PORSCHE

# 914/1.8

## ELECTRONIC FUEL INJECTION

(AIR FLOW CONTROLLED)

SERVICE and TRAINING

INFORMATION

MODEL 74

Printed in Germany


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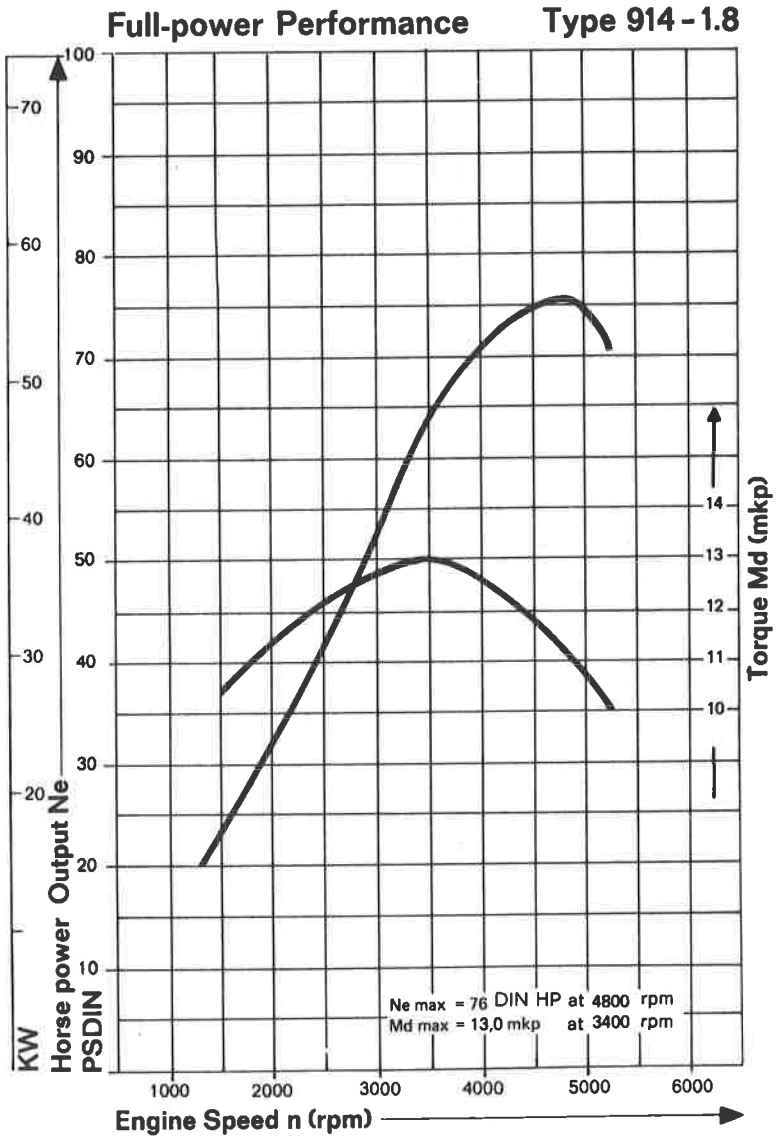
PORSCHE+AUDI
A DIVISION OF VOLKSWAGEN OF AMERICA INC.

**914 Engine with 1.8-liter Displacement**

1974 Type 914 engines have a displacement of 1.8 liters instead of 1.7, as formerly.

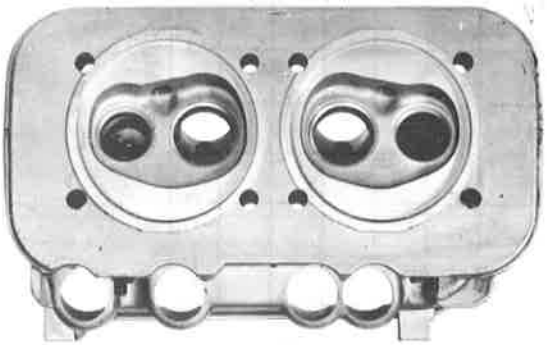
The 1.8-liter engine is equipped with a newly developed Electronic Fuel Injection AFC (Air Flow Controlled) System.




The USA model with Electronic Fuel Injection AFC develops 76 DIN/73 BHP at 4800 rpm and 13.0 mkp/94 ft-lbs of torque at 3400 rpm.

The piston displacement of 1800 cc, (1795 cc) was achieved by increasing the cylinder bore to 93 mm from 90 mm.

The engine has a compression ratio of 7,3 : 1, uses dished pistons and requires regular gasoline, lowlead or unleaded, with a minimum of 86 octane at the pump.



The cylinder-head combustion-chamber shape has been changed. Its volume is now 52 – 53.5 cc (51.5 – 52.5 for the 1.7-liter engine).

The intake and exhaust ports have also been enlarged.

Correspondingly, the valve head diameters have also been increased.

Intake valve diameter is 41 mm
(previously 39 mm).
Exhaust valve diameter is 34 mm
(previously 33 mm).

The valve adjusting screw was enlarged to M 10 x 1 (previously M 8 x 1). Wrench size of the lock nut is 14 mm.

Rocker arms have also been changed.
Only the new rocker arms will be available as a spare part.
They will fit 1.7-liter, 1.8 liter and 2.0-liter engines.

**Valve Adjustment**

Intake, 0.15 mm
Exhaust, 0.15 mm

**Clutch**

The clutch plate pressure for the 1.8-liter engines has been increased to 420 – 485 kp/ 3038 – 3508 ft-lbs. The pressure plate is available as spare-part No. 022 141 025 G.

**Ignition**

Timing is 7.5° before TDC at idling speed (850 ± 50 rpm) with both vacuum hoses disconnected.

The heat range of the spark plugs is still 175.

## Technical Data

Vehicle type 914 with 1.8-liter engine

| | **73 HP** |
|---|---|
| **1. Engine** | |
| Engine designation | EC |
| Number of cylinders | 4 |
| Bore in mm (inch) | 93 (3.66) |
| Stroke in mm (inch) | 66 (2.598) |
| Piston displacement, actual in $cm^3$ ($inch^3$) | 1795 (109.53) |
| Compression ratio | 7.3 : 1 |
| Max. engine performance: | |
| According to DIN 70020 in HP/KW at rpm | 76/56 at 4800 |
| According to SAE J 245, net power in HP/KW | 73.0/54.0 at 4800 |
| Max. torque: | |
| According to DIN 70020 in kpm/Nm at rpm | 13.0/130 at 3400 |
| According to SAE J 245, net torque in ft-lb/Nm | 90/126 at 3400 |
| Max. liter performance: | |
| According to DIN 70020 in HP/l or KW/l | 42/31 |
| According to SAE J 245, net power, HP/l or KW/l | 41/30 |
| Required fuel octane rating (at pump) | 86 |
| Normal fuel consumption (l/100 km/mpg) DIN 70030 | 7.5/31 |
| Engine weight in kg/lbs | approx. 140/308 |
| **2. Engine Construction** | |
| Type | four-stroke, Otto engine, boxer |
| Cooling | air-cooled |
| Crankcase | light metal |
| Cylinder | cast iron |
| Cylinder head | light metal |
| Arrangement of valves per cylinder | overhead 1 intake valve, 1 exhaust valve |
| Valve gear | central camshaft via push-rods |
| Camshaft drive | gear |
| Camshaft bearing | friction bearing |
| Crankshaft | forged, 4 friction bearings |
| Connecting-rod bearing | friction bearing |
| Cooling fan | crankshaft driven |
| Lubrication | pressure circulation, wet sump, thermostatically controlled oil cooling, main filter |
| Fuel feeding | elect. rotating vane pump |
| Mixture formation | electronicall controlled injection into the intake manifold (air flow controlled fuel injection) (AFC) |
| **3. Electrical System** | |
| Nominal battery voltage | 12 |
| Battery capacity (Ah) | 45 |
| Generator, performance (W) | three-phase 700 W |
| Ignition | battery ignition |
| Ignition sequence | 1–4–3–2 |
| Ignition-timing adjustment | $7.5^{o}$ BTDC at 800 – 900 $min^{-1}$ |
| Spark plug (electrode gap) | Bosch W 175 T 2 (0.7)<br>Beru 175/14/3 (0.7) |

**73 HP**

## 4. **Drive line**

| | |
|---|---|
| Clutch | dry-disc clutch |
| Transmission | Porsche synchronized transmission |
| Number of gears | 5 forward, 1 reverse |
| Gearing ratio | Teeth Ratio |
| 1st gear | 11/34 3.091 |
| 2nd gear | 18/34 1.889 |
| 3rd gear | 23/29 1.261 |
| 4th gear | 27/25 0.926 |
| 5th gear | 31/22 0.710 |
| reverse | 11/16 20/43 3.127 |
| Axle drive | spirally meshed bevel gears, differential |
| Axle ratio | 7/31 4.429 |
| Drive line | via dual drive shafts to the rear wheels |
| Transmission weight | approx. 47 kg (104 lbs) ready to mount with oil and starter |

## 5. **Chassis, Wheel Suspension**

| | |
|---|---|
| Self-supporting body | |
| Front-wheel suspension | Independent wheels mounted individually on telescopic legs and transverse link control arms |
| Front-wheel cushioning | Round torsion bar in a longitudinal direction for each wheel + progressive hollow rubber spring in the telescopic leg |
| Rear-wheel suspension | Independent wheels mounted on diagonal link control arms |
| Rear-wheel cushioning | Coil spring at each wheel with double acting telescopic shock absorbers and progressive hollow rubber spring |
| Foot brake | Hydraulic dual braking system, disc brakes on all 4 wheels, pressure reduction valve for the rear braking system |
| Hand brake | Acting mechanically on the rear-wheel brake linings of the foot brake |
| Rims and tires: | |
| standard | 5-1/2 x 15 steel with 165 SR 15 |
| optional | 5-1/2 x 15 LM forged with 165 SR 15<br>5-1/2 x 15 LM cast with 165 SR 15 |
| Snow tires, Europe and USA: | 165 SR 15 MS (E) on 5-1/2 x 15 |
| Tire pressure cold (kp/cm$^2$/bar) | 1.8/2.0//1.8/2.0;. snow tires 2.0/2.2 //2.0/2.2 |
| in psi cold/front/rear | 26/29 or snow tires 29/32 |
| Type of steering | rack and pinion |
| Steering ratio in the middle (steering-wheel angle to wheel angle) | 17.78 : 1 |
| Front wheel: camber | 0°±20′ |
| toe-in | +20′ ±10′ |
| caster | 6°±30′ |
| Rear wheel: camber | −30′ ±20′ |
| toe-in | 0°+15′ |

(Front wheel: camber, toe-in, caster — at DIN empty weight (curb weight))

(Rear wheel: camber, toe-in — at DIN empty weight)

**73 HP**

## 6. **Climbing Ability** (calculated values)

| | | |
|---|---|---|
| Vehicle weight in kg/lbs | | 1095/2414 |
| Empty according to DIN + 1/2 load | 1st gear | 50 % |
| | 2nd gear | 27 % |
| | 3rd gear | 16 % |
| | 4th gear | 10.5 % |
| | 5th gear | 6.5 % |

## 7. **Capacities**

| | |
|---|---|
| Engine | approx. 3.5 liters (3-2/3 qts) of brand-name HD oil according to API classification SD or SE<br>summer SAE 30, winter SAE 20, at permanent temperatures of 0° to −15°C.<br>SAE 20 W 20, below −15° SAE 10 W |
| Transmission with differential gear | approx. 2.5 liters (2-2/3 qts) of transmission oil of specification MIL-L-2105 viscosity classification SAE 90 or of specification MIL-L-2105 B; Northern countries SAE 80 |
| Fuel tank | 62 liters (16-1/3 gals), of which approx. 6 liters (1-1/2 gals) are reserve |
| Brake fluid reservoir | approx. 0.5 liters (1 pt) |
| Windshield washer | approx. 2.5 liters (2-2/3 qts) |
| with headlight washer | approx. 8.5 liters (9 qts) |

## 8. **Dimensions**

| | **empty (according to DIN)** | **max. load** |
|---|---|---|
| Wheel base in mm/inch | 2451.5/96.516 | 2448/96.378 |
| Track front with 165 x 15 tires on 5-1/2 x 15 rims mm/inch | 1343/52.874 | 1360/53.583 |
| Track rear with 165 x 15 tires on 5-1/2 x 15 rims mm/inch | 1383/54.449 | 1399/55.1 |
| Length for USA and Canada in mm/inch | 4095/161.2 | |
| Width in mm/inch | 1650/65.0 | |
| Height, unloaded in mm/inch | 1230/48.4 | |
| Turning diameter in m/ft. | approx. 11/36 | |
| Road clearance at max. gross weight mm/inch | 130/5.118 | |

## 9. **Weights and Loads**

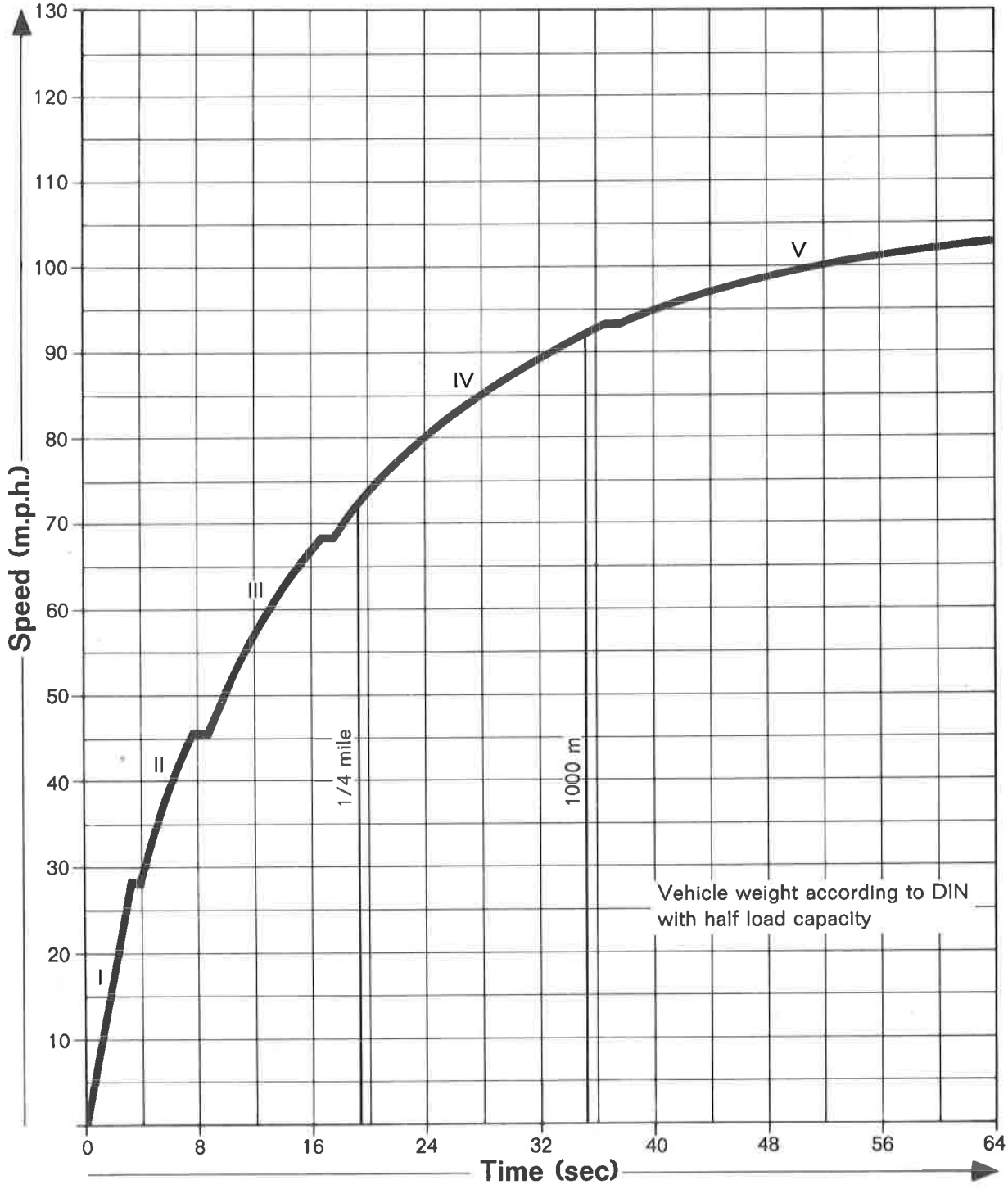
| | |
|---|---|
| Vehicle empty according to DIN for USA + Canada in kg/lbs | 970/2139 |
| Max. total axle loads (static) in kp/n/lbs | 1220/11968/2690 |
| Max. axle load front (static) in kp/N/lbs | 950/6377/1433 |
| Max. axle load rear (static) in kp/N/lbs | 650/6377/1433 |

## 10. **Driving Performance**

| | |
|---|---|
| Max. speed in km/h/mph | 173/107.5 |
| Acceleration 0 – 60 mph (vehicle empty according to DIN + 1/2 load) in sec. | 13.5 |

## Acceleration Curve

## Type 914 - 1.8



## 914/1.8-liter ENGINE – with ELECTRONIC FUEL INJECTION AFC

The electronically controlled fuel injection system used on the 1.7-liter engines had a pressure sensor as a key component in addition to the control unit. The pressure sensor delivered a basic fuel signal to the control unit depending on the vacuum in the intake air distributor. This system has been given the designation ELECTRONIC FUEL INJECTION **MPC (manifold pressure controlled)**.

For 1974, an intake air sensor has replaced the pressure sensor in the new injection system. This new system is called ELECTRONIC FUEL INJECTION **AFC (air flow controlled)**.

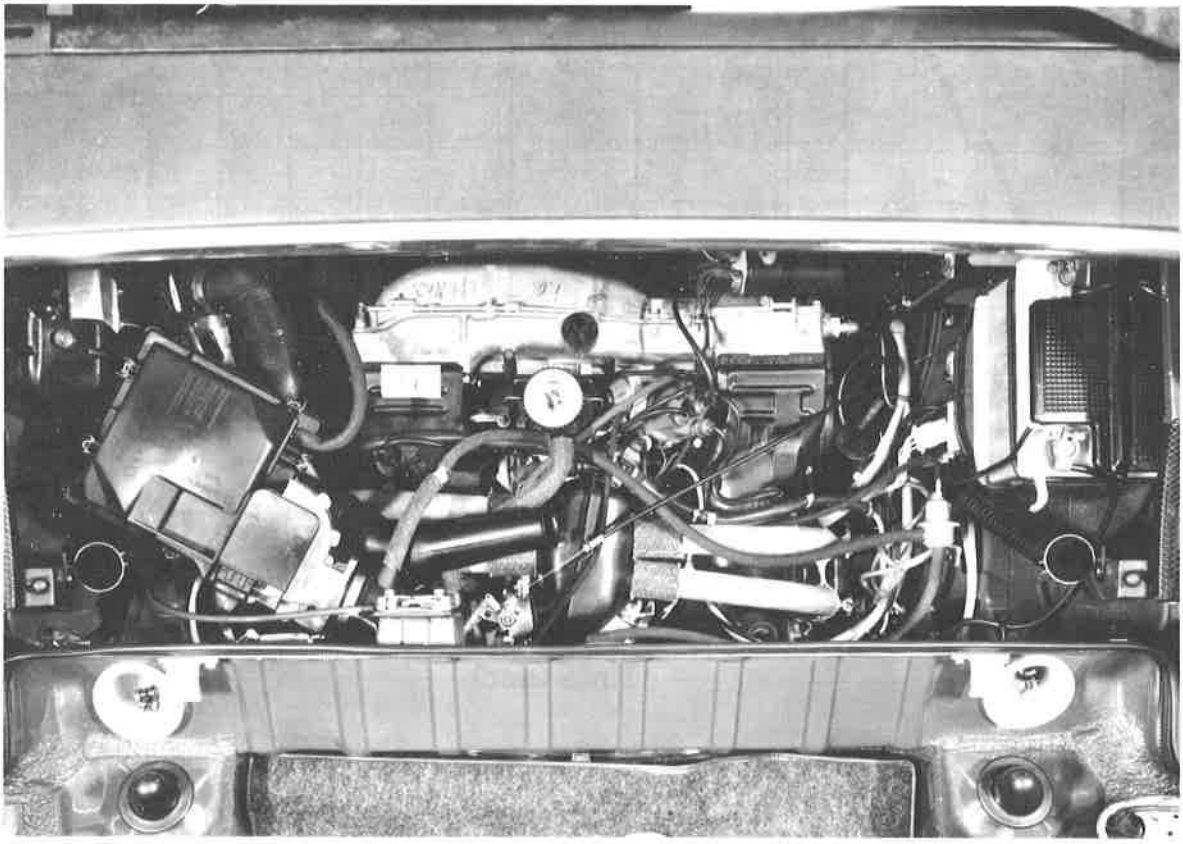
### Principle of ELECTRONIC FUEL INJECTION AFC

The basic amount of fuel is controlled by the quantity of air drawn in through the intake air sensor and by the engine rpm.

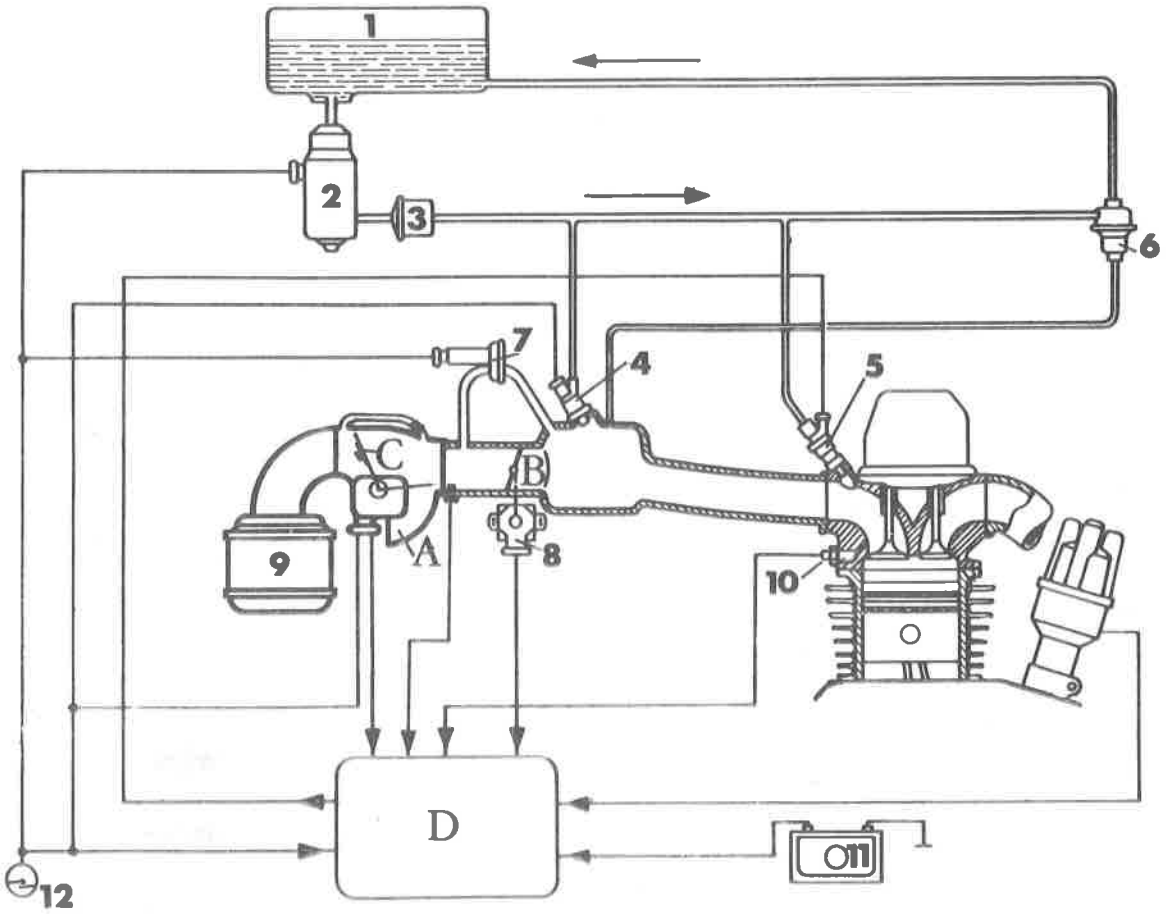
All injectors inject at the same time, and they inject once with each two revolutions of the crankshaft. The trigger contacts in the distributor have been eliminated. The fuel pressure regulator is now vacuum-controlled and not adjustable. The cold start device is similar to that of the ELECTRONIC FUEL INJECTION **MPC** system.

The warm-up enrichment is controlled by a temperature sensor (I) in the intake air sensor and by a temperature sensor (II) in the cylinder head.

An additional acceleration enrichment device is no longer required. Full-speed enrichment is controlled by the throttle valve switch, which no longer needs to be adjusted. The fuel pump is controlled by a pump contact in the intake air sensor, connected with the stator flap.

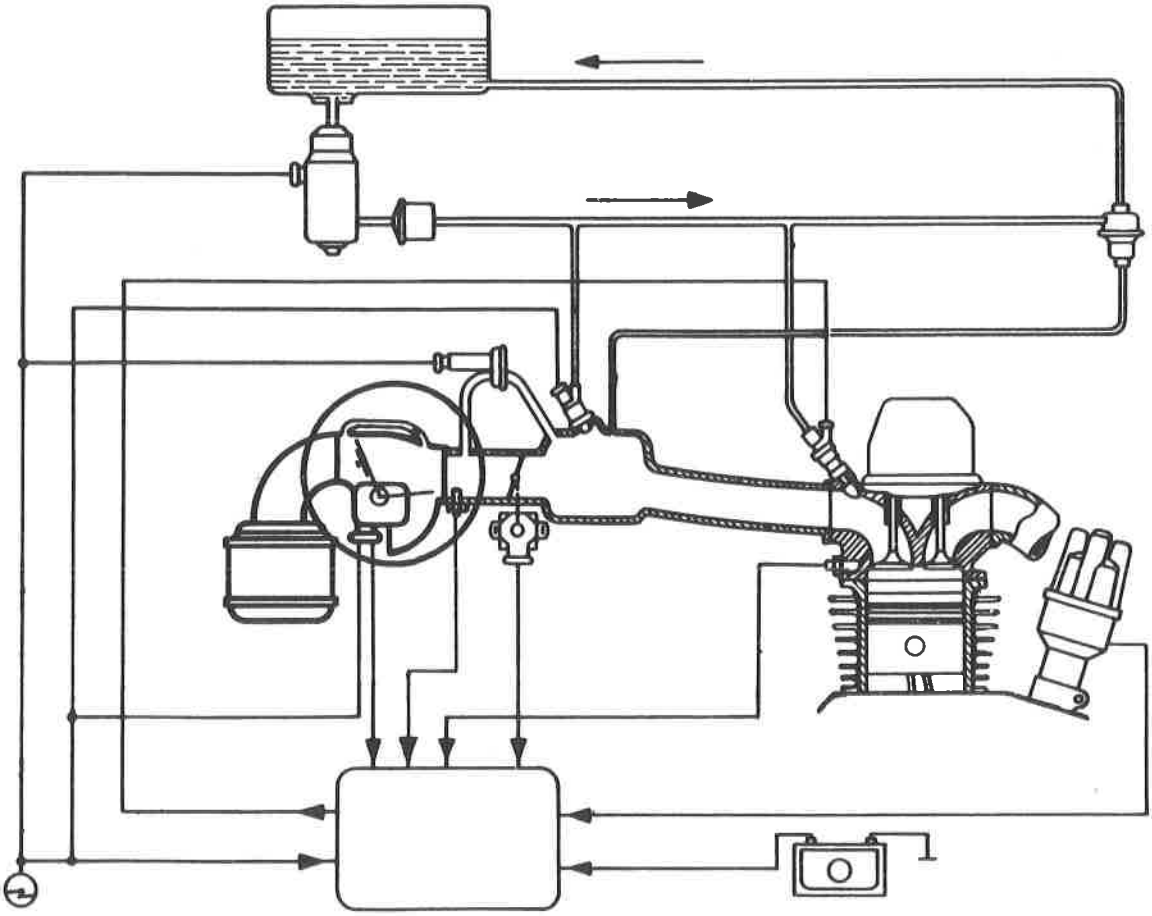


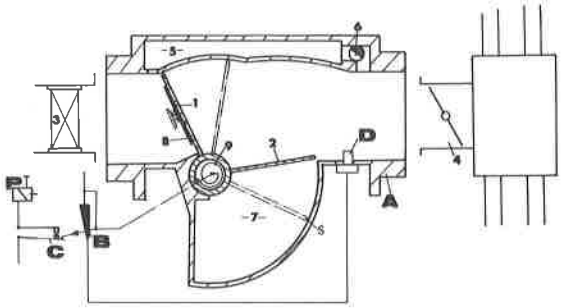
**Here is an over-all circuit diagram of the AFC system.**

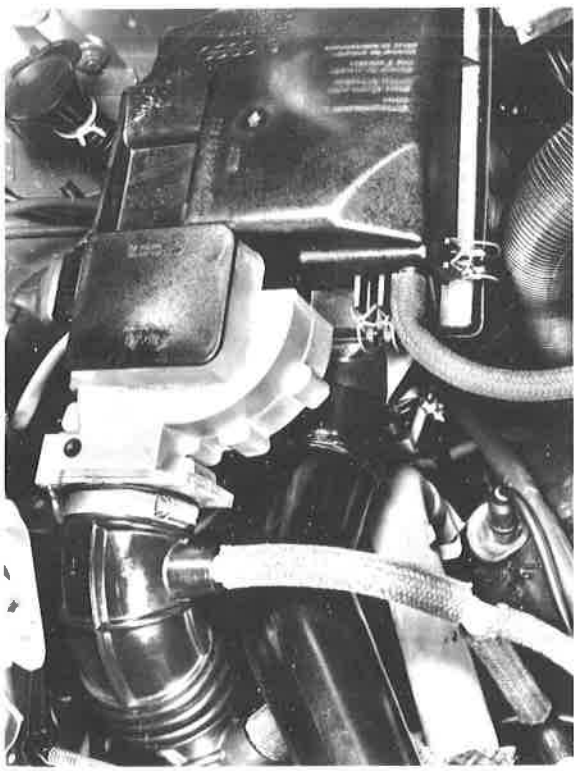



1 fuel tank
2 fuel pump
3 fuel filter
4 cold start valve
5 injectors
6 fuel pressure regulator
7 auxiliary air slide-valve
8 throttle valve switch
9 air filter
10 temperature sensor II
11 battery
12 ignition lock

A intake air sensor
B throttle valve
C stator flap
D control unit




5
1
3
2
D
A
P
B
C
7
S
4



Let's look at the components of the new injection system and oberve their functioning.

Here is a comparison of the new AFC system with the familiar MPC fuel injection system.

## AFC

### Intake air sensor

Measures: air quantity sucked in by the engine and intake air temperature.

### Construction

Light metal housing (A) with bypass channel (5) and balance chamber (7); stator flap ( 1) with back pressure valve (8), balance flap (2); return spring (9);
Potentiometer (B) with pump contact (C);
Temperature sensor I (D).

### Functioning

The intake air sensor is located on the left side of the engine compartment between the air filter (3) and the throttle valve housing (4).

The engine draws in a certain volume of fresh air according to the position of the throttle valve. This flow of fresh air causes the stator flap to move against the force of the return spring. The stator flap is connected to the potentiometer, which sends a voltage signal to the control unit. The temperature sensor I is connected to the potentiometer and influences the signal. From the control unit, an impulse is given to the injector, which causes the precise amount of fuel to be injected for this amount of air.
The balance flap has the task of eliminating vibrations of the stator flap. With increasing movement of the stator flap, the balance flap sinks into the air-tight balance chamber. The air in the balance chamber can only be equalized via slot "S". Jolts and vibration are thus dampened.
A small portion of the amount of air drawn in is directed past the stator flap through the bypass. Thus the fuel-air mixture at idling speed can be controlled by means of an adjustment screw.
The pump contact is located in the potentiometer. When the stator flap is opened, the pump contact is closed and the fuel pump begins to work.

## MPC

### Pressure sensor

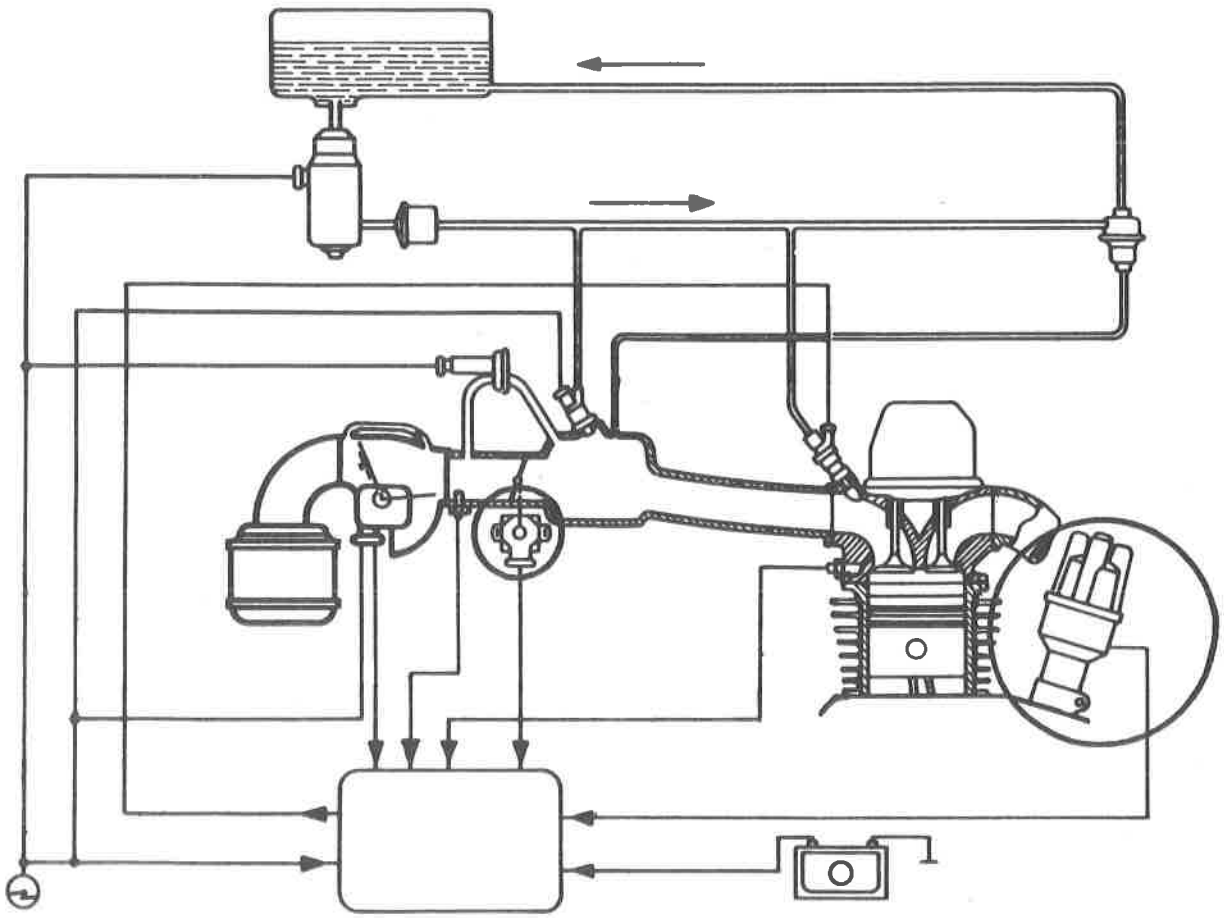
Measures: absolute pressure in the intake air distributor.

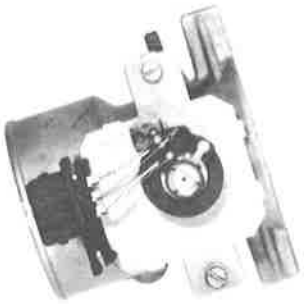
Temperature sensor I is located in the air distributor housing.

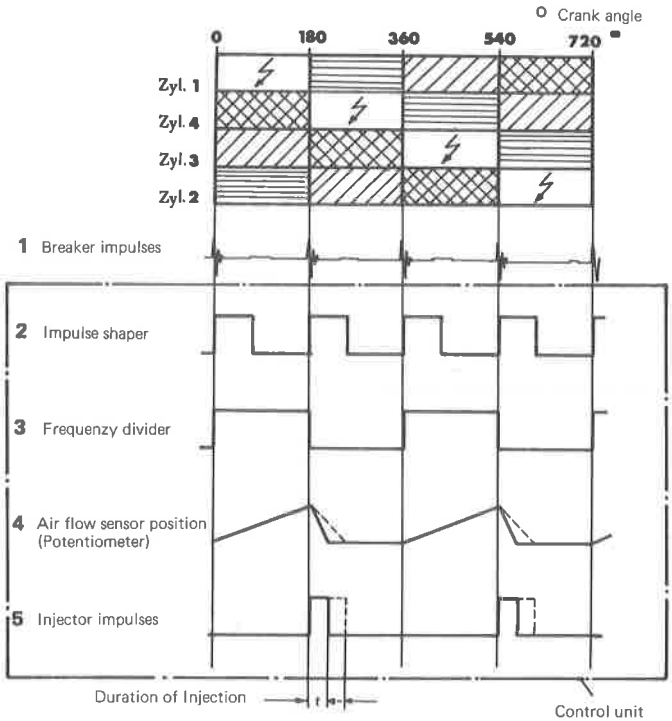
## AFC

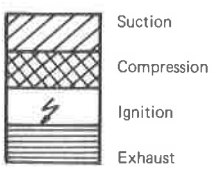
### Checking

Disconnect the plug on the potentiometer of the intake air sensor.
Connect an ohmmeter to terminals 6 and 9.
Nominal value: 200 – 400 Ω
Take a measurement also on terminals 7 and 8.
Nominal value: 120 – 200 Ω






Crank angle
0
180
360
540
720
Zyl. 1
Zyl. 4
Zyl. 3
Zyl. 2
1 Breaker impulses
2 Impulse shaper
3 Frequenzy divider
4 Air flow sensor position (Potentiometer)
5 Injector impulses
Duration of Injection
Control unit


Suction
Compression
Ignition
Exhaust

## AFC

### Throttle Valve Switch

The switch gives information to the control unit on full-speed operation. There are only two switch contacts; one for idling speed and one for full speed.
(The idling-speed contact is not used.) The throttle valve switch no longer needs to be adjusted.

### Checking

Disconnect lead from the throttle valve switch, connect ohmmeter to terminals 3 and 18, slowly open throttle valve.
The indicator must go from ∞ to o Ω.

### Distributor

The breaker arms in the distributor gives information to the control unit on engine rpm and on the timing of the injection.
The previous trigger contacts have been eliminated.

### Operation

The impulses primary ignition are fed to the control unit. Every impulse (1) is transformed into a right-angled impulse (2) in the control unit. These right-angled impulses are divided up in the control unit by an impulse divider (3). The result is that from the four incoming ignition impulses for two revolutions of the crankshaft, the control unit sends out one impulse for each crankshaft. So, at every revolution of the crankshaft all four injectors are triggered by a single opening impulse (5).
The amount of fuel injected depends on the position of the stator flap (4).
A potentiometer attached to the stator flap signals to the control unit the fuel required.
The injection duration of the injectors is correspondingly increased or decreased.
The time interval of the ignition impulses signals engine rpm.
As an engine needs two revolutions of the crankshaft for the completion of the power stroke, two injections occur during this lapse of time so that each cylinder receives the total fuel necessary for its power stroke.

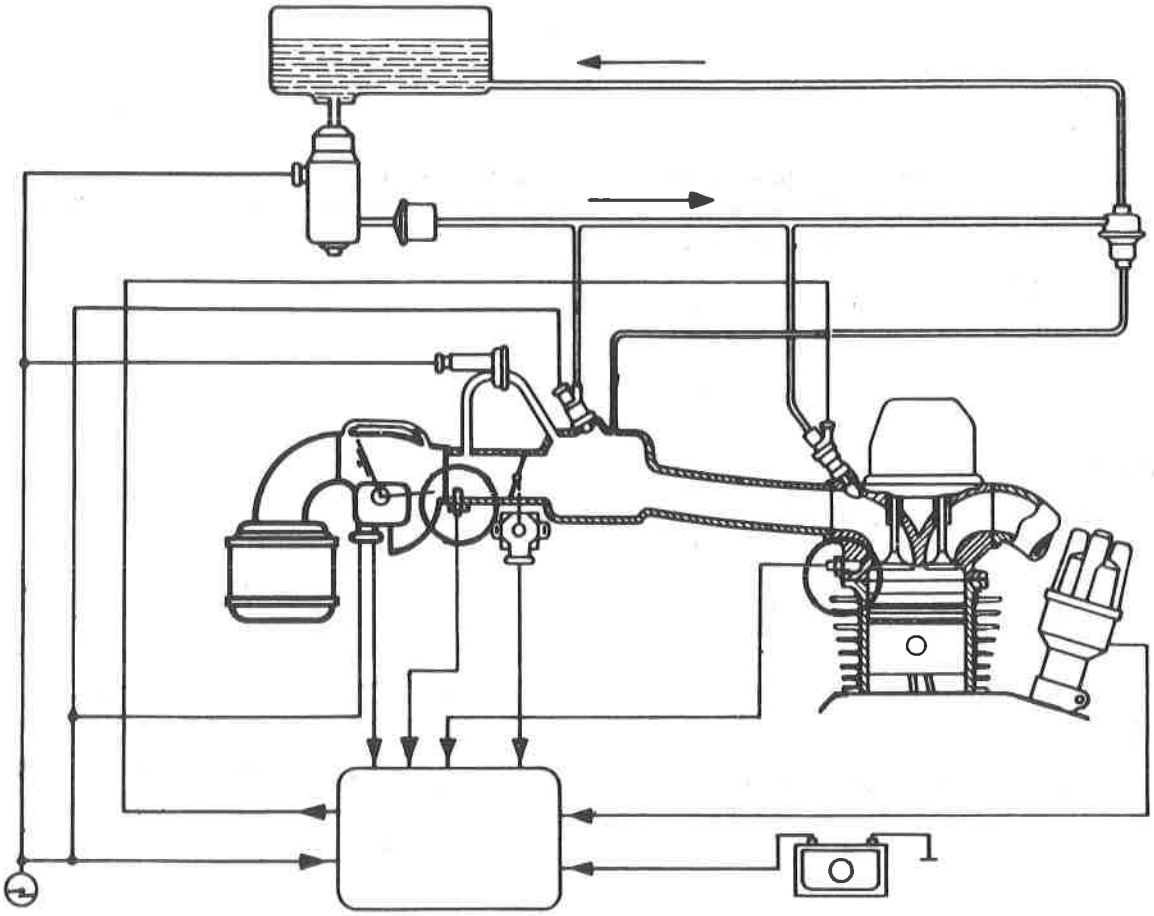
## MPC

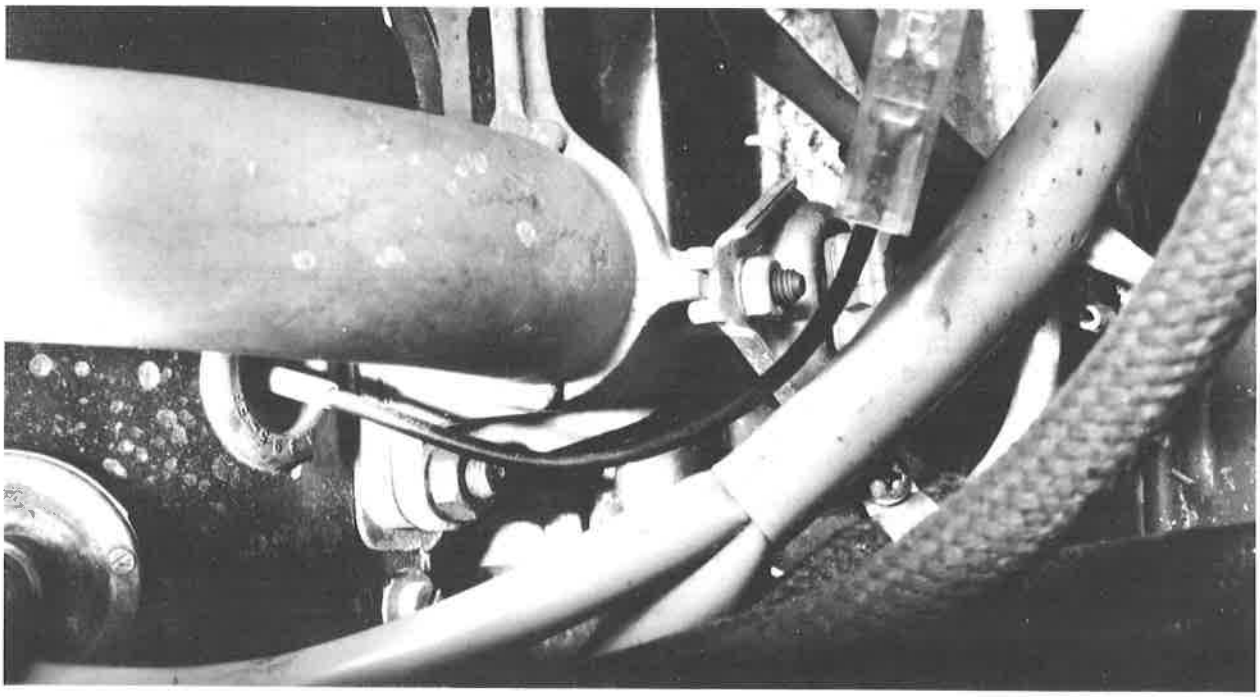
Drag switch and contact paths for acceleration enrichment. Deceleration cut off. Switch is adjustable.

The control of injection timing and information on rpm comes from the additional trigger contacts.

Additional trigger contacts to control the injectors are located in the lower part of the distributor.

Here injection occurs in two groups, thus providing adequate fuel at any time.





## AFC

### Checking

Apart from the normal checking of the ignition system (dwell angle and timing), no special checks are necessary.

### TEMPERATURE SENSOR I

Temperature sensor I is located inside the intake air sensor and cannot be replaced. It is connected with the potentiometer.

### Checking

Connect an ohmmeter to potentiometer socket terminals 6 and 9.
Nominal value: 200 – 400 Ω;
120 – 200 Ω on terminals 7 and 8.

### TEMPERATURE SENSOR II

Temperature sensor II in the cylinder head delivers information to the control unit for start and warm-up enrichment.
It is the same as that of the pressure sensor fuel injection system.

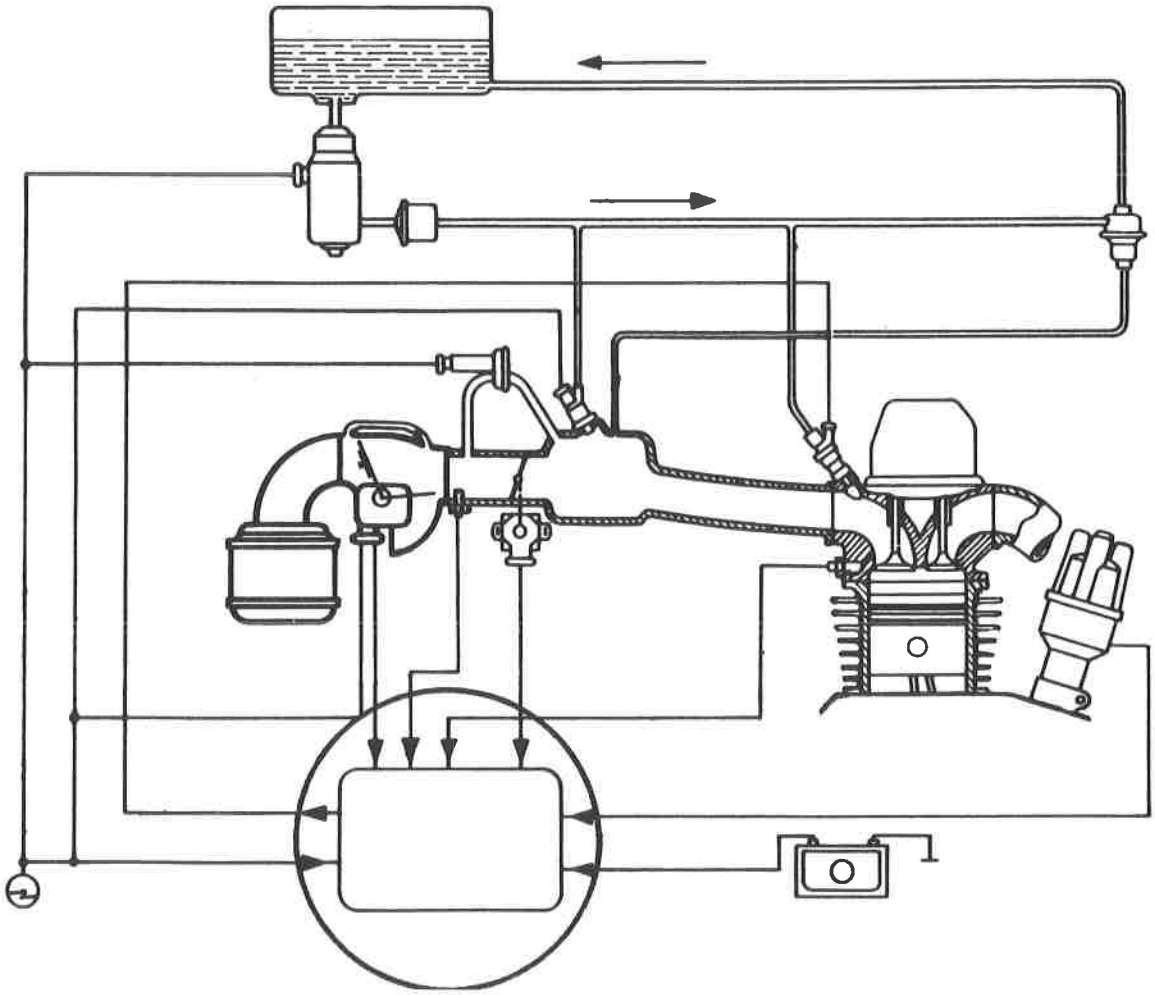
### Checking

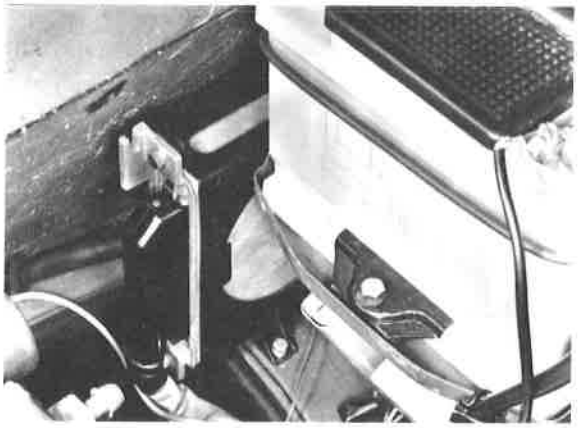
Connect ohmmeter between temperature sensor II and ground.
Nominal value: between 1.5 and 2.5 KΩ at a room temperature of 68°F. If the engine temperature is higher than 176°F., the ohm value must be less than 300 Ω.

## MPC

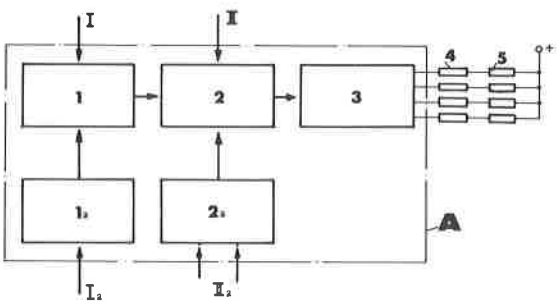
Temperature sensor I is located in the intake air filter and can be removed.

Same task and manner of operation as for AFC.





**Block circuit diagram of the control unit:**




Key:

| | |
|---|---|
| A | control unit |
| 1 | control multi-vibrator |
| 1a | impulse shaper/rpm divider |
| 2 | multiplication stage |
| 2a | warm-up enrichment |
| 3 | final stage |
| 4 | injector |
| 5 | resistors |
| I | signal from the intake air sensor |
| Ia | signal from the distributor |
| II | signal from the throttle valve switch |
| IIa | signal from ignition switch/temperature sensor II |

## AFC

### CONTROL UNIT

The control unit accepts and acts on incoming information based on:

- amount of air
- intake air temperature
- rpm
- engine temperature
- throttle valve position (full speed)

It determines and controls the injection time of the injectors.

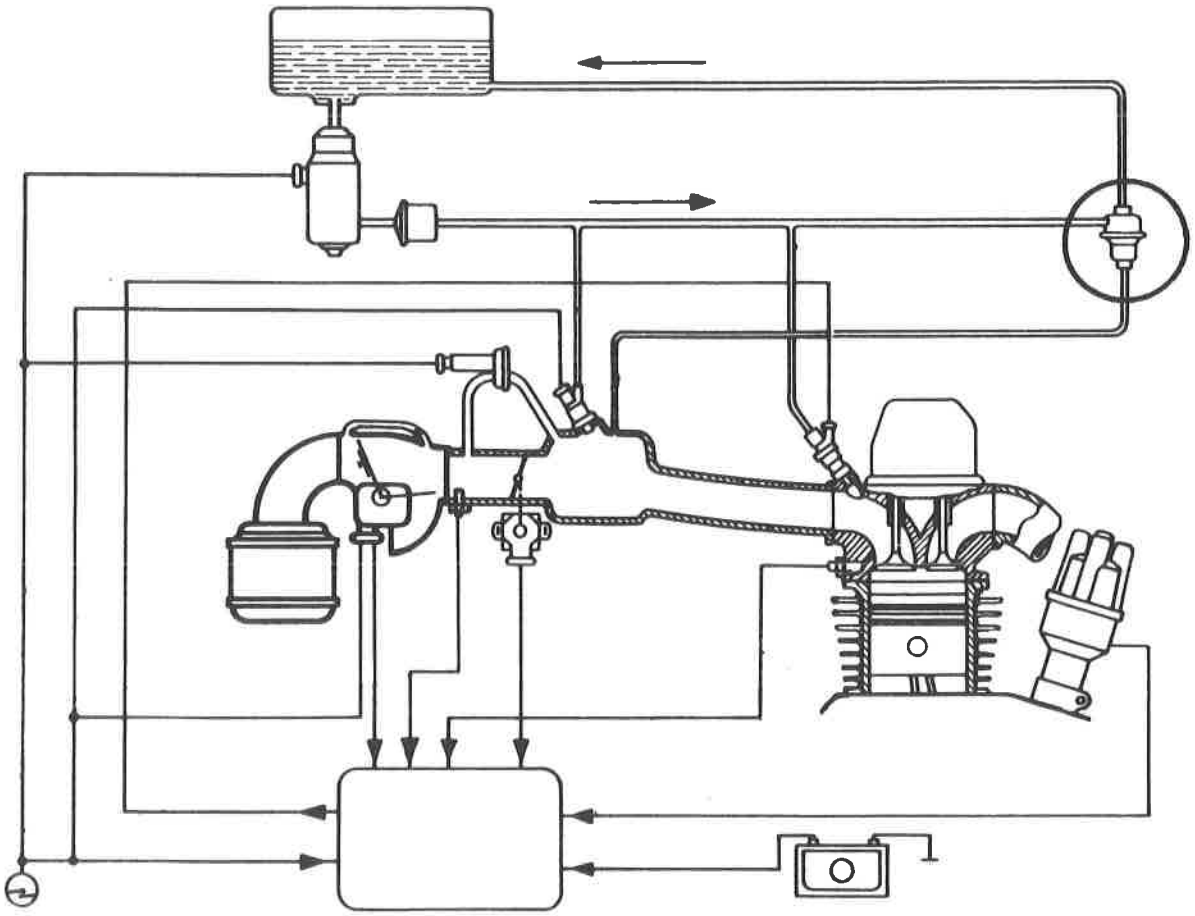
The electronic control unit is furnished with a printed circuit and with integrated circuits.
It has about 80 components.
The multi-pin connector levers into position.
It is hooked into the control unit and pressed into its socket until the spring clip catches.
To disconnect, release the spring clip and pull the plug from the bottom until it unhocks from the control unit.

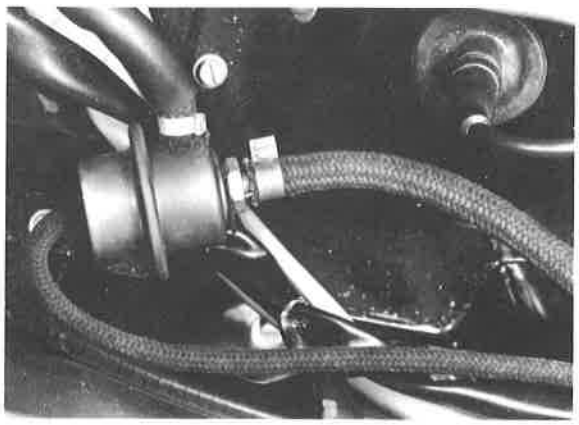
## MPC

The control unit receives information from:

- starter (ignition command) for control against flooding
- temperature sensor I — intake air temperature
- temperature sensor II — engine temperature
- pressure sensor — engine load
  trigger contacts — engine rpm and injection timing
- throttle valve switch — acceleration enrichment (or possible deceleration cut-off)

300 components





## AFC

### PRESSURE REGULATOR

The pressure regulator controls the pressure in the fuel system depending on intake air pressure.

The spring chamber of the pressure regulator is connected by a hose to the intake air distributor.

#### Operation

Manifold vacuum now influences fuel pressure.

Example:
High manifold vacuum (idling speed – low speed) – low fuel pressure.
Low manifold vacuum (full speed) – high fuel pressure.

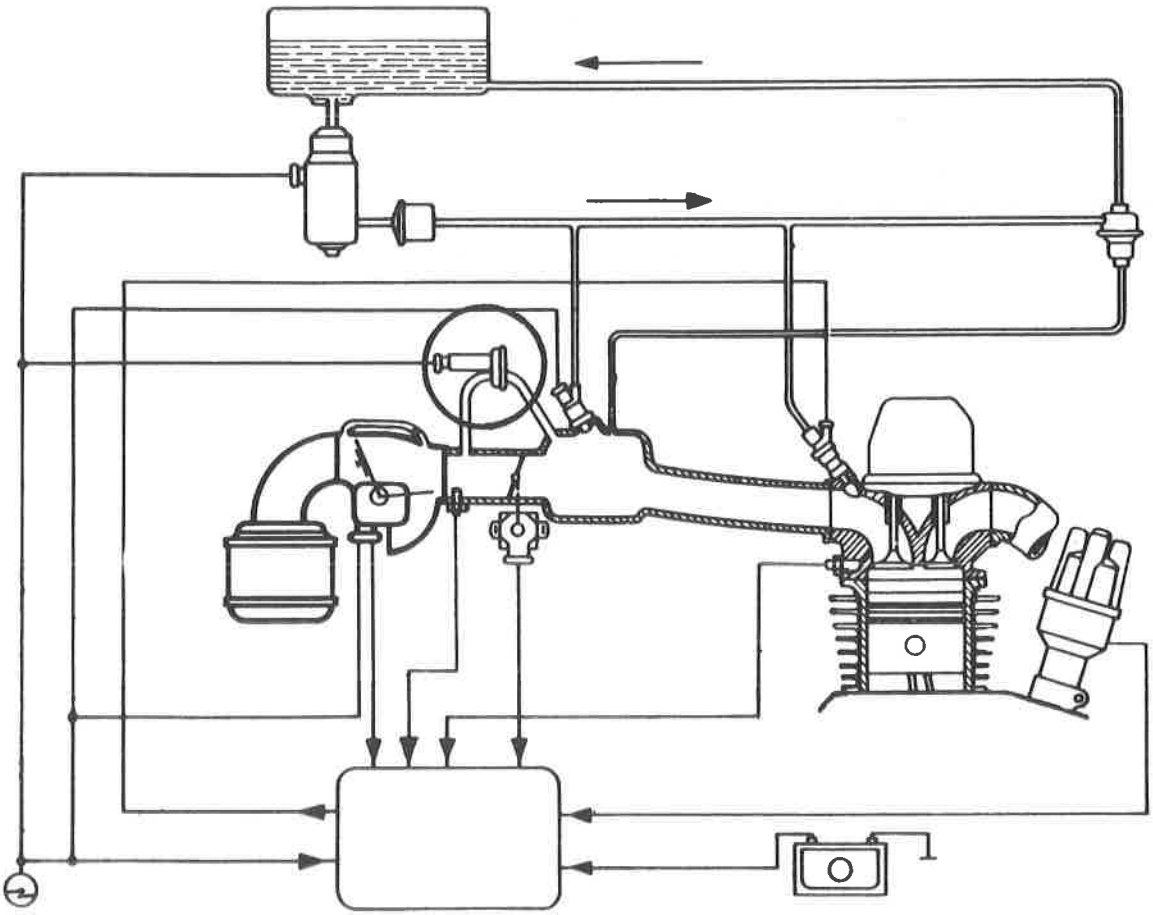
#### Checking

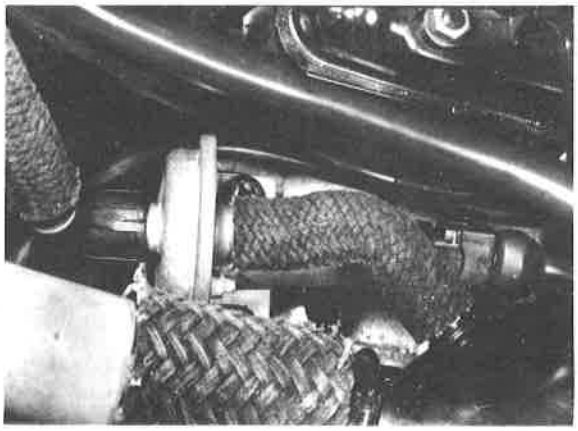
Connect a pressure gauge to the fuel line.

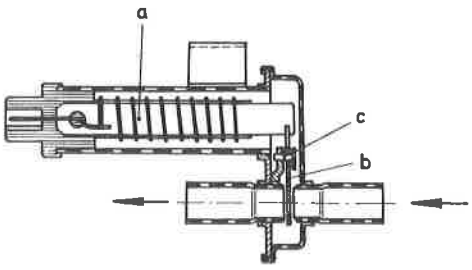
Disconnect the vacuum hose from the pressure regulator. Let engine continue running.
Nominal value: 2.5 kg/cm$^2$ (35 psi).
Reconnect vacuum hose – the fuel pressure must drop to 2.0 kg/cm$^2$ (28 psi).

## MPC

The pressure regulator is adjustable. Adjustment is made for a constant fuel pressure under all conditions of engine load.








a Bimetallic strip
b Rotary slide-valve
c Pivot

AFC

MPC

## AUXILIARY AIR REGULATOR

During warm-up the engine needs an enriched mixture. The increased fuel is determined by the control unit (signal from temperature sensor II). The additional amount of air required is regulated by the auxiliary air regulator and is fed directly into the intake air distributor, bypassing the throttle valve.

The same task and manner of operation but a different housing shape.

### Construction

The auxiliary air regulator has a rotary slide-valve and a bimetallic strip, which is surrounded by an electrical heating coil.

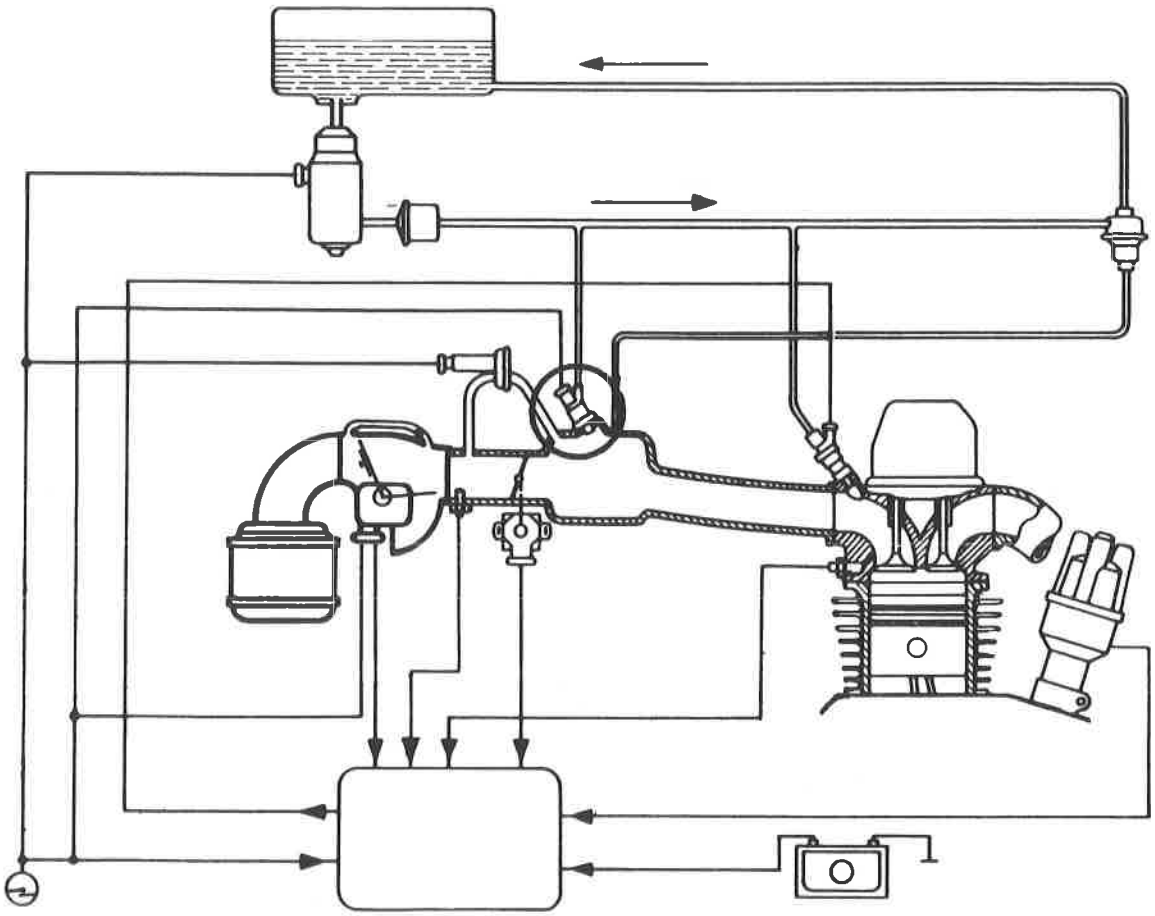
### Operation

When the engine is cold, the auxiliary air regulator is completely open. When the ignition is switched on, a heating element. Warms the bimetallic strip which deflects, thus moving the rotary slide valve, which slowly closes off the passage of air.

### Checking

**electrically –**
Disconnect the plug from the auxiliary air regulator. Connect ohmmeter.
Nominal value: approx. 30 Ω

**mechanically –**
Disconnect the hose from the intake air distributor and throttle valve connection. Blow air through it. When the engine is cold, the passage must be free. Switch on the ignition and continue blowing air through it. As the temperature increases, the passage must become smaller.



**AFC**

**MPC**

## COLD START VALVE

As with MPC fuel injection, the cold start valve is located in the intake air distributor and is activated via a thermo time switch, which is fastened on the right beside the intake air distributor beneath the intake pipe connections of cylinders 3 and 4.

Just like AFC.

The thermo time switch is located in plain view next to the intake air distributor.

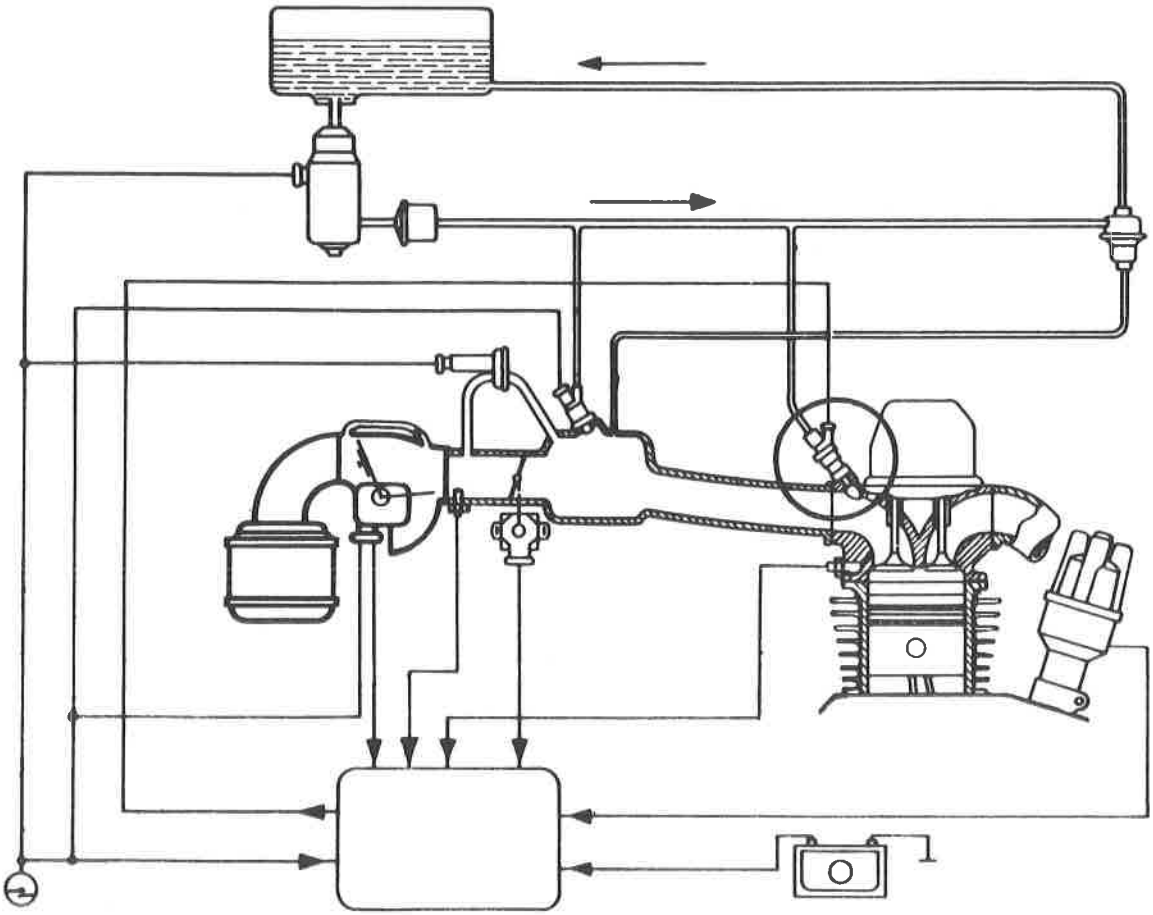
### Checking: thermo time switch

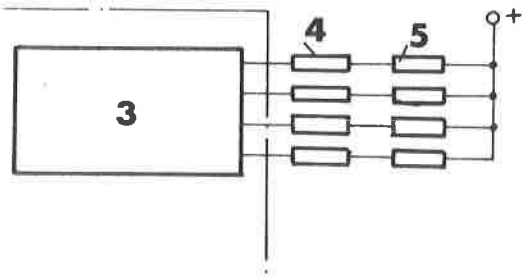
Engine temperature below 50°F.
Disconnect plug from cold start valve and connect test light. Disconnect terminal 1 of the ignition coil and activate starter: the test light must first light up brightly and then become noticlably dimmer within 11 seconds.

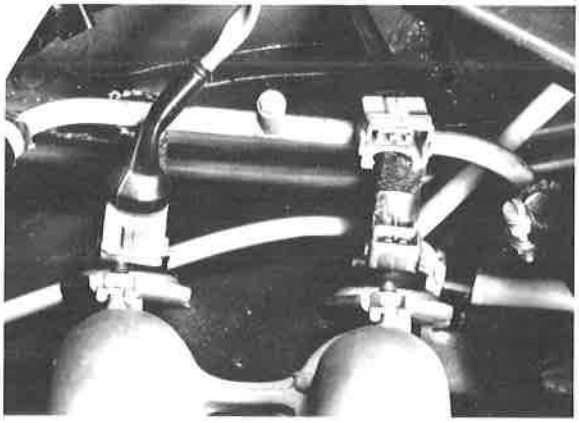
### Checking: cold start valve

Connect fuel pressure gauge to the fuel line. Briefly activate the starter so that fuel pressure can build up. Disconnect plug from cold start valve. Connect the cold start contacts to ground and to terminal 15 of the ignition coil with a jumper wire. Switch on ignition. Fuel pressure must decrease.

Just like AFC.




4
5
+
3




1

| AFC | MPC |
| --- | --- |
| **INJECTORS** | |
| The amount of fuel injected is determined by how long the injector remains open (duration of the impulse from the control unit). | |
| The injectors are connected to + plus through a series resistance (control from control unit, — minus). | The injectors are connected to — minus. Control, + plus. |
| **Injection sequence** | |
| All the injectors inject at the same time, and for every revolution of the crankshaft. | The injectors inject in pairs, once for every two revolutions of the crankshaft. |
| Note:<br>The plug contacts are so designed that they cannot be exchanged with injectors of the MPC system. | |

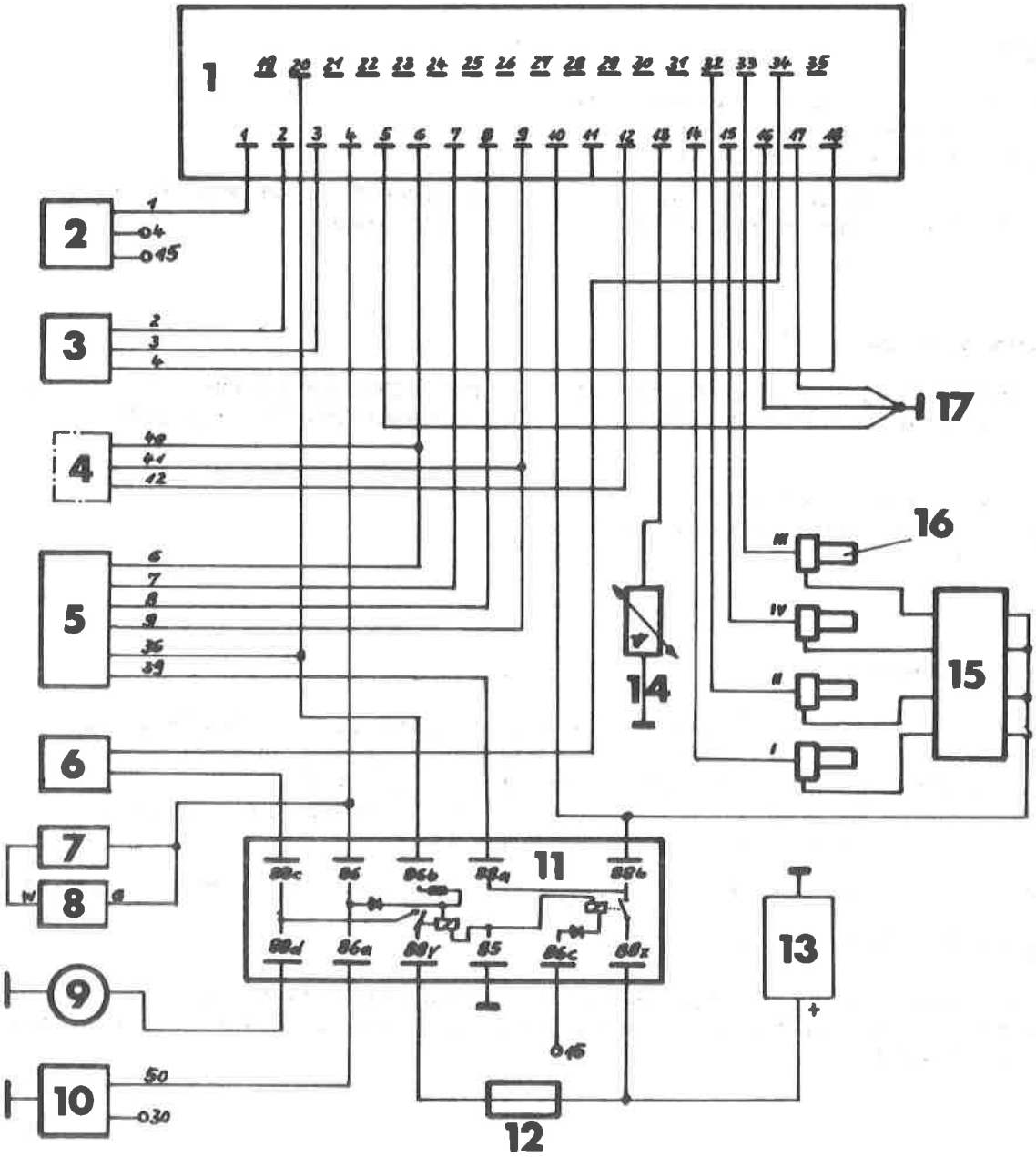
**Other Considerations**

On engines with AFC, smooth running requires that the intake passages from the intake air sensor must be absolutely tight. The intake air sensor flap must move easily over its entire range. All electric al plug contacts must it perfectly and must not be corroded.
The fuel pressure must be 2.5 kg/cm$^2$ (35 psi) when the vacuum hose is disconnected.
Ignition timing and valves must be properly adjusted.

Idling-speed and CO adjustments: The idling-speed is adjusted by the adjustment screw on the throttle valve socket.
Nominal value: 850 ± 50 rpm.

The CO is adjusted at the bypass regulating screw (sealed) on the intake air sensor and may be altered only if the nominal value of 2.5 ± 0.5 % CO can no longer be maintained with an otherwise properly adjusted.

## DIAGRAM




1 Control unit
2 Ignition coil
3 Throttle valve switch
4 Altitude-corrector sensor
5 Air flow sensor - Potentiometer
6 Auxiliary air device
7 Cold-start valve
8 Thermo time switch
9 Fuel pump
10 Starting motor
11 Double relay
12 Fuse
13 Battery
14 Temperature sensor
15 Series resistor
16 Injection valves
17 Control ground terminal (Engine case)