page

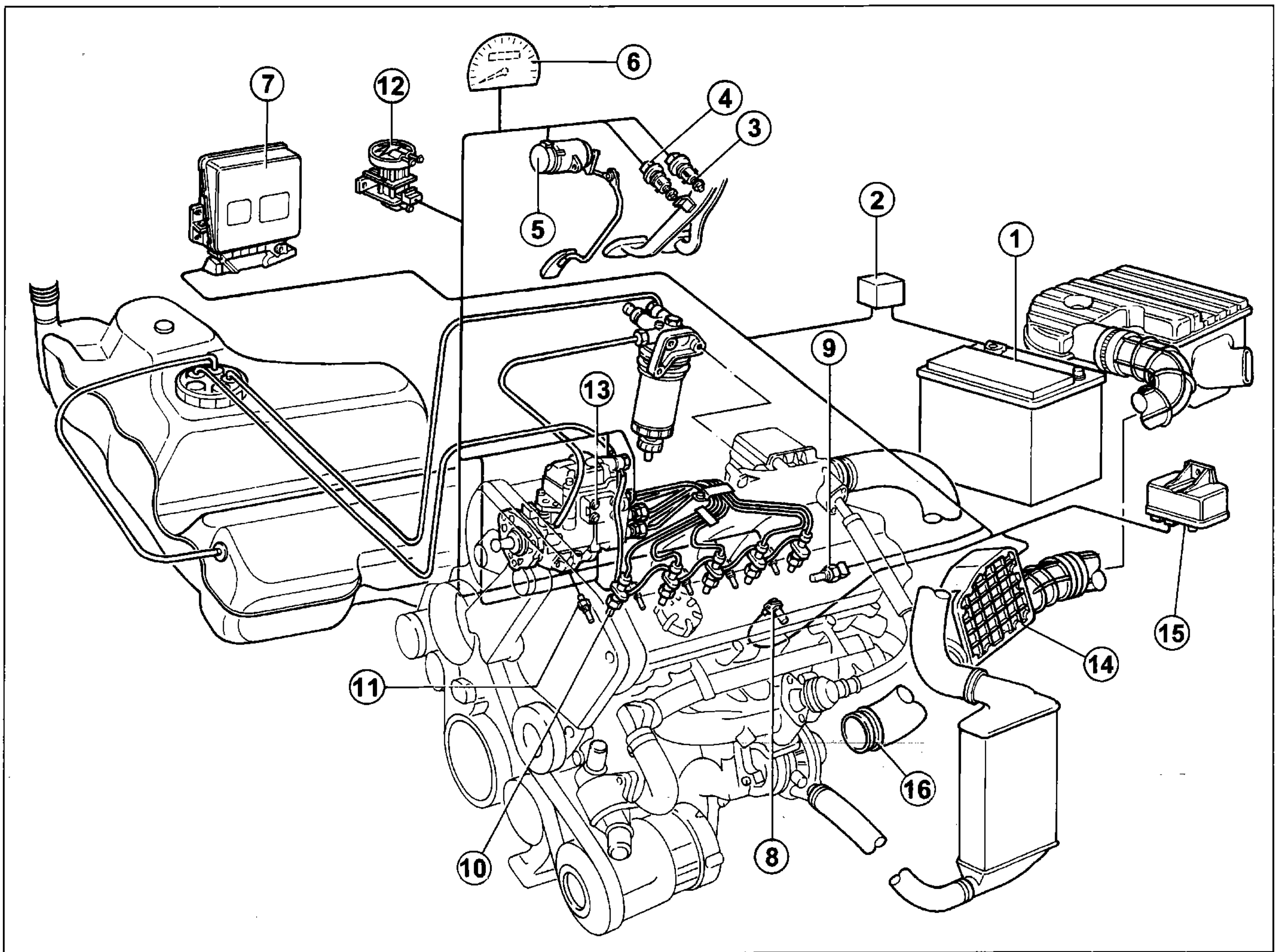
FUEL SYSTEM

INTRODUCTION

The most important features of the fuel system on the 2387 TD version with indirect injection are as follows:

- fuel injection managed by electronic control unit (ECU);
- turbocharging via IHI turbocharger and intercooler;
- cross flow inlet/outlet ducts;
- exhaust gas recirculation system (EGR) to eliminate NOx;
- oxidising catalytic converter to eliminate particulate, CO and HC.

These devices ensure the version meets regulations (EC STAGE 2) while also ensuring better running economy, reduced engine noise and better vehicle handling.



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1. Battery
2. Relay
3. Clutch pedal switch
4. Brake pedal switch
5. Accelerator potentiometer
6. Speedometer
7. Electronic control unit
8. Rpm sensor
9. Coolant temperature sensor
10. Controlled injector
11. Heater plugs
12. Borg-Warner modulator valve
13. Bosch injection pump
14. Debimeter
15. Glow plug preheater unit
16. E.G.R. valve.

Electronic management of the injection pump allows moment by moment computing of fuel quantity and injection advance, direct control of driving conditions and real-time response to changes in input parameters.

A BOSCH MSA11 electronic control unit (1) gathers the following information:

- accelerator pedal position through an associated potentiometer (3);
- engine rpm from a sensor fitted to the engine block (10);
- air intake quantity from debimeter (7) and air temperature from a sensor fitted inside;
- diesel temperature from a sensor inside injection pump (2);
- fuel quantity actuator position signal from a sensor fitted to the actuator, contained inside injection pump (2);
- coolant temperature from sensor (4)
- effective injection start point (injector pintle opens) from controlled injector (8), fitted to cylinder 1;
- vehicle speed from speedometer sensor (9) located on gearbox;
- brake operating information from contact (6), located on brake pedal;
- clutch operation from switch (5) located on clutch pedal;
- atmospheric pressure via sensor inside control unit (1);
- air conditioner compressor activation requests;

According to input parameters, control unit (1) consults internal memory maps and corrects output signals accordingly in order to control:

- fuel quantity actuator inside injection pump (2);
- injection advance regulation solenoid inside injection pump (2);
- engine stop solenoid inside injection pump (2);
- glow plug control unit (17);
- Borg Warner vacuum modulator solenoid (14) controlling E.G.R. valve;
- glow plug warning light (16);
- fault information via infocenter (13);
- rev counter (11);
- compressor electromagnetic clutch engagement for air conditioner (15);
- tester point (12).

The control unit is also responsible for the immobilizer function (Fiat CODE). This is performed by a specific control unit (Fiat CODE) (18) able to communicate with electronic control unit (1) and an electronic key with a sender unit which sends out an identification code.

Whenever the key is turned to STOP, the Fiat CODE system de-activates electronic control unit (1) fully.

When the key is turned to MAR, the following operations take place in order:

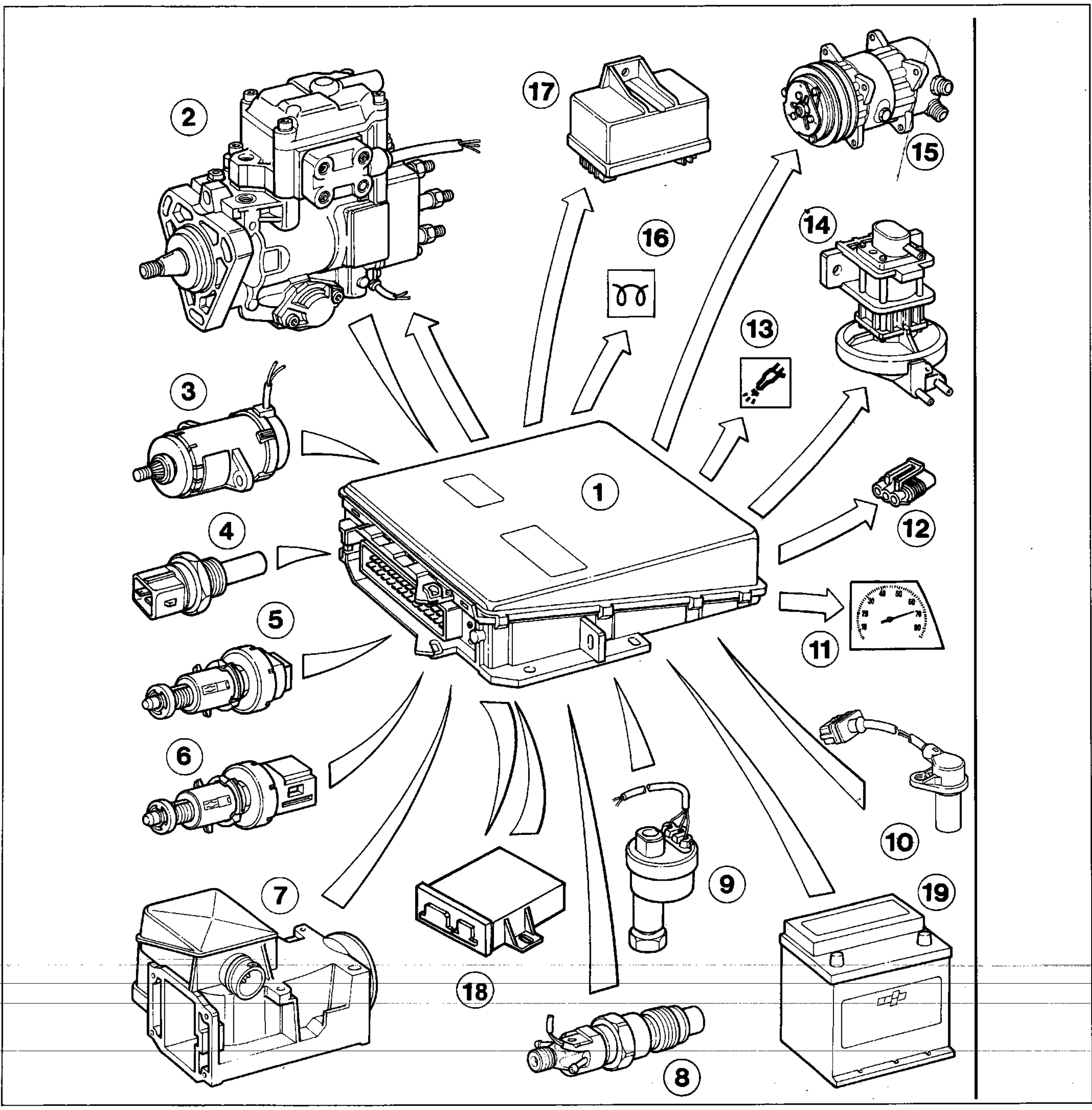
1 - control unit (1) (whose memory contains a secret code) requests the Fiat CODE to send back the secret code to de-activate the function block;

2 - the FIAT CODE control unit responds by sending out the secret code only after receiving an identification code transmitted by the ignition key;

3 - secret code identification allows de-activation of the lock on the electronic control unit (1) so that normal operation can resume.

NOTE *Due to the presennce of the Fiat CODE* **DO NOT CARRY OUT** *tests using another electronic control unit during fault diagnosis and/or functional checks. In this case, the Fiat CODE would transfer its (secret) identification code to the test control unit, which could not then be used on other vehicles.*

INPUT AND OUTPUT SIGNALS BETWEEN CONTROL UNIT/SENSORS AND ACTUATORS



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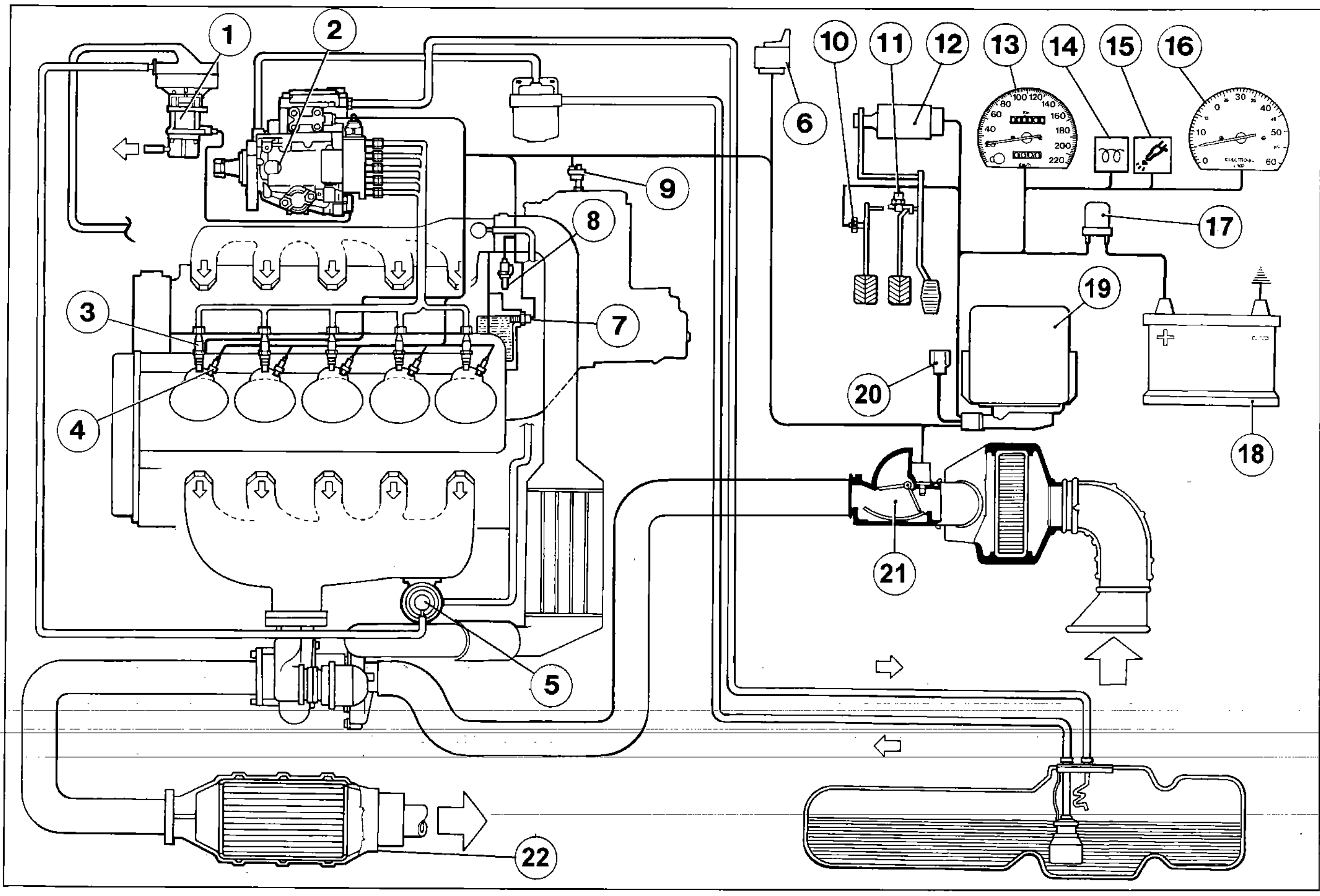
1. Electronic control unit
2. Injection pump
3. Accelerator pedal potentiometer
4. Coolant temperature sensor
5. Clutch pedal switch
6. Brake pedal switch
7. Air flow meter (debimeter)
8. Controlled injector
9. Speedometer sensor
10. Rpm sensor
11. Rev counter
12. Diagnostic socket
13. Injection system warning light bulb
14. Borg Warner solenoid
15. Heating/ventilation system
16. Glow plug warning light
17. Glow plug control unit
18. FIAT CODE control unit
19. Battery

SYSTEM OPERATION

In this section we will discuss the strategies adopted by the electronic control unit under a range of engine service conditions.

Preheating

Glow plugs (4) are controlled and timed by the injection electronic control unit (19) via a glow plug control unit (6).
The time for which the glow plugs are activated (and for which the warning light on the instrument panel is lit) is directly dependent on engine coolant temperature.
The grace period (i.e. period when engine may be started after the warning light has gone out without repeating the preheating cycle) lasts about 15 seconds.
Injection control unit (19) also controls a post-heating stategy whereby the glow plugs are still supplied with power after start-up for a time computed on the basis of engine coolant temperature (up to 60° C) and rpm (up to 1300 rpm).
This specific strategy allows engine heating time and hydrocarbon emissions to be reduced following start-up.



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1. Borg Warner modulator valve
2. Bosch injection pump
3. Controlled injector
4. Glow plugs
5. EGR valve
6. EGR valve
7. Coolant temperature sensor
8. Rpm sensor
9. Speed sensor
10. Clutch pedal sensor
11. Brake pedal sensor
12. Accelerator potentiometer
13. Speedometer
14. Glow plug warning light bulb
15. Injection system warning light
16. Rev counter
17. Relay
18. Battery
19. Injection control unit
20. Diagnostic socket
21. Air flow meter (debimeter)
22. Catalytic converter

Starting

During engine start-up, control unit (19) does not recognise the signal from accelerator pedal potentiometer (12); acceleration does not therefore influence the start-up procedure.

Fuel flow is determined solely by rpm and coolant temperature.

During start-up, the control unit determines injection advance time on the basis of a signal from coolant temperature sensor (7), ignoring the signal from controlled injector (3).

Driving

When the vehicle is being driven, ECU (19) computes fuel flow on the basis of signals from accelerator pedal potentiometer (12) and rpm sensor (8). By means of a rotary electromagnetic actuator, the ECU moves the regulation cursor, which in turns controls effective pump stroke and thus fuel quantity.

The quantity of fuel to be injected is corrected on the basis of:

- signal from debimeter (21) (intake air quantity) in order to obtain maximum possible fuel flow without exhaust smokiness
- diesel temperature, in order to compute the exact weight of fuel injected. Although the pump controls the volume of fuel, it is still necessary to compute the weight of fuel injected, which depends on density (and thus temperature) in order to caculate the air/fuel ratio. As an example, 1 cc. of diesel has a different weight at 0 °C compared to the same volume at 50 °C.
- intake air temperature and atmospheric pressure, in order to optimise the air/fuel ratio to engine service conditions.

Maximum output is limited by following a maximum torque curve, in turn dependent upon engine rpm.

The actual position of the fuel quantity actuator, required for sending the exact amount of fuel to injectors, is recorded by an inductive sensor fitted to the actuator. The ECU compares actual data with theoretical data to correct actuator position until the actual position coincides with the theoretical position.

Transitory situations

Control unit (19) implements a strategy designed to modulate engine operation during transitory situations of acceleration and or deceleration, avoid unstable operating conditions (jerks and juddering) and improve handling.
The ECU gathers information on gear currently engaged from the engine rpm and vehicle speed sensor, while a switch on the clutch pedal provides it with data on gear changes. Whereas sudden changes in input parameters (accelerator pedal and engine rpm) bring about abrupt changes in fuel flow with conventional systems, with this system the ECU controls fuel delivery gradually to alter the output curve in favour of improved handling.
A signal from the brake switch is compared with a signal from the accelerator pedal. When both signals are present at the same time for longer than 0.6 seconds below a speed of 1400 rpm, the control unit considers this a fault situation and cuts in to reduce speed to idle level.

When this fault occurs, a quick press of the accelerator pedal restores the ECU to normal management status.

Adjusting injection advance

Advance (injection point) is defined by the quantity of fuel injected, engine rpm, coolant temperature (up to 60 °C) and atmospheric pressure sensor signal.
Injection control unit (19) compares injection start point, a signal from controlled injector (3), with the theoretical instant of injection in order to govern a solenoid. This in turn modulates pressure acting on advance variator piston in order to adjust actual advance until it coincides with the theoretical value.

Exhaust gas recirculation (E.G.R.)

An exhaust gas recirculation system (E.G.R.) has been fitted to reduce NOx (nitrogen oxide) emissions further.
On the basis of fuel flow, rpm, intake air temperature and coolant temperature (from 60° C), injection control unit (19) governs a BORG WARNER vacuum modulator valve (1), which in turn controls the E.G.R. valve (5).
E.G.R. valve (5) moves a plunger to regulate the flow of burnt gases from the exhaust manifold to the intake manifold.
These gases are mixed with the intake air and then introduced into the cylinders. This achieves two results:

- less air is introduced;
- combustion temperature is reduced (due to the presence of inert gases) to reduce the formation of NOx (nitrogen oxides).

Injection control unit (19) is provided with constant information on recirculated gas quantity by debimeter (21): if intake of a given quantity of air (Qam) is required for a given rpm and the value relayed by the debimeter (Qar) is lower, the difference (Qgr) provides recirculated gas quantity.

Qam - Qar = Qgr

Qam = Theoretical air quantity in memory
Qar = Actual air quantity
Qgr = Recirculated gas quantity

The absolute atmospheric pressure signal is used to govern the modulator solenoid. It tells the control unit when the vehicle is being driven at altitude so that the recirculated gas quantity can be reduced to prevent engine smokiness.

System faults

When part of the system stops working (signal not produced or signal not properly recognised), the driver is informed of the fault by means of a message displayed on the infocenter screen.
In the case of signals crucial to implementation of the in jection strategy, the injection control unit is able to replace the parameter with an average value saved in the unit memory (recovery value). Performance is reduced but operation is nevertheless safe for the engine.

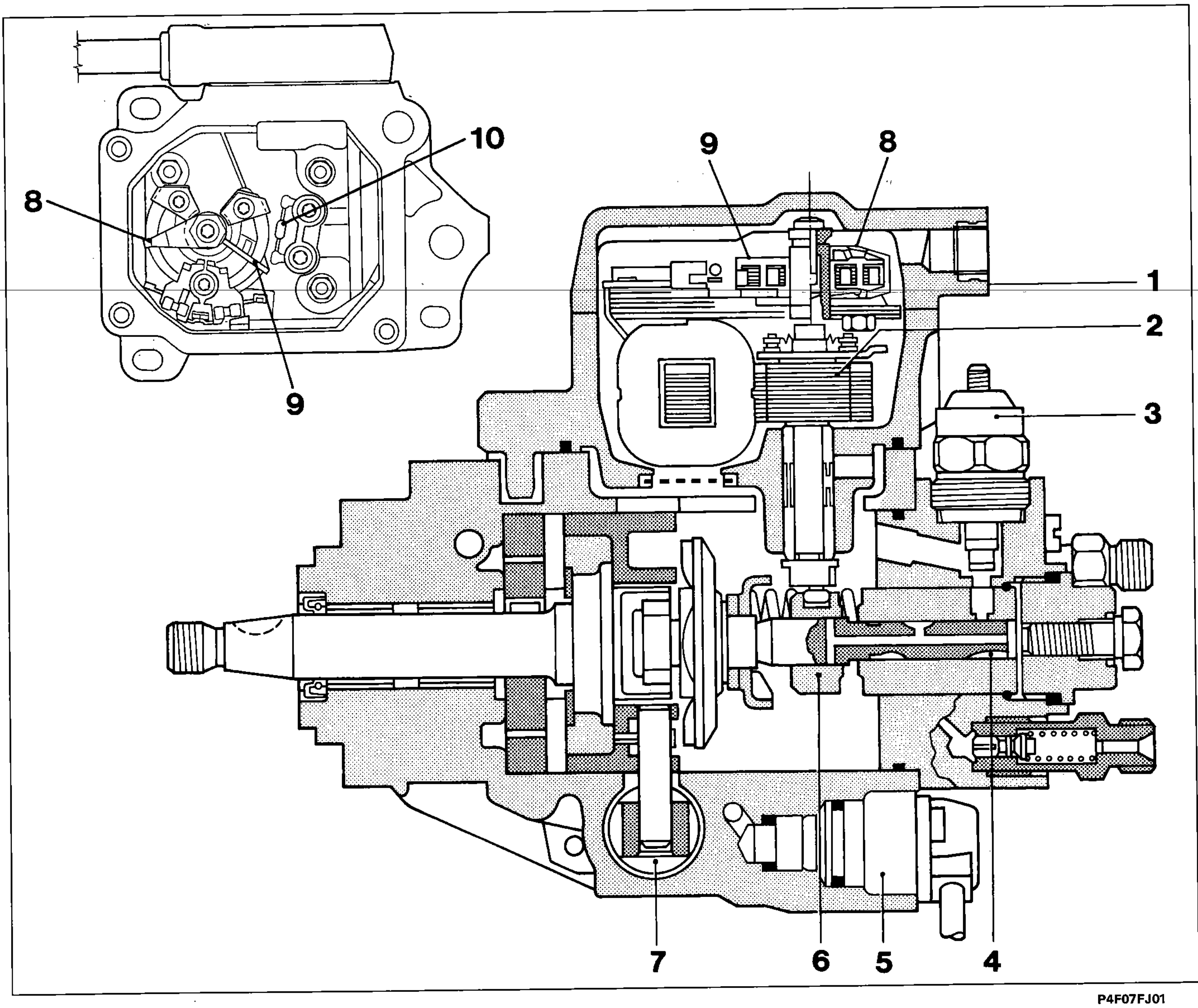
Fault diagnosis

For system testing, serial line (20) is used for connection to a Fiat/Lancia Tester and a Computerised Test Station. The module required for the injection system is coded M34A

COMPONENT DESCRIPTION

Injection pump

In an electronic injection pump, the hydraulic head with high pressure pump and operating parts are the same as used on a mechanical injection pump.
On this electronically controlled pump, flow is governed by an electromagnetic actuator (2) (see drawing on page 7). Actuator rotation is converted into linear movement of regulation cursor (6) by means of a cam coupling.
The flow to be sent to the injectors is computed according to accelerator pedal position (i.e. signal transmitted by potentiometer connected to the pedal) and the number of revs recorded by the sensor. Inductive sensor (8) fitted to the regulation cursor control shaft informs the control unit of the rotation angle set by the electromagnetic actuator (2) and consequently the position of regulation cursor (6).



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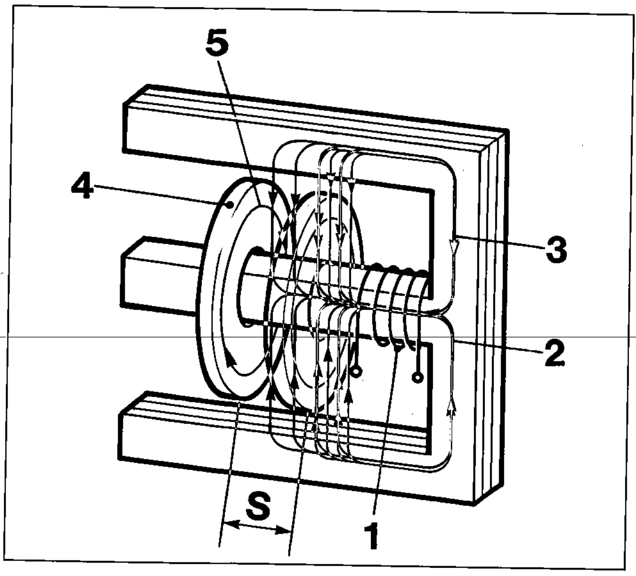
1. Pump cover
2. Electromagnetic actuator
3. STOP solenoid
4. Distributor piston
5. Injection advance actuator
6. Adjustment cursor
7. Injection advance adjustment piston
8. Mobile ring
9. Reference ring
10. Diesel temperature sensor

After comparing the position of regulation cursor (6) transmitted by sensor (8) with the position saved in its memory, the ECU performs a correction, taking into account fuel temperature recorded by sensor (10) and thus fuel density, until actual position of regulation cursor (6) coincides with theoretical value.

The exact amount of fuel required for the specific driving conditions is thus obtained to achieve: peak performance with good fuel economy and minimum levels of smokiness.

Regulation of injection point (advance) depends on the quantity of fuel to be injected, engine rpm and engine coolant temperature.

The controlled injector informs the control unit on actual injection advance, i.e. point at which needle valve begins to move. On the basis of these signals, the ECU corrects the advance set by the injection advance actuator until the theoretical level is achieved.



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Pump actuator position sensor

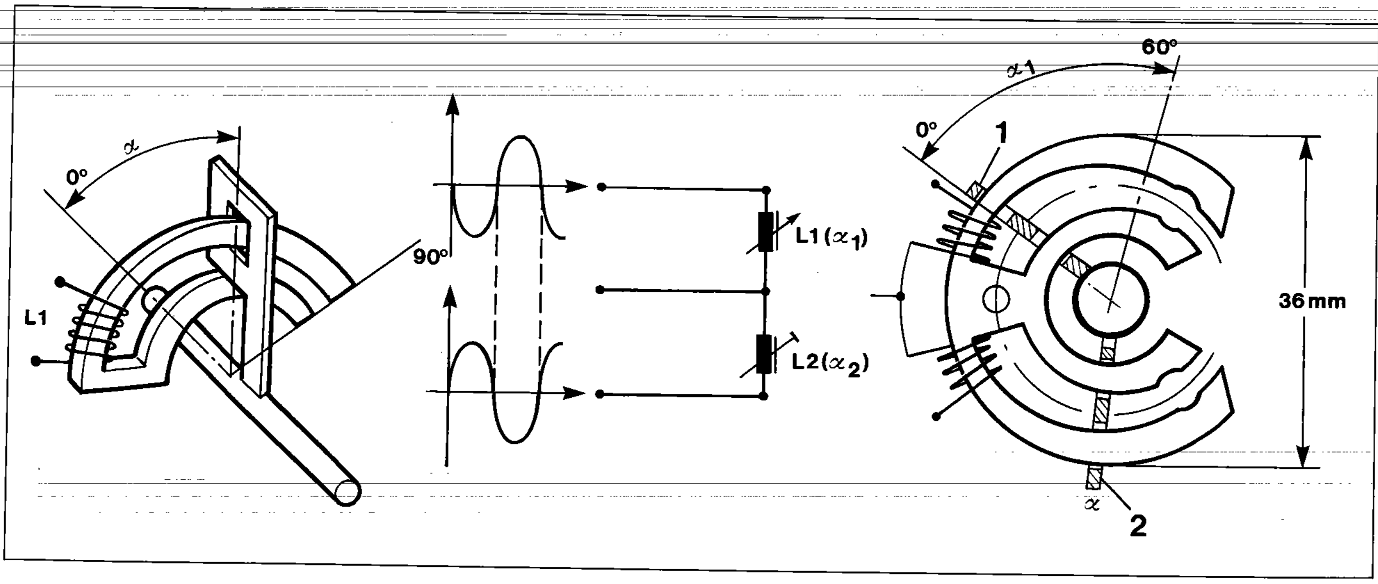
Principle of operation

The sensor used in the Bosch electronic pump to identify actuator position exploits the following principle:
Magnetic field (3) is set up around shaped magnetic core (2) by means of coil (1) wound around one branch of the core, which receives an alternating current.
When disc (4) in conductive material is fitted on the central branch of the core, disc position defines the limit of magnetic field (3).
Flow changes inside the disc set up an electrical field, which creates currents (5) known as "Foucault currents".

If disc (4) is moved, the intensity of magnetic field (3) changes; if magnetic field (3) is to be maintained constant, the intensity of current sent to coil (1) must be changed. This current change is proportional to movement S of disc (4).

Description of operation

The core is specially shaped in this particular case (see figure below).
Two coils L1 and L2 are wound onto the core. Coil L2 with fixed ring (2) forms the reference system.
Coil L1 with mobile ring (1), integral with pump actuator shaft, constitutes the measurement system.
The control unit sends an alternating current of fixed amplitude and frequency to coil L2. Coil L1 receives the same current offset by 180° so that the sum of the two currents is zero.
When ring (1) shifts, magnetic field intensity alters. This brings about a change in the amplitude of current in coil L1 and the sum of currents becomes other than zero.
At this point, the ECU alters the current sent to coil L1 in order to restore the sum of the two currents to zero. The size of the change in current to coil L1 is proprtional to the movement of mobile ringhecontrolunitthusobtains information on pump actuator position.



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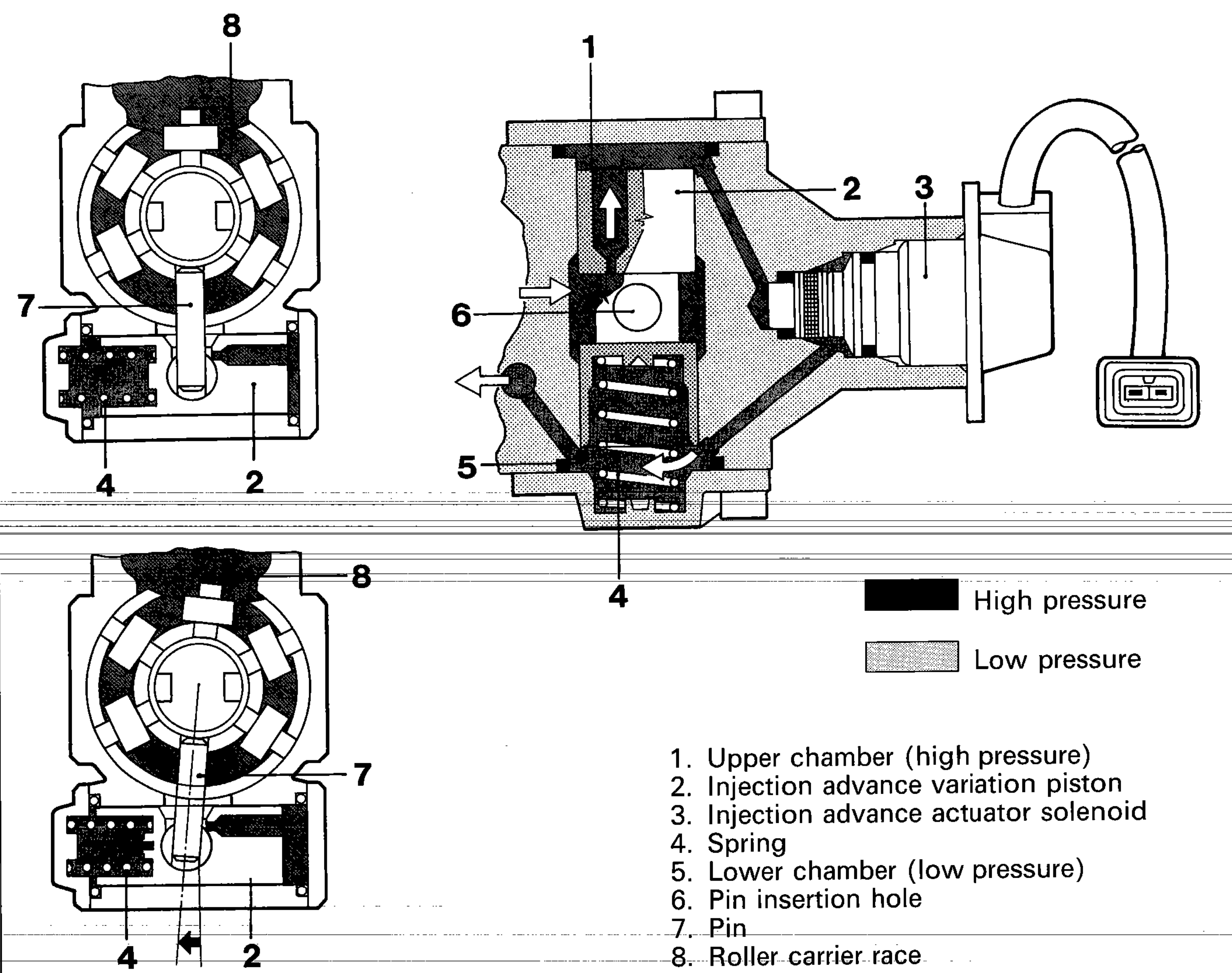
Injection advance actuator

The advance is altered by modulating pressure in chamber (1) communicating with pump case via pulse solenoid (3).
During operation, fuel pressure inside the pump reaches chamber (1) and exercises a thrust on piston (2) that is countered by spring (4) and pressure in chamber (5).
Solenoid (3) is controlled by the ECU in order to restore pressure in chamber (1) to a value corresponding to the required injection advance. Excess pressure is discharged into chamber (5), which carries fuel back to the tank.
The position of piston (2) is determined by the difference between pressures acting on the two faces. The position assumed by piston (2) also determines the position of pin (7), which is fitted in piston seat (6): when roller carrier race (8) is turned, the cam disc phase is also altered. As a result, the rollers lift the rotary cam disc earlier in order to advance the delivery phase by a very specific angle.
With the solenoid open, the pressure drop is maximal and injection delay is maximal. When the valve is operated, injection start point is gradually advanced according to the pressure drop.
Solenoid (3) remains open if not electrically activated.



1. Upper chamber (high pressure)
2. Injection advance variation piston
3. Injection advance actuator solenoid
4. Spring
5. Lower chamber (low pressure)
6. Pin insertion hole
7. Pin
8. Roller carrier race

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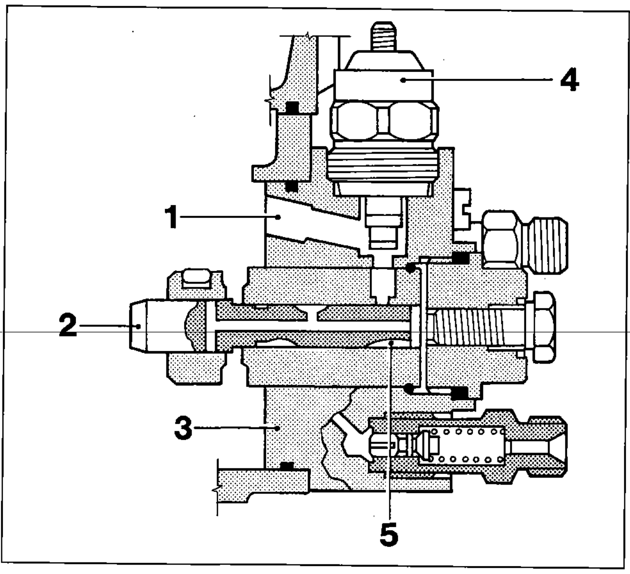

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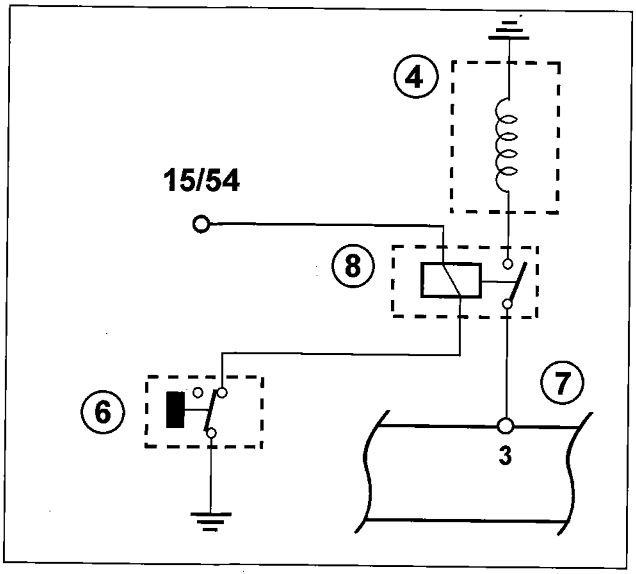
Engine stop solenoid

Solenoid (4) stops the engine when current is cut off by blocking the hole connecting the pump interior and the pump element compartment. This in turn cuts off fuel flow to the injectors. Solenoid (4) may cut in either by turning key to STOP or following activation of inertia switch (6), which cuts off electrical power to the solenoid from the ECU (7) via N.A. relay (8).



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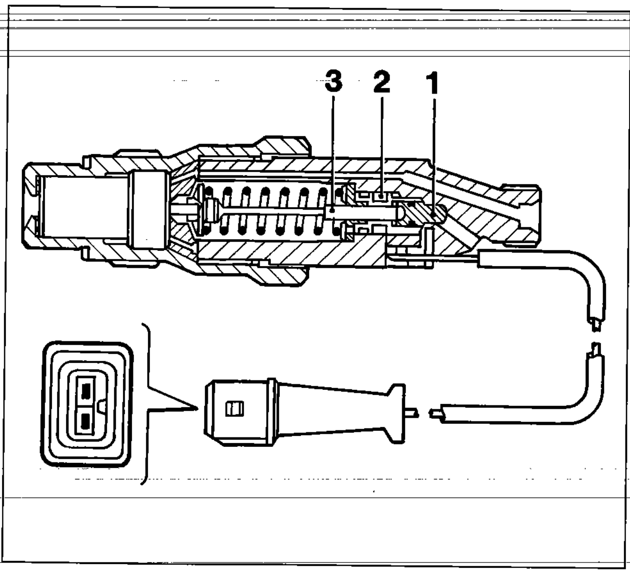
1. Outlet hole
2. Distributor piston
3. Distributor head
4. Stop solenoid
5. High pressure chamber
6. Inertia switch
7. Injection electronic control unit
8. Relay

Controlled injector

The controlled injector informs the injection control unit on actual injection advance setting (start of injection phase, or beginning of needle valve movement). On the basis of this signal, the control unit corrects the advance set by the injection actuator until the theoretical value is achieved.
The injector is fitted to cylinder 1 and equipped with a device for identifying the exact moment injection begins in addition to wiring to relay the signal and inform the injection control unit.
The injector contains coil (2), needle valve (3) and regulation pin (1). The coil is electrically powered and generates a magnetic flow that affects the needle valve (3). When the valve begins to open, the nozzle for fuel injection, magnetic flow in coil (2) alters. The control unit identifies this point as the injection start instant and uses this as a basis for its advance regulation strategy.



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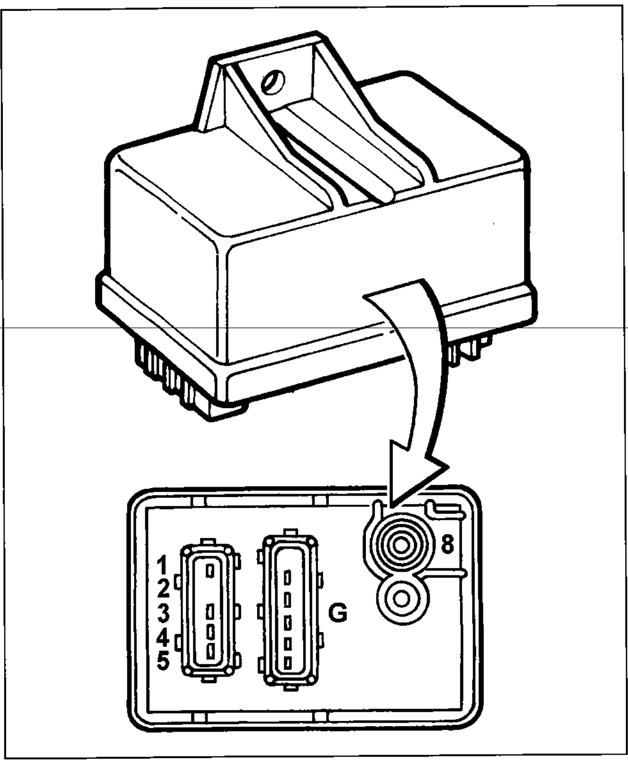

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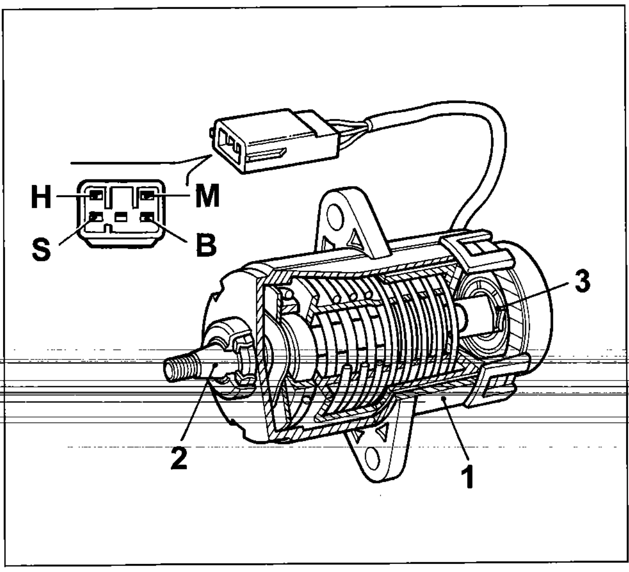
Preheating control unit

The glow plugs are controlled by a preheating control unit controlled directly by the injection control unit.
This contains a "smart" relay that sends responses ("feedback") to the electronic injection control unit, which is thus kept up to date on faults in the preheating control unit or short circuits to earth in the glow plugs.

The figure shows connectors on the base of the control unit and their associated pin-outs.
Connections

1. Vehicle earth
3. Ignition switch (+15)
4. Pump electronic control unit - pin 8 (pre--postheating activation)
5. Pump electronic control unit - pin 41 (diagnosis)
8. Battery positive
G. Battery positive



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Accelerator pedal potentiometer

Accelerator pedal position is converted to an electrical voltage signal from the potentiometer connected to the pedal, and sent to the ECU via an electrical connection. The signal is then processed and this data, together with information on engine rpm, is used to activate the injection flow flow regulation actuator.
The sensor consists of a case (1), fastened to the pedal unit by a flange. Shaft (2) connected to potentiometer (3) is fitted in an axial position on the flange.
A coil spring on the shaft ensures the correct resistance to pressure, while a second spring ensures return upon release.
An internal contact provides the control unit with an idle speed signal. This contact opens if rotation exceeds 9° during acceleration.

Air flow meter (debimeter)

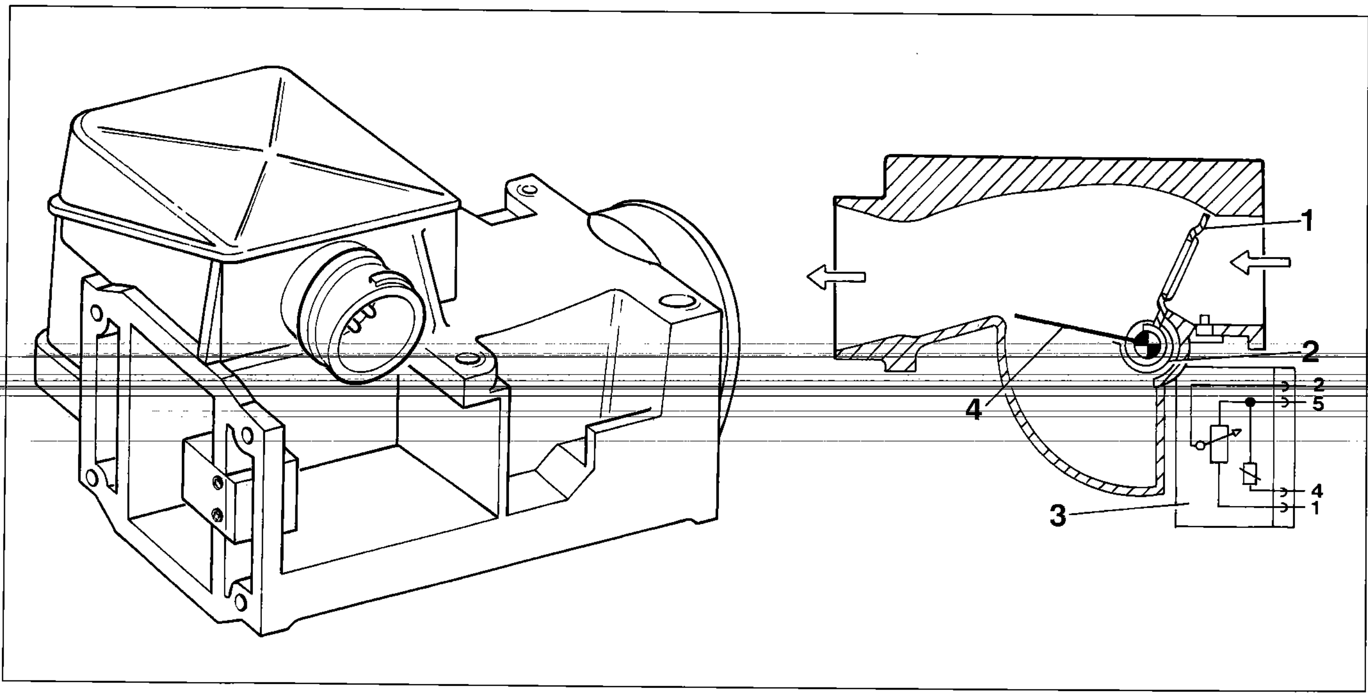
This device measures the amount of air taken up by the engine and converts the value to an electrical signal, which is then relayed to the control unit.
This signal is used to:
- calculate the amount of fuel to be injected in order to achieve the highest possible fuel flow compatible with a smoke-free exhaust;
- control the amount of exhaust gas recirculated through the EGR valve.

Calculated intake air quantity is used to carry out an indirect measurement of the quantity of exhaust gas recirculated through the EGR valve.
If intake of a certain amount of air (Qam) is required for a given rpm, and the level sent by debimeter (Qar) is lower, the difference (Qgr) corresponds to the quantity of gas recirculated.

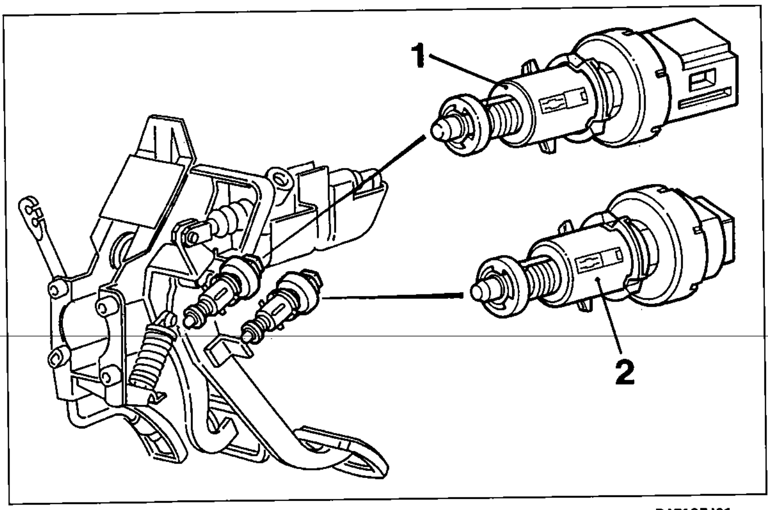
Qam - Qar = Qgr

Qam = Theoretical air quantity in memory
Qar = Actual air quantity
Qgr = Recirculated gas quantity

The quantity of air taken up by the engine exercises a thrust on floating plate (1) and this takes up a very specific angular position proportional to the pressure exercised by the incoming air flow (quantity of air taken up by the engine) and thrust of counter spring (2).
This angular position is converted into a voltage signal by potentiometer (3) connected rigidly to floating plate spindle.
Compensation plate (4) is coupled to a floating plate with the same effective surface area. This compensates for pressure fluctations due to alternating intake phases for the different cylinders because these act on both surfaces of the floating plate. In this way, forces arising are cancelled out and do not affect the measurement.



The air flow meter houses a temperature sensor with an NTC resistance. A signal from this is used by the ECU to compute air density and hence specific weight. This signal allows the control unit to compensate for injection pump regulation when the air/fuel weight ratio alters in order to obtain full combustion at all speeds.



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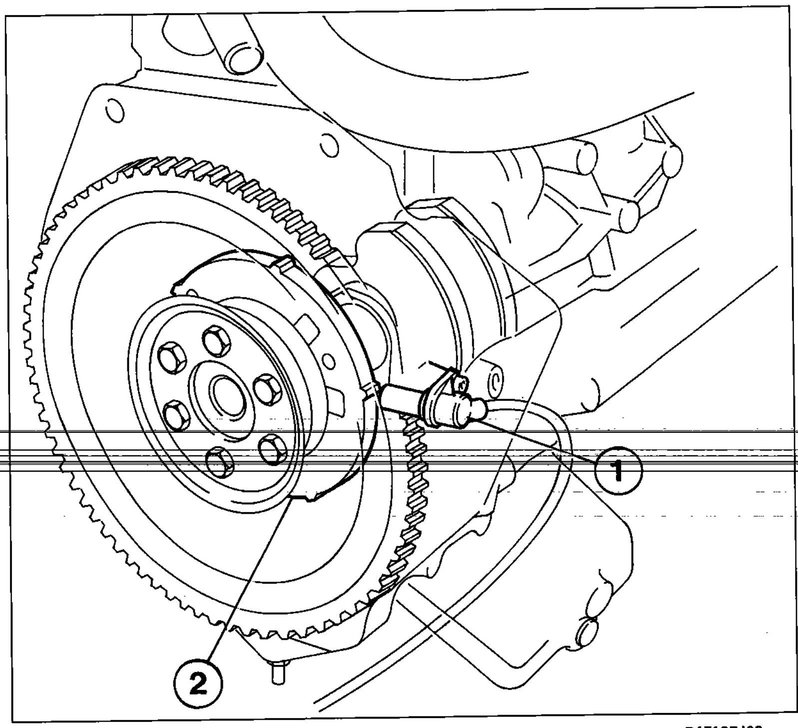
Brake pedal sensor (1)

A switch on the brake pedal controls the vehicle brake lights. The same signal sends a signal to pin 26 of the injection control unit.
The signal received when the brake pedal is pressed informs the injection control unit that:
- the vehicle is decelerating;
- it should check the plausibility of the accelerator potentiometer signal.

Clutch pedal sensor (2)

An N.A. (normally open) switch on the clutch pedal is connected to terminal 28 of the control unit and the ignition-operated power source (15/54).
To check that the switch is N.A. (normally open), keep the clutch pedal pressed down. The injection control unit uses the clutch pedal signal to identify the speed engaged and gear change situations.

Rpm sensor and phonic wheel



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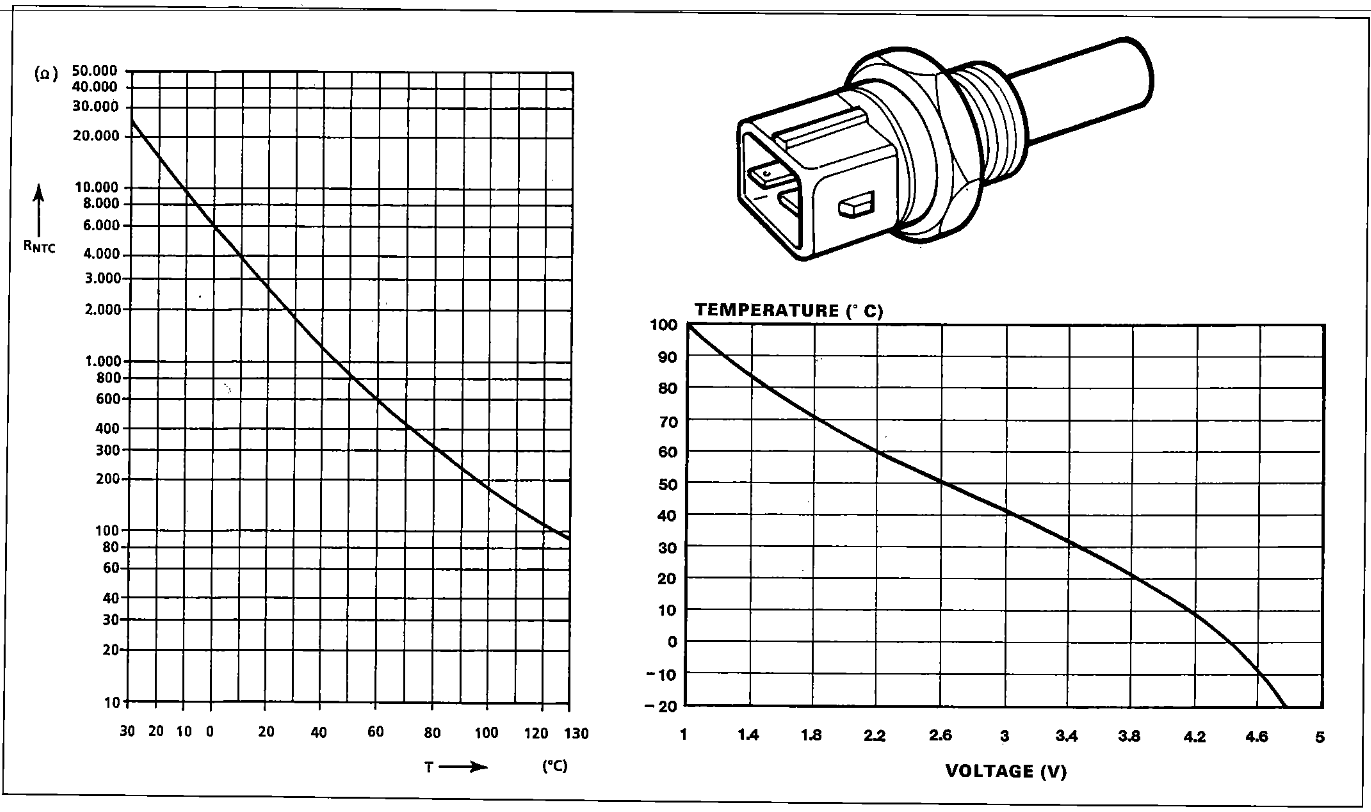
The engine rpm sensor is fitted on the crankcase and faces a phonic wheel, located inside the crankcase, fitted to the crankshaft.
The sheet steel phonic wheel is fitted with 5 reference dowls located 72° apart on the outer part of the circumference.
When these dowels or teeth pass beneath the sensor, the gap changes to bring about a change in the magnetic flux. This induces a current in the sensor spool coils.
This signal is sent to pin 47 of the control unit to measure rpm.

Coolant temperature sensor

Engine coolant temperature is measured by a sensor which consists of an NTC resistance. This alters its resistance in inverse proportion to temperature, as shown in the graph.
The ECU measures the voltage change proportional to the intensity of current flowing into the sensor through terminal 53.
The sensor must not be screwed in tighter than a torque of 15 Nm.



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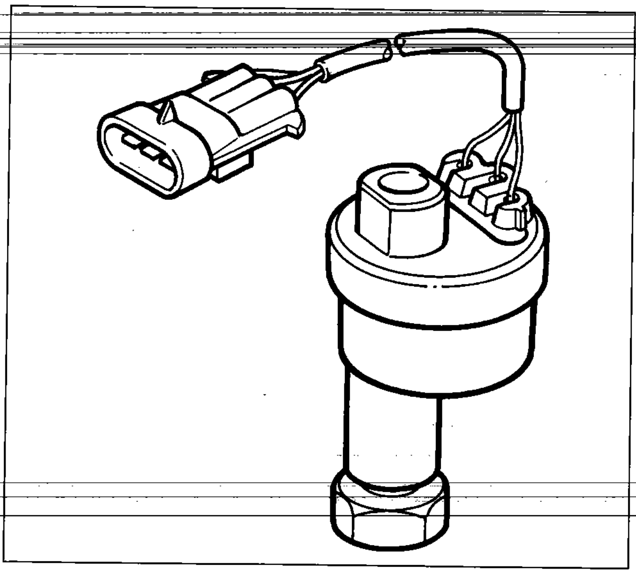

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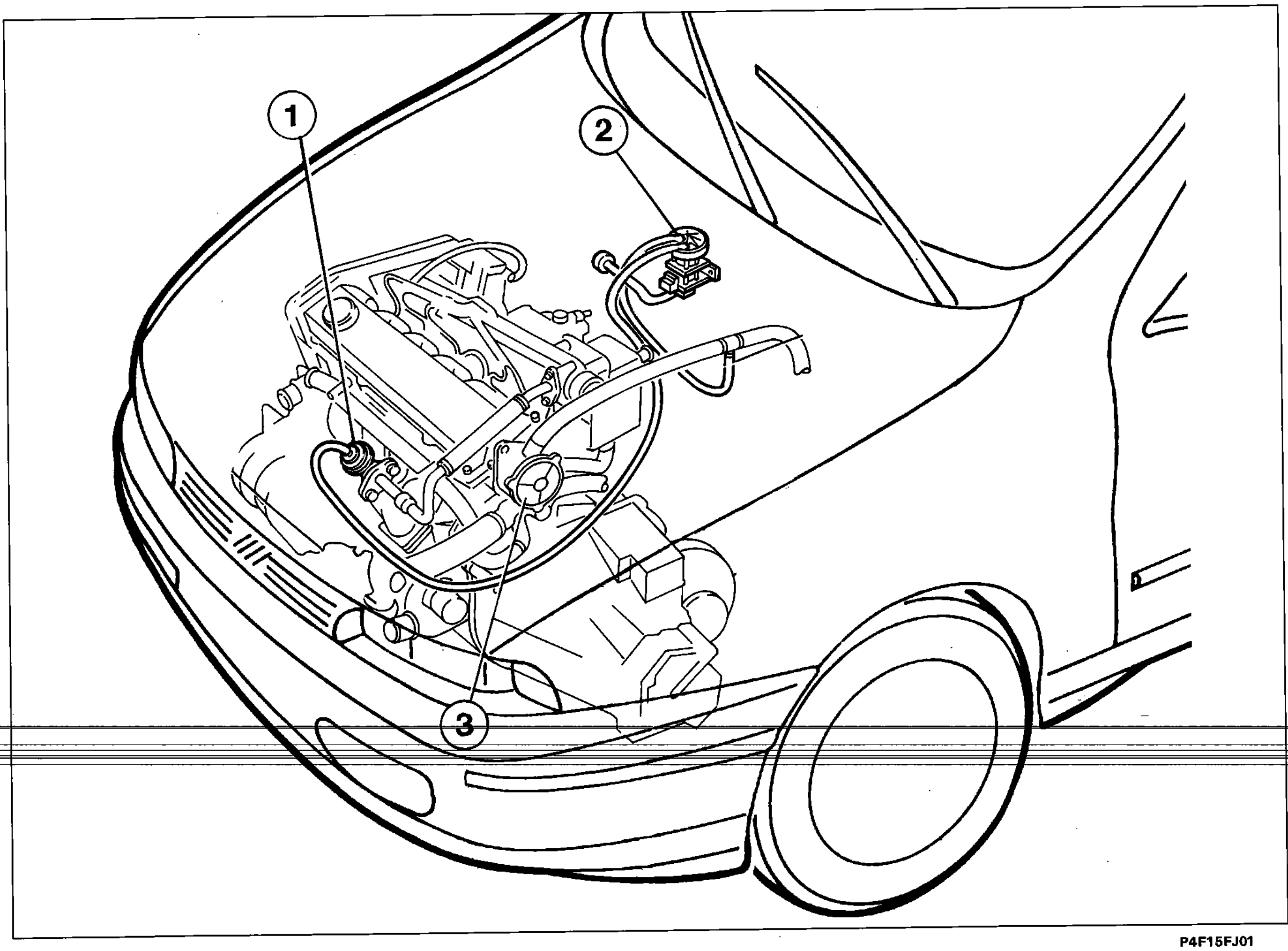
Speed sensor

The speedometer sensor fitted on the gearbox sends a signal to the instrument panel in order to operate the speedometer and also sends a signal to terminal 29 of the injection control unit.
The speedometer sensor provides the ECU with information on vehicle speed and, together with the clutch pedal sensor, the gear currently engaged;

E.G.R. system

The system consists of a PIERBURG E.G.R. valve (1) and a BORG WARNER vacuum modulator solenoid (2).
The ECU governs the BORG WARNER modulator solenoid on the basis of fuel flow, engine rpm, intake air temperature and coolant temperature (up to 60° C). This modulated vacuum controls the E.G.R. valve, which in turn moves a plunger to regulate the flow of burnt gas from the exhaust manifold to the intake manifold.
The ECU is kept constantly informed about recirculated gas quantity using data from the flow meter.
The atmospheric pressure signal (via a sensor inside the injection control unit) is important for control of the BORG WARNER modulator valve because it recognises when the vehicle is being driven at altitude so that the recirculated gas quantity can be reduced to prevent the engine from smoking.



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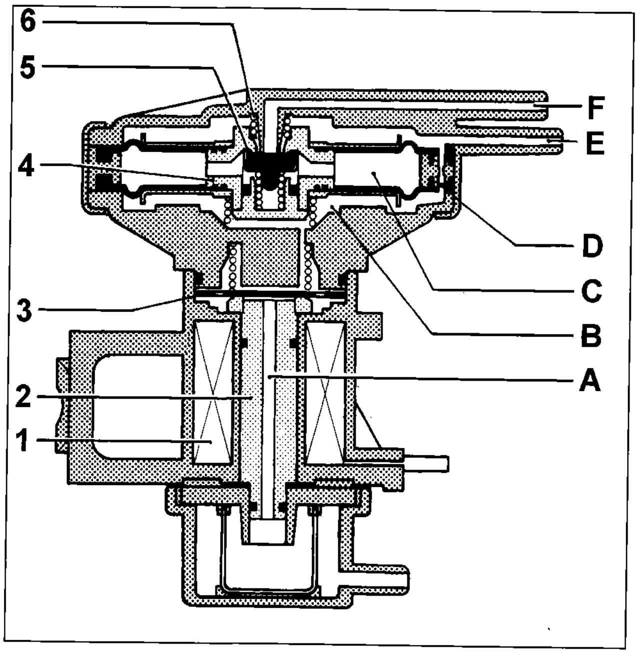
BORG WARNER vacuum modulator solenoid

BORG WARNER solenoid (2) controls the E.G.R. valve (1) by modulating output pressure of vacuum pump (3) according to atmospheric pressure.
The injection control unit controls the BORG WARNER solenoid by means of a square wave signal.

Operation

Vacuum reaches chamber E from duct F (case I), because the force of spring (6) acts on mobile unit (4) and shunt valve (5) opens up a passage.
The vacuum then flows through compensation port D to chamber B and surfaces of disc plunger (3). Once the forces acting on disc (3) are balanced, the atmospheric pressure in duct A enters chamber B to move the mobile unit downward (case II). The plunger of valve (5) therefore closes duct F and brings chamber E into communication with chamber C at atmospheric pressure to reduce the vacuum level in duct E.
The reduced vacuum level or increased absolute pressure in chamber E causes mobile unit (4) to rise (case I) to close passage C. Valve (5) therefore takes up an ideal position (E in communication with F) for the cycle to be repeated.



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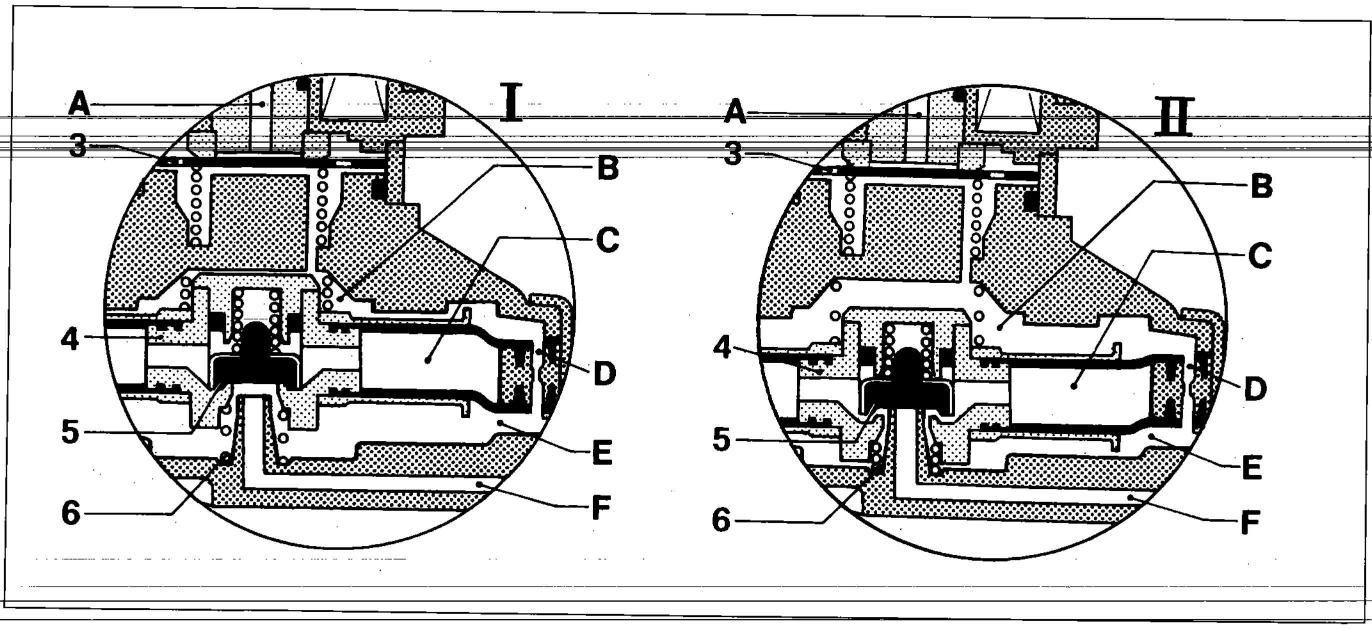

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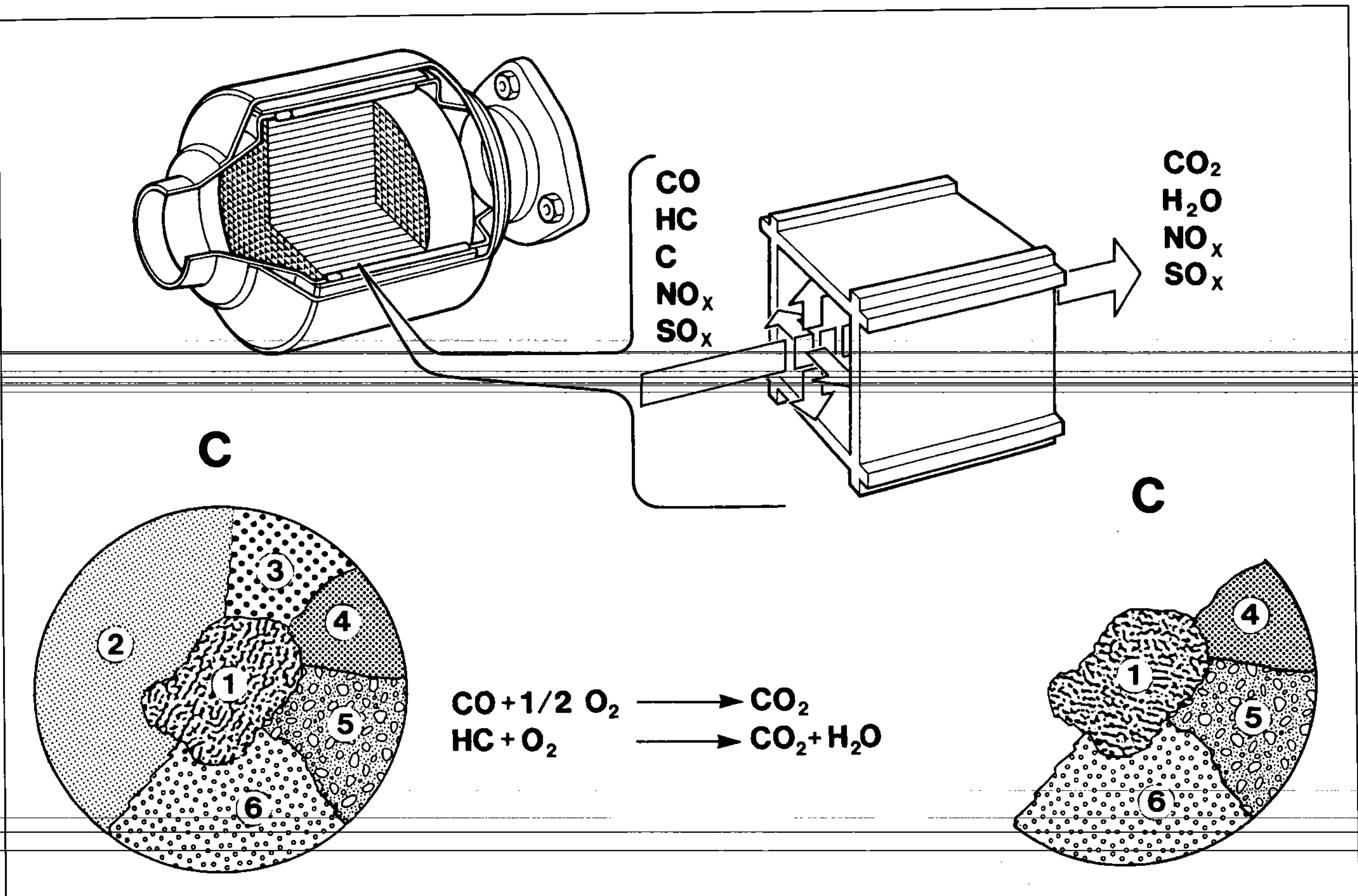
Oxidising catalytic converter

The oxidising catalytic converter is a simple and effective post-treatment device used to oxidise CO, HC and particulate, which are converted to carbon dioxide CO_2 and water vapour H_2O.
The catalytic converter used is oval in shape, with a corrugated, herringbone steel mount impregnated with Palladium and a silicon alloy. Its volumetric capacity is 1.4 litres and its density is 35 cells per square centimetre.
Exhaust gases flowing through the chambers heat the catalytic converter to trigger conversion of pollutants to inert compounds.
Individual pollutants are reduced with the following efficiency:
- 50% for CO;
- 50% for HC;
- 30% for particulate, which is a group of combustion residues (partially condensed at a temperature less than 52°C) made up of:
  1. carbon (ash); 2. saturated hydrocarbons; 3. aromatic hydrocarbons; 4. metals; 5. water; 6. sulphur compounds.

The catalytic converter treats the saturated and aromatic hydrocarbons (2-3) while the remaining elements are eliminated through the exhaust.
From 350 °C, the fuel sulphur content is oxidised to sulphur dioxide SO_2 and sulphur trioxide SO_3, When these come into contact with water vapour, they form the sulphurous and sulphuric acids responsible for acid rain.
When fuel sulphur content is reduced from its present 0.3% to 0.05%, all Diesel engine exhaust emissions will be fully converted.
The converter service temperature window within which the highest conversion rate compatible with minimum sulphur oxidation occurs is between 200 °C and 350 °C.
If the catalytic converter is of the correct size, temperature can be controlled and maintained within the optimal service window, limiting oxidation of sulphur compounds.
The catalytic converter also eliminates the characteristic exhaust gas smell.



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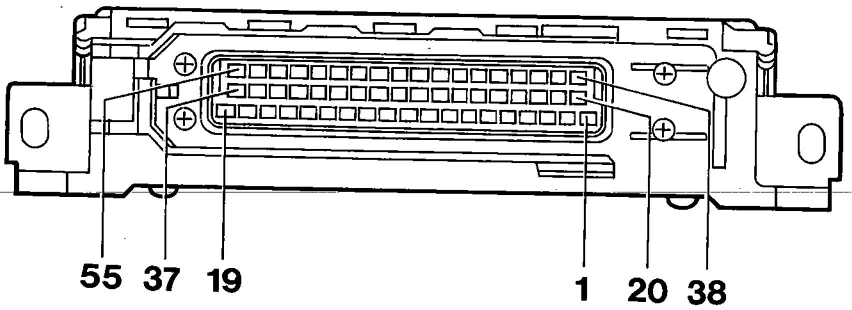
CONTROL UNIT PIN OUT



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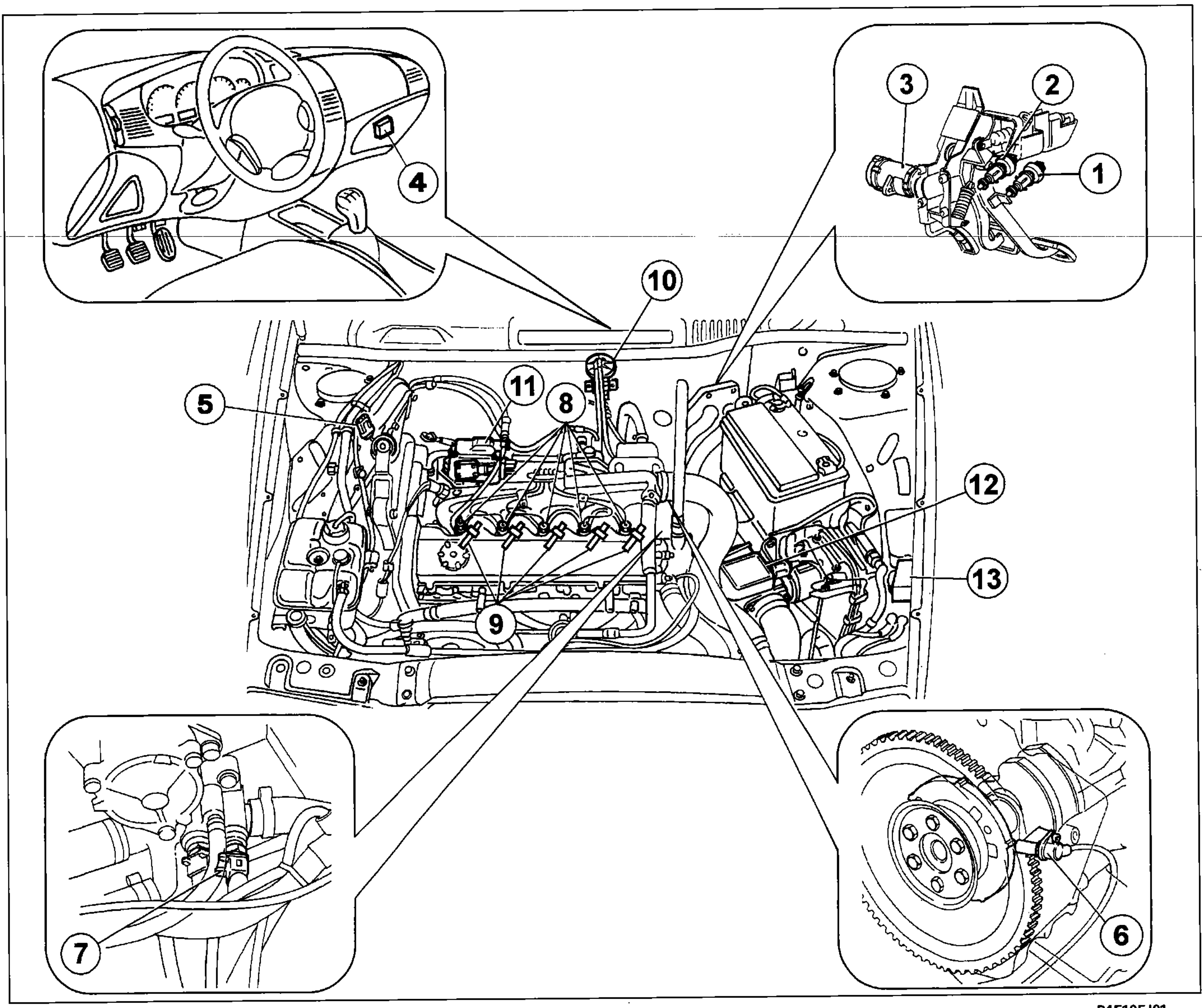
1. Fuel flow actuator
2. Fuel flow actuator
3. Engine stop solenoid
4. Infocenter
5. Controlled injector
6. Solenoid for E.G.R..
7. N.C.
8. Glow plug control unit activation
9. A.C. compressor
10. Injection advance actuator
11. Glow plug activation warning light
12. Earth for controlled injector
13. Common sensor earth
14. Cursor position sensor
15. Main relay
16. Control unit power supply via relay
17. Control unit power supply via relay
18. Earth
19. Earth
20. N.C.
21. Cursor position sensor (reference coil)
22. N.C.
23. N.C.
24. N.C.
25. Idle switch on accelerator pedal
26. Brake light switch
27. N.C.
28. Clutch pedal switch
29. Vehicle speed sensor
30. N.C.
31. N.C.
32. N.C
33. 5V accelerator pedal position sensor
34. 5V debimeter
35. Fuel temperature signal
36. N.C.
37. Accelerator pedal position sensor
38. Debimeter signal
39. Cursor position sensor signal
40. N.C.
41. Glow plug operation signal
42. K line and immobiliser
43. N.C.
44. Compressor activation request signal
45. N.C.
46. N.C.
47. Rpm sensor
48. N.C.
49. N.C.
50. Signal for tachometer
51. N.C.
52. Air temperature signal
53. Coolant temperature signal
54. N.C.
55. + ignition key

POWER SUPPLY SYSTEM COMPONENT LOCATION

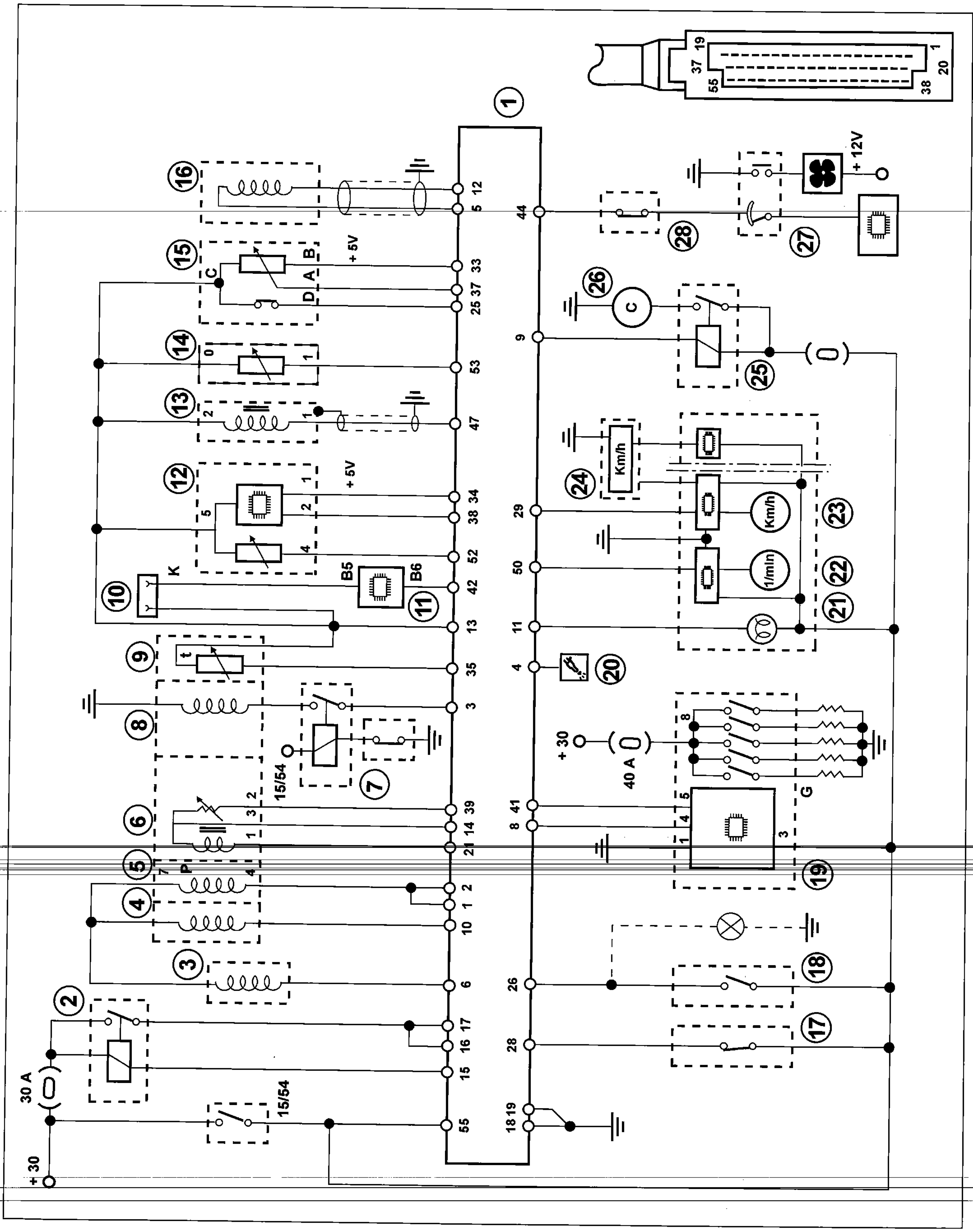


Key:

1. Clutch pedal switch
2. Brake pedal switch
3. Accelerator potentiometer
4. Electronic control unit
5. Tester socket
6. Rpm sensor
7. Coolant temperature sensor
8. Injectors
9. Heater plugs
10. Borg Warner modulator solenoid
11. Bosch injection pump
12. Debimeter
13. Glow plug control unit

10.

WIRING DIAGRAM



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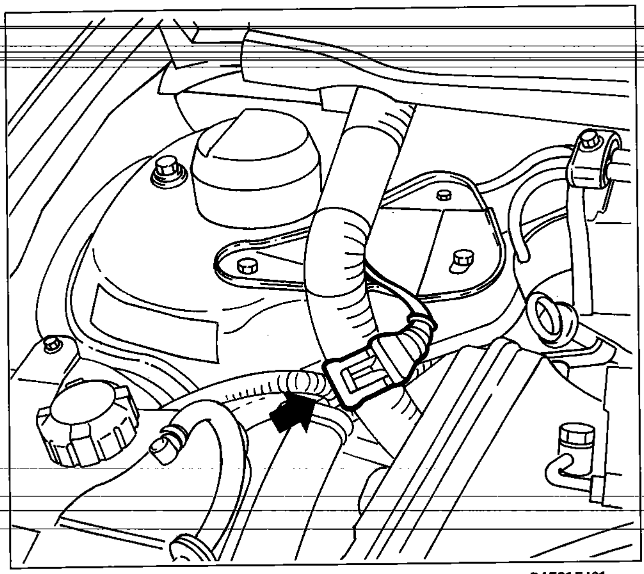
Key to wiring diagram

1. Electronic control unit
2. System protection relay
3. Borg-Warner modulator solenoid
4. Injection advance actuator
5. Fuel quantity actuator
6. Fuel quantity actuator position control
7. Inertia switch
8. Engine stop solenoid
9. Fuel temperature sensor
10. Diagnostic socket for FIAT/LANCIA tester
11. Immobilizer
12. Debimeter with air temperature sensor
13. Engine rpm sensor
14. Water temperature sensor
15. Accelerator pedal potentiometer with idle switch
16. Controlled injector
17. Clutch pedal switch
18. Brake pedal switch
19. Preheating electronic control unit
20. System failure warning light
21. Glow plug warning light
22. Rev counter
23. Speedometer
24. Speedometer sensor
25. Air conditioner compressor control relay
26. Air conditioner compressor
27. Three stage pressure switch
28. Anti-frost thermostat



Location of Fiat/Lancia Tester

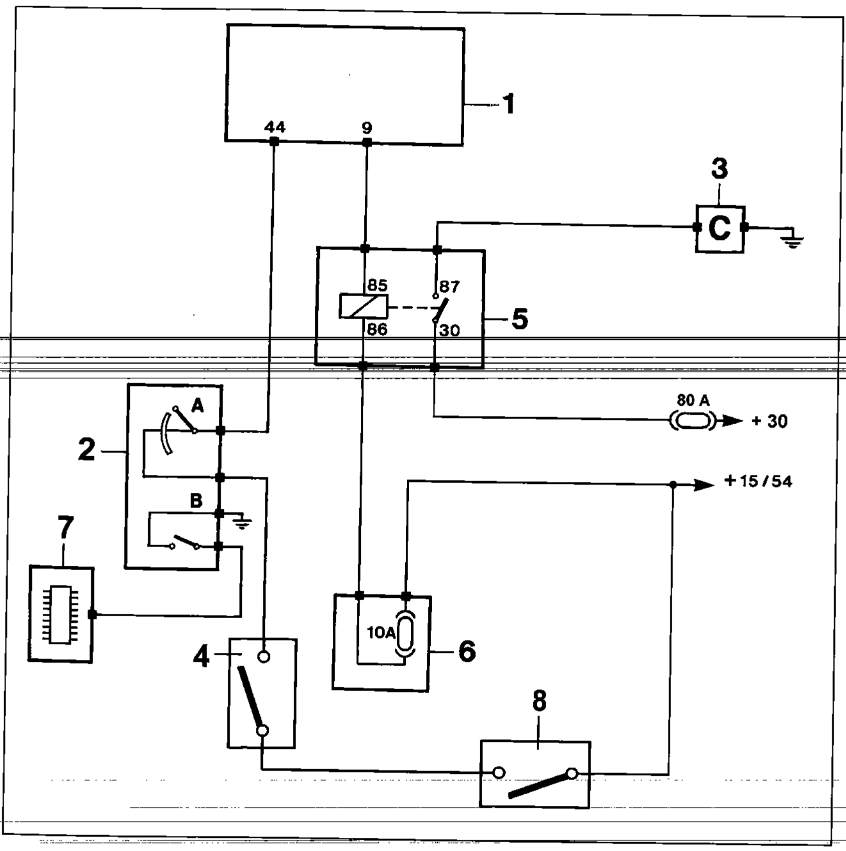
10.

Air conditioner

The injection electronic control unit manages the electromagnetic coupling of the air conditioning system compressor (3) in accordance with a strategy designed to avoid service conditions that would impair engine performance.
When the compressor is activated, the injection control unit increases idling injection pump output by means of the fuel quantity actuator in order to adjust the engine to the higher power requirement.
The injection control unit cuts off the supply to the compressor for about 6 seconds under the following conditions:
- take-off;
- acceleration;
- engine not warmed up

This power cut continues even if one of these conditions disappears before the 6 seconds have elapsed.
If the engine coolant overheats, the injection control unit cuts off power to the compressor until the coolant is restored to a temperature within the specified service range.
Power to the compressor is cut permanently if one of the injection system faults listed below occurs:
- speed signal fault;
- accelerator potentiometer signal fault;

The air conditioner activation system reaches terminal 44 of injection control unit (1) through three-stage pressure switch (2A). Operating with a slight delay, to ensure idle speed adjusts to the new power requirement, the injection control unit (1) earths terminal 9; at this point, relay (5) closes its contacts and one positive supplies electromagnetic coupling of compressor (3).

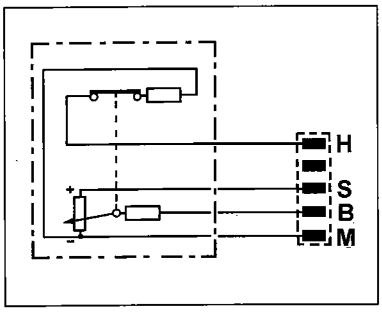


1. Bosch electronic control unit
2. A-Three stage pressure switch
   B-Pressure switch
3. Compressor electromagnetic coupling
4. Defrosting sensor
5. Relay
6. Fuse
7. Cooling fan control circuit
8. Air conditioner activation button

CHECKING, REPLACING AND ADJUSTING ACCELERATOR PEDAL POTENTIOMETER

To check accelerator pedal potentiometer, disconnect wiring connector and use an ohmmeter to check the following resistances:

- between lead H (grey and lead M (brown) 1kΩ; during acceleration, the ohmmeter will indicate an open circuit because idle contact opens
- between lead H and lead S (pink) 2kΩ; during acceleratoin, the ohmmeter will indicate an open circuit because idle contact opens
- between lead S and lead M 1kΩ
- between lead B (white) and lead S, check resistance varies continually from 1-2kΩ
- between lead B and lead M, check that resistance varies continuously from 1-2kΩ



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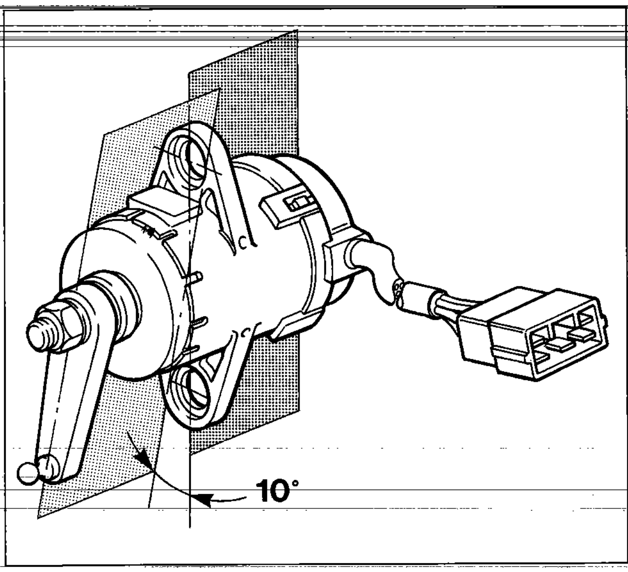
If the accelerator pedal position sensor is changed, the pedal assembly must be removed. This operation is necessary to permit potentiometer adjustment.
The operation is carried out in two stages:

Stage 1

Fitting control lever to potentiometer

Fit lever to accelerator potentiometer control shaft in the correct position (see figure)
Lever angle with regard to centre-line of sensor fitting holes must be 10°, positioned in opposite direction to direction in which lead emerges from sensor base.



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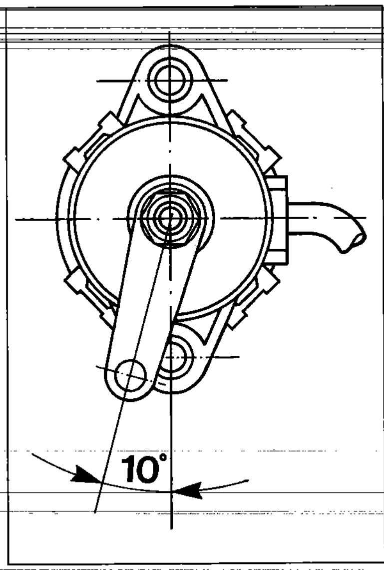

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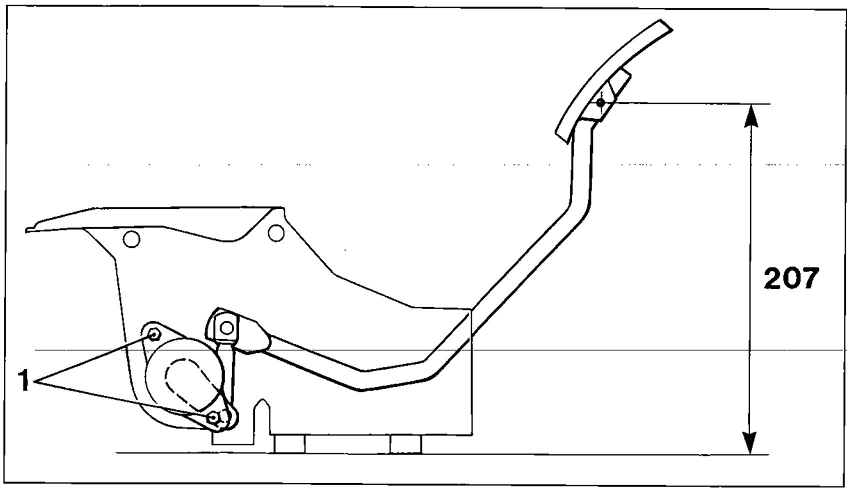

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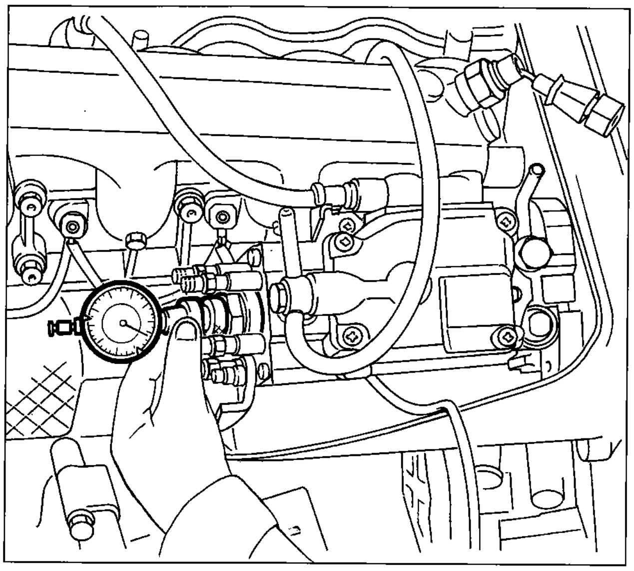
Stage 2

Fitting potentiometer to pedal assembly

Fit potentiometer in its seat, position retaining screws (1) and connect linkage.
Rest assembly on a reference plane as illustrated in the figure and measure 207 millimetres from the plane to the rivet connecting pedal to lever.
With the pedal in this position, tighten screws (1) retaining accelerator potentiometer.

INJECTION PUMP OPERATION



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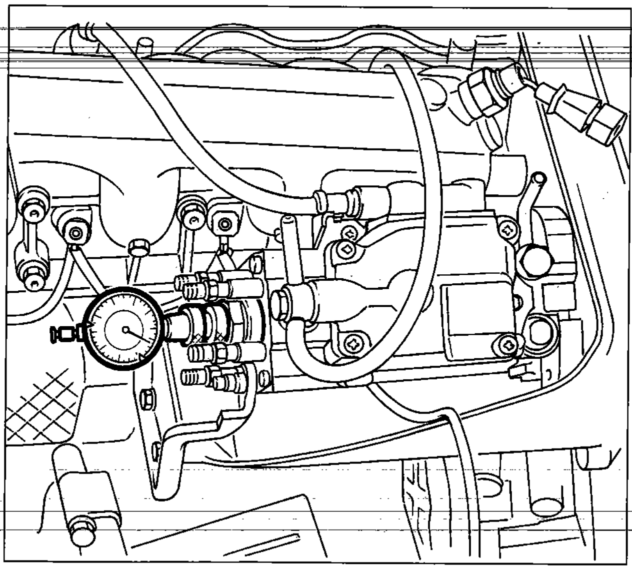
- Remove the cap on the pump cover and tighten tool 1865090000 in place, with gauge probe in contact with distributor piston crown.
- Turn the engine against its direction of rotation until pump distributor piston reaches B.D.C. indicated by the guage. Zero the gauge in this position.
- Turn the engine in its direction of rotation until engine piston n°1 is at T.D.C. Pump distributor piston must have travelled through 0.75 mm under these conditions.
- If travel is not 0.75 mm, turn pump case in its slot until specified value can be read off gauge. Tighten screws fastening pump to mount to a torque of 2.5 da Nm.



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