SERVICING

MAINTENANCE

Routine maintenance is not necessary. An occasional check should be made to ensure that connections are tight and that the unit is secure.

TEST PROCEDURES

To Test in Position

If the starter motor does not operate, or fails to crank the engine when the starter switch is actuated, switch on the headlamps (or connect a moving coil 0/20 voltmeter between the battery terminals) and again use the starter switch and observe the following symptons.

1. The lamps dim (or the voltmeter reading falls appreciably), but the motor does not crank the engine.

(a) Check, by hand cranking, that the engine is not abnormally stiff.

(b) If the motor is not heard to operate, but the symptons above exist, this indicates that the current is flowing through the motor windings but the armature is not rotating, possibly due to a seized armature shaft.

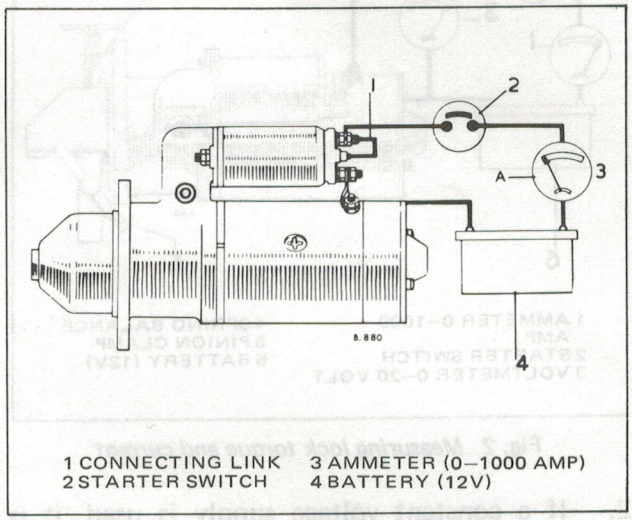
(c) Uncertain action of the starter motor may be due to a discharged battery. Check by disconnecting the existing cables and re-connecting the motor to a battery known to be fully charged. If the starter motor now gives normal cranking of the engine, the vehicle battery must be examined. Uncertain or slow action may also be traced to a loose terminal connection in the wiring circuit.

2. The lamps do not dim (or the voltmeter reading remains unaffected) and the motor does not crank the engine.

(a) Check the starter circuit for continuity, by means of a voltmeter or a battery voltage test lamp, up to the field terminal on the motor. Check the starter switch feed to the solenoid.

(b) If the solenoid unit is suspect, check on removal from the starter drive end bracket, as detailed under 'Solenoid Unit".

(c) When the motor is heard to operate but does not crank the engine, damage to the drive assembly is indicated. Remove the starter motor for examination.



1 CONNECTING LINK
2 STARTER SWITCH
3 AMMETER (0—1000 AMP)
4 BATTERY (12V)

Fig. 1 *Measuring light running current*

Testing on the Bench

Measuring the Light Running Current

1. Secure the starter motor in a vice then connect the motor in series with the starter motor switch, an ammeter and a 12 volt battery (see Fig. 1). Do not use small gauge cables as they are liable to burn out. A fixing lug on the drive end bracket is a suitable earth point on the starter motor.

2. Operate the switch and check the speed of the armature rotation, using a tachometer, and observe the reading given by the ammeter. Compare the starter motor performance against the figures given under "DATA" at the beginning of the section.

3. Whilst the motor is running at speed, check for excessive sparking at the commutator and for undue brush movement. If faulty brush action is observed, check the brush gear as detailed under "Inspection and Overhaul".

Measuring the Lock Torque and Lock Current

1. With the starter motor still secured in the vice and connected in series with the starter switch, ammeter and battery, connect a voltmeter

between the motor terminals and yoke (see Fig. 3) clamp an arm to the driving pinion and to the free end of the arm attach a spring scale (see Fig. 4).

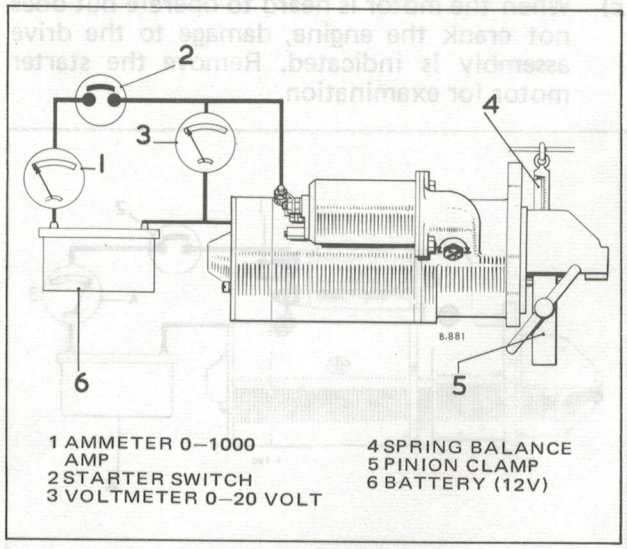


Fig. 2 *Measuring lock torque and current*

2. If a constant voltage supply is used, it is important to adjust this to 6.4 volts at the starter terminal when testing.

3. Operate the switch and note the current consumption, the voltage and the spring scale reading. Compare the starter motor performance with the figures given under "DATA" at the beginning of the section.

NOTE: To calculate the lock torque, multiply the reading on the spring scale in pounds, by the length of the arm, in feet.

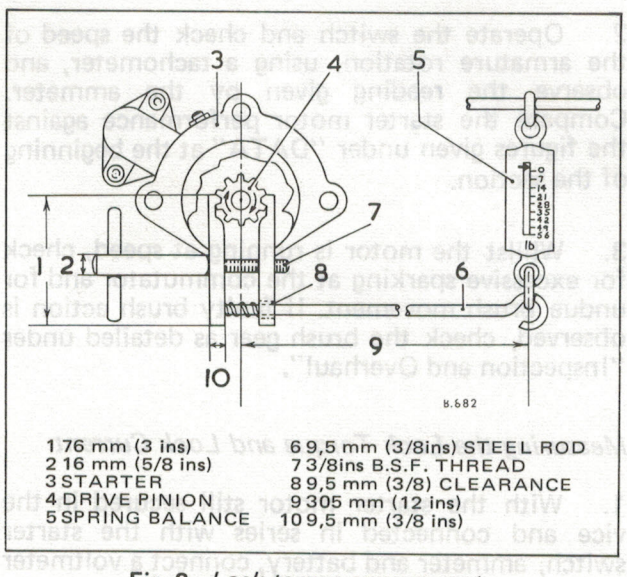


Fig. 3 *Lock torque arrangement*

OVERHAUL

To Dismantle (see Fig. 7)

1. Disconnect the copper link between the lower solenoid terminal and the starter motor field terminal on the yoke.

2. Remove the solenoid unit securing bolts. Withdraw the solenoid from the drive end bracket casting, carefully disengaging the solenoid plunger from the starter driving engagement lever.

3. Remove the cover band, hold back the brush springs and lift the brushes from their holders.

4. Unscrew and withdraw the two through bolts from the commutator end bracket. The commutator end bracket and yoke can now be removed from the intermediate and drive end brackets.

5. Extract the rubber seal from the drive end bracket.

6. Remove the nut securing the eccentric pin, on which the starter drive engagement lever pivots, and unscrew the pin.

7. Separate the drive end bracket from the armature and intermediate bracket assembly.

8. Remove the washer from the end of the armature shaft extension, and slide the drive assembly and engagement lever off the shaft. For information concerning dismantling and overhauling the drive assembly refer to "SELF-INDEXING CLUTCH DRIVE ASSEMBLY".

9. Remove the intermediate bracket retaining ring from the armature shaft extension, and slide the bracket and brake assembly off the shaft.

Inspection and Overhaul

The procedure given in respect of the brush gear and the commutator should be carried out at regular intervals, after removing and dismantling the motor as detailed previously. During this operation opportunity should be taken to lubricate the pinion sleeve indented bearings using Shell Retinax "DX" and the indented bronze bearing in the intermediate bracket using Shell Retinax "AM".

Keep all electrical contacts clean and tight. Any terminals that have become dirty must be cleaned and the contacting surfaces lightly smeared with petroleum jelly.

Check for the correct operation of the drive assembly.

Brush Gear

Pull back the brush spring and check the brushes for free movement in their boxes. If the brushes tend to stick, remove them from their boxes and clean with a petrol moistened lintless rag. If necessary polish the sides with a smooth file. If the overall length of the brushes is worn to, or approaching 7.9mm (5/16 in.) in length they must be renewed.

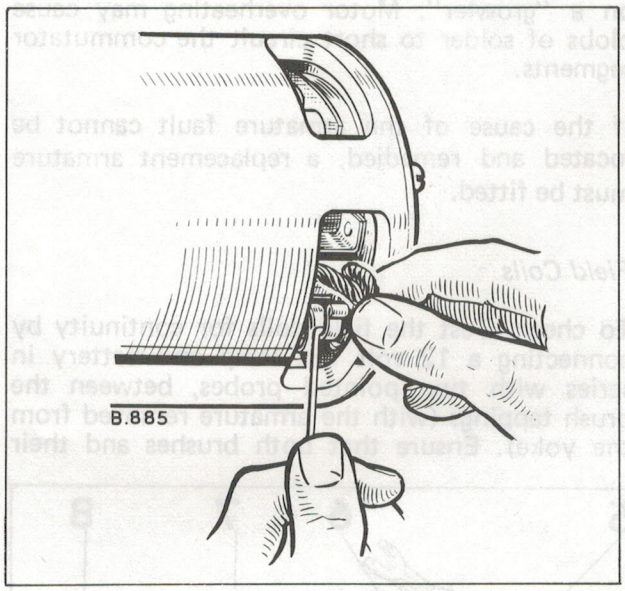


Fig. 4 *Removing brushes*

Two of the brushes are connected to terminal tags on the brush boxes and the other two are connected to the free ends of the field coils. Unsolder the flexible connectors and solder the connectors of the new brushes in their place. All new brushes are preformed so that "Bedding" them into the commutator is unnecessary. Check that the new brushes can move freely in their respective boxes.

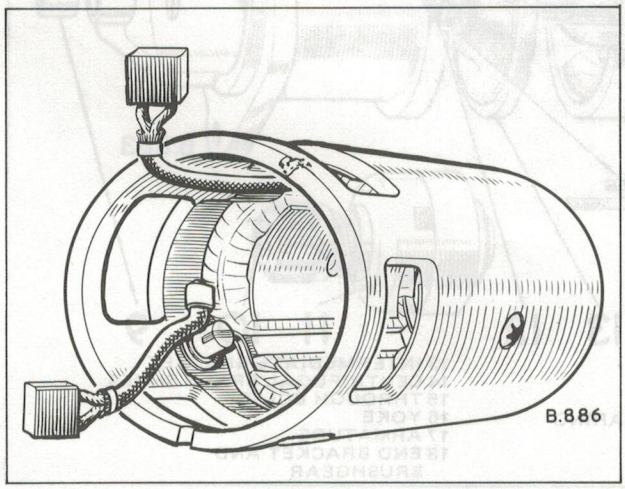


Fig. 5 *Brush connections to field coils*

Test the brush spring tension using a spring balance held radially to the commutator. The correct tension is 851/1135 grm., (30/40 oz.) renew the spring if the tension is low.

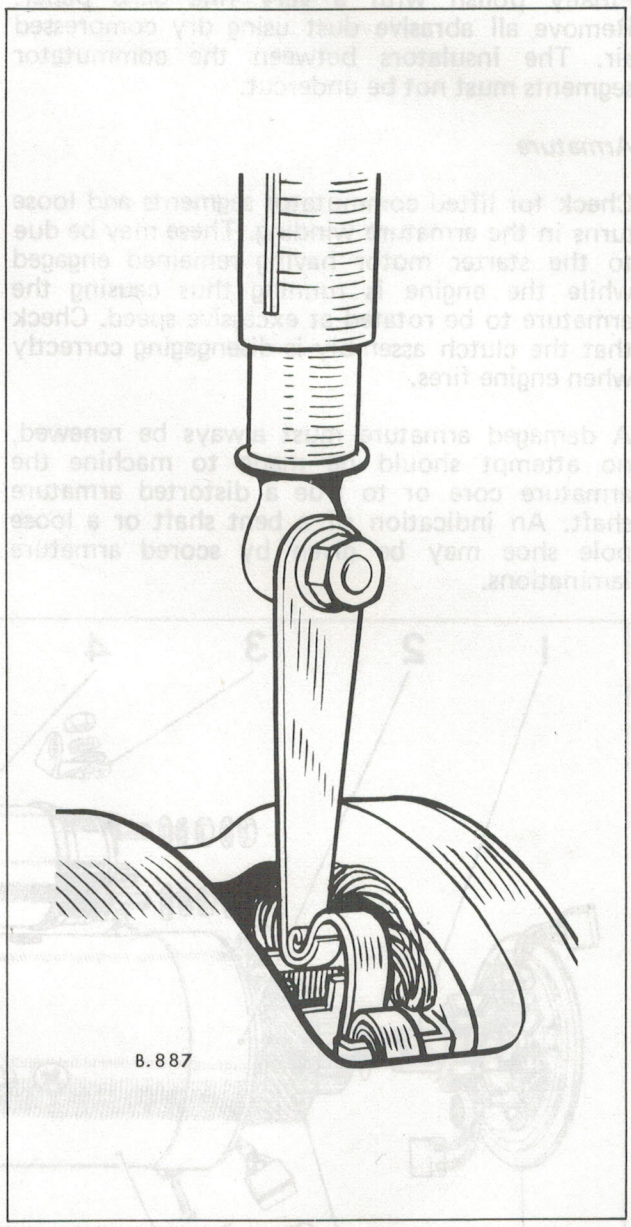


Fig. 6 *Checking brush spring tension*

Commutator

A commutator in good condition will be burnished and free from pits and burn spots. Clean the commutator with a petrol moistened lintless cloth. If this is ineffective, spin the armature and carefully polish the commutator with a strip of fine glass paper. Never use emery cloth. Remove all abrasive dust with dry compressed air.

If the commutator is badly worn mount the armature between centres in a lathe, rotate at high speed and take a light cut with a very sharp tool. See "DATA" for minimum diameter. Do not remove more metal than is necessary. Finally polish with a very fine glass paper. Remove all abrasive dust using dry compressed air. The insulators between the commutator segments must not be undercut.

Armature

Check for lifted commutator segments and loose turns in the armature winding. These may be due to the starter motor having remained engaged while the engine is running thus causing the armature to be rotated at excessive speed. Check that the clutch assembly is disengaging correctly when engine fires.

A damaged armature must always be renewed, no attempt should be made to machine the armature core or to true a distorted armature shaft. An indication of a bent shaft or a loose pole shoe may be given by scored armature laminations.

To check the armature insulation, use an ohmmeter, or a 110 volt A. C. test lamp. A high reading should be given on the meter when connected between the armature shaft and the commutator segments. If a test lamp is used it must not light when connected as above. Faulty insulation will be indicated by a low ohmic reading, or by lighting of the test lamp.

If a short circuit is suspected, check the armature on a "growler". Motor overheating may cause blobs of solder to short circuit the commutator segments.

If the cause of the armature fault cannot be located and remedied, a replacement armature must be fitted.

Field Coils

To check. Test the field coils for continuity by connecting a 12 volt test lamp and battery in series with two pointed probes, between the brush tappings (with the armature removed from the yoke). Ensure that both brushes and their

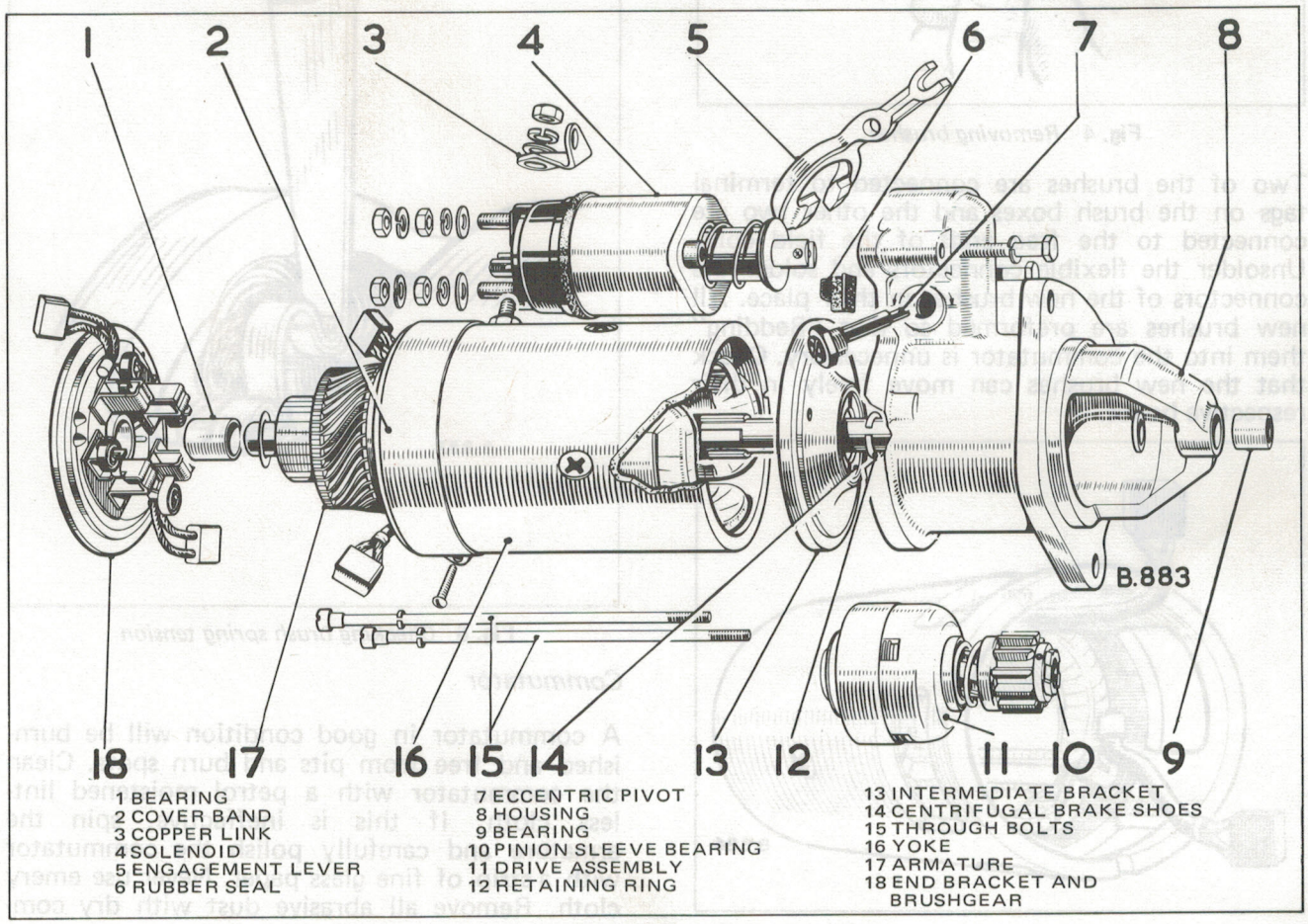


Fig. 7 *Exploded view of starter.*

flexible connectors are clear of the yoke. If the lamp does not light, an open circuit in the field coils is indicated and the defective coils must be renewed.

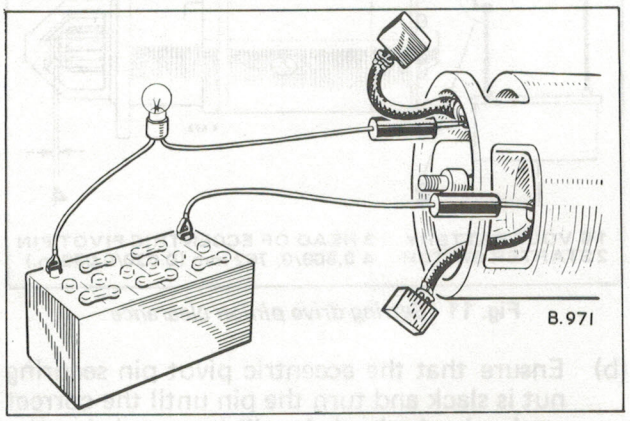


Fig. 8 *Field coil continuity test*

Lighting of the test lamp does not necessarily indicate that the field coils are in order. It is possible that the field coils may be earthed to a pole shoe, or to the yoke. This may be checked by connecting an ohm-meter or a 110 volt A.C. test lamp between the terminal posts and a clean part of the yoke. The test lamp lighting or a low ohmic reading indicates that the field coils are earthed to the yoke and must be renewed.

In either case, unless a replacement starter motor is available, the field coils must be renewed.

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

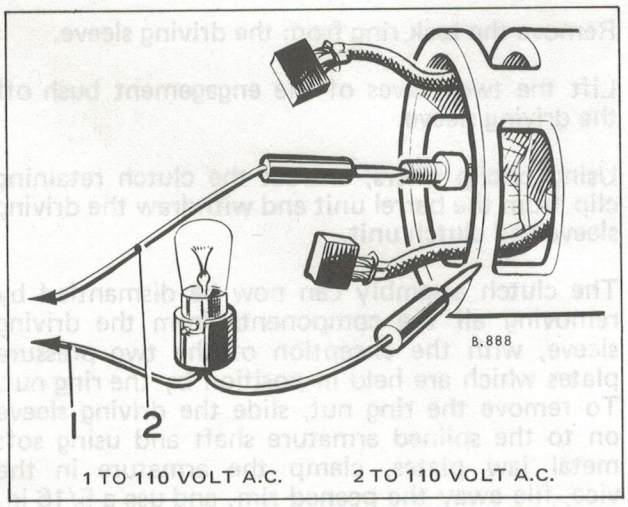


Fig. 9 *Field coil insulation test*

To renew, carry out the following procedure, using a wheel operated screwdriver.

(a) Mark the yoke and pole shoes in order that they can be refitted in the original position.

(b) Unscrew the four pole shoe retaining screws using a wheel operated screwdriver.

(c) Remove the insulation piece which is fitted to prevent the inter-coil connectors from contacting with the yoke.

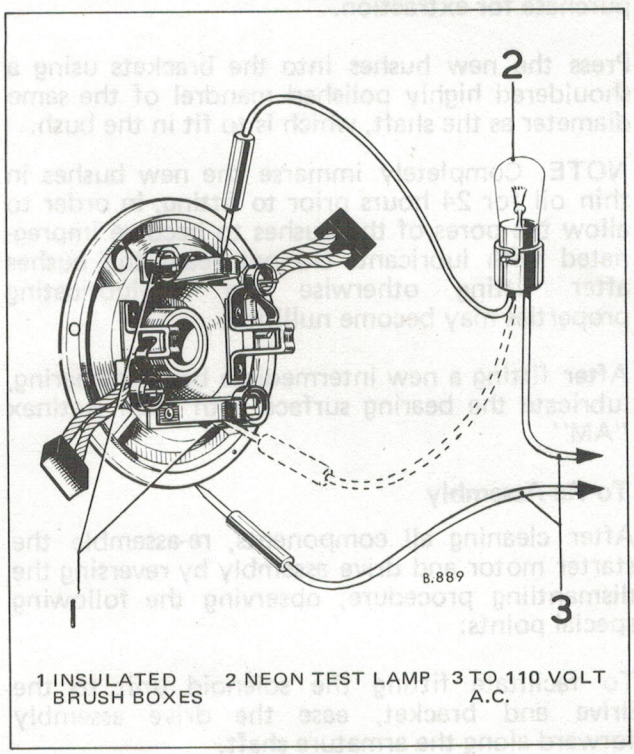


Fig. 10 *Brush box insulation test*

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

(e) Fit the new field coils over the pole shoes and place them in position inside the yoke. Ensure that the tapping of the field coils is not trapped between the pole shoes and the yoke.

(f) Locate the pole shoes and field coils by lightly tightening the retaining screws.

(g) Refit the insulating piece between the field coil connections and the yoke.

(h) Finally tighten the screws by means of the wheel operated screwdriver.

Bearings

The starter motor is fitted with porous bronze bushes in the commutator and drive end brackets, and an indented bronze bearing in the intermediate bracket. Bushes which are worn to such an extent that they will allow side movement of the armature shaft must be renewed.

The bushes in the intermediate and drive end brackets may be pressed out, whilst that in the commutator end bracket is best removed by inserting a 17.46mm (11/16 in.) tap squarely into the bush for a few turns to provide a purchase for extraction.

Press the new bushes into the brackets using a shouldered highly polished mandrel of the same diameter as the shaft, which is to fit in the bush.

NOTE: Completely immerse the new bushes in thin oil for 24 hours prior to fitting, in order to allow the pores of the bushes to become impregnated with lubricant. Do not ream the bushes after fitting otherwise the self-lubricating properties may become nullified.

After fitting a new intermediate bracket bearing, lubricate the bearing surface with Shell Retinax "AM"

To Re-Assembly

After cleaning all components, re-assemble the starter motor and drive assembly by reversing the dismantling procedure, observing the following special points:

To facilitate fitting the solenoid unit to the drive end bracket, ease the drive assembly forward along the armature shaft.

Set the pinion movement before tightening the eccentric pivot pin securing nut as detailed in the following paragraphs.

(a) After complete assembly of the starter motor, connect the small centre terminal on the solenoid unit by way of a switch to a 6 volt battery (see Fig. 11). Connect the other terminal of the battery to one of the solenoid fixing bolts and then close the switch (this throws the drive assembly forward into the engaged position). With the drive assembly in this position measure the distance between the pinion and the washer on the armature shaft extension. Make this measurement with the pinion pressed lightly back towards the armature to take up any slack in the engagement linkage. For the setting to be correct this distance should be 0.508/0.762 mm (0.020/0.030 in.)

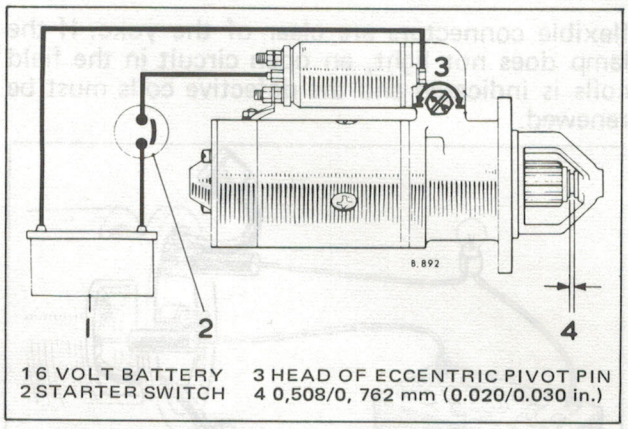


Fig. 11 *Setting drive pinion clearance*

(b) Ensure that the eccentric pivot pin securing nut is slack and turn the pin until the correct setting is obtained. It will be noted that the arc of adjustment is 180° and the head of the arrow marked on the pivot pin (see Fig. 11), should be set only between the arrow heads on the drive end bracket casing. After setting, tighten the securing nut to retain the pin in position.

NOTE: In the event of a replacement motor or drive end bracket being fitted, check the out-of-mesh clearance when assembling the starter motor to the engine. This should be 3.175 mm (1/8 in.) between the leading edge of the pinion and the flywheel starter ring with a 0.794 mm (1/32 in.) tolerance each way.

SELF-INDEXING CLUTCH DRIVE

To Dismantle (see Fig. 12)

It is assumed that the starter motor is dismantled and the drive assembly has been withdrawn from the armature shaft.

Remove the lock ring from the driving sleeve.

Lift the two halves of the engagement bush off the driving sleeve.

Using circlip pliers, extract the clutch retaining clip from the barrel unit and withdraw the driving sleeve and clutch unit.

The clutch assembly can now be dismantled by removing all the components from the driving sleeve, with the exception of the two pressure plates which are held in position by the ring nut. To remove the ring nut, slide the driving sleeve on to the splined armature shaft and using soft metal jaw plates, clamp the armature in the vice, file away the peened rim, and use a 5/16 in. A.F. spanner to remove the nut.

To remove the pinion from the helical splined sleeve, knock out the rivet that holds the pinion retaining ring. The retaining ring, pinion, cushion spring with the cup washers and the sleeve can now be separated.

Inspection and Overhaul

Examine the teeth of the pinion for wear or damage and renew if necessary.

The correct spring-tension is 4.99 kg (11 lb.) measured with spring compressed to 22.2 mm (7/8 in.) in length and 7.25 kg. (16 lb.) when it is compressed to 12.70 mm (½ in.) in length.

To Re-Assemble

Re-assemble the driving assembly in a reverse manner to that described for dismantling, noting the following:

Always use a new ring nut and peen the rim over the notch in the driving sleeve to lock the nut in position.

Check the slipping torque of the clutch, bearing in mind the points outlined below.

(a) Fit the drive assembly on the armature shaft and clamp the armature between soft metal jaw plates in a vice.

(b) Apply an anti-clockwise torque to the pinion with a suitable torque wrench secured to the pinion teeth. The clutch should slip between 89,48/107,11 Nm (66.66/79.16 lb. ft.).

(c) If the clutch slips at too low a torque figure dismantle again by withdrawing the circlip and add shims, one at a time, until the correct figure is obtained.

(d) If the clutch does not slip between the torque limits given again dismantle, by withdrawing the circlip, and remove the shims, one at a time, until the correct figure is obtained. The correct adjusting shims are:

Lucas Part No.	Thickness
291374	0.152 mm (0.006 in.)
291378	0.127 mm (0.005 in.)
291379	0.101 mm (0.004 in.)

When assembled to the armature shaft, the driving assembly and lever mechanism must be capable of being pushed to the full extent of the set travel along the armature shaft extension, smoothly and freely, but without slackness.

Before fitting the drive assembly to the armature shaft, lightly smear the shaft and pack the space between the indented bearings inside the pinion sleeve with Shell Retinax "DX".

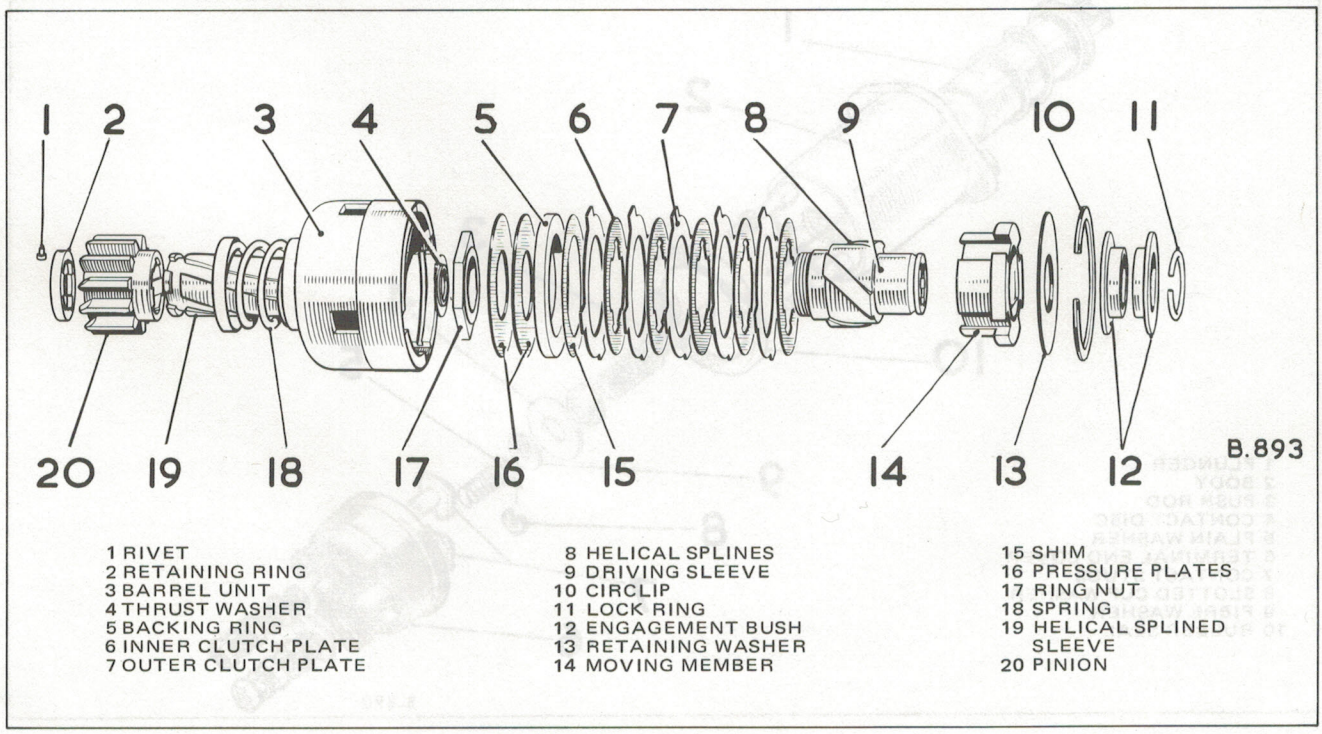


Fig. 12 *Exploded view of self indexing clutch*

SOLENOID

The solenoid unit contains two coils, a closing coil which is by-passed when the plunger is drawn fully home and a hold-on coil to retain the plunger in the "fully home" position.

To check the individual coils, remove any existing external connection and, using a constant voltage 4 volt D.C. supply with cables of adequate size, proceed as follows:

(a) Closing Coil. Connect the supply between the solenoid large terminal marked "STA" and the small centre terminal. This should cause a curent of 24/28 amp. to pass.

(b) Hold-on Coil. Using the 0–10 ammeter connect the supply between the solenoid body and the small centre terminal. This should cause a current of 5.1/5.8 amp to pass.

NOTE: Do not carry out these tests while the solenoid unit is hot.

If a constant voltage supply is not available, check the coil resistance using a Wheatstone Bridge, or some other accurate method of measuring resistance values. Connect the measuring instrument as for measuring current and compare the resistance with those given in paras. (a) and (b).

(a) Closing Coil Resistance 0.144/0.166 ohm.

(b) Hold-on Coil Resistance 0.68/0.792 ohm.

(c) Push rod movement to close contacts 2.946/4.800 mm (0.116/0.189 in.)

(d) Total push rod movement 6.680/6.934 mm (0.263/0.273 in.).

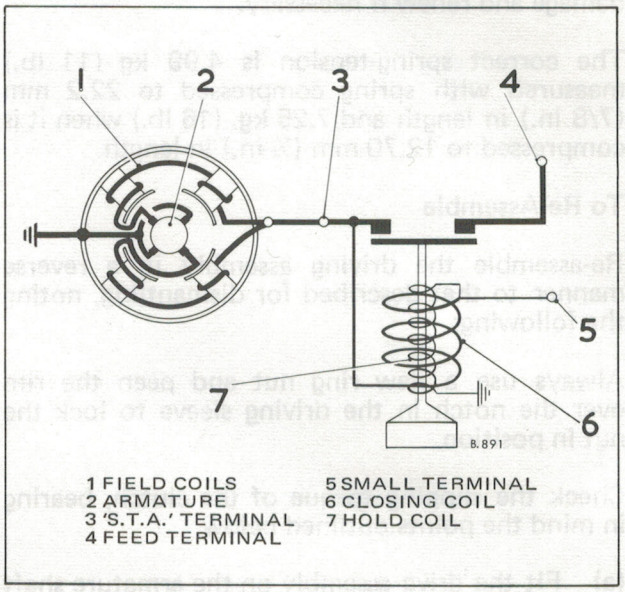


Fig. 13 *Solenoid circuit*

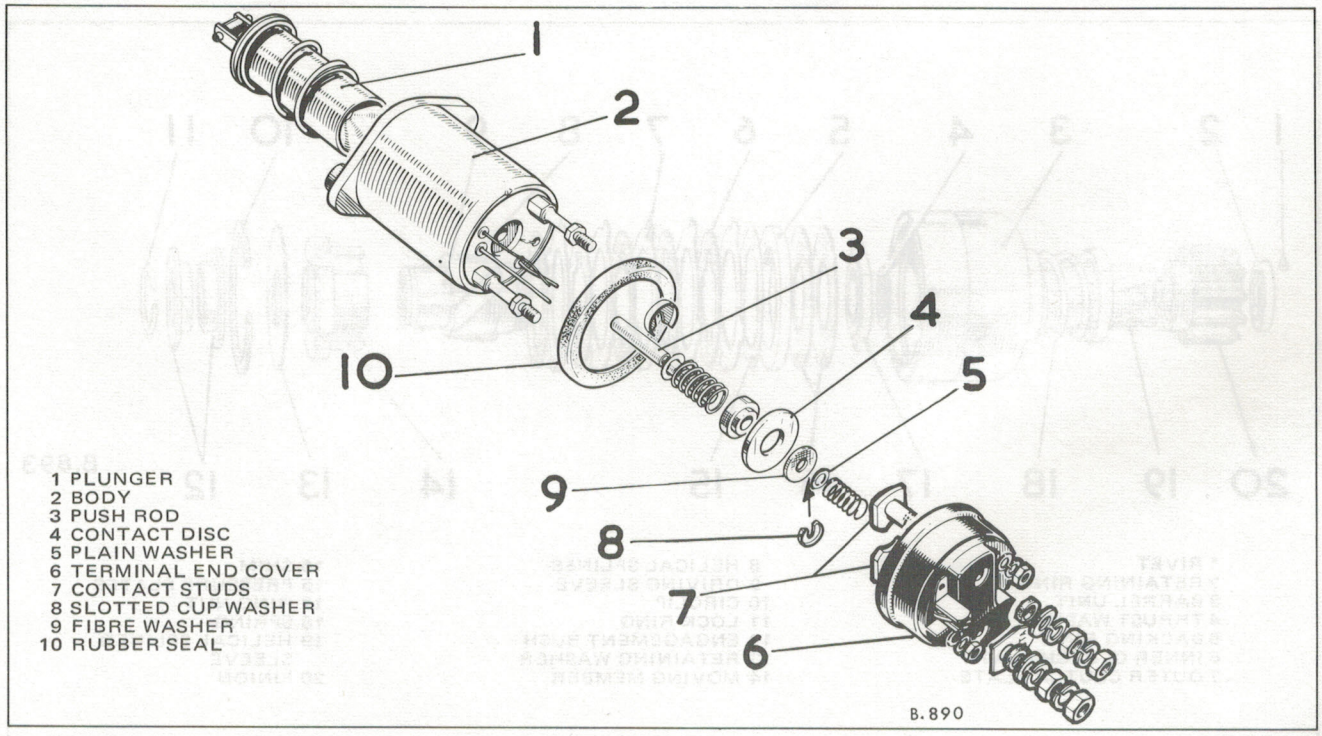


Fig. 14 *Exploded view of solenoid*

Check also the spring pressure and push rod travel with the following:

(a) Spring pressure to close contacts 1.81/3.17 kg. (4/7 lb.) with plunger return spring removed.

(b) Spring pressure to push plunger home 4.76/7.26 kg. (10.5/16 lb.) with plunger return spring removed.

Except for the fitting of replacement solenoid contacts, no attempt should be made to repair a faulty unit.

Contact Renewal. Renew the contacts as a complete set. Unscrew the two smaller nuts and washers on the moulded cover, and unsolder the wires attached to the terminal strips. Lift off the cover. Withdraw the push rod from the solenoid unit. Remove the small slotted spring cup from the push rod end, and withdraw the fibre washer and the moving contact disc complete with its adaptor from the push rod. Lift away the worn contact disc from the disc adaptor, and then fit the replacement disc so that the smoothest side will be the contacting face. Re-assemble the components to the push rod by reversing the dismantling procedure. Fit the rubber seal and moulded cover, carefully threading the wires through, and refit the two smaller nuts and washers.
Finally resolder the wires as necessary.

NOTE: When fitted, ensure that the terminal "Lucar" blade is refitted in its former position.