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# EQUIPMENT

VOLUME 2

# WORKSHOP INSTRUCTIONS

## MOTOR CYCLE

## PRE-ENGAGED STARTING MOTOR WITH ROLLER CLUTCH DRIVE

## MODEL M3 6-VOLT


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# MOTOR CYCLE

# PRE-ENGAGED STARTING MOTOR WITH ROLLER-CLUTCH DRIVE

## MODEL M3

## 1. GENERAL

Model M3 starting motor is a four-pole four-brush earth return machine with series-parallel connected field coils. A lever-operated drive assembly incorporating a roller clutch is carried on a straight-splined extension of the armature shaft. The starter switch is mounted on the yoke and when the drive is almost fully engaged, the contacts are arranged to close and connect the motor to the battery.

The drive and armature are spring-loaded in the out-of-mesh position.

Overspeed protection is afforded by the clutch to prevent rotation of the armature by the engine.

## 2. MAINTENANCE

Keep the supply terminal on the starter switch clean and tight. If the connection has become dirty, clean the contacting surfaces and lightly smear them with petroleum jelly. No periodic lubrication is necessary, but when the machine is stripped down for a general overhaul the starting motor should be removed and given a thorough examination on the bench.

## 3. PERFORMANCE DATA

(a) Light running current: 38 amp. at 5,300 r.p.m.

(b) Lock torque: 3.85 lb.-ft. with 245 amp. at 3.75 terminal volts.

(c) Torque at 1,000 r.p.m.: 1.8 lb.-ft. with 165 amp. at 4.5 terminal volts.

These figures are based on the use of a fully charged 6-volt battery having a capacity of 22.5 amp.-hr. at the 10-hour rate.

## 4. SERVICING

### (a) TESTING IN POSITION

Switch on the headlamp, operate the starter and watch for the following symptoms.

(i) *The lamp dims and the motor does not crank the engine*
Remove the sparking plug and check by hand that the engine is not abnormally stiff.
Check the battery by substitution.

(ii) *The lamps do not dim and the motor does not crank the engine*
Check the starter circuit for continuity. If necessary, remove the starter switch from the yoke and examine the contacts.
If the armature rotates, check for damaged pinion or drive mechanism.

If the source of trouble cannot be located, remove the starting motor from the engine for examination.

### (b) BENCH TESTING

(i) *Removing the starting motor from the engine*
Disconnect the battery. Remove the fixing bolts from the drive end bracket and lift the starting motor from the engine.

(ii) *Measuring the light running current*
With the starting motor clamped in a vice and using a 6-volt 22.5 amp.-hr. battery, check the light running current and compare with the value given in Para. 3 (a). Look for excessive arcing at the commutator and, if necessary, remedy.

(iii) *Measuring lock torque and lock current*

Carry out a torque test and compare with the values given in para. 3 (b). If a constant voltage supply is used, it is important to adjust this to be 3.75 volts at the starter terminal when testing.

(iv) *Fault diagnosis*

An indication of the nature of the fault, or faults, may be deduced from the results of the light running and lock torque tests.

| SYMPTOM | PROBABLE FAULT |
|---|---|
| 1. Speed, torque and current consumption correct. | Assume motor to be in normal operating condition. |
| 2. Speed, torque and current consumption low. | High resistance in brushgear, e.g. faulty connections, dirty or burned commutator causing poor brush contact. |
| 3. Speed and torque low, current consumption high. | Tight or worn bearings, bent shaft, insufficient end play, armature fouling a pole shoe, or cracked spigot on drive end bracket. Short-circuited armature, earthed armature or field coils. |
| 4. Speed and current consumption high, torque low. | Short-circuited windings in the field coils. |
| 5. Armature does not rotate, no current consumption. | Open-circuited armature or field coils. If the commutator is badly burned there may be poor contact between brushes and commutator. |
| 6. Armature does not rotate, high current consumption. | Earthed field coil or switch. Armature physically prevented from rotating. |
| 7. Excessive brush movement causing arcing at commutator. | Low brush spring tension, worn or out-of-round commutator. 'Thrown' or high segment on commutator. |

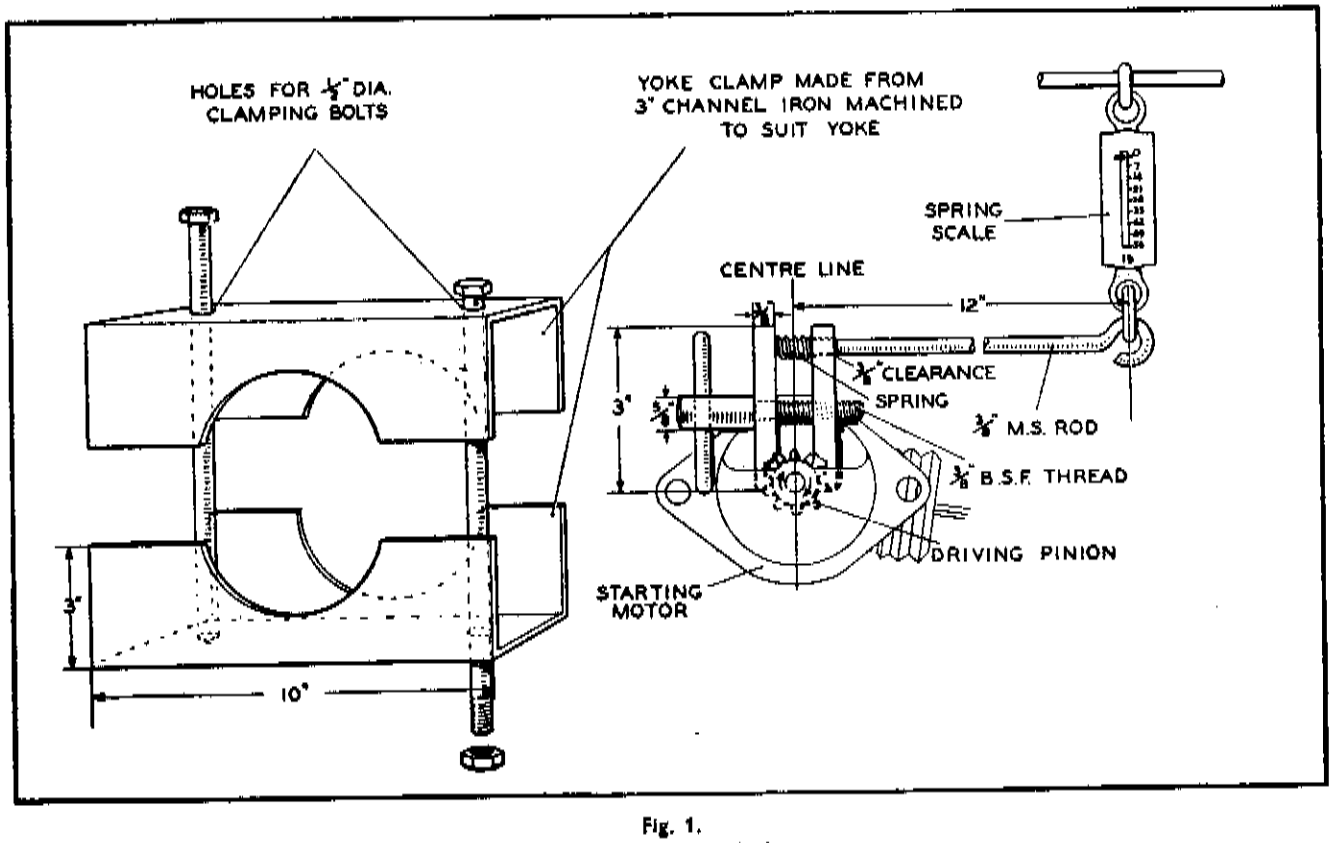


Fig. 1.
Apparatus for measuring lock torque

| | | |
|---|---|---|
| 8. | Excessive arcing at the commutator. | Defective armature windings, sticking brushes or dirty commutator. |

If a fault is indicated, dismantle the motor.

(c) DISMANTLING

(i) Withdraw the two screws which secure the starter switch to the yoke and remove the switch.

(ii) Remove the nuts, locking washers and insulating washers from the field terminal posts on the commutator end bracket. Unscrew and withdraw the two through bolts. The drive end and commutator end brackets can now be detached from the yoke.

(iii) Remove the nut securing the pin on which the starter drive engagement lever pivots, and withdraw the pin.

(iv) Lift the engagement lever from the engagement bush on the starter drive. Take care not to lose the pivoted shoes and return spring. Mark the pivoted shoes to facilitate correct refitting.

(v) Withdraw the armature and starter drive from the starting motor yoke. Take care not to lose the washer from the commutator end of the armature shaft.

(vi) Spring the split thrust washer from the groove round the end of the armature shaft extension and remove the starter drive assembly.

(d) BENCH INSPECTION

After dismantling the motor, examine the parts as follows:

(i) *Drive assembly*

A fault in the starter drive assembly usually necessitates replacing the drive, but occasionally it may be necessary only to replace the engagement bush or spring. This is effected by pressing the engagement bush (see sectioned bush in Fig. 2) back against the roller clutch housing and remove the split ring from its groove in the pinion sleeve. The bush and spring can then be withdrawn for inspection.

(ii) *Brushgear*

Check that the brushes move freely in their holders. A sticking brush can be cleaned with a petrol-moistened cloth. Be careful to refit brushes in their original

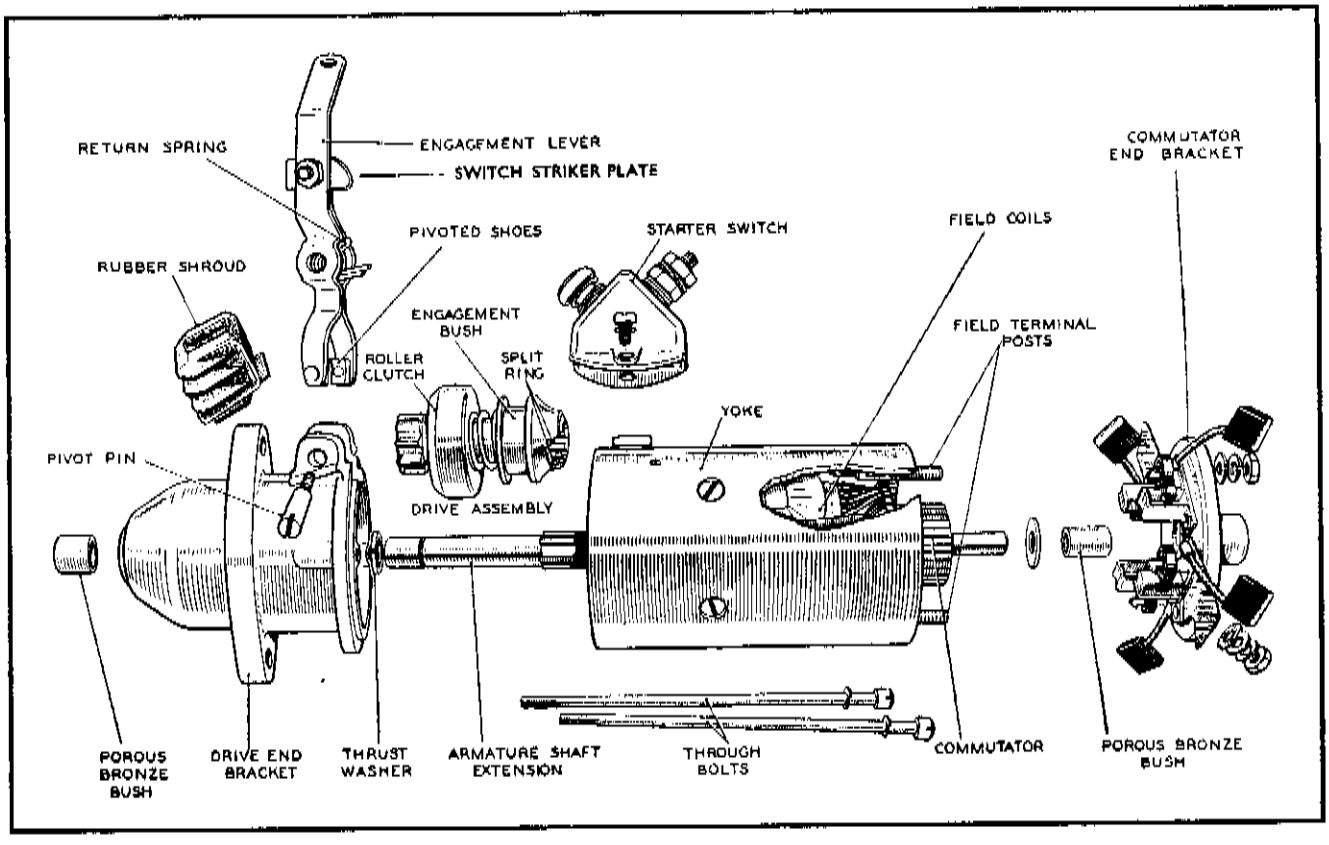


**Fig. 2.**
**Starting motor dismantled**

positions in order to retain the 'bedding.' Renew brushes which have worn to $\frac{3}{8}$" or less in length.

Check the brush spring tension. The correct tension is 28—32 oz. Fit new springs if the tension has dropped below 20 oz.

The flexible connectors are soldered to terminal tags on the brush boxes and can be unsoldered for replacement.

The brushes are pre-formed so that 'bedding' to the commutator is unnecessary.

(iii) *Commutator*

A commutator in good condition will be burnished and free from pits or burned spots. Clean the commutator with a petrol-moistened cloth. Should this be ineffective spin the armature and polish the commutator with fine glass paper; remove all abrasive dust with a dry air blast. If the commutator is badly worn, mount the armature between centres in a lathe, rotate at high speed and make a light cut with a very sharp tool. Do not remove more metal than is necessary. Finally polish with very fine glass paper. The INSULATORS between the commutator segments MUST NOT BE UNDERCUT.

(iv) *Armature*

Lifted conductors:

If the armature conductors are found to be lifted from the commutator risers, overspeeding is indicated. In this event, suspect the drive assembly and check by replacement.

Fouling of armature core against the pole faces:

This indicates worn bearings, a misaligned pole piece or a distorted shaft. A damaged armature must in all cases be replaced and no attempt should be made to machine the armature core or to true a distorted armature shaft.

Insulation test:

To check armature insulation, use a 110-volt A.C. test lamp. The test lamp must not light when connected between the armature shaft and the commutator segments.

If a short circuit is suspected check the armature on a 'growler.' Overheating can cause blobs of solder to short circuit the commutator segments.

(v) *Field coils*

Continuity Test:

Connect a low voltage test lamp and battery between the switch contact on the outside of the yoke and each insulated brush terminal in turn (with the armature removed from the yoke).

If the lamp does not light, an open circuit in the field coils is indicated. Replace the defective coils.

Insulation test:

Connect a 110-volt A.C. test lamp between the switch contact on the yoke and a clean part of the yoke. The test lamp lighting, indicates that the field coils are earthed to the yoke and must be replaced.

When carrying out this test, check also the insulated pair of brush boxes on the commutator end bracket. Clean off all traces of brush deposit before testing. Connect the 110-volt test lamp between each insulated brush box and the bracket. If the lamp lights this indicates faulty insulation and the end bracket must be replaced.

Replacing the field coils:

Using a wheel-operated screwdriver, unscrew the four pole-shoe retaining screws.

Remove the insulation piece which is fitted to prevent the inter-coil connectors from touching the yoke.

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. Ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

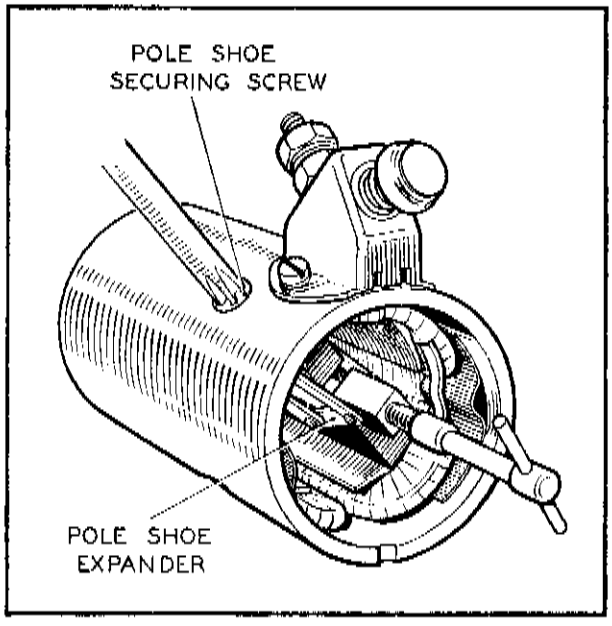


Fig. 3.
Fitting pole shoes using pole shoe expander

Locate the pole shoes and field coils by lightly tightening the fixing screws.

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

Finally, tighten the screws with the wheel-operated screw-driver, while the pole pieces are held in position by a pole shoe expander (see Fig. 3) or a mandrel of suitable size.

(vi) *Bearings and Bearing Replacement*

The two end brackets are each fitted with a porous bronze bush.

Replace bearings which are worn to such an extent that they will allow excessive side play of the armature shaft.

The bush in the drive end bracket can be pressed out, whilst that in the commutator end bracket is best removed by inserting a $\frac{7}{16}$ in. tap squarely into the bearing and withdrawing the bush with the tap.

Before fitting a new porous bronze bearing bush it should be completely immersed for 24 hours in clean engine oil (SAE 30-40). In cases of extreme urgency, this period may be shortened by heating the oil to 100°C. for 2 hours and then allowing the oil to cool before removing the bush.

Fit new bushes by using a shouldered, highly polished mandrel approximately 0.0005″ greater in diameter than the shaft which is to fit in the bearing.

**Porous bronze bushes must not be reamered out after fitting, as the porosity of the bush will be impaired.**

(e) REASSEMBLY

After cleaning all parts, the re-assembly of the starting motor is mainly a reversal of the dismantling procedure given in para. 4 (c), but the following special points should be noted:

(i) To facilitate re-assembling the commutator end bracket to the armature and yoke, proceed as follows:

Partially withdraw the brushes from their brush-boxes until each brush is trapped in position by the side pressure of its spring. Insert the armature shaft into the commutator end bracket bearing and release the brushes on to the commutator.

Now, fit the yoke over the armature and locate the field terminal posts in the insulated holes in the commutator end bracket.

(ii) When refitting the engagement lever, ensure that the pivoted shoes are in their original positions.

(f) SETTING SWITCH STRIKER PLATE

The switch striker plate is secured to the engagement lever by a single screw and nut. The hole through the plate is slotted and the contacting surfaces of the plate and lever are notched or serrated. To set the switch striker plate, proceed as follows:

(i) Slacken the striker plate securing screw.

(ii) Move the engagement lever until the drive assembly abuts against the thrust washer (see Fig. 2).

(iii) Move the striker plate until the switch plunger is fully depressed and tighten the striker plate securing screw.

(iv) Release the engagement lever.

(v) Slacken the striker plate securing screw and move the plate one notch in the direction of the striking tip. Retighten the screw. This will ensure that the switch plunger and striker plate act as a stop for the engagement lever and prevent striking of the thrust washer by the drive assembly.