KE-Jetronic

Since their introduction, the KE-Jetronic systems have proved themselves in millions of automobiles.
The advantages inherent in fuel injection with regard to the demands for fuel economy, engine power, and not least of all for environmental compatibility, played a major part in this development.
Whereas an increase in engine power was the major consideration when the development work first started on gasoline fuel injection, we are today spurred on by the necessity to reduce fuel consumption and minimise toxic emissions.
Purely mechanical injection systems are unable to comply with these far-reaching stipulations. The mechanical K-Jetronic, which had already proven itself as a multi-point fuel-injection system, was therefore retained as the basic system, and uprated by means of electronics to make it more intelligent and more efficient.
This synthesis, comprising the mechanical basic functions coupled with electronic adaptation and optimization functions is the KE-Jetronic.

Adder
Here, the evaluated sensor signals are combined. The electrically processed corrective signals are added in an operational circuit and then transmitted to the current regulator.

Output stage
The output stage generates the control signal for the pressure actuator, whereby it is possible to input opposing currents into the pressure actuator in order to increase or decrease the pressure drop.
The magnitude of the current in the pressure actuator can be adjusted at will in the positive direction by means of a permanently triggered transistor. The current is reversed during “overrun” (overrun fuel cutoff), and influences the differential pressure at the differential-pressure valves so that the flow of fuel to the injection valves is interrupted.

Additional output stages
If necessary, additional output stages can be included. These can trigger the valves for EGR, and control the bypass cross-section around the throttle valve as required for idle-mixture control, to mention but two applications.

Electro-hydraulic pressure actuator
Depending upon the operating mode of the engine and the resulting current signal received from the ECU, the electro-hydraulic pressure actuator varies the pressure in the lower chambers of the differential-pressure valves. This changes the amount of fuel delivered to the injection valves.

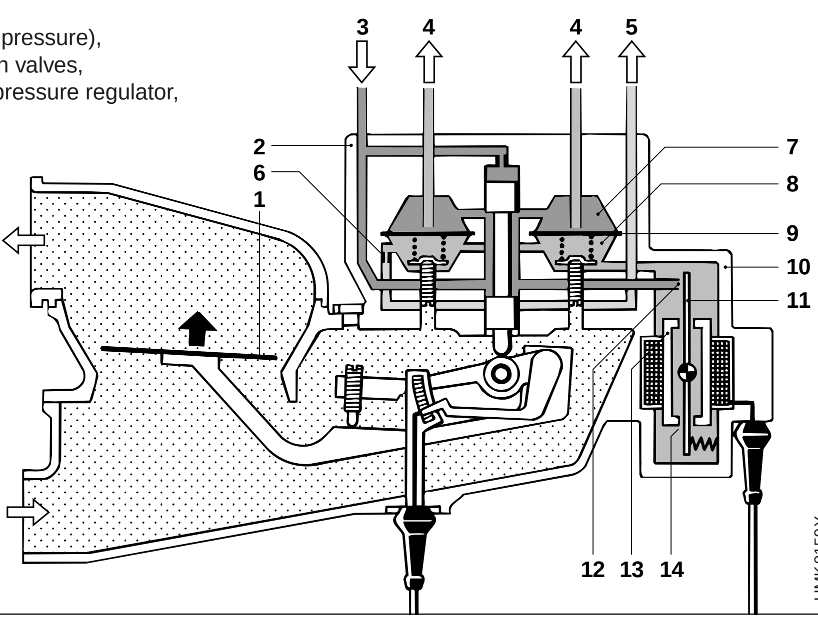
Design
The electro-hydraulic pressure actuator (Figure 20) is mounted on the fuel distributor. The actuator is a differential-pressure controller which functions according to the nozzle/baffle-plate principle, and its pressure drop is controlled by the current input from the ECU.
In a housing of non-magnetic material, an armature is suspended on a frictionless taut-band suspension element, between two double magnetic poles. The armature is in the form of a diaphragm plate made from resilient material.

Fig. 20

Electro-hydraulic pressure actuator fitted to the fuel distributor

The control signal from the ECU intervenes in the position of the baffle plate (11).
This, in turn, varies the fuel pressure in the upper chamber of the differential-pressure valves and, as a result, the quantity of fuel delivered to the injection valves (injectors). Using this principle, adaptation and correction functions can be incorporated.

1 Sensor plate,
2 Fuel distributor,
3 Fuel inlet (primary pressure),
4 Fuel to the injection valves,
5 Fuel return to the pressure regulator,
6 Fixed restriction,
7 Upper chamber,
8 Lower chamber,
9 Diaphragm,
10 Pressure actuator,
11 Baffle plate,
12 Nozzle,
13 Magnetic pole,
14 Air gap.



Section through the electro-hydraulic pressure actuator

1 Fuel inlet (primary pressure),
2 Nozzle,
3 Baffle plate,
4 Fuel outlet,
5 Magnetic pole,
6 Electromagnet coil,
7 Permanent-magnet flux,
8 Permanent magnet (turned through 90 degrees from the focal plane),
9 Adjustment screw for basic moment of force,
10 Electromagnetic flux,
11 Armature (L_1 to L_4= air gaps).

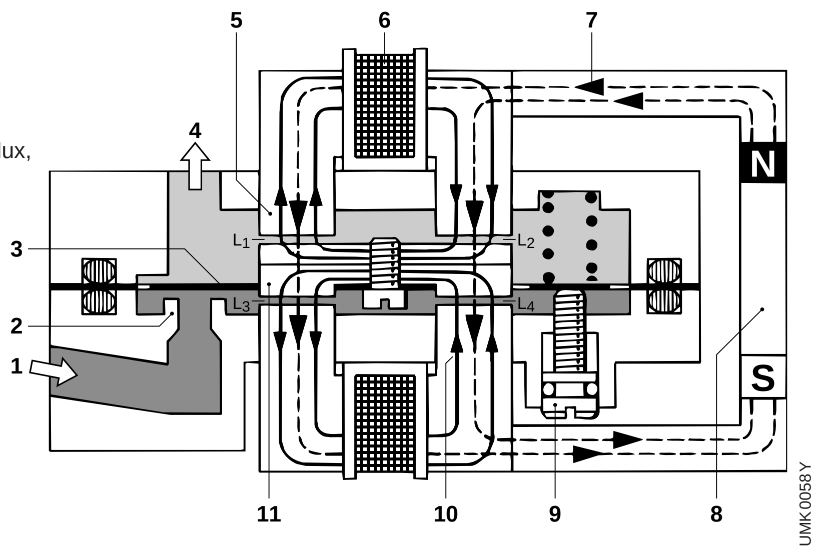


Fig. 21

Function

The magnetic flux of a permanent magnet (broken lines in Figure 21) and that of an electromagnet (unbroken lines) are superimposed upon each other in the magnetic poles and their air gaps. The permanent magnet is actually turned through 90 degrees referred to the focal plane. The paths taken by the magnetic fluxes through the two pairs of poles are symmetrical and of equal length, and flow from the poles, across the air gaps to the armature, and then through the armature.

In the two diagonally opposed air gaps (Figure 21 L_2, L_3), the permanent-magnet flux, and the electro-magnet flux resulting from the incoming ECU control signal are added, whereas in the other two air gaps (Figure 21 L_1, L_4) the fluxes are subtracted from each other. This means that, in each air gap, the armature, which moves the baffle plate, is subjected to a force of attraction proportional to the square of the magnetic flux.

Since the permanent-magnet flux remains constant, and is proportional to the control current from the ECU flowing in the electromagnet coil, the resulting torque is proportional to this control current. The basic moment of force applied to the armature has been selected so that, when no current is applied from the ECU, there results a basic differential pressure which corresponds preferably to $\lambda = 1$. This also means that, in the case of control current failure, limp-home facilities are available without any further correction measures being necessary.

The jet of fuel which enters through the nozzle attempts to bend the baffle plate away against the prevailing mechanical and magnetic forces. Taking a fuel throughflow which is determined by a fixed restriction located in series with the pressure actuator, the difference in pressure between the inlet and outlet is proportional to the control current applied from the ECU. This means that the variable pressure drop at the nozzle is also proportional to the ECU control current, and results in a variable lower-chamber pressure. At the same time, the pressure in the upper chambers changes by the same amount. This, in turn, results in a change in the difference at the metering slits between the upper-chamber pressure and the primary pressure and this is applied as a means for varying the fuel quantity delivered to the injection valves.

As a result of the small electromagnetic time constants, and the small masses which must be moved, the pressure actuator reacts extremely quickly to