



CARS

PART 3
ELECTRICAL
SYSTEM
P 1800

SERVICE MANUAL

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SPECIFICATIONS

BATTERY

	P 1800 A	P 1800 S
Type	Lucas BT 29 A or equivalent	Boliden 107 GH 60 or equivalent
Earthed	Negative terminal	Negative terminal
System voltage	12 V	12 V
Battery capacity, standard	57 Ah	60 Ah
Electrolyte specific gravity:		
Fully charged battery	1.275–1.285	1.275–1.285
When re-charging is necessary	1.230	1.230

IGNITION SYSTEM

Firing order	1–3–4–2
Ignition setting, octane rating (Research Method):	
97 at 1500 engine r.p.m.	14–19° before T.D.C.
100 at 1500 engine r.p.m.	17–19° before T.D.C.
Ignition coil	ZS/KZ 1/12 A (14/3)
Sparking plugs, type	Bosch W 225 T 1 or equivalent
thread	14 mm
spark plug gap	0.7 mm (0.028")

DISTRIBUTOR

Production type I	VJU 4 BL 33
II	VJ 4 BL 34
III	JC 4
VI	JFR 4

Test values (VJU 4 BL, VJ 4 BL)

Direction of rotation	Anti-clockwise			
Ignition setting curves, centrifugal governor:				
Crankshaft degrees	0	10	20	22±3
Crankshaft speed, r.p.m.	750–1050	1300–1850	2300–2900	2800–3300
Contact breakers, gap	0.4–0.5 mm (0.016–0.020")			
Contact breakers, contact pressure	0.4–0.5 kg (0.88–1.10 lb.)			
Dwell angle	57–63°			

Test values (JC 4, JFR 4)

Direction of rotation	Anti-clockwise			
Ignition setting curves centrifugal governor:				
Crankshaft degrees	0	10	20	26±3
Crankshaft speed, r. p. m.	510–1050	1450–1920	2350–3700	4600–4900
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	Bosch LJ/GG 240/12/2400 AR 7
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	450–600 g (1.0–1.3 lb.)

Test values

Field winding resistance	4.8+0.5 ohms
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 CONTROL

Type	Bosch RS/VA 240/12/2
Equalizing resistance aR	15.5–16.5 ohms
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 control:	
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 PROD.

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	Min. 7 V
Adjusting measurement "a" (see Figure 69)	32.2±0.1 mm (1.268±0.004")

STARTER MOTOR, LATE PROD.

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

ELECTRICAL

Starter motor unloaded:	
12.0 V and 40—50 A	6900—8100 r.p.m.
Starter motor loaded:	
9 V and 185—200 A	1050—1350 r.p.m.
Starter motor locked:	
r.p.m. = 0	6 V 300—350 A
Control solenoid:	
Cut-in voltage	Min. 8 V
Adjusting measurement (see Fig. 69)	19.0±0.1 mm (0.748±0.004")

BULBS

	Antal	Effekt
Headlamps	2	45-50 W
Direction indicators/parking lights, front	2	21/6 W
Direction indicators, rear	2	21/6 W
Stop light	2	21 W
Number plate lighting	2	4 W
Reversing light	1	21 W
Roof light	2	6 W
Instrument lighting	9	2 W
Map-reading lamp	1	6 W
Control lamps, direction indicators	1	2 W
charging	1	2 W
overdrive	1	2 W
oil pressure	1	2 W

DESCRIPTION

The electrical system of the Volvo P 1800 is of the 12 V type. The equipment can be divided up into the following main parts: Battery, dynamo, charging control, starter motor, ignition system, lighting and signalling devices and instruments.

BATTERY

The battery, see Fig. 1, is placed on a shelf to the right of the bulkhead. It is a 12 V lead battery consisting of six cells, see Fig. 2. The battery has a capacity of 60 Ah.

DYNAMO

The dynamo, Fig. 3, 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.

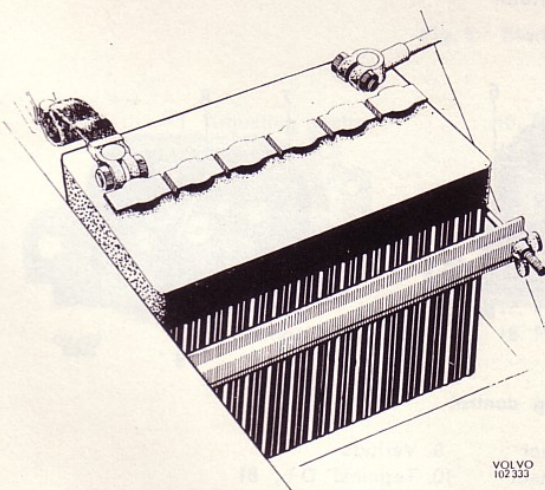


Fig. 1. Battery anchorage

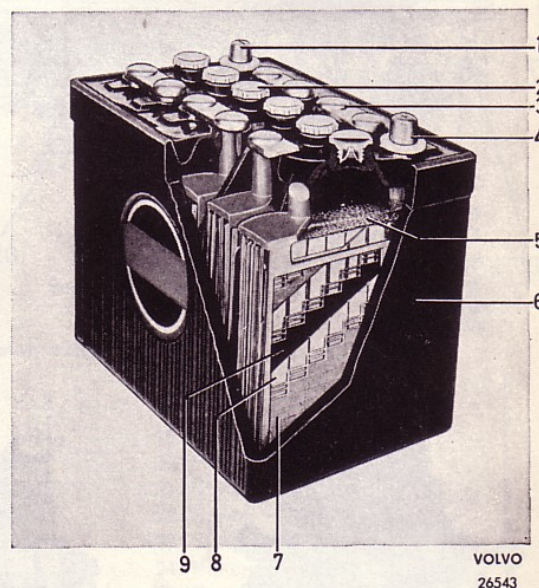


Fig. 2. Battery

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

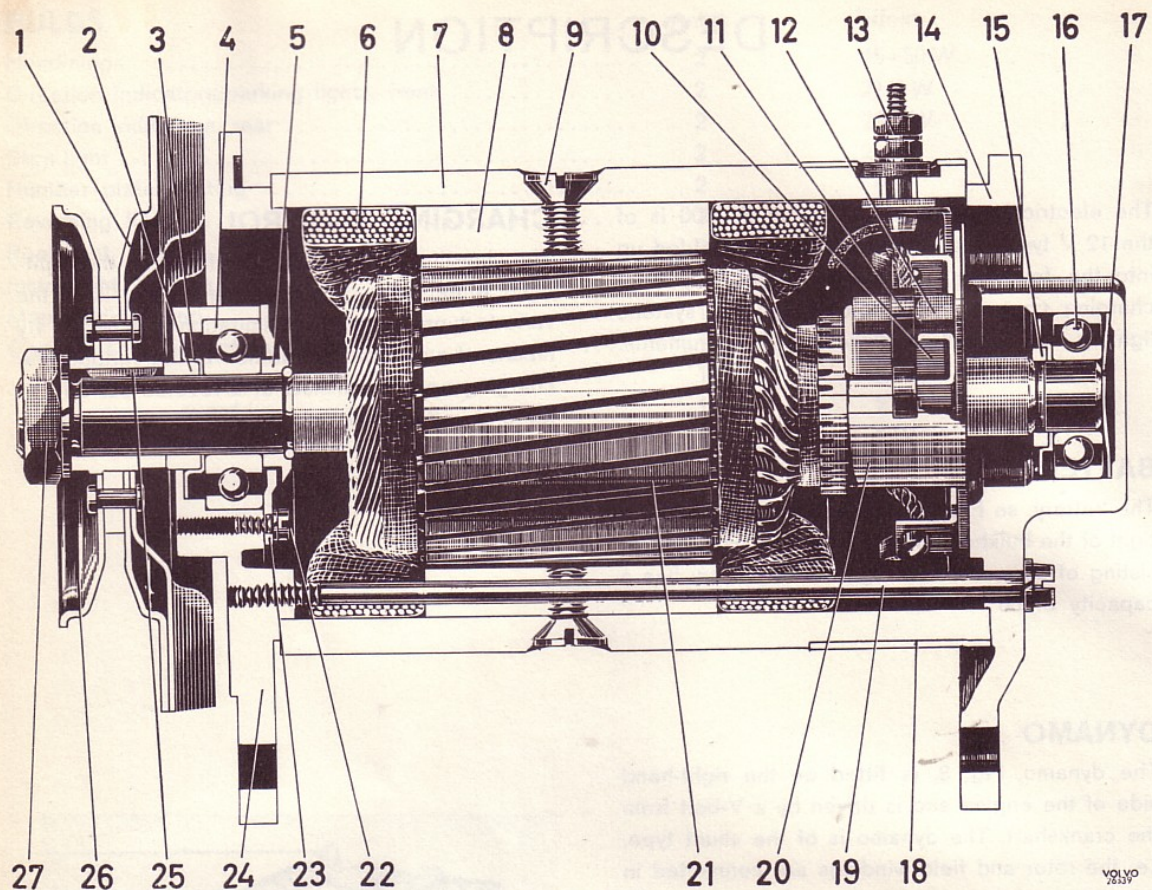


Fig. 3. Dynamo

- | | | | |
|--------------------|--------------------|---------------------|--------------------|
| 1. Belt pulley | 8. Pole shoe | 15. Sealing washer | 22. Screw |
| 2. Spacing ring | 9. Pole screw | 16. Ball bearing | 23. Sealing washer |
| 3. Oil seal washer | 10. Brush holder | 17. Spring ring | 24. End shield |
| 4. Ball bearing | 11. Brush spring | 18. Protection band | 25. Key |
| 5. Spacing ring | 12. Brush | 19. Screw | 26. Spring washer |
| 6. Field winding | 13. Terminal screw | 20. Commutator | 27. Nut |
| 7. Stator | 14. End shield | 21. Rotor | |

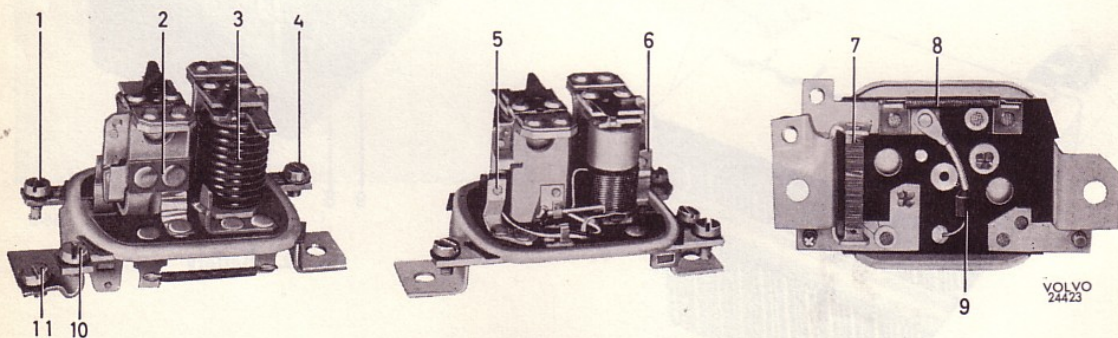


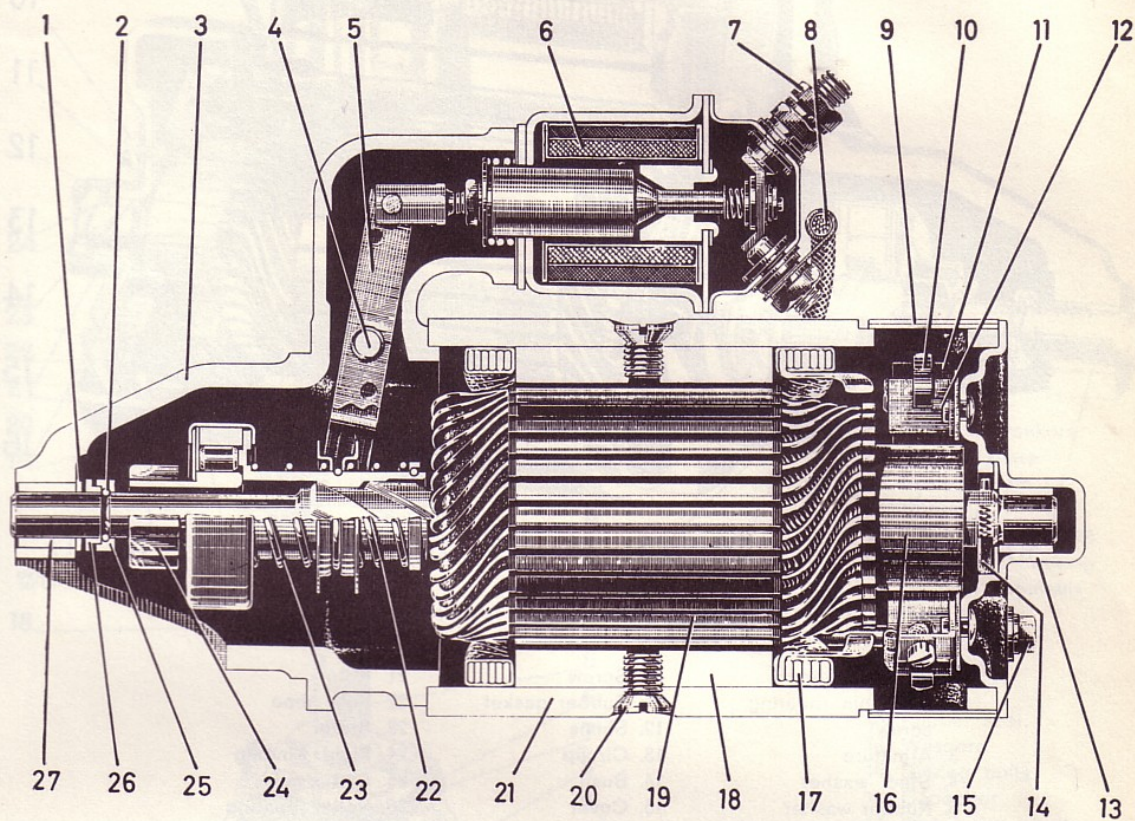
Fig. 4. Charging control

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

STARTER MOTOR

The starter motor, Figs. 5 and 6, 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.



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Fig. 5. Starter motor, early prod.

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

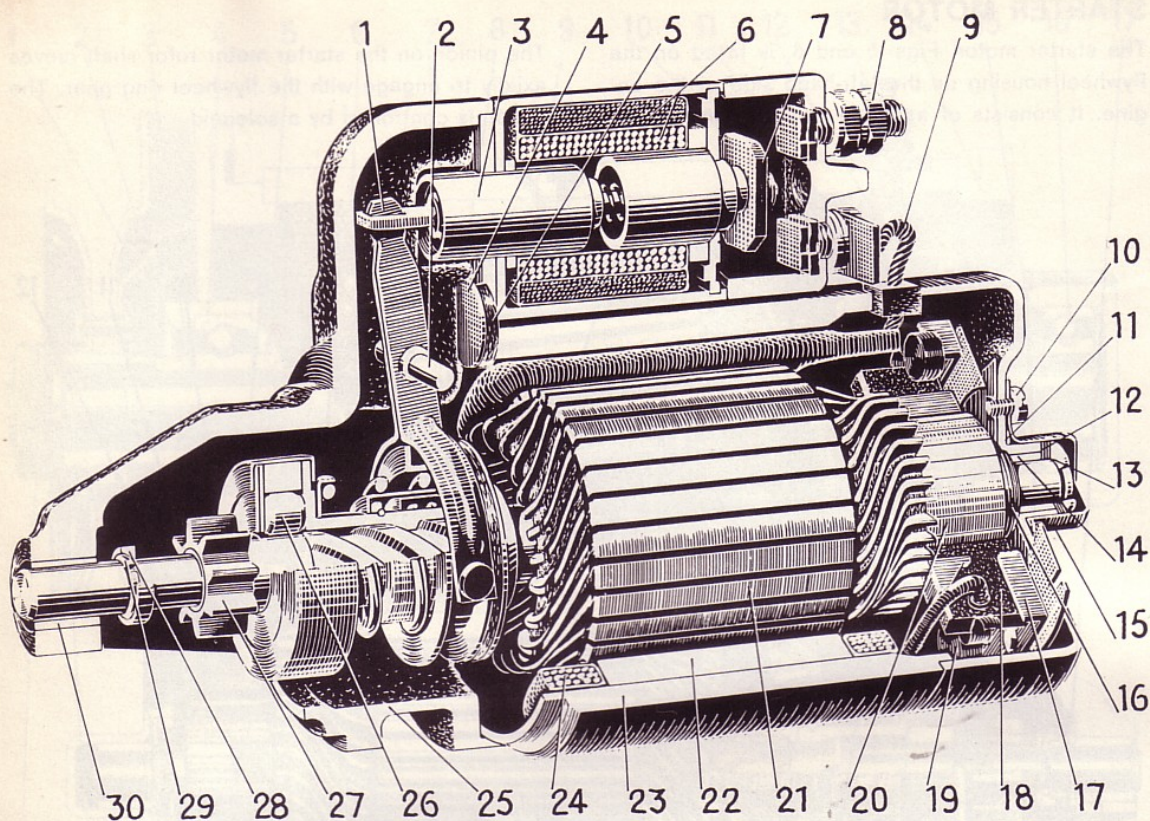
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Fig. 6. Starter motor, late prod.

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

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.

DISTRIBUTOR

The distributor, Figs. 7 and 8, is fitted on the left-hand side of the engine and is driven from the camshaft.

The distributor has two separate electrical cir-

cuits, 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.

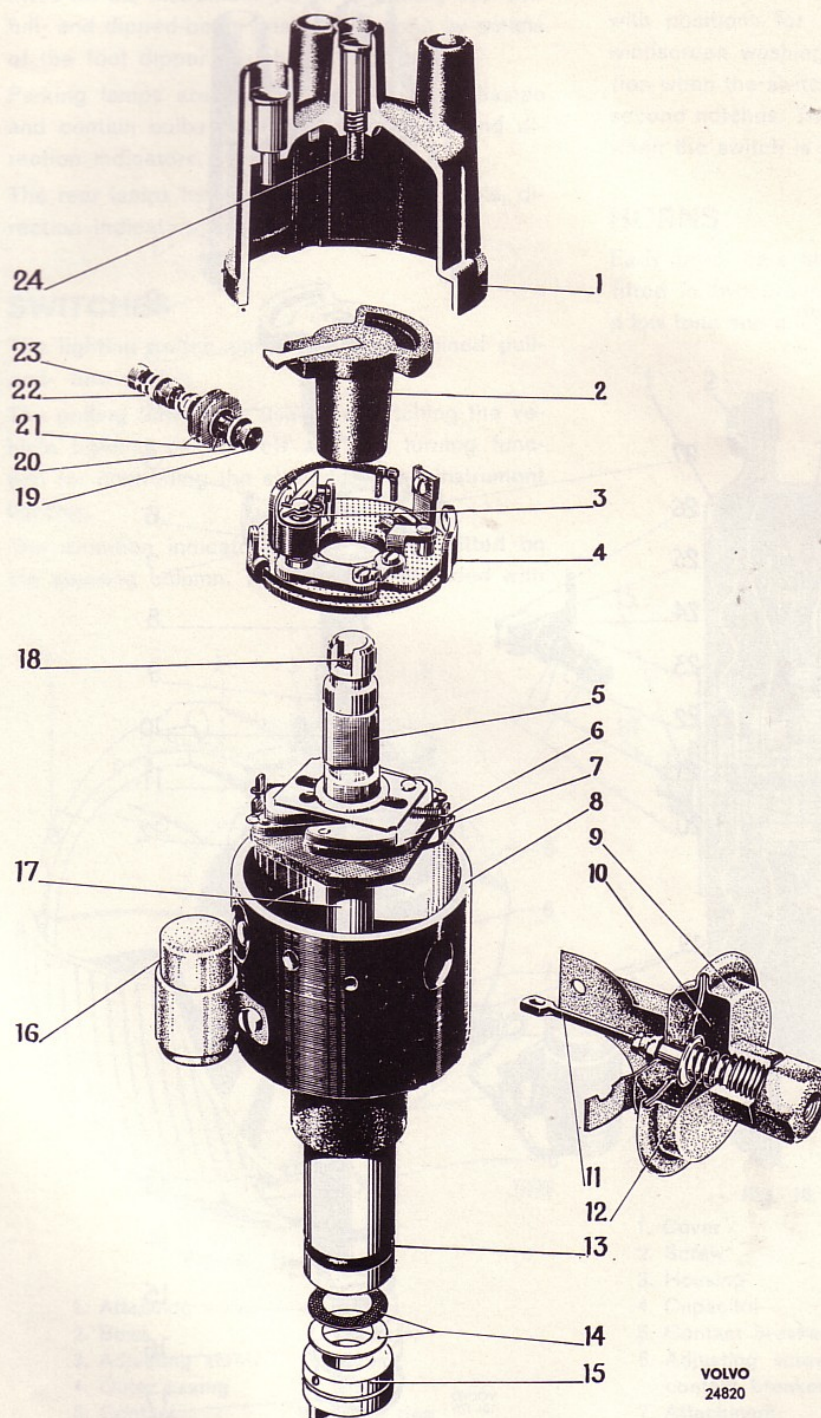


Fig. 7. Distributor, early prod.

1. Cap
2. Rotor arm
3. Contact breakers
4. Breaker plate
5. Breaker cam
6. Spring
7. Governor flyweight
8. Distributor housing
9. Vacuum regulator (not used)
10. Diaphragm
11. Link rod
12. Spring
13. Rubber seal
14. Washers
15. Driving collar
16. Capacitor
17. Distributor shaft
18. Felt seal
19. Screw
20. Flat washers
21. Insulating washers
22. Spring washer
23. Nut
24. Rod brush

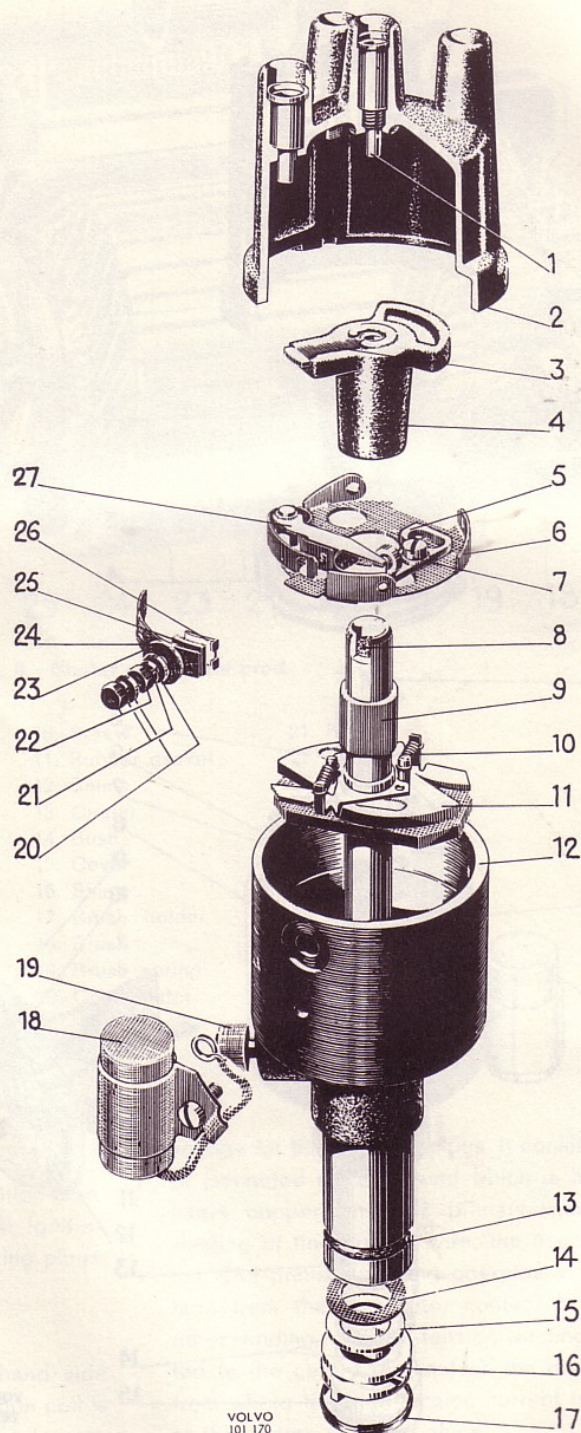
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The high-tension voltage generated in the ignition coil is distributed to the sparking plugs by the rotor arm fitted on the distributor shaft. The adjustment of the distributor in relation to the

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. 8. Distributor, late prod.

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



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LIGHTING

The lighting consists of two headlamps which have full- and dipped-beam positions, flashers 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 fitted 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 rear lights, direction indicators and stoplights.

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 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 placed next to the ignition switch.

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

HORNS

Early prod. cars are equipped with three horns, fitted in two groups. One group has two horns, a low tone and a high tone. This group is operated

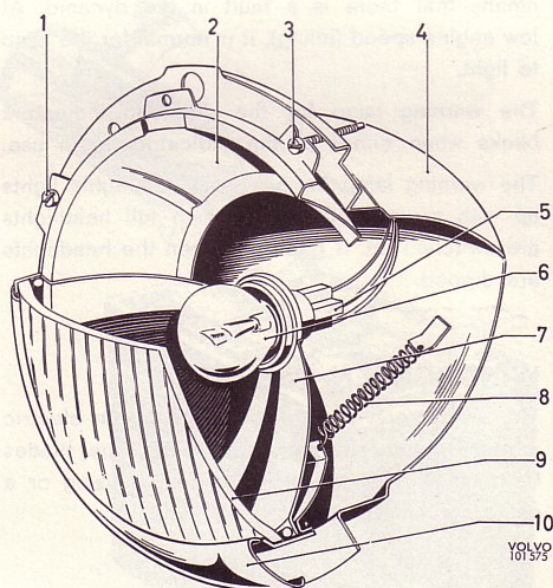


Fig. 9. Headlamp

- | | |
|--------------------|----------------|
| 1. Attaching screw | 6. Bulb |
| 2. Bowl | 7. Reflector |
| 3. Adjusting screw | 8. Spring |
| 4. Outer casing | 9. Glass |
| 5. Contact | 10. Outer ring |

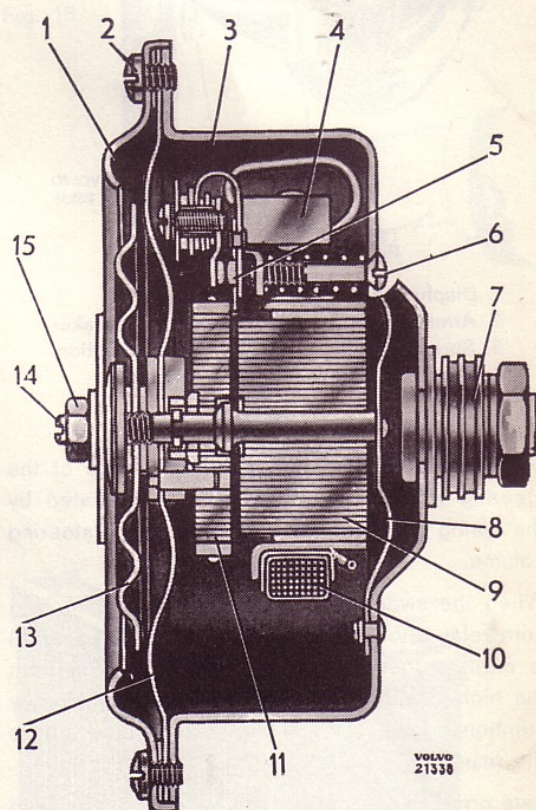


Fig. 10. Horn, early prod.

- | | |
|--|---------------------|
| 1. Cover | 9. Iron core |
| 2. Screw | 8. Leaf spring |
| 3. Housing | 10. Winding |
| 4. Capacitor | 11. Armature plate |
| 5. Contact breaker | 12. Diaphragm |
| 6. Adjusting screw for contact breaker | 13. Vibration disc |
| 7. Attachment | 14. Adjusting screw |
| | 15. Lock nut |

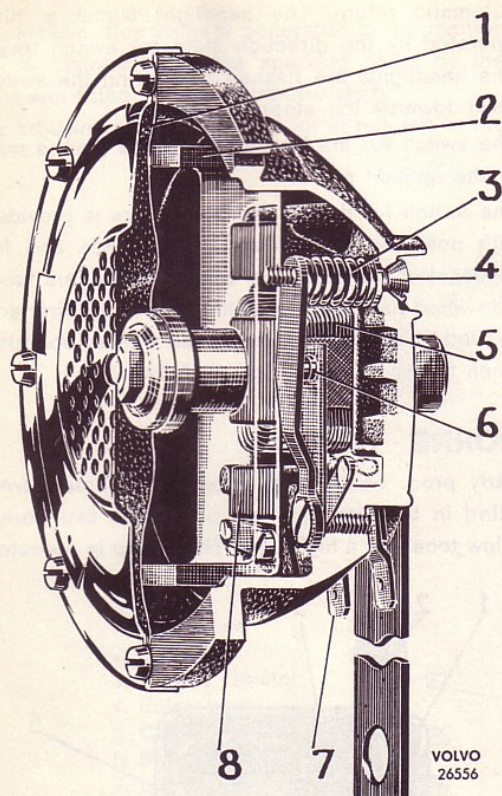


Fig. 11. Horn, late prod.

- | | |
|--------------------|--------------------|
| 1. Diaphragm | 5. Winding |
| 2. Armature | 6. Contact breaker |
| 3. Spring | 7. AMP-connection |
| 4. Adjusting screw | 8. Iron core |

by means of a horn button in the centre of the steering wheel. The other group is operated by the spring type lever switch fitted on the steering column.

When the switch is depressed, the winding in a horn relay (mounted on the left-hand wheel arch) is earthed thereby earthing the winding in both the high-tone horn and in the two horns already mentioned. The voltage feed takes place across the fuse.

Late prod. cars are fitted with two horns, a low and a high tone horn. They are operated by the horn button in the centre of the steering wheel.

CONTROL 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

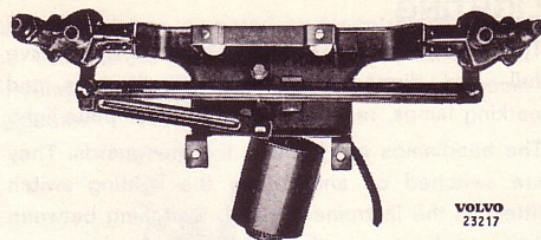


Fig. 12. Windscreen wipers, early prod.

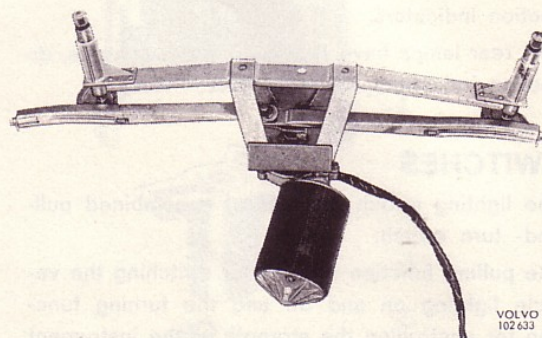


Fig. 13. Windscreen wipers, late prod.

means that there is a fault in the dynamo. At low engine speed (idling), it is normal for the lamp to light.

The warning lamp for the direction indicators blinks when either of the indicators is in use.

The warning lamp for full-beam headlights lights up with a weak blue glow when full headlights are switched on. It goes out when the headlights are dipped.

WINDSCREEN WIPERS

The windscreen wipers are driven by an electric motor. The motor is connected to the wiper blades by means of link arms and a gear housing or a cable mechanism, see Figs. 12 and 13.

FUSES

The fuses are located next to the charging relay on the left-hand wheel arch. The fuses consist of filaments mounted in glass tubes. The wiring diagram shows how the fuses are connected and the cables and components they protect.

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.

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 spe-

cified level above the plates. Make sure 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. 14.

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

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. 15.

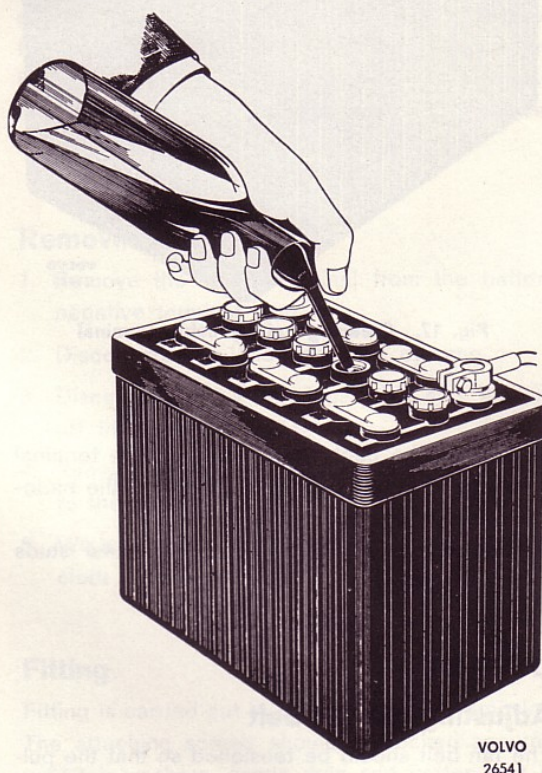


Fig. 14. Topping-up with distilled water

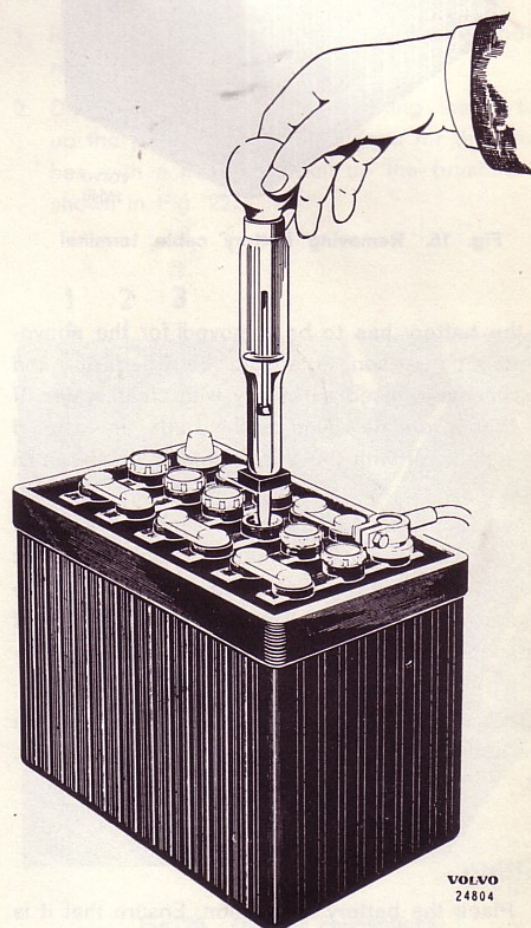


Fig. 15. Checking specific gravity of acid

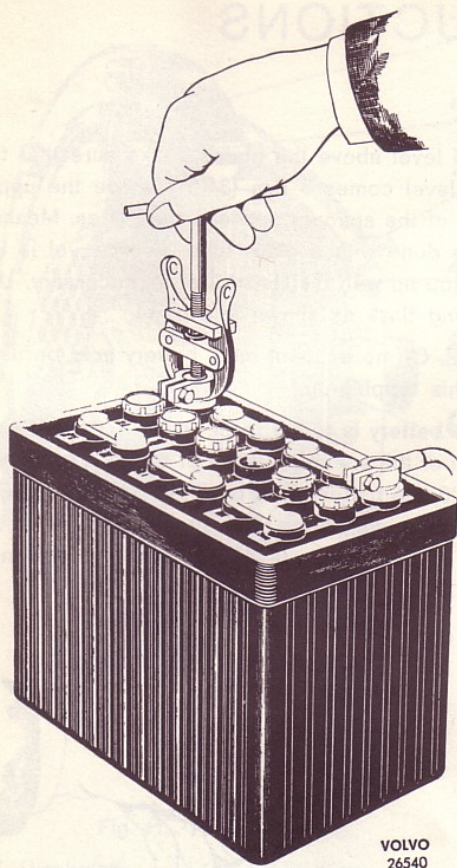


Fig. 16. Removing battery cable terminal

If the battery has to be removed for the above-mentioned reason, it should be lifted out and washed and rinsed externally with clean water. If the cable terminals bind on the studs, they should be pulled off with the special puller as shown in Fig. 16.

When fitting the battery, make sure that it is secured firmly in position, that the cable terminals are cleaned and well tightened and that they are coated with vaseline. The terminals are best cleaned with the pliers intended for this purpose, see Fig. 17.

Check to make sure that the earth lead between the body and the engine is not damaged, see Fig. 18.

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.

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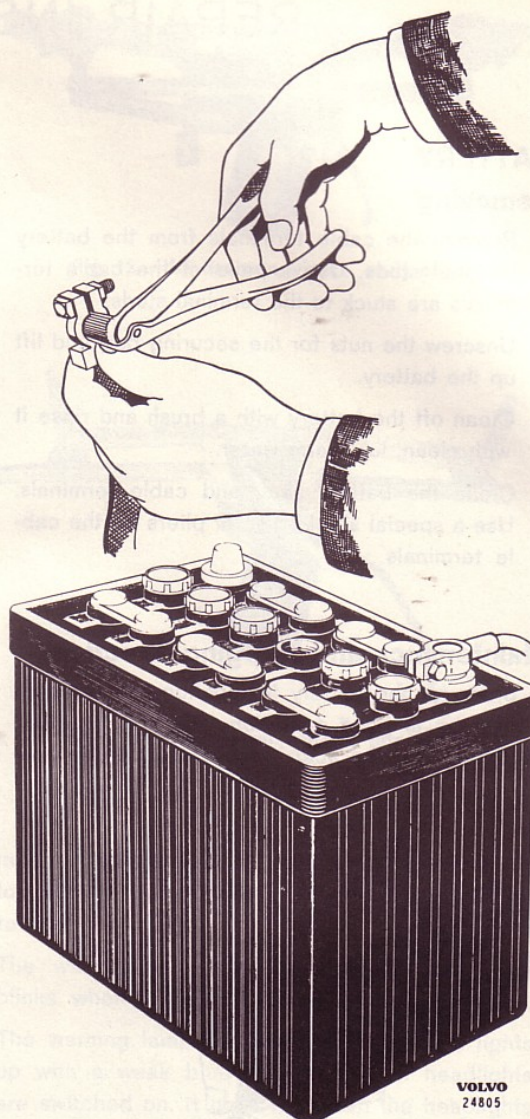


Fig. 17. Cleaning battery cable terminal

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.

DYNAMO

Adjusting the fan belt

The fan belt should be tensioned so that the pulley begins to slip at a pulling power of 8.0–11.0 kg (17–24 lb.) applied to the fan 150 mm (6")

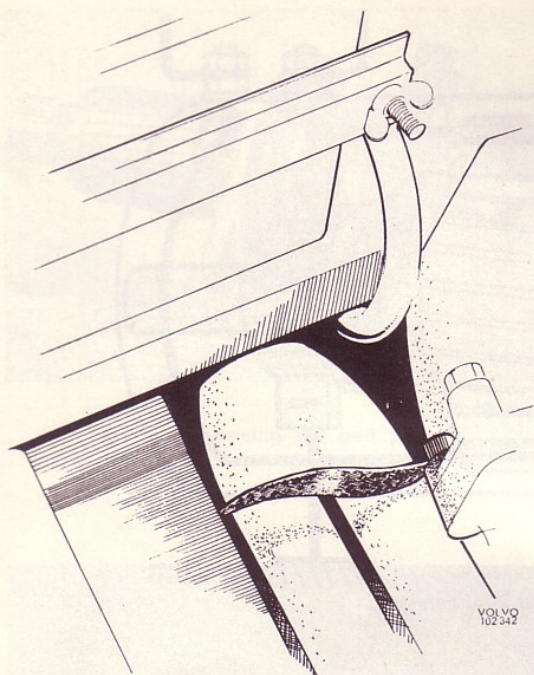


Fig. 18. Earth lead, body and engine

from the centre of the hub. Turn the fan in the engine in direction of rotation and fit a spring balance as shown in Fig. 19. To adjust, slacken the bolts on the underside of the dynamo, otherwise tensions will arise in the attachment and adversely affect it.

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.

Fitting

Fitting is carried out in reverse order to removing. The attaching screws should be locked securely with tab washers, castle nuts and cotter pins or locknuts.

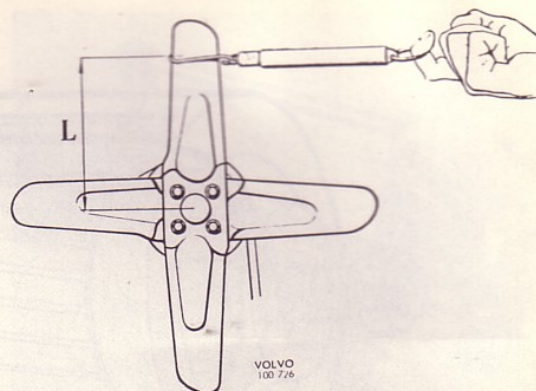


Fig. 19. Checking the fan belt tension

L = 150 mm (6"). Pulling power 8.0-11.0 kg (17-24 lb.)

Dismantling

Dismantling the dynamo for overhaul (cleaning and lubricating) is done as follows:

1. Remove the protecting band if this has been re-fitted after testing.
2. Disconnect the brush connecting leads. Lift up the pressure arms or springs for the brushes with a hook and pull up the brushes as shown in Fig. 22.

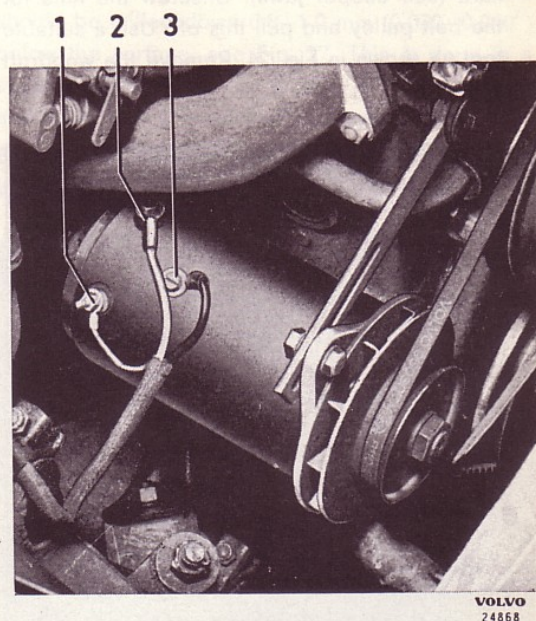


Fig. 20. Dynamo connections

1. Dynamo field, DF 2. Dynamo, D+ 3. Earth lead

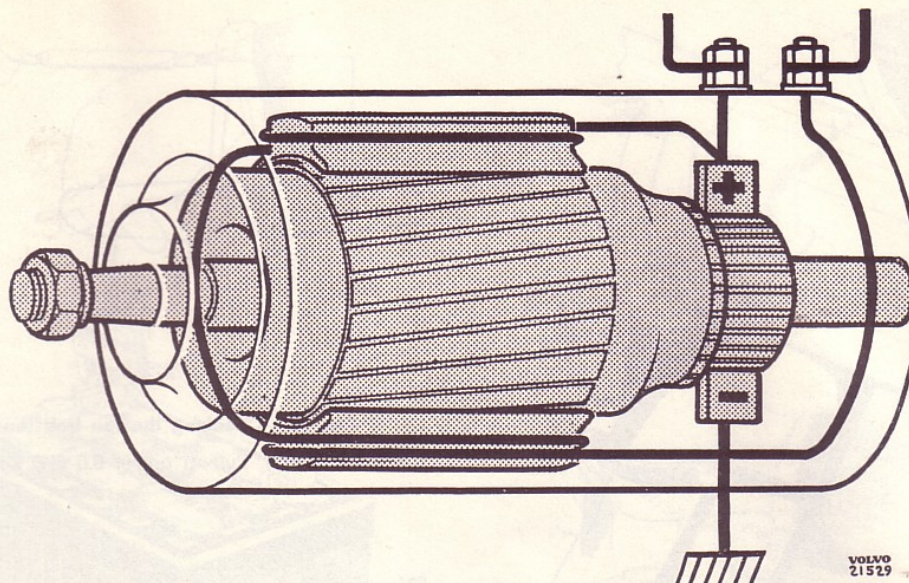


Fig. 21. Dynamo, general arrangement

3. Remove the screws which hold the dynamo housing and end shield together after having first disconnected the connecting bar as shown in Fig. 23.
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 cooper jaws). Unscrew the nuts for the belt pulley and pull this off. Use a suitable tool as shown in Fig. 24. 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 for the brushes, in clean petrol.

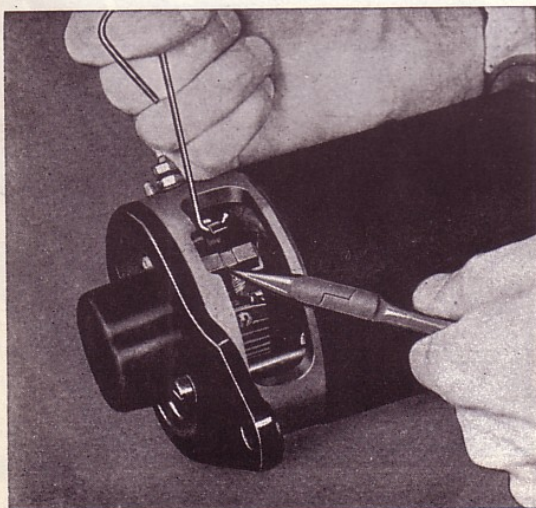


Fig. 22. Removing the brushes

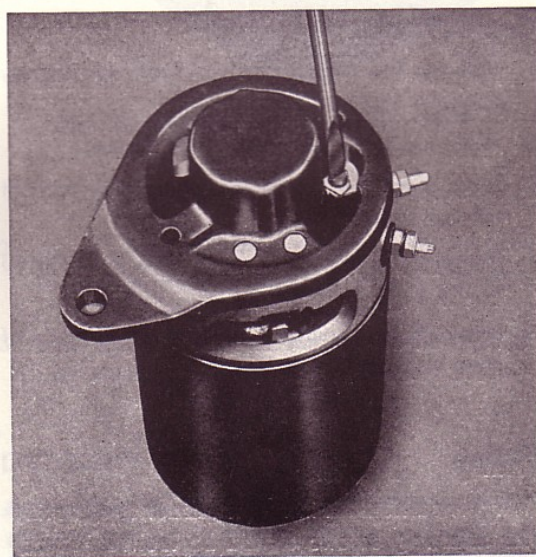


Fig. 23. Removing the connecting bar

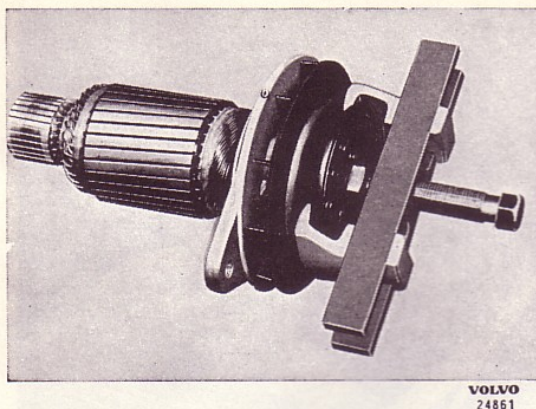


Fig. 24. Removing the belt pulley

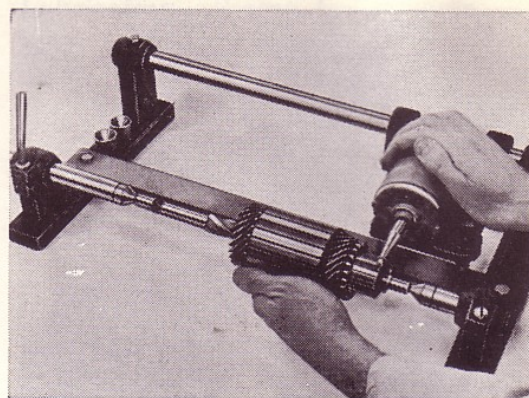


Fig. 27. Milling the grooves

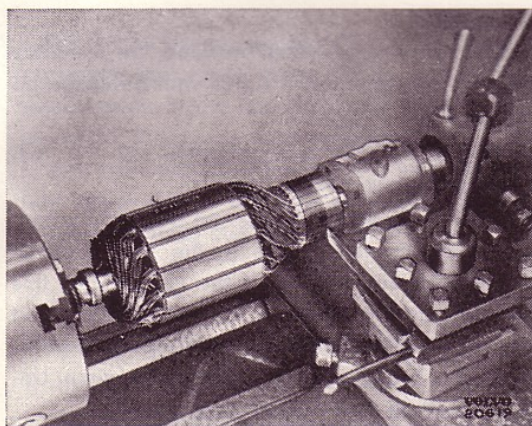


Fig. 25. Turning the commutator

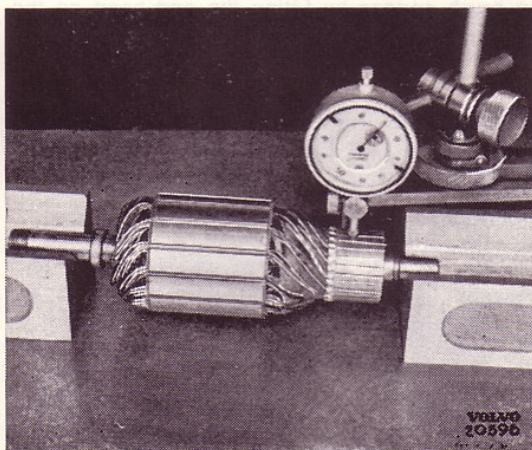


Fig. 26. Indicating the commutator

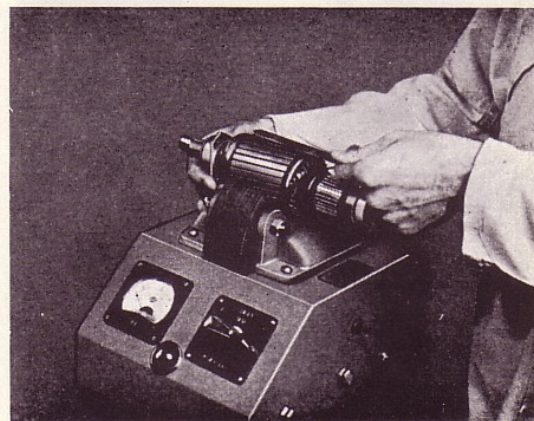


Fig. 28. Testing the rotor

Inspecting

Examine the rotor for mechanical damage such as 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.

After turning, the commutator should be indicated, as shown in Fig. 26. A maximum out-of-roundness of 0.13 mm (0.0051") can be considered permissible. The insulation between the laminations should be milled down 0.8–1.0 mm (0.032–0.040") below the surface, see Fig. 27. This is done in a special apparatus, or if one of these is not available, with a ground-off hacksaw blade.

Examine the rotor both before and after turning by placing it in a growler. Switch on the current

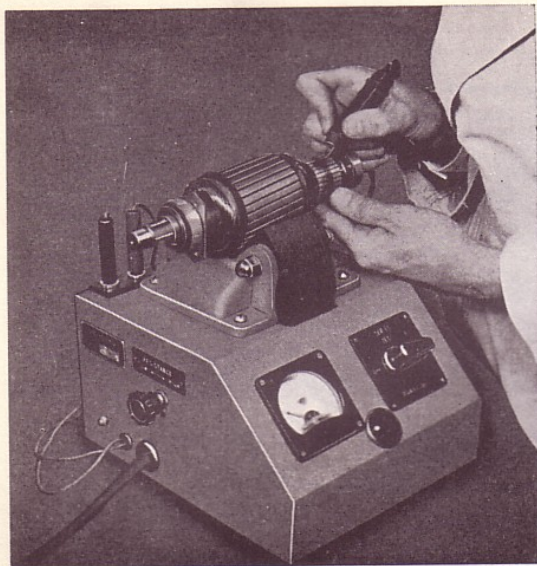


Fig. 29. Measuring the rotor

and hold a hacksaw blade close to the rotor, see Fig. 28. 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.

Shorting between the windings can be determined by holding the resistance prong against the commutator as shown in Fig. 29. 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.

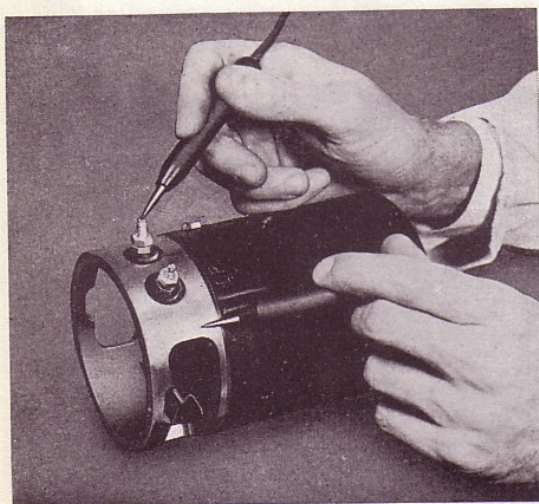


Fig. 30. Testing the stator

3-18

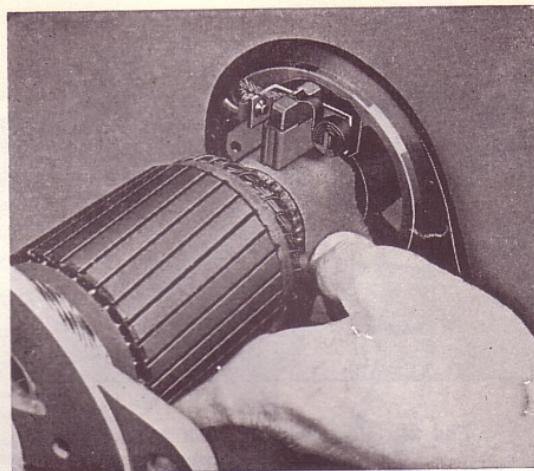


Fig. 31. Grinding-in the brushes

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 lamp.

Test that the field winding is not earthed by connecting the contact points to the field terminal and housing, see Fig. 30. If the lamp lights, this indicates shorting between the field winding and housing. Make sure that there is no contact between the field winding and the housing. Unscrew the field lead-through and test again.

Brushes which are damaged or worn down more than halfway 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. 31. Test the strength of the brush springs by fitting the end head on the rotor and connecting a spring balance to the mo-

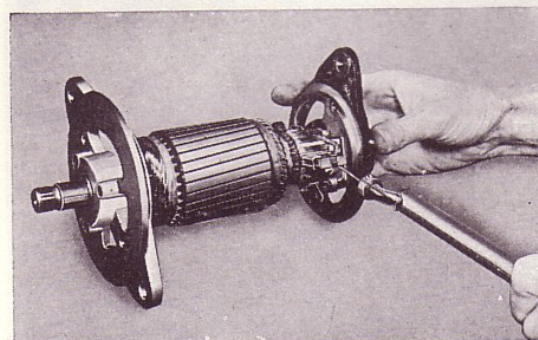


Fig. 32. Measuring the brush pressure

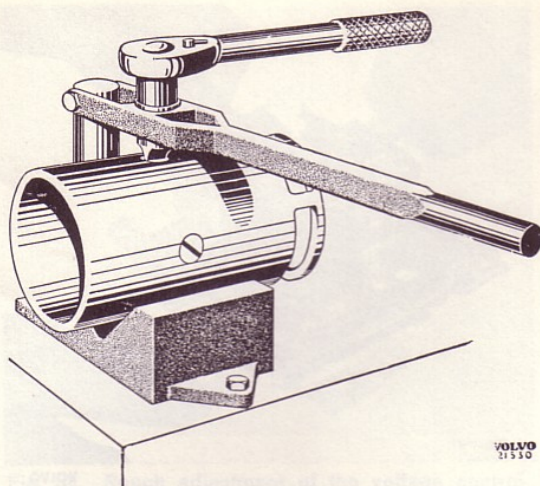


Fig. 33. Removing the field winding

vable arm or spring, see Fig. 32. 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.

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. 33. Press down at the same time while turning the screwdriver. As a rule, the screws are tightened very hard. Therefore ensure that the screwdriver head fits well into the slot in the screw and is sufficiently wide.
3. When both the screws have been slackened, the housing is lifted off. Screw out the screws with an ordinary screwdriver. Remove the cable lead-through in the housing and lift out the windings and pole shoes.
4. Fit the new field winding at the housing. Use the same device used for releasing the screws.
5. Connect the cables at the lead-through in the housing. Test for earthing.
6. Assemble the other parts of the dynamo. See under the heading "assembling".

Lubricating scheme for dynamo

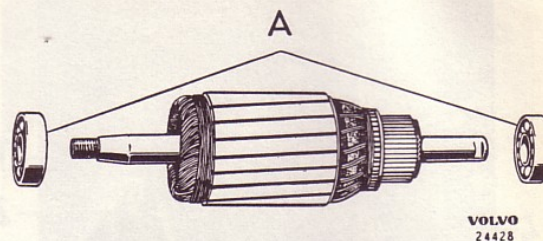


Fig. 34. Dynamo lubricating scheme

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

Assembling

1. Fit the stop ring and sleeve, if there is one, on the shaft.
2. Place the inner cover with felt ring (if fitted) on the shaft. Lubricate the bearings with heat-resistant ball bearing grease and then fit them, see Fig. 34.
3. Place the front end shield on the shaft and bearing and screw together the end shield and cover, with a felt ring (if fitted) in the end shield.
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 ensure 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. 23.

CHARGING CONTROL

Removing

1. Disconnect the leads on the charging control.
2. Remove the charging control from the plate on the wheel arch.
3. Wipe the charging control externally.

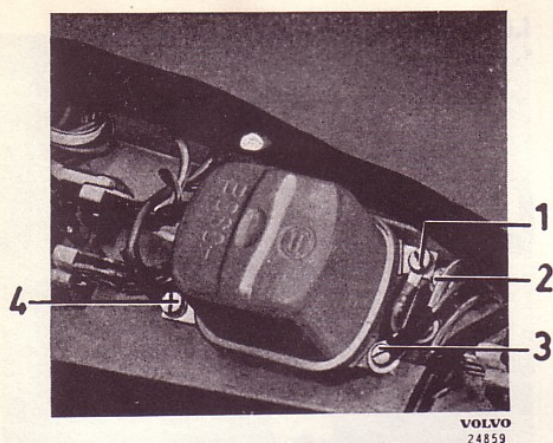


Fig. 35. Charging control terminals

- | | |
|------------------|---------------------|
| 1. Dynamo D+, 61 | 3. Dynamo field, DF |
| 2. Earth lead | 4. Battery, B+ |

Adjusting the charging control

REVERSE CURRENT RELAY

Cut-in voltage

A voltmeter is connected over D+ on the charging control 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.

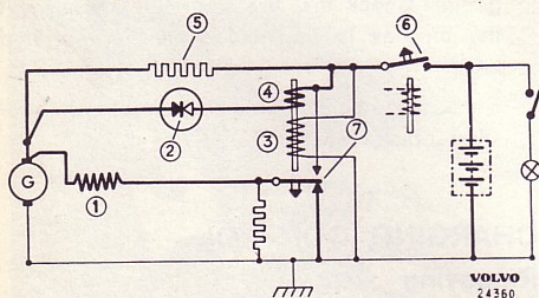


Fig. 36. Wiring diagram for charging control

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

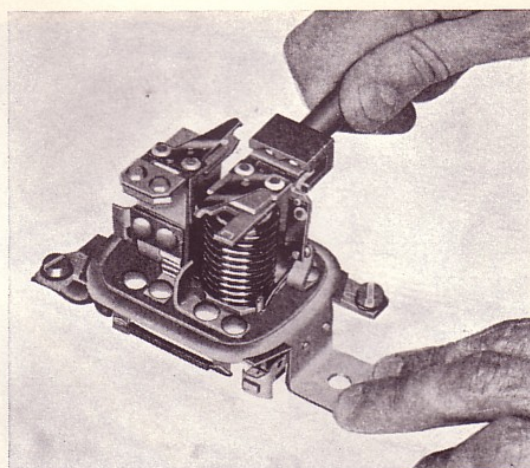


Fig. 37. Adjusting the cut-in voltage

Rough adjusting is carried out as shown in Fig. 37, and fine adjusting as shown in Fig. 39.

Reverse current

An ammeter is connected in series with B+ on the charging control 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 is read off at the turning point of the needle before it returns to the zero position. The relay has cut out when the needle returns to the zero position. 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 reduced 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.

VOLTAGE CONTROL

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

As soon as voltage control has begun, that is to say, when the voltage does not increase further, the control voltage should be read off. The control is adjusted by bending the support lip for the spring tongue as shown in Fig 39, so that the

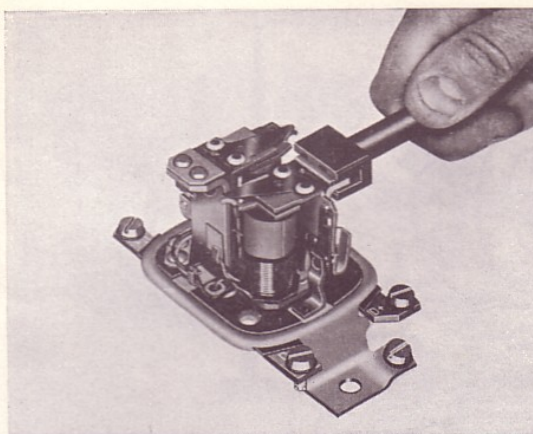


Fig. 38. Rough adjustment of the voltage control

the spring tongue is completely unloaded. After this, a rough adjustment is made by bending the relay angle piece as shown in Fig. 38. 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 tongue is tensioned, see Fig. 39. Use special tool V 395 (Robert Bosch).

Increase and decrease the speed a few times and ensure that the control 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 control 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 control must be replaced.

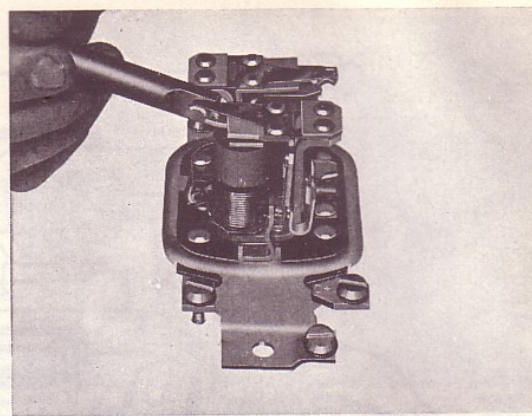


Fig. 39. Fine adjustment of the voltage control

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 control and dynamo, therefore, always check that the belt is correctly tensioned.

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. 35 or according to the wiring diagram.

STARTER MOTOR

Removing

1. Remove the cable terminal from the battery negative terminal stud.

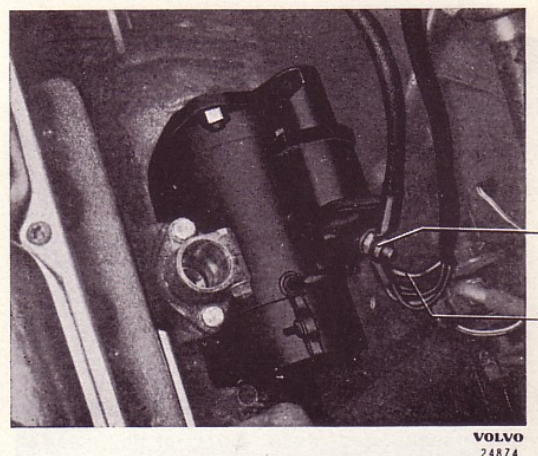


Fig. 40. Starter motor installed

1. Battery lead
2. Control lead

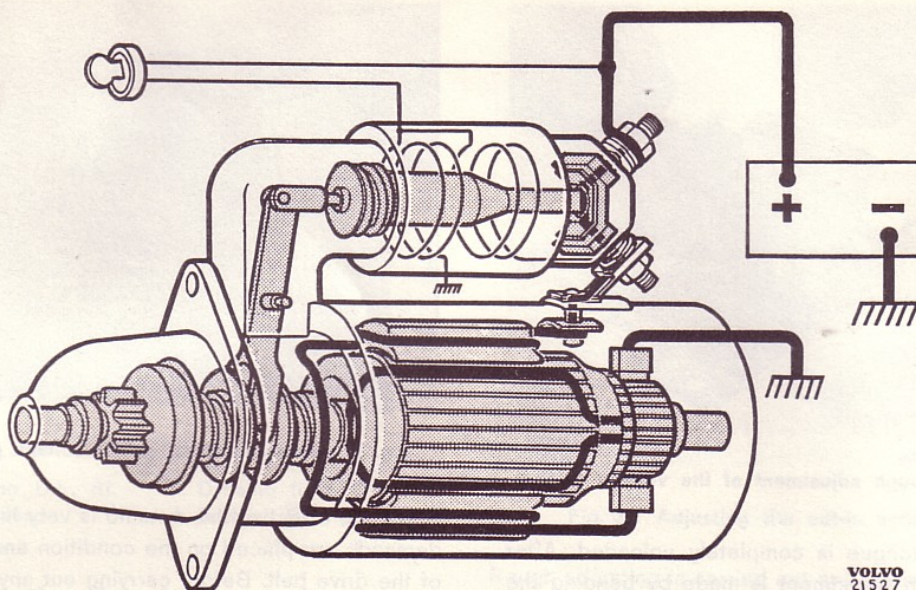


Fig. 41. Starter motor, general arrangement

2. Disconnect the leads from the starter motor.
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.

Fitting

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

Dismantling the starter motor Bosch EGD 1/12 AR 37

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

1. Remove the protection band.
2. Lift up the spring brushes and remove these, see Fig. 42.
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. 43. 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. 44), are removed by pulling straight off the shaft. The thick ring (1, Fig. 44), is first knocked in 5–8 mm (about 1/4") on the shaft so that the circlip (2, Fig. 44), can be removed, after which the washer is pulled off the shaft.



Fig. 42. Removing the brushes

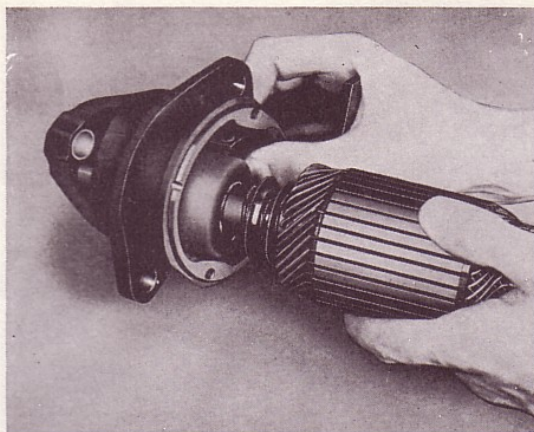


Fig. 43. Removing the pinion and rotor

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. Petrol mixtures such as bentyl must not be used since this 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. 46.
2. Lift off the locking washer and adjusting washer as shown in Figs. 47 and 48.
3. Remove the through-running bolts.

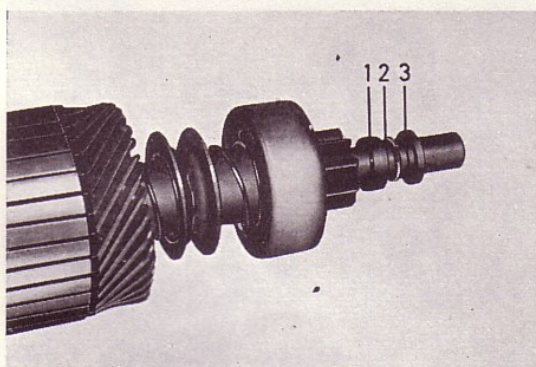


Fig. 44. Pinion, circlip and nut

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

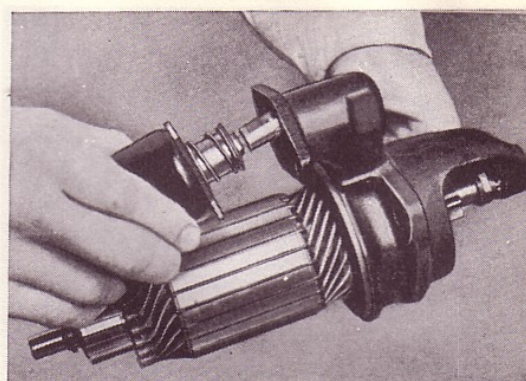
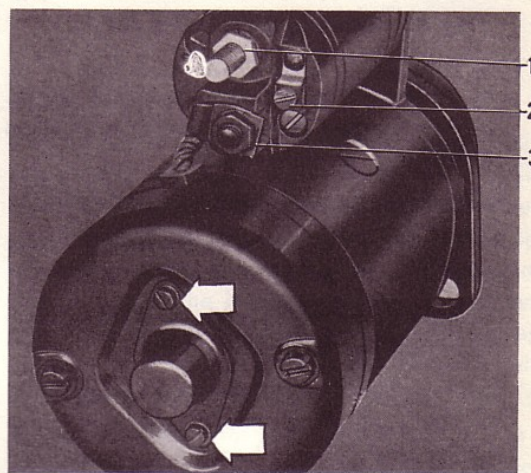


Fig. 45. Removing the control solenoid



46. Starter motor

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

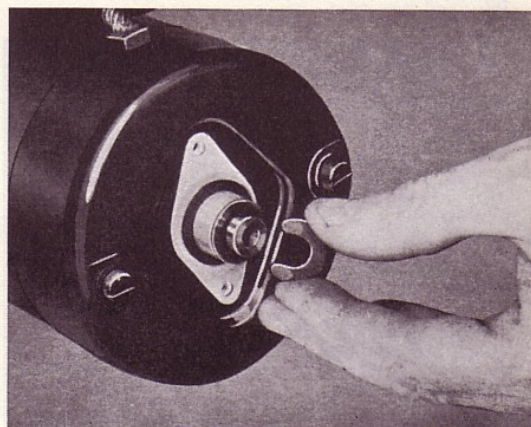
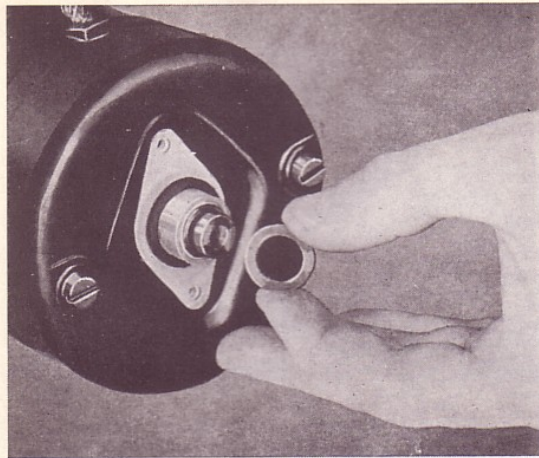


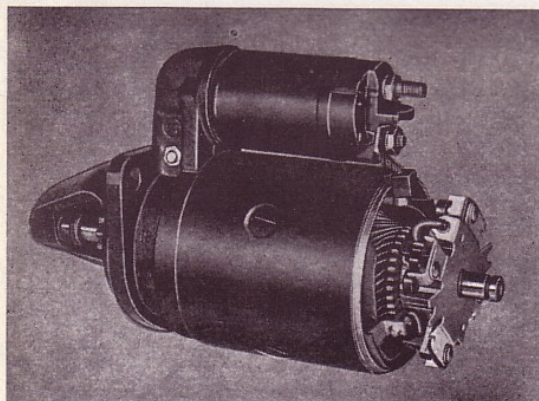
Fig. 47. Removing the circlip



VOLVO
101 087

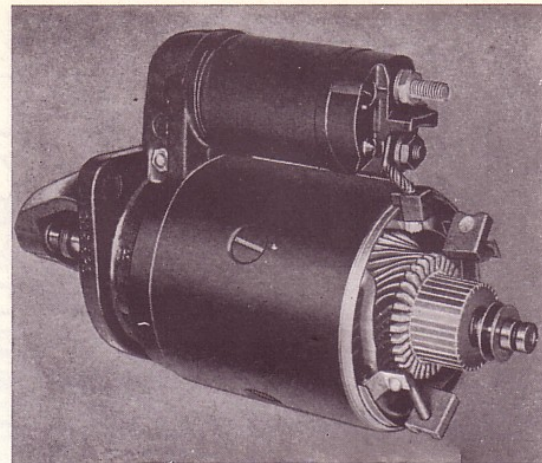
Fig. 48. Removing the adjusting washer

4. Lift off the commutator bearing shield. NOTE. The brushes and retainers remain in position on the rotor, see Fig. 49.
5. Pull the brushes out of the brush retainers.
6. Remove the brush retainer plate from the rotor shaft. Note the washers, see Fig. 50.
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. 51.
9. Remove the drive bearing shield from the pole housing.
10. Remove the pivot pin for the engaging arm.
11. Remove the rubber washer and metal washer from the drive bearing shield as shown in Fig. 52.



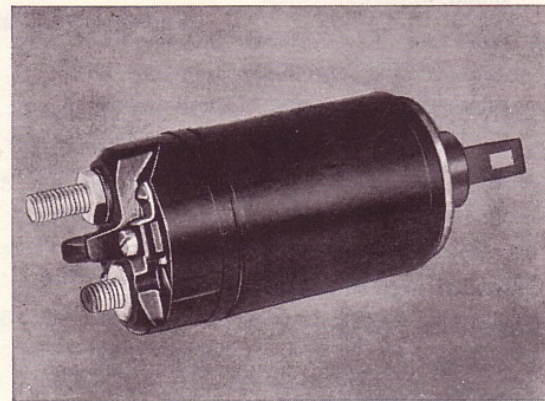
VOLVO
101 084

Fig. 49. Starter motor with end shield removed



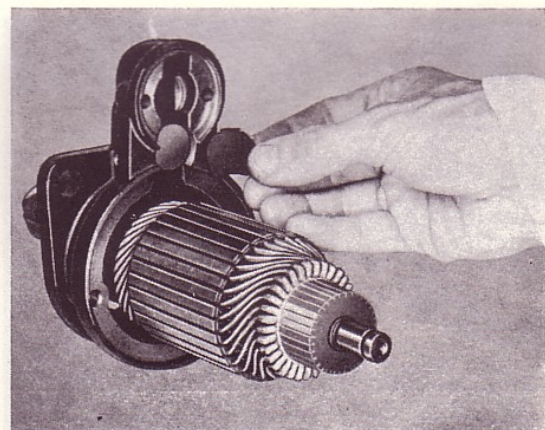
VOLVO
101 083

Fig. 50. Starter motor with brush bridge removed



VOLVO
101 089

Fig. 51. Control solenoid



VOLVO
101 082

Fig. 52. Removing the rubber washer

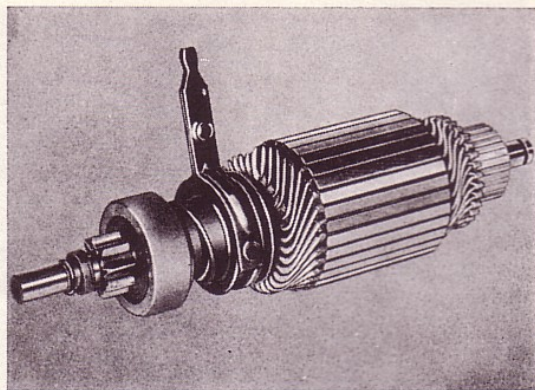


Fig. 53. Rotor with pinion

12. Lift the rotor with pinion and arm out of the bearing shield, see Fig. 53.

Knock back the stop 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 drive bearing shield.

Clean all parts, except the rotor field winding and pinion, in cleaning solution. The rotor, field filed 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.

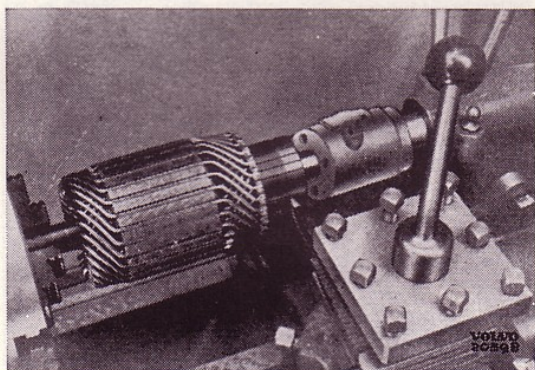


Fig. 54. Turning the commutator

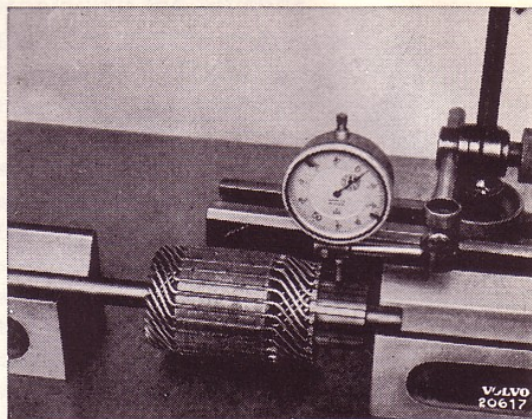


Fig. 55. Checking the rotor with dial gauge

If the commutator is scored or unevenly worn it should be turned, see Fig. 54.

The commutator should be checked with a dial gauge after turning as shown in Fig. 55. A radial throw of 0.08 mm (0.003") 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. 56 and 57. This work is carried out in a special apparatus, or if one of 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 a few mm from the rotor, see Fig. 58. If the blade vibrates in any position when the rotor is rotated, one of the following faults can be the reason: Shorting through the rotor frame, shorting in the commutator or between the windings.

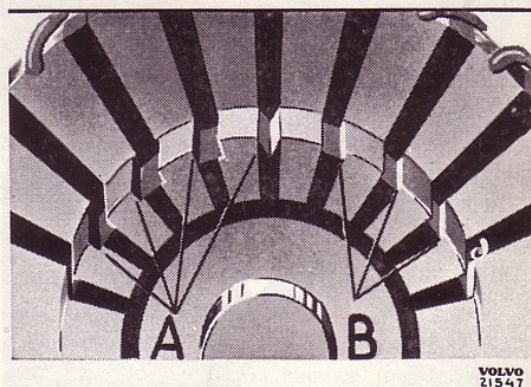


Fig. 56.

A. Incorrect milling B. Correct milling

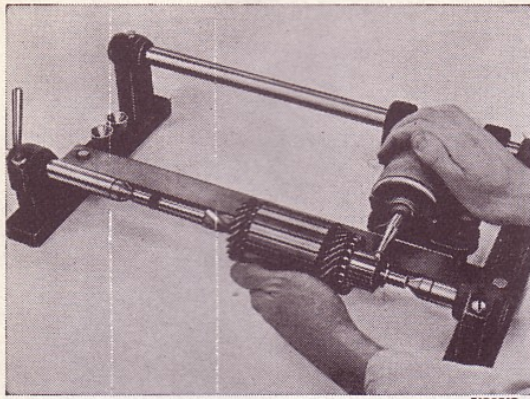


Fig. 57. Milling the grooves

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 winding as shown in Fig. 59.

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. Check that both the positive brush holders are not in contact with the end shield, see Fig. 60.

Check the spring pressure by means of a spring-balance which is hooked into the spring, see Fig. 61. 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.

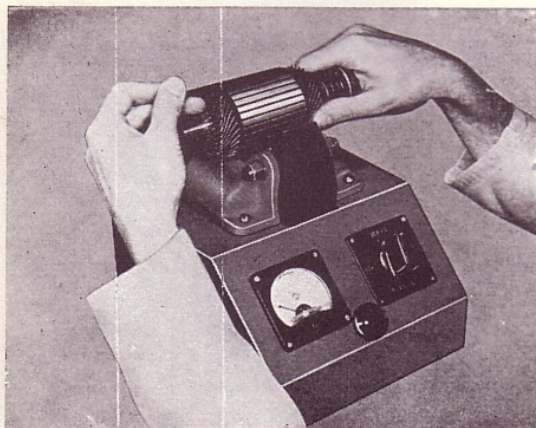


Fig. 58. Testing the rotor

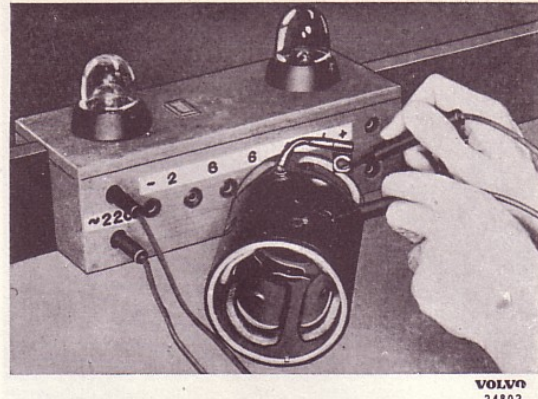


Fig. 59. Testing the field winding

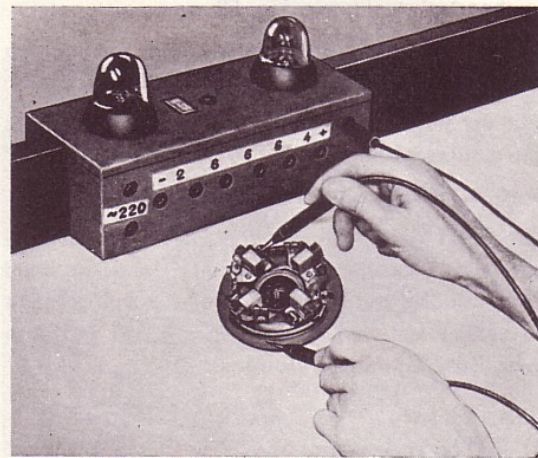


Fig. 60. Testing the brush holders

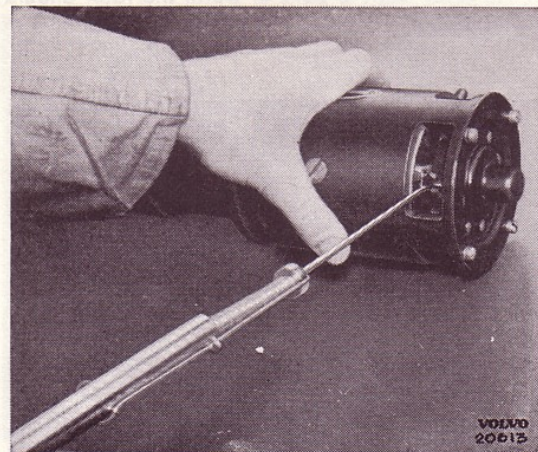


Fig. 61. Checking the brush spring tension

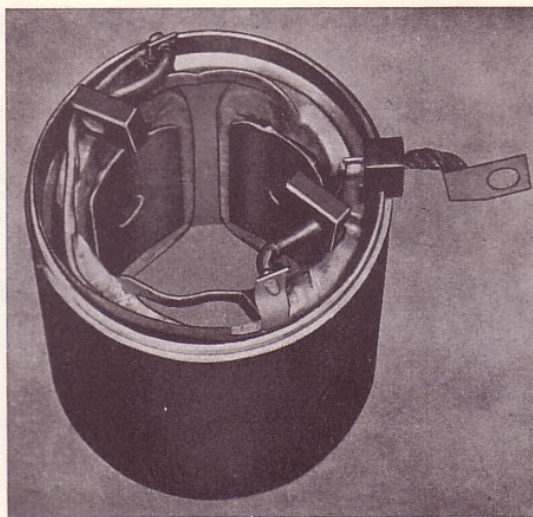


Fig. 62. Stator with soldered brushes

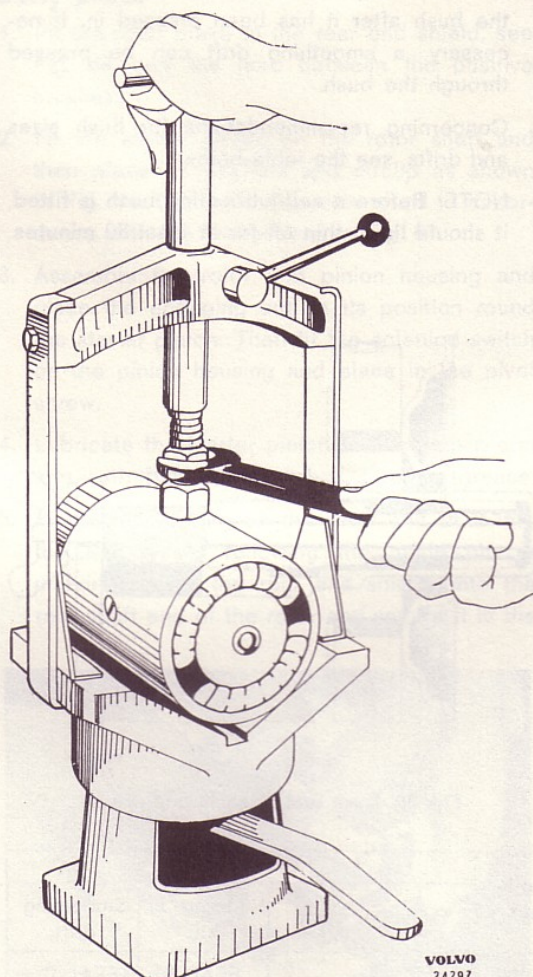


Fig. 63. Holding device for removing the field winding

Replacing the brushes

STARTER MOTOR, EARLY PROD.

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.

STARTER MOTOR, LATE PROD.

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. 63. (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. Press in a suitable drift (for measurements, see Fig. 64). Set up the stator in the holding device and tighten the pole shoes.
5. Press out the drift with a press. Check the field fitted winding for breakage and shorting.

Fitting the self-lubricating bushes

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

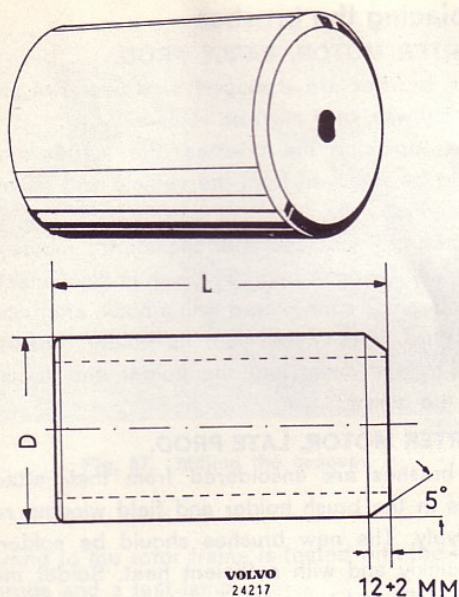


Fig. 64. Press drift (starter motor EGD)

D=66.04–66.09 mm (2.59–2.60")
L=85 mm (3.346")

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

REPLACING THE BUSHES

1. Press, knock or pull out the worn bushes with the help of a suitable tool. Special tools for the brush holder end shield are shown in Figs. 65 and 66.
2. Clean the hole for the bush and cut away any burr.
3. Press in the new bushings with the help of a suitable drift. The guide diameter of the drift

Measurement and tolerance table for bushes Starter motor Bosch EGD 1/12 AR 37

	Hole diameter for bush	Diameter and length for bush when pressed in	Tool (Bosch)		
			Puller for bush	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

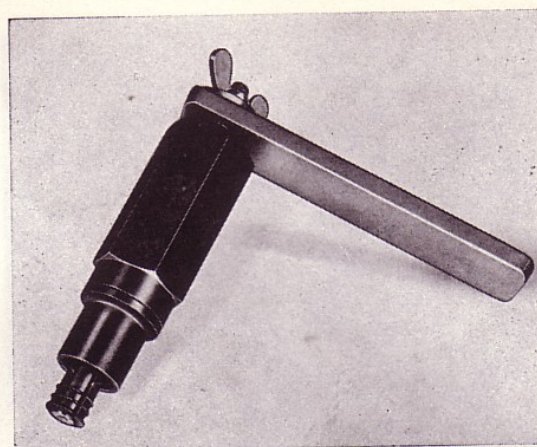


Fig. 65. Tool for removing bush

should correspond to the internal diameter of the bush after it has been pressed in. If necessary, a smoothing drift can be pressed through the bush.

Concerning recommendations for bush sizes and drifts, see the table below.

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

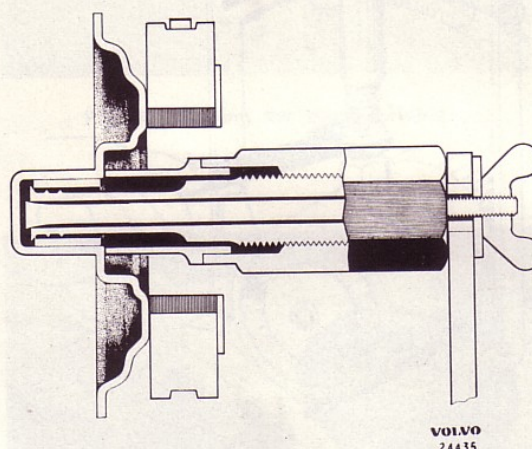
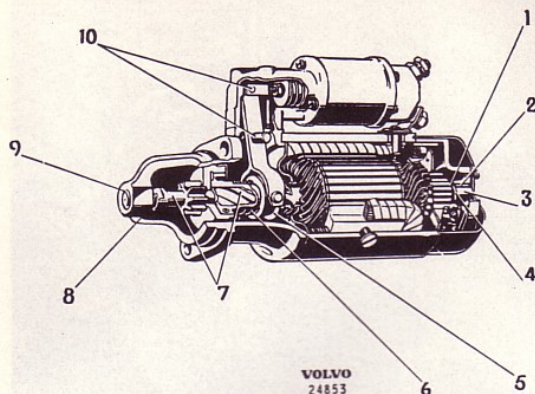
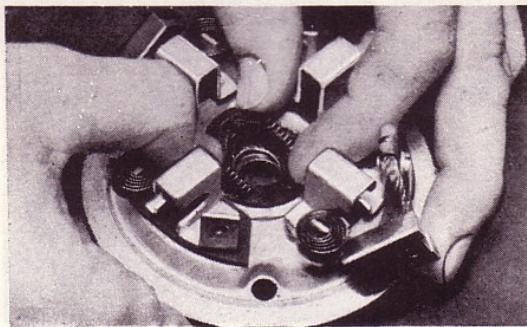


Fig. 66. Bush tool fitted in end shield

Lubricating scheme for starter motor**Fig. 67. Lubricating scheme for starter motor****Assembling the starter motor, early prod.**

1. Fit the rotor brake in the rear end shield, see Fig. 68, and the lead between the positive brushes.
2. Fit the starter pinion on the rotor shaft and then place on washers and circlip as shown in Fig. 44. Lubricate the rotor shaft in accordance with the instructions in Fig. 67.
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 end shield onto the rear shaft end of the rotor and secure it in the

**Bild 68. Montering av rotorbroms**

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 bush 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 bush in oil for 30 minutes before fitting.
10. Ft 1 v 8. Grease the pins and their bearing points lightly.

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 the "Specifications". Lubricate the shaft end and bush.

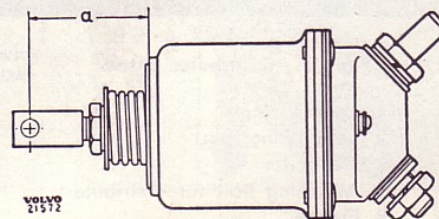
CONTROL SOLENOID

Before the control solenoid is re-fitted, distance "a" between the centre line through the pivot stud in the solenoid switch prong and the attaching flange should be checked when the iron core is fully withdrawn, see Fig. 69. 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".

Assembling the starter motor, late prod.

On assembling, lubricate the starter motor according to the directions on page 67.

1. Fit the starter pinion, the stop ring and circlip on the rotor shaft.

**Fig. 69. Adjusting distance for solenoid switch prong**

2. Assemble the rotor and pinion housing. Fit the engaging arm, the steel washer, the rubber washer and the solenoid switch.
3. Fit the stator housing on the rotor. Then fit the washers on the rotor shaft, the brush holder plate and brushes. Connect the cable to the solenoid switch.
4. Fit the commutator end shield and then the adjusting washer and lock washer. Check the axial play which should be 0.05–0.30 mm (0.002–0.012"). Fit the end shield onto the shaft end.

DISTRIBUTOR

Removing

1. Lift off the distributor cap.
2. Mark the position of the arm on the distributor housing.
3. Disconnect the primary lead (1, Fig. 70)
4. Disconnect the hose on the vacuum regulator, if fitted.
5. Unscrew the bolt (6, Fig. 70) and lift up the distributor.

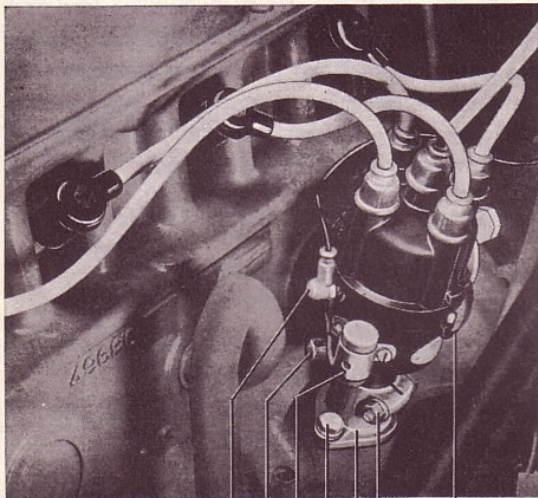
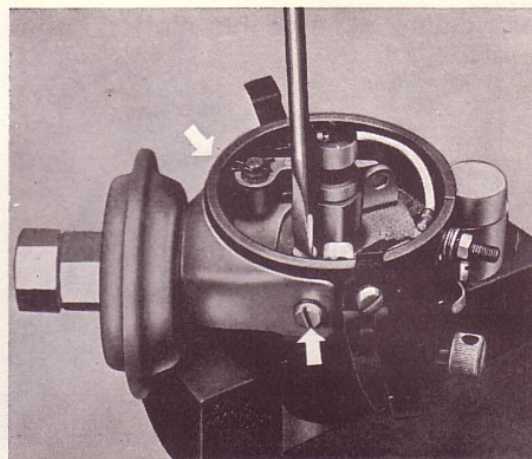


Fig. 70. Distributor fitted

VOLVO
26536

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



VOLVO
24871

Fig. 71. Removing the vacuum regulator

Fitting

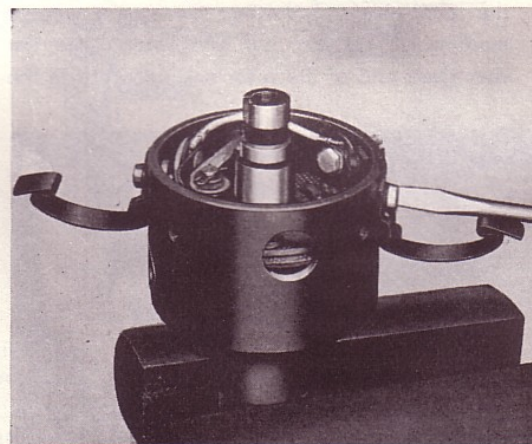
Fitting is done in the reverse order to removing. If the engine has not been moved while the distributor has been removed, fit the distributor in accordance with the marking made under point 2 above.

Adjusting the ignition

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

Dismantling the distributor

1. Pull off the rotor arm.
2. Disconnect the vacuum regulator by unscrewing the screws as shown in Fig. 71 and then and then lifting it off.



VOLVO
24849

Fig. 72. Removing the breaker plate

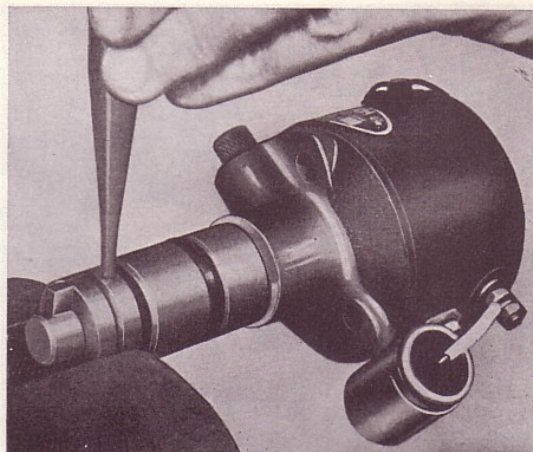


Fig. 73. Removing the driving collar

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. 72.
5. Lift off the stop spring (locking spring) and knock out the pin for the driving collar and pull this off. Mark the position of the driving collar in relation to the shaft, see Fig. 73.
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.

3. The holes in the centrifugal governor weights must not be oval or deformed in any way. The fibre washers (1, Fig. 74) must be intact.
4. The governor springs must not be deformed or damaged.

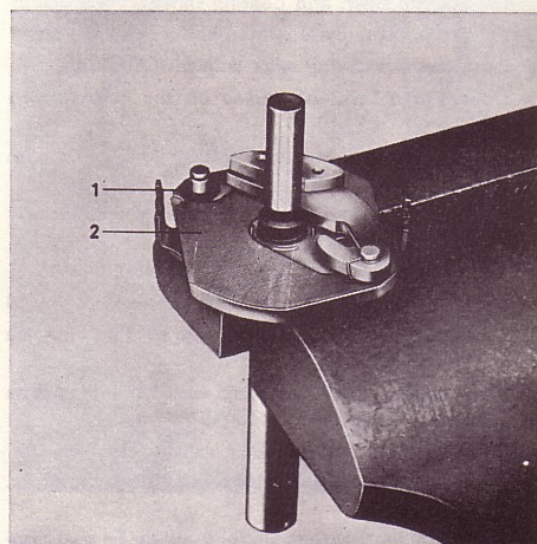
DISTRIBUTOR HOUSING

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

Assembling

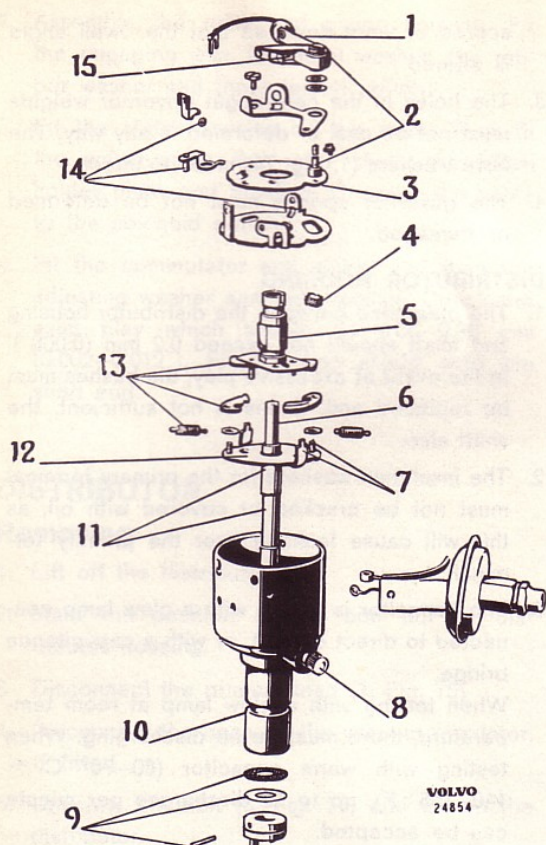
When assembling, lubricate the distributor according to the directions in Fig. 75.



VOLVO
24872

Fig. 74. Plate with fibre washers

1. Fibre washer 2. Resitex plate



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

1. Grease the spring lightly Ft 1 v 4
2. Grease the bush and bearing pin Ft 1 v 22
3. Oil the breaker plate sliding surfaces Ol 1 v 22
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 2
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 bushes 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

3-32

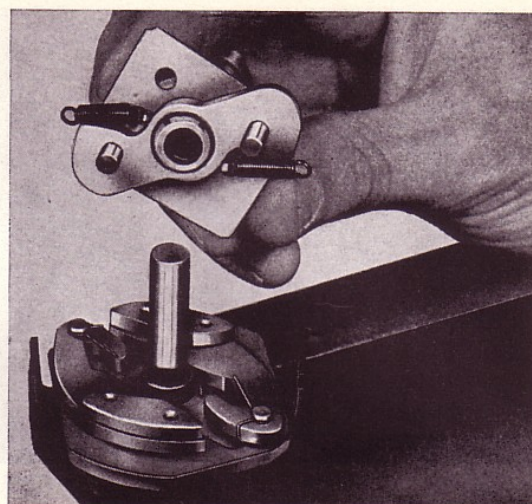


Fig. 76. Fitting the breaker camshaft

1. Place the Resitex plate on the distributor shaft and the fibre washers above this, see Fig. 74. Lubricate and place the centrifugal governor weights in position. Fit the locking springs.
2. Fit the breaker camshaft and place on the springs, see Fig. 76.
3. Lubricate the distributor shaft and place it in the distributor housing. Check that the axial adjusting washers are positioned correctly.



Fig. 77. Fitting the breaker plate

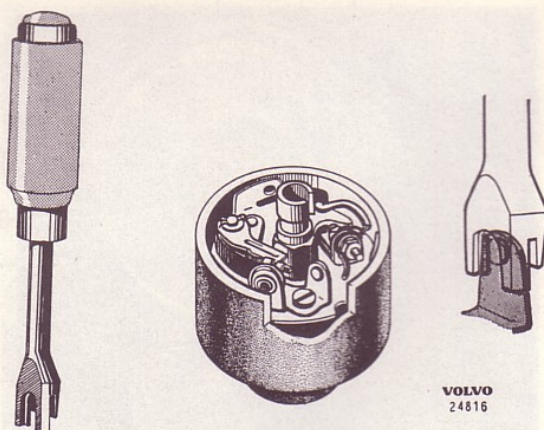


Fig. 78. Adjusting the contact breaker points

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. 77.

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. 78. Adjust the gap and check the contact pressure.
6. Fit the vacuum regulator.
7. Fit the driving collar 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").
8. Test the distributor in the distributor test bench. The values given should be according to those in the "Specifications".

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.

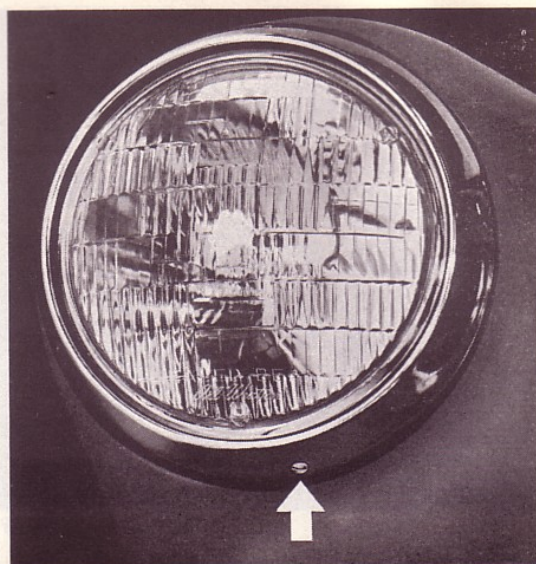


Fig. 79. Removing the headlamp rim

1. Remove the headlamp rim as shown in Fig. 79.
2. Slacken the screws marked by arrows and turn the headlamp insert retaining ring to the left and lift it off, see Fig. 80.

For the later type of headlamp, the screws are removed entirely, see Fig. 81.

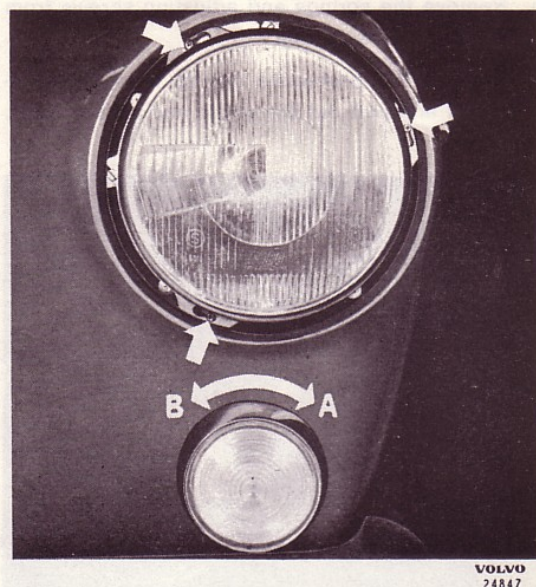


Fig. 80. Removing the headlamp insert retaining ring and flasher and parking lamp

A. Removing the glass B. Fitting the glass

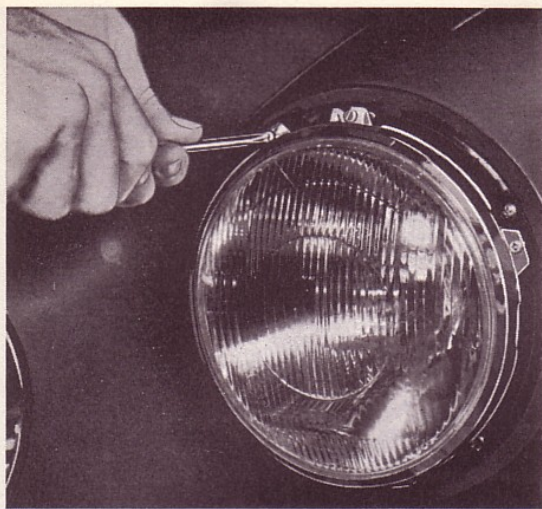


Fig. 81. Removing the headlamp insert retaining ring, late prod.

3. Remove the connecting contact from the bulb holder by pulling it straight out as shown in Fig. 82.
4. Slacken the screws (1 and 2, Fig. 83) for headlamp adjustment 8–10 turns. Unhook the springs from the bowl. Lift out the bowl from the bowl. Lift out the bowl from the protective casing.
5. Remove the springs and adjusting screws from the protective casing.
6. Remove the protective casing from the mud-guard and pull out the cable and rubber bush.

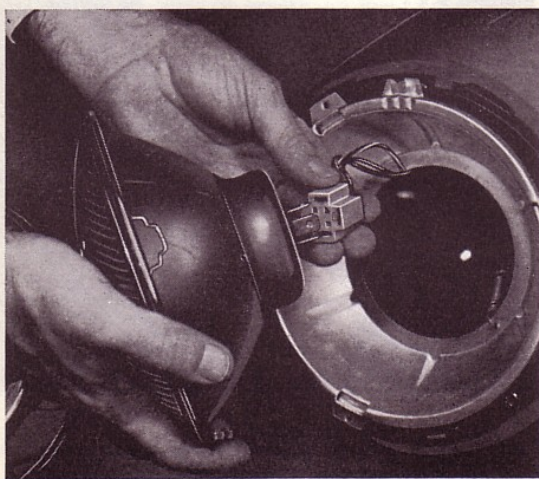


Fig. 82. Removing the connecting contact

3-34

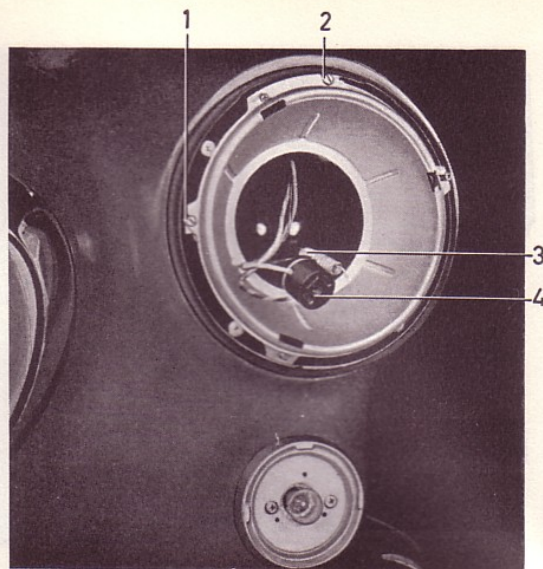


Fig. 83. Headlamp bowl

1. Adjusting screw, horizontal
 2. Adjusting screw, vertical
 3. Spring
 4. Connecting contact
7. Fitting is done in the reverse order. Make sure that the leads are correctly connected and that the screws are tightened properly.

Replacing bulbs

1. Carry out points 1–3 under the heading "Replacing the headlamps".

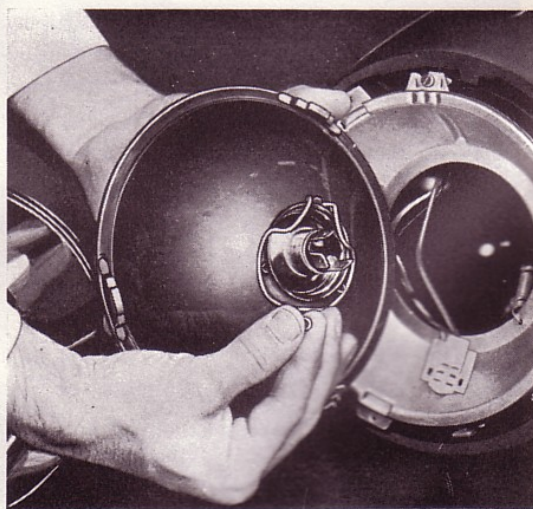


Fig. 84. Removing the bulb retaining ring

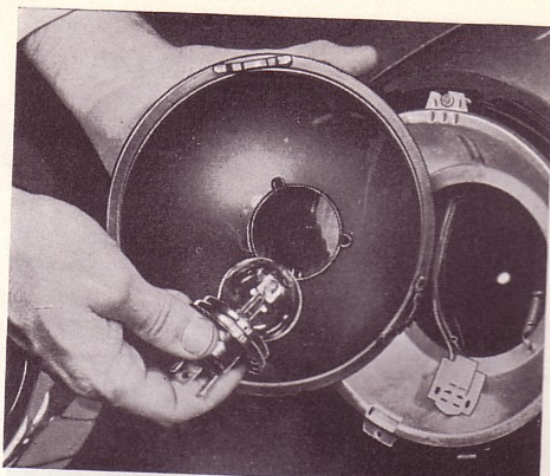


Fig. 85. Fitting the bulb

2. Remove the spring retaining the bulb holder on the insert and lift out the holder, see Fig. 84. Then remove the old bulb.

3. Fit the new bulb, see Fig. 85. Do not touch the bulb glass with your fingers.
4. Fitting takes place in the reverse order to removing.

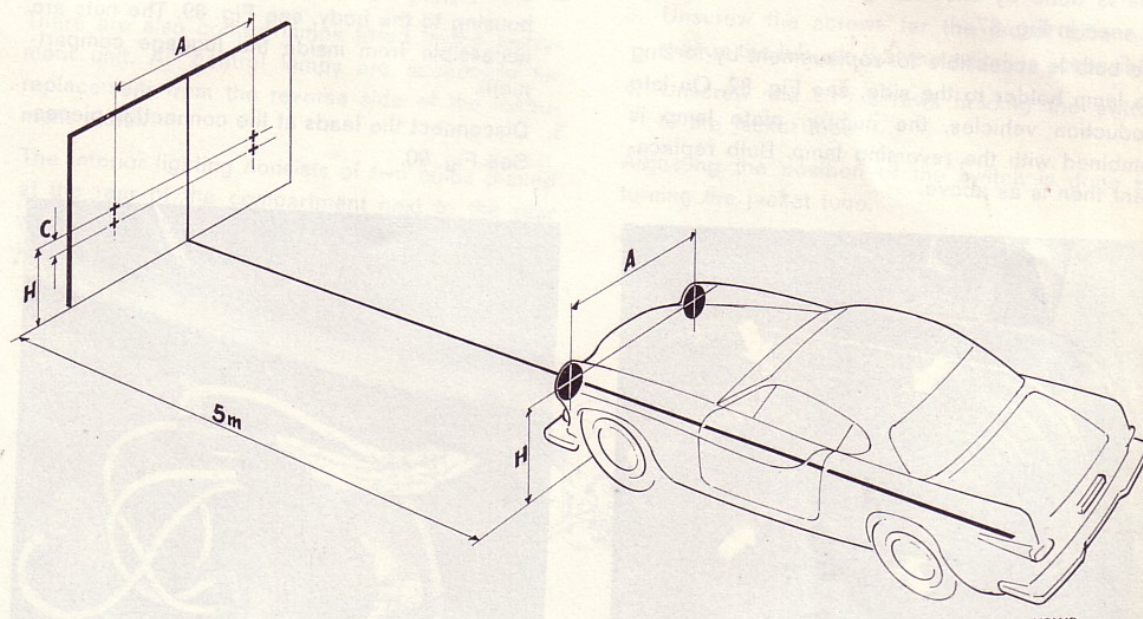
Adjusting the headlights

1. 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 two screws (1 and 2, Fig. 83). The adjustment should fulfill the requirements laid down by current provisions of law. It is carried out with the help of an approved light adjustment unit or against a wall or screen as shown in Fig. 86.

FLASHERS AND PARKING LAMPS

The glass is removed by turning it to the left, see Fig. 80. The lamp is removed by unscrewing the two screws next to the bulb, see Fig. 83.

Fig. 86. Headlight adjustment
C=5 cm (2")

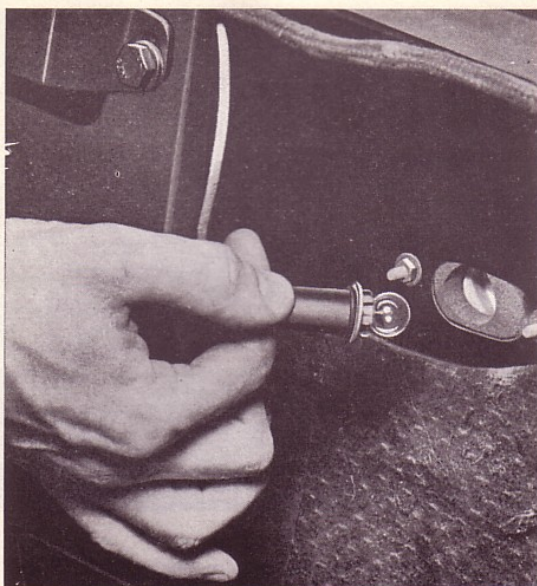


Fig. 87. Number plate lamp, removing the bulb

NUMBER PLATE LAMP

The number plate lamp is accessible for replacement from the inside of the luggage compartment. This is done by unscrewing the nuts which can be seen in Fig. 87.

The bulb is accessible for replacement by forcing the lamp holder to the side, see Fig. 87. On late production vehicles, the number plate lamp is combined with the reversing lamp. Bulb replacement then is as above.

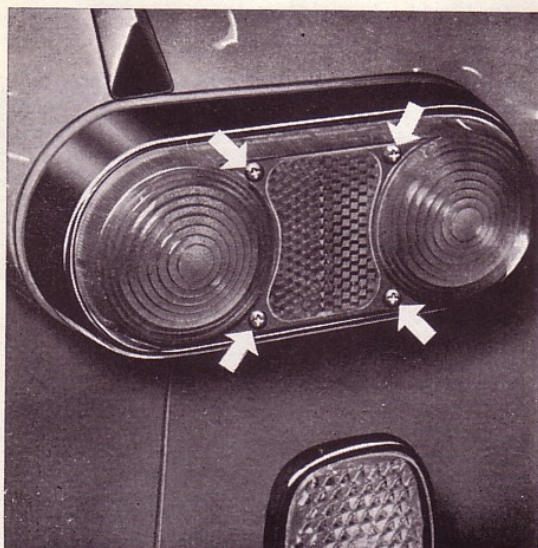


Fig. 88. Rear lamp

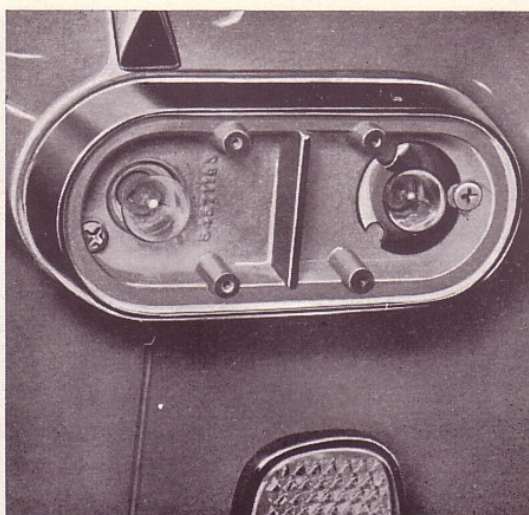


Fig. 89. Rear lamp with glass removed

REAR LAMP

Replacing the rear lamp

1. Unscrew the four nuts securing the glass, see Fig. 88.
2. Slacken the two screws retaining the rear lamp housing to the body, see Fig. 89. The nuts are accessible from inside the luggage compartment.
3. Disconnect the leads at the connection pieces. See Fig. 90.



Fig. 90. Rear lamp connecting contacts

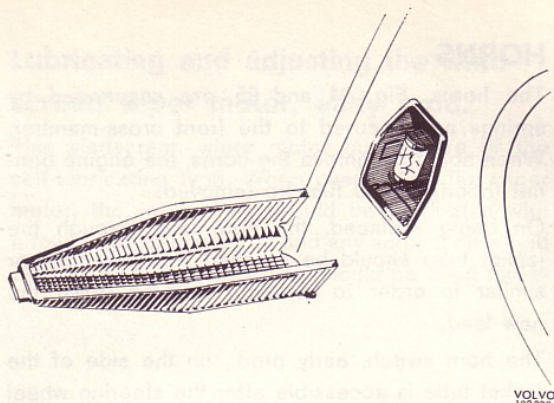


Fig. 91. Removing the glass for the interior lighting

Fitting takes place in reverse order to removal. When fitting make sure that there is good sealing between the body and the rear lamp and that good earthing is also obtained.

INSTRUMENT AND INTERIOR LIGHTING

The instrument lighting consists of six bulbs attached to the instrument unit and accessible from the reverse of the instrument panel.

There are also 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 two bulbs placed at the rear of the compartment next to the rear window. The bulbs are accessible after the glass has been removed by pulling it straight out.

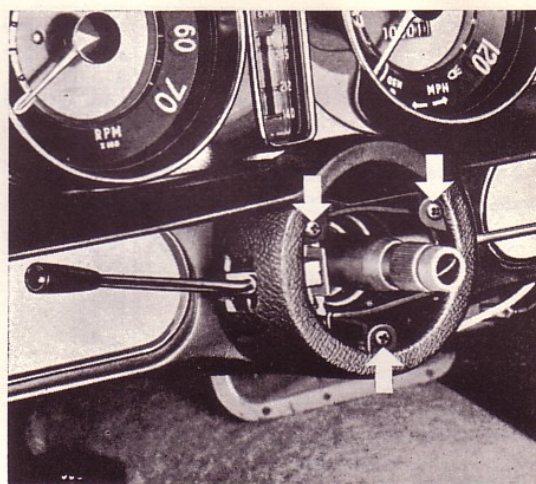


Fig. 92. Removing the direction indicator switch casing

DIRECTION INDICATOR SWITCH

1. Remove the steering wheel in accordance with the instructions in Part 6.
2. Unscrew the screws securing the switch casing to the jacket tube, see Fig. 2.
3. Unscrew the screws for the jacket tube and pull up the tube so that the switch is accessible.
4. Unscrew the two screws holding the switch to the jacket tube.

Adjusting the position of the switch is done by turning the jacket tube.

Concerning this, see Part 6.

Concerning connection of the leads, see Fig. 93.

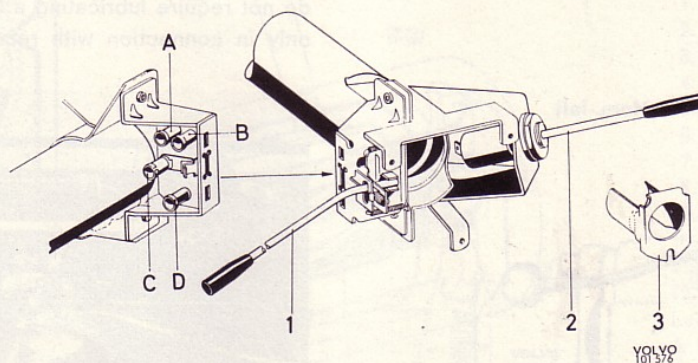


Fig. 93. Direction indicator switch and overdrive switch

1. Direction indicator switch
2. Overdrive switch
3. Flange

Switch terminals for:

- A. Right flasher
B. Left flasher

- C. Headlight signal
D. Flasher unit

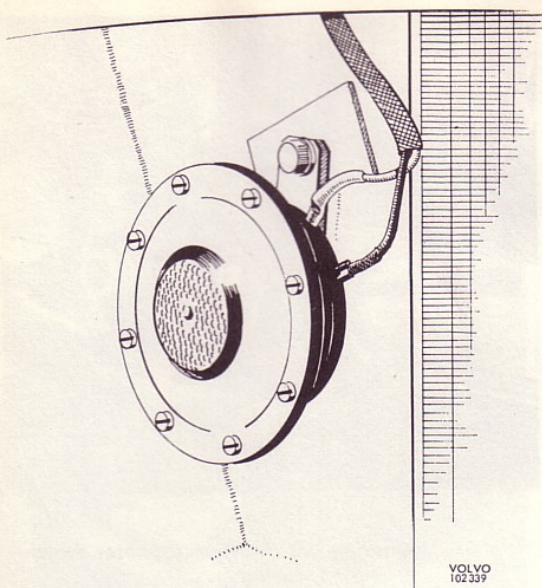


Fig. 94. Horn, right

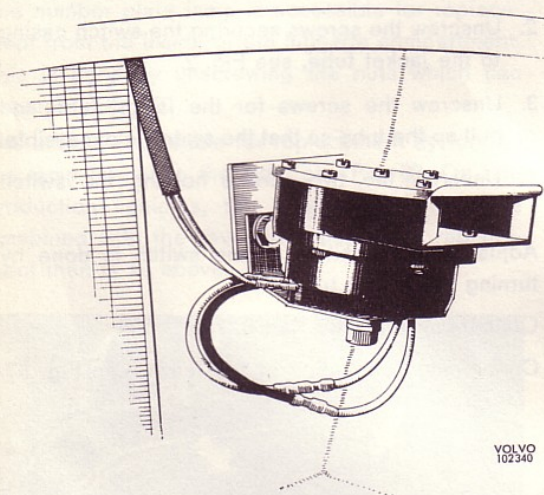


Fig. 95. Horn, left

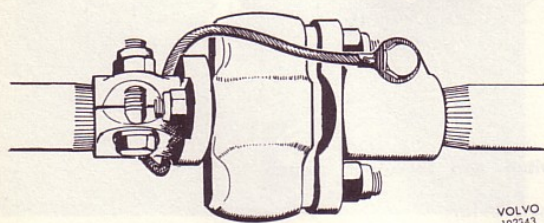


Fig. 96. Earth lead for horn

HORNS

The horns, Fig. 94 and 95, are suspended by springs and secured to the front cross-member. When about to remove the horns, the engine bonnet (hood) should first be removed.

On being replaced, the horn lead through the jacket tube should be roughed with iron wire or similar in order to facilitate drawing down the new lead.

The horn switch, early prod., on the side of the jacket tube is accessible after the steering wheel has been removed, the jacket tube screws slackened and the tube drawn up. The steering column is divided and provided with a rubber coupling disc in the middle. An earth connection is fitted over the coupling disc. When adjusting the horns, make sure that this connection is firmly attached and makes good contact, see Fig. 96.

WINDSCREEN WIPERS

Removing and fitting

1. Pull off the wiper arms.
 2. Unscrew the two nuts and lift off the washer and seal. Disconnect the leads.
 3. Slacken the two screws securing the wiper to the body and lift off the wiper.
- Fitting takes place in the reverse order.

Lubricating the windscreen wiper linkage system

The bushes and toothed segment in the linkage system of the windscreen wiper are lubricated when fitted. The link arms and toothed segment do not require lubricating after a certain time but only in connection with reconditioning.

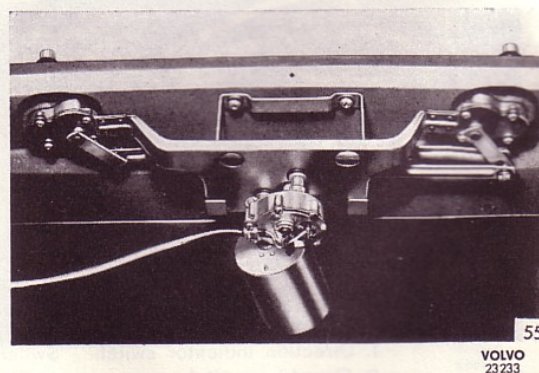


Fig. 97. Windscreen wiper installed, early prod.

Lubricating and adjusting the windscreen wiper motor, early prod.

The windscreen wiper motor bushes are of the self-lubricating type. When overhauling the wiper motor, the rotor shaft should be lubricated with a few drops of engine oil and any surplus oil wiped off. The motor gear housing should be filled three-

quarters full with gear housing grease (Auto-lite ST 294 A or equivalent).

During annual overhaul, apply a suitable quantity of grease.

The rotor shaft end float should be between 0.1 and 0.3 mm (0.004 and 0.012"). Adjusting is done with screw 14, see Fig. 98.

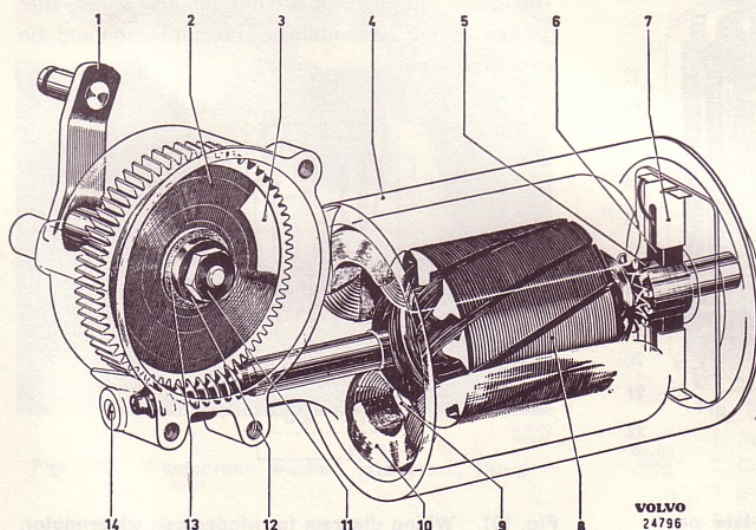


Fig. 98.
Windscreen wiper motor,
early prod.

1. Shaft
2. Contact plate
3. Gear wheel
4. Stator
5. Commutator
6. Brush
7. Brushholder
8. Rotor
9. Pole shoe
10. Field coil
11. Nut
12. Steel washer
13. Insulating washer
14. Adjusting screw

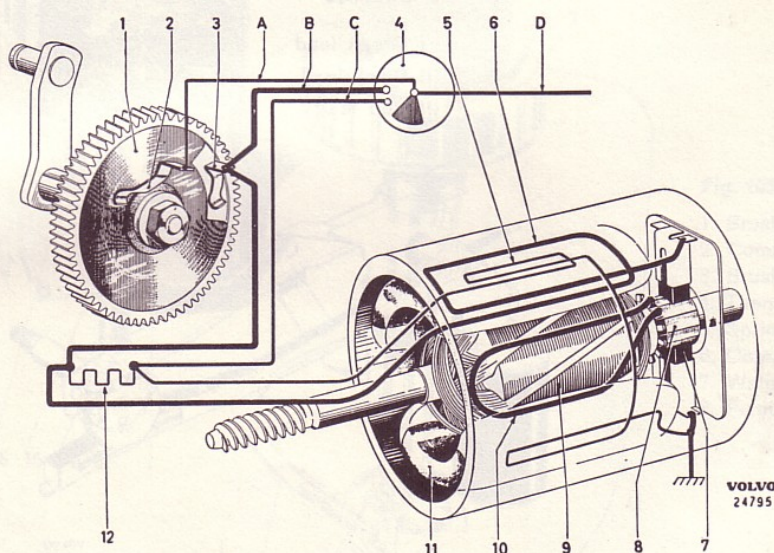


Fig. 99.
Wiring diagram for
windscreen wiper motor,
early prod.

1. Contact plate
 2. Contact strip
 3. Contact strip
 4. Switch
 5. Shunt winding
 6. Series winding
 7. Brush
 8. Commutator
 9. Rotor
 10. Rotor winding
 11. Field coil
 12. Resistance
- Lead colours, etc.
- A Green
B Black
C Red
D Current-carrying lead

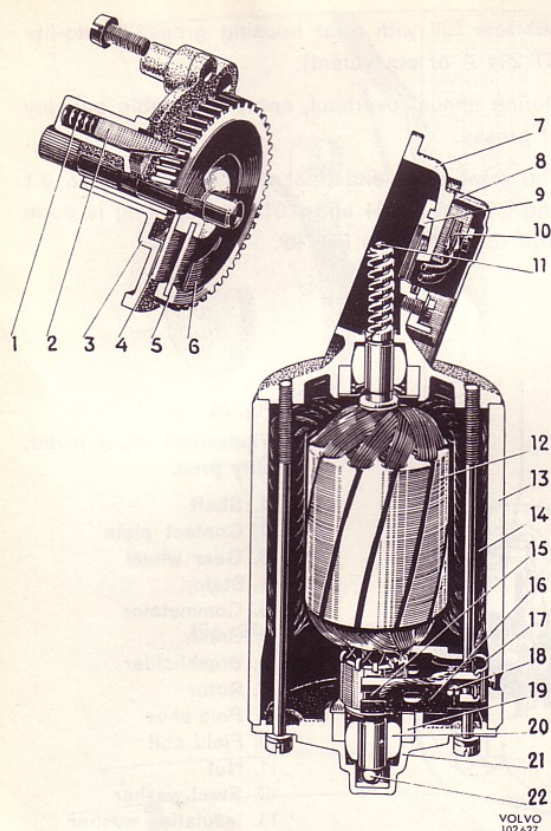


Fig. 100. Windscreen wiper motor, late prod.

1. Spring
2. Key
3. Cover
4. Washers
5. Gear wheel
6. Washers
7. Gear housing
8. Cover
9. Washer
10. Switch
11. Ball
12. Rotor
13. Stator
14. Field coil
15. Brush
16. Brush holder
17. Holder
18. Spring
19. Lubricating wick
20. Bearing bush
21. Cover
22. Ball (early prod.)

Lubricating and adjusting the wind-screen wiper motor, late prod.

The windscreen wiper motor bearings are fitted with a lubricating wick (19 Fig. 100). When checking the wiper motor, the wick should be lubricated with a few drops of oil. The motor gear housing should be filled three-quarters full with Shell Alvania 2 or equivalent.

The clearance between the worm screw and gear wheel should be 0.05–0.15 mm (0.002–0.006").

The cable mechanism should be lubricated with grease during assembling. The cables should be stretched well.

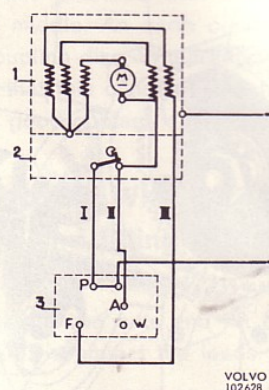


Fig. 101. Wiring diagram for windscreen wiper motor, late prod.

1. Motor
2. Switch for parking position
3. Switches
- I Green lead
- II Black lead
- III Red lead

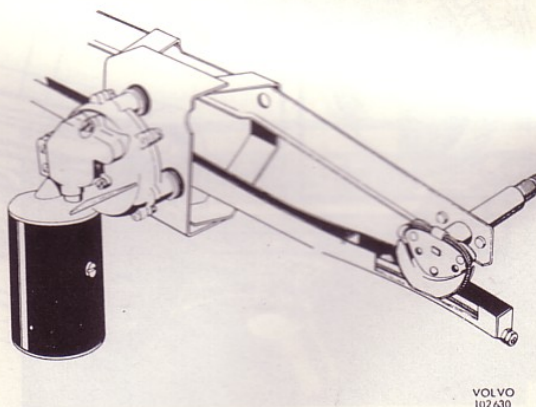


Fig. 102. Link system and cable mechanism, late prod.

WINDSCREEN WASHER

The windscreen washer pump is driven by an electric motor. The early prod. pump is of the gear type, and the late prod. pump is of the centrifugal type.

When checking, the motor bushes and shaft should be lubricated with oil.

Brushes which are worn down more than half-way must be replaced.



Fig. 103. Windscreen washer, late prod., fitted

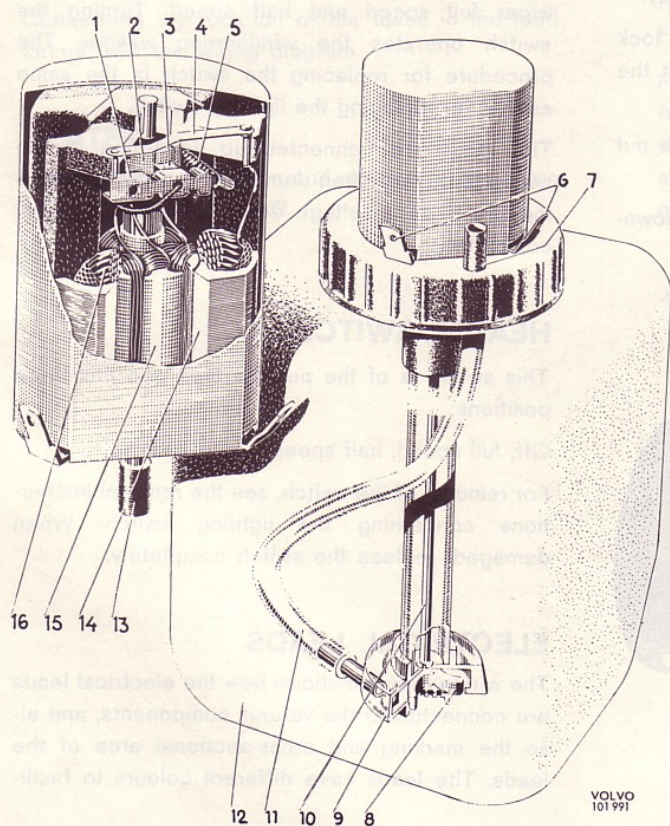


Fig. 104. Windscreen washer, early prod.

- | | |
|------------------|-------------------|
| 1. Stop lip | 9. Casing |
| 2. Commutator | 10. Field winding |
| 3. Brush holders | 11. Terminal |
| 4. Brush | 12. Pole shoe |
| 5. Rotor | 13. Rotor shaft |
| 6. Pump gear | 14. Seal |
| 7. Pump housing | 15. Outlet pipe |
| 8. Inlet pipe | 16. Pump gear |

Fig. 105. Windscreen washer, late prod.

- | | |
|-------------------|-------------------|
| 1. Brush holders | 9. Pump housing |
| 2. Commutator | 10. Shaft |
| 3. Brush | 11. Hose |
| 4. Thermal fuse | 12. Container |
| 5. Spring | 13. Flange |
| 6. Connection pin | 14. Stator |
| 7. Water outlet | 15. Rotor |
| 8. Pump gear | 16. Field winding |

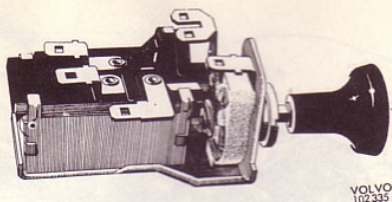


Fig. 106. Lighting switch

LIGHTING SWITCH

The lighting switch is the combined pull-and-turn type of switch. Pulling out the switch lights the exterior lights. Turning it lights up the instrument panel.

As a pull switch, the lighting switch has three positions:

Off, parking and full/dipped headlights.

The connection of the respective leads to the lighting switch is according to the wiring diagram. When damaged, the complete switch should be replaced.

The switch is removed from the instrument panel as follows:

1. Disconnect the earth lead from the battery.
2. Remove the pull button by pushing in the lock pin with a suitable tool and then pull out the button, see Fig. 107.
3. Disconnect the switch by unscrewing the nut with a suitable tool as shown in Fig. 108.
4. Lift the switch out backwards and then downwards.
5. Mark the leads and then disconnect them.

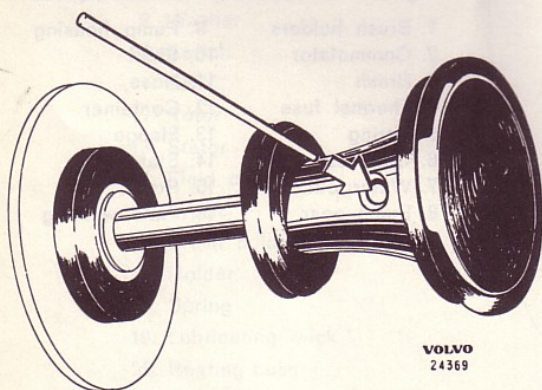


Fig. 107. Pull knob removed

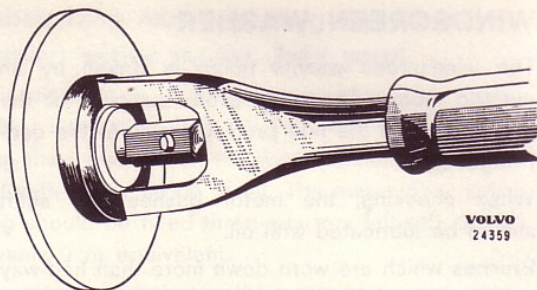


Fig. 108. Switch removed

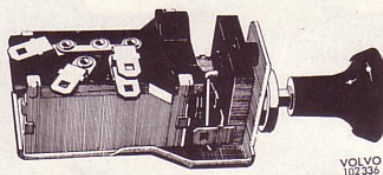


Fig. 109. Switch for windscreen wipers and washer

SWITCH FOR WINDSCREEN WIPERS AND WASHER

This switch is a combined pull-and-turn type switch. It can be pulled out to two positions for wiper full speed and half speed. Turning the switch operates the windscreen washer. The procedure for replacing the switch is the same as that for replacing the lighting switch.

The leads are connected up according to the wiring diagram. When damaged, or worn or showing too large a voltage drop, replace the switch completely.

HEATER SWITCH

This switch is of the pull-out type and has three positions:

Off, full speed, half speed.

For removal of the switch, see the removal instructions concerning the lighting switch. When damaged, replace the switch completely.

ELECTRICAL LEADS

The wiring diagram shows how the electrical leads are connected to the various components, and also the marking and cross-sectional area of the leads. The leads have different colours to facilitate

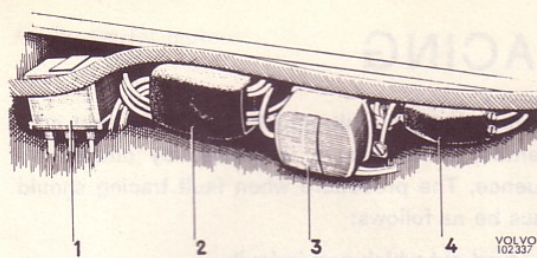


Fig. 110. Location of the fuses

1. Relay for overdrive
2. Fusebox
3. Charging control
4. Fusebox

tate 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 of the lead can result.

FUSES

The location of the fuses is shown in Fig. 110. Concerning the location of the fuses in the lead circuit, see the wiring diagram.

HEATER

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

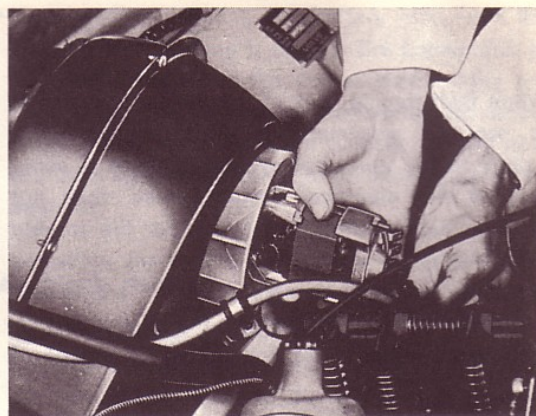


Fig. 111. Removing the heater fan motor

Removing the fan motor

1. Disconnect the leads from the connecting pin.
2. Remove the valve casing.
3. Unscrew the six screws securing the fan motor cover to the radiator shell. Unscrew also the two nuts holding the cover to the fan motor. Remove the cover and then the fan motor see Fig. 111.

Fitting takes place in the reverse order. The fan motor is fitted with self-lubricating bushes so that there is no need for lubricating after a certain time but only in connection with re-conditioning.

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.
Acid level in battery too low.
Loose or corroded terminals.

Shorting in brake contact.
Internal short in battery.

Adjust the charging control.
Top-up with distilled water.
Clean the cable terminals and tighten them properly.
Replace the brake contact.
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.
Acid level too low.
Battery has been poorly charged.
Internal short.

Adjust the charging control.
Top-up with distilled water.
Have the battery charged.
Replace the battery.

STARTER MOTOR

THE STARTER MOTOR DOES NOT FUNCTION

Battery discharged.
Poor connection and (or) earthing.
Faulty control solenoid.

Examine the battery. Charge up or replace the battery.
Check the connections on the battery, starter motor and 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.

Large resistance in starter motor circuit.

Poor contact in control solenoid.

Faulty starter motor.

Test and charge up if necessary.

Examine all lead connections on the starter motor and the leads between the motor and chassis. Make sure that the contact surfaces are clean, that all cable terminals are well soldered and tighten the leads properly.

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.

Remove and test the starter motor.

THE STARTER MOTOR SPINS WITHOUT ENGAGING THE FLYWHEEL RING GEAR

Ring gear on flywheel damaged.

Drive pinion damaged.

Drive pinion and/or engaging mechanism damaged.

Remove the plate under the engine in front of the flywheel, see Part 2. A damaged ring gear must be replaced.

Remove the starter motor and replace the damaged parts.

Remove the starter motor and replace the damaged parts.

DYNAMO AND CHARGING CONTROL

TOO LOW OR NO CHARGING WHEN THE BATTERY IS DISCHARGED

Poor contact or damaged leads.

Fan belt worn out or insufficiently tensioned.

Faulty dynamo.

Inspect all leads between the dynamo, charging control and battery for loose contacts, broken leads, poor insulation, corrosion and earthing.

Replace or tension the fan belt.

Disconnect the lead for the rotor current and the lead to the battery from the charging control 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 is increased, shows too small a reading, the dynamo must be removed for examination and repair.

Faulty charging control.

Note. Never run the dynamo, when connected as above, at so high a speed that the maximum current is exceeded.

Test and adjust the charging control. See under the heading "Charging control".

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 control. 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 control and battery.

Faulty charging control.

Test and adjust the charging control. Proceed in accordance with the directions under the heading "Charging control".

Pos. No.

1. Flasher and parking light, left-hand
2. Headlight, left-hand
3. Horn
4. High-tone horn
5. Headlight, right-hand
6. Flasher and parking light, right-hand
7. Relay for headlight signalling
8. Relay for horn
9. Distributor firing order 1, 3, 4, 2
10. Dynamo 12 V 30 A
11. Charging control
12. Foot dipper switch
13. Horn button
14. Lever for high-tone horn
15. Ignition coil
16. Starter motor
17. Battery
18. Solenoid
19. Direction indicator switch
20. Flasher mechanism for direction indicator
21. Rev. counter pickup
22. Switch on gearbox
23. Relay for overdrive
24. Brake switch
25. Fuse
26. Rev. counter
27. Fuel gauge
28. Clock
29. Switch for overdrive
30. Control lamp for overdrive
31. Windscreen washer
32. Windscreen wipers
33. 3 Control lamps
34. Charging
35. Direction indicator
36. Full headlight
37. Instrument lighting
38. Heater
39. Switch for windscreen wipers and washer
40. Light switch
41. Ignition switch
42. Switch for heater
43. Cigar lighter
44. Switch
45. Map-reading lamp
46. Door switch
47. Switch for roof lamp
48. Roof lamp
49. Roof lamp
50. Door switch
51. Rear lamp, left-hand
52. Fuel level pickup
53. Number plate lighting
54. Rear lamp, right-hand

Pos. No.

1. Flasher and parking light, left-hand
2. Headlight, left-hand
3. Horn
4. High-tone horn
5. Headlight, right-hand
6. Flasher and parking light, right-hand
7. Relay for headlight signalling
8. Relay for horn
9. Distributor firing order 1, 3, 4, 2
10. Dynamo 12 V 30 A
11. Charging control
12. Foot dipper switch
13. Horn button
14. Lever for high-tone horn
15. Ignition coil
16. Starter motor
17. Battery
18. Solenoid
19. Direction indicator switch
20. Flasher mechanism for direction indicator
21. Rev. counter pickup
22. Reversing light switch on gearbox
23. Overdrive switch on gearbox
24. Relay for overdrive
25. Brake switch
26. Fuse
27. Rev. counter
28. Fuel gauge
29. Clock
30. Switch for overdrive
31. Control lamp for overdrive
32. Windscreen washer
33. Windscreen wipers
34. 3 Control lamps
35. Instrument lighting
36. Charging
37. Direction indicator
38. Full headlight
39. Instrument lighting
40. Heater
41. Switch for windscreen wipers and washer
42. Light switch
43. Ignition switch
44. Switch for heater
45. Cigar lighter
46. Switch
47. Map-reading lamp
48. Door switch
49. Switch for roof lamp
50. Roof lamp
51. Switch for roof lamp
52. Roof lamp
53. Switch for roof lamp
54. Door switch
55. Rear lamp, left-hand
56. Fuel level pickup
57. Number plate lighting
58. Rear lamp, right-hand

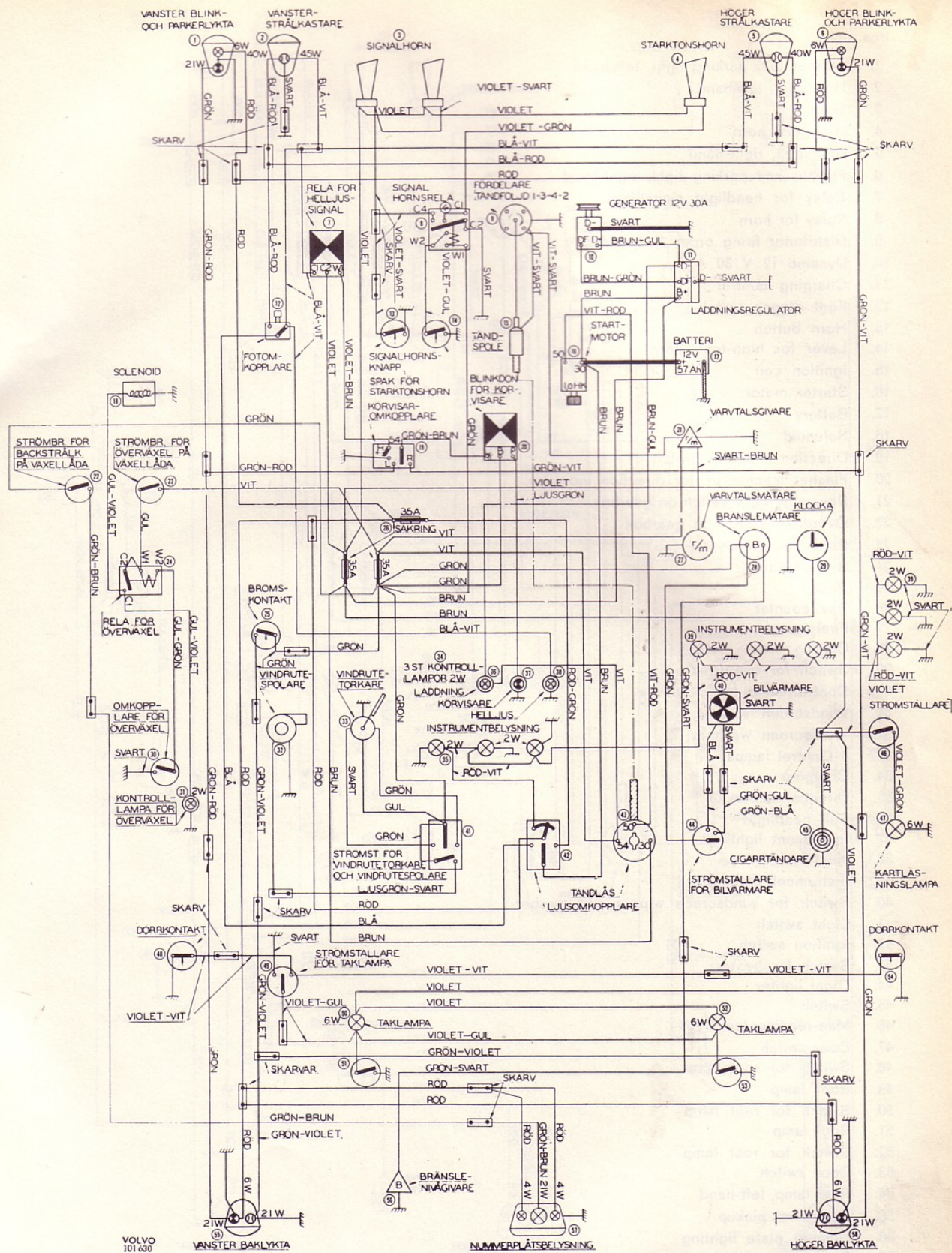


Illustration II. Wiring diagram
w.e.f. ch. No. 7001 up to ch. No. 10000

Pos. No.

1. Flasher and parking light, left-hand
2. Headlight, left-hand
3. Horn
4. High-tone horn
5. Headlight, right-hand
6. Flasher and parking light, right-hand
7. Relay for headlight signalling
8. Relay for horn
9. Distributor firing order 1, 3, 4, 2
10. Dynamo 12 V 30 A
11. Charging control
12. Foot dipper switch
13. Horn button
14. Lever for high-tone horn
15. Ignition coil
16. Starter motor
17. Battery
18. Solenoid
19. Direction indicator switch
20. Flasher mechanism for direction indicator
21. Reversing light switch on gearbox
22. Overdrive switch on gearbox
23. Relay for overdrive
24. Brake switch
25. Fuse
26. Rev. counter
27. Fuel gauge
28. Clock
29. Switch for overdrive
30. Control lamp for overdrive
31. Windscreen washer
32. Windscreen washers
33. 3 Control lamps
34. Charging
35. Direction indicator
36. Full headlight
37. Instrument lighting
38. Heater
39. Instrument lighting
40. Switch for windscreen wipers and washer
41. Light switch
42. Ignition switch
43. Switch for heater
44. Cigar lighter
45. Switch
46. Map-reading lamp
47. Door switch
48. Switch for roof lamp
49. Roof lamp
50. Switch for roof lamp
51. Roof lamp
52. Switch for roof lamp
53. Door switch
54. Rear lamp, left-hand
55. Fuel level pickup
56. Number plate lighting
57. Rear lamp, right-hand



w.e.f. ch. No. 10001 up to ch. No. 12500

Pos. No.

1. Flasher and parking light, left-hand
2. Headlight, left-hand
3. Horn
4. High-tone horn
5. Headlight, right-hand
6. Flasher and parking light, right-hand
7. Relay for headlight signalling
8. Distributor firing order 1, 3, 4, 2
9. Dynamo 12 V 30 A
10. Charging control
11. Switch for reversing light
12. Switch on gearbox
13. Solenoid
14. Foot dipper switch
15. Horn button
16. Ignition coil
17. Starter motor
18. Battery
19. Relay for overdrive
20. Direction indicator switch
21. Flasher mechanism for direction indicator
22. Control lamp for overdrive
23. Overdrive lever switch on steering column
24. Fuse
25. Rev. counter
26. Fuel gauge
27. Clock
28. Brake switch
29. Windscreen washer
30. Windscreen wipers
31. 3 Control lamps
32. Charging
33. Direction indicator
34. Full headlight
35. Instrument lighting
36. Heater
37. Instrument lighting
38. Switch
39. Switch for windscreen wipers and washer
40. Light switch
41. Ignition switch
42. Switch for heater
43. Cigar lighter
44. Map-reading lamp
45. Door switch
46. Switch for roof lamp
47. Roof lamp
48. Switch for roof lamp
49. Roof lamp
50. Switch for roof lamp
51. Door switch
52. Rear, left-hand
53. Fuel level pickup
54. Number plate lighting
55. Rear lamp, right-hand

