SECTION D-5
ISSUE I, JANUARY, 1951

LUCAS

Quality

EQUIPMENT

VOLUME 2

WORKSHOP INSTRUCTIONS

MAGNETOS

MODELS SR1, SR2 and SR4

JOSEPH LUCAS LTD · BIRMINGHAM 19 · ENGLAND

Printed in England

MAGNETOS

MODELS SR1, SR2 and SR4

1 GENERAL

The SR range of magnetos are suitable for use with industrial, agricultural and marine petrol engines. They are available in single, twin and four cylinder engine forms and either base or flange mounted. 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 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 a 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 reversal of the magnetic field linked with the secondary winding of the coil induces a very high voltage in the winding. The output terminal of the secondary winding is connected, either directly or through the distributor arm of the twin and four cylinder magnetos, to the sparking plug in the cylinder, thus igniting the mixture.

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 and continues to run. The pawls are then held out of engagement at a comparatively low speed by centrifugal force.

A simple switch is provided on the magneto body to earth the "live" side of the primary winding of the coil, thus in effect switching off the ignition and stopping the engine. There is also a terminal from which a lead may be taken to an earthing switch on the control panel, or in some other convenient position, for use when the magneto is not accessible for this purpose.

2. ROUTINE MAINTENANCE

(a) LUBRICATION

Every 150 running hours remove the moulded cover of twin and four cylinder magnetos and add a few drops of thin machine oil to the oil well on the top of the distributor gear bearing.

After every 1,000 hours' running remove the moulded cover, slacken the nut securing the end of the contact breaker spring and lift off the spring and contact breaker lever. Smear the pivot pin with a small quantitity of Mobilgrease No. 2, or clean engine oil.

Take great care to prevent oil or grease getting on or near the contacts.

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 spring of the impulse starter must be lubricated with thin machine oil.

(b) CLEANING

Occasionally remove the moulded cover by unfastening the three captive screws. Wipe the inside of the cover with a soft, dry cloth. Pay particular attention to the spaces between the metal electrodes of twin and four cylinder engine magnetos and clean the electrodes themselves, together with the rotating electrode. See that the carbon brush and the brass contact stud

are clean and move freely in their holders. Before replacing the cover, clean the outside.

Examine the contact breaker. If the contacts are burned or dirty they must be thoroughly cleaned by polishing with very fine carborundum stone or fine emery cloth, wiping away any dust with a petrol-moistened cloth. The contacts may be cleaned more easily if the arm carrying the moving contact is removed from the contact breaker.

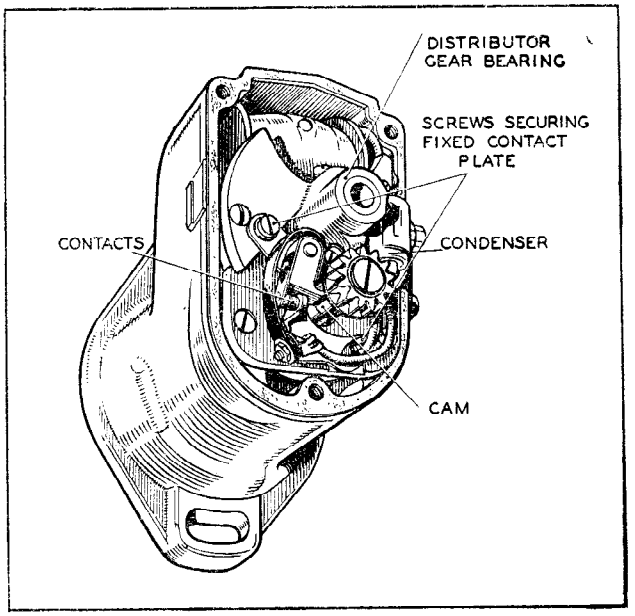

Fig. 1.
Magneto model SR4F, with moulded cover and distributor gear removed

(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. On a twin or four cylinder magneto, check the gap for the other position of the engine giving the maximum opening of the contacts.

(d) REPLACEMENT OF HIGH TENSION CABLES

Occasionally inspect the cables from the moulded cover to the sparking plugs. In cases where the cables pass through conduits, particularly examine them where they are bent between the magneto 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 moulded cover, 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.

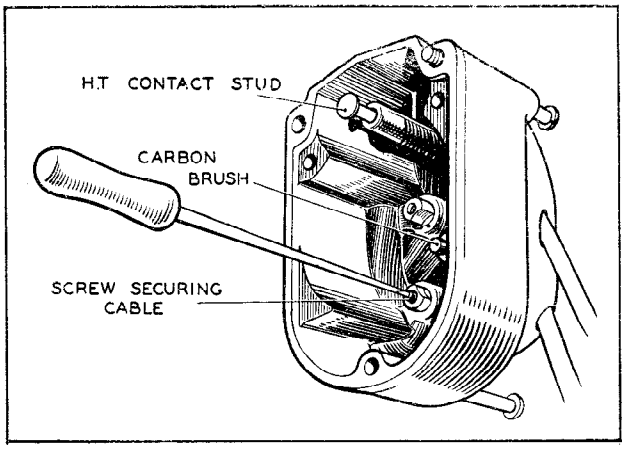

Fig. 2.
High tension cable connection

3. TEST DATA

(a) Firing angles of twin and four cylinder models (rotor shaft) : 0°, 180°, etc., ± 2°.
(b) Contact breaker gap : .010″ to .012″ (0.25 — 0.3 mm.).
(c) Contact breaker spring tension : 15 — 25 oz.
(d) Condenser capacity : 0.2 microfarad.
(e) High speed test : regular sparking should occur at all speeds between 500 and 3,000 r.p.m. on a rotary gap set at 8 kV.
(f) Slow speed test : the magneto should spark regularly on a 5.5 mm., 3-point spark gap at 125 r.p.m. for single cylinder magnetos and 150 r.p.m. for twin and four cylinder models. The impulse starter, if fitted, must be removed before this test.
(g) Impulse starter : this should operate regularly up to 150 r.p.m. and cut out completely at speeds over 250 r.p.m. The retard due to the impulse starter varies with the engine to which the magneto is fitted.

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 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 and the cable to the external earthing switch, if fitted, for signs of a short circuit. 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*) Remove the locking screw of the impulse starter securing nut (this screw has a left hand thread) and unscrew the securing nut. Prise off the complete impulse starter by levering with a screwdriver behind the impulse starter base plate. The driving member can now be pulled away from the base plate and the spring removed for examination or replacement.

Take the impulse starter key from the magneto shaft.

Remove the moulded cover, which is secured by three captive screws.

(*ii*) **Twin and four-cylinder magnetos only.** Remove the moulded cover and impulse starter as described above. Slacken the screw above the distributor gear bearing and pull out the distributor gear and rotating electrode. Both the distributor gear and the die-cast gear on the magneto shaft should be marked with spots of paint to ensure correct timing of the distributor on reassembly. Remove the screw securing the die-cast gear and pull the gear off the shaft.

(*iii*) **All models.** Remove from the low-tension terminal post the two nuts, the earthing strip and the moulded insulation piece. On some magnetos the slotted eyelets on the leads to the coil and contact breaker can now be pulled off the terminal post ; on other models it will be necessary to unsolder each lead from the terminal post. Remove the three screws securing the contact breaker base plate and withdraw the complete contact breaker assembly. Take care not to lose any shims that may be fitted between the base plate and the magneto body.

Remove the nut and washer securing the end of the contact breaker spring. Lift the contact breaker lever off its pivot pin (note that there are two fibre washers between the lever and the fixed contact plate). The

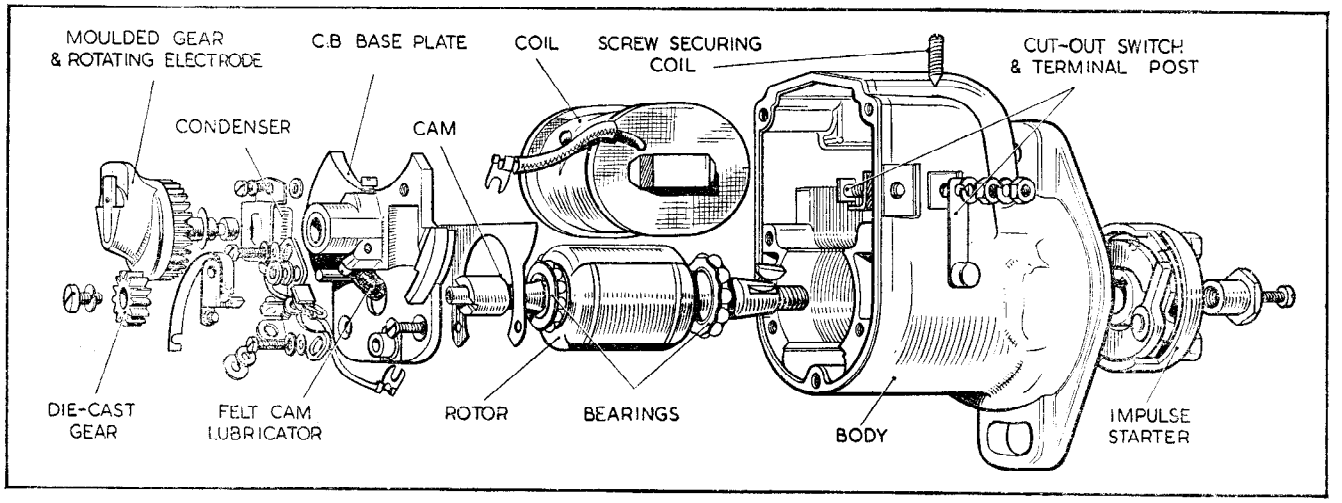

Fig. 3.
Magneto model SR4F, dismantled

square-headed bolt securing the terminal eyelet of the condenser and coil connections can now be removed, together with its associated insulating washers. Carefully note the arrangement of these washers in order to ensure their correct reassembly.

Slacken the grubscrews securing the coil in the magneto body, if necessary first scraping away the sealing compound covering them. Withdraw the coil from the magneto.

Pull the rotor out of the magneto body.

(c) BEARINGS

The two shaft bearings must be in good condition. If they are packed with high-melting-point grease every two years, or whenever the magneto is dismantled, they will give almost unlimited trouble-free service. However, if, due to lack of lubrication, they show signs of wear, they must be replaced. It is essential that a completely new set, comprising inner and outer races, balls and cages, be fitted.

The cages and balls can easily be pulled off the rotor shaft, and the inner races pulled off with an extractor. To remove the inner race of the contact breaker end bearing it is first necessary to pull the cam off its taper (after removing the retaining screw on single cylinder models). Before doing this, note the position of the slots in the end of the cam with relation to the keyway at the driving end of the shaft ; this relation must be maintained when refitting the cam. Outer races can be removed from their housings by an expanding collet type extractor.

When fitting new bearings, see that they are clean and packed with high-melting-point grease. Fit the inner races on the rotor shaft by means of a hand press and a suitable sleeve, and position the new balls and cages on the races. Press the outer races into their housings with a mandrel, placing a serrated insulating washer between each journal and its housing. More than one washer can be used if necessary to ensure a tight fit.

(d) BENCH TESTING THE COIL

These tests may be used to check the coil, either when removed from the magneto body or when in position.

The following equipment is required :

(*i*) A four cylinder contact breaker having closed periods of not less than 42° and operating at approximately 750 r.p.m.

(*ii*) A 12 volt lead-acid battery.

(*iii*) A set of three-point spark gaps.

(*iv*) 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 terminal post 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 high tension contact stud on the coil 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.

(e) REASSEMBLY

Before reassembly see that all parts are clean and undamaged. The rotor bearings must be packed with high-melting-point grease.

(*i*) See that the rotor is free from particles of swarf, washers or other small metallic objects that are liable to adhere to it, and insert the rotor into the magneto body.

If the cam has been removed from the shaft for any reason, do not replace it at this stage.

(*ii*) Thread the bolt forming the low-tension terminal post through the hole in the magneto body, taking care that the two insulating pieces are correctly positioned. Fit the coil into the body with the high-tension terminal stud facing outwards, and secure it by tightening the two fixing screws. Fill the screw holes with sealing compound flush with the body.

(*iii*) Reassemble the contact breaker on its base plate. A thin smear of Mobilgrease No. 2, or clean engine oil, should be applied to the contact breaker pivot before fitting the lever. Take care that the contact breaker spring and the connecting tag on the spring anchoring post have insulating washers between them and the fixed contact plate. Fit the contact breaker to the magneto body and secure with the three fixing screws. Any shims fitted between the base plate and the body must be clean and in good condition.

(*iv*) With the contact breaker securing screws fully tightened, check the rotor for end play. The rotor should turn without binding but without any trace of end play. (Remember that the magnetic system will oppose rotation, with two points of maximum

resistance in each revolution, and do not mistake this for mechanical binding). If necessary add up to four brass shims behind the contact breaker base plate until the rotor can revolve freely. Finally, caulk the contact breaker fixing screws to lock them.

(*v*) Remake the connections from the coil and the contact breaker to the low-tension terminal post. Reassemble the earthing switch. The moulded insulating piece must be correctly positioned between the earthing strip and the magneto body.

(*vi*) If the position of the cam has been disturbed, the magneto must be re-timed. To do this place the cam on its taper, but do not force it fully home. Set the contact breaker gap to .010"—.012" at its maximum opening. Then proceed as follows :

Single-cylinder magnetos. Turn the rotor until it is in the firing position, i.e. with the larger gap between the rotor pole shoes corresponding to the larger of the laminated stator poles. Insert vertically, between the trailing tip of the rotor pole shoe and the adjacent stator pole, a gauge of thickness .032" for **clockwise** rotation magnetos or .060" for machines having **anti-clockwise** rotation. ("Clockwise" or "anti-clockwise" refers to the rotation of the magneto **when viewed from the driving end,** and an arrow indicating the direction of rotation is stamped on the magneto body.) A drill shank forms a convenient gauge : use a No. 67 drill for clockwise and a No. 53 drill for anti-clockwise magnetos.

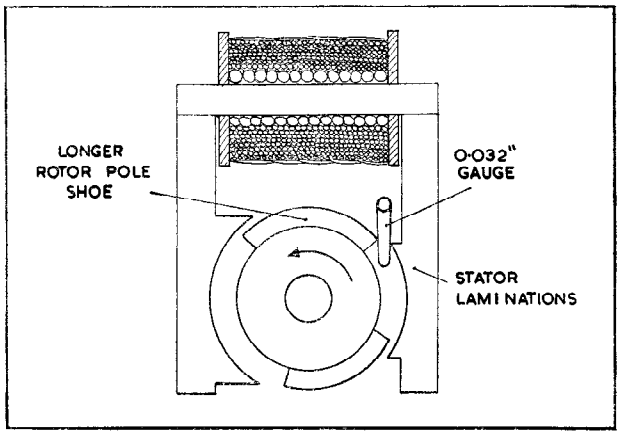

Fig. 4.
Position of gauge when timing single-cylinder (clockwise rotation) magneto

Adjust the position of the cam until the contacts are on the point of opening and further movement in the correct direction of rotation will separate them. When this condition has been obtained tap the cam fully home and insert the cam retaining screw. Finally check the timing to ensure that the cam has not moved.

Twin and four-cylinder magnetos are timed in the same way, but using a gauge of .010" for both clockwise and anti-clockwise machines. Since the rotors of these magnetos are symmetrical, the remarks on securing the correct relation between rotor and stator pole pieces do not apply.

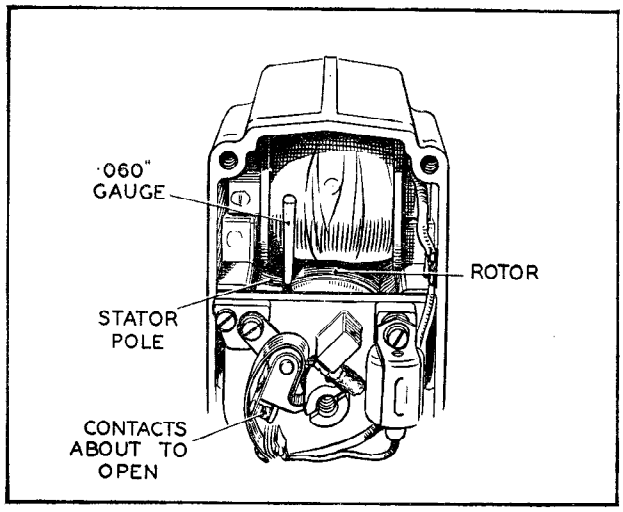

Fig. 5.
Position of gauge and cam when timing single-cylinder magneto (anti-clockwise rotation)

The distributor gears of the twin and four-cylinder magnetos can now be replaced. If these gears have no timing marks, their correct relation can be checked by fitting a special distributor block from which the centre and upper portions have been cut away. Insert a .010" gauge between the trailing tip of the rotor pole shoe and the stator laminations. The leading edge of the rotating electrode should now be between one-third and two-thirds across the appropriate distributor electrode.

If a cut-away block is not available, set the rotor arm so that the centre-line of the electrode makes an angle of 45° with the centre-line of the magneto. When the correct position has been obtained, tighten the screw securing the distributor gear in position. Mark the gears to ensure their correct timing on future occasions.

(*vii*) Finally refit the impulse starter. The spring of the impulse starter must be lubricated with thin machine oil before assembly. After refitting the magneto to the engine fill the lubricating well on the distributor gear bearing with thin machine oil, and replace the moulded cover.

(f) MAGNETISING

Before magnetising remove the impulse starter, as otherwise trouble may be encountered due to the pawls of the starter mechanism becoming magnetised.

Single-cylinder magnetos. Remove the moulded cover and turn the rotor until the longer of the two gaps between its poles is at the top, and then, facing the driving end of the magneto, check the polarity of the magneto with a compass. The end of the compass needle that normally indicates the north should point to the left-hand side of anti-clockwise rotation magnetos and to the right-hand side of clockwise rotation machines. Check the polarity of the magnetiser. Place the magneto in position so that the unlike poles of magneto and magnetiser are adjacent, and operate the magnetiser.

Twin and four-cylinder magnetos. Since the rotors of these magnetos are symmetrical, they need not be mounted in any special way to ensure correct polarisation of the spark. Turn the rotor so that its poles correspond to the stator pole pieces, place the magneto in position between the magnetiser poles and operate the magnetiser