

July 23, 1963

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3,098,635

ELECTROMAGNETIC VALVES

Filed Feb. 13, 1961

Fig. 1

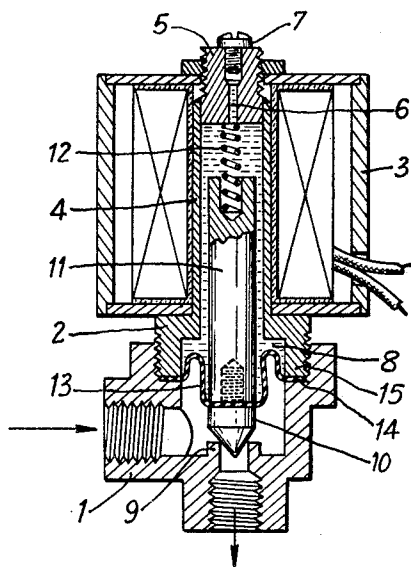
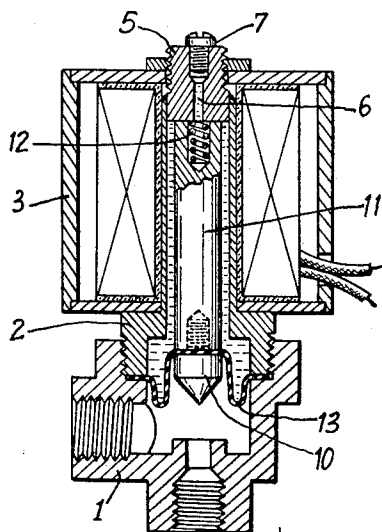


Fig. 2



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ELECTROMAGNETIC VALVES

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Filed Feb. 13, 1961, Ser. No. 88,793

Claims priority, application France Mar. 14, 1960

4 Claims. (Cl. 251—54)

The magnetic circuit of electromagnets, chiefly of the type provided with a plunger core, is normally in contact with the atmosphere and is subjected of necessity to its action which becomes objectionable after a certain time. What is still worse, and which may occur in electromagnetic valves, is the detrimental action of corrosive and the like fluids passing through them, and it is therefore essential to protect the plunger core and the pole-pieces, chiefly in the case of normally closed valves.

Now, the protecting means used hitherto suffer the drawback of having a reduced efficiency.

Our invention has for its object to remove such drawbacks and it allows using in electromagnetic valves magnetic circuits made of pure iron without any special care being required, as obtained by a perfect separation between such magnetic circuits and the corrosive or the like fluid.

According to our invention, the magnetic circuit is enclosed in a non-corrosive liquid bath, which is preferably non-compressible, the liquid being held back by a single very yielding diaphragm designed in a manner such that a modification in the location of the non-corrosive liquid produced by the movement of the plunger core may be compensated by a modification in the shape of the diaphragm without any stress being exerted on the latter.

Our invention has also for its object an electromagnetic valve provided with a plunger core and incorporating the above arrangement; in said valve, oil fills the space between the core and the vertical tubular member inside which the latter is shiftable so as to form a liquid column between the polepiece closing the upper end of the said tubular member and provided with a filling channel, and the diaphragm at its lower end; said diaphragm is advantageously in the shape of a deformable annular disc clamped along its outer periphery between the body of the valve and the tubular member carried by the electromagnet winding and along its inner periphery between the lower end of the core and the needle valve carried by the latter, the surface of said disc-shaped diaphragm forming an annular groove facing downwardly as long as the needle valve is closed whereas the diaphragm is deformed by the pressure of the above-mentioned liquid column when the core rises and consequently the needle valve opens, whereby said diaphragm assumes then a downwardly annular convex shape.

It should be remarked that, if pressure is applied to the lower surface of the diaphragm, said pressure is transmitted entirely to the liquid column while the diaphragm serving as a separating member between the liquid column above it and the liquid flowing through the valve underneath it, may be very thin by reason of the equilibrium in pressure on either side thereof. During the deformation of the diaphragm, only reduced stresses arise so that the diaphragm may allow the core to execute strokes of a considerable amplitude.

We have illustrated by way of example in the accompanying drawings a preferred embodiment of our improved electromagnetic valve. In said drawings:

FIG. 1 is a vertical diametrical cross-section of the apparatus, the needle valve being shown as urged onto its seat by the spring acting on the plunger core, the electromagnet not being energized,

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FIG. 2 is a similar view in which the electromagnet is assumed to be energized and has produced a rise of the core which it has attracted, and consequently a rise of the needle valve.

As illustrated into the body of the valve 1 is screwed a tubular member 2 carrying outwardly the support or housing 3 of the electromagnet, the member 2 forming thus a central chimney 4 at the upper end of which is fitted the electromagnet pole-piece 5 provided with a channel 6 closed by a plug 7.

The lower, wider end of the chimney 4 forms a chamber 8 facing the chamber provided inside the valve body 1 to form the seat 9 for a needle valve 10 controlling the flow through the valve system.

The needle valve 10 is provided with an axial threaded stud through which it is screwed into the lower end of the plunger core 11 which latter is provided at its upper end with a blind bore inside of which is housed a spring 12 engaging the underside of the pole-piece 5.

A single diaphragm 13 in the shape of a very yielding annular disc is clamped along its outer periphery between a bearing surface 14 on the body 1 and a corresponding bearing surface 15 on the tubular member 2 while the central periphery of said diaphragm is clamped between the lower end of the plunger core 11 and the needle valve 10, said diaphragm having an area such that its medial annular section may form a sort of groove opening downwardly when the valve is in its normal closing position, as illustrated in FIG. 1.

The closing position of the valve corresponds to the period of non-energization of the electromagnet winding; the core 11 is then urged by the spring 12 into a position for which it holds the needle valve 10 on its seat 9 to close the valve, while the space between the diaphragm 13 and the pole-piece 5 and between the core 11 and the chimney 4 is filled with oil. The weight of the oil on the diaphragm 13 is opposed by the thrust or pressure exerted in the opposite direction by the fluid held back inside the body of the valve 1.

Upon energization of the electromagnet winding, an attraction is produced, in order to raise the core 11 which must overcome the opposing force of the spring 12 and also the very slight force required for releasing the needle valve 10 with reference to its seat 9. But simultaneously, as the valve opens and the fluid controlled thereby passes out through seat 9, the pressure until now exerted on the lower surface of diaphragm 13 by the fluid is removed. There no longer being a pressure within body 1 compensating the weight of the liquid column in the chimney 4, this liquid is urged downwardly by the rising of the core 11, so as to vacate the space above the plunger core, whereby the diaphragm 13 is deformed and assumes a reversed curvature forming a downwardly convex projection, as illustrated in FIG. 2.

It will be readily understood that the arrangement provided protects completely the pole-piece 5 and the plunger core 11 from the corrosive action of the fluid controlled by the valve both in the closed and in the open condition of the valve. Further, there is no additional stress due to the diaphragm imposed upon the electromagnet as it operates to control the valve, when the latter is open.

It should be mentioned that the arrangement is also of interest for those cases where the fluid passing through the valve is under pressure and that nothing is to be modified in the data governing the rising movement of the needle valve, in contradistinction with the requirements of conventional diaphragm valves.

By gauging suitably the clearance between the core and the chimney surrounding it, it is possible to obtain a dash-pot action which brakes the speed of operation.

Furthermore, the oil bath serves for damping the vibra-

tions due to the application of A.C., and the noise produced upon energization by the impact of the core against the pole-piece is also considerably reduced. Furthermore, there is no risk of any impurities soiling the pole-piece which impurities might lead to the production of noise and to a reduction of the attraction.

Lastly a suitable viscosity of the oil allows also braking the operative speed.

Our invention is obviously applicable to A.C. controlled relays and to all arrangements incorporating an electromagnet, chiefly an electromagnet provided with a plunger core.

What we claim is:

1. An electromagnetic valve comprising a valve body provided with a passageway for a liquid to be handled and with a seat in said passageway, a tubular member carried by said body and opening into said passageway in front of said seat, an electromagnetic winding surrounding said tubular member, a pole-piece closing the outer end of said tubular member, a plunger core adapted to slide outwardly of said valve body in said tubular member under the action of said winding when energized, with a clearance between said plunger core and the wall of the tubular member, a spring urging the plunger core away from the pole-piece, a needle valve carried by the plunger core and adapted to normally close said seat and to open said seat upon energization of the electromagnetic winding, a single, very yielding diaphragm fitted across the lower end of the tubular member between the plunger core and the inner wall of said tubular member, and a mass of non-corrosive, non-compressible liquid completely filling the tubular member above the diaphragm and the pressure of which deforms the latter when the plunger core is actuated upon energization of the electromagnet.

2. An electromagnetic valve comprising a valve body provided with a passageway for a liquid to be handled and with a seat in said passageway, a tubular member carried by said body and opening into said passageway in front of said seat, an electromagnetic winding surrounding said tubular member, a pole-piece closing the upper end of said tubular member and provided with an axial filling port, a plunger core adapted to slide outwardly of said valve body in said tubular member under the action of said winding when energized, with a clearance between said plunger core and the wall of the tubular member, a spring urging the plunger core away from the pole-piece, a needle valve carried by the plunger core and adapted to normally close said seat and to open said seat upon energization of the electromagnetic winding, a single, very yielding diaphragm fitted across the lower end of the tubular member between the plunger core and the inner wall of said tubular member and a mass of non-corrosive, non-compressible liquid completely filling the tubular member, above the diaphragm, the pressure of which deforms the latter when the plunger core is actuated upon energization of the electromagnet.

3. An electromagnetic valve comprising a valve body provided with a passageway for a liquid to be handled and with a seat in said passageway, a tubular member carried by said body and opening into said passageway in front of said seat, an electromagnetic winding surrounding said tubular member, a pole-piece closing the upper end of said tubular member and provided with an axial filling port, a plunger core adapted to slide outwardly of said valve body in said tubular member under the action of said winding when energized, with a clearance between said plunger core and the wall of the tubular member, a spring urging the plunger core away from the pole-piece, a needle valve screwed into the plunger core and adapted to normally close said seat and to open said seat upon energization of the electromagnetic winding, a single, very yielding annular diaphragm fitted across the lower end of the tubular member between the plunger core and the inner wall of said tubular member, the outer periphery of said diaphragm being clamped between the wall of the tubular member and the valve body and its inner periphery being clamped between the cooperating ends of the plunger core and of the needle valve, and a mass of non-corrosive, non-compressible liquid completely filling the tubular member above the diaphragm, the pressure of which deforms the latter when the plunger core is actuated upon energization of the electromagnet.

4. An electrically controlled valve comprising a valve chamber having an open end, a valve seat within said chamber, a solenoid comprising a central tube, an armature longitudinally displaceable inside said tube, and an electromagnetic winding surrounding said tube, one end of said tube mounted over the open end of said chamber, a needle valve positioned within said chamber to cooperate with said valve seat and connected to one end of said armature, a single deformable watertight diaphragm disposed between the interior of said tube and said valve chamber containing the fluid to be distributed, and a body of noncompressible liquid filling entirely the volume limited by said tube and said flexible diaphragm, said diaphragm having a diametrical section allowing it to assume a concave or convex form, according to whether said armature is positioned at said one end of said tube or displaced by energizing said winding to the other end of said tube, said diaphragm being in continuous contact with said body of liquid.

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