STARTING MOTOR MODEL M35J

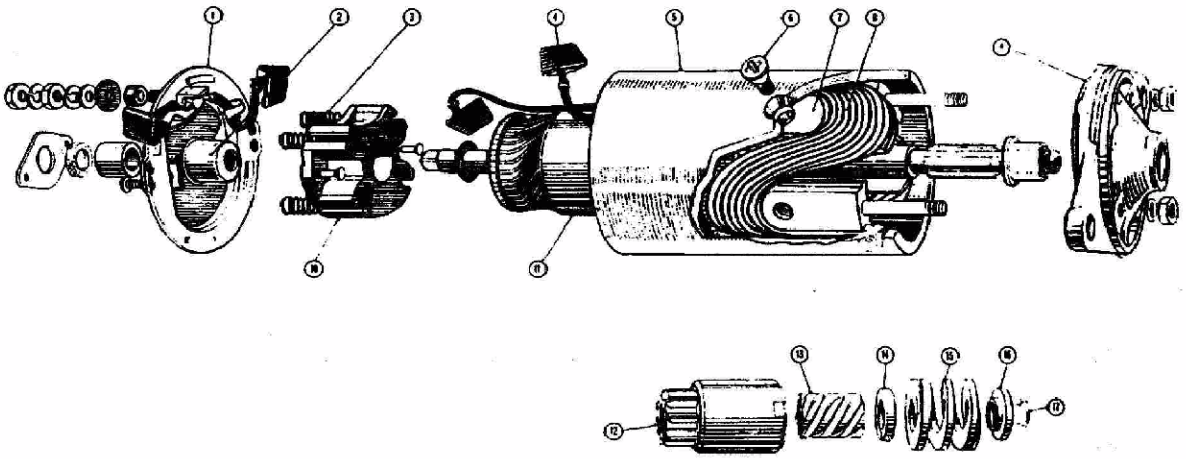

Fig. 1 Starting motor, dismantled

1 Commutator end bracket
2 Bush housing
3 Brush springs
4 Brushes
5 Yoke
6 Pole screw
7 Pole shoe
8 Field coils
9 Drive end bracket
10 Brush box moulding
11 Armature
12 Pinion and barrel
13 Screwed sleeve
14 Buffer washer
15 Main spring
16 Cup spring
17 Jump ring

1. DESCRIPTION

This starting motor is a series-wound four-pole four-brush 3½" (88.9 mm) diameter machine. The motor is shown dismantled in Fig. 1.

New features in this design include:

A face-type moulded commutator assembly on the end-face of the armature.

A fully-insulated brushgear assembly comprising wedge-shaped brushes and coil-type springs assembled into a plastic brushbox moulding which is riveted to the commutator-end bracket. The brushes are provided with a keyway to ensure correct fitting, and the springs are held captive in the brushbox moulding.

A continuously wound field-winding: the winding has no interconnecting joints, one end being earthed to the yoke either by a soldered connection or a riveted eyelet, while the other end terminates at a pair of brushes.

A windowless yoke with independently fixed end brackets and no through-bolts. With early production motors two of the pole-shoes are fitted with threaded studs on which nuts and spring-washers fix the drive-end bracket to the yoke. In later units the drive end bracket is bolted to the yoke, two of the pole shoes being tapped to accept the bolts. The commutator-end bracket is fixed to the yoke by two screws into tapped holes in the end-face of the yoke.

2. ROUTINE MAINTENANCE

Routine maintenance is not necessary, but an occasional check should be made on the tightness of the terminal connection. The motor should be dismantled for detailed examination on the occasion of major engine overhaul, when the brushes and the bearing bushes should be renewed.

3. TECHNICAL DATA

(i)	Lock torque:	7.0 lbf ft (0.97 kgf m) with 350 - 375 amperes.
(ii)	Torque at 1,000 rev/min:	4.4 lbf ft (0.61 kgf m) with 260 - 275 amperes.
(iii)	Light running current:	65 amperes at 8,000 - 10,000 rev/min.

The motor performance is dependent on the capacity and state of charge of the associated battery. The figures given are typical performance characteristics obtained with a 12-volt 43 Ah (20 h.rate) battery in a good state of charge.

4. SERVICING

Assuming the battery to be in a good state of charge, and the wiring between battery, starting motor and operating switch to be satisfactory, failure of the motor to crank the engine will mean that it must be removed from the vehicle for detailed examination.

(a) Bench Testing

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 armature speed. To do this, use heavy-duty starting motor cable to connect one terminal of the battery, via the ammeter, to the motor input terminal and the remaining battery terminal to a clean part of the yoke. Compare the current and the speed with the figures quoted in 3 (iii). Non-operation of the motor or substantially incorrect values in the light running or (where it is possible to check) lock torque tests indicates that the motor has an internal fault. It should, as a first step, be checked in accordance with 4b.

(b) Checking Brushgear and Commutator

Before proceeding to full dismantling remove the commutator-end bracket and inspect the brushgear and commutator.

(i) Brushgear

Each of the four brushes should be free to move in the brushbox moulding. Sticking brushes can usually be freed by cleaning the brushes and moulding with a petrol-moistened cloth. Brushes which are worn to or are approaching $\frac{3}{8}$" (9.5 mm) in length must be renewed as a set. Note the fitting arrangement of the long and short brush flexibles in regard to the commutator-end bracket and field winding (Fig. 2) and proceed to fit the new brushes as follows:–

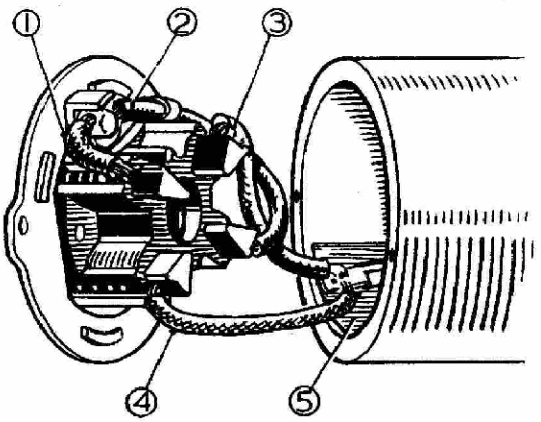

Fig. 2. Brushgear arrangement

1 Short brush-flexible, C/E bracket
2 Long brush-flexible, C/E bracket
3 Long brush-flexible, field winding
4 Short brush-flexible, field winding
5 Yoke insulation piece

Commutator-end Bracket Brushes

Cut the brush flexibles away from the terminal post. Use a file (or hacksaw) and make a groove in the head of the terminal sufficiently deep to accommodate the new brush flexibles. Solder the long and short brush-flexibles into the terminal groove.

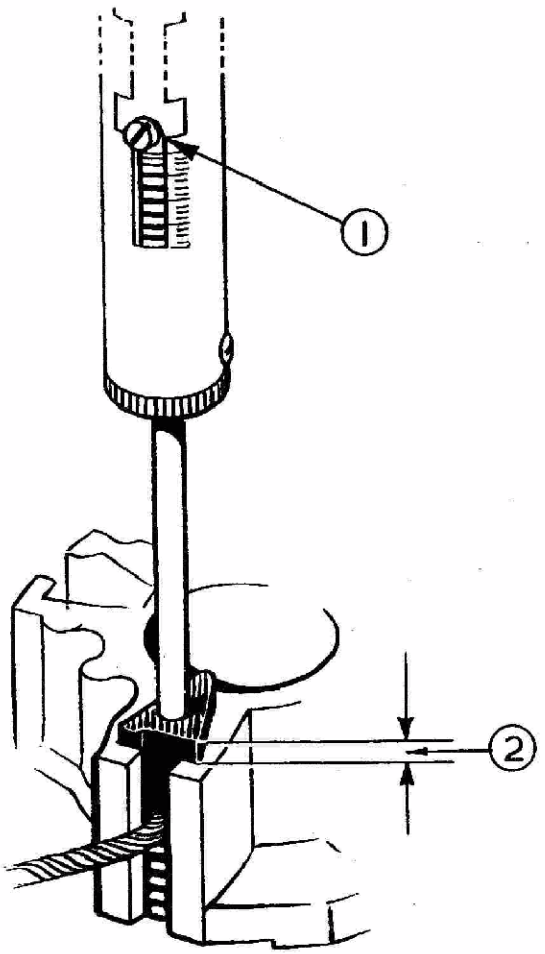

Fig. 3. Checking brush spring pressure

1 Push type spring gauge, with sliding marker indicating reading where 'arrowed'
2 $\frac{1}{16}$" (1.5 mm) approx.

Field Winding Brushes

Cut the brush flexibles about $\frac{1}{4}$" (6.35 mm) from the joint of the field winding. Solder the new long and short brush-flexibles to the ends of the original brush-flexibles.

Ensure that the insulated sleeving on the new brush-flexibles provides the maximum coverage consistent with satisfactory soldering.

(ii) Brush Springs

To measure the spring pressure, position a new brush in each of the brushboxes in turn and then press on top of the brush with a push-type spring gauge (see Fig. 3) until the top of the brush protrudes about $\frac{1}{16}$" (1.5 mm) from the brushbox moulding, when the spring pressure reading should be approximately 28 ozf (0.8 kgf).

If the spring pressures are appreciably incorrect, the bracket assembly complete with springs and moulding must be renewed.

(iii) Commutator

A commutator in good condition will be burnished and free from pits or burned spots. The surface of the commutator can be cleaned with a petrol-moistened cloth. Skimming the commutator will not normally be required, but if the surface is badly worn the armature must be removed and the commutator serviced as described in d(i).

(c) Dismantling

Remove the drive-end bracket fixing nuts (or bolts) and washers and withdraw the bracket from the yoke. Withdraw and remove the armature, complete with the internal thrust-washer and drive assembly. Remove the thrust washer from the commutator end of the armature shaft.

Remove the two commutator-end bracket fixing screws and detach the bracket from the yoke. Disengage the field winding brushes from the brush box moulding and then completely remove the bracket from the yoke assembly.

Do not at this stage dismantle the field winding from the yoke assembly (refer to d(ii)).

The drive assembly can be examined visually without the need for dismantling. The pinion and barrel must rotate freely on the screwed sleeve. Should any part of the drive assembly require renewal the assembly can be withdrawn from the armature shaft extension once the main spring is compressed sufficiently to expose the jump ring which can then be sprung from its groove. If in need of renewal the pinion and barrel and screwed sleeve should be replaced as a pair.

(d) Bench Inspection

After dismantling the motor, examine the individual items as follows:

(i) Armature

If the commutator needs to be serviced, the minimum thickness to which the commutator copper may be skimmed before a replacement armature assembly becomes necessary, is 0.080" (2.05 mm). The commutator surface should be finally polished with very fine glass paper. The insulation slots MUST NOT BE UNDERCUT.

If the armature shows signs of fouling the pole-shoes, worn bearings or an untrue armature shaft is indicated. Check the armature in a lathe and, if found to be out of true, fit a replacement. An untrue armature shaft cannot be satisfactorily rectified. If the armature is satisfactory, renew the bearings in both end brackets as described in (iv).

Check the armature insulation with a 110-volt a.c. 15-watt test lamp connected between one of the commutator segments and the shaft. The lamp will light if the insulation is not satisfactory. Replace the armature if a fault is indicated.

Check the armature for short-circuited windings, using "Growler" equipment. Replace the armature if a fault is indicated.

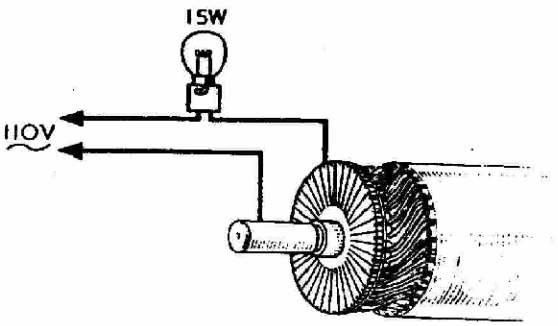

Fig. 4 Armature insulation test

(ii) Field Winding

Continuity

Connect a 12-volt battery-operated test lamp between each of the brushes in turn and a clean part of the yoke. The lamp will light if continuity is satisfactory between each of the brushes, the field winding and the yoke.

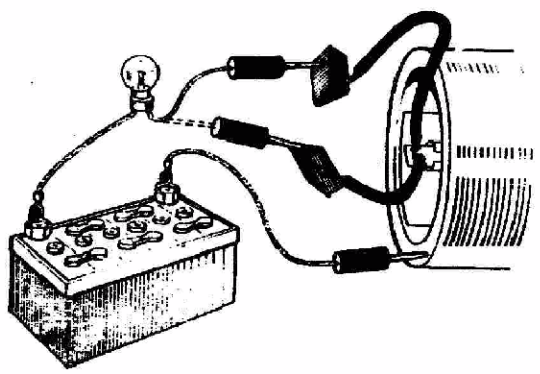

Fig. 5 Field winding continuity test

Insulation

To make a positive check on the insulation between the field winding and yoke, it will be necessary first to disconnect the earthed end of the winding where it terminates in a soldered (or riveted) connection at the yoke. (The hot-pressed joint of the copper-link to the field winding must not be disturbed).

However, to avoid disturbing the connection unnecessarily, first inspect the inside of the yoke for obvious signs of insulation breakdown, 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 and lock torque tests carried out previously. If the speed and torque were low and the current consumption high, faulty field winding insulation could be the cause and this interpretation of the motor performance would justify disconnecting the end of the field winding to enable a positive check to be carried out. The field winding insulation can be checked, after disconnecting the end of the winding at the yoke, by connecting a 110-volt a.c. 15-watt test lamp between the disconnected end of the winding and a clean part of the yoke. Care should be taken to ensure that neither of the brushes nor bare parts of their flexibles contact the yoke during the test. The test lamp will light if the insulation is not satisfactory.

Field Winding Replacement

Disconnect the earthed end of the winding at the yoke either by unsoldering or drilling out the rivet as applicable.

Slacken the four pole-shoe retaining screws with a wheel-operated screwdriver. Remove the retaining screws from a diametrically opposite pair of pole-shoes and remove the pole-shoes from the yoke. Note that the remaining pair of pole-shoes need only be slackened sufficiently to enable the winding to be withdrawn from the yoke. The winding assembly can be slid out from beneath the shoulders of the slackened-off pole shoes and out through the end of the yoke.

Wipe out the inside of the yoke and clean the insulating piece which separate the field winding brush joint from the yoke. Loosely fit the new field winding assembly and the pole shoes into the yoke, and place the insulation piece correctly between the winding brush joint and the yoke. Tighten the pole-shoes evenly, and re-make a good earth connection between the winding connector and the yoke.

(iii) Commutator End Bracket

The brushgear should be checked, if this has not previously been done. Refer to para. 4b(i) and (ii).

Check the insulation of the springs and terminal post by connecting a 110-volt a.c. 15-watt test lamp between a clean part of the bracket and each of the springs in turn and then between the bracket and the terminal post. The brushes and their flexibles (where bared) must not come into contact with the bracket during the test. The lamp will light if the insulation is not satisfactory.

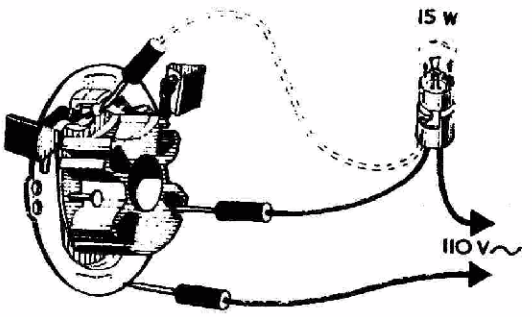

Fig. 6 Brush springs and input terminal insulation test

(iv) Bearings

Both end brackets are fitted with self-lubricating porous bronze bearing bushes. New bushes must be immersed in clean engine oil (S.A.E. 30/40 grade) for a minimum of 24 hours before fitting and they must not be reamed after fitting otherwise the self-lubricating qualities will be impaired.

Bushes should be replaced on the occasion of major engine overhaul or when the starting motor is to be fitted to a replacement engine.

Remove the bush in the commutator-end bracket by drilling out the two rivets securing the brush box moulding — this will release the bearing felt seal retaining plate. Insert a ¼" tap for a few turns into the bush from the outside of the bracket and withdraw the bush with the tap.

The bush in the drive-end bracket can be pressed out while supporting the bracket.

New bushes should be pressed into position using a suitably dimensioned, shouldered polished mandrel.

5. REASSEMBLY

Reassembling the starting motor is in general a reversal of the dismantling procedure.

When assembling the commutator-end bracket to the yoke, it is important to position the brushes and their flexibles correctly (see Fig. 2).

Take care to re-fit the internal thrust washer to the armature shaft at the commutator end.