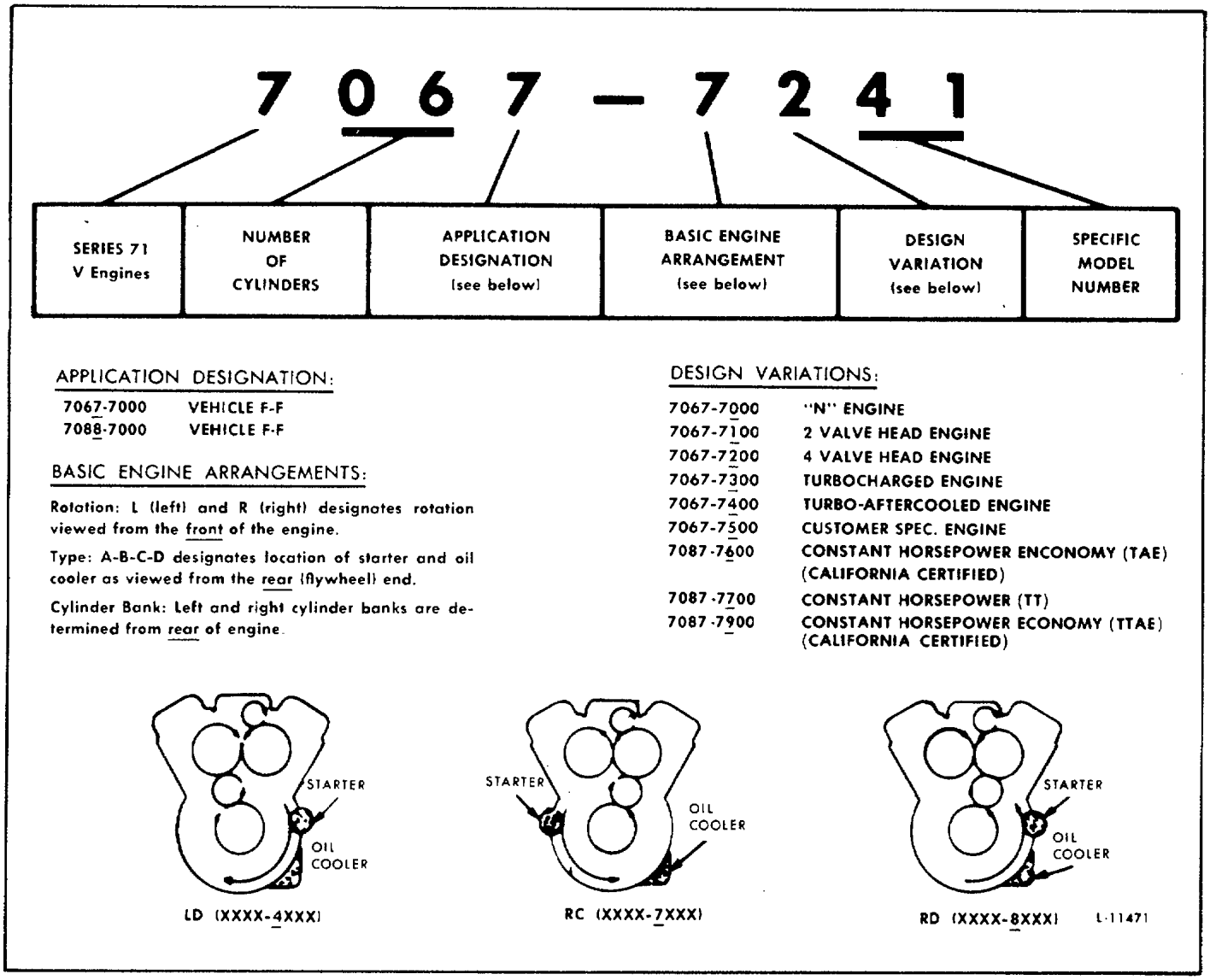


FIG. 2 - Model Numbering, Rotation and Accessory Arrangement

ENGINE MODEL, SERIAL NUMBER AND OPTION PLATE

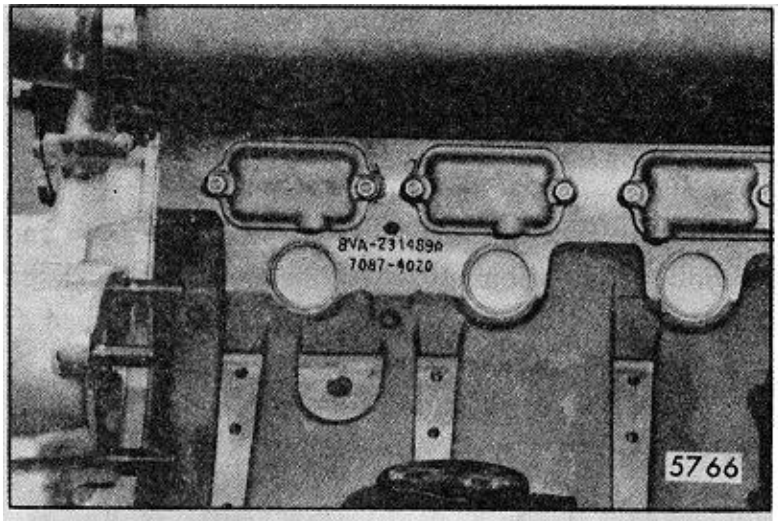


FIG. 4 - Typical Engine Serial Number and Model Number As Stamped on Cylinder Block

The engine serial number and the engine model number are stamped on the right rear side of the cylinder block (Fig. 4). This applies to former 6 and 8V-71 engines and current 12V-71 engines. To allow for easier engine serial number and model number identification on 6 and 8V-71 engines the location has been moved to the upper right front corner of the block.

> **NOTE**: The 12V and 16V-71 engine identification will continue to be stamped at the former location, the right rear side of the cylinder block.

An option plate, attached to one of the valve rocker covers, is also stamped with the engine serial number and model number and. in addition, lists any optional

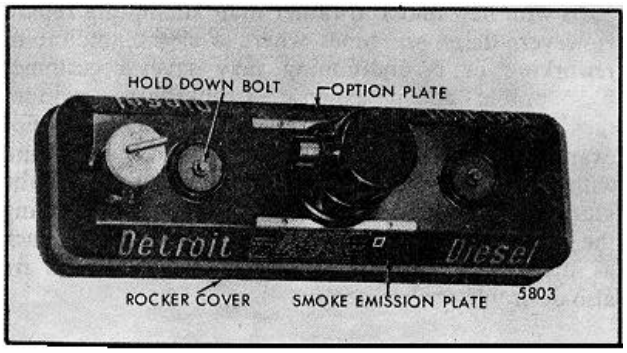


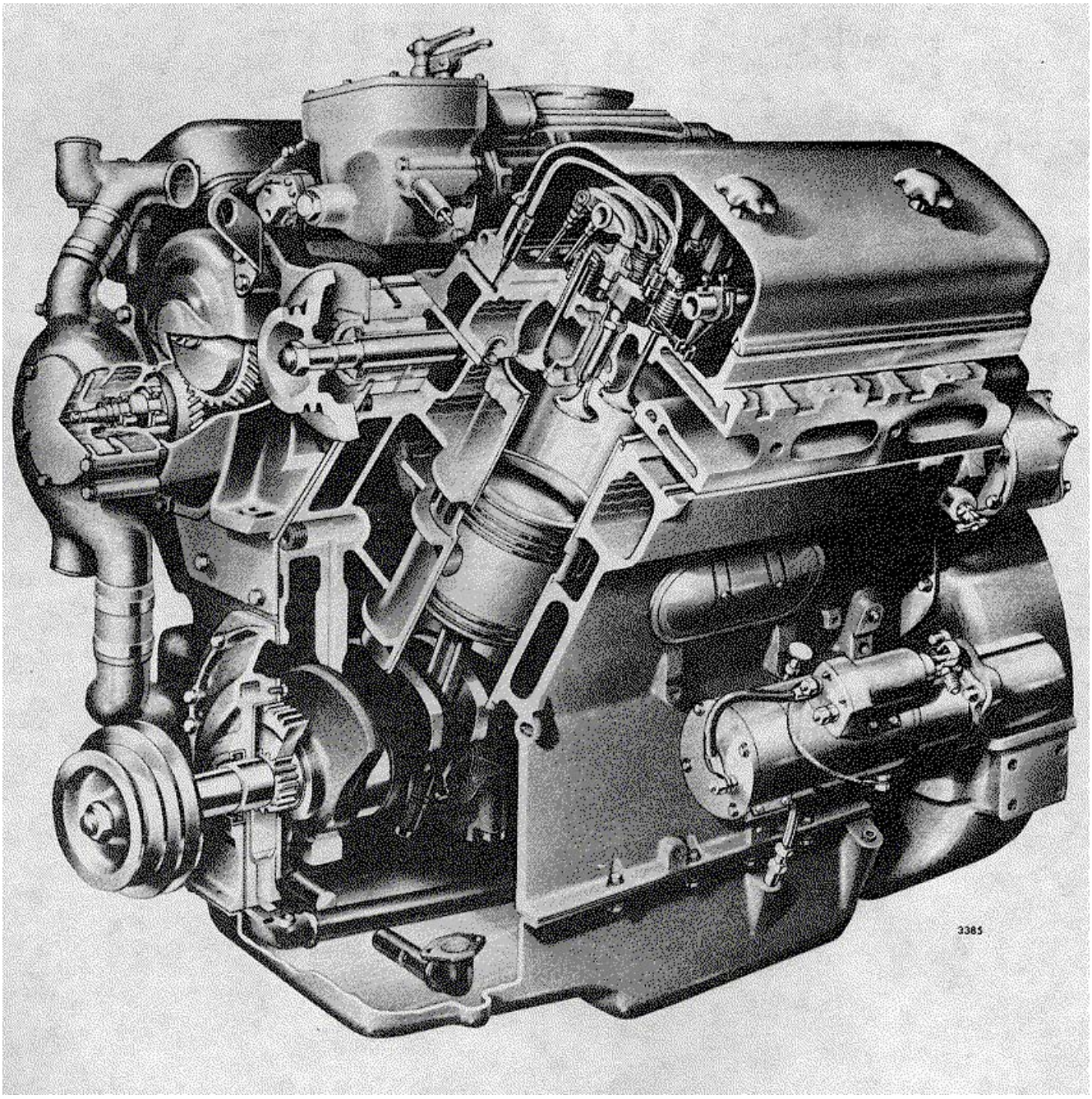
FIG. 5 - Option Plate

equipment used on the engine (Fig. 5).

An exhaust emission certification label. separate from the option plate. is mounted permanently in the option plate retainer. The current label includes information relating to an engine family for the maximum fuel injector size and maximum speed. Due to Federal regulations, the exhaust emission plate should not be removed. from the rocker cover. Refer to Section 14 for further information regarding emission regulations.

With any order for parts, the engine model number and serial number must be given. In addition, if a type number is shown on the option plate covering the equipment required, this number should also be included on the parts order.

All groups of parts used on an engine are standard for the engine model unless otherwise listed on the option plate.



Three-Quarter Cutaway View of V-71 Engine (Dry Block)

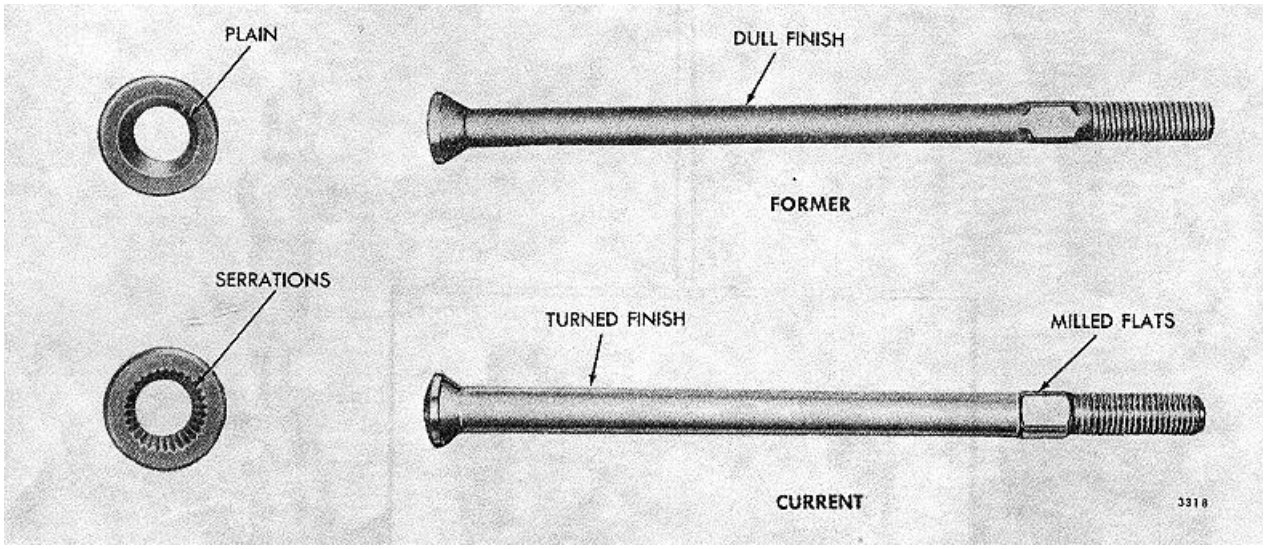


FIG. 6 - Comparison of Push Rods and Lower Spring Seats

check the side clearance (Fig. 5). The clearance must be .011" to .023 ".

Install Cam Follower and Push Rod

If new cam follower assemblies are to be installed, remove the preservative by washing with Cindol 1705 and wipe dry. *Do not use fuel oil.*

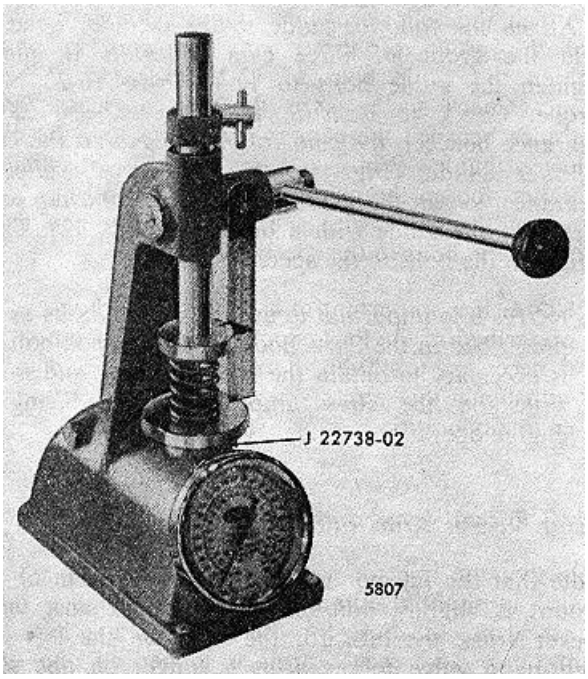


FIG. 7 - Testing Cam Follower Spring

Before cam followers are installed, immerse them in clean Cindol 1705 (heated to 100-125°F or 38-52°C) for at least one hour to ensure initial lubrication of the cam roller pins and bushings. Rotate the cam rollers during the soaking period to purge any air from the bushing-roller area. The heated Cindol oil results in better penetration as it is less viscous than engine oil and flows more easily between the cam roller bushing and pin. After the cam followers are removed from the heated Cindol 1705, the cooling action of any air trapped in the bushing and pin area will tend to pull the lubricant into the cavity.

> **NOTE:** Heat the Cindol 1705 in a small pail with a screen insert. The screen will prevent the cam followers from touching the bottom of the pail and avoid the possibility of contamination.

Install used cam followers and push rods in their original locations. Refer to Fig. 9 and proceed as follows:

CYLINDER HEAD ON ENGINE:

1. Note the oil hole in the bottom of the cam follower. With the oil hole directed away from the exhaust valves (Fig. 10), slide the cam follower in position in the cylinder head.

EXHAUST VALVES

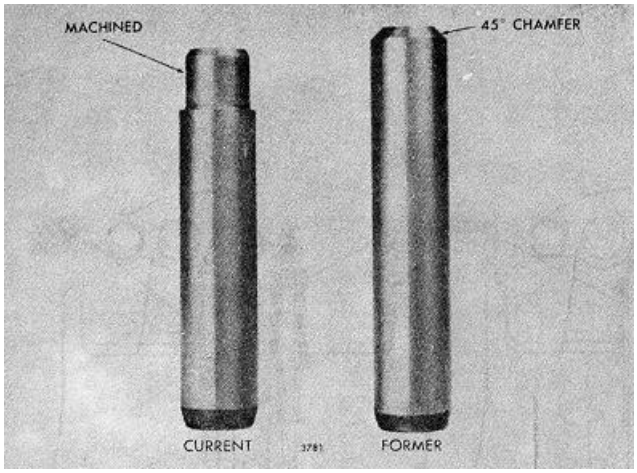


FIG. 8 - Former and Current Valve Guides

guide will facilitate field installation of valve guide seals when it is felt their use will be beneficial.

When replacing the valve guides in a two-valve cylinder head, use valve guide installer J 4144 with the former thick exhaust valve insert (.268"-.272") and use J 9530 with the current thin exhaust valve insert (.2465"-.2505") or when a valve guide oil seal is used.

2. Position the valve guide squarely in the bore in the cylinder head and press the installing tool gently to start the guide in place (Fig. 9). Then press the guide in until the tool contacts the cylinder head.

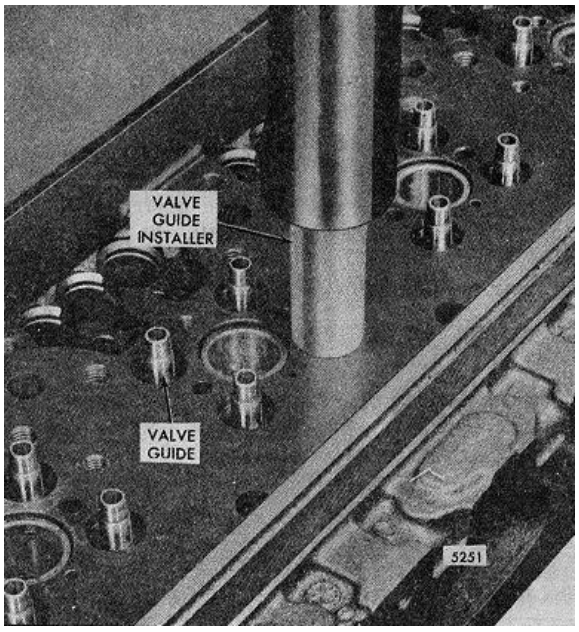


FIG. 9 - Installing Valve Guide

NOTE: Do not use the valve guides as a means of turning the cylinder head over or in handling the cylinder head.

Service replacement valve guides are completely finish reamed during manufacture and, therefore, do not require reaming after installation.

A service replacement valve guide which is .016" oversize on the outside diameter is also provided for service (two-valve cylinder head only).

3. Install a new valve guide oil seal, if used (refer to Item 5 under *Install Exhaust Valves and Springs).*

Inspect Exhaust Valve Bridge and Guide (Four-Valve Cylinder Head)

Inspect the valve bridge guide, valve bridge and adjusting screw for wear. Replace excessively worn parts.

The former threaded exhaust valve bridge guides have been replaced by press-fit bridge guides in the four-valve cylinder heads (Fig. 10). To conform with this change, current cylinder heads incorporate reamed bridge guide holes in place of the 7/16"-14 tapped holes. The former threaded bridge guide had an integral spring seat to accommodate the valve bridge spring. To permit the use of spring-loaded valve bridges on a replacement cylinder head which incorporates the press-fit guides, separate valve bridge spring seats were used.

The current press-fit valve bridge guide is hardened steel while the valve bridge is relatively soft steel. The former threaded valve bridge guide was of soft steel and was used with a hardened steel valve bridge. The soft valve bridge may be identified by the letter "S" forged on one side of the bridge.

Avoid a combination of a soft steel guide and soft steel bridge, otherwise premature wear of the bridge and guide will occur. For service requirements, a threaded valve bridge guide of hardened steel is available and is identified by 3/16" or 1/4" drill spot in the top end.

Two designs of the valve bridge are used. One has a drilled oil hole and the other has a forged oil hole in the side. The two bridges are interchangeable and can be mixed in an engine.

In addition, a new valve bridge adjusting screw with a redesigned valve contact surface replaces the former adjusting screw. The new screw may be identified by the machined (undercut) surface at the lower end of the screw. Only the new adjusting screw is available

brackets or eye bolts at each end of the engine, remove the engine from the vehicle.

5. Remove all of the accessories and assemblies with their attaching parts as necessary to permit the engine to be mounted on an overhaul stand.

6. Mount the engine on an overhaul stand and fasten it securely to the mounting plate.

> **CAUTION**: Be absolutely sure the engine is securely attached to the stand before releasing the lifting sling. Severe injury to personnel and destruction of engine parts will result if the engine breaks away from the stand.

7. Remove the oil pan.

8. Remove the lubricating oil pump, if the pump is mounted on the main bearing caps.

9. Remove the flywheel and flywheel housing.

10. Remove the crankshaft cap or pulley retaining bolt and washer at the front end of the crankshaft. Then remove the pulley, if used.

I 1. Remove the vibration damper, if used.

12. Remove the front engine support.

13. Remove the crankshaft front cover and oil pump assembly.

14. Remove the vibration damper inner cone or oil seal spacer.

15. Remove the cylinder heads.

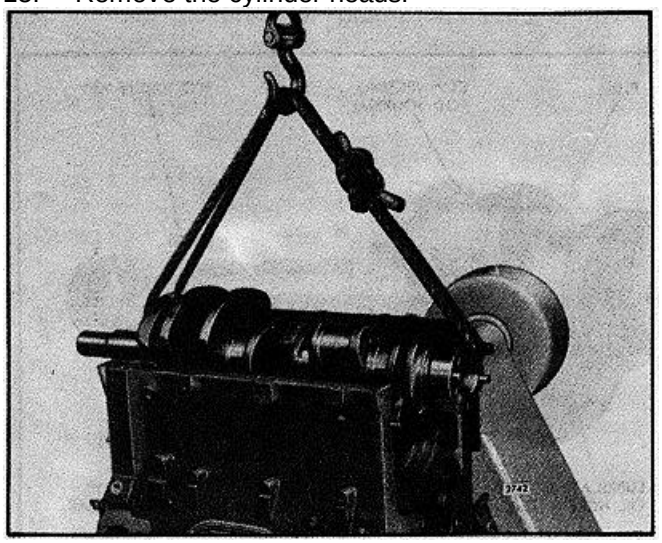


FIG. 2 Removing or installing Crankshatt

16. Remove the connecting rod bearing caps.

17. Remove the main bearing caps and stabilizers.

18. Remove the thrust washers from each side of the rear main bearing.

19. Remove the pistons, connecting rods and liners.

20. Remove the crankshaft, including the timing gear and oil pump drive gear (Fig. 2).

21. Refer to Section 1.7.5 for removal of the crankshaft timing gear.

22. Remove the oil pump drive gear and Woodruff keys from the crankshaft.

Inspection

After the crankshaft has been removed, clean and inspect it thoroughly before reinstalling it in the engine.

Remove the plugs and clean out the oil passages thoroughly with a stiff wire brush. Clean the crankshaft with fuel oil and dry it with compressed air. Then reinstall the plug's.

Inspect the keyways for evidence of cracks or wear. Replace the crankshaft, if necessary.

If the crankshaft shows evidence of excessive overheating, replace the crankshaft since the heat treatment has probably been destroyed.

Used crankshafts will sometimes show a certain amount of ridging caused by the groove in the upper main bearing shell or lower connecting rod bearing shell (Fig. 3). Ridges exceeding .0002" must be removed. If the ridges are not removed, localized high unit pressures on new bearing shells will result during engine operation.

The ridges may be removed by working crocus cloth, wet with fuel oil, around the circumference of the crankshaft journal. If the ridges are greater than .0005", first use 120 grit emery cloth to clean up the ridge, 240 grit emery cloth for finishing and wet crocus cloth for polishing. Use of a piece of rawhide or other suitable rope wrapped around the emery cloth or crocus cloth and drawn back and forth will minimize the possibility of an out-of-round condition developing (keep the strands of rawhide apart to avoid bind). If rawhide or rope is not used, the crankshaft should be rotated at intervals. If the ridges are greater than .001", the crankshaft may have to be reground.

Carefully inspect the rear end of the crankshaft in the

CRANKSHAFT VIBRATION DAMPER

On 12V, a viscous type vibration damper is mounted on the front end of the crankshaft to reduce crankshaft stresses to a safe value. The new 12 " nylon coated flywheel style vibration dampers are now being used on the 12V-71 engines. Only the current nylon coated flywheel style vibration dampers will be serviced. The vibration damper is bolted to a hub which is retained on the front end of the crankshaft.

A viscous type vibration damper consists of an inertia mass (flywheel) enclosed in a silicone fluid-tight outer case but separated therefrom by a thin wall of viscous liquid not responsive to temperature changes. Any movement of the inertia mass, therefore, is resisted by the friction of the fluid, which tends to dampen excessive torsional vibrations in the crankshaft.

The vibration damper must be removed whenever the crankshaft, crankshaft front oil seal, or the crankshaft front cover is removed.

The new crankshaft bolts are now lubrite coated to prevent possible damage (galling) to the bolt threads and to increase the clamp load to the front end stack up (crankshaft pulley, vibration damper, etc). Also the new washer (retainer) is now case hardened.

The new bolts and washer can be identified by their black color. The former bolts and washer are steel (gray) color.

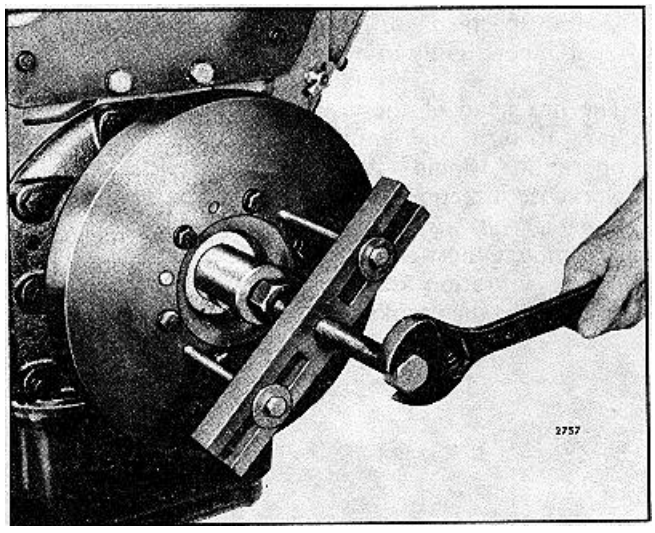


FIG. 1 - Removing Vibration Damper Outer Cone from a 12V Engine

Remove Vibration Damper From Crankshaft (12V Engine)

1. Remove the crankshaft pulley retaining bolt and washer.

2. Remove the crankshaft pulley. If required, use a suitable puller to remove the pulley.

3. Reinstall the pulley retaining bolt in the end of the crankshaft.

4. Attach puller J 24420 to the vibration damper hub. as shown in Fig. 1, with two long bolts threaded into the two 3/8 "-24 tapped holes provided in the hub. Pull the damper and hub assembly together with the outer cone, until the outer cone is loose on the crankshaft. On the rubber type vibration damper (Fig. 1), remove two damper-to-hub bolts and lock washers diametrically opposite to each other and attach the puller with two long 7/16 "-20 bolts.

5. Remove the puller from the damper hub and pull the outer cone off the crankshaft.

> **NOTE**: *Pounding with a hammer or prying with other tools must not be resorted to when removing a viscous type damper from the crankshaft.* Dents in the damper outer case may render the damper ineffective. The damper cannot be repaired.

6. Slide the vibration damper and damper hub as an assembly off the end of the crankshaft by hand.

7. If necessary. remove the vibration damper inner cone from the crankshaft.

Inspect Vibration Damper

The viscous type damper should be inspected for dents, nicks. fluid leaks or bulges in the outer casing of the damper. Any indications of the above are sufficient causes for replacement of the damper. Due to the close clearances between the damper internal flywheel and outer casing. dents may render the damper ineffective. Bulges or splits indicate fluid in the damper has deteriorated and has bulged or forced the casing open at its crimped edges.

Regardless of condition. a viscous type damper must be replaced at the time of normal periodic major engine overhaul.

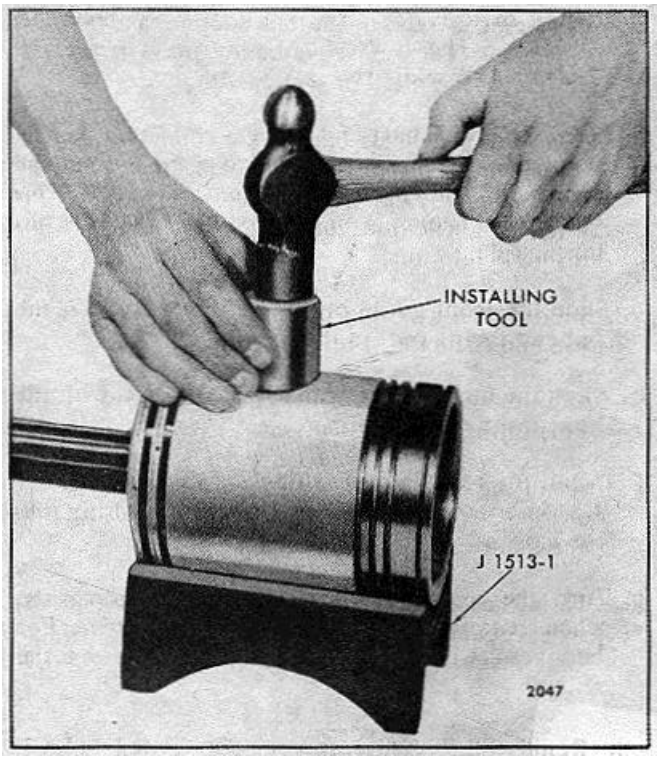


FIG. 12 Installing Piston Pin Retainer

3. Place the upper end of the connecting rod between the piston pin bosses and in line with the piston pin holes. Then slide the piston pin in place. If the piston pin-to-bushing clearances are within the specified limits, the pin will slip into place without use of force.

4. Install the second piston pin retainer as outlined in Steps 1 and 2.

5. After the piston pin retainers have been installed, check for piston pin end clearance by cocking the connecting rod and shifting the pin in its bushings.

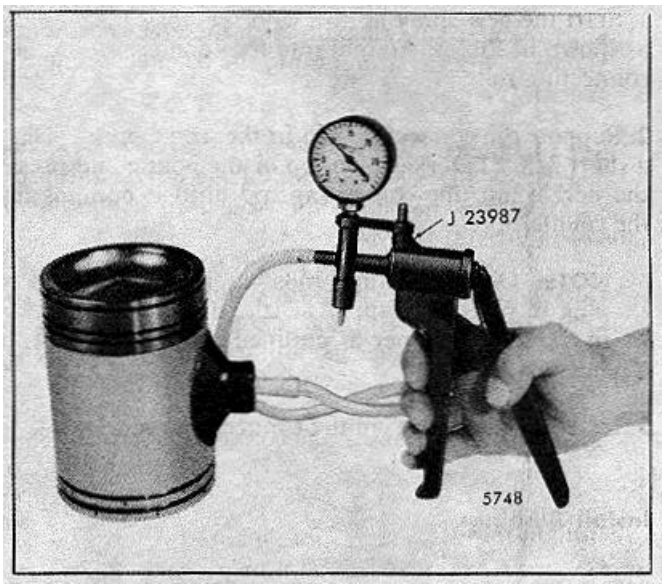


FIG. 13 - Checking Piston Pin Retainer for Proper Sealing

6. One important function of the piston pin retainer is to prevent the oil. which cools the underside of the piston and lubricates the piston pin bushings, from reaching the cylinder walls. Check each retainer for proper sealing with leak detector J 23987 (Fig. 13). Place the suction cup over the retainer and hand operate the lever to pull a vacuum of ten inches on the gage, a drop in the gage reading indicates air leakage at the retainer.

7. Install the piston rings on the piston as outlined in Section 1.6.

8. Install the piston and connecting rod assembly in the engine as outlined in Section 1.6.3.

CAMSHAFT GEARS

The camshaft gears (Fig. 1) located at the flywheel end of the engine, mesh with each other and run at the same speed as the crankshaft. Either one of the gears may be driven by the crankshaft timing gear through an idler gear, depending upon engine rotation. Viewing the engine from the gear train end, the right-hand camshaft gear has right-hand helical teeth and the left-hand camshaft gear has left-hand helical teeth. The idler gear mates with the right-hand camshaft gear on right-hand rotation engines and the left-hand camshaft gear on left-hand rotation engines as shown in Fig. 2, Section 1.7.1.

Since the two camshaft gears must be in time with each other, timing marks are stamped on the rim of both gears. Also, since these two gears as a unit must be in time with the crankshaft, timing marks are located on the idler gear and the crankshaft gear.

Each camshaft gear on the right hand rotation engines and the right bank camshaft gear on former 6 and 8V left hand rotation engines are keyed to the shaft and held securely by a nut, nut retainer, retainer bolts and lock washers. On current 6 and 8V left hand rotation engines the right bank camshaft gear is keyed to the shaft and held securely by a lock bolt and washer (Fig. 2).

The camshaft gears used on 6V engines are identical to those used on 8V engines, except that when the gears are used on 8V engines, additional balance weights are attached to the gears. Camshaft gears used on 12V engines are not interchangeable with those used on 6V or 8V engines due to the difference in the size of the integral balance weights.

Effective with engine serial number 8VA-1203, a new balance weight (with drilled bolt holes) replaced the former balance weight (with tapped holes) on the 8V engines, The current weight is attached to the camshaft gear with two 3/8 "-24 flat head screws and nuts in place of the former bolts (Fig. 3).

The current weight must be used with the cross-head pistons. Only the current weight is serviced for either the cross-head or the trunk type pistons for 8V engines.

When cross-head pistons are to be installed in an 8V-71 engine built prior to serial number 8VA-115016, and an in-frame overhaul is desired, a new bolt-on rear balance weight must be used in addition to the existing balance weight attached to the engine side of each rear camshaft gear. For the installation procedure refer to Section 1.0.

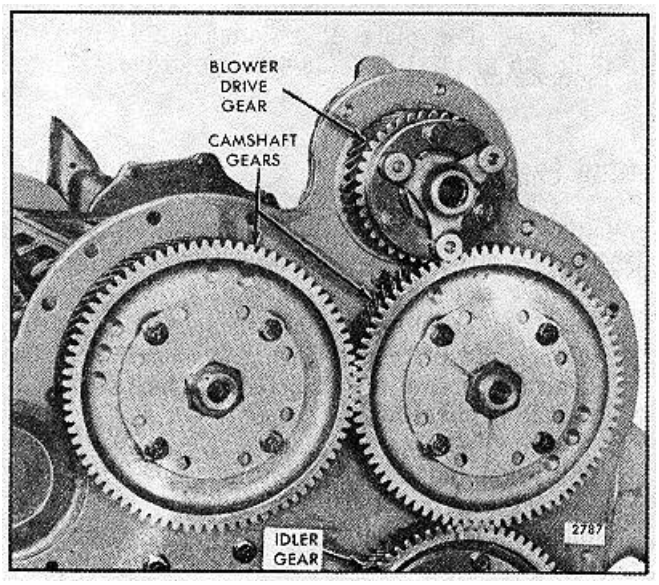


FIG.1 - Camshaft Gears Mounted on Engine

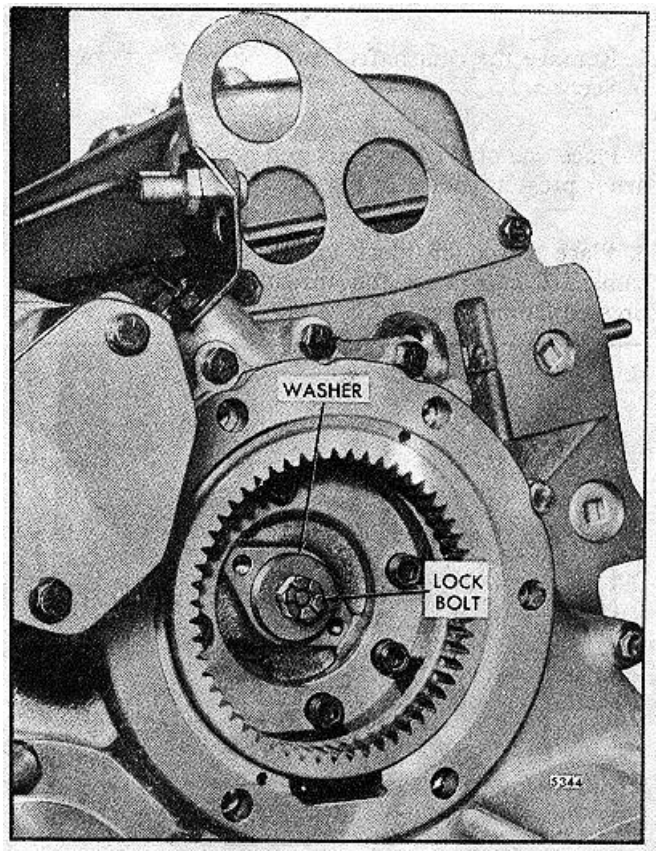


FIG.2 - Left-Hand Rotation (Right bank) Camshaft Gear Mounting

CHECKING BEARING CLEARANCES

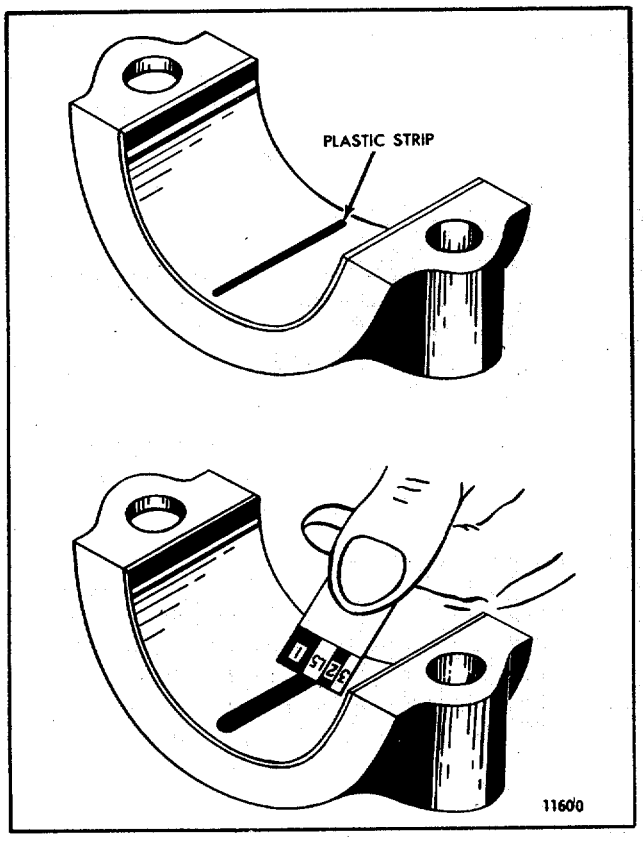


FIG.. 1 - Using Plastic Strip to Measure Bearing-to-Crankshaft Clearance

A strip of soft plastic squeezed between the crankshaft journal and the connecting rod bearing or main bearing may be used to measure the bearing clearances.

The strip is a specially molded plastic "wire" manufactured commercially and is available in three sizes and colors. Type PG-1 (green) has a clearance range of .001 " to .003", type PR-1 (red) has a range of .002 " to 006 " and type PB-1 (blue) has a range of .004 " to .009 ".

The plastic strip may be used for checking the bearing clearances as follows:

1. Remove the bearing cap and wipe the oil from the bearing shell and the crankshaft journal.

> **NOTE**: When checking the main bearing clearances with the engine in a position where the main bearing caps are supporting the weight of the crankshaft and the flywheel, an erroneous reading, due to the weight of the crankshaft and flywheel, can be eliminated by supporting the weight of the crankshaft with a jack under the counterweight adjoining the bearing being checked.

2. Place a piece of the plastic strip the full width of the bearing shell, about 1/4 " off center (Fig. 1).

3. Rotate the crankshaft about 30 ° from bottom dead center and reinstall the bearing cap. Tighten the bolts to the specified torque.

4. Remove the bearing cap. The flattened plastic strip will be found adhering to either the bearing shell or the crankshaft.

5. Compare the width of the flattened plastic strip at its widest point with the graduations on the envelope (Fig. 1). The number within the graduation on the envelope indicates the bearing clearance in thousandths of an inch. Taper may be indicated when one end of the flattened plastic strip is wider than the other. Measure each end of the plastic; the difference between the readings is the approximate amount of taper.

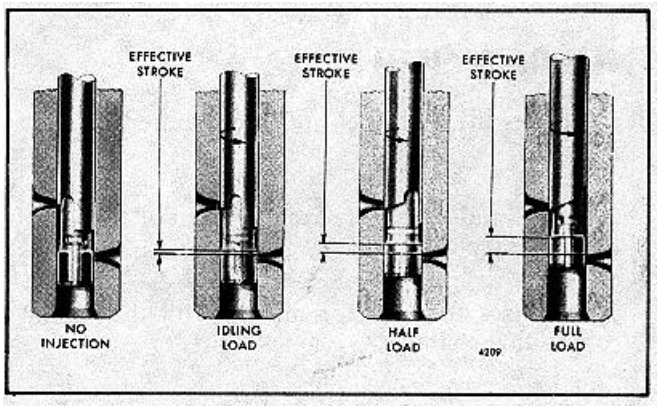


FIG. 3 - Fuel Metering from No-Load to Full Load

Figure 4 illustrates the phases of injector operation by the vertical travel of the injector plunger.

The continuous fuel flow through the injector serves, in addition to preventing air pockets in the fuel system, as a coolant for those injector parts subjected to high combustion temperatures.

To vary the power output of the engine, injectors having different fuel output capacities are used. The fuel output of the various injectors is governed by the helix angle of the plunger and the type of spray tip used. Refer to Fig. 5 for the identification of the injectors and their respective plungers and spray tips.

Since the helix angle on the plunger determines the output and operating characteristics of a particular type of injector, it is imperative that the correct injectors are used for each engine application. If injectors of different types are mixed, erratic operation will result and may cause serious damage to the engine or to the equipment which it powers.

NOTE: Do not intermix the needle valve

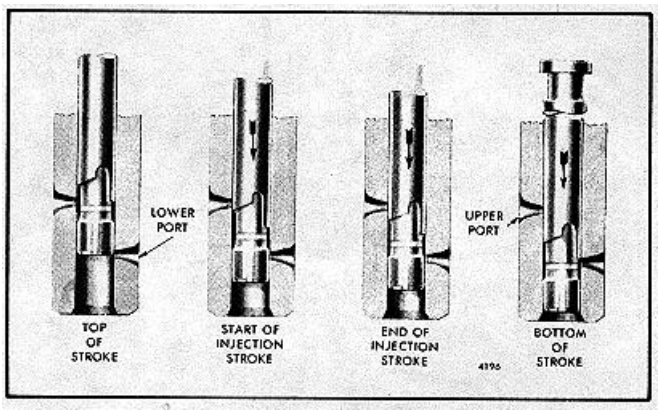


FIG. 4 - Phases of Injector Operation Through Vertical Travel of Plunger

injectors with other types of injectors in an engine.

Each fuel injector has a circular disc pressed into a recess at the front side of the injector body for identification purposes (Fig. 5). The identification tag indicates the nominal output of the injector in cubic millimeters.

Each injector control rack (Fig. 2) is actuated by a lever on the injector control tube which, in turn, is connected to the governor by means of a fuel rod. These levers can be adjusted independently on the control tube, thus permitting a uniform setting of all injector racks.

The fuel injector combines in a single unit all of the parts necessary to provide complete and independent fuel injection at each cylinder.

Operation

Fuel, under pressure, enters the injector at the inlet side through a filter cap and filter (Fig. 2). From the filter, the fuel passes through a drilled passage into the supply chamber, that area between the plunger bushing and the spill deflector, in addition to that area under the injector plunger within the bushing. The plunger operates up and down in the bushing, the bore of which is open to the fuel supply in the annular chamber by two funnel-shaped ports in the plunger bushing.

The motion of the injector rocker arm is transmitted to the plunger by the follower which bears against the follower spring (Fig. 6). In addition to the reciprocating motion, the plunger can be rotated, during operation, around its axis by the gear which meshes with the control rack. For metering the fuel, an upper helix and a lower helix are machined in the lower part of the plunger. The relation of the helices to the two ports changes with the rotation of the plunger.

As the plunger moves downward, under pressure of the injector rocker arm, a portion of that fuel trapped under the plunger is displaced into the supply chamber through the lower port until the port is closed off by the lower end of the plunger. A portion of the fuel trapped below the plunger is then forced up through a central passage in the plunger into the fuel metering recess and into the supply chamber through the upper port until that port is closed off by the upper helix of the plunger. With the upper and lower ports both closed off, the remaining fuel under the plunger is subjected to increased pressure by the continued downward movement of the plunger.

When sufficient pressure is built up, it opens the flat, non-return check valve. The fuel in the check valve

the air cylinder. Remove the seal ring from the groove in the plug.

e. Insert a 3/32"diameter steel rod in the plunger opening in the air cylinder and push the piston, seal ring, dual idle spring and spring follower out of the air cylinder as an assembly. Then remove the air cylinder spring from the cylinder.

f. Remove the seal ring from the groove in the piston. Apply pressure on the spring follower and remove the follower retaining ring from the groove in the piston. Remove the follower and spring.

Inspection

Wash all of the governor components in clean fuel oil and dry them with compressed air. Then inspect them as outlined in Section 2.7.1.

Examine the fast idle air cylinder components for wear or any defects. Replace worn or damaged parts.

Assemble Governor

1. Assemble the governor as outlined in Section 2.7.1.

2. Assemble the fast idle cylinder as follows:

a. Refer to Fig. 2 and insert the dual idle spring inside of the fast idle air cylinder. Place the spring follower, with the small diameter end down, inside of the spring. Apply pressure on the spring follower and compress the spring enough to expose the retaining groove. Then install the retaining ring in the groove.

b. Install a new seal ring in the groove in the piston. Then install the air cylinder spring over the small diameter end of the piston.

c. Lubricate the seal ring on the piston with engine oil. Then insert the piston and spring assembly, with the small diameter end of the piston first, straight into the air cylinder spring seats on the shoulder in the cylinder.

d. Install a new seal ring in the groove of the air cylinder air inlet plug.

e. Lubricate the seal ring with engine oil. Then insert the air inlet plug straight into the air cylinder and against the piston.

f. Clamp the air cylinder in a vise equipped with soft jaws. Apply pressure on the end of the air inlet plug and compress the spring enough to expose the retaining ring groove. Then install the retaining ring.

g. If removed, thread the lock nut on the air cylinder. Then insert the plunger through the buffer spring and into the air cylinder.

3. Install the fast idle air cylinder assembly in the governor housing buffer screw hole.

Install Governor

1. Install the governor on the engine as outlined in Section 2.7. 1.

2. Install the throttle locking and engine shutdown air cylinders.

3. Connect the air hoses to the air cylinders.

4. Adjust the governor as outlined in Section 14.3.4.

suitable air connection and shutoff valve to maintain two pounds pressure (14 kPa) in the air duct system. The outlet plug need only be of sufficient size to form a completely air-tight seal at the out]et end of the system. Then check the system as follows:

1. Remove the air inlet hood.

2. Insert the plug (with the fitting for the air hose) in the air cleaner inlet to form an air-tight seal.

3. Insert the other plug in the outlet end of the system to form an air-tight seal.

4. Attach an air hose to the plug in the air cleaner inlet and regulate pressure *not* to exceed 2 psi (14 kPa).

5. Brush a soap-suds solution on all air duct connections. Any opening which would allow dust to enter the engine can then be detected by the escaping air causing bubbles in the soap-suds solution. All leaks thus discovered should be remedied to ensure an air-tight system.

6. Remove the plugs and install the air inlet hood.

TWO-STAGE DRY TYPE AIR CLEANER

The Donaldson dry type air cleaners shown in Figs. 4 and 5 are designed to provide highly efficient air filtration under all operating conditions. The cleaners have a replaceable impregnated paper filter element that can be cleaned.

The fins on the element give high speed rotation to the intake air, which separates a large portion of the dust from the air by centrifugal action. The plastic fins, the element and the gasket make up a single replaceable element assembly.

The dust is swept through a space in the side of the baffle and collects in the lower portion of the body or dust cup. The dust remaining in the precleaned air is removed by the element.

The dry type cleaner *cannot be used* where the atmosphere contains oil vapors, or fumes from the breather can be picked up by the air cleaner.

Service (Dry Type)

The air cleaner should be serviced as operating conditions warrant. See Section 15.1 for element change intervals.

Under no engine operating conditions should the maximum allowable air intake restriction shown in Section 13.2 of the service manual be exceeded. Check restriction with a water manometer using the procedure outlined under "final run-in" in Section 13.2.1. In addition, inlet restriction should be adjusted for high altitude conditions (see TABLE 1). A clogged air cleaner element will cause excessive intake restriction, reduce air supply to the engine, poor performance and higher valve and cylinder temperatures.

Disassemble the cleaner as shown in Fig. 4 as follows:

1. Loosen the cover bolt and remove the cover and bolt as an assembly.

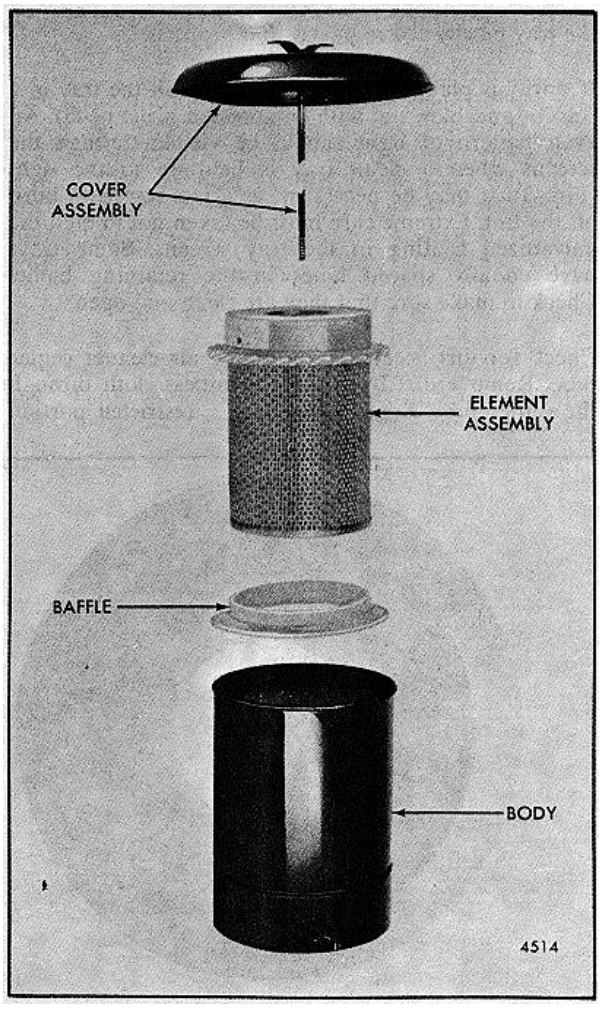


FIG. 4 - Dry Type Air Cleaner

a. Affix a new gasket to the forward face of the blower end plate.

b. Place the fuel pump drive fork on the fuel pump shaft. Position the governor and fuel pump assembly in front of the blower. Rotate the fuel pump fork until the prongs of the fork align with the slots in the drive disc. Rotate the weight shaft and align the splines on the shaft with the splines in the blower rotor.

c. Push the governor straight on the dowel pins in the blower end plate and against the gasket.

d. Refer to Section 2.7.1 for the location and install the bolts, lock washers, copper washers and plain washer which secure the governor to the blower. Tighten the bolts to 13-17 lb-ft (18-23 Nm) torque.

Install Slower on Engine

Refer to Fig. 3 and install the blower assembly on the engine as follows:

1. Affix a new blower housing gasket to the cylinder block with Scotch Grip rubber adhesive No. 1300, or equivalent, to prevent the gasket from shifting when the blower is lowered into position.

2. If removed, place a fuel rod cover tube hose and clamp on each fuel rod cover tube at each side of the governor housing and tighten the clamps.

3. Place the blower end plate cover seal ring and clamp on the end of the blower drive support.

4. Thread eyebolts in diagonally opposite tapped holes in the top of the blower housing. Then attach a rope sling and chain hoist to the eyebolts.

5. Lift the blower assembly at a slight angle and position it on top of the cylinder block, with the flange of the rear end plate cover inside the seal ring.

6. Thread two 7/16"-14 x 8-1/4" bolts and special washers finger tight in each blower end plate. Then thread the 3/8"-16 x 5-1/2" bolts and retaining washers finger tight at each side of the blower housing.

NOTE: The lip at the beveled end of the bolt retaining washer goes in the small recess in the housing just above the bolt slot.

7. Tighten the bolts as follows:

a. First tighten the blower-to-block end plate bolts to 40-45 lb-ft (54-61 Nm) torque.

b. Then tighten the blower housing-to-block side angle bolts uniformly to 30-35 lb-ft (41-47 Nm) torque in 5 lb-ft (7 Nm) increments.

c. Recheck the blower-to-block end plate bolts.

8. Place the blower rear end plate cover seal ring and hose clamp into position and tighten it. The former rubber seal ring (.740" wide) incorporates two raised edges which provide a groove to retain the hose clamp.

NOTE: To retain seal load on the molded blower drive seal rings, a new 4.87" diameter spring loaded T-bolt style clamp is now being used.

After installing the new T-bolt style clamp on the blower drive seal, tighten the clamp nut on the bolt until the spring in the clamp is completely compressed.

9. Connect the lubricating oil tube to the fitting in the blower drive support.

10. Insert the blower drive shaft through the blower drive coupling and into the blower drive hub (Fig. 1). Install the snap ring in the coupling. Then attach the flywheel housing cover to the flywheel housing.

NOTE: The new 48-tooth *blower drive shafts* have been carbonitride hardened and drilled to accept a spring. The spring *must* be removed for 8V and 16V-71 usage. To remove the spring, grasp it firmly with pliers and pull it out. Make sure the entire spring has been removed before using the drive shaft.

11. Attach the tachometer drive adaptor, if used, to the blower. Then connect the tachometer drive cable to the drive adaptor.

12. Slide each fuel rod cover tube hose down on the cover tubes attached to the cylinder heads and tighten the hose clamps.

13. Install the fuel rods between the cylinder heads and governor as follows:

a. Insert the end of the left-bank fuel rod through the hole in the cylinder head and up through the fuel rod cover tube to the control link operating lever.

b. Raise the connecting pin up in the connecting link lever. Insert the end of the fuel rod between the two bosses on the lever and insert the connecting pin through the fuel rod and into the lower boss.

c. Connect the opposite end of the fuel rod to the injector control tube lever with a clevis pin and cotter pin.

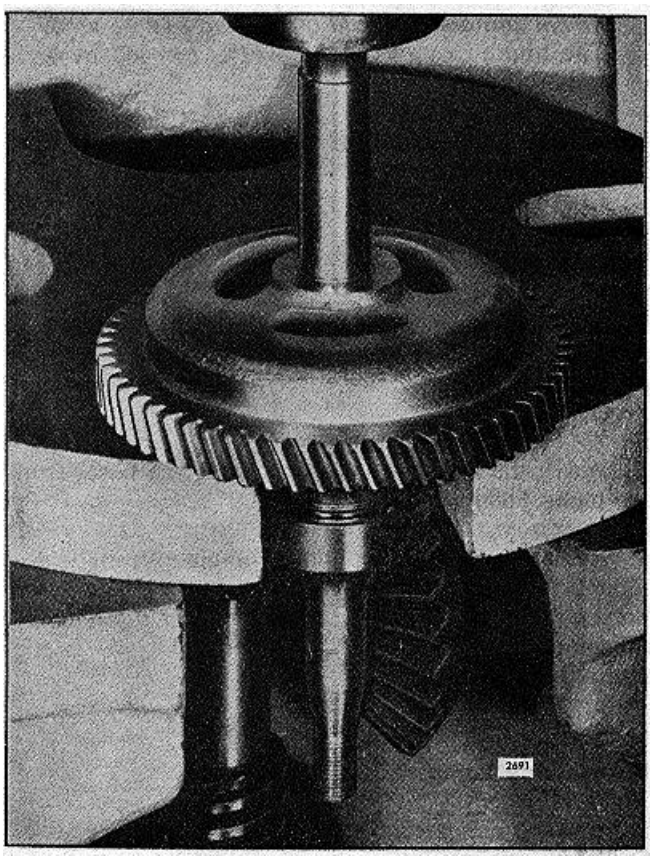


FIG. 5 - Pressing Shaft Out of Gear

9. If necessary, remove the water seal as described under *Replace Water Seal.*

10. Push the oil seal out of the pump body.

NOTE: New seals must be used as replacements each time the water and oil seals are removed.

Inspection

Wash all of the pump parts in clean fuel oil and dry them with compressed air. Inspect them for cracks, wear or other damage.. Replace damaged or worn parts.

Inspect the ceramic impeller insert for cracks, scratches and bond to the impeller. The insert may be replaced, if necessary, as noted under *Replace Water Seal.*

The bearings should be examined for corrosion, pitting, wear and freedom of movement. Apply engine oil to the bearings, hold the inner race and slowly revolve the outer race to check for roughness. Replace the. bearings, if necessary.

NOTE: When replacing an inner or outer bearing always replace the other bearing.

Effective with engine serial number 8VA-1 15016, a new bolt-on balance weight is attached to the front camshaft gear (water pump drive gear). Only the current weight is serviced for either the trunk type or the cross-head type piston 8V engines. The current weight must be used with the cross-head piston engines.

Assemble Pump

1. Lubricate the bearing bores and shaft bearing surfaces. Use bearing and gear installer J 25257 and install the bearings on the shaft (Fig. 8).

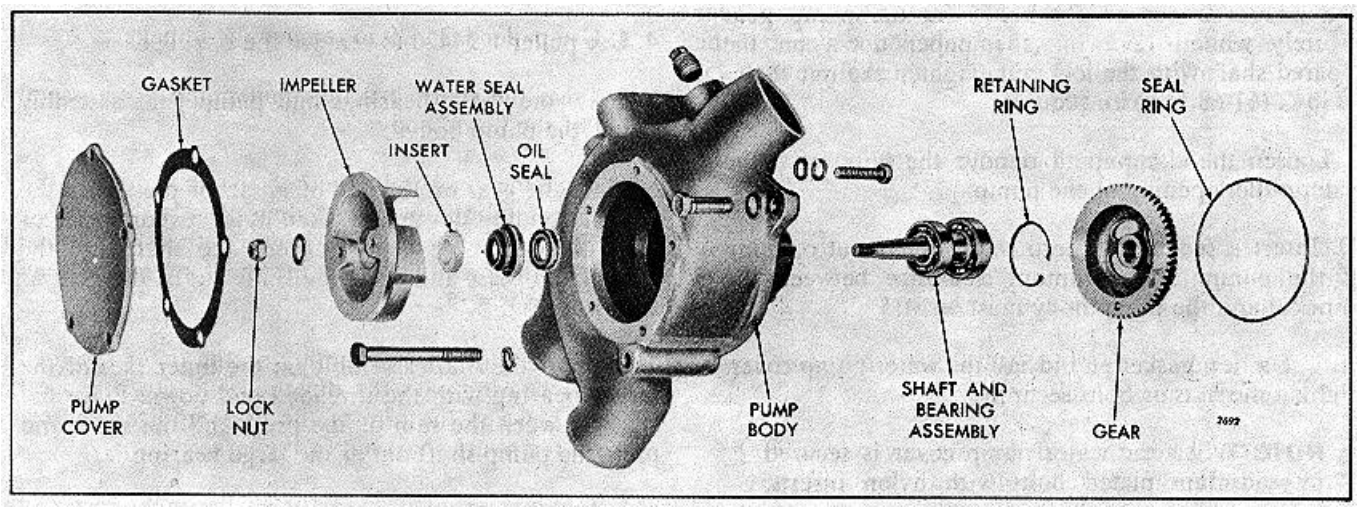


FIG. 6 - Water Pump Details and Relative Location of Parts