SECTION B-2
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WORKSHOP INSTRUCTIONS

STARTING MOTORS

MODELS

M45G, M418G and M35G

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STARTING MOTORS

MODELS M45G, M418G AND M35G

1. GENERAL

The electric starting motor is a four-pole machine having an extended shaft which carries the engine engagement gear, or starter drive as it is more usually named. Three starter sizes are in general use, of $4\frac{1}{2}$", $4\frac{1}{8}$" and $3\frac{1}{2}$" yoke diameter.

The starting motor is of similar construction to the generator except that heavier copper wire is used in the construction of armature and field windings, as it must be remembered that the current consumption of the motor is very high. For example, the average 12 volt starter under lock conditions takes 450—500 amperes at about 7 volts.

Models M45G and M418G are four brush machines and have series-parallel field connections. Earlier M35G machines had two brushes only, but recent models incorporate four brushes. In both cases, the M35G starter has a series wound field.

Some starting motors are fitted with a switch on the commutator end bracket, while other machines are controlled by a separately mounted switch. Details of manual and solenoid operated starter switches will be found in SECTION E-2.

The construction, operation and servicing of the various designs of starter drive are described in SECTION B-3.

2. ROUTINE MAINTENANCE

The only maintenance normally required by the starting motor is the occasional checking of brush-gear and commutator. About every 12,000 miles, remove the metal band cover. Check that the brushes move freely in their holders by holding back the brush springs and pulling gently on the flexible connectors. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol-moistened cloth. Be careful to replace brushes in their original positions in order to retain the "bedding". Brushes which have worn so that they will not "bed" properly on the commutator must be renewed.

The commutator should be clean, free from oil or dirt and should have a polished appearance. If it is dirty, clean it by pressing a fine dry cloth against it while the starter is turned by hand by means of a spanner applied to the squared extension of the shaft. Access to the squared shaft is gained by removing the thimble-shaped metal cover, sometimes secured by two screws. If the commutator is very dirty, moisten the cloth with petrol.

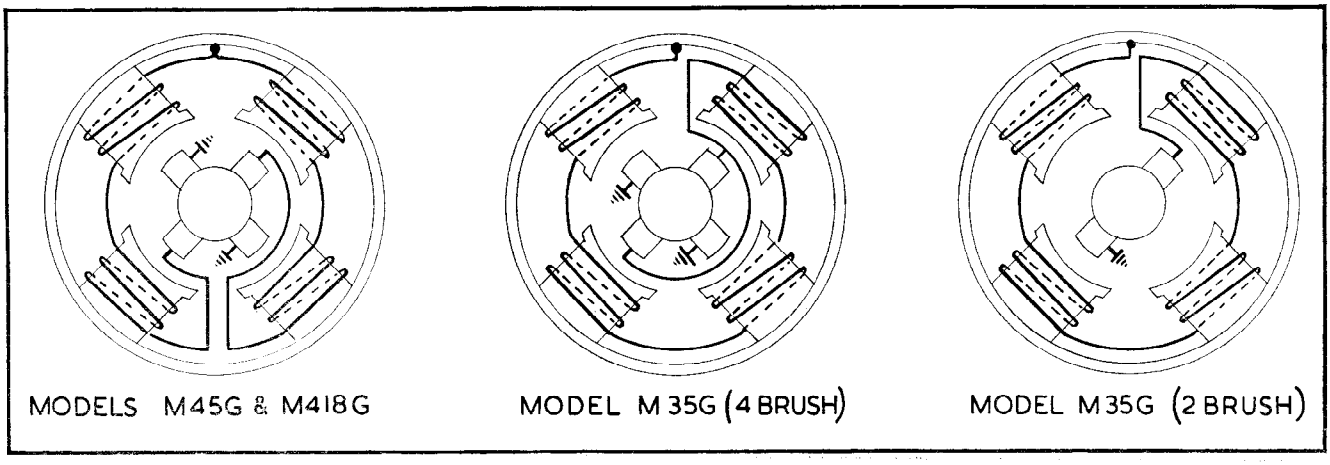

Fig. 1.
Internal connections of starting motors

3. PERFORMANCE DATA

Model	Nominal voltage	Lock torque lbs./ft.	Current amps.	Voltage	Torque at 1,000 r.p.m. lbs./ft.	Current amps.	Voltage
M45G	12	22	430—450	7·4—7·8	8·3	200—220	9·8—10·2
M45G	6	14	540—560	2·8—3·2	4·2	190—210	4·4— 4·8
M418G	12	17	440—460	7·0—7·4	8·0	240—260	9·0—9·4
M418G	6	9·25	510—530	2·7—2·9	4·0	290—310	8·7—9·1
M35G	12	9·3	325—345	7·7—8·1	4·9	200—220	8·9—9·3
M35G	6	6	390—410	3·0—3·4	2·9	240—260	4·0—4·4

4. SERVICING

(a) TESTING IN POSITION

(*i*) Switch on the lamps and operate the starter control. If the lights go dim, but the starting motor is not heard to operate, an indication is given that current is flowing through the starting motor windings but that the armature is not rotating for some reason; possibly the pinion is meshed permanently with the geared ring on the flywheel. In this case, the starting motor must be removed from the engine for examination.

(*ii*) Should the lamps retain their full brilliance when the starter switch is operated, check the circuit for continuity from battery to starting motor via the starter switch, and examine the connections at these units. If the switch is found to be faulty, proceed as described in SECTION E-2. If the supply voltage is found to be applied to the starting motor when the switch is operated, an internal fault in the motor is indicated and the unit must be removed from the engine for examination.

(*iii*) Sluggish or slow action of the starting motor is usually caused by a poor connection in the wiring giving rise to a high resistance in the motor circuit. Check as described above.

(*iv*) If the motor is heard to operate, but does not crank the engine, indication is given of damage to the drive.

(b) BENCH TESTING AND EXAMINATION OF BRUSHGEAR AND COMMUTATOR

(*i*) If it is necessary to remove the starting motor from the engine, first proceed as follows :—

Disconnect the cable from the positive battery terminal to avoid any danger of causing short circuits.

Disconnect the heavy cable from the starting motor. When the switch is of the solenoid-operated type mounted on the end bracket, disconnect the cable from starter push to solenoid switch.

When the switch is of the manually-operated type mounted on the end bracket, remove the switch lever from the switch. This lever is held in position by the spring pressure of the switch plunger, and the lever can be pulled out instead of disconnecting the wire control. To replace the lever, insert at an angle to get behind the spring, then bring upright and push down until the slots in the lever register with the end cap.

(*ii*) After removing the starting motor from the engine, secure the body in a vice and test by connecting it with heavy gauge cables to a battery of the appropriate voltage. One cable must be connected to the starter terminal and the other held against

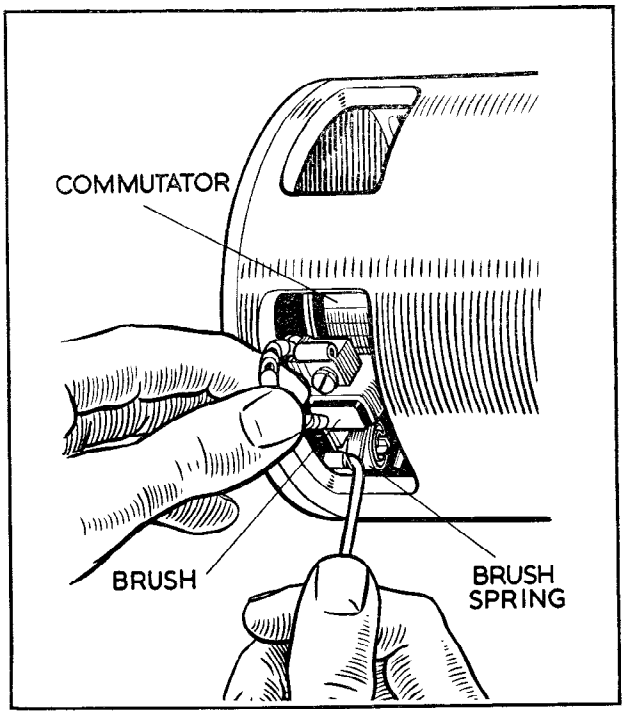

Fig. 2.
Checking brushgear

the body or end bracket. (In the case of starters fitted with switches on the end bracket it will be necessary to operate the switch by hand to carry out this test. Solenoid-operated switches are provided with an extension of the plunger, covered by a rubber cap, which must be pressed for hand operation. A spare lever should be fitted to manually-operated switches as in (*i*) on p.2). Under these light load conditions, the starter should run at a very high speed.

NOTE : In the case of a few cars, on which the drive end bearing is incorporated with the engine, it is necessary to fit a slave driving end bracket to the starting motor in order to carry out this light running test. Details can be supplied upon application.

(*iii*) If the operation of the starting motor is unsatisfactory, remove the cover band and examine the brushes and commutator. Hold back each of the brush springs and move the brush by pulling gently on its flexible connector. If the movement is sluggish, remove the brush from its holder and ease the sides by lightly polishing on a smooth file. Always replace brushes in their original positions. If the brushes are worn so that they will not bear on the commutator or if the brush flexible is exposed on the running face they must be replaced (see Para. 4d).

Check the tension of the brush springs with a spring scale. The correct tension is 30—40 ozs. (except model M35G, 4 brush, which is 15—25 ozs.) and new springs should be fitted if the tension is low.

If the commutator is blackened or dirty, clean it by holding a petrol-moistened cloth against it while the armature is rotated.

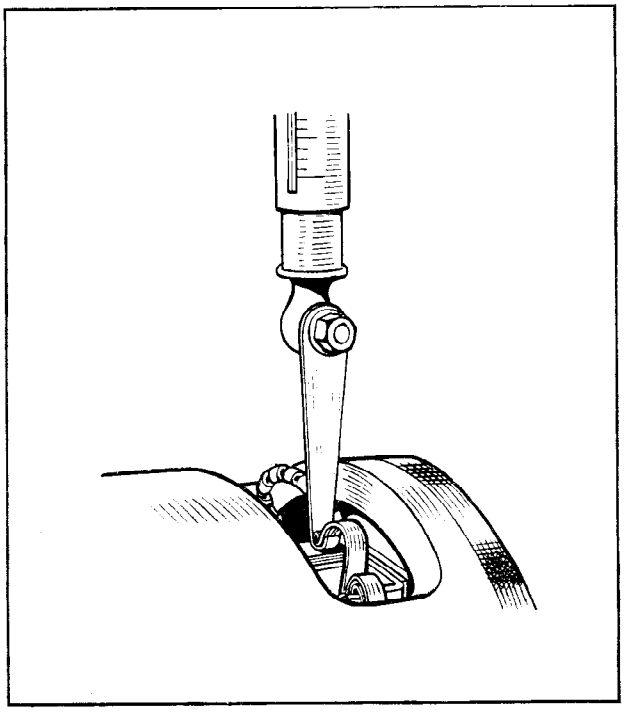

Fig. 3.
Testing brush spring tension

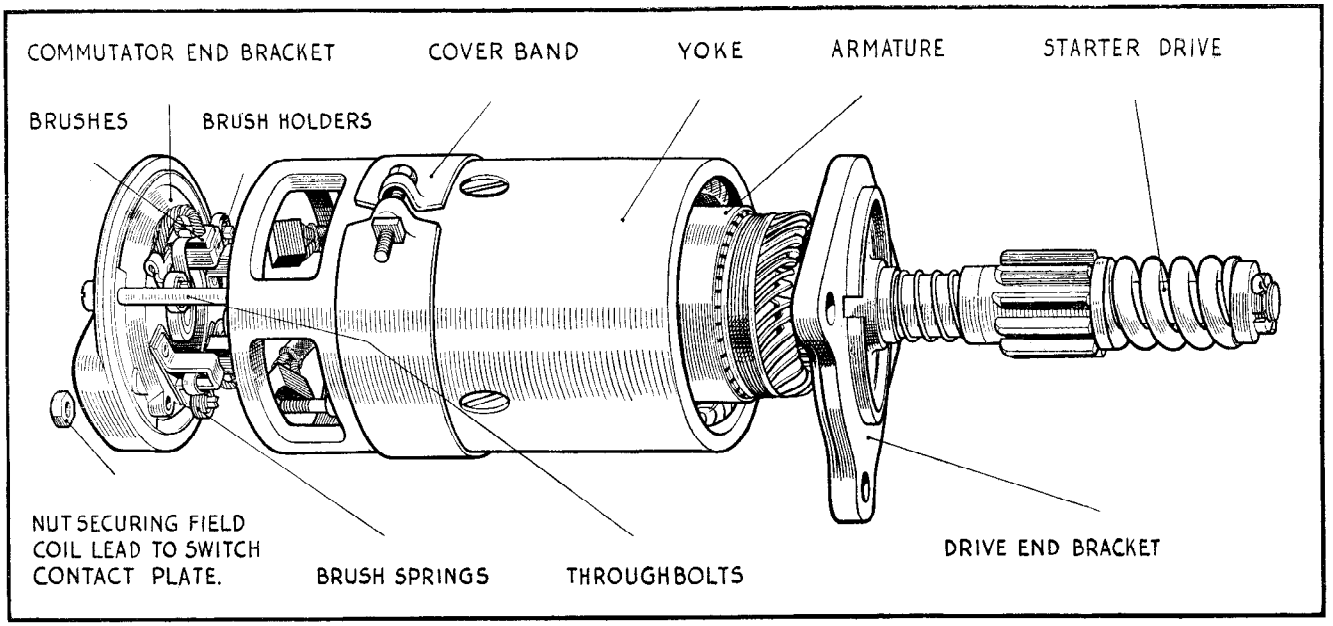

Fig. 4.
Starting motor, model M418G

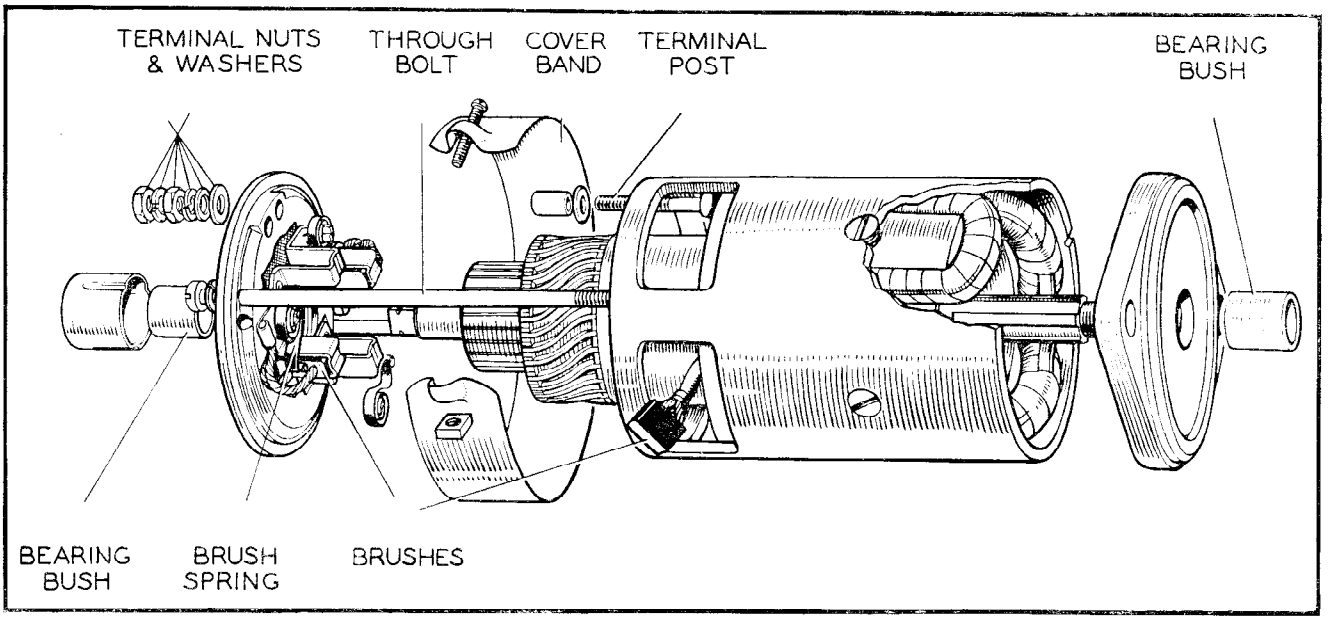

Fig. 5.
Starting motor, model M35G, without drive

(*iv*) Re-test the starter as described under (*ii*) on p.3. If the operation is still unsatisfactory, the unit must be dismantled for detailed inspection and testing.

(c) TO DISMANTLE

(*i*) Remove the cover band, hold back the brush springs and lift the brushes from their holders.
(*ii*) If the switch is of the pattern secured to the commutator end bracket, remove the switch as described in SECTION E-2.

(*iii*) With starters having the field coil terminal post protruding from the commutator end bracket, unscrew the single nut or terminal nuts (Figs. 6 and 7) from the terminal post.

(*iv*) Unscrew the two through bolts from the commutator end bracket. Remove the commutator end bracket from the yoke.

(*v*) Remove the driving end bracket complete with armature and drive from the starting motor yoke. If it is necessary to remove the armature from the driving end bracket on inboard types, it can be done

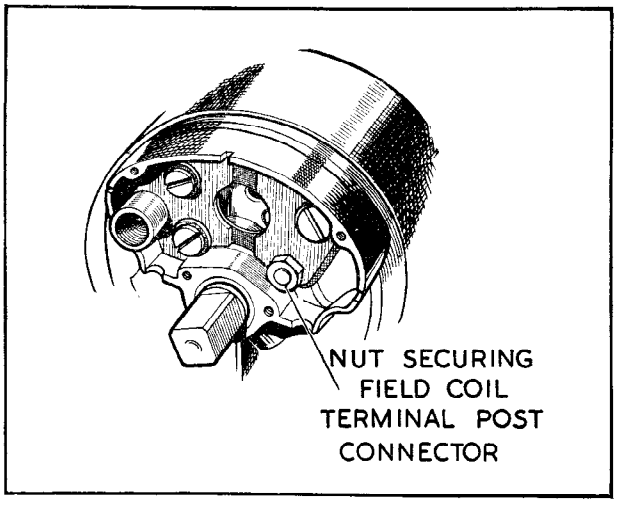

Fig. 6.
Starter with switch on end bracket

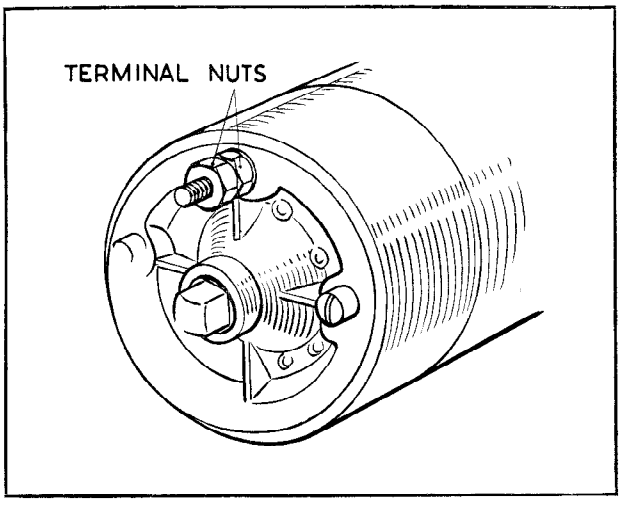

Fig. 7.
Starter operated by separately mounted switch

by means of a hand press after the drive has been dismantled (see SECTION B-3).

Certain starting motors with outboard drive incorporate an intermediate bracket between yoke and drive end bracket.

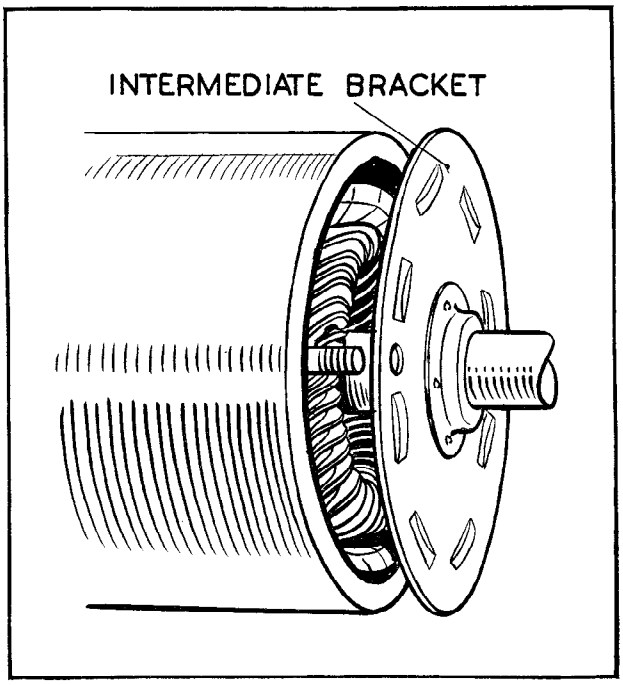

Fig. 8. Starting motor with intermediate bracket

(d) REPLACEMENT OF BRUSHES

If the brushes are worn so that they do not bear on the commutator, or if the flexible connectors are exposed on the running face, they must be replaced.

With four-brush machines, two of the brushes are connected to terminal eyelets attached to the brush boxes on the commutator end bracket (Fig. 9) and two are connected to tappings on the field coils (Fig. 10 and 11).

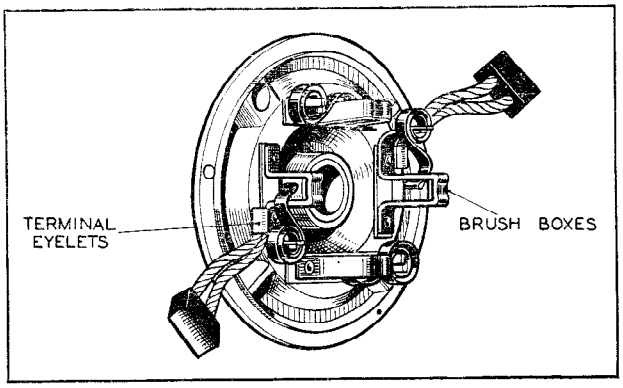

Fig. 9. C.E. bracket brush connections (4 brush starter)

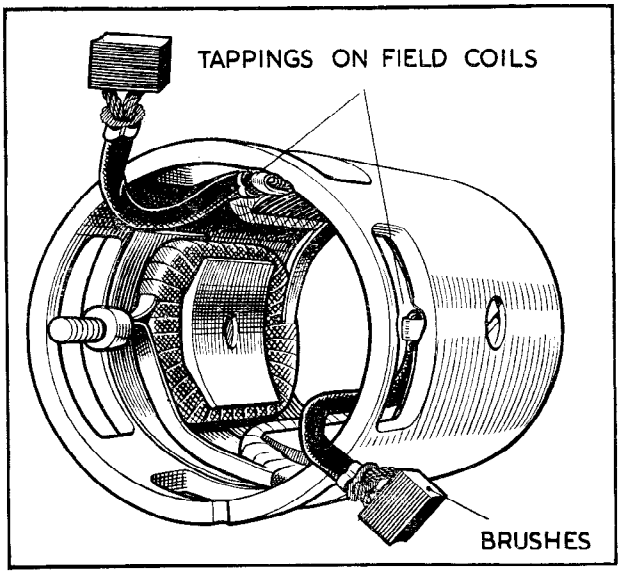

Fig. 10. Brush connections to field coil tappings (models M45G and M418G)

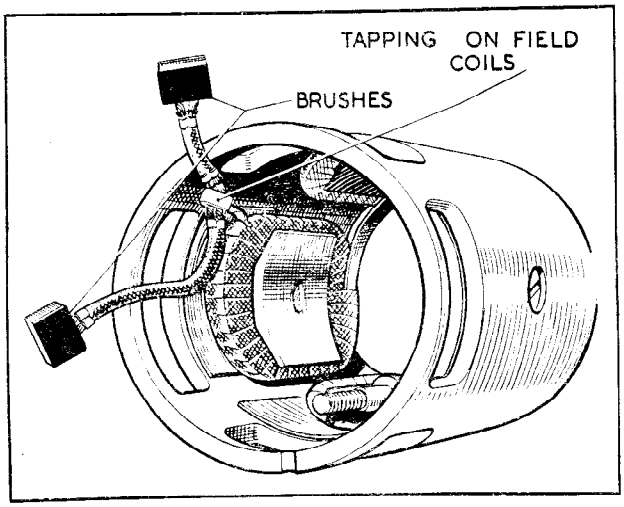

Fig. 11. Brush connections to field coil tapping (model M35G 4-brush starter)

On model M35G two-brush machines, one brush flexible is attached to the brush box on the commutator end bracket and the second to the field coil tapping.

The flexible connectors must be removed by unsoldering and the connectors of the new brushes secured in their place by soldering. The brushes are pre-formed so that bedding to the commutator is unnecessary.

(e) COMMUTATOR

A commutator in good condition will be smooth and free from pits and burned spots. Clean the com-

mutator with a petrol-moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper, while rotating the armature. To remedy a badly worn commutator, dismantle the starter drive as described in SECTION B-3 and remove the armature from the end bracket. Now mount the armature in a lathe, rotate at a high speed and take a light cut with a very sharp tool. Do not remove any more metal than is necessary. Finally polish with very fine glass paper. The insulators between the commutator segments MUST NOT BE UNDERCUT.

(f) ARMATURE

Examination of the armature may reveal the cause of failure, e.g. conductors lifted from the commutator due to the starting motor being engaged while the engine is running and causing the armature to be rotated at an excessive speed. A damaged armature must in all cases be replaced — no attempt should be made to machine the armature core or to true a distorted armature shaft.

(g) FIELD COILS

(*i*) Test the field coils for continuity by connecting a 12 volt battery with a 12 volt bulb in series between the tapping points of the field coils at which the brushes are connected, in the case of models M418G and M45G ; or between the field coil terminal post and the tapping point at which the brush(es) is(are) connected in the case of model M35G two and four brush machines. Failure of the lamp to light indicates an open circuit in the wiring of the field coils.

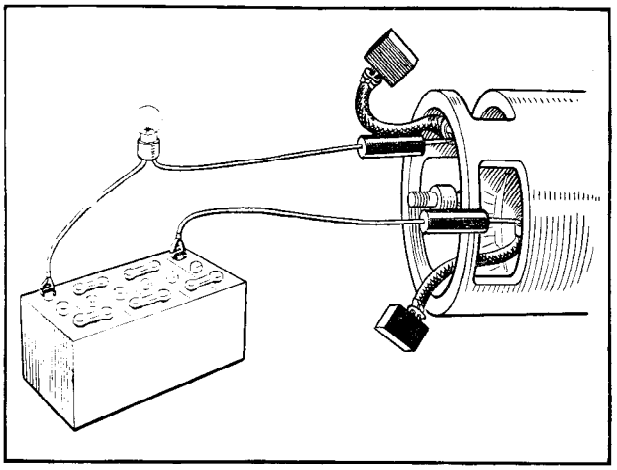

Fig. 12.
Checking field coils for open circuit on models M45G and M418G

(*ii*) Lighting of the lamp does not necessarily mean that the field coils are in order, as it is possible that one of them may be earthed to a pole shoe or to the yoke. This may be checked with a test lamp connected from the supply mains, the test leads being connected to one of the field coil tapping points on M45G and M418G machines, or the field coil terminal post on M35G machines, and to a clean part of the yoke. Should the lamp light, it indicates that the field coils are earthed to the yoke.

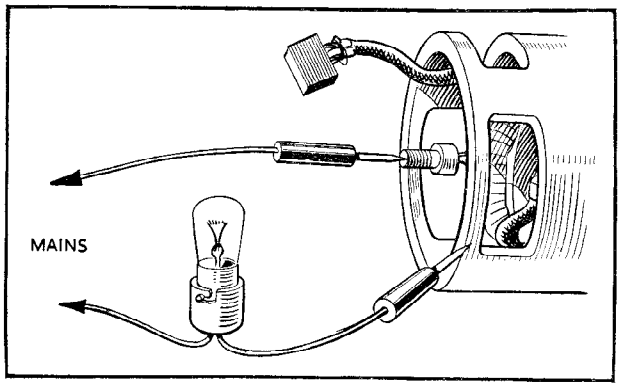

Fig. 13.
Checking field coils for earthing on model M35G

In either case, unless a replacement starting motor is available, the field coils must be replaced. To do this, carry out the procedure outlined below, using a pole shoe expander and a wheel-operated screwdriver.

Remove the insulation piece which is provided to prevent the intercoil connectors from contacting with the yoke.

Mark the yoke and pole shoes in order that they can be fitted in their original positions.

Unscrew the four pole shoe retaining screws by means of the wheel operated screwdriver.

Draw the pole shoes and coils out of the yoke and lift off the coils.

Fit the new field coils over the pole shoes and place them in position inside the yoke. Take care to ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.
Locate the pole shoes and field coils by lightly tightening the fixing screws.

Insert the pole shoe expander, open it to the fullest extent and tighten the screws.

Finally tighten the screws by means of the wheel operated screwdriver.

Replace the insulation piece between the field coil connections and the yoke.

(h) BEARINGS

Bearings which are worn to such an extent that they will allow excessive side play of the armature shaft must be replaced. To replace the bearing bushes proceed as follows :—

(*i*) Press the bearing bush out of the end bracket.

(*ii*) Press the new bearing bush into the end bracket using a shouldered, highly polished mandrel of the same diameter as the shaft which is to fit in the bearing. Porous bronze bushes must not be opened out after fitting, or the porosity of the bush may be impaired.

NOTE : Before fitting a new porous bronze bearing bush it should be completely immersed for 24 hours in clean thin engine oil. In cases of extreme urgency this period may be shortened by heating the oil to 100°C. when the time of immersion may be reduced to 2 hours.

(j) REASSEMBLY

The reassembly of the starting motor is a reversal of the dismantling procedure.

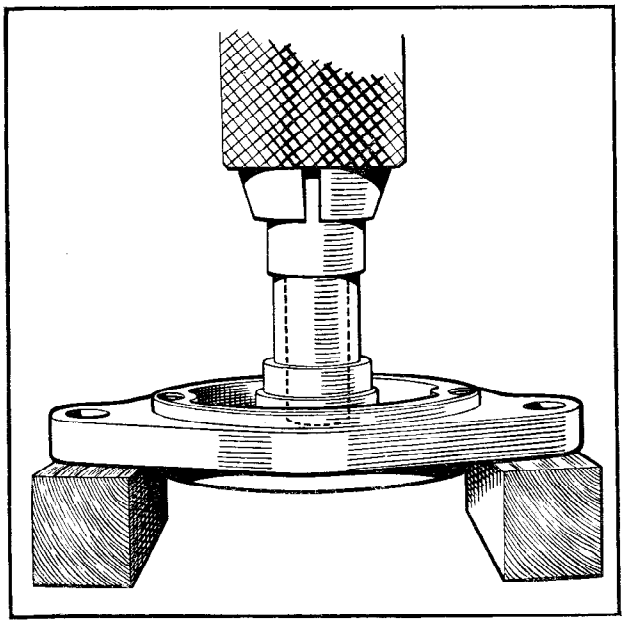

Fig. 14.
Method of fitting bearing bushes