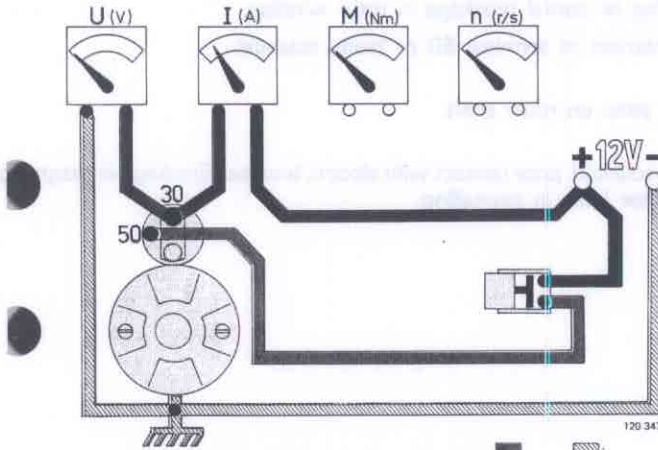


Testing the starter motor on test bench

Wipe the outside of the starter motor with a damp cloth and then secure it on a test bench. Connect the measuring instruments according to the diagram below. NOTE! The test bench must be provided with a shunt for minimum 500 A.



The following values should be obtained:

1. Starter motor unloaded
Power consumption 40–50 A
Voltage 12 V
Speed 115–135 r/s (6900–8100 r/min)
2. Starter motor loaded
Power consumption 185–200 A
Voltage 9 V
Speed 17.6–22.5 r/s (1050–1350 r/min)
3. Starter motor locked
Power consumption 300–350 A
Voltage 6 V
Speed 0 r/s

If the values deviate from the guide values of the maker, this may be due to the fact that the battery capacity of the test bench differs slightly from the capacity available when the guide values were drawn up.

In order to check whether the measured values agree, they should be re-calculated according to the following formula:

$$I = \frac{I_x \cdot U}{U_x}$$

I = Maker's guide value (300–350 A according to Test 3)

I_x = The current measured by you on test bench

U = Maker's guide value (6 V according to Test 3)

U_x = The voltage measured by you on test bench

Example: Starter motor locked

$$I = \frac{I_x \cdot U}{U_x}$$

Measured values $I_x = 270 \text{ A}$ $U_x = 5 \text{ V}$

Makers' guide values $I = 300\text{--}350 \text{ A}$ $U = 6 \text{ V}$

Calculate what I will be and compare this with the maker's guide value (I).

$$I = \frac{I_x \cdot U}{U_x} = \frac{270 \cdot 6}{5} = \frac{1620}{5} = 324 \text{ A}$$

The calculated value, 324 A, is within the maker's guide value, which was 300–350 A.

Comments

The measured value, 270 A, has thus been re-calculated to 324 A, which is an approved value.

Concerning functional disturbances, see overleaf.

Operational Disturbances

Symptoms

- Low speed and low current.
- Low speed and high current.
- Powerful sparking, low rotation.
- Pinion goes back to rest position before voltage cuts-out.
- Pinion does not go back to rest position when voltage cuts-out.
- Solenoid cuts in, but starter motor does not start.

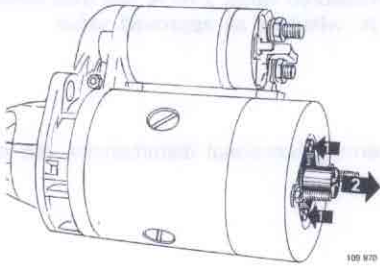
Reason

- Large resistance because of dirty commutator, worn brushes or low brush spring pressure (poor batteries).
- Short-circuiting in magnetic windings. Rotor slips round against pole shoes because of worn bearings or bent rotor shaft.
- Low spring pressure because of worn brushes or displaced brush springs. Short-circuiting or partial breakage in rotor winding.
- Poor contact at terminal 50 or faulty solenoid.
- Pinion jams on rotor shaft.
- Faulty solenoid, poor contact with electric brushes. Breakage in magnetic winding. Rotor jams in journaling.

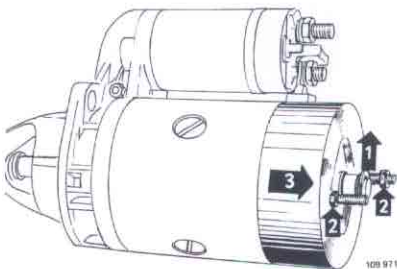
Overhauling the starter motor

Disassembling the starter motor

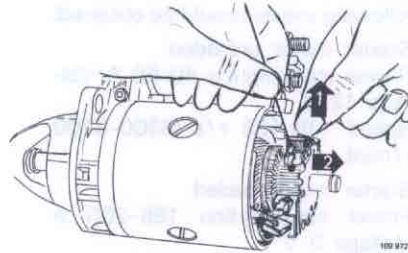
Remove the cover from the commutator frame.



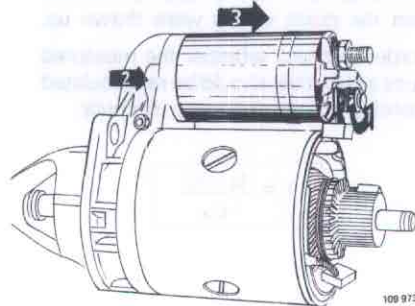
Remove the lock washers and adjusting screws as well as the two nuts. Remove the frame.



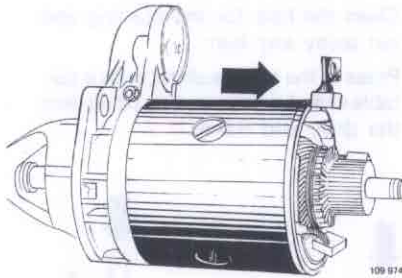
Remove the negative brushes and the brush holder.



Remove the nut securing the magnetic winding terminal from the solenoid. Remove the screws holding the solenoid.



Remove the pole housing from the armature and drive end frame.



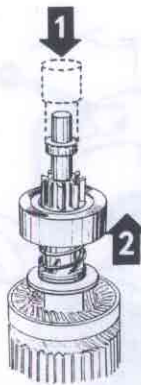
Remove the rubber washer and metal washer.

Remove the screw on which the shift lever is carried.

Remove the armature and shift lever.

Knock back the stop washer with the help of a suitable sleeve.

Remove the snap ring, stop washer and pinion.

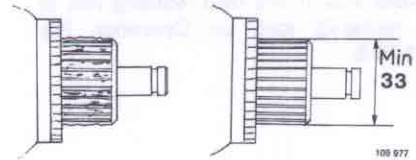


Checking and replacing parts

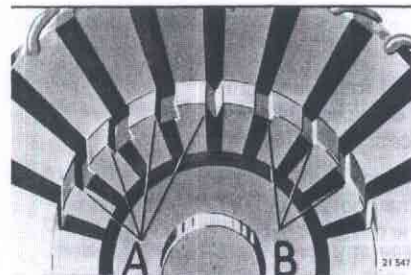
Armature

Examine the armature for mechanical damage. A bent or worn armature shaft must be replaced.

If the commutator is scored or unevenly worn, it should be turned. The minimum diameter is 33 mm (1.3").



After turning the commutator, check it with a micrometer. A radial throw of up to 0.08 mm (0.003") is permitted. The insulation between the laminations should be milled down to 0.4 mm (0.016") below the surface. This work is to be carried out in a special apparatus intended for this purpose, or if such is not available, with a ground-off hacksaw blade.

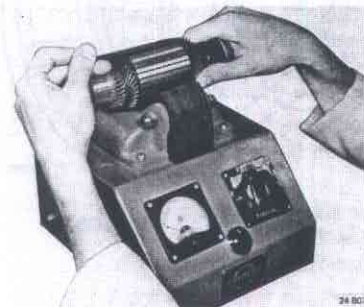


(max. 0.4 mm = 0.016" milling)

A = incorrectly milled
B = correctly milled

Examine the armature for shorts by placing it in a growler.

Switch on and hold a hacksaw blade a few mm from the armature. If the blade



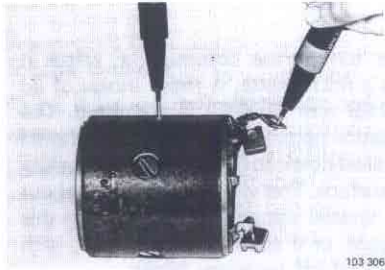
vibrates in any position when the armature is rotated, one of the following faults can be the reason.

Shorting through the armature frame, shorting in the commutator or between the windings.

the housing

Check the field winding for shorting. Test with 40 volts A.C.

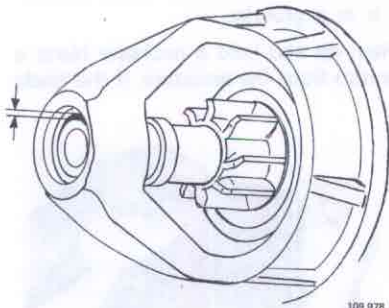
Also test the winding for breakage with 40 volts A.C. If the field winding has to be replaced, look up Operation No. 33175-5.



103 306

Examine the drive end frame and brush holders. If damaged or excessively worn, they must be replaced.

The clearance between the armature shaft and bushings may not exceed 0.12 mm (0.005"). Examine the other parts and replace any that are damaged or worn. The snap ring should always be replaced with a new one, since it may have been damaged or lost its tension when being removed.



109 978

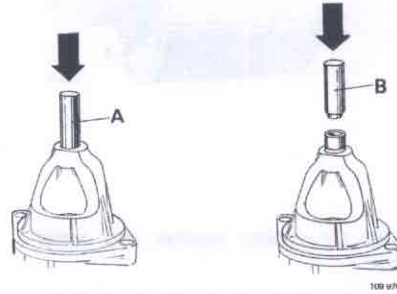
A = max. 0.12 mm (0.005")

Replacing the self-lubricating bushings

The self-lubricating bushings, so-called "compo-bushings" should wear insignificantly during operation if lubricated correctly.

The bushings should be immersed in oil for at least 1/2 hour (use e.g. Bosch 01 1V 13 or corresponding) before being fitted.

1. Drive out the worn bushing with the help of a suitable tool. Use a counterhold against the drive end frame.
2. Clean the hole for the bushing and cut away any burr.
3. Press in the new bushing with a suitable drift. Use a counterhold against the drive end frame.

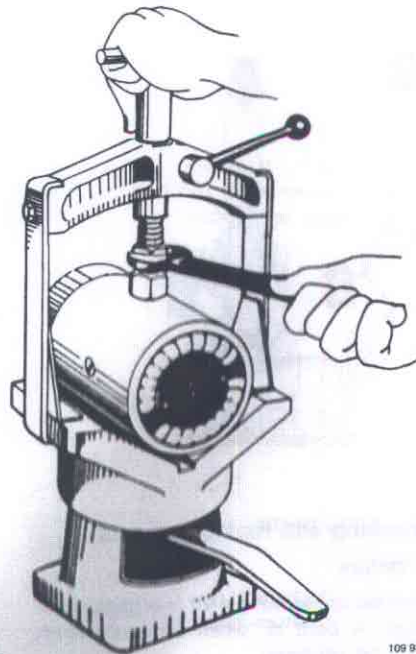


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33175-5

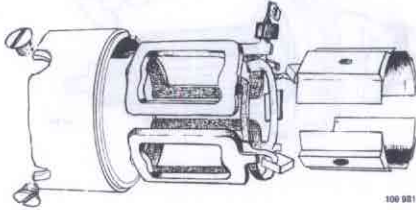
Replacing the field coils

1. Mark the pole shoes and pole housing in a suitable manner so that they are re-fitted in their initial position.
2. Place the pole housing in a rotating clamping block (Bosch EFAW 9) and remove the pole shoes.

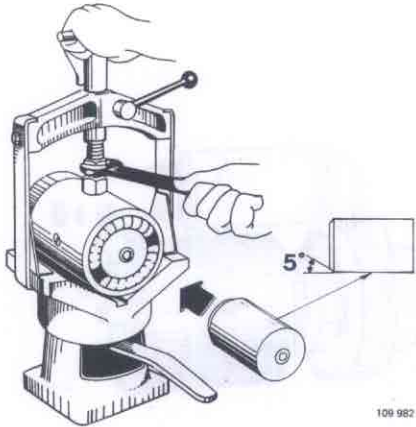


109 980

3. Remove the pole shoes and magnetic winding from the pole housing.
4. Fix the new magnetic windings loosely in the housing together with the pole shoes. Make sure the pole shoes are located according to the marks.



5. Press in a suitable drift in the housing and tighten up the pole shoes.

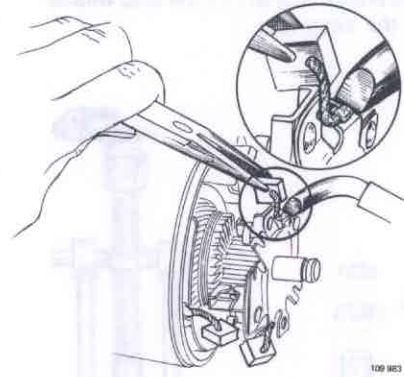


6. Remove the press drift.
7. Check the installed field coils for breakage and shorts (with 40 volts A.C.).

Replacing the brushes

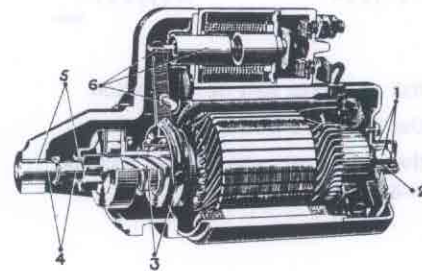
Brushes shorter than 14 mm (approx. 1/2") must be replaced with new ones.

1. Solder loose the brushes from their respective attachments.
2. Solder well the new brushes. This must be done rapidly and with sufficient heat. The solder must not run down onto the brush wires, since this will impede the movement of the brushes in the holder and thereby reduce the brush spring pressure.



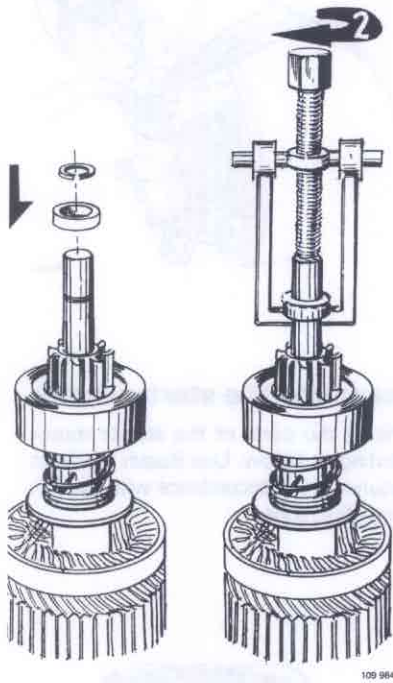
Assembling the starter motor

Lubricate the parts of the starter motor according to below. Use Bosch lubricant (or equivalent) in accordance with the following directions:

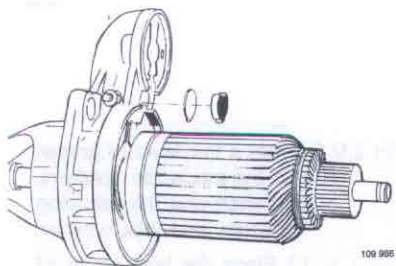


1. Ft 2 V 3 Place a thin layer of grease on the insulation washers, the shaft end, the adjusting washers and lock washer.
2. Ol 1 V 13 Place the bushing in oil for 1/2 hour before installation.
3. Ft 2 V 3 Apply plenty of grease to the armature thread and the engaging lever groove.
4. Ft 2 V 3 Place a thin layer of grease on the armature shaft.
5. Ol 1 V 13 Place the bushings in oil for 1/2 hour before installation.
6. Ft 2 V 3 Lubricate the engaging lever joints and the iron core of the solenoid with a thin layer of grease.

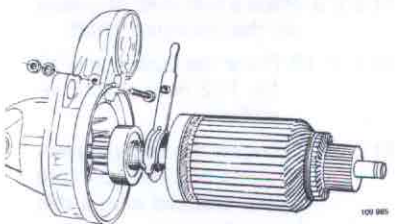
the pinion, stop washer and snap ring the armature shaft. Fit the stop washer or the snap ring.



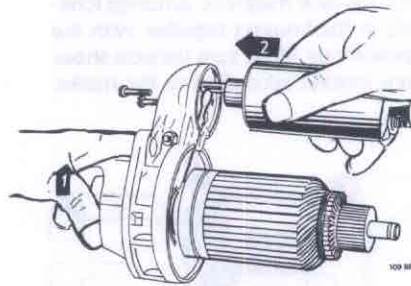
Fit the engaging arm on the pinion.
 Fit the armature in the drive frame.
 Fit the screw, nut and washer securing the engaging arm.



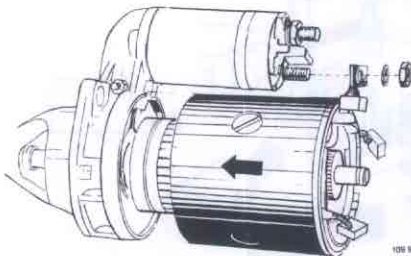
Fit the metal washer and rubber washer.



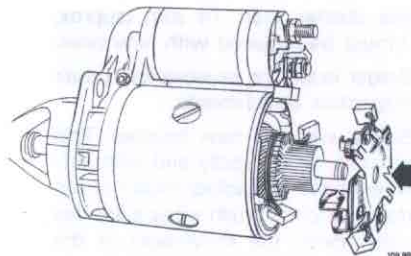
Fit the solenoid.



Fit the starter motor housing.
 Connect the cable to the solenoid.

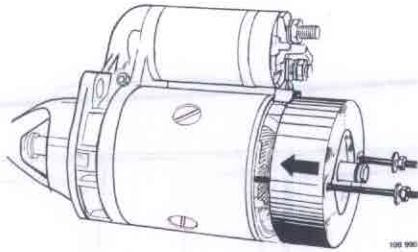


Fit the brush holder in position. Fit the brushes.



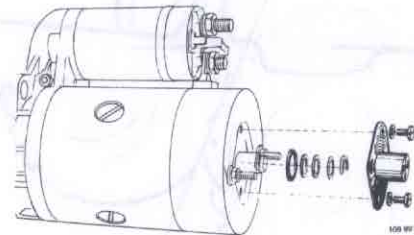
Fit the commutator bearing frame.

Screw the starter motor together with the two long bolts.



Fit the adjusting washers and snap ring on the shaft end. Check the armature axial clearance.

This should be 0.05–0.030 mm (0.002–0.012"). If necessary, adjust with a suitable number of washers until the clearance is correct. Screw tight the small casing of the shaft end.



Before installing the starter motor, run it on a test bench. Compare Figs. from page 19.

33172-1

Installing the starter motor

1. Screw the starter motor into position on the flywheel casing.
2. Connect the cables to the starter motor.
3. Fit the gear lever control ball joints on the gearbox.
4. Fit the rear engine casing.
5. Connect the negative cable to the battery.

Group 34 Ignition System

Construction and Function

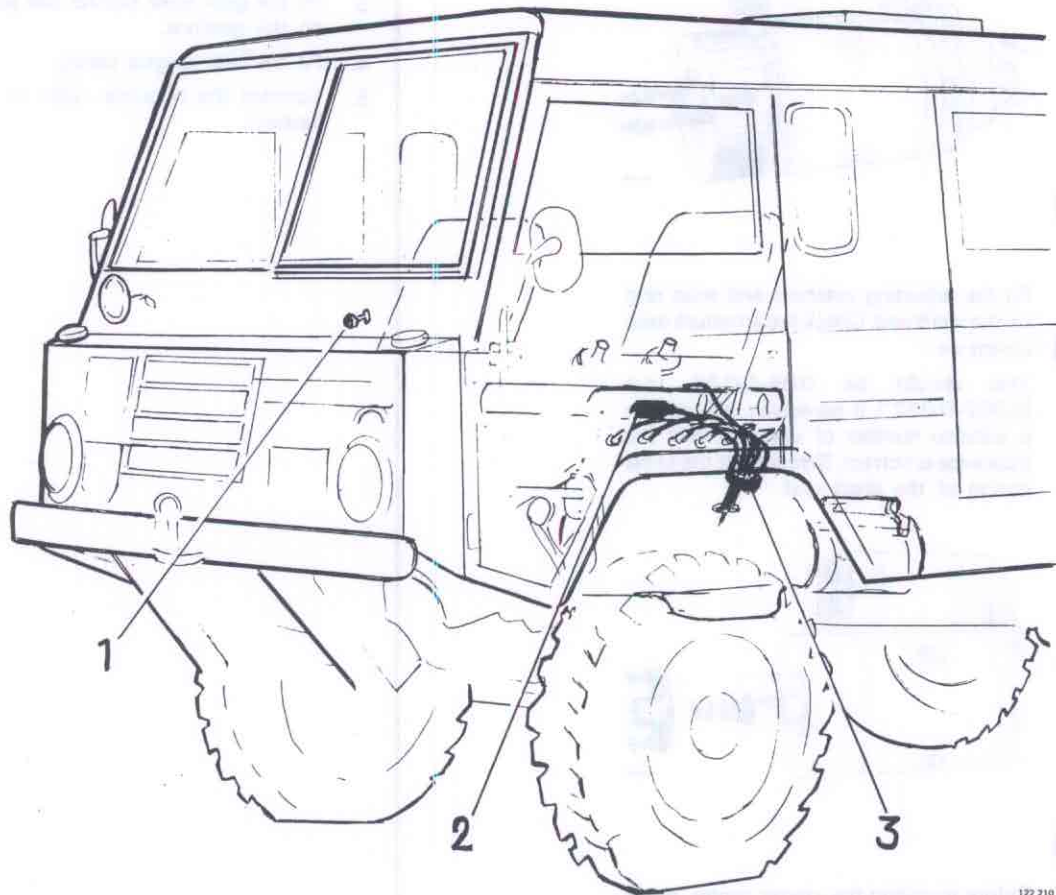


Fig. 34-1. Ignition components

1. Ignition
2. Ignition coil
3. Distributor

The ignition system is of the battery-ignition type. It consists of the following main components: ignition coil, ignition switch, distributor, ignition cables and spark plugs.

Ignition coil

The ignition coil is situated in the engine compartment on the left-hand side, see Fig. 34-2.

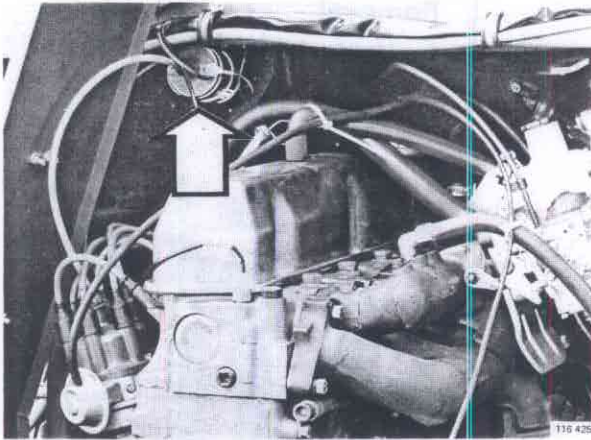


Fig. 34-2. Ignition coil

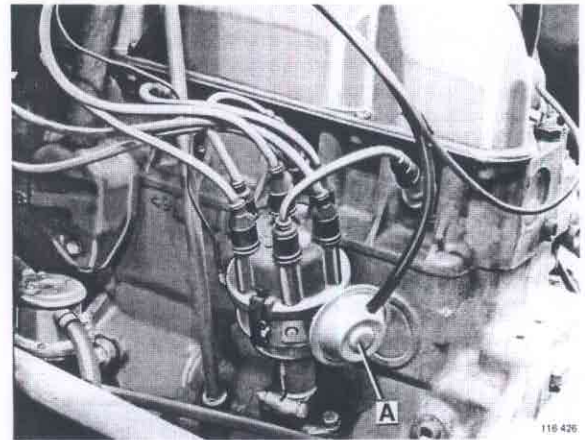


Fig 34-4. Distributor with ignition cables

Firing order: 1-5-3-6-2-4

Its setting in relation to engine speed is regulated by the centrifugal governor located under the breaker plate (see 8, Fig. 34-5).

Ignition

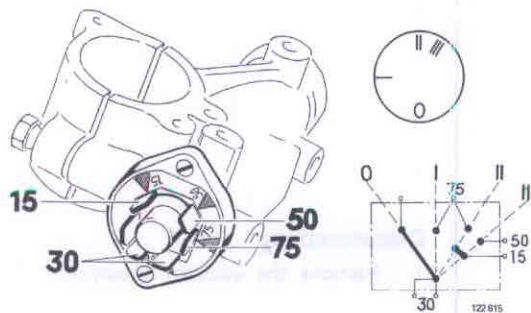


Fig. 34-3. Ignition

Distributor

The distributor is situated on the left-hand side of the engine, see Fig. 34-4, and is driven from the camshaft.

Its setting in relation to engine speed is regulated by the vacuum governor mounted on top of the distributor (see A, Fig. 34-4).

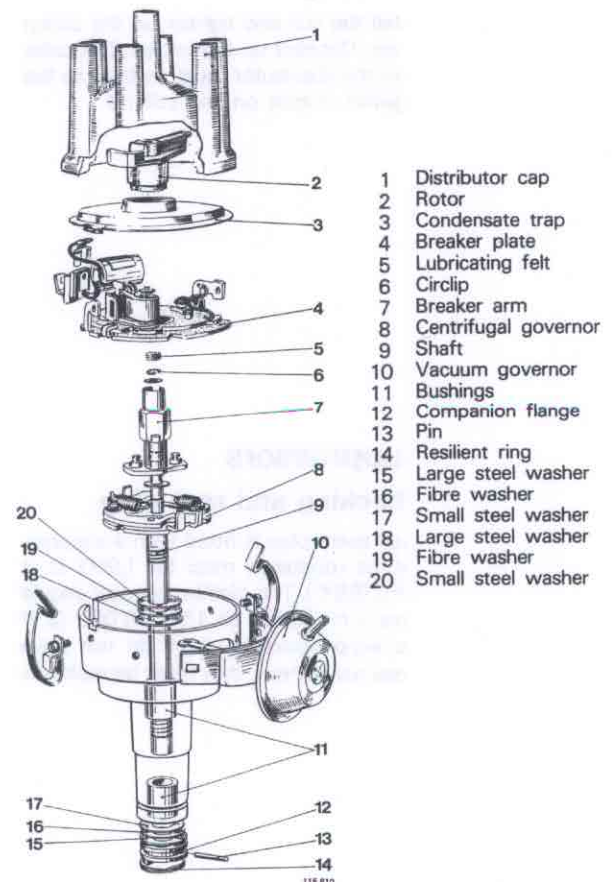


Fig. 34-5. Exploded view of distributor

Service Procedures

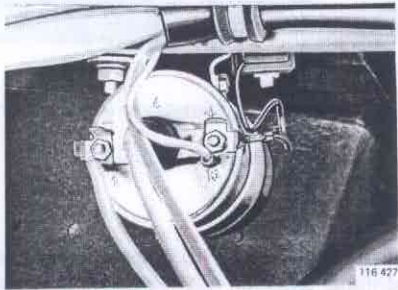
Ignition coil

Removal

Disconnect the cables from the ignition coil.

Release the screw securing the ignition coil.

Remove the ignition coil.



Installation

Install the coil and tighten up the clamp screw. Connect up the cables. The cable from the distributor must be fixed to the negative output on the coil (1).

Resistors

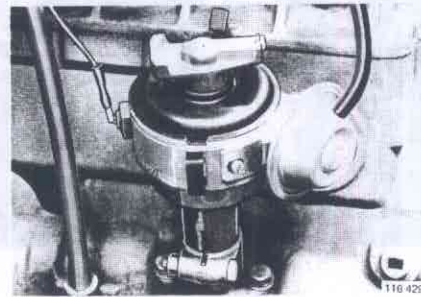
Checking and replacing

Each spark plug is fitted with a resistor. Its resistance must be 1,000 Ω at 20°C (68°F). The distributor rotor should give a resistance of 4,500–6,000 Ω . If the resistors or rotor do not have these resistances, they must be replaced.

Distributor

Removal

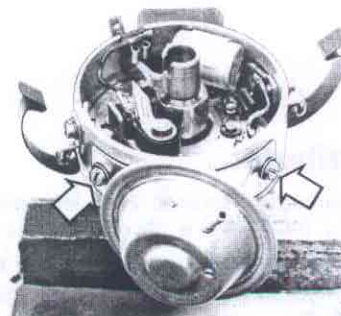
1. Unclasp the lock clasps for the distributor cap and lift off the cap.



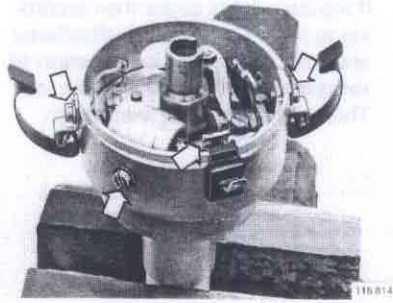
2. Disconnect the low-voltage cable at the distributor. Remove the vacuum hose from the vacuum governor. Lift off the distributor rotor and remove the condensate trap. Release the retaining screw and pull up the distributor.

Disassembling

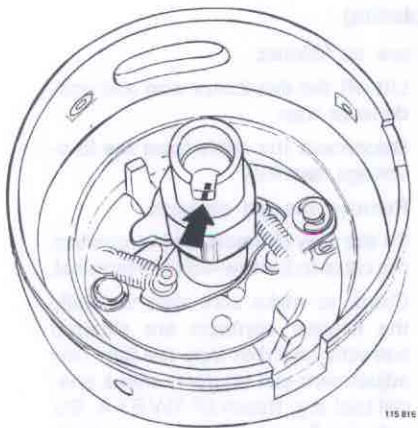
1. Remove the vacuum governor.



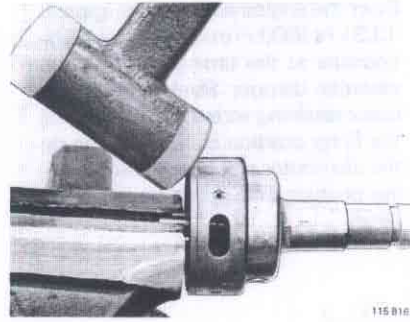
2. Unclasp the lock clasps for the cap. Disconnect the cable from the breaker contacts and remove the condenser with its low-voltage terminal.



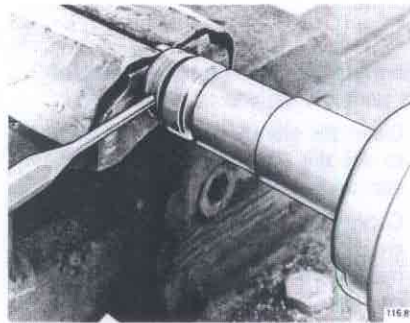
3. Mark the location of the breaker plate in relation to the distributor housing and lift up the plate.
4. Release the springs for the centrifugal governor. Remove the lubricating felt and line-up mark to ensure that the breaker cam is re-fitted in the right place in relation to the distributor shaft.



5. Fix the breaker cam in a vice with soft jaws. Carefully tap on the distributor housing with a plastic mallet until the circlip loosens. Take care of the circlip and the washers.



6. Remove the resilient ring and line-up mark the flange to ensure that it is refitted in the proper place in relation to the distributor shaft.
Tap out the pin. Lift off the flange and pull up the distributor shaft. Take care of the washers.



7. Remove the lock pins for the centrifugal weights and lift off the weights.

Checking and replacing parts

Breaker plate

The contacts should be smooth and even on the contact surfaces. The colour of the contacts should be grey.

Replace oxidized or burnt contacts. The breakers can get worn after being used for some time and the spring can become fatigued, so that the contacts should be replaced if the distributor is disassembled for some reason or other.