Service Instruction Note

JOSEPH LUCAS (SALES & SERVICE) LTD.
GREAT HAMPTON STREET BIRMINGHAM 18

SI/SM/72

September 1970

INTRODUCTION OF THE LUCAS

2M100 PRE-ENGAGED STARTING MOTOR

(Incorporating 7SD Roller Clutch and 19S Derated Solenoid)

FIG. 1

Description

The model 2M100 P.E. Starting Motor is a four pole, four brush machine having a yoke diameter of 4" (100 mm). It is intended as a replacement for the M418G P.E. and incorporates some of the features recently introduced on other machines, i.e. face-type commutator, fully insulated brushgear assembly and directly earthed series field coils.

- continued -

The face-type commutator works in conjunction with the insulated brushgear assembly, which comprises two pairs of wedge-shaped brushes and coil springs assembled into the brushbox moulding. The brushes are provided with a keyway to ensure correct fitting and the springs are held captive in the brush-box moulding.

The directly-earthed field coil assembly consists of four conventional field coils connected in series. The supply is taken to the field coils via the brushes, and is earthed at the starter yoke by a rivetted connection.

End-float and axial movement of the armature are determined by the position of a "spire" retaining ring which is fixed to the armature shaft, where it extends through the commutator end bracket.

The actuating position of the engagement lever in the drive-end bracket is pre-set and cannot be altered. (This eliminates setting the pinion to obtain the correct operation of the actuating solenoid). The lever swivels on a non-adjustable pivot pin which is retained in the drive-end bracket by a "spire" retaining ring.

ROUTINE MAINTENANCE

Routine maintenance is not necessary, but the tightness of the terminal connections should be checked occasionally. The motor should be dismantled for detailed examination during major engine overhauls and the brushes and the bearing bushes should be renewed.

TECHNICAL DATA

Starting Motor

Lock Torque:- 14.4 lbf ft (19.52 Nm) with 463A at 7.0v
Torque at 1000 rev/min:- 7.3 lbf ft (9.9 Nm) with 300A at 9.0v
Light Running Current:- 40A at 6000 rev/min.

NOTE: Starting motor performance is dependent on the capacity and the state of charge of the battery. The above are typical figures obtained with a 12 volt 60Ah (20 hr rate) battery in a 70% charged condition, at 20 C.

Solenoid

Resistance of Closing (or Series) winding (Measured between the small unmarked 'Lucar' terminal and the main terminal marked "STA"):- 0.25 - 0.27 ohm.

Resistance of Hold-on (or Shunt) winding (measured between the small unmarked 'Lucar' terminal and a good earth point on the solenoid body:- 0.76 - 0.80 ohm.

SERVICING

Testing in Position

Check that the battery is in a good state of charge (at least 70% charged) and that there is no excessive voltage drop in the wiring between the battery, starting motor and the operating switch.

- continued -

If the motor fails to crank the engine after carrying out these checks, it must be removed from the vehicle for detailed examination.

BENCH TESTING

Disconnect the battery earth cable and the starting motor cables and remove the starting motor from the engine.

Measuring Light Running Current

Clamp the motor in a vice, and, using a 12 volt battery and a moving coil ammeter of suitable range, check the light running current and the armature speed as follows:-

Use heavy duty starting motor cable to connect one terminal of the battery, via a 0 - 50A ammeter to the main input terminal of the solenoid. From this terminal connect a short test link to the small unmarked 'Lucar' terminal to energise the solenoid. Connect the other battery terminal to a clean part of the yoke using heavy duty cable. If the solenoid operates and the motor runs, check the current and speed against the figures given in the technical data. If the test figures are satisfactory, proceed to check the Lock Torque and Current. If the test figures are not satisfactory, check the brush gear and commutator, (see below).

If the motor does not run, whether the solenoid operates or not, transfer the battery supply lead to the solenoid-to-motor link. The motor should now run. If it does, and the light running current and speed are satisfactory, check for a faulty solenoid.

Measuring Lock Torque and Current

Carry out a lock torque test. If the readings vary considerably from those in the Technical Data, the motor probably has an internal fault and should be dismantled for detailed examination.

BENCH INSPECTION

Checking Brush gear and Commutator

Before dismantling the starting motor completely, the commutator end bracket should be removed for an inspection of the brushgear and commutator. Ensure that a replacement "spire" retaining ring is available for use when reassembling the starting motor.

(i) Remove the end cap seal to gain access to the "Spire" retaining ring.

(ii) Remove the retaining ring before unscrewing the through bolts. Use an engineers chisel to cut through several retaining ring claws, so that the grip on the armature shaft is sufficiently released to allow it to be removed.

(iii) Remove terminal nut and washers and remove through bolts. Withdraw commutator end cover taking care when disengaging the two field coil brushes from the brush box moulding.

- continued -

(iv) Check that the brushes move freely in their respective guides in the brush box moulding. A sticking brush can be cleaned with a petrol moistened cloth. Brushes that are worn to approximately 0.375" (9.53 mm) must be renewed as a set.

To renew the brushes, cut the worn brush flexibles from the field coil leaving approximately 0.25" (6mm) of flexible each side of the coil end. Solder the new brushes to the remaining ends of the old flexibles to ensure a good connection. Also ensure that the soldered connection is insulated. Replace the other two brushes complete with terminal link and moulded rubber grommet. Ensure the new brush set is correctly fitted in regard to brush positions as shown in Fig.2.

(v) Check the brush springs for correct tension by means of a push-type spring balance (Fig. 3). Position a new brush in each of the brush boxes in turn and press down the brush with the spring gauge until the top protrudes approximately 0.062" (1.5 mm) from the moulding. The spring pressure reading should be 36 ozf (10 N).

If the spring pressures are appreciably lower springs should be replaced as follows:-

Tip and remove old spring with long nosed pliers. Replace by fully compressing new spring between first finger and thumb. Place spring horizontally in brushbox moulding and finally locate in position.

(vi) Check the brush spring insulation by connecting a 110 volt a.c. 15 watt test lamp between a clean part of the end cover and each of the springs in turn. The lamp should not light, if the insulation is satisfactory.

Check that the connecting link grommet is in good condition.

(vii) Check that the commutator is in good condition. It should be burnished and free from pits or burned spots. The surface of the commutator can be cleaned with a petrol moistened cloth. The commutator should be skimmed only if the surface is badly worn. If this occurs the armature must be removed and the commutator serviced as described later.

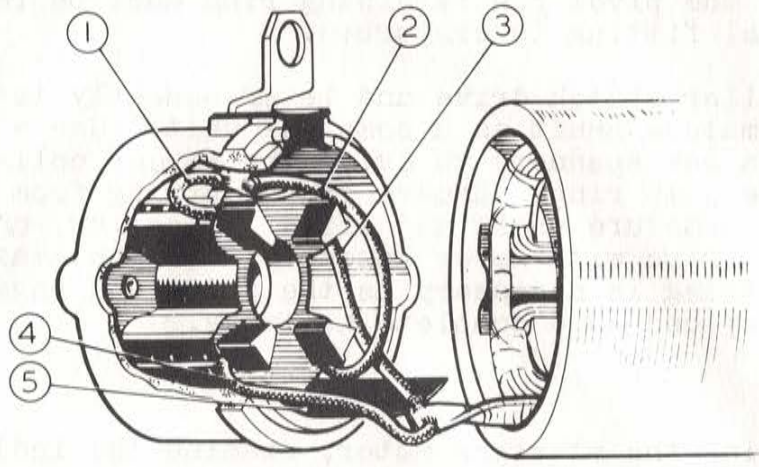
DISMANTLING

If the above checks do not reveal the fault, the starting motor should be completely dismantled and a bench check made on the individual parts. To dismantle follow on from (iii) above:-

(i) Remove the nuts and washers which secure the solenoid unit to the fixing bracket, and withdraw the solenoid body from the bracket. Remove plunger from drive engagement lever, by gripping the plunger in the hand and applying an upward lift at the front end of the plunger.

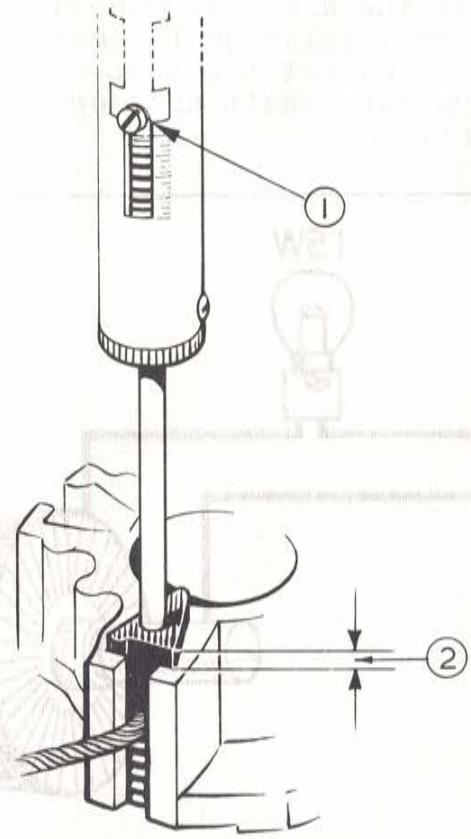
(ii) Remove the "Spire" retaining ring from the drive engagment lever pivot pin, and withdraw the pivot pin from the fixing bracket.

- continued -



1. SHORT BRUSH - FLEXIBLE, C/E COVER
2. LONG BRUSH - FLEXIBLE, " "
3. LONG BRUSH-FLEXIBLE, FIELD WINDING
4. SHORT BRUSH-FLEXIBLE, " "
5. INSULATION PIECE

FIG. 2



1. PUSH TYPE SPRING GAUGE, WITH SLIDING MARKER INDICATING READING WHERE 'ARROWED'
2. 0·063" (1·60 mm)

FIG. 3

The armature assembly comprising roller clutch drive and lever assembly can then be separated from the fixing bracket.
Note: The pivot pin retaining ring must be renewed if the original fitting is disturbed.

The roller clutch drive and lever assembly is removable from the armature shaft as a complete unit. Use a tubular tool (e.g. a box spanner) to drive the thrust collar squarely off the jump ring. Remove the jump ring from its groove in the armature shaft and slide the collar, and the roller clutch drive with lever assembly, off the shaft. No further dismantling is necessary as the drive and engagement lever are serviced as a complete assembly.

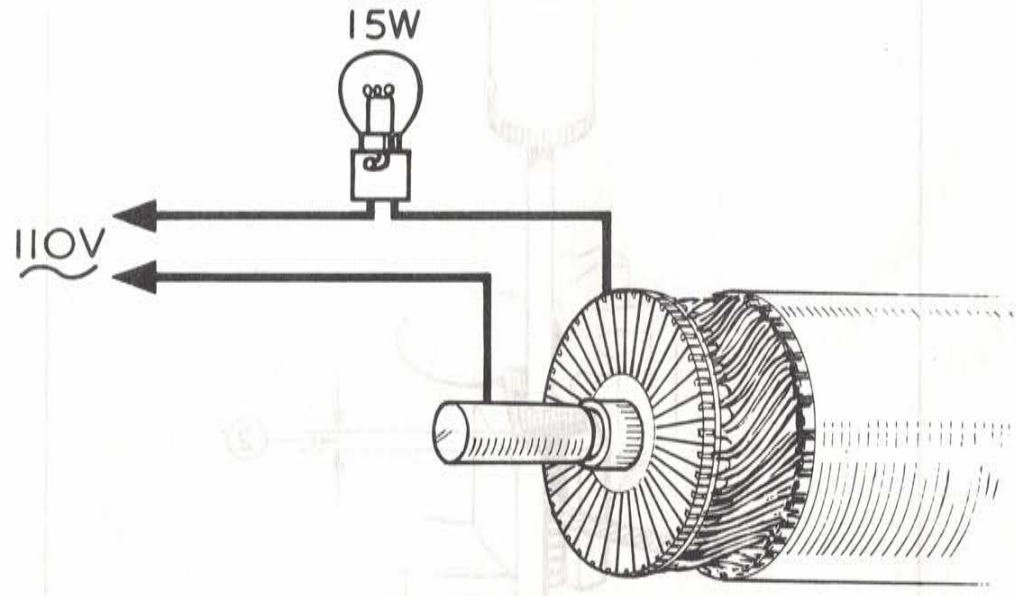
BENCH TESTING

After dismantling the starting motor, examine the individual parts as follows:-

(i) Armature

Check the armature for signs of the core fouling the pole shoes. This indicates worn bearings or a distorted shaft. A damaged armature must be replaced and no attempt should be made to machine the armature core or to straighten a distorted shaft. Check for signs of thrown solder or lifted commutator segments. This indicates overspeeding of the motor and the operation of the roller clutch should be checked.

The condition of the armature should be checked as follows:- Test the armature insulation by means of a 110 volt a.c. 15 watt test lamp. Connect the lamp between one commutator segment and the armature shaft as shown in Fig.4. The test lamp should not light.



ARMATURE INSULATION TEST

FIG. 4

- continued -

If it does the insulation has broken down, and the armature must be replaced.

Check the armature for short-circuited windings using a "growler". Fit a replacement armature, if a fault is indicated.

If the commutator needs servicing, the copper may be skimmed to a minimum thickness of 0.140" (3.55 mm) before a replacement armature is necessary. The surface should then be polished with fine emery cloth, and finally cleaned with a petrol-moistened cloth. The insulation between the commutator segments MUST NOT BE UNDERCUT.

(ii) Field Winding

Continuity

Check the winding for continuity by means of a 12 volt test lamp and battery. Connect the test lamp between each of the brushes in turn, and a clean part of the yoke. If the test lamp does not light, an open-circuit in the field winding is indicated and a replacement must be fitted.

Insulation

To make a positive check of the insulation between the field winding and yoke, it will be necessary to disconnect the riv-etted earth connection at the yoke.

To avoid disturbing this connection unnecessarily, first inspect the inside of the yoke for obvious signs of insulation break-down, and if so, rectify or replace the field winding assembly as necessary. If there are no obvious signs of a fault consider the results of the light running current and Lock torque tests carried out previously. If the speed and torque are low and the current consumption high, faulty field winding insulation could be the cause. This would justify disconnecting the end of the field winding and carrying out a positive check.

The field winding insulation can be checked, after disconnecting the end of the winding at the yoke by connecting a 110v a.c. 15 watt test lamp between the disconnected end of the winding and a clean part of the yoke. If the test lamp lights, it indicates an earth at some point on the yoke or pole shoes and a replace-ment field winding is necessary. Check that the earth connec-tion, brush flexibles and brushes are not contacting the yoke before suspecting the field windings.

Replacement of Field Windings

Disconnect the earthed end of the field windings at the yoke by drilling out the rivet.

Remove the four pole shoe retaining screws using a wheel-operated or power-operated screwdriver, and withdraw the field winding assembly from the yoke.

Clean the inside of the yoke and the insulating pieces, and loosely fit the new field windings and the pole shoes into the yoke.

- continued -

The through bolt insulating pieces should be assembled between the field coils and yoke in a position 180° apart and 90° each side of the field coil brush connection point.

Tighten the pole shoes evenly, re-rivet and make a good earth joint between the winding connection and the yoke.

(iii) Roller Clutch and Drive Operating Mechanism

The roller clutch drive assembly, if in good condition will provide instantaneous take-up of the drive in one direction and rotate smoothly and easily in the other. The assembly should move freely round and along the armature shaft splines without roughness or tendency to bind. The armature shaft splines and moving parts of the engagement lever should be liberally smeared with Shell SB2628 (Home and Cold Climates), Retinax 'A' (Hot climates).

The roller clutch mechanism is a sealed unit. During production it is pre-packed with sufficient grease to last the life of the starting motor. In the unlikely event of the clutch becoming faulty, it is not possible to rectify the fault and the whole drive assembly should be renewed.

(iv) Bearings

Both end brackets are fitted with porous bronze bearing bushes. New bushes should be allowed to stand for 24 hours at room temperature completely immersed in Shell Turbo 41, or if not available clean light engine oil. Alternatively, the bush may be immersed in the above lubricant at 100°C for two hours and allowed to cool before removal.

New bushes must not be reamed after fitting as the porosity of the bush will be impaired.

The bushes must be renewed when there is excessive side-play of the armature shaft. Fouling of the pole-shoes by the armature, or inefficient operation of the starting motor is likely to occur when the inner diameter of the bushes exceeds the following dimensions:-

Commutator end cover bush - 0.441" (11.20 mm)
Drive end fixing bracket bush - 0.476" (12.09 mm)

Worn bearings should be removed by using a wheel-operated press. Alternatively, support the bearing housing and lightly tap the bush out with a mandrel.

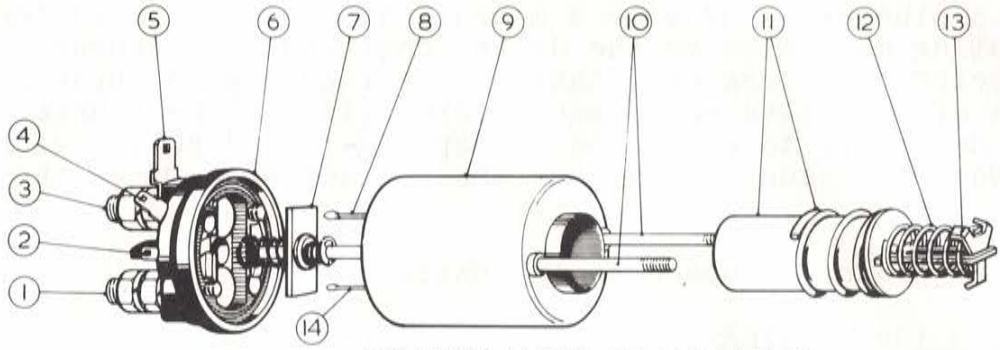
New bushes should be pressed into position by means of a shouldered polished mandrel with dimensions as follows:-

Commutator end cover bush - 0.4377" (11.117 mm)
Drive en fixing bracket bush - 0.4729" (12.011 mm)

SOLENOID

There are three springs associated with the solenoid plunger,
(i) Drive return spring,
(ii) Drive engagement spring (incorporated inside the plunger to overcome the difficulty of pinion engagement on occasions of tooth-to-tooth abutment), and

- continued -



SOLENOID MODEL 19S, DISMANTLED

1. MAIN TERMINAL 'STA'.
2. SMALL LUCAR TERMINAL 'IGN'.
3. MAIN INPUT TERMINAL.
4. LUCAR TERMINAL (SOLENOID OPERATING)
5. LUCAR TERMINAL (MAIN EXTERNAL CIRCUITS)
6. BASE ASSY., COMPRISING, FIXED MAIN CONTACTS & BALLAST IGNITION 'IGN' CONTACT
7. MOVING SPINDLE AND CONTACT ASSY.
8. START OF SHUNT & SERIES WINDINGS. (LUCAR TERMINAL SOLENOID OPERATING)
9. SOLENOID BODY
10. SOLENOID FIXING STUDS
11. PLUNGER & DRIVE RETURN SPRING
12. LOST MOTION SPRING
13. SPRING RETAINING PLATE
14. END OF SERIES WINDING (MAIN TERMINAL STA)

FIG. 5

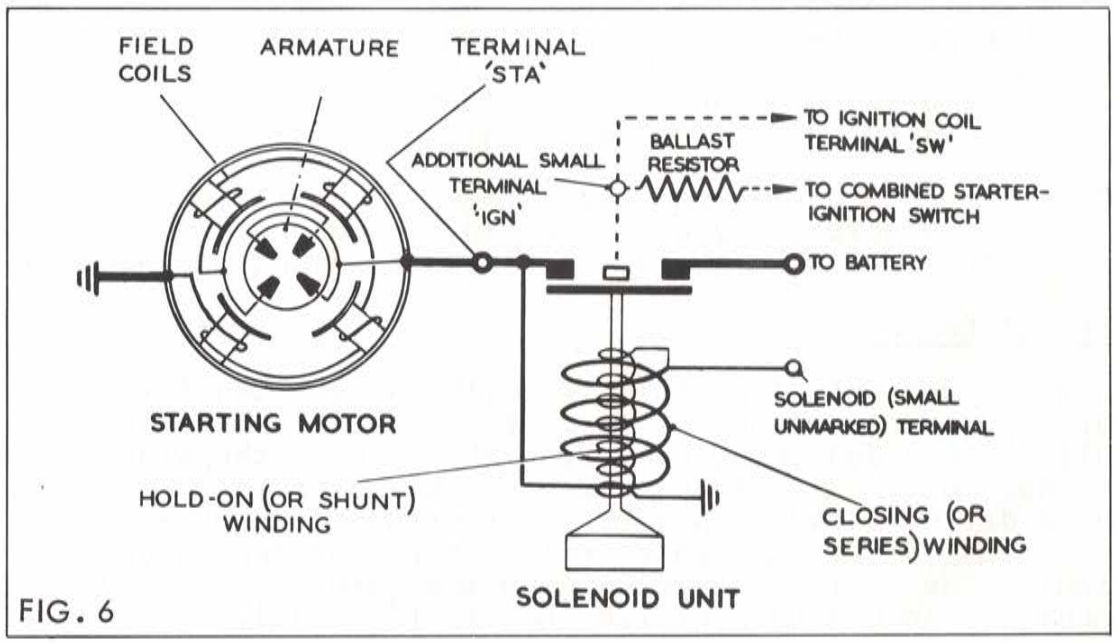


FIG. 6

(iii) The 'Lost Motion' spring.

The 'Lost Motion' spring is assembled to the connecting part of the solenoid plunger to provide a measure of lost motion in the drive operating mechanism as the drive commences to disengage. It is sufficient to check only that the springs are not broken. In the case of the drive engagement spring (inside the plunger), it will be necessary to ensure that a spring-loaded pull action exists between the plunger body and the connecting part of the plunger.

To check the solenoid proceed as follows:-

(i) Checking the Windings

Disconnect the connecting link to the motor terminal at the 'STA' terminal on the solenoid, if the solenoid is to be checked in-situ.

Check for continuity of the windings by connecting a 12 volt battery operated test lamp of low wattage between the solenoid main terminal 'STA' and a good earth point on the solenoid body. If Lamp lights, it indicates that both windings are satisfactory.

Check the winding resistance and compare with the figures given in the Technical Data.

(ii) Checking the Contacts

Check that the contacts open and close satisfactorily by connecting a 12 volt battery and a high wattage (60 w) test lamp between the solenoid main terminals. The lamp should not light. Energise the solenoid with separate 12 volt circuit connected between the small unmarked 'Lucar' terminal and a good earth point on the solenoid body. The solenoid should be heard to operate, and satisfactory closing of the contacts will be indicated by the lamp lighting with full brilliance.

NOTE: Check that the additional small 'Lucar' marked 'IGN' is electrically connected to the solenoid main input terminal when the solenoid is energised.

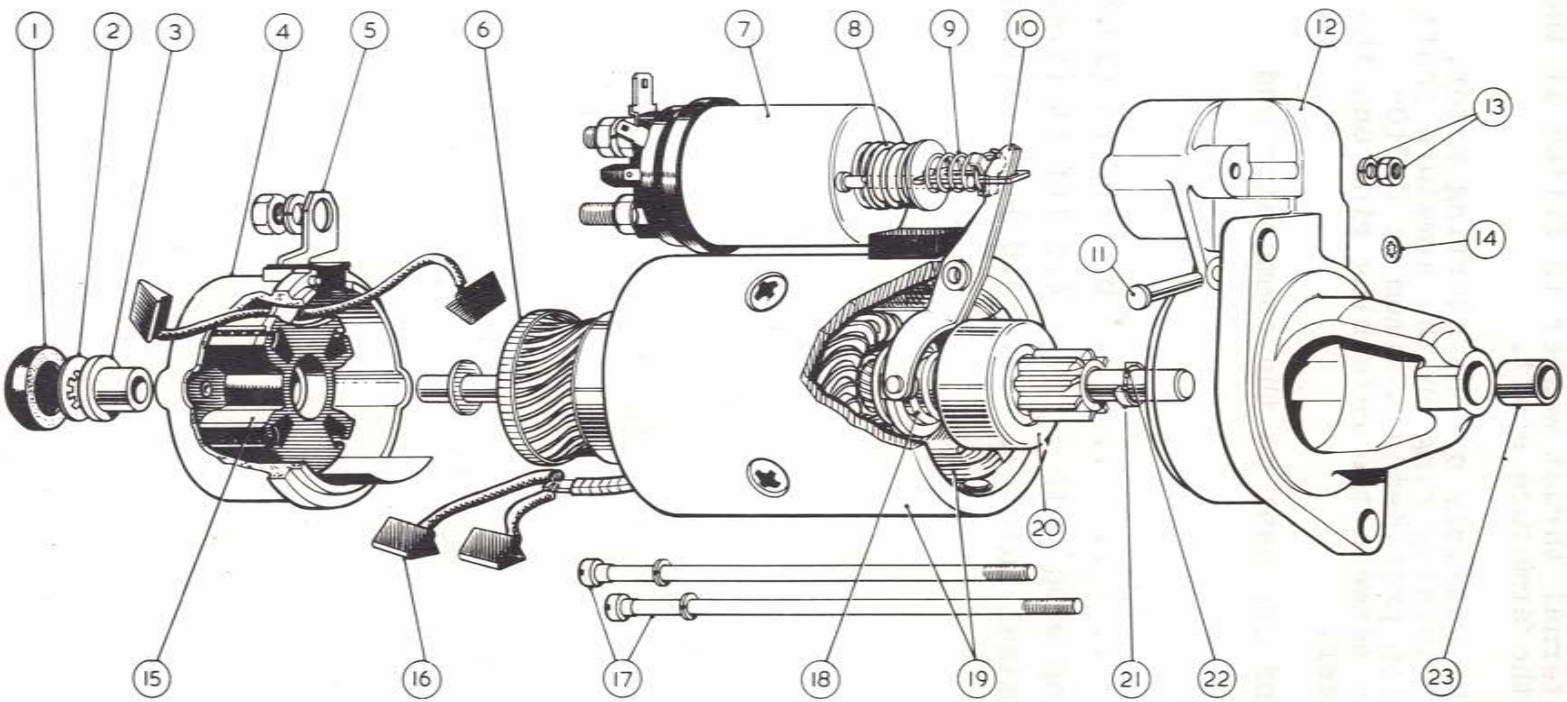
Contact Renewal

To gain access to the contacts, withdraw the two fixing screws. Unsolder the two terminal connections and carefully pull the moulded cover away from the ends of the windings and the solenoid body. When re-making the solenoid connections, avoid dry-soldered joints by ensuring that the parts are cl n and adequately heated before applying the solder. Tighten the fixing screws holding the terminal-and-base assembly, to a torque of 1.8 lbf ft. (2.44 Nm).

REASSEMBLY

Reassembling the starting motor and solenoid is in general a reversal of the dismantling procedure. The sequence is as shown in Fig. 7.

- continued -



1 END CAP
2 RETAINING RING
3 BEARING BUSH
4 COMMUTATOR END COVER
5 CONNECTOR LINK (SOLENOID TO STARTER)
6 ARMATURE
7 SOLENOID UNIT 19S
8 RETURN SPRING
9 LOST MOTION SPRING
10 DRIVE ENGAGEMENT LEVER
11 PIVOT PIN
12 DRIVE END BRACKET
13 SOLENOID FIXING NUT & WASHER (2 OFF)
14 PIVOT PIN RETAINING RING
15 BRUSH BOX MOULDING
16 BRUSHES
17 THROUGH BOLTS
18 SPACING SPRING
19 YOKE & FIELD COIL ASSEMBLY
20 DRIVE ASSEMBLY
21 THRUST COLLAR
22 JUMP RING
23 BEARING BUSH

FIG. 7

Fit the commutator end bracket, and then the solenoid. Otherwise it will be difficult to fit the block shaped grommet between the yoke, solenoid and fixing bracket.

Ensure that the internal thrust washer is fitted at the commutator end of the armature shaft.

After completing the assembly of the starting motor, drive the 'Spire' retaining ring on the armature shaft into a position which provides a maximum of 0.010" (0.25 mm) clearance between the retaining ring and the bearing bush shoulder.

Finally, fit the end cap seal to the commutator end cover.

Tightening torques

Through bolts	8.0 lbf ft (10.85 Nm)
Solenoid Unit fixing stud nuts ..	4.5 lbf ft (5.42 Nm)
Solenoid upper-terminal nuts	3.0 lbf ft (4.07 Nm)