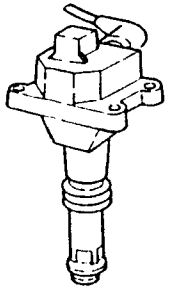
GROUP 05

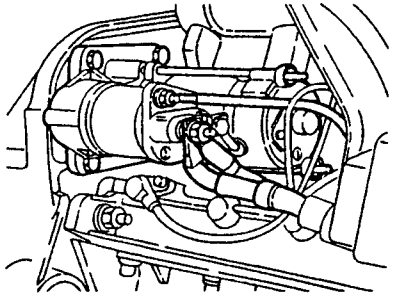
ENGINE IGNITION, STARTING AND RECHARGING

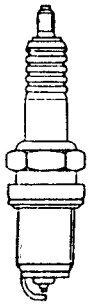
INDEX

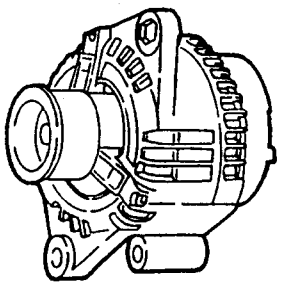
(*): See INSTRUCTIONS FOR REPAIR - ENGINES - PA4655B1000000

ILLUSTRATED INDEX

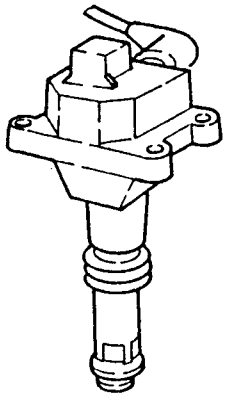








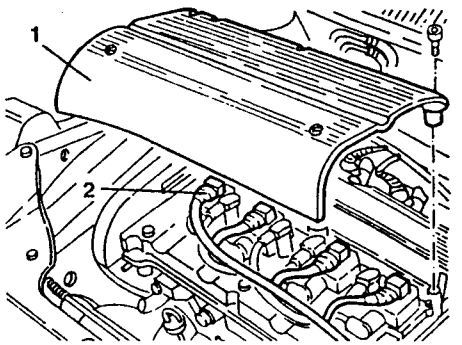
IGNITION COILS



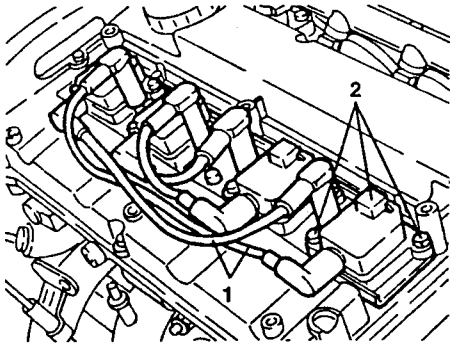
The ignition system includes two spark plugs per cylinder in an asymmetrical position which differ in size.
This static distribution system with lost spark has four coils, each of which supplies the spark plug of the cylinder below and simultaneously that of the paired cylinder (1-4) (2-3).
This system is a sophisticated evolution of the T.Spark ignition system.
This new system offers further advantages, such as:
- limited high voltage cable routing thereby achieving increased reliability and lowering electrical interferences;
- the position and length of the cables makes it impossible to invert the connection of the cables to the corresponding spark plugs during servicing operations.

REMOVAL/REFITTING

- Disconnect the battery (-) terminal.
1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



1. Remove the high voltage cables.
2. Slacken the fastening screws and remove the ignition coils.
- If necessary, slacken the fastening screws and remove the ignition coil support bracket.



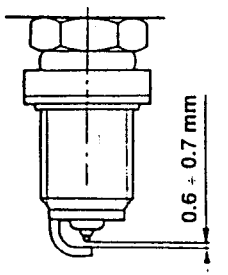
CHECKS AND INSPECTIONS

- Check that the ignition coil characteristics are within the specified limits. If not, change the coils.

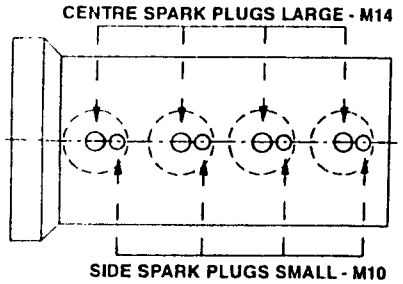
Specifications	
Primary winding resistance	0.3 Ω ± 12%
Secondary winding resistance	7k Ω ± 12%

SPARK PLUGS

The standard spark plugs are of the type with surface discharge with one point and a centre electrode.
In order to operate correctly a precise gap must be maintained between the electrodes.



The spark plugs are positioned asymmetrically in the bursting chamber and they differ in size as shown in the following diagram.



Firing order
1 - 3 - 4 - 2

CHECKING AND REPLACEMENT

- With the engine cold, remove the spark plugs blowing inside to remove any traces of dirt.
- Check for dirt or breaks on the ceramic insulation. In which case change the spark plugs.

CAUTION:
The use of spark plugs of a different type or size than those specified can cause serious damage to the engine and alter the level of harmful emissions at the exhaust.

CAUTION:
A dirty or burnt out spark plug is often symptomatic of a fault in the engine supply system. For example:

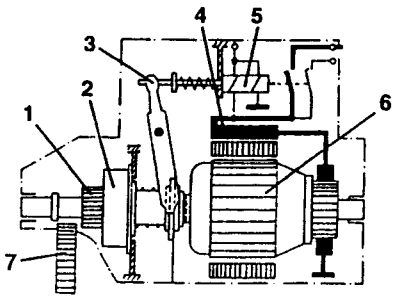
- **Traces of carbon powder: incorrect mixture, air cleaner very dirty;**
- **Oil stains: oil seepage from the piston rings;**
- **Formation of ash: presence of aluminium material, especially in the oil;**
- **Melted electrodes: overheating due to unsuitable combustion, valve defects;**
- **Highly worn electrode: damaging additives in the fuel or oil, pinging or overheating;**
- **Etc.**

- When fitting, tighten the spark plugs to the following torque:

Centre spark plugs (large - M14)	25 ÷ 35 Nm 2.6 ÷ 3.6 kgm
Side spark plugs (small - M10)	10 ÷ 12 Nm 1 ÷ 1.2 kgm

STARTER MOTOR

Overcoming the inertia and frictions the starter motor cranks the engine to set a number of revolutions in order to begin the formation of the mixture necessary for combustion and subsequent autonomous movement of the engine.
The motion is transmitted by a direct current electric motor, powered by the battery, through a coupling pinion which turns the ring gear on the flywheel.



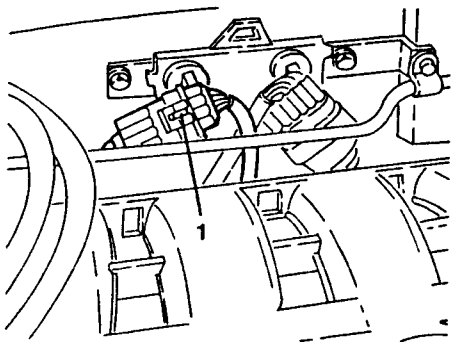
1. Pinion
2. Roller type freewheel
3. Coupling lever
4. Excitation coil
5. Relay
6. Rotor
7. Flywheel ring gear

Due to a freewheel coupling, the pinion disengages when the main engine turns faster than the motor.
A relay energized by the motor current engages the pinion through a fork.
The starter motor installed is of the translating screw pinion type, with relay housed directly above the starter motor.

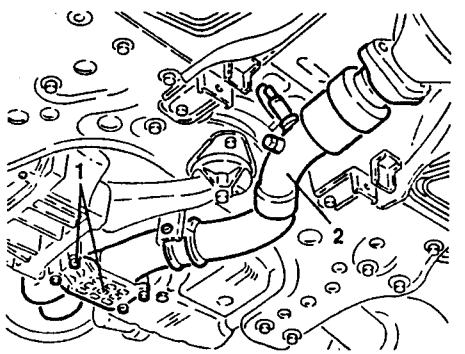
REMOVAL/REFITTING

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

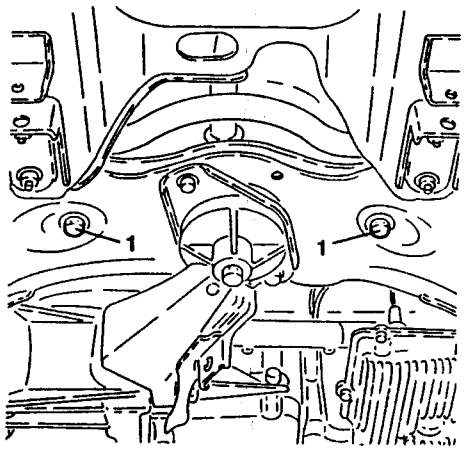
1. Disconnect the electrical connections of the lambda sensor.



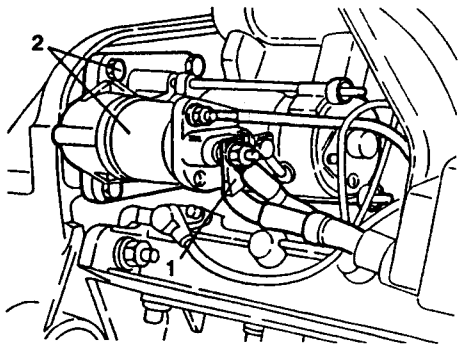
1. Raise the car, slacken the fastening screws and remove the reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with lambda sensor after slacken the fastenings.



1. Slacken the screws fastening the power steering box to the suspension crossmember.

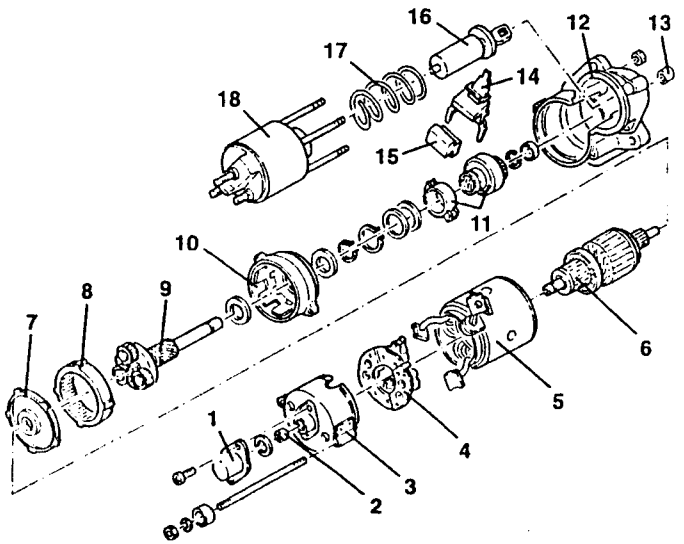


1. Disconnect the electrical connections from the starter motor.
2. Slacken the three fastening screws and remove the starter motor.



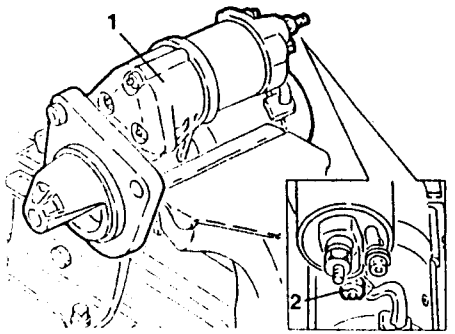
DIS-ASSEMBLY

1. Dust cover
2. Bushing
3. Manifold side support
4. Brush holder plate
5. Polar frame
6. Rotor
7. Protection plate
8. Differential drive wheel
9. Inverter
10. Inverter box
11. Starting coupling
12. Control side support
13. Bushing
14. Fork lever
15. Rubber pad
16. Coupling relay rotor
17. Return spring
18. Coupling relay

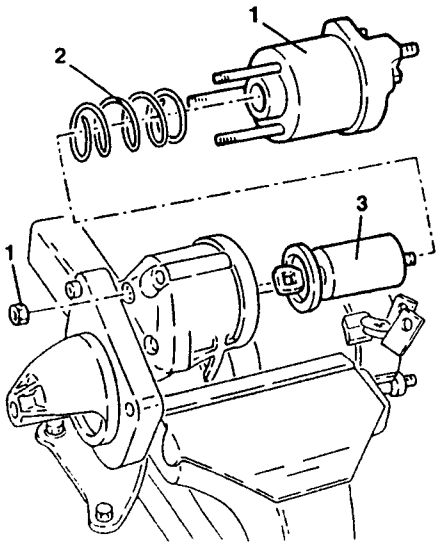


WARNING:
Owing to their structure, compared with the previous versions, the starter motors are more sensitive to shocks, bumps and squashing.

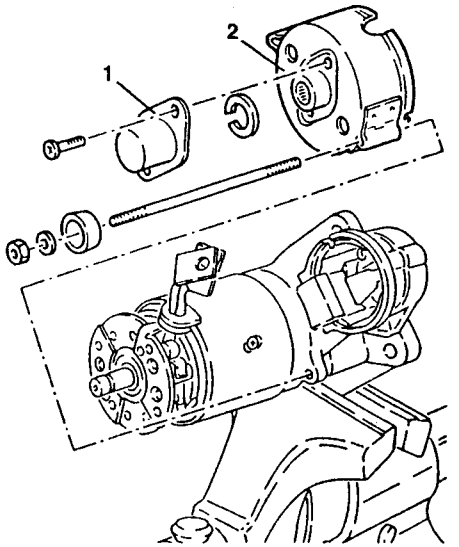
1. Fasten the starter motor on the vice fitted with protective jaws as illustrated.
2. Slacken the nut fastening the terminal to the coupling relay.



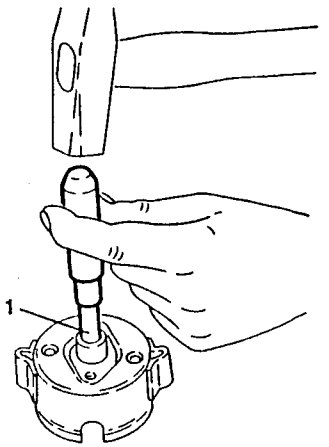
1. Slacken the three fastening nuts and remove the coupling relay.
2. Remove the return spring.
3. Remove the coupling relay rotor.



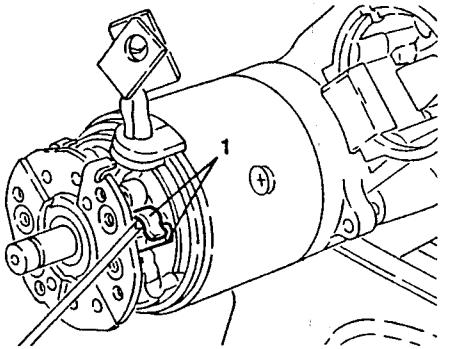
1. Slacken the two fastening screws and remove the dust cover.
2. Remove the circlip, slacken the fastening studs and remove the collector side support.



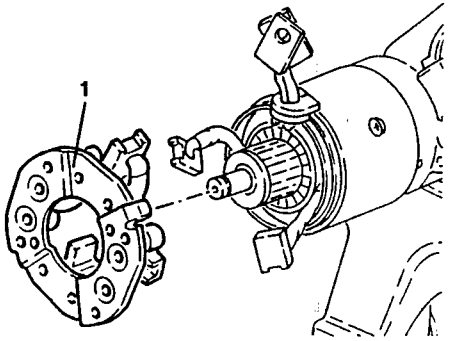
1. If necessary replace the bushing on the manifold side support using a suitable tool.



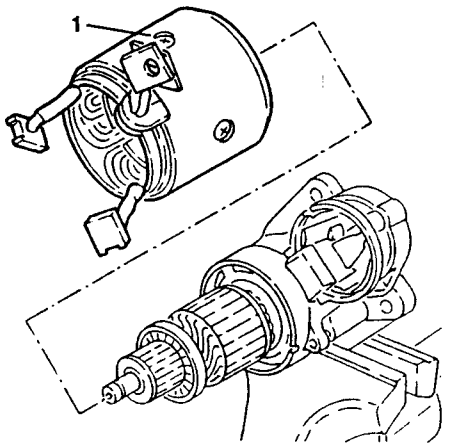
1. Release the fastening clamps and from the brush holder plate withdraw the two brushes connected directly to the polar frame.



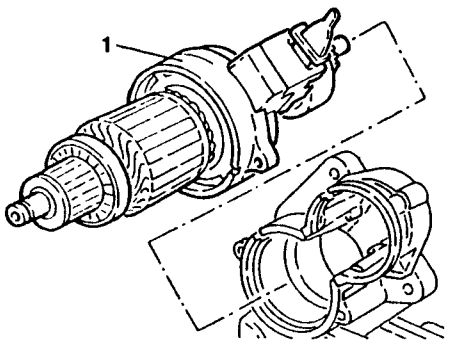
1. Remove the brush holder plate withdrawing it from the rotor.



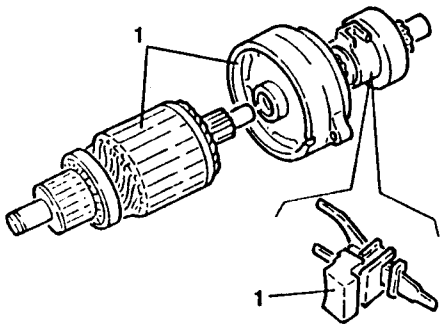
1. Withdraw the polar frame from the rotor.



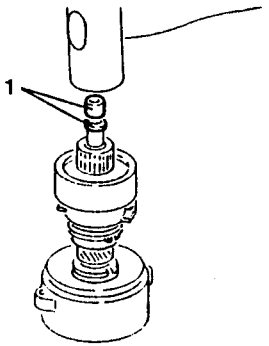
1. From the drive side support, withdraw the rotor assembly, epicyclic gear with idler and fork levers.



1. Separate the epicyclic gear with idler from the rotor and from the fork levers.

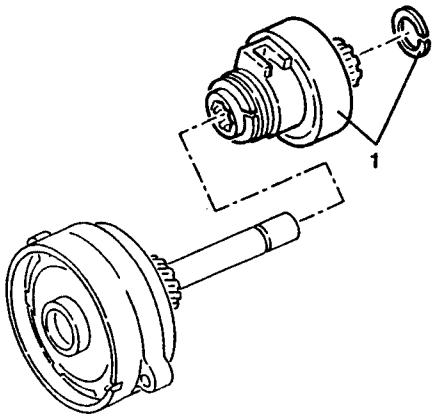


1. Using a suitable bush and rubber hammer tap the stop ring of the starting coupling.

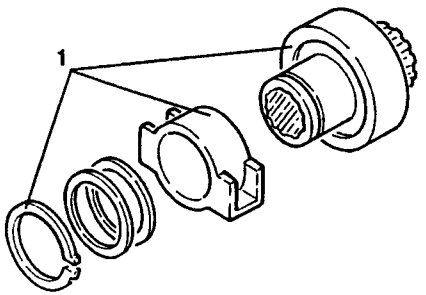


1. Remove the circlip and withdraw the starting coupling from the inverter shaft.

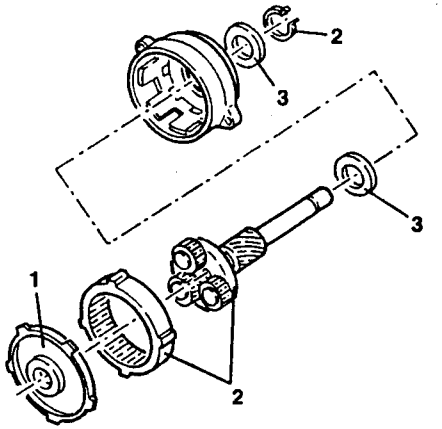
WARNING:
Removing the circlip avoid damaging the inverter shaft.
Carefully eliminate any burrs in the inverter shaft groove, otherwise the inverter shaft will be damaged



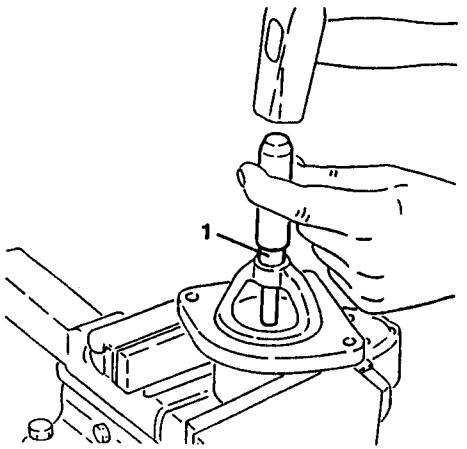
1. Remove the circlip, retrieve the washers and separate the fork lever connection from the starting coupling.



1. Remove the protecction plate.
2. Remove the circlip, then withdraw the inverter and differential drive wheel.
3. Retrieve the washers.

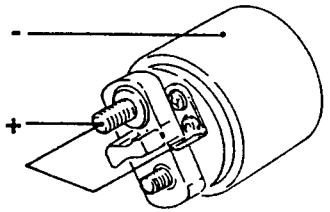


1. If necessary replace the bushing on the control side support using a suitable tool.



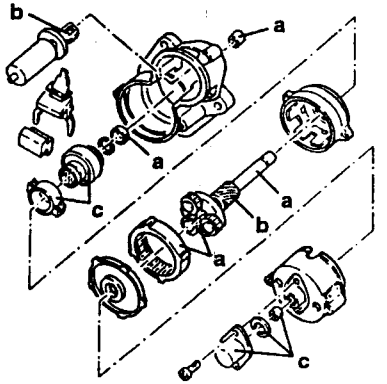
Checking the efficiency of the coupling relay

- Position the coupling relay on the test bench top and supply the actual top negatively (alternatively connect to the (-) of the battery).
- Connect the positive pole of the test bench or battery to the positive pole of the relay short circuited with the starting pin.
- The prod of the starting relay which actuates the starting control fork trigger; if not replace the electromagnet.



RE-ASSEMBLY

- Re-assemble the starter motor reversing the sequence followed for dis-assembly and observing the following instructions.
- Lubricate the components illustrated below with the specified products.



a. Oil
b. Grease
c. Silicone grease

CHECKS AND INSPECTIONS

- Clean the rotor, internal toothed gear, the gear with idler and the relay only with compressed air (max 4 bar) and a clean cloth. Do not use liquid detergents.

The other parts, such as screws and rotor shaft may be washed using uninflammable liquid detergents normally to be found on the market.

WARNING:
Thoroughly dry the washed parts, otherwise in the sealed motor explosive gases may form.

Checking the outside of the collector

- Check the collector for signs of worn points; in which case turn it proceeding as follows:
- Tighten the rotor on the collector and drive side supports taking care not to damage the rotor shaft.

WARNING:
When turning do not tighten the rotor shaft in the centering.

- Turn the collector using suitable tools checking that the diameter is within the specified limits.

Minimum diameter of collector
28.3 ÷ 28.4 mm

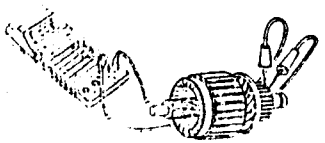
- Also check that the eccentricity of the collector and stator pack is within the specified limits.

Collector eccentricity	≤ 0.01 mm
Plate pack eccentricity	≤ 0.05 mm

- If the collector reveals annealed points or interruptions, replace the rotor.

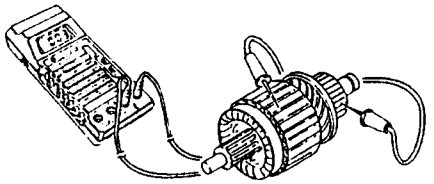
Collector continuity test

- Set the tester prods on the collector plates and check that the tester signals the passage of current.
In the lack of electrical continuity replace the rotor.
- Repeat the above operations for all the pairs of corresponding plates.



Rotor insulation test

- Set a tester prod on the collector and the other on the plate pack or on the shaft and check that the tester does not signal the passage of current.
In the lack of insulation (short circuit) replace the rotor.
- Repeat the above tests for all the collector blades.

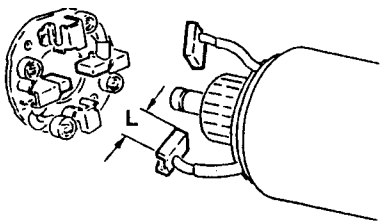


Checking brush wear

- Check that the length of the brushes is within the specified limits and that they are not damaged; if not, replace the whole brush holder plate.

Minimum length of brushes
Not available at time of going to press

- Also check that the brush springs are not stretched and that they are stiff enough to ensure good contact of the brushes on the collector.

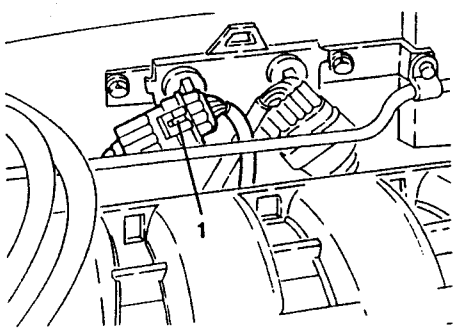


ALTERNATOR

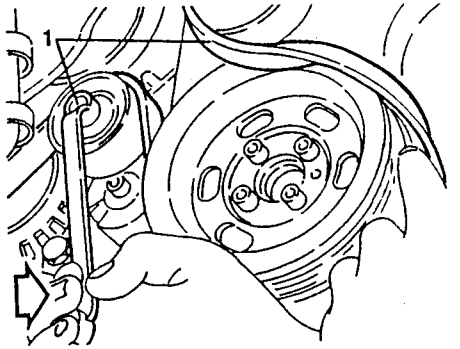
When the engine is running the alternator supplies electrical energy to the electronic control units and to the various services which can be operated at all times.
It also charges the accumulator (battery), so that it can deliver current when the engine is stationary.
The electric current is produced by a stator which "cuts" the magnetic field generated by a rotary coil (rotor). The rotor is integral with a pulley operated directly by the crankshaft through a belt.
The contact brushes supply the rotor with the excitation current.
The alternate current generated by the alternator is rectified by the diodes and adjusted by the voltage regulator located on the alternator body.
The electronic voltage regulator used is compact in size and it warrants constant voltage in all fields of operation of the engine, regardless of the changes in load and rpm.
A cooling fan turns together with the pulley to prevent the alternator from reaching dangerous temperatures that might adversely affect its operation.
The alternator installed is of the type with claw terminals and collector rings; it is very light and compact.
CAUTION:
The fan will correctly cool the alternator if it turns clockwise (seen from pulley side).

REMOVAL/REFITTING

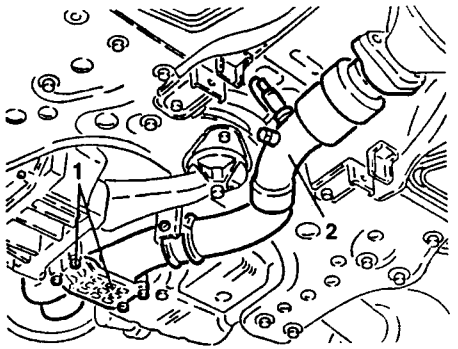
- Set the car on a lift.
- Disconnect the battery (-) terminal.
1. Disconnect the lambda sensor electrical connections.



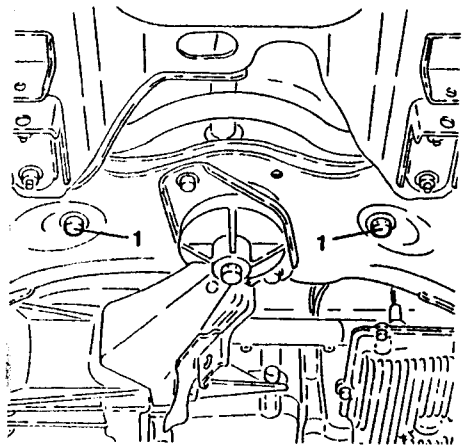
- Raise the car.
- Remove the right front wheel and mud flaps.
1. Working as shown on the guide pulley, slacken the tension of the auxiliary components drive pulley and remove it.



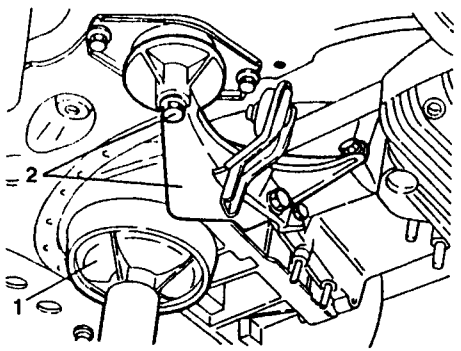
1. Slacken the fastening screws and remove the reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with lambda probe after slackening their fastenings.



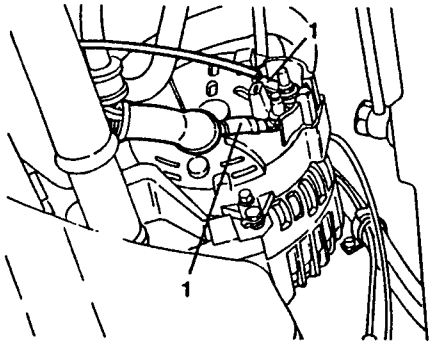
1. Slacken the screws fastening the power steering box to the suspension crossmember.



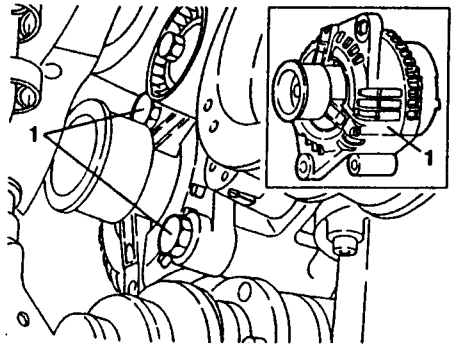
1. Set a hydraulic jack under the gearbox as illustrated.
2. Slacken the fastening screws and remove the rear power unit support.



1. Disconnect the electrical connections from the alternator.



1. Slacken the two fastening bolts and remove the alternator retrieving it from under the car pulling it out of the opening obtained by removing the power unit rear support.



TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

BATTERY

Nominal voltage	12 V
Capacity	45 A/h 50 A/h with air conditioner

ALTERNATOR

Nominal voltage	14 V
Nominal current	100 A
Maximum continous speed	18000 rpm
Inductor winding resistance (measured between collector rings at 20 °C)	2.6 Ω ± 5%

STARTER MOTOR

			1870	1598 1747
Nominal voltage		(V)	12	12
Nominal power rating		(kW)	1.4	1.4
Test under load	Voltage	(V)	Not available at time of going to press	7 ± 0.1
	Absorption	(A)		325
	Revolutions	(rpm)		1020
	Torque	(Nm)		> 10.7
Loadless test	Voltage	(V)		12 ± 0.1
	Absorption	(A)		< 90
	Revolutions	(rpm)		> 4500
Short circuit test	Voltage	(V)		4 ± 0.1
	Absorption	(A)		< 750
	Torque	(Nm)		> 21.5

IGNITION COILS

Primary winding resistance	0.3 Ω ± 12%
Secondary winding resistance	7 k Ω ± 12%

TIGHTENING TORQUES

PART	Nm	kgm
Centre spark plugs (large - M14)	25 ÷ 35	2.6 ÷ 3.6
Side spark plugs (small - M10)	10 ÷ 12	1 ÷ 1.2

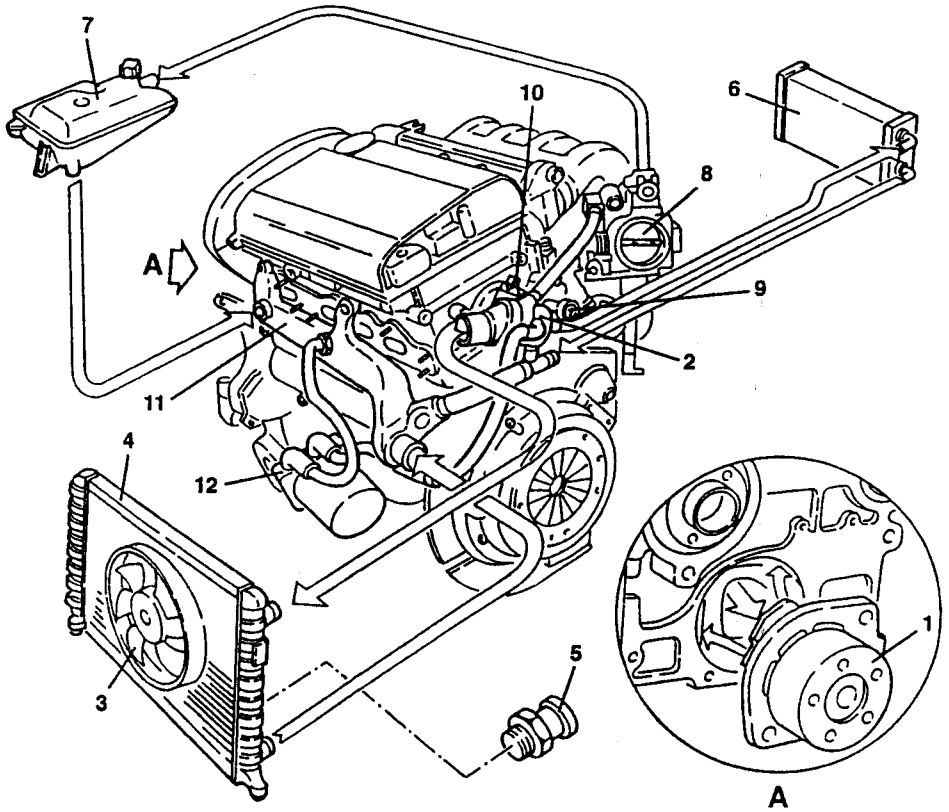
GROUP 07

ENGINE COOLING SYSTEM

INDEX

ILLUSTRATED INDEX

ENGINE COOLING SYSTEM



1. *Water pump*
2. *Thermostatic cup*
3. *Cooling fans*
4. *Radiator*
5. *Fan control thermal contact (Specific for 1970 '95 versions)*
6. *Climate control unit heater*
7. *Expansion tank*
8. *Throttle body*
9. *Coolant temperature gauge sender and maximum temperature warning light contact*
10. *Coolant temperature sensor (NTC)*
11. *Longitudinal manifold*
12. *Coolant - engine oil heat exchanger*

DESCRIPTION

The cooling system is of the sealed type with forced circulation by a centrifugal pump (1) located on the cylinder head and operated by the timing gear belt.
A thermostatic valve (2), fitted on the rear of the engine keeps the engine temperature at an optimum level; it opens when the coolant reaches a temperature of 83 °C.
The radiator (4) cools the engine fluid by the dynamic air and also by a fan (3) which is turned on:
- for the "95 Versions" (M2.10.3 injection-ignition system) by a thermal contact (5) on the radiator;
- for the "96 Versions" (M2.10.4 injection-ignition system) directly by the MOTRONIC control unit, depending on the signal received from the engine coolant temperature sensor (NTC).

(For further details about how the fan works, see ELECTRIC- ELECTRONIC DIAGNOSIS - Sect. 26 for versions with air conditioner and Sect. 28 for versions without air conditioner).
The expansion tank (7) tops up the circuit if the level falls and absorbs the changes in the volume of the coolant due to changes in temperature: it also vents air from the circuit.
The circuit is fitted with a coolant fluid temperature sender for the max. temperature gauge and thermal contact (9) for the warning light.

OPERATION OF THE CIRCUIT

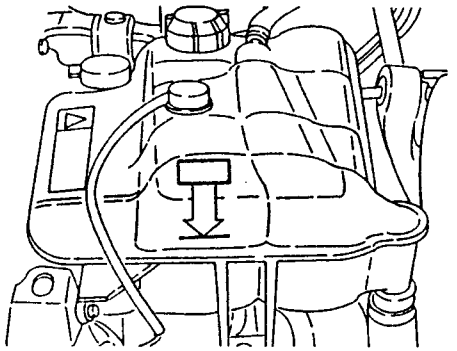
After the fluid has cooled the engine, it leaves the cylinder head and reaches the thermostatic unit (92).
From here, if the temperature is below 83 °C, it is drawn into the pump (1) through a longitudinal coolant return manifold located on the left-hand side of the cylinder head.
Conversely, if the temperature exceeds this value, the fluid is directed to the radiator (4) through the opening of the thermostat.
After being cooled in the radiator, the fluid returns, still through the longitudinal manifold, to the pump which directs it to the engine.
From the thermostatic cup the fluid is also sent to:
- heat the throttle body (8) from which it flows to the expansion tank (7) also venting air from the system;
- the climate control system heater (6) from which it returns to the longitudinal manifold;
- the heat exchanger (12) for cooling the engine oil before being ducted directly into the longitudinal manifold through which it returns to the pump.

The expansion tank supplies the engine cooling system via a special pipe connected with the longitudinal manifold.

CHECKING THE LEVEL AND CHANGING THE ENGINE COOLANT FLUID

Checking

- With the engine cold, visually check that the level of the coolant reaches the notch indicated by the arrow on the header tank, otherwise fill the system with the specified fluid.



Draining and replenishing

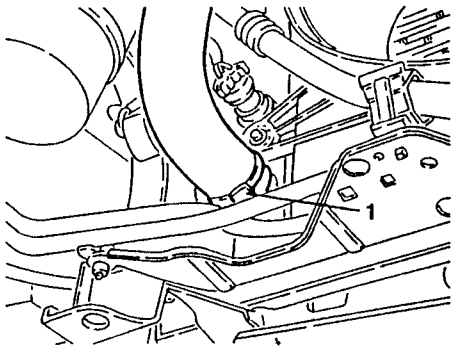
- Set the car on a lift.
- Slacken and remove the header tank plug.

WARNING:
Absolutely never remove the header tank plug when the engine is hot!

- Raise the car.

1. Slacken the radiator outlet hose and drain the coolant into a suitable recipient.

WARNING:
The anti-freeze mixture used as coolant can harm the paintwork: therefore avoid any contact with painted components.

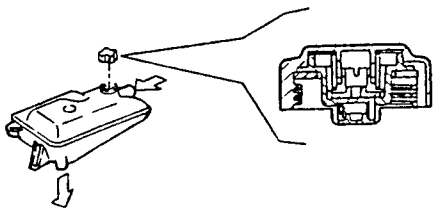


- Reconnect the sleeve to the radiator and any disconnected pipes, checking that all the clamps are firmly tightened.
- Fill the header tank to the MAX mark with fluid of the specified type and quantity.
- Start the engine and bring it to normal operating temperature so that the thermostat opens to release the amount of residual air in the circuit.
- With the engine cold, top up to the MAX mark on the header tank.
- Retighten the pressurised cap on the header tank.

WARNING:
It is unwise to mix anti-freeze fluids of different types or brands!
Never use antirust additives: they might not be compatible with the anti-freeze in use!

EXPANSION TANK

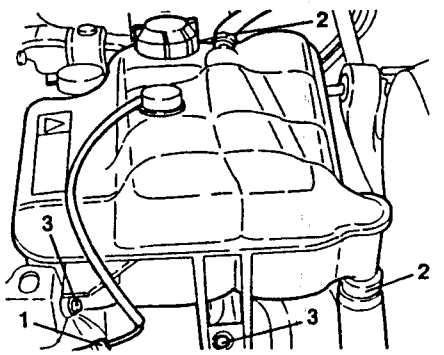
The expansion tank supplies the circuit and absorbs the variations in coolant volume due to the changes in engine temperature.
The tank also allows air, collected through the pipe coming from the throttle body, to bleed from the system by way of a calibrated valve in the pressurized cap.
This valve also acts as a washing function enabling outside air to enter the system to compensate for the vacuum created as the system cools.



REMOVAL/REFITTING

- Drain the engine cooling system (see relative paragraph).

1. Disconnect the electrical connection of the engine coolant fluid minimum level warning light sensor.
2. Loosen the two clamps and disconnect the coolant delivery and return hoses from the expansion tank.
3. Unscrew the three screws and remove the expansion tank.

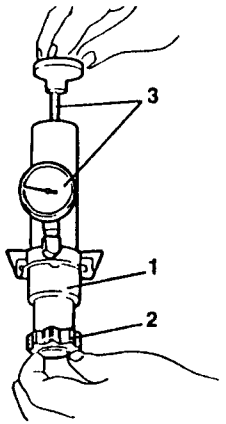


PRESSURIZED CAP SEALING TEST

- Perform the test using a seal test tool.

1. Screw the fitting to the lower end of the test tool.
2. Install the expansion tank pressurized cap onto the fitting of the test tool.
3. Manually operate the piston of the test tool and pressurize the cap. Check that the valve opens at the specified pressure read from the manometer.

Pressurized cap setting
0.98 ± 0.1 bar



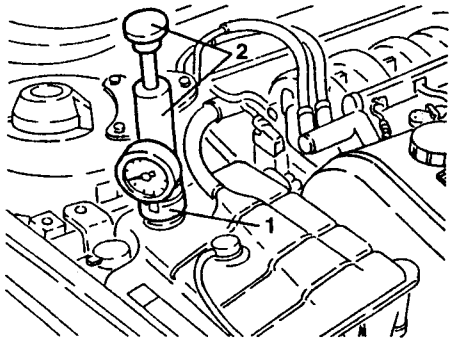
HYDRAULIC SYSTEM PROOF TEST

- Unscrew and remove the pressurized cap from the expansion tank.

1. Screw the hydraulic system proof testing tool and relevant fitting onto the expansion tank filler neck.
2. Manually pressurize the circuit and check that the pressure is maintained at the specified value. If the pressure is incorrect, check that there are no leaks in the radiator or sleeves.

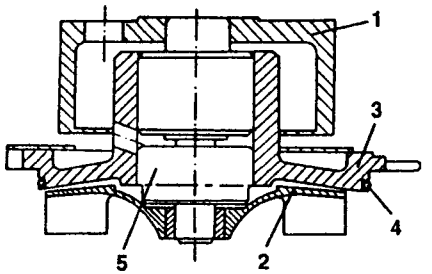
Hydraulic system test pressure
1.08 bar

CAUTION:
For safety reasons never let the pressure rise above 1.38 bar when testing with the testing tool.



WATER PUMP

The water pump is of the centrifugal type with blades. It is fastened to the cylinder head and operated by the crankshaft via the timing gear belt. An O-Ring ensures tightness between the cylinder head and the pump. The water pump is kept running constantly to ensure that the coolant fluid circulates continuously.

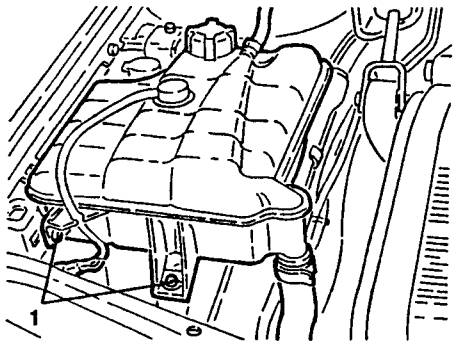


1. Pulley
2. Impeller
3. Pump casing
4. O-Ring
5. Bearing

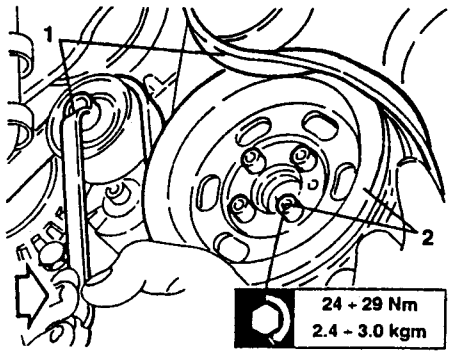
REMOVAL/REFITTING (For engines with counter-rotating shafts)

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the engine cooling system (see relative paragraph).

1. Slacken the screws and move the header tank to one side without disconnecting the piping.

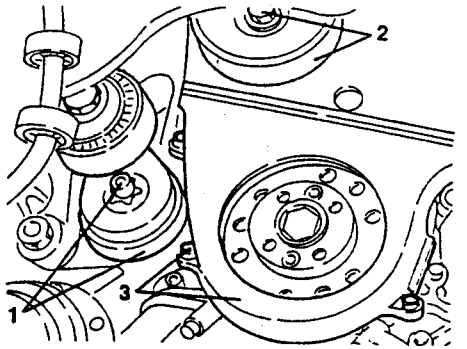


1. Raise the car and working as illustrated on the belt tensioner loosen the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxliary components drive pulley.



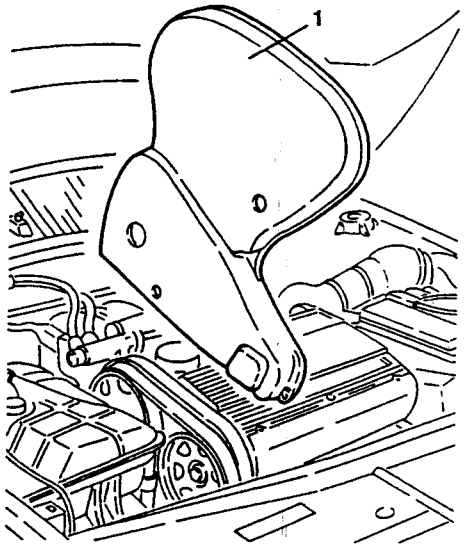
1. Slacken the fastening screw and remove the belt tensioner.
2. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.

3. Slacken the fastening screws and remove the lower cover of the timing gear and counter-rotating shaft drive belts.

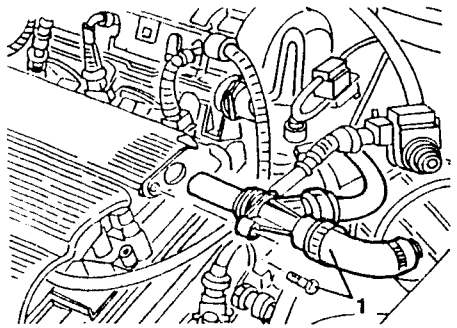


- Slacken the lower screws of the upper cover of the timing gear and counter-rotating shaft drive belts.

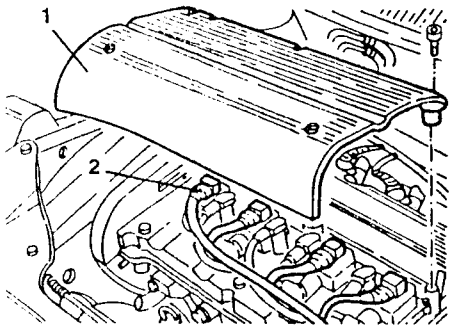
1. Lower the car, slacken the fastening screws and remove the upper cover.



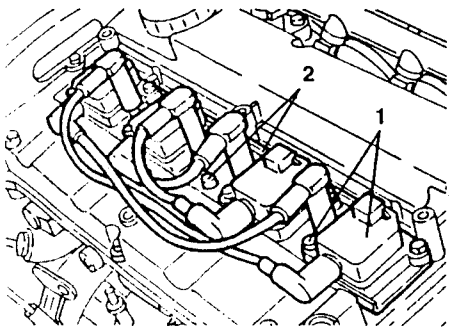
1. Slacken the fastening screw and remove the socket for the oil vapour recovery pipe.



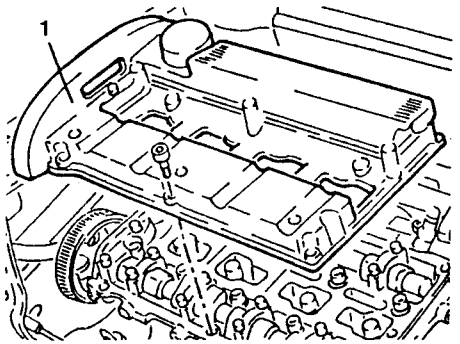
1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



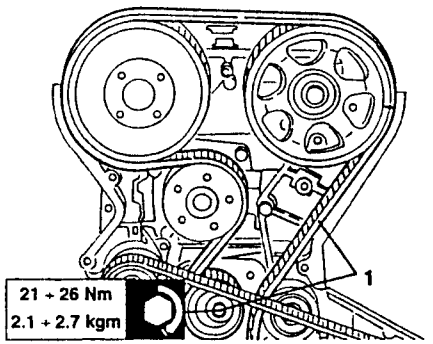
1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



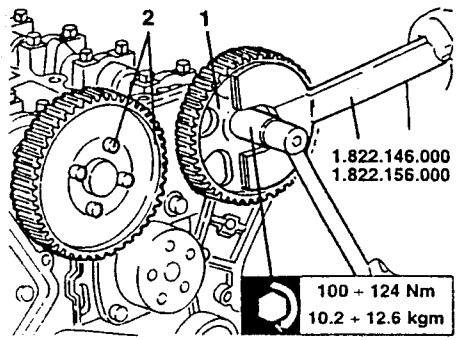
1. Slacken the fastening screws and remove the cylinder head cover complete with gasket.



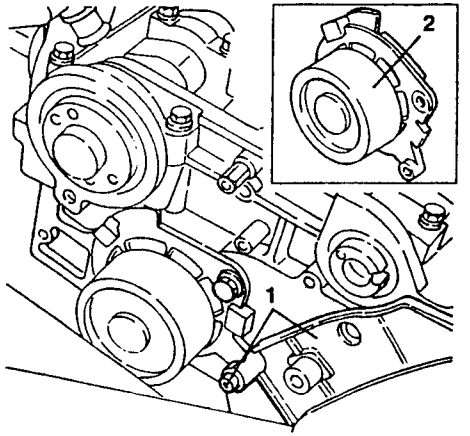
1. Working on the timing gear belt tensioner, loosen the tension on the belt, then take it off the timing gear drive pulleys.



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



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



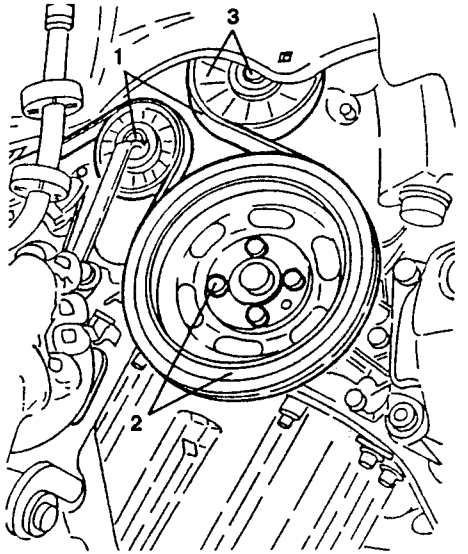
- Refit reversing the sequence followed for removal.

For refitting the timing gear drive belt and timing and for assembly of the auxiliary components drive belt see GROUP 00.

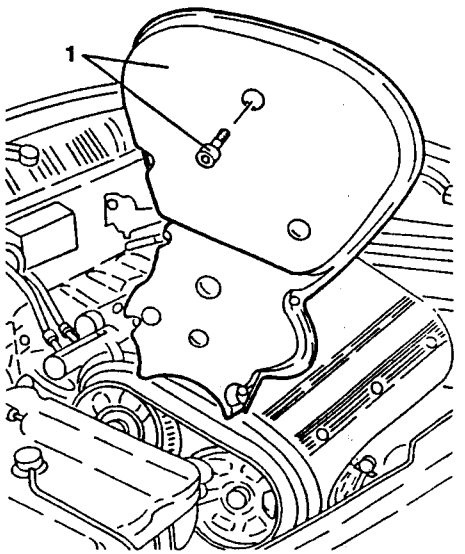
REMOVAL/REFITTING (For engines without counter-rotating shafts)

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the engine cooling system (see relative paragraph).
- Slacken the screws and move the header tank to one side without disconnecting the piping.
1. Raise the car and working as illustrated on the belt tensioner loosen the tension of the auxiliary components drive belt and remove it.
2. Slacken the four fastening screws and remove the auxiliary components drive pulley.

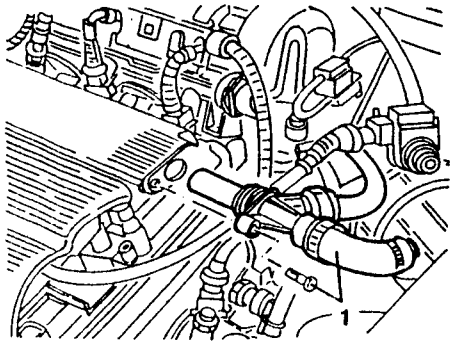
3. Slacken the fastening screw and remove the auxiliary components drive belt guide pulley.



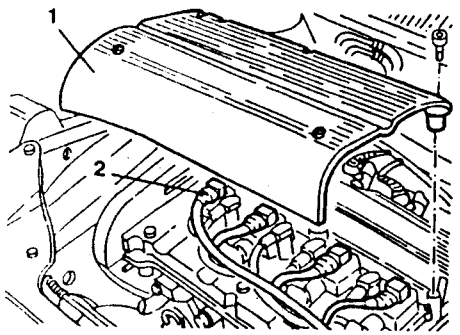
- Slacken the lower screws of the cover of the timing gear drive belt.
1. Lower the car, slacken the fastening screws and remove the cover of the timing gear drive belt.



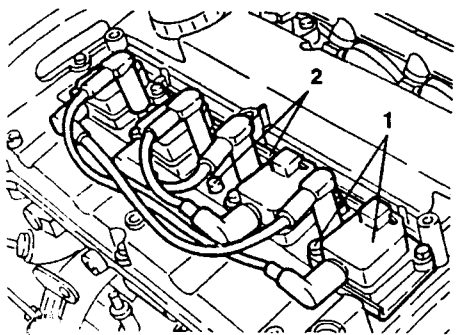
1. Slacken the fastening screw and remove the socket for the oil vapour recovery pipe.



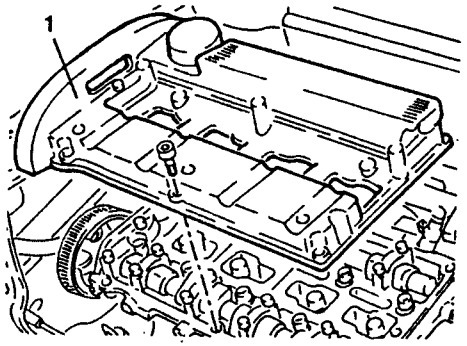
1. Slacken the fastening screws and remove the ignition coils cover.
2. Disconnect the electrical connections from the ignition coils.



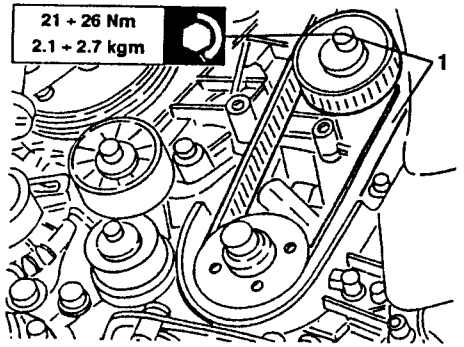
1. Slacken the fastening screws and remove the ignition coils.
2. Slacken the fastening screws and remove the ignition coils support bracket.



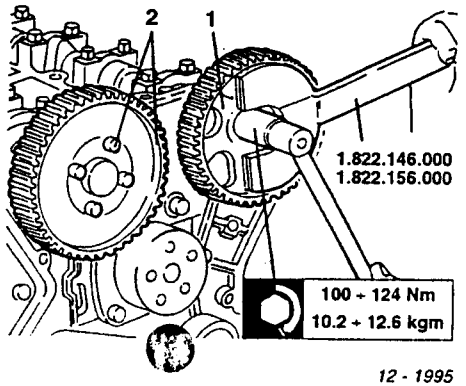
1. Slacken the fastening screws and remove the cylinde head cover complete with gasket.



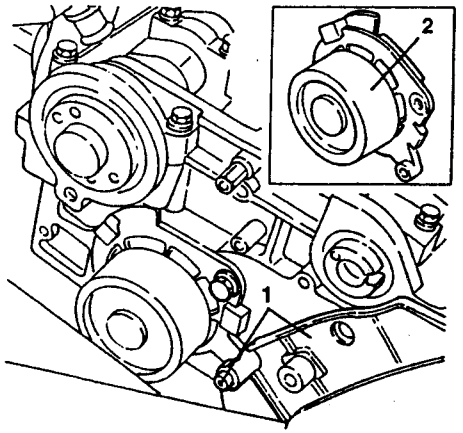
1. Working on the timing gear belt tensioner, loosen the tension on the belt, then take it off the timing gear drive pulleys.



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



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



- Refit reversing the sequence followed for removal.

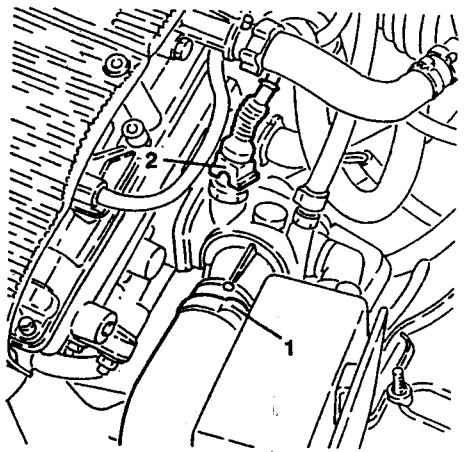
For refitting the timing gear drive belt and timing and for assembly of the auxiliary components drive belt see GROUP 00.

THERMOSTAT UNIT

The thermostat unit is fitted on the rear end of the cylinder head.
Its purpose is to prevent the engine from exceeding the optimum temperature: until the coolant temperature reaches 83 °C, the thermostatic valve diverts the coolant fluid towards the pump; at higher temperatures, the opening of the thermostatic valve enables the passage of the fluid towards the radiator.
On the thermostat unit there is a sensor (NTC) for detecting the coolant temperature to be sent to the control unit.

REMOVING/REFITTING

- Remove the battery.
1. Drain the engine coolant fluid disconnecting the radiator delivery sleeve from the thermostatic cup.
2. Disconnect the electrical connection from the engine coolant temperature sensor (NTC).



1. Disconnect all the pipes connected to the thermostat unit.
2. Slacken the fastening screws and remove the thermostat unit.

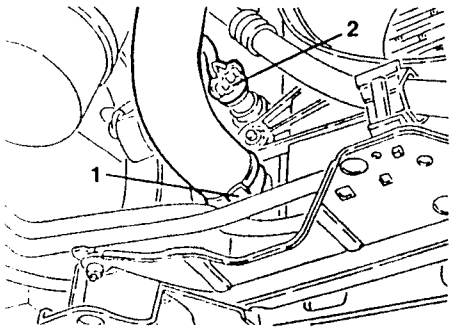
RADIATOR

The radiator is sized to meet the heat dispersal requirements when the engine is running.
It comprises a radiant mass and two side reservoirs fitted with inlet and outlet unions for the coolant fluid; the pipes and radiant mass fins are in aluminium, the reservoirs are in plastic.

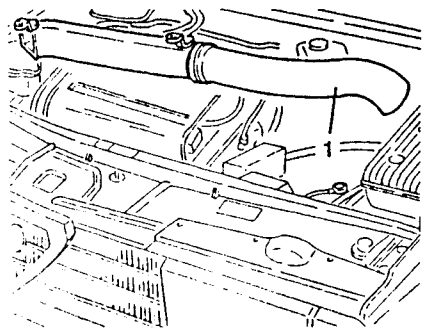
REMOVING/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
- Drain the coolant fluid from the air conditioning system (see specific paragraph).

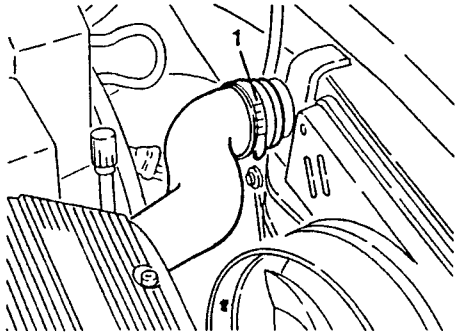
1 Raise the car and drain the engine coolant fluid disconnecting the radiator outlet sleeve.
2. Disconnect the electrical connection from the solenoid valve control thermal contact (1970 '95 versions).



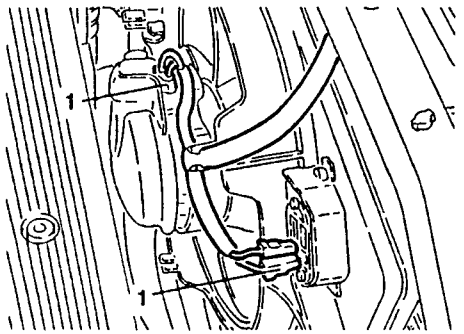
1. Slacken the fastening screws and remove the air inlet pipe from the crossmember.



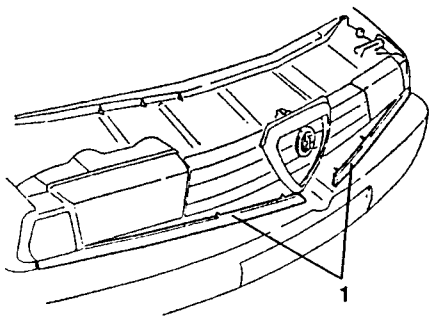
1. From the radiator disconnect the coolant sleeve leading from the thermostatic cup.



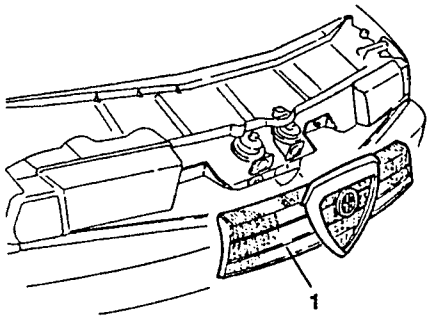
1. Disconnect the electrical connections from the cooling fan.



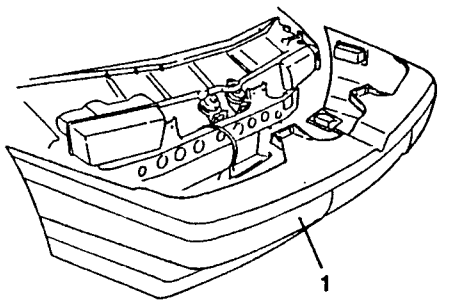
1. Centrally detach the two grille trim profiles.



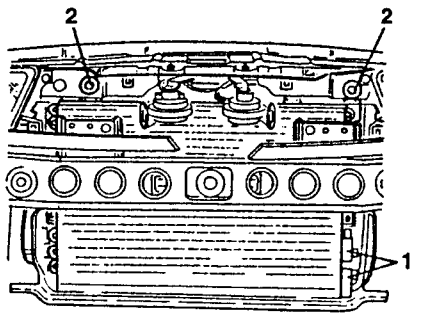
1. Remove the grille (see specific paragraph).



1. Remove the front bumper (see specific paragraph).

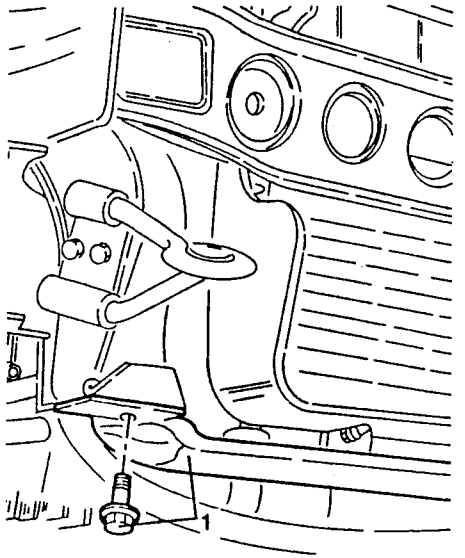


1. Raise the car and disconnect the two coolant inlet and outlet pipes from the conditioner condenser.
2. Slacken the two upper radiator fastening screws.

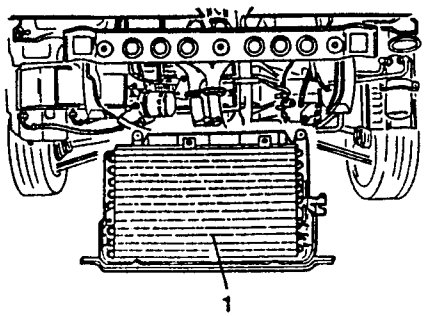


- Release the power steering pipes from the fastenings on the lower radiator crossmember.

1. Remove the two screws fastening the lower radiator crossmember to the body.

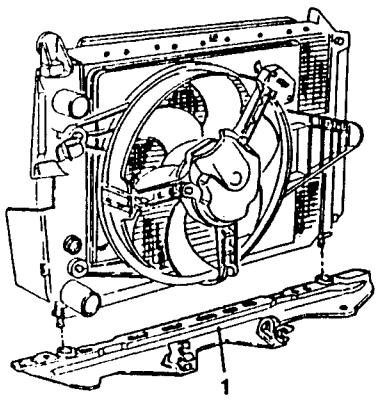


1. Remove the radiator, condenser, fan and lower radiator crossmember assebly withdrawing from below.

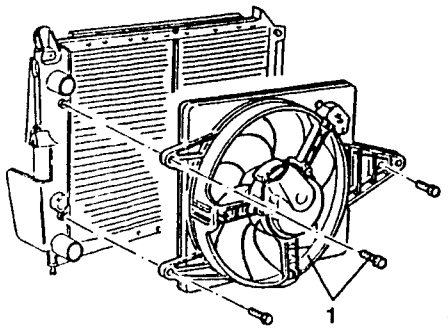


DIS-ASSEMBLY

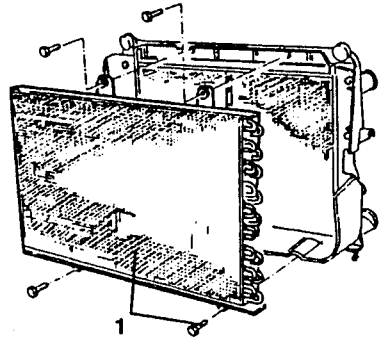
1. Remove the lower crossmember from the radiator.



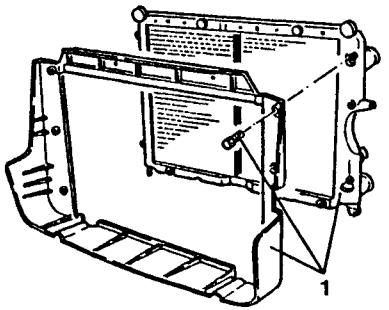
1. Slacken the three fastening screws, then remove the complete fan.



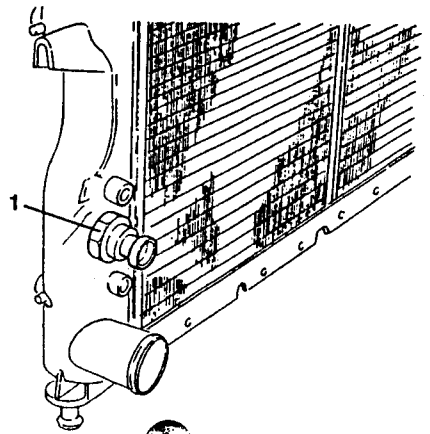
1. Slacken the four fastening screws, then remove the iconditioner condenser.



1. Slacken the six fastening screws and separate the air duct from the radiator.



1. Remove the fan control thermal contact from the radiator (1970 '95 versions).

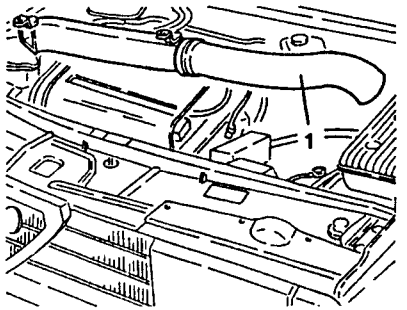


COOLING FAN

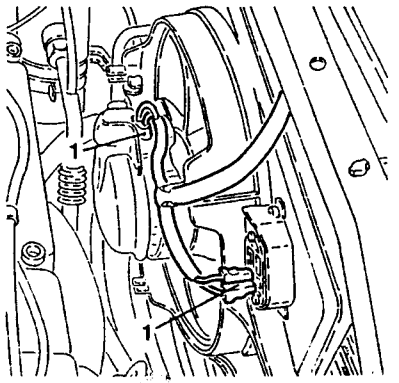
The cooling fan makes it possible to increase the heat dispersion capacity of the radiator.
The fan is turned on by:
- for the "'95 Versions" (M2.10.3 injection-ignition system) by a thermal contact on the radiator;
- for the "'96 Versions" (M2.10.4 injection-ignition system) directly by the MOTRONIC control unit, depending on the signal received from the engine coolant temperature sensor (NTC).
(For further details about how the fan works, see ELECTRIC- ELECTRONIC DIAGNOSIS - Sect. 26 for versions with air conditioner and Sect. 28 for versions without air conditioner).

REMOVING/REFITTING

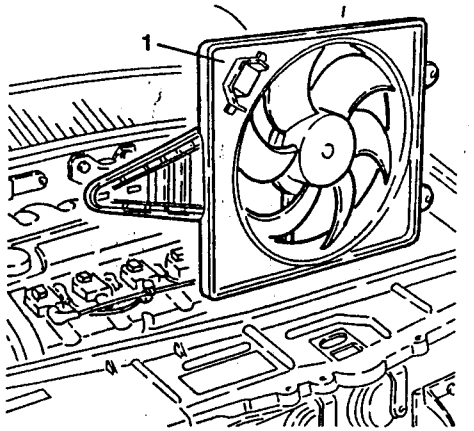
- Disconnect the battery (-) terminal.
1. Slacken the fastening screws and remove the air intake pipe from the crossmember.



1. Disconnect the electrical connections from the cooling fan.

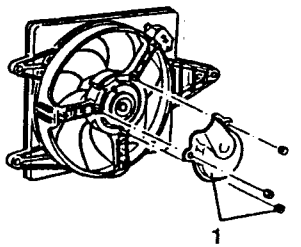


1. Slacken the fastening screws and remove the cooling fan.

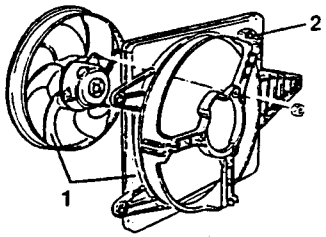


DIS-ASSEMBLY

1. Slacken the three fastening nuts and remove the heat shield.



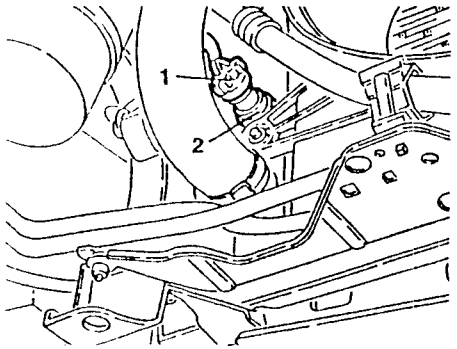
1. Slacken the three fastening nuts, then separate the fan from the duct.
2. Remove the additional resistance slackening the two fastening screws.



FAN CONTROL THERMAL CONTACT (Specific for 1970 '95 versions)

REMOVING/REFITTING

- Set the car on a lift.
- Disconnect the battery (-) terminal.
1. Raise the car and disconnect the electrical connection of the fan control thermal contact.
2. Slacken and remove the fan control thermal contact and recover the coolant fluid that comes out.



CHECKS AND INSPECTIONS

Check the setting of the thermal contact referring to the wiring diagram (see "Electric System Diagnosis").

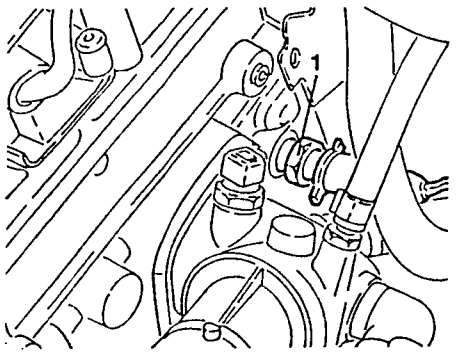
Cut-in/cut-out temperatures of cooling fan		
1st speed	Cut-in (contacts closed)	92 ± 2°C
	Cut-out (contacts open)	87 ± 2°C
2nd speed	Cut-in (contacts closed)	97 ± 2°C
	Cut-out (contacts open)	92 ± 2°C

- Change the thermal contact if the values are not correct

COOLANT TEMPERATURE GAUGE TRANSMITTER AND MAXIMUM TEMPERATURE WARNING LIGHT CONTACT

REMOVING/REFITTING

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



CHECKS AND INSPECTIONS

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

Temperature (°C)	Resistance (Ω)	
	1970	1598 1747
60 (test fluid water)	525 ÷ 605	470 ÷ 600
90 (test fluid water)	195 ÷ 245	160 ÷ 230
120 (test fluid glicerine)	82 ÷ 94	73 ÷ 93

	1970	1598 1747
Contact closing temperature	122 ± 2°C	120 ± 2°C
Contact opening temperature	112 ± 3°C	108 ± 2°C

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

COOLING SYSTEM

Pressurised plug setting pressure	0.98 ± 0.1 bar
Hydraulic circuit control pressure	1.08 bar

THERMOSTAT

Start of opening temperature	83° ± 2°C
Valve stroke at 100° ± 2°C	7.5 mm

COOLING FAN THERMAL CONTACT (Specific for 1970 '95 versions)

	Fan cut-in/cut-out temperature	
1st speed	Cut-in (contacts closed)	92 ± 2°C
	Cut-out (contacts open)	87 ± 2°C
2nd speed	Cut-in (contacts closed)	97 ± 2°C
	Cut-out (contacts open)	92 ± 2°C

COOLANT TEMPERATURE GAUGE TRANSMITTER AND MAX. TEMPERATURE WARNING LIGHT CONTACT

Temperature (°C)	Resistance (Ω)	
	1970	1598 1747
60 (test fluid water)	525 ÷ 605	470 ÷ 600
90 (test fluid water)	195 ÷ 245	160 ÷ 230
120 (test fluid glycerine)	82 ÷ 94	73 ÷ 93

	1970	1598 1747
Contact closing temperature	122° ± 2°C	120° ± 2°C
Contact opening temperature	112° ± 3°C	108° ± 2°C

TIGHTENING TORQUES

Part	Nm	kgm
Auxiliary components drive belt pulley fastening screws	24 ÷ 29	2.4 ÷ 3.0
Timing gear belt fastening nut	21 ÷ 26	2.1 ÷ 2.7
Exhaust side timing gear belt drive pulley fastening screws	100 ÷ 124	10.2 ÷ 12.6

155
T.SPARK 16V

REPAIR MANUAL

● MECHANICAL UNITS

GROUP 12

CLUTCH

INDEX

For all the parts not mentioned herein, see the corresponding Group of the manual "155 - INSTRUCTIONS FOR REPAIR" - PA465500000000 - (pages with publication no. PA4655C1000000)

CLUTCH

DESCRIPTION

The clutch adopted is single-plate, dry with diaphragm pressure plate springs.

The clutch is disengaged by a hydraulic device comprising a reservoir (1) shared with the braking system, a pump (2) fastened to the pedal unit, a control cylinder (3) fastened to the gearbox cover and a thrust bearing (4).

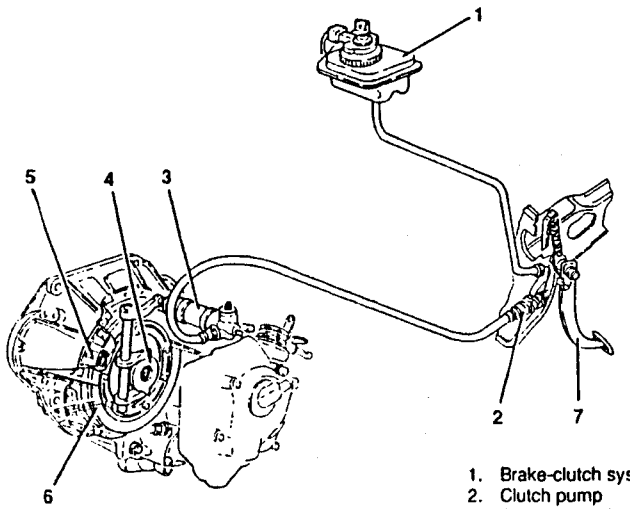
The pump, operated by the pedal, transmits the fluid pressure increase to the control cylinder piston through the special pipe.

Through a prod, the piston acts on the lever and transmits the control to the fork which moves the thrust bearing overcoming the action of the diaphragm pressure plate springs.

In addition to reducing the effort required on the pedal, the adoption of the hydraulic clutch release device makes it possible to obtain:

- increased reliability in relation to the conventional, mechanical solution.
- improved smoothness due to the damping of the hydraulic system during disengagement which avoids jerking, particularly when the transmitted torque is high.
- greater operating precision as this device permits constant adjustment of the height of the clutch pedal.
- increased driving comfort as a result of the reduction of the level of vibrations transmitted from the engine, due to the damping effect of the oil.

In order to meet the current laws concerning environmental pollution problems, ecological material (asbestos free) material has been used for the friction linings.



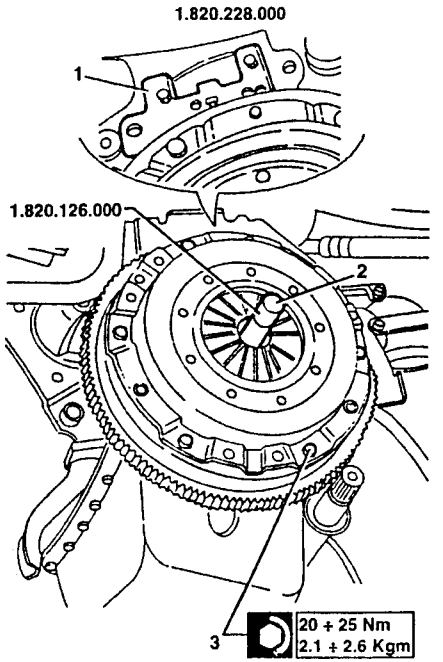
1. Brake-clutch system reservoir
2. Clutch pump
3. Clutch control cylinder
4. Thrust bearing
5. Clutch plate
6. Pressure plate
7. Clutch pedal

UTCH UNIT

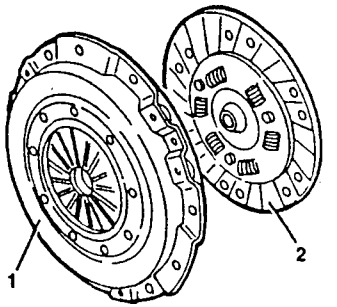
REMOVING/REFITTING

- Remove the gearbox-differential unit (see GROUP 13).
- When changing only the clutch plate, mark its position between the pressure plate and flywheel to simplify re-assembly operations.

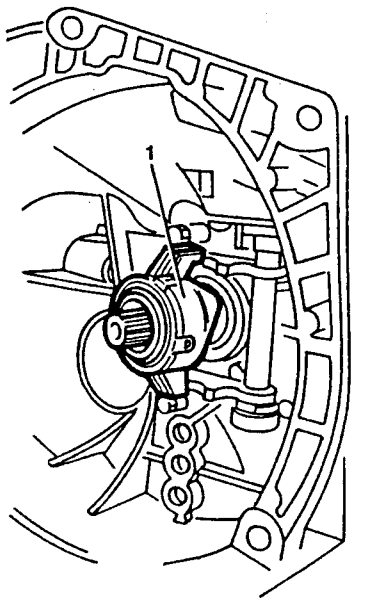
1. Install the flywheel stopper tool no. 1.820.228.000.
2. Install tool no. 1.820.126.000 in the clutch plate hub.
3. Slacken the screws fastening the pressure plate to the flywheel.



1. Remove the pressure plate.
2. Remove the clutch plate.



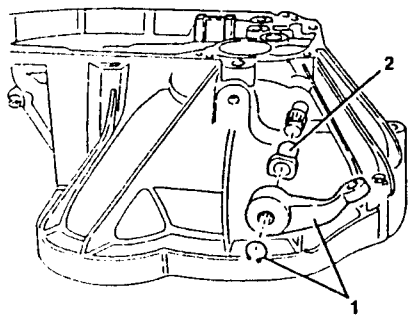
1. Withdraw the thrust bearing from its sleeve in the gearbox cover.



When refitting the bearing it must not stick or turn noisily, otherwise it must be replaced.

- Only if necessary:

1. Remove the seeger lockring and withdraw the clutch engagement control lever.
2. Prise and remove the antislip bush from the gearbox cover.
3. Working from inside the gearbox cover withdraw the clutch engagement sleeve control fork and pin.
4. Slacken the screws fastening the thrust bearing sleev and remove it.



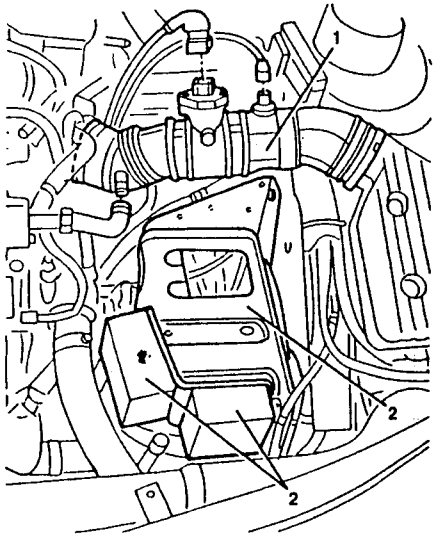
When refitting install a new antislip bush if the pin has too much play.
When refitting, grease the bushes and sleeve with the specified product. The sleeve complete with splash guard must be replaced each time oil leaks are found.

CLUTCH CONTROL CYLINDER

REMOVING / REFITTING

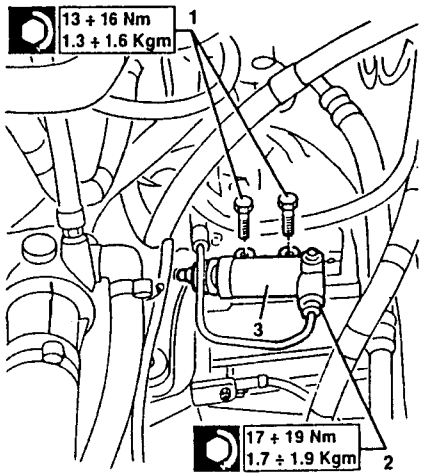
- Remove the battery after disconnecting the terminals.

1. Remove the corrugated air intake pipe between the cleaner and the throttle, after disconnecting it from the air-flow meter.
2. Remove the battery tray after separating the two injection relay support brackets.



- Empty the brake-clutch fluid reservoir using a suitable syringe.

1. Slacken the two screws fastening the clutch control cylinder
2. Disconnect the pump hose fitting from the clutch control cylinder.
3. Remove the clutch control cylinder.



TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

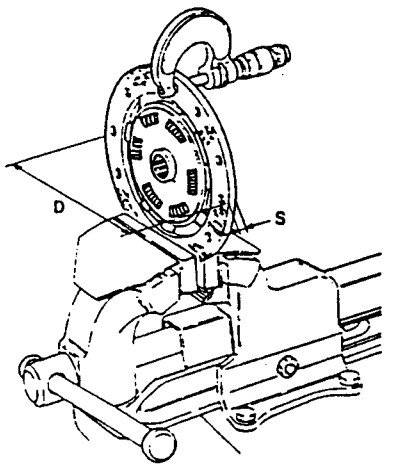
GENERAL SPECIFICATIONS

FLUIDS AND LUBRICANTS

APPLICATION	TYPE	NAME
Thrust bearing housing and clutch control lever shaft Clutch control cylinder prod	GREASE	TUTELA MR3
Lubrication of pump inner components and hydraulic system filling	FLUID Class: DOT 4 SAE J 1703 F	ALFA ROMEO BRAKE FLUID SUPER DOT 4

CHECKS AND ADJUSTMENTS

CLUTCH PLATE



Clutch plate thickness	New	7.1 ÷ 7.7 mm
	At wear limit	6.3 mm
Clutch plate diameter		228.5 mm

TIGHTENING TORQUES

Part	Nm	kgm
Screws fastening pressure plate to flywheel	20 ÷ 25	2.1 ÷ 2.6
Screws fastening clutch control cylinder to gearbox cover	13 ÷ 16	1.3 ÷ 1.6
Nuts fastening clutch pump to pedal unit	13 ÷ 21	1.3 ÷ 2.1
Clutch circuit pipe fitting on pump	17 ÷ 19	1.7 ÷ 1.9
Clutch circuit pipe fitting on control cylinder	17 ÷ 19	1.7 ÷ 1.9
Thrust plate bearing sleeve fastening screws	7 ÷ 9	0.7 ÷ 0.9

SPECIAL TOOLING

TOOL NUMBER	DESCRIPTION
1.820.126.000	Tool for centering clutch plate
1.820.228.000	Flywheel stopper tool

GROUP 13

GEARBOX - DIFFERENTIAL

INDEX

For all the parts not mentioned herein, see the corresponding Group of the manual "155 - INSTRUCTIONS FOR REPAIR" - PA465500000000 - (pages with publication no. PA4655C1000000)

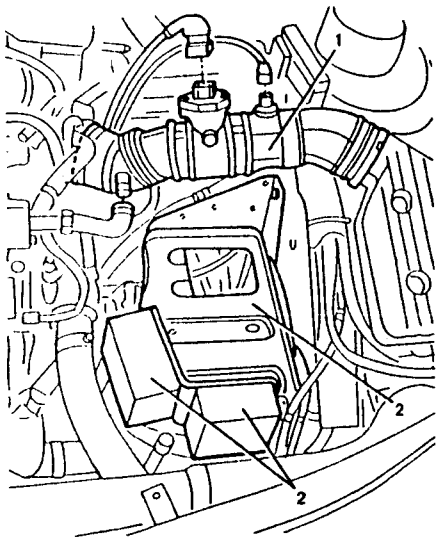
(•) See publication PA494200000000. "Instructions for Repair - OVERHAULING OF MECHANICAL UNITS" referring to overhauling of Gearbox C.510.5.XX.YY.

GEARBOX UNIT

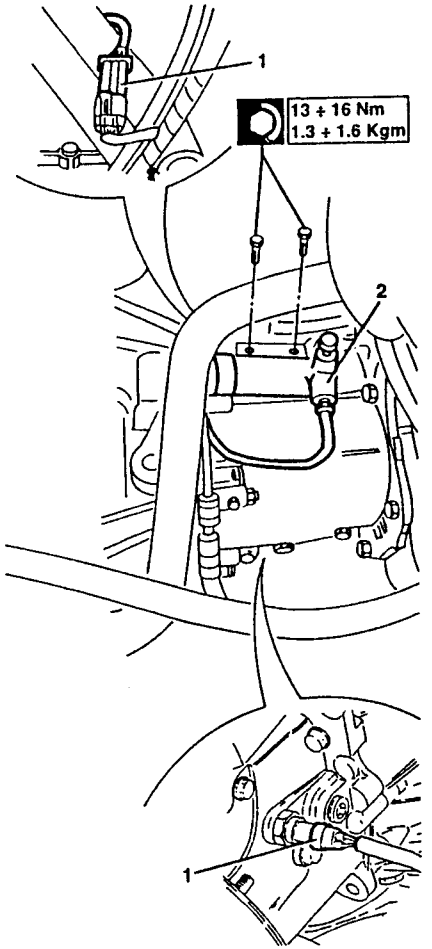
REMOVAL AND REFITTING

- Set the car on a lift.
- Remove the front wheels with gravel guards.
- Remove the battery after disconnecting the terminals.

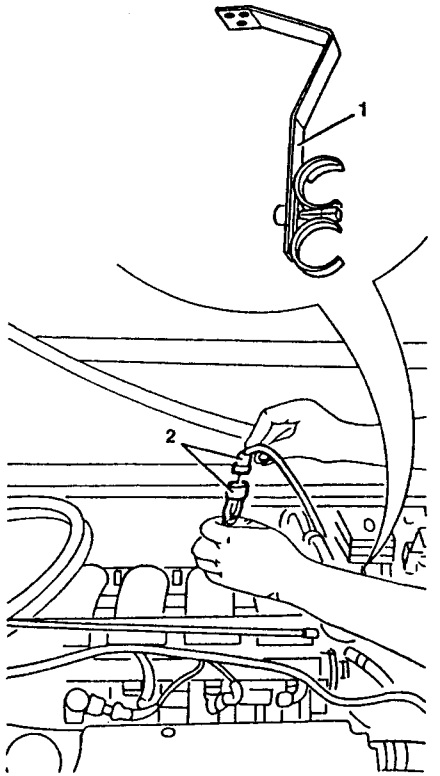
1. Remove the corrugated intake pipe between the cleaner and throttle, after disconnecting the air-flow meter.
2. Remove the battery tray after separating the two injection relay support brackets.



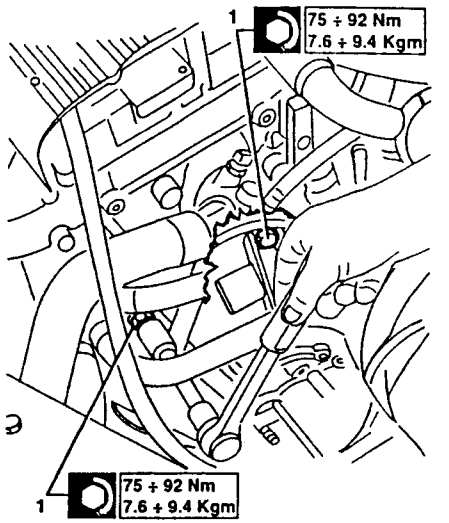
1. Disconnect the reversing switch and speedometer sensor connections from the gearbox.
2. Slacken the two screws and remove the clutch cylinder from the gearbox, moving it upwards: the cylinder remains restrained by the pipe leading from the clutch pump.



1. Remove the heater pipe fastening clamps from the throttle body.
2. After removing the cover, disconnect the lambda probe connection disconnecting it from its stay clamp.



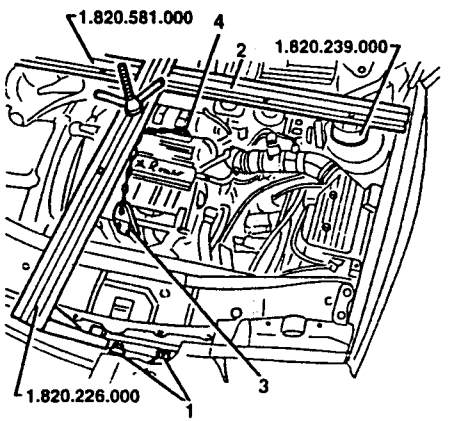
1. Slacken the two upper screws fastening the gearbox to the engine.



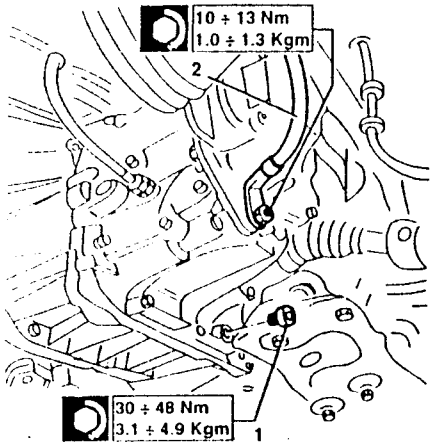
- Remove the front grille (Group 75).

1. Disconnect the horn fastening bracket.
2. Position engine support no.1.820.226.000, with supports 1. 820.239.000 and crossmember 1.820.581.000.
3. Place a support square on the front of the crankcase.
4. Place a support square on the rear of the crankcase, between two injectors.

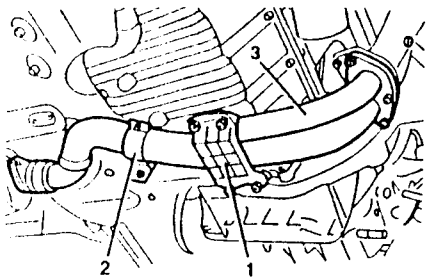
- Place a chain between the two squares and the support, hooking the engine to the support.



- Raise the car.
1. Slacken the plug and drain the gearbox-differential oil into a suitable recipient.
2. Disconnect the gearbox earth cable.

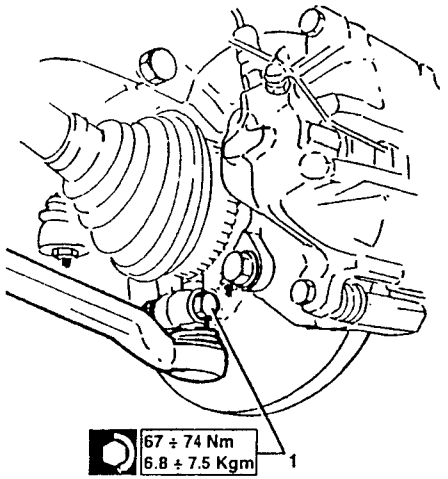


1. Remove the reinforcement under the exhaust pipe.
2. Disconnect the exhaust pipe fastening bracket.
3. Remove the exhaust pipe, front section.

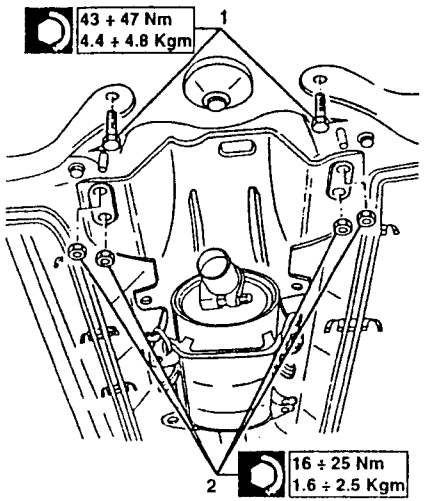


NOTE: carefully retrieve the lambda probe wiring to avoid tearing or damaging it.

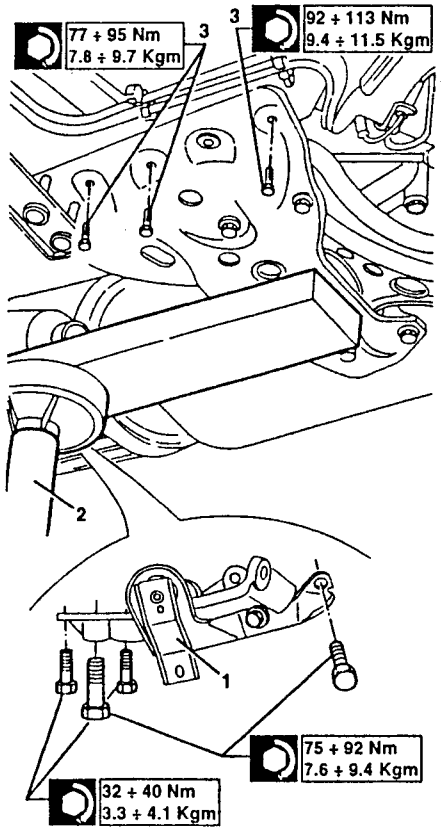
1. On both sides, slacken the two screws fastening the front crossmember to the wheel hub.



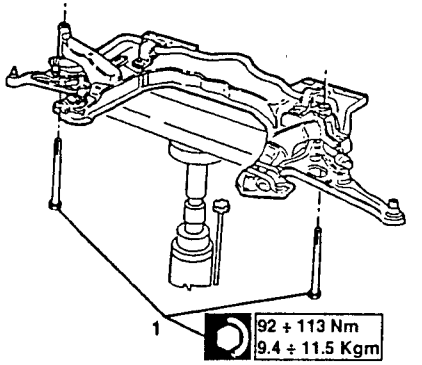
1. Slacken the two screws fastening the power steering to the front crossmember.
2. Slacken the four front nuts and loosen the other screws fastening the gearshift controls support, which needs to be lowered slightly to enable release from the front crossmember.



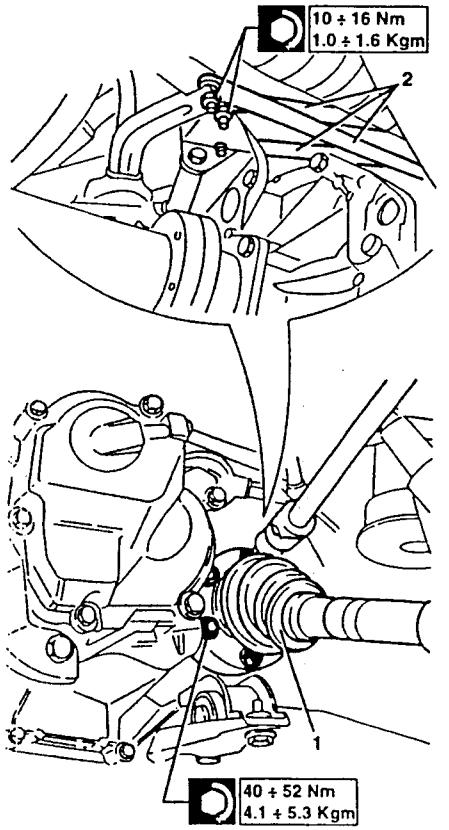
1. Remove the engine rear support.
2. Position a suitable hydraulic jack under the cross-member
3. Slacken the six rear screws fastening the cross-member to the body.



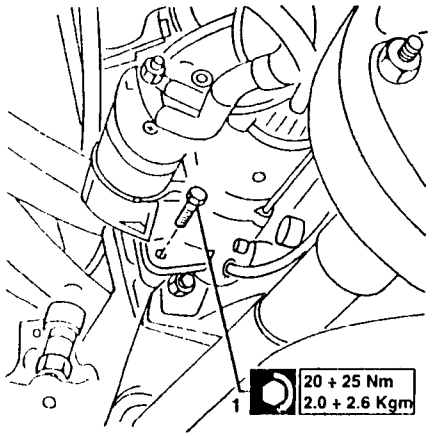
1. Slacken the two front screws fastening the cross-member to the body.
2. Lower the front crossmember and remove it.



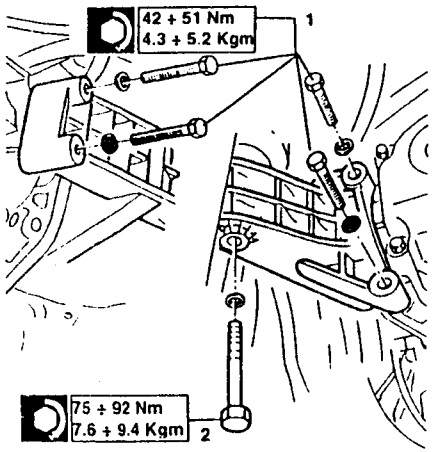
1. Slacken the six fastening bolts and disconnect the left C.V. joint of the differential axle shaft.
2. Disconnect the three gearshift control rods.



1. Slacken the three screws fastening the starter motor to the gearbox.



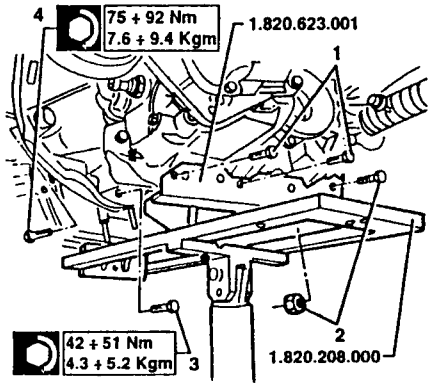
1. Slacken the fours screws fastening the rear gearbox support to the gearbox.
2. Slacken the bolt fastening the support to the body and remove it.



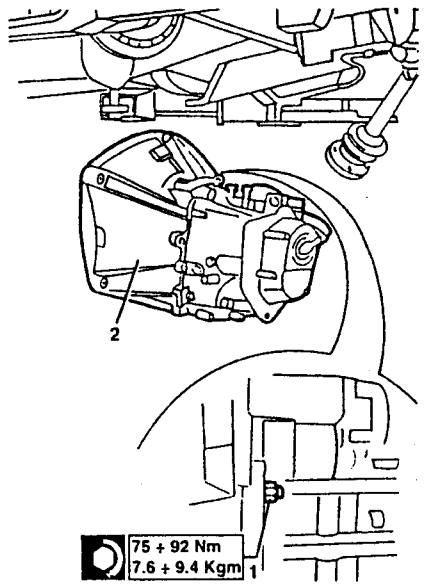
1. Slacken the two lower gearbox cover fastening screws and in their place insert bracket no. 1.820.623.001 with support no. 1.820.208.000.

NOTE: use screws slightly longer than those removed

2. Add a suitably-sized bolt in the hole on the right.
3. Slacken the two screws fastening the lower cover.
4. Slacken the bolt fastening the gearbox to the engine.



1. Slacken the nut fastening the gearbox to the engine.
2. Lower the gearbox disconnecting it from the engine.



TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

TECHNICAL CHARACTERISTICS

GEARBOX RATIO

Version	Axle ratio	Gear engaged	Gearbox ratio	Total ratio
167A2G	17/57 1 : 3.353	1^	1 : 3.545	1 : 11.886
		2^	1 : 2.238	1 : 7.504
		3^	1 : 1.520	1 : 5.096
		4^	1 : 1.156	1 : 3.876
		5^	1 : 0.946 1 : 0.970 (*)	1 : 3.172 1 : 3.254 (*)
		RM	1 : 3.909	1 : 13.107
167A4N 167A6A	17/57 1 : 3.353	1^	1 : 3.909	1 : 13.107
		2^	1 : 2.238	1 : 7.504
		3^	1 : 1.520	1 : 5.096
		4^	1 : 1.156	1 : 3.876
		5^	1 : 0.971	1 : 3.256
		RM	1 : 3.909	1 : 13.107
167A4P	20/63 1 : 3.150	1^	1 : 3.909	1 : 12.313
		2^	1 : 2.238	1 : 7.050
		3^	1 : 1.520	1 : 4.789
		4^	1 : 1.156	1 : 3.641
		5^	1 : 0.971	1 : 3.059
		RM	1 : 3.909	1 : 12.313
167A6	16/57 1 : 3.562	1^	1 : 3.909	1 : 13.924
		2^	1 : 2.238	1 : 7.972
		3^	1 : 1.520	1 : 5.414
		4^	1 : 1.156	1 : 4.118
		5^	1 : 0.970	1 : 3.455
		RM	1 : 3.909	1 : 13.924

(*): '96 Versions.

GENERAL SPECIFICATIONS

FLUIDS AND LUBRICANTS

APPLICATION	TYPE	NAME
Gearbox-differential unit oil	OIL	TUTELA ZC 80/S
Gear engagement control rod bushes and gearshift lever ball joint	GREASE	TUTELA ZETA 2 ISECO MOLIKOTE LONGTERM No. 2

CHECKS AND ADJUSTMENTS

DIFFERENZIAL

Bearing preload (relieved)	0.12 mm *
Sun - planetary gears backlash	≤ 0.10 mm

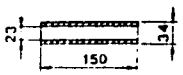
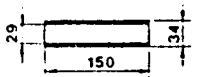
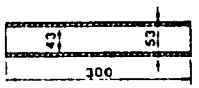
*** NOTE: The bearing preload adjustment is carried out using spare rings with a thickness of from 1.70 mm to 2.60 mm in steps of 0.05 mm.**

TIGHTENING TORQUES

Part	Nm	kgm
Screws and nuts fastening gearbox-engine	75 ÷ 92	7.6 ÷ 9.4
Screw fastening front engine support to body	75 ÷ 92	7.6 ÷ 9.4
Screws fastening lower gearbox cover	42 ÷ 51	4.3 ÷ 5.3
Screws fastening gearbox to front engine support	42 ÷ 51	4.3 ÷ 5.3
Screw fastening reversing shaft	29 ÷ 36	2.9 ÷ 3.6
Ring nut for main and transmission shaft for fastening 5th gear	100 ÷ 124	10 ÷ 13
Screw fastening gearshift control forks	15 ÷ 19	1.6 ÷ 1.9
Screw fastening lever on gearshift control shaft	20 ÷ 25	2.0 ÷ 2.5
Screw fastening support reverse control lever	9 ÷ 11	0.9 ÷ 1.1
Screw fastening bush for gearshift control shaft	9 ÷ 11	0.9 ÷ 1.1
Screw fastening differential crown wheel	75 ÷ 92	7.6 ÷ 9.4
Screw fastening differential retainer flange to gearbox	21 ÷ 26	2.2 ÷ 2.7
Screw fastening tachometer support	8 ÷ 13	0.8 ÷ 1.3
Magnetic threaded taper plug for filling gearbox oil	30 ÷ 48	3.1 ÷ 4.9
Threaded taper plug for filling gearbox oil	30 ÷ 48	3.1 ÷ 4.9
Screw fastening differential right-hand shaft support	7 ÷ 11	0.7 ÷ 1.1
Threaded taper plug for 1st and 2nd gear rod housing on gearbox	13 ÷ 21	1.3 ÷ 2.1
Front screws fastening gearbox controls support	16 ÷ 25	1.6 ÷ 2.5
Screw fastening differential side joint to flange	40 ÷ 52	4.1 ÷ 5.3
Screw for reversing light switch	20 ÷ 32	2.0 ÷ 3.2
Screw fastening starter motor to gearbox	20 ÷ 25	2.0 ÷ 2.5
Screw fastening earth cable to gearbox	10 ÷ 13	1.0 ÷ 1.3
Screws fastening rear engine support to body	75 ÷ 92	7.6 ÷ 9.4
Screws fastening rear engine support to crossmember	32 ÷ 40	3.3 ÷ 4.1
Screws fastening supporto gearshift control lever to body	10 ÷ 16	1.0 ÷ 1.6
Nut per pin fastening intermediate gear	10 ÷ 16	1.0 ÷ 1.6
Nut fastening engagement tie-rod to intermediate lever	10 ÷ 16	1.0 ÷ 1.6
Nut for screw fastening selection transmission on gearbox	10 ÷ 16	1.0 ÷ 1.6

SPECIAL TOOLING

TOOL NUMBER	DESCRIPTION
1.820.017.000	Half rings for: - removing main shaft 4th speed driven gear - main shaft dis-assembly
1.820.019.000	Plate for removing transmission shaft 2nd and 3rd speed driven gears
1.820.022.000	Half plates for fitting main shaft front bearing inner race
1.820.024.000	Half ring support plate and for removing transmission shaft 1st speed driven gear
1.820.085.000	Tool for measuring thickness of differential shim rings
1.820.146.000	Plate for supporting gearbox on rotary stand
1.820.208.000	Support for gearbox removing/refitting
1.820.226.000	Engine supprort
1.820.229.000	Flange for removing differential flange
1.820.239.000	Support for engine and gearbox
1.820.581.000	Engine support crossrail
1.820.623.001	Bracket for removing/refitting gearbox
1.821.003.000	Drift for removing differential support outer bearing race
1.821.028.000	Installing tool for differential support outer bearing race
1.821.034.000	Puller tool for differential bearings
1.821.047.000	Installing tool for safety pawls for 1st - 3rd - 5th speed control rods
1.821.049.000	Half plates for installing main shaft rear bearing
1.821.050.000	Installing tool for 4th speed driven gear
1.821.062.000	Installing tool for differential bearings
1.821.092.000	Installing tool for 1st speed driven gear

TOOL NUMBER-	DESCRIPTION
1.821.117.000	Puller tool for removing transmission and main shaft front bearing inner race
1.821.161.000	Mallet for extracting differenial flange
1.821.170.000	Installing tool for differential carrier gearbox side oil seal
1.821.171.000	Grip for installing tools
1.821.225.000	Installing tool for differential carrier engine side oil seal
	Installing tool for: main shaft front bearing inner race
	Installing tool for: main and transmission shaft rear bearing
	Installing tool for: synchronizer hub and transmission shaft 2nd and 3rd speed gears

GROUP 17

AXLE SHAFTS

CONTENTS

For all parts not mentioned herein, refer to the corresponding Group of manual "155 - INSTRUCTIONS FOR REPAIR" - PA465500000000 - (Pages with publication no. PA4655C1000000)

AXLE SHAFTS

DESCRIPTION

The axle shafts, together with the constant velocity joints and the intermediate shaft, form the set of devices which transmit motion from the gearbox to the driving wheels. The assembly of these devices, commonly known, alongwith the gearbox, as "transmission", comprises the following:

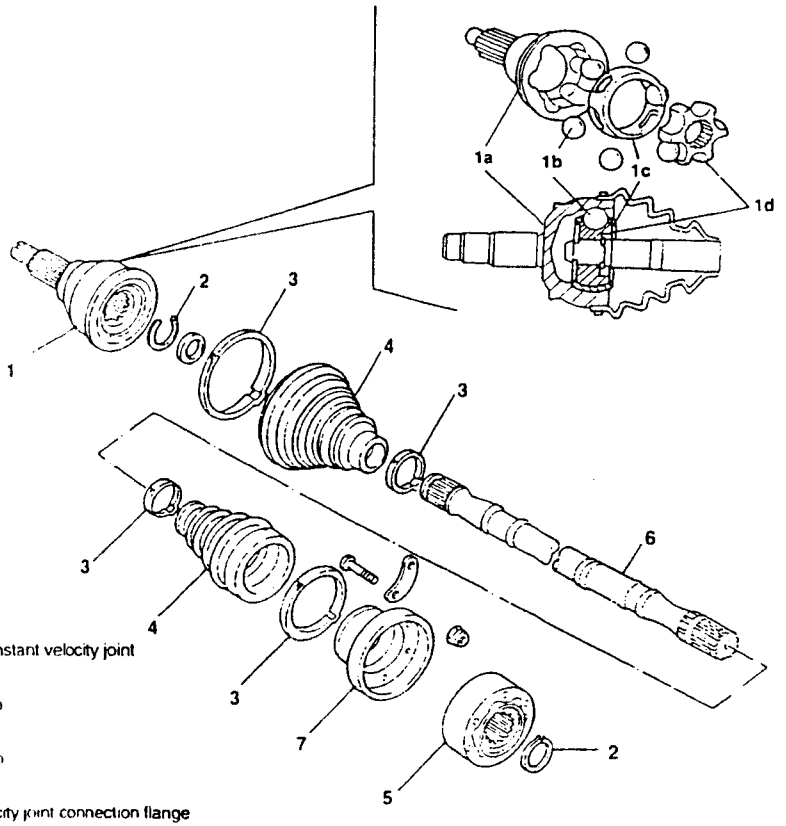
- right and left axle shafts;
- gearbox and wheel side constant velocity joints;
- intermediate shaft.

The axle shafts (6), made from high-strength steel, have grooved ends to enable coupling with the constant velocity joints (1) and (5). On the ends there are the seats for the circlips (2) which retain the actual joints.

Constant velocity joints are formed of an inner core (1d) known as "drive", keyed onto the input shaft, and an outer shell (1a), known as "driven", which is the output piece of the joint.

On the outer surface of the inner core, there are six round grooves which contain six balls (1b), held in place by a cage (1c).

These balls are the actual motion transmission element and they are contemporaneously housed in six grooves machined on the inner surface of the shell.



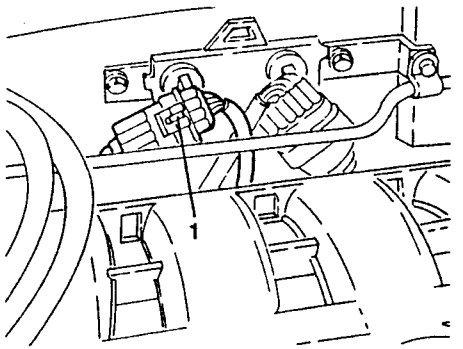
1. Wheel side constant velocity joint
2. Circlip
3. Retainer clamp
4. Boot
5. Retainer clamp
6. Axle shaft
7. Constant velocity joint connection flange

INTERMEDIATE SHAFT

REMOVING/REFITTING

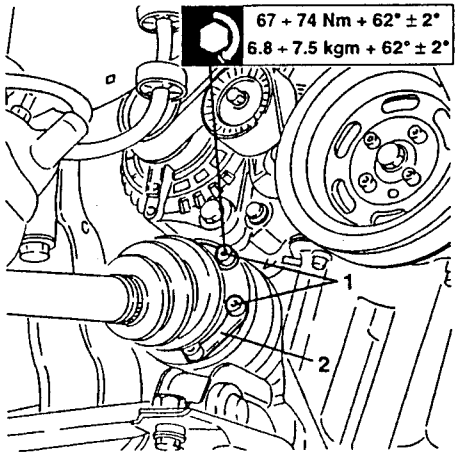
- Set the car on a lift.
- Disconnect the battery (-) terminal.

1. Disconnect the electrical connection of the lambda sensor.

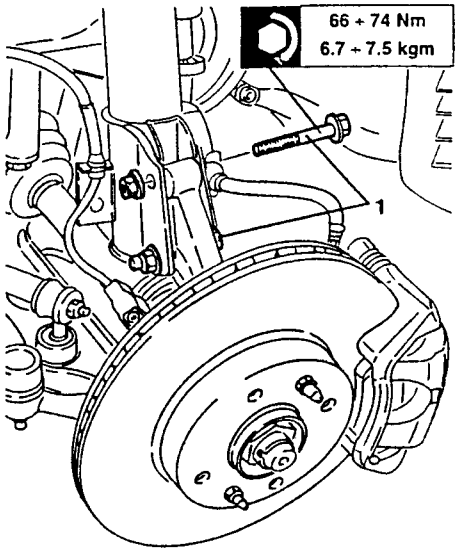


- Raise the car.
- Remove the right-hand front wheel and mud flap.

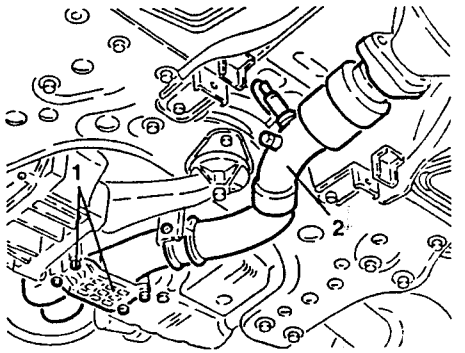
1. Slacken the bolts fastening the right axle shaft from the intermediate shaft flange.
2. Retrieve the safety plates.



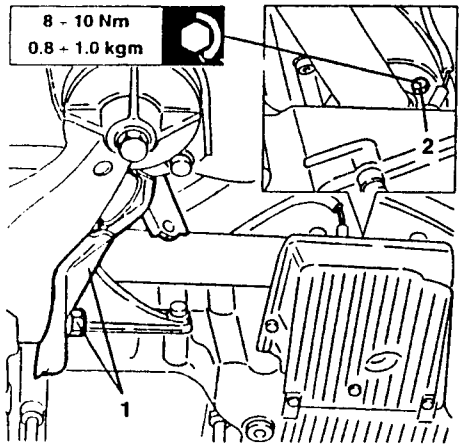
1. Slacken the two bolts fastening the wheel upnght to the shock absorber stem, then remove only the upper one to free the axle shaft from the intermediate shaft.



1. Slacken the fastening screws and remove the reinforcement bracket.
2. Remove the front section of the exhaust pipe complete with lambda sensor after slackening the associated fastenings.

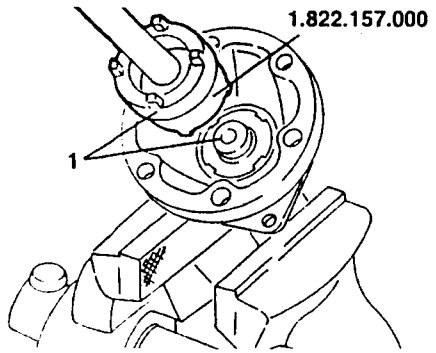


1. Slacken the fastenings and remove the exhaust pipe support bracket.
2. Slacken the fastening screws of the intermediate flange to the support, then withdraw the intermediate flange from the differential.
- Retrieve the dust cover ring.

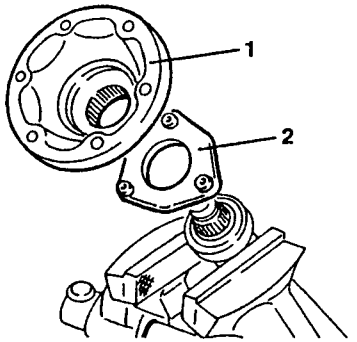


DIS-ASSEMBLY

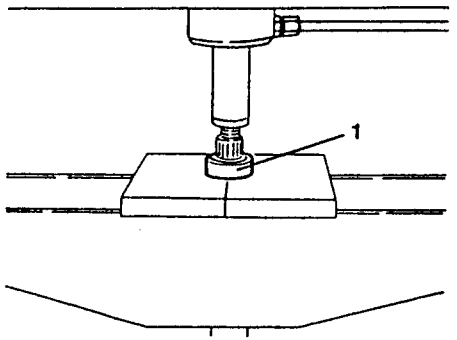
- Position the intermediate shaft in a vice fitted with protective jaws.
1. Using tool no. 1.822.157.000, slacken the lock nut.



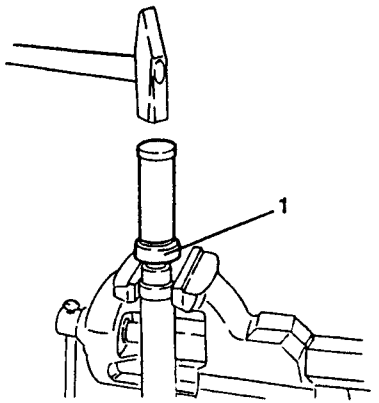
1 Withdraw the flange from the intermediate shaft.
2 Retrieve the bearing retainer plate.



1. Working under a press and using two special half support plates, remove the bearing from the intermediate shaft.



1. Refit a new bearing on the intermediate shaft using a suitable installing tool.



- Complete re-assembly of the intermediate shaft reversing the sequence described for dis-assembly.

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

GENERAL SPECIFICATIONS

FLUIDS AND LUBRICANTS

APPLICATION	TYPE	NAME
Axle shaft constant velocity joints	GREASE	OPTIMOL PU 035 BERUTOX GKN HTB

TIGHTENING TORQUES

Part	Nm	kgm
Screws fastening differential side axle shaft joint to flange	40 ÷ 52	4.1 ÷ 5.3
Screws fastening intermediate axle shaft flange	8 ÷ 10	0.8 ÷ 1.0
Nut fastening axle shafts to wheel hub	67 ÷ 74 + 62° ± 2°	6.8 ÷ 7.5 + 62° ± 2°
Bolt fastening wheel upright - shock absorber	66 ÷ 74	6.7 ÷ 7.5

SPECIAL TOOLS

TOOL NUMBER	DESCRIPTION
1.820.082.000	Pliers for installing fastening clamps for joint protection boot
1.820.084.000	Pliers for installing fastening clamps for joint protection boot
1.821.161.000	Mallet (use with No. 1.821.165.000)
1.821.165.000	Removing tool for constant velocity joint
1.822.157.000	Wrench for intermediate shaft flange lock nut

GROUP 21

FRONT SUSPENSION

INDEX

For all the parts not mentioned herein, see the corresponding Group of the manual "155 - INSTRUCTIONS FOR REPAIR" - PA465500000000 - (pages with publication no. PA4655C1000000)

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

TECHNICAL CHARACTERISTICS

COIL SPRINGS

SPECIFICATIONS		Version with heater	Version with air conditioner
Inside diameter	(mm)	150	150
Outside diameter	(mm)	177.4	177.6
Wire diameter	(mm)	13.7	13.8
Number of Coils		5.58	5.58
Direction		Right-handed	
Free length	(mm)	384	386.5

SHOCK ABSORBERS

Type: telescopic hydraulic pressurized lamellar		BOGE
Stroke	(mm)	167
Stem diameter	(mm)	22

ANTIROLL BAR

Bar diameter	(mm)	22

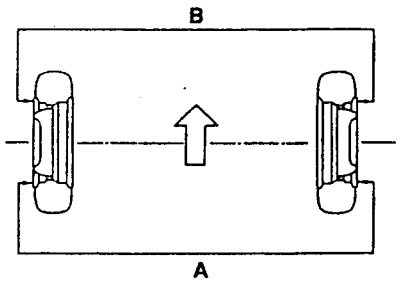
GENERAL SPECIFICATIONS

FLUIDS AND LUBRICANTS

APPLICATION	TYPE	NAME
Wishbone flexible supports	GREASE	GREASE MOLYKOTE 7544 PG 54 TUTELA MR3
Steering track rods	GREASE	MOLYGUARD SYL113

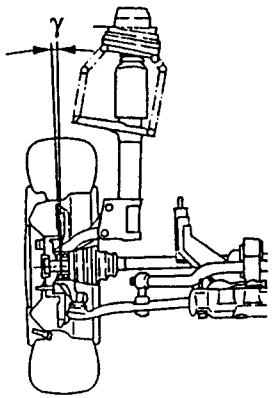
CHECKS AND ADJUSTMENTS

FRONT WHEEL TOE-IN

A - B	1598	1747	1970
	-1 ± 1 mm		

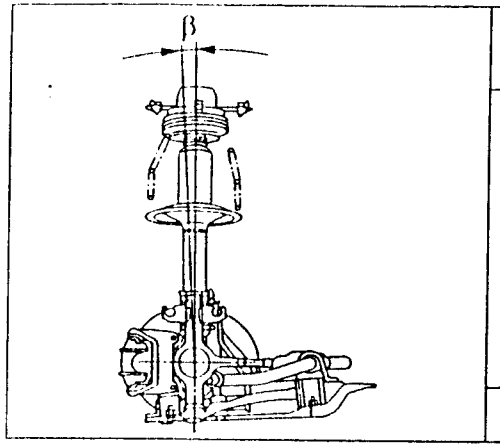
N.B. Values measured with car unladen in running order (with specified fluids).

WHEEL CAMBER ANGLES

	1598	1747	1970
	γ = -20' ± 20'		
	(unadjustable characteristic)		

N.B. Values measured with car unladen in running order (with specified fluids).

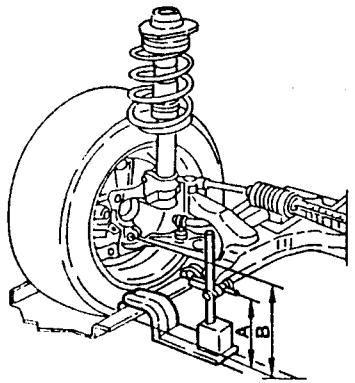
FRONT WHEEL CASTER ANGLES



1598	1747	1970
β = 3° 10' ± 30'		
(unadjustable characteristic)		

N.B. Values measured with car unladen in running order (with specified fluids)

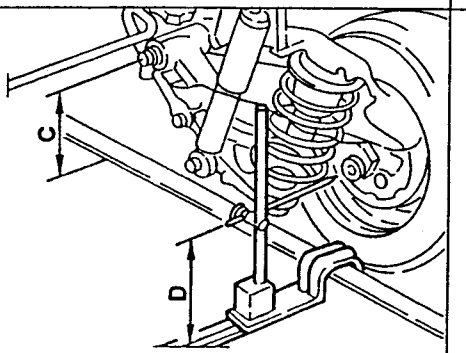
FRONT GEOMETRY

B - A	1598	1747	1970
	- 20 ± 5 mm	- 20 ± 5 mm -35 ± 5 mm (1)	- 20 ± 5 mm -35 ± 5 mm (1)

(1): Sports version

N.B. Values measured with car unladen in running order (with specified fluids).

REAR GEOMETRY

C - D	1598	1747	1970
	-10 ± 5 mm	-10 ± 5 mm -25 ± 5 mm (1)	-10 ± 5 mm -25 ± 5 mm (1)

(1): Sports version

N.B. Values measured with car unladen in running order (with specified fluids).

PA4978C116V002 12 - 1995

TIGHTENING TORQUES

Part	Nm	kgm
Bolts fastening shock absorber to wheel upright	66 ÷ 74	6.7 ÷ 7.5
Centre nut retaining helical spring to shock asborber	95 ÷ 105	9.7 ÷ 10.7
Screws fastening shock absorber to body	34 ÷ 42	3.5 ÷ 4.3
Nut fastening track rod to wheel upright	29 ÷ 37	3.0 ÷ 3.8
Bolt fastening wishbone to wheel upright	67 ÷ 74	6.8 ÷ 7.5
Nut fastening connecting rod to stabiliser bar	43 ÷ 53	4.4 ÷ 5.4
Nut fastening stabiliser bar connecting rod to wishbone	26 ÷ 33	2.7 ÷ 3.3
Screws fastening wishbone U-bolts to crossmember	59 ÷ 72	6.0 ÷ 7.3
Front screws fastening crossmember to body	92 ÷ 113	9.4 ÷ 11.5
Screws fastening upper crossmember connections	92 ÷ 113	9.4 ÷ 11.5
Screws fastening steering box to crossmember	43 ÷ 47	4.4 ÷ 4.8
Nuts fastening U-bolts connecting stabiliser bar to crossmember	29 ÷ 35	3.0 ÷ 3.6
Nut fastening axle shaft to wheel hub	67 ÷ 74 ÷ 62° ± 2°	6.8 ÷ 7.5 ÷ 62° ± 2°

SPECIAL TOOLS

TOOL NUMBER	DESCRIPTION
1.820.047.002	Plate per removing front wheel hub bearing inner rign (To be used with 1.820.223.000 and 1.821.051.000)
1.820.089.000	Tool for compressing front suspension spring
1.820.223.000	Half rings for removing front wheel hub bearing inner ring (To be used with 1.820.047.002 and 1.821.051.000)
1.820.238.000	Plate for compressing front suspension springs (To be used with 1.820.089.000)
1.820.247.000	Tool for retaining front shock absorber stem
1.821.045.000	Tool for removing installing bearing outer ring from front wheel upright (To be used with 1.821.149.000)
1.821.051.000	Tool for: – removing wheel hub from wheel upright – removing front wheel hub bearing inner ring (To be used with 1.820.047.002 and 1.820.223.000)
1.821.099.000	Tool for removing bearing outer ring from wheel upright
1.821.149.000	Supporto per removing bearing outer ring from front wheel upright (To be used with 1.821.045.000)
1.821.209.000	Tool for installing bearing and wheel hub in front wheel upright
1.822.117.000	Wrenche for slackening and tightening front shock absorber fastening nut

GROUP 22

FRONT AND REAR BRAKES

INDEX

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

TECHNICAL CHARACTERISTICS

BRAKE PUMP

Model	Type	Diameter	Stroke
2.0 T.S. 16V	ISOVAC	15/16" (23.8 mm)	9/16" (14+14 mm)
2.0 T.S 16V right hand drive		7/8" (22.23 mm)	5/8" (16+16 mm)

SERVOBRAKE

Model	Type	Diameter of operating cylinder
2.0 T.S.	ISOVAC	7"+8" (17.78 + 20.32 cm)
2.0 T.S. 16V right-hand drive		9" (22.86 cm)

FRONT BRAKE CALIPERS

Model	Type	Diameter of piston (mm)	Area of brake pads (cm^2)	Brake pad nominal thickness (mm)
2.0 T.S. 16V	LUCAS	54	50	18.3 ±0.2

REAR BRAKE CALIPERS

Model	Type	Diameter of piston (mm)	Area of brake pads (cm^2)	Brake pad nominal thickness (mm)
2.0 T.S. 16V	LUCAS	34	21	$14^{0}_{+0.4}$

GENERAL SPECIFICATIONS

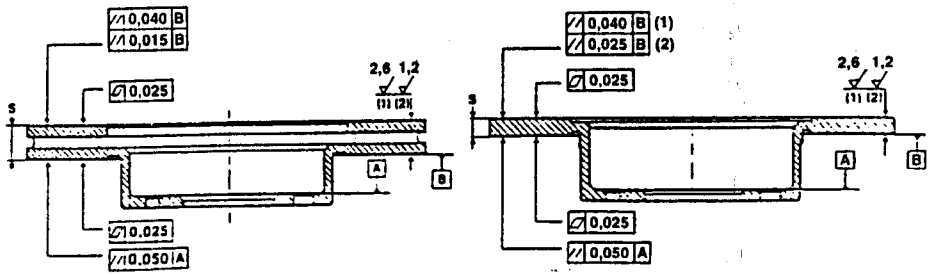
FLUIDS AND LUBRICANTS

APPLICATION	TYPE	NAME
Joints and pedal bushes	GREASE	TUTELA ZETA 2
Filling brake/clutch hydraulic system	FLUID Class: DOT 4 SAE J 1703 F	ALFA ROMEO BRAKE FLUID SUPER DOT 4
Front/rear wheel inductive sensor seat for wheel antilock device	GREASE	TUTELA ZETA 2

CHECKS AND ADJUSTMENTS

BRAKE DISK		FRONT	REAR
Diameter	(mm)	284	240
Use limit thickness	(mm)	20.2	9.2
Min.thickness after grinding	(mm)	21.2	10.2
Nominal thickness	(mm)	22.2	11.2

DIMENSIONS FOR GRINDING BRAKE DISKS



1. Radial
2. Circumference

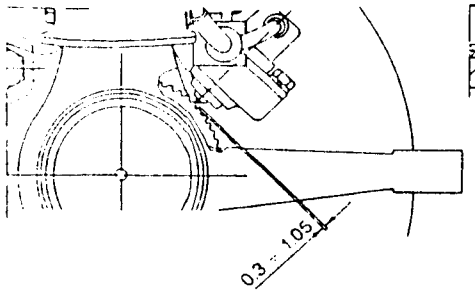
BRAKE PADS

BRAKE PADS	FRONT	REAR
Use limit thickness	1.5 mm(1)	1.5 mm

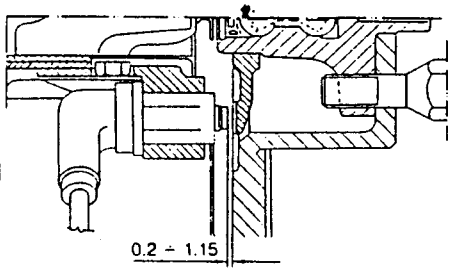
(1) Signalled by brake pad wear sensor

ADJUSTMENT OF GAP BETWEEN INDUCTIVE SENSORS AND PHONIC WHEELS

Front wheele



Rear wheels



TIGHTENING TORQUES

Description	N·m	kg·m
Fitting for stiff pipe on brake pump	15 ÷ 19	1.5 ÷ 1.9
Nut fastening brake pump	13 ÷ 21	1.3 ÷ 2.1
Nut fastening servobrake to pedal unit	10 ÷ 15	1.0 ÷ 1.5
Nut fastening accelerator pedal to pedal unit	3 ÷ 5	0.3 ÷ 0.5
Front and rear wheel fastening studs	83 ÷ 103	8.5 ÷ 10.5
Screw fastening front brake calipers	22 ÷ 32	2.2 ÷ 3.3
Screw fastening front brake caliper support bracket	85 ÷ 105	8.6 ÷ 10.7
Screw with centering pin fastening front and rear brake disks	5 ÷ 13	0.5 ÷ 1.3
Screw fastening front and rear brake disks	5 ÷ 13	0.5 ÷ 1.3
Bleed screw on brake calipers	4 ÷ 6	0.4 ÷ 0.6
Fitting connecting hoses on brake calipers	15 ÷ 19	1.5 ÷ 1.9
Screw fastening rear brake calipers	45 ÷ 55	4.6 ÷ 5.6
Screw fastening rear brake caliper support bracket	20 ÷ 25	2.0 ÷ 2.5
Connections between stiff pipes and hoses	15 ÷ 19	1.5 ÷ 1.9
Screw fastening braking load proportioning valve to rear crossmember	4 ÷ 5	0.4 ÷ 0.5
Screw for square lever for proportioning valve adjustment	20 ÷ 25	2.0 ÷ 2.5
Fitting for connecting stiff pipes on braking load proportioning valve and 4-way distributor	9 ÷ 11	0.9 ÷ 1.1
Screw fastening parking brake to body	18 ÷ 29	1.8 ÷ 3.0
Screw fastening brake-clutch fluid reservoir to body	3 ÷ 4	0.3 ÷ 0.4
Nut fastening hydraulic control unit to bracket	3 ÷ 4	0.3 ÷ 0.4
Screw fastening control unit support bracket to body	20 ÷ 25	2.0 ÷ 2.5
Screw fastening front and rear wheel inductive sensor	5 ÷ 6	0.5 ÷ 0.6

SPECIAL TOOLING

TOOL NUMBER	DESCRIPTION
1.820.248.000	Tool for moving back front brake piston
1.822.108.000	Tool for moving back rear brake piston

BOSCH 5.3 ABS

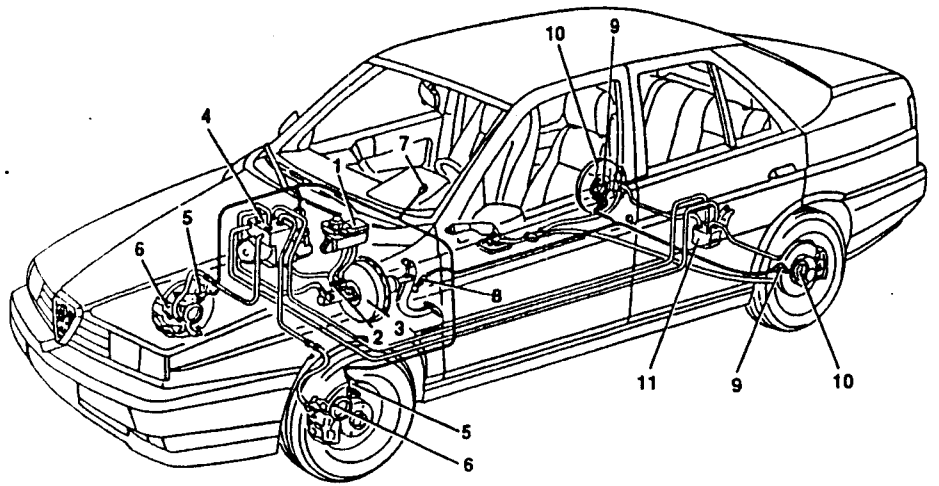
(from chassis no. replaces the previous version "2E")

DESCRIPTION

The Bosch 5.3 A.B.S. further optimises compactness (ease of assembly), lightness and reliability.
The use of new microhybrid electronic components, optimisation of the flows as a result of the study of the new, more compact shapes of the valve bodies and the reduction of the number of hydraulic components since they are pressed directly onto the valve seat of the nozzles which are previously assembled separately have made it possible to improve the characteristics of the solenoid valves.
The main components of the system are:
- new electronic control unit, more powerful and versatile than the previous ones;
- electrohydraulic control unit (4) which modulates the braking pressure at the brake calipers through eight solenoid valves, two for each wheel;
- four sensors (5) and (9), one for each wheel, which detect the angular rotation speed of the wheels.

The system is completed by:
- the hydraulic system piping;
- a specific wiring loom;
- a switch on the brake pedal (8) for detecting the the braking condition;
- a warning light (7), on the check panel.

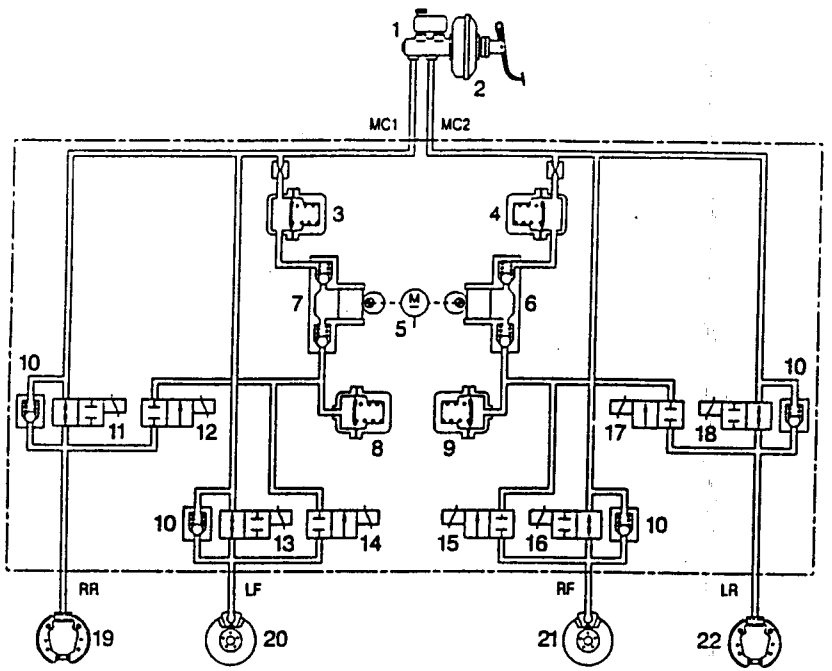
In addition, under particular diagnosis conditions, the warning light (7), supplies information about the faults memorised by the control unit through a series of coded flashes (see Electric System Diagnosis").



Layout of Bosch 5.3 A.B.S. System

1. Brake fluid reservoir
2. Brake pump
3. Vacuum servobrake
4. Electrohydraulic control unit with electronic control unit incorporated
5. Front wheel rpm sensor
6. Front brakes
7. Warning light
8. Stop lights control switch
9. Rear wheel rpm sensor
10. Rear brakes
11. Proportioning valve

HYDRAULIC LAYOUT OF BOSCH 5.3 A.B.S. SYSTEM



Braking system with double crossed circuit

1. Brake control pump
2. Servobrake
3. High pressure accumulator (damping chamber)
4. High pressure accumulator (damping chamber)
5. Recovery pump drive motor
6. Recovery pump
7. Recovery pump
8. Low pressure accumulator (reservoir)
9. Low pressure accumulator (reservoir)
10. Fast pressure reduction valve
11. Right rear charge solenoid valve
12. Right rear discharge solenoid valve
13. Left front charge solenoid valve
14. Left front discharge solenoid valve
15. Right front charge solenoid valve
16. Right front discharge solenoid valve
17. Left rear charge solenoid valve
18. Left rear discharge solenoid valve
19. Right rear drum brake
20. Left front disk brake
21. Right front disk brake
22. Left rear drum brake

MC1.	Supply union for brake pump 1st stage
MC2.	Supply union for brake pump 2nd stage
RR.	Delivery union to right rear cylinder
FL.	Delivery union to left front caliper
FR.	Delivery union to right front caliper
RL.	Delivery union to left rear cylinder

COMPONENTS

Electrohydraulic control unit

The electrohydraulic control unit comprises two sections fastened to one another: an electronic control unit and the electrohydraulic control unit.

On the basis of the signals received from the sensors and with the help of charactenstic programmes mapped in its memories, the electronic control unit commands the electrohydraulic control unit.

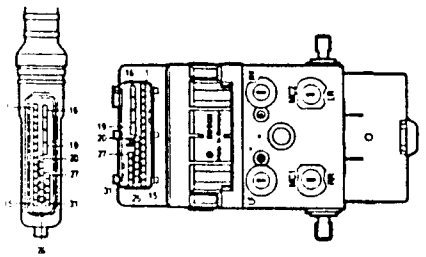
The electrohydraulic control unit is connected to the brake pump and to the A.B.S. system components through the pipes of the braking system.

The main change with respect to the previous versions is the replacement of the three-way valves with two 2-way solenoid valves for each wheel.

Electronic control unit

The electronic control unit is formed of hybrid circuits with resistances, diodes, transistors and integrated logic circuits. The heart of the system are two CMOS microprocessors with 12K ROM which autonomously carry out the same programme and monitor one another mutually. Both receive the same input signals which each processes individually and only when the results obtained are identical, the control unit sends the operative command to the electrohydraulic control unit.

Conversely, if for example there is a fault in the wheel anti-lock system, the device cuts itself out and braking takes place conventionally: simultaneously, the fault warning light on the check panel comes on.



Operating logic

The signals (alternate or analogue) sent by the rpm sensors to the electronic control unit are transformed by the input amplifier into square wave signals.

The frequency of these signals gives the control unit the corresponding values of speed, acceleration or deceleration of the single wheels.

From the combination of the single wheel peripheral speeds, a reference speed is processed which is continuously updated and indicates the speed of the car at all times.

When the driver presses the brake pedal the wheels can each decelerate to a different extent: comparison of the peripheral speed of each wheel with the reference speed keeps the skidding of each wheel constantly under control.

If the braking force causes a wheel to skid with respect to the others, the electronic control unit sends the command to the solenoid valves of the electrohydraulic control unit to reduce the braking force on the wheel that has lost grip. This way the wheel concerned regains speed.

The memory of the electronic control unit also contains threshold acceleration and deceleration values that none of the wheels may ever exceed.

Therefore, through systematic, very rapid comparison of the wheel skidding, deceleration and acceleration values, rolling of the tyre during braking is kept under control.

As soon as the foreseen combined acceleration/deceleration and skid values are exceeded, the electronic control unit intervenes with commands to the solenoid valves of the electrohydraulic control unit, in the three adjustment phases to lower, maintain or return the pressure generated by the driver on the brake pedal to the brake calipers, bringing the braking condition to the optimum values set by the system.

These phases determine an intermittent but extremely fast adjustment cycle which is repeated until the car stops. The electronic control unit commands the different phases supplying the solenoid valves pulses with different current intensities. It also makes sure that both rear wheels are given the same braking force applicable to the rear wheel that is more subjected to locking, i.e. the one with lower grip (to ensure stability).

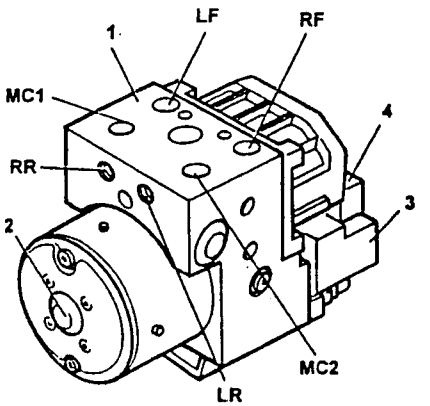
If a fault is detected, the wheel anti-lock device cuts out and alerts the driver by turning on the warning light on the check panel, while however ensuring operation of the conventional braking system.

The electronic control unit is informed that the driver is braking by the signal from the switch on the brake pedal. Besides controlling braking, this information is also helpful under certain particular conditions, such as for example if a sharp acceleration that makes the wheels skid is followed by heavy braking, or in the case of irregular road surfaces (humps, steps) that can involve changes in speed of the wheel due to causes not linked with the braking in progress.

In these conditions the microprocessors process a strategy connected with the changes of speed of the wheels of these particular moments, bringing braking back to the correct parameters. Since these are particular conditions of braking control, the lack of connection of the switch on the brake pedal to the control unit does not compromise the efficiency of the system. For this reason it is not signalled by the warning light, nor is the A.B.S. system disabled.

Further details about the operating principle of the ABS are given below.

Electrohydraulic control unit



1. Electrohydraulic control unit
2. Elecric recovery pump
3. Electronic control unit
4. Control unit connector

The electrohydraulic control unit is connected to the brake pump and to the brake caliper cylinders through the brake system lines and together with the electronic control unit it fosrms the electrohydraulic control unit.

Its task is to change the pressure of the brake fluid in the brake caliper cylinders according to the command signals leading from the electronic control unit.

It comprises eight two-way solenoid valves (two for each hydraulic circuit) and an electric recovery pump (2) with double circuit. The eight solenoid valves and the electnc recovery pump are driven by the electronic control unit depending on the signals of the four rpm sensors. The pump makes it possible to recover the brake fluid during the pressure reduction phase making it available again upstream of the solenoid valves for the next pressure increase phase.

The accumulators absorb the brake fluid during pressure reduction.

The unit is connected to the braking system through unions identified by the codes stamped on them as illustrated.

Pipe outlets

MC1	Supply union from brake pump- circuit 1
MC2	Supply union from brake pump - circuit 2
LF	Delivery union to left front brake caliper
LR	Delivery union to left rear brake caliper
RF	Delivery union to right front brake caliper
RR	Delivery union to right rear brake caliper

Inductive sensors

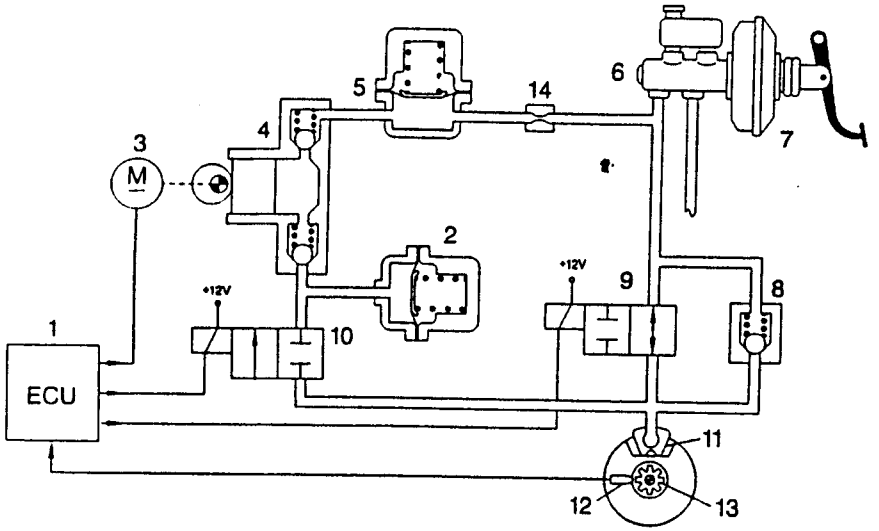
These are quite the same as those used for the previous versions.

DESCRIPTION OF HOW THE WHEEL ANTI-LOCK SYSTEM WORKS

Rest position

Each branch of the Bosch 5.3 ABS system is fitted with two 2-way solenoid valves; all the solenoid valves are managed by the control unit (1).

When the charge solenoid valve (9) is deactivated (not connected to earth by the control unit) it is in the open position, thereby allowing the flow of fluid to the brake caliper.
The pressure is maintained closing this valve, i.e. supplying it electrically.



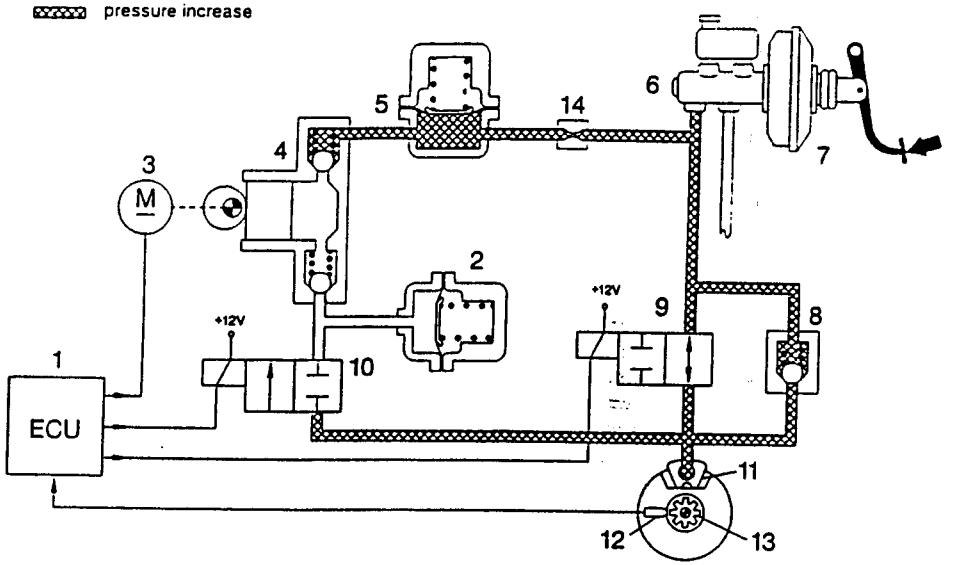
1. Electronic control unit
2. Low pressure accumulator (reservoir)
3. Recovery pump drive motor
4. Recovery pump
   High pressure accumulator (damping chamber)
6. Brake control pump
7. Servobrake
8. Fast pressure reduction valve
9. Charge solenoid valve
10. Discharge solenoid valve
11. Brake caliper
12. Rpm sensor
13. Phonic wheel
14. Restrictor

When the discharge solenoid valve (10) is deactivated (not connected to earth by the control unit) it is in the closed position and does not allow the fluid to be discharged on the low pressure accumulator (2).
The accumulators (2) and (5) have the task of temporarily storing the brake fluid made available during the pressure reduction phase.

The recovery pump (4) sends the brake fluid that flows back from the brake calipers during pressure reduction to the brake pump via the corresponding accumulator.
On the basis of the signals received from the rpm sensors on the front and rear wheels, the electronic control unit drives the electrohydraulic control unit, which in turn changes the pressure of the brake fluid sent to the calipers according to three phases: increase, maintenance or reduction of the pressure.

Pressure increase phase

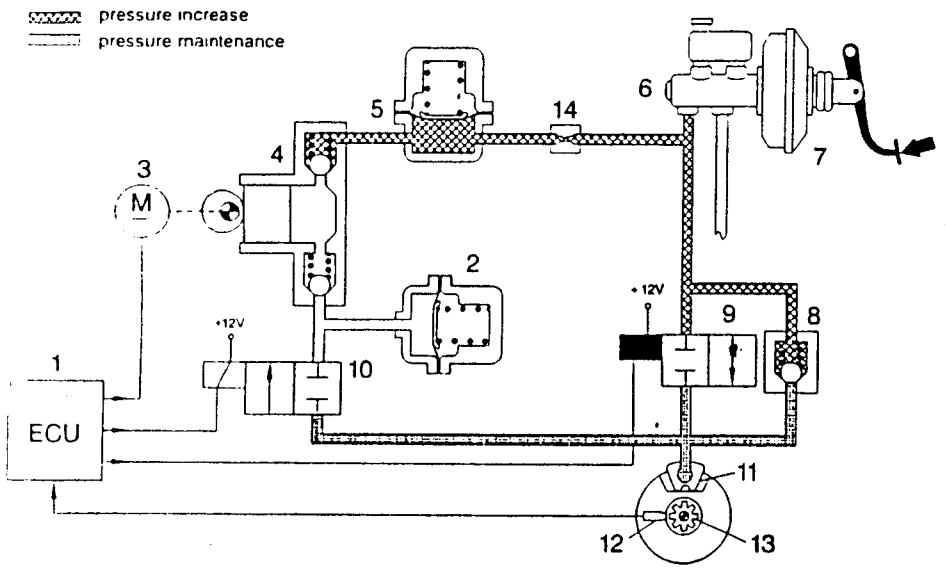
pressure increase



1. Electronic control unit
2. Low pressure accumulator (reservoir)
3. Recovery pump drive motor
4. Recovery pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Servobrake
8. Fast pressure reduction valve
9. Charge solenoid valve
10. Discharge solenoid valve
11. Brake caliper
12. Rpm sensor.
13. Phonic wheel
14. Restrictor

When the driver presses the brake pedal, the pressure generated by the brake pump (6) reaches the brake caliper without undergoing changes, as the solenoid valves (9) and (10) of the hydraulic unit are not connected to earth by the electronic control unit.
When the braking force increases, deceleration of the wheel increases accordingly; this causes faster deceleration of the car (i.e. wheel slip increases).
The slip rate must not exceed a determinate value beyond which the wheel loses its grip on the ground and starts to slide, losing direction and lengthening braking distances.
The rpm sensor (12) signals that deceleration values have been reached that would compromise the grip of the wheel with the ground: at this point the electronic control unit (1) commands the solenoid valves of the electrohydraulic unit, reducing the braking force and allowing the wheel to increase speed and recover grip.

Pressure maintenance phase

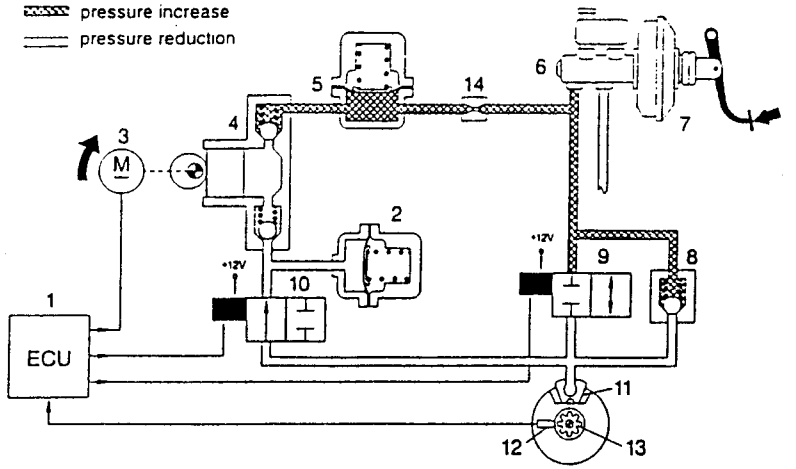


1. Electronic control unit
2. Low pressure accumulator (reservoir)
3. Recovery pump drive motor
4. Recovery pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Servobrake
8. Fast pressure reduction valve
9. Charge solenoid valve
10. Discharge solenoid valve
11. Brake caliper
12. Rpm sensor
13. Phonic wheel
14. Restrictor

During this phase, the electronic control unit (1) connects the charge solenoid valve (9) to earth, so it closes, while the discharge solenoid valve (10) that is not connected to earth, is already closed.
The hydraulic connection between the brake pump (6) and the brake caliper (11) is cut off (standby position). The pressure in the brake caliper (11) is kept constant at the rating reached previously, regardless of the pressure on the brake pedal.
Although the braking effort maintains a continuous slowing action, the wheel changes its speed, in relation to the grip on the ground, until the signal of the rpm sensor (12) is a value similar to the reference speed calculated by the electronic control unit (1).

At this point, the control unit passes from the maintenance phase to the pressure increase phase (if the wheel accelerates) or reduction (if the wheel tends to lock).

Pressure reduction phase



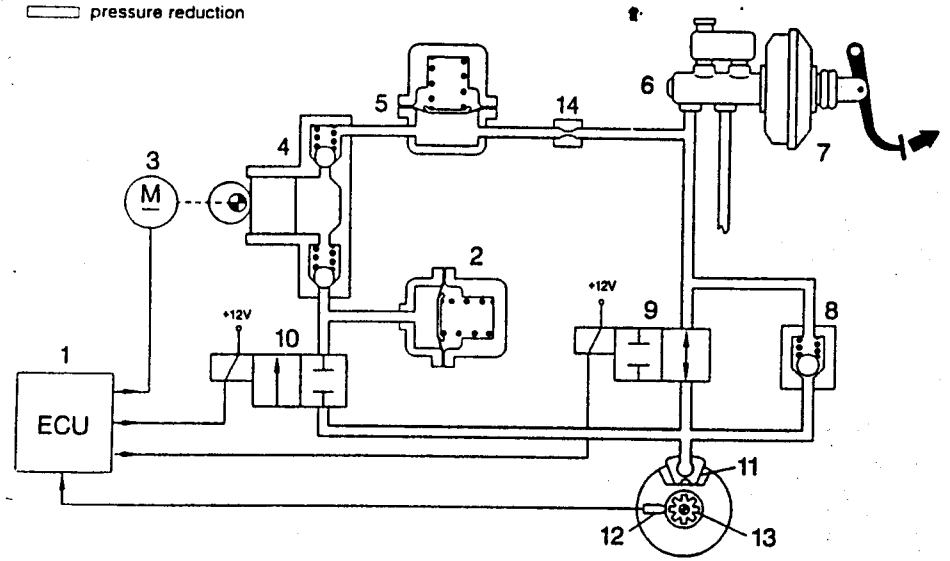
1. Electronic control unit
2. Low pressure accumulator (reservoir)
3. Recovery pump drive motor
4. Recovery pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Servobrake
8. Fast pressure reduction valve
9. Charge solenoid valve
10. Discharge solenoid valve
11. Brake caliper
12. Rpm sensor
13. Phonic wheel
14. Restrictor

The electronic control unit (1) detects the tendency of the wheel to lock and activates the electrohydraulic unit to keep deceleration of the wheel within the thresholds allowed.
The electronic control unit (1) connects to earth the charge (9) and discharge (10) solenoid valves.
The charge solenoid valve (9) remains closed keeping the connection between the brake pump (6) and brake caliper (11) shut; The discharge solenoid valve (10) opens putting the brake caliper (11) into hydraulic connection with the low pressure accumulator (2) and the recovery pump (4), in order to withdraw part of the fluid at the brake caliper (11) and reduce the pressure on the caliper itself.
Simultaneously, the electronic control unit (1) supplies the drive motor (3) of the recovery pump (4) which makes it possible to re-admit the fluid taken from the brake caliper (11) to the main circuit.
The accumulator (2) or low pressure reservoir in the circuit has the task of storing part of the brake fluid taken from the calipers. Through the circuit of the recovery pump (4), the fluid is withdrawn and sent, via the damping chamber (5) and the restrictor (14), into the main circuit of the brake pump (6).
In this phase a series of pressure waves (or hydraulic thrusts) are generated which are dampened by the presence of the damping chamber (5) and the restrictor (14).
During braking, light pushes on the brake pedal are to be considered normal when the ABS system is operational. During this phase, due to the effect of the lowering of the braking force, the wheel tends to resume the reference speed calculated by the electronic control unit (1).
The type of braking is intermittent or by steps with a succession of the phases depending on the wheel rolling conditions and according to a repetitive cycle that is not perceived by the driver, in the form of jerks, owing to the quickness and frequency with which it occurs and because it is evened out by the inertia of the wheel which is prevented from reaching extreme skidding conditions because of the rapidity of the device.

With the car without A.B.S. the driver is able to act intermittently on the brake pedal with a frequency of 2 cycles per second (2 presses and 2 releases).
With the A.B.S. system, the cycles increase to 4 10 per second (depending on grip).
Normally operation of the A.B.S. ceases at speeds below 2,75 km/h to allow the wheels lock completely when the car reaches a halt.

NOTA The recovery pump is of the free piston type with double circuit, driven by an electric motor that turns constantly during the recovery phase.
The pistons are not coupled with the electric motor but they are moved by the cam, only upon arrival of the brake fluid. Therefore, the pump can perform only one impelling stroke while suction is not possible owing to the lack of mechanical connection between motor and pump.

Brake pedal release



1. Electronic control unit
2. Low pressure accumulator (reservoir)
3. Recovery pump drive motor
4. Recovery pump
5. High pressure accumulator (damping chamber)
6. Brake control pump
7. Servobrake
8. Fast pressure reduction valve
9. Charge solenoid valve
10. Discharge solenoid valve
11. Brake caliper
12. Rpm sensor
13. Phonic wheel
14. Restrictor

To enable rapid reduction of the pressure on the brake per (11) when the brake pedal is released, the system is fitted with a non return valve (8) in parallel with the inlet solenoid valve (9).

REPAIR OPERATIONS ON THE UNIT

Instructions for correct repairing

- **To replace the electronic control unit it is necessary to disassemble the whole hydraulic unit, owing to reasons of space and to avoid damaging the internal connector.**
- **The electrohydraulic control unit cannot be overhauled and it is fault-proof until it is tampered with. It must be replaced if found to be faulty.**
- **After each replacement of a hydraulic unit, rpm sensor, electronic control unit or wiring (especially if after an accident) the entire A.B.S. system must be checked with the Tester.**
- **After all operations on the hydraulic system of the A.B.S. or brake system, it is necessary to fill with DOT 4 brake fluid, relieve the air, and check the tightness of all the connection points.**
- **The electrohydraulic control unit is supplied filled with DOT 4 brake fluid and with the solenoid valves not supplied. The operation for filling with fluid and relieving the air is the same as for a conventional system, but requires more time.**
- **During removal of the electrohydraulic unit avoid overturning it to prevent spilling the oil contained in the hydraulic part.**
- **When refitting pay attention to the unions: to prevent mistakes in connecting the various parts of the braking circuit during repair operations, the connections of the hydraulic modulator unit are of different sizes (M10x1 and M12x1), the unions are also identified by the codes stamped on them.**

GROUP 23

STEERING SYSTEM

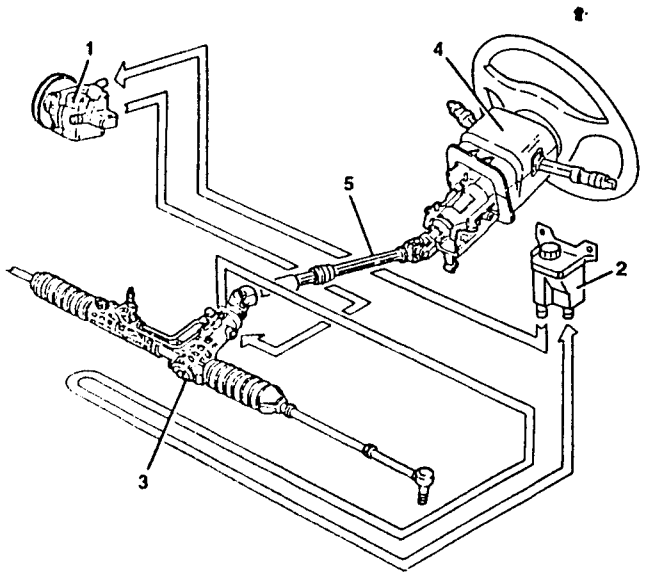
INDEX

For all the parts not mentioned herein, see the corresponding Group of the manual "155 - INSTRUCTIONS FOR REPAIR" - PA465500000000 - (pages with publication no. PA4655C1000000)

STEERING SYSTEM

DESCRIPTION

The power assisted steering system reduces effort at the steering wheel when manoeuvring from a standstill while keeping steering accurate at high speeds.
The system comprises a pump (1) operated directly by the engine through a belt. The pump withdraws oil through the suction pipe from the tank (2) located in the engine compartment and sends it under pressure through the delivery pipe to the distributor valve on the power steering box (3).
The distributor valve, controlled by the turning of the steering wheel (4) and steering column (5), sends the oil under pressure from one side or the other of the hydraulic cylinder, which is integral with the rack and pinion, inside the steering box.
A pipe returns to the tank, thereby closing the circuit.



NOTE: the location of the components in the engine compartment is illustrated above.

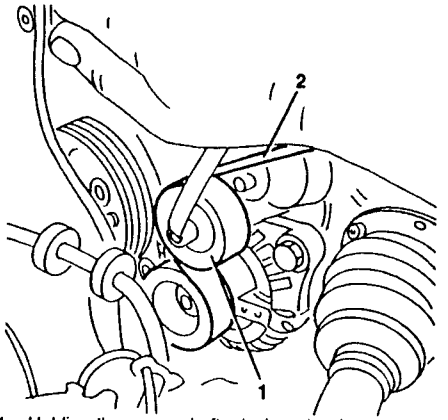
For the removing and refitting service procedures, refer to the corresponding group of the manual "155 - INSTRUCTIONS FOR REPAIR" PA465500000000 with the exception of the following concerning the power steering pump.

POWER STEERING PUMP

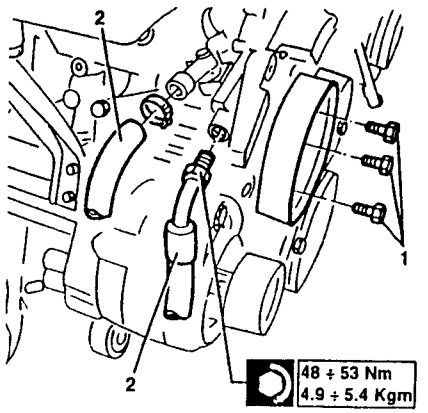
REMOVAL AND REFITTING

- Set the car on a lift.
- Remove the right front wheel with gravel guard (see GROUP 70).
- Remove the right engine compartment shield.
- Using a syringe, withdraw the oil from the power steering tank

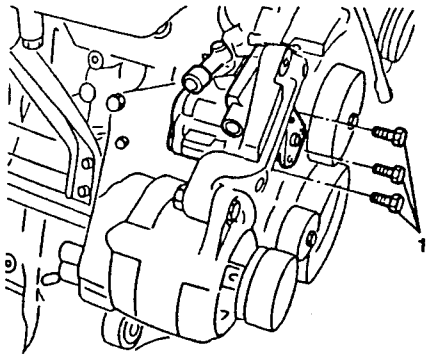
1. Slacken the belt tensioner and remove the pulley guide
2. Remove the services drive belt.



1. Holding the pump shaft, slacken the three screws fastening the power steering pump pulley and remove it.
2. Working from above, disconnect the two pump inlet and delivery pipes.



1. Slacken the three fastening screws and remove the power steering pump



Refit the pump reversing the procedure followed for removal. Tension the belt as described in group 00.
Fill the hydraulic circuit and relieve the air (see specific patagraph).

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

GENERAL SPECIFICATIONS

FLUIDS AND LUBRICANTS

APPLICATION	TYPE	NAME
Filling power steering system	OIL	TUTELA GI/A
Roller bush seat on steering column support	GREASE	SPCA Spagraph ISECO Ergon Rubber Grease REINACH Sferal B2 AR

TIGHTENING TORQUES

Description	N·m	kg·m
Self-braking nut for fastening steering wheel to steering column	42 ÷ 52	4.3 ÷ 5.4
Self-braking nut for fastening track rod ball pin to wheel upright	29 ÷ 36	3.0 ÷ 3.7
Oil inlet pipe fitting on power steering	38 ÷ 42	3.9 ÷ 4.3
Oil outlet pipe fitting on power steering	29 ÷ 32	3.0 ÷ 3.3
Bolt fastening steering column to power steering pinion	17 ÷ 21	1.7 ÷ 2.1
Screws fastening steering box to front crossmember	47 ÷ 57	4.8 ÷ 5.8
Nut for locking steering track rod	10 ÷ 15	1.0 ÷ 1.5
Self-locking nuts for fastening steering column cardan joint forks	17 ÷ 21	1.7 ÷ 2.1
Self-locking nut fastening steering wheel on steering column	42 ÷ 52	4.3 ÷ 5.3
Screws fastening steering column to body	21 ÷ 26	2.1 ÷ 2.7
Screw fastening steering wheel adjustment lever	15 ÷ 19	1.5 ÷ 1.9
Nut fastening lower reaction strut (air-bag)	14 ÷ 23	1.4 ÷ 2.3
Rear steering wheel fastening screws (air-bag)	7 ÷ 8	0.7 ÷ 0.8

SPECIAL TOOLING

TOOL NUMBER	DESCRIPTION
1.821.105.000	Steering wheel puller tool
1.821.169.000	Track rod pin puller tool

GROUP 25

REAR SUSPENSION

INDEX

For all the parts not mentioned herein, see the corresponding Group of the manual "155 - INSTRUCTIONS FOR REPAIR" - PA465500000000 - (pages with publication no. PA4655C1000000)

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

TECHNICAL CHARACTERISTICS

COIL SPRINGS

CHARACTERISTICS		
Inside diameter	(mm)	100
Outside diameter	(mm)	124.8
Diameter of wire	(mm)	12.4
Number of coils		6.32
Direction		Right-handed
Free length	(mm)	305

SHOCK ABSORBERS

Type		telescopic hydraulic pressurized lamellar
Stroke	(mm)	160
Diameter of stem	(mm)	11.5

STABILIZER BAR

Diameter of ba	(mm)	17

ANGOLI / ASSETTI ALFA 155 - Edizione 95

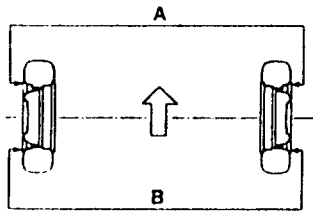
VETTURE		RUOTE ANTERIORI					RUOTE POSTERIORI			
		CAMPANATURA	CONVERGENZA mm A - B	INCIDENZA B	ASSETTO mm B - A		CAMPANATURA	CONVERGENZA mm A - B	ASSETTO mm C - D	
Alfa 155	1.7	-20' ± 20'	-1 ± 1	3°10' ± 30'	-20 ± 5	//	-1° ± 15'	0,5 ± 2	-10 ± 5	//
	1.8	-20' ± 20'	-1 ± 1	3°10' ± 30'	-20 ± 5 *Lusso	-35 ± 5 *Sportiva	-1° ± 15'	0,5 ± 2	-10 ± 5 *Lusso	-25 ± 5 *Sportiva
	2.0 16v	-20' ± 20'	-1 ± 1	3°10' ± 30'	-20 ± 5 *Super	-35 ± 5 *Sportiva	-1° ± 15'	0,5 ± 2	-10 ± 5 *Super	-25 ± 5 *Sportiva
	2.5 V6	-20' ± 20'	-1 ± 1	3°10' ± 30'	//	-35 ± 5	-1° ± 15'	0,5 ± 2	//	-25 ± 5
	2.0 TB 4x4	-20' ± 20'	-1 ± 1	3°10' ± 30'	//	-39 ± 5	-1° ± 15'	1,3 ± 2	//	-15 ± 5
	TD	-20' ± 20'	-1 ± 1	3°10' ± 30'	-20 ± 5	//	-1° ± 15'	0,5 ± 2	-10 ± 5	//
	2.5 TD	-20' ± 20'	-1 ± 1	3°10' ± 30'		-35 ± 5	-1° ± 15'	0,5 ± 2	//	-25 ± 5

N.B. - Valori misurati a vuoto in ordine di marcia (con rifornimenti prescritti)

* Allestimenti

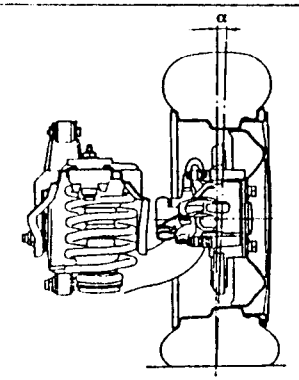
CHECKS AND ADJUSTMENTS

REAR WHEEL TOE-IN

A-B	2.0 T.SPARK 16V	
	Version with heater	Version with air conditioner
	2.9 ± 1 mm	2.7 ± 1 mm
	(not adjustable)	

N.B. Values measure with unladen vehicle in running order (with fuel and specified fluids).

REAR WHEEL CAMBER

2.0 T.SPARK 16V
 α = *
(not adjustable)

N.B. Values measure with unladen vehicle in running order (with fuel and specified fluids).

* NOT AVAILABLE AT TIME OF GOING TO PRESS

REAR ALIGNMENT

(see GR 21 - Front suspension - Technical Characteristics and Specifications).

TIGHTENING TORQUES

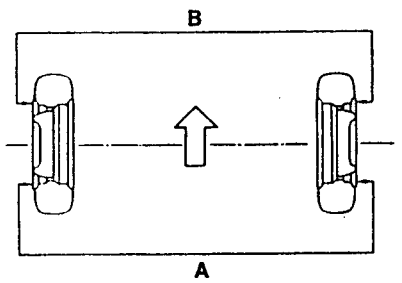
Description	N·m	kg.m
Hex. head screw for fastening front rebound pad to the body	92 ÷ 113	9.4 ÷ 11.6
Hex. head screw for fastening rear rebound pad to the body	92 ÷ 113	9.4 ÷ 11.6
Bolt fastening rear suspension wishbone to frame	142 ÷ 157	14.5 ÷ 16.0
Nut for screw fastening lower shock absorber to suspension	75 ÷ 92	7.6 ÷ 9.4
Hex. head screw for fastening upper shock absorber to the chassis	48 ÷ 59	4.9 ÷ 6.0
Nut for pin fastening rear hub	226 ÷ 294	27 ÷ 30
Hex. head screw for fastening stabilizer bar to rear suspension arm	48 ÷ 59	4.9 ÷ 6.0
Hex. head screw for fastening stabilizer bar support U-bolts to rear suspension arm	24 ÷ 29	2.4 ÷3.0
Wheel stud	83 ÷ 103	8.5 ÷ 10.5

SPECIAL TOOLS

TOOL NUMBER	DESCRIPTION
1.820.003.000	Tool for removing and refitting rear axle
1.822.005.000	Extension wrench for tightening rear wheel hub fastening nut

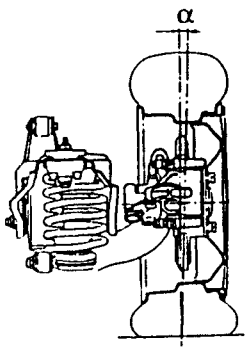
CHECKS AND ADJUSTMENTS

REAR WHEEL TOE-IN

A - B	1598	1747	1970
	0.5 ± 2 mm ↑		

N. B. Values measured with unladen car in running order (with specified fluids).

REAR WHEEL CAMBER

	1598	1747	1970
	α = -1° ± 15'		
	(unadjustable characteristic)		

N.B. Values measured with unladen car in running order (with specified fluids)

REAR GEOMETRY

(see GR. 21 - Front suspension - Technical characteristics and specifications).

TIGHTENING TORQUES

Description	Nm	kgm
Hexagon head screw for fastening front rubber rebound to body	92 ÷ 113	9.4 ÷ 11.6
Hexagon head screw for fastening rear rubber rebound to body	92 ÷ 113	9.4 ÷ 11.6
Bolt fastening rear suspension wishbone to frame	142 ÷ 157	14.5 ÷ 16.0
Nut for screw fastening front shock absorber to suspension	75 ÷ 92	7.6 ÷ 9.4
Hexagon head screw for fastening upper shock absorber to chassis	48 ÷ 59	4.9 ÷ 6.0
Nut for rear hub fastening pin	226 ÷ 294	27 ÷ 30
Hexagon head screw for fastening stabilizer bar to rear suspension arm	48 ÷ 59	4.9 ÷ 6.0
Hexagon head screw for fastening U-bolts supporting stabilizer bar to rear suspension arm	24 ÷ 29	2.4 ÷ 3.0
Wheel stud	83 ÷ 103	8.5 ÷ 10.5

SPECIAL TOOLS

TOOL NUMBER	DESCRIPTION
1.820.003.000	Tool for removing and refitting rear axle
1.822.005.000	Extension wrench for tightening rear wheel hub fastening nut

GROUP 28

WHEELS AND TYRES

INDEX

For all the parts not mentioned herein, see the corresponding Group of the manual "155 - INSTRUCTIONS FOR REPAIR" - PA465500000000 - (pages with publication no. PA4655C1000000)

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

TIGHTENING TORQUES

PART	N · m	kg · m
Wheel fastening screws (with rims in sheet metal)	83 ÷ 103	8.5 ÷ 10.5
Wheel fastening screws (with rims in alloy)	83 ÷ 103	8.5 ÷ 10.5

CHARACTERISTIC DATA

Dimensions

MODEL	RIM SIZES	TYRE SIZES	PRESSURES (bar)			
			REDUCED LOAD (2 PERSONS)		FULLY LADEN	
			FRONT	REAR	FRONT	REAR
2.0 T. Spark 16V	6.5Jx15"	195/55 VR15	2.2	2.0	2.5	2.5
	6.5Jx15"	205/50 VR15	2.5	2.3	2.8	2.5
	OPTIONAL 7J X 16"	205/45 ZR16				
	SPARE WHEEL (compact type) 4B X 15" for alloy rims 4J X 15" for steel rims	115/70 R15 90M	4.2			

CAUTION: In the event of continued driving at top speed, the pressures should be increased by 0.3 bar.

NOTE: For improved mating between the wheels and the car body the rims have a specific camber value for each rim size. Therefore, in addition to the correct rim adnd tyre match it is also necessary to check and mainatin the rim camber.

RIM SIZE	RIM CAMBER
6.5 J X 15"	37 mm
7 J X 16"	41 mm

155
T.SPARK 16V
REPAIR MANUAL

● BODY

 GROUP 40 - ELECTRICAL SYSTEM

 GROUP 43 - INSTRUMENT PANEL AND ELECTRONIC INSTRUMENTS

155 ◀  GROUP 49 - BODYWORK

155 ◀  GROUP 55 - DOORS

155 ◀  GROUP 56 - BOOT AND BONNET

155 ◀  GROUP 66 - INTERIOR TRIM

155 ◀  GROUP 75 - EXTERNAL TRIM

 GROUP 80 - HEATING AND VENTILATION

155 ◀ Refer to the corresponding Group in the "155 - REPAIR MANUAL" - PA4655D1000000

155
T.SPARK 16V
REPAIR MANUAL
ELECTRICAL & ELECTRONIC DIAGNOSIS

GROUP 40

ELECTRIC SYSTEM

INDEX

For all the parts not mentioned herein, see the corresponding Group of the manual "155 - INSTRUCTIONS FOR REPAIR" - PA465500000000 - (pages with publication no. PA4655D1000000)

ELECTRIC SYSTEM

RULES AND PRECAUTIONS

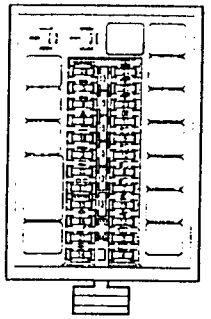
WARNING:
Before removing and refitting the components of the electric system, carefully read the RULES AND PRECAUTIONS.

Before starting any work, make sure that the ignition key is in the "parking" position and that the battery earth cable is disconnected and always:

- avoid connecting the output of control units directly to the load;
- never work directly on devices with cables connected to "positive" or to earth without before disconnecting the control units;
- avoid short circuiting the sensors of the system unless otherwise stated;
- before doing any electric welding, disconnect the control units to prevent possible damage to the electronic components caused by induced currents.

CAUTIONS:
Work on the systems foreseeing the possible consequences and do not intervene if you are not perfectly aware of the characteristics of the components concerned.
When re-assembling and/or refitting, reverse the sequence described for disassembly and/or removal, unless otherwise specified and restore the battery connection.
After replacing a component of the electric system you are strongly advised to re-stock with Genuine Alfa Romeo Spares. The use of non original Alfa Romeo components, with even slightly different features, can adversely affect the functional reliability and operating safety of the vehicle.
Never touch the glass surfaces of halogen bulbs with the hands. When replacing halogen bulbs only touch the parts in metal.

FUSES



LOCATION IN THE FUSEBOX

NOTE: in the centre, in the vertical position, there are some spare fuses.
The table below lists the fuses contained in the fusebox, with the corresponding symbol, amp rating and the services protected.

FUSE			SERVICES PROTECTED
SYMBOL	N°	AMP.	
	1	10A	Hazard warning lights
	2	25A	Horns, stop lights, radio, Boot opening control
	3	20A	Windscreen wiper
	4	25A	Cigar lighter, ceiling lamps
	5	10A	Controls lighting, LH rear sidelights, RH no. plate light., RH front sidelights, sidelights warning light.
	6	10A	Controls lighting, cluster lighting, RH rear sidelights, LH no. plate light, LH front sidelight, headlamp aiming device
	7	10A	Right low beam
	8	10A	Left low beam
	9	15A	Right high beam
	10	15A	Left high beam, high beam warning light
	11	7.5A	Rear fog guard, fog guard warning light
	12	30A	Heated rearscreen, heated rearscreen warning light, mirror defrosteri
	13	30A	Fan, rear power windows, adjustable and heated seats, radio
SERVICES	15	15A	Instr. cluster, windscreen-headlamp washer electric pump, reversing lights, glovebox light, check panel, engine fan, ALFA ROMEO CODE
	16	10A	Clock, ceiling lamps, conditioner control unit, alarm remote control
	17	7.5A	Direction indicators, mirror adjustment
	18	20A	Door locking device
	19	20A	Fog lamps, fog lamp warning light
	20	30A	Electric sunroof
	21	30A	Adjustable and heated seats
	22	25A	Left front power window (*)
	23	25A	Rear power window

(*) Versions with automatic LH front power window control

LOCATION ON AUXILIARY BRACKET

There is a set of fuses on an auxiliary bracket (not removable) at the left of the main fusebox.
The fuses are distinguished by the colour of the fuse-holder base that connects them to the wiring, according to the following table:

COMPONENT	AMP.	COLOUR OF BASE
Headlamp fuse	20 A	Yellow
ABS fuse - NOT CONNECTED -	10 A	Red
Front power window fuse	25 A	White
Front left power window fuse (*)	25 A	White
Climate control fan fuse	30 A	Green
Air conditioning system fuse	10 A	Red

(*): Versions with manual LH front power window control

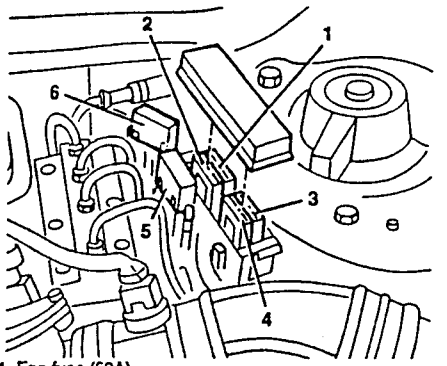
N.B. In addition to the colour of the base, it is also wise to check the exact location of a fuse by the colour of the wires that converge on it (for this see the corresponding wiring diagram in "ELECTRIC - ELECTRONIC DIAGNOSIS").

LOCATION IN THE ENGINE COMPARTMENT

In the engine compartment there are the fuses for the following systems:
general and system supply;
Injection and ignition system.

GENERAL AND SYSTEM SUPPLY

In the branch box, next to the A.B.S. control unit, there are the main supply fuses for all the systems of the vehicle:

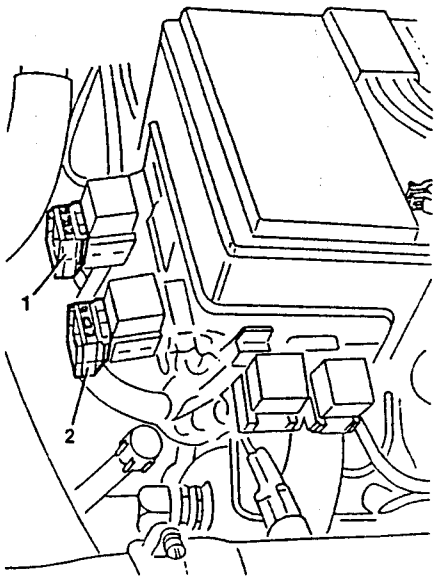


1. Fan fuse (50A)
2. Services supply fuse (50A)
3. General supply fuse (70A)
4. General supply fuse (70A)

Outside there are two other fuses:
5. Motronic system supply fuse (40A);
6. ABS system supply fuse (60A).

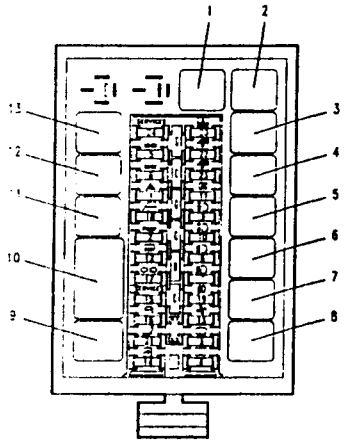
INJECTION AND IGNITION SYSTEM

The fuses, together with the relays of the same system are to be found on two brackets next to the battery.
1. Fuel pump fuse (10A)
2. Lambda probe fuse (7.5) (Models 2.0 m.y. '95)
   Lambda probe fuse (8) (Models 1.6 - 1.8 - 2.0 m.y. '96)



ELECTROMECHANICAL DEVICES, TIMERS AND INTERMITTENCES

LOCATION IN THE FUSEBOX



1- Engine water cooling fan 1st speed relay (only air conditioned versions)
2- Sunroof relay
3- Hazard warning lights and direction indicator relay
4- Rear fog guard relay
5- High beam relay
6- Key-operated supply relay
7- Fog lamp relay
8- Low beam relay
9- Heated rearscreen relay
10- Door locking control unit
11- Horns relay
12- Sidelights relay
13- Windscreen wiper electronic intermittence

LOCATION ON AUXILIARY BRACKET

Aset of relays is located on an auxiliary bracket (not removable) at the left of the main fusebox; next to this there are the power window control unit and the ALFA ROMEO CODE control unit (see Group 43).
The relays are distinguished by the colour of the relay holder base which connects them to the wiring, according to the following table:

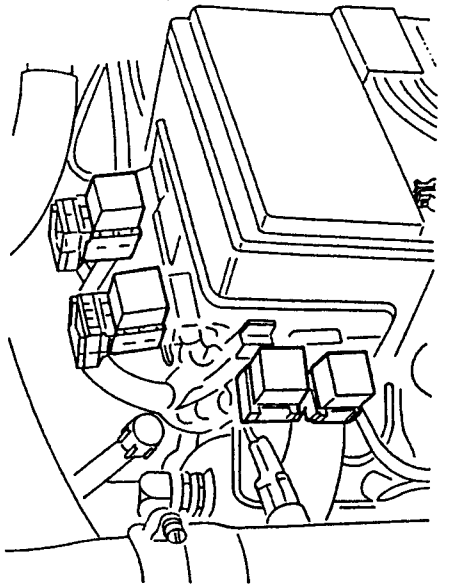
COMPONENT	COLOUR OF BASE
Boot opening relay (with 30 A fuse)	Red
Timer for headlamp washer	Black
Climate control auxiliary relay	Grey - Purple (*)
Compressor joint control relay	Grey
Engine cooling fan relay	Black

(*): Models 1.6 - 1.8 - 2.0 m.y. '96

N.B. In addition to the colour of the base, it is also wise to check the exact location of a relay by the colour of the wires that converge on it (for this see the corresponding wiring diagram in "ELECTRIC - ELECTRONIC DIAGNOSIS").

LOCATION IN THE ENGINE COMPARTMENT

A set of relays - for the Injection/ignition system - is located on two auxiliary brackets next to the battery.



The relays are distinguished by the colour of the relay holder base that connects them to the wiring, according to the following table:

COMPONENT	COLOUR OF BASE
Main relay	Black
Secondary timer	Black
Fuel pump relay	Black
Timing variator relay	Black

N.B. In addition to the colour of the base, it is also wise to check the exact location of a relay by the colour of the wires that converge on it (for this see the corresponding wiring diagram in "ELECTRIC - ELECTRONIC DIAGNOSIS").

GROUP 43

INSTRUMENT CLUSTER AND ELECTRONIC INSTRUMENTS

INDEX

For all the parts not mentioned here see the corresponding group of manual "155 - INSTRUCTIONS FOR REPAIR" - PA465500000000 - (Pages with publication no. PA4655D1000000)

INSTRUMENT CLUSTER AND ELECTRONIC INSTRUMENTS

RULES AND PRECAUTIONS

WARNING

Before disconnecting and refitting components of the electric system, carefully read the following RULES AND PRECAUTIONS.

Before doing any work, make sure that the ignition key is in the "parking" position and that the battery earth cable is disconnected, and at all tines:

- avoid connecting the output of control units directly to the load;
- absolutely avoid working directly on devices with cables connected to "positive" or earth without firstly disconnecting the control units;
- avoid short circuiting the sensors of the system unless otherwise specified;
- before doing any electric welding disconnect the control units to avoi damaging the electronic components due to induced currents.

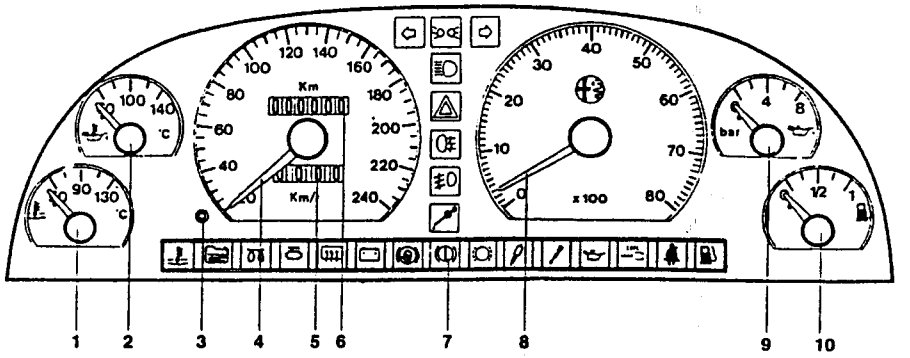
CAUTIONS:

Work on systems foreseeing the possible consequences and do not intervene when you are not perfectly familiar with the specifications of the components involved.

Whem re-assembling and/or refitting reverse the sequence followed for dis-assembly and/or removal, unless otherwise specified, and restore the battery connection.

After replacing a component of the electric system, you are strongly recommended to replace the spare with Original Alfa Romeo Spare Parts. The failure to use original Alfa Romeo components, with even slightly different characteristics may adversely affect operating reliability and safety of the vehicle.

ELECTRONIC INSTRUMENT CLUSTER



1. Engine coolant temperature gauge
2. Engine oil temperature gauge
3. Trip meter reset
4. Speedometer
5. Trip meter
6. Mileage recorder
7. Services warning light (see details on following page)
8. Rev counter
9. Engine oil pressure
10. Fuel level gauge

SERVICES WARNING LIGHT


LH direction indicator


Sidelights and low beam lights


RH direction indicator


High beam lights


Hazard warning lights


Rear fog guards


Fog lamps


Low engine oil level


High engine coolant temperature


Water in fuel oil filter (N.C.)


Glow plugs (N.C.)


Catalytic silencer temperature
(only for certain Versions/Markets)


Heated rearscreen


Generator warning light


ABS wheel anti-lock system


Low brake fluid level/handbrake engaged


Worn brake pads


Electronically-controlled suspension
(N.C.)


Injection system


Low engine oil pressure

ALFA ROMEO CODE


Seat belts


Fuel reserve

GROUP 80

HEATING AND VENTILATION

INDEX

For all the parts not mentioned herein, see the corresponding Group of the manual "155 - INSTRUCTIONS FOR REPAIR" - PA465500000000 - (pages with publication no. PA4655D1000000)

AUTOMATIC CLIMATE CONTROL WITH AIR CONDITIONER

The climate control system is the same as the one fitted on the other versions of the 155.

In the other version with T.SPARK 16V engines the layout of the cooling system in the engine compartment is different.

While the compressor coupled with these engines is a NIPPONDENSO TV 1450 with variavle dispalacement. Therefore the description given here only refers to the specific characteristics for this version, while for all the other shared parts, reference should be made to "155 - REPAIR INSTRUCTIONS - GROUP 80 "HEATING AND VENTILATION".

AIR CONDITIONING CIRCUIT

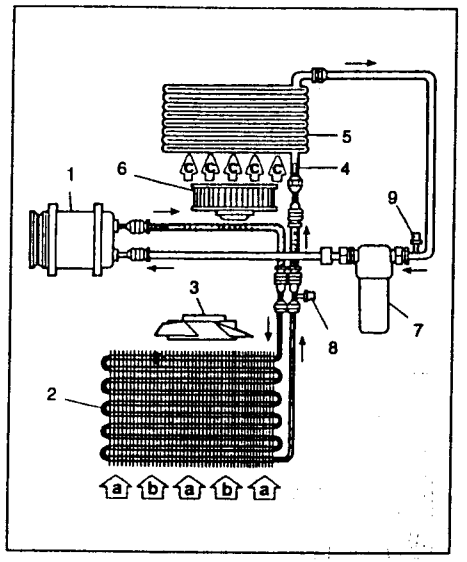
This circuit is shown schematically below and mainly comprises the following components:

- a **compressor** fitted on the engine, which compresses the refrigerant fluid from the evaporator outlet;
- a **condenser**, fitted in front of the engine refrigerant fluid radiator;
- an **evaporator**, located in the ducting unit;
- a **drier filter**.

The above-mentioned parts are connected to one another by suitable pipes. On the pipe connecting the condenser to the evaporator there is a **three-level pressure switch** which acts as a system control and safety device, protecting the circuit against over and underpressures.

For the **2.0 T.S. 16V** engine also an **antifrost pressure switch** is installed - before the drier filter - which prevents excessively low pressures in the circuit that might "freeze" the evaporator and block the system.

An **expansion valve** is inserted on the high pressure line.



High pressure circuit

Low pressure circuit

1. Compressor
2. Condenser
3. Condenser fan
4. Expansion valve
5. Evaporator
6. Evaporator fan
7. Drier filter
8. Three-level pressure switch (trinary)
9. Antifrost pressure switch

a. Flow of air for cooling the condenser: leading from the front grille when the car is on the move.

b. Flow of air for cooling the condenser: caused by the fan (3) when the car is at a standstill or travelling at low speed

c Flow of air for the evaporator: caused by the fan (5) fitted in the ducting-distributor unit.

OPERATING PRINCIPLE

The purpose of the air conditioner is to cool and dehumidify the air directed to the passenger compartment.

It works according to a common cooling cycle in the circuit of the - FREON R134a - fluid in which the changes of state (from liquid to gas and vice-versa) are exploited to absorb and release heat.

During operation, two levels of pressure are created in the circuit which are maintained on one side by the compressor and on the other side by an expansion valve at the evaporator inlet.

Two needle valves are fitted on the pipes for draining and refilling the system: one on the high pressure side and the other on the low pressure side.

The refrigerant fluid leaves the compressor as a gas at high pressure and high temperature. It then enters the condenser where it is cooled and comes out as a liquid.

The expansion valve, at the evaporator inlet lowers the pressure of the fluid thus also its temperature. The fluid, still in liquid form, enters the evaporator where it is vapourised, absorbing heat from the air pushed against its fins by the fan. The air in contact with the cold walls of the evaporator loses a high percentage of humidity which condenses and is drained off outside the car through a special drainage tube.

This way the air admitted inside the car is colder and less humid.

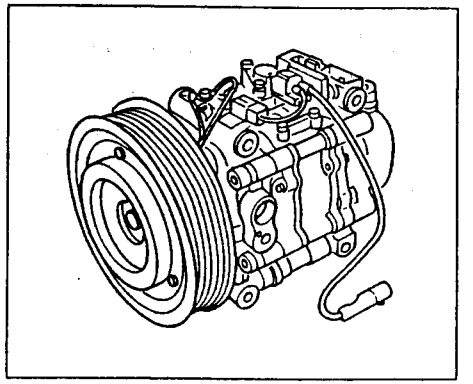
The fluid in a gaseous state leaves the evaporator and then passes through the drier filter which absorbs any water particles, which, if allowed to continue in the cycle could freeze and block the expansion valve, thereby reducing or nullifying the efficiency of the cycle; lastly, it returns to the compressor to resume the cycle.

COMPRESSOR

This compressor is a **NIPPONDENSO TV14SC** with variable displacement: the change in this parameter is carried out automatically by the compressor in relation to the load (difference in the pressure up and downstream of it): a special valve controls the opening of a by-pass which shuts off part of the fluid from the compression stroke; the displacement can be reduced to 17% of the maximum rate.

Adjustment takes place on the inlet pressure:

- **a low inlet pressure will make the system reduce the displacement.** This happens for instance when the cooling cycle is working in the best conditions : high engine rpm (and of the compressor), high thermal exchange at the condenser etc.; (without a compressor with this variable configuration the compressor would cut in and out continuously);
- **a high inlet pressure**, on the other hand, **increases the displacement** to its maximum value. This happens for instance with low engine rpm and high requirements for "cold".



Composition and operation

The compressor consists of a body (1) in which a chamber (2) has been made. Four blades (3) turn inside this chamber pulled by a hub (4) whose axis of rotation does not coincide with the chamber's theoretical axis. The particular geometry of the chamber is such that as the blades turn they always contact the inner surface of the chamber: this means that differences in the compartments between one blade and the next can be obtained during rotation.

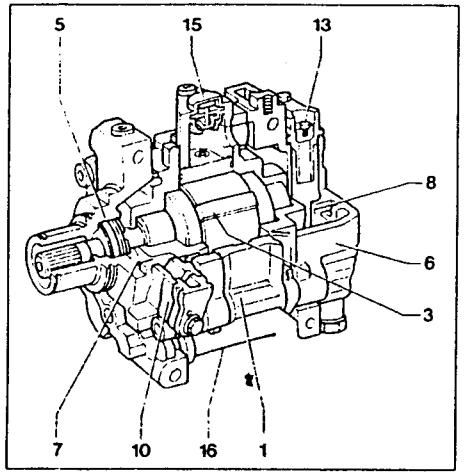
Two covers, front (5) and rear (6) are fastened to the compressor body (1) to form an intake or low pressure chamber (7) and a high pressure chamber (8) respectively. The gas taken in through union (10) on cover (5) passes through the low pressure chamber (7) and slot (11) on the body (1).

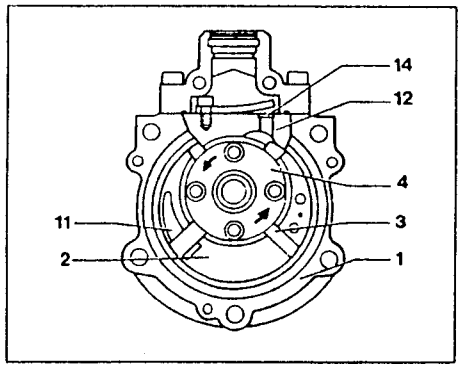
The gas is then compressed and pushed through the duct (12) in the high pressure chamber (8) and sent to the system via union (13). The reed valve (14) prevents the high pressure gas from returning to the compressor.

On the top section of the body there is a temperature sensitive contact (15) connected in series to an electromagnetic joint. When the temperature reaches dangerous limits (over 160°C), this contact (15) cuts out the compressor; it activates it again if the temperature falls below 140°C.

This way operation is prevented under dangerous conditions such as lack of fluid or oil.

The pressure regulator (16) in the lower section of the compressor serves to adjust the flow rate of the fluid in the compressor, as described on the next page.





Flow rate control

The flow rate control is obtained through a pneumatic mechanism incorporated in the compressor, which by-passes part of the gas in the compression phase, at the intake, i.e. in the low pressure chamber.

When activated, this system makes it possible to reduce the compressor flow rate gradually and continuously to appr. 17% of the total capacity.

The mechanism comprises the piston (A) which can run in the cylinder (C) countered by the spring (B).

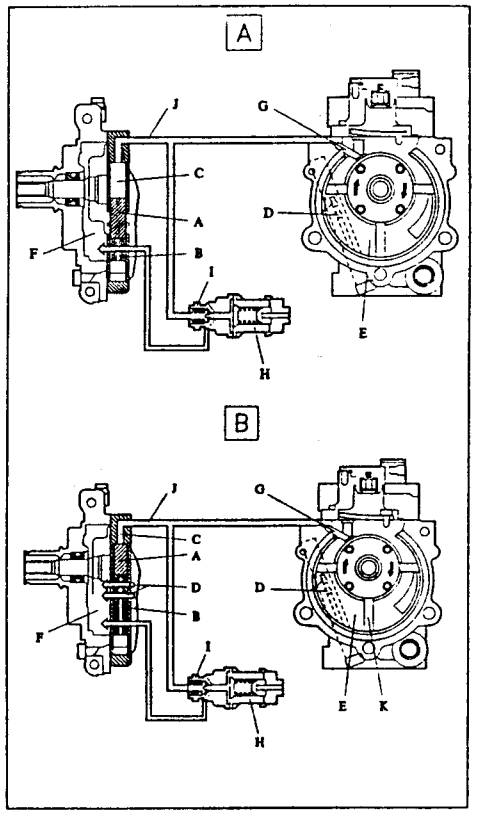
When the piston is positioned as shown in figure A, it cuts off holes (D) which connect compartment (E) - in which the gas begins to be compressed - with the low pressure chamber (F). Conversely, when the piston (A) is in the position shown in Figure B, the holes (D) connect the two chambers.

The piston is operated by a small amount of the pressurised gas withdrawn from duct (J) which communicates with the calibrated hole (G).

The pressure regulator (H) is adjusted by the difference in pressure between intake - chamber (F) - and delivery: when the intake pressure is high valve (I) is closed, and the pressure of the gas acts on piston (A) taking it to the position of figure A. Holes (D) are cut off and by-passing does not take place. This starts off compression of the gas in chamber (E) as described.

When the intake pressure falls, the regulator (H) opens the valve (I) allowing the pressurised gas in duct (J) and in cylinder (C), to discharge into the low pressure chamber (F). Becasue of, piston (A) is pushed by the spring (B) allowing the by-pass holes (D) to open.

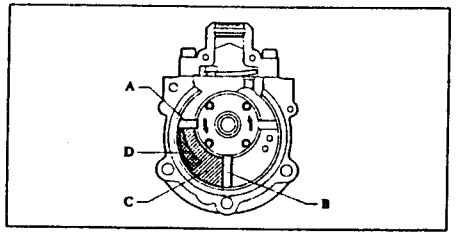
This way, part of the gas in chamber (E) - start of compression - can flow into the low pressure chamber (F), until blade (K) has covered the holes (D); this reduces the amount of gas in chamber (E) resulting in the reduction of the compressor flow rate.



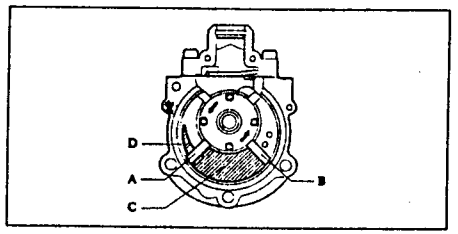
a -Nnormal operation
(100% Capacity - by-pass closed)

Intake

The gas is taken in through the inlet slot (D) as compartment (C) gradually expands between blades (A) and (B): This is the beginning of the intake phase.

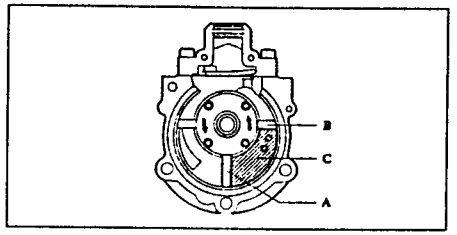


The new position of blades (A) and (B) gives compartment (C) its maximum volume. Blade (A) cuts compartment (C) off from slot (D) thereby completing the intake phase.



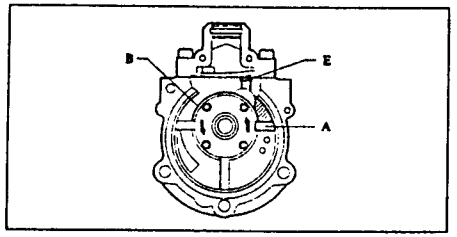
Compression

The volume of compartment (C) is reduced and the gas pressure increases. This begins the compression phase.

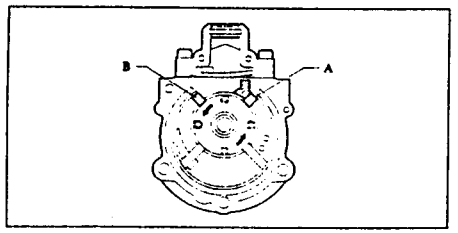


Discharge

The pressure of the gas increases further until the reed valve (E) opens: this precise instant ends the compression phase and begins the discharge phase.



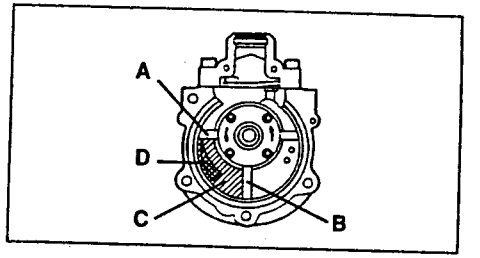
When blades (A) and (B) reach the position illustrated the discharge phase ends.



B - Operation with reduction of the displacement (Down to 17% of the displacement - by-pass open)

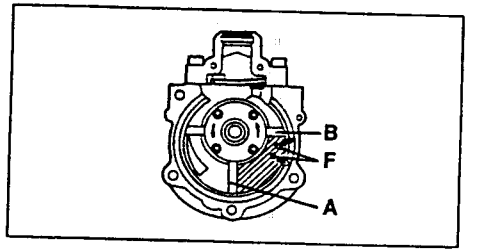
Intake

The gas is drawn in by the intake port (D) due to the gradual expansion of compartment (C), delineated by blades (A) and (B): this is the start of the compression stage.



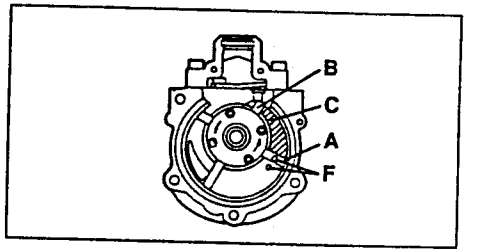
By - pass

If the holes (F) are open part of the gas flows out: the compression stage does not start yet.



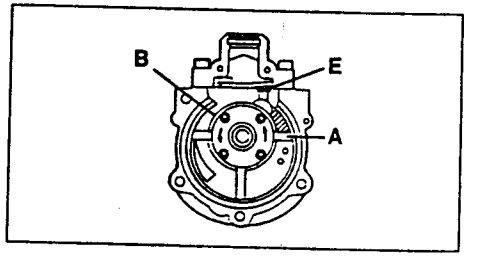
Compression

Once past the holes (F), compartment (C) reduces in volume thereby increasing the pressure of the remaining gas (down to a minimum of 17% of the total): the compression stage starts.



Exhaust

The pressure of the gas further increases until it opens the reed valve (E): in this precise moment the compression stage ends and exhaust begins.



Lubrication

The lubricating oil is contained in the high pressure chamber (A).

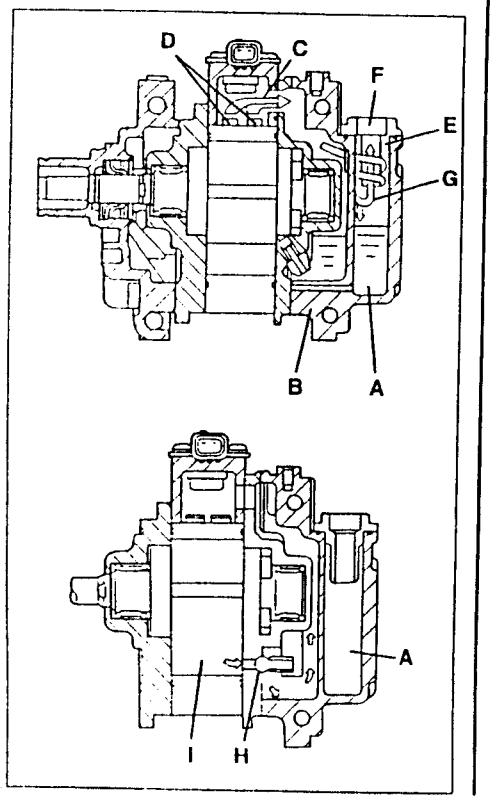
When the compressor is operating the high pressure in the chamber pushes the oil through the calibrated hole (B) into the inner moving components.

The oil mixed with gas (C) is sent out through the reed valves (D) in the high pressure chamber.

A separator device (E) installed in the gas outlet union separates it from the oil(G) which falls by gravity into the bottom of the chamber (A) while the gas flows out of the union (F).

This device makes it possible to minimise the quantity of oil admitted into the system piping thereby increasing the thermal yield.

The compressor is also fitted with two safety valves (H) which relieve any overpressure in the compression chamber (I).



Compressor cut-in and cut-out strategy

Compressor engagement is operated by the electromagnetic joint controlled by the electronic injection management system of the engine.

Indeed the compressor absorbs a fair amount of power to the disadvantage of the overall output of the engine, and in certain instances, this must be avoided:

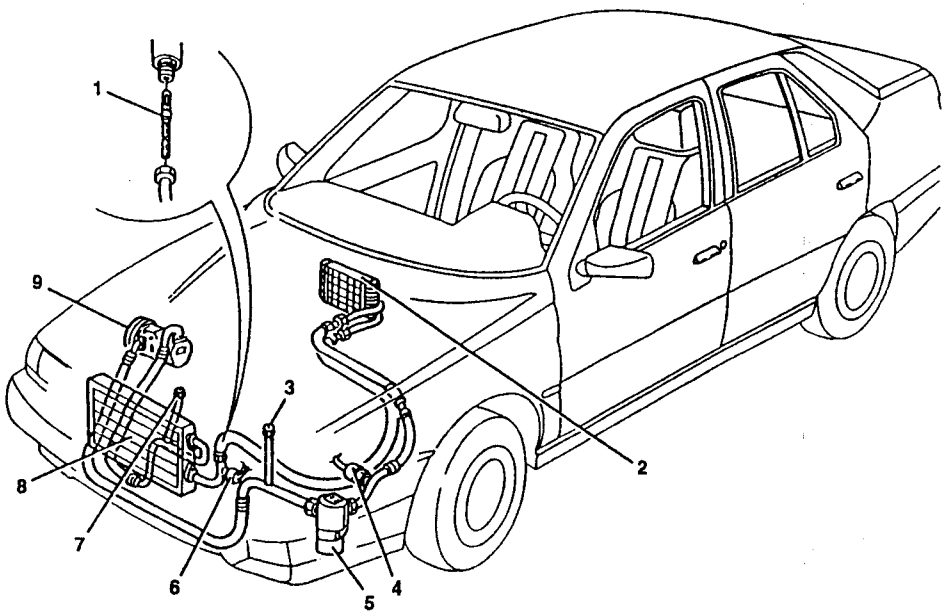
- at idle speed the engine must adapt its own speed taking account of this increase in absorbed power;
- when the engine is started or when high load is required, the compressor is cut off to leave all the available power for the engine.

The control unit carries out the following strategies:

- adapts the engine idle speed each time the compressor is engaged; if the speed falls below the idle speed rate, the compressor is cut off;
- in the event of the need for high power, over 6000 rpm (high throttle opening speed), or full load, or high engine temperature (above 117°C), the compressor is momentaneously disengaged;
- when the engine is started it prevents the compressor from being engaged until normal operating conditions are reached.

NOTE: You are reminded that the NIPPONDENSO TV14SC compressor with which this version is fitted, automatically cuts off the compressor if the temperature of the coolant fluid inside the compressor exceeds 160°C.

LOCATION OF COMPONENTS



1. Expansion valve
2. Evaporator
3. Needle valve on low pressure pipe
4. Antifrost pressure switch
5. Drier filter
6. Three-level pressure switch
7. Needle valve on high pressure pipe
8. Condenser
9. Compressor

OPERATING PROCEDURES

GENERAL PRECAUTIONS FOR OPERATIONS ON THE CLIMATE CONTROL SYSTEM

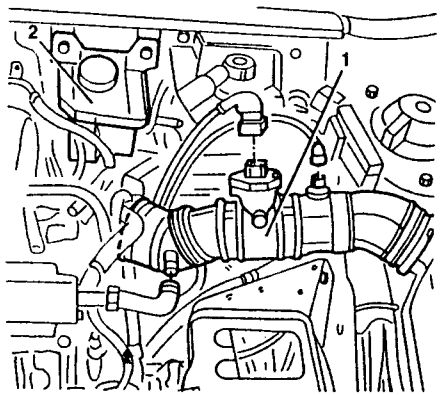
- Before doing any maintenance and repair work you are advised to disconnect the battery negative terminal.
- Before dis-assembling the system it is necessary to drain the system and recover the coolant fluid.
- During operations, when the system components are disconnected, suitably plug the disconnected fittings to prevent the entrance of moisture and impurities in the system.
- When refitting the pipe fittings replace the O-rings on the fittings themselves.
- Lubricate pipe fitting threads with the specified antifreeze oil and tighten the fittings to the specified torque.

DUCTING/DISTRIBUTOR UNIT

REMOVAL

- Dis-assemble and remove the tunnel console (see: GR. 66).
- Dis-assemble and remove the control unit (see corresponding paragraph).
- Dis-assemble and remove the underdash trim (see: GR. 66).
- Remove the battery after disconnecting the terminals.

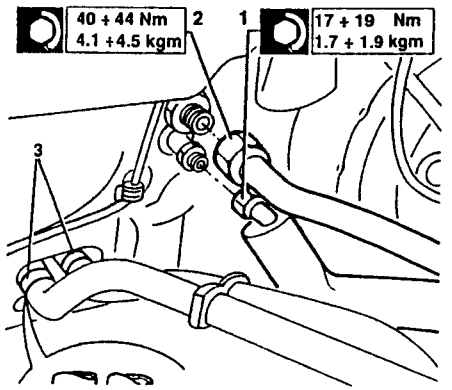
1. Remove the corrugated air inlet pipe between the cleaner and the throttle after disconnecting the air-flow meter.
2. Empty the power steering tank and remove it slackening the two screws fastening it to the services tray partition and disconnecting the pipes.



1. Using wrenches 1.822.111.000 and 1.822.113.000 disconnect the piping from the evaporator to the condenser.
2. Using wrenches 1.822.112.000 and 1.822.115.000 disconnect the piping from the evaporator to the drier filter.

– Remove the exhaust pipe - front section.

3. Open the clamps and disconnect the two engine coolant delivery and return pipes in the heater: N.B. recover the fluid.



NOTE: The two pipes are distinguished by only one notch (A) and two notches (B) so that it is impossible to invert them.

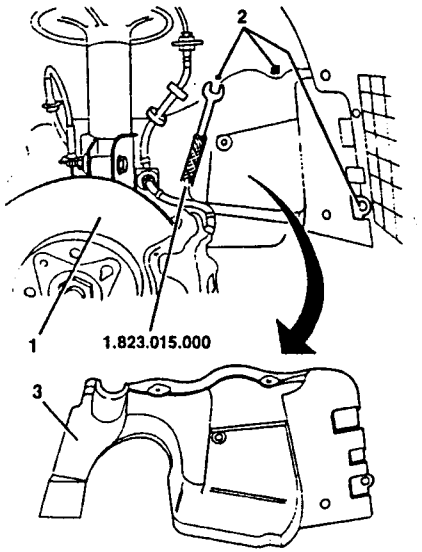
Continue with the removal procedure following the instructions given - for on-vehicle operations - in the corresponding Group of manual "155 - INSTRUCTIONS FOR REPAIR" - PA465300000000 - (pages with publication no. PA4653D1000000).

COMPRESSOR

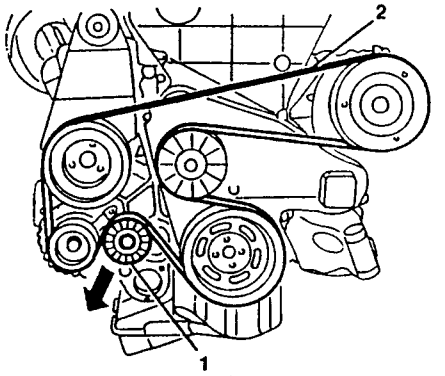
Removal

– Disconnect the battery negative terminal.
– Drain the coolant fluid.

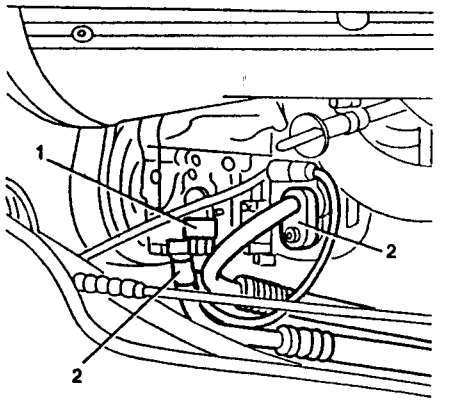
1. With the car on the lift remove the right front wheel.
2. Using the special tool No. 1.823.015.000 remove the plastic buttons fastening the partition between the wheelhouse and the engine compartment.
3. Remove the partition.



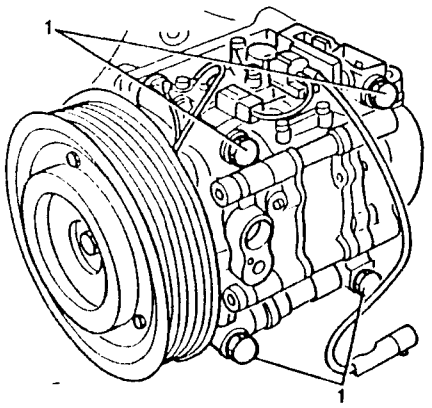
1. Lower the belt tensioner guide pulley slackening it slightly.
2. Remove the belt.



1. Working in the engine compartment disconnect the electrical connection of the compressor.
2. Disconnect the two pipes from the compressor.



1. Slacken the four fastening screws and remove the compressor, withdrawing from above.



Refitting

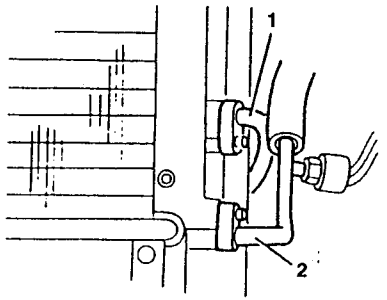
Tension the belt (see GROUP 00).
Lubricate the fittings with the specified oil.
Tighten to the specified torque where applicable.
NOTE: The spare compressor is supplied pressurised with nitrogen to prevent the entry of moisture and impurities; therefore when assembling it is necessary to remove the inlet and outlet fitting plugs slowly and with the compressor strictly positioned as illustrated below (with the cover facing upwards).

CONDENSER

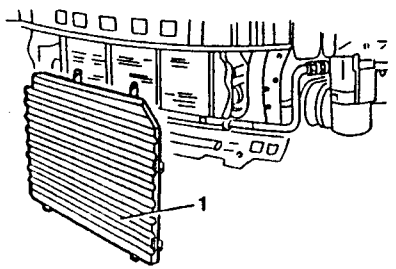
Removal

- Drain the coolant fluid;
- Set the car on the lift.
- Remove the front bumper (see GROUP 75).

1. Disconnect the coolant fluid pipe leading to the compressor
2. Disconnect the pipe leading to the evaporator.



1. Slacken the fastening screws and remove the condenser withdrawing it from below.



Refitting

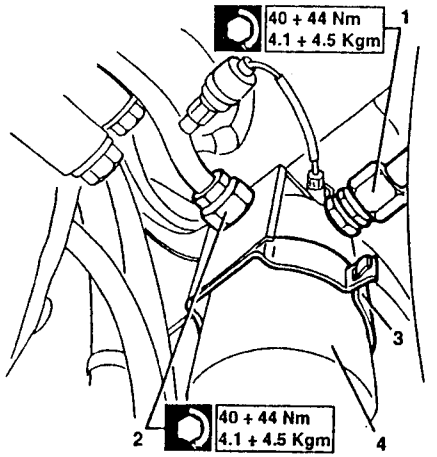
Take care not to damage the thermal fins of the condenser.
Lubricate the fittings with the specified oil and tighten them to the specified torque.

DRIER FILTER

Removal

- Drain the coolant fluid.
- Set the car on the lift.

1. Disconnect the pipe leading from the compressor.
2. Disconnect the pipe leading from the evaporator.
3. Slacken the fastening clamp.
4. Remove the filter.



Refitting

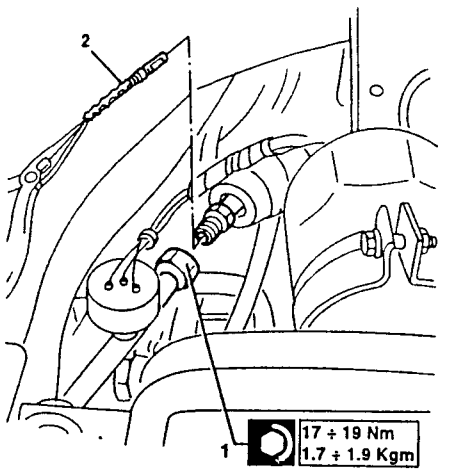
Lubricate the fittings with the specified oil.
Tighten the fittings to the specified torque.

EXPANSION VALVE

Removal

- Drain the coolant fluid.
- Set the car on the lift.
- Remove the front bumper (see GROUP 75).

1. Slacken the connection nut and gain access to the valve.
2. Withdraw the valve using a pincer and taking care not to damage it.



Refitting

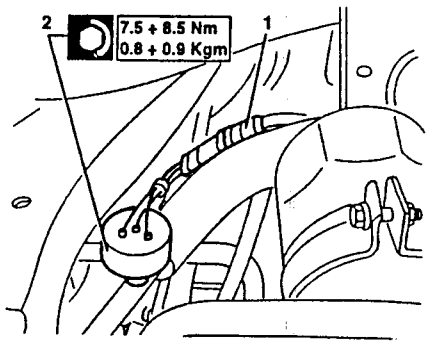
Lubricate the fittings with the specified oil.
Tighten to the specified torque.

THREE-LEVEL PRESSURE SWITCH

Removal and Refitting

- Disconnect the battery negative terminal.

1. Disconnect the pressure switch connector.
2. Using a suitablke wrench remove the pressure switch.



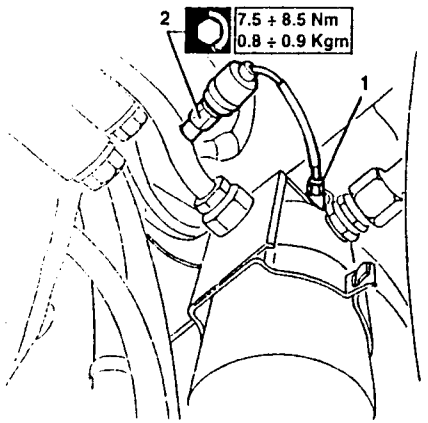
NOTE: Due to the presence of a check valve, the pressure switch can be removed without having to drain the coolant fluid, like all the other components of the air-conditioning system.

ANTIFROST PRESSURE SWITCH

Removal and Refitting

- Disconnect the battery negative terminal.
- Set the car on the lift.
- Remove the front bumper (see GROUP 70).

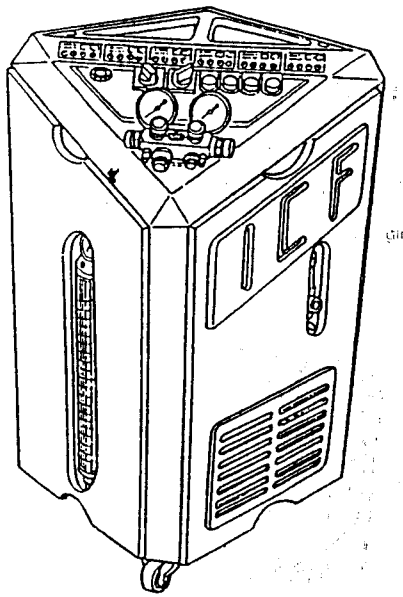
1. Disconnect the pressure switch connector.
2. Slacken the pressure switch and remove it.



NOTE: Due to the presence of a check valve, the pressure switch can be removed without having to drain the coolant fluid, like all the other components of the air-conditioning system.

SYSTEM EMPTYING AND RECHARGING OPERATIONS

N.B. Only use the special emtyping and recharging station for R134a fluid no. 1.826.004.000.



For the following operations:

- **Emptying the system and recovering the coolant fluid;**
- **Recharging the coolant fluid;**
- **Topping up the compressor oil level;**
- **Flushing the system,**

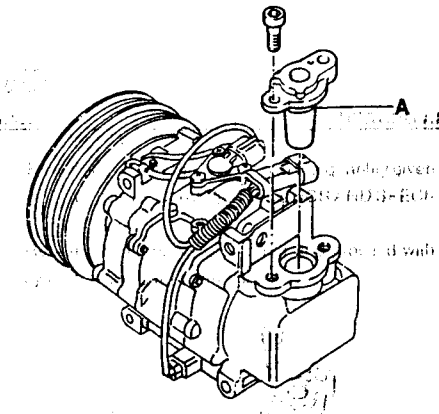
follow the instructions given in the corresponding group of the manual "155 - INSTRUCTIONS FOR REPAIR" - PA4653D1000000).

For the engine in question also observe the following instructions:

REPLACING THE COMPRESSOR OIL

- Remove the compressor (see specific paragraph).
- Remove the oil separator device (A) fastened next to the outlet union of the compressor and drain all the oil contained in the compressor.

- Fill with new oil of the type and in the quantity given in "TECHNICAL CHARACTERISTICS AND SPECIFICATIONS".
- Refit the compressor on the car and proceed with system recharging operations.



REPLACING THE DRIER FILTER

In production (and also as spare) the drier filter is supplied with a certain quantity of oil.

NOTE: this filter is easily distinguished by a label with the wording "CONTAINS 130 C.C. OF NIPPONDENSO N.D.9 OIL".

- Drain the R134a fluid from the conditioning system.
- Remove the filter (see specific paragraph).
- Drain the oil from the filter just removed, recovering it in a special recipient.
- Carry out the same operation for the new filter.
- In the new filter pour the same amount of oil as removed from the old filter (eliminate or add accordingly).
- Refit the filter on the car and proceed with system recharging operations.

TECHNICAL CHARACTERISTICS AND SPECIFICATIONS

MINIMUM PRESSURE SWITCH SETTING

Contact opening pressure	1.7 ± 0.02 bar
Contact closing pressure	3.4 ± 0.5 bar

THREE-LEVEL PRESSURE SWITCH (TRINARY) SETTING

1. Level	contact opens	2.45 ± 0.25 bar
	contact closes	2.60 ± 0.34 bar
2. Level	contact opens	15.2 ± 0.98 bar
	contact closes	11.28 ± 1.99 bar
3. Level	contact opens	25 ÷ 30 bar
	contact closes	17 ÷ 26 bar

EXPANSION VALVE

Diameter of calibrated hole	Brown mesh	1.55 mm
	White mesh	1.8 mm

COMPRESSOR

Brand	NIPPONDENSO
Type	TV 14SC
Number of blades	2
Length of blades	72.5 mm
Depth of blades	38.5 mm
Cylinder displacement	127 cm^3/turn
Weight	4.05 kg
Quantity of oil (type ND9)	160 ± 20 cm^3
Operating voltage of electromagnetic joint	12V
Minimum current absorbed by electromagnetic joint	2.2A
Power absorbed by electromagnetic joint	min. 40W

FLUIDS AND LUBRICANTS

TYPE	APPLICATION	QUANTITY	NAME
OIL	Oil for filling the compressor and lubricating system pipe fittings	290 ± 30 cm^3 (1)	NIPPONDENSO ND-9
FLUID	Filling conditioner system circuit	0.7 ± 0.05 kg (2)	RIVOIRA: SUVA R134a HOECHST - TAZZETTI: FRIGEN R134a ICI - TAZZETTI: KLEA R134a

(1) In the event of replacing components:
- the compressor is supplied with 160 ± 20 cm^3 of oil.
- the drier filter is supplied with 130 ± 10 cm^3 of oil.

(2) added quantity to be calculated taking account of the fluid remaining in the pipes of the recharging equipment.

TIGHTENING TORQUES

Part	Nm	kgm
Union fastening the evaporator/drier filter pipe on the evaporator	40 ÷ 44	4.1 ÷ 4.5
Union fastening the evaporator/drier filter pipe on the drier filter	40 ÷ 44	4.1 ÷ 4.5
Union fastening the drier filter/compressor pipe on the drier filter	40 ÷ 44	4.1 ÷ 4.5
Union fastening the condenser/evaporator pipe on the evaporator	17 ÷ 19	1.7 ÷ 1.9
Intermediate pipe union on which the expansion valve is installed	17 ÷ 19	1.7 ÷ 1.9
Trinary pressure switch fastening	7.5 ÷ 8.5	0.8 ÷ 0.9
Minimum pressure switch fastening	7.5 ÷ 8.5	0.8 ÷ 0.9

SPECIAL TOOLS

TOOL NUMBER	DESCRIPTION
1.822.111.000	Socket wrench for Freon pipe fittings
1.822.112.000	Polygon claw wrench for Freon pipe fittings
1.822.113.000	Square wrench for Freon pipe fittings
1.822.115.000	Toothed wrench for Freon pipe fittings
1.823.015.000	Puller tool for plastic buttons
1.826.004.000	Emptying and recharging station for R134a

GENERAL INDEX

This manual "155 T.SPARK 16v - REPAIR MANUAL - ELECTRICAL-ELECTRONIC DIAGNOSIS" has been divided into sections each of which deals with a subject inherent to an installation, electrical or electronic system present on the vehicle.
The first sections are of a general nature and show the supply to the various systems and installations. This is followed by the sections relevant to the external and internal illumination and then those of the various accessory systems (windscreen wipers, door locks, power windows etc.).
The sections relative to the more complex systems (conditioner etc.) and to the engine and vehicle control systems (electronic ignition/injection, ABS etc.) are to be found towards the end of the manual.

The sections are divided and numbered thus:

ALPHABETICAL INDEX

INTRODUCTION

INDEX

This Group "ELECTRIC SYSTEM DIAGNOSIS" contains all the necessary information regarding the **electric and electronic systems and circuits on these models.**

All the instruments which are useful in finding faults and failures that might occur in the above-mentioned systems are given particular attention.

Each circuit is dealt with separately in a specific section in which the following can be found:

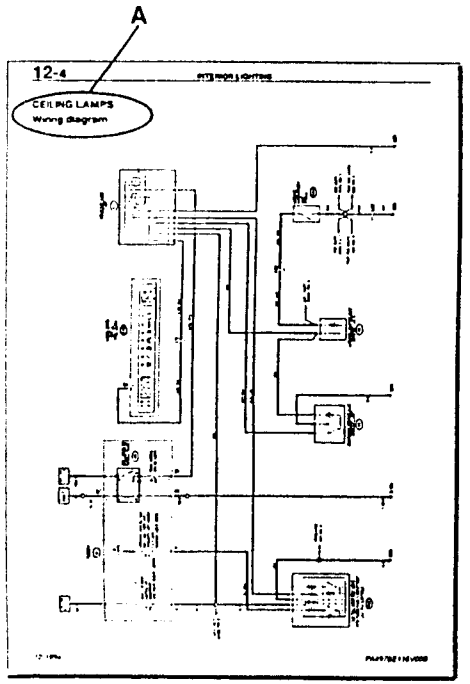
- operation and description of the circuit;
- wiring diagram;
- locating the main components;
- table for locating the more frequent faults with relative test procedures for the components.

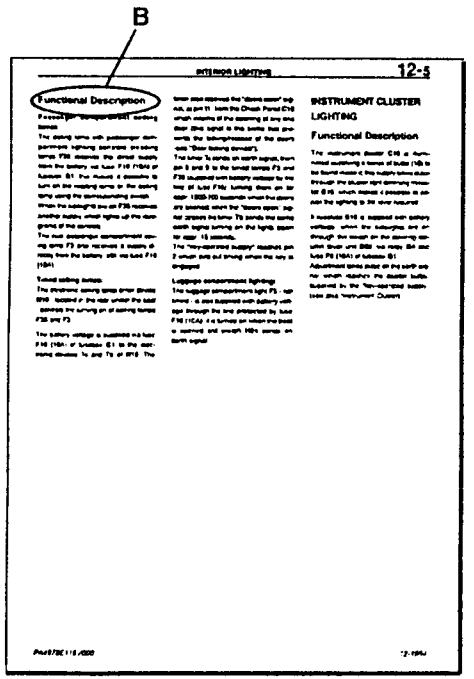
STRUCTURE OF THE MANUAL

This manual is subdivided into sections, each dealing with and analyzing a single circuit. All the sections are identical in lay-out and comprise 5 parts:

A wiring diagram:

B general description (description of the circuit and its operation) and functional description (analytical illustration of the wiring system): Sometimes the general description is extensive and detailed, as important service information is given: in this case it precedes the wiring diagram to introduce the subject.



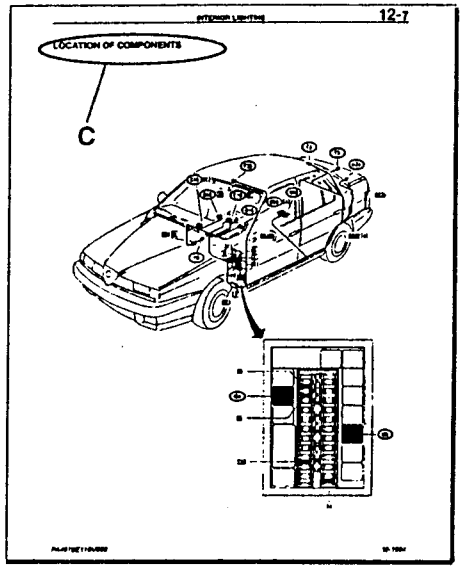


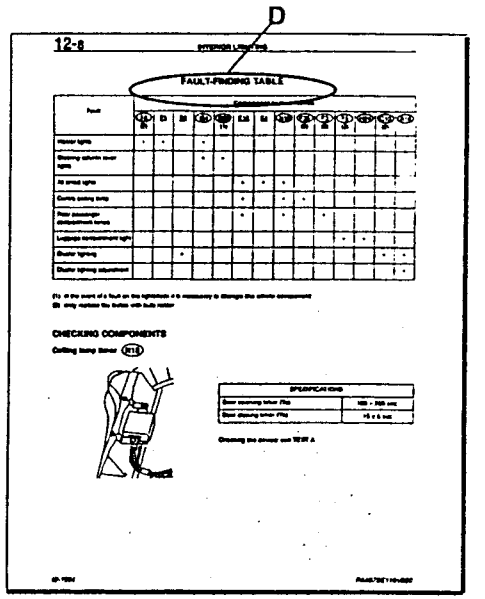
C location of the components on the car;

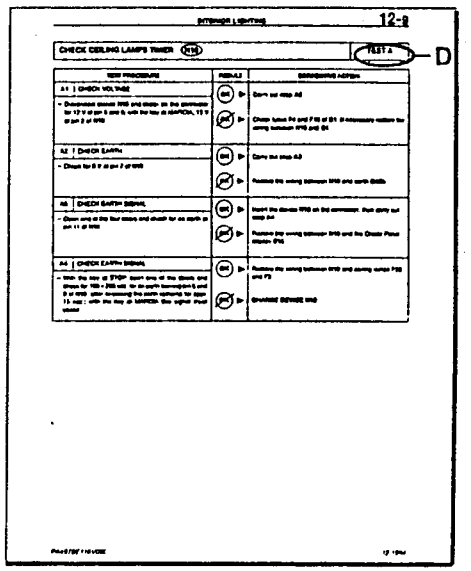
D trouble-shooting including "fault-finding tables", "checking components" and tests:

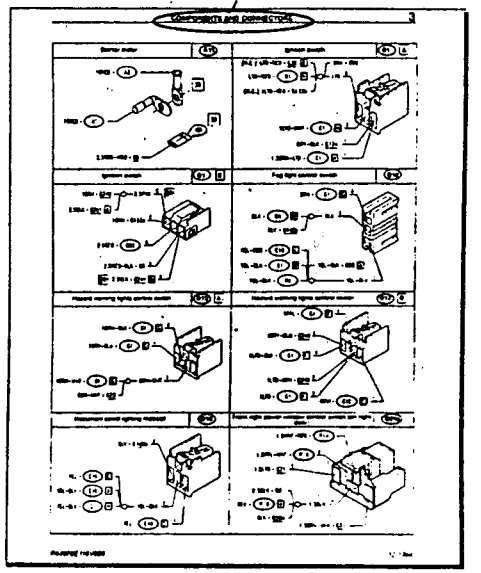
At the end of each section the following are given:

- **key to components;**
- **tables of components and connectors**, illustrated one by one completely (in alphabetical order);









WIRING DIAGRAMS

The wiring diagrams are made following the operation of the circuit in order to make it easier to understand them, therefore quicker to identify a fault.
The lay-out follows the "flow" of the current and signals, starting from the power source (always placed higher up) passing the components and reaching the earths located lower down.
The power supply is represented schematically with different symbols which vary depending on the position of the key in the ignition:


– line under constant supply (directly connected to the battery)


– line supplied when the ignition key is turned to "RUN" (first position of the key)


– line supplied when the key is turned to "STARTING" (second position of the key which is disengaged when the key is released)


– line supplied when the key is either in the "RUN" or "STARTING" position.


– line supplied when the key is in the "PARKING" position (key turned in the opposite direction and withdrawn after pressing the special button.

A special section ("**Power Supply**") deals in detail with the power supply to all the lines and operation of the ignition switch.

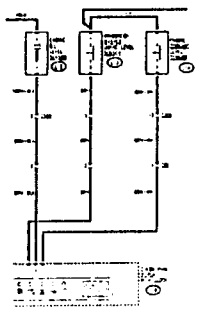
The fusebox is not represented wholly in the single diagrams and only the components useful to the diagram under examination are given, a complete description of the whole fusebox is given in the specific section ("**Fusebox**").

All the components and connectors are represented in the diagrams by an alphamenc code (eg. A10). The initial letter of this code represents the type of component:

A	STARTING - RECHARGING
B	MANUAL ELECTRICAL CONTROLS
C	INSTRUMENTATION
D	WARNING LIGHTS
E	EXTERIOR LIGHTS
F	INTERIOR LIGHTS
G	FUSEBOXES - CONNECTORS - EARTHS
H	SWITCHES
I	RELAYS
L	SENDERS
M	ELECTROMAGNETS - SOLENOID VALVES
N	ELECTRONIC DEVICES - INTERMITTENCES - TIMERS
O	SERVICES
P	ELECTRIC MOTORS
Q	HEATING/VENTILATION - AIR CONDITIONING
R	SAFETY DEVICES
S	ELECTRONIC INJECTION
T	DIAGNOSIS

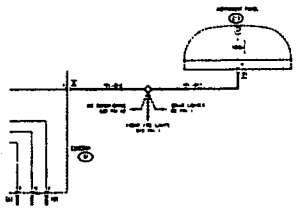
A complete key is given at the end of all the wiring diagrams.

The names of the components are given in the charts and the codes are circled, but, for reasons of space, the codes for simple connectors (connections) are only underlined.



The components are always shown in their rest position: eg. the N.C. (normally closed) contacts are shown closed, the relays deactivated, etc..

The outline of a component is hatched to indicate that in the chart in question only part of it is shown; for example, the fusebox, due to the reasons mentioned above, will always be shown hatched.
Wherever necessary, arrows indicate references to other relevant diagrams.



The earth lines only show the earth point (located in the lower part of the diagram) to which they are connected and not the other lines connected to it; A special section "Location of Earths" gives all the lines converging on each earthing point.

NOTE: these crossed references between the lines and on the earths make it possible to easily identify the faults in the event of failures in more than one circuit at the same time: for example, a faulty earth point will cause a failure to all the circuits which converge on it.

NOTE:
The versions with a smaller number of accessories might not have all the solderings to be found in the wirings of the complete versions.

CABLE IDENTIFICATION

Each cable shown in the diagrams is characterised by a code formed by numbers and letters: the numbers indicate the cable diameter in sq.mm (0.5 where not stated), while the letters indicate the colour according to the table given below:

CABLE IDENTIFICATION TABLE

COLOUR	IDENTIFICATION LETTER
Black	BLK
White	WHT
Light blue	LTB
Brown	BRN
Yellow	YEL
Red	RED
Green	GRN
Grey	GRY
Pink	PNK
Orange	ORN
Purple	PPL
Blue	BLU

NOTE: for combinations the colours are simply coupled:

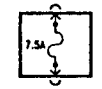
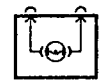
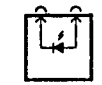
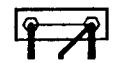
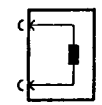
Light blue-white	LTB-WHT
Green-black	GRN-BLK
Blue-Red	BLU-RED

ELECTRICAL COMPONENTS

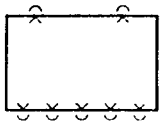
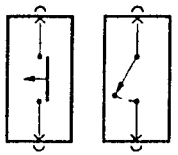
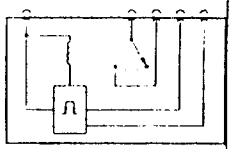
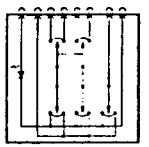
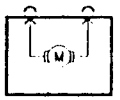
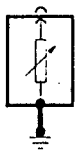
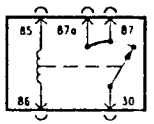
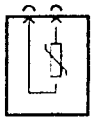
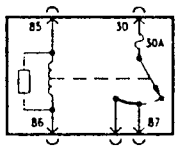
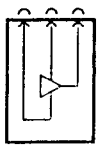
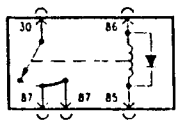
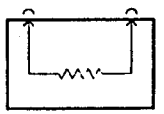
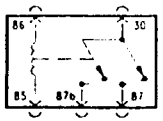
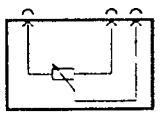
The electrical components are represented in the diagrams by the most-frequently used and best-known international symbols.

The following table lists these symbols as they are shown in the diagrams:

COMPONENT SYMBOLOGY

SYMBOL	NAME
	Connector
	Earth point
	Ultrasound solder
	Fuse
	Bulb
	Led
	Battery
	Branch point
	Solenoid

COMPONENT SYMBOLOGY

SYMBOL	NAME	SYMBOL	NAME
	Electronic control unit		Switch/ contact
	Electronic device (eg. intermittence-timer)		
	Electric motor		
	Relay		Sensor/ sender
	Relay with fuse		
	Relay with diode		Resistance
	Relay with double contact		Rheostat

DESCRIPTION

The first part (general description) describes the purpose of the circuit or system under examination and shows how it works: this is a condition which is necessary for each subsequent operation check and for any trouble-shooting found to be necessary.
The second part (functional description) shows the wiring diagram analytically, following the "flow" of the supply signals towards earth from the upper section downwards.
The components are identified by the same alphameric codes used in the diagrams (and in the key at the end of this publication).
A brief description is also given of the components which need to be outlined from an electrical point of view (eg. relays, contacts, fuses, connectors,...) in order to be able to check their functioning during the subsequent fault diagnosis tests.

LOCATION OF COMPONENTS

Schematic diagrams representing the silhouette of the car makes it easy to find the various components of the circuit under examination and to locate, where necessary, the routing of the cables fastened to the body of the vehicle itself.

FAULT FINDING

The descriptive section is followed by the **"FAULT-FINDING TABLE"** which lists the possible (and most frequent) faults which can affect the circuit in question: for each of these, the possible components involved are listed: **the components are listed in the order of likelihood of a fault (for example first the fuses) or the ease with which access may be gained to them.** In the example below, the fault affecting function X involves components 1 and 5, that of Y involves components 2, 3 and 4.

Failure	Component				
	1	2	3	4	5
X	•				•
Y		•	•	•	

N.B. All the fault finding procedures given in this publication begin from the hypothesis that there is ONLY ONE FAULT in the system. In the very unlikely event of simultaneous faults it will be necessary to combine more than one procedure.
If more than one circuit or system are out of order at the same time, there are at least two situations that can be easily recognized: the failure of a fuse protecting different lines (for this refer to the section "Fuseboxes") or a fault in an earth point on which different lines converge (for this, refer to the section "Location of Earths". After the faultfinding table the list of **COMPONENT CHECKS** is given: this lists the characteristics and technical data needed to quickly check the operation of components that are not considered elementary (eg. bulbs, switches, fuses, etc.).

If the checking operation is complex, it is described in detail in a **FAULT FINDING TEST** to be found at the end of the section.

N.B.
If the fault persists when the single components and their connections have been checked, it is necessary to check the electrical continuity and for any short circuits or cut offs following the different lines concerned, referring to the wiring diagram at the beginning of each section.

Each of the above-mentioned tests is identified by a letter.

The tests are described in three column tables with the following arrangement:

1st column: "TEST PROCEDURE":
this column indicates the "steps" to be carried out to check the circuit and locate the fault in question.

2nd column: "RESULT":
this column indicates the two possible outcomes of the tests carried out: "OK" or "NOT OK" which indicate the remedy to be followed.

3rd column: "CORRECTIVE ACTION":
depending on the outcome of the tests, this column gives the possible remedies which may be used to restore the correct operation of the vehicle: for example, changing a component etc.., or reference to the next step to be carried out towards locating the fault.
All the operations and checks listed can be carried out with a simple multimeter, as shown below.

FAULT-FINDING BY SELF-DIAGNOSIS

Some of the electronic systems installed on the car possess a self-diagnosis function.
Fault finding on these systems can be carried out quickly and effectively using the **ALFA ROMEO TESTER** after inserting the suitable cartridge for the system concerned

In this case, this manual only describes the preliminary checks to be carried out before connecting the Tester; special publications describe the use of the Tester and its different cartridges.

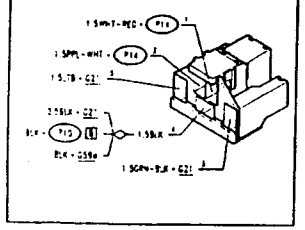
Where possible the data are given for checking the single components.
Some of these systems also give another possibility of diagnosis through a **FLASHING CODE** which indicates the failures recorded in the system control unit: in these cases all the tests to be carried out according to the failures recorded are described.

COMPONENTS AND CONNECTORS

A table lists all the components and connectors used in the wiring diagram of the section. Both parts ("male" and "female") are shown for the intermediate connectors.
Alongside the schematic diagram of the component the cables indicated in the corresponding wiring diagram are shown, indicating the cross-section, colour and the component to which this cable is connected.

N.B. In certain cases unconnected or spare cables will be shown.

Front RH power window control switch	B21a



N.B. The connectors are seen from the cable inlet side; only the electronic control units with combs with a high number of pins are shown from the connection side between combs and control unit.

The connectors are listed in alphameric order according to the IDENTIFICATION CODE (corresponding to the component to which they are connected, see Key to components): this way it is possible to distinguish them by their shape and connections pin by pin.

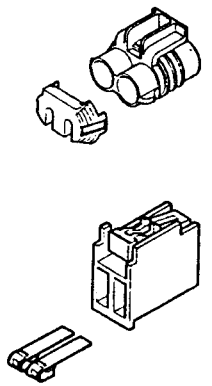
If a connector is specific for a determinate model-version, the reference of the model-version will be given.

The same may be said for the strips which identify the colour and cross-section of the cable, i.e. any specificity will be given at the side.

The symbols used to distinguish the model-version are the following:

2.0m.y.'95	Models 2.0 T. SPARK 16V Version '95
1.6-1.8-2.0m.y.'96	Models 1.6-1.8-2.0 T. SPARK 16V Version '96
	Anti-theef versions
	Air-conditioned versions
	Heated versions

Some connectors are fitted with a secondary lock which prevents the cable terminals from being accidentally separated from the connector itself.
NOTE: ensure that the secondary lock is removed before disconnecting a cable from the connector. When refitting reposition the secondary lock after connecting all the cables.
The "secondary lock" may be one of a variety of types depending on the connector to which it is fastened. as shown in the following examples.



ELEMENTARY CHECKS FOR ELECTRICAL LINES AND COMPONENTS

Series of elementary checks and tests are given below which refer to the lines and the most common components in the electric system of the vehicle.
It will be necessary to refer to them when the fault diagnosis pages indicate that the continuity, intactness, or correct operation, etc. of a single component should be checked.
All of these tests can be carried out using a multimeter with a resistance scale (ohmmeter), voltage scale (volt meter) and current scale (ammeter).
NOTE: before any readings are taken it is advisable to check that the terminals of the contact are free from rust or foreign particles (oil, dirt, etc...). If necessary, they should be accurately cleaned.

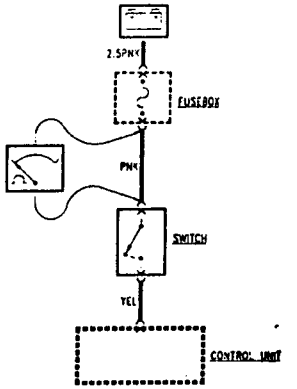
During diagnosis operations it is often necessary to simulate the closing of a contact or short circuit a switch.
In these cases a bridge is used: this simple device is formed of an insulated cable of adequate length, with the insulation stripped at the ends or fitted with terminals; a floating fuse holder is inserted in the middle of the cable.
A fuse of the suitable capacity is fitted on the fuse holder each time to protect the circuit being short circuited.

In order to locate fast voltage changes, for example the control voltage at the terminals of the door lock gear motors, the use of a polarity detector is recommended.
The polarity indicator shows if there is a difference in potential between the prod and the terminal, regardless of its value and polarity.
This is signalled by the turning on of a telltale, for example a green one if the terminal is connected to earth and the pushbutton to a positive, while for example the red telltale lights up if the terminal is connected to the positive and the prod is connected to earth.

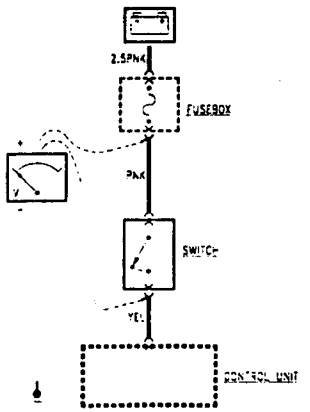
LINE CHECKS:

MEASURING ELECTRICAL CONTINUITY:
NOTE: first of all ensure that the supply to the component in question is disconnected! This applies to all resistance measurements.
Set the multimeter to measure ohms and set it to read 0 Ω when the two prods of the instrument are touched together.

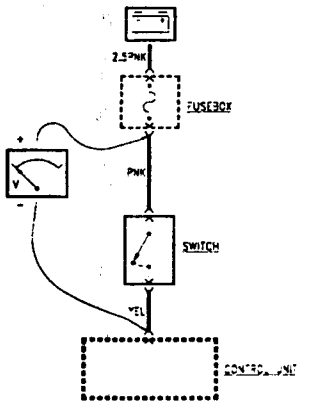
Place the two prods of the instrument at the ends of the component or cable being examined and read the resistance: 0 Ω means electrical continuity in a cable, fuse, etc....; ∞ (infinitive) means a cut off.
For certain components, such as resistances, sensors, electric motors, etc... a specific value should be read corresponding to the impedance of the component itself.



MEASURING VOLTAGE:
NOTE: before taking any readings, ensure that the component or line being examined is connected to the power supply as shown in the wiring diagram.
Set the multimeter to measure volts.
Connect the negative prod of the multimeter to earth (for example the battery earth).
Connect the positive prod to the point to be measured and take the reading selecting the appropriate scale. If the exact voltage at various points along a line or circuit is known, the affected part can be quickly located.



MEASURING VOLTAGE DROP:
NOTE: before taking any readings, ensure that the component or line being examined is connected to the power supply as shown in the wiring diagram.
Set the multimeter to measure volts.
Connect the two prods of the voltmeter to the two points where you wish to know the difference in voltage and take the reading selecting the appropriate scale; the positive prod should be connected to the part nearest the power source.
As the connectors and contacts are designed in such a way as to minimise loss of voltage, a value of above 1 V indicates that there is a problem in the stretch being measured.

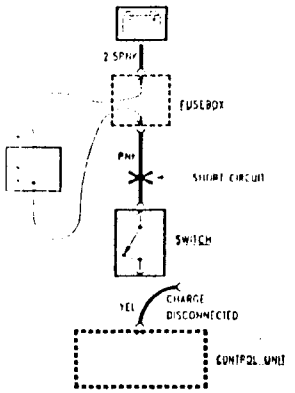


CHECKING FOR A SHORT CIRCUIT:

using the volt meter:

NOTE: before taking any readings, ensure that the component or line being examined is connected to the power supply as shown in the wiring diagram
Set the multimeter to measure volts.
Remove the fuse of the circuit concerned (which will be burnt out) and disconnect the charge.
Connect the prods of the multimeter to the fuse terminals: the positive prod should be connected to the part nearest the power source.

If the voltmeter gives a reading indicating that voltage is present, part of the circuit will be short circuited to earth (bared, worn, pinched wire, etc.); the part concerned can be located by moving the wire to find a point in which the reading is not 0 V.



using the ohmmeter.

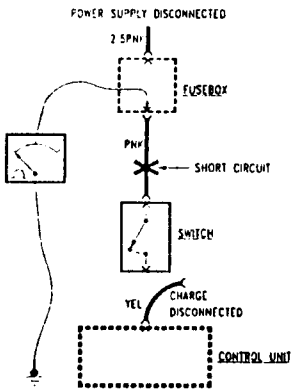
NOTE: first of all ensure that the supply to the component in question is disconnected!

Set the multimeter to measure ohms and set it so that the reading is 0 Ω when the two prods are touched together.

Remove the fuse of the circuit concerned (which will be burnt out) and disconnect the charge.

Connect one prod of the instrument to the terminal of the fuse nearest to the charge and the other to a good earth point.

If the Ohmmeter shows a resistance of 0 Ω, or very low, part of the circuit will have been short circuited to earth (bared, worn or pinched wire etc.); If the resistance is ∞ (infinitive), then in that particular stretch the circuit is intact. The part involved can therefore easily be located moving the cable to find out the positions in which the ohm rating is not ∞ (infinitive).

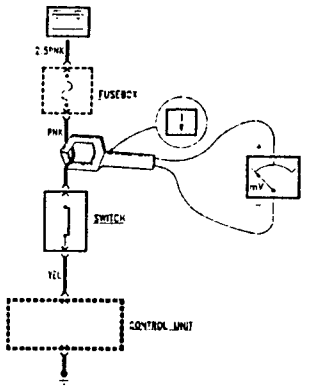


NOTE: measurements taken with a voltmeter are more accurate and if both options are possible the voltmeter should be chosen.

MEASURING CURRENT

It may sometimes be necessary to measure the current absorption: in this case the multimeter will not suffice. It is therefore necessary to use another instrument such as a snap on ammeter, operating as follows:

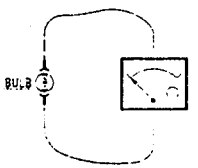
- insert the lead of which the current is to be measured in the pincers, suitably connected to the multimeter set for volt measurement (mV);
- NOTE: ensure that the flow of current (from positive towards earth) is the same as indicated on the pincers;
- take a reading in mV which corresponds to the value of the current in A.



TESTING COMPONENTS:

BULBS:

NOTE: a bulb is characterized by two values: voltage and wattage rating. The resistance of the bulb is lower as its wattage increases. For example, a headlight bulb (12V-45W) will have a much lower resistance than an instrument panel warning light bulb (12V-3W). To check whether a bulb is damaged or not, remove it and connect the prods of a multimeter set to measure ohms to the terminals of the bulb itself: a finite resistance rating (lower or higher as mentioned above) indicates that the bulb is working, whereas a resistance value of ∞ (infinitive) means that the filament is damaged.



HALOGEN BULBS:

Halogen lamps have the bulb made of quartz instead of glass: due to the high temperature reached when the bulb is working, the presence of grease on the bulb surface causes "devitrification" of the quartz, thereby lowering its luminosity. Therefore, halogen bulbs must be handled by the metal collar taking care not to touch the bulb with the hands: should this occur, carefully clean the bulb with epthane or an equivalent degreasing product.

FUSES:

A fuse is an electrical conductor the cross section of which is such that if the load passing through the cable exceeds a certain value called fuse amperage, it will blow and interrupt the circuit.
If it is not possible to see visibly whether the fuse filament is intact or not, it can be checked by connecting the prods of the multimeter set to measure ohms to its terminals: a 0 value (0 Ω) means that the fuse is still working, whereas a resistance of ∞ (infinitive) means that the filament has "blown".

CAUTION!
Before changing a fuse the cause of the damage to it should be eliminated. If the fuse supplies more than one circuit, it might have blown due to a failure on a different circuit than the one suspected.

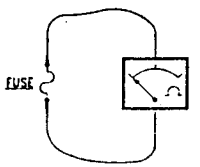
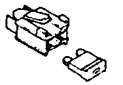


TABLE OF FUSE COLOURS

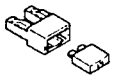
Stanndard fuses (for example those of fusebox **G1**) are identified according to a colour correlated with the amp rating:

AMP.	COLOUR
7.5 A	Brown
10 A	Red
15 A	Light blue
20 A	Yellow
25 A	White
30 A	Green



The **wander "maxifuses"** are distinguished according to their colour:

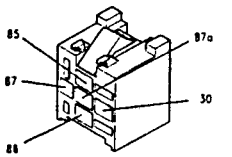
AMP.	COLOUR
40 A	Orange
50 A	Red
60 A	Light blue
70 a	Yellow

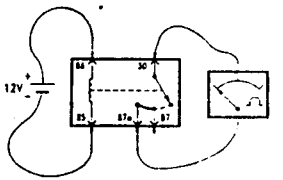


RELAYS:

In its simplest form, a relay is composed of a coil and a contact: when "excitation" or "drive" voltage is applied to the ends of the coil, the contact closes.
Normally the coil terminals are identified as pin 85 and 86, while the contact terminals are pin 30 (from the power supply) and pin 87 towards the load.
There may also be two output pins towards the load: 87 and 87a when the contact closes simultaneously on both; 87 and 87b when it closes separately.
The contact can also be a switch and close itself on one pin (87a) at the same time as opening the other (87).
(For the different types of relays refer to the previous table of component symbols).
To check a relay, connect pins 85 and 86 with a 12 V power source (the coil does not have a polarity and therefore the two pins are interchangeable) and measure with the multimeter set to read ohms: when the coil is "energized" (between the ends of the coil there will be a difference in voltage of -12 V-) the multimeter should read continuity (0 Ω) between pin 30 and pin 87 (or 87a or 87b); conversely, when the coil is not energized the multimeter should read an open circuit (resistance ∞ -infinitive-).

In a switching relay, the check will consist in the passage from continuity to open circuit on one pin and vice-versa on the other.
One of the more frequent failures on relays is "locking" of the contact: this can be identified immediately as the ohm signal does not vary when activating or deactivating the coil (always 0 Ω or always ∞).



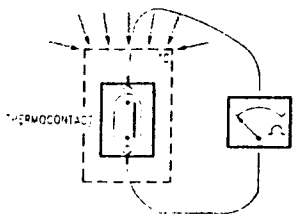


NOTE: some relays have a built-in fuse: this must always be checked separately, before checking the relay.
In other relays a resistance is placed in parallel to the excitation circuit, in others a diode protects the excitation: in all these cases, the method for checking the operation of the relay does not differ from the one given above.

THERMAL CONTACTS:

Thermal contacts change their state (circuit open or closed) when a certain temperature is reached.
NOTE: they can be N.C. (normally closed) or N.O. (normally open): in the diagrams they are shown in their rest position.
To check a thermal contact, remove it from the car and connect the terminals to a multimeter set to measure ohms.
Using suitable equipment (containers

which can be heated and cooled) check that at the pre-established temperature for each thermal contact, the resistance passes from 0 Ω to ∞ or vice-versa.



SENSORS:

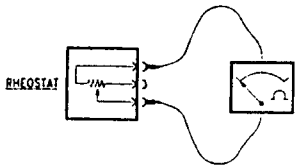
These are components of varying types, but in general they are similar to contacts (N.O. or N.C.) which change their state when a certain measured physical value changes (for example temperature, see thermal contacts, or pressure etc.). For these components the same rules apply as for checking thermal contacts.
Other sensors measure specific values and emit a signal which is proportional to them: as each occasion arises, these will be given in the table load diagram, through which it will be possible to locate the correct resistance or voltage ratings and check them using a multimeter.

RHEOSTATS:

Rheostats are variable resistances: when voltage (12 V) is applied to the main terminals, the output signal from the third terminal is changed by a mechanical action (eg. rotating an adjustment washer....).
To check correct operation connect one prod of a multimeter set to measure ohms to one of the main terminals and the other to the third terminal: by acting on the adjustment washer for example, the resistance measured should change noticeably

TERMOSTATS/PRESSURE SWITCHES:

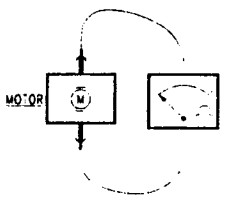
These are instruments which emit a signal which is directly proportional to the temperature/pressure they measure.



From a schematic electrical point of view they are rheostats of which the resistance varies with the readings taken.
To check these devices therefore, follow the indications given for rheostats using suitable equipment to enable the temperature or pressure to be changed.

ELECTRIC MOTORS/SOLENOIDS:

Electric motors and solenoids are mechanisms which are essentially composed of electrical windings and for this reason checking the operation of these components consists in verifying if electrical continuity has reached the windings or not; then proceed as mentioned above using the multimeter.
It is also possible to check a component when it is installed on the vehicle: disconnect it and check the operation (for instance the rotation of the motor) connecting the terminals to a 12 V power source.



N.B. Inverting the polarity (positive and earth) of an electric motor inverts its direction of rotation: therefore, particular attention must be paid that the two terminals are connected correctly, using for example a polarity detector.

NOTE: for these mechanisms it is possible for faults to be caused by mechanical and not electric problems. In this case the other groups of the manual should be consulted.

EARTH POINTS:

An earth point is not correctly connected if oxidation is present, if it is not securely fastened to the body or if the cables reaching it are bared or damaged.
To check whether an earth point is really at "0 potential", connect it to the prod of a multimeter set to measure ohms; connecting the other prod to the battery negative pole the resistance reading should be ≃ 0 Ω; if this is not the case, carefully inspect the earth as it is faulty.

SOLDERS:

Numerous solders between wires are present on the vehicle: they are carried out using the ultrasound technique which makes them extremely reliable and safe.

If it becomes necessary to check a solder, simply check the continuity between the different wires which converge on it; if this proves unsuccessful the solder cannot be repaired and the wiring must be replaced.

CONTROL UNITS AND ELECTRONIC DEVICES IN GENERAL:

Nowadays, electronic control units are the most important components of the car. Because of this reason, they are almost 100% reliable as their protection circuits have been designed especially for this purpose.

Because of their complexity, electronic control units require special diagnosis devices as the use of the multimeter is neither sufficient nor advisable.

Generally, the control units are provided with a special diagnosis socket for connection to the ALFA ROMEO TESTER.

These components cannot be dealt with in a general context, therefore reference should be made to the single fault- finding procedures in the specific sections.
You are however reminded that it is not possible to work on these electronic components internally and they have to be replaced if found to be faulty.

GENERAL PRECAUTIONS AND SAFETY MEASURES

Before carrying out any work on the electrical components, carefully follow the precautions given below:

- Remove rings, wrist-watches or other metal objects.
- Disconnect one of the battery terminals each time an electrical component has to be removed.
- Only use original Alfa Romeo spare parts when a component needs replacing.

When working on the electric system of a car never forcibly pull wires or cables, as this might accidentally disconnect them from connectors or terminals.
Disconnect all the control units and electronic devices when arc welding on the vehicle body.

AVOIDING ELECTRICAL ARCHING

Even if the voltage of the electric system is only 12 V, the power of the battery can cause high voltage in the event of a short circuit causing arches or sparks that can cause a fire hazard or direct danger to the operator.

BEWARE OF HIGH VOLTAGE

The electronic ignition system generates voltages of 20.000 V and over which could be very dangerous, especially to peole suffering from heart problems.
Therefore, always proceed with the utmost care when operating on or near these components.

AVOIDING FIRES

Do not smoke while working near the battery or components containing fuel or other engine fluids.

HEAT SOURCES

When it is necessary to operate on components which are subject to heating during use (eg. halogen bulbs), or inside the engine compartment when the engine is still warm, particular care must be taken to avoid burns or damage to tools or components.

POWER SUPPLY

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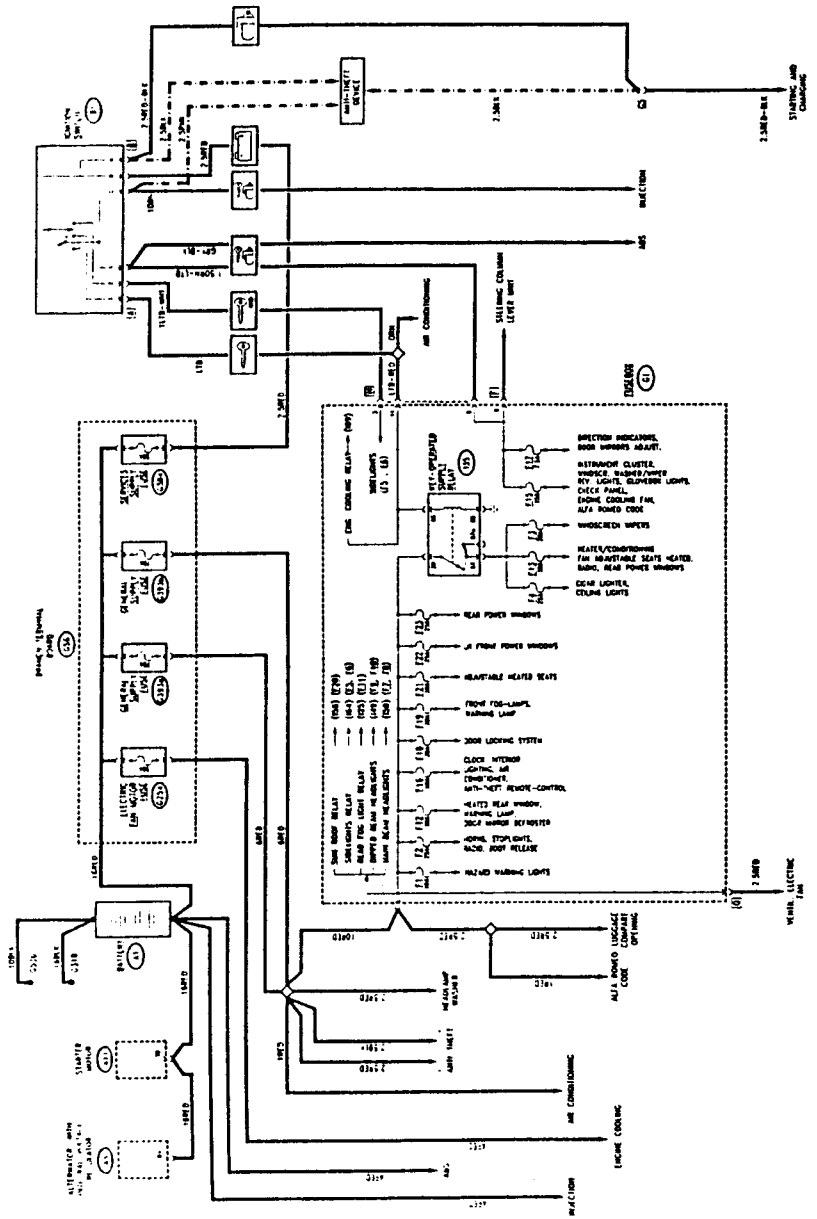
WIRING DIAGRAM



— . — . — versions with anti-theft

PA4978E116V000

GENERAL DESCRIPTION

General diagram

All the systems and electrical installations are supplied by the battery **A1** with 12 V current.
The lines through which the battery voltage is distributed to the various services are shown in the wiring diagrams corresponding to the different functions and systems.
In this general diagram all the lines are shown as they leave the battery and the branch terminal board **G56**, with reference being given to the specific diagrams for more detailed information.
Some circuits are supplied continuously even when the vehicle is stationary and the ignition key disengaged, as they are connected directly to the battery **A1**.
All the supply lines of the car have been designed and planned taking account of the latest directives in terms of safety and protection, especially against the possibility of fire.

There are two main types of protection:

- **active protection**, intended to reduce possible causes of faults at the "source".
- **passive protection**, intended to minimise the effects in the event of a fault.

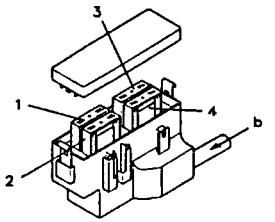
The first category involves attentive design of the wiring looms accurately positioning and securing them, carefully defining suitably shielded and protected routes.

For this reason appropriate changes have been made to the cables of the alternator and starter motor, with the adoption of protective caps etc.
A "reinforced" sheath has been adopted for certain lengths of particularly exposed wiring.

The passive protections include all the items which have always been used on cars to reduce high fault currents (overcharging and short circuit).

All the fuses fitted in the system have been sized according to the nominal absorption of the loads that can be engaged contemporaneously, to ensure that they trip in the event of a decided short circuit.

Through the adoption of a **branch terminal block G56** with incorporated fuses, it is possible to protect all the supplies with the exception of the starter motor cable (battery-motor) and the charging cable (motor-alternator): these cables have been protected by an additional "reinforced" sheath.



b. line (cavo 16 mm) from battery
1. Fan fuse (50A) : **G254**
2. Services supply fuse (50A) : **G384**
3. General supply fuse (70A): **G393a**
4. General supply fuse (70A) : **G393b**

- Inserting the key and turning it to the first position, "RUN", supplies the numerous circuits which are in fact termed "key-operated";
- the second position "STARTING" - supplies the starter motor and disconnects other circuits (those which absorb the greatest amount of current) thereby ensuring that the starter motor receives the maximum amount of current;
- withdrawing the key and turning it in the opposite direction (and pressing the corresponding button) engages the "PARKING" position which supplies the side lights even when the key is removed.

These different systems of supply are shown schematically in the wiring diagrams using the following symbols:

 – line supplied constantly

 – line supplied with the key in the "STARTING" position

 – line supplied with the key in the "RUN" position

 – line supplied with the key engaged (in both of the previous positions

 – line supplied with the key in the "PARKING" position

NOTE: this general diagram makes it possible to easily identify the circuits supplied by the same line: this simplifies fault-finding in the event of problems affecting more than one system.

PA4978E116V

FUNCTIONAL DESCRIPTION

The supply leading from the battery **A1** is divided among various lines in the branch terminal board **G56**, from where numerous cables lead, directly supplying some systems (protected by special "wander" fuses) and the line that supplies the fusebox **G1**, inside the fusebox the power is distributed to the various circuits, protected by the corresponding fuses.

The battery recharging line leads from the alternator **A3**, through the starter motor **A11**.

The ignition switch **B1** is also supplied via the terminal board **G56** and fuse **G384** (50A) at pin B of connector B.

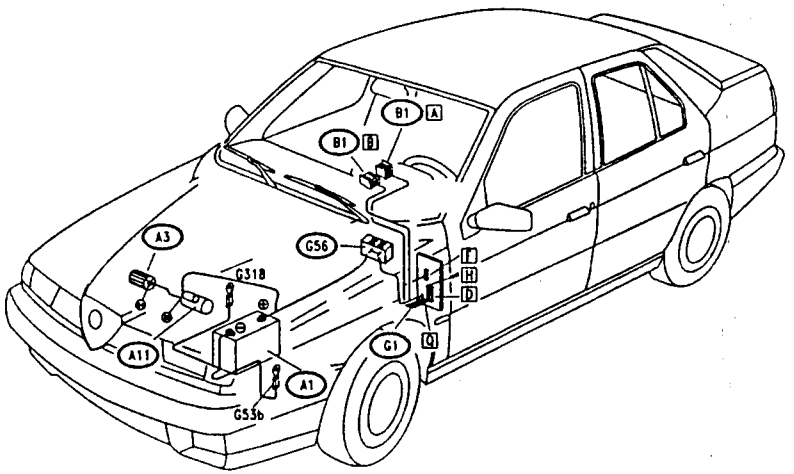
The line that leaves pin A of connector B corresponds to the "STARTING" position and it supplies the starter motor **A11**, either directly or through the alarm control unit.

The two lines leaving pin 3 of connector A - "RUN" position - via the fusebox **G1**, supply the "key-operated" circuits, which are however disengaged in the "STARTING" position.

The three lines that leave pin 1 of connector A and pin C of connector B supply, either directly or through the fusebox **G1**, (relay **I35**) the "key-operated" circuits which also remain engaged in the "STARTING" position.

Lastly, the line that leaves pin 2 of connector A corresponds to the "PARKING" position and supplies the sidelights circuit inside the fusebox **G1**.

LOCATION OF COMPONENTS



FUSEBOX

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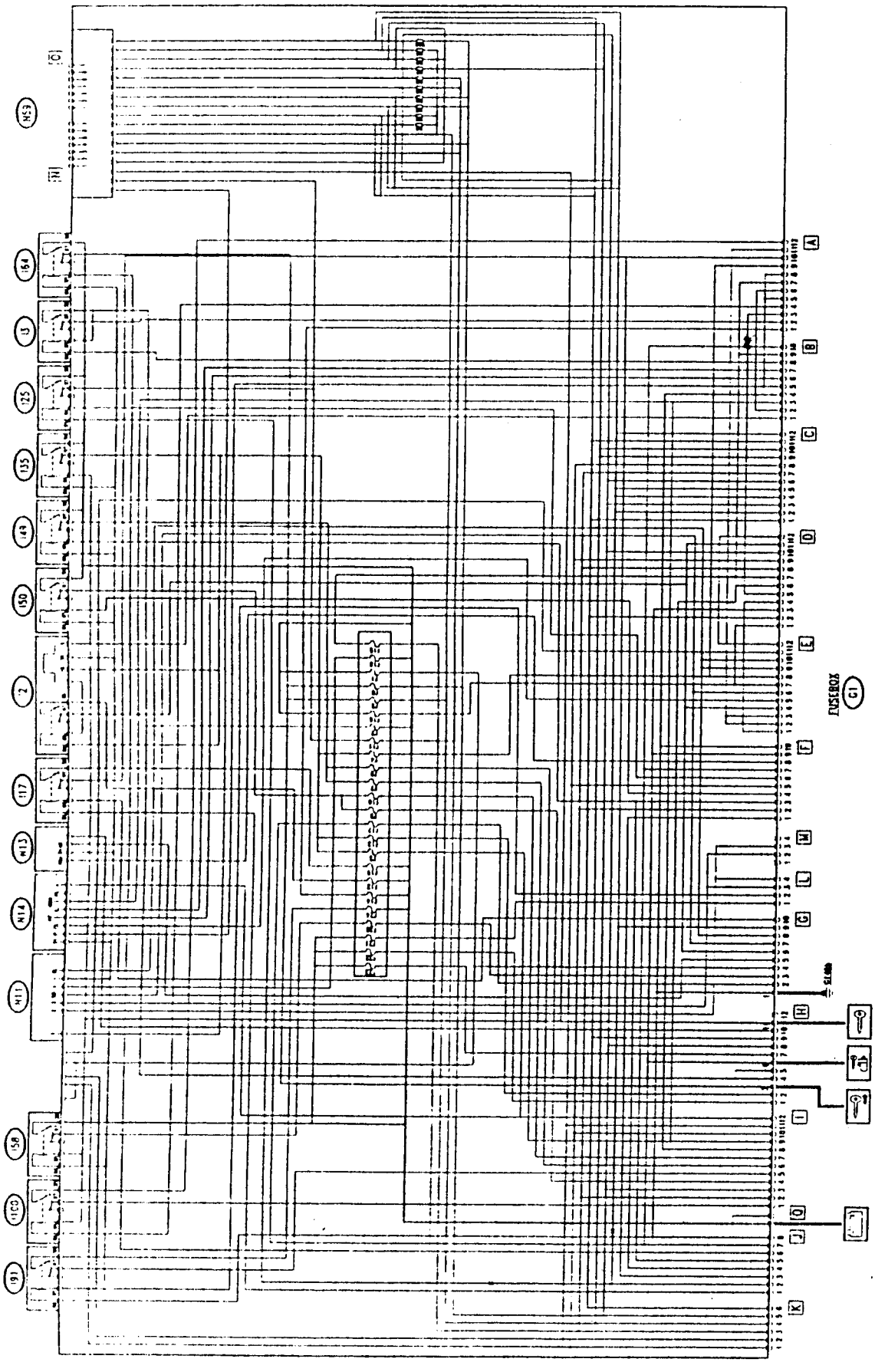
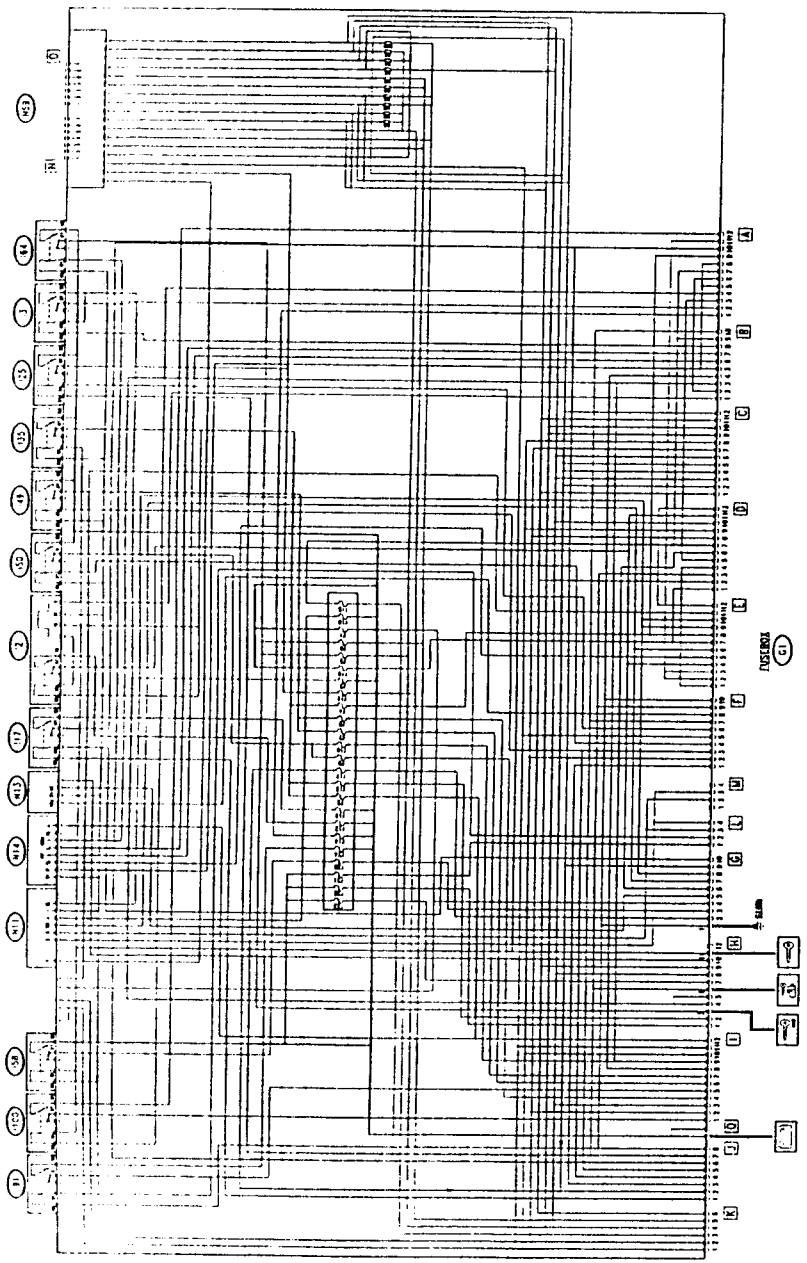
WIRING DIAGRAM



PA4978E116V000

WIRING DIAGRAM



GENERAL DESCRIPTION

This section describes the complete printed circuit that makes the connections inside the fusebox **G1**.
In the various diagrams referring to the individual systems and circuits only the lines associated with the case under examination are shown: this chart gives a complete, overall view of the entire fusebox **G1**.

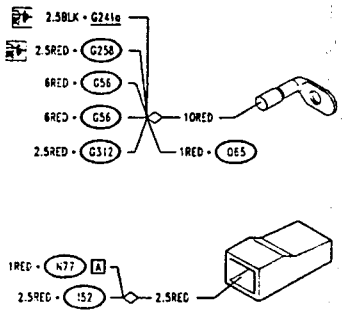
The fusebox houses a number of relays and other devices, shown here with the corresponding codes, and the fuses (**F1,...., F19**).

For versions with "Check Panel", the fusebox is fitted with the Check Panel control unit **N59** on certain lines connected to it there are measurement shunts (distinguidhed with SH).

NOTE: not all the output pins of the box **G1** are actually connected for all versions of the car: some lines therefore may be found to be redundant though they will be present on the printed circuit.
Next to the schematic drawings of the connectors a list of output signals from the different pins is given: this simplifies for instance faultfinding work on the different circuits affected.
NOTE: the letters N.C. indicate pins connected inside the fusebox but not used for the present versions of the car).

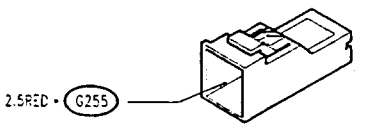
FUSEBOX SUPPLY

PIN	CIRCUITS
-	Supply from terminal block
-	Boot opening control supply, ALFA ROMEO CODE



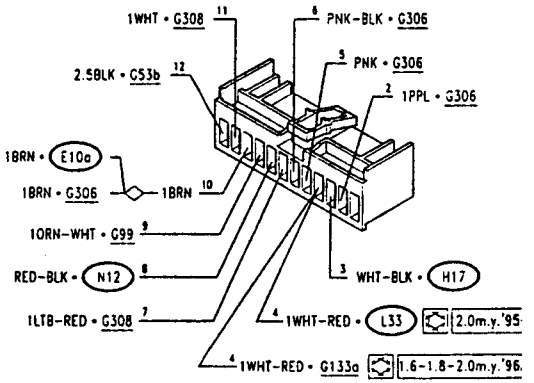
CONNECTOR Q

PIN	CIRCUITS
-	Climate control fan supply (direct)



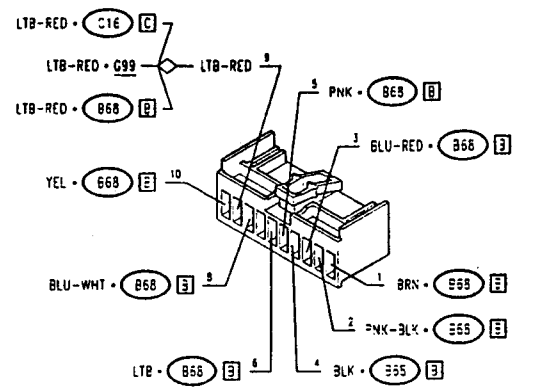
CONNECTOR A

PIN	CIRCUITS
1	N.C.
2	Horns
3	Brake fluid level signal
4	Radiator thermal contact signal (cond.) (2.0 m.y. '95) Motronic control unit signal for fan (conditioner) (1.6 - 1.8 - 2.0 m.y. '96)
5	Windscreen washer
6	Windscreen washer
7	Reversing light supply
8	Headlamp washer control
9	Cigare lighter supply
10	Fog lamps
11	Reversing light control
12	Earth



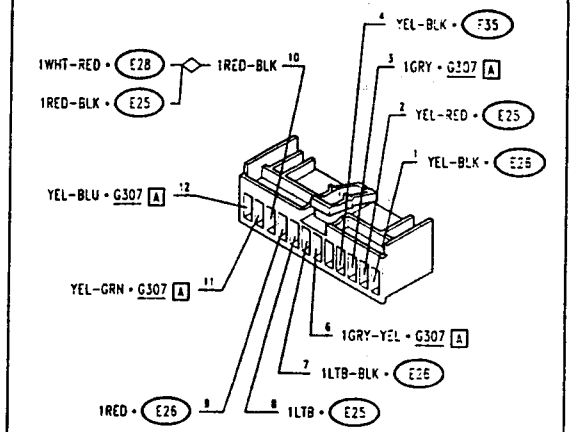
CONNECTOR B

PIN	CIRCUITS
1	Heated rearscreen control
2	Windscreen washer control
3	Windscreen wiper control
4	RH lever unit earth
5	Windscreen wiper Control
6	Wiper intermittence control
7	N.C.
8	Horn control
9	Fan relay supply, check. windscreen washer
10	RH lever unit lighting



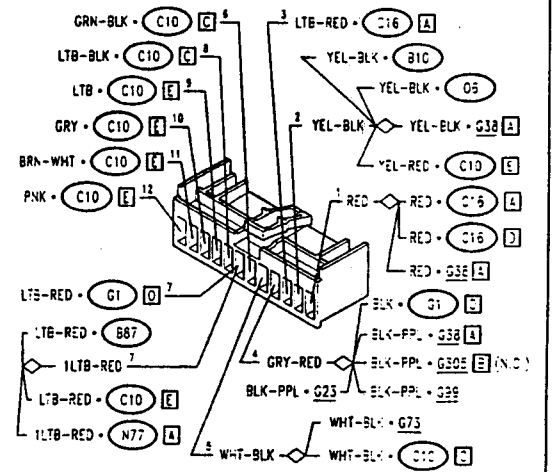
CONNECTOR C

PIN	CIRCUITS
1	LH rear sidelights
2	RH rear sidelights
3	LH foglamp
4	Sidelights for front ceiling lamp
5	N.C.
6	RH rear fog guard
7	LH rear direction indicators
8	RH rear direction indicators
9	LH stop light
10	RH stop light and third stop
11	RH no. plate light
12	LH no. plate light



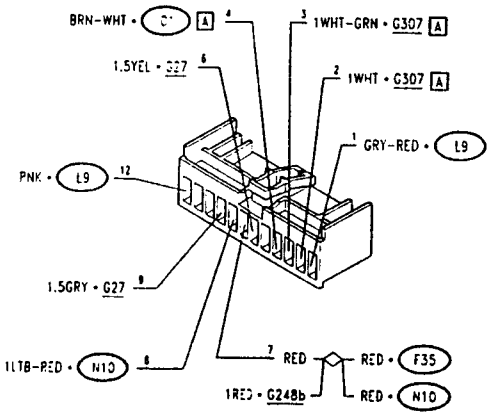
CONNECTOR D

PIN	CIRCUITS
1	Conditioner supply, check panel (direct)
2	Controls lighting, indicators etc., sidelights warning light
3	Check panel supply (key-operated)
4	Controlled earth
5	Handbrake/brake fluid warning light
6	High beam warning light
7	Cluster supply, check panel control unit, ALFA ROMEO CODE control unit, glovebox light (key-operated)
8	LH direction indicator warning light
9	RH direction indicator warning light
10	Fog guard warning light
11	Heated reasrcreen warning light
12	Fuel level gauge



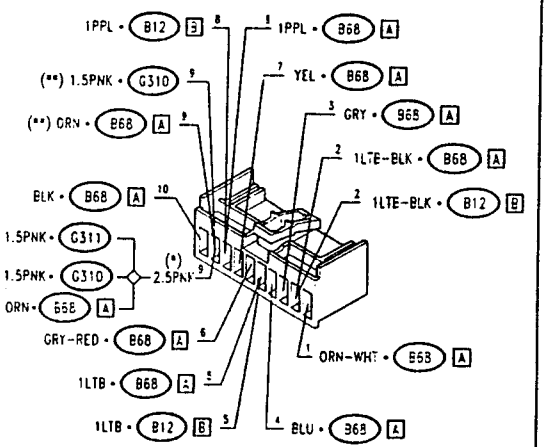
CONNECTOR E

PIN	CIRCUITS
1	Fuel level earth
2	LH reversing light
3	RH reversing light
4	Heated rearscreen
5	N.C.
6	Rear door locking device
7	Supply for ceiling lamps and alarm remote control (direct)
8	Ceiling lamps supply (key-operated)
9	Rear door locking device
10	N.C.
11	N.C.
12	Fuel level signal



CONNECTOR F

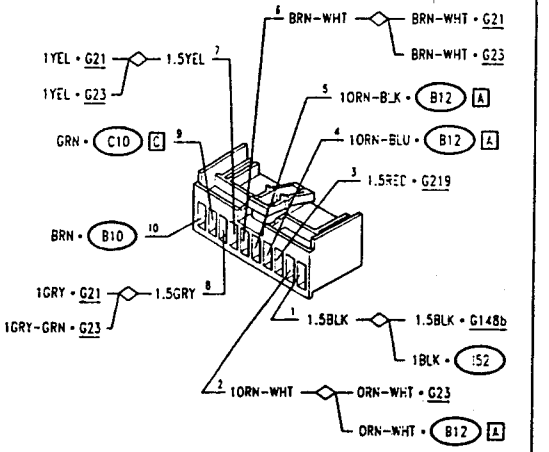
PIN	CIRCUITS
1	Fog guard consent
2	LH direction indicator control
3	Low beam control
4	High beam control
5	RH direction indicator control
6	Fog guard control
7	Rear sidelights & LH lever lighting control
8	Hazard warning lights control
9	Lever unit supply, front power windows
10	LH lever unit earth



(*) Versions with manual LH front power window control
(**) Versions with automatic LH front power window control

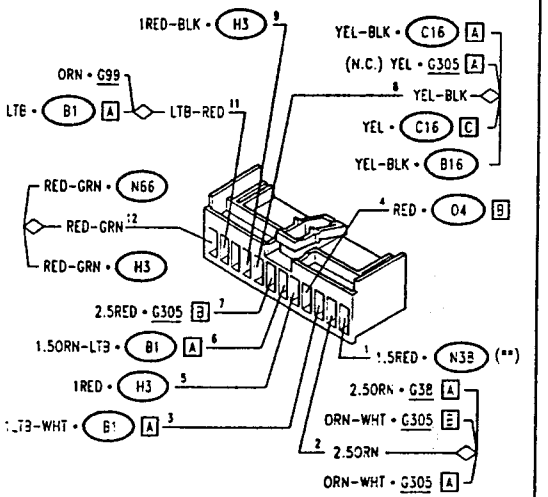
CONNECTOR G

PIN	CIRCUITS
1	**Fusebox earth**
2	Direction indicators supply., rearview mirrors (key-operated)
3	Sunroof supply
4	Hazard warning lights supply (direct)
5	Hazard warning lights control
6	Door mirror defrosting
7	Doorlocking device control
8	Door locking device control
9	Fog lamp warning light
10	Fog lamp control



CONNECTOR H

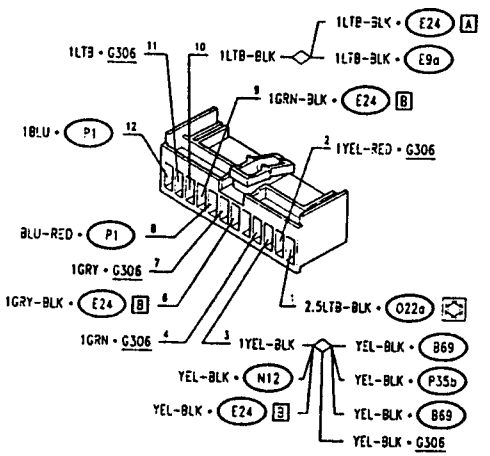
PIN	CIRCUITS
1	Power window control unit supply (**)
2	Fan supply climate control, rear power windows., adjustable and heated seats, radio (key-operated)
3	**"key-operated" supply (PARK)**
4	Radio supply (direct)
5	Stop lights supply
6	**"Key-operated" supply**
7	Rear power window supply (direct)
8	Check lighting, controls etc.
9	Stop lights control
10	N.C.
11	**"Key-operated" supply (excluding starting)**
12	Stop lights control



(**): Versions with automatic LH front power window control

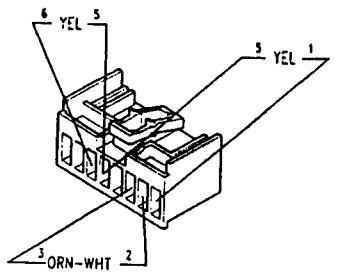
CONNECTOR I

PIN	CIRCUITS
1	Engine fan control (cond.)
2	RH front sidelights
3	LH front sidelights, headlamp aiming supply, controls lighting
4	RH high beam
5	N.C.
6	LH low beam
7	RH low beam
8	Windscreen wiper control
9	LH high beam
10	LH front and side direction indicators
11	RH front and side direction indicators
12	Windscreen wiper supply



CONNECTOR J

PIN	CIRCUITS
1	Fog lamp consent relay
2	Fog guard consent relay
3	Fog guard control
4	Low beam control
5	Sidelights control
6	Sidelights consent relay
7	N.C.
8	N.C.



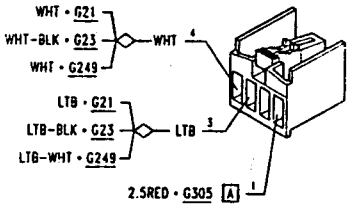
CONNECTOR K

PIN	CIRCUITS
1	LH direction indicator
2	RH direction indicator
3	LH sidelights
4	Fog guard
5	RH sidelights
6	Stop lights

Connector K: provision for trailer lights

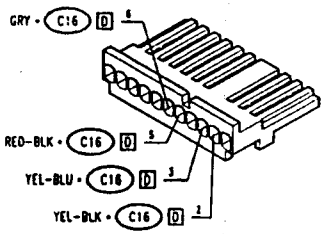
CONNECTOR L

PIN	CIRCUITS
1	Adjustable and heated seats supply (direct)
2	N.C.
3	Door release control, alarm remote control
4	Door locking control, alarm remote control



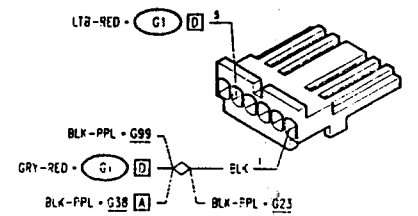
CONNECTOR N (Check)

PIN	CIRCUITS
1	N.C.
2	Sidelights fault led
3	No. plate light fault led
4	N.C.
5	Stop lights fault led
6	Fog guard fault led
7	N.C.



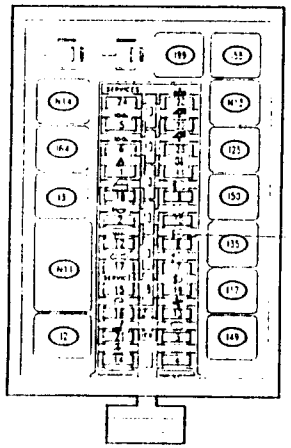
CONNECTOR O (Check)

PIN	CIRCUITS
1	Check earth
2	N.C.
3	N.C.
4	N.C.
5	Check supply
6	N.C.



The following diagram shows the location of the fuses and relays and the position of the connectors:

LOCATION OF FUSES AND RELAYS

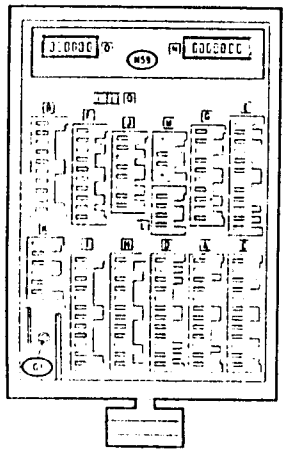


Relays

- I2 Heated rearscreen relay
- I3 Horn relay
- I17 Fog lamp relay
- I25 Fog guard relay
- I35 Key-operated supply relay
- I49 Low beam relay
- I50 High beal relay
- I58 Sunroof relay
- I64 Sidelights relay
- I99 Engine water cooling fan 1st speed relay
- N11 Door locking control unit
- N13 Hazard warning and direction indicator intermittence
- N14 Electronic windscreen wiper intermittence

Fuses (see following page).

REAR VIEW, CONNECTOR SIDE



N59 Check Panel Control Unit

FUSES

The following list gives the fuses contained in fusebox G1, with the corresponding symbol, amp rating and type of supply and the protected circuits

FUSE			SUPPLY	SERVICES PROTECTED
SYMBOL	N°	AMP.		
	1	10A		Hazard warning lights
	2	25A		Horns, stop lights, radio, boot opening control
	3	20A	(135)	Windscreen wiper
	4	25A	(135)	Cigar lighter, celing lamps
	5	10A	(164)	Controls lighting, LH rear sidelights, RH no. plate light, RH front sidelight, sidelights warning light
	6	10A	(164)	Controls lighting, cluster lighting, RH rear sidelights, LH no. plate, LH front sidelight, headlamp aiming device
	7	10A	(149)	Right low beam
	8	10A	(149)	Left low beam
	9	15A	(150)	Right high beam
	10	15A	(150)	Left high beam, high beam warning light
	11	7.5A	(125)	Fog guard, fog guard warning light
	12	30A		Heated rearscreen, heated rearscreen warning light, mirror defroster
	13	30A	(135)	Fan, rear power windows, adjustable and heated seats, radio
SERVICES	15	15A		Instrument cluster, windscreen-headlamp washer electric pump, reversing lights, glovebox light, check panel, engine fan, ALFA ROMEO CODE
	16	10A		Clock, ceiling lamps, conditioner control unit, alarm remote control
	17	7.5A		Sidelights, door mirror adjustment
	18	20A		Door locking device
	19	20A		Fog lamp, fog lamp warning light
	20	30A	(158)	Electric sunroof
	21	30A		Adjustable and heated seats
	22	25A		Left front power window (*)
	23	25A		Rear power windows

(*): Versions with automatic LH front power window control

FUSES AND RELAYS ON AUXILIARY BRACKET

A set of fuses and relays is located on the auxiliary bracket (not removable) to the left of the main fusebox; next to these there are also the power window control unit N38 and that of the ALFA ROMEO CODE N77.

The fuses and relays can be distinguished according to the colour of the base (fuse holder or relay holder) which connects them to the wiring, according to the following table:

COMPONENT	CODE	BASE COLOUR
Boot opening relay (with 30A fuse)	I52	Red
Timer for headlamp washer	N12	Black
Climate control auxiliary relay	Q32	Grey
Compressor joint control relay	Q22	Grey
Engine cooling fan relay	I1/I100	Black
Headlamp washer fuse (20A)	G312	Yellow
ABS fuse (10A) - NOT CONNECTED -	G125a	Red
Front power window fuse (25A)	G310	White
LH front power window fuse (25A) (*)	G311	White
Climate control fuse (30A)	G255	Green
Conditioner system fuse (10A)	Q65	Red

(*): Versions with manual LH front power window control

N.B. In addition to the colour of the base, it is wise to check the exact location of a relay or fuse by the colour of the wires which converge on it (for these, see the wiring diagram on the next pages).

LOCATION OF GROUNDS

INDEX

GENERAL DESCRIPTION

The following diagrams show the different earths present on the vehicle and the connecting cables for each of them; each cable shows the circuit to which it refers and the component earthed through that line.

The earths shown are the following:

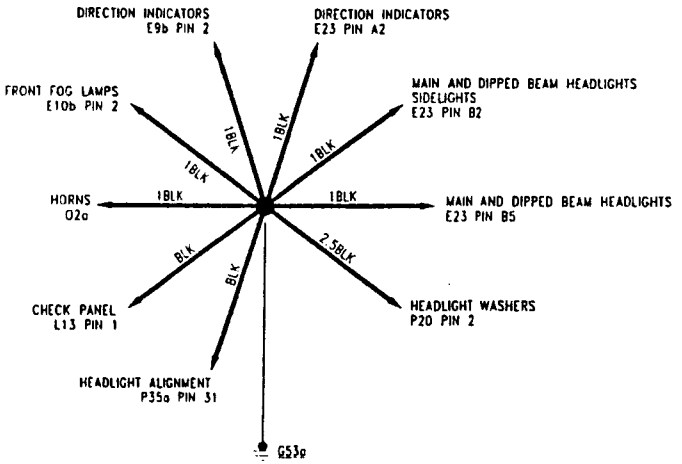
- **G53a** Right-hand engine compartment earth
- **G53b** Left-hand engine compartment earth
- **G55b** Left-hand side panel earth
- **G60** Injection wiring earth
- **G63a** Right-hand rear earth
- **G63b** Left-hand rear earth
- **G92** Earth for electric aerial
- **g106** Earth under seat
- **G148b** Earth under left-hand dashboard
- **G381** Earth on gearbox
- **Q36** Conditioning system earth

There is also an **earth braid**, which connects the power unit to the body.

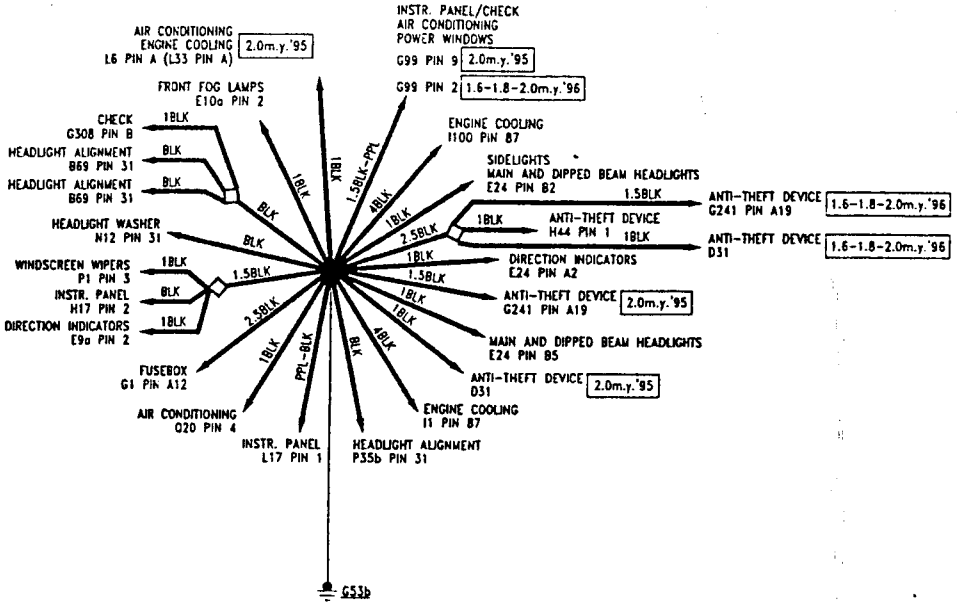
NOTE: Using these diagrams it is easy to locate those circuits which are connected to earth by the same line: this simplifies faultfinding work in the event of problems affecting more than one system.

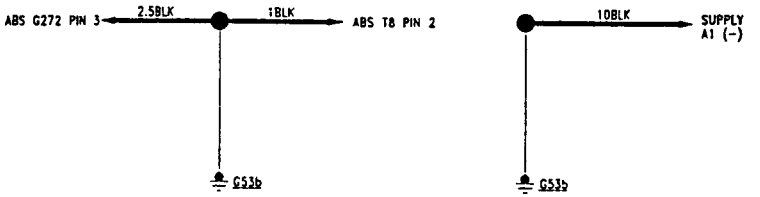
WIRING DIAGRAMS

G53a

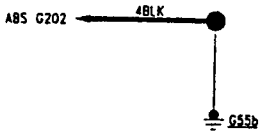


G53b

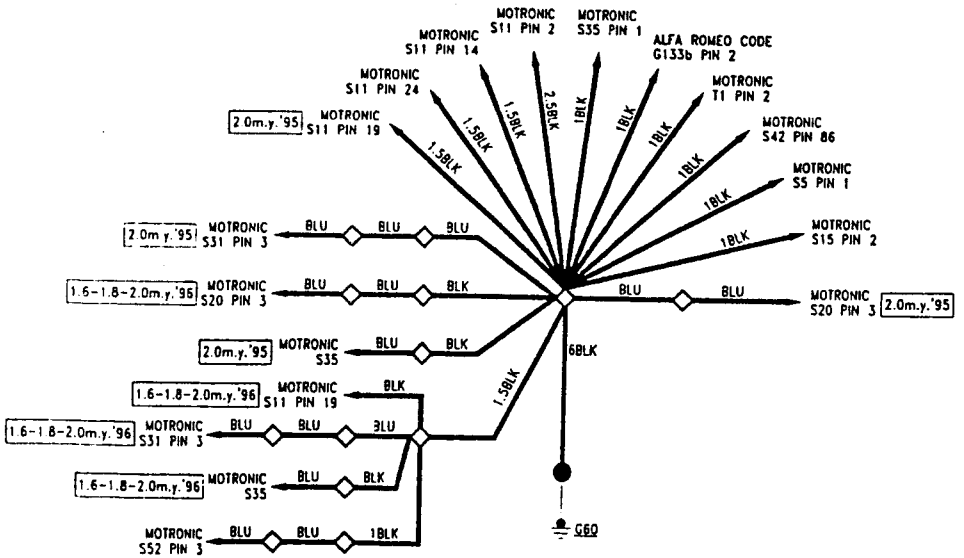




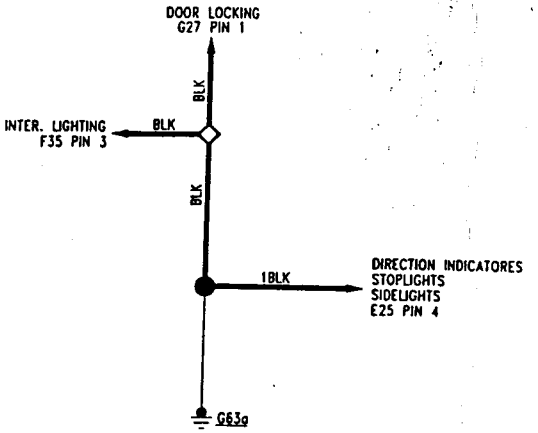
G55b



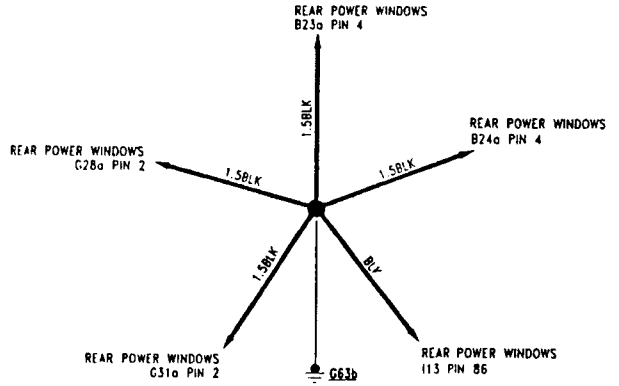
G60

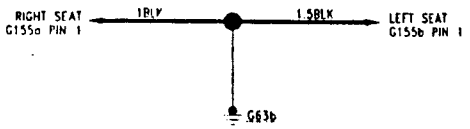


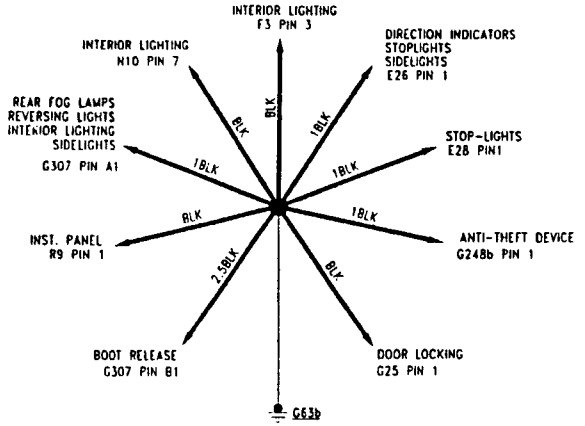
G63a

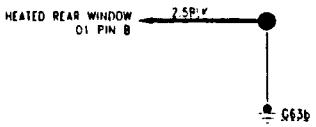


G63b

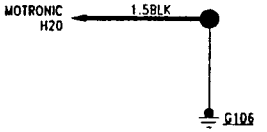




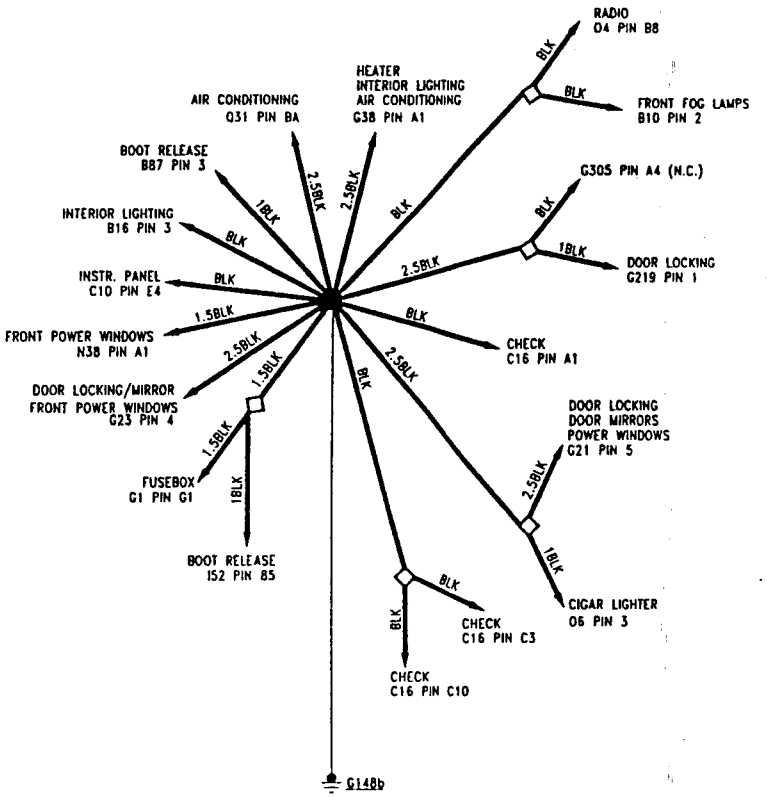




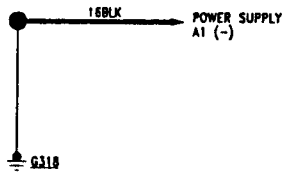
G106



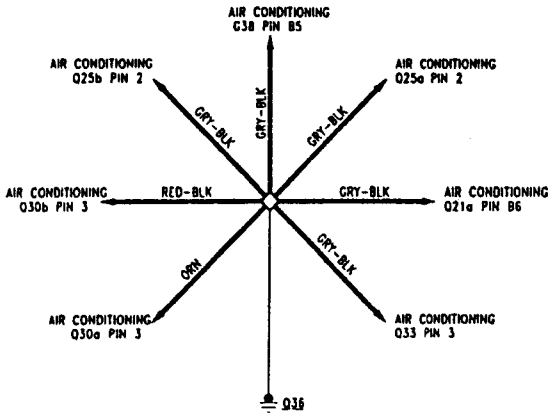
G148b



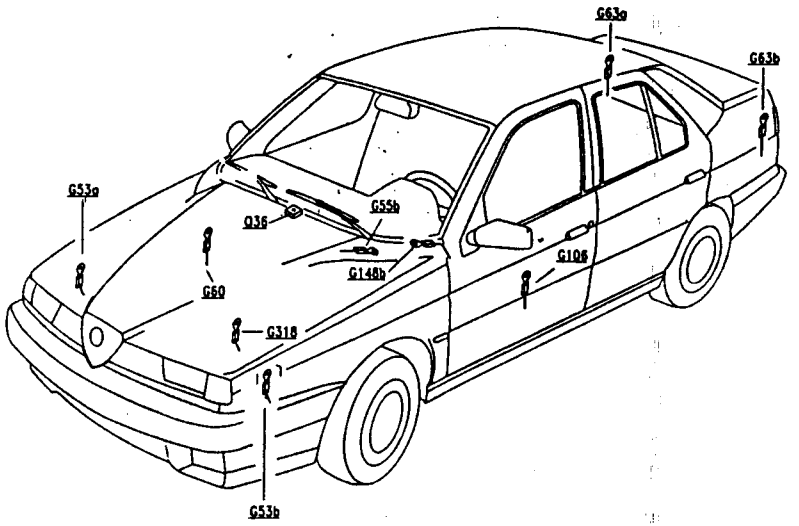
G318



Q36



LOCATION OF COMPONENTS



SIDELIGHTS

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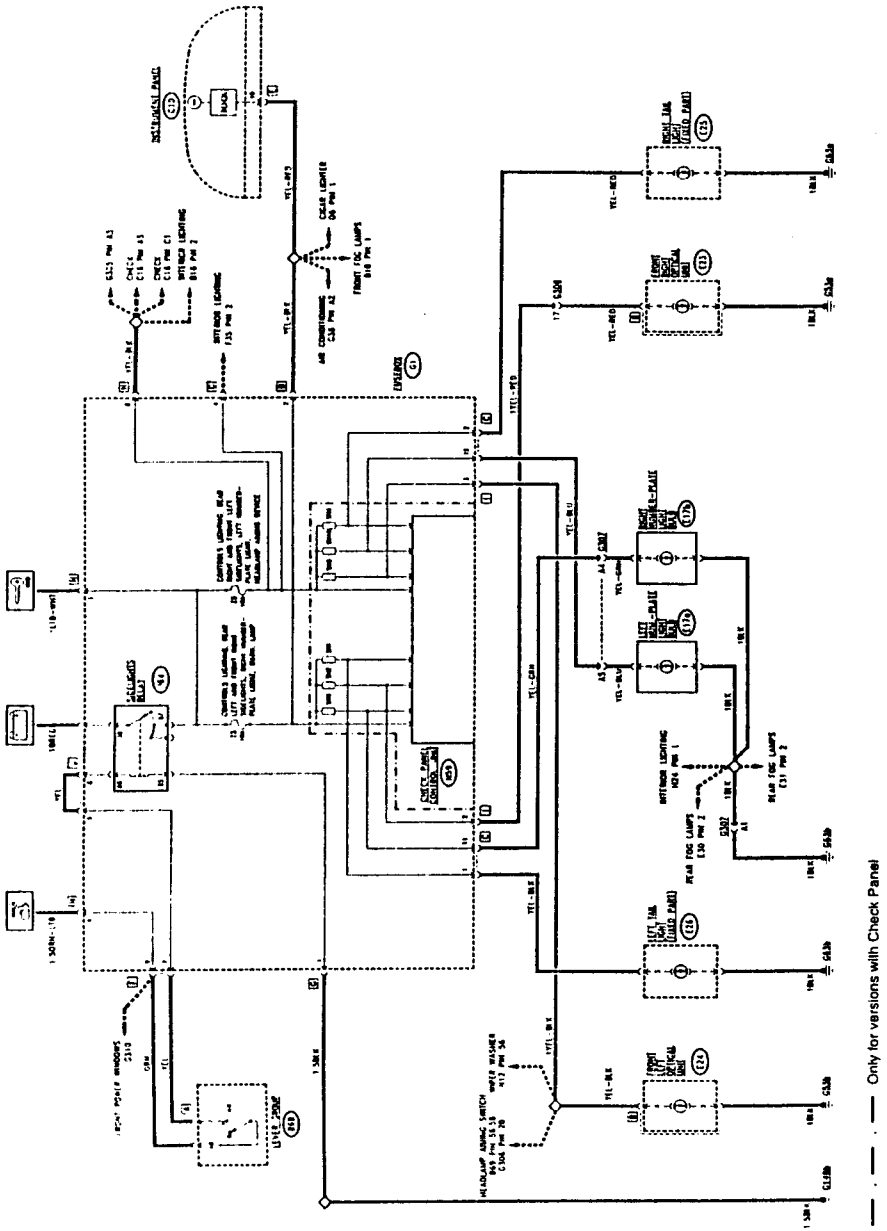
WIRING DIAGRAM



PA4978E116V000

GENERAL DESCRIPTION

N.B. Two distinct wiring diagrams are given, one for the models equipped with the Check Panel and one for models without this device.

The sidelights are illuminated when the switch on the lever group is rotated to the first position, and only when the ignition key is engaged: this prevents the battery from being drained if the lights are inadvertently left on when the vehicle is left.

They can also be illuminated though, by slightly withdrawing the ignition key and rotating it in the opposite direction, and holding down the special button: key in the "PARKING" position (see also "Power Supply")

When the sidelights are illuminated, the numberplate lights and numerous interior lights for the illumination of the passenger compartment, instruments and controls are also illuminated (see "Interior Lighting").

A warning lamp on the instrument panel signals that the sidelights are on.

For safety reasons the circuit is protected by two fuses employed in the "crossed" system: one for the front right and rear left lights and the other for the front left and rear right lights.

The correct operation of the sidelights and numberplate lights is - for some versions - verified by the Check Panel device which signals any malfunction affecting these important circuits (see "Check Panel").

FUNCTIONAL DESCRIPTION

The sidelights circuit is activated by relay **I64** located in fusebox **G1**.

Moving the switch on the lever group **B68** to position "I" when the ignition key is engaged, the coil of relay **I64** is supplied and the circuit is closed which sends supply to the sidelights; this circuit is protected by two fuses in fusebox **G1**: **F5** (10A) for the front right and rear left lights and **F6** (10A) for the front left and rear right lights. In this way the front sidelights **E23** (right) and **E24** (left) are supplied along with the rear lights **E25** (right) and **E26** (left) and the numberplate lights **E17**.

The line supplying fuse **F5** sends a signal to the instrument panel **C10** to illuminate the relative warning lamp.

As the sidelights are controlled by the Check Panel device, signals (both direct and by "SH" shunt) are emitted from the circuit supplying the lights themselves and are received by the control unit **N59** which can then check the line load (for greater detail see "Check Panel").

With the ignition key at the "PARKING" position, all the sidelights are illuminated as the fuses **F5** and **F6** in fusebox **G1** are supplied directly, by-passing the relay **I64**.

NOTE: Selecting the sidelights supplies numerous other circuits with "consensus" signals (circuits which operate only when when the sidelights are illuminated) or by supply lines in the real sense of the term (for example by illuminating the ideograms of the various buttons and controls...).

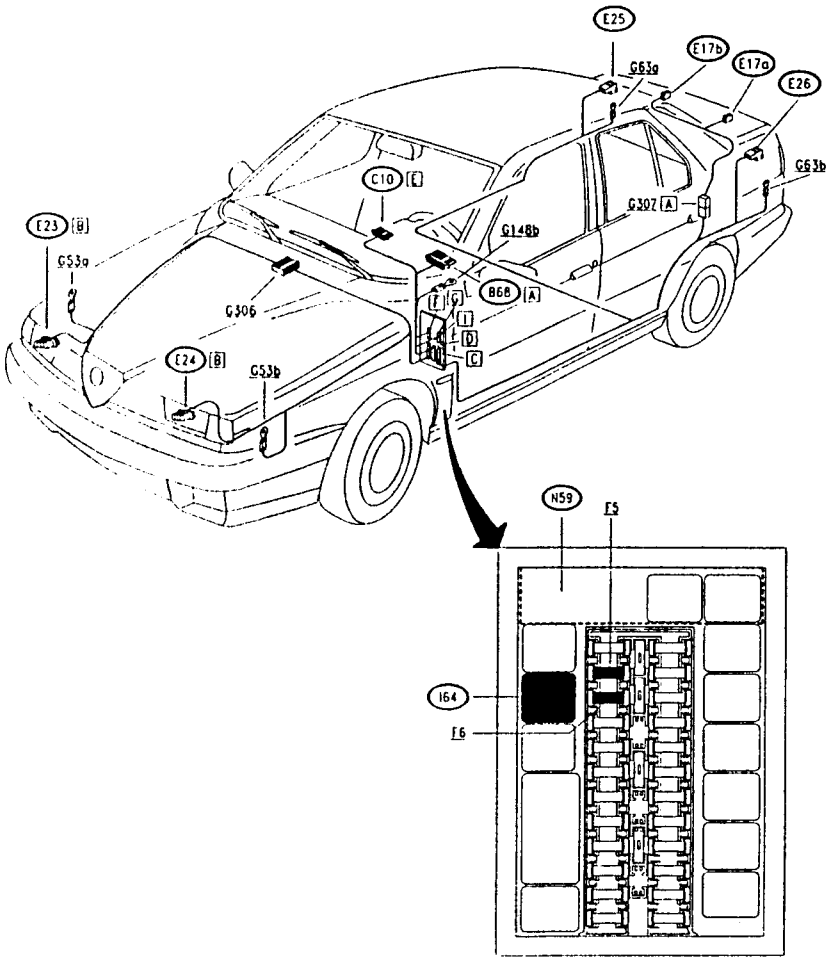
These lines are described and illustrated in the diagrams relative to the components to which they refer, or in the section "Interior Lighting").

TROUBLESHOOTING TABLE

Malfunction	Component to be checked										
	I64	B68	F5	F6	E23	E24	E25	E26	E17a	E17b	C10
All sidelights	•	•									
Front right			•		•						
Front left				•		•					
Rear right				•			•				
Rear left			•					•			
Right numberplate			•							•	
Left numberplate				•					•		
Sidelights warning lamp											•

PA4978E116V000

LOCATION OF COMPONENTS



MAIN AND DIPPED BEAM HEADLIGHTS

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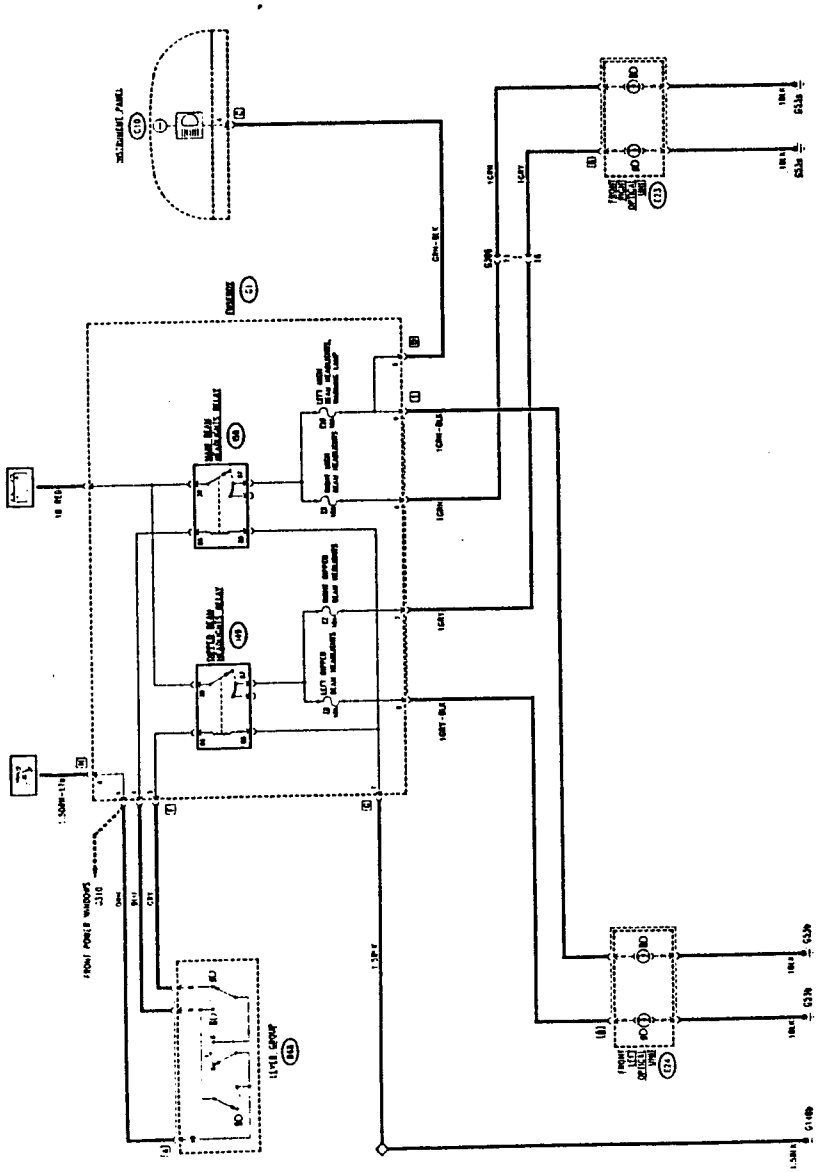
WIRING DIAGRAM



GENERAL DESCRIPTION

The vehicle is equipped with two lamps for the dipped beam and two for main-beam.

Dipped beam is selected by rotating the switch located on the lever group one position on from the sidelights position. From this position the main-beam can be permanently selected by acting on the main/dipped beam switch; lightly pulling the lever activates the mainbeam "flashing" function which will continue to flash for as long as the lever is pulled.

A warning lamp on the dashboard signals the selction of the main-beam.

For safety reasons each light is protected by two fuses, one for the right-hand lamp and the other for the left.

NOTE: some versions are equipped with an elecrically operated device which regulates the alignment of the headlights (see "Adjusting headlight alignment") however a manual device permits a rapid and simple adjustment of the beam to the loading conditions of the vehicle.

FUNCTIONAL DESCRIPTION

The circuit of the dipped beam headlights is activated by relay I49 located in fusebox G1.
Moving the lever group switch **B68** to position II - one position on from the sidelights position - and with the swith at the dipped beam position, the coil of relay I49 is "turn key" supplied closing the circuit supplying the lamps **E24** (left) and **E23** (right). Each circuit is protected by a fuse in box G1: **F7** (10A) for the right-hand lamp and **F10** (10A) for the left.

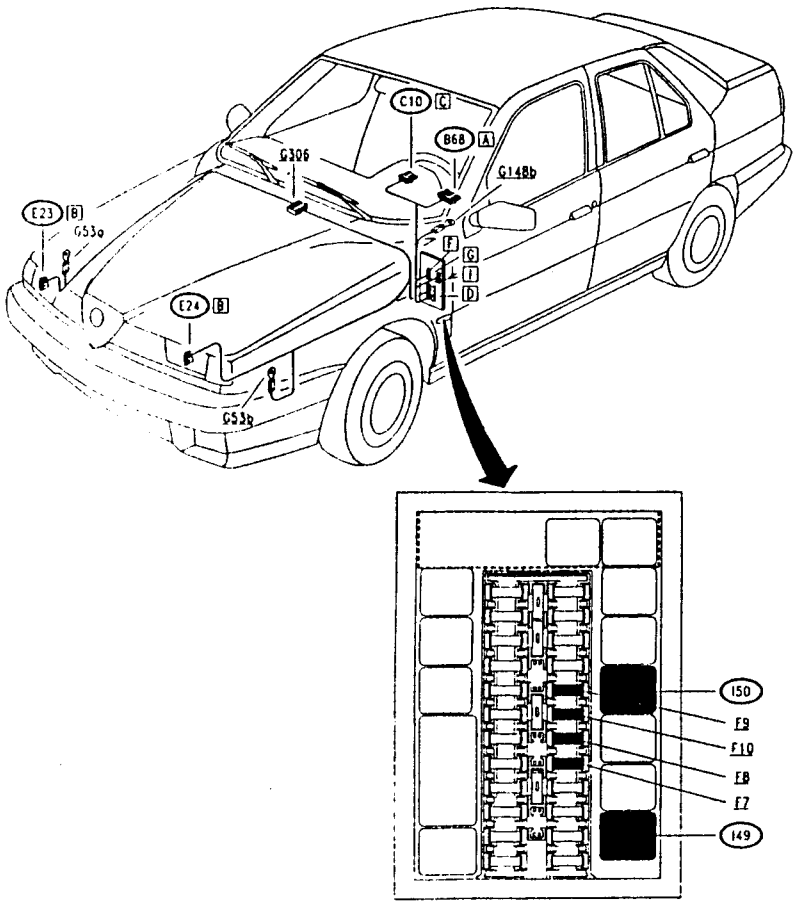
The main-beam circuit is activated by relay **I50** located in fusebox **G1**.
Moving the switch to the main-beam position, with the switch on the lever group **B68** to position II. or by closing the "flashing" contact, the coil of relay I50 is "turn key" supplied and closes the circuit which supplies the lamps **E24** (left) and **E23** (right). Each circuit is protected by a fuse in fusebox G1: F9 (15A) for the right-hand lamp and F10 (15A) for the left.

The supply line of the left lamp also sends a signal to the instrument panel **C10** which illuminates the "main-beam on" warning lamp.

TROUBLESHOOTING TABLE

Malfunction	Component to be checked									
	I49	I50	F7	F8	F9	F10	B68	E23	E24	C10
Both dipped beam lamps	•						•			
RH dipped beam lamp			•					•		
LH dipped beam lamp				•					•	
Both main beam lamps		•					•			
RH main beam lamp					•			•		
LH main beam lamp						•			•	
Main beam warning lamp										•

OCATION OF COMPONENTS



ADJUSTING HEADLIGHT ALIGNMENT

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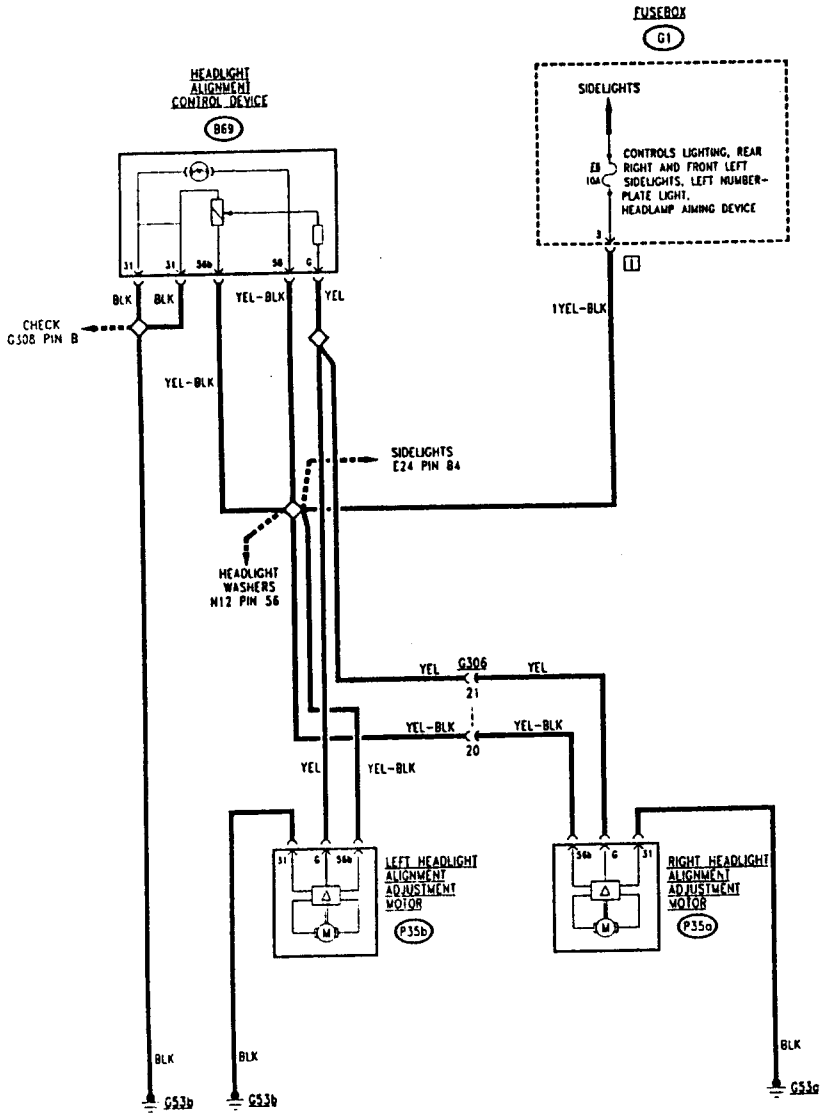
WIRING DIAGRAM



GENERAL DESCRIPTION

For certain markets the car offers the possibility to adjust the headlight beam in relation to the load directly from the driver's seat.
In this way the problem or invonvenlences caused by incorrect headlamp aiming is avoided and the delicate task of direct lamp adjustment is simplified (this is not substituted by the electrical device but integrated with it). For further details, see "155 - INSTRUCTIONS FOR REPAIR - BODY", Group 40.

The adjustment device consists of a motor fitted on each of the two headlamps which suitably slopes them to lower the beam when the car is heavily loaded and raise it when the load is lightened.
The driver operates the system directly by turning a knob on the dashboard, which allows four positions to be chosen according to the following table.

Knob position	Load conditions
0	driver only or driver and passenger on front seat
1	all seats occupied
2	all seats occupied plus load in the luggage compartment (up to the maximum allowable load on the rear axle)
3	driver plus load in luggage compartment up to the maximum allowable load on the rear axle)

The system can be operated only when the side lights are on - line of fuse F6 (10A): it is completely de-activated when they are off.

NOTE: for safety reasons the system is designed so that in the event of a failure it cannot be moved to a higher position than the one it is already at.

FUNCTIONAL DESCRIPTION

The headlamp aiming device B69 is supplied at pin 56b by a line leading from the side lights circuit: this line receives voltage only when the side lights are on. The same supply (pin 58) turns on the led inside device B69 itself which illuminates the ideogram identifying the function.
Pins 31 of device B69 are earthed, while the adjustment signal obtained by pressing the four-position selection knob leads from pin G. This signal varies the output voltage through a potentiometer (100% voltage at position "0"; with voltage decreasing for the successive positions).

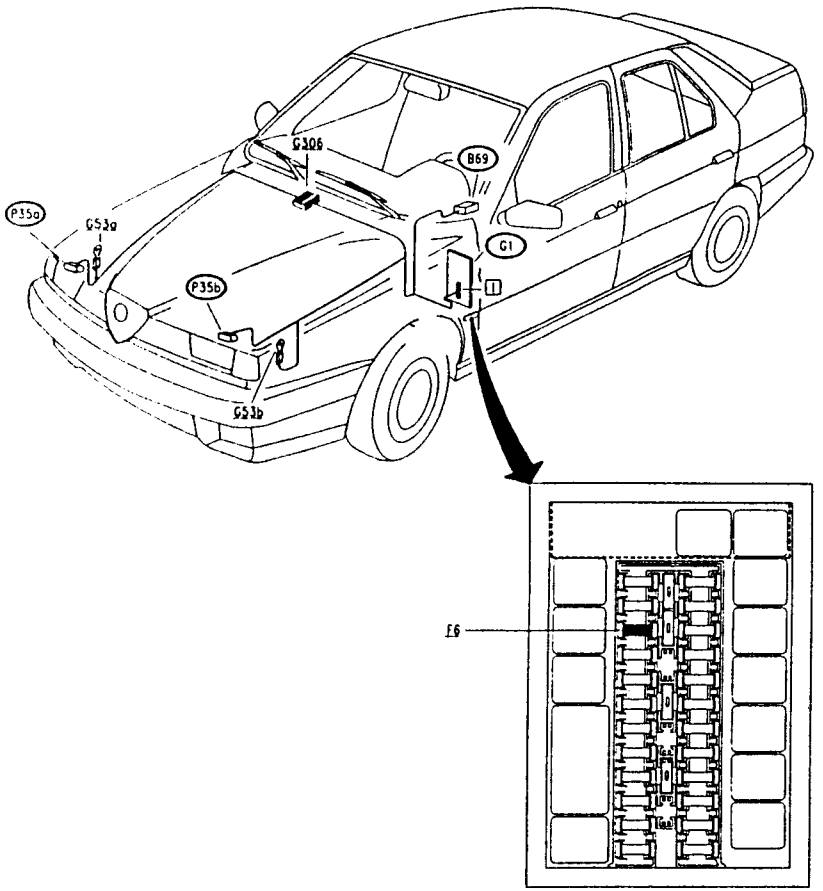
Motors P35a and P35b are formed by a motor in the strict sense of the word controlled by a transducer which establishes the stroke on the basis of the voltage of the adjustment signal reaching pin g, from device B69.
The transducers are supplied at pins 56b, by the same line that supplies device B69, while pins 31 are earthed.
Il sistema è azionabile solo a luci di posizione inserite - linea del fusibile F6 (10A): in caso contrario è completamente disattivato.

NOTA: il sistema è realizzato in modo tale che, in caso di avaria, non può essere portato in una posizione "più alta" di quella in cui si trova, questo per evidenti ragioni di sicurezza.

FAULT-FINDING TABLE

Fault	Component to be checked			
	F6	B69	P35a	P35b
Adjustment not working	•	•		
RH headlamp			•	
LH headlamp				•
Control device lighting	•	•		

LOCATION OF COMPONENTS



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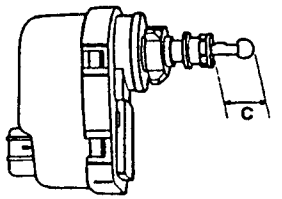
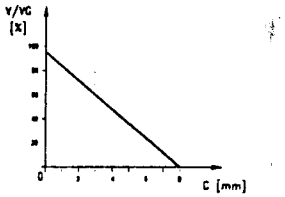
CHECKING COMPONENTS

RH/LH headlamp adjustment motor (P35a) (P35b)



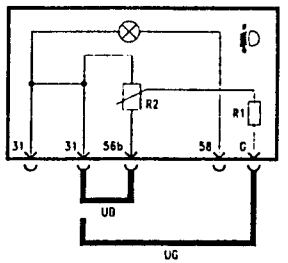


Operating diagram: trend of stroke C in relation to the voltage V/VG

V = voltage between pin 56b and pin 31 (12V)

VG = voltage between pin G and pin 31

Headlamp aiming control device (B69)



SPECIFICATIONS	
R1	390 Ω ± 2%
R2	1 kΩ

Knob position	Voltage between terminals G and 31 (UG)
0	100% UB ± 3%
1	88.7% UB ± 3%
2	80% UB ± 3%
3	66.3% UB ± 3%

(UB: voltage between pins 31 and 56b = 12V)

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REAR AND FRONT FOG-LAMPS

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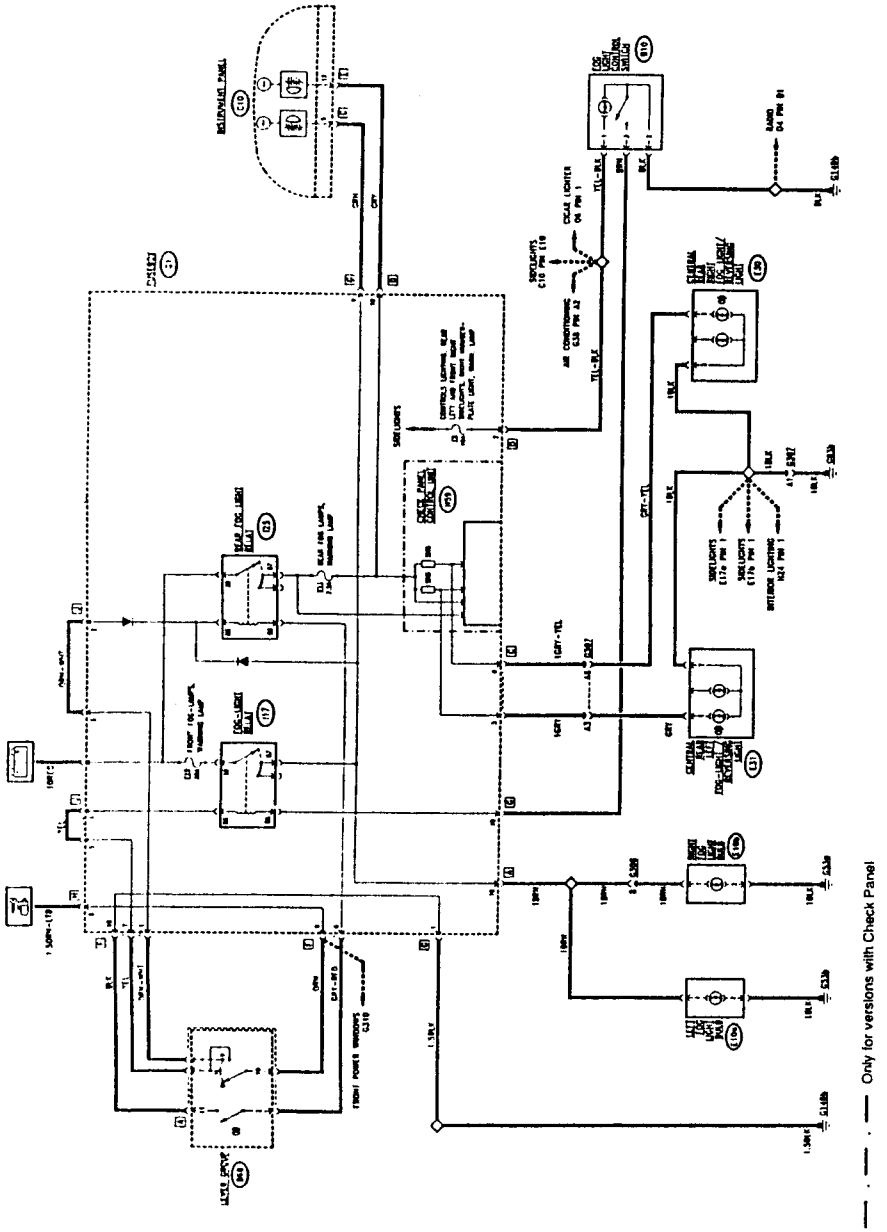
WIRING DIAGRAM



GENERAL DESCRIPTION

Upon request, the vehicle is equipped with special halogen type fog-lamps and high luminosity rear lights located in the central part of the rear light assembly, necessary under low visibility conditions.

The entire system ensures the greatest visibility possible both active and passive under any conditions.

The front fog-lamps are illuminated by acting on the switch located on the central console between the front seats; the rear fog-lamps by the control located on the lever group.

The front fog-lamps can be illuminated when the sidelights are on while the rear-fog-lamps only when the headlights are on dipped beam, or fog lamps are on.

A warning light on the instrument panel signals that the front fog- lamps are on and another signals illumination of the rear fog-lamps.

Each of the two circuits is protected by a fuse.

The rear fog-lamps are controlled - for some versions - by the Check Panel device which immediately signals any possible malfunction (see "Check Panel").

NOTE

In a few countries the vehicles are equipped with a single rear fog- lamp located on the left light assembly **E31**. The right light assembly **E30** and the relative wiring is not altered in comparison to other versions apart from the simple elimination of the rear fog-lamp. These specific light assemblies are identified with a green spot located on the inner part.

FUNCTIONAL DESCRIPTION

The circuit pertaining to the front fog-lamps is controlled by relay **I17** located in the fusebox **G1**.

By actioning switch **B10** when the sidelights are on (switch on the lever group **B68** at position "I"), a ground is sent which excites the coil of relay **I17** and in this way closes the circuit which supplies the two front fog-lamps **E10**.

Switch **B10** is illuminated when the sidelights are on. The circuit is protected by fuse **F19** (20A) in box **G1**.

The supply line also sends a signal to the instrument panel **C10** to illuminate the relative warning lamp; the line differs depending on the type of instrument panel **C10** used (see "Instrument Panel").

The circuit of the rear fog-lamps is controlled by relay **I25** located in fusebox **G1**.

With the switch on the lever group **B68**, when the headlights are on dipped beam (switch on the lever group at position "II"), voltage and ground are sent to the coil of relay **I25** in this way closing the circuit which supplys the voltage to the rear fog light **E31** (left) and **E30** (right), the same takes place with the fog lamps on, via the special circuit inside the fusebox.

The circuit is protected by fuse **F11** (7.5A) in box **G1**.

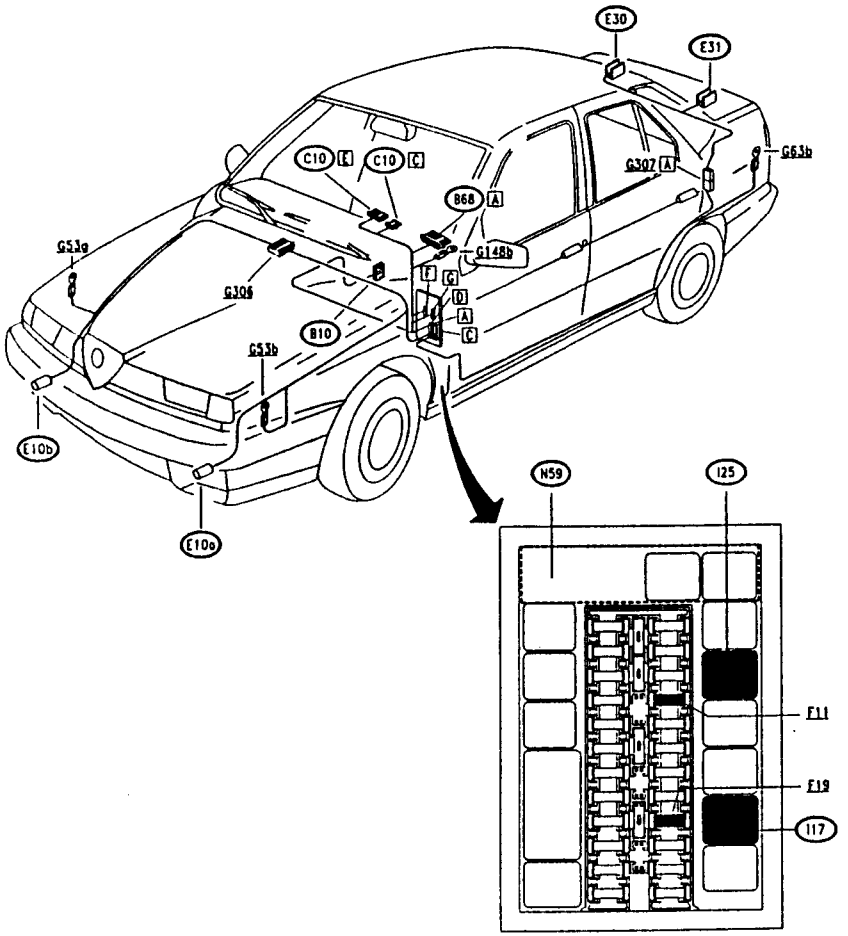
The supply line also sends a signal to the instrument panel **C10** to illuminate the relevant warning lamp.

The rear fog-lamps are controlled by the Check Panel device and therefore signals are sent from the supply circuit (both direct and by "SH" shunt) to the control unit **N59** which checks the voltage of the line (for more details see (Check Panel").

TROUBLESHOOTING TABLE

Malfunction	Component to be checked										
	I25	F11	B68	E30	E31	I17	F19	B10	E10a	E10b	C10
Both rear fog-lamps	•	•	•								
RH rear fog-lamp				•							
LH rear fog-lamp					•						
Rear fog-lamp warning light		•									•
Both front fog-lamps						•	•	•			
RH front fog-lamp										•	
LH front fog-lamp									•		
Front fog-lamp warning light											•
Front fog-lamp switch illumination							•	•			

LOCATION OF COMPONENTS



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DIRECTION INDICATORS AND HAZARD WARNING LIGHTS

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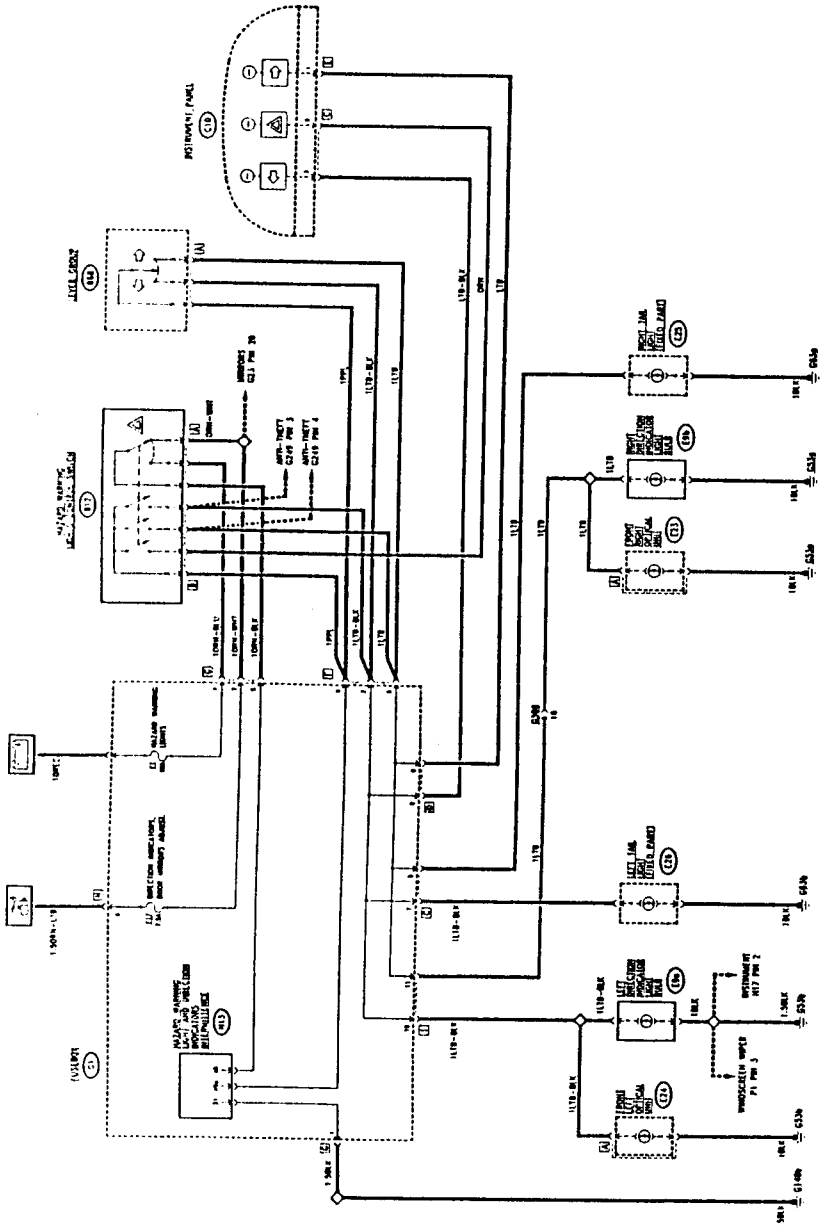
WIRING DIAGRAM



GENERAL DESCRIPTION

The intermittent direction indicators and hazard warning lights are positioned at the corners of the vehicle.

The right and left direction indicators are selected by raising or lowering the specific lever located in the lever group; the hazard warning lights (right and left direction indicators activated simultaneously) are switched on by acting on the switch located behind the steering wheel near the instrument panel.
The direction indicators operate when the ignition key is inserted, the hazard warning lights, for obvious reasons of safety, are supplied directly by the battery.
Two intermittent warning lamps located on the instrument panel flash when either the right or left direction indicator has been selected. Another intermittent warning lamp signals the operation of the hazard warning lights.
The circuits of the direction indicators and the hazard warning lights are both protected by their own separate fuses.

FUNCTIONAL DESCRIPTION

The circuit is controlled by the hazard warning lights and direction indicators intermittence **N13** located in fusebox **G1**.
The intermittence, grounded, pin 31, receives a supply signal, pin 49, throught the hazard warning lights switch **B12**: when these are not selected, supply is key-operated through fuse **F17** (7.5A) of fusebox **G1**; when the hazard warning lights are selected, the supply comes directly from the battery through fuse **F1** (10 A) in **G1**.
The device **N13** generates an intermittent signal which leaves pin 49a and supplies the contacts of switch **B12** and the direction indicators switch of lever group **B68**.

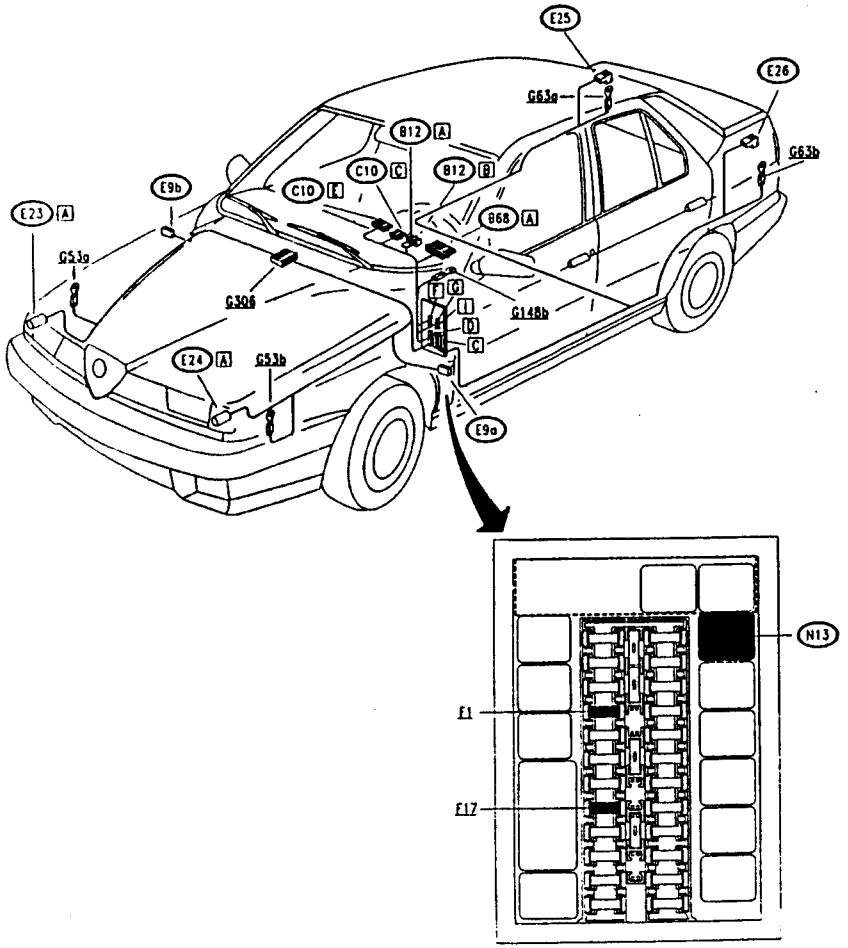
By acting on the specific lever in lever group **B68**, the right-hand direction indicators (**E23, E9b** and **E25**) or the left-hand indicators (**E24, E9a** ed **E26**) are actuated as is the relative warning lamp on the instrument panel **C10**.

Pressing switch **B12** closes the three contacts which supply the right and left-hand indicators and the hazard warning lights warning lamp on the instrument panel **C10**.

TROUBLESHOOTING TABLE

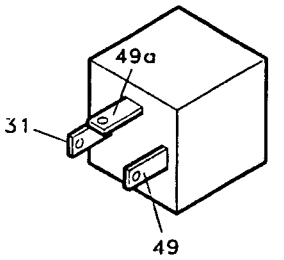
Malfunction	Component											
	E1	E17	N13	B68	B12	E23	E24	E9a	E9b	E25	E26	C10
All direction indicators		•	•	•								
Hazard warning lights	•		•		•							
RH direction indicator				•								
LH direction indicator				•								
Front right light						•						
Right side light									•			
Right rear light										•		
Front left light							•					
Left side light								•				
Left rear light											•	
RH warning lamp												•
LH warning lamp												•
Hazard warning lights warning lamp												•

LOCATION OF COMPONENTS



CHECKING COMPONENTS

Hazard warning lights and direction indicator intermittence (N13)



Check device: see TEST A

CHECK HAZARD WARNING LIGHTS AND DIRECTION INDICATOR INTERMITTENCE (N13)	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect the intermittence **N13** from the fusebox **G1**, and check on the base - with the key engaged or with the hazard warning lights on - for 12V at pin 49 of **N13**	OK ▶	Carry out step **A2**
	OK ▶	Check fuses **F17** and **F1** of fusebox **G1**. If necessary, restore the wiring between **G1** and **B12**
A2 CHECK EARTH – Check for 0V at pin 31 of **N13**	OK ▶	Insert device **N13** on the base and continue with step **A3**
	OK ▶	Restore the wiring between **G1** and earth **G148b**
A3 CHECK INTERMITTENT VOLTAGE – With the key turned, operate the RH blinker and check for intermittent 12V at pin 49a of **N13**; in the same way operate the LH blinker, or the hazard warning lights	OK ▶	DEVICE **N13** IS WORKING PROPERLY Check the connections with the other components. NOTE: If the flashing frequency doubles, one of the bulbs has blown.
	OK ▶	CHANGE DEVICE **N13**

STOP-LIGHTS

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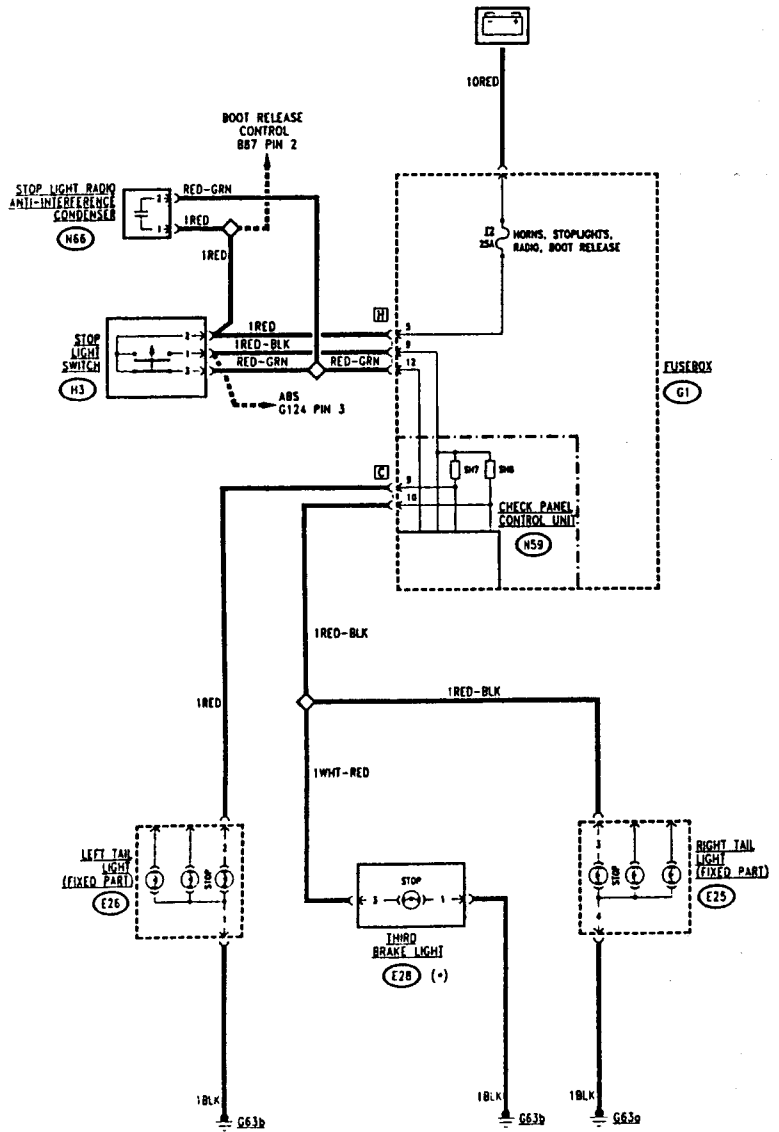
WIRING DIAGRAM



— · — · — Only for versions with Check Panel

(•) present for some markets only

GENERAL DESCRIPTION

The lights indicating that the vehicle is braking ("stop-lights") are operated each time the brake pedal is depressed; they are located at the rear of the vehicle in the side light assemblies. A third, central brake light is fitted for some markets. The lights are illuminated automatically by a switch located on the brake pedal and operate under all conditions, even when the ignition key is disengaged. The circuit is protected by its own fuse.

The correct functioning of the stop-lights is - for some versions - verified by the Check Panel which immediately alerts the driver in the event of a malfunction in the circuit. This is vital to safety. (see "Check Panel").

The braking signal from the switch is also sent to the ABS system control unit which recognizes the situation and as a consequence controls the braking parameters (see "A.B.S. System").

A radio anti-interference condenser has been fitted to vehicles equipped with radio-system to prevent disturbances from the brake switch.

FUNCTIONAL DESCRIPTION

The stop-light circuit is supplied directly by battery voltage through fuse F2 (25A) in the fusebox G1.
The stop-lights switch H3 is formed by two contacts: the "rest position" contact is closed when the brake pedal is not depressed and signals the continuity of the circuit to the Check Panel control unit N59.

By depressing the brake pedal the "operating position" contact is closed and the stop lights located in the rear light assemblies E25 (right) and E26 (left) and for markets where applicable - in the central brake light E28. From these supply circuits the signals (both direct and by "SH" shunt) are then sent to the control unit N59 which verifies the line load (see "Check Panel").

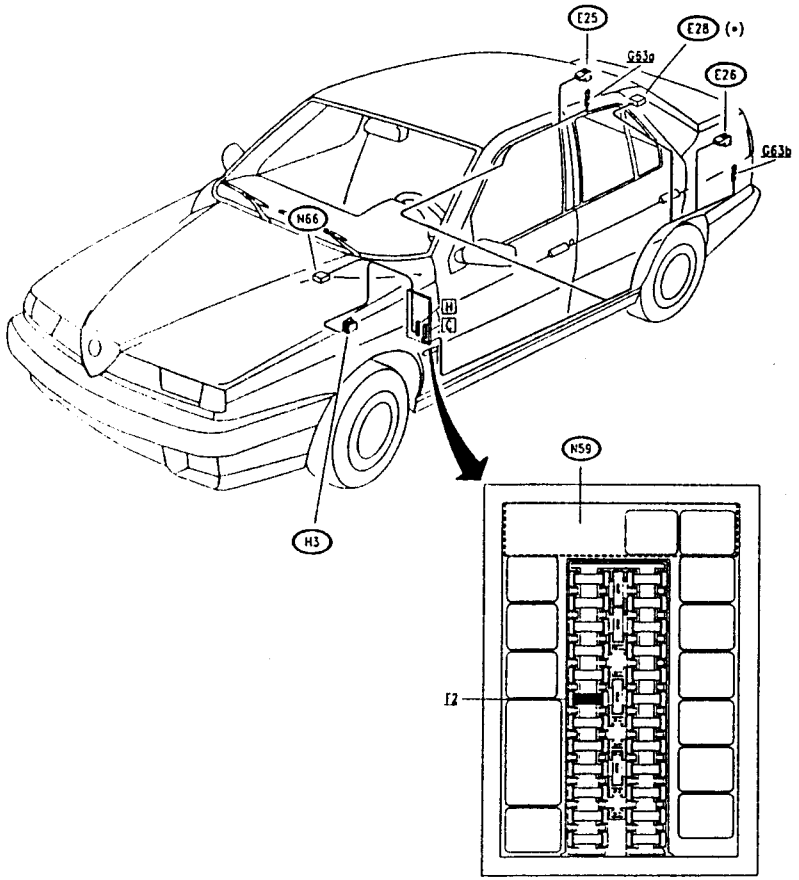
A radio anti-interference condenser N66 is connected in parallel to switch H3.

TROUBLESHOOTING TABLE

Malfunction	Component to be checked				
	E2	H3	E26	E25	E28
All brake lights	•	•			
RH stop-light				•	
LH stop-light			•		
"Third brake light" (•)		•			

(•) Present for some markets only.

OCATION OF COMPONENTS



•) present for some markets only

REVERSING LIGHTS

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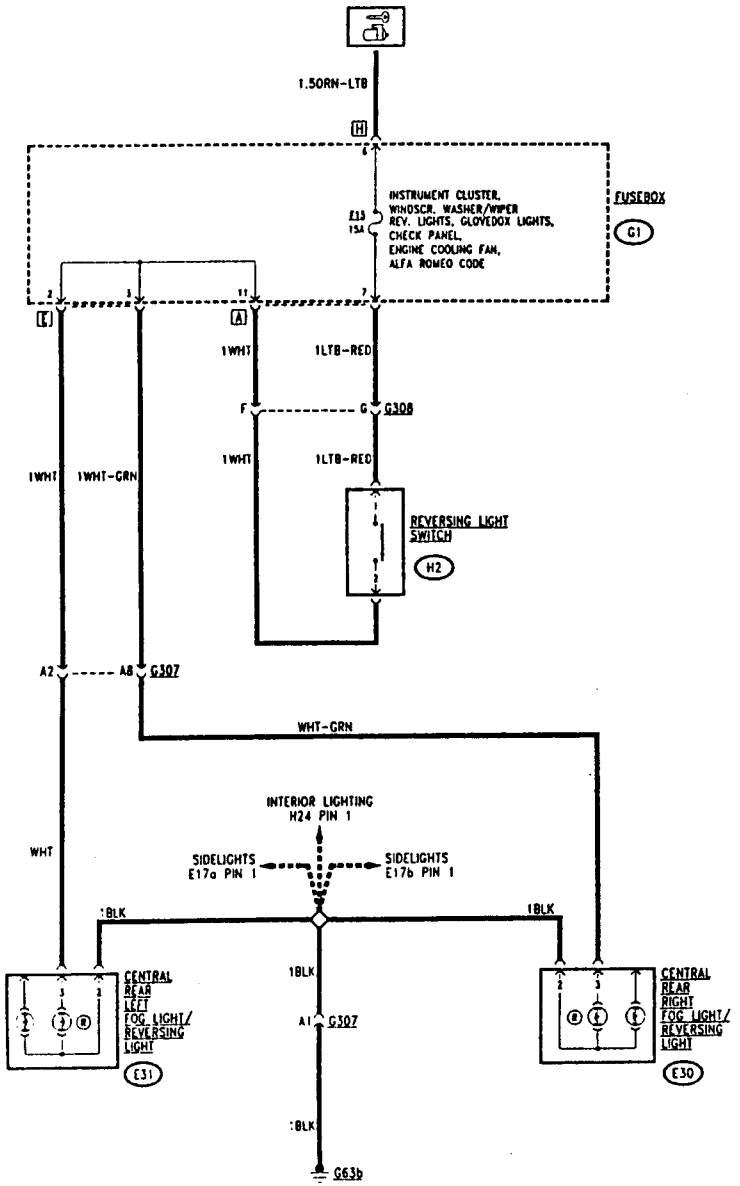
WIRING DIAGRAM



GENERAL DESCRIPTION

The vehicle is equipped with reversing lights located in the central part of the rear light assembly.
When reverse gear is selected, the reversing lights are automatically engaged by way of a switch located on the gearbox.

The circuit is protected by a fuse.

The reversing lights are operated when the ignition key is inserted and are independent from the other lights on the vehicle.

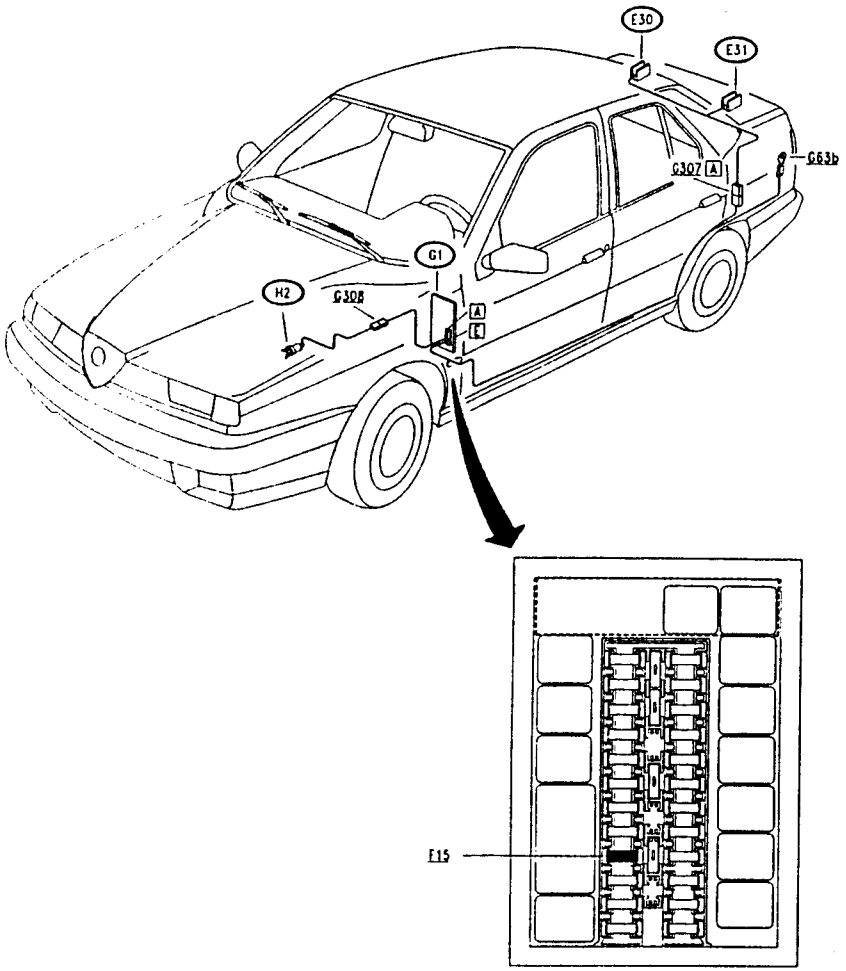
FUNCTIONAL DESCRIPTION

The circuit of the reversing lights is under key operated supply and is routed through fuse F15 (15A) in fusebox G1.
When reverse gear is engaged, switch H2 supplies the right (E30) and left (E31) reversing lights.

TROUBLESHOOTING TABLE

Malfunction	Component to be checked			
	F15	H2	E30	E31
Both reversing lights	•	•		
RH reversing light			•	
LH reversing light				•

OCATION OF COMPONENTS



INTERIOR LIGHTING

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GENERAL DESCRIPTION

The numerous light sources make it easy to locate the controls and switches, and when necessary offer good lighting of the entire passenger compartment and/or of certain specific points.
The wiring diagram referring to the interior lighting has been subdivided into three sections:

- the first one shows the lights which illuminate the ideograms of the controls and switches when the sidelights are on;
- the second one includes the ceiling lights and light points operated via the special timer which turns them off or on for a few seconds when the doors are opened or closed.
- a third specific diagram is dedicated to instrument cluster lighting, as this is adjustable in intensity with a special rheostat.

Lighting of controls and ideograms:
When the sidelights are on, the ideograms on the steering column lever unit are illuminated, and also the heater controls (**for the automatic air conditioner, see "Climate control - control unit: supply and diagnosis"**).
The specific diagrams show the lighting of the ideograms of the Check Panel display, ashtray, seats adjustment, fog lamp switch.
In addition, the opening of the glovebox turns on a special light (see "Boot opening control").
N.B. Therefore, reference should be made to the above-mentioned sections for further details, and for fault-finding if the various ideograms fail to light up.

Ceiling lamps:
When the doors are opened and closed a timer device **N10** turns on and off the front centre ceiling lamp **F35**, and the rear one **F3**. This device works according to the following logic:

- when any one door is opened the lights are turned on, the go off after appr. 100-200 seconds or if the doors are closed again;
- after closing the lights stay on for appr. 15 seconds, then they go off definitively;
- Turning the key to "MARCIA", timing is cut out;
- with the engine running, normal timing as described above takes place.

Of course, the two ceiling lamps may also be turned on manually, using the switch provided.

On the same element of the ceiling lamp there is also a spot light, supplied directly by the battery, which for example makes it possible to read without disturbing the driver.

NOTE: In the versions with alarm system, the rear ceiling lamp **F3** incorporates the receiver for the signals of the remote control **N67**.

Lastly, a special lamp **F5** illuminates the luggage compartment, controlled by the opening of the boot lid.

Instrument cluster lighting:
The instrument cluster **C10** is illuminated through a rheostat **B16**, which adjusts the luminosity to the required level.

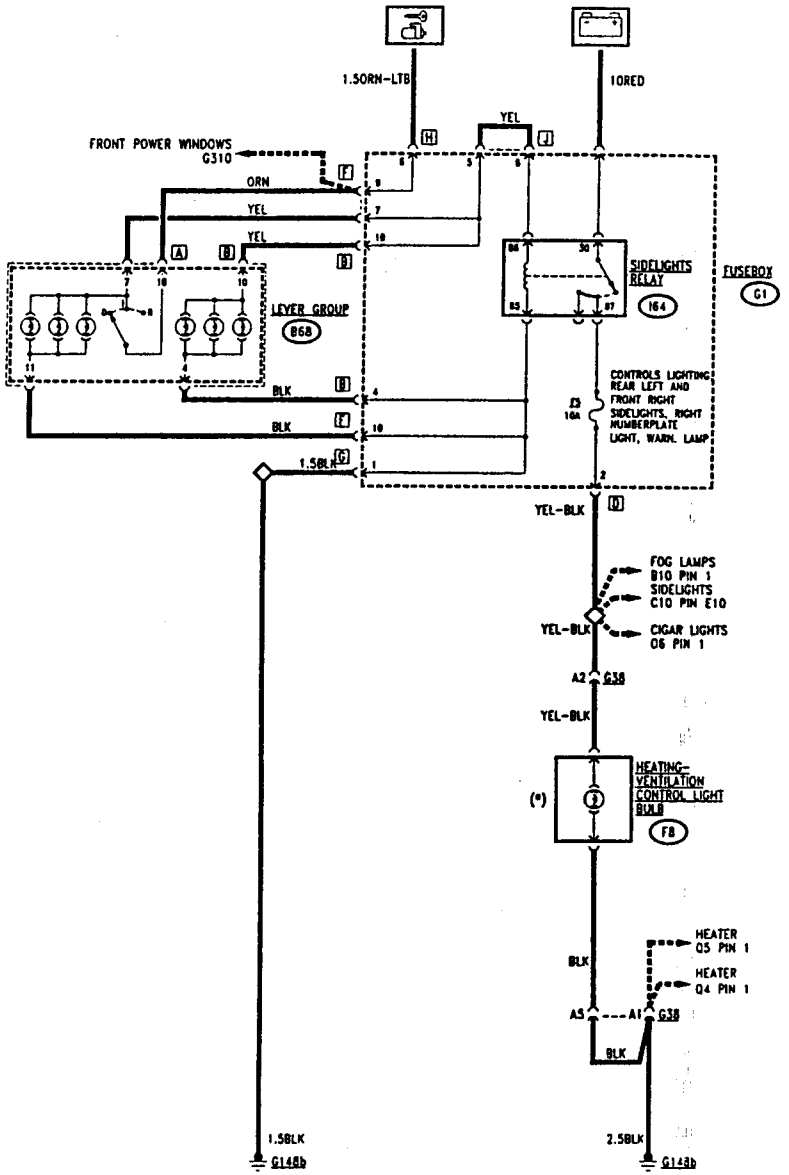
LIGHTING OF CONTROLS AND IDEOGRAMS

Functional Description

The steering column lever unit ideograms **B68** are lit when the side lights are turned on: the left ones directly by the sidelights switch the right ones via a supply which returns from the fusebox **G1**.

Through the sidelights relay **I64** and fuse **F5** (10A) of **G1** also the heater controls **F8** are supplied (for the automatic conditioner see "Climate control - control unit: supply and diagnosis").

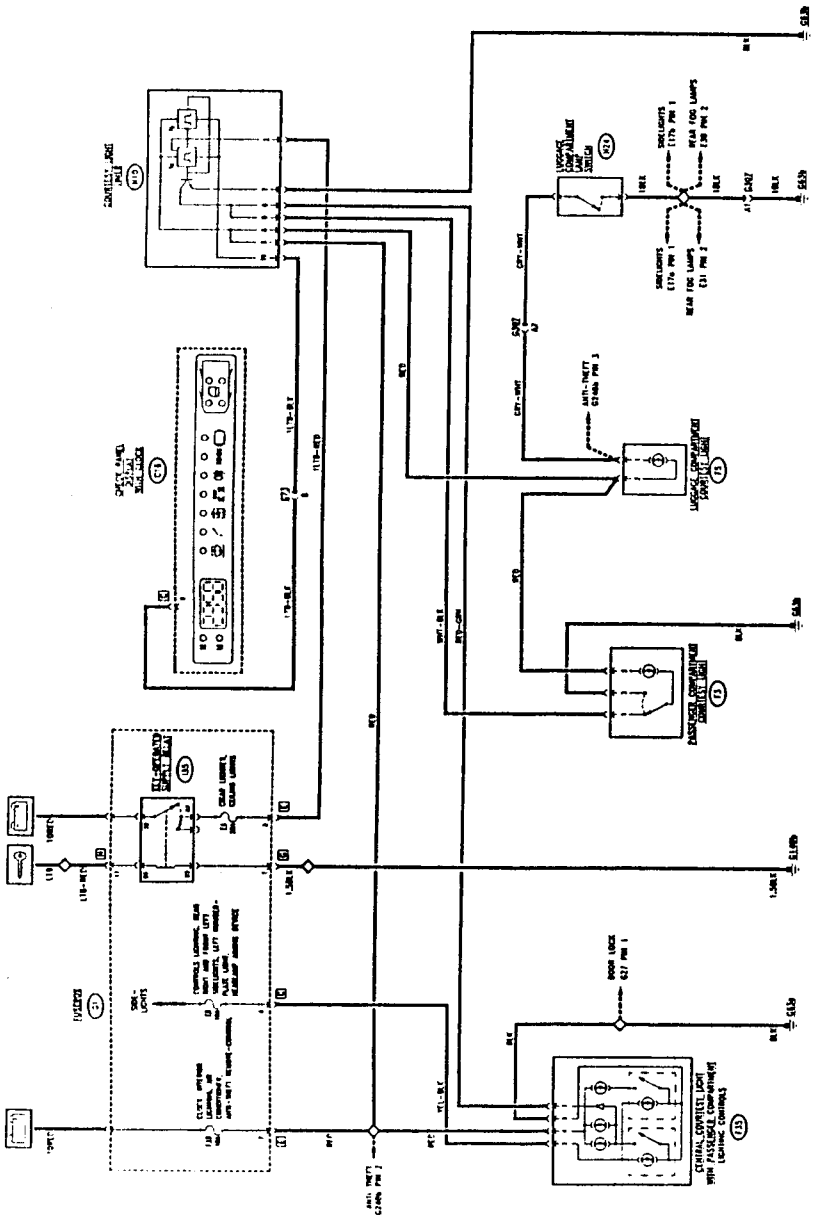
Wiring diagram



(*) Manual heater (for the automatic conditioner, see Sect. 26)

CEILING LAMPS

Wiring diagram



Functional Description

Passenger compartment ceiling lamps

The ceiling lamp with passenger compartment lighting controls (reading lamp) **F35** receives the direct supply from the battery via fuse **F16** (10A) of fusebox **G1**: this makes it possible to turn on the reading lamp or the ceiling lamp using the corresponding switch.

When the sidelights are on **F35** receives another supply which lights up the ideograms of the controls.

The rear passenger compartment ceiling lamp **F3** also receives a supply directly from the battery, still via fuse **F16** (10A)

Timed ceiling lamps:

The electronic ceiling lamp timer device **N10** - located in the rear under the seat - controls the turning on of ceiling lamps **F35** and **F3**.

The battery voltage is supplied via fuse **F16** (10A) of fusebox **G1** to the electronic devices Ta and Tb of **N10**. The timer also receives the "doors open" signal, at pin 11, from the Check Panel **C16** which informs of the opening of any one door (this signal is the same that prevents the locking/release of the doors -see "Door locking device").

The timer Ta sends an earth signal, from pin 8 and 9, to the timed lamps **F3** and **F35** (supplied with battery voltage by the line of fuse **F16**) turning them on for appr. 1000-200 seconds when the doors are opened; when the "doors open" signal ceases the timer Tb sends the same earth signal turning on the lights again for appr. 15 seconds.

The "key-operated supply" reaches pin 2 which cuts out timing when the key is engaged.

Luggage compartment lighting:

The luggage compartment light **F5** - not timed - is also supplied with battery voltage through the line protected by fuse **F16** (10A); it is turned on when the boot is opened and switch **H24** sends an earth signal.

INSTRUMENT CLUSTER LIGHTING

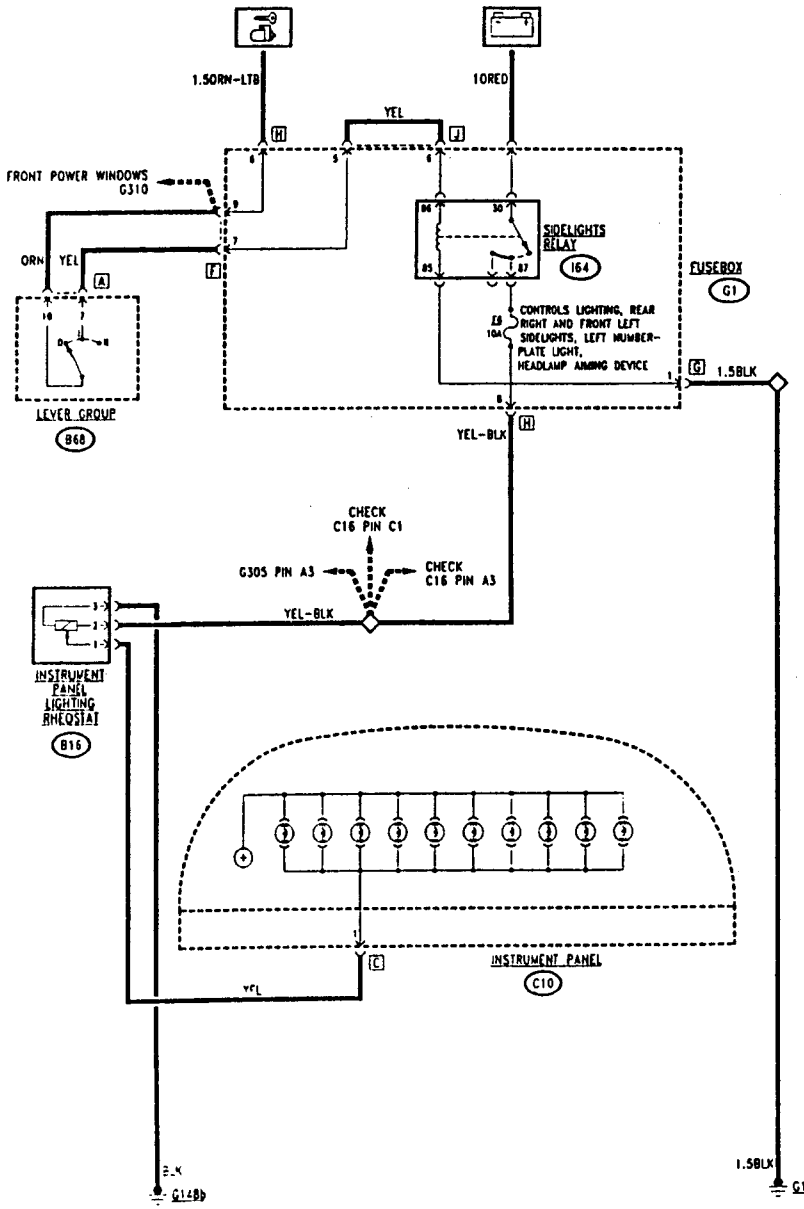
Functional Description

The instrument cluster **C10** is illuminated supplying a series of bulbs (10) to be found inside it; this supply takes place through the cluster light dimming rheostat **B16**, which makes it possible to adjust the lighting to the level required.

Il reostato B16 is supplied with battery voltage, when the sidelights are on through the switch on the steering column lever unit B68, via relay I64 and fuse F6 (10A) of fusebox G1.

Adjustment takes place on the earth signal which reaches the cluster bulbs, supplied by the "key-operated supply" (see also "Instrument Cluster).

Wiring diagram



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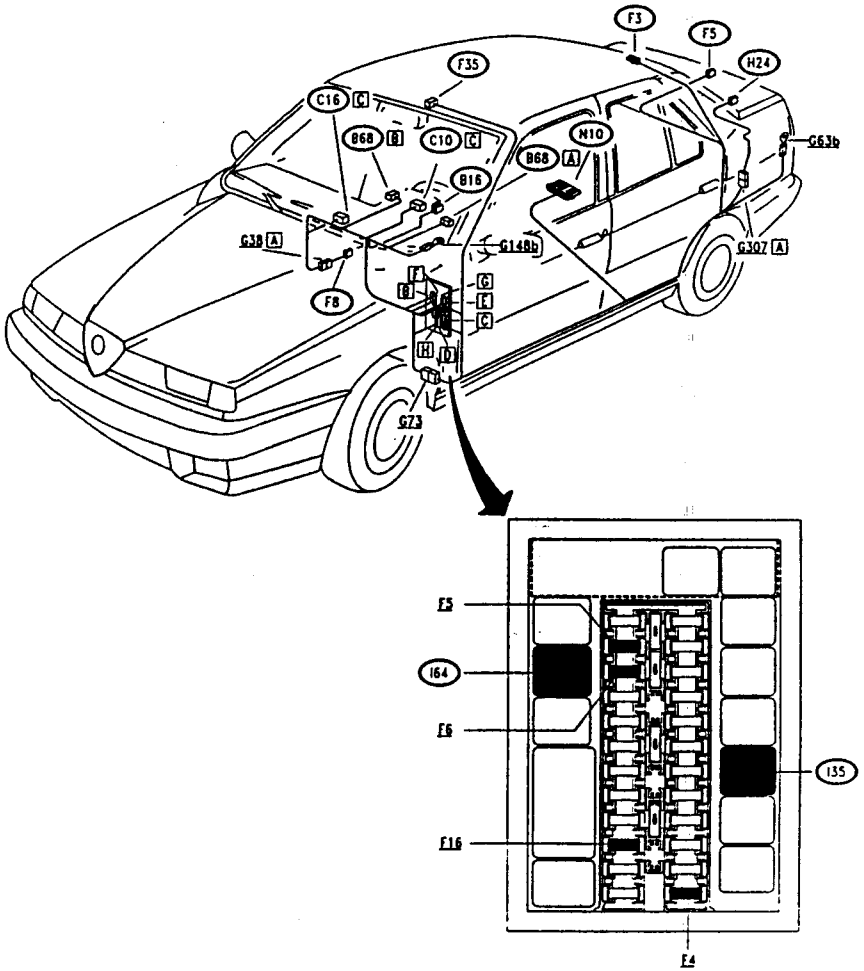
LOCATION OF COMPONENTS



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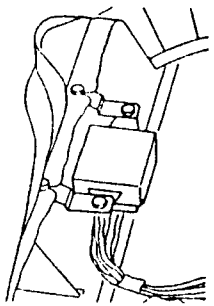
FAULT-FINDING TABLE

Fault	Component to be checked													
	F8 (2)	F5	F6	I64	B68 (1)	F16	F4	N10	F35 (2)	F3 (2)	F5 (2)	H24	C10 (2)	B16
·eater lights	•	•		•										
·eering column lever ·hts				•	•									
·l timed lights						•	•	•						
·ntre ceiling lamp						•		•	•					
·ear passenger compart- ·ent lamps						•		•		•				
·ggage compartment light											•	•		
·uster lighting			•										•	•
·uster lighting adjustment														•

(1) in the event of a fault on the lights/leds it is necessary to **change the whole component**
only replace the bulbs with bulb holder

HECKING COMPONENTS

·iling lamp timer (N10)



SPECIFICATIONS	
Door opening timer (Ta)	100 ÷ 200 sec.
Door closing timer (Tb)	15 ± 5 sec

Checking the device: see **TEST A**

CHECK CEILING LAMPS TIMER (N10)	TEST A

TEST PROCEDURE	RESULT	CORRECTIVE ACTION
A1 CHECK VOLTAGE – Disconnect device **N10** and check on the connector for 12 V at pin 5 and 6; with the key at MARCIA, 12 V at pin 2 of **N10**	OK ▶ ~~OK~~ ▶	Carry out **step A2** Check fuses **F4** and **F16** of **G1**. If necessary restore the wiring between **N10** and **G1**
A2 CHECK EARTH – Check for 0 V at pin 7 of **N10**	OK ▶ ~~OK~~ ▶	Carry out **step A3** Restore the wiring between **N10** and earth **G63b**
A3 CHECK EARTH SIGNAL – Open one of the four doors and check for an earth at pin 11 of **N10**	OK ▶ ~~OK~~ ▶	Insert the device **N10** on the connector, then carry out **step A4** Restore the wiring between **N10** and the Check Panel display **C16**
A4 CHECK EARTH SIGNAL – With the key at STOP, open one of the doors and check for 100 ÷ 200 sec. for an earth leaving pin 8 and 9 of **N10**; after re-closing the earth remains for appr. 15 sec.; with the key at MARCIA this signal must cease	OK ▶ ~~OK~~ ▶	Restore the wiring between **N10** and ceiling lamps **F35** and **F3** **CHANGE DEVICE N10**

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INSTRUMENT PANEL

INDEX

GENERAL DESCRIPTION

he instrument cluster provides all the fications and information concerning e conditions of the vehicle which are dispensable for safe driving

he instrument cluster is of the analogue pe with two generously-sized indica- rs for the speedometer and rev unter, other gauges for the engine oil mperature and pressure, fuel level d coolant fluid temperature.

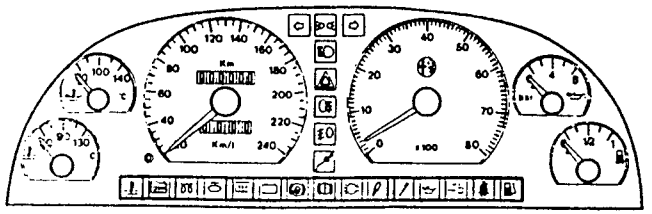
eries of plainly visible warning lights mplete the information given to the iver.

NB.: The instrument cluster is made as single component. all the internal con- ections are made on a printed circuit hich contains the contacts of the instru- ents and of the different warning lights. herefore, repair operations are not ssible except for the replacement of arning light bulbs (see "CHECKING OMPONENTS").

Note: the wiring diagram has bee sub-divided into 6 parts:

- the first 5 diagrams describe certain specific functions: **here a descriptio is only given of those functios that are not dealt with elsewhere and connected only with the indications of the instrument cluster;** other functions, i.e. the check warning lights, are included in the diagram of the system to which they belong : for example the high beam warning light is to be found in the diagram: "High-Low beam headlamps", etc....
- the sixth diagram involves all the internal connections of the printed circuit of the cluster itself.

The instrument cluster lighting, supplied when the sidelights are on, is adjusted by a special rheostat (B16) in a circuit described separately (see "Interior lighting").

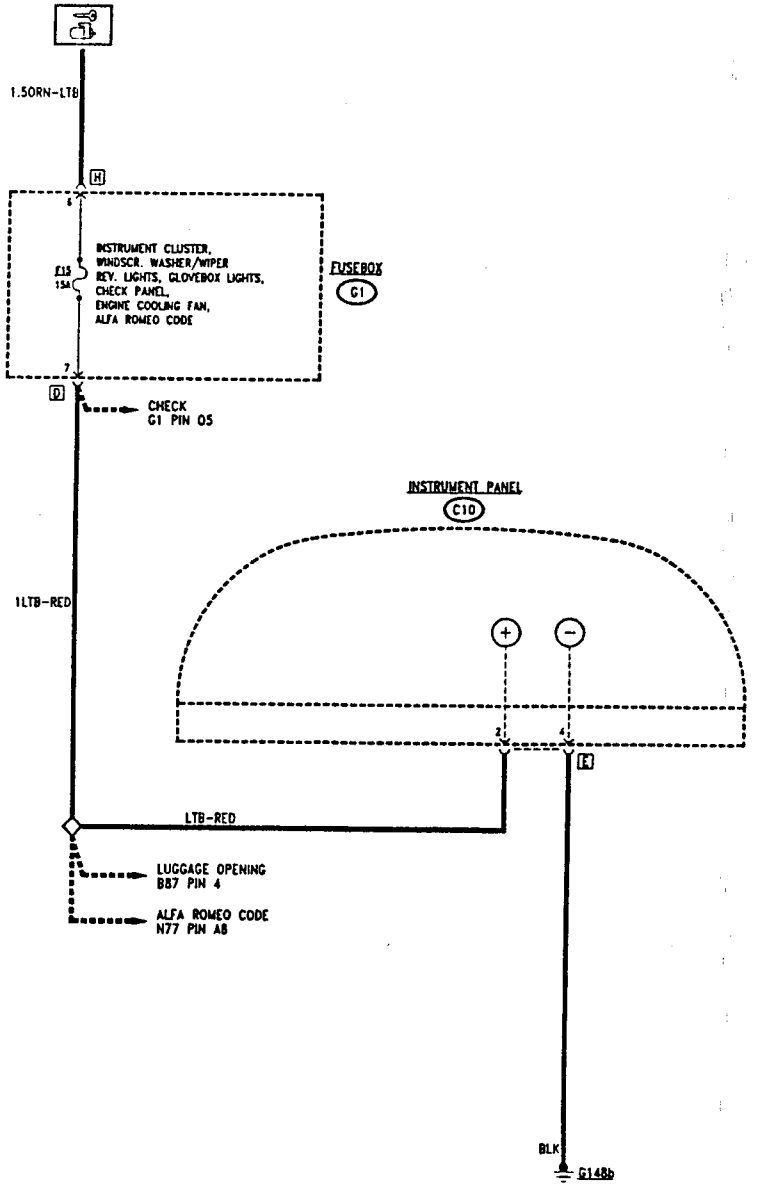


INSTRUMENT CLUSTER SUPPLY

Functional Description

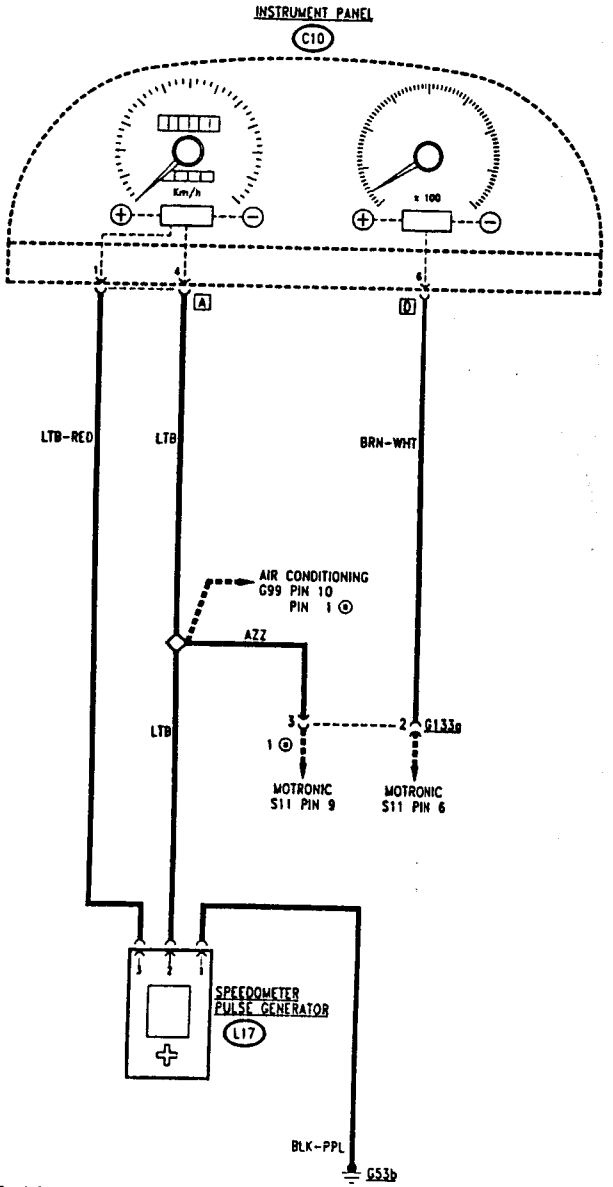
The instrument cluster is supplied by battery voltage via fuse F15 (15A) of fusebox G1. Connection takes place at pin 2 of connector E of the cluster C10. The cluster C10 is earthed through the cable leading from pin 4 of connector E to earth G148b.

Wiring Diagram



REV COUNTER AND SPEEDOMETER

Wiring Diagram



⊙ Variant for models 1.6 - 1.8 - 2.0 m.y. '96

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Functional Description

The rev counter signal is sent to the instrument cluster by the Motronic control unit S11, which receives a signal proportionate with engine rpm from sensor S31 (see "MOTRONIC supply system").
The signal reaches the cluster C10 at pin 6 of connector D, leading from connector G133a which connects the Motronic system with the other circuits; inside the cluster it then reaches the electronic device which operates the rev counter.

The speedometer signal is sent by the tachometric sensor L17: this is fitted on the gearbox and detects the speed of the car at all times.
This is a pulse generator which, through a Hall-effect probe, generates and processes a signal that is proportionate with the speed of the transmission shaft at the gearbox output, and therefore that of the wheels.

Sensor L17 is supplied at pin 3 with stabilized voltage through an electronic device inside the cluster (from pin 1 of connector A of C10); pin 1 is connected to earth G53b, while the tachometric signal (proportionate with the speed of the car) leads from pin 2 and is sent to the cluster C10 at pin 4 of connector A, and from here to the electronic device that operates the speedometer and the two odometers (total and trip).

The same signal is also sent to certain other systems which need the "car speed" information:

- through connector G99 to the air conditioning system, i.e. to control unit Q21a, the control of which engages the radiator fan when the car is stationary (see "Climate control: automatic climate control with air conditioner");
- through connector G133a to the Motronic control unit S11 which optimises certain operating strategies according to the speed of the car.

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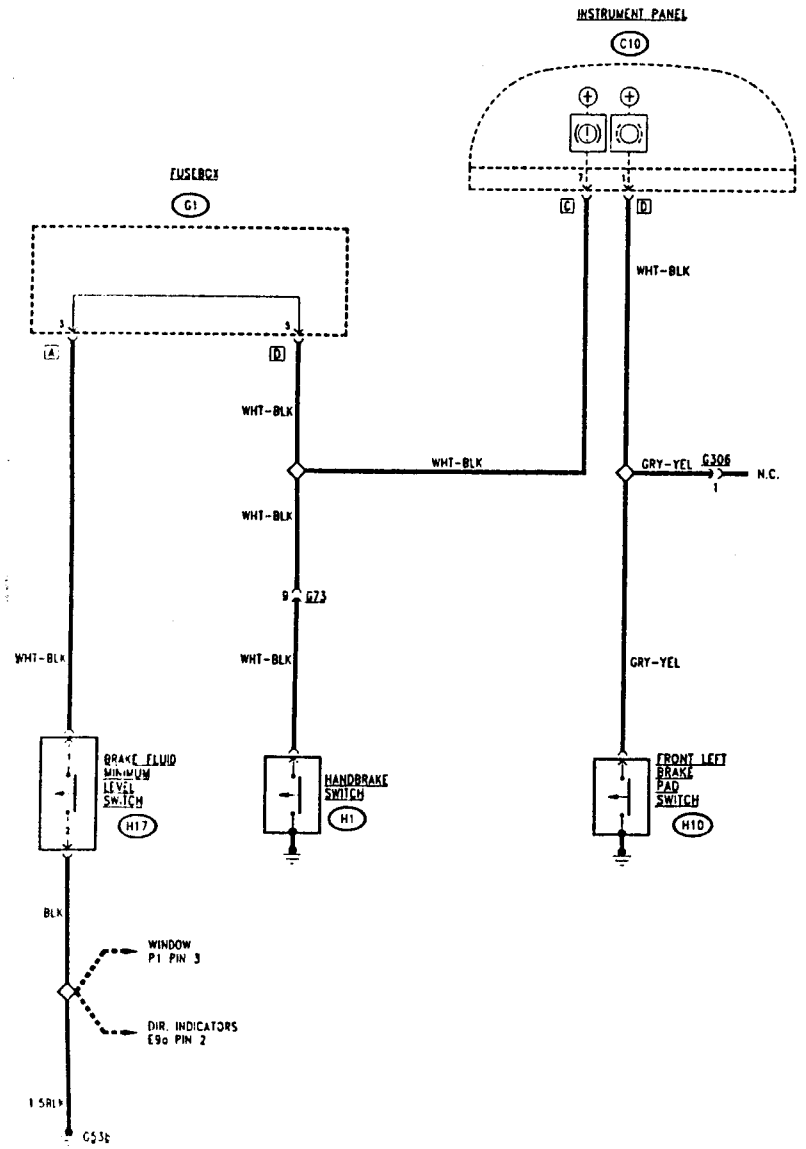
BRAKING SYSTEM WARNING LIGHTS

Wiring Diagram



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Functional Description

Three warning lights alert the driver in the event of problems in the braking system.

The brake pad switch **H10**, which comprises a microswitch on the pad, connects to earth when the pad thickness is reduced, sending a signal to the cluster **C10** at pin 1 of connector D thereby turning on the **"brake pad wear warning light"**.

The handbrake switch **H1** and the minimum brake fluid level control switch **H17** (two microswitches which send an earth signal) send a signal to the cluster **C10**, to pin 7 of connector C: both turn on the **"handbrake engaged or low brake fluid level warning light"**.

The former closes when the handbrake lever is pulled, and the latter when the level of the fluid in the braking system, in the storage reservoir, falls below a certain reference level.

The third warning light involving the braking system is the "ABS system failure" warning light described in the corresponding chapter (see "ABS System").

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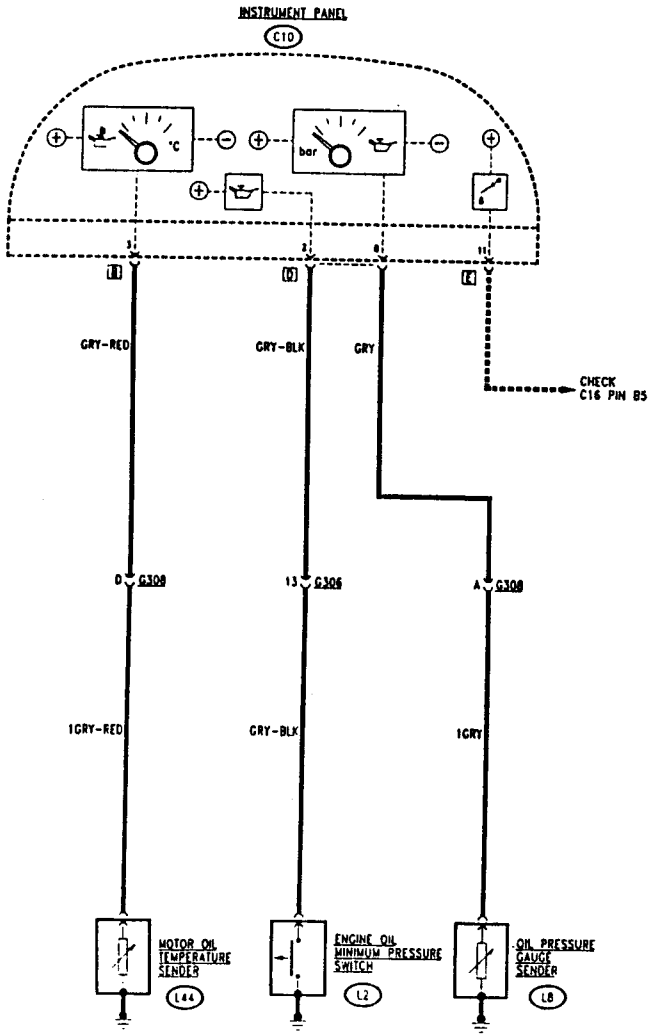
ENGINE OIL INDICATORS

Wiring Diagram



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Functional Description

The oil pressure transmitter L8 sends an earth signal to the cluster C10, at pin 8 of connector D, for the analogue oil pressure indicator. This is a pressure switch fitted in a suitable position on the crankcase which generates a signal proportionate with the pressure of the engine oil.
Similarly the oil temperature transmitter L44 sends an earth signal to the cluster C10, at pin 3 of connector B, for the analogue oil temperature indicator. A thermostat in contact with the engine oil detects its temperature.

In addition the minimum oil pressure contact L2, also fitted on the crankcase, closes when the pressure falls below the limit of 0.2 ÷ 0.5 bar, thereby sending an earth signal to the cluster C10 at pin 2 of connector D turning on the "minimum oil pressure" warning light.
The "minimum oil presssure" warning light is connected to the Check Panel C16 (see "Check Panel") which, if the oil level in the sump is low, turns on the corresponding led and sends a signal to the cluster C10 at pin 11 of connector E.

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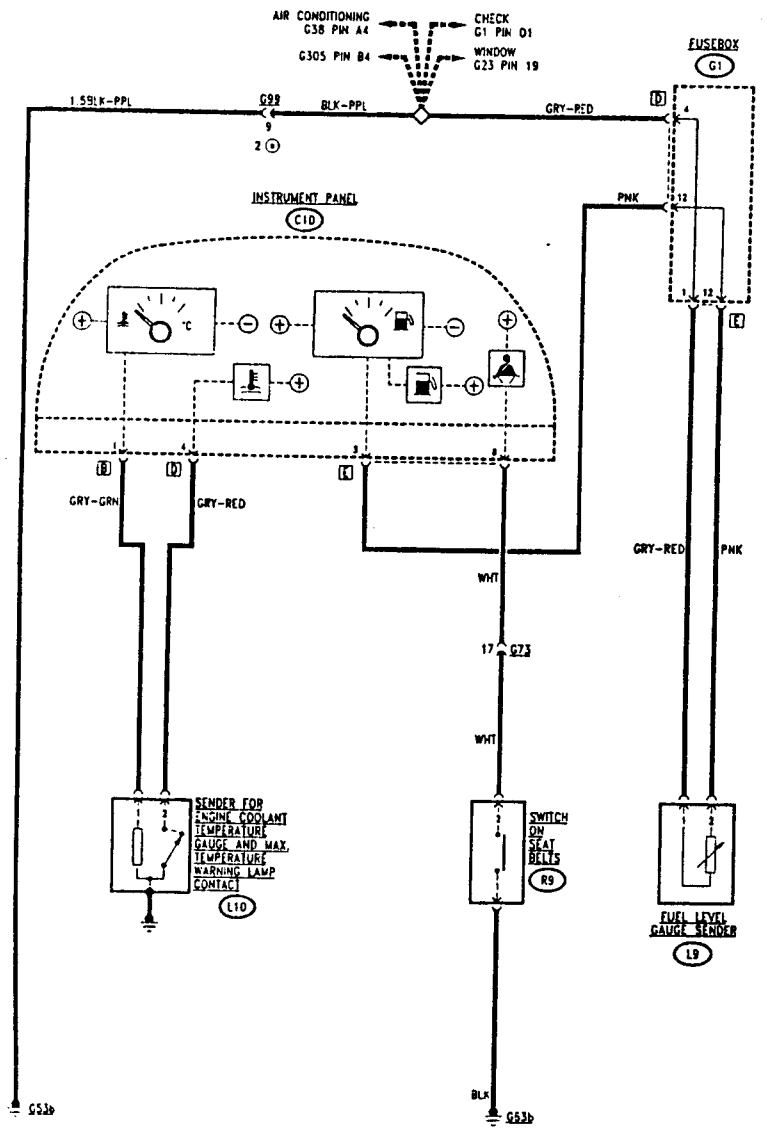
VARIOUS INDICATORS

Wiring Diagram



⊙ Variant for models 1.6 - 1.8 - 2.0 m.y. '96

Functional Description

The **engine coolant temperature** is continuously displayed by the analogue indicator, while if the temperature is too high the **"maximum coolant temperature"** warning light turns on.

The engine coolant temperature transmitter and maximum temperature warning light contact **L10** is fitted on the engine head and comprises a thermistor which generates a signal proportionate with the temperature of the fluid and a contact which closes to earth when the fluid reaches 122°C. The first signal is sent to the cluster **C10** at pin 1 of connector B, and the second to pin 4 of connector D.

The fuel level transmitter **L9** is a sensor submerged in the fuel tank, the resistance of which changes as the level of the fuel in the tank changes (from 0-7 Ohm with a full tank to 290-310 Ohm when the tank is empty).
An earth signal reaches pin 1 of **L9**, while a signal proportionate with the level is sent from pin 2, through the fusebox, to the cluster **C10**, at pin 3 of connector E.
Inside the **fuel level gauge** an electronic device selects the signal corresponding to **reserve** (262 Ω, corresponding to appr. 7 litres) and turns on the warning light.

The switch on the **seat belts R9** is located on the driver's buckling device: when the belt is correctly inserted it opens the contact and cuts off the earth signal to the cluster **C10** (pin 8 of connector E) thereby turning off the **"seat belts unfastened"** warning light.

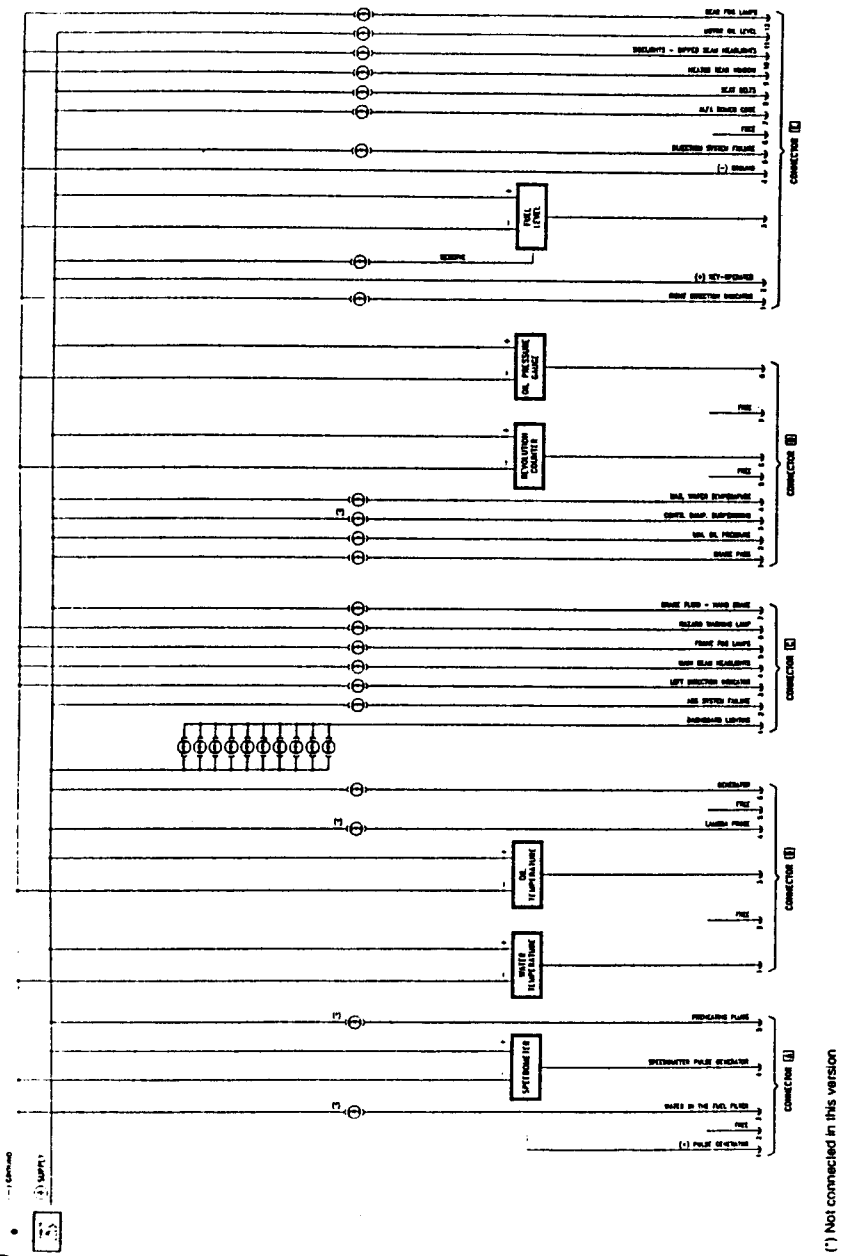
The other warning lights not described here are to be found in the wiring diagram of the system to which they belong.

INTERNAL CIRCUITRY

This wiring diagram represents the printed circuit and the connections inside the instrument cluster **C10**.
In the other diagrams referring to the outside connections of the cluster itself (or in those of the single circuits connected with the warning lights inside the cluster) only the lines concerned are shown, while this diagram gives an overall view of the whole cluster **C10**.

NOTE: not all the output pins are connected for all the versions of the vehicle: therefore this diagram may not contain - as indicated - lines not used (for example warning lights not connected but present in the printed circuit.

Wiring Diagram



(*) Not connected in this version

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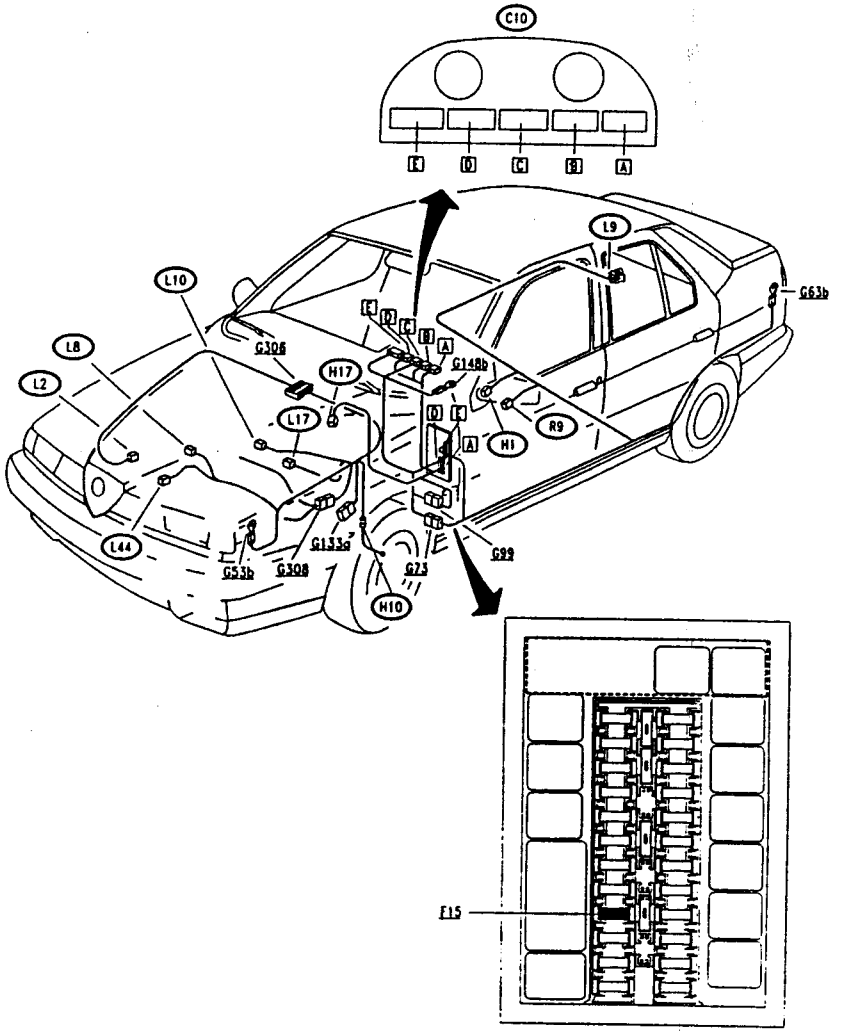
LOCATION OF COMPONENTS



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TROUBLESHOOTING TABLE

NOTE:: The faults of warning lights not described here are to be found in the section concerning the system to which they refer: eg. for the high beam warning light, see the section "High and low beam lamps"
The faults described here as "warning light not working" summarize all the cases in which the behaviour of the warning light does not correspond to correct operation: es. the warning light turns on to signal a fault and the fault does not exist, or vice-versa a function is engaged but the warning light fails to show it etc...

Fault	Component to be checked											
	E15	C10	L17	L8	L44	L2	L10	L9	R9	H17	H1	H10
All the cluster is off	•	•										
Tachometer		•	•									
Rev counter		•										
Oil p. gauge		•		•								
Oil t. gauge		•			•							
Water t. gauge		•					•					
Fuel gauge		•						•				
Handbrake warning light		•								•	•	
Brake pad warning light		•										•
Min. oil p. warning light		•				•						
Max. water t. warning light		•					•					
Seat belt warning light		•							•			

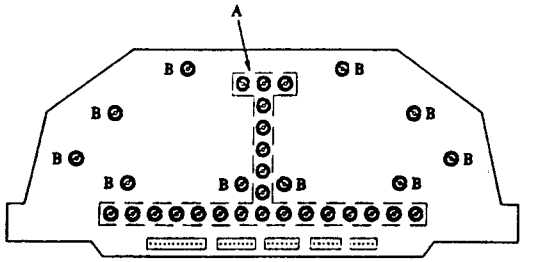
CHECKING COMPONENTS

Instrument cluster (C10)

N.B.: The cluster is made as a single component: all the internal connections are made on a printed circuit which joins the contacts of the instruments and various warning lights.
Therefore it is not possible to carry out repairs, other than changing warning light bulbs:

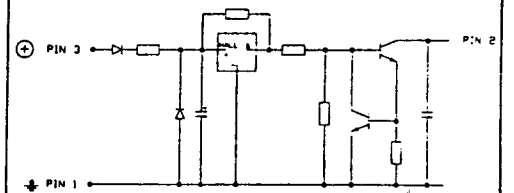
– warning light bulbs (A);

– cluster lighting bulbs (B).

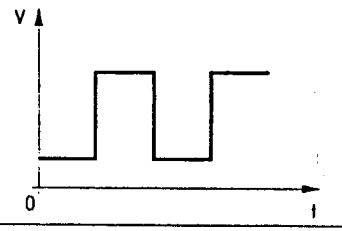


Tachometric sensor (L17)

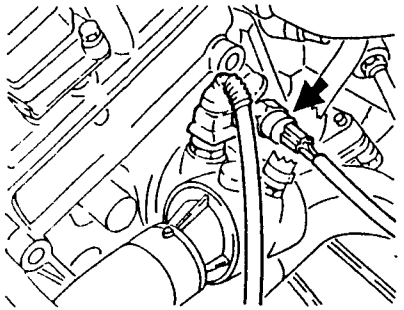
Wiring diagram:



Output signal trend (with car on the move): voltage at pin 2: 16 pulses per turn

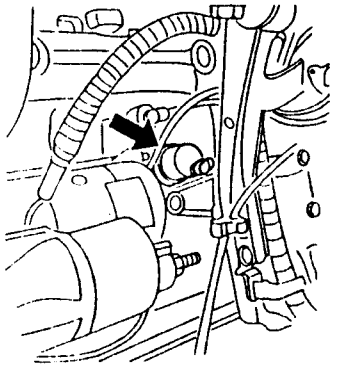


Engine coolant temperature gauge warning light and max. temperature warning light contact transmitter (L10)



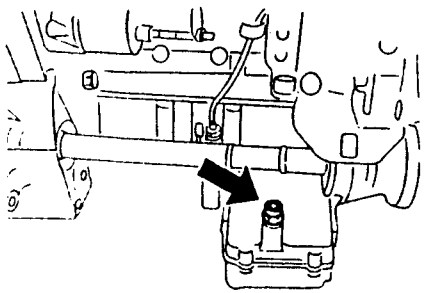
SPECIFICATIONS		
Transmitter		
Temperature °C	Resistance Ω	Type of fluid for test
60	525 ÷ 605	Water
90	195 ÷ 245	Water
120	82 ÷ 94	Glycerine
Contact		
Contact closing		122 ± 2°C
Contact opening		112 ± 3°C

Transmitter for oil pressure gauge (L8)



SPECIFICATIONS	
Pressure bar	Resistance Ω
0	305 ± 15
2	190 ± 15
4	118 ± 15
8	20 ± 20

Transmitter for oil temperature gauge (L44)



SPECIFICATIONS	
Oil temperature °C	Resistance Ω
50	800 ÷ 900
70	350 ÷ 450
90	180 ÷ 220

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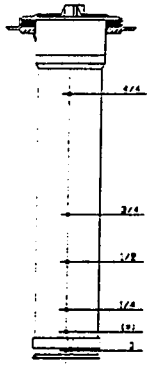
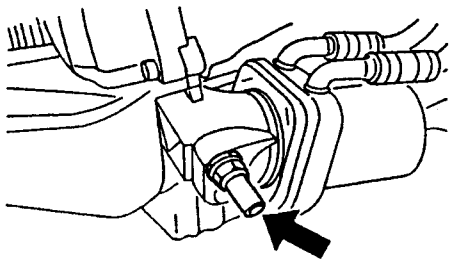
Fuel level transmitter (L9)



SPECIFICATIONS	
Level (see figure)	Resistance (Ω)
4/4	0 ÷ 7
3/4	56 ÷ 71
1/2	111 ÷ 131
1/4	181 ÷ 206
start of reserve (*)	262
0	290 ÷ 320

(*) appr. 7 litres

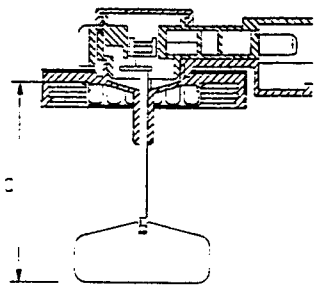
Min. engine oil pressure contact (L2)



SPECIFICATIONS	
Contact closing (pressure failing)	0.2 ÷ 0.5 bar
Contact opening (pressure rising)	0.2 ÷ 0.5 bar

NOTE: In certain versions engine oil minimum pressure contact (L2) is fitted instead of the oil pressure gauge sender (L8).

Min. brake fluid level switch (H17)



SPECIFICATIONS
The float closes the contact if dimension C (see figure) exceeds 40 ± 1 mm.

NOTE: to check whether the switch is working it is sufficient to lightly press on the upper end of the cover: in this case the contact closes and it is possible to check that the warning light is working properly.

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