

SECTION 6A

ENGINE

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CORVAIR—500, 700 900 SERIES (Except Models 535 and 735)

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GENERAL DESCRIPTION

The Turbo-Air horizontal opposed air cooled six cylinder engine has a compression ration of 8.0:1 and a displacement of 145 cubic inches, with a $3\frac{7}{16}$ " bore and a 2.60" stroke. It is standard equipment on all models and is available with 3-speed, 4-speed or Powerglide transmissions.

The optional Super Turbo-Air 145 cubic inch opposed air cooled six cylinder engine is essentially the same engine as the Turbo-Air with the following exceptions: camshaft, cylinder heads, H. D. bearings, carburetors and distributor. It is available with 3-speed or 4-speed transmissions.

The cast aluminum alloy crankcase is vertically divided into two halves which are held together by bolts at the parting line. Each crankcase half has three pilot openings for individual cast iron cylinders which are positioned to the opening by means of four long studs at each cylinder (fig. 6A-1). These studs pass freely through the cylinder head and serve to secure the cylinders and head to the crankcase.

The two opposing and identical cast aluminum cylinder heads incorporate cooling fins and integral intake manifolds and contain wedge-shaped combustion chambers and valves for each cylinder. The valves are

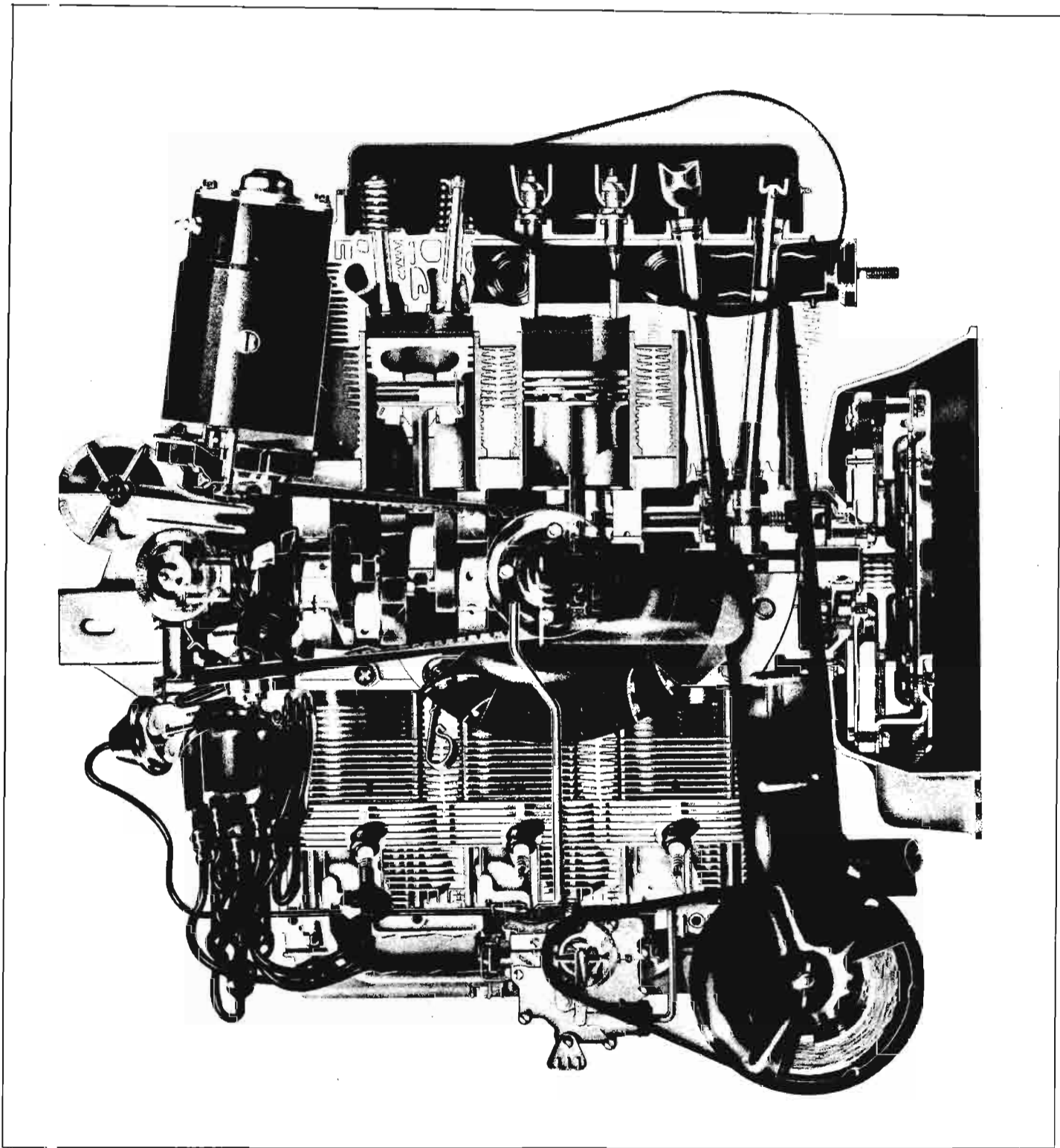


Fig. 6A-1—Engine Top View Cross-Section

actuated by push rods through stamped rocker arms similar to conventional Chevrolet V-8 engines. Steel alloy valve seat inserts are provided for durability.

Steel tubes are used to house the push rods in the open area between the crankcase and cylinder heads adjacent to the cylinders (fig. 6A-1). These tubes serve

to protect the exposed push rods as well as drain back oil from the cylinder heads to a relatively shallow oil pan bolted to the bottom of the crankcase.

The alloy cast iron camshaft, which actuates the push rods through hydraulic lifters, is nested between the two halves of the crankcase below the crankshaft.

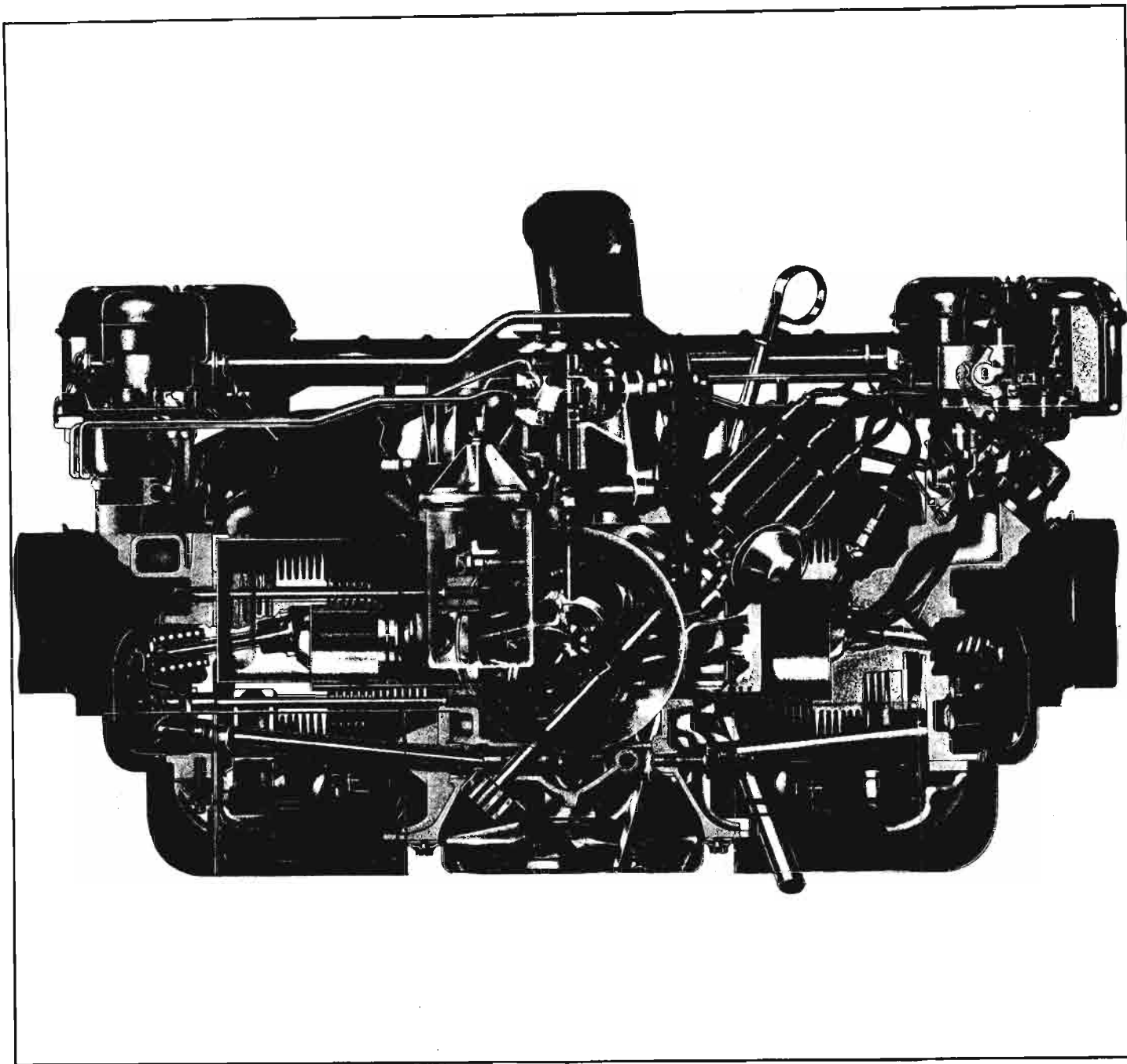


Fig. 6A-2—Engine Cross-Section Across Crankshaft

This camshaft deviates from a conventional camshaft design in that each of three exhaust valve lobes are twice the width of the intake valve lobes and actuate a pair of exhaust valve lifters. The camshaft journals ride directly on the machined base metal of the crankcase. Thrust of the camshaft is taken by a thrust washer, located between the camshaft gear and front bearing.

A forged steel crankshaft is housed above the camshaft between the split halves of the crankcase. The crankshaft has six throws arranged in pairs, each crankpin being removed 180° from the other member

of its pair. Pairs are located 60° apart. No separate main bearing caps are required since the four steel-backed babbit bearings are supported entirely by the crankcase halves. The crankshaft drives the camshaft through a composite gear and drive hub. The front crankshaft seal is installed to the cast aluminum clutch housing (or flywheel housing) which mounts to the front of crankcase assembly.

Pistons are the conventional flat head aluminum alloy type with cast in steel struts. Each piston is coated with a light tin plate and utilizes two compression rings and a two piece oil control ring. The piston

pin is a press fit in the connecting rod. All connecting rod bearings are steel-backed babbit inserts.

The cast aluminum engine rear housing mounts to the rear of the crankcase over four free fitting long studs. This housing contains the oil pump, crankshaft seal and primary oil passages. It provides a mounting for the distributor and the generator adapter ("B" fig. 6A-1) to which the fuel pump, oil fill pipe, generator, oil filter and idler pulley are mounted.

A rectangular aluminum crankcase cover mounts to the top of the crankcase and forms a base for the centrifugal blower (fig. 6A-2).

Engine Mounting

The engine-transmission-axle is mounted as a unit to the chassis on a three-point mounting system at the rear of the vehicle. The two shear-type front mounts secure the transmission to the rear crossmember, while the single shear type mount centered at the rear of the engine secures the engine to the body. The engine is sealed in its compartment against entrance of road dust and dirt from below.

Cylinder Numbering and Firing Order

The front of the engine in the installed position is the flywheel end. Engine rotation, as viewed from the rear of the vehicle, is counterclockwise. Cylinders are numbered from the rear of the engine. The right rear

cylinder is No. 1 and the left rear cylinder is No. 2. Thus reading in order from the rear, the right bank is numbered 1, 3 and 5 and the left bank 2, 4 and 6.

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

Lubrication System

(Refer to Figure 6A-4, except as noted)

Oil in the oil pan sump (fig. 6A-3) is drawn through the sump pick-up tube and screen assembly and forced through the lubrication system by a spur gear pressure type pump, which is driven by the end of the distributor shaft. A spring loaded pressure regulator (fig. 6A-76) located in the engine rear housing, regulates the maximum pressure of the lubrication system to 35 psi.

All the oil discharged by the oil pump, enters a passage (16) formed by cast hollows in the rear of the crankcase and adjacent front face of the engine rear housing. The oil then travels up to the top of the crankcase (10) where it enters a full flow oil filter (7) (disposable cartridge type). The oil filter incorporates a 10 psi filter by-pass valve (9), which by-passes the filter cartridge, if the filter becomes plugged.

Leaving the oil filter, oil passes through an air-cooled oil cooler (22). The oil cooler also incorporates a 10 psi by-pass valve (4). Oil leaving the oil cooler enters another gallery (17) formed by the crankcase and rear housing, and then passes on to the main oil galleries.

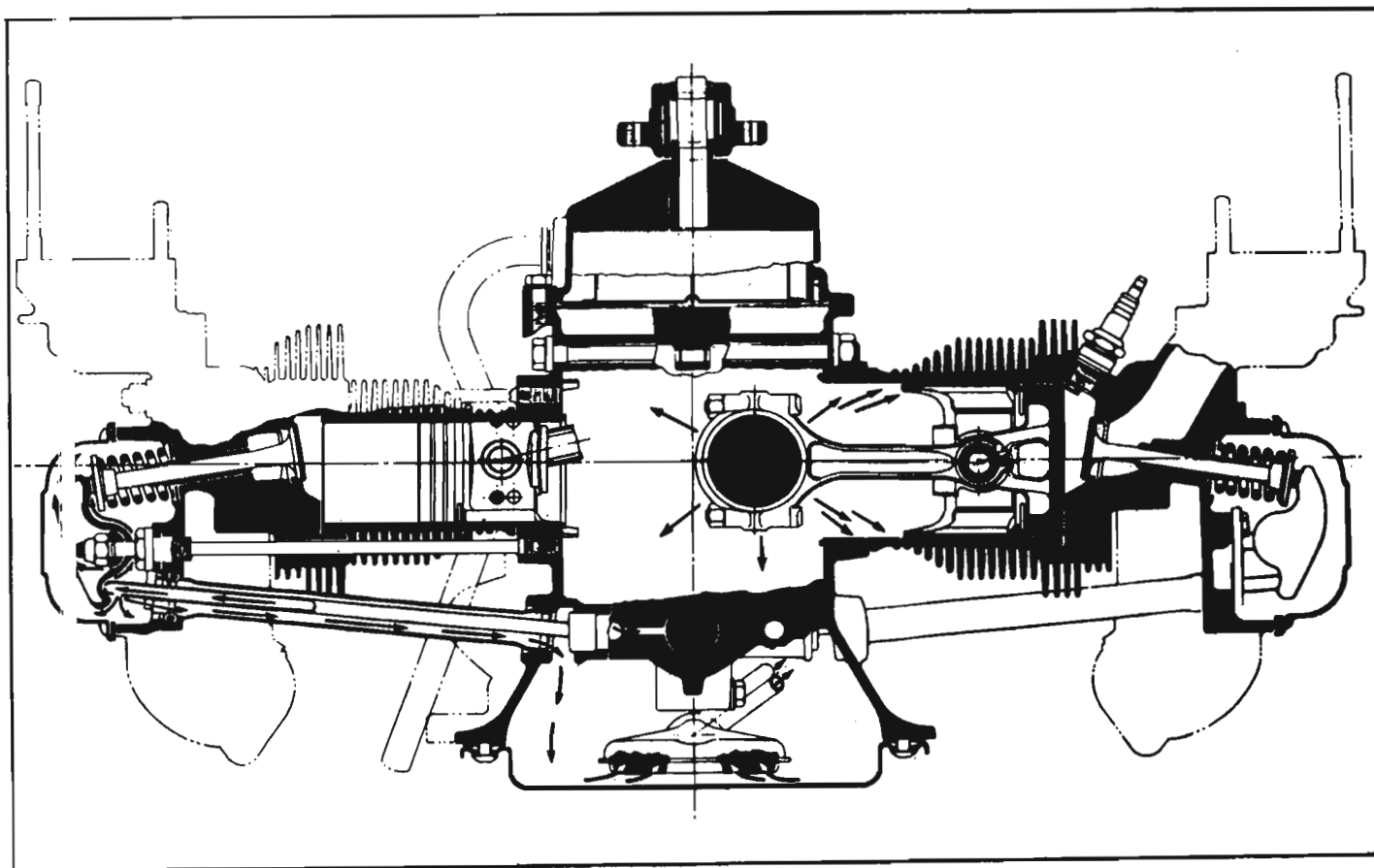


Fig. 6A-3—Engine Lubrication—Cylinder Head

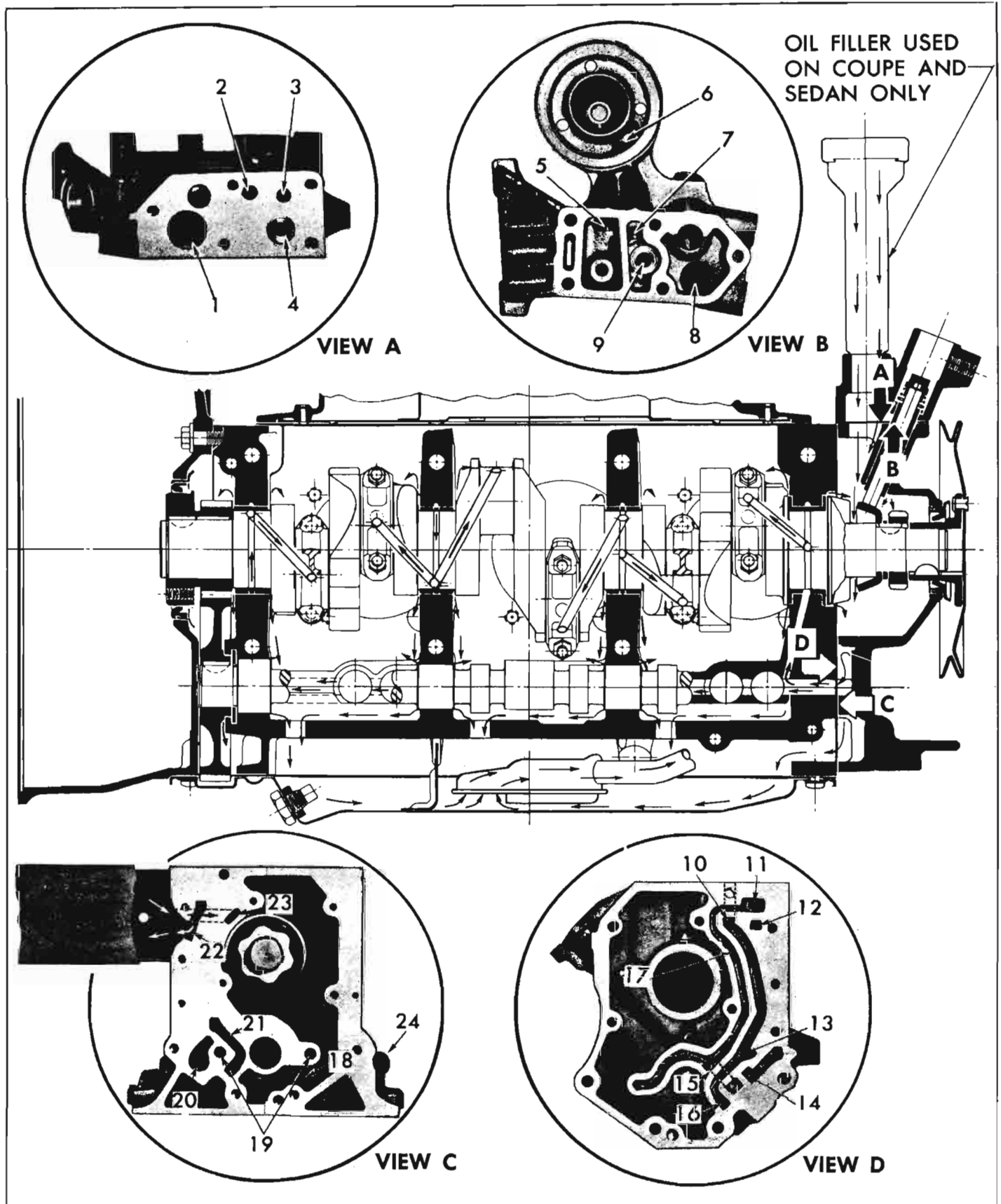


Fig. 6A-4—Engine Lubrication

View A Top face of engine rear housing

View B Bottom face of oil filter and generator adapter

View C Rear of engine crankcase

View D Front face of engine rear housing

NOTE: ● Face of oil filter and generator adapter shown in view "B" mounts to top face of engine rear housing shown in View "A."
● Front face of engine rear housing shown in View "D" mounts to rear face of engine crankcase shown in View "C."

- | | | | |
|-----------------------------|---------------------------------------|---|---|
| 1. Oil Filler Inlet | 8. Oil Filler Inlet | 15. Oil Passage to Main Oil Gallery Left Side | 20. Oil Pump Suction |
| 2. Oil Filler | 9. Oil Filler By-Pass Valve | 16. Oil Pump Outlet | 21. Oil Pump Outlet Cavity |
| 3. Oil Cooler | 10. To Oil Filter | 17. Oil Enters Ditch Here from Oil Cooler | 22. Oil Cooler Inlet |
| 4. Oil Cooler By-Pass Valve | 11. Oil Cooler By-Pass Valve Exit | 18. Entrance to Crankcase Sump | 23. Oil from Cooler to Main Galleries |
| 5. Oil Filter Outlet | 12. To Oil Cooler from the Oil Filter | 19. Main Oil Galleries | 24. Oil Filter Location for Station Wagon and Corvair 95 Series |
| 6. Oil Filter Element Inlet | 13. Oil Pressure Regulator Entrance | | |
| 7. Oil Filter Inlet | 14. Oil Pump Inlet | | |

The main oil galleries which are parallel passages (19) running longitudinally through the crankcase, intersect the valve lifter openings (fig. 6A-3) and act as valve lifter oil galleries as well as main oil galleries. The four main bearings and four camshaft bearings are supplied with oil at full system pressure through holes drilled in the crankcase. With rear bearings designated as No. 1 the right bank main oil gallery flows to No. 1 and 3 main bearings and No. 1, 3 and 4 camshaft bearings. The left bank main oil gallery flows to No. 2 and 4 main bearings and No. 2 camshaft bearing.

Oil is carried from the main oil gallery through lubricating holes in the main bearings and crankshaft journals (fig. 6A-4), then through the crankshaft to the connecting rod journals and bearings. Overspray from the connecting rod bearings lubricates the cylinder bores and pistons (fig. 6A-3).

Front main bearing oil also lubricates the timing gears, which are enclosed by the front end of the crankcase and the rear side of the flywheel housing. Lubrication for the timing gears is accomplished by overspray oil from the front main bearing and camshaft bearing (fig. 6A-4).

The main oil galleries supply oil directly to the hydraulic valve lifters, which in turn supply the hollow push rods. A lubricating hole in the upper side of each push rod (fig. 6A-3) allows oil to spray out the side of the push rod into the valve spring and valve stem area. The tappet rotates and in turn rotates the push rod which sprays the valve chamber. The through hole of the push rod indexes once during every revolution with the hole in the rocker arm, sending oil upwards to the rocker arm ball, which in turn carries oil to the rocker arm, rocker arm studs, and valve stems (fig. 6A-3).

The fill pipe fits into the oil filter and generator adapter. Oil being added to the system drains between the rear housing and the crankcase into the oil pan. The oil level gauge fits into its tube at the right rear side of the engine.

Crankcase Venting

A vent tube is provided which passes out of the crankcase cover on top of the engine, then out on the right hand side and downward. The oil separator or

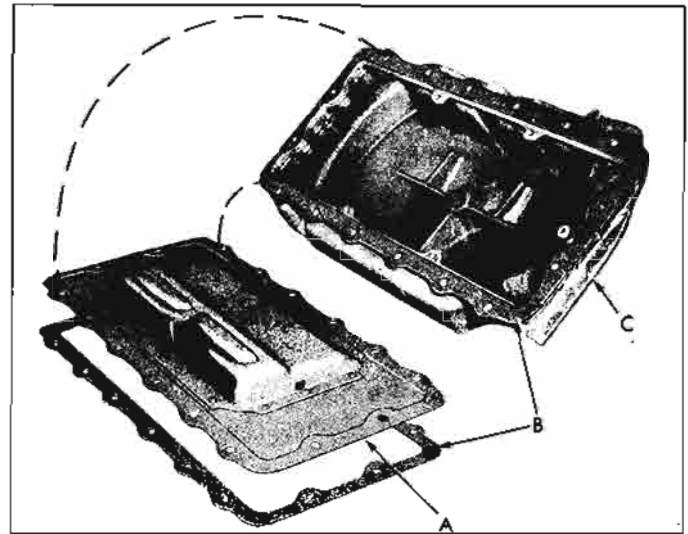


Fig. 6A-5—Crankcase Cover and Vent Assembly

A. Crankcase Vent
B. Gaskets

C. Crankcase Cover

crankcase vent, is basically a louvered plate with a separating chamber spot welded to the upper side. It is assembled between gaskets and mounted between the crankcase cover (fig. 6A-5) and crankcase.

Cooling System

The engine is entirely shrouded with sheet metal pieces attached directly to the engine to form a plenum chamber.

A centrifugal blower, mounted to the top of the crankcase cover, spins on a vertical shaft to deliver cooling air outward and downward over the cylinders and cylinder heads. The air then enters a duct under each bank from where it travels rearward to be exhausted at openings at the rear of the engine.

The rate of engine cooling is regulated by a bellows type thermostat mounted in the lower part of each engine lower shroud and exhaust duct (fig. 6A-9). The exhaust duct damper doors in the exhaust duct are controlled by the thermostat to start opening at 195° F. and are fully opened at 210° F. In normal

ENGINE 6A-8

operation, exhaust duct damper door angles will vary between full open and closed to maintain engine temperatures in operating range (fig. 6A-6).

The cooling air thermostat (with expanded convolutions) is filled with Butyl Alcohol under vacuum, thus compressing the bellows. In the event of a failed thermostat, atmospheric pressure is equalized and the bellows returns to its normal position (expanded), automatically bringing the damper cooling air doors to full open position.

The engine front shrouds have openings (fig. 6A-16) for heater installation and are covered when heater is not installed.

The blower, which runs on a sealed, permanently lubricated ball bearing, is belt driven by a pulley mounted at the extreme rear end of the crankshaft. A generator drive pulley at the left rear of the engine and an idler pulley at the right rear provide a means of changing belt direction from a vertical plane at the crankshaft pulley to a horizontal plane at the blower pulley.

An oil cooler, through which a portion of the cooling air passes before discharge, is mounted above the

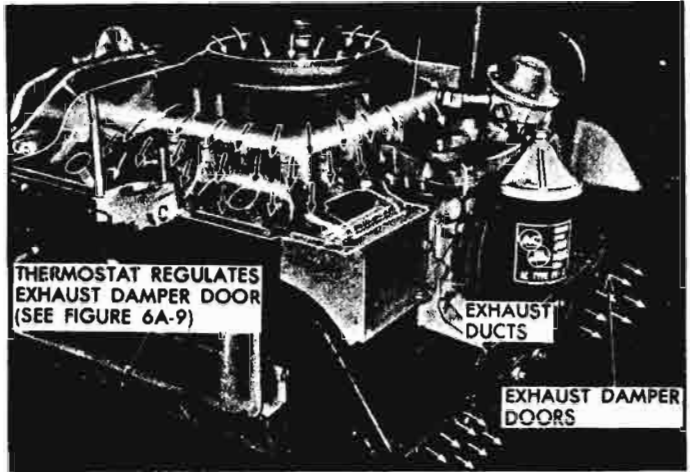


Fig. 6A-6—Engine Cooling System

air exhaust duct near the left rear corner of the engine.

Air Induction System

See Section 9—Fuel and Exhaust System for a description of the two carburetor air induction systems.

MAINTENANCE AND ADJUSTMENTS

ENGINE OIL

See "Lubrication and General Maintenance," Section 2.

ENGINE OIL LEVEL

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

FAN BELT OR BLOWER BELT

See Section 7.

IGNITION TIMING

See Section 7.

COMPRESSION CHECK

See Section 7.

VALVE LASH ADJUSTMENT—(ENGINE RUNNING)

NOTE: To catch excess oil, cut a discarded valve cover to $\frac{1}{2}$ its normal size, which can be used as a trough.

1. Remove valve cover and install oil trough at the bottom of the cylinder head to catch any oil that may run out.
2. With the engine normalized and running at idle, back up valve rocker arm nut (one at a time) until the valve rocker starts to clatter against the valve, then turn the valve rocker nut down until

the clatter of the valve rocker arm is just stopped.

3. Turn off the engine and turn down each valve rocker arm nut exactly $\frac{3}{4}$ of a turn.

NOTE: On Super Turbo-Air engines turn nut exactly $1\frac{1}{4}$ turn.

This will set the plunger ("7," fig. 6A-88) of the hydraulic lifter in the center of its operating travel.

NOTE: Adjustment procedure is the same for both cylinder heads.

4. Install valve rocker covers with new cover gaskets. Torque valve rocker covers 30 to 50 inch pounds.

HYDRAULIC VALVE LIFTERS

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

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

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

Another method is to place a finger on the face of the valve spring retainer. If the lifter is not function-

ing properly, a distinct shock will be felt when the valve returns to its seat.

The general types of valve lifter noise are as follows:

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

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

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

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

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

AIR CLEANER AND CARBURETION

See Section 9.

ENGINE ELECTRICAL COMPONENTS

See Section 8.

ENGINE TUNE-UP

See Section 7.

ENGINE CLEANLINESS

Engine cleanliness is very important, oil leaks or contaminants within the engine shrouding in the engine compartment may result in objectionable fumes within the passenger compartment.

Sources of all such leaks should be promptly corrected and the area thoroughly cleaned.

Areas of suspicion would be push rod oil drain tubes at their seals, oil cooler seals and oil cooler adapter gasket, oil filter gaskets, oil filter and generator adapter gasket, valve rocker cover gaskets, engine top cover gaskets, crankcase ventilator tube seal and gasket, cylinder head gaskets, engine cylinder gaskets, engine rear housing gasket, ignition timer distributor gasket, and exhaust manifold sleeve gaskets.

Oil or grease should not be left on engine or engine shrouding after service operations, as this condition tends to accumulate foreign material deposits causing objectionable fumes that could be forced into the passenger compartment.

Since the cylinder and cylinder head fins are cooled directly by the air forced over them by the blower, it is important that they be kept clean and free of foreign matter.

The cooling fins can be cleaned with the use of an air gun, after removing the engine lower shrouds.

Every 5000 miles—Remove oil cooler access cover and brush or blow out accumulated dirt as shown in Figures 6A-7 and 8.

NOTE: Material usually found in the oil cooler consists primarily of twigs, straw, chaff, and leaves.

Cleaning Oil Cooler

1. Remove oil cooler access hole cover (fig. 6A-7)



Fig. 6A-7—Oil Cooler Access Hole Cover

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and brush foreign particles away from oil cooler fins.

2. With the oil cooler access hole cover removed, insert an air hose gun under oil cooler (fig. 6A-8) and blow up through oil cooler fins.

NOTE: Hold exhaust door open with a block of wood.

3. Replace oil cooler access hole cover.

COOLING SYSTEM EXHAUST DUCT DAMPER

In the event of a failed thermostat bellows, the exhaust damper door (fig. 6A-9) will remain in the open position allowing a maximum air flow over the engine to prevent overheating. Recirculating slots are located in each exhaust duct for circulating warm air into the engine compartment.

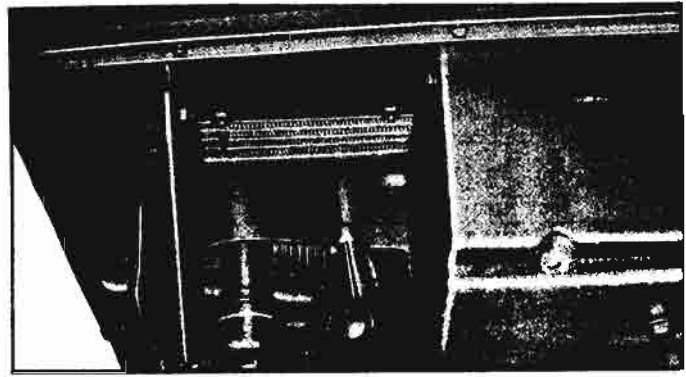


Fig. 6A-8—Cleaning Oil Cooler

When installing a new thermostat, it is necessary to adjust the exhaust duct damper door opening to

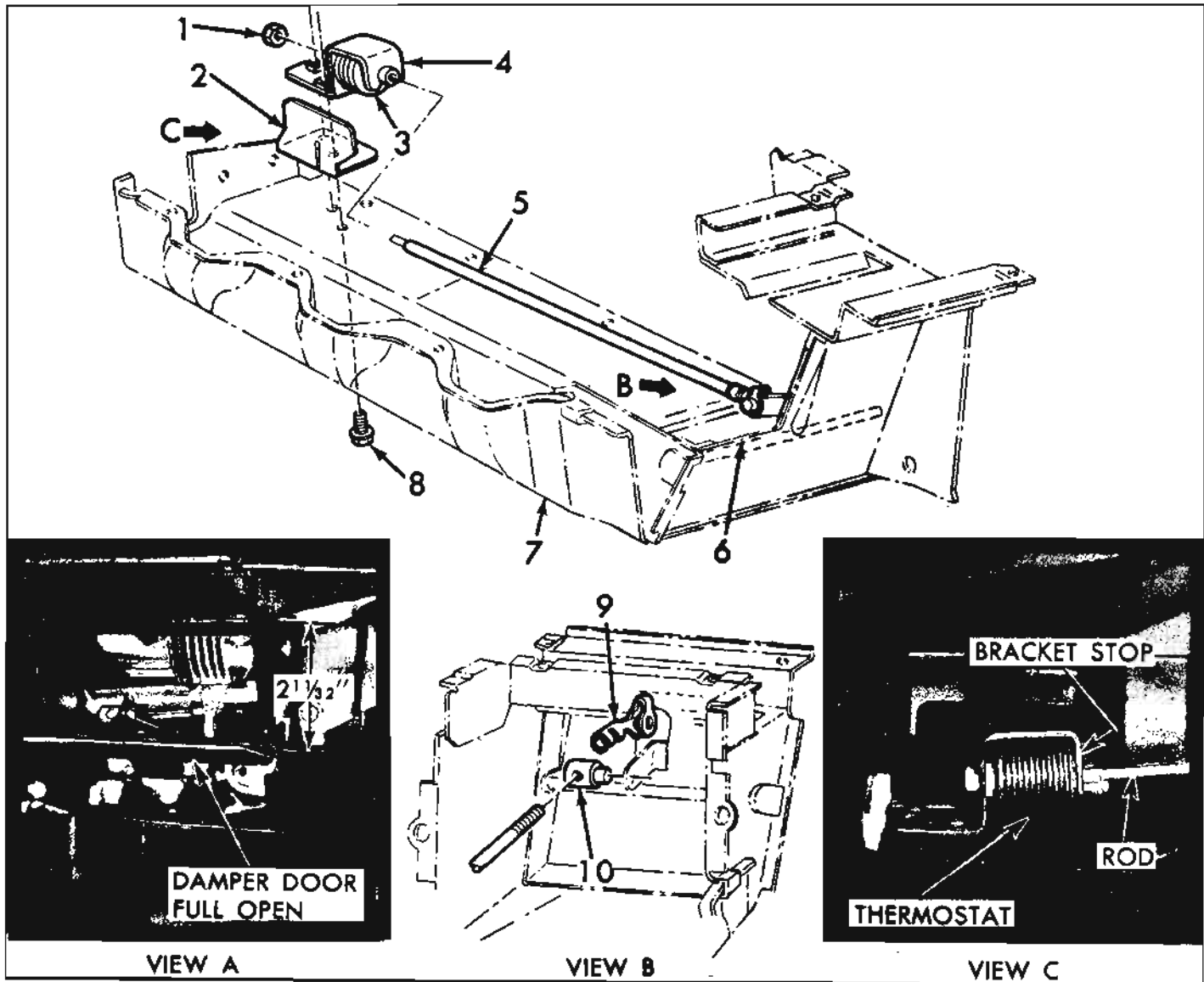


Fig. 6A-9—Exhaust Duct Damper Thermostat Adjustment

1. Retainer Nut
2. Heat Shield
3. Thermostat Assembly

4. Bracket Assembly
5. Actuating Rod
6. Exhaust Damper Door

7. Lower Shroud and Exhaust Duct
8. Screw

9. Retainer Clip
10. Swivel

provide the correct air flow. This adjustment should be made with the exhaust duct assembly installed on the engine.

NOTE: The thermostat rod is attached to the thermostat bellows by threads. The thermostat is fastened securely to the thermostat mounting bracket with a nut. The damper door actuating rod is provided with flats to attach a wrench when tightening rod to thermostat.

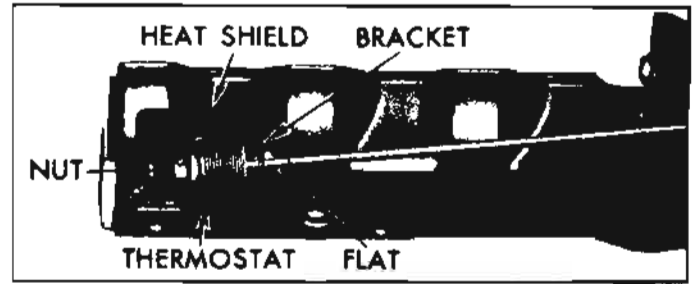


Fig. 6A-10—Cooling Air Exhaust Door Thermostat

the maximum travel (thermostat against bracket stop, fig. 6A-10).

Adjustment

1. With the exhaust damper door full open, (view 'A', Figure 6A-9) pull the actuating rod out to

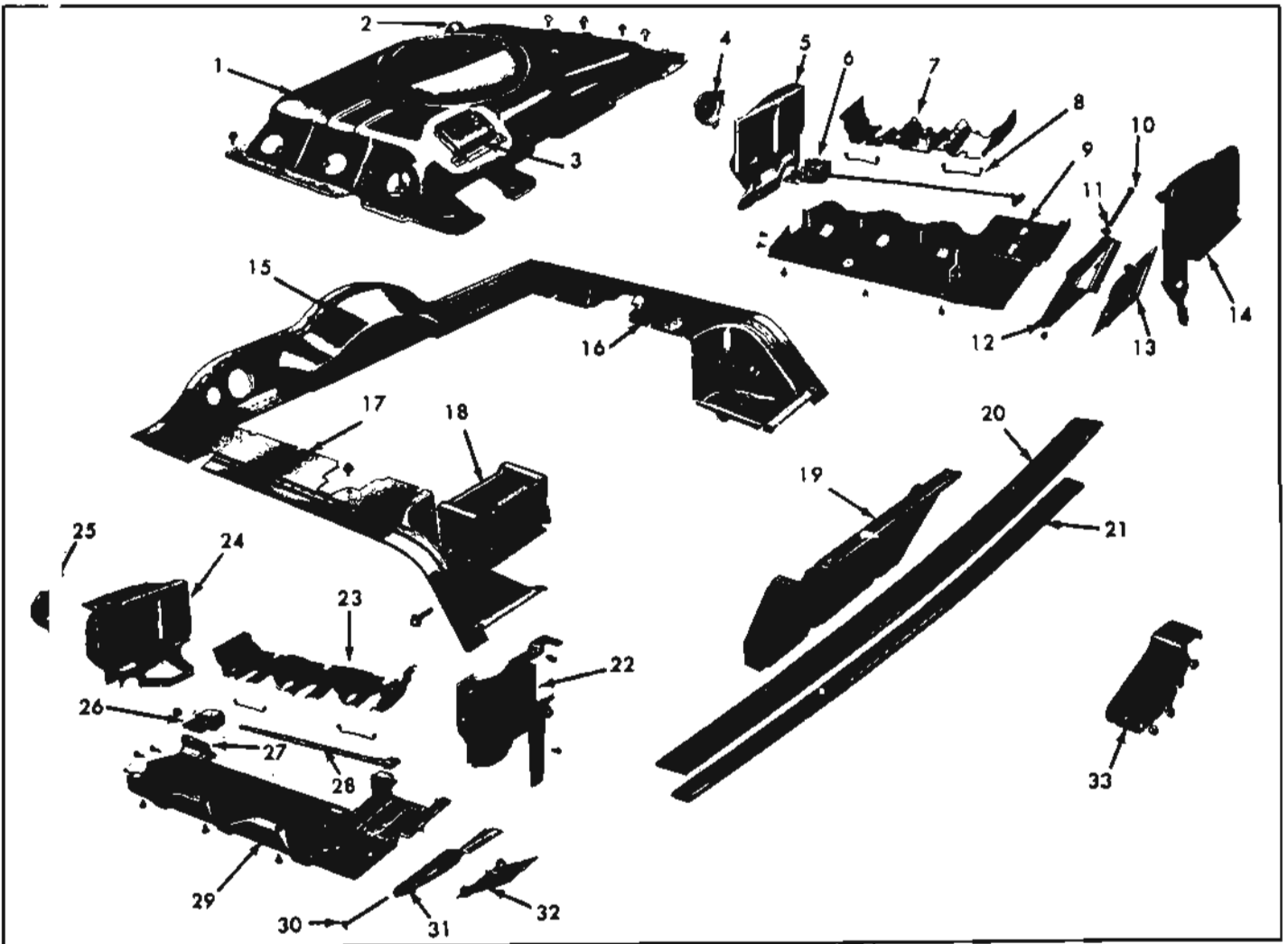


Fig. 6A-11—Engine Sheet Metal Components

- | | | |
|---|---------------------------------------|--|
| 1. Engine Upper Shroud | 12. Exhaust Duct Opening | 24. Engine Front Shroud—L. H. |
| 2. Water Connection | 13. Exhaust Duct Damper Door | 25. Engine Front Shroud Cover |
| 3. Oil Cooler Access Hole Cover | 14. Engine Rear Shroud R. H. | 26. Thermostat and Bracket |
| 4. Engine Front Shroud Cover | 15. Engine Front Shield | 27. Thermostat Heat Baffle |
| 5. Engine Front Shroud Assembly—R. H. | 16. Engine Side Shield Assembly—R. H. | 28. Actuating Rod |
| 6. Thermostat, Bracket and Actuating Rod | 17. Engine Side Shield Assembly—L. H. | 29. Engine Lower Shroud and Exhaust Duct—L. H. |
| 7. Engine Cylinder Air Baffle—R. H. | 18. Oil Cooler | 30. Exhaust Duct Door Shaft |
| 8. Engine Cylinder Air Baffle Retainer | 19. Engine Rear Center Shield | 31. Exhaust Duct Opening |
| 9. Engine Lower Shroud and Exhaust Duct—R. H. | 20. Engine Rear Seal | 32. Exhaust Duct Damper Door |
| 10. Exhaust Duct Door Shaft | 21. Engine Rear Seal Retainer | 33. Engine Rear Mounting Bracket |
| 11. Flat Washer | 22. Engine Rear Shroud L. H. | |
| | 23. Engine Cylinder Air Baffle—L. H. | |

- Adjust swivel until it enters damper door and retain with clip, fig. 6A-9.
- Both damper doors are adjusted the same, with thermostat against the stop bracket, measure from the flat of damper door edge to the exhaust duct upper edge. This opening should measure approxi-

mately 2 $\frac{1}{32}$ " as shown in Figure 6A-9, View "A".

NOTE: Thermostat can be installed by attaching it to actuating rod and bracket, then insert the thermostat, bracket and actuating rod through the exhaust duct damper door opening.

SERVICE OPERATIONS

GENERAL SERVICE INFORMATION

Service Operations will be outlined in two parts. The first part will consist of "On the Vehicle," service operations (engine installed in vehicle), while the second part will consist of "Off the Vehicle," service operations (engine removed from vehicle). The "Engine Service Reference Guide," is designed to show in advance the items that can be serviced on the engine, while the engine is in the vehicle.

Some service operations can be done either in or out of the vehicle, so the most practical method should be followed depending on the conditions involved. Some items like the crankshaft and camshaft, involve complete engine removal from the vehicle and complete disassembly of the crankcase for their removal.

Component items are outlined for removal and installation, under "Engine Component Service Procedures," and repairs are outlined under, "Repairs—Engine Components."

COMPONENT SERVICE PROCEDURES—ENGINE IN VEHICLE

On all service operations where threads enter aluminum, use anti-seize compound, such as Permatex No. 404 or its equivalent.

ENGINE SHEET METAL COMPONENTS

Refer to Figure 6A-11

Adequate engine cooling greatly depends on proper alignment of engine sheet metal components (fig. 6A-11).

Handle sheet metal components carefully to prevent bending or distortion.

Upper Shroud Assembly

Removal

- Remove air cleaner assemblies and supports.
- Disconnect fuel lines at fuel pump and carburetors. Disconnect accelerator and throttle linkage, choke cable assembly and heater hose at upper shroud. Remove blower belt.
- Remove carburetor cross-shaft and disconnect vacuum balance tube from carburetor mounting flange and upper shroud assembly. Remove both carburetors.
- Remove wire harness from each spark plug.
- Remove all fuel lines and oil level gauge.
- Remove generator bracket bolts at engine upper shroud and swivel generator bracket out of the way.
- Remove all engine upper shroud assembly retaining screws (fig. 6A-12) and remove upper shroud.

NOTE: Tip engine upper shroud assembly away from the oil filter and generator adapter.

Installation

- Install engine upper shroud, tipping while lowering over blower assembly.

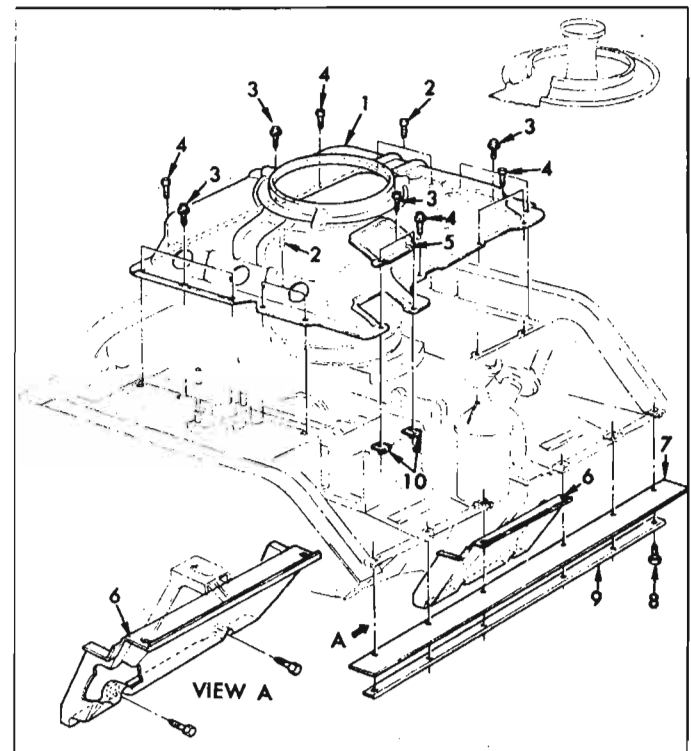


Fig. 6A-12—Engine Upper Shroud Assembly, Rear Shield and Center Shroud

- | | |
|---------------------------------|------------------|
| 1. Upper Shroud Assembly | 6. Rear Shield |
| 2. Bolt | 7. Seal |
| 3. Bolt | 8. Screw |
| 4. Screw | 9. Seal Retainer |
| 5. Oil Cooler Access Hole Cover | 10. U-Nuts |

NOTE: When tightening engine upper shroud retaining screws, turn blower to assure adequate clearance of blower to engine shroud.

2. Install all engine upper shroud screws as shown in Figure 6A-12 and torque 30 to 40 in. lbs. Install generator bracket bolts and tighten as outlined in Section 8.
3. Install carburetors and connect fuel lines and vacuum balance tube. If removed, install and connect heater hose at upper shroud.
4. Install carburetor cross-shaft, throttle linkage and choke cable assembly. Install supports and air cleaners. Adjust accelerator and throttle linkage as described under "Carburetor Synchronization", in Section 9.
5. Install wire harness and oil level gauge. Install blower belt and adjust as described in Section 7.

Front Shield

Refer to Figures 6A-11 and 6A-13.

Removal

1. Remove air cleaners and air cleaner supports. Remove vacuum balance tube. Remove vacuum balance tube strap retaining bolts and six screws from engine front shield.
2. Remove accelerator rod and fuel lines entering front shield.
3. Disconnect choke cable assembly and heater hose connection to upper shroud.
4. Remove engine front shield.

Installation

1. Install engine front shield, while guiding front seal edges into front shield seal retainer.

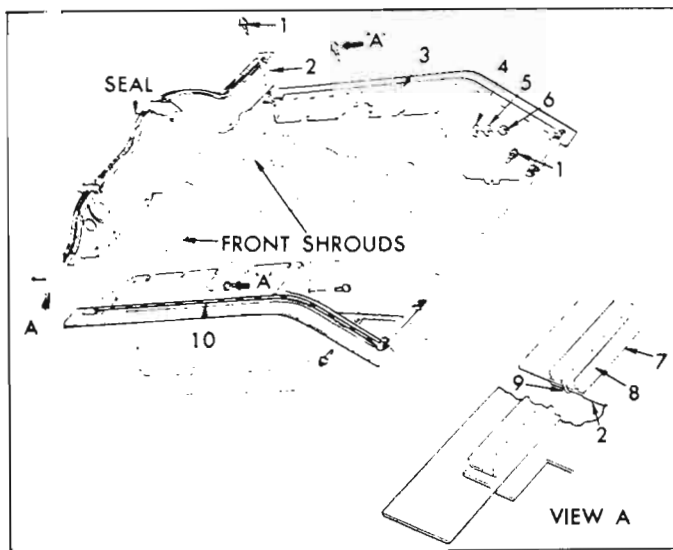


Fig. 6A-13—Front and Side Shields

- | | |
|-------------------------------|-------------------------------|
| 1. Screw | 6. Nut |
| 2. Front Shield Assembly | 7. Seal |
| 3. Right Side Shield Assembly | 8. Seal Retainer |
| 4. Washer | 9. Wire Staple |
| 5. Lockwasher | 10. Left Side Shield Assembly |

2. Install six retaining screws and two in the support strap, shown in Figure 6A-11.
3. Install accelerator rod, fuel lines and throttle rod through engine front shield.
4. Replace vacuum balance tube. Install air cleaner supports and air cleaner assemblies.

Side Shield Assembly (Left Side)

Removal

1. Remove air cleaners and left hand support. Loosen retaining screws at engine upper shroud, attaching engine side shield to the cylinder head (figures 6A-12 and 13). Remove screw ("A", fig. 6A-13) from under carburetor and remove screws attaching side shield to the lower shroud and exhaust duct assembly.
2. Remove oil cooler screws attached to engine side shield assembly ("18", fig. 6A-11). Disconnect radio ground.
3. Remove screws attached at engine rear shield seal.
4. Remove engine side seal retainer and remove engine side shield assembly, by sliding out from under the upper shroud assembly as shown in Figure 6A-14.

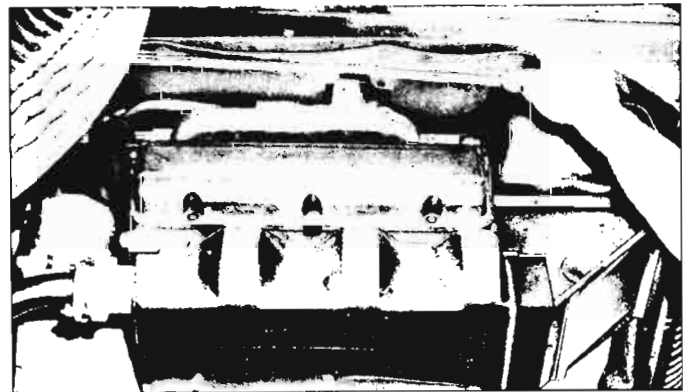


Fig. 6A-14—Removal and Installation of Engine Side Shield

Installation

1. Slide engine side shield assembly under the engine upper shroud and into place as shown in Figure 6A-13.
2. Install attaching screws in engine side shield to rear shield.
3. Install screw ("A", fig. 6A-13) under carburetor. Install screws attaching engine side shield to the cylinder head. Install radio ground.
4. Install retaining screws to lower shroud exhaust duct assembly and engine side shield seal retainer.
5. Tighten all screws at engine upper shroud, attaching side shield to cylinder head.
6. Install air cleaner support and air cleaner assemblies.

Side Shield Assembly (Right Side)

Removal

1. Remove spare wheel and tire. Remove coil and coil mounting bracket. Remove muffler support and muffler shield.
2. Remove engine side shield seal retainer (fig. 6A-11).
3. Remove air cleaners and right hand support. Remove screw ("A", fig. 6A-13) under carburetor at side shield right side.
4. Loosen retaining screws at engine upper shroud, attaching engine side shield to the cylinder head (figures 6A-12 and 13). Disconnect radio ground.
5. Remove screws attaching side shield to the lower shroud exhaust duct assembly and rear shield.
6. Remove engine side shield assembly by sliding out from under the upper shroud assembly, similar to Figure 6A-14.

Installation

1. Slide engine side shield into place, under engine upper shroud. Install screw under carburetor.
2. Install all attaching screws at lower shroud exhaust duct assembly and rear shield seal.
3. Install coil bracket and coil. Install exhaust muffler baffle and support.

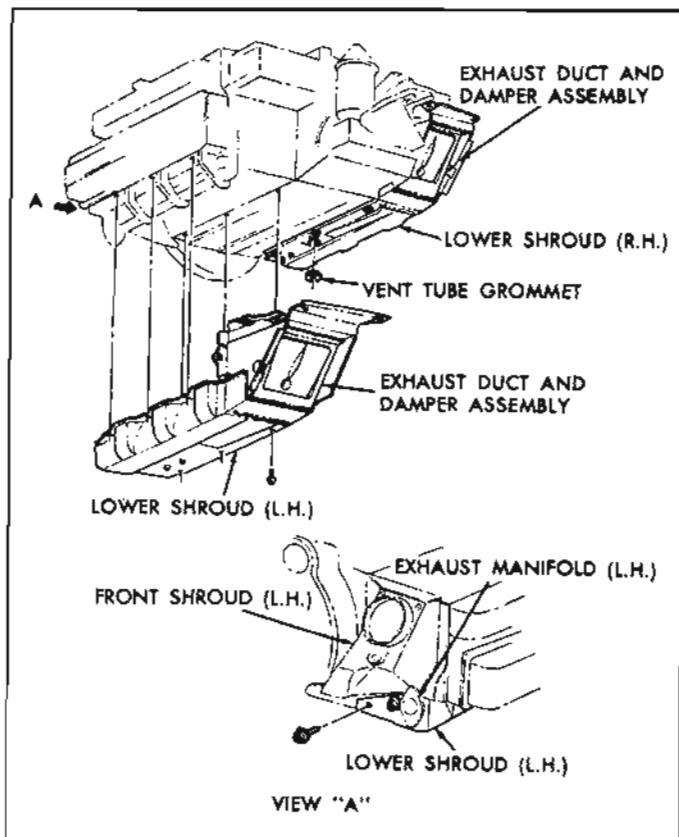


Fig. 6A-15—Engine Lower Shroud and Exhaust Duct

4. Tighten all retaining screws at upper shroud, attaching side shield to cylinder head.
5. Install support and air cleaner assemblies.

Lower Shroud and Exhaust Duct

Refer to Figures 6A-11 and 6A-15.

Removal and Installation

1. Remove attaching screws from lower shroud and exhaust duct entering cylinder head. Remove screws attaching lower shroud and exhaust duct to front shroud and side shield assembly. Loosen side shield at rear so lower shroud and exhaust duct can be pivoted outward.
2. Remove screws at rear center shield, retainer and rear seal retainer (fig. 6A-11).
3. On left lower shroud and exhaust duct, remove screws at oil cooler; and on right lower shroud and exhaust duct, remove coil and bracket and muffler support bracket.
4. Remove engine lower shroud and exhaust ducts.
5. Install engine lower shroud and exhaust duct in position. On the right side lower shroud, align shroud so that the crankcase vent tube centers in hole on the lower shroud.
6. Align matching holes with an awl or other pointed tool. Install all retaining screws in shroud.

NOTE: Do not leave out any screws attaching shroud components to the engine. This will cause unnecessary rattles.

7. Install coil and bracket on right side and screws attaching oil cooler to lower left shroud assembly.

NOTE: Replace gasket seal between exhaust manifold and lower shroud, if damaged.

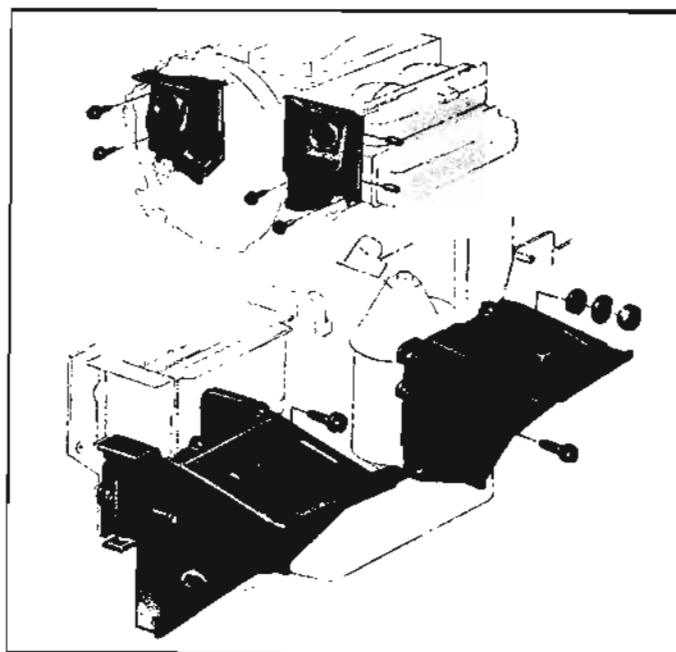


Fig. 6A-16—Engine Front Shrouds and Exhaust Ducts

Front Shrouds

Refer to Figures 6A-11 and 6A-16.

Removal and Installation

1. Remove engine lower shroud assemblies and exhaust manifolds.
2. Remove screws retaining front shrouds to the cylinder head.

NOTE: If heater equipped, disconnect heater attaching hoses.

3. Remove engine front shrouds.
4. Install front shrouds into place, and install retaining screws attaching shroud to crankcase and cylinder head.
5. Install exhaust manifolds using new gaskets, and engine lower shroud assemblies with retaining screws.

Remove Shroud (Left Side)**Removal**

1. Remove oil cooler retaining bolts and screws (fig. 6A-11).
2. Remove oil cooler seals.
3. Remove screws retaining lower shroud and exhaust duct assembly to the engine rear shroud, and remove lower shroud assembly.
4. Remove all screws retaining engine, rear shroud to cylinder head and shrouds.
5. Remove engine rear shroud.

Installation

1. Install engine rear shroud in place on crankcase cast lips.
2. Install attaching screws to cylinder head. Install lower shroud and exhaust assembly.
3. Install new oil cooler seals (two) in place on oil cooler adapter.
4. Install oil cooler retaining bolt and torque 8 to 12 ft. lbs. and install screws attaching oil cooler at lower shroud exhaust duct assembly.
5. Install remaining screws retaining engine rear shroud.
6. Start engine and check for oil leaks around engine oil cooler.

Remove Shroud (Right Side)**Removal**

1. Remove muffler shield and muffler support from engine right side cylinder head.
2. Remove retaining screws from rear shroud. Disconnect oil temperature and oil pressure sending unit wires.
3. Remove spare tire and wheel assembly.

4. Remove bolt and nut securing coil and coil bracket to cylinder head. Remove screws retaining engine upper shroud to engine rear shroud, at cylinder head.
5. Remove lower shroud exhaust duct assembly.
6. Remove engine rear shroud.

Installation

1. Install shroud in place and install all retaining screws.
2. Install coil and coil bracket retaining bolt and nut at stud (6) (fig. 6A-13).
3. Install muffler support and muffler shield to cylinder head and engine rear shroud.
4. Connect engine oil temperatures and oil pressure sending unit connections.
5. Install lower shroud and exhaust duct.
6. Install spare tire and wheel assembly.

ENGINE MOUNTINGS

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

Front Mounts**Removal**

1. On vehicles equipped with Standard Transmission, remove clutch lever control cable cross-shaft ball stud, at engine front mounting bracket. Refer to Section 6B, "Clutch Lever Control Cable Cross-Shaft, Ball Stud Removal." On vehicles equipped

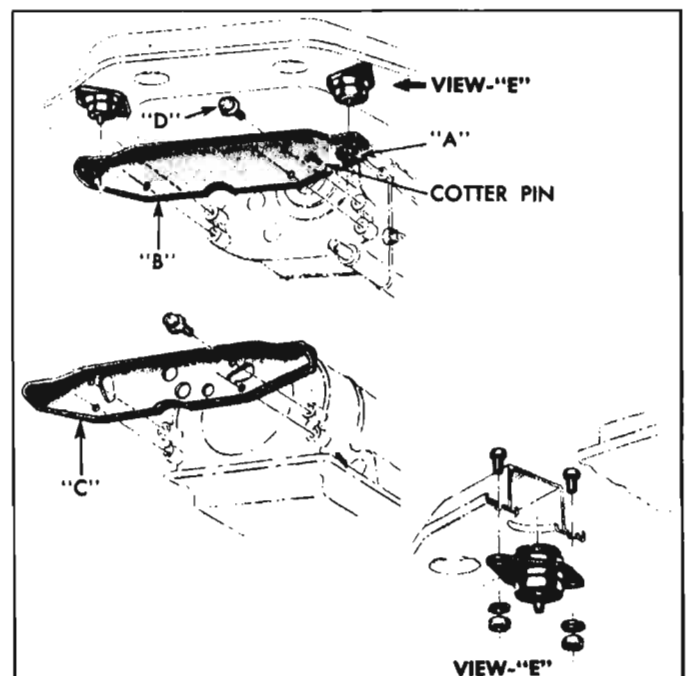


Fig. 6A-17—Engine Front Mounts

- with Automatic Transmission, disconnect control cable.
- Place a hydraulic jack with Tool J-7894 under engine as outlined in Section 6.
 - Remove cotter pin and castellated nut "A" from each engine mount (fig. 6A-17).
 - Slide dust boot away from shift rod coupling on vehicles equipped with standard transmissions, and remove cotter pin and clevis pin (fig. 6A-18). Remove shift rod coupling from transmission shift rod. Lower engine, about 2" until front engine bracket clears front mount stud. Disconnect emergency brake cable from front mounting bracket.
 - Remove bolts at ("D" fig. 6A-17) on either standard or automatic transmission bracket "B" or "C" and remove mounting bracket.

NOTE: Shims between transmission and front mounting bracket "B" or "C," must be replaced and in the original locations.

- Remove front mounting retaining nuts and lock-washers and remove front mounts View "E" Figure 6A-17.

Installation

- Install new front mounts as shown in View "E" Figure 6A-17. Torque nuts to 25 to 35 ft. lbs.
- Reinstall engine front mounting bracket to transmission with same amount of shims as removed. Install retaining bolts ("D" fig. 6A-17) and torque 20 to 30 ft. lbs.
- Raise engine and guide mounting studs (rubber molded stud) into place, on front mounting bracket. Install castellated nuts, torque 60 to 80 ft. lbs. and install cotter pins.

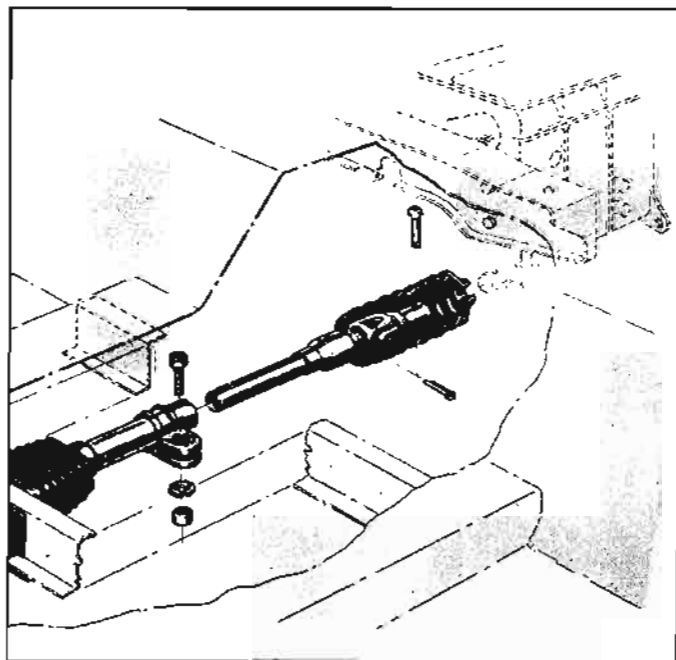


Fig. 6A-18—Shift Rod Coupling (Standard Transmission)

- On vehicles equipped with Standard Transmission replace ball stud and clutch lever control cable cross-shaft as outlined under "Clutch Lever Control Cable Cross-Shaft" in Section 6B. Adjust "Clutch Linkage," as outlined in Section 6B. Install shift rod coupling as shown in Figure 6A-18.
- On vehicles equipped with Automatic Transmission, connect control cable clip to underbody.
- Connect emergency brake cable return spring to front mounting bracket.

Rear Mount

Refer to Figures 6A-11 and 6A-19.

Removal and Installation

- Position hydraulic jack with Tool J-7894 under engine as outlined in Section 6.
- Remove engine rear center shield.
- Remove cotter pin, castellated nut and washers attaching engine bracket to mounting.

NOTE: Mounting bolt is molded in rubber.

- Lower engine to release weight from engine rear mount.
- Remove two retainer bolts from mounting and remove mount.
- Install new mount with bolts and torque 40 to 50 ft. lbs.
- Raise engine to body mounting bracket and install castellated nut to mounting bracket bolt.



Fig. 6A-19—Engine Rear Mount

8. Torque 50-60 ft. lbs. and install cotter pin.
9. Install engine rear center shield.

OIL FILTER AND GENERATOR ADAPTER

Removal

1. Release pulley belt tension at idler pulley and remove blower pulley belt. Disconnect battery ground and generator harness.
2. Remove generator from oil filter and generator adapter and generator bracket.
3. Disconnect fuel lines at fuel pump.
4. Remove bolts around oil filler tube, then remove all remaining bolts from adapter.
5. Remove adapter with fuel pump, oil filter and idler pulley as a unit.
6. Remove adapter gasket and discard.

Installation

1. Check surface of engine rear housing and adapter for nicks or cracks.
2. Install a new adapter gasket.
3. Place bolts and flat washers (3) in adapter around oil filler tube.
4. Insert fuel pump push rod and return spring into push rod guide as shown in Figure 6A-20.
5. Fold adapter cover in place and tighten bolts around oil filler tube.
6. Install remaining bolts and flat washers and torque bolts 7 to 13 ft. lbs.
7. Install generator and torque as outlined in Section 6, "Electrical Systems."
8. Connect fuel lines to fuel pump.
9. Install pulley belt and adjust as outlined in Section 7.
10. Start engine and check for leaks.



Fig. 6A-20—Installation of Oil Filter and Generator Adapter

BLOWER BEARING, BLOWER AND CRANKCASE COVER ASSEMBLY

Removal

1. Disconnect battery ground cable.
2. Disconnect accelerator linkage and fuel lines.
3. Remove oil level gauge.
4. Remove air cleaners and supports.
5. Remove spare tire and wheel assembly.
6. Remove carburetor vacuum balance tube and retaining strap at engine upper shroud assembly and front shield (fig. 6A-11).
7. Remove pulley belt and distributor wire harness. Remove oil level gauge.
8. Remove carburetor cross-shaft and choke cable assembly from both carburetors and mountings. Disconnect generator brace and swivel away from upper shroud.
9. Remove engine upper shroud.
10. Remove four retaining bolts from blower pulley and remove blower pulley and blower from blower bearing hub assembly.
11. Remove crankcase cover bolts and flat washers.
12. Remove crankcase cover and blower bearing assembly as a unit.
13. Remove crankcase to crankcase vent gasket and crankcase vent. Remove crankcase vent to crankcase gasket. Discard gaskets.

Blower Bearing Replacement

1. While supporting crankcase cover, press blower bearing shaft out of cover.
2. Remove blower bearing and shaft assembly from the hub while pressing on the outer race with a suitable piece of tubing or a $\frac{7}{8}$ " deep socket.

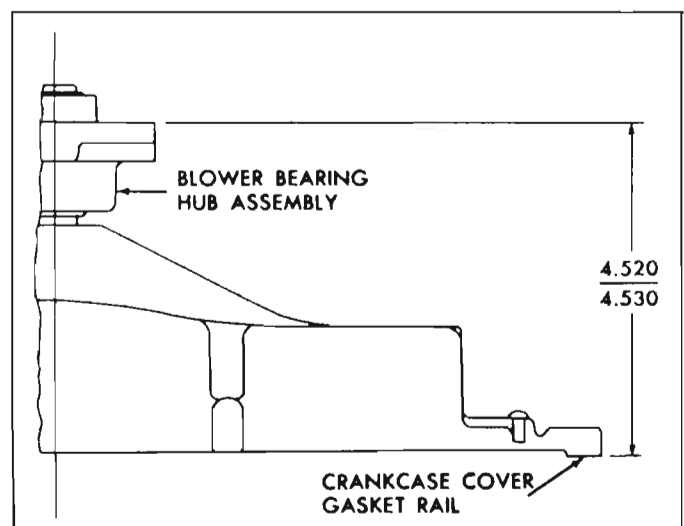


Fig. 6A-21—Blower Bearing and Crankcase Cover Assembly

NOTE: Press only on bearing outer race when removing or installing bearing and shaft assembly to blower hub.

3. While supporting crankcase cover, press blower bearing hub assembly in crankcase cover using hypoid lubricant on bearing shaft.
4. Press on shaft of blower bearing, and press assembly in place to a height of 4.520" as shown in Figure 6A-21. 4.530"

NOTE: Do not press on bearing inner race.

Installation

1. Wipe crankcase gasket surface with a clean cloth and install a new crankcase cover gasket. Install crankcase vent and another crankcase cover gasket on top of crankcase vent. Position crankcase cover, on crankcase vent and gasket and install bolts and flat washers, using anti-seize compound.
2. Install blower, blower pulley bolts, lockwashers and torque 20 to 25 ft. lbs.
3. Install the engine upper shroud and tighten all retaining bolts.

NOTE: When tightening upper shroud bolts, turn blower several times to make sure blower edge does not rub against upper shroud.

4. Install vacuum balance tube and retaining strap at engine upper shroud and front shield.
5. Install wire harness and oil level gauge.
6. Install fuel lines, choke cables and heater hose at the front of engine upper shroud (fig. 6A-11). Install accelerator linkage and fuel lines.
7. Install carburetor cross-shaft, air cleaner supports and air cleaner assembly.
8. Install spare tire and wheel assembly.
9. Install generator brace and torque as outlined in Section 8.
10. Connect battery ground strap. Start engine and check for leaks.

OIL COOLER

Removal

1. Remove all screws retaining oil cooler to engine shrouds, shields and cylinder head.
2. Remove oil cooler access hole cover (fig. 6A-7) and remove long oil cooler mounting bolt ($\frac{3}{8}$ -16 x 3" long) with flat washer and remove oil cooler. Remove and discard worn seals from oil cooler adapter.
3. Invert oil cooler and allow oil to drain from cooler. Clean radiation fins of oil cooler with an air hose before and after cleaning in solvent.

Installation

1. Install new oil cooler seals in place on oil cooler adapter.

2. Install oil cooler with long retainer bolt and flat washer and torque 8 to 12 ft. lbs.
3. Install all screws and bolts to engine shrouds, shields and cylinder head.
4. Start engine and check for oil leaks around oil cooler at oil cooler seal location.

OIL PAN

Removal and Installation

1. Drain crankcase oil and remove all bolts retaining oil pan to crankcase. Remove oil pan and discard oil pan gasket.
2. Clean oil pan rails on crankcase and oil pan, using cleaning solvent. Install a new oil pan gasket, using a little petrolatum to adhere gasket to crankcase while installing oil pan.
3. Install oil pan, bolts and torque bolts 40 to 60 in. lbs.
4. Fill engine with 4 quarts of oil (wet engine). Specifications for grade and weight are outlined in Section 2.

OIL PUMP PICK UP TUBE AND SCREEN

Refer to "Off the Vehicle Service Operations—Engine Assembly (Engine Removed)" for complete removal and installation procedure.

CRANKCASE VENT TUBE AND GASKET

Removal and Installation

1. Remove engine upper shroud assembly.
2. Remove blower pulley.
3. Remove crankcase vent tube retaining bolt and clamp.
4. Remove crankcase vent tube and discard gasket.
5. Install a new cork gasket over crankcase vent tube end, and insert into crankcase cover.
6. Install crankcase vent tube retainer clamp with bolt and tighten securely.
7. Install blower pulley and engine upper shroud assembly.

CYLINDER HEAD AND COMPONENT PARTS

CYLINDER HEAD (Left Bank)

Removal

1. Drain crankcase oil.
2. Disconnect battery cables and ground connection to the generator. Disconnect radio ground strap.
3. Remove air cleaner, accelerator return spring and left air cleaner support.
4. Disconnect accelerator rod from carburetor. Remove cross-shaft retainer at shaft support.
5. Remove three attaching screws from left side carburetor cross-shaft support and disconnect from carburetor.

6. Disconnect fuel line and choke cable at carburetor. Remove carburetor attaching stud nuts from carburetor, and remove left carburetor. Remove outboard carburetor stud (long stud) from carburetor mounting pad.
7. Remove vacuum balance tube from carburetor mounting flange as shown in Figure 6A-22. Remove generator bracket mounting bolts (fig. 6A-22) and swivel generator bracket, up away from the engine upper shroud.

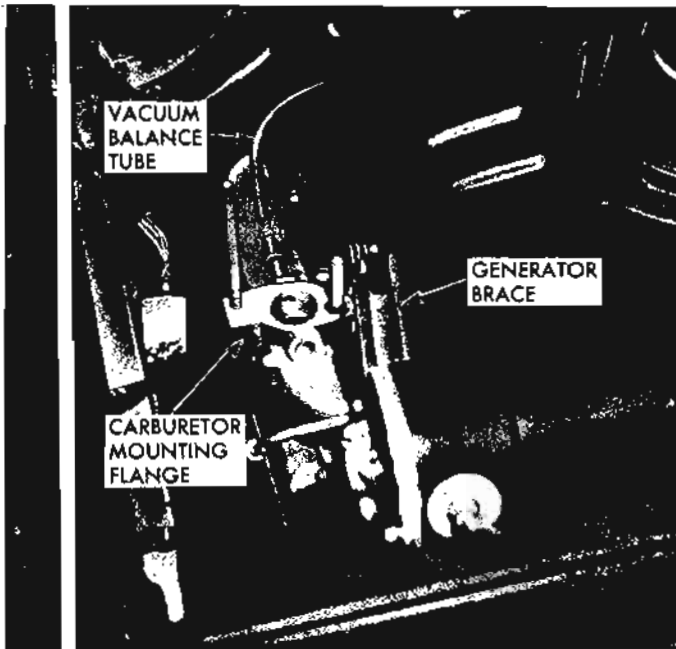


Fig. 6A-22—Engine Compartment—Cylinder Head Removal and Installation

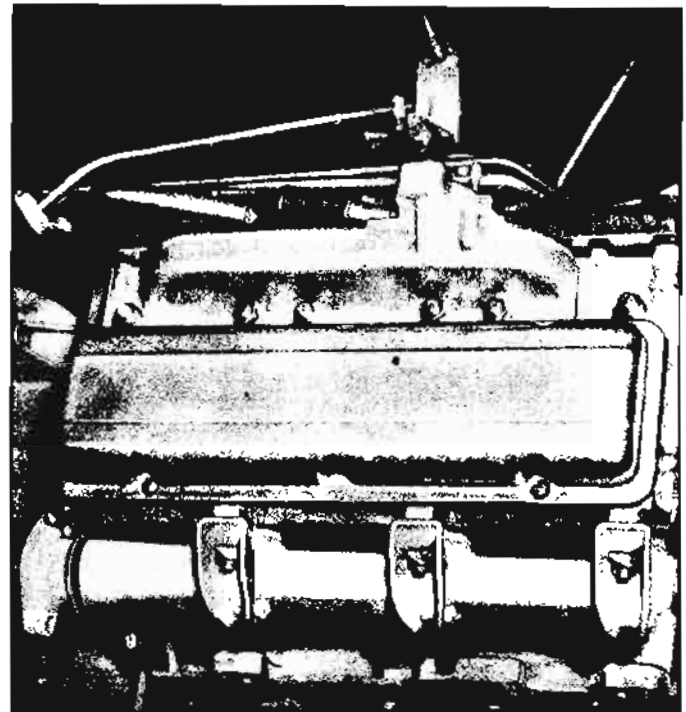


Fig. 6A-23—Engine Assembly—Showing Access to Cylinder Head

8. Remove wires and spark plugs from cylinder head. Remove spark plug gaskets and discard.
9. Loosen all engine side shield retaining screws and remove screw from engine side shield under carburetor in engine compartment attached to cylinder head (fig. 6A-13). Remove engine side shield (fig. 6A-14).
10. Remove oil cooler access hole cover and remove oil cooler (this allows engine rear shroud freedom of movement during cylinder head removal).
11. Raise vehicle on a hoist and attach Tool J-7894, as outlined in Section 6.
12. Remove both engine side seal retainers and engine rear seal retainers.
13. Remove the engine rear center shield and seal assembly (fig. 6A-11).
14. Remove lower engine shroud and exhaust duct retaining screws and bolts and remove engine lower shroud and exhaust duct. Remove exhaust pipe to manifold nuts.
15. Open french locks on the exhaust manifold and remove holding clamp nuts (fig. 6A-38). Remove exhaust manifold and discard gaskets.

16. Remove engine rear mounting cotter pin, nut and washer from rear mounting bracket bolt.
17. Remove four valve rocker arm cover screws and remove valve rocker cover, while holding a pan below, to catch oil draining from cylinder head.
18. Remove rocker arm nuts, balls and rocker arms. Remove push rods, valve rocker studs and push rod guides (fig. 6A-24).
19. Remove "O" rings from cylinder head.
20. Remove "O" rings from bottom of push rod drain

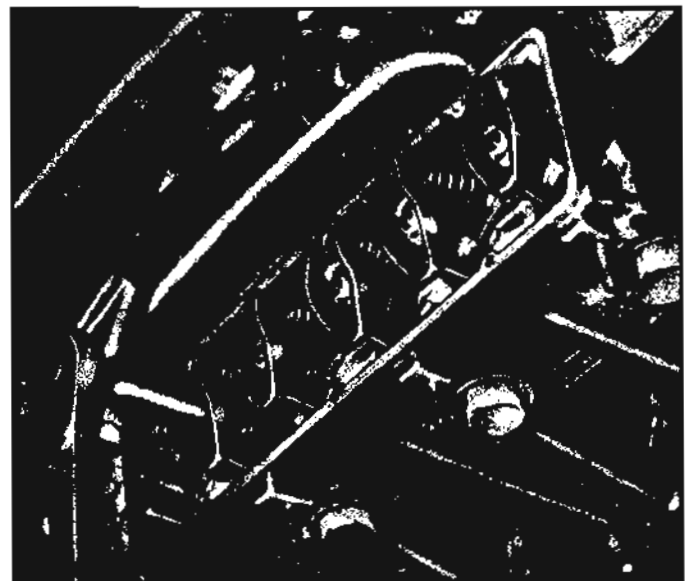


Fig. 6A-24—Removal and Installation of Valve Rocker Arms, Balls and Nuts

tubes, with a pair of hooked tweezers, then remove from cylinder head as shown in Figure 6A-26.

21. Remove cylinder head nuts and flat washers, retaining cylinder head (fig. 6A-23).
22. Carefully lower engine assembly approximately 3" to clear cylinder head carburetor flange as shown in Figure 6A-22.
23. Remove cylinder head from crankcase studs and discard cylinder head gaskets (fig. 6A-27).

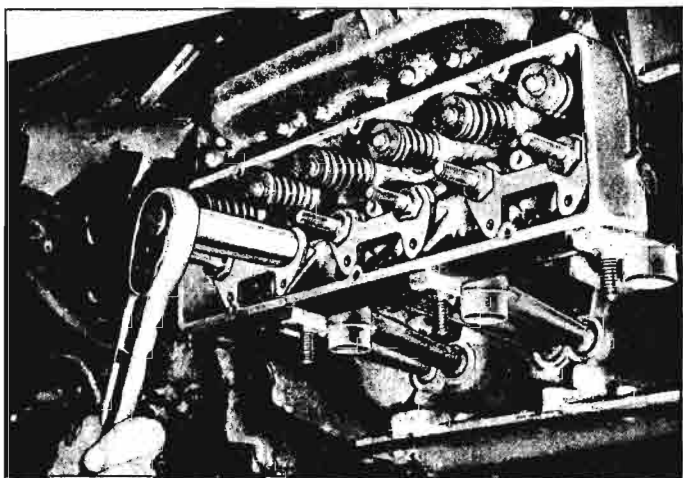


Fig. 6A-25—Removal and Installation of Valve Rocker Studs

Installation

1. Install new cylinder head gaskets in cylinder head as shown in Figure 6A-64. Guide cylinder head over crankcase studs. Install new lubricated "O" rings (use engine oil) in cylinder head at valve rocker stud hole location shown in Figure 6A-104.
2. Install push rod drain tubes, using new "O" rings.

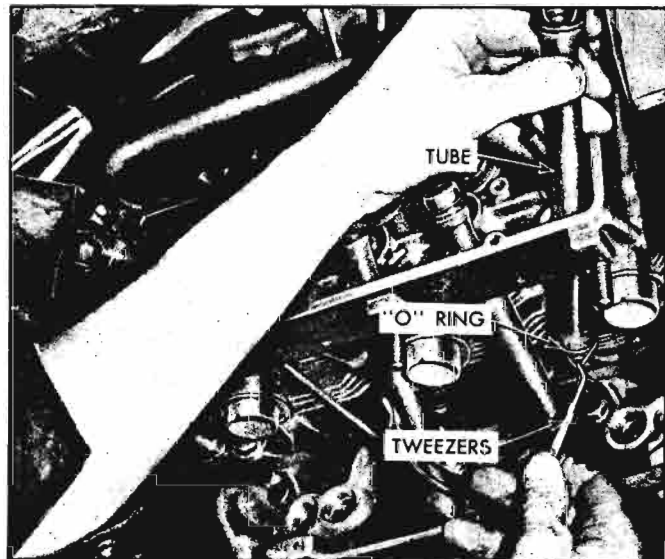


Fig. 6A-26—Removing Push Rod Oil Drain Tubes

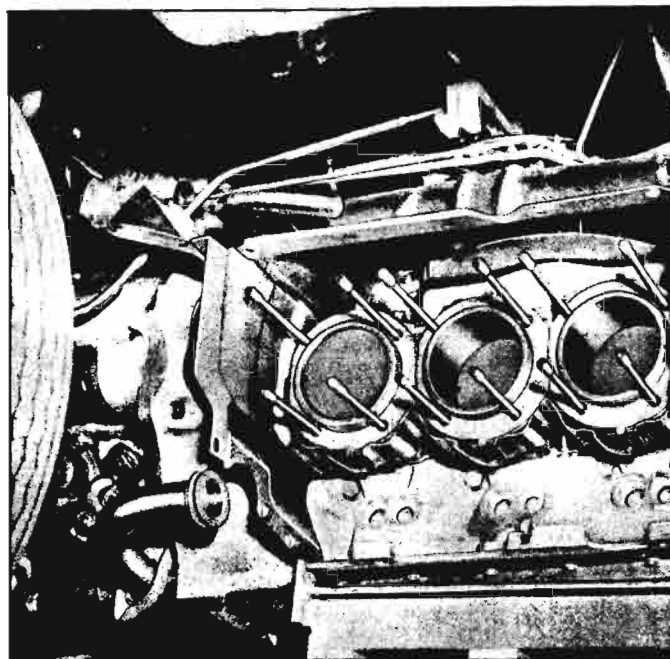


Fig. 6A-27—Cylinder Head Removed (Showing Access to Cylinders and Pistons)

NOTE: Push rod drain tubes must be installed before push rod guides. The "O" ring on bottom of oil drain tube next to the crankcase must be put on after oil drain tube is inserted through the cylinder head, otherwise, "O" ring may shear when pushed through cylinder head.

3. Install push rod guides (chamfered side up) under valve rocker studs as shown in Figure 6A-104. Install valve rocker studs (fig. 6A-25) using anti-seize compound. Install cylinder head flat washers and nuts on studs protruding through the cylinder head.
4. Torque cylinder head in sequence as shown in Figure 6A-105.
5. Insert push rods with .050" side oil hole (end of push rod with a blue band) up to the cylinder head and the other end of push rod seated in the valve lifter seat.
6. Install valve rocker arms, balls and nuts. Lash the valves as outlined under "Engine Assembly" (Engine Removed).
7. Install the valve rocker cover with a new gasket and torque cover screws 30 to 50 in. lbs.
8. Install the oil cooler with new seals and torque mounting bolt 8 to 12 ft. lbs.
9. Install engine side shield assembly (fig. 6A-14). Raise engine assembly and install the rear mounting nut, washer and torque nut 50 to 60 ft. lbs. Install cotter pin.
10. Install left, right and center shield seals, refer to Figure 6A-11. Install exhaust manifold with new

gaskets and tighten as outlined under "Engine Disassembly" (Engine Removed).

11. Install engine lower shroud and exhaust duct. Refer to Figure 6A-15. Remove Tool J-7894 from the engine and install engine skid bolt and torque 20 to 30 ft. lbs. Hook up exhaust pipe to exhaust manifold.
12. Lower vehicle to ground level and continue the following operations:
12. Tighten all upper shroud screws. Install spark plugs with new copper gaskets. Attach wiring harness to spark plugs. Install carburetor and carburetor fuel line. Install carburetor cross-shaft and retainer.
13. Install generator bracket bolts, using anti-seize compound, and tighten as outlined in Section 8, "Electrical System."
14. Install vacuum balance tube and carburetor linkage. Adjust throttle and accelerator linkage as outlined under "Carburetor Synchronization" in Section 9 "Fuel Systems."
15. Install left air cleaner support, heater connection to upper shroud and air cleaner assembly.

CYLINDER HEAD (Right Bank)

Removal and Installation of the right bank cylinder head is essentially the same as the left, except the coil, oil pressure and cylinder head temperature sending units must be disconnected.

VALVE ROCKER ARMS, BALLS AND NUTS

Removal and Installation

1. Remove valve rocker cover and gasket.
2. Remove valve rocker arm nuts, balls and rocker arms (fig. 6A-24).
3. Replace rocker arms, balls and nuts and lash valves as outlined under "Engine Assembly (Engine Removed)—Valve Lash".
4. Install valve cover and gasket. Torque valve cover screws 30 to 50 in. lbs.

VALVE SPRINGS

Removal and Installation

1. Remove valve cover and gasket.
2. Remove valve rocker nut, ball and valve rocker arm.
3. Remove spark plug from cylinder requiring valve spring replacement and use compressed air to retain valves in the closed position.
4. Install a valve rocker nut on valve rocker stud while using Tool J-5892-1 as a lever, compress valve spring far enough to remove valve locks. Remove valve spring cap and valve spring.
5. Install valve spring on valve spring seat shim with cap. Compress valve spring with Tool J-5892-1 and install valve locks.

6. Install valve rocker arm, ball and nut. Lash valves as outlined under "Engine Assembly (Engine Removed)—Valve Lash" and install valve cover and gasket. Install engine oil 4 quarts full.
7. Start engine and check for leaks.

PUSH RODS

Removal and Installation

1. Remove valve cover and gasket. Loosen valve rocker arms, balls and nuts from cylinder requiring push rod replacement.
2. Install push rod with .050" side oil hole up into cylinder head (blue band marked end).
3. Lash valves as outlined under "Engine Assembly (Engine Removed)—Valve Lash".

HYDRAULIC LIFTERS

Removal and Installation

1. Drain crankcase oil.
2. Remove valve rocker cover and gasket.
3. Remove engine lower shroud and exhaust duct.
4. Remove valve rocker arms, balls, valve rocker studs, push rod guides, push rod and push rod drain tubes from cylinder, that valve lifter is to be removed.
5. Remove lifter with a strong magnet or:
 - a. Remove snap ring retaining the push rod seat and remove the push rod seat. Remove valve lifter with a pair of pliers inserted in the valve lifter snap ring groove.
 - b. If valve lifters are coated with varnish and are hard to remove, the oil pan should be removed and the lifter body squirted with solvent to remove all varnish on the lifter body. Refer to "Repairs—Engine Components," under "Off the Vehicle Service Operations" in this section for disassembly, cleaning and assembly of valve lifters.
6. Install valve lifters well lubricated with engine oil.
7. Install push rod drain tubes with new "O" rings, and set push rods in place on lifter seat with side oil hole up next to valve rocker arms.
8. Install push rod guides, valve rocker studs and torque studs as shown in Figure 6A-105.
9. Install valve rockers, arms, balls and nuts.
10. Install valve rocker cover and gasket.
11. Add engine oil as outlined in Section 2, "Lubrication".

OIL PUMP GEARS

Removal

1. Drain crankcase oil.
2. Position a piece of hard wood between oil pan

rail and Tool J-7894. Install wood block adjacent to the engine skid plate.

NOTE: Installation of wood block will allow easy removal of engine skid plate.

3. Disconnect engine rear mount, and remove engine rear shield seal and center shield. Remove retaining bolts from exhaust air ducts, connected to the engine rear center shield plate. Remove left lower shroud and exhaust duct. Lower engine about 1" (to clear rear mount).
4. Remove rear mounting bracket stud nuts and flat washers.
5. Remove rear mounting bracket and engine skid plate.
6. Remove oil pump cover and gasket. Refer to "Repairs—Engine Components," under "Off The Vehicle Service Operations" in this section for oil pump repair.

Installation

1. Install oil pump gears, gasket and cover. Torque oil pump cover bolts 60 to 80 in. lbs.
2. Install engine skid plate and engine rear mounting bracket with washers and nuts. Torque mounting bracket nuts 20 to 30 ft. lbs.
3. Raise engine and install rear mount and torque mounting nut and bolt 50 to 60 ft. lbs. Install cotter pin.
4. Install rear shield seal, center shield and seal. Install engine left lower shroud and exhaust duct. Install screws in exhaust air ducts retained to center shield, side shield and engine skid.
5. Remove engine lifting Tool J-7894 and supporting block.
6. Add engine oil, start engine and check for leaks.

OIL PUMP PRESSURE REGULATOR

Removal and Installation

1. Drain crankcase oil.
2. Remove left side lower shroud and exhaust duct retaining screws and remove engine lower shroud and exhaust duct.
3. Remove pressure regulator plug, nylon gasket, spring and valve.
4. Refer to "Repairs—Engine Components," Figure 6A-76 under "Off the Vehicle Service Operations" in this section.
5. Install valve, spring, nylon gasket and plug.
6. Install lower shroud and exhaust duct retaining screws. Add engine crankcase oil.

NOTE: Remove plug on top of oil filter and generator adapter, and install an oil pressure gauge to check oil pressure. Oil pressure regulator should regulate at 35 psi oil pressure.

7. Start engine and check for oil leaks.

CONNECTING ROD BEARINGS

Removal

1. Disconnect battery ground cable. Remove air cleaner assemblies and air cleaner support.
2. Remove carburetor linkage and choke cable assemblies.
3. Disconnect fuel lines to carburetor. Disconnect and remove carburetor cross-shaft. Remove left bank carburetor.
4. If direct air heater equipped, disconnect heater hose at upper shroud.
5. Disconnect spark plug wires from spark plugs.
6. Release idler pulley tension on blower pulley belt and remove from engine assembly.
7. Remove all fuel lines to fuel pump. Remove vacuum balance tube.
8. Remove all engine upper shroud retaining bolts and screws. Remove generator brace (fig. 6A-22).
9. Remove screws on each side of front engine shield.
10. Remove engine upper shroud, tipping front lip up so that it clears front engine shield.
11. Remove engine blower pulley and blower, retaining bolts and remove blower and blower pulley.
12. Loosen crankcase vent tube clamp bolt and remove from crankcase. Remove crankcase cover bolts and flat washers. Remove crankcase cover, gaskets and crankcase vent.
13. Position connecting rod by using a remote starter switch to crank engine. Remove connecting rod nuts, cap and bearing insert.
14. Install a piece of $\frac{5}{16}$ " plastic hose on each connecting rod stud, to protect crankshaft journals as shown in Figure 6A-28.
15. Remove spark plug from cylinder requiring new rod bearing. Position connecting rod and remove rod cap and bearing insert from connecting rod.

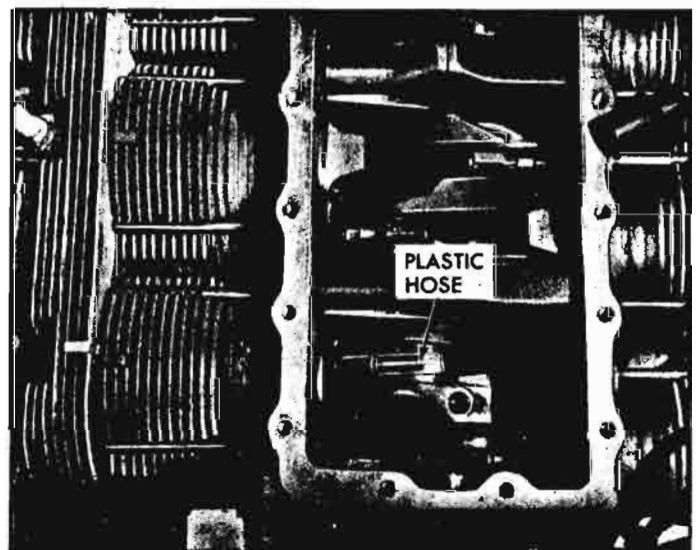


Fig. 6A-28—Connecting Rod Bearing Installation—No. 2 Shown

Installation

1. Refer to "Repairs—Engine Components—Connecting Rod Bearing Clearance" under "Off the Vehicle Service Operations" for connecting rod bearing installation and specifications. Torque connecting rod nuts 20 to 26 ft. lbs.
2. Clean gasket surface of crankcase, crankcase vent and crankcase cover with solvent.

NOTE: Do not use a scraper on gasket surfaces because it may scratch or nick the crankcase gasket surface.

3. Install crankcase gasket, crankcase vent and gasket and crankcase cover. Install crankcase ventilator, vent tube and gasket. Install crankcase cover flat washers and bolts using anti-seize compound on all threads. Torque bolts 7 to 13 ft. lbs.
4. Install blower and blower pulley.
5. Install spark plugs using new gaskets and torque 10 to 25 ft. lbs.
6. Install engine upper shroud and connect heater hoses. Install cooling air throttle valve assembly.
7. Install all retaining bolts in engine upper shroud.

NOTE: Rotate blower while tightening upper shroud bolts. Check for interference at blower on upper shroud.

8. Torque generator bolts in sequence as outlined in Section 8.
9. Install pulley belt and adjust as outlined in Section 8.
10. Install carburetor, vacuum balance tube and carburetor linkage. Install air cleaner support and air cleaner assembly.
11. Install wire harness and hook up to each spark plug.
12. Install carburetor cross-shaft and retainer.
13. Install carburetor choke cable assembly. Adjust carburetor throttle linkage as outlined under "Carburetor Synchronization" in Section 9.
14. Add engine oil, start engine and check for leaks. Refer to Section 7 for tune-up of engine assembly.

CRAKSHAFT PULLEY AND ENGINE REAR HOUSING SEAL

Removal

1. Disconnect battery cable to engine. Drain crankcase oil.
2. Remove all side shield seal retainers.
3. Remove engine rear center shield. Remove engine shield bolt and attach Tool J-7894 to bottom of engine with vehicle on a hoist.
4. Remove engine rear body grille and engine rear mount.

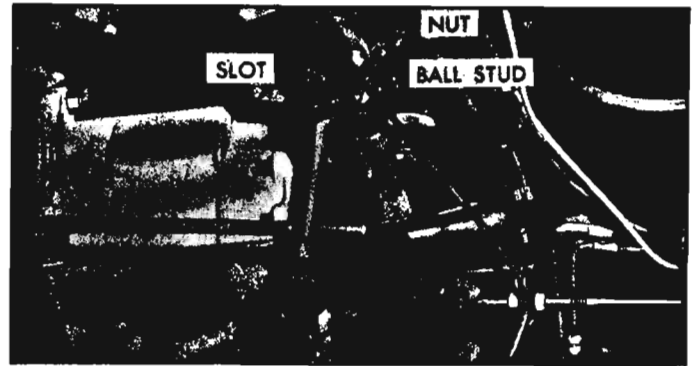


Fig. 6A-29—Lowering Front Engine Mount

5. On vehicles equipped with standard transmission, refer to "Clutch Linkage" Section 6B. Remove clutch return spring and disconnect clutch control cable. Disconnect clutch pull rod.
6. Loosen outboard stud nut (fig. 6A-29) and slide, part way, out of the engine front mounting bracket slot. Remove shift rod coupling as shown in Figure 6A-18.
7. Remove cotter pins and loosen front mounting nuts and lower engine until nuts are flush with the front engine mount studs (fig. 6A-17).

NOTE: Do not remove front mounting nuts.

8. Lower engine assembly far enough to remove engine rear mounting bracket.
9. Remove the oil filter and pulley belt. Install Tool J-8105 on crankshaft pulley, as shown in Figure 6A-30.

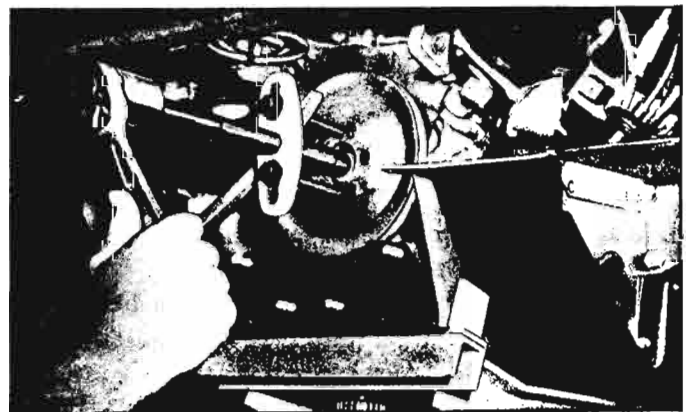


Fig. 6A-30—Removing Crankshaft Pulley—Engine Installed

NOTE: Install bolts in pulley hub a depth of 1/4" only, otherwise the bolts will injure the rear housing seal.

10. Remove crankshaft pulley. Remove engine rear housing seal, by prying on the outer edge of the seal with a couple of screw drivers. Remove and discard seal.

Installation

NOTE: The sealing lips of the rear housing seal are coated with high melting cup grease for the life of the seal (350°F.). Refer to Figure 6A-76, for a cross-section of seal.

1. Install seal over crankshaft and tap in place with a wooden drift.
2. Install crankshaft pulley, flat washer and bolt, using crankshaft pulley bolt as a jack screw, tighten until crankshaft pulley is in place. Back bolt off ½ turn and then tighten bolt 60 to 80 ft. lbs. torque.
3. Install oil filter and torque bolt 9 to 15 ft. lbs.
4. Install engine rear mounting bracket, washers and nuts. Torque nuts 20 to 30 ft. lbs.
5. Raise engine and install rear engine mount. Torque rear engine mount 50 to 60 ft. lbs. and install retainer cotter pin.
6. Tighten front engine mount nuts 60 to 80 ft. lbs. torque (fig. 6A-17), and install cotter pins. On vehicles equipped with standard transmission, refer to "Clutch Linkage", Section 6B. Slide outboard ball stud into place, and continue clutch linkage adjustment as outlined in Section 6B, "Clutch."
7. Install rear body grille, rear center shield and seal assembly. Remove engine Tool J-7894 and install engine skid plate bolt. Torque bolt 20 to 30 ft. lbs.
8. Install side shield seal retainers and seals. Roll front shield seal into place at engine front shield.
9. Install battery cable to engine.
10. Add engine oil, start engine and check for leaks.

PISTON RING REPLACEMENT

Keep in mind that cylinders and pistons are serviced as a unit and the operation outlined below, is only for one or more pistons in one bank, requiring ring replacement. The operation below is not intended for complete engine piston and piston ring overhaul. Refer to "Repairs—Engine Components, Pistons, Rings and Cylinder Assembly" under Off the Vehicle Service Operations".

1. Drain crankcase oil and remove cylinder head.
2. Remove cylinder from piston requiring piston ring replacement.
3. Remove piston rings and install new rings. Position oil control ring gap towards the top of the engine and compression rings with the gap 45° from the oil ring gap location.

NOTE: When installing compression rings, make sure the face with the bevel is assembled away from the top of the piston and the ring face markings are to the top of piston.

4. Lubricate piston rings with engine oil and slide Tool J-8356 over piston rings. Tighten Tool J-8356,

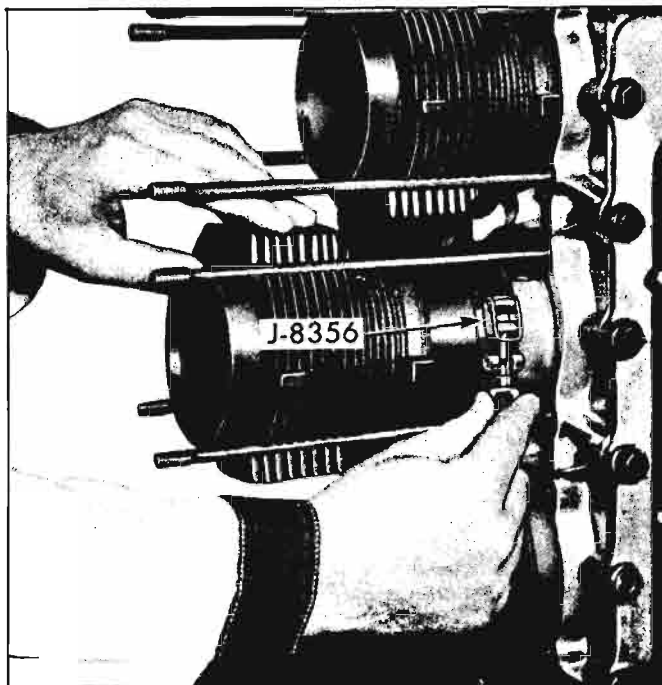


Fig. 6A-31—Compressing Piston Rings, using Tool J-8356

5. Install a new cylinder gasket over cylinder pilot and slide cylinder over piston and piston rings. Remove Tool J-8356, by unhooking clamp and pulling from piston assembly as shown in Figure 6A-32.

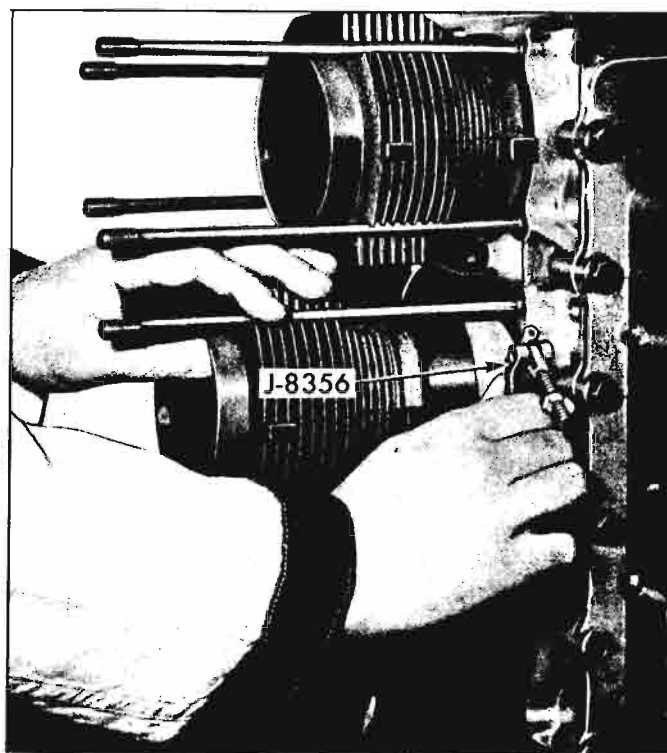


Fig. 6A-32—Removing Tool J-8356 from Piston Assembly

6. Install cylinder head using new gaskets for each cylinder. Refer to "Cylinder Head Installation" in this section.
7. Add engine oil, start engine and check for leaks.

CHECKING CAMSHAFT LOBE LIFT

This procedure is similar to that used for checking valve timing. Check the lift of each lobe in consecutive order and record the readings.

1. Drain crankcase oil and remove valve covers and gaskets.
2. Remove valve rocker arms, balls and nuts. Install adapter provided in Tool J-8520 on the valve rocker stud at desired cylinder to be checked, and attach dial indicator.

NOTE: Tool J-8520 holding fixture (having a 1/8"-24 tapped hole) must be installed on the opposite valve rocker stud, than the camshaft lobe to be checked. If exhaust cam lobe is to be checked, install Tool J-8520 on the inlet valve rocker stud.

3. Install the push rod in place and make sure the push rod is in the lifter socket and adapter on Tool J-8520 with a socket used, as shown in Figure A-33.
4. Attach an auxiliary starter switch. Using the auxiliary starter switch, "bump" the engine over until the lifter rests on the heel of the camshaft lobe. At this point the push rod is in its lowest position. Set the dial indicator on zero then "bump" the engine over until the push rod is in its fully raised position and note the total lift recorded on the indicator. Continue to rotate the camshaft until the indicator reads zero. This will check the original indicator reading.
5. If the camshaft reading on any lobe is below specification wear limits, the camshaft and lifters

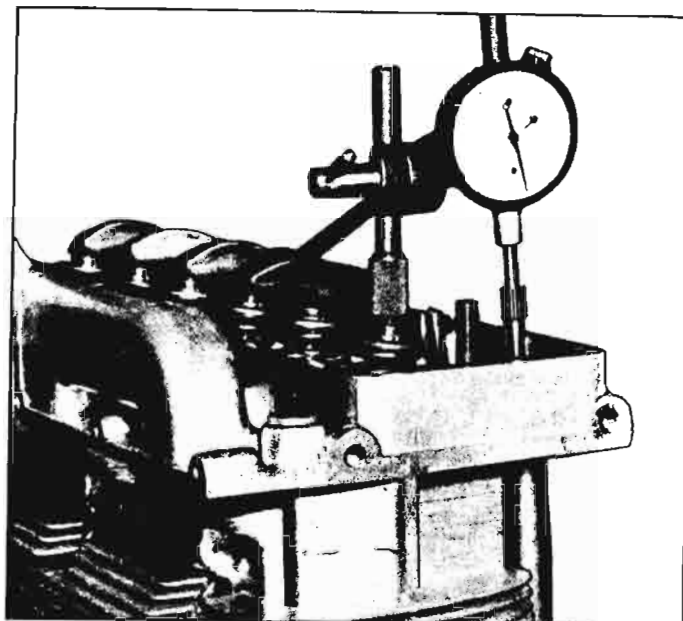


Fig. 6A-33—Checking Camshaft Lobe Lift

- should be replaced. To replace camshaft, refer to "Engine Disassembly" (Engine removed).
6. If camshaft readings for all lobes are within specifications, remove dial indicator and adapter Tool J-8520.
 7. Install valve rocker arms, balls and nuts and lash valves as outlined under, "Engine Assembly" (Engine Removed).
 8. Install valve covers and gaskets. Add engine oil and start engine and check for leaks.

GENERATOR—DISTRIBUTOR—COIL—SPARK PLUGS

Refer to Section 8.

CARBURETOR—FUEL PUMP—AIR CLEANER

Refer to Section 9.

EXHAUST MUFFLER AND PIPE ASSEMBLY

Refer to Section 9.

OIL FILTER

Refer to Section 2.

PULLEY BELT

Refer to Section 7.

CAMSHAFT LOBE WEAR LIMIT			
	TURBO-AIR		SUPER TURBO-AIR (R.P.O. 649)
	Inlet	Exhaust	Inlet and Exhaust
New	.209"	.229"	.252"
Worn	.209-.202"	.229-.222"	.252-.245"
Maximum Wear	.007"	.007"	.007"

OFF THE VEHICLE SERVICE OPERATIONS

ENGINE DISASSEMBLY (ENGINE REMOVED)

1. Remove transmission from "Power Train" as outlined in Section 6.
2. Remove the differential carrier from the engine assembly as outlined in Section 6.

3. Remove clutch assembly if so equipped from engine as outlined in Section 6B.
4. A difference of 1 5/8" between the center line of the crankshaft and engine rear mounting bracket requires a special lifting adapter as shown in Figure 6A-34. This adapter when made from angle iron

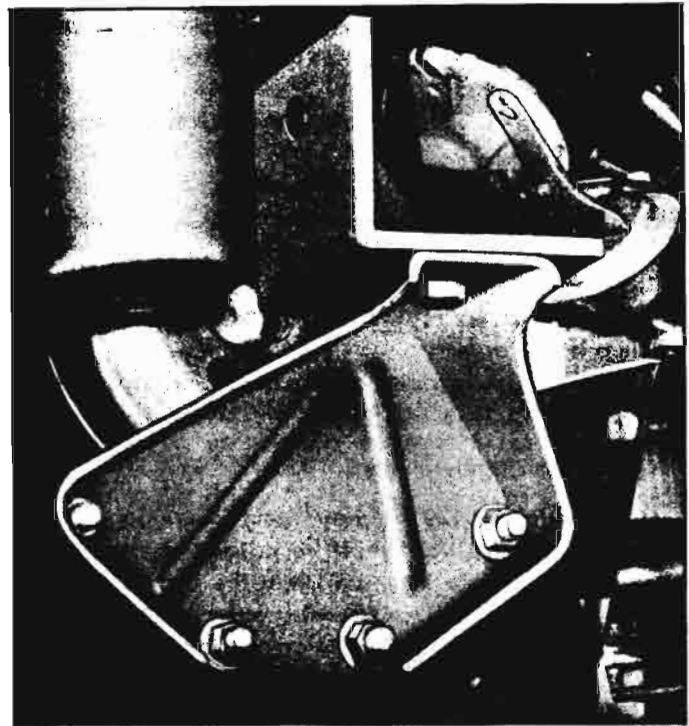
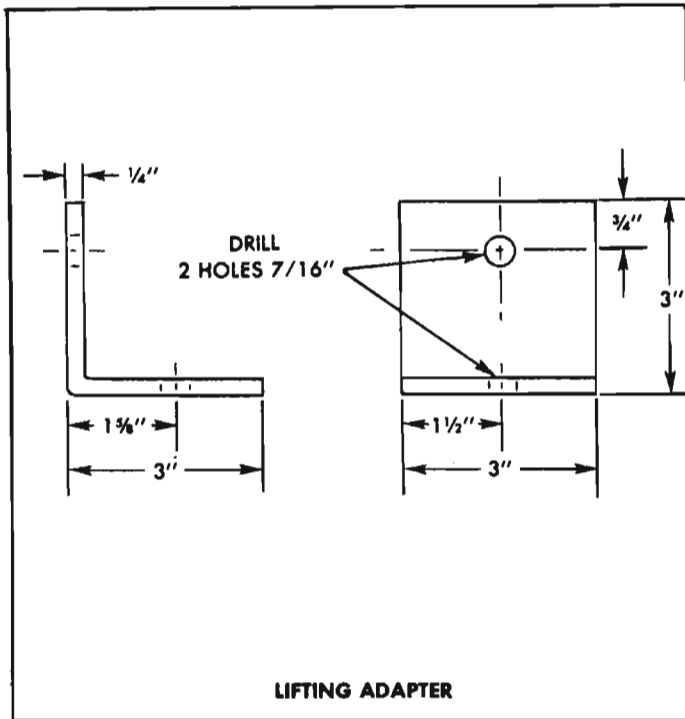


Fig. 6A-34—Engine Lifting Adapter

(3" x 3" x 1/4") and mounted as shown in Figure 6A-34 will provide a center line lifting point.

5. Remove air cleaner assemblies.
6. Disconnect throttle linkage and remove carburetor cross-shaft.
7. Release tension on blower belt, at idler pulley and remove blower belt from engine.

Fuel Pump

8. Disconnect fuel lines at carburetors and fuel

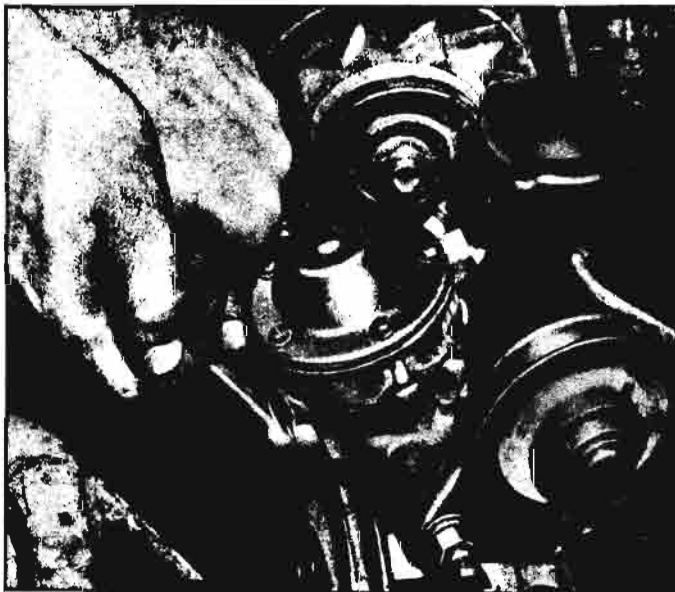


Fig. 6A-35—Removing Fuel Pump

pump. Loosen locknut at holding screw (fig. 6A-35) and remove fuel pump, push rod return spring from oil filter and generator adapter.

9. Disconnect generator at generator brace, oil filter and generator adapter and remove generator.
10. Disconnect vacuum balance tube at engine carburetor mounting pads. Remove vacuum balance tube. Remove engine front shield.

Flywheel

11. With lifting adapter bolted to the rear engine mounting bracket as shown in Figure 6A-34, attach a chain and shackle from Tool J-4536-A (Lifting Kit) to lifting adapter and at the flywheel housing lifting eye. Remove flywheel or flex plate retaining bolts and remove flywheel or flex plate.
12. Lift engine with chain sling off of lifting jack and Tool J-7894. Install engine assembly onto engine stand Tool J-5856, by mounting flywheel housing to adapter Tool J-8280 as shown in Figure 6A-36. Drain crankcase oil.
13. Remove both carburetors. Disconnect and remove cooling air throttle valve. Remove fuel lines and oil level gauge.
14. Disconnect and remove wire harness at spark plugs and distributor. Remove distributor and cap assembly.
15. Remove coil and generator brace from cylinder head. Remove engine upper shroud and left and right side shields (fig. 6A-11). Remove all spark plugs and gaskets.

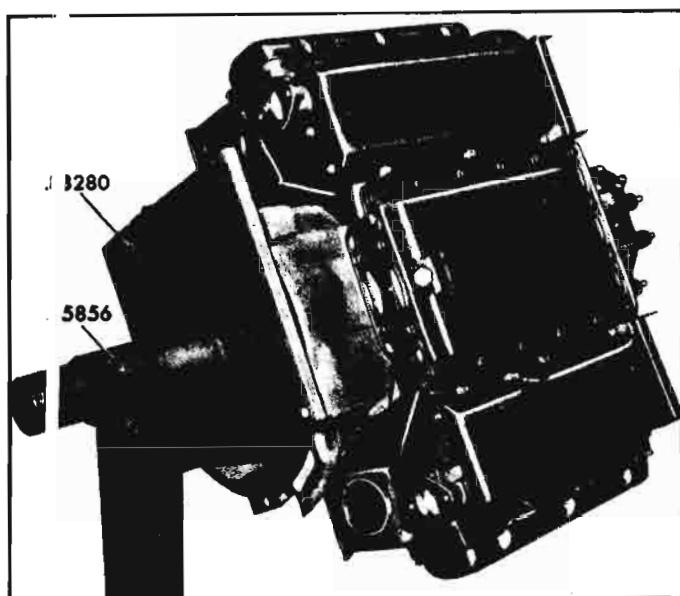


Fig. 6A-36—Engine, Engine Adapter and Stand Installation

- 16 Remove oil filter and generator adapter retaining bolts and washers and remove oil filter and generator adapter. Discard adapter gasket.
- 17 Remove the blower pulley and blower assembly from the crankcase cover. Remove the crankcase vent tube and gasket (fig. 6A-37).
- 18 Remove the crankcase cover, blower bearing assembly (fig. 6A-37) crankcase cover gasket, vent assembly and the vent to crankcase gasket (fig. 6A-5). Discard gaskets.
- 19 Remove engine rear and lower shrouds and exhaust ducts (figures 6A-11, 6A-15 and 6A-16). Remove muffler bracket and shield.

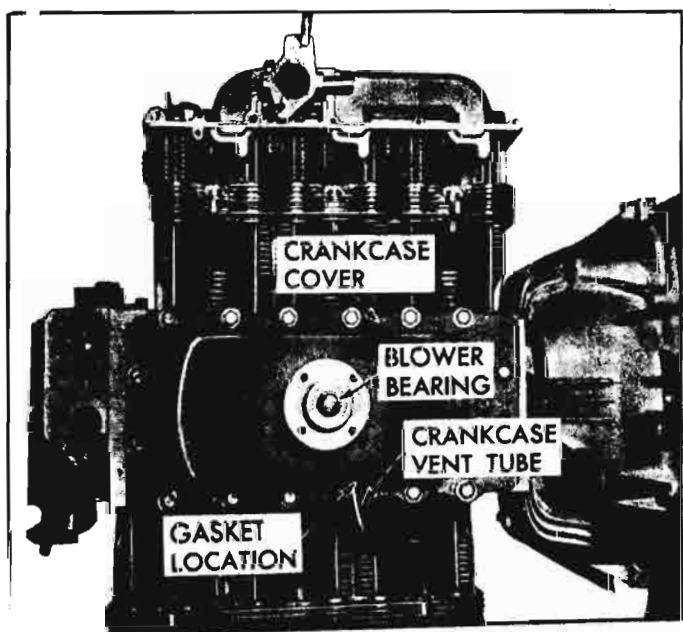


Fig. 6A-37—Crankcase Cover, Vent Tube and Blower Bearing Assembly

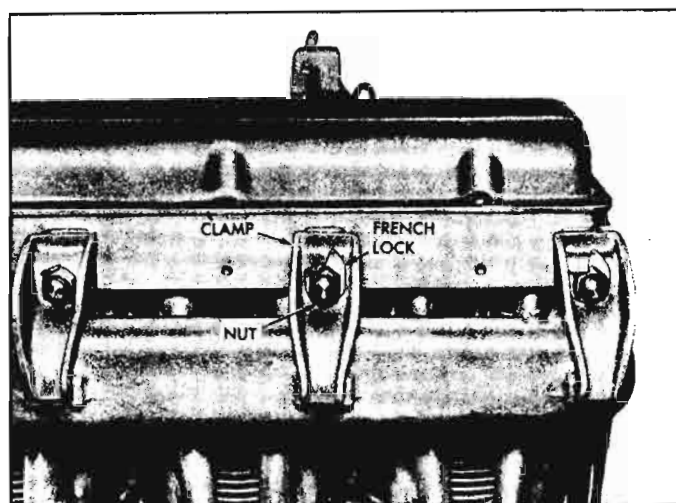


Fig. 6A-38—Exhaust Manifold Installed

Oil Pan

20. Invert engine on work stand and remove oil pan retaining bolts and remove oil pan and discard gasket.

Exhaust Manifold

21. Bend french lock tabs back and remove nuts. Remove exhaust manifold holding clamps (fig. 6A-38).
22. Remove exhaust manifolds and discard gaskets (fig. 6A-39).

NOTE: Exhaust manifold to exhaust port sleeves are a press fit and should be removed with a soft hammer. If exhaust sleeves are removed, they should be replaced with the next largest diameter exhaust sleeve.

23. Remove engine front shrouds.

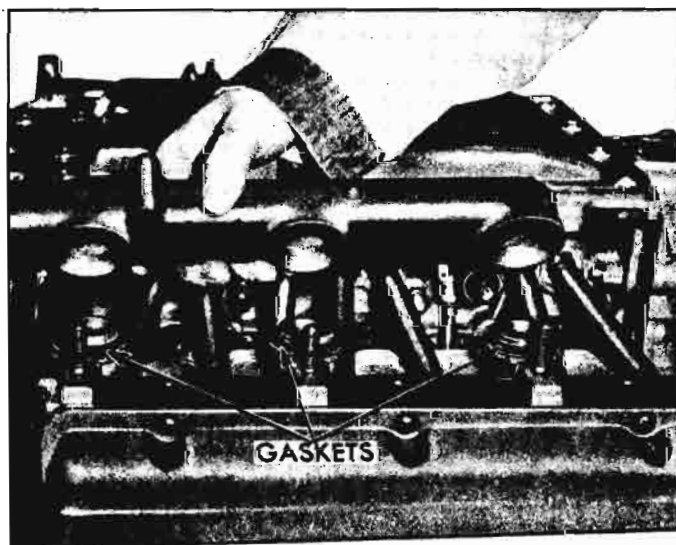


Fig. 6A-39—Exhaust Manifold Gaskets

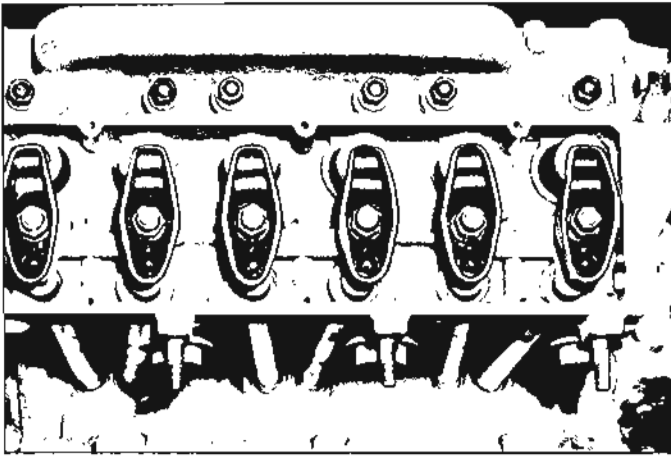


Fig. 6A-40—Cylinder Head Assembly—Valve Cover Removed

24. Remove engine rear mounting bracket and engine skid plate at engine rear housing.

Cylinder Head

25. Remove valve rocker cover and discard gasket. Remove valve rocker arm nuts, balls and rocker arms (fig. 6A-40).
26. Remove push rods and identify, so they can be reinstalled in their original locations.

NOTE: The side .050" oil hole in each push rod must be installed up, and next to the valve rocker arms. If by error a push rod is installed with the side oil hole down, lubrication to that particular valve rocker arm and ball would be cut-off.

27. Remove valve rocker studs and push rod guides, and discard "O" rings.

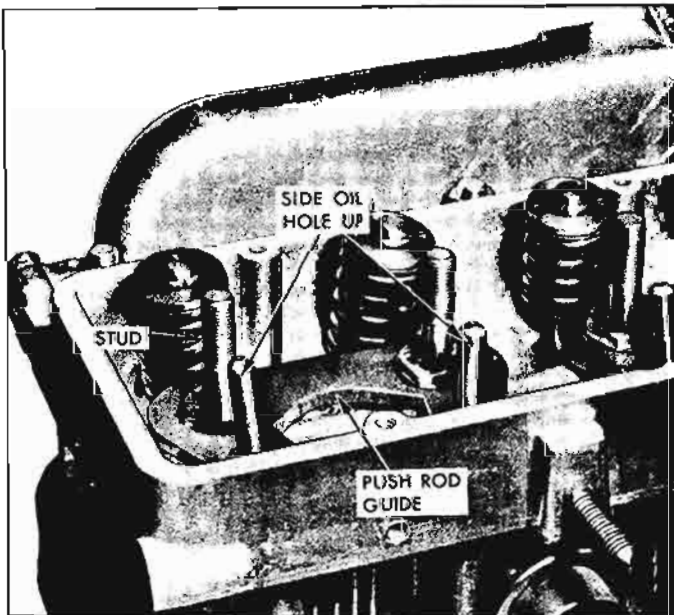


Fig. 6A-41—Push Rods Installed

NOTE: Valve rocker stud "O" rings must be replaced with new "O" rings.

28. Remove nuts and flat washers (attached to long studs) from cylinder head (fig. 6A-40).
29. Remove bottom "O" ring from push rod oil drain tubes (fig. 6A-26) and remove push rod oil drain tubes.
30. Remove cylinder head assemblies and discard cylinder head gaskets.

NOTE: Cast Iron Cylinders will need a holding fixture when crankshaft is turned for engine disassembly, which can be readily made. Six 1/2" O.D. steel tubes 4 1/4" long to be used on long cylinder studs, one on each cylinder. Six 1/2" O.D. steel tubes 3 1/2" long will also be needed for each short stud shown in Figure 6A-42.

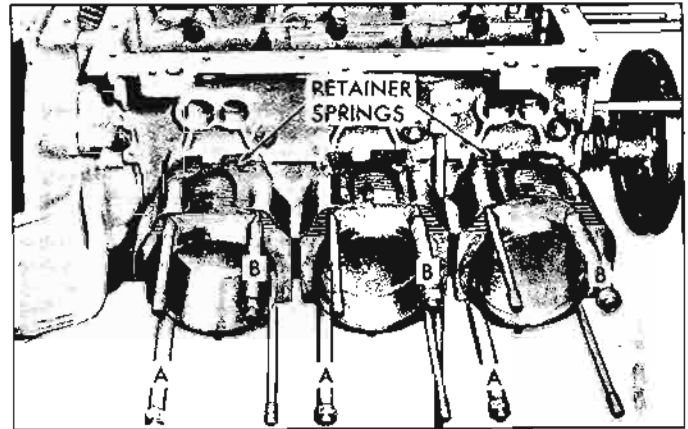


Fig. 6A-42—Cylinder Holding Tube Fixture

A. Long 4 1/4"

B. Short 3 1/2"

31. Install one long 4 1/2" x 1/2" tube on one long stud and one short 3 1/2" x 1/2" tube on each short stud on each cylinder.

Hydraulic Lifters

32. Remove hydraulic lifters from lifter bores with a strong magnet or wire hook and identify so they can be replaced in their proper places after cleaning.

Piston and Connecting Rod Assemblies

33. Invert engine on stand so crankcase cover rail is up. Install two 3/8"-16" bolts in crankshaft pulley.

NOTE: Install bolts in pulley hub a depth of 1/4" ONLY, otherwise bolts will injure rear housing oil seal.

NOTE: Crankshaft can also be turned with a wrench on the pulley attaching bolt.

34. Using a bar between the bolts on crankshaft pulley, (fig. 6A-43) turn crankshaft, positioning con-

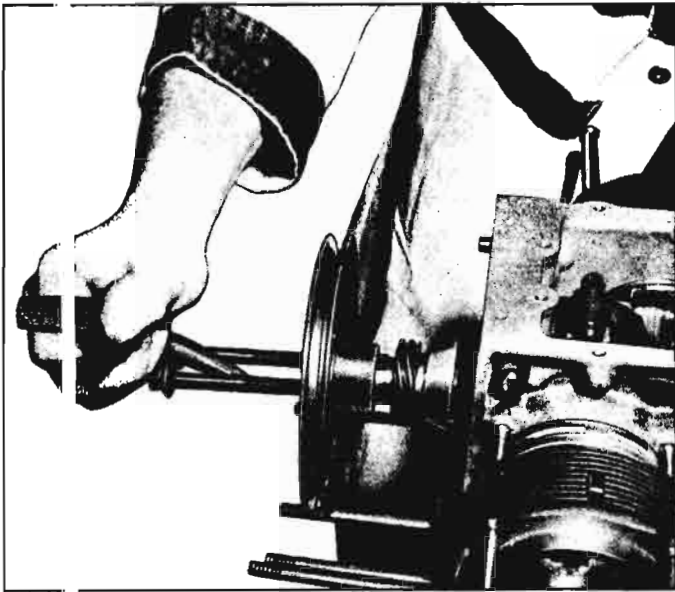


Fig. 6A-43—Turning Crankshaft, using Crankshaft Pulley

ecting rod so connecting rod cap and bearing can be removed.

NOTE: Mark cylinder numbers on each connecting rod and piston to identify for reassembly, if they are not marked.

NOTE: Cylinders are numbered from the rear of engine: right side 1, 3 and 5.—left side 2, 4 and 6.

35. Remove cylinder holding fixture (long and short tube) from one cylinder at a time.

Cylinder Air Baffle

36. To remove spring retainers on cylinder air baffle, refer to Figure 6A-42 and remove air baffle.
37. Remove each cylinder with piston and connecting rod assembly as a unit (fig. 6A-44).

Piston and Cylinder Bore

38. Piston assembly can be removed from cylinder, by pushing piston through cylinder with the end of a hammer handle, as shown in Figure 6A-45.

NOTE: Ridge and/or deposits from the upper end of cylinder can be removed after piston is removed from cylinder. A cylinder mounted ridge reamer is available at local jobbers.

39. Remove ridge and/or deposits from cylinder bore while holding cylinder with studs or bolts mounted on a wooden board as shown in Figure 6A-68. Procedure is outlined under "Piston, Rings and Cylinder Assembly."

Crankshaft Pulley

40. Remove crankshaft pulley retaining bolt and flat

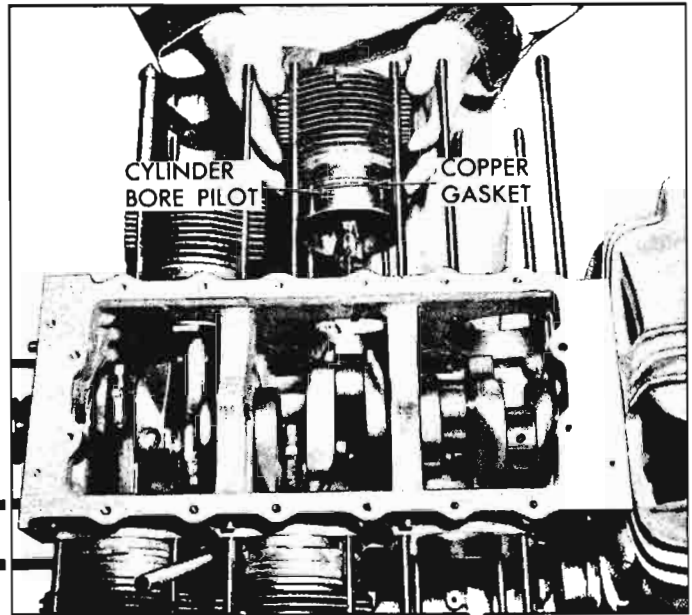


Fig. 6A-44—Removal and Installation of Cylinder, Piston and Rod

washer. Remove crankshaft pulley with Tool J-8105 as shown in Figure 6A-46. Remove rear engine housing bolts and washers and remove engine rear housing. Discard the gasket.

41. Disconnect flywheel housing from Tool J-8280 and crankcase assembly from engine stand and place on a couple of short lengths of 2" x 4" wood (to protect oil pump screen and pick up tube).

Camshaft and Crankshaft

42. Remove flywheel housing and gasket.

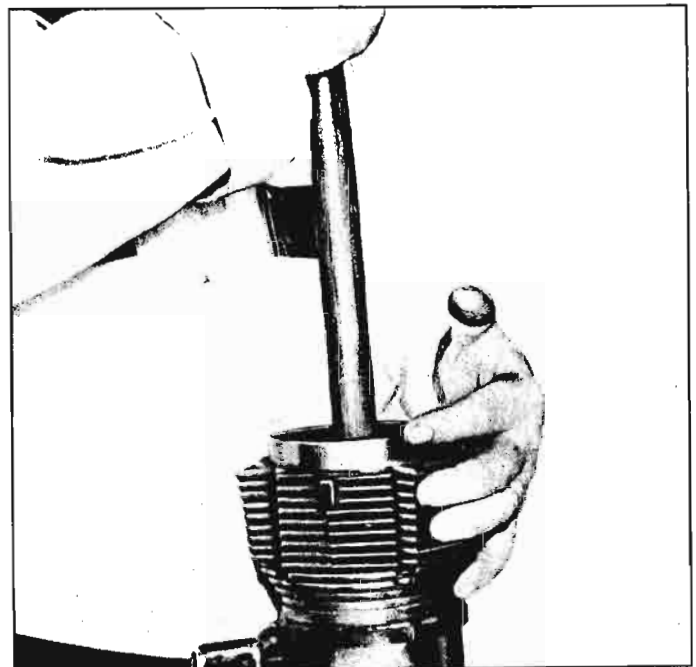


Fig. 6A-45—Removing Piston from Cylinder

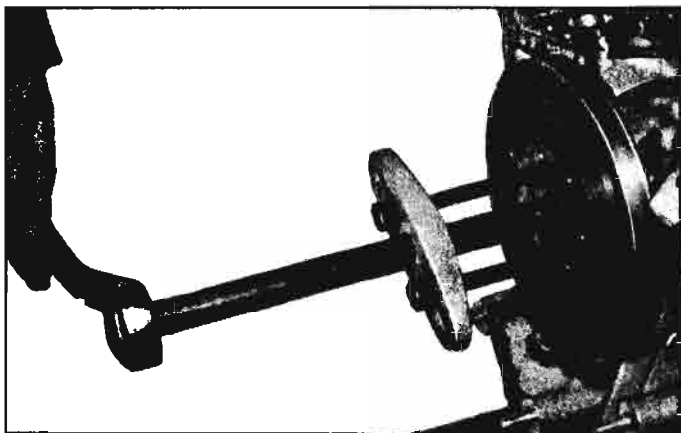


Fig. 6A-46—Removing Crankshaft Pulley Tool J-8105

43. Loosen crankcase bolts (located on side of crankcase), 8 long and 1 short bolt shown in Figure 6A-42. Engines provide just one small bolt for mounting, the oil pump suction pipe clamp (fig. 6A-110). Place crankcase on a block of wood at an angle of about 15° so crankshaft and camshaft will not fall out when crankcase half is removed) as shown in Figure 6A-47.

44. Remove left crankcase half as shown in Figure 6A-47.

45. Remove camshaft by turning while lifting.

NOTE: Handle camshaft carefully, to avoid injury to camshaft bearing surfaces in crankcase.

47. Install Tool J-971 under camshaft gear and place assembly in an arbor press to remove camshaft gear as shown in Figure 6A-48.

48. Remove crankshaft, lifting straight out to avoid injury to rear crankshaft bearing.

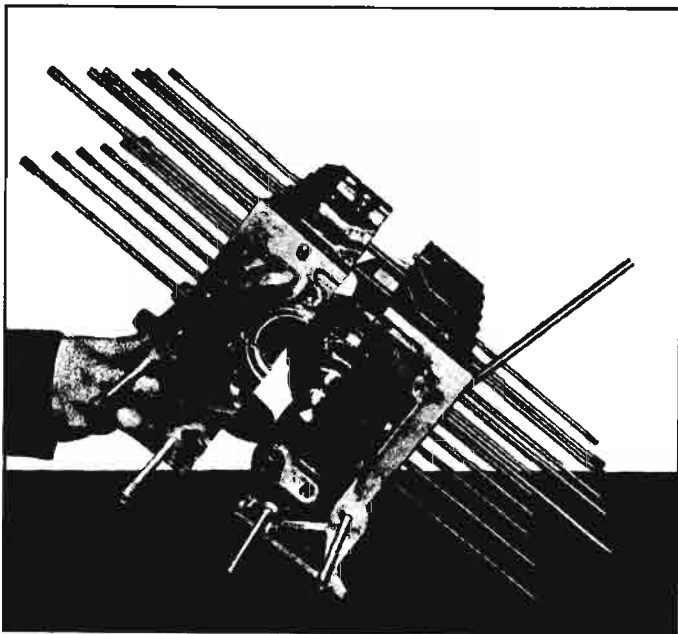


Fig. 6A-47—Removal and Installation of Crankcase Sections

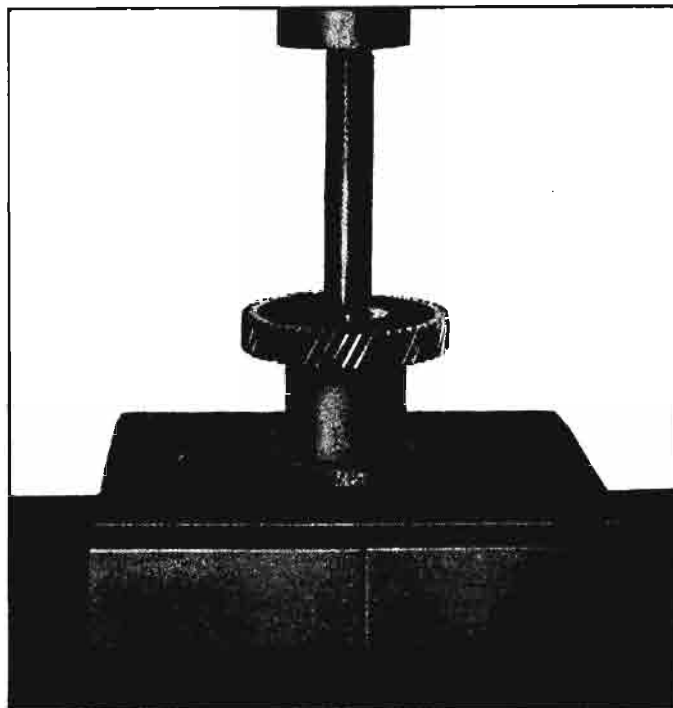


Fig. 6A-48—Removing Camshaft Gear, Using Tool J-971

NOTE: Crankshaft end thrust is taken at the rear bearing and crankshaft rear journal flange surfaces.

49. Remove distributor drive gear with Tool J-7112-1 with adapter Tool J-7112-2 as shown in Figure 6A-49. Remove spacer and fuel pump eccentric.

NOTE: Be sure Tool J-7112-1 is on distributor gear solidly, so gear will not be damaged during removal operation.

50. Remove crankshaft gear by placing each half of Tool J-7028 under gear.

51. Install crankshaft with Tool J-7028 into Tool J-358-1 on a hydraulic press as shown in Figure 6A-50. Remove gear from crankshaft using a small piece of round steel to press crankshaft out of crankshaft gear.

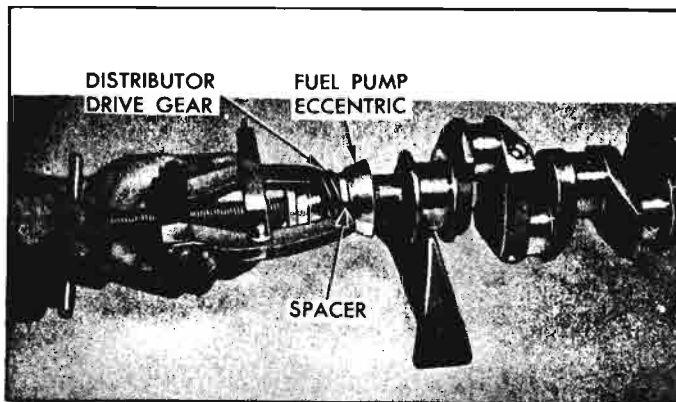


Fig. 6A-49—Removing Distributor Drive Gear

NOTE: To remove gear from crankshaft, a hydraulic press is required.

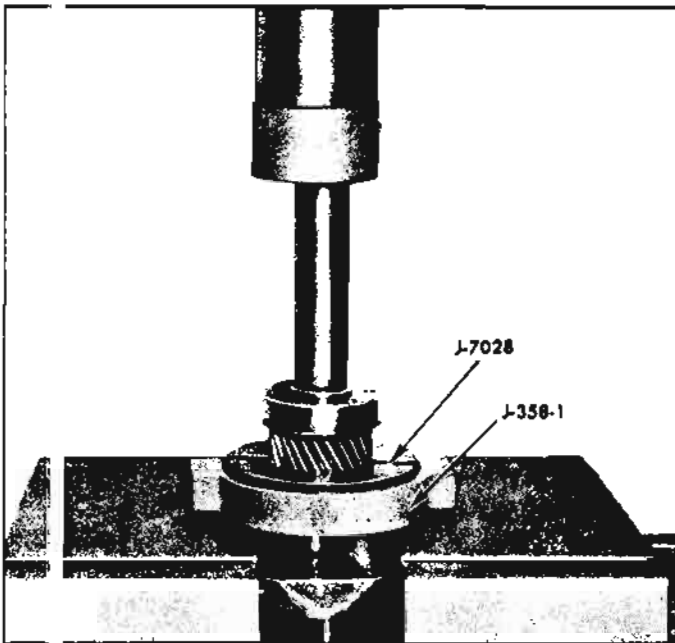


Fig. 6A-50—Removing Crankshaft Gear

Main Bearings

52. Remove main bearing inserts from each half of crankshaft by rotating bearing insert with fingers, tang end first, as shown in Figure 6A-51. Identify each bearing insert and place on a board or suitable storage area.

NOTE: Since the engine rear housing incorporates the oil pump, pressure regulator and oil

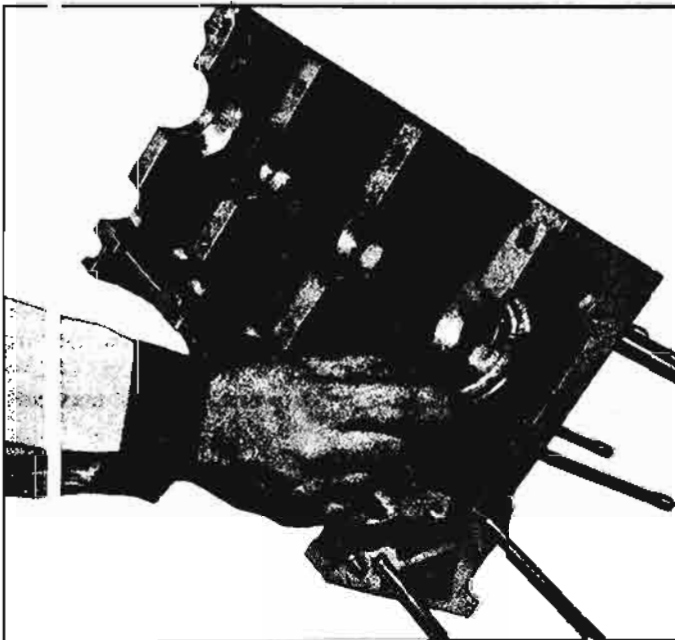


Fig. 6A-51—Removing and Installing Main Bearings

cooler by-pass valve, the disassembly, repair and assembly of these parts are outlined under "Repairs—Engine Components."

REPAIRS—ENGINE COMPONENTS

Repairs to engine components, preceding engine assembly are outlined below for cylinder heads, pistons and connecting rods, engine rear housing, crankcase and main bearings.

CYLINDER HEADS

NOTE: Always use extreme care to avoid damage to cooling fins.

Disassembly

1. Place cylinder head assembly on one end of a bench and, using Tool J-8062 with off-set jaws, compress valve spring and remove valve locks as shown in Figure 6A-52.

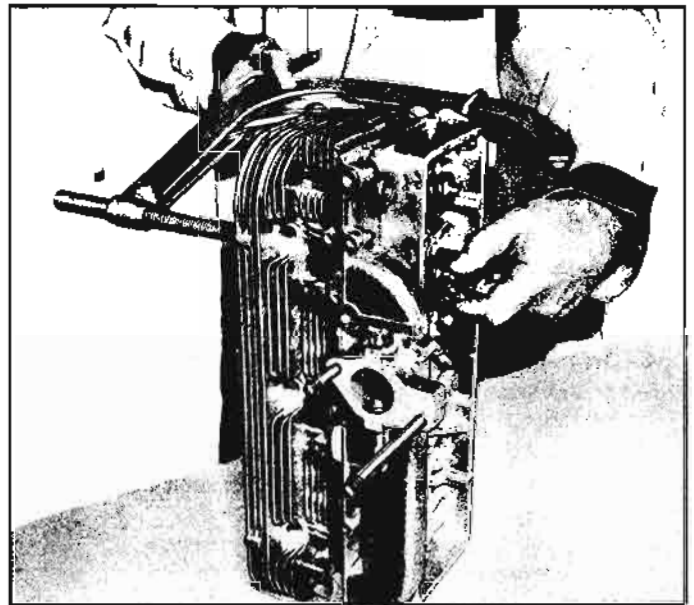


Fig. 6A-52—Removing Valves Using Tool J-8062

2. Release Tool J-8062 and remove valve spring cap, spring, shim and valve (fig. 6A-53). Repeat this operation on each valve assembly.

Cleaning

1. Clean carbon from combustion chambers and ports using Tool J-8358 (fine wire brush) shown in Figure 6A-54.

CAUTION: Avoid injury to cylinder sealing face surface in cylinder head as shown in Figure 6A-55. Injury will cause premature combustion chamber leaks.

2. Thoroughly clean valve guide bores, using Tool J-8101 (fig. 6A-55).

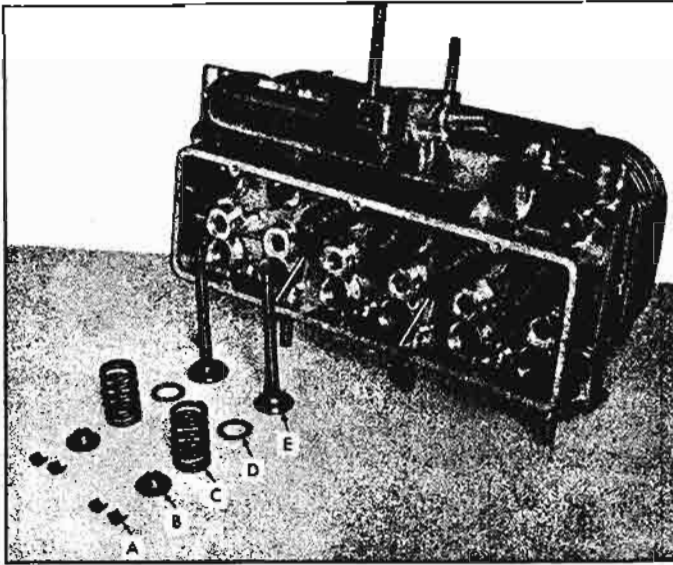


Fig. 6A-53—Removal and Assembly of Valves

A. Lock B. Cap C. Spring D. Shim E. Valve

3. Clean valve stems and valve heads on a buffing wheel.
4. Wash all parts in cleaning solvent and dry them thoroughly.

Inspection

1. Inspect cylinder heads for damage. Check fit of exhaust manifold sleeve assembly; if loose or cracked, replace.
2. Inspect the valves for burned seats, excessive seat pound in cracked faces or badly scuffed or worn stems.
3. Inspect valve seat inserts for cracks or burnt seats. Inspect valve guides for cracks or excessive wear.

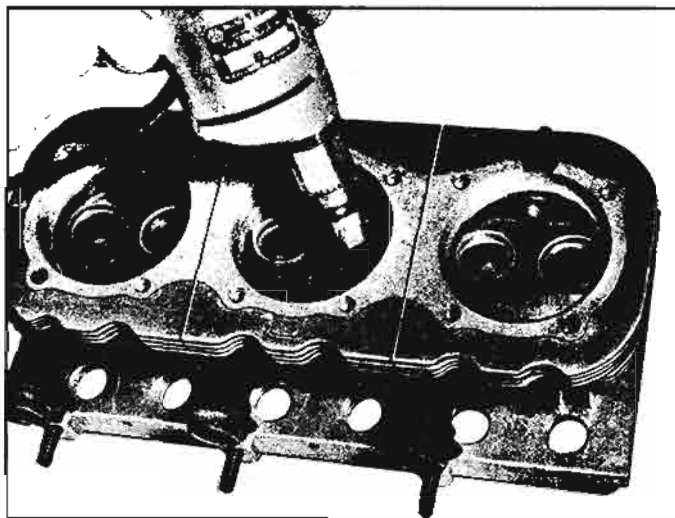


Fig. 6A-54—Removing Carbon from Combustion Chamber (Using Tool J-8358)



Fig. 6A-55—Cleaning Valve Bores, Using Tool J-8101

NOTE: If valve seat inserts or valve guides are beyond repair, cylinder head replacement is necessary.

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

4. Valve Stem clearance may be accurately determined by two methods:

a. Micrometer and Telescope Gage

Intake valve stem to bore clearance should be .001" to .0027" (new) and .001" to .004" (worn) while exhaust stem clearance should be .0015" to .0032" (new) and .002" to .005" (worn). Using a micrometer and a suitable telescope hole gage, check the diameter of the valve stem in three places; top, center and bottom. Insert telescope hole gage in valve guide bore, measuring at the center. Subtract highest reading of valve stem diameter from valve guide bore center diameter to obtain valve to guide clearance. If clearance is not within .002" of above limits, use next oversize valve and ream valve bore to fit.

b. Using a Dial Indicator

Intake valve stem to bore clearance should be .001" to .0027" (new) and .001" to .004" (worn) while exhaust stem clearance should be .0015" to .0032" (new) and .002" to .005" (worn). Using a Last Word Indicator, clamp the indicator on one side of cylinder head rocker cover gasket rail, arranging the indicator so that

movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the cylinder guide. With the valve head dropped about $\frac{1}{16}$ " off the valve seat, move the stem of the valve from side to side with light pressure to obtain the clearance. By trying new valves in the old bores it can be determined whether the valves should be replaced, or the bores reamed and oversize valves installed.

NOTE: Valves with oversize stems are available in the following sizes, .003" and .010". Tool J-5830-01 may be used to ream the bores or new valves (fig. 6A-56).

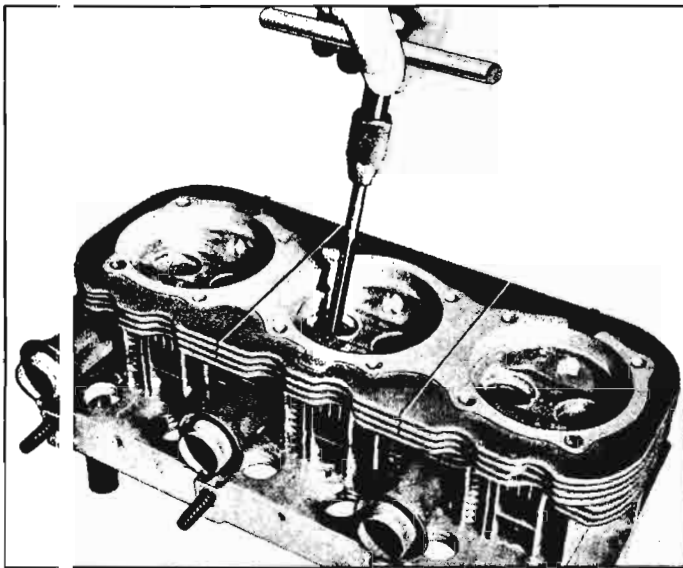


Fig. 6A-56—Reaming Valve Guide Bores

5. Check valve spring tension with Tool J-8056 (fig. 6A-57).

Turbo Air Engine:

Spring should be compressed to $1\frac{1}{2}$ " at which weight it should check 58 to 64 lbs.

Super Turbo Air Engine: (E.P.O. 649)

Spring should be compressed to $1\frac{1}{8}$ " at which weight it should check 71 to 81 lbs.

Weak springs affect power and economy and should be replaced if not within 5 lbs. of the above limits.

Reseating Valve Seats

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

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat

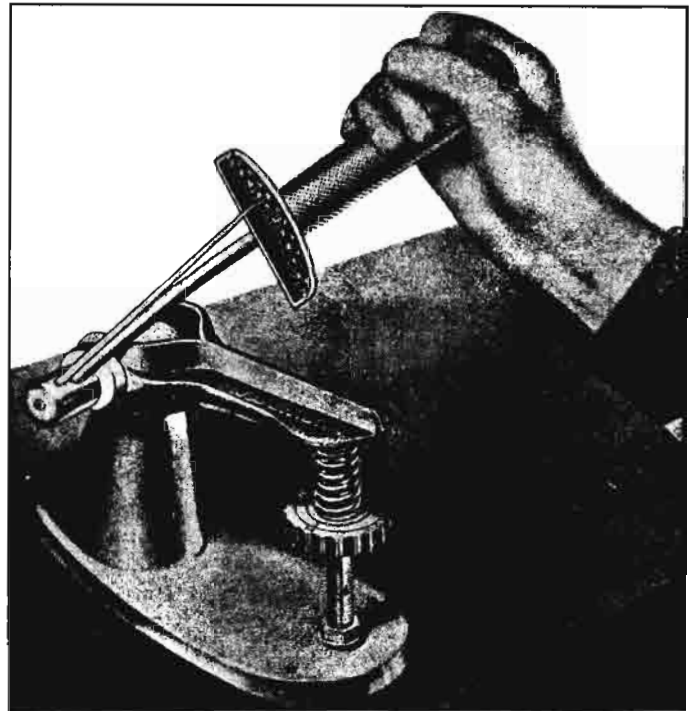


Fig. 6A-57—Checking Valve Spring Tension

in the head is imperative to insure that the heat in the valve head will be properly carried away.

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

Regardless of what type of equipment is used, however, it is essential that valve guides be free from carbon or dirt and not worn excessively to insure proper centering of the pilot in the guide.

NOTE: Cylinder Heads have hardened exhaust and inlet valve seat inserts.

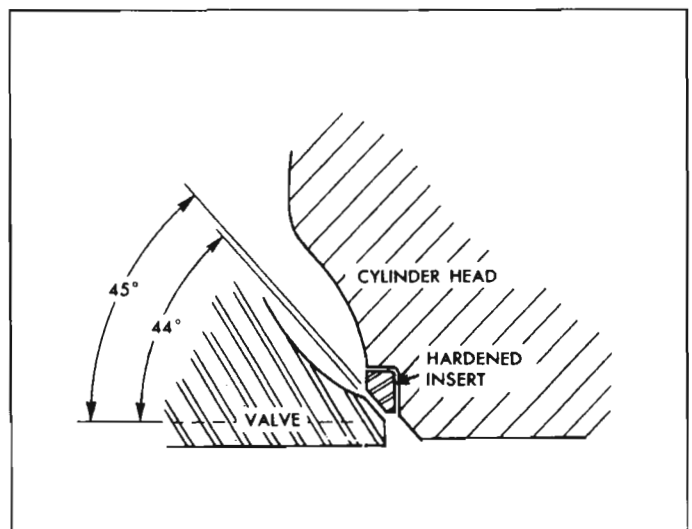


Fig. 6A-58—Relation of Valve and Seat Angles

Regardless of the methods used for valve seat repair, the final seat width in cylinder head should be as follows:

Inlet $\frac{1}{8}$ " to $\frac{3}{8}$ "

Exhaust $\frac{1}{10}$ " to $\frac{1}{8}$ "

Valve seat angle on all valves should be 44° and should be concentric within .002" indicator reading. Always dress stones to proper angle before grinding valve seat.

NOTE: Valve face to seat angles should be as shown in Figure 6A-58.

Refacing Valves

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem on a valve refacing machine. Valve stems which show excessive wear, or valves that are pounded in or warped excessively should be replaced. When a valve head which is pounded in or warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to premature breakage, burning and pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than $\frac{1}{8}$ " thick after grinding, replace the valve.

1. If necessary, dress the valve refacing machine grinding wheel to make sure it is true and smooth.
2. Set chuck angle at 44° mark for grinding valves.
3. After setting chuck angle, insert valve and grind carefully.

Exhaust Valve Seat Inserts

When reconditioning valves, the inserts in the cylinder head should be inspected. If either valve inserts or valve guides are beyond repair, cylinder head will need to be replaced as a unit.

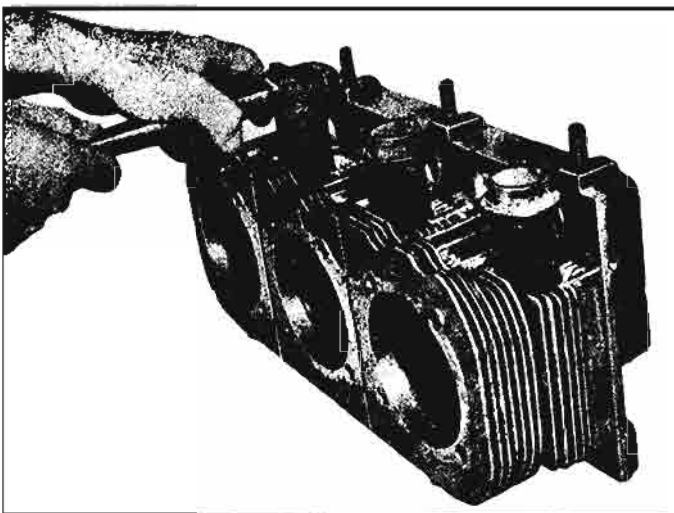


Fig. 6A-59—Removing Exhaust Manifold Sleeves

Exhaust Manifold Sleeves Replacement

NOTE: Do not remove exhaust manifold sleeves unless absolutely necessary. Warm cylinder head to 200°F .

1. Remove exhaust manifold sleeves with a suitable pipe wrench by turning gradually (fig. 6A-59).

NOTE: Do not tap or pry sleeves from cylinder head.

2. Check exhaust manifold sleeve installation holes in cylinder head for nicks or damage.
3. Coat new sleeves with anti-seize compound and locate flat side, parallel to exhaust push rod drain tube hole.

NOTE: Be careful when replacing sleeves. They are installed in the cylinder head with a press fit and must be started into place, true with the exhaust bore in the cylinder head.

NOTE: Sleeves are available in standard, .002" and .010" oversize for service.

4. Place sleeves in a container of dry ice (solidified carbon dioxide) for about 10 minutes.
5. Warm cylinder head to about 200°F . Support cylinder head to avoid damage to cooling fins.

NOTE: Do not use an open flame.

6. Remove sleeves, one at a time from dry ice and tap into place with a soft tool.

NOTE: Do not damage exhaust manifold end of sleeves, they are a press fit into the exhaust manifold.

Cylinder Head Assembly

1. To install carburetor attaching studs if replacement is necessary, coat threads with Permatex anti-seize compound #404 or equivalent and install long stud $\frac{5}{16}$ "-18-24 x $4\frac{1}{8}$ ", using Tool J-8534-2, in intake manifold flange at "A" on left and right bank cylinder heads (fig. 6A-60) to a length of $4\frac{3}{8}$ ".
2. Install short stud $\frac{5}{16}$ "-18 x 24 x $2\frac{1}{4}$ ", using Tool J-8354-2 in intake manifold flange at "B" on left and right bank cylinder heads to a length of $1\frac{5}{8}$ ".
3. If necessary to replace exhaust manifold studs ("C" fig. 6A-60 and 6A-61) coat new stud with anti-seize compound and using Tool J-8354-3 install to a length of $3\frac{1}{2}$ ".

NOTE: Cylinder Heads are identical except for location of vacuum balance tube hose connector "E" which is on one side of carburetor mounting pad on the right bank and the other side on the left bank (fig. 6A-60).

4. Install each valve coated with SAE #30 engine oil or molykote solution in the valve guide from which it was removed or to valve guide it was fitted. Lightly coat valve spring shim with petrolatum

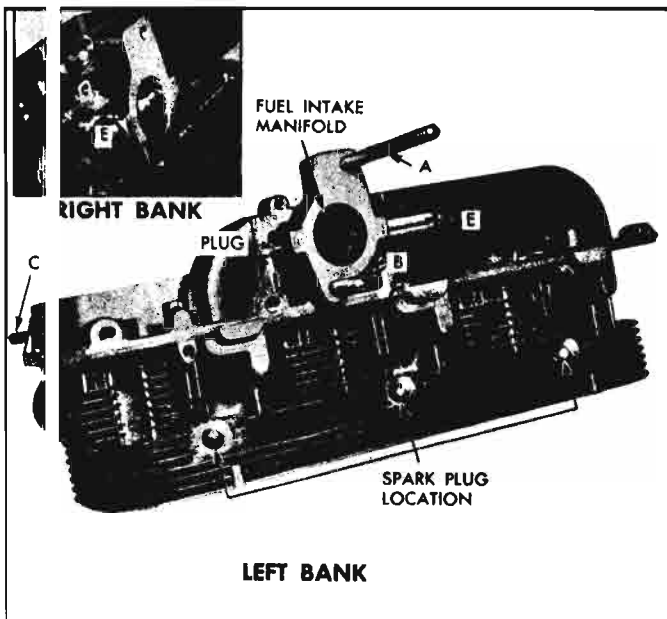


Fig. 6A-60—Carburetor Attaching Studs, and Vacuum Balance Tube

this will hold shim in place for assembly) and place on valve spring seat (fig. 6A-61).

5. Set valve spring in place on shim in cylinder head. Place cap in position and compress valve spring with Tool J-8062 (fig. 6A-62).

NOTE: Super Turbo-Air engines incorporate valve spring dampers.

6. Install valve locks and release spring compressor tool, making sure locks seat properly in valve groove on stem.
7. Assemble the remaining valves, valve springs, shims, spring caps and valve locks in cylinder head in the same manner.

NOTE: Each valve spring must have a hardened shim (minimum of .020") under it, to protect aluminum surface. Shims are available for service in .030" thickness.

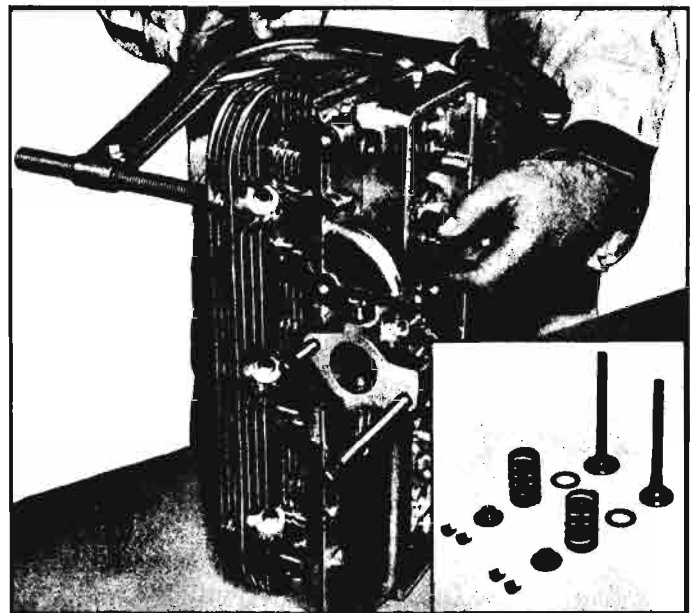


Fig. 6A-62—Valve Assembly

8. Check installed height of the valve springs. Re-seating valves raises the installed height of the valve springs and, if excessive, will have the effect of weak valve springs. Use a narrow, thin scale and measure from the spring seat in the head to the top of the valve spring (fig. 6A-64).

Turbo-Air Engine:

- 1½" exhaust valve springs.
- 1¹⁵/₃₂" inlet valve springs.

Super Turbo-Air Engine:

- 1¹¹/₁₆" exhaust and inlet valve springs.

If readings are found in excess of the above readings, install a valve spring shim, approximately .030" thick. At no time should the spring be shimmed to give an installed height of less than:

Turbo-Air Engine:

- 1¹⁵/₁₆" exhaust valve springs.
- 1⁷/₁₆" inlet valve springs.

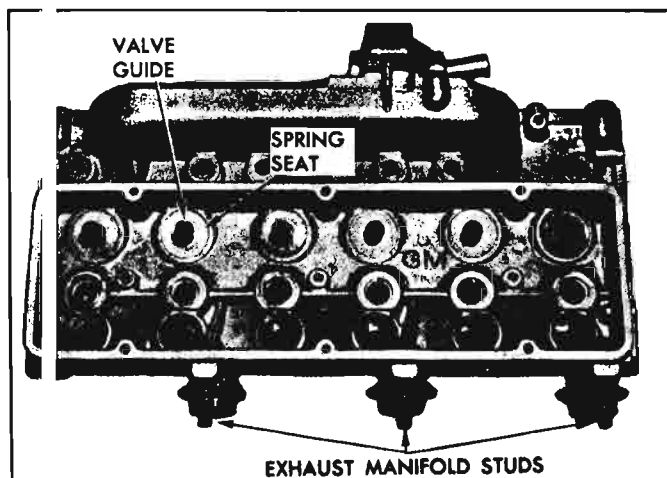


Fig. 6A-61—Top View of Cylinder Head (Right Bank Shown)

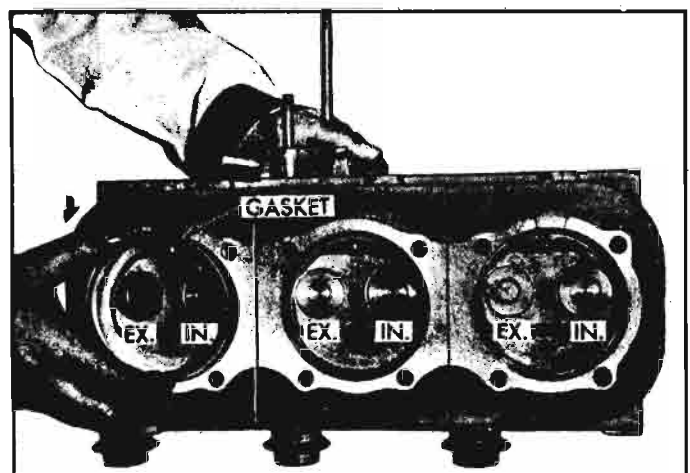


Fig. 6A-63—Installation of Cylinder Head Gasket

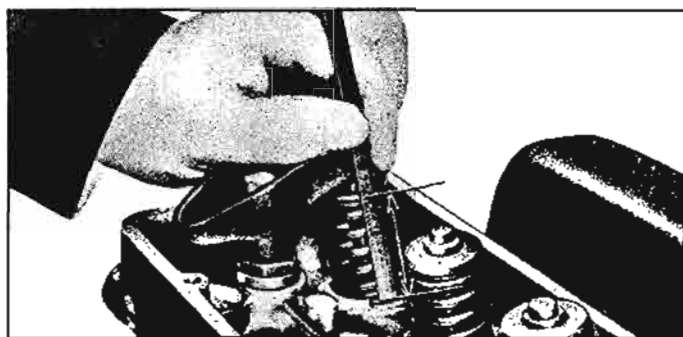


Fig. 6A-64—Checking Installed Height of Valve Springs

Super Turbo-Air Engine:

1 2 1/32" exhaust and inlet valve springs.

9. Coat cylinder head, cylinder counterbore pilot with a light coat of petrolatum (this will retain gasket for assembly) and install new cylinder head gaskets in place as shown in Figure 6A-63.

PISTONS AND CONNECTING RODS

Disassembly

1. Remove all piston rings by expanding them and sliding them off the top of the pistons. Tool J-8014 is available for this purpose.
2. Install piston and connecting rod assembly on support J-6994-1 with spring and adapter J-8355-1. Place assembly in an arbor press as shown in Figure 6A-66. Press pin out of connecting rod, using Tool J-8355-3.
3. Remove from press and remove piston pin from support and remove tool from piston and rod.

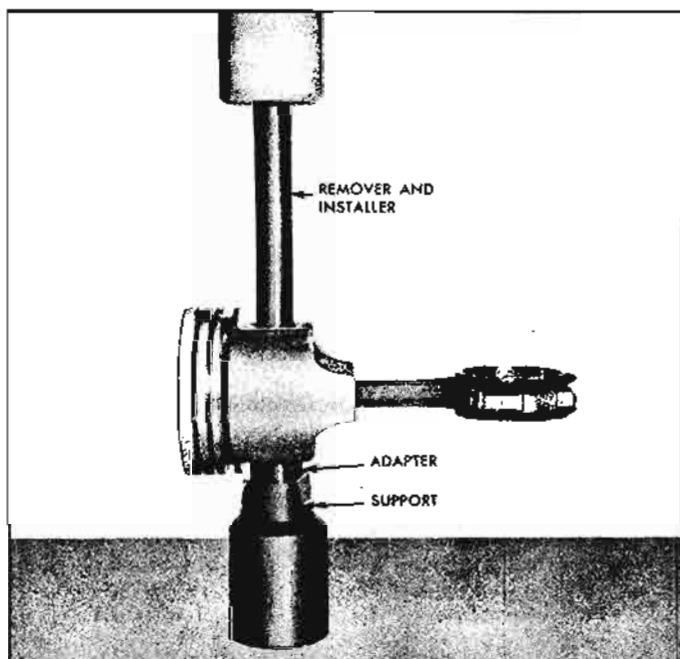


Fig. 6A-65—Removing and Installing Piston Pin

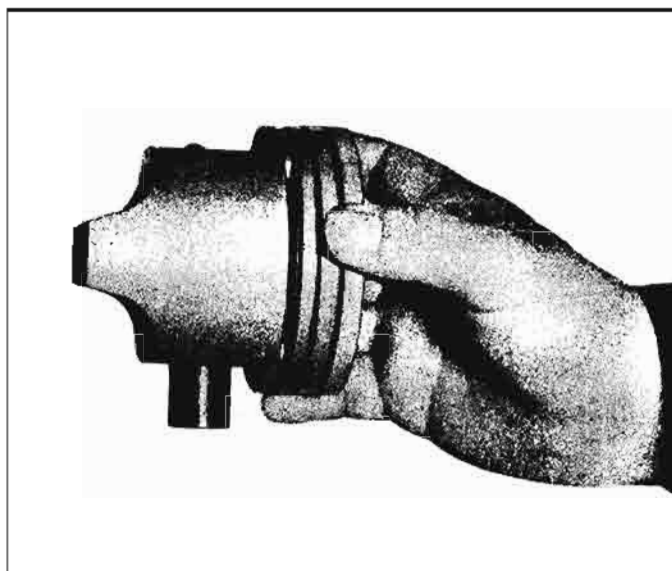


Fig. 6A-66—Checking Piston Pin Fit

Piston Pin Fit

Piston pins should be capable of supporting their own weight in either pin boss (fig. 6A-66) when coated with light engine oil and at 70°F. Higher or lower temperatures will cause false indications. Pistons, pins and cylinders are serviced as assemblies.

PISTONS, RINGS AND CYLINDER ASSEMBLY

Cylinders

1. Using a block of wood for a fixture, drill two holes, spaced to provide a location for two long bolts, holes should be small enough to require driving the bolts into the block of wood (fig. 6A-67).

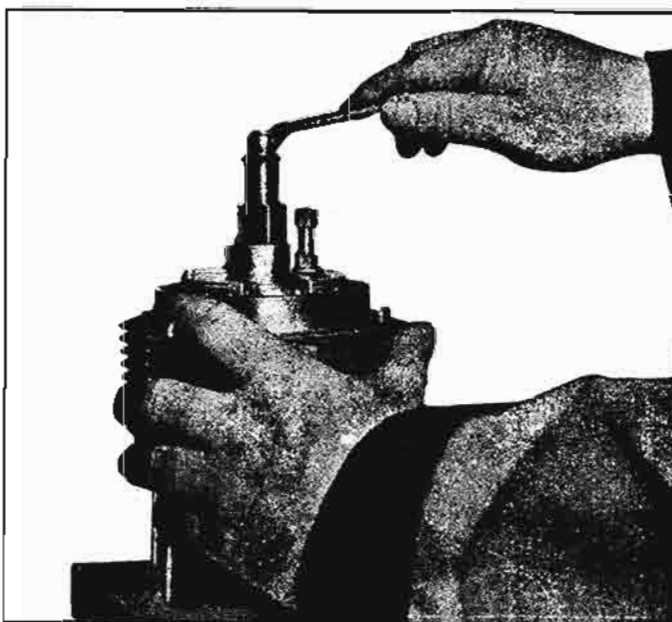


Fig. 6A-67—Removing Ridge and/or Carbon from Cylinder

2. Clamp wood block fixture in a suitable vise.
3. Install cylinder over bolts on wood fixture. Holding cylinder with one hand, insert ridge reamer and remove ridge and/or carbon from cylinder.
4. Check the cylinder walls for taper, out-of-round or excessive ridge at the top of ring travel. This can be done with Tool J-8087 (fig. 6A-68). Set gauge so that thrust pin must be forced in about $\frac{1}{4}$ " to enter gauge in cylinder bore. Center gauge in cylinder and turn dial to "0". Carefully work gauge up and down cylinder to determine taper and turn it to different points around cylinder wall to determine the out-of-round condition.

If the cylinders were found to have taper or wear in excess of .005" the cylinder and piston must be replaced.

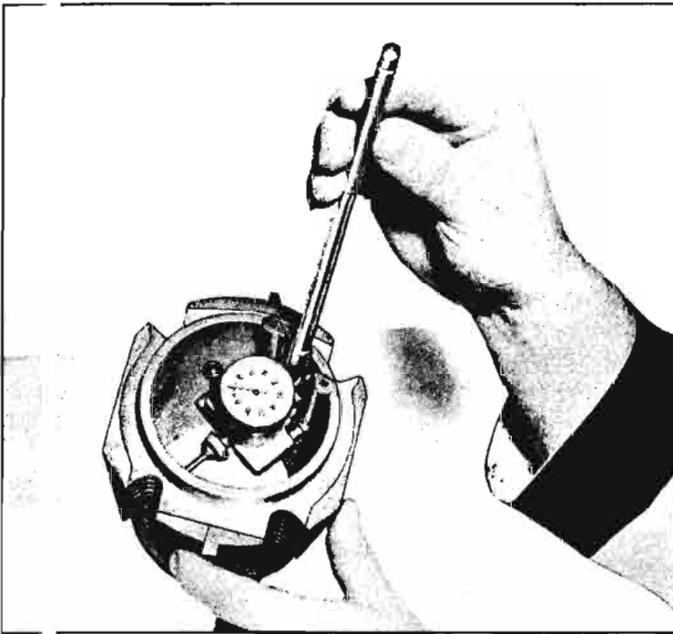


Fig. 6A-68—Checking Cylinder Bore

NOTE: Cylinders and pistons are serviced as a unit.

Piston Rings

All compression rings are marked with the letters "G. I." or "TOP" on the upper side of the ring.

When installing compression rings, make sure the face with the bevel is assembled away from the top of the piston. The face with markings is to top of piston.

NOTE: Piston rings are furnished in standard size only.

The oil control ring consists of a flexible expander with six horizontal slots, for a one piece cast iron constructed oil ring, with slots equally spaced, and the entire piston ring outside diameter having an undercut leaving two wiping surfaces.

1. Slip a piston ring in the cylinder bore; then using

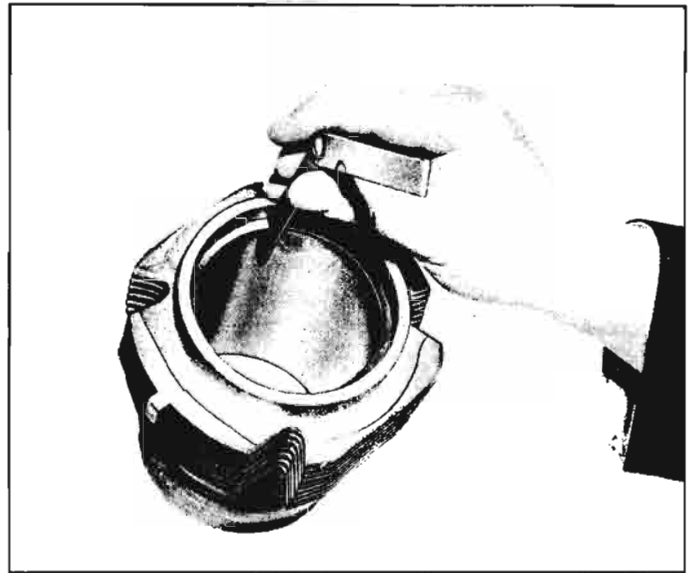


Fig. 6A-69—Checking Ring Gap

the head of a piston, press the ring down into the cylinder bore about two inches.

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

2. Check the space or gap between the ends of the ring with a feeler gauge (fig. 6A-69). This should be from .010" to .020".
3. If the gap between the ends of the ring is less than .010", remove the ring and try another for fit, or file the ends for the proper gap.
4. New pistons, rings and cylinder bores wear considerably during seating and gaps widen quickly; however, engine operation will not become seriously affected if ring gaps do not become greater than $\frac{1}{32}$ ".
5. Carefully remove all particles of carbon from the ring grooves in the piston and inspect the grooves carefully for burrs or nicks that might cause the rings to hang up.
6. Slip the outer surface of the compression ring into

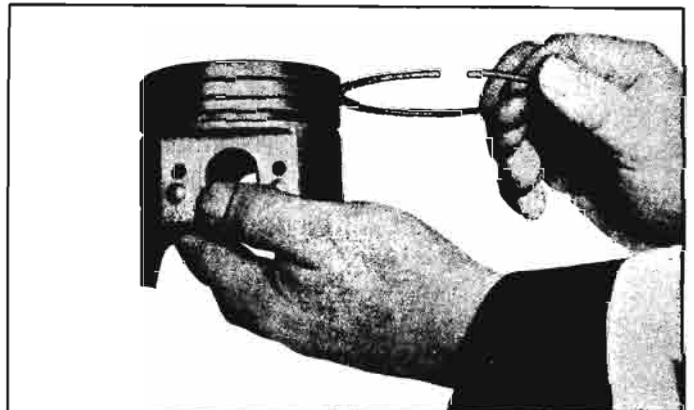


Fig. 6A-70—Rolling Ring in Groove

the piston ring groove and roll the ring entirely around the groove to make sure that the ring is free and does not bind in the groove at any point (fig. 6A-70). If binding occurs, the cause should be determined and removed by carefully dressing with a fine cut file. However, if the binding is caused by a distorted ring, install a new ring.

7. Proper clearance of the piston ring in its piston ring groove is very important in maintaining engine performance and in preventing excessive oil consumption. Therefore, when fitting new rings, the clearance between the top and bottom surfaces of the ring grooves should be .0012" to .0032" for compression rings and .002" to .0035" for oil rings (fig. 6A-71).
8. Install the oil ring expander in the oil ring groove and position gap in line with piston pin hole. Using ring expander Tool J-8014 expand oil control ring, and install in the oil ring groove, with the gap toward the top of the engine.
9. Flex the oil ring assembly in its groove to make sure ring is free and does not bind in the groove at any point. If binding occurs, the cause should be determined and removed by carefully dressing with a fine cut file. However, if the binding is caused by a distorted ring, install a new ring.



Fig. 6A-71—Checking Groove Clearance

PISTON AND CONNECTING ROD

Assembly

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.
2. Position connecting rod in its respective piston.
3. Install piston pin on installer J-8355-3 and pilot spring, adapter J-8355-1 and pilot in support (fig. 6A-72).
4. Install piston and rod on support, indexing pilot J-8355-4 through piston and rod.
5. Place support on an arbor press (fig. 6A-72), start pin into piston and press on installer until piston pin pilot bottoms.

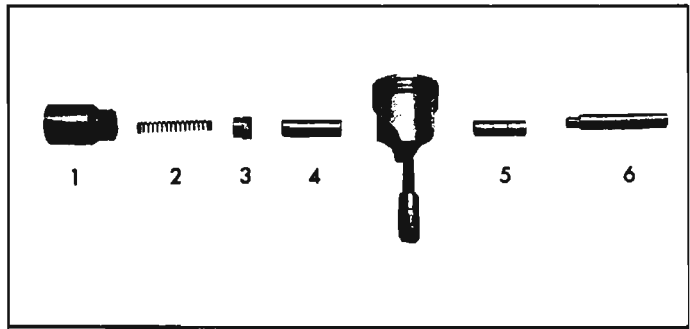


Fig. 6A-72—Piston Pin Assembly

- | | |
|-----------------------|-------------------------------------|
| 1. Support (J-6994) | 4. Pilot (J-8355-4) |
| 2. Spring | 5. Piston Pin |
| 3. Adapter (J-8355-1) | 6. Installer and Remover (J-8355-3) |
6. Remove installer and support assembly and adapter from piston and connecting rod assembly.
 7. Check piston pin for freedom of movement in piston bore.

NOTE: Piston pins are a matched fit to each piston and are not available separately.

ENGINE REAR HOUSING

Oil Pump

The oil pump consists of two gears enclosed in the engine rear housing as shown in Figure 6A-74 and is driven from the distributor shaft, which in turn is driven by a helical gear on the crankshaft (fig. 6A-49).

The oil pump pressure regulator is located as shown in Figure 6A-75.

Disassembly

1. Remove pump cover attaching bolts, cover, gasket, idler gear and drive gear and shaft (fig. 6A-74).
2. Remove pressure regulator plug, nylon gasket, spring and regulator valve.

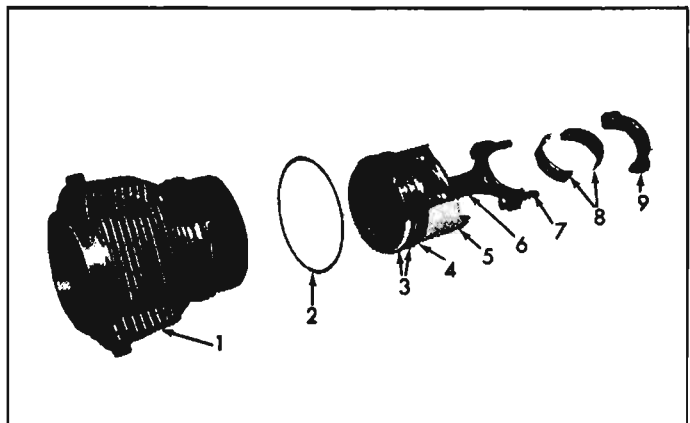


Fig. 6A-73—Piston, Connecting Rod and Related Parts

- | | |
|----------------------|---------------------------|
| 1. Cylinder | 6. Connecting Rod |
| 2. Cylinder Gasket | 7. Connecting Rod Bolt |
| 3. Compression Rings | 8. Connecting Rod Bearing |
| 4. Oil Ring | 9. Connecting Rod Cap |
| 5. Piston | |

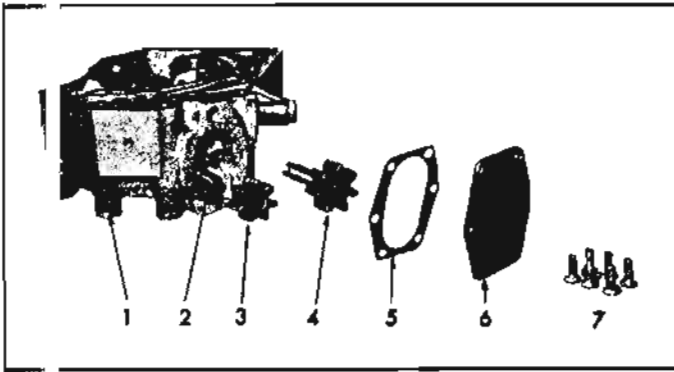


Fig. 6A-74—Oil Pump Exploded

- | | |
|------------------------|-----------------|
| 1. Engine Rear Housing | 5. Cover Gasket |
| 2. Idler Gear Shaft | 6. Pump Cover |
| 3. Idler Gear | 7. Cover Bolts |
| 4. Drive Gear & Shaft | |

- Wash all parts in cleaning solvent and dry with compressed air, if available.

Assembly

- Install idler gear on idler gear shaft (fig. 6A-74). Idler gear shaft should be .010" to .020" below gasket surface.
- Place drive gear and shaft in pump housing.
- Check projection of oil pump gears above gasket surface; this should be .0045" maximum and .0025" minimum. Clearance between gears and housing .002"/.005". Gear backlash .002" to .008".

Since end clearance of oil pump gears is essential to oil pump prime, selective oil pump gears are available in .001" oversize thickness.

NOTE: Lubricate oil pump gears with engine oil before installation.

- Install pump cover and attaching bolts, and torque 60 to 80 inch pounds.
- Insert a long screwdriver down the distributor mounting hole in the engine rear housing and turn

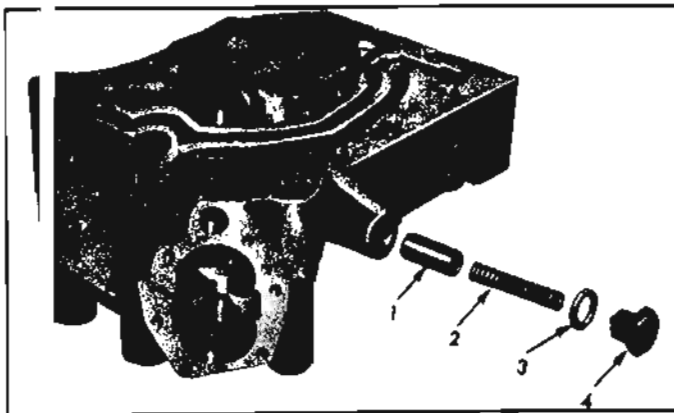


Fig. 6A-75—Oil Pump, Pressure Regulator Exploded

- | | |
|-----------|-----------------|
| 1. Valve | 3. Nylon Gasket |
| 2. Spring | 4. Plug |

oil pump drive shaft to see that oil pump turns freely.

- Install pressure regulator valve, spring, nylon gasket and plug.

Rear Housing Seal Replacement

- Tap seal out of rear housing assembly with a wood or fibre drift.
- Clean rear housing seal surface with a suitable solvent and check surface for nicks or damage.
- Lubricate seal outer surface (beaded area) with lubriplate or petrolatum and install with a suitable tool as shown in Figure 6A-76.

NOTE: Seal is coated with a high melting (350°F) point cup grease between sealing lips on the inside diameter as shown in Figure 6A-76. Seal to be installed must have this cup grease, which is maintained for the life of the seal.

Housing Replacement

When replacing the engine rear housing as a new unit, certain operations are required as outlined below.

- Install groove pin (fig. 6A-77) which holds oil pump pressure regulator valve in place.
- Install oil pump gallery plug flush with the counter-bore using sealing compound (fig. 6A-78).
- Install a new rear housing seal as previously outlined.
- Install distributor holding stud 1 1/8" measured from distributor pad on engine rear housing (fig. 6A-76).

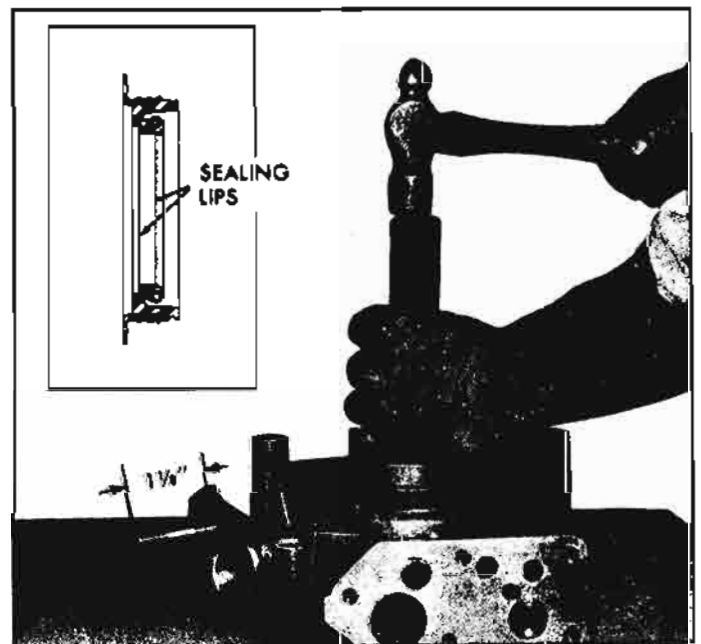


Fig. 6A-76—Installing Rear Housing Seal, Using Tool J-270-6

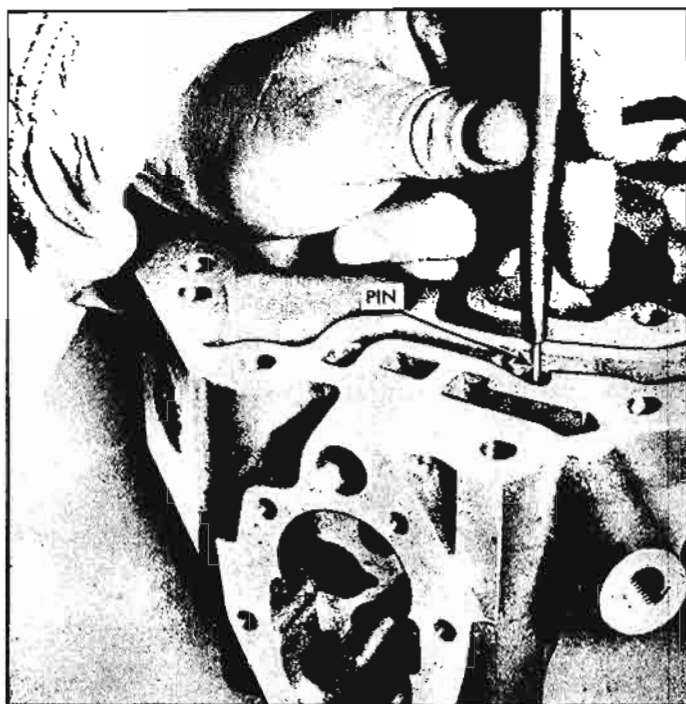


Fig. 6A-77—Installing Oil Pressure Regulator Stop Groove Pin

OIL COOLER BY-PASS VALVE

Removal and Installation

NOTE: The oil filter by-pass valve opens at 10 psi.

1. Remove oil cooler by-pass valve in the same way as the oil filter by-pass valve and discard valve.
2. Install oil cooler by-pass valve with the spring down as shown in Figure 6A-79.

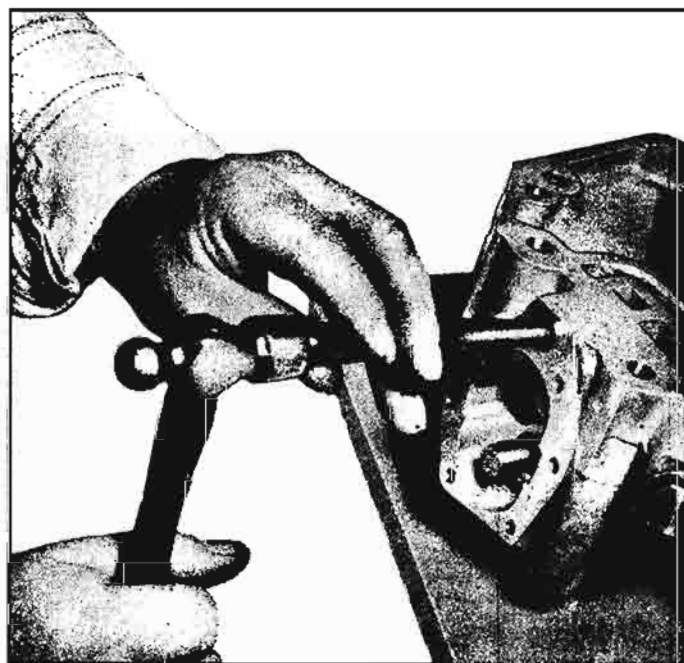


Fig. 6A-78—Installing Oil Gallery Plug

OIL FILTER BY-PASS VALVE

Removal and Installation

NOTE: The oil filter by-pass valve opens at 10 psi.

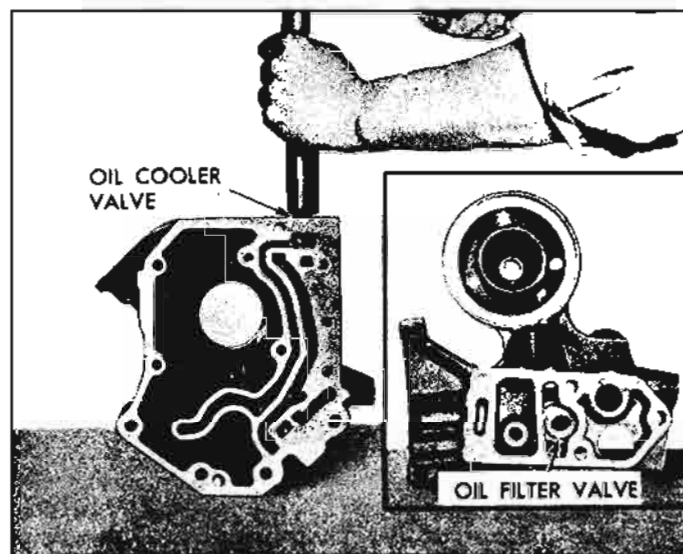


Fig. 6A-79—Oil Cooler and Oil Filter Valve Installation

1. Remove oil filter by-pass valve from the oil filter and generator adapter by catching the inner edge of the valve with a suitable hook or small screwdriver and discard valve.
2. Install the oil filter by-pass with the spring up in the adapter housing (fig. 6A-79).

CRANKCASE

Cleaning, Inspection and Repairs

1. Remove two oil gallery plugs located at flywheel housing end of crankcase. These oil gallery passages should be thoroughly cleaned with cleaning solvent.
2. Check cylinder pilot bores and bearing surfaces in each half of crankcase for nicks, cracks or other damage that would interfere with the proper fit of component parts.

NOTE: Do not use scrapers or other sharp tools to clean gasket surfaces. A good cleaning solvent should be used to dissolve gasket material or varnish that may adhere to surfaces.

NOTE: The crankcase unit is serviced with all studs and main bearings installed.

Stud and Thread Repairs

Always use anti-seize compound Permatex #404 or equivalent on all threads entering aluminum.

1. To replace crankcase studs, install long cylinder studs to a projected length of $8\frac{1}{2}$ " (fig. 6A-80) and short cylinder studs to a projected length of $7\frac{1}{16}$ " using Tool J-8354-1 ($\frac{3}{8}$ -24) (fig. 6A-81). For

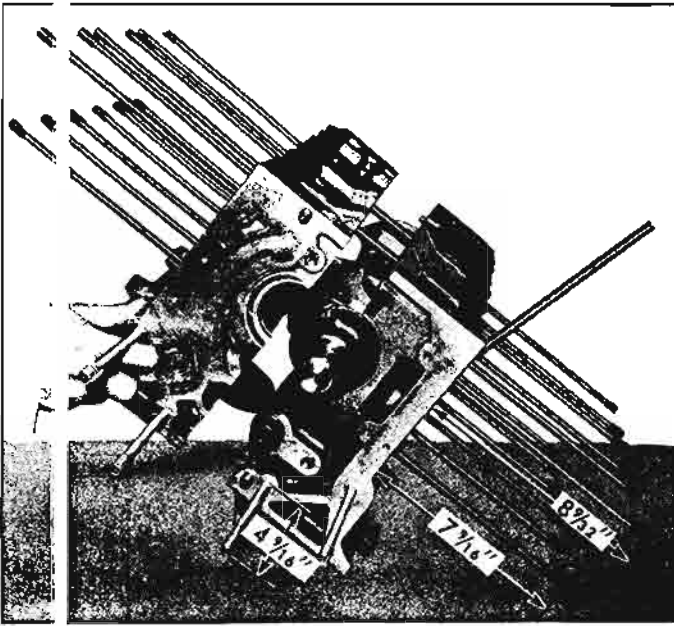


Fig 6A-80—Crankcase and Engine Rear Housing Stud Installed Length

easy measuring of stud installed length, measure from Tool J-8354-1-2-3 shoulder as shown in Figure 6A-81.

NOTE: Cylinder stud torque should be a maximum of 30 ft. lbs. and a minimum of 10 ft. lbs. Under 10 ft. lbs. another selected stud should be used.

Studs are available for service in the following oversizes, .003" and .006".

2. Install engine rear mounting bracket studs, to a projected length of $4\frac{9}{16}$ " using Tool J-8354-3 ($\frac{3}{8}$ "-16) as shown in Figure 6A-81.

NOTE: Rear mounting bracket studs should be torqued 5 ft. lbs. minimum.

NOTE: Inserts are commercially available for thread repairs at local jobbers and should be installed to prescribed methods furnished by the manufacturer.

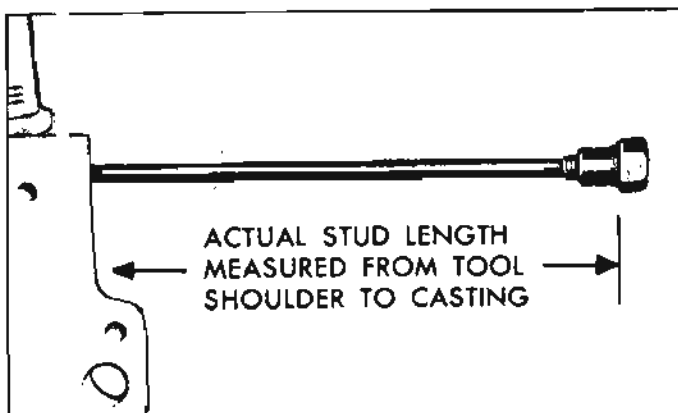


Fig. 6A-81—Installing Studs, using Tool J-8354-1-2-3

NOTE: All cylinder studs installed in the crankcase adjacent to the crankcase main bearing webs, have blind holes, while all other cylinder studs entering the crankcase do not.

Oil Level Gauge Tube Replacement

The oil level gauge tube can easily be replaced by removing tube with a pair of pliers. Install a new oil level gauge tube using Permatex anti-seize compound or equivalent on the leading surface and tap oil level gauge tube into crankcase with a block of wood until rolled ring bottoms at the crankcase.

Blower Bearing Replacement

Refer to "Component Service Procedures—Engine In Vehicle", for blower bearing replacement.

MAIN BEARINGS

Bearing and Journal Inspection

Whenever the crankcase is parted, the bearing inserts and the crankshaft journals should be inspected.

If upon inspection one half shows evidence of fatigue, distress, abrasion, erosion, scoring or the like, both halves should be replaced. Never should one-half be replaced without replacing the other half.

If the running clearance of a bearing is too great with used inserts, it will be necessary to install both bearing halves. Should this become necessary, the crankshaft journal should be checked with a micrometer for out-of-round, taper or undersize dimensions. Experience has shown that clearance increase from wear in main bearings is not only due to bearing wear, but is also due in part to crankshaft journal wear.

Main Bearing Clearance (Using Plastigage)

Plastigage consists of a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface. To obtain the most accurate results with Plastigage, certain precautions should be observed.

NOTE: To assure the proper seating of the bearings, all crankcase bolts must be at their specified torque. Eight long bolts $7/16$ "-20, 42 to 48 ft. lbs. and one $5/16$ "-18, 7 to 13 ft. lbs. torque. Hold bolt head, on crankcase bolts $7/16$ "-20" while tightening the nut. Do not tighten at bolt head. Figure 6A-82 shows tightening sequence. One $5/16$ " bolt (#9, Fig. 6A-82) is used to fasten the oil suction tube retaining bracket. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearings should be wiped clean of oil.

1. Remove one half of the crankcase, while the other is supported on its side, wipe oil from journal and bearings with a soft clean cloth.
2. Place a piece of Plastigage the full width of the bearing (parallel to the crankshaft on the journal) (fig. 6A-83).

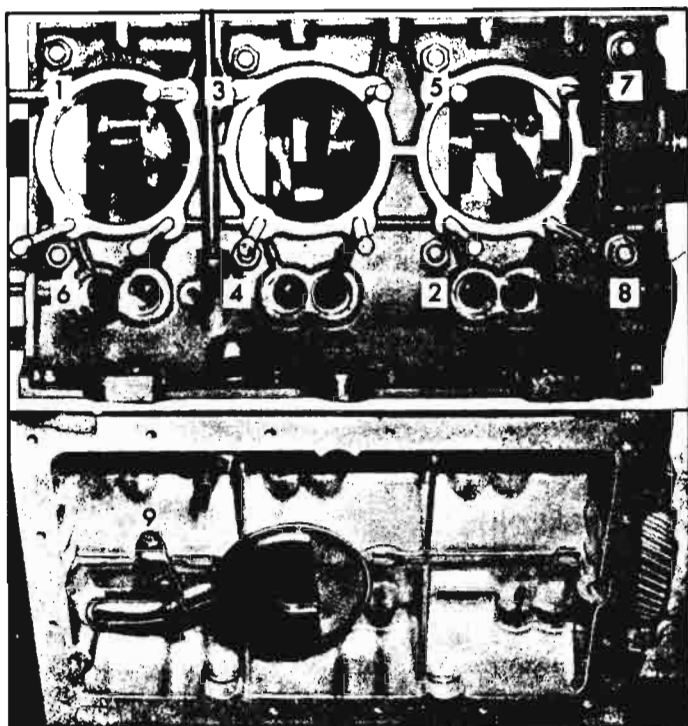


Fig. 6A-82—Crankcase Tightening Sequence

NOTE: Crankcase split line surfaces, must be free of nicks and foreign matter.

3. Install other half of crankcase with bearings and evenly tighten the crankcase bolts to proper torque.

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

4. Remove one half of crankcase. The flattened Plastigage will be found adhering to either the bearing shells or journals. On the edge of Plastigage packing envelope there is a graduated scale which is correlated in thousandths of an inch.
5. Without removing the Plastigage, check its compressed width (at the widest point) with the

graduations on the Plastigage envelope (fig. 6A-83).

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

NOTE: Crankshaft journal diameters are 2.0978" to 2.0988" for No. 1 and 2. For No. 3 and 4 2.20993"-2.0983".

6. If the main bearing clearance for No. 3 and No. 4 main bearings is .0025" (worn) and .0007" to .0022" (new), No. 1 and No. 2 main bearing clearance is .004" (worn) and .0012" to .0027" (new) the bearing insert is satisfactory. If the clearance is not within these limits, replace the bearing insert.

CAUTION: Do not install No. 4 main bearing in No. 2 or No. 3 bearing locations. The No. 4 main bearing halves are .0015" thicker than No. 2 and No. 3 main bearings at the ends which are located at the top half of the crankcase and are thinner by the same amount at the opposite ends. This has the effect of lowering the center line of the bearing .0015".

The No. 4 main bearing is identified by a brown dye on edges of the bearing shell.

NOTE: Bearings are available in standard sizes and .001", .002", .003", .010" and .020" undersize.

REPLACEMENT BEARINGS

If clearance with plastigage is	Install bearing sets
.0010	.000 (Std.)
.0015	.001 U/S
.0020	.001 U/S
.0025	.002 U/S
.0030	.002 U/S
.0035	.003 U/S
.0040	.003 U/S

If these undersize bearings do not produce the proper clearance, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.

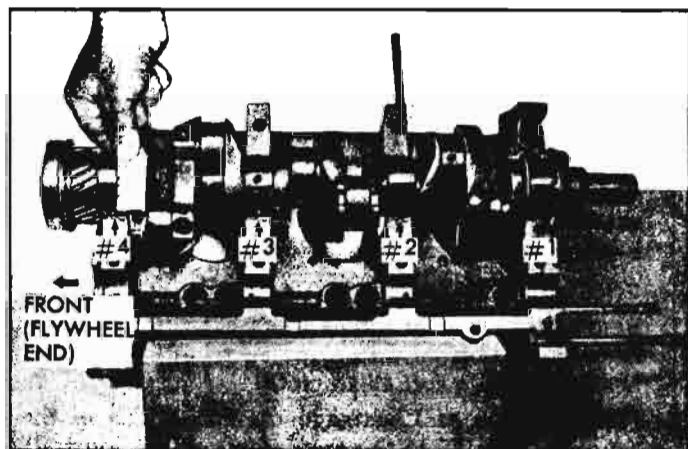


Fig. 6A-83—Measuring Plastigage on Crankcase Journals

7. Proceed to each bearing. After all bearings have been checked and installed, rotate the crankshaft to see that there is no excessive drag.
8. Check the end play by forcing the crankshaft to its extreme front position. Check with a dial indicator as shown in Figure 6A-84. This clearance should be from .002" to .006".

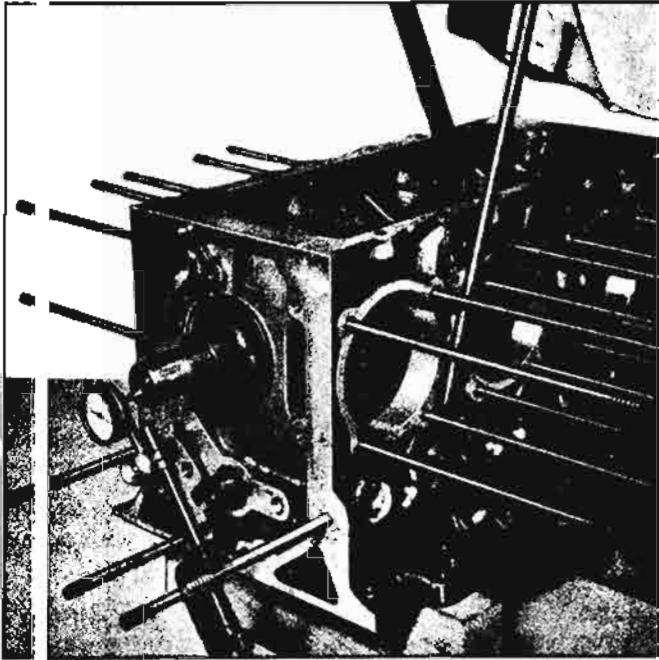


Fig. 84—Checking Crankshaft End Play

CONNECTING ROD BEARINGS

Bearing Clearance

Connecting rod bearing inserts are available in standard sizes and undersizes of .001", .002", .010" and .020". These bearings are not shimmed and when clearance becomes excessive the next undersize bearing insert should be used. Do not file rod or rod caps.

1. Remove the connecting rod bearing cap.

NOTE: Install a piece of plastic hose with at least 5/16" I.D. over each bolt as shown in figure 6A-85.

2. Wipe bearing insert shell and crankpin clean of oil.

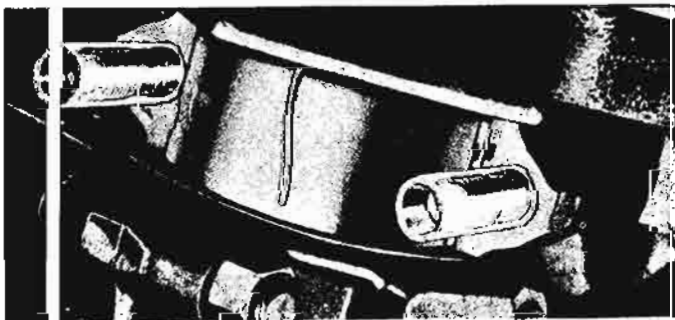


Fig. 6A-85—Plastigage on Crankpin

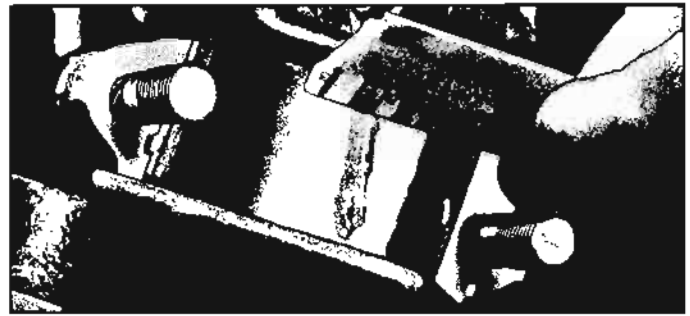


Fig. 6A-86—Measuring Plastigage

3. Place a piece of Plastigage the full width of the bearing or crankpin (parallel to the crankshaft) (fig. 6A-85).
4. Reinstall the bearing cap and evenly tighten the retaining bolts to 20 to 26 ft. lbs. torque.

CAUTION: Do not turn crankshaft with the Plastigage installed.

5. Remove the bearing cap and without removing the Plastigage, check its width at the widest point with the Plastigage scale (fig. 6A-86).

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

6. If the reading is not over .003" (worn), or .002" (new) or not less than .001" the fit is satisfactory. If however, the clearances are not within these

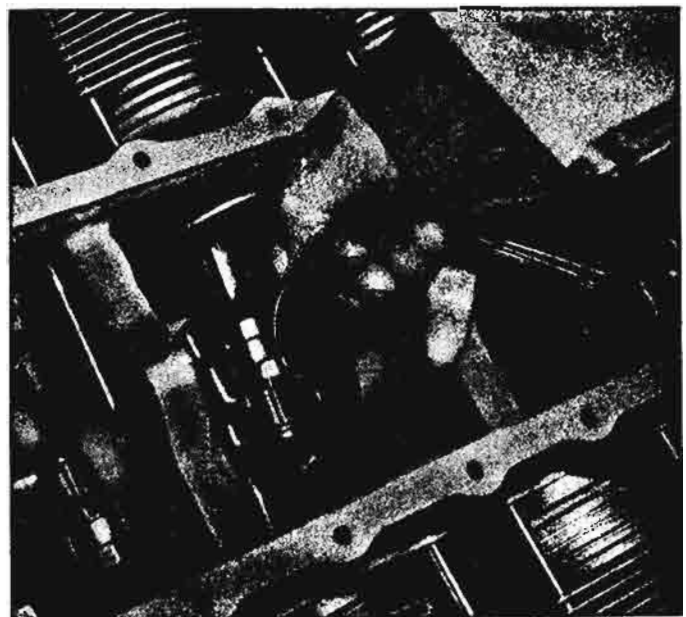


Fig. 6A-87—Connecting Rod Side Clearance

limits, replace the bearing with the proper under-size bearings.

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

7. Rotate the crankshaft after bearing adjustment to be sure the bearings are not too tight.
8. Check connecting rod side clearance between upper half of connecting rod and side of crank pin. This clearance should be .005" to .010" (fig. 6A-87).

VALVE LIFTERS

Disassembly and Assembly

Refer to Figure 6A-88.

1. Hold plunger down with a push rod and, using a small screwdriver or awl, remove push rod seat retainer.
2. Remove push rod seat and inertia valve assembly, plunger and spring from lifter body.
3. Pull check ball retainer from plunger and remove ball and spring.
4. Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged, the entire lifter assembly should be replaced. The inertia valve in the push rod seat should move when the plunger is shaken.

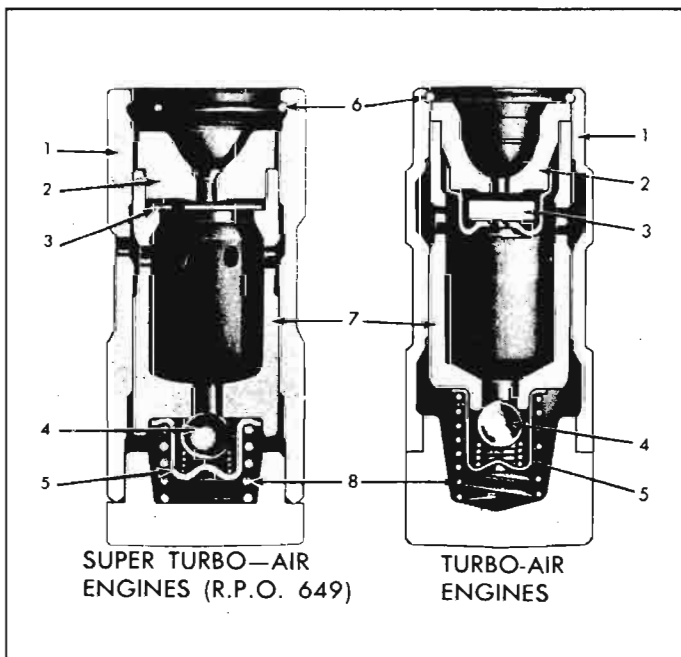


Fig. 6A-88—Hydraulic Valve Lifter

- | | |
|--|---------------------------|
| 1. Lifter Body | 5. Ball Retainer |
| 2. Push Rod Seat | 6. Push Rod Seat Retainer |
| 3. Inertia Valve (Present)
Metering Valve (Early) | 7. Plunger |
| 4. Check Ball | 8. Plunger Spring |

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

Flywheel Housing Seal Replacement

1. Tap seal out of flywheel housing with a wood or fibre drift.
2. Clean flywheel housing seal surface with a suitable solvent and check this surface for nicks or damage.
3. Lubricate seal outer surface (beaded area) with lubriplate or petrolatum and install with a suitable tool as shown in Figure 6A-89.

NOTE: Flywheel Housing Seal, sealing lips are coated with high melting (350°F) cup grease for the life of the seal. If seal is removed and still usable, pack sealing lips with a good grade of cup grease, with a melting point of 350°F minimum.

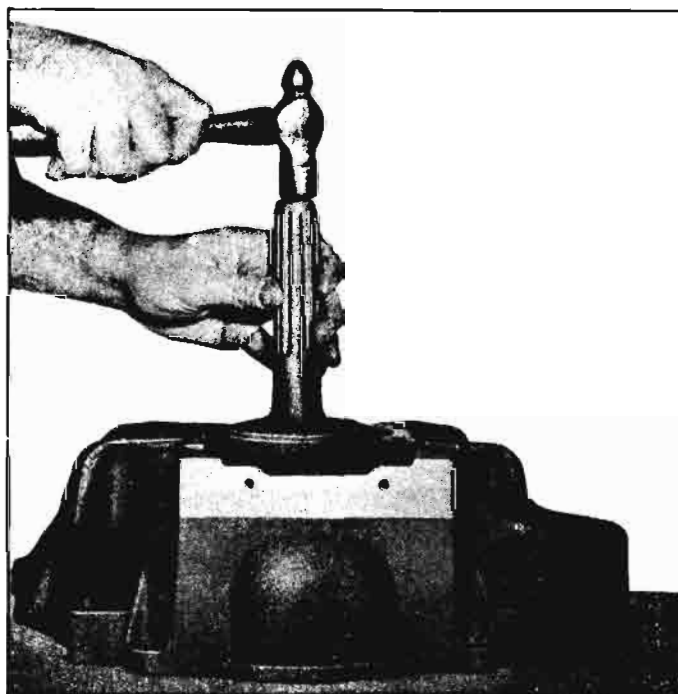


Fig. 6A-89—Installing Flywheel Housing Seal, using Tool J-2221-A

ENGINE ASSEMBLY (ENGINE REMOVED)

Crankshaft

1. To assemble the crankshaft gear to the crankshaft, proceed as follows:
 - a. Firmly support crankshaft between front crankshaft throw and front journal with a support in on a hydraulic press as shown in Figure 6A-90.

NOTE: Since the crankshaft gear to crankshaft uses a high press tolerance, a hydraulic press is required for removal and installation.

Note: Support must clear thrust face on No. 6 crankpin.

- b. Lubricate crankshaft with hypoid lubricant, and install woodruff key in shaft keyway.
- c. Install crankshaft gear and press into place, using available Tool J-6175 as shown in Figure 6A-90.
- d. Install woodruff keys (two) on rear end of crankshaft (Engine Rear Housing End), one for the fuel pump eccentric distributor drive gear and the other for the crankshaft pulley (fig. 6A-49). Position fuel pump eccentric and spacer on crankshaft. Lubricate crankshaft and distributor drive gear with engine oil and install distributor drive gear until it bottoms, using Tool J-5590. Install oil slinger with concave side away from distributor drive gear. (Fig. 6A-91).

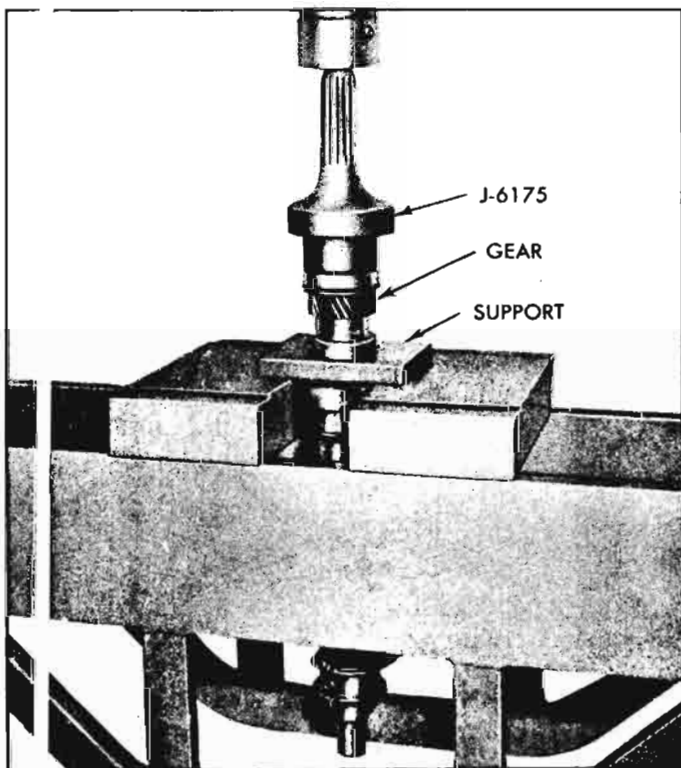


Fig. 6A-90—Installing Crankshaft Gear, using Tool J-6175

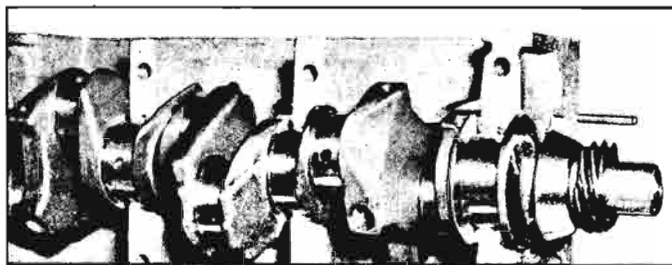


Fig. 6A-91—Crankshaft Installed

2. If crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and crankcase bearing bores are clean. Foreign material under the inserts may distort the bearings and cause a failure.
3. Place one half of crankcase on a block of wood (preferably the left side) and install bearing insert and lubricate with a light coat of engine oil.
4. Install bearing insert in other half (right side) of crankcase.
5. Install crankshaft assembly in the crankcase (left side), being careful not to damage bearings and lubricate with engine oil (fig. 6A-91).

Camshaft

The camshaft bearing journals (fig. 6A-93) are 1.2005"—1.1995" in diameter for the front intermediate, rear intermediate and rear journal. The front journal is 1.4405"—1.4395" in diameter.

NOTE: Each exhaust cam lobe serves two exhaust lifters, one on each bank.

6. Check the journals with a micrometer for an out-of-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.
7. Check camshaft alignment. The best method is by use of "V" blocks and a dial indicator. The dial

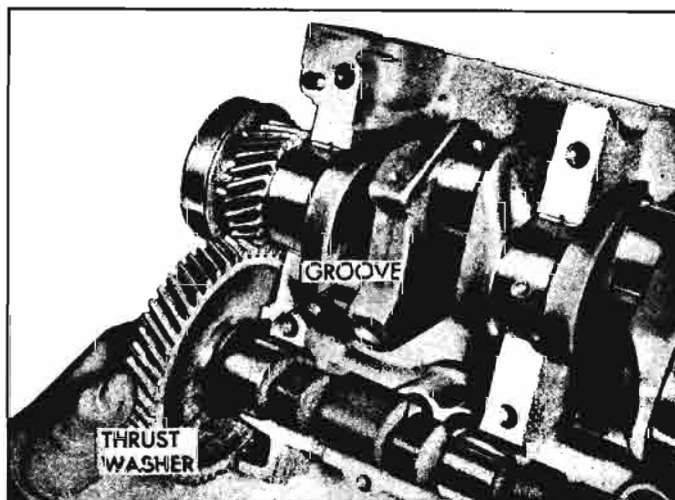


Fig. 6A-92—Installing Camshaft in Crankcase

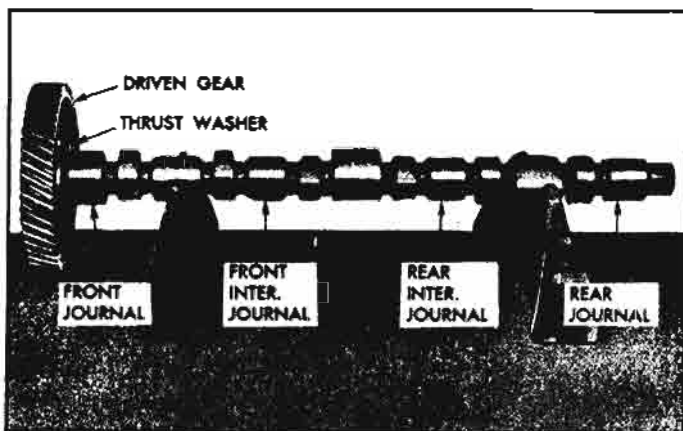


Fig. 6A-93—Camshaft Assembly

indicator will indicate the exact amount the camshaft is out of true. If it is out more than .002" dial indicator reading, the camshaft should be replaced.

NOTE: Camshaft journal clearance should be .0015" to .0035" (new) and .002" to .004" (used). If camshaft clearance is beyond these limits either the crankcase or camshaft should be replaced.

8. To assemble camshaft driven gear and thrust washer to camshaft, proceed as follows:
 - a. Firmly support shaft at back of the front journal in an arbor press.
 - b. Place thrust washer over end of shaft, and install woodruff key in shaft keyway.
 - c. Lubricate camshaft with hypoid lubricant.
 - d. Install camshaft driven gear on camshaft and press into place, using Tool J-971 supporting gear until it bottoms against the thrust washer.

Timing Gear Marks

9. Install camshaft assembly guiding camshaft thrust washer into groove in crankcase (fig. 6A-92) while indexing camshaft driven gear to crankshaft gear, so that valve timing marks line up as shown in Figure 6A-94. Lubricate camshaft bearings and drive gear.
10. Install other half of crankcase and main bearing assembly onto crankshaft and camshaft as shown in Figure 6A-51. Seal crankcase parting line ends with sealer. Install all crankcase bolts, flat washers and nuts. Torque the eight long bolts $\frac{1}{8}$ "-20, 42 to 48 ft. lbs. and one small bolt $\frac{3}{16}$ "-18, 7 to 13 ft. lbs. Figure 6A-82 shows crankcase tightening sequence.

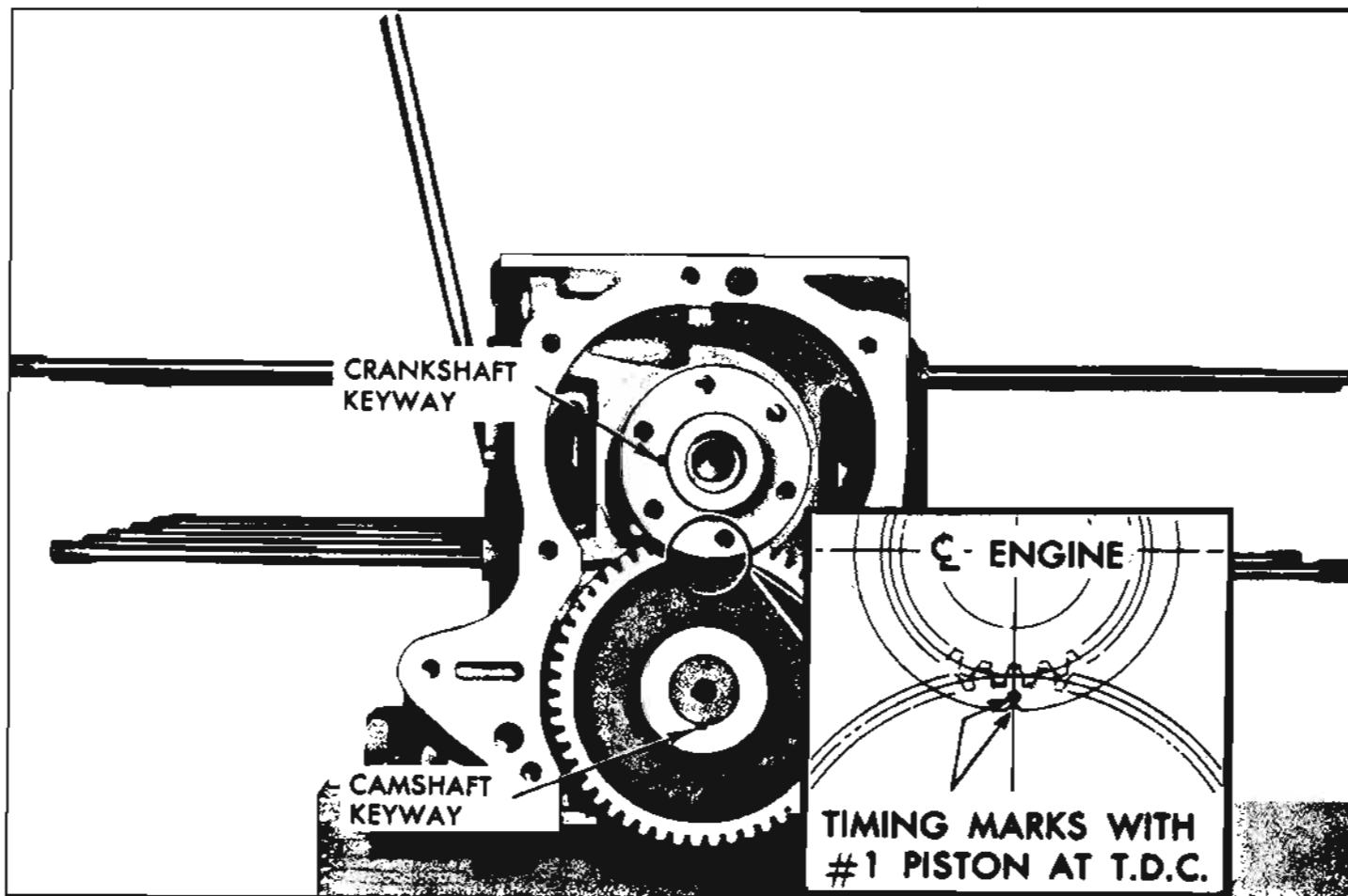


Fig. 6A-94—Timing Marks

Camshaft End Play

11. Install a dial indicator so that indicator point touches the end of the camshaft as shown in Figure 6A-95. Zero dial indicator and push camshaft one direction then the other. Dial indicator reading should be .002" to .007".
12. If the end play is excessive, check the thrust washer and/or crankcase groove for wear. Replace timing gears in matched set and/or thrust washer.

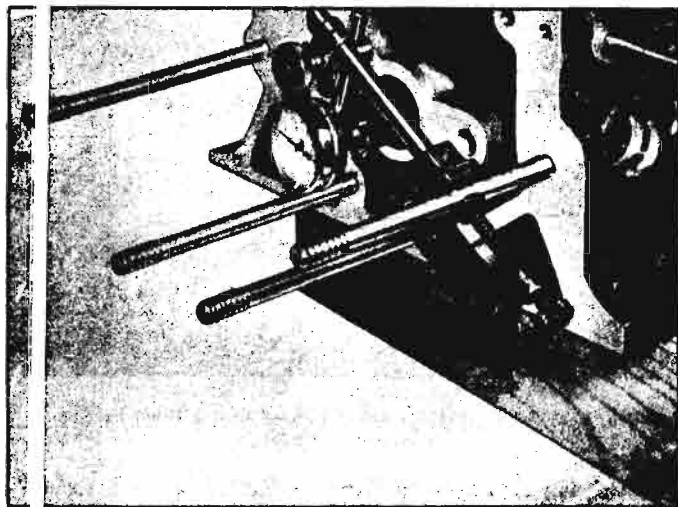


Fig. 6A-95—Checking Camshaft End Play

Timing Gear Backlash

13. Check timing gear backlash by installing a dial indicator as shown in Figure 6A-96. Backlash should be .002" to .004".
14. Install main oil gallery plugs, with "Permatex Anti-seize Compound" #404 or its equivalent.

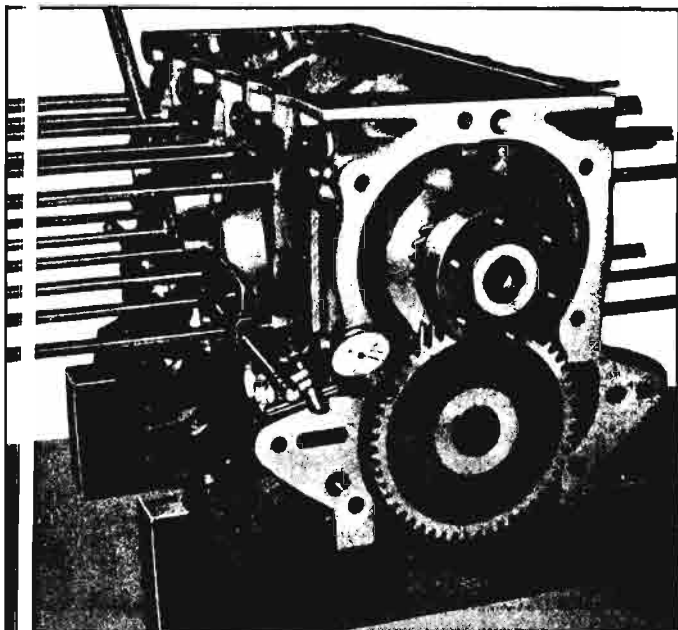


Fig. 6A-96—Timing Gear Backlash

Flywheel and Clutch Housing

15. Install a new gasket between the flywheel or clutch housing and crankcase. Install flywheel or clutch housing with bolts and flat washers and torque bolts 20-30 ft. lbs.

NOTE: Total indicator runout for flywheel or clutch housing pilot is .015".

Flywheel

16. Install flywheel or flex plate on crankshaft flange with sealer between flywheel and crankshaft. Install spacer and bolts with sealer on bolt threads. Torque bolts 20 to 26 ft. lbs.

NOTE: Flywheel face runout installed and torqued on crankshaft is .020" T.I.R. Flywheel O.D., T.I.R. .010".

17. Mount engine crankcase and flywheel or clutch housing assembly, to engine stand Tool J-5856 and adapter Tool J-8280 as shown in Figure 6A-36.

Piston, Cylinders and Connecting Rods

18. Apply a light coat of engine oil to the piston rings. Install piston rings by expanding them with available Tool J-8014. Position oil ring gap towards the top of engine and compression ring gap 45° from the oil ring gap location.

NOTE: Piston rings must be installed with markings and inside bevel away from top of piston.

19. Install piston ring compressor Tool J-8037 over the piston and rings. Tighten snugly and insert piston and connecting rod assembly into the respective cylinder bore. (Corresponding number).
20. Push piston assembly in with a hammer handle, while holding cylinder bore in one hand until it is slightly below the top of the cylinder bore (fig. 6A-97).

NOTE: Notch on piston top must be installed, towards the front of engine (flywheel end) on both banks.

21. With piston assemblies in the cylinder bores, place connecting rod bearing inserts in place on connecting rods and caps.
22. Position crankcase pins, by turning crankshaft with crankshaft pulley, so that crankshaft journal is in line with piston and rod to be installed.
23. Place a piece of plastic hose with at least a 5/16" I.D. over each connecting rod bolt (this will protect the bearing surface on the crankshaft journal).
24. Install a new (copper) cylinder gasket over cylinder pilot (fig. 6A-98). Push piston assembly with a hammer handle, while guiding cylinder bore pilot into crankcase. Remove plastic hose sections from connecting rod bolts. Install connecting rod, bearing, cap and nuts. Torque connecting rod nuts 20 to 26 ft. lbs. Install cylinder holding fixture tubes (used previously on engine disassembly), one long and one short of cylinder studs to hold

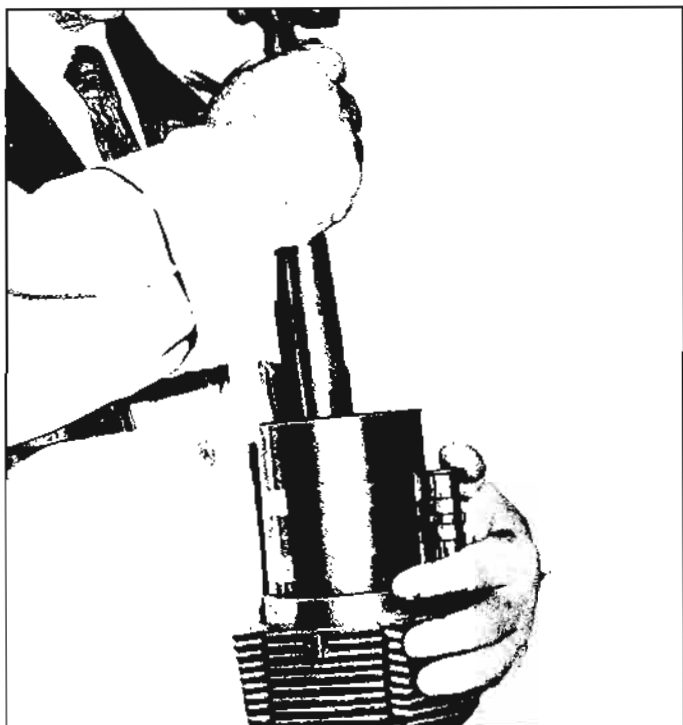


Fig. 6A-97—Installing Piston Assembly, Using Tool J-8037

cylinder in place. Continue procedure until all cylinders and pistons are installed. Refer to Figures 6A-42 and 6A-98.

25. After all piston and connecting rod assemblies have been installed, check the side clearance between the connecting rod on each crankshaft journal. This clearance should be .005" to .010" (fig. 6A-87).
26. Install cylinder air baffles with retaining springs (fig. 6A-98).

NOTE: Air baffles are not interchangeable. Right side air baffle has a hole for crankcase vent tube.

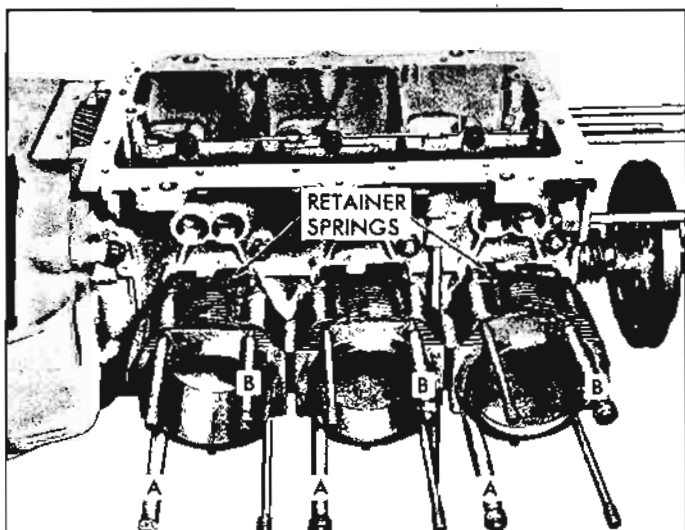


Fig. 6A-98—Installing Cylinder, Piston and Rod

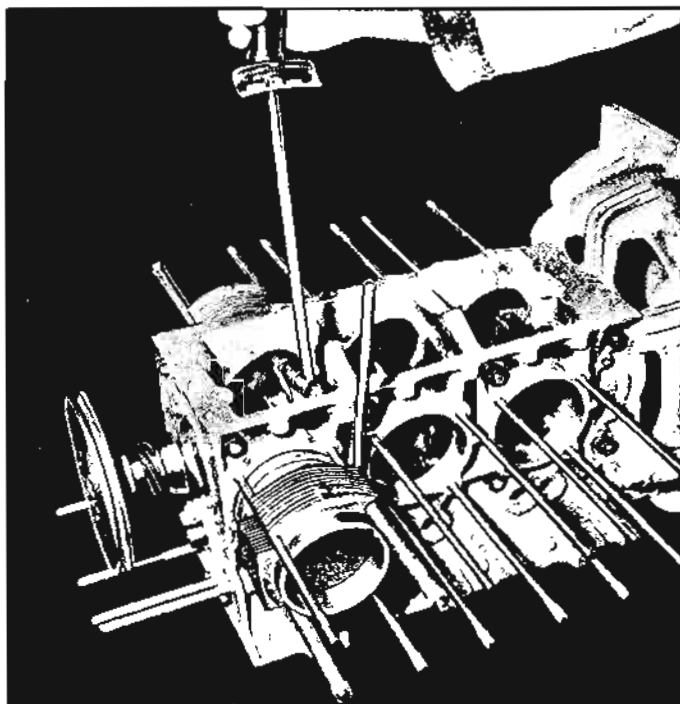


Fig. 6A-99—Torquing Connecting Rods—Showing Tubes Holding Opposite Cylinder

Crankcase Cover and Blower Bearing

27. Install a new crankcase cover gasket on crankcase. Install crankcase vent and another crankcase gasket. Install crankcase cover and blower bearing assembly in place and install washers and bolts using anti-seize compound and torque bolts 7 to 13 ft. lbs. Install crankcase vent tube and gasket.

Oil Pump Screen and Tube

28. Invert the engine assembly on the work stand.

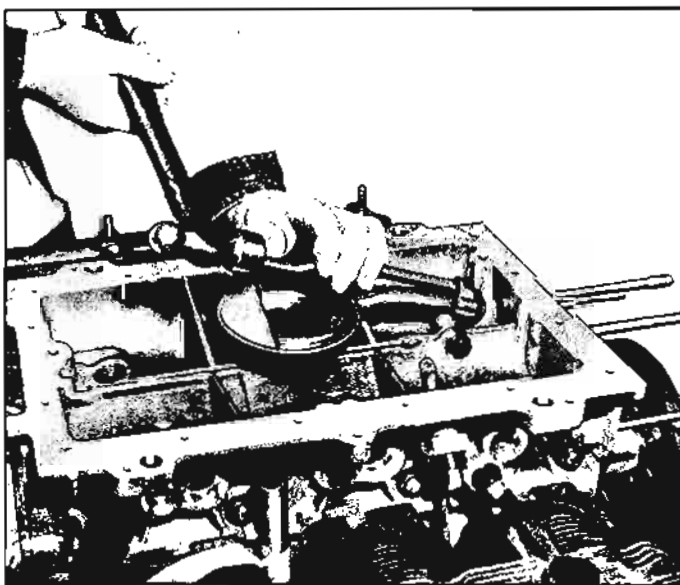


Fig. 6A-100—Installing Oil Pump, Screen and Pickup Tube, Using Tool J-8369

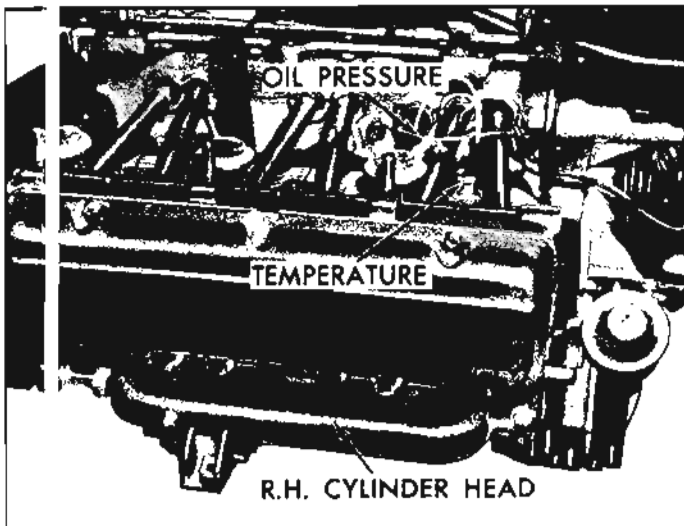


Fig. 6A-101—Oil and Temperature Sending Unit Location

NOTE: If the original or a new oil pump screen and tube assembly is to be installed in the original crankcase, the outside diameter of the end of the tube will have to be tinned with solder before installing in the crankcase.

Install oil pump, screen and pickup tube assembly, using Tool J-8369 into the cylinder case with the pickup screen positioned parallel to the oil pan rails as shown in Figure 6A-100. Install pickup tube retaining clamp to tube and crankcase as shown in Figure 6A-109.

29. Coat threads on engine temperature and oil pressure sending units, with anti-seize compound such as Permatex #404D or its equivalent. Install oil temperature sending unit in cylinder head (fig. 6A-101) and torque 10 to 15 ft. lbs.

Install oil pressure sending unit and torque 45 to 65 in. lbs.

Cylinder Head

30. Position engine with cylinders up in a vertical position so that cylinder head may be lowered over the cylinder studs.

NOTE: Be sure all cylinder head gaskets are in the cylinder head combustion chamber as shown in Figure 6A-63. Remove all cylinder retaining tubes from cylinder bank to which cylinder head is to be installed.

Install cylinder head over studs and carefully lower in place (fig. 6A-102).

Push Rod Oil Drain Tube

31. Lightly oil hydraulic lifters and install in their proper bores. Install push rod oil drain tubes through cylinder head. Place "O" rings, one on each end of drain tube as shown in Figure 6A-105. Oil "O" rings with motor oil and push into place, at lifter bore in crankcase and cylinder head.

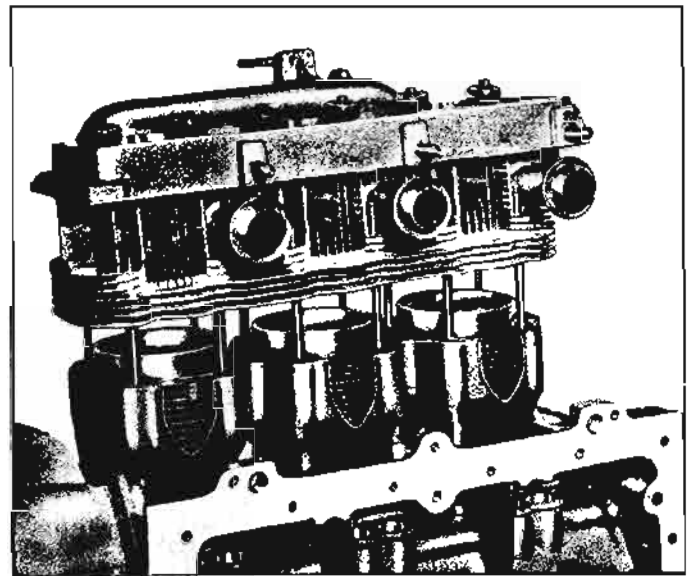


Fig. 6A-102—Installation of Cylinder Head

NOTE: Long end of push rod oil drain tube must be installed up towards cylinder head.

32. Install six flat washers and nuts on long studs, adjacent to the intake manifold. Install six new "O" rings lubricated with lubriplate in counterbore of cylinder head (location for valve rocker studs)

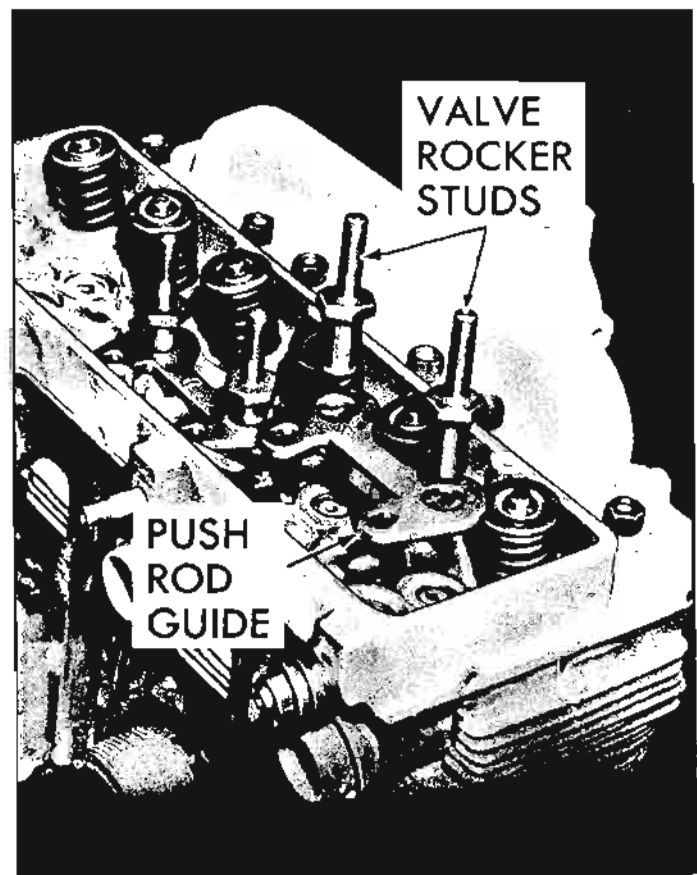


Fig. 6A-103—Installation of Valve Rocker Studs

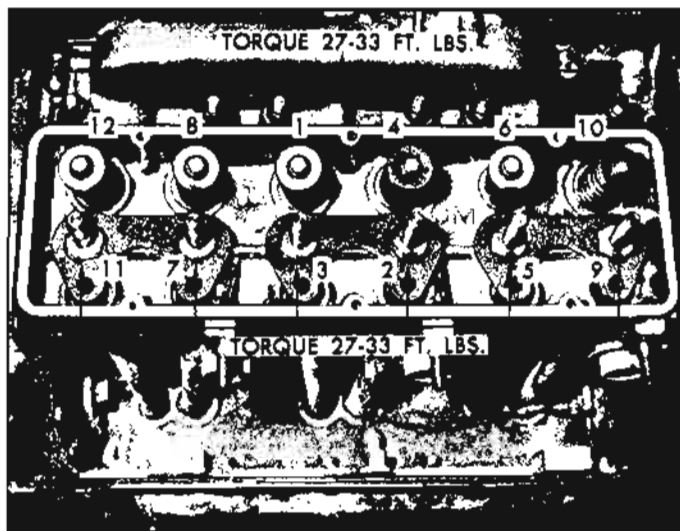


Fig. 6A-104—Cylinder Head Tightening Sequence

and coat rocker stud bore with anti-seize compound. Install push rod guides and valve rocker studs, with the threads coated with anti-seize compound as shown in Figure 6A-103.

33. Tighten the nuts and valve rocker studs in the sequence shown in Figure 6A-104. Two sizes of sockets will be required when tightening cylinder head, a $\frac{1}{4}$ " deep socket for the valve rocker studs and a $\frac{9}{16}$ " socket on the cylinder head nuts. Torque nuts 27 to 33 ft. lbs. and valve rocker studs 27 to 33 ft. lbs.
34. Install push rods with the side oil hole up into the valve rocker arm socket as shown in Figure 6A-106. A $\frac{1}{2}$ " band of blue ink for identification is marked on the push rod at the .050" side oil hole end of the push rod.

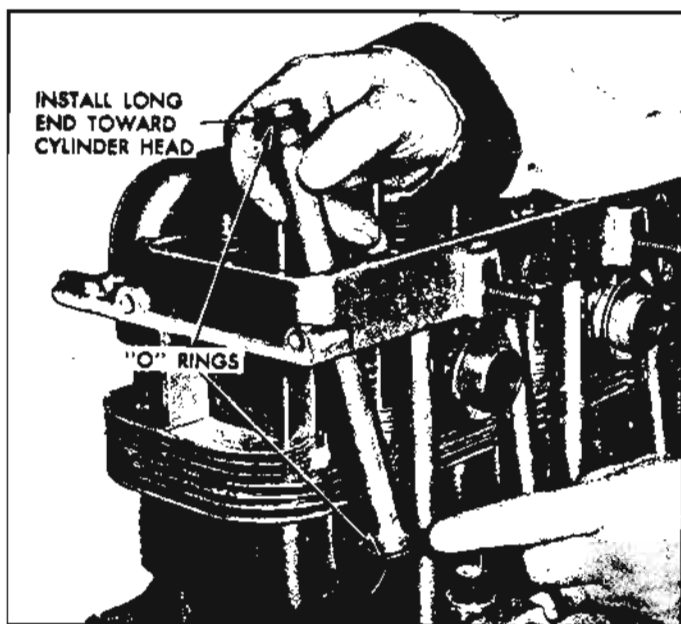


Fig. 6A-105—Installation of Push Rod Drain Tubes

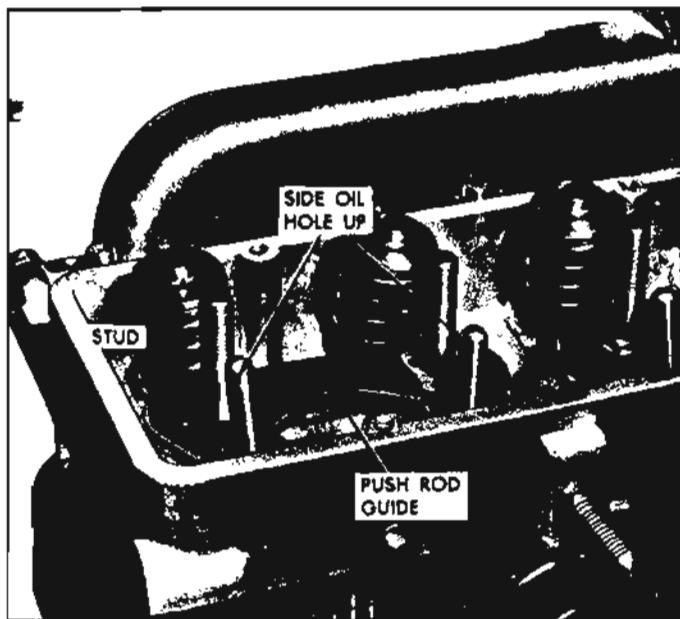


Fig. 6A-106—Push Rod Installation

NOTE: Push rod guides are installed under the valve rocker studs (fig. 6A-103).

35. Install valve rocker arms, balls and nuts loosely in place. Install remaining cylinder head and valve rocker arms, balls and nuts.

Engine Rear Housing

36. Install a new engine rear housing gasket and position engine rear housing in place. Coat bolt threads with anti-seize compound such as "Permatex" #404 or its equivalent. Install flat washers and bolts and torque bolts 7 to 13 ft. lbs.

Crankshaft Pulley

37. Block crankshaft from rotating with a wooden wedge. Coat crankshaft pulley seal surface with oil. Place crankshaft pulley on crankshaft and insert heavy flat washer and retaining bolt. Draw crankshaft pulley into place on crankshaft, by turning retaining bolt until crankshaft pulley bottoms in place. Back crankshaft pulley retaining bolt off one turn and torque 40 to 50 ft. lbs. Remove wooden wedge from crankshaft.

NOTE: Do not drive crankshaft pulley on crankshaft, this will damage crankshaft thrust bearing and crankcase.

Oil Cooler

38. Install a new oil cooler adapter gasket and oil cooler adapter with bolts and flat washers, using anti-seize compound on bolt threads. Torque oil cooler adapter bolts 7 to 13 ft. lbs. Install engine left rear shroud in place. Install new oil cooler seals in oil cooler adapter (fig. 6A-107).
39. Install oil cooler retaining bolt and flat washer using anti-seize compound on threads and torque 8 to 12 ft. lbs.

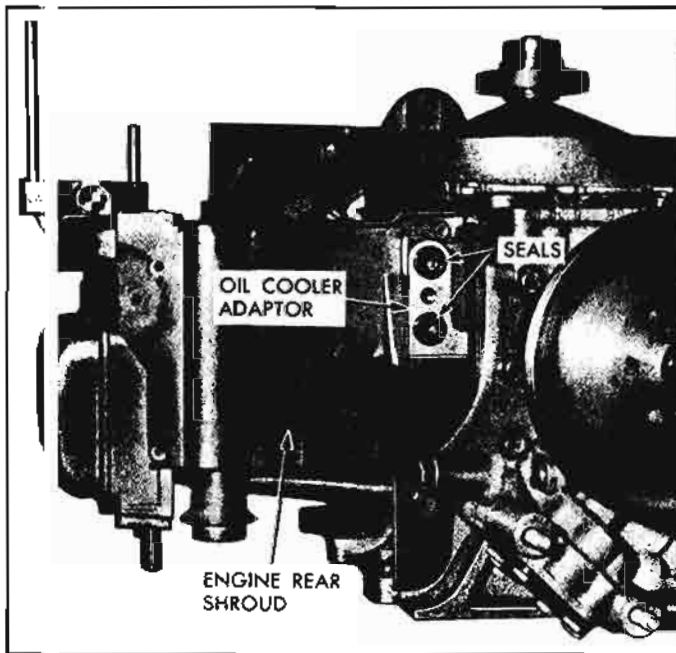


Fig. 6A-107—Installation of Oil Cooler Adapter and Seals

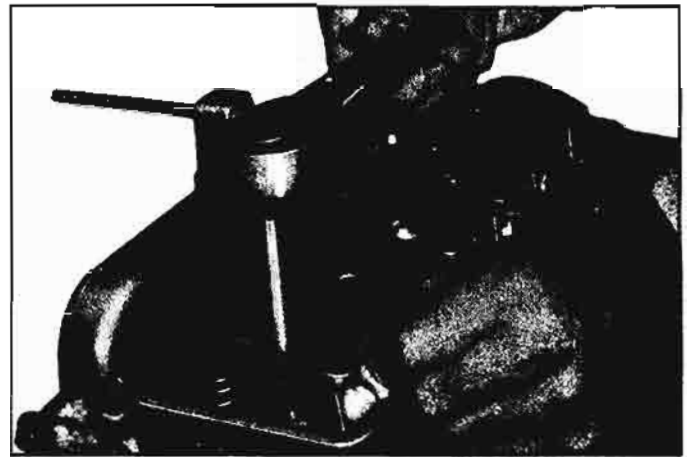


Fig. 6A-108—Adjusting Valve Lash

Exhaust Manifolds

40. Install new exhaust manifold gaskets.

NOTE: The steel flange on small steel type exhaust manifold gaskets must be installed next to exhaust port tubes.

CAUTION: Exhaust port tubes are a press fit in the cylinder head and the exhaust manifold. They must fit correctly to prevent exhaust manifold leaks.

Install clamps, french locks and nuts as shown in Figure 6A-38. Torque nuts 23 to 27 ft. lbs. and bend tab on french lock to lock nut in place.

Valve Lash Adjustment

41. Refer to Section 8, "Electrical System" for distributor, cylinder firing positions. Install distributor on engine rear housing with hold down clamp and nut. Turn crankshaft counter clockwise to set engine distributor firing No. 1 cylinder and crankshaft pulley notch at 0° on timing pad. Lash valves No. 1 Intake, No. 1 Exhaust, No. 3 Intake and No. 5 Exhaust on the right bank and No. 4 Exhaust and No. 6 Intake on the left bank.

Valves are to be lashed in the following manner: Turn down rocker arm adjusting nut using a 5/8" deep socket and ratchet wrench, until there is no axial movement of the push rod, felt with the fingers as shown in Figure 6A-108, then turn adjusting nut a 3/4 turn more on Turbo-Air engines and 1 1/4 turn more on Super Turbo-Air (R.P.O. 649) engine.

Turn crankshaft counter clockwise and set engine distributor firing on No. 2 cylinder and crank-

shaft pulley notch at 0° on timing pad. Lash valves No. 3 Exhaust and No. 5 Intake on the right bank and No. 2 Intake, No. 2 Exhaust, No. 4 Intake and No. 6 Exhaust on the Left Bank.

42. Install new gaskets in valve covers and carefully attach valve cover and gasket to the cylinder heads, torque valve cover screws 30-50 in. lbs.

Oil Filter and Generator Adapter

43. Install a new oil filter and generator adapter gasket on the engine rear housing. Install oil filter and generator adapter on the engine rear housing. Install all bolts and flat washers using anti-seize compound and torque bolts 7 to 13 ft. lbs. Install a new oil filter cartridge and torque oil filter bolt 9 to 15 ft. lbs. Install engine rear right shroud.
44. Install engine skid plate and rear mounting bracket with retaining nuts. Torque nuts 20 to 30 ft. lbs. Install lifting adapter (fig. 6A-34) and mount to rear engine mount.
45. Install blower and blower pulley to crankcase cover blower bearing hub assembly.
46. Install front shrouds (figures 6A-15 and 16). Install left and right side shields (fig. 6A-11).
47. Install upper shroud assembly (fig. 6A-12). Turn blower and check clearance while tightening upper shroud retaining screws.
48. Install fuel lines and oil level gauge. Install lower engine shroud and exhaust ducts.
49. Install idler bracket and pulley assembly in place on oil filter and generator adapter, with adjusting slot towards the flywheel end of engine, shown in Figure 6A-35.
50. Install coil bracket, coil and generator brace on cylinder head. Install generator and torque bolts as outlined in Section 8. Install blower belt and adjust as outlined in Section 7.

NOTE: Sequence of tightening mounting, is to prevent misalignment of brackets to generator and frames.

Spark Plugs

51. Install spark plugs and gaskets and torque 20 to 25 ft. lbs. Install wire harness to spark plugs and distributor. Install coil and wires. Install carburetors.

NOTE: Spark plugs are long reach plugs especially designed for aluminum threads. Substitutes should not be used.

52. Invert engine on stand and install oil pan with a new gasket. Check parting line to see if flywheel housing gasket is far enough up for good sealing (fig. 6A-109). Torque oil pan bolts 40 to 60 ft. lbs.
53. Attach a chain and shackle from Tool J-4536-A (lifting kit) to lifting adapter (fig. 6A-34) and at the flywheel housing lifting eye. Remove bolts at flywheel housing adapter Tool J-8280.

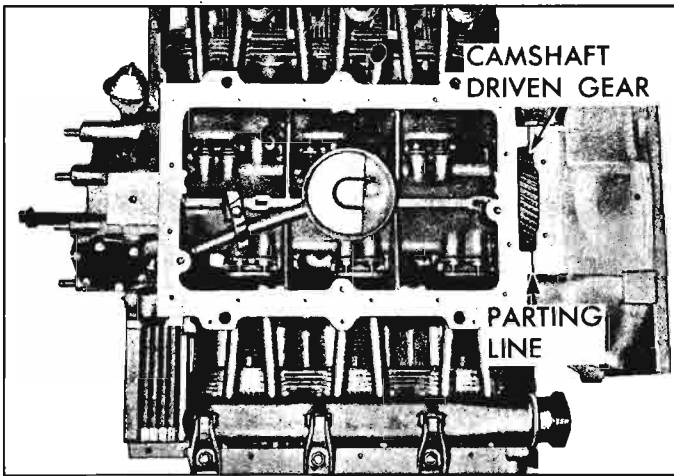


Fig. 6A-109—Oil Pan Rails

54. Lift engine with chain sling off of engine stand Tool J-5856 and onto Tool J-7894 mounted on a lifting jack. Remove chain and adapter from rear mounting bracket.

Fuel Pump

55. Install fuel pump push rod return spring (large diameter down) into oil filter and generator adapter. Install fuel pump push rod well lubricated with oil in adapter and install fuel pump with a new "O" ring seal. Turn set screw finding hole in fuel pump and tighten 9 to 15 ft. lbs. Tighten locknut 9 to 15 ft. lbs. torque (fig. 6A-35).
56. Connect fuel lines to carburetors and fuel pump. Install engine front shield and support strap (fig. 6A-11), connect vacuum balance tube to both carburetors.
57. Install carburetor cross-shaft and choke cables. Install carburetor air cleaner.
58. Refer to "Cooling System Exhaust Adjustment," in this section for cooling air damper valve and thermostat adjustment. Refer to Section 9 for accelerator and throttle linkage adjustment.

Engine Oil

59. Add oil before or after installation of engine to vehicle. Add 5½ quarts of oil to a dry engine (overhauled engine) and 4 quarts to a wet engine (oil change). Refer to Section 2, for lubrication specifications.
60. Refer to Section 6 for assembly of transmission and axle differential and installation of "Power Train," in the vehicle.

CORVAIR 95 and GREENBRIER—1200 SERIES

CORVAIR STATION WAGON—MODELS 535 and 735

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GENERAL DESCRIPTION

The Turbo-Air horizontal opposed air cooled six cylinder engine for Corvaire 95 and Greenbrier—1200 Series and Station Wagon 535 and 735 Models is the same basic light weight engine used for Corvaire Sedan and Coupes. The engine is located and mounted in the rear underbody (fig. 6A-110). The Corvaire 95 and Greenbrier Series incorporates an engine access

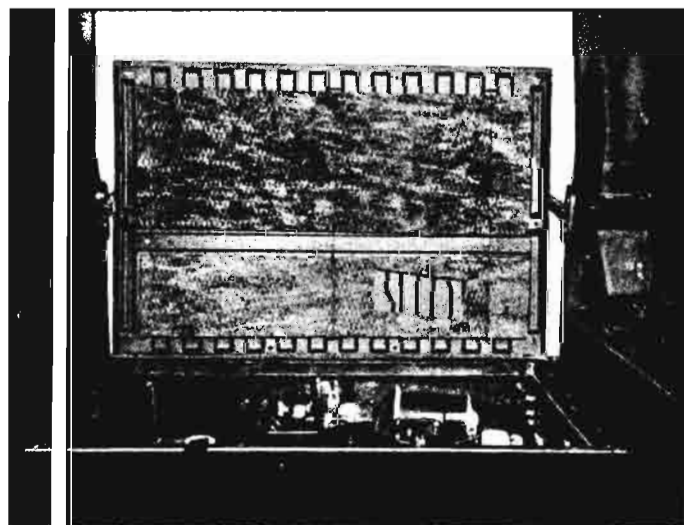


Fig. 6A-110—Engine Location

panel for complete engine accessibility. Carried on the under-surface of the panel is a $\frac{5}{8}$ inch thick sound deadening and heat insulating blanket of fiber glass. It is retained by spring-loaded screw type fasteners. The Lakewood Station Wagon Models 535 and 735 incorporate a hinged engine access panel. An optional Super Turbo-Fire (R.P.O. 649) engine is available for the Lakewood Station Wagon Models.

An engine access door (fig. 6A-111) affords access to the engine oil filler tube and other components, such as the distributor, coil, generator and oil filter. The door is hinged at the bottom with a rolled hinge. Retention of the door is through a slam-type lock which is opened with a lift handle.

The Service Information and Procedures are the same for Corvaire Station Wagon Models 535 and 735, Corvaire 95 and Greenbrier—1200 Series, except for "Service Operations," outlined below.



Fig. 6A-111—Engine Access Door

SERVICE OPERATIONS

OIL FILLER TUBE

Removal and Installation

1. Drain crankcase.
2. Remove engine access panel (fig. 6A-110) on Greenbrier and Corvaire 95 Models. Open tail gate and remove four retaining screws on Lakewood

Station Wagon Models, raise engine access panel.

3. Remove retaining bolt at oil filler tube flange attached to the right side exhaust duct (fig. 6A-112).
4. Remove oil filler tube from crankcase.

NOTE: To be sure of a tight seal at oil filler

tube, always use a new "O" ring when installing oil filler tube.

5. Check oil filler tube mounting hole in crankcase for burrs or nicks and remove before inserting oil filler tube.
6. Install a new, well lubricated "O" ring on oil filler tube. Install oil filler tube in place and secure with attaching bolt to right side exhaust duct.
7. Replace engine access panel.
8. Fill crankcase, start engine and check for leaks.

LOWER SHROUD AND EXHAUST DUCT (Right Side)

Removal and Installation

1. Remove or raise engine access panel. Open engine access door and remove oil filler tube.
2. Remove all attaching screws from the lower shroud and exhaust duct at the cylinder head, side shield and shrouds.

3. Remove the lower shroud and exhaust duct as a unit.
4. Check exhaust manifold gaskets for wear, then install lower shroud and exhaust duct.
5. Install oil filler tube and oil level gauge.
6. Fasten engine access panel in place.
7. Fill crankcase with oil, start engine and check for leaks.

ENGINE CRANKCASE

The only difference in the crankcase for Corvair 95, Lakewood and Greenbrier engines is the oil filler tube boss located on the lower right hand side.

MAIN BEARINGS AND CONNECTING ROD BEARINGS

Main and connecting rod bearings use the same diameter and specifications as used in the Corvair 500, 700 and 900 series engines; however, the bearing material is a heavy duty type.

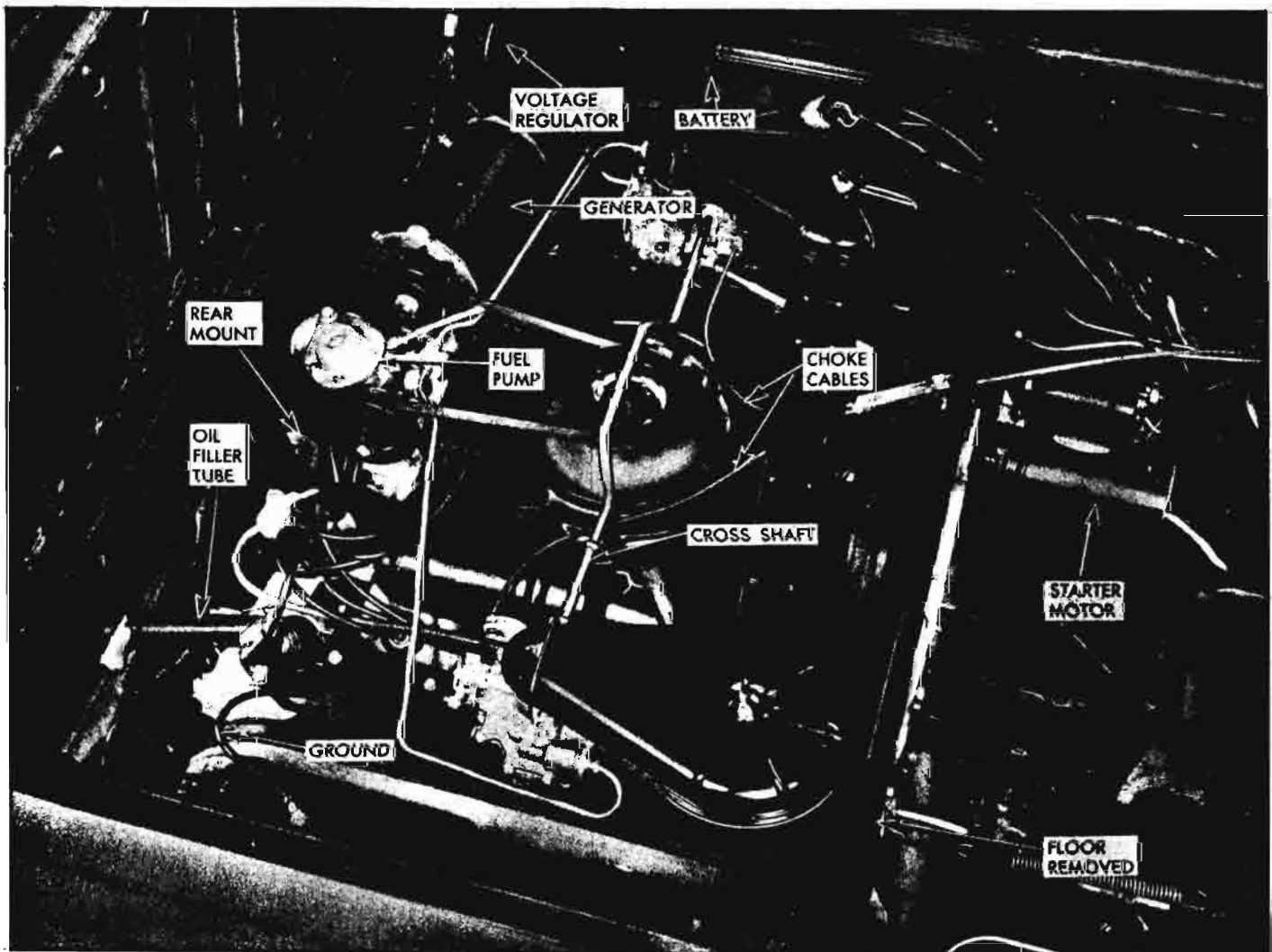


Fig. 6A-112—Corvair 95 and Greenbrier—1200 Series
Engine Installation

REAR MOUNT

Refer to Figure 6A-113.

Removal and Installation

1. Position hydraulic jack with Tool J-7894 under engine as outlined in Section 6.
2. Remove engine rear center shield (21).
3. Remove cotter pin and castellated nut from engine rear mount.
4. Lower engine, to release weight from engine rear mount.
5. Remove bolt, upper retainer, sleeve, mounting and lower retainer at top of body bracket.
6. Remove rebound pad and lower rebound retainer.
7. Install rear lower mounting rebound retainer and rebound pad.
8. Raise engine to body mounting bracket and install lower retainer, mounting, sleeve, upper retainer and bolt on top of body mounting bracket.
9. Install mount retaining washer and castellated nut and torque 50-60 ft. lbs. and install cotter pin.
10. Install engine rear center shield.

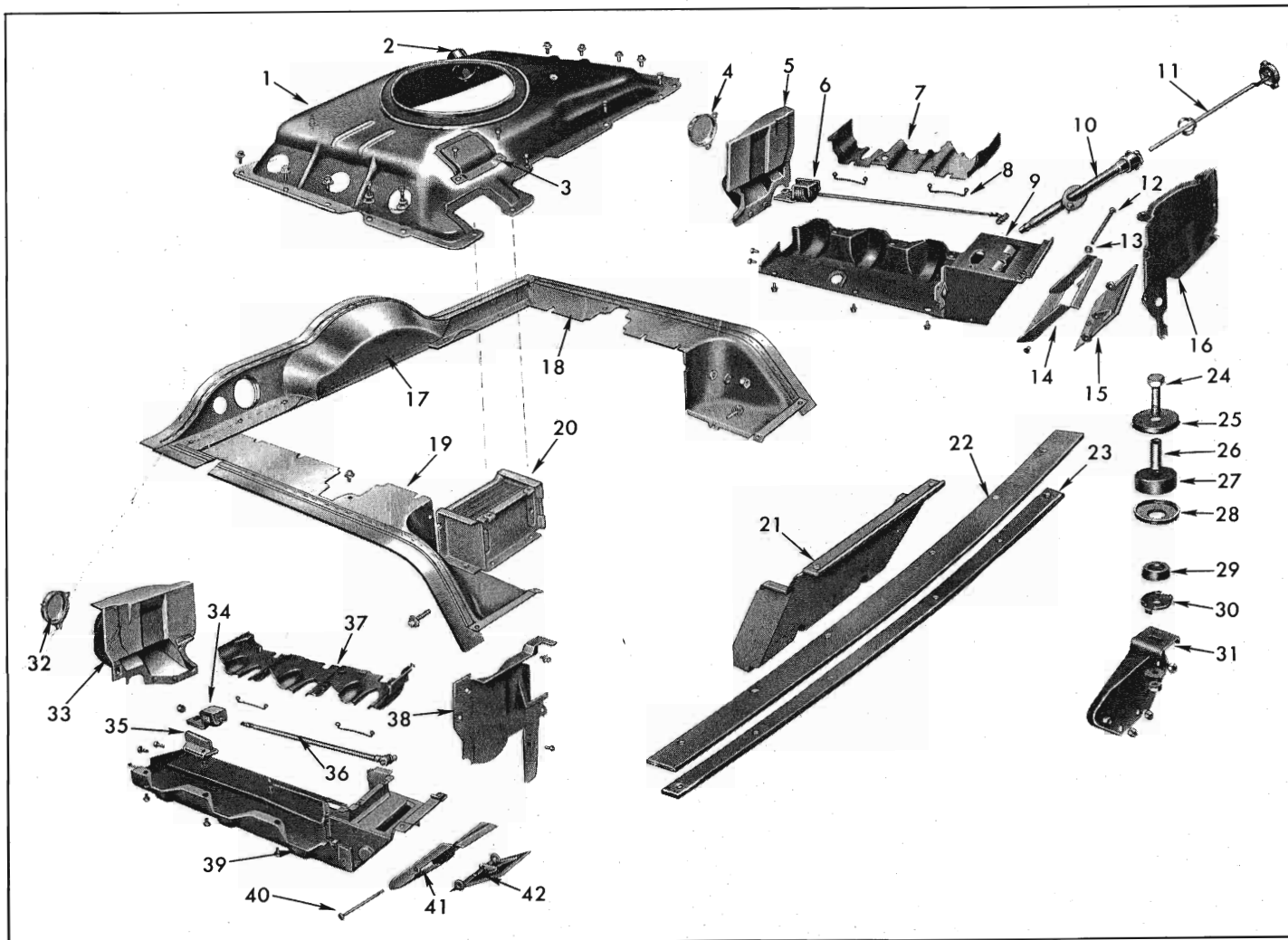


Fig. 6A-113—Engine Sheet Metal Components

- | | | | |
|---|--------------------------------|--|--|
| 1. Engine Upper Shroud | 11. Oil Level Gauge | 22. Engine Rear Seal | 33. Engine Front Shroud (L. H.) |
| 2. Heater Connection | 12. Exhaust Duct Door Shaft | 23. Engine Rear Seal Retainer | 34. Thermostat and Bracket |
| 3. Oil Cooler Access Hole Cover | 13. Flat Washer | 24. Rear Mount Bolt | 35. Thermostat Heat Shield |
| 4. Engine Front Shroud Cover | 14. Exhaust Duct Opening | 25. Rear Mount Upper Retainer | 36. Actuating Rod |
| 5. Engine Front Shroud Assembly (R. H.) | 15. Exhaust Duct Damper Door | 26. Sleeve | 37. Engine Cylinder Air Baffle (L. H.) |
| 6. Thermostat, Bracket and Actuating Rod | 16. Engine Rear Shroud | 27. Mounting | 38. Engine Rear Shroud (L. H.) |
| 7. Engine Cylinder Air Baffle (R. H.) | 17. Engine Front Shield | 28. Lower Retainer | 39. Engine Lower Shroud and Exhaust Duct (L. H.) |
| 8. Engine Cylinder Air Baffle Retainer | 18. Engine Side Shield (R. H.) | 29. Rebound Pad | 40. Exhaust Duct Door Shaft |
| 9. Engine Lower Shroud and Exhaust Duct (R. H.) | 19. Engine Side Shield (L. H.) | 30. Rear Lower Mounting (Rebound Retainer) | 41. Exhaust Duct Opening |
| 10. Oil Filler Tube | 20. Oil Cooler | 31. Engine Rear Mounting Bracket | 42. Exhaust Duct Damper Door |
| | 21. Engine Rear Center Shield | 32. Engine Front Shroud Cover | |

TROUBLES AND REMEDIES

Symptom and Probable Cause

Probable Remedy

Lack of Power

1. Poor Compression

- a. Incorrect valve lash
- b. Leaky valves
- c. Valve stems or lifters sticking
- d. Valve springs weak or broken
- e. Valve timing incorrect
- f. Leaking cylinder head gasket
- g. Piston ring broken
- h. Poor fits between pistons, rings and cylinders

- a. Adjust valve lash according to instructions under "Valve Lash Adjustment"
- b. Remove cylinder head and grind valves
- c. Free up or replace
- d. Replace springs
- e. Correct valve timing
- f. Replace gaskets
- g. Replace rings
- h. Overhaul engine

2. Ignition System Improperly Adjusted

- a. Ignition not properly timed
- b. Spark plugs faulty
- c. Distributor points not set correctly

- a. Set ignition according to instructions under "Engine Tune-Up"
- b. Replace or clean, adjust and test spark plugs
- c. Set distributor points and time engine

3. Lack of Fuel

- a. Dirt or water in carburetor
- b. Gas lines partly plugged
- c. Dirt in gas tank
- d. Air leaks in gas line
- e. Fuel pump not functioning properly

- a. Clean carburetor and fuel pump
- b. Clean gas lines
- c. Clean gas tank
- d. Tighten and check gas lines
- e. Replace or repair fuel pump

4. Carburetor Air Inlet Restricted

- a. Air cleaner dirty
- b. Carburetor choke partly closed
- c. Improperly installed and/or torn side and front shields, seals

- a. Clean air cleaner or replace element
- b. Adjust or replace choke mechanism
- c. Adjust or replace

5. Overheating

- a. Oil cooler dirty
- b. Blower belt loose
- c. Blower belt worn or oil soaked
- d. Thermostat sticking closed
- e. Incorrect cooling air exhaust damper valve opening
- f. Engine cooling fins plugged
- g. Incorrect ignition or valve timing
- h. Brakes dragging
- i. Improper grade and viscosity oil being used
- j. Fuel mixture too lean
- k. Valves improperly adjusted
- l. Defective ignition system
- m. Exhaust system partly restricted
- n. Loose shield seals
- p. Spark plug boots loose
- r. Sheet metal loose

- a. Clean oil cooler
- b. Adjust or replace
- c. Replace belt
- d. Replace thermostat
- e. Adjust thermostat
- f. Clean engine
- g. Retime engine
- h. Adjust brakes
- i. Change to correct oil
- j. Overhaul or adjust carburetor
- k. Adjust valves
- l. See "Engine Tune-Up"
- m. Clean or replace
- n. Tighten or replace
- p. Install properly
- r. Tighten

Symptom and Probable Cause**Probable Remedy****6. Overcooling**

- a. Thermostat holding wide open

- a. Replace or adjust thermostat

Excessive Oil Consumption**1. Leaking Oil**

- a. Oil pan drain plug loose
- b. Oil pan retainer bolts loose
- c. Oil pan gaskets damaged
- d. Rear housing loose or gasket damaged
- e. Rocker arm cover gaskets damaged or loose
- f. Fuel pump loose or seal damaged
- g. Crankshaft seal leaking oil into clutch housing or flywheel housing
- h. Oil drain slots in crankcase cover vent closed

- a. Tighten drain plug
- b. Tighten oil pan bolts
- c. Replace pan gaskets
- d. Tighten housing bolts or replace gasket
- e. Tighten covers or replace gaskets
- f. Tighten fuel pump or replace "O" ring seal
- g. Replace oil seal
- h. Remove crankcase cover and clean slots

2. Burning Oil

- a. Broken piston rings
- b. Rings not correctly seated to cylinder walls
- c. Piston rings worn excessively or stuck in ring grooves
- d. Piston ring oil return holes clogged with carbon
- e. Excessive clearance between piston and cylinder wall due to wear or improper fitting
- f. Cylinder walls scored, excessive tapered or out-of-round

- a. Replace rings
- b. Give sufficient time for rings to seat. Replace if necessary
- c. Replace rings
- d. Replace rings
- e. Replace piston and cylinder bore as a unit
- f. Replace cylinders and new pistons as a unit

Hard Starting**1. Slow Cranking**

- a. Heavy engine oil
- b. Partially discharged battery
- c. Faulty or undercapacity battery
- d. Poor battery connections
- e. Faulty starter switch
- f. Faulty starting motor or drive

- a. Change to lighter oil
- b. Charge battery
- c. Replace battery
- d. Clean and tighten or replace connections
- e. Replace switch
- f. Overhaul starting motor

2. Ignition Trouble

- a. Distributor points burned or corroded
- b. Points improperly adjusted
- c. Spark plugs improperly gapped
- d. Spark plug wires loose and corroded in distributor cap
- e. Loose connections in primary circuit
- f. Series resistance in condenser circuit
- g. Low capacity condenser
- h. Ballast resistor faulty or out of circuit

- a. Clean or replace points
- b. Readjust points to .016", adjust new points to .019"
- c. Set plug gap at .035"
- d. Clean wire and cap terminals
- e. Tighten all connections in primary circuit
- f. Clean all connections in condenser circuit
- g. Install proper condenser
- h. Inspect and correct

Symptom and Probable Cause

Probable Remedy

3. Engine Condition

- a. Valves holding open
- b. Valves burned
- c. Leaking exhaust manifold gasket
- d. Loose carburetor mounting
- e. Faulty pistons, rings or cylinders

- a. Adjust valves
- b. Grind valves
- c. Tighten manifold nuts or replace gasket
- d. Tighten carburetor
- e. See "Poor Compression"

4. Carburetion

- a. Choke not operating properly
- b. Throttle not set properly
- c. Carburetor dirty and passages restricted

- a. Adjust or repair choke mechanism
- b. Set throttle
- c. Overhaul carburetor

Popping, Spitting and Detonation**1. Ignition Trouble**

- a. Loose wiring connections
- b. Faulty wiring
- c. Faulty spark plugs
- d. Incorrect ignition timing, fuel 92 octane or better.
- e. Fuel below 92 octane rating

- a. Tighten all wire connections
- b. Replace faulty wiring
- c. Clean or replace and adjust plugs
- d. Adjust timing to 4° BTC—Synchronesh
13° BTC—Powerglide & Super Turbo-Air
- e. Retard timing towards 0 degrees

2. Carburetor

- a. Lean combustion mixture
- b. Dirt in carburetor
- c. Restricted gas supply to carburetor
- d. Leaking carburetor or intake manifold gaskets

- a. Clean and adjust carburetor
- b. Clean carburetor
- c. Clean gas lines and check for restrictions
- d. Tighten carburetor to manifold and manifold to head bolts or replace gaskets

3. Valves

- a. Valves adjusted too tight
- b. Valves sticking
- c. Exhaust valves thin and heads overheating
- d. Weak valve springs
- e. Valves timed early

- a. Adjust valve lash
- b. Lubricate and free up. Grind valves if necessary
- c. Replace valves
- d. Replace valve springs
- e. Retime

4. Cylinder Head

- a. Excessive carbon deposits in combustion chamber
- b. Partly restricted exhaust ports in cylinder head
- c. Cylinder head gaskets blown between cylinders

- a. Remove head and clean carbon
- b. Remove cylinder head and clean exhaust ports
- c. Replace cylinder head gaskets

5. Spark Plugs

- a. Spark plugs glazed
- b. Wrong heat range plug being used

- a. Clean or replace spark plugs
- b. Change to correct spark plugs

SPECIFICATIONS

Refer to Section 12 for "Engine Specifications."

SPECIAL TOOLS

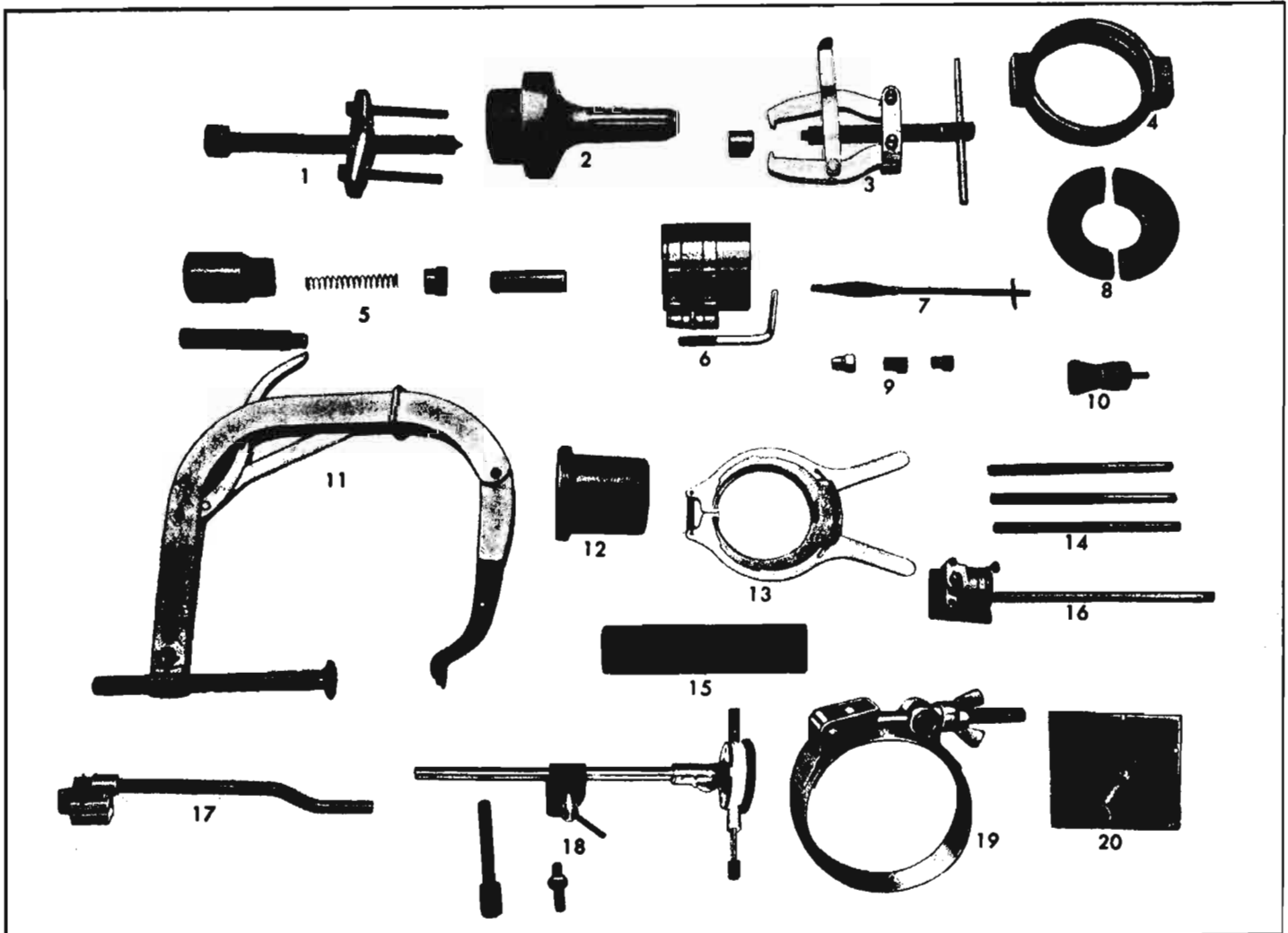


Fig. 6A-114—Engine Special Tools

- | | | | | | | | |
|-------------|--|-------------|-----------------------------|------------|--------------------------------------|------------|------------------------------|
| 1. J-8105 | Crankshaft Pulley Remover | 6. J-8037 | Piston Ring Compressor | 11. J-8062 | Valve Spring Compressor | 16. J-8087 | Cylinder Bore Checking Gauge |
| 2. J-6175 | Differential Side Bearing Installer | 7. J-8101 | Valve Guide Cleaner | 12. J-0971 | Camshaft Gear Remover and Installer | 17. J-8369 | Oil Suction Pipe Installer |
| 3. J-7112-2 | Adapter | 8. J-7028 | Rear Pinion Bearing Remover | 13. J-8014 | Piston Ring Expander | 18. J-8520 | Camshaft Lobe Indicator |
| 4. J-358-1 | Press Plate Holder | 9. J-8354-1 | $(\frac{3}{8}-24)$ | 14. J-5830 | Valve Bore Reamer Set | 19. J-8356 | Ring Compressor |
| 5. J-8355-4 | Piston Pin Assembly Adapter, used with Tool J-6994 | J-8354-2 | $(\frac{5}{8}-24)$ | 15. J-5590 | Transmission Front Bearing Installer | 20. J-8280 | Engine Stand Adapter |
| | | J-8354-3 | $(\frac{3}{8}-16)$ | | | | |
| | | 10. J-8358 | Carbon Remover Brush | | | | |