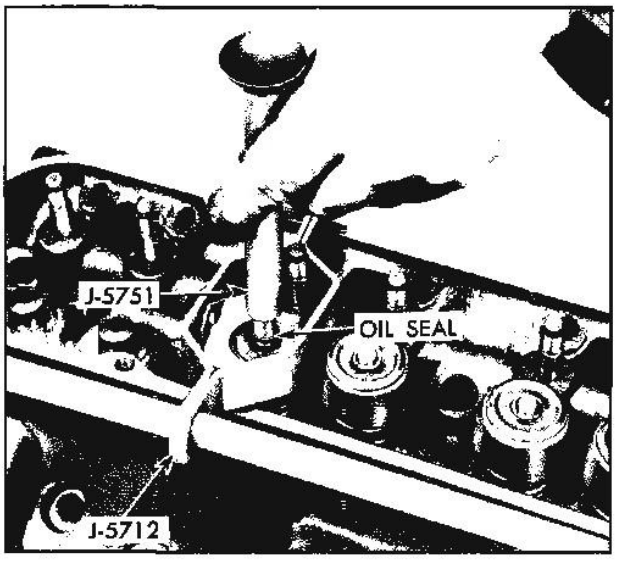

Fig. 6-115 Installing Valve Stem Seal With J-5751

FITTING VALVE STEMS TO GUIDES

Correct valve stem clearance for valve guides : .0021" to .0038" for the intake valve and .0026" t .0043" for the exhaust valve.

Valves with oversize stems are available in .001' .003" and .005" larger than standard. The sam valve stem to guide clearance applies for oversiz stems.

Oversize reamers are required to enlarge valv guide holes to fit the oversize stems. When th reamer is turned through the valve guide it will siz the hole to fit the valve stem according to the abov limits.

Carefully ream the valve guide using valve guid reamer J-5830-1 for .003" oversize stems and valv guide reamer J-6621 for .005" oversize stems (Fi 6-114). For best results when installing .005" over size valve stem use the .003" oversize reamer firs and then ream to .005" oversize. Always reface th valve seat after reaming valve guide.

NOTE: Valves are marked .001, .003 or .005 wit colored ink.

CYLINDER HEAD AND VALVES-- ASSEMBLE

1. Install valves, valve springs, valve ste shields, valve spring retainer cups, valve stem seal and retainer cup locks using suitable spring com pressor. The valve stem seals must be installed i

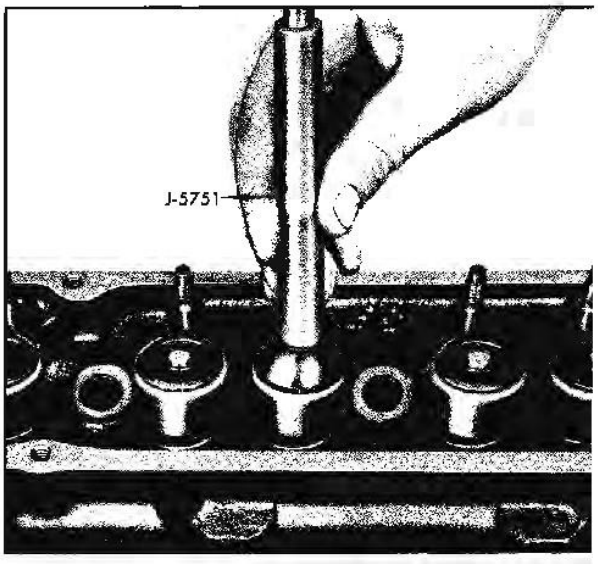

Fig. 6-116 Checking Valve Stem Seal

he second groove (from end of stem). Valve stem seal installer and tester J-5751 can be used to install his seal (Fig. 6-115).

After the valves have been installed, the suction cup end of special tool J-5751 should be used to test for leaks between the valve spring retainer cup and valve stem seal (Fig. 6-116). The suction cup will tend to be held to the valve spring retainer cup by suction when the seal is satisfactory. If a leak is detected, replace seal or valve spring retainer cup as necessary. It is important to have a positive seal between the valve spring retainer cup and the valve stem seal to prevent excessive amount of oil from being drawn down the valve stem which will cause exhaust smoke and oil consumption.

2. Install spark plugs.

HARMONIC BALANCER—TIMING CHAIN COVER AND GASKET—TIMING CHAIN AND SPROCKETS—OIL SEAL—FUEL PUMP ECCENTRIC

HARMONIC BALANCER—REMOVE AND REPLACE

1. Loosen generator at adjusting bracket and lower pivot bolt and remove fan belt from harmonic balancer. On cars equipped with power steering, also remove power steering pump belt from harmonic balancer.

2. Position fan so wide angles will be at top and bottom allowing access to balancer (Fig. 6-117).

3. Remove harmonic balancer attaching bolt and retainer washer.

4. Remove harmonic balancer by sliding it off end of crankshaft.

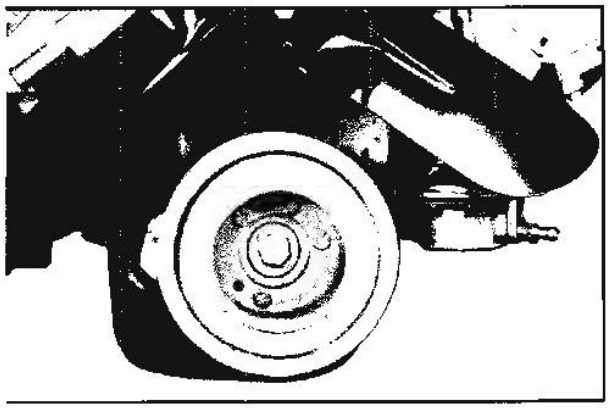

Fig. 6-117 Harmonic Balancer

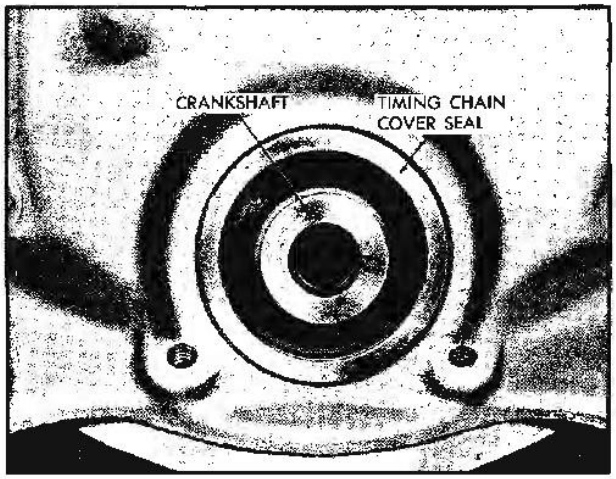

Fig. 6-118 Timing Chain Cover Seal

5. Install new harmonic balancer by reversing above steps, lining up keyway in balancer with key on crankshaft.

6. Tighten harmonic balancer attaching bolt to 130-190 lb. ft. torque.

NOTE: Remove flywheel cover and lock flywheel before tightening balancer bolt.

TIMING CHAIN COVER SEAL—REMOVE AND REPLACE

1. Loosen alternator adjusting bolts.

2. Remove chain and accessory drive belt.

3. Remove harmonic balancer.

4. Remove timing chain cover seal by prying out of bore with a pry bar (Fig. 6-118).

5. Install new seal with lip of seal inward using seal installer J-21147.

6. Replace harmonic balancer.

7. Install drive belts and adjust to proper tension.

TIMING CHAIN COVER, GASKET, OR FUEL PUMP ECCENTRIC—REMOVE AND REPLACE

1. Drain radiator and cylinder block.

2. Loosen alternator adjusting bolts.

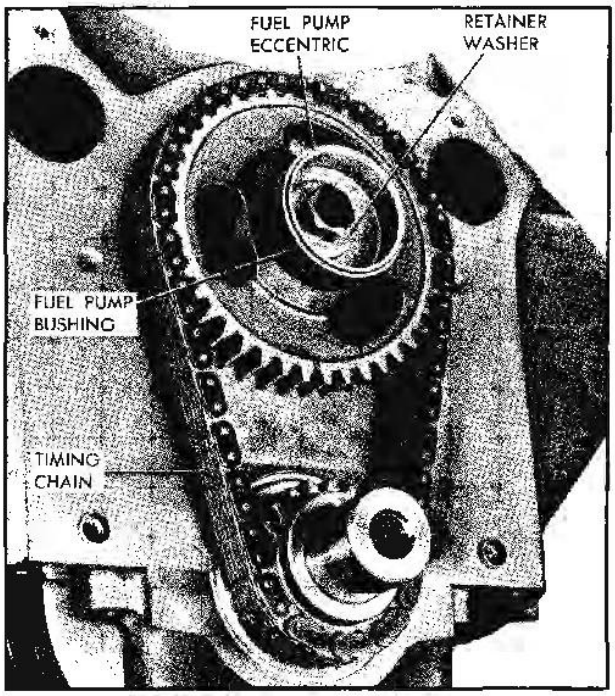

Fig. 6-119 Front of Engine With Timing Chain Cover Removed

3. Remove fan belt and accessory drive belt.

4. Remove fan and pulley from hub of water pump.

5. Disconnect upper and lower radiator hoses.

6. Remove fuel pump.

7. Remove harmonic balancer.

8. Remove front four oil pan to timing chain cover screws.

9. Remove timing chain cover to block attaching bolts and nuts and timing chain cover to intake manifold bolt.

10. Pull timing chain cover forward to clear studs and remove.

11. Remove "O" ring seal from recess in intake manifold water recirculation passage.

12. Remove timing chain cover gasket and thoroughly clean gasket surfaces on block and cover. Use care to prevent gasket particles and other foreign material from falling into oil pan.

13. Inspect front oil pan gasket and replace if damaged. If new gasket is installed, it should be cemented to oil pan.

14. If new fuel pump eccentric and bushing are t be installed, remove camshaft sprocket retainer bo and retaining washer and remove the eccentric ar bushing. Place fuel pump bushing over eccentric wit rolled flange toward camshaft sprocket (Fig. 6-119

NOTE: Bushing retaining flange should be betwee eccentric and sprocket for retention of bushing operation.

Install bushing and eccentric, indexing tang c eccentric with keyway cutout in camshaft sprocke Insert retaining screw with retainer washer ar tighten securely.

15. Position new timing chain cover gasket ove studs and dowels against block.

16. Transfer water pump to new timing cha cover if new cover is to be installed.

17. Install new "O" ring seal in water recircul tion passage of intake manifold.

18. Position timing chain cover on engine indexir over dowels, install bolts and nuts and tight securely.

19. Install four oil pan to timing chain cov screws and tighten to 10-15 lb. ft. torque.

20. Install harmonic balancer, retainer bolt wi retainer, and tighten to 130-190 lb. ft. torque.

21. Connect lower radiator hose to pump inl

22. Position pulley and fan on water pump h and install attaching bolts. Tighten to 15-25 lb. torque.

23. Install power steering pump and belt on ca so equipped.

24. Install generator adjusting strap.

25. Install fan belt and accessory drive belt Adjust to proper tension.

26. Install fuel pump.

27. Refill cooling system and check for leak

TIMING CHAIN AND SPROCKETS— REMOVE AND REPLACE

1. Remove timing chain cover, making certa "O" ring seal and hollow dowels are retained f installation at assembly.

2. Remove fuel pump eccentric, bushing and timing hain cover oil seal.

3. Align timing marks to simplify proper positioning of sprockets during reassembly (Fig. 6-120).

4. Slide timing chain and sprockets off ends of rankshaft and camshaft.

5. Install new timing chain and/or sprockets making sure marks on timing sprockets are aligned xactly on a straight line passing through the shaft enters (Fig. 6-120). Camshaft should extend through procket so that hole in fuel pump eccentric will ocate on shaft.

6. Install fuel pump eccentric and bushing, indexng tab on eccentric with keyway cutout in sprocket. nstall retainer bolt with retainer washer and tighten ecurely.

7. Making certain hollow dowels are in place in lock, place timing chain cover gasket over studs nd dowels.

8. Install timing chain cover, making sure "O" ing seal is in place.

'AMSHAFT AND/OR CAMSHAFT BEARING— EMOVE AND REPLACE

The camshaft and camshaft bearings can be relaced with engine installed in car or with engine emoved and disassembled for overhaul; however, o replace the rear camshaft bearing without reoving and completely disassembling engine, the ropeller shaft, transmission and clutch housing ust first be removed.

To replace the camshaft and/or the rear center, enter, front center or front camshaft bearing without removing and completely disassembling the enine, proceed as follows:

1. Drain radiator.

2. Remove carburetor air filter.

3. Disconnect all water hoses, vacuum hose and park plug wires.

4. Disconnect carburetor linkage, fuel lines and ires to thermogage unit.

5. Remove hood latch bracket.

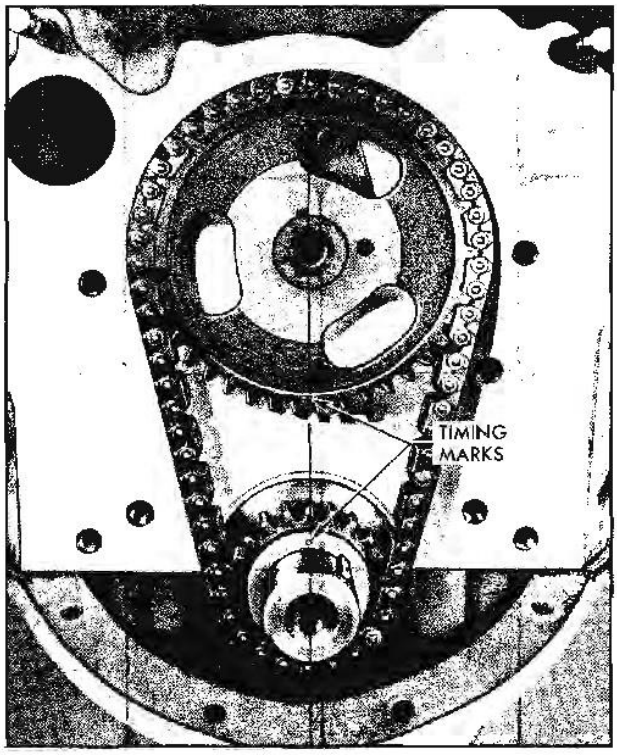

Fig. 6-120 Aligning Timing Marks

6. Remove radiator, fan and pulleys.

7. On air conditioned cars, remove alternator mounting bracket and alternator.

8. Remove crankcase ventilator hose, and remove both rocker arm covers and gaskets.

9. Remove distributor hold-down clamp and remove distributor.

10. Remove intake manifold and gaskets.

NOTE: Make certain "O" ring seal between intake manifold and timing chain cover is retained and installed during assembly.

11. Remove push rod cover.

12. Loosen rocker arm ball retaining nuts so that rocker arms can be disengaged from push rods and turned sideways.

13. Remove push rods and hydraulic lifters. Store push rods in stand J-5709 and lifters in lifter box J-5763 so they can be reinstalled in original positions.

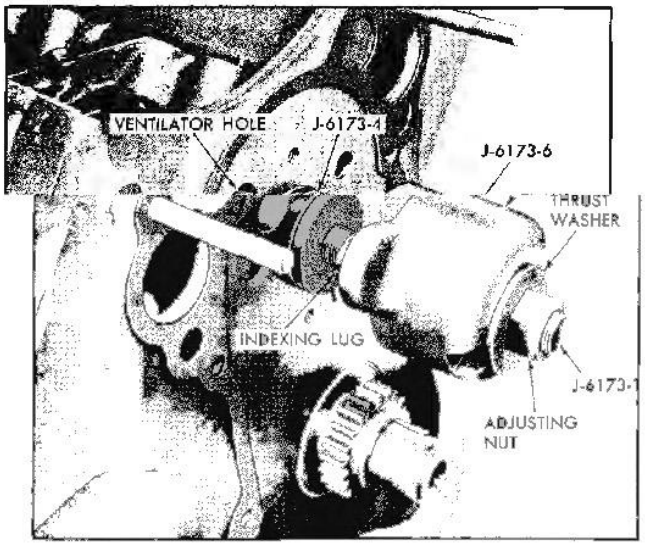

Fig. 6-121 Positioning Index Collar

14. Remove harmonic balancer.

15. Remove fuel pump.

16. Remove four oil pan to timing chain cover screws.

17. Remove timing chain cover and gasket.

18. Remove fuel pump eccentric and fuel pump bushing.

19. Align timing marks on timing chain sprockets and remove timing chain and sprockets.

20. Remove camshaft thrust plate.

21. Carefully pull camshaft from engine, exercising caution so as not to damage bearings in block.

NOTE: The clearance for camshaft removal is very limited and, in cases where engine mounts are worn excessively, it may be necessary to raise the front of the engine to permit removal.

22. Stuff clean rags through openings in engine block as an aid in preventing foreign material or parts of bearing remover tool from dropping into block.

CAUTION: It is imperative that operator exercise extreme caution when inserting bearing remover adapters or key through openings in engine block to prevent them from dropping into engine.

CAMSHAFT BEARING--REMOVE

1. Insert remover adapter J-6173-4 into fro bearing to act as a support for shaft J-6173-1 (Fi 6-121).

NOTE: If front bearing is to be replaced, inse installer adapter in center bearing to act as su port for shaft.

2. Insert replacer adapter J-6173-3 into rear bearing to be removed so that shoulder on remov bears against rear edge of bearing.

NOTE: If rear bearing is to be removed, it w be necessary to remove camshaft rear plug.

3. Place indexing collar J-6173-6 on threaded e of shaft with open side toward unthreaded end a start thrust washer and nut on shaft (Fig. 6-12

4. Insert shaft and indexing collar through r mover and replacer adapters and position lug indexing collar in ventilator hole in front of blo (Fig. 6-121). This indexes the shaft so that it cann rotate.

5. Slip key J-6173-5 into notches in shaft behi bearing to be removed (Fig. 6-122).

6. Turn nut on front of shaft to pull key again remover adapter J-6173-4, then continue to turn r until bearing is pulled out of its hole.

CAMSHAFT BEARING -- REPLACE

1. Place a clean rag against each side of t transverse member just below the bearing hole

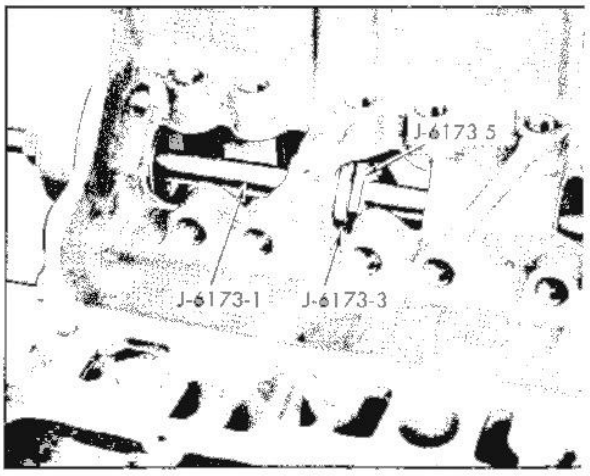

Fig. 6-122 Preparing to Remove Camshaft Bearing

catch any shavings and carefully clean up the hole. All scratches or nicks in the cast iron should be smoothed with a scraper or file, being careful not to get any chips in cylinder head gallery feed hole. Chamfer the rear edge of the hole slightly to reduce the possibility of shaving down the outer diameter of the bearing when it is installed.

2. Insert remover adapter J-6173-4 into front bearing to act as a support for the shaft.

NOTE: If front bearing is being replaced, insert remover adapter in center bearing to act as support for the shaft.

3. Insert pilot J-6173-7 into hole in which bearing is to be installed.

4. Coat outside of new bearing with oil and place it over replacer adapter J-6173-3, indexing notch in edge of bearing with pin on replacer adapter.

NOTE: The notch in the edge of the bearing is used to properly position the bearing, with respect to the oil holes, when it is installed. When bearings are installed in production, the notches all face the front except the one in the rear bearing. In the field it is necessary to install bearings with the notch facing the rear.

5. Position replacer adapter J-6173-3, with bearing in position against shoulder, against rear of hole in which bearing is to be installed (Fig. 6-123). Index mark on shoulder of replacer must point down toward crankshaft side) to properly position bearing.

6. Insert shaft with indexing collar, thrust washer, and nut through remover, pilot and replacer adapters and index lug on collar with ventilation hole in front of block (Fig. 6-121).

7. Slip key J-6173-5 into notches in shaft behind replacer adapter J-6173-3 and tighten nut to start bearing into hole (Fig. 6-123). Continue to tighten nut until bearing has been pulled completely into its hole. When properly positioned, it will be approximately flush with both sides of the transverse member.

NOTE: Rear bearing should be pulled in until front edge is flush with block. This will leave shoulder at end of counterbore for camshaft rear plug visible behind bearing.

8. Remove remover and replacer set J-6173.

9. Visually observe that holes in bearing line up with drillings in block.

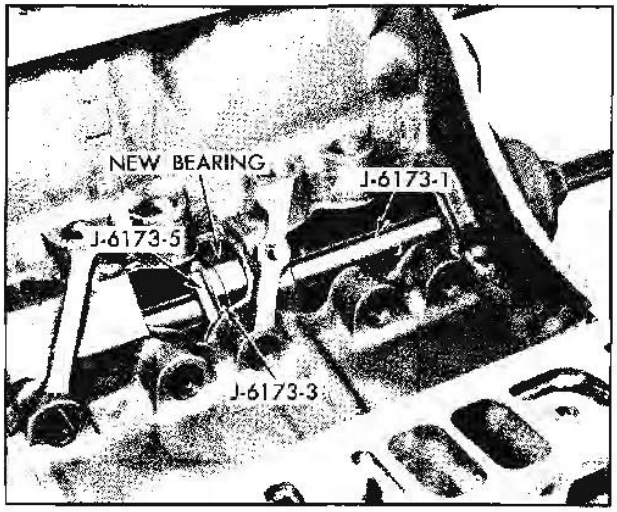

Fig. 6-123 Preparing to Install Camshaft Bearing

10. Carefully remove rags used to catch particles of metal and use magnet or vacuum cleaner to make sure that all metal particles are removed from block surfaces and oil drillings.

CAMSHAFT - REPLACE

1. Coat inner diameters of all camshaft bearings with oil and carefully install camshaft. Rotate camshaft through several revolutions to make sure it is completely free. If any tight spots are found, remove camshaft and very carefully polish down the center journal slightly. If still not free, polish the front and rear journals slightly. If any particular bearing causes binding of the camshaft, replace that bearing also.

NOTE: Front center and rear center journals should not be polished except to remove slight roughness or scratches. Slight warpage of the camshaft is not harmful provided the journals are polished down until the camshaft rotates freely in its bearings.

2. With camshaft properly seated, install camshaft thrust plate and tighten bolts 10-25 lb. ft. torque.

3. Install timing chain sprockets and timing chain, making sure marks on sprockets are aligned properly (Fig. 6-120).

4. Install fuel pump eccentric and bushing. Tighten camshaft sprocket retaining bolt 30-45 lb. ft. torque.

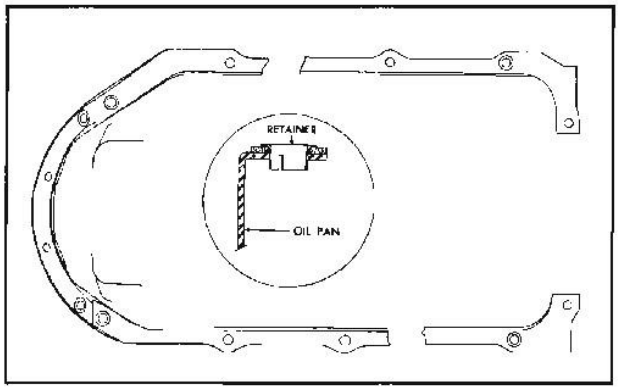

Fig. 6-124 Installing Oil Pan Gasket Retainers

5. Install timing chain cover dowels and new gasket and tighten cover to cylinder block bolts and cover to block stud nuts 20-35 lb. ft. torque.

6. Insert four oil pan to timing chain cover screws and tighten 10-15 lb. ft. torque.

7. Install fuel pump and tighten bolts 15-30 lb. ft. torque.

8. Install harmonic balancer. Tighten bolt 130-190 lb. ft. torque.

9. Install hydraulic lifters and push rods, making certain they are replaced in their original positions.

10. Engage rocker arms on push rods and tighten rocker arm ball retaining nuts 15-25 lb. ft. torque.

11. Install push rod cover. Tighten bolts 25-70 lb. in. torque.

12. Install intake manifold and gasket. Tighte bolts 30-45 lb. ft. torque.

NOTE: "O" ring seal must be installed betwee intake manifold and timing chain cover before man fold is securely positioned.

13. Install distributor, positioning rotor pointe to number six cylinder, and install distributor hold down clamp. Tighten clamp retaining screw 15-2 lb. ft. torque.

14. Install crankcase ventilator outlet pipe ar both rocker arm covers and gaskets. Tighten cove bolts 45-80 lb. in. torque.

15. If generator bracket and generator were r moved, install and tighten bolts 10-25 lb. ft. torqu

16. Install fan and pulleys.

17. Install radiator, tightening all bolts securel

18. Install hood latch bracket and tighten bol 15-20 lb. ft. torque.

19. Connect carburetor linkage, fuel lines a thermogage unit.

20. Connect all water hoses, vacuum hose a spark plug wires.

21. Install carburetor air filter.

22. Refill cooling system and check for leak

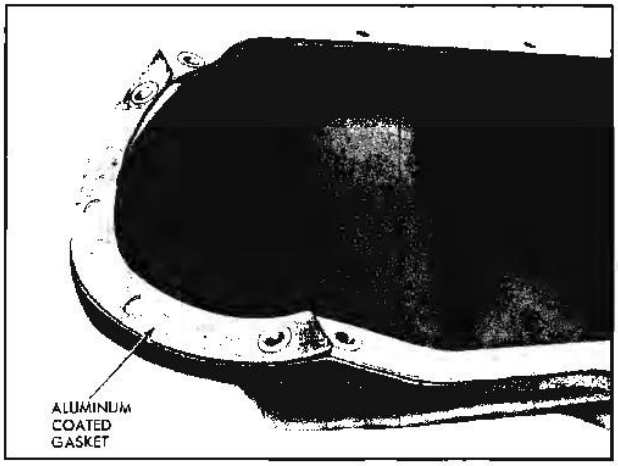

Fig. 6-125 Front Oil Pan Gasket Overlapping Side Gaskets

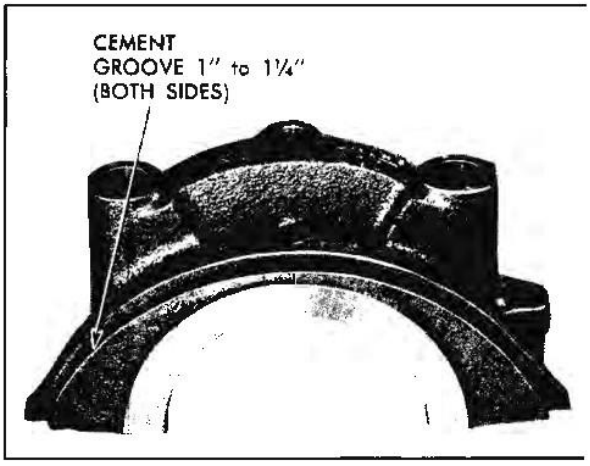

Fig. 6-126 Rear Oil Pan Gasket Positioned in Bearing C

OIL PAN AND/OR OIL PAN GASKETS—REMOVE AND REPLACE

REMOVE

1. Remove engine, clutch (SM) and transmission as an assembly from vehicle.

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

3. Place engine on a suitable stand.

4. Remove oil pan.

REPLACE

1. Install new gaskets on oil pan using gasket retainers (Figs. 6-124, 125).

2. Install new oil pan gasket in rear main bearing cap (Fig. 6-126).

3. Install oil pan into position and torque retaining screws 10-15 lb. ft.

4. Remove engine from stand.

5. Install clutch (SM) and transmission to engine and install complete assembly in vehicle.

OIL PUMP—REMOVE AND REPLACE

1. Remove engine oil pan (See "Oil Pan - Remove and Replace").

2. Remove oil pump attaching bolts while holding oil pump in place. Carefully lower oil pump away from block with one hand while removing oil pump drive shaft with other hand (Fig. 6-127).

3. Position drive shaft in distributor and oil pump drive gears. Place pump against block using new gasket between pump and block. Index drive shaft with pump drive gear shaft. Install two attaching screws with lockwashers and tighten securely.

NOTE: Removal and installation of pump does not affect ignition timing, since the oil pump and distributor drive gear is mounted on the distributor shaft.

4. Install oil pan

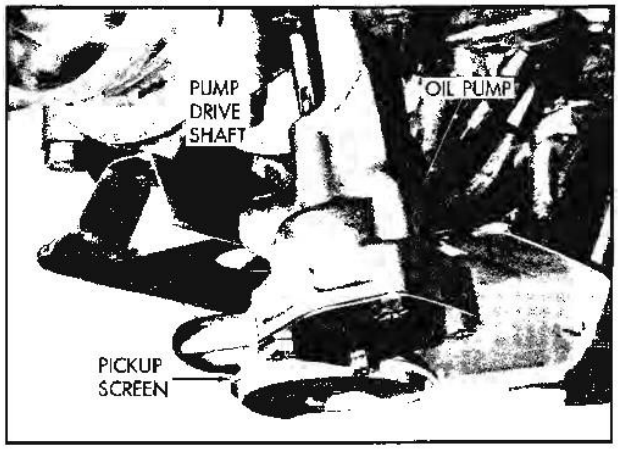

Fig. 6-127 Oil Pump and Oil Pump Drive Shaft

OIL PUMP—RECONDITION

DISASSEMBLE

1. Remove pressure regulator spring retainer, spring, and pressure regulator ball.

2. Remove screws retaining cover to oil pump body and remove cover.

3. Remove driven gear and drive gear with shaft.

NOTE: Oil pump screen should not be removed from pump body. Be careful not to loosen screen.

CLEAN AND INSPECT

1. Clean all parts thoroughly. Screen must be thoroughly cleaned by using a fluid such as used for carburetor cleaning.

2. Inspect pressure regulator spring (Fig. 6-128) for distortion, cracks, and wear on sides.

3. Inspect pressure regulator ball to see that it is not nicked or otherwise damaged.

4. Inspect pump body, driven gear shaft and cover for evidence of wear.

5. Inspect pump gears and end of drive gear shaft for wear (Fig. 6-128).

6. Inspect oil pump drive shaft (distributor to pump shaft) for evidence of wear and cracks.

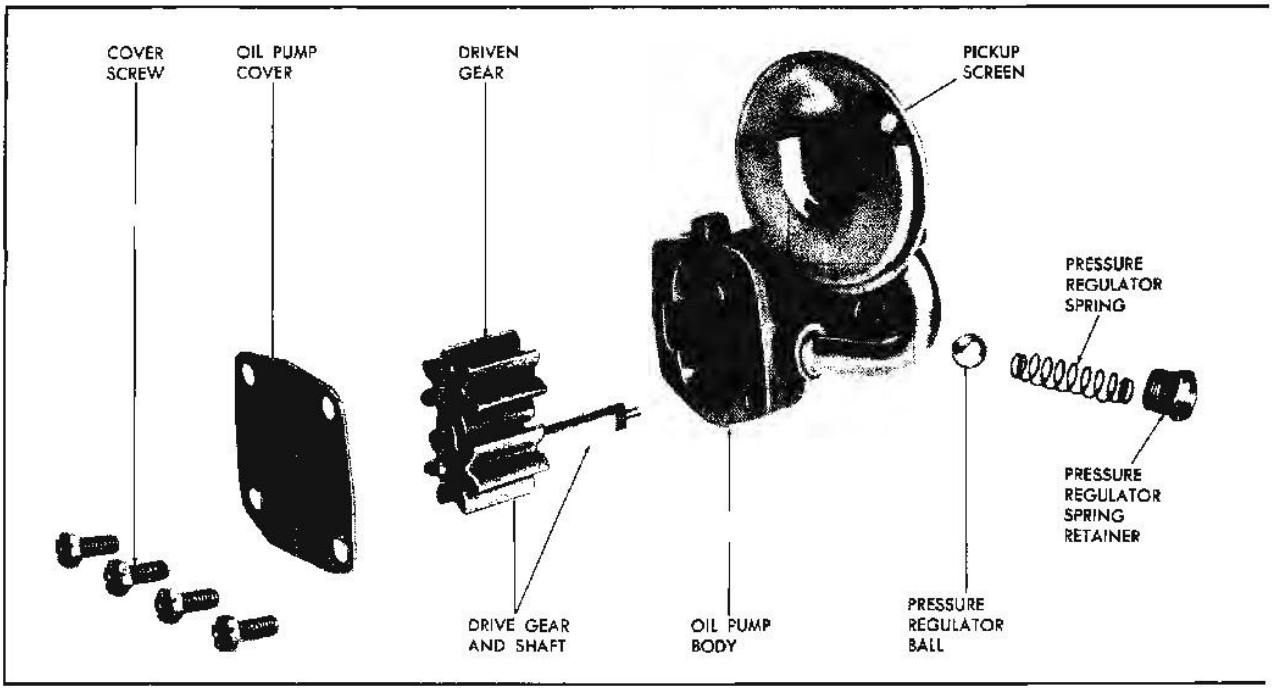

Fig. 6-128 Oil Pump - Exploded View

ASSEMBLE

1. Install drive and driven gears.

2. Install cover and turn drive shaft by hand to ensure that it turns freely.

3. Install pressure regulator ball, spring and retainer.

CAUTION: Do not attempt to change oil pressure by varying length of pressure regulator valve spring.

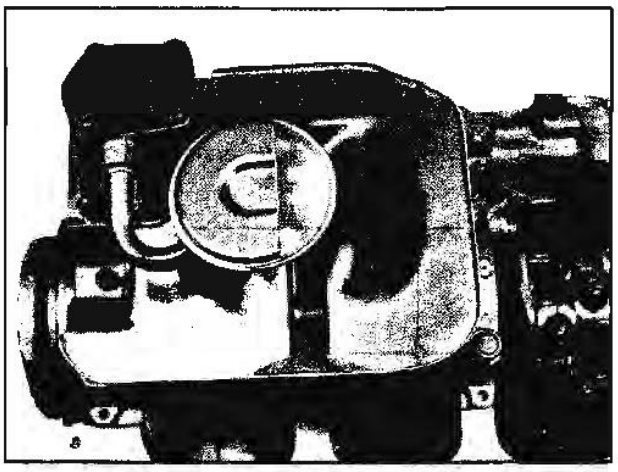

Fig. 6-129 Oil Pump and Baffle

REAR MAIN BEARING OIL SEAL— REMOVE AND REPLACE

1. Remove oil pan (See "Oil Pan - Remove an Replace").

2. Remove oil pump and baffle (Fig. 6-129).

3. Remove rear main bearing cap.

4. Use tool shown in Fig. 6-130 made from bras bar stock to pack upper seal as follows:

a. Insert tool against one end of the oil seal the cylinder block and drive the seal gently int the groove until the tool bottoms.

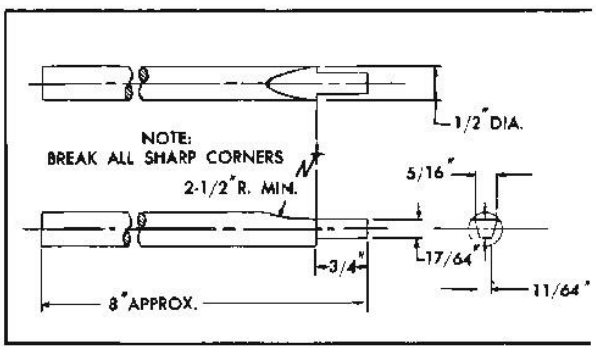

Fig. 6-130 Rear Main Bearing Oil Seal Tool

b. Remove the tool and repeat at the other end of the seal in the cylinder block.

5. Clean the block and bearing cap parting line thoroughly.

6. Form a new seal in the cap (Fig. 6-131).

7. Remove the newly formed seal from the cap and cut four (4) pieces approximately 3/8" long from this seal.

8. Work two 3/8"pieces into each of the gaps which have been made at the end of the seal in the cylinder block. Without cutting off the ends, work these seal pieces in until flush with the parting line and no fibers are protruding over the metal adjacent to the groove.

9. Form another new seal in the cap (Fig. 6-131).

10. Assemble the cap to the block and tighten to 110-130 lb. ft. torque.

11. Remove the cap and inspect the parting line to insure that no seal material has been compressed between the block and the cap. Clean as necessary.

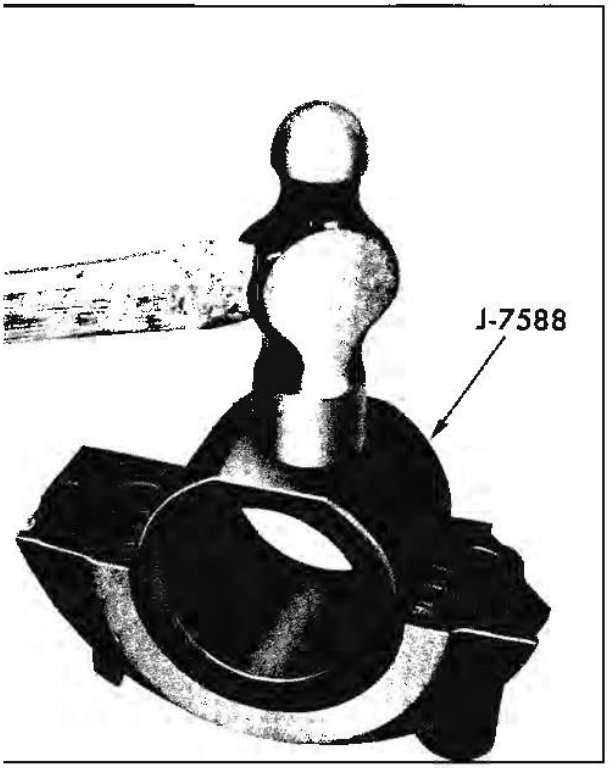

Fig. 6-131 Forming New Seal in Cap

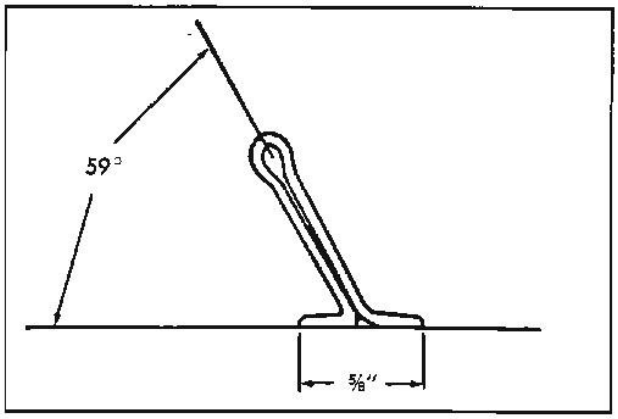

Fig. 6-132 Tool for Removing Upper Half of Main Bearing

12. Apply a 1/16" bead of sealer from the center of seal across to the external cork groove.

13. Reassemble the cap. Tighten to 110-130 lb. ft. torque.

14. Install baffle and oil pump.

15. Install oil pan (See "Oil Pan - Remove and Replace").

MAIN BEARINGS—REMOVE AND REPLACE

1. Remove oil pan. (See "Oil Pan - Remove and Replace").

2. To gain access to rear center bearing cap, remove oil baffle. To gain access to rear main, remove oil pump in addition to oil baffle.

3. Remove bearing cap of main bearing to be replaced.

4. Make a tool for removing upper half of bearing shell as shown in Fig. 6-132. KMO 734 can also be used.

5. Insert tool in oil hole of crankshaft and rotate crankshaft in usual direction of rotation. This will cause bearing to be moved from between shaft and bearing seat.

6. Oil bearing surface of shell and install by inserting plain end of bearing shell at indented side of bearing seat and gently rotating shell into place by turning shaft.

7. Install new bearing lower half by inserting in bearing cap so indentation in shell and cap coincide.

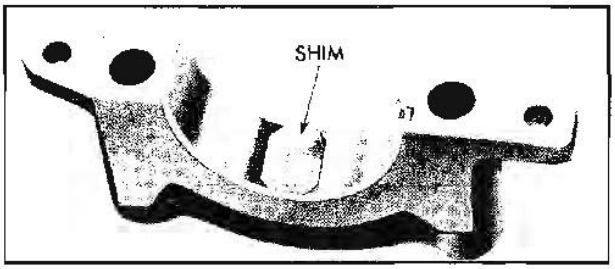

Fig. 6-133 .002 Shim Positioned in Cap for Checking Bearing Clearance

8. Install bearing cap and check fit of bearing using plastigage or shim stock as outlined below.

CAUTION: Under no circumstances should bearing caps be filed or shimmed in an effort to effect a fit.

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 (Fig. 6-133).

Tighten all cap bolts to proper torque as follows: rear - 110-130 lb. ft., all others 90-110 lb. 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 b checked. Wipe the bearing and the journal free c oil.

3. Place a piece of Plastigage the length of th bearing (parallel to the crankshaft) on the journal o bearing surface (Fig. 6-134). Install the cap an tighten cap bolts to proper torque.

NOTE: Do not turn crankshaft with Plastigage i place.

4. Remove bearing cap and using Plastigage scal on envelope measure width of compressed Plastigat before removing it from the bearing or journal (Fi 6-135). If the bearing clearance is between .0005 and .0020", the clearance is satisfactory. If th clearance is more than .0020", replace the bearin with the next size undersize bearing and rechec clearance. Bearings are available in standard size .001" and .002" undersize.

5. Install a new rear main bearing oil seal in th cylinder block and main bearing cap if the rea main bearing was checked and/or replaced (see pag 6-).

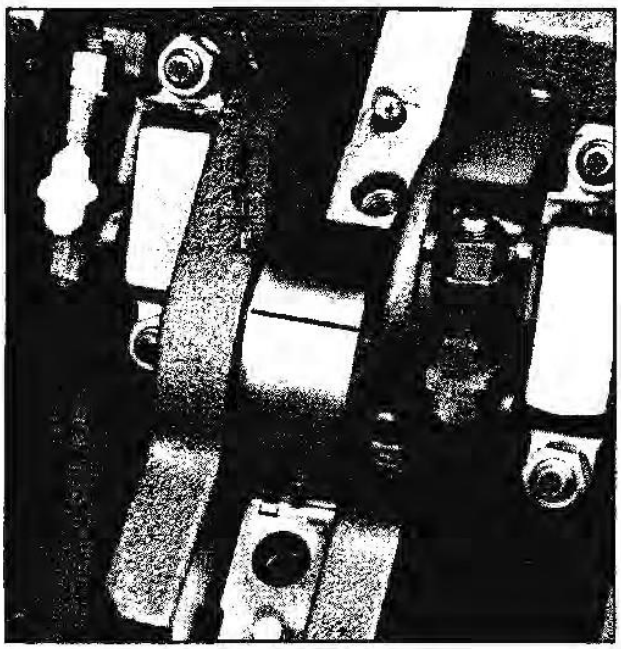

Fig. 6-134 Plastigage on Journal

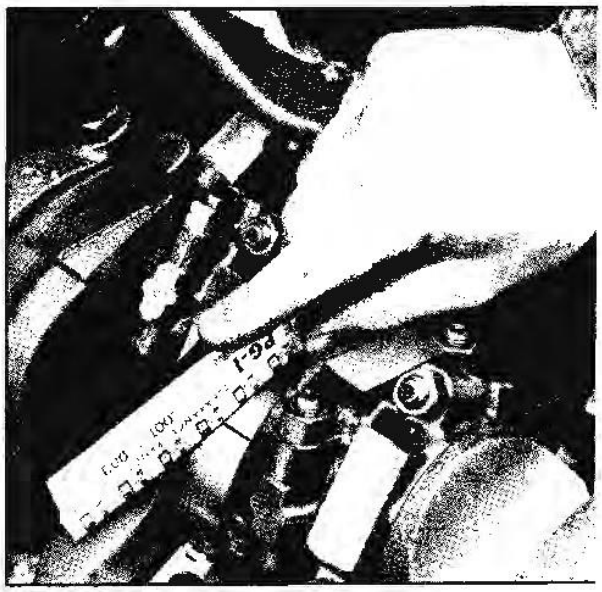

Fig. 6-135 Measuring Plastigage

CONNECTING ROD BEARINGS— REMOVE AND REPLACE

1. Remove oil pan. (See "Oil Pan - Remove and Replace").

2. To gain access to numbers 5, 6, 7, or 8 connecting rod caps it will be necessary to remove oil pump screen and oil baffle.

3. Rotate crankshaft as necessary to bring crankpin carrying bearing to be replaced straight down (Fig. 6-136).

4. Remove bearing cap of bearing to be replaced.

5. Install connecting rod bolt guide set J-5239 on connecting rod bolts (Fig. 6-137).

6. Push piston and rod assembly up far enough to allow removal of bearing shell. Remove bearing shells from rod and cap.

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

8. Reassemble cap and rod with new bearing shells and check fit using Plastigage or shim stock as outlined below.

CAUTION: Under no circumstances should a bearing cap be filed or shimmed in an effort to effect a fit.

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.

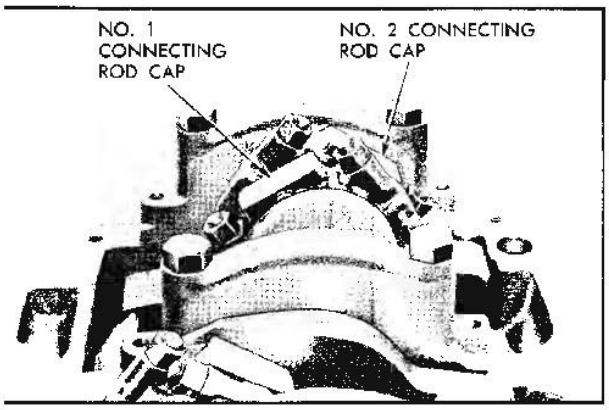

Fig. 6-136 Crankshaft Positioned for Removal of No. 1 and No. 2 Connecting Rod Caps

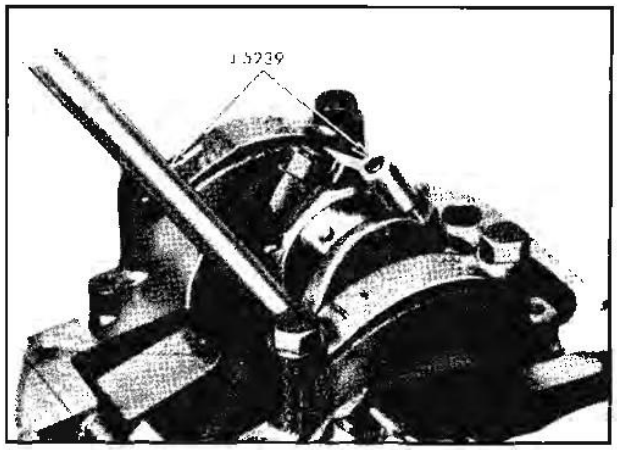

Fig. 6-137 J-5239 Positioned for Removal of Rod Connecting Bearing Shell

2. Place a piece of Plastigage the length of the bearing (parallel to the crankshaft) on the crankpin or bearing surface, Fig. 6-138. Install the cap and tighten cap bolts to 45 lb. ft.

NOTE: Do not turn crankshaft with Plastigage in place.

3. Remove bearing cap and using Plastigage scale on envelope measure width of compressed Plastigage before removing it from the crankpin or bearing (Fig. 6-139). If the bearing clearance is between .0005" and .0025" the clearance is satisfactory. If the clearance is more than .0025" replace the bearing with the next size undersize bearing and recheck clearance. Bearings are available in .001" and .002" undersize.

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

CONNECTING ROD AND PISTON ASSEMBLY— REMOVE AND REPLACE

REMOVE

1. Remove oil pan and if number 5, 6, 7 or 8 rod and piston assembly is to be removed, remove oil baffle and oil pump. (See "Oil Pan - Remove and Replace").

2. Remove intake manifold and cylinder head on bank from which piston is to be removed.

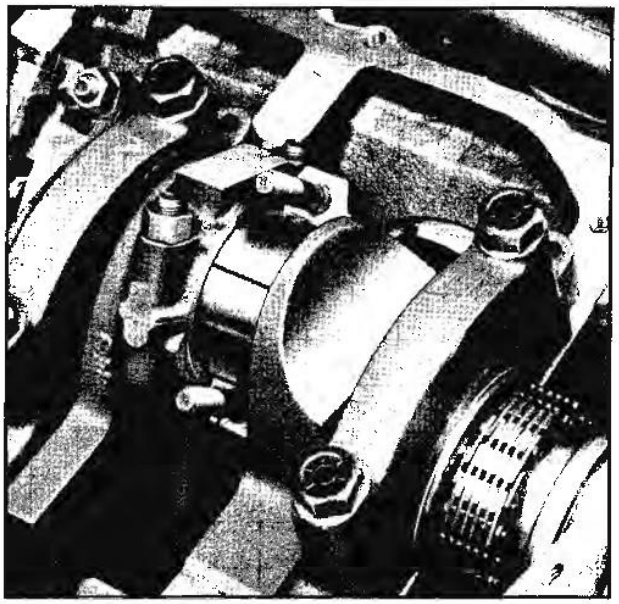

Fig. 6-138 Plastigage on Crankpin

3. Rotate crankshaft so crankpin carrying assembly to be replaced projects straight downward (Fig. 6-136).

4. Remove bearing cap and install connecting rod bolt guide set J-5239.

5. Carefully remove connecting rod and piston assembly by pushing out with knurled handle of long guide (Fig. 6-137).

REPLACE

1. Install connecting rod bolt guide set on connecting rod bolts with long handle guide on same side as oil groove in rod.

2. Using suitable ring compressor insert piston and connecting rod assembly into cylinder so that notch in top of piston is toward front of engine. This will place the oil groove of the connecting rod so that it will direct oil against the opposite cylinder wall.

3. From beneath engine, pull connecting rod, with bearing shell in place, into position against crankpin.

4. Remove guide set J-5239. Install bearing cap and cap nuts and tighten to 40-46 lb. ft. torque.

5. Replace oil pump screen and oil baffle, if they were removed.

6. Install cylinder head and intake manifold

7. Replace oil pan, using new gaskets. Tighten oil pan screws to 10-15 lb. ft. torque.

CONNECTING ROD AND PISTON ASSEMBLY— RECONDITION

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.

CONNECTING ROD AND PISTON -- DISASSEMBLE

1. Remove piston rings using suitable piston ring remover.

NOTE: It is important that rings be removed carefully to prevent scratching or burring of ring grooves and lands.

2. Using a suitable arbor press place the spring and plunger into the bore of the base support and position on an arbor press with the pilot plunger indexed in the bottom of piston pin bore. See Fig. 6-140 insert for correct base support and pilot plunger for the type pistons being serviced.

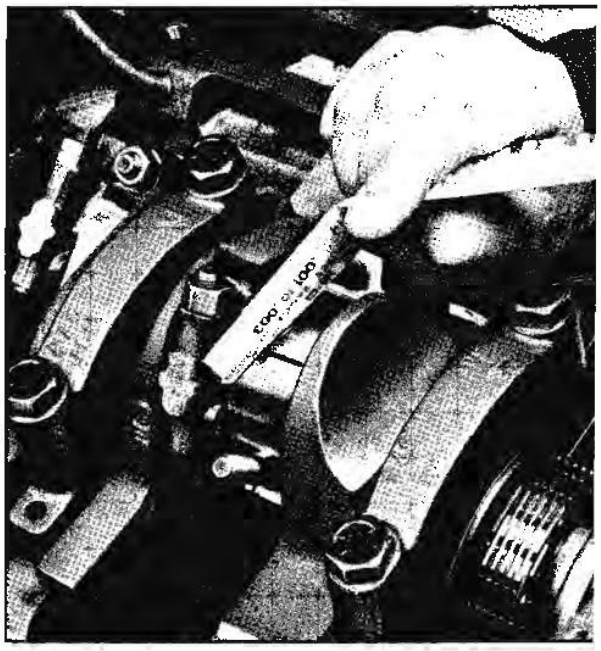

Fig. 6-139 Measuring Piston

3. Place tool J-6901-5 between connecting rod and piston boss (Fig. 6-140).

4. Place tool J-6901-3 (Fig. 6-140) in piston pin and press piston pin down until pilot bottoms in tool J-6901.

5. Remove tool J-6901-5 from between connecting rod and piston boss.

6. Remove pilot plunger and spring from tool J-6901.

7. Place end of piston pin in tool J-6901 and place on arbor press.

8. Using tool J-6901-3 (Fig. 6-140) press pin out of piston and connecting rod.

9. Remove bearing cap and bearing.

CONNECTING ROD AND PISTON--
CLEAN AND INSPECT

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

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

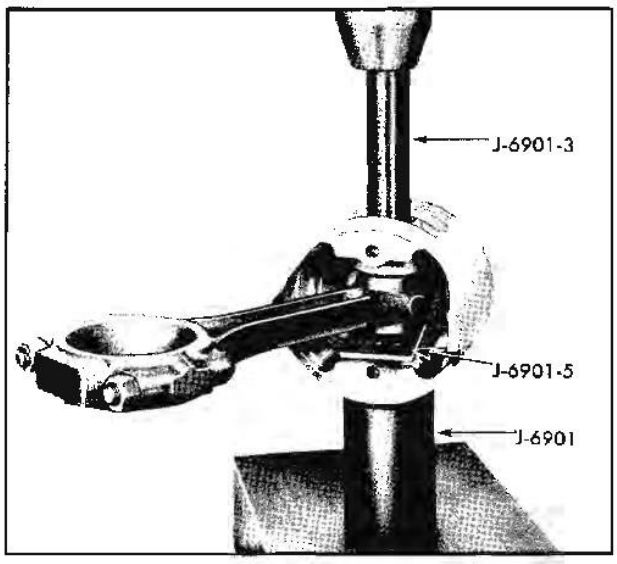

Fig. 6-140 Piston Positioned in Arbor Press for Removal of Pin

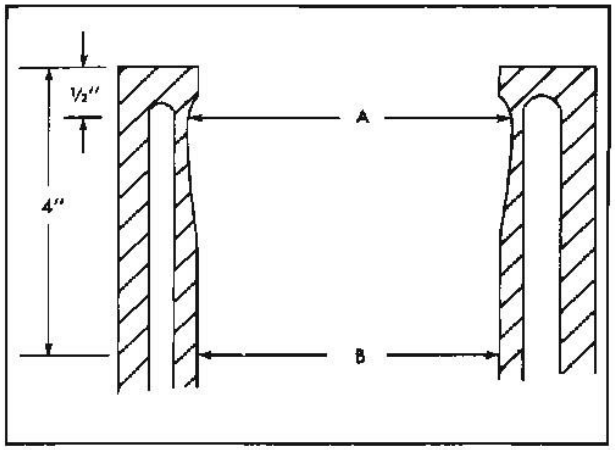

Fig. 6-141 Normal Cylinder Wear Pattern

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

NOTE: If piston pin bosses are rough or worn out-of-round and the piston is otherwise serviceable, the pin bosses may be honed for oversize pins. Before fitting oversize pins, however, it is advisable to check fit the piston in bore.

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

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

CYLINDER BORES--INSPECT

Inspect cylinder bores for out-of-round or excessive taper with an accurate cylinder gauge J-8087 or comparable, at top, middle and bottom of bore. Measure cylinder bore parallel and at right angles to the center line of the engine to determine out-of-round. Variation in measure from top to bottom of cylinder indicates the taper in the cylinder.

Fig. 6-141 illustrates area in cylinder where normal wear occurs. If the measurement at dimension A, taken at a point one half inch down from top of cylinder is .007" in excess of dimension B taken at a point four inches down from top of cylinder, this indicates the necessity of cylinder boring and installing new rings and pistons. Cylinder bore can be measured by setting the cylinder gauge dial at zero

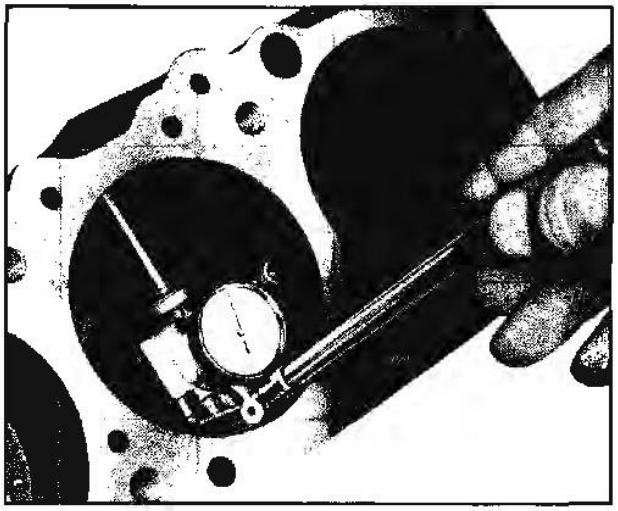

Fig. 6-142 Measuring Cylinder Bore

in the cylinder at the point of desired measurement. Lock dial indicator at zero before removing from cylinder, and measure across the gauge contact points with outside micrometer with the gauge at the same zero setting when removed from the cylinder (Fig. 6-142 and 6-143).

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

HONING OR BORING

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

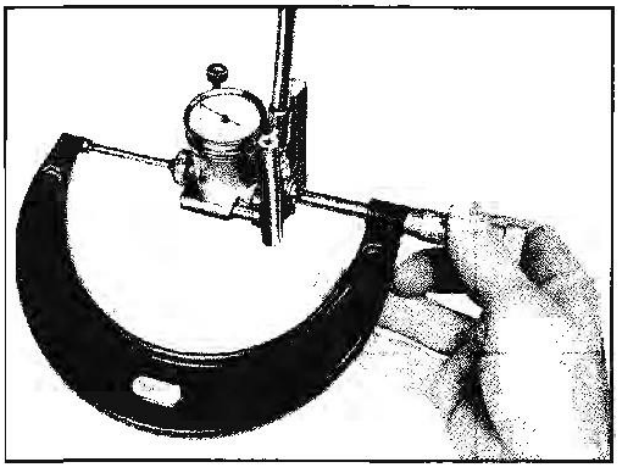

Fig. 6-143 Measuring Cylinder Gauge

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

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

NOTE: Honing or boring operation must be done under close supervision so that specified clearance between pistons, rings, and cylinder bores is maintained.

By measuring the piston to be installed at the sizing points (Fig. 6-144) and adding the mean of the clearance specification, the finish hone cylinder measurement can be determined. It is important that both the block and piston be measured at normal room temperature, 60°-90°F.

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

Intermixing different size pistons has no effect on engine balance as all Pontiac pistons from standard

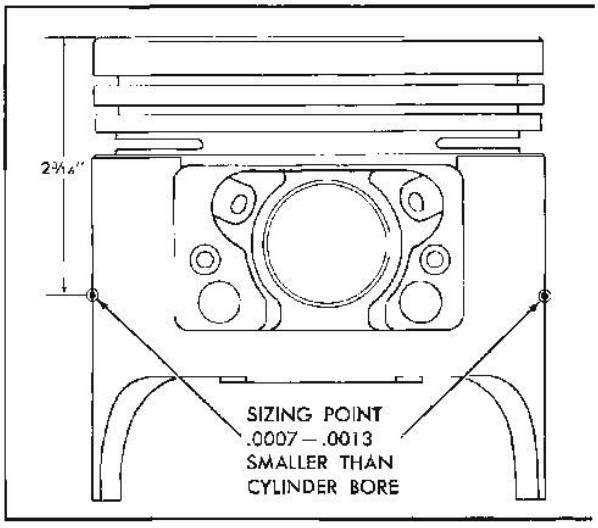

Fig. 6-144 Piston Sizing Points

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.

FIT AND REPLACE PISTON

Pistons should be fitted in the bores by actually measuring the fit. Clearance between the piston and the cylinder bore should be .0007" to .0013".

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

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

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

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

Measure the piston skirt perpendicular to the piston pin boss (piston pin removed) and at the sizing point indicated in Fig. 6-144.

Make sure the micrometer is in full contact (Fig. 6-145).

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

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

New pistons are serviced for both standard and premium fuel engines in standard size and .005", .010", .020" and .030" oversize.

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

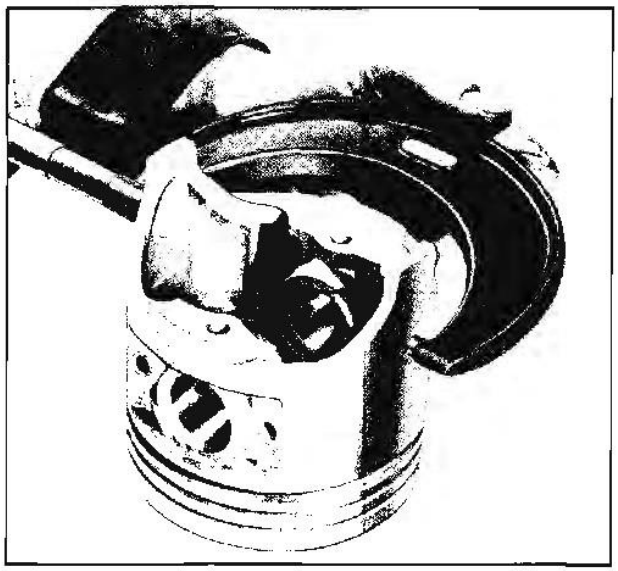

Fig. 6-145 Measuring Piston

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

FITTING PIN IN PISTONS

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

NOTE: Piston and pin must be at room temperature when checking fit and pin must be able to fall from piston by its own weight.

In case the standard size pin does not fit properly in the piston, an oversize piston pin must be fitted. Piston pins are available in .001" and .003" oversize.

When oversize pins are used, the piston pin bosses must be honed to give the required fit. It will also be necessary to hone the connecting rod pin bore to fit the oversize pin using a Sunnen hone or similar accurate equipment.

NOTE: A special grit hone is used for honing the connecting rod pin bore. The piston pin size should be .0008" to .0016" larger than the connecting rod pin bore for the proper press fit. The piston pin should not show any movement under 1500 lb. minimum load after assembly in rod.

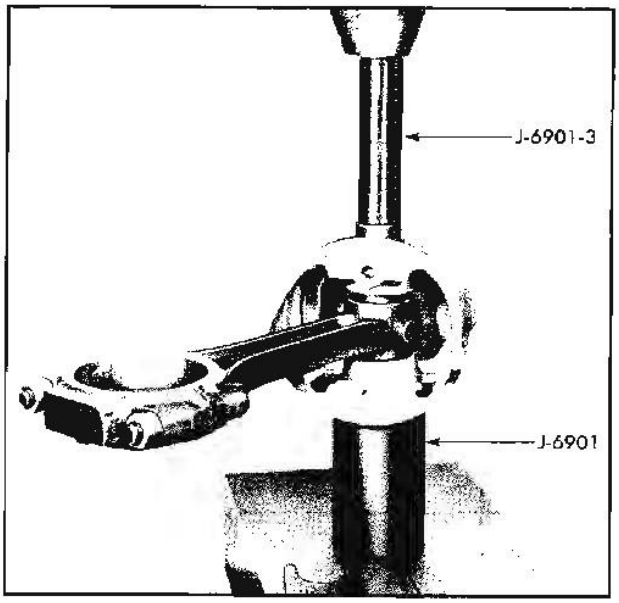

Fig. 6-146 Installation of Piston Pin

ASSEMBLE CONNECTING ROD TO PISTON

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

1. Place pilot plunger J-6901-6 and spring in the support base to be used as a pilot end stop. Use base support J-6901-8.

2. Place pilot plunger of tool J-6901 in piston pin bore and place on arbor press.

3. Coat piston pin and rod lightly with graphite lubricant.

4. Place tool J-6901-3 in piston pin and press pin into piston and connecting rod (Fig. 6-146) until piston pin bottoms against plunger of tool J-6901. Piston must turn freely on pin. If piston binds on pin, disassemble, hone piston pin bosses slightly and reassemble.

The odd numbered piston assemblies will always be installed in the left hand bank of cylinders, while the even numbered piston assemblies will always be installed in the right hand bank of cylinders.

One side of the connecting rod will have small identifying bosses (Fig. 6-147). The small identifying bosses on odd numbered rods will always be facing the rear of the engine, while the small identifying bosses on even numbered rods will be facing th front of the engine. When the rod and piston ar correctly installed, the oil groove between the ro and cap will be on the left side on even numbere rods, and on the right side on odd numbered rods

PISTON RINGS REPLACE

1. Remove oil pan.

2. Remove oil pump and baffle.

3. Remove intake manifold.

4. Remove cylinder heads.

5. Rotate crankshaft so crankpin carrying assem bly to be replaced projects straight upwards.

6. Remove bearing cap and install connecting ro bolt guide set J-5239. Reinstall cap on connectin rod to ensure against subsequent mix of caps an connecting rod.

7. Carefully remove connecting rod and pisto assembly by pushing out with narrow handle of rin guide (J-5239).

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

9. Carefully examine piston for rough or score bearing surfaces; cracks in skirt or head; cracked

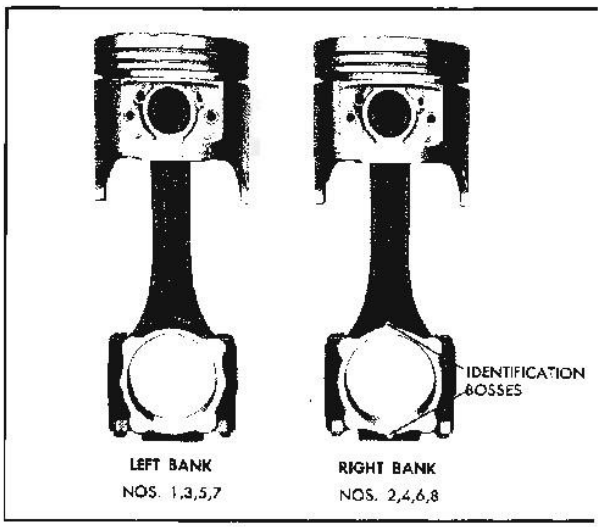

Fig. 6-147 Correct Assembly of Rod to Piston

broken, or worn ring lands; scored, galled, or worn piston bosses. Damaged or faulty pistons should be replaced.

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

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, or worn beyond specified limits, the cylinder block should be rebored and new pistons and rings installed.

PISTON RINGS - INSTALL ON PISTON

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 or chamfer on the inside but should always be installed with the mark (letter "T", dot or word "TOP") toward the top.

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,

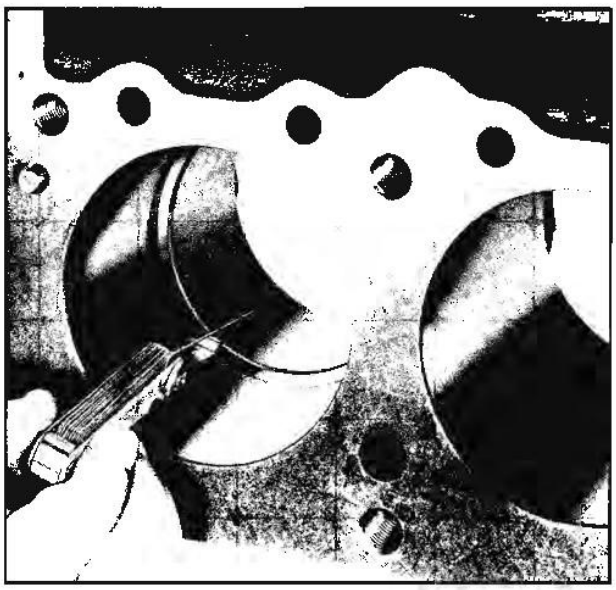

Fig. 6-148 Checking Ring Gap

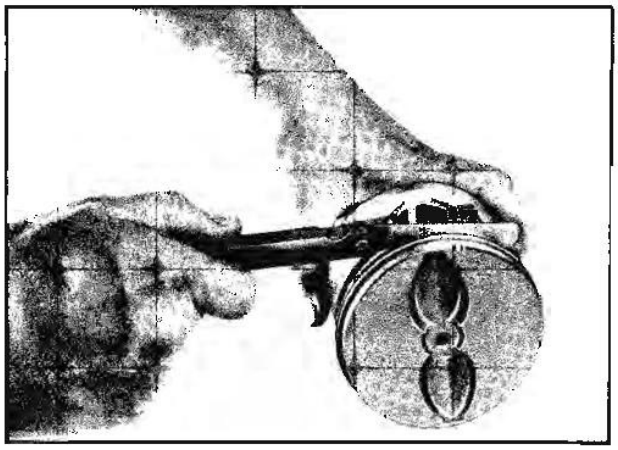

Fig. 6-149 Measuring Ring to Groove Side Clearance

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

1. Check pistons to see that ring grooves and oil return holes have been properly cleaned.

2. Place ring down at the bottom of the ring traveled part of the cylinder bore in which it will be used. Square ring in bore by pushing it into position with head of piston.

3. Measure gap between ends of ring with feeler gauge (Fig. 6-148). Gaps should be as follows:

Upper Compression Ring	.016" - .026"
Lower Compression Ring	.013" - .025"
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 be necessary to alter ring gap by filing.

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

5. Measure side clearance of rings in ring groove (Fig. 6-149) as each ring is installed. Clearance with 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 be replaced.

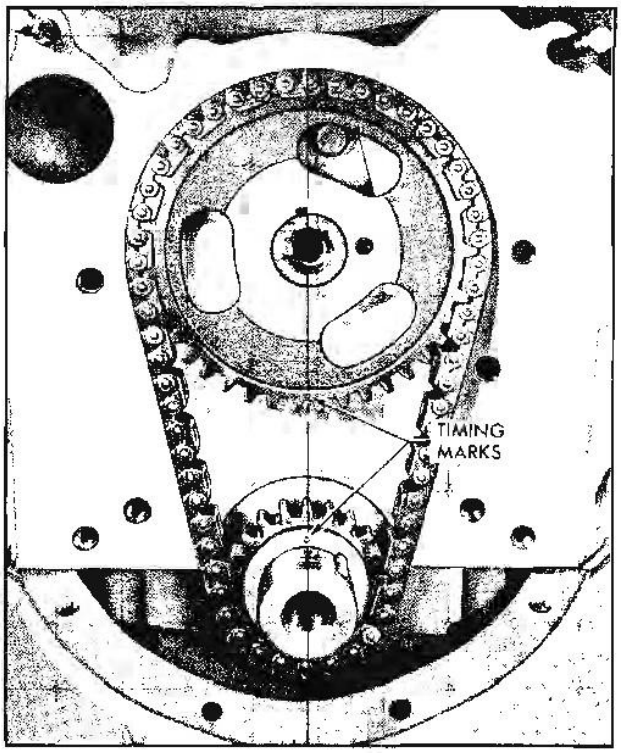

Fig. 6-150 Aligning Timing Marks

CONNECTING ROD AND PISTON ASSEMBLY-REPLACE

1. Install connecting rod bolt guide set on connecting rod bolts with long handle guide on same side as oil groove in rod.

2. Using suitable ring compressor insert piston and connecting rod assembly into cylinder so that notch in top of piston is toward front of engine.

3. From beneath engine, pull connecting rod, with bearing shell in place, into position against crankpin.

4. Remove guide set J-5239. Install bearing cap and cap nuts and tighten to 45 lb. ft. torque.

5. Replace oil pump and oil baffle, if they were removed.

6. Replace oil pan using new gaskets. Tighten oil pan screws to 15 lb. ft. torque.

7. Install cylinder head and intake manifold.

8. Install engine, clutch (SM) and transmission as an assembly.

9. Refill crankcase and cooling system, and check for leaks.

CRANKSHAFT—REMOVE AND REPLACE

The crankshaft can be removed and replaced with cylinder heads, pistons, rods, manifolds and other upper engine components installed, but the flywheel, clutch and transmission assemblies must be removed.

REMOVE

1. Remove engine, clutch (SM) and transmission as an assembly.

2. Remove clutch (SM) and transmission from engine and install engine on suitable stand.

3. Remove spark plugs.

4. Remove engine oil pan.

5. Remove oil pump assembly and oil pump drive shaft (Fig. 6-127).

6. Remove oil baffle and oil baffle tube.

7. Remove harmonic balancer.

8. Remove fuel pump.

9. Remove timing chain cover, gasket and "O" ring seal.

10. Remove fuel pump eccentric and bushing (Fig. 6-119).

11. Remove sprockets and timing chain (Fig. 6-150).

12. Remove connecting rod caps.

NOTE: Mark connecting rod caps for proper reinstallation.

13. Remove main bearing caps from block.

NOTE: Before removing crankshaft, tape thread of connecting rod bolts to prevent damage to crankshaft. Depress pistons until connecting rods are free of crankshaft.

14. Lift crankshaft from block.

REPLACE

1. With upper bearings installed position crankshaft in block.

2. Install main bearing caps (with bearing shells in place) but do not tighten retaining bolts.

3. Pull connecting rods and piston assemblies into place, rotating crankshaft as necessary to properly seat rods.

NOTE: Make sure upper bearings remain in proper position.

4. Remove tape from connecting rod threads and install connecting rod caps (with bearings) and retaining nuts, but do not tighten.

5. Tighten rear main bearing cap to 110-130 lb. ft. torque and all remaining bearing caps 90-110 lb. ft. torque.

6. Tighten connecting rod bearing cap retaining nuts 40-46 lb. ft. torque.

7. Install sprockets and timing chain, making sure timing marks on sprockets are aligned properly (Fig. 6-150).

8. Install fuel pump eccentric and bushing and insert sprocket retaining bolt with washer. Tighten securely.

9. Install timing chain cover, new cover gasket and new "O" ring seal.

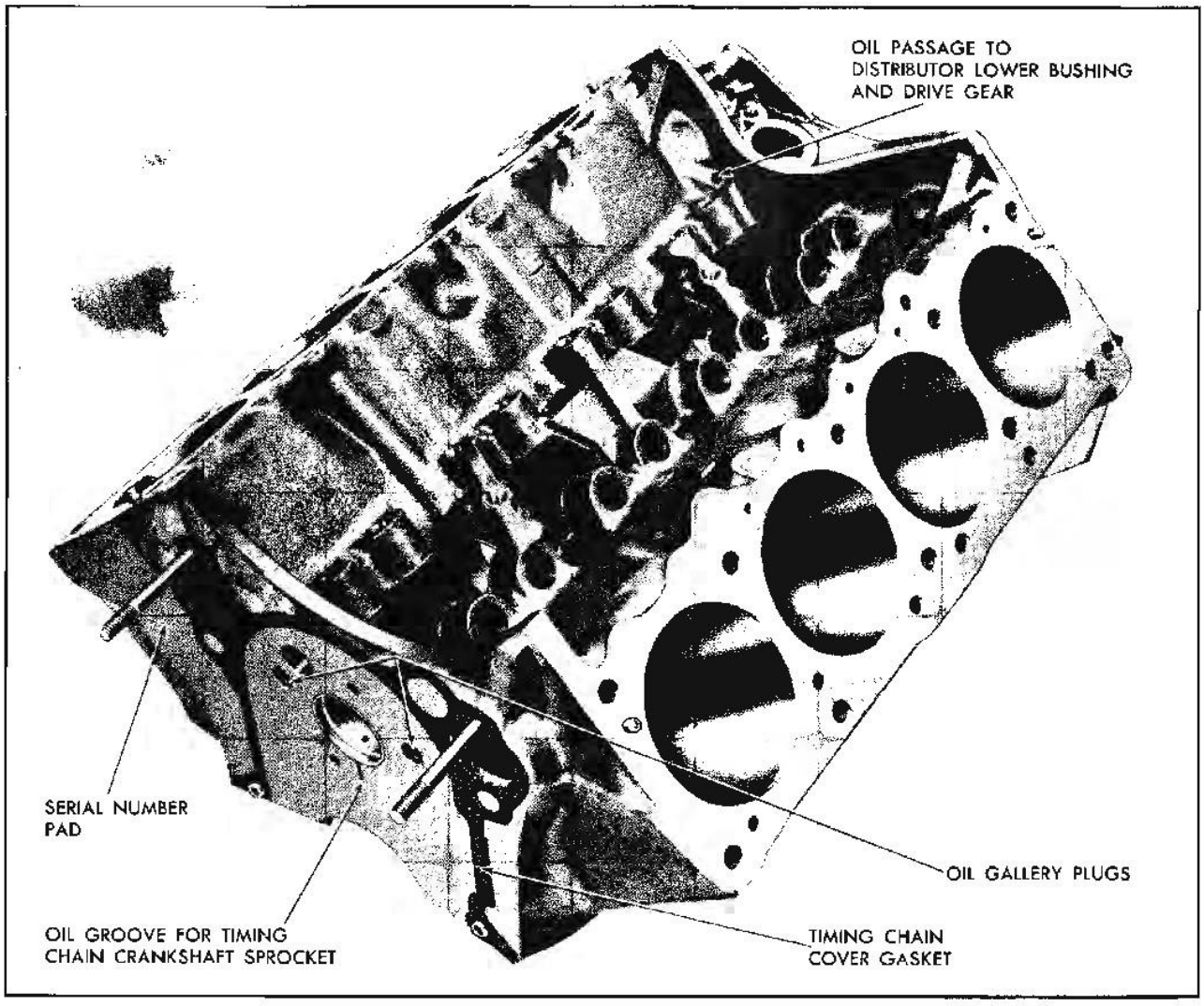

Fig. 6-151 Cylinder Block View from Left Front

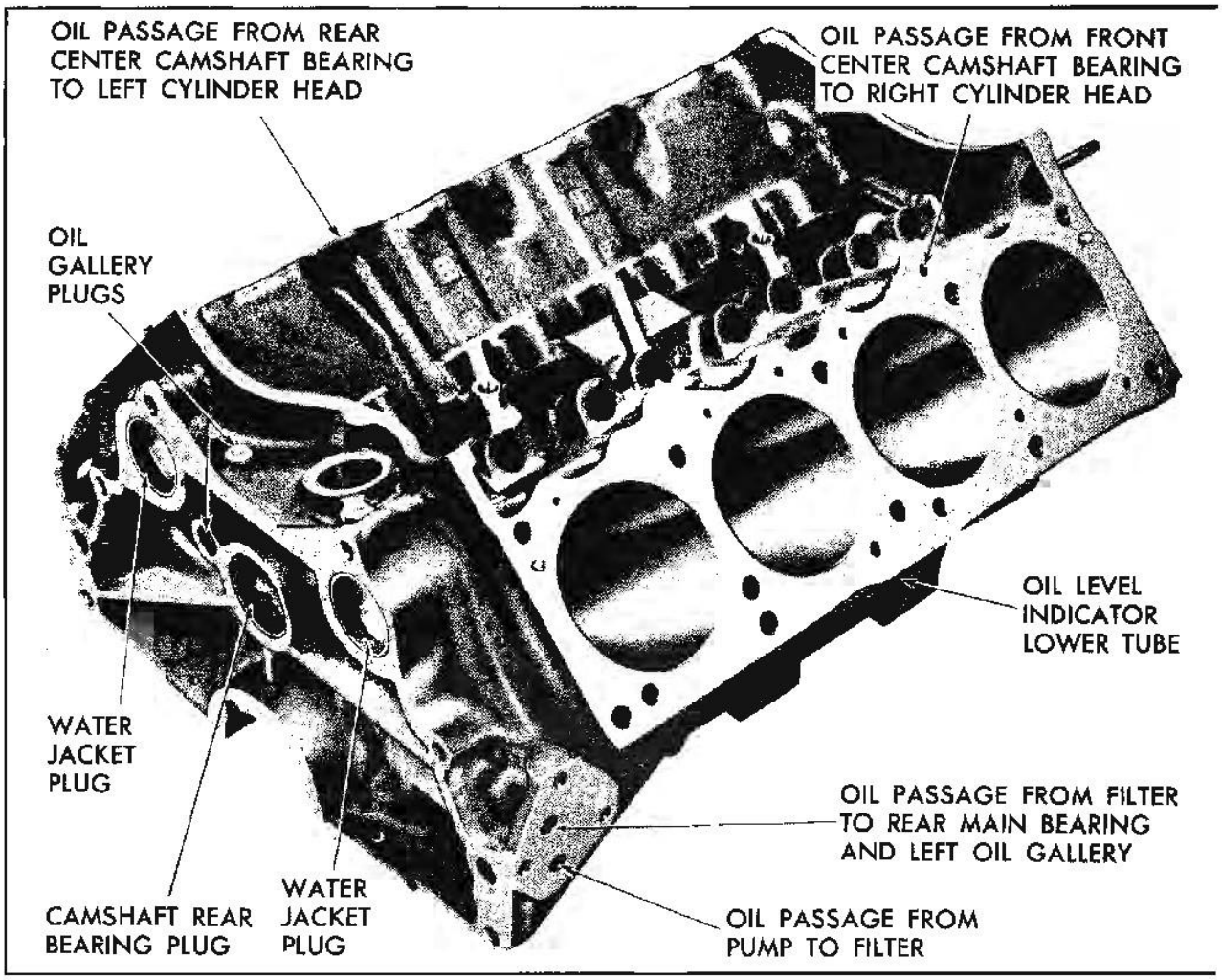

Fig. 6-152 Cylinder Block - View From Right Rear

10. Install fuel pump.

11. Install harmonic balancer.

12. Install oil baffle and oil baffle tube.

13. Install oil pump drive shaft and oil pump assembly.

14. Install engine oil pan.

15. Install spark plugs.

16. Remove engine from stand and install clutch (SM) and transmission to engine.

17. Install complete assembly in vehicle.

ENGINE BLOCK CORE HOLE PLUGS AND OIL PASSAGE PLUGS—INSPECT AND REPLACE

Engine moving part failures may be caused by lac of proper lubrication. In such case it may be neces sary to trace oil supply in the block to determine th area of obstruction. Oil pressure drop may be cause by leaking oil passage plugs. For these reasons th following procedures and block illustrations ar provided.

NOTE: Oil circulation diagram is provided in th engine lubrication section. Figures 6-151, 6-15 and 6-153 also show the various locations of wate jacket core hole plugs.

a. With cylinder block inverted, use pen light t see that passage from oil pump to filter is ope (Fig. 6-153).

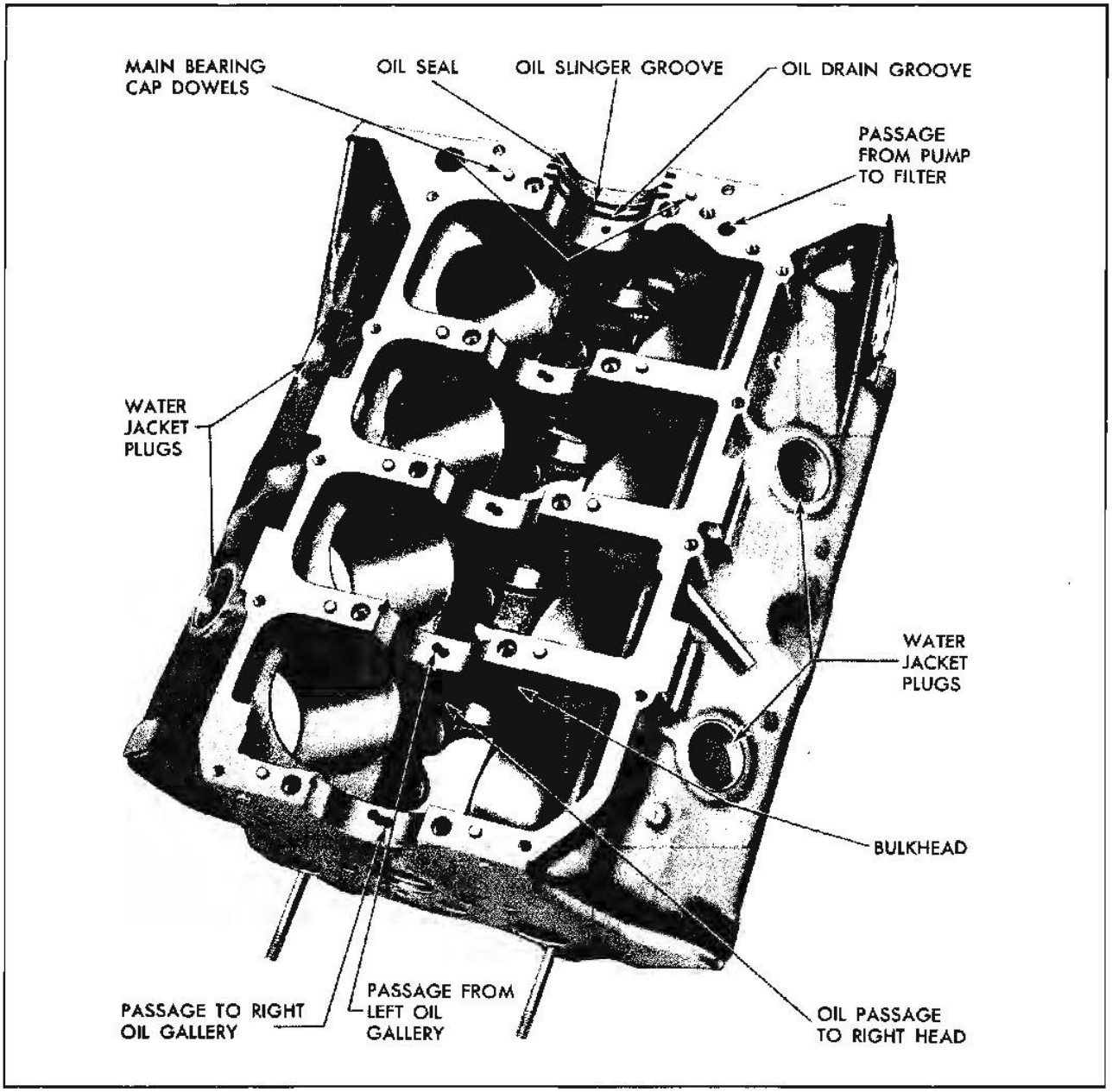

Fig. 6-153 Cylinder Block - View From Bottom

b. Check passage from filter outlet to rear main bearing by inserting wire in oil filter outlet passage and using pen light to see that wire is visible in passage to rear main bearing (Fig. 6-152).

c. Visually check passage from each main bearing to corresponding camshaft bearing (Fig. 6-153).

d. Check passage from filter outlet (through left oil gallery) to main bearings. Use rubber hose to blow smoke in oil filter outlet while observing to see that smoke passes out passages leading to all main bearings.

e. With cylinder block right side up, check oil passages to left bank lifter bosses. Use rubber hose to blow smoke in oil filter outlet while observing for smoke passing out oil passages from left main oil gallery to lifter bosses (Fig. 6-151).

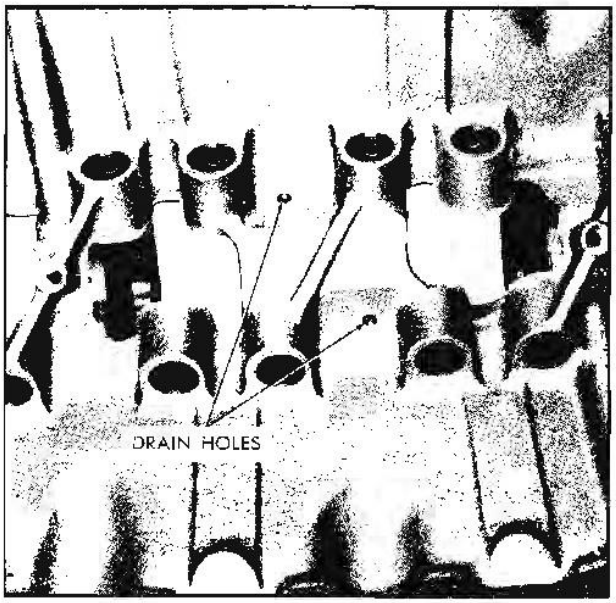

Fig. 6-154 Drain Holes in Lifter Gallery

f. Check oil passages to right bank lifter bosses. Use rubber hose to blow smoke in passage from front main bearing to right main oil gallery while observing for smoke passing out passages from right gallery to lifter bosses (Fig. 6-152).

g. Visually check passage from rear center camshaft bearing to left cylinder head and passage from front center camshaft bearing to right cylinder head (Fig. 6-152).

h. Use wire to check two drain holes in lifter gallery (Fig. 6-154).

INSTALL NEW PLUGS

The following plugs can be installed by driving into place using a flat piece of metal or hard wood bearing against the outer surface: Camshaft plug, water jacket plugs, rear oil gallery plug in block, cylinder head core hole plugs, valve spring chamber plug, and the oil hole plug in the top of the cylinder head.

Front oil gallery plugs in the block, and cylinder head oil gallery plugs must be driven into place using a tool which bears against the bottom of the plug. A 1/2" x 3" bolt will make a satisfactory tool for this purpose.

All plugs should be driven in until the outer edge is flush with the surrounding surface.

FITTED BLOCK ASSEMBLY—REPLACE

Fitted block contains pistons, rings, pins, camshaft bearings and main bearings.

DISASSEMBLE

1. Remove flywheel housing and clutch assembly

2. Remove flywheel and mount engine in holding stand.

3. Remove motor mounts and linkage bracket

4. Remove generator and mounting bracket.

5. Remove fuel pump.

6. Remove harmonic balancer.

7. Remove timing chain cover, fan and pulley Remove timing cover mounting studs.

8. Remove fuel pump eccentric and bushing.

9. Slide timing chain and sprockets off end o camshaft and crankshaft.

10. Remove camshaft thrust plate.

11. Remove distributor and high tension wires

12. Remove coil.

13. Remove starter assembly.

14. Remove intake manifold.

15. Remove push rod cover.

16. Remove oil level indicator.

17. Remove rocker arm covers.

18. Loosen rocker arm nuts, rotate rocker arms and remove push rods. Store push rods so that they may be reinstalled in the same position as removed

19. Remove cylinder heads and exhaust manifolds

20. Remove cylinder head gaskets.

21. Remove oil filter assembly.

22. Remove valve lifters; use J-3049 if necessary

Place valve lifters in storage box J-5763 so lifters can be reinstalled in original location.

23. Remove camshaft.

24. Invert engine and remove oil pan and flywheel front cover.

25. Remove oil pump assembly and drive shaft.

26. Remove baffle and oil indicator tube extension.

27. Remove crankshaft.

28. Remove all connecting rod and piston assemblies.

29. Remove connecting rods from pistons and identify for installation in original location.

30. Remove old block from stand and mount new fitted block on stand.

31. Remove each piston and pin assembly from new block and identify for installation in original position.

This completes disassembly for fitted block replacement. Proceed with assembly operations. Use new gaskets throughout and pay special attention to torque requirements.

ASSEMBLE

1. Install old connecting rods to proper piston and pin assemblies and install in cylinder from which pistons were removed.

2. Install crankshaft.

NOTE: New block has fitted upper main bearings and standard size lower main bearings. It is necessary to check main bearing to crankshaft clearance using Plastigage to be sure main bearings do not allow excessive clearance with the old crankshaft. Replace main bearings with undersize bearings if necessary.

3. Install two timing cover mounting studs.

4. Install camshaft using care not to damage bearings.

5. Install camshaft thrust plate indexing oiling slot in plate with oil groove in block.

6. Make sure keys are in place in crankshaft and camshaft. Install timing chain and sprockets making sure marks in sprockets are aligned exactly on a straight line passing through the shaft centers. Alignment can be simplified by first installing sprockets without chain to align timing marks. If timing chain is excessively loose, new chain or new chain and sprockets should be used.

7. Position fuel pump eccentric bushing over eccentric with flange toward camshaft sprocket.

8. Install fuel pump eccentric and bushing on camshaft sprocket, indexing tang on eccentric with keyway cutout in camshaft sprocket.

9. Position timing cover gasket over mounting studs and dowels on block.

10. Install timing cover, water pump, fan and pulley. Do not install stud nuts at this time.

11. Slide harmonic balancer onto crankshaft, and install harmonic balancer to crankshaft bolt and washer. Place hammer handle between block and crankshaft counterweight to keep crankshaft from turning and tighten harmonic balancer to crankshaft bolt 160 lb. ft. torque.

12. Install baffle and oil indicator tube extension.

13. Insert oil pump drive shaft with dimpled end towards block.

14. Install oil pump and gasket.

15. Cement new gaskets to oil pan and rear main bearing cap; use retainers to hold gasket. Install oil pan except for two rear screws. Position flywheel housing front shield and gasket against oil pan and install two rear oil pan bolts.

16. Position new cylinder head gaskets on block.

17. Position cylinder heads and exhaust manifolds on locating pins. Install head bolts and torque to 95 lb. ft.

NOTE: Three different length bolts are used. When inserted on proper holes, all will project an equal amount from their respective bosses.

18. Install lifters in bosses from which they were removed.

19. Install push rods in same location as originally removed and with same end facing valve lifter.

20. Tighten rocket arm ball retaining nuts to 15-25 lb. ft. torque.

21. Install distributor as follows:

a. Turn crankshaft to firing position of number one cylinder (number one exhaust and intake valve lifters both on base circles of their cams and timing mark on harmonic balancer indexed with pointer). NOTE: Number one intake must have just closed.

b. Position new distributor to block gasket on block.

c. Install distributor (without cap and wires) so that vacuum diaphragm faces the left side of the engine and rotor arm points toward contact in cap for number one cylinder. It will also be necessary to turn the oil pump drive shaft so it will index with distributor shaft.

22. Install distributor hold down clamp and special bolt and tighten enough to hold distributor in place.

23. Install coil.

24. Cement new gaskets to push rod covers. Install push rod covers with screws and flat washers and tighten to 5 lb. ft. torque.

25. Cement new gaskets to rocker arm cover and install cover.

26. Install intake manifold gasket with plastic locating sleeves in cylinder head as shown in Fig. 6-22.

27. Start intake manifold to timing cover draw bolt into intake manifold.

28. Position intake manifold and install retaining screws finger tight.

29. Tighten draw bolt to 10-20 lb. ft. torque to obtain metal to metal contact between manifold and timing cover.

30. Tighten manifold screws to 40 lb. ft. torque.

31. Install oil filter assembly and gasket.

32. Install oil level indicator.

33. Install throttle linkage.

34. Install starter assembly.

35. Install fuel pump.

36. Install generator and bracket.

37. Install fan belt and adjust belt tension as covered in Section 6A.

SPECIFICATIONS—6 CYL. ENGINE

GENERAL

Type	In Line
Bore and Stroke	3-3/4 x 3-1/
Piston Displacement	215 cu. in
Taxable Horsepower	33.7
Compression Ratio	8.6:
Horsepower	140 @ 4200 rpm
Torque	206 @ 200
Compression Pressure at Cranking Speed (with throttle open)	140 psi
Firing Order	1-5-3-6-2-
Production Engine No.	Pad at Right Front Side by Distributor Shaft Hol
Cylinder Nos. — Front to Rear	1-2-3-4-5-

CAMSHAFT

Material	Alloy Cast Iro
Journal Diameter	1.8687
Bearing —Outside Diameter	2.014"-2.016
Bearing Length	.860
Bearing Clearance	.0015"-.0030
End Play	.001"-.005

CONNECTING RODS

Material	Forged Steel
Length, center to center	5.70"
Bearing Clearance on Crankpin—Limits When New	.0005"-.0025"
End Play of Connecting Rod on Crankpin	.008"-.014"

CRANKSHAFTS

Material	Cast Nodular Iron
Journal Diameter	2.30"
Bearing Length — Bearing Shell, Including Chamfer	
1-2-3-4-5-6	.80"
7	.101"
Thrust Taken On	7
Crankpin Diameter	2.00"
Journal Maximum Out of Round and Taper	.0002"
Pin Maximum Out of Round (New)	.0002"
Pin Maximum Taper (New)	.0003"
End Play — Limits When New	.002"-.006"
Main Bearing Clearance — Limits When New	.0005"-.002"

FLYWHEEL

Teeth on Ring	
Teeth on Starter Pinion	

PISTONS AND CYLINDERS

Cylinder Bore Out-of-Round and Taper When New	.001"
Piston Material	Aluminum Alloy
Piston Clearance in Cylinder —	.0005"-.0011"
Piston Ring Gap	
Compression Rings	.010"-.020"
Oil Ring Segments	.015"-.055"
Piston Ring to Groove Clearance	
Compression Rings	
Upper	.0015"-.0030"
Lower	.0015"-.0035"
Oil Ring Assembly	.0005"-.0055"

PISTON PINS

Fit in Piston	.0003"-.0005" loose with piston and pin at 70°F.
Fit in Rod	.0008"-.0016"
Diameter (Selective)	.9272"
Length	3.00"

TIMING GEARS

Camshaft Gear Material	Bakelite and Fabric Composition with Steel Hub
Crankshaft Gear Material	Steel

VALVES

Material	
Intake	1041 Steel
Exhaust	21-4N Steel

VALVES (CON'T.)

Head Diameter	
Intake	1.715"-1.72
Exhaust	1.495"-1.50
Stem Diameter	
Intake	.3410"-.341
Exhaust	.3410"-.341
Seat Angle	
Intake	4
Exhaust	4
Fit of Stem in Guide (New)	Intake .0010"-.0027" — Exhaust .0020"-.003
Valve Lift (Measured at Stem)	.3

VALVE LIFTER

Leak Down Rate	12-60 seconds with 50 lbs. lo
Plunger Travel	.0

VALVE SPRING

Spring Pressure and Length	84-92 lbs. @ 1.660" — 163-173 lbs. @ 1.33

6 CYL. ENGINE
WRENCH TORQUE SPECIFICATIONS

NOTE: Torque in lb. ft. unless otherwise shown.

TORQUE	SIZE	APPLICATION
		CYLINDER BLOCK - BEARINGS & CAPS
60-70	7/16-14	Bolt - Main Bearing Cap to Block
60-70	7/16-14	Stud - #6 Main Brg. Cap to Block
		CYLINDER HEAD
85-100	1/2-13	Bolt - Cylinder Head
		FLYWHEEL
55-65	7/16-20	Bolt - Flywheel Assy. to Crankshaft Auto Trans.
20-35	3/8-16	Bolt - Cover Plate Assy. to Flywheel
60-75	7/16-20	Bolt - Flywheel Assy. to Crankshaft SMT
		CONNECTING RODS - PISTONS - RINGS
30-35	11/32.24	Nut - Connecting Rod & Bushing Assy. Cap to Rod
		OIL PAN
5-8	1/4-20	Bolt - Oil Pan to Cylinder Block
8-15	5/16-18	Bolt - Oil Pan to Cylinder Block (Also attaches Clutch Housing Cover Shield)
18-25	1/2-20	Screw - Oil Pan Drain
		OIL PRESSURE, PRESSURE REGULATOR & OIL SCREEN
5-8	1/4-20	Bolt - Engine Oil Pump Cover to Body
10-20	5/16-18	Bolt - Engine Oil Pump Assy. to Block

6 CYL. ENGINE

TORQUE	SIZE	APPLICATION
		OIL PLUGS
*	3/8-PTF	Plug - Cylinder Block Oil Gallery
5-10	1/4-20	Screw - Oil Pump & Screen Supp. to Oil Pump & Screen
20-35	3/8-16	Nut - Oil Pump & Screen Supp. to #6 Crankshaft Bearing Stud
		OIL FILTER
		CRANKCASE FRONT END COVER
5-8	1/4-20	Screw & L/W Assy. - C/Case Frt. End Cover to Cylinder Block
		ENGINE FAN & PULLEY
15-25	5/16-24	Bolt - Fan & Pulley to Water Pump Hub
		WATER PUMP
10-25	5/16-18	Bolt - Water Pump to Cylinder Block
		THERMOSTAT & WATER OUTLET FITTING
20-35	3/8-16	Bolt - Water Outlet Fitting to Manifold
20-35	3/8-16	Bolt - Thermostat Housing to Water Outlet Fitting
		MANIFOLD - INTAKE & EXHAUST
25-40	3/8-24	Nut - Intake & Exhaust Manifold Clamp
25-40	3/8-16	Bolt - Intake & Exhaust Manifold Clamp
20-35	3/8-16	Bolt - Exhaust Manifold to Intake Manifold
15-25	3/8-16	Bolt - Intake & Exhaust Manifold Clamp (at end Exh. Port)
		CARBURETOR & AUTO CHOKE
20-35	3/8-24	Nut - Carburetor to Manifold (Stud)
5-8	1/4-20	Screw & L/W - Choke Heat Plate to Manifold
		CARBURETOR AIR CLEANER & SILENCER
10-20 lb. in.	1/4-20-PC	Stud - Air Cleaner & Silencer to Carburetor
10-20 lb. in.	1/4-20-PC	Nut - Air Cleaner & Silencer to Carburetor
		FUEL PUMP & PIPES
10-25		Screw & L/W Fuel Pump to Cylinder Block
*		Fitting - Fuel Pump Fuel Hose to Carburetor & Pump
		ACCELERATOR CONTROL
10-25	5/16-18	Stud - Accelerator Control Lever to Manifold
60-120 lb. in.	1/4-28	Stud - Accelerator Pedal Pivot Ball
25-45 lb. in.	#12-28-PC	Screw & L/W Accelerator Pull Back Spring Bracket to Carburetor
55-65 lb. in.	1/4-14-PC	Screw - Accelerator Pedal Rod Supp. to Dash

*Torque not a requirement, other means of control and/or specifications used, checked for alignment, bottoming, height and/or leaks.

6 CYL. ENGINE

TORQUE	SIZE	APPLICATION
		ENGINE TO FRAME MOUNTING
	3/8-16-PC	Bolt - Engine Mounting Engine Bracket to Cylinder Block
	3/8-16-PC	Bolt - Engine Mounting Frame Bracket to Cross Member
	7/16-14-PC	Bolt - Engine Mounting Assy. to Frame Bracket
	7/16-20	Bolt - Engine Mounting Assy. to Engine Mounting Engine Bracke
	7/16-14-PC	Bolt - Trans. Supp. Mounting Assy. to Trans.
	3/8-16-PC	Bolt - Engine Rear Cross Member Insulator Retainer to Frame
	7/16-20	Bolt - Engine Mounting Assy. to Engine Mounting Engine Brackets
	3/8-16-PC	Bolt - Engine Mounting RH & LH Brackets to Cylinder Block
	3/8-16-PC	Bolt - Engine Mounting Frame RH & LH Bracket to Cross Member
	7/16-14-PC	Bolt - Mounting Assy. to Frame Bracket
	7/16-14-PC	Bolt - Trans. Supp. Mounting Assy. to Cross Member
		CAMSHAFT & DRIVE, VALVE & VALVE COVERS
6-10 lb. in.	5/16-18	Bolt - Valve Push Rod Cover Assy. to Block
5-8	1/4-20	Bolt L/W - Camshaft & Gear Assy. to Cylinder Block
		VALVE ROCKER ARM & COVERS
25-50 lb. in.	1/4-20	Bolt - Valve Rocker Arm Cover to Head
55-124 lb. in.	3/8-24	Nut - Valve Rocker Arm Ball Adjusting
		DISTRIBUTOR
8-12	3/8-16	Bolt - Distributor Hold-Down Clamp to Cylinder Block
*	3/16 (Tube)	Nut - Distributor to Carburetor Vacuum Control
*	1/8 NPTF	Plug - Distributor Intake Manifold Vacuum Hole
		IGNITION SWITCH, COIL, WIRES & SPARK PLUGS
		Bolt - Ignition Coil Bracket
		Ferrule - Ignition & Starter Sw to Instrument Panel
15-25	1/4MM	Plug Assembly - Spark
		GEARSHIFT LEVER & PARTS
10-20	5/16-18	Bolt & Nut - Trans. Shifter Levers to Shafts
8-12	3/8-16	Nut - Trans. Control Lever to 1st & Rev. Shift Rod
8-12	3/8-16	Nut - Trans. Control Idler Lever to 2nd & 3rd Shift Rod
		CLUTCH HOUSING & COVER
5-8	1/4-20	Screw & L/W - Clutch Housing Cover to Cylinder Block
		Bolt - Clutch Fork Ball to Clutch Housing
		CLUTCH CONTROL
30-45	7/16-20	Bolt - Clutch Fork Ball to Flywheel Housing
8-12	3/8-16	Nut - Clutch Fork Rod Assy. Adj. Jam
25-35	3/8-24	Nut - Clutch Cont. Shaft Stud to Mounting Bracket on Side Rail
		Screw - Clutch Cont. Rod Bellows Retainer to Floor Pan
		Bolt - Clutch Release Brg. Supp. Retainer
25-30	1/2-13	Stud - Clutch Cont. Shaft Stud Assy. to Cylinder Block
		Bolt - Cover & Pressure Plate Assy. to C/Shaft
		MUFFLER - EXHAUST PIPE - TAIL PIPE
15-20	5/16-18	Nut - Exhaust Pipe to Muffler U-Bolt
15-20	5/16-18	Nut - Tail Pipe to Muffler U-Bolt
10-15	5/16-18	Screw - Muffler Tail Pipe Hanger to Frame
10-15	5/16-18	Screw - Tail Pipe Hanger to Frame
6-9	20-9	Screw - Tail Pipe Clamp to Hanger Assy.
14-18	3/8-16	Nut - Exhaust Pipe Manifold Stud (6-Cylinder Engine)

*Torque not requirement, other means of control and/or specifications used, checked for alignment, bottoming, height and/or leaks.

SPECIFICATIONS—V-8 ENGINE

Type	90° V-8 O.H. Valve
Bore and Stroke	3-23/32" x 3-3/4"
Taxable Horsepower (326)	44.3
(326 HO)	
Compression Ratio - 326	8.6:1
Compression Ratio - 326 HO	10.5:1

	326 SM	326 Auto.	326 HO SM	326 HO Auto.
Horsepower	250 @ 4600 rpm		280 @ 4800 rpm	
and Torque	333 @ 2800 rpm		355 @ 3200 rpm	

Compression Pressure at Cranking Speed 8.6:1 Compression Ratio	140-160 psi @ 155-165 rpm
Compression Pressure at Cranking Speed 10.5:1 Compression Ratio	170-190 psi @ 155-165 rpm
Firing Order	1-8-4-3-6-5-7-2
Production Engine No. Location	Front Face of Right Cylinder Bank
Cylinder Nos.—Front to Rear	
Left Bank	1-3-5-7
Right Bank	2-4-6-8

CAMSHAFT

Material	Alloy Cast Iron
Journal Diameter	1.8987"-1.8997"
Bearing—Inside Diameter (after line reaming)	1.9012"-1.9017"
Bearing Length	
Front	1.060"
All Others	.680"
Bearing Clearance	.0015" to .0030"
End Play	.003"-.007"

CONNECTING RODS

Material	Arma Steel
Length, center to center	6.625"
Bearing Length	.88"
Bearing clearance on crank pin—limits when new	.0005"-.0025"
End play of connecting rod on crank pin	.006" to .011"

CRANKSHAFT

Material	Pearlitic Malleable Iron
Journal Diameter	3.000"
Bearing Length—bearing shell, including chamfer	
Front	.94"
Front Center	.94"
Center	.94"
Rear Center Including Thrust Flanges	1.13"
Rear	1.59"
Thrust Taken On	Rear Center
Crank Pin Diameter	2.25"
Journal and Pin Maximum Out of Round and Taper	.00025"
Thrust Bearing End Play—Limits When New	.0035"-.0085"
Main Bearing Clearance—Limits When New	.0005"-.0020"

FLYWHEEL

Teeth on ring	166
Teeth on starter pinion	9

PISTONS AND CYLINDERS

Cylinder bore out-of-round and taper when new	.001"
Piston material	Tin Plated Aluminum Alloy
Piston clearance in cylinder-Standard	.0007" to .0013"
Piston ring gap	
Compression rings	
Upper	.016"-.026"
Lower	.013"-.025"
Oil Ring Segments	.015"-.055"
Piston ring to groove clearance	
Compression rings	
Upper	.0015" to .0030"
Lower	.0015" to .0035"
Oil Ring Assembly	.0005" to .0055"

PISTON PINS

Fit in piston	.0003" to .0005" loose with piston and pin at 70° F.
Fit in rod	.0008" to .0016" press
Diameter (selective)	.9800" to .9804"
Length	3.250"

TIMING CHAIN

Camshaft sprocket material	Cyanide hardened cast iron (cylinder iron)
Crankshaft sprocket material	Case hardened steel--SAE 1020 or 1022
Number of links in chain	60

VALVES

Material	
Intake	1041 Steel
Exhaust	GM T-XCR Steel
Head Diameter	
Intake	1.88"
Exhaust	1.60"
Stem Diameter	
Intake	.3407"-.3414"
Exhaust	.3402"-.3409"
Seat Angle	
Intake	30°
Exhaust	45°
Fit of stem in guide (new)	Intake .0021" to .0038"
	Exhaust .0026" to .0043"
Valve Lift	.365"-.373"

VALVE LIFTER

Diameter	.8424" to .8427"
Clearance in boss	.0013" to .0028"
Length-overall	2.000"
Leak-down rate	12-60 seconds with 50 lb. load
Plunger travel (for gauging purposes)	.125 (1/8")

VALVE SPRINGS

	326		326 H.O.	
	Pressure	Length	Pressure	Length
Outer				
Valve Opened	106-112 lbs.	@ 1.15"	117-127 lbs.	@ 1.17"
Valve Closed	55-61 lbs.	@ 1.53"	56-62 lbs.	@ 1.53"
Inner				
Valve Opened	59-65 lbs.	@ 1.10"	94-100 lbs.	@ 1.107"
Valve Closed	24-30 lbs.	@ 1.47"	30-36 lbs.	@ 1.48"

V-8 ENGINE
WRENCH TORQUE SPECIFICATIONS

TORQUE	SIZE	APPLICATION
		CYLINDER BLOCK
90-110	1/2-13	Bolt - Crankshaft Bearing Cap (Exc. Rear Main)
110-130	9/16-12	Bolt - Crankshaft Bearing Cap (Rear Main)
		CYLINDER HEAD
85-100	1/2-13	Bolt - Cylinder Head
		HARMONIC BALANCER
15-25	5/16-24	Bolt - Weight to Balancer
130-190	5/8-16	Bolt - Balancer Assy. to Crankshaft
		FLYWHEEL
85-100	1/2-20	Bolt - Flywheel Assy. to Crankshaft
		CONNECTING RODS, PISTONS & RINGS
40-46	3/8-24	Nut - Connecting Rod & Bearing Assy. Cap to Rod
		OIL PAN
10-20	5/16-18	Bolt - Engine Oil Baffle to Bearing Caps
18-25	1/2-20	Plug - Oil Pan Drain
8-15	5/16-18	Bolt - Oil Pan Assy. to Cylinder Block
10-20	5/16-18	Bolt - Oil Pan to Cylinder Block (also attach Oil Pan Reinf.)
		OIL PUMP
10-20	5/16-18	Bolt - Oil Pump Cover to Body
20-35	3/8-16	Bolt - Oil Pump to Cylinder Block
		OIL PLUGS
*	3/8 PTF	Plug - Cylinder Block Oil Gallery
		OIL FILTER
20-35	3/8-16	Bolt - Oil Filter to Cylinder Block
		CRANKCASE VENTILATION
30-45	3/8-16	Bolt - Crankcase Vent. Hose Brkt. to Intake Manifold
		TIMING CHAIN COVER
10-20	5/16-18	Bolt - Timing Chain Cover to Intake Manifold Clamp
20-35	3/8-16	Bolt - Timing Chain Cover to Cylinder Block
*	3/8-24	Stud - Timing Chain Cover to Block (Block End)
20-35	3/8-16	Nut - Timing Chain to Block (Stud)
		ENGINE FAN & PULLEY
15-25	5/16-24	Bolt - Fan Assembly to W/P Shaft Flange
		WATER PUMP
10-25	5/16-18	Bolt - Pump Assy. to Timing Chain Cover
*	5/16-24	Stud - Pump Assy. to Timing Chain Cover
10-25	5/16-24	Nut - Pump Assy. to Timing Chain Cover Stud

*Torque not a requirement, other means of control and/or specifications used, checked for alignment, bottoming, height and/or leaks.

V-8 ENGINE

TORQUE	SIZE	APPLICATION
		THERMOSTAT & WATER OUTLET
20-35	3/8-16	Bolt - Water Outlet Fitting to Intake Manifold
		MANIFOLDS
30-45	3/8-16	Bolt - Exhaust Manifold to RH Head
30-45	3/8-16	Bolt - Exhaust Manifold to LH Head
20-35	3/8-16	Bolt - Intake Manifold to Cylinder Head
		CARBURETOR & AUTO CHOKE
10-25	5/16-18	Bolt - Carburetor to Manifold
10-25	5/16-18	Bolt - Choke Heat Tube & Plate to Manifold
*	1/4 Tube	Nut - Carburetor to Manifold Tube to Carburetor
		AIR CLEANER & SILENCER
10-20 lb. in.	1/4-20	Stud - Air Cleaner to Carburetor
10-20 lb. in.	1/4-20	Nut - Air Cleaner & Silencer to Carburetor
		FUEL FILTER, PUMP & PIPES
5-15 lb. in.	10-12-PC	Screw - Fuel Filter to Carburetor Pipe Hose Bracket to Hose
*	3/8-16	Nut - Pipe Assy. Fuel Pump & Filter to Carburetor
15-30	3/8-16	Bolt - Fuel Pump to Timing Chain Cover
		ACCELERATOR & THROTTLE CONTROLS
60-120 lb. in.	1/4-28-PC	Bolt - Throttle Return Check Diaphragm
60-120 lb. in.	1/4-28-PC	Bolt - Carburetor Lever Ext. to Carburetor Lever
55-65 lb. in	1/4-14-PC	Accelerator Pedal Lever Supp. Assy. to Dash
55-65 lb. in.	1/4-14-PC	Throttle Control Cable to Dash
60-120 lb. in.	1/4-28-PC	Throttle Control Cable Clamp to Bracket
60-120 lb. in.	1/4-28	Stud - Accelerator Pedal Pivot Ball
		ENGINE TO CROSS MEMBER MOUNTING
	7/16-14-PC	Bolt - Engine Front Mounting Bracket to Cylinder Block
	7/16-14-PC	Bolt - Engine Front Mounting Insulator to Supp. Bracket
		CAMSHAFT & DRIVE, VALVES & COVERS
25-70 lb. in.	5/16-18	Bolt - Valve Push Rod Cover to Cylinder Block
10-25	5/16-18	Bolt - Camshaft Thrust Plate to Cylinder Block
30-45	1/2-20	Bolt - Camshaft Sprocket to Camshaft
		VALVE ROCKER ARMS & COVERS
45-80 lb. in.	5/16-18	Bolt - Valve Rocker Arm Cover to Head
15-25	3/8-24	Nut - Valve Rocker Arm Ball Retainer
		AIR CLEANER & SILENCER
10-20 lb. in.	1/4-20-PC	Stud - Air Cleaner & Silencer to Carburetor
10-20 lb. in.	1/4-20-PC	Nut - Air Cleaner & Silencer to Carburetor
		FUEL FILTER PUMP & PIPES
5-15 lb. in.	10-12	Screw - Fuel Filter Assy. to Bracket A/C Only

*Torque not a requirement, other means of control and/or specifications used, check for alignment, bottoming, height and/or leaks.

V-8 ENGINE

TORQUE	SIZE	APPLICATION
		ENGINE TO FRAME MOUNTING
	7/16-14-PC	Bolt - Engine Frt. Mounting Bracket to Cylinder Block
	7/16-14-PC	Bolt - Engine Frt. Mounting Insulator to Supp. Bracket
		ALTERNATOR & VOLTAGE REGULATOR
25-40	3/8-16	Nut - Alternator & Pulley Assy. to Bracket & Plate
10-25	5/16-18	Bolt - Alternator & Pulley Assy. to Adj. Strap
25-40	3/8-16	Bolt - Alternator & Bracket Ext. Plate to Bracket & Head
25-35	3/8-16	Bolt - Alternator Mounting Bracket to Cylinder Head
		STARTING MOTOR & CONTROL
20-45	3/8-16	Bolt - Starting Motor to Cylinder Block
	1/4-20	Nut - Starting Motor Brace to Starting Motor
		DISTRIBUTOR
15-25	3/8-16	Bolt - Distributor - Hold Down Clamp
		IGNITION SWITCH, WIRES, ETC.
20-35	3/8-16	Bolt - Coil Assembly to Cylinder Block
		MUFFLER, EXHAUST PIPES & TAIL PIPES
15-20	5/16-18	Nut - Exhaust Pipe to Muffler U-Bolt
25-35	3/8-16	Bolt - Exhaust Pipe to Manifolds
15-20	5/16-18	Nut - Muffler to Tail Pipe "U" Bolt
6-9	20-9	Screw - Clamp to Tail Pipe Hanger
10-15	5/16-18	Screw - Tail Pipe Hanger to Frame
10-15	5/16-18	Screw - Muffler to Tail Pipe Hanger to Frame

*Torque not a requirement, other means of control and/or specifications used, check for alignment, bottoming, height and/or leaks.

TROUBLE DIAGNOSIS

ENGINE FAILS TO START

CAUSE:

a. Corroded or loose battery terminal connections and/or weak battery.

b. Broken or loose ignition wires and/or faulty ignition switch.

c. Excessive moisture on plugs, caps or ignition system.

d. Damaged distributor rotor, cracked distributor cap and/or corroded distributor contact points.

e. Fouled spark plugs and/or improper spark plug gap.

f. Weak or faulty coil.

g. Carburetor flooded and/or fuel level in carburetor bowl not correct.

h. Dirt and water in gas line or carburetor.

i. Sticking choke.

j. Faulty fuel pump.

k. Faulty solenoid or starting motor.

l. Park or neutral switch inoperative.

ENGINE "LOPES" WHILE IDLING

CAUSE:

a. Air leaks between intake manifold and heads.

b. Blown head gasket.

ENGINE "LOPES" WHILE IDLING (Cont'd)

c. Worn timing gears chain or sprockets.

d. Worn camshaft lobes.

e. Overheated engine.

f. Plugged crankcase vent valve.

ENGINE MISSES WHILE IDLING

CAUSE:

a. Spark plugs damp or gap incorrectly set.

b. Excessive moisture on ignition wires and caps.

c. Leaks in ignition wiring.

d. Ignition wires making poor contact.

e. Uneven compression.

f. Burned, pitted or incorrectly set contact points.

g. Faulty coil or condenser.

h. Worn distributor cam or cracked distributor cap.

i. Incorrect carburetor idle adjustment and/or dirty jets or plugged passages in carburetor.

j. Foreign matter, such as dirt or water, in gas line or carburetor.

k. Air leak at carburetor mounting gasket.

l. Choke inoperative.

m. Faulty spark advance mechanism.

n. Burned, warped, pitted, or sticking valves.

o. Incorrect valve lifter clearance.

p. Low compression.

ENGINE MISSES AT VARIOUS SPEEDS

CAUSE:

a. Dirt and water in gas line or carburetor.

b. Fouled carburetor jets.

c. Incorrect ignition timing.

d. Points dirty, pitted or incorrectly spaced.

e. Excessive play in distributor shaft.

f. Insufficient spring tension on points.

g. Distributor cam lobe worn.

h. Weak coil or condenser.

i. Spark plugs dirty or damp and/or gaps set too wide.

j. Insufficient point dwell.

k. Detonation or pre-ignition.

l. Heat control valve not functioning properly.

m. Excessively worn fuel pump diaphragm.

n. Weak valve spring.

o. Worn camshaft lobes.

p. Engine overheating.

q. Sub-standard fuel.

ENGINE STALLS

CAUSE:

a. Carburetor idle speed set too low and/or idle mixture too rich or too lean.

b. Carburetor needle valve and seat inoperative.

c. Incorrect carburetor float level and/or carburetor flooding.

d. Dirt or water in gasoline or carburetor.

e. Choke improperly adjusted or sticking.

f. Faulty ignition system.

g. Spark plugs damp or dirty and/or gaps incorrectly set.

h. Faulty coil or condenser.

i. Distributor points burned, pitted, dirty, or incorrectly set.

ENGINE STALLS (Cont'd)

j. Distributor advance inoperative.

k. Exhaust system restricted.

l. Leaks in carburetor mounting gasket or intake manifold.

m. Incorrect valve lifter clearance.

n. Burned, warped, or sticking valves.

o. Low compression.

p. Engine overheating.

ENGINE HAS NO POWER

CAUSE:

a. Weak coil or condenser.

b. Incorrect ignition timing.

c. Excessive play in distributor shaft or distributor cam worn.

d. Insufficient point dwell.

e. Spark plugs dirty or gaps incorrectly set.

f. Carburetor not functioning properly.

g. Improper carburetor float level.

h. Carburetor fuel mixture too rich or too lean.

i. Foreign matter, such as dirt or water, in gas line or carburetor.

j. Faulty fuel pump.

k. Valve springs weak and/or valves sticking when hot.

l. Burned, warped, or pitted valves.

m. Valve timing incorrect.

n. Incorrect valve lifter clearance.

o. Worn camshaft lobes.

p. Pistons incorrectly fitted in block.

q. Blown cylinder head gasket.

r. Low compression.

s. Flow control valve inoperative (Power Steering).

t. Clutch slipping.

u. Brakes dragging.

v. Engine overheating.

w. Transmission regulator valve sticking (Hydra-Matic).

x. Faulty spark plug wires.

y. Sub-standard fuel.

z. Fuel filter plugged.

EXTERNAL ENGINE OIL LEAKAGE

CAUSE:

a. Improperly seated or broken fuel pump gasket.

b. Improperly seated or broken push rod cover gasket.

c. Improperly seated or broken oil filter gasket.

d. Broken or improperly seated oil pan gasket.

e. Gasket surface of oil pan bent or distorted.

f. Improperly seated or broken timing chain cover gasket.

g. Worn timing chain cover oil seal.

h. Worn or improperly seated rear main bearing oil seal.

i. Engine oil pan drain plug improperly seated.

j. Rear camshaft bearing drain hole plugged.

k. Loose rocker arm covers, gasket broken, or cover distorted or bent.

EXCESSIVE OIL CONSUMPTION DUE TO OIL ENTERING COMBUSTION CHAMBER THROUGH HEAD AREA

CAUSE:

a. Intake valve seals damaged or missing.

b. Worn valve stems or guides.

c. Cylinder head porous between oil gallery and intake ports.

d. Plugged drain back holes in head.

e. Intake manifold gasket leak in conjunction with rocker cover gasket leak.

f. Cylinder head gasket leak at head oil gallery feed passage.

EXCESSIVE OIL CONSUMPTION DUE TO OIL ENTERING COMBUSTION CHAMBER BY PASSING PISTON RINGS

CAUSE:

a. Oil level too high.

b. Excessive main or connecting rod bearing clearance.

c. Piston ring gaps not staggered.

d. Incorrect size rings installed.

e. Piston rings out of round, broken or scored.

f. Insufficient piston ring tension due to engine overheating.

g. Ring grooves or oil return slots clogged.

h. Rings sticking in ring grooves of piston.

i. Ring grooves worn excessively in piston.

j. Compression rings installed upside down.

k. Excessively worn or scored cylinder walls.

l. Oil too thin.

NO OIL PRESSURE WHILE IDLING

CAUSE:

a. Faulty oil gauge.

b. Oil pump not functioning properly. (Regulator ball stuck in position by foreign material).

c. Excessive clearance at main and connecting rod bearings.

d. Loose camshaft bearings.

e. Leakage at internal oil passages.

NO OIL PRESSURE WHILE ACCELERATING

CAUSE:

a. Oil pump not functioning properly.

b. Low oil level in oil pan.

c. Leakage at internal oil passages.

BURNED, STICKING OR BROKEN VALVES

CAUSE:

a. Weak valve springs.

b. Improper valve lifter clearance.

c. Improper valve guide clearance and/or worn valve guides.

d. Out-of-round valve seats or incorrect valve seat width.

e. Deposits on valve seats and/or gum formation on stems or guides.

f. Warped valves or faulty valve forgings.

g. Exhaust back pressure.

h. Improper spark timing.

NOISY VALVES

CAUSE:

a. Incorrect valve lifter clearance.

b. Excessively worn or faulty valve lifters.

c. Worn valve guides.

d. Excessive run-out of valve seat or valve face.

e. Worn camshaft lobes.

f. Pulled or loose rocker arm studs.

g. Bent push rods.

NOISY PISTONS AND RINGS

CAUSE:

a. Excessive clearance between piston and bore.

b. Improper fit of piston pin.

c. Excessive accumulation of carbon in heads.

d. Connecting rods improperly aligned.

e. Excessive clearance between rings and grooves.

f. Rings broken.

BROKEN PISTONS AND/OR RINGS

CAUSE:

a. Undersize pistons installed.

b. Wrong type and/or size rings installed.

c. Cylinder bores tapered or eccentric.

d. Connecting rods improperly aligned.

e. Excessively worn ring grooves.

f. Rings improperly assembled.

g. Insufficient ring gap clearance.

h. Engine overheating.

i. Fuel of too low octane rating.

NOISY CONNECTING RODS

CAUSE:

a. Connecting rods improperly aligned.

b. Excessive bearing clearance.

c. Eccentric or out-of-round crankshaft journals.

d. Insufficient oil supply.

e. Low oil pressure.

f. Connecting rod bolts not tightened correctly.

NOISY MAIN BEARINGS

CAUSE:

a. Low oil pressure and/or insufficient oil supply.

b. Excessive bearing clearance.

c. Excessive crankshaft end play.

d. Eccentric or out-of-round crankshaft journals.

e. Sprung crankshaft.

f. Excessive belt tension.

g. Loose harmonic balancer.

NOISY VALVE LIFTERS

CAUSE:

a. Broken valve springs.

b. Worn or sticking rocker arms.

c. Worn or bent push rods.

NOISY VALVE LIFTERS (Cont'd)

d. Valve lifters incorrectly fitted to bore size.

e. Faulty valve lifter plunger or push rod seat.

f. Plungers excessively worn causing fast leakdown under pressure.

g. Excessively worn camshaft lobes.

h. Valve lifter oil feed holes plugged causing internal breakdown.

i. Faulty valve lifter check ball. (Nicked, flat spot, or out of round).

j. Rocker arm retaining nut installed upside down.

k. End of push rod excessively worn or flaked.

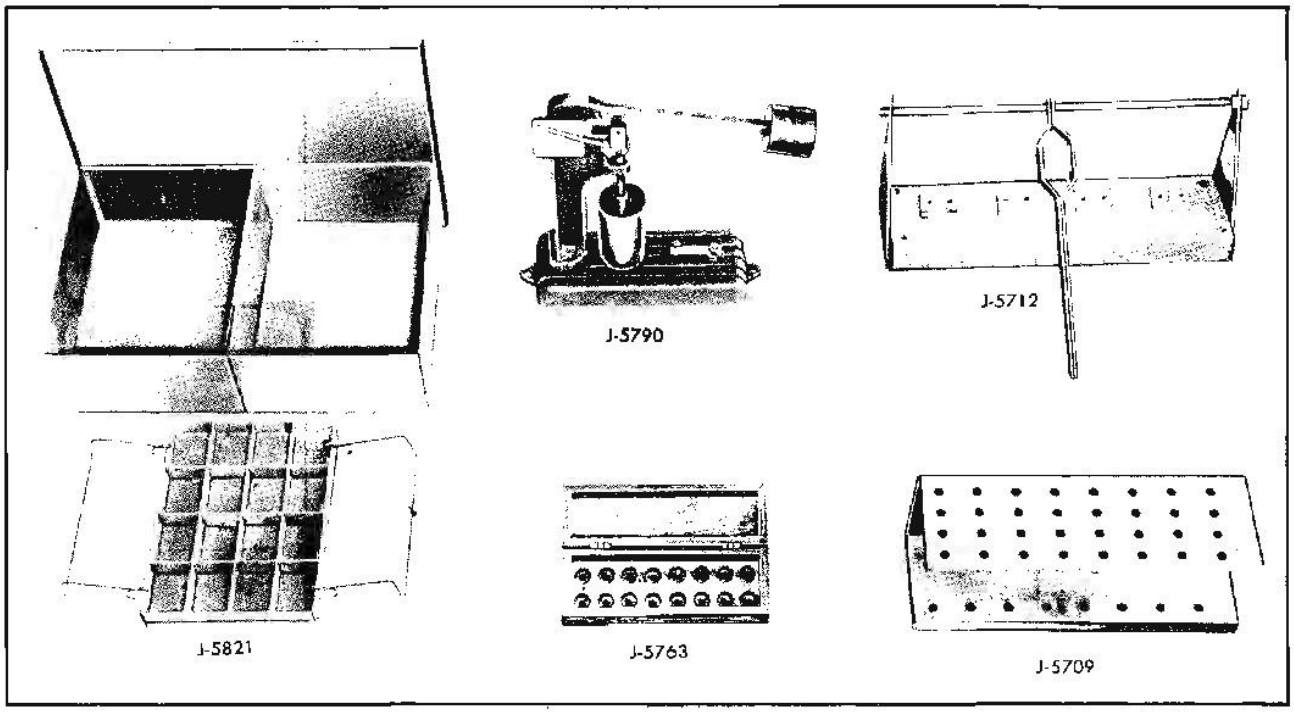

Fig. 6-155 Special Engine Tools

J-5709 Valve and Valve Train Holding Stand

J-5712 Cylinder Head Holder and Valve Spring Compressor

J-5763 Hydraulic Valve Lifter Storage Box

J-5790 Hydraulic Valve Lifter Tester

J-5821 Hydraulic Valve Lifter Solvent Tank and Tray

J-21147 Timing Chain Cover Seal Installer

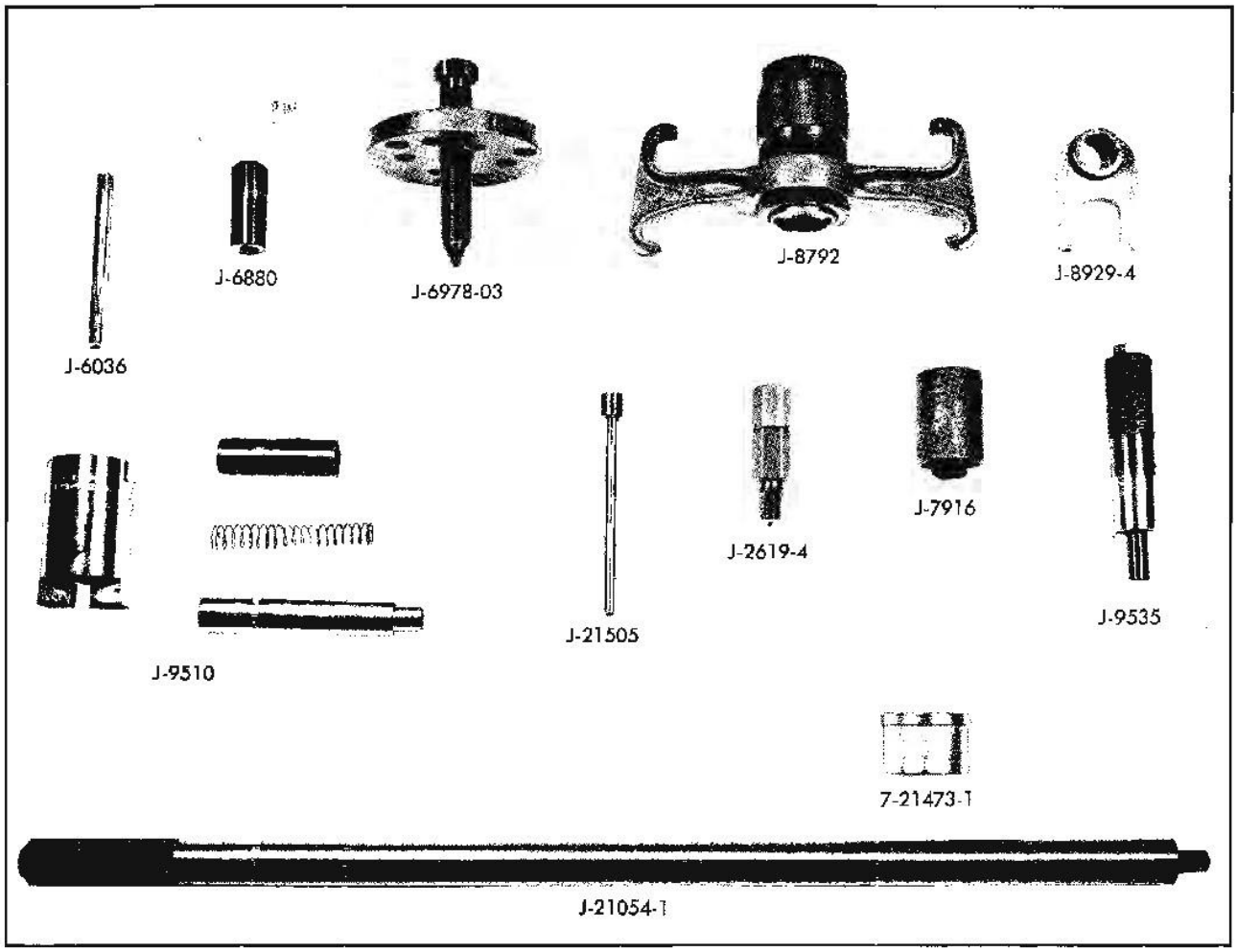

Fig. 6-156 Special Engine Tools (6 Cylinder Engine)

J-6036	Rocker Arm Stud Reamer (.013 O.S.)
J-6880	Rocker Arm Stud Installer
J-6978-03	Harmonic Balancer Puller
J-8792	Harmonic Balancer Installer
J-8929-4	Valve Spring Compressor Adapter
J-9510	Piston Pin Remover and Replacer
J-21505	Fan Hub Locating Gauge
J-2619-4	Slide Hammer Adapter
J-7916	Oil Signal Sending Switch Socket
J-9535	Distributor Shaft Bearing Installer Burnisher
J-21473-1	Adapter - Camshaft Bushing Remover and Replacer
J-21054-1	Handle - Camshaft Bushing Remover and Replacer

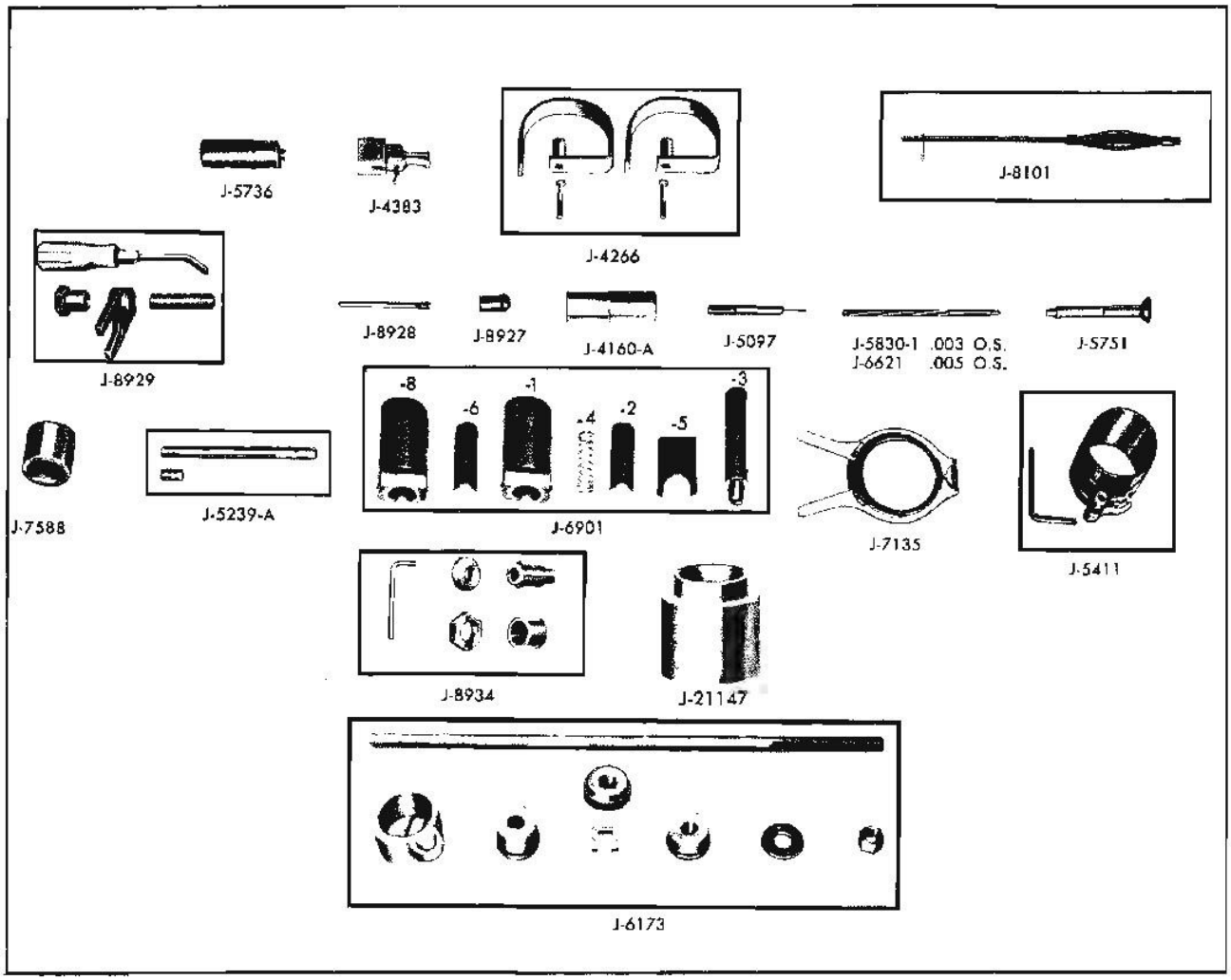

Fig. 6-157 Engine Special Tools

J-4160-A	Hydraulic Valve Lifter Plunger Remover	J-8927	Rocker Arm Stud Installer
J-4266	Cylinder Head Lifting Hooks	J-8928	Valve Train Gauge
J-5097	Hydraulic Valve Lifter Plunger Unloading Tool	J-8929	Valve Spring Compressor Set
J-5239-A	Connecting Rod Bolt Guide Set	J-8934	Rocker Arm Stud Remover
J-5411	Piston Ring Compressor	J-6621	Valve Guide Reamer .005 oversize
J-5751	Intake and Exhaust Valve Stem Installer and Tester	J-6901	Piston Pin Remover and Replacer Set
J-5830-1	Valve Guide Reamer .003 oversize	J-7135	Piston Ring Remover and Replacer
J-6173	Camshaft Bearing Remover and Replacer	J-7588	Rear Main Bearing Oil Seal Installer