

# GROUP 05

## CONTENTS

BATTERY .....	05-2	Bench test .....	05-19
ELECTRICAL SYSTEM .....	05-3	Service data and specifications .....	05-20
Engine ignition .....	05-3	Trouble diagnosis and corrections .....	05-21
Engine starter .....	05-4	DIGITAL ELECTRONIC IGNITION ...	05-22
Engine charging .....	05-5	Description .....	05-22
Service data and specifications .....	05-6	Cautions .....	05-23
STARTING .....	05-7	Checks and inspections on vehicle .....	05-24
Disassembly .....	05-8	Disassembly .....	05-26
Inspection .....	05-10	Checks and inspections .....	05-26
Assembly .....	05-12	Assembly .....	05-27
Bench test .....	05-12	Bench test .....	05-27
Service data and specifications .....	05-13	On - vehicle distributor installation .....	05-27
Trouble diagnosis and corrections .....	05-14	Electrical tests .....	05-27
CHARGING .....	05-16	Engine temperature sensor .....	05-28
Disassembly .....	05-17	Ignition advance control unit .....	05-28
Inspection .....	05-18	Service data and specifications .....	05-29
Assembly .....	05-19	EZ-L ignition system diagnostics .....	(*)

(\*) Refer to: Group 00

# BATTERY

**WARNING:**

- a. Do not touch positive and negative battery poles simultaneously with bare hands.
- b. When starting engine with jumper leads through auxiliary battery, source voltage should not exceed 12V.

## INSPECTION

- a. Check that battery does not leak acid and/or has no cracks in its outer case.
- b. Check that battery top is clean and that contacts are free from oxidation.
- c. Check terminal clamps for tightness, to ensure efficient contact.

## CLEANING

- a. Clean battery top, posts and clamp using a solution of water and sodium bicarbonate.
- b. Prior to installing clamps, coat with the specified type of grease (REINACH-E10 Tac).

## VOLTAGE TEST

1. Check the voltage at the battery terminals at regular intervals in order to confirm correct calibration of the voltage regulator.
2. The voltage value, read at the battery terminals, should be between 13.7V and 14.7V, with the engine running at 3.000 r.p.m.
3. In particular, check that the minimum value with engine hot loads connected (at least full beam) or maximum value with engine cold, loads disconnected are observed.
4. If the values obtained are not within the specified range, it will be necessary to check the components of the electrical system.

## BATTERY CHARGE CHECK

1. Allow the battery to rest for at least two hours then measure the open circuit voltage with the negative terminal disconnected so as to

prevent dispersion into the electrical system.

2. The battery is flat if a value of less than 12.30V is recorded.
3. The charge condition of a battery may be evaluated approximately on the basis of the following table.

Voltage at the terminals V	Load %
12.30	50
12.36	
12.42	
12.48	75
12.54	
12.60	
12.66	100
12.70	

**CAUTION:**

It is advisable to use a digital voltmeter which has the advantage of a reading to a hundredth of a volt (range of measurement 0-20V), besides low absorption.

## CHARGE

1. To recharge, work with a current equal (in A) to approximately 1/20 of the battery capacity (given in Ah) or equal to approximately 1/100 of the plate current.
2. Recharging is considered accomplished when the battery voltage varies less than 0.05V for two consecutive readings with a pause of one hour between them. Duration of recharging is in direct proportion to charge condition of the battery.

**CAUTION:**

Check that the temperature of the electrolyte during recharging does not exceed 50°C, nor the voltage 16.5V.

3. Once recharging has been accomplished, check the battery voltage again at least two hours subsequent to concluding recharging.

**CAUTION:**

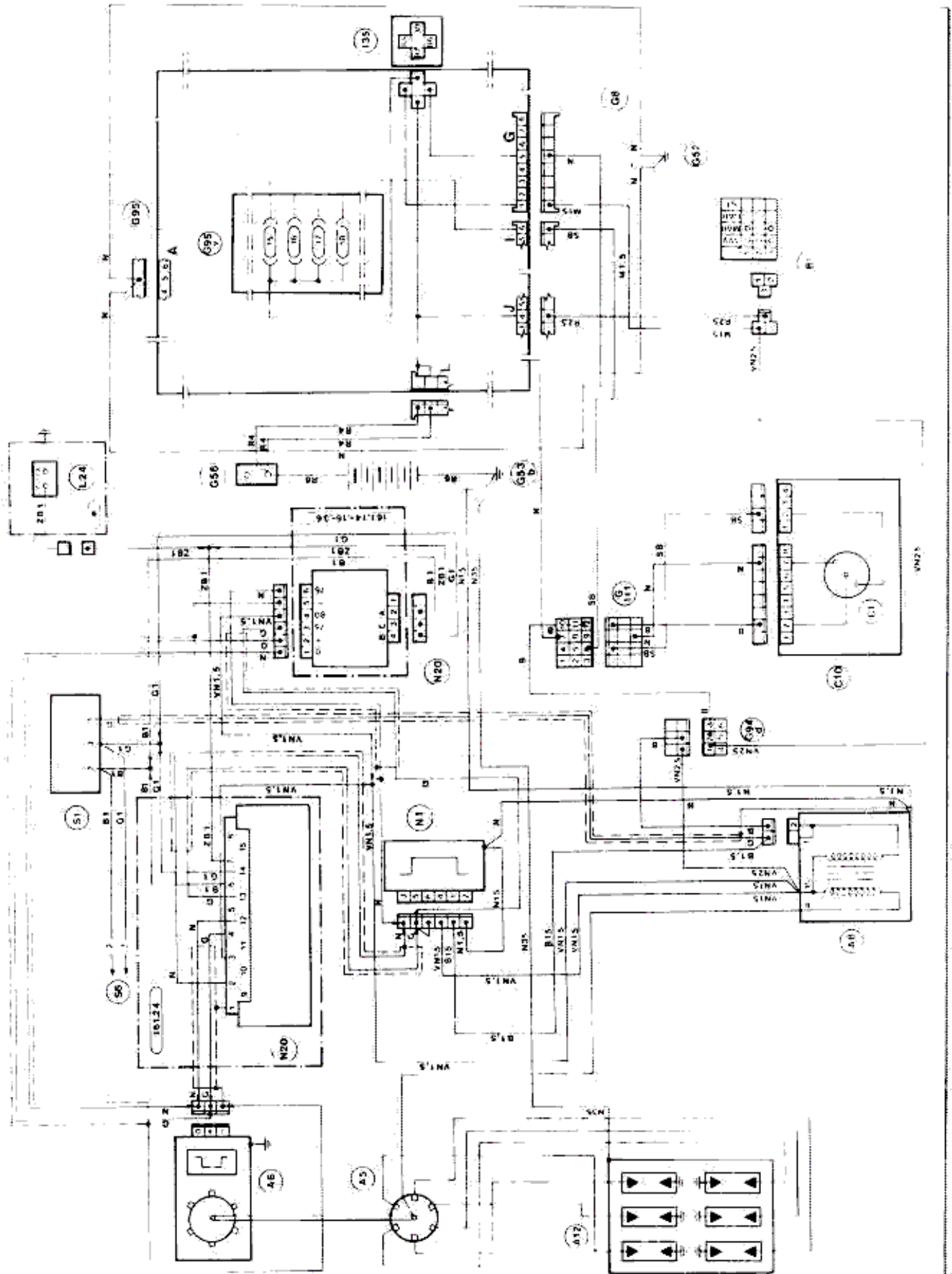
Maintenance free batteries do not have top up plugs. Some of them may have a cover which may be opened only in an emergency to bring the electrolyte up to level with distilled water when the maladjusted voltage regulator (too high voltage) has caused excessive water consumption.

## GENERAL SAFETY REGULATIONS

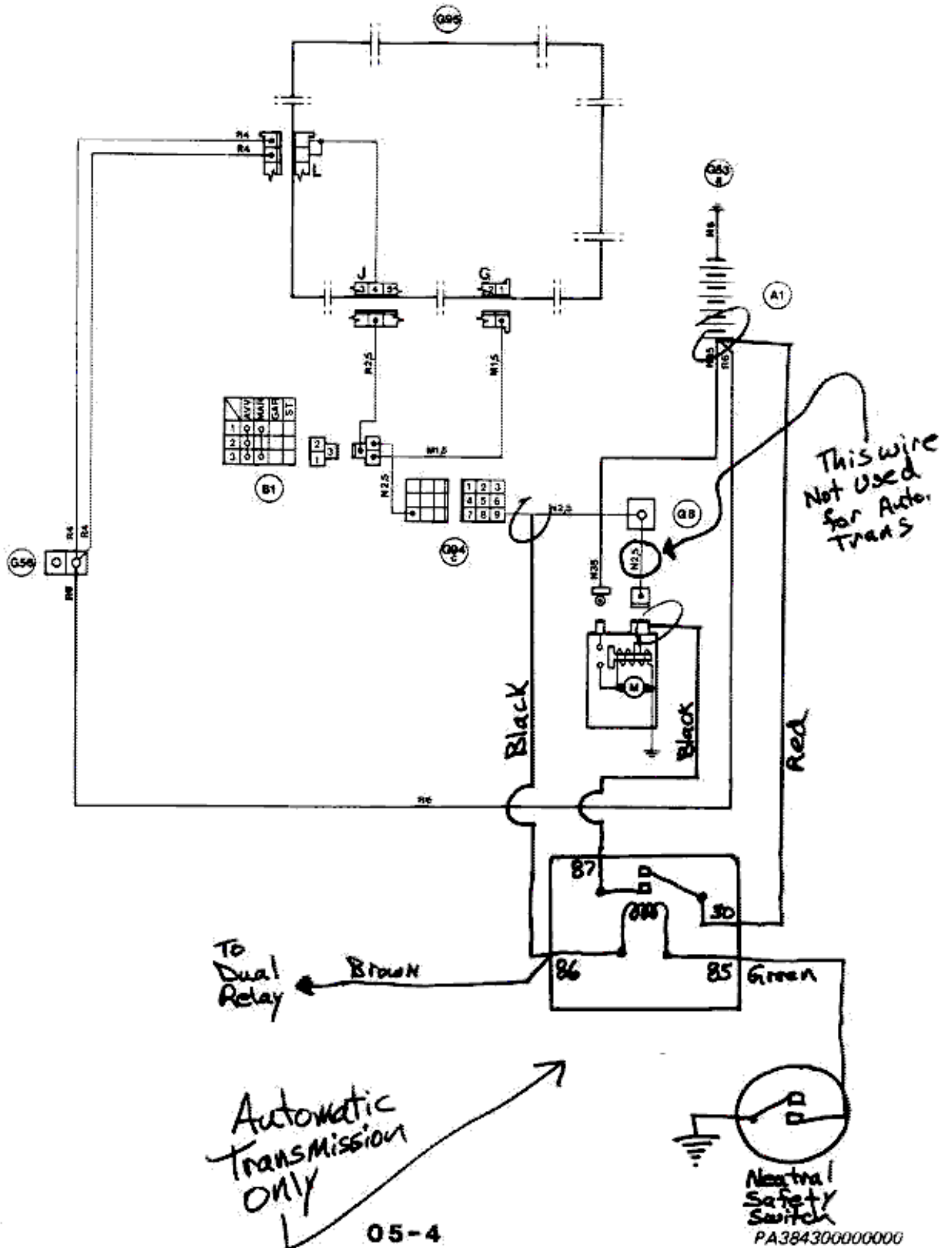
1. Lead acid storage batteries (especially in charging) generate an explosive mixture of hydrogen and oxygen. It is therefore necessary to adhere to specific safety regulations to avoid causing harm to persons or vehicle.
2. Recharging site should be sufficiently aired for dispersion of any gases produced. Forced ventilation is essential in small rooms.
3. Acid should be handled with extreme care and protective clothing - rubber gloves and anti-acid apron used to safeguard clothes and body; always wear safety goggles.
4. When mixing acid with water (for example when diluting an acid that has too high a density) it is of the utmost importance to pour the acid slowly into the water (never vice-versa).
5. Do not use metal funnels and containers; use glass or plastic jugs and funnels, ensuring that they are perfectly clean.
6. Never approach or inspect batteries with a naked flame (match or lighter).

# ELECTRICAL SYSTEM

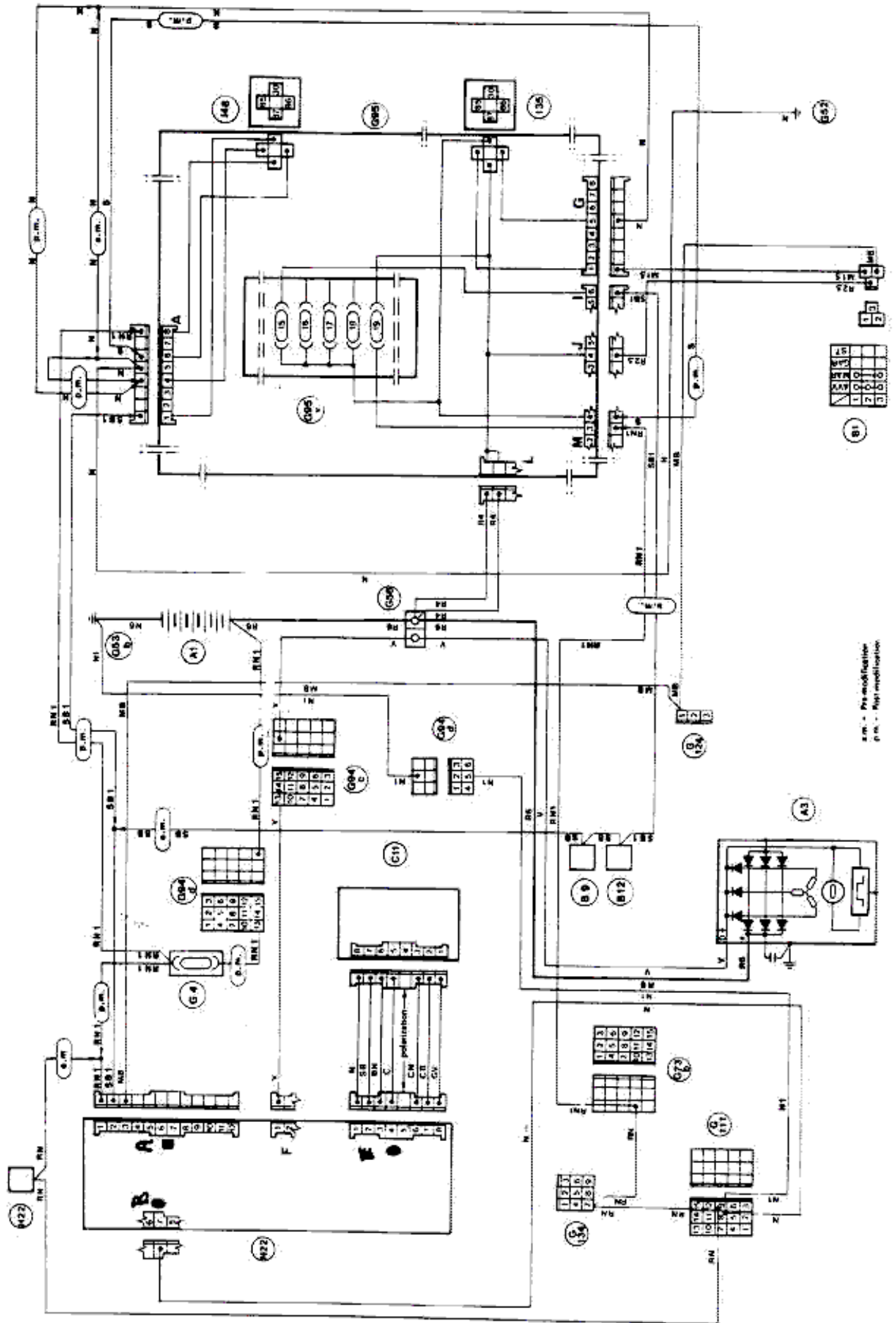
## ENGINE IGNITION



ENGINE STARTER



ENGINE CHARGING



a.m. - Pre-modification  
p.m. - Post-modification

**SERVICE DATA AND SPECIFICATIONS**

**TECHNICAL DATA**

**Components**

Starter	Alternator (1)	Distributor	Coil/electronic module	Spark plug	Electronic advance control unit	Temperature sensor (ignition)
116.46.05.030.00 BOSCH 0.001.311.139 GF-12V-1.5CV	119.13.05.060.00 BOSCH (2) 0.120.489.905.906 K1-14V65A21	116.69.05.011.00 BOSCH 0.237.322.001	116.97.85.079.00 BOSCH 0.221.600.002	119.11.05.106.00 SILVER LODGE HL-E alternatively - CHAMPION RN 11 YC	116.69.05.012.00 BOSCH (2) 0.227.921.001  195.50.05.012.00 BOSCH (3) 0.227.921.036	113.10.05.372.00
	195.46.05.060.00 BOSCH (3) 0.120.488.103					

(1) Integral electronic voltage regulator

(2) For 2500 engine (019.11)

(3) For 3000 engine (061.24)

**Battery**

Voltage (V)	12
Capacity (Ah)	70
Discharge rating (A)	380

**GENERAL SPECIFICATIONS**

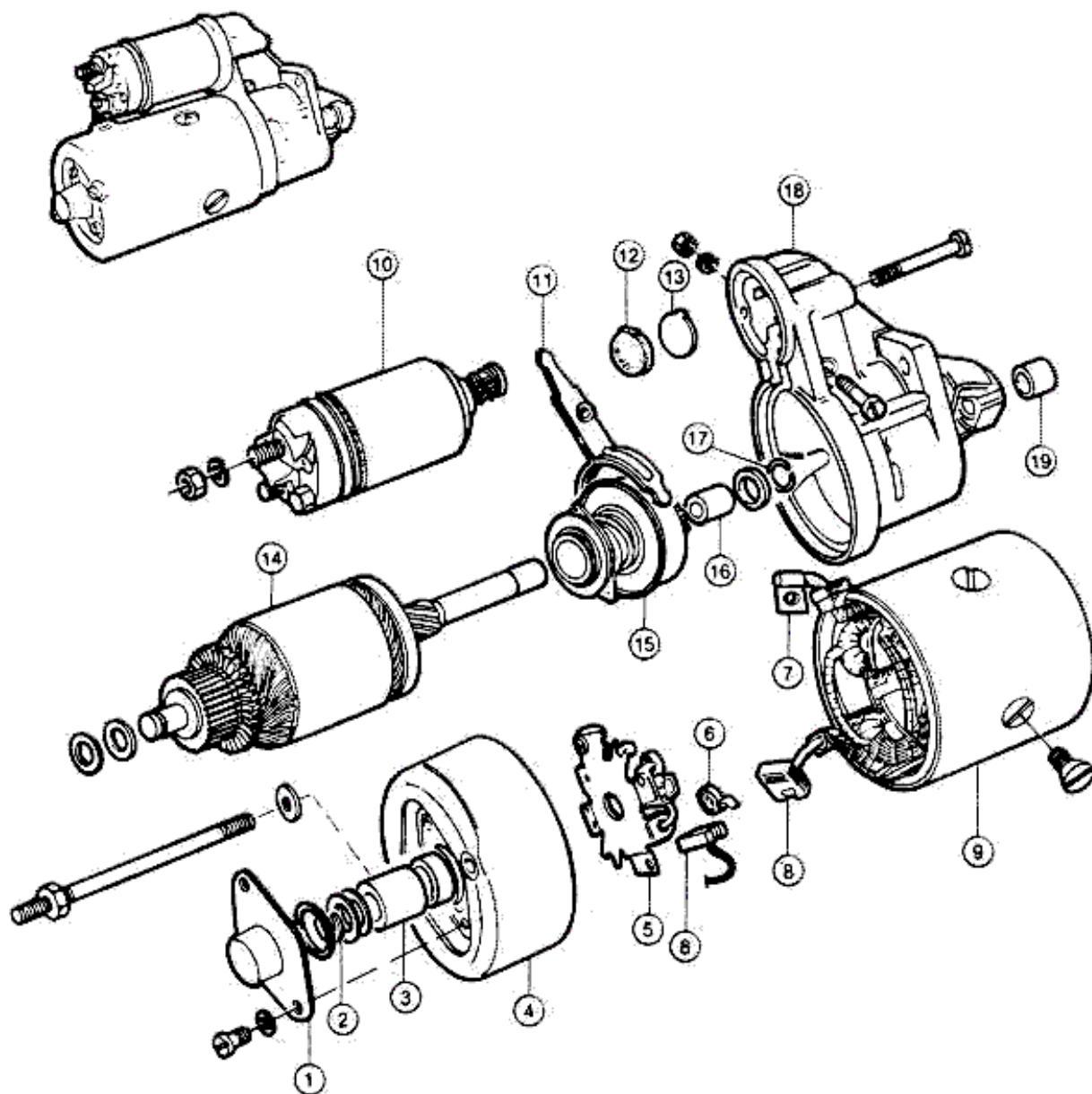
**Fluids and Lubricants**

Description	Type	Recommended products	Quantity
Battery terminal	GREASE	Grease REINACH: E10 Tac Part. No. 3671-69812	As necessary

*Group Size 34  
Cold Cranking Amps 675  
Reserve Capacity Min. 120*

# STARTING

## BOSCH STARTER



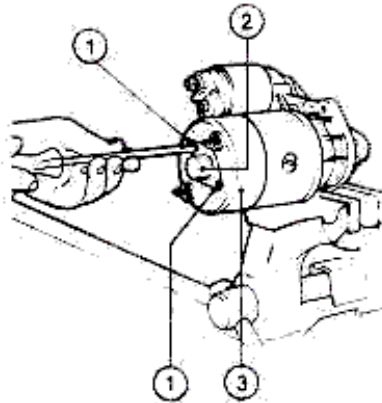
- 1. Dust excluder
- 2. Retaining ring
- 3. Bush
- 4. Commutator and support
- 5. Brush carrier
- 6. Brush spring
- 7. Field winding terminal
- 8. Brush
- 9. Yoke
- 10. Solenoid

- 11. Fork
- 12. Rubber plate
- 13. Backing plate
- 14. Armature
- 15. Starter drive
- 16. Bush
- 17. Pinion stop ring
- 18. Drive end support
- 19. Bush

**DISASSEMBLY**

Clamp starter in vice provided with soft jaw liners.

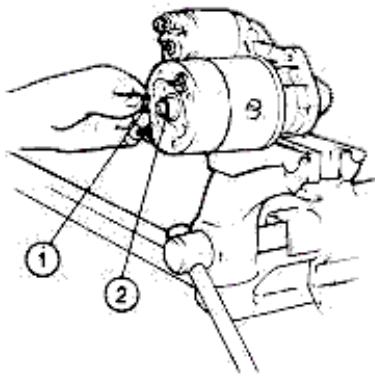
a. Back off two capscrews (1) retaining dust cover (2) to commutator end support (3). Remove dust cover.



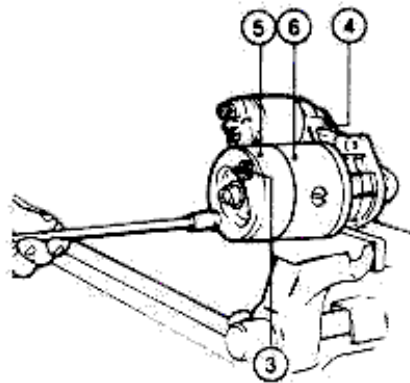
- 1. Capscrews
- 2. Dust cover
- 3. Commutator end support

b. Remove rear retaining ring (1) from armature shaft and shims (2) for pinion adjustment.

c. Back off two nuts retaining tie bolts (3) to drive support (4) and commutator end support (5) to yoke (6).

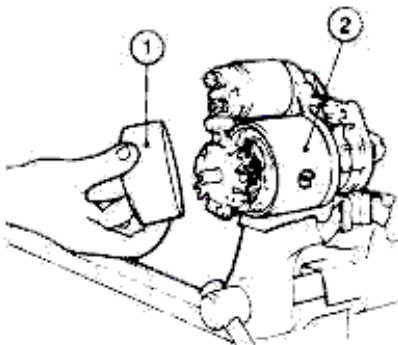


- 1. Retaining ring
- 2. Shims



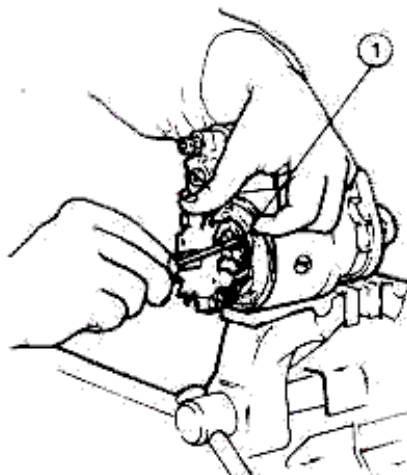
- 3. Tie bolts
- 4. Drive end support
- 5. Commutator end support
- 6. Yoke

d. Using a plastic mallet, remove commutator end support (1) from yoke (2).



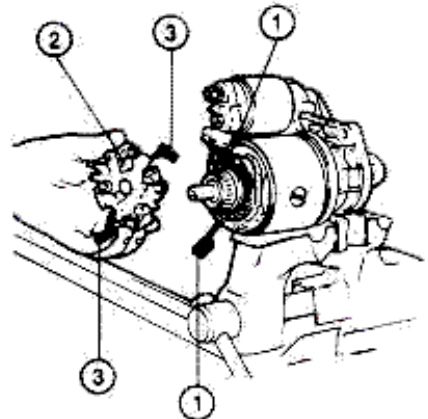
- 1. Commutator end support
- 2. Yoke

e. Take load off brush springs (1) using a screwdriver as shown.



- 1. Brush springs

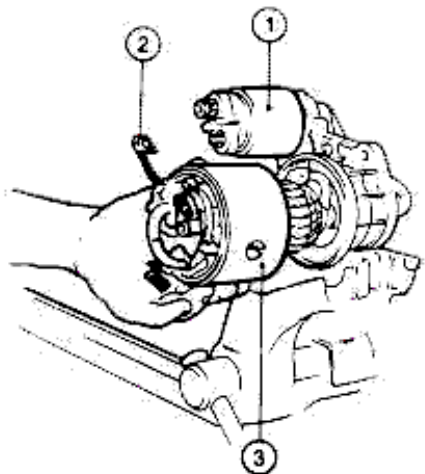
f. Take off two positive brushes (1) from carrier (2) and remove carrier with two negative brushes (3) attached.



- 1. Positive brushes
- 2. Brush carrier
- 3. Negative brushes

g. Back off nut retaining field winding terminal (2) to solenoid terminal (1).

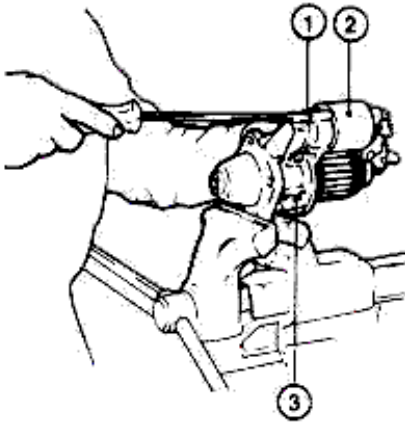
Take off yoke (3) with field winding attached.



- 1. Solenoid
- 2. Field winding terminal
- 3. Yoke

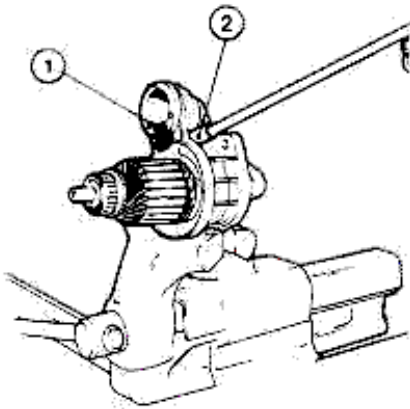
h. Remove three capscrews (1) retaining solenoid (2) to drive end support (3). Remove solenoid.





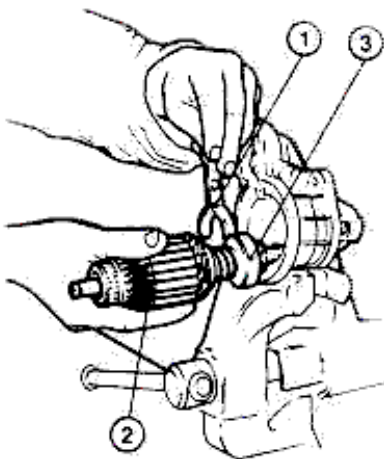
- 1. Capscrew
- 2. Solenoid
- 3. Drive and support

- i. Remove rubber pad (1) with plate
- j. Back off bolt (2) acting as pivot for engagement fork.



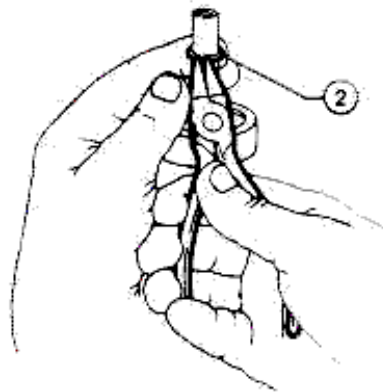
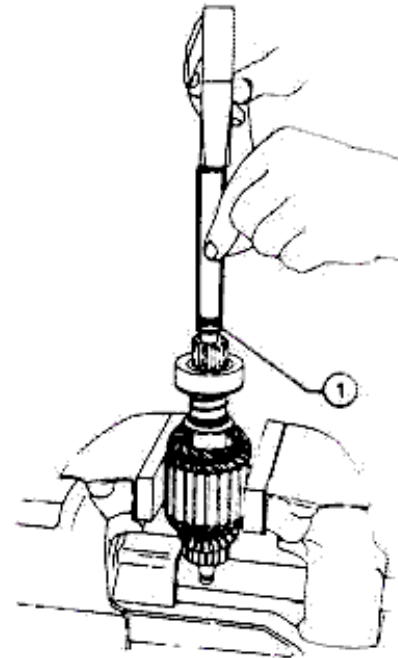
- 1. Rubber pad
- 2. Bolt

- k. Remove armature (2) together with starter drive (3) and fork lever (1).



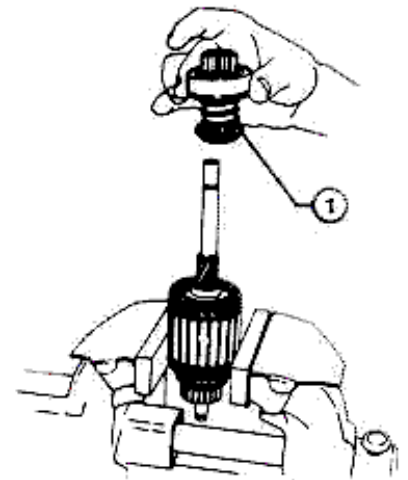
- 1. Fork
- 2. Armature
- 3. Starter drive

- l. Clamp armature in vice provided with soft jaw liners. Using a special tubular box wrench, release pinion stop ring (1) from retaining ring (2).
- m. Using suitable pliers remove retaining ring (2) from armature shaft. Remove pinion stop ring.



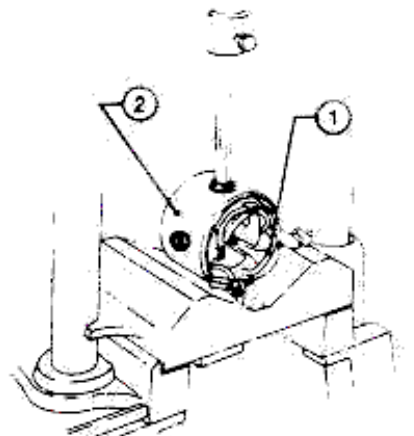
- 1. Pinion stop ring
- 2. Retaining ring

- n. Remove starter drive (1).



- 1. Starter drive

- o. Back off field winding screws (1) on yoke (2) and remove winding.



- 1. Field winding
- 2. Yoke

- p. If necessary, remove bushes from commutator end support and drive end support using the special remover.

## INSPECTION

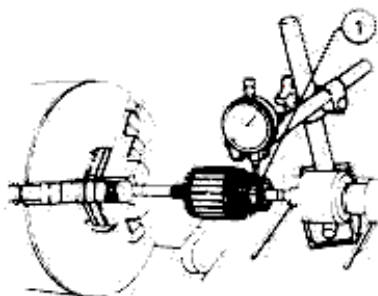
Prior to performing electrical test, thoroughly clean all components with compressed air.

Pay particular attention to windings.

Clean commutator using a cloth moistened with fuel.

### Commutator eccentricity check

- Grip commutator on a lathe.
- Place a magnetic-base dial gauge on lathe carriage with stylus in contact with commutator ①
  - Check that eccentricity is within specifications.
  - If eccentricity is higher than specified or the commutator is badly scored, replace commutator or, if still recoverable, dress by turning and polish using an armature grade emery cloth.



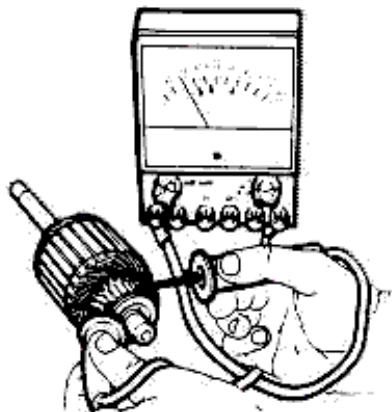
1. Commutator

Max. eccentricity allowance for commutator is: 0.06 mm (0.0024 in)

Max. dressing depth allowed on nominal dia. is: 0.25 mm (0.010 in)

### Commutator open-circuit (O/C) test

- Turn tester switch to Ohm scale  $\Omega \times 100$ .
- Place tester probes in contact with bars of commutator under test.



- Check that tester signals current flow. If O/C is detected, replace armature

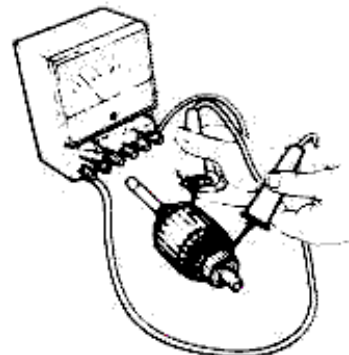
#### CAUTION:

Repeat operations b. and c. on all corresponding pairs of commutator bars.

### Armature insulation test

- Turn tester switch to Ohm scale  $\Omega \times 1$ .
- Place one tester probe in contact with the commutator and the other with commutator bars or shaft.
- Check that tester does not signal current flow.

- If insulation is not efficient, i.e. in case of open circuit (O/C) replace armature without hesitation.

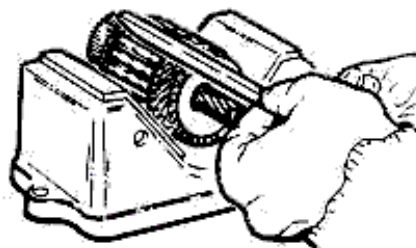


#### CAUTION:

Repeat operations b. and c. on all commutator bars.

### Armature S/C test on bench tester

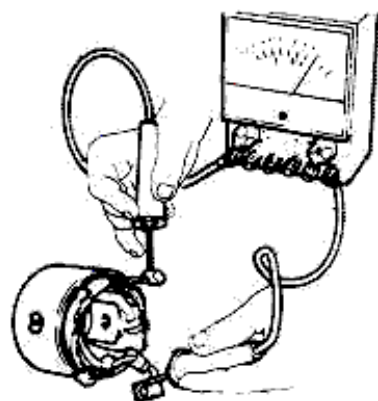
- Place armature across pole shoes of armature tester and supply current through tester switch.
- Slowly turn armature and place the steel bar over armature pack.



c. If a S/C exists, the bar will vibrate and/or stick to the commutator over the slots housing the defective conductors.

**Field winding insulation test**

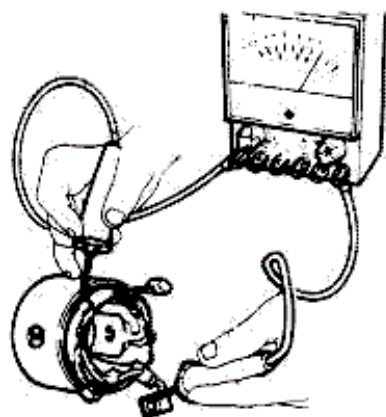
- a. Turn tester switch to Ohm scale  $\Omega \times 1$ .
- b. Place one of the tester probes in contact with the field winding terminal and the other in contact with the yoke.
- c. Check that tester does not signal current flow.



d. If insulation is defective, remove and replace field windings. For removal from yoke refer to step a. on «BOSCH Starter» disassembly.

**Field winding O/C test**

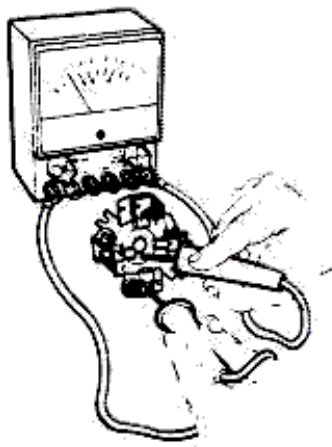
- a. Turn tester switch to Ohm scale  $\Omega \times 100$ .
- b. Place one of the tester probes in contact with field winding lead and the other in contact with a positive brush. Repeat the operation on the other brush.
- c. Check that tester signals current flow.



d. If field windings are found to be affected by O/C, remove and replace windings referring to step a., «BOSCH Starter» disassembly.

**Positive brush holder insulation test**

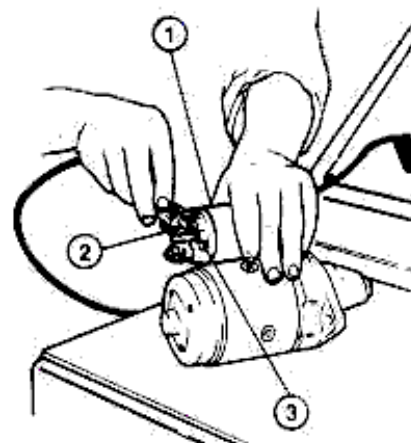
- a. Turn tester switch to Ohm scale  $\Omega \times 1$ .
- b. Connect one of tester probes to brush carrier and the other to a positive brush holder.
- c. Check that tester does not signal current flow.
- d. Repeat the test on the other positive brush holder.



e. If insulation is defective replace the brush carrier without hesitation.

**Solenoid efficiency test**

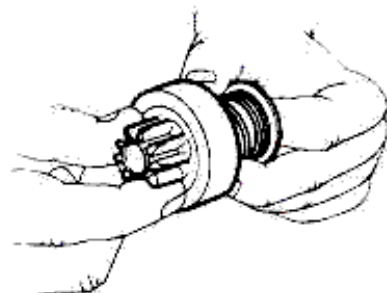
- a. Connect solenoid to tester and apply negative current. Alternatively, connect solenoid body ① to negative battery pole.
- b. Connect solenoid positive ② to battery positive, short-circuiting solenoid to pin ③.
- c. Solenoid plunger actuating engagement fork should move; if not replace solenoid.



- 1. Solenoid body
- 2. Solenoid positive
- 3. Terminal pin

**Pinion efficiency test**

- a. Turn pinion clockwise as shown. It should rotate freely.
- b. Try to turn pinion counterclockwise, i.e. toward ring gear. No rotation should be possible.
- c. Visually inspect pinion teeth for wear or damage.

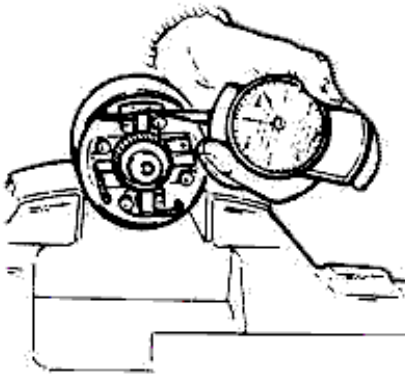


d. If pinion operation is found to be defective or teeth are worn, particularly near the chamfered side, replace starter drive without hesitation.

**Brush spring load check**

- a. Check brush springs for weakness. Spring stiffness should be adequate to ensure correct brush contact on commutator.

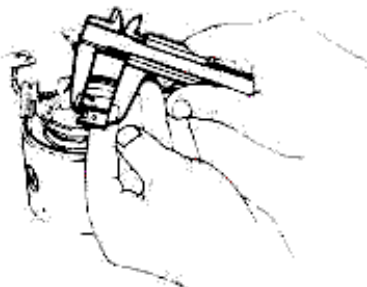
- b. With brush carrier in position on armature, check brush spring fitted load using a suitable spring balance. The correct load should be 16 N max. At brush end of travel spring load should be 13 N approx.



#### Brush wear check

Check stator and rotor brushes for flaking, carbon dust, and for correct length.

Max. brush length:  
11 mm (0.43 in)



#### Brush wear check

- a. Check bushes in front and rear armature supports for excessive and/or uneven wear. Ensure that armature shaft running clearance in bushes is as specified.

Armature shaft running clearance in bushes (bush bore dia. - shaft dia):  
0.02 to 0.05 mm (0.001 to 0.002 in)

- b. If wear is found to be excessive replace bushes referring to "BOSCH Starter" disassembly instructions of step p.

#### CAUTION:

Bushes are correctly installed if rotor shaft rotates without binding or play.

### ASSEMBLY

For starter assembly reverse the disassembly sequence.

Lubricate the following parts using the specified type of grease.

Parts involved in starter operation

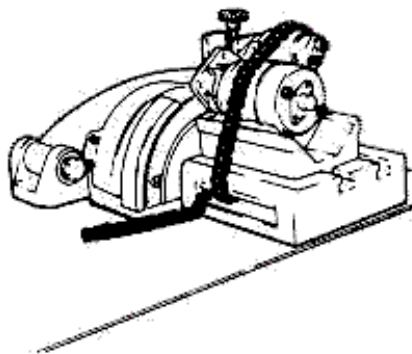
- Commutator end support bush
- Drive end support bush
- Pinion
- Starter drive helix
- Solenoid plunger

### BENCH TEST

Place starter on tester next to ring gear and establish electrical connections.

#### CAUTION:

Supply starter through high-capacity battery to prevent significant changes in voltage during testing.



- a. Running torque test.

- Supply starter at rated voltage and operate starter to engage pinion.
- Brake tester ring gear to bring current consumption to the rating specified for running torque test.

Check that torque is as specified under Service Data and Specifications.

- b. Lock torque test.

- Supply starter at rated voltage.
- Apply tester ring gear brake.
- Operate starter and take a quick reading.

Current, voltage and torque values should be as specified under Service Data and Specifications.

- c. Starter-mounted switch test.

- Move starter away from ring gear so that pinion is prevented from meshing with ring gear when moving outward.
- Supply starter at the rated voltage and operate the starter switch and check that current consumption is as specified under Service Data and Specifications.
- Check that cut-in voltage is as specified under Service Data and Specifications.

## SERVICE DATA AND SPECIFICATIONS

## TECHNICAL DATA - CHECKS AND ADJUSTMENTS

Starter	Alfa Romeo Part No.	116.46.05.030.00
	Type	BOSCH GF 12 V 1.4 kW 0.001.311.138
Rated voltage	V	12
Rated output	kW (HP)	1.1 (1.5)
Max. brush length	mm (in)	— —
Max. commutator eccentricity	mm (in)	— —
Armature shaft running clearance	mm (in)	0.02 to 0.05 (0.001 to 0.002)
Running torque test (pinion meshing with braked ring gear)		
— Voltage	V	9
— Current consumption	A	290 max.
— Speed	rpm	1200 min.
— Torque	Nm (ft-lb) (kgm)	8 (5.9) (0.8)
Lock torque test (pinion meshing with locked ring gear)		
— Voltage	V	6
— Current consumption	A	500 max.
— Torque	Nm (ft-lb) (kgm)	13 (9.6) (1.3)
Freewheel overrunning torque	Ncm (in-lb) (kgcm)	14 to 20 (1.2 to 1.8) (1.4 to 2.0)
Starter-mounted switch test		
— Max. draw at rated voltage	A	38
— Min. cut-in voltage	V	7.5 (*) 9.5 (**)
Pinion teeth module		2.1167

(\*) At -20°C (-4°F)

(\*\*) At +80°C (+176°F)

## **TROUBLE DIAGNOSIS AND CORRECTIONS**

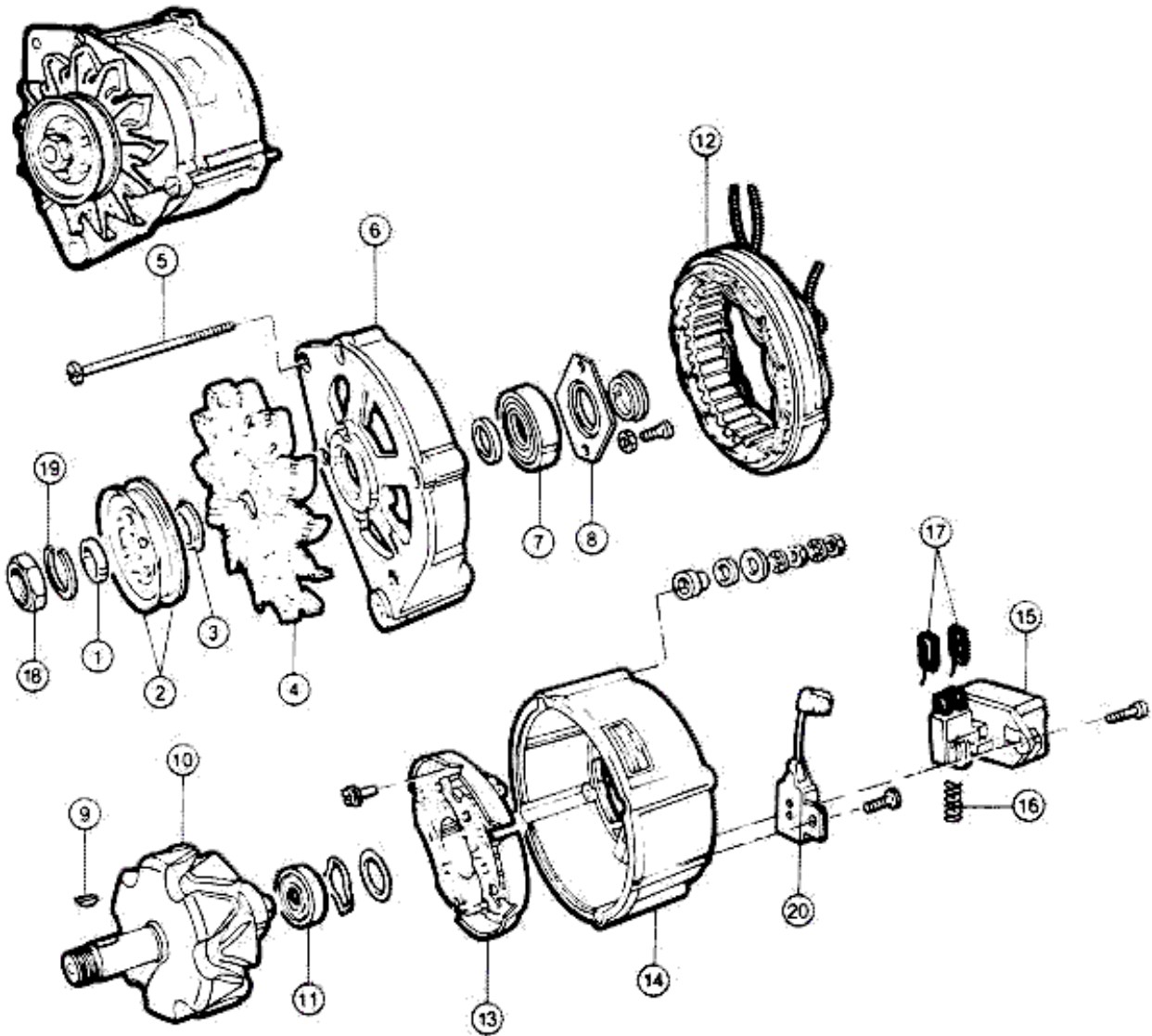
<b>Condition</b>	<b>Probable Cause</b>	<b>Corrective Action</b>
Starter does not crank. No current draw	<ul style="list-style-type: none"> <li>• O/C across battery and starter</li> <li>• O/C across starter and starter switch</li> <li>• Battery terminals oxidized or clamps loose</li> <li>• Starter solenoid contacts or winding O/C or grounded</li> <li>• Worn brushes preventing proper contact on commutator</li> </ul>	<p>Trace and remedy O/C</p> <p>Check battery terminals and starter lead terminals Tighten nuts</p> <p>Trace and remedy O/C</p> <p>Check switch contacts and replace as necessary</p> <p>Clean battery terminals and tighten clamps</p> <p>Clean switch moving contact and fixed contacts or replace switch</p> <p>Replace brushes with genuine spares and check commutator conditions</p>
Starter draws current but does not turn or turns slowly or does not crank the engine	<ul style="list-style-type: none"> <li>• Armature fouling pole shoes or stuck between poles</li> <li>• Seized armature shaft</li> <li>• Field winding S/C or grounded</li> <li>• Armature O/C or grounded</li> <li>• Armature S/C</li> </ul>	<p>If bushes are worn replace bushes and/or supports</p> <p>Check support alignment</p> <p>Check armature shaft</p> <p>Ensure that pole shoes are correctly positioned and tight on yoke</p> <p>Replace armature and seized bush</p> <p>Replace field winding</p> <p>Replace armature</p> <p>Clean commutator and brush holders to remove carbon and copper dust</p> <p>Check and replace armature as necessary</p>
Starter turns but does not crank the engine	<ul style="list-style-type: none"> <li>• Ring gear teeth worn; pinion does not mesh</li> <li>• Incorrect assembly; pinion does not mesh fully</li> <li>• Foreign matter in drive; starter drive binds on armature shaft</li> <li>• Pinion meshes with ring gear but engine does not crank</li> </ul>	<p>Replace starter ring gear on flywheel</p> <p>Check pinion-to-ring gear alignment and distance</p> <p>Clean and lubricate; clean the entire drive as necessary</p> <p>Freewheel defective needing replacement</p> <p>Clutch defective needing overhaul</p> <p>Incorrect solenoid operation needing repair or replacement</p>
Starter operates but generates excessive or undue noise	<ul style="list-style-type: none"> <li>• Defective mechanical components</li> <li>• Trapped foreign matter</li> </ul>	<p>Check supports</p> <p>Check bushes</p> <p>Replace supports as necessary</p> <p>Remove foreign matter</p>
Starter lacks power	<ul style="list-style-type: none"> <li>• Incorrect brush contact</li> <li>• Brushes binding in holders</li> </ul>	<p>Replace or bed in brushes by operating starter in no-load conditions</p> <p>Check brush spring load</p> <p>Replace any weak springs</p> <p>Clean holders or replace as necessary</p>
Premature brush wear	<ul style="list-style-type: none"> <li>• Commutator ovalized</li> <li>• Mica protruding from commutator bars</li> <li>• Brush spring load excessive</li> <li>• Unsuitable brushes</li> </ul>	<p>Dress commutator within specified limits, undercut mica and clean commutator</p> <p>Undercut mica and clean commutator</p> <p>Check brush spring load and compare with requirements</p> <p>Replace brushes with the specified type</p>

## ENGINE IGNITION, STARTER, CHARGING

Condition	Probable Cause	Corrective Action
Commutator sparking	<ul style="list-style-type: none"><li>• General overload</li><li>• Weak brush springs</li><li>• Mica protruding from copper bars</li></ul>	Overhaul starter Replace brush springs Undercut mica and clean commutator

# CHARGING

## BOSCH ALTERNATOR



- 1. Spacer
- 2. Split pulley
- 3. Spacer
- 4. Fan
- 5. Tie bolt
- 6. Drive end head
- 7. Drive end bearing
- 8. Plate
- 9. Key
- 10. Rotor

- 11. Regulator end bearing
- 12. Stator
- 13. Heat sink
- 14. Regulator end support
- 15. Voltage regulator brush carrier
- 16. Brush spring
- 17. Brush
- 18. Fan nut
- 19. Lockwasher
- 20. Regulator connector

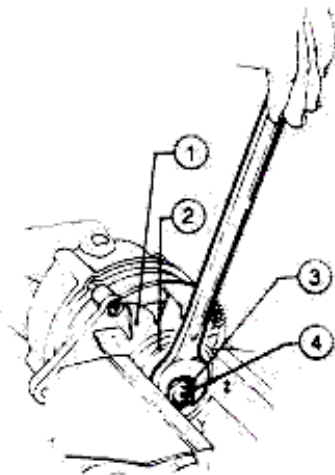


**DISASSEMBLY**

**CAUTION:**

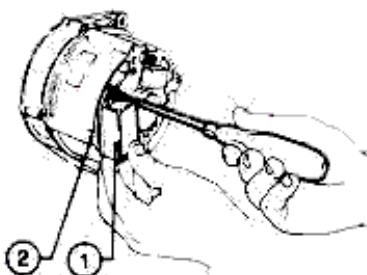
The following procedures apply to component replacement.  
For inspection purposes do not perform debonding operations described.

a. Clamp alternator drive pulleys (2) in a vice provided with soft jaw liners. Loosen nut (3) retaining pulley and fan (1) to rotor shaft (4). Remove nut, lockwasher, split pulley with spacer and fan with washers and key.



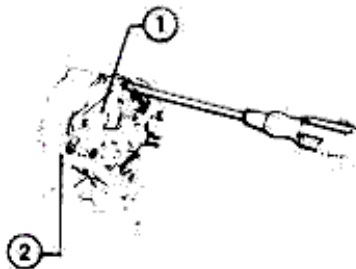
- 1. Fan
- 2. Pulley
- 3. Nut
- 4. Shaft

b. Back off two capscrews securing voltage regulator (1) to regulator end support (2). Remove regulator with brush carrier attached.



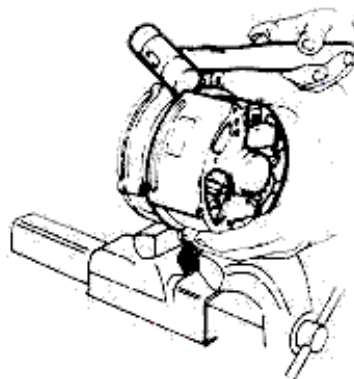
- 1. Voltage regulator
- 2. Regulator end support

c. Clamp drive end head (1) in a vice and back off tie bolts retaining head to regulator end support (2).

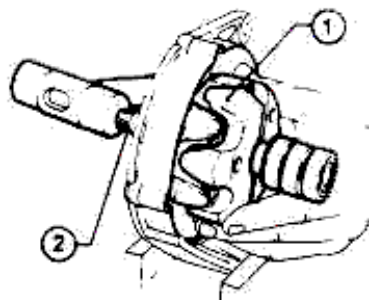


- 1. Drive end head
- 2. Regulator end support

d. Remove regulator end support tapping support periphery lightly with a plastic mallet as shown.

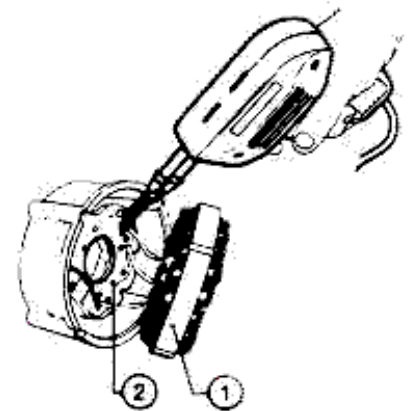


e. Take out rotor (1) tapping rotor shaft (2) with a plastic mallet as shown.



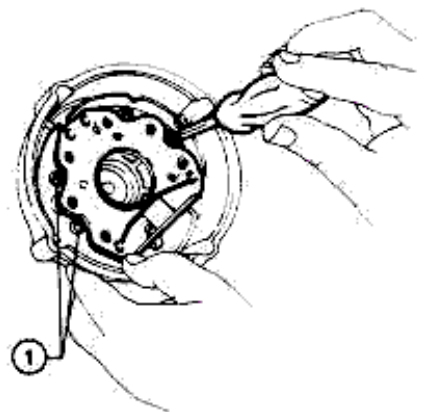
- 1. Rotor
- 2. Rotor shaft

f. Unsolder the three phase connections from stator (1) on heat sink (2).



- 1. Stator
- 2. Heat sink

g. Back off screws (1) retaining heat sink to regulator end support. Remove heat sink.

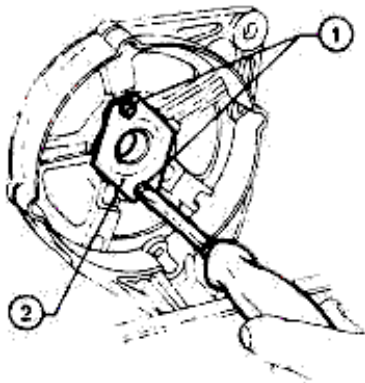


- 1. Heat sink retaining screws

h. Back off two screws (1) retaining bearing plate (2) to drive end head. Take off bearing.

**CAUTION:**

If worn or damaged the bearing must be replaced on assembly.

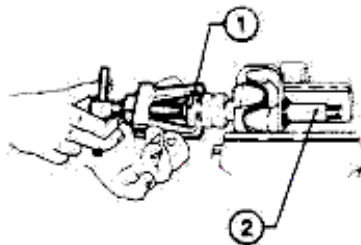


- 1. Screws
- 2. Plate

i. Using a suitable pulley as shown or a press with ring adapters and punch remove regulator end bearing (1) from rotor shaft (2).

**CAUTION:**

If worn or damaged replace bearing on assembly installing it at the press using a tubular adapter resting on bearing inner race only.



- 1. Bearing
- 2. Shaft

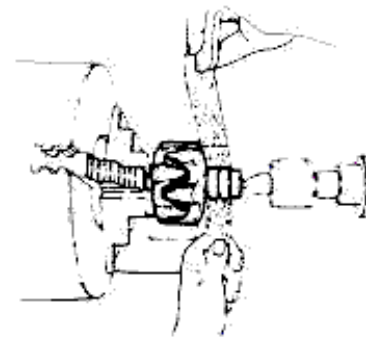
**INSPECTION**

**CAUTION:**

Prior to performing electrical tests, thoroughly clean all components with compressed air.

**Slip rings**

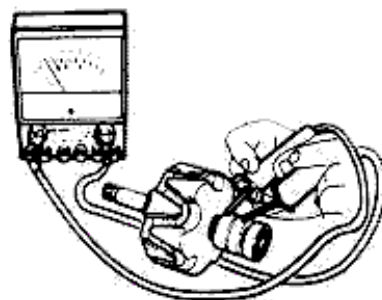
- a. Check slip rings for wear.
- b. If slip rings are lightly scored, grip rotor on the lathe and polish using armature grade emery cloth. If badly scored, the rotor should be replaced.



**Rotor O/C test**

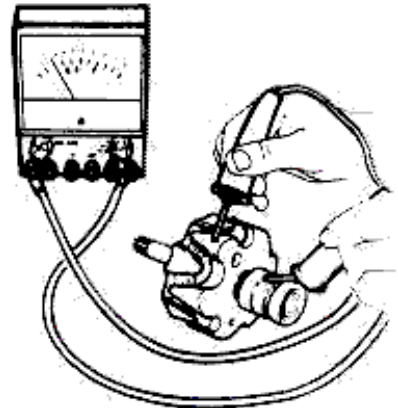
- a. Turn tester switch to Ohm scale  $\Omega \times 1$ .
- b. Place tester probes in contact with slip rings.
- c. Check that rotor winding resistance is within the specified limits.
- d. If an O/C condition is found to exist replace rotor.

$4 \pm 0.1 \text{ Ohm}$



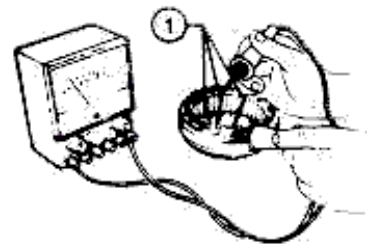
**Rotor Insulation test**

- a. Turn tester switch to Ohm scale  $\Omega \times 1$ .
- b. Place one tester probe in contact with one slip ring and the other probe in contact with rotor body. Repeat the operation on the other slip ring.
- c. The tester should indicate zero current flow.
- d. If insulation is defective replace the rotor.



**Stator winding insulation test**

- a. Turn tester switch to Ohm scale  $\Omega \times 1$ .
- b. Rest one tester probe on stator pack and the other on each phase terminals (1) in turn.
- c. The tester should indicate zero current flow.
- d. If insulation is defective replace the stator.

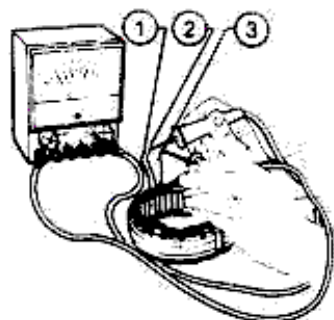


- 1. Phase terminals

**Stator winding O/C test**

- a. Turn tester switch to Ohm scale  $\Omega \times 100$ .
- b. Check for O/C condition across 1-2, 1-3 and 2-3.

- c. The tester should indicate current flow in each case.
- d. If an O/C condition is found to exist replace the stator.



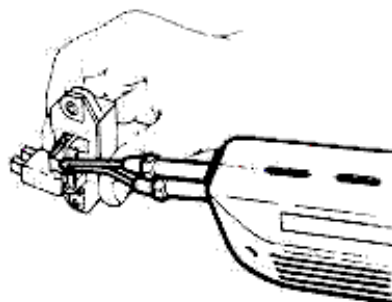
- 1. Phase terminal
- 2. Phase terminal
- 3. Phase terminal

**Brush wear**

- Check brushes in carrier on voltage regulator for flaking and carbon dust. Brush length should be as specified.

Min. brush stand-out:  
5 mm (0.20 in)

- If brushes are worn, unsolder the lead as shown and replace brushes.

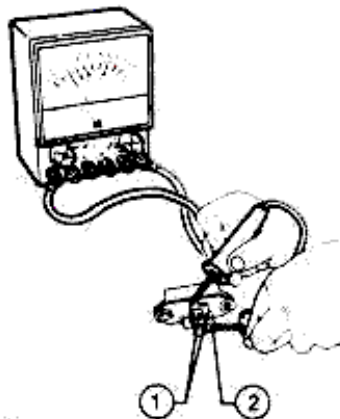


**Brush spring check**

Check brush spring for weakness. Spring load should be adequate to ensure proper brush contact with slip rings. If inadequate contact is detected, replace the entire voltage regulator.

**Brush carrier O/C test**

- a. Turn tester switch to Ohm scale  $\Omega \times 100$ .
- b. Rest one tester probe on one brush ① at a time.
- c. Rest the other probe on terminal ②.
- d. Check that tester indicates a current flow.
- e. If an O/C condition is detected check brush seating. If necessary, replace brushes and/or carrier.



- 1. Brushes
- 2. Terminal

**Diode test**

- Zero tester over Ohm scale  $\Omega \times 1$ .
- Place tester probes on ends of a diode.
- Either of the following should occur:
  - Tester does not indicate a flow of current (infinite resistance):

Diode resistance to reverse current flow:  $R = \infty$

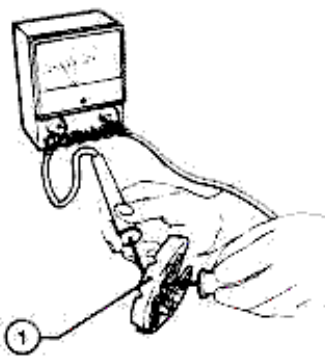
Change over probes and check whether tester indicates the specified current:

Diode resistance to forward current flow:  $R = 0$  to 10 Ohm

- Tester indicates a current flow and, hence, the specified resistance.
- Change over probes and check to ensure that tester does not indicate a current flow (infinite resistance).

**CAUTION:**  
The above operations must be carried out on all field diodes.

- If the specified readings are not obtained replace the entire heat sink.



- 1. Heat sink

**ASSEMBLY**

To assemble alternator reverse the disassembly sequence, bearing in mind the points indicated in the note below.

**CAUTION:**

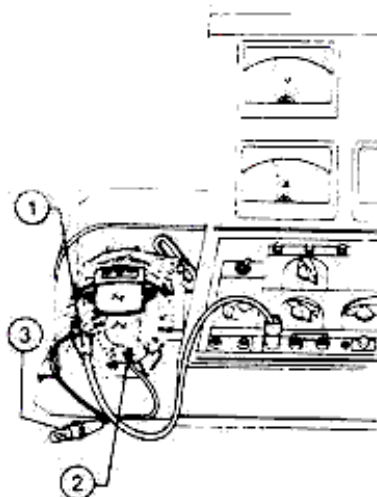
The soldering operation to join the three stator leads to the heat sink, and on Bosch alternator to replace the brushes, should be accomplished in the shortest possible time in order to prevent diode overheating.

**BENCH TEST**

- a. Place alternator on tester and establish the electrical connections to tester motor.
- b. Establish the following connections:
  - Terminal B+ on alternator to tester positive.
  - Indicator bulb to alternator terminals B+ and D+.
  - Energize tester.
- c. Run alternator for one hour at 3000 rpm, suitably inserting rheostats to produce a load adequate to bring voltage to 13 to 14 V.
- d. Slow down motor to obtain 1 to 2 A output, disconnect load rheostats and adjust speed to obtain the 13 to 14 V specified for testing. In these conditions, take a current reading and record the corresponding rpm rate.

e. Hold voltage steady at 13 to 14 V through battery, adjust speed and load rheostats and record current output and corresponding rpm rate. This operation should be repeated at several points, starting from the lower readings (1 to 2 A) up to maximum rated output.

f. Check that output readings for the various rpm rates are equal to or higher than specified under Service Data and Specifications.



- 1 Terminal B+
- 2 Terminal D+
- 3 Indicator bulb

## SERVICE DATA AND SPECIFICATIONS

### TECHNICAL DATA – CHECKS AND ADJUSTMENTS

Alternator (1)		Alfa Romeo Part No.	119.13.05.050.00	195.46.05.060.00
		Type	BOSCH K1-14V65A21 0.120.489.905.906	BOSCH 0.120.488.103
Rated voltage		V	14	
Voltage range		V	-	
Output data	Rated current (65 A)	rpm	6000	
	Initial output speed	rpm	1060	
	Speed at 2/3rd of max. output	rpm	2100	
Maximum alternator speed		rpm	15000	
Brush wear limit		mm (in)	-	
Field winding resistance		Ω	-	
Voltage regulator resistance		Ω	-	
Diode resistance		Ω	-	

(1) Integral electronic voltage regulator version

## **TROUBLE DIAGNOSIS AND CORRECTIONS**

Prior to initiating alternator diagnosis ensure that battery is fully charged (see: Battery).

<b>Condition</b>	<b>Probable Cause</b>	<b>Corrective Action</b>
Alternator fails to charge	<ul style="list-style-type: none"> <li>• Slack drive belt</li> <li>• Charging or ground return circuit affected by O/C</li> <li>• Defective brushes</li> <li>• Field diode S/C</li> <li>• Field circuit affected by O/C</li> <li>• Rotor winding O/C</li> <li>• Voltage regulator inefficient</li> <li>• Stator winding grounded</li> </ul>	<ul style="list-style-type: none"> <li>Tension belt</li> <li>Check circuit</li> <li>Replace brushes</li> <li>Replace heat sink</li> <li>Check circuit</li> <li>Replace rotor</li> <li>Replace voltage regulator</li> <li>Replace stator</li> </ul>
Output low or unsteady	<ul style="list-style-type: none"> <li>• Slack drive belt</li> <li>• Intermittent O/C in charging circuit</li> <li>• Worn brushes</li> <li>• Voltage regulator inefficient</li> <li>• Field diode O/C or S/C</li> <li>• Rotor partially S/C</li> <li>• Stator O/C, grounded or partially S/C</li> </ul>	<ul style="list-style-type: none"> <li>Tension belt</li> <li>Check circuit</li> <li>Replace brushes</li> <li>Replace voltage regulator</li> <li>Replace heat sink</li> <li>Replace rotor</li> <li>Replace stator</li> </ul>
High output	<ul style="list-style-type: none"> <li>• Voltage regulator inefficient</li> </ul>	<ul style="list-style-type: none"> <li>Replace voltage regulator</li> </ul>
Noisy alternator	<ul style="list-style-type: none"> <li>• Worn drive belt</li> <li>• Loose drive pulley</li> <li>• Bearings inefficient</li> <li>• Field diode S/C</li> <li>• Alternator loose</li> </ul>	<ul style="list-style-type: none"> <li>Replace belt</li> <li>Tighten retaining nut</li> <li>Replace bearings</li> <li>Replace heat sink</li> <li>Tighten retaining capscrews</li> </ul>

# DIGITAL ELECTRONIC IGNITION

## DESCRIPTION

Digital electronic ignition is an inductive-discharge system without contacts that controls the conduction time and the coil current resulting in constant-energy sparks regardless of engine speed and battery voltage. This system consists of the following components (see following diagram):

- Ignition distributor A5, with Hall-effect sensor.
- Ignition coil A8, on heat sink with electronic module N1.
- Ignition electronic advance control unit N20.
- Spark plugs A12.

The ignition system also receives the engine temperature and acceleration throttle opening signals from sensors located on the engine (some vehicles are not equipped with the engine coolant temperature sensor).

## IGNITION DISTRIBUTOR AND HALL SENSOR

The ignition distributor A5 is fitted with magnetic pulse generator A6 (Hall-effect sensor) and a vacuum advance control device to alter the ignition advance in relation to the air supply system vacuum.

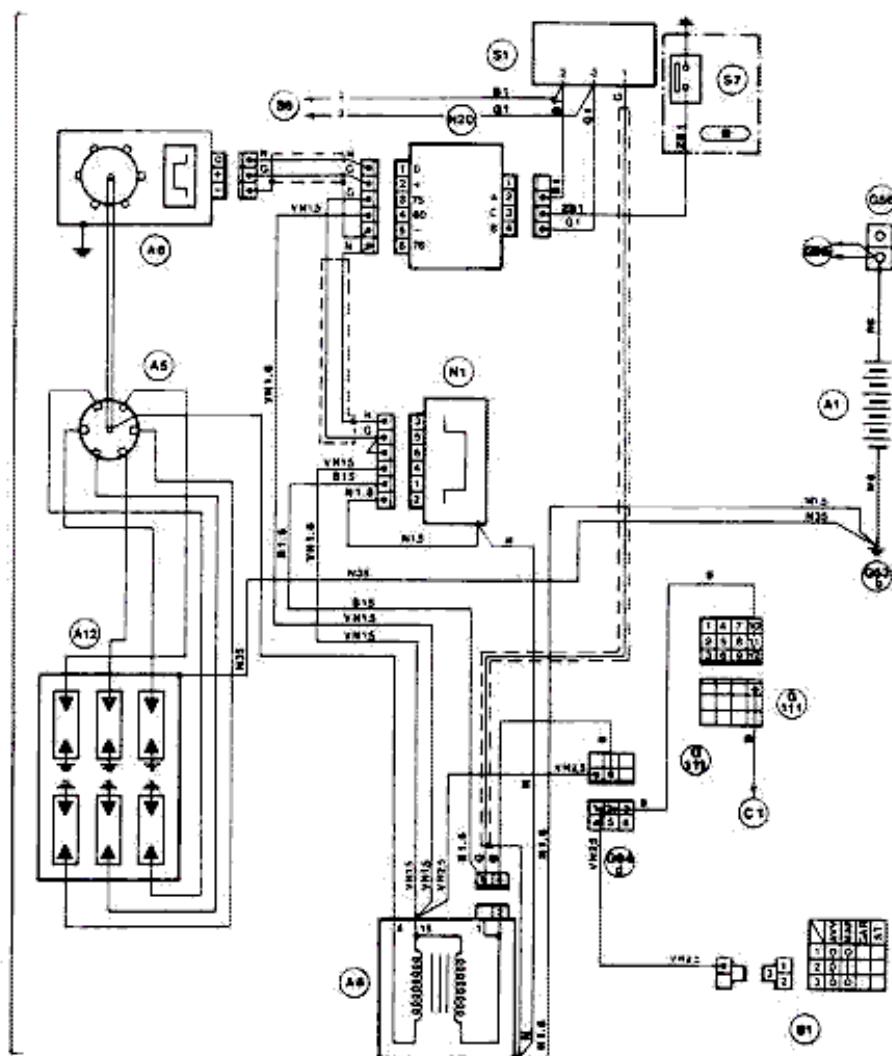
High voltage is supplied to the spark plugs via a rotor arm and respective cap.

The Hall sensor is positioned inside the ignition distributor and generates six pulses each time it turns, i.e. every two crankshaft turns. The control unit uses these pulses as a reference to calculate the advances. The sensor operates according to the sensitivity of certain semiconductors to magnetic fields. This phenomenon is known as the Hall-effect. The system consists of a Hall-effect device with a small permanent magnet that determines conduction. A ferrous, sector disk rotates on the distributor shaft. Whenever a disk sector enters the magnetic field, it alters the magnetic flux thus causing the sensor to generate a positive pulse that lasts for the same amount of time as the magnetic field interruption.

The Hall-effect sensor differs from the inductive type sensors in that the output signal is perfectly squared and has constant intensity even when the number of revolutions varies, thus permitting direct control of the digital electronic devices without having to treat the signal in any special way.

In order to operate, the sensor must be supplied with +12V and ground, while the signal is picked up via a third wire with amplitude 0 or 5 V.

**Note - This diagram is applicable to both V6 2.5 and V6 3.0 versions with the exception of the numbering of the control unit N20 connector (see wiring diagram on page 05-3).**



- A5 Ignition distributor
- A6 Magnetic pulse generator
- A8 Ignition coil
- A12 Spark plugs
- B1 Ignition switch
- C1 Electronic rev-counter
- G53b Left engine compartment ground
- G94d Left engine compartment connector
- G111 Dashboard instrumentation wiring connector
- N1 Electronic ignition module
- N20 Ignition advance variation control unit
- S1 Injection control unit
- S6 Accelerator throttle body switch
- S7 Engine coolant temperature sensor

The sensor output signal is used by the ignition electronic advance control unit.

## IGNITION ELECTRONIC ADVANCE CONTROL UNIT

A microprocessor in this control unit stores optimal design ignition advance angles for all possible vehicle operating conditions. The correct advance value for any given operating condition is selected through digital processing of signals from various sensors in the engine and comparison with design values stored in microprocessor.

## ELECTRONIC MODULE IGNITION COIL

This unit consists of electronic module N1, ignition coil AB mounted on a finned aluminum alloy heat sink.

The electronic module incorporates the whole system in the form of a set of integrated circuits mounted on a ceramic support, with adequate compensation for stable performance over a wide range of operating temperatures, and is suitably filtered to minimize RF interference both ways. A sealed container protects the device.

### Electronic module operation

The electronic module receives signals from the ignition advance control unit and then processes them on the basis of the information received from primary current limiting circuit and from output transistor energization time control circuit. The energizing time (coil charging) consequently remains steady when engine r.p.m. varies and

the primary current reaches the pre-established value, thereby resulting in steady secondary voltage as well. The control of energizing time and primary current amplitude also ensures that in limit starting conditions (low engine cranking speed and low battery charge) secondary voltage is still sufficient to ignite the fuel.

## CAUTIONS

Prior to starting work on the ignition system, switch off the ignition and disconnect the battery.

Possible work on the ignition system includes:

- Connection to engine test equipment (strobe lamp, dwell angle tester, oscilloscope, etc.).
- Ignition system component replacement (spark plugs, ignition coil, distributor, H.V. leads, etc.).

If during ignition system testing or on-engine adjustment the ignition or the voltage supply is to be turned on, the **entire system is energized** and becomes dangerous. The risk of injury by electric shock is very real as regards not only the ignition system components proper (e.g. distributor, coil, electronic units, spark plugs), but also the wiring harness (such as tachometer connection, diagnostic jack) of pin connections and test equipment.

- Resistance readings should only be recorded with ignition switched off or battery isolated (defective apparatus).
- For compression testing, disconnect the power module terminal pin or positively ground terminal 4 on the coil to the auxiliary lead to prevent injury and damage to components. The auxiliary lead should be connected to a resistance of at least 2 k Ohm. For instance using the R.F. interference suppressor (5 k Ohm).
- The ignition coil should only be replaced with the specified coil for the vehicle.

- No R.F. interference suppressor should be connected to terminals 1 and 15 on the coil.
- Coil terminal 1 should not be grounded for anti-theft protection (when ignition is switched on, the coil would be damaged beyond repair).
- Coil terminal 1 should not be connected to the battery positive, nor to an inspection lamp (the power module would be damaged beyond repair).
- Ignition lead from coil terminal 4 to distributor terminal 4 should not be disconnected during operation.
- There should be no voltage discharge across coil terminal 4 and coil terminals 1 and 15 since injectors and power module would be damaged beyond repair.
- To prevent power unit damage, connect the ignition system secondary to at least 2 k Ohm; original distributor rotor arm should have an R.F. interference suppressor resistance of 1 k Ohm (do not use 5 k Ohm rotor for R.F. interference suppression).
- Do not connect any separate voltage source (e.g. Ohmmeter) to the electronic switch (Hall sensor).
- Pay attention when switching test equipment measurement range.
- Leads across Hall sensor and power module should be separated from the other leads. The distance from Hall sensor leads to ignition leads and lead across power module terminal 1 and coil terminal 1 should be at least 100 mm (4 in) (otherwise the Hall sensor will be damaged beyond repair).
- Distributor cap retaining springs should not be allowed to fall inside the sensor when turning the crankshaft with the dust cover removed.
- Any voltage discharge or breakdown of the distributor cap (defective insulation) could damage both power module and Hall sensor beyond repair.
- Never disconnect battery terminals with the engine running.
- If the battery cables are interchanged, the distributor sensor, the power module, the coil and ignition advance ECU will be damaged beyond repair.
- Do not jump start at a voltage higher than 16 V or using a quick charger.

## CHECKS AND INSPECTIONS ON VEHICLE

### a. General checking regulations

**CAUTION:**

Avoid checking for voltage or current by sparking or grounding the high and low voltage points unless special checks are specified with the appropriate procedure to be followed.

In addition, do not:

- Disconnect cable across coil high voltage tap and distributor when starting or with engine running.
- Ground the coil low voltage terminal connected to the rev-counter.
- Use diagnostic equipment that allows the LV signal to be short-circuited across coil primary and rev-counter.

**CAUTION:**

Before energizing the unit, ensure that electrical system connectors are well inserted and that the coil-module unit is positively grounded to ensure effective connection.

**CAUTION:**

The stroboscopic gun should always be connected directly to battery terminals.

### b. System operation check

- With ignition key set to off (ignition switch open) visually check system installation and wiring. If the results are positive, proceed as follows:

- check the ground connection between ignition unit heat sink and engine block, and heat sink and negative battery pole respectively.

The ohmmeter reading must be less than 0.2 ohm.

- check whether the connector connecting the distributor to the ignition unit is properly seated with the connector pin hooked onto heat sink stop.

- With the ignition key set to on (ignition switch closed) and engine stationary take a voltmeter reading to ensure that the voltage on the coil's positive terminal is the same as the battery voltage (approx. 12V). The voltage on the coil's other terminal should not vary from that of positive terminal by more than 0.3V (approx. 11.7V).

If the voltage readings are not as specified, check whether the cause is to be attributed to coil primary open circuit.

- After ignition timing (see Group 00 - Engine Ignition), check coil windings for open circuits. To do this, disconnect rev-counter lead and with ignition key set to off, take an ohmmeter reading to ensure that primary and secondary resistance is as specified.

Coil		Bosch
Primary winding resistance at 20°C (68°F)	Ω	0.7 to 1.2
Secondary winding resistance at 20°C (68°F)	kΩ	6.9 to 11.9

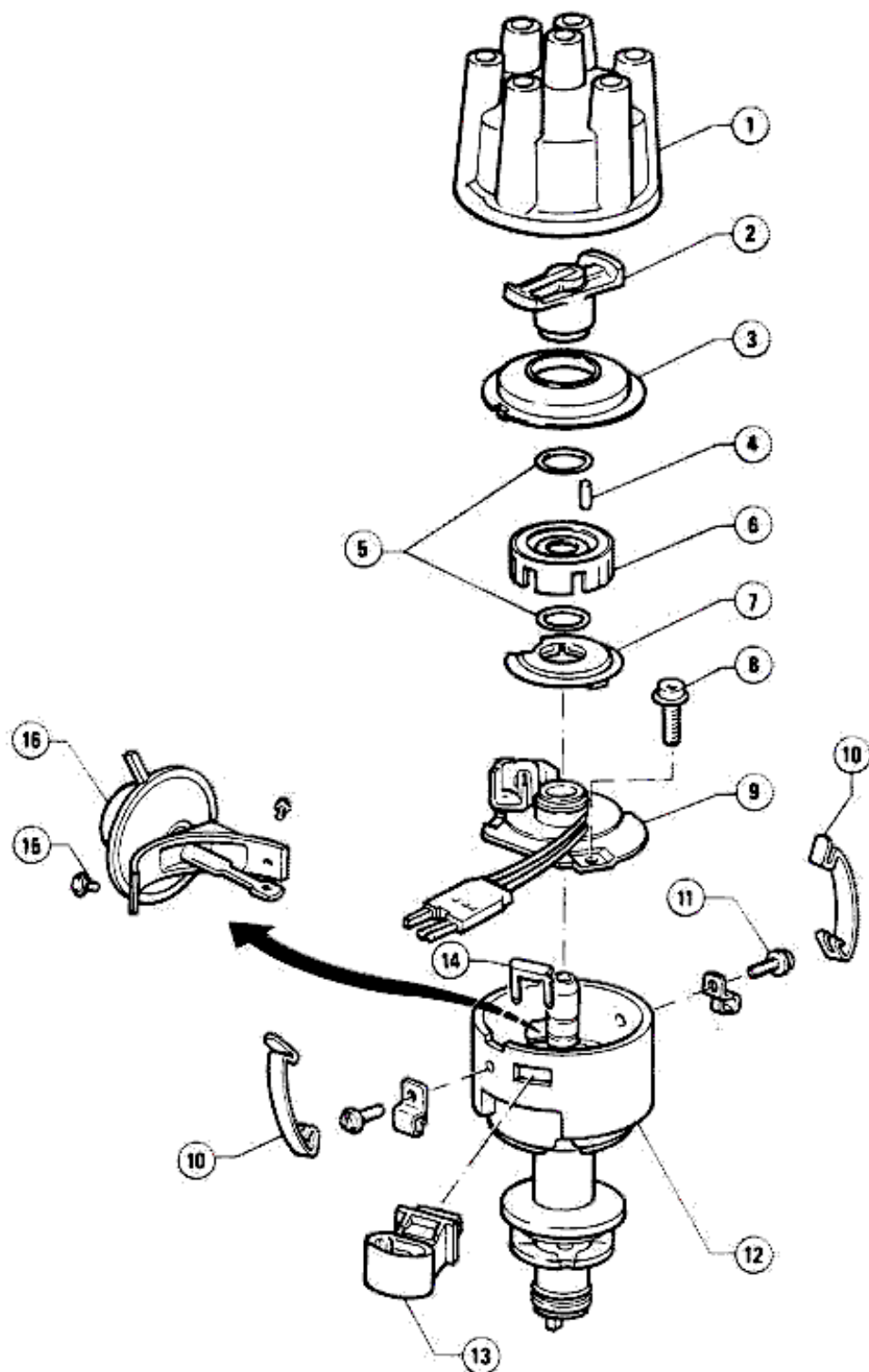
- General ignition system check: With ignition key set to on, disconnect one LV lead from a spark plug and hold free end of lead 5 mm (1/4 in) away from engine block.

**CAUTION:**

Wear insulating gloves, start engine and check that sparking takes place.



BOSCH DISTRIBUTOR



- |   |   |
|---|---|
| 1 Cap   | 9 Device controlling vacuum advance with Hall-effect sensor |
| 2 Rotor arm   | 10 Clip securing cap  |
| 3 Dust cover  | 11 Screw securing clip                                      |
| 4 Driving key                                       | 12 Distributor body   |
| 5 Retaining ring                                    | 13 Hall-effect sensor connector                             |
| 6 Sector disk                                       | 14 Clamp  |
| 7 Plastic disk                                      | 15 Screws securing advance regulator                        |
| 8 Screw securing advance device to distributor body | 16 Vacuum advance regulator                                 |

## DISASSEMBLY

Below are described the operations for disassembling the ignition distributor for those parts that are to be serviced.

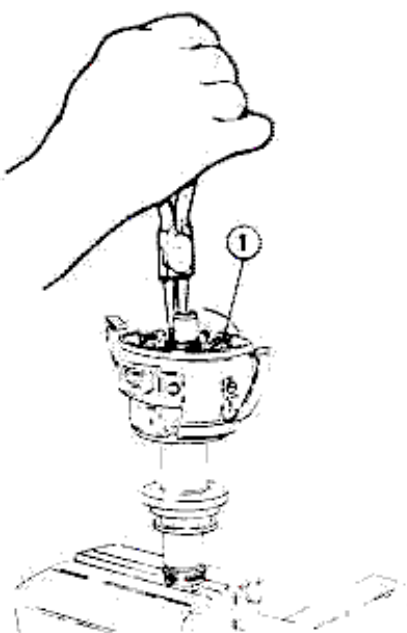
a. Secure the distributor in a vice fitted with protective jaws.

b. Unhook the securing clips, remove cap ① and rotor arm ② together with the dust cover underneath.



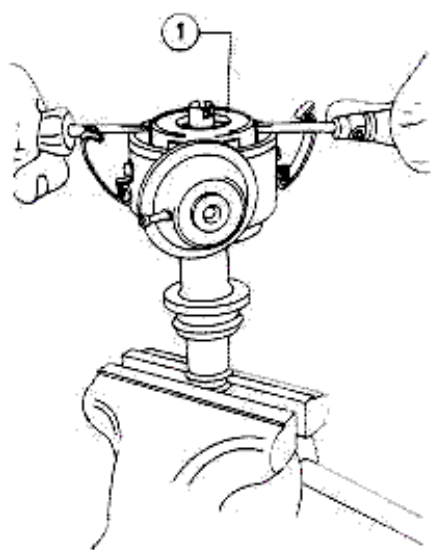
- 1 Cap
- 2 Rotor arm

c. Remove disk retaining ring ① as illustrated in figure.



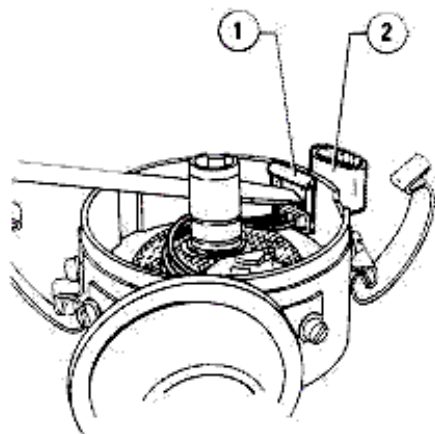
- 1 Sector disk

d. Prise sector disk ① out with the driving key and then remove the retaining ring underneath.



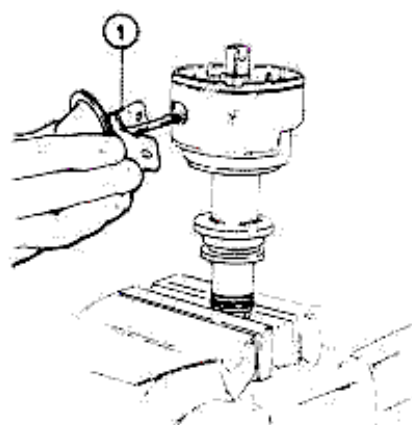
- 1 Sector disk

3. Remove the pressed-in plastic disk, then remove clamp ①, disconnect wiring and remove connector ②.



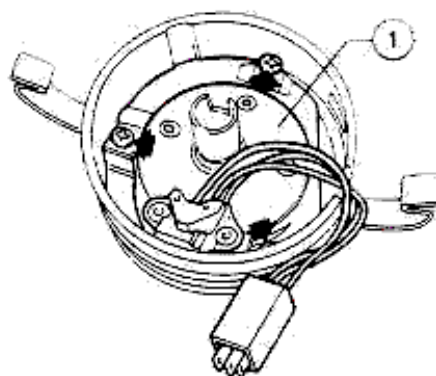
- 1 Clamp
- 2 Hall-effect sensor connector

f. Unscrew securing screws on advance regulator ① and remove it from the drive pin inside the distributor.



- 1 Vacuum advance regulator

g. Unscrew the three securing screws inside the distributor and remove device ① controlling the vacuum advance, with Hall-effect sensor.



- 1 Device controlling vacuum advance with Hall-effect sensor

h. If necessary, unscrew the screws of the clips securing the cap and remove them.

## CHECKS AND INSPECTIONS

a. Check that the shaft inside the distributor rotates freely and that there is no running clearance.

b. Check that the Hall-effect sensor wiring is in good condition.

c. Check that the device controlling the vacuum advance rotates freely with respect to the securing bracket.

## ASSEMBLY

To reassemble reverse the order of removal in accordance with the following:

- Remember to fit the sector disk driving key.
- After fitting the sector disk check that the disk rotates freely without touching the Hall-effect sensor.

## BENCH TEST

### Vacuum advance

- Install distributor on tester and establish the necessary connections.
- Zero the spark on angle dial on tester turning distributor by hand or through tester motor. Do not exceed 50 rpm.
- Connect vacuum hose to tester vacuum gauge.
- Read advance curve in a condition of increasing vacuum (see: Group 00 - Engine maintenance - Engine Ignition).
- If the curve obtained is not as specified, replace vacuum advance device.

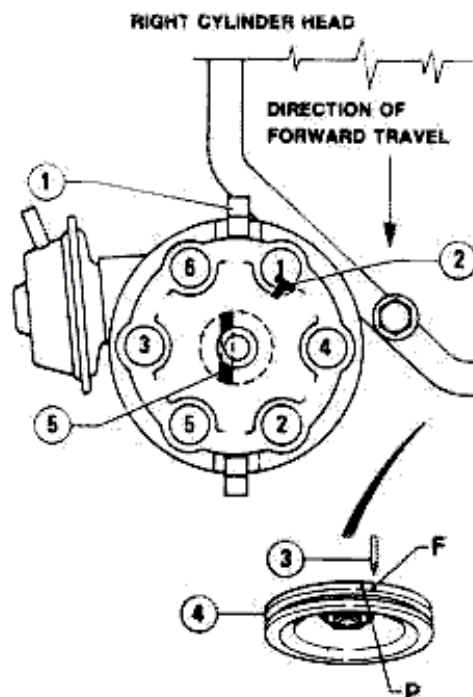
## ON-VEHICLE DISTRIBUTOR INSTALLATION

To install the ignition distributor on the engine proceed as follows:

- Turn the crankshaft to bring piston number 1 on compression stroke, i.e. with both valves closed. To do this, turn crankshaft pulley (4) so that reference mark "F" stamped on the pulley, lines up with reference pointer (3).

stamped on the pulley, lines up with reference pointer (3).

- Lubricate the gasket on the lower part of the distributor body with engine oil; remove the cap and install the distributor with the rotor arm pointing toward cylinder number 1.
- Position the distributor correctly as illustrated in the figure, and rotate it until the reference mark on the edge of the body is in line with rotor arm (2) centerline.
- Fasten the distributor in this position with the clip provided.
- Install cap on distributor and connect the spark plug leads in the correct ignition sequence (1-4-2-5-3-6).
- Carry out ignition timing using a stroboscopic lamp.



- Cap retaining clip
- Rotor arm to 1st cylinder
- Reference pointer
- Crankshaft pulley
- Keying tooth

## ELECTRICAL TESTS

- Make sure that both the connectors on the control unit are inserted. Raise rubber protector on receptacle connector of distributor.
- With connector inserted, place voltmeter probes in contact with positive (+) and negative (-).
- Turn on ignition and check that voltage from ECU is 12V approx.
- Place one voltmeter probe in contact with center conductor (0) on sensor connector and the other probe in contact with vehicle ground.
- Turn on ignition, rotate crankshaft by hand through one revolution and check that 5V voltage is indicated for a given distributor angle of rotation only.

### CAUTION:

This voltage indicates the point at which ferromagnetic material discontinues magnetic flow across permanent magnet and sensor.

- Check cable continuity between Hall sensor and electronic control unit.
- Also check for S/C across conductors relative to one another and across each conductor and ground.

## ENGINE TEMPERATURE SENSOR

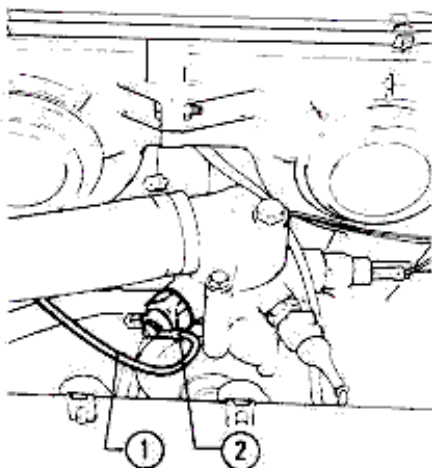
### LOCATION

The engine temperature sensor for the ignition advance control unit is secured on the front right of the thermostat body.

### REMOVAL AND INSTALLATION

1. Disconnect wiring ①
2. Unscrew sensor ② from thermostat body and remove it with relative gasket.

Collect coolant that drains from the system.



- 1 Wiring
- 2 Engine temperature sensor for ignition advance control unit

3. When reinstalling, replace the gasket, apply antiseize R.GORI Never Seez on the threading and tighten sensor to specified torque.

- Ⓡ : Tightening torque  
 Engine temperature sensor on thermostat container  
 30 N·m  
 (22.4 ft·lb;  
 3.1 kg·m)

4. Reconnect wiring to the sensor and top up the cooling system with the specified liquid (see: Group 07).

### CHECKS AND INSPECTIONS

The engine temperature sensor contact is normally closed; check that the contact opens at a temperature of 35 to 41°C (95 to 106°F).

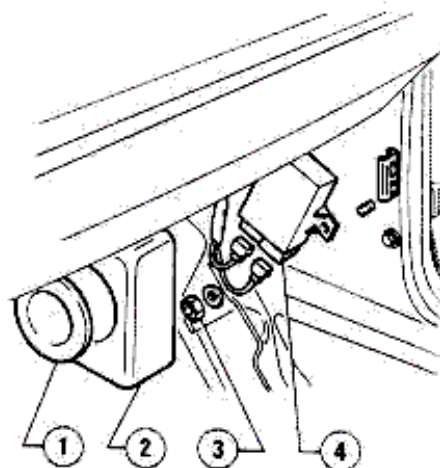
## IGNITION ADVANCE CONTROL UNIT

### LOCATION

The ignition advance control unit is located at the front right of the passenger compartment, under the dashboard.

### REMOVAL AND INSTALLATION

1. Remove the pressure-inserted protective cover ② and disconnect roof lamp wiring ①.
2. Unscrew nut ③, disconnect wiring and remove the ignition advance control unit.



- 1 Roof lamp
- 2 Cover
- 3 Nut
- 4 Ignition advance control unit

3. Install the ignition advance control unit by reversing the order of removal.

## SERVICE DATA AND SPECIFICATIONS

## TECHNICAL DATA

## Ignition distributor

Distributor	Alfa Romeo Part No.	116.69.05.011.00
	Type	BOSCH 0.237.322.001
Firing order	1-4-2-6-3-6	

## Ignition advance

Static advance (1) (2)	$2^{\circ} \pm 1^{\circ}$ B.T.D.C. (3) at idle
	$7^{\circ} \pm 1^{\circ}$ B.T.D.C. (4) at idle

(1) Check static advance with distributor vacuum hose disconnected

(2) Static advance position: Align pointer to ref. mark "F"

(3) For 2500 engine (019.11)

(4) For 3000 engine (061.24)

## ECU

Supply voltage	4 to 16 V
Max. current	6 A
Operating temperature range	-30 to 125°C (-22 to 257°F)

## Spark plugs

Alfa Romeo Part No.	119.00.05.106.01
Type	SILVER LODGE HL-E (1)

(1) Alternatively: CHAMPION RN 11 YC

## Ignition coil with electronic module

Ignition coil with electronic module	Alfa Romeo Part No.	116.97.65.079.00
	Type	BOSCH 0.221.600.002
Primary winding resistance [at 20°C (68°F)]	$\Omega$	0.7 to 1.2
Secondary winding resistance [at 20°C (68°F)]	$\Omega$	6900 to 11900

## Engine temperature sensor (ignition)

Normally closed; contact opens at temperature	35 to 41°C (95 to 106°F)
---	-----------------------------

## SERVICE DATA AND SPECIFICATIONS

## TECHNICAL DATA

## Ignition distributor

Distributor	Alfa Romeo Part No.	116.69.05.011.00
	Type	BOSCH 0.237.322.001
Firing order	1-4-2-6-3-6	

## Ignition advance

Static advance (1) (2)	$2^{\circ} \pm 1^{\circ}$ B.T.D.C. (3) at idle
	$7^{\circ} \pm 1^{\circ}$ B.T.D.C. (4) at idle

(1) Check static advance with distributor vacuum hose disconnected

(2) Static advance position: Align pointer to ref. mark "F"

(3) For 2500 engine (019.11)

(4) For 3000 engine (061.24)

## ECU

Supply voltage	4 to 16 V
Max. current	6 A
Operating temperature range	-30 to 125°C (-22 to 257°F)

## Spark plugs

Alfa Romeo Part No.	119.00.05.106.01
Type	SILVER LODGE HL-E (1)

(1) Alternatively: CHAMPION RN 11 YC

## Ignition coil with electronic module

Ignition coil with electronic module	Alfa Romeo Part No.	116.97.65.079.00
	Type	BOSCH 0.221.600.002
Primary winding resistance [at 20°C (68°F)]	$\Omega$	0.7 to 1.2
Secondary winding resistance [at 20°C (68°F)]	$\Omega$	6900 to 11900

## Engine temperature sensor (ignition)

Normally closed; contact opens at temperature	35 to 41°C (95 to 106°F)
---	-----------------------------

**GENERAL SPECIFICATIONS**

**Fluids and lubricants**

Description	Type	Type of product	Quantity
Spark plug thread	OIL	ISECO Molykote A Part No. 4500-18304	—
Engine temperature sensor	GREASE	R. GORI Never Seez Part No. 3671-69850	—

**TIGHTENING TORQUES**

Item	Unit of measurement	N-m (ft-lb ; kg-m)
Spark plug (wet, ISECO Molykote A)		25 to 34 (18.4 to 25.1 ; 2.5 to 3.5)
Engine temperature sensor on thermostat container (1)		30 (22.4 ; 3.1)

(1) With antiseize: R. GORI Never Seez