VOLVO SERVICE

CARS

Part 3 (32)
ALTERNATOR EQUIPMENT
12 Volts
(S.E.V. Motorola)

SERVICE MANUAL

CONTENTS

SPECIFICATIONS

ALTERNATOR

Make and type	S.E.V. Motorola 14 V-26641
Output	450 W
Max. amperage	35 A
Max. speed	15000 r.p.m.
Direction of rotation	optional
Resistance in field winding	5.2±0.2 ohms
Voltage drop across the insulation diode	0.8—0.9 V
Check values	30 A (min.) at 3000 r.p.m. and approx. 13 V

VOLTAGE REGULATOR

Transistor regulator

Make and type	S.E.V. Motorola 14V-33087
Control voltage (fully charged battery, warm regulator)	13.85—14.25 V

Mechanical regulator

Make and type	S.E.V. Motorola 14V-33525
Control voltage, cold regulator	13.1—14.4 V
after running 45 minutes	13.85—14.25 V

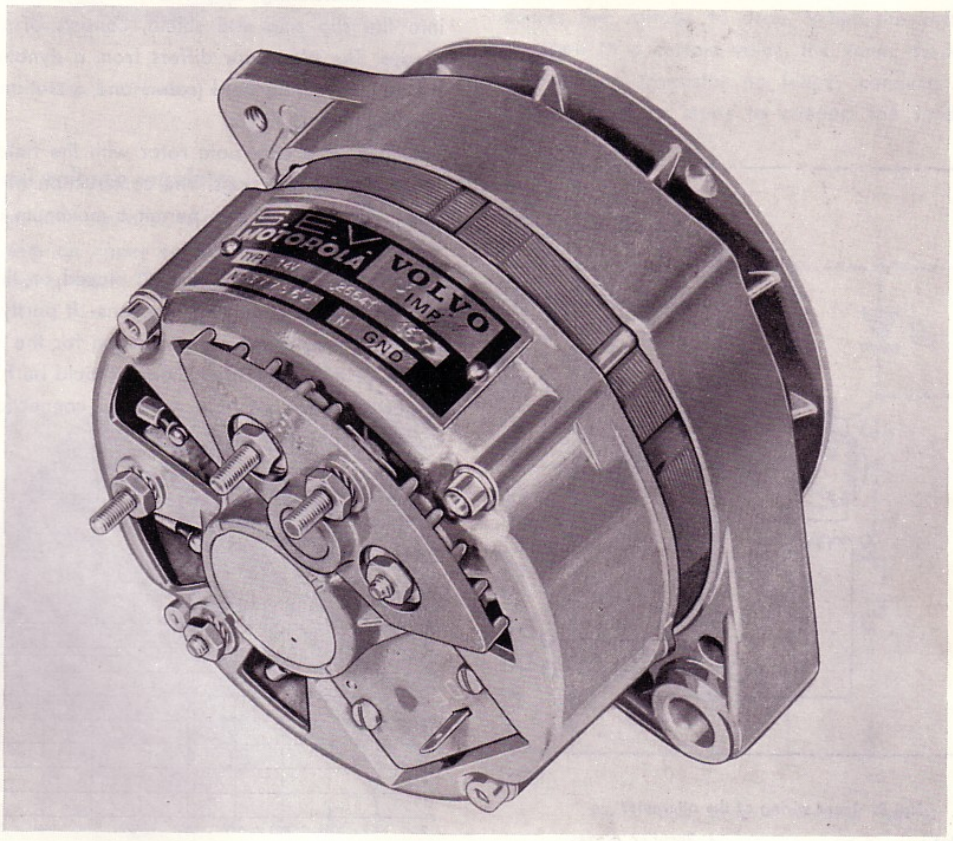

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Fig. 1. Alternator

DESCRIPTION

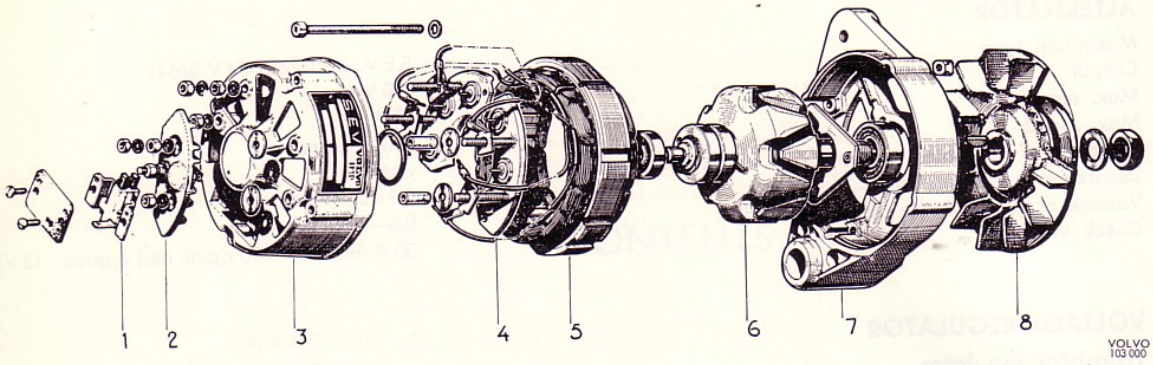


Fig. 2. Exploded view of alternator

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

The alternator equipment consists of an alternator with built-in rectifier and voltage regulator.

ALTERNATOR

The alternator, Fig. 1, is a three-phase, delta-connected alternating unit. The rectifier, which is built into the slip ring end shield, consists of six silicon diodes. The alternator differs from a dynamo in that it has a revolving field (rotor) and a stationary main winding (stator), Fig. 2.

The rotor is a claw-pole rotor with the field winding fed over two slip rings. The construction of the rotor has made it possible to permit a maximum alternator speed of 15000 r.p.m.

The insulation diode (2, Fig. 2) placed on the outside of the alternator has two functions: It partly provides an extra reverse current protection for the alternator if any of the six rectifier diodes should be faulty, and it partly makes possible a simple connection of the charging control lamp.

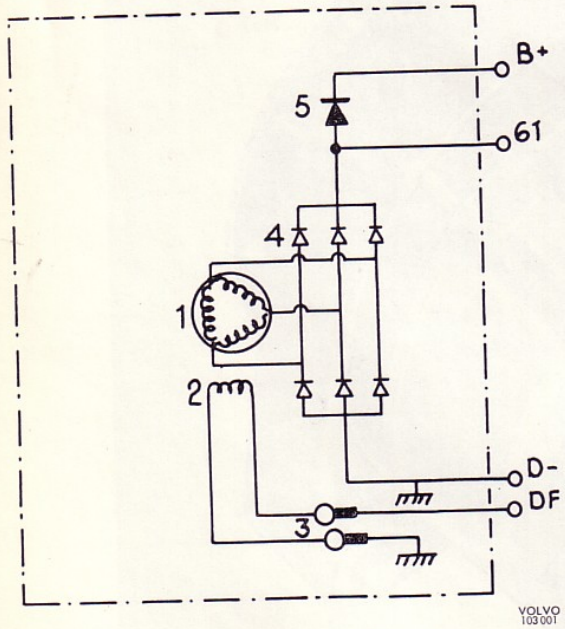


Fig. 3. Inner wiring of the alternator

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

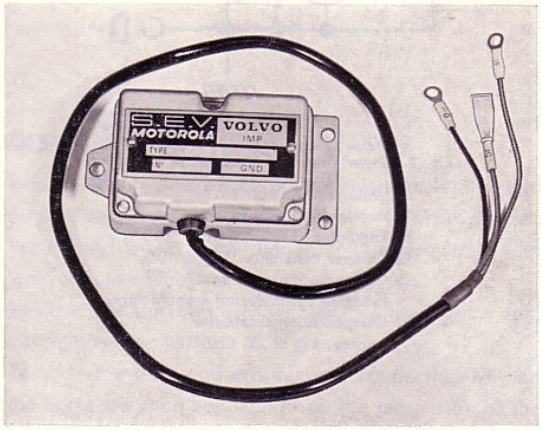
Fig. 4. Output curve for alternator

VOLTAGE REGULATOR

There are two types of voltage regulators available: Fully transistorised and mechanical.

Transistor regulator

The transistor regulator, Fig. 5, consists of a power transistor, a steering transistor, a zener diode, an inverse voltage diode, a thermistor and diverse resistances. (See the wiring diagram.) The transistor regulator is fully sealed and cannot be adjusted or repaired.

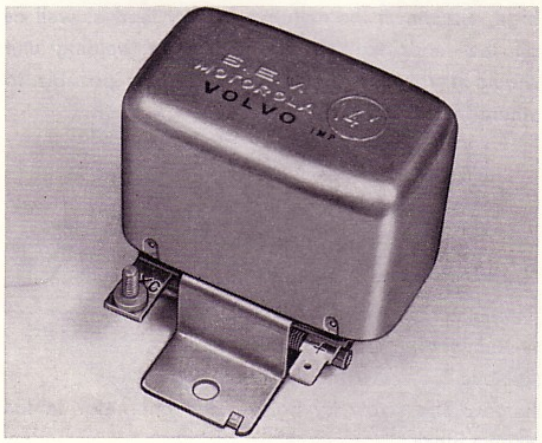


VOLVO 103003

Fig. 5. Transistor regulator

Mechanical voltage regulator

The mechanical regulator, fig. 6, is a two-contact regulator with an upper contact, a movable contact and a lower contact. The movable contact is fixed on an armature which is operated by a voltage coil. The regulator also contains three resistances and one thermistor.



VOLVO 103004

Fig. 6. Mechanical voltage regulator

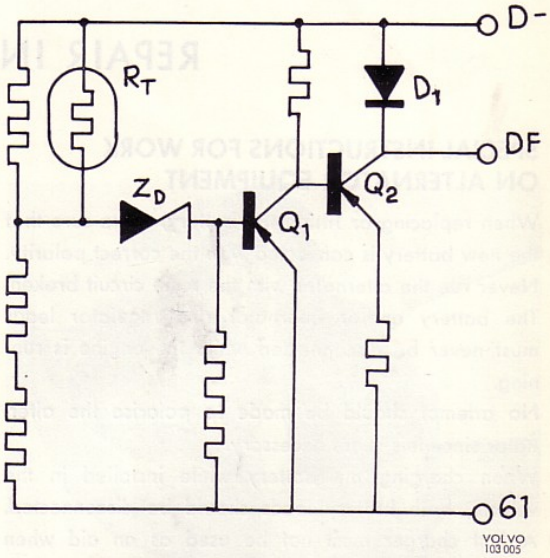
FUNCTION, ALTERNATOR — VOLTAGE REGULATOR

Transistor regulator

When the ignition is switched on, current flows through the charging control lamp to terminal D + (61) on the alternator. From there the current is led to the regulator.

In the regulator the current is conducted via the power transistor Q_2, Fig. 7, to the DF-terminal on the alternator. From the DF-terminal the current flows across two brushes and slip rings, through the field winding in the rotor, to earth.

When the alternator starts to revolve, alternating current is formed in the stator. This alternating current is rectified in the silicon diodes and the extracted direct current is refed via the regulator to the field windings until regulating voltage has been reached. When the regulating voltage has been reached, the zener diode opens and this influences the steering transistor so that it starts conducting. During the time the steering transistor is 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 steering transistor no longer conducts and the output transistor starts to conduct the field current



VOLVO 103005

Fig. 7. Inner circuit of transistor regulator

Q1 Steering transistor
Q2 Power transistor
D1 Inverse voltage diode
ZD Zener diode
RD Thermistor

again. This operation is repeated very rapidly and in this way maintains the voltage constant.
The thermistor is temperature-compensating and it influences the regulator in such a way that the alternator at low temperature produces higher voltage than at high temperature.

Mechanical regulator

When the starter switch is closed, current flows through the charging warning lamp to D + on the regulator. Through the regulator the current is conducted via the field winding and then to earth.
When the alternator starts revolving, alternating current is formed in the stator. The alternating current is rectified by the silicon diodes and the extracted direct current is refed via the regulator to the field winding until regulating voltage has been reached. When the regulating voltage has been reached, the armature is attracted by the coil. The contacts open and the field current must pass resistance R1, see Fig. 8.
If the voltage rises in spite of this, the armature is pulled further down and the movable contact meets the lower contact and this earths the field winding at both ends causing the voltage to drop sharply. The operation is repeated continously so that the voltage is maintained constant.

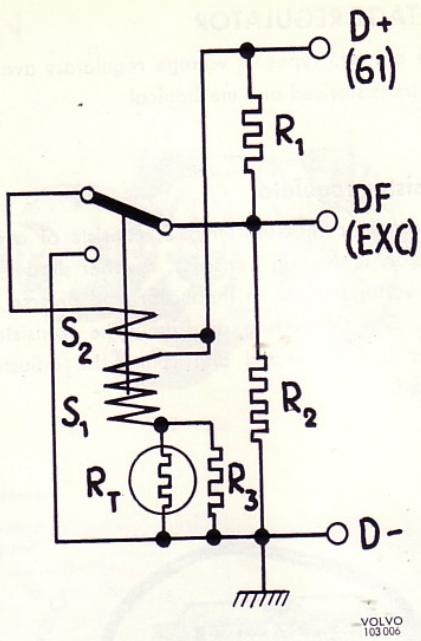


Fig. 8. Inner circuit of mechanical regulator

S1 Voltage winding
S2 Acceleration winding
R1 Regulator resistance 10 Ω ± 10 %
R2 Damper resistance 30 Ω ± 10 %
R3 Compensation resistance
(adapted to RT during manufacture)
RT Compensation thermistor
approx. 4 Ω at 25° C (77° F)

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 polarise the alternator since this is not necessary.
When charging the battery while installed in the vehicle, both battery leads should be disconnected.
A fast charger must not be used as an aid when 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 leads to the alternator. The welding unit should always be connected as near as possible to where the welding is to be done.

REMOVING THE ALTERNATOR

Disconnect the negative lead to the battery.
Disconnect the leads to the generator.
Remove the screw for the tensioning iron.
Remove the screw by holding the alternator to the engine block.
Remove the fan belt and lift forward the alternator.

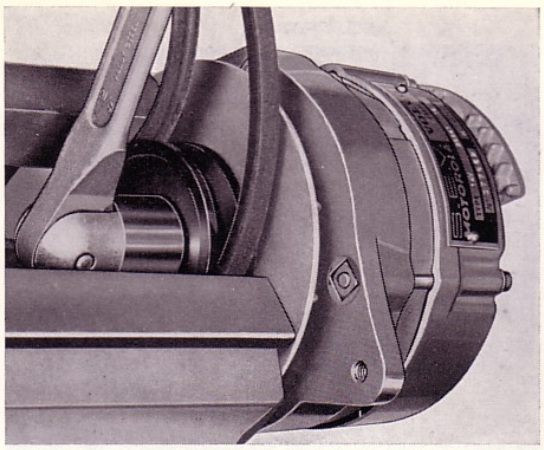


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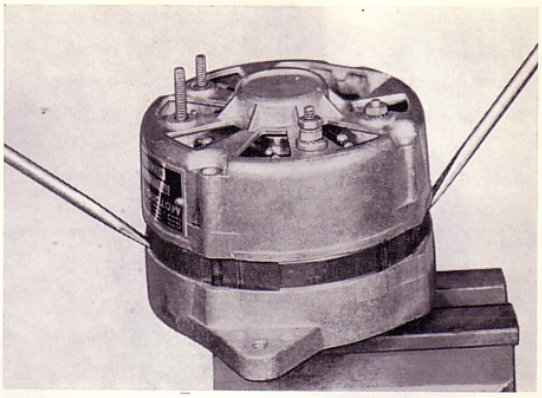
Fig. 9. Removing the pulley nut



VOLVO 103 009

Fig. 11. Dismantling the alternator

DISMANTLING THE ALTERNATOR

Release the two screws holding the brush holder and remove the insulating plate. Pull out the brush holder.

Secure the pulley with belt in a vice provided with soft jaws, see Fig. 9.

Remove the nut and washer. Lift off the pulley, fan, key and spacer washer.

Remove the nuts and washers on connection 61 and the corresponding connection on the other side of the insulation diode. Lift off the insulation diode holder, see Fig. 10.

Make scribe marks on the drive end shield, stator and slip ring end shield to avoid possible confusion when assembling. Remove the four attaching screws.

Remove the rotor and the drive end shield with the help of two screwdrivers which are inserted in the two recesses between the stator and the drive end shield, see Fig. 11.

N.B. The screwdrivers must not be inserted in further than 2 mm (5/64"), otherwise the stator can be damaged.

Release the three screws holding the drive end shield bearing support plate. Release the bearing by tapping the end of the shaft against a piece of wood, see Fig. 12.

Remove the nuts and washers of the diode holder for the negative diodes.

Remove the stator and diode holders from the slip ring end shield.

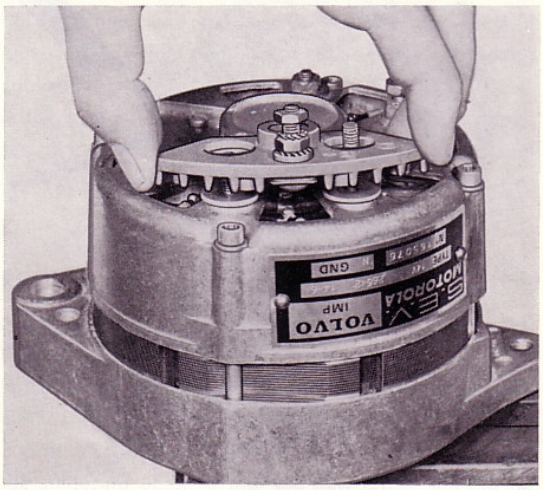


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Fig. 10. Removing the insulation diode

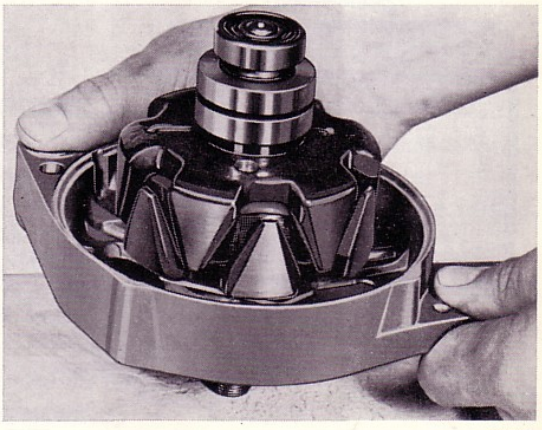

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Fig. 12. Removing the drive end shield

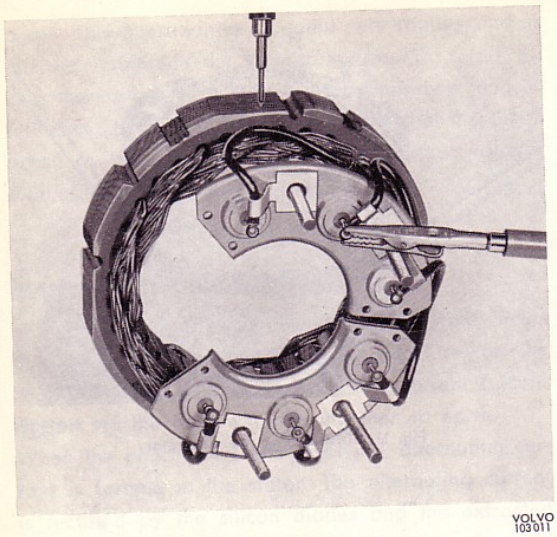

Fig. 13. Checking the stator

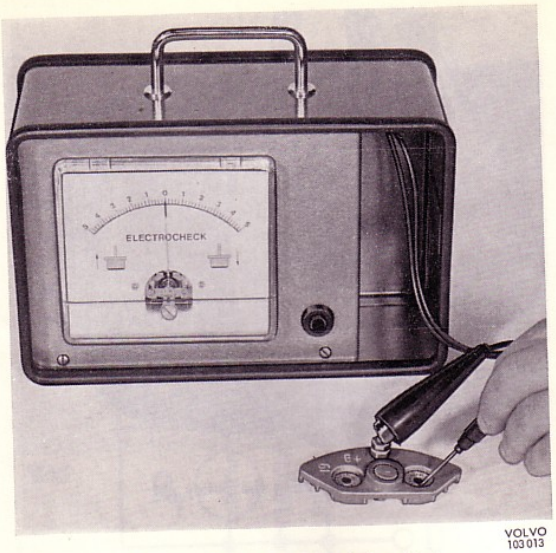

Fig. 15. Checking the insulation diode

CHECKING THE DISMANTLED ALTERNATOR

Stator

Check the stator for possible short-circuiting. If one or several coils are burned, there is short-circuiting in the stator. Connect a test lamp (12 V, 2—5 W between the stator plates and a connection on the stator, see Fig. 13.

If the lamp lights, the insulation between the stator winding and the stator plates is damaged. In this case the stator must be replaced.

N.B. Only a test lamp of 12 V, 2—5 W may be used: 110 or 220 Volts, D.C. or A.C. lamps must NOT be used. This applies to all the components in the alternator.

Check the diodes with a diode tester, see Fig. 14. If any of the rectifier diodes is faulty, the entire diode holder (with three diodes) must be replaced. If the protection diode is faulty, replace the holder, complete with insulation diode.

If a diode tester is not available, the diodes may be soldered loose (see page 3—7) and tested with an ohmmeter. The diodes should have high resistance in the anti-feedback direction and low resistance in the flow direction.

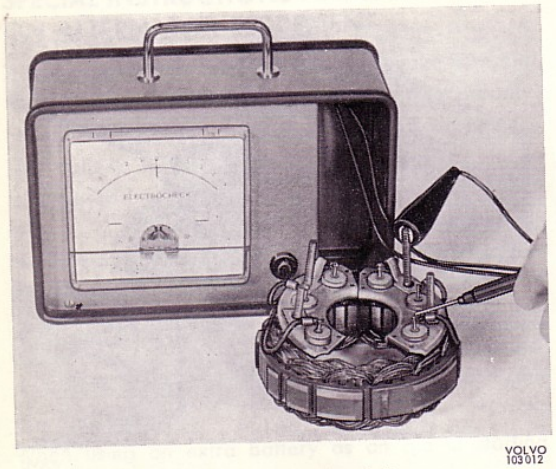

Fig. 14. Checking the diodes

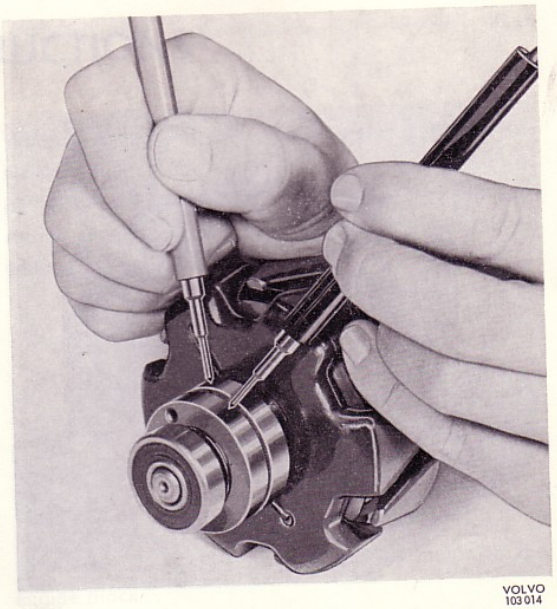

Fig. 16. Check-measuring the rotor

Rotor

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

Check the winding for breakage or damaged insulation.

Measure the resistance between slip rings, see Fig. 16. At 25° C (77° F) the resistance should be 5.2±0.2 ohms.

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

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

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

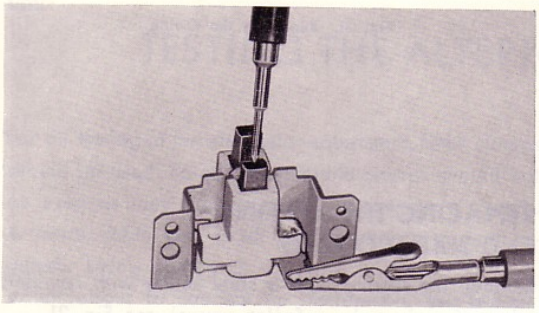

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Fig. 17. Checking the brush holder

Brush holder

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

Connect the test lamp between the DF-connection and "+" brush. The lamp should give a steady light even if the brush or the connecting cable is moved, see Fig. 17. Connect the test lamp between the brush holder frame and the "—"brush. The lamp should give a steady light even if the brush or the connecting cable is moved.

If the brush holder does not comply with the above requirements, or if the brush length is less than 5 mm (3/16"), it should be replaced.

REPLACING THE RECTIFIER DIODES

Mark the cables connecting the stator to the diodes. Solder loose the cable.

Place the new diode holder exactly in the same position as the old one. Hold the diode output cable with a pair of flat pliers. (This is to divert the heat from the soldering point so that the new diode will not be damaged.)

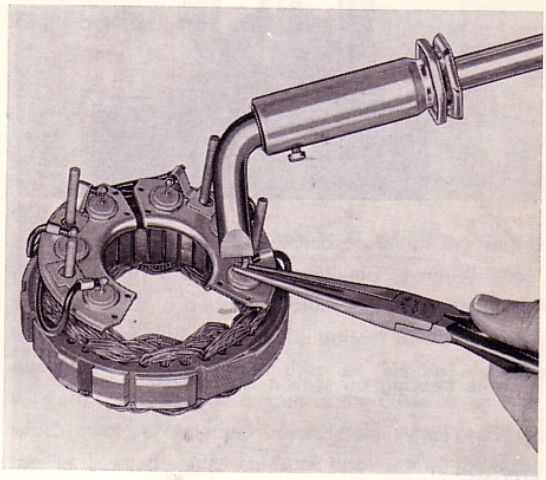
Solder on the diodes, see Fig. 18.

N.B. The whole "+" or "—" diode holder must be replaced even if only one diode is faulty.

Use a well-heated soldering rod of minimum 100 W when soldering.

Never change places for the two diode holders. **The positive diode holder is** insulated from the material with insulation washers and sleeves and its diodes are marked with **red ink.**

The negative diode holder is not insulated and its diodes are marked with **black ink.**



VOLVO 103016

Fig. 18. Soldering on the diodes

REPLACING THE BEARINGS

Drive end bearing

REMOVING

Place the rotor in a vice provided with soft jaws. Pull the bearing off with a claw puller, see Fig. 19.

FITTING

Place the support plate on the rotor shaft with the three elevations against the rotor winding.

Press the bearing on with the help of a tubular sleeve which presses on the bearing inner ring, see Fig. 20.

Slip ring end bearing

REMOVING

Place the rotor in a vice with soft jaws.

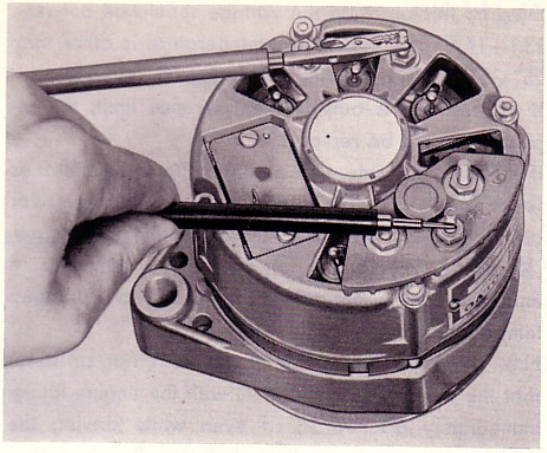


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Fig. 22. Checking the alternator

Connect the test lamp between B + and the alternator earth. Invert the connections. The lamp should only light in one direction, Fig. 22.

After repairs, the alternator should be test-run in a test bench.

FITTING THE ALTERNATOR

Place the alternator in position and fit the fan belt. Fit the attaching screws and tensioning iron without tightening. Adjust the belt tensioning (see Part 2, Engine, Group 25) and tension the alternator securely.

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

Fit the leads on the alternator.

Fit the battery lead.

TESTING THE ALTERNATOR AND 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.

CHECKING THE ALTERNATOR CIRCUIT

Before any tests are made on the alternator or regulator in the vehicle, the battery should be checked and the vehicle wiring tested with regard to faulty cables or insulation, loose or corroded cable 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 an hydrometer and battery tester. If the battery is not fully charged, remove it from the vehicle 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 earth lead of the battery. 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 about 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 leads or contacts, measure once again. With the same load as above, measure the voltage drop between the minus 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 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 the alternator as shown in Fig. 23.

Check that the current power through the field winding (ammeter C) is 2—2.5 amps. (If the current is not correct, then check the brush holder and field winding.)

Run the alternator at 3000 r.p.m. (engine speed 1500 r.p.m.). The alternator should then give at least 30 amps at about 13 volts. (Possibly a further load must be connected 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 61, otherwise the protection diode is faulty and should be replaced.

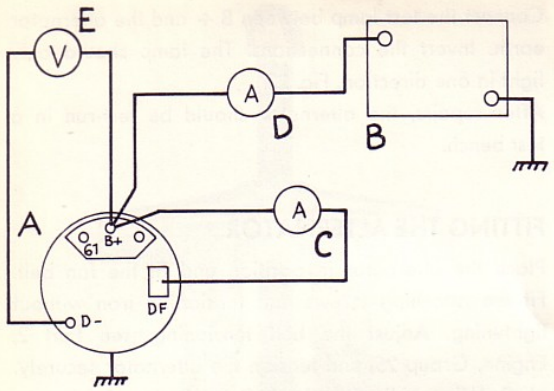


Fig. 23. Wiring diagram for testing the alternator

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

CHECKING THE VOLTAGE REGULATOR

(In a test bench or in the vehicle.)

Connect the alternator and regulator as shown in Fig. 24.

Run the alternator at about 5000 r.p.m. (engine speed 2500 r.p.m.) for 15 seconds. Then read the voltage on the voltmeter. With no load on the alternator, the voltmeter should read 13.1—14.4 volts when the regulator ambient temperature is 25° C (77° F).

Load the alternator with 10—15 amps, for example by switching on the mainbeam lights, and read off the voltage.

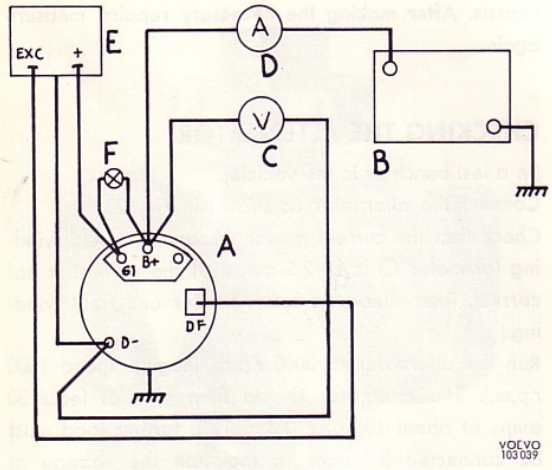


Fig. 24. Wiring diagram for testing the voltage regulator

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

Even on this occasion the voltage should be between 13.1—14.4 volts. Where the temperature is other than 25° C (77° F), see the diagram on Fig. 25.

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

If a more accurate test of the voltage regulator is to be made, install it in the vehicle and drive it for about 45 minutes at a speed exceeding 50 km/p.h. (30 m.p.h.). The reason for driving the vehicle is to enable the regulator to reach the correct operating temperatur.

N.B. The vehicle **must be** driven. It is not sufficient that the vehicle is standing still with the engine idling. Immediately afterwards, or even while driving the vehicle, measure the voltage between B + and D — on the alternator. When measuring, the engine should be at a speed of about 2500 r.p.m. With the regulator ambient temperature about 25° C (77° F) the voltage should be 13.85—14.25 volts. Where the temperature is otherwise, see Fig. 26.

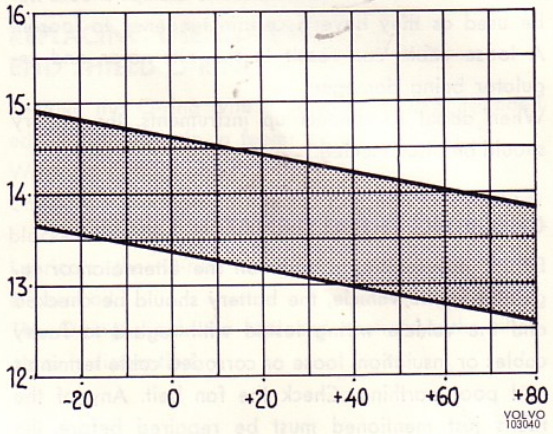


Fig. 25. Voltage-temperature diagram for cold voltage regulator

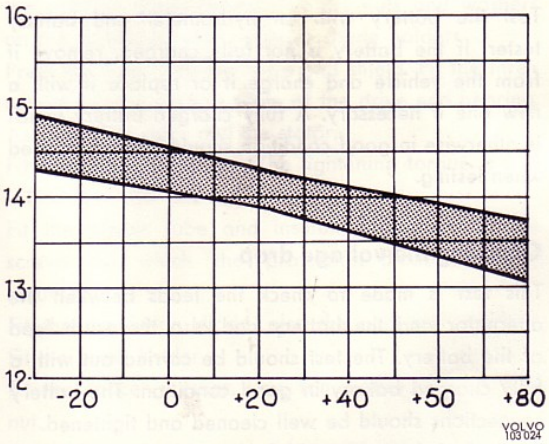
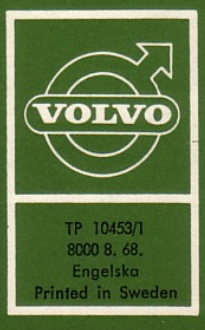


Fig. 26. Voltage-temperature diagram for warm voltage regulator

FAULT TRACING

FAULT	REASON
Alternator does not charge.	**Worn or insufficiently tensioned fan belt.** Breakage in the charging circuit. Worn brushes. Breakage in rotor winding. Breakage in insulation 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 by about 5 amps. Short-circuiting in a diode limits the alternator charging current to 7—8 amps and results in a rumbling noise in the alternator.) Partial short-circuiting in the rotor. Breakage or short-circuiting in the stator. Faulty regulator.
Too high charging.	Faulty regulator. Faulty connections on regulator or alternator. Short-circuiting in insulation diode. Worn fan belt. Loose pulley.
Noise in alternator.	Worn bearings. Short-circuiting in one or several rectifier diodes. Alternator pulley wrongly adjusted in relation to pulley on crankshaft.
Charging warning lamp lights.	Voltage drop in fuse box.



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