# PRE-ENGAGED STARTING MOTORS

## WITH ROLLER CLUTCH DRIVES

MODELS M3, M325, M35G, M418G and M45G

**Supplementary Information to Section B-5 Issue 2**

### (a) INTRODUCTION

Since SECTION B-5 Issue 2 covering pre-engaged starting motors with roller clutch drives was prepared, certain test figures have been modified and new units introduced.

Both M418G and M45G starting motors (having 23-slot armatures) are now fitted to diesel engines. Hitherto, model M45G has always carried a plate clutch drive in this application.

### (b) ROLLER CLUTCH DRIVE, MODEL 7SD

A four-roller small clutch drive, model 7SD, has been introduced to supersede and interchange with model 6SD. It is applicable to all sizes of petrol engine starting motors up to the 'short core' version of model M45G with a 37-slot armature — test data for the latter machine being given below in para. (g) (ii), column 3.

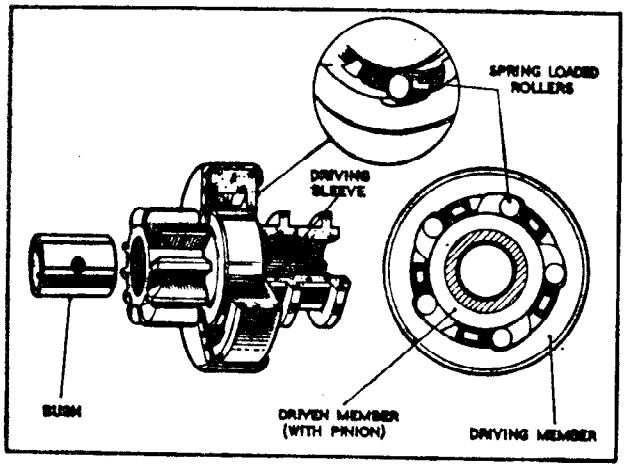


Fig. 1
Five-roller clutch drive, model 9SD

### (c) ROLLER CLUTCH DRIVE, MODEL 9SD

A five-roller large clutch drive, model 9SD, has been introduced for large diesel engine applications.

In some clutches, including model 9SD, the driving sleeve is to be produced by extrusion (as opposed to machining), a process which enables riveted anchor pegs (see SECTION B-5 Fig. 5) to be dispensed with and integral spring reaction buttresses to be formed in their stead, as shown in Fig. 1.

### (d) DRIVE ACTUATING SOLENOID, MODEL 7S

A later design of solenoid model 7S (for use with roller clutch drives and briefly referred to in SECTION E-2 PART C Issue 2 on page 1), in which the drive engagement spring is located within the solenoid plunger instead of on the drive sleeve, is now being fitted to certain M45G diesel engine starting motors together with model 9SD roller clutch drives with push-screw engagement. The resulting reduction of drive sleeve length enables these machines to be made shorter. Standard length 23-slot armatures are used and the electrical performance remains unchanged. A typical arrangement is shown in Fig. 2.

On occasions of tooth-to-tooth abutment, the drive and engaging lever remain stationary while the solenoid plunger continues its travel by compressing the engaging spring within it. Closure of the solenoid starter switch contacts causes the armature to rotate and the pinion teeth to clear the abutment. As tooth alignment occurs, the drive is moved fully into mesh by the engaging spring with push-screw assistance from the drive sleeve helix.

**Note:** Since the above version of Starter Solenoid Model 7S cannot be fitted to starting motors having self-indexing plate clutch drives but will be used only on roller clutch starting motors, the relevant TEST DATA and SERVICING information is, for convenience, repeated under paragraph (g) (iv) and (v) below.

### (e) COMMUTATOR SKIMMING

The minimum diameters to which commutators of pre-engaged (and also inertia) drive starting motors may be skimmed and still remain serviceable are as follows:

Models M3 and M325 (33-bar), $1\frac{1}{8}$" (28.58 mm.); models M325 and M35G (29-bar), $1\frac{9}{32}$" (32.54 mm.); model M35G (37-bar), $1\frac{17}{64}$" (36.12 mm.); models M418G and M45G (23-bar and 37-bar), $1\frac{17}{32}$" (38.89 mm.).

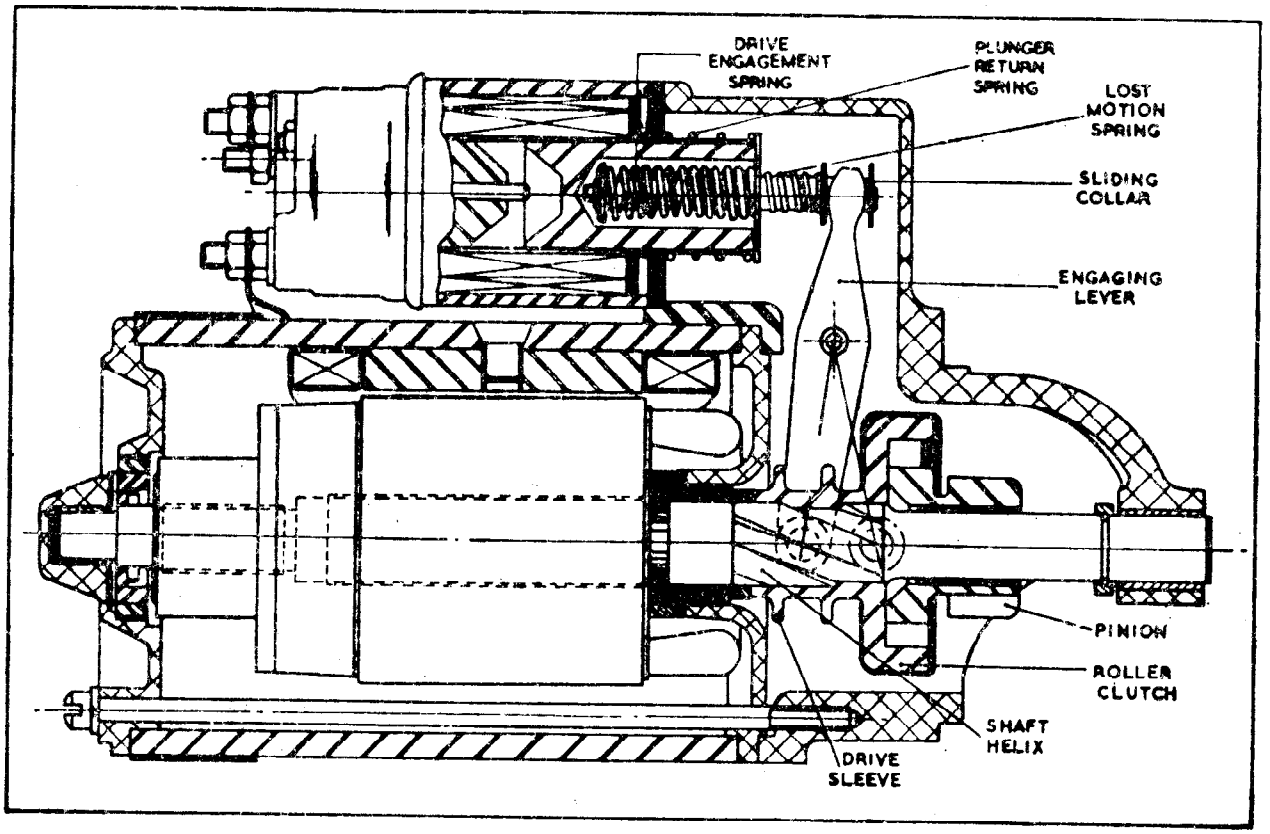


Fig. 2
Starting motor model M45G, with roller clutch drive model 9SD and actuating solenoid model 7S, showing drive engagement spring in solenoid plunger

(f) BRUSHGEAR DATA

The following information supersedes that tabulated in SECTION B–5 Issue 2 page 7 para. 2(b):

| Model | *Number of Armature Slots* | *Engine Application* | *Minimum Spring Pressure on New Brush* | *Length of Brush when half the available wearing length has worn away** |
|---|---|---|---|---|
| M3 | 23 | Petrol | 34 oz. (0.96 kg.) | $\frac{13}{32}$" (10.3 mm.) |
| M325 | 29 | Petrol | 38 oz. (1.08 kg.) | $\frac{13}{32}$" (10.3 mm.) |
| | 33 | | | |
| M35G | 29† | Petrol | 34 oz. (0.96 kg.) | $\frac{13}{32}$" (10.3 mm.) |
| | 37 | Petrol | 38 oz. (1.08 kg.) | $\frac{7}{16}$" (11.1 mm.) |
| M418G, M45G | 37† | Petrol | 32 oz. (0.91 kg.) | $\frac{13}{32}$" (10.3 mm.) |
| M418G, M45G | 23 | Diesel | 42 oz. (1.19 kg.) | $\frac{9}{16}$" (14.3 mm.) |

*See Footnote to superseded table.

†Applicable also to Inertia drive versions described in SECTION B–2, Issue 2, July 1955.

(g) TEST DATA (SECTION B–5 Issue 2 Page 8)

(i) *Pinion Clearance*

The standard clearance limits between pinion and thrust collar, washer or jump ring in the fully engaged drive position (see table, column 2) have been increased from 0.005"–0.010" (0.127–0.254 mm.) to 0.005"–0.015" (0.127–0.381 mm.). Both windings must be energised on 6 volts, either with copper link in place or, as in paragraph (j), removed.

(ii) *Other Modifications and Additions to Table on Page 8*

| Model | M418G | M45G | M45G | M45G |
|---|---|---|---|---|
| Number of armature slots | 37 | 23 | 37 | 37 |
| Yoke length | 6½" (155.6 mm.) | 6½" (158.8 mm.) | 5 13/16" (133.0 mm.) | 6½" (158.8 mm.) |
| Voltage to be applied to solenoid shunt and series windings when checking pinion clearance | 6 | 6 | 6 | 6 |
| Typical lock torque : | | | | |
| Lb.-ft. | 14.8 | 26.0 | 13.9 | 22.6 |
| Kg.-m. | 2.05 | 3.6 | 1.94 | 3.13 |
| Amp. | 386 | 800 | 430 | 465 |
| Volts | 6.6 | 5.6 | 6.0 | 7.6 |
| Typical 1000 rev./min. torque : | | | | |
| Lb.-ft. | 6.8 | 13.5 | 7.2 | 9.6 |
| Kg.-m. | 0.94 | 1.87 | 0.99 | 1.33 |
| Amp. | 245 | 500 | 285 | 240 |
| Volts | 9.2 | 8.0 | 8.0 | 9.7 |
| Typical light running speed and current : | | | | |
| Rev./min. | 5800–6500 | 5000–6000 | 5000–6000 | 5800–6500 |
| Amp. | 70 | 100 | 65 | 70 |
| Voltage to be applied to solenoid shunt and series windings when checking starter switch operation | 6.0 | 10.0 | 10.0 | 10.0 |

(iii) *Starter Solenoids* (table page 9)

In addition to Part No. 76705 (See Footnote[2] to above table), the following starter solenoids with uprated windings have been added to the Design Specifications: 76721–29–30–45 and 46. The winding resistances of all uprated starter solenoid coils are now:—Closing or series winding, 0.27–0.33 ohm; Hold-on or shunt winding, 1.0–1.2 ohm.

(iv) *Test Data for Starter Solenoid, Model 7S*

| | |
|---|---|
| Resistance of closing or series winding | 0.144–0.166 ohm |
| Resistance of hold-on or shunt winding | 0.688–0.792 ohm |
| Force required to close contacts with plunger return spring removed | 4–10 lb. (1.81–4.54 kg.) |
| Force required to push plunger fully home with plunger return spring removed | 10–19 lb. (4.54–8.62 kg.) |
| Spindle movement to close contacts | 0.116"–0.189" (2.9–4.8 mm.) |
| Total spindle movement (inclusive of contact 'follow-through') | 0.152"–0.299" (3.9–7.6 mm.) |

| | |
|---|---|
| Maximum voltage drop measured across starter switch contacts, with hold-on winding energised at 10 volts | 300 mV. at 600 A. |
| Tightening torques : | |
| Nuts on copper main terminals ... ... | 20 lb.-in. (0.23 kg.-m.) |
| Solenoid fixing bolts ... ... ... ... | 4.5 lb.-ft. (0.62 kg.-m.) |

(v) *Contact Replacement* (Model 7S only)

The contact arrangement in Starter Solenoid, model 7S, consists of two fixed contacts, integral with the copper main terminals, and a copper disc moving contact. An exploded view is shown in Fig. 3. Fixed and moving contacts must be renewed together.

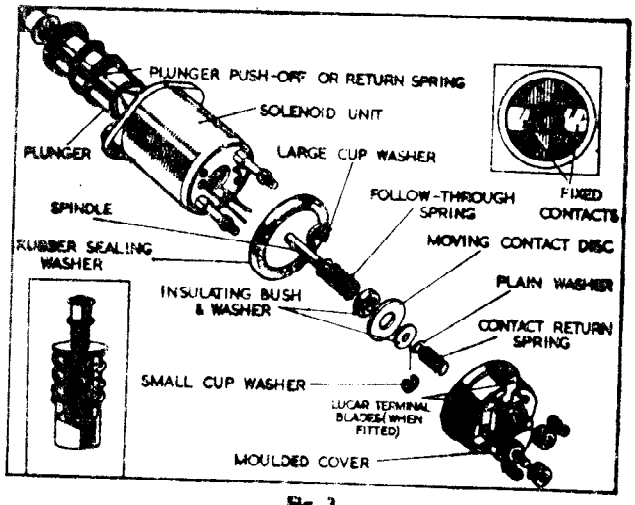


Fig. 3
Drive actuating solenoid, dismantled, with (inset, upper right) underside view of moulded cover and (inset, lower left) sectional view of plunger showing built-in drive engagement spring

The fixed contact replacement set comprises a moulded cover and terminal assembly, gasket, plain and lock washers, cover securing nuts and (for use if required) a terminal screw. The moving contact replacement set comprises contact disc, washers insulating, plain and cup, and contact return spring.

Access to the contacts is gained by removing the two moulded cover securing nuts, unsoldering the ends of the windings from the terminal strips and withdrawing the moulded cover.

Withdraw from the spindle the contact return spring, plain washer, small cup washer, insulating washer and contact disc. Discard these items.

Fit the replacement items to the spindle in the reverse order to that of withdrawal.

**N.B.** It is important that the moving contact disc is fitted on to the spindle and bush with its smoother side toward the fixed contact to form the contacting surface.

Check that the moulded cover fixing posts are securely screwed into the solenoid body.

Fit the replacement gasket to the solenoid body.

Fit the replacement moulded cover and terminal assembly, carefully threading the ends of the windings through the holes in the terminal strips.

Fit and tighten the cover securing washers and nuts.

Resolder the ends of the windings to the terminal strips.

When applicable, re-fit any Lucar terminal blades in their former positions.

(h) PRINTING ERROR (SECTION B–5 Issue 2 Page 10 Para. 4(a) (v) )

Line 5 should read ". . . the endwise manufacturing tolerances of the . . ." not ". . . the endwise manufacturing and tolerances of the . . .".

(j) CHECKING OPENING AND CLOSING OF STARTER SWITCH CONTACTS

When carrying out the above test, as given in SECTION B–5 Issue 2 page 11 para. 4(c) (i), it is usually necessary to energise both the series and the shunt windings. The period of energisation should be as brief as possible to avoid overheating of the series winding.
After removing the copper link (to prevent rotation of the starting motor armature), terminal 'STA' must be connected to earth and the test voltage (as given in the table page 8 column 7) applied between the solenoid small unmarked terminal and earth.