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EQUIPMENT

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WORKSHOP INSTRUCTIONS

MAGNETO

MODEL RF4

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MAGNETO

MODEL RF4

1. GENERAL

This magneto, of four cylinder design, is used extensively on tractors and marine engines, and embodies special features to ensure that the magneto will render reliable service under the most arduous conditions.

Great care has been exercised to guard against the ingress of dirt or moisture. For this reason, the body is formed in a single casting, eliminating joints, and the H.T. leads in the distributor block have their outlets pointing downwards, thus preventing the retention of water at the terminal connections.

The rotating magnet principle is employed, so that the less robust parts, such as the coil and condenser, remain stationary. The contact breaker does not rotate and the need for pick-up and slip ring is avoided. These features make for a sturdier mechanical construction, and thus for increased reliability and reduced maintenance.

The rotor is driven, through suitable gearing, from the engine. The magnetic field about its poles induces an alternating field in the laminated core of the coil. This, in turn, generates a low tension alternating current in the primary winding of the coil. At about the instant when this current reaches a maximum value, it is interrupted by a cam-operated contact breaker ; the subsequent collapse of the magnetic field linked with the secondary winding of the coil induces a very high voltage in the winding. At the same time, a rotor arm in the distributor connects the output terminal of the secondary winding with one of four metal electrodes, from which cables lead to sparking plugs in the engine cylinders.

Some magnetos are fitted with an impulse starter, the purpose of which is to retard the spark when starting the engine and to improve the low speed performance of the magneto, facilitating hand starting.

The impulse starter consists essentially of two members which are flexibly coupled by means of a coil spring. One member is fitted on the driving shaft, while the other is secured to the magneto spindle. As the engine is slowly rotated by hand, a pawl prevents the movement of the magneto rotor, whilst the driving member continues to rotate, thereby stressing the coupling spring. On further rotation, a projection on the driving member trips the pawl, the magneto rotor is accelerated rapidly through the sparking position and a powerful spark is produced, the timing of which is retarded for ease of starting. The sequence is repeated until the engine fires. The pawls are then held out of engagement at a comparatively low speed by centrifugal force.

In order to advance the spark after starting the engine, a timing lever is provided in the contact breaker cover. Movement of the lever rotates the contact breaker plate, carrying the moving arm and the contacts, about the cam, so varying the ignition timing. To advance the spark, move the lever in a direction opposite to that of rotation of the magneto spindle.

With some magnetos, the ignition is switched off by moving the timing lever to the fully retarded position, when a short-circuiting strip on the contact breaker spring touches an earthing pillar on the contact breaker base.

Other magnetos are fitted with a terminal at the side of the contact breaker housing, from which a lead is taken to a switch, usually mounted on the instrument panel. Operation of the switch earths the primary winding and stops the engine.

Before starting the engine, move the timing lever to the mid-position. After the engine has started, advance the ignition timing as far as possible without causing the engine to knock.

2. ROUTINE MAINTENANCE

(a) LUBRICATION

Every 150 running hours, add a few drops of thin machine oil through the lubricator on the top of the magneto body to lubricate the distributor gear bearings. See that the spring-loaded lever closing the lubricator returns fully home after use. Apply a few drops to the felt pad in the contact breaker housing to lubricate the cam.

The magneto should be overhauled every two years, and the ball bearings cleaned and repacked with high-melting-point grease. At the same time, the cover of the impulse starter should be removed, in order to lubricate between the springs with thin machine oil.

(b) CLEANING

Occasionally remove the distributor block by unfastening the two spring clips. Wipe the inside of the block with a clean dry cloth, paying particular attention to the spaces between the metal electrodes. Clean the rotating electrode and the electrodes inside the cover. Before replacing the block, clean the outside.

The ventilating slots at the side of the magneto body must be kept clear, otherwise internal condensation may impair the performance of the magneto.

Remove the contact breaker cover, which is held in position by two screws, and examine the mechanism. If the contacts are dirty, they must be thoroughly cleaned by polishing with very fine carborundum stone or fine emery cloth. The moving contact may be more easily cleaned if it is removed from the con-

tact breaker housing. To do this, unscrew the nut securing the end of the contact breaker spring, remove the locking, plain and insulating washers, and the condenser lead eyelet. Take out the split pin and remove the washer from the contact breaker pivot.

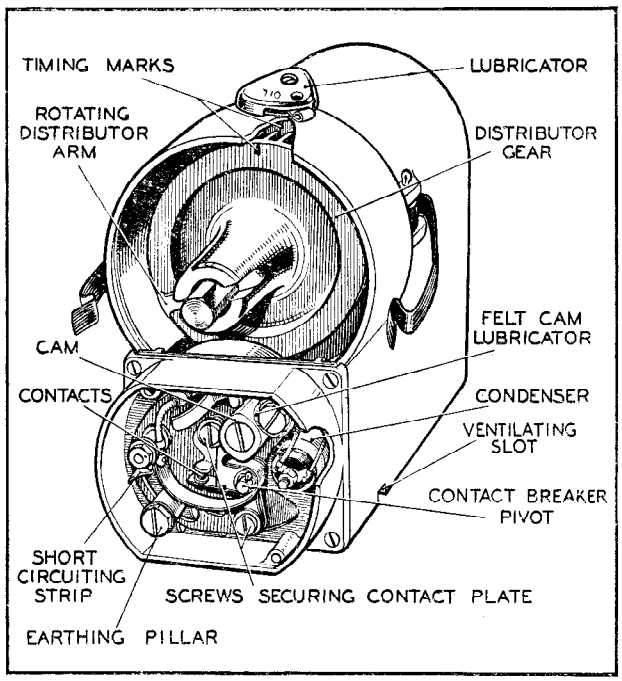

Fig. 1.
Magneto with distributor block and contact breaker cover removed

It is now possible to withdraw the contact breaker lever, together with the spring and the contacts. Make a careful note of the original positions of the washers, etc., to ensure correct refitting on assembly.

(c) ADJUSTMENT OF CONTACT BREAKER

After cleaning, check the gap between the contacts. Turn the engine by hand until the contacts show the maximum opening, which should measure 0·010″ to 0·012″. If the setting is incorrect, slacken the two screws securing the fixed contact plate and move the plate to give the correct gap. Tighten the securing screws and measure the gap again. Check the gap for other positions of the engine giving the maximum opening of the contacts.

(d) REPLACEMENT OF HIGH TENSION CABLES

Occasionally inspect the cables from the distributor block to the sparking plugs. In cases where the cables pass through conduits, particularly examine them where they are bent between the distributor and the conduit and between the conduit and the sparking plugs. Lightly pull out the cables to inspect that portion which is normally inside the conduit. Replace any cables which have the rubber insulation cracked or damaged, otherwise the spark may occur between the cable and some part of the engine instead of at the sparking plug.

Use 7 mm. rubber-covered ignition cable for all high tension leads. When connecting a new cable to the magneto, do not bare the cable but cut it off flush to the required length. Remove the distributor block, unscrew the pointed screws from the inside of the moulding and then pull out the old cables. Push the new cables fully home and secure by tightening the screws, which will pierce the insulation and make good contact with the cable core.

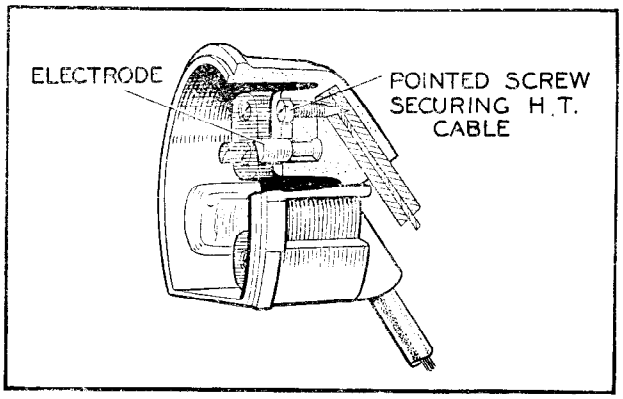

Fig. 2.
High tension cable connection

3. TEST DATA

(a) Firing angles (rotor shaft): 0°, 180°, etc., ±2°.

(b) Contact breaker gap : ·010″ to ·012″.

(c) Contact breaker spring tension : 20 — 24 oz.

(d) Condenser capacity : 0·2 microfarad.

(e) High speed test :
With the ignition timing fully advanced, regular sparking should occur at all speeds between 500 and 3000 r.p.m. on a rotary gap set at 8 kV.

(f) Slow speed test :
The magneto should spark regularly on a 7 mm., 3-point spark gap when the impulse starter body is slowly rotated by hand, and over the full speed range up to 200 r.p.m. Particular attention should be paid to speeds just above the cutting-out speed of the impulse starter.

(g) Impulse starter :
This should operate regularly up to 120 r.p.m. and cut out completely at speeds over 180 r.p.m. The retard due to the impulse starter should be 30° ± 5°.

4. SERVICING

(a) TESTING MAGNETO IN POSITION TO LOCATE CAUSE OF MISFIRING OR FAILURE OF IGNITION.

If misfiring occurs in any one cylinder, either the cable or the plug may be at fault. An examination of the high tension cables may reveal that the rubber shows signs of perishing or cracking. If a spare sparking plug is at hand, it may be substituted for the suspected one, or if it is merely that the gap is too large, it should be adjusted to the setting recommended by the engine maker. Missing on full throttle is sometimes caused by the plug gaps being too wide.

If it is suspected that the ignition has failed completely in all cylinders, this may be checked by removing from the plug terminals one or more of the high tension cables and observing whether a spark occurs on turning the engine by hand with the end of the cable held about $\frac{1}{8}$" from some metal part of the engine.

If no spark takes place, examine the short-circuiting strip ; it may be touching the earthing pillar on the contact breaker base.

If the magneto has been replaced recently, it may be incorrectly timed. Refer to the engine maker's instructions.

If the performance of the magneto is still unsatisfactory, the contact breaker may require cleaning or adjustment (see Para. 2) or there may be an internal fault in the magneto.

(b) DISMANTLING

(*i*) Hold the impulse starter body firmly in the hand and unscrew the securing nut. Lift the starter from the shaft and remove the key. Remove the screws holding the impulse starter stop plate on the end of the magneto and ease the plate from its dowel pin.

(*ii*) Unscrew the two bolts from the contact breaker cover and remove the cover complete with the timing control lever.
Spring back the two clips securing the distributor block, and remove the block.

(*iii*) Remove the nut from the post carrying the end of the contact breaker spring, lift off the lock and plain washers, the insulating bush and the condenser lead eyelet.

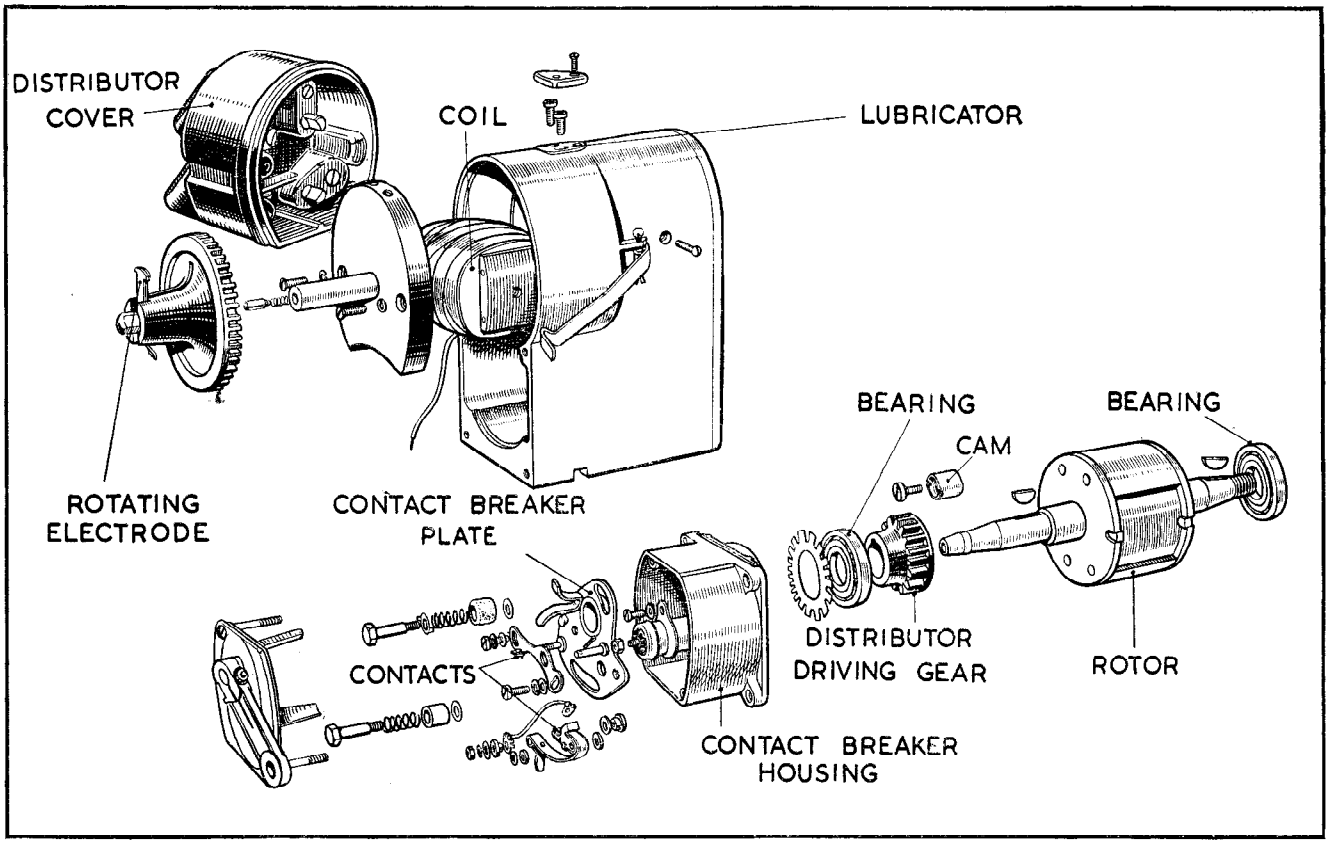

Fig. 3
Magneto dismantled

(*iv*) Take out the split pin from the contact breaker pivot, lift off the plain and insulating washers and remove the contact breaker lever and spring. Lift the second insulating washer from the contact breaker pivot, and the plain washer and insulating bush from the spring anchorage post.

(*v*) Remove the two screws securing the fixed contact plate, together with their locking washers. Withdraw the plate.

(*vi*) Unscrew and withdraw the bolt carrying the lubricator pad together with the pad.

(*vii*) Unscrew the bolt from the earthing pillar and withdraw, complete with collar, washers and spring.

(*viii*) Detach the condenser connection from the contact breaker plate and remove the plate from the contact breaker housing.

(*ix*) Unscrew the condenser terminal nut, lift off the two eyelets, undo the condenser fixing screw and remove the condenser.

(*x*) Unsolder the eyelet from the connection which passes through the contact breaker housing, unscrew the four securing screws and remove the housing. Carefully retain the thin brass shims and the insulating tube through which the condenser connection passes.

(*xi*) Withdraw the moulded gear from its spindle, together with the insulating washer.

(*xii*) Remove the rotor assembly from the magneto.

NOTE.—It is recommended that keepers be fitted across the gaps between the rotor poles whenever the rotor is removed from the body of the magneto.

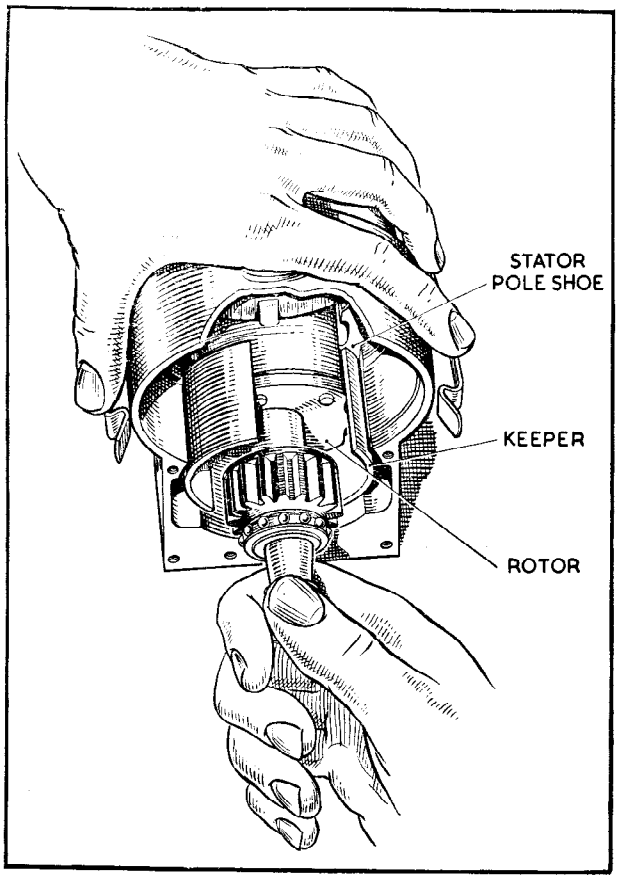

Fig. 4. Inserting the rotor in the magneto

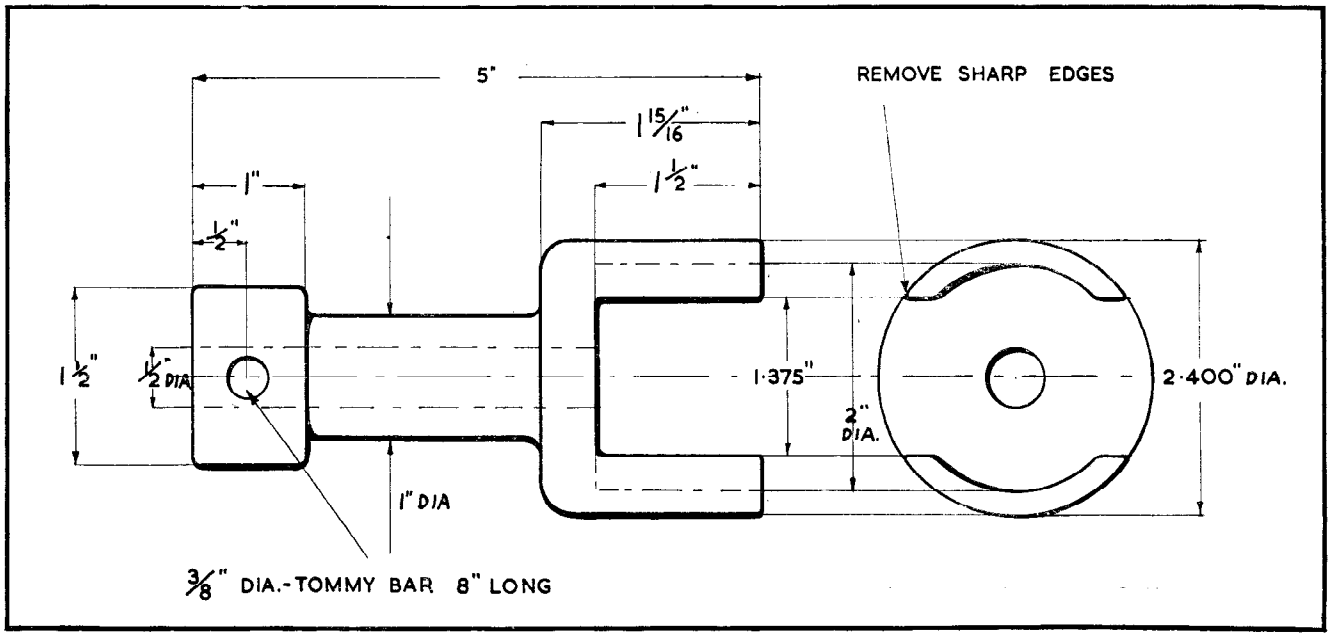

Fig. 5. Tool for coil removal

The keepers should be slipped over the rotor as it emerges from the magneto, so that the magnetic circuit remains unbroken, and should not be removed until the rotor is actually being inserted in the magneto body, when they will be pushed off by the ends of the stator pole shoes. This precaution is especially necessary if facilities for re-magnetisation are not available.

The bearings, cam and distributor driving gear should not be removed unless badly worn or damaged. The cages and balls may readily be taken from the inner races. To remove the cam, take out the securing screw and pull the cam from its tapered pin. The inner races may be removed using an extractor, allowing the gear to be pulled from the shaft.

(*xiii*) Remove the screw securing the lubricator on top of the magneto body, unscrew the air vent and lubricator insert. Remove the two screws from the gear support plate and withdraw the plate from the magneto body.

(*xiv*) From the side of the magneto body, remove the two coil securing screws. The coil may now be withdrawn. If tight, it may be necessary to turn the coil clear of the pole shoes. This is facilitated by use of a special tool, illustrated in Fig. 5.

(c) BEARINGS

The two rotor shaft bearings must be in good condition. If they are packed on assembly with high-melting-point grease, they will give almost unlimited trouble-free service. Should they begin to fail, due to a bent shaft or loss of lubricant, they must be replaced. It is essential that a complete set, comprising inner and outer races, balls and cages be fitted.

The cages and balls may easily be removed from the rotor shaft and the inner races pulled off with an extractor, without removing the cam. Outer races may be removed using an expanding collet type extractor.

When fitting new bearings, ensure that they are clean and lightly packed with high-melting-point grease. Fit the inner races on the rotor shaft using a hand press and suitable sleeve, then position the balls and cages on the journals.

Press the assembly carrying the felt ring into its housing at the driving end, then press the outer races into their housings using a suitable mandrel, ensuring that a serrated insulating washer is placed between each journal and its housing. More than one insulating washer may be used to ensure a good, tight fit.

(d) IMPULSE STARTER

If it is necessary to dismantle the impulse starter (to inspect the impulse spring, etc.), remove the jump ring securing the action plate to the impulse starter body. Remove the action plate from the body, disengaging the spring anchoring projection and leaving the spring inside the body. The spring may now be carefully pulled out, allowing it to unwind gently and taking care not to twist or strain it.

If a new spring is to be fitted, soak the fibre strip in oil and fit it between the two leaves of the spring. Hold the body of the impulse starter lightly in a vice,

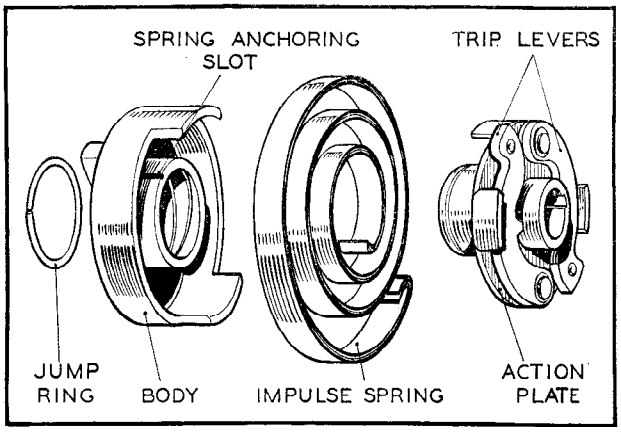

Fig. 6.
Impulse starter

hook the inner end of the spring into its slot and hook the other end over the projection on the action plate.

Wind in the spring until the action plate and the body can be fitted together (remember that the spring must be fitted so that it winds up when the impulse starter body is turned in the correct direction of rotation). Secure the two members in position by means of the jump ring.

On some impulse starters there may be a tendency, when the engine is started, for the trip levers to become trapped behind the trip ear. If this happens, the mechanism jams and either the ear or the lever will shear.

The impulse starter of the magneto should be inspected for this fault, which is due to excessive play in the trip lever pivot. If necessary the impulse starter should be replaced by a satisfactory unit.

(e) BENCH TESTING THE COIL

The following tests may be used to check the coil, when removed from the magneto body, or in position with the support plate fitted but with the rotor removed.

The following equipment is required :

(a) A four-cylinder contact breaker having closed periods of not less than 42° and operating at approximately 750 r.p.m.
(b) A 12 volt lead-acid battery.
(c) A set of three-point spark gaps.
(d) A 1 ohm resistance (to limit the coil current under standstill conditions).

Testing when fitted in the magneto body.

Connect the coil, test contact breaker, resistance and, if desired, a moving coil ammeter (0 — 5 amps.) in

series across 8 volts (four cells) of the battery. The lead from the coil normally connected to the condenser should be connected to the positive terminal of the battery. The other end of the coil is earthed to the magneto body, to which a connection should be made. Connect a cable from the bearing spindle on the support plate to the three-point spark gap, which should be set to 7 mm.

With the test contact breaker running at the recommended speed, there should be no missing and the ammeter reading should be 0·7 to 0·8 amperes.

Testing when removed from the magneto body.

Connect as described above, and reduce the supply voltage to 6 volts. Running the test contact breaker at 750 r.p.m., there should be no missing and the reading on the ammeter should be 1·0 to 1·1 amperes.

Replacement Coils

Only genuine Lucas replacement coils of the latest pattern may be fitted. These coils—marked "V", "VP" or "VHP"—are factory wound to an accurate specification and are vacuum impregnated; no other type of coil should be used. (Magnetos fitted with vacuum-impregnated coils must be marked with a letter "V" on the top of the body near the driving end of the magneto.)

Instances have occurred of coils wound to non-Lucas specifications giving an apparent improvement in low speed performance when used as service replacements. Any such improvement, however, would be obtained at the expense of overall efficiency. Maximum performance and reliability of the unit will result only from the fitting of the correct replacement coil and the employment of the recommended re-magnetisation procedure.

(f) VENTILATION

Ventilating slots are formed in each side of the base of the body casting to allow the free passage of air beneath the magneto body. It is essential that these slots be at all times free from dirt, paint or other obstructing matter. Instances may be encountered where the ventilating slots are slightly under-sized or are obstructed by "flash" from the casting process; the slots must be cleaned out to the correct section of 3/16 in. square (4.75 m.m. square) with a small file. If this operation is performed with the magneto assembled, the ventilating holes in the magneto body must be covered with adhesive tape to prevent swarf entering the body, and all swarf must be carefully removed after filing. Inspect the ventilating screw at the bottom of the distributor cover and see that it is free from all traces of dirt, paint, etc.

The lubricator on the top of the body is closed by a spring-loaded lever. This lever and its seating must be free from dirt which would prevent the lever returning fully home after use and thus permit the entry of dirt or moisture into the magneto.

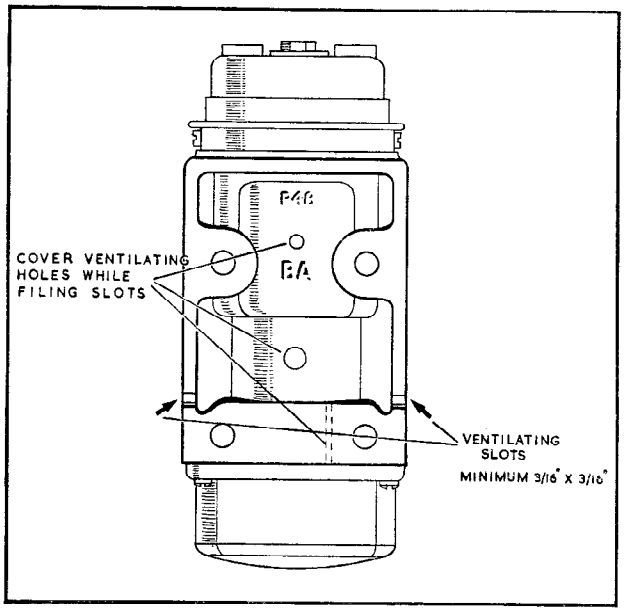

Fig. 7. Underside of magneto body.

(g) PREVENTION OF TRACKING

Distributor Covers

All new covers sent out from the Works are treated with "Dulux" anti-tracking varnish. If the cover of the magneto is fit for further service, it should be re-sprayed with this varnish; the electrodes and the cover register should be masked during spraying. After treatment the ventilation screw in the cover must be removed and all traces of varnish removed from the threads before refitting.

Parts treated with 'Dulux' varnish should be stoved for 30 minutes at 200°-250°F.

Gear Support Plate

The gear support plate should be buffed lightly, dried out and treated with 'Dulux' anti-tracking varnish as described above. Mask the edge of the plate while spraying. New plates sent out from the Works are already treated in this way.

(h) REASSEMBLY

Before reassembling, ensure that all components are quite clean and undamaged.

(*i*) Insert the coil into the magneto body with the connector strip facing outwards. Secure by fully tightening the two fixing screws. Caulk the screw heads to lock them in position.

(*ii*) Pass the condenser lead through its hole in the support plate and insert the plate squarely into the magneto body, pressing into position with the fingers. Secure by means of the two screws at the front and by the lubricator insert and air vent. Replace and

secure the lubricator. See that the spring-loaded brass bush is fitted in the end of the gear spindle.

(*iii*) Ensure that the rotor is clean and free from adherent particles or swarf. Insert it into the magneto body.

(*iv*) Fit the insulating washer and the rotor gear on the spindle and engage the gears so that the two yellow spots are together. If a new gear is fitted, the timing must be set as described in Para. (g) below.

(*v*) Ensure that the felt ring in the groove in the contact breaker end plate is in good condition and well impregnated with petroleum jelly. Fit the insulating tube in the end plate and pass the condenser lead through it. Position the contact breaker end plate on the magneto body, together with the brass shims. Secure by means of the four screws, caulking to lock them in position.

(*vi*) Check the rotor for end play. It should revolve freely under hand pressure but without end play. If necessary, insert brass shims behind the contact breaker end plate.

(*vii*) Locate the condenser in the contact breaker housing, securing by means of the fixing screw. Solder the eyelet on to the end of the wire from the coil (using a non-corrosive flux) and fit the eyelet over the condenser terminal, followed by the eyelet on the contact breaker connection and the locking washer. Tighten the terminal nut.

(*viii*) Place the contact breaker plate in the housing and secure the earthing pillar assembly comprising screw, washer, spring, collar and metal bush. The screw should pass through the longer slot in the contact breaker plate.

(*ix*) Locate the fixed contact plate over the pivot post on the contact breaker plate and secure by lightly tightening the two screws on to their spring and plain washers.

N.B.—If the contacts are worn, a replacement set comprising both fixed and moving contacts must be fitted.

(*x*) Place the insulating washer over the contact breaker pivot, and the insulating bush and plain washer over the spring anchorage post. Lightly smear the pivot pin with clean engine oil and position the contact breaker lever and spring over the pivot pin and anchorage post. Fit the insulating and plain washers over the pivot, insert and open out the split pin. Place the eyelet on the wire from the condenser over the anchorage post so that the two ears of the eyelet fit over the spring, follow with the insulating bush (passing through the eyelet into the spring), plain and locking washers, and secure by means of the fixing nut. Position the wire from the condenser round the outside of the felt pad and locate it under the clip on the contact plate.

(*xi*) Adjust the contact breaker setting, as described in para. 2 above.

(*xii*) Replace the contact breaker cover, ensuring that the shorter of the two strips attached to the timing lever cover engages with the fork on the contact breaker plate. Tighten the two screws.

(*xiii*) Fit the key in the driving shaft, replace the impulse starter and secure it in position. If the rotor is to be re-magnetised, do not replace the impulse starter until this has been done.

(j) TIMING

(*i*) Remove the distributor block and fit another from which the centre portion has been cut away.

(*ii*) Place a 0·010" gauge between the pole tip in the magneto body and the trailing edge of the rotor.

(*iii*) Engage the distributor gear with the pinion so that the leading edge of the rotating electrode is between one third and two thirds across the appropriate distributor electrode. On standard magnetos there is a red mark on the support plate and a corresponding mark on the distributor gear when the distributor is correctly timed for No. 1 cylinder : if a replacement gear is fitted, it should be marked similarly, after timing.

(k) SAFETY GAP SETTING

Still using the cut-away distributor block, set the distance from the safety gap electrode to one of the distributor electrodes to between 6·75 and 7·25 mm.

(l) MAGNETISING

Re-magnetisation will usually be necessary if the magneto has been dismantled, or if an unmagnetised replacement rotor has been fitted.

A magnetiser conforming to the following **minimum** specification will ensure the satisfactory performance of the re-magnetised magneto:

Minimum core area	...	9 square inches.
Windings	...	65,000 ampere-turns (minimum)
Core material	...	Soft iron (preferably Swedish iron)
Magneto platform	...	Brass or other non-magnetic material.
Minimum width of magneto platform	...	Width of magneto body (approx. $3\frac{1}{2}$ in.)

Either 'pot' or vertical type magnetisers are suitable provided they conform to the minimum specification.

Positioning the Rotor

Before magnetisation the rotor must be turned so that its laminated pole shoes correspond with the pole pieces of the stator laminations, and held in this position while the magnetiser is operated. The correct position of the rotor is obtained when the keyway at the driving end of the shaft is horizontal. It is most important that the end covers be in position

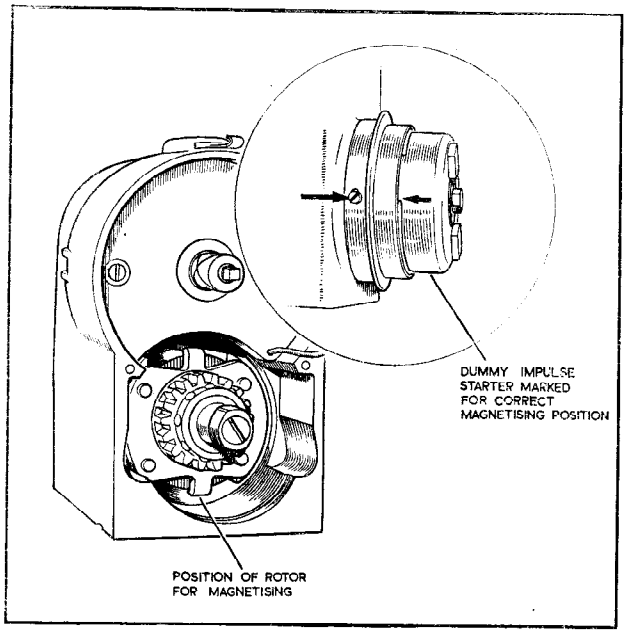

Fig. 8. Position of rotor for magnetising. Note: end covers **must** be replaced before magnetising.

before operating the magnetiser, as otherwise there is a risk of metallic dust or swarf being drawn into the magneto.

The impulse starter, if one is fitted, must always be removed before magnetisation. Should the trip levers of the impulse starter become magnetised the correct operation of the mechanism will be impossible.

If the number of magnetos received for reconditioning is considerable, it will be found useful to prepare a spare or dummy impulse starter which can be slipped on to the magneto shaft and loosely keyed to it. This spare impulse starter should be marked so that by aligning the mark with the impulse starter cover securing screw the rotor is held in the correct position for magnetisation.

The use of this device also helps to ensure (**a**) that the impulse starter belonging to the magneto is removed before magnetising, and (**b**) that the distributor and contact breaker covers are not removed unnecessarily. As mentioned above, it is important that these covers be in place when the magnetiser is operated.

When magnetising, operate the magnetiser switch four or five times at intervals of roughly half a second. It is unnecessary to leave the magnetiser switched on for any length of time.