

Part 3

## ELECTRICAL SYSTEM

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## GROUP 30

# GENERAL

The electrical system is designed for a voltage of 12 V. The equipment is made up of the following main parts: Battery, alternator and voltage regulator,

starter motor, ignition system, lighting and other electrical standard equipment.

## GROUP 31

# BATTERY

## DESCRIPTION

The battery, Fig. 3-1, is placed on a shelf to the left of the radiator. It is a 12 V lead battery with a capa-

city of 60 amperehours and with the negative pole stud grounded.

## REPAIR INSTRUCTIONS

### REMOVING

1. Remove the cable terminals on the battery terminal studs. Use a puller if the cable terminals are stuck to the terminal studs.
2. Remove the securing 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.

### FITTING

1. Place the battery in position.
2. Refit the securing 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 about the plates. Ensure that the acid level is about 5 mm (3/16") above the plates. If the level is too low, fill with

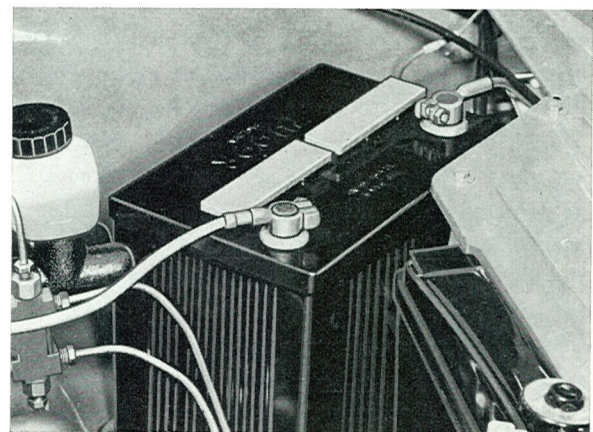


Fig. 3-1. Battery

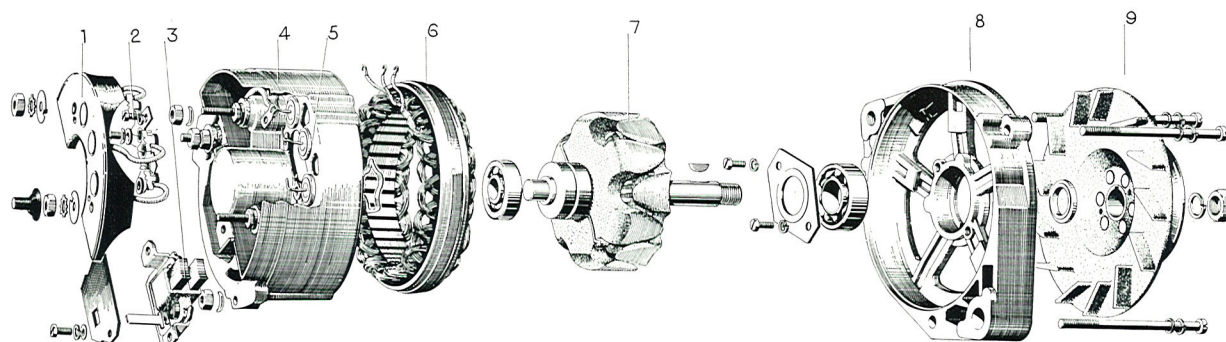
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distilled water to the extent necessary. Also make sure that the battery is securely fixed and that the cable terminals are well-tightened.

The cable terminals and battery terminal studs should be coated with a light layer of vaseline to prevent oxidation.

## GROUP 32

# ALTERNATOR DESCRIPTION



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Fig. 3-2. Alternator

- |  |                                |
|--|--------------------------------|
| 1. Rectifier<br>(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 490 W 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. As distinct from D.C. generators, the alternator has a rotating field (rotor) and stationary main winding (stator).

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

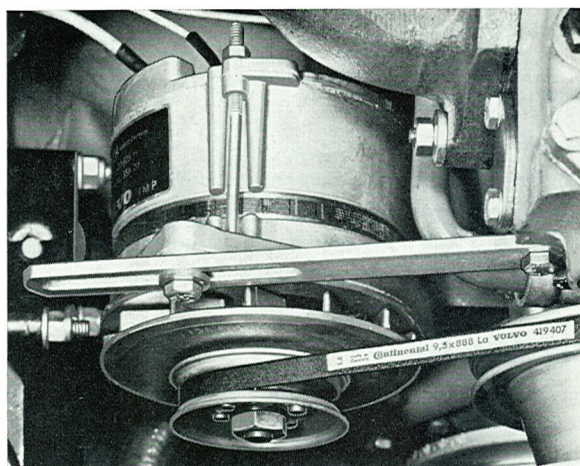
Since the alternator is self-limiting with regard to current (max. 35 amps.), a simple mechanical voltage regulator is used with only voltage control as its function.

## FUNCTION, ALTERNATOR — VOLTAGE REGULATOR

When the ignition is switched on, current flows through the charging control lamp to terminal D+ on the voltage regulator. From there the current is led to the field winding and is grounded.

Alternating current is formed in the stator when the rotor starts rotating. Most of the current is rectified

by the plus and minus 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 the voltage regulator and from there to the field winding. The procedure is



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Fig. 3-3. Alternator fitted



repeated until the regulating voltage has been reached, at which point the lower contacts (1, Fig. 3-25) on the voltage regulator 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 upper contacts (2, Fig. 3-25) close whereby the field winding is grounded at both ends the voltage falls quickly. The procedure is repeated continuously so that the voltage is maintained at a constant value.

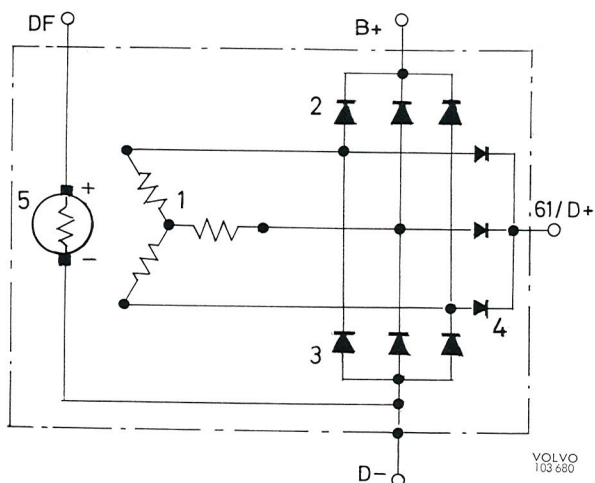


Fig. 3-4. Inner wiring of the alternator

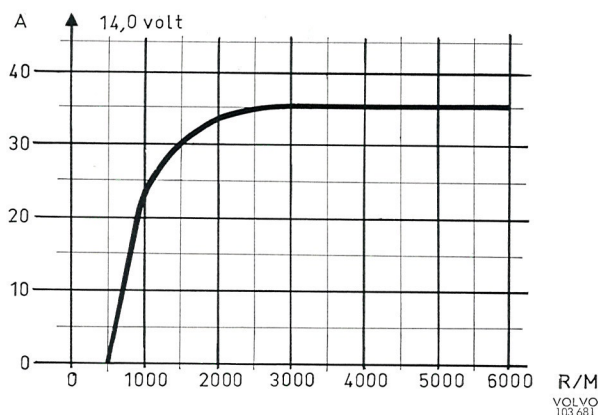


Fig. 3-5. Output curve for alternator  
A = amp RM = alternator speed/minute

## REPAIR INSTRUCTIONS

### SPECIAL INSTRUCTIONS FOR WORK ON ALTERNATOR EQUIPMENT

1. When replacing or fitting the battery, make sure that the new battery is connected with the correct polarity.
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 polarise the alternator since this is not necessary.
4. When charging the battery while installed in the vehicle, the negative battery lead should be disconnected.
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 two-pin 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.

### REMOVING THE ALTERNATOR

1. Disconnect the negative lead to the battery.
2. Disconnect the leads to the generator.
3. Remove the screw for the tensioning iron.
4. Remove the screw holding the alternator to the engine block.
5. Remove the fan belt and lift the alternator forward.

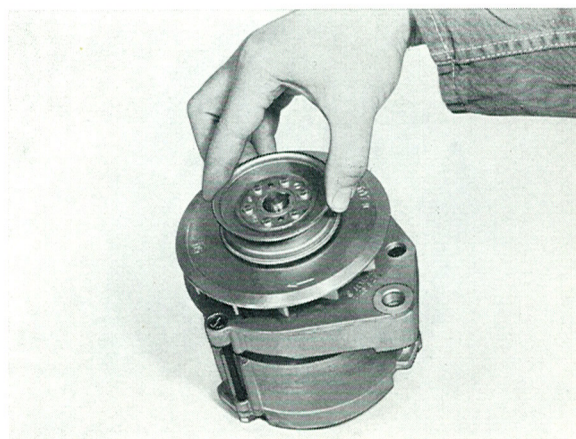


Fig. 3-6. Removing the pulley

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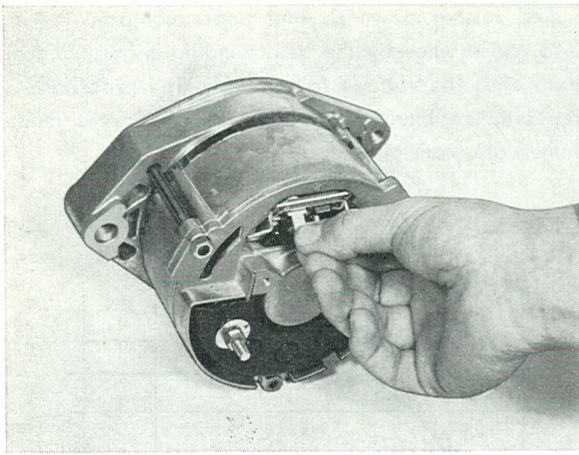


Fig. 3-7. Removing the brush holder

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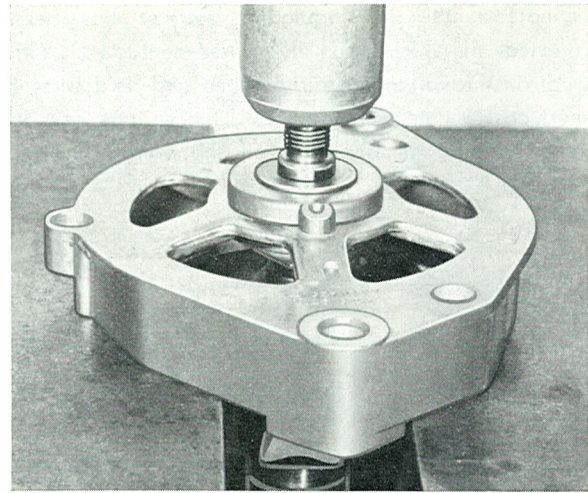


Fig. 3-9. Removing the rotor

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## DISMANTLING THE ALTERNATOR

1. Release 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. 3-7.
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. 3-9.
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 connecting 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. 3-13. The resistance should be 0.26 ohm + 10 %.

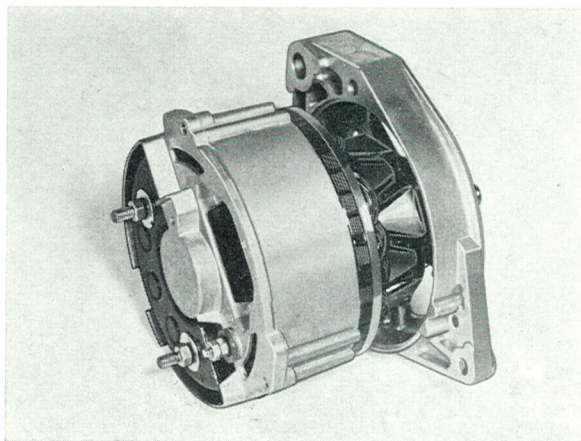


Fig. 3-8. Removing the rotor and drive end shield

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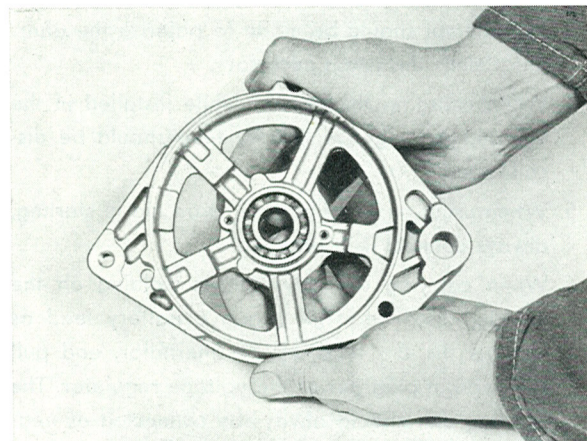


Fig. 3-10. Removing the drive end shield bearing

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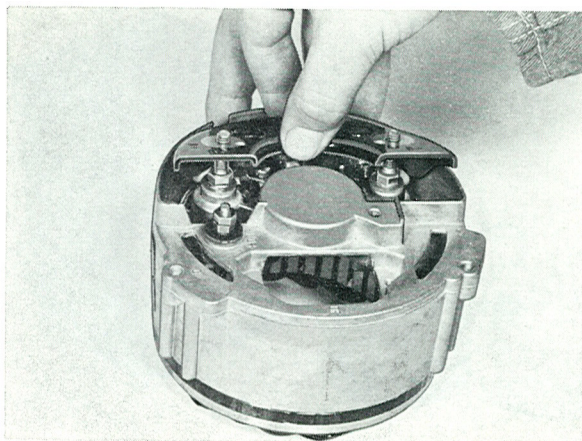


Fig. 3-11. Removing the positive diode plate

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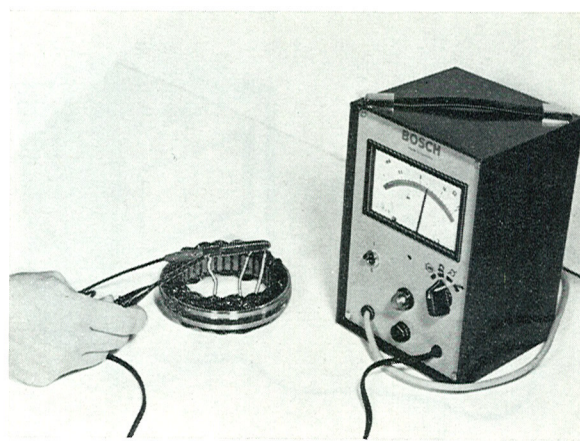


Fig. 3-13. Checking the stator resistance

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### ROTOR

Check the isolation of the rotor by connecting a 40 V alternating current between the rotor frame and a slip ring, see Fig. 3-14.

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 tailstock 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 isolation of the brush holder with a 40 V alternating current. Measure the length of the brush according to Fig. 3-16. Minimum length is 8 mm (0.32").

### DIODES

Check the diodes with the diode tester. If any of the diodes is faulty, it should be replaced as follows:

### REPLACING THE DIODES

#### POSITIVE DIODES

1. Solder loose the positive diode plate from the connecting 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 OL63V2).

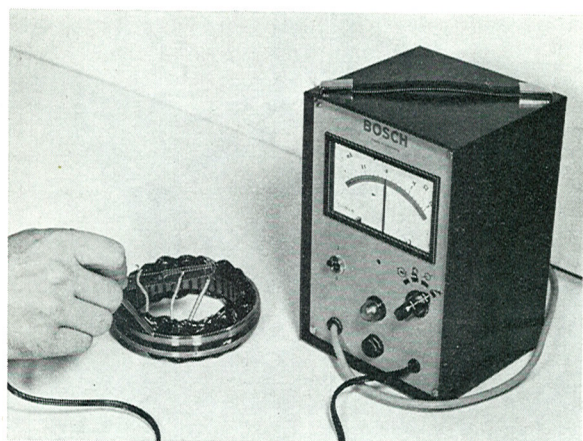


Fig. 3-12. Checking the stator isolation

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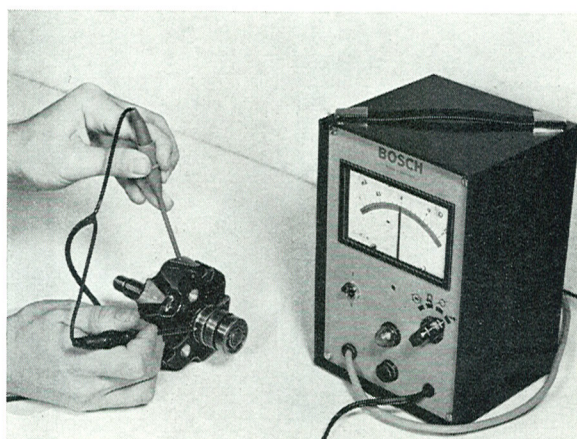


Fig. 3-14. Checking the rotor isolation

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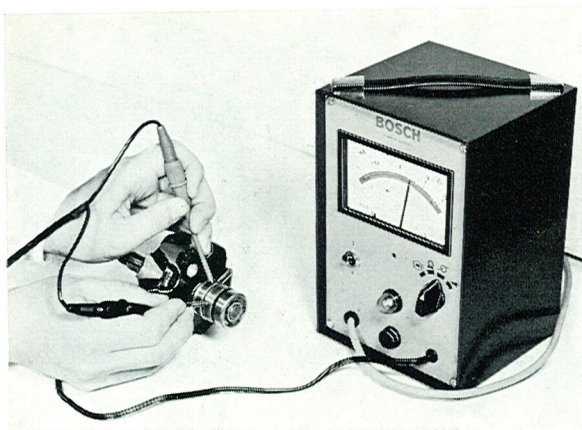


Fig. 3-15. Checking the rotor resistance

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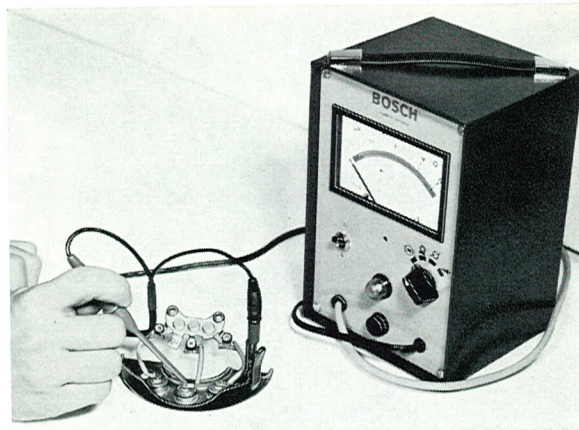


Fig. 3-17. Checking the diodes

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4. Paint the new diode and any bare spots on the outside of the cooling plate with black chlorinated rubber enamel (Bosch FL87V1 or corresponding) in order to prevent corrosion.
5. Solder the cooling plate to its original position. Check with the diode tester.

#### NEGATIVE DIODES

1. Solder loose the negative diodes from the connecting 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 OL63V2) and install it in the end shield.
4. Solder the negative diodes to the connecting points and check with the diode tester.

#### MAGNETIZING DIODES

1. If any of the magnetizing diodes is 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 connecting point. Fit the positive diode plate.
2. Grease the drive end bearing (use Bosch Ft1V34 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. 3-18.
4. Grease the slip ring end shield bearing (use Bosch Ft1V34 or corresponding). Coat the slip ring end shield bearing seat with a light layer of Molykotpaste and assemble the alternator. (Do not forget the spring ring on the slip ring end shield bearing seat). Secure the alternator parts together by means of the bolts and nuts. The bolts 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.).

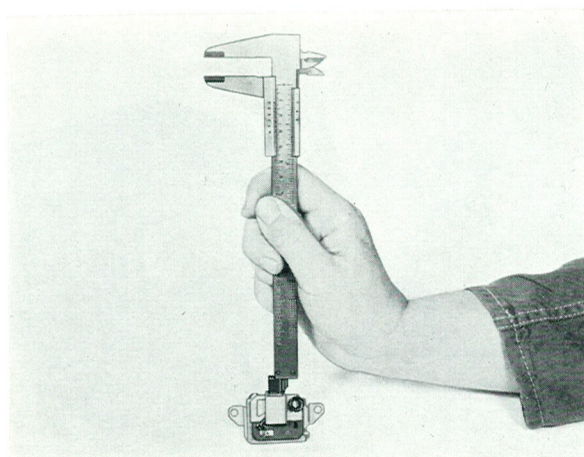


Fig. 3-16. Checking the brush length

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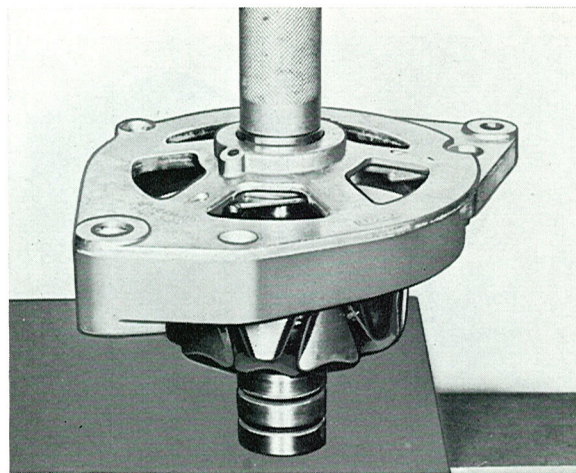


Fig. 3-18. Assembling the rotor and drive end shield

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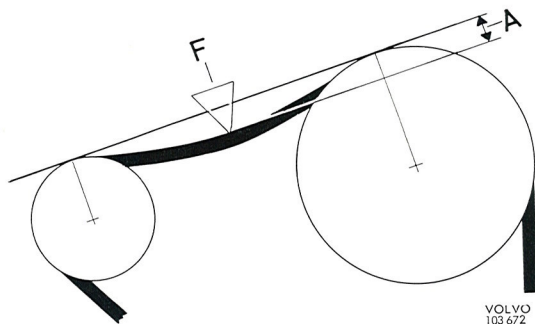


Fig. 3-19. Checking the belt tension

$F = 5.6-7.6 \text{ kp (12-17 lb.)}$      $A = 10 \text{ mm (approx. } 3/8\text{'')}$

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 car.

### 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.

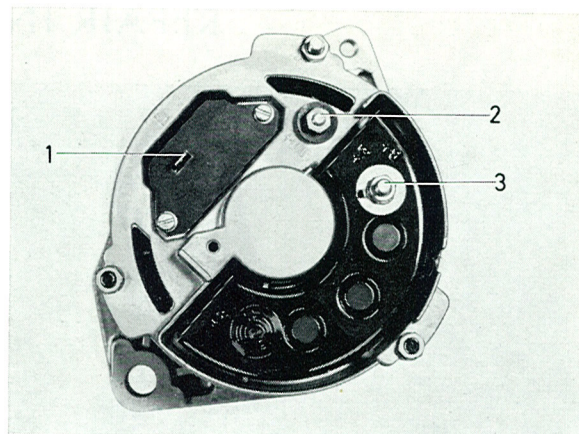


Fig. 3-20. Alternator connections

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

(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.).

N.B. When adjusting the belt tension, force may only be applied to the front end of the alternator.

4. Refit the leads to the alternator.
5. Refit the negative lead to the battery.

## VOLTAGE REGULATOR

### DESCRIPTION

The voltage regulator is mounted on the front end to the right of the radiator, see Fig. 3-21. The regulator is mechanical and has only one coil, a voltage coil.

The voltage regulator is a two-contact type with one lower and one upper control range. Temperature compensation is operated by a bi-metal spring.



## REPAIR INSTRUCTIONS

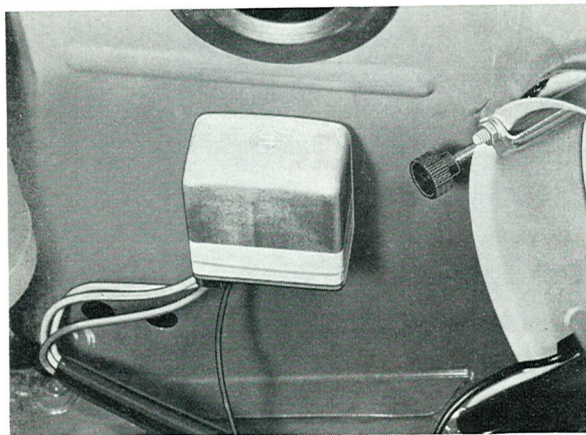


Fig. 3-21. Voltage regulator fitted

### REPLACING THE VOLTAGE REGULATOR

1. Remove the negative battery lead.
2. Pull the two-pin plug out of the voltage regulator.
3. Remove the bolts and change the regulator.
4. Secure the new regulator and insert the pin plug in the regulator.
5. Refit the negative battery lead.

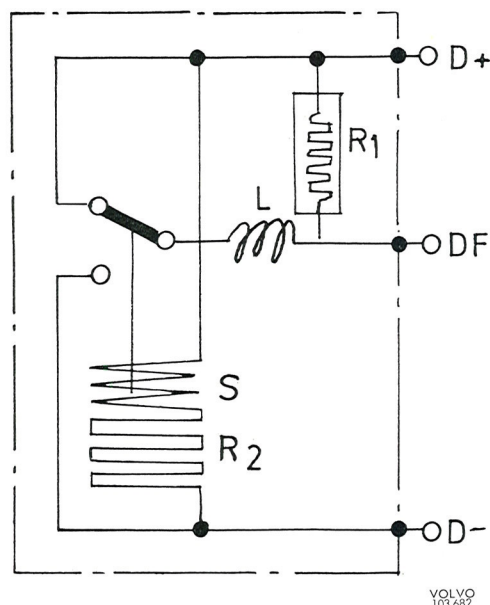


Fig. 3-22. Inner wiring of voltage regulator

- 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

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

## 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 cable can result in the alternator and regulator being damaged.

When about to connect up instruments, the battery should be disconnected.

### TESTING THE ALTERNATOR CIRCUIT

Before any tests are carried out on the alternator or regulator in the car, the battery should be checked and the car wiring tested with regard to faulty leads or isolation, loose or corroded lead terminals and poor grounding. 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 ground 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 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 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 connection D—. Here the voltage drop must not exceed 0.2 volt. If the voltage drop exceeds 0.2 volt, check the battery ground lead, the alternator contact with the engine and the engine contact with the chassis. After making the necessary repairs, measure again.

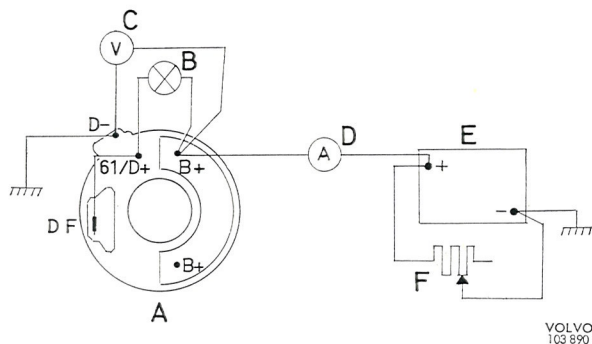


Fig. 3-23. Wiring diagram for testing alternator

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

## TESTING THE ALTERNATOR

(In a test bench or in the car).

Connect the alternator as shown in Fig. 5-23.

Run the alternator to 2000 r.p.m. (engine speed 1000 r.p.m. until the alternator has become warm, about 140° F). When the alternator has become warm, it should then give at least 23 amps at about 14 volts (speed 2000 r.p.m.).

(Regulate the voltage by means of the load resistance F, see Fig. 3-23).

Increase the alternator speed to 4000 r.p.m. (engine speed 2000 r.p.m.) and check that the warning lamp does not glow or light. If the alternator does not meet the above requirements, check first the brush holder and diodes.

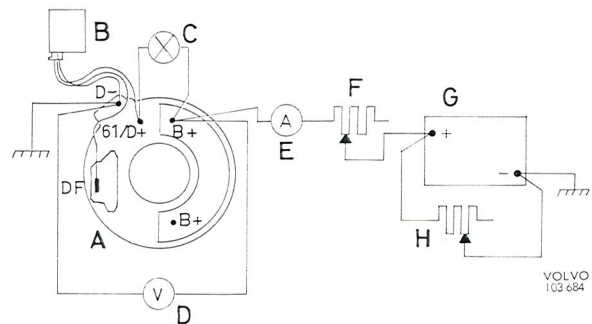


Fig. 3-24. Wiring diagram for testing voltage regulator

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

## TESTING AND ADJUSTING THE VOLTAGE REGULATOR

(In a test bench or in the car).

Connect the regulator to an alternator as shown in Fig. 3-24.

Run the alternator to 4000 r.p.m. (engine speed 2000 r.p.m.). Load the alternator with 28—30 amps. Lower the alternator speed to about 1000 r.p.m. (in the vehicle, idling speed), raise the speed again to 4000 r.p.m. (engine speed 2000 r.p.m.) and adjust the load to 28—30 amps. Read off the voltmeter. The voltage should be 14.0—15.0 volts. The regulator should be regulated on the left (lower) contact (1, Fig. 3-25). The reading should be made within 30 seconds after the test has begun.

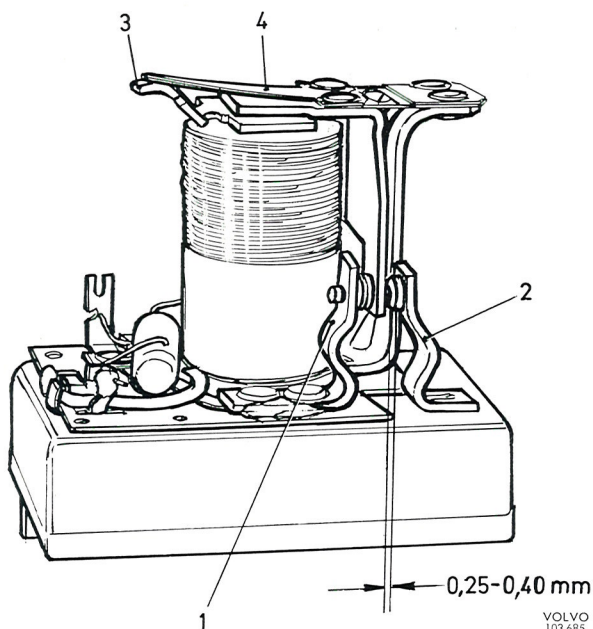


Fig. 3-25. Voltage regulator

1. Regulator contact for lower control range (lower contact)
2. Regulator contact for upper control range (upper contact)
3. Stop clamp
4. Spring upper section: Steel spring  
lower section: Bimetal spring

Reduce the load on the alternator to 3—8 amps and read off the regulator voltage. The voltage should now lie within the tolerance minus 0.9 volt to plus 0.2 volt in relation to the first reading. The regulator should now be regulated on the right (upper) contact (2, Fig. 3-25).

The regulator voltage in the lower regulator range is adjusted by bending the stop clamp for the bi-metal spring, see Fig. 3-26.

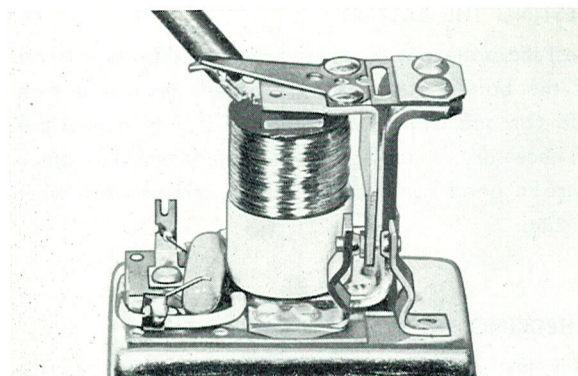


Fig. 3-26. Adjusting the regulator voltage

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 (minus 0.1 volt to plus 0.2 volt), this is adjusted by bending the holder for the left (lower) contact and correcting at the same time the distance between the right (upper) contact and the movable contact according to Fig. 3-25.

If the holder is bent towards the right (upper) contact, the regulating voltage reduces in the upper regulating range. In order to avoid faulty adjustment due to residual magnetism in the iron parts of the regulator, it is necessary to reduce the alternator speed down towards 0 after each adjustment and then to increase the speed and make a new reading.

# 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.

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

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

Short-circuiting in a positive diode.

Test lamp between 61/D+ and body 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.

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

2.0—2.5 amps

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

#### Warning lamp lights with engine standing and running

Disconnect the plug at the regulator:  
Control lamp still lights.

Short-circuiting in the circuit between D+ on regulator and 61/D+ on the alternator.

Warning lamp goes out. Refit the plug in the regulator and connect an ammeter between B+ and D+ on the alternator. Read off the value on the ammeter:

Less than 2.0—2.5 amps.

Defective regulator (breakage).

Greater than 2.0—2.5 amps.

Short-circuiting in the circuit between DF on the regulator and DF on the alternator. Short-circuiting in the rotor winding.

**Warning lamp lights with engine standing but starts to give a weak light  
when the engine is running**

Test lamp between B+ and 61/D+ on the alternator  
with the engine running:

Does not light.

Transition resistance in the charging circuit or in the  
lead to the warning lamp.

Gives weak light

Defective regulator (overcharging of the battery) or  
defective alternator (insufficient charging of the bat-  
tery).

Fit new regulator.

Test lamp between B+ and 61/D+ :

Does not light

Removed regulator defective.

Gives weak light.

Defective alternator.



## GROUP 33

# STARTER MOTOR

## TOOLS

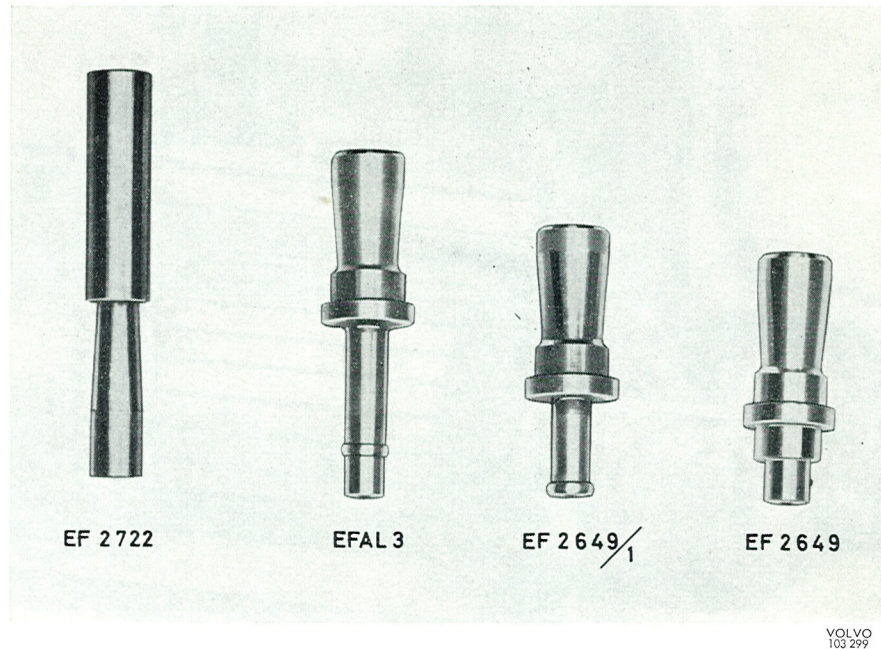


Fig. 3-27. Bosch special tools

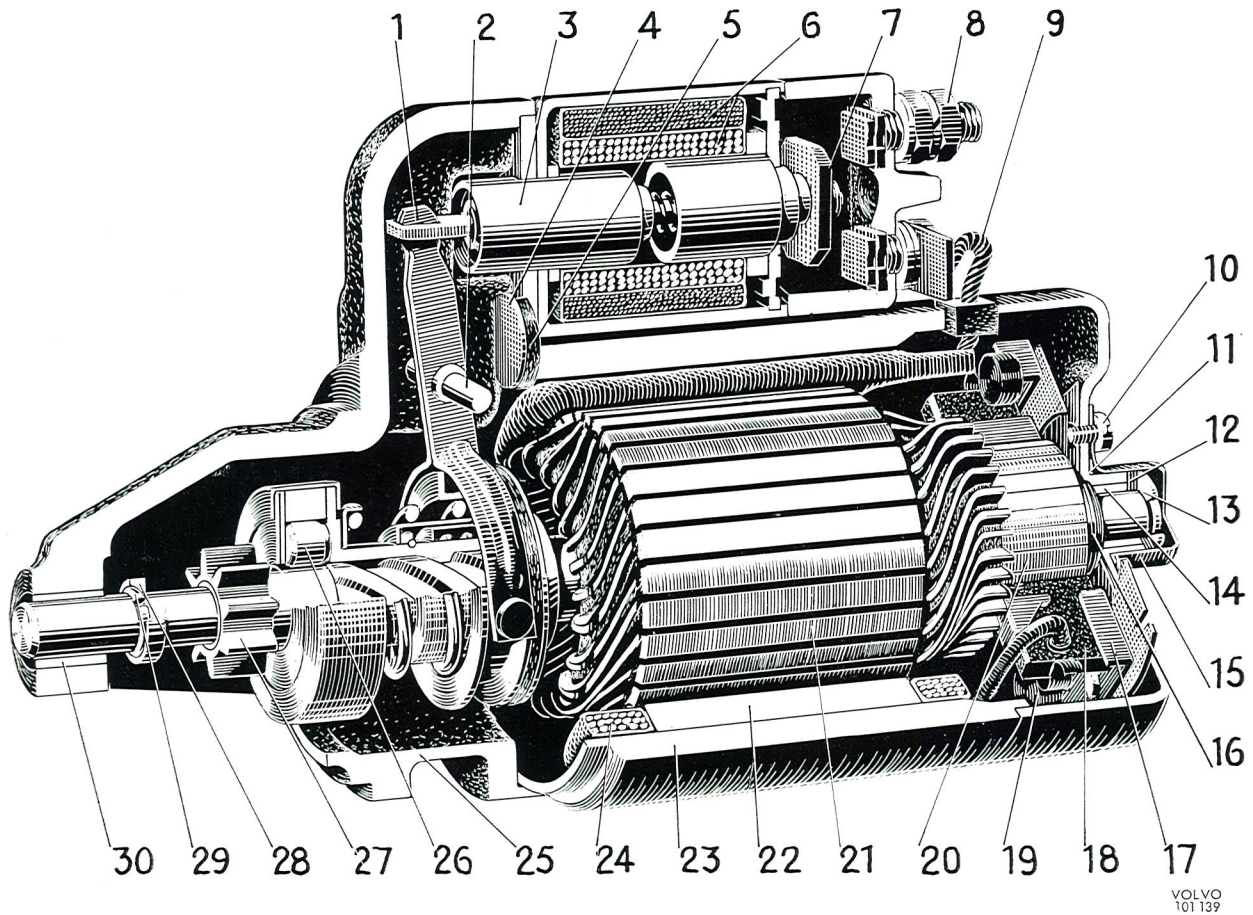
- |          |                                      |
|----------|--------------------------------------|
| EF 2722  | Sleeve and drift for fitting circlip |
| EFAL 3   | Smoothing drift                      |
| EF2649/1 | Smoothing drift                      |
| EF 2649  | Drift for fitting bush               |

## DESCRIPTION

The starter motor, Fig. 3-28, is mounted on the flywheel housing on the left-hand side of the engine. It consists of a 4-pole series-wound motor. The pinion on the starter motor rotor shaft moves axially to engage with the flywheel ring gear. The pinion is controlled by a solenoid.

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

# REPAIR INSTRUCTIONS



VOLVO  
101 139

Fig. 3-28. Starter motor

- |                              |                       |                    |
|------------------------------|-----------------------|--------------------|
| 1. Engaging arm              | 11. Rubber gasket     | 21. Rotor          |
| 2. Pivot pin (bearing screw) | 12. Shims             | 22. Pole shoe      |
| 3. Armature                  | 13. Circlips          | 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           |

## REMOVING

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



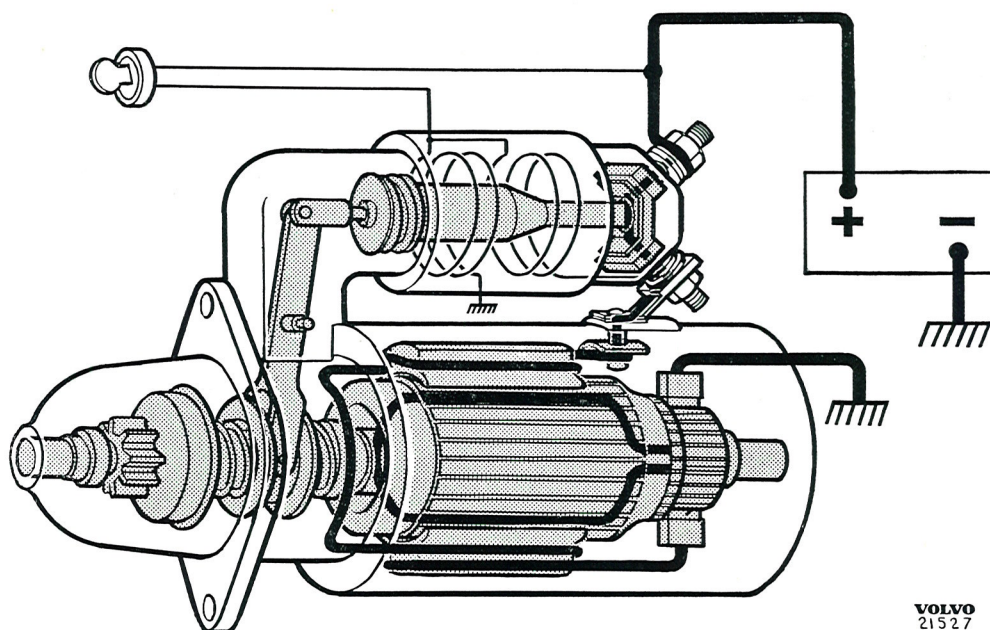


Fig. 3-29. Starter motor, general arrangement

### DISMANTLING THE STARTER MOTOR

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. 3-32 and 3-33.
3. Remove the two bolts holding the commutator bearing shield and remove the shield.
4. Lift up the brushes and retainers.
5. Remove the brush bridge from the rotor shaft.

N.B. The washers are as shown in Fig. 3-35.

When the bridge is removed, the negative brushes follow also, but the positive brushes will remain in the field winding.

6. Unscrew the nut which holds the field terminal connection to the control solenoid.
7. Unscrew the attaching screws for the control solenoid. Remove the solenoid.
8. Remove the drive end shield and rotor from the stator.
9. Remove the rubber washer and metal washer, see Fig. 3-37.
10. Remove the screw on which the engaging arm is carried.
11. Lift the rotor with pinion and arm out of the drive end shield.

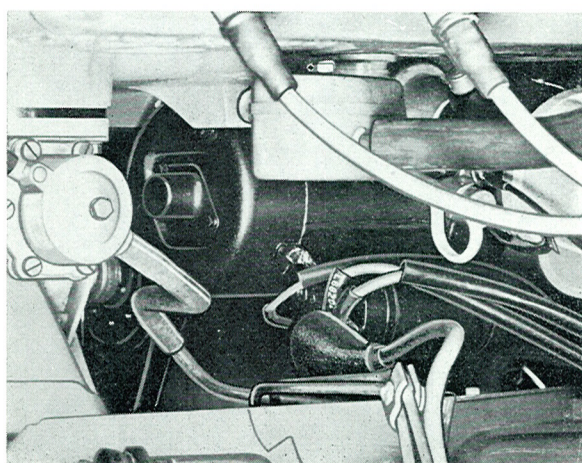


Fig. 3-30. Starter motor installed

VOLVO  
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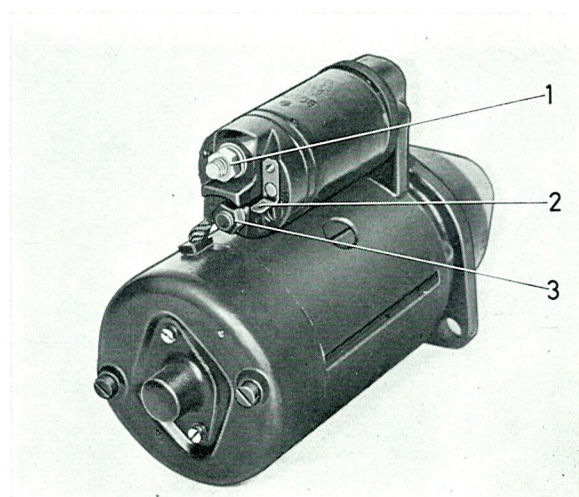


Fig. 3-31. Starter motor terminals

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

VOLVO  
103 675



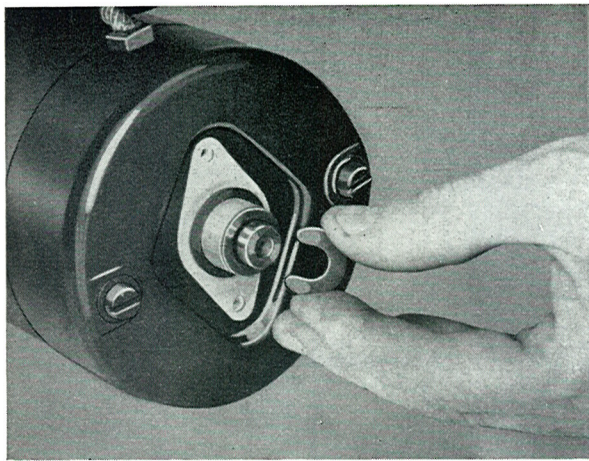


Fig. 3-32. Removing the lock washer

VOLVO  
101 066

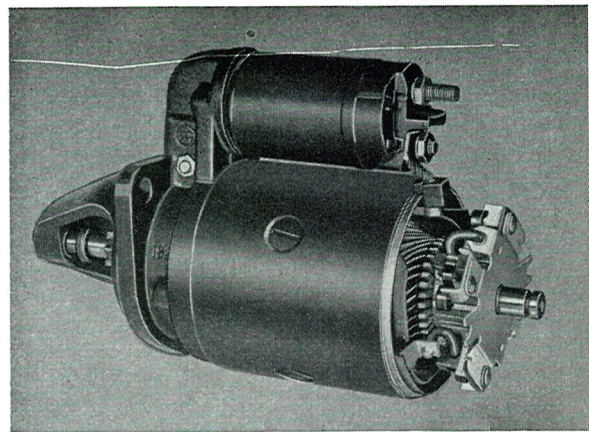


Fig. 3-34. Starter motor with bearing shield removed

VOLVO  
101 064

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.

## INSPECTING

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

If the rotor shaft is bent or worn, the rotor should be replaced.

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 turning. 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. 3-39 and 3-40. 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 blade a few mm from the rotor, see Fig. 3-41. If the blade vibrates in any position when the rotor is rotated, one of the following faults can be reason: Shorting through the rotor frame, shorting in the commutator or between the windings.

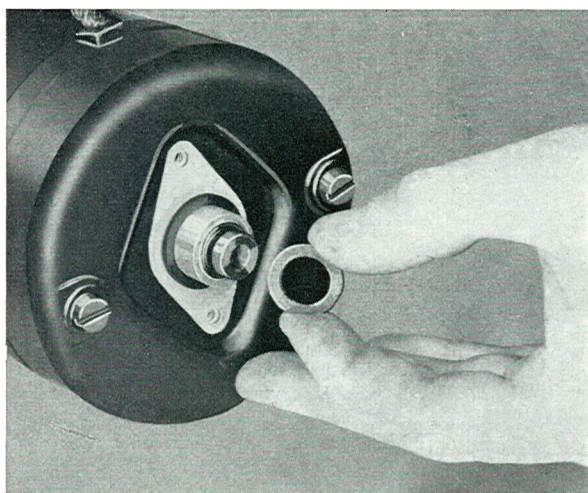


Fig. 3-33. Removing adjusting washers

VOLVO  
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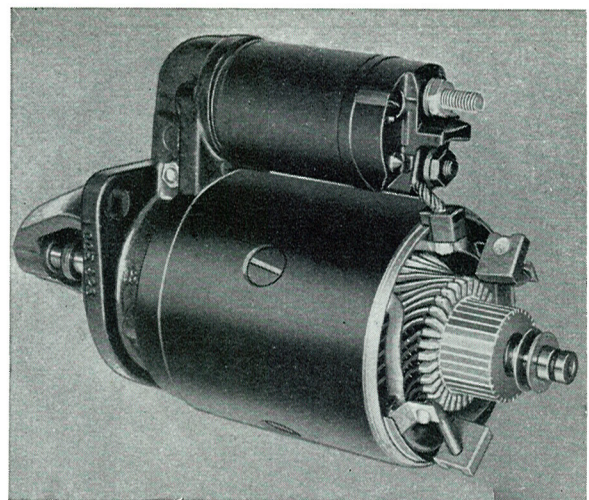


Fig. 3-35. Starter motor with brush bridge removed

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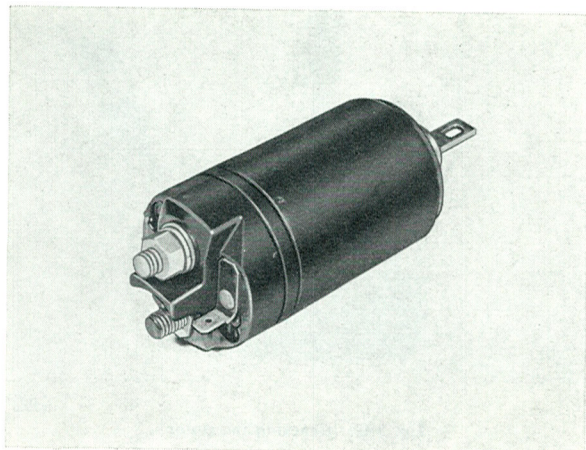


Fig. 3-36. Control solenoid

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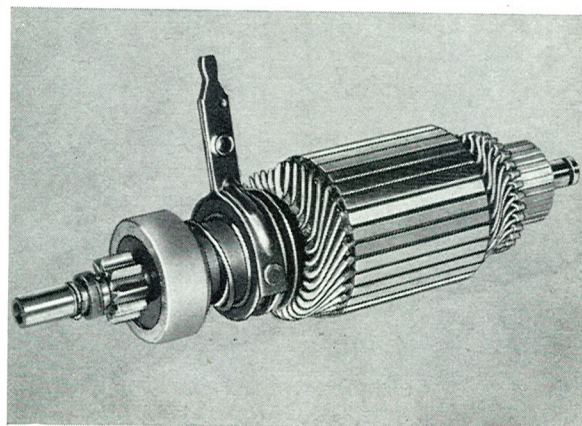


Fig. 3-38. Rotor with pinion

VOLVO  
101 080

Check the stator with 40 volts A.C., see Fig. 3-42. 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 replaced with a new one, since when being removed it may have been damaged or lost its tension.

### CHECKING THE CONTROL SOLENOID

If the control 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 control solenoid contact screw for the control lead. If the control solenoid still does not engage the starter pinion and main current, it should be removed from the starter

motor. If, on the other hand, it engages satisfactorily, examine the starter switch and leads.

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

### REPLACING THE BRUSHES

When replacing the brushes, the starter motor is removed and dismantled. 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 the brushes in the brush holders and may reduce the brush spring pressure. Brushes which have worn down less than 14 mm (approx. 1/2") should be replaced with new ones.

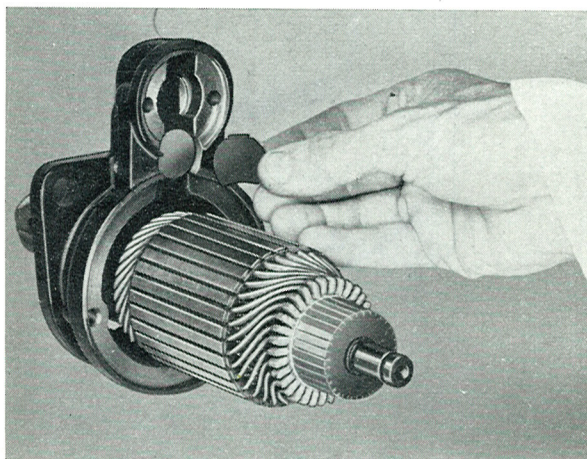


Fig. 3-37. Removing the sealing washer

VOLVO  
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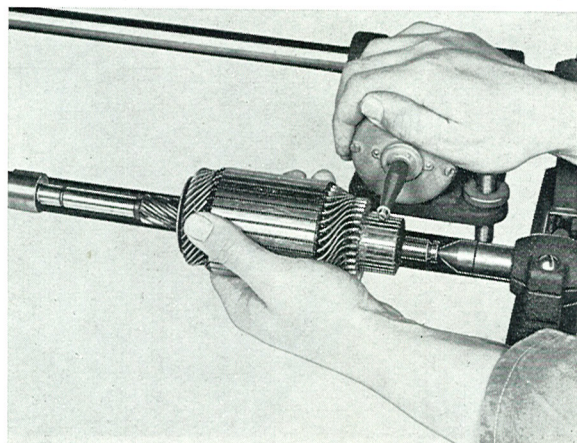


Fig. 3-39. Milling the commutator

VOLVO  
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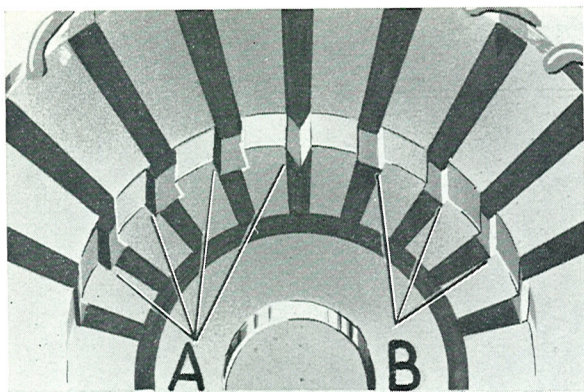


Fig. 3-40. Commutator milling  
A. Incorrect milling B. Correct milling

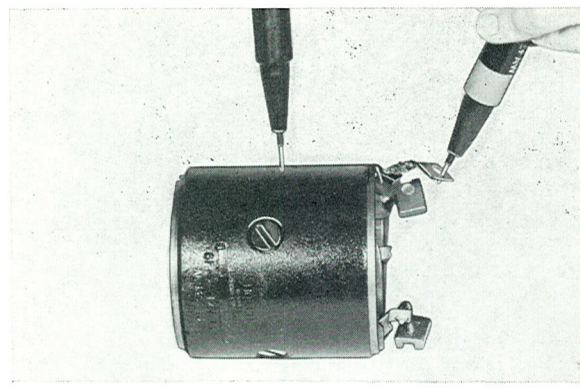


Fig. 3-42. Checking the stator

### FITTING THE SELF-LUBRICATING BUSHES

The self-lubricating bushes are only worn insignificantly during operation if they are lubricated in the correct manner. If lubricating is neglected, the bushes dry out, with the result that they wear quickly. For replacement purpose, bushes are supplied ready-machined to suitable dimensions. When being fitted, the bushes should not be machined 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.

N.B. Before a self-lubricating bush is fitted, it should lie in light oil for at least a 1/2 hour.

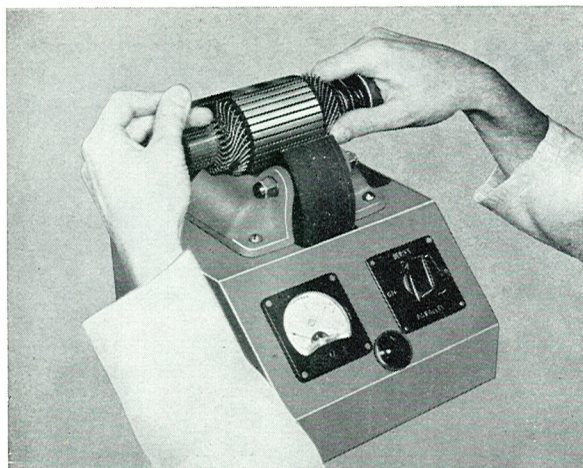


Fig. 3-41. Testing the rotor

### REPLACING THE FIELD WINDING

1. If the starter motor has not been dismantled, this must be done. Follow the instructions under the heading "Dismantling".
2. Mark the pole shoes and pole housing in a suitable manner so that they come in the same position when assembling.
3. Then place the stator in the holding device as shown in Fig. 3-43 (Bosch EF AW 9) or similar and unscrew the pole screws.
4. Before fitting new field coils, warm them slightly.

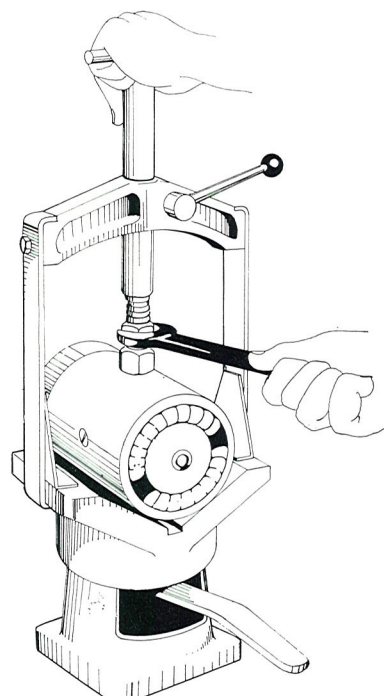


Fig. 3-43. Holding device for removing field winding



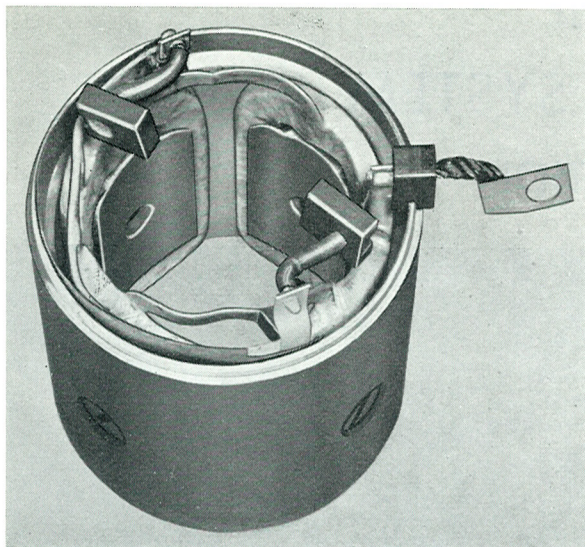


Fig. 3-44. Stator with soldered brushes

VOLVO  
101078

Then place the pole shoes in position in the field coils and slide them into the stator. Tighten the pole screws lightly. Press in a suitable drift. Set up the stator in the holding device and tighten the pole shoes firmly.

5. Force out the press drift with a drift press. Check the fitted field windings for breakage and short-circuiting.

## ASSEMBLING THE STARTER MOTOR

1. Lubricate the parts of the starter motor according to Fig. 3-46.

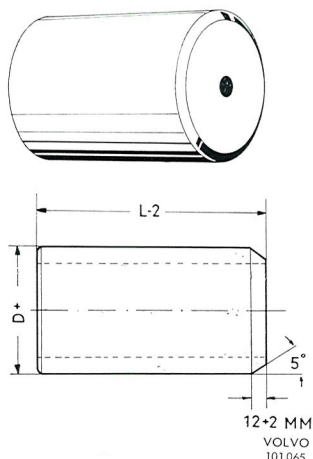
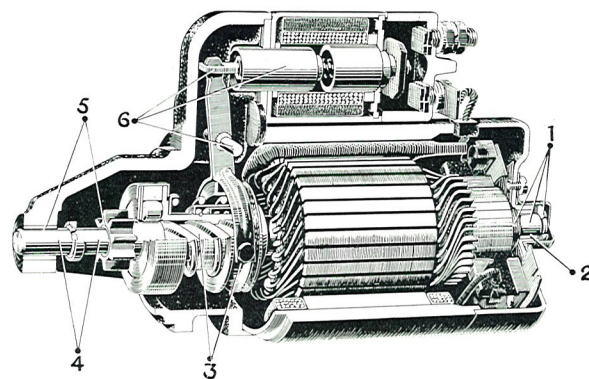


Fig. 3-45. Press drift for fitting field winding  
D = 66.4—66.09 mm (2.599—2.602") L = 85 mm (3.346")



VOLVO  
102968

Fig. 3-46. 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 bush in oil for 1 hour before fitting.
3. Ft 2 V 3. Apply plenty of grease in the rotor thread and the engaging lever groove.
4. Ft 2 V 3. Place a thin layer of grease on the rotor shaft.
5. OI 1 V 13. Place the bushes in oil for a 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.

2. Fit the starter pinion on the rotor shaft, and the wear washer as well as the circlip. Secure the wear washer in position.
3. Fit the engaging arm on the pinion. Fit the rotor in the 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. 3-35.
9. Place the brush bridge in position. Fit the brushes.
10. Fit 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 casting over the shaft end.

## FITTING

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



# IGNITION SYSTEM

## DESCRIPTION

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

### IGNITION COIL

The ignition coil is fitted on the firewall, see Fig. 3-47. The function of the ignition coil is to transform the battery voltage to high tension voltage for the spark plugs. It consists of a core of laminated metal around which is a winding of heavy copper wire, the primary winding, and a winding of fine copper wire, the secondary winding. The primary winding operates at battery voltage from the distributor contact breakers. The other winding, the high-tension winding, is connected to the center terminal on the distributor cap, from where the high-tension current is distributed to the engine spark plugs.

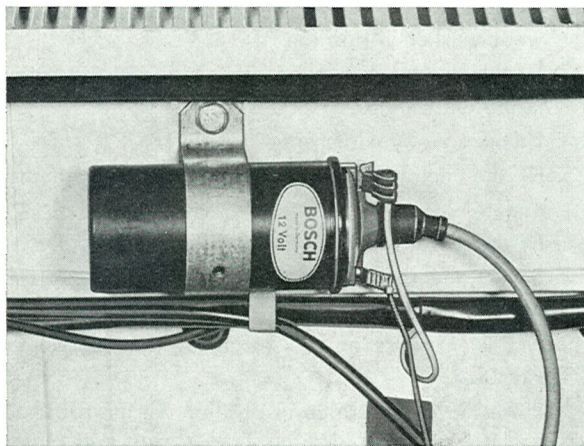


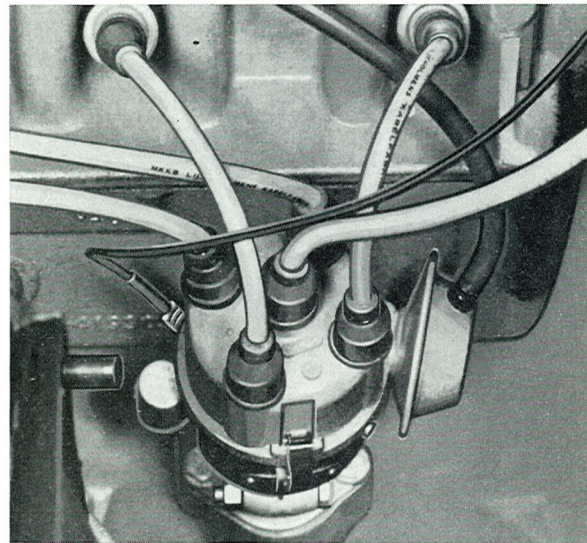
Fig. 3-47. Ignition coil fitted

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### DISTRIBUTOR

The distributor, Figs. 3-48 and 3-49, is fitted on the left-hand side of the engine and is driven from the camshaft. The adjustment of the distributor in relation to engine speed is regulated by a centrifugal governor fitted under the breaker plate. The adjustment in relation to loading is controlled by a vacuum regulator.

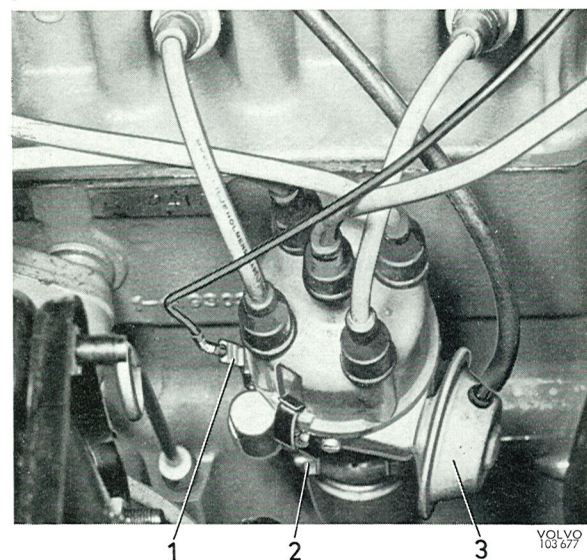
The vacuum regulator on the B 20 A engine raises the firing when the load on the engine reduces. On the



VOLVO  
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Fig. 3-48. Distributor B 20 A fitted

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



VOLVO  
103 677

Fig. 3-49. Distributor B 20 B fitted

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





# 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 connection, 1 Fig. 3-49.
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. 3-49) and pull up the distributor.

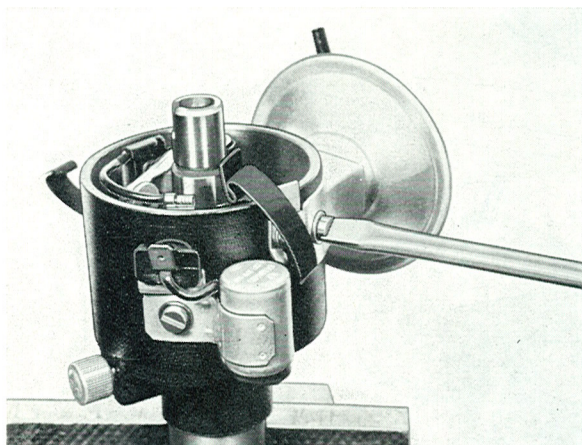


Fig. 3-51. Removing the vacuum regulator

VOLVO  
103717

### DISMANTLING

1. Pull off the distributor arm.  
Remove the circlip for the pull rod from the vacuum regulator.  
Remove the vacuum regulator according to Fig. 3-51.
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 connection, Fig. 3-52.  
Lift up the breaker plate.
3. Disconnect the springs for the centrifugal governor and mark up how the breaker cam is located in relation to the distributor shaft. Secure the

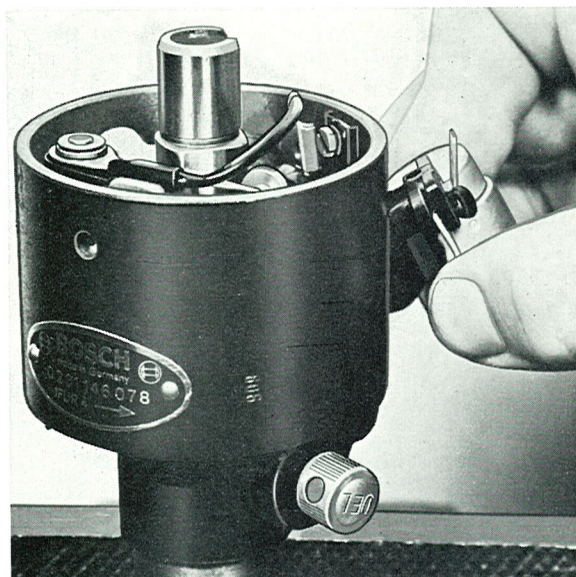


Fig. 3-52. Removing the primary connection

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103720

breaker cam in a vice with soft jaws. Carefully knock on the distributor housing with a plastic mallet (Fig. 3-53) until the circlip (5, Fig. 3-50) has released.

4. Remove the resilient ring (13, Fig. 3-50) and mark up how the driving collar (11, Fig. 3-50) is located in relation to the distributor shaft.

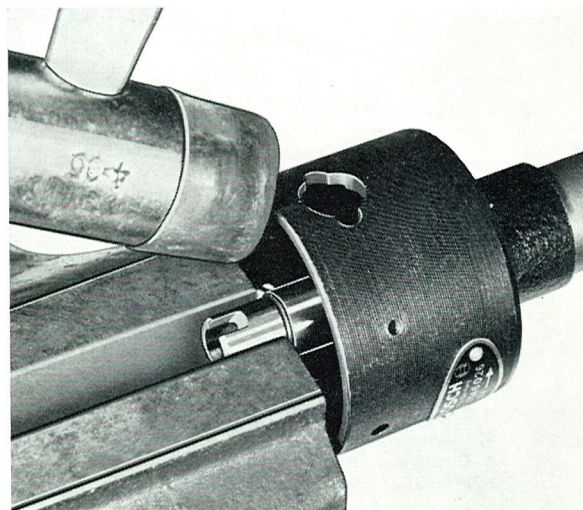


Fig. 3-53. Removing the circlip

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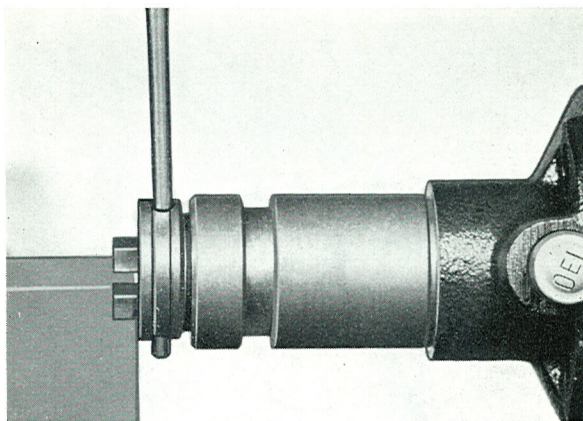


Fig. 3-54. Removing the driving collar

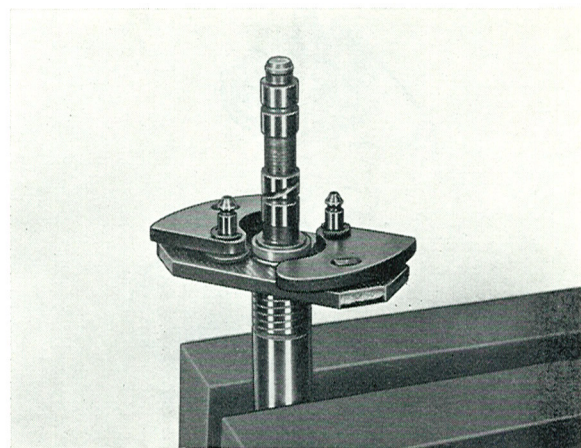


Fig. 3-55. Distributor shaft with centrifugal weights

Tap out the pin (Fig. 3-54), 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 breaker points should be flat and smooth. The colour of the contacts should be grey. Oxidized or burnt contacts must be replaced. After a long period of use, the contact lip can be worn and the spring fatigued, so that the contacts should be replaced if the distributor for any reason is disassembled.

The contact plate must not be loose, worn or have burr on.

### Distributor shaft

The play between the distributor shaft and the breaker camshaft must not exceed 0.1 mm (0.004").

The cams on the breaker camshaft 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 play between the distributor housing and the shaft should not exceed 0.2 mm (0.008"). If the play 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. 3-56.
2. Fit the centrifugal weights and also the lock springs on to the weights. Fit the breaker camshaft on to the distributor shaft. Hook on the springs for the centrifugal governor. Fit the washer and circlip for the breaker camshaft. 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 connection 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 contacts with trichloroethylene or chemically pure gasoline.

Run the distributor on a test bench and check according to the "Specifications".



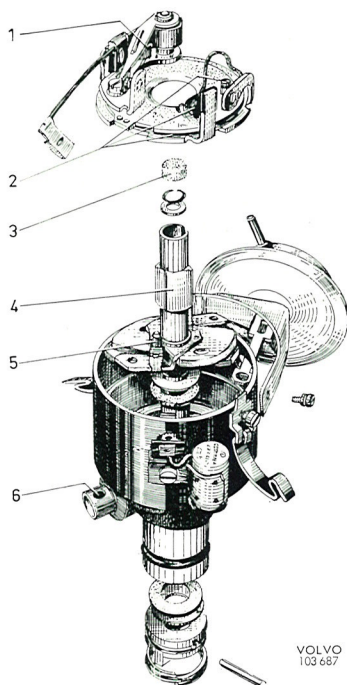


Fig. 3-56. Lubricating scheme for distributor

Use Bosch Lubricant (or equivalent) according to below.

1. Ft 1 v 4. Place a little grease on the contact lip
2. Ft 1 v 26. Grease
3. Ol 1 v 13. Lubricate
4. Ft 1 v 4. A very light layer of grease
5. Ft 1 v 26. Grease
6. Ol 1 v 13. Fill with oil

### REPLACING THE CONTACT BREAKER

The contact breaker can be replaced with the distributor fitted, but it **should** be done with the distributor dismantled.

1. Remove the distributor rotor arm.
2. Disconnect the electric lead at the primary connection.
3. Remove the screw for the contact breaker and lift up the old contacts.
4. Lubricate the distributor according to the instructions given in Fig. 3-56.
5. Fit the new contact breaker.
6. Connect the electric cable at the primary connection.
7. Check that the contact breaker is located correctly both vertically and horizontally.

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 trichloroethylene or chemically pure gasoline.

Run the distributor on a test bench and check according to the "Specifications".

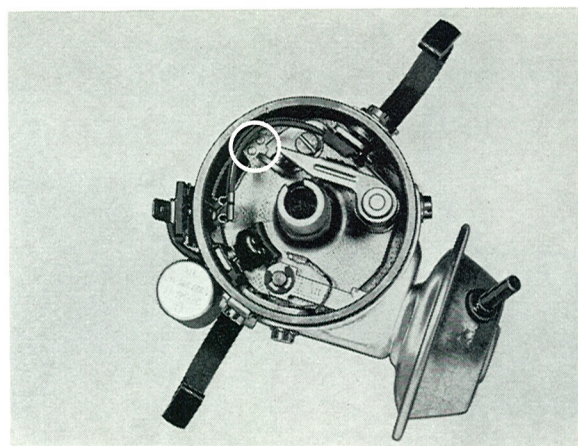


Fig. 3-57. Recess for adjusting the contact breaker

### TESTING THE DISTRIBUTOR IN TEST BENCH

1. Run the distributor at 500 r.p.m. in its ordinary direction of rotation (anti-clockwise) and adjust the contact breaker dwell angle according to the "Specifications".
2. Adjustment is made by slackening a little the screw for the breaker contacts and then inserting a screwdriver in the recess, Fig. 3-57, and turning the screwdriver until the dwell angle is the correct one.  
Then tighten the screw for the contact breaker.
3. Run the distributor and set the protractor on the test bench so that a marking comes opposite 0° at such a low speed (below 300 distributor r.p.m.) that the centrifugal governor 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°. 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 distributor arm, 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).

## IGNITION SETTING

Ignition setting should always be carried out while the engine is running and with the help of a Stroboscope.

1. Clean the flywheel damper so that the graduation marks are visible, see Fig. 3-58.
2. Remove the hoses 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. Slacken the distributor (3, Fig. 3-49) and

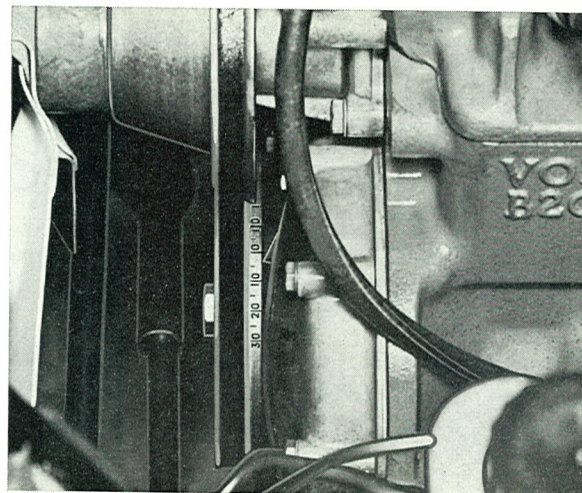


Fig. 3-58. Graduation for ignition setting

VOLVO  
103 721

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 refit the hose on the vacuum regulator.

## GROUP 35

# LIGHTING

## DESCRIPTION

The lighting consists of two full- and dipped-beam headlights, Fig. 3-59, parking lamps, rear lamps and number plate light.

The headlights are fitted in the grille. They are switched on and off by the lighting switch on the instrument panel. Switching between full- and dipped-

beam positions is done by moving the directional indicator lever switch towards the steering wheel. The relay (2, Fig. 3-77) then connects up the lighting.

The rear lights have separate bulbs for rear lights, stop lights, reverse lights and directional indicators.

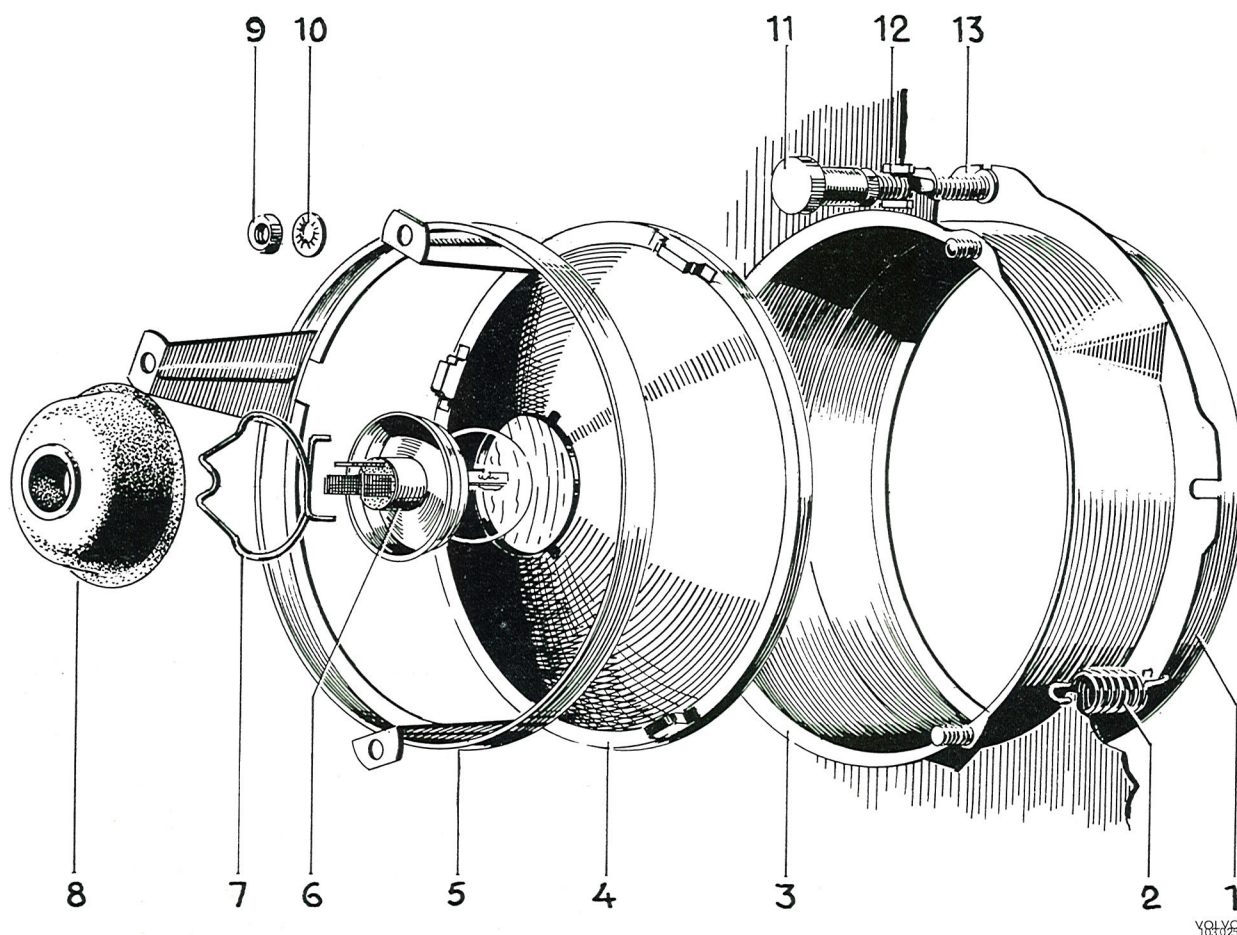


Fig. 3-59. Headlight

- |                       |                   |
|-----------------------|-------------------|
| 1. Ring               | 8. Rubber cover   |
| 2. Spring             | 9. Nut            |
| 3. Retainer           | 10. Tab washer    |
| 4. Insert             | 11. Adjusting nut |
| 5. Ring               | 12. Nut           |
| 6. Bulb holder        | 13. Screw         |
| 7. Bulb holder spring |                   |



# REPAIR INSTRUCTIONS

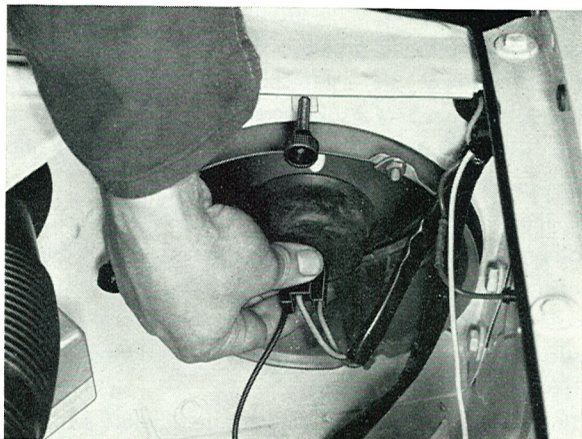


Fig. 3-60. Removing the connecting contact

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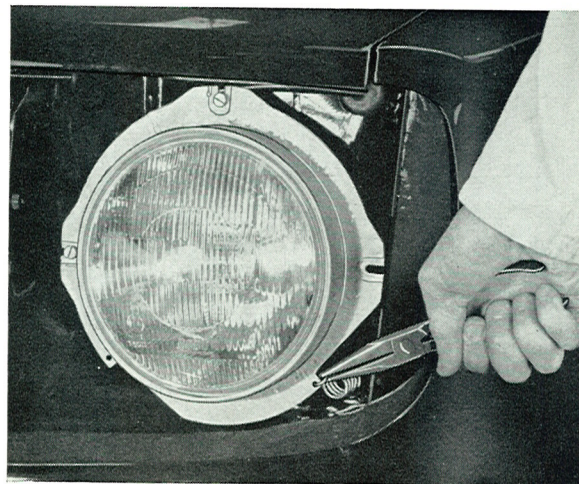


Fig. 3-62. Removing the spring

VOLVO  
102 006

## HEADLIGHTS

### REMOVING

1. Remove the grille. Disconnect the connecting contact for the cables by pulling it straight back. See Fig. 3-60. Remove the two adjusting buttons by pulling them straight back, see Fig. 3-61. Unhook the spring on the lower side of the headlight. See Fig. 3-62.
2. Unscrew the two long screws and lift out the insert with the bowl. The insert is released from the bowl by removing the three nuts securing the inner ring to the bowl. The plastic nut can be removed by pressing the tabs together with pliers and taking them out through the hole in the grille.

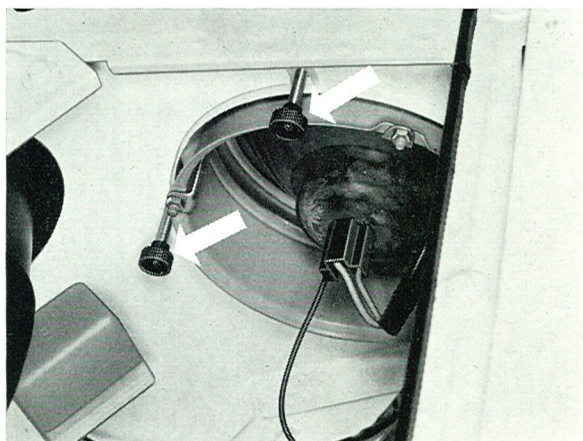


Fig. 3-61. Adjusting button

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103 723

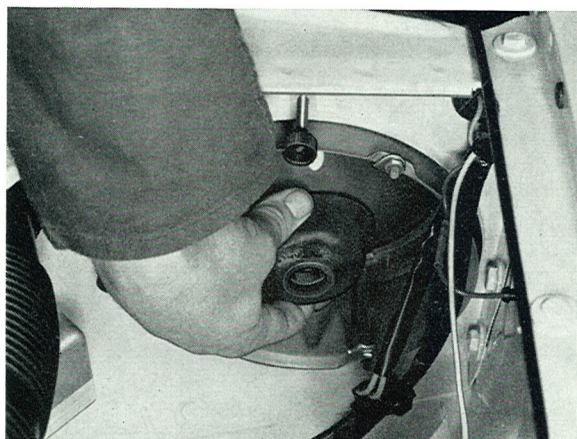


Fig. 3-63. Removing the rubber cover

VOLVO  
103 726

### FITTING

1. Fix the insert in the bowl with the help of the inner ring and screw on the three nuts. Fit the headlight with the two screws and hook on the spring underneath the headlight.
2. Fit the cables and the grille. Screw on the adjusting nuts and adjust the headlights.

### REPLACING THE HEADLIGHT INSERT INSIDE THE ENGINE COMPARTMENT

1. Disconnect the cables by pulling the connecting contact back. (When replacing the left headlight insert, first remove the battery. For removal of the



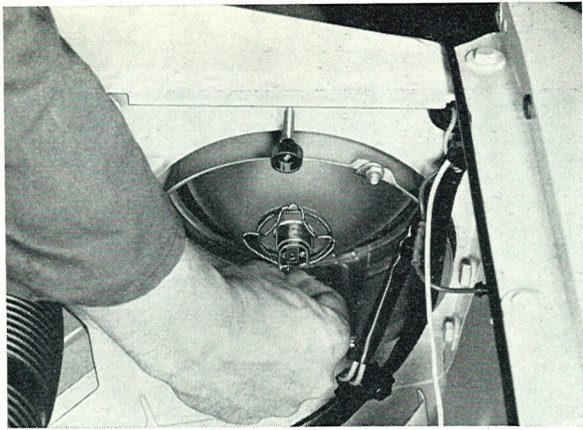


Fig. 3-64. Removing the lock spring

right headlight insert, take off the windshield washer).

2. Remove the three nuts (9, Fig. 3-59) and lift out the inner ring. Remove the insert bulb.
3. Fitting is in reverse order to removal.

### REPLACING THE HEADLIGHT BULB

1. Disconnect the leads by drawing the connecting contact back. Pry off the rubber protection, see Fig. 3-63. Clamp together and remove the spring retaining the bulb to the insert, Fig. 3-64.
2. Remove the bulb, Fig. 3-65. When refitting the bulb, make sure that it is placed correctly in the insert. The small tabs on the collar of the bulb should correspond to the jacket in the insert.

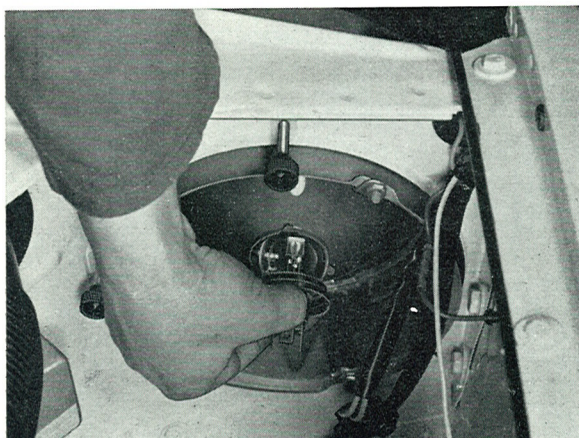


Fig. 3-65. Removing the bulb

### CHECKING AND ADJUSTING

The headlights should be examined to check the condition of the glass, reflector and bulb. If the glass is damaged by flying gravel or cracked or defective in any other way, the insert should be replaced. Glass which has become "sand-blasted" by stone impact, etc. will considerably reduce the lighting effect and can give rise to dazzling, irregular beams, 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 or brown colour. The lighting effect normally deteriorates to such an extent that the bulbs 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 strength is to be produced.

The headlights should be adjusted in accordance with current legislation. Approved equipment should be used.

Adjustment is made by varying the two adjusting screws behind the headlight, see Fig. 3-61. The upper screw adjusts the headlight vertically and the screw at the side adjusts the headlights laterally.

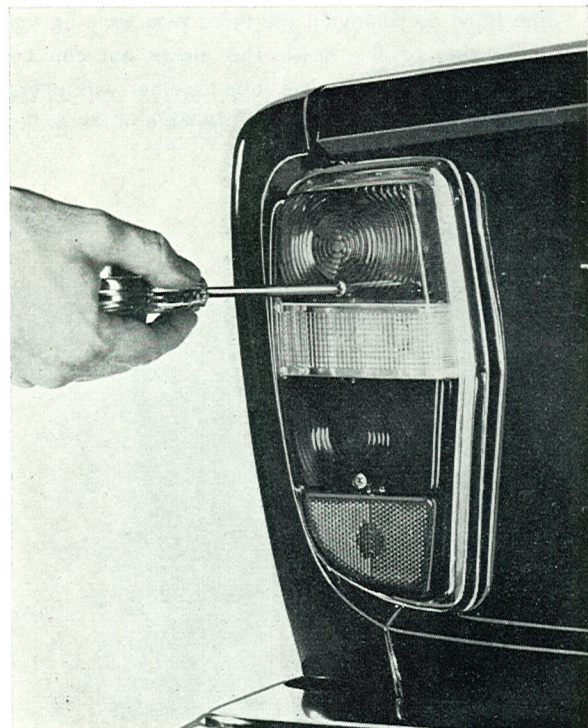


Fig. 3-66. Removing the light glass



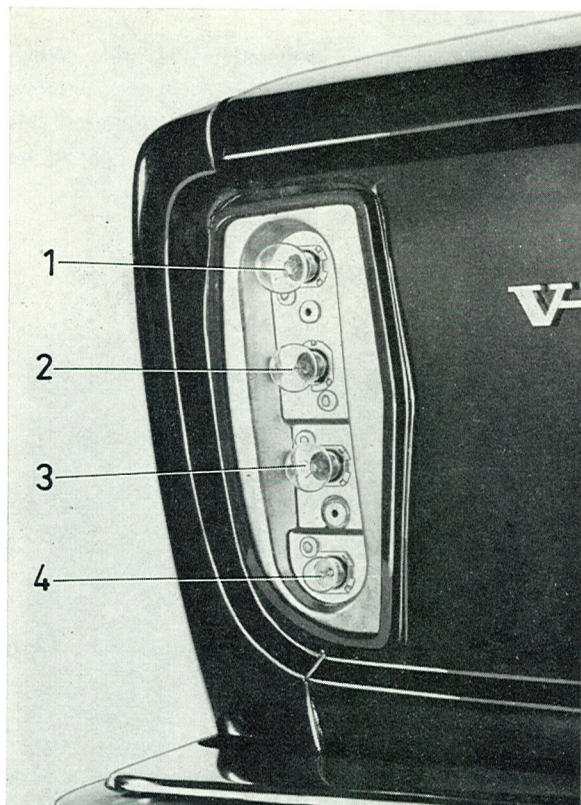


Fig. 3-67. Bulb location

- |                          |                |
|--------------------------|----------------|
| 1. Directional indicator | 3. Brake light |
| 2. Reversing light       | 4. Rear light  |

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102015

## REAR LIGHTS

### REMOVING

The rear light is removed as a complete unit by unscrewing the two screws retaining the light to the body. These screws are accessible from inside the luggage boot. After removing the light from the body, the leads are accessible.

The glass is held firmly to the reflector with two visible screws in the glass. Fig. 3-66. The location of the bulbs is shown in Fig. 3-67. From Fig. 3-68 can be seen the connections for the rear light.

## NUMBER PLATE LIGHT

142, 144:

The number plate light is attached to the body by means of two screws accessible from inside the luggage boot. Replacement of the bulb is carried out by removing the small light glasses. The screws for the light glasses are accessible from beneath the plate lighting, see Fig. 3-69.

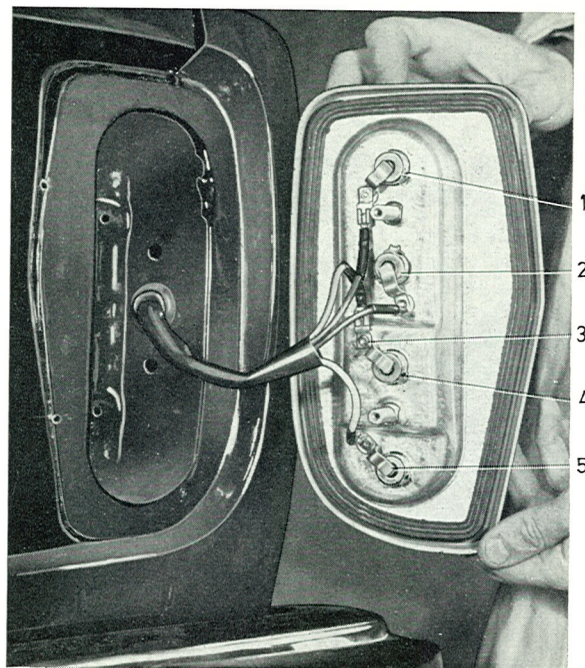


Fig. 3-68. Cable connections

- |                                |                           |
|--------------------------------|---------------------------|
| 1. Directional indicator light | 3. Brake light connection |
| 2. Reversing light             | 4. Brake light            |
|                                | 5. Rear light             |

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145:

The number plate light consists of two bulb housings secured to the tailgate. The bulbs are changed as follows:

Press in the catches in the bulb housing by inserting a screwdriver in the opening on the left-hand side of the housing, see Fig. 3-70. Pull the housing out of its attachment.

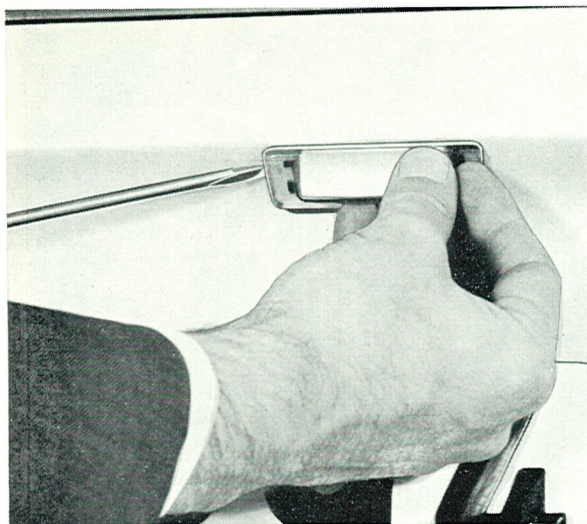
Pull out the cover end not provided with a pin. The bulb is now accessible for replacement.



Fig. 3-69. Number plate light with cap removed (142, 144)

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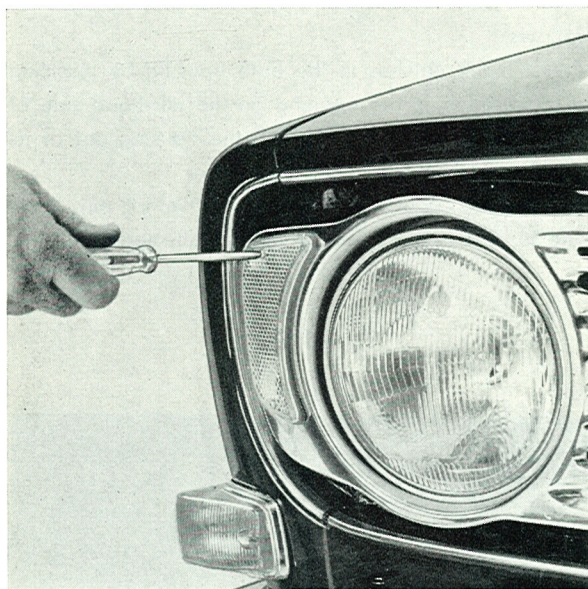




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102 972

Fig. 3-70. Number plate light removal, 145

When installing, fit first the guide pins in the recesses and then press on the cover. Check that the rubber liner is correctly in position and push the bulb housing securely into the attachment.

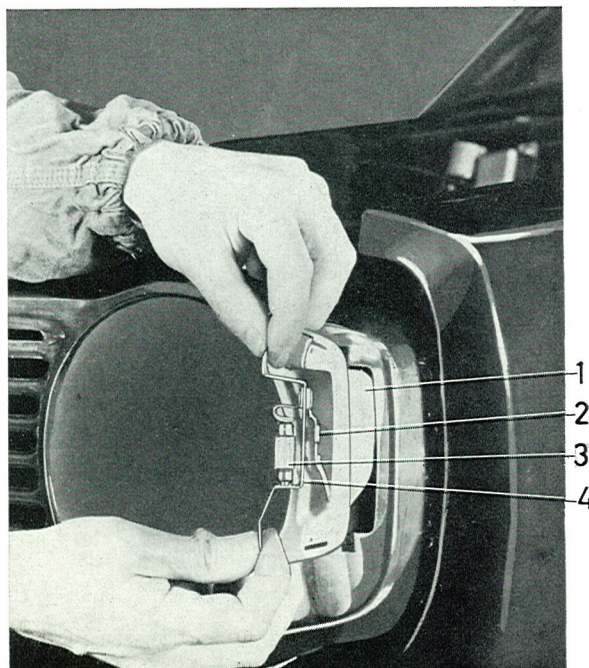


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Fig. 3-71. Parking light, removing the glass

## PARKING LIGHTS

The parking lights are mounted in the grille. When removing the light to change the bulb etc., unscrew the two screws holding the light to the grille and this will allow all the parts belonging to the light to be accessible for removal, see Figs. 3-71 and 3-72.



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102 019

Fig. 3-72. Parking light removed

- |                 |                |
|-----------------|----------------|
| 1. Rubber cover | 3. Bulb        |
| 2. Connection   | 4. Bulb holder |



# OTHER ELECTRICAL STANDARD EQUIPMENT DESCRIPTION

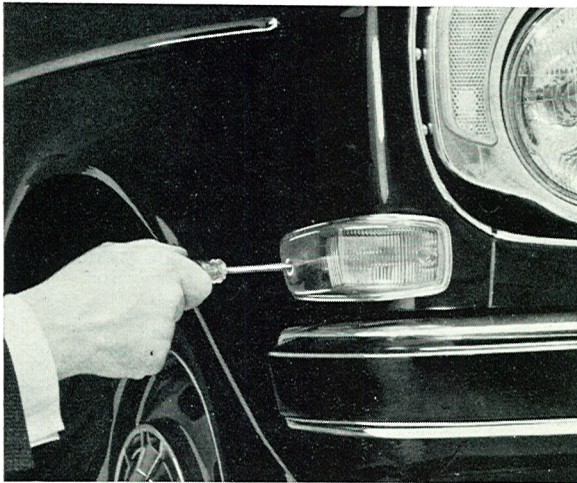


Fig. 3-73. Removing the glass for directional flashers

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## DIRECTIONAL INDICATOR SYSTEM

The directional indicator system consists of a thermal-type flasher relay, directional indicator switch and bulbs in the rear lights. The flasher relay is located under the dashboard. The directional indicator lever switch, see Fig. 3-74, which has an automatic return,

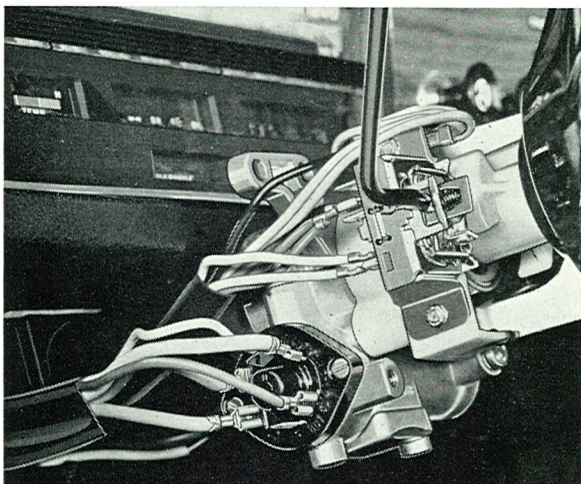


Fig. 3-74. Directional indicator lever switch and ignition switch

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103328

is placed under two plastic covers on the steering column. The control lamp for the directional indicators is connected in parallel across the indicator lever switch.

## IGNITION SWITCH

The ignition switch is integrally built with the steering wheel lock. The switch has four positions.

0. Complete electrical system disconnected and steering wheel lock engaged.
1. Radio (75) is cut in.
2. Current to ignition coil and fusebox (driving position).
3. Same as position 2 but current is also supplied to control solenoid on starter motor (starting position). When ignition key is released in position 3, it returns automatically to position 2.

## HORN

The horn is mounted to the left of the radiator behind the grille.

One of the horns has a low frequency and the other a high frequency.

The horn ring mounted inside the steering wheel operates the horns.

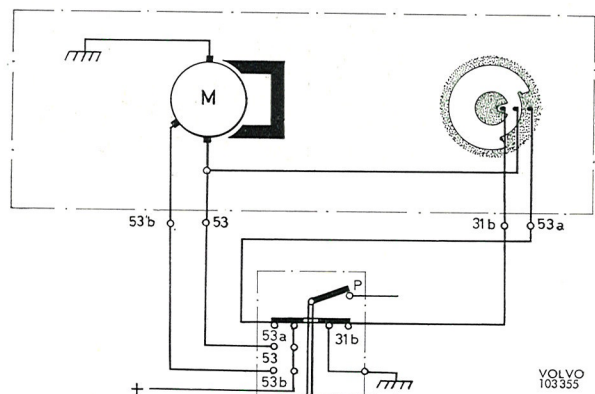


Fig. 3-75. Wiring diagram for windshield wiper motor

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## WINDSHIELD WIPERS

The windshield wipers are driven by an electric motor. The motor is connected to the wiper blades by means of link arms. The motor, which has a permanently magnetized field, has two speeds which are selected by means of the switch mounted on the dashboard. The motor is fitted with 3 brushes, one negative brush and two positive brushes. The positive brushes are connected up one at a time for full and half speed respectively. The gear housing for the wiper unit contains an integrally built parking switch. The purpose of this switch is to return the blades to a suitable, previously determined, parking position irrespective of where the blades are when shut off. See Fig. 3-75.

## WINDSHIELD WASHER

The windshield washer, which is placed on the left-hand wheel arch is driven by an electric motor, see Fig. 3-76. The pump located at the bottom of the water container is connected to the motor by means of a shaft. The pump is of the centrifugal type. Turning the windshield washer switch mounted on the dashboard engages the windshield washer.

## SWITCHES

All switches are of the pull-push type. The switches for lighting and the fan have three positions. The switch for the windshield wiper has also three positions but the washer is also engaged by turning the knob on this switch.

## INTERIOR LIGHTING

The interior lighting consists of a lamp located in the middle of the roof. The lamp is switched on by means of a switch built into the light. The switch has three positions. In its first position, the light is switched off completely, in the second position the light is on when any of the front doors is opened, and in the third position the light is on continuously.

The 145 model has an extra light in the roof over the cargo space. Opening the tailgate switches on this light.

## CONTROL RELAYS

As standard the cars in the 140-series are fitted with two control relays, a step relay for the full-beam and dipped lights and a control relay for the back-up lights. The control relays are mounted on the front side of the cowl, see Fig. 3-77.

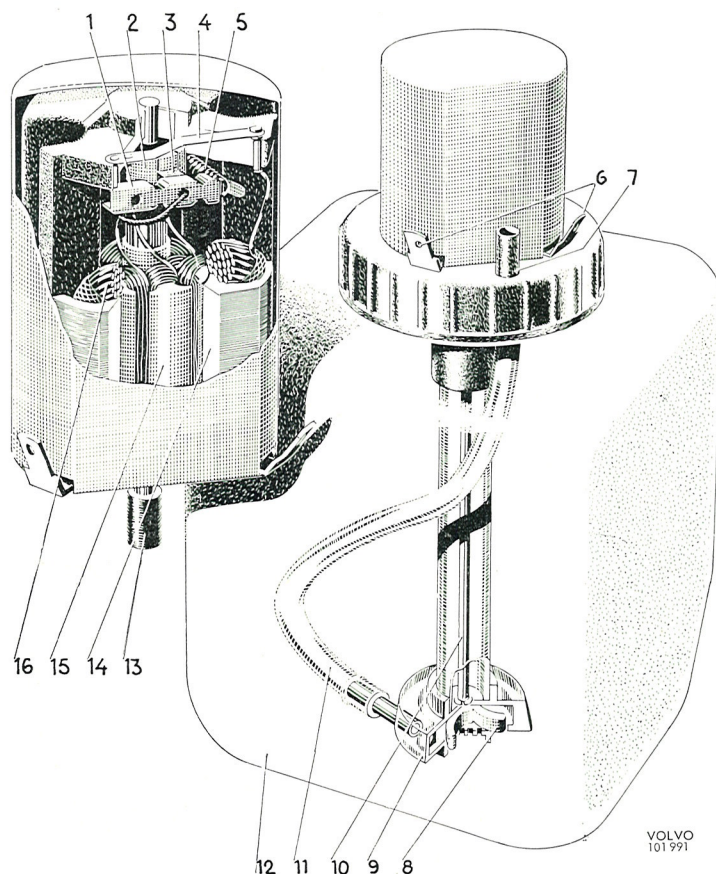


Fig. 3-76. Windshield washer

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



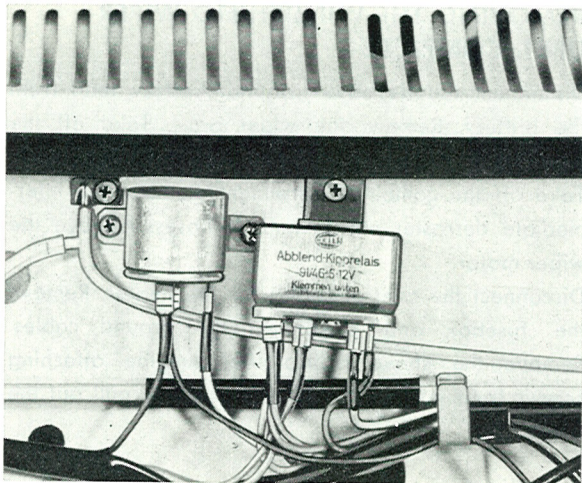


Fig. 3-77. Control relays

1. Back-up light relay
2. Step relay for dipped/full-beam switching

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## FUSES

The fuses are mounted in a fusebox secured to a bracket fitted on the car heater behind an opening in the protection panel under the dashboard.

## BRAKE LIGHT SWITCH

The brake light switch is placed on the pedal carrier beneath the dashboard. It is operated mechanically by the brake pedal.

# REPAIR INSTRUCTIONS

## REPLACING THE DIRECTIONAL INDICATOR LEVER SWITCH

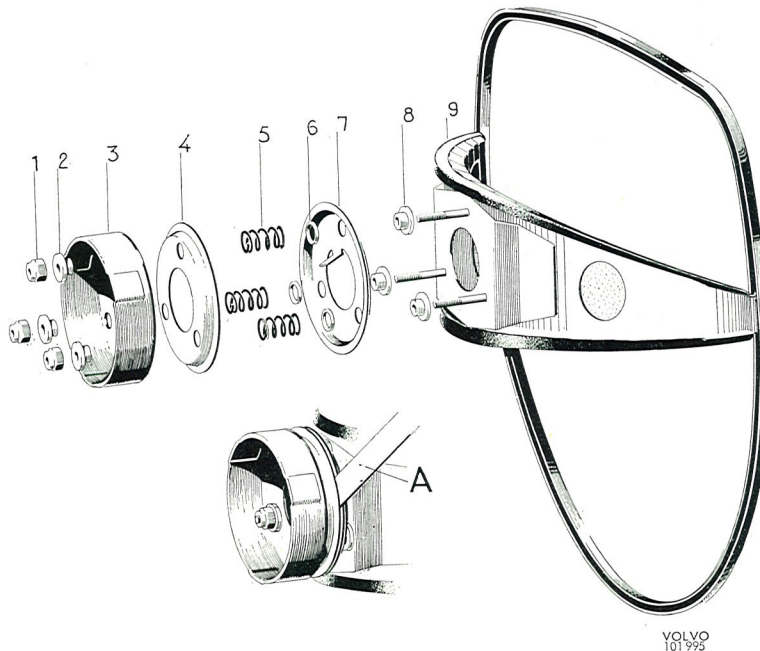
Remove the screws holding the plastic covers (one screw for the upper cover, three screws for the lower cover) and remove the covers. Remove the screws holding the switch. (If the vehicle is fitted with an overdrive, the bracket holding the switch for the overdrive must first be removed). Replace the switch and secure the new one firmly. Fit the plastic covers.

## REPLACING THE IGNITION SWITCH

Remove the plastic covers round the ignition switch. Remove the ignition switch from the steering wheel lock by taking off the two screws holding the ignition switch to the steering wheel lock. Replace the ignition switch and fit the new one on the steering wheel lock. Re-fit the plastic covers.

Fig. 3-78. Horn ring

1. Nut
2. Bush
3. Retainer
4. Plate
5. Spring
6. Washer
7. Contact plate
8. Bush
9. Horn ring



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## REMOVING AND ADJUSTING THE HORN RING

To remove the horn ring unscrew the two screws underneath the steering wheel. Then turn the ring about 30° and pull it upwards. The electric cable is then accessible and can be removed.

The distance A, Fig. 3-78, should be 0.4—0.6 mm (0.016—0.024") if the horn ring is to function satisfactorily. The distance is adjusted by means of the three self-locking nuts (1, Fig. 3-78).

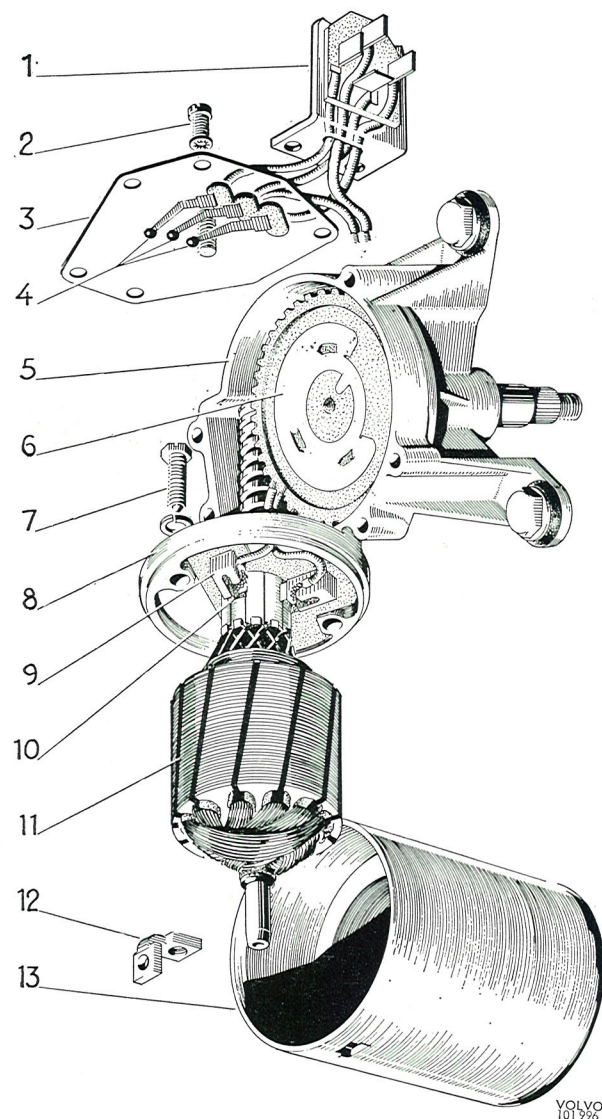


Fig. 3-79. Windshield wiper motor

- |                     |                 |
|---------------------|-----------------|
| 1. Terminal contact | 8. End          |
| 2. Screw            | 9. Brush holder |
| 3. Cover            | 10. Brush       |
| 4. Contacts         | 11. Rotor       |
| 5. Housing          | 12. Nut         |
| 6. Gear             | 13. Stator      |
| 7. Screw            |                 |

## REMOVING THE WINDSHIELD WIPER UNIT, COMPLETE

Disconnect the negative (ground) battery lead from the battery. Remove the wiper arms. Take off the panel under the dashboard. Remove the heater switch. Take off the combined instrument. Remove the intermediate defroster nozzle and its hoses. Remove the wiper motor.

Disconnect the control cables for the heater. Remove the fusebox and disconnect the ground cables. Remove the choke control. Release the attaching screws for the wiper frame and carefully pull out the frame.

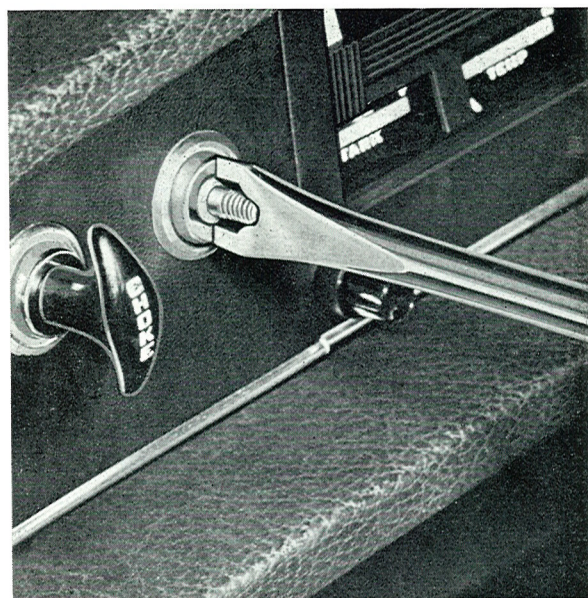


Fig. 3-80. Removing the switch nut

## DISMANTLING THE WINDSHIELD WIPER MOTOR

Remove the nut on the outgoing shaft and tap loose the crank arm.

Release the five screws (2, Fig. 3-79) and bend the cover (3) out of the way, then press out the plastic gear wheel. Remove the screws (7) and pull out the stator. Remove the screws for the negative brush and the washer on the ball bearing axial lock. Remove the washer for the axial lock. Move the brushes aside and carefully pull out the rotor. Take great care with the brushes since the ball bearing has a larger diameter than the collector. When assembling the motor, adjust the axial play for the plastic gear wheel (6) by means of the adjusting screw in the cover.



## FITTING THE WINDSHIELD WIPER UNIT, COMPLETE

Fit the wiper frame. Install the intermediate defroster nozzle. Re-fit the fusebox and secure the ground cables. Secure the control cables.

Fit the wiper motor. Fit the choke control and also the combined instrument. Install the switch for the heater. Fit the wiper arms and the battery lead.

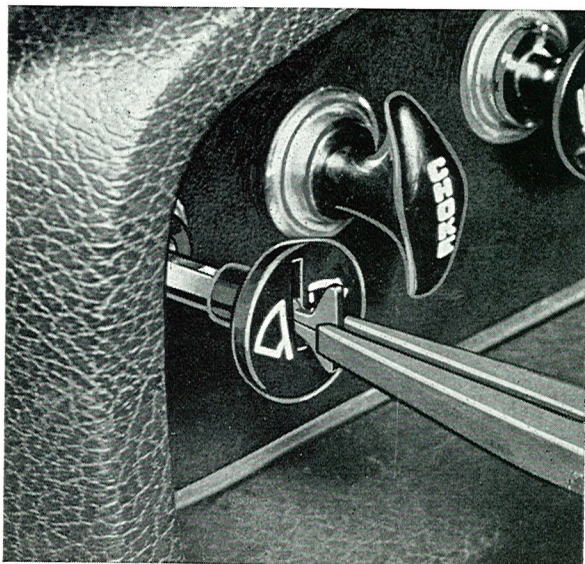


Fig. 3-81. Removing the lock key

## REMOVING THE SWITCHES

To remove the switch, first unscrew the switch knob and then release the nut for the switch with a suitable screwdriver, see Fig. 3-80. To remove the windshield wiper switch, the plastic key inserted in the knob must first be removed by pulling it straight out, see Fig. 3-81. When re-fitting, push the plastic key straight in.

## REPLACING THE INTERIOR LIGHT BULB

Pull down the glass at the short side opposite the switch. Pull out the bulb. The glass is re-fitted by hooking it securely at the side where the switch is situated and then pressing in the glass firmly.

## REPLACING THE BRAKE LIGHT SWITCH

When replacing the brake light switch, make sure that the new switch is adjusted correctly so that it functions satisfactorily. The distance between the brake pedal released and the threaded bronze hub on the switch should be  $4 \pm 2$  mm ( $0.16 \pm 0.08$ ") (A, Fig. 3-82). If the distance must be adjusted, release the attaching screw for the bracket and move the bracket until the correct distance is obtained.

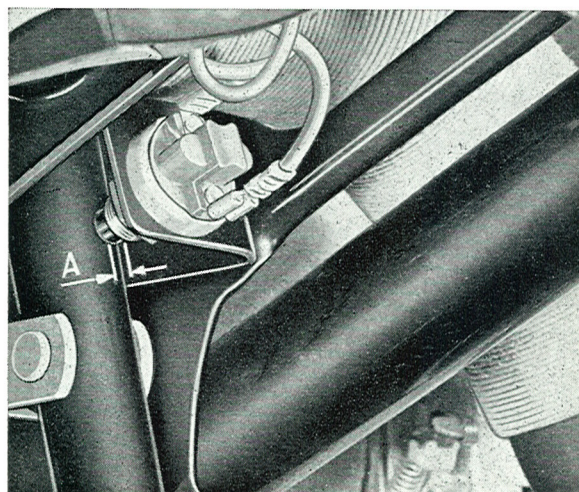


Fig. 3-82. Brake light switch







**Illustration 3-A** Wiring diagram 142, 144 standard FSS



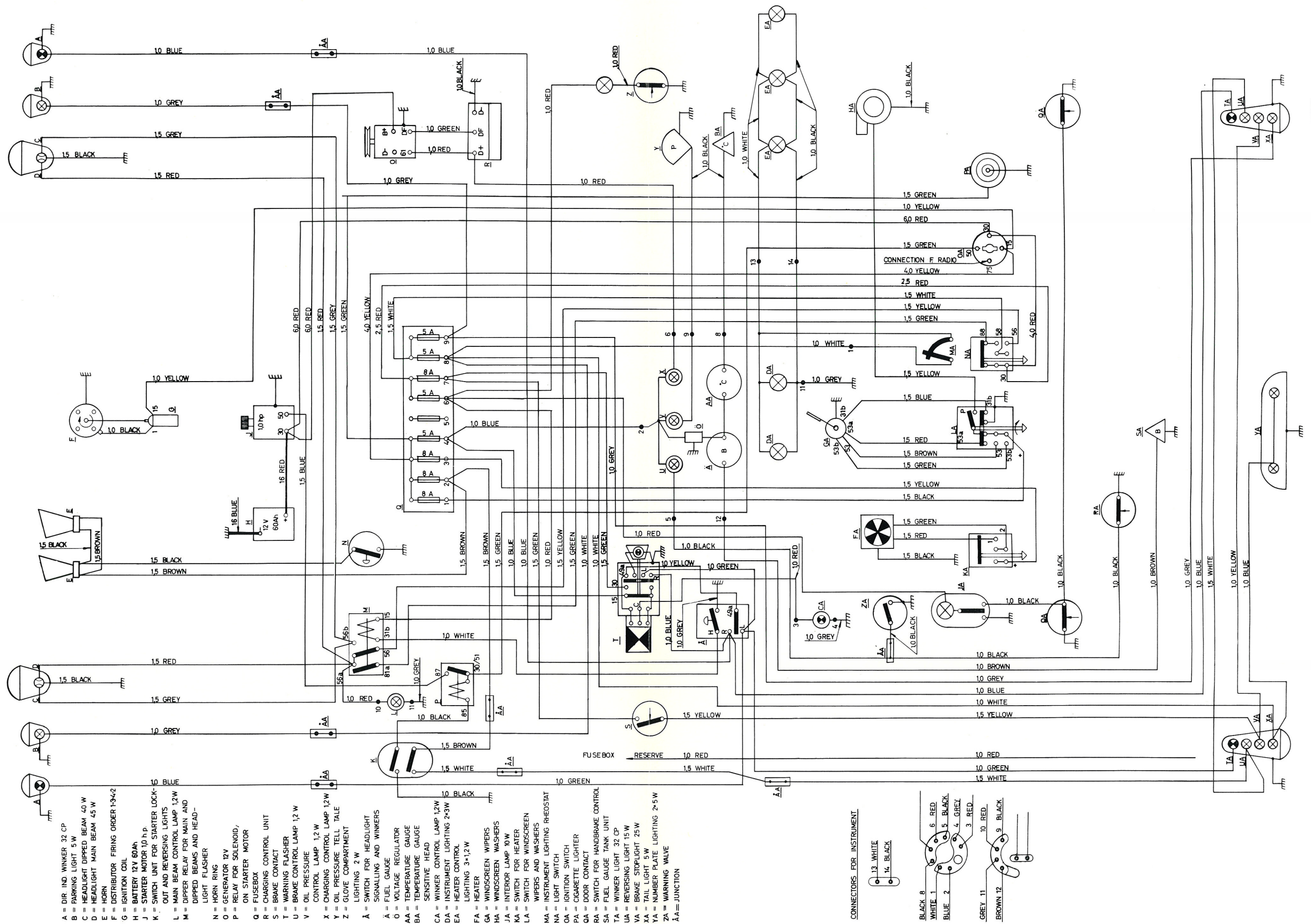


Illustration 3-B Wiring diagram 142, 144 automatic FSS



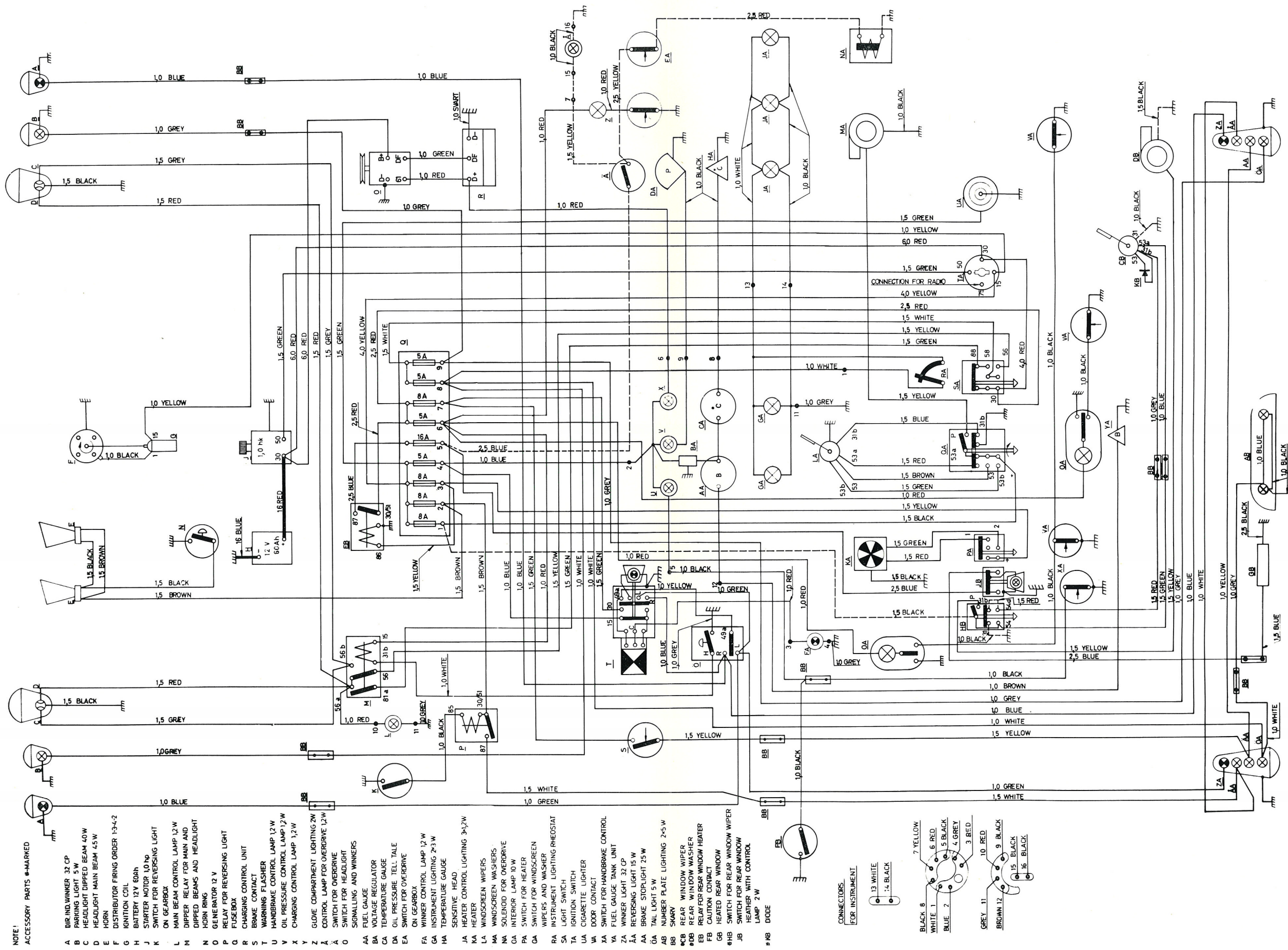


Illustration 3-C Wiring diagram 145 standard FSS



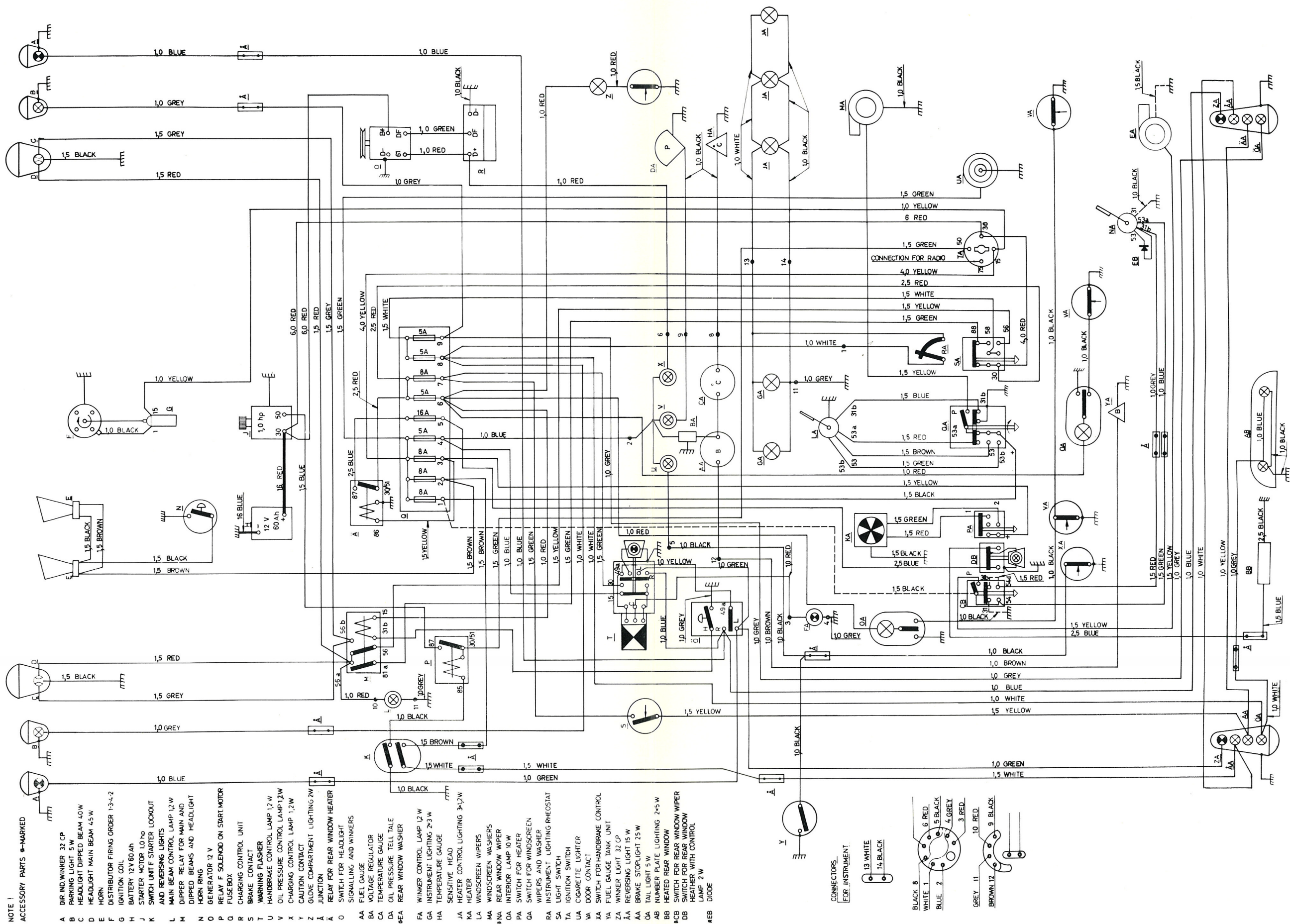


Illustration 3-D Wiring diagram 145 automatic FSS