



PART 3

ELECTRICAL SYSTEM

120 (12 volts)

**CARS**

**SERVICE  
MANUAL**



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# TECHNICAL DATA

## BATTERY

Type .....	Tudor 6 E × 4 or corresponding
System voltage .....	12 V
Earthing .....	Negative pole
Battery capacity, standard .....	60 Ah
Specific gravity of electrolyte:	
Fully charged battery .....	1.28
When recharging is necessary .....	1.21
Recommended charging current .....	5.5 A

## GENERATOR

### Dynamo

**BOSCH G 14 V 30 A 25-027**  
-036

Output .....	420 W
Max. continuous current .....	30 A
Earthing .....	Negative pole
Direction of rotation .....	Clockwise
Ratio, engine—dynamo .....	1:1.8
Brushes, number .....	2
brush force .....	0.45—0.60 kp (1.0—1.3 lb.)

### Test values

Minimum diameter of commutator .....	35 mm (1.38")
Resistance of field winding .....	4.8+0.5 ohms
Rated voltage speed, off-load .....	1 630 r.p.m.
Output test, warm dynamo, 20 A .....	2 400 r.p.m.
cold dynamo, 20 A .....	2 550 r.p.m.

## Alternator

**S.E.V. MOTOROLA 14 V-26641**

Output .....	490 W
Max. current rating .....	35 A
Max. speed .....	15 000 r.p.m.
Direction of rotation .....	Optional
Ratio, engine—alternator .....	1:2
Minimum length, brushes .....	5 mm (0.20")
Tightening torques:	
Attaching bolts .....	0.28—0.30 kpm (2.0—2.2 lb.ft.)
Pulley nut .....	4 kpm (29 lb.ft.)

### Test values

Resistance in field winding .....	5.2±0.2 ohms
Voltage drop across isolation diode .....	0.8—0.9 V
Output test .....	30 A (min. at 3 000 r.p.m. and approx. 13 V)



**BOSCH K 1 (R) - 14 V 35 A 20**

Output .....	490 W
Max. current rating .....	35 A
Max. speed .....	12 000 r.p.m.
Direction of rotation .....	Clockwise
Ratio, engine—alternator .....	1:2
Slip rings, min. diameter .....	31.5 mm (1.24")
Max. permissible radial throw on slip rings .....	0.03 mm (0.0012")
Max. permissible radial throw on rotor body .....	0.05 mm (0.0020")
Brushes, min. length .....	8 mm (0.32")
Brush force .....	0.3—0.4 kp (0.66—0.88 lb.)
Tightening torque for pulley .....	3.5—4.0 kpm (25—29 lb.ft.)

**Test values**

Resistance in stator .....	0.26 + 0.03 ohm
Resistance in rotor .....	4.0 + 0.4 ohms
Output test .....	35 A (min. at 6 000 r.p.m. and approx. 14 V)

**CHARGING REGULATOR****Type**

Dynamo Bosch G 14 V 30 A 25 .....	Bosch VA 14 V 30 A
Alternator S.E.V. Motorola 14 V-26641, mechanical regulator .....	S.E.V. Motorola 14 V-33525
transistor regulator .....	S.E.V. Motorola 14 V-33087
Alternator Bosch K 1 (R) - 14 V 35 A 20 .....	Bosch AD - 14 V

**BOSCH VA 14 V 30 A****Cut-out relay:**

Adjusted for, cut-in at .....	12.4—13.1 V
cut-out at .....	2.5—9.5 A

**Voltage regulator:**

Regulating voltage, broken charging circuit (measured with half field current) .....	13.5—14.5 V
Regulating voltage, loaded dynamo (measured with half field current) .....	12.8—13.8 V
Load current .....	45 A

**S.E.V. MOTOROLA 14 V-33525 (mechanical regulator)**

Regulating voltage, cold regulator .....	13.1—14.4 V
after 45 minutes' running .....	13.85—14.25 V

**S.E.V. MOTOROLA 14 V-33087 (transistor regulator)**

Regulating voltage, fully charged battery, warm regulator .....	13.85—14.25 V
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**BOSCH AD - 14 V**

Regulating voltage at 4 000 alternator r.p.m., cold regulator, read off within 30 seconds (lower contact pair) .....	14.0—15.0 V
Load current, lower contact pair .....	28—30 A
Regulating range (between lower and upper contact pairs) .....	0 to —0.3 V
Load current, upper contact pair .....	3—8 A

**STARTER MOTOR**

Type, early prod. ....	Bosch EGD 1/12 AR 37
Voltage .....	12 V
Earthing .....	Negative pole
Direction of rotation .....	Clockwise
Output .....	approx. 1 h.p.
Number of teeth on pinion .....	9
Brushes, number .....	4



**TEST VALUES****Mechanical**

Rotor end float .....	0.1—0.3 mm (0.002—0.12")
Brush spring tension .....	0.8—0.9 kp (1.8—2.0 lb.)
Distance from pinion to ring gear .....	2.5—3 mm (2.61—4.34 lb.in.)
Pinion idling torque .....	1.3—1.8 kpcm (1.13—1.56 lb.in.)
Tooth clearance .....	0.35—0.60 mm (0.0138—0.0236")
Drive module .....	2.11
Min. diameter of commutator .....	33.5 mm (1.32")

**Electrical**

Unloaded starter motor:	
11.5 V and 40—60 A .....	5 500—7 500 r.p.m.
Loaded starter motor:	
10 V and 200—230 A .....	1 100—1 300 r.p.m.
Locked starter motor:	
8 V and 400—450 A .....	0 r.p.m.

**Control solenoid**

Cut-in voltage .....	Min. 7 V
Adjusting measurement "a" .....	32.2±0.1 mm (1.268±0.0039")

**STARTER MOTOR**

Type, late prod. ....	Bosch GF 12 V 1 PS
Voltage .....	12 V
Earthing .....	Negative pole
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—0.3 mm (0.002—0.12")
Brush spring tension .....	1.15—1.30 kp (2.53—2.86 lb.)
Distance from pinion to ring gear .....	1.2—4.4 mm (0.047—0.173")
Frictional torque of rotor brake .....	2.5—4.0 kpcm (2.17—3.18 lb.in.)
Pinion idling torque .....	1.3—1.8 kpcm (1.13—1.56 lb.in.)
Tooth clearance .....	0.35—0.60 mm (0.0138—0.0236")
Drive module .....	2.11
Min. diameter of cummutator .....	33 mm (1.29")
Min. length of brushes .....	14 mm (0.55")

**Electrical**

Unloaded starter motor:	
12 V and 40—50 A .....	6 900—8 100 r.p.m.
Loaded starter motor:	
8 V and 185—220 A .....	1 050—1 350 r.p.m.
Locked starter motor:	
6 V and 300—350 A .....	0 r.p.m.

**Control solenoid**

Cut-in voltage .....	Min. 8 V
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**IGNITION SYSTEM**

Voltage .....	12 V
Firing sequence .....	1-3-4-2
Ignition setting (B 18 A) (B 20 A), 97 octane (Research Method) at 1 500 engine r.p.m. (vacuum governor disconnected) .....	21—23° B.T.D.C.
Ignition setting (B 18 D)/90 h.p., 97 octane (Research Method) at 1 500 engine r.p.m. (vacuum governor possibly disconnected) .....	22—24° B.T.D.C.
Ignition setting (B 18 D)/95 h.p. and 100 h.p., 97 octane (Research Method) at 1 500 engine r.p.m. (vacuum governor possibly disconnected) .....	17—19° B.T.D.C.
Ignition setting (B 18 B), 100 octane (Research Method) at 1 500 engine r.p.m. ....	17—19° B.T.D.C.
Ignition setting (B 18 B) with exhaust emission control, 100 octane (Research Method) at 850 engine r.p.m. ....	3—5° B.T.D.C.
Ignition setting (B 20 B), 100 octane (Research Method) at 600—800 engine r.p.m. (vacuum governor disconnected) .....	10° B.T.D.C.
Spark plug — B 18 A, B 18 D, B 20 A .....	Bosch W 175 T 35 or corresponding
B 18 B, B 20 B, normal driving .....	Bosch W 200 T 35 or corresponding
hard driving .....	Bosch W 225 T 35 or corresponding
Spark plug gap .....	0.7—0.8 mm (0.028—0.320")
tightening torque .....	3.5—4.0 kpm (25.3—29.0 lb.ft.)

**Distributor****B 18 A**

Type .....	VJ 4 BL 34, VJU 4 BL 33, VJUR 4 BL 33
Direction of rotation .....	Anti-clockwise
Breaker points, gap .....	0.4—0.5 mm (0.016—0.020")
dwell angle .....	57—63°
contact force .....	0.50—0.63 kp (1.0—1.4 lb.)
Centrifugal governor:	
Advance, total .....	11 ± 1.5 degrees (distr.)
Advance begins at .....	375—525 distr. r.p.m.
Values 5° .....	650—925 distr. r.p.m.
10° .....	1 150—1 450 distr. r.p.m.
Advance finishes at .....	1 500 distr. r.p.m.
Vacuum governor:	
Advance, total .....	7.5 ± 2 degrees (distr.)
Values 3° .....	60—100 mm (1.97—3.96") Hg
Advance finishes at .....	160—180 mm (6.30—7.09") Hg

**B 18 D**

Type .....	JC 4, JFB 4, JFUR 4
Direction of rotation .....	Anti-clockwise
Breaker points, gap .....	0.4—0.5 mm (0.016—0.020")
dwell angle .....	59—65°
contact force .....	0.50—0.63 kp (1.10—1.40 lb.)
Centrifugal governor:	
Advance, total .....	13 ± 1.5 degrees (distr.)
Advance begins at .....	250—550 distr. r.p.m.
Values 5° .....	700—1 000 distr. r.p.m.
10° .....	1 150—1 900 distr. r.p.m.
Advance finishes at .....	2 400 distr. r.p.m.



## Vacuum governor:

Advance, total .....	5 ± 1.5 degrees (distr.)
Advance begins at .....	50—100 mm (1.97—3.96") Hg
Values 3° .....	75—125 mm (2.95—4.92") Hg
Advance finishes at .....	100—130 mm (3.96—5.12") Hg

**B 18 B**

Type .....	Bosch JFR 4
Direction of rotation .....	Anti-clockwise
Breaker points, gap .....	0.4—0.5 mm (0.016—0.020")
dwell angle .....	59—65°
contact force .....	0.50—0.63 kp (1.10—1.40 lb.)

## Centrifugal governor:

Advance, total .....	13 ± 1.5 degrees (distr.)
Advance begins at .....	250—550 distr. r.p.m.
Values 5° .....	700—1 000 distr. r.p.m.
10° .....	1 150—1 900 distr. r.p.m.
Advance finishes at .....	2 400 distr. r.p.m.

**B 18 B with exhaust emission control**

Type .....	Bosch JFR 4
Direction of rotation .....	Anti-clockwise
Breaker points, gap .....	0.4—0.5 mm (0.016—0.020")
dwell angle .....	60—64°
contact force .....	0.50—0.63 kp (1.10—1.40 lb.)

## Centrifugal governor:

Advance, total .....	14.5 ± 1 degrees (distr.)
Advance begins at .....	450—550 distr. r.p.m.
Values 5° .....	580—710 distr. r.p.m.
10° .....	870—1 125 distr. r.p.m.
Advance finishes at .....	1 550 distr. r.p.m.

**B 20 A**

Type .....	Bosch JFUR 4
Direction of rotation .....	Anti-clockwise
Breaker points, gap .....	0.4—0.5 mm (0.016—0.020")
dwell angle (at 500 r.p.m.) .....	59—65°
contact force .....	0.50—0.63 kp (1.10—1.40 lb.)

## Centrifugal governor:

Advance, total .....	13 ± 1 degrees (distr.)
Advance begins at .....	300—500 distr. r.p.m.
Values 5° .....	750—950 distr. r.p.m.
10° .....	1 210—1 750 distr. r.p.m.
Advance finishes at .....	2 400 distr. r.p.m.

## Vacuum governor:

Advance, total .....	5 ± 1 degrees (distr.)
Advance begins at .....	60—100 mm (2.36—3.96") Hg
Values 3° .....	105—145 mm (4.13—5.71") Hg
Advance finishes at .....	150—160 mm (5.91—6.30") Hg



**B 20 B**

Type .....	Bosch JFUR 4
Direction of rotation .....	Anti-clockwise
Breaker points, gap .....	0.4—0.5 mm (0.016—0.020")
dwell angle (at 500 r.p.m.) .....	59—65°
contact force .....	0.50—0.63 kp (1.10—1.40 lb.)

Centrifugal governor:

Advance, total .....	13.5±1 degrees (distr.)
Advance begins at .....	500—600 distr. r.p.m.
Values 5° .....	675—775 distr. r.p.m.
10° .....	1 430—2 100 distr. r.p.m.
Advance finishes at .....	2 900 distr. r.p.m.

Vacuum governor (negative):

Drop, total .....	3±0.5 degrees (distr.)
Drop, begins at .....	160—240 mm (5.91—9.45") Hg
Values 2° .....	230—305 mm (9.06—12.0") Hg
Drop finishes at .....	280—320 mm (11.0—12.6") Hg

**BULBS**

	Power	Socket	Number
Headlights, asymmetrical .....	45/40 W	P 45 t	2
Turn indicators/parking lights, front (early prod.) .....	20/5 W	Ba Y 15 d	2
Turn indicators, rear (early prod.) .....	20 W	Ba 15 s	2
Parking lights, front (late prod.) .....	5 W	Ba 15 s	2
Turn indicators, front and rear (late prod.) .....	32 CP	Ba 15 s	4
Stop/parking lights, rear .....	32/4 CP	Ba Y 15 d	2
Reversing lights .....	15 W	BA 15 s	2
Licence plate lighting .....	5 W	S 8.5	2
Interior lighting .....	10 W	S 8.5	1
Glove locker .....	4 W	Ba 9 s	1
Instrument panel lighting .....	4 W	Ba 9 s	3
Warning lamps, turn indicators .....	2 W	Ba 9 s	1
headlights .....	2 W	Ba 9 s	1
battery charging .....	2 W	Ba 9 s	1
oil pressure .....	2 W	Ba 9 s	1
brakes .....	2 W	Ba 9 s	1

**FUSES**

8 amps .....	3
25 amps .....	1



## GROUP 30

# GENERAL

The electrical system is designed for a voltage of 12 volts. The equipment is made up of the following main parts: Battery, generator (early type—dynamo; late type—alternator) and voltage

regulator, starter motor, ignition system, lighting, other electrical standard equipment, cables, fuses and instruments.

## GROUP 31

# BATTERY DESCRIPTION

The battery (Fig. 1) is placed on a shelf to the right on the engine side of the cowl. It is a 12 V lead

battery with a capacity of 60 Ah and with the negative pole stud-earthed.

## REPAIR INSTRUCTIONS

### REMOVING

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

low, fill with **distilled** water to the extent necessary. Also make sure that the battery is securely fixed and that the cable terminals are well-tightened. The cable terminals and the battery terminal studs should be coated with a light layer of vaseline to prevent oxidation.

### FITTING

1. Re-fit the battery.
2. Re-fit the holding bar and secure the battery.
3. Tighten the cable terminals to the battery terminal studs. Coat the cable terminals and battery studs with vaseline.

### SERVICING

If the battery is to function satisfactorily, the acid must be maintained at the specified level above the plates. Ensure that the acid level is about 5 mm (3/16") above the plates. If the level is too

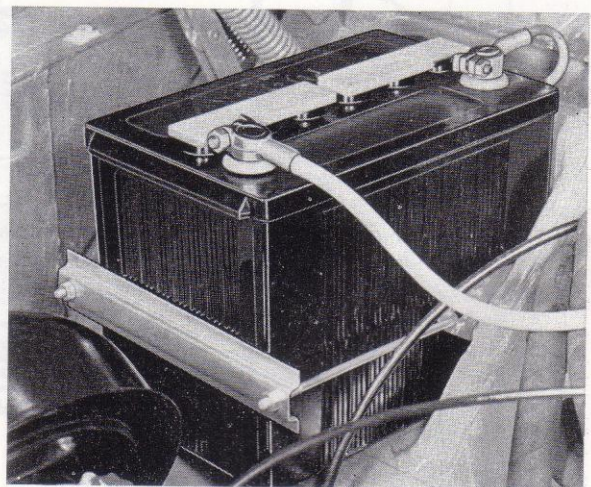


Fig. 1. Battery

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GROUP 32

# DYNAMO DESCRIPTION

The dynamo, Fig. 2, is mounted on the right-hand side of the engine and is belt-driven from the crankshaft. The dynamo is of the shunt type, that

is, the armature and field winding are connected in parallel. The dynamo charging is controlled by a charging regulator.

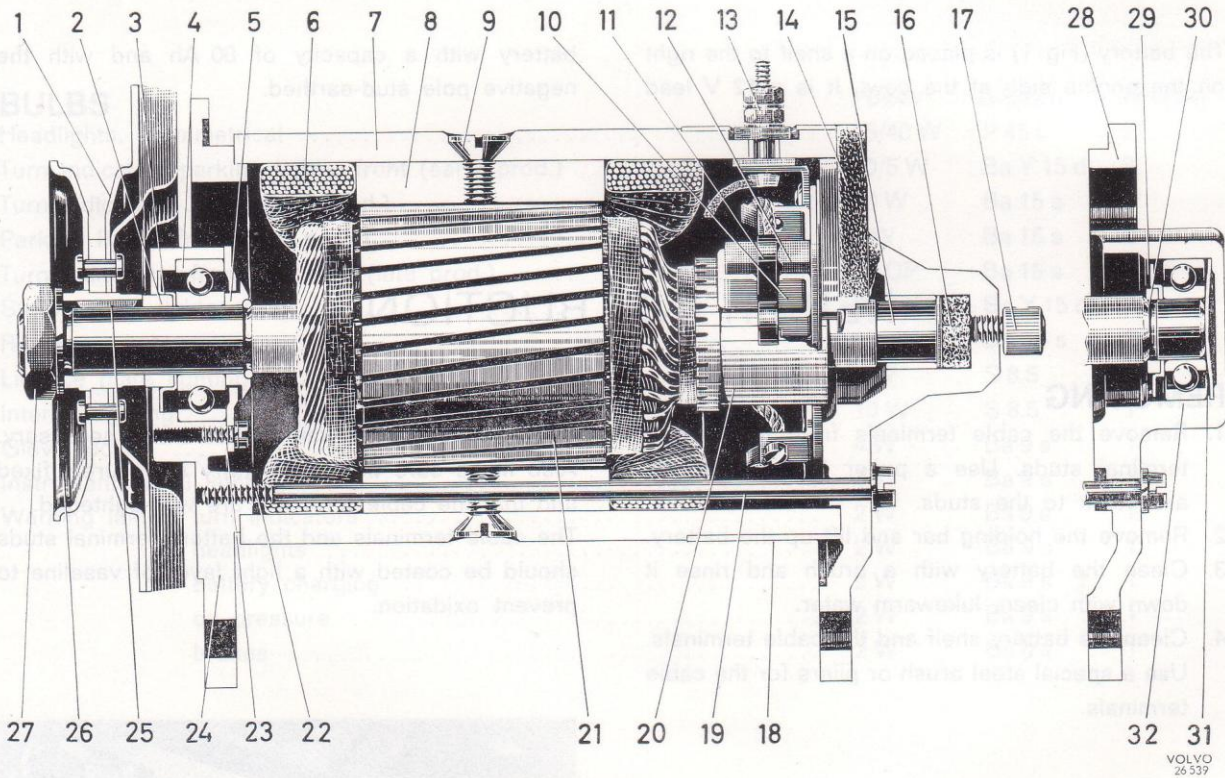


Fig. 2. Dynamo

- |                             |                                    |                                    |
|-----------------------------|------------------------------------|------------------------------------|
| 1. Pulley                   | 13. Terminal screw                 | 24. Drive-end bearing bracket      |
| 2. Spacer ring              | 14. Commutator-end bearing bracket | 25. Key                            |
| 3. Oil protection washer    | 15. Bush                           | 26. Resilient washer               |
| 4. Roller bearing           | 16. Lubricating felt               | 27. Nut                            |
| 5. Spacer ring              | 17. Lubricator                     | 28. Commutator-end bearing bracket |
| 6. Field winding            | 18. Inspection cover               | 29. Oil protection washer          |
| 7. Yoke                     | 19. Bolt                           | 30. Spacer ring                    |
| 8. Pole shoe                | 20. Commutator                     | 31. Resilient ring                 |
| 9. Pole shoe securing screw | 21. Armature                       | 32. Ball bearing                   |
| 10. Brush holder            | 22. Bolt thread                    |                                    |
| 11. Brush spring            | 23. Sealing washer                 |                                    |
| 12. Carbon brush            |                                    |                                    |



# REPAIR INSTRUCTIONS

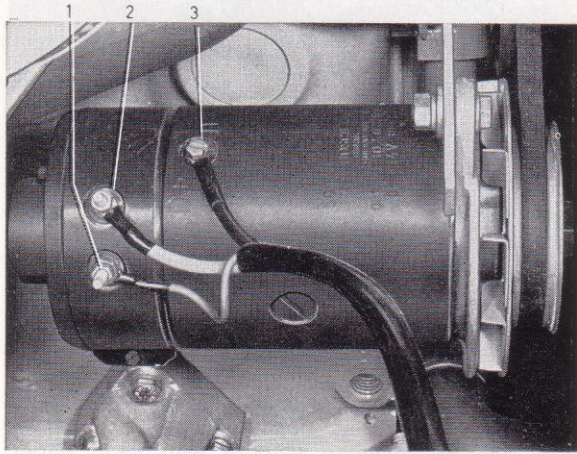


Fig. 3. Dynamo terminal

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

## REMOVING

1. Remove the cable terminal from the battery negative terminal stud.
2. Disconnect the leads from the dynamo.
3. Disconnect the drive-belt tensioning stay and lift off the drive belt.
4. Remove the two bolts securing the dynamo to the engine and lift off the dynamo.

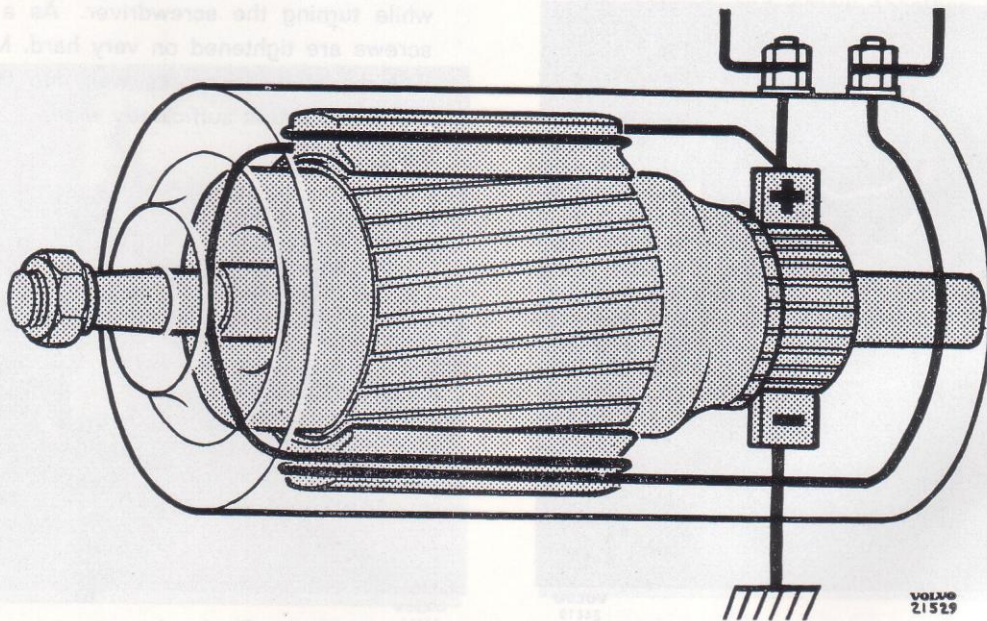


Fig. 4. Dynamo, principle

## DISMANTLING

1. Remove the inspection cover.
2. Disconnect the brush connecting leads. Lift up the springs for the brushes with a hook and pull the brushes up as shown in Fig. 5.
3. Remove the screws holding together the dynamo housing and end shield after having first disconnected the connecting bar as shown in Fig. 6.
4. Lift off the commutator-end bearing shield with the brush holders.
5. Lift the armature out of the yoke.
6. Place the armature in a vice but do not tighten too hard (use copper jaws). Unscrew the nuts for the belt pulley and pull this off. A suitable tool for this is shown in Fig. 7.
7. Remove the woodruff key.
8. Remove the drive-end bearing bracket from the armature.
9. Pull the ball bearing off with a standard puller.

## INSPECTING

Examine the armature for mechanical damage. If scored or unevenly worn, the commutator should be skimmed. When skimmed, use a special chuck intended for this purpose. After skimmed, check the commutator with a dial indicator. Maximum permissible out-of-round is 0.03 mm (0.0012"). The insulation between the laminations should be slotted down 0.8—1.0 mm (0.032—0.040") below



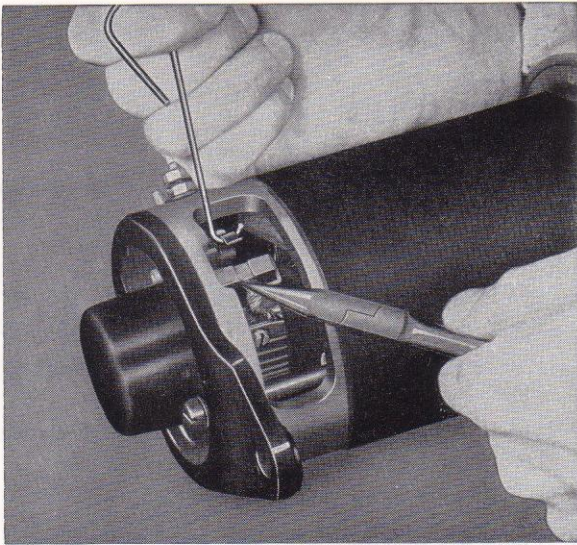


Fig. 5. Removing the brush

the surface, see Fig. 8. This is done in a special apparatus, or if such is not available, with a ground-off hacksaw blade. Check the armature both before and after the skimming by placing it in a growler, see Fig. 9.

Check the yoke with the help of test rods and a test lamp, see Fig. 10. Check to make sure that the field winding is not earthed inside the yoke. If it is, the field winding must be replaced, see below.

Check that the positive brush holders are insulated from the commutator-end bearing shield.

Brushes which are damaged or more than half worn, should be replaced, brushes which are scored or have poor contact against the commu-

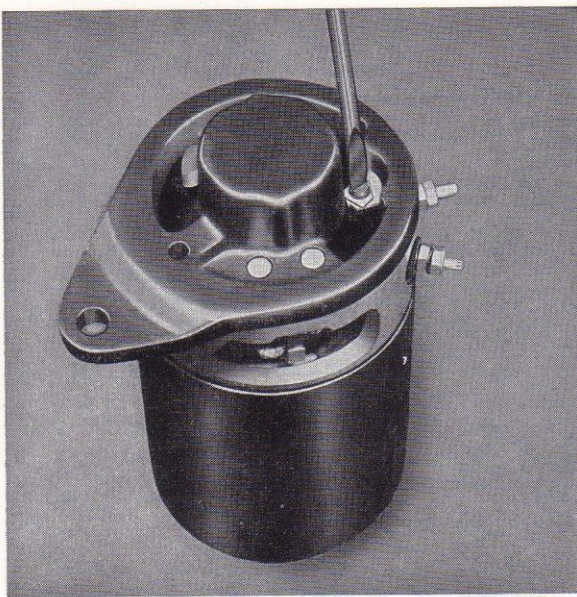


Fig. 6. Removing the connecting bar

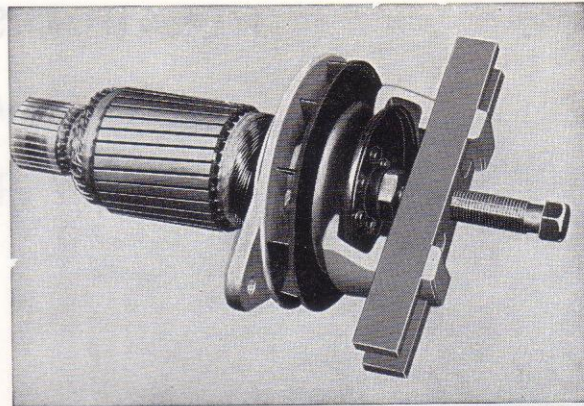


Fig. 7. Removing the pulley

tator can be polished smooth with sand paper, grain size 00 or 100, see Fig. 11.

Test the brush spring force by fitting the bearing shield on the armature and connecting a spring balance to the spring, see Fig. 12. The force required to lift the arm or the spring should be the same as that given in the "Specifications". If the values do not agree, the spring should be replaced.

Check the bearings. The ball bearings should roll easily without any noticeable play when they are rotated. Damaged or worn bearings should be replaced.

## REPLACING THE FIELD WINDING

1. If the dynamo is not dismantled, proceed in accordance with the instructions given under "Dismantling". Place the dynamo housing in a V-block as shown in Fig. 13. Press downwards while turning the screwdriver. As a rule, the screws are tightened on very hard. Make sure that the screwdriver fits well into the slot in the screw and is sufficiently wide.

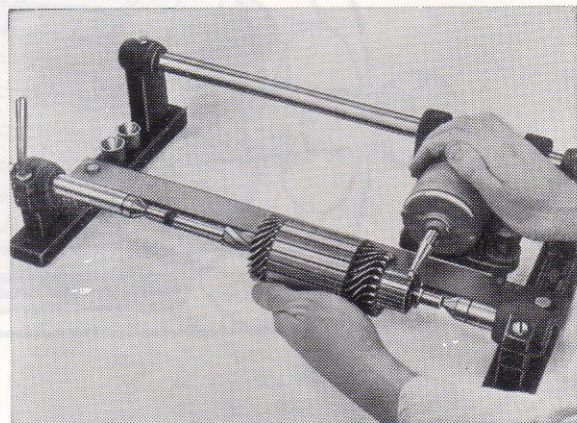


Fig. 8. Slotting the commutator



VOLVO  
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Fig. 9. Testing the armature

2. When both screws been released with a screwdriver, lift out the housing. Disconnect the grommet for the leads in the housing and lift out the winding and pole shoes.
3. Fit the new field winding to the housing. Use the same screwdriver used for removing the screws.
4. Connect up the leads at the grommet in the housing. Test for earthing.
5. Assemble the other parts of the dynamo. See under the heading "Assembling".

## SERVICING

### Dynamos with ball bearings at both ends

When servicing the dynamos, clean the ball bearings with white spirit and lubricate them with some suitable ball bearing grease. See the lubricating chart for the dynamo, Fig. 14.

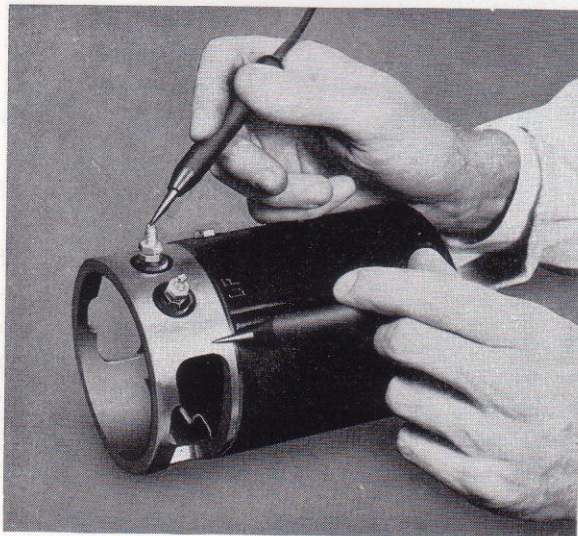
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Fig. 10. Testing the yoke

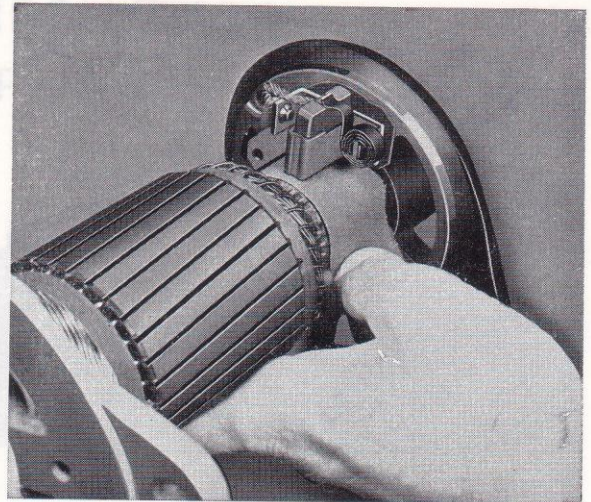
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Fig. 11. Sandpapering the brushes

### Dynamo with ball bearing and bush

Clean the ball bearing with white spirit and lubricate it with some suitable ball bearing grease. Bush: Fill the lubricator on the commutator side of the dynamo with engine oil every 10 000 km (6 000 miles). Use an ordinary oil can for this purpose. An oil-pressure can must not be used. N. B. Before fitting a new bush, place it in an oil bath for at least half an hour.

## ASSEMBLING

1. Fit the stop ring and sleeve, where fitted, on the shaft.
2. Place the inner cover with felt ring, if fitted, on the shaft. Lubricate the bearing with heat-resistant ball bearing grease and fit it.
3. Install the front bearing shield on the shaft and the bearing and screw together the bearing shield and cover.
4. Drive in the key and press on the pulley. Place the rotor in a vice. Do not tighten it too hard otherwise it may be deformed. Fit the resilient washer and nut.

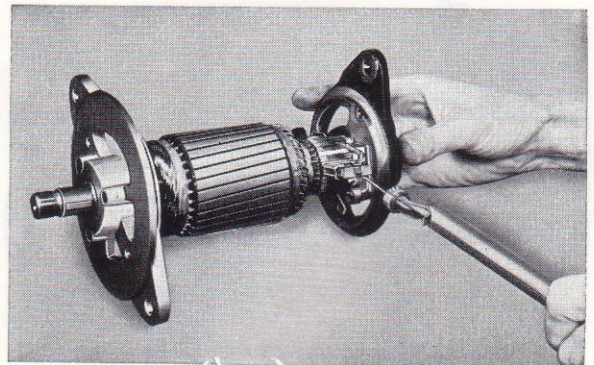
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24860

Fig. 12. Measuring the brush force



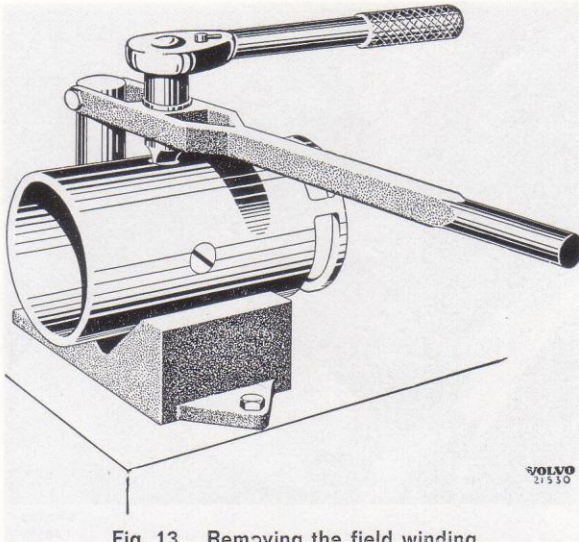


Fig. 13. Removing the field winding

5. Fit the armature in the yoke and make sure that the guide pin locates correctly.
6. Place the bearing shield on the shaft, press in the guide pin and screw in the two screws holding together the yoke and bearing shields. Check to make sure that the armature rotates easily.
7. Fit the brushes with holders in the rear bearing shield.
8. Connect the connecting bar for the main current to the positive brush, see Fig. 6.

The dynamo should be bench-tested before being fitted.

## BENCH TESTING

The dynamo should be tested before re-fitting it in the vehicle. Place the dynamo in a test bench,

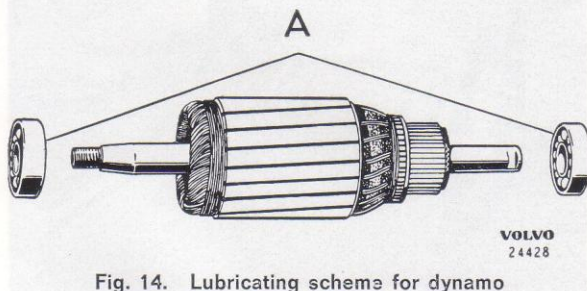


Fig. 14. Lubricating scheme for dynamo

- A. Bearings are lubricated with grease, Bosch Ft 1 V 26 or similar

connect up a voltmeter and ammeter, and also connect DF to earth.

First run the dynamo as an engine for a short while. Make sure that the dynamo has the correct polarity, that is, negative to earth. Points to observe are normal current consumption (approx. 8 amps), smooth and quiet running, etc.

Start the drive motor and run the dynamo without battery and check that it gives 14 volts at the speed indicated in the "Specifications". Cut in the battery and load the dynamo. Check that the current indicated is at least that given in the "Specifications".

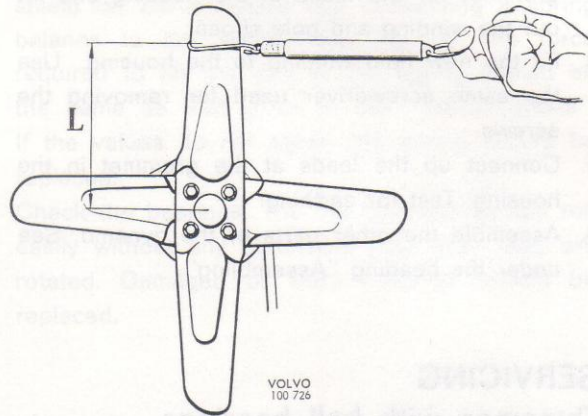


Fig. 15. Checking the belt tension

$L = 150 \text{ mm (6")}$  Pulling power = 8—11 kp (18—24 lb.)

## FITTING THE DYNAMO

1. Mount the dynamo in position.  
Fit the two suspension bolts but do not tighten them securely.
2. Fit the bolt between the tensioning stay and dynamo and adjust the belt tension.  
The fan belt tension should be satisfactory if the pulley starts to slip when a force of 8.0—11.0 kp (18—24 lb.) is brought to bear on the fan (150 mm = 6") from the hub centre. Pull in the engine's direction of rotation and use a spring balance as shown in Fig. 15.
3. Tighten the suspension bolts and connect up the leads.
4. Fit the cable terminal to the battery negative terminal stud.



# CHARGING REGULATOR DESCRIPTION

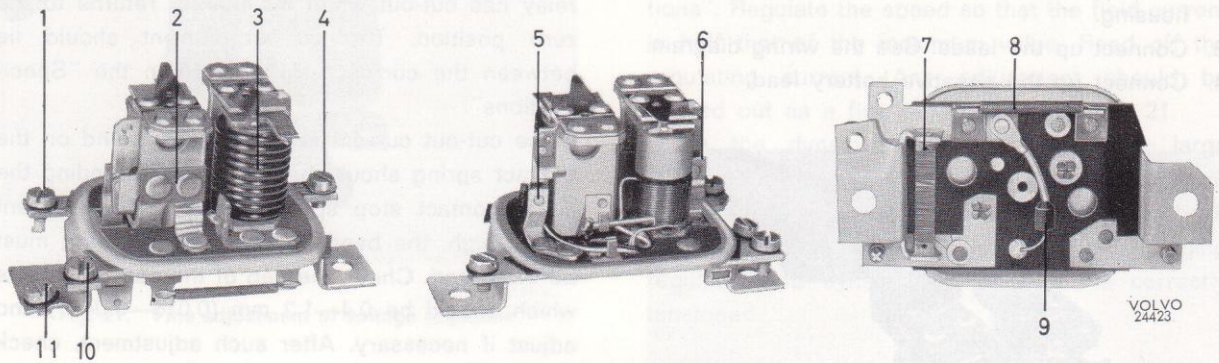


Fig. 16. Charging regulator

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

The charging regulator, Fig. 16, is mounted on the right-hand side wheel housing. The regulator is of the so-called variode type, that is, current

limitation is by means of a variode. In addition to the variode, the charging regulator consists of a cut-out relay and voltage regulator.

# REPAIR INSTRUCTIONS

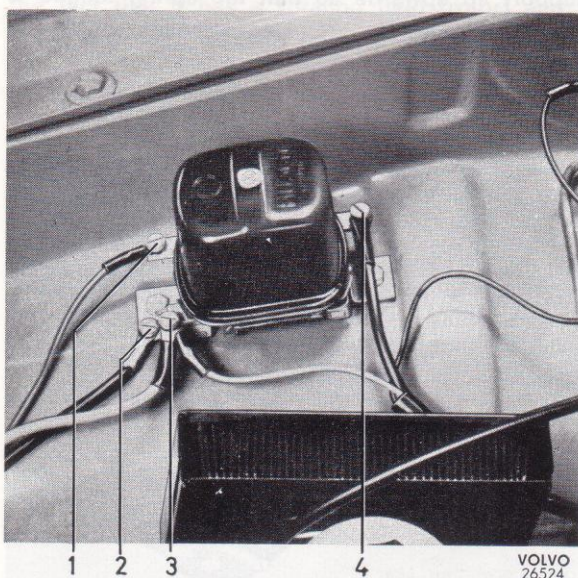


Fig. 17. Charging regulator terminals

- |                         |                   |
|-------------------------|-------------------|
| 1. Alternator field, DF | 3. Alternator, B+ |
| 2. Ground lead          | 4. Battery, B+    |

## REMOVING

1. Disconnect the negative battery lead.
2. Disconnect the leads on the charging regulator.
3. Remove the charging regulator from the wheel housing.

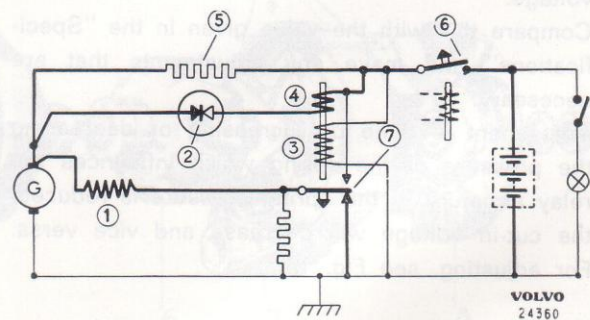


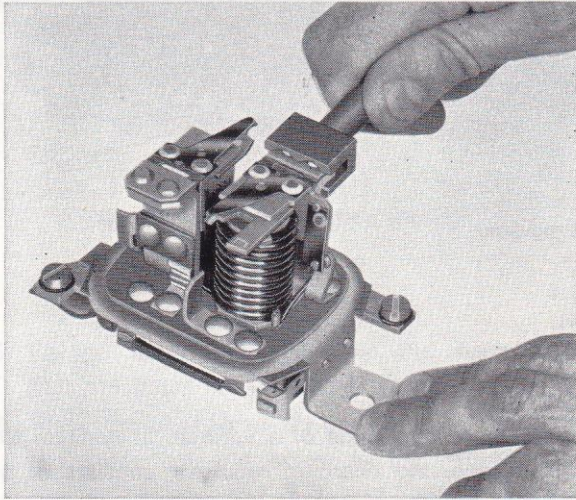
Fig. 18. Wiring diagram for charging regulator

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



## FITTING

1. If the charging regulator has been replaced, check to make sure that the new one is of the correct type.
2. Secure the charging regulator to the wheel housing.
3. Connect up the leads. See the wiring diagram.
4. Connect up the negative battery lead.



VOLVO  
24432

Fig. 19. Adjusting the cut-in voltage

## ADJUSTING THE CHARGING REGULATOR

### Cut-out relay

#### CUT-IN VOLTAGE

Connect a voltmeter across D+ on the charging regulator and dynamo frame. Start the engine and increase the speed while watching the voltmeter. The reading should first increase and then fall back to 0.1—0.2 volt, when the cut-out 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.

Compare this with the value given in the "Specifications" and make any adjustments that are necessary.

Adjustment 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. For adjusting, see Fig. 19.

#### CUT-OUT CURRENT

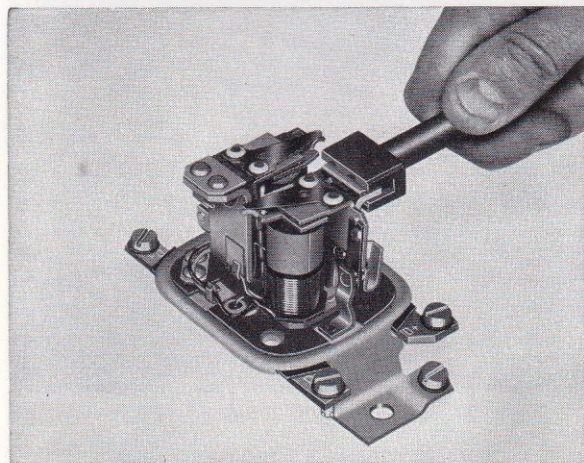
Connect an ammeter in series with B+ on the charging regulator and the battery lead. Increase the dynamo speed until the ammeter indicates

charging. Then gradually decrease the speed. The ammeter pointer should swing back to 0 and then over to discharging. Then it should suddenly return to 0. At the turning point before the pointer returns to 0, read off the cut-out current. The relay has cut-out when the pointer returns to the zero position. The cut-out current should lie between the current values given in the "Specifications".

If the cut-out current is too low, the bend on the contact spring should be reduced by bending the cut-in contact stop spring. If the cut-out current is too high, the bend on the contact spring must be increased. Check the gap of the cut-in contacts which should be 0.4—1.2 mm (0.016—0.048") and adjust if necessary. After such adjustment, check the cut-in voltage again.

## Voltage regulator

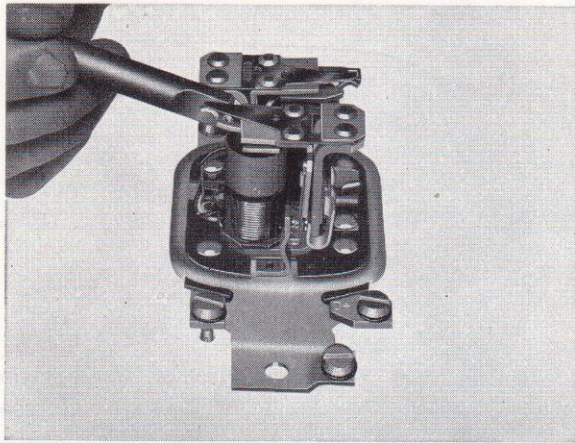
Disconnect the connection B+ on the charging regulator. Connect a voltmeter between B+ and the charging regulator frame and increase the dynamo speed gradually. As soon as voltage regulation has begun, that is, when the voltage does not increase further, the regulating voltage should be read off. The regulator is adjusted by bending the support lip for the spring tongue as shown in Fig. 21, so that the spring tongue is completely unloaded. After this, make a rough adjustment by bending the relay angle piece, see Fig. 20. If the angle piece is bent downwards, this will increase the voltage and vice versa. Rough adjustment should lie about 1—2 volts lower than final adjustment. This is done by bending the support lip upwards so that the spring tongue is tensioned, see Fig. 21. Use special tool Bosch V 397.



VOLVO  
24431

Fig. 20. Rough adjustment of voltage regulator





VOLVO  
24422

Fig. 21. Fine adjustment of voltage regulator

Connect an ammeter between B+ on the regulator and the battery also a load resistance, which can be regulated, in parallel across the battery. Run the dynamo at high speed (approx. 6000 r.p.m.) and load it according to the "Specifications". Regulate the speed so that the field current is half that of the maximum value. Read off the regulating current. Any adjustment should be carried out as a fine adjustment, see Fig. 21. Since the dynamo output is very high, large demands are placed on the condition and tensioning of the drive belt. For this reason, always check before carrying out any work on the charging regulator and dynamo that the belt is correctly tensioned.

## ALTERNATOR S.E.V. MOTOROLA DESCRIPTION

The alternator is a three-phase, delta-connected alternating unit which is placed on the left-hand side of the engine and is belt-driven from a pulley on the crankshaft.

The alternator has a built-in rectifier in the slip ring end shield. This rectifier consists of six silicon diodes.

The alternator differs from a D.C. generator by the fact that it has a rotating field (rotor) and a stationary main winding (stator), see Fig. 22.

The rotor is a claw-pole type with the field winding fed across two slip rings. The rotor is so designed as to permit a maximum alternator speed of 15000 r.p.m.

The isolation diode (2, Fig. 22) placed on the outside of the alternator has two functions: it acts as an extra cut-out current protection for the alternator should any of the six rectifier diodes stop functioning; and it makes simple connecting up of the warning charging lamp possible.

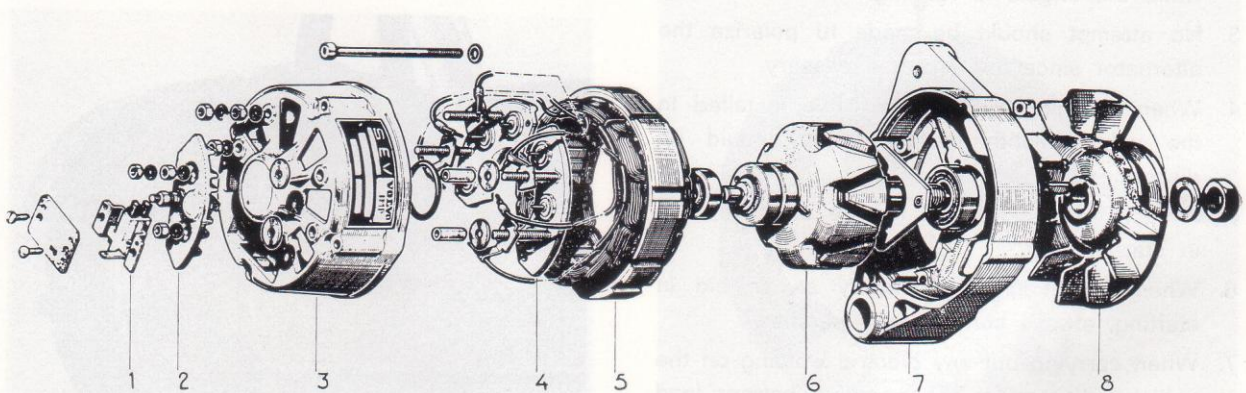


Fig. 22. S.E.V. Motorola alternator dismantled

- |                                |                               |           |                     |
|--------------------------------|-------------------------------|-----------|---------------------|
| 1. Brush holder                | 3. Slip ring end shield       | 5. Stator | 7. Drive end shield |
| 2. Isolation diode with holder | 4. Rectifier (silicon diodes) | 6. Rotor  | 8. Pulley with fan  |

VOLVO  
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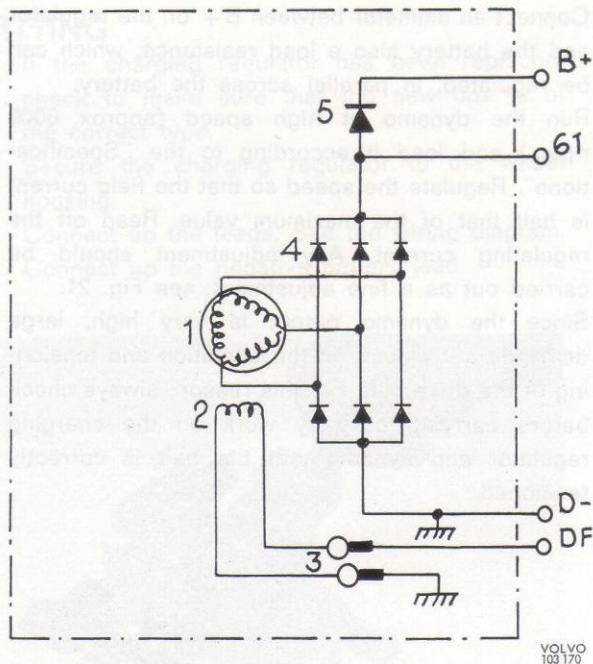


Fig. 23. Inner wiring of the alternator

- |                                |                     |
|--------------------------------|---------------------|
| 1. Stator                      | 4. Rectifier diodes |
| 2. Rotor (field winding)       | 5. Isolation diode  |
| 3. Slip rings and brush holder |                     |

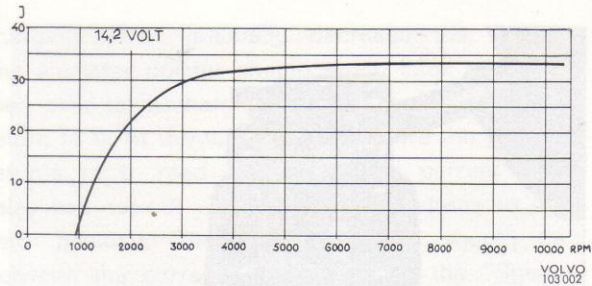


Fig. 24. Output curve for alternator

The alternator is self-limiting (max. 35 A). A simple voltage regulator with only voltage control can therefore be used. There are two types of voltage regulators: Fully transistorised and mechanical.

## REPAIR INSTRUCTIONS

### SPECIAL INSTRUCTIONS FOR WORK ON ALTERNATOR EQUIPMENT

- When replacing or fitting the battery, make sure that the new battery is connected with the correct polarity.
- Never run the alternator with the main circuit broken. The battery and/or alternator and regulator leads must never be disconnected while the engine is running.
- No attempt should be made to polarize the alternator since this is not necessary.
- When charging the battery while installed in the vehicle, both battery leads should be disconnected.
- A rapid charger should not be used as help in starting.
- When using an extra battery as an aid in starting, always connect it in parallel.
- When carrying out any electric welding on the vehicle, disconnect the negative battery lead as well as all the alternator leads. The welding unit should always be connected as near as possible to where the welding is to be carried out.

### REMOVING THE ALTERNATOR

- Disconnect the negative lead to the battery.
- Disconnect the leads to the alternator.
- Remove the bolt for the tensioning iron.
- Remove the bolt holding the alternator to the engine block.
- Remove the fan belt and lift the alternator forwards.

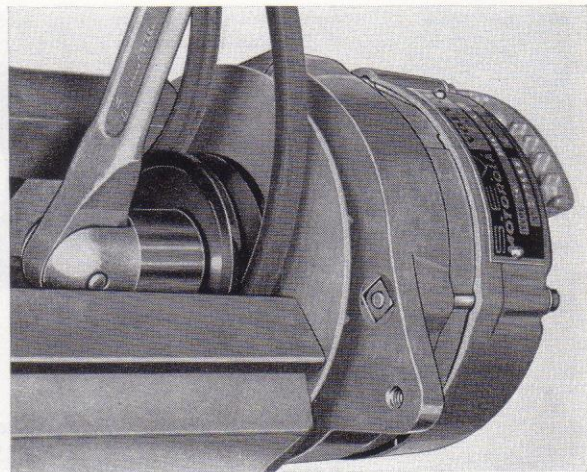


Fig. 25. Removing the pulley nut



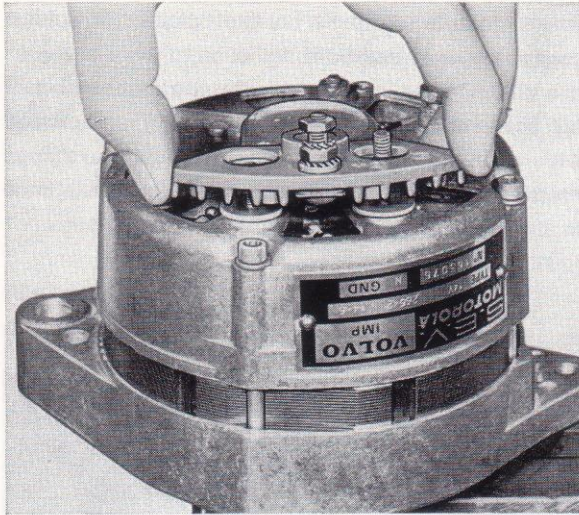


Fig. 26. Removing the isolation diode

VOLVO  
103008

## DISMANTLING THE ALTERNATOR

1. Release the two screws holding the brush holder and remove the isolation plate. Pull out the brush holder.
2. Fix the pulley with belt in a vice with soft jaws, see Fig. 25.
3. Remove the nut and washer. Lift off the pulley, fan, key and spacer washer.
4. Remove the nuts and washers on terminal 61 and the corresponding on the other side of the isolation diode. Lift off the isolation diode holder, see Fig. 26.
5. Mark the drive end shield, stator and slip ring end shield to avoid confusion when assembling. Remove the four attaching screws.

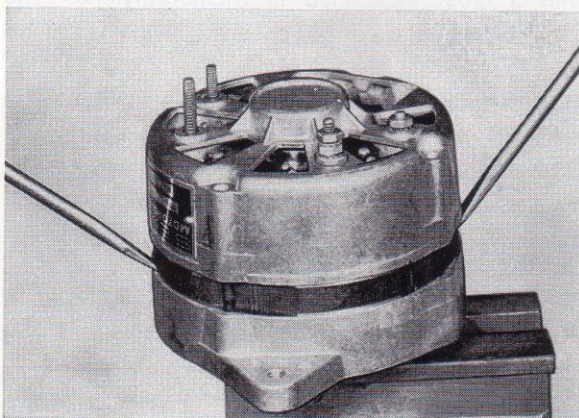


Fig. 27. Dismantling the alternator

VOLVO  
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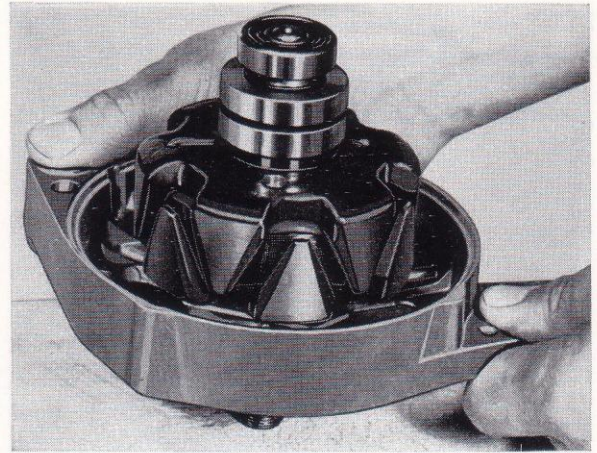


Fig. 28. Removing the drive end shield

VOLVO  
103010

6. Remove the rotor and drive end shield with the help of two screwdrivers, which are inserted in two of the sockets between the stator and drive end shield, see Fig. 27.

**N.B. The screwdrivers may not be inserted deeper than 2 mm (just over 1/16"), otherwise the stator may be damaged.**

7. Release the three screws holding the support plate of the drive end bearing. Release the bearing by knocking the end of the shaft against a piece of wood, see Fig. 28.
8. Remove the nuts and washers for the diode holder for the negative diodes.
9. Remove the stator and diode holders for the slip ring end shield.

## REPLACING THE BEARINGS

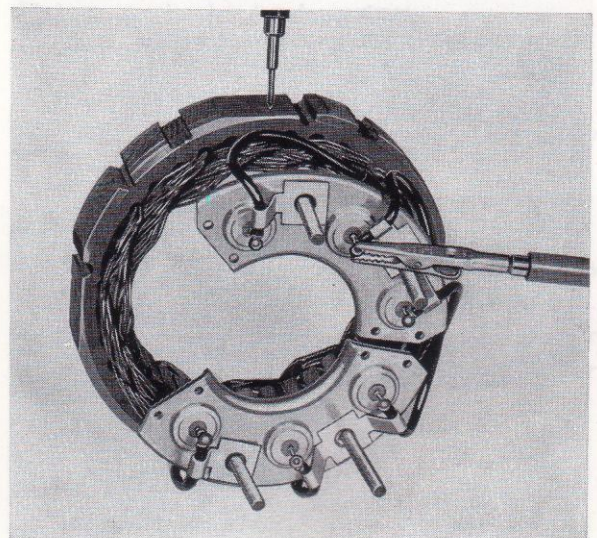


Fig. 29. Checking the stator

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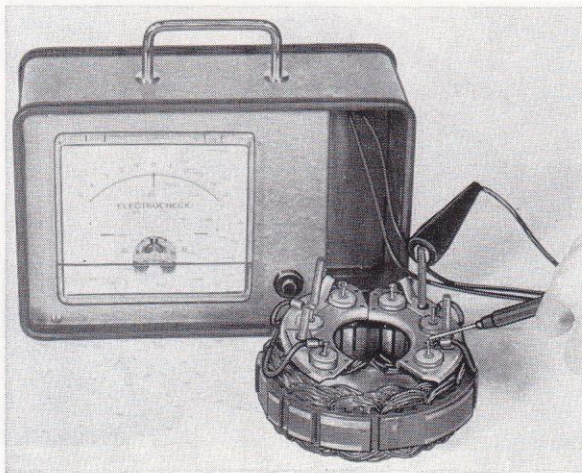


Fig. 30. Checking the diodes

## CHECKING THE DISMANTLED ALTERNATOR

### Stator

Check the stator for any short-circuiting. If one or several of the coils are burnt, there must be a short-circuit in the stator. Connect a test lamp (12 V, 2—5 W) between the stator plates and a terminal on the stator, see Fig. 29.

If the lamp lights, the isolation between the stator winding and the stator plates must be burnt out, in which case, the stator should be replaced.

**N.B. Only a 12 V, 2—5 W test lamp may be used; 110 or 220 V, D.C. or A.C. lamps may NOT be used. This applies to all the alternator components.** Check the diodes with a diode tester, see Fig. 30. If any of the rectified diodes is faulty, the entire diode holder (with three diodes) must be replaced.

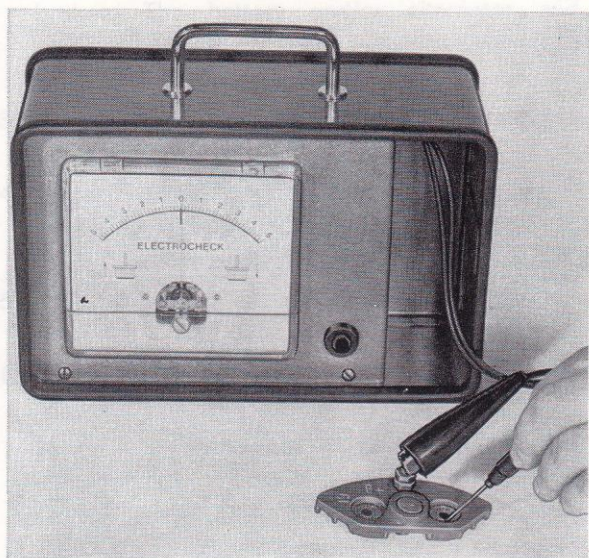


Fig. 31. Checking the isolation diode

If the isolation diode is faulty, replace the holder, complete with isolation diode.

If a diode tester is not available, the diodes should be soldered loose (see page 3—18) and tested with an ohmmeter. The diodes should have high resistance in reverse direction and low resistance in the flow direction.

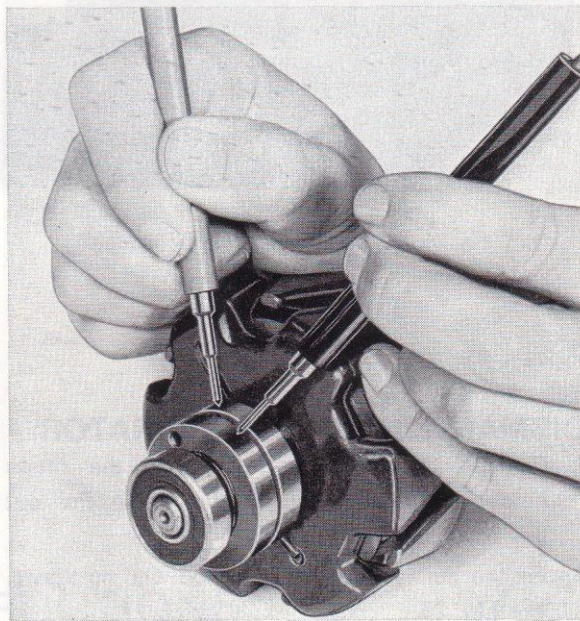


Fig. 32. Check-measuring the rotor

### Rotor

Check to make sure that the slip rings are not dirty or burnt.

Check the winding for breakage or damaged isolation.

Measure the resistance between the slip rings, see Fig. 32. At 25°C (77°F) the resistance should be  $5.2 \pm 0.2$  ohms.

If the slip rings are dirty, clean them carefully with a cloth moistened in trichlorethylene. The slip rings can also be polished with fine sand paper.

If the winding is faulty, the entire rotor must be replaced.

Check the bearings. (The bearings should always be replaced when the alternator has been dismantled.)

### Brush holder

Connect a test lamp between the brushes. The lamp must not light.

Connect the test lamp between the DF-terminal and "+" brush. The lamp should give a steady



light even if the brush or the terminal cable to the brush is moved, see Fig. 33. Connect the test lamp between the brush holder frame and "—" brush. The lamp should give a steady light even if the brush or the terminal lead is moved.

If the brush holder does not meet the above requirements, or if the brush length is less than 5 mm (approx. 3/16"), then replace the brush holder.

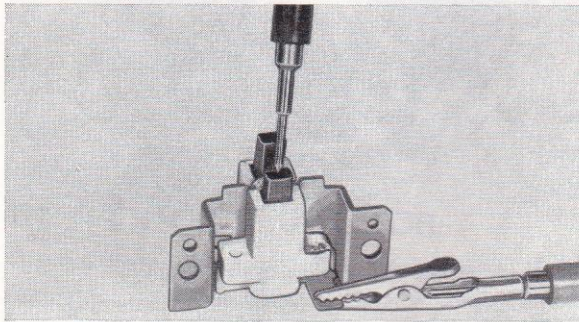
VOLVO  
103013

Fig. 33. Checking the brush holder

## REPLACING THE RECTIFIER DIODES

1. Mark the leads connecting the stator to the diodes. Solder loose the leads.
2. Place the new diode holder in exactly the same position occupied by the old one. Hold the outgoing diode lead with a pair of flat pliers. (This is to conduct the heat from the soldering point so as not to damage the new diode.)
3. Solder on the diodes, see Fig. 34.  
N.B. The complete "+" or "-" diode holder must be replaced even if only one diode is faulty.

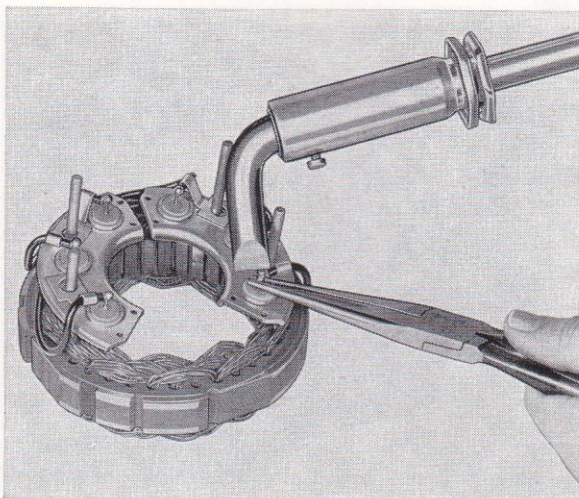
VOLVO  
103016

Fig. 34. Soldering the diodes

Use a well-heated soldering iron, minimum 100 W, for the soldering.

Never change places for the two diode holders.

The **positive diode holder** is isolated from the frame by means of isolation washers and sleeves and its diodes are marked in **red**.

The **negative diode holder** is not isolated and its diodes are marked in **black**.

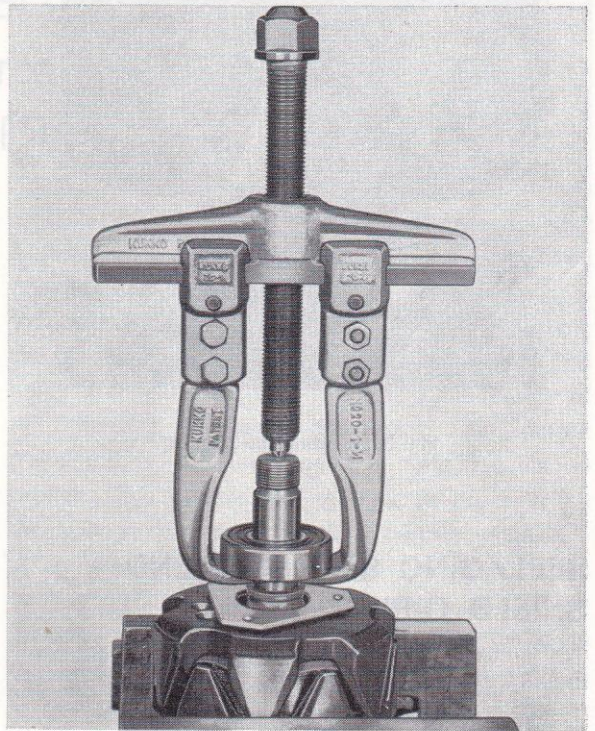
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Fig. 35. Removing the bearings

## REPLACING THE BEARINGS

### Drive end shield bearing

#### REMOVING

1. Place the rotor in a vice with soft jaws.
2. Pull the bearing off with a claw puller, see Fig. 35.

#### FITTING

1. Place the support plate on the rotor shaft with the three elevations facing the rotor winding.
2. Press the bearing in with the help of a tubular sleeve which presses on the bearing inner ring, see Fig. 36.

### Slip ring end bearing

#### REMOVING

1. Place the rotor in a vice with soft jaws.
2. Pull the bearing off with a claw puller.



**FITTING**

1. Press the bearing on with a tubular sleeve which presses on the bearing inner ring.

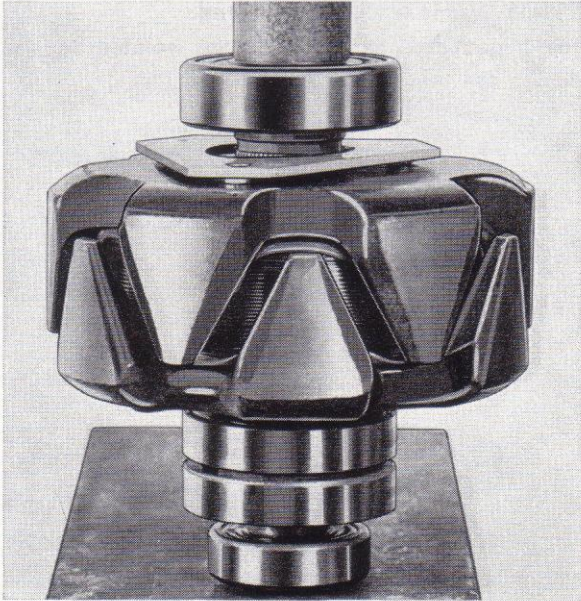


Fig. 36. Fitting the bearing

VOLVO  
103 018

## REPLACING SLIP RING END SHIELD O-RING

1. Remove the O-ring with a steel blade with rounded edges (for example, a feeler gauge), see Fig. 37.
2. Wash the groove clean.  
Check that the hole in the bearing shield is not blocked.
3. Fit a new O-ring.  
Lubricate the O-ring and the hole with mineral oil or similar.

The O-ring should be replaced each time the alternator has been dismantled.

## ASSEMBLING THE ALTERNATOR

1. Fit the stator and the diode holders in the slip ring end shield. (Do not forget the isolation washers for the positive diode holder). Fit the nuts and washers on the negative diode holder screws.
2. Press the rotor into the drive end shield. Fit the three screws for the drive bearing support plate.
3. Fit together the rotor and stator sections.
4. Fit the attaching screws. Tightening torque 0.28—0.30 kpm (2.0—2.2 lb.ft.).

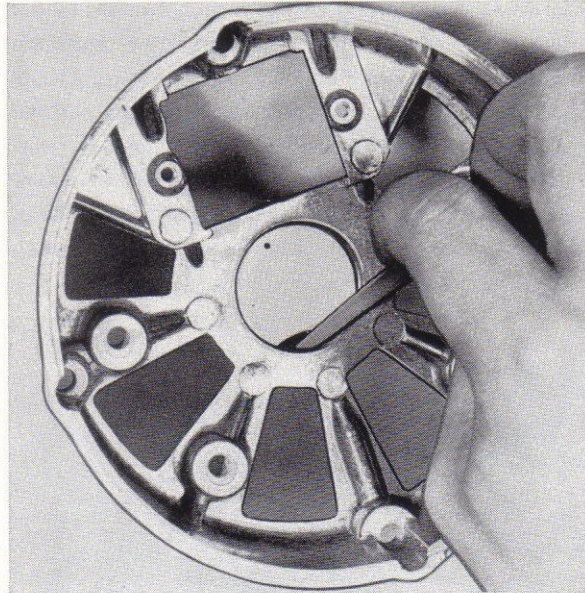


Fig. 37. Removing the O-ring

VOLVO  
103 019

5. Fit the plastic tube and isolation washers on the screws on which the isolation diode is to be mounted.  
Fit the isolation diode, put on the nuts and washers. Fit the brush holder.
6. Fit the spacer washer, key, fan, pulley, washer and nut. Tightening torque 4 kpm (29.0 lb.ft.).
7. Connect a test lamp between B+ and the alternator frame. Switch the terminals. The lamp should light only in one direction, see Fig. 38. After any repairs, the alternator should be test-run in a test bench.

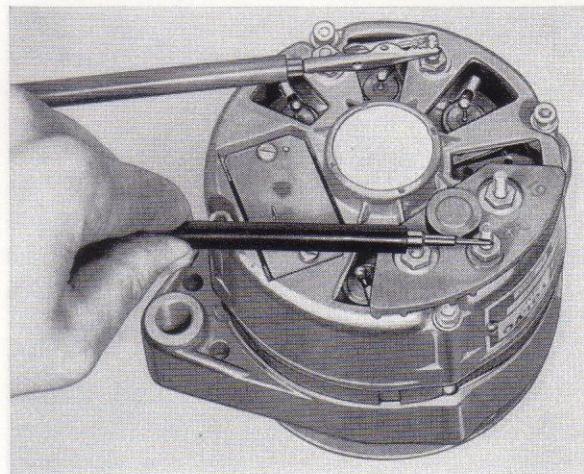


Fig. 38. Checking the alternator

VOLVO  
103 020



### FITTING THE ALTERNATOR

1. Place the alternator in position while fitting on the fan belt at the same time.
2. Fit the attaching bolts and tensioning iron without tightening up the bolts. Adjust the belt tension (see "Fitting the dynamo" on page 3—12) and secure the alternator.

- N.B. Force may only be applied to the front end of the alternator when adjusting the belt tension.
3. Fit the leads to the alternator.
  4. Fit the battery lead.

## VOLTAGE REGULATOR

### S.E.V. MOTOROLA DESCRIPTION

#### TRANSISTOR REGULATOR

The transistor regulator, Fig. 39, consists of an output transistor, a guide transistor, zener diode, cut-out current diode, thermistor and a number of resistances. The transistor regulator is fully enclosed and can neither be adjusted nor repaired.

direct current produced is re-fed via the regulator to the field winding until the regulating voltage has been reached.

When the regulating voltage has been reached, the zener diode opens and this influences the guide transistor so that it starts conducting. At the moment it starts conducting, the output transistor is blocked and the field current is broken. This causes the voltage to drop. When the voltage has dropped to a certain value, the zener diode closes, the guide transistor stops conducting and the output transistor starts conducting the field current again. The cycle is repeated very rapidly and in this way the voltage is kept constant. The thermistor is temperature-compensating and it influences the regulator so that at low temperature the alternator produces a higher voltage than at high temperature.

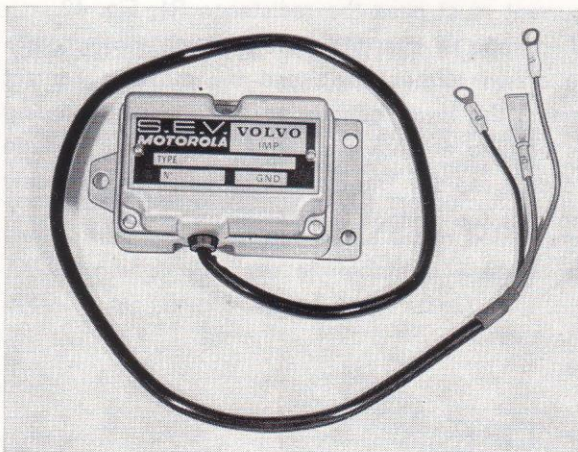


Fig. 39. Transistor regulator

#### Function

When the ignition key switches on the circuit, current flows through the charging warning lamp to terminal D+ (61) on the alternator. From there the current is conducted to the regulator. In the regulator the current goes via the output transistor Q2, Fig. 40, to the DF-terminal on the alternator. From the DF-terminal the current is taken across two brushes and slip rings, through the field winding in the rotor to earth.

When the alternator starts rotating, alternating current is formed in the stator. This alternating current is rectified in the silicon diodes and the

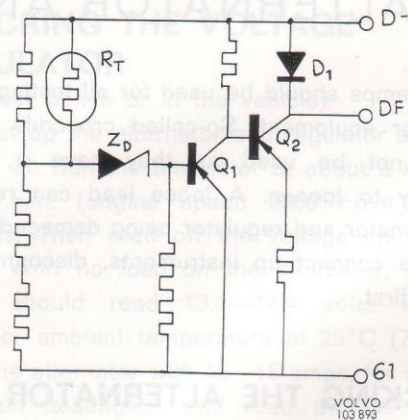


Fig. 40. Inner wiring of transistor regulator

- |                          |                |
|--------------------------|----------------|
| Q1 Guide transistor      | ZD Zener diode |
| Q2 Output transistor     | RT Thermistor  |
| D1 Cut-out current diode |                |



## MECHANICAL VOLTAGE REGULATOR

The mechanical regulator, Fig. 41, is a twin contact regulator with one upper contact which is a movable contact, and a lower contact. The movable contact is secured to an armature which is influenced by a voltage coil. The regulator also contains three resistances and one thermistor.

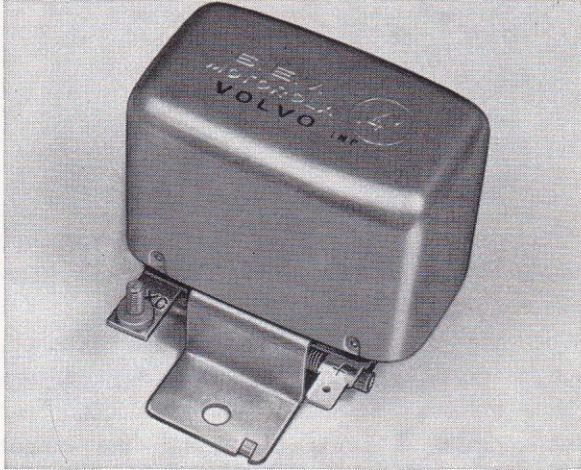


Fig. 41. Mechanical voltage regulator

### Function

When the ignition key is switched on, current flows through the charging warning lamp to D+ on the regulator. It is then conducted via the

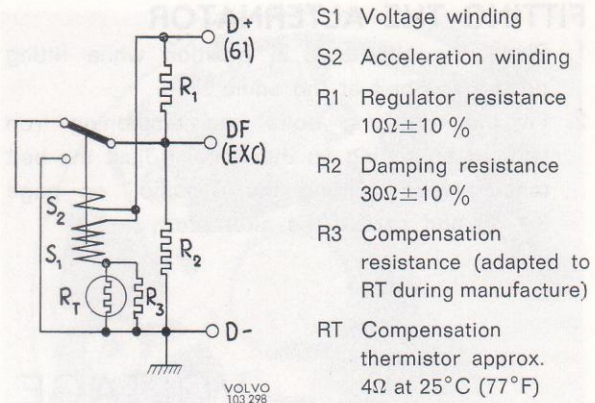


Fig. 42. Inner wiring of mechanical regulator

regulator through the field winding to earth. When the alternator starts rotating, alternating current is formed in the stator. This alternating current is rectified by the silicon diodes and the direct current produced is re-fed via the regulator to the field winding until the regulating voltage has been reached. When the regulating voltage has been reached, the armature is attracted by the coil. This causes the contacts to open and the field current must pass the resistance R1, Fig. 42.

If in spite of this, the voltage rises, the armature is drawn further down and the movable contact meets the lower contact so that the field winding is earthed at both ends, this causing the voltage to drop rapidly. The cycle is repeated continuously so that the voltage is maintained constant.

## TESTING THE ALTERNATOR AND VOLTAGE REGULATOR

Fixed clamps should be used for all testing of the alternator equipment. So-called crocodile clamps should not be used as they have a certain tendency to loosen. A loose lead can result in the alternator and regulator being damaged. When about to connect up instruments, disconnect the battery first.

### CHECKING THE ALTERNATOR CIRCUIT

Before carrying out any tests on the alternator or regulator in the vehicle, check the battery and vehicle wiring system for damaged leads or in-

sulation, loose or corroded lead terminals and poor earthing. **Check the fan belt.** Any of the above faults must be remedied before the electrical checks can be started.

### Testing the battery

Test the battery with a hydrometer and battery tester. If the battery is not fully charged, remove it from the car and charge it or replace it with a new one if necessary. A fully charged battery which is otherwise in good condition should always be used when testing.



### Checking the voltage drop

This test is made to check the leads between the alternator and the battery and also the battery earth lead. The test should be carried out with a fully charged battery in good condition. The battery terminals should be well cleaned and tightened.

Load the alternator with about 10 amps. Suitable load: Mainbeam light switched on. With the engine running and the alternator supplying 10 amps., measure with a suitable voltmeter the voltage between the positive pole of the battery and B+ on the alternator. If the voltage drop at this test exceeds 0.3 volt, there must be a fault in the lead or contact, which must be remedied immediately. After repairing the leads or contacts, measure once again. With the same load as above, measure the voltage drop between the negative pole of the battery and the alternator terminal D-. Here the voltage drop must not exceed 0.2 volt. If the voltage drop exceeds 0.2 volt, check the battery earth lead, the alternator contact with the engine and the engine contact with the chassis. After making the necessary repairs, measure again.

### CHECKING THE ALTERNATOR

(In a test bench or in the vehicle)

Connect up the alternator as shown in Fig. 43. Check that the current through the field winding (ammeter C) is 2—2.5 amps. (If the current is not the correct one, then check the brush holder and field winding.) Run the alternator to a speed of 3000 r.p.m. (Engine speed 1500 r.p.m.)

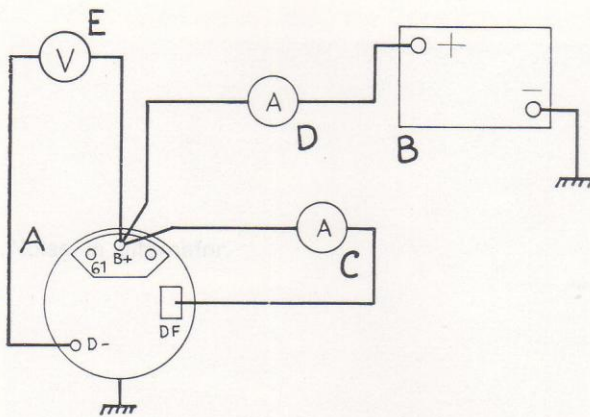


Fig. 43. Wiring diagram for testing alternator

- A. Alternator
- B. Battery 60 Ah
- C. Ammeter 0—10 amps.
- D. Ammeter 0—50 amps.
- E. Voltmeter 0—20 volts

The alternator should then produce at least 30 amps at about 13 volts. (A further load may be connected up in order to maintain the voltage at about 13 volts.)

Measure the voltage at B+ and 61 when the alternator charges.

The voltage should be 0.8—0.9 volt higher at terminal 61, otherwise the isolation diode must be faulty and should be replaced.

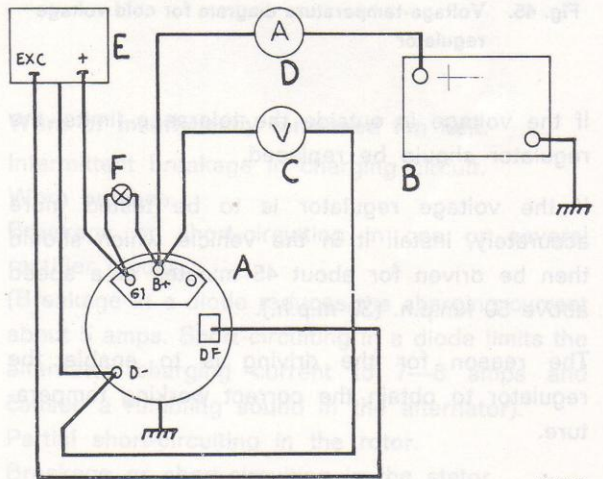


Fig. 44. Wiring diagram for testing voltage regulator

- A. Alternator
- B. Battery 60 Ah
- C. Voltmeter 0—20 volts
- D. Ammeter 0—50 amps.
- E. Voltage regulator
- F. Warning lamp 12 volts, 2 watts

### CHECKING THE VOLTAGE REGULATOR

(In a test bench or in the vehicle)

Connect up the alternator and regulator as shown in Fig. 44. Run the alternator at about a speed of 5000 r.p.m. (engine speed 2500 r.p.m.) for 15 seconds. Then read off the voltage on the voltmeter. With no load on the alternator, the voltmeter should read 13.1—14.4 volts with the regulator ambient temperature at 25°C (77°F). Load the alternator with 10—15 amps, for example, full-beam headlights, and read off the voltage. The voltage should also lie on this occasion between 13.1—14.4 volts. For ambient temperatures other than 25°C (77°F), see the diagram in Fig. 45.



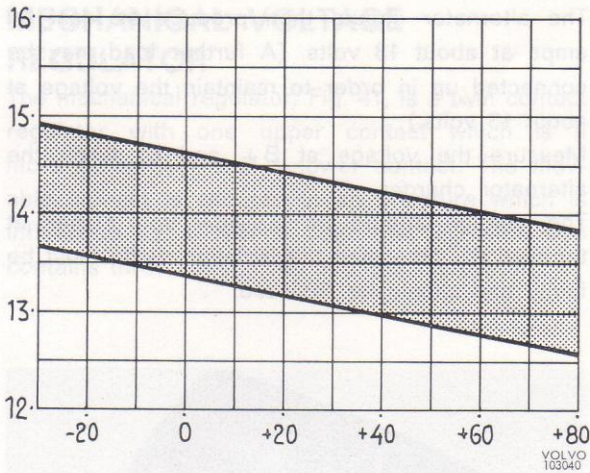


Fig. 45. Voltage-temperature diagram for cold voltage regulator

If the voltage is outside the tolerance limits, the regulator should be replaced.

If the voltage regulator is to be tested more accurately, install it in the vehicle which should then be driven for about 45 minutes at a speed above 50 km.p.h. (30 m.p.h.).

The reason for the driving is to enable the regulator to obtain the correct working temperature.

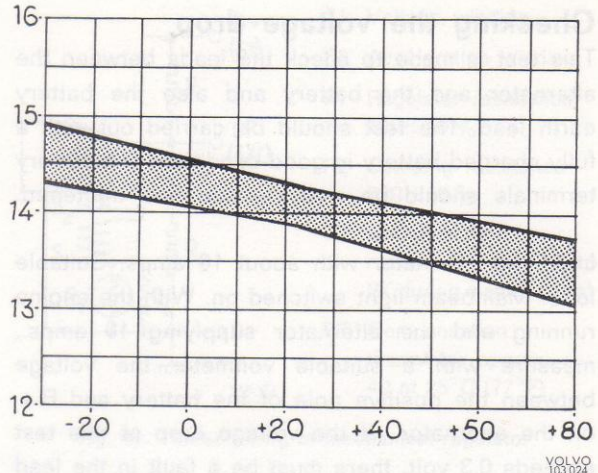


Fig. 46. Voltage-temperature diagram for warm voltage regulator

N.B. The vehicle **must** be driven. It is not sufficient just to have the engine idling.

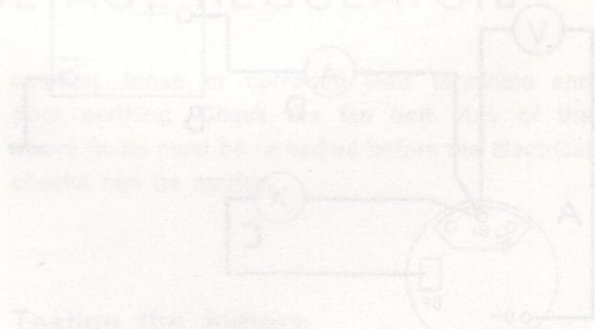
Immediately after, or preferably during driving, measure the voltage between B+ and D— on the alternator. The engine should be turning over at about 2500 r.p.m. when the measuring is being carried out. When the regulator ambient temperature is about 25°C (77°F), the voltage should be 13.85—14.25 volts. For other ambient temperatures, see Fig. 46.

Relation

When driving, the voltage regulator should be tested at a speed above 50 km.p.h. (30 m.p.h.).

Connect up the alternator as shown in Fig. 47. Check that the current through the field winding is 1.5—2.5 amps (if the current is not correct then check the brush holder and the correct one then check the brush holder and field winding) for the alternator to a speed of 3000 r.p.m. (Engine speed 1500 r.p.m.)

TESTING THE ALTERNATOR AND VOLTAGE REGULATOR



Load the alternator with 10—15 amps, for example. The voltage should also be on a digital meter 13.85—14.25 volts. When the regulator ambient temperature is 25°C (77°F) the meter should read 13.1—14.4 volts.



# FAULT TRACING

the voltage regulator and from one terminal to the other further...  
 winding. This cycle is repeated until the upper contacts (2, Fig. 70) close,  
 voltage has been reached, at which point the...  
 lower contacts (1) starting now...  
 the open...  
 in each...  
 DESCRIPTION

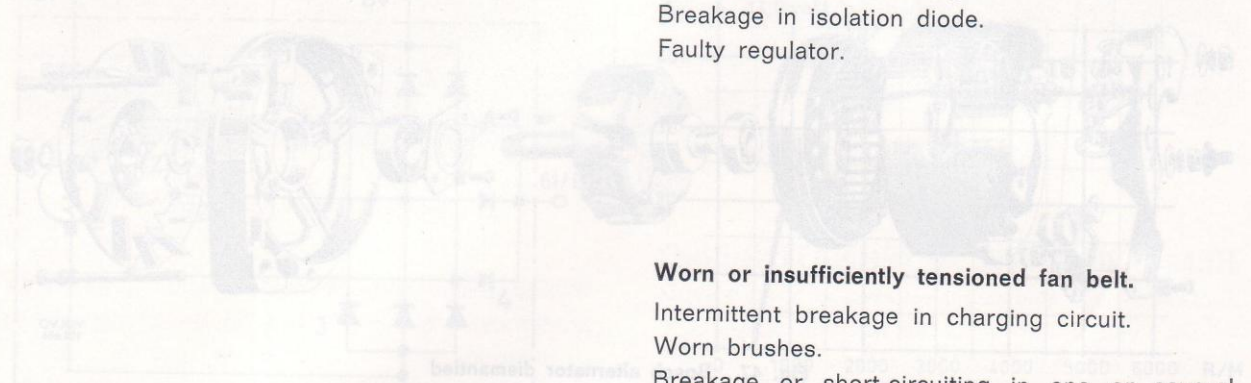
## FAULT

## REASON

Alternator does not charge.

**Worn or insufficiently tensioned fan belt.**

- Breakage in charging circuit.
- Worn brushes.
- Breakage in rotor winding.
- Breakage in isolation diode.
- Faulty regulator.



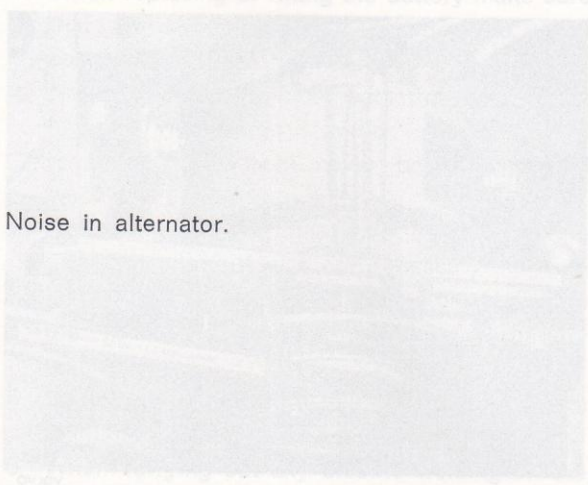
Charging weak or irregular.

**Worn or insufficiently tensioned fan belt.**

- Intermittent breakage in charging circuit.
- Worn brushes.
- Breakage or short-circuiting in one or several rectifier diodes.
- (Breakage in a diode reduces the charging current about 5 amps. Short-circuiting in a diode limits the alternator charging current to 7—8 amps and causes a rumbling sound in the alternator).
- Partial short-circuiting in the rotor.
- Breakage or short-circuiting in the stator.
- Faulty regulator.

Too high charging.

- Faulty regulator.
- Faulty terminals on regulator or alternator.
- Short-circuiting in isolation diode.



Noise in alternator.

- Worn fan belt.
- Loose pulley.
- Worn bearings.
- Short-circuiting in one or several rectifier diodes.
- Alternator pulley incorrectly aligned in relation to the crankshaft pulley.

Charging warning lamp glows.

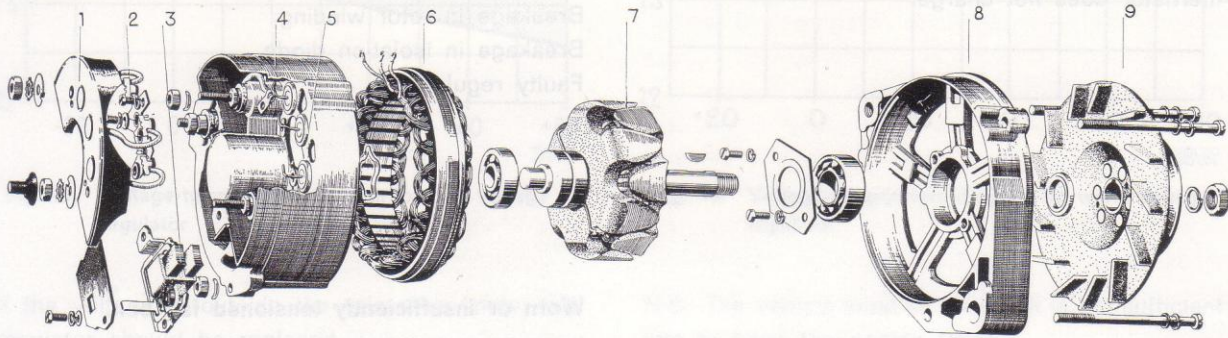
Voltage drop in fusebox.



# ALTERNATOR

## BOSCH

### DESCRIPTION



VOLVO  
103 486

Fig. 47. Bosch alternator dismantled

- |                                     |                                |
|-------------------------------------|--------------------------------|
| 1. Rectifier (positive diode plate) | 5. Rectifier (negative diodes) |
| 2. Magnetizing rectifier            | 6. Stator                      |
| 3. Brush holder                     | 7. Rotor                       |
| 4. Slip ring end shield             | 8. Drive end shield            |
|                                     | 9. Pulley with fan             |

The alternator is a three-phase, delta-connected alternating unit. The rectifier, which is built into the slip ring end shield, consists of six silicon diodes. Also housed in the slip ring end shield are three so-called magnetizing diodes, which feed the field winding via the voltage regulator. This type of generator differs from a D.C. generator in that it has a rotating field winding (rotor) and a stationary main winding (stator).

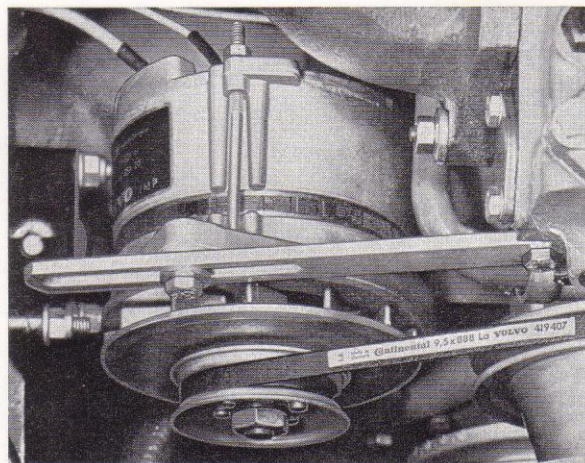
The rotor is a 12-pole claw-type with the field winding fed across two slip rings.

Since the alternator is self-limiting concerning the current (max. 35 amps), a simple mechanical voltage regulator is used with only voltage control as its function.

### FUNCTION, ALTERNATOR— VOLTAGE REGULATOR

When the ignition is switched on, current flows through the charging warning lamp to terminal D+ on the voltage regulator. Via the regulator, the current is conducted through the field winding to earth.

When the rotor starts rotating, alternating current is formed in the stator. Most of the current is rectified by the positive and negative diodes and is conducted via the B+ on the alternator to the battery. A small part of the current is rectified by the magnetizing diodes and is led via 61/D+ to



VOLVO  
103 671

Fig. 48. Alternator fitted



the voltage regulator and from there to the field winding. This cycle is repeated until the regulating voltage has been reached, at which point the lower contacts (1, Fig. 70) on the voltage control open and field current must pass a control resistance. If the voltage rises in spite of this,

the armature on the voltage coil is pulled further down so that the upper contacts (2, Fig. 70) close, whereby the field winding is earthed at both ends, this causing the voltage to drop rapidly. The cycle is repeated continuously so that the voltage is maintained constant.

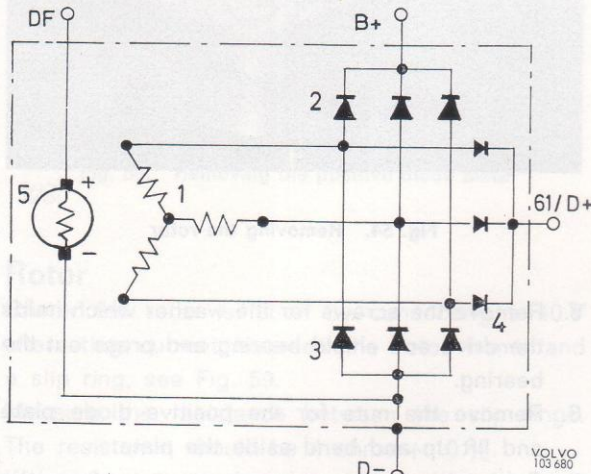


Fig. 49. Inner wiring of the alternator

- |                    |                       |
|--------------------|-----------------------|
| 1. Stator          | 4. Magnetizing diodes |
| 2. Positive diodes | 5. Rotor              |
| 3. Negative diodes |                       |

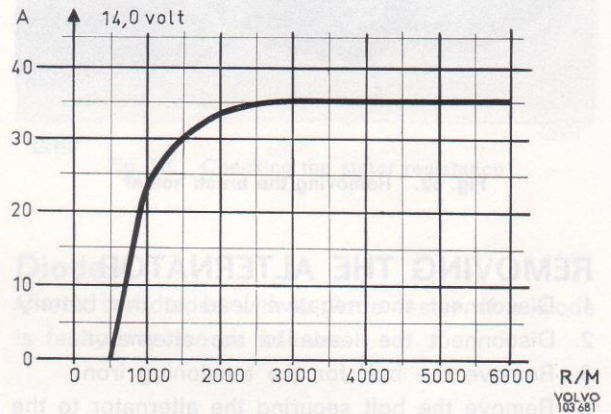


Fig. 50. Alternator output curve

A = amps. RM = alternator speed/minute

## REPAIR INSTRUCTIONS

### SPECIAL INSTRUCTIONS FOR WORK ON ALTERNATOR EQUIPMENT

1. When replacing or fitting the battery make sure that the proper polarity is observed when connecting up the new battery.
2. Never run the alternator with the main circuit broken. The battery and/or alternator and regulator leads must never be disconnected while the engine is running.
3. No attempt should be made to polarize the alternator since this is not necessary.
4. When about to charge the battery installed in the vehicle, disconnect the negative battery lead.
5. When using an extra battery as an aid in starting, always connect it in parallel.
6. When carrying out any electric welding on the vehicle, disconnect the negative battery lead as well as the B+ lead on the alternator and

pull the plug out of the voltage regulator. The welding unit should always be connected as near as possible to where the welding is to be carried out.



Fig. 51. Removing the pulley



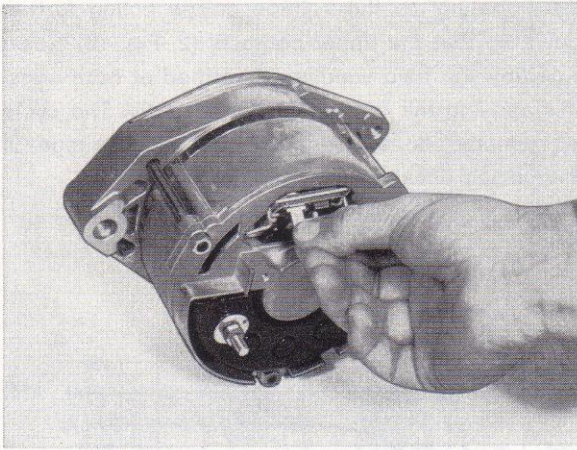
VOLVO  
103 904

Fig. 52. Removing the brush holder

## REMOVING THE ALTERNATOR

1. Disconnect the negative lead to the battery.
2. Disconnect the leads to the alternator.
3. Remove the bolt for the tensioning iron.
4. Remove the bolt securing the alternator to the engine block.
5. Remove the fan belt and lift out the alternator.

## DISMANTLING THE ALTERNATOR

1. Remove the nut and washer for the pulley and pull off the pulley. Remove the key.
2. Remove the screws holding the brush holder and then take off the holder, see Fig. 52.
3. Remove nuts, washers and screws holding together the alternator and take off the drive end shield and rotor from the stator and then the slip ring end shield.
4. Press the rotor out of the drive end shield, see Fig. 54.

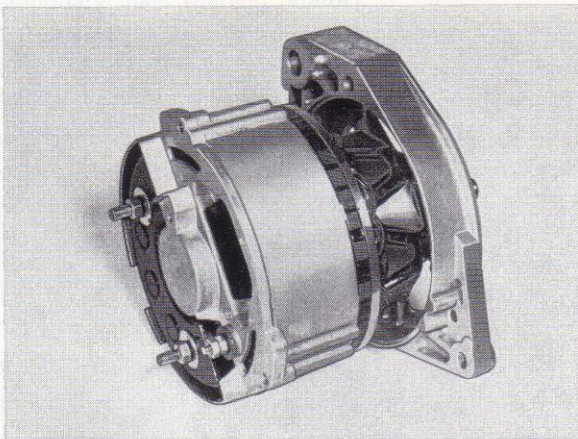
VOLVO  
103 905

Fig. 53. Removing the rotor and drive end shield

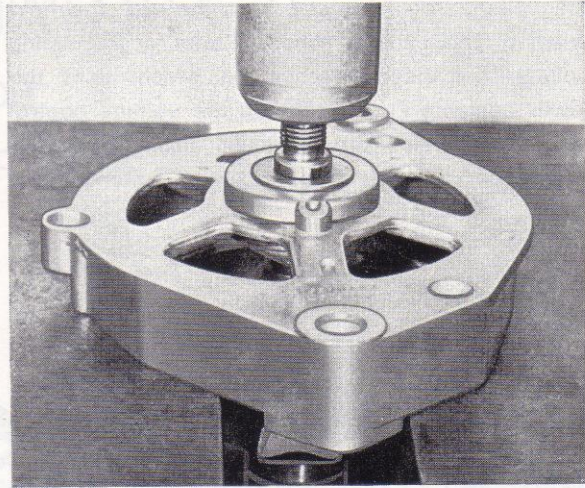
VOLVO  
103 906

Fig. 54. Removing the rotor

5. Remove the screws for the washer which holds the drive end shield bearing and press out the bearing.
6. Remove the nuts for the positive diode plate and lift up and bend aside the plate.
7. Solder loose the stator connections from the terminal points and lift off the stator.

## CHECKING THE DISMANTLED ALTERNATOR

### Stator

Check the stator isolation by connecting a 40 V alternating current between the body and a phase lead. Check the stator for breakdown by measuring the resistance between the phase leads, see Fig. 58.

The resistance should be  $0.26 \text{ ohm} + 10\%$ .

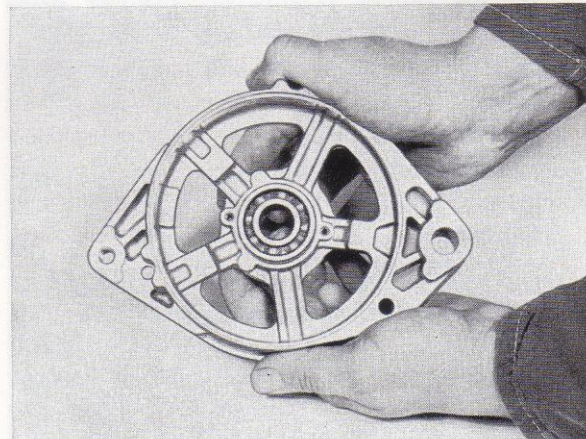
VOLVO  
103 907

Fig. 55. Removing the drive end shield bearing



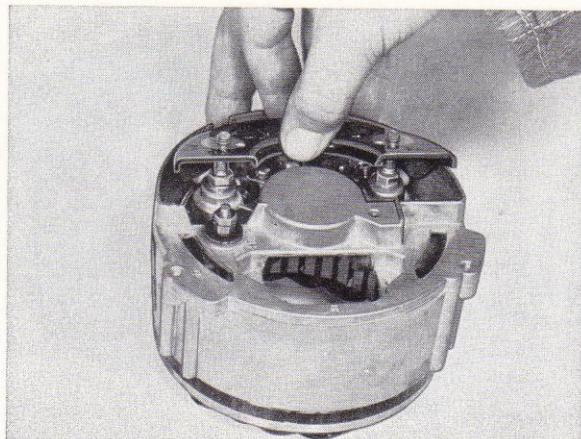
VOLVO  
103 808

Fig. 56. Removing the positive diode plate

### Rotor

Check the rotor isolation by connecting a 40 V alternating current between the rotor frame and a slip ring, see Fig. 59.

Measure the resistance between the slip rings. The resistance should be 4 ohms + 10 %.

If the slip rings are burnt or damaged in any other way, they can be lathed. For the lathing, a tail-stock chuck should be used. The diameter of the slip rings may not be less than 31.5 mm (1.3"). After the lathing, check the slip rings for possible out-of-round with a dial indicator. Max. radial throw is 0.03 mm (0.0012").

### Brush holder

Check the brush holder isolation with a 40 V alternating current. Measure the length of the brush as shown in Fig. 61. Minimum length is 8 mm (0.32").

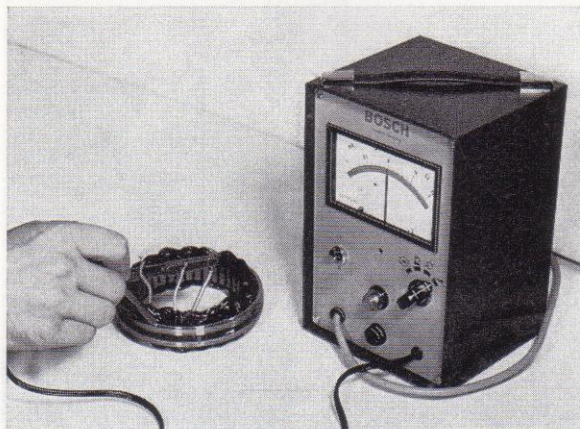
VOLVO  
103 809

Fig. 57. Checking the stator isolation

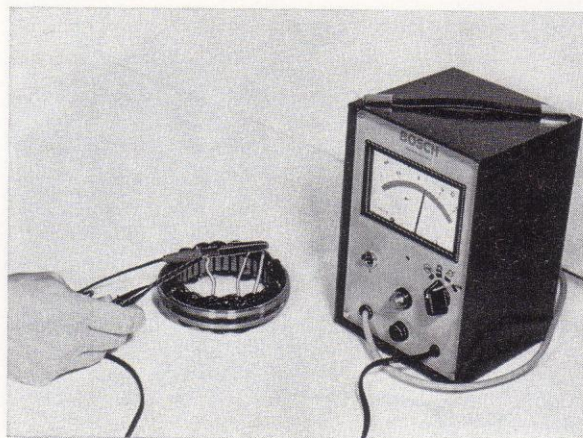
VOLVO  
103 810

Fig. 58. Checking the stator resistance

### Diodes

Check the diodes with a diode tester. If a diode is faulty, replace as follows:

## REPLACING THE DIODES

### Positive diodes

1. Solder loose the positive diode plate from the terminal points. Press out the faulty diode with a suitable drift.
2. Calibrate the hole in the positive diode plate with a suitable tool (for example, Bosch EFLJ 57/0/3 and 57/0/5).
3. Press the new diode in with a suitable tool. Before fitting the new diode, oil it with silicon oil (for example, Bosch OI 63 V 2).
4. Paint the new diode and any bare spots on the outside of the heat sink with black chlorinated rubber enamel (Bosch FI 87 V 1 or corresponding) to prevent corrosion.
5. Solder the heat sink to its original position. Check with the diode tester.

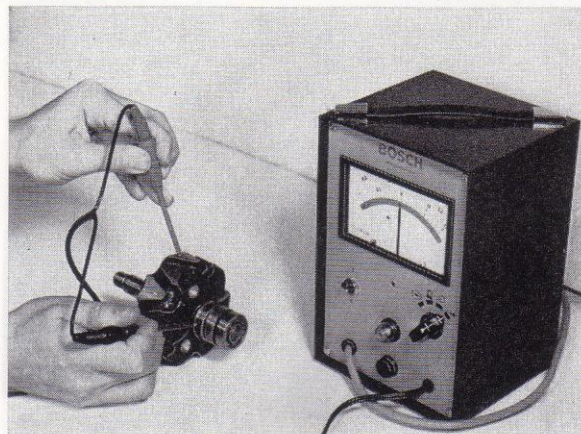
VOLVO  
103 811

Fig. 59. Checking the rotor isolation



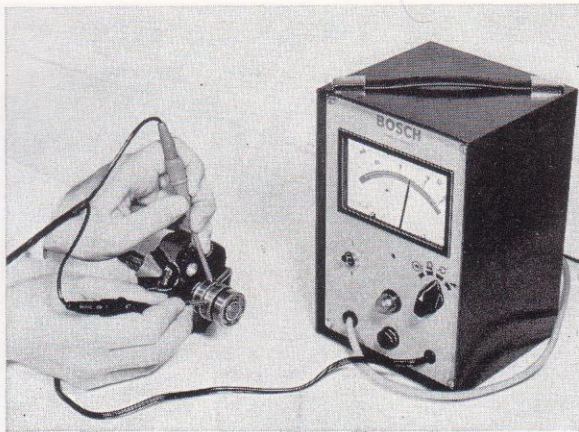
VOLVO  
103 812

Fig. 60. Checking the rotor resistance

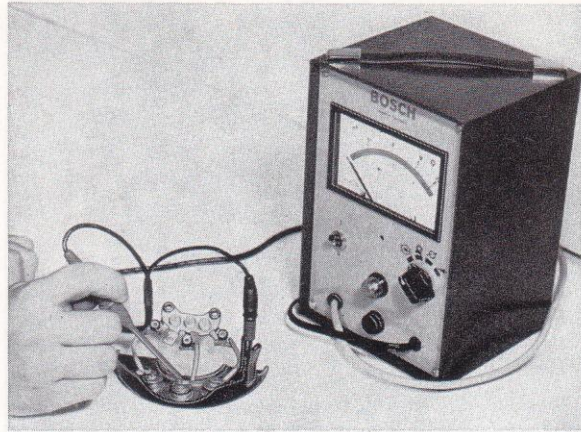
VOLVO  
103 814

Fig. 62. Checking the diodes

### Negative diodes

1. Solder loose the negative diodes from the terminal points and lift off the positive diode plate with the magnetizing diodes.
2. Press out the faulty diode with a suitable tool.
3. Oil the new diode with silicon oil (for example, Bosch OI 63 V 2) and install it in the drive end shield.
4. Solder the negative diodes to the terminal points and check with the diode tester.

### Magnetizing diodes

1. If a magnetizing diode should be faulty, replace the entire plate with all three diodes.

### ASSEMBLING THE ALTERNATOR

1. Fit the stator in the slip ring end shield and solder the stator leads to the terminal point. Fit the positive diode plate.

2. Grease the drive end bearing (use Bosch Ft 1 V 34 or corresponding) and fit the bearing and washer in the drive end bearing shield.
3. Press the drive end bearing shield and spacing ring on the rotor, see Fig. 63.
4. Grease the slip ring end shield bearing (Bosch Ft 1 V 34 or corresponding). Coat the slip ring end shield bearing seat with a light layer of Molykote paste and assemble the alternator. (Do not forget the spring ring on the slip ring end shield bearing seat.) Assemble the alternator components together with the screws and nuts. The screws should be tightened to a torque of 0.50—0.60 kpm (3.6—4.3 lb.ft.) and the nuts to 0.45—0.60 kpm (3.3—4.3 lb.ft.).
5. Fit the brush holder.
6. Fit the key, pulley, washer and nut.
7. Tighten the nut to a torque of 4 kpm (29.0 lb.ft.).

After assembling the alternator, test-run it on a test bench before installing it in the vehicle.

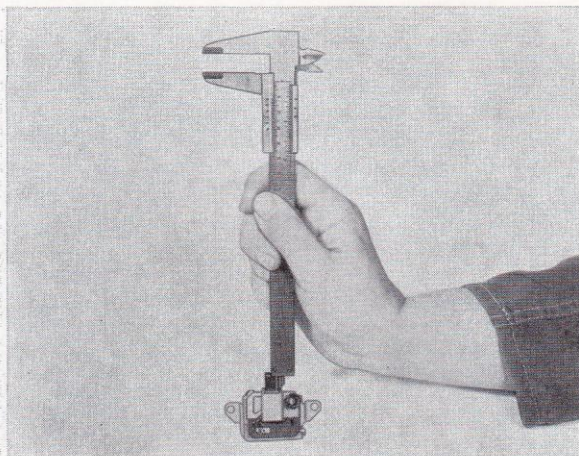
VOLVO  
103 813

Fig. 61. Checking the brush length

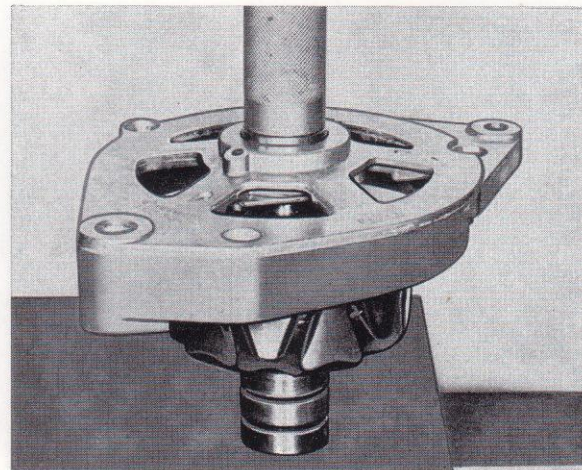
VOLVO  
103 815

Fig. 63. Assembling the rotor and drive end shield



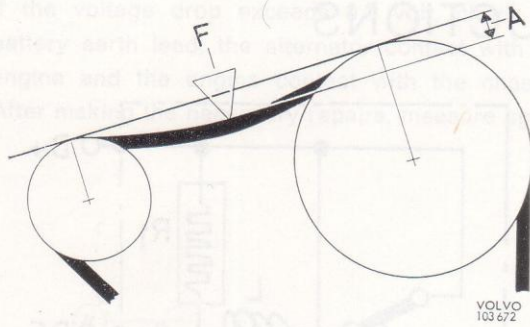


Fig. 64. Checking the belt tension

F = 5.6—7.6 kp (12—17 lb.) A = 10 mm (approx. 3/8")

### FITTING THE ALTERNATOR

1. Install the alternator and fit the fan belt at the same time.
2. Fit the attaching bolts and tensioning iron without tightening it.
3. Adjust the belt tension and secure the alternator. (The belt tension is correct when the belt is pressed in between the alternator pulley and water pump pulley 10 mm (approx. 3/8") using a force of 5.6—7.6 kp (12—17 lb.).)

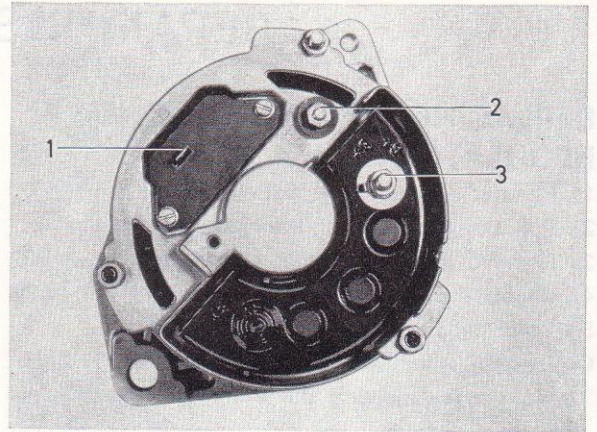


Fig. 65. Alternator terminals

1. DF To field winding
2. 61/D+ From magnetizing rectifier
3. B+ To battery

N.B. Force may only be applied to the front end of the alternator when adjusting the belt tension.

4. Re-fit the leads to the alternator.
5. Re-fit the negative lead to the battery.

## VOLTAGE REGULATOR DESCRIPTION

The voltage regulator is mounted on the right wheel arch by means of two screws. It is a mechanical, single-pole voltage regulator with a lower contact, a movable contact and an upper contact, see Fig. 70. It is connected to the charging circuit by means of a three-pole plug. The regulator resistance is placed under a plate underneath the regulator. Temperature compensation is operated by a bimetal spring which influences the spring tension so that the regulator receives lower regulating voltage at higher temperatures.

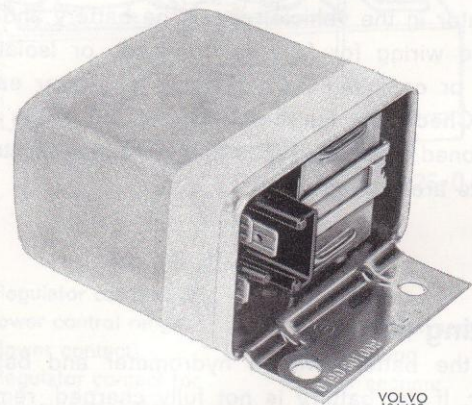


Fig. 66. Voltage regulator



## REPAIR INSTRUCTIONS

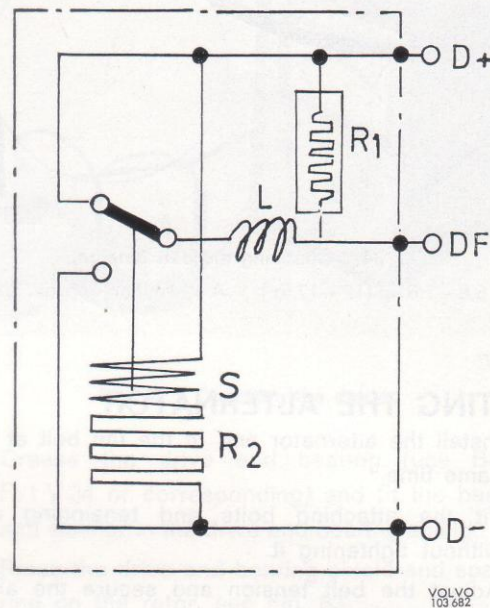
### REPLACING THE VOLTAGE REGULATOR

1. Remove the negative battery lead.
2. Pull the plug out of the voltage regulator.
3. Remove the screws and change the regulator.
4. Fit on the new regulator and insert the plug.
5. Re-fit the negative battery lead.

Concerning regulator adjustment, see under "Testing and adjusting the voltage regulator".

Fig. 67. Inner wiring of voltage regulator

S	Voltage winding 35 $\Omega$
R <sub>1</sub>	Regulator resistance 2.45 $\Omega$
R <sub>2</sub>	Compensation resistance 50 $\Omega$
L	Contact impedance coil



VOLVO  
103 682

## TESTING THE ALTERNATOR AND VOLTAGE REGULATOR

For all testing of the alternator equipment, fixed clamps should be used. So-called crocodile clamps should not be used as they have a certain tendency to loosen. A loose lead can result in the alternator and regulator being damaged. Disconnect the battery before connecting up any instruments.

### TESTING THE ALTERNATOR CIRCUIT

Before carrying out any tests on the alternator or regulator in the vehicle, check the battery and the vehicle wiring for fault in the leads or isolation, loose or corroded lead terminals and poor earthing. **Check the fan belt.** Any of the faults just mentioned must be repaired before the electrical checks are started.

### Testing the battery

Test the battery with a hydrometer and battery tester. If the battery is not fully charged, remove it from the car and charge it or replace it with a

new one if necessary. A fully charged battery which is otherwise in good condition should always be used when testing.

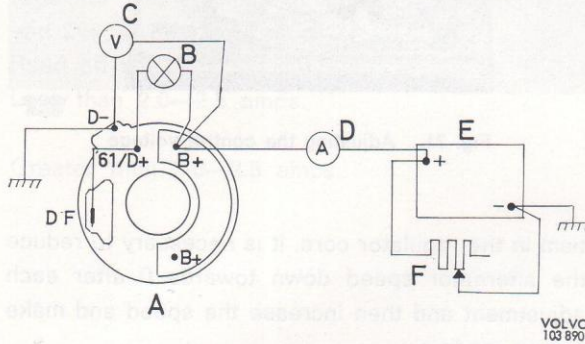
### Checking the voltage drop

This test is made to check the leads between the alternator and the battery and also the battery earth lead. The test should be carried out with a fully charged battery in good condition. The battery connections should be well cleaned and tightened.

Load the alternator with about 10 amps. Suitable load: Mainbeam lights switched on. With the engine running and the alternator supplying 10 amps, measure with a suitable voltmeter the voltage between the positive pole of the battery and B+ on the alternator. If the voltage drop at this test exceeds 0.3 volt, there must be a fault in the cable or contact, which must be remedied immediately. After repairing the faulty leads or contacts, measure once again. With the same load as above, measure the voltage drop between the negative pole of the battery and the alternator terminal D-. Here the voltage drop must not exceed 0.2 volt.



If the voltage drop exceeds 0.2 volt, check the battery earth lead, the alternator contact with the engine and the engine contact with the chassis. After making the necessary repairs, measure again.



**Fig. 68. Wiring diagram for testing alternator**

- |                                   |                           |
|-----------------------------------|---------------------------|
| A. Alternator                     | D. Ammeter 0—50 amps      |
| B. Control lamp 12 volts, 2 watts | E. Battery 60 ampèrehours |
| C. Voltmeter 0—20 volts           | F. Load resistance        |

## TESTING THE ALTERNATOR

(In a test bench or in the vehicle)

Connect up the alternator as shown in Fig. 68. Run it to a speed of 6000 r.p.m. (Regulate the voltage to about 14 volts by means of the load resistance F.)

The alternator should produce 35 amps at 6000 r.p.m. and a voltage of 14 volts.

At the same time check to make sure that the charging warning lamp does not light or glow.

If the alternator does not meet the above requirements first check the brushes and diodes.

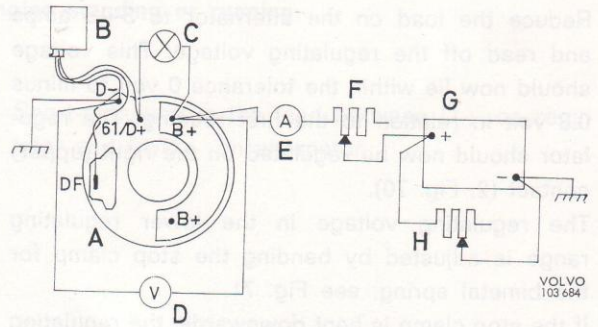
## TESTING AND ADJUSTING THE VOLTAGE REGULATOR

(In a test bench or in the vehicle)

Connect up the regulator to an alternator in good condition as shown in Fig. 69.

Run the alternator to a speed of 4000 r.p.m. (engine speed 2000 r.p.m.). Load the alternator with about 28—30 amps.

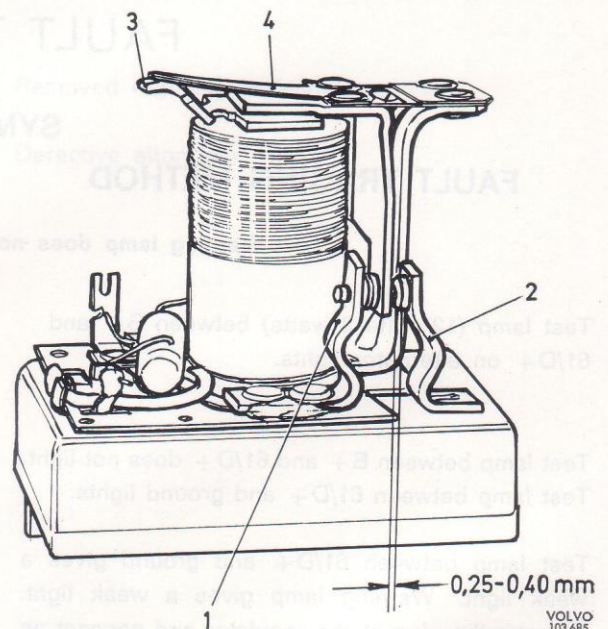
Rapidly lower the alternator speed to about 1000 r.p.m. (in vehicle, idling speed), raise the speed again to 4000 r.p.m. (engine speed 2000 r.p.m.) and adjust the load to about 28—30 amps. Read



**Fig. 69. Wiring diagram for testing voltage regulator**

- |                                   |                           |
|-----------------------------------|---------------------------|
| A. Alternator                     | E. Ammeter 0—50 amps      |
| B. Voltage regulator              | F. Regulating resistance  |
| C. Control lamp 12 volts, 2 watts | G. Battery 60 ampèrehours |
| D. Voltmeter 0—20 volts           | H. Load resistance        |

off the voltmeter. The voltage should be 14.0—15.0 volts and the regulator should be regulated on the left (lower) contact (1, Fig. 70). The reading should be made within 30 seconds after the test has begun.



**Fig. 70. Voltage regulator**

- |  |  |
|--|--|
| 1. Regulator contact for lower control range (lower contact) | 3. Stop arm  |
| 2. Regulator contact for upper control range (upper contact) | 4. Spring upper section: Steel spring<br>Lower section: Bimetal spring |



Reduce the load on the alternator to 3—8 amps and read off the regulating voltage. This voltage should now lie within the tolerance 0 volt to minus 0.3 volt in relation to the first reading. The regulator should now be regulated on the right (upper) contact (2, Fig. 70).

The regulating voltage in the lower regulating range is adjusted by bending the stop clamp for the bimetal spring, see Fig. 71.

If the stop clamp is bent downwards, the regulating voltage should drop, if bent upwards the opposite should be the effect. If the regulating voltage in the upper regulating range is too high or too low in relation to the lower regulating range (0 volt to minus 0.3 volt) this is adjusted by bending the holder for the left (lower) contact and correcting at the same time the gap between the right (upper) contact and the movable contact according to Fig. 70.

If the holder is bent towards the right (upper) contact, the regulating voltage in the upper regulating range will drop.

To avoid faulty adjustments due to residual magne-

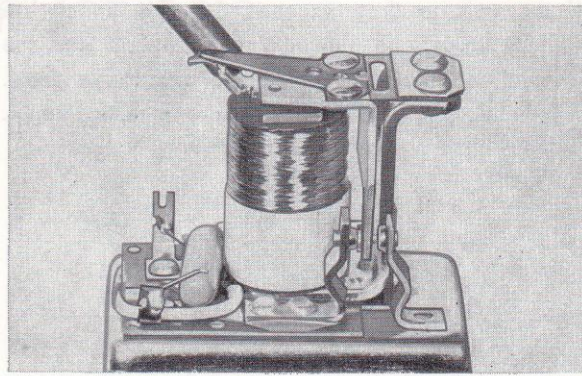
VOLVO  
103 696

Fig. 71. Adjusting the control voltage

tism in the regulator core, it is necessary to reduce the alternator speed down towards 0 after each adjustment and then increase the speed and make a new reading.

(If the adjusting is comprehensive and the regulator is warm, it can be suitably cooled to ambient temperature by means of compressed air before the final reading is made.)

## FAULT TRACING

### SYMPTOM

#### FAULT TRACING METHOD

#### FAULT

**Warning lamp does not light with engine off.**

Test lamp (12 volts 2 watts) between B+ and 61/D+ on alternator lights.

Test lamp between B+ and 61/D+ does not light.  
Test lamp between 61/D+ and ground lights.

Test lamp between 61/D+ and ground gives a weak light. Warning lamp gives a weak light.  
Remove the plug at the regulator and connect an ammeter between B+ and DF on the alternator. The ammeter shows: 0 amp.

2.0—2.5 amps.

Warning lamp burnt out or break in its circuit to D+ on regulator.

Short-circuiting in a positive diode.

Worn brushes, oxide on slip rings or breakage in rotor winding.

Breakage in regulator or in lead DF from regulator to DF on alternator.







GROUP 33  
STARTER MOTOR  
TOOLS

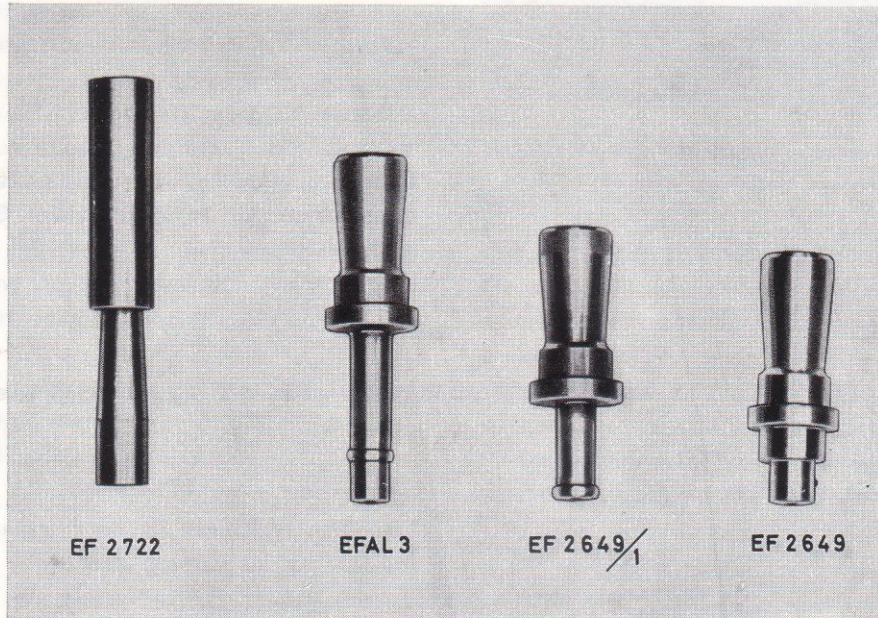


Fig. 72. Bosch special tools for starter motor (late prod.)

- |           |                                      |
|-----------|--------------------------------------|
| EF 2722   | Sleeve and drift for fitting circlip |
| EFAL 3    | Smoothing drift                      |
| EF 2649/1 | Smoothing drift                      |
| EF 2649   | Drift for fitting bush               |

## DESCRIPTION

The starter motor, Figs. 73 and 74, is mounted on the flywheel housing on the left-hand side of the engine. It consists of a four-pole series-wound motor. The driving collar on the starter motor rotor shaft moves axially to engage with the flywheel ring gear. The driving collar is controlled by a solenoid.

Turning the ignition key to the starting position cuts in the solenoid causing the armature in the solenoid to be drawn in and the driving collar to engage the ring gear on the engine flywheel. When the solenoid's armature has moved a certain distance, the contacts for the main current close and the starter motor starts running.



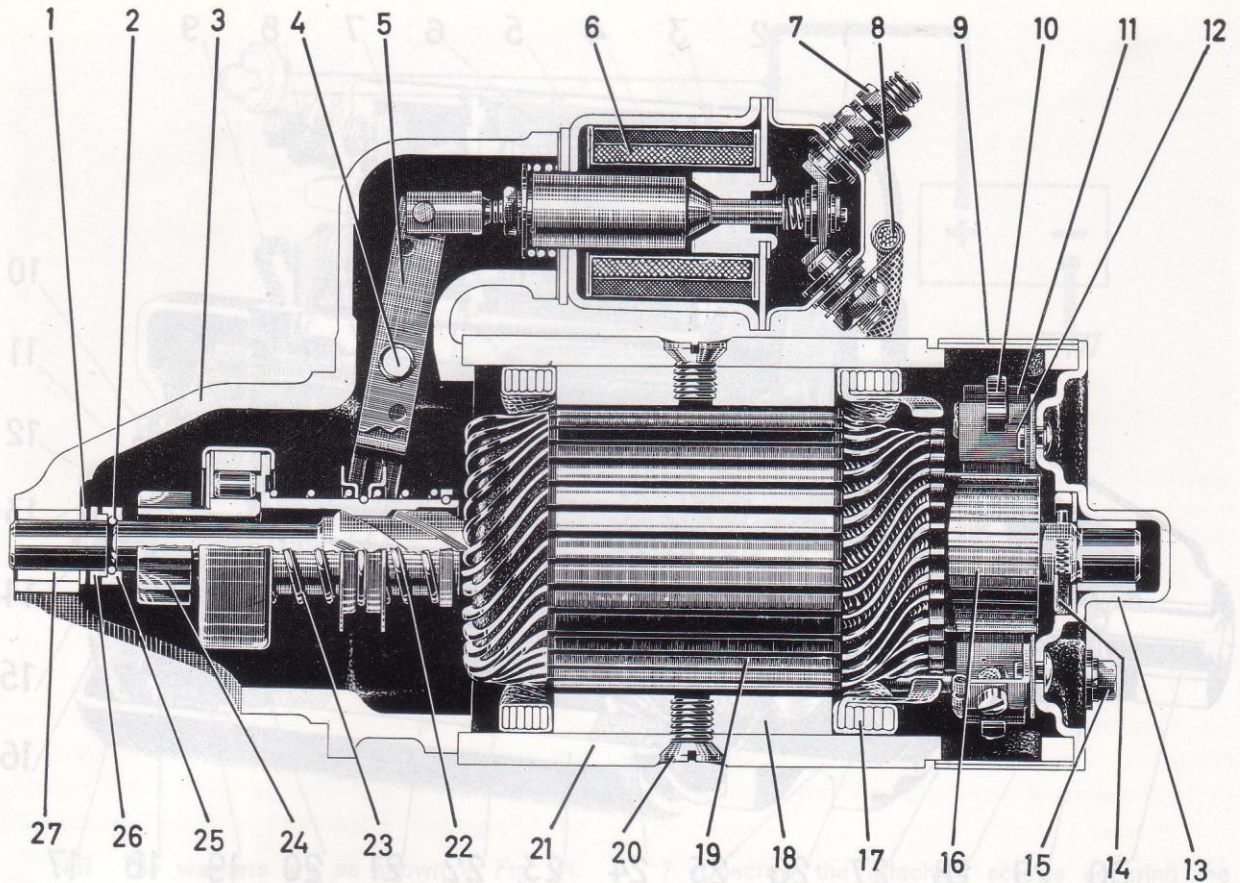
VOLVO  
26555

Fig. 73. Starter motor, early prod.

- |                              |                            |                  |
|------------------------------|----------------------------|------------------|
| 1. Adjusting washer          | 10. Brush spring           | 19. Rotor        |
| 2. Circlip                   | 11. Brush                  | 20. Pole stud    |
| 3. Drive end bearing bracket | 12. Brush holder           | 21. Pole housing |
| 4. Shaft                     | 13. Commutator end bracket | 22. Spring       |
| 5. Engaging arm              | 14. Rotor brake            | 23. Drive        |
| 6. Solenoid switch           | 15. Bolt                   | 24. Drive        |
| 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         |

## REPAIR INSTRUCTIONS

### REMOVING

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

### DISMANTLING THE STARTER MOTOR, early prod.

1. Remove the protecting band.
2. Lift the springs for the brushes and pull up the brushes, see Fig. 78.
3. Make line-up marks for the drive bearing and commutator bearing brackets to ensure that they are re-fitted in the same place during assembling.



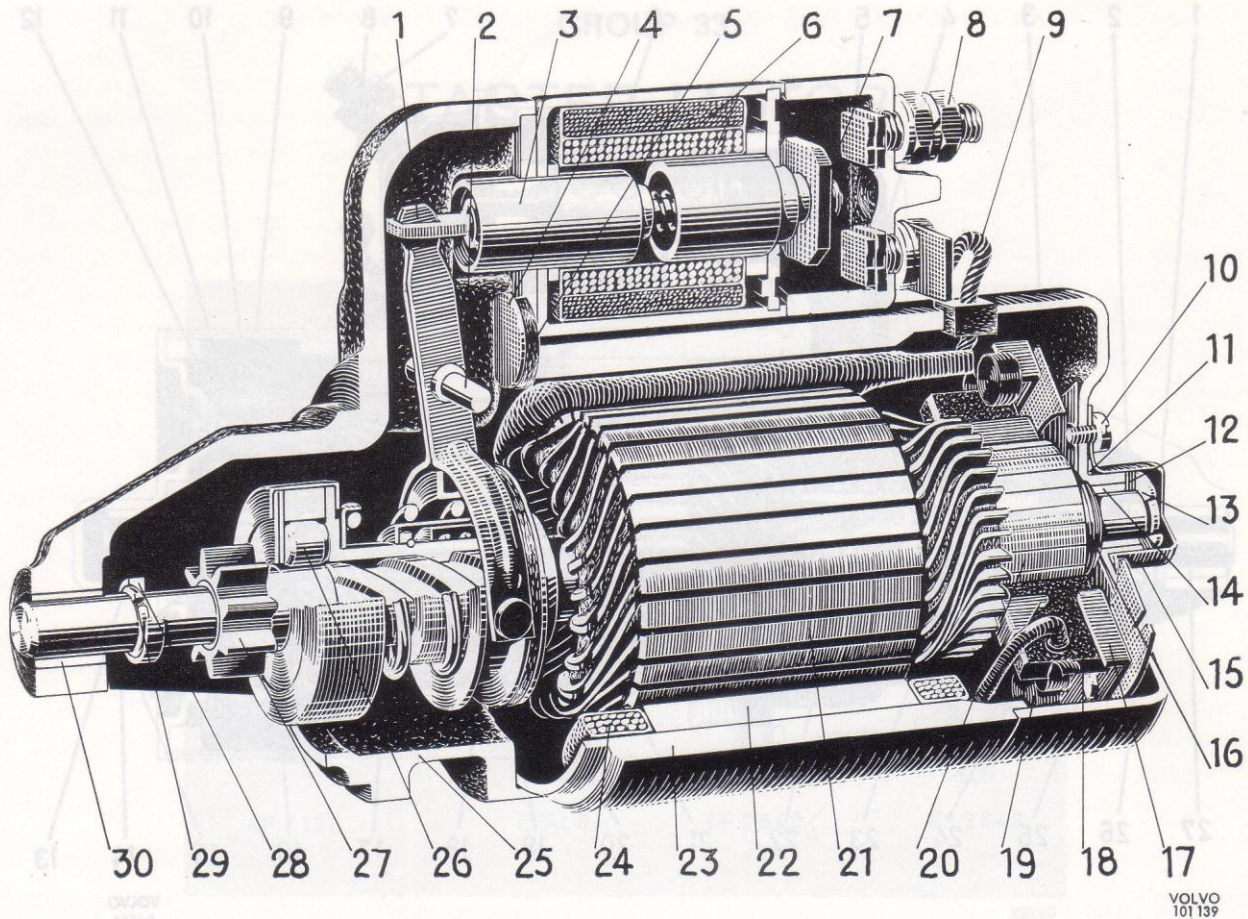


Fig. 74. Starter motor, late prod.

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

4. Remove the bolts holding the starter motor together. Lift off the bearing bracket with rotor brake, also the housing after the cable between the control solenoid and housing has been disconnected.
5. Lift the rotor with drive out of the drive housing. See Fig. 79. This can be done after the pivot bolt for the solenoid switch fork has been screwed loose.
6. Remove the stop washer on the rotor shaft. The thin washers (axial adjusting washers) and the washer (3, Fig. 80) are lifted out by drawing them straight out on the shaft. The thick washer (1, Fig. 80), is first tapped in 5—8 mm (1/4") on the shaft so that the circlip (2, Fig. 80) can be removed, after which the washer can be drawn off the shaft.

7. Remove the rotor brake from the commutator bearing bracket.

### DISMANTLING THE STARTER MOTOR, late prod.

1. Remove the small cover on the front end of the shaft.
2. Lift off the lock washer and adjusting washers as shown in Figs. 81 and 82.
3. Remove the two bolts holding the commutator bearing shield and remove the shield.
4. Lift up the brushes.
5. Remove the brush gear from the rotor shaft.



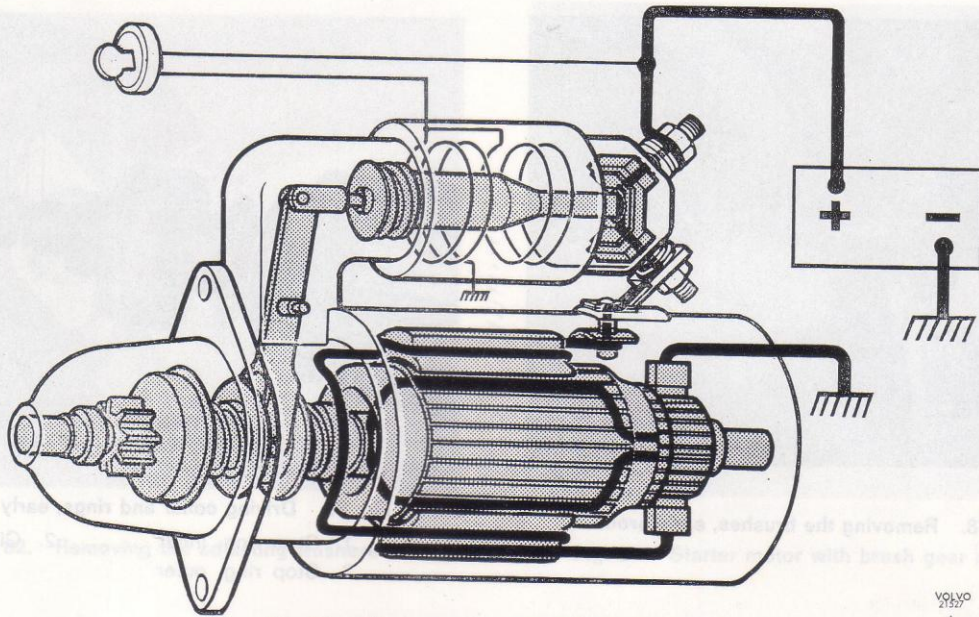


Fig. 75. Starter motor, general arrangement

N.B. The washers are as shown in Fig. 84. When the brush gear is removed, the negative brushes also follow, but the positive ones will remain in the field winding.

6. Unscrew the nut holding the field terminal connection to the control solenoid.

7. Unscrew the attaching screws securing the solenoid to the drive end shield. Remove the solenoid.

8. Remove the drive end shield and rotor from the stator.

9. Remove the rubber washer and metal washer, see Fig. 86.

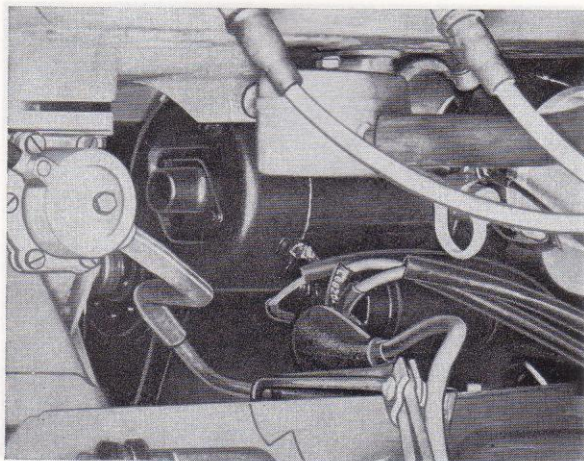


Fig. 76. Starter motor installed

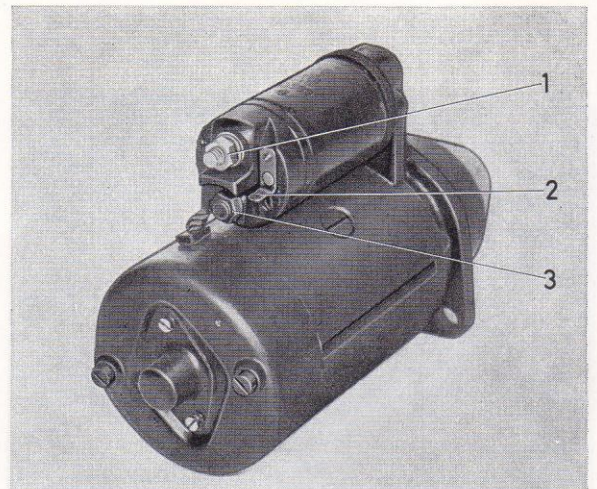


Fig. 77. Starter motor terminals, late prod.

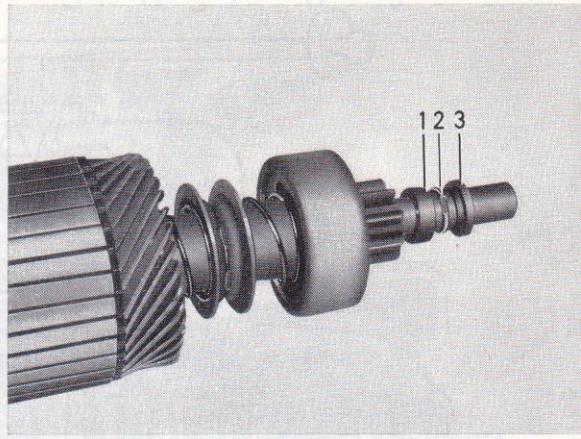
- 1. From battery
- 2. From ignition switch
- 3. To field winding





VOLVO  
24808

Fig. 78. Removing the brushes, early prod.



VOLVO  
24806

Fig. 80. Driving collar and rings, early prod.

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

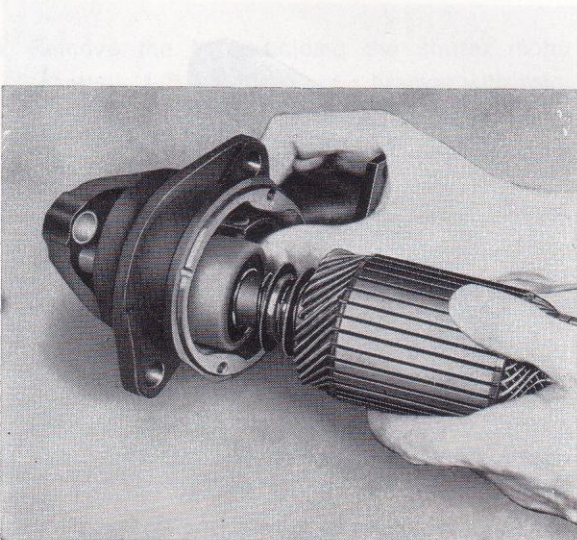
- 10. Remove the screw which carries the engaging arm.
- 11. Lift the rotor with pinion and lever out of the drive end shield.
- 12. Knock back the stop washer and remove the circlip on the rotor shaft.
- 13. Remove the stop washer and pull off the starter pinion.

If the rotor shaft is bent or worn, the rotor must be replaced. If the commutator is scored or unevenly worn, it should be turned. The commutator diameter must not be less than 33 mm (1.3").

The commutator should be checked with a dial gauge after being turned. A radial throw of 0.08 mm (0.003") may be considered permissible. The isolation between the laminations should be milled down to 0.4 mm (0.016") below the surface of the laminations, see Figs. 88 and 89. This work is carried out in a special apparatus, or if such 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

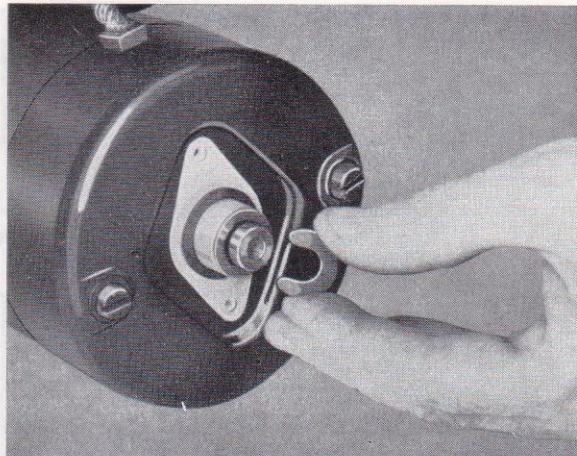
**INSPECTING**

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



VOLVO  
24801

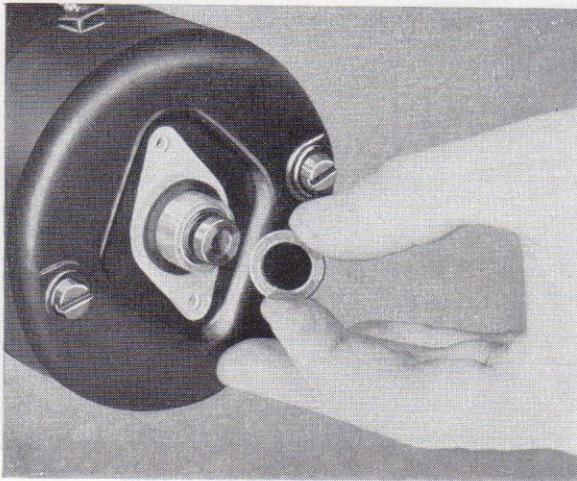
Fig. 79. Removing collar and rotor, early prod.



VOLVO  
101 089

Fig. 81. Removing the lock washer





VOLVO  
101 087

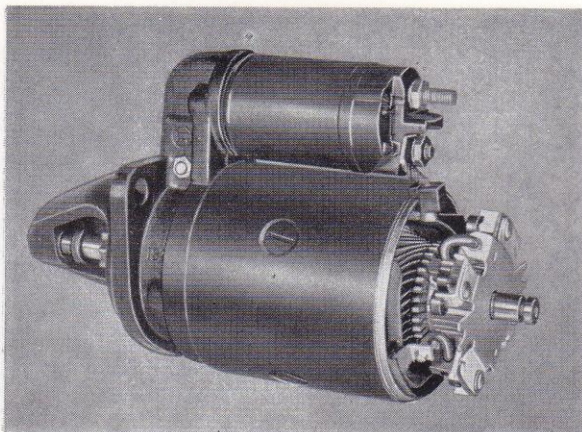
Fig. 82. Removing the adjusting washers

blade a few mm from the rotor, see Fig. 90. If the blade vibrates in any position when the rotor is rotated, one of the following points must be the reason: Flashover to the rotor frame, flashover in the commutator or between the windings.

Check the stator with a voltage of 40 volts A.C., see Fig. 91.

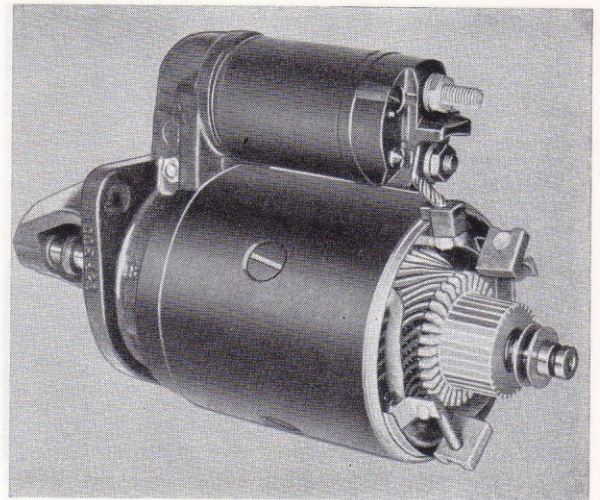
Examine the end shield with brush holders. If any of these parts are damaged or excessively worn, they must be replaced. A bearing clearance of up to 0.12 mm (0.005") may be considered permissible. Inspect the other parts and replace any that are damaged or worn. The circlip should always be

For purposes of replacement, brushes are supplied ready-machined to suitable dimensions. When being fitted, the brushes should not be machined



VOLVO  
101 084

Fig. 83. Starter motor with end shield removed



VOLVO  
101 083

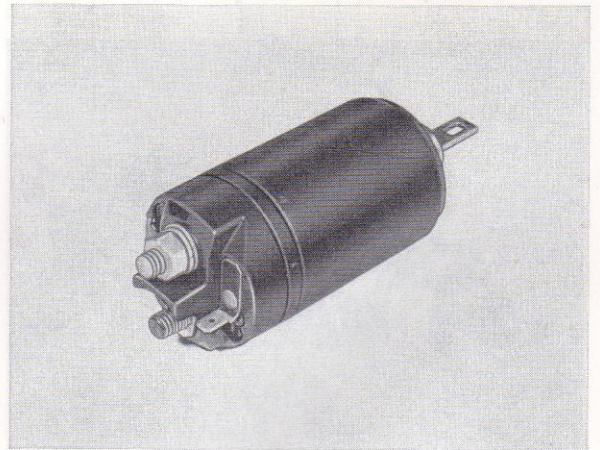
Fig. 84. Starter motor with brush gear removed

1. Drive out the worn bushes with the help of a suitable tool.

2. Clean the hole for the bushes and cut away the surplus metal. The bushes should be replaced with a new one, since when being removed it may have been damaged or lost its tension.

### CHECKING THE SOLENOID

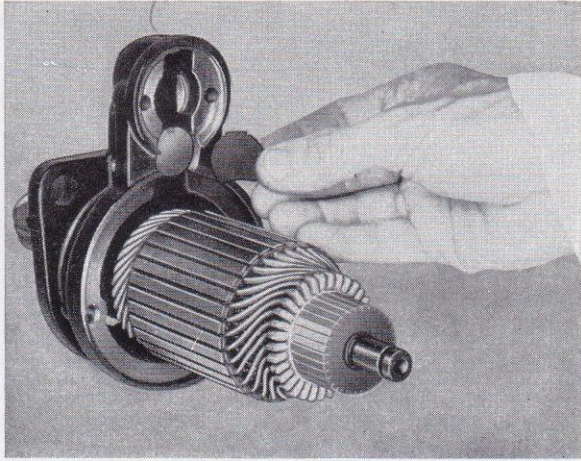
If the solenoid does not function, first check that the battery is in good condition. If there is no fault in the battery, connect a lead between the battery positive terminal and the solenoid contact for the control lead. Should the solenoid still



VOLVO  
103 272

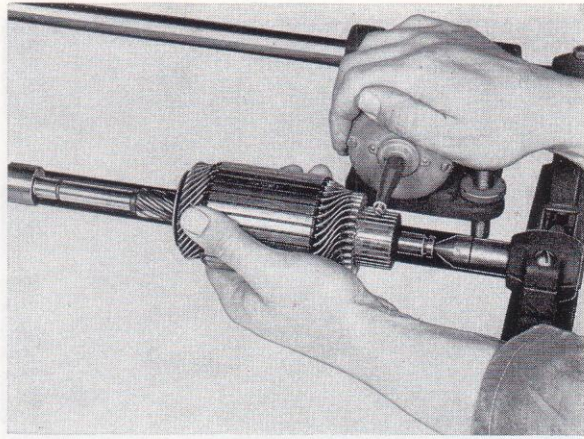
Fig. 85. Solenoid





VOLVO  
101 082

Fig. 86. Removing the sealing washer



VOLVO  
103 354

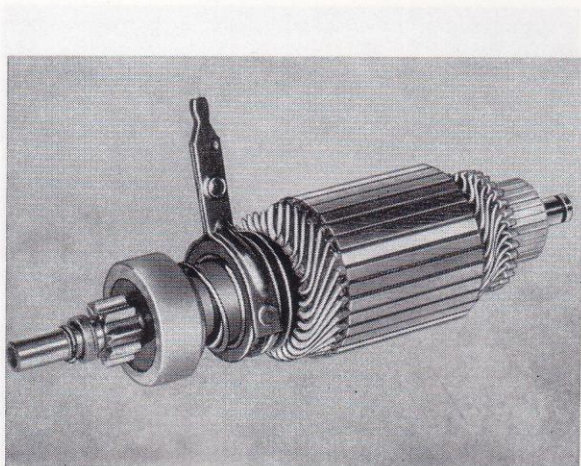
Fig. 88. Slotting the commutator

not cut-in the starter pinion and main current, it should be removed from the starter motor. If, on the other hand, it cuts-in satisfactorily, examine the starter switch and leads.

The solenoid should be wiped clean on being removed. Then press the armature in several times and test again by connecting it to a battery. If the solenoid does not function after the above measures, replace it with a new one.

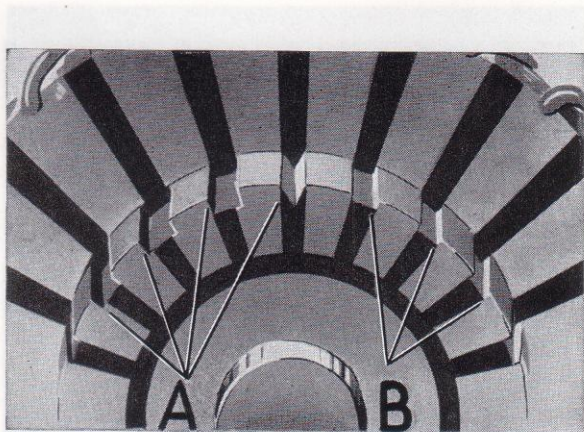
### REPLACING THE BRUSHES, late prod.

To replace the brushes, remove the starter motor and dismantle it. The brushes are soldered loose 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



VOLVO  
101 080

Fig. 87. Rotor with pinion

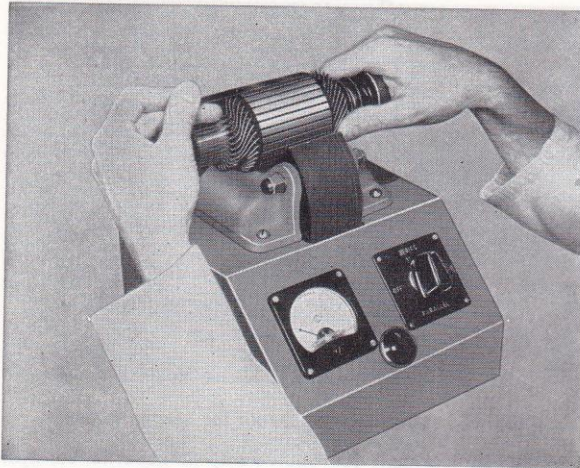


VOLVO  
21547

Fig. 89. Commutator milling

A. Incorrect milling B. Correct milling





VOLVO  
24807

Fig. 90. Testing the rotor

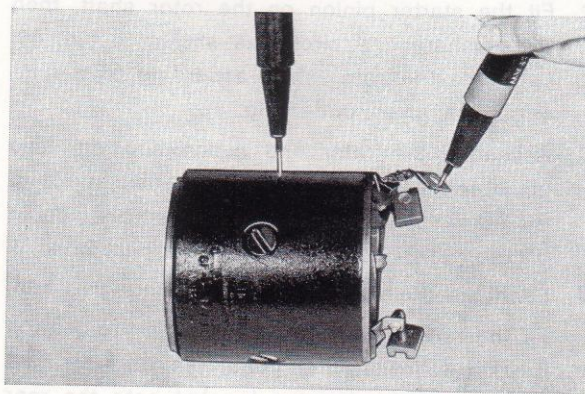
the brushes in the holders and may reduce the brush spring force.

Brushes worn down below 14 mm (approx. 1/2") should be replaced with new ones.

### REPLACING THE SELF-LUBRICATING BUSHES

The self-lubricating bushes wear slightly during operation if they are lubricated in the correct manner. If lubricating is neglected, the bushes dry out so that they seize and wear quickly.

For purposes of replacement, bushes are supplied ready-machined to suitable dimensions. When being fitted, the bushes should not be machined



VOLVO  
103 306

Fig. 91. Checking the stator

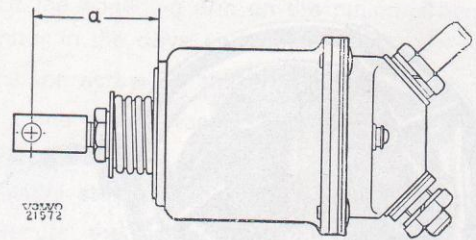
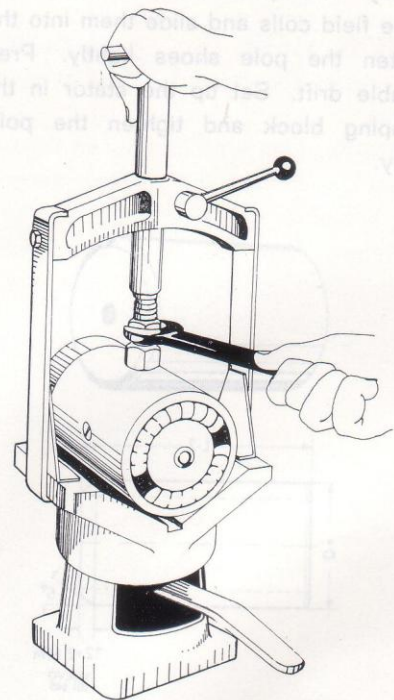


Fig. 92. Adjusting distance for solenoid lever fork

internally or externally since the pores can then be partially blocked up, resulting in reduced lubricating capacity. Replace the bushes as follows:

1. Drive out the worn bushes with the help of a suitable tool.
2. Clean the hole for the bushes and cut away any burr.
3. Press in the new bushes with the help of a suitable drift.



VOLVO  
101 064

Fig. 93. Rotary clamping block for removing field windings



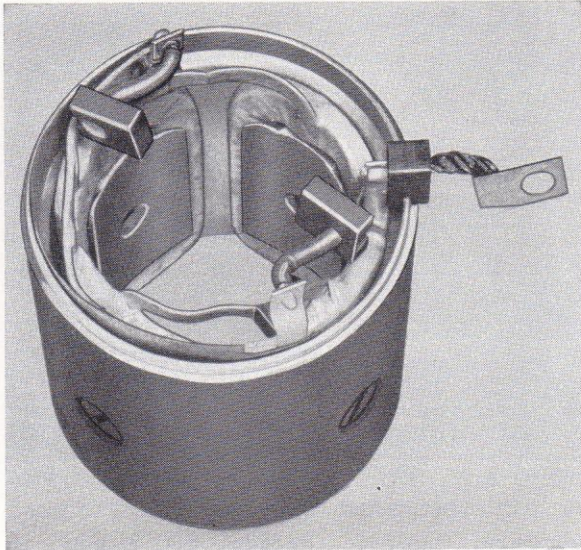


Fig. 94. Stator with soldered brushes, late prod.

## REPLACING THE FIELD WINDING

1. Dismantle the starter motor if not already dismantled. Follow the instructions under the heading "Dismantling the starter motor".
2. Mark the pole shoes and stator in a suitable way so that they can be fitted in the same position on being assembled.
3. Then place the stator in the rotary clamping block as shown in Fig. 93 (Bosch EFAL W 9) or similar and unscrew the pole screws.
4. Before fitting new field coils, warm them slightly. Then place the pole shoes in position in the field coils and slide them into the stator. Tighten the pole shoes lightly. Press in a suitable drift. Set up the stator in the rotary clamping block and tighten the pole shoes firmly.

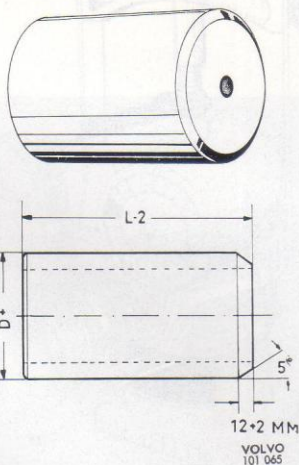


Fig. 95. Press drift for fitting field windings

$D = 66.09 - 66.04 \text{ mm (2.599 - 2.602")}$

$L = 85 \text{ mm (3.346")}$

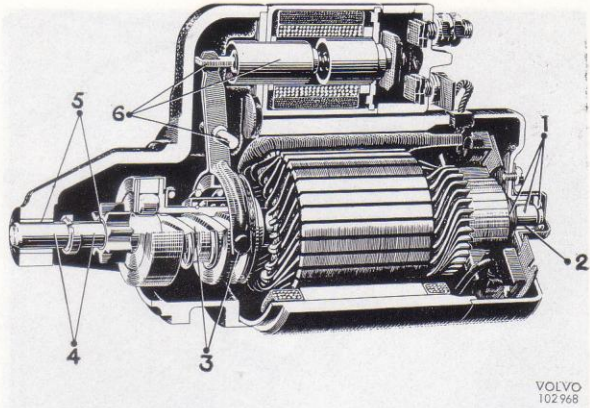


Fig. 96. Lubricating scheme for starter motor

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

1. FT 2 V 3 Place a thin layer of grease on the insulation washers, the shaft end, the adjusting washers and lock washer.
  2. OI 1 V 13 Place the bushing in oil for 1/2 hour before fitting.
  3. FT 2 V 3 Apply plenty of grease to the rotor thread and the engaging lever groove.
  4. FT 2 V 3 Apply a thin layer of grease to the rotor shaft.
  5. OI 1 V 13 Place the bushes in oil for 1/2 hour before fitting.
  6. FT 2 V 3 Lubricate the engaging lever joints and the iron core of the solenoid with a thin layer of grease.
5. Force out the press drift with a drift press. Check the fitted field winding for breakage and short-circuiting.

## ASSEMBLING THE STARTER MOTOR, early prod.

1. Fit the rotor brake in the rear bearing bracket, see Fig. 97, and the cable between the positive brushes.
2. Fit the starter pinion on the rotor shaft, then the washers and circlip as shown in Fig. 80. Lubricate the rotor shaft according to the instructions given under Fig. 96.
3. Assemble the rotor and pinion housing, also place the engaging arm in its position round the starter pinion. Then fit the control solenoid on the pinion housing and fit the joint bolt.
4. Lubricate the starter pinion and engaging arm.
5. Fit the housing on the rotor and in the bearing bracket following the guide pin or mark. Fit the commutator bearing bracket onto the rear axle end of the rotor and secure it in the right



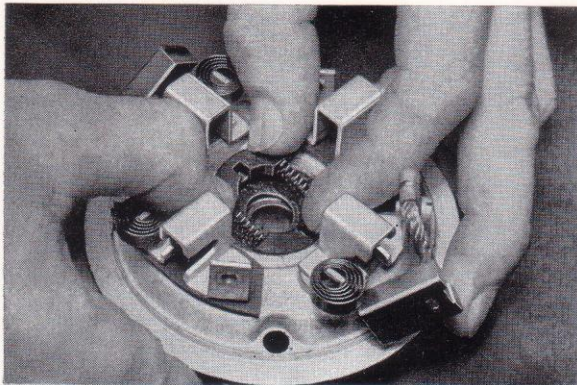


Fig. 97. Fitting the rotor brake

position with the through bolts. Rotate the motor and check that it runs easily. Measure the axial clearance and compare the value with that given in the "Specifications". Lubricate the shaft end and bush.

6. Fit the brushes and protection band.

### ASSEMBLING THE STARTER MOTOR, late prod.

1. Lubricate the starter motor parts according to Fig. 96.
2. Fit the starter pinion on the rotor shaft, fit on the stop washer as well as the circlip. Secure the stop washer in position.



3. Fit the engaging arm on the pinion. Then the rotor in the drive end shield.
4. Fit the screw for the engaging lever.
5. Fit the metal washer and rubber washer in the end shield.
6. Fit the stator on the rotor and the end shield.
7. Secure the solenoid in the engaging lever. Screw tight the solenoid.
8. Fit the washers on the rotor shaft as shown in Fig. 84.
9. Fit the brush gear in position. Mount the brushes.
10. Mount the commutator bearing shield. Screw the starter motor together with the two through bolts.
11. Fit the adjusting washers and the circlip on the shaft end. Check the axial clearance of the rotor. If necessary, adjust with the washers until the play agrees with the values in the "Specifications".
12. Screw on securely the small casing over the shaft end.

### FITTING

1. Place the starter motor in position and secure it.
2. Connect up the electric leads.
3. Fit the lead terminal on the negative pole stud of the battery.



## GROUP 34

# IGNITION SYSTEM

## DESCRIPTION

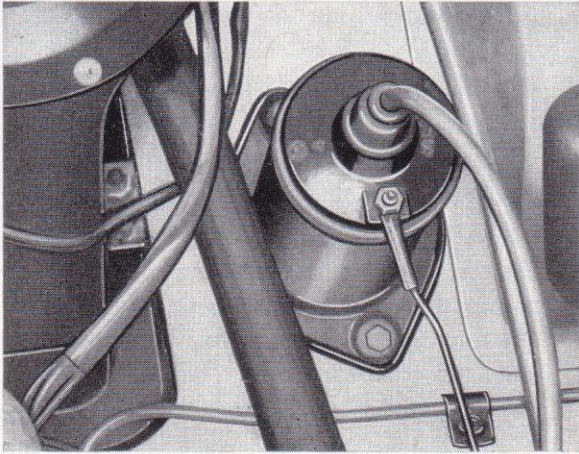


Fig. 98. Ignition coil, early prod.

VOLVO  
104 178

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

### IGNITION COIL

The ignition coil is located on the cowl, see Figs. 98 and 99.

The late prod. type was introduced from the 1969 model and combined the ignition switch with a steering wheel lock.

The early prod. type has the ignition switch joined to the ignition coil via a reinforced cable. If the coil or switch get damaged, the entire unit must be replaced.

### DISTRIBUTOR

The distributor, Figs. 100 and 101, is fitted on the left-hand side of the engine and is driven from the camshaft. The distributor setting in relation to engine speed is regulated by a centrifugal regulator fitted under the breaker plate. The adjustment in relation to loading is controlled by a vacuum regulator. (The B 18 B and D do not have a vacuum regulator.)

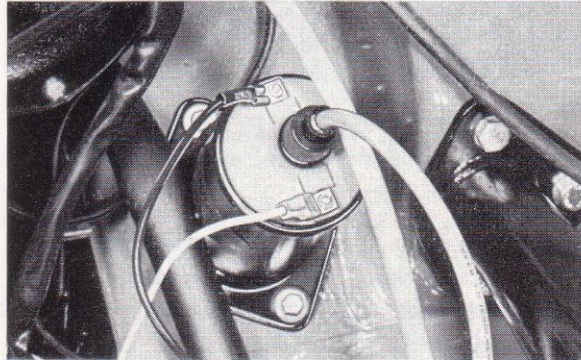


Fig. 99. Ignition coil, late prod.

VOLVO  
104 177

The vacuum regulator on the B 18 A, D and B 20 A engines raises the firing when the load on the engine reduces.

On the B 20 B engine, the vacuum regulator lowers the firing below the basic setting during idling and

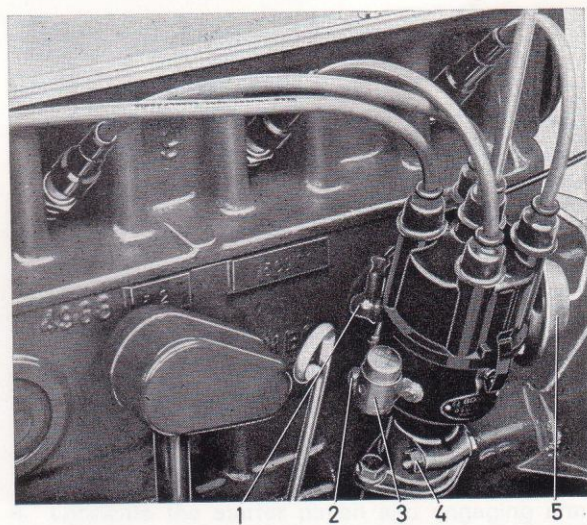
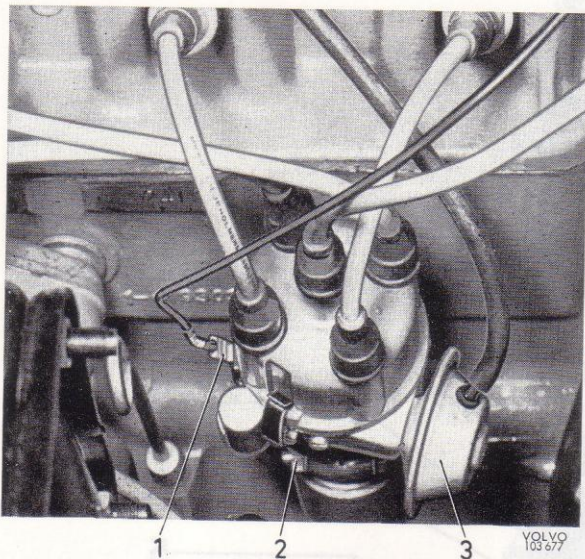


Fig. 100. Distributor B 18 A fitted

- |                       |                     |
|-----------------------|---------------------|
| 1. Primary connection | 4. Attaching screw  |
| 2. Lubricator         | 5. Vacuum regulator |
| 3. Capacitor          |                     |

VOLVO  
102 977





engine braking. Reducing the firing is part of exhaust emission control and prevents the engine from emitting excessive, noxious exhaust gases at idling and engine braking.

Fig. 101. Distributor B 20 B fitted

- |                       |                     |
|-----------------------|---------------------|
| 1. Primary connection | 3. Vacuum regulator |
| 2. Attaching screw    |                     |

## REPAIR INSTRUCTIONS

### DISTRIBUTOR

#### Removing

1. Release the lock clasps for the distributor cap and lift off the cap.
2. Remove the primary lead from the primary terminal.
3. Remove the vacuum hose from the vacuum regulator. (When removing the hose from the bakelite connection, observe great care not to break the connection.)
4. Slacken the screw (2, Fig. 101) and pull up the distributor.

#### Dismantling

1. Pull off the distributor arm.  
Remove the circlip for the pull rod from the vacuum regulator.  
Remove the vacuum regulator. (Not on B 18 B-distributor, late prod.)

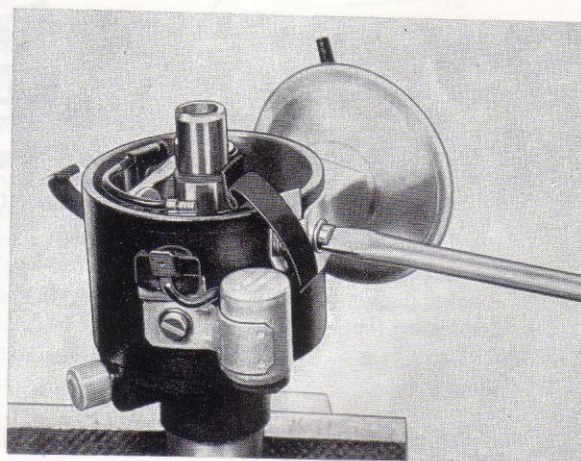
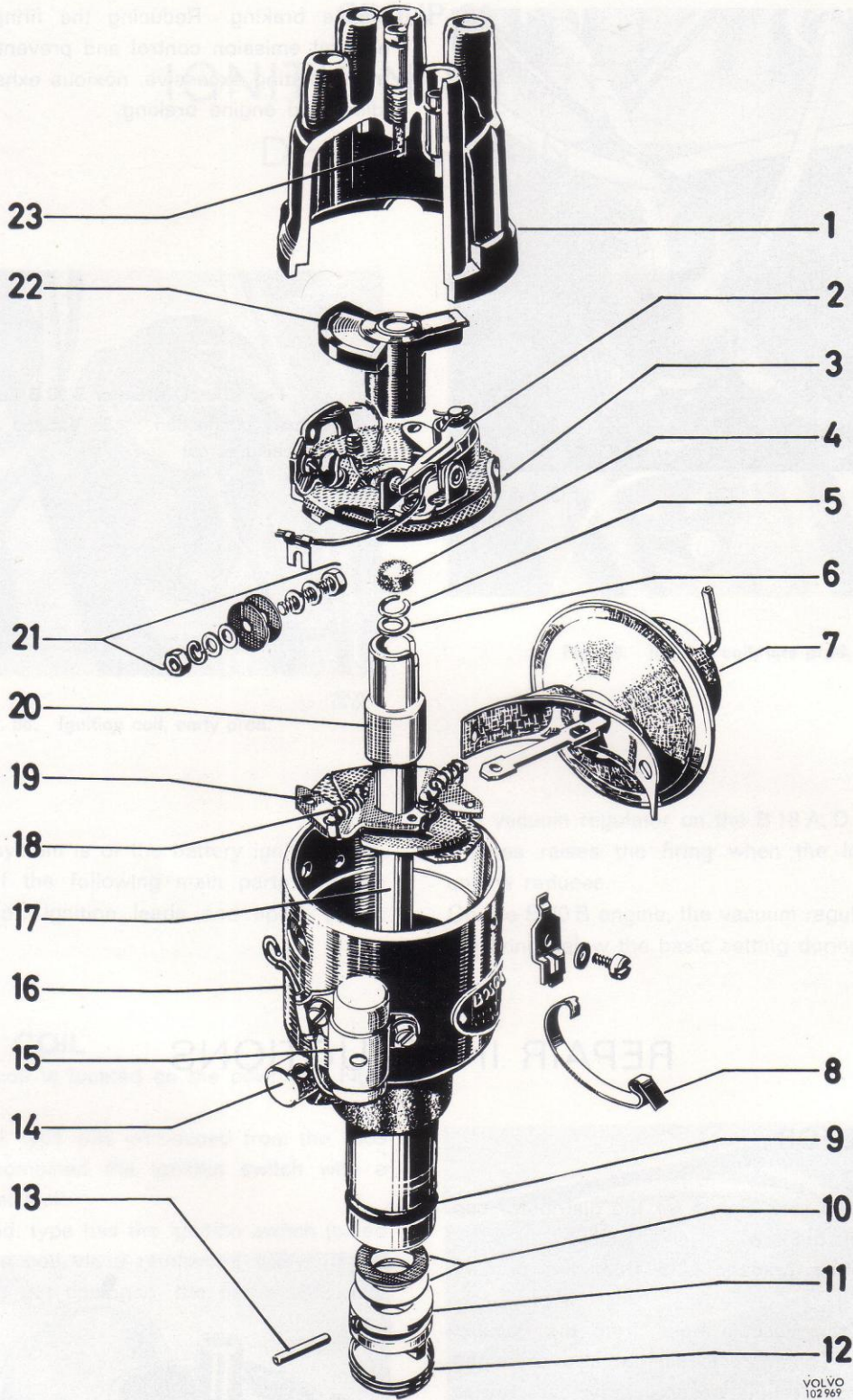


Fig. 102. Removing the vacuum regulator, B 20 B





VOLVO  
102969

Fig. 103. Distributor, B 18 A

- |                     |                     |                                  |                        |
|---------------------|---------------------|----------------------------------|------------------------|
| 1. Distributor cap  | 7. Vacuum regulator | 13. Lock pin                     | 19. Centrifugal weight |
| 2. Contact breaker  | 8. Cap clasp        | 14. Lubricator                   | 20. Breaker cam        |
| 3. Breaker plate    | 9. Rubber washer    | 15. Capacitor                    | 21. Primary connection |
| 4. Lubricating felt | 10. Washers         | 16. Distributor housing          | 22. Distributor arm    |
| 5. Circlip          | 11. Driving collar  | 17. Distributor shaft            | 23. Rod brush (carbon) |
| 6. Washer           | 12. Resilient ring  | 18. Centrifugal regulator spring |                        |



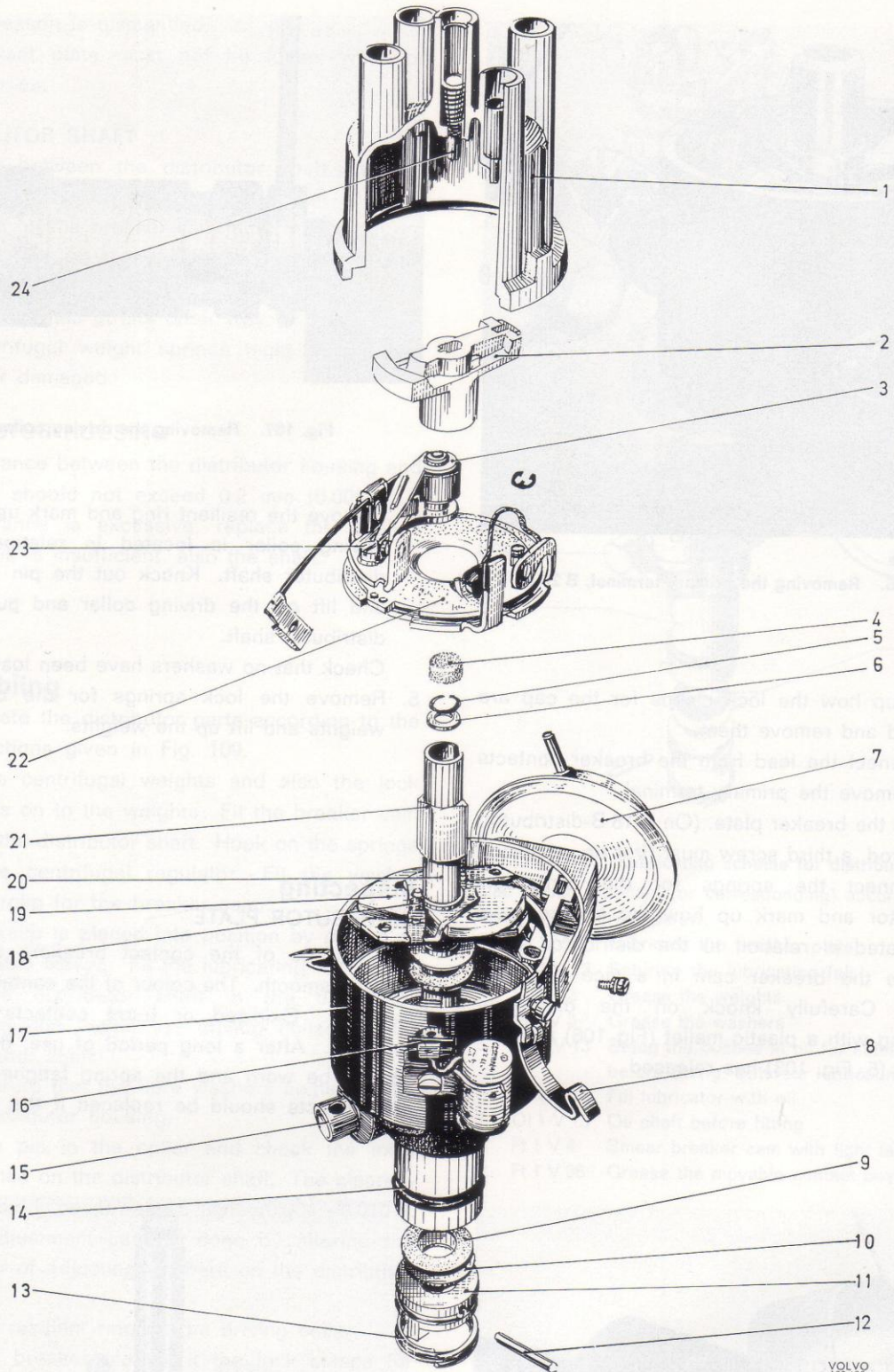


Fig. 104. Distributor, B 20 B

- |                     |                    |                                     |                                     |
|---------------------|--------------------|-------------------------------------|-------------------------------------|
| 1. Distributor cap  | 8. Cap clasp       | 15. Lubricator                      | 21. Breaker cam                     |
| 2. Distributor arm  | 9. Fibre washer    | 16. Primary connection to capacitor | 22. Breaker plate                   |
| 3. Contact breaker  | 10. Steel washer   | 17. Distributor housing             | 23. Lock screw for breaker contacts |
| 4. Lubricating felt | 11. Driving collar | 18. Centrifugal regulator spring    | 24. Rod brush (carbon)              |
| 5. Circlip          | 12. Lockpin        | 19. Centrifugal weight              |                                     |
| 6. Washer           | 13. Resilient ring | 20. Breaker camshaft                |                                     |
| 7. Vacuum regulator | 14. Rubber seal    |                                     |                                     |

VOLVO  
103 288



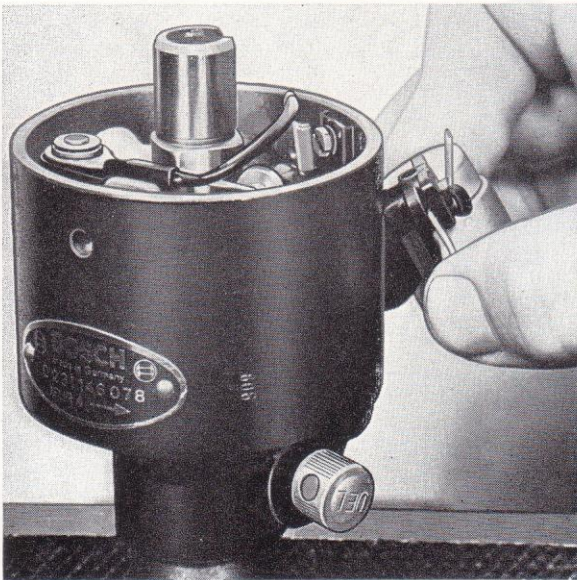


Fig. 105. Removing the primary terminal, B 20 B

2. Mark up how the lock clasps for the cap are located and remove them.  
Disconnect the lead from the breaker contacts and remove the primary terminal.  
Lift up the breaker plate. (On B 18 B-distributor, late prod. a third screw must first be released.)
3. Disconnect the springs for the centrifugal regulator and mark up how the breaker cam is located in relation to the distributor shaft. Secure the breaker cam in a vice with soft jaws. Carefully knock on the distributor housing with a plastic mallet (Fig. 106) until the circlip (5, Fig. 103) has released.

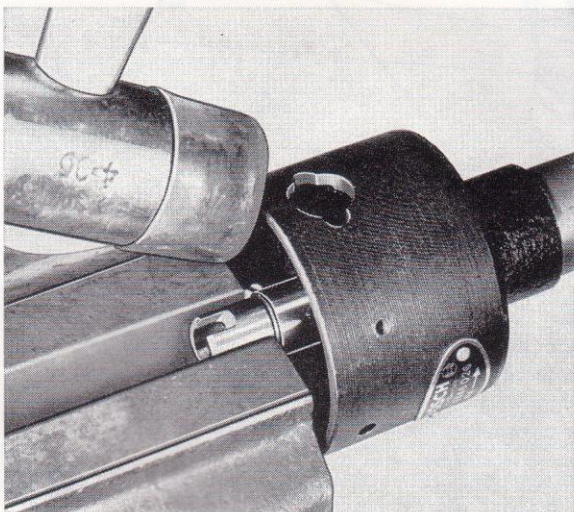


Fig. 106. Removing the circlip

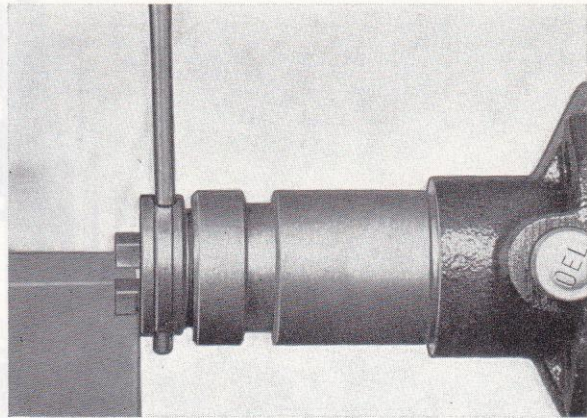


Fig. 107. Removing the driving collar

4. Remove the resilient ring and mark up how the driving collar is located in relation to the distributor shaft. Knock out the pin (Fig. 107) and lift off the driving collar and pull up the distributor shaft.  
Check that no washers have been lost.
5. Remove the lock springs for the centrifugal weights and lift up the weights.

### Inspecting DISTRIBUTOR PLATE

The surface of the contact breakers 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 contacts should be replaced if the distributor

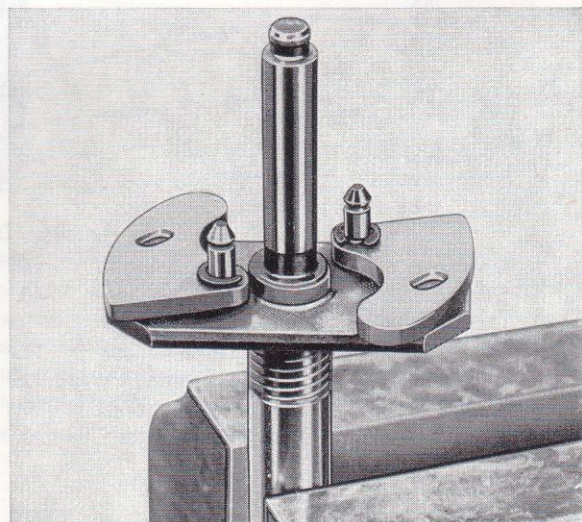


Fig. 108. Distributor shaft with centrifugal weights, B 18



for any reason is dismantled. The contact plate must not be loose, worn or have burr on.

### DISTRIBUTOR SHAFT

The play between the distributor shaft and the breaker cam must not exceed 0.1 mm (0.004"). The cams on the breaker cam must not be scored or worn down so that the dwell angle is altered. The holes in the centrifugal weights must not be oval or deformed in any other way. The centrifugal weight springs must not be deformed or damaged.

### DISTRIBUTOR HOUSING

The clearance between the distributor housing and the shaft should not exceed 0.2 mm (0.008"). If the clearance is excessive, replace the bushes and, if this is insufficient, also the shaft.

### Assembling

1. Lubricate the distributor parts according to the instructions given in Fig. 109.
2. Fit the centrifugal weights and also the lock springs on to the weights. Fit the breaker cam on to the distributor shaft. Hook on the springs for the centrifugal regulator. Fit the washer and circlip for the breaker cam. The circlip is placed into position by means of a suitable sleeve. Fit the lubricating felt.
3. Fit the distributor shaft in the distributor housing and install the driving collar on the distributor shaft.

Make sure that the fibre washers come against the distributor housing.

Fit the pin in the collar and check the axial clearance on the distributor shaft. The clearance should be 0.1—0.25 mm (0.004—0.010"). Any adjustment can be done by altering the number of adjusting washers on the distributor shaft.

Fit the resilient ring on the driving collar.

4. Fit the breaker plate. Fit the lock clasps for the cap. Fit the primary terminal and connect the lead from the breaker contacts.
5. Fit the vacuum regulator and connect the pull rod to the breaker plate.
6. Check that the breaker contacts are mounted correctly both horizontally and vertically.

Adjustment should be made with a suitable tool (for example Bosch EFAW 57 A), but only the fixed contact may be bent.

Wash the breaker contacts with trichlorethylene or a chemically pure gasoline.

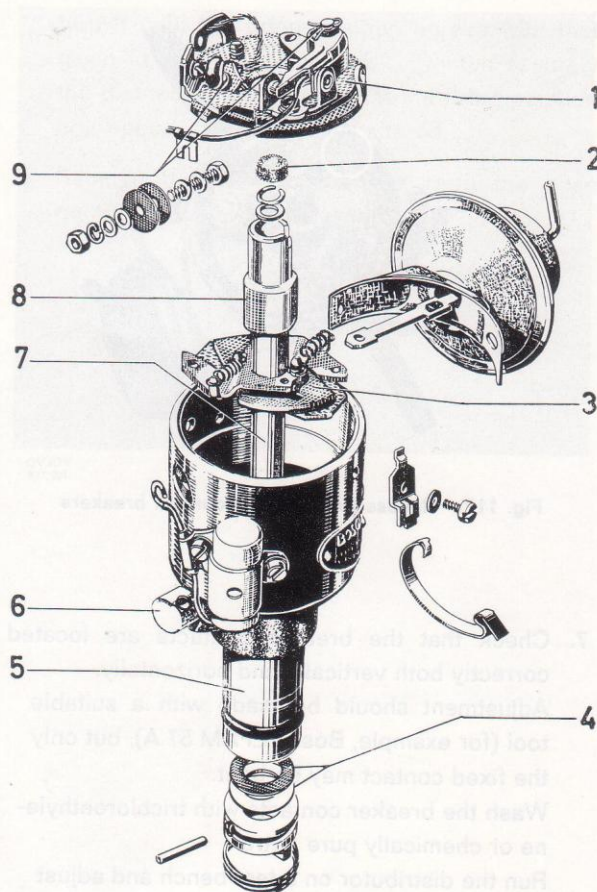


Fig. 109. Lubricating scheme for distributor

Use Bosch lubricant (or corresponding) according to the designations given below:

1. OI 1 V 2 Lubricate the breaker plate
2. OI 1 V 13 Saturate the lubricating felt
3. Ft 2 V 3 Grease the weights
4. Ft 2 V 3 Grease the washers
5. OI 1 V 13 Steep the bushes in oil for at least 1/2 hour before fitting. Saturate lubricating felt
6. OI 1 V 13 Fill lubricator with oil
7. OI 1 V 13 Oil shaft before fitting
8. Ft 1 V 4 Smear breaker cam with light layer
9. Ft 1 V 26 Grease the movable contact bush

### Replacing the breaker contacts

The breaker contact can be replaced with the distributor dismantled.

1. Remove the distributor rotor arm.
2. Remove the electric lead at the primary terminal.
3. Remove the old contacts.
4. Lubricate the distributor according to the directions given in Fig. 109.
5. Fit the new breaker contacts.
6. Connect the electric lead at the primary terminal.



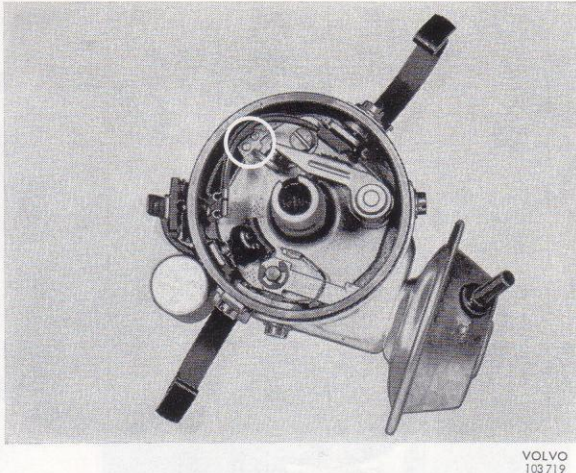


Fig. 110. Recess for adjusting contact breakers

7. Check that the breaker contacts are located correctly both vertically and horizontally. Adjustment should be made with a suitable tool (for example, Bosch EFAM 57 A), but only the fixed contact may be bent. Wash the breaker contacts with trichloroethylene or chemically pure petrol. Run the distributor on a test bench and adjust it according to the "Specifications".

### Testing the distributor in test bench

1. Run the distributor at about 500 r.p.m. in its ordinary direction of rotation (anti-clockwise) and adjust the breaker contacts dwell angle according to the "Specifications".
2. Adjust by slackening a little the screw for the breakers contact and inserting a screwdriver in the recesses, see Fig. 110. Turn the screwdriver until the dwell angle is the correct one. Then tighten the screw for the contact breakers.
3. Run the distributor and set the protractor on the test bench so that a marking comes opposite  $0^\circ$  at such a low speed (200 distributor r.p.m.) that the centrifugal regulator does not function. Increase the speed slowly and read off the values at the prescribed graduations. A newly lubricated distributor should first be run up to maximum speed several times. Permissible tolerance for the centrifugal regulator is  $\pm 1^\circ$ .
4. Run the distributor at low speed and adjust the protractor so that marking is obtained at  $0^\circ$ .

Connect the vacuum hose from the test bench to the vacuum regulator.

Increase the vacuum gradually and read off the values at the prescribed graduations.

### Fitting

1. Place the distributor in position.
2. Press the distributor downwards while turning the distributor arm at the same time. When the distributor goes down about 5 mm (3/16") and it is no longer possible to turn the rotor, the driving collar of the distributor is then in the slot on the distributor drive.
3. Turn the distributor housing so that it takes up the same position it had before removal.
4. Connect the primary lead. Fit on the distributor cap.
5. Start the engine and set the ignition. (If the engine does not start, turn the distributor housing until it does so.)

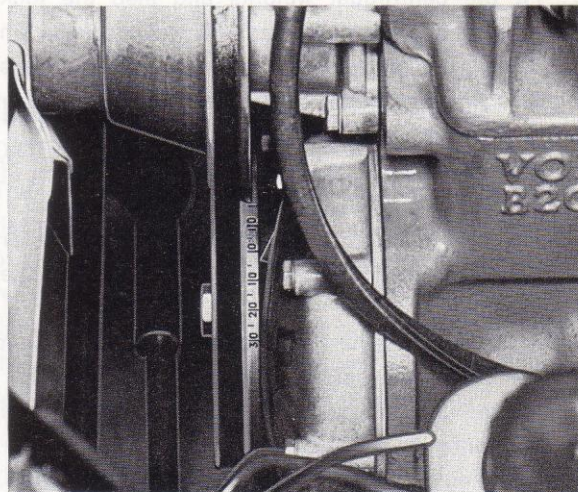


Fig. 111. Ignition timing marks

### IGNITION TIMING

The ignition timing should always be carried out while the engine is running and with the help of a stroboscope.

1. Clean the pulley so that the timing marks are visible, see Fig. 111.
2. Remove the hose from the vacuum regulator. (On the B 20 B the hose for the intake manifold should be shut off by, for example, bending it or by sealing it with a suitable plug, so that the engine does not draw in unwanted air.)



3. Connect the stroboscope to No. 1 cylinder spark plug and to the battery.
4. Start the engine and run it at the r.p.m. given in the "Specifications". Use a tachometer for this purpose.  
Aim the stroboscope at the graduations on the pulley. Slacken the distributor (2, Fig. 101) and turn it until the firing position agrees with that given in the "Specifications". Tighten securely the distributor and check that the firing position and speed have not been altered.
5. Remove the stroboscope and re-fit the hose on the vacuum regulator.

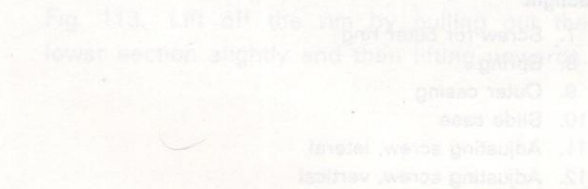


Fig. 113. Removing the distributor

**HEADLIGHTS**

**Removing**

1. Remove the cap for the headlight on the left-hand side of the car.



2. Turn the lamp bulb holder outwards.
3. Turn the lamp bulb holder outwards.
4. Turn the lamp bulb holder outwards.
5. Turn the lamp bulb holder outwards.
6. Turn the lamp bulb holder outwards.
7. Turn the lamp bulb holder outwards.
8. Turn the lamp bulb holder outwards.
9. Turn the lamp bulb holder outwards.
10. Turn the lamp bulb holder outwards.
11. Turn the lamp bulb holder outwards.
12. Turn the lamp bulb holder outwards.
13. Turn the lamp bulb holder outwards.

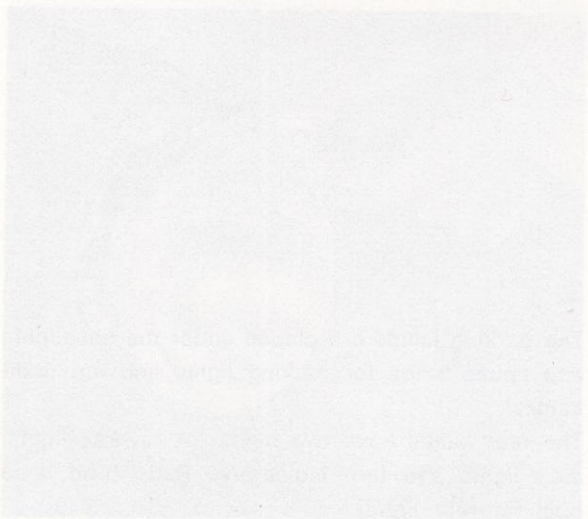


Fig. 114. Removing the holding ring

1. Attaching screw for headlight insert.
2. Fullbeam and dipped lamp.
3. Reflector.
4. Glass.



The fullbeam and dipped beam headlights are mounted in the mudguards. They are operated by the lighting switch on the instrument panel. Switching from full and dipped beam is done by means of a foot tipper on the floor.



## GROUP 35

# LIGHTING

## DESCRIPTION

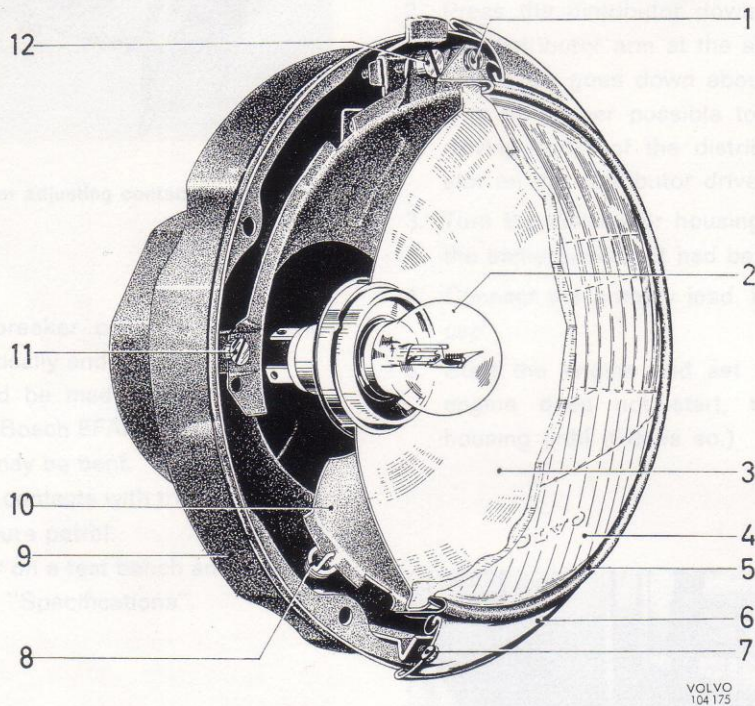


Fig. 112. Headlight

- |   |                               |
|---|-------------------------------|
| 1. Attaching screw for headlight insert   | 7. Screw for outer ring       |
| 2. Fullbeam and dipped lamp, asymmetrical | 8. Spring                     |
| 3. Reflector                              | 9. Outer casing               |
| 4. Glass                                  | 10. Slide case                |
| 5. Sealing ring                           | 11. Adjusting screw, lateral  |
| 6. Outer ring                             | 12. Adjusting screw, vertical |

The lighting consists of full- and dipped-beam headlights, flashers, parking lamps, rear lamps and licence plate light.

The full- and dipped-beam headlights are mounted in the mudguards. They are operated by the lighting switch on the instrument panel. Switching from full- and dipped-beam is done by means of a foot dipper switch in the floor.

The parking lamps are placed under the headlights and house bulbs for parking lights and turn indicators.

The rear lamps have two bulbs for reverse lights, stop lights and turn indicators. (Late prod. also bulb for rear light.)



# REPAIR INSTRUCTIONS



Fig. 113. Removing the headlight rim

VOLVO  
101 093

## HEADLIGHTS

### Removing

1. Remove the screw for the headlight rim, see Fig. 113. Lift off the rim by pulling out the lower section slightly and then lifting upwards.



Fig. 114. Removing the holding ring

VOLVO  
101 091

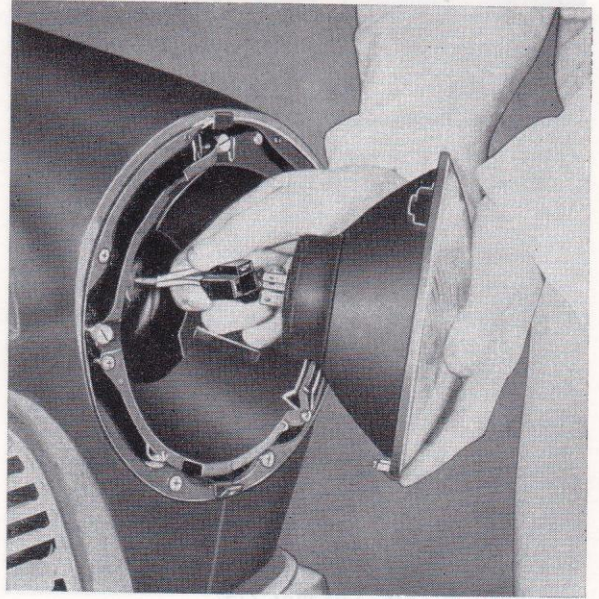


Fig. 115. Removing the connecting contact, asymmetrical headlight insert

VOLVO  
101 097

2. Slacken the screws for the holding ring for the headlight insert some turns, see Fig. 114. Turn the holder until the hooks are free from the screws and lift out the holder and insert with bulb holder.

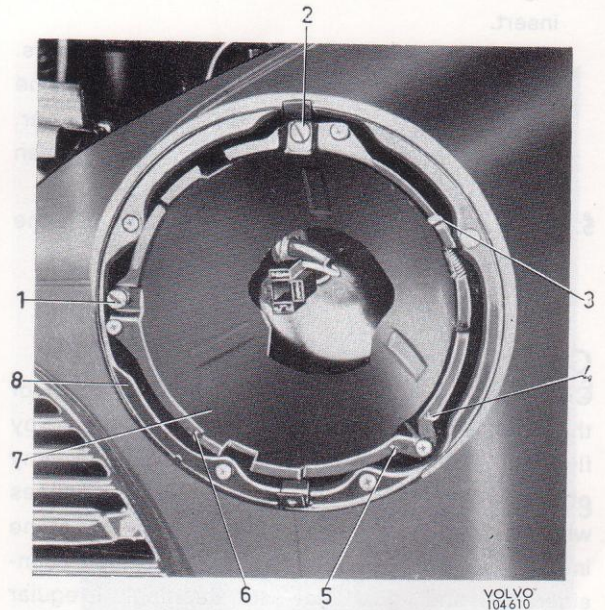


Fig. 116. Headlight cover

VOLVO  
104 310

- |                    |               |
|--------------------|---------------|
| 1. Adjusting screw | 5. Spring     |
| 2. Adjusting screw | 6. Spring     |
| 3. Spring          | 7. Slide case |
| 4. Spring          | 8. Outer case |



3. Disconnect the connecting contact from the bulb holder by pulling it straight out, see Fig. 90.
4. Slacken the screws (1 and 2, Fig. 116) 8—10 turns to adjust the headlight. Unhook the springs (3—6) from the slide cover (7). Lift off the slide cover from the protection cover (8).
5. Remove the springs and adjusting screws from the protection cover.
6. Disconnect the protection cover from the mud-guard and pull out the cable and rubber bush.
7. Fitting is in reverse order. Make sure that the cables are connected properly and that the screws are tightened well.
8. Adjust the headlights.

### Replacing the headlight insert

1. Remove the headlight rim and holding ring as shown in Figs. 113 and 114.
2. Disconnect the plug contact from the insert.
3. Change the insert.
4. Fitting is in reverse order. Before fitting the headlight rim, adjust the headlights.

### Replacing the headlight bulb

1. Remove the headlight insert as above.
2. Lever off the rubber protection.
3. Compress the holding spring for the bulb and lift off the spring, see Fig. 117.
4. Change the bulb. Make sure that the small registers on the bulb fit into the recess on the insert.

N.B. Never hold the bulb glass with the fingers. Grease and oil, even in small quantities, on the bulb glass can impair the bulb lighting power. Use the bulb packing as a protection when fitting.

5. Fit the rubber protection on the insert. Fit the insert and check the lighting adjustment.

### Checking and adjusting

Check the headlights concerning the condition of the reflector and bulb. If the lens is damaged by flying gravel, or is cracked or defective in any other way, the insert should be replaced. Lenses which have become "sand-blasted" by stone impact, etc., will reduce the lighting effect considerably and give rise to dazzling, irregular beaming, etc.

If the reflector is dull, buckled or damaged in any other way, the insert should be replaced. The inside of the bulb must not be oxidized to a black

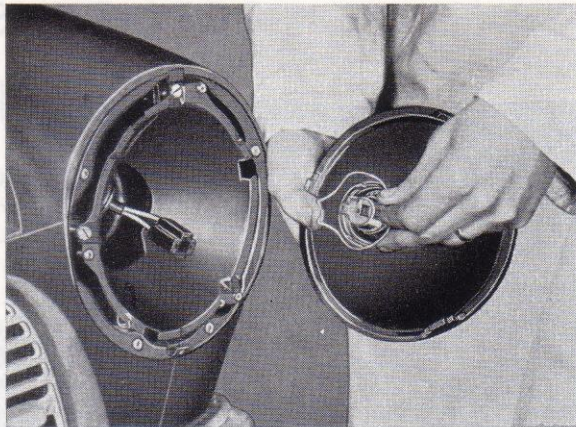
VOLVO  
101 094

Fig. 117. Removing the holding spring for the bulb

or brown colour. The lighting effect normally deteriorates to such an extent that the bulb should be replaced after 100—200 hours of operation. The voltage at the bulb with the headlights switched on and the engine running, at charging speed, should be at least 12.5 volts if sufficient lighting power is to be produced. The headlights should be adjusted in accordance with current legislation. Approved equipment should be used for the adjusting.

### FLASHER AND PARKING LAMP Replacing the bulb

1. Remove the screws for the rim, see Fig. 118. Remove the rim and lens.

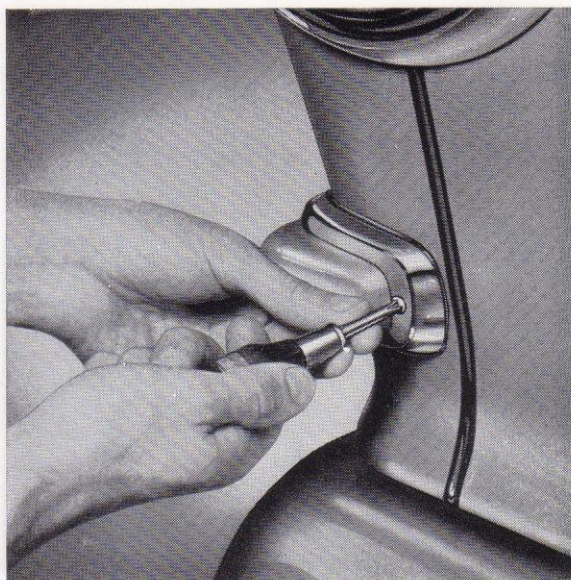
VOLVO  
23275

Fig. 118. Removing the rim



2. Replace the defective bulb. Re-fit the rim and lens.
3. Fit the screws loosely. Check that the packing is located properly and then tighten the screws.



VOLVO  
26549

Fig. 119. Flasher and parking lamp terminals (late prod.)

1. Turn indicator
2. Ground cable
3. Parking light

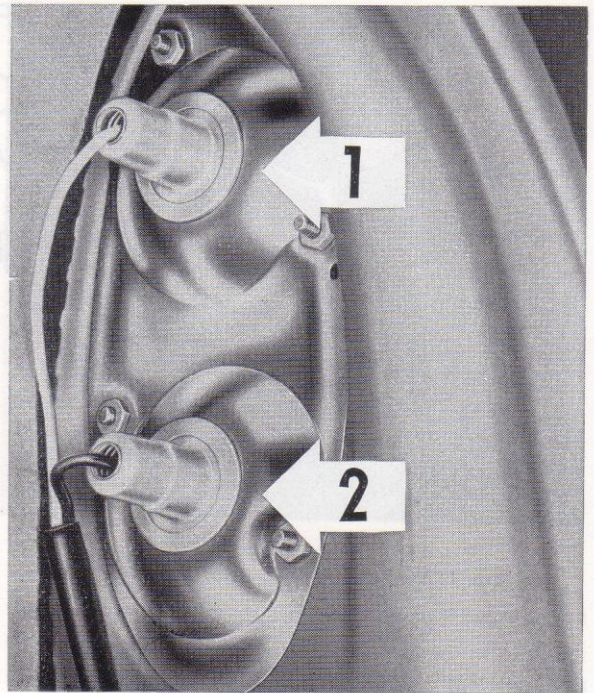
## REAR LAMP

### Changing glass, early prod.

1. Unscrew the four nuts from the inside of the luggage compartment.
2. Then pull the reflector in towards the luggage compartment and the glass outwards.
3. Fitting is in reverse order. When fitting, make sure that the rubber packing seals properly against the mudguard and that the toothed washers are placed between the reflector and mudguard. Without these there will be no or poor grounding for the bulbs.

### Replacing the glass, late prod.

1. Remove the glass by unscrewing the two screws holding the glass to the reflector. The screws are accessible from the inside of the glass.
2. Make sure that the rubber packing seals properly when re-fitting and that the screws are tightened evenly.



VOLVO  
23881

Fig. 120. Location of bulbs in rear lamp, early prod.

1. Turn indicator
2. Rear light and stop light

### Replacing the rear lamp bulbs

The bulbs on the early prod. type rear lamps are accessible for replacement from inside the luggage compartment. The lamp holder is released by levering it to the one side.

For late prod. type rear lamps, the bulbs are accessible for replacement after the glass has been removed.

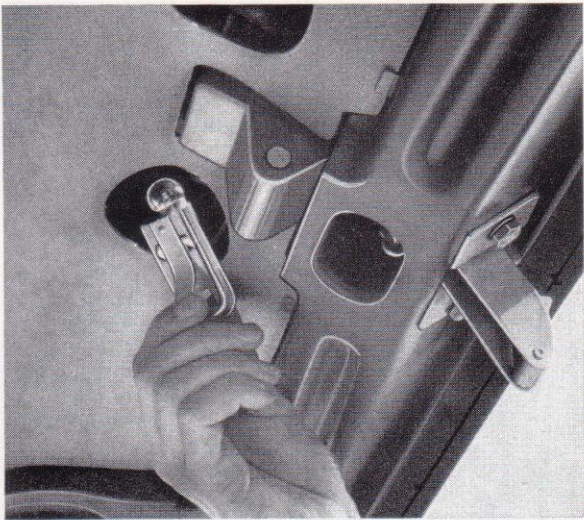


VOLVO  
104180

Fig. 121. Rear lamp, late prod.

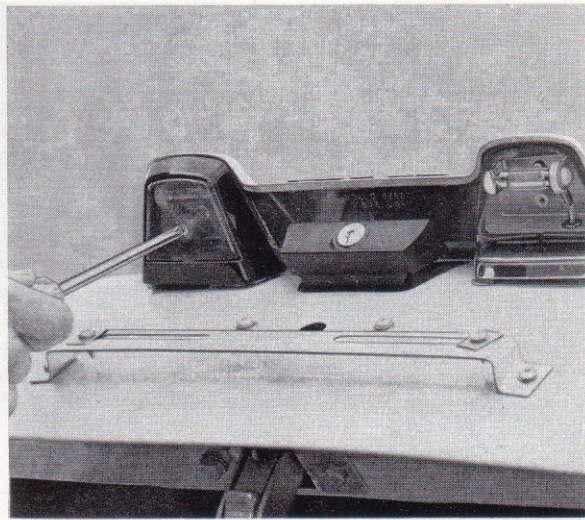
1. Turn indicator
2. Rear light and stop light
3. Reversing light





VOLVO  
104172

Fig. 122. Removing the bulb, early prod.



VOLVO  
104171

Fig. 123. Removing the bulb, late prod.

### LICENCE PLATE LAMP

The bulb of the licence plate lamp is accessible for replacement from underneath the luggage compartment lid. For the early prod. version, the

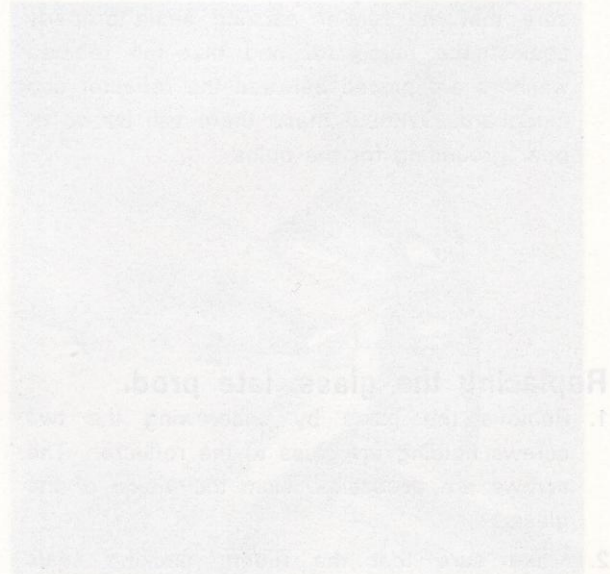
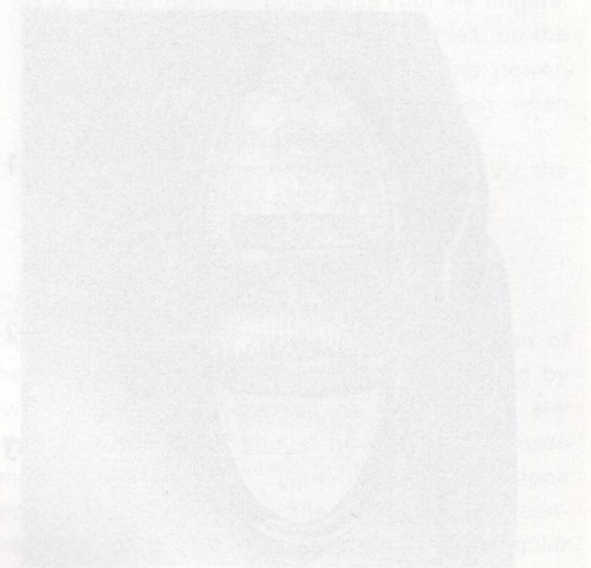
bulb with bulb holder is released by pressing in the spring and pulling out the bulb holder, see Fig. 122. On late prod. versions, the bulb is accessible after the glass has been removed as shown in Fig. 123.

### Replacing the rear lamp bulbs

The bulbs on the early prod. type rear lamps are accessible for replacement from inside the luggage compartment. The lamp holder is released by levering it to the one side. For the prod. type rear lamps the bulbs are accessible for replacement after the glass has been removed.

### REAR LAMP FLASHER AND PARKING LAMP

Changing glass, early prod.  
1. Uncover the foot plate from the inside of the luggage compartment.  
2. Then pull the reflector in towards the luggage compartment and the glass outwards.  
3. Fitting is in reverse order. When fitting, make





## GROUP 36

# OTHER ELECTRICAL STANDARD EQUIPMENT DESCRIPTION

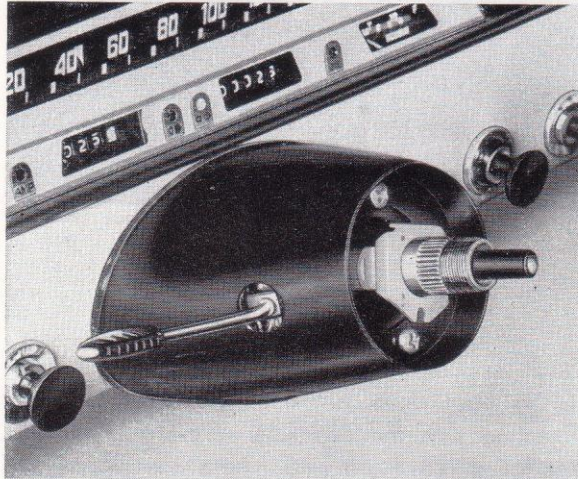
VOLVO  
24917

Fig. 124. Turn indicator switch cover

## TURN INDICATORS

The turn indicators consists of a thermal flasher relay, lever switch, flasher lamps on the front mudguards and bulbs in the rear lamps. The

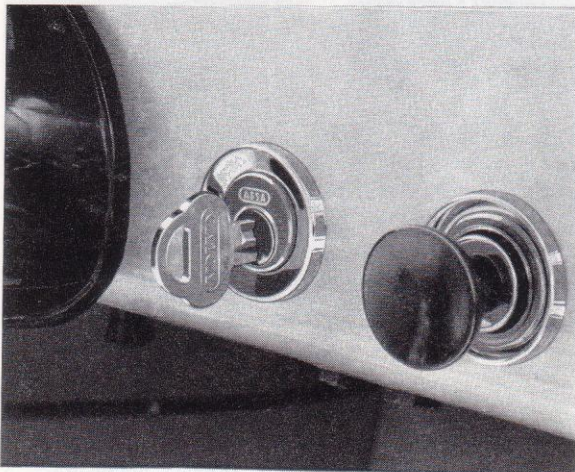
VOLVO  
104189

Fig. 125. Ignition switch, early prod.

flasher relays is located under the dashboard. The turn indicator switch, which has automatic parking, is located under a plastic cover on the steering column. The control lamp for the turn indicators is connected in parallel across this switch.

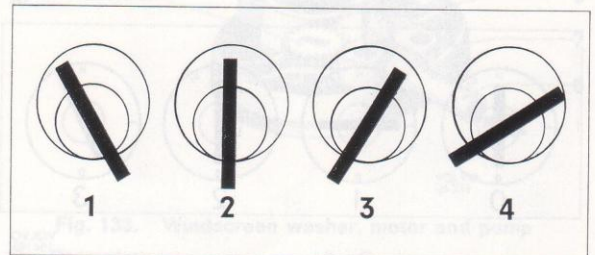
VOLVO  
104182

Fig. 126. Various positions of ignition switch, early prod.

1. Elec. system of vehicle switched on except ignition system.
  2. Neutral, everything switched off.
  3. Driving position, current to ignition system and vehicle electrical system.
  4. Start position, same as position 3, but current to control solenoid on starter motor also.
- When the ignition switch key is released in position 4 it returns automatically to position 3.

## IGNITION SWITCH, early prod.

The early prod. type of ignition switch is linked with the ignition coil by means of a reinforced cable. The ignition switch is mounted in the dashboard as shown in Fig. 125.



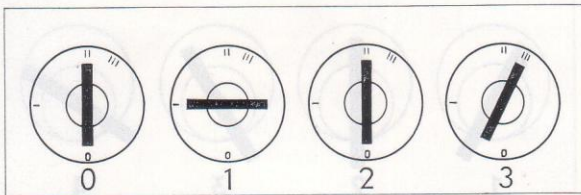


VOLVO  
104 184

Fig. 127. Ignition switch, late prod.

### IGNITION SWITCH, late prod.

The late prod. type ignition switch is integrally built with the steering wheel lock which is mounted on the steering column.



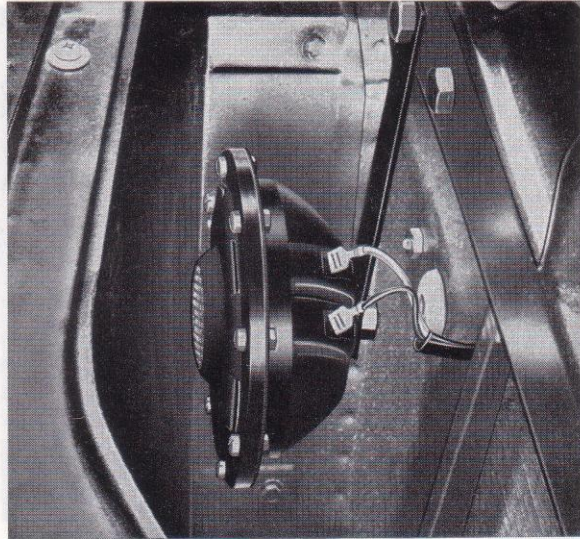
VOLVO  
104 183

Fig. 128. Various positions of ignition switch key, late prod.

- 0. Everything switched off and steering wheel locked.
  - 1. Radio (75) in-current.
  - 2. Current to ignition coil and to fusebox (driving position).
  - 3. Same as position 2 but also current to control solenoid on starter motor (start position).
- When the ignition switch key is released in position 3 it returns automatically to position 2.

### HORNS

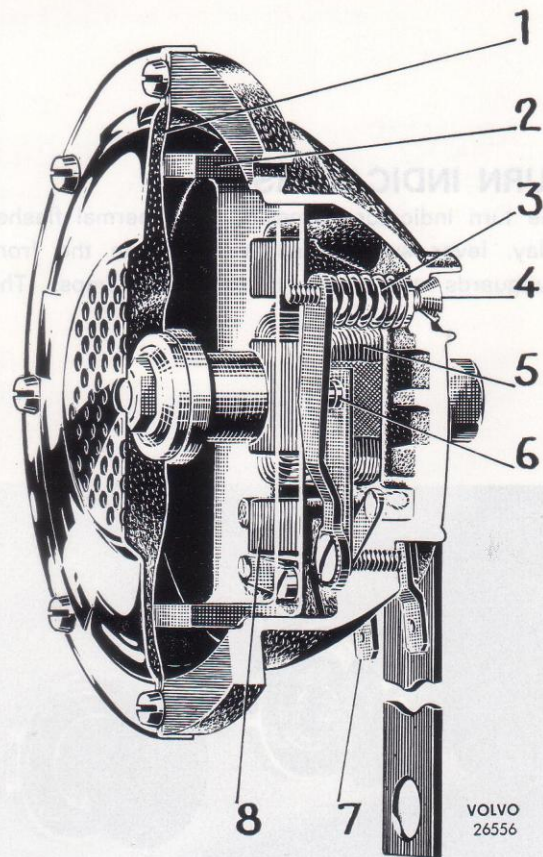
The horns, Fig. 129, are mounted in front of the radiator. One is a low-frequency, and the other a high-frequency horn. They are operated by the horn ring mounted on the inside of the steering wheel.



VOLVO  
26559

Fig. 129. Horns

If the horn does not emit the right tone, try adjusting with the adjusting screw (4, Fig. 139). The function of the horn depends to a great extent on its suspension, which should be checked.

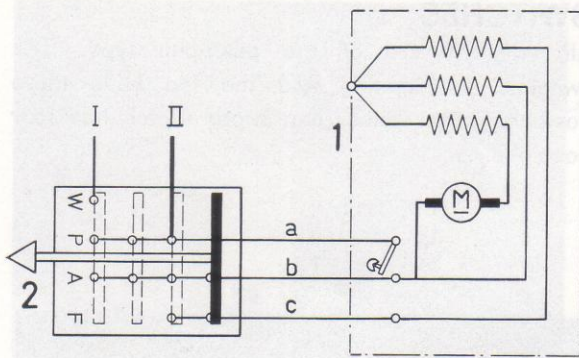


VOLVO  
26556

Fig. 130. Horn

- 1. Diaphragm
- 2. Armature
- 3. Spring
- 4. Adjusting screw
- 5. Coil
- 6. Breaker contacts
- 7. AMP-connection
- 8. Iron core





VOLVO  
104185

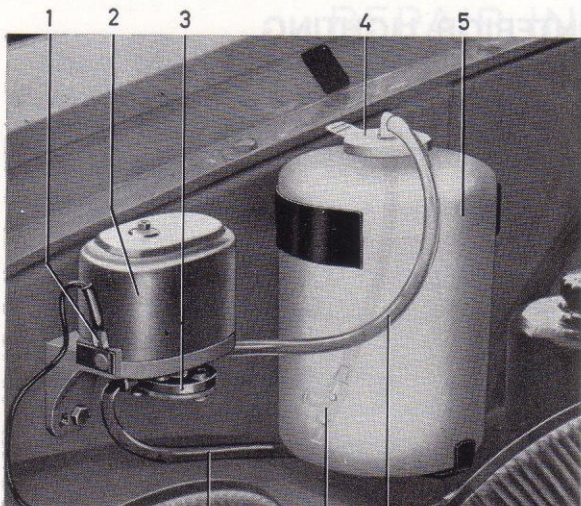
Fig. 131. Wiring diagram for windscreen wiper unit

- |                         |          |
|-------------------------|----------|
| 1. Wiper motor          | a. Black |
| 2. Switch               | b. Green |
| I. To windscreen washer | c. Red   |
| II. From fuse 25 amps.  |          |

**WINDSCREEN WIPERS**

The windscreen wipers are driven by an electric motor, which is fitted under the dashboard and which drives the wipers via linked arms.

The electric motor is a two-pole, compound motor with parking switch built into the gear housing. The motor has two speeds. Two types are available: SWF and Electrolux.



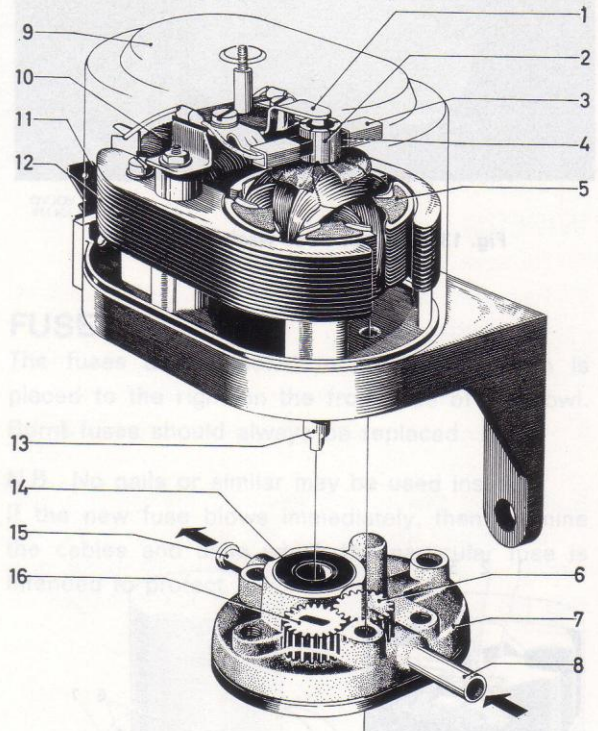
VOLVO  
26544

Fig. 132. Windscreen washer, early prod.

- |                    |                     |
|--------------------|---------------------|
| 1. Terminal        | 5. Fluid container  |
| 2. Elec. motor     | 6. Hose             |
| 3. Gear wheel pump | 7. Non-return valve |
| 4. Filler cap      | 8. Hose to nozzle   |

**WINDSCREEN WASHER, early prod.**

The windscreen washer is mounted on the right-hand wheel housing and consists of a gear-wheel pump, which is driven by an electric motor, also a container for the washer fluid, see Fig. 132.



VOLVO  
26211

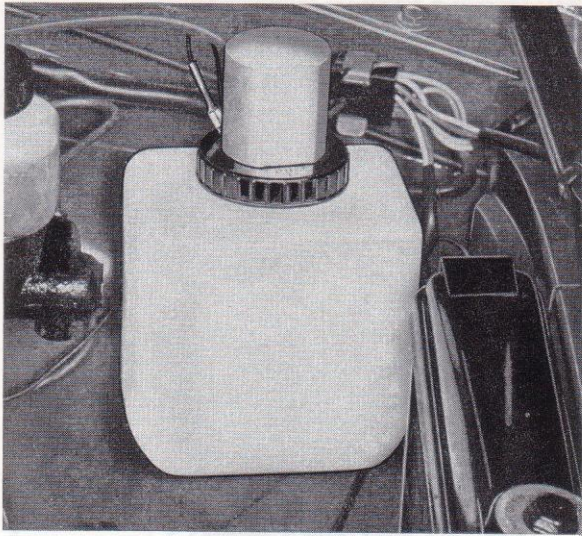
Fig. 133. Windscreen washer, motor and pump

- |                           |                   |
|---------------------------|-------------------|
| 1. Stop plate             | 9. Casing         |
| 2. Commutator             | 10. Field winding |
| 3. Elec. brush holder     | 11. Terminal      |
| 4. Elec. brush            | 12. Pole shoe     |
| 5. Rotor                  | 13. Rotor shaft   |
| 6. Gear wheel (pump gear) | 14. Sealing       |
| 7. Pump body              | 15. Outlet pipe   |
| 8. Inlet pipe             | 16. Pump gear     |

**WINDSCREEN WASHER, late prod.**

The windscreen washer is placed on the left-hand wheel housing. It consists of a centrifugal pump which is driven by an electric motor. The pump is located down inside the container for the washer fluid, see Fig. 134.



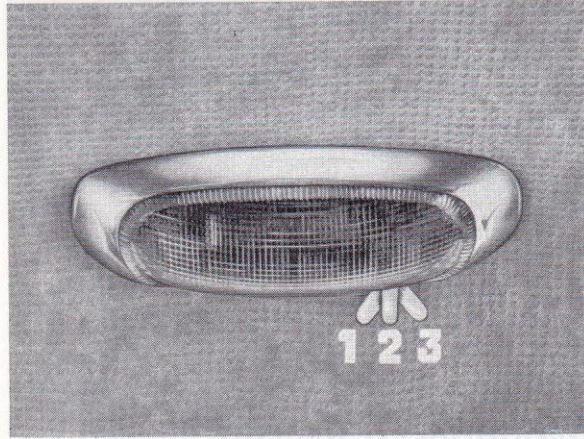


VOLVO  
104179

Fig. 134. Windscreen washer, late prod.

## SWITCHES

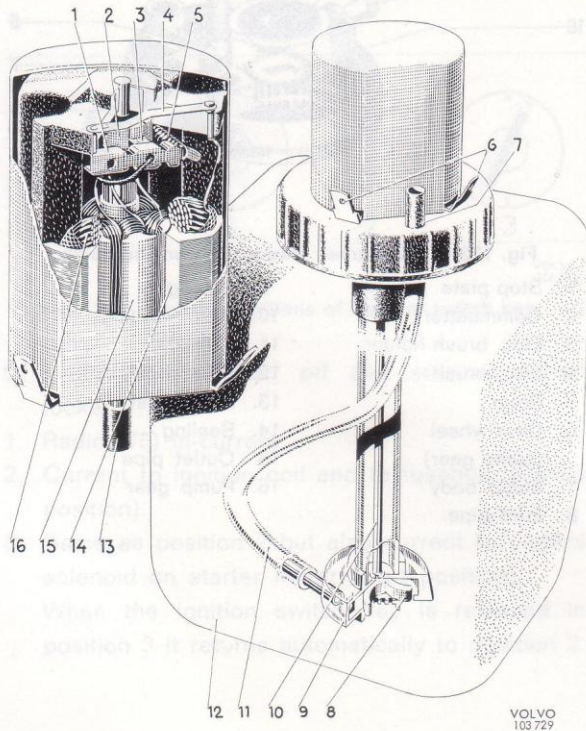
All switches are of the push-pull type. The switches for lighting and the fan have three positions. The windscreen wiper switch has four positions.



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Fig. 136. Interior lighting

- |  |                       |
|--|-----------------------|
| 1. Lamp lights when one of the front doors opens | 2. Lamp is always off |
|  | 3. Lamp is always on  |



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Fig. 135. Windscreen washer

- |                   |                   |
|-------------------|-------------------|
| 1. Brush holder   | 9. Pump body      |
| 2. Commutator     | 10. Shaft         |
| 3. Elec. brush    | 11. Hose          |
| 4. Thermal fuse   | 12. Container     |
| 5. Spring         | 13. Flange        |
| 6. Connecting tag | 14. Stator        |
| 7. Water outlet   | 15. Rotor         |
| 8. Impeller       | 16. Field winding |

## INTERIOR LIGHTING

The interior lighting consist of a lamp located in the middle of the roof. It is switched on by means of a knob which is built into the lamp.

## CONTROL RELAYS

The vehicles in the 120-series are equipped with two control relays, one for the rear light and one for the full-bebam flasher. (Vehicles with overdrive have also a control relay for the overdrive. N.B. Not B 20.) The control relays are mounted on the left-hand wheel housing.



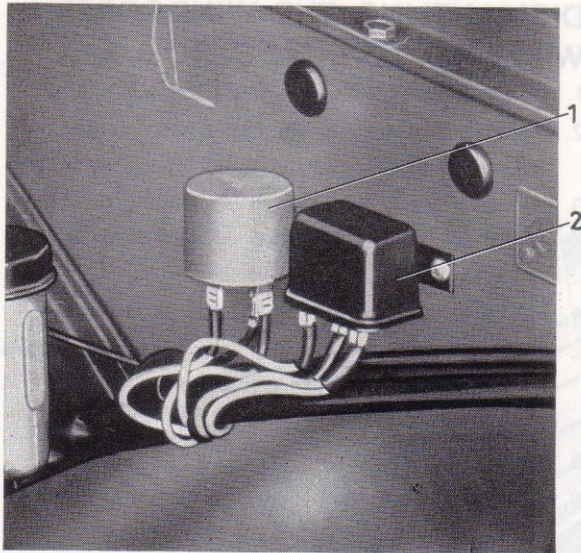


Fig. 137. Control relays

- |                               |                                 |
|-------------------------------|---------------------------------|
| 1. Relay for reversing lights | 2. Relay for full-beam flashers |
|-------------------------------|---------------------------------|

## STOP LIGHT SWITCH

There are two types of stop light switches. The early prod. type has the stop light switch mounted on the front side of the cowl, see Fig. 138, and is influenced hydraulically by the pressure in the brake lines.

The late prod. type is mounted on the pedal carrier and is mechanically actuated by the brake pedal.

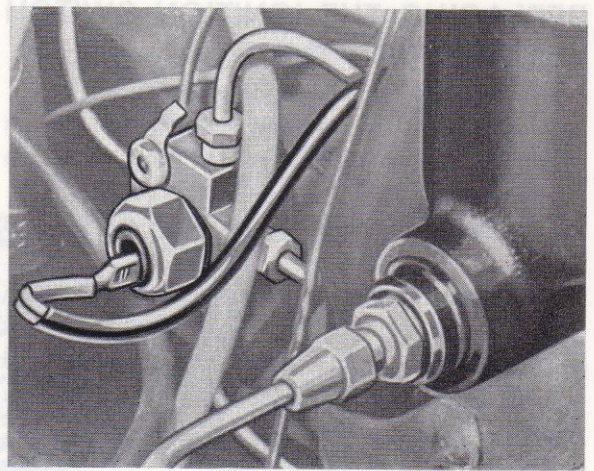


Fig. 138. Stop light switch, early prod.

## FUSES

The fuses are collected in a fusebox which is placed to the right on the front side of the cowl. Burnt fuses should always be replaced.

N.B. No nails or similar may be used instead.

If the new fuse blows immediately, then examine the cables and units which the particular fuse is intended to protect.

# REPAIR INSTRUCTIONS

## REPLACING TURN INDICATOR LEVER SWITCH

1. Remove the steering wheel according to the instructions given in Part 6.
2. Take off the screws (5, Fig. 139) holding the protective casing to the steering column and lift off the casing.
3. Disconnect the cables from the switch. (Pull straight down.) Remove the screws securing the switch to the steering column. Take off the switch.

Fitting is in reverse order.

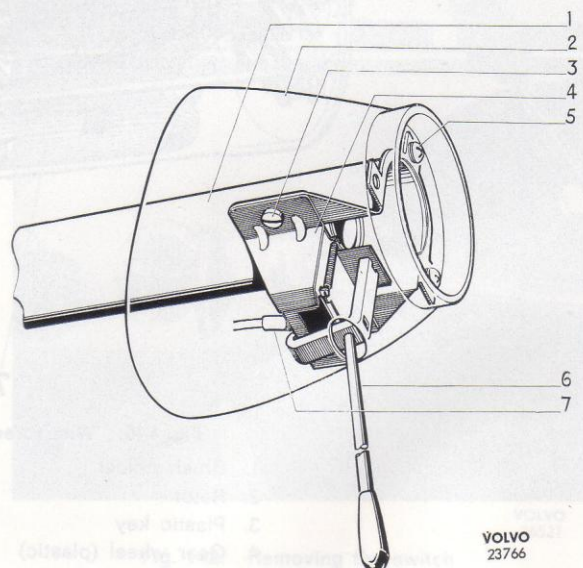


Fig. 139. Turn indicator switch

- |                    |                  |
|--------------------|------------------|
| 1. Steering column | 5. Screw         |
| 2. Casing          | 6. Control lever |
| 3. Screw           | 7. Ground cable  |
| 4. Switch          |                  |

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## REPLACING THE IGNITION SWITCH AND IGNITION COIL, early prod.

1. Remove the negative battery lead.
  2. Unscrew the two screws holding the ignition switch to the dashboard and pull down the switch.
  3. Remove the electric cables from the ignition switch.
  4. Remove the electric cable from the ignition coil.
  5. Take off the screws securing the ignition coil and lift out the ignition coil and ignition switch.
- Fitting is in reverse order.

## REPLACING THE WINDSCREEN WIPERS

1. Remove the negative battery lead.
2. Remove the wiper arms, also nuts and seals on the shafts.
3. Remove the switch for the windscreen wiper. Disconnect the cables from the switch.
4. Slacken and move the heater controls to the one side.
5. Remove the screws securing the wiper to the dashboard and lift out the wiper.

Fitting is in reverse order. Check to make sure that the seals for the shafts are not damaged.

## DISMANTLING THE WINDSCREEN WIPER MOTOR, ELECTROLUX

1. Remove the crank arm from the shaft.
2. Remove the screws for the cover on the gear housing and remove the cover and gear wheel.
3. Remove the two long screws holding the motor together. Take off the commutator bearing bracket.
4. Remove the spring holding the brushes.
 

N.B. Make sure that the small rubber covers at the attachment for the brushes do not get lost.
5. Rotate the rotor.
6. Remove the screws for the cover over the parking switch and lift off the cover.
7. Check the pole housing, rotor and brush holder with brushes and if necessary remove damaged parts.

Assembling is in reverse order. When assembling, lubricate the gear housing with grease, for example, Bosch Ft 1 V 35.

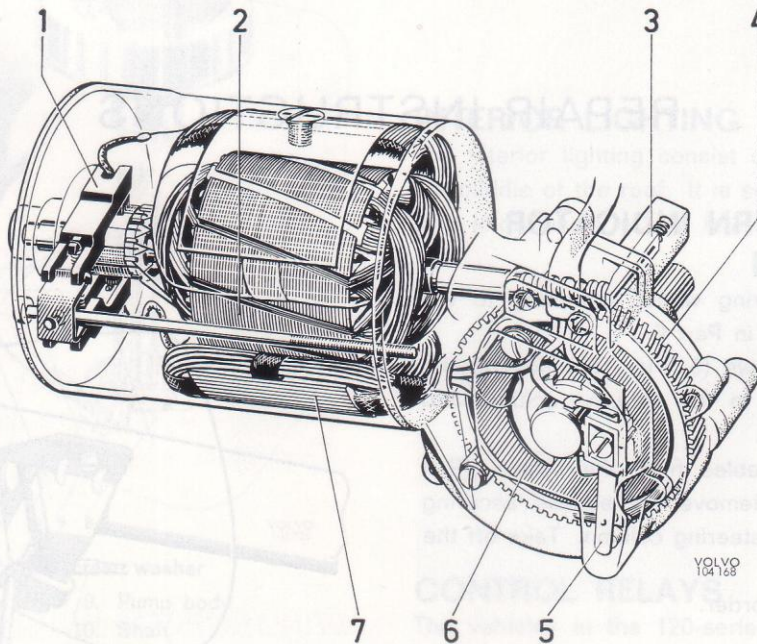


Fig. 140. Windscreen wiper motor, Electrolux

- |                         |                   |
|-------------------------|-------------------|
| 1. Brush holder         | 5. Parking switch |
| 2. Rotor                | 6. Spring washer  |
| 3. Plastic key          | 7. Field winding  |
| 4. Gear wheel (plastic) |                   |



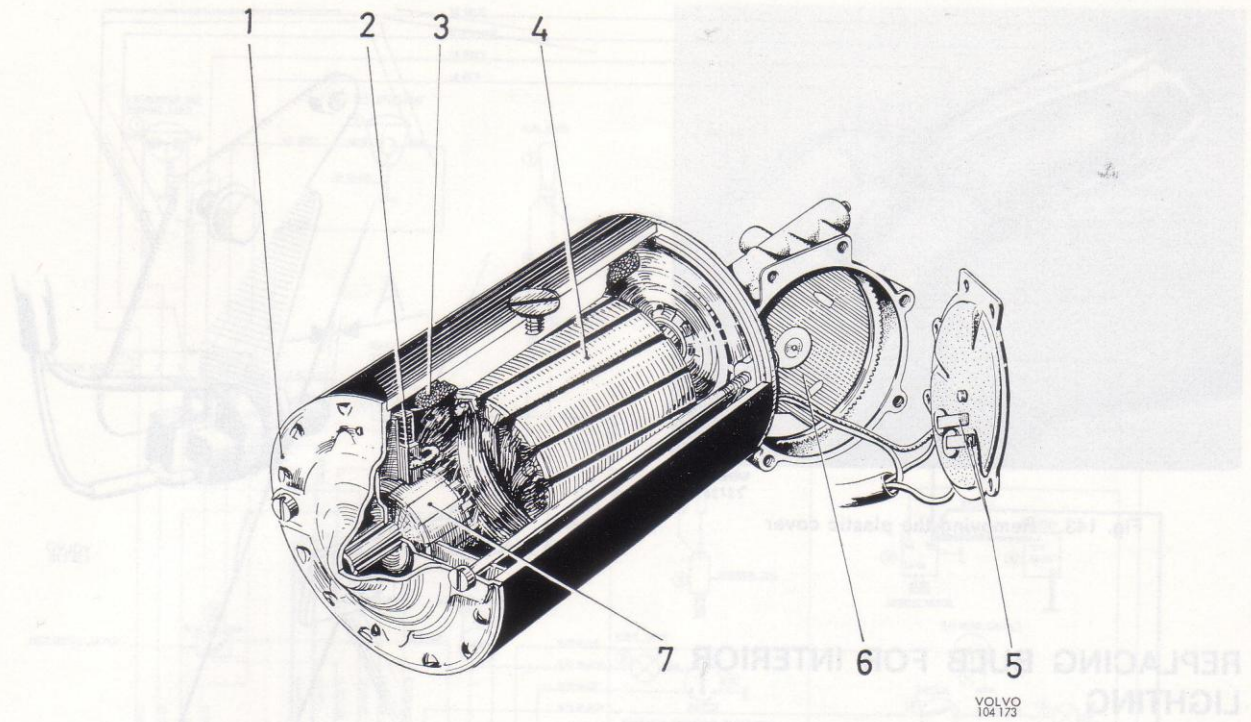


Fig. 141. Windscreen wiper motor, SWF

- |                    |                                       |
|--------------------|---------------------------------------|
| 1. Bearing bracket | 5. Contact springs for parking switch |
| 2. Brush           | 6. Contact plate                      |
| 3. Field winding   | 7. Commutator                         |
| 4. Rotor           |                                       |

### DISMANTLING THE WINDSCREEN WIPER MOTOR, SWF

1. Remove the crank arm from the shaft.
2. Remove the screws for the cover over the gear housing, bend the cover to the one side and press out the gear wheel.
3. Remove the two long bolts holding the motor together. Bend the gear housing to the one side and pull out the rotor.
4. Check the pole housing, rotor and brush holder with brushes and exchange if necessary any parts that are damaged.

Assembling is in reverse order. When assembling, lubricate the gear housing with grease, for example, Bosch Ft 1 V 35.

### REMOVING THE LIGHTING SWITCH

1. Unscrew the switch knob.
2. Unscrew the nut for the switch with a suitable tool, see Fig. 142.

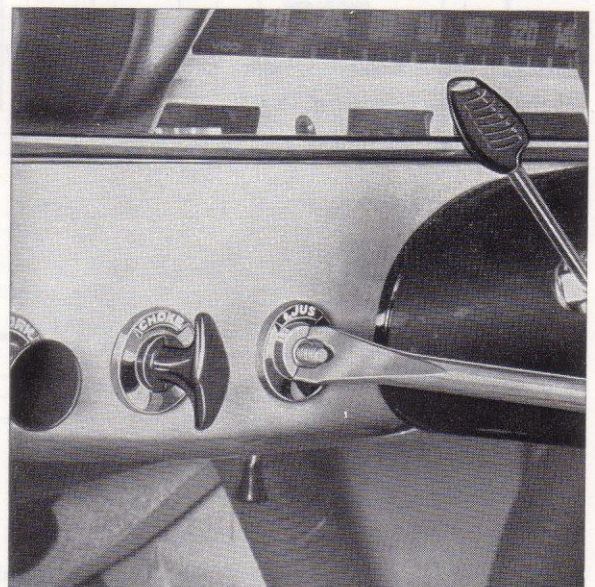


Fig. 142. Removing the switch

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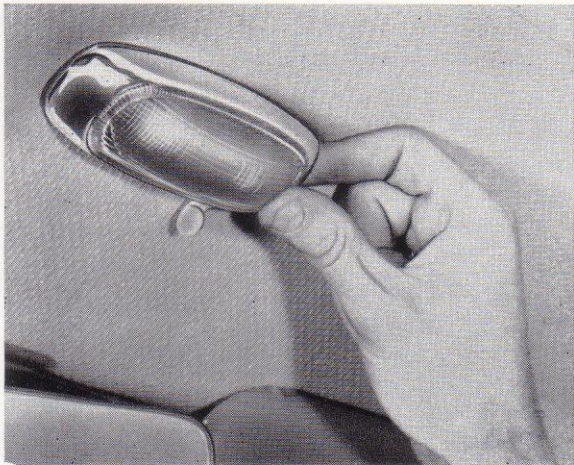
VOLVO  
23738

Fig. 143. Removing the plastic cover

## REPLACING BULB FOR INTERIOR LIGHTING

1. Pull down the plastic cover as shown in Fig. 143.
2. Change the bulb.
3. Press the plastic cover carefully back into position.

## REPLACING THE STOP LIGHT SWITCH, early prod.

1. Remove the electric cables from the switch.
2. Screw loose the switch.
3. Fit the new switch.
4. Fit the electric cables.
5. Bleed the brake system according to the instructions given in Part 5 "Brakes".
6. Check the function.

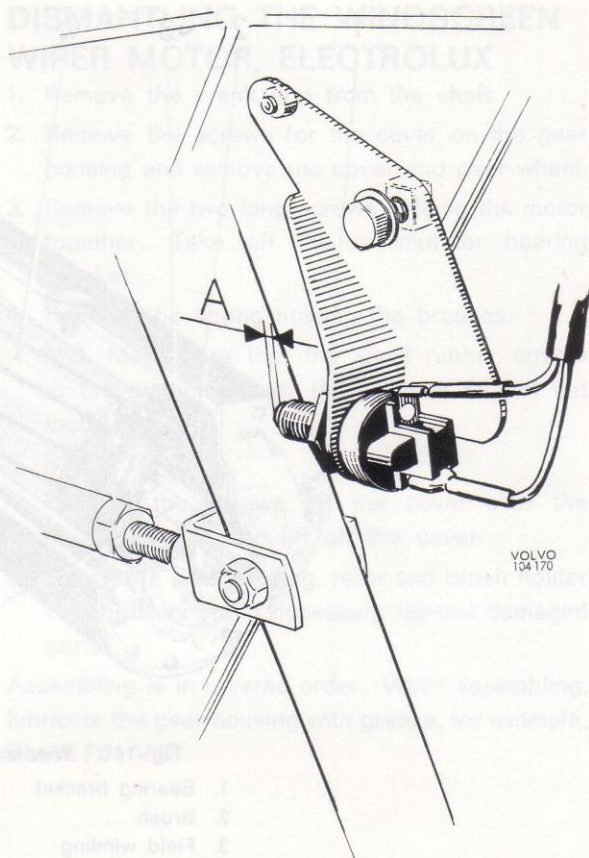
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Fig. 144. Stop light switch, late prod.

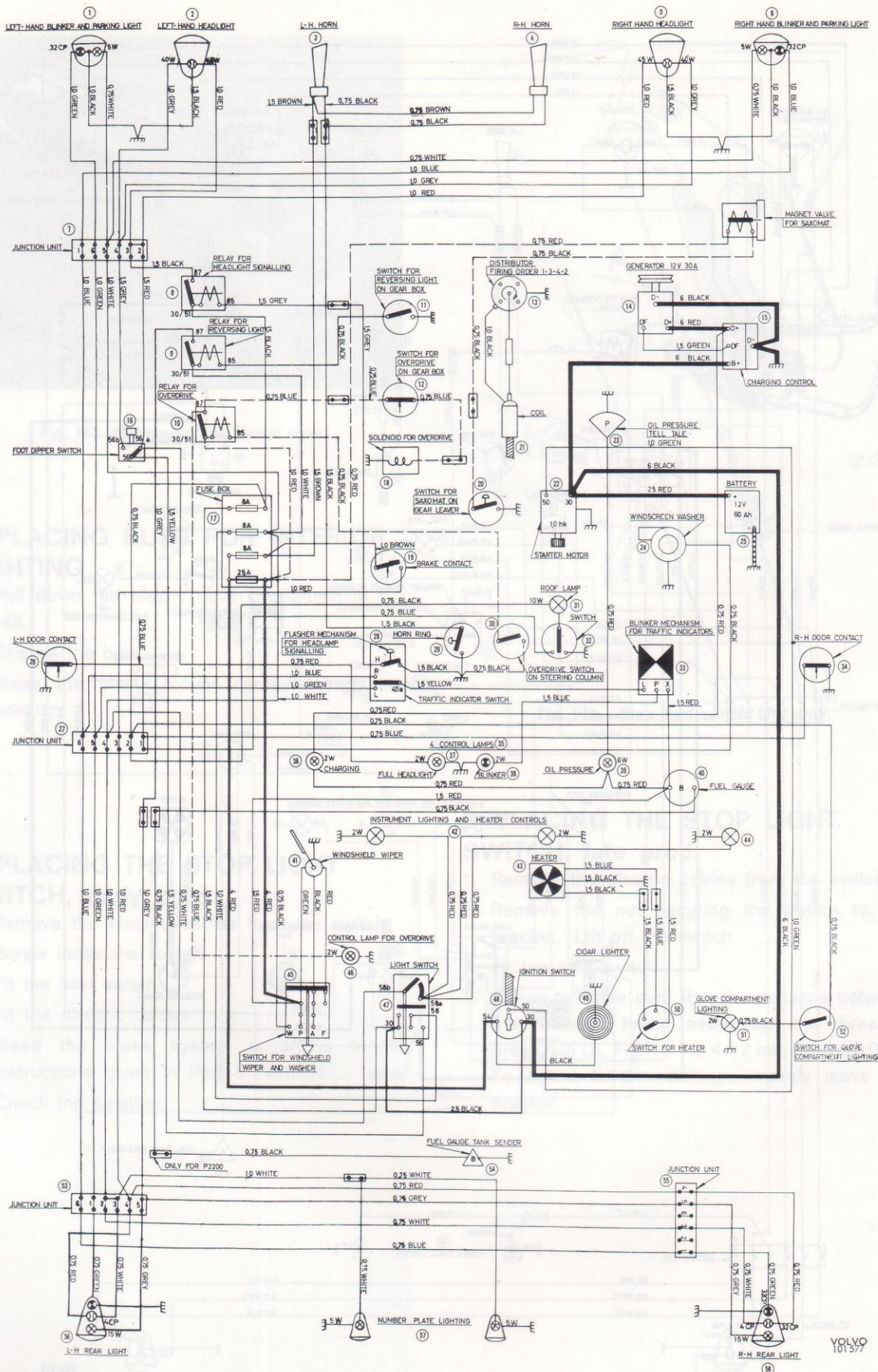
## REPLACING THE STOP LIGHT SWITCH, late prod.

1. Remove the electric cables from the switch.
2. Remove the nut securing the switch to the bracket. Lift off the switch.
3. Fit the new switch.
4. Check to make sure that the distance between the released brake pedal and the threaded brass hub (A, Fig. 144) is  $4 \pm 2$  mm ( $0.16 \pm 0.08$ "'). To adjust to this distance, merely move the bracket.









**ILLUSTRATION 2. WIRING DIAGRAM**  
 from ch. No. 10500 to ch. No. 39999, 2-door model  
 from ch. No. 112800 to ch. No. 139999, 4-door model  
 from ch. No. 1 to ch. No. 8274, Station Wagon

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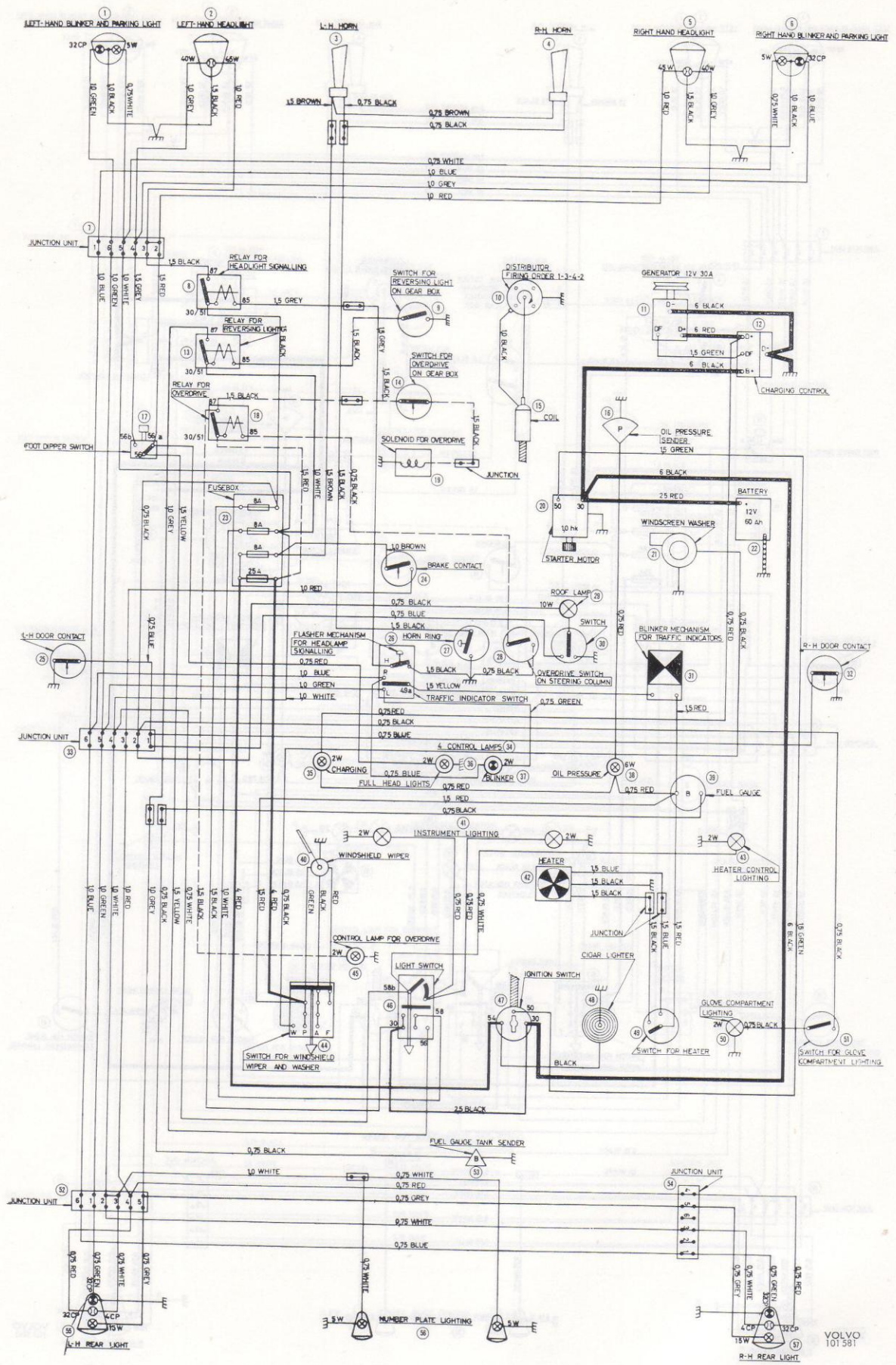
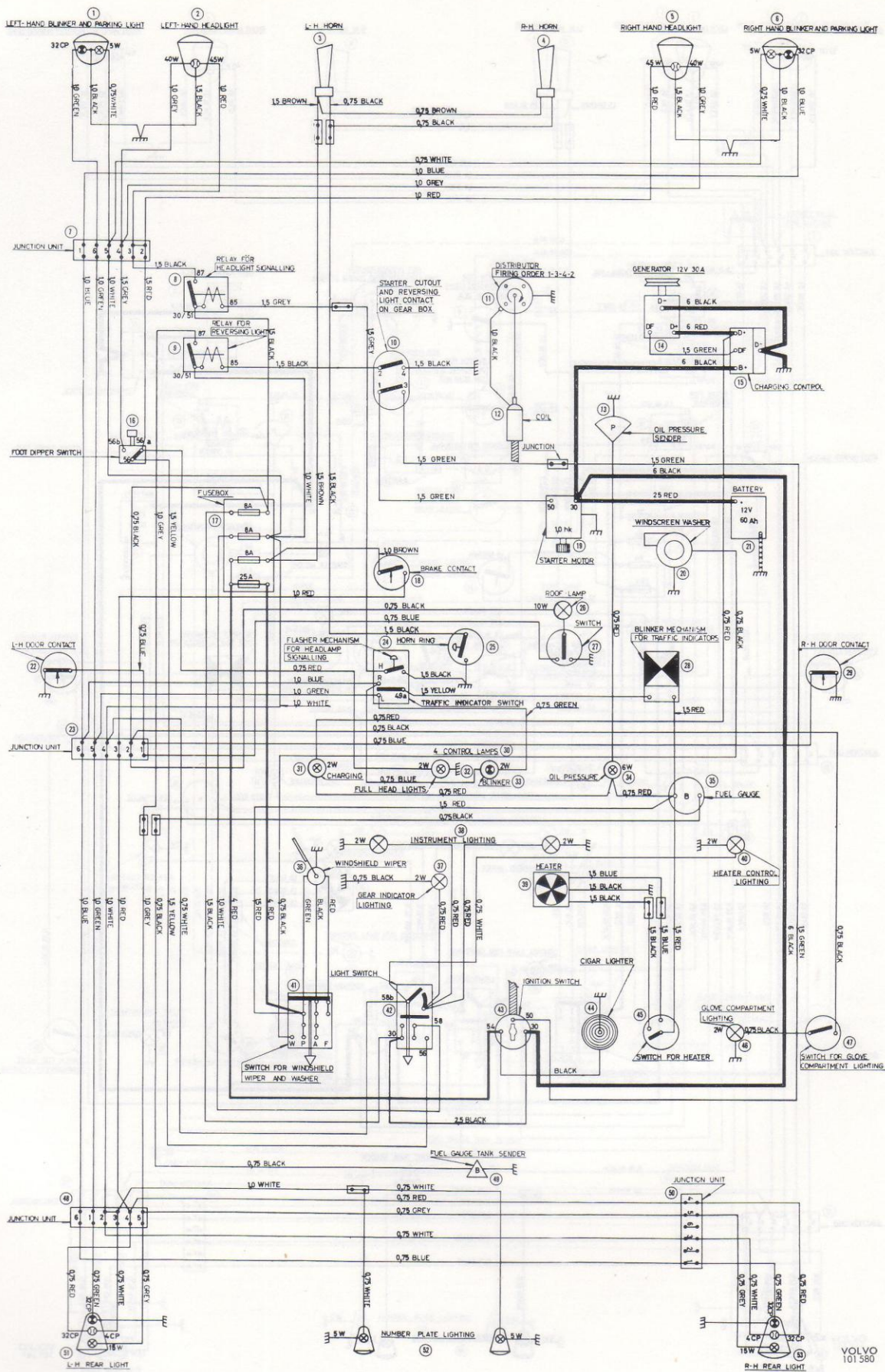


ILLUSTRATION 3. WIRING DIAGRAM

from ch. No. 40000 to ch. No. 84599, 2-door model  
 from ch. No. 134000 to ch. No. 166399, 4-door model





VOLVO  
101 580

#### ILLUSTRATION 4. WIRING DIAGRAM

from ch. No. 40000 to ch. No. 84599, 2-door model with automatic transmission  
from ch. No. 134000 to ch. No. 166399, 4-door model with automatic transmission



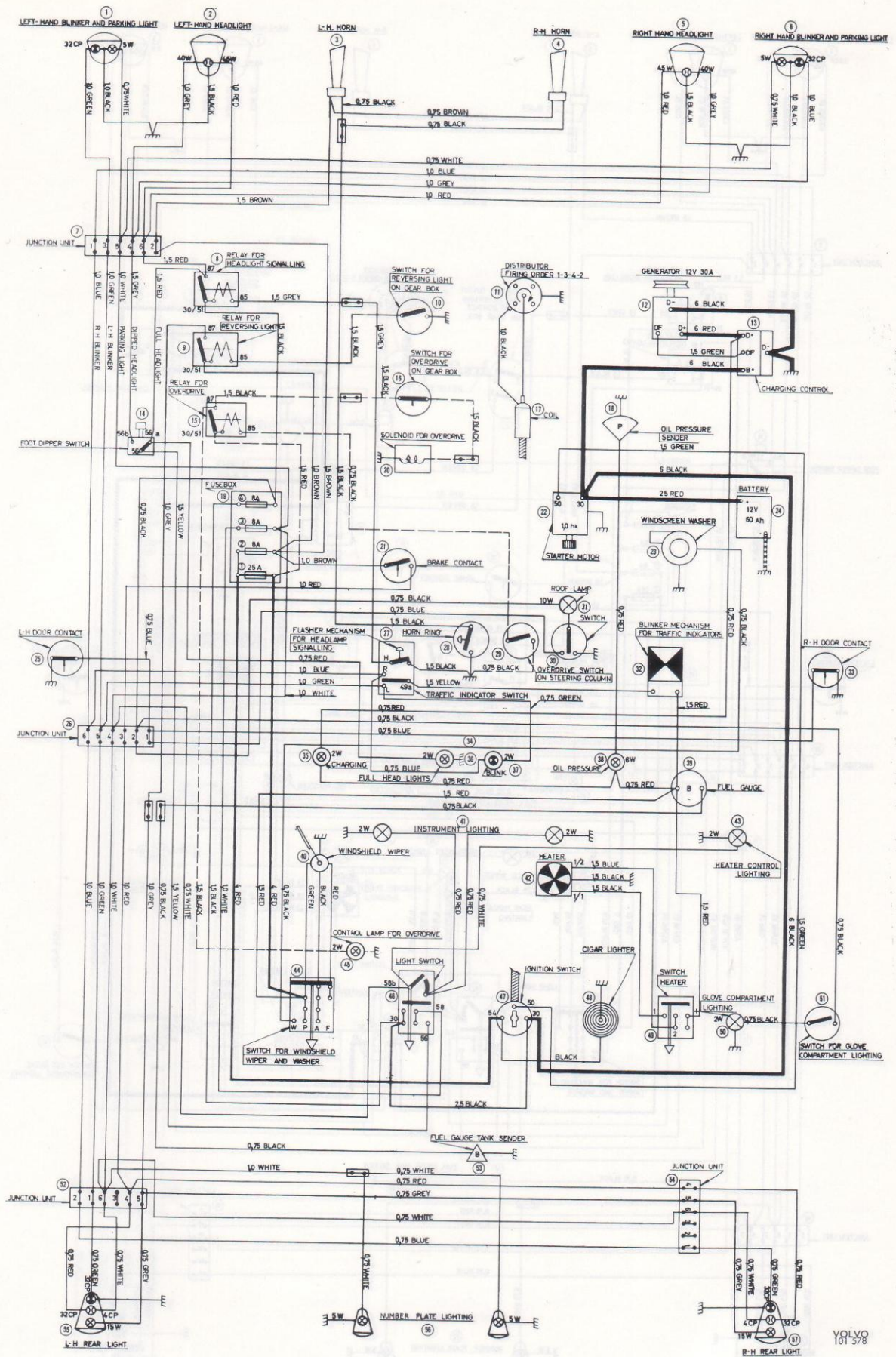


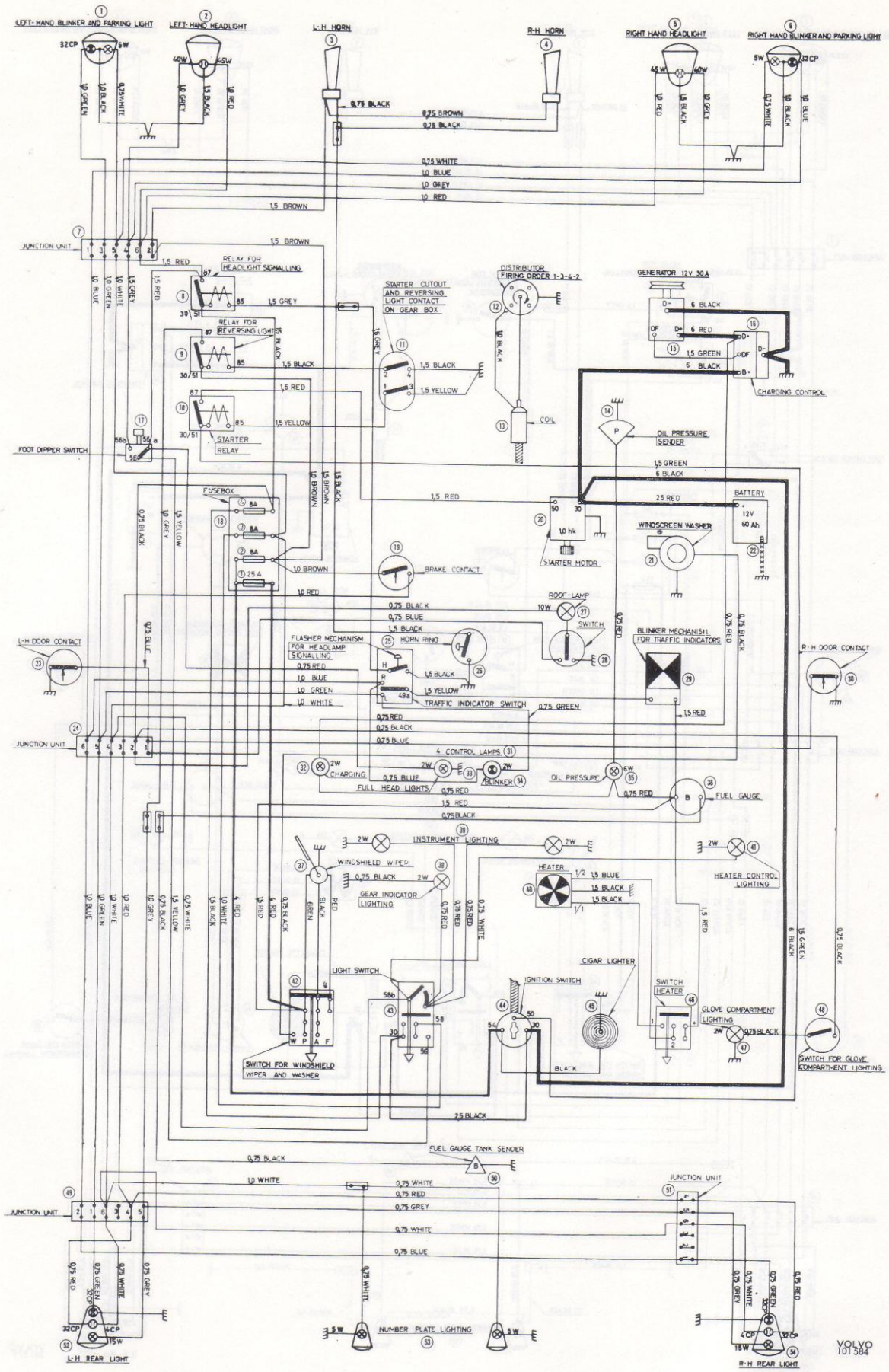
ILLUSTRATION 5. WIRING DIAGRAM

from ch. No 84600 to ch. No. 312499, 2-door model  
 from ch. No 166400 to ch. No. 234653, 4-door model





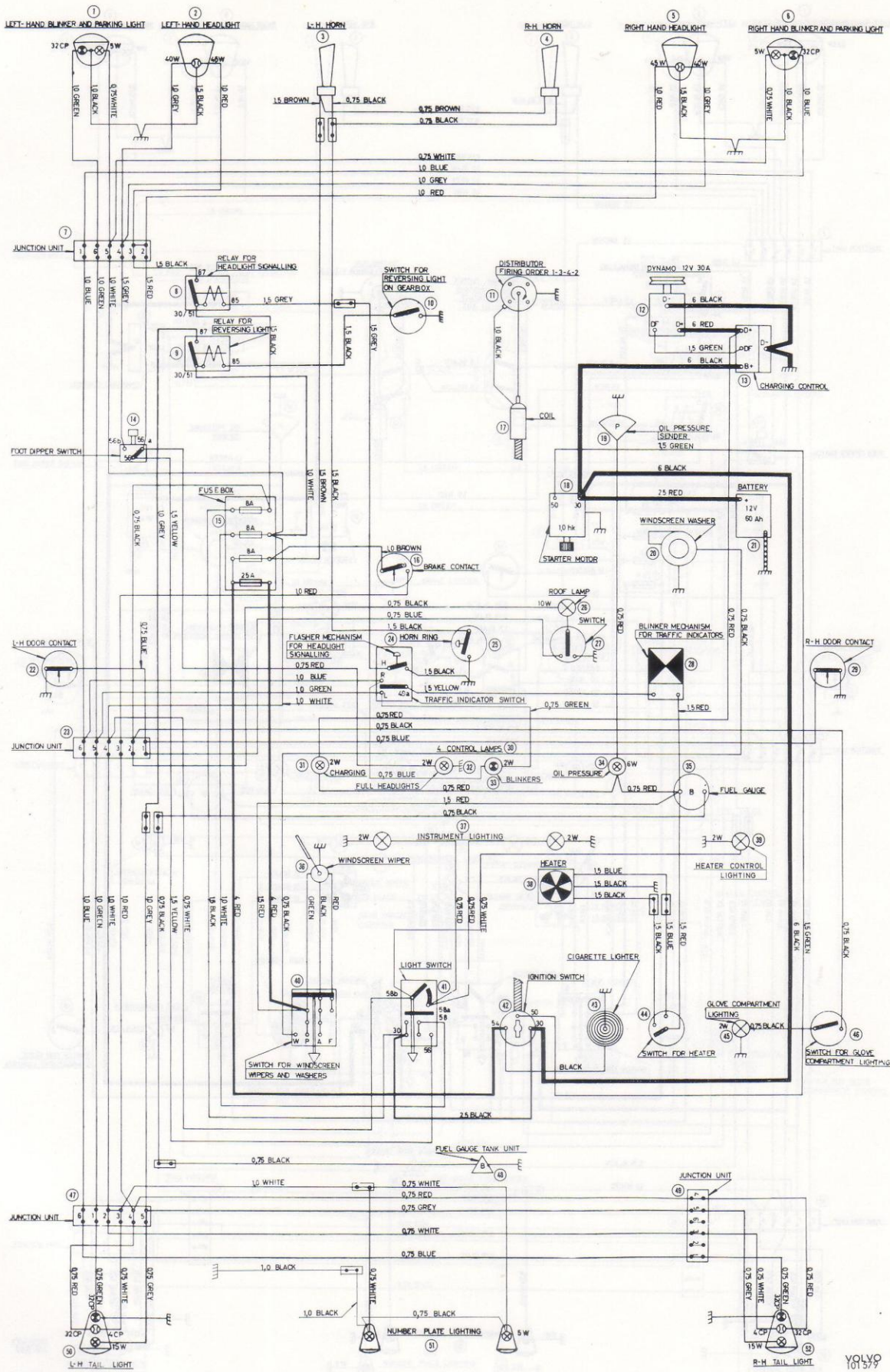




**ILLUSTRATION 7. WIRING DIAGRAM**

from ch. No. 144400 to ch. No. 312499, 2-door model with automatic transmission  
 from ch. No. 193800 to ch. No. 234653, 4-door model with automatic transmission





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ILLUSTRATION 8. WIRING DIAGRAM  
from ch. No. 8275 to ch. No. 17949, Station Wagon



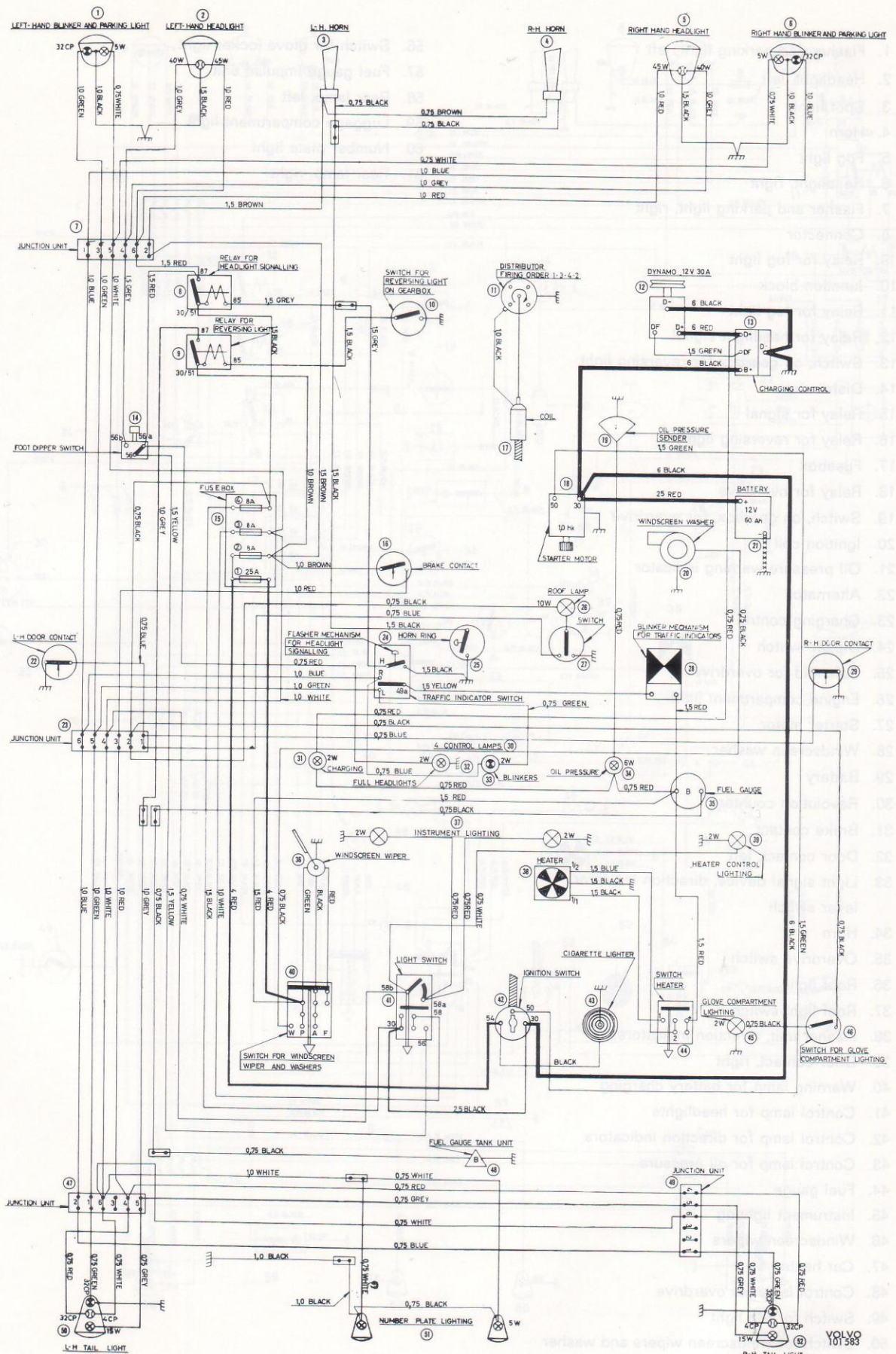


ILLUSTRATION 9. WIRING DIAGRAM  
 from ch. No. 17950 to ch. No. 70299, Station Wagon



- 
1. Flasher and parking light, left
  2. Headlight, left
  3. Spot light
  4. Horn
  5. Fog light
  6. Headlight, right
  7. Flasher and parking light, right
  8. Connector
  9. Relay for fog light
  10. Junction block
  11. Relay for fog light
  12. Relay for headlight signal
  13. Switch, on gearbox for reversing light
  14. Distributor
  15. Relay for signal
  16. Relay for reversing light
  17. Fusebox
  18. Relay for overdrive
  19. Switch, on gearbox, for overdrive
  20. Ignition coil
  21. Oil pressure warning indicator
  22. Alternator
  23. Charging control
  24. Dipper switch
  25. Solenoid for overdrive
  26. Engine compartment light
  27. Starter motor
  28. Windscreen washer
  29. Battery
  30. Revolution counter
  31. Brake contact
  32. Door contact, left
  33. Light signal device, direction indicator lever switch
  34. Horn
  35. Overdrive switch
  36. Roof light
  37. Roof light switch
  38. Flasher unit, direction indicators
  39. Door contact, right
  40. Warning lamp for battery charging
  41. Control lamp for headlights
  42. Control lamp for direction indicators
  43. Control lamp for oil pressure
  44. Fuel gauge
  45. Instrument lighting
  46. Windscreen wipers
  47. Car heater
  48. Control lamp for overdrive
  49. Switch for fog light
  50. Switch for windscreen wipers and washer
  51. Switch for headlights and parking lights
  52. Ignition switch
  53. Cigarette lighter
  54. Switch for car heater
  55. Glove locker light
  56. Switch for glove locker light
  57. Fuel gauge impulse unit
  58. Rear lamp, left
  59. Luggage compartment light
  60. Number plate light
  61. Rear lamp, right







1. Flasher and parking light, left
2. Headlight, left
3. Horn
4. Headlight, right
5. Flasher and parking light, right
6. Connector
7. Junction block
8. Relay for headlight signal
9. Reverse light contact
10. Distributor
11. Alternator
12. Charging regulator
13. Brake warning switch
14. Relay for reverse light
15. Foot dipper switch
17. Ignition coil
18. Oil pressure warning indicator
19. Brake warning lamp
20. Switch for handbrake control
21. Fusebox
23. Brake contact
25. Starter motor
26. Windscreen washer
27. Battery
29. Door switch, left
30. Light signal device, direction indicators
31. Horn ring
32. Roof light
33. Flasher unit, direction indicators
34. Door contact, right
35. Control lamp for charging
36. Control lamp for mainbeam headlights
37. Control lamp for direction indicators
38. Control lamp for oil pressure
39. Fuel gauge
40. Instrument lighting
41. Windscreen wiper
42. Ventilation fan
44. Control for windscreen wiper and washer
45. Lighting switch
46. Ignition switch
47. Cigarette lighter
48. Switch for ventilation fan
49. Glove compartment lighting
50. Switch for glove locker lighting
51. Fuel gauge pickup
52. Rear lamp, left, with rear light, stop light, flasher and back-up light
53. Number plate light
54. Rear lamp, right, with rear light, stop light, flasher and back-up light

ILLUSTRATION OF WIRING DIAGRAM

from of No. 318950 to Ch. No. 312468, (GT model)



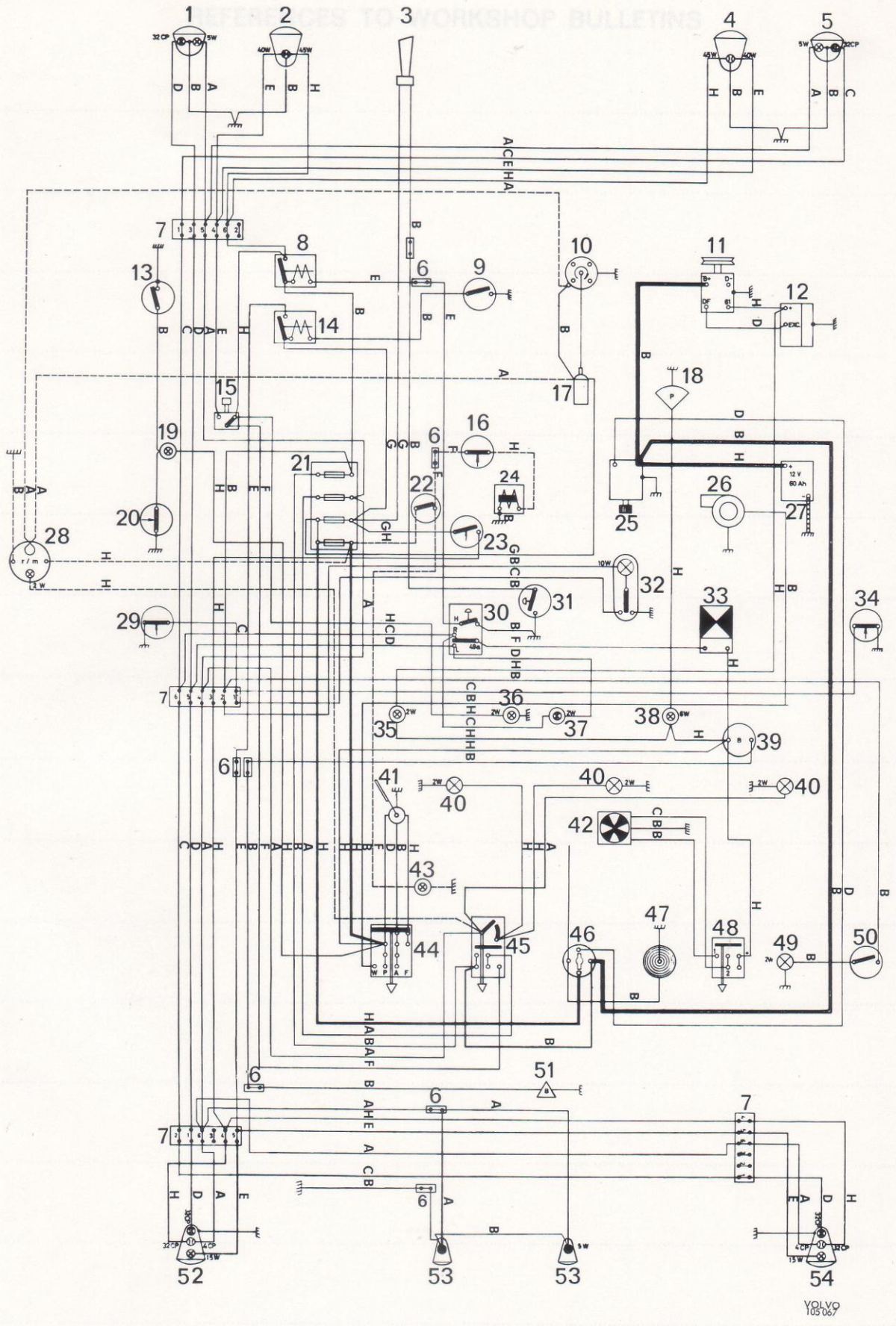


ILLUSTRATION 11. WIRING DIAGRAM  
 from ch. No. 312500, 2-door model, GT-model  
 from ch. No. 70300, Station Wagon

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## REFERENCES TO WORKSHOP BULLETINS

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