

The alternator is a three-phase, delta-connected alternator unit, of make Bosch 14V/55A. The rectifier, which is built into the slip ring end shield, consists of six silicon diodes. The drive end shield houses three magnetizing diodes which feed the rotor winding via the charging regulator.

An alternator differs from a dynamo in that it has a rotating field coil (rotor) and stationary generating winding (stator).

The rotor is of the claw-pole type with the field windings fed across two slip rings. Since the alternator is self-limiting with regard to current (max. 55A), a simple, mechanical charging regulator can be used with only voltage control.

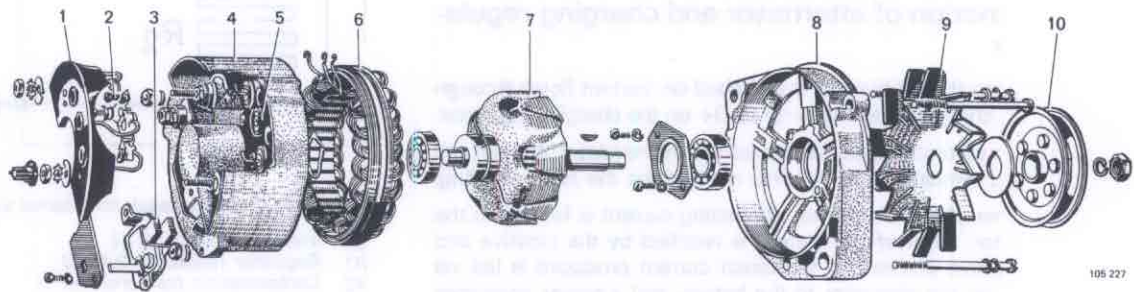


Fig. 32-2. Exploded view of alternator

- | | |
|------------------------------------|--------------------|
| 1 Rectifier (positive diode plate) | 6 Stator |
| 2 Magnetizing rectifier | 7 Rotor |
| 3 Brush holder | 8 Drive end shield |
| 4 Slip ring end shield | 9 Fan |
| 5 Rectifier (negative diodes) | 10 Pulley |

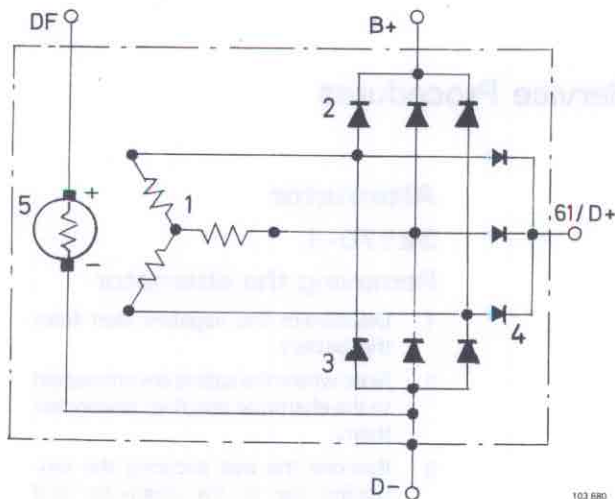


Fig. 32-3. Alternator internal wiring

- | |
|-----------------------------|
| 1 Stator windings |
| 2 Positive rectifier diodes |
| 3 Negative rectifier diodes |
| 4 Magnetizing diodes |
| 5 Rotor winding |

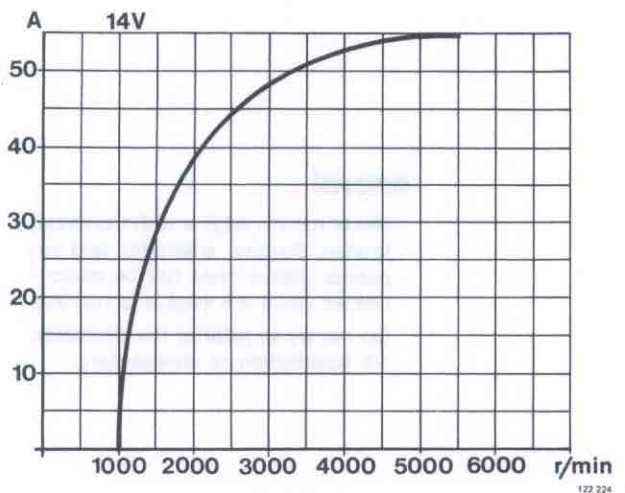


Fig. 32-4. Output curve
The above speed applies to alternator

Charging regulator Bosch AD 14 V

A charging regulator is a mechanical, single-pole voltage regulator.

It consists of a contact system which consists of 1, a movable contact, 2, a lower contact, 3, an upper contact, see Fig. 32-5.

A regulator resistor is placed under a plate underneath the regulator. Temperature compensation is operated by a metal spring which influences the spring tension so that the regulator receives lower regulating voltage at higher temperatures.

Function of alternator and charging regulator

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

A current is then conducted via the regulator through the field winding to earth. This magnetizes the rotor winding.

When the rotor rotates, alternating current is formed in the rotor. Most of the current is rectified by the positive and negative diodes and the direct current produced is led via the alternator to the battery and a power consumer (consumers) if switched on. A small part of the current is rectified by the magnetizing diodes and is led via 61/D+ to the charging regulator and then onto the rotor winding. The cycle is repeated until the regulating voltage has been reached. When this has been reached, contact is broken between 1 and 2 on Fig. 32-5. This forces the magnetizing current to the rotor winding to pass resistance R_1 , Fig. 32-5. The voltage rises in spite of this, the armature is drawn further down in the voltage coil and the movable contact meets the upper contact (3), Fig. 32-5. This earths the field winding at both ends and the voltage drops. The cycle is repeated continuously so that voltage is maintained constant.

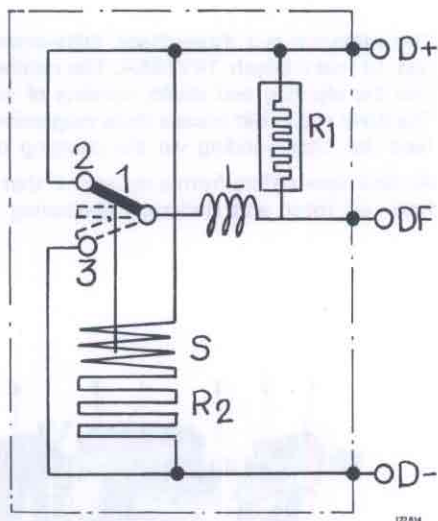


Fig. 32-5. Charging regulator internal wiring

- S Voltage winding 35Ω
- R1 Regulator resistance 2.45Ω
- R2 Compensation resistance 50Ω
- L Contact impedance coil

- 1 Movable contact
- 2 Lower contact
- 3 Upper contact

Service Procedures

General

Never run the engine with the circuit broken. Battery, alternator and regulator cables must not be disconnected while the engine is running. Do not try to polarize the alternator. All polarization is unnecessary.

Alternator

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Removing the alternator

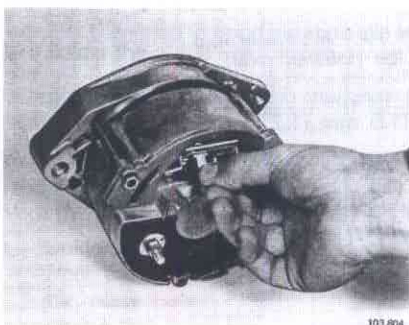
1. Disconnect the negative lead from the battery.
2. Note where the cables are connected to the alternator and then disconnect them.
3. Remove the bolt securing the tensioning bar to the alternator and slacken a couple of turns the bolt securing the tensioning bar to the cylinder head.
4. Remove the alternator retaining bolt and its spacer washer. Remove the drive belts and the alternator.

Alternator (removed)

Overhauling

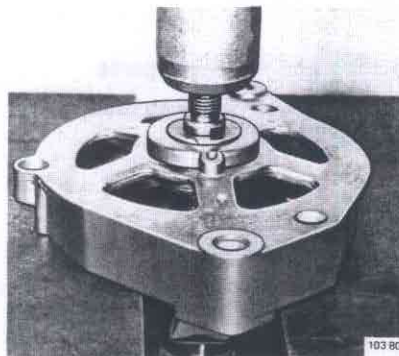
Disassembling

1. Fit the alternator pulley and pulley belt in a vice with soft jaws. Remove the nut, washer, pulley, fan and key.
2. Remove the screws securing the brush holder. Pull out the holder.

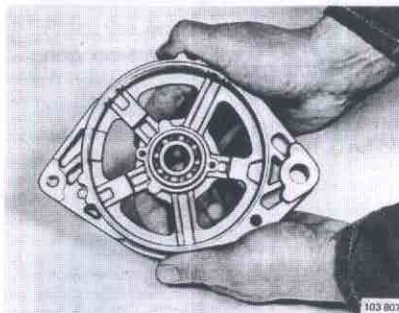


3. Mark the drive end shields and stator to ensure they are re-fitted correctly when assembling.
4. Remove the three screws holding the alternator together. Separate the drive end shield and rotor from the slip ring end shield and stator.

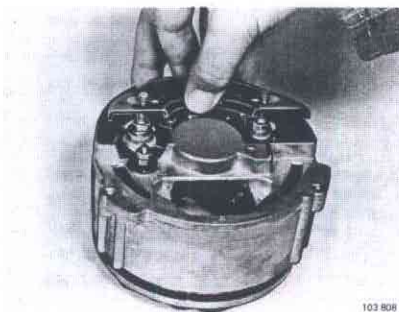
5. Press the rotor out of the drive end shield.



6. Remove the screws for the cover washer which holds the drive end bearing and press out the bearing.



7. Remove the nuts for the positive diode plate and lift up and bend the plate aside.



Solder loose the stator connections from the terminals and remove the stator.

Pull the slip ring bearing from the rotor.

Checking and replacing parts

Wash the removed parts with white spirit before checking them.

Stator

Check the stator insulation by connecting 40 V alternating current between the axis and a phase winding.



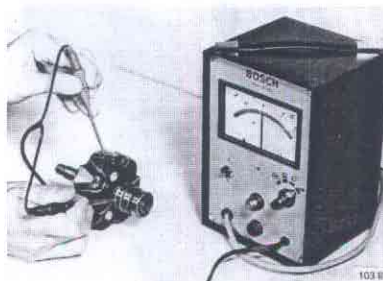
Check the stator for any short-circuiting by measuring the resistance between the stator windings (three measurements). The resistance should be 0.14–0.15 ohm.



0,14–0,15 Ω

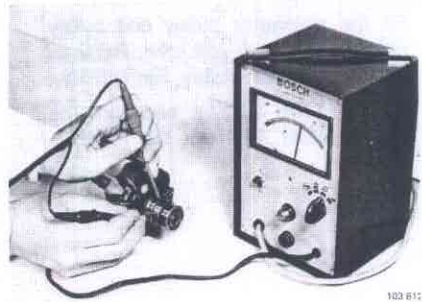
Rotor

Check the rotor insulation by connecting 40 V alternating current between the rotor body and a slip ring.



Measure the resistance between the slip rings with the help of an ohmmeter.

The resistance should be 4.0–4.4 ohms.



4,0–4,4 Ω

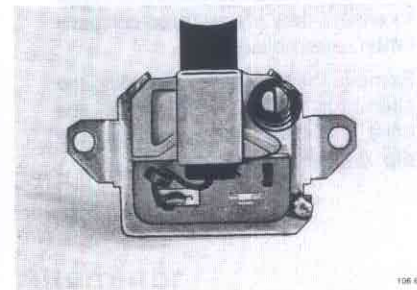
If the slip rings are burnt or damaged, they can be polished with, e.g., pinol chuck.

The minimum diameter for the slip rings is 31.5 mm (1.2").

After polishing, check the roundness on the slip rings with a dial indicator. Max. permissible radial throw is 0.03 mm (0.0012").

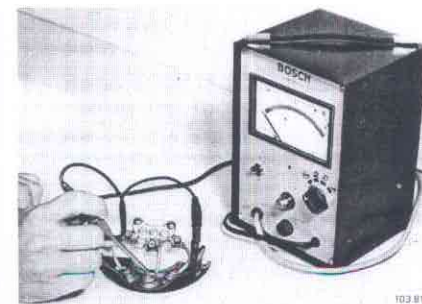
Brush holder

Check the brush holder insulation with a 40 V alternating current. Measure the brush length which should be minimum 14 mm (0.5").



Diodes

Check the diodes with a diode tester. Faulty diodes must be replaced as follows.



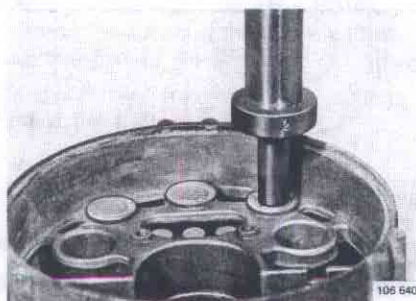
Replacing the diodes

Positive diodes

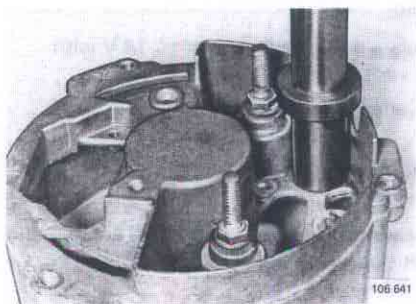
1. Solder loose the positive diode plate from the connections. Press out the faulty diode with a suitable drift.
2. Calibrate the hole in the positive diode plate with a suitable tool (e.g. Bosch EFLJ 57/0/3 and 57/05).
3. Oil the new diode with silicon oil (e.g. Bosch OI 63V2) and press it in with a suitable drift.
4. Paint the new diode and any bare spots on the outside of the positive diode plate with black paint (Bosch F 1 87 V 1 corresponding) to prevent corrosion.
5. Solder the positive diode plate to the connections. Check with a diode tester.

Negative diodes

1. Solder loose the negative diodes from the connections. Screw loose the plate holding the magnetizing diodes and lift off the plate together with the positive diode plate.
2. Press out the faulty diode with a suitable tool.



3. Oil the new diode with silicon oil (e.g. Bosch OI 63V2) and fit it in the bearing shield.



4. Solder on the negative diodes to the connections and check with a diode tester.

Magnetizing diodes

1. If any of the magnetizing diodes is faulty, replace the entire plate and all three diodes.

Bearings

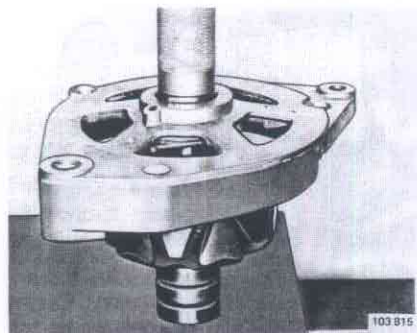
Check to make sure the bearings are not damaged or worn.

Grease the old bearings (or new ones if fitted) with Bosch special grease Ft 1 V 34 or corresponding.

Fit the bearing on the rotor. Fit the bearing in the drive end shield and fix the washer over the bearing.

Assembling

1. Fix the stator in the slip ring end shield and solder the stator windings to the connections. Fit the positive diode plate.
2. Press the bearing shield and spacer ring onto the rotor.



3. Smear the bearing rear seat with a light layer of Molykote paste and assemble the alternator. (Do not forget the spring ring on the bearing rear seat.) Assemble the alternator by means of the screws and nuts (check the marking).
4. Fit the brush holder.
5. Fit the key, fan, pulley, washer and nut.
6. Tighten the nut to a torque of 40 Nm (4 kgf m = 29 lbf ft). After assembling the alternator, test it on a test bench before installing it in the vehicle, see under "Charging Test" (on test bench or in vehicle), page 14.

40 Nm

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Installing the alternator

Place the alternator in position and fit the retaining bolt and spacer washer. (Do not tighten up the bolt.)

Fit the drive belts.

Fit the bolt securing the tensioning bar. (Do not tighten up the bolt.)

Tension the drive belts by levering with a suitable tool on the alternator drive bearing end and then tighten up the bolt securing the tensioning bar.

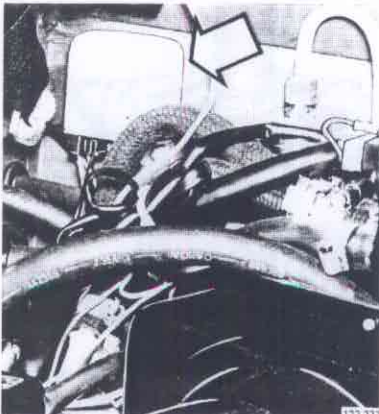
Tighten up the alternator retaining bolt.

Tighten up the bolt on the cylinder head and connect the cables to their terminals.

Fit the front engine cover. Connect the negative cable to the battery and fit the cover over the battery.

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Replacing the charging regulator



Pull the insert plug out of the charging regulator.

Remove the bolts securing the regulator.

Check that the number on the new regulator is the same as that on the old one.

Mount and secure the regulator and connect the insert plug.

Testing the alternator and regulator

Before testing the alternator or regulator in the vehicle, check the battery and test the electrical circuit for faulty cables or insulation, loose or corroded cable shoes and poor earthing. **Check the drive belts.** Any faults discovered must be put right before doing any electrical checks.

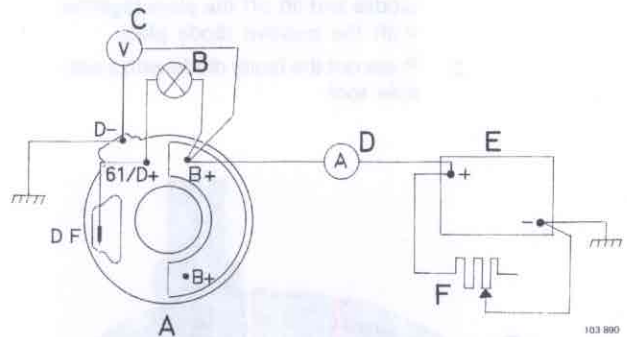
Always make sure that the circuit is not broken when checking the alternator equipment. A disconnected cable can ruin both alternator and regulator.

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Charging test (on test bench or in vehicle)

Alternator

Wire the alternator according to the diagram below.



- | | | | |
|---|-----------------------|---|-----------------|
| A | Alternator | D | Ammeter 0-60 A |
| B | Check lamp (12 V 2 W) | E | Battery |
| C | Voltmeter 0-20 V | F | Load resistance |

Run the alternator at 100 r/s (6000 r/min) (engine speed 58 r/s = 3500 r/min).

Regulate the voltage to approx. 14 V with load resistance F.

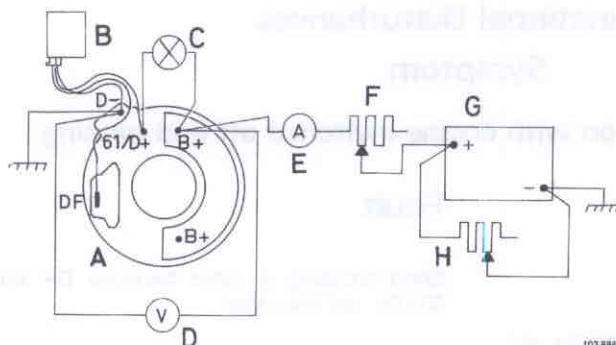
The alternator should now generate 55 A.

If it does not, first check the brushes and the diodes.

If speeds differing from the above are obtained, compare with the output curve in Fig. 32-4.

Testing and adjusting the regulator (in the vehicle or on test bench)

Connect the regulator to a fault-free alternator according to the wiring diagram below.



- | | | | |
|---|-------------------------|---|--------------------|
| A | Alternator | E | Ammeter 0-60 A |
| B | Regulator | F | Control resistance |
| C | Control lamp (12 V 2 W) | G | Battery |
| D | Voltmeter 0-20 V | H | Load resistance |

Run the alternator at 67 r/s (4000 r/min) (engine speed 39 r/s = 2300 r/min). Load the alternator to 44-46 A. Lower the alternator speed to approx. 16.7 r/s (1000 r/min) (engine idling speed). Again increase the speed to the above and adjust the load to 44-46 A.

Read off the voltmeter. The voltage should be 13.9-14.8 volts.

13.9-14.8 V

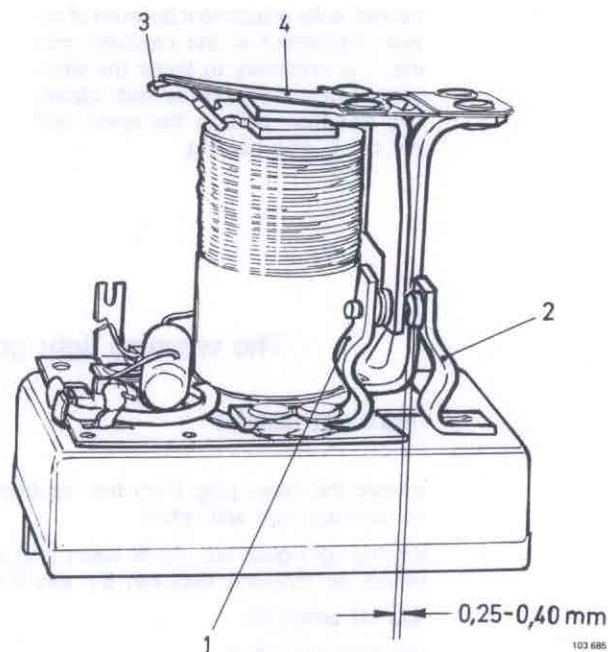
The regulator should regulate on the left (lower) contact. Read-off within 30 seconds after starting the test.

Reduce the alternator load to 3-8 A and read off the control voltage.

3-8 A

The control voltage should now be within the tolerance 0 V to minus 0.4 V in relation to the first reading.

The regulator should now regulate on the right (upper) contact.

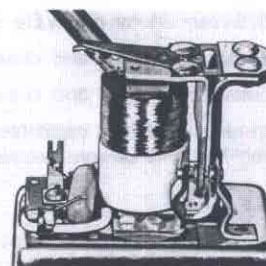


- 1 Regulator contact for lower control range (lower contact)
- 2 Regulator contact for upper control range (upper contact)
- 3 Stop bracket
- 4 Spring upper section: Steel spring
lower section: Bimetal spring

If the control voltage in the upper control range is high or low in relation to the lower control range 0 V to minus 0.4 V, adjust by bending the retainer for the left (lower) contact while correcting the gap between the right (upper) contact and the movable contact according to the Fig. above.

If the holder is bent towards the right (upper) contact, this lowers the control voltage in the upper control range.

The control voltage in the lower control range is adjusted by bending the stop bracket for the bimetal spring.



If the stop bracket is bent downwards, this lowers the control voltage, if it is bent upwards, this increases the voltage.

to avoid faulty adjustment because of residual magnetism in the regulator iron parts, it is necessary to lower the alternator speed towards 0 after each adjustment, and then increase the speed and carry out a new reading.

(If the adjusting work is going to take some time and the regulator is warm, it can be suitably cooled to room temperature with compressed air before carrying out the final reading.)

Functional Disturbances

Symptom

The warning light goes on with engine switched off and running

Test measure

Remove the insert plug from the regulator: the warning light still lights.

Warning light goes out. Re-fit insert plug in regulator and connect an ammeter between B+ and D+ on alternator.

Read-off ammeter:

Less than 2.0–2.5 A

Greater than 2.0–2.5 A.

Fault

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

Defective regulator (breakage).

Short-circuiting in cable between DF on regulator to DF on alternator. Short-circuiting in rotor winding.

Warning light goes on with engine switched off but starts to glint when engine is running

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

Lamp does not light

Lamp glints

Fit new regulator.

Test lamp between B+ and 61/D+:

Lamp does not light

Lamp glints

Transit resistance in charging circuit or in cable to warning light.

Regulator defective (battery overcharges) or alternator defective (insufficient charging of battery).

Removed regulator defective

Alternator defective

Warning lamp does not light with engine switched off

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

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

Test lamp between 61/D+ and chassis lights.

Test lamp between 61/D+ and chassis glints.

Warning light glints. Remove insert plug from regulator and connect an ammeter between B+ and DF on alternator.

Ammeter shows: 0 A

2.0–2.5 A

Burnt-out warning light or breakage in its circuit to D+ on regulator.

Short-circuiting in a positive diode.

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

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

Group 33 Starter Motor

Construction and Function

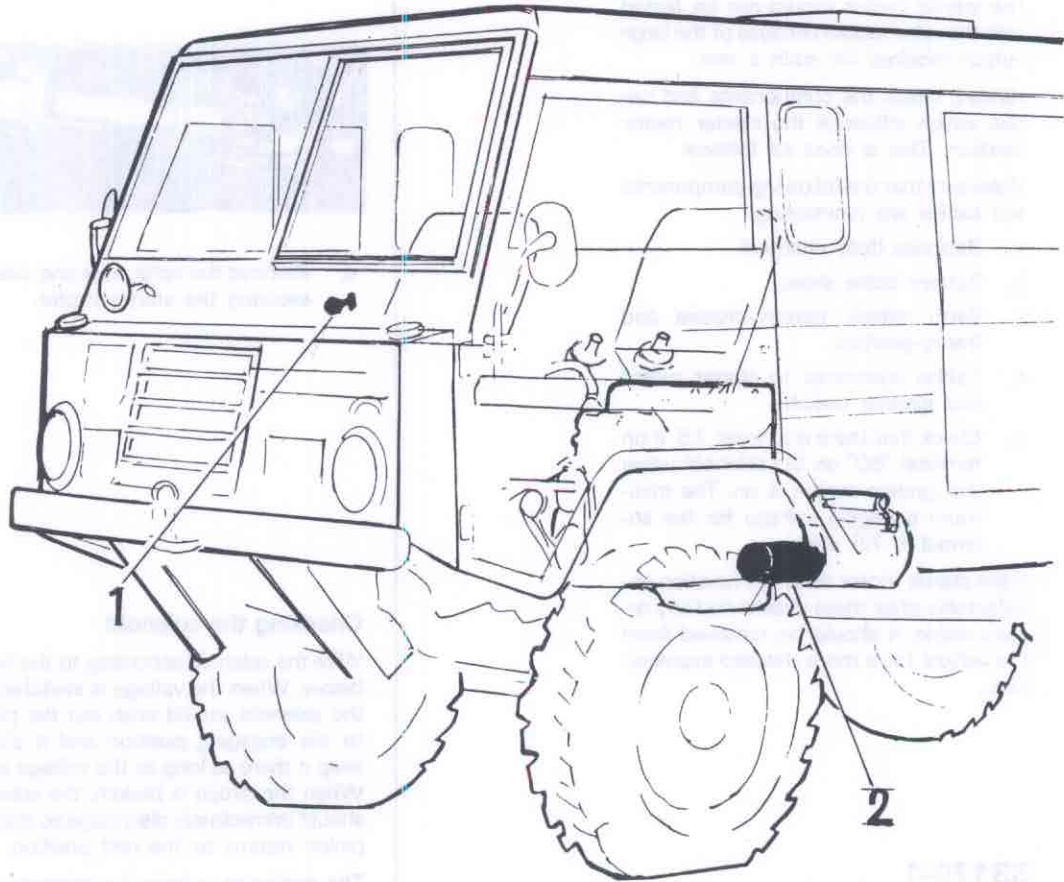


Fig. 33-1. Starter motor

- 1 Ignition switch
- 2 Starter motor

Starter motor

The starter motor is a four-pole, series-wound motor and has an output of approx. 815 W (1.1 h.p.). It is situated on the left-hand side of the engine. The starter motor rotor shaft pinion 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, this 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.

Service Procedures

Starter Motor

Testing in vehicle

The starter motor should not be tested with the rotor locked because of the large output required for such a test.

Instead, check the components and cables which influence the starter motor function. This is done as follows:

Make sure that the following components and cables are functioning.

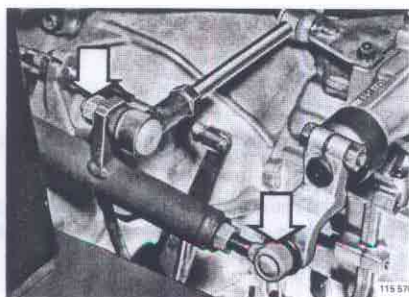
1. Batteries (fully charged)
2. Battery cable shoes.
3. Earth cables, battery-chassis and frame-gearbox.
4. Cables connected to starter motor and ignition switch.
5. Check that there is at least 7.5 V on terminal "50" on the solenoid when the ignition switch is on. The minimum engaging voltage for the solenoid is 7.5 volts.

If the starter motor does not function satisfactorily after these checks and any repairs made, it should be removed from the vehicle for a more detailed examination.

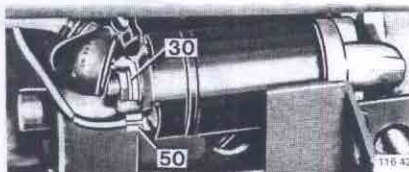
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Removing the starter motor

1. Disconnect the negative cable from the battery.
2. Remove the rear engine casing. Remove the gear lever control ball joints from the gearbox and lift up the control pipe.



3. Disconnect the cables from the starter motor.



4. Remove the bolts, nuts and washers securing the starter motor.

Checking the solenoid

Wire the solenoid according to the figure below. When the voltage is switched on, the solenoid should push out the pinion to the engaging position and it should keep it there as long as the voltage is on. When the circuit is broken, the solenoid should immediately disengage so that the pinion returns to the rest position.

The minimum voltage for engaging the solenoid is 8 volts.

