

# **LUCAS**

*Quality*

# **EQUIPMENT**

## **W O R K S H O P I N S T R U C T I O N S**

### **INDUCTOR-GENERATORS**

**MODEL IA45**



**JOSEPH LUCAS LTD · BIRMINGHAM 19 · ENGLAND**

# LUCAS WORKSHOP INSTRUCTIONS

## INDUCTOR-GENERATORS

### MODEL IA45

#### 1. GENERAL

Model IA45 Inductor-Generator comprises two main components, a stator and a rotor. The stator carries two coils wound on laminated steel cores, and two magnets cast integral with an aluminium shell. An output similar to that given by a twelve pole rotating magnet alternator is obtained by using a six-toothed rotor, also of laminated steel. Thus, as the rotor turns, rapid and repeated reversals of flux take place in the coil cores, to induce alternating e.m.f.'s in the coils.

Connections from the ends of the coils are taken to a terminal board and thence, through multi-cored cable, to a separately mounted control switch.

A contact-breaker mechanism is included in the design for use with coil ignition. The cam is carried by an extension to the rotor core, whilst the contact-breaker plate is carried by an extension to the stator casting.

Three basically similar designs are produced and can be identified as follows:

One design includes an auto-advance mechanism fitted to the rotor extension; on another, the rotor extension is partially supported or steadied by a roller

bearing mounted behind the contact-breaker assembly; whilst a third design, usually fitted to light delivery vans, carries neither an auto-advance mechanism nor a steady bearing.

The rotor is taper-coupled with, and driven by, an extension to the crankshaft. It is important, therefore, that excessive wear in the engine bearings is not allowed to develop. In the event of such wear developing and resulting in a badly scored rotor and stator, the complete unit should be returned to the Works for repair or replacement.

**Warning** To prevent the magnets from becoming de-energised, avoid unnecessary removal of the rotor. When such removal is unavoidable, special keepers must be fitted to the stator and the precautions recommended in Section D-6, page 7, observed. The dimensions and method of fitting the keepers is shown in Section D-6, Fig. 8a.

If the rotor is removed, and these precautions are not observed, it will be necessary to return the complete unit to the Works for re-magnetisation.

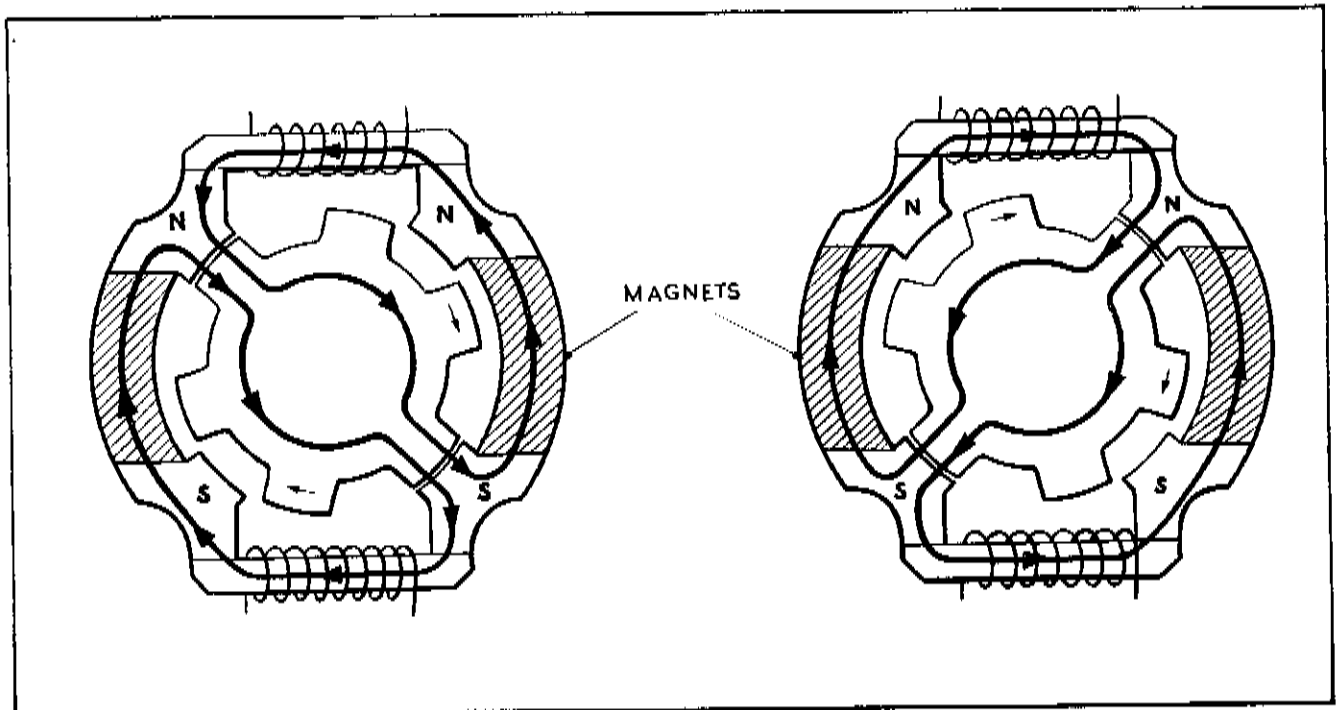


Fig.1.  
Inductor-generator, principle of operation



# LUCAS WORKSHOP INSTRUCTIONS

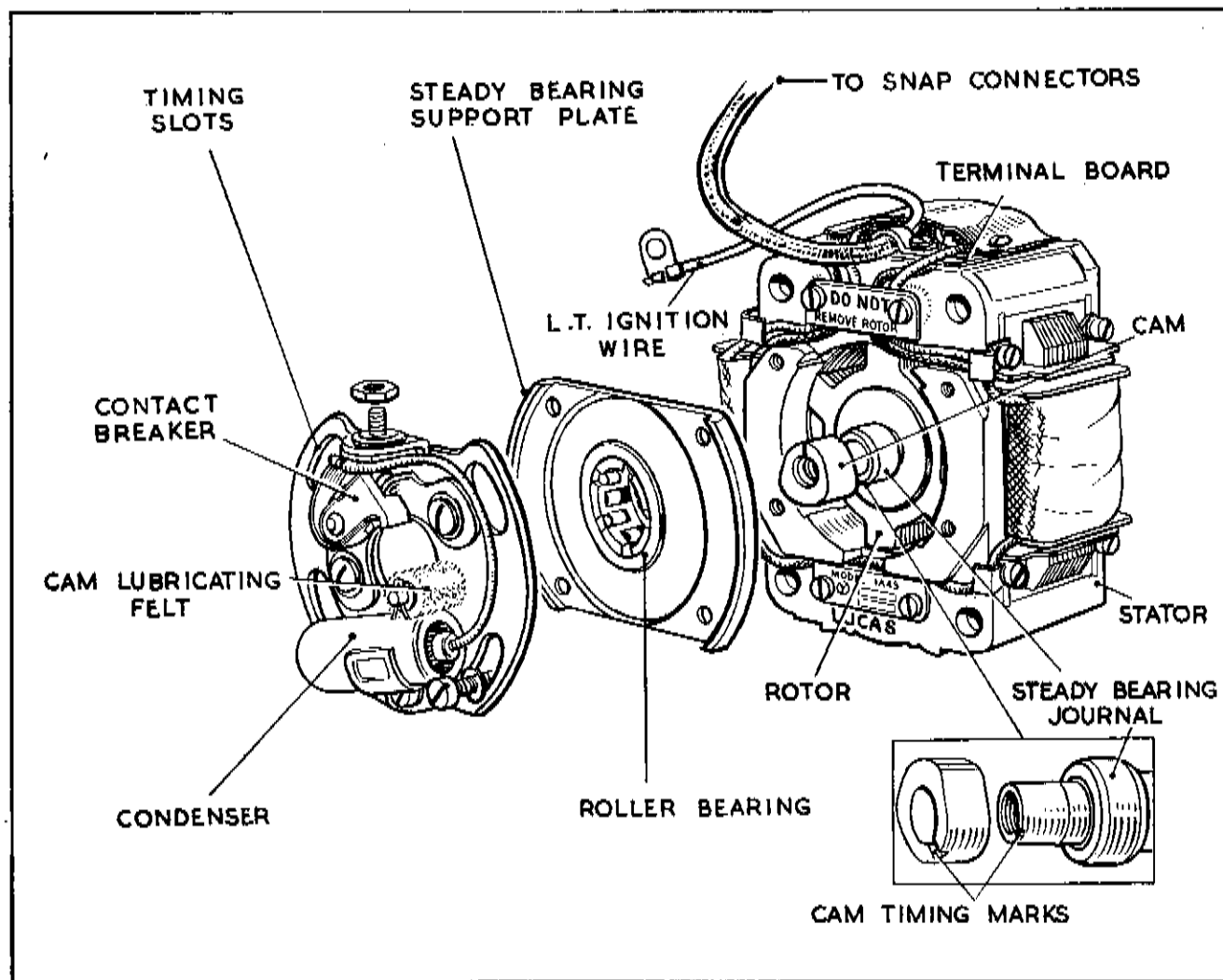


Fig. 2.

Exploded view of an inductor-generator fitted with a steady bearing

## GENERAL PRECAUTIONS

The inductor-generator set is designed for working with a 'positive earth' system. Should the battery be connected with its negative terminal to earth, the rectifier will be burnt out when the ignition is switched on.

Since it is not possible to repair a burnt out or badly damaged rectifier, a defective unit must be replaced. It is important to fit the new rectifier in the manner specified by the makers, i.e. spacer bushes to be used to allow free ventilation to both sides of the rectifier, and the unit to be mounted vertically with the cables emerging from its lower edge.

The set has an ample margin of safety. Nevertheless, it should not be run with the battery disconnected for longer than is necessary - whether or not the ignition switch is in the Emergency position. The

higher operating voltage generated under these conditions can cause overheating of the ignition coil and burning of the contact-breaker points.

## 2. MAINTENANCE

In general, the only maintenance required is to lubricate and clean the contact-breaker assembly as described below. This procedure should be carried out every 3,000 miles.

*When lubricating take great care to prevent oil or grease from getting on or near the contact-breaker points.*

### (a) LUBRICATION

#### The Cam:

The contact-breaker cam is lubricated by an impregnated felt pad, which should not need renewing during the normal service life of the generator. Occasionally, bend out the pad securing tag and turn the pad to



# LUCAS WORKSHOP INSTRUCTIONS

expose a fresh rubbing surface to the cam. Bend in the tag to prevent the pad from rotating in service. Do not apply oil or grease to this lubricator, even if the felt seems dry to the touch.

## Automatic Advance Mechanism:

To lubricate this mechanism (when fitted) the contact-breaker plate must be removed. The plate is secured by two screws which pass through slotted holes. It is important therefore to mark both plate and body before separating and thus avoid alteration to the ignition timing during reassembly. Apply a trace of thin machine oil to the spindle and moving parts. Refit the contact-breaker plate.

## Roller Bearings:

The roller bearings (when fitted) are housed in a dished plate which together with the contact-breaker plate, is secured by four screws. Again, before removing, mark both contact-breaker plate and body, to avoid altering the ignition timing during reassembly. Lift off the contact-breaker plate, and carefully lever off the bearing plate. Lightly smear cage and rollers with a small quantity of high melting point grease. Refit the bearing and contact-breaker plates.

## (b) CLEANING

Examine the contact-breaker. The contacts must be quite free from grease or oil. If they are burned or blackened, clean them with very fine carborundum stone or emery cloth, afterwards wiping with a clean petrol-moistened cloth.

Cleaning is facilitated if the contact-breaker is removed. To do this, slacken the nut or nuts on the low tension terminal post to release the slotted end of the contact-breaker spring, and lift the contact-breaker lever off its pivot. Note that the contact-breaker spring is sandwiched between the tag of the condenser connection and a fibre washer.

After cleaning, smear the contact-breaker pivot with a trace of Mobilgrease No. 2 or clean engine oil. Replace the contact-breaker lever and tighten the low tension terminal.

## 3. DESIGN DATA

- (a) Rotation: Anti-clockwise when viewed from contact-breaker end.

Direct Current Output: Should exceed 7 amperes at 2,200 r.p.m and be less than 10 amperes at 4,000 r.p.m.

- (b) Contact Gap: 0.010 - 0.012 in.

- (c) Spring Tension at Contacts: 18 - 24 oz.

- (d) Condenser Capacity: 0.2 microfarad.

- (e) Automatic Timing Control:

(The following characteristics apply only to machines bearing the Service No. 47 069 and are quoted from ECM 457):

Accelerating	
Speed (r.p.m.)	Cam Advance (degrees)
up to 500	Zero
4000	28 - 32

## Decelerating

Speed (r.p.m.)	Cam Advance (degrees)
3000	20 - 24
2000	6 - 10
1600	0 - 5

## 4.

## SERVICING

### (a) TESTING IN POSITION

The following tests are designed to check performance and to assist in tracing faults.

Test (i) is suitable for use when a simple and rapid check is required.

Tests (ii) (iii) and (iv) provide miscellaneous checks on the equipment.

Test (v) is the recommended method of checking performance in which the voltage drop across a one-ohm resistance is measured using an a.c. voltmeter.

Test (vi), using a d.c. voltmeter, is an alternative to Test (v) and may be used when an a.c. voltmeter is not available.

For constructional details of the one-ohm resistance used in Tests (iv), (v) and (vi), see para. 5 (a) and 5 (b).

Internal connections of the Inductor-Generator are brought out in multi-core cable and coloured Purple, Yellow and Green. A fourth wire coloured White is connected to the contact breaker terminal. The ends are fitted with snap connectors.

When carrying out tests (i), (iii), (v) and (vi), disconnect the Purple, Yellow or Green wires as required at the snap connector, but leave the White or Black and White ignition wire connected in order that the engine may be run.

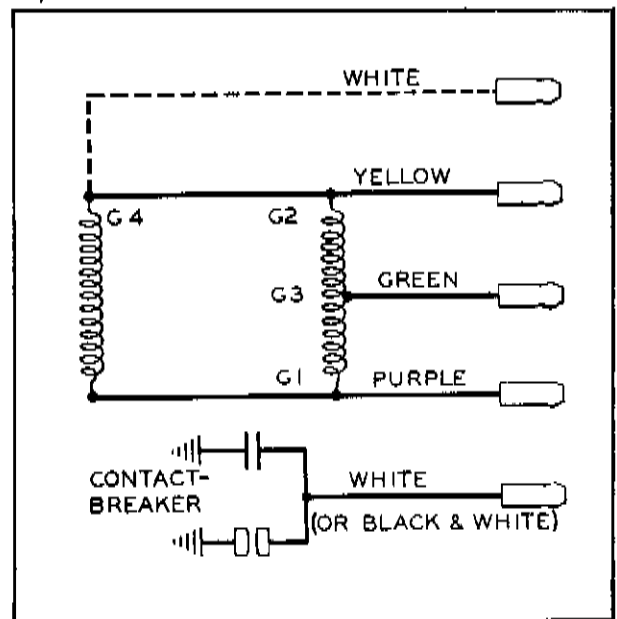


Fig. 3.  
Terminal arrangement and internal connections of Model IA45 inductor-generator



BRITISH MADE

# LUCAS WORKSHOP INSTRUCTIONS

The most usual terminal arrangement is shown diagrammatically in Fig. 3. However, in the case of Inductor-Generators fitted to light delivery vans, terminals G4 and G2 are not connected internally. Instead, the connection to G4 (shown in broken line) is brought out, using the white core normally connected to the contact-breaker. A separate wire, run outside the four-core cable, is connected to the contact-breaker.

(i) **Bulb Tests.** Using a 6-volt 36-watt test lamp, connect one test lead to snap connector G3 (Green) and the other to snap connector G1 (Purple). Start the engine and run it at about 2,000 r.p.m. The bulb should light to full brilliance.

Stop the engine and disconnect the test lead from G1. Connect it to snap connector G2 (Yellow) and re-test. The bulb should again light to full brilliance.

Note: In the case of light delivery vans, snap connectors G2 (yellow) and G4 (white) must be joined together.

(ii) **Insulation Test.** Using a 500-volt Insulation tester, test between the coloured connectors (G1, G2 and G3 bunched together) and the stator casting. A reading of not less than 10M $\Omega$  should be obtained.

(iii) **Battery Input Tests.** Connect an ammeter calibrated 0—10 amps. in series with the battery cable. Turn the lighting switch to OFF. Start the engine and accelerate until the ammeter needle steadies.

This should indicate 3.0 to 3.5 amperes.

A reading of approximately 7 amps would indicate an open circuit. Check therefore at the following points:

For vehicles fitted with half-charge resistance (B.S.A. 'Bantam' and Brockhouse Motor-Cycles) refer to Fig. 10.

Check resistance for continuity (6.5 ohms.).

Check switch contacts connecting G1 to R.

Check wiring between the switch and the resistance, and from the snap connectors to the switch and to the resistance.

Turn the lighting switch to position 'P'. The ammeter needle should indicate 5.5—6.0 amperes.

For vehicles not fitted with half-charge resistance (light delivery vans) refer to Fig. 11.

Check the switch rocker arms. The left-hand rocker arm should be in contact with switch terminal '7', and the right-hand arm should be lifted clear of terminal '1'.

Turn the lighting switch to the Headlamp position. The ampere output should now increase. If it does not:—Check that the right-hand rocker arm has contacted terminal '1'; check wiring for continuity between generator terminal G4 (yellow) and the rocker arms, and between generator terminal G2 and switch terminal '1'.

In the event of zero output in all positions of the lighting switch check the rocker arms—these may be contacting terminals '1' and '7' simultaneously.

(iv) **Rectifier Tests.** The rectifier is designed for use with a Positive Earth Battery. It must not be connected to a negatively earthed battery.

Remove the rectifier from the machine. Connect it in series with a 6-volt battery, ammeter, and loading resistance, using a centre (0.5 ohm.) tapping of the one-ohm resistance, as shown in Fig. 4.

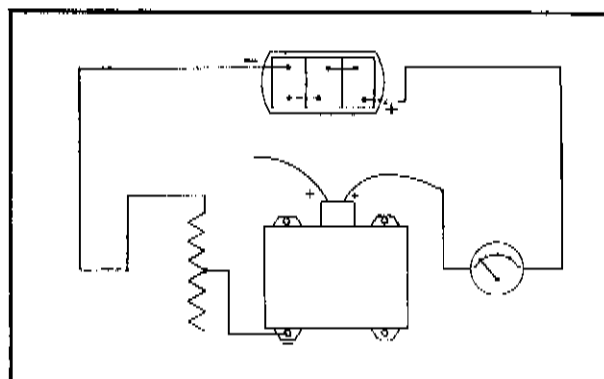


Fig. 4.  
Circuit diagram for rectifier test

The ammeter should indicate a current of not more than 10 amperes when either of the two rectifier cables are connected to it.

If the current flows freely, then reverse the battery connections and measure the back current through each rectifier cable. This current should not exceed 100 milli-amps. If a current greatly in excess of 100 milli-amps is measured, then the rectifier plates are shorted and a replacement rectifier must be fitted.

If the above tests show the rectifier to be sound, refit it to the machine, taking care to see that the rectifier-to-machine contact is good. A faulty earthing contact will cause erratic or zero generator output.

If Tests (i) to (iv) suggest demagnetisation or a faulty stator coil, proceed with Test (v); or if an A.C. voltmeter is not available, with Test (vi).

(v) **A.C. Voltmeter Tests.** Tests (a), (b) and (c) below require points G2 and G4 to be connected. On the majority of machines these points are joined internally by a soldered connector at the terminal board, but with light delivery vehicles snap-connectors G2 (Yellow cable) and G4 (White cable) must be wired together externally.

Tests (d) and (e) require points G2 and G4 to be isolated. It will be necessary with some machines, therefore, to remove the generator in order to unsolder the link G2-G4. Great care must be taken to ensure that stator and rotor are removed simul-



# LUCAS WORKSHOP INSTRUCTIONS

taneously and that the rotor is not allowed, even momentarily, to leave the stator. See Warning, page (1) and para. 4 (e) and 4 (g).

Using the one-ohm loading resistance with an a.c. voltmeter connected in parallel make the following tests, and note the voltage reading when the engine runs at 4000 — 5000 r.p.m.

	One-ohm Resistance Connected between:	Voltmeter Reading:
(a)	... G1 and G2 - - G4	4.7 to 5.7
(b)	... G3 „ G1	8.5 „ 10.3
(c)	... G3 „ G2	8.5 „ 10.3
(d)	... G1 „ G4	2.35 „ 2.85
(e)	... G1 „ G2	2.35 „ 2.85

Analysis of Tests (a) to (e):

Test(s):	Result:	Conclusion:	Action:
(a)	Reading of 3.0 to 3.8 volts.	Rotor has been withdrawn and replaced.	If tests (b) and (c), and (d) and (e), give pairs of identical but low readings, return generator to Works for remagnetisation.
(b) & (c)	Low reading.	An internally shorted coil.	Identify faulty coil from Tests (d) and (e).
(d) & (e)	Low reading.	As above.	Replace faulty coil, see page 6, para. (c).
	Zero reading.	Open circuited coil.	As above.

(vi) **D.C. Voltmeter Test.** Disconnect snap connectors G1, G2, G3 (Purple, Yellow, Green) and, in

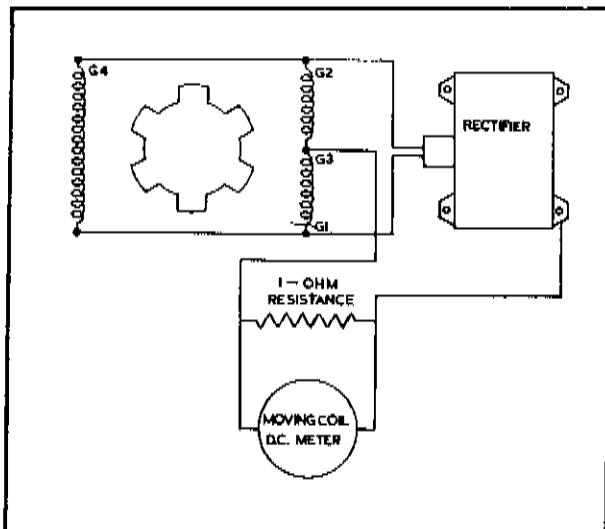


Fig. 5.

Circuit diagram for D.C. voltmeter test

the case of light delivery vans, also G4 (White) and join it to G2 (Yellow).

Connect the rectifier, one-ohm loading resistance, and D.C. voltmeter as shown in Fig. (5). Start the engine and run it at 4000 — 5000 r.p.m. when the voltmeter should show 8.5 to 10.3 volts.

A low reading can be caused by: a faulty coil or defective insulation; a defective rectifier; loss of magnetism.

If the generator insulation and the rectifier are shown to be sound by Tests (ii) and (iv), then either check the coils by substitution, para. (c), or return the complete unit to the Works for repair or remagnetisation.

## (b) IGNITION TESTS

To carry out the following ignition tests, the generator must be removed from the machine, as described in para. 4 (e) or 4 (g).

A special bench fixture to support the generator is required, equipped with a variable-speed electric motor to drive the rotor. In addition, a Type CQ Ignition coil and a contact-breaker set in accordance with Design Data 3 (b) and 3 (c) are also required.

(1) **High Speed Test.** Connect the plug cable to an 8 kV rotary gap (see Section C8, Fig. 2) and turn the ignition switch to IGN., i.e. with coil terminal SW, and battery negative, connected to G3, see Fig. 6 (a). Regular sparking should occur up to 5000 r.p.m.

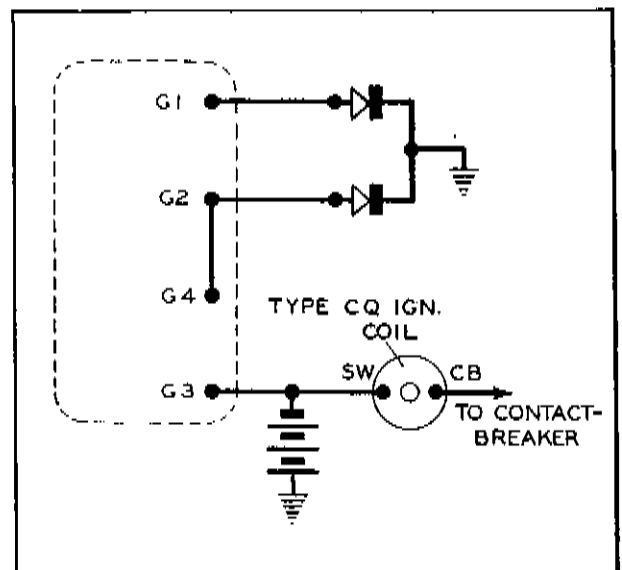


Fig. 6 (a).

High speed sparking test

(2) **Low Speed Test.** Connect the plug cable to an 8kV rotary gap or an equivalent (4½ milli-metres) 3-point stationary gap. Turn the ignition switch to the Emergency Start position, i.e., with battery disconnected and coil terminal SW connected to G1, see Fig. 6 (b).



# LUCAS WORKSHOP INSTRUCTIONS

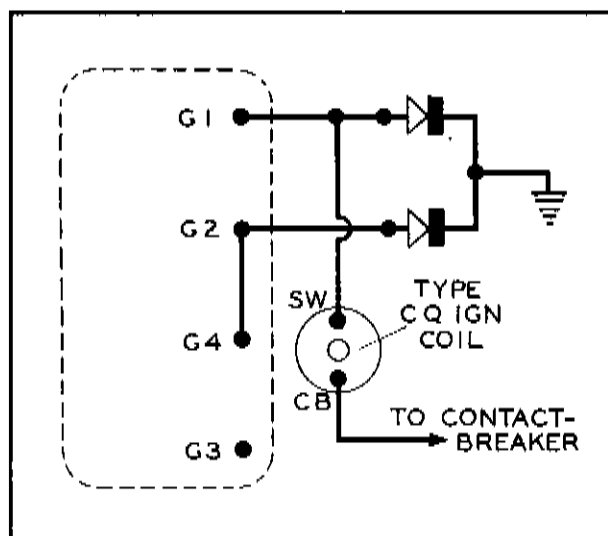


Fig. 6 (b).  
Low speed sparking test

Regular sparking should occur, at a speed less than 550 r.p.m., through a range of  $\pm 5^\circ$  with respect to a pre-set nominal firing position of the contact-breaker base plate.

To obtain this position, face the drive end and turn the rotor so that a centre-line drawn through the rotor keyway is displaced with respect to a vertical centre-line drawn through the stator. This displacement is  $25^\circ$  to the **right** of bottom with models stamped 47 068 or 47 077, or  $34^\circ$  to the **left** with models stamped 47 069, as shown in Fig. 7. With the rotor in this position, set the contact-breaker base plate so that the contacts are just separating. The contact-breaker base plate is now in the nominal firing position.

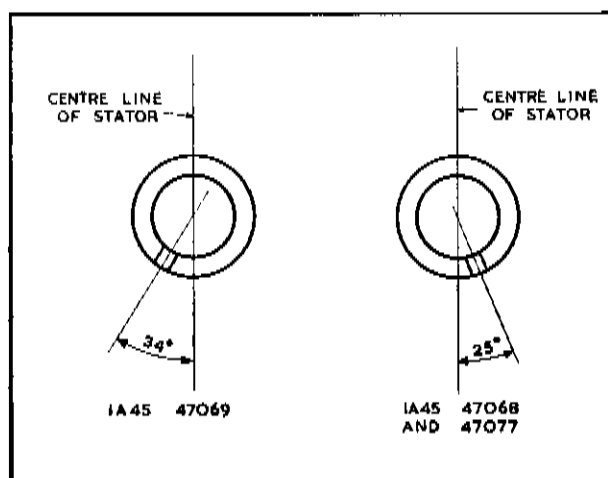


Fig. 7.  
Location of rotor keyway for nominal firing point

## (c) COIL REPLACEMENT

A stator coil is classified as right-hand or left-hand when viewed from the drive side of the rotor. There are two coils which, with the terminal plate and cable, form a soldered assembly that can be removed as follows:—

Remove the two terminal plate retaining screws and the cable clamping screws. Remove the labels and insulating strips from the front of the stator. Release the four coil retaining clamps and lift the coil assembly from the generator.

Before fitting new coils, check that the contacting surfaces of the laminations are perfectly clean and free of grease or magnetically attracted particles such as swarf and filings.

## (d) CONTACT-BREAKER REMOVAL

The base plate fixing holes are slotted. It is therefore important to mark both plate and stator before separation in order that the manufacturers' ignition setting shall not be altered when reassembling.

Remove the low tension ignition cable (white, or white with a black tracer) from the contact-breaker terminal. Withdraw the base plate fixing screws and lift off the plate complete with contact-breaker and condenser.

## (e) REMOVAL OF GENERATORS NOT FITTED WITH STEADY BEARING

Remove the generator cover and disconnect all cables from the machine. Withdraw the rotor retaining bolt and insert the special extracting bolt shown in Fig. 8. Turn the extracting bolt until the rotor is just free of the crankshaft.

Withdraw the stator securing bolts and lift the complete generator away from the crankcase. See Warning, on page 1.

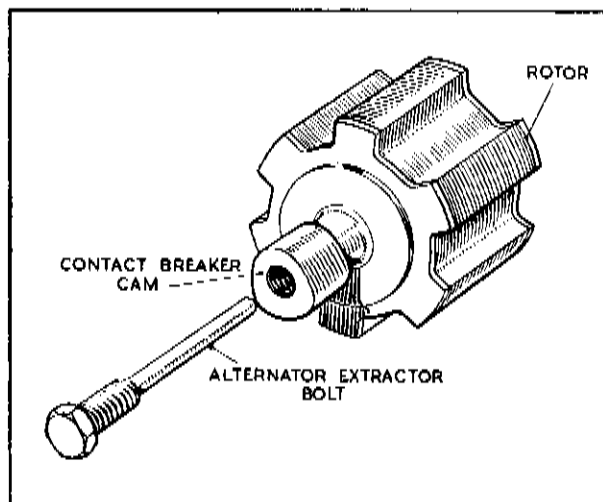


Fig. 8.  
Extractor bolt



# LUCAS WORKSHOP INSTRUCTIONS

## (f) REFITTING

Place the generator on the crankcase so that it locates with the register or spigot. Apply medium pressure to the rotor and turn it until it registers with the driving key on the engine crankshaft. Insert the centre bolt in the rotor and fully tighten. Replace the stator securing bolts and tighten evenly.

## (g) REMOVAL OF GENERATORS FITTED WITH STEADY BEARING

Removal is generally as described in para. 4 (e). Provision is made for the easy removal and replacement of the steady bearing plate or bearings, see para. 2 (a). The cam and steady bearing journal are both press fits on the rotor shaft extension. These fitments can, if necessary, be withdrawn using a suitable extractor of standard pattern.

If a cam is removed for any reason, it is most important when reassembling to fit the cam in correct relation to the rotor shaft (see insert, Fig. 1), otherwise the engine performance, when the machine is run with the ignition switch in the Emergency Start position, will be affected adversely.

## (h) REFITTING

Refitting is generally as para. 4 (f) except for the following additional procedure which must be observed to ensure correct alignment of the steady bearing: the contact plate securing screws must be left loose until the rotor and stator bolts have been fully tightened. The contact plate fixing holes are drilled to provide clearance and, providing the above method of refitting is followed, the plate and bearing will automatically align with the rotor shaft.

## 5. CONSTRUCTION

### (a) CONSTRUCTION OF ONE-OHM TEST RESISTANCE

Material required:

- (i) 12 feet of 18 SWG Nichrome resistance wire.
- (ii) An asbestos former of approximately 2 in. dia.
- (iii) Two terminals, test leads and crocodile clips.

### Method of Winding:

In order to carry the normal test currents without overheating, the resistance wire should be wound on the former as follows:

Hold the ends of the wire together and fold it at the centre, to give a single six-foot length of double wire. Wind this double wire round the former and secure one end with a suitable terminal. The other end should not be permanently anchored until the resistance has been calibrated as described below.

### (b) CALIBRATION OF ONE-OHM RESISTANCE

Apparatus required:

- (i) A 6-volt battery.
- (ii) A first grade 0-10 moving coil voltmeter.
- (iii) A first grade 0-10 moving coil ammeter.
- (iv) A test prod, and connecting cables.

The above items should be connected to the resistance as shown in Fig. 8. Apply the test prod firmly to the free end of the resistance and note the deflection thus caused to each meter pointer. If necessary, move the test prod along the resistance until the voltmeter and ammeter readings are numerically equal, i.e., the value of resistance between the first terminal and the prod is one ohm, and is the point at which the second terminal should be placed. Secure the end of the Nichrome wire to the terminal and cut off any surplus.

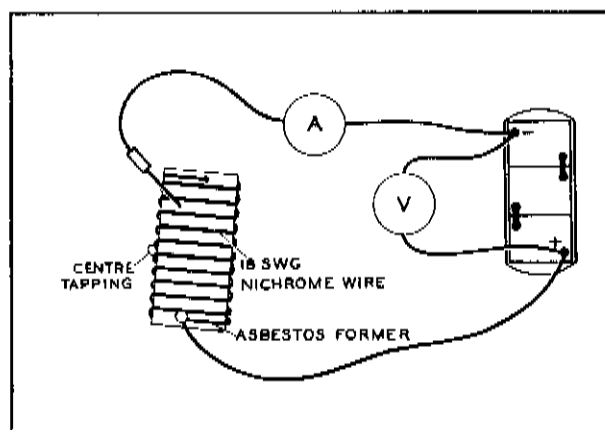


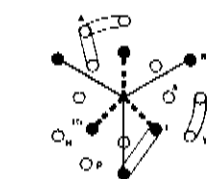
Fig. 9.

Circuit required to calibrate a one-ohm load resistance

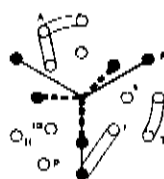




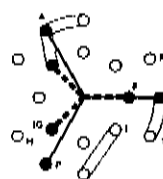
# LUCAS WORKSHOP INSTRUCTIONS



LIGHTING OFF  
(TURN L.T. SW. LEFT TO O)  
EMERGENCY IGNITION ON  
(TURN IGNITION KEY LEFT)



LIGHTING OFF  
(TURN L.T. SW. LEFT TO O)  
IGNITION OFF  
(TURN IGNITION KEY CENTRAL)



TAIL & PILOT L.T'S ON  
(TURN L.T. SW. RIGHT TO P)  
IGNITION ON  
(TURN IGNITION KEY RIGHT)



TAIL & HEAD L.T'S ON  
(TURN L.T. SW. RIGHT TO H)

DIAGRAMS SHOWING SWITCH POSITIONS LOOKING ON TOP OF SWITCH

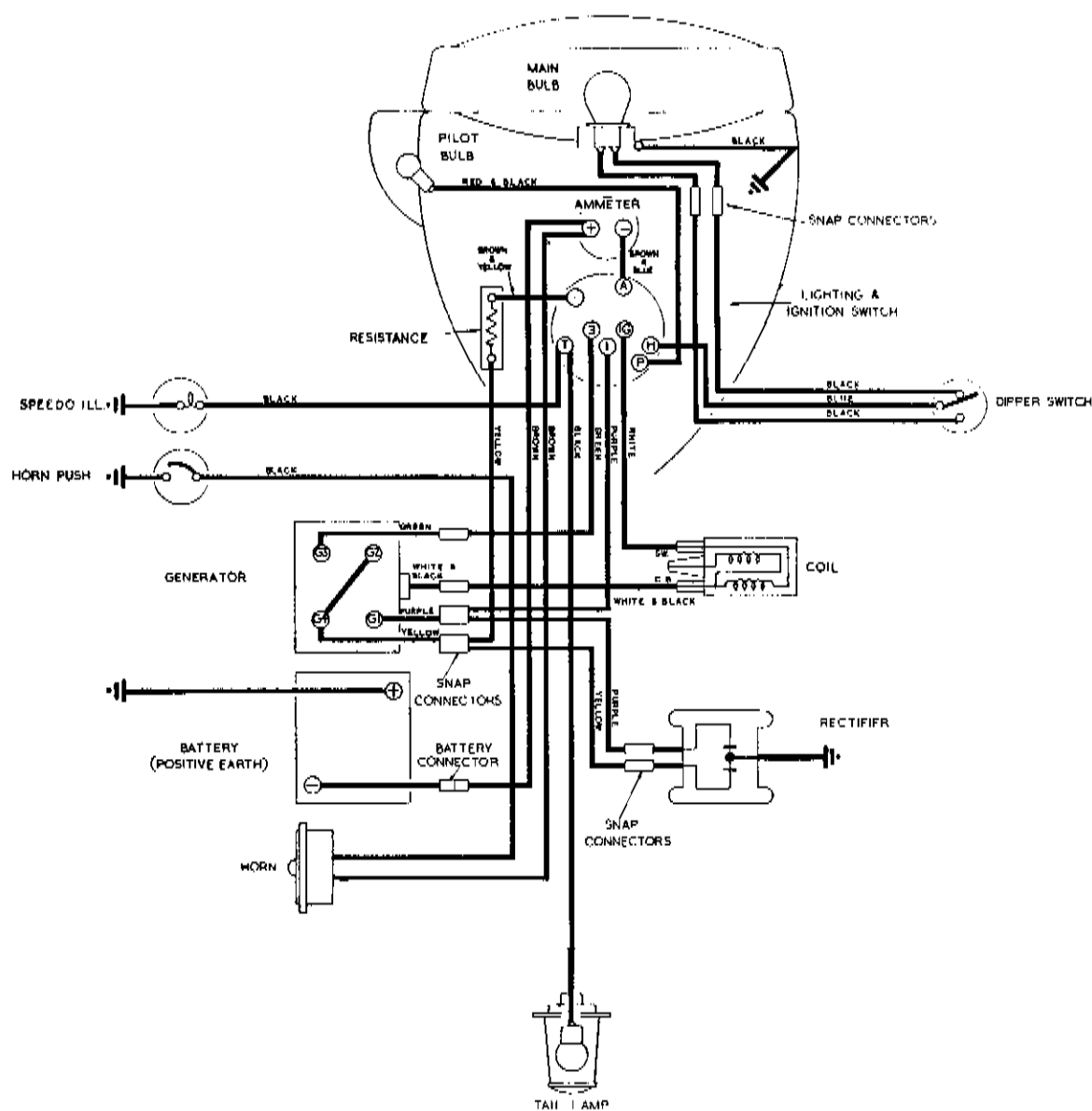


Fig. 10.

An inductor-generator circuit with half-charge resistance



# LUCAS WORKSHOP INSTRUCTIONS

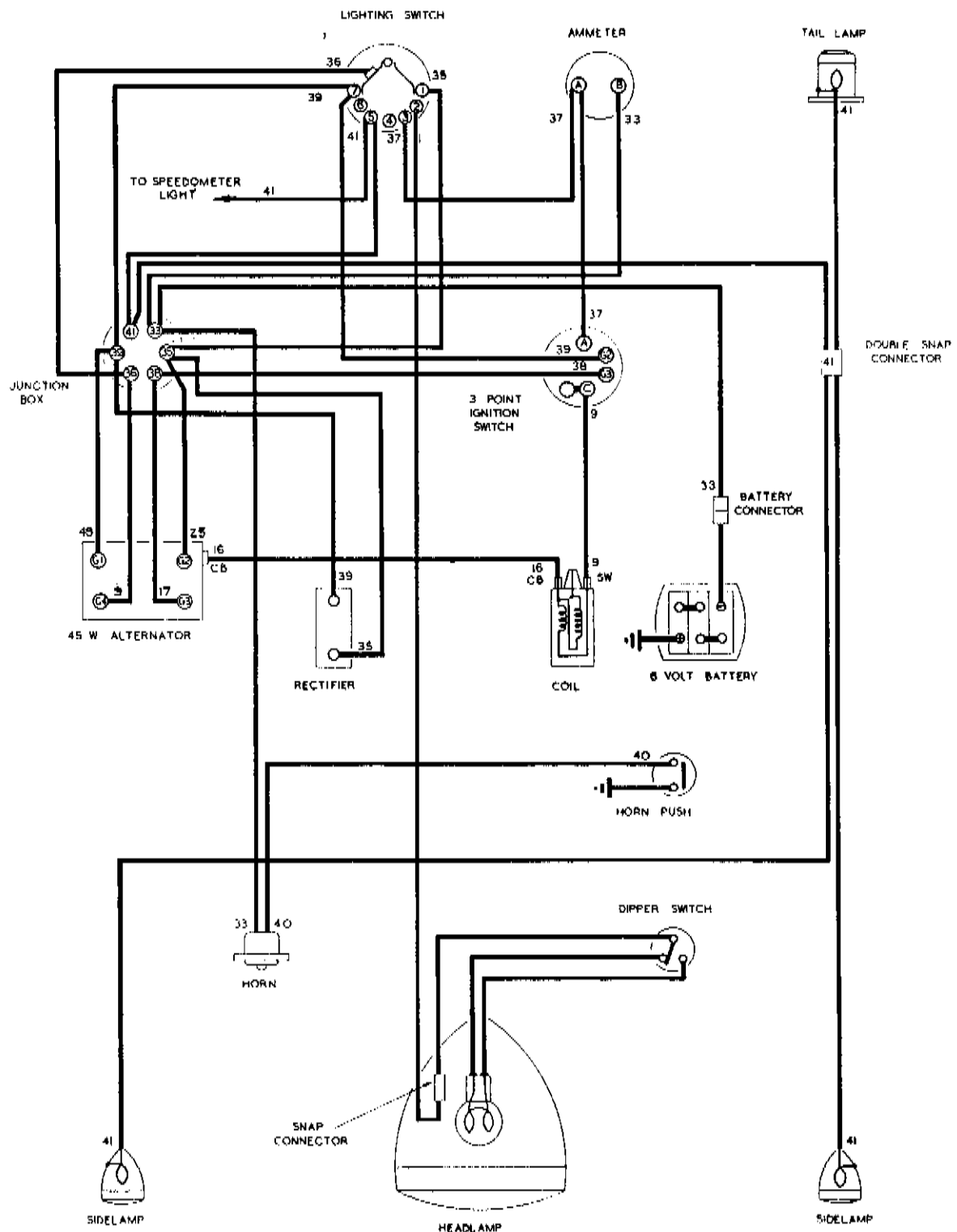


Fig. 11.  
An inductor-generator circuit without half-charge resistance

