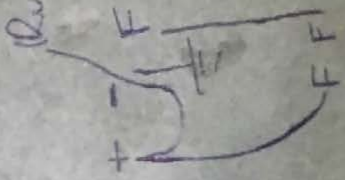
CAEDOR (WORKSHOPS) WINKFIELD

THE OCTOPUS AUTO-ELECTRICAL REFERENCE MANUAL



PRECISE OCTOPUS SERVICE

Issued by the

ARMATURE MANUFACTURING COMPANY
MIDDLETON ROAD
OLDHAM

Price 5/-

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THE "OCTOPUS" EQUIPMENT
including the
ELECTRICAL TEST BENCH AND WORKSHOP
are used in the manual to describe the testing of Electrical Components, it is of the very latest design and is a joint development of
THE ARMATURE MANUFACTURING COMPANY,
MIDDLETON ROAD, OLDHAM,
and the
SERVICE DEPARTMENT OF VAUXHALL MOTORS,
LUTON.

FOREWORD

Detailed instructions and data are given in this hand-book for the guidance of auto-electricians using the "Octopus" Electrical Workshop to diagnose and service the major electrical components of a vehicle.

It is not our intention to describe tests to be carried out in position on the vehicle, but rather to demonstrate the method of examining and testing components, using the Auto Electrical Workshop for the purpose, although any man with a reasonable knowledge of auto electrical principles should be able to carry out the tests with the aid of this Manual.

When using the Manual always read the whole of the text relevant to the particular item before commencing the work, in this way, special instructions will not be overlooked.

Fig. 1. The OCTOPUS complete electrical workshop.

CONTENTS

SAFETY

1. DO NOT leave couplings or drivings in the driving member after the completion of a test.

   These fittings will be thrown out if the motor is restarted and a serious accident may result.

2. ALWAYS return the speed control wheel to the centre Zero position after using and before switching the motor on.

3. DO NOT adjust the work table when the driving motor is in motion.

4. ENSURE that the vice clamping lever is tightened on the tubular mountings before running the motor.

5. RETURN all switches and controls to "OFF" position after a test has been completed.

   Owing to the presence of battery current on the equipment, this is very important otherwise damage may be caused.

6. ON LEAVING the test bench for any period, put the mains switch in the battery compartment to "OFF" to protect the motor from damage.

7. **DO NOT** leave any test leads connected to the test bench after the completion of a test.

   Failure to remove leads may result in damage to the machine if another test is undertaken with these leads already in position.

SECTION I : GENERAL DESCRIPTION

The electrical workshop section comprises a centre test unit and bench-mounted ancillary equipment.

Starters, generators and magnetos up to a maximum of 6 in. diameter can be accommodated in the vice gear. The applied voltage, test components and instruments are suitably adjustable for dealing with both 6 and 12 volt electrical equipment of either polarity.

Motor speed is continuously variable clock or anti-clockwise from 45 to 5,000 r.p.m. for testing generators and distributors.

An ignition coil, contact breaker and condenser are fitted for standard comparison testing.

INSTALLATION

Batteries

Two batteries should be installed in the centre section battery compartment. It is recommended that they are of 6 volt, 15 plate type and of 100 amp./hr. capacity at a 20 hr. rate. When two batteries are used they should be wired in series to give 12 volts and with the third lead from the machine taken to the series connection for the 6 volt tapping.

Mains Connection

The mains switch box is located on the inside wall of the battery compartment. The mains lead is taken into the bottom of the box and a straightforward connection made to the switch block.

THE TEST UNIT

The centre section of the complete workshop contains the necessary instruments and controls grouped conveniently for accurate testing of distributors, coils, condensers, starters, generators, cut-outs, regulators and other electrical equipment. The main features and components are described in the following paragraphs which should be read with reference to *Fig.* 2.

1 & 7. Fuses

On eaither side of the panel are mounted the generator main and field fuses.

2 & 6. Rheostats

The large control on the top right hand of the panel imposes a load on the generator output,

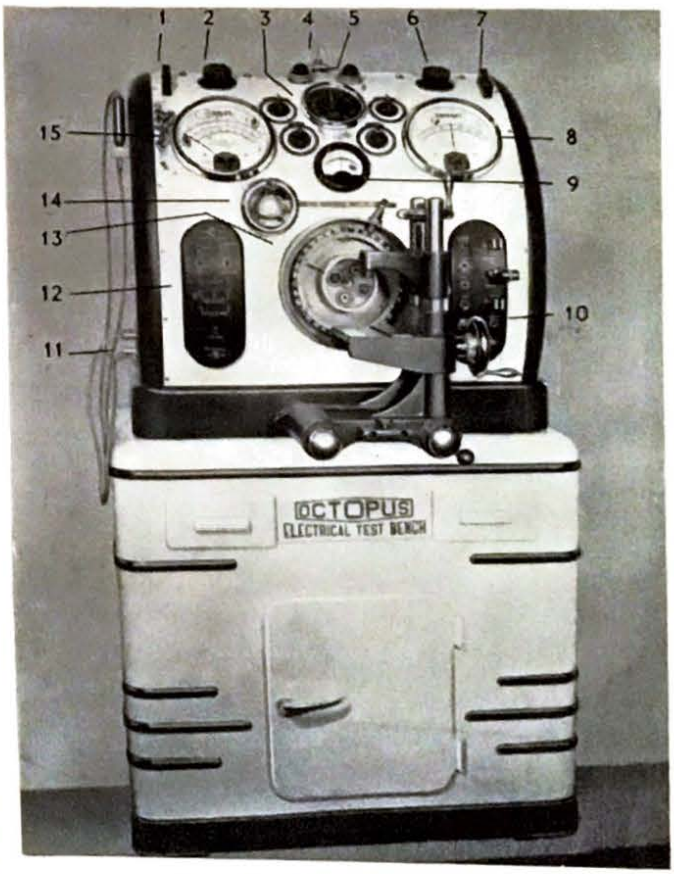

Fig. 2. *Test unit details.*

thus preventing overcharge of the batteries during extended output tests, while that on the left hand side introduces additional resistance in the field circuit as and when necessary.

3. Revolution Counter

This is a centre-zero instrument reading 5,000-0-5,000 r.p.m. used in conjunction with the syncroscope and generator output tests.

4. Spark Gap

Mounted centrally at the top of the panel, this gap enables the output of coils to be checked for high tension efficiency. In addition it provides a safety gap when using high tension search leads or test prods.

5. Continuity Test Units.

Two lamp holders are fitted to the panel under ruby glass dome covers. The lamps, containing bulbs of the same voltage as the supply mains are used for earth and continuity tests in conjunction with the test prods when these carry mains voltage. Each lamp is connected in series with one of the test prods thus eliminating the possibility of a direct short to earth.

8. Main Ammeter

On the right of the panel, this high grade moving coil instrument has two centre-zero scales 40-0-40 and 800-0-800 amps., either being selected by the ammeter selector switch.

9. Field Current Ammeter

Immediately below the revolution counter is a centre reading 10-0-10 field ammeter. This is automatically brought into circuit when generator test connections are made.

10. Right Hand Panel

The fittings on this panel are :—

1. Starter switch, push type.
2. Generator test sockets. Field, Dyn. + and Dyn. —.
3. Battery 6 and 12 volt change-over switch.
4. Starter test terminals.
5. Jumper lead earth socket.

11. Side Panel

The sockets on this small panel carry the supply of—

1. H.T. current supply.
2. Mains voltage for continuity testing.
3. Current (up to 30 amps.) at battery voltage.

In addition a "wander" lead enables the H.T. supply to be transferred from the H.T. test sockets to the coil test socket (see left hand panel).

12. Left Hand Panel

In descending order the fittings on this panel are :—

1. Coil test switch.
2. Coil and condenser test sockets.
3. H.T. switch and condenser switch.
4. Voltmeter tapping sockets.
5. Cut-out test sockets.
6. Current supply sockets (5 amp.) at battery voltage.
7. Coil test H.T. socket.
8. Motor switch.

13. Rotary Spark Gap or Syncroscope

The rotary spark gap or syncroscope incorporates a graduated scale calibrated in 360°. The 60° and 90° intervals are clearly indicated for cam spacing.

14. Speed Control Wheel

Below the voltmeter is mounted a hand wheel giving speed control and direction of rotation of the built-in electric motor which provides the drive for generator and syncroscope tests.

15. Voltmeter

An accurate moving coil voltmeter is fitted on the left of the panel. It has three scales 0-9, 0-18 and 0-36 volts, controlled by the voltmeter selector switch on the right of the dial.

SPECIAL EQUIPMENT

Puller Press (*Fig.* 3)

This tool is specially designed for easy dismantling or re-assembling of generators and starters.

The "U" shaped supporting plate is adjustable up and down the main frame and is arranged to hook on to the studs between the main members. The tool fixing rod prevents rotation of the tool or adaptor when in use.

When using the puller press for pressing bearings on and off, make sure that the work is directly under the centre line of the screwed

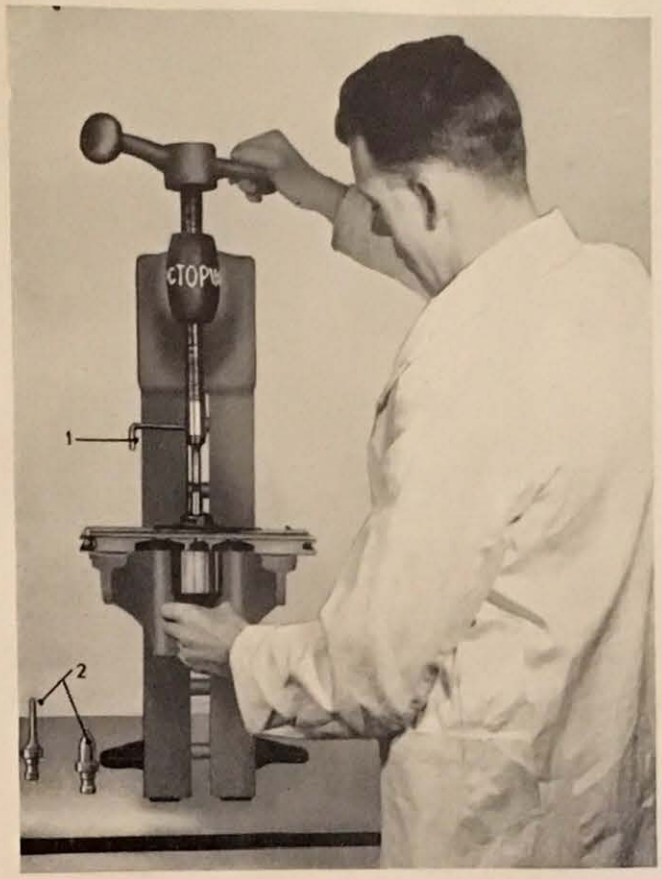

Fig. 3. Using the puller press to remove the end plate from an armature. 1. Tool fixing rod. 2. Tool adaptors.

shaft in order to avoid any possibility of lateral strain on the shaft.

Growler

The armature testing growler provides a simple method of locating open circuits, short circuits and earthed coils in generator and starter armatures.

With an armature in place, the switch is moved to the "series" position for testing generator armatures or to the "parallel" position for starter armatures. It must not however be switched on unless an armature is in position otherwise there is a risk of burning out the exciting coils.

Test prods are provided for measuring the current induced at the commutator which is then shown on the adjustable ammeter.

Pole Shoe Screwdriver (*Fig.* 4)

When tests have shown the necessity of removing and refitting field coils this tool offers the easiest, quickest and sometimes the only way of unscrewing the pole screws.

With a suitable screwdriver bit in position the pole screws can either be loosened and removed, or securely tightened with the turning arm. The direction of rotation is changed by means of the ratchet stop screw.

If a screw is found to be particularly stubborn it may be freed by tapping the swinging arm of the screwdriver sharply with a hammer on the boss provided directly above the screwdriver bit while this is held in engagement with the screw.

To deal with varying sizes of machines there are six alternative positions of the screwdriver pillar. To increase the capacity by raising the pillar, turn the swinging arm through 45° to the right and lift. Further increases are made by moving the arm alternately to left and right and lifting a step higher each time at the 45° position.

Ball Race Extractor (*Fig.* 5)

The tool has been especially designed to simplify removal of ball races without damage to components. The outer race is held in the jaws provided, but no clamping strain is imposed or

Fig. 4. The pole shoe screwdriver in use.

Fig. 5. Method of withdrawing an armature ball race using the extractor. 1. Long adaptor. 2. Short adaptor.

necessary as the jaw lugs bear against the face of the outer race. By operating the end handle the shaft is pushed out of engagement thus conveniently removing the ball race.

Of the two accessories supplied, the long adaptor can be used for extracting small bore races of the type on most electric drills. Before use, the main spindle must first be screwed right back. The short adaptor is of greater diameter than the spindle and can also form a useful floating member, preventing damage to the armature shaft. When extracting a race the armature should be permitted to revolve freely if there is any tendency to do so

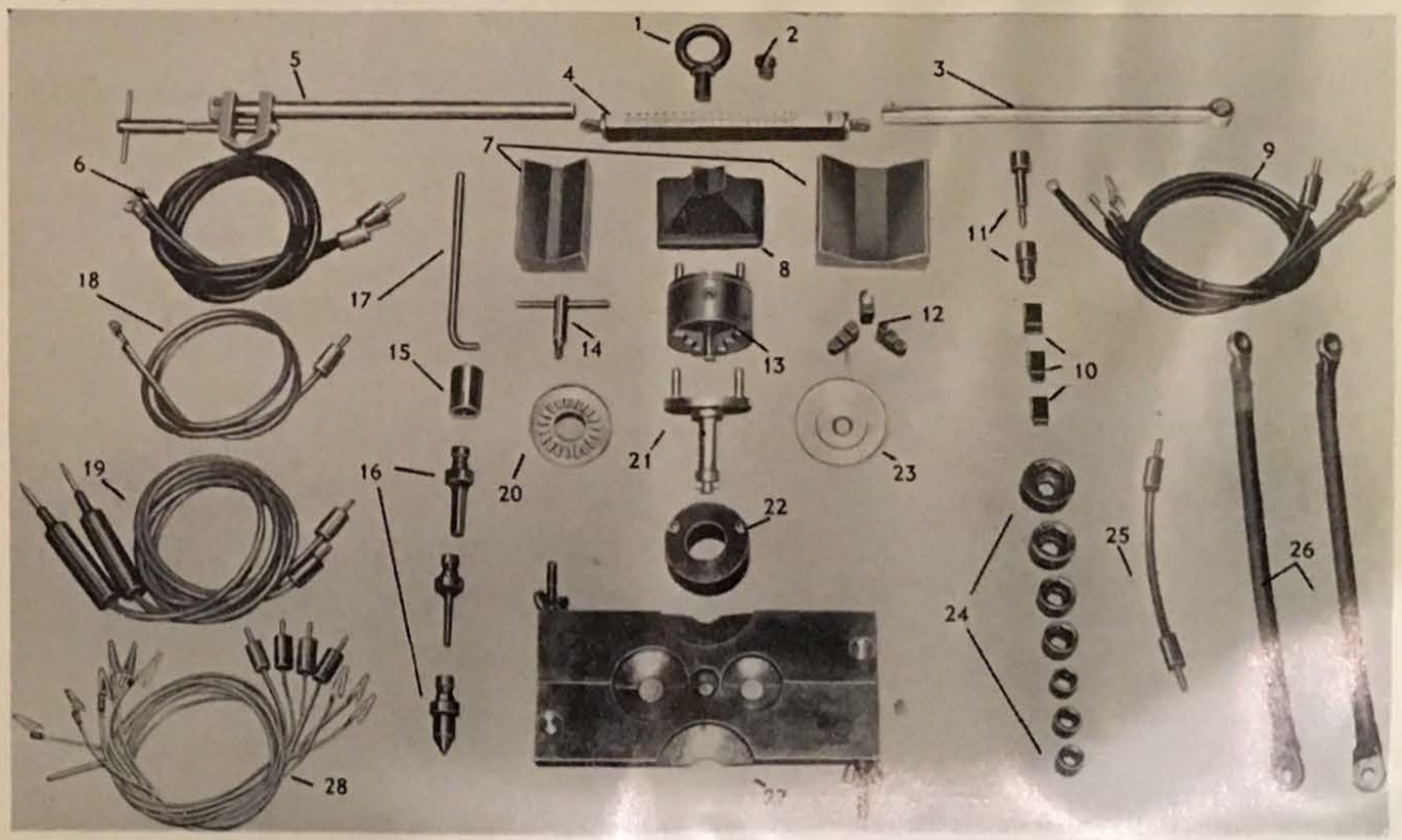

Fig. 6. Leads and accessories. 1. Eye bolt. 2. Eye bolt plug. 3. Starter torque test arm—lower. 4. Spring balance. 5. Starter torque test arm—upper. 6. 30-amp. test socket leads (2). 7. Vice "V" blocks (2). 8. Vice pedestal. 9. Generator test leads (3). 10. Pole shoe screwdriver bits (3). 11. Ball race extractor centres (2). 12. Alternative set of chuck jaws. 13. Three-jaw chuck. 14. Chuck key. 15. Puller press tool holder. 16. Puller press tools (3). 17. Puller press tool fixing rod. 18. H.T. lead. 19. Test leads and prods (2). 20. Magneto drive coupling. 21. Distributor drive and shaft assembly. 22. Distributor drive holder. 23. Generator drive plate. 24. Set of hexagon couplings (7). 25. Jumper lead. 26. Starter test leads (2). 27. Puller press plate. 28. Cut-out test leads (3), regulator test leads (3) and coil test H.T. lead (1).

Note: An 8-point annular spark gap is available as extra equipment for [illegible] testing.

SECTION 2 : GENERATOR

Failure of the generator to produce a satisfactory charging current may be traced to a fault in any one or more of the component parts.

For a complete overhaul, carry out tests in the sequence given and rectify troubles where necessary. It is assumed that possible faults in the external wiring system and in the cut-out or regulator will already have been found and dealt with, and will not therefore be wrongly ascribed to generator trouble.

To avoid unnecessary extra work, the machine should be thoroughly examined before any dismantling is considered. A preliminary inspection will frequently indicate the cause of the trouble, which may be due to mechanical or electrical defects as listed below.

Mechanical Troubles

1. Loose terminals.
2. Broken or slack brush springs.
3. Badly bedded or worn brushes.
4. Brushes sticking in the holders.
5. Dirt, oil or water in the machine.
6. Armature not rotating freely.
7. Bent shaft.
8. Slack or defective bearings.

The correct remedy, whether to clean, repair or replace will be obvious in each case.

Electrical Troubles

1. Commutator surface in bad condition.
2. Earthing of brush gear.
3. Earthed, short or open circuit in the field coils.
4. Earthed, short or open circuit in the armature windings.
5. Insufficient output due to third brush setting incorrect.

TO INSPECT GENERATOR

1. Brushes and Holders

Before dismantling, test for free movement of the brushes in their guides. Clean all carbon deposit away with petrol and if necessary ease by lightly polishing the sides of the brush with a smooth file. Care should be taken to replace the brushes in their original positions. Excessively worn brushes should be removed and renewed.

Test the tension of the brush springs with a small spring balance as shown in *Fig.* 7. Details

Fig. 7. Testing brush spring tension using spring balance.

of spring tensions for the various types of generators fitted to Vauxhall and Bedford vehicles are shown in Table 1 on page 31.

On the 12 volt generator fitted to Bedford OB models, the tension of the brush springs can be adjusted by positioning the spring in different slot locations on the trigger. On all other models, however, the spring tension is not adjustable, and if the tension of the spring does not come within the limits quoted, the spring should be renewed.

After dismantling the generator, test the insulation of the brush holder mountings using the test prods carrying mains voltage.

The procedure is as follows :—

Place one of the prods on the brush holder and the other on the commutator end bracket (*see Fig.* 8). When the prods are applied to the earthed brush holder the lamps should light up, but when testing the other main and third brush holders the bulbs will remain unlit if the insulation is in a satisfactory condition.

2. Armature and Commutator

To make a thorough check on the condition of the armature the use of a growler is essential. Testing with a growler is a simple and speedy method of locating open circuits, short circuits, earthed and reversed coils. Instructions for performing the various tests on the generator armature are given in the following paragraphs together with the inference of results.

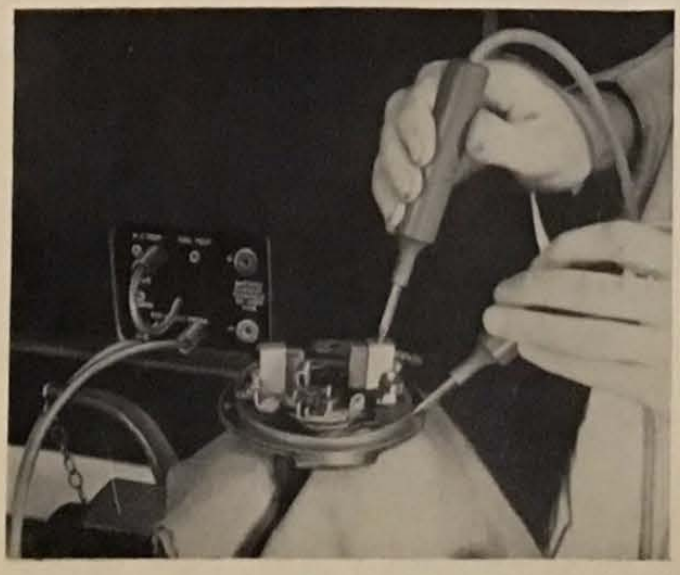

Fig. 8. *Testing insulation of brush holder mounting.*

Fig. 9. *Testing armature windings or earths using the growler.*

To Test the Armature Windings for Earth

For this operation the test prods carrying mains voltage are used in conjunction with the continuity test lamps as follows :—

(a) Switch on the mains current. Place one test prod on the armature core and the other on each of the commutator segments in turn as shown in *Fig.* 9.

(b) If the test lamps light, an earth in the armature is denoted and should be rectified by repair or renewal of the armature.

(c) If the test lamps remain unlit the condition of the armature for earth is satisfactory.

To Test Armature for Short Circuits

(a) Place the armature on the growler and move the switch over to the "series" position.

(b) Hold a hacksaw blade or steel rule over and in line with the armature core and slowly rotate the armature a complete revolution (*see Fig.* 10).

Fig. 10. Testing armature windings for short circuits.

(c) If the saw blade does not vibrate this indicates that the condition of the armature for shorts is satisfactory. If however, the saw blade does vibrate this indicates that a short circuit exists. To determine whether the short is in the armature or the commutator, switch off the growler and examine the commutator, clearing any segments which have burred together.

(d) Retest as in paragraph (a) above: if the saw blade continues to vibrate, the armature is short circuited and should be rewound or renewed.

(e) Make sure that the armature to commutator leads are securely soldered to the commutator segments.

To Test Armature for Open Circuits

(a) Mount the armature on the growler and move the switch to the "series" position. Place the test fingers on adjacent segments at the topmost point of the commutator. Adjust the ammeter by means of the left hand control knob to obtain a mid-scale reading and note the figure (*see Fig.* 11)

(b) Rotate the armature just sufficiently to bring the next gap on the commutator to the top position and again place the test fingers on adjacent segments. Repeat the test until all segments have been checked. If from any pair of segments a low or zero reading is obtained on the ammeter, an open circuit in the windings is indicated. There is however, the possibility of a short circuit between segments of the commutator, therefore before proceeding further, make sure the inter-segment insulation is clear.

(c) Retest as in paragraph (a) above; if the low reading persists an open circuited coil is indicated which should be rectified by repair or renewal of the armature.

3. Field Coils

It is essential that the field coils are in position in the generator yoke when testing for earth, therefore complete all the following tests without removing the coils.

Fig. 11. Testing armature windings for open circuits.

To Test Field Coils for Earths

Before starting this test make sure that the field coil terminals are not touching the generator yoke.

Place one of the mains test prods on the field coil terminal and the other on the generator yoke (*see Fig.* 12). The lamp should remain unlit. If the lamp does light this indicates an earth which can be traced to the individual coil in the following manner :—

(a) Disconnect the series wires between the coils, using a soldering iron where necessary.

(b) Place one test prod on the wire from one end of the coil and the other test prod on the generator yoke. If the lamp lights the coil is faulty.

(c) Repeat the test for all coils.

To Test Field Coils for Continuity

For this test use the two test prods carrying mains voltage and with the lamp in series.

(a) Place the two test prods on the field leads (*Fig.* 13).

(b) If the test lamp lights, the coils are satisfactory.

(c) If the test lamp remains unlit an open circuit is indicated. In this case clean a part of the series connection between the coils and test each coil individually to determine which of the coils is at fault.

Fig. 12. *Testing field coils for earthed windings.*

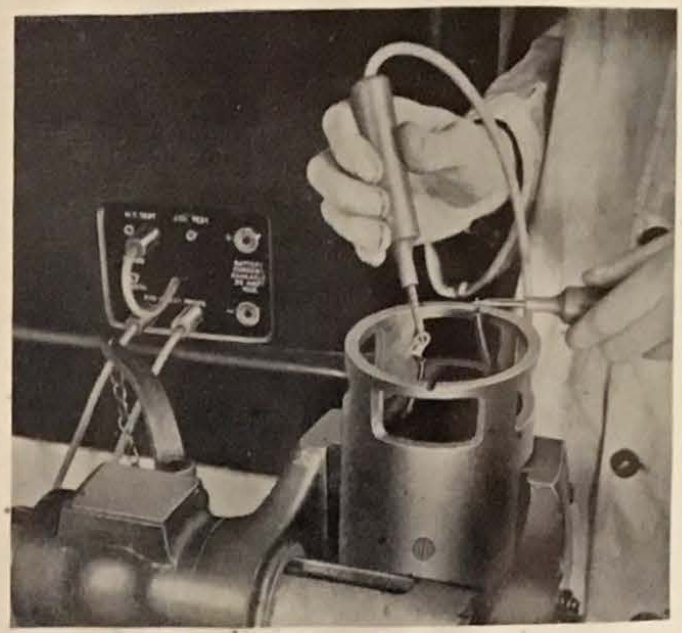

Fig. 13. *Testing field coils for continuity.*

Voltage Drop Test

To carry out this test use two test leads provided carrying appropriate battery voltage connected to the field coil leads.

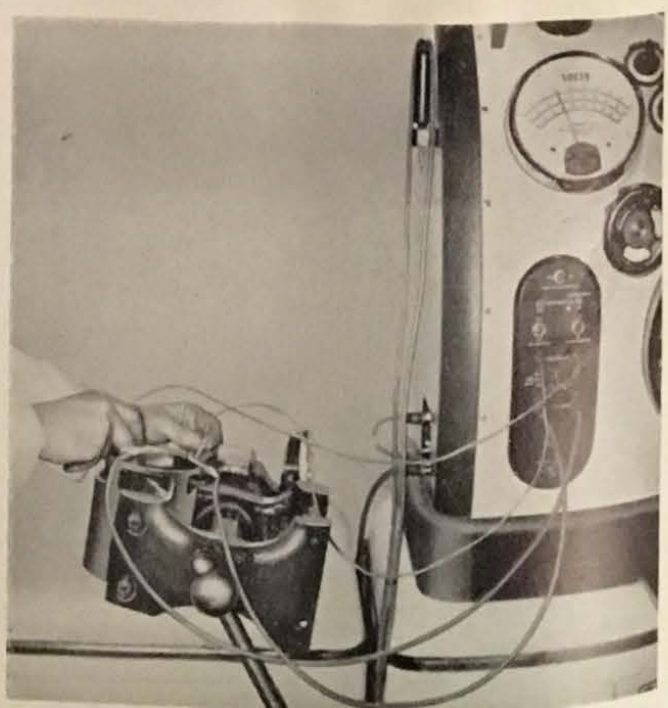

Fig. 14. *Testing field coils for short circuits by voltage drop method.*

(a) Set cut-out switch to "Through" and close battery switch. The applied voltage across the field coils is now indicated on the voltmeter.

(b) Turn cut-out switch to "Off" and connect two leads from left-hand panel voltmeter sockets. Connect negative voltmeter lead to negative applied voltage lead.

(c) Place positive voltmeter lead in firm contact with a cleaned part of each series connection (*see Fig.* 14) and observe the reading obtained on the voltmeter from each coil. If one reading differs from the remainder a fault is indicated and the coil should be renewed.

GENERATOR TESTING

Having located and rectified the electrical failure, it now remains to test the machine on the Test Bench and in so doing, approach vehicle running conditions as far as possible.

First of all decide how the machine is to be driven on the test bench: two methods are available :—

1. By a Hexagon Coupling, using the nut and shaft as the driving member (with pulley).

2. By a Three-jaw Chuck for driving without a pulley.

The former method should be used for preference as it permits the machine to be completely built up with pulley located in position and represents running conditions. The latter method can be used where it is required to test a machine less pulley and nut.

When using the hexagon coupling, locate the drive plate assembly into the flexible motor coupling and insert the appropriate hexagon (a set of seven different sizes is provided) between the armature shaft nut and the drive plate (*Fig.* 15). Place the machine in the most suitable "V" block (set of two). Raise or lower the test bench vice until correct alignment is obtained, then lock the machine in the vice by means of the hand wheels. Turn the generator by hand for a few revolutions to check for runout. The machine will then be ready for test and the following procedure should be adopted.

After the machine has been mounted correctly in position, connect up to the test panel as follows :—

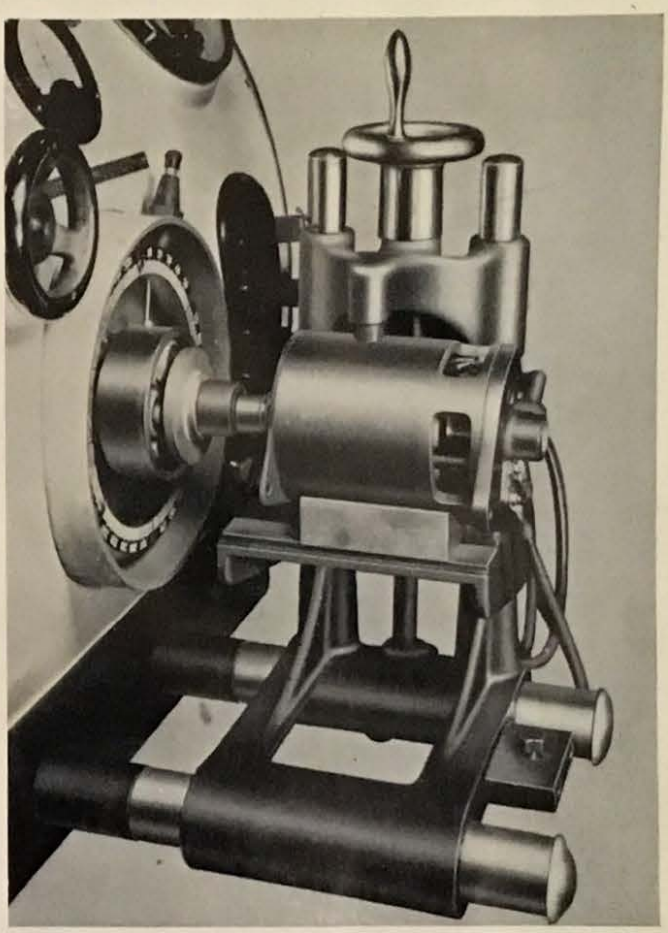

Fig. 15. *Generator mounted for test, using hexagon drive coupling.*

1. Make sure that the battery voltage change-over switch is in the "Neutral" position.

2. Select from the drawer under the right-hand plug panel the three generator test connections (positive, negative and field).

3. Plug these leads into the appropriate sockets of the right-hand panel and connect the other ends to the corresponding terminals of the generator under test.

NOTE.—In the case of a positive earth machine, the positive lead should be connected to earth. With a negative earth machine the negative lead should be earthed.

4. Set ammeter switch to "Off".
   Set voltmeter switch to the 36 volt range.
   Set cut-out switch to "Through".