SERVICING

MAINTENANCE

Apart from keeping all connections clean and tight, no periodic attention is necessary.

TEST PROCEDURES

In Position

Test the battery to make sure it is in good condition, minimum specific gravity reading of 1,220, temperature corrected.

If the connections and battery are good, proceed as follows in checking the supply circuit.

Starter Current

Engine should be up to operating temperature. Extremely heavy oil or a tight engine will increase starter amperage draw.

Connect a reliable Battery-Starter Tester per instructions of its manufacturer.

Turn the variable resistor control knob tester to the off or zero position.

Connect a remote starter jumper per instructions of its manufacturer.

Crank the engine long enough to read the cranking voltage on voltmeter and note.

Caution: Do not crank engine excessively or the starter may overheat and damage will occur.

Without cranking the engine, turn the variable resistor control knob on the tester until the voltmeter reads the cranking voltage previously noted. When this point is reached you can read the starter current draw on the ammeter. Refer to "Data" for current draw limits.

Circuit Resistance

High resistance in the supply circuit wiring or connections will cause the starter motor to crank the engine at a slower rate than normal. These connections can be tested for high resistance with the use of a reliable voltmeter which will indicate tenths of a volt. Also, all tests are made without separating or disconnecting any connection. Voltmeter leads are to be connected across each of the connections shown in the Circuit Resistance Chart. While the engine is being cranked note the reading of the voltmeter. If any of the readings are higher than the specified limits there is high resistance in that connection and it must be cleaned or repaired. After doing so repeat test at the connection.

Control Circuit

The starter control circuit consists of the starter, solenoid, starter relay, ignition switch, and all their wiring connections. If any of these components malfunction no engine cranking will occur.

Testing procedures for these components are as follows and should be followed in order as described.

Caution: Before performing any test disconnect coil wire from distributor cap and secure to a good earth to prevent engine from starting.

Starter Solenoid

Connect a heavy jumper wire on the starter relay between the battery and solenoid terminals. If the engine cranks the starter solenoid is good. Proceed to the starter relay test.

If the engine does not crank, check the wiring and connectors from the relay to the starter for loose or corroded connections, particularly at the starter terminals. Repeat test and if the engine still fails to crank the trouble is within the starter and it must be removed for repairs.

Starter Relay (after starter solenoid test)

Connect a jumper wire on the starter relay between the battery and ignition terminals. If the engine cranks the starter relay is good.

If the engine does not crank connect a second jumper wire between the starter relay housing and to a good earth. Repeat test and if engine cranks the starter relay is good, however, there is a poor earth through the relay mounting bracket. If there is not a poor earth and engine still does not crank, the relay is defective and must be replaced.

Ignition Switch

After testing the starter solenoid and relay and they prove to be in good working order, the trouble is within the ignition switch or its wiring or connections. Check all connections for corrosion or for looseness.

Bench Tests

Free Running

Place starter in a vice and connect a fully charged 12 volt battery to starter as follows:

(a) Connect a test ammeter (100 amperes scale) and a carbon pile rheostat in series with battery positive post and starter terminal.

(b) Connect a voltmeter (15 volt scale) across starter.

(c) Rotate carbon pile to full-resistance position.

(d) Connect battery cable from battery negative post to starter frame.

(e) Adjust the rheostat until battery voltage shown on voltmeter reads 11 volts. Amperage draw should be as shown in "Data".

Locked Resistance

Install starter in a test bench.

Follow instructions of test equipment manufacturers and test starter against following specifications. With applied battery voltage adjusted to 4 volts amperage draw should be as shown in "Data".

OVERHAUL

To Dismantle

Remove through bolts and end head assembly, Fig. 1.

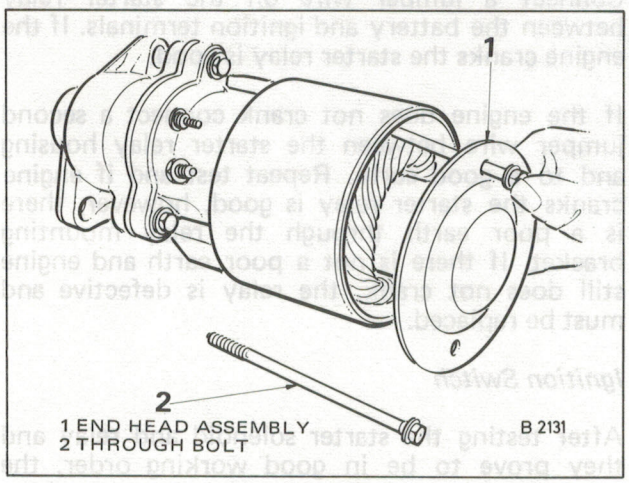


Fig. 1 *Removing through bolts*

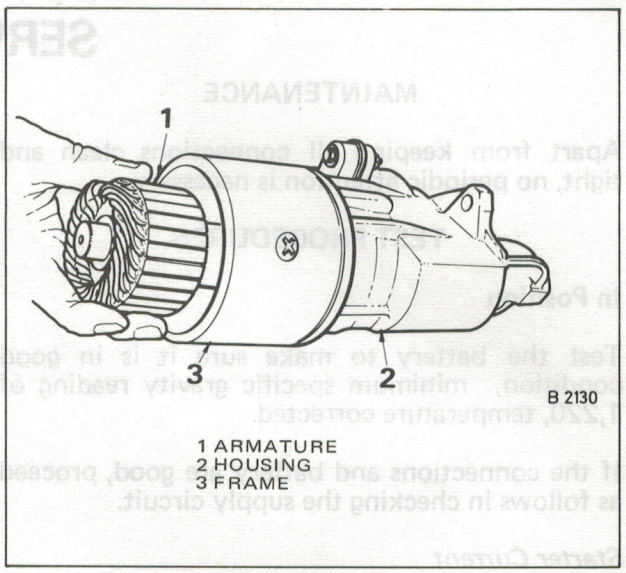


Fig. 2 *Removing armature*

Carefully remove armature from gear housing and field frame assembly, by pulling outwards (Fig. 2).

Carefully pull field frame assembly from gear housing far enough to expose terminal screw.

Remove terminal screw. It may be necessary to support terminal by placing finger behind it (Fig. 3).

Remove field frame assembly.

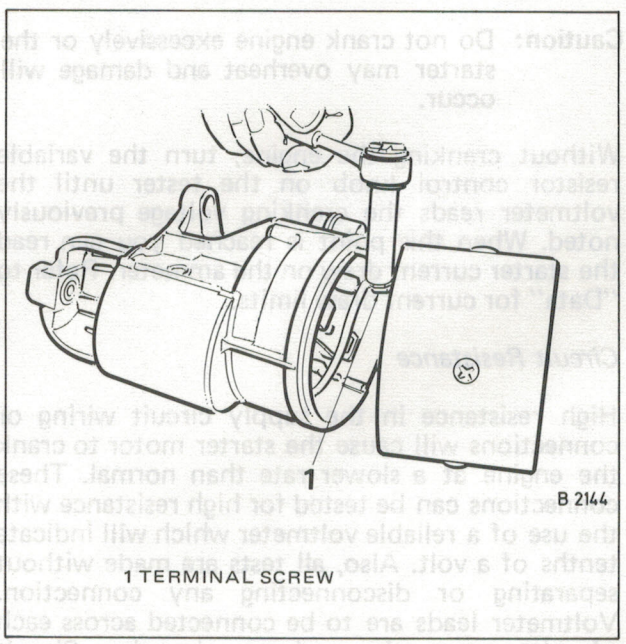
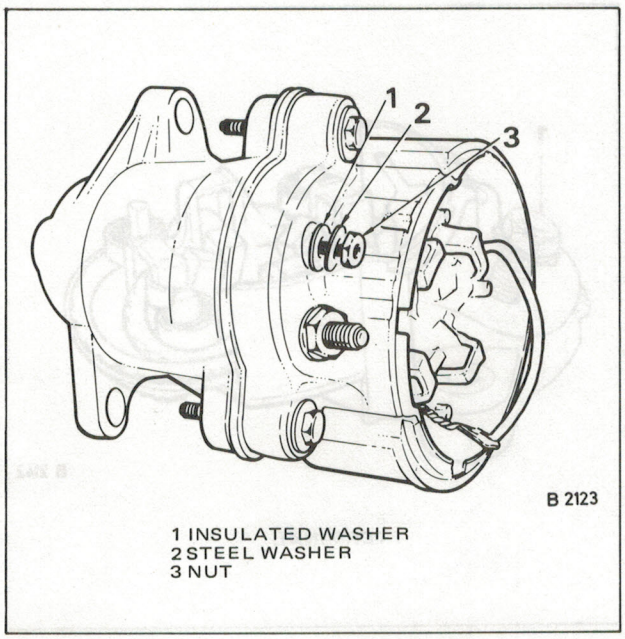


Fig. 3 *Remove terminal screw*



1 INSULATED WASHER
2 STEEL WASHER
3 NUT

Fig. 4 *Remove solenoid terminal nut*

Remove nut, steelwasher, and sealing washer from solenoid terminal (Fig. 4)

Unwind solenoid lead wire from brush terminal (Fig. 5)

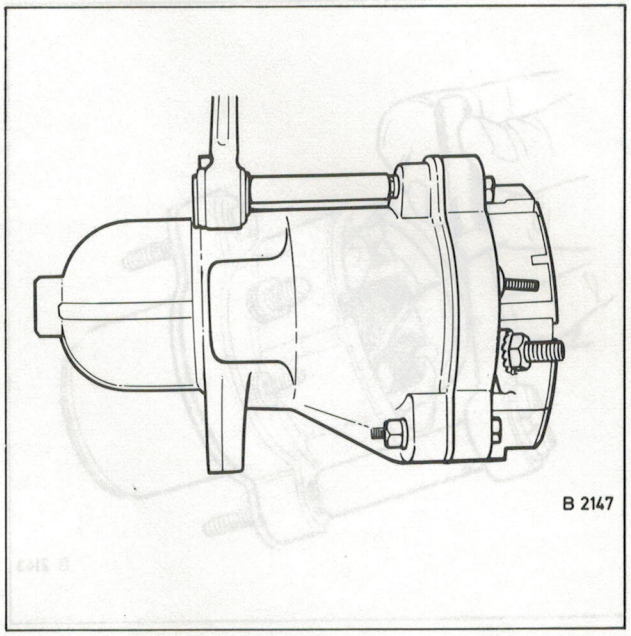
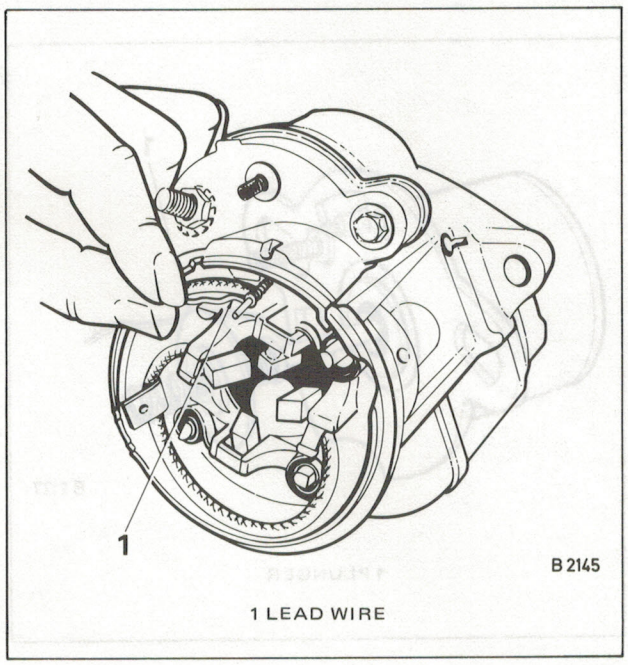


Fig. 6 *Remove solenoid and brush plate nuts*

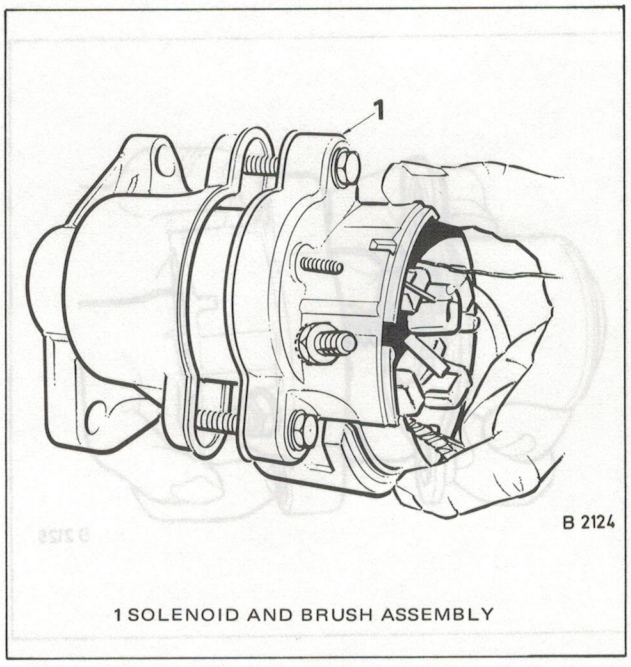
Remove nuts, attaching solenoid, and brush holder plate assembly to gear housing (Fig. 6).

Remove solenoid and brush plate assembly from gear housing (Fig. 7)



1 LEAD WIRE

Fig. 5 *Unwind solenoid lead*



1 SOLENOID AND BRUSH ASSEMBLY

Fig. 7 *Remove solenoid and brush plate assembly*

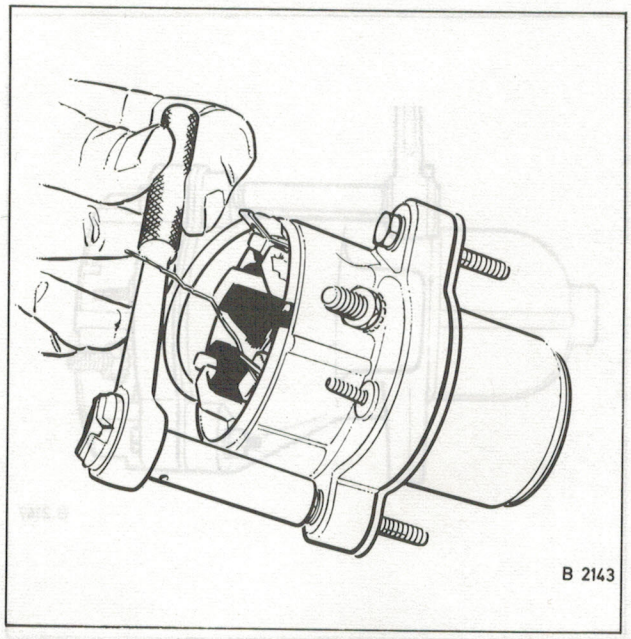


Fig. 8 *Remove solenoid fixing screws*

Remove screws attaching solenoid to brush plate (Fig. 8)

Remove solenoid from brush plate (Fig. 9)

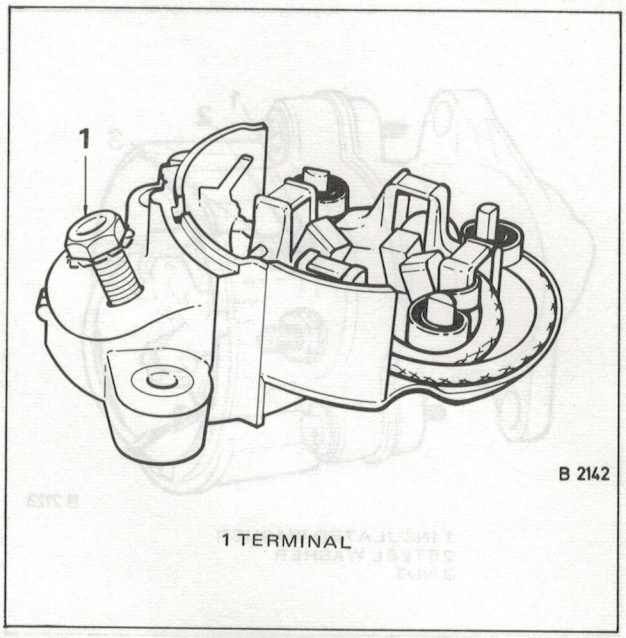


Fig. 10 *Remove battery terminal nut*

On brush plate remove nut from battery terminal and remove terminal (Fig. 10)

Remove solenoid contact and plunger assembly from solenoid (Fig. 11)

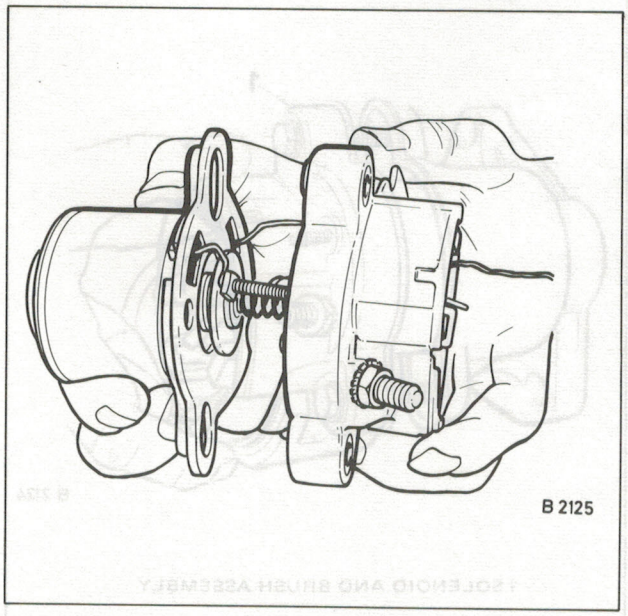


Fig. 9 *Remove solenoid*

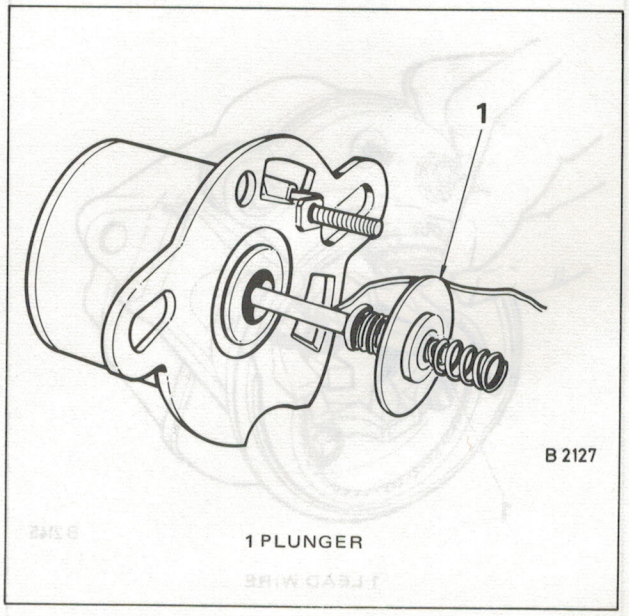


Fig. 11 *Remove contact and plunger*

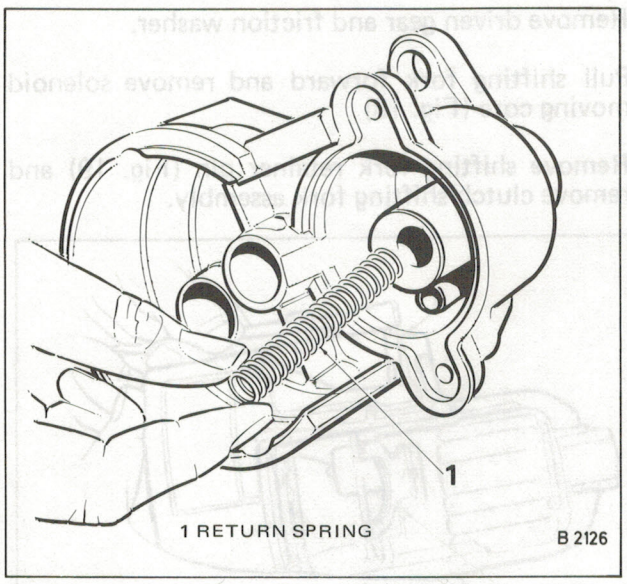


Fig. 12 *Remove return spring*

Remove return spring from inside of solenoid moving core (Fig. 12)

Remove dust cover from gear housing (Fig. 13)

Caution: Retainer is under tension and a cloth should be placed over the retainer to prevent it from springing away after removal.

Release retainer clip that positions driven gear on pinion shaft (Fig. 14)

Release retainer ring at front of pinion shaft (Fig. 15). Do not spread retainer ring more than outside diameter of pinion shaft otherwise lock ring can be damaged.

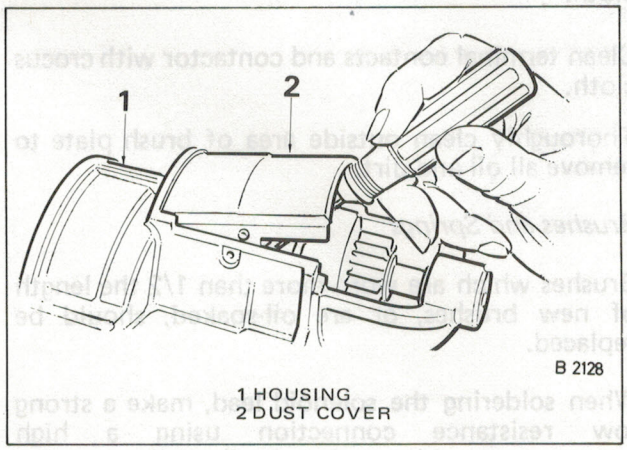


Fig. 13 *Remove dust cover*

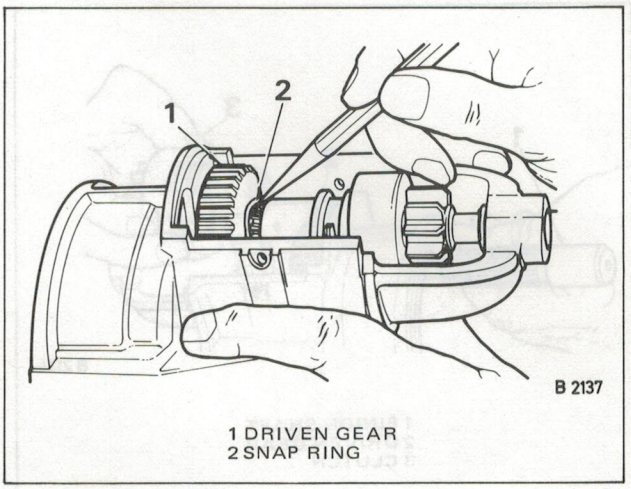


Fig. 14 *Remove snap ring*

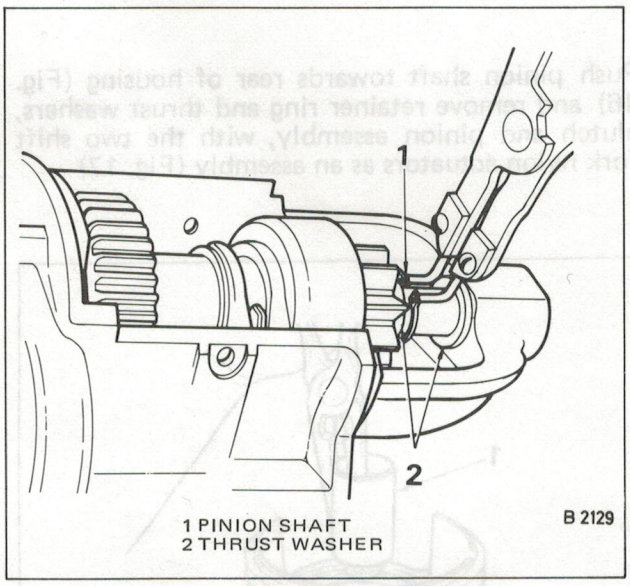


Fig. 15 *Remove pinion shaft retainer*

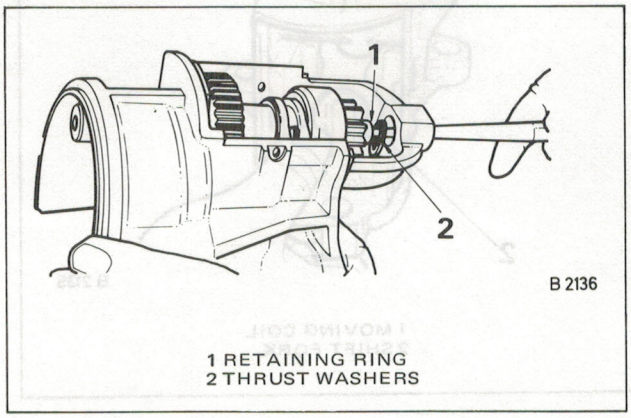


Fig. 16 *Remove pinion shaft*

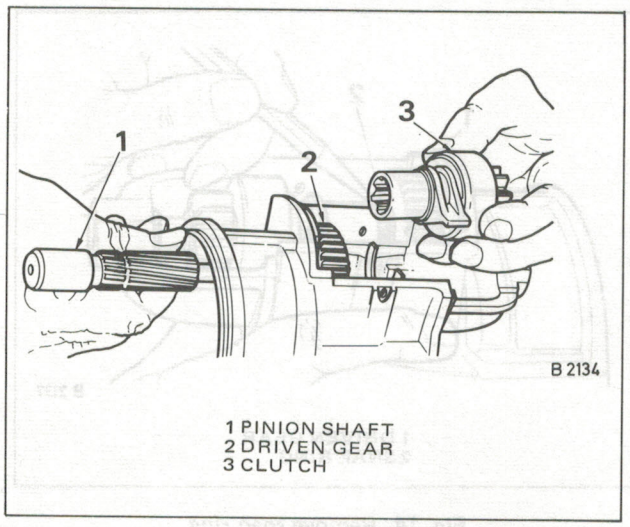


Fig. 17 *Remove clutch assembly*

Push pinion shaft towards rear of housing (Fig. 16) and remove retainer ring and thrust washers, clutch and pinion assembly, with the two shift fork nylon actuators as an assembly (Fig. 17)

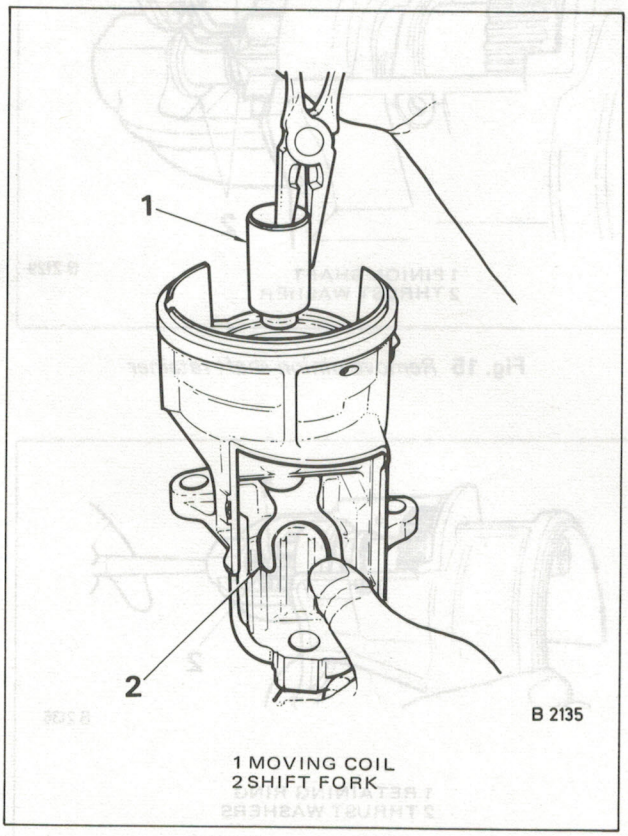


Fig. 18 *Remove solenoid core*

Remove driven gear and friction washer.

Pull shifting fork forward and remove solenoid moving core (Fig. 18)

Remove shifting fork retainer pin (Fig. 19) and remove clutch shifting fork assembly.

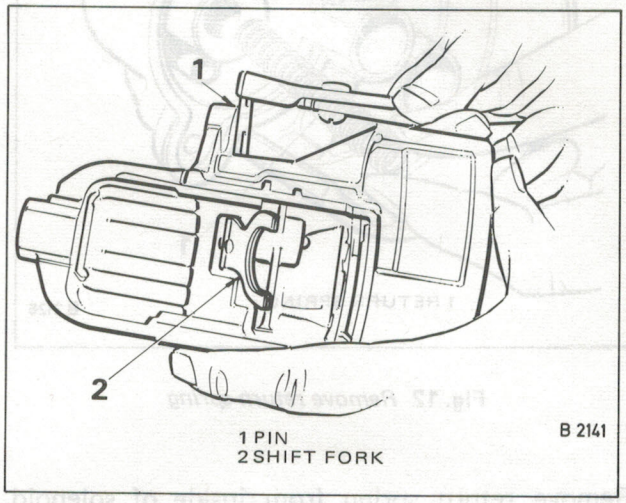


Fig. 19 *Remove shift fork pin*

Inspection and Overhaul

Do no immerse parts in cleaning solvent. Immersing field frame and coil assembly and/or armature will damage insulation. Wipe these parts with a clean dry cloth.

Do not immerse clutch unit in cleaning solvent. The clutch is pre-lubricated at the factory and solvent will wash lubricant from the clutch.

The starter clutch outer housing and pinion gear may be cleaned with a cloth moistened with cleaning solvent and wiped dry with a clean dry cloth.

Clean terminal contacts and contactor with crocus cloth.

Thoroughly clean outside area of brush plate to remove all oil and dirt.

Brushes and Springs

Brushes which are worn more than 1/2 the length of new brushes, or are oil-soaked, should be replaced.

When soldering the solenoid lead, make a strong low resistance connection using a high temperature solder and resin flux. Do not use acid or acid core solder.

Measure brush spring tension with a spring scale hooked under the spring near the end. Pull scale on a line parallel to the edge of brush and take a reading just as spring leaves brush. Spring tension should be 0,86/1,02kg (32/36 ounces). Replace springs that do not meet specifications.

Testing Armature for Short-Circuit

Place armature in growler and hold a thin steel blade parallel to the core and just above it, while slowly rotating armature in growler. A short will cause the blade to vibrate and be attracted to the core. Replace armature if shorted.

Testing Armature for Earth

Contact armature shaft and each of the commutator riser bars with a pair of test lamp probes. If lamp lights, it indicates an earthed armature. Replace armature.

Testing Commutator Run-Out, and Refacing

Place armature in pair of "V" blocks and measure runout with dial indicator. Measure both shaft and commutator. A bent shaft requires replacement of armature. When commutator runout exceeds 0,1016 mm (.004 inch), commutator should be refaced. Remove only a sufficient amount to provide a smooth, even surface.

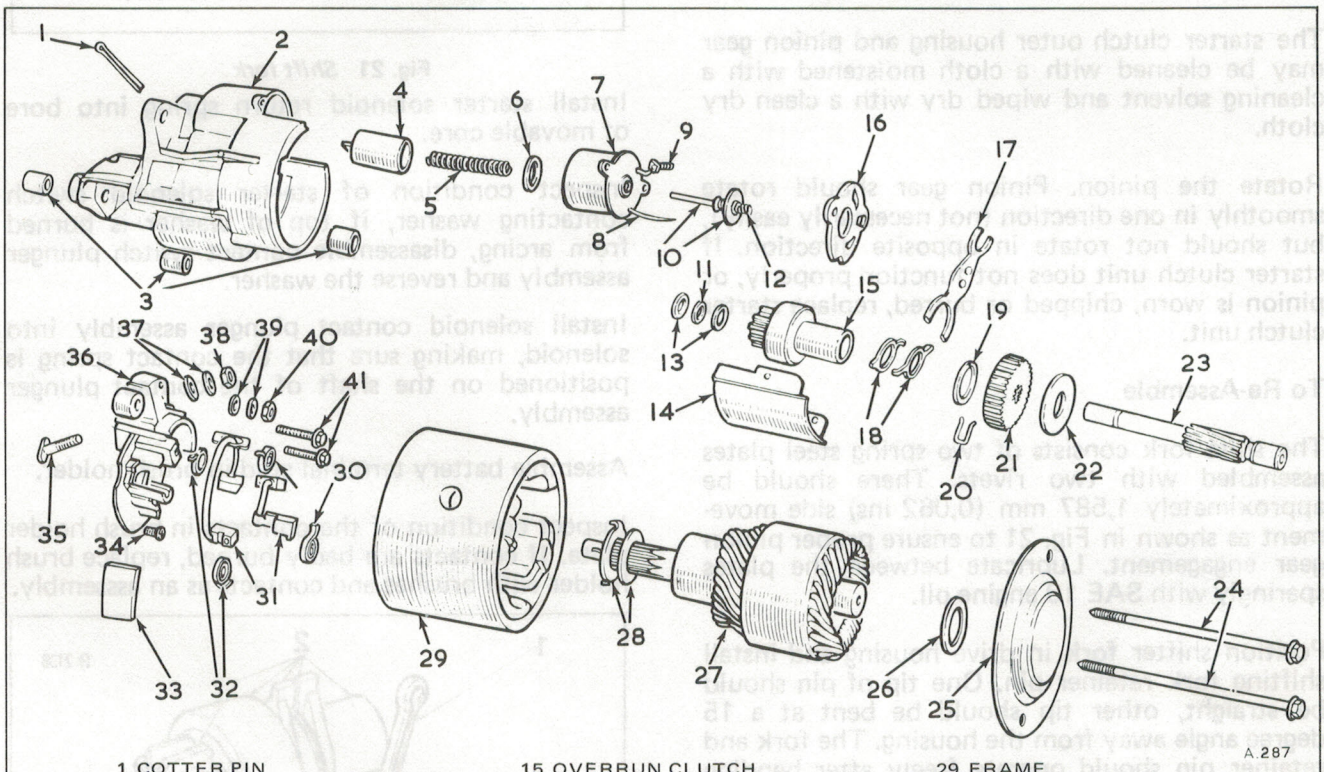
Testing Field Coils for Earth

Remove field frame assembly from starter.

Carefully drill out the rivet attaching the field coil earth leads to field frame.

Insulate field coil leads from field frame.

Test for earth using a 110 volt test lamp. Touch one probe of test lamp to field coil lead and other probe to field frame. Lamp should not light.



1 COTTER PIN
2 HOUSING
3 BEARINGS
4 CORE
5 SPRING
6 RING
7 SOLENOID
8 LEAD
9 TERMINAL
10 CONTACT & PLUNGER
11 RING
12 SPRING
13 WASHER
14 DUST COVER
15 OVERRUN CLUTCH
16 SEAL
17 FORK
18 ACTUATOR
19 RING
20 RETAINER
21 GEAR
22 WASHER
23 SHAFT
24 THROUGH BOLTS
25 END PLATE
26 WASHER
27 ARMATURE
28 THRUST WASHER
29 FRAME
30 BRUSH SPRING
31 BRUSHES
32 BRUSH SPRINGS
33 INSULATOR
34 SCREW
35 TERMINAL
36 BRUSH PLATE
37 WASHERS
38 NUT
39 WASHERS
40 NUT
41 SCREWS AND WASHERS

Fig. 20 *Exploded view of starter*

If lamp lights, it indicates that field coils are earthed and require replacement.

Note: The field coils are not serviced as a separate item. They are serviced in the Field Frame Assembly.

Starter Bushes

Inspect armature shaft bearing, pinion shaft surfaces and bushings for wear. Try the bushes for wear by inserting the shafts and test for side play.

Note: Pre-sized starting motor bushes are available for service. No burnishing or reaming is required to fit pre-sized bushes.

Starter Clutch Unit

Do not immerse starter clutch unit in a cleaning solvent. Starter clutch is pre-lubricated at the factory and a solvent will wash lubricant from the clutch.

The starter clutch outer housing and pinion gear may be cleaned with a cloth moistened with a cleaning solvent and wiped dry with a clean dry cloth.

Rotate the pinion. Pinion gear should rotate smoothly in one direction (not necessarily easily), but should not rotate in opposite direction. If starter clutch unit does not function properly, or pinion is worn, chipped or burred, replace starter clutch unit.

To Re-Assemble

The shift fork consists of two spring steel plates assembled with two rivets. There should be approximately 1,587 mm (0,062 ins) side movement as shown in Fig. 21 to ensure proper pinion gear engagement. Lubricate between the plates sparingly with SAE 10 engine oil.

Position shifter fork in drive housing and install shifting fork retainer pin. One tip of pin should be straight, other tip should be bent at a 15 degree angle away from the housing. The fork and retainer pin should operate freely after bending tip of pin.

Install solenoid moving core and engage shifting fork (Fig. 18).

Enter pinion shaft into drive housing and install friction washer and drive gear.

Install clutch and pinion assembly, thrust washer, retaining and thrust washer (Fig. 17).

Complete installation of pinion shaft, engaging shifting fork with clutch actuators. Figs. 21 and 22 show correct relation of parts at assembly.

Note: The friction washer must be positioned on shoulder on splines of the pinion shaft before driven gear is positioned.

Install driven gear snap ring (Fig. 14)

Install pinion shaft retaining ring (Fig. 15)

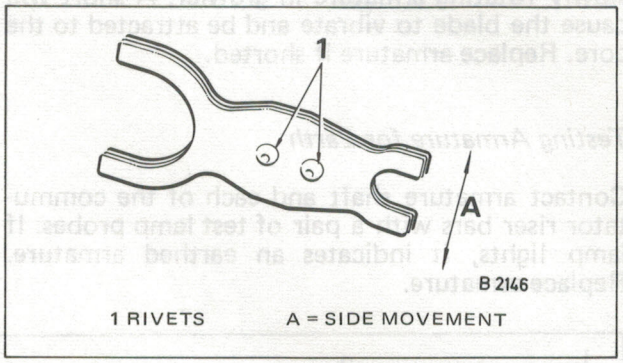


Fig. 21 *Shift fork*

Install starter solenoid return spring into bore of movable core.

Inspect condition of starter solenoid switch contacting washer, if top of washer is burned from arcing, disassemble contact switch plunger assembly and reverse the washer.

Install solenoid contact plunger assembly into solenoid, making sure that the contact spring is positioned on the shaft of the contact plunger assembly.

Assemble battery terminal stud in brush holder.

Inspect condition of the contacts in brush holder plate. If contacts are badly burned, replace brush holder with brushes and contacts as an asssembly.

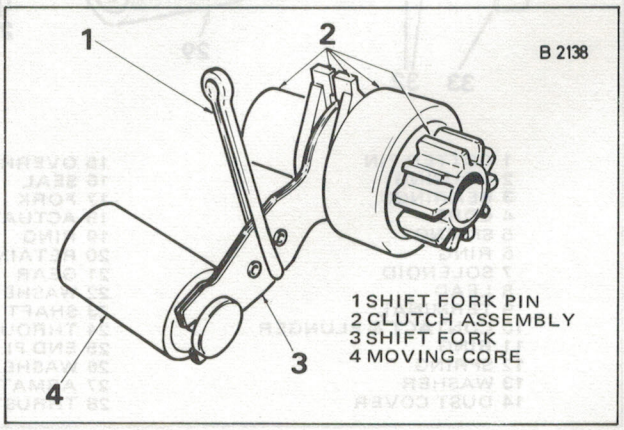


Fig. 22 *Shift fork and clutch*

Position seal on brush holder plate.

Enter solenoid lead wire through hole in brush holder (Fig. 23) and install solenoid stud, insulating washer, flat washer and nut.

Wrap solenoid lead wire tightly around brush terminal post as shown in Fig. 24 and solder securely with a high temperature resin core solder.

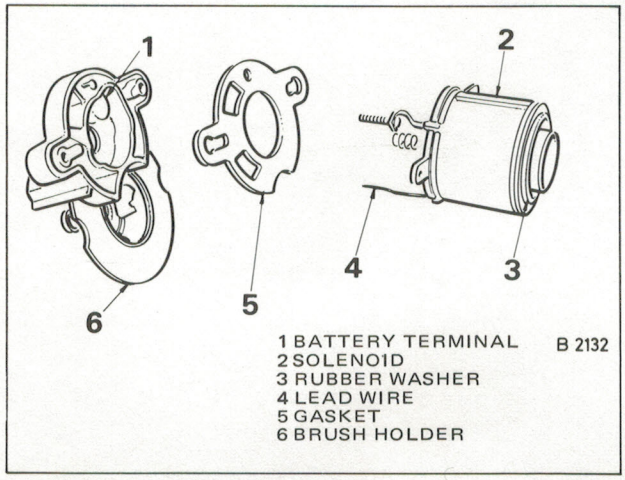


Fig. 23 *Arrangement of solenoid to brush plate*

Install brush holder to solenoid attaching screws.

Carefully enter solenoid coil and brush plate assembly into bore of gear housing and position brush plate assembly into starter gear housing (Fig. 25) and install housing attaching nuts. Tighten securely.

Position brushes with armature thrust washer as shown in Fig. 24. This will hold brushes out and facilitate proper installation of armature.

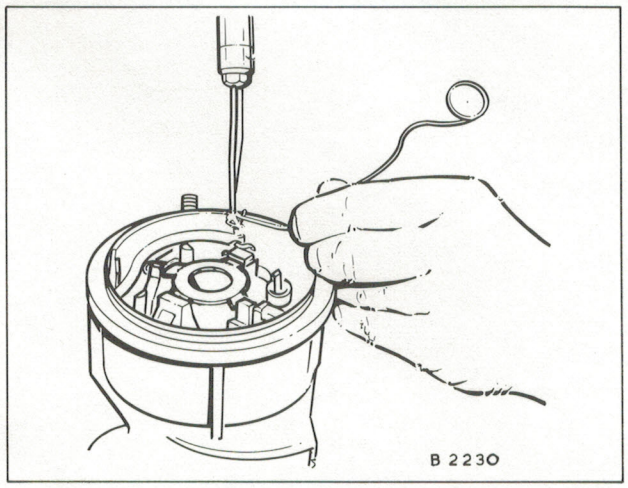


Fig. 24 *Solder solenoid lead to brush terminal*

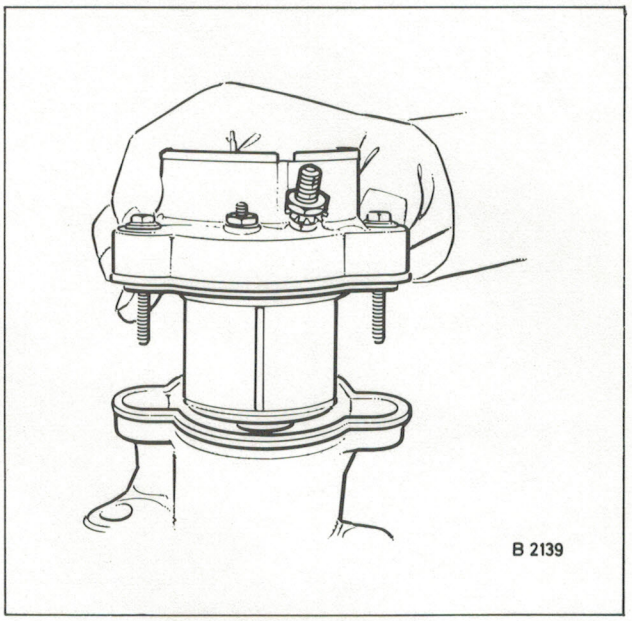


Fig. 25 *Replace solenoid and brush plate assembly*

Install brush terminal screw (Fig. 3).

Position field frame to the exact position on gear housing and enter armature into field frame and starter gear housing (Fig. 26) carefully engaging splines of shaft with reduction gear by rotating armature slightly to engage the splines.

Install thrust washer on armature shaft.

Position starter end head assembly and install through bolts. Tighten through bolts securely.

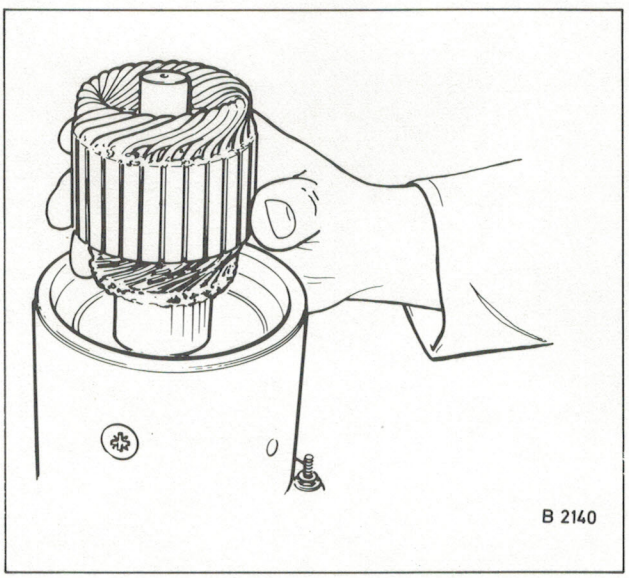


Fig. 26 *Replace armature*