Fuel Pump

The fuel pump delivers the fuel from the tank to the injection valves and to the starting valve, while simultaneously generating the injection pressure. It is an electrically driven roller cell pump.

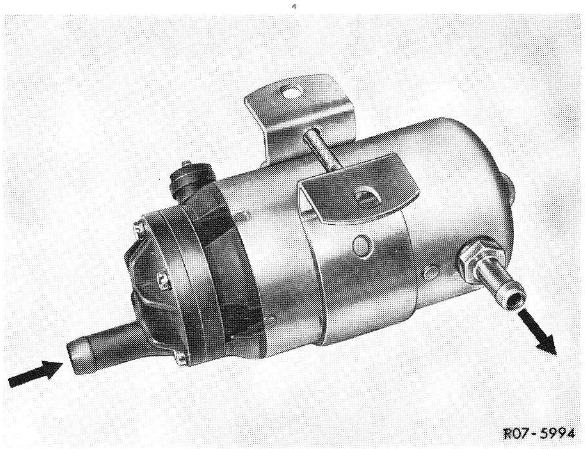

Fig. 1
Fuel pump

In this pump, an eccentrically arranged rotor disc rotates in a cylindrical cavity with inlet and outlet duct. The rotor disc is provided at its circumference with semi-circular recesses containing small metal rollers which are pressed against the walls of the cylindrical cavity during rotation and are serving as rotating seals. The pump effect is established by the rotating metal rollers, by means of which the cell volume at the inlet duct increases while the volume at the outlet duct decreases.

The pump operates without return flow line. The fuel is delivered from the intake connection through the pump to the delivery connection. To keep the fuel pressure as uniformly as possible, a pressure holding device (ball valve in delivery connection) is installed. In addition, the pump has a pressure relief device in the shape of a bypass which disconnects the suction and delivery line at approx. 5 atü.

The fuel pump and the fuel filter are attached to a holding bracket at rear floor plate. As a protection against damage and contamination, the pump and the filter are covered by a protective encasing.

When assembling a new pump, be sure that the suction connection is at its lowest point.

The delivery rate of the fuel pump at 12 V voltage and 2 atü counter pressure is 120 lits/h at a constant speed of 2,500 rpm.

Fuel Filter

The paper filter element is held in a metal housing with one hose connection each at both ends.

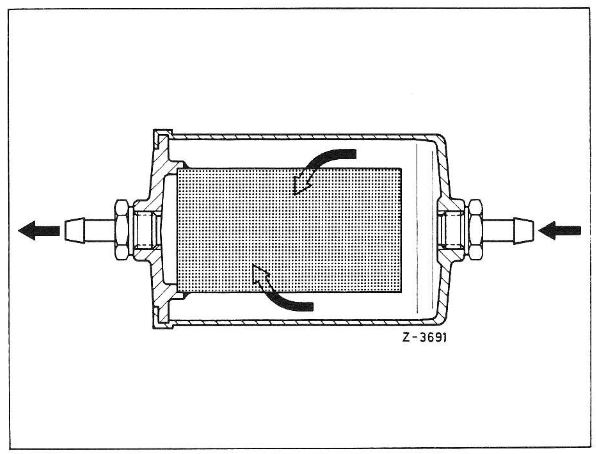

Fig. 2
Fuel filter

The so-called one-way filter is replaced every 40,000 km (voucher E). Observe flow direction (arrow) during installation.

Pressure Regulator

The fuel pressure and simultaneously the injection pressure is held to a constant value (2.0 + 0.1 atü) at high accuracy by a pressure regulator. A springloaded diaphragm (1) in a metal housing opens an overflow duct when the nominal pressure is exceeded so that the excess fuel can flow back to the fuel tank through a return line.

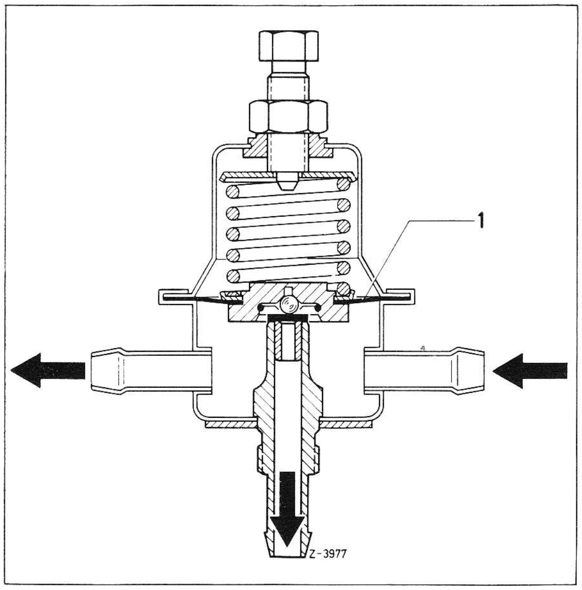

Fig. 3
Pressure regulator
1 Diaphragm

Injection Valve

The electro-magnetically actuated injection valves serve for metering and atomizing the fuel. Opening period at idling speed approx. 3.1 msec., at full load approx. 9.3 msec. The injection valves consist mainly of a valve body and a spring-loaded nozzle needle (1)

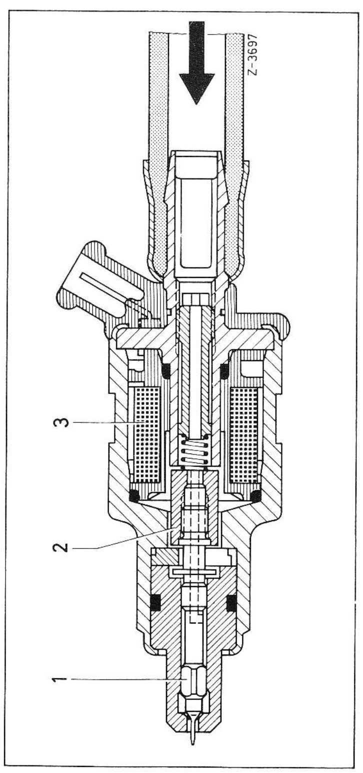

Fig. 4
Injection valve
1 Nozzle needle
3 Magnetic coil
2 Magnet armature

with armature of magnet (2) attached. When the magnet is excited, the nozzle needle rises 0.16 mm from its seat and the fuel can emerge through a calibrated annular gap. When the magnetic coil (3) is not excited, the nozzle needle is held to its seat by the spring. The front end of the nozzle needle has a ground injection pin for atomizing the fuel.

Electronic Control Unit

The electronic control unit is held in a sheet steel housing containing the transistors, diodes, resistances and capacitors on a printed circuit board. The impulse trigger in the ignition distributor effects the opening of the injection valve groups while simultaneously starting the function of the electronic control unit which determines the opening period in dependence of the operating condition of the engine, and closes the injection valves again.

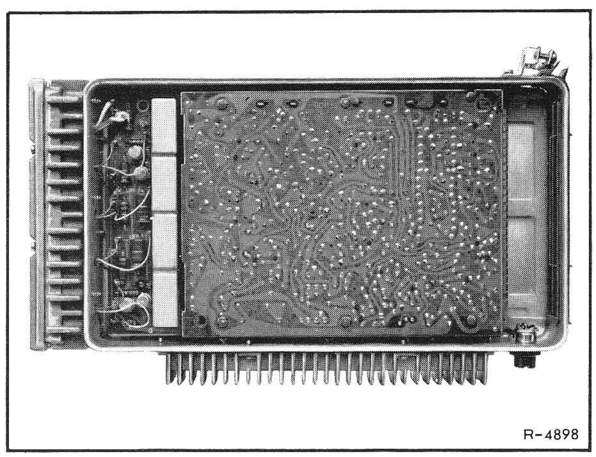

Fig. 5
Electronic control unit (opened)

The duration of the fuel injection is mainly determined by the intake pipe pressure. In addition it is under the influence of the engine speed and the cooling water and intake air temperature via pertinent correcting links. Additional control links are taking the conditions during acceleration (fuel enrichment) and under thrust (fuel shutoff) into account.

In addition, the fuel delivery pump is also controlled. When the ignition is switched on, the pump will run for only approx. 1 second and will stop again unless the starter is operated or an engine speed of at least

100 rpm is exceeded. This will prevent that with the engine stopped and the ignition switched on the cylinders are filled with fuel if the injection valves are not tightly sealing.

To prevent voltage fluctuations in the vehicle circuit to influence the injection period, the control unit is provided with a voltage correction circuit. The temperature error of the control unit in the range of –30°C to + 70°C is less than ± 2 %.

The injection quantitiy at idling speed can be changed by ± 10 % by means of an adjusting screw on the electronic control unit.

and atmospheric pressure being the same, this diaphragm permits matching the mixture to operating conditions at maximum efficiency. A spring will then displace the diaphragm together with the armature of the coil from the partial load stop (3) to the full load stop (1) in the direction of "rich".

The hose line connection is provided with a dampening throttle (7) which prevents any vibrations of the system caused by the pulsating pressure in the intake pipe. To permit a quick response of the pressure sensor when the throttle valve is suddenly opened, the throttle point is bridged by a pressure relief valve (7) with large cross section as soon as the pressure difference at the throttle point exceeds a given value.

Intake Pipe Pressure Sensor (M 116)

The intake pipe pressure sensor is located in the engine compartment and is connected to the intake pipe by means of a short hose line. Two evacuated diaphragm boxes (4) in a pressure housing will displace the armature (6) of a coil (5) under the influence of pressure changes in the intake pipe which will change the inductivity of the coil. This inductivity is fed to the control unit as the characteristic value of the intake pipe pressure.

The diaphragm boxes are suspended opposite the coil and armature on a diaphragm (2) which closes the vacuum chamber (9) against an atmospheric chamber (10). Under full load, with the pressure in the vacuum

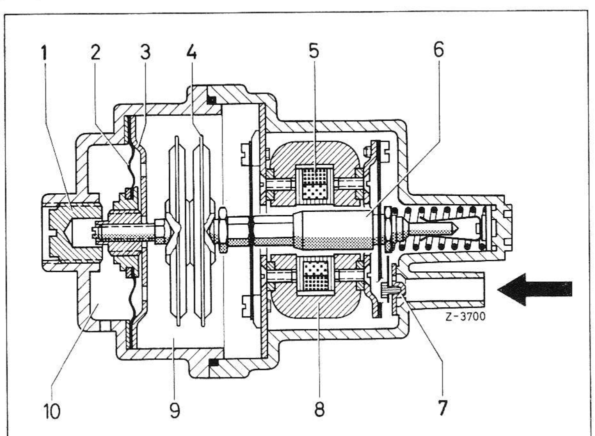

Fig. 6 Intake pressure sensor with full load enrichment

1 Full load stop
2 Diaphragm
3 Partial load stop
4 Diaphragm boxes
5 Coil
6 Armature
7 Pressure relief valve with damping throttle
8 Core
9 Vacuum chamber
10 Atmospheric chamber

Intake Pipe Pressure Sensor (M 117)

The design is in principle the same of the known version, but without the possibility of enriching the fuel under full load, since this is done by means of the full load contact in the throttle valve switch. A pressure housing (1) holds two permanently connected diaphragm boxes of which one is evacuated and acts as a working box (2), while the other is connected to the outside air by means of a hollow screw (3) and serves as an altitude correction box (4) (Fig. 6 a).

The movements of the boxes will displace an armature (6) in a coil (5) and will change their inductivity. This inductivity is fed to the control unit as the characteristic value of the intake pipe pressure. The armature is always pressed positively against the boxes by spring (7). An altitude correction in the direction of enriching the mixture is required for the following reasons:

1 At higher altitudes the volume of the mixture is increased as a result of the reduced exhaust back pressure. At the same intake pipe pressure relatively more fuel is required, since otherwise the mixture is too lean.

2 In absolute terms, the atmospheric pressure is added to the fuel pressure of 2 atü controlled by the pressure regulator.

When the atmospheric pressure is reduced, the pressure in the ring line is also reduced by the pertinent amount. To obtain the same quantity of fuel at higher altitudes, the injection period must be extended.

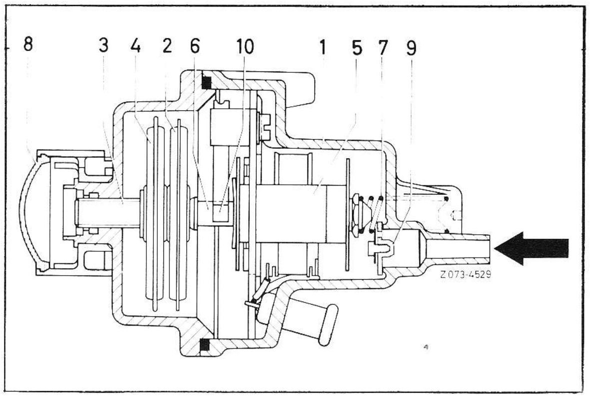

Fig. 6 a

Intake pipe pressure sensor with altitude correction

1 Pressure housing
2 Working box
3 Hollow screw
4 Altitude correction box
5 Coil
6 Armature
7 Spring
8 Dust cap
9 Pressure relief valve with damping throttle
10 Armature damper

The function of the altitude correction is explained in the following example:

The working box (2) and the correction box (4) are mechanically connected to each other. They are attached to the housing by means of the hollow screw (3) and surrounded by the intake pipe pressure. With the atmospheric pressure remaining the same at for example 750 Torr and under increasing intake pipe pressure the evacuated working box is increasingly compressed (at max. pressure difference of 1.5 mm).

Simultaneously, the max. expansion of the correction box (at maximum pressure difference of 0.6 mm) which is largest at minimum intake pipe pressure is constantly reduced. The sum of both movements is a movement of the armature to the left in the direction of rich. If the vehicle is driven under constant intake pipe pressure from a normal altitude of 750 Torr to an altitude of for example 600 Torr atmospheric pressure, the correction box is compressed because the pressure inside the box has been reduced by 150 Torr.

The armature is additionally displaced for a given distance to the left in the direction of rich. The higher the vehicle is driven, the larger the pressure difference and thereby the travel of the correction box.

The same adjustment applies to any momentary intake pipe pressure.

The connection for the intake pipe pressure is provided with a damping throttle (9) which prevents vibrations of the system by the pulsating intake pipe pressure. The throttle area is bridged by a pressure relief valve with large cross section so that the pressure sensor will respond faster when the throttle valve is suddenly opened.

Impulse Trigger

The opening of the injection valve groups and thereby the begin of the injection is determined by the impulse trigger.

The lower housing portion of the slightly higher ignition distributor is provided with two trigger contacts each offset by 180° in relation to each other mounted on a slide-in in one or two levels, which are actuated by a cam on the distributor shaft. Each of the trigger contacts is associated with a valve group.

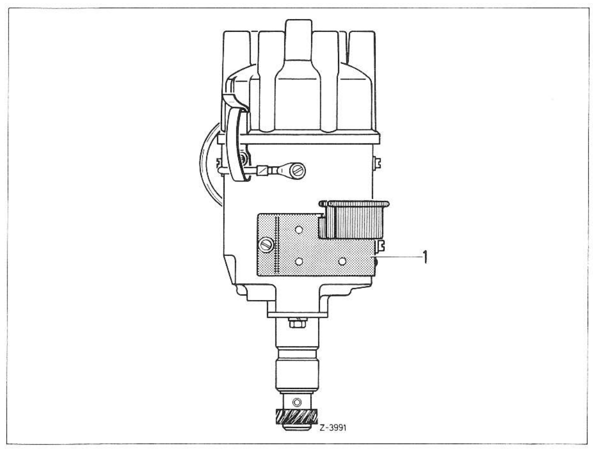

Fig. 7 Ignition distributor with slide-in for impulse trigger

1 Slide-in

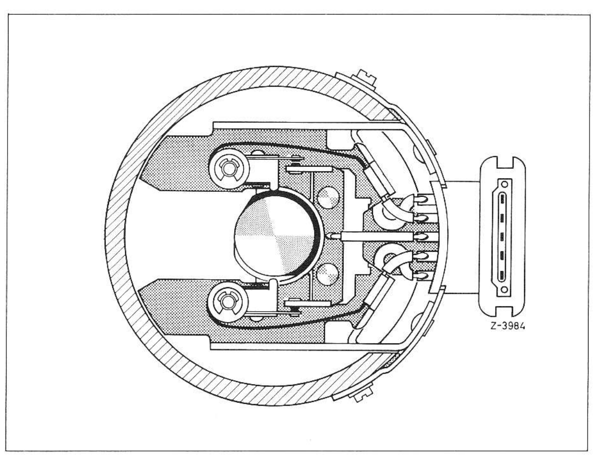

Fig. 8 Slide-in with trigger contacts

Temperature Sensor

Temperature sensors are temperature-dependent resistances which are housed with good thermal contact in protective envelopes in the shape of a hexagon bolt. One temperature sensor each is measuring the cooling water and intake air temperature to match the fuel to the pertinent temperature via the electronical control unit.

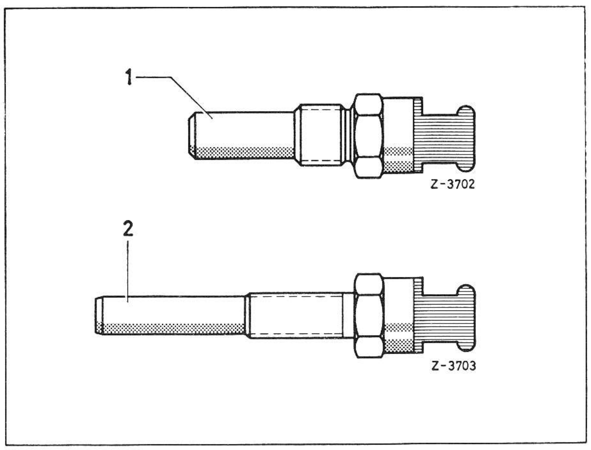

Fig. 9

1 Cooling water temperature feeler
2 Induction air temperature feeler

Starting Valve

The electro-magnetic starting valve with spiral nozzle is located at the intake pipe and connected to the fuel delivery line. The valve is controlled by the ignition starter switch and by a thermal time switch around which the cooling water is circulating. When the cold engine is started below + 35°C finely atomized fuel is injected through the spiral nozzle into the intake pipe in addition to the normally injected fuel.

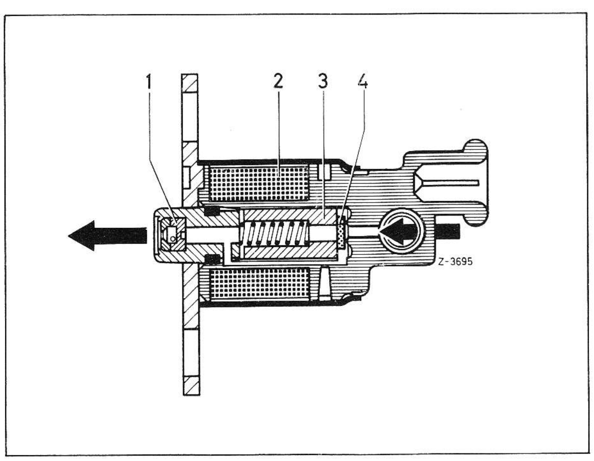

Fig. 10

1 Spiral nozzle
2 Magnet winding
3 Armature
4 Seal

The thermal time switch controls the injection which will start only at temperatures below + 35°C and will increase in time with decreasing temperature attaining 12 seconds at –20°C.

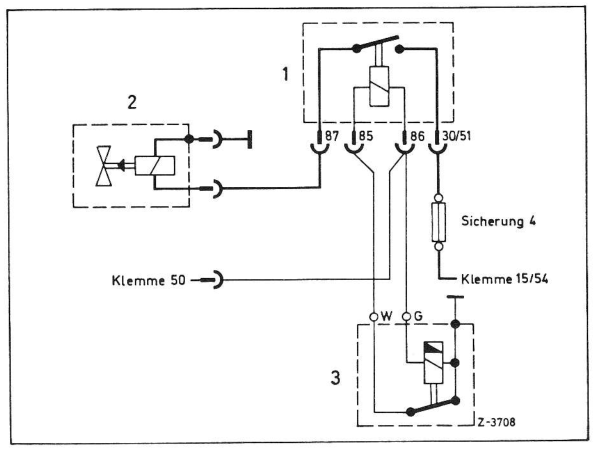

Fig. 11
Circuit diagram of starting valve

1 Relay
2 Starting valve
3 Thermal time switch

Supplementary Air Valve

During the warming-up period the engine requires additional fuel to overcome the higher internal friction and to obtain a smoothly running engine. The required supplementary air is taken from the air

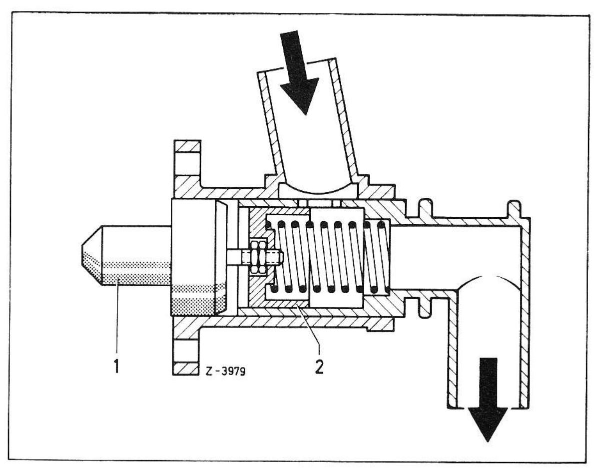

Fig. 12

Supplementary air valve
1 Expanding element
2 Valve

filter via an air line and is fed to the intake pipe via a control valve while bypassing the throttle valve. An expanding element (1) surrounded by cooling water controls the cross section of the valve (2) independence of the temperature and thereby the air quantity. The valve is fully opened below –20°C and fully closed at +65°C.

Throttle Valve Switch (M 116)

The throttle valve switch attached to the valve connection and actuated by the throttle valve shaft serves a double function. For once, together with an electronic speed switch it will actuate the cutout of the fuel delivery while driving under thrust conditions, that is, in idling position of the throttle valve. In addition, it will extend the regular duration of the impulse under acceleration and will trigger additional injection impulses to bridge the time loss of the pressure sensor. Simultaneously, a slip contact (3) slides across a circular sector (1) with several contacts each of which will release an injection impulse.

At a maximum, each valve group may have approx. 10 impulses of max. 2.5 msec. duration each, which provides an additional quantity of 20–30 %. The slide contact is designed as a drag switch, so that the enrichment of the mixture becomes effective only during acceleration, but not during deceleration.

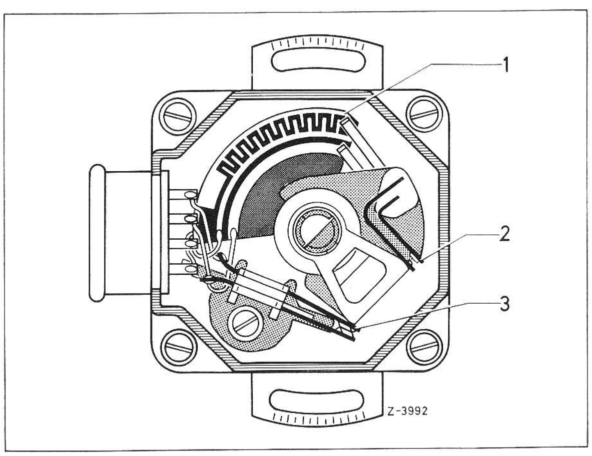

Fig. 13

Throttle valve switch

1 Circular sector with contacts 3 Drag switch
2 Idling speed switch

To prevent any stopping of the engine, the fuel shutoff is cancelled when the engine revolutions drop below a given speed which is dependent on the engine temperature.

Throttle Valve Switch (M 117)

The throttle valve switch attached to the valve connection and dependent on the throttle valve shaft has several functions:

1 Together with an electronic engine speed switch it will effect the cutout of the fuel supply under thrust conditions, that is at idling speed position of the throttle valve.

2 During acceleration it will extend the normal impulse duration while triggering additional injection impulses to bridge the time delay of the pressure. sensor.

For this purpose, a slide contact moves across a circular segment having several contacts which are each triggering one injection impulse. The slide contact is connected to a drag switch, so that the mixture is enriched only during acceleration, but not during deceleration.

3 The mixture is matched to maximum efficiency (full load switch) by means of a double slide contact with the throttle valve fully opened. This type of full load enrichment assures that the additional quantity is injected only as from 5° prior to max. opening of throttle valve.

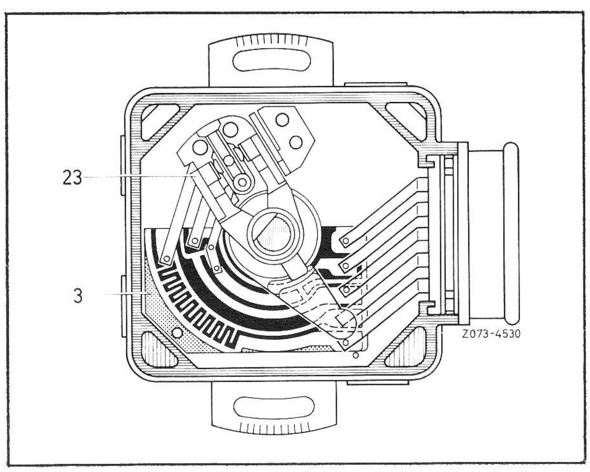

Fig. 14

Throttle valve switch with full load contact