

DESCRIPTION AND MAINTENANCE

and diaphragm spring in place over the two bosses (hollow cones) on the inside of the cover. See Illustration No. 40.

22. Put the two dished spring caps over the ends of the springs, rims down. See Illustration No. 40.
23. Place gasket on cover flange. See Illustration No. 40.
24. Holding the pump body over this lower cover with your other hand, bring them together. See Illustration No. 42.

NOTE: Be sure that the cup of one cap fits around the end of the pull rod and the cup of the other fits around the end of the rocker arm.

25. Install cover screws and lockwashers in holes provided, and tighten securely.

D. Attaching Top Cover To Body

26. Put the body in a vise. Line up the scratch on the edge of the body with the scratch on the edge of the top cover. See Illustration No. 41.
27. Get the diaphragm level by moving the rocker arm. Hold it while you put in at least two opposite screws and washers finger tight. Release rocker arm and install balance of screws and lockwashers. Be sure that they pass through the holes in the diaphragm easily without chewing the fabric. Tighten these screws only enough so that they just touch the lockwashers.
28. Actuate the rocker arm several strokes, releasing with a snap.
29. Tighten the cover screws. Do this alternately—first, a screw on one side, then a screw on the opposite side. Tighten all screws securely. The most important single item in the repair of fuel pumps is the proper flexing of the diaphragm when the cover is assembled to the body.

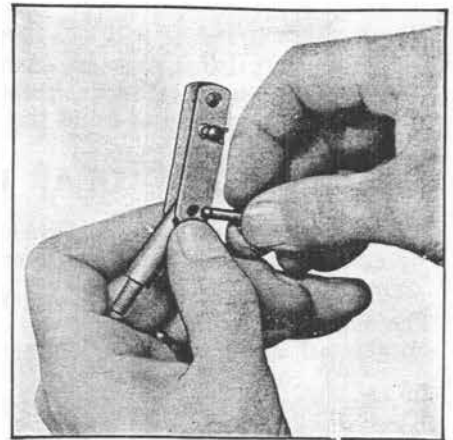


Illustration No. 38

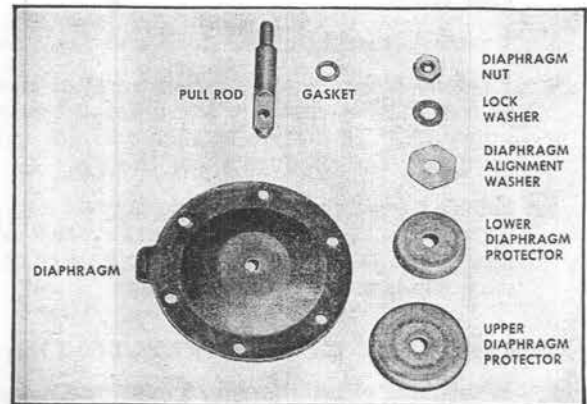


Illustration No. 39

TO TEST FUEL PUMP

Before installing fuel pump it is always desirable to test it. This can be accomplished as follows:

1. Hook the fuel supply line from the tank to the pump inlet connection.
2. Holding the pump in hand, work rocker arm using long, even strokes. After quite a few strokes the bowl will fill with fuel and after it is filled a few more strokes will force it through the pump and out the outlet side.
3. With strokes approximately $\frac{1}{4}$ " to $\frac{1}{2}$ " at the tip of the rocker arm, the pump should be able to deliver quite a bit of fuel. If it does not with these short strokes this would indicate that the diaphragm was not correctly installed or that some of the valves were sticking.
4. Disassemble and recheck.

INSTALLING FUEL PUMP

1. Place new gasket on fuel pump and if gasket cement is available, cement the gasket to the pump body and allow to dry.
2. Insert the rocker arm in hole in crankcase, being careful to keep the flange of the fuel pump in correct position while the two cap screws are started (some installations use studs and nuts).

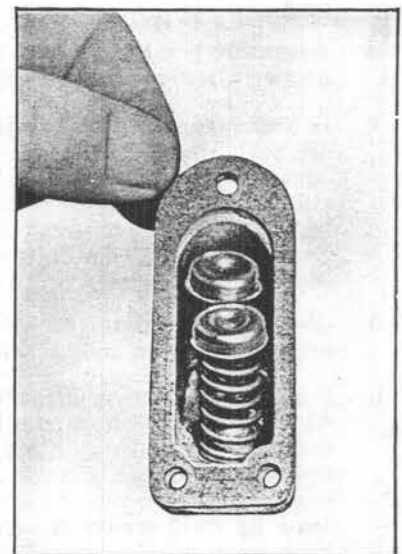


Illustration No. 40

3. A slight pressure will be exerted by the rocker arm springs while the screws are being pulled tight. However, if this pressure is excessive, remove pump and turn engine over one turn and endeavor to install the pump as outlined above. This light pressure can be noted but it should not be so excessively strong as to tend to bend the rocker arm or prevent installation.

GEAR COVER

The gear cover used on this engine is usually cast iron and covers the gear train at the front of the engine.

The governor and front support are mounted on the gear cover. The camshaft, idler shaft and water pump end thrust is controlled by suitable adjusting screws assembled in the gear cover.

TO REMOVE THE GEAR COVER

1. Assuming that the radiator has been removed, disconnect governor to carburetor control rod hooked to governor lever, Illustration No. 43.
2. Remove governor attaching screws and lift governor away from gear cover.
3. Remove starting crank grab and fan drive pulley.
4. Remove front motor support screws. If necessary to raise front of motor to release the front support, use a large block of wood under front of oil pan so jack will not damage it. The front support may be removed from the gear cover if necessary.
5. Remove gear cover attaching screws and pull gear cover forward away from the engine. The crankshaft oil seal will pull off the shaft with the gear cover. If no gasket or seals are available, use care when removing these parts.

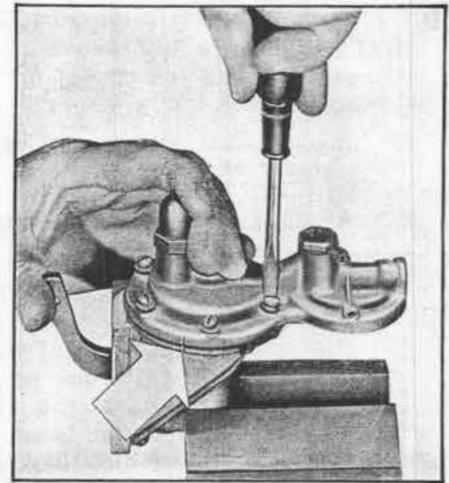


Illustration No. 41



Illustration No. 42

TO ASSEMBLE GEAR COVER TO THE ENGINE

1. Wash and clean the gear cover and fasten a new gasket to the gear cover with gasket cement. Loosen thrust screw lock nuts and back screws out two or three turns.
2. Carefully install the oil seal on the crankshaft and slide the seal about one inch back on the shaft. If available, use new seal and ring.
3. Assemble the gear cover on the seal. Use care that the seal is properly sealed in the groove provided for it in the gear cover.
4. In order to avoid any difficulty with the oil seal sleeve when pushing the gear cover back in place, loosen the oil pan and allow the front end of the oil pan to drop $\frac{1}{8}$ " to $\frac{1}{4}$ ". Then push the gear cover back into place. (To do this, relocate jack supporting engine.)
5. Check to see that the oil seal sleeve is properly located in the oil pan.
6. Start the gear cover attaching screws and with some tension on the lockwashers of the gear cover to cylinder block screws, tighten the oil pan screws, also the oil pan to gear cover screws. After these are tight, draw up the gear cover screws. Keep seal concentric with crankshaft.
7. Assemble front motor support.

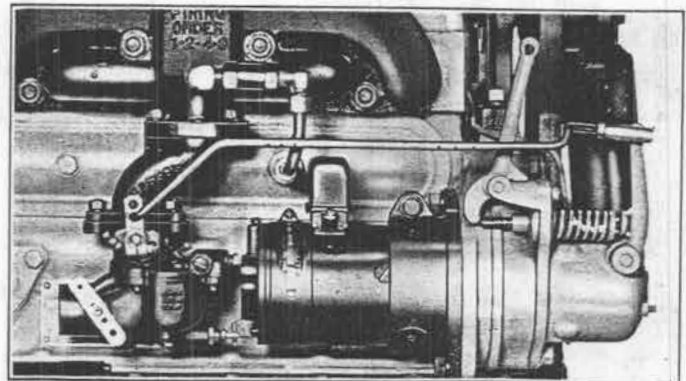


Illustration No. 43

DESCRIPTION AND MAINTENANCE

8. Assemble fan drive pulley and starting crank grab.
9. Assemble governor to gear cover and fasten in place with cap screws.
10. Connect governor to carburetor control rod.
11. Adjust camshaft, idler shaft and water pump thrust screws. To adjust these screws, loosen the lock nut and turn the screw until it contacts the thrust plugs in their respective shafts, then turn the screw out approximately $\frac{1}{8}$ th turn and tighten the locknut. See Illustration No. 44.

GENERATOR

A periodic inspection should be made of the charging circuit. The intervals between these checks will vary depending upon the type of service. Dirt, dust and high speed operation are factors which contribute to increased wear of the bearings, brushes, et cetera. Under normal conditions an inspection of the generator should be made every 100 hours.

1. **Wiring**—A visual inspection should be made of all wiring to insure that there are no broken wires and that all connections are clean and tight. Special attention should be paid to the ground connections at the battery and generator.
2. **Commutator**—If the commutator is dirty or discolored it can be cleaned by holding a piece of 00 sandpaper against it while turning the armature slowly. Blow the sand out of the generator after cleaning the commutator. If the commutator is rough or worn the generator should be removed from the engine, the armature removed and the commutator turned down.
3. **Brushes**—The brushes should slide freely in their holders. If the brushes are oil soaked or if they are worn to less than one-half of their original length they should be replaced.
4. **Lubrication**—Add 3 to 5 drops of medium engine oil to the oilers in the end heads every 100 hours of operation.

If the generator does not function properly after the above checks, the generator and the regulator or circuit breaker should be taken to an authorized service station for inspection and repairs.

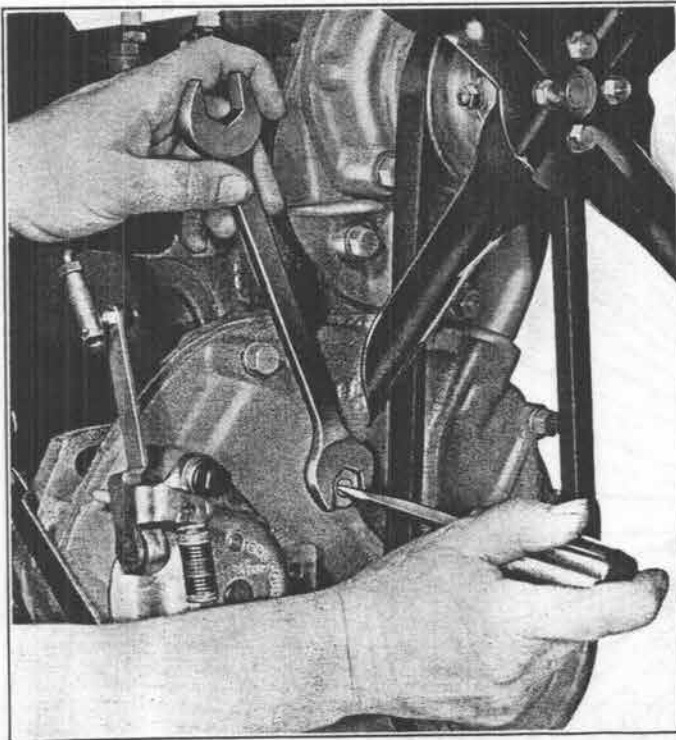


Illustration No. 44.

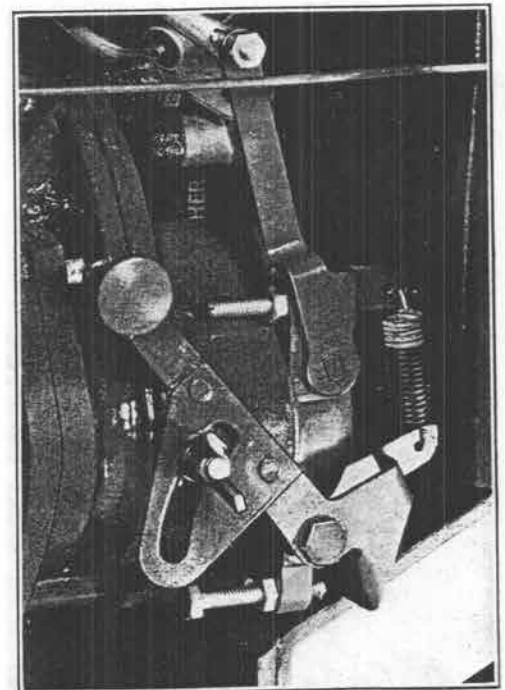


Illustration No. 45

GOVERNOR

Some engines are equipped with a governor for speed regulation which is mounted on the gear cover and is driven by a gear meshing with the camshaft gear.

The IX-5 engines are equipped with a governor similar to that shown in Illustration No. 43 while the IX-3 engines are equipped with a governor similar to that shown in Illustration No. 45.

This governor operates on the principle of centrifugal weights or "flyballs." In operation the force developed by the revolving weights is opposed or balanced by a spring called the operating spring. The spring is of the correct length and of the proper tension to control the engine speed at certain specified speeds with FULL LOAD.

CAUTION on maximum speed. The governor is set for the maximum engine speed at the factory and should require no further adjustment. However, if necessary the governed speed may be changed, within certain limits, by turning the screw, KS Illustration No. 46 in to increase or out to decrease the speed. Do not set governor for a higher speed than that specified for a particular application.

If governor surges, (sometimes called "hunting"), it may be necessary to make some slight adjustments. First make sure that spark plugs are clean and working properly and that carburetor jets are clean, also the carburetor throttle rod and all connections or joints on the governor rod work freely without binding and at the same time have no lost motion.

The length of the rod connecting the governor lever to the valve box lever is also important. The length of this rod should be such that with the engine at rest the valve box throttle should be wide open. The position of the surge spring, LE Illustration No. 46, should be such that it is compressed about $\frac{1}{16}$ " when the lever is pushed all the way to the closed position. However, it may be necessary, if the engine still surges, to loosen lock nut and turn surge screw out several turns. Then slowly screw it back until surging stops and then tighten lock nut.

If necessary to inspect or repair the governor it can readily be removed for this purpose. Disconnect governor control rod and lubricating oil line then remove the governor attaching screws and lift governor away from the engine.

TO DISASSEMBLE THE GOVERNOR — IX-5

The following reference letters are found in Illustration No. 46 (unless otherwise noted).

- Loosen governor operating spring adjusting screw KS and remove the spring KC and pilots KR and I.I.

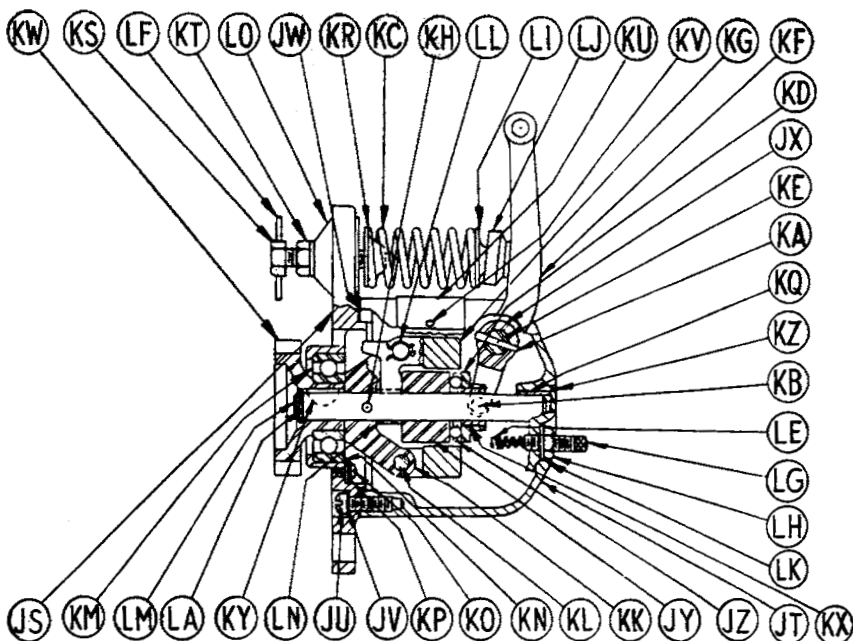


Illustration No. 46

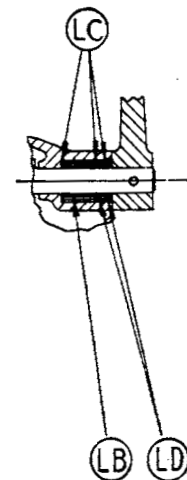


Illustration No. 47

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2. Remove screws JU and lockwashers JV then remove body assembly JT from base assembly JS.
3. Remove fork riser bearing JY from shaft I.M.
4. Remove snap ring LA and pull gear KW from shaft LM then remove Woodruff key KY.
5. Remove bearing retaining screws KO, lockwashers KP and plain washers KN then pull shaft and weights from base.
6. Remove weight pin clips LL, weight pins KL, and weights KG. (The weights are similar.)
7. Remove taper pin KH from weight carrier KK then with suitable support under weight carrier KK press shaft LM out of weight carrier. (These parts should be serviced as an assembly, therefore, this paragraph may be disregarded.)
8. Press shaft LM out of bearing KM.
9. Remove small expansion plug from body and with a small pin punch inserted through this hole remove fork pin KA.
10. Pull shaft KE and lever KF from body as an assembly. (CAUTION: be careful of the twelve roller bearings LB, Illustration No. 47, which may fall out when this shaft is removed.)
11. Remove packing retainer LC, packing LD, bearing retainer LC, roller bearings LB and inner bearing retainer LC, Illustration No. 47.
12. Remove bumper spring screw nut LH, screw LG, gasket LK and spring LE.
13. To remove bushing KQ remove expansion plug KZ and press out bushing.
14. Clean all parts and inspect for wear or damage.

TO REASSEMBLE THE GOVERNOR

1. Press bushing KQ into body KX and install expansion plug KZ.
2. Place bearing retainer LC, Illustration No. 47, in control shaft hole and insert roller bearings LB, outer bearing retainer LC, packing LD, packing retainer LC and insert control shaft KE, Illustration No. 46, while holding fork in position so that shaft KE may enter it. Be sure fork bumper spring arm is on the correct side. (Light cup grease applied to the roller bearings will hold them in place until the control shaft is installed.)
3. Install fork taper pin KA and small expansion plug.
4. Press shaft LM into bearing KM.
5. Press weight carrier KK on to shaft LM and insert taper pin KH.
6. Assemble weights KG, insert weight pins KK and lock with pin clips LL.
7. Assemble shaft and weight assembly in base plate JS and install bearing retainer screws KO, lockwashers KP and plain washers KN.
8. Insert Woodruff key KY and with suitable support under shaft press on gear KW and install snap ring LA.
9. Place fork riser bearing JY on shaft I.M with the large end toward the weights.
10. Place new gasket JN on base and assembly to body with screws JY and lockwashers JV.
11. Assemble operating spring pilot KR on adjusting screws KS.
12. Place pilot LI on spring KC and assemble spring and pilot to governor.

GOVERNOR IX-3

The instructions for the care, adjustments, etc., for this governor are the same as for the IX-5 governor.

CAUTION: If necessary to remove the governor, be sure that the timing of the gear is

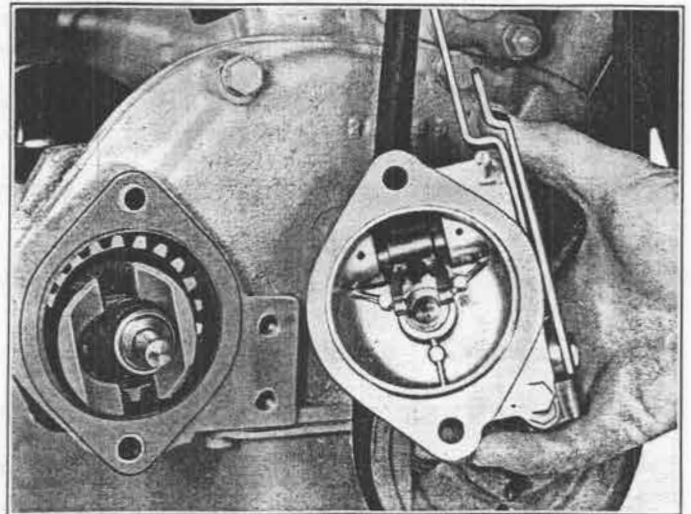


Illustration No. 48

known before it is disengaged from the camshaft. See Ignition Timing, Page 55.

If necessary to inspect or repair governor it can readily be removed for this purpose. Disconnect governor control rod. Then remove the two cap screws and lift governor cover assembly away from engine. Pull governor shaft and weight assembly forward out of engine, Illustrations No. 48 and No. 49.

With the governor disassembled to this extent all of the working parts can be inspected and tested to see that all working parts are free and not binding. If no repairs are necessary the governor should be washed in kerosene and then oiled before the parts are put back together.

Two or three tablespoons of oil in the governor housing before it is put back on the engine will provide lubrication until the oil collector groove supplies the governor with oil.

If further disassembly is necessary see instructions for "Disassembling Governor."

In the following instructions for disassembling and reassembling the governor all reference numbers refer to Illustration No. 50, unless otherwise noted.

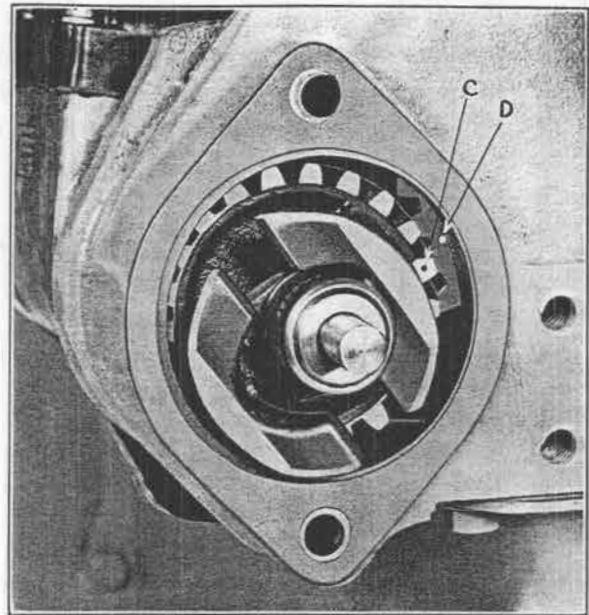


Illustration No. 49

TO DISASSEMBLE THE GOVERNOR COVER ASSEMBLY

1. Remove shoulder screw (M), disconnect spring (H) from lever (D) and remove lever assembly (L).
2. Remove plug (G) from cover (K).
3. With small pin punch drive taper pin (I) out of fork (F).
4. Pull lever and shaft assembly (D) from cover (K).
5. Remove bushing (J) from cover. Also remove cork seal (E).
6. Remove governor speed control screws (A and T) from cover.

TO REASSEMBLE GOVERNOR COVER ASSEMBLY

1. Press new bushing (J) in cover (K).
2. Insert new cork seal (E) in cover then hold fork (F) in position, (rounded tips of fork must be to the outside, see Illustration No. 51), and insert lever and shaft assembly (D). Lock in place with taper pin (I). Before drilling hole for pin (I) be sure fork and lever are in position shown. This is important.
3. Install governor body plug (G).
4. Install speed control screws (A and T), also lock nuts (B and U).

TO DISASSEMBLE SHAFT, GEAR AND WEIGHTS

1. Remove fork riser bearing (S) from shaft.
2. Remove snap ring (N) from weight pins (O) and, with suitable support under weights, drive out weight pins.
3. Press shaft (R) out of gear (Q).

TO REASSEMBLE SHAFT, GEAR AND WEIGHTS

1. Press shaft (R) into gear (Q) so that end of shaft is even with inner edge of slots in gear hub.
2. Assemble weights (P) and drive in pins (O). Install snap rings (N).
3. Install riser bearing (S) as instructed on bearing housing.

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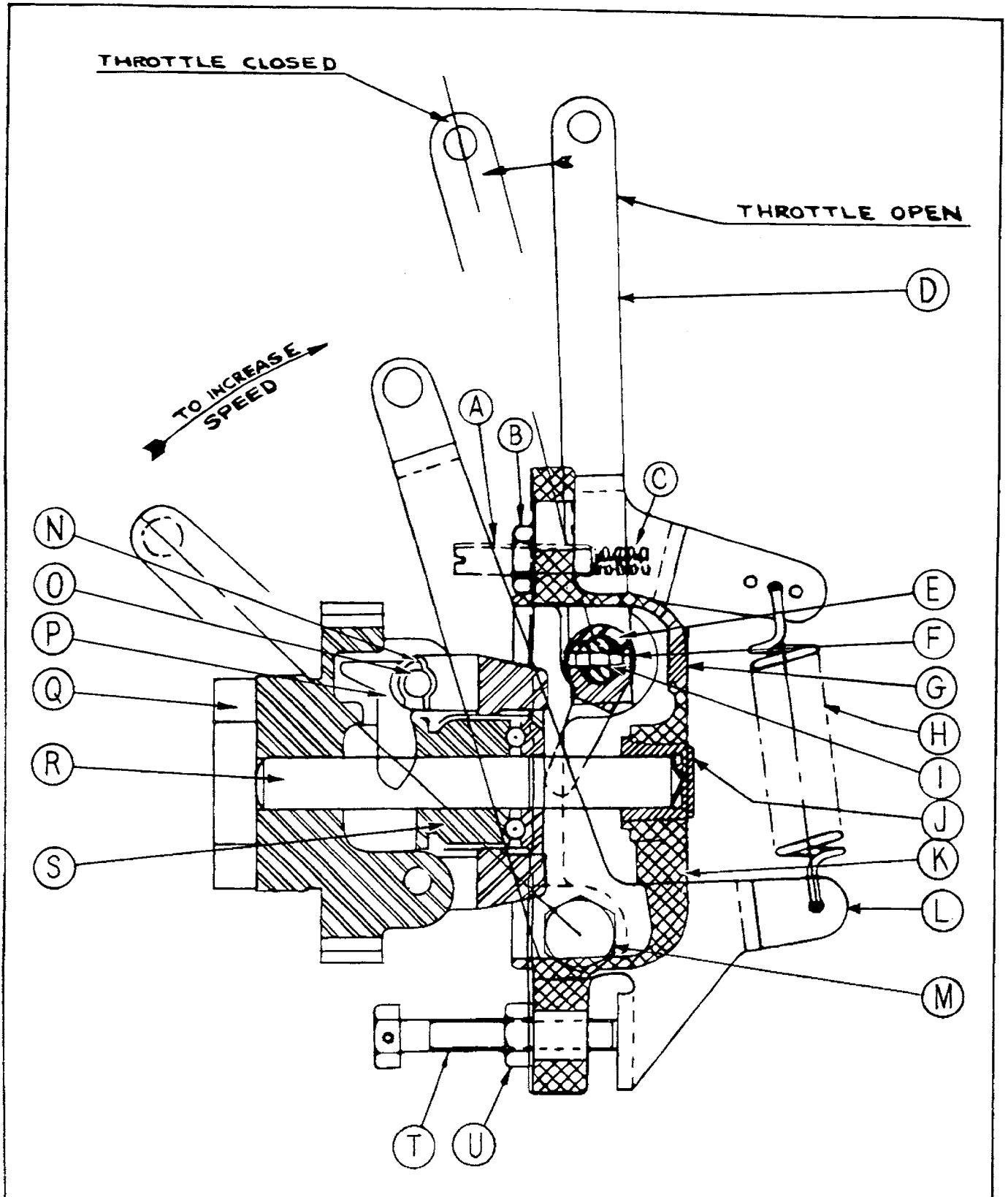


Illustration No. 50

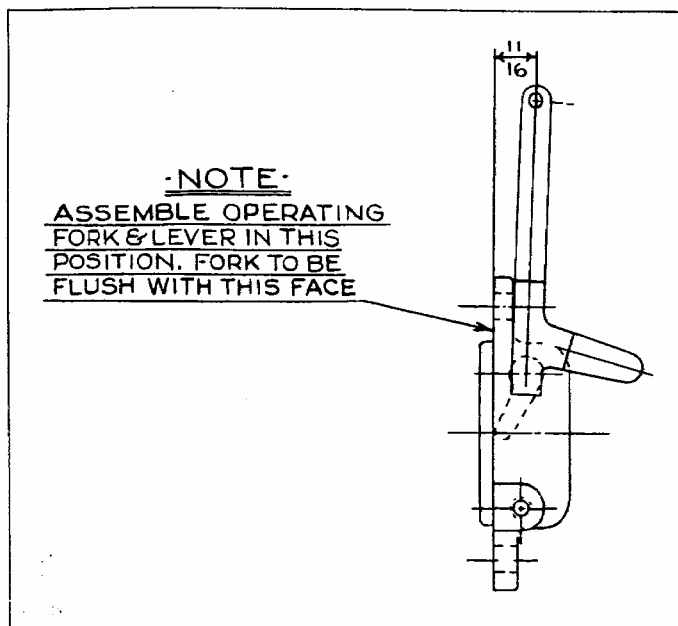


Illustration No. 51

GOVERNOR LUBRICATING PARTS

(See Oil Lines—Page 60.)



Illustration No. 52

IDLER GEAR

The idler gear (IX-5 engine) is supported on a shaft which in turn is supported in a bushing pressed into the cylinder block. The shaft is pressure lubricated from passages drilled from the main oil passage. By this method the timing gears are assured ample lubrication.

TO REMOVE THE IDLER GEAR AND BUSHING

1. Remove gear cover. See Page 48.
2. Pull idler gear and shaft forward out of crankcase.
3. Press shaft out of gear.
4. The bushing may be removed by using a puller as shown in Illustration No. 52.

TO INSTALL NEW GEAR AND BUSHING

1. Install new bushing. Note position of hole in bushing. Use extreme care that the oil hole in the bushing is in line with the hole in crankcase. A driver is used to install the bushing.
2. These bushings are usually reamed to size. However, try the shaft in the bushing; it should have .001" to .0015" clearance.
3. Insert Woodruff key in the idler shaft and press the shaft into the gear.
4. Apply a small amount of grease to the thrust washer. This will tend to hold the thrust washer onto the gear hub while the gear is being installed in the engine.
5. Start the shaft in the bushing, line up teeth so that they mesh with the cam and water pump, then press the gear into place. If camshaft or water pump gears have not been moved it will not be necessary to re-time the distributor. If the gears have been moved, see Ignition Timing below.
6. Reassemble the gear cover. See Page 48.

IGNITION TIMING (BATTERY)

NOTE: Since the ignition system is usually not furnished by the Hercules Motors Corporation, the following is inserted here for general information only. Instructions for ignition timing will differ slightly

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with different makes of electric equipment and the following is in the nature of general instructions suitable for any type of battery ignition. If the distributor has been removed or for any reason it becomes necessary to check or reset the ignition timing, proceed as follows:

There is a timing hole through the bellhousing for spotting engine, see Illustration No. 31. When the dead center mark (DC 1 and 4) on the flywheel lines up with the mark across the center of the hole in the bellhousing, the pistons for No. 1 and No. 4 are on top dead center. The first step in setting or checking the ignition timing is to locate the (DC 1 and 4) mark and line it up with the mark on the bellhousing. To determine whether the engine is in firing position for No. 1 or No. 4 the engine can be cranked with spark plugs removed to determine the compression stroke of one of these cylinders, or the valve tappet cover can be removed and the position of the valves noted. If both tappets for No. 1 cylinder are clear, indicating that the valves are closed, and exhaust on No. 4 is not completely closed, this will indicate firing position for No. 1 cylinder.

With the ignition points clean and making a square contact and set to the proper gap opening of .018" to .020", the points should be just beginning to open on dead center with retarded spark. The automatic advance or manual advance or combination of the two, whichever is employed, will then advance the spark to the proper position when the engine is running.

There are several methods of checking accurately the exact point of contact opening. One method is by using a test light which, if connected in series with primary circuit (when ignition switch is on), will be lighted when ignition contacts are closed and not lighted when contacts are open. To change ignition timing, loosen clamp screw holding spark control arm to distributor and turn distributor until correct timing is obtained and then tighten clamp screw. If distributor is being retimed after having been removed, it is now necessary to see if rotor lines up with distributor cap segment connected to No. 1 cylinder and that the remaining ones are connected in the order 1-2-4-3 which is the firing order of the standard engine. For counter-clockwise engine the firing order is 1-3-4-2.

MAGNETO IGNITION TIMING (IX - 3 SERIES)

TIMING THE MAGNETO

The camshaft on the IX-3 engines is timed to the crankshaft like all Hercules engines by lining up two punch marks, A and B, Illustration No. 14, on the camshaft and crankshaft gear. After these gears are correctly timed the gear cover is installed; then facing the governor opening in the gear cover, rotate the engine clockwise (this allows the camshaft gear to rotate counter-clockwise) until the punch mark on the camshaft gear can be seen through the governor opening.

There have been two different types of governor gears. The first type has only one punch mark while the second type has two designating timing marks. In some cases this has been a 2 and 3, A and C, Illustration No. 53, while in other cases it has been 20° and 34° (the marking 2 and 3 corresponds to 20° and 34°). The flange of the magneto is marked with the degree of timing to which the governor drive gear is to be timed to the camshaft gear.

After determining the degree to which the governor drive gear is to be timed, insert the governor drive gear and shaft so that the timing mark will line up with the punch mark on the cam gear. In other words, time these two gears the same as the camshaft and crankshaft gear were timed. See A and B Illustration No. 53 and C and D Illustration No. 49.

Next install the balance of the governor, making sure that the engine is not turned. In this way the slot in the governor gear will remain in the correct position to time the engine on No. 1 cylinder.

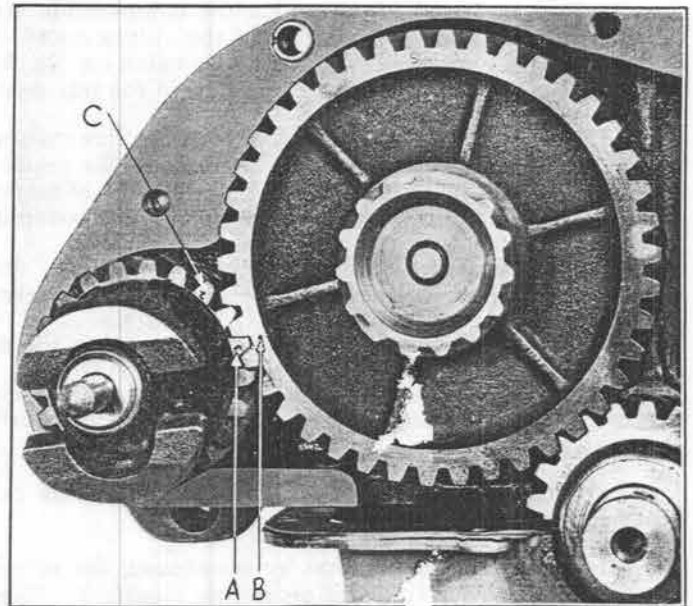


Illustration No. 53

HERCULES MOTORS CORPORATION

Now rotate the magneto which is off of the engine until it is ready to fire on No. 1 cylinder. It is possible that the tangs on the coupling of the magneto will be out of position with reference to the slot in the governor gear. This is due to the dogs of the magneto impulse coupling locking the impulse so that it will trip when the magneto is turned. Here either one of the two methods can be used for aligning the tangs with the groove in the gear. The first and easiest is to trip the impulse coupling by rotating the coupling, then back it up to a point where the magneto will slip into place. This is the point where the tangs and the groove coincide. The other method is to rotate the engine counter-clockwise which will move the slot in the gear back to the place where it will come in line with the tangs on the magneto when they are ready to take up the lag in the impulse coupling.

With the magneto in position tighten the cap screws or stud nuts finger tight so that the magneto can be moved or rotated. Now rotate the engine until the mark on the flywheel marked "Spark" is in the middle of the timing hole in the bellhousing. Then with the breaker cap off of the magneto move the magneto until the breaker points just start to open.

It is suggested that should the magneto be removed for any reason that the engine be set in such a position before its removal so that the magneto can be retimed without removing the governor.

If necessary to remove governor, be sure that the timing of the gear is known before it is disengaged from the camshaft gear.

MAGNETO IGNITION TIMING (IX - 5 SERIES)

The magneto, producing an ignition spark only at certain definite points in the rotation of the magnet rotor must be connected and timed to the engine in such a manner that the spark is always available at the instant it is required in the cylinder.

If the magneto has been removed for any reason and it becomes necessary to check or reset the ignition timing, proceed as follows:

There is a timing hole through the bellhousing for spotting engine, see Illustration No. 31. When the spark mark (do not confuse with DC mark) which is before top dead center of the flywheel lines up with the mark across the center of the hole in the bellhousing, the cylinders are in firing position. The first step in setting or checking the ignition timing is to locate the spark mark and line it up with the mark on the bellhousing.

To determine whether the engine is in firing position for No. 1 or No. 4, the engine can be cranked with spark plugs removed to determine the compression stroke of one of these cylinders, or the valve tappet cover can be removed and the position of the valves noted. If both tappets for No. 1 cylinder are clear, indicating that the valves are closed, and exhaust valve on No. 4 is not completely closed, this will indicate firing position for No. 1 cylinder. (No. 1 cylinder is the one nearest to the timing gears.)

a. Rotate the impulse coupling until the line on the distributor gear is visible in the observation window. This operation is best performed by turning the impulse coupling in the opposite direction of rotation to that in which it will be driven by the engine, thus eliminating the engagement of the impulse weights. (On some magnetoes the timing marks are on the impulse coupling and coupling housing.)

b. Mesh the impulse coupling with the engine drive. Approximate timing is now obtained. Carefully align the magneto with the engine drive and securely fasten the unit in place.

c. Remove the distributor plate by loosening the four screws. This will expose the interrupter assembly.

d. To obtain the exact timing, the interrupter points must just begin to open. It may be necessary, in order to get that position, to loosen the adjustable drive member and turn the impulse coupling in a clockwise or anti-clockwise direction.

e. Reinstall the distributor plate and insert the cable between outlet No. 1 and cylinder No. 1 which is then timed to fire correctly.

Complete the installation by connecting the remaining cables of the magneto to the spark plugs in their proper firing order (marked on engine manifold). The firing sequence on the distributor or high-tension end of the magneto follows the opposite direction of rotation from that indicated by the arrow on the magneto name plate and must be taken into consideration when the cables are connected to the spark plugs.

MAIN BEARINGS

The crankshaft is supported on three main bearings of very liberal dimensions. The bearing caps are each held in place by two alloy steel cap screws $\frac{9}{16}$ " in diameter.

Two types of bearings have been used which effect the bearing bore in the cylinder block and bearing caps. These are discussed in the following paragraphs.

In the poured babbitt type, the babbitt is poured directly to the caps after the caps have been properly tinned. In this type of bearing the upper half of each bearing is a babbitt lined, bronze shell $\frac{1}{8}$ " thick.

The alternate type is known as the shell type, and in this construction there is a removable shell in each cap as well as for the upper part. In this type of construction the upper shell is interchangeable with the lower shell for each bearing. The shell type has no shims for adjustment and reconditioning of this type bearing is accomplished only by replacing the shells. These Precision type shells are completely finished before being put in place and no line reaming or scraping is required. This allows renewal of bearings to be easily accomplished. The Precision type shells each have a small ear or projection which fits into a recess which allows the ear to rest against the adjoining case or cap to prevent the shell from rocking or rotating. These shells are approximately $\frac{1}{16}$ " thick and are not interchangeable with the upper shells used with the babbitt type caps.

ADJUSTMENT AND FITTING OF BEARINGS — Spun Babbitt Type

The bearings in these engines are readily accessible after the oil pan and oil pump are removed. The bearings are adjusted for excessive clearance, due to normal wear, by removing shims. The bearings should never be adjusted so tight that they bind or grab. A certain minimum clearance is required at all times to provide an adequate oil film between the shaft and bearing and insure a free running engine. The bearings in these engines are of ample proportion and the full pressure lubrication system employed will give long lasting bearings provided they are not adjusted too tight. The best method is to remove just enough shims from each bearing in turn until the shaft can be turned only with considerable effort, then add the proper amount of shimming to each side of bearing. See Table of Clearances, Page 77. Shim thickness corresponding to the clearance figure given in the table should be added to each side of the bearing. While testing each bearing for tightness by cranking, the spark plugs should be removed to relieve compression and the other bearings should be comparatively loose. After all bearings are adjusted and all caps tightened it should be possible to turn the shaft readily with the crank. When using trial shimming to get the proper drag on the shaft and before adding the clearance shimming, the shims can be decreased .001" by removing a .003" and putting in a .002" shim on each side. To increase the shimming .001" at a time remove a .002" shim and put in a .003" shim on each side.

Tightening of main bearing cap screws requires some care to prevent too much strain on the parts. Special wrenches are on the market which enables the mechanic to measure the force of his pull when tightening such parts. The wrench tension values given on Page 77 show the correct amount of pull to use on various screws. No attempt should be made to refit these bearings by filing or grinding the caps as this will ruin the cap so new shells cannot be installed.

REPLACEMENT OF MAIN BEARINGS— Shell Type

It is not necessary to remove the engine from the unit to replace the shell type main bearings. Unless of course, the crankshaft is damaged or worn to the extent that it must be replaced.

The following outline may be used as a guide when replacing the bearings when the engine has not been removed from unit.

1. Disconnect battery cable at battery.
2. Disconnect starter cable and wiring then remove starter.
3. Drain crankcase oil.
4. Remove oil pan.
5. Remove oil pump.