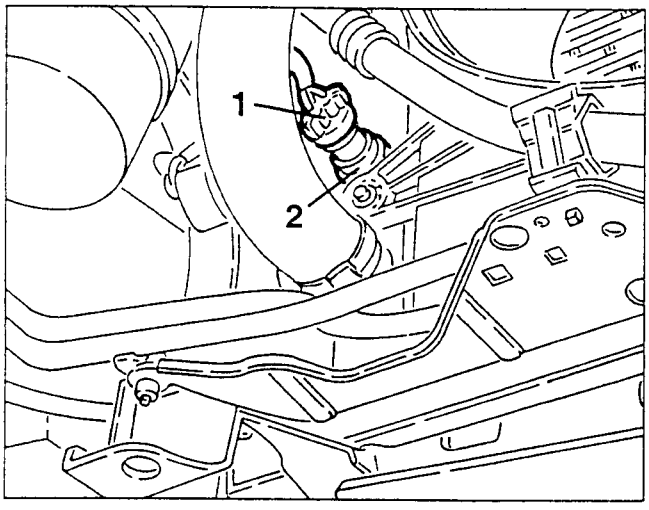
## FAN CONTROL THERMAL CONTACT (Specific for versions with M2.10.3 injection - ignition system)

### REMOVING/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.

1. Raise the car and disconnect the electrical connection from the fan control thermal contact.
2. Slacken and remove the fan control thermal contact and recover the coolant that comes out.




### CHECKS AND INSPECTIONS

Check the setting of the thermal contact referring to the wiring diagram of the specific manual.

| Cooling fan cut-in/cut-out temperature | | |
|---|---|---|
| 1st speed | Cut in (contacts close) | 92 ± 2°C |
| | Cut out (contacts open) | 87 ± 2°C |
| 2nd speed | Cut in (contacts close) | 97 ± 2°C |
| | Cut out (contacts open) | 92 ± 2°C |

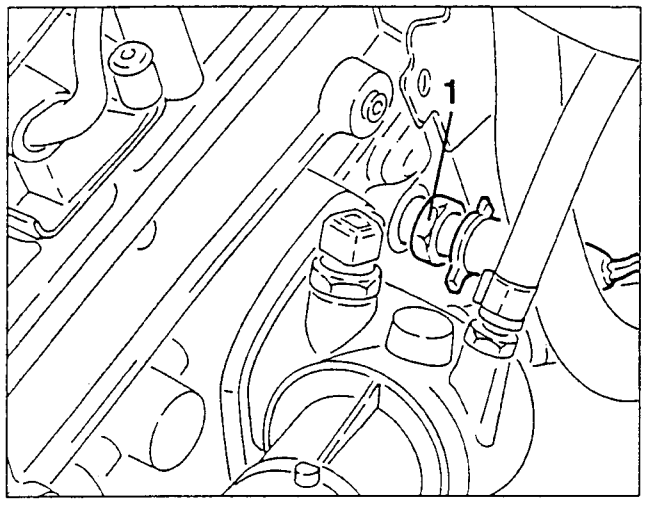
- If the values are not as specified, change the thermal contact.

## COOLANT TEMPERATURE GAUGE TRANSMITTER AND MAXIMUM TEMPERATURE WARNING LIGHT CONTACT

### REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Disconnect the electrical connection from the coolant temperature sensor (NTC).

1. Disconnect the electrical connection from the coolant temperature gauge transmitter and maximum temperature warning light contact, then remove it recovering the coolant that comes out.




### CHECKS AND INSPECTIONS

Check the setting of the transmitter referring to the wiring diagram of the specific manual.

| Temperature (°C) | Resistance (Ω) |
|---|---|
| 60 (Water test liquid) | 525 ÷ 605 |
| 90 (Water test liquid) | 195 ÷ 245 |
| 120 (Glycerine test liquid) | 82 ÷ 94 |

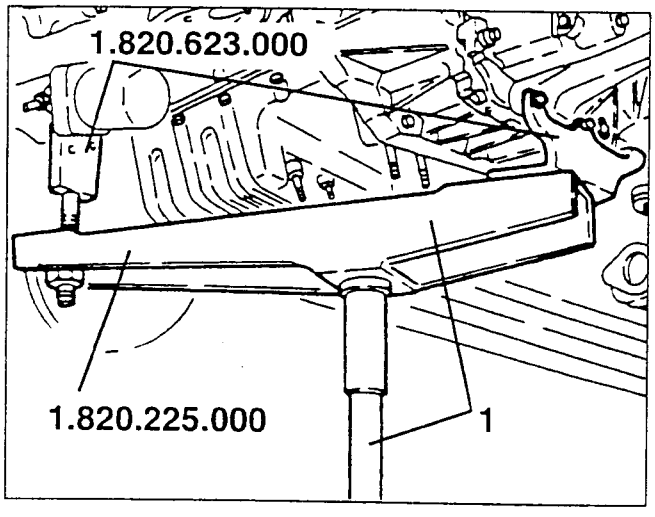
| | |
|---|---|
| Contact closing temperature | 122 ± 2°C |
| Contact opening temperature | 112 ± 3°C |

THE FOLLOWING PROCEDURE IS VALID FOR ALL ENGINES 1598 T. SPARK 16V AND 1747 T. SPAR 16V WHILE FOR ENGINE 1370 T. SPARK 16V IT IS VALID ONLY FOR VERSIONS WITH GEARBOX C.510.5 (UP TO CHASSIS NO. .....)

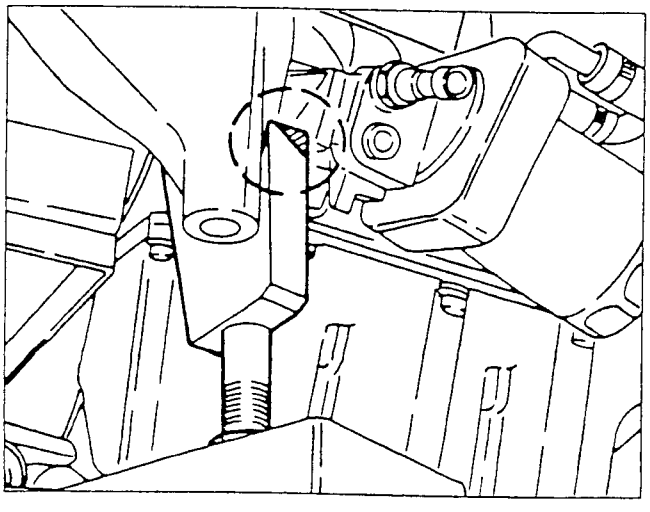
## REMOVAL

Proceed as described for 1970 T. SPARK 16V engine removal with the exception of the following steps.

1. Set a hydraulic jack complete with tools no. 1.820.225.000 and no. 1.820.623.000 as illustrated.




**NOTE: The camshaft side engine support part of tool no. 1.820.623.000, is to be relieved in the area illustrated to avoid interference with the oil filter support.**

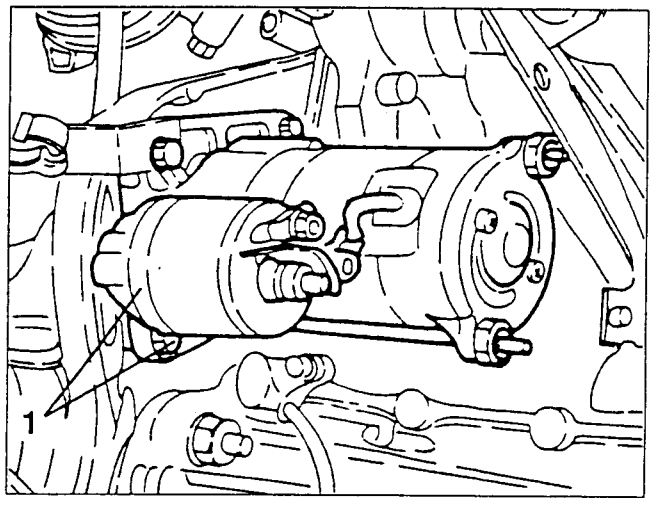


Complete removal of the engine from the car working as described for 1970 T. SPARK 16V engine.

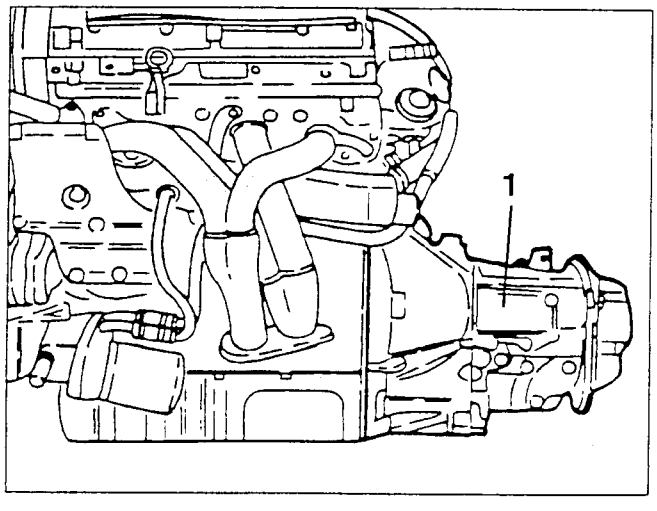
Once on the bench, remove the components as described below to make it possible to set the engine on the overhauling stand.

- Free the power unit from the support tools, then position it on a special work bench.

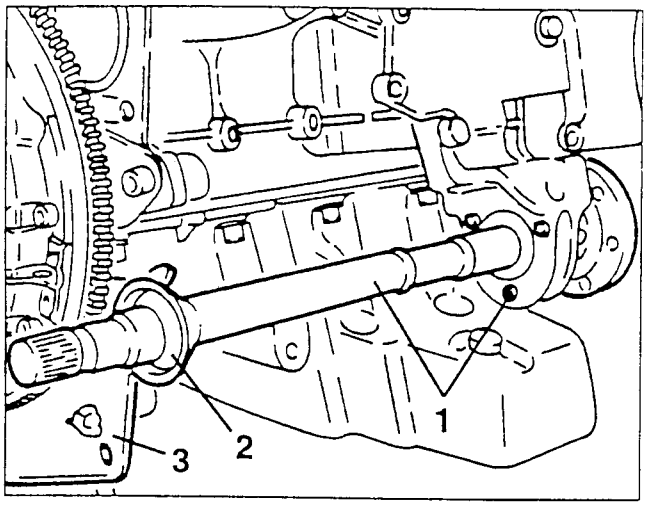
1. Slacken the fastening screws and remove the starter motor.



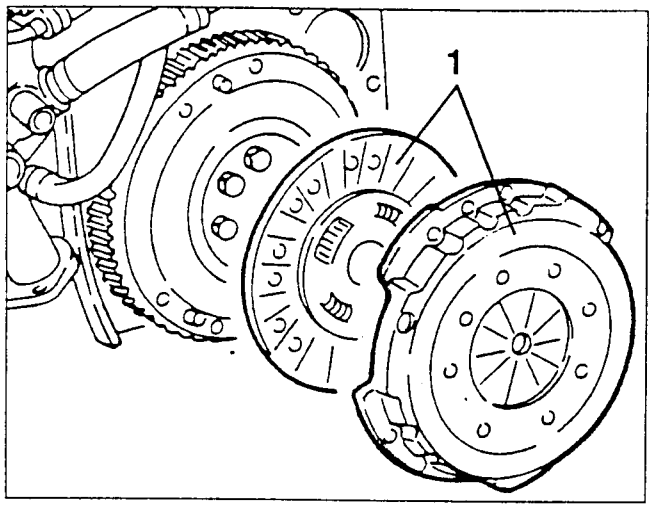

1. Slacken the fastening nuts and remove the gearbox and differential unit.



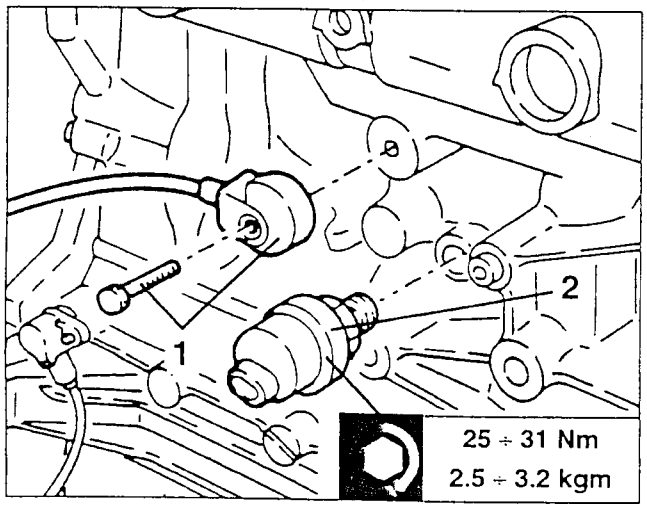
1. Slacken the three fastening screws and remove the intermediate shaft.
2. Remove the dust guard ring.
3. Retrieve the lower flywheel guard.



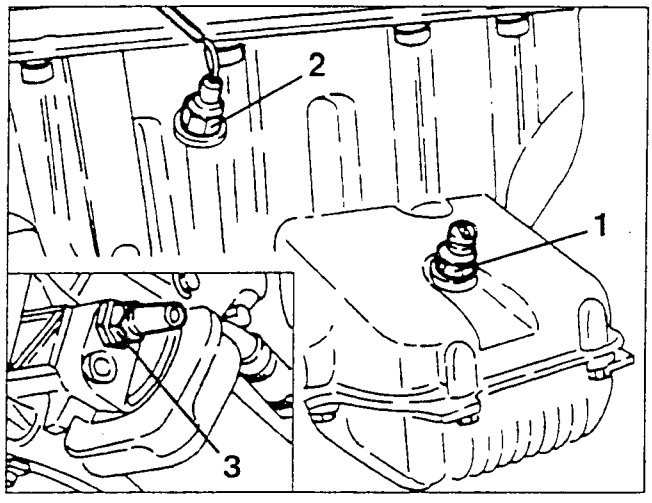

1. Slacken the fastening screws and remove the pressure plate body and clutch plate.



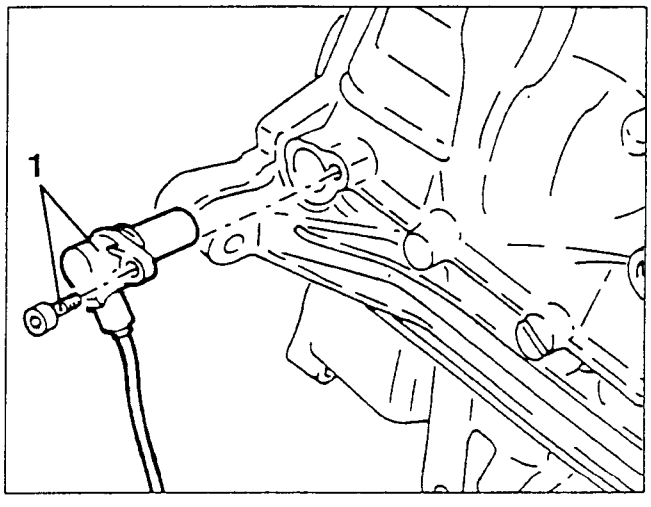

1. Slacken the fastening screw and remove the pinging sensor from the crankcase.
2. Remove the engine oil pressure meter.




1. Slacken and remove the engine oil temperature sensor.
2. Slacken and remove the engine oil minimum level sensor.
3. Slacken and remove the engine oil minimum pressure sensor.




1. Slacken the fastening screw and remove the rpm sensor.

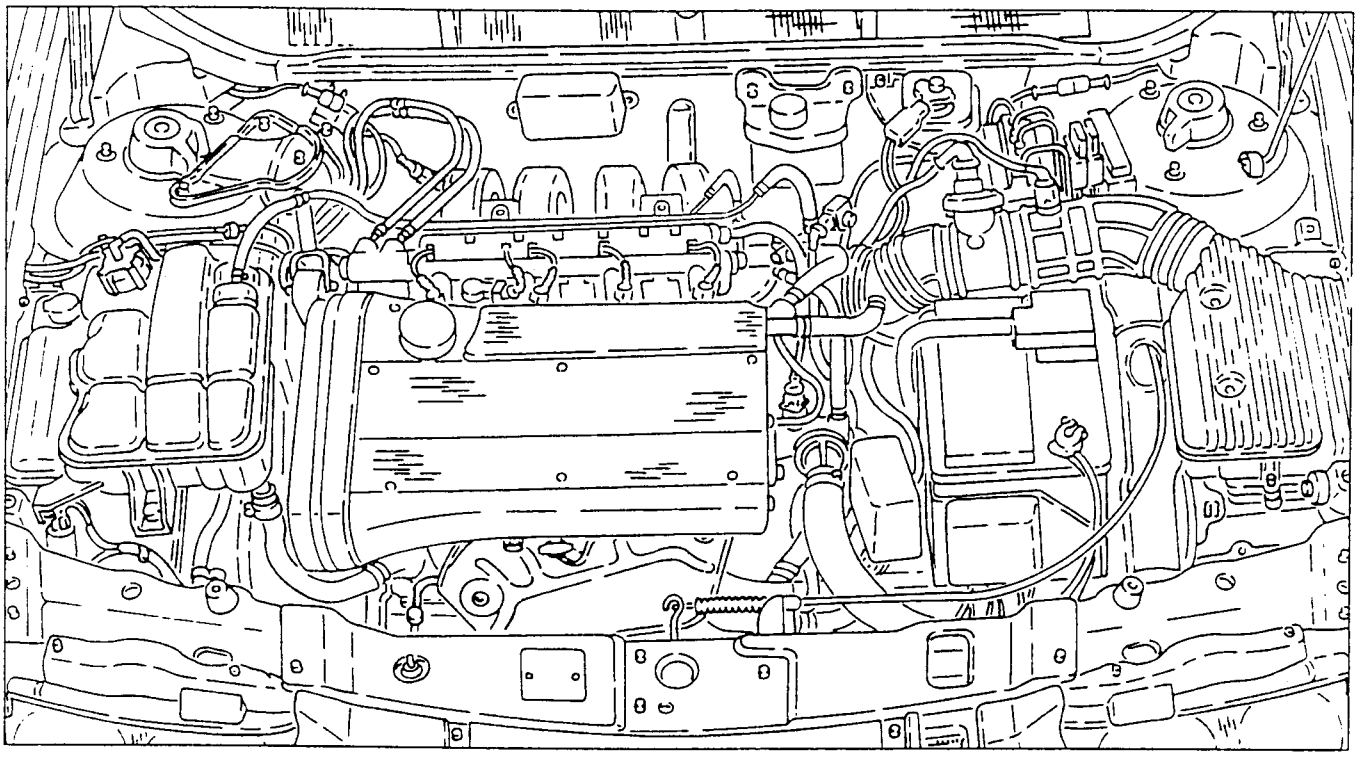


## THE FOLLOWING PROCEDURE IS VALID ONLY FOR VERSIONS WITH GEARBOX C.513.5 (FROM CHASSIS NO.....)

## GENERAL

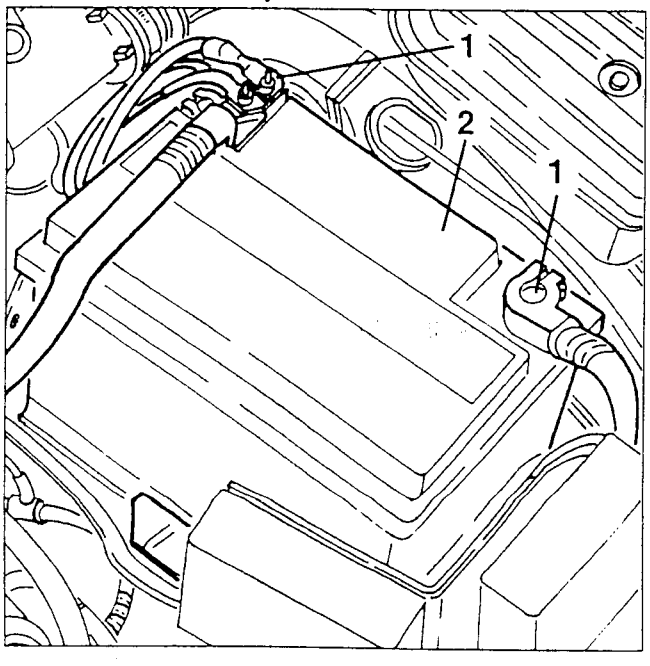
The information and illustrations givene below make it possible to quickly remove the power plant from its housing and subsequent refitting.
Disassembly of the single components on the bench is described in volume "ENGINE OVERHAULING".

The following procedure may be used only in part according to necessity.
For further information and details, see the chapters concerning specific components or units.

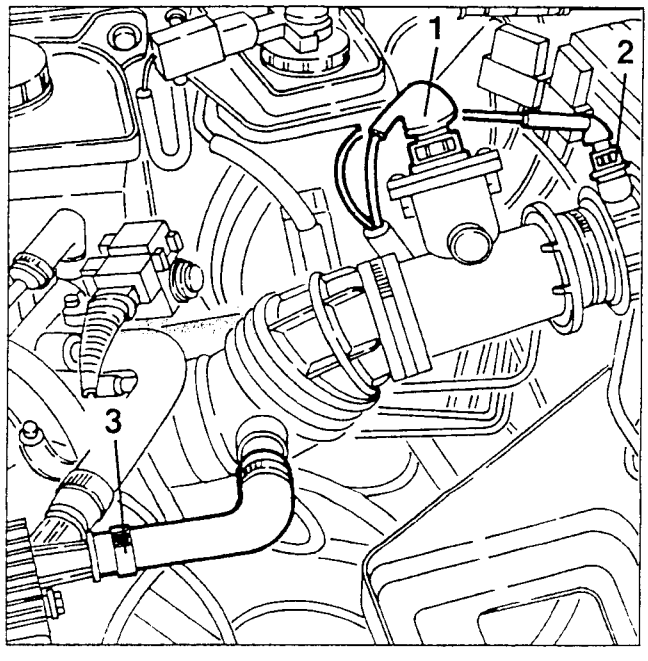


## REMOVAL

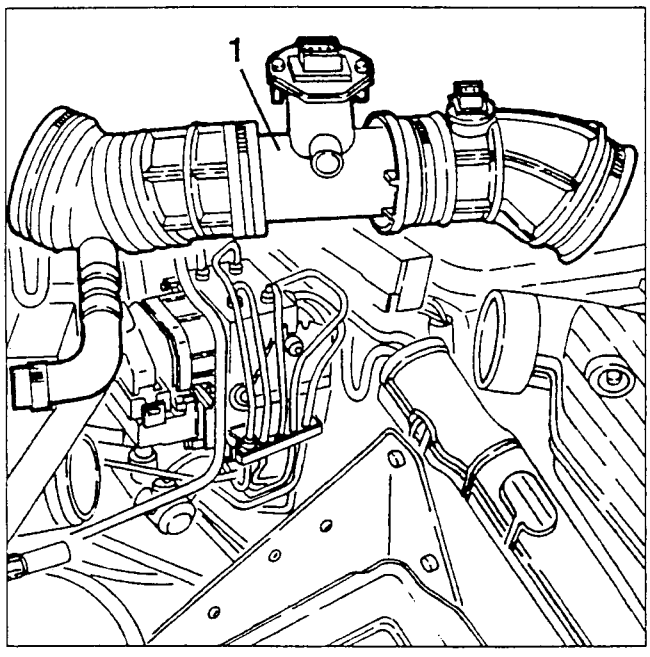
- Set the car on a two column lift.
1. Disconnect the battery terminals, also disconnecting the two starter motor supply cables from the positive terminal.
2. Remove the battery.



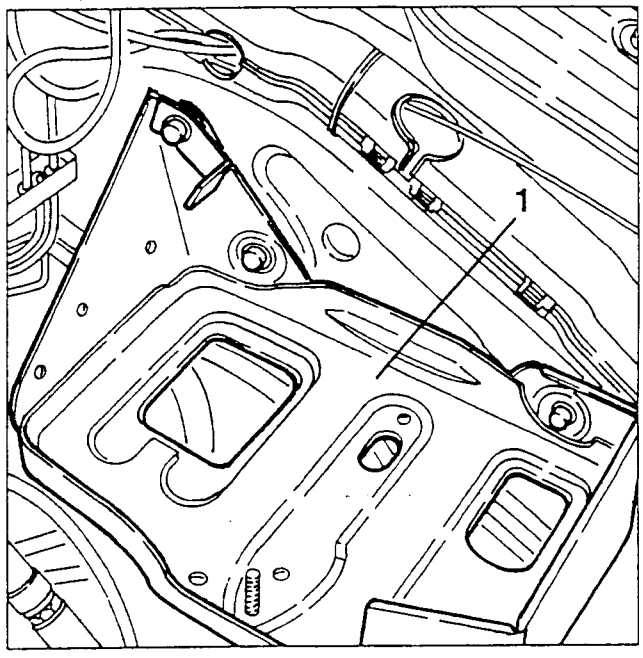

- Remove the front wheels and mud flaps.
1. Disconnect the electrical connection from the air flow meter.
2. Disconnect the electrical connection from the intake air temperature sensor.
3. Loosen the fastening clamp and disconnect the oil vapour recirculation pipe from the cylinder head cover.



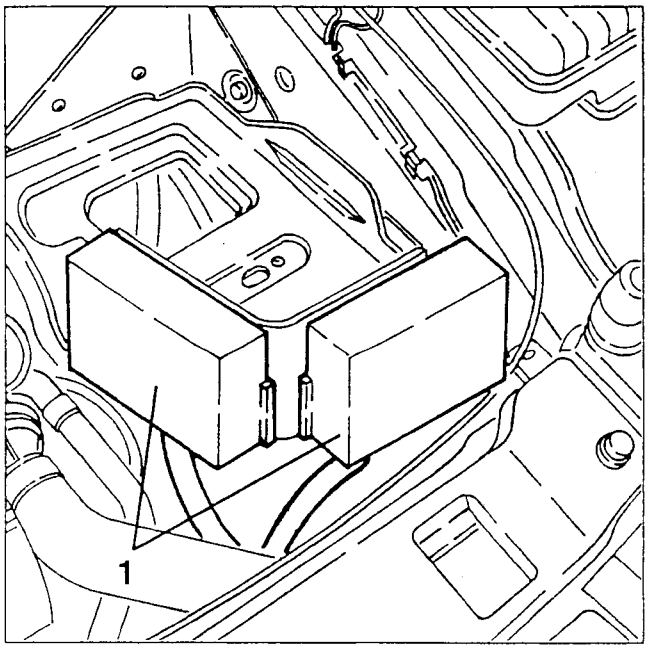
1. Loosen the two fastening clamps, then remove the corrugated sleeve complete.



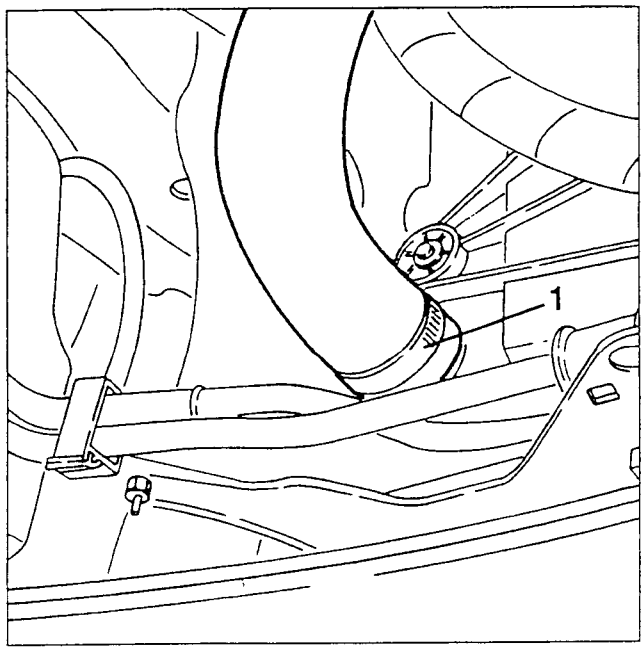

1. Slacken the fastening screws and remove the battery support complete with drainage tube after freeing this from the wheel house.



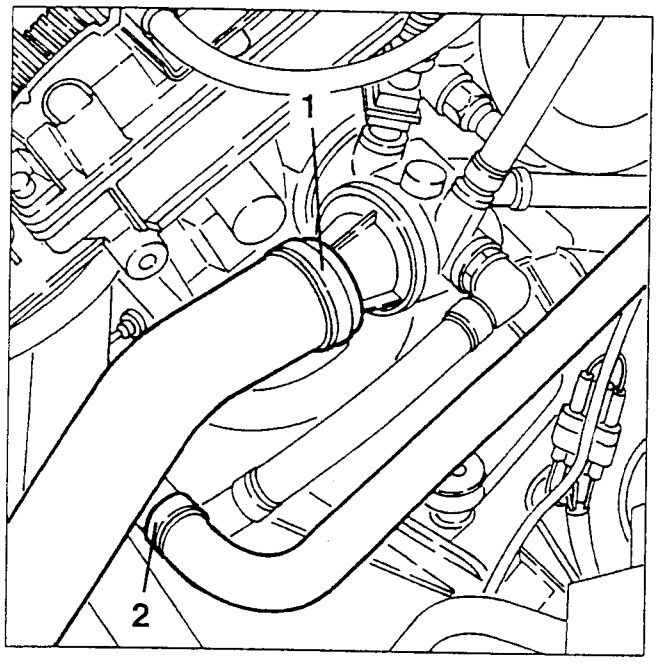

1. From the battery support release the two relay boxes and set them aside.



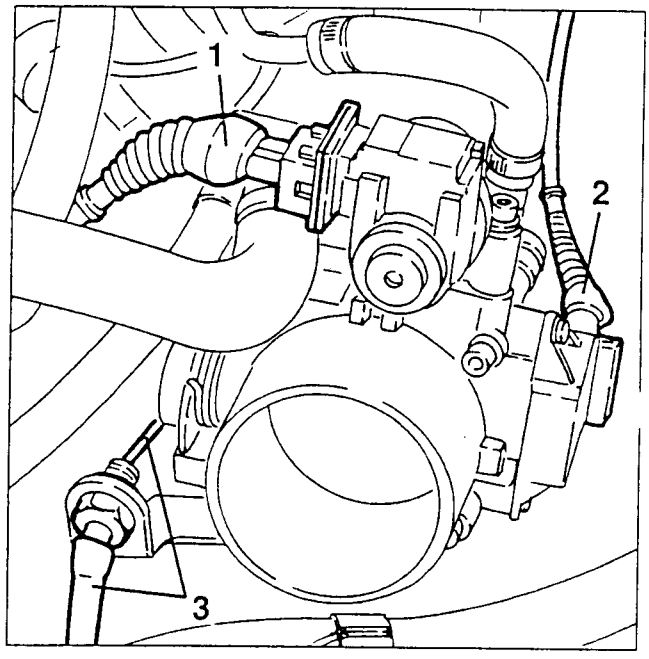

1. Raise the car and drain the engine coolant fluid disconnecting the outlet sleeve from the radiator.



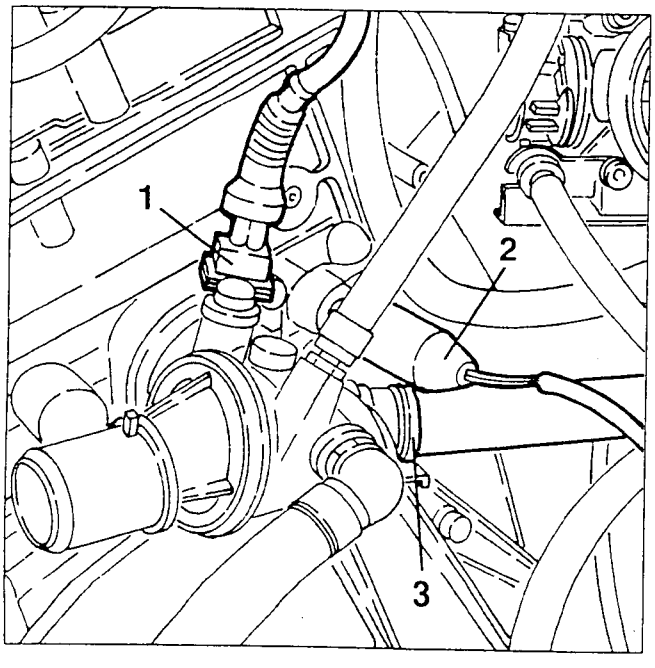
1. Lower the car then disconnect the radiator coolant delivery sleeve from the thermostatic cup.
2. Disconnect the coolant fluid return pipe from the climate control system heater from the longitudinal manifold.



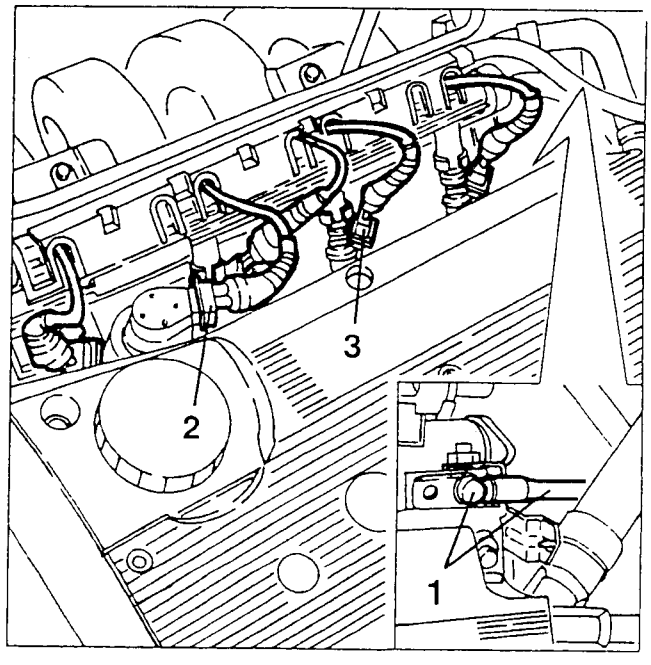

1. Disconnect the electrical connection from the constant idle speed actuator.
2. Disconnect the electrical connection from the throttle potentiometer.
3. Disconnect the accelerator cable from the throttle body.



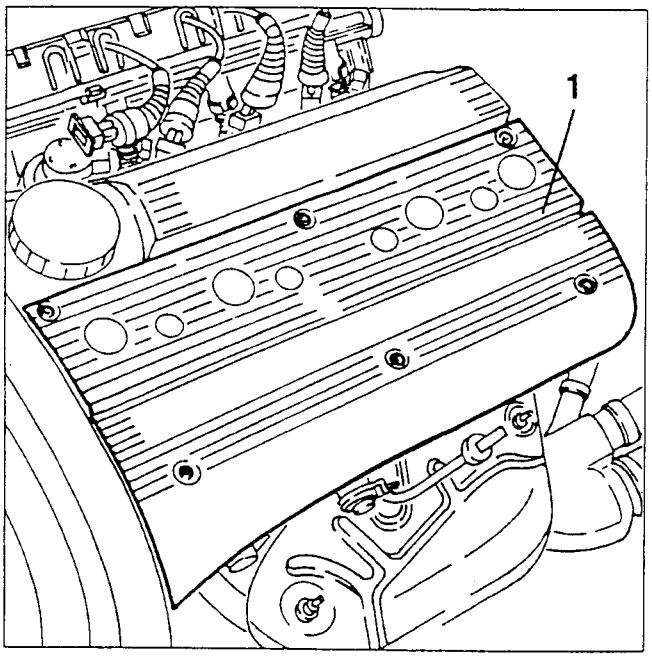

1. Disconnect the electrical connection from the coolant fluid temperature sensor NTC).
2. Disconnect the electrical connection from the engine coolant temperature gauge transmitter and maximum temperature warning light contact.
3. Disconnect the coolant delivery pipe to the climate control heater from the thermstatic cup.



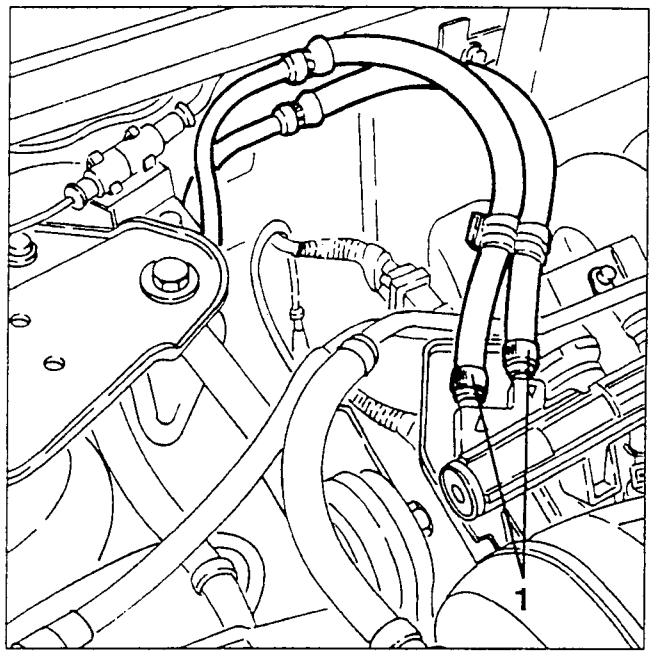

1. Disconnect the earth cable from the air intake manifold.
2. Disconnect the electrical connection from the timing variator electromagnet.
3. Disconnect the electrical connections from the injectors.



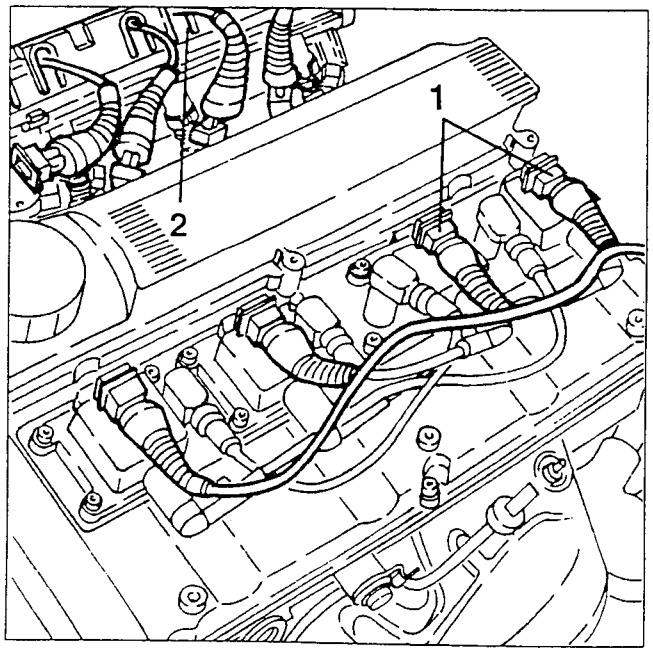
1. Slacken the fastening screws and remove the ignition coils cover.



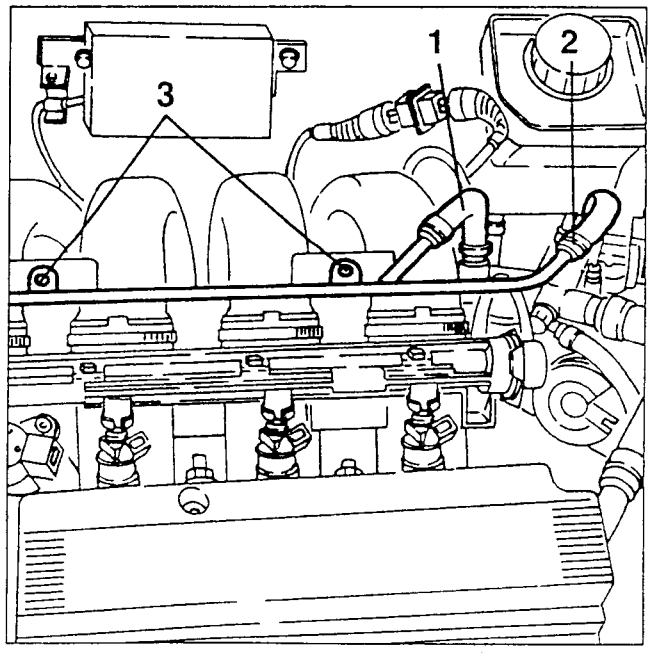

1. Disconnect the fuel inlet and outlet pipes from the distributor manifold.



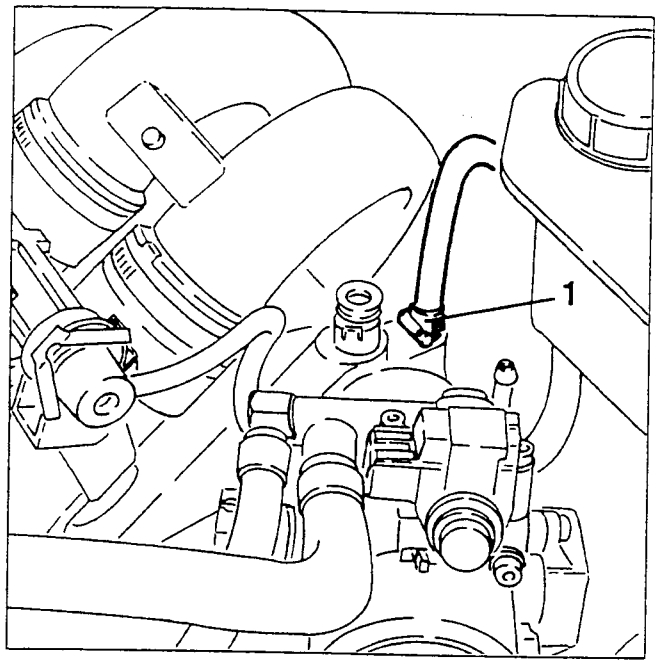

1. Disconnect the electrical connections from the ignition coils.
2. Release the cable race from the fuel distributor manifold, then withdraw the electric wiring and move it aside to prevent it from hindering the following operations.



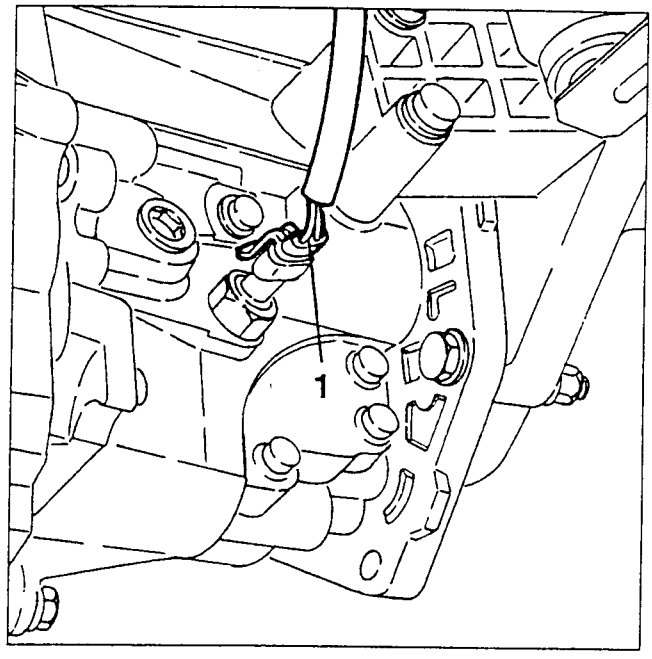

1. Disconnect the fuel vapour inlet pipe from the intake box.
2. Disconnect the the coolant return pipe to the header tank from the throttle body.
3. Slacken the two screws fastening to the intake box then turn aside the two stiff pipes.



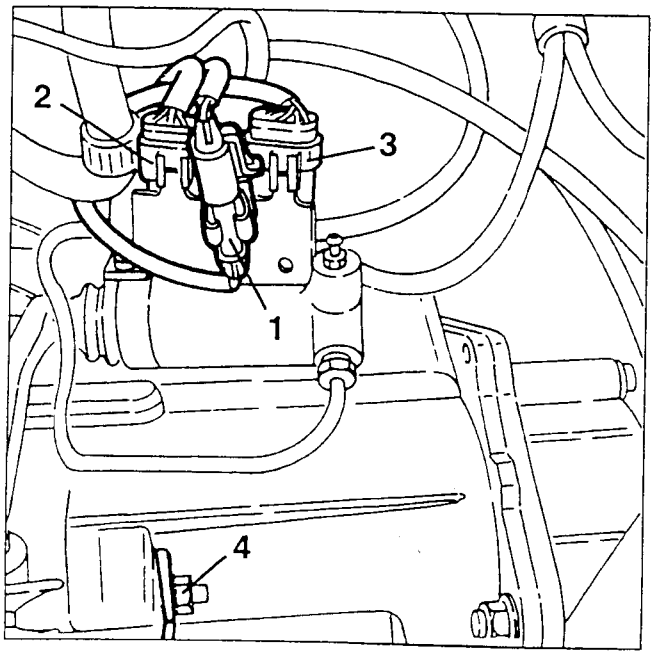
1. Disconnect the servobrake vacuum takeoff pipe from the intake box.



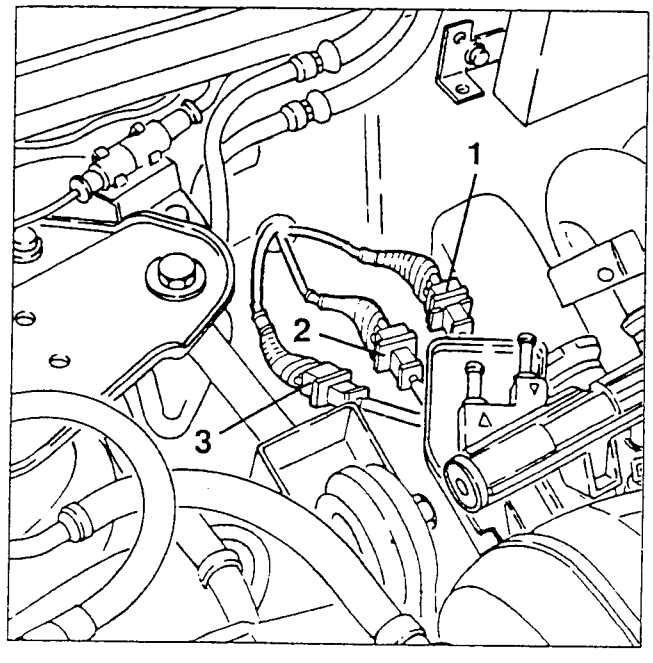

1. Disconnect the electrical connection from the reversing switch.



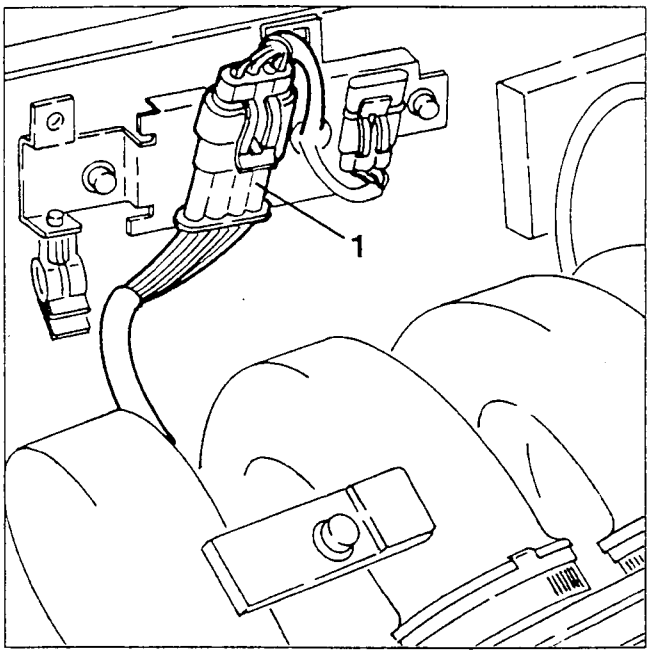

1. Disconnect the electrical connection of the starter motor.
2. Disconnect the electrical connection of the tachometric sensor.
3. Disconnect the electrical connection of the injection system.
4. Disconnect the earth cable from the gearbox cover.



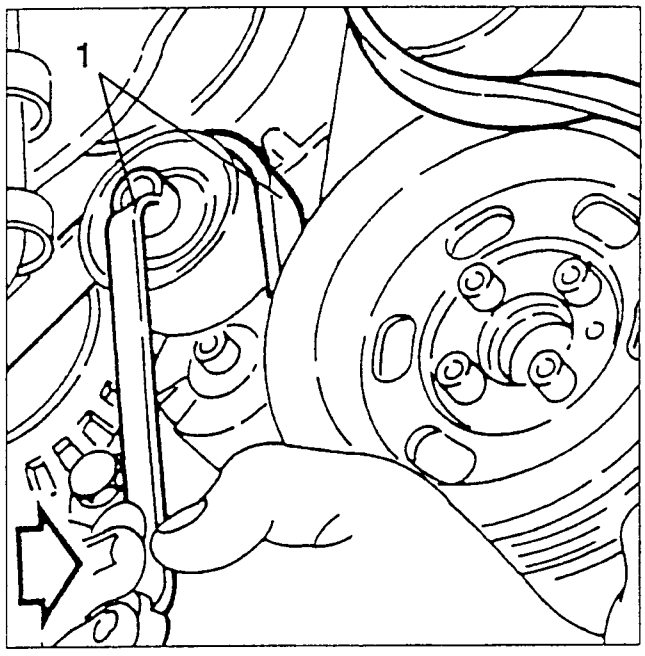

1. Disconnect the electrical connection of the timing sensor (blue).
2. Disconnect the electrical connection of the pinging sensor (white).
3. Disconnect the electrical connection of the rpm and timing sensor (brown).



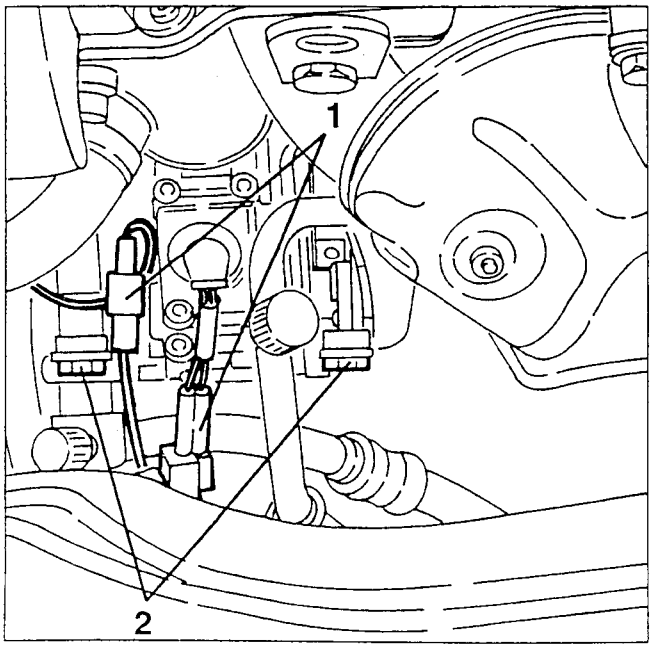
1. Remove the plastic protection, then disconnect the electrical connection of the lambda sensor.



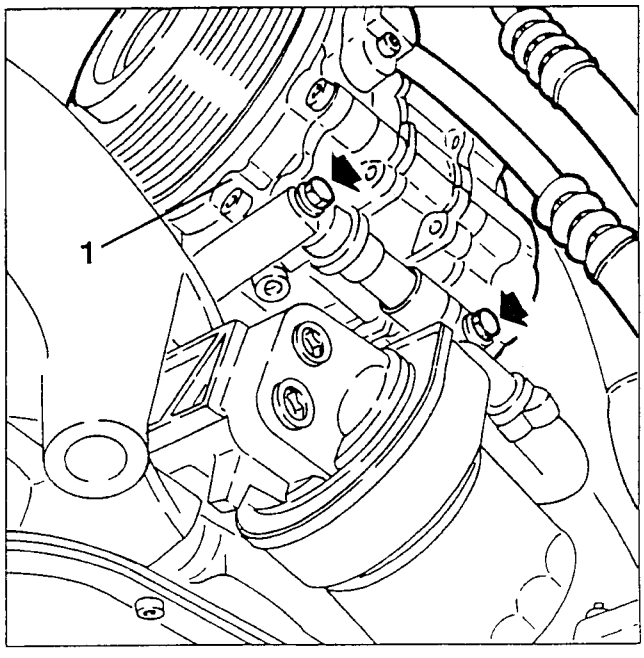

1. Working as illustrated on the pulley guide, loosen the tension of the auxiliary components drive belt and remove it.



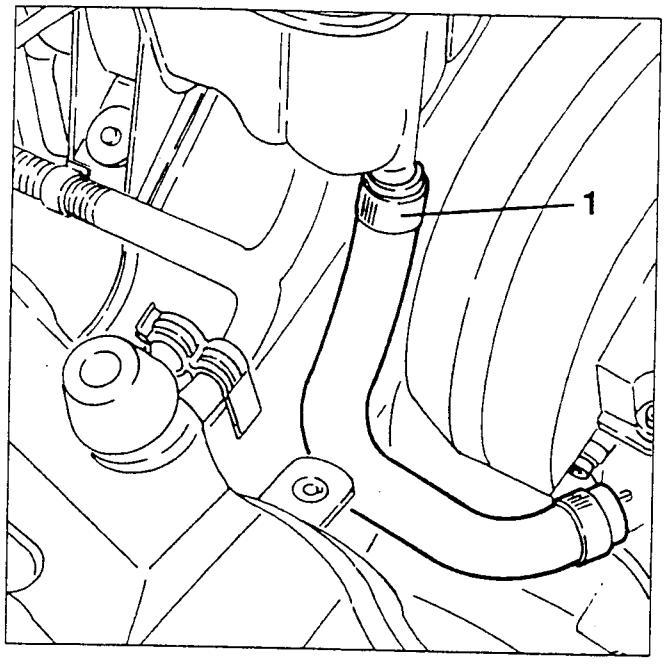

1. Disconnect the two electrical connections from the climate control system compressor.
2. Slacken the two upper compressor fastening screws.



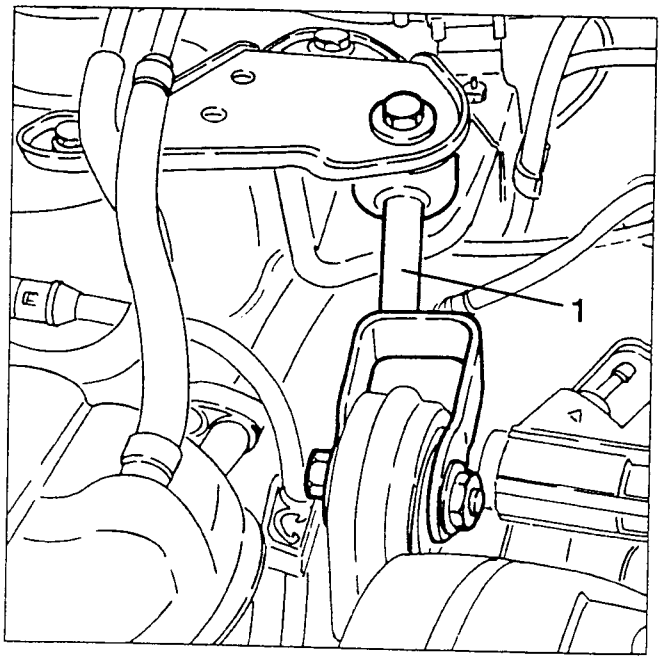

1. Slacken the two lower screws fastening the climate control system compressor, then without disconnecting the pipes, remove it and fasten it to one side so that it does not hinder the following operations.



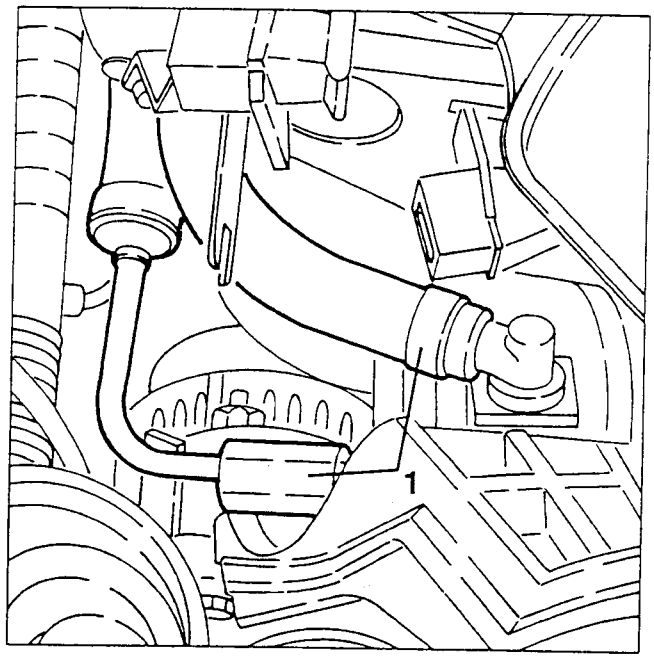
1. Lower the car and disconnect the system supply pipe from the header tank.



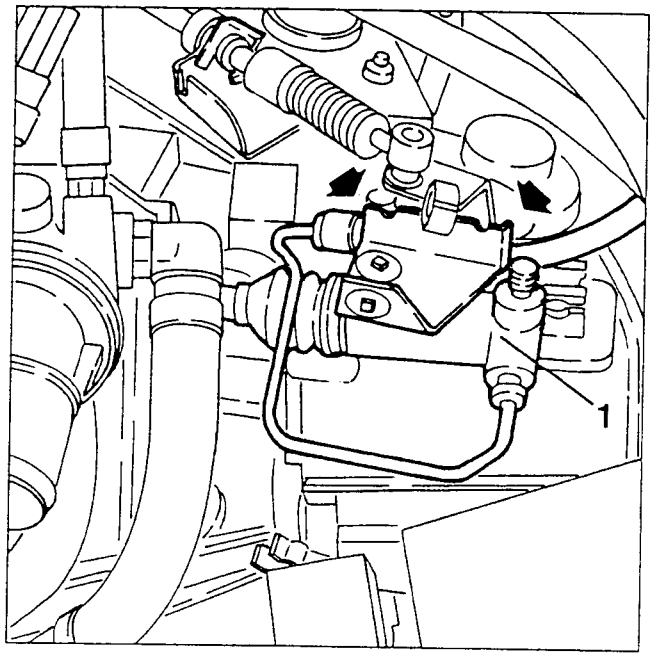

1. Slacken the fasteners and remove the engine stay rod.



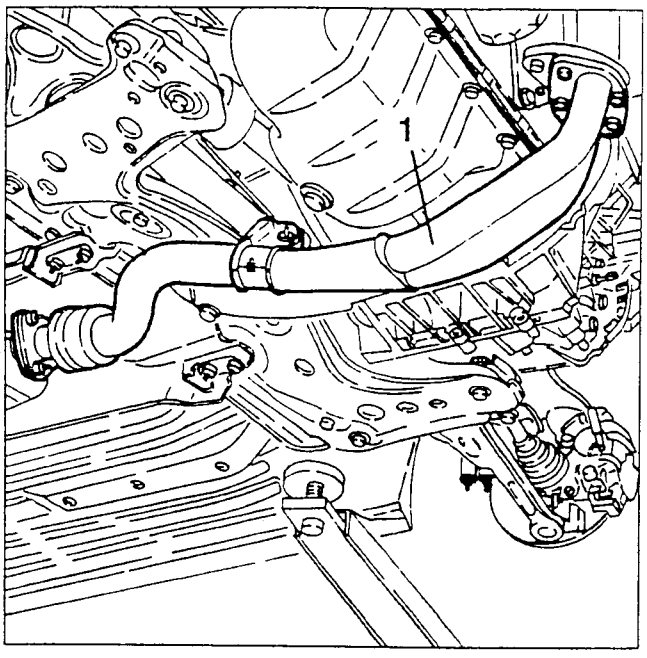

- Using a suitable syringe, withdraw the oil from the power steering tank.
1. Disconnect the two oil intake and delivery pipes from the power steering pump.



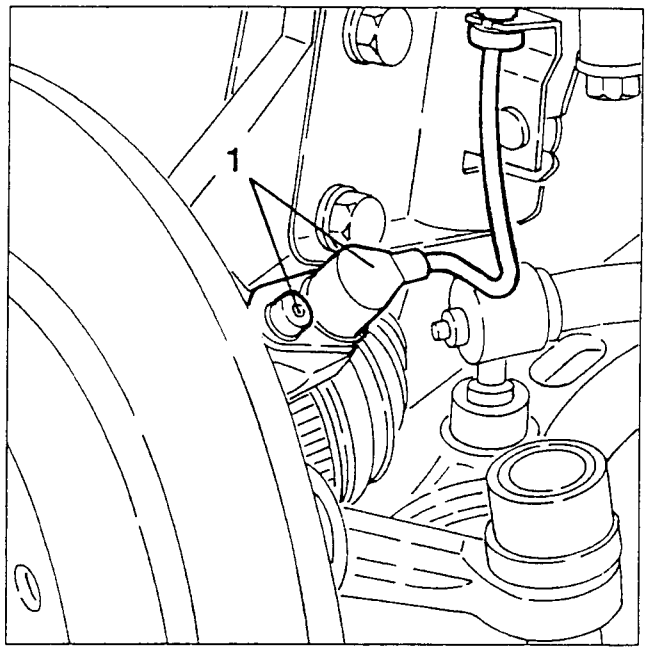

1. Slacken the fastening screws, then move the clutch control cylinder without disconnecting the associated pipes.



1. Slacken the fasteners and remove the front section of the exhaust pipe complete with lambda sensor.

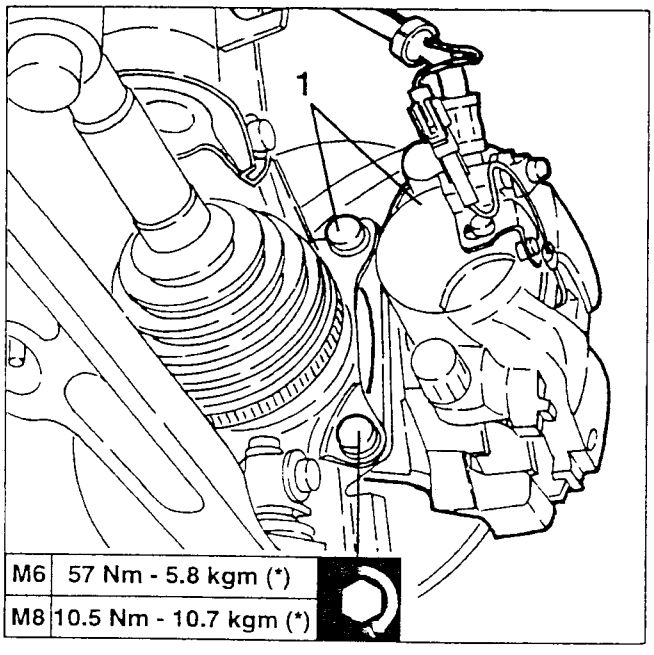



1. Slacken the fastening screw and remove the A.B.S. inductive sensor from the wheel upright.



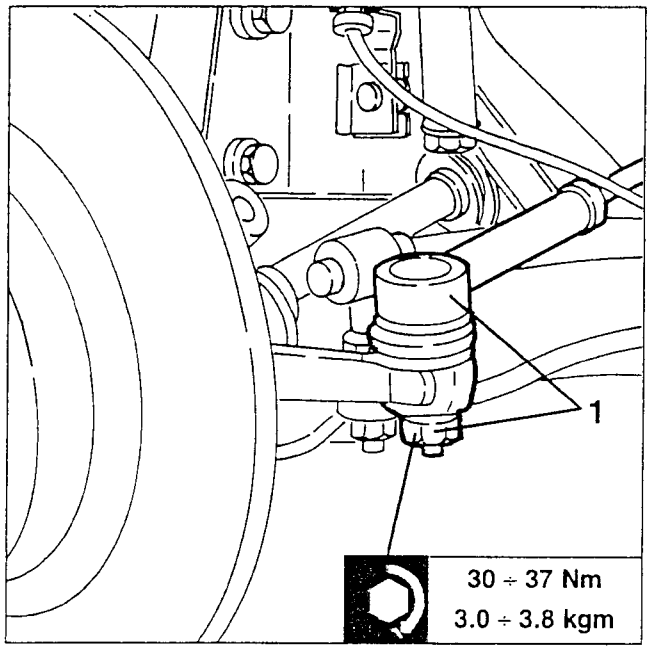

**The following operations concerning removal of the complete axle shaft, wheel upright and brake disk are shown for the left hand side of the car, proceed in the same way for the right hand side.**

1. Slacken the two fastening screws and remove the brake caliper complete without disconnecting the associated pipes and fasten it to one side so that it does not hinder the following operations.

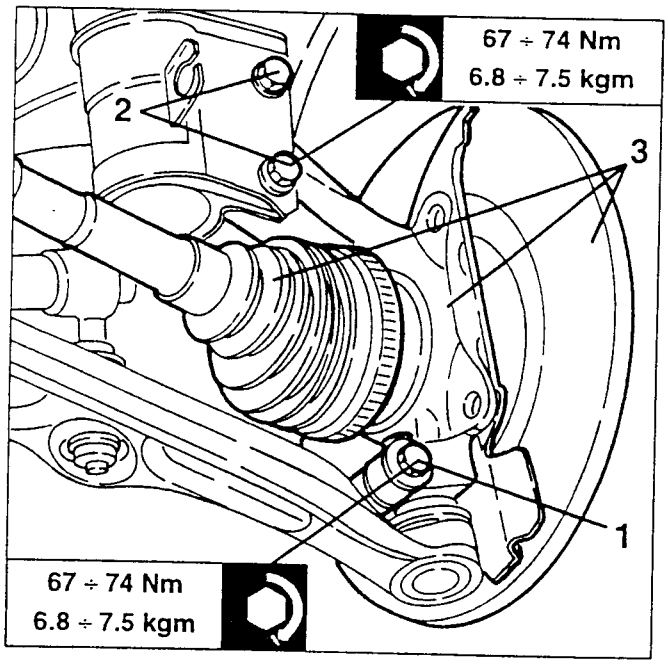



(*): Screws with "Driloc"; must be changed each time they are tightened or loosened.

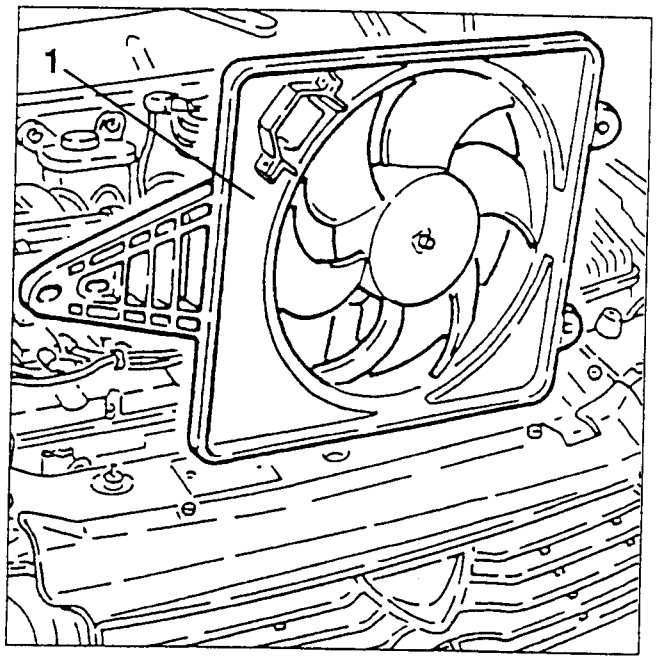
1. Slacken the fastening nut and disconnect the track rod from the wheel upright.



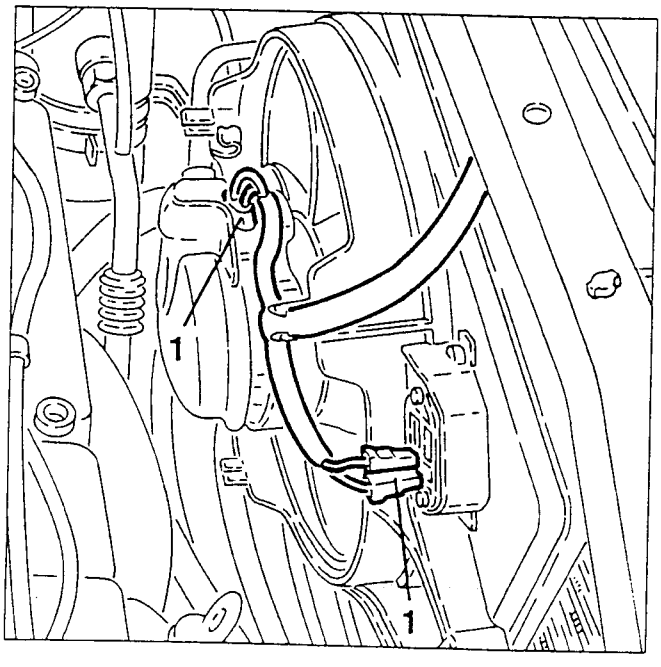
1. Slacken the bolt fastening the wishbone to the wheel upright.
2. Slacken the two bolts fastening the upright to the shock absorber.
3. Withdraw the axle shaft complete with wheel upright and brake disk after releasing the axle shaft boot from the differential.



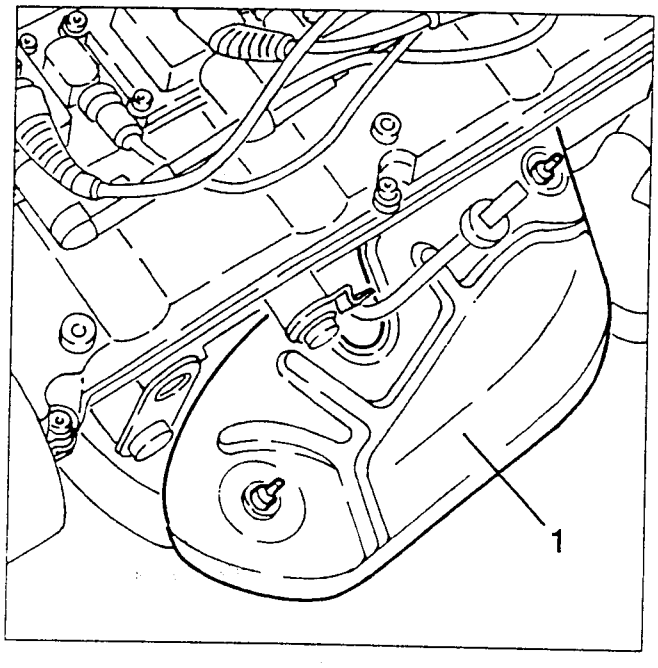

1. Slacken the fastening screws and remove the cooling fan.



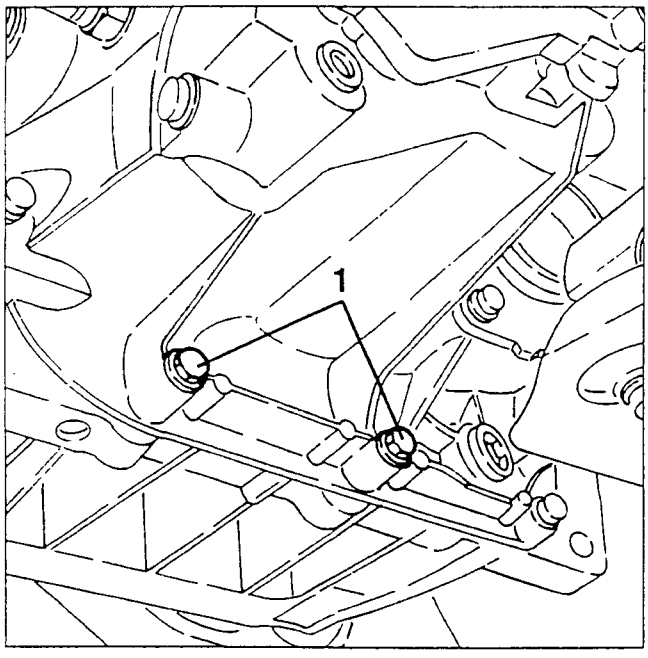

1. Disconnect the electrical connections from the cooling fan.



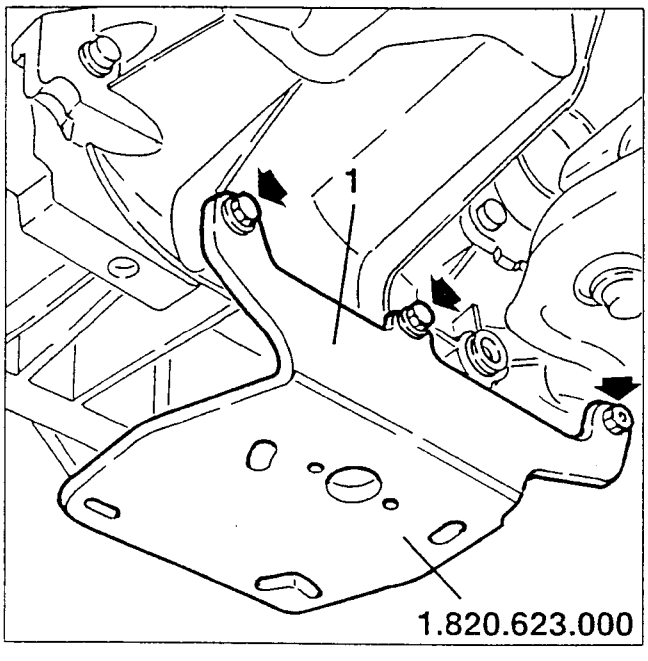

1. Remove the heat guard from the exhaust manifold.



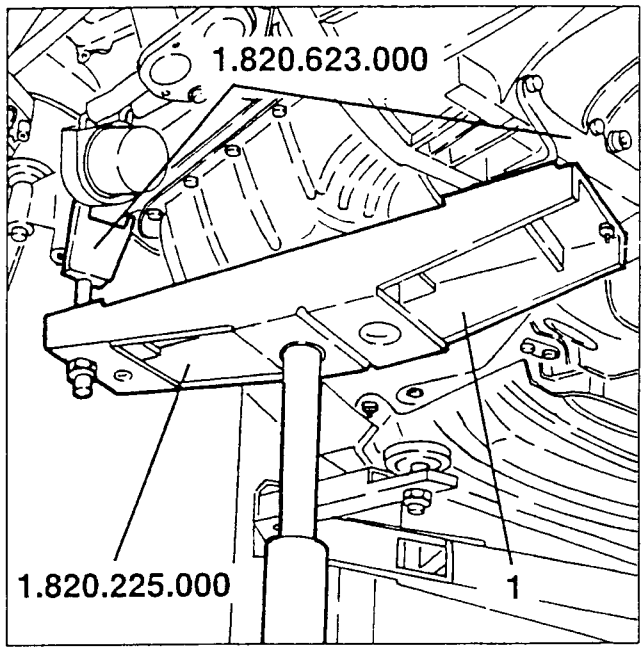
1. Slacken the two screws illustrated fastening the gearbox.



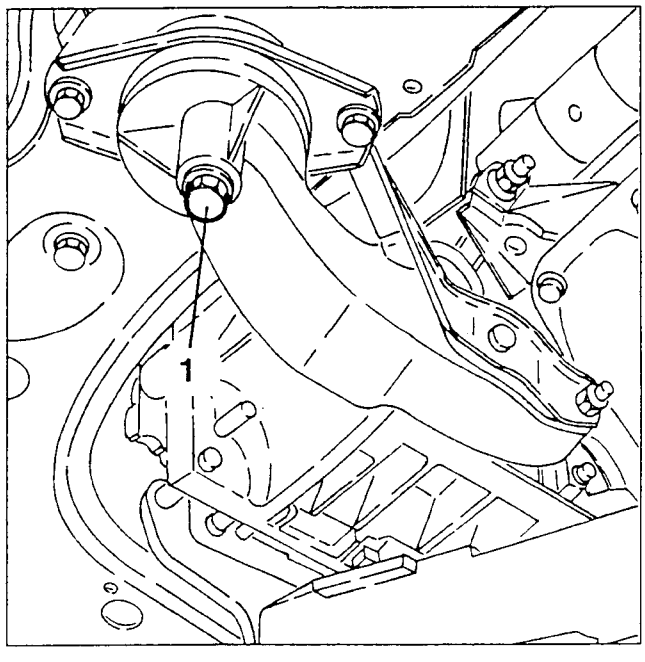

1. Position the bracket of tool no. 1.820.623.000 fastening it to the gearbox using the two screws removed previously and with a bolt in the hole already existing on the gearbox as illustrated.



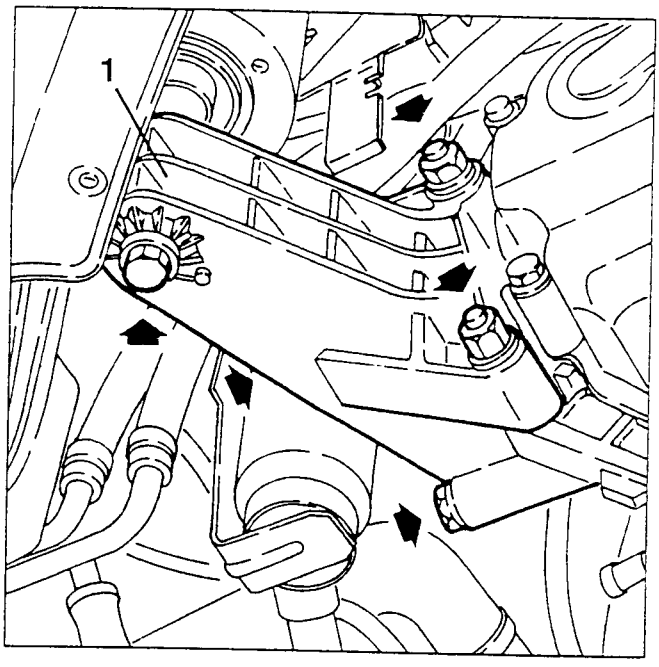

1. On hydraulic jack install support no. 1.820.225.000 complete with fork no. 1.820.623.000 and set it under the power unit as illustrated fastening the support to the bracket previously fitted on the gearbox.



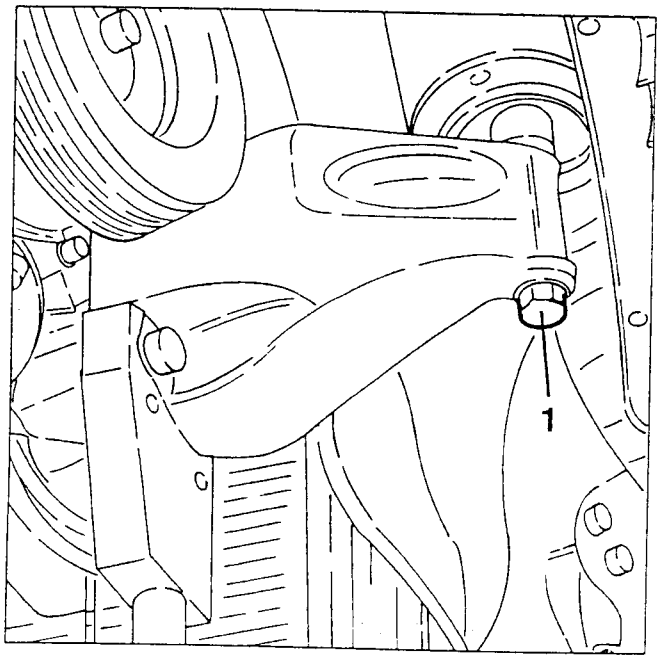

1. Slacken the fastening screw of the rear power unit support.



1. Slacken the fasteners and remove the power unit support on the gearbox side.

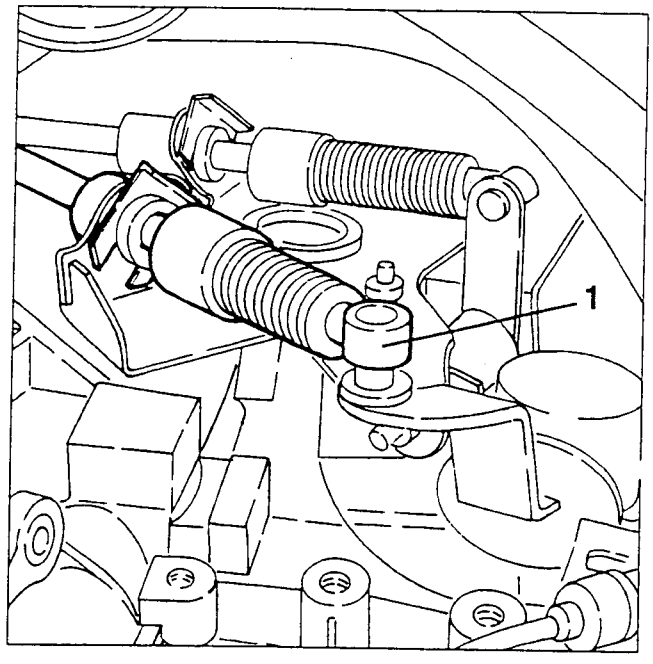



1. Slacken the screw fastening the camshaft side power unit support to the body.

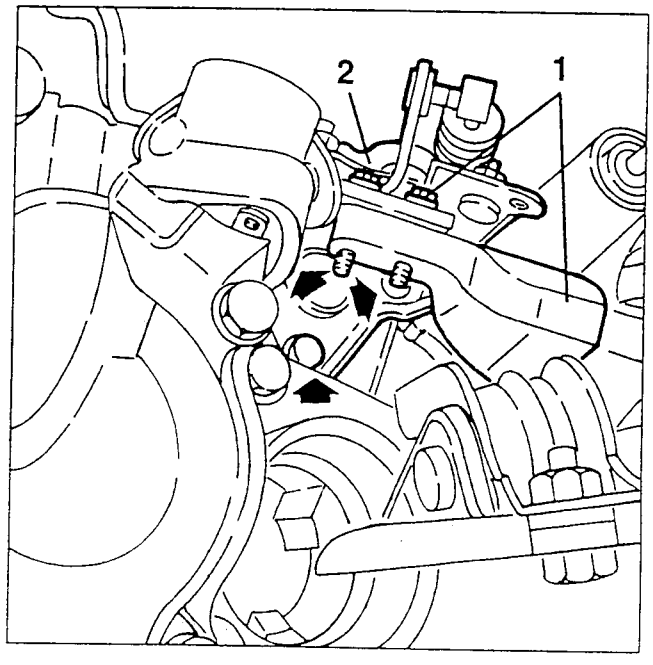



**Specific for versions with bpwden gearbox control**

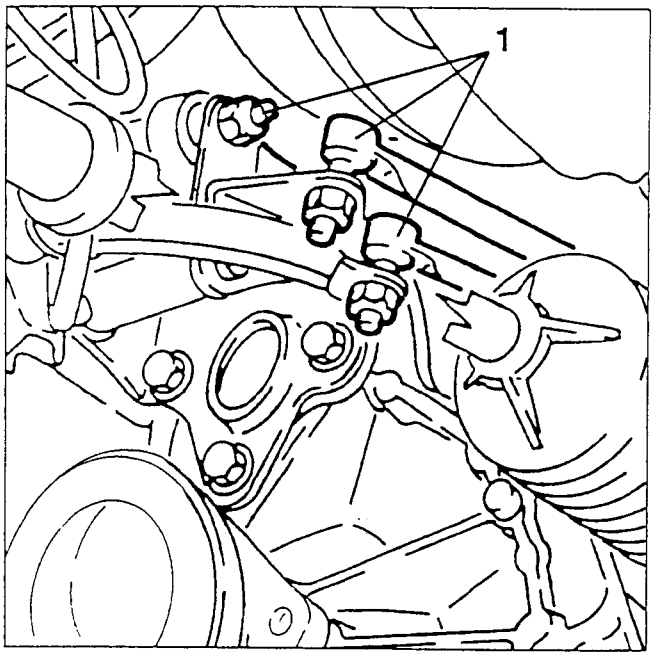
1. Lower the power unit as far as necessary and disconnect the gearshift control bowden illustrated.




1. Slacken the two fastening screws and remove the damping mass.
2. Slacken the fastening screws and remove the gearshift control bowden connection bracket from the gearbox.

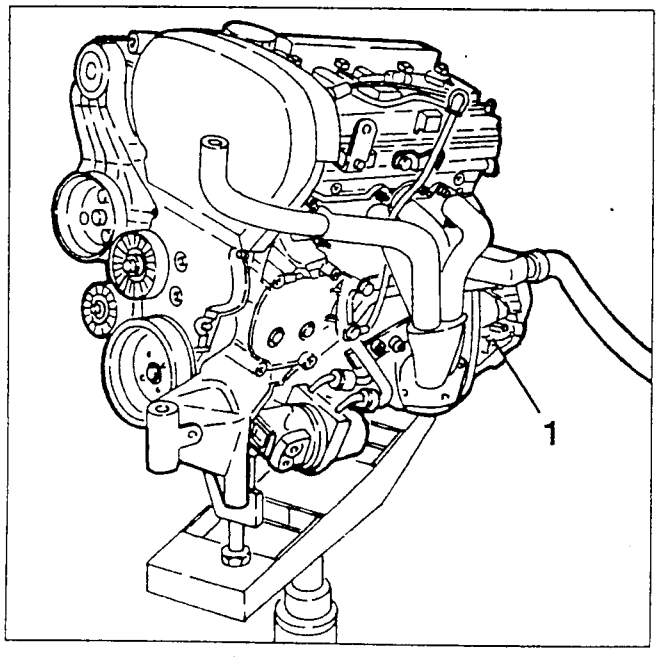


Specific for versions with rod gearbox control
1. Slacken the fastening nuts and disconnect the gearshift control rods.




1. Lower the hydraulic jack completely and remove the power unit from the engine compartment.

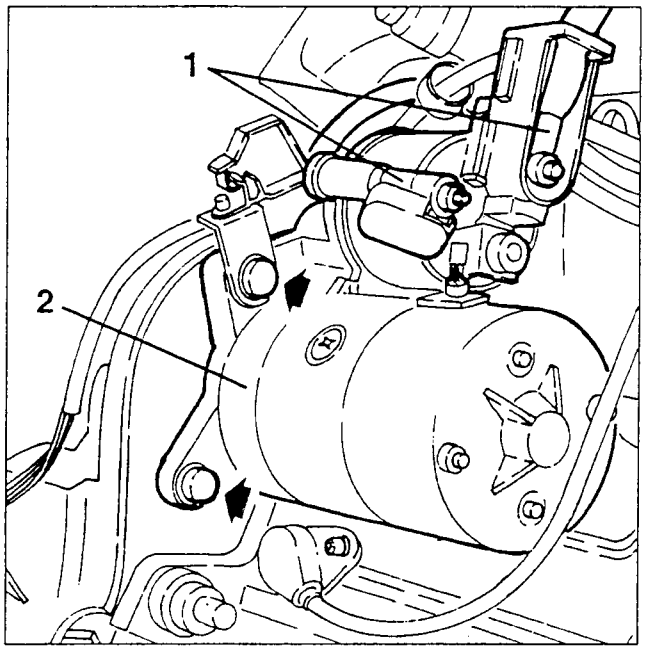
**WARNING:**
**The hydraulic jack must have a capacity of at least 1000 kg.**



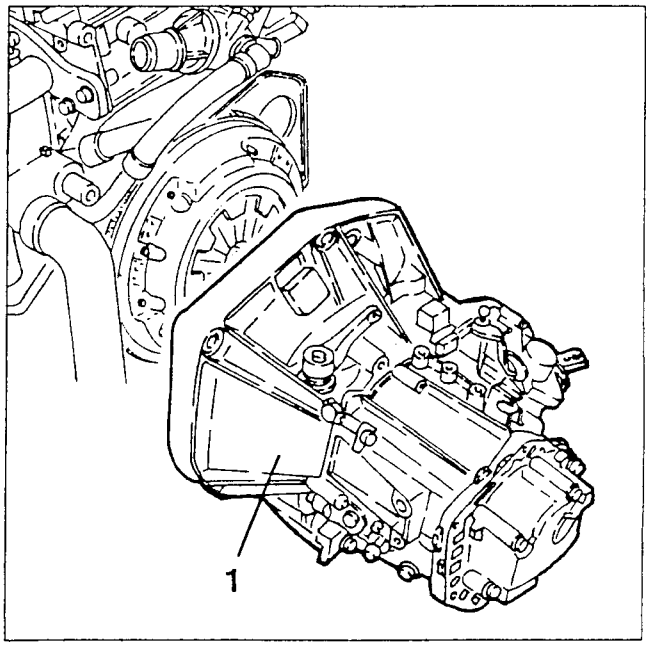

- Support the power unit with a hydraulic hoist in addition to the hydraulic jack used for removal.

**WARNING:**
**For handling the power unit use a hydraulic hoist after firstly releasing it from the hydraulic jack.**

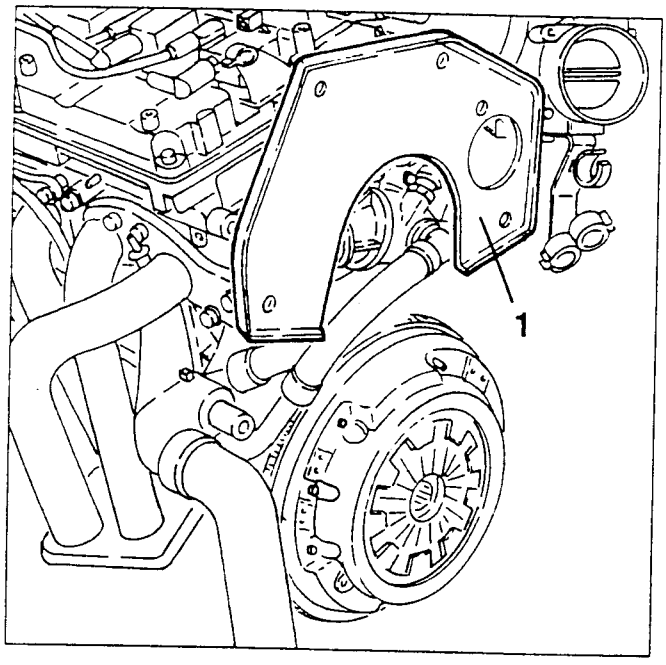
- Release the power unit from the support tools, then set it on a special work bench.
1. Disconnect the electrical connections from the starter motor.
2. Slacken the fastening screws and remove the starter motor.



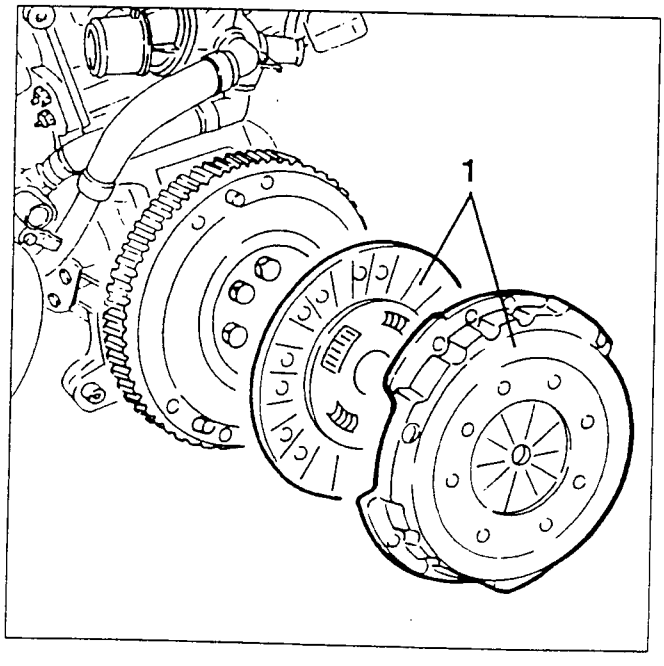

1. Slacken the fasteners and remove the gearbox-differential unit.



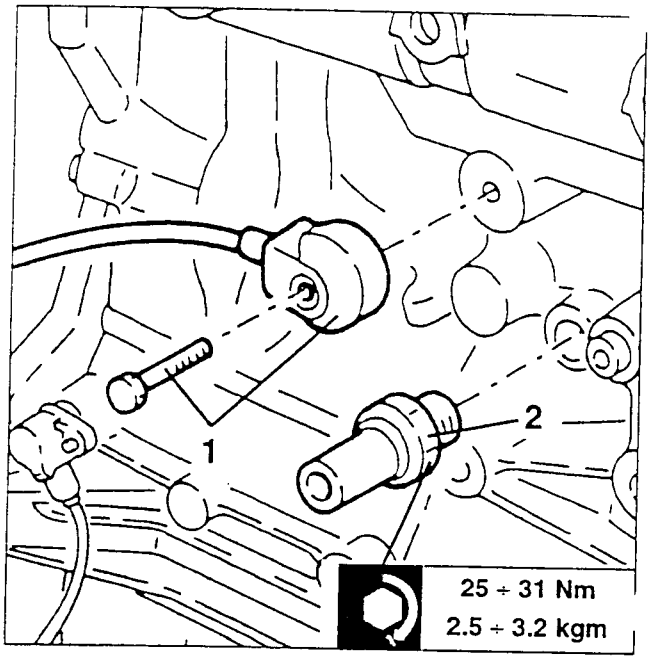
1. Retrieve the rear flywheel guard.



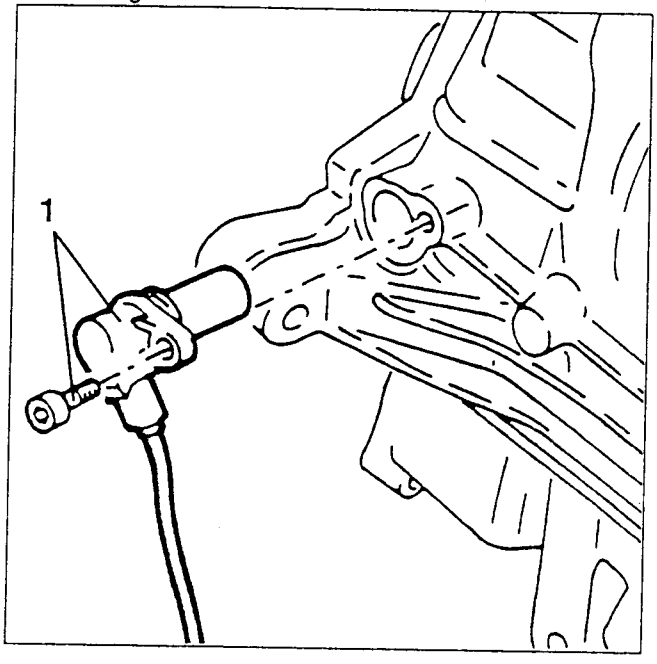

- Release the engine wiring from the cable clamps, disconnect the electrical connections still connected, then remove the wiring.
1. Slacken the fastening screws and remove the thrust plate and clutch plate.




1. Slacken the fastening screw and remove the pinging sensor from the crankcase.
2. Remove the engine oil minimum pressure sensor.




1. Slacken the fastening screw and remove the rpm and timing sensor.




## REFITTING

Repeate the operations of the removal procedure reversing their sequence and following the instructions given below:
- Prepare the engine compartment for refitting the power unit, placing all the electrical cables, pipes, etc. so that they do not interfere.

**WARNING: Make sure that the power unit support points have been fastened correctly.**

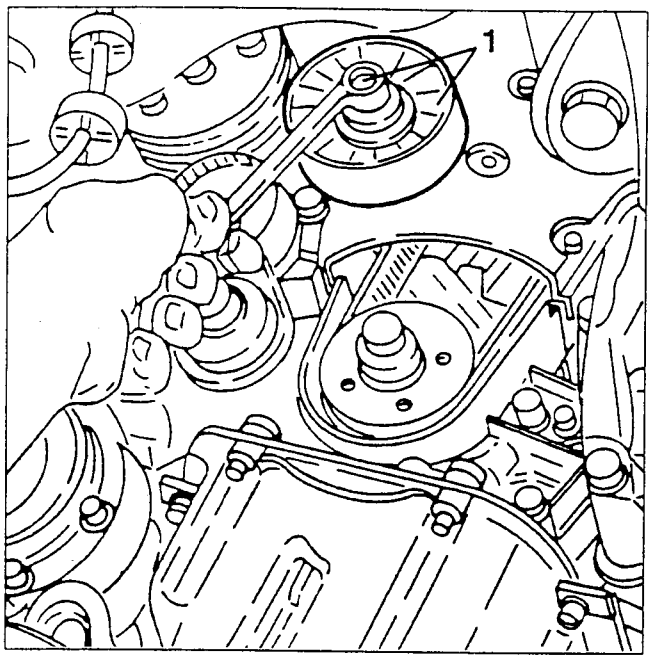
- After assembly, fill the systems as specified (see GROUP 00).
- Carry out all the checks and operations necessary (see GROUP 00).

# CYLINDER HEAD

## REMOVING/REFITTING

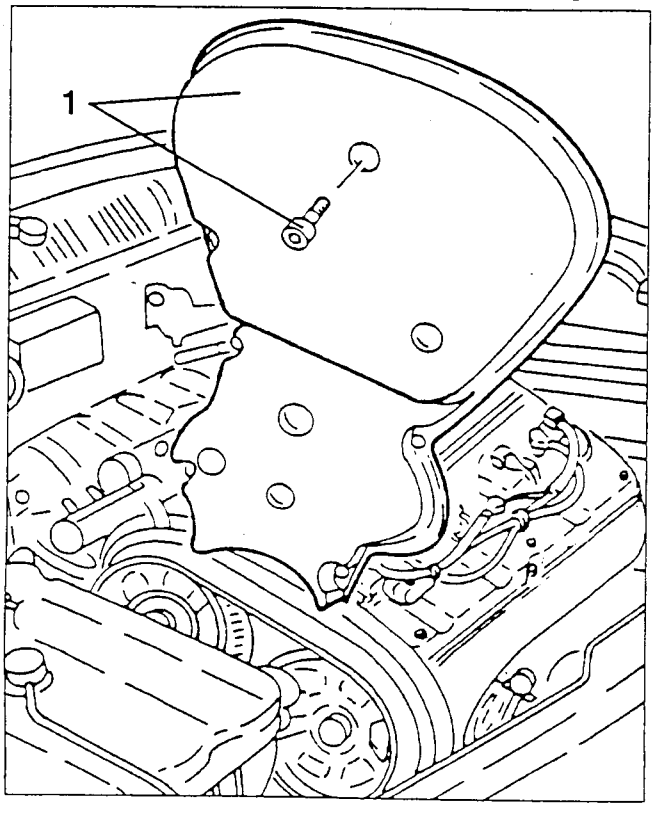
**Proceed as described for 1970 T. SPARK 16V engine up to removing the auxiliary components drive pulley included.**

1. Slacken the fastening screw and remove the auxiliary components drive pulley guide.

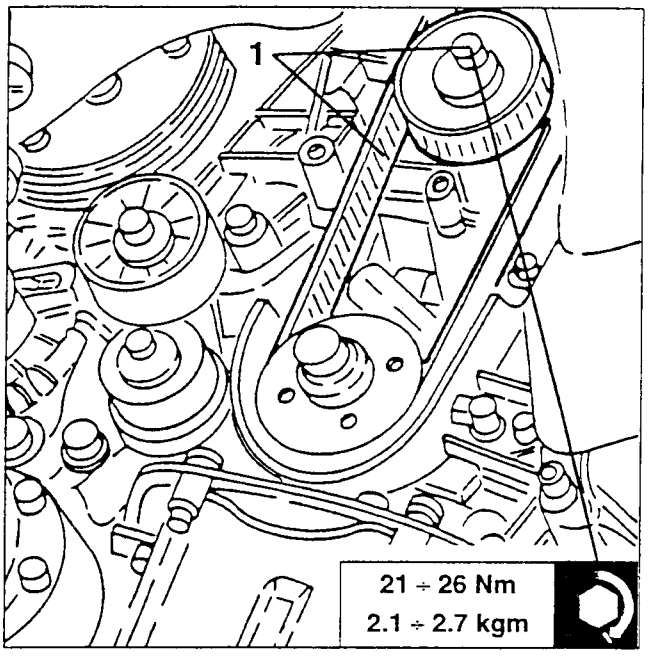



- Slacken the lower screws fastening the timing gear belt guard.

1. Lower the car, slacken the remaining fastening screws and remove the timing gear drive belt guard.




1. Working on the timing gear belt tensioner, loosen the tension of the belt, then remove it from the camshaft drive pulleys.



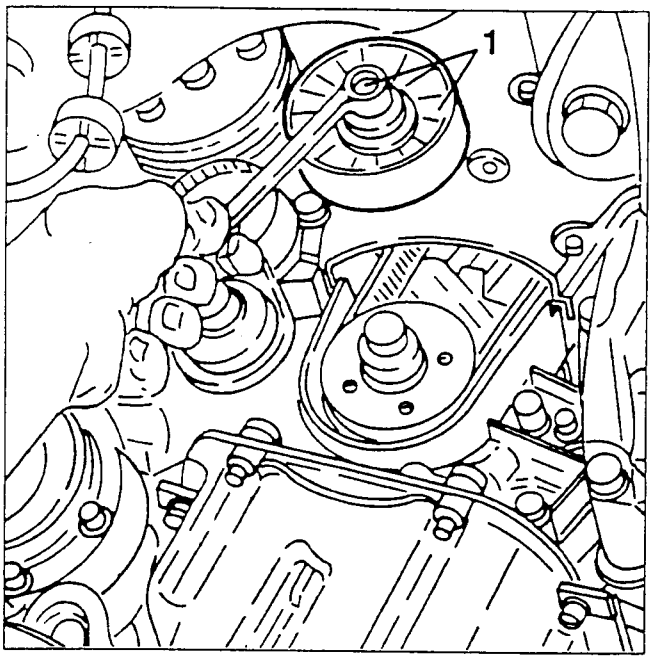

**Complete the cylinder head removing/refitting procedure proceeding as described for 1970 T. SPARK 16V engine.**

## OIL SUMP 1598 T. SPARK 16V 1747 T. SPARK 16V

### REMOVING/REFITTING

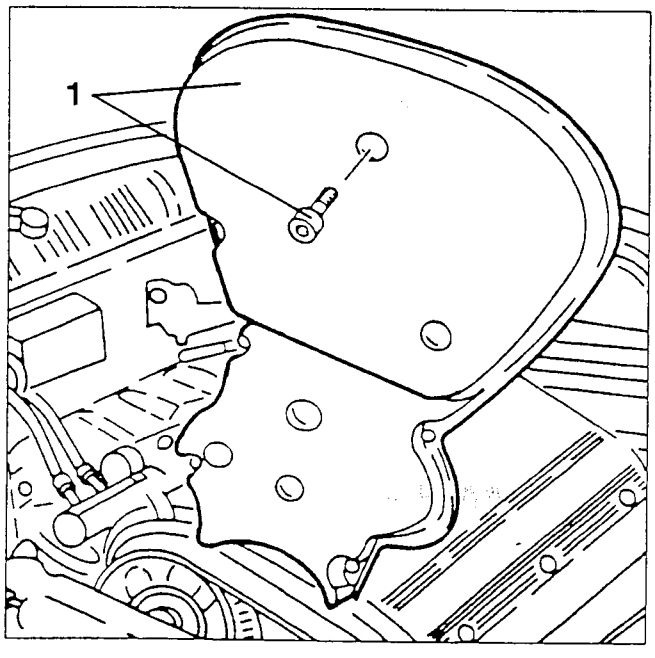
**Proceed as described for 1970 T. SPARK 16V engine up to removing the auxilisry components drive pulley included.**

1. Slacken the fastening screw and remove the auxiliary components drive belt pulley guide.




- Slacken the lower screws fastening the timing gear guard.

1. Lower the car, slacken the remaining fastening screws and remove the timing gear drive belt guard.

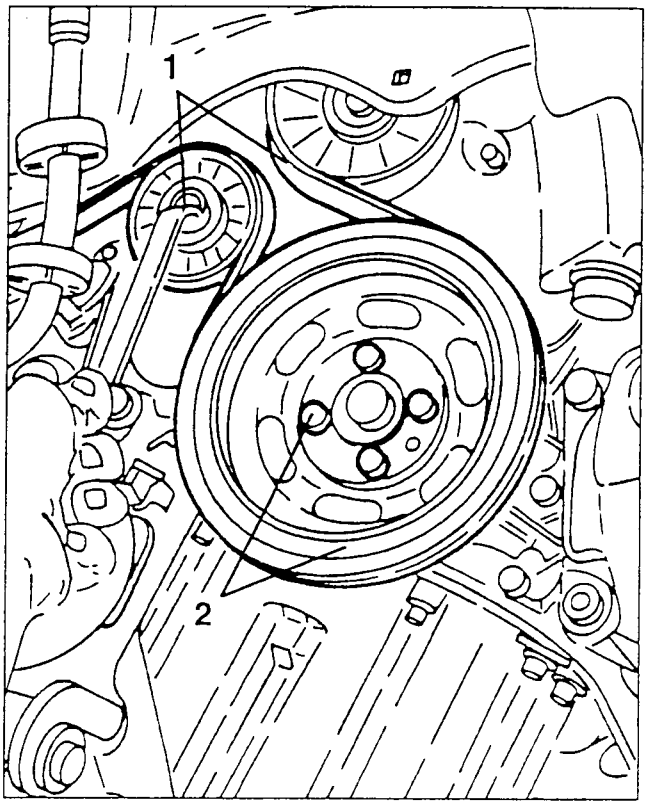



**Complete the procedure for removing/refitting the head oil sump proceeding as described for 1970 T. SPARK 16V engine.**

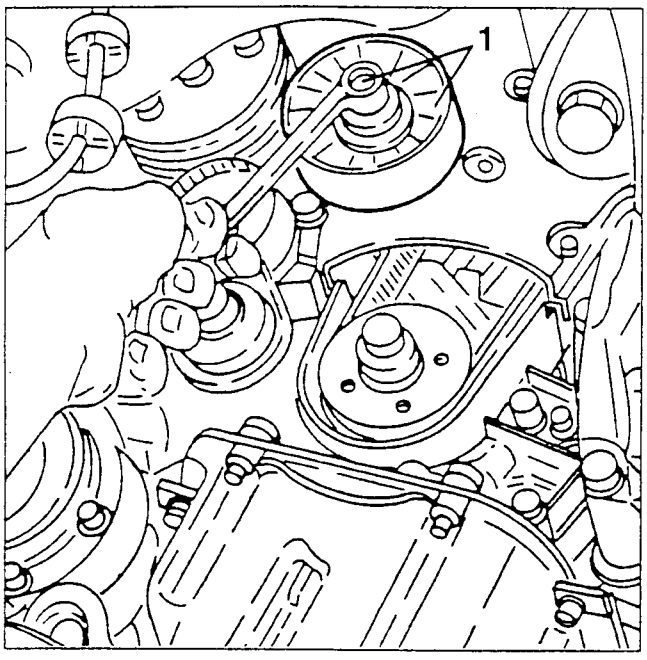
## CHANGING THE FRONT CRANKSHAFT OIL SEAL

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flaps.

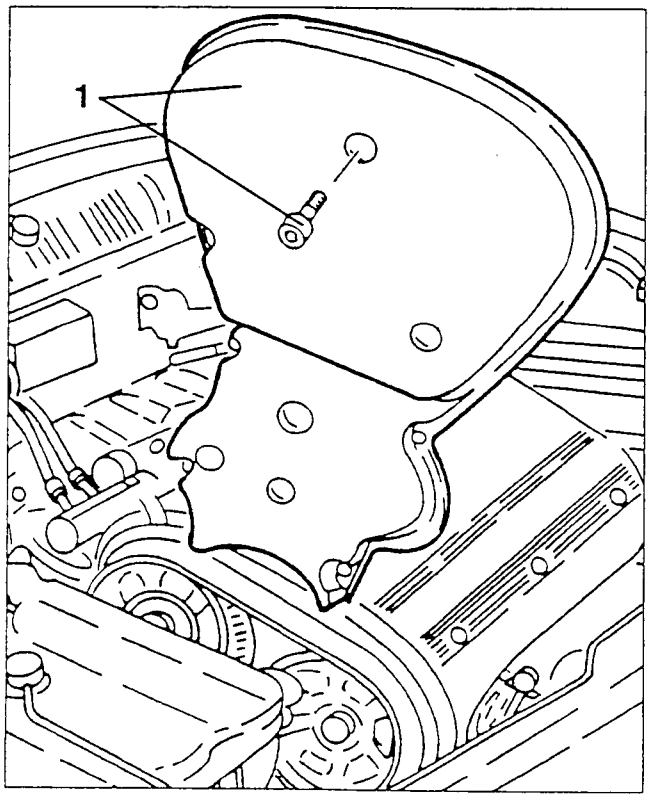
1. Raise the car and working on the belt tensioner as illustrated, slacken the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.



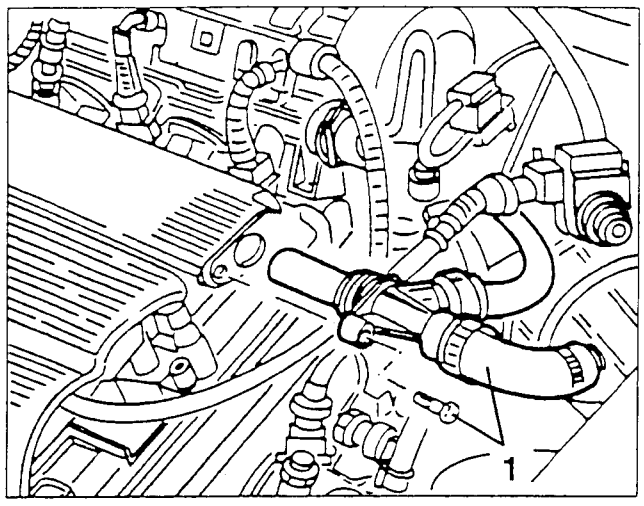
1. Slacken the fastening screw and remove the auxiliary components drive belt pulley guide.



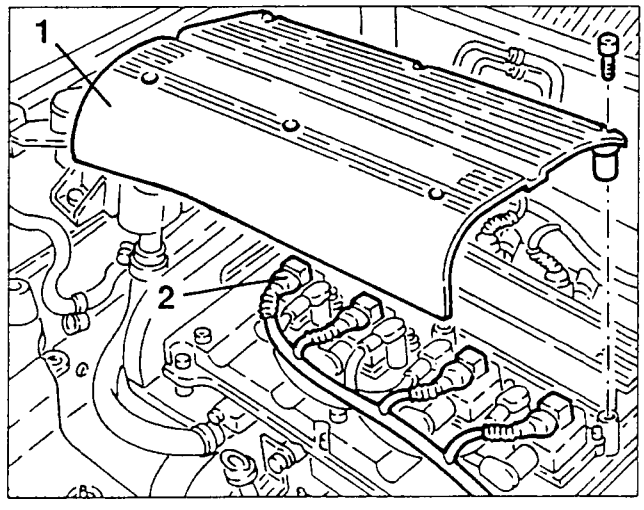

- Slacken the lower screws fastening the timing gear drive belt guard.
1. Lower the car, slacken the remaining fastening screws and remove the timing gear drive belt guard.



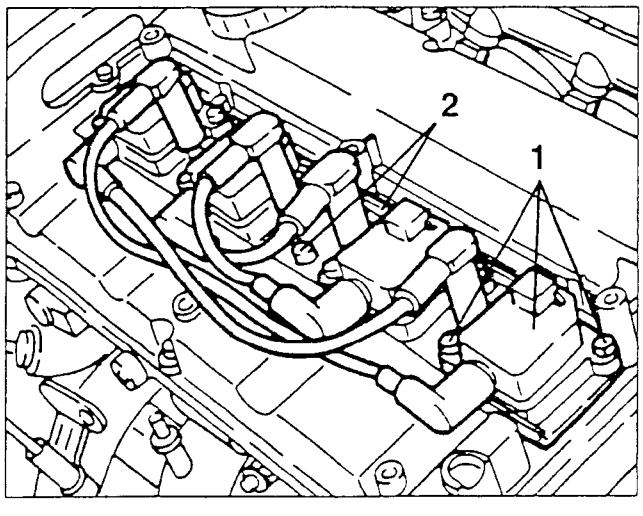

1. Slacken the fastening screw and withdraw the oil vapour recovery pipe socket.



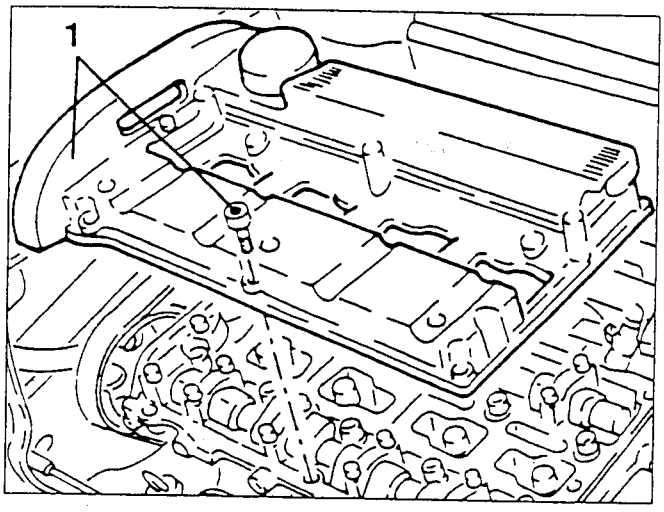

1. Slacken the fastening screws and remove ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



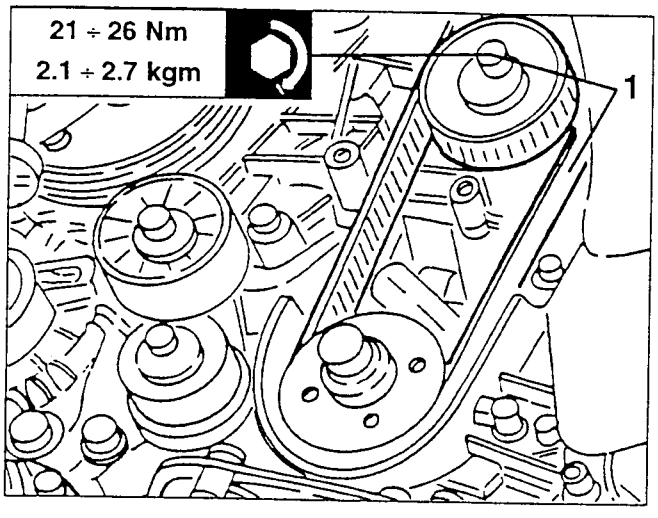

1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



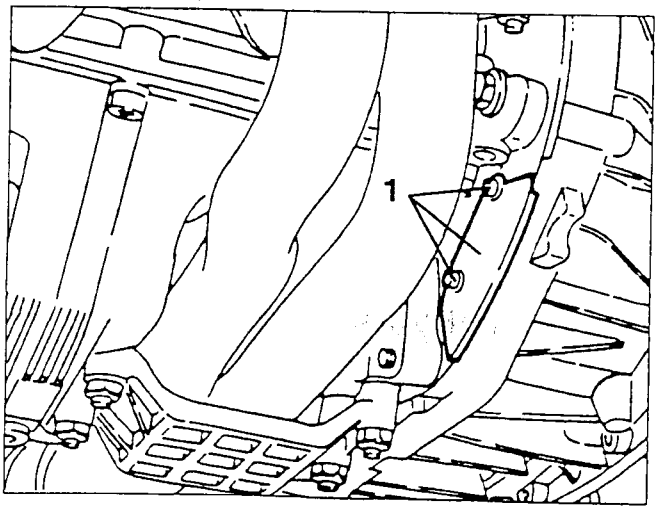
1. Slacken the fastening screws and remove the cylinder head cover complete with seal.



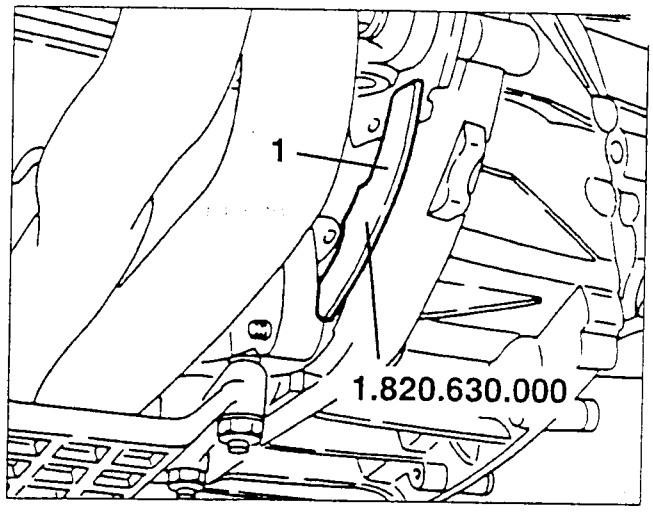

1. Working on the timing gear belt tensioner, slacken the tension of the belt, then remove it.



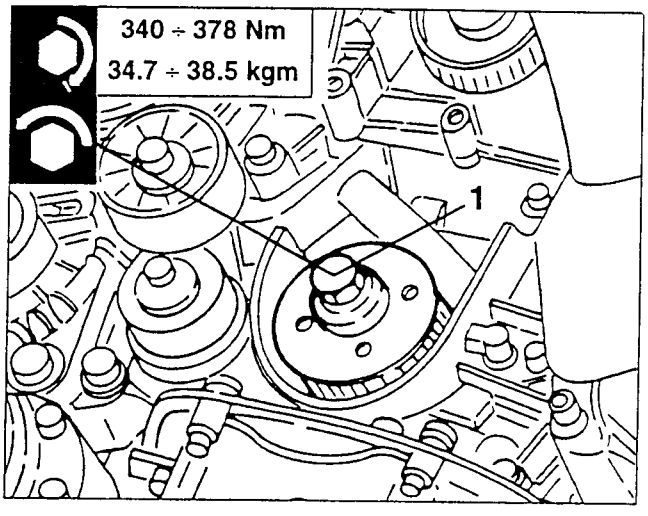

1. Slacken the two fastening screws and remove the flywheel guard plate.



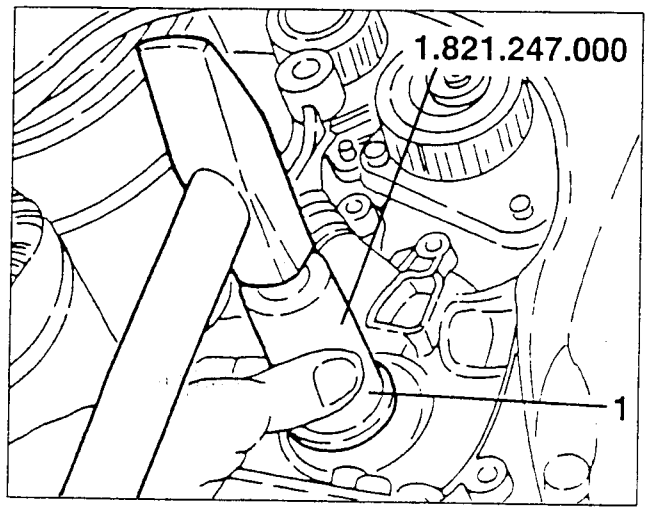

1. Install flywheel stopper tool no. 1.820.630.000, as illustrated.




1. Slacken the fastening screw (lefthand) of the timing gear drive belt pulley, then remove it.




1. Remove the oil seal and install a new one using tool no. 1.821.247.000.

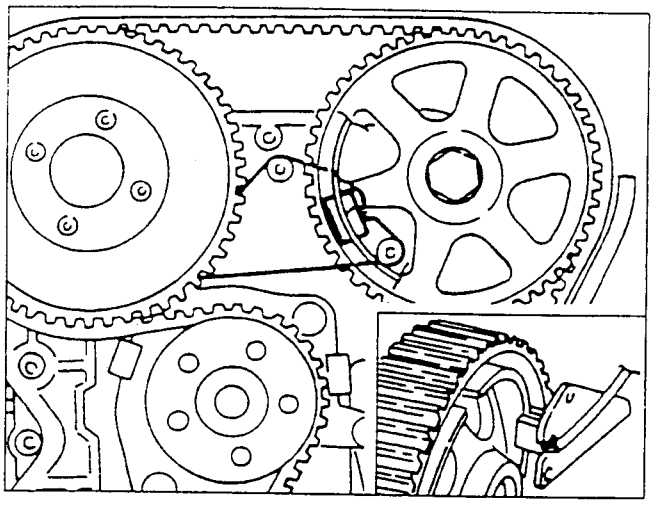



- Refit reversing the sequence described for removal.

Refer to GROUP 00 for refitting the timing gear drive belt and timing operations.

## TIMING SENSOR

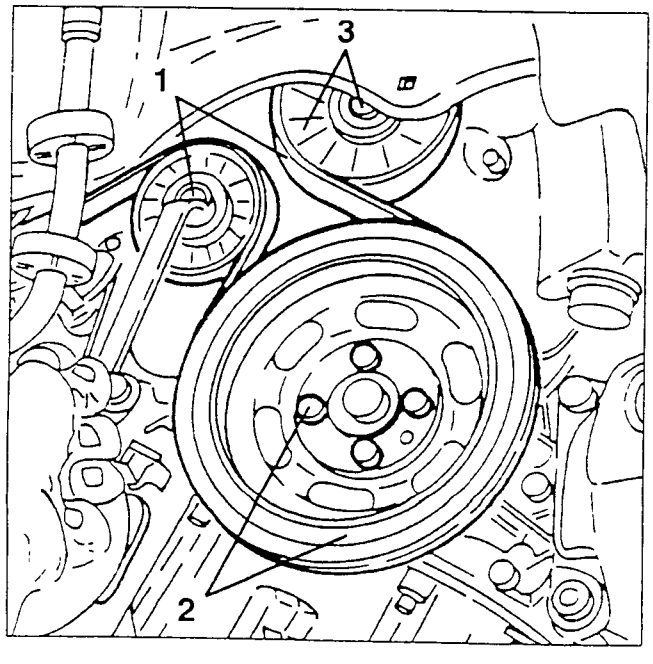
The timing sensor (cam angle sensor) is formed of a Hall effect device.
The voltage signal lowers abruptly when the tooth on the camshaft drive pulley facing the sensor passes in front of the sensor itself.



## REMOVING/REFITTING (For engines without counter-rotating shafts)

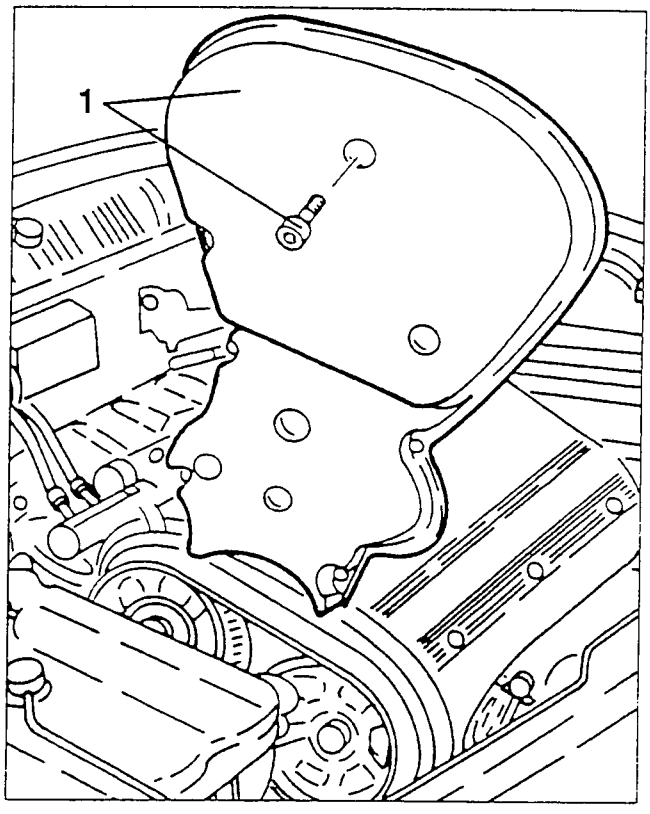
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Remove the right front wheel and mud flap.

1. Raise the car and proceeding as illustrated on the belt tensioner, slacken the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.
3. Slacken the fastening screw and remove the auxiliary components drive belt pulley guide.

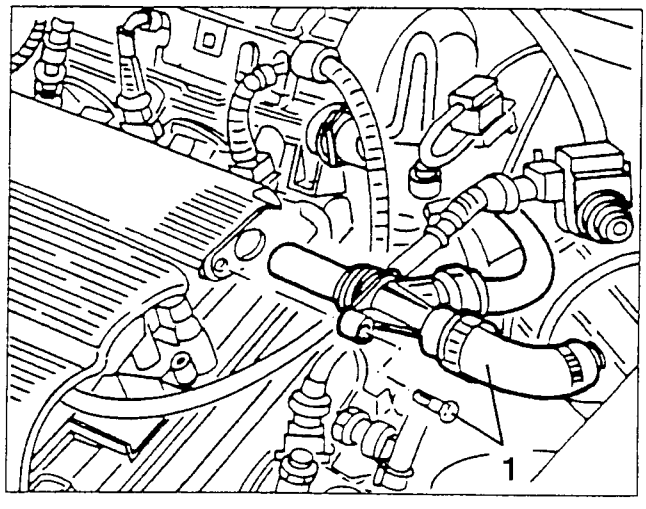



- Slacken the lower screws fastening the timing gear drive belt guard.

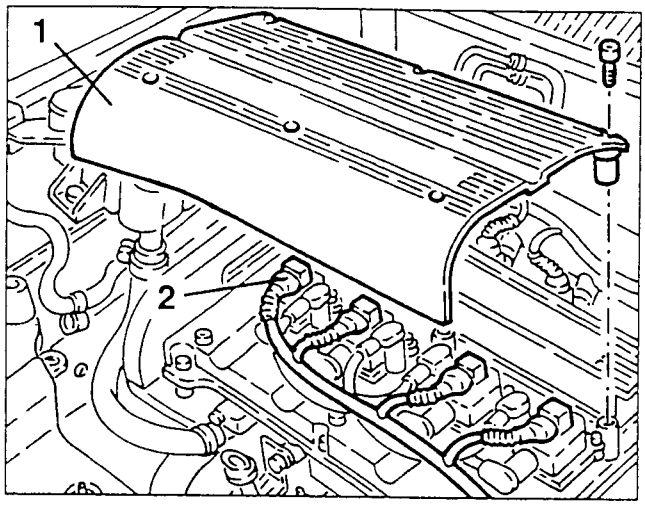
1. Lower the car, slacken the remaining screws and remove the timing gear drive belt guard.



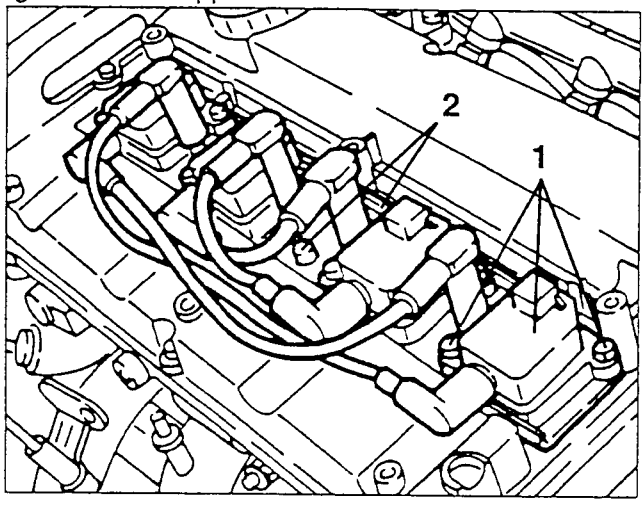

1. Slacken the fastening screw and clamp and remove the oil vapour recovery pipes.



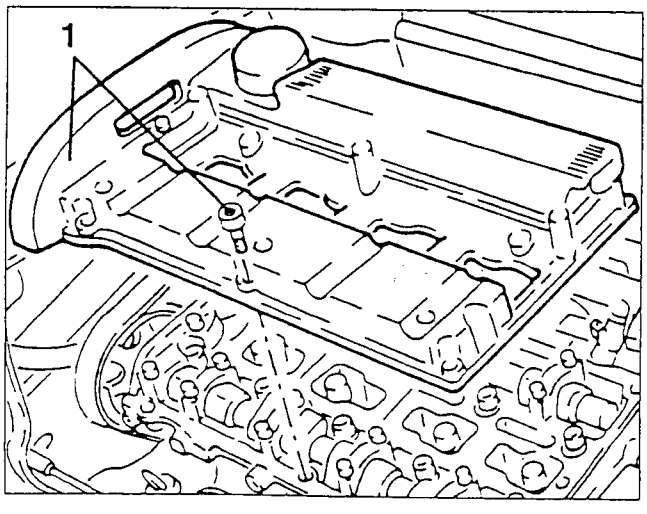
1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



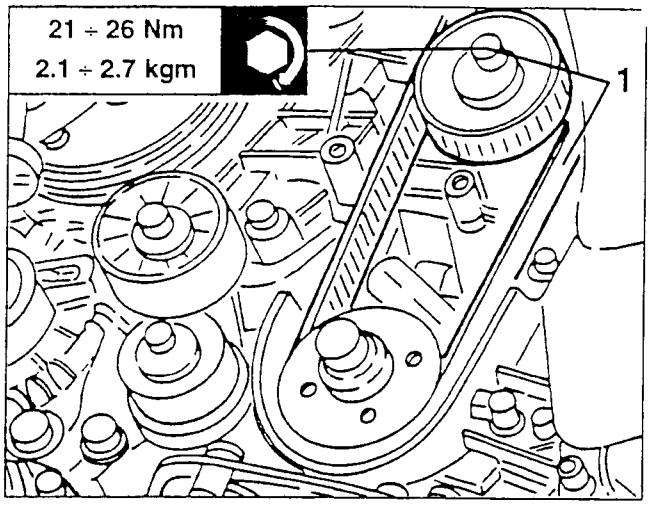

1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



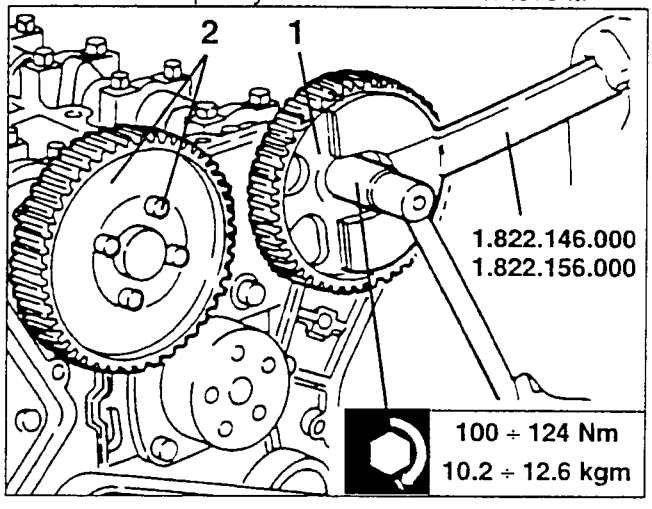

1. Slacken the fastening screws and remove the cylinder head cover complete with seal.



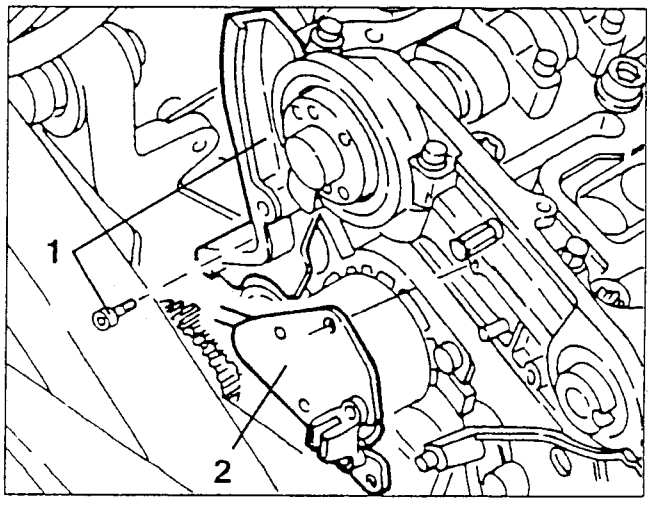

1. Working on the belt tensioner, slacken the tension of the belt, then remove it from the timing gear pulleys.




1. Using tools no. 1.822.146.000 and no. 1.822.156.000 slacken the screw fastening the timing gear drive pulley on the exhaust side and remove it.
2. Slacken the four fastening screws and remove the camshaft drive pulley intake side end remove it.

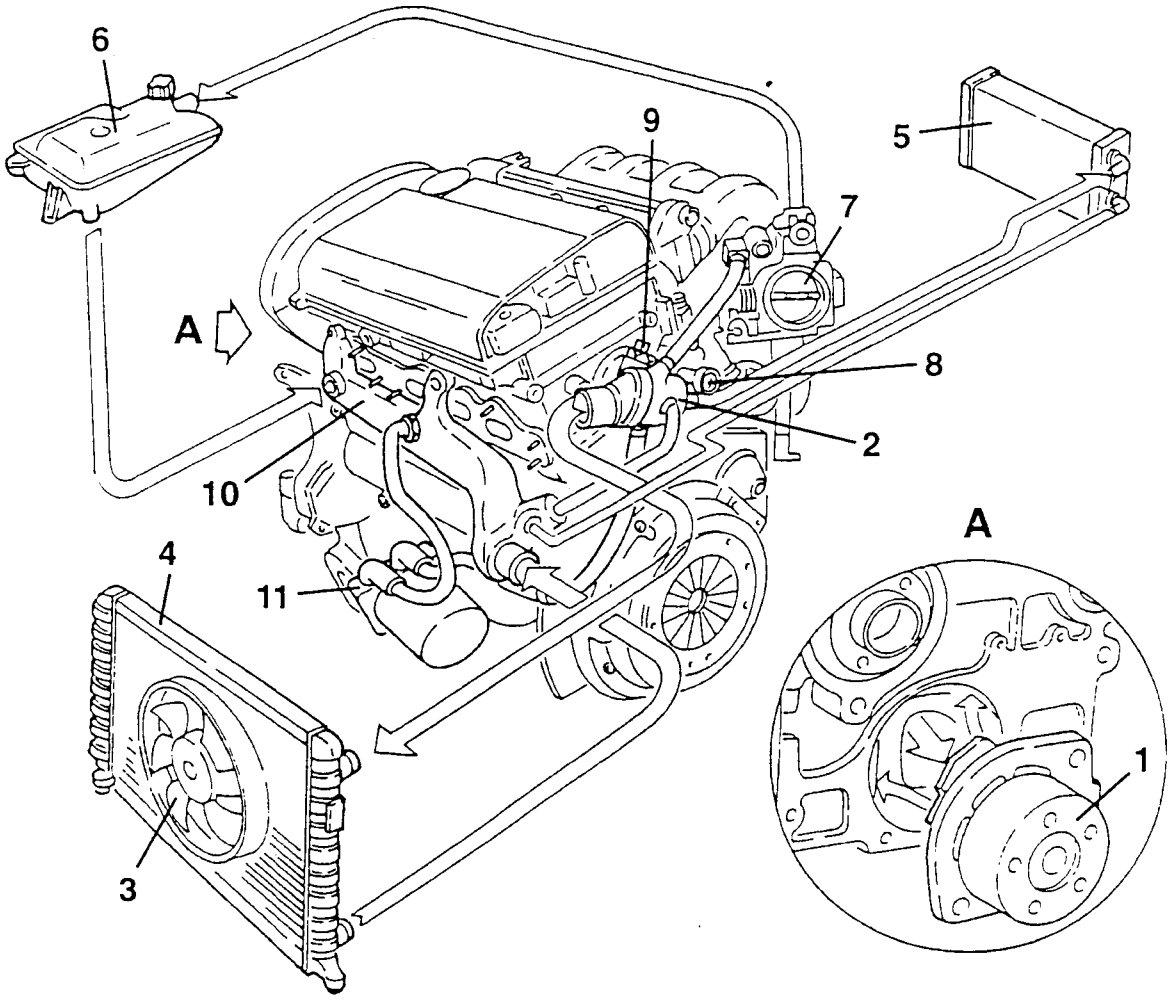



1. Slacken the fastening screws and remove the side guard on the intake side.
2. Disconnect the electrical connection, slacken the two fastening screws and remove the timing sensor complete with support plate.




**Refer to GROUP 00 for refitting the timing gear drive belt and timing operations.**

## DESCRIPTION OF ENGINE COOLING SYSTEM




1. *Water pump*
2. *Thermostatic cup*
3. *Cooling fan*
4. *Radiator*
5. *Climate control heater*
6. *Header tank*
7. *Throttle body*
8. *Coolant fluid temperature gauge transmitter and maximum temperature warning light contact*
9. *Coolant fluid temperature sensor*
10. *Longitudinal manifold*
11. *Coolant fluid - engine oil heat exchanger*

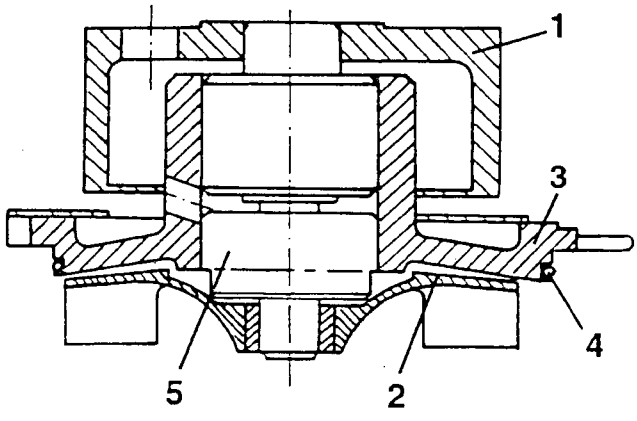
The cooling system is of the sealed type with forced circulation by centrifugal pump (1) located on the cylinder head and controlled by the timing gear belt.
A thermostatic valve (2), on the rear of the cylinder head, keeps the engine at optimum temperatures; it opens when the coolant fluid reaches a temperature of 83 °C.
In addition to the flow of dynamiic air the radiator (4) cools the engine fluid also through a two-speed fan (3) controlled directly by the MOTRONIC control unit, depending on the signal received from the engine coolant temperature sensor (NTC).
(For further details on how the fan works see ELECTRIC- ELECTRONIC DIAGNOSIS - Sect. 26 for versions with air conditioner and Sect. 27 for versions with heater).
The header tank (7) supplies the circuit if the level falls and acts as a lung absorbing the changes in volume of the fluid as the temperature changes; it also vents air from the circuit.
The circuit is fitted with a coolant fluid temperature transmitter for the gauge and a maximum temperature thermal contact (9) for the warning light.

## OPERATION OF THE CIRCUIT

After cooling the engine, the fluid passes through the cylinder head to the thermostatising unit.
From here, if its temperature is below 83 °C, it is withdrawn by the pump (1) via a longitudinal coolant fluid return manifold (11) on the lefthand side of the cylinder head.
Converselym if the temperature exceeds this value, it is ducted by the opening of the thermostat towards the radiator (4).
After cooling in the radiator, the fluid returns, again through the longitudinal manifold, to the pump which channels it into the engine.
From the thermostatic cup the coolant fluid is also sent:
- to warm the throttle body (8) from which it flows to the header tank (7) also relieving air from the system;
- to the heater (6) of the climate control system and then return to the longitudinal manifold;
- to the heat exchanger (12) for cooling the engine oil from which it is ducted directly into the longitudinal manifold for coolant fluid return to the pump.
The header tank supplies the engine cooling system via a special connection hose to the longitudinal manifold.

## WATER PUMP

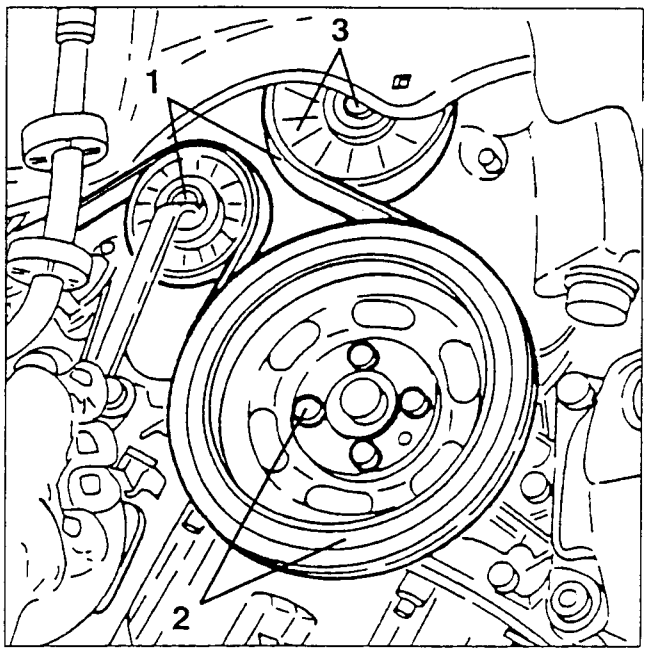
The water pump is of the centrifugal type with blades. It is fastened to the cylinder head and operated through the timing gear belt, by the crankshaft.
An O-Ring ensures tightness between the cylinder head and pump. The water pump operates constantly thereby ensuring the continuous circulation of the coolant fluid.



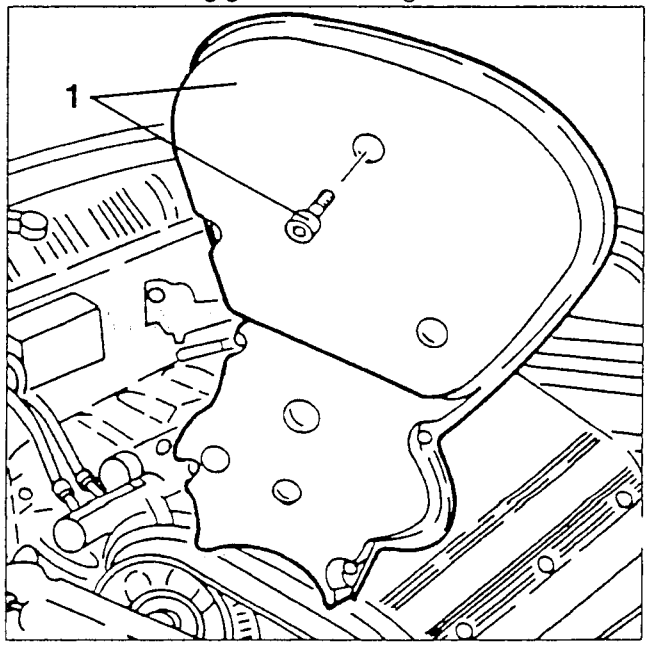

*1. Pulley*
*2. Impeller*
*3. Pump casing*
*4. O-Ring*
*5. Bearing*

## REMOVING/REFITTING
## (For engines without counter-rotating shafts)

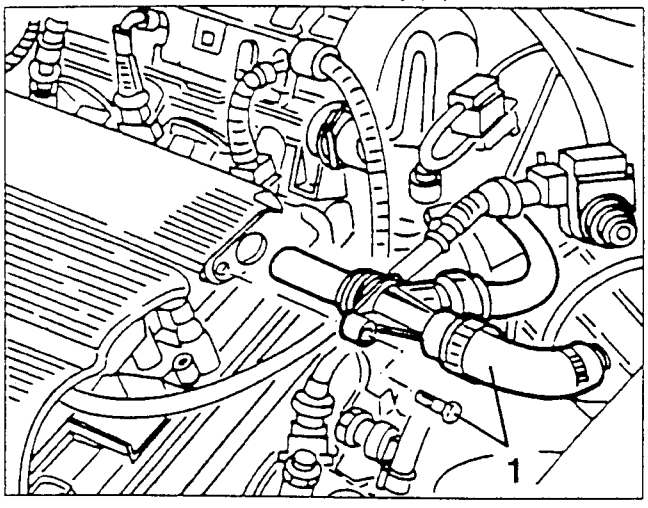
- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the engine coolant fluid (see specific paragraph).
- Slacken the screws and move aside the header tank without disconnecting the hoses.
1. Raise the car and working as illustrated on the belt tensioner, loosen the tensione of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.
3. Slacken the fastening screw and remove the auxiliary components drive belt guide.



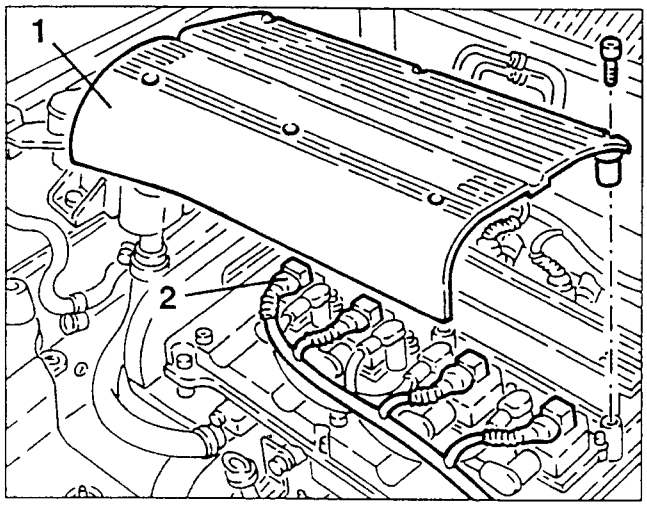

- Slacken the lower screws fastening the timing gear drive belt guard.
1. Lower the car, slacken the remaining screws and remove the timing gear drive belt guard.



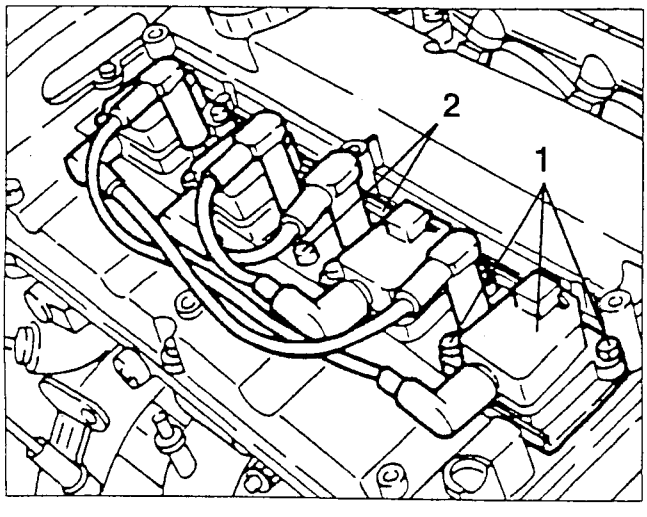
1. Slacken the fastening screw and withdraw the socket for the oil vapour recovery pipes.



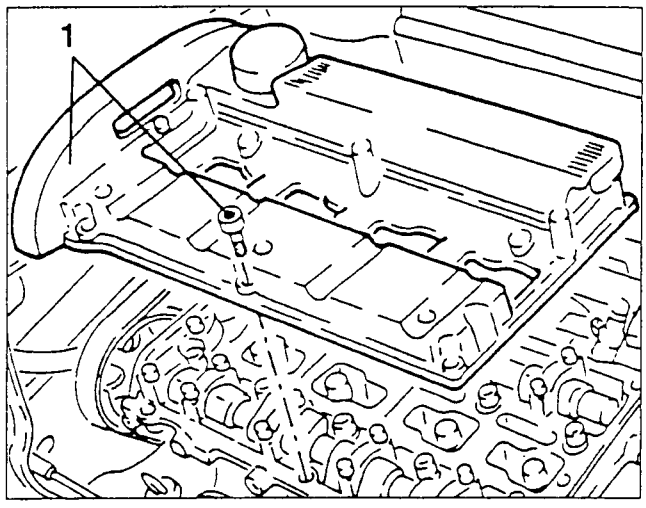

1. Slacken the fastening screws and remove the ignition coil cover.
2. Disconnect the electrical connections from the ignition coils.



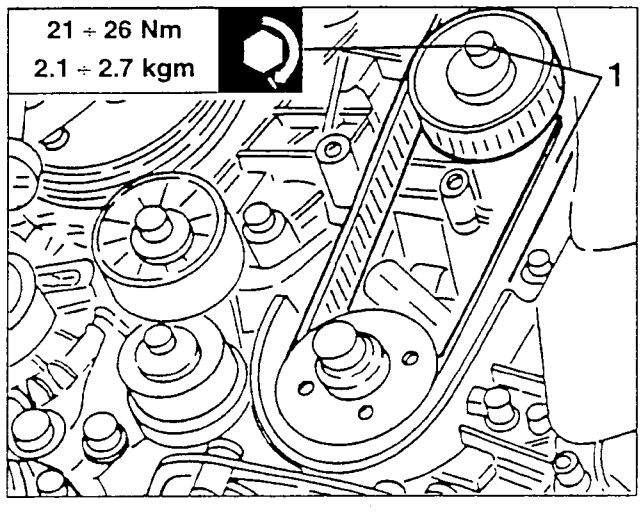

1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coil support bracket.



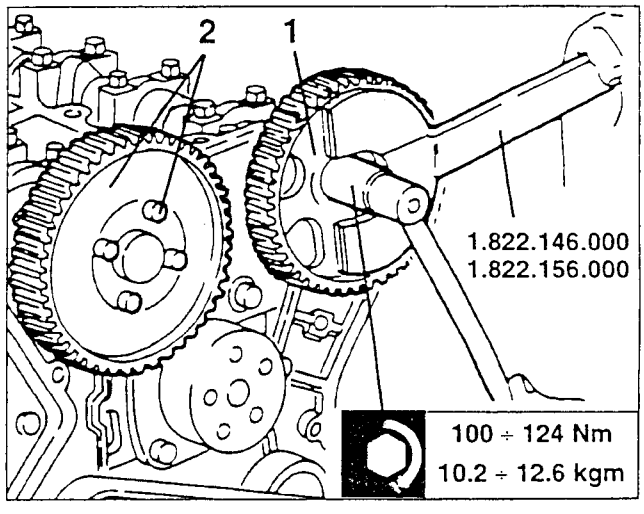

1. Slacken the fastening screws and remove the cylinder head cover complete with seal.



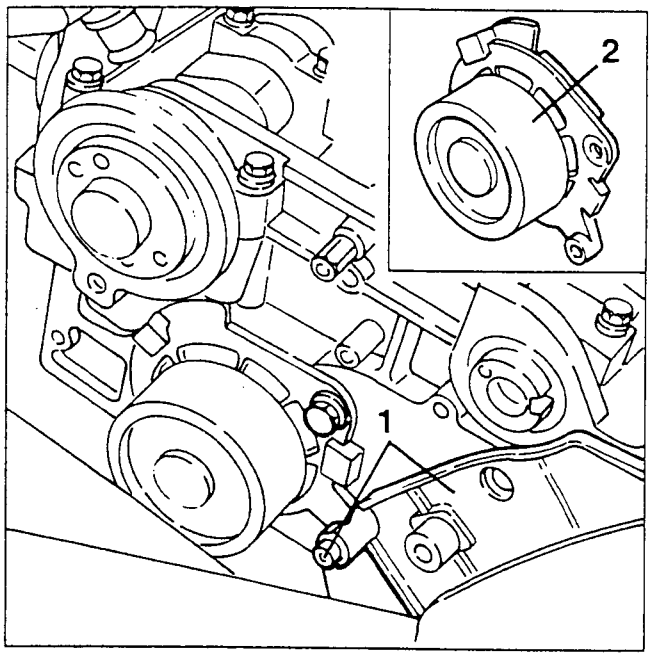

1. Working on the timing gear belt tensioner, loosen the tension of the belt, then remove it from the timing gear drive pulleys.




1. Using tools no. 1.822.146.000 and no. 1.822.156.000, slacken the screw fastening the camshaft drive pulley on the exhaust side and remove it.
2. Slacken the four screws and remove the intake side camshaft drive pulley.



1. Slacken the fastening screws and remove the exhaust side protection.
2. Slacken the two fastening screws and remove the water pump complete with O-Ring.



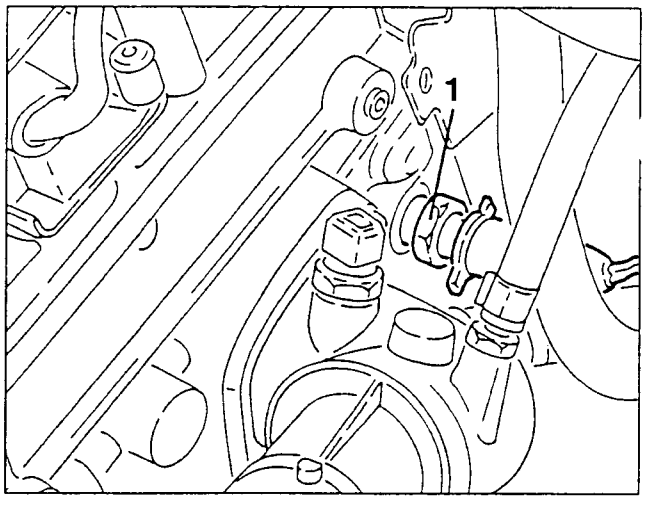

- Refit reversing the sequence followed for removal.

**For reassembly of the camshaft drive belt and timing see GROUP 00.**

## COOLANT TEMPERATURE GAUGE TRANSMITTER AND MAXIMUM TEMPERATURE WARNING LIGHT CONTACT

### REMOVING/REFITTING

- Disconnect the battery (-) terminal.
- Disconnect the electrical connection from the coolant fluid temperature sensor (NTC).
1. Disconnect the electrical connection from the coolant fluid temperature gauge transmitter and maximum temperature warning light contact, then remove it and collect the coolant fluid that comes out.




### CHECKS AND INSPECTIONS

Check the transmitter setting referring to the wiring diagram (see "Electric System Diagnosis").

| Temperature (°C) | Resistance (Ω) |
|---|---|
| 60 (test fluid water) | 470 ÷ 600 |
| 90 (test fluid water) | 160 ÷ 230 |
| 120 (test fluid glycerine) | 73 ÷ 93 |

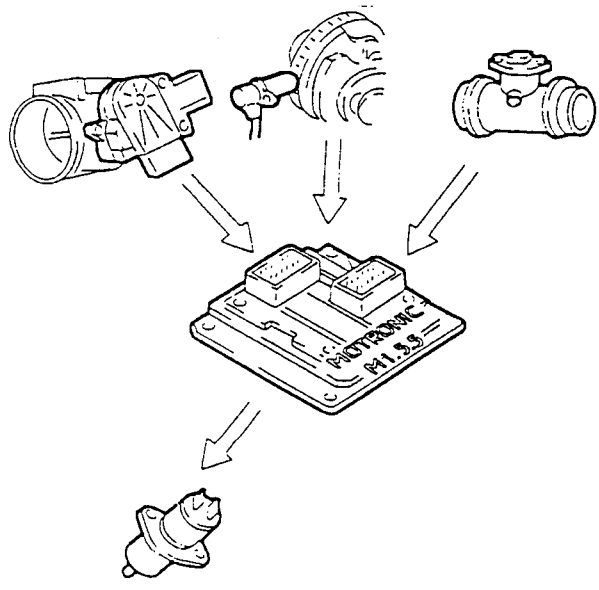
| | |
|---|---|
| Contacts closing temperature | 120 ± 2 °C |
| Contacts opening temperature | 108 ± 2 °C |

# GENERAL DESCRIPTION

Refer to the instructions given for the **1747 T.S. 16V** and **1970 T.S. 16V** engines but bearing in mind that the system is not fitted with the variable geometry intake box and the associated components.
Therefore, the operating logic for "Timing variator and modular intake manifold control" is as described below.

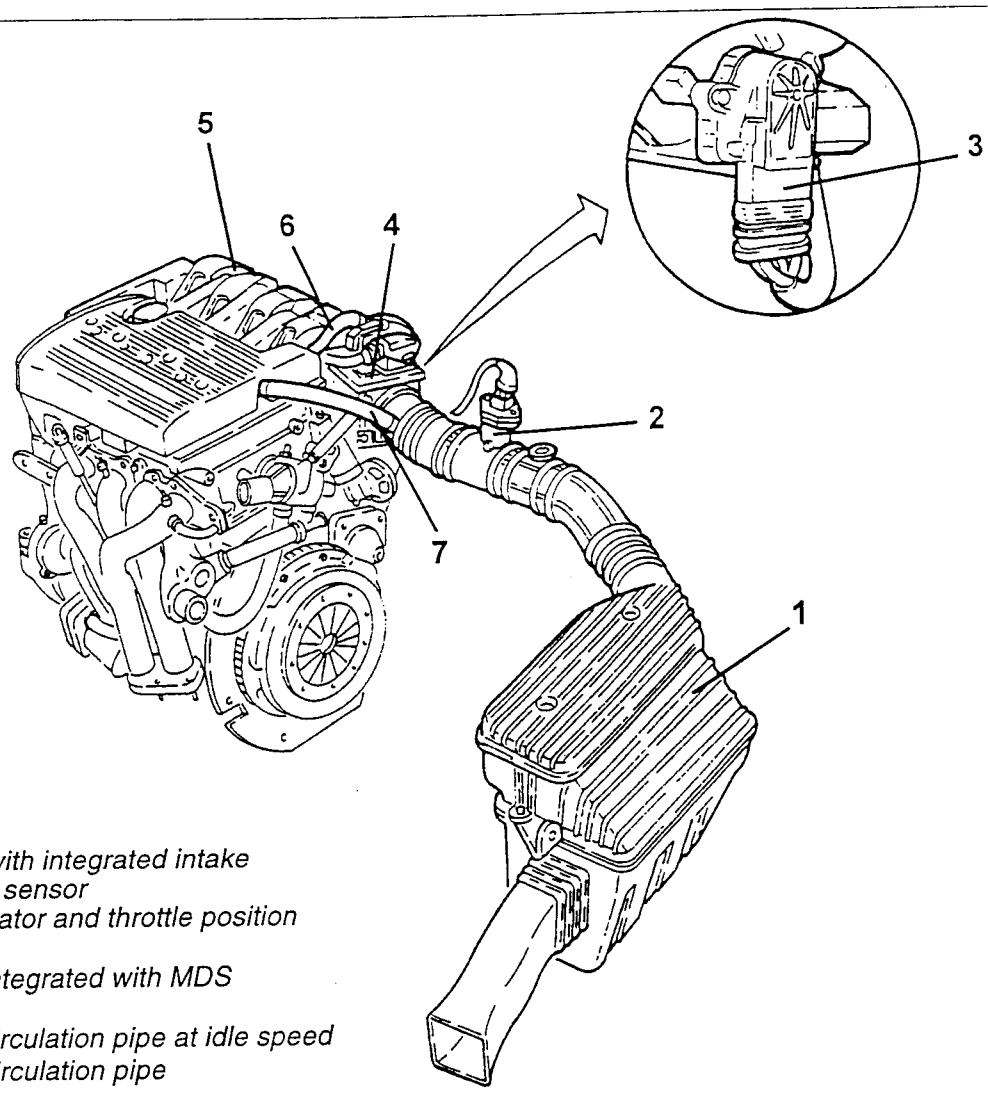
## Timing variator control

In order to optimise the amount of air taken in by the engine the control unit controls intake timing on two angular positions.
At maximum torque the control units sets the "open" phase with the cam advance by 25° of the engine.
At full power and at idle speed, the control unit sets the "closed" phase with the cam in the normal position.
In the other engine operating conditions, the control unit chooses the most suitable configuration to optimise performance, consumption and emission rates.




For all the other operating logics, refer to the instructions for the **1747 T.S. 16V** and **1970 T.S. 16V** engines.

# DESCRIPTION OF AIR SUPPLY AND OIL VAPOUR RECOVERY SYSTEM




*1. Air cleaner*
*2. Air flow meter with integrated intake air temperature sensor*
*3. Idle speed actuator and throttle position sensor (MDS)*
*4. Throttle body integrated with MDS*
*5. Intake manifold*
*6. Oil vapour re-circulation pipe at idle speed*
*7. Oil vapour re-circulation pipe*

The air, taken in through a dynamic inlet and filtered by a cartridge element (1), through the corrugated sleeve on which the hot film air flow meter (2) with integrated intake air temperature sensor is fitted, reaches the throttle body integrated with MDS.
The latter, controlled by the accelerator cable, adjusts the amount of air in the intake manifold.
The throttle body integrates the idle speed actuator and throttle position sensor which are controlled directly by the injection control unit.
The fuel vapours (see specific paragraph) and oil vapours flow to the air supply system.
The oil vapours are developed when the engine is running and gather in the cylinder head from where the condensed oil falls back into the crankcase, while the remaining vapours are sent to the intake through two pipes.
When the engine is running at idle speed, the oil vapours are ducted to the throttle body through the special pipe (8). At higher loads, the vapours are sent upstream of the throttle valve through a connection pipe (9) to the corrugated sleeve and are then burnt in the engine.

## INTAKE MANIFOLD

The intake manifold is made of plastic and differs from the one fitted on the **1747 T.S. 16V** and **1970 T.S. 16V** engines only in the fact that it does not have the control of the manifolds with variable geometry.

### REMOVAL/REFITTING

Refer to the instructions given for the **1747 T.S. 16V** and **1970 T.S. 16V** engines, with the following differences:
- do not disconnect the electrical connection of the modular intake manifold control actuator (not present)
- do not remove the front section of the exhaust pipe and manifold support bracket (not present)
- free the cables from the clamp under the intake manifold during removal.

## GENERAL DESCRIPTION

Bosch Motronic M1.5.5 is an electronic system with the following integrated functions:
- induced discharge digital electronic ignition
- static distribution
- timed sequenced electronic injection (1 - 3 - 4 - 2).

When the engine is idling, the unit controls:
- the instant of ignition
- the air intake

thus ensuring the engine is running regularly regardless of the environment conditions or applied loads.
The control unit handles injection ensuring that the stoichiometric ratio (i.e. air/fuel ratio) is constantly optimal.
The system functions are, essentially, the following:
- injection timing
- spark advance control
- cold start control
- acceleration enrichment control
- release phase fuel cut-off
- idling control and handling
- maximum rev limitation
- exhaust control - lambda sensor
- cylinder position acknowledgement
- fuel fume re-circulation
- air conditioner connection (where fitted)
- Alfa Romeo CODE (Immobilizer) ECU connection
- system self-adjustment
- self-test
- cooler fan control.

## INJECTION SYSTEM

The essential air-fuel mixing conditions for the correct operation of controlled ignition engines are:
- the air/fuel ratio must be appropriately "dosed" and kept as close as possible to the stoichiometric value to ensure fast combustion and avoid unnecessary fuel consumption
- the mix must be "homogenous" i.e. must consist of petrol fumes spread as finely and evenly as possible in the air.

For optimal dosing, the ECU processes electric signals transmitted from:
- the intake air flow meter with integrated temperature sensor, signalling the exact amount of intake air
- the rev sensor, which generates an alternating single phase signal indicating the engine revolution frequency
- the throttle position potentiometer (integrated in the constant idle actuator), indicating minimum, partial and full loads
- the lambda sensor, defining the amount of oxygen contained in the exhaust gas.

## IGNITION SYSTEM

This is a static inductive discharge ignition system (i.e. without high voltage distributor) with power modules located inside the injection ECU.
The system consists of a signal coil for each for each spark plug (MONO-COIL). The advantages of this solution are:
- lower electric overload;
- constant discharge on each spark plug.

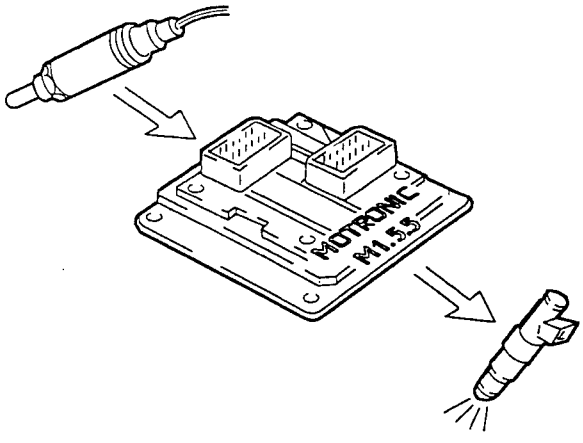
A map, containing the sequence of optimal spark advance values (for cylinder in explosion stroke) that the engine can adopt according to the required ratio or load, is stored in the ECU memory.
The ECU corrects the spark advance mainly on the basis of the following information:
- engine coolant temperature
- inlet air temperature
- knock
- throttle position.

The ECU processes the electric signals from the following devices and pilots the mono-coil:
- the intake air flow meter with integrated temperature sensor, signalling the exact amount of intake air
- the rev sensor, which generates an alternating single phase signal indicating the engine revolution frequency
- knock sensor (on the rear part of the crankcase between cylinders 2° and 3°) to acknowledge which cylinder is exploding and consequently correct spark advance
- the throttle position potentiometer (integrated in the constant idle actuator), indicating minimum, partial and full loads.

## INJECTION SYSTEM OPERATING LOGIC

### System self-adjustment

The ECU is equipped with a self-adjusting function with the purpose of acknowledging changes due to time and ageing in the engine and in its components. These changes are saved in the ECU memory as modifications to the basic map.
The purpose is to adjust the system operation to the progressive alterations of the engine and the engine components with respect to new units.
The self-adjustment function also compensates for the inevitable diversity between spare parts (due to manufacturing tolerance rates) which may be changed in time.
The exhaust gas analysis ECU changes the basic map with respect to new engines.
The self-adapting parameters are not deleted when the battery is disconnected.

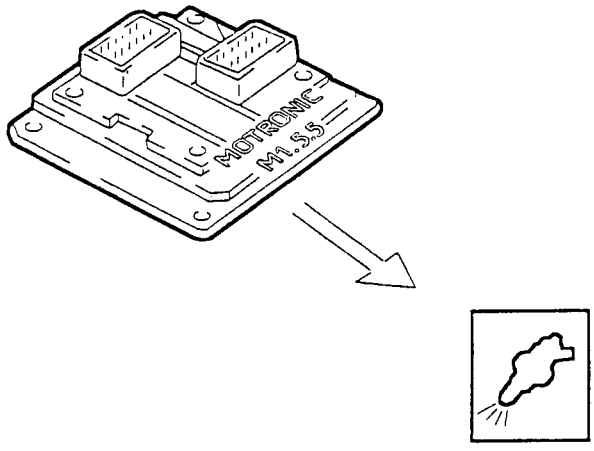



### Self-test

The ECU self-test function checks the signals from each sensor and compares them to the thresholds:
- faults signalled during ignition
  - warning light on for 4 seconds indicates the test is being run
  - warning light off after 4 seconds indicates there are no faulty components which could alter pollution parameters
  - warning light on after 4 seconds indicates there is a fault.

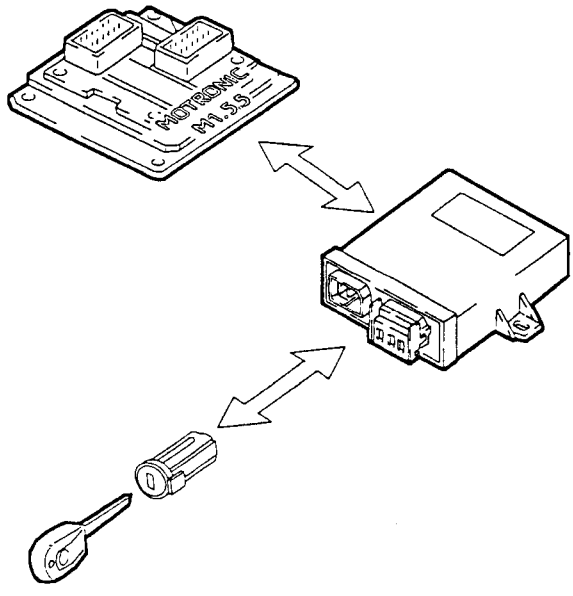
- faults signalled during operation
  - warning light on indicates a fault
  - warning light off indicates there are no faulty components which could alter pollution parameters.

- recovery
  - the ECU defines the type of recovery according to the faulty component
  - recovery parameters are not handled by faulty components.




### Alfa Romeo CODE acknowledgement

When the ECU receives a signal indicating the ignition key is turned to "MAR", it dialogues with the Alfa Romeo CODE ECU and enables engine ignition.
The communication is performed along a two-way dedicated diagnostic serial line connecting the two ECU's.

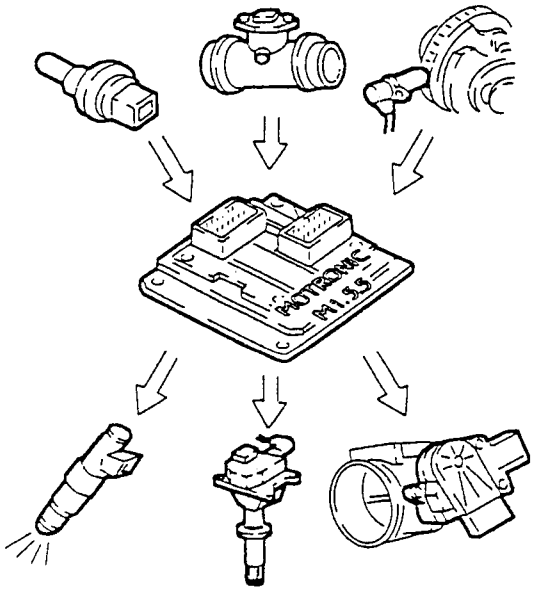


## Cold starting control

Under cold starting conditions the following occur:
- natural impoverishment of the mixture (due to poor swirl of the fuel particles at low temperature)
- low fuel evaporation
- condensation of the fuel on the inner walls of the intake manifold
- higher viscosity of the lubricating oil.

The control unit detects this condition and corrects the injection time on the basis of the:
- coolant fluid temperature
- intake air temperature
- battery voltage
- engine rpm.

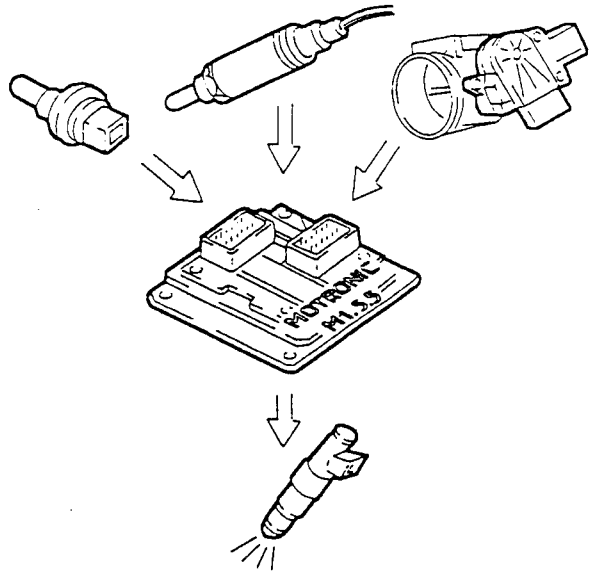
The spark advance depends only on the rpm and on the engine coolant fluid temperature.
During starting the control unit commands a first, simultaneous injection for all the injectors (full-group injection) and, after detecting the stroke of the cylinders, it starts normal, timed, sequential operation.
During the engine warming phase, the control unit governs the idle speed actuator to adjust the amount of air needed to ensure the engine self-supporting speed.
The rotation speed is decreased proportionately with the increasing engine temperature until obtaining the nominal rating when the engine reaches normal operating temperature.




## Combustion control - lambda sensor

With the engine in the following conditions:
- idle speed
- medium load
- temperature > 30°C

with a special integrator, the control unit processes the lambda sensor signal and determines the injector opening time.




## Timing variator control and modular intake manifold

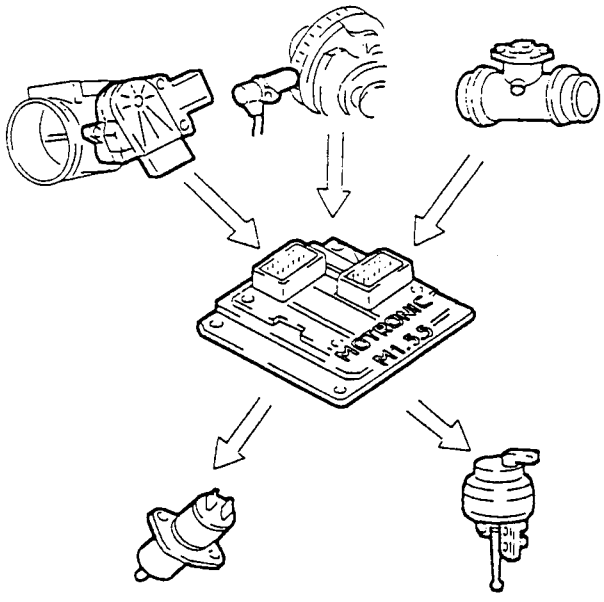
To optimise the amount of air taken in by the engine, the control unit controls:
- intake timing on two angular positions
- the geometry of the intake manifolds on two lengths.

At maximum torque the control unit sets the "open" phase:
- cam advanced by 25° of the engine
- intake box long manifolds.

At full power the control unit sets the "closed" phase:
- cam in normal position
- intake box short manifolds.

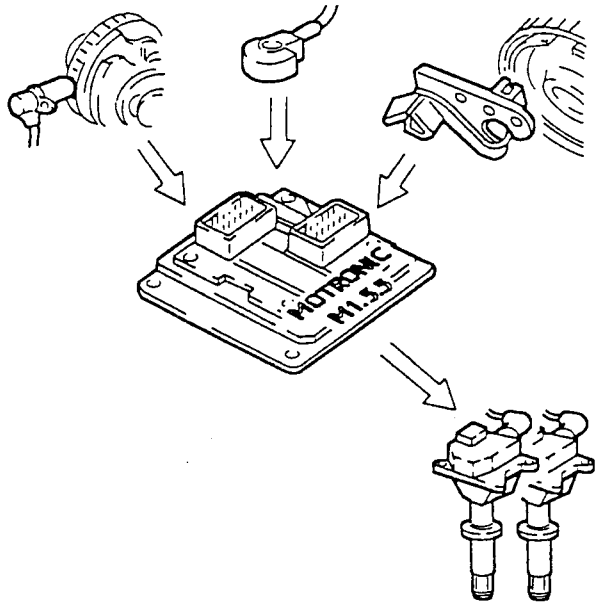
At idle speed the control unit sets the "closed" phase:
- cam in normal position
- intake box short manifolds.

In the other engine operating conditions, the control unit chooses the most suitable configuration to optimise performance - consumption - emissions.
During deceleration the box intake ducts are alwasy "short".



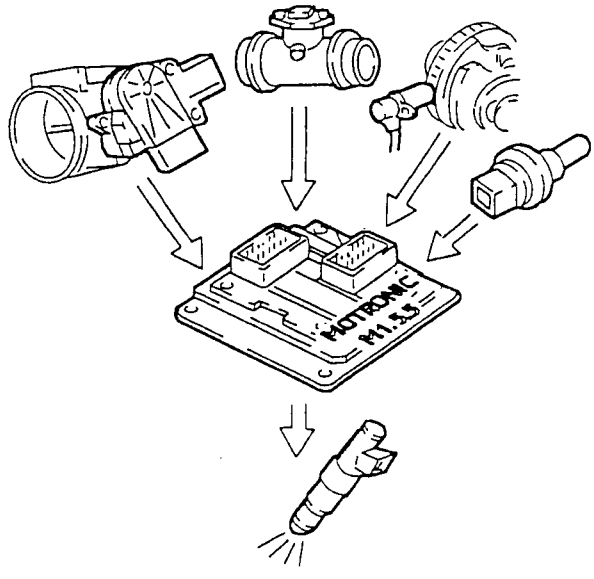

## Pinging control

The control unit detects the presence of pinging by processing the signal leading from the corresponding sensor. The control unit continuously compares he signals from the sensor with a threshold value, which is in turn continuously updated, to take account of the engine background noise and engine ageing.
This way the control unit is able to detect the presence of pinging, (or incipient pinging) and reduces the spark advance (in steps of 3° up to a maximum of 6°) until pinging ceases.
The advance is then gradually restored to the base value (in 0.8° steps).
During acceleration, a higher threshold is used to take account of the higher engine noise in this condition.
The pinging control logic also has a self-adapting function which any continuously repeated advance reductions in order to adapt the map to the different engine conditions.




## Enrichment control during acceleration

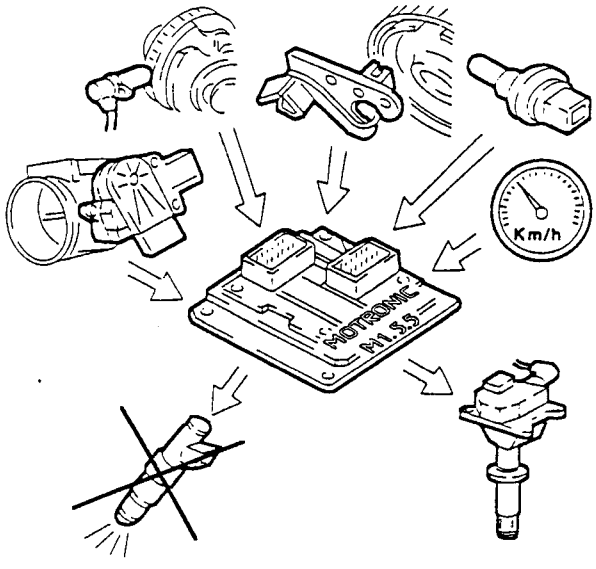
If during the request for acceleration the change in the air flow meter signal exceeds a pre-defined threshold, the control unit increases injection (injection time) to rapidly reach the required engine speed.
Recovery:
- the control unit replaces the signal leading from the faulty air flow meter with the throttle potentiometer signal.



## Fuel cut-off during release

When the accelerator pedal is released and the engine rating exceeds a specific pre-set value, the ECU:
- cuts off injector power
- returns power to the injectors at 1300 ÷ 1500 rpm.

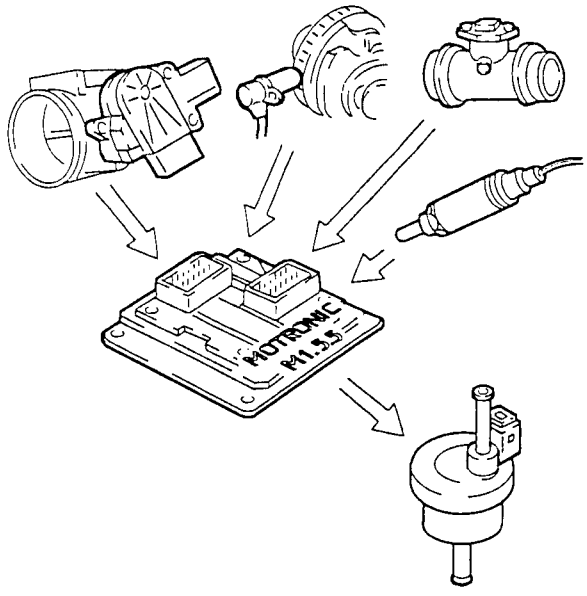
When the throttle is closed and the engine rating is 1700 rpm, the ECU inhibits injector opening.
Without fuel supply, the rating decreases more or less rapidly according to the vehicle running conditions.
Before idle rating is reached, the revolution decrease is checked.
If rating is higher than a pre-set value, fuel supply is partially reactivated to take the engine to idle rating "smoothly".
The fuel supply and fuel cut-off thresholds vary according to the following:
- engine coolant temperature
- vehicle speed
- rpm.




## Fuel fume re-circulation

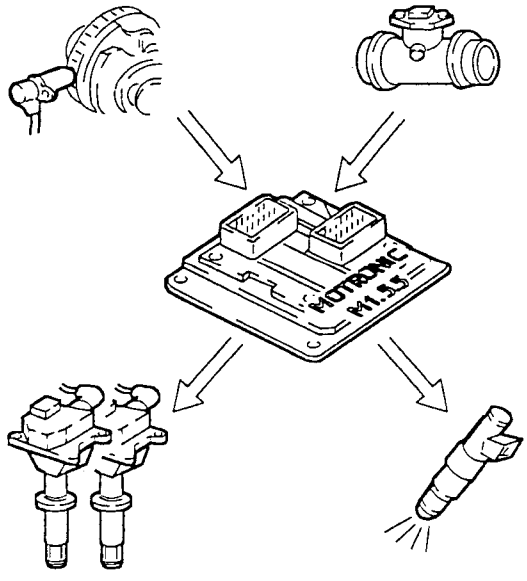
Fuel fumes (pollutants) are collected in an active carbon filter (canister) and sent through the intake manifolds to be burnt.
This is controlled by means of a solenoid valve controlled by the ECU only when engine running conditions allow.

The ECU, in fact, compensates the amount of supplementary fuel by reducing feed to the injectors.




## Maximum revolution limiter

According to the following engine ratings:
- over 6800 rpm the ECU reduces injection time
- over 7000 rpm the ECU cuts injector feeding
- under 6800 rpm the ECU pilots the injectors again.

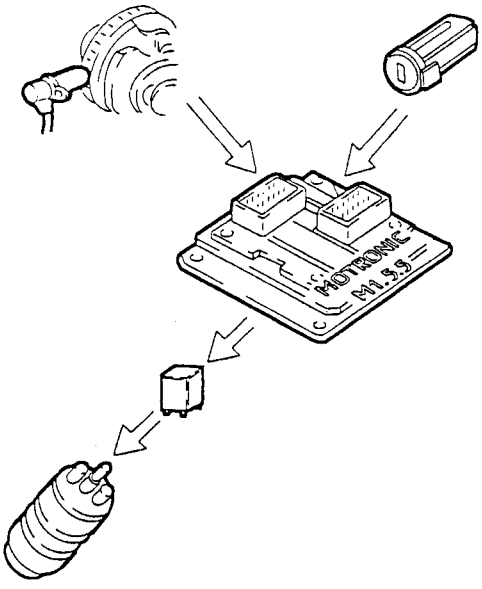


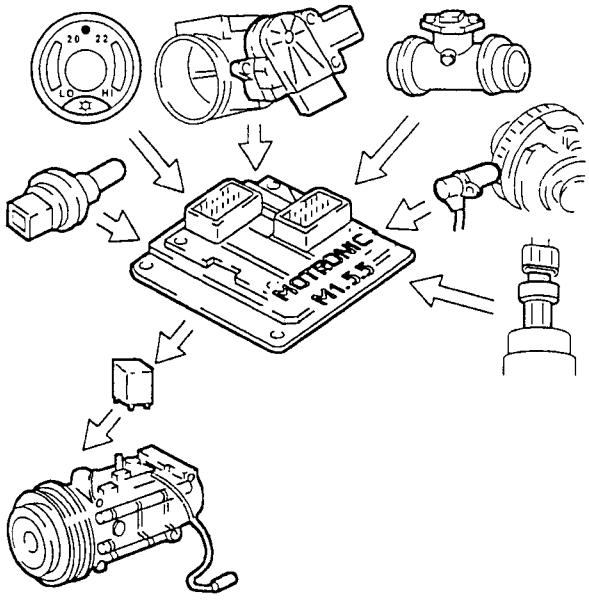
## Fuel pump supply control

The ECU operates the fuel pump:
- for 0.8 seconds when the key turned to MAR
- when the key turned to AVV and engine rating is > 22.8 rpm.

The ECU cuts power to the pump:
- when the key turned to STOP
- when the engine rating is < 22.8 rpm.

The "no return" fuel supply system has a constant petrol pressure of 3.5 bars.

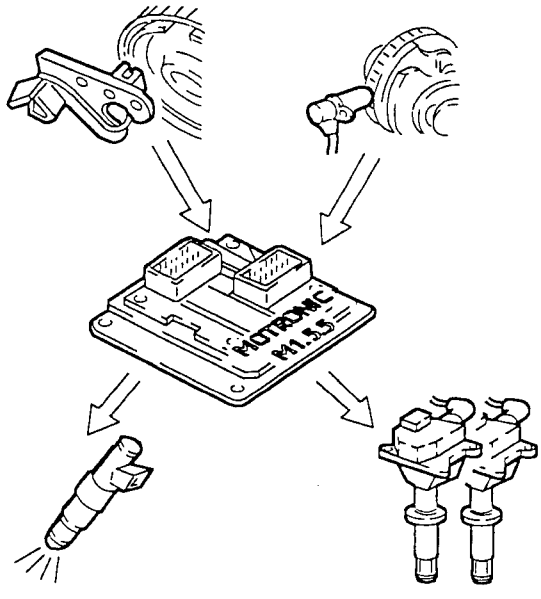



## Cylinder position acknowledgement

During each engine cycle, the ECU acknowledges the cylinder in explosion stoke:
- it controls the injection and ignition sequence to the correct cylinder.

With no timing sensor signal, the ECU:
- deactivates the knock sensor
- if the vehicle is moving, it keeps timed injection
- if the vehicle is standing, it controls a simultaneous operation of cylinders 1-4 and 2-3.




## Climate control system connection

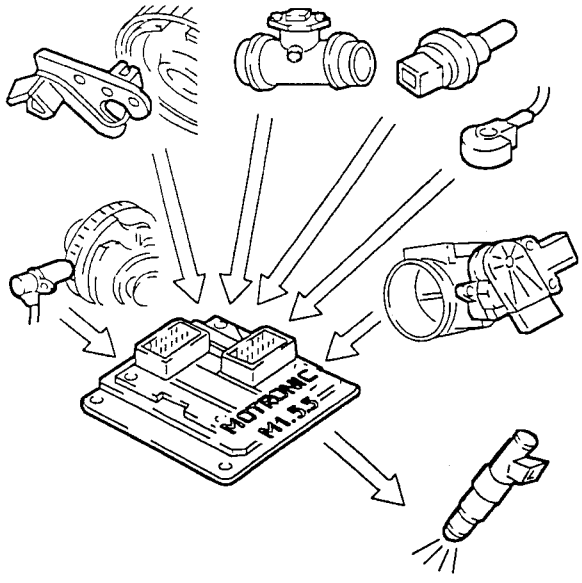
When the compressor is started and power demand is increased, the ECU pilots the idling actuator to increase air intake.

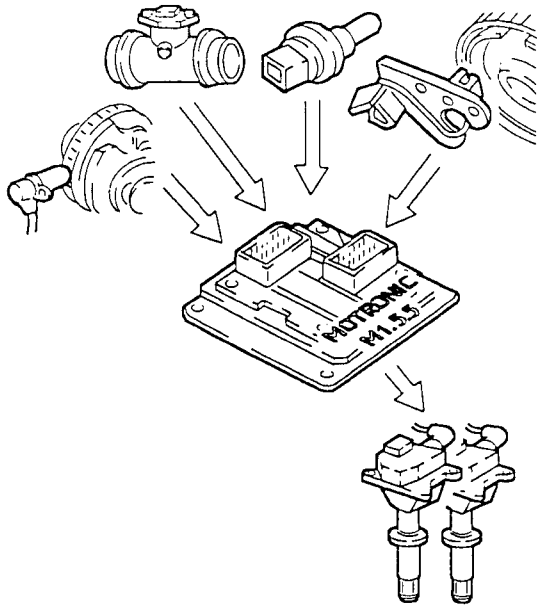
When the demand for power is high, the ECU temporarily cuts off power supply to the compressor as follows:
- over 6500 rpm, power to the compressor is cut off
- engine temperature > 112°C power to the compressor is cut off.

## Injection time control

The ECU controls the injection opening time with extreme speed and accuracy according to the following:
- engine load (rpm and air intake)
- battery voltage
- engine coolant temperature.

Injection is sequential and timed for each cylinder.
"Injection start" is optimised.
"Injection end" is constant.



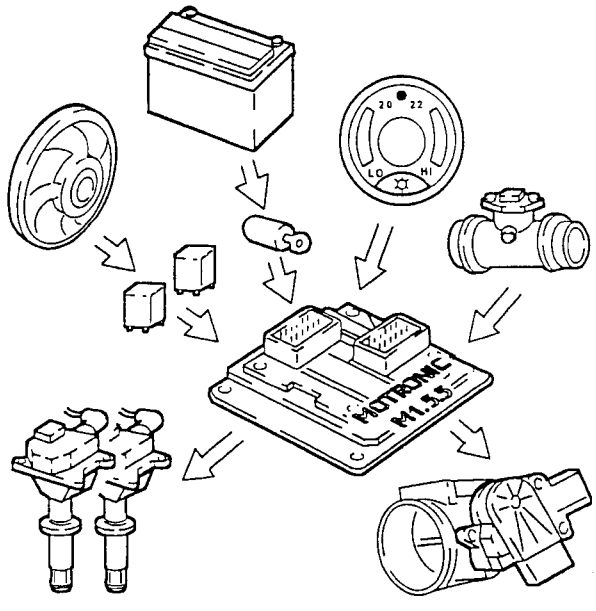

## Spark advance

The ECU can compute, thanks to a map saved in its memory, spark advance on the basis of the following:
- engine load (minimum, partial, full, according to rpm and air intake)
- inlet air temperature
-engine coolant temperature.

Spark can be postponed only on the cylinder requiring it which is recognised be means of the values registered by the rev and timing sensors.

## Idle control/handling

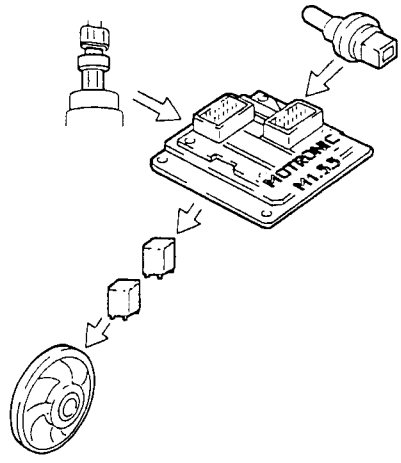
Idle status is acknowledged by the ECU via the potentiometer integrated in the idle actuator located on the throttle (valve axis).
The ECU controls idling ratio (850 ± 30 rpm) according to the devices in use by:
- changing spark advance
- piloting the throttle position (0° ÷ 15°), by means of the idling actuator, to control air intake.



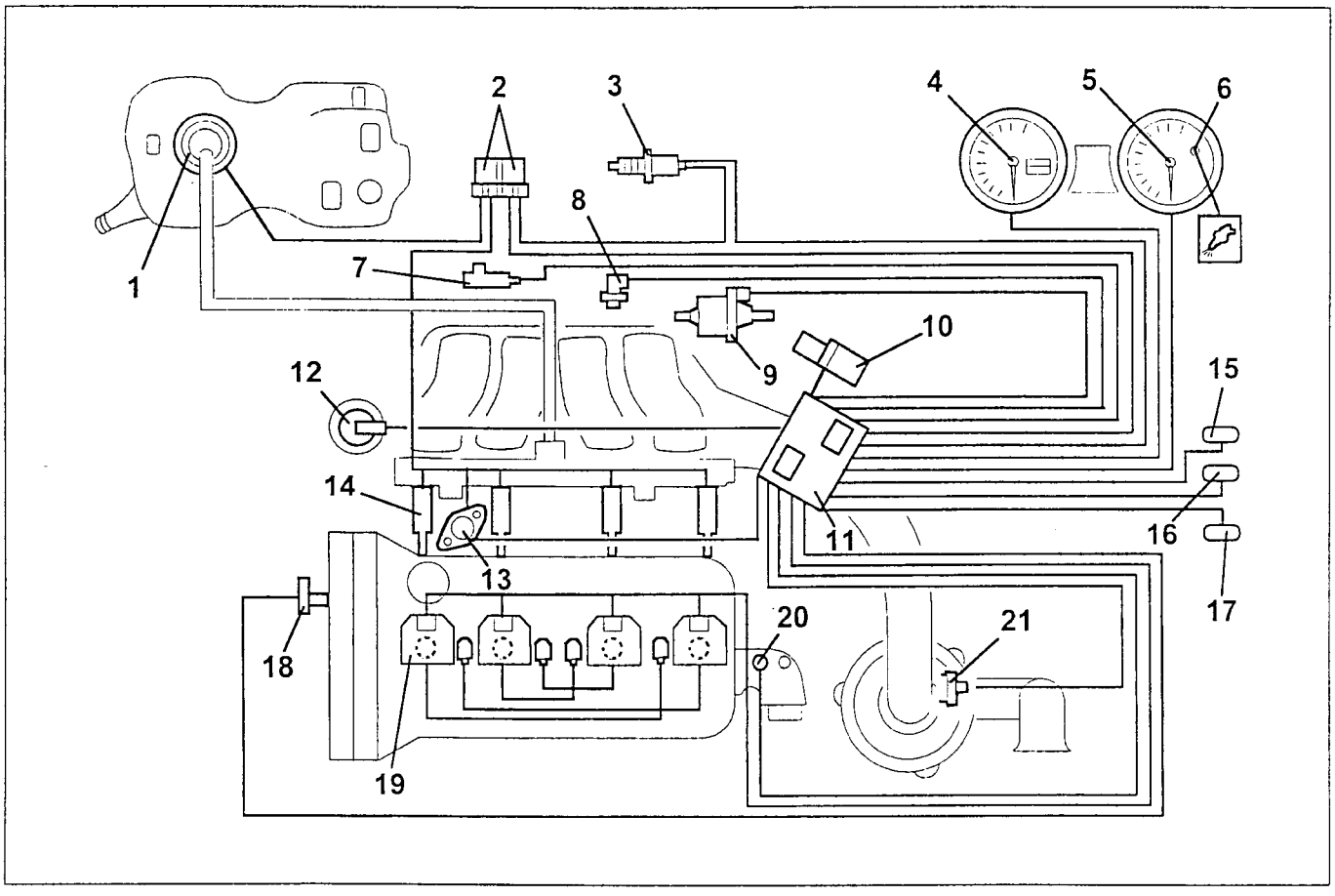
## Radiator cooling fan

According the coolant temperature, the ECU controls the fan:
- 1st speed at 98°C
- 2nd speed at 101°C

An additional check (quadrinary signal), starts the fan at the 1st or 2nd speed according to the cooling gas pressure when the climate control system is on.
If no coolant temperature signal is received, the ECU runs a recovery function and operates the fan at 2nd speed until the error is solved.

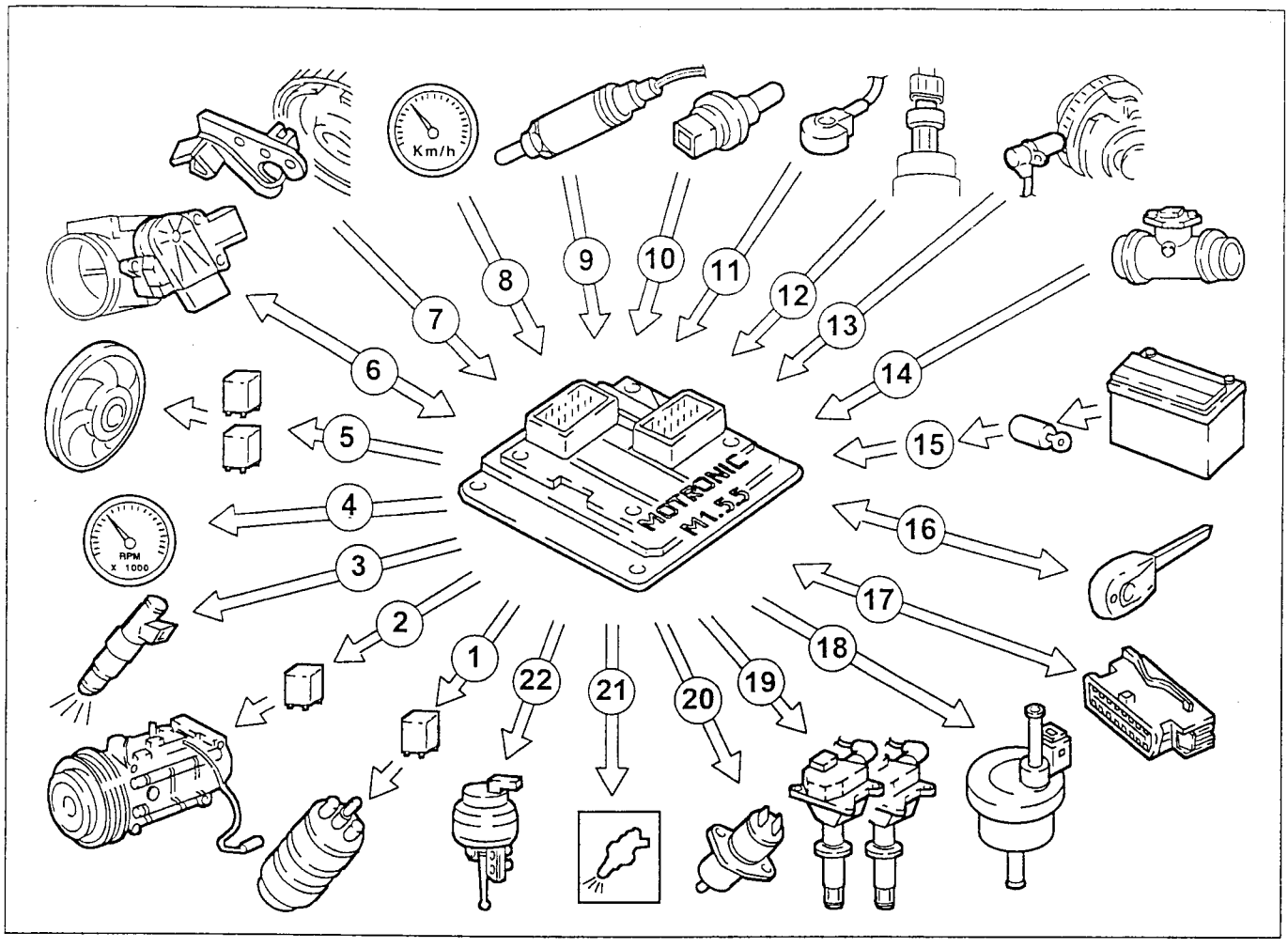



## M1.5.5 IGNITION - INJECTION SYSTEM COMPONENTS




1. *Fuel pump*
2. *Relays*
3. *Lambda sensor*
4. *Speedometer*
5. *Rev counter*
6. *Check Engine warning light*
7. *Knock sensor*
8. *Rev sensor*
9. *Fuel fume re-circulation solenoid valve*
10. *Throttle position sensor (MDS) and idling actuator*
11. *Injection-ignition ECU*
12. *Modular intake manifold solenoid valve*
13. *Timing variator*
14. *Injectors*
15. *Climate control connector*
16. *Diagnostic connector*
17. *Alfa Romeo CODE connector*
18. *Timing sensor*
19. *Ignition coils*
20. *Engine coolant temperature sensor*
21. *Air flow meter with integrated air temperature sensor*

## M1.5.5 IGNITION - INJECTION SYSTEM COMPONENTS

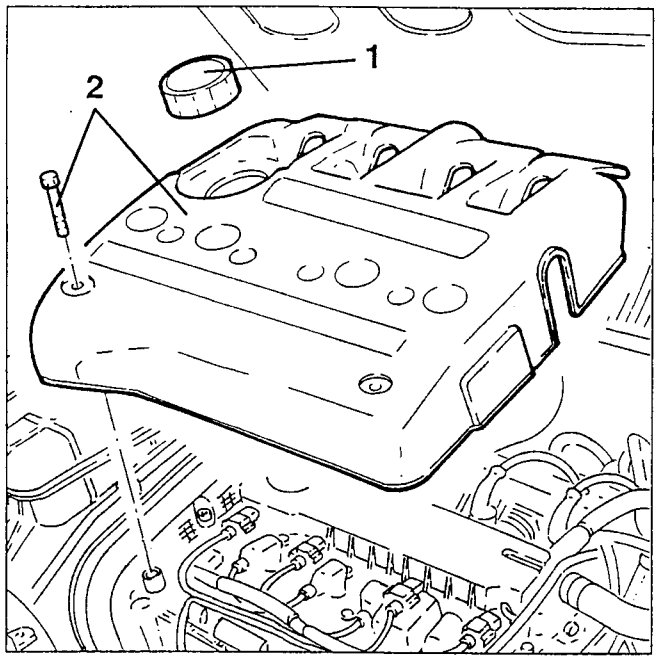



1. *Fuel pump*
2. *Air conditioner compressor*
3. *Injectors*
4. *Rev counter*
5. *Fan*
6. *Throttle position sensor (MDS) and idling actuator*
7. *Timing sensor*
8. *Speedometer*
9. *Lambda sensor*
10. *Engine coolant temperature sensor*
11. *Knock sensor*
12. *Quadrinary*
13. *Rev sensor*
14. *Air flow meter with integrated air temperature sensor*
15. *Battery*
16. *Alfa Romeo CODE*
17. *Diagnostic socket*
18. *Fuel fume re-circulation solenoid valve*
19. *Ignition coils*
20. *Timing variator*
21. *Check Engine warning light*
22. *Modular intake manifold solenoid valve*

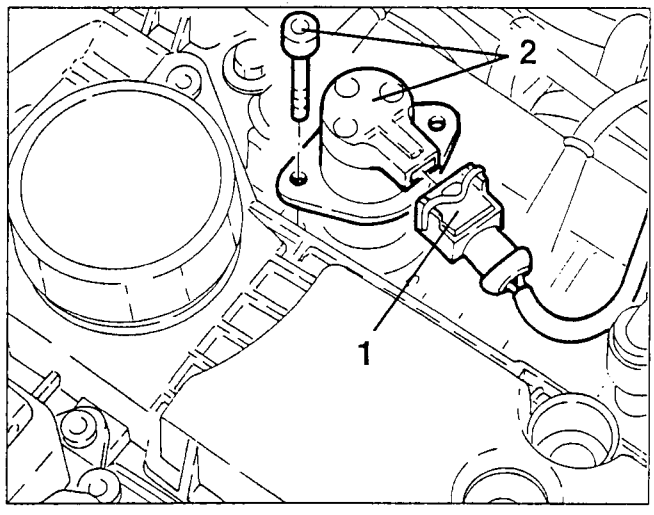
# TIMING VARIATOR ELECTROMAGNET

## REMOVAL/REFITTING

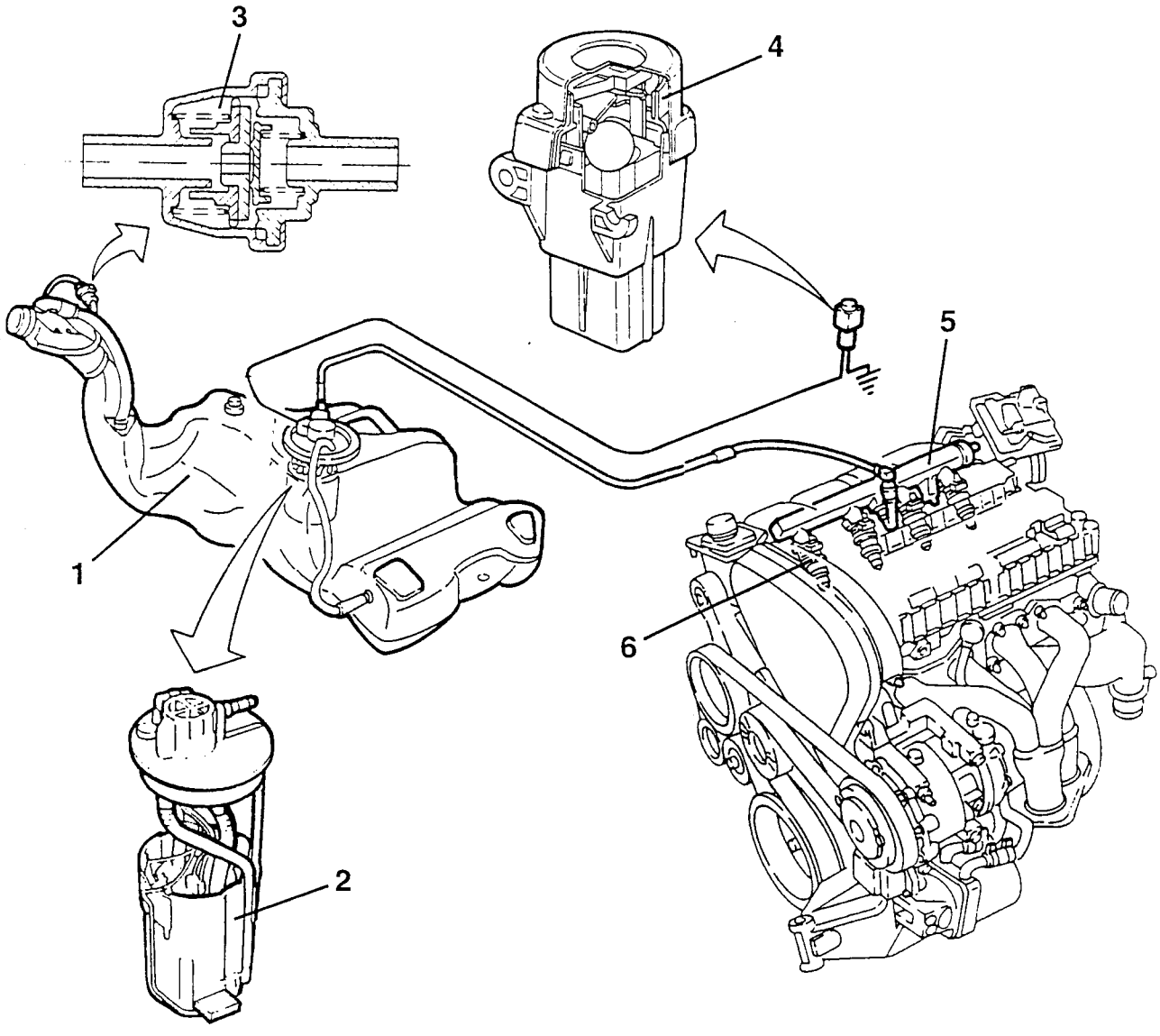
- Disconnect the (-) battery terminal.
1. Remove the engine oil filler cap.
2. Remove the fastening screws and remove the ignition coil cover.




- Refit the engine oil filler cap.
1. Reconnect the electric connection from the timing variator electromagnet.
2. Remove the electromagnet fastening screws and remove the electromagnet.



## FUEL FEEDING SYSTEM DESCRIPTION




1. *Fuel tank*
2. *Submerged pump unit and level gauge*
3. *Safety valve*
4. *Inertial switch*
5. *Distribution manifold*
6. *Injectors*

This is a return-less fuel feeding system, i.e. with a single pipe connecting the fuel pump and the engine. This allows:
- to reduce the risk of fire in the event of an accident
- to reduce fuel fume emission in the atmosphere.

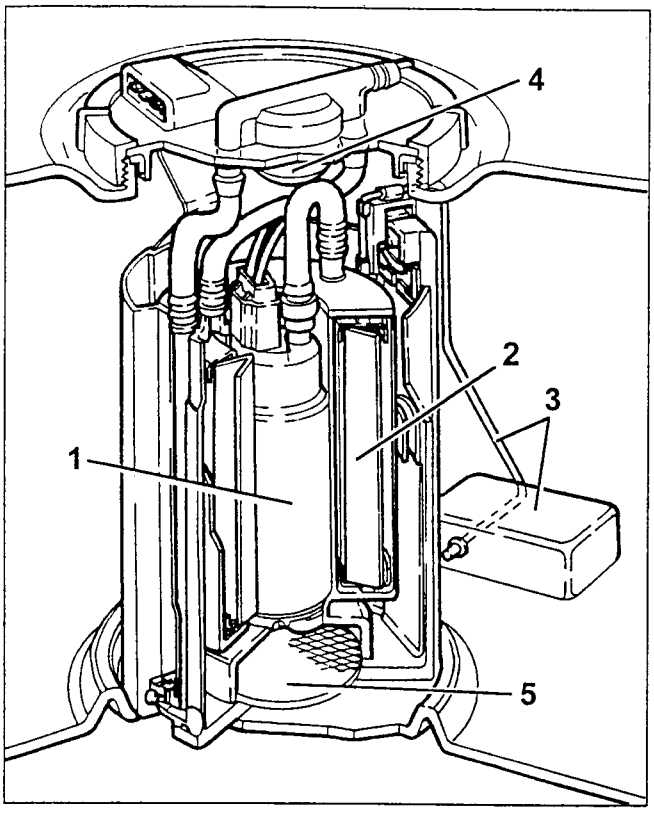
The fuel tank located under the body (boot) is made of high mechanical resistance plastic.

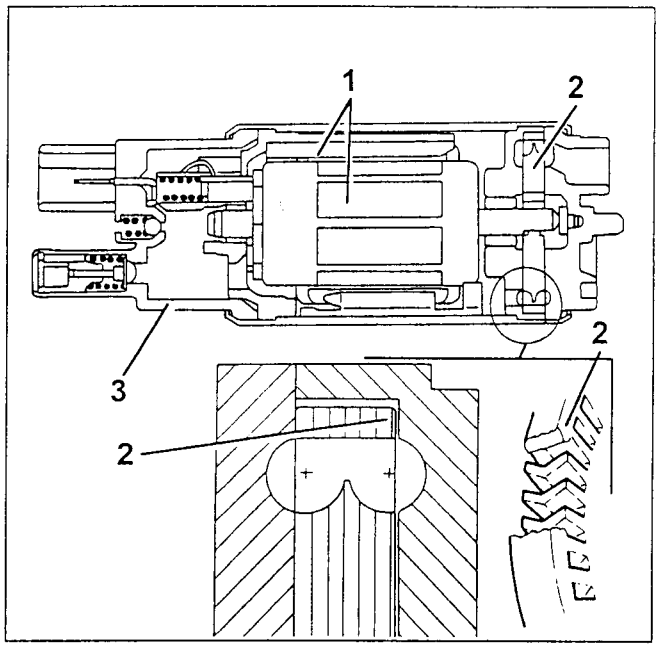
The pump is included in a rack which also contains:
- the fuel pressure regulator
- the fuel level gauge
- the fuel filter.

The system is equipped with an inertia switch which cuts off the fuel pump in the event of an accident.

## SUBMERGED PUMP UNIT AND LEVEL GAUGE

This unit essentially consists of:
- a fuel pump (1)
- a fuel filter (2)
- a floating level gauge (3)
- a membrane pressure regulator (4)
- a net pre-filter (5).



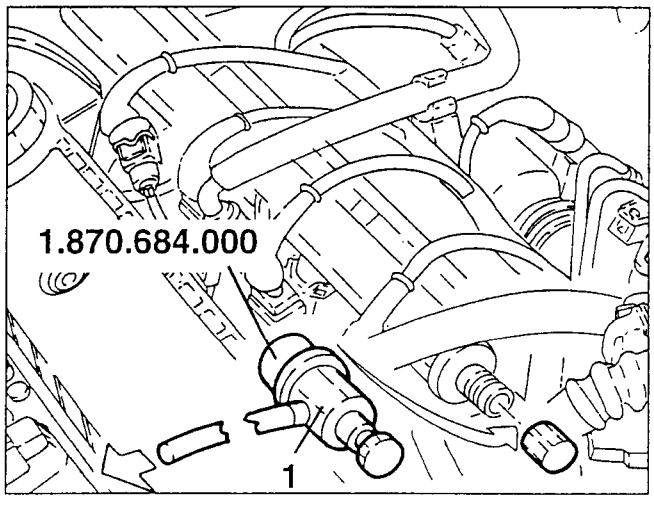




### Fuel pump EKP 13.5

The fuel pump is equipped with a permanent magnet electric motor (1) which controls the pump impeller (2) and a terminal support cover (3) containing the electric and hydraulic connections.
This is a single stage, peripheral flow pump suited to operate in conditions of low voltage and temperature.
The advantages of this type of pump with respect to volumetric pumps are:
- reduced weight
- reduced size.

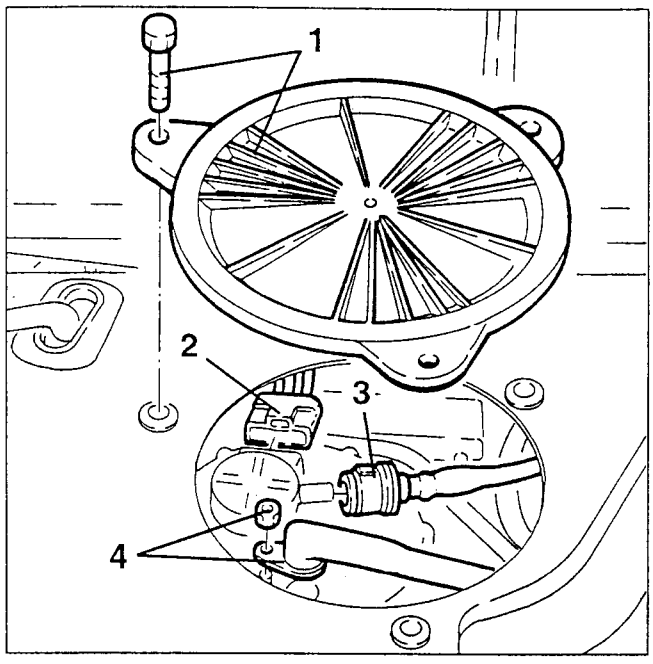
## REMOVAL/REFITTING

- Disconnect the (-) battery terminal.
1. Connect tool No. 1.870.684.000 to the distribution manifold bleeder valve and discharge the fuel pressure.

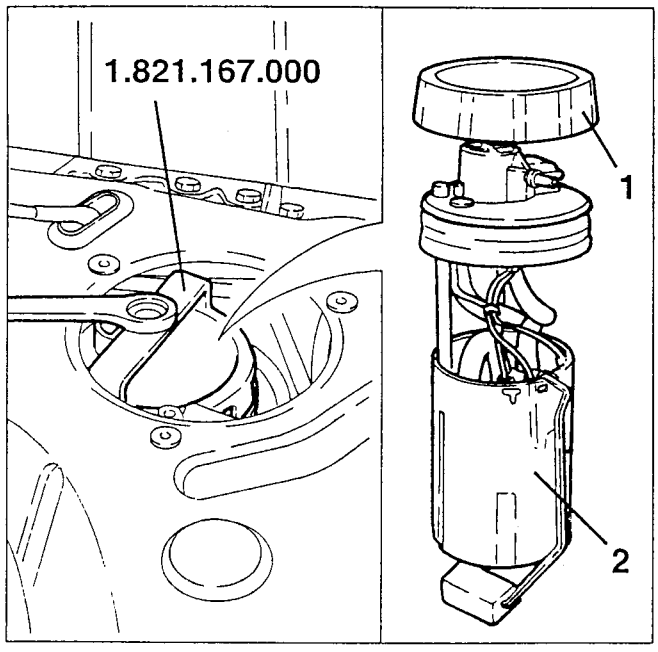



- Tilt the rear seat back forward.
- Lift the boot carpeting.
1. Remove the fastening screws and remove the pump cover.
2. Disconnect the pump electric connections.

3. Disconnect the fuel delivery manifold to the pump.
4. Remove the fastening nut and disconnect the breather pipe between the upper and lower part of the tank from the pump.

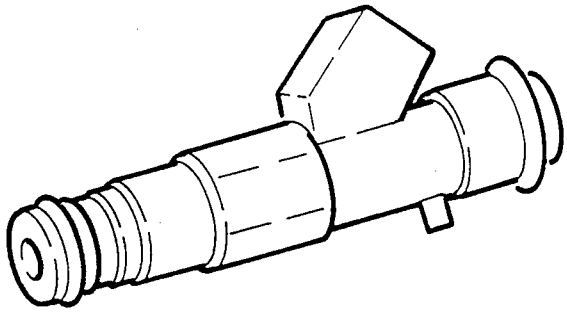



1. Remove the fuel pump nut screw with tool No. 1.821.167.000.
2. Remove the submerged pump – gauge unit and seal.



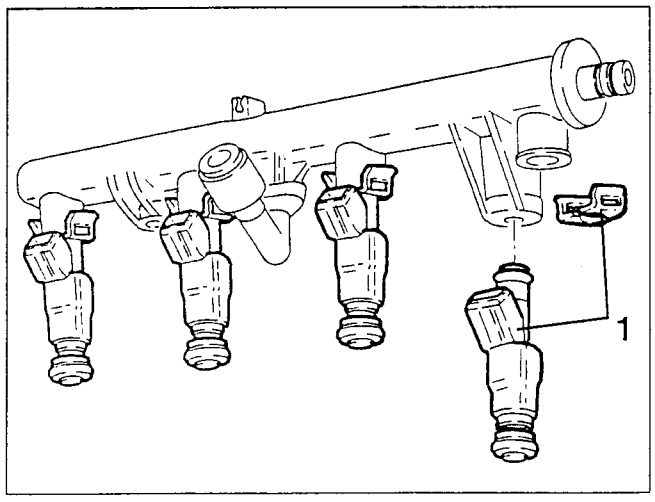

## INJECTORS

These double jet injectors are installed on the distribution manifold.
They are secured to the distribution manifold by means of safety clips and sealed with O-rings.
The injectors output the appropriate quantity of fuel to the engine.
They are "all or nothing" type devices, i.e. they present two stable stages, either completely open or completely closed.
They let fuel flow through when they are open and stop the fuel flow when they are closed.



### REMOVAL/REFITTING

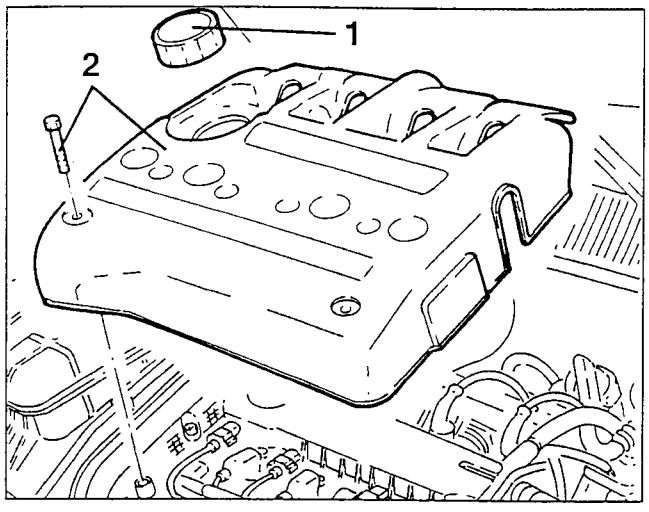
- Remove the fuel distribution manifold (see specific paragraph).
1. On a work bench, remove the safety clips. Remove the injectors from the distribution manifold.



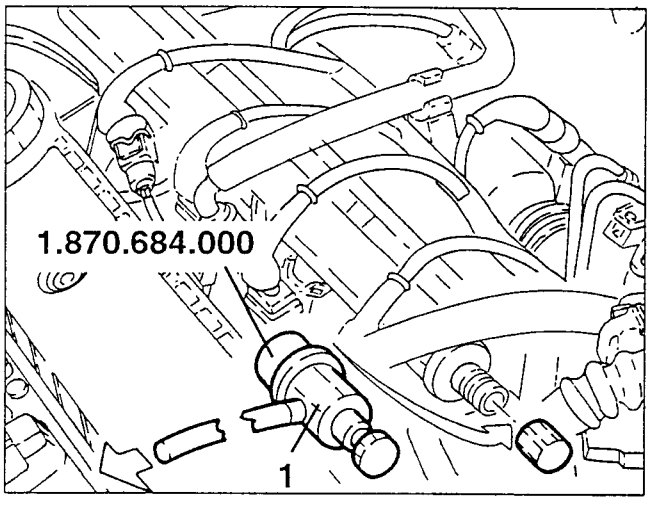
# FUEL DISTRIBUTION MANIFOLD

## REMOVAL/REFITTING

- Disconnect the (-) battery terminal.
1. Remove the engine oil filler cap.
2. Remove the ignition coil screws and cover.
- Refit the engine oil filler cap.



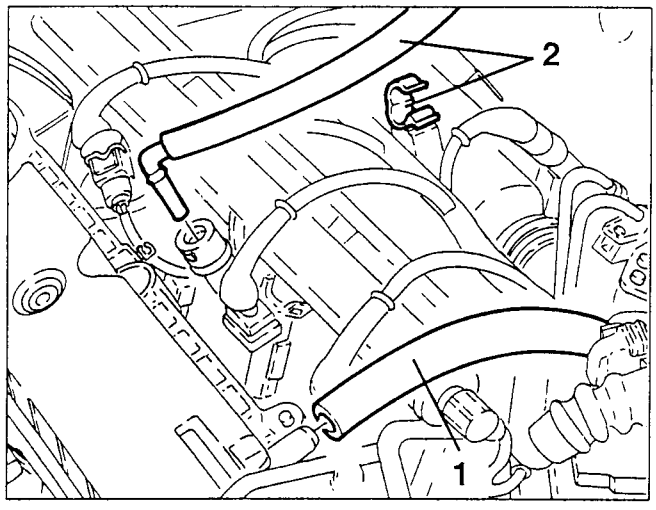

1. Connect tool No. 1.870.684.000 to the distribution manifold bleeder valve and discharge the fuel pressure.



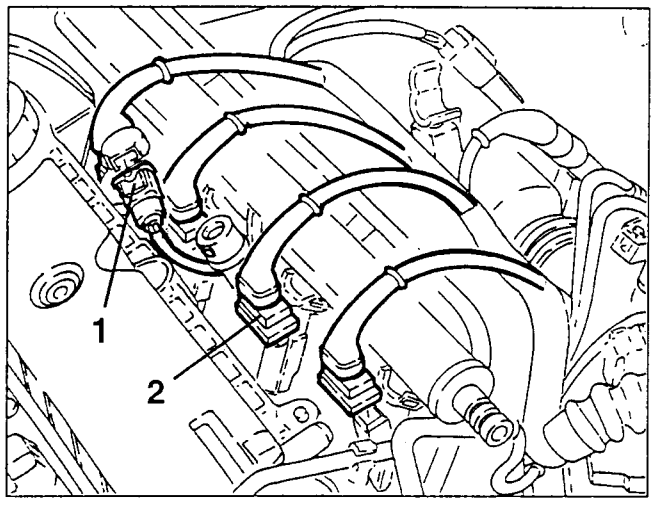

1. Disconnect the oil fume re-circulation pipe from the tappet cover.

**NOTE: Collect the fuel in a suitable container.**

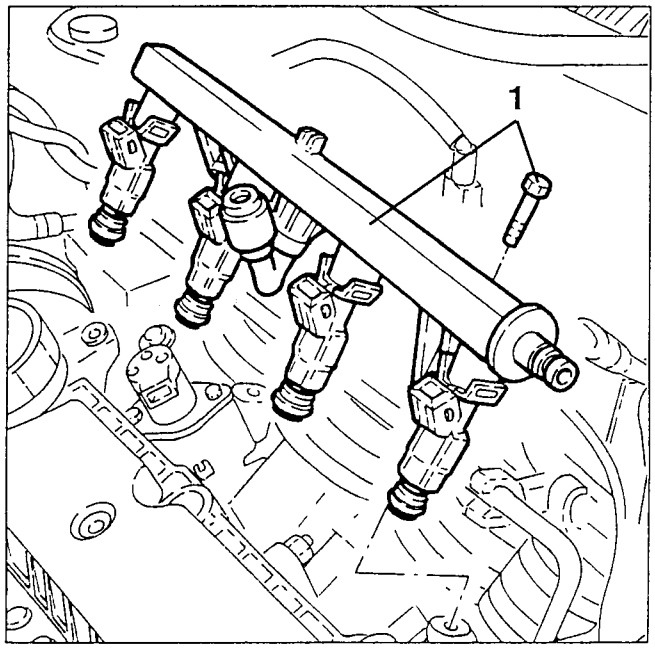
2. Disconnect the delivery pipe from the fuel distribution manifold. Release it from the clip on the modular intake manifold. Shift it to a side.




1. Disconnect the electric connection from the timing variator electromagnet.
2. Disconnect the electric connections from the injectors.



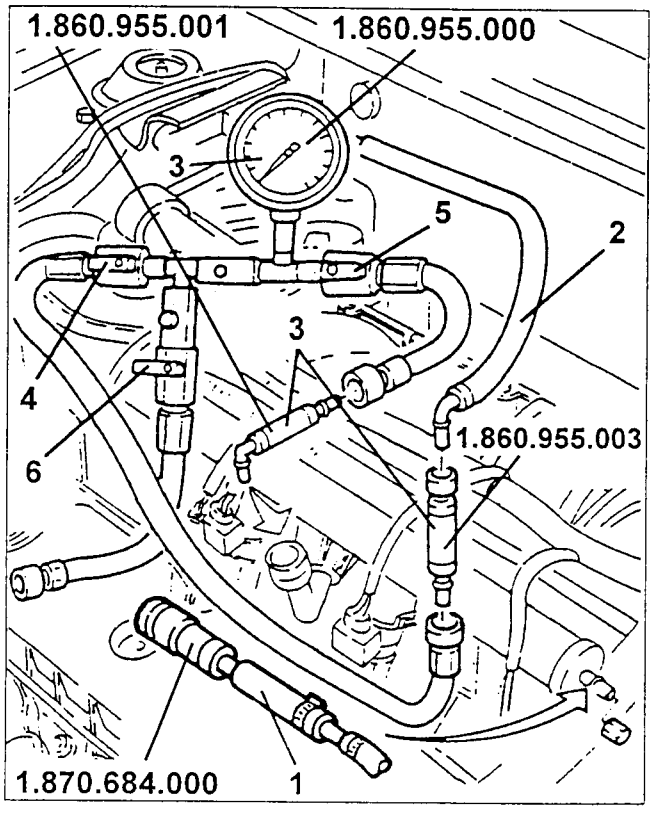

1. Remove the fastening screws and remove the distribution manifold and the injectors.
- If required, remove the safety clips and remove the injectors from the manifold.



# CHECKING THE PRESSURE AND TIGHTNESS OF THE FUEL CIRCUIT

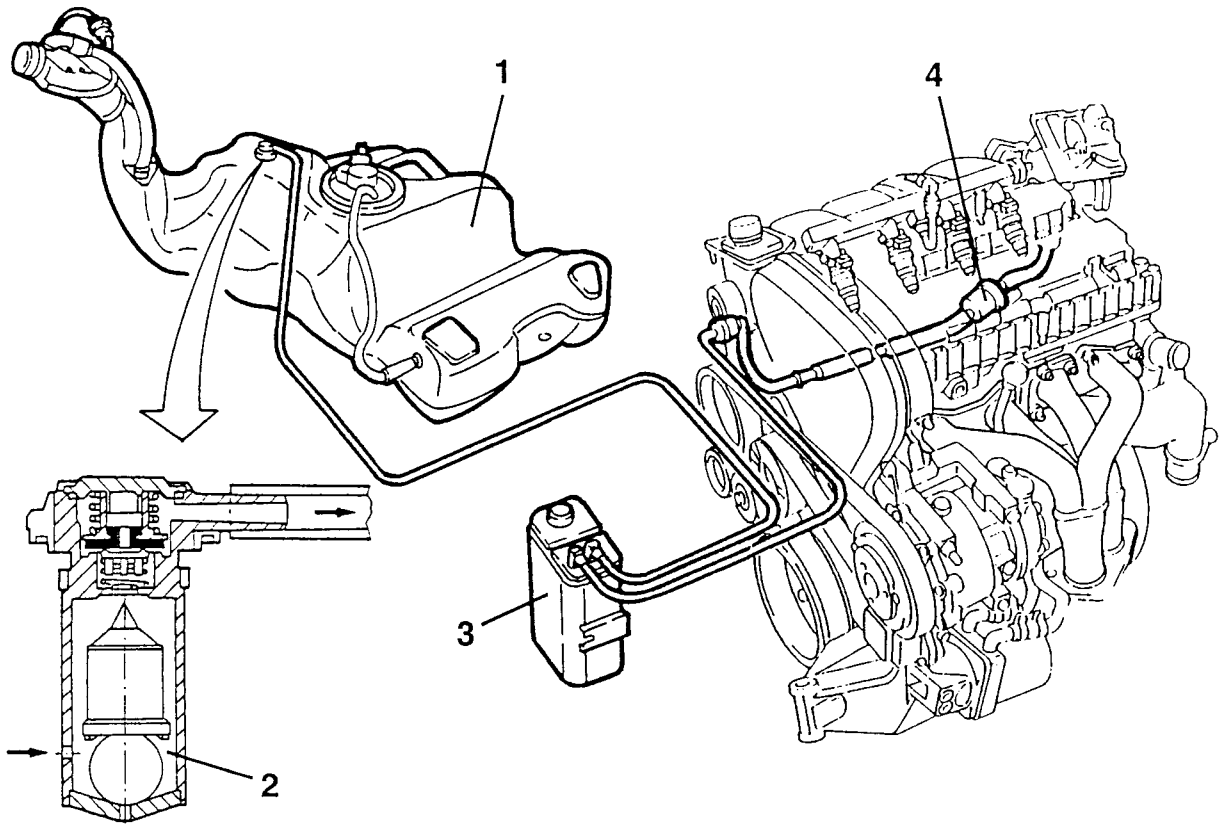
1. Connect tool no. 1.870.684.000 to the distributor manifold relief valve and relieve the fuel pressure.
2. Disconnect the fuel delivery pipe from the distributor manifold.
3. Assemble couplings no. 1.860.955.003 and no. 1.860.955.001 on pressure gauge no. 1.860.955.000.
- Connect the tool made in this way to the fuel delivery pipe and to the distributor manifold.
4. Open the ball valve.
5. Open the ball valve.
6. Close the engine and at idle speed, check that the fuel pressure is within the specified limits.

| Fuel pressure at idle speed |
|---|
| 3.3 ÷ 3.7 bar |



# BLANK

# FUEL FUME RE-CIRCULATION SYSTEM DESCRIPTION



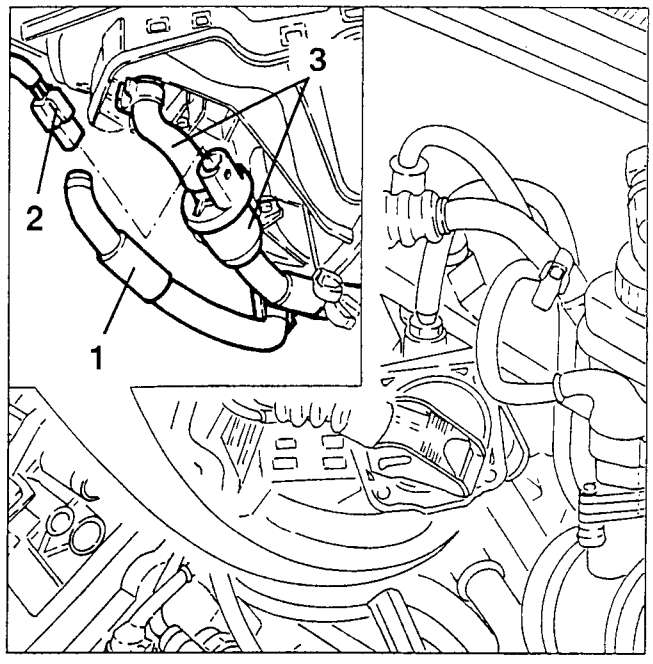

*1. Tank*
*2. Multifunction valve*
*3. Fuel fume filter (canister)*
*4. Solenoid valve*

The fuel in the tank (1) contains a considerable amount of fumes which would pollute the atmosphere if released. The re-circulation system collects these fumes and conveys them to the engine to be burnt.
When the fume pressure in the reservoir reaches 0.038 ÷ 0.053 bar, the multifunctional valve opens (2) and the fumes are conveyed to the fuel fume "canister" (3) via a specific pipe.
The canister absorbs and stores the fumes in an active carbon filter.
A solenoid valve (4) is located between the fuel fume filter and the intake unit. When the valve is not energised, the connection with the intake unit is closed and the fuel fumes are stored in the canister.
In certain load conditions, the Motronic ECU controls the opening of the solenoid valve allowing the intake of the fumes from the canister.
This condition persists also when the lambda sensor detects the decrease of oxygen in exhaust due to excessive presence of fuel in combustion chamber. This fact is signalled to the ECU which reduces the fuel feed to the injectors so that the engine is always fuelled appropriately.
If there are no fuel fumes in the canister and consequently only air is taken in, the lambda sensor detects the condition and signals in increase in oxygen to the ECU.
The ECU closes the solenoid thus closing the connection to the canister and eliminating the air in excess.

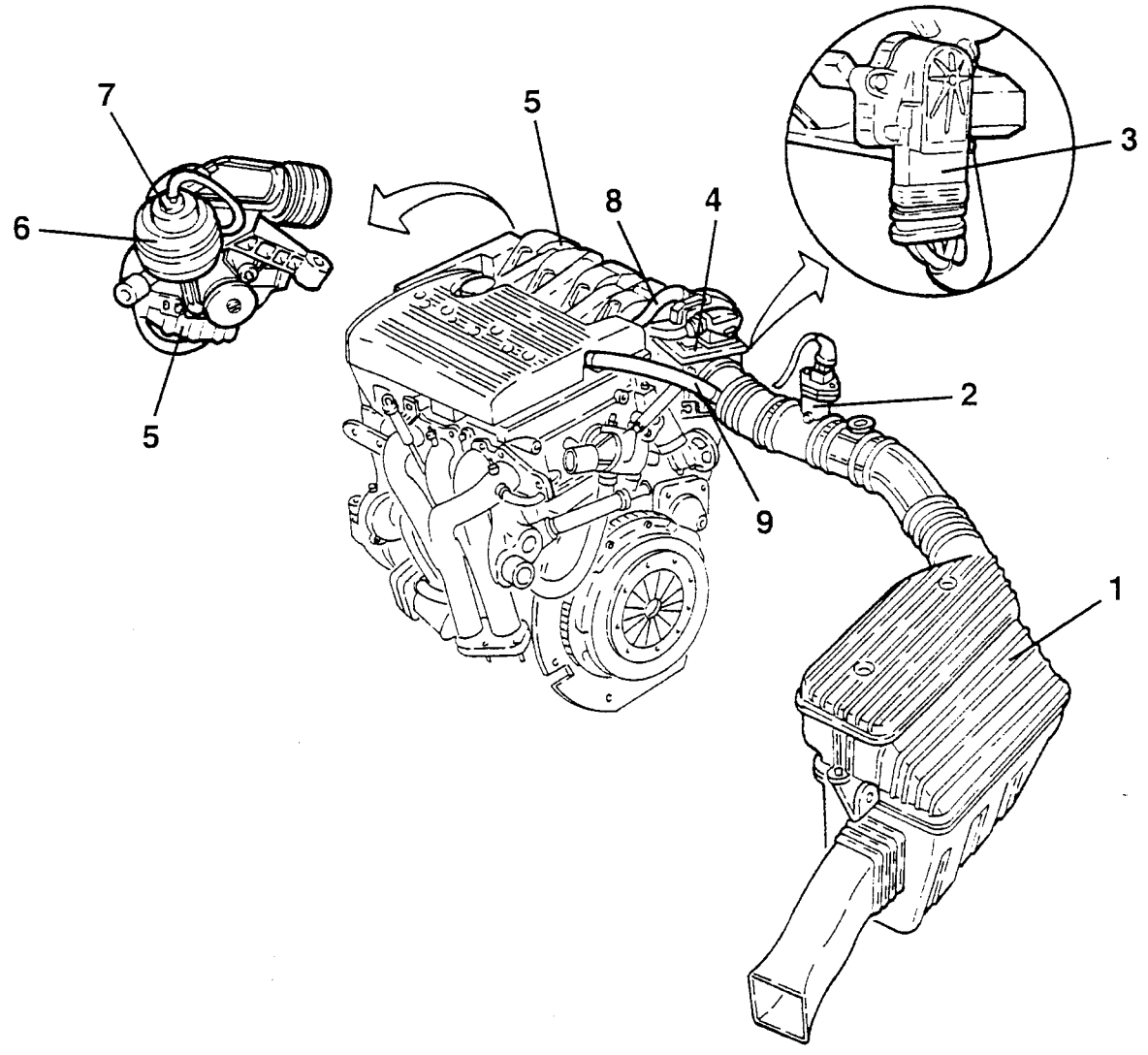
# FUEL FUME INTERCEPTOR VALVE

## REMOVAL/REFITTING

- Remove the throttle (see specific paragraph).
1. Disconnect the pipe from the distribution manifold, as shown in the illustration, to access the fuel fume interceptor valve.
2. Disconnect the electric connections of the fuel fume interceptor valve.
3. Disconnect the pipes and remove the fuel fume interceptor valve removing it from the support rod.



# AIR INTAKE SYSTEM AND OIL FUME RE-CIRCULATION SYSTEM DESCRIPTION




1. *Air filter*
2. *Intake air flow meter with integrated air temperature sensor*
3. *Idling actuator and throttle position sensor (MDS)*
4. *Throttle*
5. *Modular intake manifold*
6. *Modular intake manifold pneumatic control actuator*
7. *Modular intake manifold control solenoid valve*
8. *Idling oil fume re-circulation pipe*
9. *Oil fume re-circulation pipe*

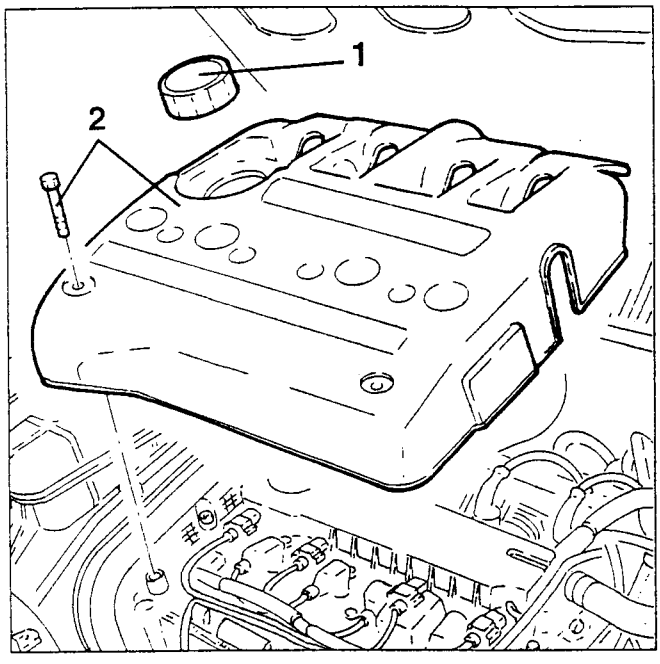
The intake air crosses a dynamic inlet and is filtered by a cartridge (1). It reaches the throttle (4) via a corrugated sleeve on which a hot film flow meter with integrated air intake temperature sensor is located.
The throttle is controlled by the accelerator wire and adjusts the amount of intake air in the unit.
The idling actuator is located on a side of the throttle.
The throttle position sensor (MDS) (3) controlled by the injector ECU and is also located on the throttle.
The fuel fumes (see specific paragraph) and the oil fumes are conveyed to the fuel feed system.

Oil fumes develop during engine operation.
They are collected in the cylinder head.
The condensed oil drips back to the crankcase while the fumes are conveyed to the intake unit via two pipes.
When idling, the oil fumes are conveyed to the throttle via the specific pipe (8).
At higher loads, the fumes are conveyed upstream with respect to the throttle via a connection pipe (9) to the corrugated sleeve to be burnt in the engine.

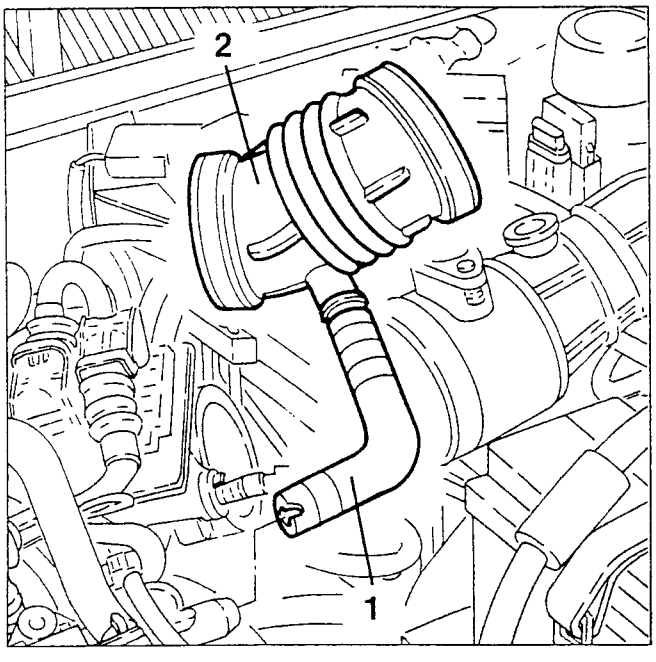
# THROTTLE

## REMOVAL/REFITTING

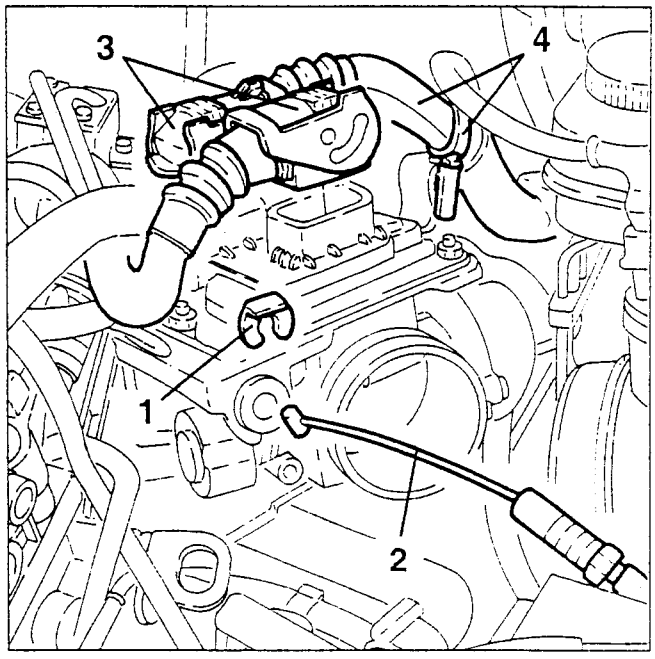
- Disconnect the (-) battery terminal.
1. Remove the engine oil filler cap.
2. Remove the fastening screws and remove the ignition coil cover.



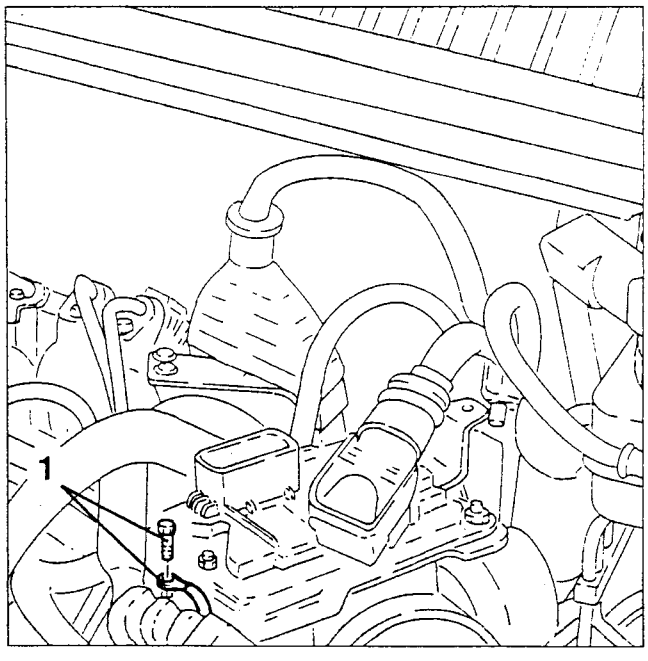

- Refit the engine oil filler cap.
1. Disconnect the oil fume re-circulation pipe from the tappet cover.
2. Disconnect the air flow meter sleeve from the throttle and remove it.



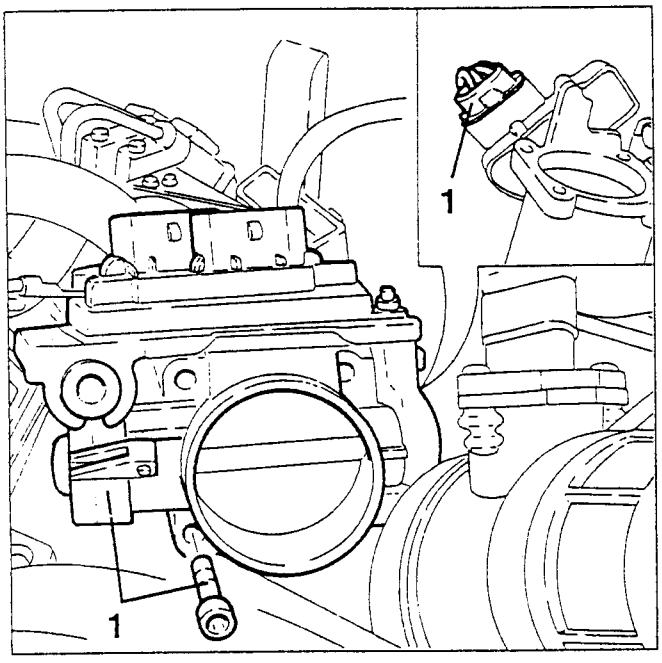

1. Remove the fastener from the accelerator wire from the rod.
2. Release the accelerator wire from the cam on the throttle and shift it.
3. Disconnect the engine ECU electric connections.
4. Release the wiring from the clip on the ECU.




1. Disconnect the earth from the engine ECU support.

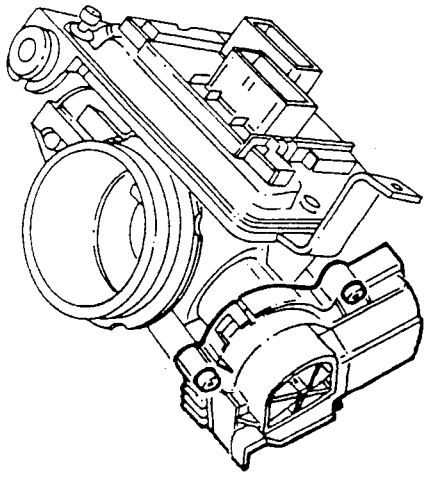


1. Remove the fastening screws and remove the throttle, disconnecting the idling actuator electric connection.



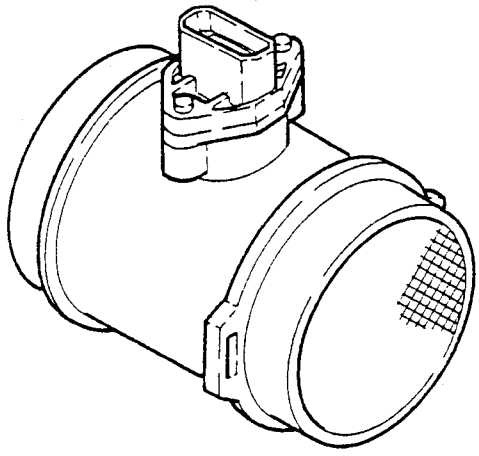

## IDLING ACTUATOR AND THROTTLE POSITION SENSOR (MDS)

The actuator is located on the throttle and is controlled by the injection ECU.
It consists of a DC motor which adjusts the throttle opening from 0° to 15°.
Two potentiometers integrated in the actuator transmit the angle to the ECU, respectively:
- 0° ÷ 15° for idling
- 0° ÷ 83° for other engine ratios.

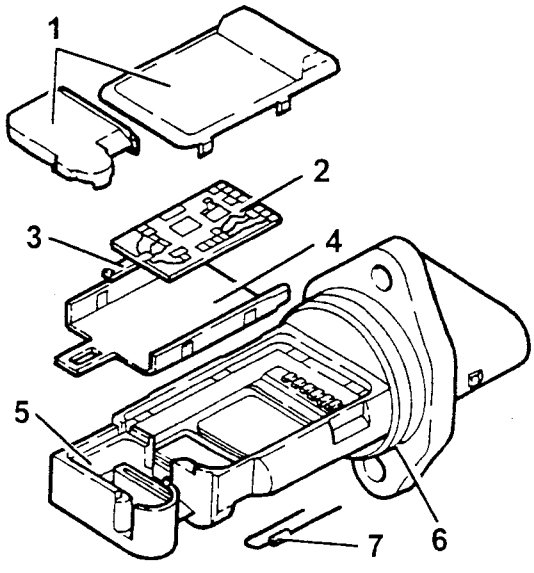


## INTAKE AIR FLOW METER WITH INTEGRATED AIR TEMPERATURE SENSOR

This "heated film" flow meter is located on the intake manifold.



An intake air temperature sensor is integrated in the sensor.




1. *Covers*
2. *Electronic board*
3. *Sensors*
4. *Support plate*
5. *Support*
6. *O-ring*
7. *Temperature sensor*

The operation principle is based on a heated film interposed in the measuring channel the intake air directed to the engine flows through.

The membrane film is kept at constant temperature (approximately 120°C higher than the intake air temperature) by a resistance.
The intake air crossing the channel tends to take heat from the membrane.
To keep temperature constant, therefore, a certain current must cross the element.
This current is measured by means of a specific Wheatstone bridge and is proportional to the air flow.
**A flow meter directly measures the amount of air (not the volume) thus eliminating problems due to temperature, altitude, pressure, etc.**

## MODULAR INTAKE MANIFOLD

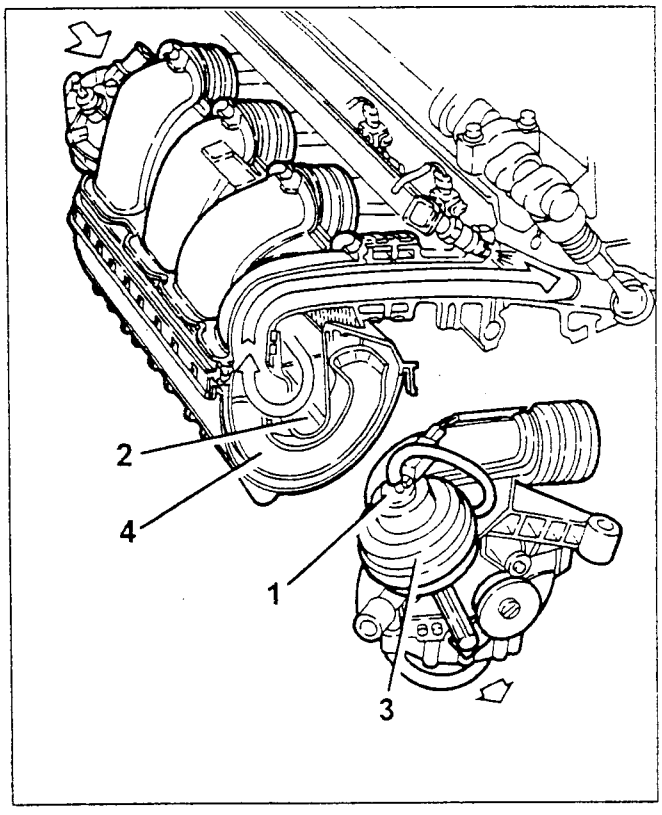
This modular length intake manifold is controlled by the injection ECU.
It increases volumetric performance and consequently:
- optimises torque output at low/medium ratios
- increases power at high ratios.

The manifold consists of:
- two half cases made in nylon
- an internal rocking manifold
- a vacuum accumulator inside the manifold
- a modular intake manifold actuator with an integrated three-way control solenoid valve.

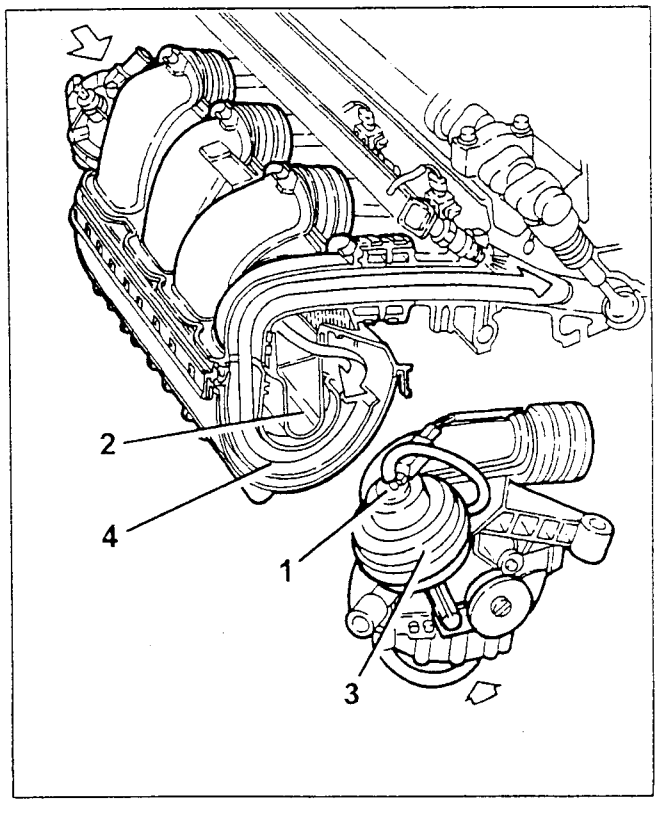
## OPERATION

The injection ECU controls the three-way solenoid valve (1) thus connecting the vacuum accumulator (2) and the pneumatic actuator (3) which, by means of specific linkages, controls the movement of the rocking manifold (4).
The rocking manifold rotation configures the manifolds as follows:

- short power manifolds for engine ratio over 4900 rpm.



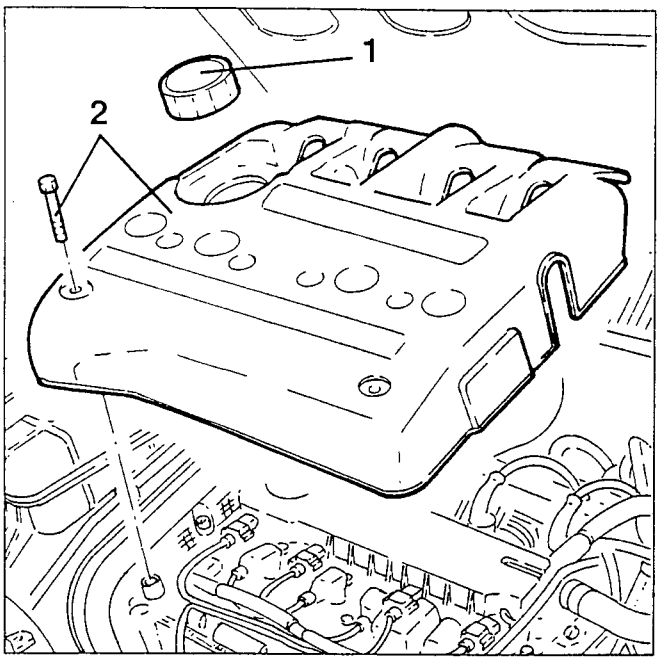

- long torque manifolds for engine ratio from 800 to 4900 rpm.



## REMOVAL/REFITTING

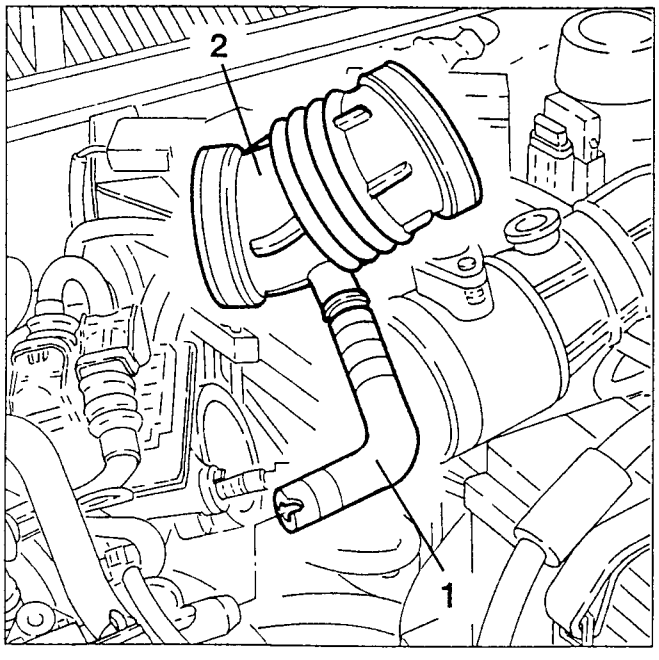
- Position the vehicle on a shop jack.
- Disconnect the (-) battery terminal.

1. Remove the engine oil filler cap.
2. Remove the fastening screws and remove the ignition coil cover.

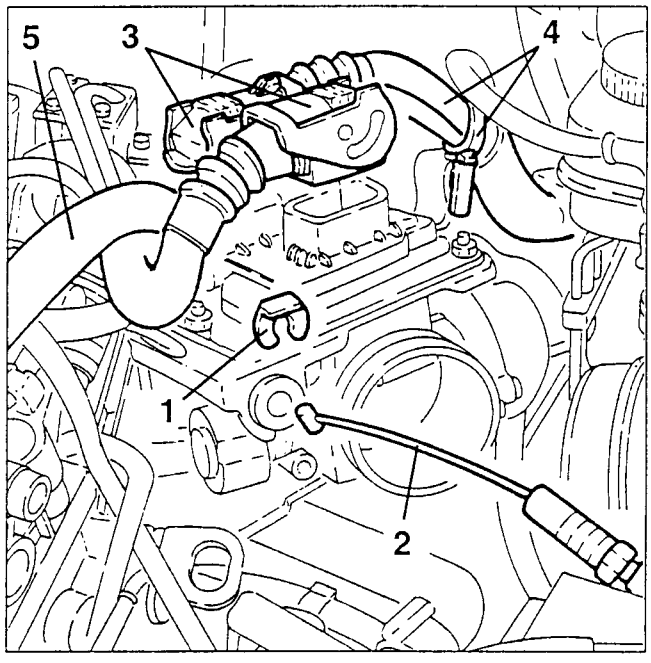



- Refit the engine oil filler cap.

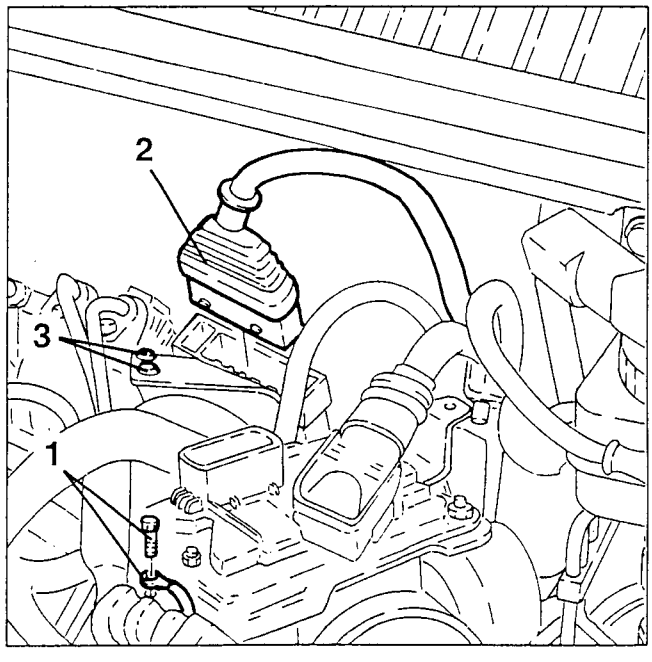
1. Disconnect the oil fume re-circulation pipe from the tappet cover.
2. Disconnect the air flow meter sleeve from the throttle and remove it.



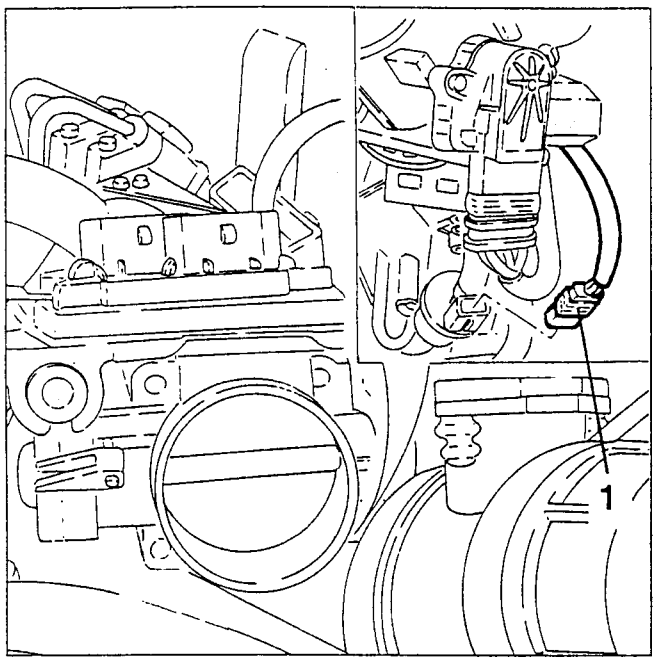

1. Remove the accelerator wire fastener from the rod.
2. Release the accelerator wire from the cam on the throttle and shift it.
3. Disconnect the engine ECU electric connections.
4. Release the wiring from the clip on the ECU.
5. Disconnect the oil fume intake pipe from the throttle.



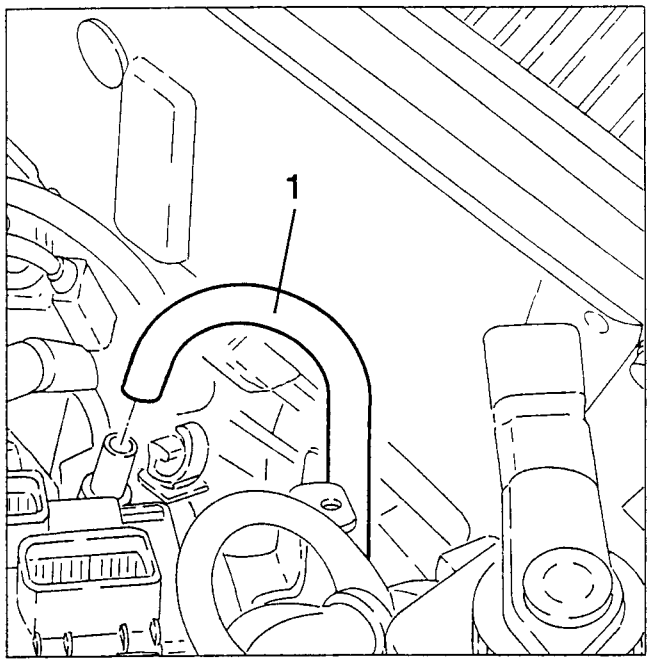

1. Disconnect the earth from the engine ECU support.
2. Disconnect the electric connection from the front/engine connection wiring.
3. Remove the screws fastening the front/engine connection wiring to the modular intake manifold.



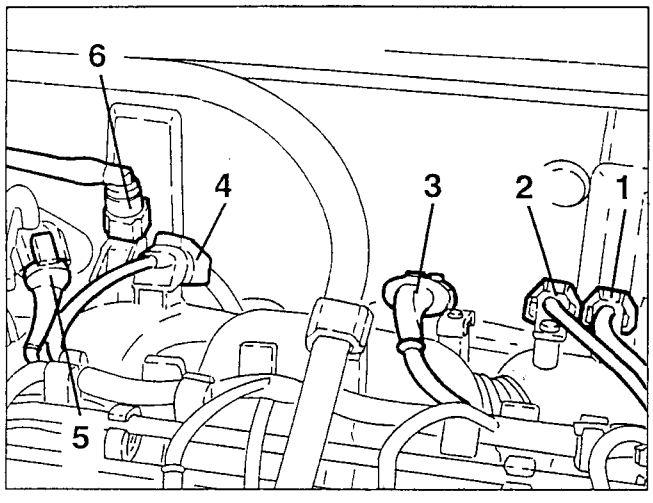
1. Disconnect the fuel fume interceptor valve electric connection.



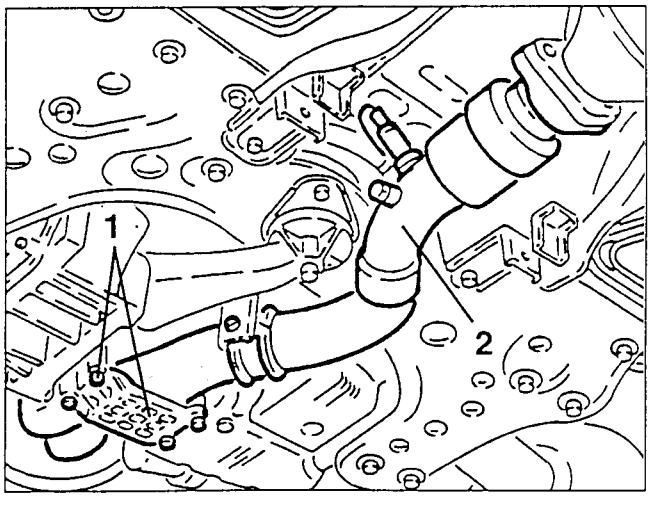

1. Disconnect the brake booster vacuum pipe.



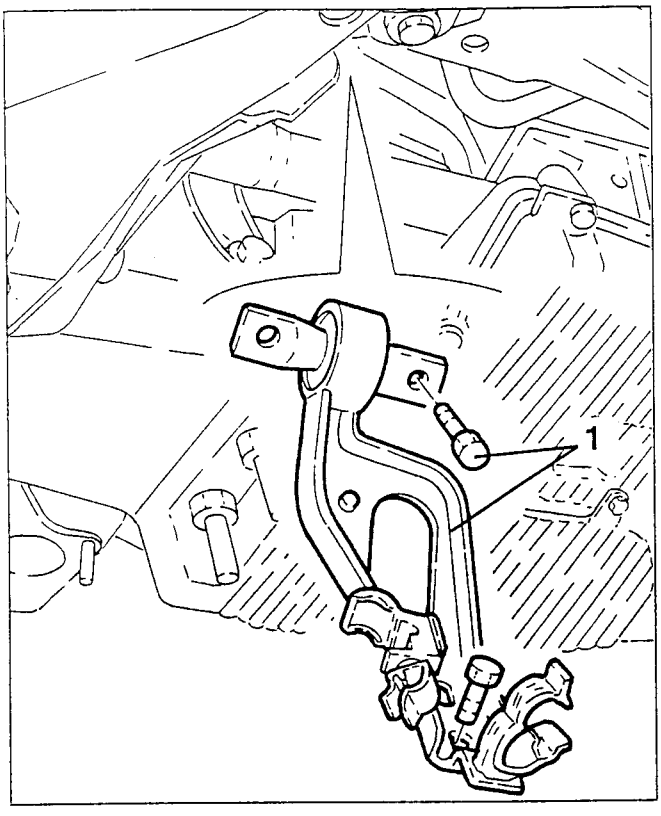

1. Disconnect the rev and timing sensor electric connection.
2. Disconnect the knock sensor electric connection.
3. Disconnect the lambda sensor electric connection.
4. Disconnect the timing sensor electric connection.
5. Disconnect the electric connection from the modular intake manifold actuator.
6. Disconnect the fuel fume hose.
- Release the electric wiring and pipes from the clips on the modular intake manifold.



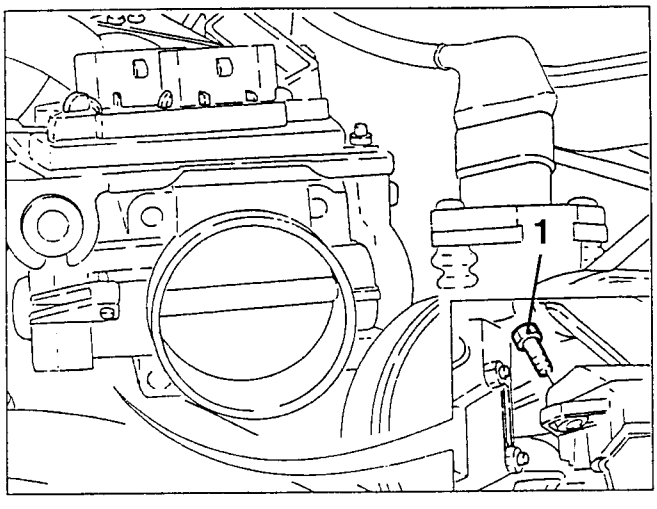

- Release the injector wiring from the fastening clips on the modular intake manifold.
- Release the coolant return pipe to reservoir from the clips on the modular intake manifold.
- Lift the vehicle.
- Remove the guard under the motor.
1. Remove the fastening nuts and the front exhaust pipe reinforcement.
2. Remove the fasteners and the front section of the exhaust pipe with lambda sensor and seals.



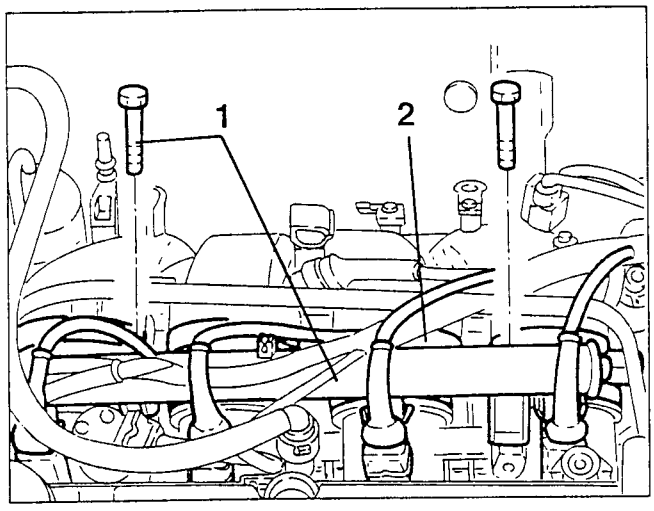
1. Remove the fastening screws and the modular intake manifold support rod.
- Remove the screw fastening the right-hand side of the modular intake manifold.



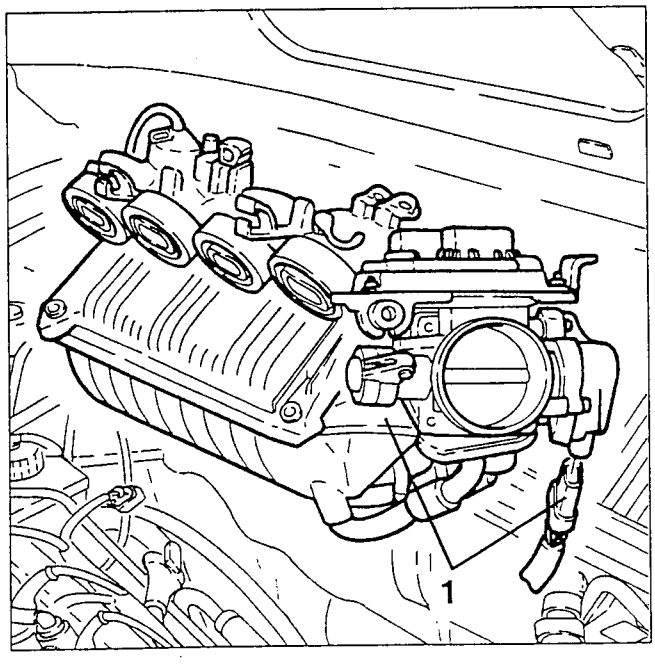

- Lower the vehicle.
1. Remove the screw fastening the left-hand side of the modular intake manifold.




1. Remove the fuel distribution manifold fastening screw and shift it to access the rubber sleeves.
2. Disconnect the rubber sleeve fastening clips. Shift the modular intake manifold and remove the sleeves.

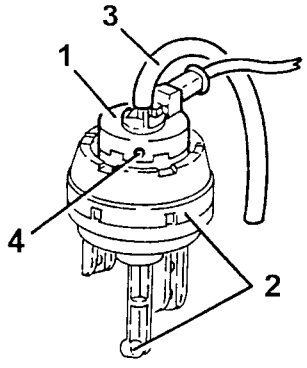



1. Remove the modular intake manifold, after disconnecting the constant idling actuator.



## INTAKE MANIFOLD SOLENOID VALVE

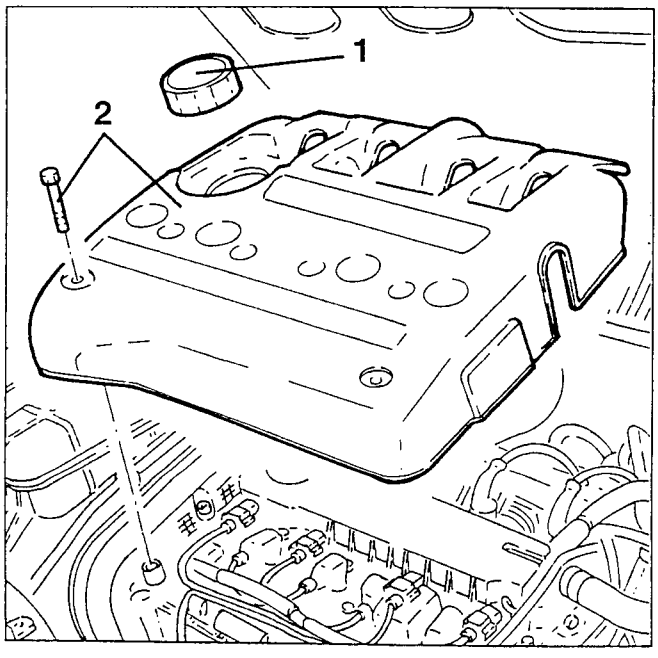
This is a three-way solenoid valve integrates in the pneumatic actuator controlling the variable geometry unit.
It is controlled by the injection ECU.
It enables the vacuum in the vacuum reservoir (inside the intake unit) to act on the rocking manifold control pneumatic actuator.



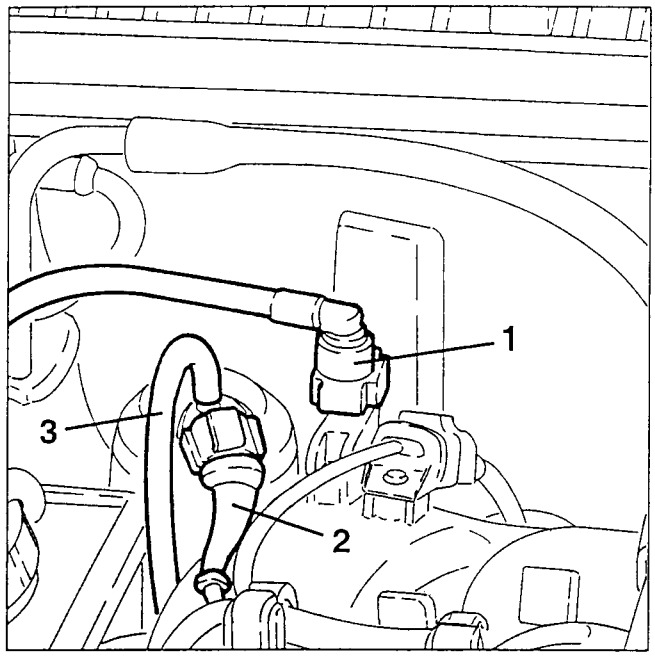

1. *Modular intake manifold solenoid valve*
2. *Modular intake device control actuator*
3. *Vacuum pipe*
4. *Atmospheric pressure air inlet*

## REMOVAL/REFITTING

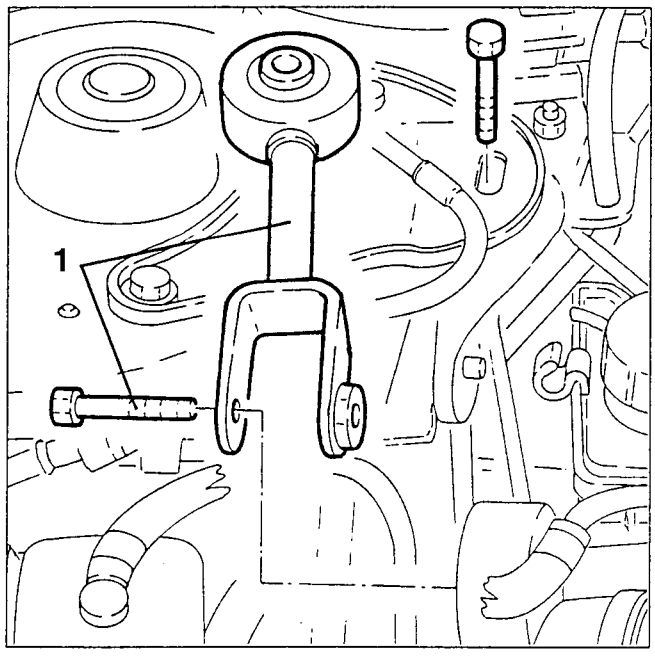
- Disconnect the (-) battery terminal.
1. Remove the engine oil filler cap.
2. Remove the fastening screws and remove the ignition coil cover.




- Refit the engine oil filler cap.
1. Disconnect the fuel fume quick coupling pipe and release it from the clip on the power steering reservoir.
2. Disconnect the modular intake manifold actuator electric connection.
3. Disconnect modular intake manifold actuator vacuum pipe.

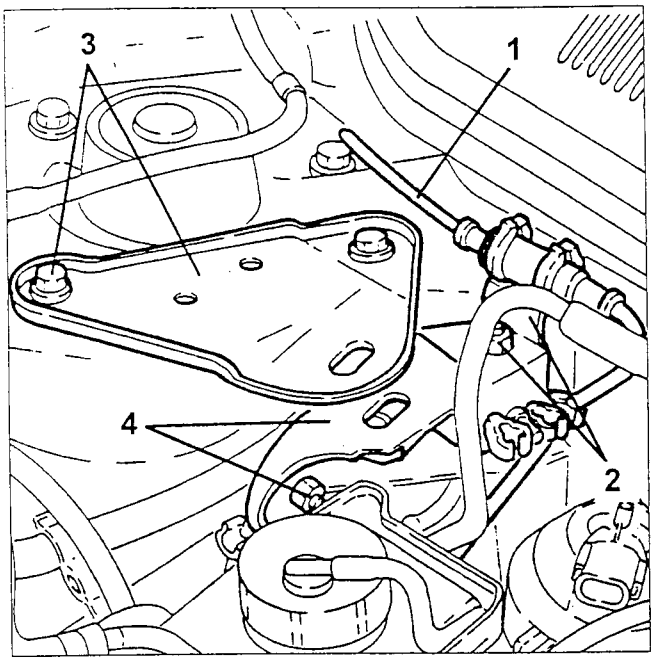



1. Remove the fastening screw and remove the engine reaction tie-rod.

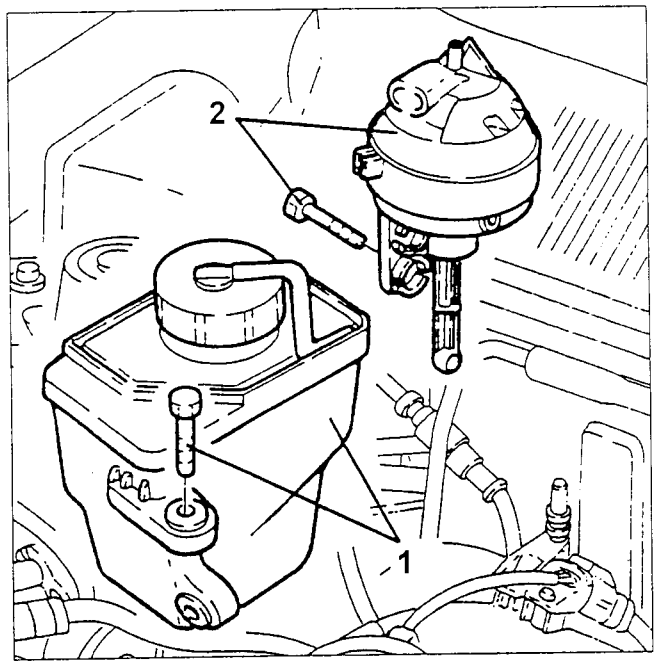



1. Disconnect the right-hand ABS sensor electric connection from the support rod.
2. Remove the fastening nut and remove the ABS sensor electric connection support rod.

3. Slacken the fastening screws and remove the upper support bracket of the power unit reaction rod.
4. Slacken the nut and fastening screw, then remove the power unit reaction rod support bracket.

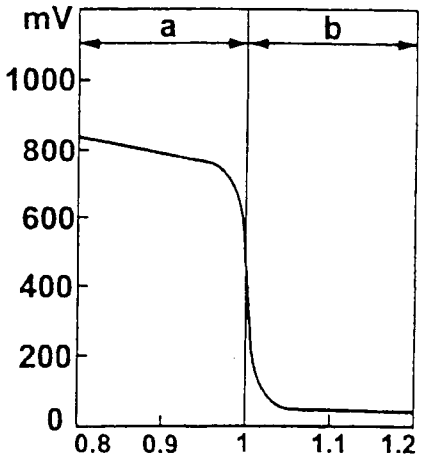



1. Slacken the fastening screws and move aside the power steering tank.
2. Slacken the fastening screws, disconnect the rod from the joint and remove the modular box control actuator.



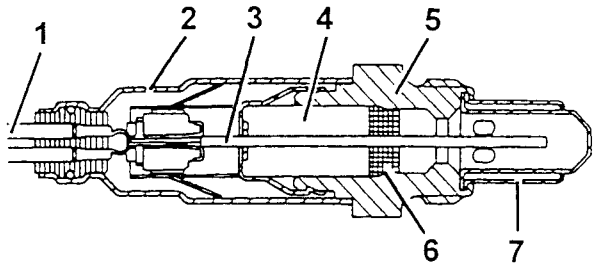
## LAMBDA SENSOR

This is of the "planar" type and is fitted on the front section of the exhaust pipe. It informs the injection - ignition control unit about combustion (stoichiometric ratio).
The electronic control unit identifies the composition of the mixture (lean or fat) from the lambda sensor output voltage.
It adapts the amount of fuel injected to ensure an optimum composition of the mixture ($\lambda = 1$), to create the ideal conditions for treating the exhaust gases in the catalytic converter.
If the mixture is too fat ($\lambda < 1$), the amount of fuel must be reduced and if the mixture is too lean ($\lambda > 1$), the amount of fuel must be increased.



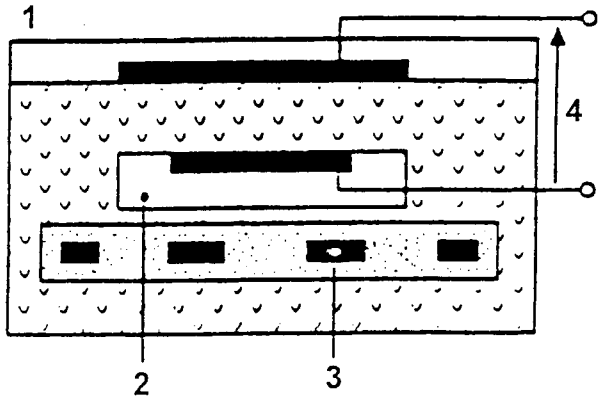

*a. Fat mixture (lack of air)*
*b. Lean mixture (excess air)*

The lambda sensor, placed in contact with the exhaust gas, generates an electric signal, the voltage of which depends on the concentration of oxygen in the gas.
This voltage is characterised by an abrupt change when the composition of the mixture departs from $\lambda = 1$.
Lambda sensor heating is controlled by the injection control unit proportionately with the temperature of the exhaust gas.
This prevents thermal shocks to the ceramic body due to contact with the condensed water contained in the exhaust gas when the engine is cold
The measurement cell and the heater are integrated in the "planar" (stratified) ceramic element with the advantage of obtaining quick heating of the cell, so that closed loop control ($\lambda = 1$) is enabled within 10 seconds from starting the engine.




*1. Connection cable*
*2. Protective sleeve*
*3. Planar sensor element*
*4. Ceramic support pipe*
*5. Sensor housing*
*6. Ceramic seal*
*7. Protection pipe*

The lambda sensor works on the principle of an oxygen concentration cell with solid electrolyte.
The measuring cell surfaces are coated with microporous layers of precious material.




*1. Exhaust gas*
*2. Reference air passage*
*3. Heater*
*4. Lambda sensor voltage*