# Workshop Manual LT.

## Electrical System.

**April 1985 Edition.**
**Supersedes August 1978 Edition.**

**The manual is divided into separate booklets** which can be ordered individually and allocated on the shop floor as required.

This manual is valid for the LT from the start of production (August 1975).

It describes all operations which require special instructions to ensure satisfactory work.

### Layout of booklets

This booklet has an index according to repair groups to make it easy to find the information required.

Where practical, each description of an operation is preceded by an explosed view which also contains all the main repair instructions. This is supplemented, where necessary, by illustrations – which are referred to in the exploded view – giving details of the fitting positions of parts or showing special tools in use. If a definite sequence has to be followed when dismantling and assembling a component, the exploded view is followed by a description of the main steps of the work sequence.
Any adjustments required are also explained.

### Workshop Bulletins

The workshop bulletins allocated to this booklet should be filed at the back of the booklet. To remind you that bulletins have been published, the manual pages should be marked by hand with the bulletin number as explained in the bulletin heading.

### Fault finding

The basis for fault finding is the current flow diagram. Further information is given in
- this manual
- "Fault Finding with V.A.G 1466" booklet
- "Fault Finding" binder

Instructions on the elimination of current defects are given in the "Service Handbook".

**Technical information should always be made available to all foremen and mechanics because compliance with the instructions given is essential to ensure vehicle roadworthiness and safety.**

In addition, the normal safety precautions to be observed when working on motor vehicles are also applicable.

## INDEX ACCORDING TO REPAIR GROUPS

## CHECKING BATTERY

From Model Year 1982 the batteries are fitted with plugs which can only be removed with a screwdriver.

**Note:**

Removal of plugs is only necessary when the acid level is below the "min" mark on battery housing.

– Pierce the plastic skin at the location provided (arrow) with a screwdriver.


– Place screwdriver in slot and turn plug anti-clockwise to stop.

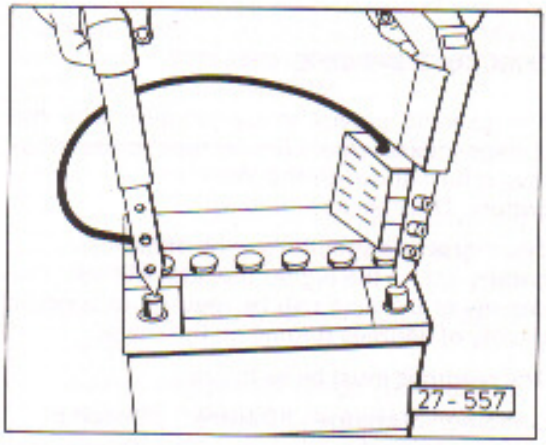

**Note:**

The new plugs can still be screwed in by hand as before.

## CHECKING VOLTAGE UNDER LOAD

– **Disconnect battery earthing strap**

The voltage under load can checked with a battery tester – e. g. V.A.G 1498 (Fig.).




The current load and the minimum voltage vary according to capacity of battery and are shown on a sticker on the tester:

| Capacity | Current | Minimum voltage |
|---|---|---|
| 36 Ah – 175 A | 100 A | 10.0 V |
| 45 Ah – 220 A | 200 A | 9.2 V |
| 54 Ah – 265 A | 200 A | 9.4 V |
| 63 Ah – 300 A | 200 A | 9.5 V |
| 63 Ah – 380 A | 300 A | 9.0 V |
| 88 Ah – 395 A | 300 A | 9.5 V |
| 110 Ah – 420 A | 300 A | 9.5 V |

If the voltage is below the specified figure when tested under load for 5/10 seconds the battery is either dischaged of defective. Check specific gravity of acid.

**Note:**

To avoid the risk of explosion, do not check battery when it is gassing.

**Batteries** with a capacity of more than **63 Ah** must not be checked with the battery tester/ charger VW 1266 because this tester is only designed for batteries up to approx. 63 Ah.

### Checking acid level

When the acid level is below the "min" mark, add distilled water only.

Batteries in which the acid level is too high will tend to "boil over" when charged heavily (long journeys in daylight). If acid level is too low it will shorten the service life of battery.

### CHECKING SPECIFIC GRAVITY

The specific gravity in conjunction with the voltage measurement (under load) gives accurate information on the state of charge of a battery. The check is done with a hydrometer.

The higher the specific gravity of the siphoned battery acid is the higher the float will rise. The density of the acid can be read off in specific gravity of degrees Baumé on the scale.

The readings must be as follows:

| Condition of charge in normal climatic zones | ° Baumé | Specific gravity |
|---|---|---|
| discharged | 16 | 1.12 |
| half charged | 24 | 1.20 |
| fully charged | 32 | 1.28 |

| Condition of charge in the tropics | ° Baumé | Specific gravity |
|---|---|---|
| discharged | 11 | 1.08 |
| half charged | 18 | 1.14 |
| fully charged | 27 | 1.23 |

### CHARGING BATTERY

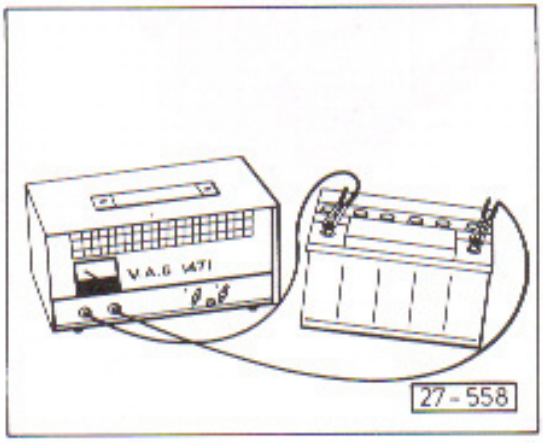
**Note:**

Smoking or the use of naked lights are not allowed in rooms in which batteries are being charged. Precision tools should also not be left in such rooms.

Frozen batteries must be thawed out before being charged.

With the battery charger V.A.G 1471 up to four 12 Volt batteries and also batteries with different capacities (Ah = Ampere hour) and nominal voltages can be charged normally.

- Disconnect battery earth and positive wire from battery.
- Connect battery to charging appliance. positive to positive, negative to negative.




- Switch on the charging current. The charging current depends on the capacity of the battery and it should be about 20% of the capacity. With a 45 Ah battery it should be about 9.0 A.

  When the gassing voltage is reached the charging current should not be than 10% of battery capacity.
  With a 45 Amp. hour battery it should be approx. 4.5 Amp.

## QUICK CHARGING/STARTING BOOST

Quick charging only is possible with the battery test and charging appliance VW 1266 whereas with the battery starter charger V.A.G 1472 a starting boost can also be given.

## BATTERY HANDLING

Batteries which have not been used for a long period (e.g. in stock vehicles) tend to self-discharge and can also in addition become sulfated. If these batteries are quick charged with normal charging appliances they do not absorb any charging current or appear to be prematurely fully charged as a result of so-called surface charging. They appear to be defective.

Before these batteries are finally classified as defective, they should be checked:

a – If the specific gravity of the acid in all cells does not deviate by more than **0.02 kg/dm³** (e.g. 1.13 to 1.11) from one another, the battery is to be charged. On completion of the charging process the battery is then given a load test. If it is then discovered that specified readings are not obtained, the battery is defective.

b – If the specific gravity in one or two adjacent cells drops noticeably (e.g. five cells show 1.6 and one cell 1.08), then the battery has a short circuit and is defective).

## REMOVING AND INSTALLING BATTERY

After putting battery back into vehicle, ensure that the cover is fitted again.

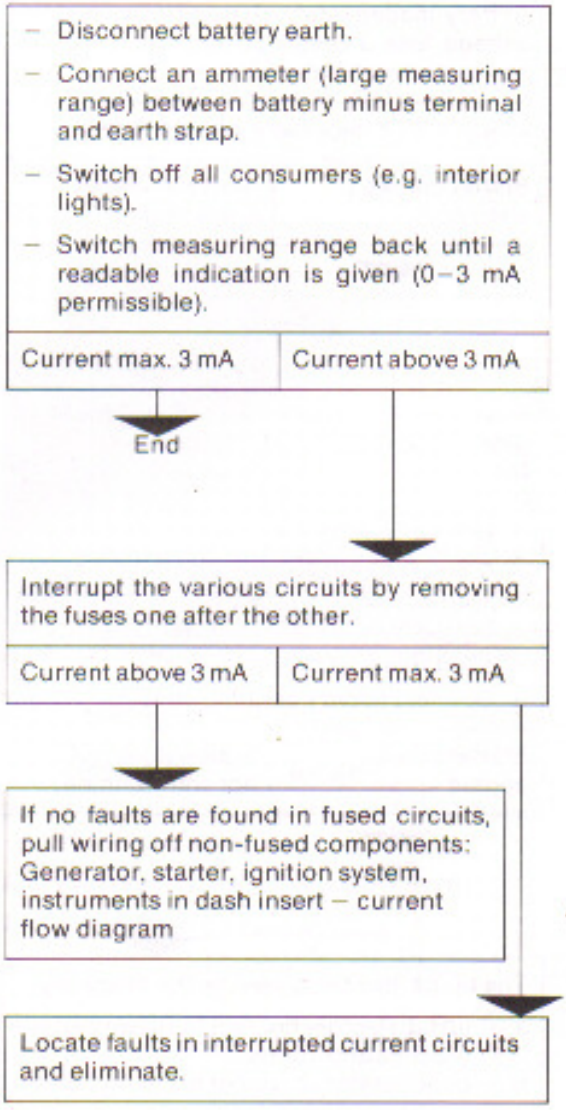
## FAULT FINDING

### BATTERY DISCHARGES
(Leakage current suspected)

**Test conditions:** Battery fully charged, clock disconnected.

**Note:**

Possible faults: corroded and dirty contacts, wires with chafed through insulation, internal short circuit in components.



**FAULT FINDING :**

**STARTER TURNS TOO SLOWLY TO START ENGINE**

**Test conditions:**

- Engine oil appropriate to the ambient temperature must be used in the winter months.
- V-belt tension OK.

Battery inadequately charged or excessive voltage loss a result of loose or oxidized connections on battery.

Check and, if necessary, charge battery.

| Starter cranks engine | Starter does not crank engine |
|---|---|

→ END

Excessive voltage loss as a result of loose or oxidized connections on starter terminal 30.

- Disconnect earthing strap from battery.
- Clean and tighten connections on starter and earthing strap between gearbox and bodywork (do not loosen earthing strap on bodywork).
- Connect battery earthing strap.

| Starter cranks engine | Starter does not not crank engine |
|---|---|

→ END

The faults may be caused by the following:

a – unsatisfactory contact between carbon brushes and commutator
b – commutator scored or burnt and dirty

Remedies:

a – replace carbon brushes and clean brush guides

b – replace armature

## FAULT FINDING

### STARTER DOES NOT TURN

**Test conditions:**

- The cable terminals on the solenoid and earthing strap between the gearbox and bodywork must be firmly fixed and not oxidized.
- Battery charged.

**Note:**

To connect the test lead to the solenoid detach the battery earthing strap.

No voltage at terminal 50 (solenoid) Fig. 1

- Start engine.
- Measure voltage at terminal 50 of solenoid (at least 8 V)

| Voltage less than 8 V | Voltage above 8 V |
|---|---|

Continued on next page

Measure voltage at connection for field winding at solenoid (at least 8 V).

Start engine (terminal 50).

| No voltage | Voltage present |
|---|---|
| Replace solenoid | Repair starter motor |

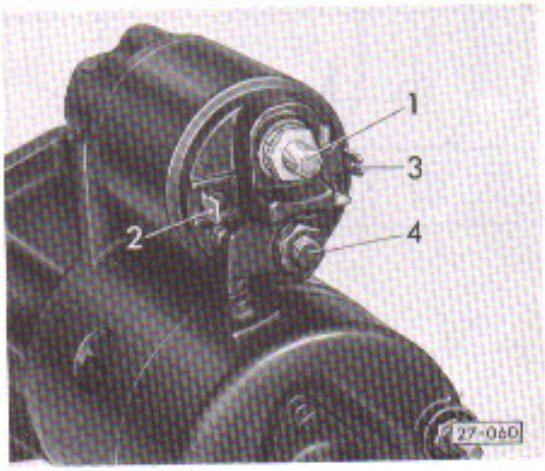



**Fig 1 Solenoid**

1 – Terminal 30 – from battery

2 – Terminal 15a – to coil (not on Diesel engined vehicle)

3 – Terminal 50 – from ignition switch

4 – Connection for field winding

**Continued on next page**

Continuation

Measure voltage at terminal 50 of ignition switch (at least 8 V). Fig. 2.

Start engine (terminal 50).

| No voltage | Voltage present |
|---|---|
| Check wiring to ignition switch (terminal 30). Replace ignition switch. | Check and repair wiring between ignition switch terminal 50 and starter terminal 50 (for wire routing see CF diagram, on Diesel vehicle note relay for starter) |

END

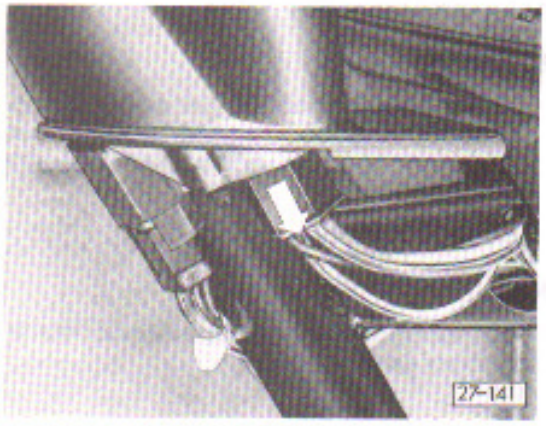



**Fig. 2 Ignition switch**

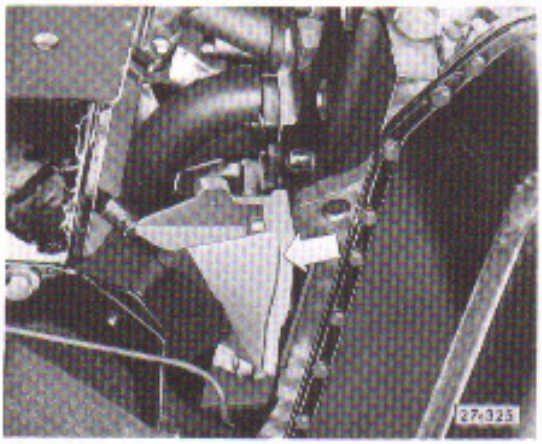
## REMOVING AND INSTALLING STARTER

**Tightening torque for starter securing screws:**

Carburetor and Diesel/Turbo Diesel engines: 80 Nm

**Removing (6 cyl. Diesel) up to 11.82**

- Detach battery earth.
- Support engine with 10-222 and tension lightly.
- Remove oil filter from below.



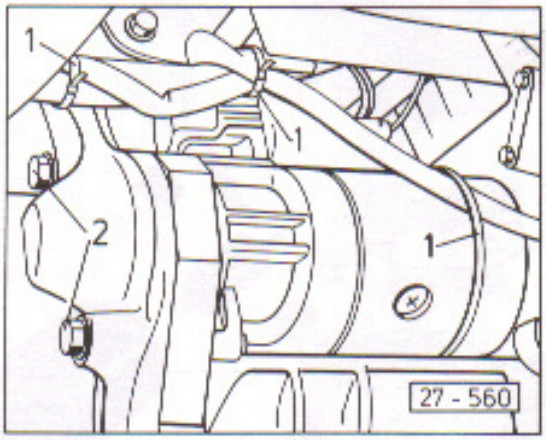

- Remove engine mounting – arrow –
- Take off starter together with strut.

**Installing (6 cyl. Diesel), up to 11.82**

- Attach starter to cylinder block.
- Secure starter strut together with engine mounting to cylinder block.
- Secure starter strut.
- Bolt engine mounting to bonded rubber bush.
- Install oil filter.
- Connect wiring to starter.
- Attach battery earth.

**Removing – from 12.82**

- Detach battery earth.



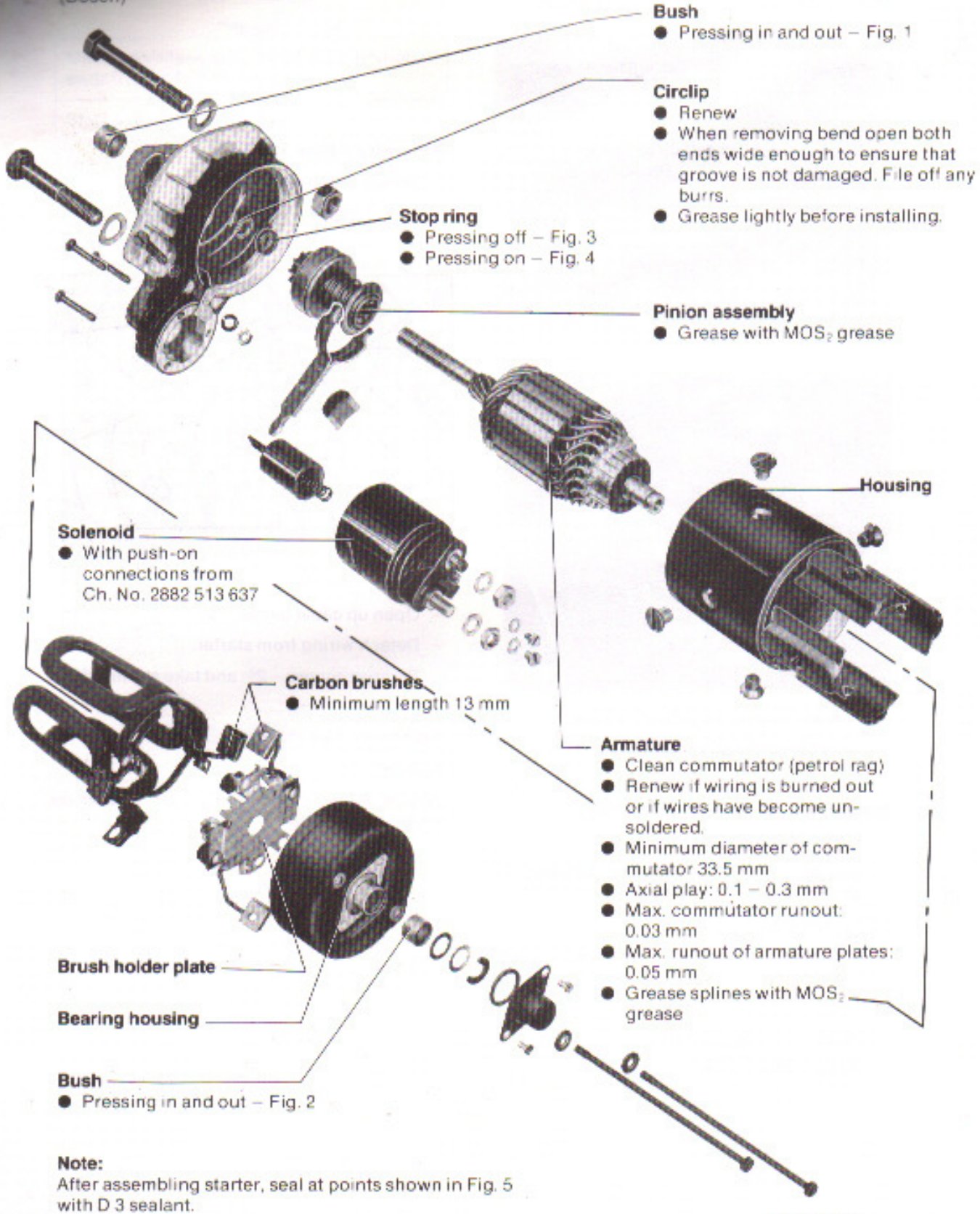

- Open up cable binder –1–.
- Detach wiring from starter.
- Remove screws –2– and take starter off.

**Installing – from 12.82**

**Note:**

Secure wiring with binders –1– so that no damage can occur.

## REPAIRING STARTER (2.0 litre engine)
(Bosch)




**Note:**
After assembling starter, seal at points shown in Fig. 5 with D 3 sealant.

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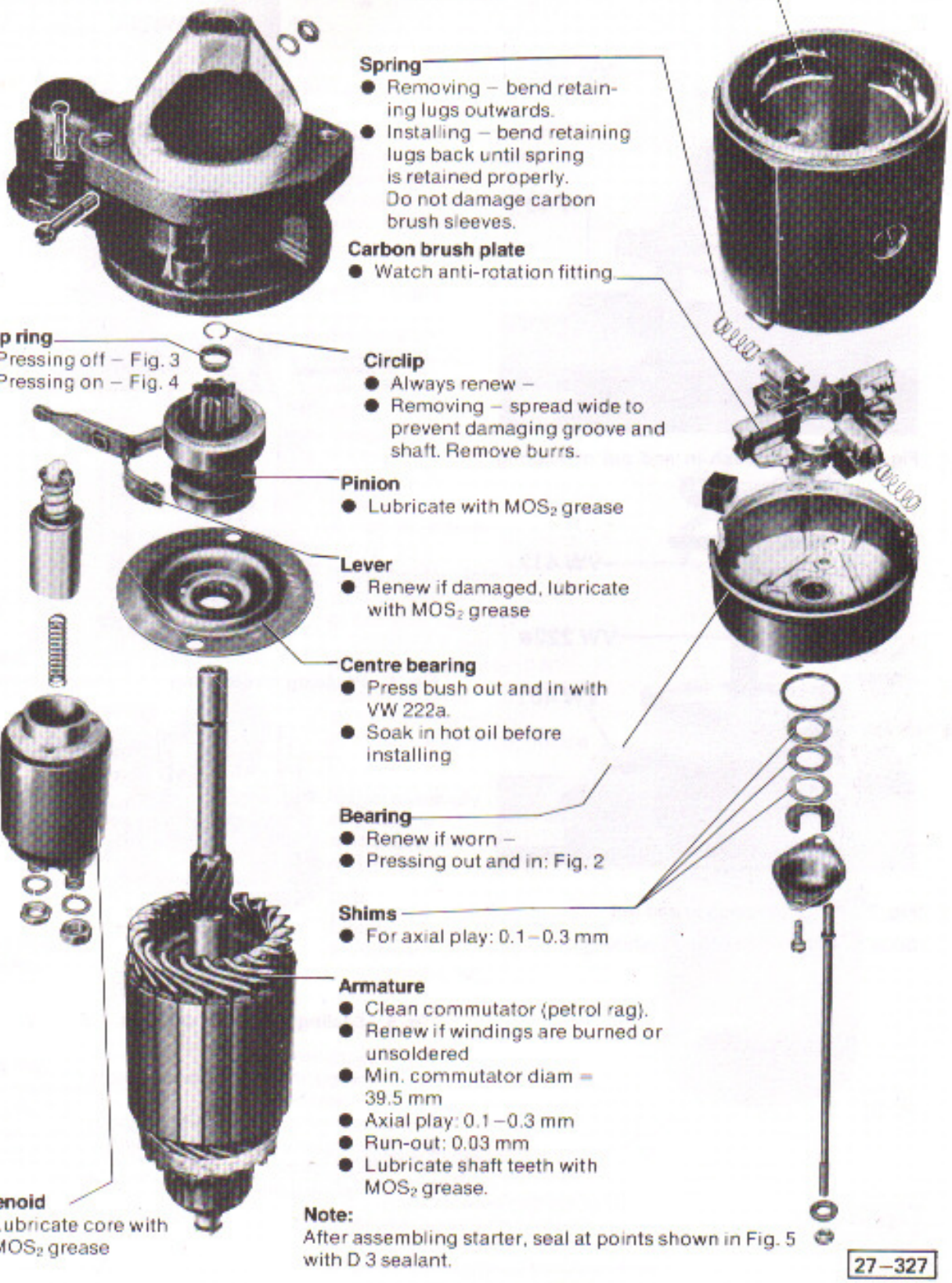
**REPAIRING STARTER**
**(6-cylinder Diesel)** (Bosch)



**Housing with windlings**
- Renew, together with carbon brushes, if windings are burned or unsoldered

**Spring**
- Removing – bend retaining lugs outwards.
- Installing – bend retaining lugs back until spring is retained properly. Do not damage carbon brush sleeves.

**Carbon brush plate**
- Watch anti-rotation fitting

**Stop ring**
- Pressing off – Fig. 3
- Pressing on – Fig. 4

**Circlip**
- Always renew –
- Removing – spread wide to prevent damaging groove and shaft. Remove burrs.

**Pinion**
- Lubricate with $MOS_2$ grease

**Lever**
- Renew if damaged, lubricate with $MOS_2$ grease

**Centre bearing**
- Press bush out and in with VW 222a.
- Soak in hot oil before installing

**Bearing**
- Renew if worn –
- Pressing out and in: Fig. 2

**Shims**
- For axial play: 0.1–0.3 mm

**Armature**
- Clean commutator (petrol rag).
- Renew if windings are burned or unsoldered
- Min. commutator diam = 39.5 mm
- Axial play: 0.1–0.3 mm
- Run-out: 0.03 mm
- Lubricate shaft teeth with $MOS_2$ grease.

**Solenoid**
- Lubricate core with $MOS_2$ grease

**Note:**
After assembling starter, seal at points shown in Fig. 5 with D 3 sealant.

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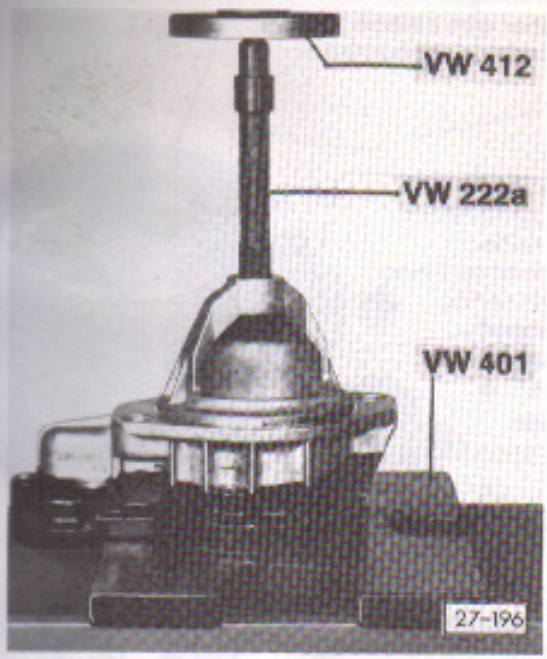



Fig. 1 Pressing bush in and out of bearing housing

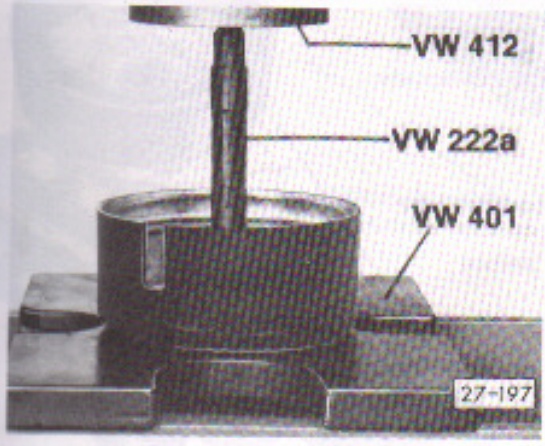



Fig. 2 Bush, pressing in and out

Soak bush in hot oil before installing

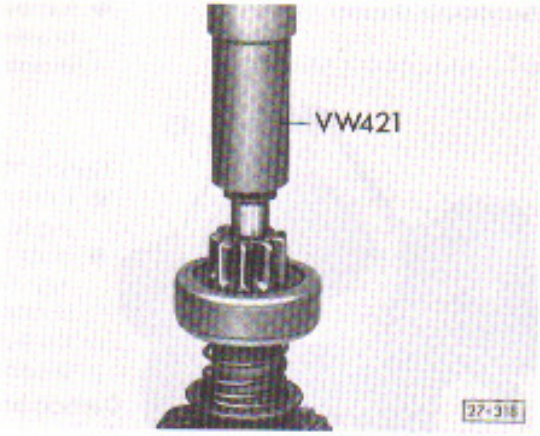



Fig. 3 Pressing off stop ring

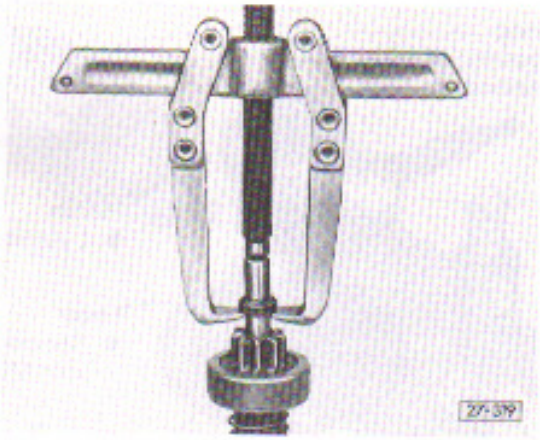



Fig. 4 Pressing on stop ring

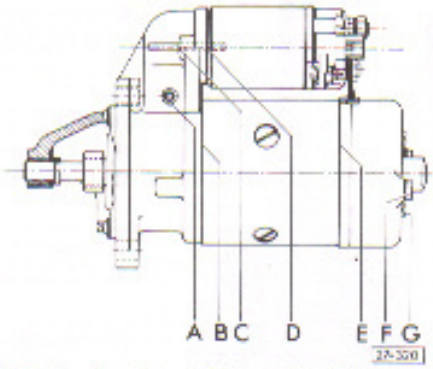
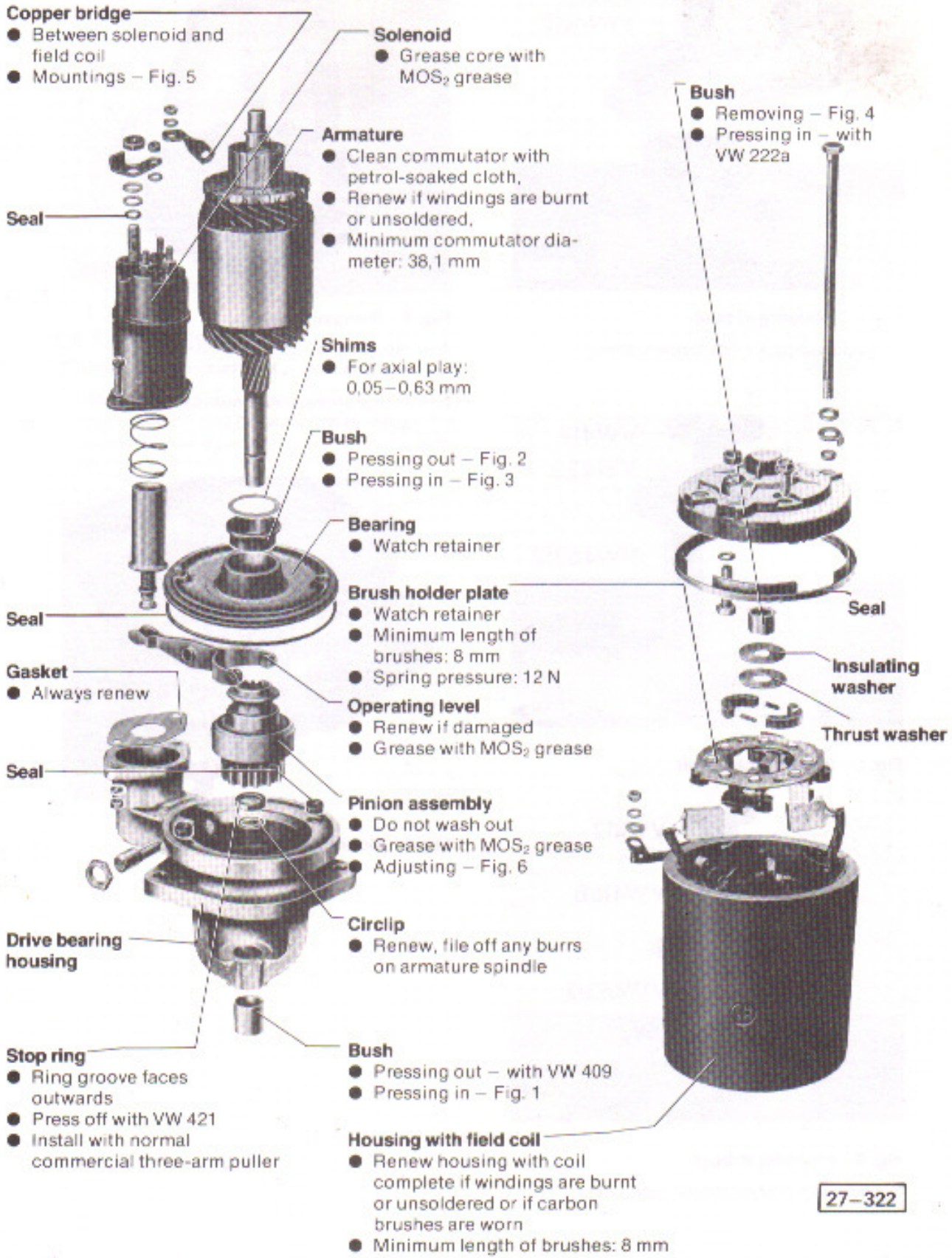



Fig. 5 Sealing joints and drillings

A – Operating lever bolt
B – Housing/mounting bracket joints
C – Solenoid bolts
D – Solenoid/mounting bracket joint
E – Bearing housing/housing joint
F – Housing bolts
G – End plate bolts

**REPAIRING STARTER (4-cylinder Diesel)**
(Lucas)

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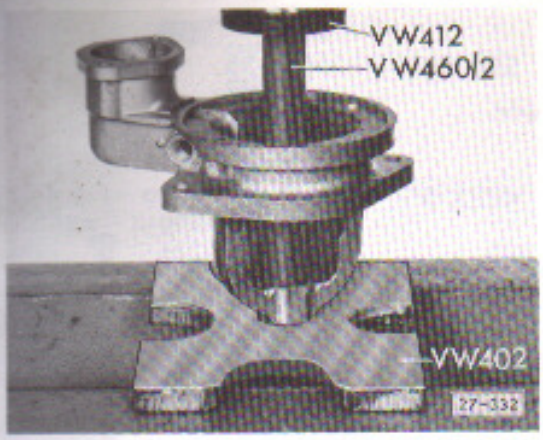



**Fig. 1 Pressing in bush**

Soak bush in hot oil before installing.

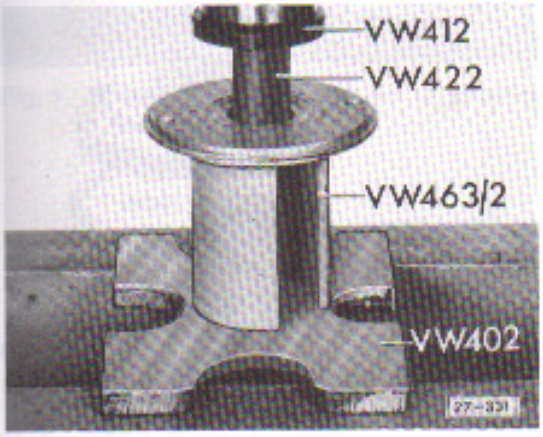



**Fig. 2 Pressing out bush**

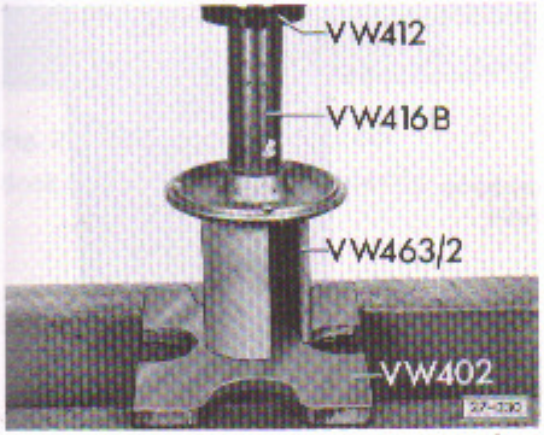



**Fig. 3 Pressing in bush**

Soak bush in hot oil before installing

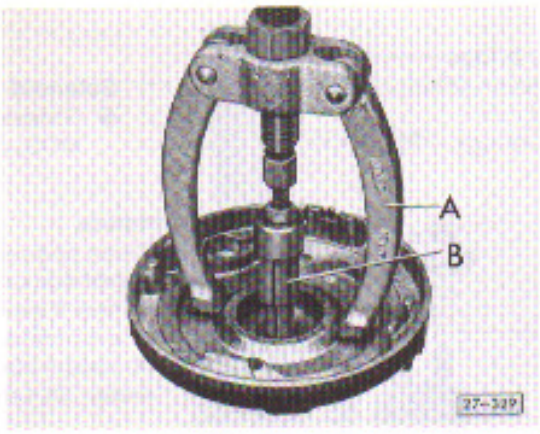



**Fig. 4 Removing bush**

A – Support (normal commercial type, such as Kukko No. 22-1)

b – Puller (normal commercial type, such as Kukko No. 21/1)

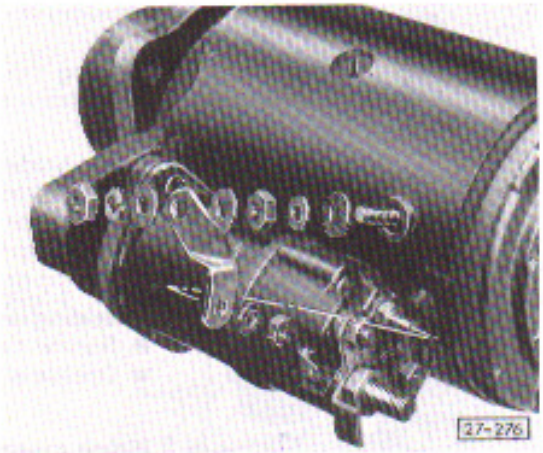



**Fig. 5 Mountings for copper bridge**

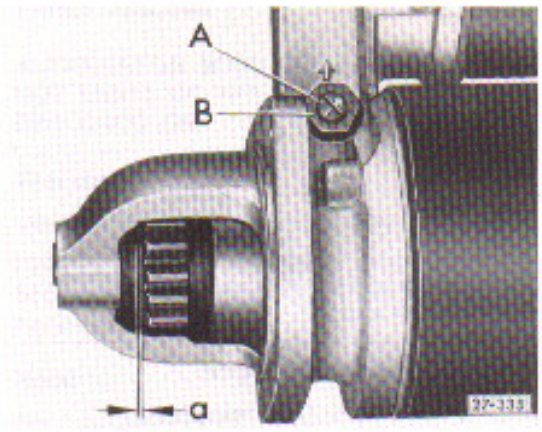



**Fig. 6 Adjusting pinion**

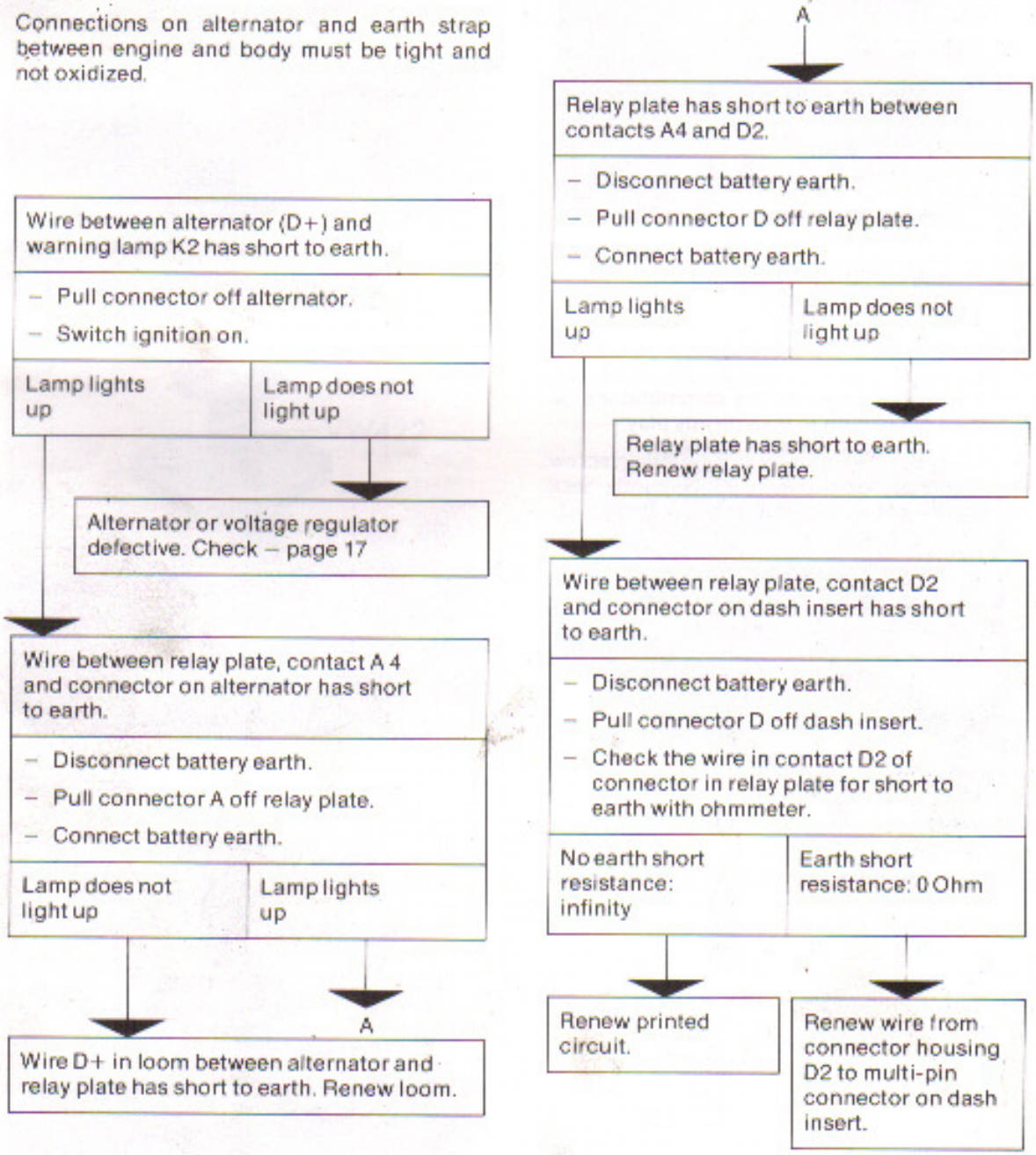
- Energize solenoid
- Required clearance between ring gear and stop ring a = 0,25 to 0,5 mm. Press the pinion lightly against the commutator side when measuring to take up any play.
- If clearance is not correct, adjust with screw –A–. Lock screw with nut –B– and check adjustment again. Then seal nut with paint.

## FAULT FINDING

### ALTERNATOR WARNING LAMP DOES NOT GO OUT WHEN SPEED INCREASES

**Test conditions:**

Connections on alternator and earth strap between engine and body must be tight and not oxidized.



## FAULT FINDING

### ALTERNATOR WARNING LAMP DOES NOT LIGHT UP WHEN IGNITION IS SWITCHED ON

**Test conditions:**

Vee belt tension OK, battery fully charged.

Connections on alternator and earth strap between engine and body must be tight and not oxidized.

**Note:**

On alternator with flexible mounting, earth strap between alternator and engine must have good electrical contact.

Break in wiring between alternator (D+) and warning lamp K2.

- Pull connector off alternator.
- Connect a test lamp to the blue wire leading to warning lamp, and earth it.
- Switch ignition on.

| Warning lamp lights up | Warning lamp does not light up |
|---|---|
| A **next page** | Alternate warning lamp defective – see Note below |

- Disconnect battery earth.
- Renew bulb, see page 40. Connect battery earth.
- Switch ignition on.

| Warning lamp lights up | Warning lamp does not light up |
|---|---|
| End | B |

**Note:**

Warning lamp is resistance for exciter current circuit of alternator. 80–90 mA should flow through single connector of D+ wire.

B

Wiring fault between alternator (D+) and relay plate, contact A4. Single connector defective.

- Disconnect battery earth.
- With a test lead, earth contact A 4 of relay plate.
- Connect battery earth.

| Warning lamp lights of | Warning lamp does not light up |
|---|---|
| Fault in wire between alternator (D+) and relay plate, contact A4. Single connector faulty. Repair. | Fault in relay plate between contact A4 and D2. |

- Disconnect battery earth.
- With a test lead, earth contact D2 relay plate.
- Connect battery earth.

| Warning lamp lights up | Warning lamp does not light up |
|---|---|
| Renew relay plate. | C **next page** |

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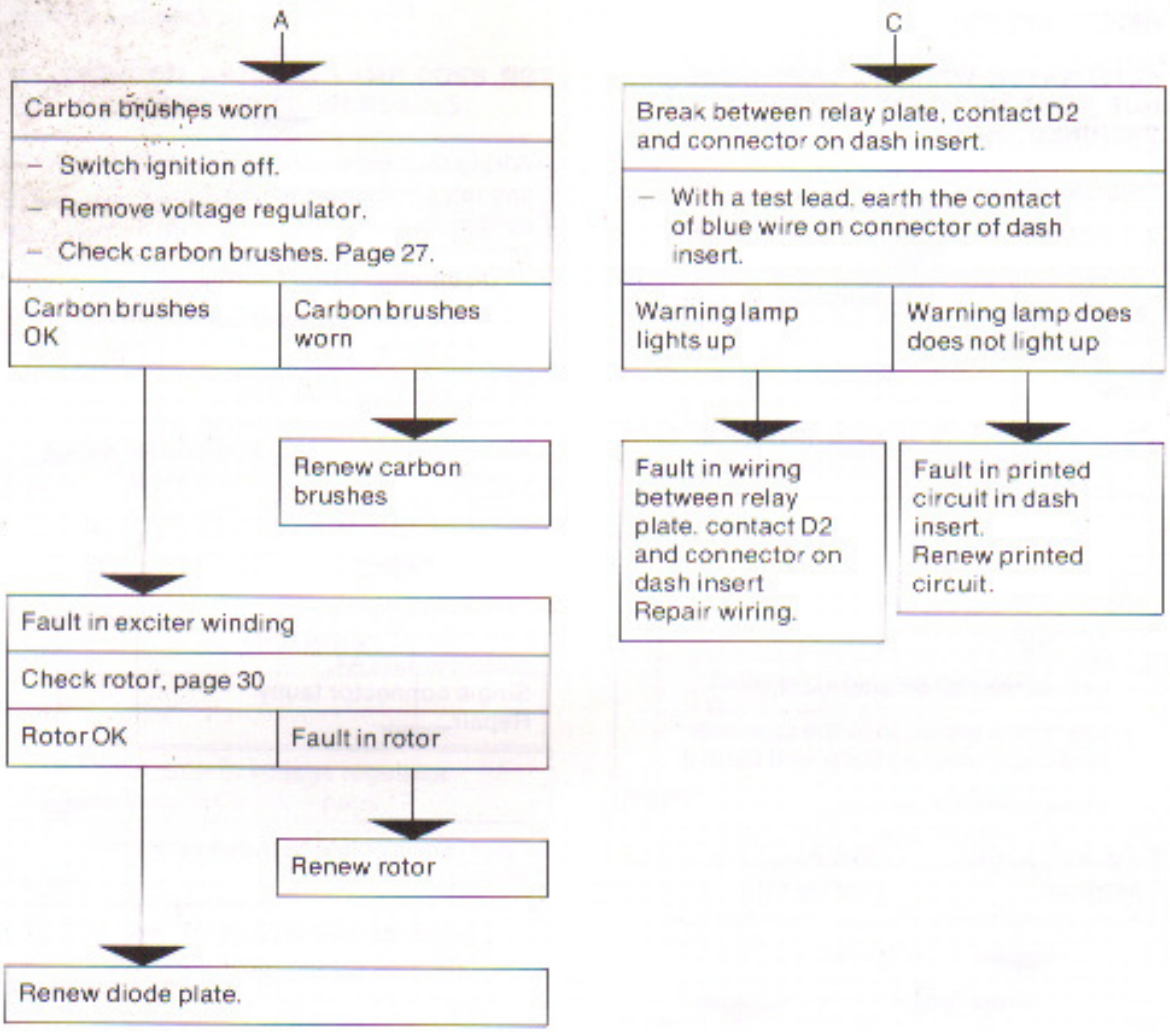

A
Carbon brushes worn
– Switch ignition off.
– Remove voltage regulator.
– Check carbon brushes. Page 27.
Carbon brushes OK
Carbon brushes worn
Renew carbon brushes
Fault in exciter winding
Check rotor, page 30
Rotor OK
Fault in rotor
Renew rotor
Renew diode plate.
C
Break between relay plate, contact D2 and connector on dash insert.
– With a test lead, earth the contact of blue wire on connector of dash insert.
Warning lamp lights up
Warning lamp does does not light up
Fault in wiring between relay plate, contact D2 and connector on dash insert Repair wiring.
Fault in printed circuit in dash insert. Renew printed circuit.

## FAULT FINDING

### CHECKING ALTERNATOR AND VOLTAGE REGULATOR WITH DIGITAL MULTIMETER V.A.G 1315 A

**Note:**

- Before testing, check Vee belt tension, alternator mountings, wire routing and earth straps.
- Check only with battery fully charged and engine warm.

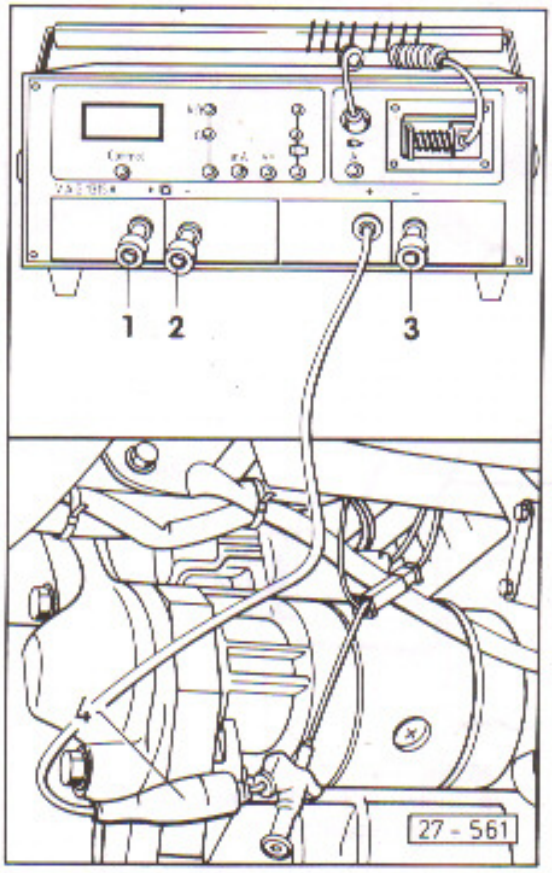
**Connecting multimeter**

Current supply:

1 – red clip to battery plus
2 – black clip to battery minus

Test leads:

3 – black clip to vehicle earth
4 – red clip with test probe on blue D+ wire, near starter
(in engine compartment up to 11.82)




- Connect multimeter.
- Press button for alternator testing.

| Voltage: 8 – 12 V | Voltage: 0 V |
|---|---|
| Alternator defective. (Plus diode short circuit). Renew diode plate. | |

- Start engine
- Speed: 2000 – 3000 rpm
- Switch large consumer on: high or low headlights, heated rear window, fan

**Note:**

Below the test speed the red LED has no meaning

| Green LED comes on | Red LED comes on |
|---|---|
| Alternator O.K. | |

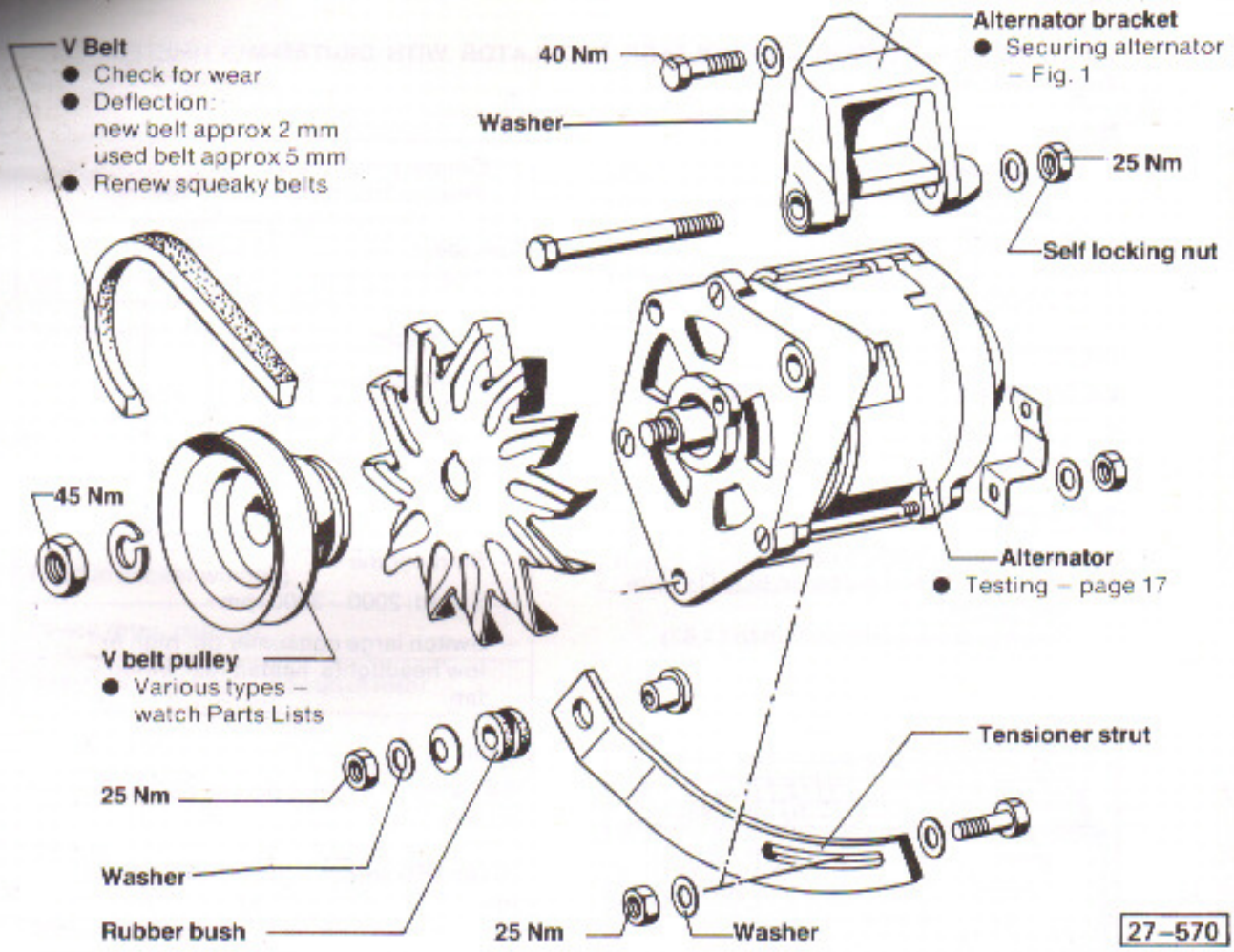
Renew voltage regulator – page 27.

Repeat test.

| Green LED comes on | Red LED comes on |
|---|---|
| Alternator O.K. Voltage regulator was defective. | |

Alternator defective. Check parts, and renew as necessary. Install old voltage regulator again.

REMOVING AND INSTALLING ALTERNATOR (2,0 litre engine)



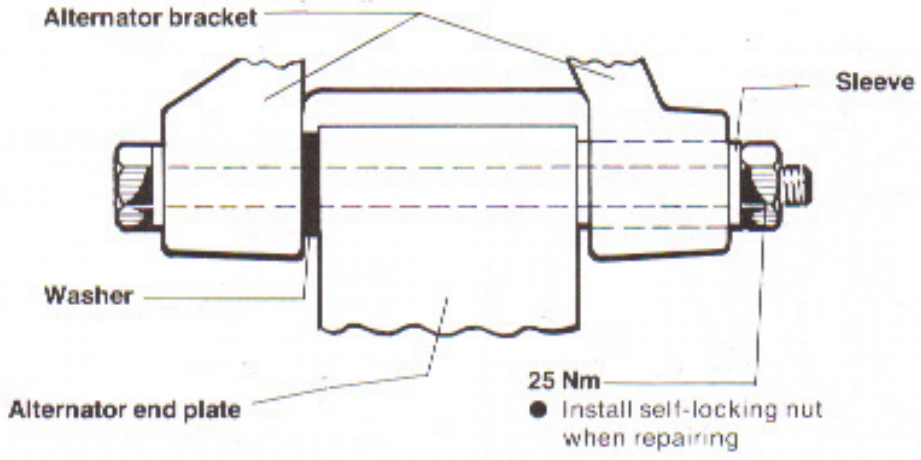
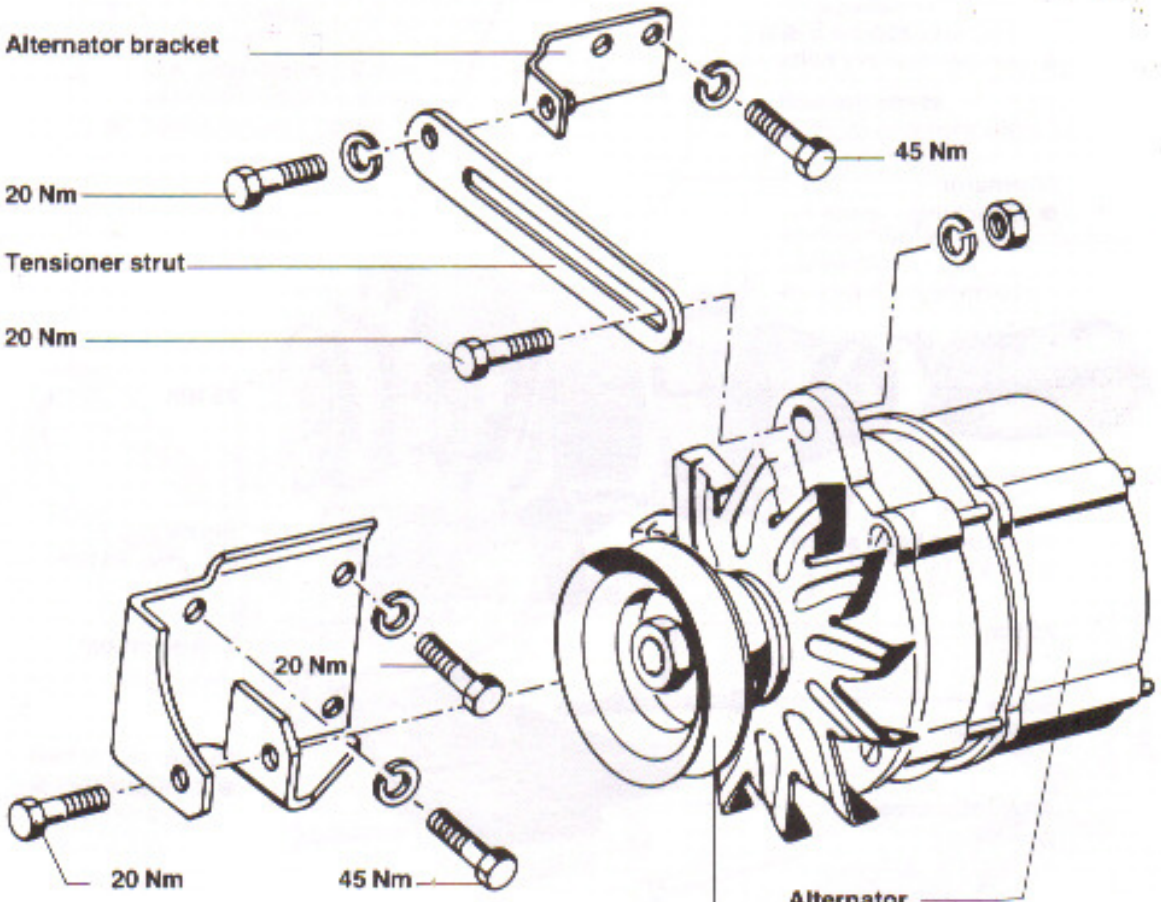



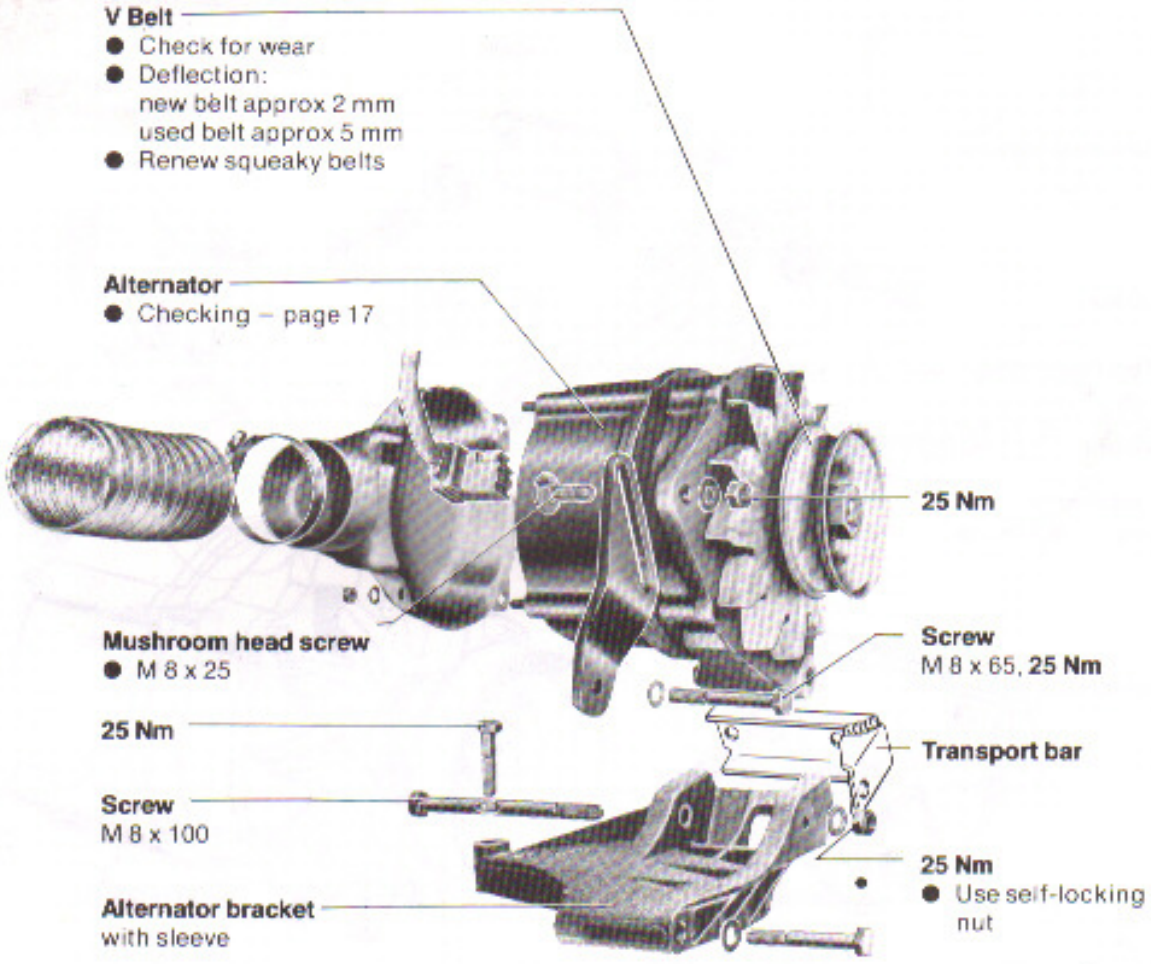

Fig. 1 Securing alternator to bracket

## REMOVING AND INSTALLING ALTERNATOR (4-cylinder Diesel)



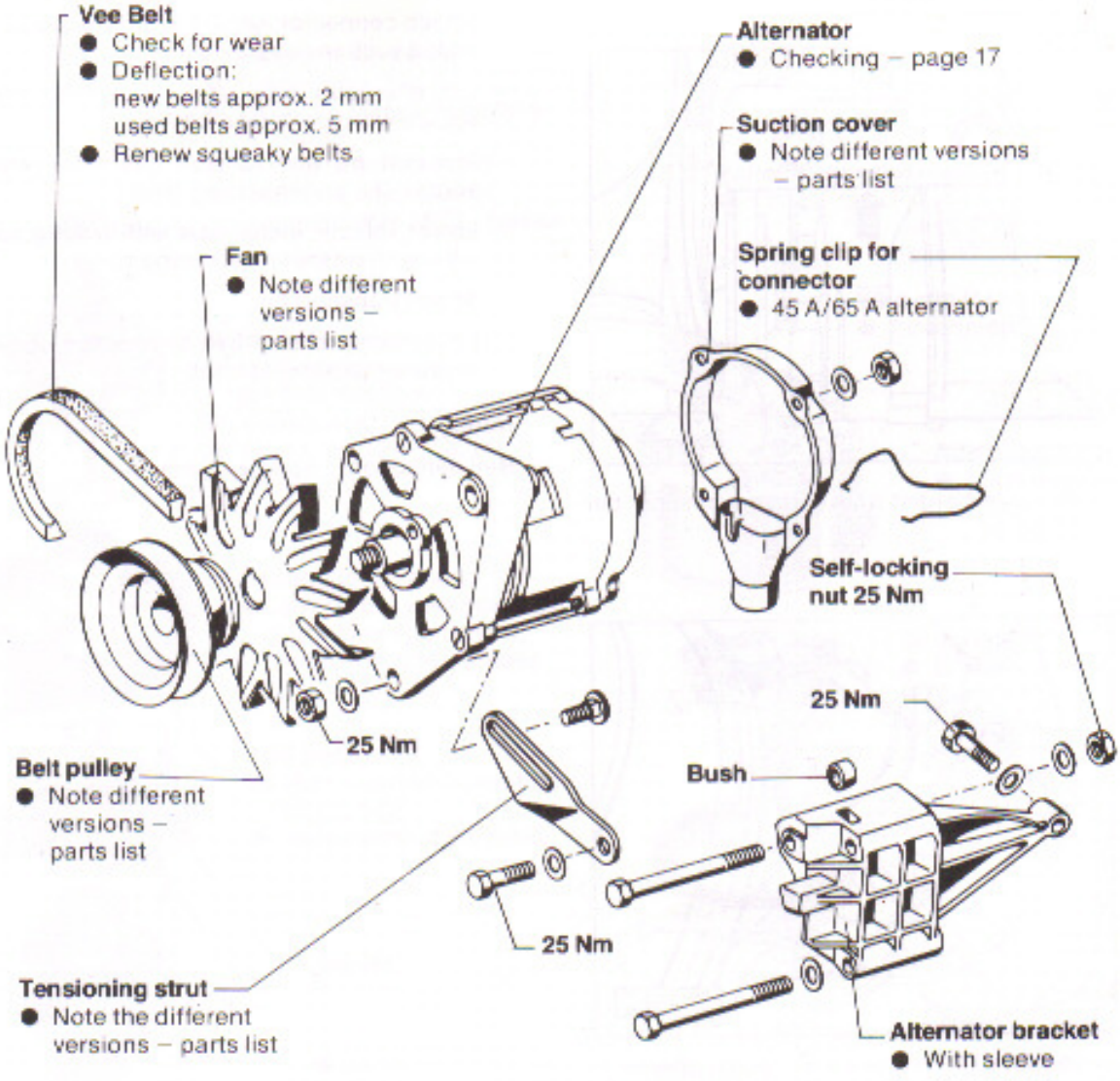

27–571

## REMOVING AND INSTALLING ALTERNATOR (6-cylinder Diesel) up to 11.82




27–572

## REMOVING AND INSTALLING ALTERNATOR (6-cylinder Diesel, from 12.82)

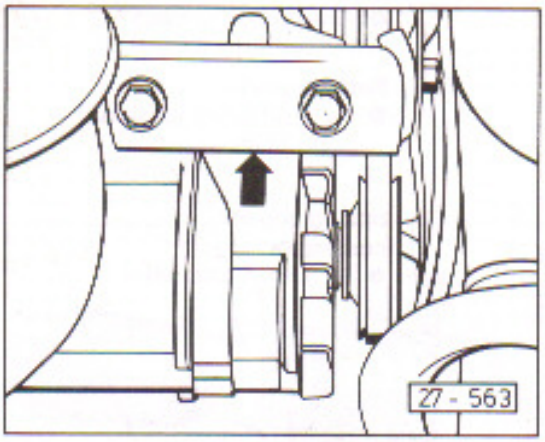


## REMOVING AND INSTALLING ALTERNATOR

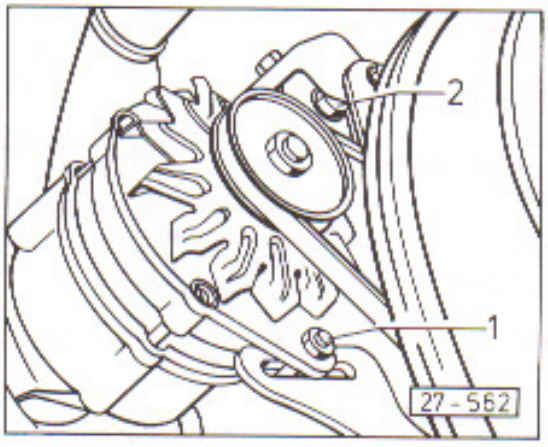
**(6-cylinder Turbodiesel)**

**Removing**

– Disconnect battery earth.




– Remove bonnet and detach transport bar –arrow–.




– Remove self-locking nut –2– on alternator mounting.

– Lift vehicle and remove screw –1– in tensioning strut.

– Remove upper securing screw.

– Take Vee belt off and take generator out downwards.

– Remove suction cover. Release wire clip and pull connector off.

**Installing**

– Attach connector, secure with wire clip and install suction cover.

– Lift alternator into upper mounting and secure with screw (M 8 x 100).

– Put belt on and tension alternator with screw –1– on tensioning strut.

– Lower vehicle, **install new self-locking nut** –2– with washer on securing screw.

– Attach transport bar.

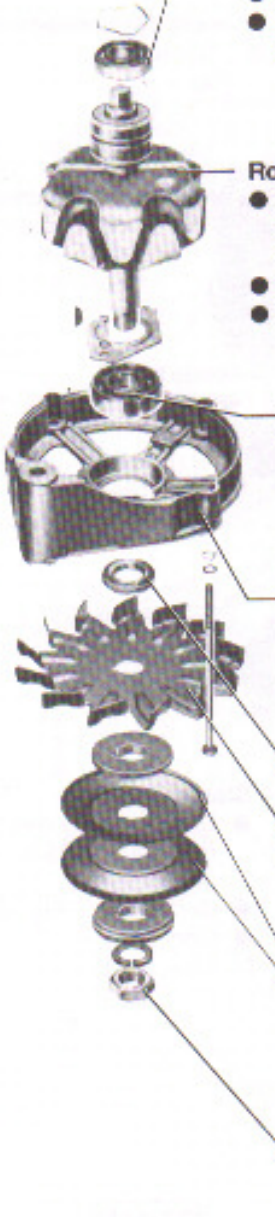
– Lift vehicle, tension belt and secure upper screw on tensioning strut.

**Note:**

Belt deflection – approx. 2 mm.

## REPAIRING 45 A AND 65 A ALTERNATORS

(Bosch)



**Bearing** (slip ring end)
- Removing – Fig. 6
- Installing: Press inner race onto stop.
- Always fit new bearing.
- Lubricate open side to alternator with $MOS_2$ grease

**Rotor**
- Different versions for 35 A and 55 A alternators.
- Checking – Fig. 13, 14
- Removing – Fig. 7

**Bearing** (drive end)
- Always use new bearing. Lubricate open end to rotor with $MOS_2$ grease

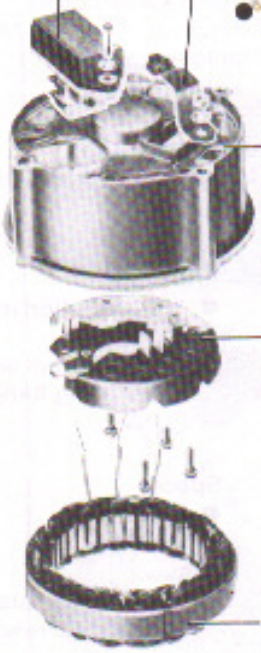
**End plate**
- Mark position in relation to housing
- Note different Part Nos.

**Spacer**
- Press on

**Fan**
- Direction of rotation shown by arrows

**Vee belt pulley**
- Different versions – note Parts Nos.

**40 Nm**



**Voltage regulator/carbon brushes**
- Checking – Fig. 1
  – with V.A.G 1315 A: page 17

**Wire clip for connector**
- Attachment – Fig. 3, 4

**Alternator housing**
- Mark position in relation to end plate

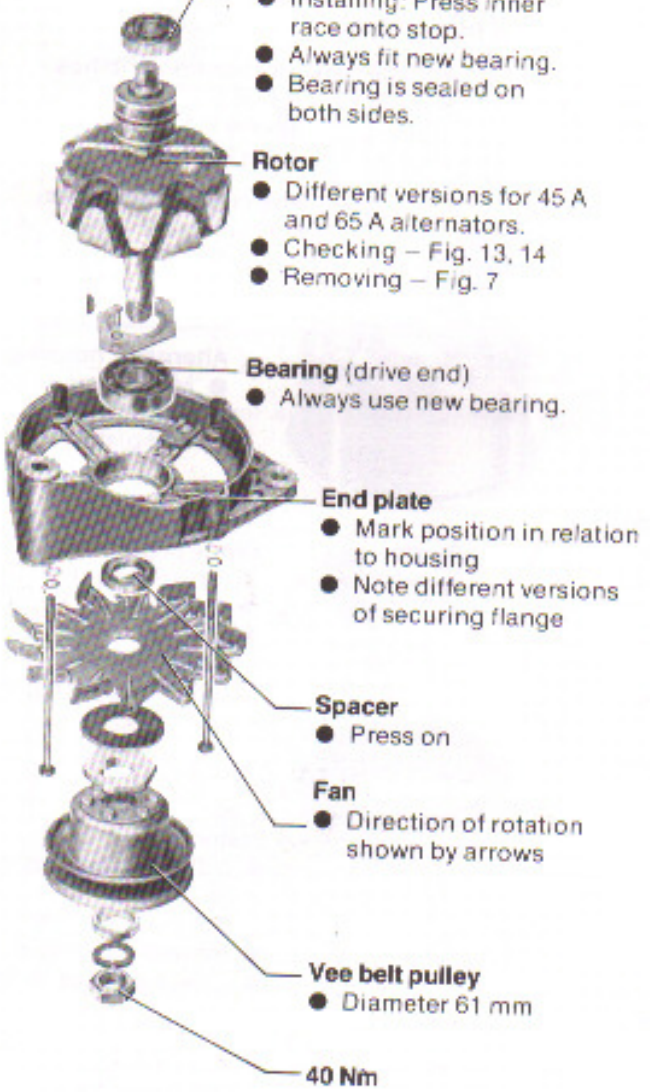
**Diode plate**
- Checking – Fig. 15
- Removing – Fig. 8
- Installing suppression condenser – Fig. 5

**Stator**
- Different versions for 35 A and 55 A alternators
- Removing – Fig. 8
- Checking Figs. 9, 11

27-567

## REPAIRING 45 A AND 65 A ALTERNATORS (2.80 up to 7.80)

(Bosch)



**Bearing** (slip ring end)
- Removing – Fig. 6
- Installing: Press inner race onto stop.
- Always fit new bearing.
- Bearing is sealed on both sides.

**Rotor**
- Different versions for 45 A and 65 A alternators.
- Checking – Fig. 13, 14
- Removing – Fig. 7

**Bearing** (drive end)
- Always use new bearing.

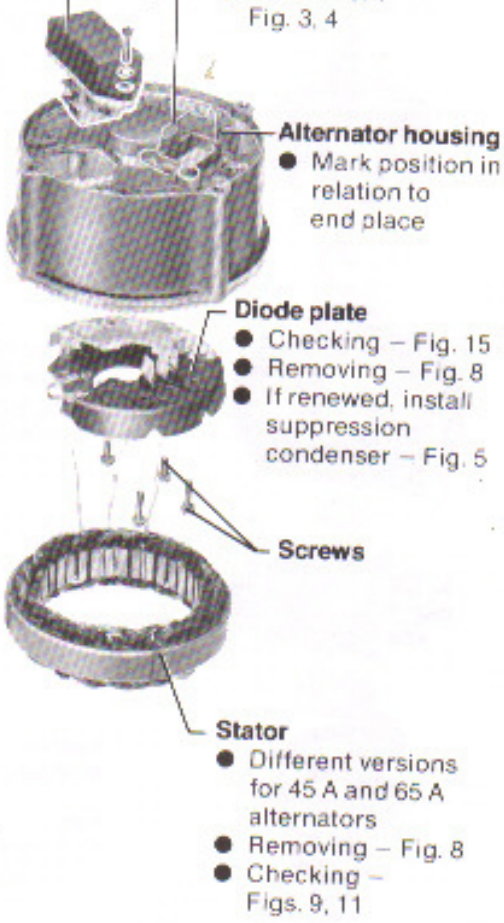
**End plate**
- Mark position in relation to housing
- Note different versions of securing flange

**Spacer**
- Press on

**Fan**
- Direction of rotation shown by arrows

**Vee belt pulley**
- Diameter 61 mm

**40 Nm**



**Voltage regulator/carbon brushes**
- Checking – Fig. 1 – with V.A.G 1315 A page 17

**Wire clip for connector**
- Attachment – Fig. 3, 4

**Alternator housing**
- Mark position in relation to end place

**Diode plate**
- Checking – Fig. 15
- Removing – Fig. 8
- If renewed, install suppression condenser – Fig. 5

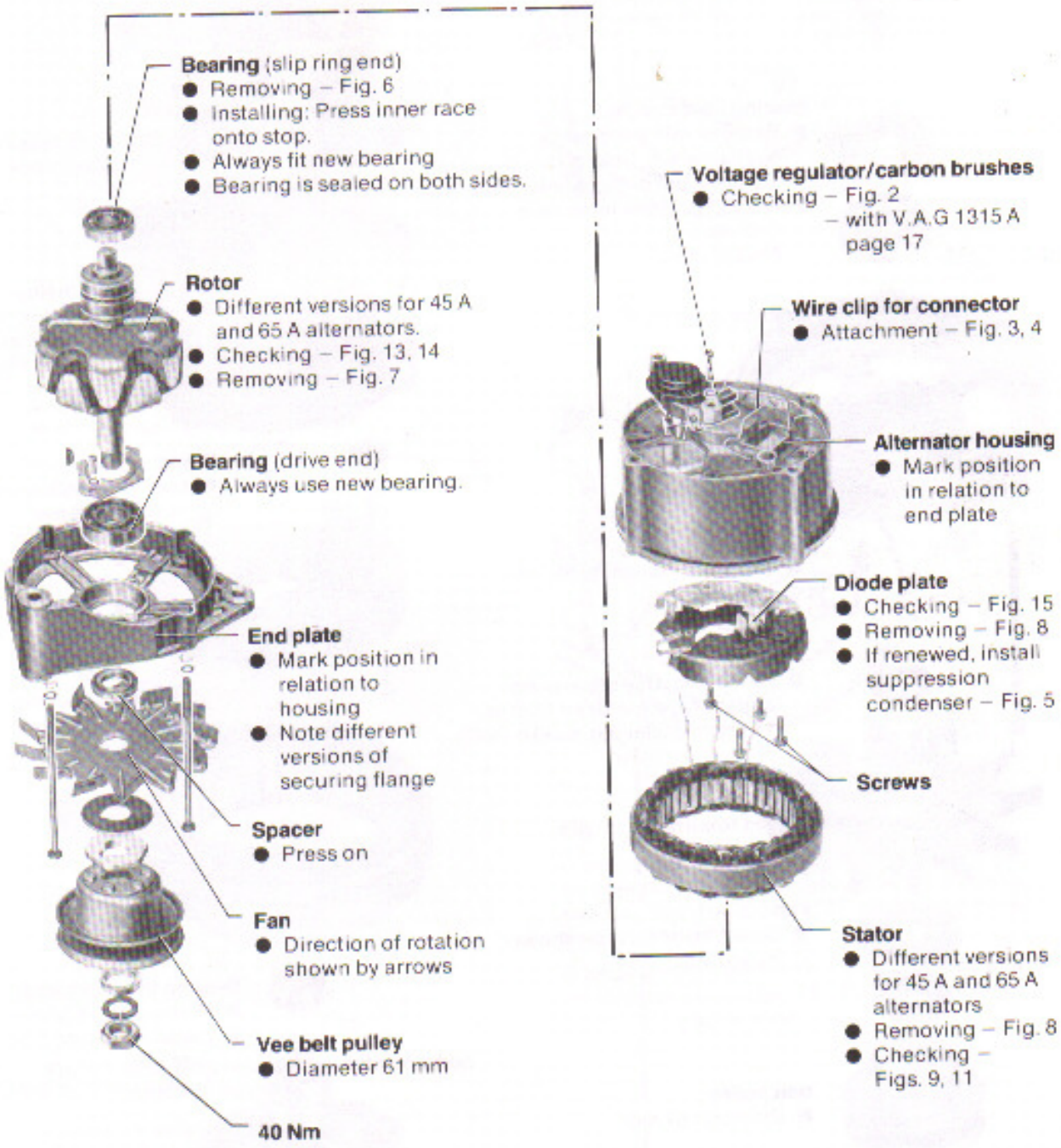
**Screws**

**Stator**
- Different versions for 45 A and 65 A alternators
- Removing – Fig. 8
- Checking – Figs. 9, 11

27-568

## REPAIRING 45 A AND 65 A ALTERNATORS (from 8.80)

(Bosch)



## REPAIRING 90 A ALTERNATOR
(Bosch)

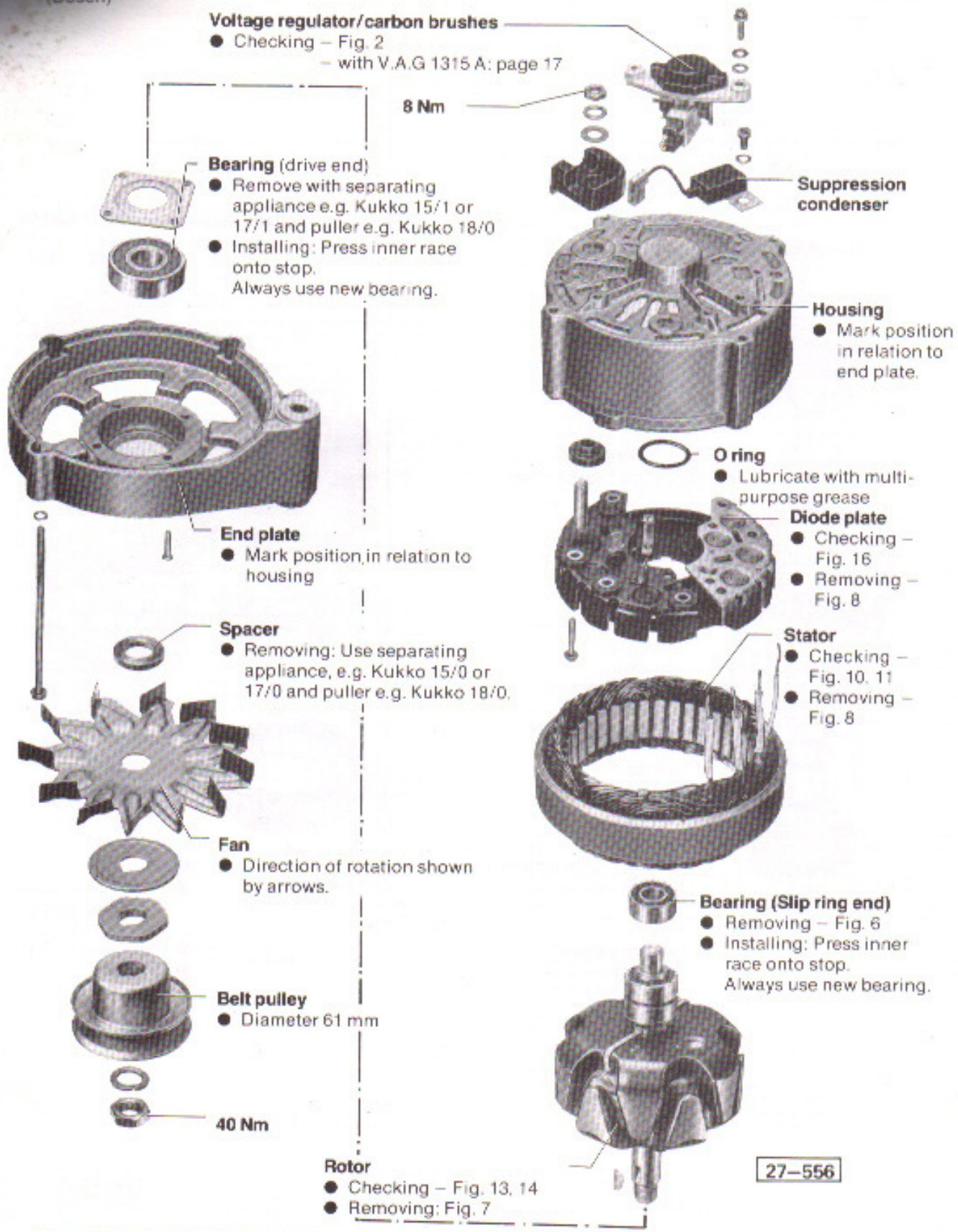



**Fig. 1 Checking voltage regulator/carbon brushes**

Length of carbon brushes:

New: approx. 10 mm

Wear limit: approx. 5 mm. if necessary unsolder connections (arrows) and renew carbon brushes.

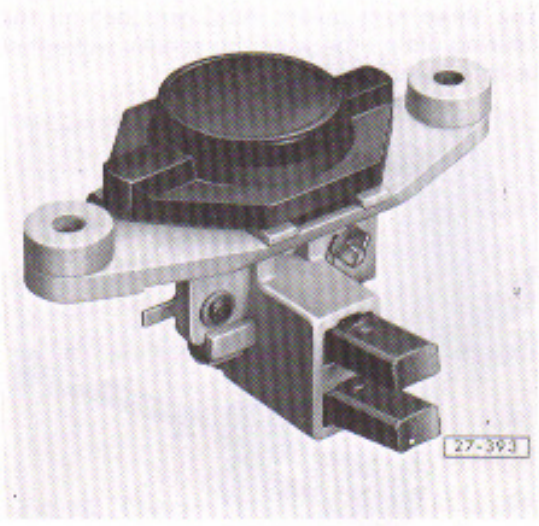



**Fig. 2 Checking voltage regulator/carbon brushes (hybrid)**

Length of carbon brushes:

new approx. 13 mm

Wear limit approx. 5 mm

**Note:**

Supplied complete as service part and can be installed with alternator in situ.

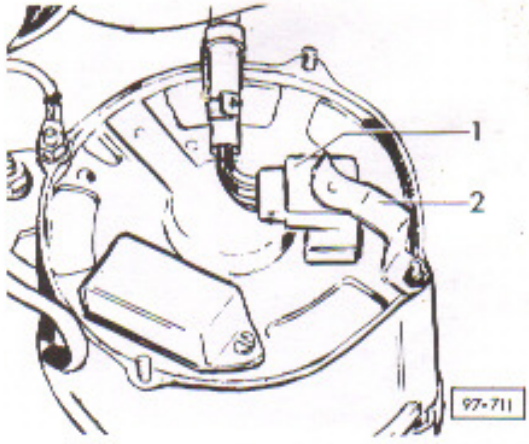



**Fig. 3 Alternator connector with flat clip**

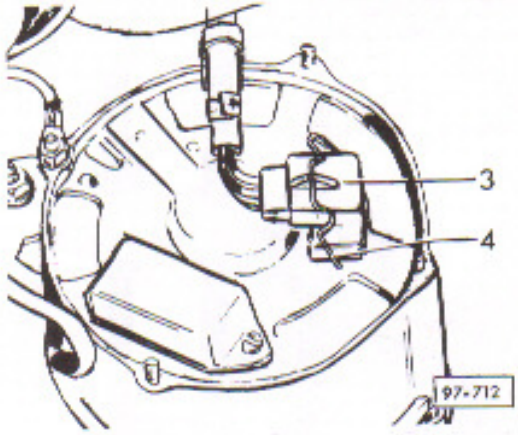



**Fig. 4 Alternator connector with wire clip**

If the connector –1– with flat clip is replaced by connector –3– the detent lug for the wire clip –4– must be ground off in order to ensure that clip fits properly.

If an alternator with wire clip is installed in a vehicle with connector –1– the flat clip attachment –2– is to be used.

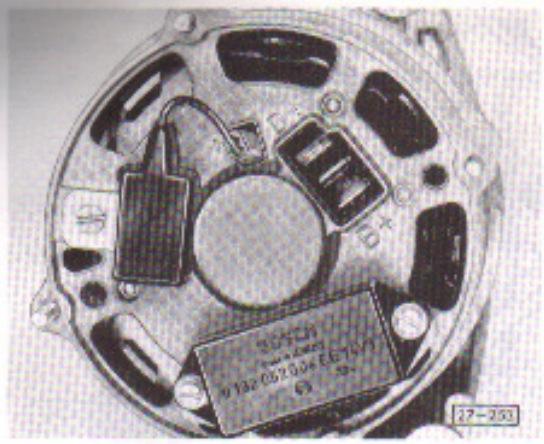



**Fig. 5 Suppression condensor connection**

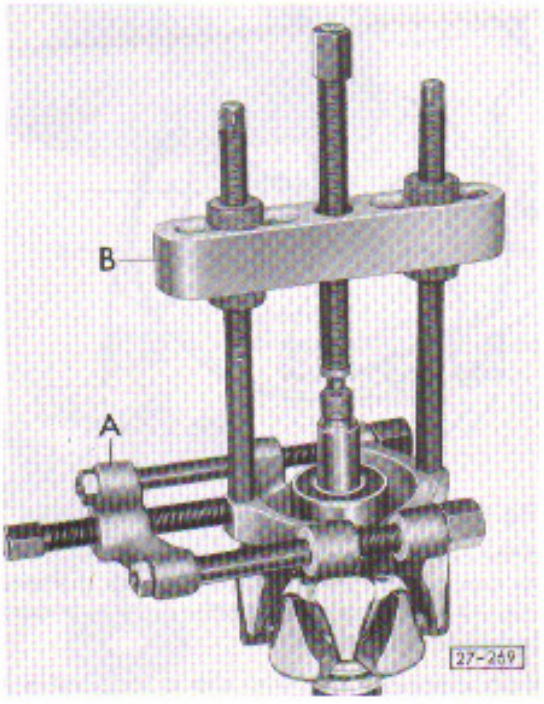



**Fig. 6 Removing ball bearing**

A – Separating appliance
e.g. Kukko 15/0 or 17/0

B – Puller
e.g. Kukko 18/0

**Note:**

Do not damage slip ring.

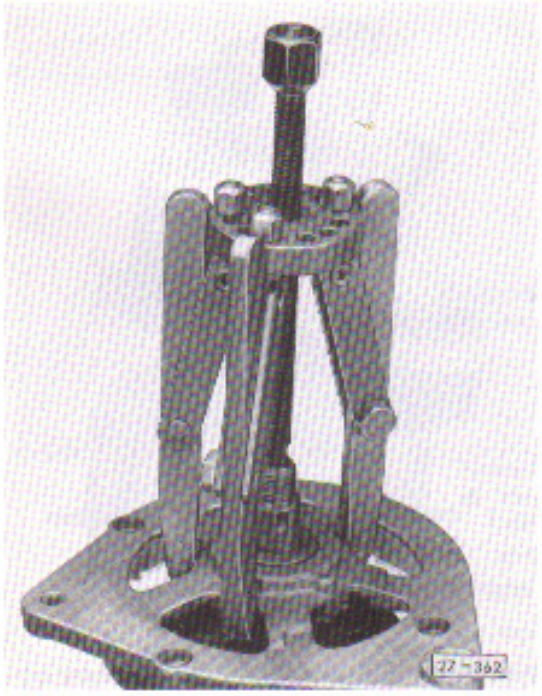



**Fig. 7 Removing rotor** – Three arm puller

**Note:**

The three arm puller must grip behind the bearing plate otherwise the screws will either be torn out or sheared.

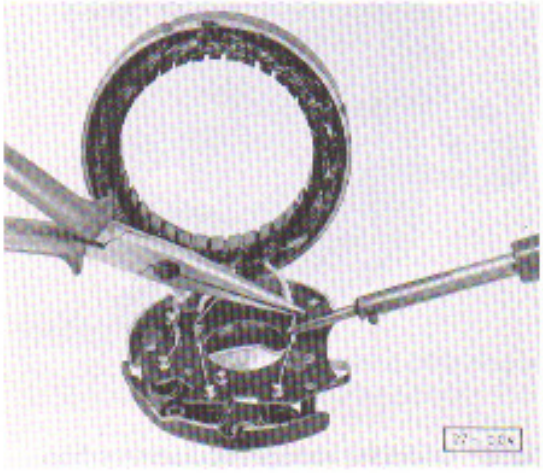


**Fig. 8 Removing and installing stator/diode plate**

To unsolder connections use iron with max. 300 Watts. Use long nosed pliers to dissipate heat. (One connection more on 90 A alternator).

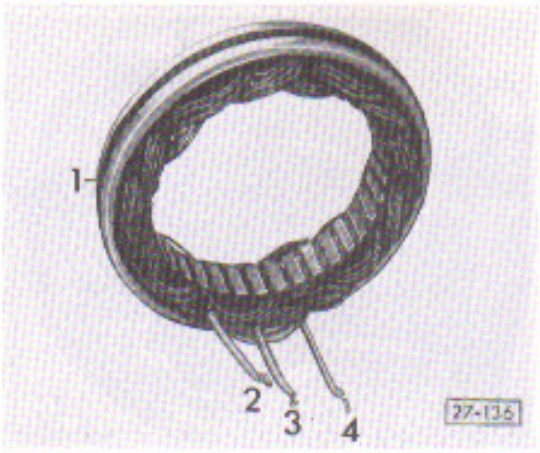



Fig. 9 Checking stator/earth short

**Tester: V.A.G 1315 A**

Press button for resistance measurement. Connect leads to the measuring points 1 and 2; 1 and 3; 1 and 4 in turn.

A flashing resistance reading must be indicated in the kΩ range.


Fig. 11 Checking stator/open circuit

**Tester: V.A.G 1315 A**

Press button for resistance measurement. Connect test leads to winding ends 1 and 2; 1 and 3; 2 and 3 in turn. At each measurement 0 Ohms should be indicated:

If there is a break in circuit a flashing resistance reading must be indicated in the KΩ range.

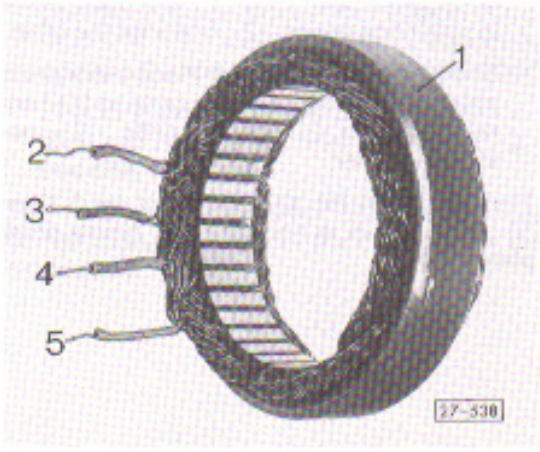



Fig. 10 Checking stator/earth short on 90 A alternator

**Tester: V.A.G 1315 A**

Press button for resistance measurement. Connect leads to the measuring points 1 and 2; 1 and 3; 1 and 4; 1 and 5 in turn.

A flashing resistance reading must be indicated in the kΩ range.

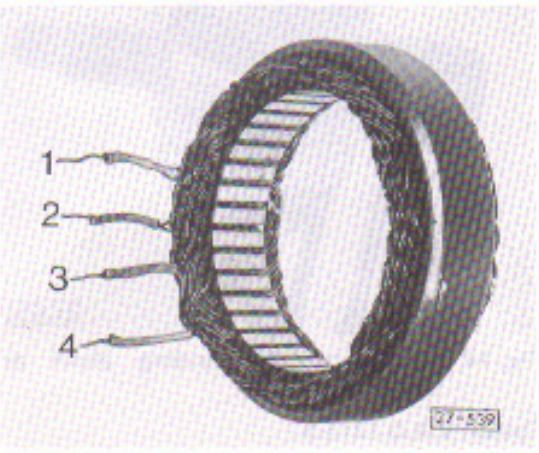



Fig. 12 Checking stator/open circuit 90 A alternator

**Tester: V.A.G 1315 A**

Press button for resistance measurement. Connect test leads to winding ends 1 and 2; 1 and 3; 1 and 4; 2 and 3; 2 and 4; 3 and 4 in turn.

At each measurement 0 Ohms should be indicated.

If there is a break in circuit a flashing resistance reading must be indicated in the kΩrange.

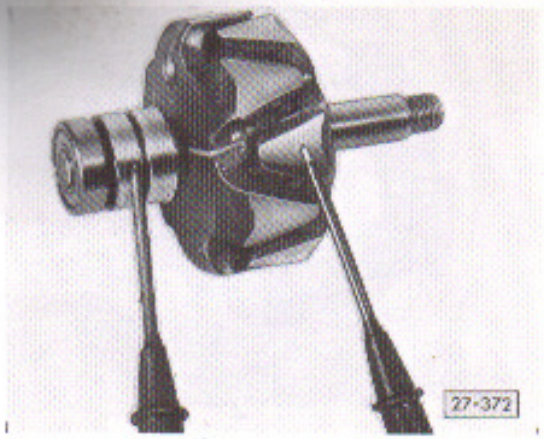



**Fig. 13 Checking rotor/earth short**

**Tester: V.A.G 1315 A**

Press button for resistance measurement. A flashing resistance value must be indicated in the KΩ range.

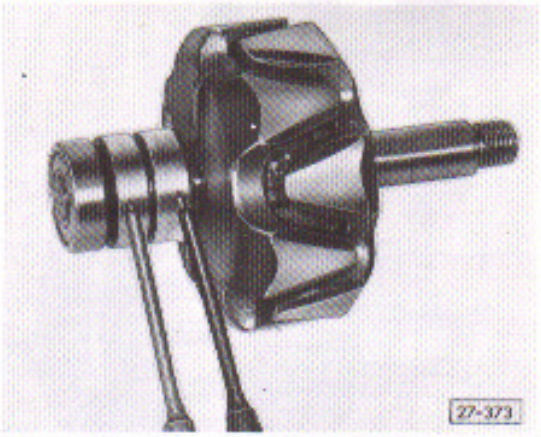



**Fig. 14 Checking rotor/winding short or open circuit**

**Tester: V.A.G 1315 A**

Press button for resistance measurement. Specified readings.

35 A-alternator – 3.4–3.75 Ω
45 A-alternator – 3.4–3.7 Ω
55 A-alternator – 3.4–3.75 Ω
65 A-alternator – 2.8–3.0 Ω
90 A-alternator – 3.0–4.0 Ω

Open circuit if a flashing resistance value is indicated in the KΩ range. Winding short if resistance is below specified reading.

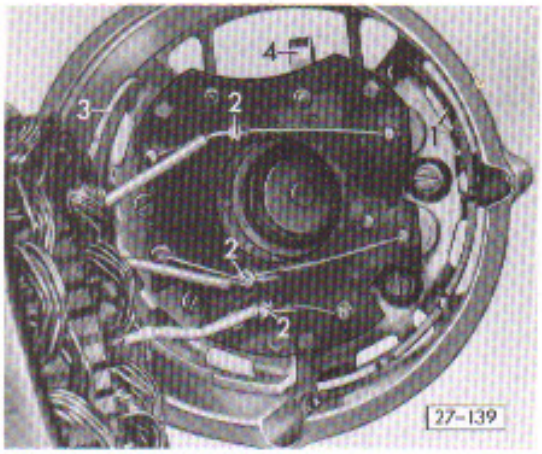



**Fig. 15 Checking diode plate**

**Tester: V.A.G 1315 A**

- Unsolder stator windings. Press resistance and voltage measuring buttons simultaneously.
- Checking plus diodes: place black test probe on positive heat sink –1– (the same as B+) and the red probe to the collection points –2– one after the other.
- Checking minus diodes – place red probe to negative heat sink –3– and black probe to collection points –2– one after the other.
- Checking **exciter diodes**: Place black probe onto contact rail –4– (the same as D+) and red probe to collection points –2– one after the other.

The indication for all tests must be 3 times 50–80 Ω. If this is not the case, renew diode plate.

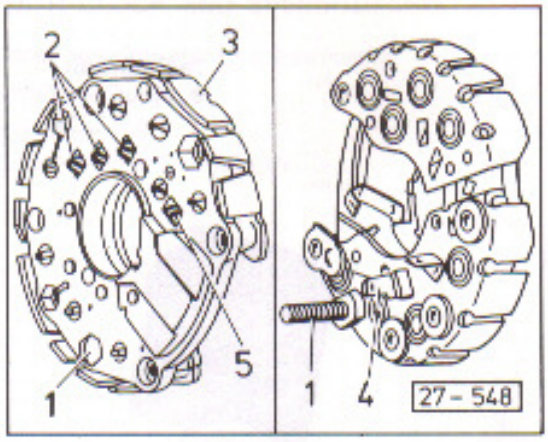



**Fig. 16 Checking diode plate 90 A alternator**

**Tester: V.A.G 1315 A**

- Unsolder stator windings.
- Press buttons for resistance and voltage test at same time.
- Checking plus diodes: Black clip on plus heat sink –1– (B+) and red clip to collection points –2– and point 5 one after the other.
- Checking minus diodes: Red clip on minus heat sink –3– and black clip to collection points –2– and point 5 one after the other.
- Checking exciter diodes: Black clip on –4– (D+) and red clip to collection points –2– one after the other.

The readings for all tests must be 3 times 50–80 Ohm. If this is not the case, renew the diode plate.

## REPAIRING DASH PANEL INSERT (up to 11.82)

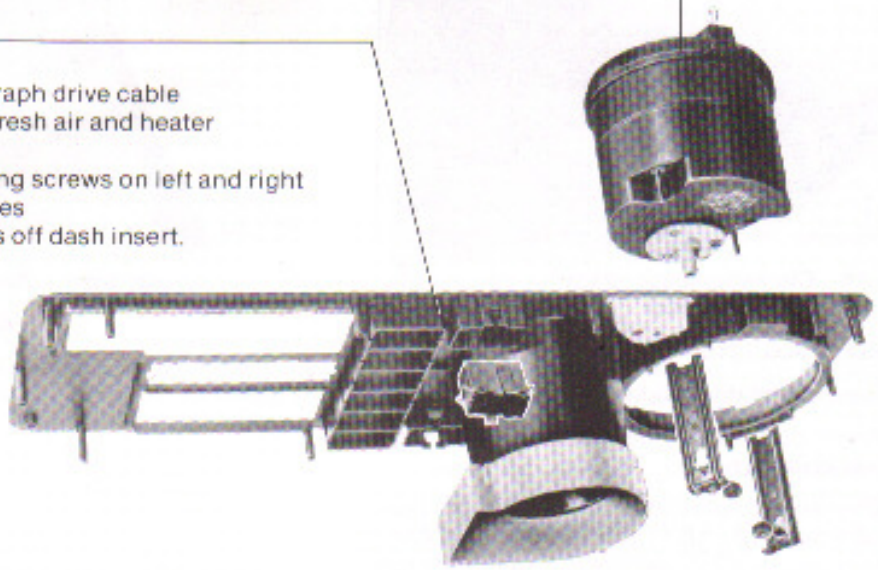
### WITH TACHOGRAPH

**Notes on tachograph – page 43**

**Caution:**
Disconnect battery earth.

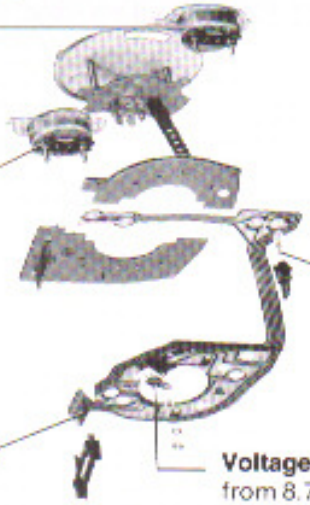
**Tachograph**
- Routing of drive cable – Fig. 12, 13

**Dash panel insert**
- Removing:
  - Detach tachograph drive cable
  - Pull knobs off fresh air and heater controls
  - Remove securing screws on left and right
  - Remove switches
  - Pull connectors off dash insert.



**Coolant temperature gauge**
- Checking – Fig. 3
  up to 7.76 with built-in voltage stabilizer
  from 8.76 one voltage stabilizer for fuel and coolant temperature gauges – Fig. 4

**Fuel gauge**
- Checking – Fig. 2
  up to 7.76 with built-in voltage stabilizer
  from 8.76 one voltage stabilizer for fuel gauge and coolant temperature gauge – Fig. 4



**Bulb**
12 V/1.2 W

**Voltage stabilizer**
from 8.76
- Measuring the stabilized voltage – Fig. 7

**Printed circuit**
- Check circuits for continuity with an ohmmeter.
- Wiring of connections on multi-pin connector – Fig. 1

**Note:**
Do not install printed circuit from 3.77 (Fig. 8. 9) together with voltage stabilizer from 8.76 to 2.77 (Fig. 5)

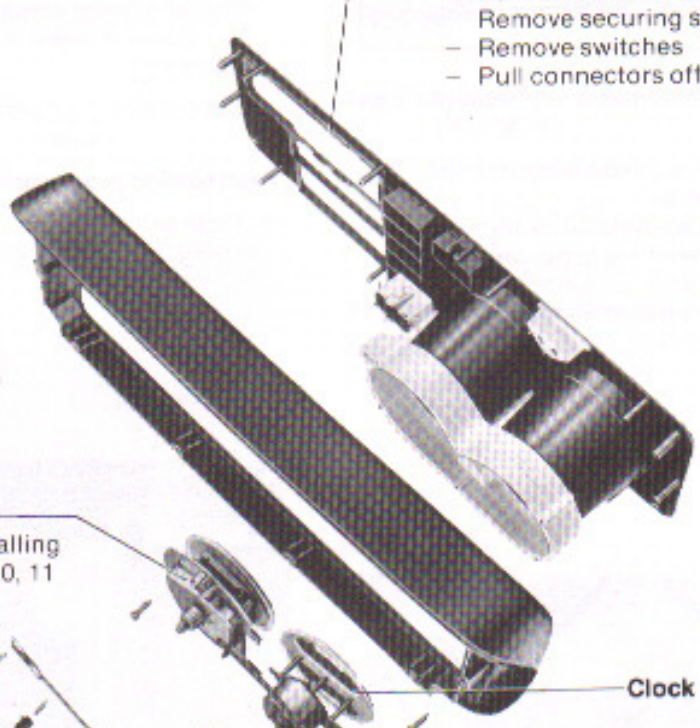
90–646

## REPAIRING DASH PANEL INSERT (up to 11.82)

### WITH CLOCK AND SPEEDOMETER

**Note on odometer in speedometer**
– page 43.

**Caution:**
Disconnect battery earth.



**Dash panel insert**
- Removing
  - Detach speedometer drive cable
    Pull knobs off fresh air and heater controls
    Remove securing screws on left and right
  - Remove switches
  - Pull connectors off dash insert.

**Speedometer**
- Removing and installing drive cable – Fig. 10, 11

**Bulb**
12 V/1.2 W

**Clock**

**Coolant temperature gauge**
- Checking – Fig. 3

**up to 7.76** with built-in voltage stabilizer
**from 8.76** one voltage stabilizer for fuel and coolant temperature gauges – Fig. 4

**Printed circuit**
- Check circuit for continuity with an ohmmeter.
- Wiring of connections on multi-pin connector – Fig. 1

**Fuel gauge**
- Checking – Fig. 2

**up to 7.76** with built-in voltage stabilizer
**from 8.76** one voltage stabilizer for fuel gauge and coolant temperature gauge – Fig. 4

**Note:**
Do not install printed circuit from 3.77 (Fig. 8, 9) together with voltage stabilizer form 8.76 to 2.77 (Fig. 5).

90–647

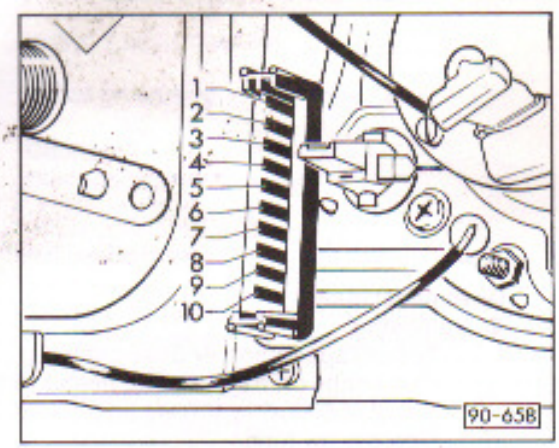



**Fig. 1 Wiring of contacts on multi-pin connector**

1 – Oil pressure warning lamp from oil pressure switch
2 – Turn signal warning lamp, terminal 49a
3 – High beam warning lamp, terminal 56a
4 – Clock/plus wire, terminal 30
5 – Temperature gauge sender
6 – Earth, terminal 31
7 – Instrument lighting
8 – Plus wire, terminal 15
9 – Fuel gauge sender
10 – Alternator warning lamp, terminal 61


**Fig. 2 Checking fuel gauge**

**Test conditions:** Battery O.K.

– Pull wire from fuel gauge sender off, connect tester V.A.G 1301 to open wire and earth.

– Set following values on potentiometer:
R : 350
1/4: 215
1/1: 60

**Fault finding programme (from 8.76)**

– page 44

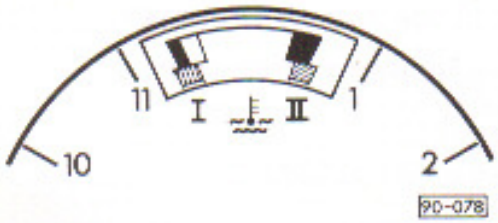



**Fig. 3 Checking coolant temperature gauge**

**Test conditions:** Battery O.K.

– Pull wire from coolant temperature sender off, connect tester V.A.G 1301 to open wire and earth.

– Set following values on potentiometer:
I : 500; II : 60

**Fault finding programme (from 8.76)**

– Page 44

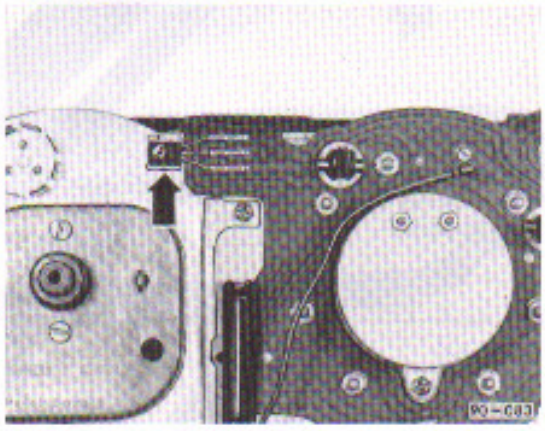



**Fig. 4 Voltage stabilizer (from 8.76)**

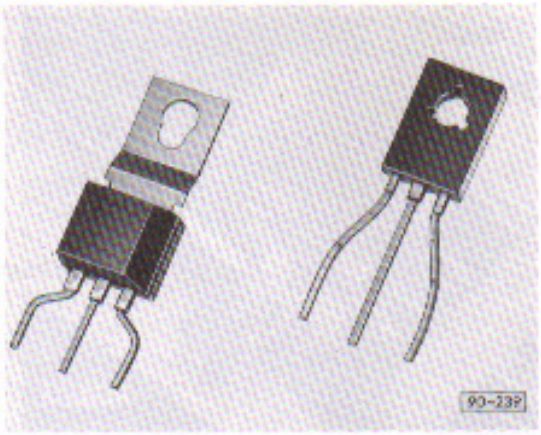



**Fig. 5 Voltage stabilizer**

left : from 3.77
right: from 8.76 to 2.77

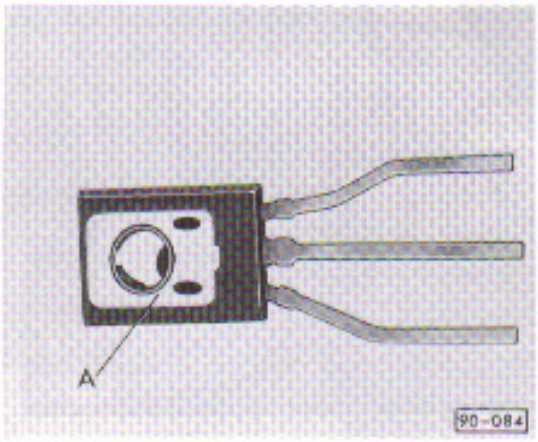



**Fig. 6 Voltage stabilizer (from 8.76 to 2.77)**

A = Cooling surface

To prevent reversal of polarity and damage, the cooling surface must be in contact with the metal cover of the speedometer.

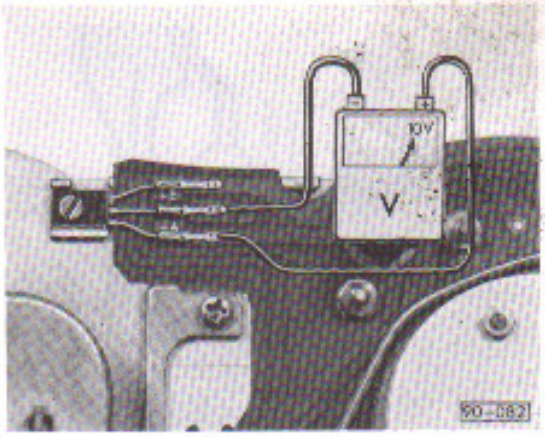



**Fig. 7 Checking voltage stabilizer (from 8.76)**

Connections on stabilizer:

| | |
|---|---|
| Plus input | (+E) |
| Earth | (⊥) |
| Plus output | (+A) |

**Test conditions:** Battery O.K.

Measure voltage between plus output and earth. It must be approx. 10 V. If the voltage is above 10.5 V or below 9.5 V, the stabilizer is defective.

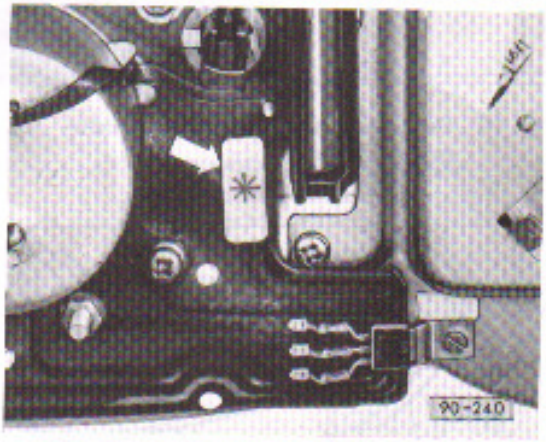



**Fig. 8 Identification of printed circuit of voltage stabilizer from 3.77 (see Fig. 9 also)**

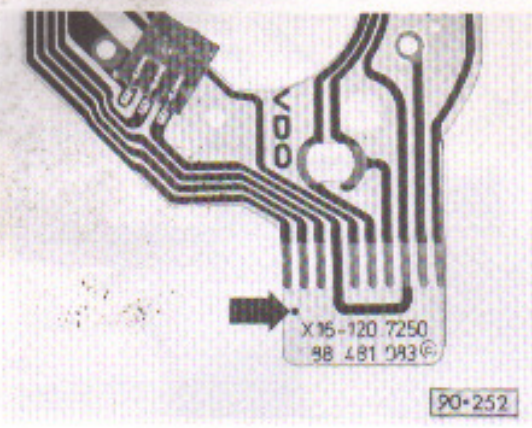



Fig. 9 Identification of printed circuit for voltage stabilizer from 3.77 (see Fig. 8 also)

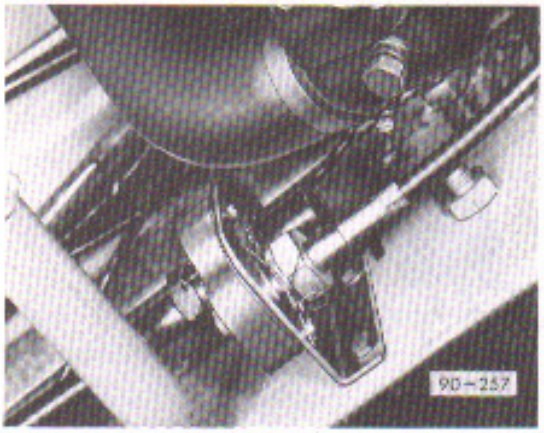



Fig. 12 Routing of tachograph cable

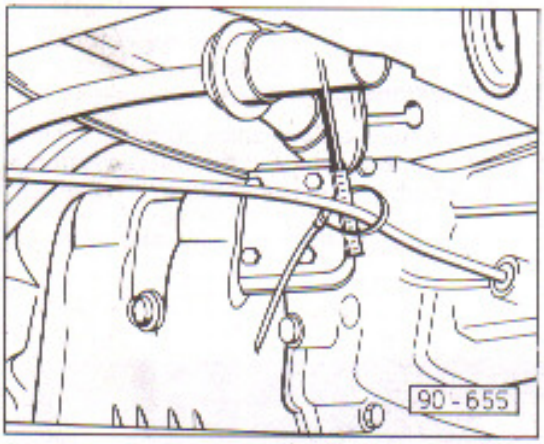



Fig. 10 Removing and installing speedometer cable

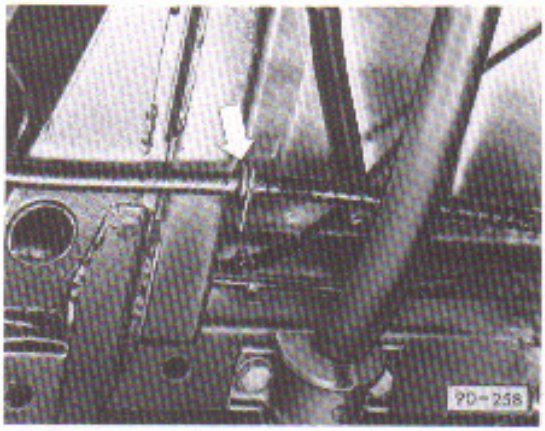



Fig. 13 Routing of tachograph cable

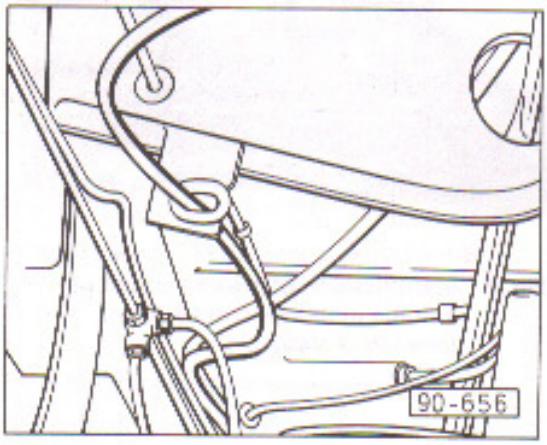



Fig. 11 Removing and installing speedometer cable

**Note:**

Route the cables so that they are neither squeezed, kinked or damaged, otherwise indication will be incorrect or cable will break.

Do not grease connection to speedometer. Grease can get into instrument and cause needle to stick.

## REPAIRING DASH INSERT (from 12.82)

## WITH REV COUNTER AND TACHOGRAPH

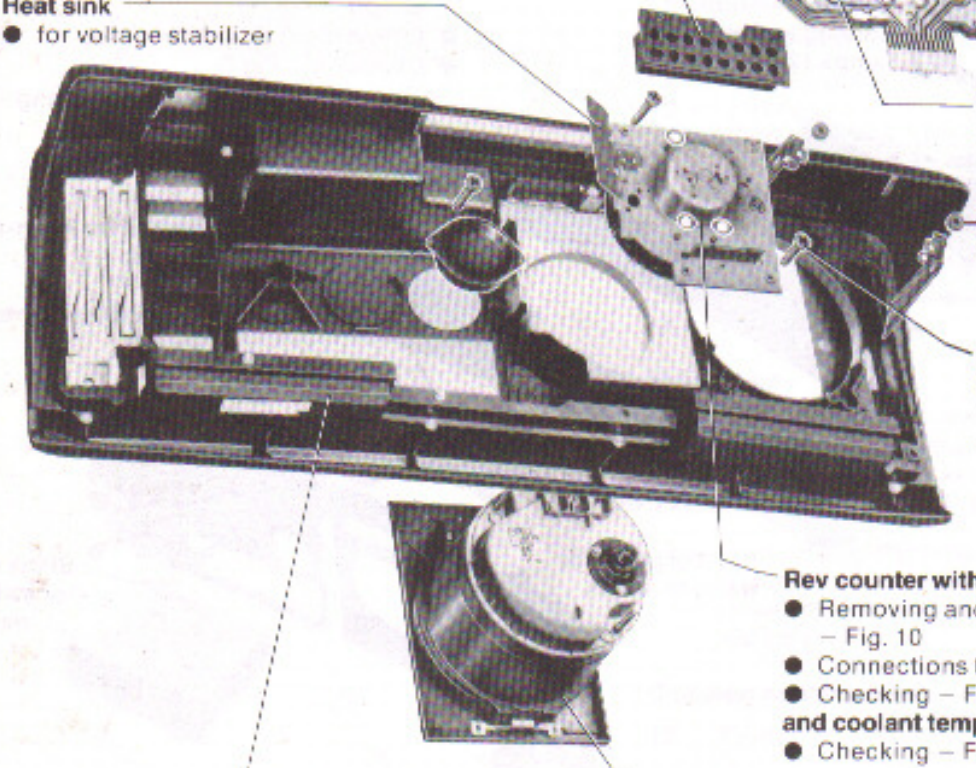
Notes on trip recorder – Page 43

**Important:**
Detach battery earthing strap

**Printed circuit**
- Allocation of connections at multiple connectors – Fig. 1
- Designation of connections on printed circuit – Fig. 2

**Warning lamp housing**
- Designation of bulbs – Fig. 3

**Heat sink**
- for voltage stabilizer



**Bulb 12 V/1.2 W**

**Common earthing point**

**Voltage stabilizer**
- checking – Fig. 4

**Securing screw** for tachograph

**Securing screw** for retaining plate

**Rev counter with fuel gauge**
- Removing and installing sensor – Fig. 10
- Connections to sensor – Fig. 12
- Checking – Fig. 5

**and coolant temperature indicator**
- Checking – Fig. 6

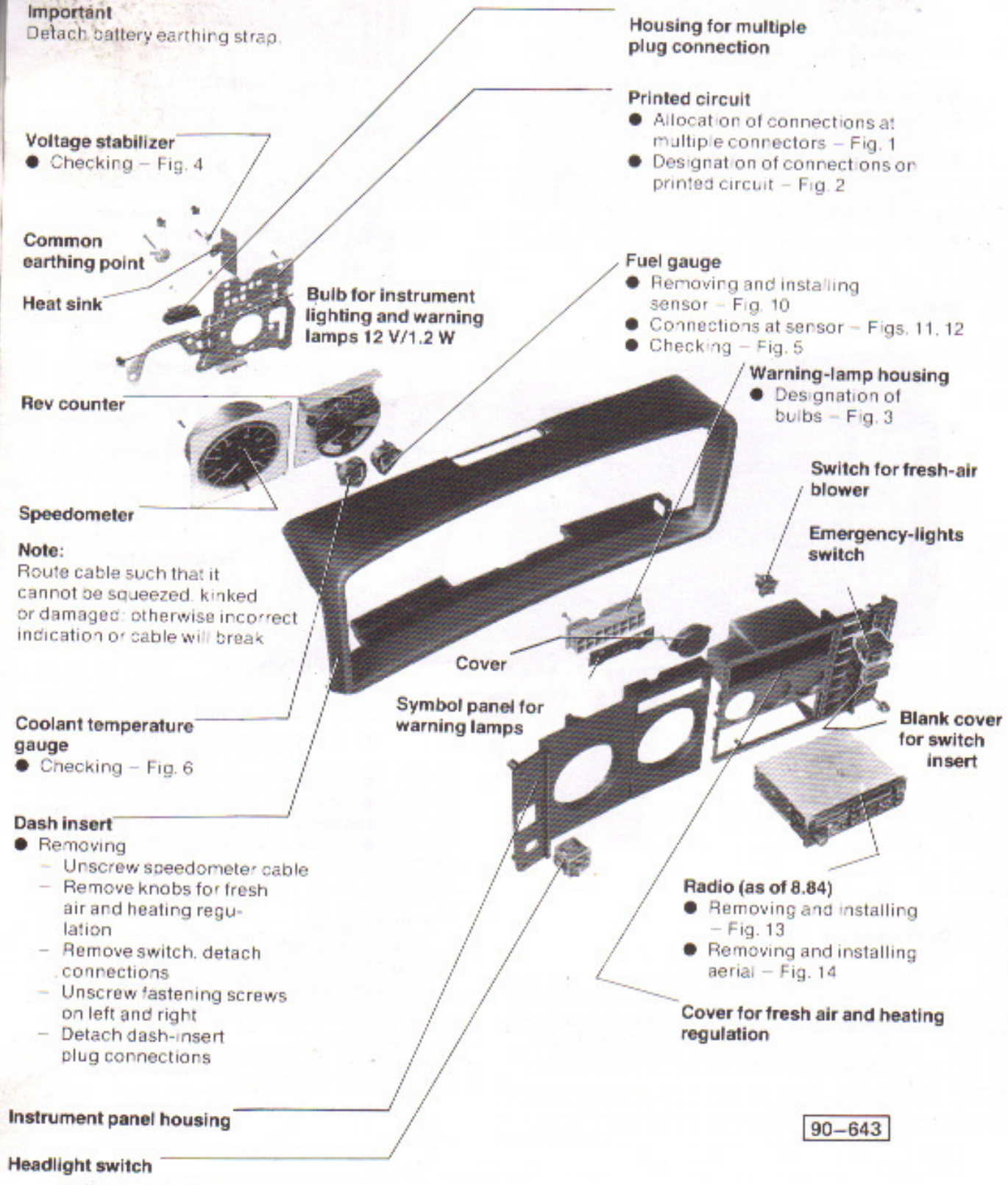
**Dash insert**
Removing
- Unscrew tachograph cable
- Remove knobs for fresh air and heating
- Remove switch, detach connections
- Unscrew fastening screws on left and right
- Detach dash-insert plug connections

**Tachograph**
- Routing cable – Figs. 7, 8, 9
- Route cable so that it cannot be squeezed, kinked or damaged: otherwise incorrect indication or cable will break

90–648

## REPAIRING DASH INSERT (from 12.82) WITH SPEEDOMETER AND REV COUNTER

Notes on odometer in speedometer – Page 43.
Notes on tachograph – Page 43.



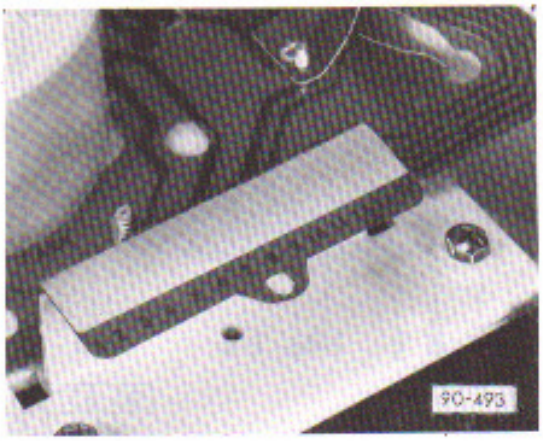



**Fig. 1 Allocation of connections at multiple connector**

1 – Warning lamp for oil pressure
2 – Indicator lamp for preheating time
3 – +, terminal 15
4 – Indicator lamp for trailer operation
5 – Bulbs for instrument lighting
6 – Fuel gauge from sensor
7 – Gauge, terminal 30 or rev counter, terminal 1 or terminal W (diesel engine)
8 – Coolant temperature indicator from sensor
9 – Earth, terminal 31
10 – Main-beam indicator lamp
11 – Roof-vent indicator lamp
12 – Turn-signal indicator lamp
13 – Generator warning lamp
14 – Indicator lamp for dual brake circuit and handbrake

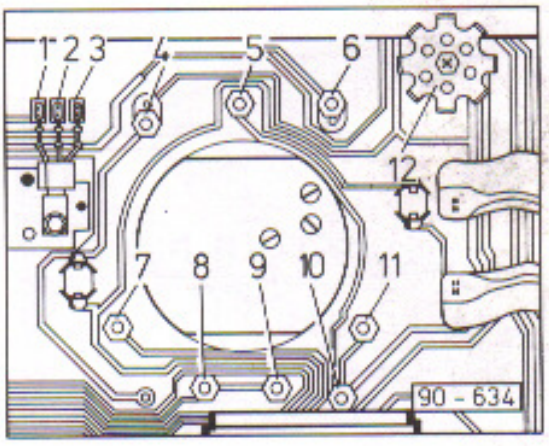



**Fig. 2 Designation of connections on printed circuit**

**Voltage stabilizer**

1 – Input, terminal 15
2 – Earth
3 – Output: approx. 10 V

**Rev counter**

4 – Earth
5 – Terminal 1 (petrol engine)
Terminal W (diesel engine)
6 – Terminal 15

**Fuel gauge**

7 – to fuel gauge sensor
8 – from voltage stabilizer output

**Coolant temperature indicator**

9 – from voltage stabilizer output
10 – Earth
11 – to sensor, coolant temperature indicator

**Common earthing point**

12 – Earth

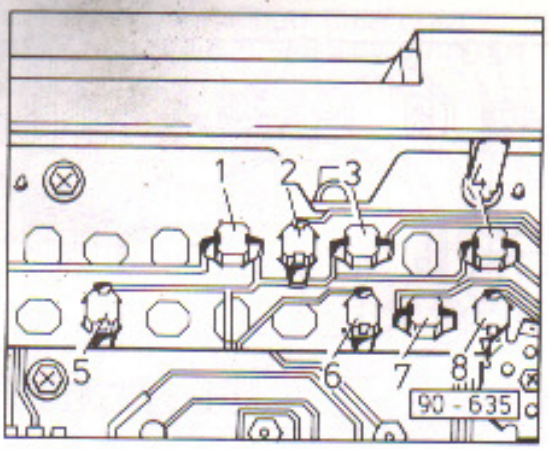



**Fig. 3 Designation of bulbs in lamp housing**

1 – Warning lamp for oil pressure (red)
2 – Indicator lamp for dual brake circuit and handbrake (red)
3 – Generator warning lamp (red)
4 – Turn-signal indicator lamp (green)
5 – Indicator lamp for preheating time (yellow)
6 – Indicator lamp for trailer operation (green)
7 – Roof-vent indicator lamp (green)
8 – Main-beam indicator lamp (blue)

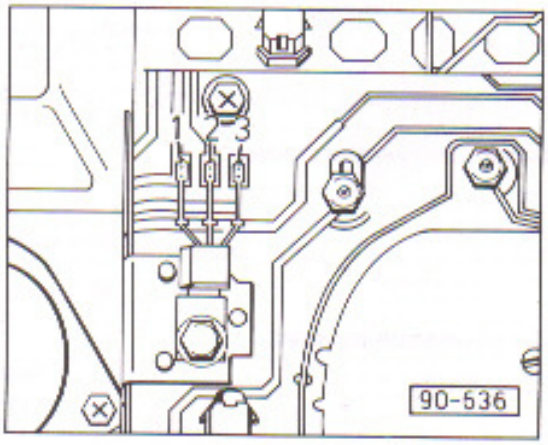



**Fig. 4 Checking voltage stabilizer**

1 – Input, terminal 15
2 – Earth
3 – + output

**Test condition:** Battery O.K.

Connect voltmeter between – output –3– and earth –2–. Voltage must be approx. 10 V.

If voltage in excess of 10.5 V or less than 9.5 V, voltage stabilizer is defective.

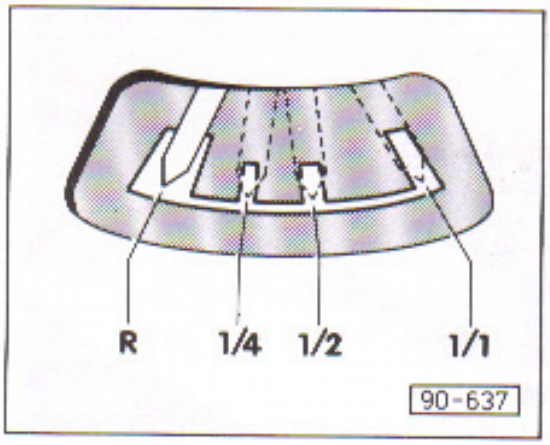



**Fig. 5 Checking fuel gauge**

**Test condition:** Battery O.K.

– Detach wire from sensor for fuel gauge, connect V.A.G tester 1301 to detached wire and earth.

**Note:**

In the delivery van the fuel gauge sensor is not accessible: remove fuel tank – Workshop Manual, engine booklet.

– Start engine and set following values at potentiometer:

350 – needle position R
200 – needle position 1/4
140 – needle position 1/2
50 – needle position 1/1

Permissible deviation: one needle width to right or left.

**Faut finding chart** – Page 44

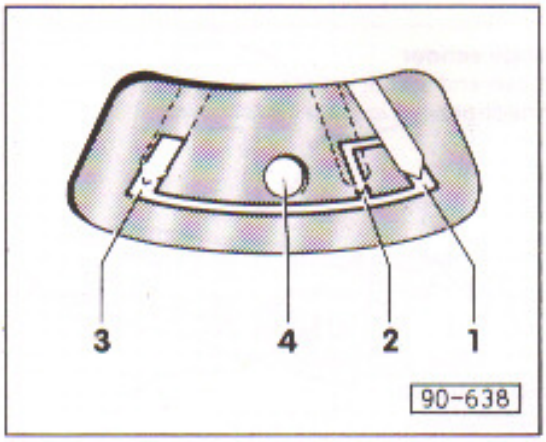



Fig. 6 **Checking coolant temperature indicator**

**Test conditions:** Battery O.K. and relay for coolant level indicator detached.

- Detach wire from sensor for coolant temperature indicator, connect V.A.G 1301 to detached wire and earth.
- Start engine and set following values at potentiometer:

  650 – needle position 1, engine cold
  300 – needle position 2
  70 – needle position 3, engine warm

  Permissible deviation: one needle width to right or left.

  4 – LED for coolant temperature (too hot, red)/lack of coolant

**Fault finding chart** – Page 44

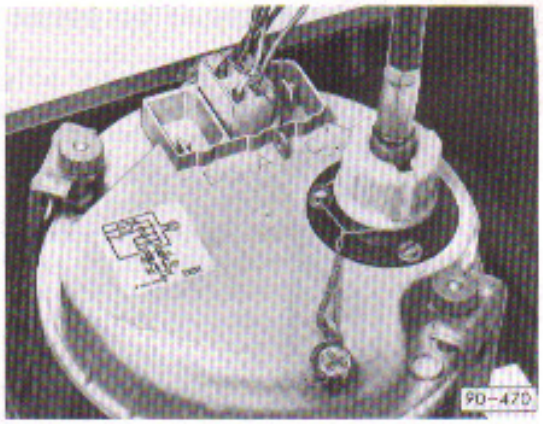



Fig. 7 **Routing tachograph cable**

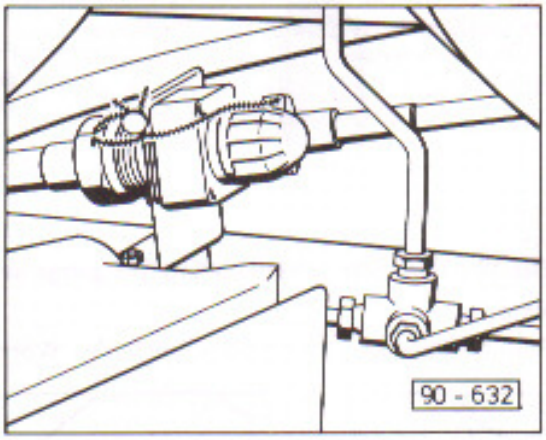



Fig. 8 **Routing tachograph cable**

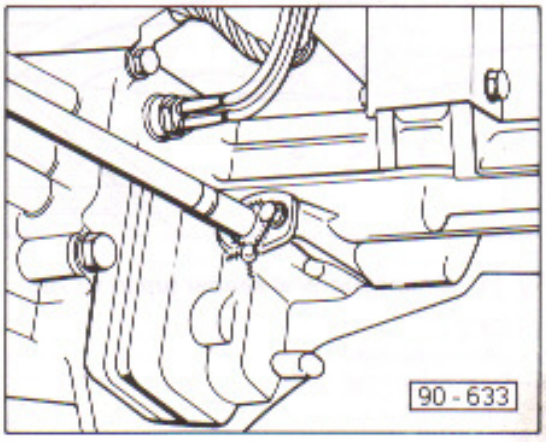



Fig.9 **Routing tachograph cable**

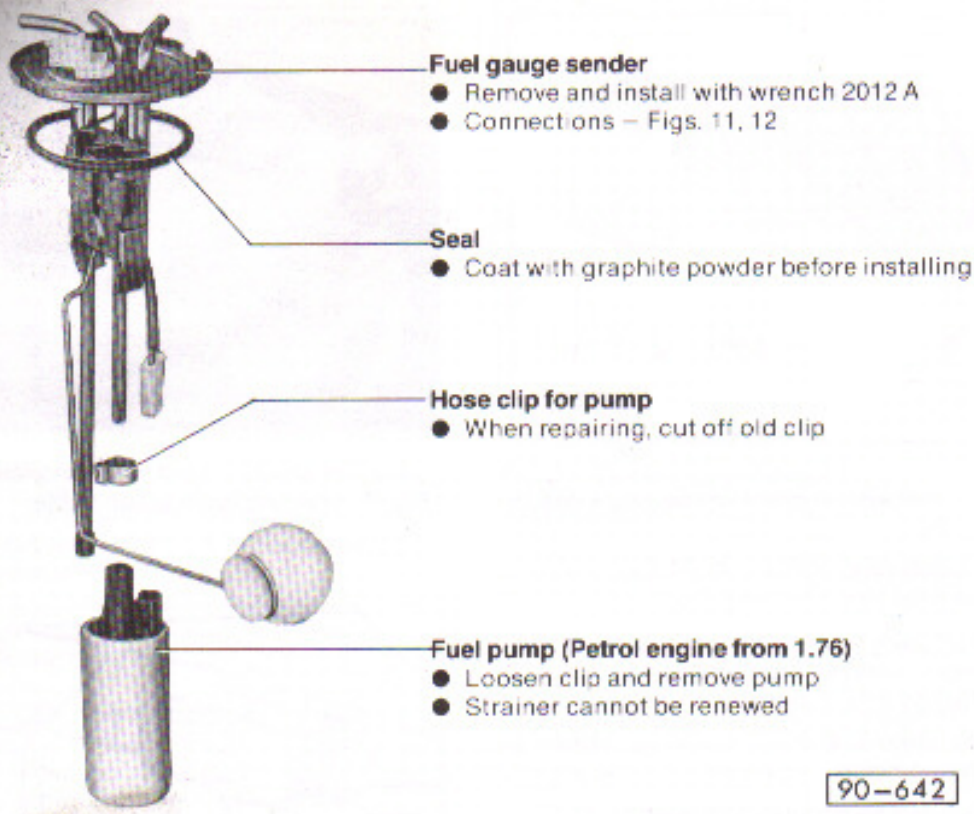



**Fig. 10 Removing and installing fuel gauge sender**

**Note:**
With delivery van only, remove fuel tank – Workshop Manual, engine booklet.

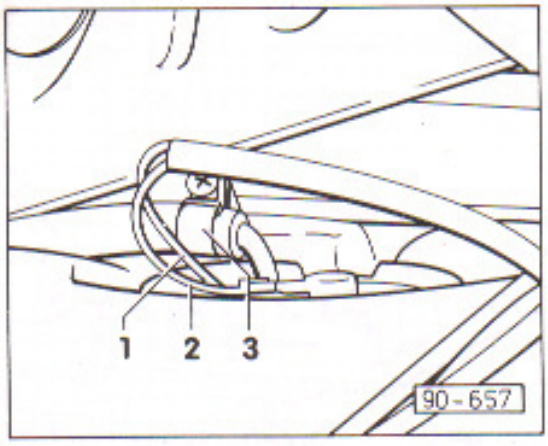



**Fig. 11 Connections at sender (up to 12.75)**

1 – Earth
2 – to fuel gauge
3 – Fuel hose clip

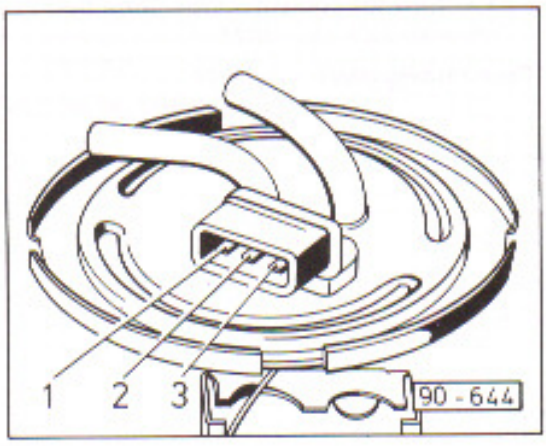



**Fig. 12 Connections at sender (from 1.76)**

Petrol engine: Connector, 3 pins
1 – Earth
2 – Positive connection for fuel pump
3 – to fuel gauge

Diesel engine: Connector, 2 pins
1 – Earth
2 – to fuel gauge

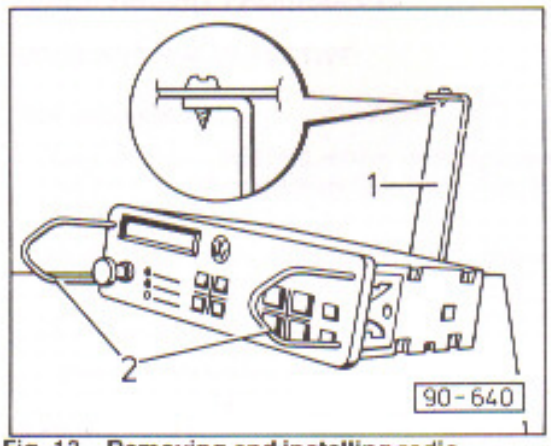



**Fig. 13 Removing and installing radio (from 8.84)**

- Disconnect battery earth strap.
- Remove securing bracket –1– on reverse side of radio.
- Push wire loop –2– through the holes in the front plate until the side retainers are disengaged.
- Pull radio out of dash panel and detach connections.

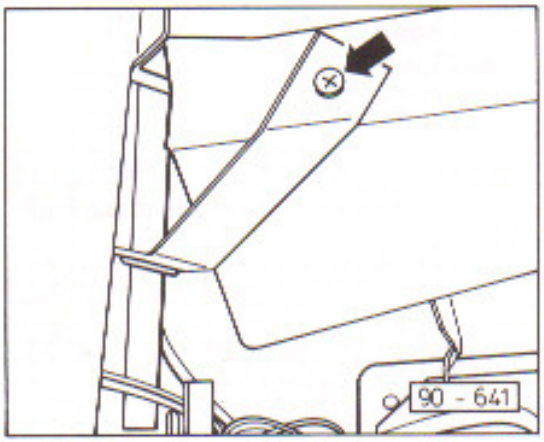



**Fig. 14 Removing and installing aerial**

- Disconnect battery earthing strap.
- Detach relay plate.
- Remove tapping screw –arrow– from retaining bracket.
- Remove aerial cap nut.
- Pull aerial connection out of radio.
- Pull aerial out from underneath.

**NOTES ON TACHOGRAPH:**

The tachograph drive shaft is sealed at the gearbox, at the differential and on the tachograph itself.

In the Federal Republic of Germany, the system has to be checked and resealed by an authorised person, in accordance with German traffic regulations, after every repair, change to distance/turns and after expiry of the time prescribed by law since the last check.

Outside the Federal Republic of Germany please contact the tachograph manufacturers agents.

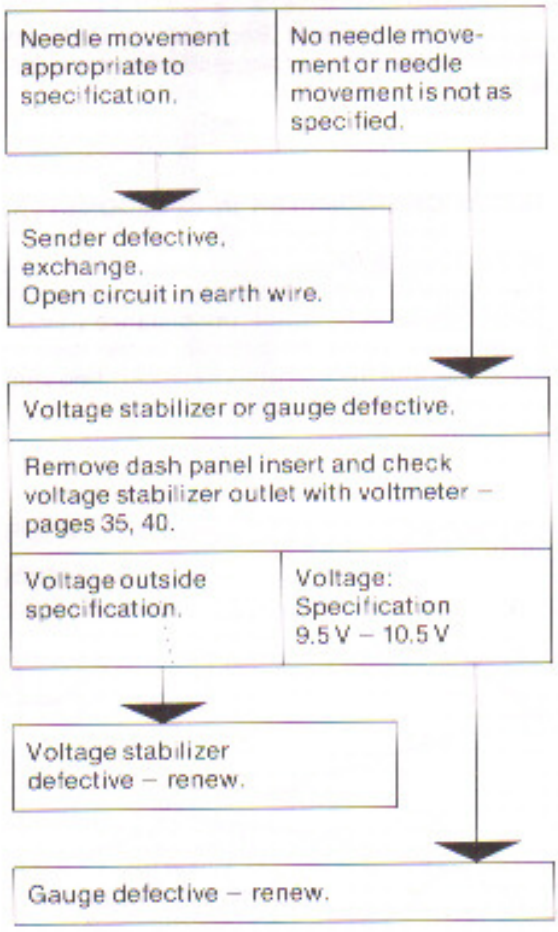
**NOTES ON ODOMETER IN SPEEDOMETER:**

In the Federal Republic of Germany, zeroing the odometer is not permitted, and when the speedometer is renewed, the distance travelled thus far has to be entered in the service schedule, and the entry has to be certified with an official stamp and signature.

**FAULT FINDING PROGRAMME:**

**CHECKING FUEL AND COOLANT TEMPERATURE GAUGES**

Dependent upon the defect, the following results could be obtained when checking the gauges with V.A.G 1301 tester – pages 34, 40, 41 –.



**FAULT FINDING PROGRAMME:**

**HORN SYSTEM DEFECTIVE**

**Test conditions:**

- Gap between steering wheel and steering column switch correctly adjusted (up to 9.79) – Fig. 1.
- Horn contact wire underneath horn plate in order.
- S9 fuse in order.
- Ignition switched on.

**Note:**

If the defect is not found using fault finding programme, check earth wire between steering column and steering box – page 67, Fig. 2.

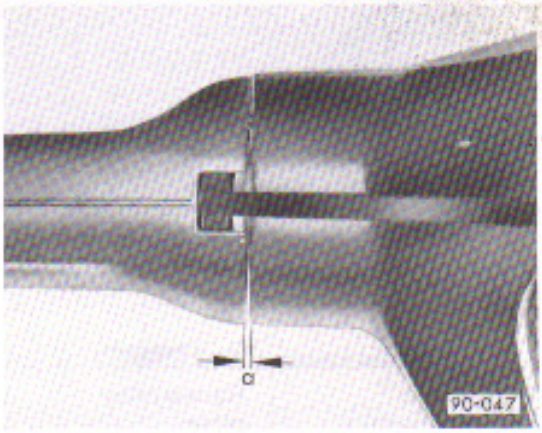



**Fig. 1 Gap between steering wheel and steering column switch (up to 9.79)**

a = 2 up to 3 mm

| Horn defective | |
|---|---|
| Pull earth wire from horn. Connect test wire (1.5 m²) from vacant horn terminal to earth. | |
| Horn does not sound | Horn sounds. |

Continued on next page, section A

| Horn has open circuit. | |
|---|---|
| Using test lamp, check voltage on black/yellow wire (on horn). | |
| Test lamp lights up | Test lamp does not light up |

Renew horn

END

Continues on next page, section B

B continued

Open circuit in the black/yellow wire from horn to relay plate, contact A 11 (Fig. 2 arrow).

Detach battery earthing strap.
Pull test wire off, from horn to relay plate, contact A 11.
Attach battery earthing strap.

| Horn sounds | Horn does not sound |
|---|---|
| Renew wire. Seal off openings. Remove test wires. | Renew relay plate |

End

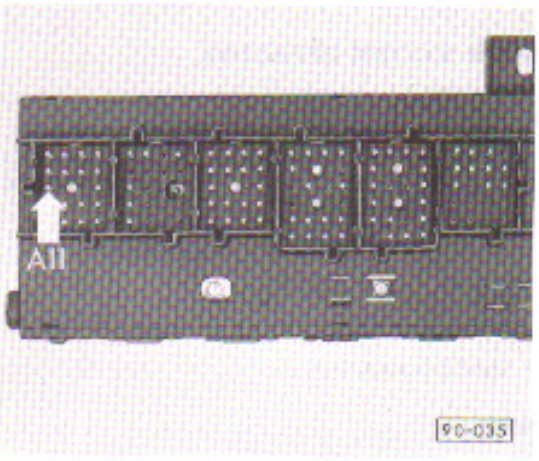



Fig. 2 Contact A 11, connect test wire

A continued

Horn contact in steering column switch defective.

Pull contact out at steering column switch. Connect brown/blue wire in connector housing to earth with test wire (Fig. 3).

| Horn sounds | Horn does not sound |
|---|---|
| Eliminate open circuit to horn contact | Continued on next page, section C |

End

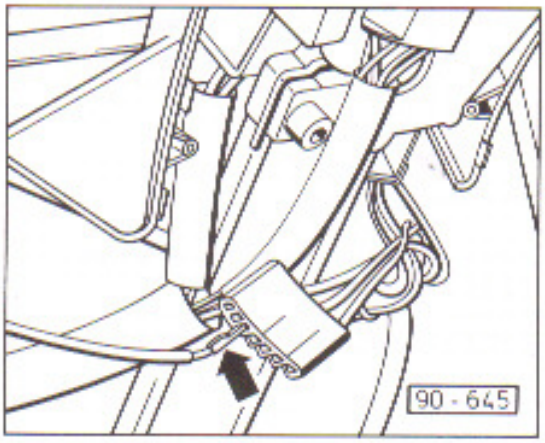



Fig. 3 Connect brown/blue wire to earth

C continued

Open circuit in brown/blue wire from contact housing to relay plate – contact E 11 (Fig. 4 arrow).

Connect test wire from contact housing to contact E 11 on relay plate.

| Horn sounds | Horn does not sound |
|---|---|

Renew wire

End

Open circuit in brown/blue wire from relay plate, contact A 7, to horn (Fig. 5, arrow).

Connect test wire from relay plate, contact 7, to horn.

| Horn sounds | Horn does not sound |
|---|---|

Renew wire

Renew relay plate

End

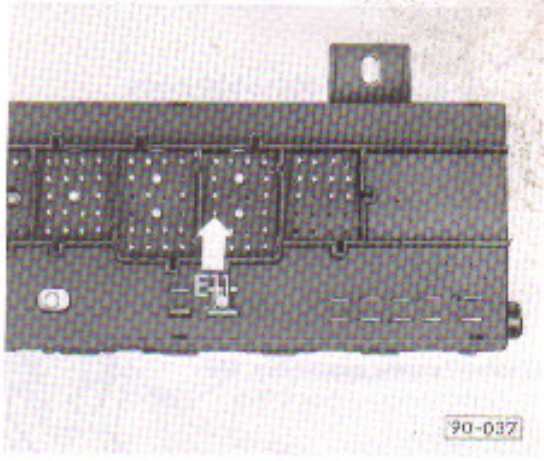



Fig. 4 Contact E 11, connect test wire

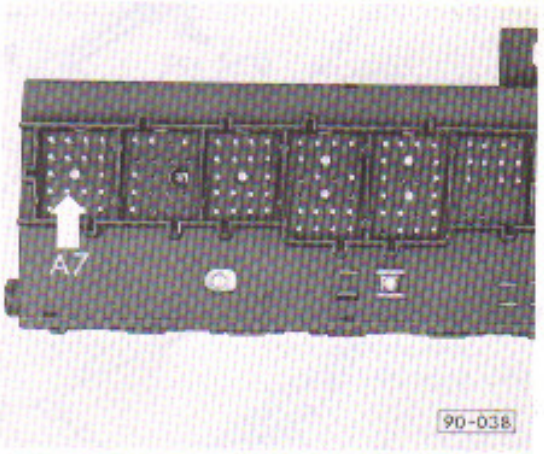
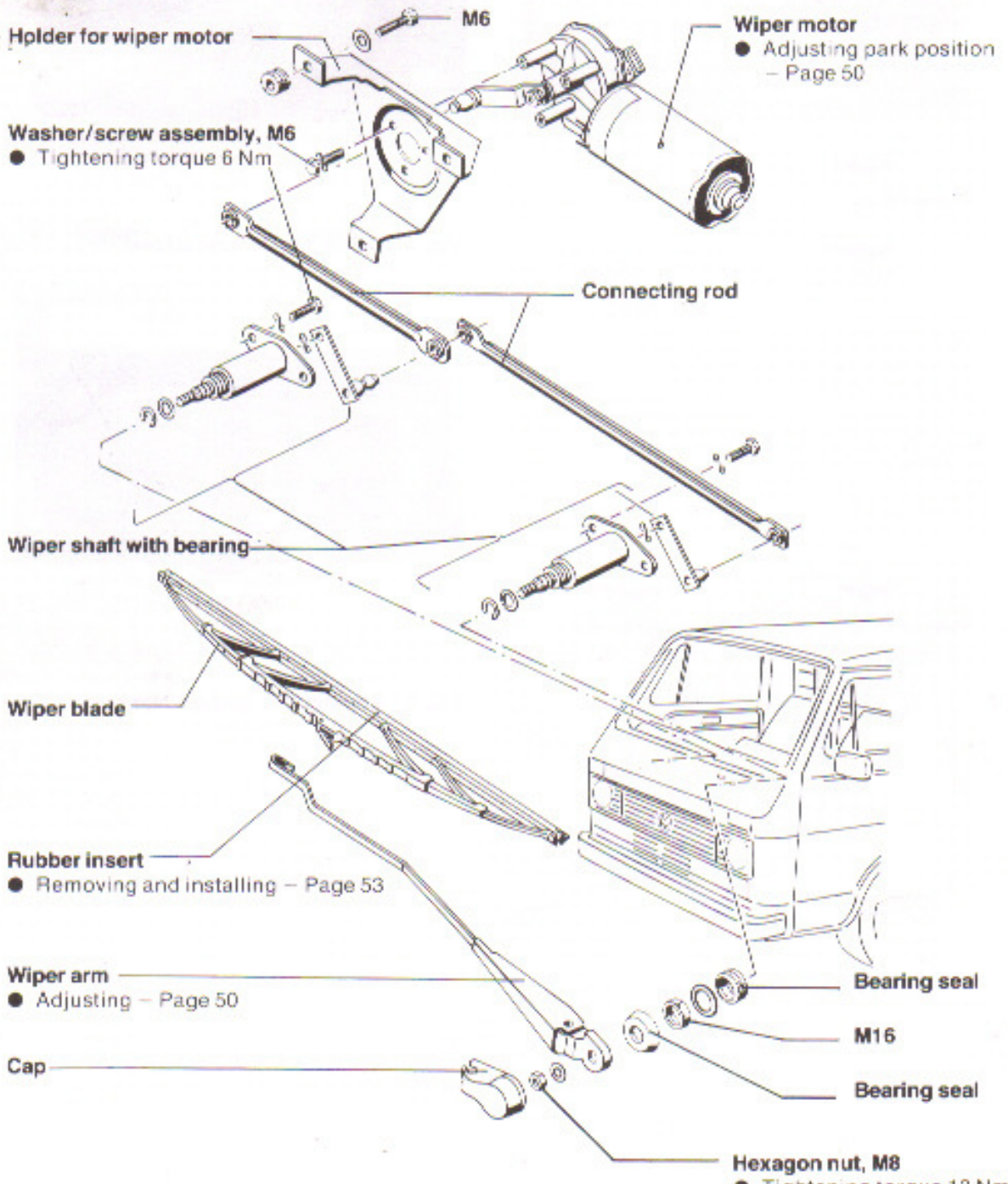



Fig. 5 Contact A 7, connect test wire

## REPAIRING WINDSCREEN WIPER SYSTEM

**Note:**
Apply grease G 000 602 to ball joints at wiper bracket and wiper motor

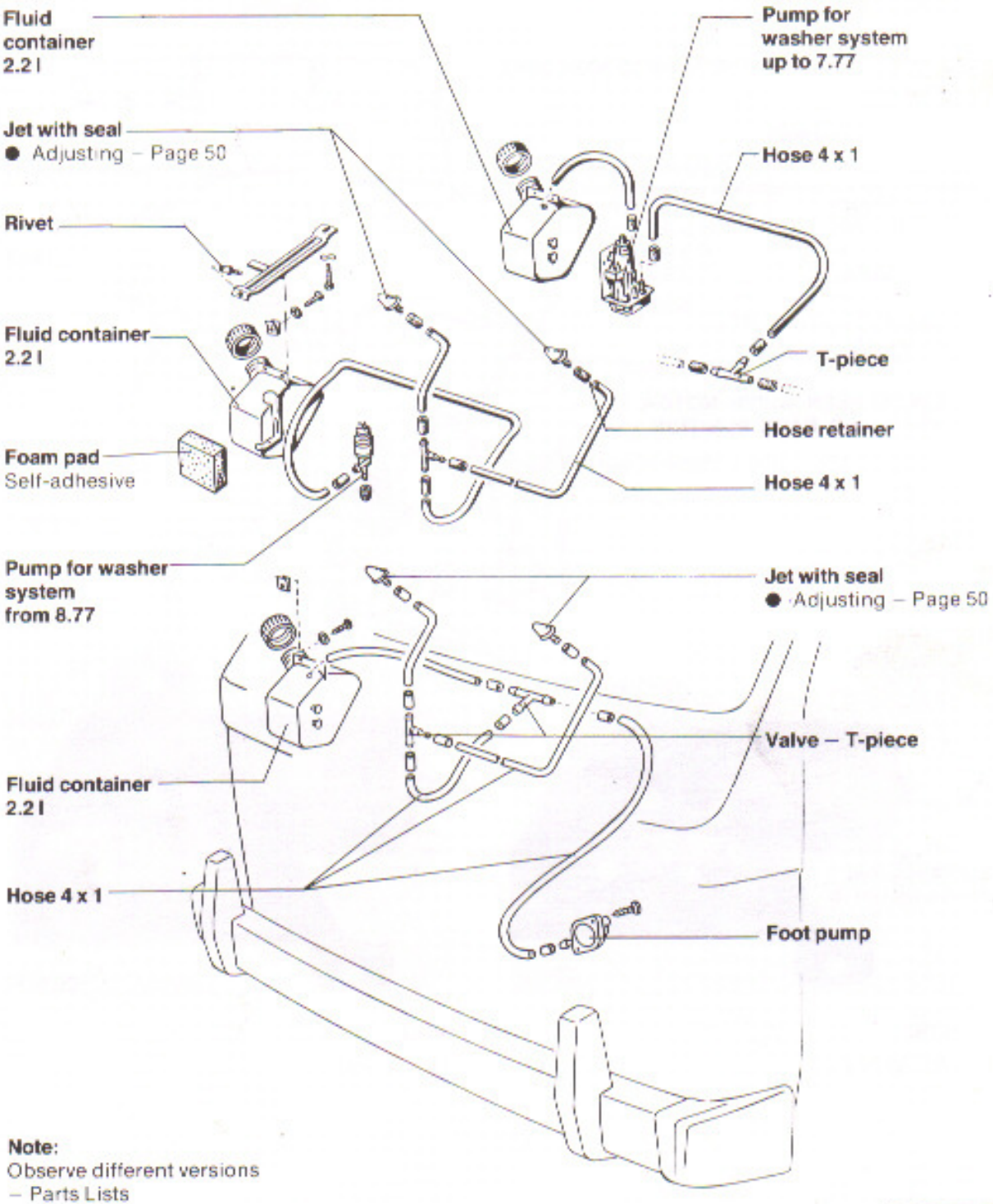



**Note:**
Observe different versions – Parts Lists

92-368

REPAIRING WINDSCREEN WASHER SYSTEM,

with electric or foot pump




**Note:**
Observe different versions – Parts Lists

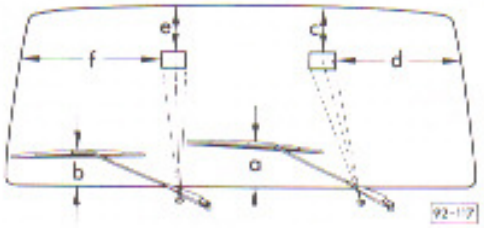
92–369

## ADJUSTING WIPER ARM
## ADJUSTING JET
## (WINDSCREEN WASHER SYSTEM)

**Wiper arm:**

a = 120 mm
b = 130 mm

Tighten hexagon nut for securing wiper arms to 12 Nm.



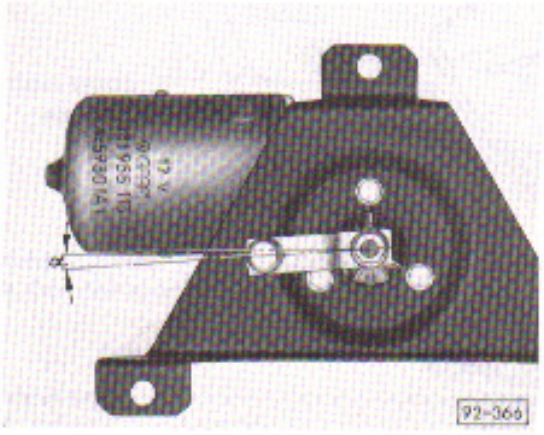

**Jet** for system with:

| Foot pump | Electric pump |
|---|---|
| c = 50 mm | c = 200 mm |
| d = 480 mm | d = 480 mm |
| e = 50 mm | e = 200 mm |
| f = 540 mm | f = 540 mm |

Adjust jet with tool 3125.

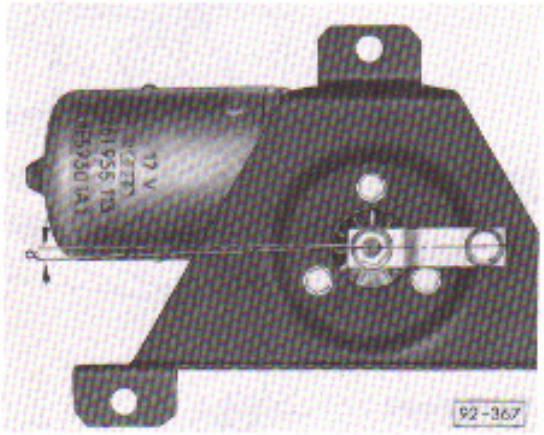
## WINDSCREEN WIPER MOTOR – ADJUSTING PARK POSITION

- Allow wiper motor to move to end position.
- Fit crank and align as indicated.




**LHD**

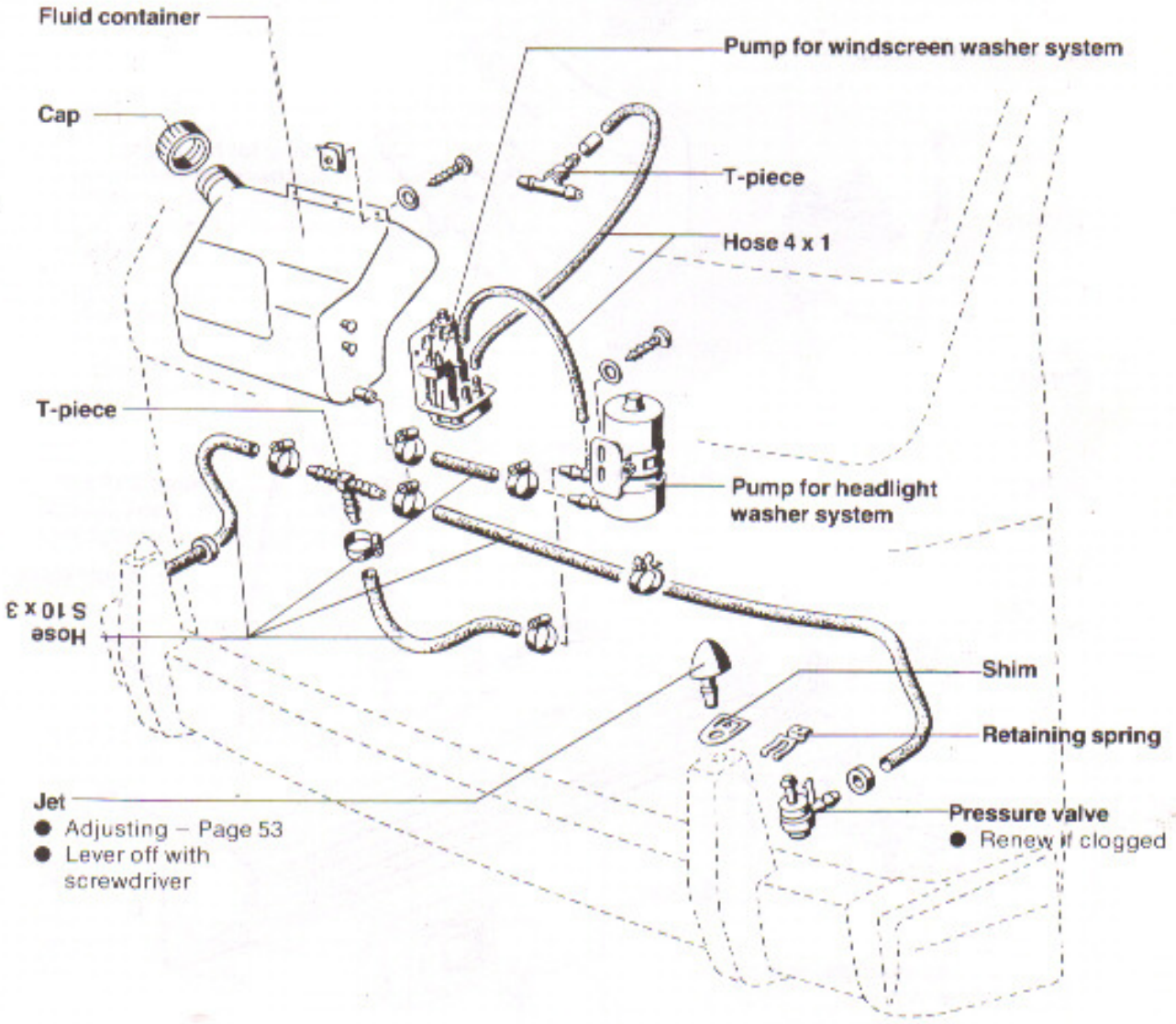
$\alpha = 0° \pm 8°$




**RHD**

$\alpha = 0° \pm 8°$

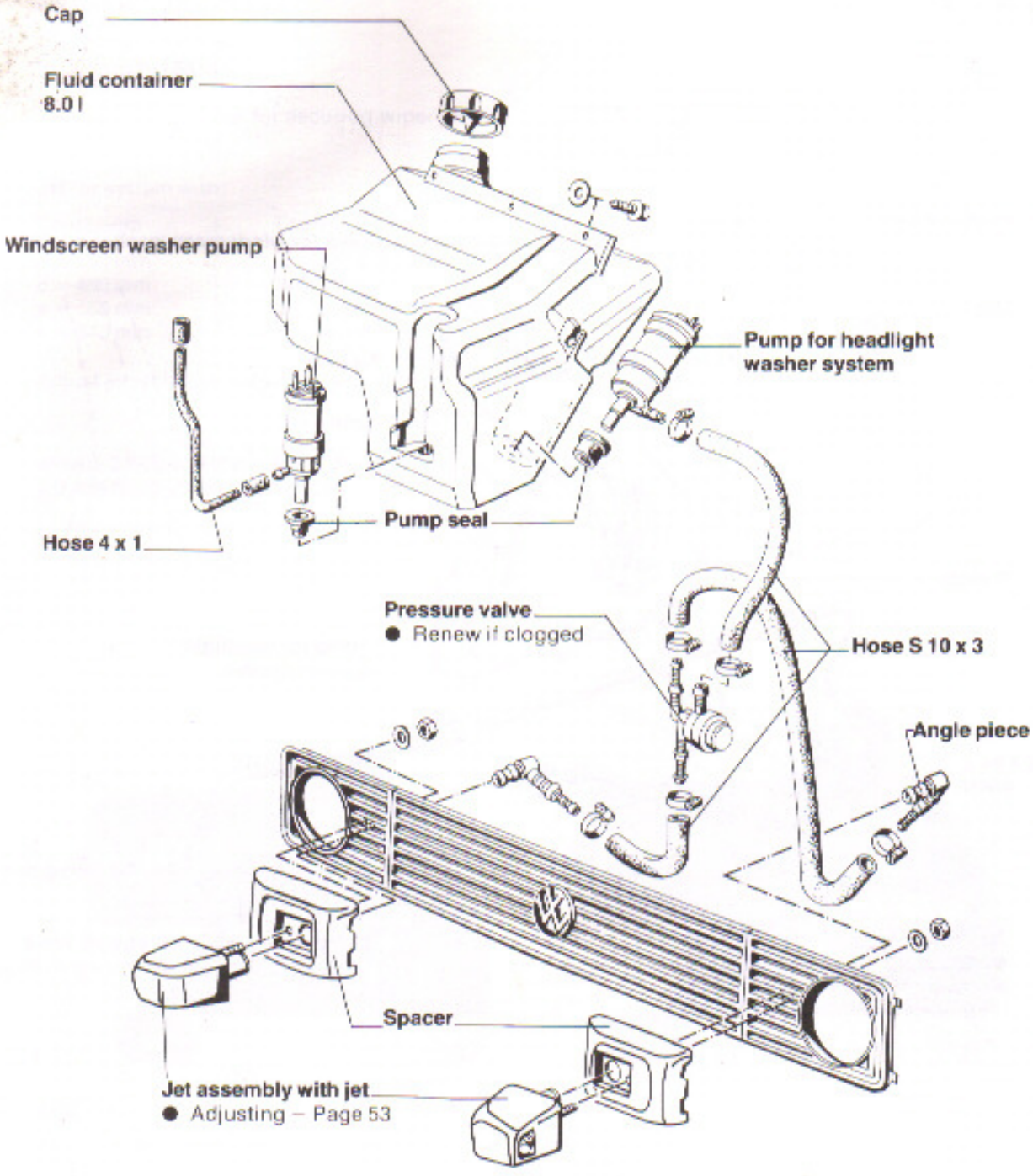
## REPAIRING HEADLIGHT WASHER SYSTEM, up to 11.82




**Note:**
Observe different versions – Parts Lists

92–370

REPAIRING HEADLIGHT WASHER SYSTEM, from 12.82



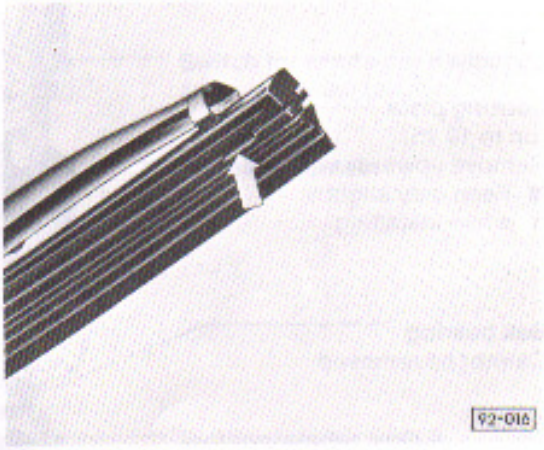

**Note:**
Observe different versions
– Parts Lists

92–371

## REMOVING AND INSTALLING RUBBER INSERT

- At closed side of rubber insert press both steel rails together using universal pliers, remove laterally from upper clamp and pull rubber insert complete with rails out of remaining wiper-blade clamps.


- Insert new rubber insert into lower clamps of wiper blade.
- Insert both rails into first groove of rubber insert so that recesses in rails face the rubber insert and engage in rubber lugs of groove.
- Press both steel rails and rubber insert together again using universal pliers and insert into upper clamp so that lugs engage on both sides in retaining grooves (arrow) of rubber insert.




## ADJUSTING JET (HEADLIGHT WASHER SYSTEM)

Up to 11.82 jet beneath headlight:
Adjust with tool 3125

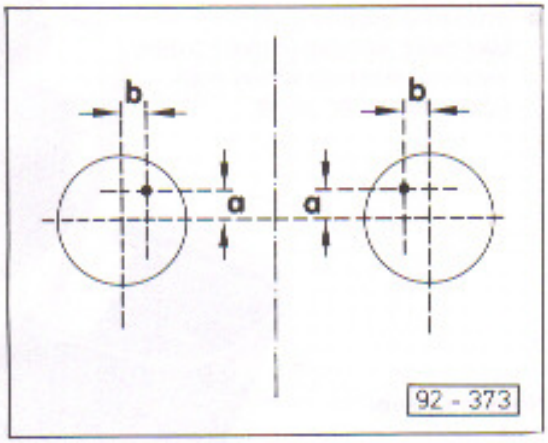
a = 20 mm
b = 15 mm

As of 12.82 jet next to headlights:
Adjust with tool 3019 A

a = 15 mm
b = 12 mm

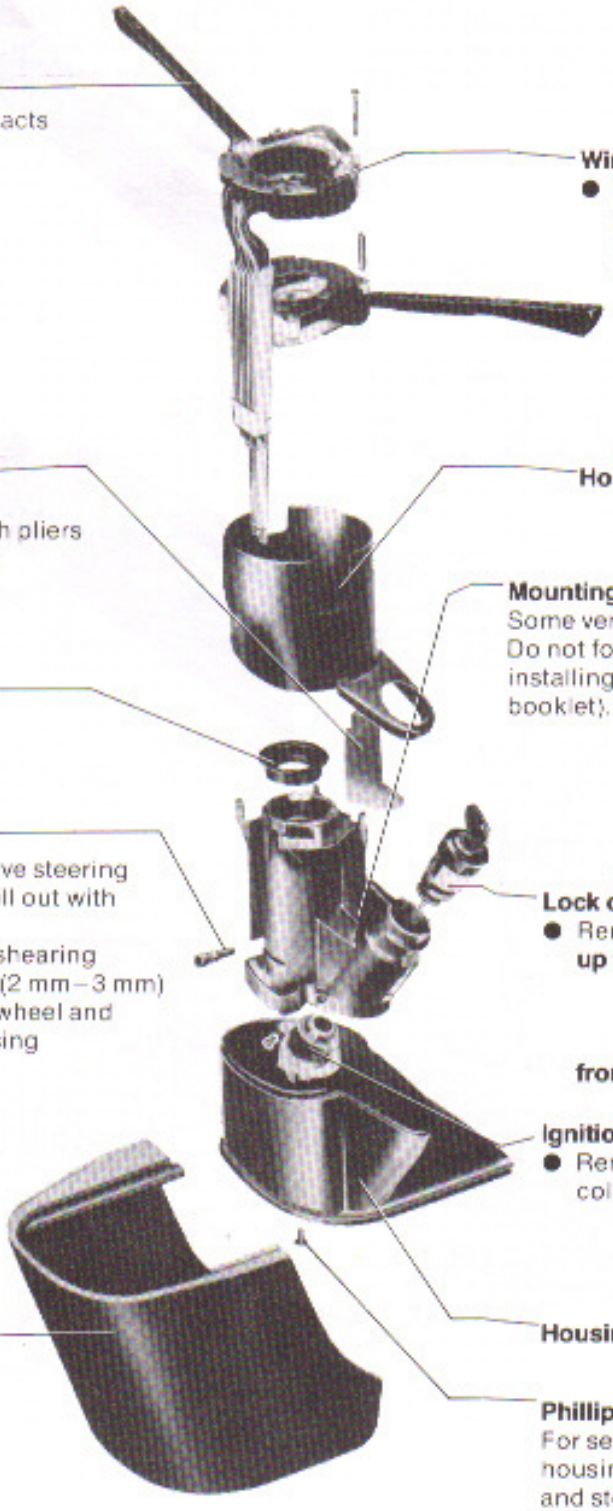
**Note:**

Press tool into jet assembly as far as stop and perform appropriate adjustment.
Do not damage jet.



## REPAIRING STEERING COLUMN SWITCH, up to 9.79

**Note:**
- Detach battery earthing strap
- Tightening torque of hexagon nut M 16 × 1.5 for securing steering wheel: 50 Nm



**Turn-signal switch**
Service part has contacts for parking light
- Adjusting gap – shear bolt

**Windscreen wiper switch**
- Service part has contacts for headlight washer system, windscreen washer pump and intermittent function

**Locking plate**
(up to 10.75)
Remove upwards with pliers
- Peen over slightly when installing

**Housing, upper part**

**Mounting for switch with steering lock**
Some versions have no locking pin. Do not forget support ring when installing (see "Running Gear" booklet).

**Ball bearing**
Cannot be removed

**Shear bolt**
- Removal: To remove steering column switch, drill out with left-hand drill
- Installing: Before shearing bolt head, set gap (2 mm – 3 mm) between steering wheel and upper part of housing

**Lock cylinder**
- Removal

**up to 10.75:** Opening for removal of lock cylinder is accessible after locking plate has been removed

**from 11.75:** – Page 56, Fig. 1

**Ignition/starter switch**
- Removal: Remove steering column switch complete

**Housing, centre part**

**Phillips screw**
For securing centre part of housing to mounting for switch and steering lock

**Housing, lower part**
- Pull off towards driver's seat

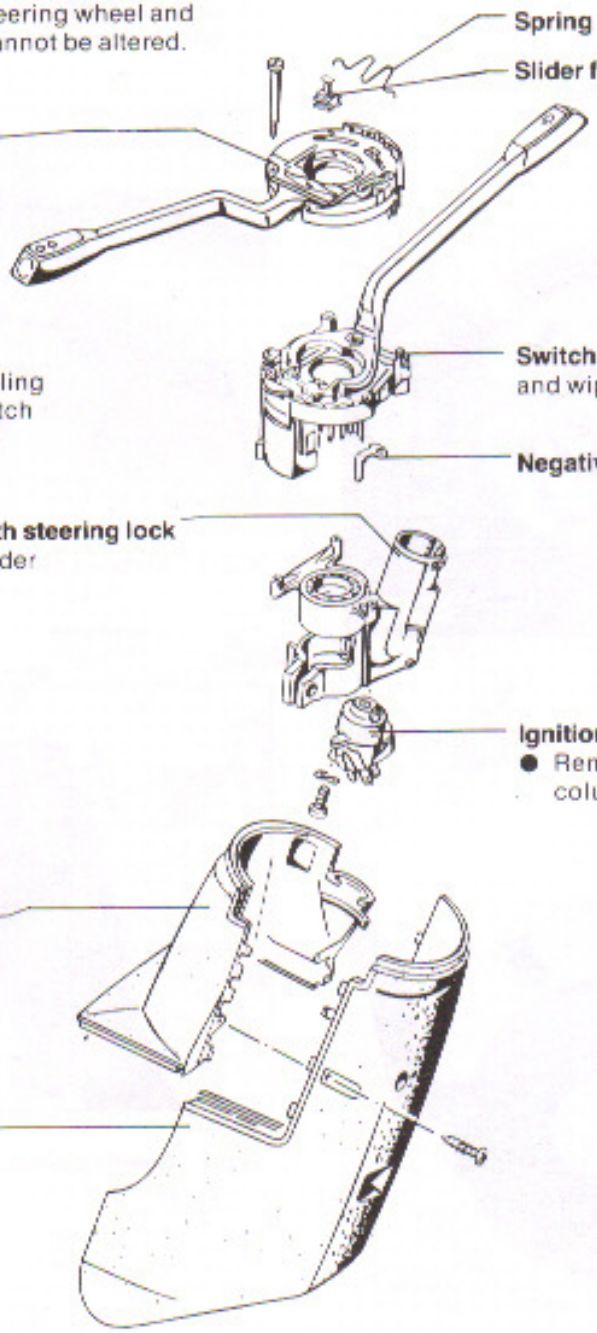
**Note:**
Observe different versions – Parts Lists

94 –202

54 **Repairing steering column switch (up to 9.79)**

## REPAIRING STEERING COLUMN SWITCH, from 10.79

**Note:**
- Detach battery earthing strap
- Tightening torque of hexagon nut M 16 x 1.5 for securing steering wheel: 50 Nm
- Distance between steering wheel and turn-signal switch cannot be altered.




**Note:**
- Removing and installing steering column switch – Page 56

**Mounting for switch with steering lock**
- Removing lock cylinder – Page 56, Fig. 2

**Ignition/starter switch**
- Removal: Remove steering column switch complete

**Housing, upper part**

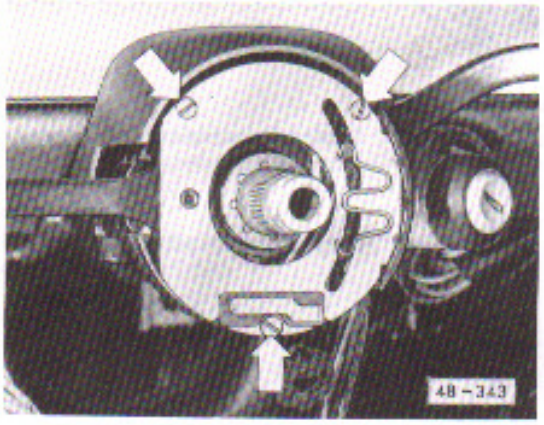
**Housing, lower part**
- Pull off towards driver's seat

**Note:**
Observe different versions – Parts Lists

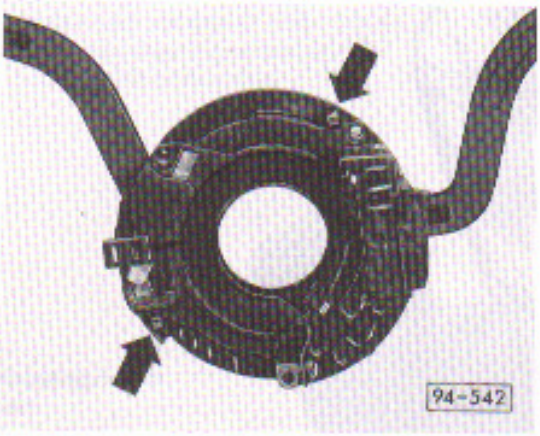
94-541

**REMOVING AND INSTALLING STEERING COLUMN SWITCH,** from 10.79

- Detach battery earthing strap.
- Remove steering column trim.
- Detach connector.
- Lever off horn plate.
- Remove steering wheel.




- Remove screw – arrow –
- Pull turn signal switch and windscreen wiper switch off steering column.




- Disengage windscreen wiper switch – arrow – and pull off from turn signal switch.

**REMOVING LOCK CYLINDER**

- Detach battery earthing strap.
- Remove turn signal and windscreen wiper switches.
- Carefully drill (3 mm diam.) the steering column lock switch housing – Figs. 1, 2.

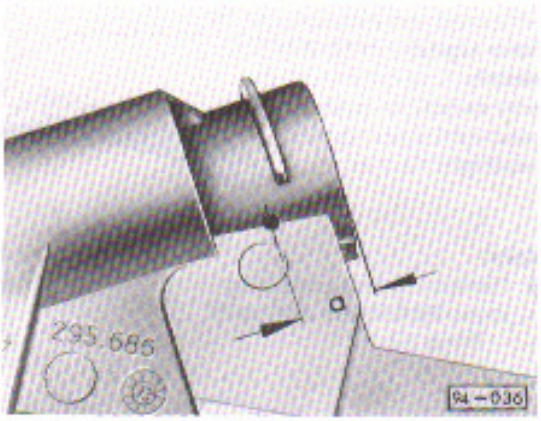



**Fig. 1 Steering column lock housing** (11.75 up to 9.79)

a = 13 mm

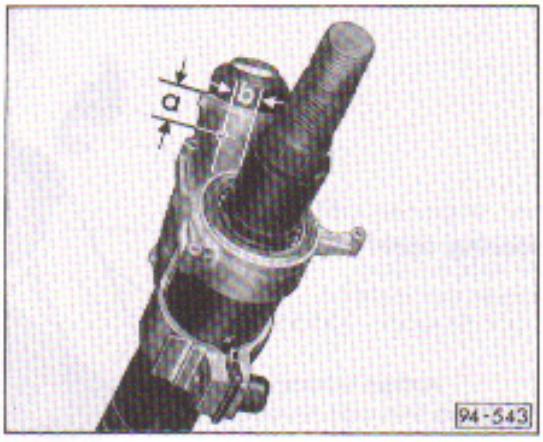


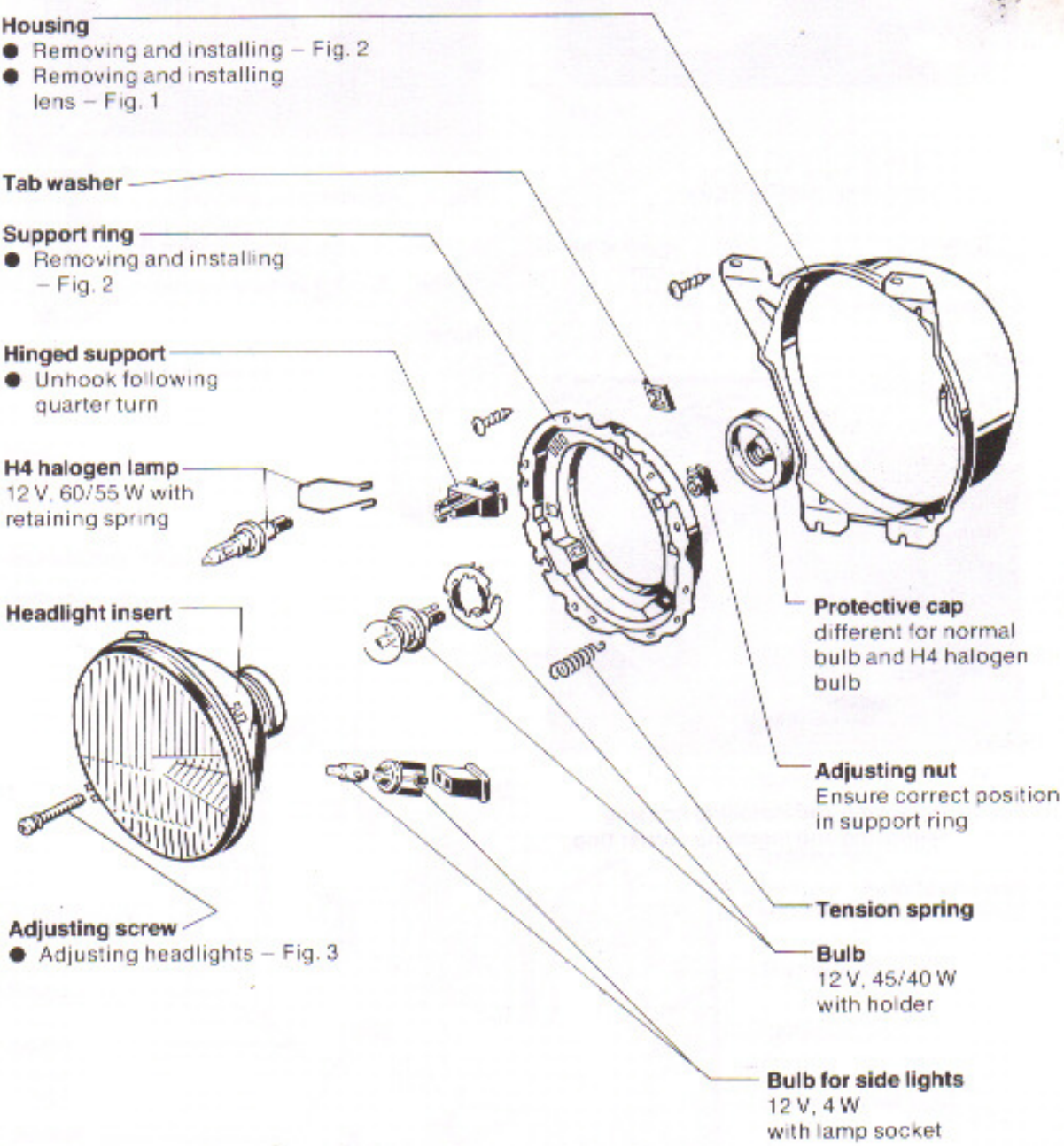

**Fig. 2 Steering column lock switch housing** (from 10.79)

a = 12 mm
b = 7 mm

- Depress lock cylinder retaining spring through the drilling and remove lock cylinder.
- Do not remove locking plate (up to 10.75) to prevent the lug on the turn signal switch from being inadvertently broken off on vehicles without intermittent facility.

## REPAIRING HEADLIGHTS

**Note:**
- Adjusting headlights – Fig. 3
- Specified values for headlight adjustment – "Maintenance" booklet




**Note:**
Observe different versions – Parts Lists

94–544

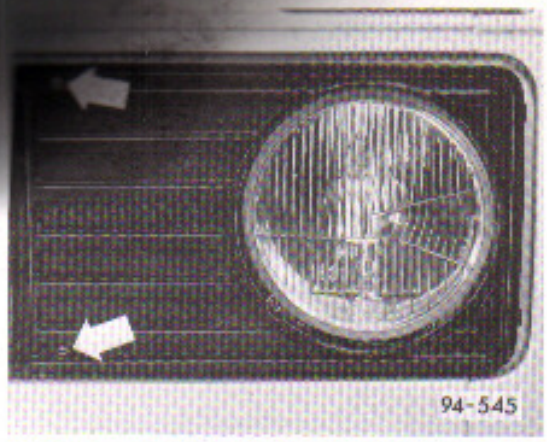



**Fig. 1 Removing headlight trim**

- Disengage headlight trim quickrelease screws – arrow – by turning ¼ turn.
- Remove trim.

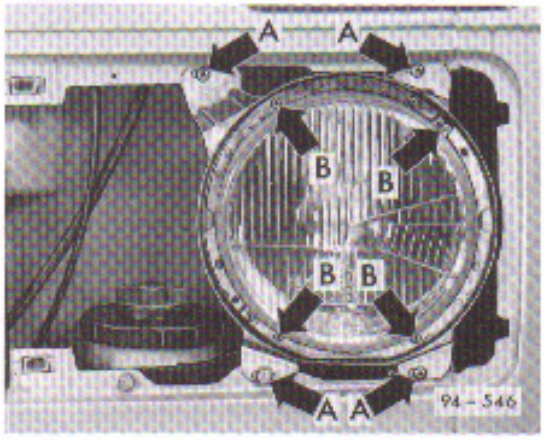



**Fig. 2 Removing and installing housing**
**Removing and installing carrier ring**

Housing screws – Arrow A
Carrier ring screws – Arrow B

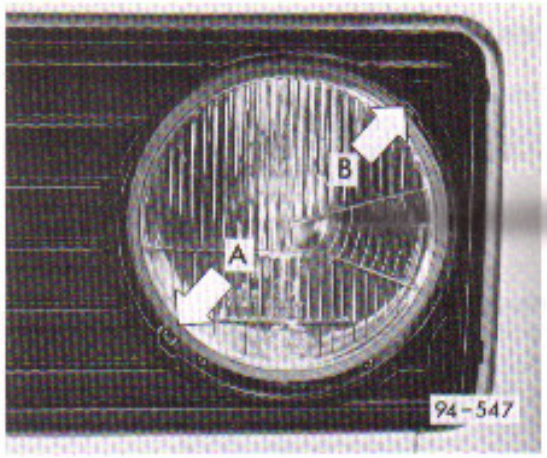



**Fig. 3 Adjusting headlight**

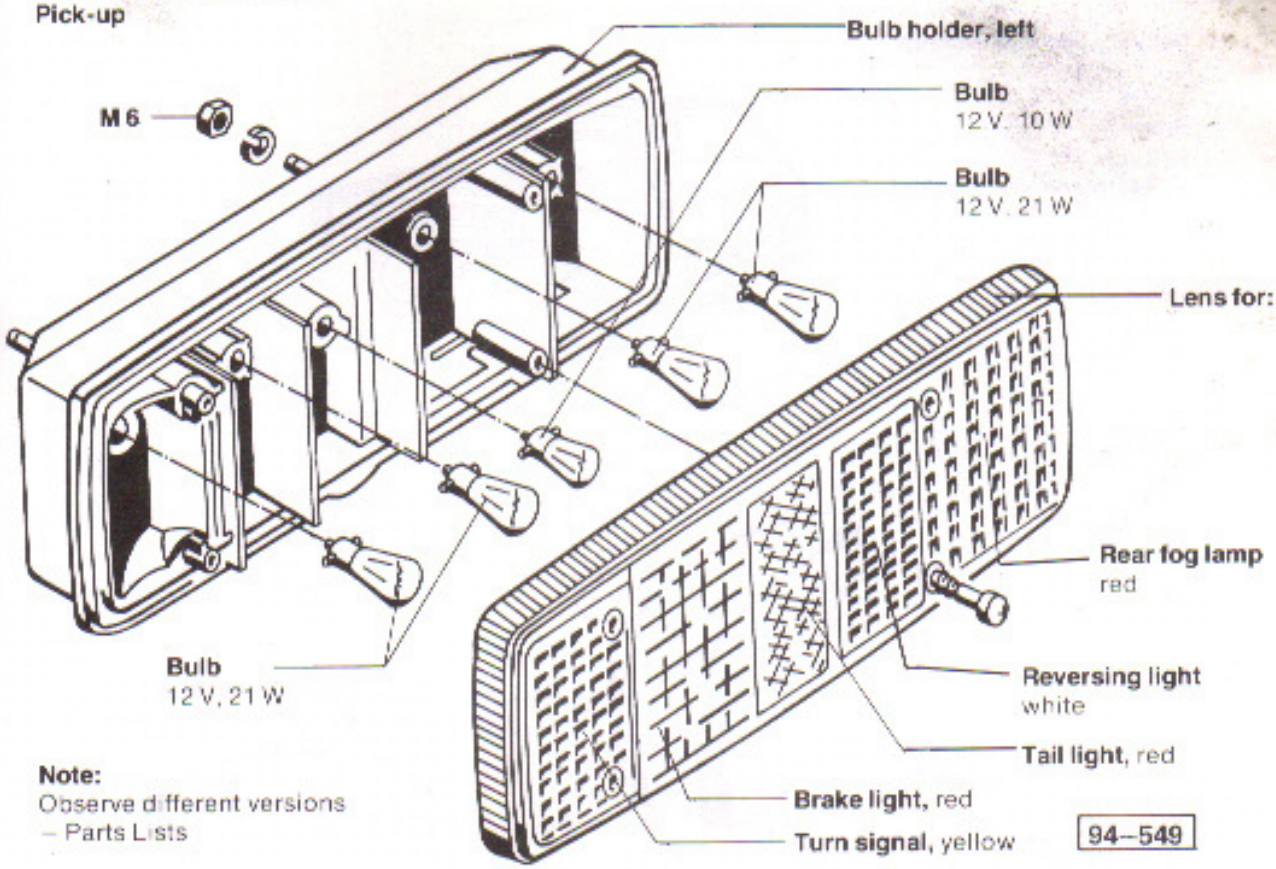
Screw – A – for horizontal setting

Screw – B – for vertical setting

**Note:**

See "Maintenance" booklet for setting figures.

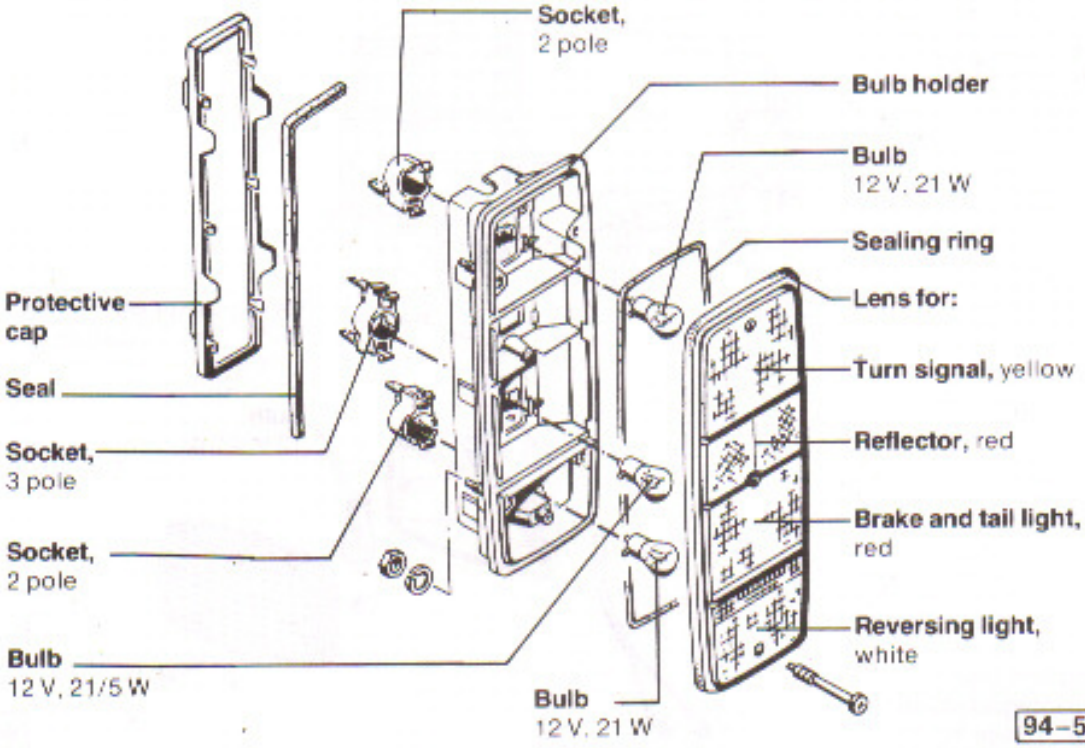
## REPAIRING TAIL LIGHT
Pick-up




**Note:**
Observe different versions
– Parts Lists

## REPAIRING TAIL LIGHT
**Delivery van**

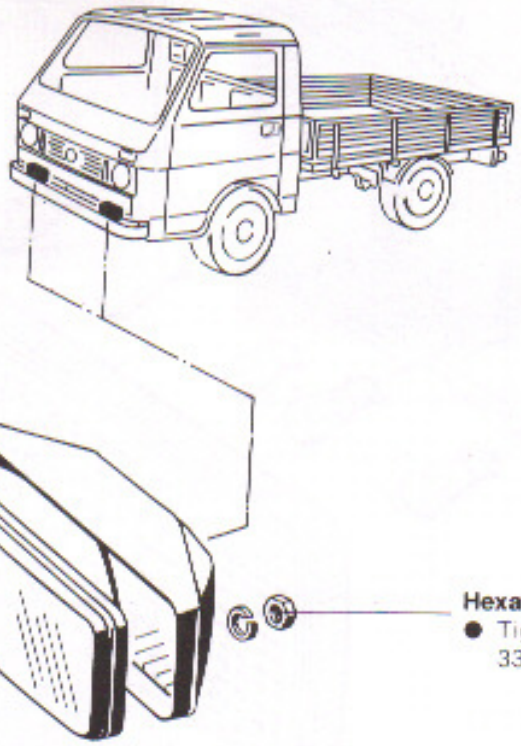
**Note:**
Observe different versions
– Parts Lists



## REPAIRING FOG LAMPS,

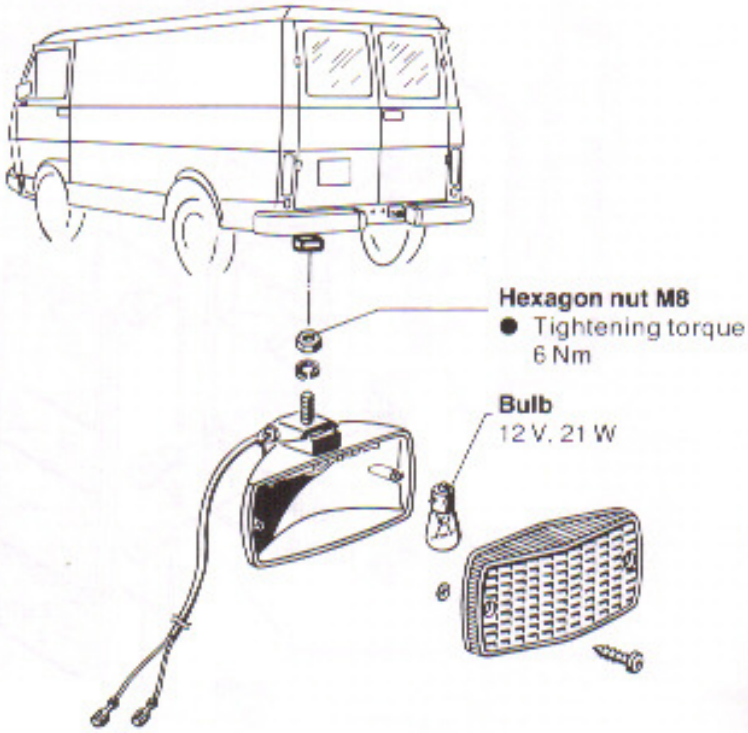
**Delivery van and Pick-up**

**Note:**
Settings
– "Maintenance" booklet




## REPAIRING REAR FOG LAMP,

**Delivery van**




**Note:**
Rear fog lamp for
Pick-up integrated into
tail light – Page 59

## REMOVING AND INSTALLING FUSE BOX/RELAY PLATE (up to 9.79)

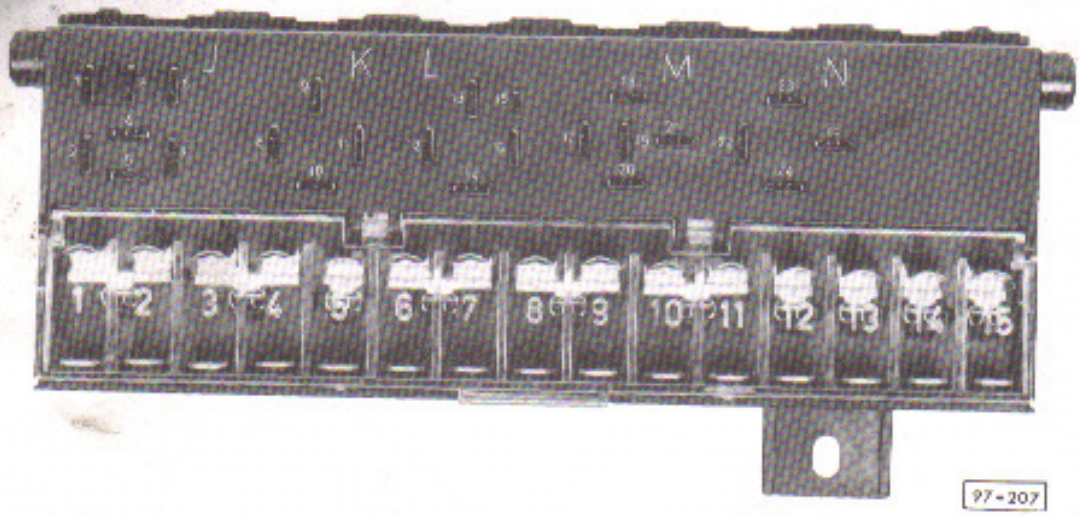



**Fig. 1 Front view of fuse box/relay plate**

**Attention**

**Always** detach the battery earthing strap when working on the electrical system.

**Fuse positions**

| | |
|---|---|
| 1 – Dipped headlight, left | 8 A |
| 2 – Dipped headlight, right | 8 A |
| 3 – Main beam, left | 8 A |
| 4 – Main beam, right | 8 A |
| 5 – Heated rear window | 16 A |
| 6 – Brake lights, emergency flasher | 8 A |
| 7 – Interior light | 8 A |
| 8 – Turn signals | 8 A |
| 9 – Reversing light, horn | 8 A |
| 10 – Heated rear window control | 8 A |
| 11 – Fresh air blower, wiper motor | 8 A |
| 12 – Fog lights | 8 A |
| 13 – Parking light, right | 8 A |
| 14 – Parking light, left | 8 A |
| 15 – Electric fuel pump | 16 A |

**Relays on relay plate**

J – Headlight dimmer/flasher relay
K – Heated rear window relay
L – Vacant
M – Windscreen wiper motor relay
N – Emergency warning light relay

**Note:**

For different fuse layout and installation of further relays, control units and fuses on relay adapters, see the appropriate current flow diagrams.

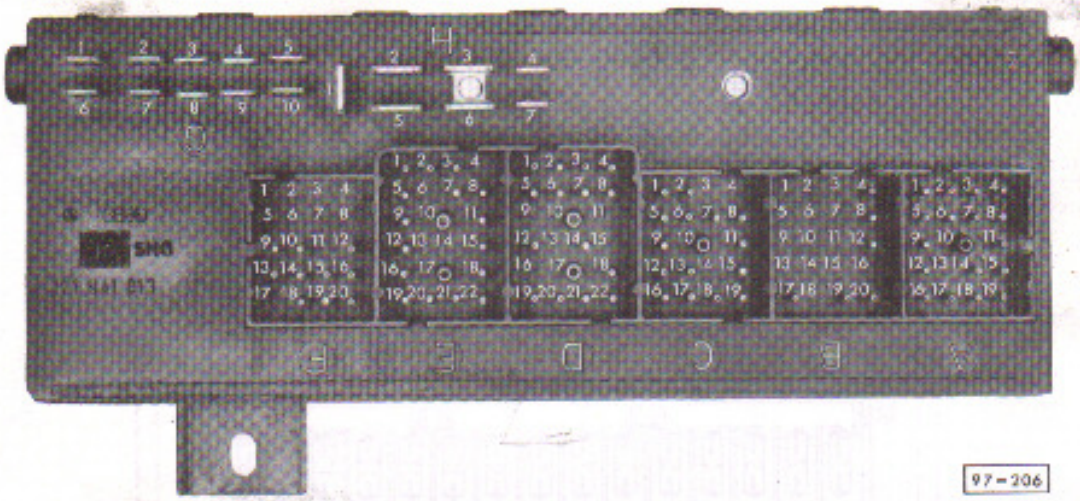



**Fig. 2 Rear view of fuse box/relay plate**

**Attention**

Always detach battery earthing strap when working on electrical system.

**Connection layout**

A – Front wiring loom connection (white)
B – Vacant
C – Front wiring loom connection (colourless)
D – Dash panel wiring loom connection (blue)
E – Dash panel wiring loom connection (black)
F – Rear wiring loom connection (yellow)
G – Separate connector
H – Separate connector (terminal 30)

**Note:**

The designation of the connectors A–H in block capitals and figures are identical with the contact designations in the Current Flow Diagrams and Fault Finding Programmes.

## REMOVING AND INSTALLING RELAY PLATE AND FUSE BOX (as of 10.79)

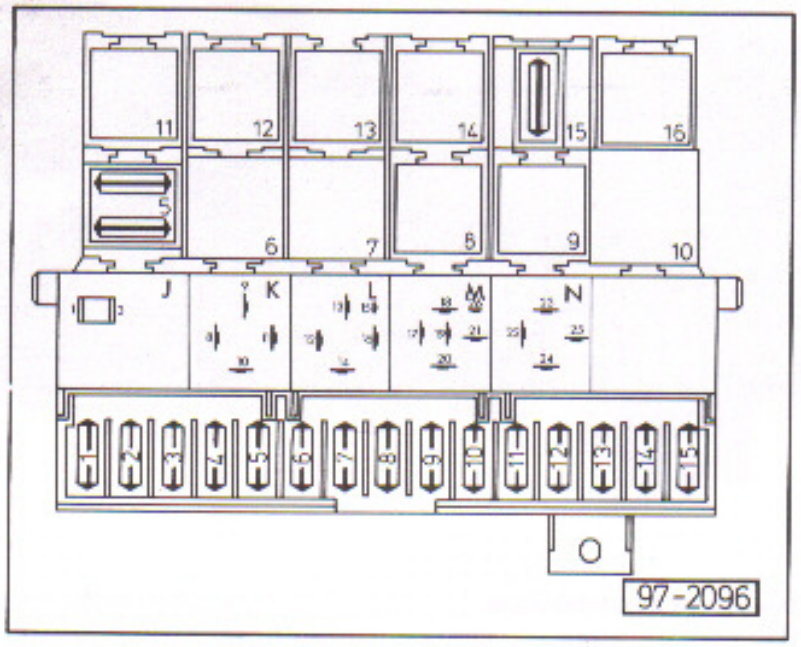



**Fig. 1 Relay plate and fuse box/front view**

**Caution**

Disconnect battery earthing strap when working on electrics.

**Fuse assignment**

| | |
|---|---|
| 1 – Dipped beam, left | 8 A |
| 2 – Dipped beam, right | 8 A |
| 3 – Main beam, left | 8 A |
| 4 – Main beam, right | 8 A |
| 5 – Heated rear window | 16 A |
| 6 – Brake light, hazard warning | 8 A |
| 7 – Interior light | 8 A |
| 8 – Turn signal | 8 A |
| 9 – Reversing light, horn | 8 A |
| 10 – Fresh-air blower | 16 A |
| 11 – Wiper motor | 8 A |
| 12 – Fog lamp | 8 A |
| 13 – Side light, right | 8 A |
| 14 – Side light, left | 8 A |
| 15 – Reversing lights, electric fuel pump | 25 A |

**Relays on relay plate**

J – vacant
K – Relief relay for X-contact
L – vacant
M – Relay for intermittent wipe/wash facility
– Bridge for wiper motor from M 19 to M 21 (without intermittent operation)
N – Hazard warning relay

**Note:**

Differing fuse layout and installation of further relays, control units and fuses on relay adapters 5-16 are to be taken from the valid current flow diagrams.

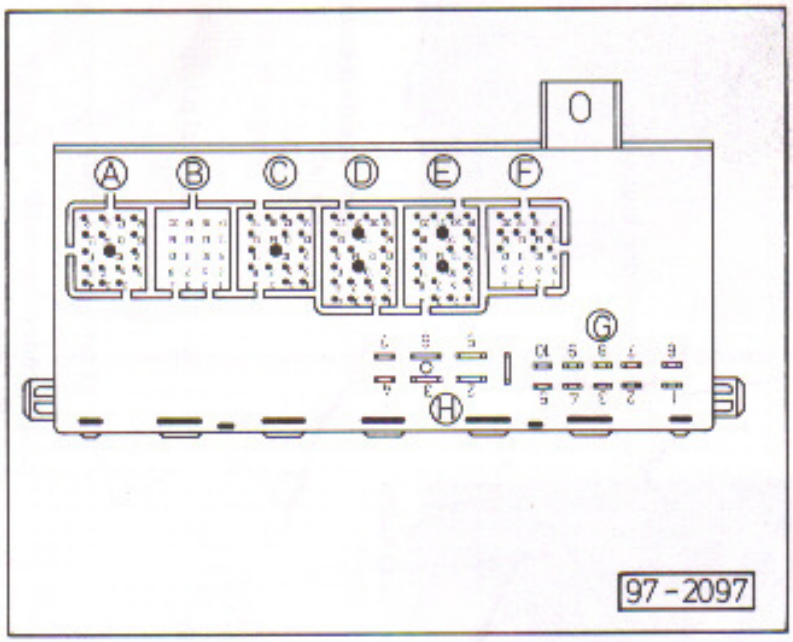



**Fig. 2 Relay plate and fuse box/back view**

**Caution!**

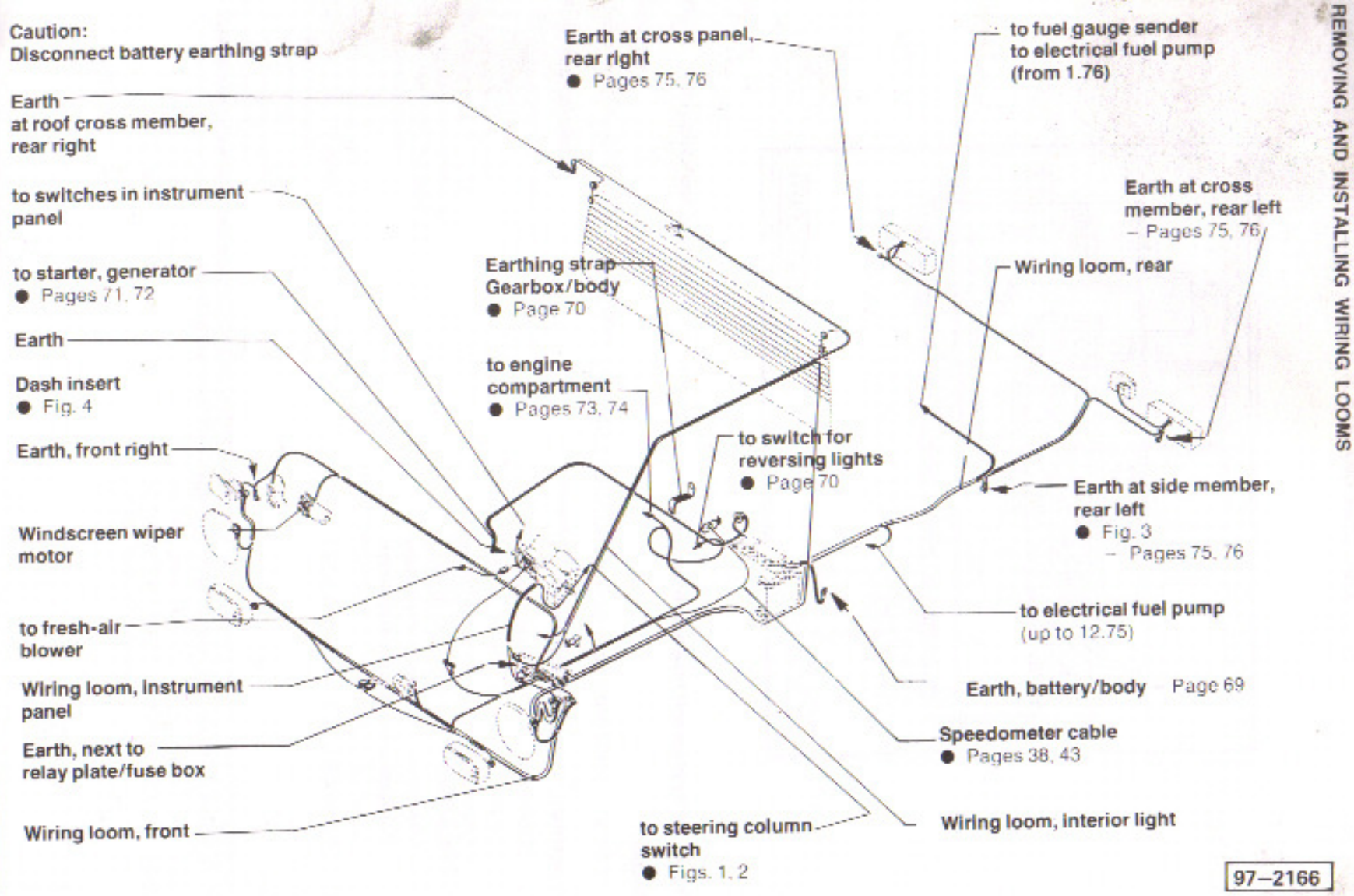
Disconnect battery earthing strap when working on electrics.

**Assignment of plug connections**

A – Connection for front loom (white)
B – vacant
C – Connection for front loom (colourless)
D – Connection for dash loom (blue)
E – Connection for dash loom (black)
F – Connection for rear loom (yellow)
G – Individual connector
H – Individual connector (terminal 30)

**Note:**

The designations of the connectors A–H in capital letters and figures are identical with the contact designations in the current flow diagrams and fault finding instructions.


Caution:
Disconnect battery earthing strap
Earth
at roof cross member,
rear right
to switches in instrument
panel
to starter, generator
● Pages 71, 72
Earth
Dash insert
● Fig. 4
Earth, front right
Windscreen wiper
motor
to fresh-air
blower
Wiring loom, instrument
panel
Earth, next to
relay plate/fuse box
Wiring loom, front
Earth at cross panel,
rear right
● Pages 75, 76
Earthing strap
Gearbox/body
● Page 70
to engine
compartment
● Pages 73, 74
to switch for
reversing lights
● Page 70
to steering column
switch
● Figs. 1, 2
to fuel gauge sender
to electrical fuel pump
(from 1.76)
Earth at cross
member, rear left
– Pages 75, 76
Wiring loom, rear
Earth at side member,
rear left
● Fig. 3
– Pages 75, 76
to electrical fuel pump
(up to 12.75)
Earth, battery/body
Page 69
Speedometer cable
● Pages 38, 43
Wiring loom, interior light
97–2166

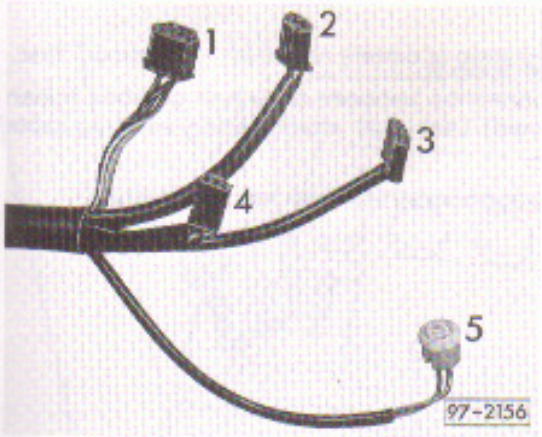



**Fig. 1 Designation of connectors in steering column vicinity**

1 – to ignition/starter switch
2 – to windscreen wiper switch
3 – to turn signal switch to horn plate
4 – to headlight dimmer/flasher switch
5 – to brake light switch

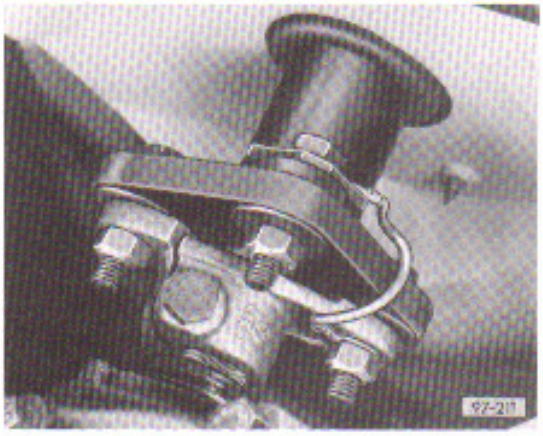



**Fig. 2 Earth wire on steering column coupling**

If horn does not work, check for good electrical connection.

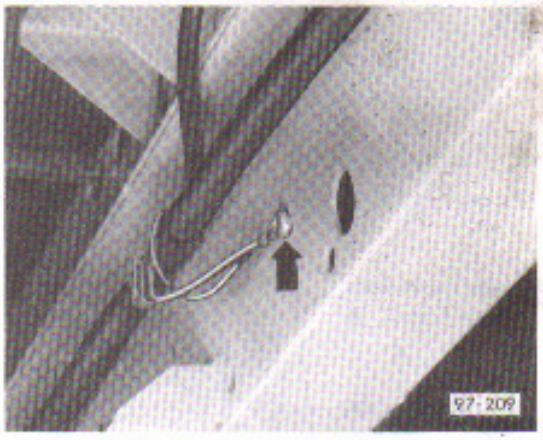



**Fig. 3 Earthing point on rear longitudinal member, left**

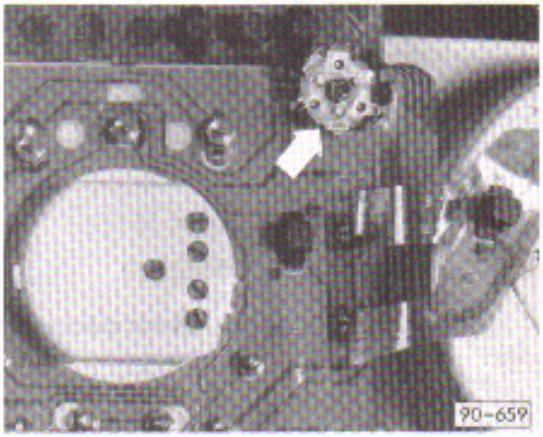



**Fig. 4 Earthing point on dash panel insert** (from 12.82)

Connection for following earth wires:

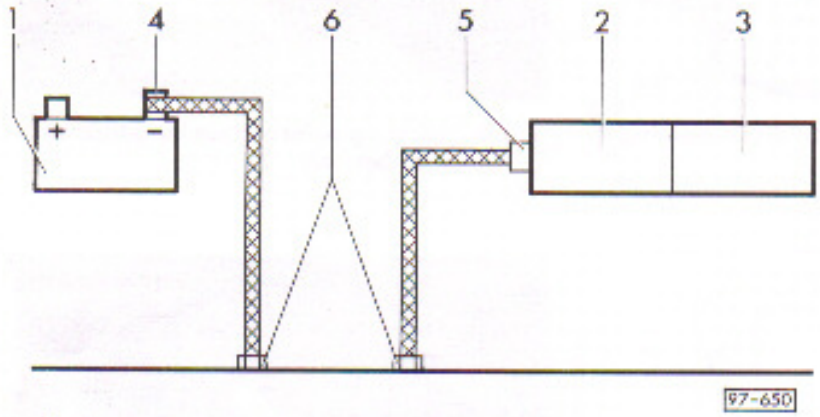
- to earthing point near relay plate/fuse box
- to 14-pin connector on dash panel insert
- to the switches in dash panel area
- to fresh air blower/to emergency flasher warning lamp
- to fresh air controls lights
- to brake fluid level warning contact
- to tachograph

## EARTHING STRAP CONNECTION SEQUENCE

1 – When dismantling, always detach battery earthing strap at battery negative (–) terminal* first.

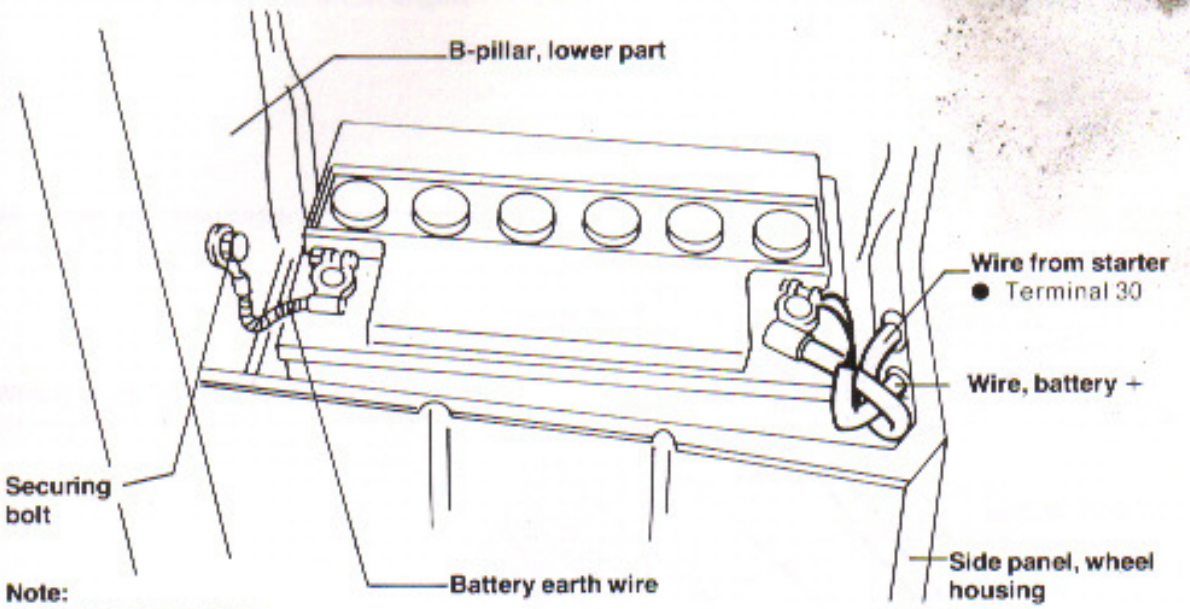
2 – When assembling, first ensure a good earth connection between body and gearbox (clean metallic connection, threaded connection tightened). Last of all, attach battery earthing cable to battery negative (–) post.

* To prevent voltage drop and corrosion damage, the earthing straps must **not** be detached.




1 – Battery
2 – Gearbox
3 – Engine
4 – Battery negative (–) post
5 – Earthing point – gearbox
6 – Earthing points – body – **do not slacken off**

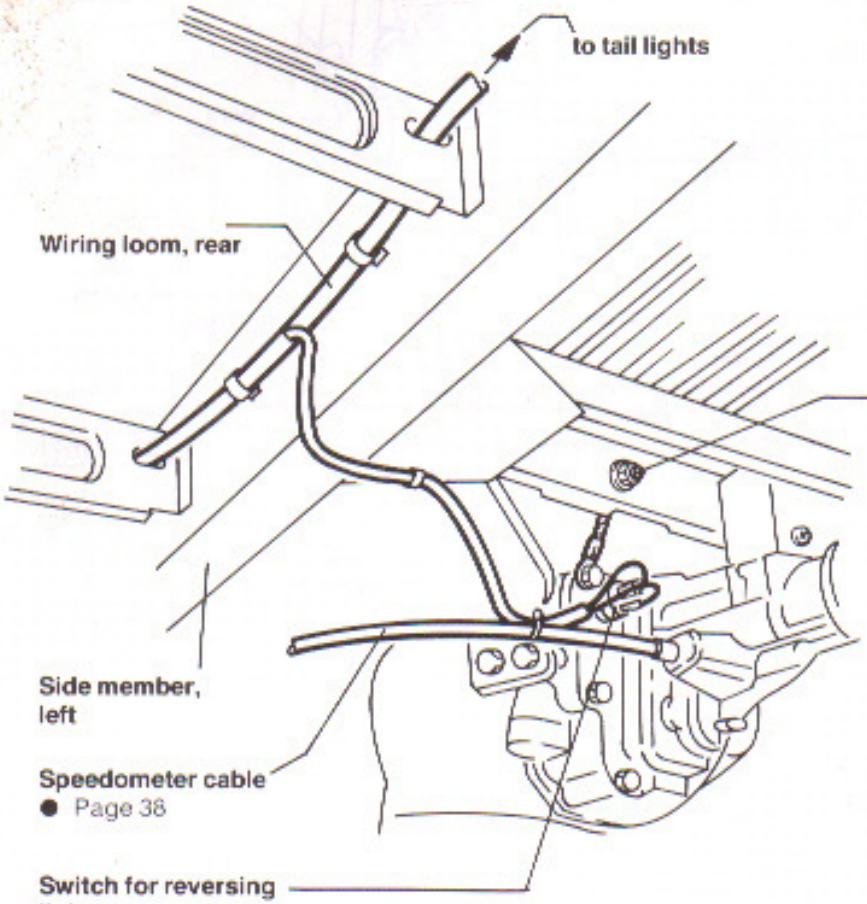
## ROUTING WIRES IN VICINITY OF BATTERY




**Note:**
To avoid voltage drop and corrosion. the earthing strap must not be detached at the B-pillar

**Note:**
Detach earthing strap at battery when working on electrics.

## ROUTING LAYING WIRES IN VICINITY OF GEARBOX
6 cylinder engine

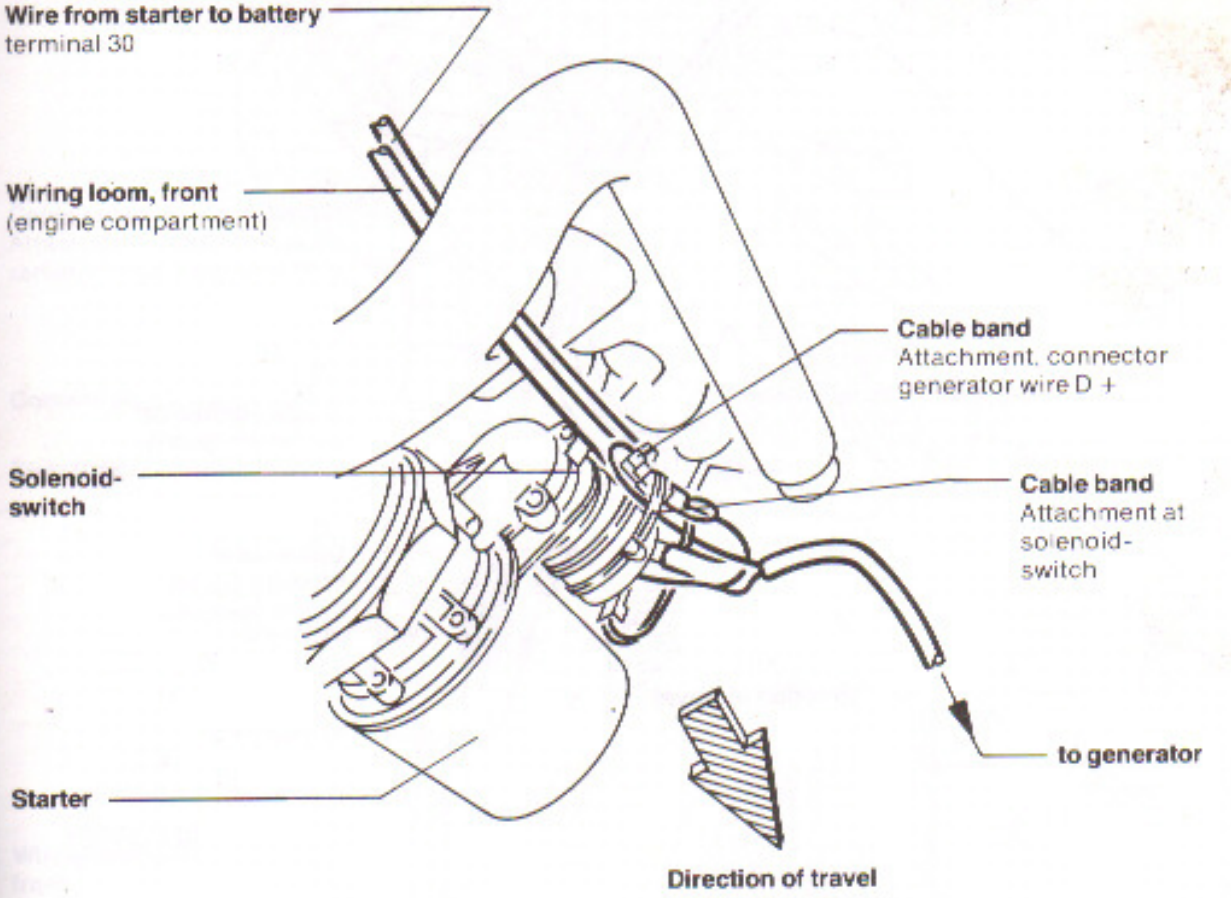



**Securing bolt**
Earth, gearbox at gearbox support.

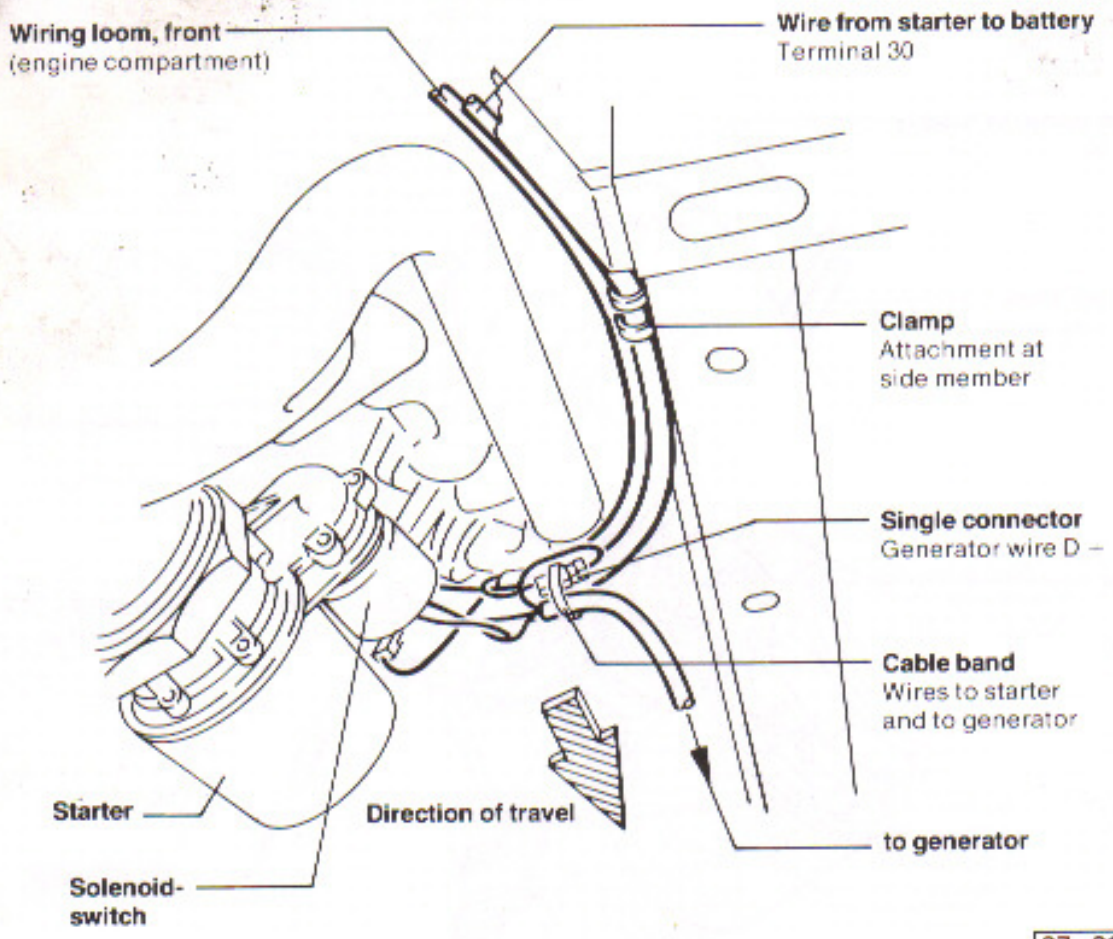
**Note:**
To avoid voltage drop and corrosion, earthing strap must not be detached at gearbox support.

97–2158

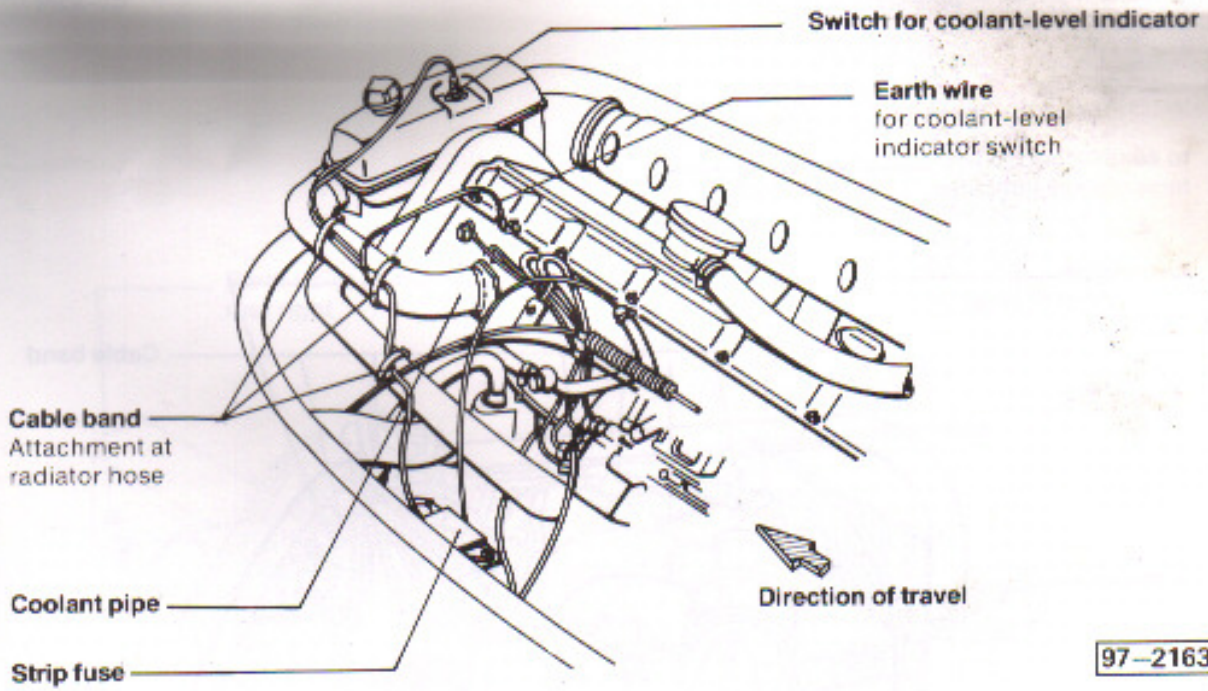
**ROUTING WIRES IN VICINITY OF STARTER**
**6 cylinder turbocharged diesel engine**

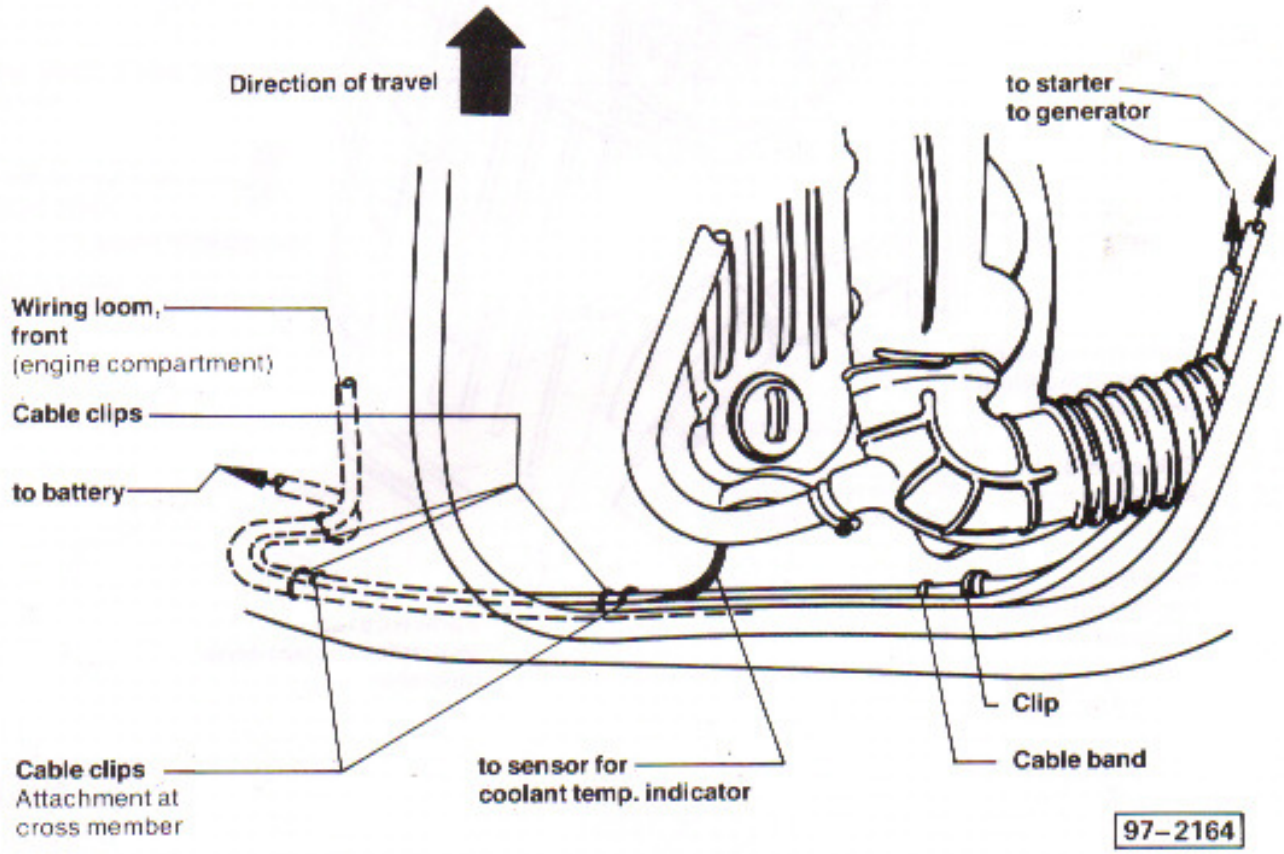


**ROUTING WIRES IN VICINITY OF STARTER**
**6 cylinder petrol and naturally aspirated diesel engine**

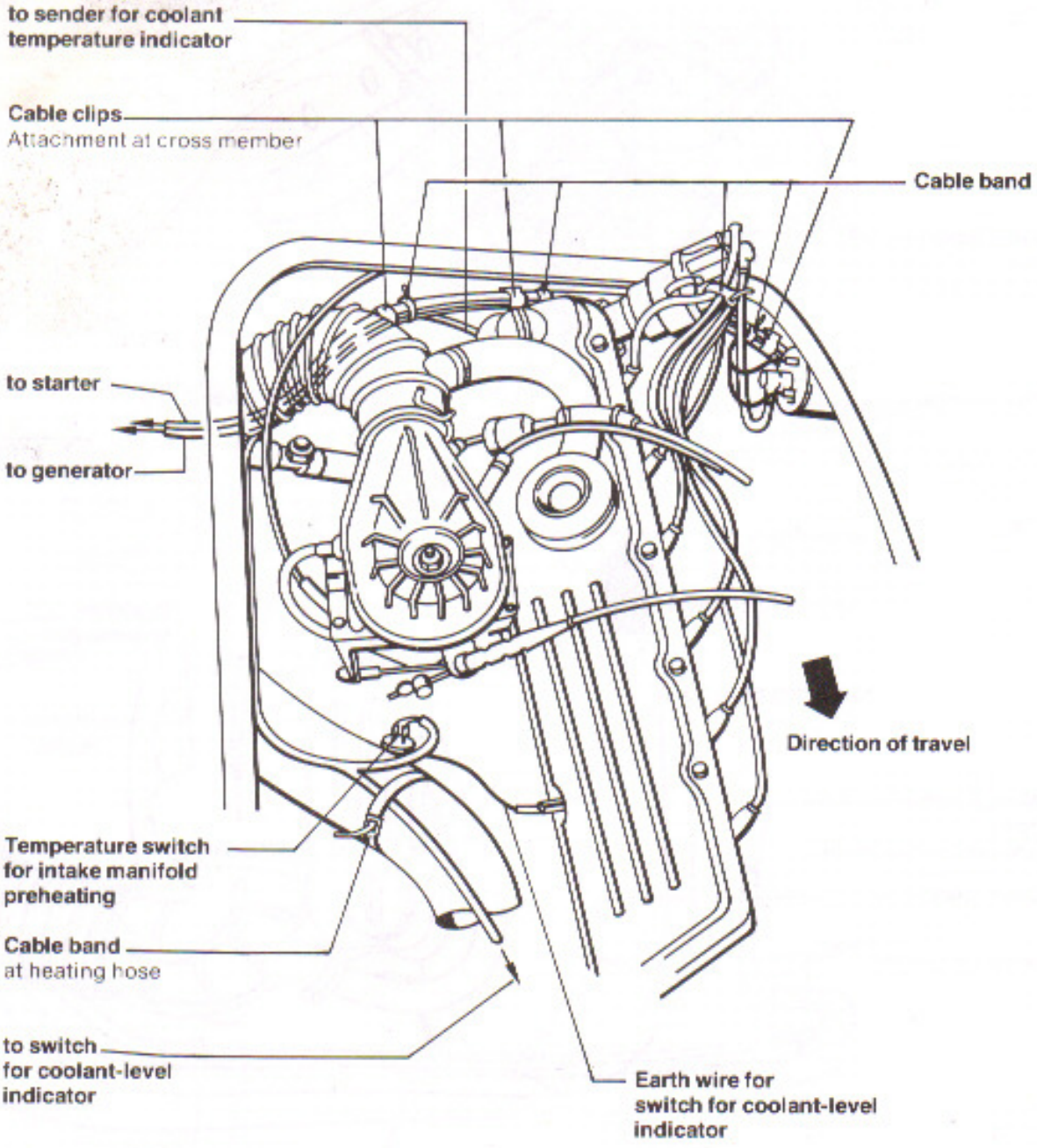


ROUTING WIRES IN ENGINE COMPARTMENT
6 cylinder naturally aspirated and turbocharged diesel engine

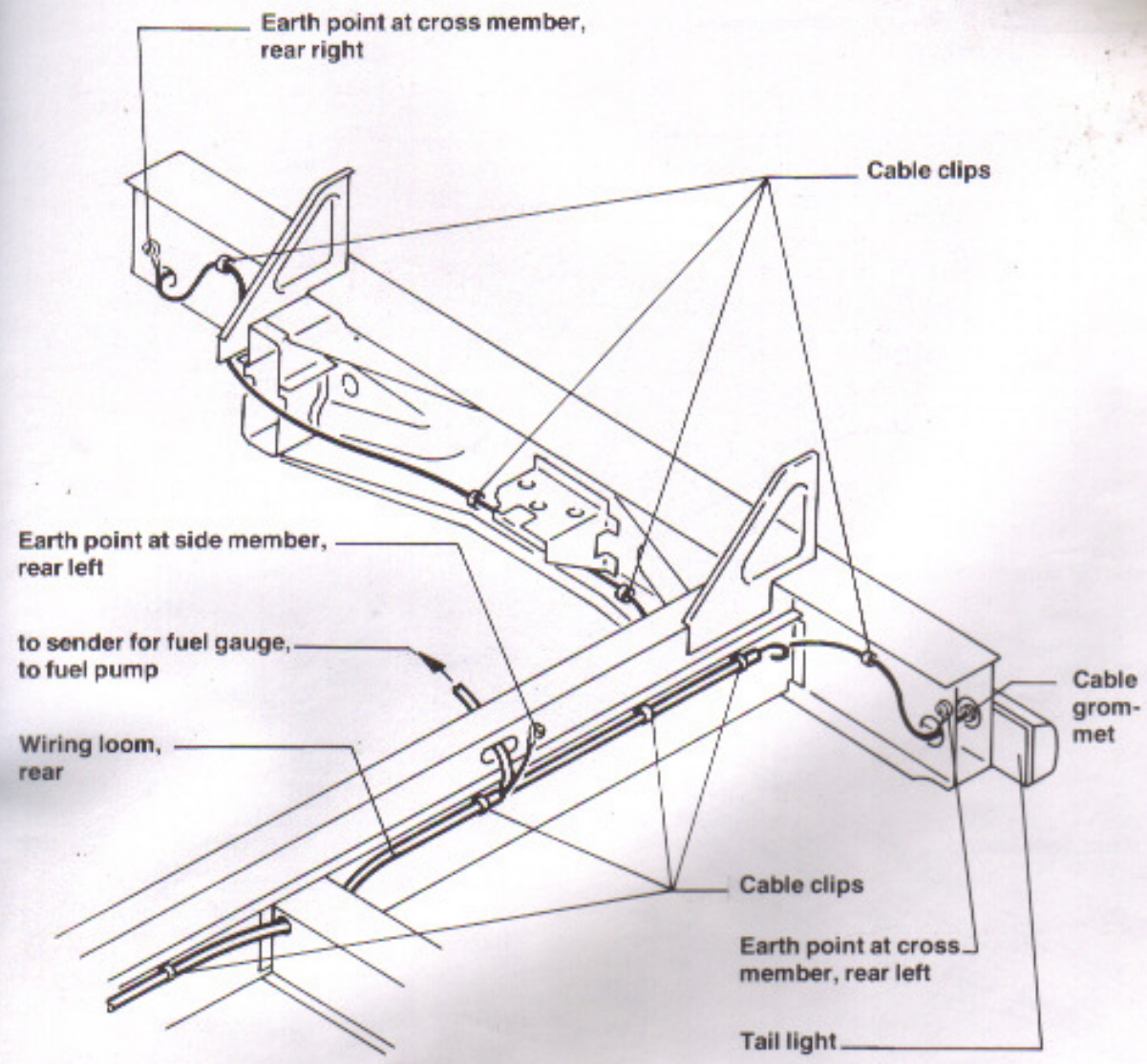


ROUTING WIRES IN ENGINE COMPARTMENT
6 cylinder petrol engine



ROUTING WIRES, REAR WIRING LOOM
Pick-up



ROUTING WIRES, REAR WIRING LOOM
Delivery van