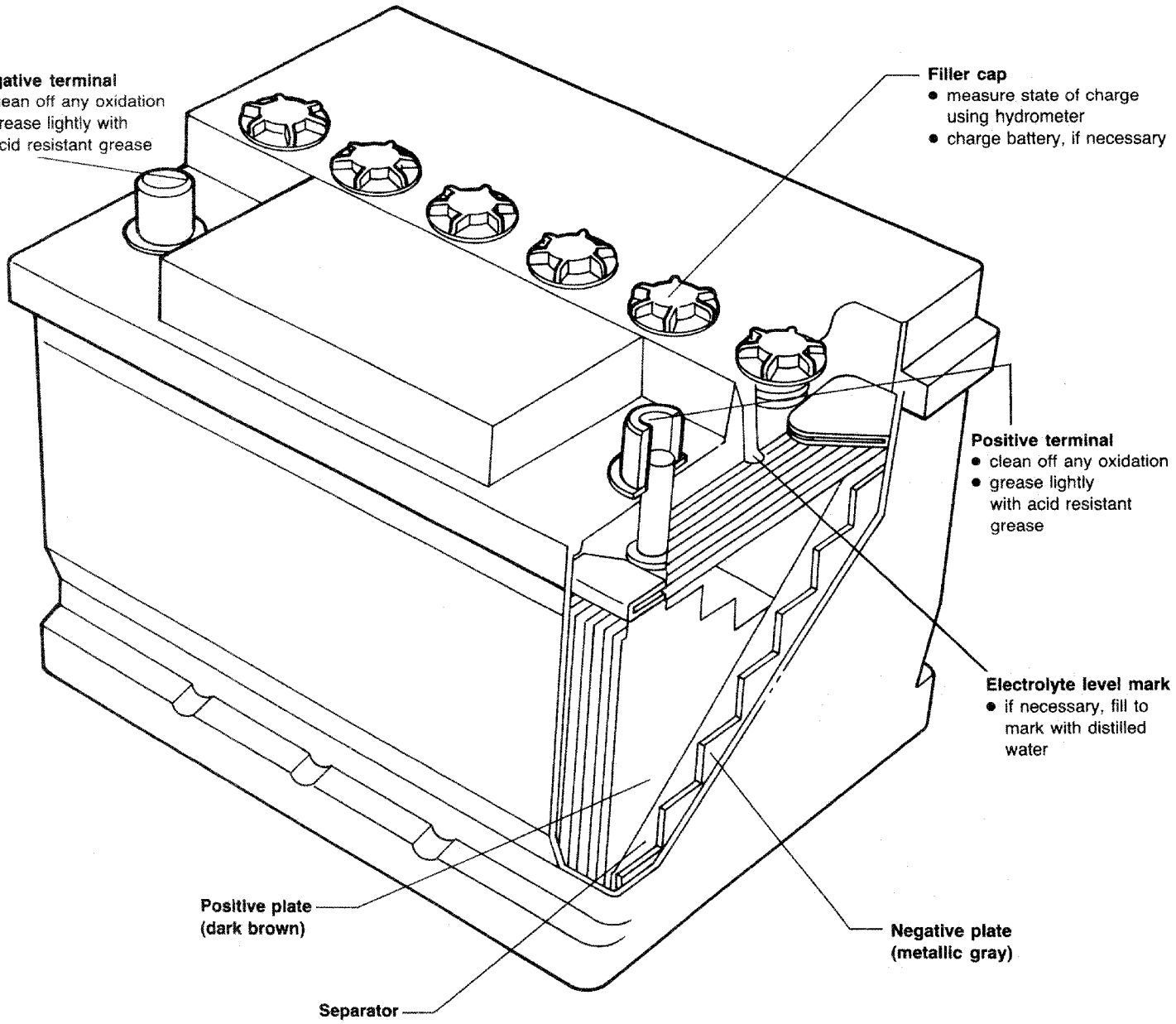
Index

Battery, checking and changing

CAUTION

Before beginning repairs on the electrical system, disconnect battery ground strap.



Battery

Battery precautions

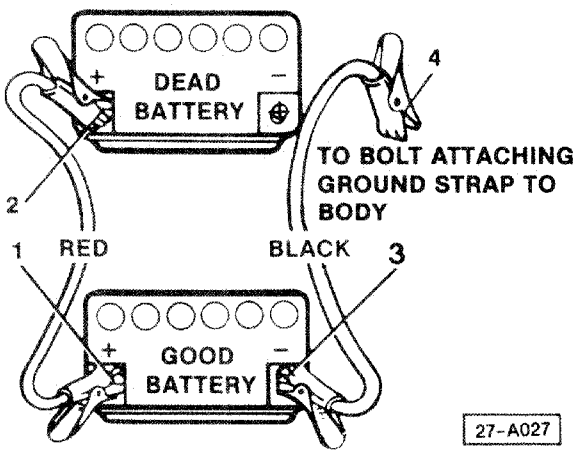
WARNING

Battery acid can cause severe burns. When working with electrolyte always wear goggles, rubber gloves, and apron. If electrolyte is spilled on skin or clothing, flush at once with large quantities of water. If it gets into eyes, immediately flush with large quantities of water for several minutes and call a doctor.

Batteries produce explosive gases. Keep flames and sparks away from batteries. Do not smoke near batteries

Battery, jump starting

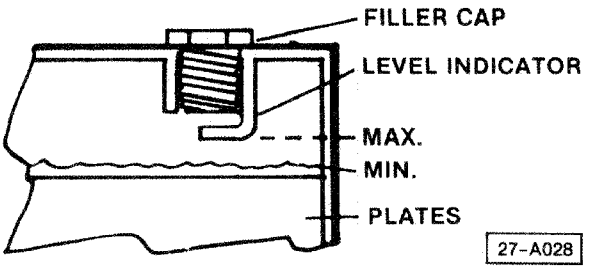
- car with good battery must not be running when connecting jumper cables



— connect jumper cables in following order:
- 1 — one end of positive cable to + post of good battery
- 2 — other end of positive cable to + post of dead battery
- 3 — one end of negative cable to − post of good battery
- 4 — other end of negative cable to bolt attaching ground strap to body

— start car which has good battery first
— next start car which has dead battery
— disconnect jumper cables in reverse order

Battery electrolyte level, checking



— check that electrolyte covers battery plates (including separators) by 5 mm (1/4 in.)
— check battery electrolyte level indicator on side of battery

Note

Only use distilled water when refilling battery

Battery condition, checking

Note

Weak battery can be caused by:
- alternator belt slipping (replace belt when glazed)
- ground straps corroded, loose or broken
- alternator or voltage regulator defective
- alternator warning light bulb burned out
- poor ground connection between warning light socket and circuit board

Battery terminals and cables should be coated with grease or petroleum jelly and, if necessary, cleaned to prevent corrosion and ensure good connection

Visual checks

— check for
- cracked or leaking case
- loose or corroded terminals
- low electrolyte level. If electrolyte is low, refill with distilled water and fast charge battery for several minutes after cells begin gassing (boiling)

Hydrometer test
(for batteries with removable caps)

— test electrolyte in all cells
- average specific gravity should be at least 1.225

— correct for electrolyte temperature if necessary
- for every 10°F **above** 80°F **add** .004 to hydrometer reading
- for every 10°F **below** 80°F **subtract** .004 from hydrometer reading

— if specific gravity is **above** 1.225, load test battery

— if specific gravity is **below** 1.225, recharge battery
— if specific gravity varies by more than .050 between cells, replace battery

Specific gravity	% of charge
1.265	100%
1.225	75%
1.190	50%
1.155	25%
1.120	0%

CAUTION

Do not expose fully discharged battery to freezing temperature because battery will be damaged by freezing

Voltage test—engine not running (for sealed batteries only)

— turn headlights on high beam for 1 minute to remove surface charge
— disconnect battery ground strap
— check battery voltage with an **accurate** voltmeter
  • voltage should be at least 12.4 volts
— if battery is **above** 12.4 volts, load test battery
— if battery is **below** 12.4 volts, charge battery until voltage is at least 12.4 volts

Voltage	% of charge
12.6 or more	100%
12.4	75%
12.2	50%
12.0	25%
11.7 or less	0%

Load test

Note

Before load testing, battery must be at least 75% charged

— connect load tester according to manufacturer's instructions
— load battery to 3 times amp/hour rating **or** 1/2 0°F cold cranking current rating
— wait 15 seconds and read voltage
  • battery voltage at room temperature should be at least 9.6 volts
— if battery voltage at room temperature is below 9.6 volts, replace battery
— if battery is colder than room temperature, voltage under load will be lower. Use table below if cold battery must be tested

Approx. electrolyte temp. °F (°C)	Minimum acceptable voltage under load
60 (16)	9.5
50 (10)	9.4
40 (4)	9.3
30 (−1)	9.1
20 (−7)	8.9
10 (−12)	8.7
0 (−18)	8.5

Battery charging

WARNING

Gases given off during charging are explosive. Do not smoke or allow sparks or flame near a charging battery.

Battery charger must be turned off when connecting or disconnecting cables on battery

CAUTION

Do not allow battery voltage to exceed 17 volts. If battery begins gassing (boiling) violently when charging, reduce charging rate. Do not disconnect battery while engine is running

Note

Follow battery charger manufacturer's instructions. Before testing a battery that has been charged, load battery with 15 amps for 1 minute to remove surface charge

Battery with removable caps

If battery level is low and water is added, fast charge battery for a few minutes after battery begins gassing (boiling). Slow charging current should be approximately 10% of battery capacity. Fast charging should be approximately 80-90% of battery capacity. Remove cell caps while charging

— charge battery according to following table:

Specific gravity	Fast charge up to
1.150 or less	1 hour
1.150 to 1.175	3/4 hour
1.175 to 1.200	1/2 hour
1.200 to 1.225	1/4 hour
above 1.225	slow charge **ONLY** to 1.250-1.280

Sealed batteries

Only **slow** charge sealed batteries. Sealed batteries, sometimes called "maintenance free," will not accept high rate of charge, making it necessary to charge it for up to twice as long as battery with removable caps. Also, voltmeter reading will not increase as rapidly as when charging battery with removable caps

WARNING

Battery acid can cause severe burns. When working with electrolyte always wear goggles, rubber gloves, and apron. If electrolyte is spilled on skin or clothing, flush at once with large quantities of water. If it gets into eyes, immediately flush with large quantities of water for several minutes and call a doctor.

Batteries produce explosive gases. Keep flames and sparks away from batteries. Do not smoke near batteries

CAUTION

Before working on any part of electrical system disconnect battery ground strap.

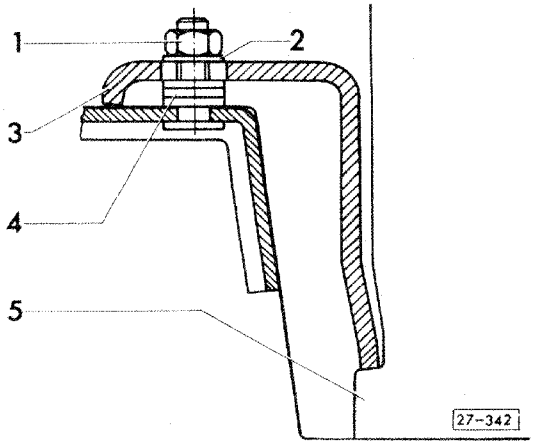
Never run alternator with battery disconnected

Battery, removing

— disconnect battery ground strap from negative terminal of battery, not from body
— disconnect positive terminal from battery
— remove battery hold-down (note number of shims)
— remove battery

Note

Special bolt is used to attach ground strap to body. If bolt has been loosened, it must be removed and cleaned free of paint and undercoating. Mounting area must also be cleaned free of paint and undercoating. After installing, coat bolt and mounting area with corrosion resistant material



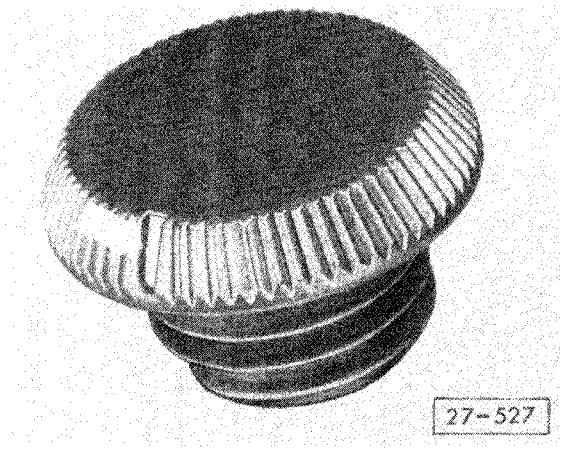
Battery, installing

1 = nut, tighten to **10 Nm (7 ft lb)**
2 = washer
3 = bracket
4 = shims (note number)
5 = base of battery case

Note

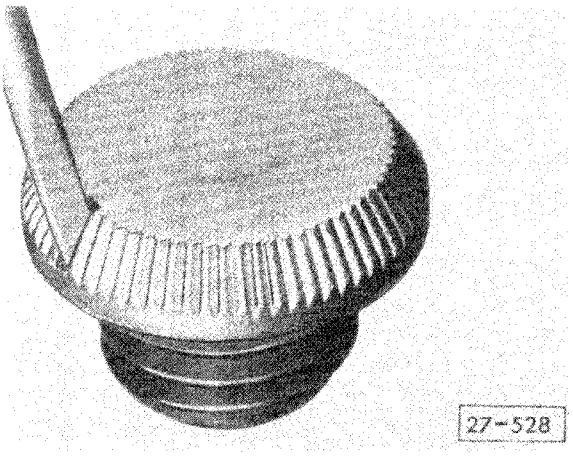
Bracket must press on base of battery case

Battery filler cap (new style)



Filler cap, removing

— cut filler cap skin at notch (**arrow**) with pocket knife or sharp edged screwdriver



— insert suitable screwdriver into slot
— turn upper part of filler cap counter-clockwise to stop
— remove filler cap

Filler cap, installing

— install new type of filler cap in same manner as old type filler cap

Battery location

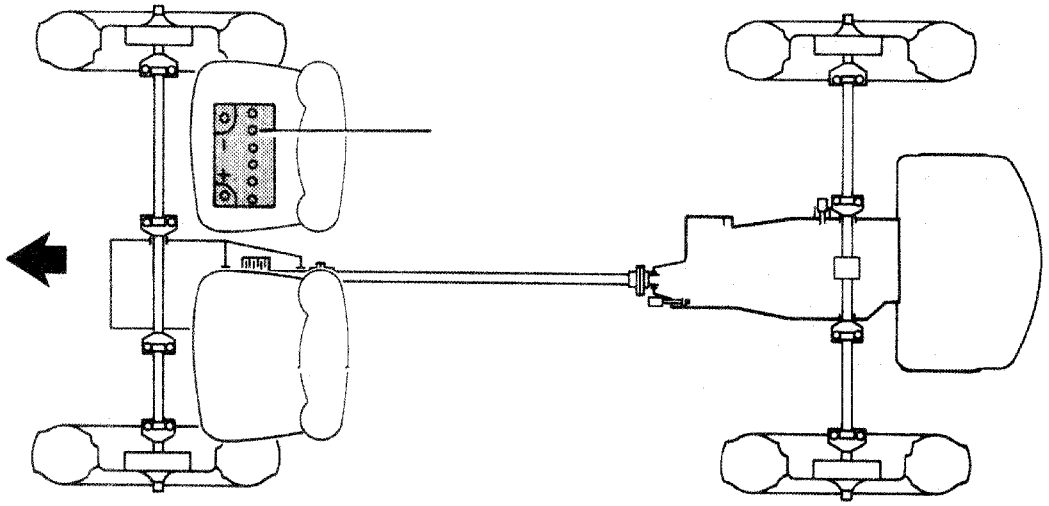


Fig. 1 Battery location

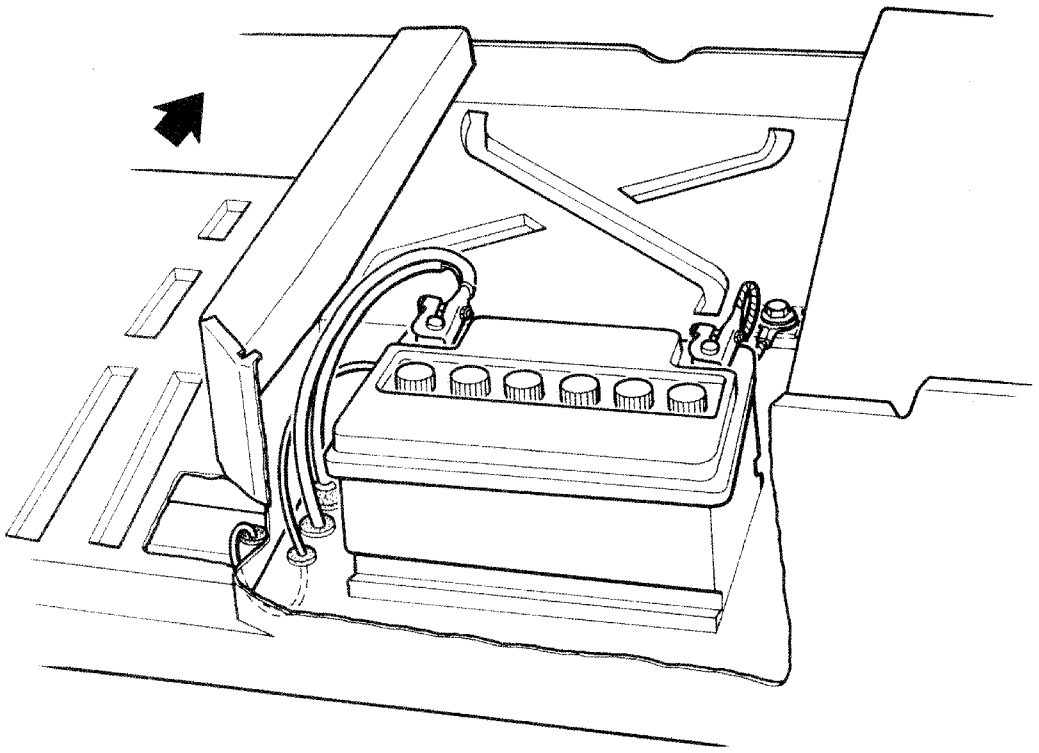


Fig. 2 Installation detail (under right front seat)

Battery locations, for non-propane refrigerator equipped Camper (P21)

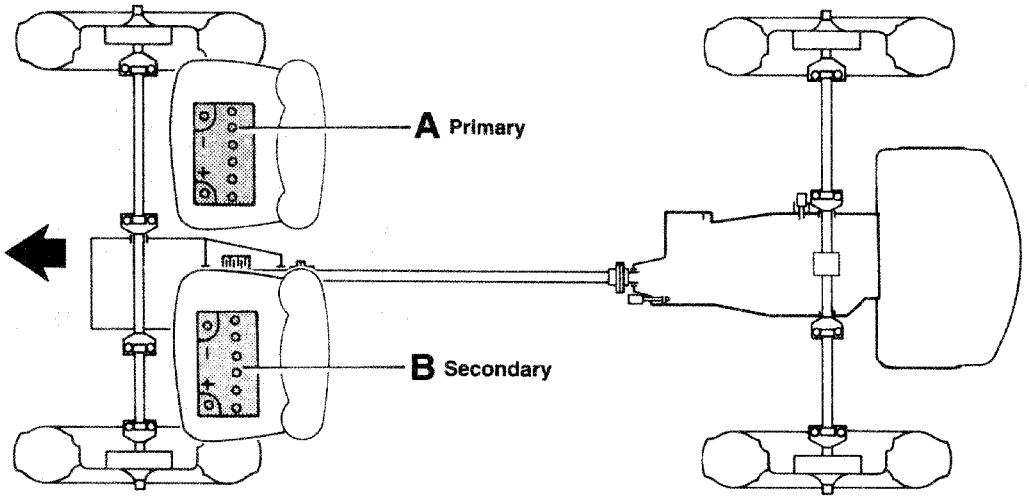


Fig. 3 Battery locations

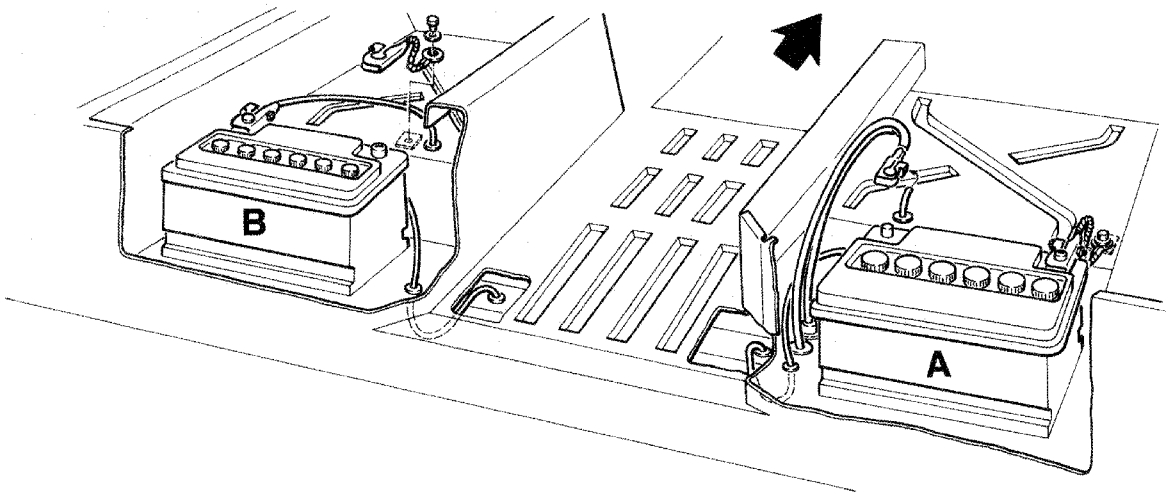


Fig. 4 Installation detail (under front seats)

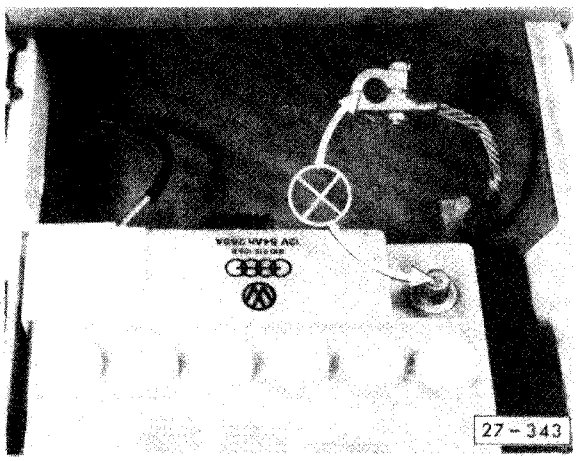
Battery discharges—troubleshooting
current draw suspected

Test conditions
fully charged battery
clock disconnected

Battery discharges

Possible causes:
corroded and fouled contacts
chafed-through wirings
internal short-circuits in electrical equipment

— disconnect battery ground (–) strap
— connect test light between negative (–) battery terminal and ground (–) strap
— turn off all electrical consumers
— close all doors

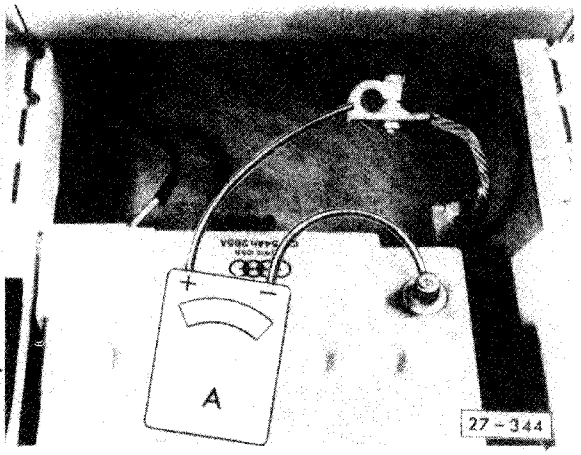


Test light lights up

Test light does not light up

— eliminate individual circuits by removing fuses
— if test light goes out in one of interrupted circuits, source of fault is to be found there

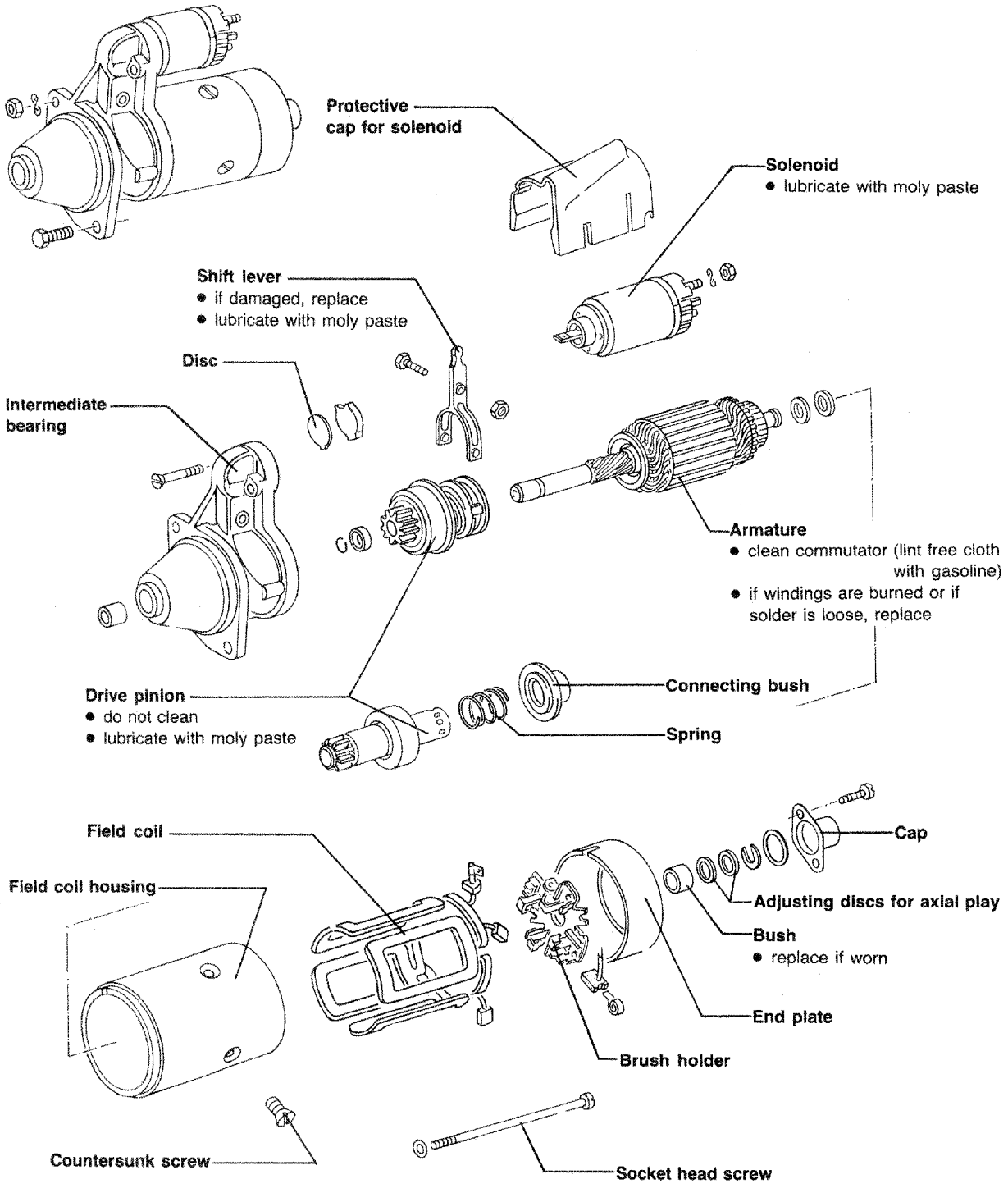
— in place of test light, connect ammeter (measuring range 0 – 200 Amp.) between negative (–) battery terminal and battery ground strap
— reduce measuring range until a clear reading is shown (1 – 3 mAmp is permitted)



— eliminate individual circuits by removing fuses
if reading drops to zero in one of interrupted circuits, source of fault is to be found there

• if no faults are found in fused circuits, disconnect wiring connectors from nonfused components:
alternator
starter
ignition system
cluster instruments
coolant fan and so on

Starter, repairing



Starter turns engine too slowly or engages and will not turn engine

Note

Check that engine is filled with oil of recommended viscosity

CAUTION

Before working on any part of electrical system, disconnect battery ground strap.

— check V-velt tension
— check battery voltage and charge if necessary
— clean battery terminals and check wire connections for tightness

Starter turns engine	Starter does not turn engine

End

— clean starter terminals and tighten connections
— clean and tighten ground strap between transmission and body at transmission

Starter turns engine	Starter does not turn engine

End

Starter defective

— repair starter

Following defects could be cause of trouble:

Possible causes	Remedy
• carbon brushes sticking or poor contact between brushes and commutator	— clean brushes and brush guides; if necessary replace carbon brushes
• commutator dirty, or grooved and burnt	— clean commutator or replace starter armature

End

Starter does not turn engine when ignition/starter switch is operated

Note

Check connection on solenoid switch and ground straps for corrosion and tightness

— disconnect connectors from terminal **1** on ignition coil before operating starter

— measure voltage at terminal **50** of solenoid switch (min. 8 volts)

No voltage or **less** than 8 volts	Voltage **OK**

— measure voltage at terminal **50** of ignition/starter switch (min. 8 volts)

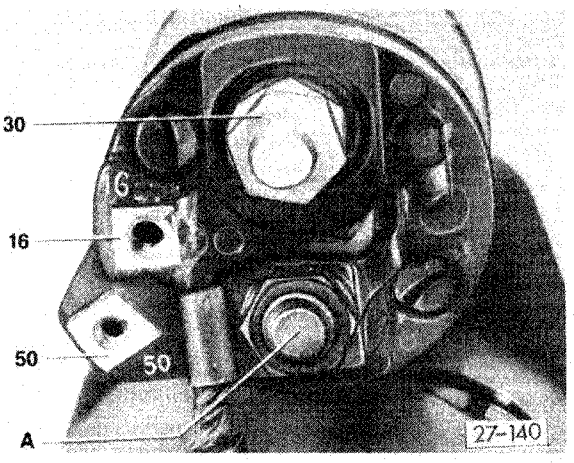
No voltage	Voltage **OK**

— replace ignition/ starter switch

End

— check wiring between terminal **50** on ignition/ starter switch and terminal **50** on starter solenoid and make necessary repairs
— on vehicles with automatic transmission, also check neutral/park starter switch. Replace if defective

End



Voltage at solenoid, measuring

- terminal **30** = from battery
- terminal **16** = to ignition coil
- terminal **50** = from ignition/starter switch
- connection **A** = for field windings

— measure voltage at connection **A** for field winding on solenoid switch (min. 8 volts)

No voltage	Voltage **OK**

— replace solenoid switch

End

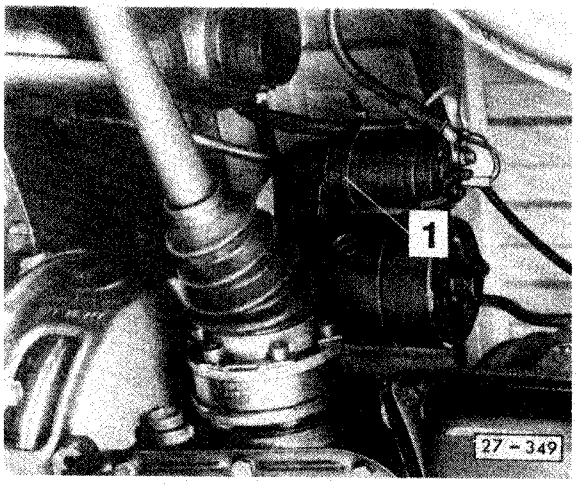
— repair starter

End

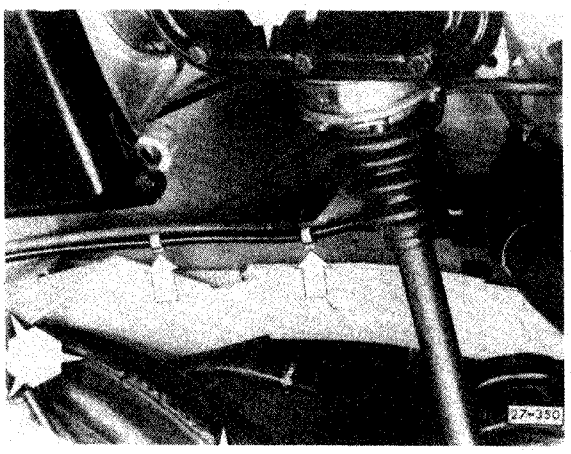
Starter, installing

Work sequence

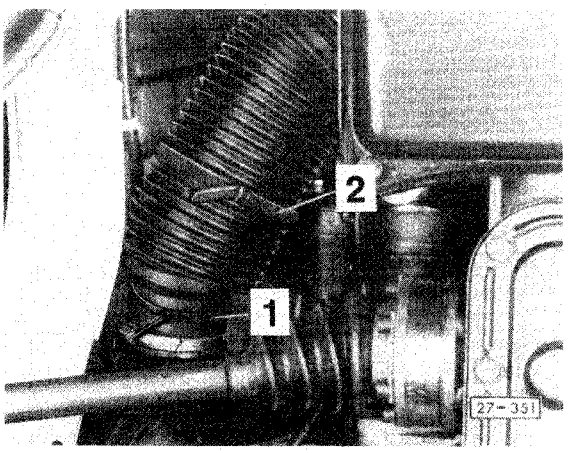
> **CAUTION**
>
> Before starting work on any part of electrical system disconnect battery ground strap



— attach wiring from alternator and wiring for terminal **50** from ignition/starter switch to starter solenoid with cable tie **1**



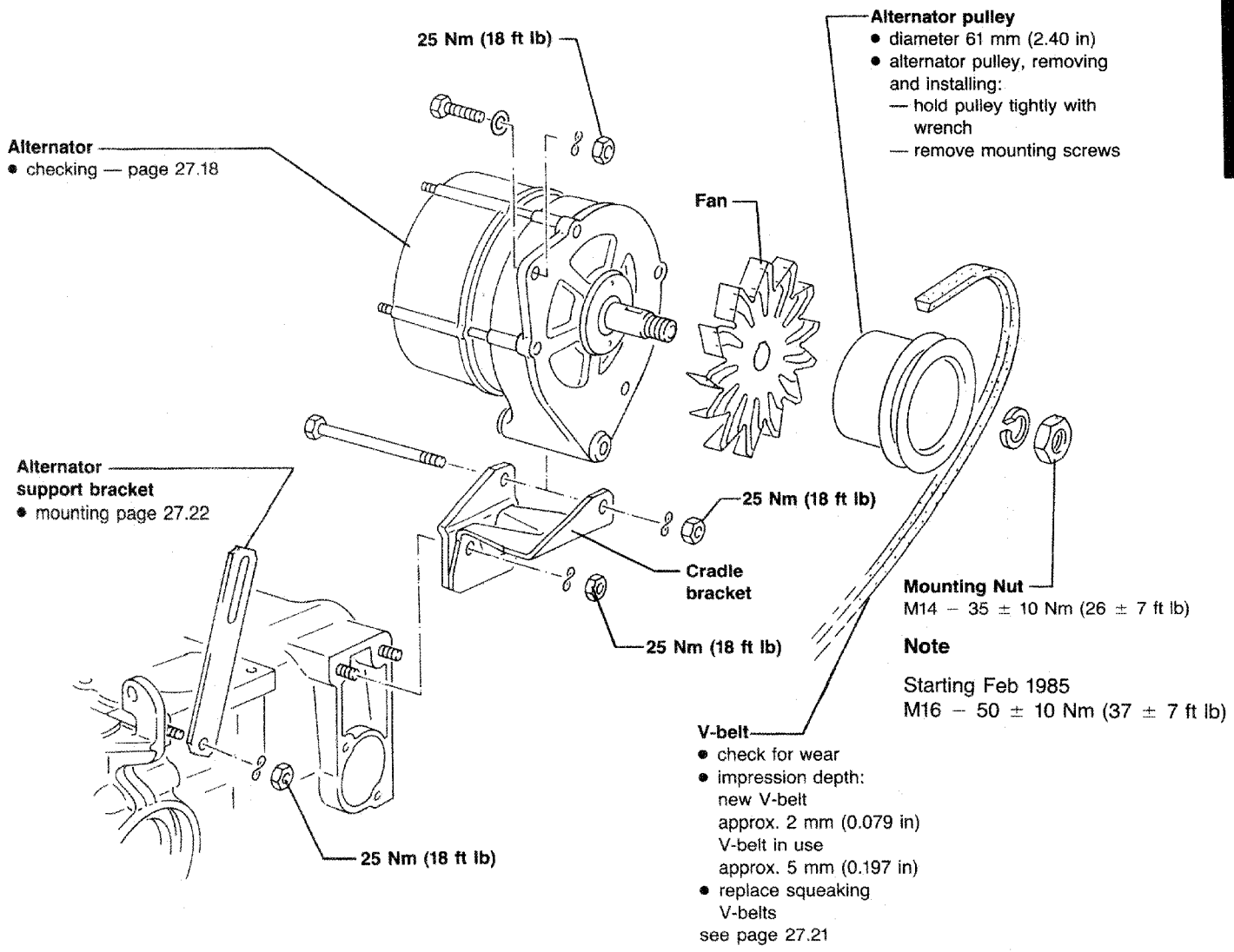
— attach battery/starter cable to frame side member with cable clips (**arrows**)



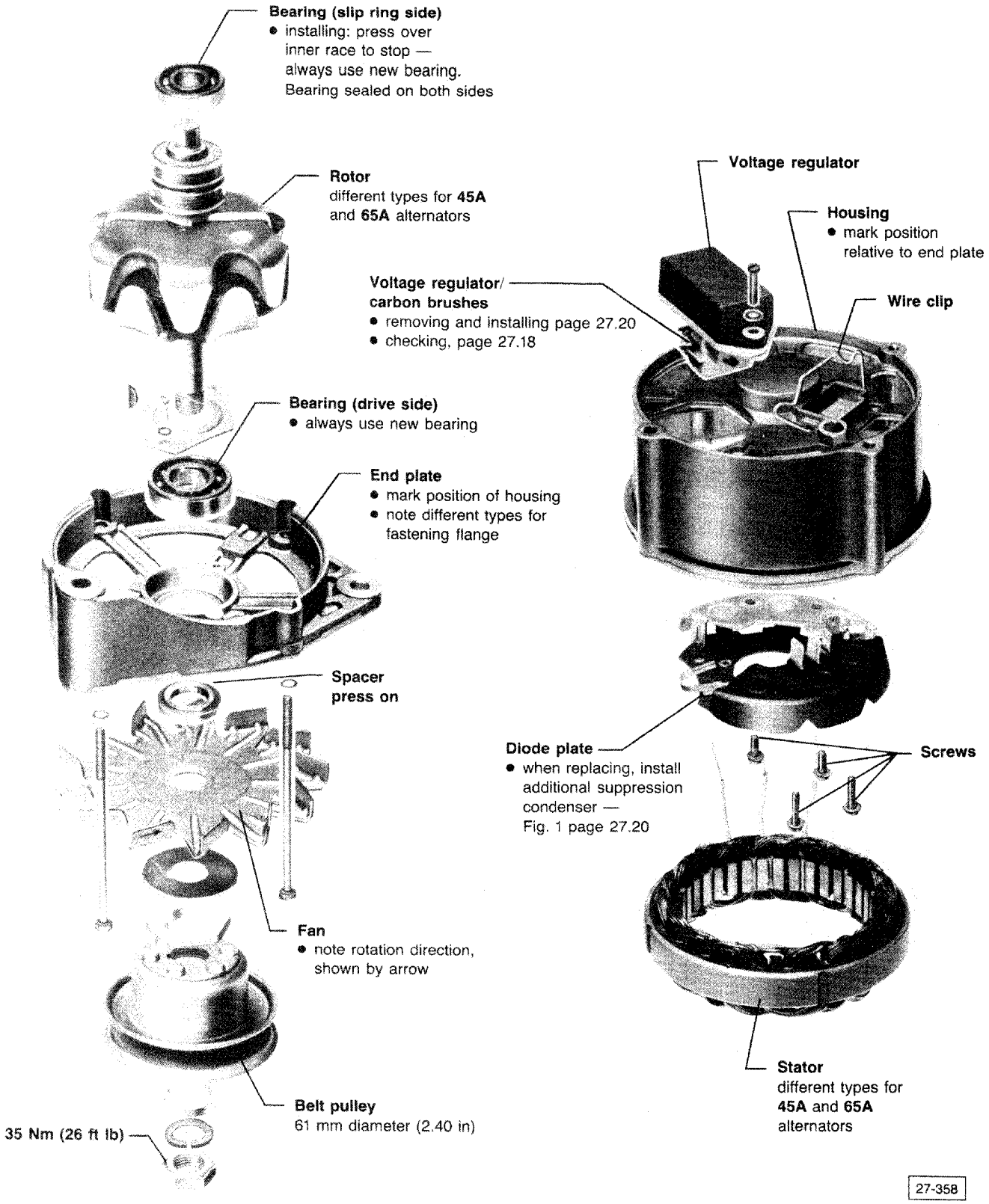
— attach battery/starter cable to warm air hose with cable tie at:

- **1** = vehicles with manual transmission
- **2** = vehicles with automatic transmission

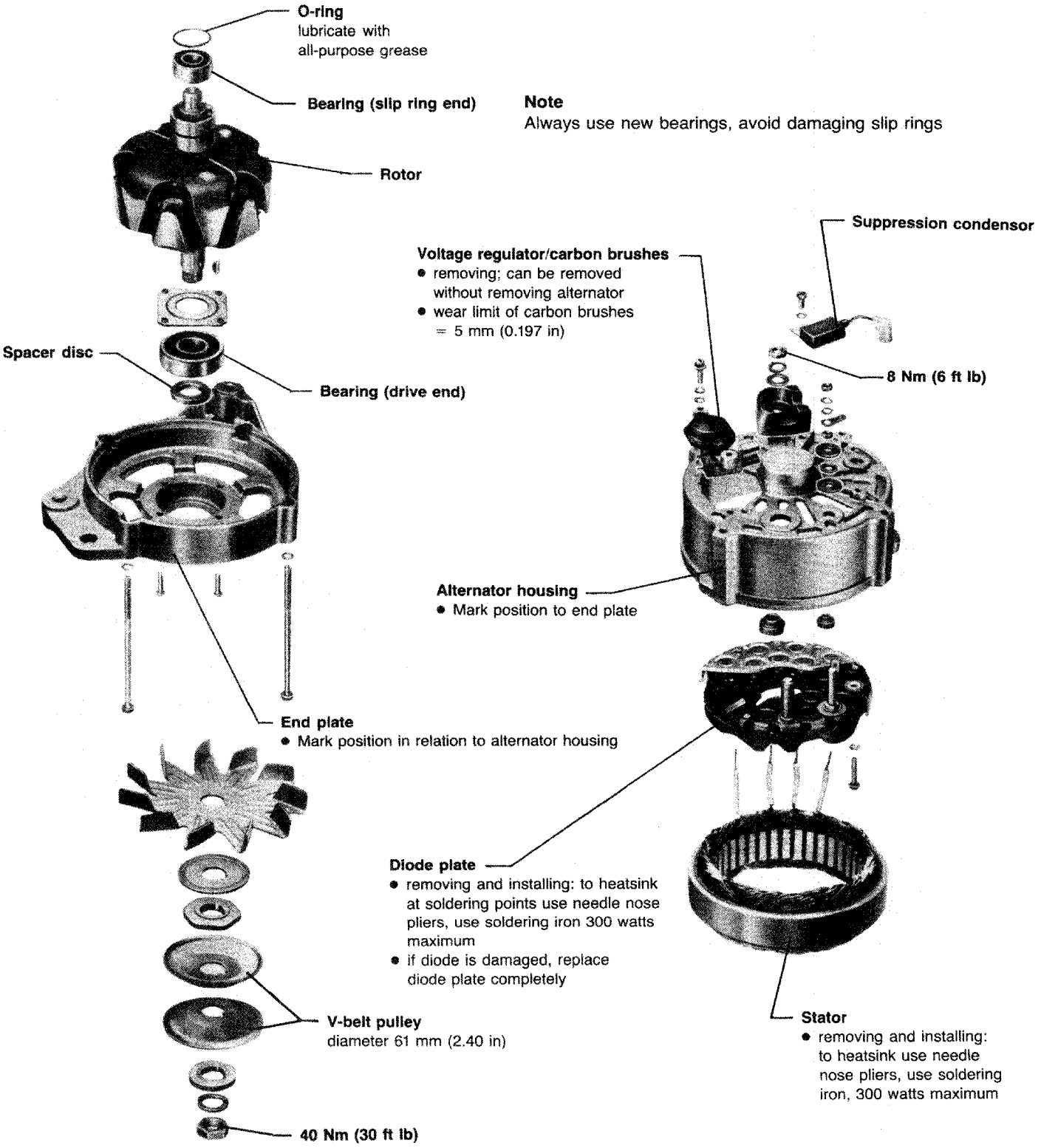
Alternator (90A), removing and installing (Bosch)



Alternator, 45A and 65A, repairing (Bosch)



Alternator, repairing (90A, Bosch) starting October 1982



Note
Always use new bearings, avoid damaging slip rings

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Alternator/regulator, checking (with Sun VAT-40 or equivalent)

Visual checks

— check for:
- loose or broken ground straps
- loose or damaged V-belt
- properly operating alternator charging light
- proper tightening of alternator

Work sequence

Alternator output test

— connect alternator/regulator tester according to manufacturer's instructions
— start engine and run at 3,000 rpm
- all electrical accessories must be **OFF**

— adjust load to maximum ammeter reading
- do not allow voltage to go below **12** volts
- maximum ammeter reading should be at least alternator rated output minus **16** amps
- if ammeter reading is more than **16** amps below alternator rating, replace regulator and retest
- if ammeter reading is still too low, alternator is defective

Regulator test

- tester still connected
- all electrical components **OFF** and **NO** ammeter load

— run engine at 3,000 rpm until voltage stops rising
- voltage should be **13.5-14.5** volts

if **NO**, replace regulator and retest

Diode test

- tester still connected

— run engine at 3,000 rpm
— adjust load according to manufacturer's instructions
- if meter reads "bad," replace alternator

> **CAUTION**
>
> Never run alternator with battery disconnected

Current drain test

— turn **OFF** ignition switch, radio, and all lights
— leave rear window defogger switch and air conditioning switches **ON** to check air conditioner relay and load reduction relay
— disconnect ground cable from battery
— connect test light between ground cable and negative battery terminal
- if test light burns brightly, something is switched **ON** or shorted and draining battery

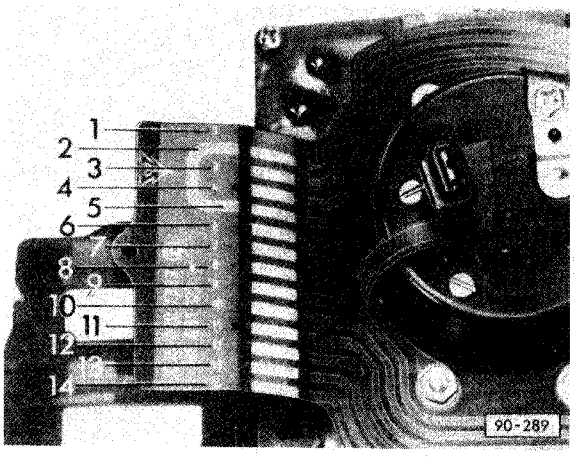
— remove fuses from fuse/relay panel one at a time until test light goes out to help locate problem
- if no faults are found in fused circuits, disconnect cables from non-fused components, i.e. alternator, starter motor, ignition system and dashboard instruments until test light goes out

Alternator charging light test

Note

If battery is still not being charged, even though charging light operates properly, check alternator charging light circuit

— disconnect battery ground strap
— remove instrument cluster



— attach multimeter US1119 between contacts **9** and **13** on printed circuit board
- specification: 140-160 ohms

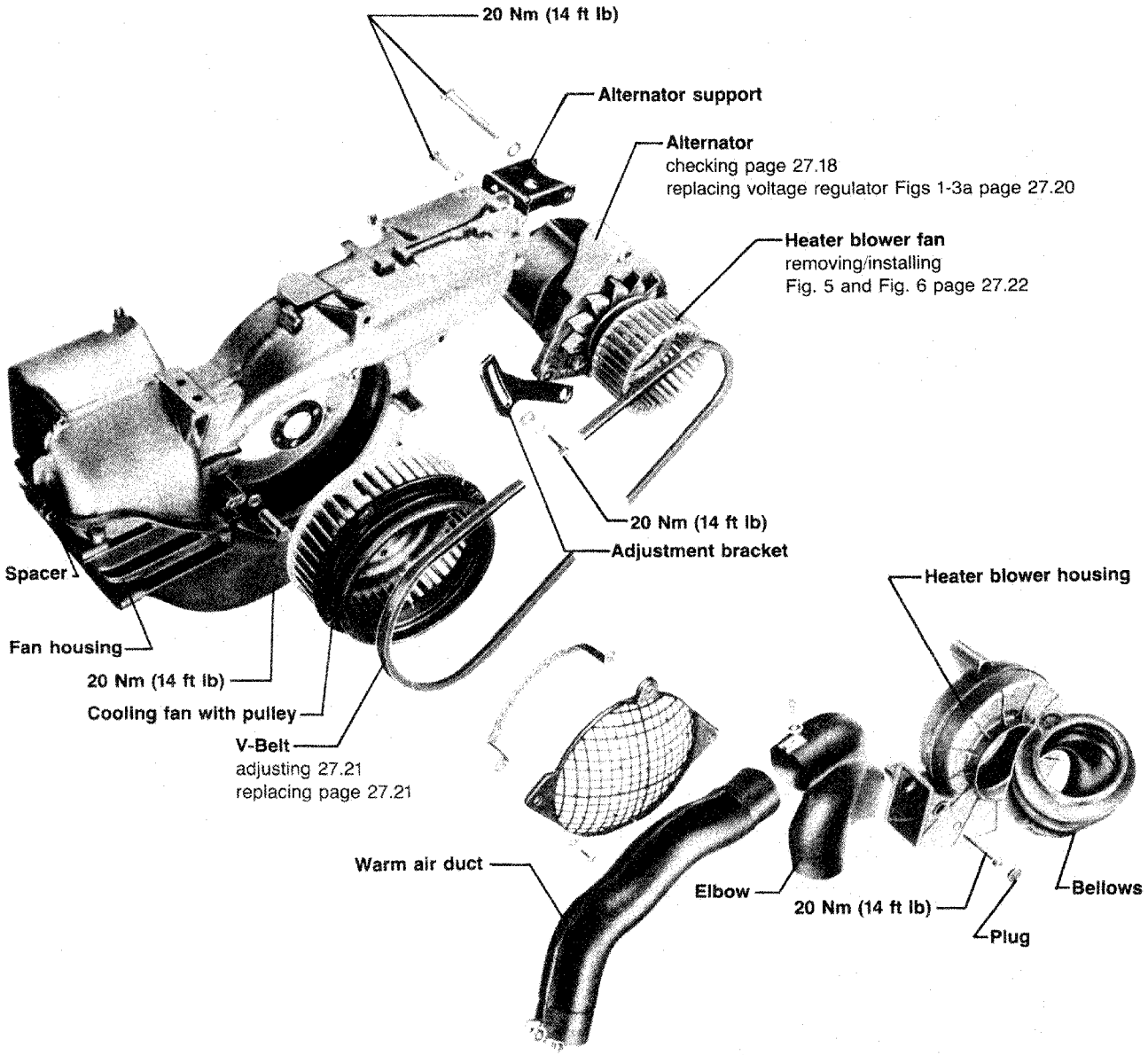
If value is greater than 160 ohms:
— replace printed circuit board

Alternator and related components, layout

CAUTION

Before starting to work on any part of electrical system disconnect battery ground strap.

Never run alternator with battery disconnected.



27-352

Voltage regulator, removal, installation and maintenance

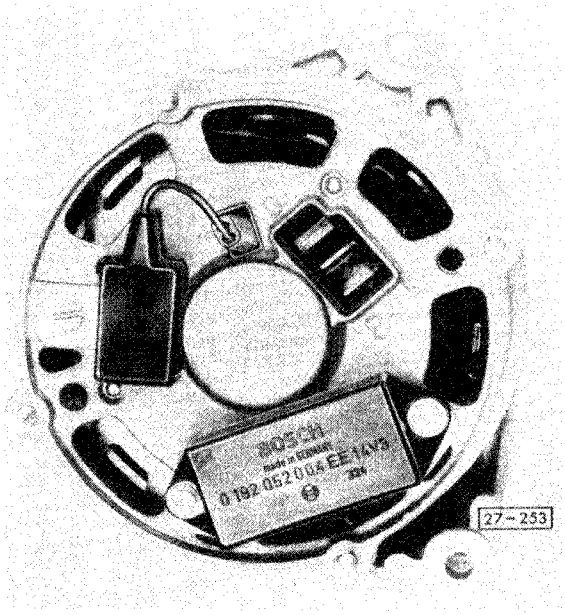


Fig. 1 Suppression condenser, connecting

Note

Voltage regulator with black rectangular housing is supplied as replacement. Part No. 028 903 803A

Voltage regulator can be replaced without removing alternator

- if voltage regulator is replaced, suppressor condenser (Fig. **1**) (if not already installed) must be added

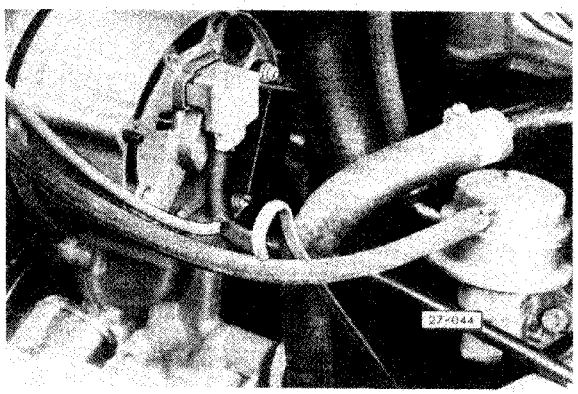


Fig. 2 Voltage regulator, removing and installing

> **CAUTION**
>
> Part numbers are for reference only. Always check with your Parts Department for latest information.

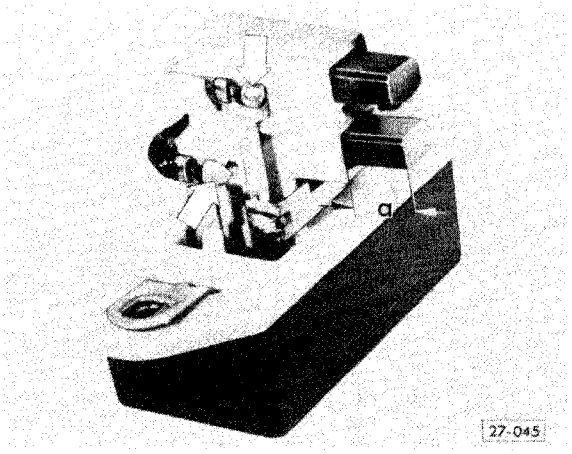


Fig. 3 Voltage regulator/carbon brushes, removing and installing

a = new = 10 mm, wear limit = 5 mm
If necessary, remove solder from connecting wires (arrows) and replace carbon brushes

Alternator/Voltage regulator (from 1981 model)

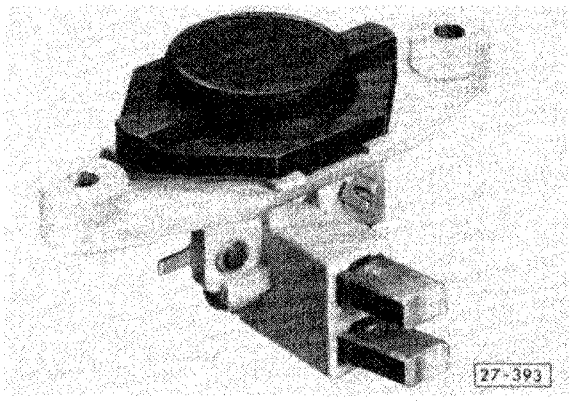


Fig. 3A

Voltage regulator (hybrid-type) now has longer carbon brushes
a = approx. 13 mm (19/32 in)
wear limit = approx. 5 mm (7/32 in)

Note

Do not install new-type voltage regulator (with longer brushes) into old-type alternators

Slip ring (on which brushes make contact) has been reduced in diameter to 28 mm (1 1/8 in) (was 32 mm)

Shape of cooling openings in alternator housing has been changed

V-belt, adjustment

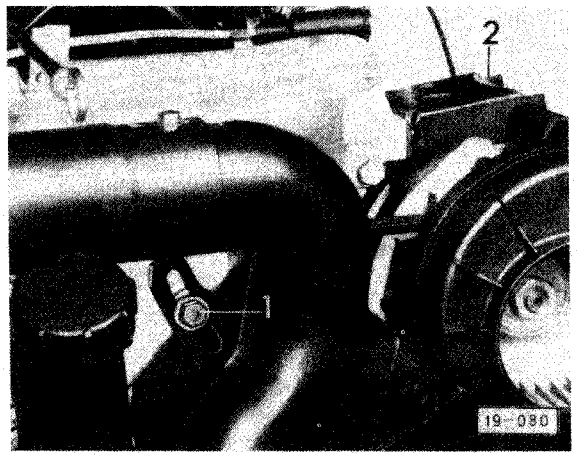


Fig. 4 V-belt, adjusting

Due to higher alternator output, present V-belt tension is insufficient.
Adjust belt tension as follows:
— loosen bolts **1** and **2** and pivot alternator

Alternator V-belts up to 1000 mm long (39.4 in)

- 2 mm max. (0.079 in) deflection with new belt, thumb pressure
- 5 mm max. (0.197 in) deflection with previously run belt, thumb pressure

Alternator V-belts over 1000 mm long (39.4 in)

- 10 mm max. (0.394 in) deflection with new belt, thumb pressure
- 15 mm max. (0.59 in) deflection with previously run belt, thumb pressure

Note

Extremely loud squealing may indicate damaged V-belt that should be replaced

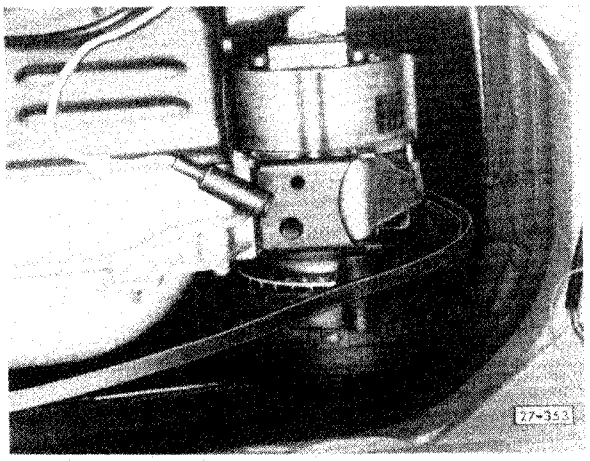
V-belt, replacing

Work sequence

— disconnect battery ground strap
— remove bellows from heater blower housing
— remove warm air duct and elbow

— remove guard for fan and ignition timing scale
— loosen bolt for adjustment bracket on fan housing
— remove alternator pivot bolt/upper heater blower housing mounting bolt

— remove lower heater blower housing mounting bolt (on right side of alternator)
— loosen bolt attaching adjustment bracket/heater blower housing to alternator (on left side of alternator)



— remove V-belt from V-belt pulley between alternator and heater blower fan
— install new V-belt and adjust
  - after installing new V-belt, bellows must fit tightly on heater blower housing and fresh air intake duct (see also, pages 27.19, 27.22)

Heater blower fan, removing and installing

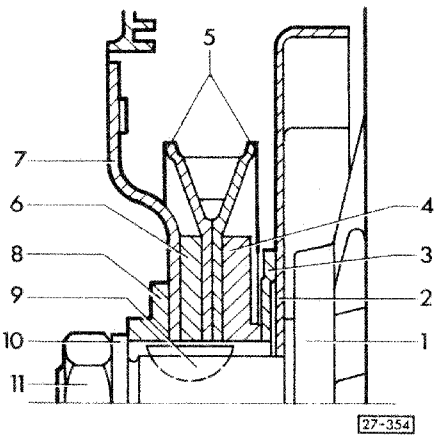


Fig. 5 Heater blower fan, removing/installing

1 = alternator
2 = alternator cooling fan
3 = support ring
4 = shim with collar
5 = V-belt pulley
6 = spacer
7 = heater blower fan
8 = thrust washer
9 = woodruff key
10 = spring washer
11 = nut, tighten to **35 Nm (25 ft lb)**

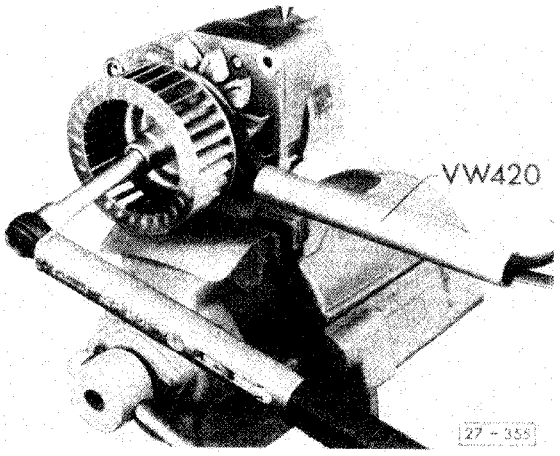


Fig. 6 Heater blower fan, removing/installing

— hold pulley with V-belt and VW 420

Alternator mount, adjusting
(from illustration 27-576 page 27.15)

If alternator mount is loose, with a consequent rattling noise, the cause can be the elimination of the spring washer under each bracket mounting bolt. The mounting bolts may only partly touch the uneven and rough surface of the cast iron bracket, causing the preload force to be insufficient even with correctly applied torque.

To correct,

— install spring washer, Part No. NO12 24 111, on each bracket mounting bolt
— install bolts and torque to 22 Nm (16 ft lb)

Note

Spring washers are now installed on cars beginning with January, 1982 Vanagon production (from **VIN 25CH089151**).

Mounting bolts, tightening

If alternator mounting bolts become loose, follow this procedure:

Waterboxer

— replace old bolts with new bolts of higher strength (New bolt P/N N14 400.4)
— re-torque new bolt to higher torque specification

Diesel motor

— re-torque old bolts

Torque specification:
- Waterboxer 24.0 Nm (18 ft lb)
- Diesel motor 28.0-33.0 Nm (21.0-24.0 ft lb)

CAUTION

Part numbers are for reference only. Always check with your Parts Department for latest information.

Troubleshooting indicator light for alternator (LED)

Does not illuminate with ignition ON (engine NOT started)

Possible open circuit between alternator D+ and indicator light (LED)

— remove alternator cover
— remove D+ wire from alternator
— connect jumper wire between D+ and ground
— turn **ON** ignition

Alternator indicator light (LED) lights up

Possible causes:

— improper alternator ground
— worn out carbon brushes
— defective voltage regulator
— defective rotor

Check alternator grounding and brushes:

If **NOT OK**:
make necessary corrections
— if light now comes on — END

If **OK**:
— replace voltage regulator

If light still fails to come on:

replace alternator

END

Alternator indicator light (LED) does **NOT** light up

Alternator indicator light (LED) burnt out

— disconnect battery ground strap
— replace indicator lamp (LED)
— connect battery ground strap
— turn on ignition

Alternator indicator light (LED) lights up

END

Alternator indicator light (LED) does **NOT** light up

Wiring between alternator D+ and indicator light (LED) is open

— correct break in wiring (or open circuit) between alternator D+ and indicator light (LED)

Note

Consult specific current flow diagram for vehicle in question, to determine exact signal path.

END

Troubleshooting indicator light for alternator (LED)

Light is on with ignition **OFF**

— diode (or diodes) defective

— replace alternator

END

Alternator indicator light does **NOT** go out when RPM increases

Possible causes:

— slipping fanbelt, tighten if necessary
— ground short between alternator D+ and indicator light (LED)
— Defective alternator

END

Possible short to ground between alternator D+ and indicator light (LED)

— disconnect alternator wiring
— turn **ON** ignition

Alternator indicator light (LED) lights up

— short to ground in wiring between alternator D+ and indicator light (LED) must be corrected

Note

Consult specific current flow diagram for vehicle in question, to determine exact signal path.

END

Alternator indicator light (LED) does **NOT** light up

— Test alternator output
— test voltage regulator

— replace defective component

END