VOLVO

SERVICE

PART 3

ELECTRICAL SYSTEM

12 Volt System

PV 544, P 210

CONTENTS

DESCRIPTION

The electrical system for the PV 544 and P 210 (with B 18 engines) is of the 12 V type. The equipment can be divided up into the following main parts:

Battery, dynamo, charging regulator, starter motor, ignition system, lighting and signalling units.

BATTERY

The battery, Fig. 1, is placed on a shelf on the front of the bulkhead. It is a 12 V lead battery consisting of six cells. The battery has a capacity of 60 Ah.

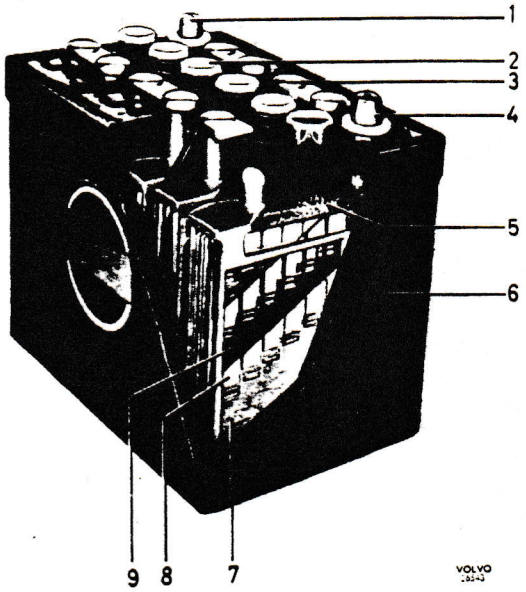


Fig. 1. Battery

1. Negative terminal
2. Filling plug
3. Cell connection
4. Positive terminal
5. Protective grid
6. Battery casing
7. Negative plate
8. Spacer
9. Positive plate

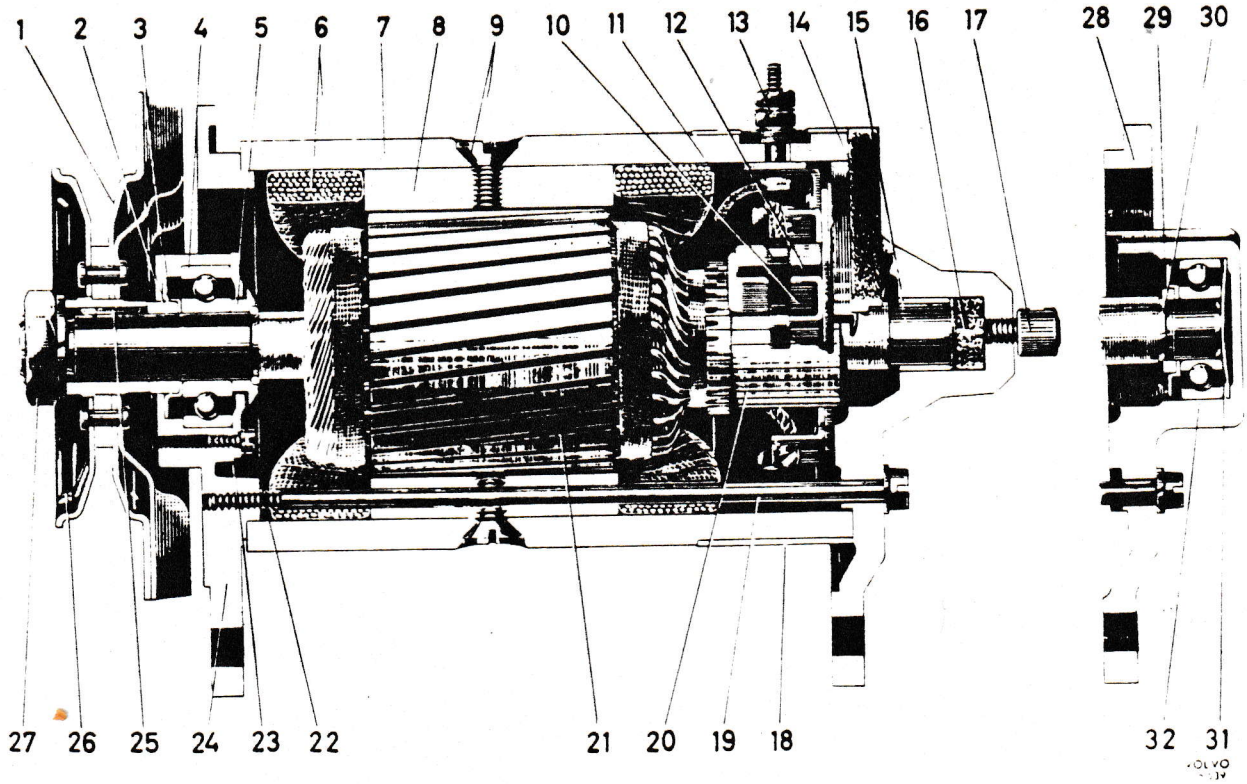


Fig. 2. Dynamo

DYNAMO

The dynamo, Fig. 2, is fitted on the right-hand side of the engine and is driven by a V-belt from the crankshaft. The dynamo is of the shunt type, i.e. the rotor and field windings are connected in parallel. The charging capacity of the dynamo is regulated by a charging regulator.

CHARGING REGULATOR

The charging regulator, Fig. 3, is fitted on the right-hand wheel arch. It is of the variode type, i.e. current limitation is done by means of a variode. In addition to the variode, the charging regulator consists of a reverse current relay and voltage regulator.

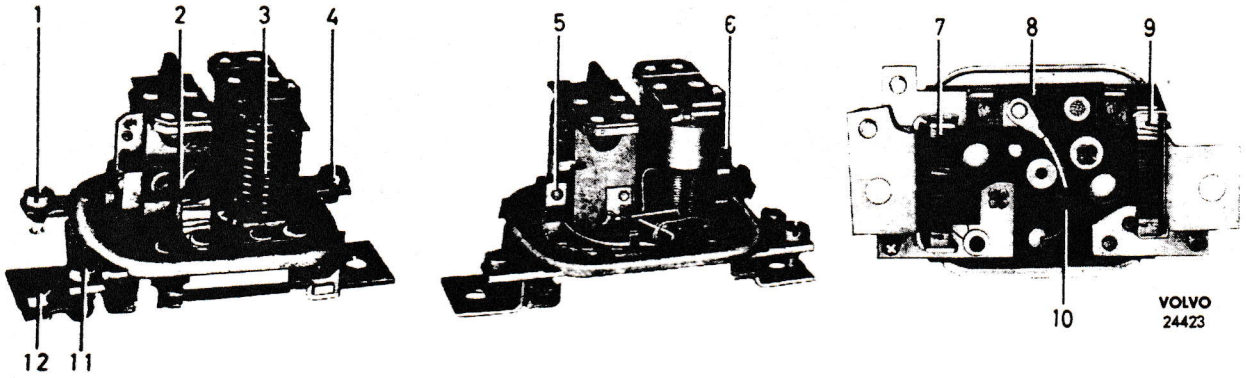


Fig. 3. Charging regulator

1. Terminal, DF
2. Voltage regulator
3. Cut-in relay
4. Terminal, B+
5. Cut-in contact
6. Control contact
7. Resistor wR
8. Variode resistor
9. Resistor aR
10. Variode
11. Terminal D+, 61
12. Earth connection

STARTER MOTOR

The starter motor, Figs. 4 and 5, is fitted on the flywheel housing on the left-hand side of the engine. It consists of a 4-pole series-wound motor. The pinion on the starter motor rotor shaft moves axially to engage with the flywheel ring gear. The pinion is controlled by a solenoid.

Text for Fig. 2. Dynamo

1. Belt pulley
2. Spacing ring
3. Oil seal washer
4. Ball bearing
5. Spacing ring
6. Field winding
7. Stator
8. Pole shoe
9. Pole screw
10. Brush holder
11. Brush spring
12. Brush
13. Terminal screw
14. End shield
15. Bushing
16. Lubricating felt
17. Lubricating cup
18. Protecting band

Dynamo type AR 6

19. Screw
20. Commutator
21. Rotor
22. Screw
23. Sealing washer
24. End shield
25. Key
26. Spring washer
27. Nut
28. End shield
29. Oil seal washer
30. Spacing ring
31. Spring ring
32. Ball bearing

Dynamo type AR 7

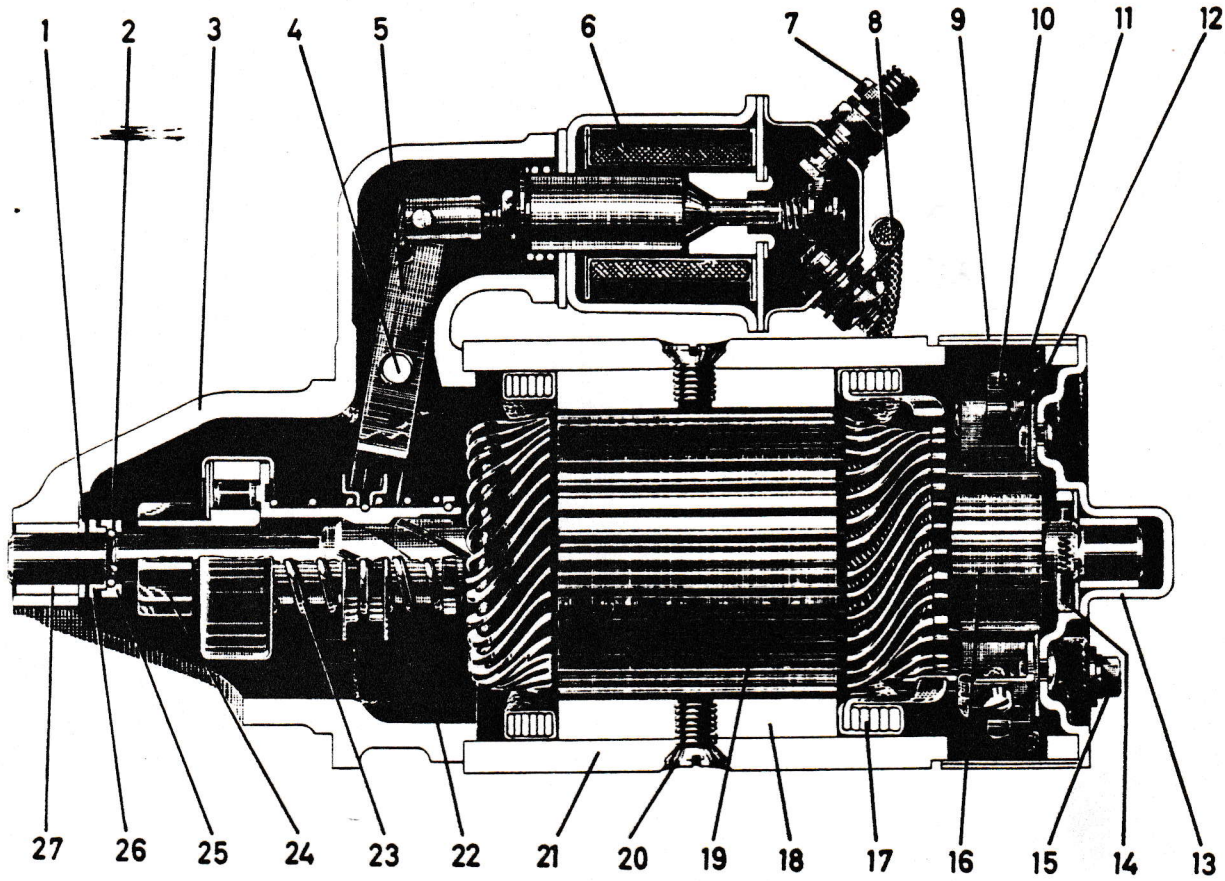


Fig. 4. Starter motor, early production

VOLVO 26555

1. Adjusting washer
2. Circlip
3. End shield
4. Pivot pin
5. Engaging arm
6. Solenoid switch
7. Terminal stud
8. Main lead
9. Protecting band
10. Brush spring
11. Brush
12. Brush holder
13. End shield
14. Rotor brake
15. Bolt
16. Commutator
17. Field winding
18. Pole shoe
19. Rotor
20. Pole screw
21. Stator
22. Spring
23. Spring
24. Pinion
25. Stop washer
26. Stop washer
27. Bushing

IGNITION SYSTEM

The ignition system is of the battery ignition type. It consists of the following main parts: Ignition coil, distributor, ignition leads and sparking plugs.

IGNITION COIL

The ignition coil is fitted on the left-hand side of the bulkhead.

The purpose of the ignition coil is to transform the battery voltage to high-tension voltage for the sparking plugs. It consists of a core of laminated metal around which is a winding of heavy copper wire, the primary winding, and a winding of fine copper wire, the secondary winding. The primary winding operates at battery voltage from the distributor contact breakers. The other winding, the high-tension winding, is connected to the centre terminal on the distributor cap, from where the high-tension current is distributed to the engine sparking plugs.

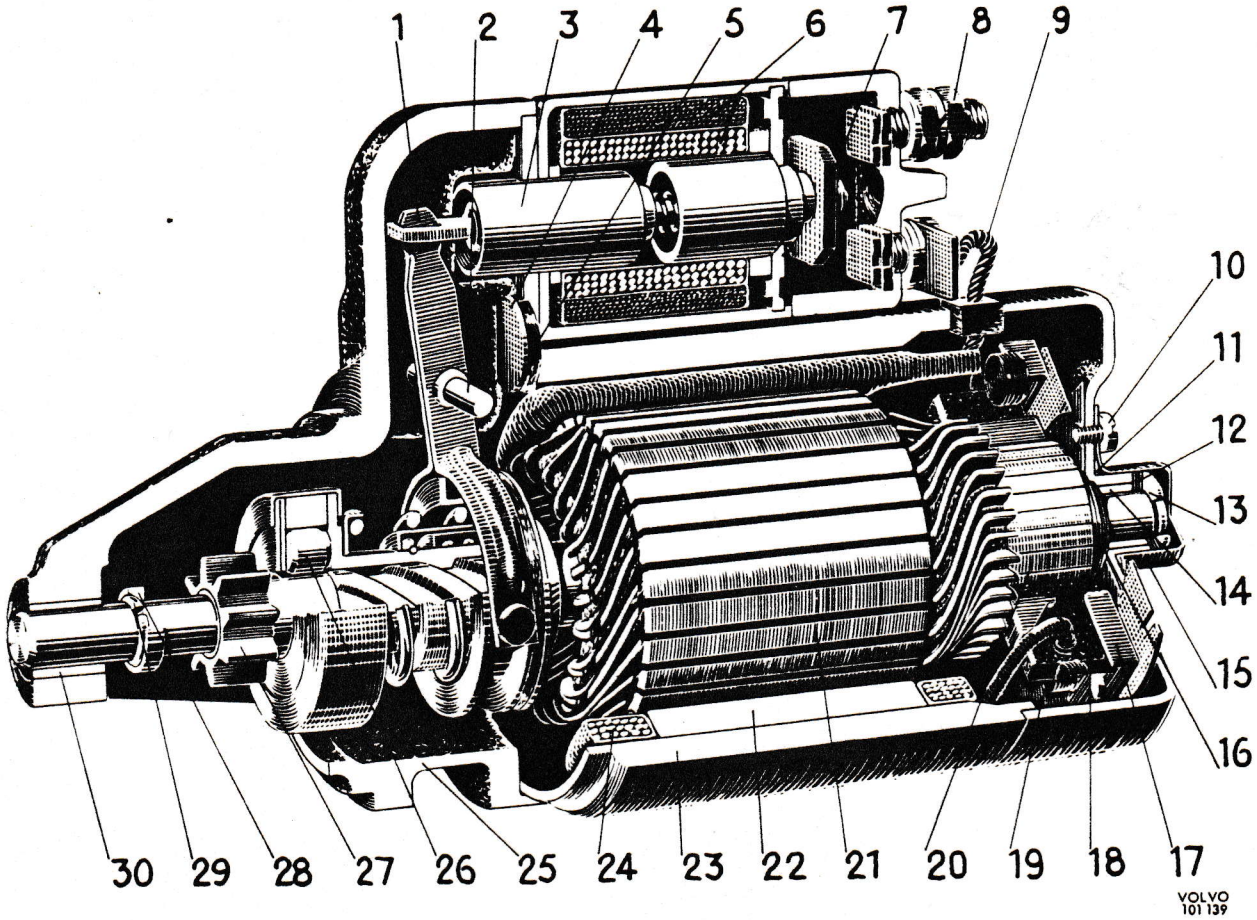


Fig. 5. Starter motor, late production

1. Engaging arm
2. Pivot pin
3. Armature
4. Steel washer
5. Rubber washer
6. Winding
7. Contact plate
8. Terminal for battery
9. Connecting lead to field
10. Screw
11. Rubber gasket
12. Shims
13. Circlip
14. Bushing
15. Cover
16. Shims
17. Brush holder
18. Brush
19. Brush spring
20. Commutator
21. Rotor
22. Pole shoe
23. Stator
24. Field winding
25. End shield
26. Roller bearing
27. Pinion
28. Stop ring
29. Circlip
30. Bushing

DISTRIBUTOR

The distributor, Fig. 6, is fitted on the left-hand side of the engine and is driven from the camshaft.

The distributor has two separate electrical circuits, low-tension and high-tension. The low-tension (battery voltage) is distributed to the ignition coil by the contact breakers, the breaking function of which is actuated by a cam fitted on the distributor shaft.

The high-tension voltage generated in the ignition coil is distributed to the sparking plugs by the rotor arm fitted on the distributor shaft.

The adjustment of the distributor in relation to engine speed is regulated by a centrifugal governor fitted under the breaker plate. The adjustment in relation to loading is controlled by a vacuum regulator.

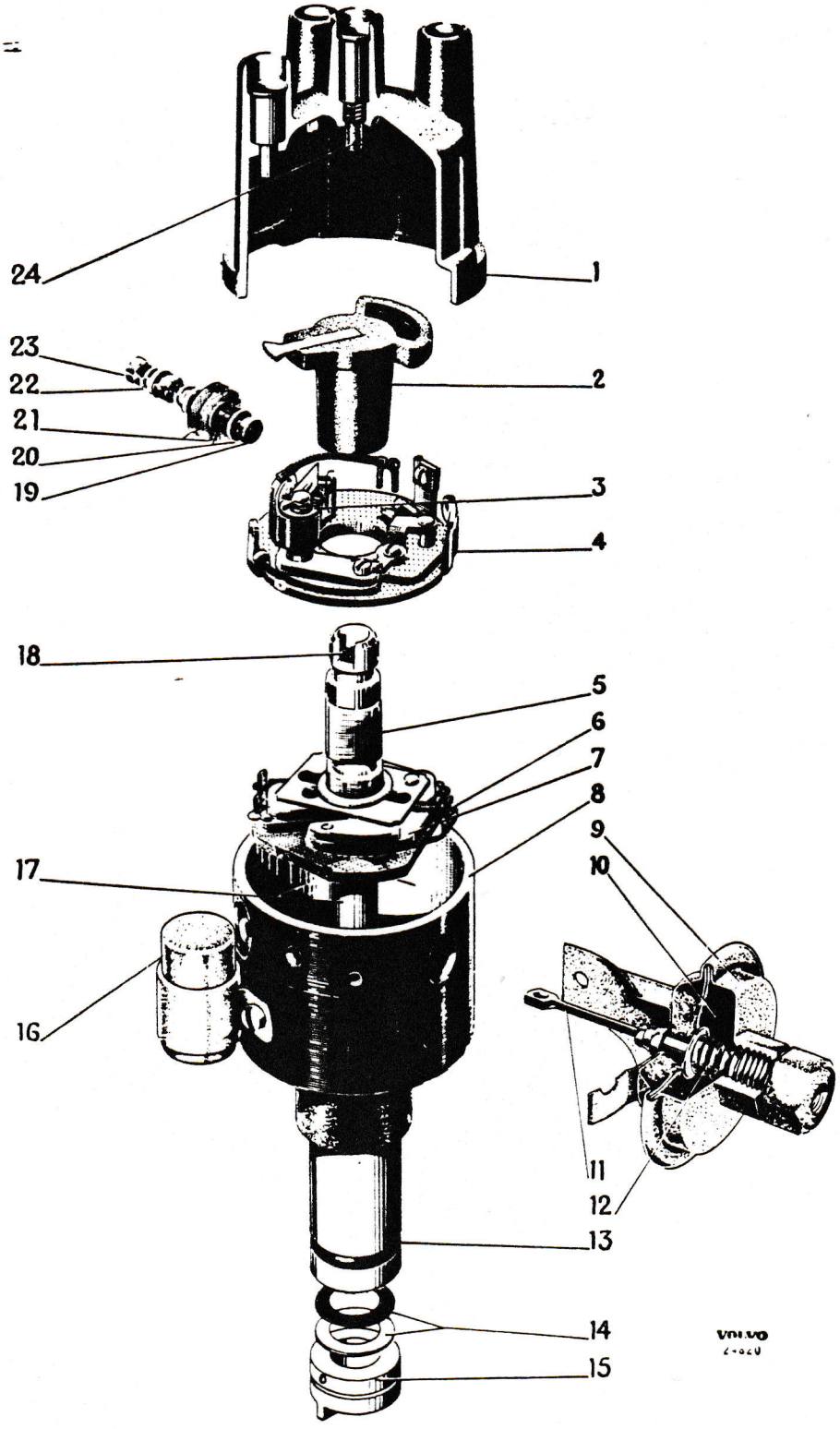


Fig. 6. Distributor, B 18 A engine

1. Cap	7. Governor flyweight	13. Rubber seal	19. Screw
2. Rotor arm	8. Distributor housing	14. Washers	20. Flat washers
3. Contact breaker	9. Vacuum regulator	15. Driving collar	21. Insulating washers
4. Breaker plate	10. Diaphragm	16. Capacitor	22. Spring washer
5. Breaker cam	11. Link rod	17. Distributor shaft	23. Nut
6. Spring	12. Spring	18. Felt seal	24. Rod brush

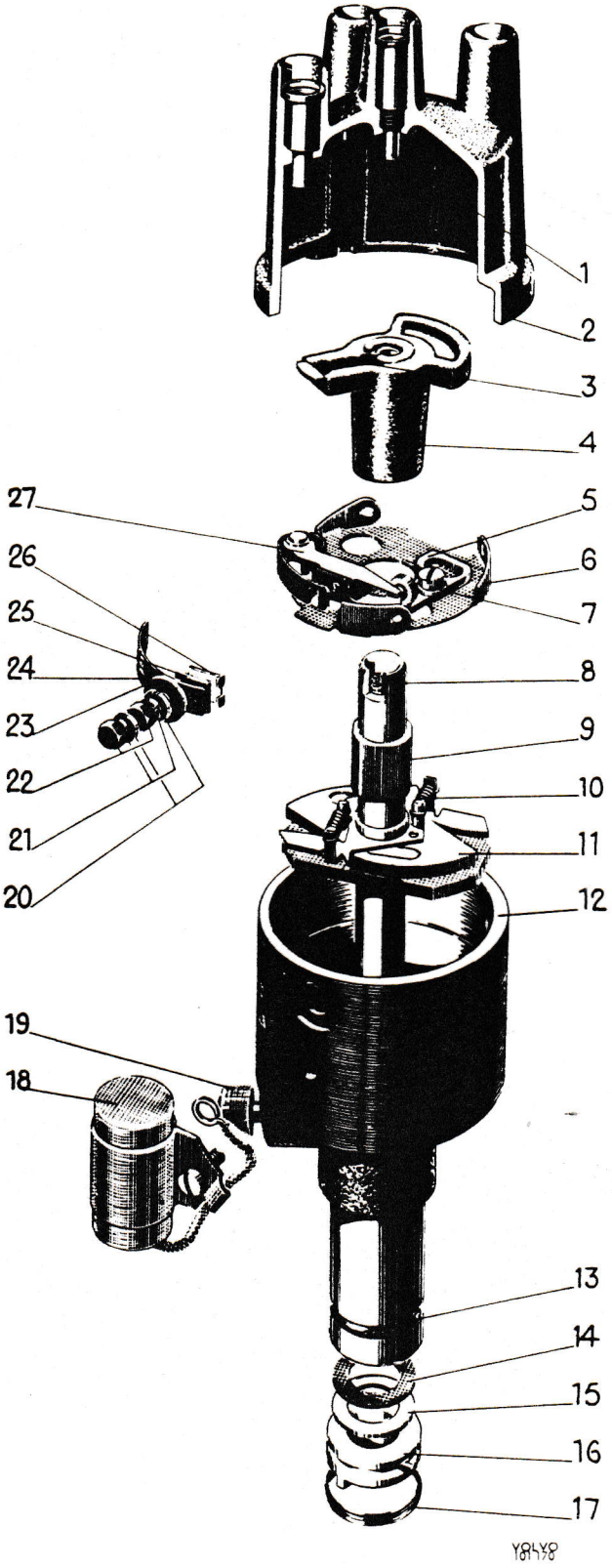


Fig. 7. Distributor, B 18 D engine, late production

1. Rod brush
2. Cap
3. Built-in resistor
4. Rotor arm
5. Contact plate
6. Breaker plate
7. Locking screw
8. Lubricating felt
9. Breaker cam
10. Spring
11. Governor flyweight
12. Distributor housing
13. Rubber seal
14. Fibre washer
15. Steel washer
16. Driving collar
17. Spring ring
18. Capacitor
19. Lubricating cup
20. Flat washer
21. Spring washer
22. Nut
23. Fibre washer
24. Insulating strip
25. Fibre washer
26. Flat washer
27. Breaker arm

LIGHTING

The lighting consists of two headlamps which have full- and dipped-beam positions, direction indicators and parking lamps, rear lamps and number plate light.

The headlamps are fitted in the mudguards. They are switched on and off by the lighting switch on the instrument panel. Switching between full- and dipped-beam positions is done by means of the foot dipper switch on the floor.

Parking lamps are placed below the headlamps and contain bulbs for the parking lights and direction indicators.

The rear lamps have two bulbs for tail lights, stop lights and direction indicators.

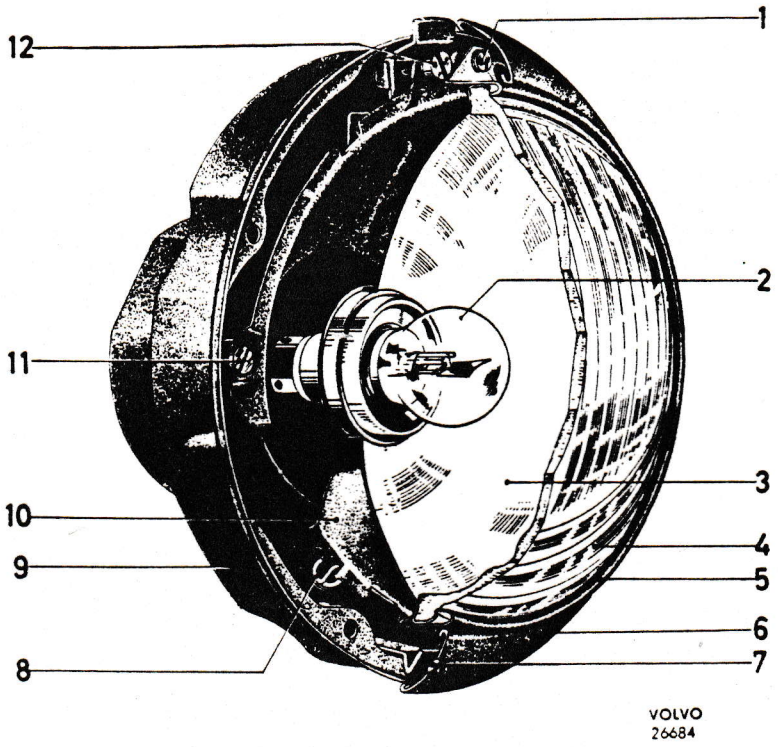


Fig. 8. Headlamp

1. Attaching screw for headlamp insert
2. Full- and dipped-beam bulb, asymmetrical lights
3. Reflector
4. Glass
5. Sealing ring
6. Outer ring
7. Screw for outer ring
8. Spring
9. Outer casing
10. Bowl
11. Screw for horizontal adjustment
12. Screw for vertical adjustment

SWITCHES

The lighting switch consists of a combined pull-and-turn switch.

The pulling function is used for switching the vehicle lighting on and off and the turning function for controlling the strength of the instrument panel lighting.

The direction indicator switch lever is fitted on the steering column. The switch is provided with automatic return. The headlight signal is also operated by the direction indicator switch lever. The headlights are flashed by moving the switch lever towards the steering wheel.

The switch for the heater element is located on the dashboard next to the steering column.

The switch for the windscreen wiper is provided with positions for full and half speeds and for windscreen washing. The windscreen wiper functions when the switch is pulled out the first and second notches. The windscreen washer operates when the switch is pulled out fully.

HORNS

The horns, Fig. 9, are fitted in front of the radiator. One of these gives a low note and the other a high note. The horns are operated by means of the horn ring fitted on the steering wheel.

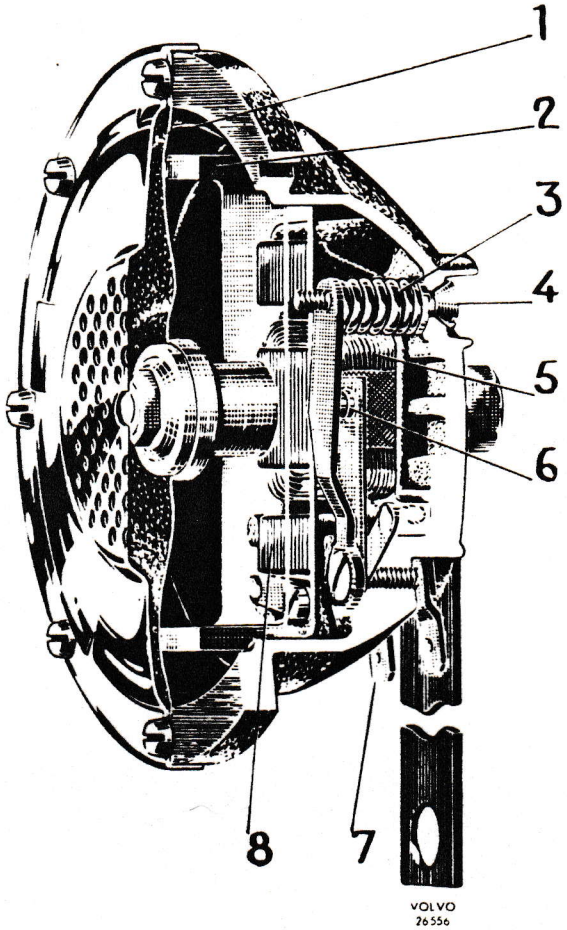


Fig. 9. Horn

1. Diaphragm
2. Armature
3. Spring
4. Adjusting screw
5. Winding
6. Breaker contact
7. AMP connection
8. Iron core

WINDSCREEN WIPER

The windscreen wiper, Fig. 10, is driven by an electric motor. The motor is connected to the wiper blades by means of link arms and a gear housing. The windscreen wiper is self-parking.

DIRECTION INDICATORS

The direction indicators are of the flasher type. These are fitted at the front and rear. The flashing action is caused by an automatic unit fitted under the instrument panel. Controlling is done by means of a lever under the steering wheel which operates a switch.

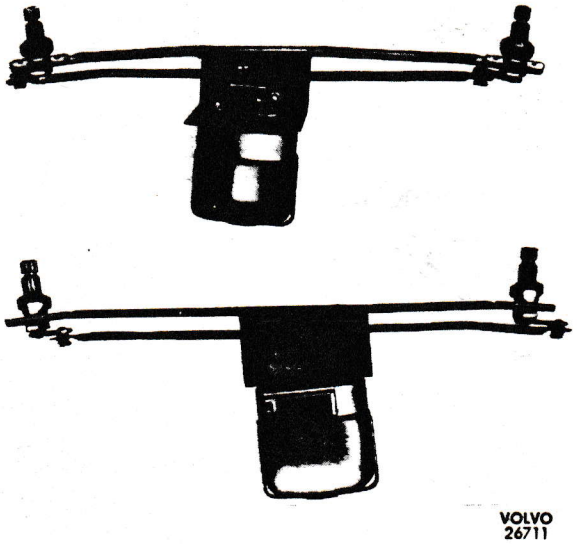


Fig. 10. Windscreen wiper

FUSES

The fuses consist of filaments mounted on porcelain bodies. The filament wire melts when the current exceeds the value for which the fuse is intended. The fuses are rated at 8 and 25 A. The fuses are placed in a fusebox fitted on the bulkhead under the bonnet.

Warning lamps

The charging control lamp should go out when the engine is running. This indicates that the dynamo is charging the battery. If the lamp lights, this means that there is a fault in the dynamo. At low engine speed (idling), it is normal for the lamp to light.

The oil pressure warning lamp receives current from the starting switch via the fusebox and is earthed through a pressure switch fitted on the engine. When the engine is running and the oil pressure is normal, the connection between the lamp and engine frame through the pressure switch is broken. When the oil pressure has fallen to a pre-determined value, the pressure switch closes the circuit and the lamp lights.

The warning lamp for the direction indicators flashes when either of the indicator is in use. The warning lamp for full-beam headlights gives a weak blue glow when full headlights are switched on.

REPAIR INSTRUCTIONS

BATTERY

Removing

1. Remove the cable terminals from the battery terminal studs. Use a puller if the cable terminals are stuck to the terminal studs.
2. Unscrew the nuts for the securing bar, and lift up the battery.
3. Clean off the battery with a brush and rinse it with clean, lukewarm water.
4. Clean the battery shelf and cable terminals. Use a special steel brush or pliers for the cable terminals.

Fitting

1. Place the battery in position. Ensure that it is turned the right way round. Fasten the battery with the securing bar and nuts.
2. Tighten the cable terminals onto the terminal studs. The negative terminal stud of the battery should be connected to earth.
3. Coat the cable terminals and terminal studs with vaseline.

Maintenance and charging directions

In order for the battery to function satisfactorily, it must be in good condition. The first condition for this is that the acid is maintained at the specified level above the plates. If the acid level is allowed to fall below the upper edge of the plates, it is not possible to utilize the full capacity, since only that part of the plates surrounded by acid can take part in charging and discharging. Ensure that the acid level comes 5 mm (3/16") above the upper edge of the spacers between the plates. Measuring is done with a glass tube. If the level is too low, top up with **distilled** water as necessary. Use a filling flask as shown in Fig. 12.

NOTE. On no account must battery acid be used for this topping-up.

Ensure that the battery is secured firmly in position. The filling plugs, connections and cable terminals should be well tightened. The cable terminals should be coated with vaseline.

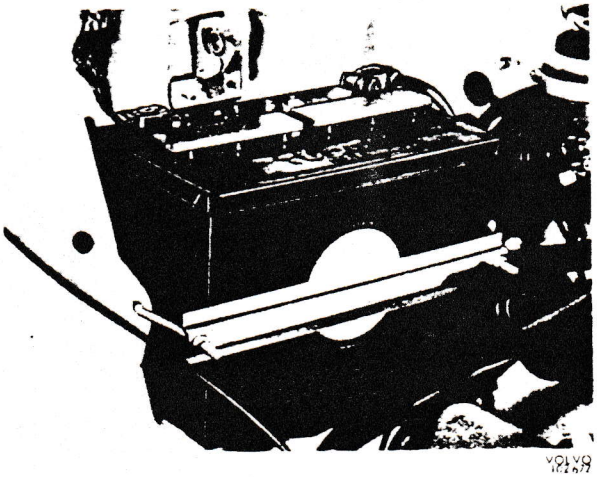


Fig. 11. Battery

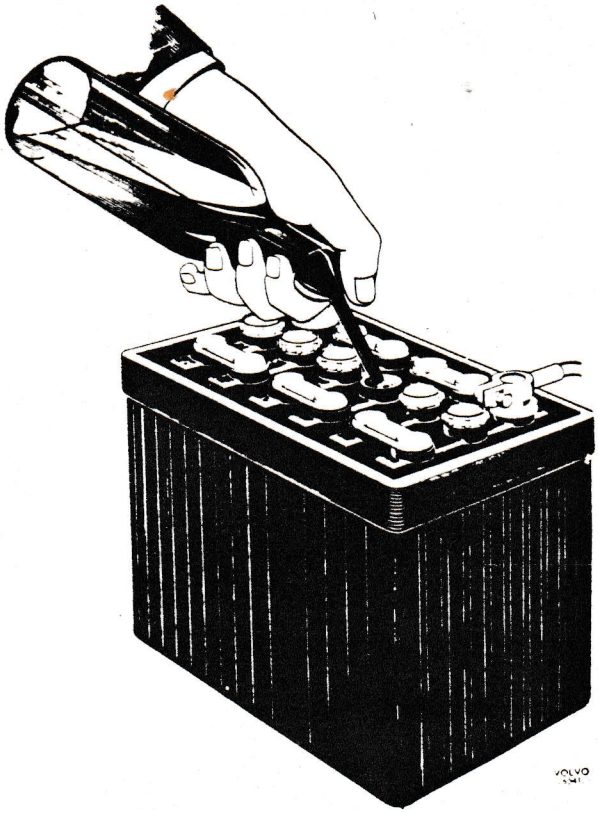


Fig. 12. Topping-up with distilled water

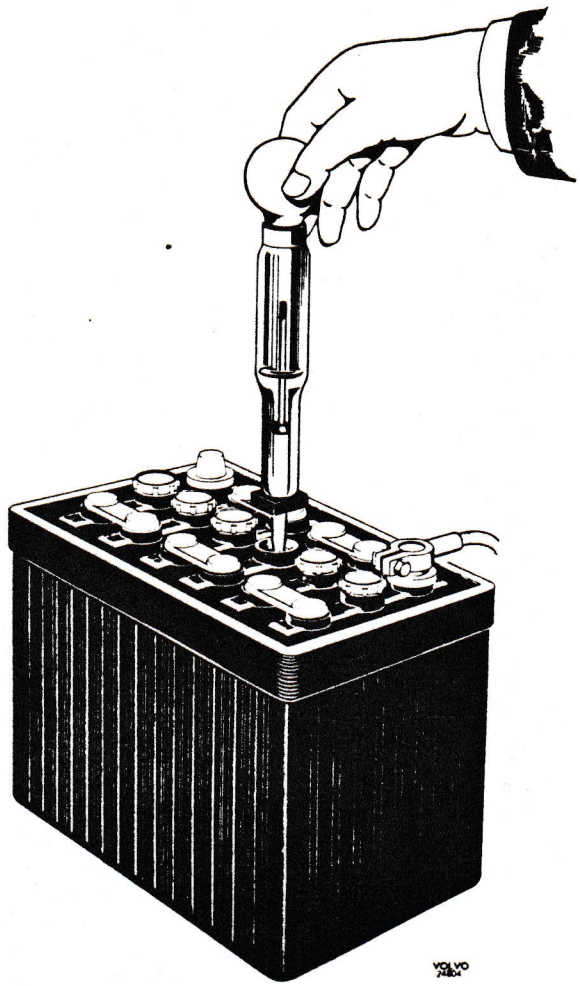


Fig. 13. Checking specific gravity of acid

The specific gravity of the electrolyte at 15° C (60° F) and at various charging conditions of the battery is as follows:

Charging condition	Specific gravity of electrolyte
Fully charged (1/1)	1.28
Three-quarters charged (3/4)	1.24
Half-charged (1/2)	1.21
Quarter-charged (1/4)	1.16
Discharged (0)	1.12

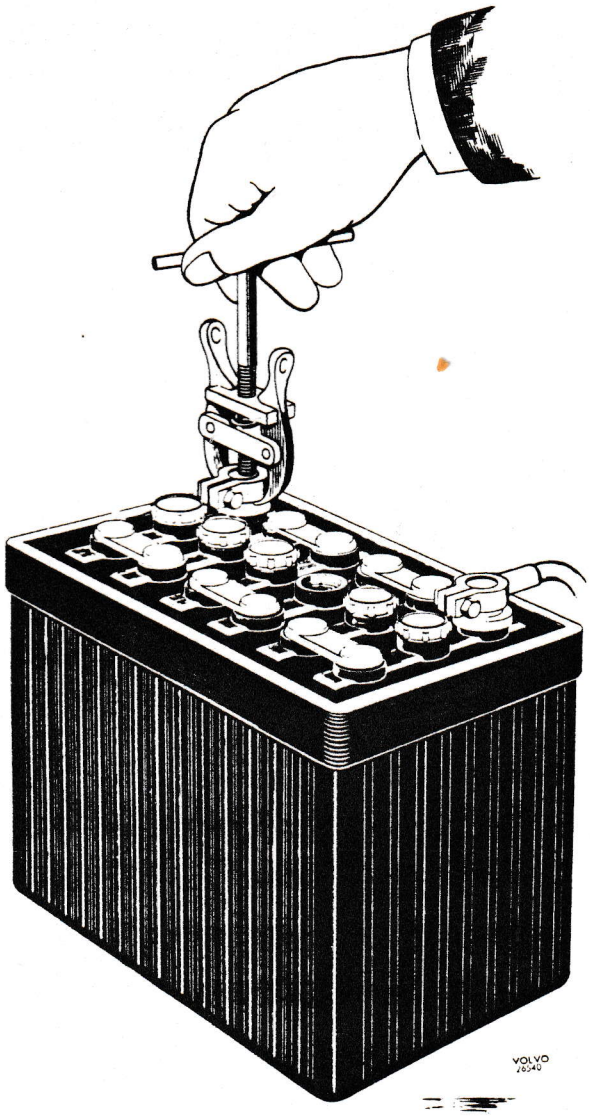


Fig. 14. Removing battery cable terminal

If the battery is found to be in a discharged condition or the specific gravity of the acid has fallen to 1.20, the battery must be lifted out and charged at a charging station. The specific gravity of the acid is measured with a hydrometer as shown in Fig. 13.

When fitting the battery into the vehicle, ensure that it is properly in position, that the cable terminals are cleaned and carefully tightened and then coated with vaseline. The best way of cleaning the cable terminals is with a special pair of pliers as shown in Fig. 15.

In order to obtain an idea of the condition of the battery under loading, it can be tested with a cell tester. During 10—15 seconds discharging, the voltage must not be less than 1.6 V per cell and the variation not greater than 0.2 V.

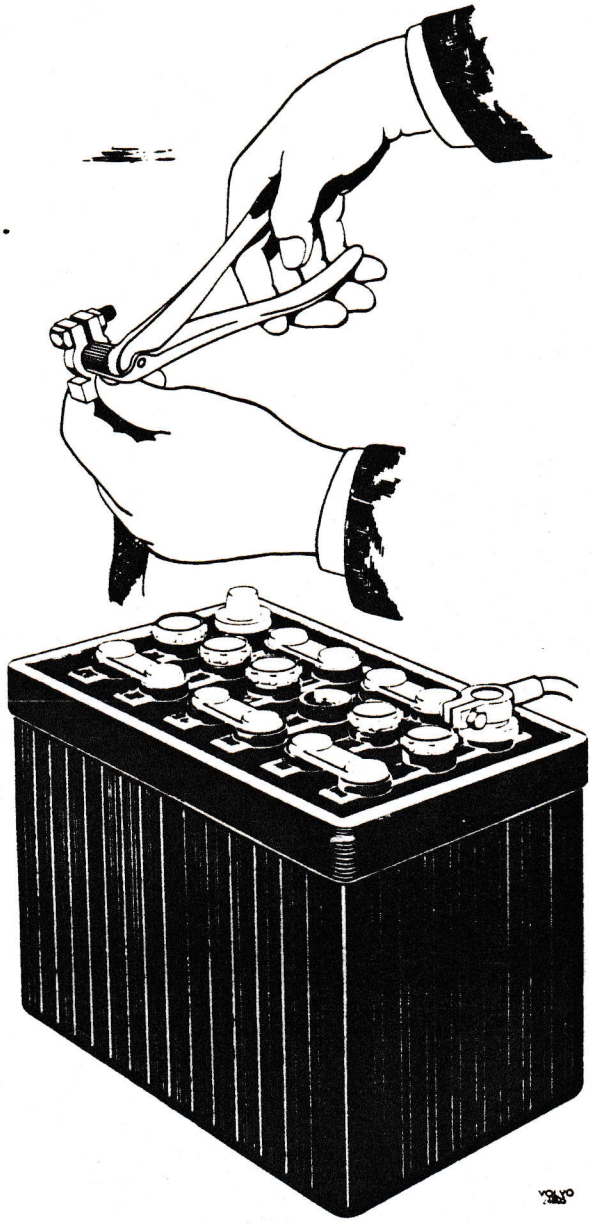


Fig. 15. Cleaning battery cable terminal

DYNAMO

Removing

1. Remove the cable terminal from the battery negative terminal stud.
2. Disconnect the leads from the dynamo.
3. Disconnect the V-belt tensioning stay and lift off the V-belt.
4. Remove the two bolts which hold the dynamo to the engine and lift it off.
5. Wipe off the dynamo externally with a piece of cloth soaked in petrol.

Measures to be taken before removing and dismantling

If the dynamo does not charge, or if there is reason to suspect that it is not producing sufficient current, or gives off excessive current or voltage, it must be ascertained whether the fault lies in the dynamo itself or if the charging regulator and leads are out of order.

First check that the connection from the battery to the relay terminal marked B 51+ is intact. This is done with a voltmeter. The voltmeter is connected between the relay terminal B (51 B+) and the chassis. The voltage here must not be less than the battery voltage. If the voltmeter gives a poor reading, the leads and contact points must be examined. If the voltmeter gives no reading at all, this indicates a breakage in the system.

If there is no fault, the following tests should be carried out on the dynamo. The leads on the dynamo are disconnected. The field terminal (DF) is connected with a lead to the dynamo current terminal (D+) and the dynamo frame. The engine is started and the speed increased from idling up to about 2000 r.p.m. during which time the voltage should rise in proportion to the increase in engine speed.

Then go back to idling speed and disconnect the earth connection of the field. The voltmeter should then return to 0. If it does not do so, this means that the field is earthed inside the dynamo, causing the charging regulator to be put out of function with

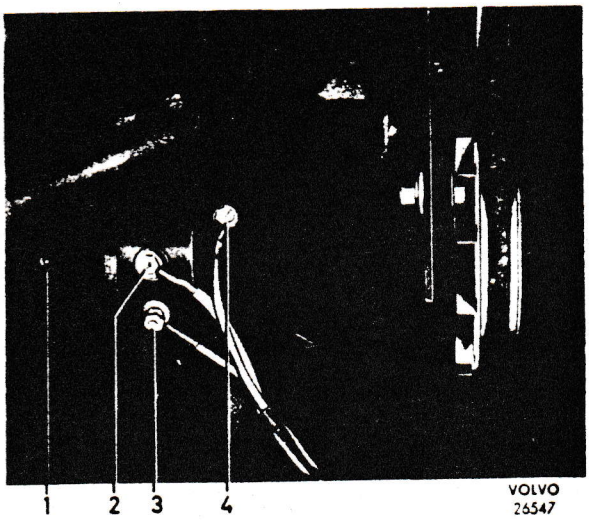


Fig. 16. Dynamo connections

1. Lubricating cup (only on dynamo type AR 6)
2. Dynamo, D+
3. Dynamo field, DF
4. Earth lead

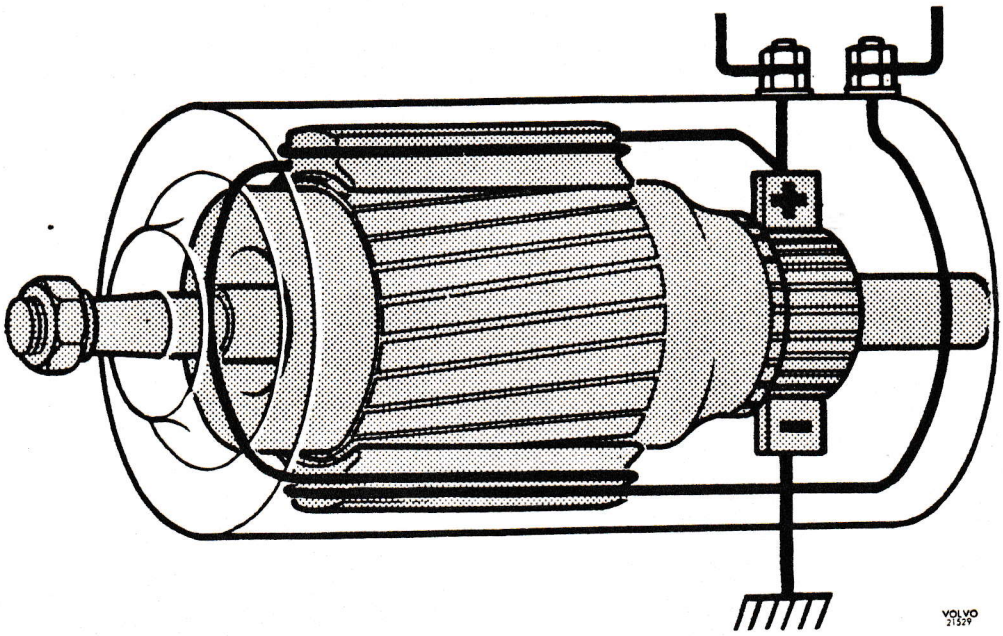


Fig. 17. Dynamo, general arrangement

the result that the dynamo will burn out. The test can also be carried out as follows: disconnect the dynamo leads on the charging regulator. The field lead is earthed and the engine speed gradually increased during the time the other lead from the dynamo is brought into contact with the charging regulator frame a few times. Heavy sparking should then occur when contact is made between the lead and the charging regulator frame.

Contact between the charging regulator frame and field winding should then be broken and the main lead brought into contact with the charging regulator frame again, when no sparking must occur. If so, this indicates that the field is earthed inside the dynamo.

If there is no sparking, or if the voltmeter does not give a reading, this means that the dynamo is faulty and must be removed.

Examining the dynamo

After removing, the dynamo should be cleaned externally with petrol or similar. The protecting band for the brushes should be removed and the dynamo placed on a test bench. The testing to be carried out now is done to establish the type of fault in the dynamo and it is most important that testing is carried out correctly and with reliable instruments.

The dynamo field terminal is connected to the dynamo frame and this connected to the battery negative terminal. The positive terminal on the battery is connected in series with an ammeter to the dynamo output terminal.

The dynamo should now run like the engine at a low, even speed. If not, see the following fault-tracing scheme.

Current low, rotor stationary.	Brushes worn or bind in their holders and do not reach down to the commutator.
Current low, rotor rotates slowly.	Poor contact between the brushes and commutator. Breakage in rotor winding.
Current high, rotor stationary.	Shorting in the rotor. Breakage or shorting in field. A bearing has seized.
Current high, rotor rotating.	Scored or burnt commutator. Binding bearings. Excessive brush spring pressure.
Excessive movement of brushes and heavy sparking.	Out-of-round or burnt commutator. Damaged brushes.

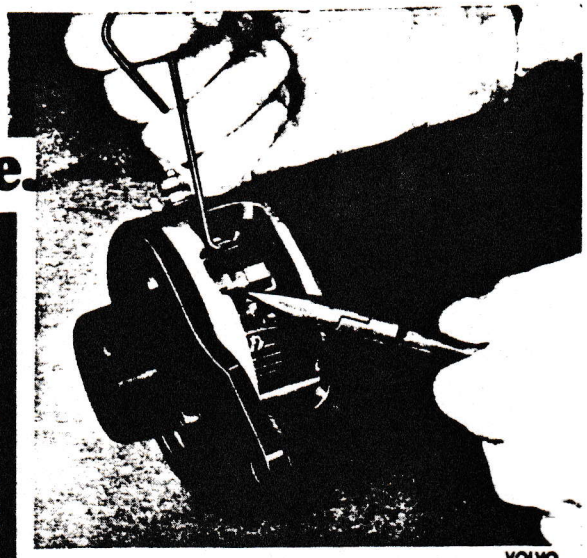


Fig. 18. Removing the brushes

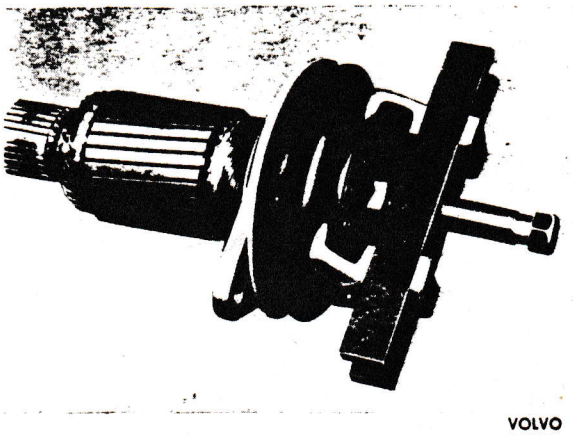


Fig. 20. Removing the belt pulley

mantling the dynamo for overhaul (cleaning and ricating) is done as follows:

Remove the protecting band if this has been re-fitted after testing.

Disconnect the brush connecting leads. Lift up the pressure arms or spring for the brushes with a hook and pull up the brushes as shown in Fig. 18.

Remove the screws which hold the dynamo housing and end shield together after having first disconnected the connecting bar as shown in Fig. 19.

Fig. 19. Removing the connecting bar

4. Lift off the rear end shield with brush holders.
5. Lift the rotor out of the housing.
6. Place the rotor in a vice but do not tighten too hard (use copper jaws). Unscrew the nuts for the belt pulley and pull this off. Use a suitable tool as shown in Fig. 20. Remove the Woodruff key.
7. Remove the front end shield from the rotor.
8. Pull off the ball bearing with a standard puller.
9. Blow the dynamo housing with field winding and rotor clean from dust and dirt. Wipe with a linen rag soaked in petrol. Note. Spirit mixtures such as bentyl must not be used since these can dissolve the insulation. Wash the other parts, except the brushes, in clean petrol.

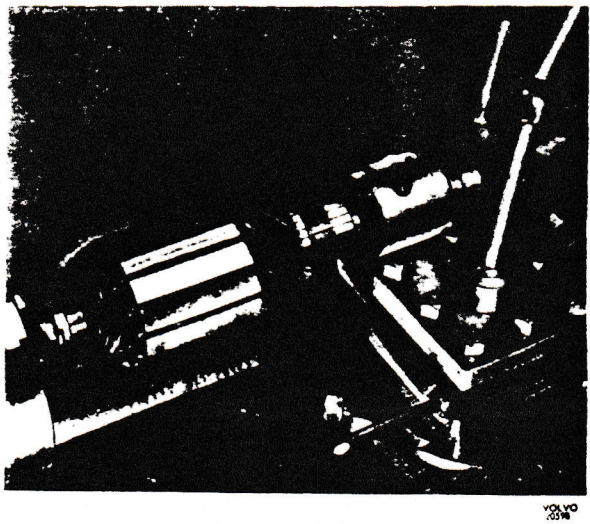


Fig. 21. Turning the commutator

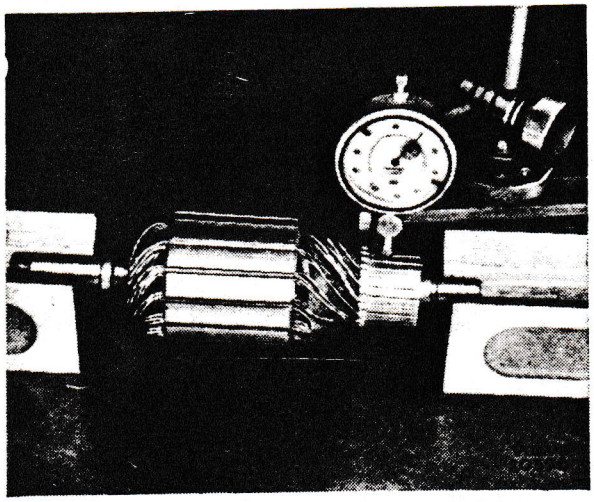


Fig. 22. Measuring the commutator with dial gauge

Inspecting

Examine the rotor for mechanical damage such as a bent or worn shaft, scored commutator and damaged or loose rotor winding.

A shaft which is only slightly bent can be straightened in a press, but this is not recommended. It is preferable to replace the rotor. If the commutator is scored or unevenly worn, it should be turned. When turning, a special chuck should be used. The greatest care must be observed. Take small cuts at a time so that no more material is removed than is absolutely necessary. If too large cuts are taken, this can damage the insulation and laminations. Make sure that no object touches the rotor or winding during the turning.

After turning, the commutator should be measured with a dial indicator gauge as shown in Fig. 22. A maximum out-of-roundness of 0.013 mm (0.0005″) can be considered permissible. The insulation between the laminations should be milled down 0.8—1.0 mm (0.032—0.039″) below the surface see Fig. 23. This is done in a special apparatus, or if one of these is not available, with a ground-of hacksaw blade.

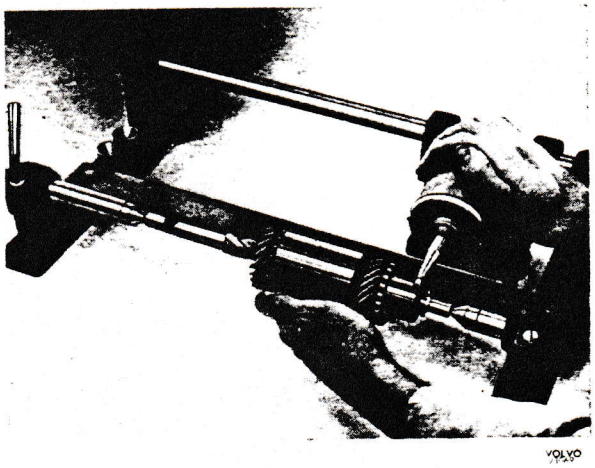


Fig. 23. Milling the grooves

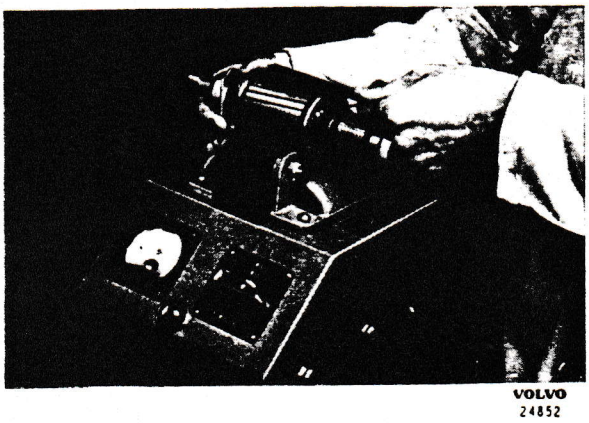


Fig. 24. Testing the rotor

Examine the rotor both before and after turning by placing it in a growler. Switch on the current and hold a hackshaw blade close to the rotor, see Fig. 24.

If the blade vibrates in any position when the rotor is turned round one of the following faults can be the reason: shorting to rotor frame, shorting in commutator or windings.

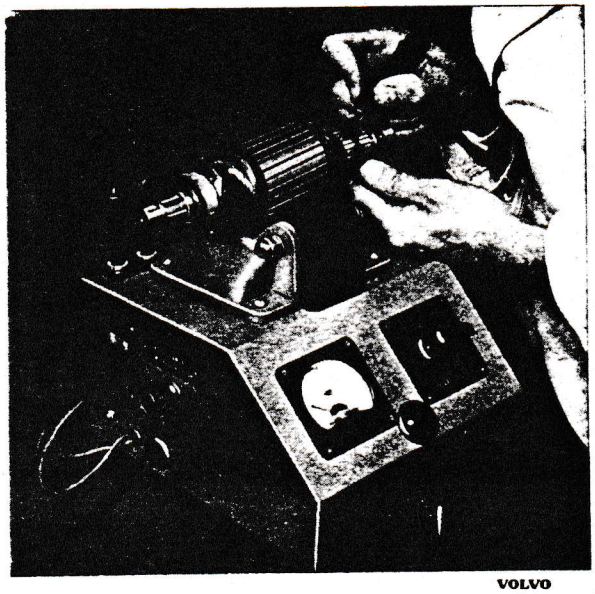


Fig. 25. Measuring the rotor

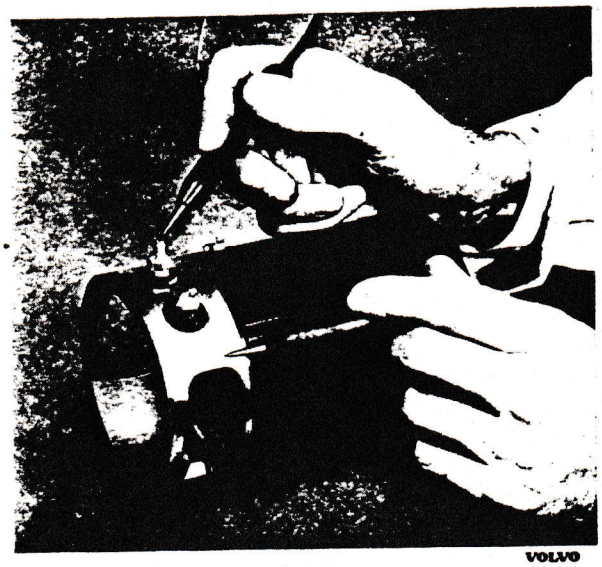


Fig. 26. Testing the stator

Shorting between the windings can be determined by holding the resistance prong against the commutator as shown Fig. 25. Switch on the current and adjust the rheostat while turning the rotor backwards and forwards until the highest reading is obtained on the meter. Turn the rotor (the prong must be held still) so that the next pair of laminations comes opposite the prong and hold this against these. If there is no fault, the reading should be the same for all the other laminations. A rotor coil with shorting between the windings shows a low reading and a coil with breakage, no reading at all. Shorting to the rotor body is tested with the help of test prods and testing lamps as shown in Fig. 26.

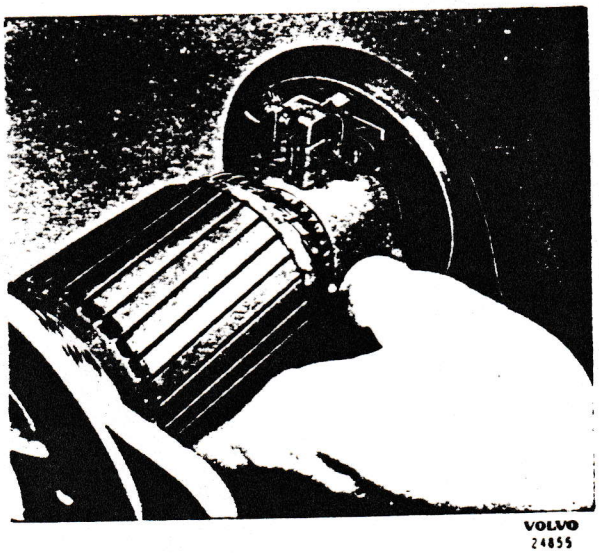


Fig. 27. Sand-papering the brushes

Examine the housing and field winding for any damage which could be caused by the rotor. Test that the field winding is not earthed by connecting the contact points to the field terminal and housing. If the lamp lights, this indicates shorting between the field winding and housing. Unscrew the field lead-through and test again. If the lamp still lights, this indicates that the field winding is in contact with the housing. The winding must then be removed. Concerning this see under "Replacing the field winding".

Internal faults in the field coil can be determined by measuring the current consumption of the coils. This is done with an ohmmeter or a volt-ammeter. If the latter is used, conversion must be done in accordance with Ohm's law.

Examine the rear end head with brush holders. If any of the parts are damaged, they must be replaced. Test to make sure there is no shorting between the positive brush holder (insulated) and the end head.

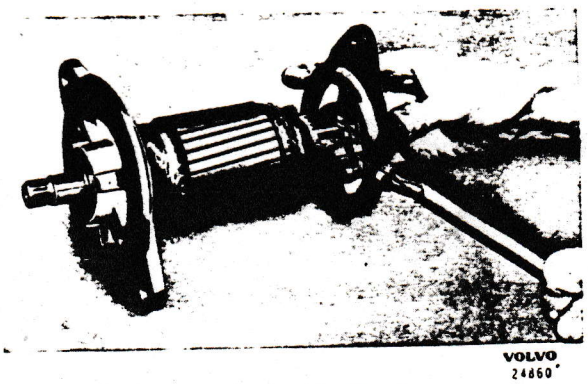


Fig. 28. Measuring the brush pressure

Brushes which are damaged or worn down more than half way must be replaced. Brushes which are scored or have poor contact with the commutator can be ground-in with sand paper gauge 00 or 000 as shown in Fig. 27.

Test the strength of the brush springs by fitting the end head on the rotor and connecting a spring balance to the moveable arm or spring, see Fig. 28. The force necessary to lift the arm or spring should agree with the values given in the "Specifications". If there is any deviation, the spring must be replaced.

Check the bearings. The ball bearings should rotate easily without any noticeable play. Damaged or worn bearings must be replaced.

Assembling

1. Fit the stop ring and sleeve, it there is one, on the shaft.
2. Place the inner cover with felt ring, if fitted, on the shaft. Lubricate the bearing with heat-resistant ball bearing grease and then fit it.
3. Place the front end shield on the shaft and bearing and screw together the end shield and cover.
4. Drive in the key and press on the belt pulley. Place the rotor in a vice. Do not tighten too hard as otherwise the rotor can be deformed. Fit the spring washer and nut.
5. Place the rotor in the housing and make sure that the guide peg comes in the right position.
6. Place the end shield on the shaft, adjust in the guide peg, and screw in the two screws which hold the dynamo housing and end shields together. Check that the rotor turns easily. Fit the brushes to the holders in the rear end head.
7. Connect the bar for the main current to the positive brush, see Fig. 19.

Replacing the brushes

If the brushes are damaged or worn down more than half way, they must be replaced. This can usually be determined by the fact that the dynamo ceases to charge. Remove the protecting band and inspect the brushes and commutator. If it is seen that the above-mentioned fault can be the reason for no charging, the dynamo should be removed. Carefully wash or wipe the dynamo externally with a piece of cloth soaked in petrol.

Take out the brushes by removing the connection at the brush holder, lifting up the brush spring and pulling out the brush with a pair of pliers as shown in Fig. 18. If the commutator is scored or unevenly worn, the dynamo must be dismantled and the commutator turned. Concerning this, see under "Dismantling, inspecting and assembling". Place in the brushes, ensuring that the correct types are used, and fit the protecting band. If there are dynamo testing devices available, it is advisable to test the dynamo before re-fitting it into the vehicle. Concerning this, see under "Testing the dynamo".

Replacing the field winding

1. If the dynamo is not dismantled, proceed in accordance with points 1 to 5 under the heading "Dismantling".
2. Place the dynamo housing in a V-block as shown in Fig. 29. Press down while turning the wrench at the same time. As a rule, the screws are tightened very hard. Therefore, make sure that the screwdriver head fits well into slot in the screw and is sufficiently wide.
3. When both these screws have been slackened, the housing is lifted off. Unscrew these screws using an ordinary screwdriver. Remove the cable lead-through in the housing and lift out the windings and pull shoes.
4. Connect the cables at the lead-through in the housing. Test for earthing.
5. Assemble the other parts of the dynamo. See under the heading "Assembling".

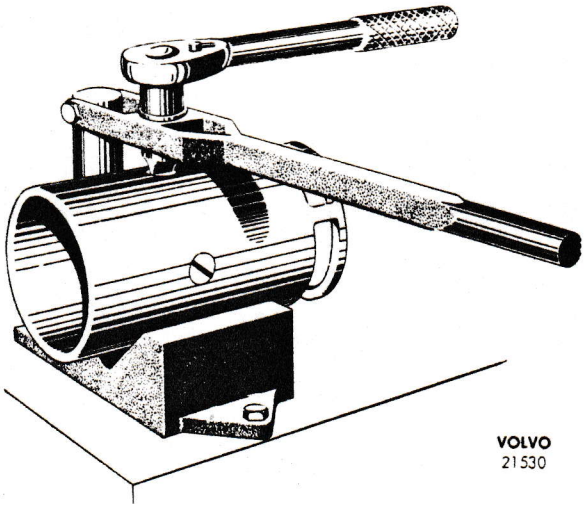


Fig. 29. Removing the field windings

TESTING THE DYNAMO

Before the dynamo is refitted into the vehicle, it should be tested. Place the dynamo on the test-bench and connect the volt-ammeter.

First run the dynamo like the engine for a short while. Ensure that the dynamo has the correct polarity, negative to frame. Make sure that the current consumption of the dynamo is normal and that it runs evenly and quietly. Then start the drive motor, check its direction of rotation and ensure that the dynamo produces the necessary voltage at the speeds mentioned in the specifications. Check that there is no sparking on the commutator and that the brushes do not jump.

LUBRICATING INSTRUCTIONS

Dynamos with ball bearings at both ends

The ball bearings should be cleaned with white spirit and lubricated with suitable ball bearing grease when overhauling. See the dynamo lubricating scheme, Fig. 30.

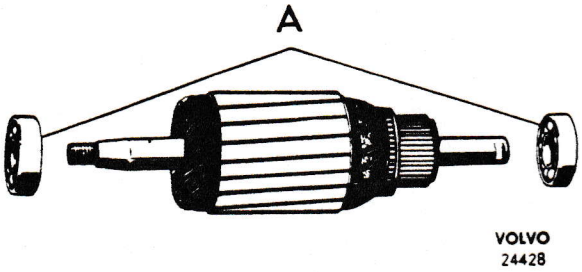


Fig. 30. Dynamo lubricating scheme

A. Bearings lubricated with grease, Bosch Ft 1 v 22 or equivalent

Dynamo with ball bearing and bushing

For the ball bearing, see above.

Bushing: The lubricating cup on the commutator end of the dynamo should be filled with engine oil every 10,000 km (6,000 miles). Lubricating is done with an ordinary oil can. A pressure oil can must not be used.

NOTE. A new bushing should lie in an oil bath for at least half an hour before being fitted.

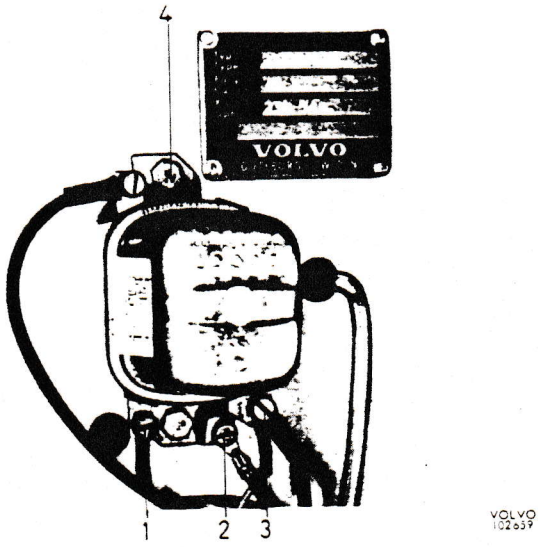


Fig. 31. Charging regulator terminals

1. Dynamo field DF
2. Earth lead
3. Dynamo D+
4. Battery B+

CHARGING REGULATOR

Removing

1. Disconnect the leads on the charging regulator.
2. Remove the charging regulator from the bulkhead.
3. Wipe off the charging regulator externally.

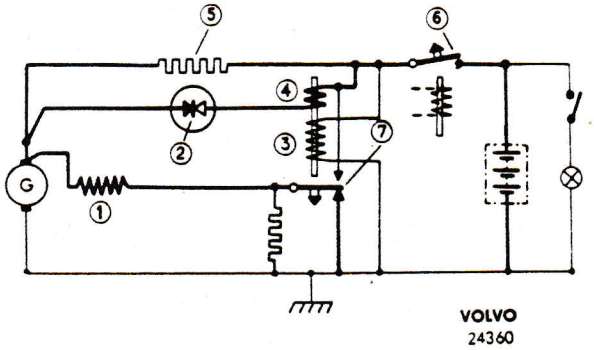


Fig. 32. Wiring diagram for charging regulator

1. Field winding
2. Variode
3. Voltage winding
4. Current winding
5. Variode resistance
6. Cut-in contacts
7. Regulator contacts

Fitting

1. If the charging control has to be replaced, check that the new one is of the correct type.
2. Screw the charging control onto the wheel housing.
3. Connect the leads as shown in Fig. 31.

Adjusting the charging regulator

REVERSE CURRENT RELAY

Cut-in voltage

A voltmeter is connected over D+ on the charging regulator and dynamo frame. The engine is started and the speed increased while watching the voltmeter. The reading should first increase and then fall back to 0.1—0.2 V when the reverse current relay cuts in, after which it should remain still. The reading given by the voltmeter up to the point when cutting-in takes place is known as the cut-in voltage.

This should be compared with the value given in the "Specifications" and any necessary adjustment carried out.

Adjusting is done by increasing or decreasing the pressure of the spring which influences the relay armature. If the spring pressure is reduced, the cut-in voltage will decrease and vice versa.

Rough adjusting is carried out as shown in Fig. 33, and fine adjusting as shown in Fig. 34.

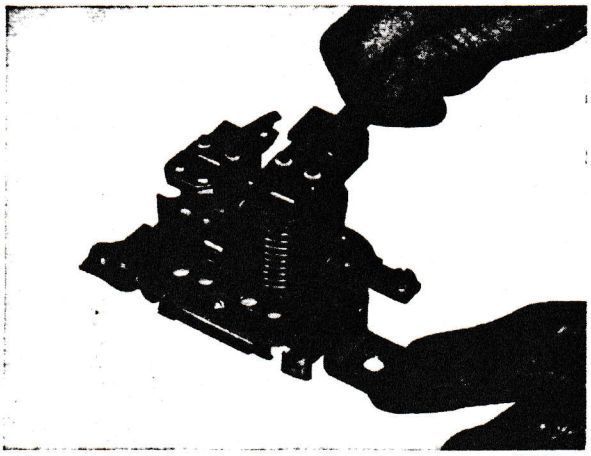


Fig. 33. Adjusting the cut-in voltage

Reverse current

An ammeter is connected in series with B+ on the charging regulator and the lead to the battery. The speed of the dynamo is increased until the ammeter shows a reading. The speed is then reduced gradually. The ammeter needle will go down to zero and then over to discharge. After this, it will suddenly go up again to zero. The reverse current should lie between the values given in the "Specifications". If the reverse current is too low, the bend of the contact spring should be lessened by bending the contact yoke of the cut-in contact. It may be necessary to file off the pole pin slightly.

If the reverse current is too high, the bending of the contact spring must be increased. Check the cut-in contact gap and adjust this if necessary. After any adjusting, check the cut-in voltage again.

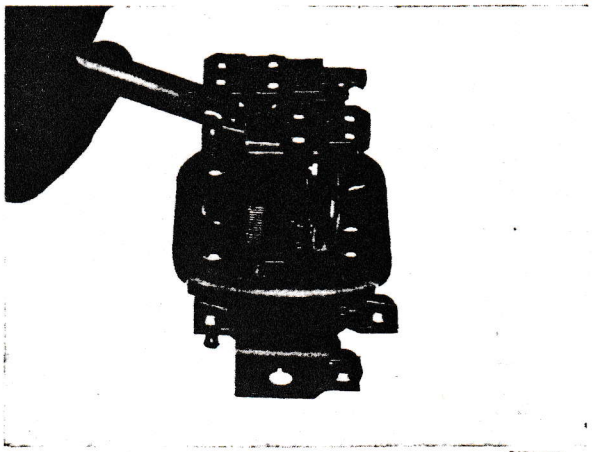


Fig. 34. Fine adjustment of the voltage regulator

VOLTAGE REGULATOR

Disconnect the connection B+ on the charging regulator. Connect a voltmeter between B+ and the charging regulator frame and increase the dynamo speed gradually.

As soon as voltage regulation has begun, that is to say, when voltage does not increase further, the control voltage should be read off. The regulator is adjusted by bending the support lip for the spring tongue as shown in Fig. 34, so that the spring tongue is completely unloaded. After this, a rough adjustment is made by bending the relay angle piece as shown in Fig. 35. If the angle piece is bent downwards, the voltage is increased and vice versa. Rough adjustment should lie about 1—2 V lower than final adjustment. This is done by bending the support lip upwards so that the spring tanque is tensioned, see Fig. 35. Use special tool V 397 (Robert Bosch).

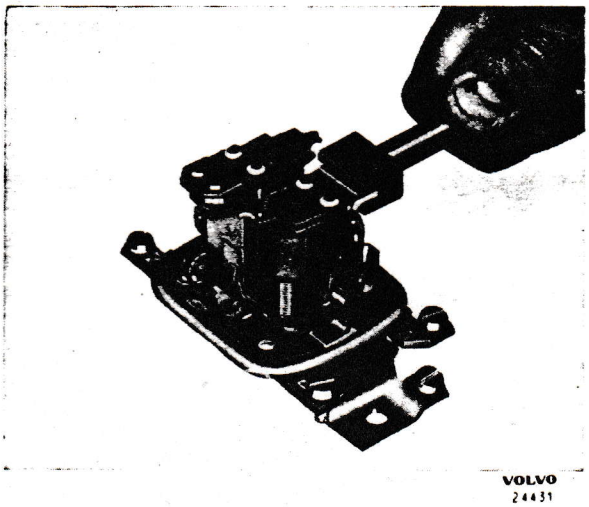


Fig. 35. Rough adjustment of the voltage regulator

Increase and decrease the speed a few times and ensure that the regulator is correctly adjusted.

NOTE. This adjustment must be done after the dynamo has reached full operating temperature, that is to say, at least 12 minutes after the engine has been started from cold.

CHECKING THE VARIODE UNDER LOADING (COLD DYNAMO)

Connect an ammeter between B+ and the live lead, and connect an adjustable loading resistance

of suitable size between the battery side of the ammeter and the frame. In addition, a voltmeter should be connected between B+ and frame.

Increase the speed and note the meter readings. Adjust the loading resistance so that a loading current =1 max. is obtained. Check the regulator voltage under loading.

Run the engine at the above loading. After about 2—3 minutes the current value must not be higher than 2/3 of the max. current stamped on the dynamo (1 max.). If the loading does not fall, this indicates a fault in the variode, so that the charging regulator must be replaced.

Since the effect of the dynamo is very high, great demands are placed on the condition and tension of the drive belt. Before carrying out any work on the charging regulator and dynamo, therefore, always check that the belt is correctly tensioned.

3. Unscrew the bolts which hold the starter motor to the flywheel housing and lift it off.
4. Wipe off the starter motor externally with a piece of cloth soaked in petrol.

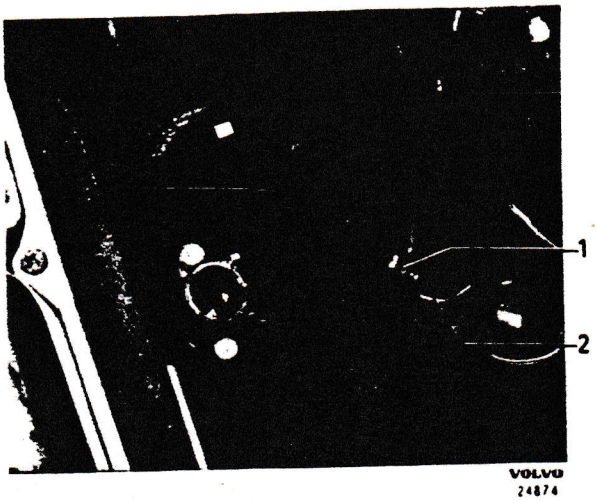


Fig. 36. Starter motor installed

1. Battery lead 2. Control lead

STARTER MOTOR

Removing

1. Remove the cable terminal from the battery negative terminal studs.
2. Disconnect the leads from the starter motor.

Fitting

Fitting is carried out in the reverse order to removing. Tighten the bolts evenly, but not too tightly. Connect the leads carefully.

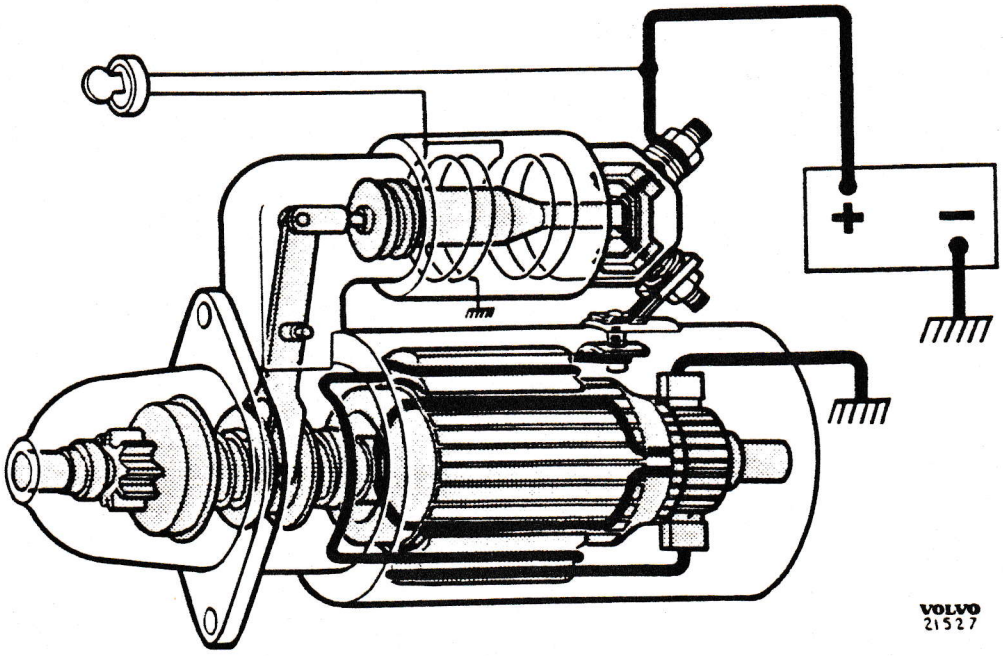


Fig. 37. Starter motor, general arrangement

Measures to be taken before dismantling

If the starter motor shows signs of not functioning satisfactorily, or perhaps not at all, first make sure that it is not the battery, leads, starter contact or solenoid that are out of order. If the trouble is traced to the starter motor, remove it. Before dismantling is started, it is important to carry out correct testing. Reliable instruments must be available if the results of the test are to be of any value. Testing is carried out as follows:

Place the starter motor on a test bench and remove the protecting band.

Connect the starter motor to the correct voltage. The starter motor housing is connected to the negative terminal. If the starter motor functions without any signs of shorting or stiffness when the current is connected, testing is continued. Connect up a voltmeter/ammeter to a 500 A shunt. Hold a revolution counter against the shaft end of the rotor. Connect the current and read off voltage, amperage and revolutions. Also watch the

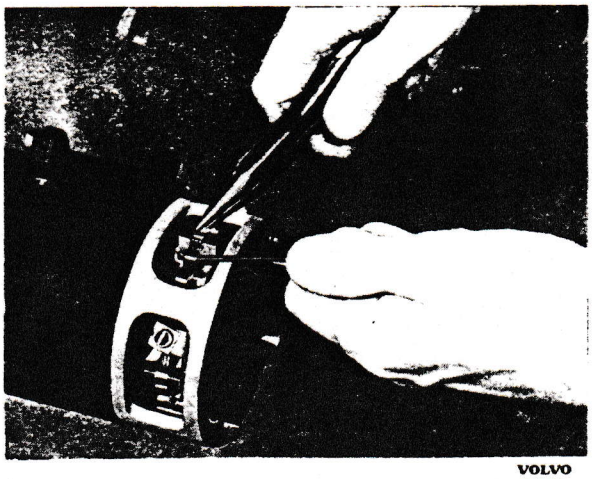


Fig. 38. Removing the brushes

brushes and commutator. Make a note of the values and observations. Compare the values with those given in the "Specifications" for an unloaded starter motor. The following reasons can now be established:

1.	Low revolutions and low amperage.	Excessive resistance caused by dirty commutator, worn brushes or poor spring pressure.
2.	Low revolutions and high amperage.	Shorting in field windings. The rotor drags against the pole shoes due to worn bearings or bent rotor shaft.
3.	Heavy sparking, low rotation.	Low spring pressure due to worn brushes of fatigued brush springs. Shorting or partial breakage in rotor winding.
4.	Excessive movement of brushes.	Poor spring pressure or out-of-round commutator.

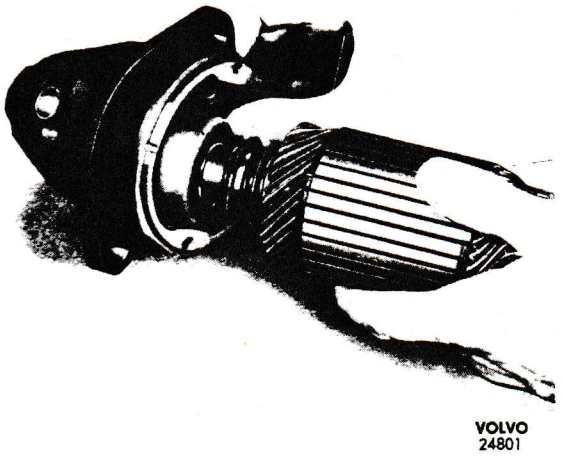


Fig. 39. Removing the pinion and rotor

Dismantling the starter motor Bosch EGD 1/12 AR 37

Dismantling the starter motor for overhaul (cleaning and lubricating) or repairs is done as follows:

1. Remove the protecting band.
2. Lift up the spring brushes and remove these, see Fig. 38.
3. Mark the position of the front and rear end heads in relation to the housing.
4. Remove the screws which hold together the above-mentioned main parts of the starter motor. Lift off the rear end head with rotor brake together with the housing after the lead between the control solenoid and housing has been removed.
5. Lift out the rotor with pinion from the pinion housing, see Fig. 39. This can be done after the pivot screw for the solenoid engaging fork has been removed.
6. Remove the stop washers on the rotor shaft. The thin washers (axial adjusting washers) and ring (3, Fig. 40), are removed by pulling straight off the shaft. The thick ring (1, Fig. 40), is first knocked in 5—8 mm (about 1/4") on the shaft so that the circlip (2, Fig. 40), can be removed after which the washer is pulled off the shaft.

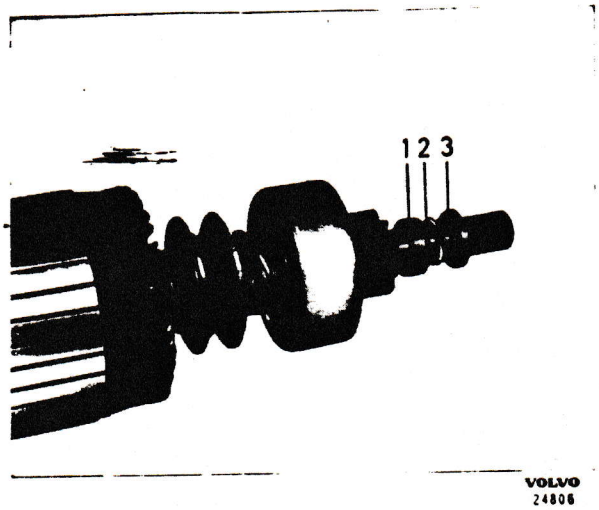


Fig. 40. Pinion, circlip and nut

1. Stop ring, inner 2. Circlip 3. Stop ring, outer

7. Remove the rotor brake from the rear end shield.
8. Blow the starter motor housing and field winding with rotor clean from dirt and dust. Wipe off with a piece of cloth soaked in petrol. Note. Spirit/petrol mixtures such as bentyl must not be used since they can dissolve the insulation.

Dismantling the starter motor

Bosch AL/EGF

1. Remove the small cover over the front end of the shaft, see Fig. 42.
2. Lift off the lock washer and adjusting washer as shown in Figs. 43 and 44.
3. Remove the through-running bolts.
4. Lift off the commutator bearing shield. NOTE. The brushes and retainers remain in position on the rotor, see Fig. 45.
5. Pull the brushes out of the brush retainers.

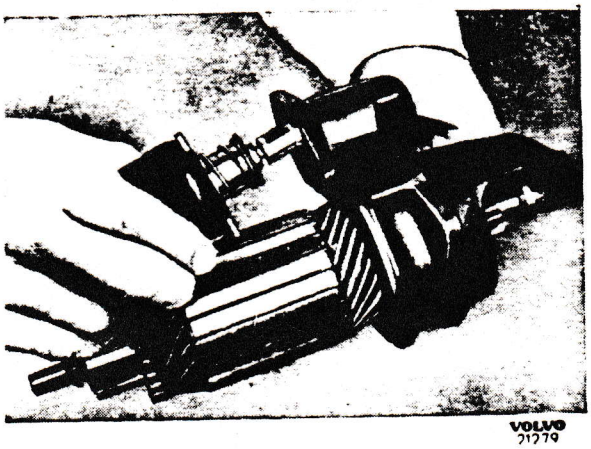


Fig. 41. Removing the control solenoid

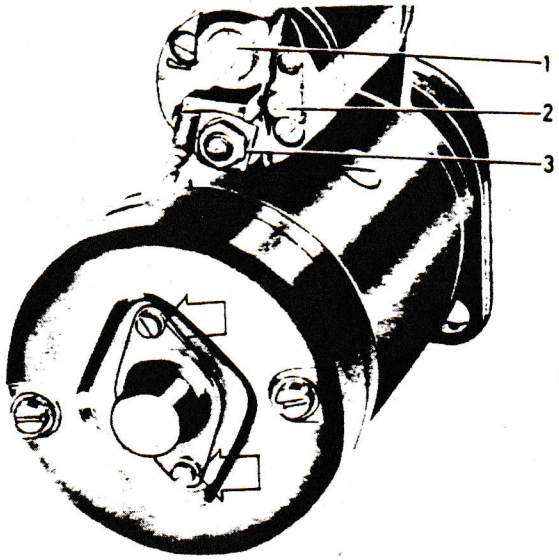


Fig. 42. Starter motor

1. Terminal for battery
2. Terminal for starter switch
3. Terminal for field

6. Remove the brush retainer plate from the rotor shaft. Note the washers, see Fig. 46.
7. Unscrew the nut which holds the field terminal connection to the control solenoid.
8. Unscrew the attaching screws for the control solenoid and remove this from the drive bearing shield. Control solenoid, see Fig. 47.
9. Remove the drive bearing shield from the pole housing.
10. Remove the pivot pin the engaging arm.
11. Remove the rubber washer and metal washer from the drive bearing shield as shown in Fig. 48.
12. Lift the rotor with pinion and arm out of the bearing shield, see Fig. 49.

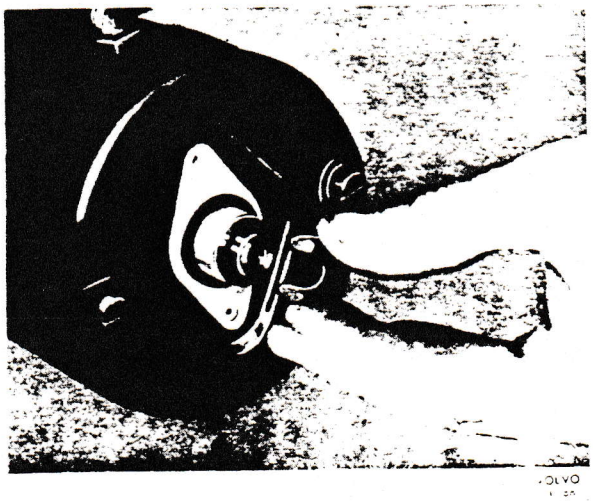


Fig. 43. Removing the lock washer

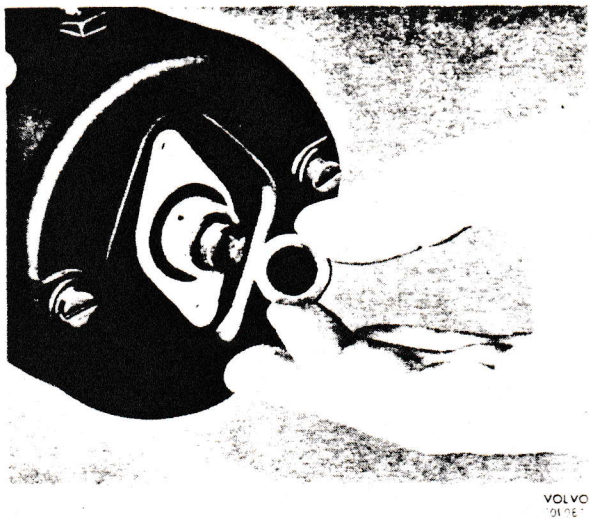


Fig. 44. Removing the adjusting washer

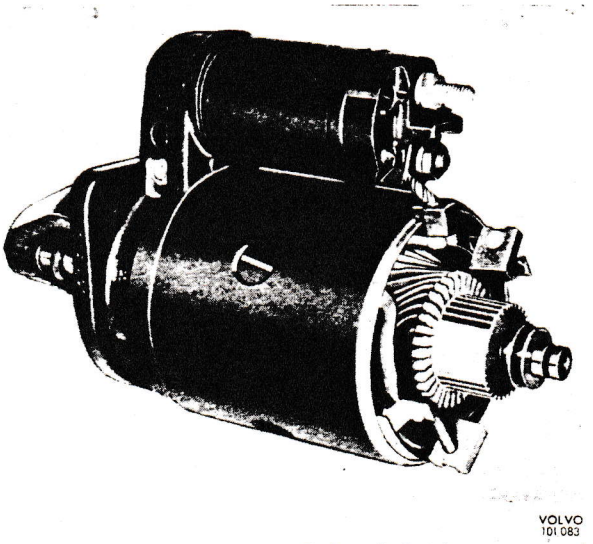


Fig. 46. Starter motor with brush bridge removed

Knock back the wear washer and remove the circlip on the rotor.

Pull off the stop ring on the rotor shaft. Remove the starter pinion.

Remove the rotor from the end (drive bearing) shield.

Clean all parts, except the rotor field winding and pinion in cleaning solution. The rotor, field winding and pinion are cleaned with a piece of cloth moistened in cleaning solution and then blown dry with compressed air.

Inspecting

Examine the rotor for mechanical damage such as a bent or worn shaft, scored commutator and damaged windings. If the rotor shaft is bent or worn, the rotor should be replaced. Only in exceptional cases should the shaft be straightened, and this must be done in a press.

If the commutator is scored or unevenly worn, it should be turned, see Fig. 50. When doing so, a special chuck should be used, see the figure. Take small cuts at a time so that no more material is removed than is necessary. If too large cuts are taken, the insulation and laminations can be damaged.

The commutator should be checked with a dial gauge after turning, see Fig. 51. A radial throw of 0.003" (0.08 mm) can be considered permissible. The insulation between the laminations should be milled down to 0.4 mm (0.016") below the surface of the laminations, see Figs. 52 and 53. This work is carried out in a special apparatus, or if one these is not available, with a ground-off hacksaw blade.

Examine the rotor for shorting by placing it in a growler machine. Switch on and hold a hacksaw blade near to the rotor, see Fig. 54. If the blade vibrates in any position when the rotor is rotated, one of the following faults can be the reason: shor-

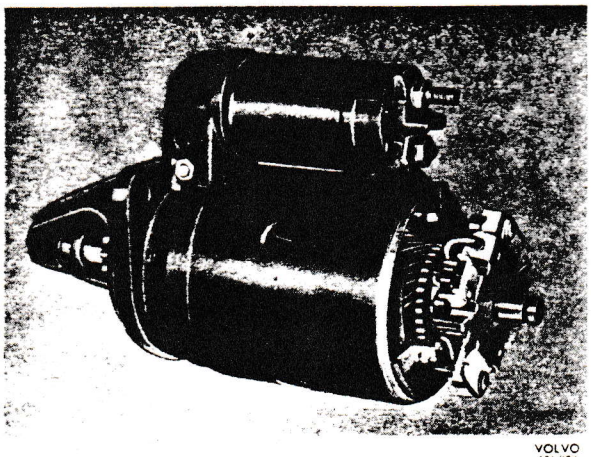


Fig. 45. Starter motor with bearing shield removed

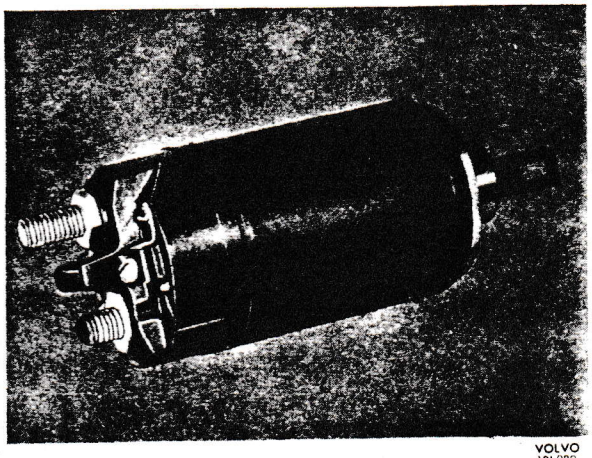


Fig. 47. Control solenoid

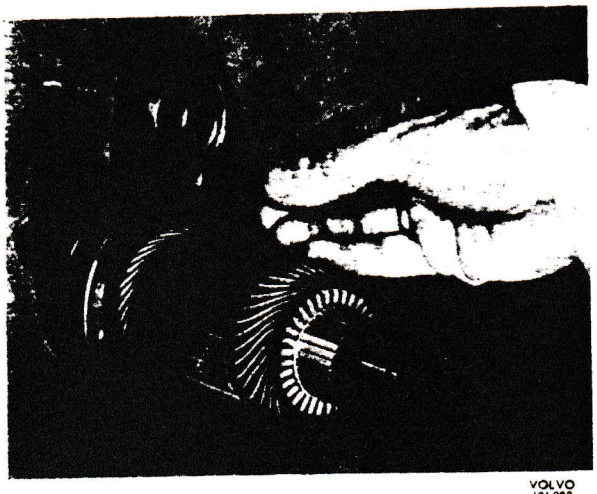


Fig. 48. Removing the rubber washer

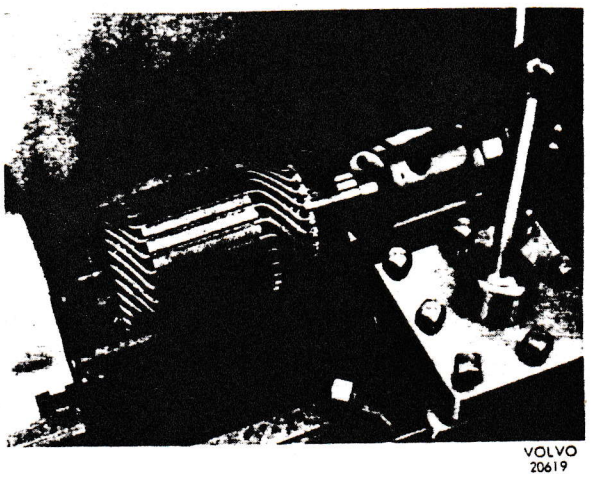


Fig. 50. Turning the commutator

ting through the rotor frame, shorting in the commutator or between the windings.

Shorting to the rotor frame is tested with the help of prods and a test lamp.

Examine the housing and field winding for damage caused by the rotor. Test that the field winding is not earthed by connecting the contact points to the housing and field windings as shown in Fig. 55. If the lamp lights, the winding or lead-through in the housing is damaged. Ensure that the brushes do not lie against the housing. Remove the lead-through in the housing and test again. If the lamp continues to light, the field is earthed. In this case the field winding must be removed. See under "Replacing the field winding".

Examine the end shield brush holders. If any of these parts are damaged or excessively worn, they must be replaced. A bearing clearance of up to 0.12 mm (0.005") can be considered as permissible. See under "Fitting the self-lubricating bushings". Check that both the positive brush holders are not in contact with the end shield, see Fig. 56.

Brushes which are damaged, scored or worn down more than halfway, must be replaced.

Check the spring pressure by means of a spring-

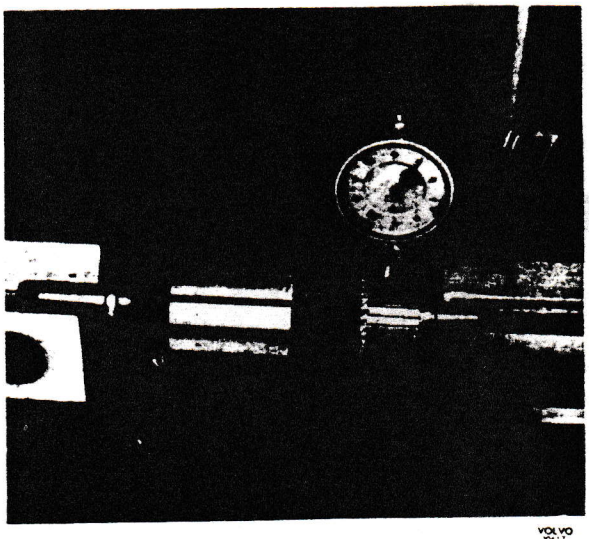


Fig. 51. Checking the rotor with dial gauge

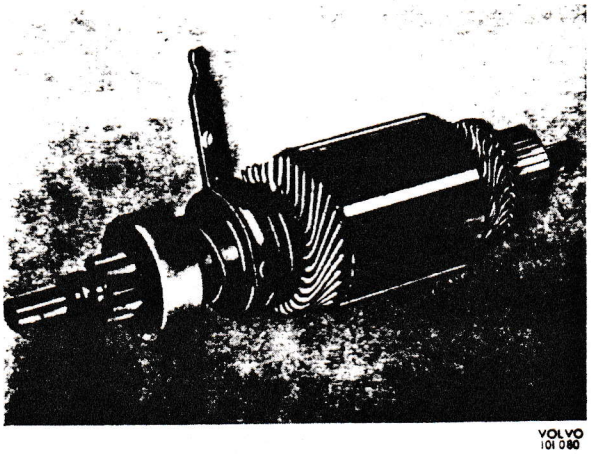


Fig. 49. Rotor with pinion

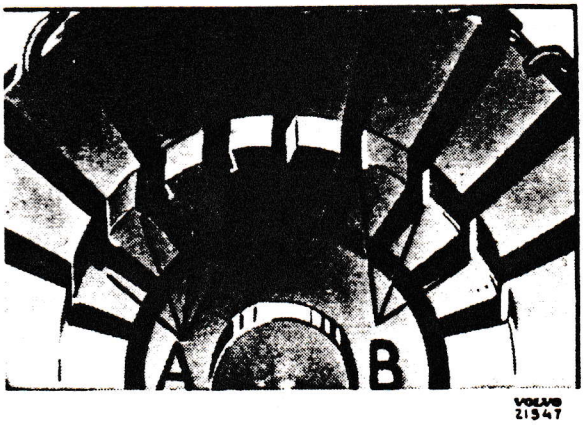


Fig. 52.

A. Incorrect milling B. Correct milling

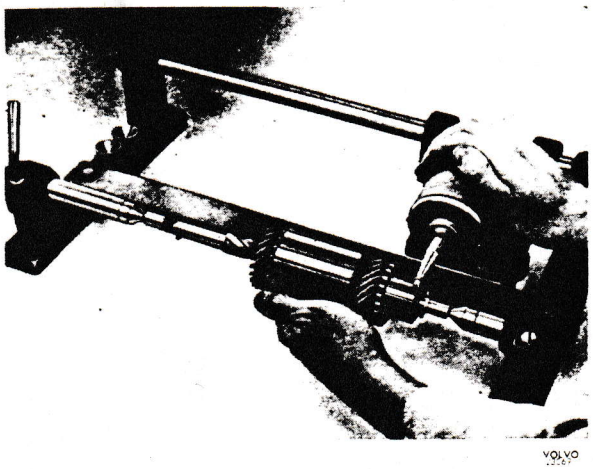


Fig. 53. Milling the grooves

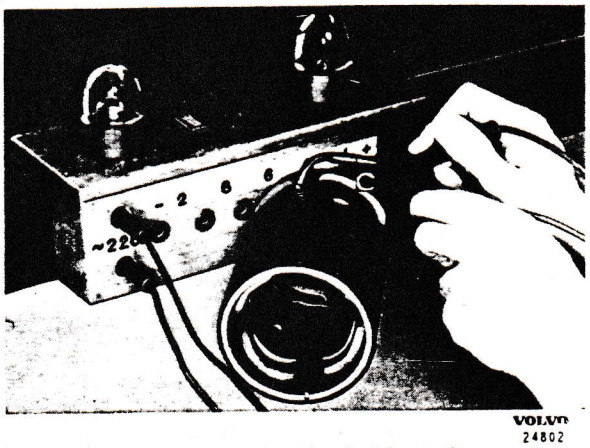


Fig. 55. Testing the field winding

balance which is hooked into the spring, see Fig. 57. The force necessary to lift the spring from the brush should lie between the values given in the 'Specifications". If there is any deviation in the values, the springs concerned should be replaced. Examine the pinion housing. Test the bearing on the shaft. Clearance should not exceed 0.12 mm (0.005").

Inspect the other parts and replace any which are damaged or worn. The circlips should always be replaced with new ones, since they may have been damaged or lost their tension when being removed.

Assembling the starter motor, early production

1. Fit the rotor brake in the rear end shield, see Fig. 58, and the lead between the positive brushes.
2. Fit the starter pinion on the rotor shaft and place on washers and circlip as shown in Fig. 40. Lubricate the rotor shaft in accordance with the instructions for Fig. 66.
3. Assemble the rotor and pinion housing and place the engaging arm in its position round the starter pinion. Then fit the solenoid switch on the pinion housing and place in the pivot screw.
4. Lubricate the starter pinion and engaging arm with heat-resistant ball bearing grease.
5. Place the housing on the rotor and fit it into the end shield following the guide pin or marking. Place the rear shield onto the rear shaft end of the rotor and secure it in the correct position with the screws which run through. Turn the rotor and check that it rotates easily. Measure the axial clearance and compare this with that in the "Specifications". Lubricate the shaft end and bushing.

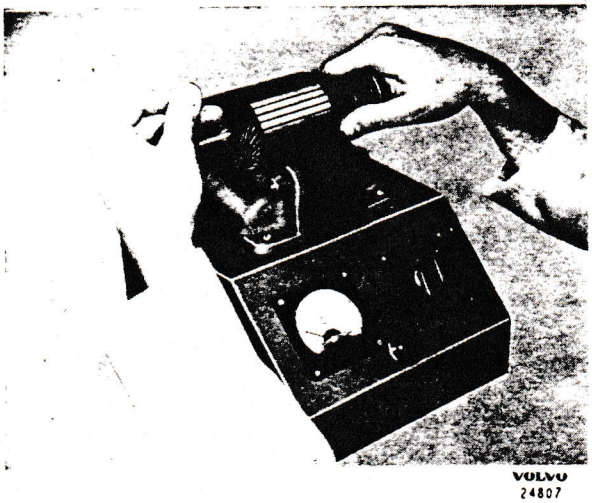


Fig. 54. Testing the rotor

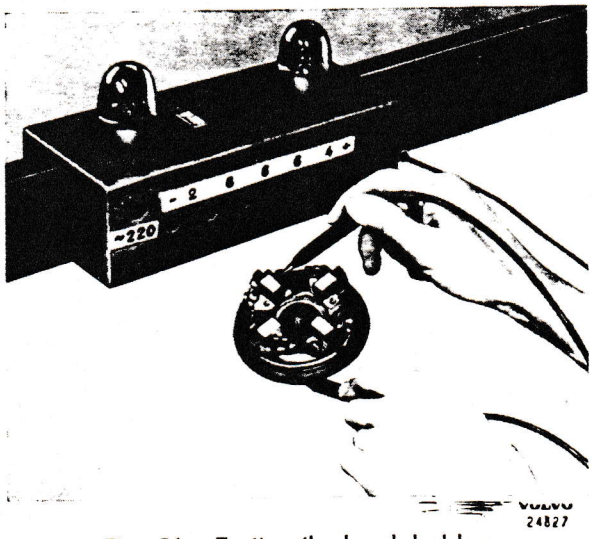


Fig. 56. Testing the brush holders

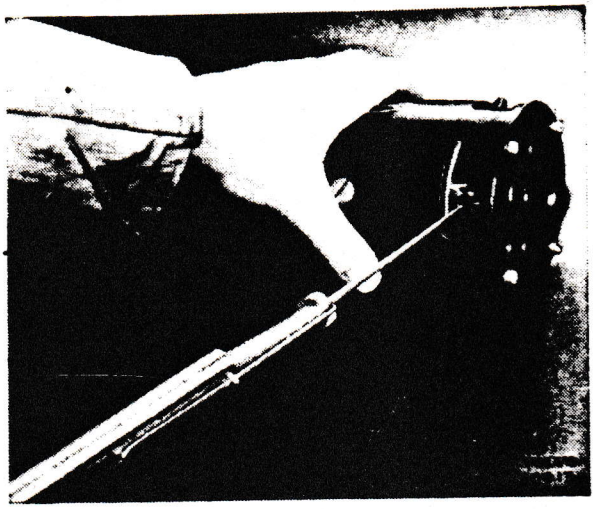


Fig. 57. Checking the brush spring tension

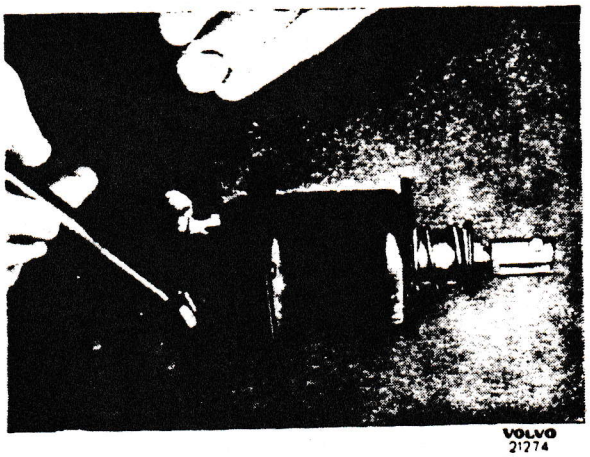


Fig. 59. Testing the control solenoid

Assembling the starter, late production

When assembling, lubricate the starter motor according to the instructions given for Fig. 66.

1. Fit the starter pinion, the wear ring and the circlip on the rotor shaft.
2. Assemble the rotor and the pinion housing. Fit the engaging arm, the steel washer, the rubber washer and the solenoid.
3. Mount the stator housing on the rotor. Then fit the washers on the rotor shaft, the brush holder plate and the brushes. Connect the cable to the solenoid.
4. Fit the commutator end shield and then the adjuster washer and circlip. Check the axial clearance, which should be 0.05—0.30 mm (0.0020—0.0120"). Fit the casing over the shaft end.

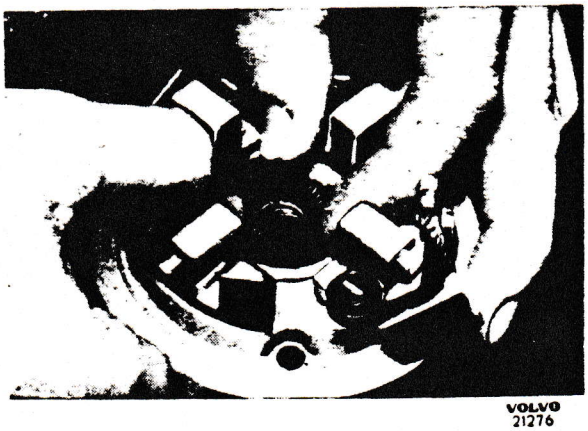


Fig. 58. Fitting the rotor brake

Control solenoid

If the control solenoid does not function, first check that the battery is in good condition. If there is no fault with the battery, connect a lead between the battery positive terminal and the control solenoid contact screw for the control lead. If the control solenoid still does not engage the starter pinion and main current, it should be removed from the starter motor. If, on the other hand, it engages satisfactorily, examine the starter switch and leads. When the control solenoid has been removed, it should be wiped clean. Then press the armature in several times and test again by connecting it to a battery. If it still does not function, the coil must be measured and the values obtained should agree with those in the "Specifications". A faulty control solenoid should be replaced.

Before the control solenoid is re-fitted, the distance "a" between the centre line through the pivot stud in the engaging fork and the attaching flange should be checked when the iron core is fully withdrawn, see Fig. 60. After the distance has been adjusted and the locknut tightened, the distance "a" is checked again. The nut and fork stud are then locked with sealing compound. Concerning the distance "a", see "Specifications".

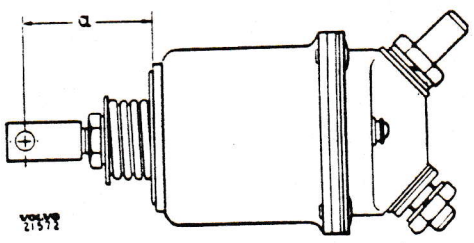


Fig. 60. Adjusting distance for solenoid fork

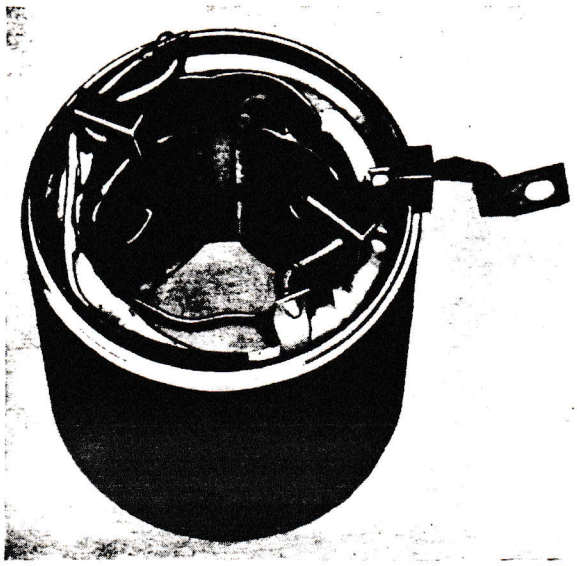


Fig. 61. Stator with soldered brushes

Replacing the brushes

STARTER MOTOR, EARLY PRODUCTION

If the brushes are damaged or worn down more than halfway, they must be replaced.

When replacing the brushes, the starter motor should be removed from the vehicle and cleaned externally.

Brushes are replaced with the starter motor assembled. The lead from the brush is disconnected and the brush spring lifted with a hook, after which the brush is removed from its holder. The new brush is slid down into the holder and secured with the screw.

Replacing the brushes

STARTER MOTOR, LATE PRODUCTION

When replacing the brushes, the starter motor is removed and dismantled up to point 6 as described under "Dismantling the starter motor". The brushes are unsoldered from their attachments in the brush holder and field winding respectively. The new brushes should be soldered on quickly and with sufficient heat. Solder must not be allowed to run down into the brush leads as this will prevent the movement of the brushes in the brush holders and may reduce the brush spring pressure. Brushes which have worn down shorter than 14 mm (9/16") should be replaced with new ones.

Replacing the field winding

1. If the starter motor has not been dismantled, this must be done. Follow the instructions under the heading "Dismantling".
2. Mark the pole shoes and pole housing in a suitable manner so that they come in the same position when assembling.
3. Place the stator in the holding device as shown in Fig. 62. (Bosch EF AW 9) and unscrew the pole screws.
4. Before fitting new field coils, these should be warmed slightly. Then place the pole shoes in position in the field coils and slide them into the stator. Tighten the pole screws slightly.

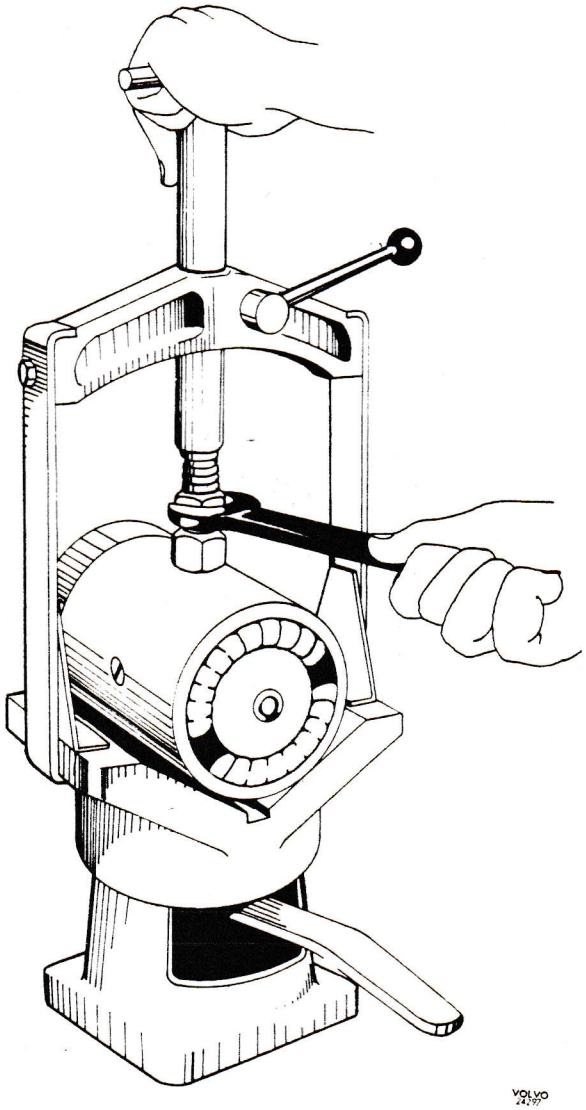


Fig. 62. Holding device for removing the field winding

Press in a suitable drift (for measurements, see Fig. 63). Set up the stator in the holding device and tighten the pole shoes.

5. Press out the drift with a press. Check the fitted field winding for breakage and shorting.

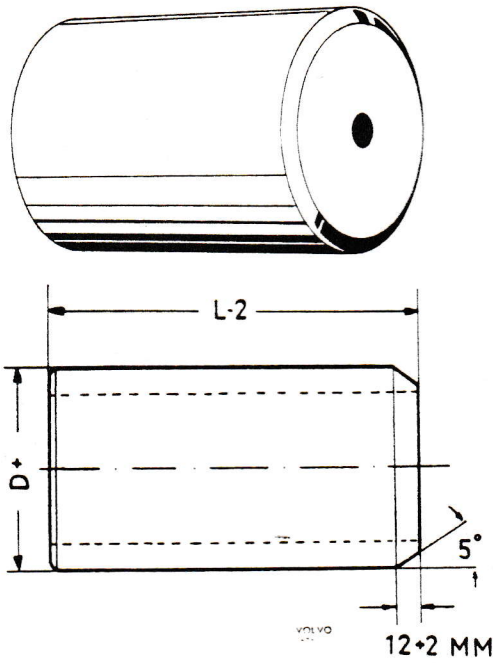


Fig. 63. Press drift (starter motor EGD)

D = 66.1 $^{-0.01}_{-0.06}$ mm (2.602 $^{-0.0040}_{-0.0023}$")
L = 85 mm (3.346")

Fitting the self-lubricating bushings

The self-lubricating bushings are only worn insignificantly during operation if the bushings are lubricated in the correct manner. If lubrication is neglected, the bushings dry out, with the result that they are worn quickly.

For replacement purposes, bushings are supplied ready-machined to suitable dimensions. When being fitted, the bushings should not be machined internally or externally since the pores can then be partially blocked up, resulting in reduced lubricating capacity.

Replacing the bushings

1. Press, knock or pull out the worn bushings with the help of a suitable tool. Special tools for the brush holder end shield are shown in Figs. 64 and 65.

Fig. 64. Tool for removing bushing

2. Clean the hole for the bushing and cut away any burr.
3. Press in the new bushings with the help of a suitable drift. The guide diameter of the drift should correspond to the internal diameter of the bushing after it has been pressed in. If necessary, a smoothing drift can be pressed through the bushing.

   Concerning recommendations for bush sizes and drift, see the table on the next page.

   NOTE. Before a self-lubricating bushing is fitted, it should lie in light oil for at least 30 minutes.

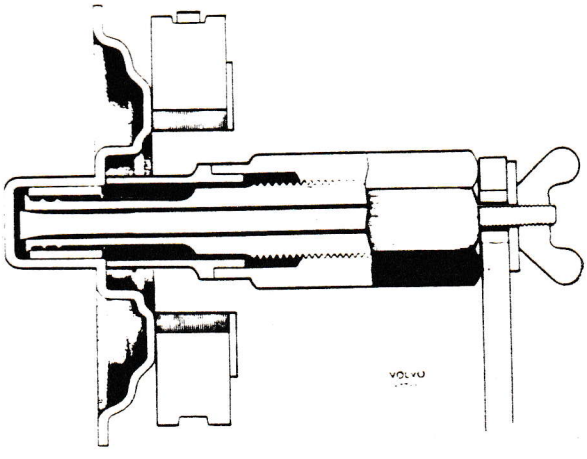


Fig. 65. Bushing tool fitted in end shield

MEASUREMENT AND TOLERANCE TABLE FOR BUSHINGS

Starter motor Bosch EGD 1/12 AR 37

	Hole diameter for bushing mm	Diameter and length for bushing when pressed in		Tool (Bosch)		
				Puller for bushing	Pressing-in drift	Smoothing drift
Drive bearing	15.8+0.027	12+0.027	16	—	EFAL 2	EFAL 3
Commutator bearing	16.45+0.018	12.46+0.043	15.8	EFAL 1	EF 2649	EF 2649/1
Starter pinion	14+0.018	12+0.018	12	—	EFAL 2	EFAL 3

Starter motor Bosch GF(R) 12 V 1 PS

	Hole diameter for bushing mm	Diameter and length for bushing when pressed in		Tool (Bosch)		
				Puller for bushing	Pressing-in drift	Smoothing drift
Drive bearing	15.8+0.027	12.0+0.027	16	—	EFAL 2	EFAL 3
Commutator bearing	16.0+0.07	12.5+0.002	11.5	EFAL 1	EF 2649	EF 2649/9
Starter pinion	14.0+0.018	12.0+0.018	12	—	EFAL 2	EFAL 3

Smörjschema för startmotor

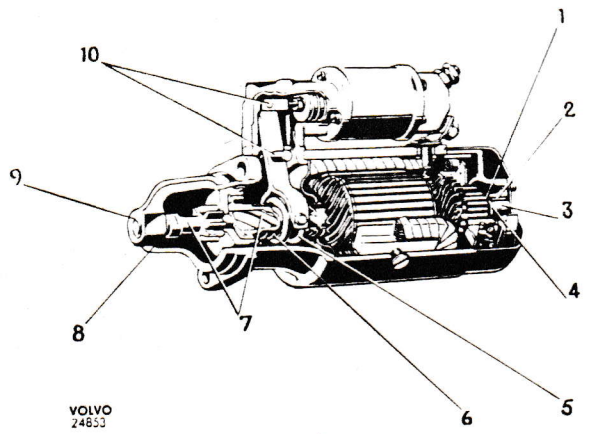


Fig. 66. Lubricating scheme for starter motor

Use Bosch lubricant (or equivalent) in accordance with the following designations:

1. Ft 1 v 8. Grease the rotor brake springs lightly.
2. Ol 1 v 13. Place the bushing in oil for 30 minutes before fitting.
3. Ft 1 v 8. Grease the adjusting washers and shaft end lightly.
4. Ft 1 v 8. Apply plenty of grease to the rotor brake.
5. Ft 1 v 8. Apply plenty of grease in the groove.
6. Ft 1 v 8. Grease the flange sleeve and coil spring lightly.
7. Ft 1 v 8. Grease the shaft end and cams lightly.
8. Ft 1 v 8. Grease the adjusting washers lightly.
9. Ol 1 v 13. Place the bushing in oil for 30 minutes before fitting.
10. Ft 1 v 8. Grease the pins and their bearing points lightly.

DISTRIBUTOR

Removing

1. Lift off the distributor cap.
2. Mark the position of the rotor arm on the distributor housing.
3. Disconnect the primary lead (1, Fig. 67).
4. Disconnect the hose on the vacuum regulator.
5. Unscrew the bolt (6, Fig. 67) and lift up the distributor.

Fitting

Fitting is done in the reverse order to removing. If the engine has not been moved while the distributor has been removed, fit the distributor in accordance with the marking made under point 2 above.

Adjusting the ignition

Concerning the adjustment of the ignition, see Part 2, Engine.

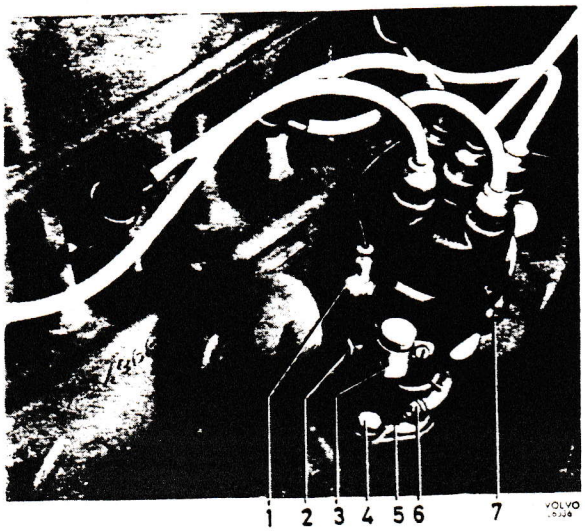


Fig. 67. Distributor fitted

1. Lead for coil
2. Lubricating cup
3. Capacitor
4. Attaching bolt for distributor
5. Flange
6. Clamping bolt
7. Clamping catch for cap

Dismantling the distributor

1. Pull off the rotor arm.
2. Disconnect the vacuum regulator, if fitted, by unscrewing the screws as shown in Fig. 68 and then lift it off.
3. Unscrew the primary terminal screw and remove the washers belonging to it.
4. Remove the breaker plate. This is done by unscrewing the two screws which hold the catch springs for the cap, see Fig. 69.
5. Lift off the stop spring (locking spring) and knock out the pin for the flange and pull this off. Mark the position of the flange in relation to the shaft, see Fig. 70.
6. Lift up the distributor shaft.
7. Remove the locking springs and springs between the centrifugal governor and contact breaker camshaft and lift this up.
8. Wash all parts in petrol or white spirit and lay them out for inspection.

Inspecting

DISTRIBUTOR PLATE

1. The surface of the contact breaker points should be flat and smooth. The colour of the contacts should be grey. Oxidized or burnt contacts must be replaced. After a long period of use, the contact lip can be worn and the spring fatigued, so that the contact breaker should be replaced.
2. The contact plate must not be loose or worn so that there is any burr.

DISTRIBUTOR SHAFT

1. The play between the distributor shaft and the breaker camshaft must not exceed 0.1 mm (0.004").
2. The cams on the breaker camshaft must not be scored or worn down so that the dwell angle is altered.

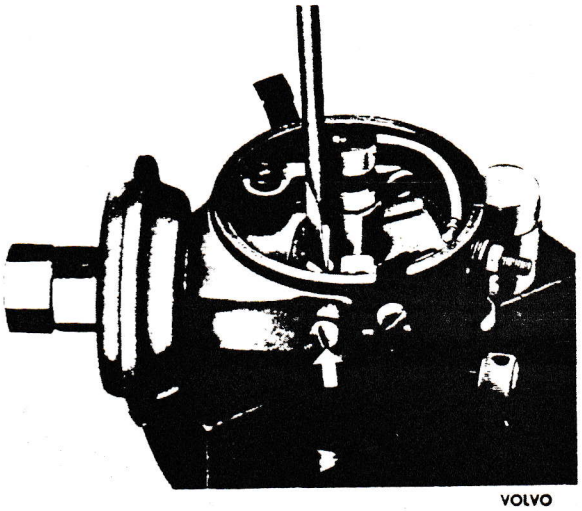


Fig. 68. Removing the vacuum regulator

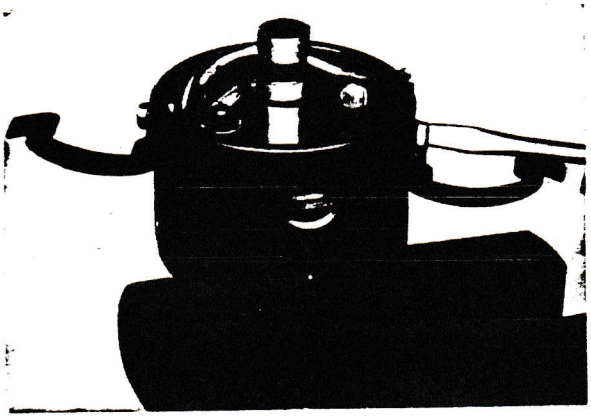


Fig. 69. Removing the breaker plate

Fig. 70. Removing the driving collar

3. The holes in the centrifugal governor weights must not be oval or deformed in any other way. The fibre washers, 1, Fig. 71, must be intact.
4. The governor springs must not be deformed or damaged.

DISTRIBUTOR HOUSING

1. The clearance between the distributor housing and shaft should not exceed 0.2 mm (0.008"). In the event of excessive play, the bushings must be replaced and, if this is not sufficient, the shaft also.

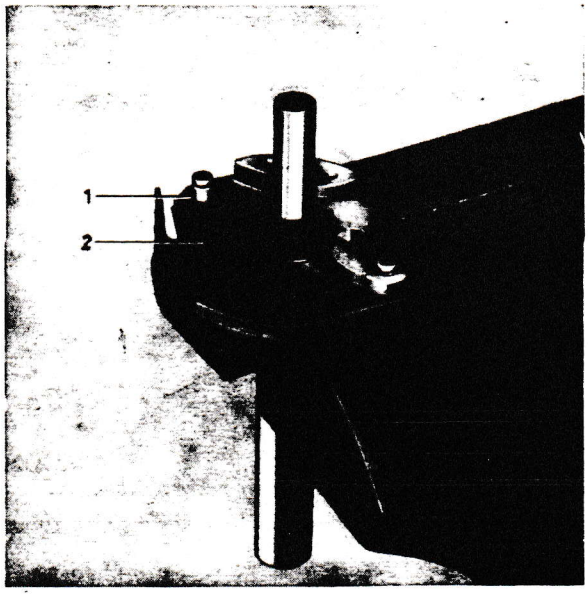


Fig. 71. Plate with fibre washers

1. Fibre washer 2. Resitex plate

2. The insulation washers for the primary terminal must not be cracked or covered with oil, as this will cause leakage over the primary terminal.
3. The capacitor is tested with a glow lamp connected to direct current, or with a capacitance bridge.
   When testing with a glow lamp at room temperature, there must be no discharging. When testing with warm capacitor (60—70° C = 140—158° F), up to 15 discharges per minute can be accepted.

Fig. 72. Fitting the breaker camshaft

Assembling

1. Place the Resitex plate on the distributor shaft and the fibre washers above this, see Fig. 71. *Lubricate and place the centrifugal governor* weights in position. Place on the locking springs. Concerning lubrication, see Fig. 74.
2. Lubricate and fit the breaker camshaft and place on the springs, see Fig. 72.
3. Lubricate the distributor shaft and place it in the distributor housing. Check that the axial adjusting washers are positioned correctly. The fibre washers should contact the inside of the distributor housing. The steel washers should contact the flange.
   Fit the breaker plate and distributor cap catch springs, see Fig. 73.

Fig. 73. Fitting the breaker plate

4. Fit the primary terminal and connect this to the breakers and capacitor.
5. If the contacts have been replaced, ensure that the new ones lie correctly horizontally and that their faces close flush against each other. Adjustment can be made with a special tool, for example, Bosch EFAW 57 or similar. Only the fixed contact may be bent as shown in Fig. 74. Adjust the gap and check the contact pressure.
6. Fit the vacuum regulator.
7. Fit the flange and check the axial play. The fibre washer should lie against the distributor housing and the steel washer or washers against the flange. The axial play must be min. 0.1 mm (0.004"), max. 0.2 mm (0.008").

Testing the distributor

The distributor should be tested in a synchronograph or in a test bench equipped with the necessary appliances.

1. Secure the distributor in accordance with the instructions applying for the test bench concerned.
2. Run the distributor in the normal direction of rotation and set the contact dwell angle in accordance with the "Specifications".
3. Run the distributor and set the graduated disc so that sparking occurs opposite 0° when the speed is so low that the centrifugal governor has not begun to function. Increase the speed gradually and read off the values at the prescribed revolutions. A newly lubricated distributor should first be run up to maximum speed a few times. Permissible tolerance for the centrifugal governor is ±1°.
4. Run the distributor at low speed (about 200 r.p.m.) and set the graduated disc so that sparking is obtained at 0°.
   Increase the vacuum and read off the ignition adjustment. Increase the vacuum successively and check that the whole adjustment range agrees. Then test the vacuum regulator in a falling direction by lowering the vacuum and reading off the values. The differences between the rising and falling values should not exceed 1½°. If so there is a fault in the breaker plate, pull rod or vacuum regulator.

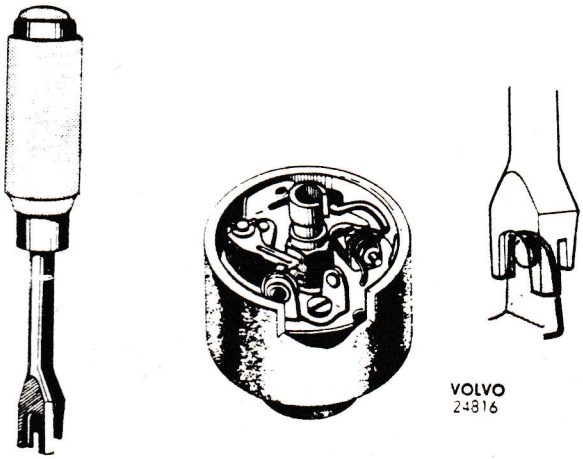


Fig. 74. Adjusting the contact breaker points

Adjusting the ignition control curve (centrifugal governor)

Adjusting the curve is done by tensioning the centrifugal governor springs. When doing this the shaft must be lifted up from the distributor housing and the screw on the other side of the flange slackened. If the flange is turned opposite to the direction of rotation, the springs are tensioned; that is to say, ignition is retarded and maximum control is reached later.

NOTE. Adjusting the curve must not be done by bending the flange spring loops.

Fig. 73. Fitting the breaker plate

4. Fit the primary terminal and connect this to the breakers and capacitor.
5. If the contacts have been replaced, ensure that the new ones lie correctly horizontally and that their faces close flush against each other. Adjustment can be made with a special tool, for example, Bosch EFAW 57 or similar. Only the fixed contact may be bent as shown in Fig. 74. Adjust the gap and check the contact pressure.
6. Fit the vacuum regulator.
7. Fit the flange and check the axial play. The fibre washer should lie against the distributor housing and the steel washer or washers against the flange. The axial play must be min. 0.1 mm (0.004"), max. 0.2 mm (0.008").

Testing the distributor

The distributor should be tested in a synchronograph or in a test bench equipped with the necessary appliances.

1. Secure the distributor in accordance with the instructions applying for the test bench concerned.
2. Run the distributor in the normal direction of rotation and set the contact dwell angle in accordance with the "Specifications".
3. Run the distributor and set the graduated disc so that sparking occurs opposite 0° when the speed is so low that the centrifugal governor has not begun to function. Increase the speed gradually and read off the values at the prescribed revolutions. A newly lubricated distributor should first be run up to maximum speed a few times. Permissible tolerance for the centrifugal governor is ±1°.
4. Run the distributor at low speed (about 200 r.p.m.) and set the graduated disc so that sparking is obtained at 0°.
   Increase the vacuum and read off the ignition adjustment. Increase the vacuum successively and check that the whole adjustment range agrees. Then test the vacuum regulator in a falling direction by lowering the vacuum and reading off the values. The differences between the rising and falling values should not exceed 1½°. If so there is a fault in the breaker plate, pull rod or vacuum regulator.

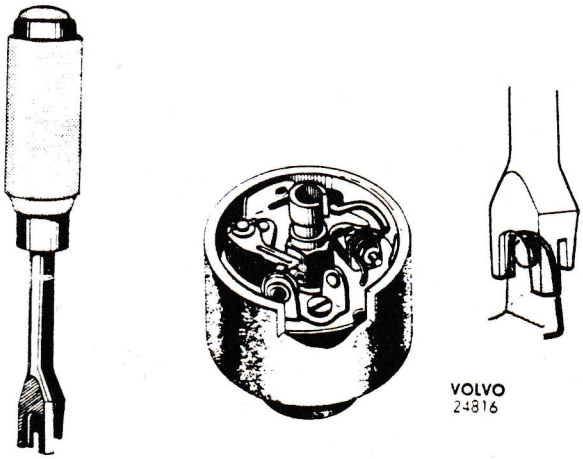


Fig. 74. Adjusting the contact breaker points

Adjusting the ignition control curve (centrifugal governor)

Adjusting the curve is done by tensioning the centrifugal governor springs. When doing this the shaft must be lifted up from the distributor housing and the screw on the other side of the flange slackened. If the flange is turned opposite to the direction of rotation, the springs are tensioned; that is to say, ignition is retarded and maximum control is reached later.

NOTE. Adjusting the curve must not be done by bending the flange spring loops.

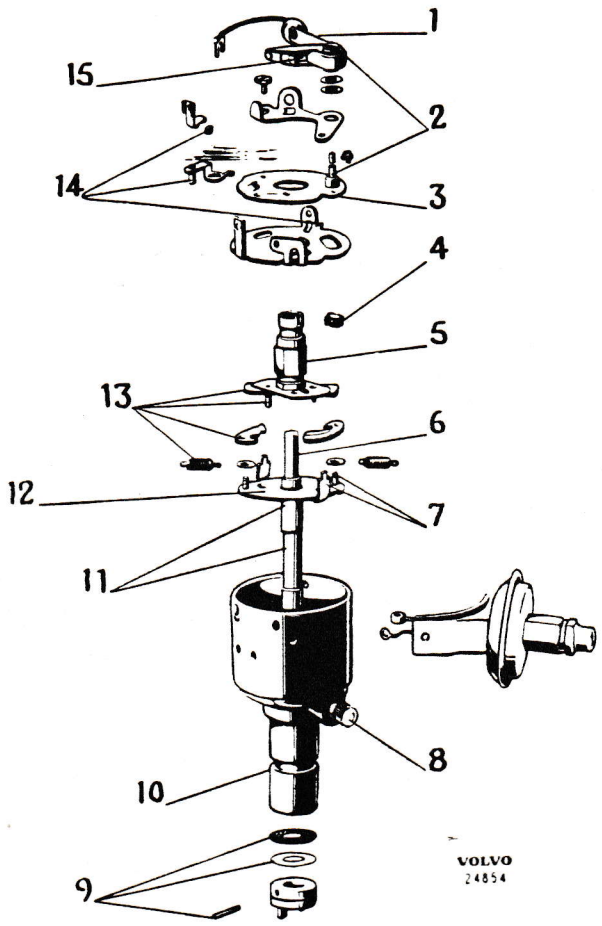


Fig. 75. Lubricating scheme for distributor (Lubricant Bosch or equivalent)

1. Grease the spring lightly Ft 1 v 4
2. Grease the bushing and bearing pin Ft 1 v 22
3. Oil the breaker plate sliding surfaces Ol 1 v 2
4. Soak the lubricating wick with oil Ol 1 v 2
5. Coat a thin layer of grease on the cam surface Ft 1 v 4
6. Grease the end of the shaft lightly and oil with Ft 1 v 8 and Ol 1 v 1
7. Grease the bearing pins and spring attachments Ft 1 v 8
8. Fill the oil cup while turning the shaft Ol 1 v 13
9. Oil the washers and pin before fitting Ol 1 v 13
10. Soak the lubricating wick between the bushings with oil Ol 1 v 13
11. Lubricate the shaft and fibre washers with grease and oil Ft 1 v 22 and Ol 1 v 13.
12. Oil the regulator plate Ol 1 v 22
13. Lightly coat the contact surfaces, flange pins etc. Ft 1 v 8
14. Lubricate the bearing pin, ball guide lip and contact surfaces with plenty of grease Ft 1 v 22
15. Apply a little grease to the rivet side of the lifting lip Ft 1 v 4

HEADLAMPS

Replacing the headlamps

The following section describes the procedure for removing the headlamps from the car and dismantling them completely. In the case of partial dismantling, proceed in accordance with the appropriate points.

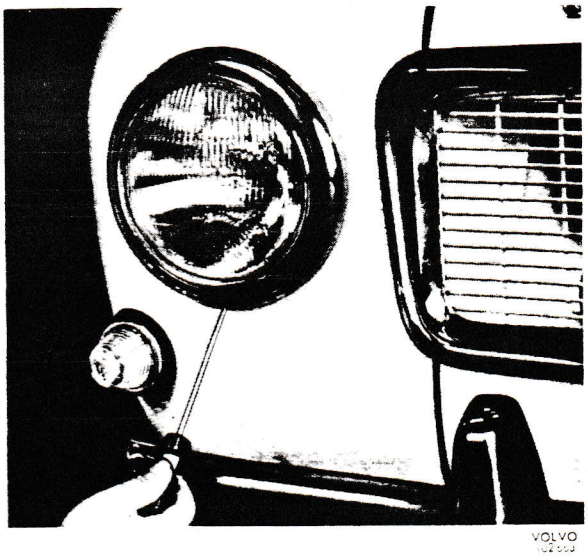


Fig. 76. Removing the headlamp rim

1. Unscrew the headlamps rim screw, see Fig. 76. Lift off the rim by pulling out the lower part slightly and then lifting it upwards.
2. Slacken the screws for the headlamps insert retaining ring a few turns, see Fig. 77. Turn the retainer until the lips are free of the screws and lift out the retainer and insert with bulb holder.
3. Remove the connecting contact from the bulb holder by pulling it straight out.
4. Slacken the screws (1 and 2, Fig. 78) for headlamp adjustment 8—10 turns. Unhook the springs (3—6) from the bowl (7) and lift out the bowl from the casing (8).
5. Remove the springs and adjusting screws from the casing.
6. Remove the casing from the mudguard and pull out the cable and rubber bushing.
7. Fitting is done in the reverse order. Ensure that the leads are correctly connected and that the screws are tightened properly.

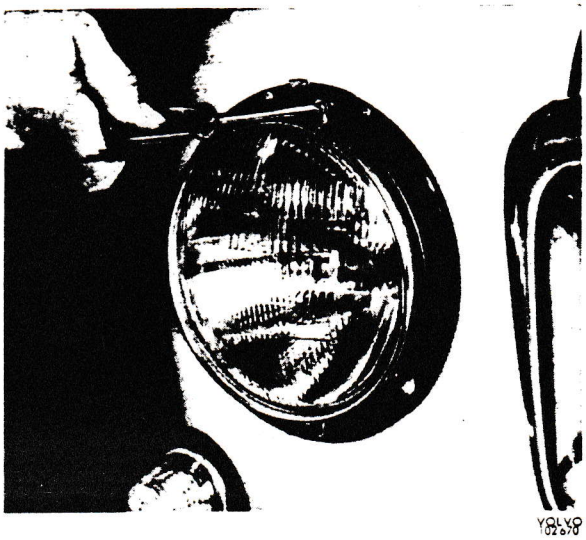


Fig. 77. Removing the retaining ring

Replacing the bulb and/or reflector

1. Remove the headlamp rim and retaining ring as shown in Figs. 76 and 77.
2. Disconnect the connecting contact.
3. If the vehicle is provided with an asymmetrical headlight insert, the rubber protector is first removed as shown in Fig. 79. and then the spring which holds the bulb as shown in Fig. 80.
4. If the vehicle is provided with a symmetrical headlight insert, the bulb holder spring is removed.

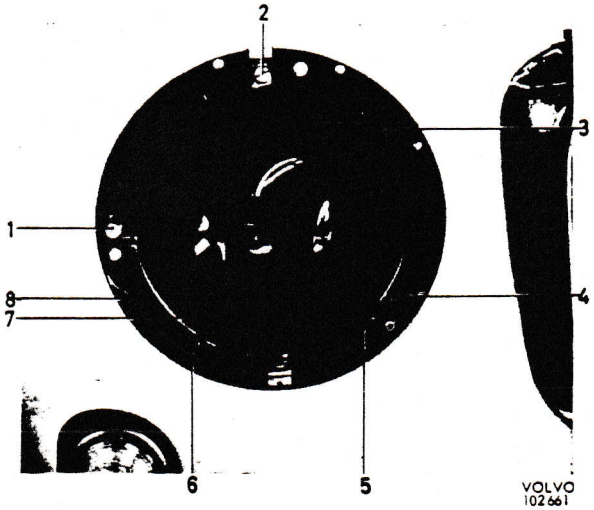


Fig. 78. Headlamps bowls

1. Adjusting screw
2. Adjusting screw
3. Spring
4. Spring
5. Spring
6. Spring
7. Inner bowl
8. Casing

Fig. 79. Removing the rubber protector

5. On asymmetrical headlight inserts the bulb is attached directly in the reflector as shown in Fig. 81. On symmetrical headlight inserts the bulb is fitted in a bulb holder which in turn is attached in the reflector, see point 4.

When fitting the bulbs, do not touch the actual bulb glass with the fingers but use the bulb carton as protection.

Adjusting the headlights

From a traffic safety point of view it is of the utmost importance that the headlights are adjusted to conform with current regulations.
Adjusting is done by turning the screws (1 and 2, Fig. 78).

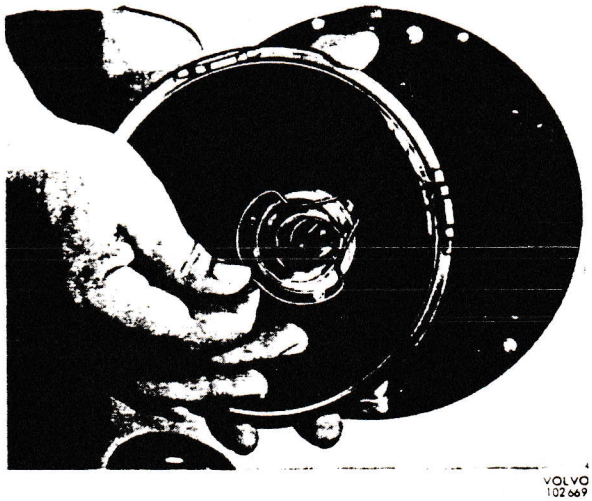


Fig. 80. Removing the bulb retaining spring

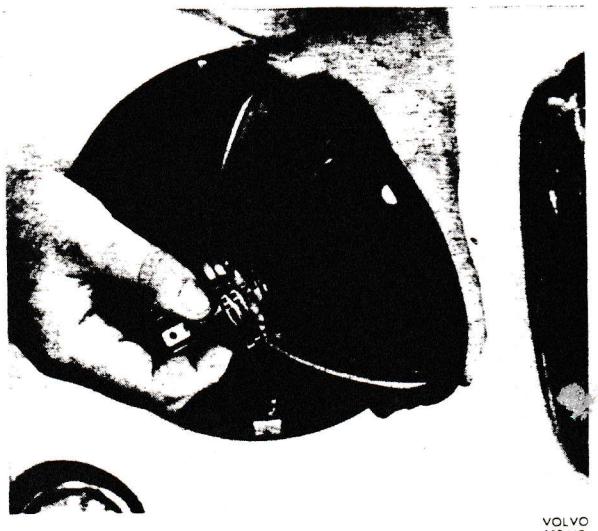


Fig. 81. Fitting the bulb, symmetrical headlights

GENERAL

The headlights should be examined to check the condition of the glass, reflector and bulb. If the glass is cracked or damaged in any other way, the insert should be replaced.

Glass which has become "sand-blasted" by stone impact, etc. will considerably reduce the lighting effect and can give rise to dazzling, irregular beams.

If the reflector is rusty, dull, buckled or damaged in any other way, the insert should be replaced.

The inside of the bulb must not be oxidized to a black or brown colour. The lighting effect normally deteriorates to such an extent that the bulbs should be replaced after 100—200 hours use.

The voltage at the bulb with headlights switched on and the engine running at charging speed, should be at least 12.5 V in order to produce sufficient lighting strength.

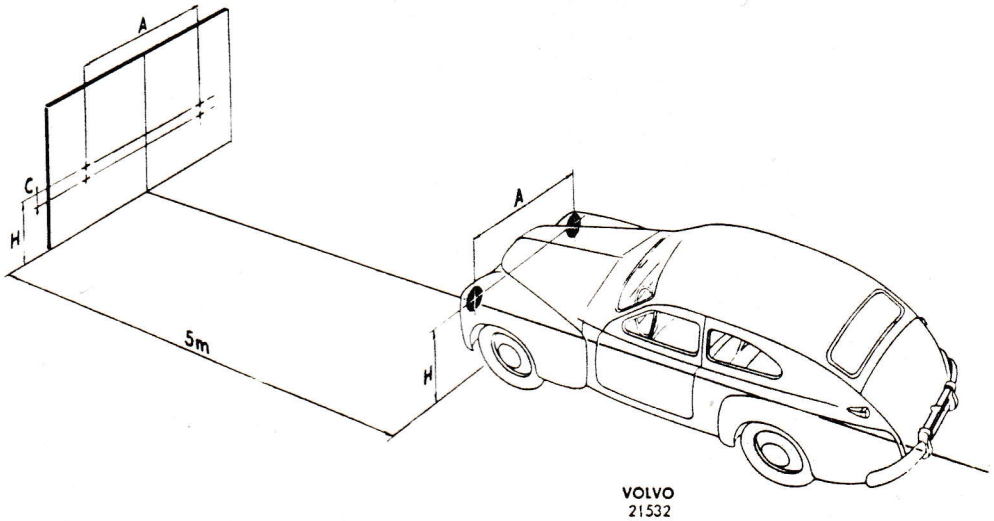


Fig. 82. Headlight adjustment
C=5 cm (2")

ADJUSTING

For lighting strength, the following applies:

Concerning full headlights, the lighting strength from each headlight measured 15 cm (6") above the road surface at a distance of 100 metres (109 yards), should be at least 1 lux.

With dipped headlights, no dazzling beams must be emitted above a horizontal plane through the centre line of the headlights. For dipped headlights the lighting strength measured at a distance of 25 metres (27 yards) must not exceed 1 lux above the horizontal plane through the headlight centre.

Adjustment can be done either on a level floor against a screen or wall, or with one of the approved lighting adjustment devices on the market. If one of these is used, follow the directions issued with it.

HEADLIGHT ADJUSTMENT ON A LEVEL FLOOR AGAINST A WALL OR SCREEN

1. The vehicle must be stood on a level base.
2. A screen should be set up 5 metres (16 feet) in front of the radiator and crosses marked out on the screen. The position of the crosses in relation to the ground, and the distance between them, should be identical with the corresponding measurements at the centre point of the lamps.

3. According to regulations, the horizontal limiting line between the illuminated and non-illuminated surface on the screen should be situated 5 cm (2") below the connecting line between the above-mentioned crosses.

4. The defraction point between the horizontal limiting line and the inclined limiting line between the illuminated and non-illuminated surface, should fall vertically below the above-mentioned cross markings respectively (asymmetrical lighting).
   As can be seen from the above, it is only necessary to check dipped headlights in order to carry out headlights adjustment.

For asymmetrical lighting (intended for left-hand driving), a sharp horizontal light — the darkness limit — only to the right of the centre cross is a sign that the dipped headlight adjustment is good both from a sight and anti-dazzle point of view.

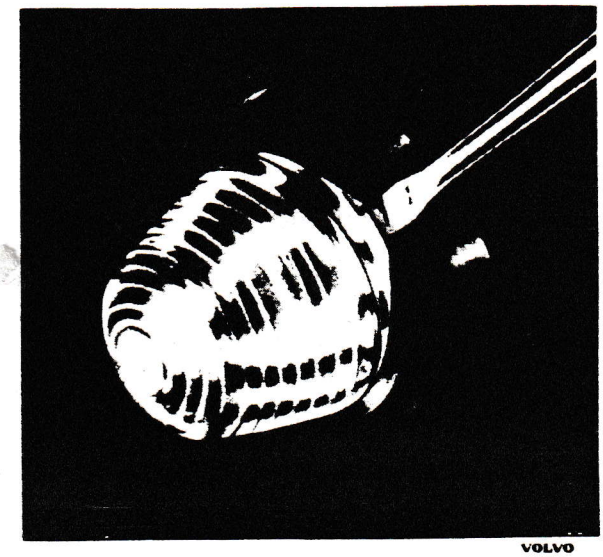


Fig. 84. Removing the glass

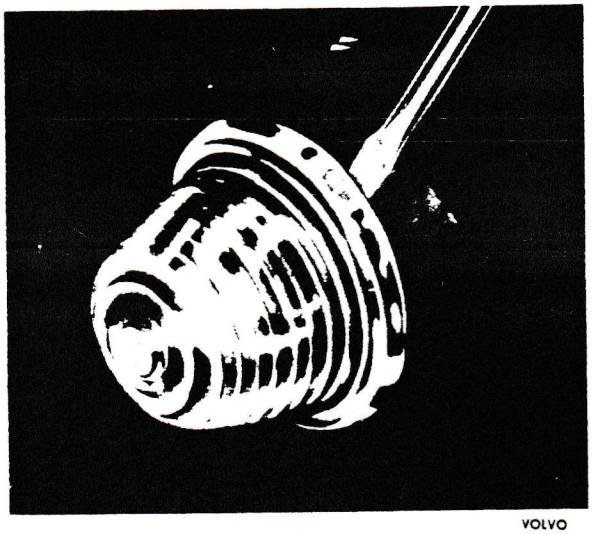


Fig. 83. Removing the rim

FLASHERS AND PARKING LIGHTS

At the front, the parking lights and direction indicators are combined. The bulbs are replaced as follows:

1. Remove the rim with a screwdriver, see Fig. 83.
2. Remove the glass in the same way, see Fig. 84.
3. The bulb is now accessible for replacement.

STOP AND TAIL LIGHTS, 544

Replacing stop, flashers and tail lights

1. Remove the glass as shown in Fig. 85.
2. Remove the bulb by pressing it inwards and then turning it anti-clockwise.
3. Fit the new bulb. Do not touch the lamp glass with your fingers.

Fig. 85. Removing the glass

Fig. 86. Tail lamp

1. Direction indicator 2. Brake light 3. Rear light

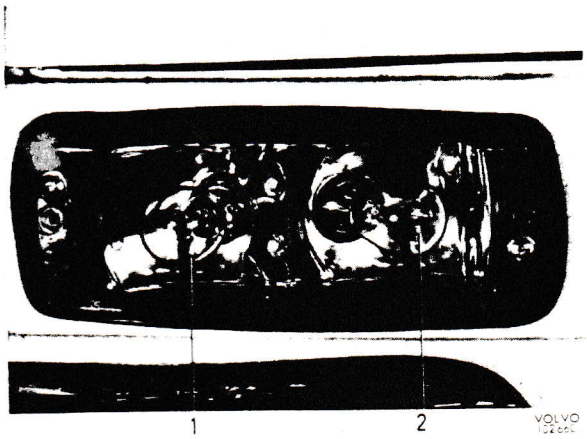


Fig. 88. Rear light, P 210

1. Flasher light 2. Stop and tail light

NUMBER PLATE LIGHTING PV 544

The lamps are located in each of the mudguard corners. The glass and lamp housing are taken off by removing the two screws, see Fig. 89. The bulb and also the cable are then accessible, see Figs. 90 and 91.

STOP AND TAIL LIGHTS, P 210

Replacing stop, flashers and rear lamp bulbs

1. Remove the glass, see Fig. 87.
2. Remove the bulb by pressing it inwards and then turning it anti-clockwise.
3. Fit the new bulb. Do not touch the lamp glass with your fingers.

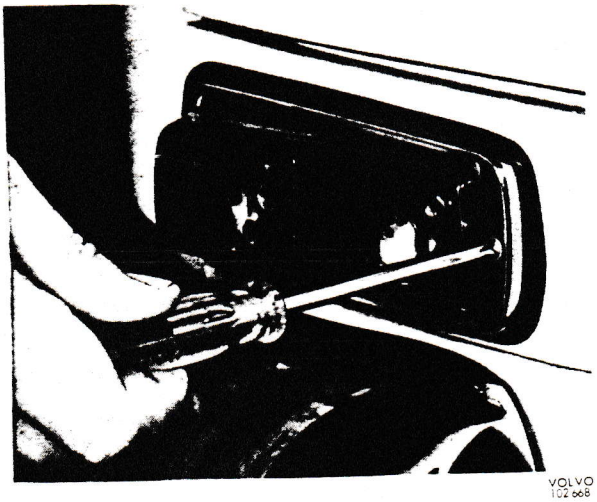


Fig. 87. Removing the glass

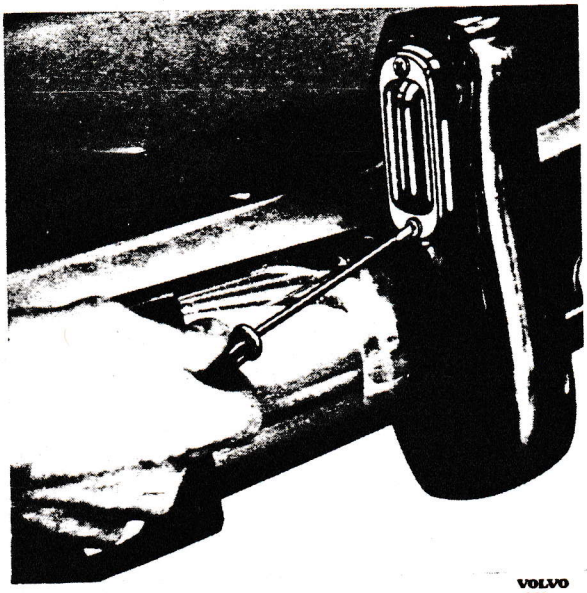


Fig. 89. Removing the glass and lamp housing

NUMBER PLATE LIGHTING P 210

The lamps are located in the door covering the spare wheel.

The bulbs are accessible by opening the door and releasing the screws, see Fig. 92.

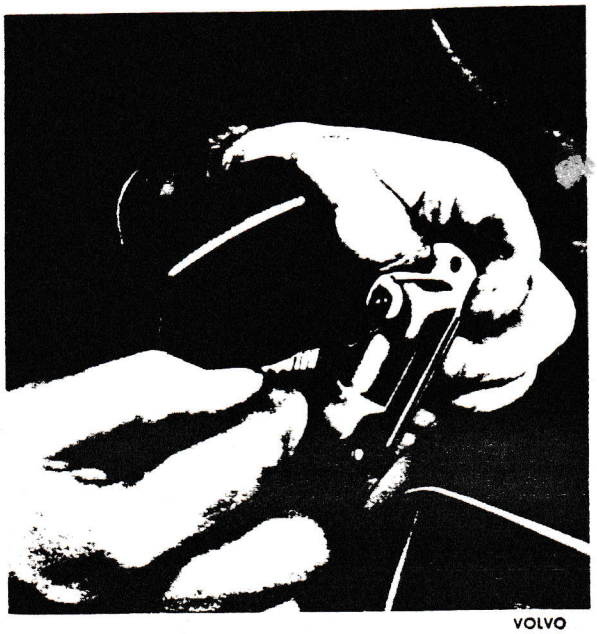


Fig. 90. Removing the cable

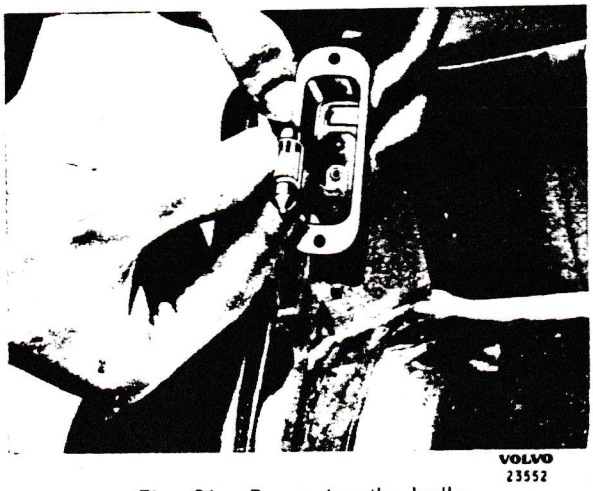


Fig. 91. Removing the bulb

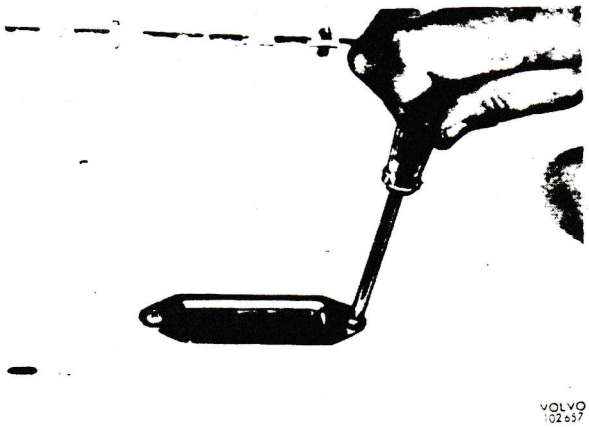


Fig. 92. Removing the lamp holder, P 210

INSTRUMENT AND INTERIOR LIGHTING

The instrument lighting consists of two bulbs attached to the instrument unit and is accessible from the reverse of the instrument panel. There are also four control lamps fitted in the instrument unit. All control lamps are accessible for replacement from the reverse side of the instrument panel. The interior lighting consists of a lamp (P 210 two lamps) in the roof. The bulb in this is accessible for replacement after the glass has been removed.

Fig. 93. Removing the interior lighting

LIGHT SWITCH

The push-pull switch for the headlights has three positions: off, parking and full/dipped head lights. The strength of the instrument lighting can be adjusted by turning the switch knob.

The switch is removed from the dashboard as follows:

1. Remove the push-pull knob by screwing it off.
2. Unscrew the nut holding the lighting switch with a suitable tool, see Fig. 94.
3. Lift off the switch by first pulling it backwards and downwards.
4. The special cable terminals are removed by pulling out from the cable holder on the contact.

The foot dipper switch has two positions: full and dipped headlights. It is fitted with screws on the top, left-hand side of the toe-plate.

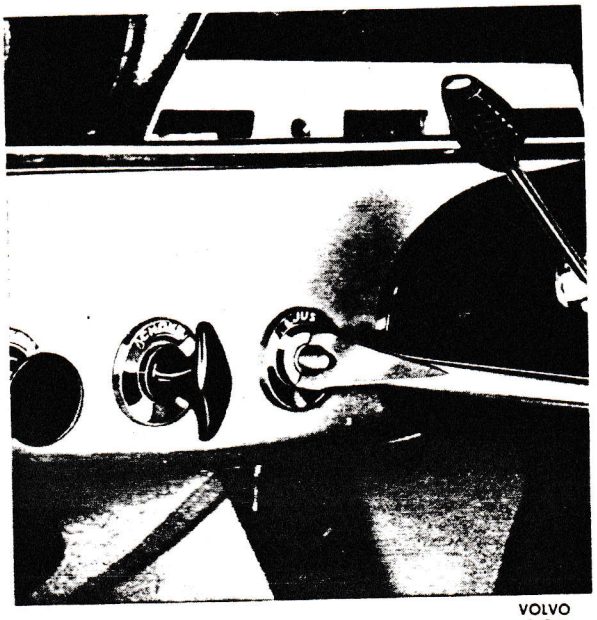


Fig. 94. Removing the lighting switch

The lighting switch and foot dipper switch must be in good condition in order for full lighting strength to be obtained. Damaged or faulty switches must therefore be replaced. If the lighting strength is low, the switch and foot dimmer switch should be examined by measuring the voltage drop across them. This should not exceed 0.1 volt.

The rheostat for the instrument lighting is built into the lighting switch. The strength of the instrument lighting is adjusted by turning the switch button.

DIRECTION INDICATOR SWITCH

Removing and fitting

1. Remove the steering wheel in accordance with the instructions in Part 6.
2. Remove the leads at the underside of the switch. These are removed by pulling out of their retainers.
3. Slacken the lock nut, (3, Fig. 96) and screw out the stop screw (4) a few turns.
4. Lift the switch casing with switch straight off from the jacket tube.
5. Fitting is done in the reverse sequence.

The switch is attached to the switch casing by two screws. When these are removed, the switch can be taken out of the casing.

The direction indicator switch can be adjusted by slackening the screw (4, Fig. 96) and then turning the casing with switch to the desired position. A space of about 2 mm (5/64") should be left between the steering wheel and casing.

The leads are connected to the direction indicator switch as shown in Fig. 95. The cable terminals are pressed firmly into the holders. After fitting, check that the leads fit properly into the holders.

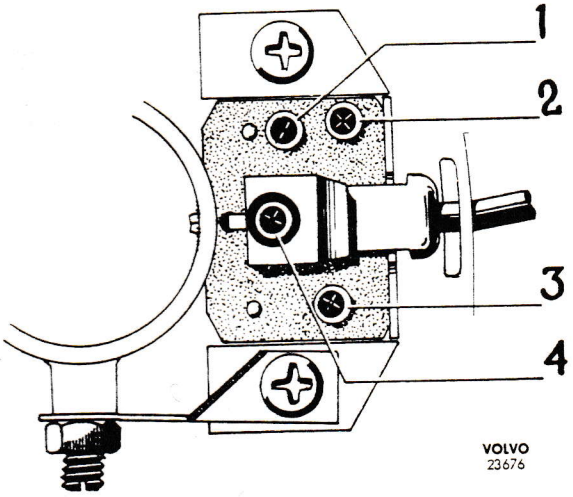


Fig. 95. Connecting the direction indicator switch
Switch seen from below

1. Terminal for right-hand indicator
2. Terminal for left-hand indicator
3. Terminal for flasher mechanism
4. Terminal for full headlight signal

HORN

Removing and fitting

The horn is fitted on the intermediate section. When removing, first take off the radiator grille and then disconnect the leads after which the horn can be removed from the intermediate section.

Inspecting

The sound of the horn is dependent to a large extent on the mounting, which therefore must be checked.

The horn is attached to the body by means of a flexible steel bar. It receives current from the fuse box. Earthing is done through the horn ring on the steering wheel.

If the horn does not work when the horn ring is

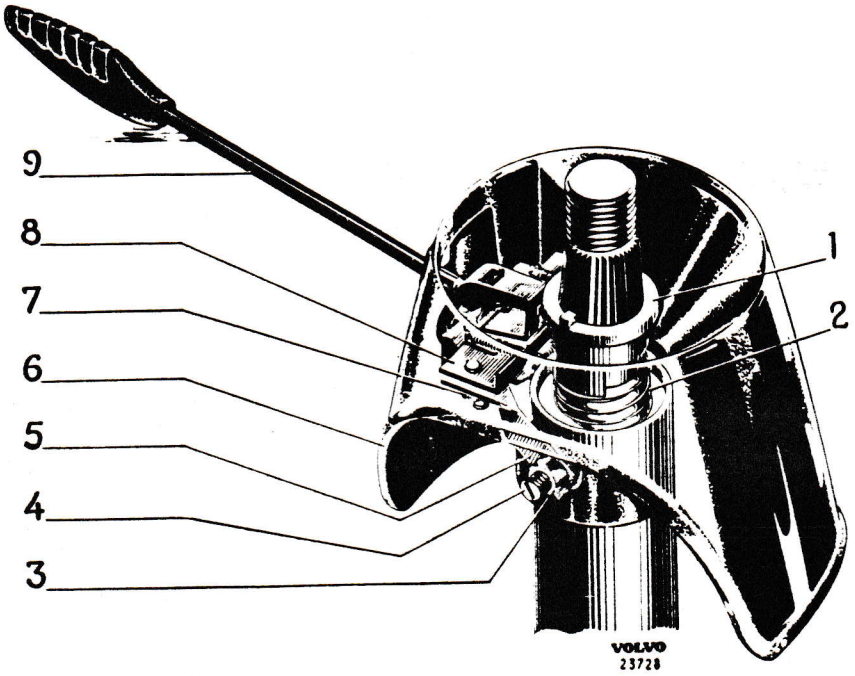


Fig. 96.
Direction indicator switch

1. Actuator
2. Spring
3. Lock nut
4. Stop screw
5. Earth strip
6. Casing
7. Screw
8. Switch
9. Control lever

pressed down, check to see if there is current at the horn connections. If not, examine the fuse and the lead. If there is current, earth the other pole screw of the horn, then it should function if it is in order. If it is in order, examine the lead to the horn button and the contacts in this. Faulty parts should be removed and adjusted or replaced. A damaged lead should be replaced.

If the tone of the horn is not correct, this can be adjusted by means of the screw for this purpose.

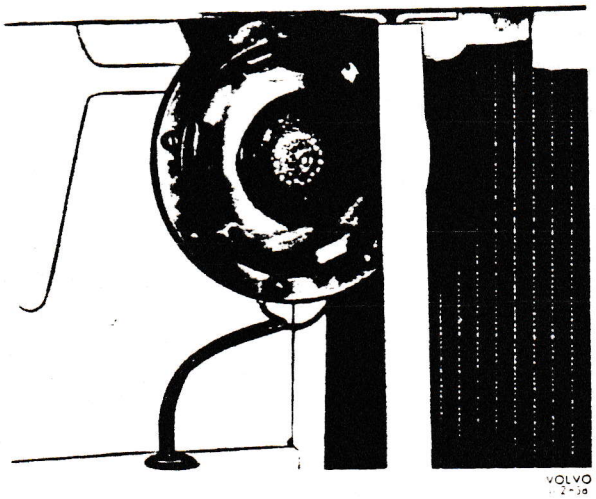


Fig. 97. Horn, fitted

WINDSCREEN WIPERS

Removing and fitting

1. Take off the wiper arm.
2. Remove the nut (1 Fig. 98) for the bearing and lift of the washer (2) and seal (3).
3. Mark and disconnect the leads from the windscreen wiper.
4. Unscrew the screw (5), Fig. 98, holding the wiper mechanism to the body. This is accessible from the reverse side of the instrument panel.
5. Fitting is done in the reverse order and the rubber seals should be checked to make sure they are in good order.

Lubrication and maintenance

The bushings on the wiper link arms are made of nylon. These bushings are lubricated with grease or vaseline. The wiper gear mechanism and outgoing shaft should be lubricated with special grease in conjunction with overhaul.

The shafts of the wiper arms should be lubricated with light engine oil every 5000 km (3000 miles).

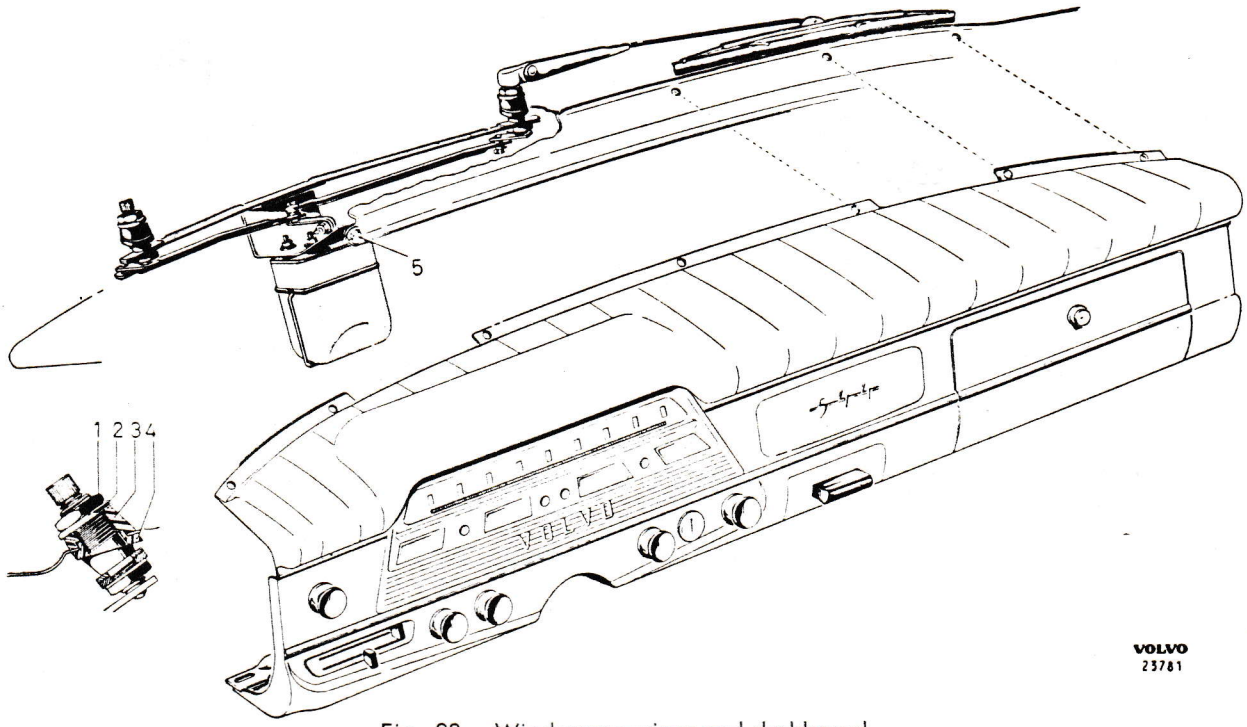


Fig. 98. Windscreen wiper and dashboard

ELECTRICAL LEADS

The wiring diagram shows how the electrical leads connect the various components, and also shows the marking and cross-sectional area of the leads. The leads have different colours to facilitate fitting and fault tracing. When fault tracing, it is important that this is carried out in accordance with the wiring diagram.

If a lead is broken or earthed, it must be replaced. When doing this it is most important that the new lead has at least the same cross-sectional area as the old one, otherwise dangerous overloading and overheating can result.

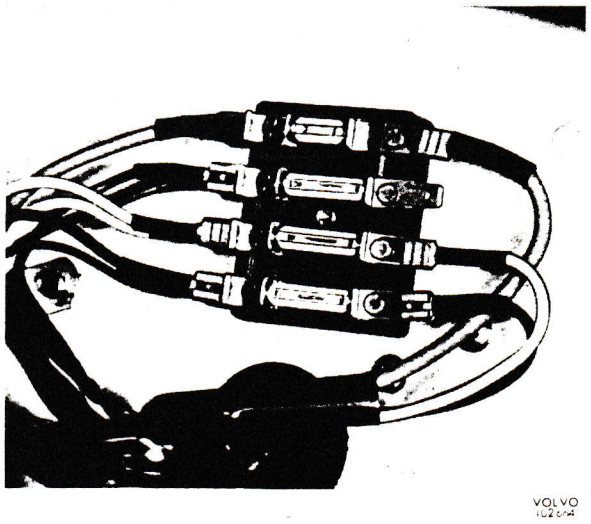


Fig. 99. Fuses

Leads for extra equipment

For fitting extra electrical equipment at the rear of the vehicle, for example, rear window fan and reversing lamp, two leads are included in the cable harness. The cable harness is placed along the roof of the vehicle inside the headlining. The extra leads are accessible under the instrument panel as shown in Fig. 97 and at the rear in the luggage compartment as shown in Fig. 98.

FUSES

These consists of four melt-type fuses fitted in a fusebox placed on the left-hand side of the bulkhead as shown in Fig. 99.

The fuses in the fusebox must be replaced when burnt out. The fuses must never be repaired or replaced with nails, wire, etc.

The fuses on cars have a rating of 8 and 25 A.

The table gives the data for the fuses.

Rating	8 A—25 A
Rated current at continuous loading	8 A—25 A
Current which the fuse should withstand for at least one hour	12 A—35 A
Current at which the fuse should melt within one hour	20 A—62.5 A

HEATER

Concerning the function and method of operation of the heater, see Part 9.

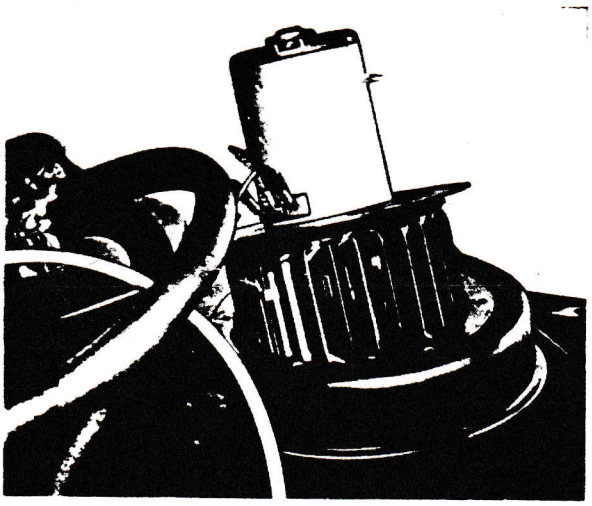


Fig. 100. Removi. heater fan motor

Removing the fan motor

1. Disconnect the current-carrying lead on the connecting piece.
2. Unscrew the six screws which hold the fan motor to the radiator shell and lift this out as shown in Fig. 100.

Fitting is done in the reverse order. The fan motor is provided with self-lubricating bushings so that lubricating need not be done after a certain time but only in connection with reconditioning.

WINDSCREEN WASHER

The windscreen washer pump is driven by an electric motor. The pump is of the gear type.

When overhauling, the bushings and shafts are lubricated with oil. Brushes which are worn down more than half-way must be replaced.

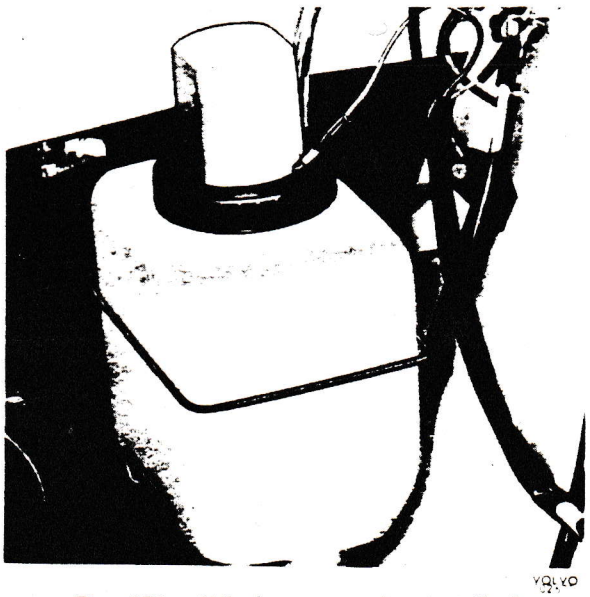


Fig. 101. Windscreen washer installed

FAULT TRACING

When fault tracing, it is of the utmost importance to proceed systematically. This applies particularly to the electrical system. If there is some part of the electrical system which does not function satisfactorily, the reason for the trouble must always be established before any measures are taken for repair or replacement. It is therefore not sufficient just to replace the faulty part or instrument without first finding out by means of testing that the fault actually lies in the part concerned, or whether it is caused by outside influence. The procedure when fault tracing should thus be as follows:

1. Find out which part is faulty.
2. Establish the reason for the occurrence of the fault.
3. Repair or replace the parts concerned.

FAULT	
REASON	**REMEDY**

BATTERY

BATTERY DISCHARGED OR DOES NOT HOLD THE CHARGE

Insufficient charge from dynamo.	Adjust the charging regulator.
Acid level in battery too low.	Top-up with distilled water.
Loose or corroded terminals.	Clean the cable terminals and tighten them properly.
Shorting in brake contact.	Replace the brake contact.
Internal short in battery.	Characterized by the fact that the specific gravity of the acid does not rise during continued charging. The battery must be replaced.

THE BATTERY BECOMES ABNORMALLY WARM OR GASES STRONGLY

Dynamo charges excessively.	Adjust the charging regulator.
Acid level too low.	Top-up with distilled water.
Battery has been poorly charged.	Have the battery charged.
Internal short.	Replace the battery.

STARTER MOTOR

THE STARTER MOTOR DOES NOT FUNCTION

Battery discharged.	Examine the battery. Charge up or replace the battery.
Poor connection and (or) earthing.	Check the connections on the battery, starter motor and control solenoid.
Faulty control solenoid.	Press the starter contact and check that the solenoid engages. If not, check to see whether current is obtained from the starter contact when this is in the starting position. See also under "Faulty starter motor". A faulty solenoid must be replaced.

Faulty starter motor.	Test by disconnecting the battery lead from the solenoid and holding it against the connection to the starter motor. If the starter motor does not function, it must be removed for testing and repair. If the starter motor does not function, do not hold the lead against the terminal for more than a few seconds.

THE STARTER MOTOR HAS POOR OUTPUT

Battery in poor condition.	Test and charge up if necessary.
Large resistance in starter motor circuit.	Examine all lead connections on the starter motor and the leads between the motor and chassis. Ensure that the contact surfaces are clean, that all cable terminals are well soldered and tighten the leads properly.
Poor contact in control solenoid.	Compare the starter motor output with and without the control solenoid by disconnecting the lead on the solenoid and holding it directly onto the starter motor output stud. A faulty control solenoid must be replaced.
Faulty starter motor.	Remove and test the starter motor.

THE STARTER MOTOR SPINS WITHOUT ENGAGING THE FLYWHEEL RING GEAR

Ring gear on flywheel damaged.	Remove the plate under the engine in front of the flywheel, see Part 1. A damaged ring gear must be replaced.
Drive pinion damaged.	Remove the starter motor and replace the damaged parts.
Drive pinion and/or engaging mechanism damaged.	Remove the starter motor and replace the damaged parts.

DYNAMO AND CHARGING REGULATOR

TOO LOW OR NO CHARGING WHEN THE BATTERY IS DISCHARGED

Poor contact or damaged leads.	Inspect all leads between the dynamo, charging regulator and battery for loose contacts, broken leads, poor insulation, corrosion and earthing.
Fan belt worn out or insufficiently tensioned.	Replace or tension the fan belt.
Faulty dynamo.	Disconnect the lead for the rotor current and the lead to the battery from the charging regulator and connect an ammeter in series with these. Start the engine and let it run at idling speed. Connect the terminal for the field current to the dynamo housing. If the ammeter at this stage, and when the speed in increased, shows too small a reading, the dynamo must be removed for examination and repair. Note. Never run the dynamo, when connected as above, at so high a speed that the maximum current is exceeded.
Faulty charging control.	Test and adjust the charging regulator. See under the heading "Charging regulator".

CHARGING TOO HIGH WITH THE BATTERY FULLY CHARGED

Faulty dynamo.	Let the dynamo run at about half charge. Disconnect the field lead from the charging regulator. If charging does not fall to zero, also disconnect the field lead from the dynamo. If charging falls to zero, examine the lead, and if this is intact, the dynamo is faulty so that it must be removed for repair.
High resistance at chassis connecting points.	Examine the chassis connections of the dynamo, charging regulator and battery.
Faulty charging regulator.	Test and adjust the charging regulator. Proceed in accordance with the directions under the heading "Charging regulator.

SPECIFICATIONS

BATTERY

Type	Boliden 107 GM 60 or equivalent
Earthed	Negative terminal
System voltage	12 V
Battery capacity, standard	60 Ah
Electrolyte specific gravity:	
Fully charged battery	1.275—1.285
When re-charging is necessary	1.230
Recommended charging current	4.5 A

IGNITION SYSTEM

Firing order	1—3—4—2	
Ignition setting with stroboscope at 1500 engine r.p.m. (vacuum regulator disconnected). (Fine adjustment with stationary engine must not be carried out.):	B 18 A	B 18 D
Octane rating (Research Method) 90	15—17° before T.D.C.	16—18° before T.D.C.
93	19—20° before T.D.C.	19—21° before T.D.C.
97	21—23° before T.D.C.	22—24° before T.D.C.
Ignition coil	Bosch ZS/KZ 1/12 A (14/3)	
Sparking plugs, type	Bosch W 175 T 1 or equivalent	
thread	14 mm	
sparking plug gap	0.7 mm (0.028")	
tightening torque	3.8—4.5 kgm (27.5—32.5 lb.ft.)	

Distributor

	B 18 A	B 18 D
Production type I	Bosch VJU 4 BL 33	Bosch VJU 4 BL 33
II	Bosch VJUR 4 BL 33	Bosch VJUR 4 BL 33
III		Bosch VJ4BL34
IV		Bosch JC 4
V	Bosch JFUR 4	Bosch JFR 4

(Distributor with designation JC is similar to JF.)

TEST VALUES (VJ 4 BL 34, VJU 4 BL 33, VJUR 4 BL 33)

Direction of rotation	Anti-clockwise			
Ignition setting curves:				
Centrifugal governor:				
Crankshaft degrees	0	10	22	22 ± 3
Crankshaft speed, r.p.m.	750—1050	1300—1850	2300—2900	2800—3300
Vacuum regulator:				
Crankshaft degrees	6			15 ± 4
Partial vacuum, Hg	6—10 cm (2.36—3.94")			18 cm (7.09")
Contact breakers, gap	0.4—0.5 mm (0.016—0.020")			
Contact pressure	0.5—0.63 kg (1.10—1.40 lb.)			
Dwell angle	57—63°			

TEST VALUES [JFU(R) 4, JF(R) 4 JC 4]

Direction of rotation	Anti-clockwise
Setting range, overall	0—26 ± 3°
Setting begins at	510—1050 r.p.m.
Values, 10°	1450—1920 r.p.m.
20°	2350—3700 r.p.m.
Setting finishes at	4600—4900 r.p.m.
Knocking at about	3000 r.p.m.
Contact breakers, gap	0.4—0.5 mm (0.016—0.020")
Contact pressure	0.50—0.63 kg (1.1—1.4 lb.)
Dwell angle	59—65°

DYNAMO

Type, B 18 A	Bosch LJ/GG 240/12/2400 AR6
B 18 D	Bosch LJ/GG 240/12/2400 AR7
System voltage	12 V
Rated effect	240 W
Max. current, continuous	30 A
Earthed	Negative terminal
Direction of rotation	Clockwise
Ratio, engine—dynamo	1.8:1
Brushes, designation	WSK 43 L 1
number	2
contact pressure	0.45—0.60 kg (1.0—1.3 lb.)

TEST VALUES

Field winding resistance	4.8 + 0.5 ohm
Charging, cold dynamo 240 W	2300 r.p.m.
warm dynamo, 240 W	2500 r.p.m.
Speed at rated voltage, unloaded	1700 r.p.m.

CHARGING REGULATOR

Type	Bosch RS/VA 240/12/2
Equalizing resistance aR	15.5—16.5 ohm
Control resistance wR	8—9 ohm

TEST VALUES

Reverse current relay:	
Adjusted for cutting-in at	12.4—13.1 V
reverse current at	2.0—7.5 A
Voltage regulator	
Control voltage, dynamo at no load (idling)	14.1—14.8 V
loaded	13.0—14.0 V
Loading current:	
Cold dynamo and charging control	45 A
Warm dynamo and charging control	30 A

STARTER MOTOR, EARLY PRODUCTION

Type	Bosch EDG 1/12 AR 37
System voltage	12 V
Earthed	Negative terminal
Direction of rotation	Clockwise
Output	Approx. 0.9 h.p. at —10°C (14°F) Approx. 1.2 h.p. at +20°C (68°F)
Number of teeth on pinion	9
Brushes, designation	Bosch DSK 35/5
number	4

TEST VALUES

Mechanical:

Rotor end float	0.1—0.3 mm (0.004—0.012")
Brush spring tension	0.8—0.9 kg (1.76—1.98 lb.)
Distance of pinion from ring gear	2.5—3 mm (0.10—0.12")
Rotor brake friction torque	3—5 kgcm (2.6—4.3 lb.in.)
Pinion idling torque	1.3—1.8 kgcm (1.13—1.56 lb.in.)
Tooth flank clearance	0.35—0.6 mm (0.014—0.023")
Pinion modulus	2.11

Electrical:

Starter motor unloaded:	
11.5 V and 40—60 A	5500—7500 r.p.m.
Starter motor loaded:	
10 V and 200 A	1100—1300 r.p.m.
Starter motor locked:	
r.p.m. = 0	8 V, 400—450 A
Control solenoid:	
Cut-in voltage	Max. 7 V
Adjusting measurement "a" (see Figure 60)	32.2 ± 0.1 mm (1.268 ± 0.004")

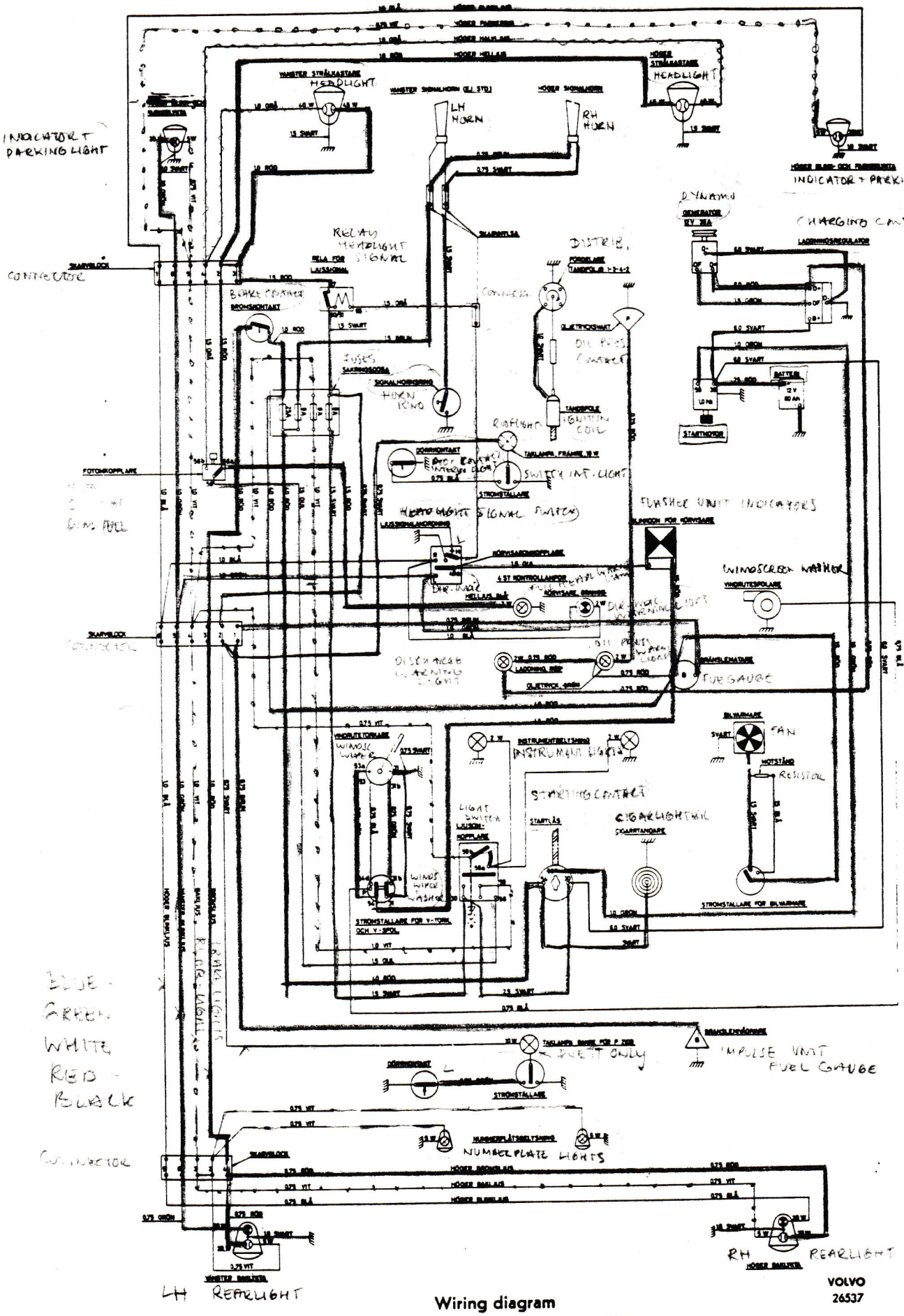
STARTER MOTOR, LATE PRODUCTION

Type	Bosch GF 12 V 1 PS
System voltage	12 V
Earthed	Negative terminal
Direction of rotation	Clockwise
Output	approx. 1 h.p.
Number of teeth on pinion	9
Brushes, number	4

TEST VALUES

Mechanical:

Rotor end float	0.05—0.30 mm (0.002—0.012")
Brush spring tension	1.15—1.30 kg (2.53—2.86 lb.)
Distance of pinion from ring gear	1.2—4.4 mm (0.047—0.173")
Rotor brake friction torque	2.5—4.0 kgcm (2.17—3.48 lb.in.)
Pinion idling torque	1.3—1.8 kgcm (1.13—1.56 lb.in.)
Tooth flank clearance	0.35—0.45 mm (0.014—0.018")
Pinion modulus	2.11



Wiring diagram
PV 544 w.e.fr. chassis No. 330100
P 210 w.e.fr. chassis No. 51935

VOLVO
26537

Electrical:

Starter motor unloaded:

12.0 V and 40—50 A ..... 6900—8100 r.p.m.

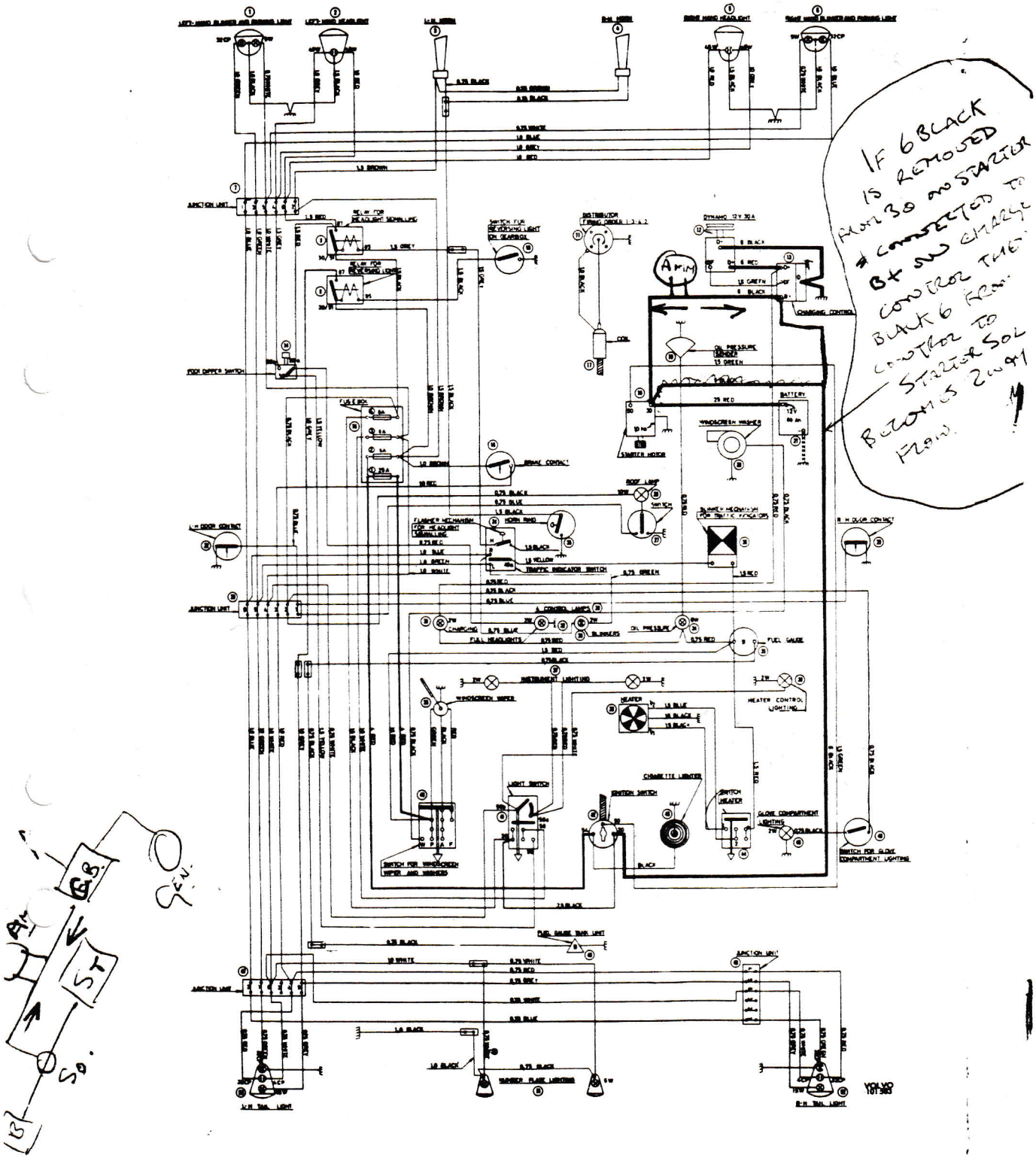


FIG 13:9 Wiring diagram. Chassis 17950 to 70299 Station Wagon