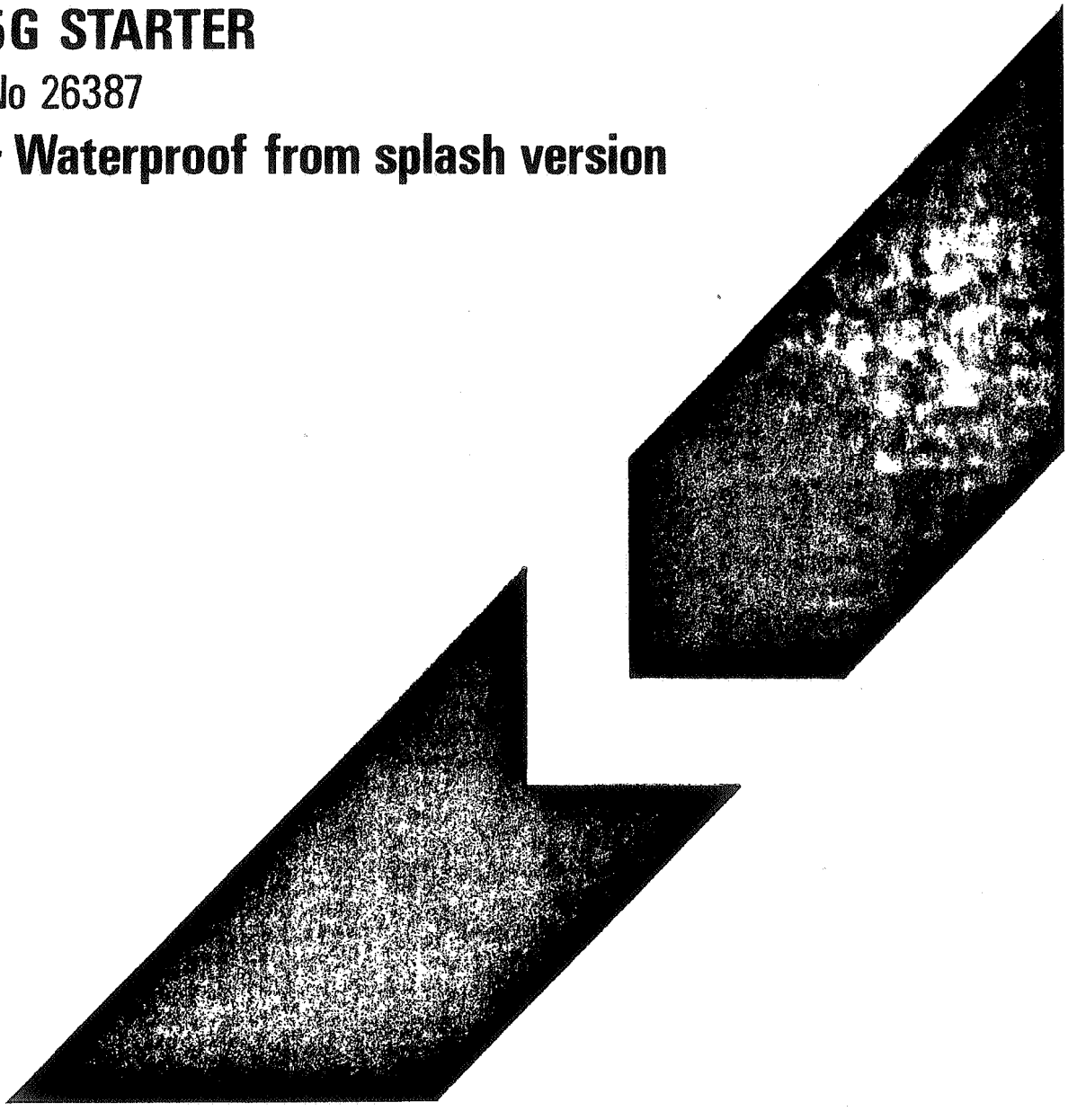
Lucas Electrical

Parts and Service Division

M45G STARTER

Part No 26387

Oil & Waterproof from splash version



LUCAS WORKSHOP INSTRUCTIONS 14.11.77

MODEL M45 24V PRE-ENGAGED STARTER (Oil and Water Proof from Splash)
Part No. 26387. Incorporating: Operating Solenoid Model 19S and Roller Clutch Drive Model 8SD.

1. DESCRIPTION

This is a conventional four-pole four-brush solenoid-operated pre-engaged starter, incorporating oil and water seals.

(i) A sealing ring is incorporated between the yoke and the aluminium cover which encloses the commutator-end bracket.

(ii) A sealing ring is incorporated between the intermediate bracket and yoke.

(iii) Seals are incorporated around the threaded-ends of each of the through bolts.

(iv) A seal is incorporated, in the assembly of the earth stud terminal protruding from the commutator-end cover and the terminal assembly in the yoke.

(v) The solenoid unit is fully-sealed and a plastic bellow (rolling seal) was incorporated (prior to October 1974) around the solenoid plunger in the drive-end fixing bracket.

Operation of the Starter

When the starter control switch is operated, the starter solenoid is energised and the solenoid plunger moves the drive assembly along the armature shaft to engage the starter pinion with the engine flywheel. Full engagement of the pinion with the flywheel normally takes place, in which case the solenoid contacts close to connect the starter motor to the battery and the engine is then cranked.

If tooth-to-tooth abutment between pinion and flywheel occurs, the solenoid plunger continues its normal movement by compressing a drive-engagement spring inside the plunger. This plunger movement causes the solenoid contacts to close, connecting the starter motor to the battery. The starter motor armature now commences to rotate and the pressure of the drive-engagement spring, combined with push-screw assistance from the drive helix, causes the pinion to be fully-engaged with the flywheel, and the engine is then cranked.

The solenoid plunger linkage incorporates a lost-motion spring, which ensures that the solenoid contacts will open to disconnect the starter motor from the battery prior to disengagement of the pinion from the flywheel.

The Purpose of a Roller-Clutch Drive

The roller clutch incorporated in the drive assembly, prevents the armature from being excessively rotated if the pinion is retained in mesh with the flywheel after the engine has started.

2. ROUTINE MAINTENANCE

No routine maintenance is necessary, but the starter should be dismantled during major engine overhaul and the commutator should then be serviced and the brushes and the bearing bushes renewed. (See 4.d, i, ii and iv).

3. TECHNICAL DATA

Starter performance is dependent on the capacity and state of charge of the associated battery. The figure given are typical performance characteristics obtained with two 12V 128Ah (20h rate) batteries connected in series in a 70% charged condition.

Lock Torque:	39.30 Nm (33.5 lbf ft or 4.0 kgf m) with 940A & 6.5V
Torque at 1000 rev/min:	14.9 Nm (17.0 lbf ft, or 1.5 kgf m) with 455 & 15.0V

Light Running Current:

100A at 5500-8000 rev/min

Solenoid

Closing (or series) winding resistance. (measured between the small unmarked 'Lucar' terminal and the main terminal marked 'STA'.	0.595-0.625
Hold-on (or shunt) winding resistance. (measured between the small unmarked 'Lucar' terminal and good earth point on the solenoid body).	1.625-1.675

4. SERVICING

For satisfactory starter performance, the battery must be in good condition and at least 70% charged. Check the specific gravity of the electrolyte in each of the battery cells, with a hydrometer. If there is a variation of more than 40 points (0.040) in any cell readings, the battery is suspect and should be removed for testing by a battery is suspect and should be removed for testing by a battery agent. If possible, prove the battery by substitution.

Specific gravity readings should be:-

	SPECIFIC GRAVITY READINGS CORRECTED TO 15°C (60°F)	
STATE OF CHARGE	CLIMATES NORMALLY BELOW 25°C (77°F)	CLIMATES NORMALLY ABOVE 25°C (77°F)
FULLY CHARGED	1.270 - 1.290	1.210 - 1.230
70% CHARGED	1.230 - 1.250	1.170 - 1.190
DISCHARGED	1.100 - 1.120	1.050 - 1.070

Electrolyte Temperature Correction

For every 10°C (18°F) below 15°C (60°F) subtract 0.007

For every 10°C (18°F) above 15°C (60°F) add 0.007

Assuming the battery to be satisfactory, and the wiring between battery, starter and operating switch to be satisfactory, a low cranking speed or failure of the starter to crank the engine will mean that it must be removed from the vehicle for individual testing and examination.

(a) Testing in Position

(i) Starter cranks engine, but at reduces speed

Check the battery.

Check for satisfactory connections in the external circuit of the starter system. Check terminal connections at the battery, check battery earth connection to the vehicle frame, and check connections at the starter solenoid and the terminal in the yoke. If visual inspection does not locate a faulty connection, a 0-20 range moving coil voltmeter should be used to carry out volt-drop tests to determine whether the external circuit of the starter system is electrically sound. To carry out volt-drop tests, it will be necessary to crank the engine with the starter (without starting the engine). For the purpose of the tests, the engine should be temporarily prevented from starting by disconnecting the white/black cable from the ignition coil low-tension terminal marked '-'.

NOTE: In the case of diesel engines, switch off the fuel supply.

Carry out three separate volt-drop tests, connecting the voltmeter as follows:- (1) between the earth terminal of the battery and a good earth point on the vehicle frame, (2) between the earth terminal incorporated in the starter end-cover and a good earth point on the vehicle frame (3) between the insulated terminal of the battery and the main input terminal of the solenoid. When the starter is operated, not more than 0.5V should be registered for each test.

If an unsatisfactory test result is obtained, the faulty cable or connection must be rectified.

If satisfactory test results are obtained, a low cranking speed could be due to a high resistance in the solenoid contacts, or a fault inside the starter motor. Remove the starter from the vehicle and check the solenoid before comtemplating full dismantling. (Proceed direct to 4 (b) Bench Testing).

(ii) Starter does not crank the engine

Check the battery.

Check the tightness of the external connections, particularly the battery terminals.

Using a 0-20 range moving-coil voltmeter, (1) check that the battery voltage is registered at the starter solenoid main input terminal, (2) detach the solenoid operating 'Lucar' terminal connection at the solenoid and check that battery voltage is registered at the cable-end when the starter control switch is operated. If not, inspect the control switch cables and connections and then suspect the switch.

If both tests are satisfactory (Battery voltage registered at the solenoid main input terminal and battery voltage available at the solenoid-operating 'Lucar' terminal when the control switch is operated), failure of the starter to crank the engine must be due to a faulty solenoid unit or a fault inside the starter motor. Remove the starter from the vehicle and prove the solenoid unit before contemplating full dismantling (Proceed to (b) Bench Testing).

(b) Bench Testing

(i) Determine whether the fault is due to the starter motor or solenoid unit

Clamp the starter in a vice and, using a 12V battery and heavy-duty starter cable, connect one side of the supply voltage to the starter frame and the other side direct to the yoke terminal.

The starter motor should run under light running conditions, independent of the solenoid unit.

If the starter motor does not run, proceed to dismantle the unit sufficient to enable the commutator and brushgear first to be checked before continuing with full dismantling.

If the starter motor runs, if the necessary equipment is available, check the light running current and speed. If this is unsatisfactory, procced to dismantle the starter sufficient to enable the commutator and brushgear first to be checked before contemplating full dismantling.

In reference to the first test, transfer the supply voltage from the yoke terminal to the solenoid main input terminal and connect from this terminal a temporary link to the solenoid-operating 'Lucar' terminal, to energise the solenoid.

If the starter motor now fails to run, the solenoid unit is faulty. Providing the solenoid-operating windings are satisfactory, faulty solenoid contacts can be rectified by renewing the terminal-and-base assembly (Proceed to check the solenoid 4.d, para. vi).

If the starter motor runs, if the necessary equipment is available, check the lock-torque performance. If this is unsatisfactory, the fault could be due to the starter motor or a high-resistance in the solenoid contacts. If the solenoid unit is satisfactory (see 4.d., para vi), proceed to dismantle the starter for detailed inspection Proceed to 4.c.).

(c) Dismantling

(i) Remove link, connecting solenoid to starter motor yoke-terminal.

(ii) Remove the solenoid fixing bolts and withdraw main part of solenoid from fixing bracket and solenoid plunger. To remove the solenoid plunger, complete with seal (when fitted): Grasp plunger in hand and lift front end of plunger to release it from the top of the drive engagement lever.

(iii) Remove commutator-end sealing cover.

(iv) Remove through bolts, Part the commutator-end bracket from the yoke and remove the two field coil brushes from their brush-boxes, to release the bracket from the yoke.

(v) Withdraw the yoke and field coil assembly from the armature and intermediate bracket. (Take care of sealing ring fitted to the intermediate bracket).

(vi) Slacken locknut and remove the drive engagement lever eccentric pivot pin from the fixing bracket. Drive-end fixing bracket, drive engagement lever and armature assembly comprising drive assembly and intermediate bracket can now be separated (Take care of the four through bolt seals fitted in the threaded holes of the fixing bracket).

(vii) The roller clutch drive assembly and intermediate bracket can now be removed from the armature after first removing the thrust collar from the jump ring in a groove in the armature shaft. Use a mild steel tube of suitable bore (e.g. a box spanner), drive the thrust collar from the jump ring and then remove the jump ring from the groove in the shaft.

(d) Bench Inspection

(i) Armature

Inspect the armature: If solder appears to have been thrown or has been thrown sufficiently to cause the conductors to lift from the commutator segments, overspeeding of the armature has occurred and the armature must be repaired or renewed and the action of the roller clutch drive must also be checked (see para. v.). If the armature laminations show signs of fouling the pole-shoes, worn bearings on an untrue armature shaft is indicated. Check the armature in a lathe. If the shaft is out of true, the armature must be renewed.

Check the armature insulation: Connect a 110V a.c. 15-watt test lamp between any one of the commutator segments (See Fig. 3) and the shaft. If the lamp lights, the armature must be renewed.

Check the armature for short-circuited turns: If available, use specialised "Growler" equipment, otherwise the armature must be proved by substitution.

Check the commutator: If cleaning only is necessary, use very fine glass paper, or emery cloth, and then wipe the commutator surface with a petrol-moistened cloth. If the commutator needs to be serviced by 'skimming' this may be carried out providing a finished surface can be obtained before exceeding a minimum diameter of 38 mm (1.5"), otherwise the armature must be renewed.

(ii) Brushgear

Inspect the brushes: Brushes must have freedom of movement in the brushboxes. Rectify sticking brushes by wiping with a petrol-moistened cloth. Brushes worn to approximately 8 mm (5/16") in length must be renewed. New brushes are pre-formed and do not require 'bedding' to the commutator.

Check brushbox insulation: Connect a 110V a.c. 15-watt test lamp between a clean part of the bracket and each of the two insulated brushboxes in turn (See Fig. 4). If the lamp lights, renew the commutator-end bracket assembly.

Brushspring pressure: The brush spring pressure should be approximately 11.70N (42 ozf or 1.2 kgf). Check with new brushes assembled in the bracket and the brushes contacting the commutator.

(iii) Field coils

Inspect the inside of the yoke: Visible signs of a fault affecting the field coils will eliminate the need for testing and the fault should be rectified or the field coil assembly renewed. If the field coils appear to be satisfactory, proceed to check the insulation and continuity of the windings.

Check field coil insulation: Connect a 110V a.c. 15-watt test lamp between the yoke terminal and the yoke (See Fig. 5). Check that the brushes are not touching the yoke during the test. If the lamp lights the field coil assembly must be renewed.

Check field coil continuity: Using the same test lamp as in the previous test, connect the lamp between the two field coil brushes. The lamp should light.

Renewing the field coil assembly: Use a wheel-operated (or power-operated) screwdriver for removing and refitting the pole-shoe fixing screws. Fitting new field coils is facilitated by using pole-shoe expanding equipment. Tighten pole-shoe screws to a torque of 27.11 Nm (20 lbf ft. or 2.76 kgf m) and tighten the yoke terminal lower fixing nut to 2.71 Nm (2.0 lbf ft, or 0.27 kgf m).

(iv) Bearings

Worn bearing bushes should be removed with a suitable mandrel used in conjunction with a power-press. Alternatively, support the bracket and tap the bush out of its housing. Use the same method for refitting a new bush, but a mandrel with a bush fitting dimension .0005" (0.012 mm) larger than the bearing portion of the armature shaft associated with the particular bush being fitted, should be used for fitting the new bush. This ensures a satisfactory running clearance between shaft and bush and eliminates any need to ream the bush after fitting, which would spoil the self-lubricating qualities of the bush.

NOTE: New self-lubrication porous-bronze bushes should be soaked for 20 minutes in Shell 'Turbo 41' or clean engine oil, before being fitted.

(v) Roller clutch drive assembly

A roller clutch drive assembly in good condition will provide instantaneous take-up of the drive in one direction and rotate smoothly in the other. The assembly should move freely round and along the armature shaft splines.

All moving parts of the drive should be smeared liberally with grease. Shell S.B. 2628 (Home and cold climates): Retinax 'A' (hot climates).

(vi) Solenoid Unit

NOTE: If the solenoid is being check in-situ, disconnect the solenoid-to-starter connecting link from the solenoid terminal 'STA'.

Checking the solenoid operating windings: Check both windings simultaneously (in series) by connecting a good quality battery-operated ohmmeter between the solenoid main output terminal marked 'STA' and a clean and unpainted part of the solenoid body.

If the windings are satisfactory, an ohmmeter reading of 2.2 - 2.3 ohms should be obtained. Alternative to using an ohmmeter, connect a 0-25A moving-coil ammeter in series with a 24V battery, solenoid terminal 'STA', and a clean and unpainted part of the solenoid body. A reading of 10.5 - 11A should be obtained. If either of these tests is unsatisfactory, renew the solenoid unit.

Checking the solenoid contacts: After long service the contacts may require renewing. Check for satisfactory opening and closing of the contacts by connecting a circuit comprising a 12V battery and a high wattage (e.g. 60 watt) test lamp between the solenoid main terminals.

The lamp should not light. Leave the test lamp connected and, using the same 12V battery supply, energise the solenoid by connecting 12V between the small solenoid-operating 'Lucar' terminal blade and a good earth point on the solenoid body. The solenoid should be heared to operate and the test lamp should light with full brilliance, indicating satisfactory closing of the contacts.

Renewing the solenoid contacts: Clamp the solenoid body in a vice, terminal arrangement uppermost. Apply a hot soldering iron to the soldered winding connection of the solenoid-operating 'Lucar' terminal blade and when the solder runs free, pull on the terminal-and-base assembly until it is freed from the solenoid body.

Fit the new terminal-and-base assembly complete with new contacts, tightening the fixing screws to a torque of 2.44 Nm (1.8 lbf ft or 0.24 kgf mm). Finally, resolder the 'Lucar' terminal blade connection. Avoid a dry-soldered joint, by sufficiently heating the ends of the windings and 'Lucar' terminal blade simultaneously before applying the solder.

Lubrication of solenoid plunger: The end of the plunger in contact with the return spring should be smeared with clean engine oil.

(e) Reassembly

This is in general a reversal of the dismantling procedure but after reassembly, the position of the drive pinion must be reset (Para. ii refers).

(i) Tightening torques

Through bolts	10.84 Nm	(8.0 lbf ft) (1.1 kgf m)
Solenoid unit fixing bolts	6.10 Nm	(4.5 lbf ft) (0.62 kgf m)
Solenoid upper terminal nuts	4.06 Nm	(3.0 lbf ft) (0.41 kgf m)
Eccentric pivot pin locknut	21.70 Nm	(16.0 lbf ft) (2.2 kgf m)
Yoke terminal upper nut	2.03 Nm	(1.5 lbf ft) (0.2 kgf m)
Earth stud nut (sealing cover)	8.12 Nm	(6.0 lbf ft) (0.82 kgf m)

Other tightening torques, associated with a particular fitting operation, are quoted where necessary in the script.

(ii) Setting the position of the drive pinion

Disconnect the connecting link between solenoid-and-starter and connect solenoid terminal 'STA' to the frame.

Connect a V supply between the solenoid-operating 'Lucar' terminal and the frame.

With the solenoid energised and the drive assembly now in the engage position, press the pinion lightly back towards the armature to take up any slack in the drive operating mechanism and then set the position of the eccentric pivot pin (with the arrow pointing above the horizontal) to obtain 0.127 - 0.380 mm (0.005" - 0.015") clearance between the pinion and the thrust-collar. After carrying out the adjustment, apply a sealing compound

(e.g. goldsize) to the threads of the pivot pin before tightening the locknut.

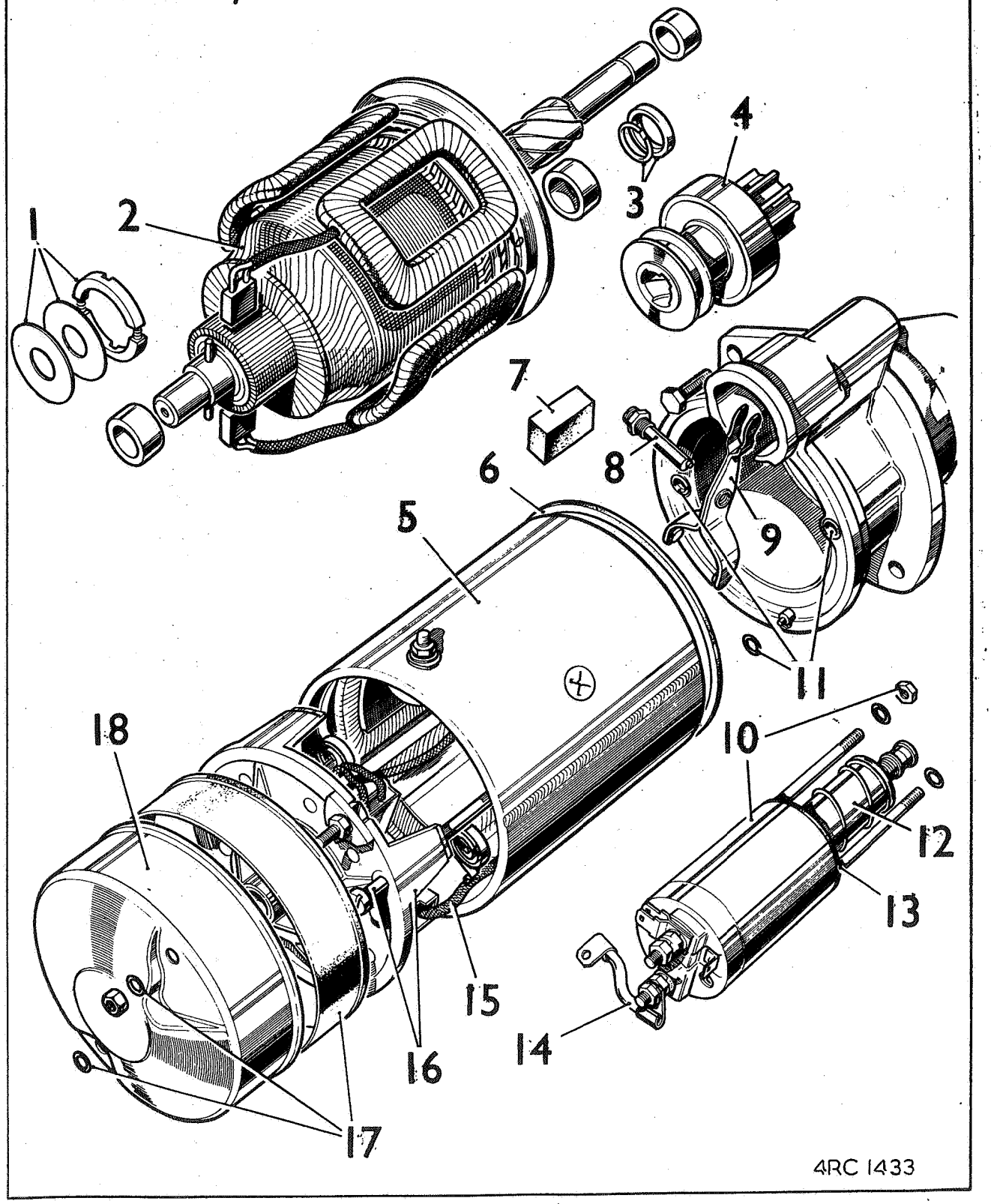
Illustrations

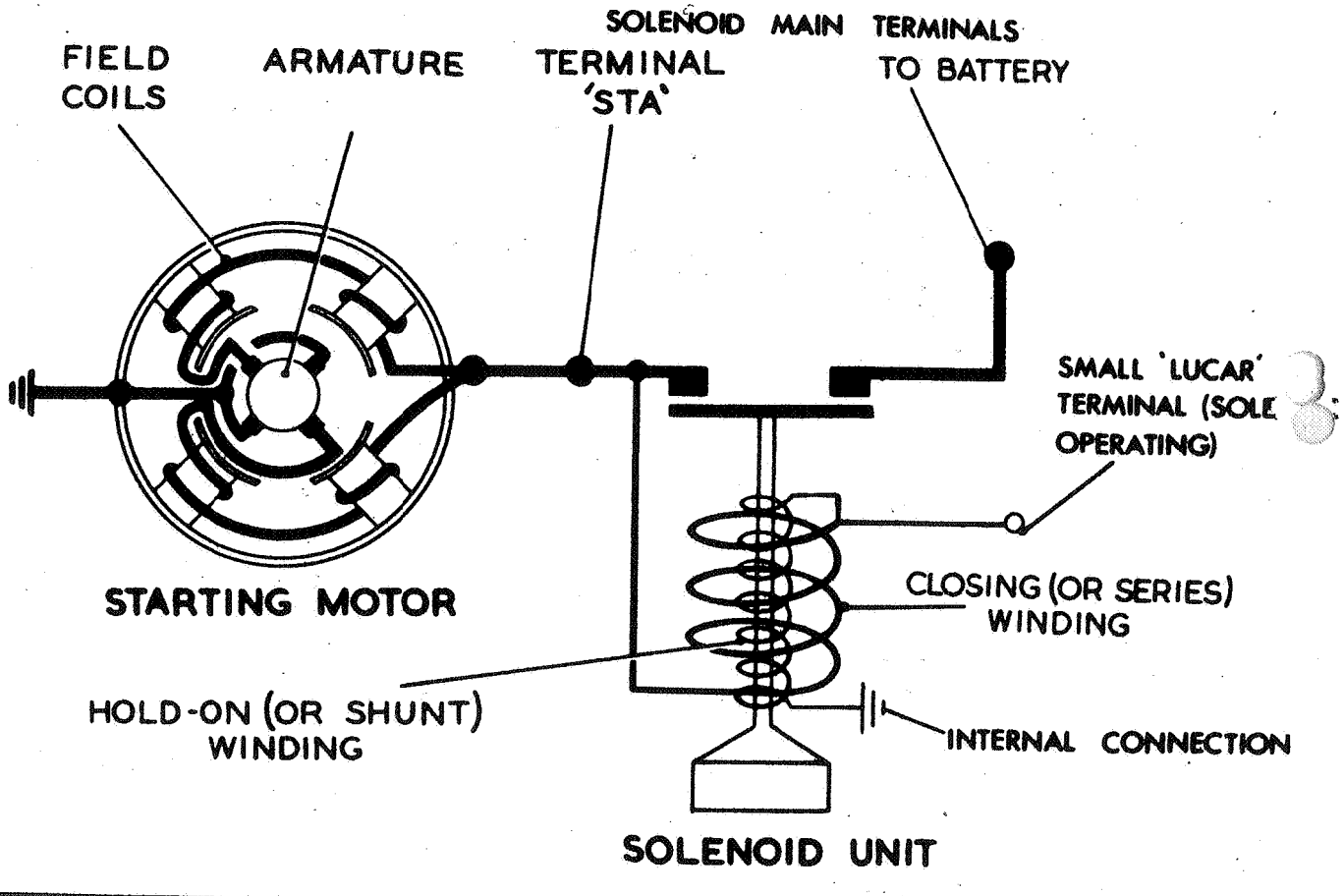
Fig. 1.	Sectioned view of the starter	REC 1760/A	GHS 3/73
Fig. 2.	Internal connections of starter motor and solenoid	REC 1567	GHS 8/70
Fig. 3.	Armature insulation test	REC 1723	
Fig. 4.	Brushbox insulation test	REC 1757	
Fig. 5.	Field coil insulation test	REC 1758	GHS 8/70

Key to Illustration of Starter Motor

1. Tufnol washer, steel washer and brake ring.
2. Armature
3. Jump ring and collar
4. Drive assembly
5. Yoke and field coil assembly
6. Sealing ring
7. Sealing grommet
8. Eccentric pin
9. Engagement lever
10. Solenoid
11. Seals for through bolts
12. Plunger for solenoid
13. Gasket
14. Link - solenoid to yoke
15. Field coil brushes
16. Commutator end bracket
17. Seals
18. End cover

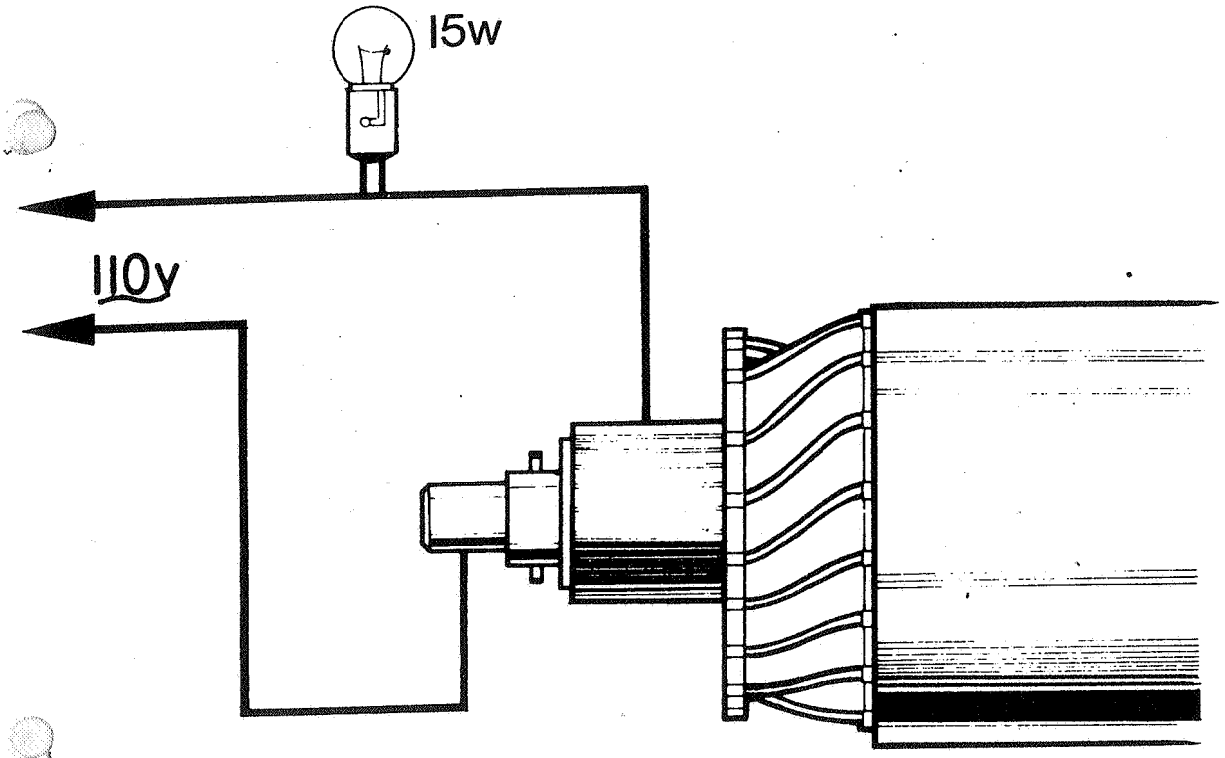
REC 1760/A GHS 3/73




FIELD COILS
ARMATURE
SOLENOID MAIN TERMINALS
TERMINAL 'STA'
TO BATTERY
SMALL 'LUCAR' TERMINAL (SOLE OPERATING)
STARTING MOTOR
CLOSING (OR SERIES) WINDING
HOLD-ON (OR SHUNT) WINDING
INTERNAL CONNECTION
SOLENOID UNIT

REC 1567/GHS

ARMATURE INSULATION TEST (REC1723)



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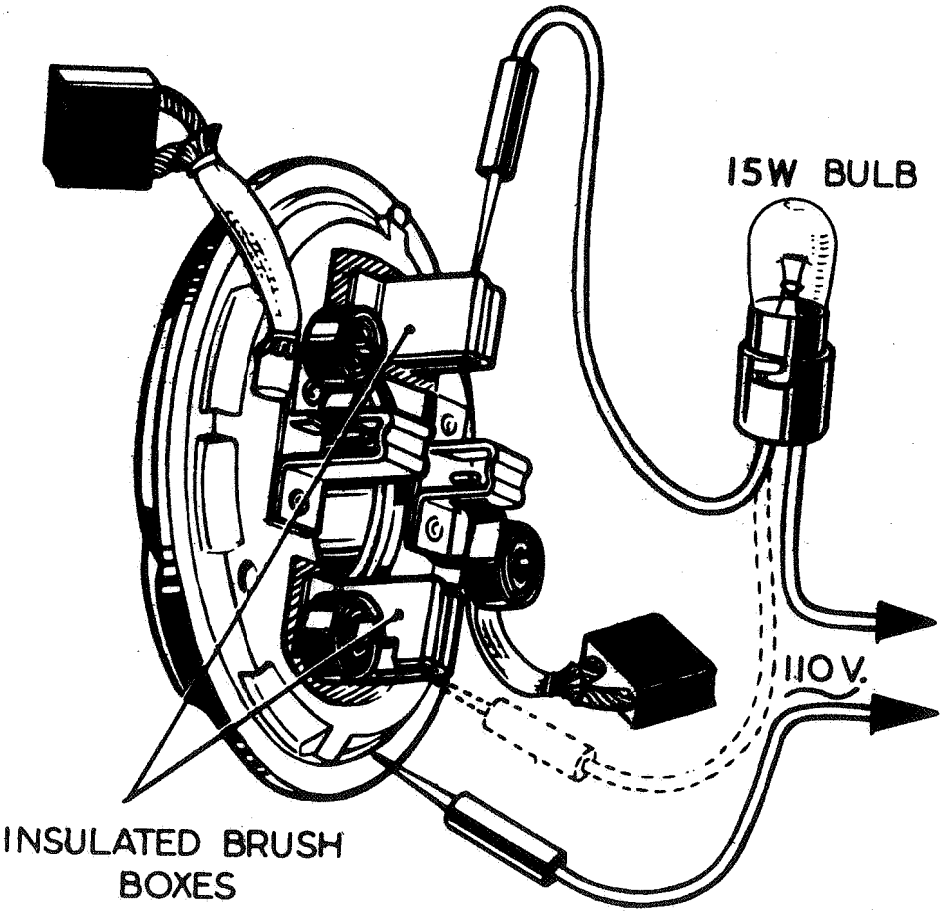
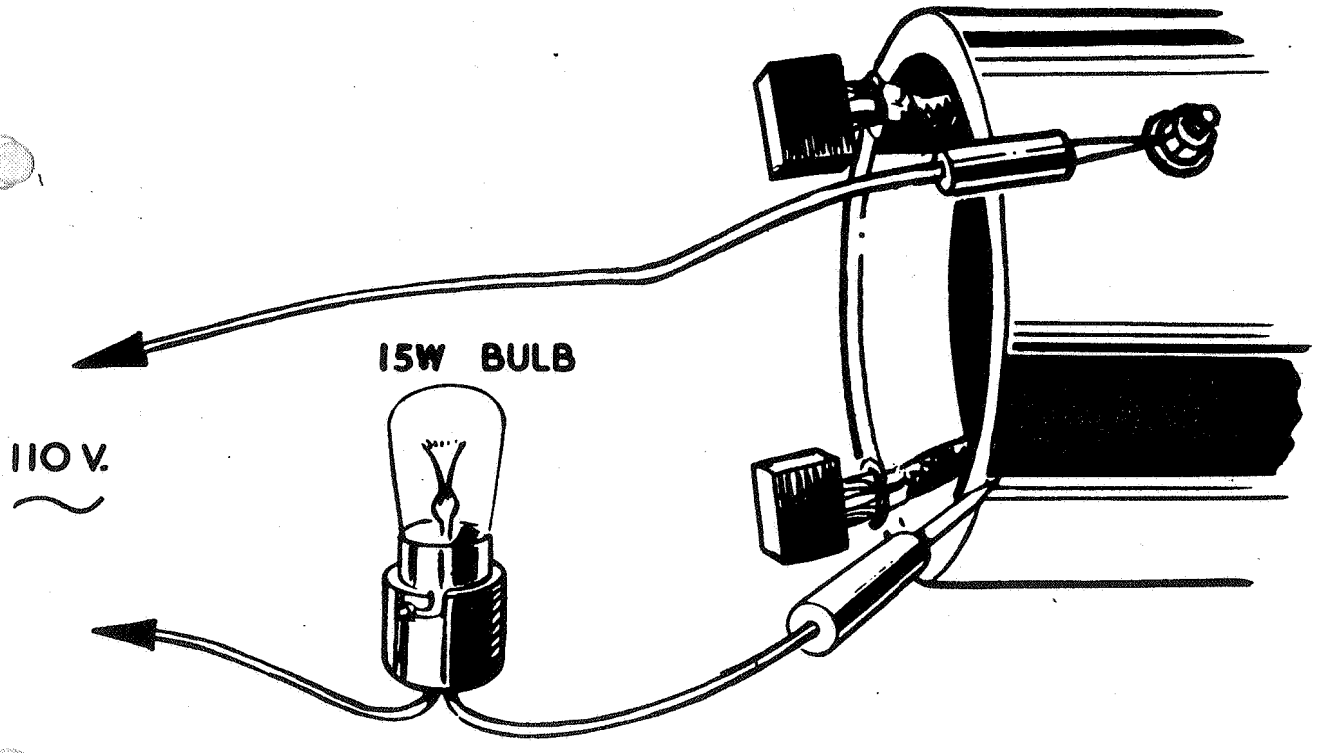
BRUSH-BOX INSULATION TEST



REC1757

FIELD COIL INSULATION TEST



REC 1758 GHS 8/70