



SERVICE MANUAL

VOLVO 164 1971

ALTERNATOR DESCRIPTION

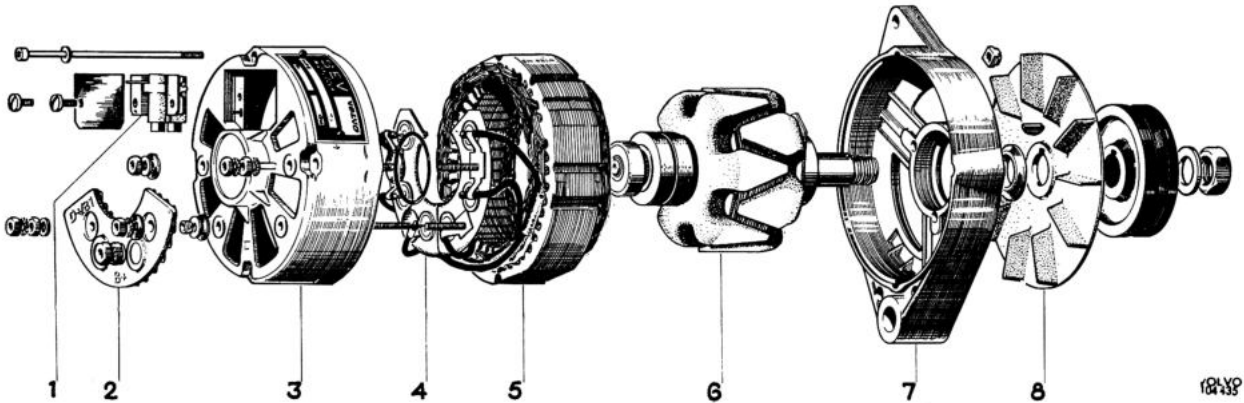


Fig. 3-2. Exploded view of alternator

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

The alternator is a three-phase, star-connected alternator unit which is located on the right-hand side of the engine and is driven by a V-belt from a pulley on the crankshaft.

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

The alternator has a rotating field (rotor) and stationary generating windings (stator).

The rotor is of the claw-pole type with the field windings fed over the slip rings. The construction of the rotor has made it possible for the alternator to have a max. speed of 15 000 r.p.m.

The isolation diodes (2, Fig. 3-2), which are placed on the outside of the alternator, have two functions: They prevent the battery from discharging through the regulator and alternator field, and they provide a simple means of operating the charging warning lamp.

The alternator is self-limiting (max. 55 amps.) and for this reason a simple voltage regulator can be used with only voltage control.

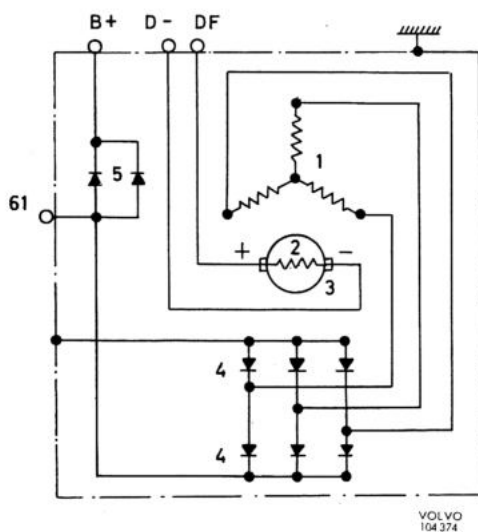


Fig. 3-3. Alternator inner circuit

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

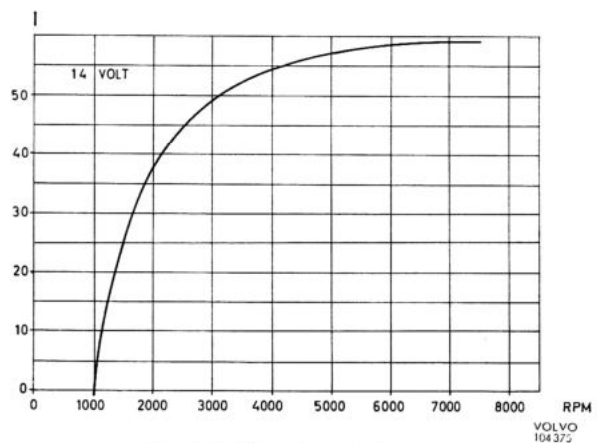


Fig. 3-4. Alternator output curve

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 polarize 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. A rapid charger should not be used as a help in starting.
6. When using an extra battery as an aid in starting, always connect it in parallel.
7. When carrying out any electric welding on the vehicle disconnect the negative battery lead as well as all the alternator leads. The welding unit should always be connected as near as possible to where the welding is to be carried out.

REMOVING THE ALTERNATOR

1. Disconnect the negative lead to the battery.
2. Disconnect the leads to the alternator.
3. Remove the bolt for the adjusting bar.
4. Remove the bolt holding the alternator to the engine block.
5. Remove the fan belt and lift the alternator forwards.

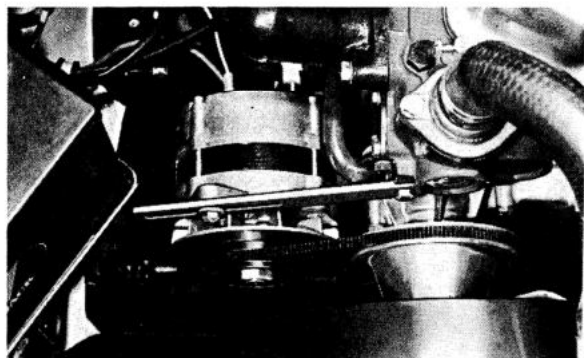


Fig. 3-5. Alternator fitted

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DISMANTLING THE ALTERNATOR

1. Release the two screws holding the brush holder and remove the isolation plate. Pull out the brush holder.
2. Remove the nut and washer. Lift off the pulley, fan, key and spacer washer.
3. Remove the nuts and washers on terminal 61 and the corresponding on the other side of the isolation diode. Lift off the isolation diode holder, see Fig. 3-6.
4. Mark the drive end shield, stator and slip ring end shield to avoid confusion when assembling. Remove the four attaching screws.
5. Remove the stator and slip ring end shield with the help of two screwdrivers, which are inserted in two of the sockets between the stator and drive end shield, see Fig. 3-7.
N.B. The screwdrivers may not be inserted deeper than 2 mm (just over 1/16"), otherwise the stator may be damaged.
6. Release the three screws holding the support plate of the drive end bearing. Release the bearing by knocking the end of the shaft against a piece of wood, see Fig. 3-8.
7. Remove the nuts and washers for the diode-holders.
8. Remove the stator and diode holders for the slip ring end shield.



Fig. 3-6. Removing the isolation diodes

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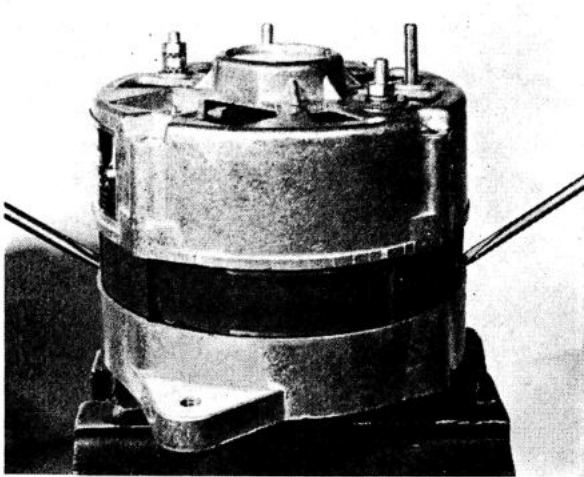


Fig. 3-7. Dismantling the alternator

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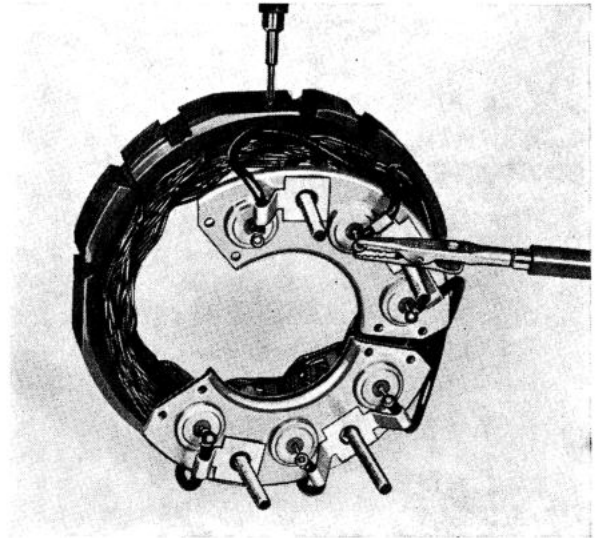


Fig. 3-9. Checking the stator

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CHECKING THE DISMANTLED ALTERNATOR

STATOR

Check the stator for any short-circuiting. If one or several of the coils are burnt, there must be a short-circuit in the stator. Connect a test lamp (12 V, 2—5 W) between the stator plates and a terminal on the stator, see Fig. 3-9.

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

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

Check the diodes with a diode tester, see Fig. 3-10. If any of the rectifier diodes is faulty, the entire

diode holder (with three diodes) must be replaced. If any of the isolation diodes is faulty, replace the holder, complete with isolation diodes.

If a diode tester is not available, the diodes should be soldered loose (see page 3—6) and tested with an ohmmeter. The diodes should have high resistance in reverse direction and low resistance in the flow direction.

ROTOR

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

Check the winding for breakage or damaged isolation. Measure the resistance between the slip rings, see Fig. 3-12. At 25° C (77° F) the resistance should be 3.7 ohms.

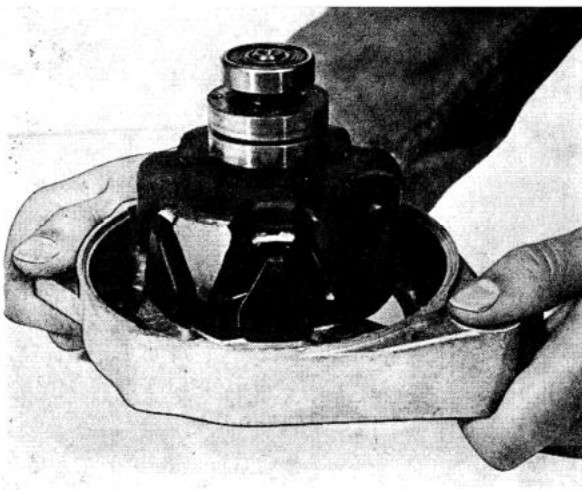


Fig. 3-8. Removing the drive end shield

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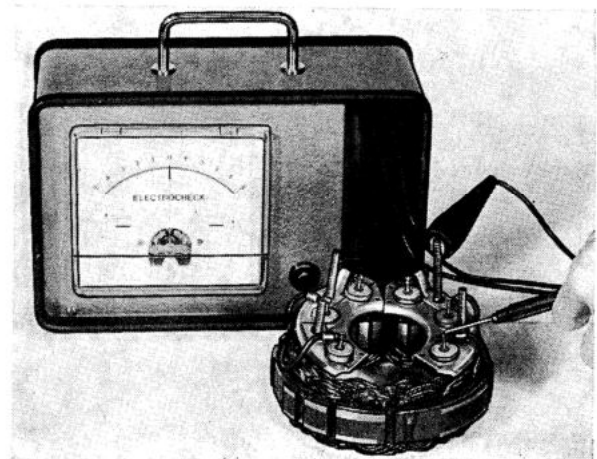


Fig. 3-10. Checking the diodes

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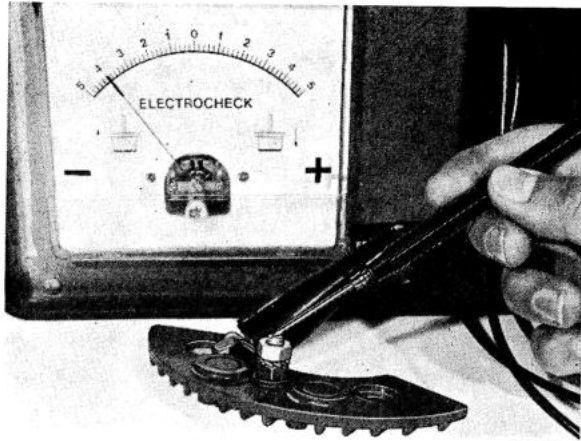


Fig. 3-11. Checking the isolation diodes

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

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

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

BRUSH HOLDER

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

Connect the test lamp between the DF-terminal and "+" brush. The lamp should give a steady light even if the brush or the terminal cable is moved see Fig. 3-13. Connect the test lamp between the brush holder

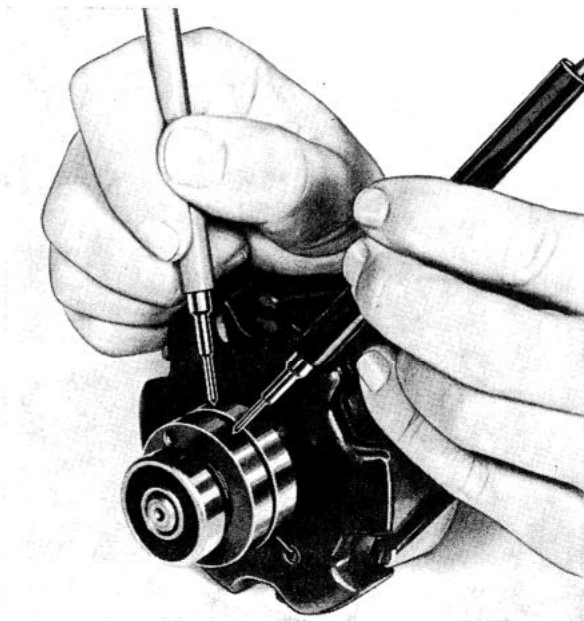


Fig. 3-12. Check-measuring the rotor

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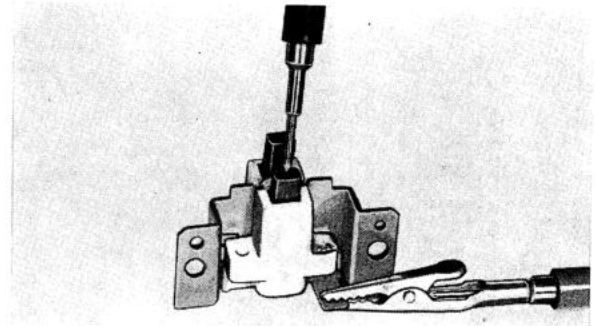


Fig. 3-13. Checking the brush holder

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frame "-" brush. The lamp should give a steady light even if the brush or the terminal lead is moved.

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

The brush length is measured between the brush contact surface and holder, with the brush resting against the spring, see Fig. 3-14.

REPLACING THE RECTIFIER DIODES

1. Mark the leads connecting the stator to the diodes. Solder loose the leads.
2. Place the new diode holder in exactly the same position occupied by the old one. Hold the outgoing diode lead with a pair of flat pliers. (This is to conduct the heat from the soldering point so as not to damage the new diode.)
3. Solder on the diodes, see Fig. 3-15.

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

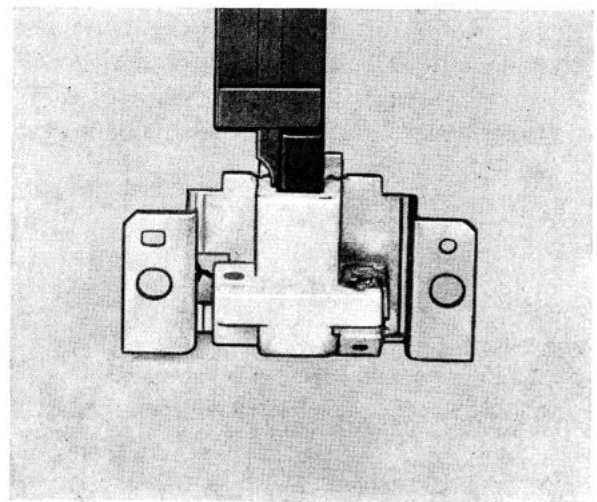


Fig. 3-14. Measuring the brush length

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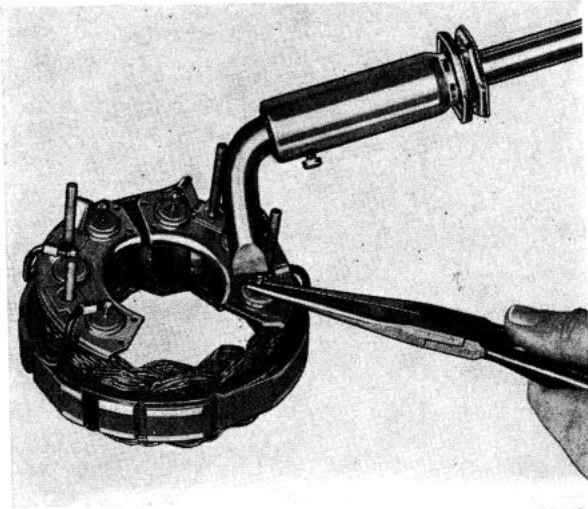


Fig. 3-15. Soldering on the diodes

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

Never change places for the two diode holders. The **positive diode holder** is isolated from the frame by means of isolation washers and sleeves and its diodes are marked in **red**.

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

REPLACING THE BEARINGS

DRIVE END SHIELD BEARING

Removing

1. Place the rotor in a vice with soft jaws.
2. Pull the bearing off with a claw puller, see Fig. 3-16.

Fitting

1. Place the support plate on the rotor shaft with the three elevations facing the rotor winding.
2. Press the bearing in with the help of a tubular sleeve which presses on the bearing inner ring, see Fig. 3-17.

SLIP RING END BEARING

Removing

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

Fitting

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

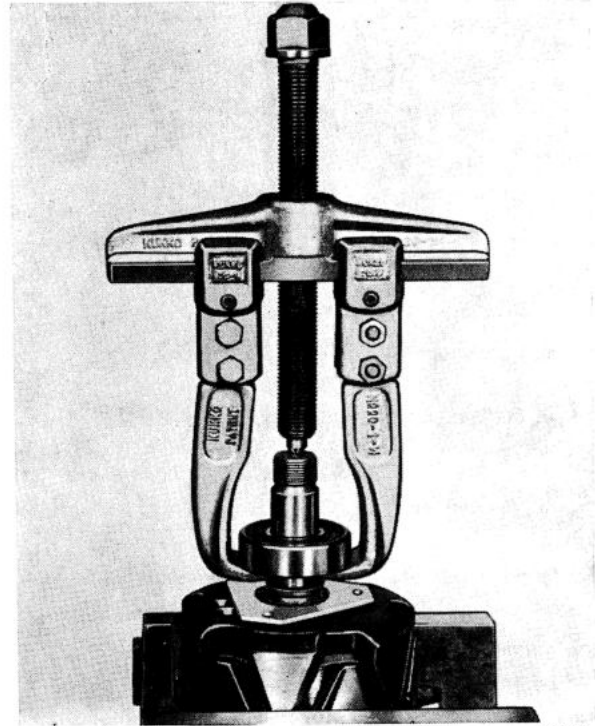


Fig. 3-16. Removing the bearing

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REPLACING SLIP RING END SHIELD O-RING

1. Remove the O-ring with a steel blade with rounded edges (for example, a feeler gauge), see Fig. 3-18.
2. Wash the groove clean.
Check that the hole in the bearing shield is not blocked.

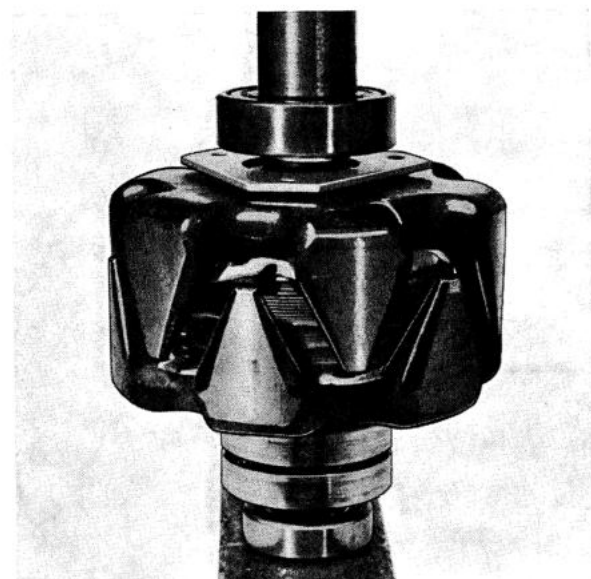


Fig. 3-17. Fitting the bearing

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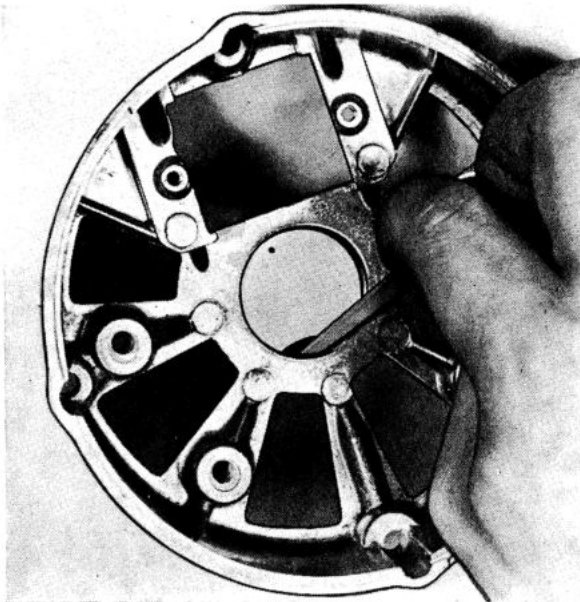


Fig. 3-18. Removing the O-ring

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3. Fit a new O-ring.

Lubricate the O-ring and the hole with mineral oil or similar.

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

ASSEMBLING THE ALTERNATOR

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

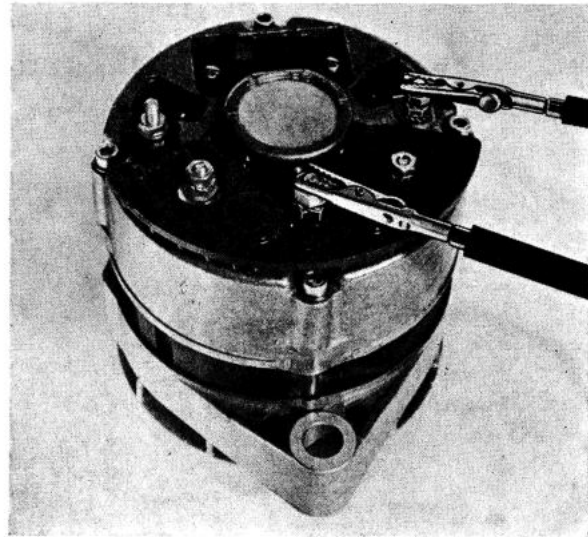


Fig. 3-19. Checking the alternator

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Fit the isolation diode, put on the nuts and washers. Fit the brush holder.

6. Fit the spacer washer, key, fan, pulley, washer and nut. Tightening torque 4 kpm (29.0 lb.ft.).
7. Connect a test lamp between B+ and the alternator frame. Switch the terminals. The lamp should light only in one direction, see Fig. 3-19. After any repairs, the alternator should be test-run in a test bench.

FITTING THE ALTERNATOR

1. Place the alternator in position while fitting on the fan belt at the same time.
2. Fit the attaching bolts and tensioning iron without tightening up the bolts. Adjust the belt tension (see Part 2, Engine, Group 25) and secure the alternator. N.B. Force may only be applied to the front end of the alternator when adjusting the belt tension. Fit the leads to the alternator.
4. Fit the battery lead.

VOLTAGE REGULATOR

DESCRIPTION

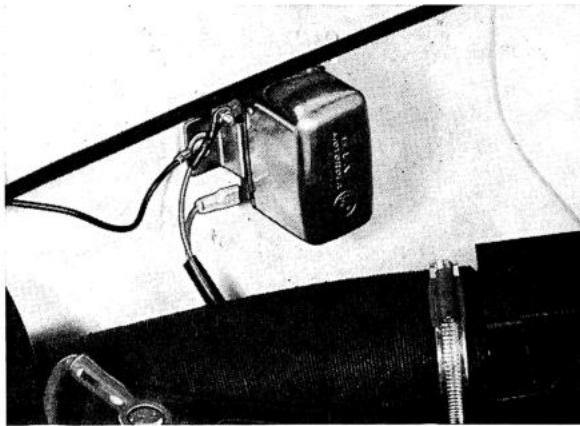


Fig. 3-20. Voltage regulator fitted

The regulator, Fig. 3—20, is a twin contact regulator with a fixed upper contact, a movable contact and a fixed lower one. The movable contact is attached to an armature which is actuated by a voltage coil. The regulator also houses four resistors and one thermistor.

FUNCTION

When the ignition key is switched on, current flows through the charging warning lamp to +(61) on the regulator. It is then conducted via the regulator through the field winding to earth.

When the alternator starts rotating, alternating current is formed in the stator. This alternating current is rectified by the silicon diodes and the direct current produced is re-fed via the regulator to the field winding until the regulating voltage has been reached.

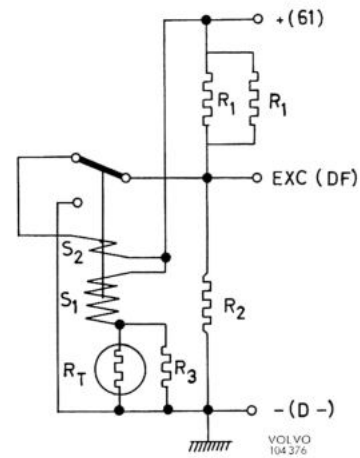


Fig. 3-21. Inner wiring of regulator

- S1 Voltage winding
- S2 Acceleration winding
- R1 Regulator resistances (2)
10 Ω ± 10 %
- R2 Damping resistance
30 Ω ± 10 %
- R3 Compensation
resistance (adapted to
RT during manufacture)
- RT Compensation
thermistor approx.
4 Ω at 25° C (17° F)

When the regulating voltage has been reached the armature is attracted by the coil. This causes the contacts to open and the field current must pass the resistances R1, Fig. 3-21.

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

TESTING THE ALTERNATOR AND VOLTAGE REGULATOR

GENERAL

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

CHECKING THE ALTERNATOR CIRCUIT

Before carrying out any tests on the alternator or regulator in the vehicle check the battery and vehicle wiring system for damaged leads or insulation, loose or corroded lead terminals and poor earthing. **Check the fan belt** (see Part 2, Engine, Group 25). Any of the above faults must be remedied before the electrical checks can be started.

TESTING THE BATTERY

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

CHECKING THE VOLTAGE DROP

This test is made to check the leads between the alternator and the battery and also the battery earth lead. The test should be carried out with a fully charged battery in good condition. The battery terminals should be well cleaned and tightened. Load the alternator with about 10 amps. Suitable load: Mainbeam 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 is a fault in the lead or contact, which must be remedied immediately. After repairing the leads or contacts, measure once again. With the same load as above, measure the voltage drop between the negative pole of the battery and the alternator terminal D—. Here the voltage drop must not exceed 0.2 volt. If the voltage drop exceeds 0.2 volt, check the battery earth lead, the alternator contact with the engine and the engine contact with the chassis. After making the necessary repairs measure again.

CHECKING THE ALTERNATOR

(In a test bench or in the vehicle)

Connect up the alternator as shown in Fig. 3-22. Check that the current through the field winding (ammeter C) is 3—3.5 amps. (If the current is not the correct one, then check the brush holder and field winding.) Run the alternator to a speed of 3000 r.p.m. (Engine speed 1500 r.p.m.).

The alternator should then produce at least 48 amps at 14 volts. (A further load may be connected up in order to maintain the voltage at 14 volts.) This applies to a warm alternator and an ambient temperature of 25° C (77° F).

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

The voltage should be 0.8—0.9 volt more than at terminal 61, otherwise the isolation diodes is faulty and should be replaced.

CHECKING THE VOLTAGE REGULATOR

(In a test bench or in the vehicle)

Connect up the alternator and regulator as shown in Fig. 3-23. Run the alternator at about a speed of 5000 r.p.m. (engine speed 2500 r.p.m.) for 15 seconds. Then read off the voltage on the voltmeter. With no load on the alternator, the voltmeter should read 13.1—14.4 volts with the regulator ambient temperature at 25° C (77° F).

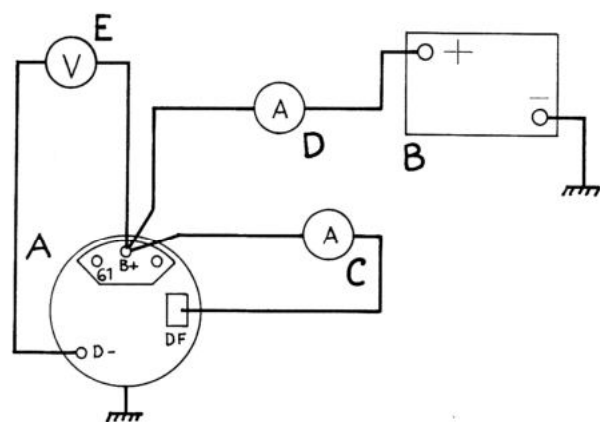
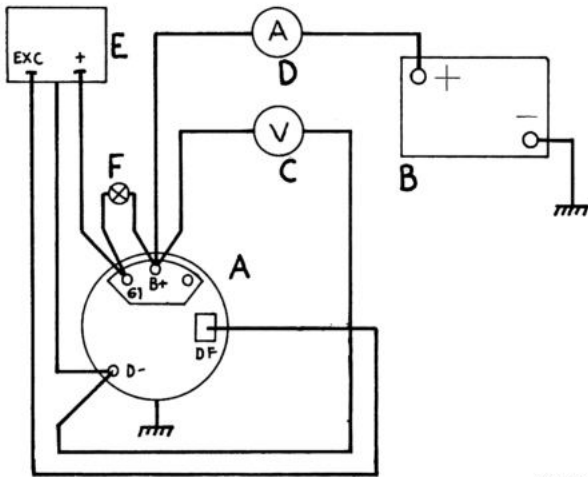


Fig. 3-22. Wiring diagram for testing alternator

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

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Fig. 3-23. Wiring diagram for testing voltage regulator

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

Load the alternator with 10—15 amps, for example, full-beam headlights, and read off the voltage. The voltage should also lie on this occasion between 13.1—14.4 volts. For ambient temperatures other than 25° C (77° F), see the diagram in Fig. 3-24.

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

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

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

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

Immediately after, or preferably during driving, measure the voltage between B+ and D— on the alter-

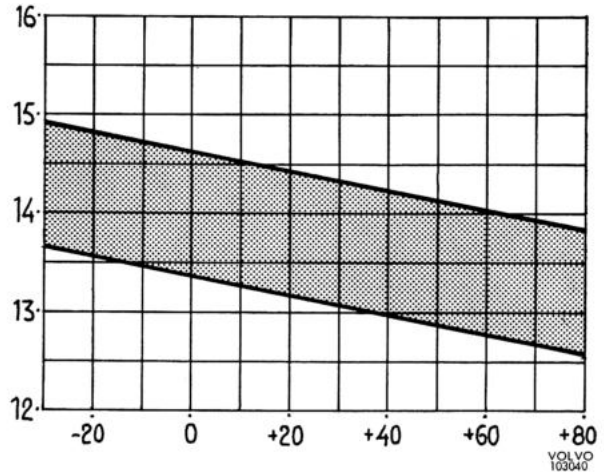


Fig. 3-24. Voltage-temperature diagram for cold voltage regulator

nator. The engine should be turning over at about 1500 r.p.m. (3000 alternator r.p.m.) when the measuring is being carried out. When the regulator ambient temperature is about 25° C (77° F), the voltage should be 13.85—14.25 volts. For other ambient temperatures, see Fig. 3-25.

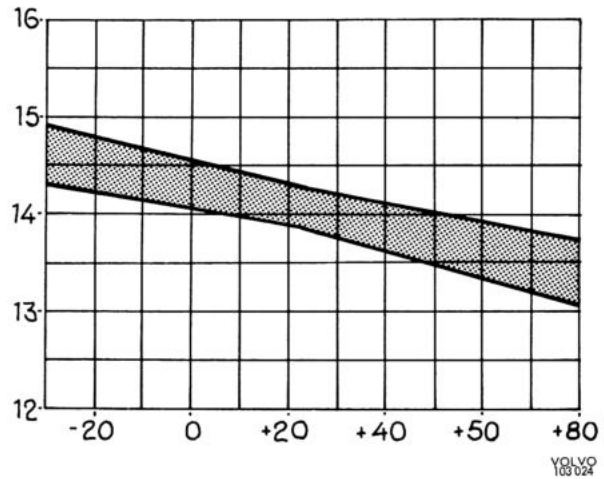


Fig. 3-25. Voltage-temperature diagram for warm voltage regulator

FAULT TRACING

FAULT	REASON
Alternator does not charge.	Worn or insufficiently tensioned fan belt. Breakage in charging circuit. Worn brushes. Breakage in rotor winding. Breakage in isolation diodes. Faulty regulator.
Charging weak or irregular.	Worn or insufficiently tensioned fan belt. Intermittent breakage in charging circuit. Worn brushes. Breakage or short-circuiting in one or several rectifier diodes. (Breakage in a diode reduces the charging current about 5 amps. Short-circuiting in a diode limits the alternator charging current to 7—8 amps and causes a rumbling sound in the alternator.) Partial short-circuiting in the rotor. Breakage or short-circuiting in the stator. Faulty regulator.
Too high charging.	Faulty regulator. Faulty terminals on regulator or alternator. Short-circuiting in isolation diodes.
Noise in alternator.	Worn fan belt. Loose pulley. Worn bearings. Short-circuiting in one or several rectifier diodes. Alternator pulley incorrectly aligned in relation to the crankshaft pulley.
Charging warning lamp glows.	Voltage drop in fusebox.