

**GROUP 05****ENGINE IGNITION,
STARTING AND RECHARGING****INDEX**

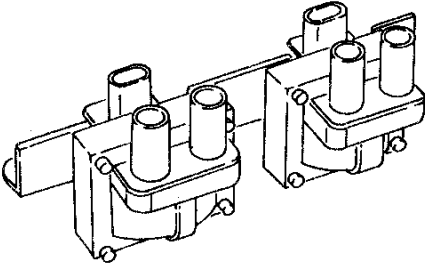
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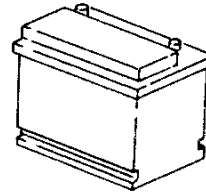
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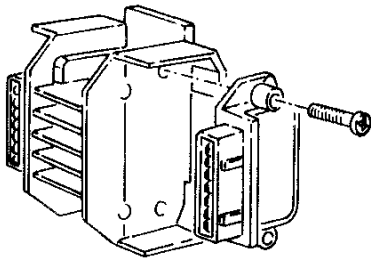
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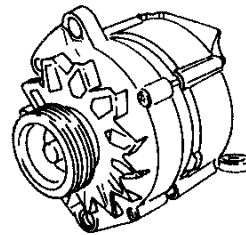
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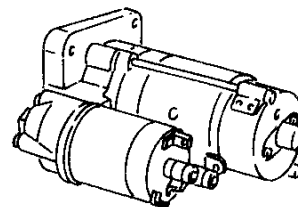
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IGNITION SYSTEM

The static ignition system is integrated with the MULTI-POINT I.A.W. injection system.

Static ignition does not require a distributor to carry the high voltage to the spark plugs and instead uses four ignition coils located inside two separate blocks each controlled by a double power module.

Each coil controls two spark plugs of different cylinders (lost spark type static distribution)

The most obvious advantages are:

- the greater power of the spark
- improved reliability
- reduction in radio interference
- smaller size.

The control unit recognizes the angular position and the speed of the crankshaft via the r.p.m. and timing sensor. In addition, processing the temperature and engine

loading signals, it calculates the ignition advance simultaneously piloting the relative pair of coils via the internal power modules (for example the spark on the spark plug of cylinder number 1 and on the corresponding cylinder number 4 are produced at the same moment).

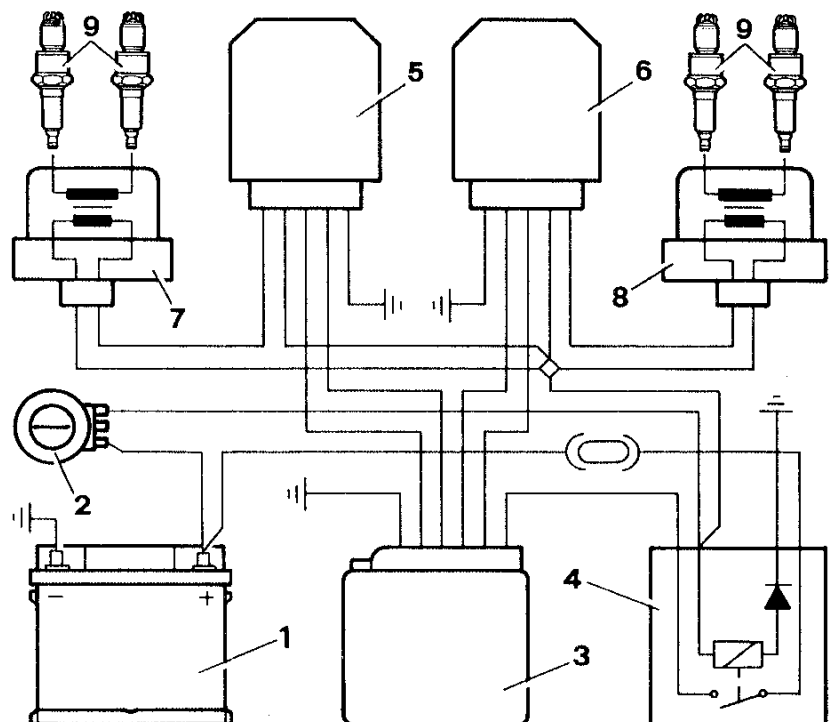
The solution employed exploits the different pressure conditions existing at the same time in the two pairs of cylinders 1-4, 2-3.

When one of the cylinders is nearing the firing phase in the presence of an air-fuel mixture, the other cylinder is at the end of the exhaust phase in the presence of exhaust gas.

Under these conditions there is a transfer of energy from the main winding to the secondary winding of the relative coil.

This transfer instantly produces an induced voltage at the ends of the secondary winding which will always have the same polarity (one end will take on a positive charge and the other a negative charge). These charges will then be transferred to the central electrodes of the spark plugs connected to them.

1. Battery
2. Ignition block
3. Ignition-injection control unit
4. Injection control relay
5. Module for electronic ignition A
6. Module for electronic ignition B
7. Ignition coil A
8. Ignition coil B
9. Spark plug





As the induced voltage on the secondary winding is always of the same polarity it follows that the discharge voltage of the coil will always travel in the same direction and the sparks will strike in opposite directions. On the spark plug with a positively charged central electrode the spark will strike the central electrode from the earth electrode while on the spark plug with the negatively charged central electrode the spark will strike the earth electrode from the central electrode.

As a consequence after a few thousand kilometers the spark plugs will show different wear patterns: on one the central electrode will be more worn and on the other the earth electrode will be more worn.

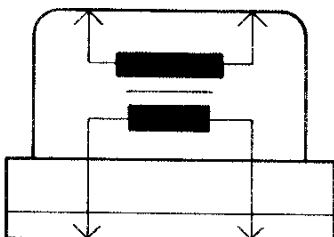
It is the operating conditions of the spark plugs themselves which determines the intensity of the spark.

In the cylinder which is at the end of the exhaust phase there will be a weak spark (lost spark) due to the presence of non-pressurized exhaust gas while in the cylinder which is at the end of the compression phase there will be an intense spark (useful spark) due to the compressed air-fuel mixture.

IGNITION COIL

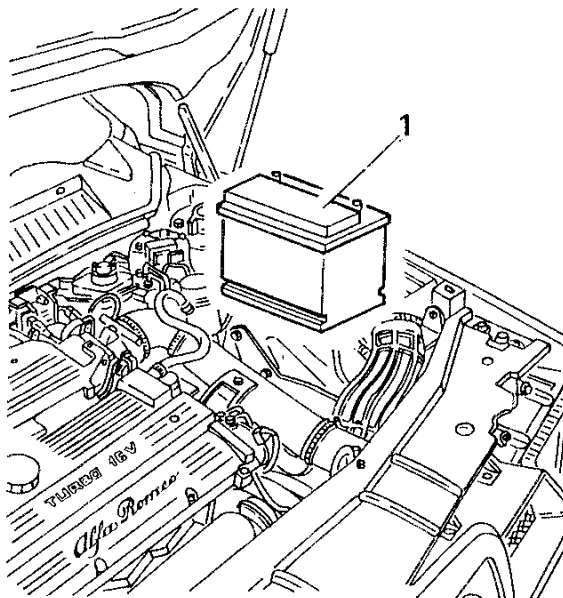
| Characteristics | Resistance (1) |
|-------------------|----------------|
| Main winding | 550 mΩ ± 10% |
| Secondary winding | 7.4 kΩ ± 10% |

(1) Measured at 23° ± 5°C.

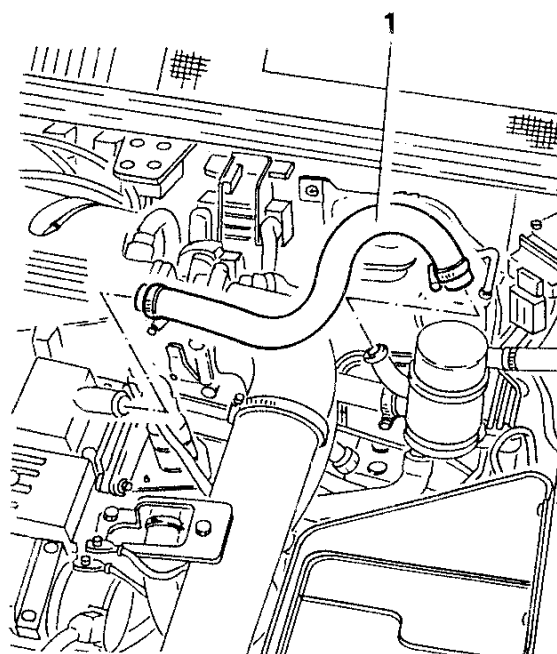


REMOVAL/REFITTING

1. Remove the battery after first disconnecting the negative (-) and then the positive (+) cables.

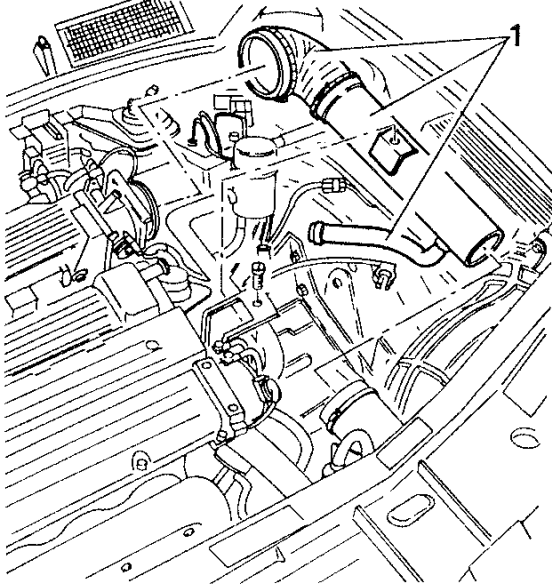


1. Remove the oil vapour recovery hose from the cylinder head.

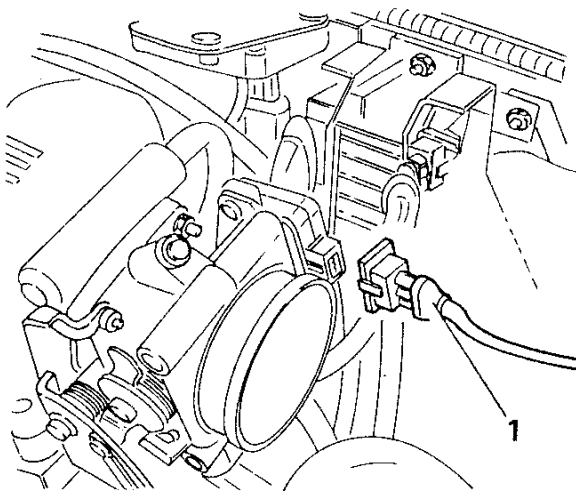




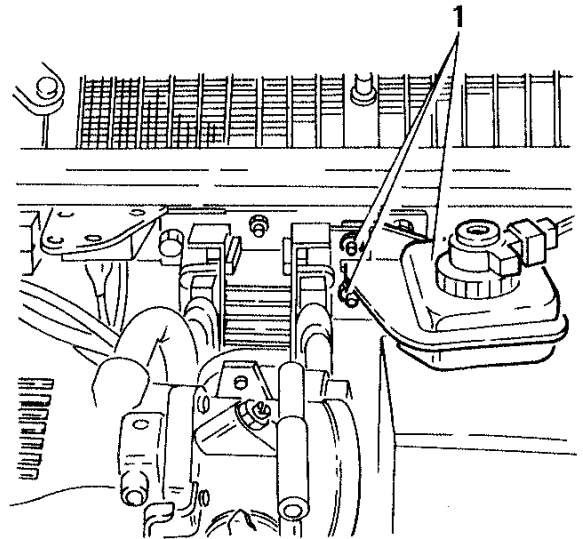
1. Remove the air intake pipe together with the connecting elbow forming the connection with the throttle body and the air intake hose for the constant idle speed actuator.



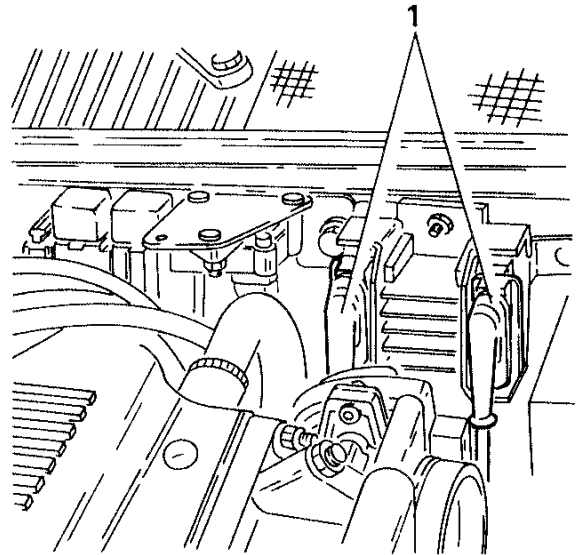
1. Disconnect the electrical connection from the throttle valve potentiometer.



1. Loosen the two screws securing the brake-clutch fluid reservoir and move it to one side.

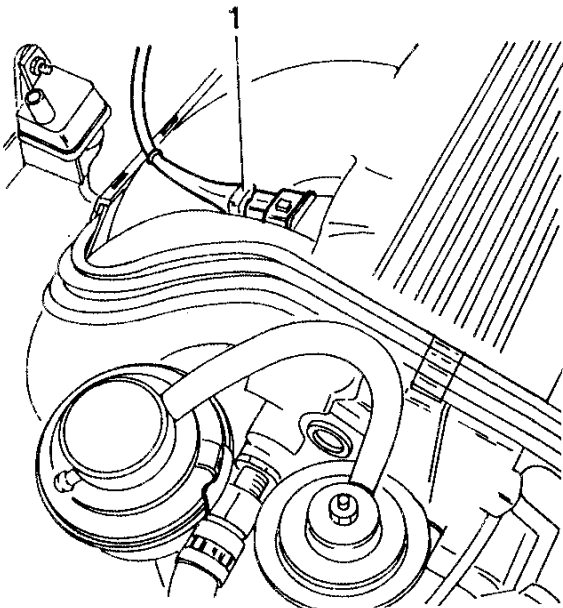


1. Disconnect the electrical connections from the two ignition modules.

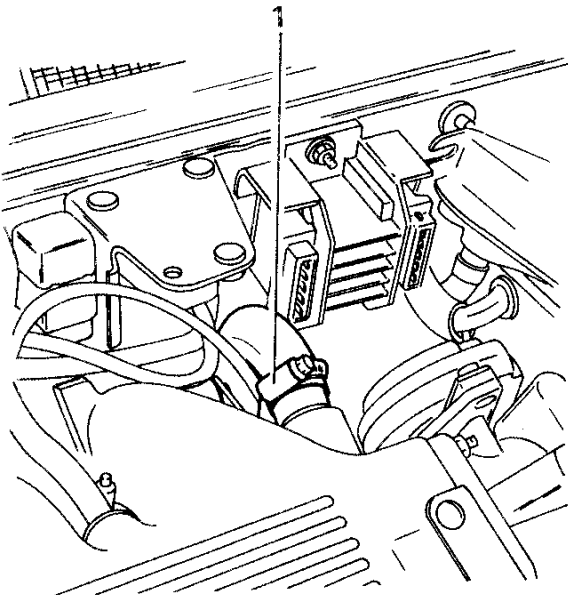




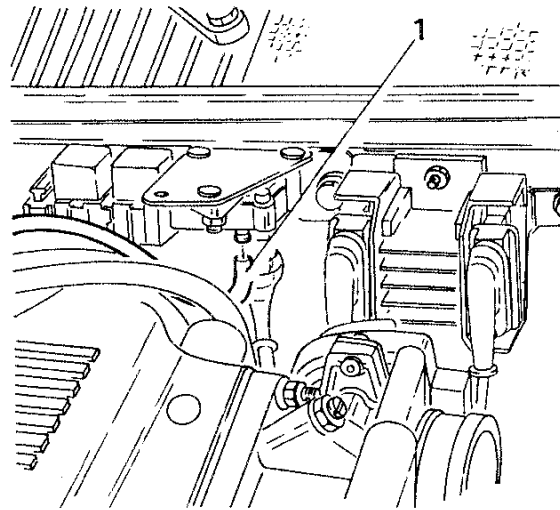
1. Disconnect the electrical connection from the intake air temperature sensor.



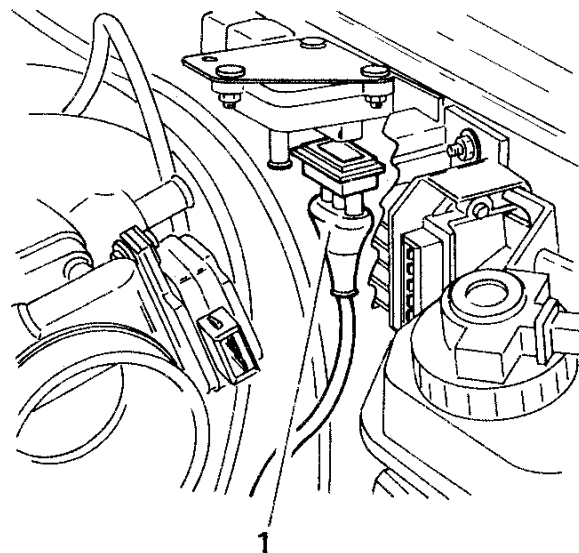
1. Disconnect the servo brake vacuum intake hose from the air intake box.



1. Disconnect the vacuum intake hose from the absolute pressure sensor.

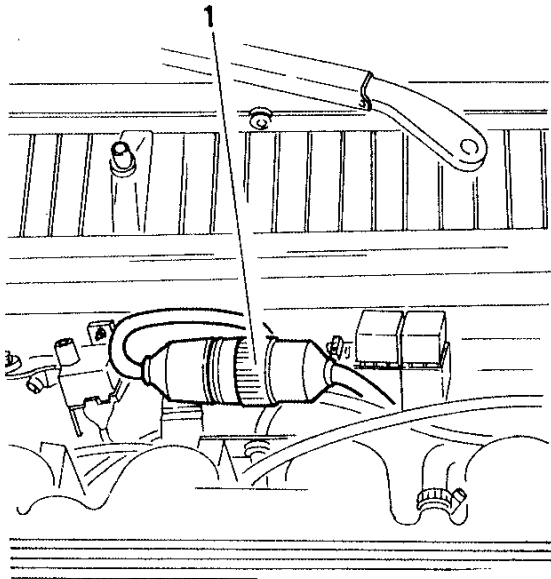


1. Disconnect the electrical connection from the absolute pressure sensor.

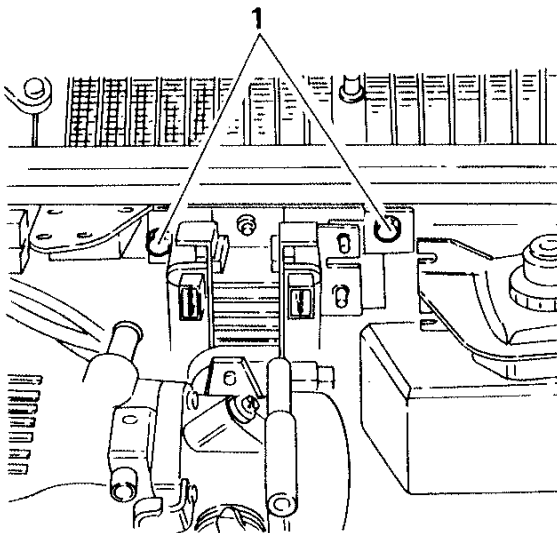




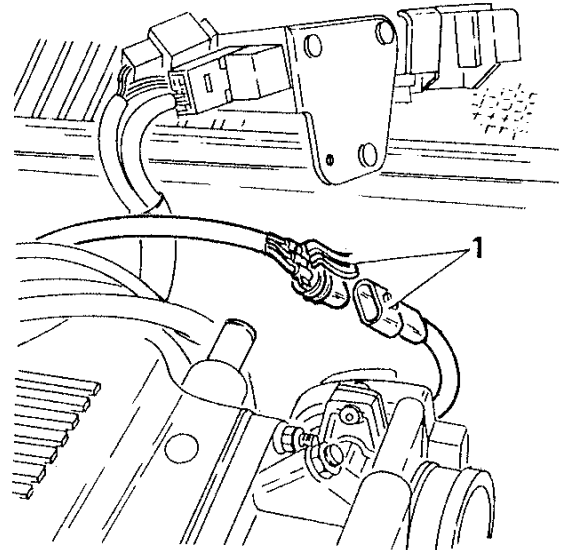
1. Disconnect the injection wiring - electroinjector wiring electrical connection.



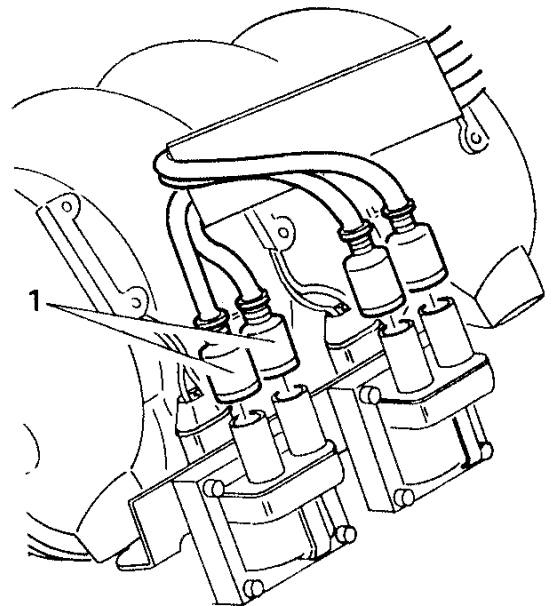
1. Loosen the screws securing the absolute pressure sensor and ignition module supporting bracket and back it off.



1. Disconnect the ignition coil power supply connection.

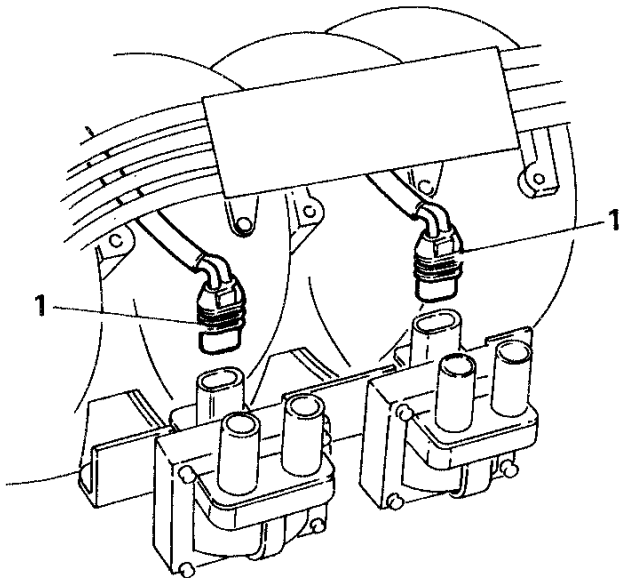


1. Disconnect the spark plug cables from the ignition coils.

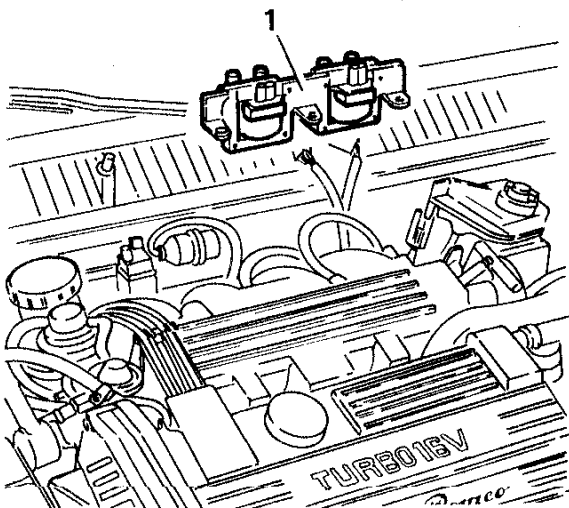




1. Disconnect the two electrical connections from the ignition coils.



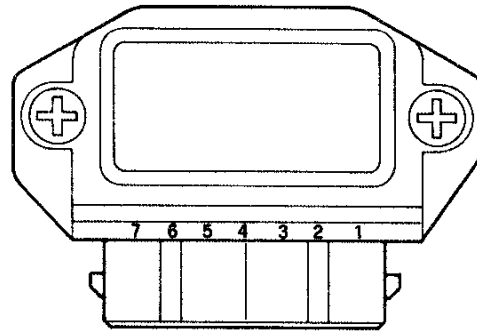
1. Loosen the three screws and remove the ignition coils.



IGNITION MODULES

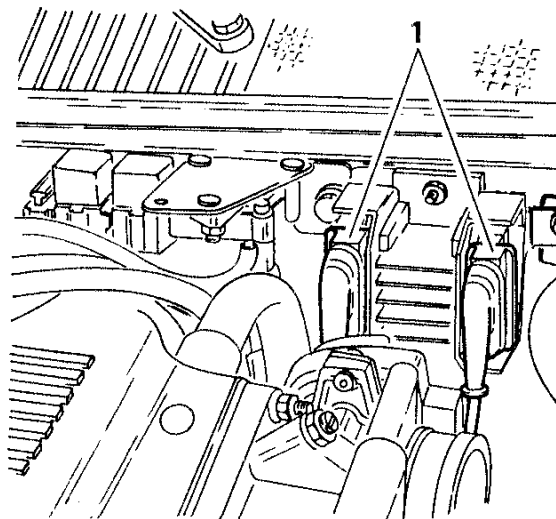
The ignition modules, connected to the I.A.W. ignition-injection control unit, have the following functions:

- control of the conduction angle of the main current;
- control of the energy contained in the ignition coil.



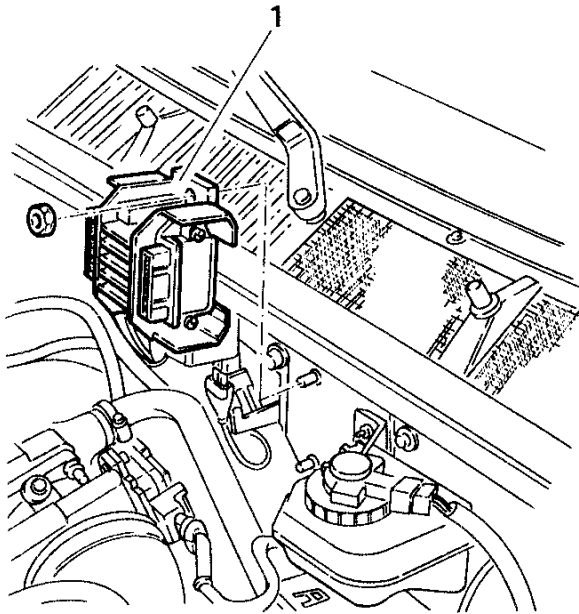
REMOVAL/REFITTING

- Disconnect the negative cable from the battery.
1. Disconnect the two electrical connections from the ignition modules.

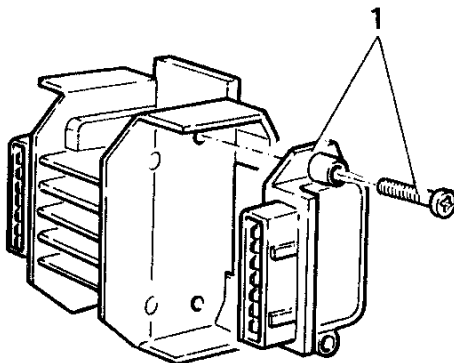




1. Loosen the two nuts and remove the support along with the ignition modules.



1. On a bench loosen the retaining screws and remove the ignition modules from the supporting bracket.

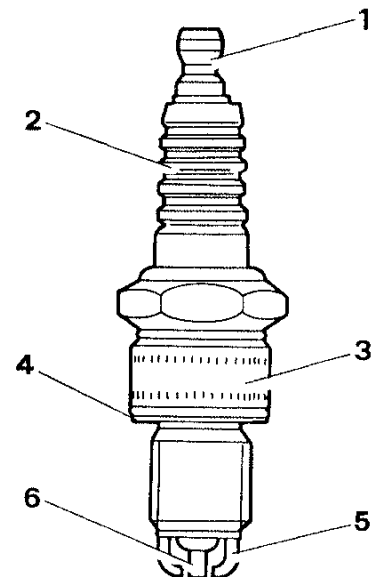


SPARK PLUGS

The spark plugs fitted as standard are of the surface discharge type with three peripheral earth electrodes and a single central electrode.

The distance between the electrodes on this type of spark plug does not require adjustment.

| | |
|-----------------|---------------|
| Firing sequence | 1 - 3 - 4 - 2 |
|-----------------|---------------|



BOSCH WR6 DTC

1. Terminal
2. Ceramic insulation
3. Body
4. Gasket
5. Central electrode
6. Peripheral earth electrodes



MAINTENANCE

Periodically check that the electrode is clean and not worn and that the ceramic insulation is not broken.

If necessary replace the spark plug.

When fitting, lubricate the thread of the spark plug with engine oil and tighten to the specified torque:



23 - 28.4 Nm (2.3 - 2.9 kgm)



CAUTION:

Do not use spark plugs with different characteristics or of a different size than those specified as this may cause serious damage to the engine and alter the level of toxic exhaust emissions.



CAUTION:

A dirty or burnt spark plug is often the sign of a malfunction in the engine supply system.

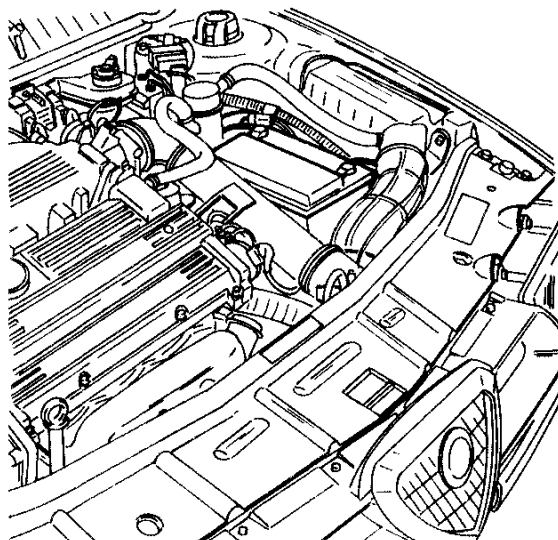
For example:

- **Traces of carbon powder:** incorrect mixture, dirty air cleaner;
- **Oil spots:** oil leaking from the piston rings;
- **Ash deposits:** aluminum particles especially in the oil;
- **Melted electrodes:** overheating due to unsuitable fuel, faults affecting the valves;
- **Electrode excessively worn:** harmful additives present in the fuel or oil, pinging, overheating;

For greater details regarding these problems refer to the fault diagnosis sections of GROUPS 01 and 04.

BATTERY

The battery is located in the engine compartment on the left-hand side.



It has been designed following criteria which make it possible to start the engine in the shortest possible time. To accomplish this it is necessary to a high torque and a preset number of minimum revolutions. This is guaranteed by the optimal size of the 6 elements contained in the battery, each of which supplies ~ 2 V (12 V in total).

The battery employed does not require periodical maintenance.

It keeps it charge much longer and contains dilute sulfuric acid; for this reason it must be kept in an upright position even if it is not installed on the vehicle. The body of the battery is fitted with small ventilation holes as the formation of gas during charging is minimum. Thanks to a reduction in the amount of gas produced there is no corrosion and therefore contact between cables and terminals is ensured.

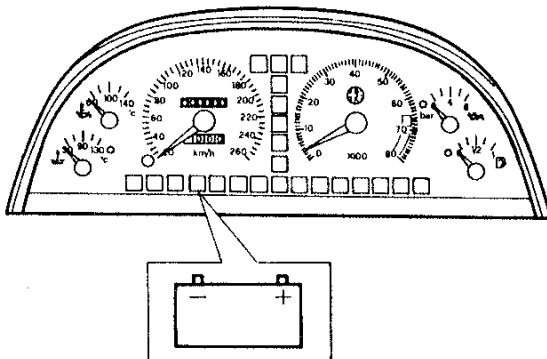


The advantages of this battery are:

- reduced consumption of water due to the new type of alloy used in the construction of the grilles and plates eliminating the necessity for topping up,
- optimal starting due to the reduced loss of charge over a period of 7 months which makes it ideal for storage (at temperatures below 28°C).

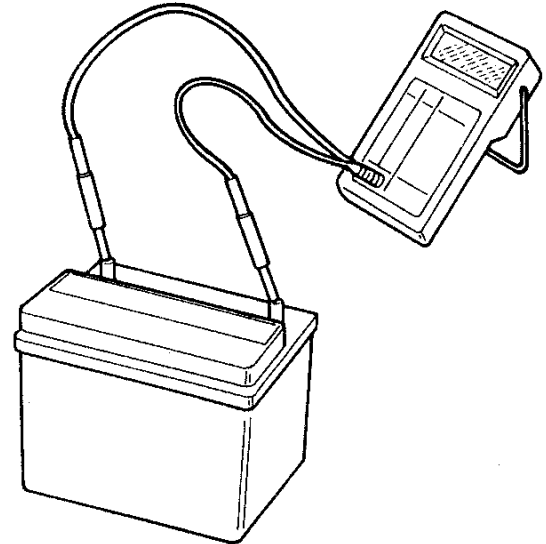
CHARGING

When the vehicle is moving the alternator recharges the battery. If the charge is insufficient or the connection between the alternator and the battery is interrupted, a warning lamp on the instrument panel lights up to signal a malfunction in the circuit.



If the battery seems to be flat, check the charge by measuring the no-load voltage on the terminals with a voltmeter.

If the voltage is below 12.30 V it is only half charged; if it reaches 12.48 V it is three-quarters charged and if it reaches 12.66 V it is fully charged.



CAUTION:

If the electrolyte level in one or more of the cells of the battery falls below the reference mark engraved on the side of the plastic container, carefully open the cover on the row of caps and add de-ionized distilled water as for a normal battery.

NOTE: It is inadvisable to carry out rapid recharging at voltages above 15.5 V.

Use a normal 12 V battery charger connecting the positive cable (red) to the (+) terminal of the battery and the negative (black) cable to the (-) terminal of the battery.

If momentarily connecting an external battery to the battery in the vehicle, connect positive to positive and negative to negative.

**CAUTION:**

- Do not connect the battery to the electrical system of the vehicle or remove the battery when the engine is running.
- Do not reverse the terminal connections (even for a few moments) as this would damage the alternator rectifier.
- When recharging the battery, first make the necessary connections and the activate the charger.
- If it is necessary to start the engine using an auxiliary battery and jumper leads the voltage in the auxiliary battery must not exceed 12 V.
- Before recharging the battery it is necessary to disconnect the negative cable from the battery.
- When recharging ensure that the temperature of the electrolyte does not exceed 45°C.

**CAUTION:**

- Never touch the negative and positive terminals of the battery at the same time.
- Keep naked flames away from the area when recharging.

When replacing the battery it is advisable to follow the instructions. If the replacement battery is of a greater power than the old battery the higher voltage could cause the coils of the starter motor induction to melt or damage the pinion or the crown gear.

MAINTENANCE

The capacity of the battery to start the engine depends on its charge and it is therefore necessary to regularly check and maintain the battery especially during the winter as the greater loading of the starter motor and the reduced battery capacity at low temperatures both negatively influence the capability of the battery to start the engine.

Clean the surfaces of the battery, terminals and clamps with a mixture of water and sodium bicarbonate. Grease the clamps before reconnecting.

**CAUTION:**

Do not allow the cleaning fluid to enter the battery as it reacts with the electrolyte fluid.

**CAUTION:**

The electrolyte fluid is an acid and as such is dangerous for hands eyes and clothes.

NOTE: Batteries stored in warehouses or installed on the vehicle and left inoperative for long periods gradually lose their charge and it is necessary to recharge before use.



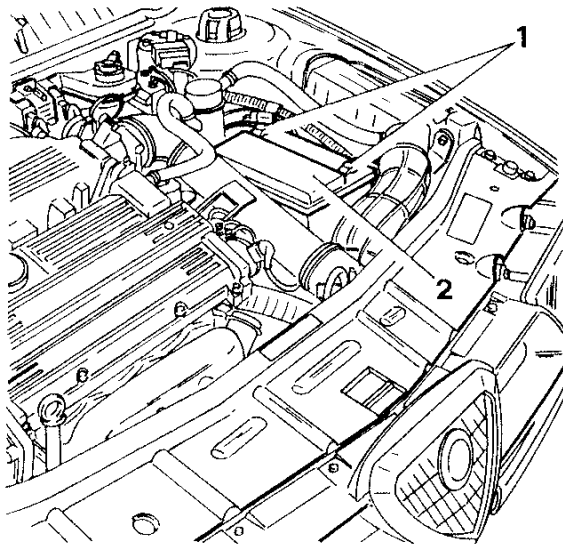
REMOVAL/REFITTING

1. Loosen the screws securing the clamps to the terminals of the battery, and disconnect the negative (-) cable first and then the positive cable (+).

**CAUTION:**

To avoid damaging the alternator ensure that the engine is switched off before attempting to disconnect the battery.

2. Remove the retaining plate and remove the battery ensuring that it is kept upright.
 - When refitting reverse the procedures followed for removal and clean and grease the clamps and terminals of the battery.



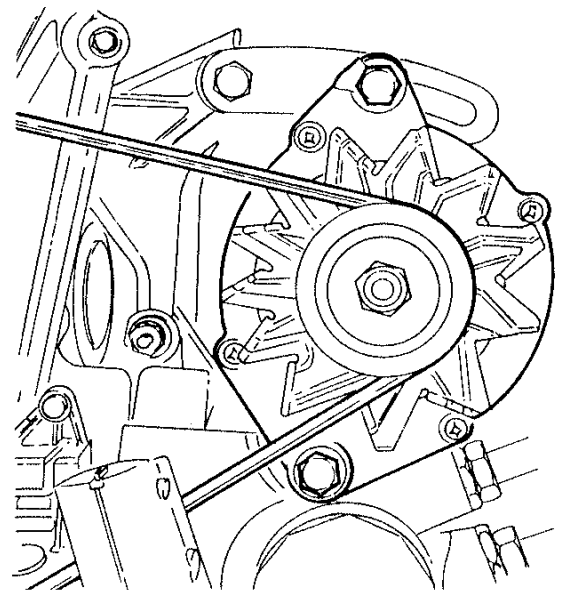
CHECKS AND INSPECTIONS

Check that the container housing the electrodes is not cracked, that the electrolyte fluid covers the filaments by about 5 mm and that the upper surface of the battery is clean and not oxidized.

Also ensure that the cable clamps are tightened onto the terminals in order to guarantee an efficient contact.

ALTERNATOR

When the engine is running the alternator provides the electronic control units and other users with electricity. It also supplies the charge to the battery for the power supply when the engine is switched off.



The electrical current is produced by a stator which "cuts" the magnetic field generated by a rotating coil (rotor). The rotor forms a single unit with a pulley activated by the crankshaft with a belt.

The brushes of the contact supply the rotor with the necessary current.

The alternating voltage generated by the alternator is rectified by diodes and by the voltage regulator located on the body of the alternator itself.

The electronic voltage regulator used, which has been reduced in size, guarantees a constant voltage during all engine running conditions even when the engine loading and r.p.m. vary considerably.

A cooling fan rotates together with the pulley ensuring that the alternator does not reach dangerously high temperatures.



The alternator fitted to this vehicle is of the claw terminal type with collector rings. It is extremely compact and weighs very little.

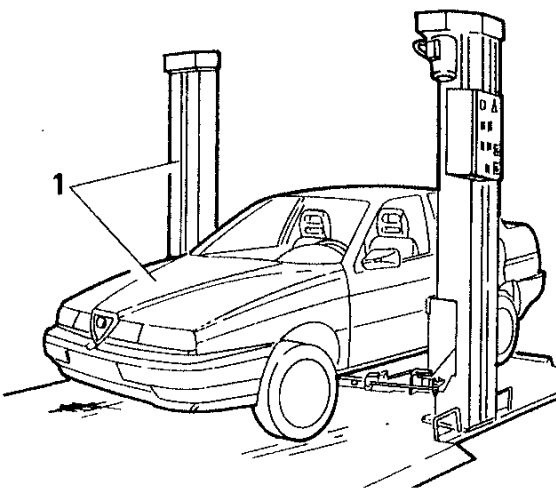
It is fixed to the engine by brackets. The upper bracket is slotted to facilitate the tightening of the drive belt (see GROUP 00).

**CAUTION:**

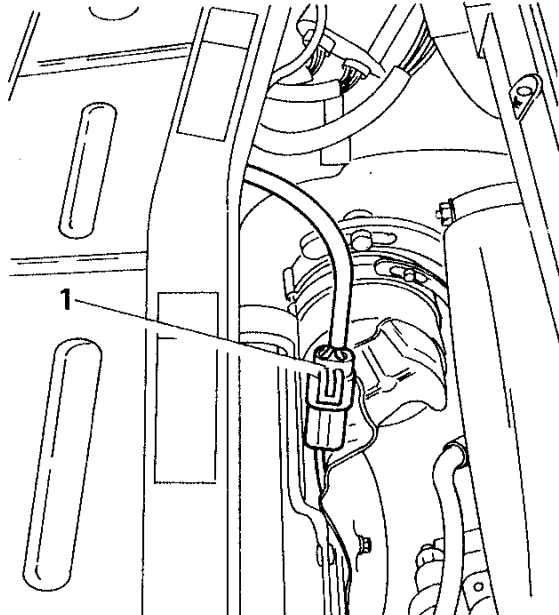
The cooling fan will only cool the alternator if the blade turns **CLOCKWISE** as seen from the pulley side.

REMOVAL/REFITTING

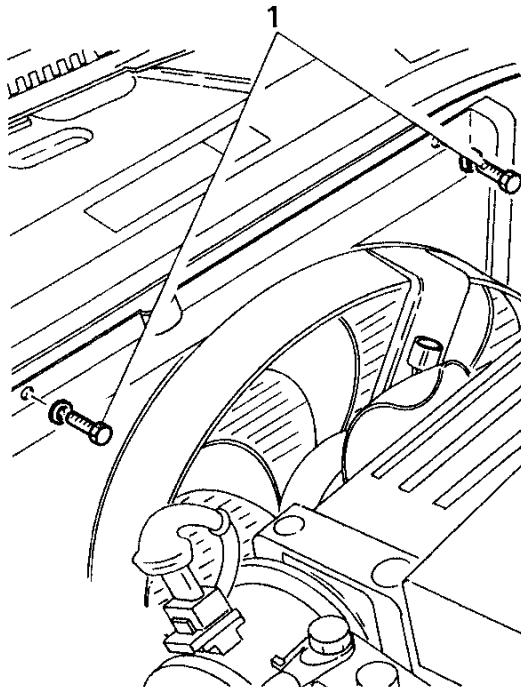
1. Place the vehicle on a lift.
 - Disconnect the negative cable from the battery.



1. Disconnect the electrical connection from the cooling fan.




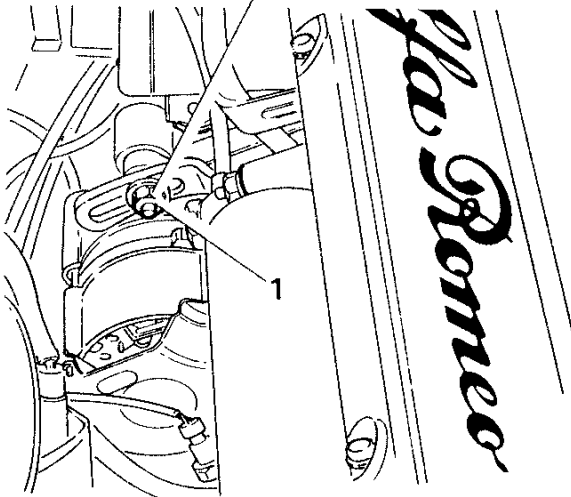
1. Loosen the two upper screws securing the cooling fan.



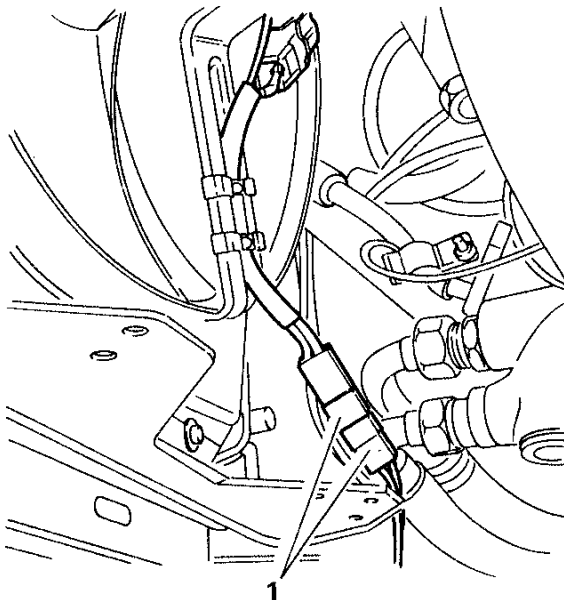


1. Completely unscrew the upper bolt securing the alternator to the slotted tensioning bracket.

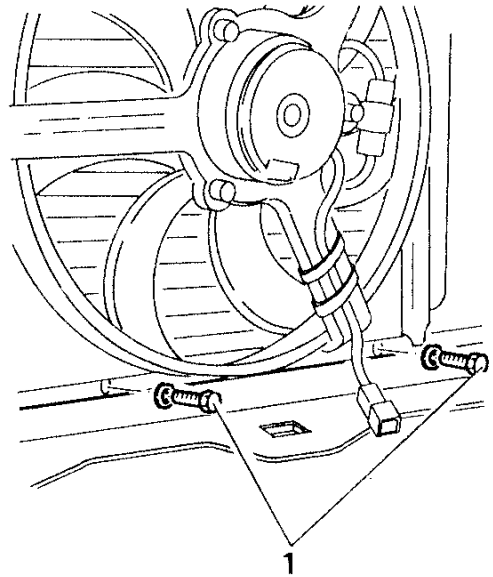
 28 ÷ 45.2 Nm
2.9 ÷ 4.6 kgm



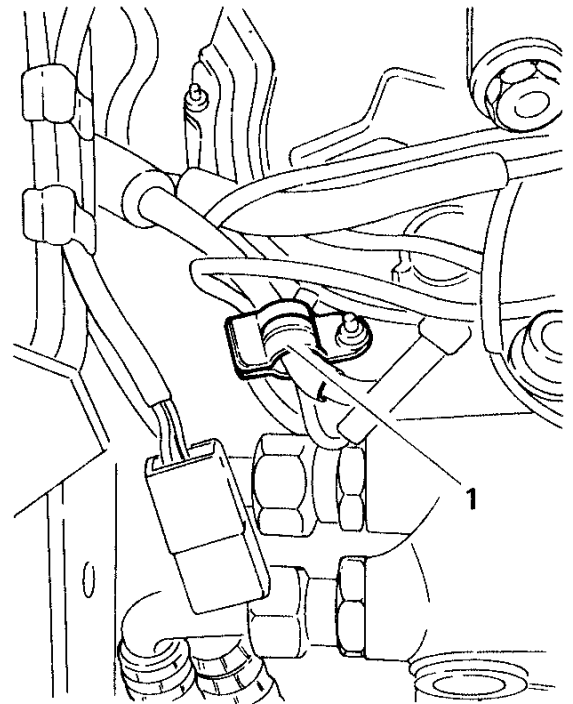
- Raise the vehicle.
1. Disconnect the electrical connection from the cooling fan resistance.



1. Loosen the two lower screws securing the cooling fan and move the fan to one side.

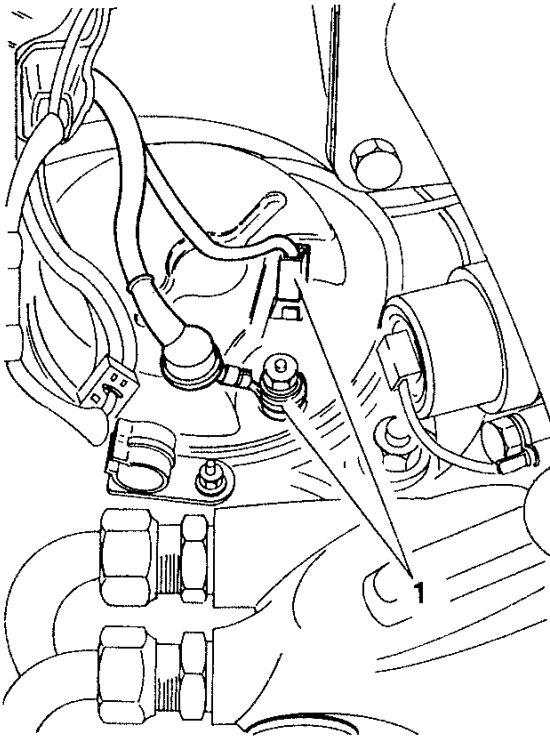


1. Free the electrical cables from the clamps on the alternator.

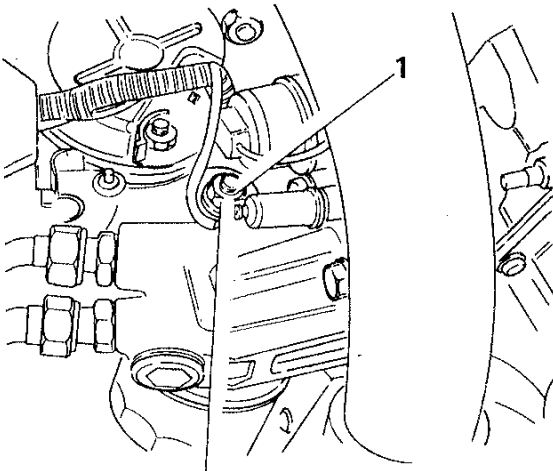





1. Disconnect the electrical connections from the alternator.



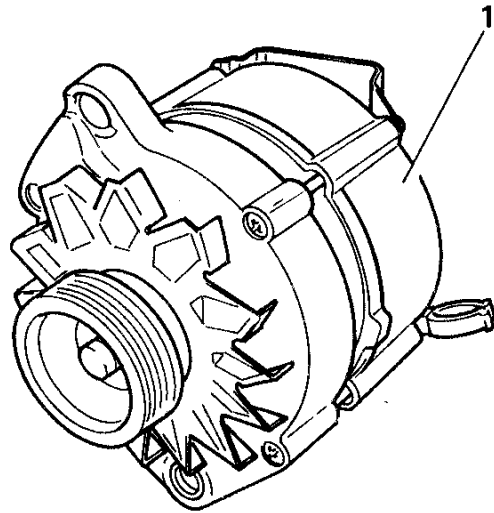
1. Completely unscrew the lower bolt securing the alternator.



 44.9 ÷ 72.5 Nm
4.6 ÷ 7.4 kgm

1. Remove the alternator from the underside of the vehicle after pulling off the drive belt.

NOTE: To facilitate the removal of the alternator, raise the previously disconnected cooling fan.



DISASSEMBLY AND REASSEMBLY

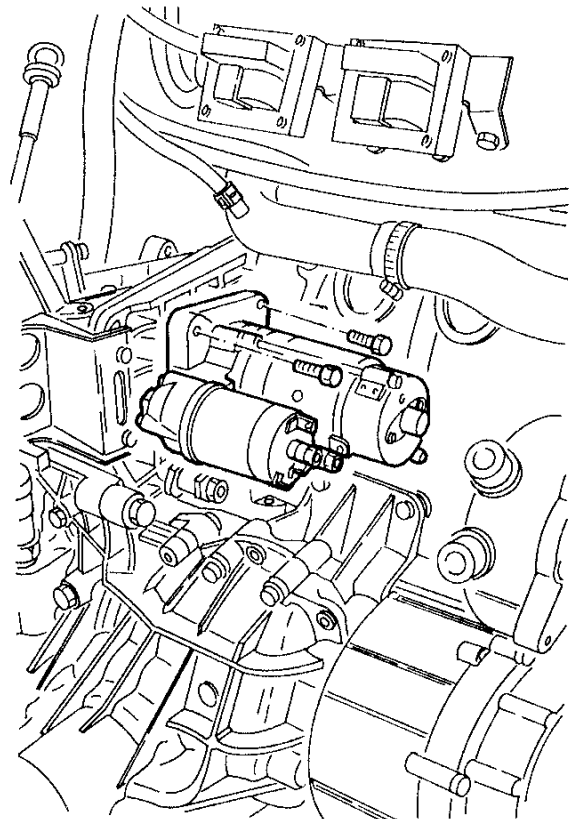
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PUBLICATION**

**CHECKS AND INSPECTIONS**

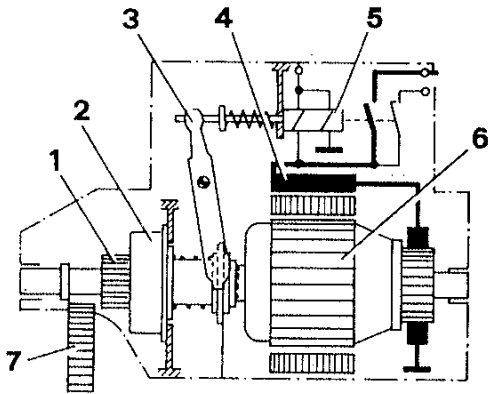
**DUE FOR
PUBLICATION**

**STARTER
MOTOR**

The starter motor cranks the engine, overcoming friction and inertia, to a set number of revolutions in order to form the mixture necessary for combustion and the autonomous running of the engine.



The movement is transmitted by a direct current electric motor activated by battery voltage via an engagement pinion which causes the toothed wheel on the engine flywheel to rotate.



- | | |
|------------------------------------|---------------------|
| 1. Pinion | 5. Relay |
| 2. Free turning wheel with rollers | 6. Induction |
| 3. Engagement lever | 7. Flywheel toothed |
| 4. Winding wheel | |

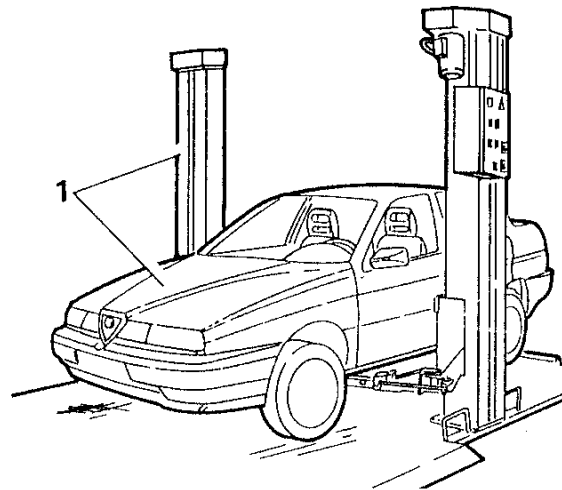
Thanks to the free wheel engagement the pinion disengages when the engine rotates faster than the starter motor.

A relay activated by the current from the starter motor engages the pinion via a yoke.

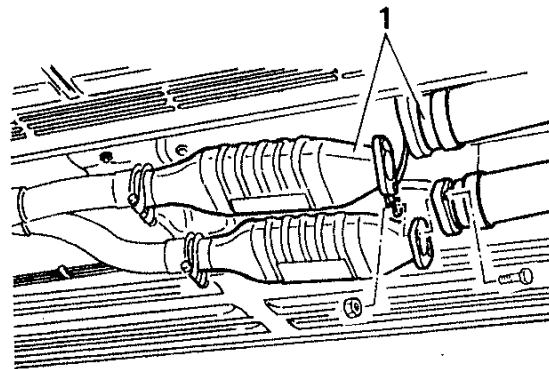
The starter motor fitted to the vehicle is of the pinion screw and translation type with the relay housed directly above the starter motor itself.

REMOVAL/REFITTING

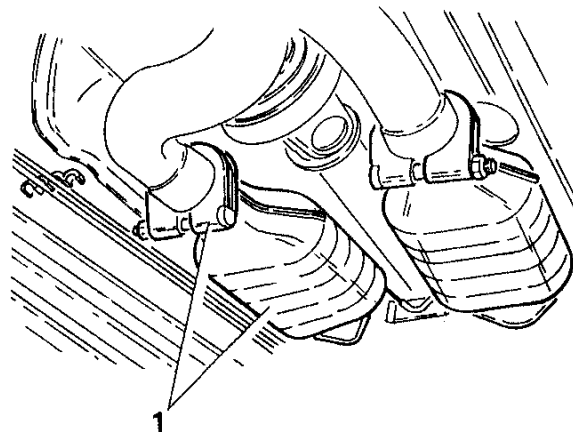
1. Place the vehicle on a lift.
- Disconnect the negative cable from the battery.



- Raise the vehicle.
1. Disconnect the two flanges of the front section of the exhaust pipe from the two catalytic converters.

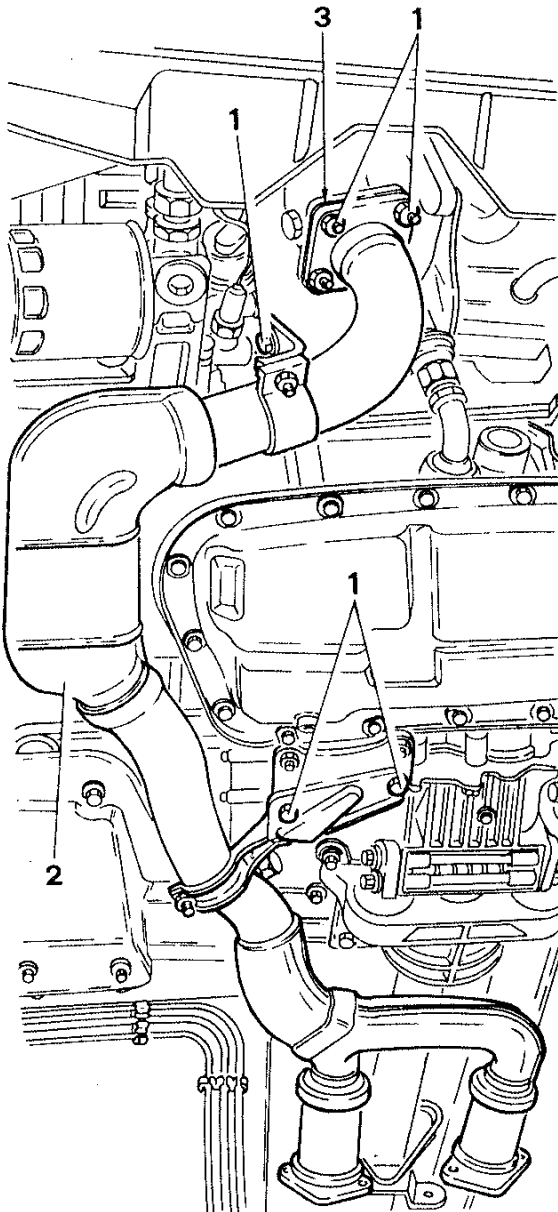


1. Loosen the collars and remove the two catalytic converters.

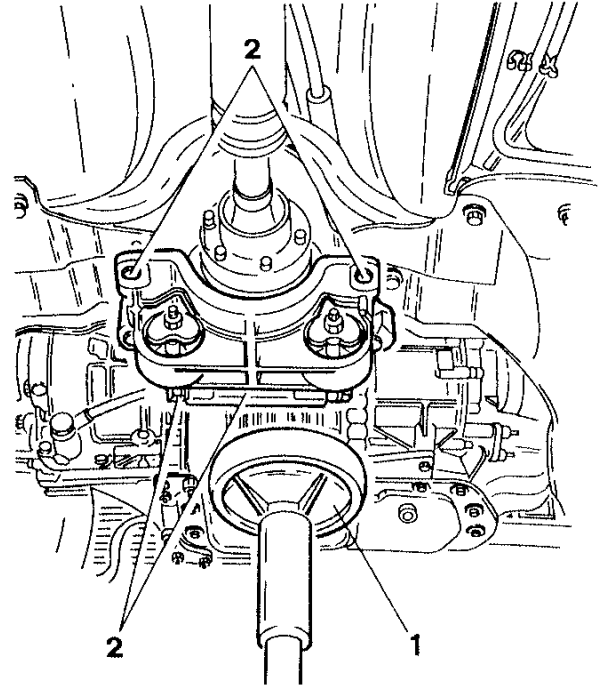




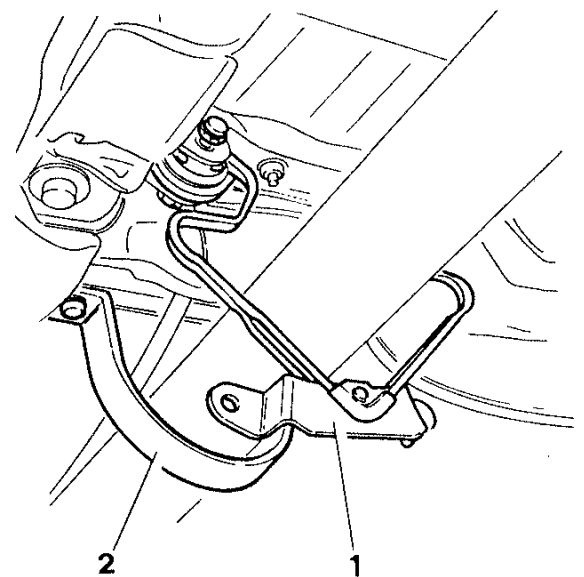
1. Loosen the screws and nuts securing the front section of the exhaust pipe to the turbocharger and to the support brackets.
2. Remove the front section of the exhaust pipe.
3. Remove the gasket.



1. Position a suitable column lift under the central differential.
2. Loosen the screws and securing the rear engine unit and remove the engine unit.

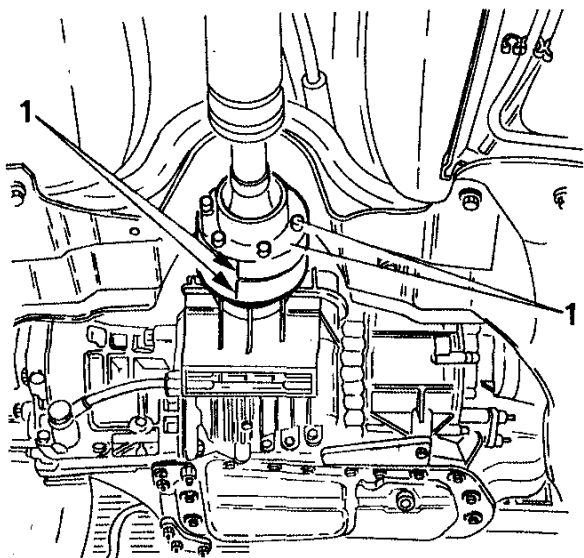


- Remove the column lift.
- 1. Remove the exhaust pipe flexible support.
- 2. Remove the drive shaft safety brackets.

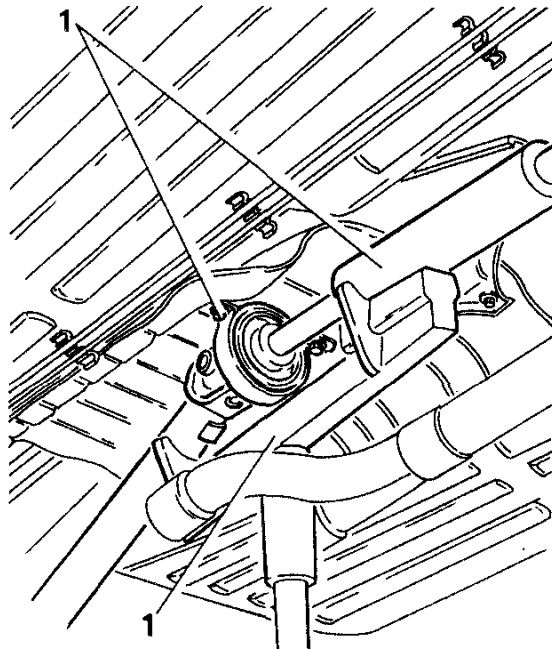




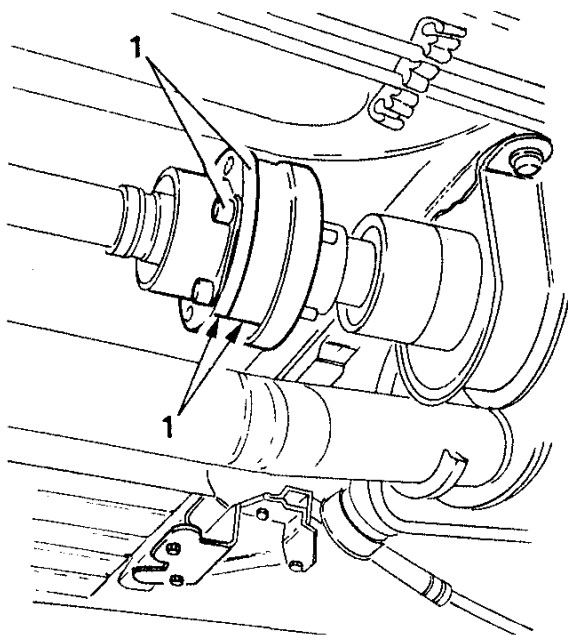
1. Make reference notches on the flange of the coupling between the front section of the drive shaft and the central differential. Disconnect the flanges by unscrewing the relative screws.



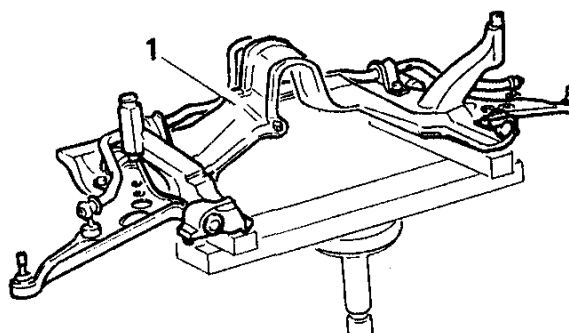
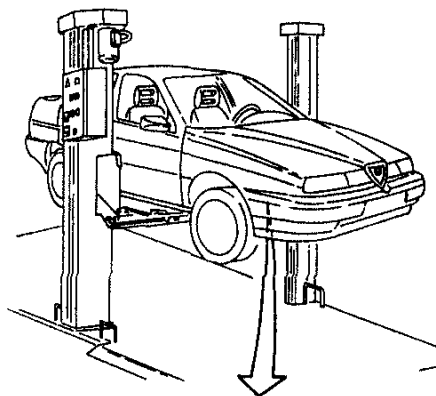
1. Using a suitable tool support the front and central sections of the drive shaft and remove them after loosening the screws securing the central flexible support.



1. Make reference notches on the flange of the coupling between the front and rear sections of the drive shaft and the central differential. Disconnect the flanges by unscrewing the relative screws.



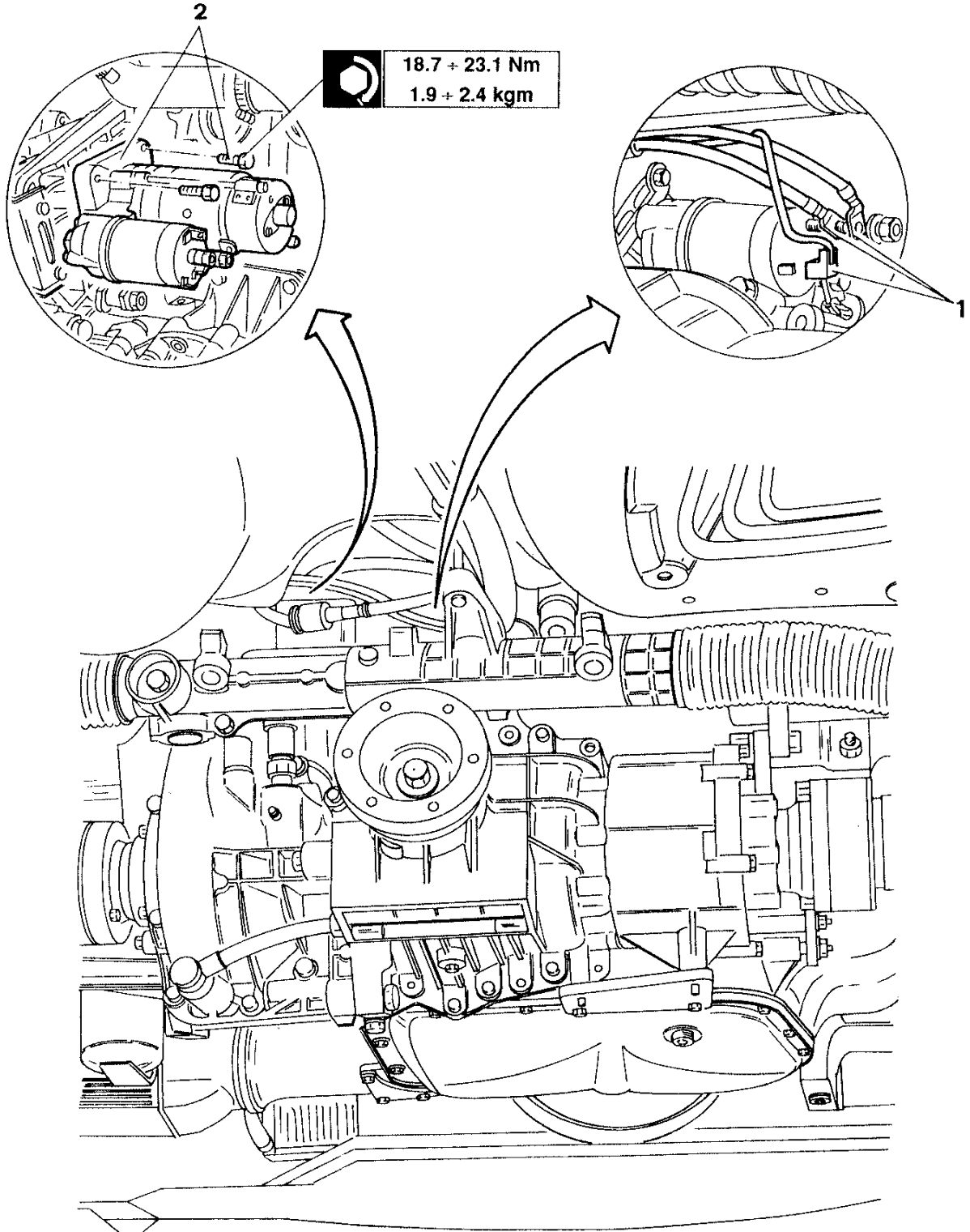
1. Loosen the screws and remove the crossmember together with the swinging arms (see GROUP 21).





1. Disconnect the electrical connections from the starter motor.

2. Loosen the three screws and remove the starter motor.





DISASSEMBLY/REASSEMBLY

CHECKS AND INSPECTIONS

**DUE FOR
PUBLICATION**

**DUE FOR
PUBLICATION**



CONTROL OF IGNITION ADVANCE

- Position the vehicle on a lift and remove the front right- hand wheel and relative dustguard.
 - Connect a stroboscopic pistol to the spark plug cable of cylinder number 1, connect the positive and negative cables of the stroboscopic pistol to the correct clamps of the battery.
1. Start the engine and warm to normal running temperature and, when idling (850 ± 30 r.p.m.), check that the reference mark located on the auxiliary units control pulley is in line with that on the timing belt cover. Under these conditions check that the advance is within the specified limits.

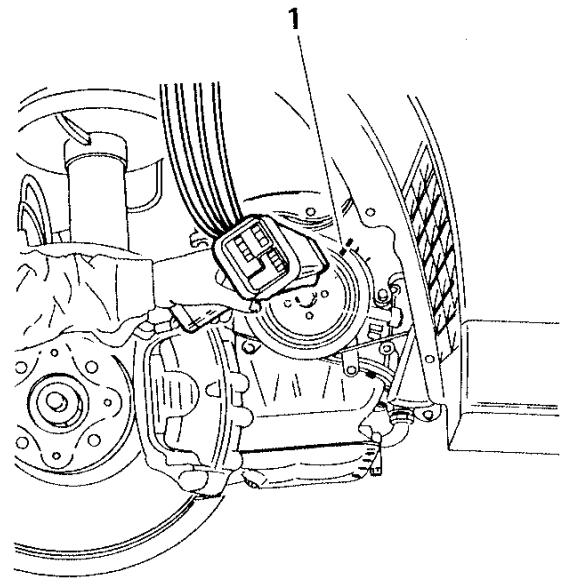


Fixed advance

$10^\circ \pm 3^\circ$

NOTE: When using a stroboscopic pistol suitable for lost spark ignition systems, the value read off the instrument corresponds to the real value.

If a traditional stroboscopic pistol is used the value read off the instrument must be halved as the spark strikes at each revolution of the engine.



CAUTION:

This system does not require or permit any adjustment to be made to the Ignition advance.

If the advance values are wrong refer to the section ELECTRICAL- ELECTRONIC DIAGNOSIS.

FAULT DIAGNOSIS AND CORRECTIVE INTERVENTIONS

For the fault diagnosis and corrective interventions refer to **GROUP 04** which also deals with the components of the ignition system.

**TECHNICAL CHARACTERISTICS AND SPECIFICATIONS****BATTERY**

| | |
|--------------------------------|-------|
| Nominal voltage | 12 V |
| Discharge current (at - 18 °C) | 320 A |
| Capacity (20 hours) | 60 Ah |

ALTERNATOR

| | |
|---|------------------------------|
| Nominal voltage | 14 V |
| Nominal current | 90 A |
| Minimum speed | 1,000 r.p.m. |
| Speed at 40A | ~ 1,600 r.p.m. |
| Speed of nominal current | ~ 4,200 r.p.m. |
| Resistance of inductor winding (measured between the collector rings) | $2.6 \pm 0.15\Omega$ a 25 °C |

STARTER MOTOR

| | | |
|--------------------|-------------|-----------------|
| Nominal voltage | 12 V | |
| Nominal output | 1.4 kW | |
| Test load | Voltage | 9 V |
| | Absorption | 280 A |
| | Revolutions | 3950 r.p.m. |
| | Torque | 24 daNm |
| Short circuit test | Voltage | 4.5 V |
| | Absorption | ≤ 700 A |
| | Torque | ≥ 1.5 daNm |

**IGNITION COIL**

| Characteristics | Resistance (1) |
|-------------------|----------------|
| Main winding | 550 mΩ ± 10% |
| Secondary winding | 7.4 kΩ ± 10% |

(1) Measurements made at 23 ± 5 °C.

SPARK PLUGS

| | |
|------|---------------|
| Type | BOSCH WR6 DTC |
|------|---------------|

TIGHTENING TORQUES

| Part | Nm | kgm |
|--|-------------|-----------|
| Spark plugs | 23 - 28 | 2.3 - 2.9 |
| Bolt securing alternator to slotted bracket | 28 - 45.2 | 2.9 - 4.6 |
| Bolt securing alternator to oil filter support | 44.9 - 72.5 | 4.6 - 7.4 |
| Screws securing starter motor to gearbox union support | 18.7 - 23.1 | 1.9 - 2.4 |