CRANKCASE VENTILATION

Forced crankcase ventilation is used on some engines in certain applications to create a flow of clean air through the crankcase of the engine to help carry off the corrosive gases, which are the by-products of combustion and which leak by the pistons and valve stems.

This system usually consists of an oil bath type breather, Illustration No. 24, and a metering valve mounted in the intake manifold and connected through suitable tubes to the valve or tappet cover plate, Illustration No. 25. The metering valve consists of three major parts, see Illustration No. 26. The two halves of the body, one which forms the connection into the intake manifold and the other which allows the attaching of the ventilation tubes from the crankcase, these two pieces forming a body in which the weighted metering pin works. The function of this valve is to meter the amount of air which will flow through the crankcase while the engine is running at either full load or part load. In order that the carburetion is not upset at idling speeds, the increased vacuum offsets the gravity pull of the weighted metering pin, moving it to its uppermost position and thus cutting down the amount of air which it will bypass into the intake manifold.

Illustration No. 26

Periodic cleaning of these parts will keep them functioning properly.

To clean the breather assembly, refer to Page 30.

To clean the metering valve, remove the ventilation tubes and take the valve apart and wash it in gasoline or kerosene and before assembling put a small quantity of very light oil on the valve itself to prevent sticking until its own lubrication is established. See Illustration No. 26.

The ventilation tube and valve cover should also be cleaned at the same time, particularly if any noticeable amount of sludge accumulation is found.

CRANKSHAFT

The crankshaft is a machined forging having all bearing journals surface-hardened. The nominal diameter of the main bearings is 2" while the nominal diameter of the connecting rod journals is 1¾". The shaft has passages drilled to carry oil under pressure to the connecting rod bearings. These passages should be cleaned with wire brush, see Illustration No. 27, before shaft is installed in engine.

While the diameters given above are only nominal, the following table gives actual sizes, both standard and undersize, to which the shaft may be reground.

Size	Main	Connecting Rod
Standard	1.988/1.987"	1.748/1.747"
.020" U.S.	1.968/1.967"	1.728/1.727"
.040" U.S.	1.948/1.947"	1.708/1.707"
.060" U.S.	1.928/1.927"	1.688/1.687"

To replace crankshaft main bearings, see Page 57 and 58. To replace crankshaft connecting rod bearings, see Page 36.

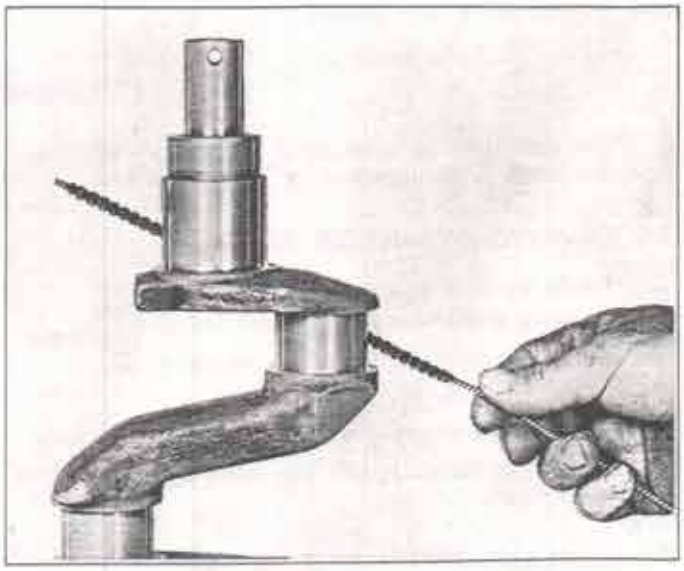


Illustration No. 27

TO REMOVE CRANKSHAFT GEAR

If a suitable arbor press is not available the following method may be used. Due to the extremely tight fit of the crankshaft gear on the crankshaft, it is almost impossible to pull this gear with any of the commercial pullers. Since replacement of this gear would only be brought about by the gear being badly worn or damaged, it may be removed in the following manner. Using a ¼" diameter drill centered midway between the edge of the keyway and the base of the gear teeth, drill through the gear parallel with the keyway, then spread the gear with a chisel and pull from shaft. CAUTION: Be careful not to drill into the crankshaft.

TO INSTALL NEW GEAR

1. Insert the Woodruff key in the shaft.
2. Lay the gear on a sheet of asbestos or other firestraw yellow. (If the gear is clean and untarnished, this color will indicate it is heated to approximately 450° F.) evenly on both sides until the gear turns a pale proof material and heat the gear with a blow torch
3. Assemble the hot gear on the crankshaft and with a suitable driver quickly force the gear into correct position. A piece of 2" diameter pipe may be used as a driver.
4. Allow the gear and shaft to cool.

CYLINDER AND CRANKCASE

The cylinders are cast integral with the crankcase and have the water jacket carried the full length of the cylinders and also around the intake and exhaust valve seats. This results in uniform cooling of the piston and cylinder wall and has a very definite bearing upon maintenance of lower oil temperatures than is possible with any other type of construction without use of oil cooler.

Material is cast iron with forged bearing caps fastened to the crankcase with 9/16" cap screws. The most casual inspection of the cylinder block will disclose the very rigid construction provided to support the crankshaft and this rigidity coupled with the large diameter of the crankshaft results in a very rugged and smooth running engine. Illustration No. 23.

The cylinders may be rebored up to .060" oversize.

For reconditioning valve seats and to replace valve guides, refer to valve grinding, Page 69.

To replace main bearings, see Page 57.

Core openings are closed by expansion type brass or steel plugs. If any of these should leak, remove and replace with new plugs.

CYLINDER HEAD

The cast iron cylinder head is the conventional "L" type and is detachable. The head is attached to the cylinder block with eighteen ⅜" cap screws and a steel asbestos gasket.

TO REMOVE CYLINDER HEAD

1. Drain cooling system.
2. Remove water outlet pipe and hose.
3. Remove cables and bracket assembly.
4. Remove spark plugs.
5. Loosen and remove cylinder head cap screws.
6. Lift off cylinder head. Tap head lightly with a soft hammer if necessary to loosen it, but do not pry on contact surface.

TO REPLACE CYLINDER HEAD

1. Before reinstalling cylinder head, clean out carbon deposits by scraping or brushing.
2. Clean cylinder block and cylinder head contact surfaces.
3. Clean the cylinder head gasket and place on cylinder block. Use new gasket if possible.

4. Assemble cylinder head on the block.
5. Assemble the cable bracket, cables, etc., that are attached by the cylinder head cap screws.
6. Start head cap screws and tighten evenly, starting at the center of the head and working progressively to the outer ends, following numerical sequence, Illustration No. 28, repeating until tight. See tension chart, Page 77.
7. Install spark plugs, be sure each has a clean gasket on it and tighten in head. Connect cables to correct spark plug.
8. Install water outlet pipe and hose (use new gasket and hose if necessary).

FAN ASSEMBLY (COOLING)

The cooling fan or water pump and cooling fan combination, which is mounted on the front of the cylinder block, is driven from the pulley mounted on the crankshaft by the use of a "vee" belt. Various types of fans, drive pulleys or generators may be driven from the fan belt. Therefore, it is not possible to list fan belt specifications.

FAN LUBRICATION

Three different types of lubrication systems are used in these fans as follows:

1. Fans with either tapered roller bearings or ball bearings use a special grease shown in the following specifications.
2. Certain fans have a lubricating oil reservoir, which should be filled with lubricating oil, S.A.E. 30, at least, once each week of operation.

   To add oil to this type of fan, remove the plug in the fan hub and fill with oil until oil runs from the shaft, then rotate the fan so that this filler plug is on the bottom and allow excess oil to drain out. Replace plug.
3. The fan and water pump combination used on the "IX-3" Engine is permanently lubricated at assembly; therefore, no further lubrication is required.

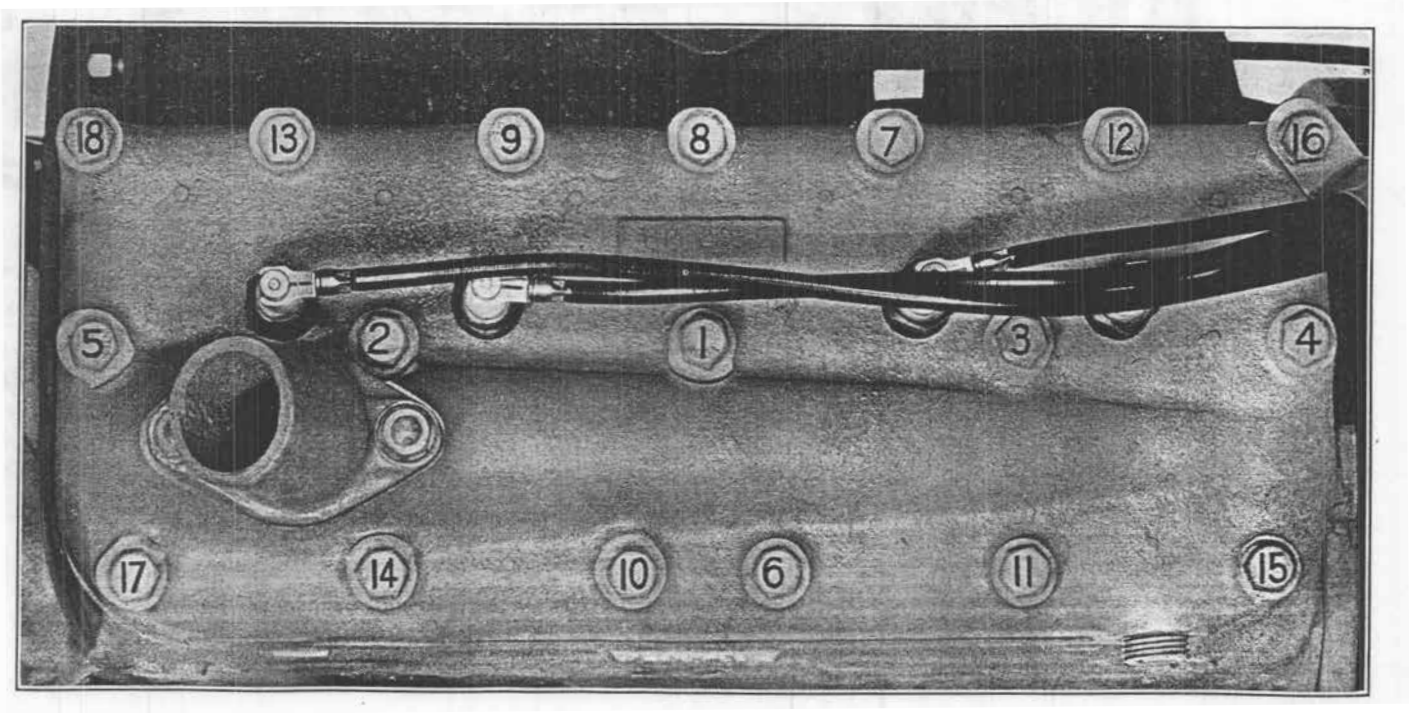
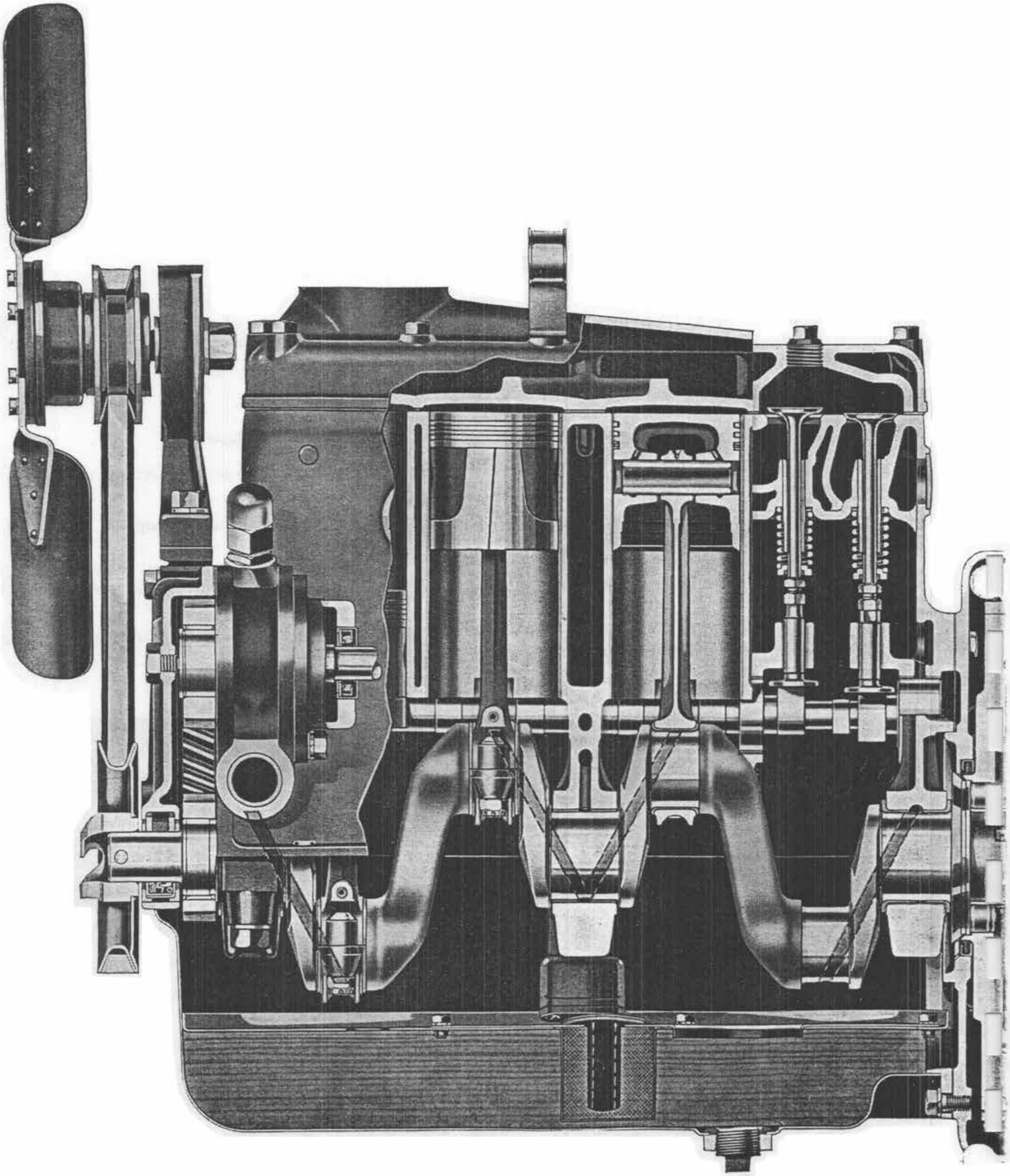
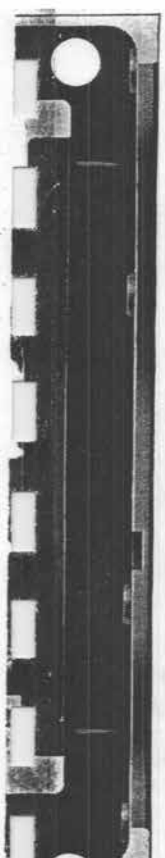
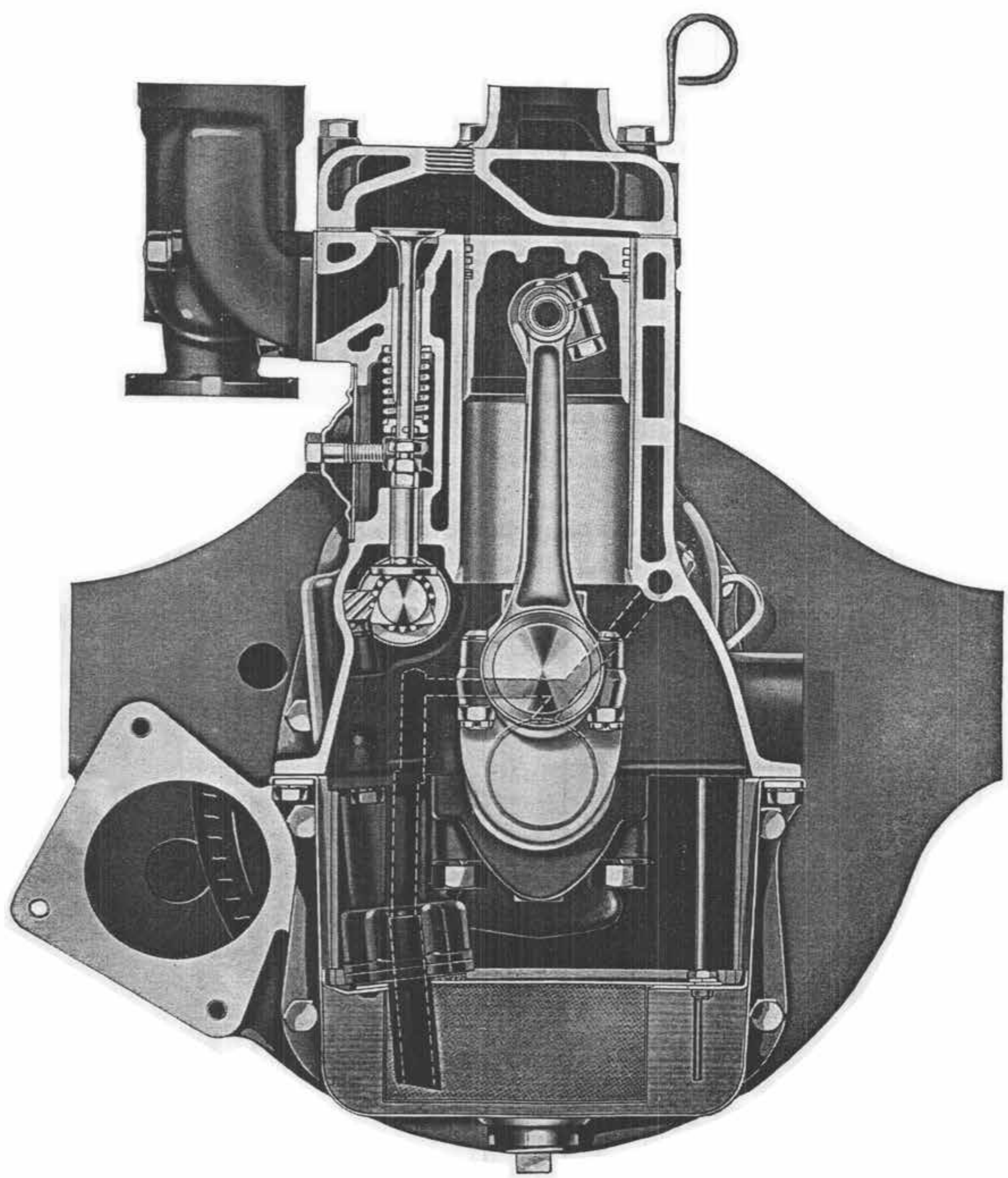


Illustration No. 28







The following are the specifications for the lubricant to be used in fans, which are equipped with either tapered roller bearings or ball bearings.

The fan is lubricated at assembly with a sodium soap grease, of the following specifications:

Soda Soap	11 — 12%
Oil	86 — 88%
Oil Viscosity @ 100° F.	140 - 160
Trade Standard No. 1½	(consistency)
Dropping	300° F.

similar to Standard Oil Company of Indiana, Onidea Grease, of high enough melting point so that the oil is fed to the bearings very sparingly. There is enough lubricant in the fan, when filled, to last for 1,000 hours or 25,000 miles of operation. To add lubricant to the fan, remove the pipe plug in the fan hub, Illustration No. 29, add the lubrication and replace the plug.

CAUTION: If a grease fitting is installed in the fan hub when greasing the fan, be sure to remove the fitting and assemble pipe plug in the opening as centrifugal force may throw the grease out through the grease fitting or weight of the grease fitting may so unbalance the fan that the vibration will break the shaft.

FAN BELT

The fan belt must be maintained at the correct tension for efficient operation and maximum belt life.

The belt is correctly tightened when, by grasping it midway between the pulleys, it can be deflected approximately one inch.

Illustration No. 30 shows the use of a spanner wrench used to tighten certain "IX-3" Fan Belts.

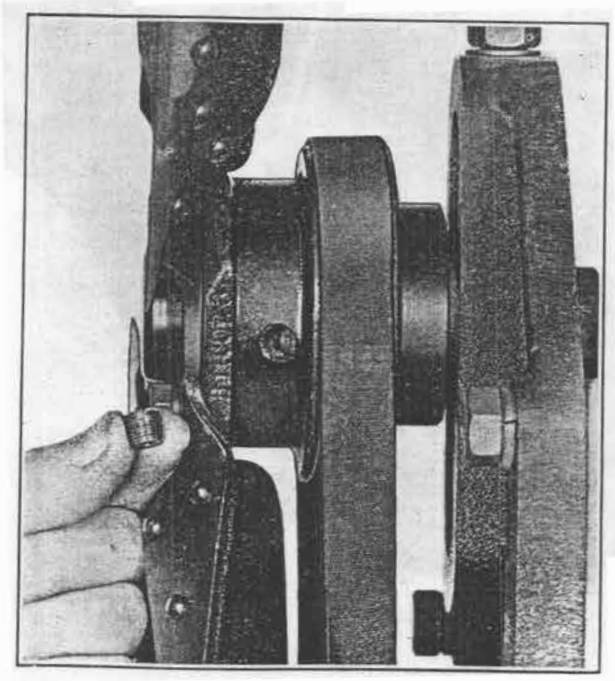


Illustration No. 29

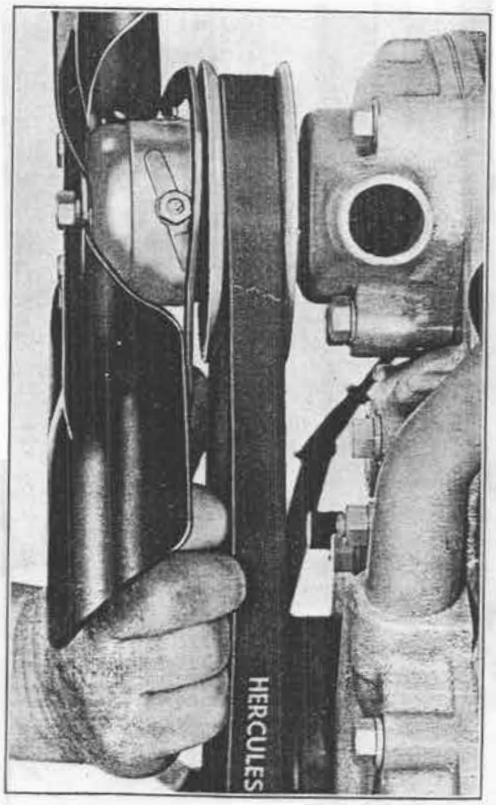


Illustration No. 30

FLYWHEEL

The various flywheels used on the IX series engines are usually made of cast iron and may be machined to accomodate different types and sizes of clutches as well as generator and other types of couplings. The flywheel is fastened to the crankshaft with four capscrews and two dowels. The timing mark which indicates that No. 1 and No. 4 pistons are on top center may be seen through a drilled hole provided in the bellhousing, Illustration No. 31.

Note: The location of the timing hole may vary with different installations.

TO REMOVE FLYWHEEL

1. Assuming that the clutch has been removed, remove the lockwires from the flywheel capscrews and remove the screws.
2. Remove starting motor.
3. Remove flywheel with the aid of a Lady-foot pry bar as shown in Illustration No. 32.
4. Inspect the flywheel and ring gear for damage.
5. If necessary to remove damaged ring gear, note position of chamfer on gear teeth, so new gear can be correctly installed.
6. The ring gear may be driven from the flywheel by use of a large drift and heavy hammer. When installing the new ring gear, the gear should be heated to, but not over 450°F. and then assembled to the flywheel. The ring gear must be assembled so that it is square and properly seated on the flywheel.

Illustration No. 31

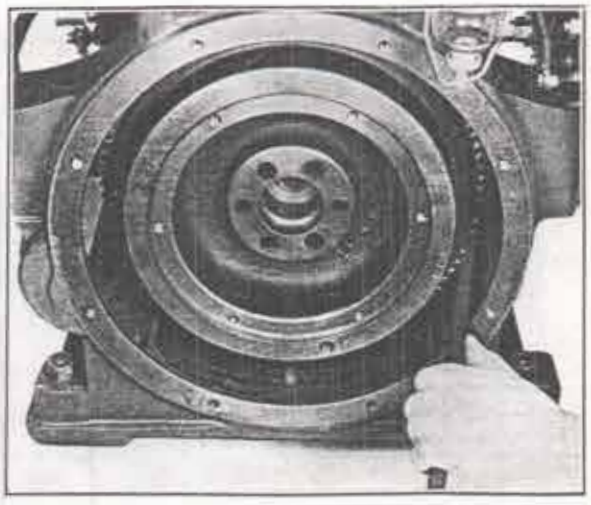


Illustration No. 32

REINSTALL THE FLYWHEEL

1. Assemble the new seal in bellhousing. See Page 30. Illustration No. 12.
2. Polish oil seal contact surface of flywheel. This surface must not be scratched, nicked or otherwise damaged.
3. Turn crankshaft so that No. 1 and No. 4 pistons are at top dead center position.
4. Install the flywheel on the crankshaft (use care that the flywheel timing mark is properly located in relation to timing hole in bellhousing) and draw into place with the flywheel screws. Do not draw any one screw down tight until all are progressively tightened.
5. Insert dowels and expansion plugs.
6. Attach indicator as shown in Illustration No. 33 to check concentricity of pilot bore. This should not exceed .005" total reading.
7. Place indicator in position shown in Illustration No. 34 to check face of flywheel. This should not exceed .005" total.
8. Install lock wires.

FUEL PUMP

There are many different types of fuel pumps used on the IX series engines, but a careful study of the following illustrations and test will be of assistance if repairs are necessary.

The fuel pump described is of the diaphragm type operated through suitable linkages by a rocker arm actuated from an eccentric on the camshaft. It is mounted at the rear of the crankcase below the manifold. Illustration No. 33 shows sectional view of pump with nomenclature of various parts.

Since in the great majority of cases trouble attributed to the fuel pump is generally caused by failure in some other part of the fuel system, therefore, be sure that the trouble is actually in the fuel pump before disassembling and repairing it. For instance, if the engine is not getting enough gasoline, check the level of the fuel in the fuel tank, check for broken, leaking, or clogged fuel supply lines. Then before removing fuel pump from engine, check for leaking bowl gasket, see Illustration No. 35, or loose diaphragm or top cover screws, see Illustration No. 41, or bad valves and springs, see Illustration No. 36.

If engine is getting too much gas, this is usually caused by defective choke arrangement, punctured carburetor float, defective carburetor needle valve or improper carburetor adjustment; this is generally not caused by the fuel pump.

REMOVING FUEL PUMP FROM ENGINE

1. Disconnect fuel line from tank and the fuel line to the carburetor and move out of the way.
2. Remove two attaching screws which hold the pump to crankcase and remove pump from crankcase, remembering that the rocker arm will catch on the case unless it is carefully pulled out of the small opening.

NOTE: If the fuel pump is forced away from the crankcase by the spring tension on the rocker arm this will indicate that the high point of the eccentric is toward the pump and in order to facilitate installation of the pump, the engine should be cranked over one full turn to place this high spot away from the fuel pump, opposite to that shown in Illustration No. 35.

DISASSEMBLING AND INSPECTING

1. Loosen thumb nut and remove bowl.
2. Remove bowl gasket and strainer.
3. Remove check valves. These will be found under hexagon nut and air dome. See Illustration No. 36.

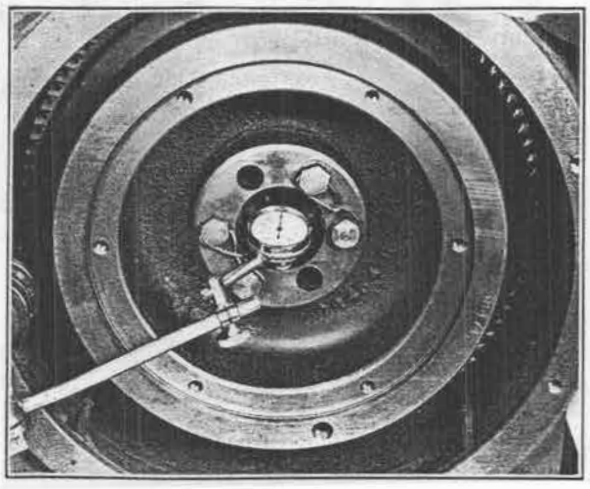


Illustration No. 33

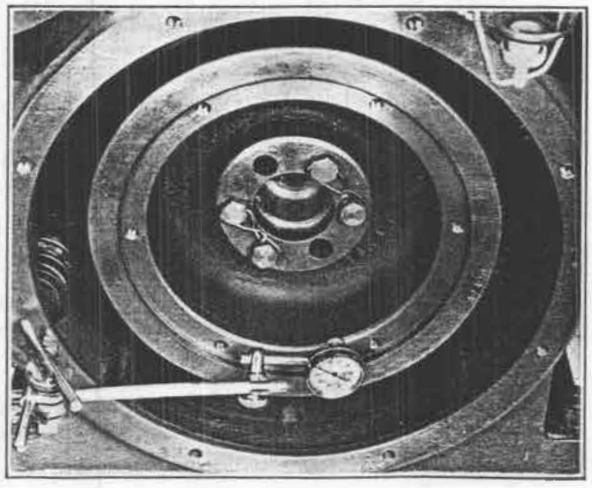


Illustration No. 34

4. Put a mark with chisel or file on top cover and body so pump can be reassembled in same position. See Illustration No. 41.
5. Remove top cover screws. At this point the top cover is completely disassembled.
6. Remove diaphragm from pull rod by taking off nut and diaphragm protector.
7. Remove three screws holding bottom cover, being careful not to lose springs and spring seats.
8. Remove rocker pin. This will allow pull rod, linkage and rocker arm to be removed.
9. Remove link pin from linkage to pull rod.
10. Inspect all parts carefully, discarding those which must be replaced. Parts with holes worn out of round and worn pins should be replaced as these cause lost motion in the actuating parts.

ASSEMBLING FUEL PUMP

A. Assembling The Top Cover

1. Thoroughly rinse the fine mesh wire screen in gasoline or a good commercial solvent. Dry it, being careful not to bend the screen.
2. Turn the top cover upside down. Put the screen into the bowl recess.
3. Place a new bowl gasket in position.
4. Thoroughly clean the bowl. Be sure that no lint is left in it. Then put the bowl in place over the gasket.
5. Swing the bail (wire loop) over the bowl. Tighten the bowl seat nut securely with your fingers. Be sure the bowl seat has not fallen off.
6. Turn the top cover right-side-up. Put a drop of light oil such as Finol (or equivalent) on a new inlet valve, then place valve in the well or recess over bowl. Be sure it lies flat. See Illustration No. 36.
7. Place a new inlet valve coil spring on top of the inlet valve.

NOTE: If the brass valve seats are worn or damaged, new ones can be installed. Special tools are required and can be secured from manufacturer.

8. Replace the inlet valve chamber plug and gasket, starting it with your fingers to be sure the valve spring fits up into the pocket in the plug. See Illustration No. 37.

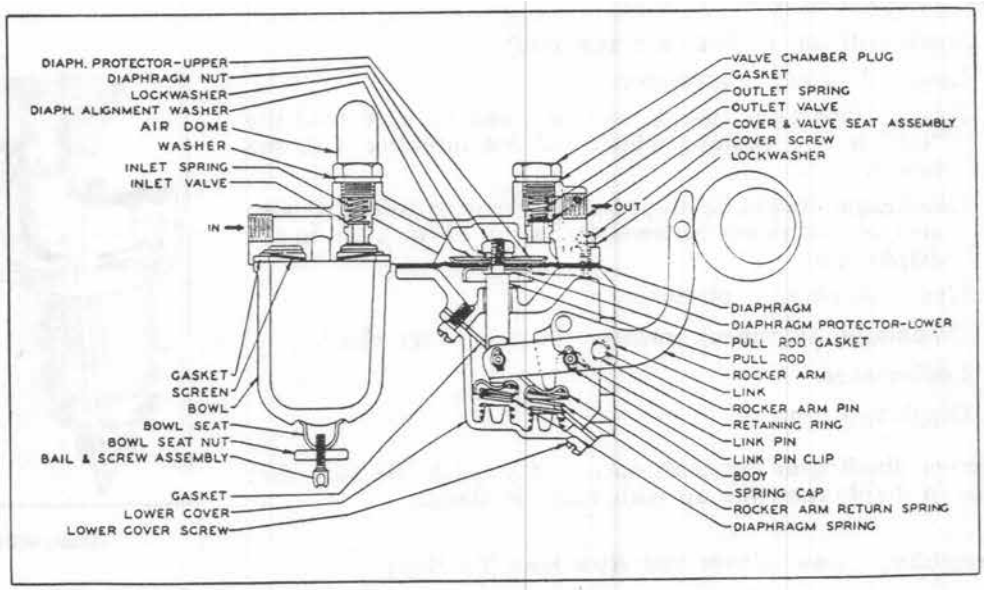


Illustration No. 35

9. Put a drop of Finol (or equivalent) on a new valve and place valve in the well or recess nearest the "outlet" opening.

10. Drop a new outlet valve coil spring down on top of the valve.

11. Replace the outlet valve chamber plug and gasket, in the same way you replaced the other plug.

NOTE: When air dome is used, it is always placed over the outlet valve.

12. The top cover is now assembled.

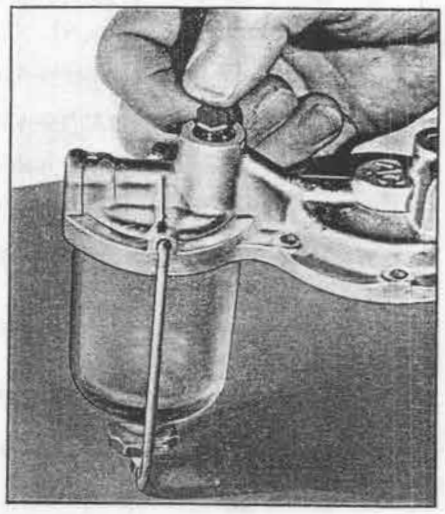


Illustration No. 36

B. Assembling The Body

13. Assemble the two links with one link pin and clips.

14. Attach the two links to the pull rod, with one link pin and clips. Illustration No. 38.

WARNING!—Notice that one corner of each link is cut off. This indicates the corner which should be nearest the diaphragm, when the links are attached to the pull rod. The pull rod slips between the links.

15. Install this assembly in the pump body, pushing the pull rod up through the hole provided for it.

NOTE: Be sure that the two links will swing to one side toward the rocker arm pinhole. This is necessary so that the rocker arm pin will pass through the holes at the ends of the links.

16. Hold the pull rod in position, and slip the rocker arm through the slot. Be sure that it slides in between the two links and that the projecting hook on it goes OVER the link pin.

17. Insert rocker arm pin through the holes in pump body (accessible from outside the pump body). See that the pin goes through one link, then the rocker arm, then another link.

18. Peen the edges of the pinhole over both ends of the pin with a pointed punch and hammer. If the rocker arm pin is of the kind which uses rings to hold it, slip the two spring rings into the grooves at each end of the pin. If the pin has a head on one end and a tapered, hollow end on the other, install a washer over the taper and spread the hollow part to retain in position.

19. Install the parts of the diaphragm assembly over the threaded end of the pull rod in the following order (See Illustration No. 39):

Small pull rod gasket (use new one).

Lower diaphragm protector.

Fabric diaphragm (use a new one, and be sure that the "tab" is in a position which will not interfere with the bowl).

Diaphragm should be dipped in kerosene to soften. It also acts as a lubricant between the layers of the cloth in the diaphragm.

Upper diaphragm protector.

Diaphragm alignment washer (six-sided, very thin).

Lockwasher.

Diaphragm nut.

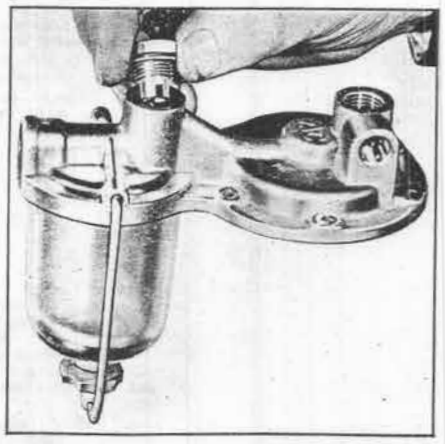


Illustration No. 37

20. Tighten diaphragm nut with open end wrench. Be sure that holes in diaphragm line up with holes in flange.

C. Assembling Lower Cover and Attaching To Body

21. Holding lower cover in your hand, set the rocker arm spring