

CITROEN

DS 21

Bosch Electronic Fuel Injection

1. Description of BOSCH System

1.1 Fuel system

Fuel is drawn by the electric fuel pump ② from the tank ① via the fine filter ③ and forced into the fuel pressure line.

The pressure regulator ④ is situated between the injection valves of cyl. 2 and 3 and limits the fuel pressure to 2 kgf/cm^2 (28.5 psi). The electro-magnetic fuel injection valves ⑧ as well as the start valve ⑪ are connected to the pressure line by means of the fuel distributor pipes ⑨. From the pressure regulator the excess fuel can flow back to the tank through the return line. The return line coming from the pump also leads into the tank. A relief valve is fitted in the fuel pump which opens if, due to a fault in the pressure system, the pressure reaches a value (approx. 4 kgf/cm^2 [57 psi]) much above that required. A check valve in the pressure connection of the fuel pump prevents a complete loss of pressure in the fuel line instantly when the pump is switched off.

1.2 Air system

The 4 cylinders are supplied with air through individual induction pipes which are connected to one common inlet

duct. The pressure sensor and the pressure switch (fullload switch) are connected to the common inlet duct. There is a throttle valve, which is operated by a Bowden cable from the accelerator pedal, at the mouth of the common inlet duct. Air is drawn into the common inlet duct through an air filter.

When driving, the air flow is controlled by the throttle valve in the common inlet duct. When idling, the throttle valve is closed. The idling air enters the common inlet duct only via a by-pass port behind the throttle valve. The idling speed is set by altering the cross-section of the by-pass pipe by means of the idling adjustment screw ⑬. Adjustment of the idling speed should only take place when the engine has reached operating temperature (approx. 80° C [175° F] cooling liquid temperature). This will ensure that the auxiliary air regulator is closed. The engine when not fully warmed up requires an additional air flow for smooth running. This is controlled by the auxiliary air regulator ⑭. It alters the effective cross-sectional area of the auxiliary air pipe depending on the cooling liquid temperature. The position of the regulator is dependent on an element made of expanding material which projects into the cooling liquid. At about -20°C (-4°F) the regulator is fully open, and at about +70°C (+158°F) it is completely closed.

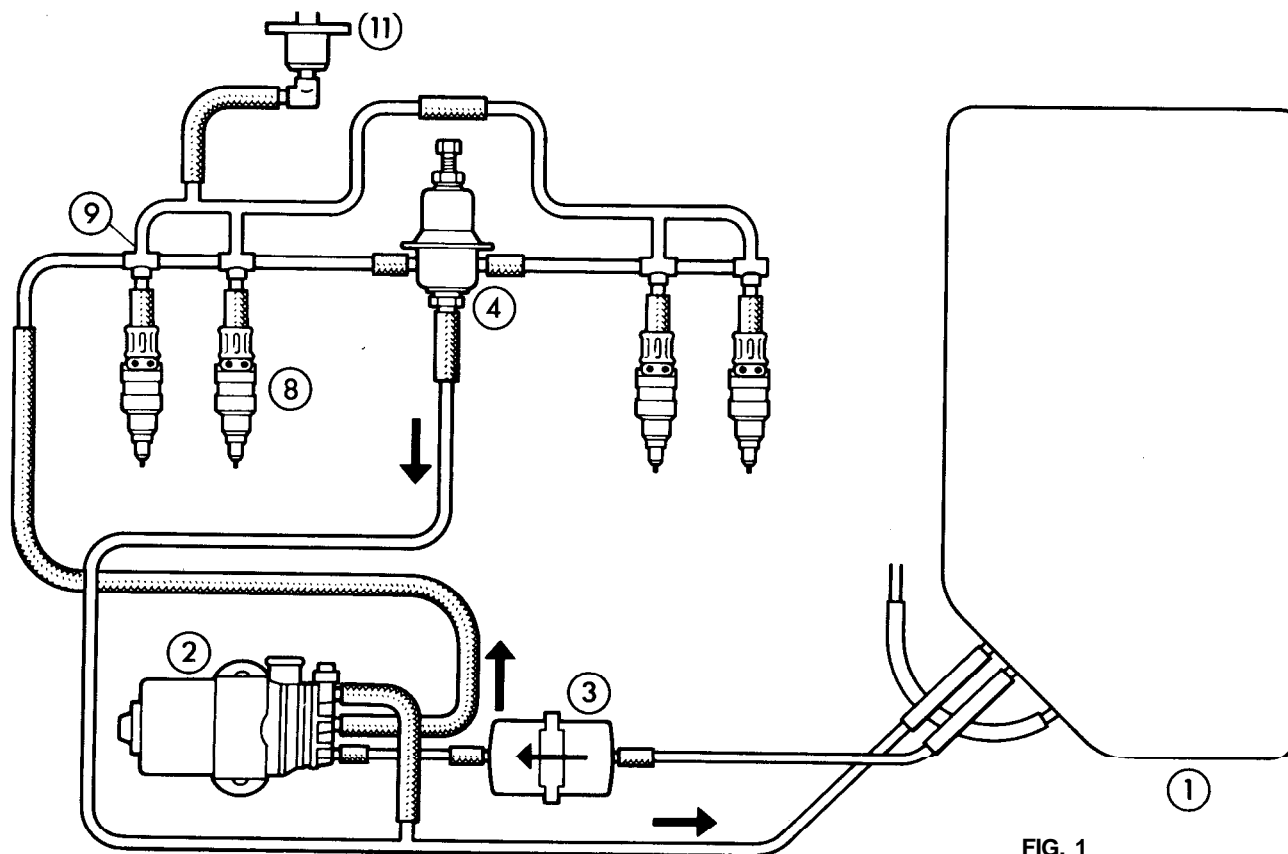
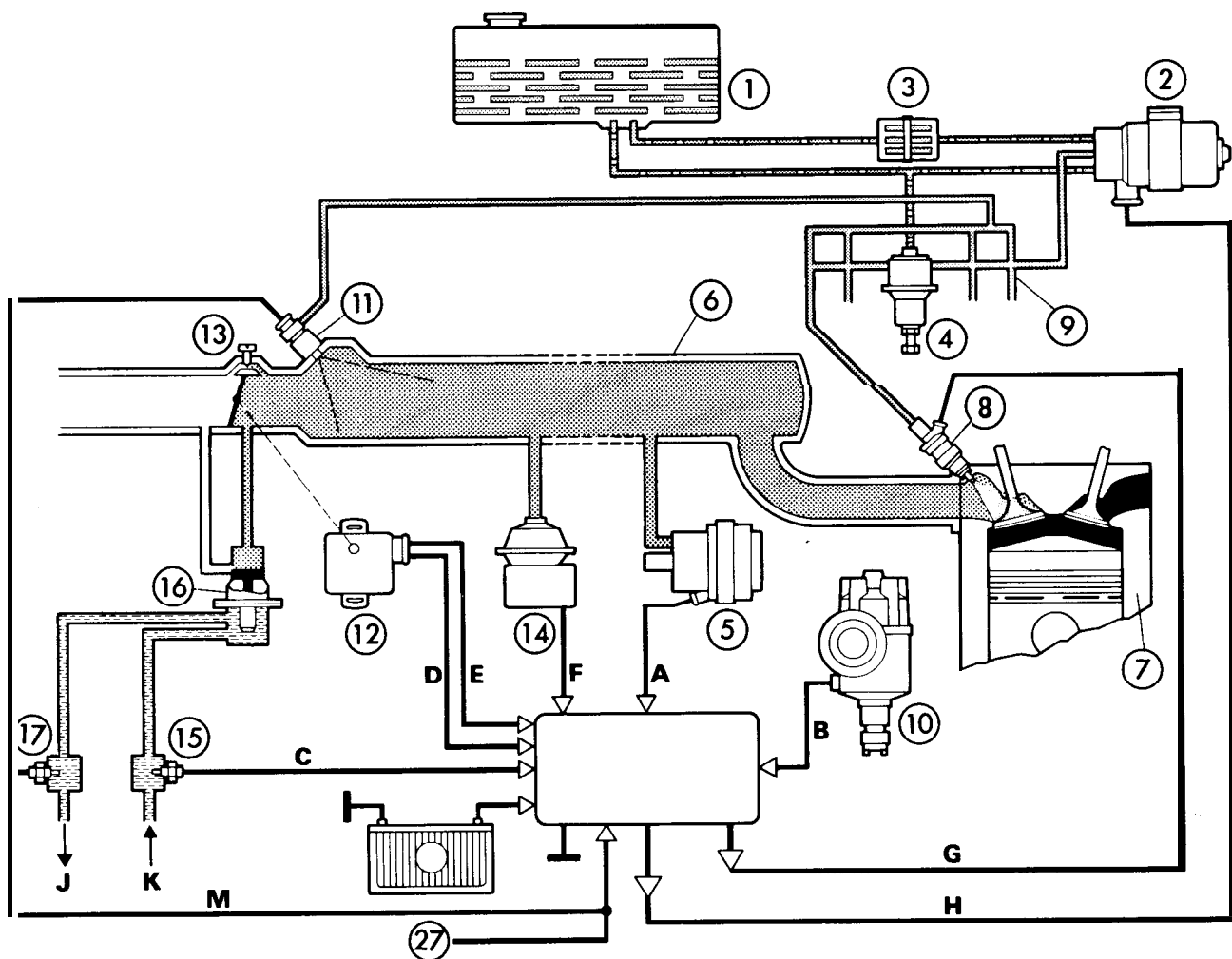


FIG. 1



1.3 Principles of operation

Key to schematic of system

- ① Fuel tank
- ② Fuel pump
- ③ Fuel filter
- ④ Pressure regulator
- ⑤ Pressure sensor
- ⑥ Common inlet duct
- ⑦ Cylinder head
- ⑧ Fuel injection valves
- ⑨ Fuel distribution pipes to the 4 injection valves
- ⑩ Ignition distributor with trigger contacts
- ⑪ Start valve
- ⑫ Throttle valve switch
- ⑬ Idling adjustment screw
- ⑭ Pressure switch
- ⑮ Temperature sensor I I (cooling liquid)
- ⑯ Auxiliary air regulator
- ⑰ Thermo-time switch
- ⑳ Terminal 87 from potential reversing relay

Information for the control unit

Information from	Signal
A Pressure sensor	Load condition of the engine
B Trigger contacts of ignition distributor	Engine speed, triggering signal for start of injection
C Temperature sensor I I (cooling liquid)	Warming up
D+E Throttle valve switch	Switching off the fuel supply while coasting in gear and after temporary enrichment
F Pressure switch	Full-load enrichment
G To fuel injection valves	
H To fuel pump	
M To start valve and thermo-time switch	
J+K Cooling liquid circuit to the auxiliary air regulator	

Due to the fuel pressure of 2 kgf/cm^2 (28.5 psi) fuel is injected during the time the injection valve is open. The nozzle duct of the injection valve is accurately calibrated. Since the fuel pressure is kept constant, the injected fuel quantity is dependent only upon the length of time the injection valve is open.

The duration of injection is "computed" by the control unit. The information processed by the electronic control unit comes from the individual sensors on the engine. This is done in the following manner:

The moment when the fuel is injected is controlled by the distributor contacts (trigger contacts I and I I) according to the position of the cam shaft (B). These contacts are installed under the centrifugal advance mechanism in the distributor and are maintenance-free.

The duration of injection (fuel quantity) is governed basically by two factors: engine speed and load condition of the engine. The engine speed is relayed to the control unit by the distributor contacts I and I I. The load condition is determined by measuring the absolute pressure in the inlet manifold. This pressure is converted to an electrical impulse and relayed to the control unit by the pressure sensor ⑤, which is connected to the common inlet duct ⑥ by a hose (A).

The control unit processes this information and gives a signal for the injection valve to be open for a longer or shorter period of time (F). The control unit thus permits, by electrical means, a varying quantity of fuel to be passed through the injection valves depending on engine load and speed. This is how the "basic fuel quantity" is governed.

In addition to the "basic fuel quantity" an accurately metered amount of fuel is injected **additionally** when starting at low ambient temperatures, when warming up, during acceleration and at full load.

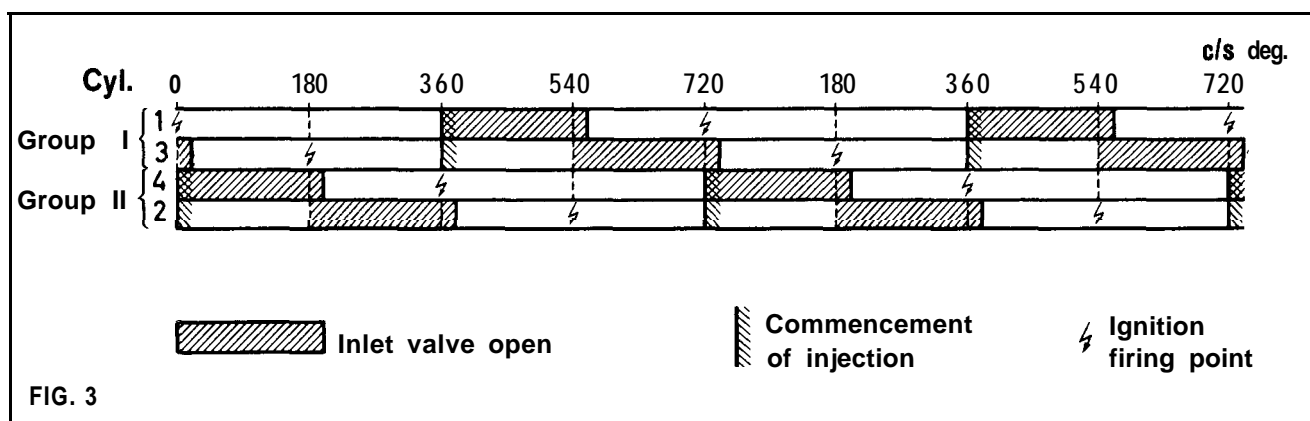
Fuel is injected into the common inlet duct by 'the start valve ⑪ as a function of temperature for a determined length of time (thermo-time switch in cooling liquid) – for as long as the starter is operated and at a cooling liquid temperature of up to approx. $+35^\circ\text{C}$ ($+95^\circ\text{F}$). The additional quantity of fuel from the start valve gives a considerably better start performance to the engine.

The control unit receives the signal "warming up" (C) from the temperature sensor I I ⑤ in the cooling liquid.

The throttle valve switch ⑫ has two functions. Firstly, it signals "coasting in gear" (D) (braking with the engine); in this condition no fuel should be injected. This operating condition is characterised by a closed throttle valve and increased engine speed. The throttle valve switch cuts off the fuel supply when coasting in gear at a speed over 1850 rev/min. If, when coasting in gear, the speed drops to 1100 rev/min the fuel supply is switched on again so that a smooth change-over to idling operation is guaranteed. When the engine is cold, the speed limits are raised by approximately 300 rpm to equalize the higher frictional resistance.

The second function of the throttle valve switch is to give the control unit the information "more fuel" (E) when the accelerator is depressed. This means that for temporary enrichment, an accurately metered fuel quantity is injected in addition to the normal fuel quantity.

The pressure switch ⑬ (full-load switch) gives the control unit the information "full-load enrichment". The pressure switch is connected to the common inlet duct by a hose and reacts to the pressure difference between inlet manifold pressure and atmospheric pressure (switch closes when pressure difference lies between 1-3/16" and 2" mercury column and opens again when pressure difference lies between 2" and 3-3/16" mercury column).



The injection valves ⑧ are opened electrically in two groups (group 1: cyl. 1 and 3; group 2: cyl. 4 and 2), by signals from the control unit.

The two fuel injection valves of one group inject at the same time. The injection valves of cylinders 1 and 4 inject fuel during the inlet stroke. The remaining injection valves inject onto the still closed inlet valves and store the fuel there. This fuel is transferred later, when the inlet valve opens, together with the air stream into the combustion chamber.

When the ignition is switched on, the control unit ② receives its operating voltage directly from the battery via

the main relay ⑨. The fuel pump is controlled by the pump relay ⑩. The pump relay only works either when the starter is operated (terminal 87 of the potential reversing relay) or when the speed of the engine is higher than 200 rpm. This flooding protection ensures that the combustion chamber cannot become filled with fuel should an injection valve become defective.

A time switch installed in the electronic control unit allows the fuel pump to run for approximately one second after the ignition is switched on in order to build up the fuel pressure at once.

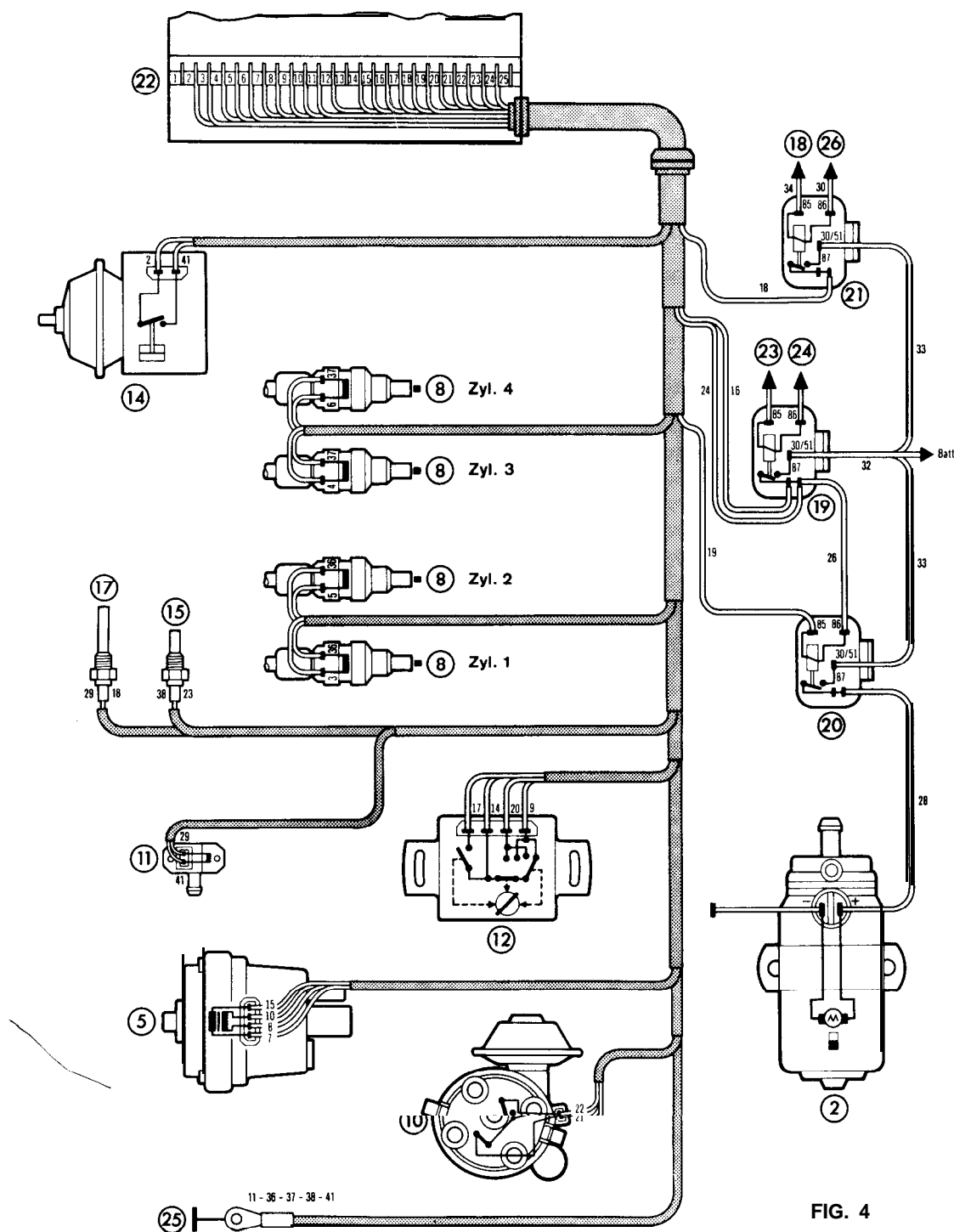


FIG. 4

1.4 Electronic controls

Description

- ② Electrically operated fuel pump
- ⑤ Pressure sensor
- ⑧ Electro-magnetic injection valves
- ⑩ Ignition distributor with trigger contacts
- ⑪ Start valve
- ⑫ Throttle valve switch
- ⑭ Pressure switch (full-load enrichment)

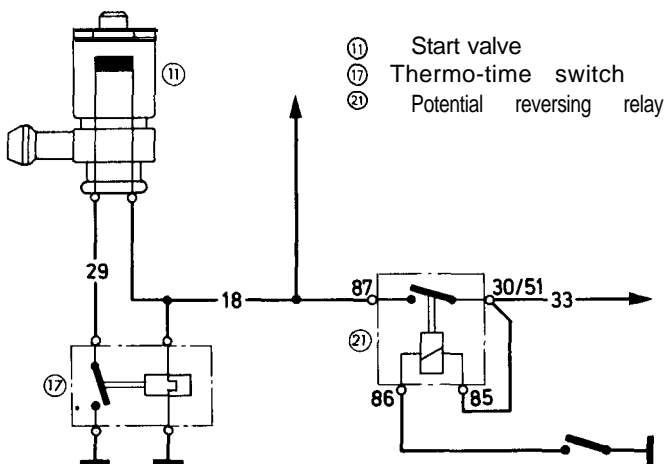
- ⑮ Temperature sensor I I (cooling liquid)
- ⑰ Thermo-time switch
- ⑱ + from the operation of the starter at battery terminal
- ⑲ Main relay
- ⑳ Pump relay
- ㉑ Potential reversing relay
- ㉒ Electronic control unit
- ㉓ To common ground connection ㉔
- ㉔ + terminal (at ignition coil series resistor)
- ㉕ Ground (on voltage regulator housing)
- ㉖ - from operation of the starter at battery terminal

Explanation of the cable runs

Note:

The individual cables are always marked at the appropriate plug with the following colors:

Cable Number	Color	From	To	Cable number	Color
1		not used			
2	red/blue	control unit	pressure switch	2	blue
3	green/white	control unit	injection valve cyl. 1	3	white
4	green/purple	control unit	injection valve cyl. 3	4	violet
5	green/blue	control unit	injection valve cyl. 2	5	blue
6	green/red	control unit	injection valve cyl. 4	6	red
7	green/gray	control unit	pressure sensor	7	gray
8	green/brown	control unit	pressure sensor	8	brown
9	yellow/white	control unit	throttle valve switch	9	yellow
10	yellow/purple	control unit	pressure sensor	10	violet
11	yellow/blue	control unit	ground (on voltage regulator housing)	11	yellow
12	yellow/red	control unit	trigger contact in ignition distributor	12	yellow
13		not used			
14	yellow/gray	control unit	throttle valve switch	14	gray
15	yellow/green	control unit	pressure sensor	15	yellow
16	yellow/brown	control unit	main relay terminal 87	16	white
17	white	control unit	throttle valve switch	17	white
18	purple	control unit	potential reversing relay terminal 87	18	white
	white	potential reversing relay terminal 87	thermo-time switch	18	blue
19	yellow	control unit	pump relay terminal 85	19	yellow
20	blue	control unit	throttle valve switch	20	blue
21	red	control unit	trigger contact in ignition distributor	21	red
22	gray	control unit	trigger contact in ignition distributor	22	gray



1.5 Electrical wiring of the start valve and potential reversing relay.

The potential reversing relay is controlled by the starter switch (ignition switch). Terminal 30/51 of the relay and connection 85 of the reversing relay are connected to B+. Terminal 87 of the relay is connected to the thermotime switch, the start valve and terminal 18 in the control unit. In addition, the switching contact of the thermotime switch is directly connected to the start valve.

When the starter is operated the potential reversing relay operates and the current flows from connection 87 of the relay to the thermo-time switch and the start valve. The ground connection for the start valve is switched by the contact in the thermo-time switch depending on the cooling liquid temperature. (Wiring diagram cable 29.)

At the same time, terminal 18 of the control unit is controlled by terminal 87 of the potential reversing relay when the starter is operated and thus the information "start" is given to the control unit, i.e. the fuel pump continues to operate.

2. Testing Instruments and Tools Required

Tester EFAW 228 S 10

for testing the system in the vehicle

0 681 500 001

Dwell-tach tester

Stroboscopic timing light

Tester trolley for carrying the testers,

e.g. EFAW 172 A

0 681 169 084

Extractor hook for cable harness plug, to be manufactured locally (Fig. 6).

a = 45 mm (1 3/4 in)

b = 12 mm (1/2 in)

c = approx. 100 mm (approx. 3-15/16 in)

Material: welding wire 2 mm \varnothing (1/16 in \varnothing)

Clamping clips for engine hood, to be manufactured locally. Round stock 7 mm \varnothing (1/32 in \varnothing) (Fig. 7).

3 clampers for closing off the fuel hoses; to be obtained from Matra-Werke, D 6 Frankfurt/Main, Dieselstraße 30, Part No. **W 157**.

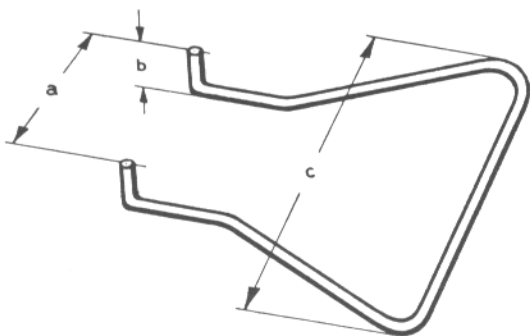


Fig. 6

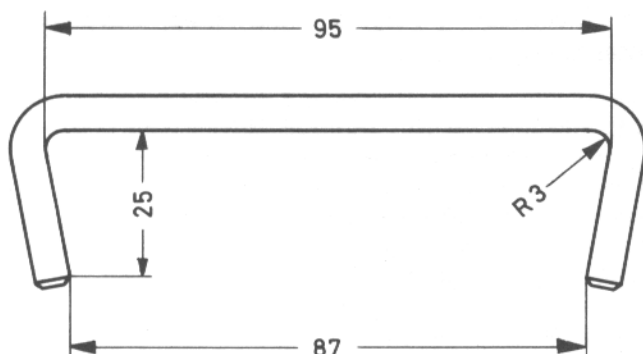


Fig. 7

3. Testing the Fuel Injection System with Tester EFAW 228 S 10

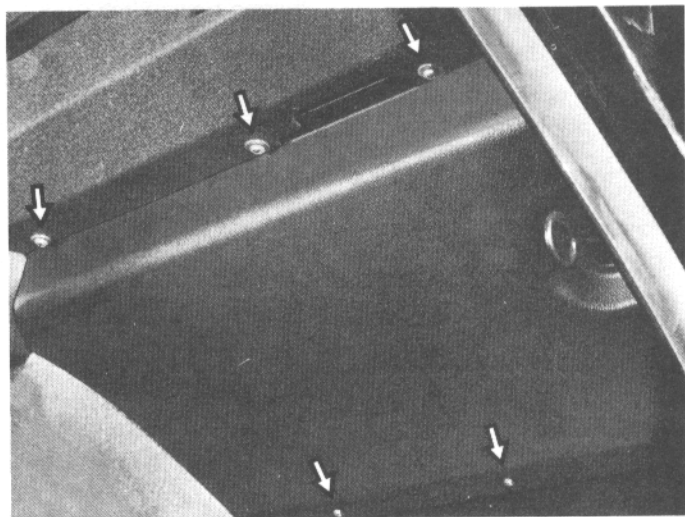
With the tester EFAW 228 S 10 all the sensors as well as the fuel pump and the injection valves are tested according to a set program. It is important that **all points** be checked.

All the operations described in the following must be carried out with the ignition switched off!

Removing the control unit:

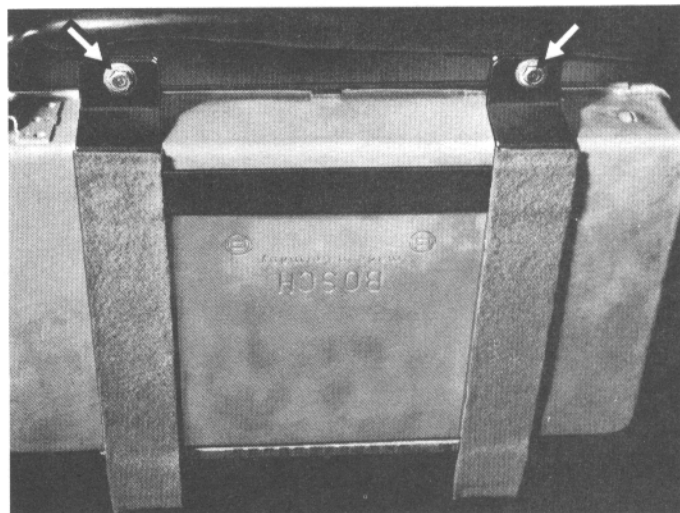
The control unit is fitted in the right hand floor area under the instrument panel. Loosen trim (arrows) and remove.

Fig. 8



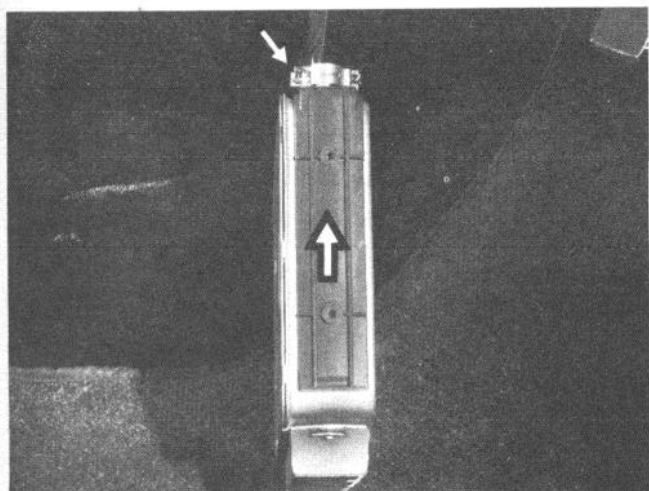
Remove fastening screws for control unit mounting with 8 mm (5/16") socket wrench. Fold mounting downwards. Remove control unit.

Fig. 9



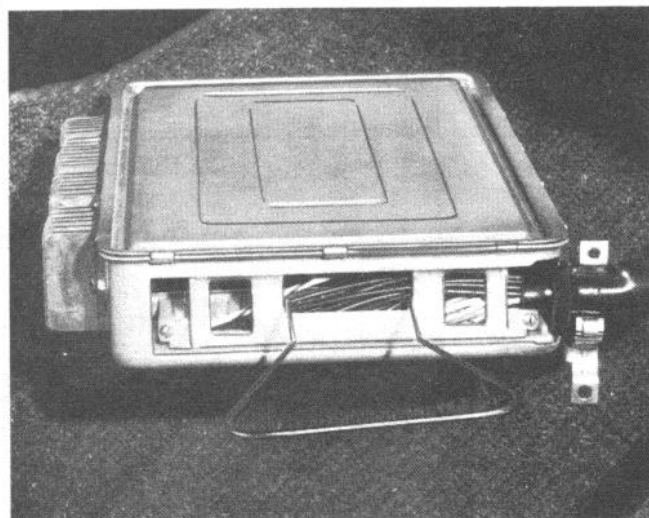
Open the cable clamp (arrow) with a Phillips screw driver and push off the cover.

Fig. 10



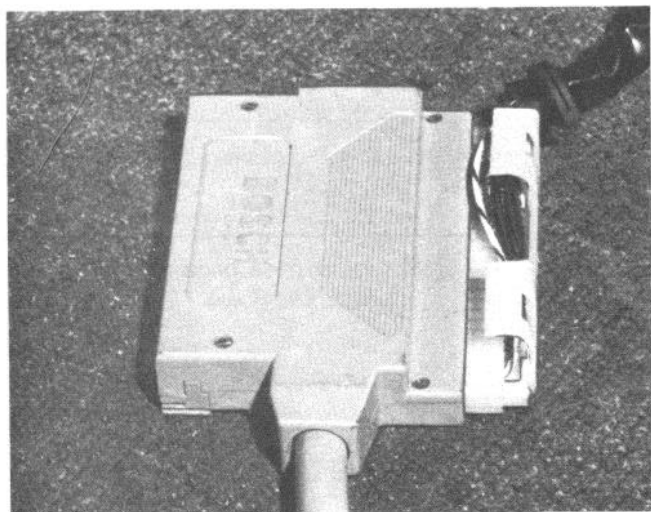
Carefully pull the cable harness plug out of the control unit with the extractor hook (to be manufactured locally according to Fig. 6).

Fig. 11



Connect the cable harness plug to the multiple plug on the tester EFAW 228 S 10.

Fig. 12

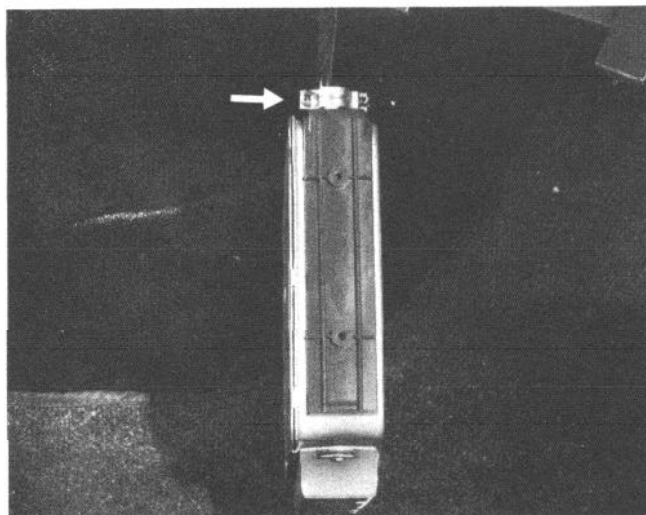


When refitting the control unit, observe the following:

Push the cable harness plug carefully into the control unit (the plug can only be connected in one direction). Carefully push the rubber grommet on the cable harness to fit faultlessly into the recess on the control unit.

Put the cover and the cable-support clamp back in place. Refit the control unit in its mounting and fasten (see Fig. 9).

Fig. 13



Preparatory work for the test (without electronic control unit connected):

Switch on ignition, turn **switch "A" to position "Measuring"**.

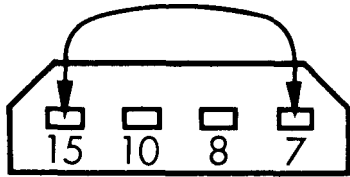
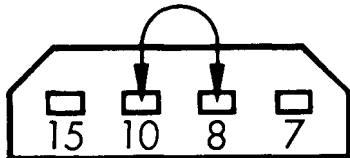
The test stages are listed in the following chart.

When checking the fuel injection system the entire test program must always be carried out.

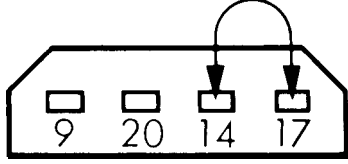
Any defects which are found should be eliminated before testing is continued.

Position of switch B	Operate	To measure
Voltage 1	Switch on ignition and leave on throughout the following test procedure. Disconnect cable 1 to the ignition distributor from the ignition coil, so that ignition coil does not overheat during test.	Voltage supply for the control unit
Voltage II		
Starting voltage	Operate starter briefly	Voltage at terminal 87 of potential reversing relay
Adjustment " ∞ ", pressure sensor	Set tester to " ∞ " by turning the knob	
	push "ground" button	Resistance between pressure sensor windings and ground (short circuit to ground)
	push "primary" button	Resistance of primary windings of pressure sensor
	Push "secondary" button	Resistance of secondary windings of pressure sensor

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Indication (nominal value)	Deviation from nominal value. Possible faults and their elimination.
11...12.5 (11...12.5V)	<p>No reading: Open circuit in cables 16 or 24 from main relay to control unit, main relay does not energize, ignition/starter switch defective (check whether voltage is present at terminals 86, 30/51 and 87 of the main relay). Check purple cable from ignition coil series resistor to lilac cable at control unit terminal 16. Check yellow/blue cable from control unit terminal 11 to main ground connection.</p> <p>Voltage below 11 V Contact resistance in white or yellow/blue cable. Battery flat.</p>
	As for voltage I but check white cable from main relay terminal 87 to brown cable 24 at control unit.
9,5...12.0 (9,5...12 V)	<p>No voltage, starter operates: Open circuit from potential reversing relay terminal 87 to the control unit terminal 18.</p> <p>No voltage as above, starter does not operate: Ignition/starter switch defective, open circuit in cable.</p> <p>Voltage below 9.5 V Battery flat, voltage drop in the potential reversing relay or in cable from + battery terminal too high.</p>
	When full deflection on the tester is not obtainable, the voltage of the vehicle battery is too low.- See also test stage "voltage I".
Resistance " ∞ " ($\infty \Omega$)	<p>Resistance "0": Short circuit to ground in cable or at pressure sensor (pull plug out of pressure sensor and if test instrument shows "∞", replace pressure sensor. If test instrument remains at "0", the cables to the pressure sensor may be short circuited; replace cable harness).</p> <p>Resistance below "∞", but not "0": Damage to insulation (proceed as described above).</p>
0.8...1.2 on the Ω scale (approx. 90 Ω)	<p>Resistance considerably lower than nominal value: Damage to insulation (pull plug out of pressure sensor and if test instrument shows "∞", replace pressure sensor).</p> <p>Resistance "0": Short circuit to ground, short circuit in primary windings (pull plug out of pressure sensor and if test instrument shows "∞", replace pressure sensor).</p> <p>Resistance considerably higher than nominal value: High contact resistance (test plugs and cables for corrosion or open circuits).</p> <p>Resistance "∞": Open circuit. Bridge plug as shown in illustration. If test instrument shows "0", replace pressure sensor. If "∞" indicated, check cables.</p>
	
3...4 on the Ω scale (approx. 350 Ω)	<p>As under "primary". With resistance "∞", bridge the two inner terminals.</p>
	

Position of switch B	Operate	To measure
Distributor contact I Distributor contact I I	Rotate distributor by operating starter for a short time	Functioning of the trigger contacts in the ignition distributor
Throttle valve switch I, then Throttle valve switch I I	Depress accelerator pedal slowly	Functioning of the temporary enrichment device
Throttle valve switch I I I	a) Throttle valve in idling position (closed) b) Throttle valve slightly open (aprox. 1°)	Functioning of the contacts in the throttle valve switch
Temperature sensor I I (cooling liquid)		Resistance of the temperature sensor
Valves	Adjust instrument again to "∞", if necessary (switch in position "Valves"). Pushbuttons: 1 = injection valve for cyl. 1 2 = injection valve for cyl. 2 3 = injection valve for cyl. 4 4 = injection valve for cyl. 3	injection valve with cable

Indication (nominal value)	Deviation from nominal value. Possible faults and their elimination.
Alternating between "0" and "∞" (0/∞ Ω)	If the needle of the test instrument does not swing when starting, i.e. remains at '∞' or "0", replace the trigger contacts (replace contact holder).
Instrument needle swings approx. 10 times between "0" and "∞", (Alternately 0/∞ Ω)	As the fully depressed accelerator pedal is released, the needle of the instrument must remain in the "∞" position. If "0" is shown then the throttle valve switch is defective, replace.
a) 0 (0 Ω) b) ∞ (∞ Ω)	<p>a) Resistance "∞": Throttle valve switch incorrectly adjusted or open circuit in cable (check adjustment, pull out plug and bridge as shown in illustration). If still at "∞", replace cable harness, otherwise replace throttle valve switch.</p> <p>3) Resistance "0": Throttle valve switch incorrectly adjusted or short circuit in the cable. Pull out plug; if the test instrument still indicates "0", replace the cable harness, otherwise adjust or replace throttle valve switch.</p> 
0.3...2.5 (approx. 2.5 kΩ) strongly affected by temperature: higher temperatures give lower value	<p>Nominal value is at +20°C (68°F). At higher temperatures, the resistance is lower.</p> <p>Reading "∞": Open circuit (pull out plug and bridge; if instrument shows "0", replace temperature sensor, otherwise replace cable harness).</p> <p>Reading "0": Short circuit (pull out plug, if reading is the same, cable is defective. If the test instrument then shows "∞", replace temperature sensor).</p>
2...3 (2.4 Ω at 20° C = 68° F)	<p>Resistance "0": Short circuit in the cable or in the injection valve (pull plug out of injection valve concerned and if test instrument shows "∞", exchange injection valve; otherwise replace cable harness).</p> <p>Resistance "∞": Open circuit in the cable or in the injector winding. Bridge contacts in injector plug; if test instrument then shows "∞", cable harness is defective. If "0", then injection valve is defective.</p> <p>Resistance over "3": Ground cable from injection valve has a bad connection on the engine.</p>

Position of switch "A" Switch "B" has no effect	Operate	To measure
Valve check	Press "pump" button	Pressure in fuel line (connect pressure gauge: disconnect fuel line at the start valve and connect pressure gauge in between).
	Press "pump" button briefly.	Leaks in the fuel system (pressure side)
Note: Carry out the following test only if injection valves are thought to be defective. Injection valves are removed.	Pressure build-up: Press "pump" button. Press buttons 1, 2, 3 and 4, one after the other.	Visual check of the injection valve spray. Collect fuel.
Checking start valve and temperature switch: a) Cooling liquid over +37°C (98.6°F)	1. Press "pump" button, operate starter (1 sec) 2. Connect gray connecting cable of thermo-time switch to ground.	Function of the thermal time switch and start valve.
b) Cooling liquid below +16°C (+60.8°F)	Press "pump" button and operate starter briefly (1 sec) (thermal time switch re-connected as normal).	

Switch off ignition and remove pressure gauge.

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Indication (nominal value)	Deviation from nominal value. Possible faults and their elimination.
Nominal value 2.0 to 2.2 kgf/cm ² (28.5 to 30.8 psi)	<p>No pressure build-up (pump does not start): Pull out 2-pole plug from pump, press "pump" button and measure the voltage with the voltmeter at the plug contacts. Reading 12 V: Pump defective, replace. Reading "0": Check by listening whether pump relay energizes or not. If yes: Break in cable from pump relay terminal 87 to pump plug or from pump plug to ground. If cables are good, pump relay is defective. If not: Break in cable from main relay terminal 87 to pump relay terminal 86 or from pump relay terminal 85 to yellow cable to control unit terminal 19. If the cables are in order, replace the pump relay.</p> <p>Pressure above or below 2.0 to 2.2 kgf/cm² (28.5 to 30.8 psi): Pressure regulator incorrectly adjusted (readjust; if adjustment is not possible, pressure regulator defect (replace).</p>
Pressure may drop back to 1.2 kgf/cm ² (17 psi); after this, any pressure drop should be very slow .	<p>Pressure drops quickly below 1.2 kgf/cm² (17 psi) as soon as the "pump" button is released or immediately falls back to "0": Leak in pressure system (from fuel pump to pressure regulator). Clamp fuel hose coming from the pump to the left of injection valve of cyl. 1. If no pressure drop occurs, the leak is at the pump or in the pressure line. If the pressure continues to drop, the leak should be sought at the connections to the injection valves, in the injection valves themselves or at the pressure regulator. Close off the fuel line with a clammer before the pressure regulator. If the pressure continues to drop, check injection valves, start valve or the pressure regulator for leaks (see the following test step). In order to determine which valve is responsible for a leak, remove the injection valves.</p> <p>Build up the pressure several times during the test as required. Make visual check to see if leaks occur at hose connections (also pressure gauge connection).</p>
	<p>Press "pump" button and check visually for leaks. The injection valve orifice may become wet, but not more than two drops should form per minute on the injection valve. If no leaks have been determined, replace the pressure regulator.</p>
1, Pressure should not drop visibly. 2. Start valve injects, gauge pressure drops.	<p>1. Pressure drops steadily as the starter is operated: temperature switch defective, exchange.</p> <p>2. Pressure does not drop when the starter is operated: check purple cable from start valve to the white cable at terminal of potential reversing relay for continuity. If broken, renew cable harness; otherwise check start valve. Winding resistance 4,2 Ω at 20°C (68°F).</p>
Pressure must drop slowly .	<p>If the pressure does not drop, replace temperature switch or check start valve as described under 2. above.</p>

Important! The following points must be observed before starting the engine:

1. Never let the engine run without the battery connected.
2. Never use a high speed battery charger as a starting aid.
3. When using a high speed charger to charge the battery in the vehicle, the battery should be disconnected from the rest of the electrical system.

Starting the engine:

Cold and warm engine: without depressing the accelerator pedal (throttle valve closed).

Test with control unit connected:

Connect the control unit to the multiple plug of the tester.
The position of the switch "B" does not affect the test.

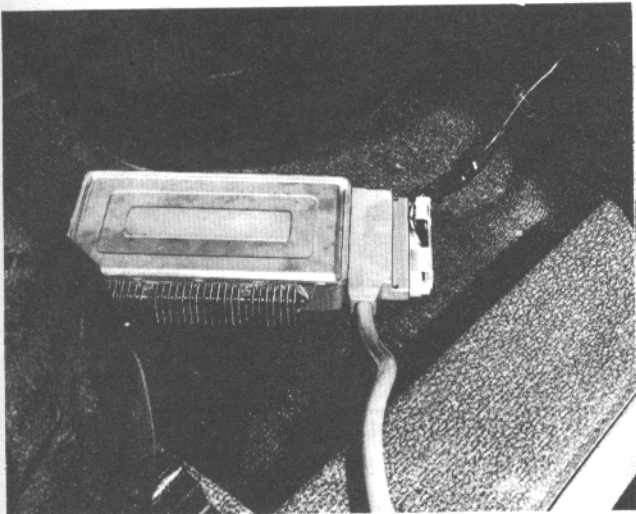
Important! Please observe the test procedure exactly.

Connect the control unit only after the ignition has been switched off.

Before starting the engine, do not fail to turn switch "A" to the position "Distributor contact I"

In position "Valve check" all injection valves are open. The engine does not start.

Position of switch "A"	Operate	To measure
Distributor contact I, then Distributor contact I I	Let engine run at about 2000rev/min Switch over tester from distributor contact I to distributor contact I I	Displacement of the trigger contacts in the ignition distributor.
Pressure switch	a) Let engine idle	Functioning of the pressure switch
	b) Switch off engine. Switch on ignition again.	



Indication	Deviation from nominal value. Possible faults and their elimination.
Needle moves toward full deflection and then oscillates about an average value. When switching over from distributor contact I to II, max. deviation may be 2 graduations from the average value on the voltage scale.	If deviation is greater, the trigger contact holder in the ignition distributor should be replaced.
The instrument pointer must move in the direction "full deflection".	If "0" is indicated, then the pressure switch is not functioning or there is a cable break. Pull off the plug and bridge it. If "0" is still indicated, replace cable harness, otherwise renew pressure switch.
2–5 on the volt scale.	

4. Trouble-shooting chart for defects in fuel injection system only. Prerequisite is that the ignition system and the engine be in satisfactory condition.

Trouble	Cause	Remedy
Engine will not start. Pump not running.	1. Cables to pump or pump relay or cables on fuel pump relay defective. 2. Check on fuel pump for good connections.	Check whether pump relay energizes (switch ignition on and off and listen for audible action of relay), if necessary test with voltmeter.
	No voltage at terminal 86 of pump relay (12 V), because main relay not operating or cable defective.	Eliminate any open circuit.
	Voltage present at terminal 86 of pump relay but no ground connection at terminal 85.	Fuel pump operates for approx. 1–2 sec. after switching on ignition. Check with voltmeter; ground for terminal 85 is made by control unit. Replace control unit.
	Open circuit in cable from pump relay terminal 87 to + connection on pump.	Eliminate open circuit. (Check plug connection.)

Engine will not start. Pump runs.	Connection from cable harness (cable 18) to starter terminal 50 defective.	Check with EFAW 228 S 10.
	Pressure sensor cable not connected or open circuit.	Push on pressure sensor cable or repair.
	Open circuit in cable connection at temperature sensor II (cooling liquid).	Check cables, if necessary replace temperature sensor.
	No pressure build-up in fuel ring main (pipe pinched or pressure regulator defective).	Check pressure with gauge; if necessary exchange pressure regulator.
Engine will start cold, but stalls.	Cable connector for triggering contacts not pushed on at ignition distributor or open circuit in cable.	If necessary, connect test instrument EFAW 228 S 10 and localize the fault; replace trigger contacts or cable harness.
	Trigger contacts defective.	Replace.
	See also "Engine will not start".	
	Pressure sensor defective.	Replace.
Engine cuts out when driving (usually preceded by misfiring)	1. Trigger contacts have excessive contact resistance or are dirty. 2. Plug loose. 3. No fuel pressure. 4. Ignition contacts defective.	1. Replace trigger contacts. 2. Check. 3. Measure pressure. Determine cause. 4. Check ignition.
Engine runs irregularly, one cylinder not firing, exhaust white.	One injection valve sticking.	Replace.
	Connection to injection valve or injection valve coil not in order.	Check connections, replace injection valve. Test with tester EFAW 228 S 10.
Engine misfiring but not caused by ignition system.	Loosen connections, main ground cable has poor connection to engine block.	Check connections, tighten up ground connection.
Engine not reaching full power.	Fuel pressure too low.	Check pressure regulator.
	Pressure switch (full-load switch) does not function.	Check.
	Pressure sensor defective.	Replace.
	Throttle valve does not open sufficiently.	Check throttle valve.

Fuel consumption too high.	“Information” sensors or the control unit not functioning correctly or the electrical connections have too high contact resistances.	Test the system according to section 3.
	Throttle valve switch I I incorrectly adjusted.	Adjust with tester EFAW 228 S 10.
	Fuel pressure incorrect.	Check pressure regulator, if necessary exchange.
Engine hunts excessively at idle (between 1400 and 1850 rev/min).	Hose between auxiliary air regulator and induction manifold detached or defective.	Push hose into position or replace.
	Throttle valve stop incorrectly adjusted (too far open).	Readjust throttle valve stop.
	Idling speed set too high.	Adjust idling speed.
Engine misfires when accelerating.	Temporary enrichment device in throttle valve switch not functioning or plug incorrectly connected.	Check throttle valve switch (tester EFAW 228 S 10).
Too high idling speed. Idling speed cannot be adjusted.	1. Idling air system leaks.	1. Check idling air system.
	2. Small rubber sealing ring under the injection valve leaks.	2. Replace rubber sealing ring.
	3. Throttle valve adjustment incorrect.	3. Readjust throttle valve.

5. Removal, Installation and Adjustment of the Individual Components

Grip the sides of the plugs when pulling them out, never pull on the cable. When reconnecting the plugs to the individual components, note the bevelled corners on the plug. Push the rubber caps correctly over the plugs.

Disconnect the battery.

In order to facilitate work in the engine compartment it is advisable to push the hood to its top position and clamp with clip (to be made locally according to Fig. 7). Fig. 14

5.1 Pressure sensor

The pressure sensor is screwed to the left bulkhead in the engine compartment. Pull off 4-pole plug.

Only loosen the 2 upper fastening screws with 8 mm (5/16") socket wrench — do not screw right out — screw lower fastening screws right out.

After removing the pressure sensor, pull off air hose from pressure sensor.

Note for installation!

The protection sleeve on the hose connection of a new pressure sensor is only to be removed immediately prior to pushing on the connecting hose. Beware of dirt!

Fig. 15

5.2 Pressure switch

The pressure switch is installed next to the pressure sensor. Using 10 mm (25/64") open end wrench, **slightly loosen** fastening screw and pull out the pressure sensor in a forward direction.

After removing the pressure switch, pull off the 2-pole plug and the pressure hose.

When installing, make sure that first the electrical plug, then the pressure hose to the inlet manifold, is connected to the pressure switch. Install pressure switch and tighten.

Fig. 16

5.3 Adjustment of throttle valve

Important note!

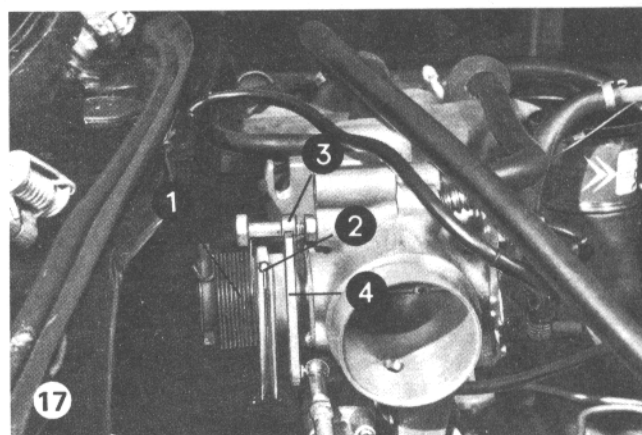
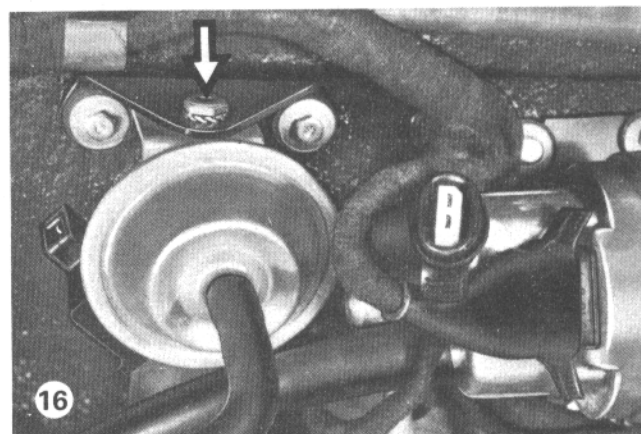
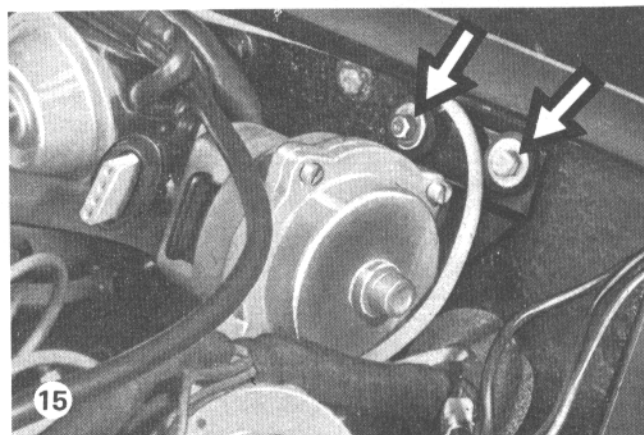
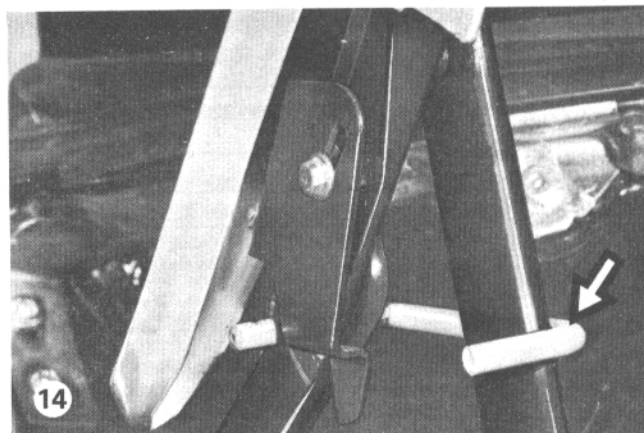
The throttle valve stop screw is set in the factory so that the valve is completely closed. The stop screw is locked and must not be readjusted. It prevents the valve from closing too hard and resulting in possible seizure of the throttle valve.

If readjustment becomes necessary, one should proceed as follows:

Disconnect air hose from throttle housing. Detach return spring (1) and Bowden cable (2). Set stop screw (3) such that, when the bracket (4) just contacts the eccentric cam of the stop screw, the throttle valve in the housing almost sticks. Then screw out the stop screw by 1/4 turn.

Tighten stop screw and secure with a lock nut. Check the throttle valve for easy operation.

Fig. 17



5.4 Throttle valve switch

Pull out four-pole plug, loosen both fastening screws and draw the switch off the throttle valve shaft.

Setting the throttle valve switch:

Fig. 18

The throttle valve switch must operate just when the throttle valve has opened 1° from its closed position. To facilitate the adjustment, graduations have been stamped into the base plate of the throttle valve switch on both sides (one graduation mark = 2°).

These graduations face an orientation marking on the inlet manifold. If there is no marking, make one yourself.

When adjusting, proceed as follows:

First possibility:

Fig. 19

Connect tester EFAW 228 S 10 as described in paragraph 3; turn switch "A" to the "measure" position; turn switch "B" to the "throttle valve switch III".

Slide switch onto throttle valve shaft and slightly tighten the two fastening screws.

Reconnect the four-pole plug and turn on the ignition. Rotate the switch until the needle on the test instrument moves from " ∞ " position to "0".

Now turn the switch by approximately $\frac{1}{2}$ graduation = 1° in a clockwise direction and tighten the fastening screws. Finally, check the adjustment by operating the throttle valve.

Second possibility:

Fig. 20

Plug 4-pole plug into the throttle valve switch and switch on ignition. Insert a 0.7 mm feeler gauge between lever 1 and stop 2. Turn the throttle valve switch until the instrument pointer moves from " ∞ " to "0". Maintaining this position, tighten the fastening screws of the throttle valves switch.

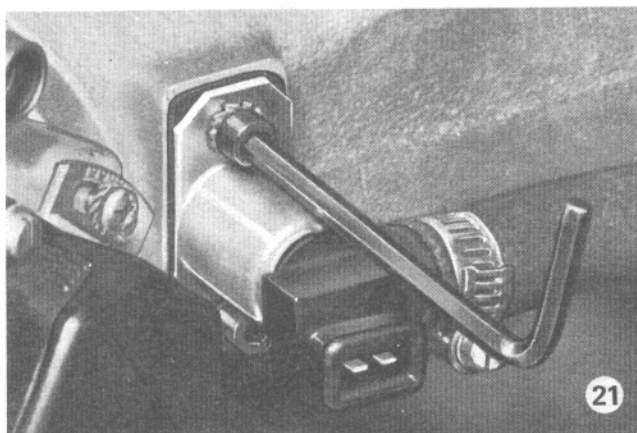
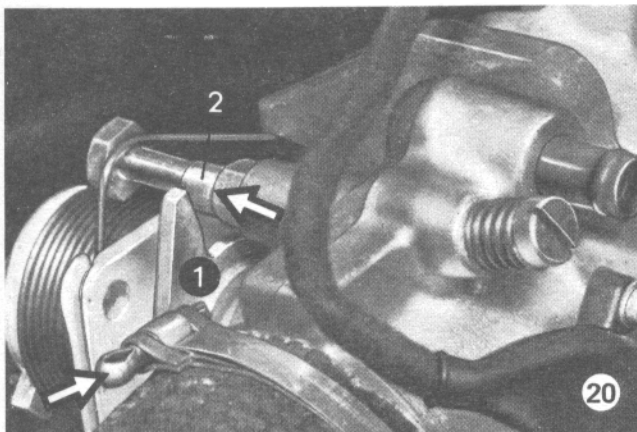
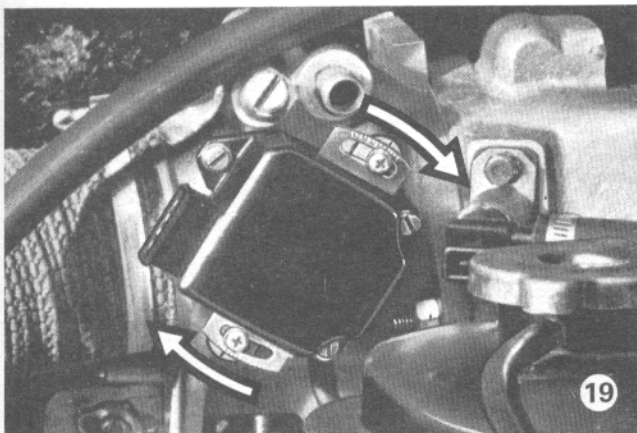
Check setting:

Insert a 1.4 mm feeler gauge between lever 1 and stop 2. The instrument pointer must indicate " ∞ ". Also check throttle valve for easy operation.

5.5 Start valve

Pull out plug from start valve. Using 5 mm ($13/64$ ") socket wrench loosen both fastening screws and pull the start valve, together with the attached fuel hose, out of the inlet manifold. Loosen fuel hose and carefully disconnect from start valve.

Fig. 21



When installing, do not forget seal (arrow).

Fig. 22

5.6 N.B. Important notes which must be observed when working on the injection valves, the pressure regulator and the auxiliary air regulator.

When removing or installing the injection valves of cylinders 3 and 4, the suspension system oil circuit must be depressurized. The entire induction system of the vehicle must also be removed. These measures must also be observed when replacing the pressure regulator. When working on the auxiliary air regulator, only the hydraulic accumulator of the suspension system needs to be removed. In vehicles with hydraulic transmission, the oil circuit for the gearbox and the clutch must also be interrupted.

All these operations must be carried out with the greatest caution and exactitude, since they also determine the safety of the vehicle.

5.6.1 Remove the hydraulic accumulator for the suspension system.

(Must be removed when working on the injection valves of cylinders 3 and 4, pressure regulator and auxiliary air regulator.)

Depress vehicle ground clearance adjusting lever fully.

Fig. 23

Check whether the suspension system is unpressurized: hydraulic accumulator on left side of vehicle (as viewed from driving position) must be manually movable (approx. 2–3 mm / 0.08–0.1"). Unscrew hydraulic accumulator by hand and remove. Cover or stop up the openings immediately.

When refitting hydraulic accumulator, the O-ring on the threaded connector of the ram for the suspension must be renewed. Place O-ring, Citroen part no. ZD 94 868–00 U, on the threaded connector and screw in the hydraulic accumulator and tighten by hand.

Fig. 24

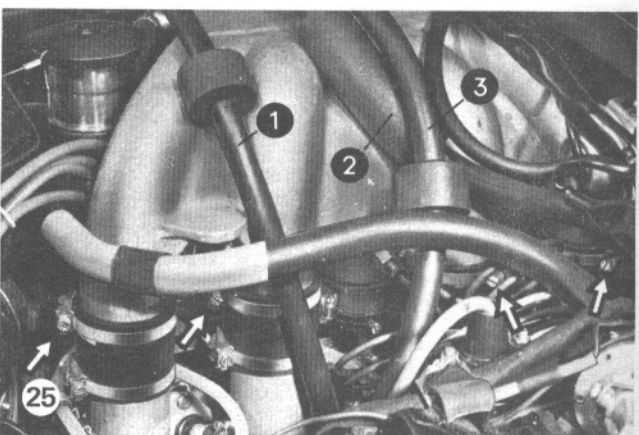
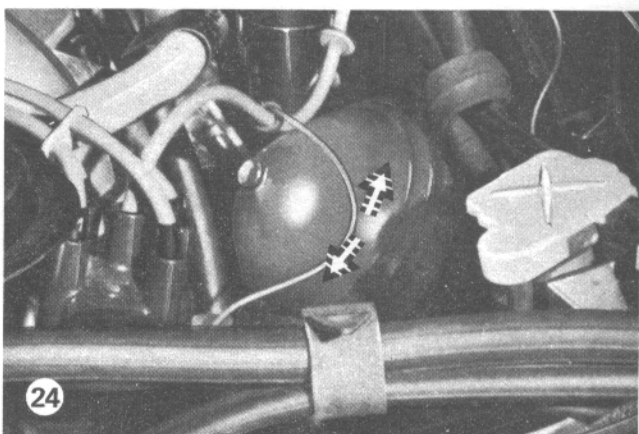
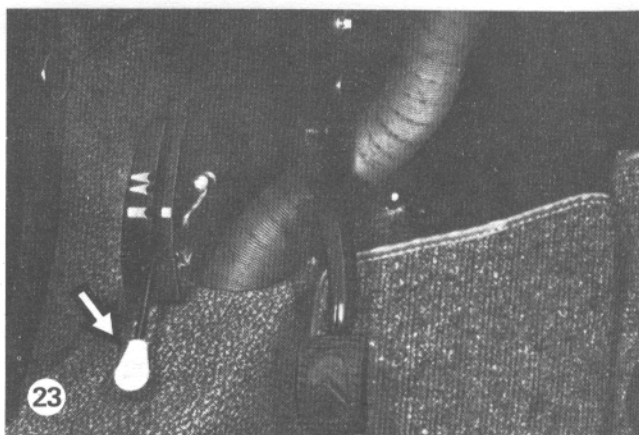
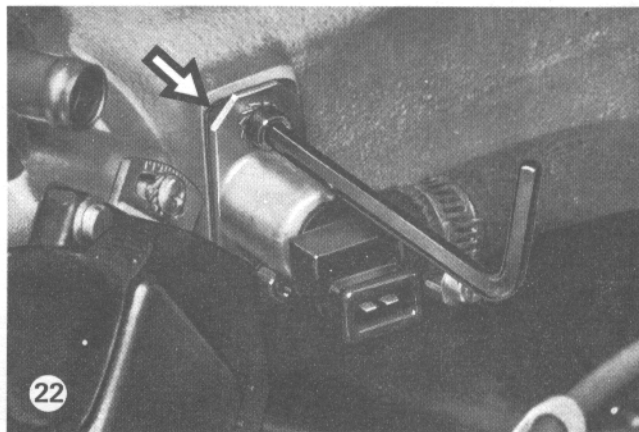
5.6.2 Remove common inlet duct.

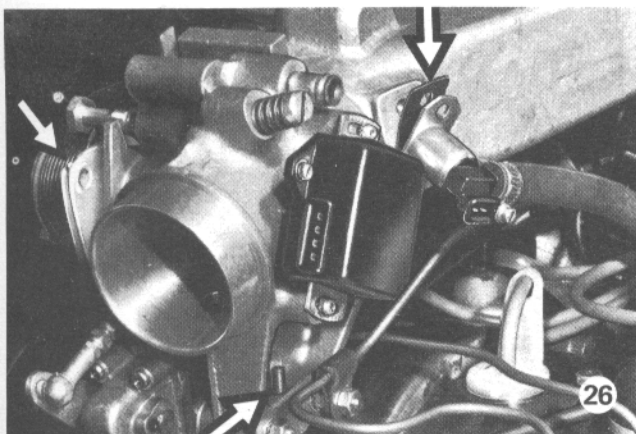
(Must be removed when working on the injection valves of cylinders 3 and 4, and when removing the pressure regulator.)

In the case of vehicles with hydraulic transmission the following sections 5.6.3, should be paid particular attention to.

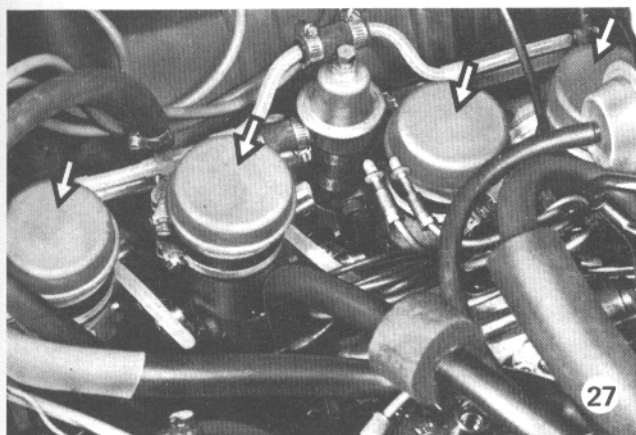
Pull off air hoses ①, ② and ③. Loosen the 4 hose clamps (arrows).

Fig. 25

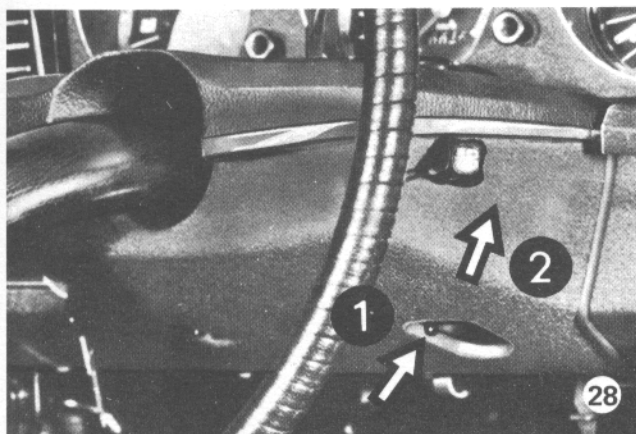




Loosen the fastening nut beneath the throttle valve (arrow). Detach Bowden cable for the throttle valve. Loosen the start valve and remove together with the fuel hose (note seal). Carefully remove inlet manifold. Fig. 26



Close openings in the common inlet duct and in the inlet connections immediately, so that no foreign matter gets into the engine. Fig. 27



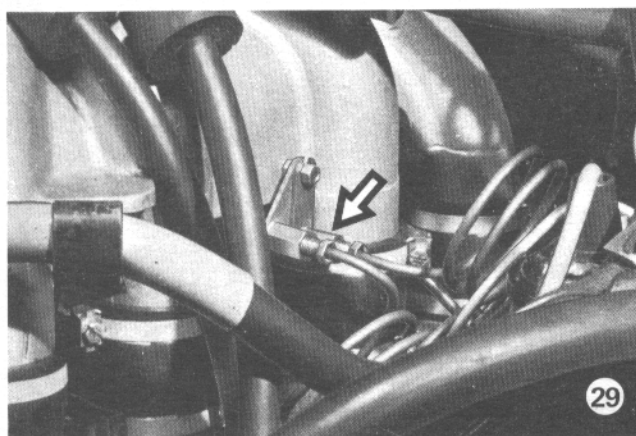
5.6.3 Remove common inlet duct in vehicles with hydraulic transmission.

Important note:

The hydraulic system is under a pressure of approx. 80 kgf/cm² (1140 psi). In order to avoid accidents when working on the hydraulic system, the following operations must be strictly adhered to.

Before loosening the hydraulic lines at the common inlet duct, release the oil pressure in the clutch circuit.

Press lever ①, on right hand side below the steering column forward. Then push upwards into the catch position ②. Fig. 28



Loosen the hydraulic connecting pipes at the common inlet duct with a 9 mm (23/64'') open end wrench (arrows). Immediately close the pipe openings, so that no foreign matter enters the hydraulic system. Fig. 29

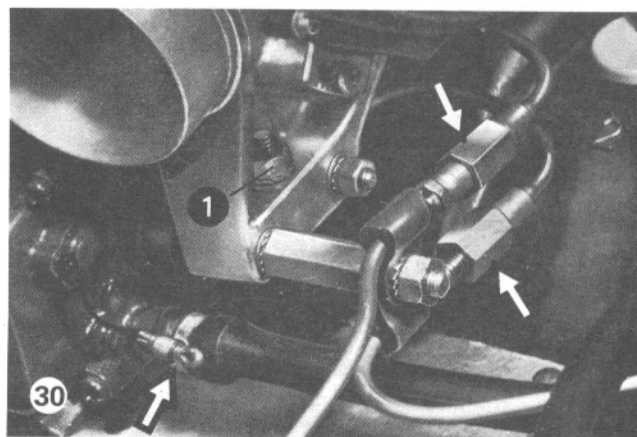
Loosen hydraulic lines with a 9 mm (23/64") open end wrench. Use a 12 mm (15/32") open end wrench to loosen the fastening screw (arrows) on the throttle valve side of the inlet manifold.

Close hydraulic lines immediately.

Loosen inlet manifold mounting 1 with a 10 mm (25/64") open end wrench.

Remove common inlet duct as described in section 5.6.2.

Fig. 30

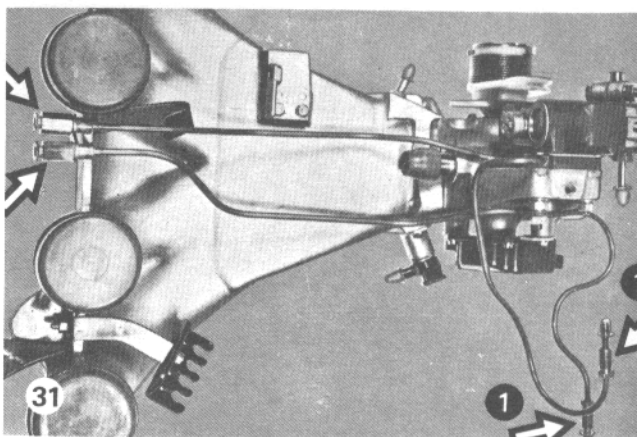


Installation notes:

Always renew the 2 O-rings of the connections (arrows) (use Citroen parts only).

Carefully screw in the hydraulic threaded connections by hand and then tighten with a 9 mm (23/64") open end wrench – tightening torque 0.8–0.9 kgf.m (5.7–6.4 ft. lb.).

Fig. 31



5.6.4 Bleed hydraulic system

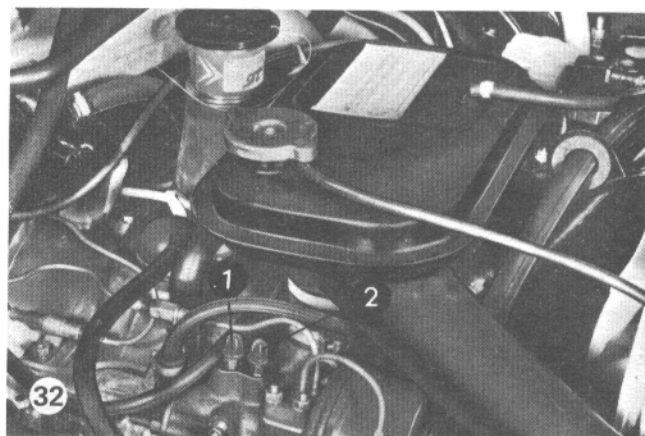
(For vehicles with hydraulic transmission only: Hydraulic accumulator for the suspension must be installed.) Return clutch lever to its start position as shown in Fig. 28.

In vehicles with hydraulic transmission there are two bleeder screws on the hydraulic regulator for bleeding the hydraulic system.

Fig. 32

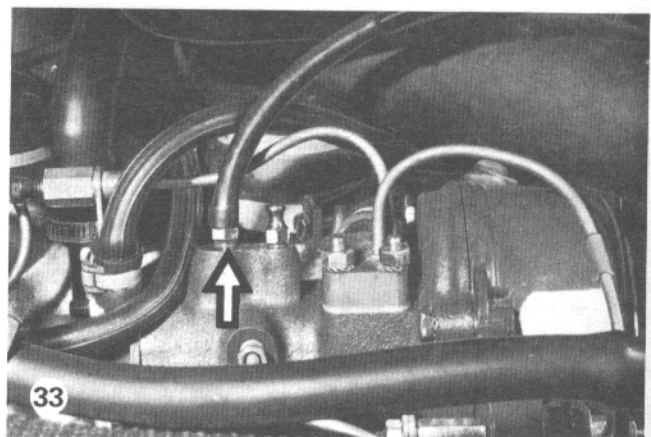
Rear screw 1 = HY regulator and clutch control

Front screw 2 = brakes



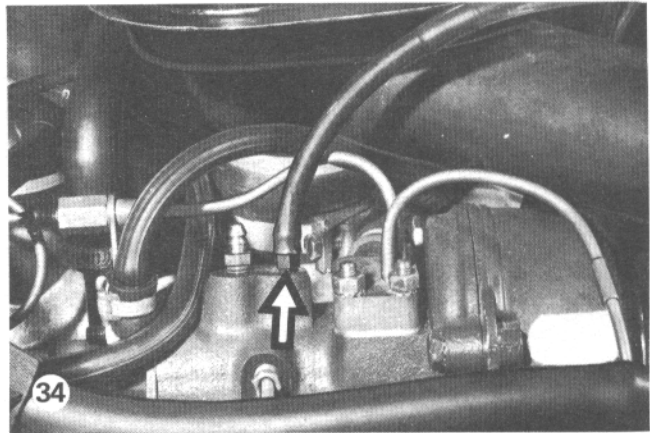
Remove protective rubber caps from the bleeder screws. Attach transparent hose to the rear screw. Place other end of the hose in the filling opening of the oil reservoir. Open bleeder screw by approx. 1 turn. Let engine idle. Close bleeder screw again as soon as bubble-free oil flows through the bleeder hose.

Fig. 33



Push bleeder hose onto the front bleeder screw. Let engine idle. Open bleeder screw by approx. 1 turn. Operate the foot brake until absolutely bubble-free oil flows out of the bleeder hose. Retighten the bleeder screw securely and push on the rubber cap correctly.

Fig. 34

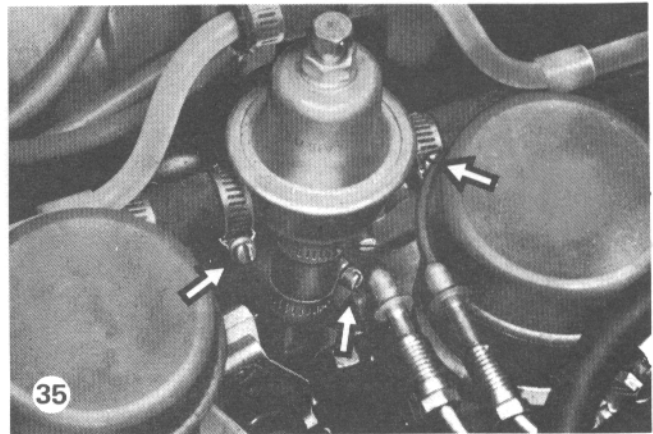


5.7 Pressure regulator

Remove the pressure regulator:

Remove common inlet duct according to section 5.6.2 or 5.6.3. Loosen hose clips at both pressure connections and at the return line and pull the pressure regulator out of the hoses. If necessary, slightly loosen the fuel lines at the injection valves.

Fig. 35



Setting the pressure regulator:

The setting of the pressure regulator (and hence the fuel pressure) has considerable influence on fuel consumption and exhaust gas composition.

For this reason the setting should only be altered if the pressure measured with a pressure gauge varies from the check value of 2.0–2.2 kgf/cm² (28.5–31.35 psi).

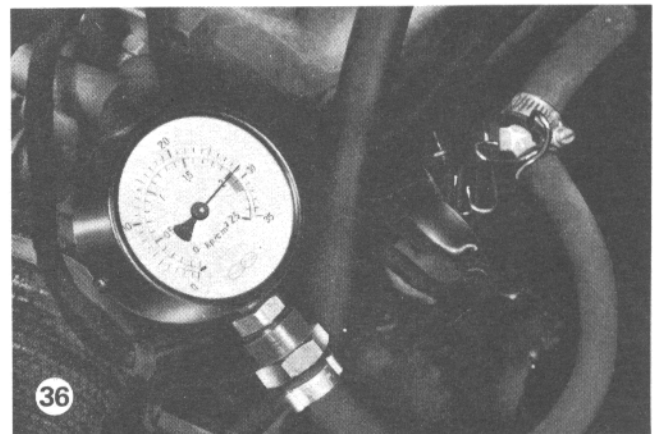
Connect pressure gauge into the fuel line leading to the start valve.

Section 5.5 must be strictly adhered to!

Start the engine and run at idling speed or control the fuel pump from the tester EFAW 228 S 10. Loosen the lock nut on the pressure regulator and set the pressure to 2 kgf/cm² (28.5 psi) using the hexagonal screw.

Finally retighten the lock nut.

Fig. 36



5.8 Temperature sensor II (cooling liquid)

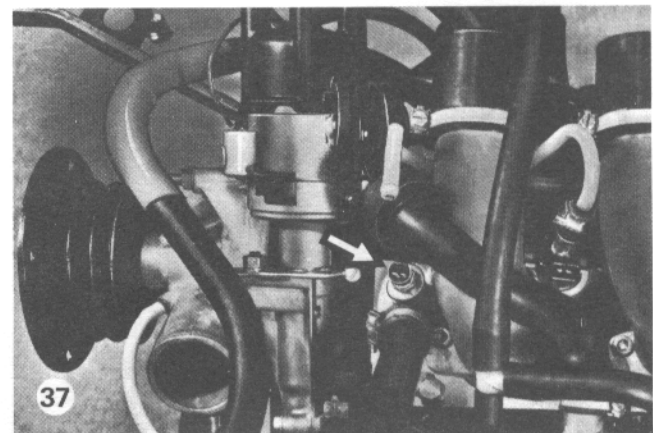
Temperature sensor II is screwed on the left side of the engine next to the ignition distributor in front of the cylinder head.

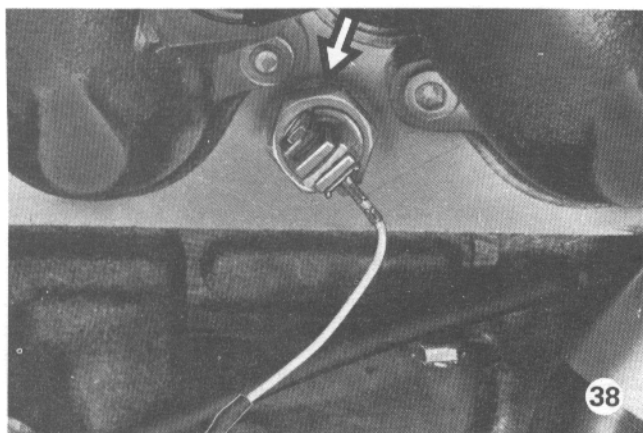
Before the temperature sensor can be removed, part of the cooling liquid must be drained off and collected.

Loosen electrical plug connection and screw out the sensor with a 13 mm (½ in) open end wrench.

When refitting the temperature sensor, the sealing ring must always be renewed.

Fig. 37



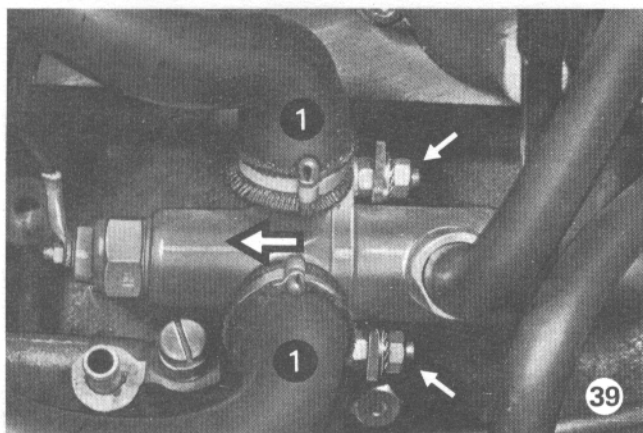


5.9 Thermo-time switch

The thermo-time switch is screwed into the left side of the engine behind the cylinder head between the third and fourth induction pipes.

Before removing the thermo-time switch, draw off and collect some of the cooling liquid. Clamp off connecting lines and screw out the switch with a straight 22 mm (55/64") socket wrench, approx. 155 mm (6-1/8") long.

When installing the temperature sensor the seal (arrow) must always be renewed. Fig. 38

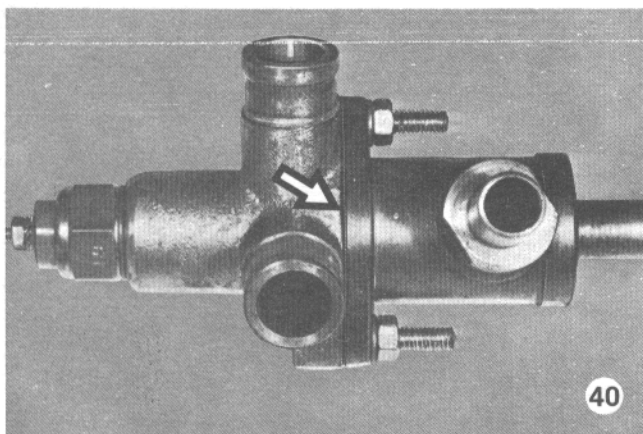


5.10 Auxiliary air regulator

When removing the auxiliary air regulator the cooling liquid in the engine must be drained and collected. Pull off both air hoses from the auxiliary air regulator.

The two cooling liquid hoses (1) must also be disconnected.

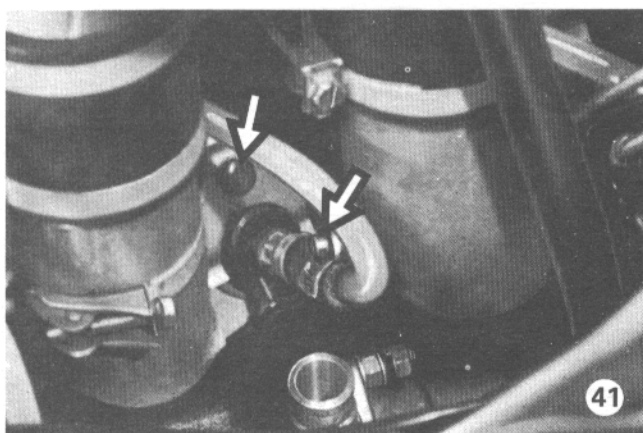
Loosen the two fastening nuts (arrows) with 10 mm (5/16") box wrench and push the auxiliary air regulator **together with** the mounting housing out of the holder in the direction of the arrow. Fig. 39



Dismount the auxiliary air regulator from the mounting housing.

Use new seal (arrow) when installing.

Fig. 40



5.11 Fuel injection valves

Removing and installing the injection valves.

Pull off the connecting plug from the injection valve.

Loosen the screw hose clip and pull the fuel line out of the connecting socket of the injection valve.

Loosen the fastening screws for the holder with a 10 mm (5/16") socket wrench and remove holder.

Pull injection valve out of the holder

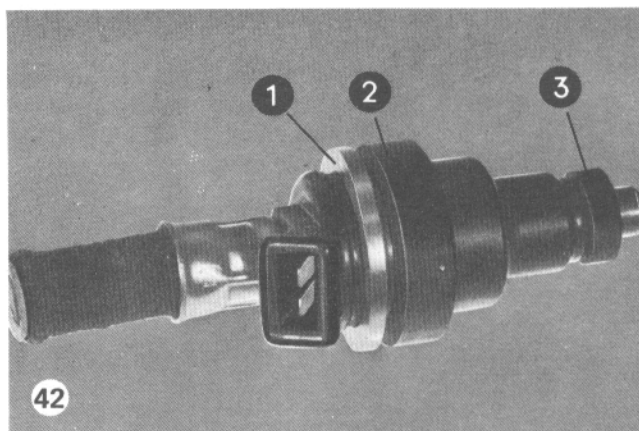
Fig. 41

Installing the injection valve:

Push thrust ring ① and rubber ring ② onto the valve. Place new rubber sealing ring ③ on the injection valve body. Place injection valve in its holder. Fig. 42

Note: Do not damage the injector needle when installing. Fasten the injection valve – see Fig. 41.

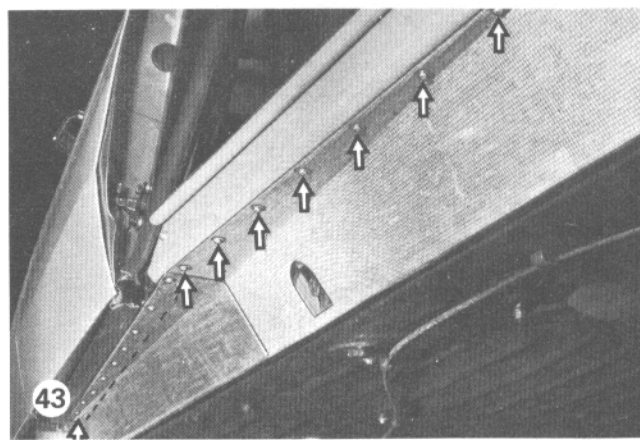
When removing or installing the injection valves for cylinders 3 and 4, the common inlet duct must also be removed. See section 5.6.3 and 5.6.4.



5.12 Fuel filter and fuel pump

In order to remove the fuel filter and the fuel pump loosen the two covering rails under the right hand doors, to do this, loosen all screws (arrows). Fig. 43

If the vehicle is placed on an auto-lift, the suspension level should be set to "wheel change" (highest position).



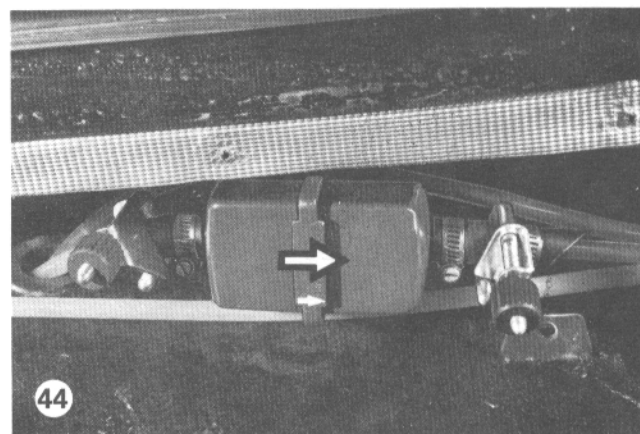
5.12.1 Fuel filter

After removing the covering rail, the filter becomes accessible. Pinch off the fuel line on each side of the fuel filter with claspers. Open hose clips and remove filter.

Fig. 44

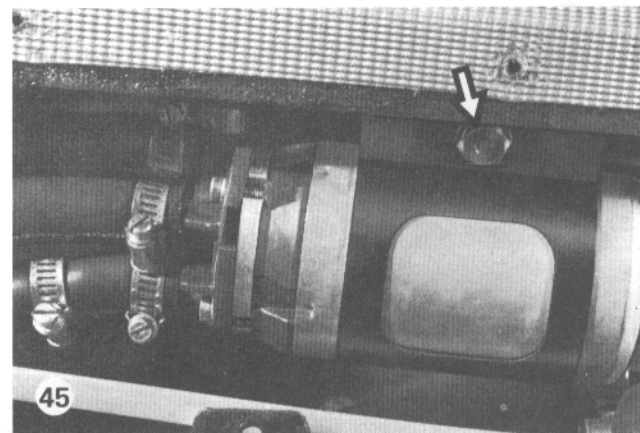
When refitting, check the direction of flow (arrow).

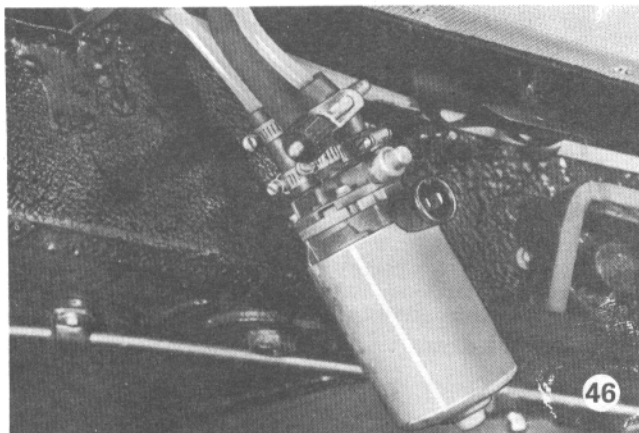
The filter must be renewed every 12,000 miles.



5.12.2 Fuel pump

Screw out the fastening screws for the retaining clip with a 12 mm (15/32") socket wrench. Fig. 45





Remove fuel pump from its frame.

Detach pump plug.

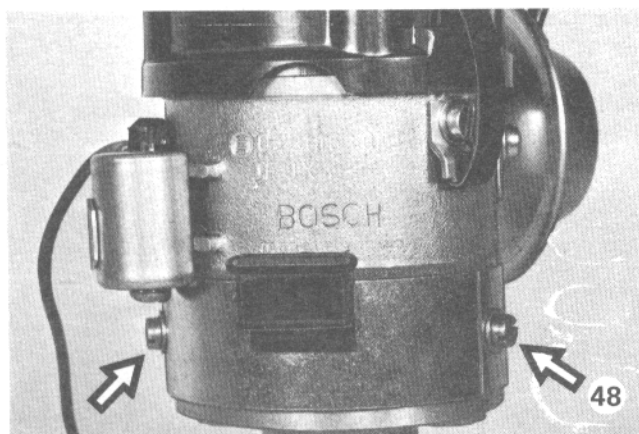
Using three clamps, clamp off the fuel hoses one after the other and pull them off the pump.

Fig. 46



When installing, do not interchange the fuel hoses. Pull rubber cap correctly over the plug. Fasten the fuel pump in the retaining clip (see also Fig. 45).

Fig. 47



5.13 Ignition distributor trigger contacts

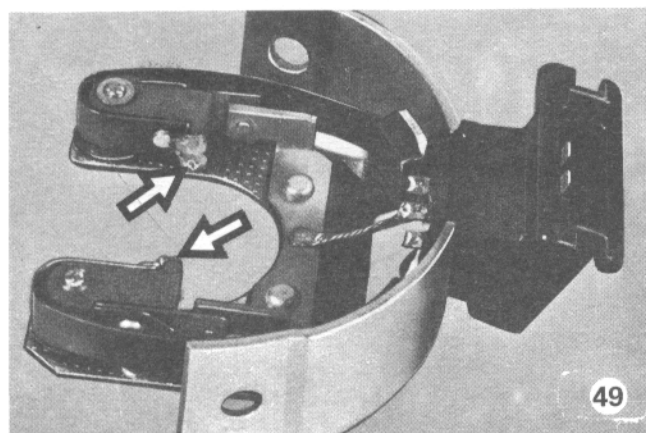
To replace the holder with the trigger contacts, the ignition distributor must be removed first.

The two trigger contacts are mounted on a holder on the lower part of the distributor.

Loosen the fastening screw for the condenser.

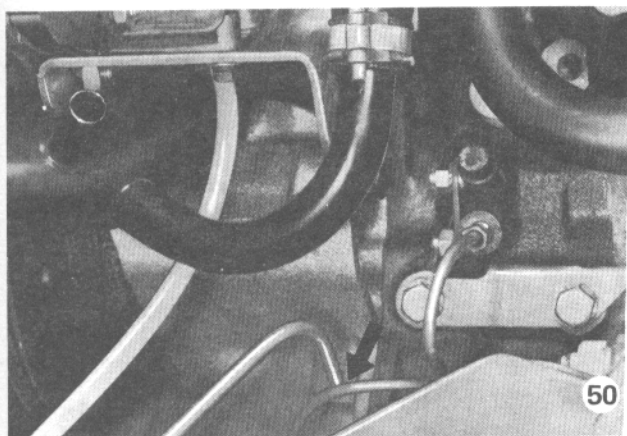
Loosen the two screws (arrows) for the holder and pull out the holder.

Fig. 48



Before fitting a new holder the sliding heels of the contact breaker lever should be lubricated with Ft 1 v 4 grease. Adjustment of the contacts is not possible.

Fig. 49



5.14 Adjust the ignition setting

Fig. 50

Assembly setting = $8\frac{1}{2}^{\circ}$ BTDC

Ignition point = 22° BTDC at 1800 rev/min

Note: The vacuum advance of the ignition distributor is not connected.

Setting procedure is as follows:

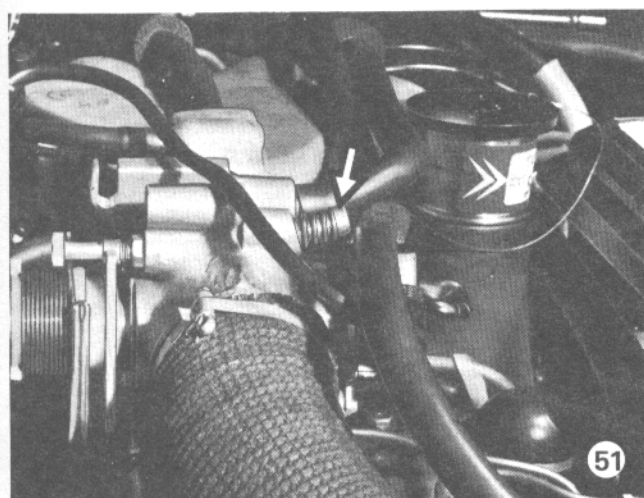
Bring cyl. 1 to a point just before TDC. Insert pin (6 mm/15/64" dia. approx. 50 mm/1-15/16" long) in the opening below the generator carrier and continue to turn the engine by hand until the pin engages the opening in the flywheel. This position (notch) is $8\frac{1}{2}^{\circ}$ BTDC.

With the engine in this position, paint a thin white line on the pulley opposite the stationary mark (stationary scale on the belt tightener of the generator).

Further timing adjustment can only be carried out with a stroboscopic timing light with built-in advance angle tester.

Remove pin from hole!

Start engine and run at 1800 rev/min. Flash the mark made. Bring the moving mark back to its original position by means of the setting wheel on the stroboscopic timing light. The advance angle instrument should indicate $13\frac{1}{2}^{\circ}$ BTDC. $13\frac{1}{2}^{\circ}$ BTDC + $8\frac{1}{2}^{\circ}$ BTDC (assembly setting) gives an ignition timing setting of 22° BTDC at 1800 rev/min.



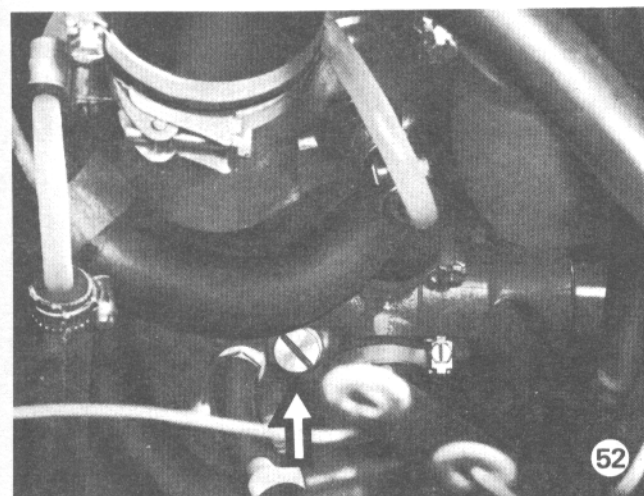
5.15 Idling speed adjustment

The idling speed is altered by variations in a by-pass. The idling adjustment screw is situated on the throttle housing. Adjustment of the idling speed may only be carried out with the engine at operating temperature ($80^{\circ}\text{C} = 175^{\circ}\text{F}$ cooling liquid temperature).

5.15.1 Vehicles with manual gear change:

Idling speed: 750 ± 25 rev/min. Adjust with idling adjustment screw.

Fig. 51



5.15.2 Vehicles with automatic transmission:

(Gear selector lever in "idling" position)

1. Screw in fully idling adjustment screw next to the auxiliary air regulator (arrow) for higher idling speed.
2. Adjust the idling speed to 750 ± 25 rev/min by means of the adjustment screw on the throttle valve (Fig. 51).
3. Finally adjust the idling speed to 1050 ± 25 rev/min by means of the adjustment screw (Fig. 52).

6. Service parts for the Electronically Controlled Fuel Injection System

Service parts which have no BOSCH Part Number are only obtainable from the Citroen service organisation.

Description	Item	BOSCH Part No.	Citroen Part No.	Qty. per vehicle
Control unit complete	1	0 280 000 011	DX 144.906 A	1
End cover for control unit	2	2 285 506 000	DX 853.278 A	1
Cable harness complete	3	—	DX 511.268 A 1) DX 51 1.269 A 2)	1
Grip for 25-pole plug	4	1 282 386 001	DX 511.239 a	1
Screws for grip	5	2910211007	DX 511.240 a	2
2-pole plug for injection valves, temperature sensor II, start valve and pressure switch	6	1 284 485 002	DX 511.241 a	7
Rubber cap for 2-pole plug	7	1 280 703 001	DX 511.244 A	7
3-pole plug for trigger contacts in ignition distributor	8	1284485010	DX 511.250 a	1
Rubber cap for 3-pole plug	9	1280703002	DX 511.243A	1
4-pole plug for pressure sensor and throttle valve switch	10	1 284 485 004	DX 511.251 a	2
Rubber cap for 4-pole plug	11	1280703003	DX 511.242 A	2
Snap-on receptacles 2.8 mm (1/8'')	*	1 284 478 003	DX 511.236 a	25
Ignition distributor complete	12	0 231 163 005	DX 211.201 A	1
Holder with trigger contacts	13	1 230 090 007	DX 211.240 a	1
Pressure sensor	14	0280100011	DX 144.263 A	1
Mounting plate for pressure sensor	15		DX 144.246 A	1
Rubber bushing for mounting plate	16	—	DX 144.245 A	3
Fastening screws for item 14	17	—	DX 144.244 A	3
Connecting hose (pressure sensor-inlet manifold)	18	—	DX 144.212 A	1
Throttle valve switch	19	0280120011	DX 144.224 A	1
Fastening screws for throttle valve switch	20		2.243 S	2
Temperature sensor II (cooling liquid)	21	0280 130 009	DX 144.228 A	1
Sealing ring for temperature sensor II	22	1240280010	DX 144.258 A	1
Auxiliary air regulator	23	0 280 140 014	DX 144.202 A	1
Seal for auxiliary air regulator	24	—	2.416 S	1
Fastening screws for item 23	25		5.240 S	2
Fuel injection valve	26	0280150003	DX 144.280 A	4
Rubber ring for injection valve	27	1 280 206 702	DX 144.102 A	4
Rubber sealing ring for injection valve	28	1 280 206 703	DX 144.101 A	4

CITROEN — DS21 — BOSCH ELECTRONIC FUEL INJECTION

Description	Item	BOSCH Part No.	Citroen Part No.	Qty. per vehicle
Valve holder	29	—	DX 144.201 A	4
Sleeve for valve holder	30	—	DX 144.268 A	4
Fastening screw for item 29	31		306 S	4
Start valve	32	0280170011	DX 144.281 A	1
Gasket for start valve	33	—	DX 144.257 A	1
Fastening screws for item 32	34		336 S	2
Thermo-time switch	35	—	DX 144.256 A	1
Sealing ring for thermo-time switch	36	—	2.416 S	1
Fuel pump	37	0580960007	DX 173.900 A	1
Plug for fuel pump	38	1 284 485 009	DX 511.252 A	1
Rubber cap for plug	39	1280703005	DX 511.245 A	1
Fuel filter	40	0 450 902 001	DX 173 202 A	1
Pressure regulator	41	0280160004	DX 144.209 A	1
Pressure switch	42	0280110003	DX 144.262 A	1
Main-, pump-, and potential reversing relay	43	0 332 003 021	DX 524.101 A	3
Screw hose clips for fuel lines				
a) Suction side	44	Commercially available 15 mm (¹⁹ / ₃₂ " dia.		
b) Pressure side	45	Commercially available 13 mm (³³ / ₆₄ " dia.		
1) Left hand drive				
2) Right hand drive				

* Use AMP crimper No. 574 860, not illustrated.