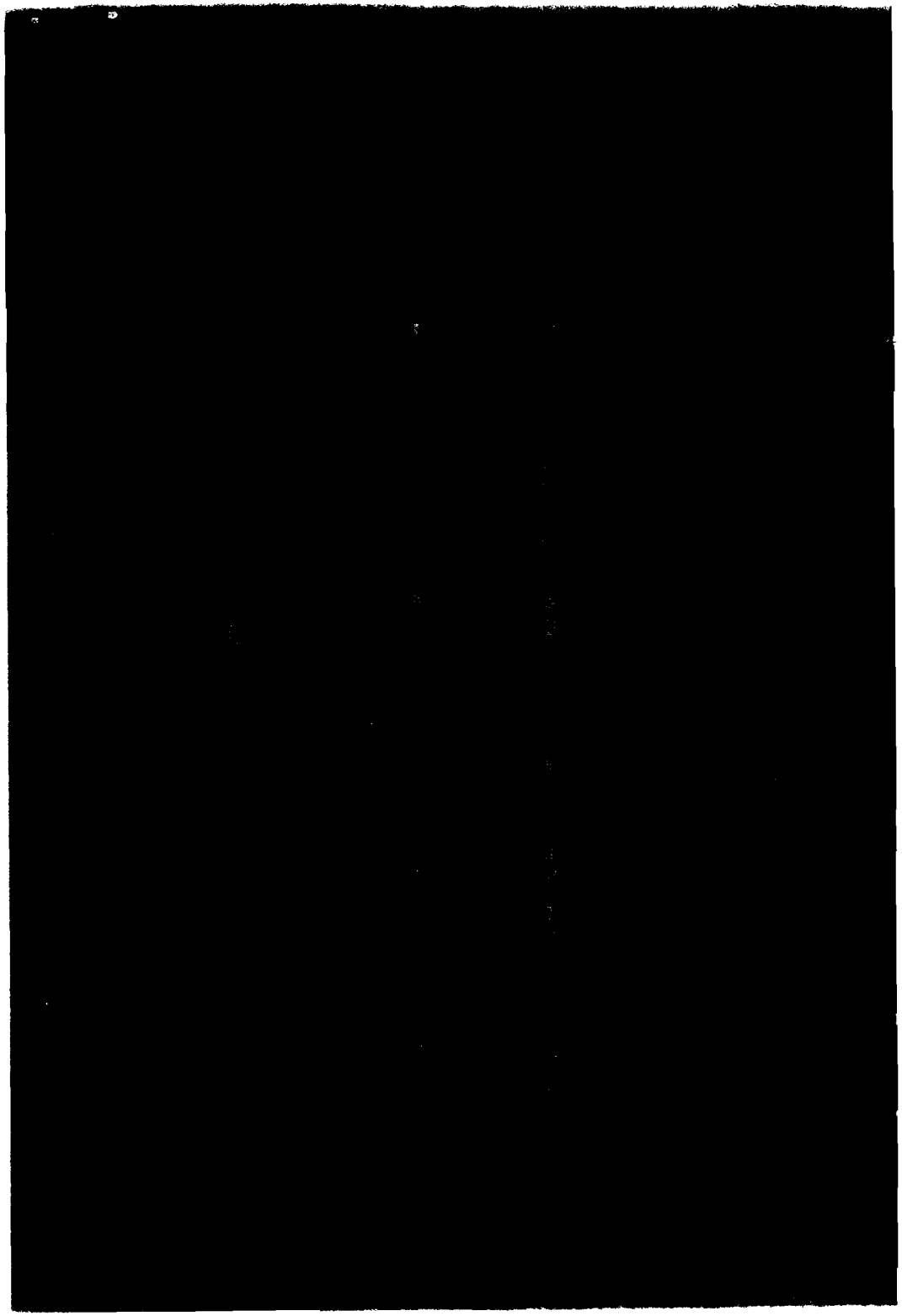


THE HOWARD ROTAVATOR "GEM" SERIES IV.
TWIN ENGINE—Part 1.

DATA:

Type: Vertical twin. Overhead valve.

Crankshaft: Steel forging. 180 crank.

Max. H.P.: 9.8 b.h.p. at 2,000 r.p.m.

Cylinder Bore: 3″

Cylinder Stroke: 3½″.

Piston Displacement: 810 c.c.

Piston: Alloy. Split skirt type.

Ring Equipment: **Top**—Compression chrome-plated.
2nd—Compression plain.
3rd—Oil Control slotted type.

Gudgeon Pin: ¾″ dia. circlip located.

Connecting Rod Bearings: Big End: Replaceable shell type. Small End: Split type steel-backed bush.

Main Bearings: Ball bearing (2).

Compression at Cranking Speed: 90 lbs. per sq. in.

Lubrication System: Wet sump (splash system).

Ignition System: Type: Wico A 1137 BZ Magneto 180 Twin.
Drive: Spur Gear.
Rotation: Clockwise (engine speed)
Magneto timing: 30°-35° B.T.D.C.
Sparking Plugs: KLG, FESO, Champion N8 or N7

Carburettor: Make: Amal.
Type: 225
Adjustments - Idle Mixture: 1 screw.
Adjustments - Main Mixture: 1 screw
Adjustments - Idle Speed. 1 screw.

Governor: Type: Variable speed, mechanically operated, centrifugal.

Governed speed range: 1,800-2,400 r.p.m.

Cooling System: Air blast from flywheel fan.

Sump capacity: 2 pints.

WHY THE 180° CRANKSHAFT?

The Twin Engine of the Howard Rotavator 'Gem' Series IV Model was designed to incorporate all those features desirable and necessary for the soil and climatic conditions in which the machine would have to operate.

Any engine will draw air into the crankcase if it develops a condition in which, at some point in its cycle a depression exists in the crankcase. If that air is polluted by fine abrasive particles from a dust-laden atmosphere, the bearing surfaces will suffer loss of efficiency and life.

By using the 180° crankshaft, the possibility of a depression existing in the crankcase is entirely eliminated. The exact displacement of the ascending piston against that of the descending piston maintains a balanced condition in the crankcase, thus eliminating the tendency to draw dust into the crankcase experienced in single and V Twin cylinder engines.

LUBRICATION SYSTEM

The Twin Engine has a splash system of lubrication which dispenses with an oil pump.

Oil is contained in the engine sump. The sump is divided into two equal parts, one compartment for each cylinder. In each compartment is fitted an oil trough into which the oil slinger, forming part of each connecting rod, dips.

When the 'Gem' is operating under normal conditions, the engine will not be working on an even keel. The oil in the sump would therefore find its own level, and this would possibly cause starvation to one or other of the two cylinders.

This is the reason for the partition in the engine sump. It ensures that an equal amount of oil is supplied to each cylinder under all conditions. Further, to ensure that oil

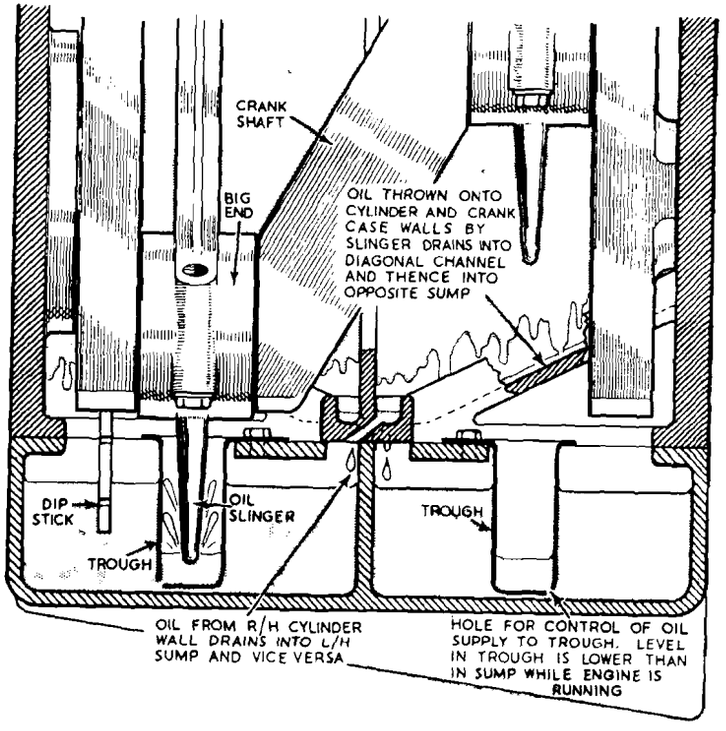


FIG. 1 DIAGRAM SHOWING PRINCIPLE OF DIVIDED SUMP

draining down the walls of the crankcase does not flow into the lower compartment of the sump, troughs are cast on the wall of each crankcase compartment. These troughs are positioned diagonally to provide a conduit to the centre of the crankcase. The outer wall of the crankcase is drilled diagonally, and the trough on the wall of the first compartment is thus connected with the second compartment in the engine sump. This ensures that should the engine operate for a long period at an angle, there will not be an oil build-up in that compartment of the sump which is lower.

To top up the oil level, follow this procedure:

1. Check that the machine is standing level. Then check the oil level. Unscrew the dipstick (on the right-hand side immediately below the governor radius arm). Wipe clean, dip and note level without engaging the thread on the dipstick. The level should be maintained above the lower mark on the dipstick, but not above the higher mark.

2. Remove the filler cap (on the right-hand side of the engine, just below the carburettor). Fill with the appropriate grade of oil until the level on the dipstick is half-way between the high and low marks. Tighten the filler cap and dipstick.

3. Run the engine for about 30 seconds and again check the oil level, which will now be on the high mark. This is because, when filling, the oil flows into the rear compartment of the crankcase which has to overflow before the front compartment is filled. When the engine is started, the surplus oil in the rear compartment is transferred to the front compartment by the transfer troughs on the crankcase wall.

LUBRICATION OF OVERHEAD VALVE AND ROCKERS

Lubrication is here obtained by using the pumping action of the cam followers which draw oil from small reservoirs machined in the face of the crankcase at the cylinder base. These reservoirs are filled by oil draining from the cylinder wall.

The hole drilled from the reservoirs breaks into the bore of the cam follower when the cam follower is at the bottom of its stroke. The cam follower is cup-like in construction, and the cup fills with oil.

A pressed-in insert is fitted in the top of the crankcase cam follower and has a reduced section which, as the cam follower rises, enters the cup in the cam follower and displaces the oil. This oil then escapes through the centre of the insert, up the push rod tube, and so to the overhead valve and rockers.

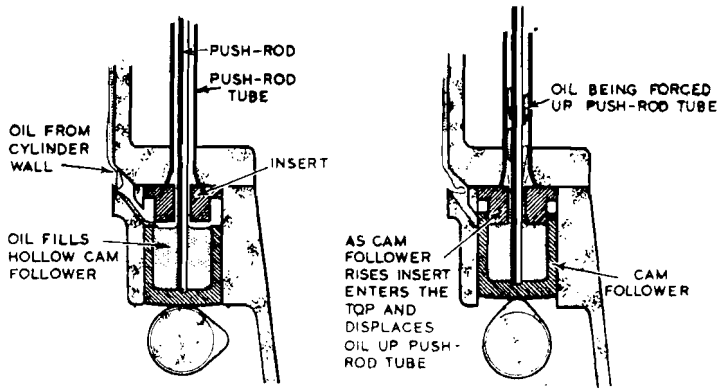


FIG. 2 SHOWING HOW VALVE ROCKERS ARE LUBRICATED BY PUMPING ACTION OF NO.'S 1 & 3 CAM FOLLOWERS.

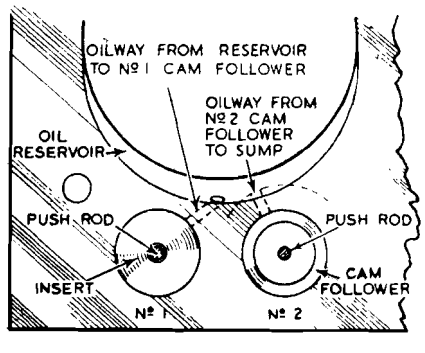


FIG. 3 PLAN OF OILWAYS TO CAM FOLLOWERS

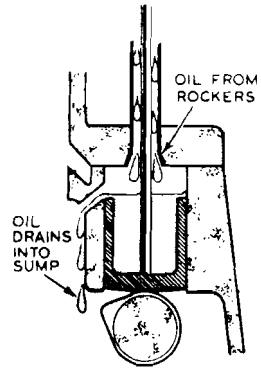


FIG. 4 OIL RETURN VIA NO.'S 2 & 4 CAM FOLLOWERS

Oil is returned by gravity from the overhead valves and rockers to the crankcase through the push rod tubes nos. 2 and 4.

AIR FILTER

Filtration of air taken into the engine during the induction stroke is of great importance, and the servicing of the Air Filter must not be neglected.

The lower compartment of the filter must be filled with engine oil to the level of the **bottom** of the air inlet pipe. To service: wash the element in paraffin or petrol daily and if working in very dusty conditions, more frequently.

Failure to maintain the air cleaner and connecting hose in good condition will result in rapid wear due to the ingress of abrasive dusts.

(To be continued)

THE HOWARD ROTAVATOR 'GEM' SERIES IV.

THE TWIN ENGINE—PART II.

DISMANTLING

Dismantling should only be done by skilled mechanics, and only when some mechanical fault has developed that makes it really necessary.

Before dismantling make sure that the fault has been found and that the necessary new parts are to hand. Faults that can be detected by feeling the fit of the bearings both laterally and endwise, etc., can rarely be diagnosed once the engine is dismantled.

PREPARING THE ENGINE

Start the engine and allow it to warm up for about five minutes.

Stop the engine and drain the oil from the sump through the two brass plugs situated on the right hand side of the sump.

Replace the plugs and washers.

Disconnect the throttle and exhaust lifter controls, and the fuel pipe and air cleaner hose from carburettor.

Obtain a box or suitable block to support the engine under the sump. The height of support needed can be adjusted by adjusting the 'Gem' depth control.

Remove the set screws securing the engine to the gear box flange.

The 'Gem' can now be pushed away from the engine, leaving the engine on its support.

Transfer the engine to a clean bench, clear of other machines, where the actual dismantling can be done.

Put some paraffin in a shallow cleaning tray for cleaning each part as it is removed from the engine. After washing, dry each part and place it on the bench in assembly order. This is of great assistance when viewing parts for service-ability.

DISMANTLING SEQUENCE

1. Remove the silencer and manifold with carburettor fitted as a complete unit. Remove the manifold gasket from the cylinder head to prevent its being damaged.

2. Remove the set screws holding the timing cover to the crankcase. Draw out the split pins and slacken the nuts holding the crankshaft and camshaft gear. Mark with paint the mating gears and the engaged keyway in the camshaft gear. This ensures exact replacement, on reassembly. **(See Fig. 1).**

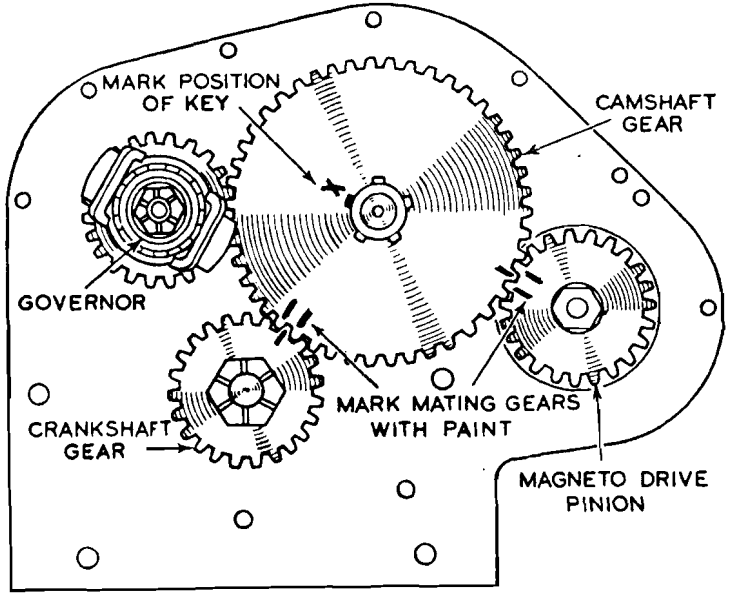


Fig. 1.

Timing gears should be marked before removal.

3. Remove the fan flywheel nut and slacken the flywheel on its taper (tapped holes provided).

4. Remove engine cowl and cowl plate.

5. Remove the two knurled hand nuts holding the rocker cover and lift the cover, taking care not to damage the gasket.

6. Remove the six $\frac{3}{8}$" B.S.F. nuts holding the cylinder head. The three under the valve cover also hold the rocker assembly.

7. Lift the rocker assembly clear of the studs.

8. Remove the cylinder head.

9. Mark the tops of pistons to ensure correct reassembly.

10. Remove the cylinder head gasket.

11. Remove the cylinder block taking care that the pistons and connecting rods are not permitted to fall against the crankcase and thus be damaged.

12. Remove the cylinder holding studs.

13. Remove the internal circlips from the piston gudgeon pin bores Push the gudgeon pin out and remove the piston.

14. Lay the engine on its side and remove the bolts holding the engine sump. Remove the sump and gasket.

15. Remove the big end bolts from con. rods and having removed the con. rods, reassemble the caps and bolts to their respective rods.

16. Remove the flywheel (which was slackened earlier) and flywheel key.

17. Remove the six $\frac{3}{8}$" B.S.F. set screws holding the fan housing and with a soft hammer tap the fan housing away from the crankcase.

18. Remove the circlip located in the bore of the front main bearing on the inside of the crankcase. **(Fig 2).**

19. With a soft hammer tap the crankshaft out of the crankcase. Screw the flywheel nut on the crankshaft

to protect the thread. Bind the big end journals with insulating tape to protect the bearing surface.

20. Remove the slackened camshaft nut and draw off the camshaft gear.

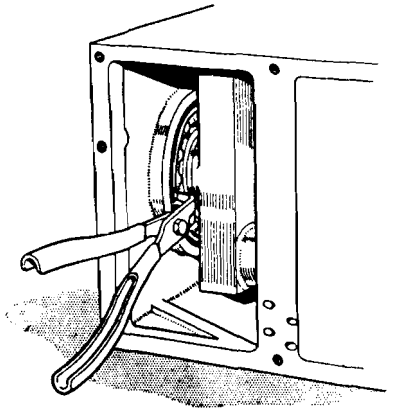


Fig. 2.

Showing tool used in removing and replacing front main bearing circlip.

21. Remove the pinch bolt from the governor radius arm and draw off the arm. **(Fig. 3).**

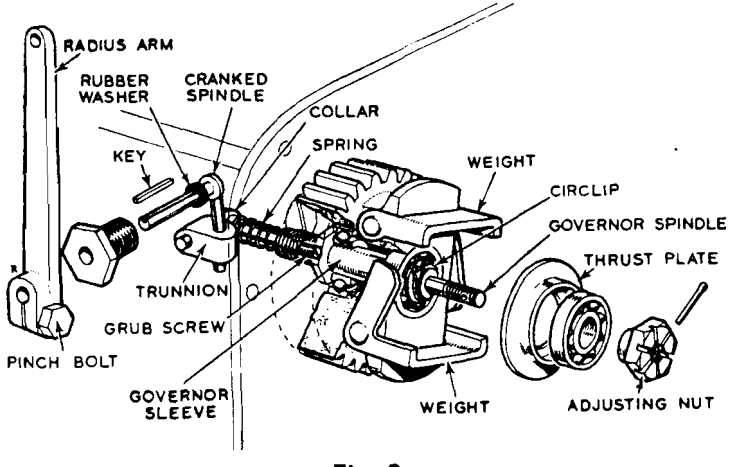


Fig. 3.

Cutaway view of the governor.

22. Remove the split pin from governor adjusting nut; and adjusting nut complete with thrust plate and bearing.

23. Draw out the governor spindle and spring from the inside of the crankcase.

24. Unscrew the threaded bush for the cranked spindle and remove the cranked spindle from the inside of the crankcase.

25. Remove the $\frac{1}{2}$" external circlip which locates the governor weight assembly on the governor sleeve.

26. Draw the governor weight assembly off the governor sleeve.

27. Remove the 2 BA grub screw locking the governor sleeve to the crankcase end plate and unscrew the governor sleeve.

28. Take off the crankcase end plate by removing the five $\frac{3}{8}$" BSF Hex. head setscrews and the one $\frac{3}{8}$" BSF counter sunk headed setscrew.

29. Remove the camshaft.

30. Tap the cam followers out with a long drift from the inside of the crankcase. The inserts in the bores of Nos. 1 and 3 cam followers will come out with the cam followers.

ASSEMBLY SEQUENCE

Assembly—No. 1.

(a) Fit main bearing to crankshaft with 3" internal circlip behind the front ball bearing.

(b) Fit the crankshaft pinion (Part No. 25285 Woodruff No. 60).

(c) Crankshaft timing pinion (Part No. 25194) $\frac{5}{8}$" B.S.F. plain washer $\frac{5}{8}$" slotted nut and secure with $1\frac{1}{2}$" x $\frac{1}{8}$" split pin.

Assembly—No. 2.

Consisting of:—Crankcase, Part No. 25126. Crankcase end plate, Part No. 25195. End plate gasket, Part No. 25196 $5\frac{5}{8}$" x $\frac{3}{8}$" B.S.F. Hex. Head. Setscrews, Part No. S/7 & 4/5 $1\frac{5}{8}$" x $\frac{3}{8}$" B.S.F. counter-sunk setscrew, Part No. S/7 1 camshaft, Part No. 25190.

(a) Fit camshaft to crankcase. Position end plate gasket with jointing compound and secure end plate to crankcase with $5\frac{3}{8}$" Hex. headed setcrews and $1\frac{3}{8}$" counter-sunk headed set.

Assembly—No. 3.

Consisting of:—1 Governor pinion, Part No. 25220. 2 Governor weights, Part No. 25253. 2 Governor pins, Part No. 25254.

(a) Assemble governor weights as shown in **Fig. 3.**

(b) Fit B.R.E. $\frac{1}{2}$" S5 bearings (Part No. 25354) into governor pinion.

(c) Screw sleeve (Part No. 25229) into assembly No. 2 and secure with 2BA grub screw. Press governor pinion with bearings fitted on to the sleeve, and secure with external $\frac{1}{2}$" circlip.

(d) Fit from the inside of the crankcase the cranked spindle (Part No. 25248) and from the outside, slide on to the keyed section of spindle the sleeve (Part No. 25317) and screw into crankcase. Hold the cranked spindle tight against the sleeve to ensure the rubber washer makes an oil seal and fit the radius lever (Part No. 25954) not forgetting the key and pinch bolt.

(e) Fit the collar (Part No. 25579) and governor spring (Part No. 25254) on to the governor spindle through the sleeve 25229 from the inside of crankcase. On the hooked end of the governor spindle and the cranked spindle fit the trunnion (Part No. 25347), thus making a link between the two.

(f) Press on the governor spindle from inside the crankcase, thus compressing the governor spring so that

the threaded end of the spindle protrudes beyond the end of the sleeve between the governor weights. Screw on this the adjusting nut (Part No. 25240) to which is assembled the thrust plate (Part No. 25225) and the bearing (Part No. 25354). Secure the adjusting nut with a 1/16" split pin. Check for freedom of operation.

Assembly—No. 4.

Consisting of:—Fan housing gasket (Part No. 25256) Fan Housing (Part No. 25129) Oil seal (Part No. S/225) and Assembly No. 1 and 2.

(a) Fit crankshaft oil seal in fan housing. Fit crankshaft to fan housing and with fan housing lying on the bench with crankshaft upward, place the crankcase with fan housing gasket in position over the crankshaft. Enter the front main bearing into the crankcase bore and with a few light blows from a soft hammer drive the crankcase on to the front main bearing until the bearing has entered the crankcase bore far enough to permit the 3" internal circlip to be inserted in the bore behind the bearing. Continue driving the crankcase on to the spigot of the fan housing. Secure the fan housing to the crankcase with six $\frac{7}{8}$" x $\frac{5}{8}$" BSF set screws. Fit the 3" internal circlip behind the front main bearing in the groove in the crankcase bearing bore.

Assembly—No. 5.

Consisting of the fan flywheel (Part No. 25128) and the flywheel nut (Part No. 25187) complete with LS5 Bearing and washer. Flywheel key (Part No. 25285). Fit flywheel key to crankshaft. Fit fan flywheel and secure with flywheel nut $\frac{1}{2}$".

Check crankshaft for freedom of rotation.

Assembly—No. 6.

Consisting of :—Cam followers (Part No. 25239) and cam follower inserts. Assemble cam followers in their bores making certain they are free in their bores. Tap the inserts into the bore of No. 1 cam follower and No. 3. cam follower.

Rotate camshaft to check that the inserts are not fouling the cam followers.

Assembly—No. 7.

Assemble the camshaft timing gear (Part No. 25204) to camshaft mating the paint-marked gears.

(For valve timing see under heading—Valve Timing).

Secure the gear to camshaft with 9/16" plain washer, 9/16" slotted nut, locking the nut by split pin.

Assembly—No. 8.

Magneto assembly consisting of :— Magneto (Part No. 25310), Magneto flange (Part No. 25201), Magneto Pinion (Part No. 25199), Magneto gasket (Part No. 25255).

Secure the magneto to the crankcase end plate with four ¼" B.S.F. set screws having first located the gasket with jointing compound. (Mate the paint marked gears).

Check crankshaft for freedom of rotation.

Assembly—No. 9.

Assemble pistons (Part No. 25290) to connecting rods (Part No. 25124). To move gudgeon pin in the piston place piston in boiling water. Oil small end bearing and gudgeon pin. Secure gudgeon pin in piston circlip.

Remove bearing caps from connecting rods. Insert pistons in their appropriate cylinder bores with the split skirt of the piston towards the side of the cylinder bore receiving least thrust. **(Fig 4). Oil bore and piston.**

Fit the cylinder base gasket after applying jointing compound. Place cylinder with pistons and connecting rods over the holding down studs and press down on to crankcase.

Oil Journals and Big Ends.

Lay the engine on its side, locate the connecting rod big ends on their appropriate crankshaft journals. Fit big end caps, tighten big end bolts.

Check crankshaft for freedom of rotation. Lock big end bolts with soft iron wire.

Assembly—No. 10.

Engine Sump (Part No. 25).

Fit oil scoop trough (Part No. 25189), secure with ¼" BSF set screws (Part No. 25) which must be locked with soft iron wire. Locate sump gasket (Part No. 25186) with jointing compound and secure the sump to crankcase with 10 ¼" BSF bolts.

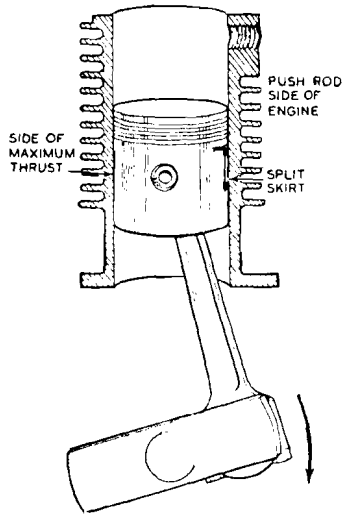


Fig. 4.

In assembling pistons split skirt should be on the side of least thrust, i.e.—push rod side of engine.

Asembly—No. 11.

Fit the cylinder head gasket. Insert the four push rods in the push rod tubes in the cylinder block.

Assemble the cylinder head to the cylinder, complete with valves assembled.

Assemble rocker assembly on the three cylinder holding studs between valves and push rods.

Secure cylinder head and rocker assembly with the six ⅜" BSF nuts and ⅜" plain washers.

Adjust clearance between rocker and valve by means of the adjusting screw (Part No. 25298) situated on the push rod end of the rockers. Clearance should be .002" or with engine hot, nil clearance; but push rods should rotate freely with finger and thumb. Check valve and magneto timing cover and gasket.

Assembly—No. 12.

Assemble rocker cover and gasket with exhaust lifters assembled, and secure with hand nuts.

Fit cowling plate (Part No. 25592), cowling, (Part No. 25591). Assemble exhaust and induction manifold: carburettor, and silencer.

Connect the governor radius arm to carburettor without disturbing the original position of the trunnion on the throttle operating rod.
Fit sparking plugs

Valve Timing—(See Figs. 5 & 6).

Adjust Tappets to 0.002" clearance.

Rotate the flywheel until the marks on the flywheel (a centre pop and a figure 1) coincide with a centre pop mark on the fan housing. **See Figure 5.** In this position the No. 1 piston is at top dead centre.

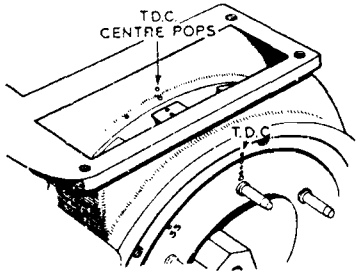


Fig. 5.

Arrangement of timing marks with No. 1 cylinder at T.D.C.

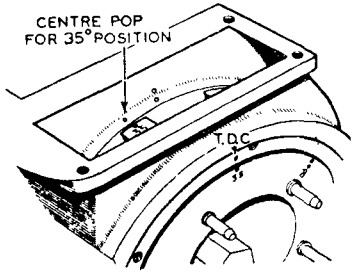


Fig. 6.

Showing magneto timing position with No. 1 piston 35° before T.D.C.

Turn the flywheel opposite to direction of rotation 13/16" measured on the edge of the flywheel (this is approximately 10° crankshaft movement).

Turn the camshaft opposite to direction of rotation until there is a slight nip on a 0.002" feeler placed between the inlet valve and rocker of No. 1 cylinder. Engage camshaft gear with crankshaft gear using the five keyways in the bore of the camshaft gear to maintain the setting of camshaft in relation to the crankshaft.

Check valve timing:—

Inlet valve open 10° - 7° before top dead centre.
Exhaust valve closed 17° - 20° after top dead centre.

Secure Camshaft Gear with slotted nut and split pin.

Magneto Timing.

Free Magneto pinion on its taper.

Turn flywheel to T.D.C. No. 1 cylinder, turn flywheel opposite to direction of rotation so that the 35° mark on the flywheel coincides with the position marked on the fan housing for determining T.D.C. (**as shown in Figure 6**). Turn magneto armature in direction of rotation to the position where the rotor arm is just leading on to the No. 1 segment of the magneto distributor cap. With a 0.002" feeler between the contact breaker points, continue to turn the armature so that the feeler is just being released. Push the magneto pinion on to its shaft and tighten retaining nut without disturbing the magneto setting relative to the crankshaft setting. Check timing and secure the rotor arm and distributor cap.

For convenience in checking the crankshaft position on occasions when the engine is not removed from the 'Gem' a duplicate set of timing marks is provided on the inside of the fan housing with corresponding T.D.C. and 35° marks on the edge of the fan itself. These marks, which are shown in Figures **5 & 6,** can be seen on removing the cowl It will be noticed that there is a double centre pop mark for the T.D.C. position which should be lined up with the corresponding mark on the fan **(see figure 5).** When setting the 35° position, however, the 35° mark on the fan should be opposite the single centre pop on the casing.

(To be continued)

THE HOWARD ROTAVATOR 'GEM' SERIES IV.

THE TWIN ENGINE—PART III.

CRANKSHAFT

This is a 45 ton steel forging of very stiff construction having big-end journals 1½" dia. at 180° to each other.

When dismantling, the journals should be checked for scoring ovality and seizure.

Crankshaft regrinding (if necessary) should be undertaken only by firms who have the necessary facilities and specialise in this work.

When the crankshaft has been reground, shell bearings of suitable dimensions should be obtained to ensure correct bearing clearances.

If the crankshaft has to be removed from the engine and complete dismantling of the engine is unnecessary, the following procedure is suggested.

1. Remove the engine sump.
2. Remove timing gear cover and mark timing gears with No. 1 Piston at T.D.C. **(See Part II, Fig. 1).**
3. Remove Cooling Blast shroud and Fan Flywheel.
4. Remove big-end, bolts and caps. Push Connecting Rods and Pistons up their cylinder bores to clear crankshaft.
5. Remove the 3" internal circlip from its groove behind the front main bearing. **(See Part II, Fig. 2).**
6. Remove the six setscrews securing the Fan Housing to the crankcase.
7. The crankshaft can now be driven out of the crankcase by tapping the timing gear end. The Fan Housing will come away with the crankshaft.

Check the main bearing ball races for slackness and renew

as necessary. Bearings should not be removed from the crankshaft merely for inspection. An engine which has been in use will have settled, and unless some part requires renewal or maintenance it is advisable to leave mated parts undisturbed.

CONNECTING RODS

When the engine is being dismantled for complete overhaul the big-end bearings should be carefully washed clean and examined. The bedding of the bearings on the crankshaft journals should be checked, and any high or low spots noted. The surface of the bearings should be further examined for

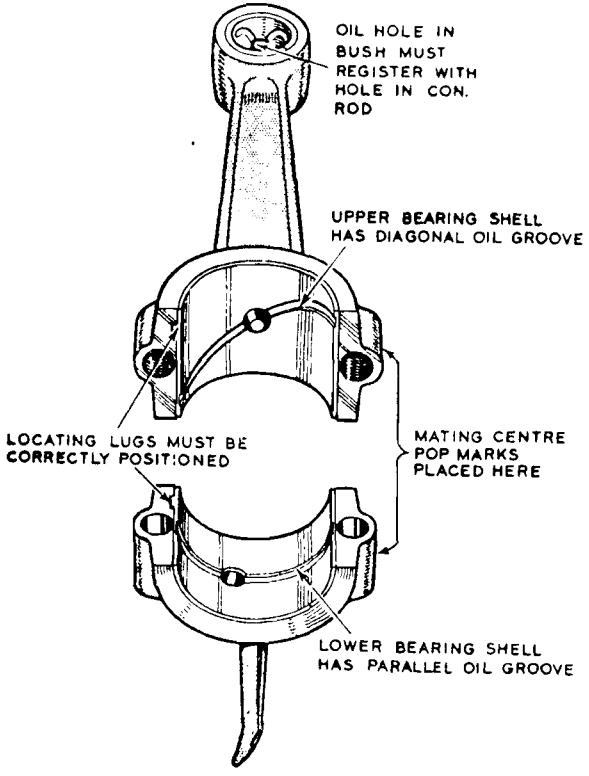


FIG. 2 UPPER AND LOWER BIG END BEARING SHELLS ARE NOT INTERCHANGEABLE AND SHOULD BE FITTED AS SHOWN ABOVE.

any signs of "picking up" and for embedded foreign material.

On no account must connecting rod caps be filed, as there is not sufficient metal in the bearings to allow this.

If the connecting rod caps have been filed and, at a later date, it is desired to fit new bearings, the connecting rods will have to be scrapped as the standard replacement shell bearings will no longer fit. If the bearing surfaces show signs of breaking up, the bearings must immediately be rejected. Also bearings showing signs of corrosion must be discarded and the quality of lubricating oil used in the engine investigated, as this is an indication that oil of the wrong quality is being used.

(It is false economy to use cheaper oil of doubtful origin).

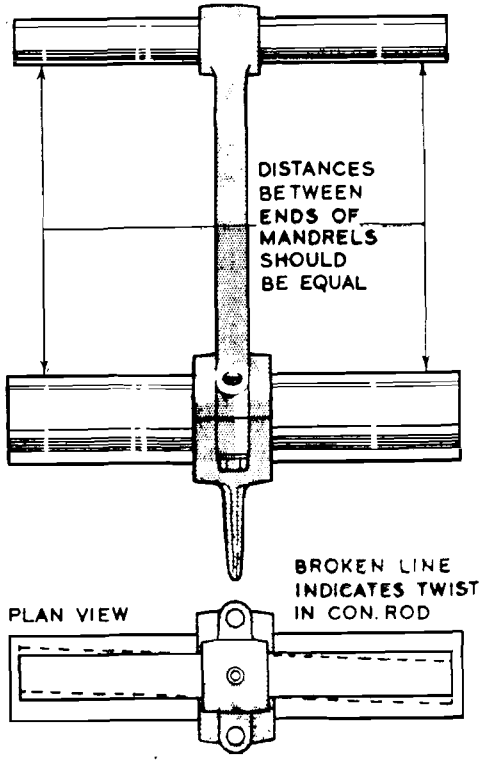


FIG. 1 A METHOD OF CHECKING CONNECTING ROD ALIGNMENT BY THE USE OF MANDRELS.

If the bearings appear to have bedded satisfactorily on the crankshaft journals—that is, show a minimum of high and low spots—they may be used again.

Both connecting rods and caps are numbered and must be fitted to the crankshaft journal correspondingly numbered.

Bearing shells, caps and rods must be scrupulously clean before assembly.

Before fitting bearing shells to the crankshaft they should be assembled and the connecting-rod caps bolted in place, so that the following can be checked:

1. That the bolts are a good fit and do not distort the bearing shells.
2. That the shells are not proud of their housing.
3. That the faces of the rod and cap are meeting squarely when the bolts are tightened.
4. That the gudgeon pins are in alignment with the big end bearings. This should be checked with the connecting rod in the horizontal and vertical position.

When this has been done dismantle the rods again and fit bearing shells, connecting rods and caps to crankshaft journals, taking care that a good marking is obtained before final assembly. Points to be noted when assembling shells are indicated in **Fig 2.** The connecting rod bolts should be examined for damaged threads or stretched threads. If you have any doubt of the servicability of a connecting rod bolt scrap it and fit a new bolt.

The small-end bushes are the split steel-backed type with anti-friction metal on the internal diameter. The anti-friction metal is burnished to size on assembly. It is advisable to have the bushes fitted and burnished. If this is impossible they should be reamed to size, provided great care is taken not to remove too much metal when reaming.

PISTON AND RINGS

Pistons are die cast aluminium alloy with split skirts. There are two compression rings and one oil control ring. This combination ensures adequate seal whilst allowing sufficient lubricant to reach the cylinder walls.

FITTING NEW PISTON RINGS

Pistons should be thoroughly washed and the rings examined for any tendency to stick in their grooves. Wear is most likely to occur in Nos. 1 and 2 — the compression rings.

Refit or replace? Use your own discretion. Generally speaking, if an engine has had a considerable amount of wear, say 500 hours, it is an advantage to fit new piston rings.

Examine the piston ring grooves for bruising and ensure that the rings are free to rotate in the ring grooves.

The correct ring gap in the bore is from 0.010" to 0.015". In a worn bore this should be checked with the ring set squarely at the lower end of the ring's travel in the bore. **(See Fig. 3).**

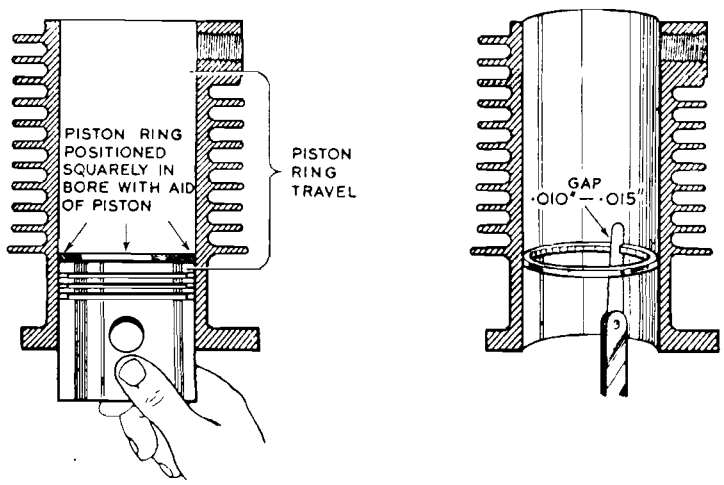


FIG. 3. (LEFT) PISTON RING GAPS SHOULD BE CHECKED WITH RING SQUARE IN THE BORE AND AT THE LOWER END OF THE RING TRAVEL. (RIGHT) CHECKING GAP WITH FEELER GAUGE.

Make sure that the ring gaps are equally spaced round the piston. When preparing to assemble the gudgeon pin, piston and connecting rod, warm the piston by immersing it in hot water. This will raise the temperature enough to permit the gudgeon pin to slide freely.

The gudgeon pin should be a free working fit in the connecting rod bush. If either pin or bush is worn beyond 0.002" it must be removed.

The gudgeon pin is located in the piston by an internal circlip at each end.
Gudgeon Pin Diameter 0.75".

CYLINDER HEAD

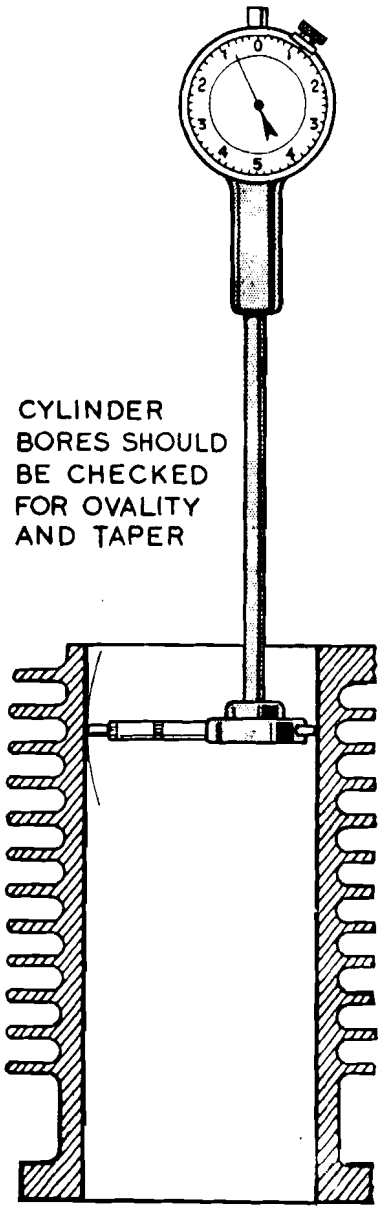
Thoroughly clean and remove all carbon deposits. Examine the valve guides for wear. If the wear is greater than 0.006" replace with new guides.

Clean the new guides, removing any burrs.

Smear the outer surface with clean oil and with a suitable press, drive home the new guides hard up to the collar.

The guides are made of cast iron, and are therefore comparatively brittle. Care should be exercised as the collar approaches the cylinder head.

CYLINDER BLOCK



Thoroughly clean the Cylinder Block and remove all accumulated dust from between the cooling fins.

(**Note:** it is essential that on Rotavators fitted with air cooled engines the cooling fins of the cylinder and cylinder head are cleaned at regular intervals. Any clogging of fins is detrimental to the efficient operation of the engine).

The efficient running of the engine is particularly dependent on good compression. Cylinder bores which are worn to the extent of 0.015" or more in diameter should be rebored and oversize pistons fitted. Checking cylinder wear with a dial gauge is shown in **Fig. 4.**

When fitting new Pistons the clearance between cylinder bore and pistons should be not less than 0.006".

FIG. 4.
A VERY ACCURATE METHOD OF DETERMINING CYLINDER WEAR IS BY CYLINDER DIAL GAUGE.

VALVES

Examine valves for cracks.

Check wear of valve stems and their fit in guides. If stems are worn more than 0.006" fit new valves. Number all new valves on head to correspond with the numbering of the old valves. Grind in valves until a continuous "high mark" is present the whole way round the seating both on the valve and the valve seatings in the cylinder head.

VALVE SPRINGS

Valve springs deteriorate because of the fatigue resulting from the combined effect of heat and the normal working of the spring. After a considerable period, the springs become weak and then prone to fail. This, of course, applies to all types of poppet valve engine.

A new set of valve springs should be fitted whenever the engine undergoes a major overhaul.

VALVE ROCKER ASSEMBLY

Wash the rocker-shaft assembly thoroughly in paraffin. Examine the rocker shaft for wear. Ensure that all rockers are free on the rocker shaft and that the oil holes in the rockers are free from obstruction.

When dismantling the rocker-shaft assembly, carefully note the order of assembly of the various parts, rocker shaft bearers, distance pieces, springs and rockers to ensure reassembly on the rocker shaft in their original positions.

GOVERNOR

This assembly has been illustrated in an earlier bulletin. **(See Part II, Fig. 3).**

Points of possible wear are:

Ball Bearings.
Governor weight pivot pins.
Governor weight radius arm.

The adjustment is set and secured by split pin and should not be disturbed unless some part requires renewal.

The Governor is of robust construction and will give long trouble-free service provided that the oil is maintained at the correct level and changed at the intervals laid down in the 'Gem' Mk. IV Handbook, i.e., oil should be changed after every 24 hours of operation.

MAGNETO

The magneto is driven from the camshaft timing gear and rotates at engine speed, delivering two sparks per revolution, the idle spark occuring during exhaust stroke.

The advantage of this system is that a stronger spark is obtained for starting than would be possible if the magneto were driven at half engine speed.

Magneto timing (35° B.T.D.C.) has already been explained.

SPARKING PLUGS

14 m.m. Long reach K.L.G. type FE50 or Champion type N7.

Contact Breaker gap. .018" - .020".

CARBURETTOR

See Page 14, Gem Series IV model instruction Book, and Spare Parts list.

VALVE ROCKER COVER AND EXHAUST LIFTERS

These must be cleaned. All joints where oil leaks may occur should be maintained in good condition.

If the oil sealing rubber washers on the exhaust lifter cams require renewal they should be assembled so that the rubber is under pressure when sandwiched between the Exhaust Lifter lever and the sleeve.

When the rocker cover is assembled to the engine ensure that the exhaust lifters are not holding the exhaust valves open.

COWLING BASE PLATE

The base plate is secured between the fan housing and the cowling. The front part of the cowling is hinged to permit the easy removal of any foreign matter obstructing the air flow over the cylinder and cylinder head fins.

The hinged section is opened by removing the brass hand nut situated at the front of the engine.