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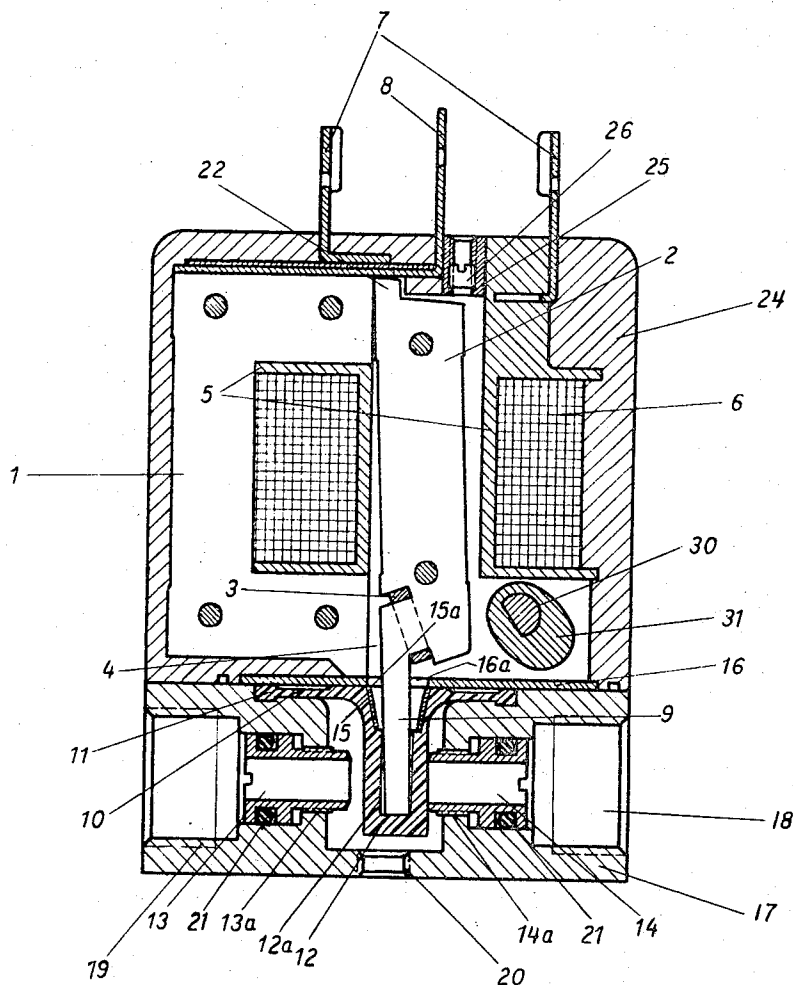
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ELECTROMAGNETIC VALVE

Filed May 13, 1965

Sheet 1 of 2

Fig. 1



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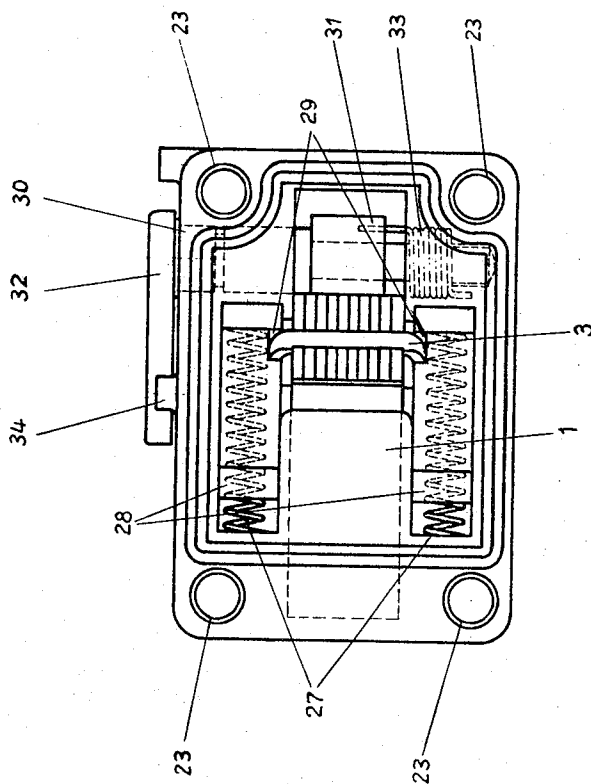
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Fig. 2



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ELECTROMAGNETIC VALVE

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8 Claims

ABSTRACT OF THE DISCLOSURE

An electromagnetic valve capable of operating with alternating current and constructed as a compact unit. The electromagnetic valve comprises a housing member including an armature having a projecting portion. A magnetic coil surrounds the armature and effects movement thereof. A valve unit is provided including a valve housing connected with the housing member. A diaphragm is disposed at the region of the interface between the housing member and the valve housing, the diaphragm including an integral extended sleeve portion located within the valve housing and providing a pocket-like compartment into which the projecting portion of the armature extends. At least one valve seat is arranged in the valve housing, the valve seat being capable of being closed directly by the integral extended sleeve portion of the diaphragm as moved by the projecting portion of the armature.

The present invention relates to the provision of an improved electromagnetic valve manifested by the features that it possesses particularly good efficiency, a relatively compact construction and a long length of life.

The inventive valve possesses an electromagnetic system constructed for complete use with alternating current.

Furthermore, this system is constructed from laminated iron and in the energized condition is completely closed. The magnetic resistances are exceptionally small so that only small losses appear.

Up to the present electromagnetic valves have become known which operate according to two different principles. The classical valve operates in accordance with the so-called solenoid principle in which the work-performing armature is moved within a coil. In order to improve the magnetic effect there has been provided during the course of time iron feed back means externally of the coil, with the purpose of improving the efficiency and reducing the magnetic resistance. The working compartment of the armature with the prescribed construction is subjected to the pressure of a liquid, gas or vapor appearing in a relevant pipe system.

Additionally, electromagnetic valves have become known in which the work-performing magnet is arranged externally of the valve proper. In this case, execution of the necessary stroke movement occurs through the agency of packing boxes, bellows or via other sealing means.

With the first-mentioned physical construction the electromagnetic efficiency is exceptionally poor because the magnetic circuit is associated with large resistances. This is attributable to the fact that the pressure of the medium, oftentimes very high, requires strong wall thicknesses for the sleeve of the armature in which the latter is displaceable. This sleeve, however, builds an air gap in the magnetic circuit. Also, by virtue of the sleeve there is formed a short-circuit winding within the coil which screens the magnetic field and which naturally increases coil current. Furthermore, as a general rule non-corroding materials are desired internally of the hydraulic or pneumatic system which are considerably poorer in their magnetic properties than the iron alloys advantageously employed for alternating current. As a general rule, silicon alloyed iron types come under consideration for alternating cur-

rent magnets which, however, are unfortunately not corrosion resistant. Thus, electromagnetic valves produced according to this construction represent a more or less good compromise.

On the other hand, valves designed according to the second-mentioned construction have not proven themselves to be operationally reliable for the reason that the through-passages of the packing box generally only function reliably for a limited time. With packing boxes difficulties oftentimes arise, particularly in the presence of higher pressures, contaminated atmospheres or impure medium. Likewise, bellows or other sealing constructions only have limited longevity. In addition thereto, all of these physical constructions require additional forces which must be overcome by the magnetic system.

Accordingly, it is a primary object of the present invention to provide an improved electromagnetic valve which overcomes the heretofore-mentioned disadvantages.

A further important object of the present invention relates to the provision of an improved electromagnetic valve which is relatively compact and simple in construction, economical to manufacture, has a long service life, and operates with relatively great efficiency.

In order to attain these and still further objects, the electromagnetic valve constructed in accordance with the teachings of the present invention is manifested by the features that, the actual force or power efficiency system is dimensioned in accordance with optimum electromagnetic considerations. It is manufactured in consideration of alternating current and the force-displacement curve is accommodated to required valve characteristics. The magnetic system is constructed to provide a compact body or unit and threaded against a valve member. In so doing, a diaphragm or membrane-like throughpassage element is pressed against the electromagnetic body, with their resulting a hinged-type oscillating throughpassage requiring little grinding and milling work. According to a further aspect of the present invention, the membrane body exhibits a reinforced or strengthen portion at which engages an extension of the armature and thus acts upon the valve seat.

Other features, objects and advantages of the invention will become apparent by reference to the following detailed description and drawings in which:

FIGURE 1 is a longitudinal cross-sectional view of a preferred form of electromagnetic valve; and

FIGURE 2 is a bottom view of the electromagnetic body.

Describing now the drawings, the magnetic system constructed according to the so-called flap or clap armature principle comprises a substantially U-shaped laminated magnet yoke 1 oppositely situated with respect to the likewise laminated armature 2. This armature 2 supports a short-circuit ring 3 which, in known manner, has the function of generating a phase displaced flux in a portion of the air gap 4, in order that the system during operation with alternating-current voltage does not hum. The flap armature 2 is encircled by a coil body 5 carrying the winding or coil means 6. The contact terminals 7 are connected to the coil body 5 to permit infeed of current. The ends of the winding 6 are connected to the contact terminals 7 in known manner and for such reason not further illustrated. A further contact 8 serving as ground connection is electrically conductively connected with the yoke 1.

The flap armature 2 is elongated towards its lower end to provide an extension or projection 9 which actuates the actual valve. A diaphragm or membrane body 10 serves to seal the electromagnetic system against the medium. It is manufactured, depending upon the material to be controlled, from natural rubber, a Buna variety rubber, neoprene, polyvinyl chloride, polytetrafluoride ethylene

or other elastomers. Where as the membrane or diaphragm body member 10 carries at its outer circumferences an O-ring type bead 11, the lower portion 12 is strengthened or reinforced in such a manner that at the same time there results an elastic sealing member for the screws 13 and 14 providing valve seats. In order to brace against the pressure of the medium a support mounting or fitting 15 is provided at the upper central region of the membrane body 10, this support mounting 15 can be provided at its upper edge with an encircling bead 15a. A cover plate 16 provided at its central region with an appropriate recess 16a supports the membrane body 10 towards the top against the pressure of the medium.

The actual valve body, which in the illustrated embodiment represents a three-way valve, is generally designated by reference numeral 17. While the medium, compressed air for instance, is connected to an inlet threading 18, the discharge means 19 provided with threading serves for removing the used compressed air. A consumer is connected at 20 in known manner. The valve seats 13 and 14 are sealed by the O-rings 21 and at the same time are adjustably positionable along their axis by suitable threading provided at the valve body 17.

Finally, the magnetic structure has poured or pressed therearound a plastic, preferably epoxy resin, such that a bearing or contact location results for an upper extension 22 of the flap armature 2. During this pouring operation metal tubes or pipes 23 (FIGURE 2) are imbedded. By virtue of these metal tubes 23 and with the aid of non-illustrated screws the compact poured electromagnetic housing or body 24 and the valve housing or body 17 are rigidly connected with one another. During the pouring operation there can be simultaneously imbedded a hollow sleeve or bushing 25 containing a screw 26. A lubricating or damping oil or paste mass can be introduced through the opening of the bushing 25 which either insures for noiseless operation or long service life, or both characteristics.

In FIGURE 2 there are visible the springs 27 which are partially seated within lengthwise displaceable slides or pistons 28. These slides 28 engage with grooves 29 at the short-circuit ring 3. The springs 27 and slides 28 ensure for the necessary pressure in the terminal position of the valve depending upon use. Instead of the spiral springs 27 the necessary force can also be generated by means of a leaf or blade spring secured in the body 24 and extending along the armature 2. The lengthwise movable slides 28 have the important function of providing an advantageous damping which is to be brought about in a small space. For this purpose, they slide with small lateral play in the body 24 and are likewise relatively narrowly limited with respect to height by the cover plate 16. Due to the filling of damping materials of different viscosity it is possible to considerably adjust operating characteristics with regard to time and noise of the magnetic system. It is furthermore possible by appropriate dimensioning of the slides and/or by channels or also by small valves to differently dampen attraction and falling-off. Finally, it is here mentioned that the valve seats 13 and 14 are defined by nozzle-like bodies provided with threading at 13a and 14a respectively, to permit adjustment axially within the valve unit and in the direction of movement of the armature 2, the protecting portion 9 of which extends into the pocket-like compartment 12a of the diaphragm 10.

For the contingency that the current is not available there is provided an advantageous emergency hand-actuation. This comprises a transversely throughpassing shaft 30 entraining a cam 31. For the actuation itself there is provided a lever 32 which is pressed, under the action of the torsion spring 33, against a stop 34.

The manner of operation of the illustrated electromagnetic valve should be apparent from the drawings and accompanying description. Upon excitation of the magnetic winding or coil 6 the flap armature 2 is pulled against

the yoke 1. Due to the extension 9 of the flap armature 2 the encircling lower portion 12 is raised from the valve seat 14 and pressed against the valve seat 13. As a result, there occurs in known manner the switching operation. The medium upwardly presses the diaphragm or membrane body 10, whereby the pressure of the medium is absorbed by the support mounting 15.

In the event the current supply is not available, then, by rocking the lever 32 the shaft 30 can be rotated against the force of the spring 33 such that the cam 31 moves the flap armature 2 towards the yoke 1. The dimensions and inclination of the cam 31 are so constructed that in so doing there still remains a minimum air gap between flap armature 2 and yoke 1. Furthermore, spring 33 is dimensioned such that the cam 31 due to frictional engagement with the flap armature 2 remains in the position displaced by hand. As soon as the current is again available, then, the armature 2 completely attracts whereby cam 31 is released. The actuating mechanism incorporating the shaft 30, cam 31 and lever 32 flies back against the stop 34 under the action of the spring 33 into the starting position.

While there is shown and described a present preferred embodiment of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practised within the scope of the following claims.

What is claimed is:

1. An electromagnetic valve comprising means providing a magnetic system capable of operating with alternating current and constructed as a compact unit, said means including a housing member of plastic material enclosing said magnetic system, an armature arranged at approximately the location of the longitudinal axis of said magnetic system, said armature having a projecting portion, and coil means surrounding said armature; a valve unit providing a throughpassage means and including a valve housing and valve seat means, said valve housing being directly connected with said housing member of said magnetic system; diaphragm-like means arranged in said valve housing such as to be urged by the pressure prevailing in said valve housing towards said housing member of said magnetic system and to provide an integral hinge-type oscillating valve member for said throughpassage means, said diaphragm-like means comprising an elastic diaphragm member provided with an integral sleeve portion cooperating in sealing relation with said valve seat means, said elastic diaphragm being positioned between said housing member of said magnetic system and said valve housing to seal said magnetic system from said valve unit, said projecting portion of said armature protruding into operable contact with said integral sleeve portion of said elastic diaphragm member to urge said integral sleeve portion to coact directly with said valve seat means, and wherein said housing member of said magnetic system includes means for enabling introduction of a dampening medium internally of said housing member, slide means cooperating with said armature for determining the operating behavior of said magnetic system in dependence upon the viscosity of a dampening medium, and spring means for loading said slide means to urge said armature into its starting position.

2. An electromagnetic valve as defined in claim 1 further including a hand-operated mechanism for directly, manually actuating said armature.

3. An electromagnetic valve as defined in claim 2 wherein said hand-operated mechanism incorporates a shaft extending transversely with respect to said magnetic system and a cam member carried by said shaft for acting upon said armature.

4. An electromagnetic valve as defined in claim 3, further including a yoke cooperating with said armature, said hand-operated mechanism further includes a return spring member cooperating with said shaft, said return spring member possessing a strength such that the cam

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member does not return into its starting position due to the return force exerted on said armature by said spring means of said slide means when the armature is not completely attracted to the yoke, yet when said armature is attracted to said yoke said cam member is released to such an extent that said hand-operated mechanism returns into its starting position.

5. An electromagnetic valve as defined in claim 4 wherein said valve seat means is defined by at least one rotatable nozzle-like body which can be adjustably positioned within said valve unit in the direction of movement of said armature.

6. An electromagnetic valve construction comprising a housing member, an armature provided with a projecting portion, said armature being hingedly supported for movement within said housing member, a coil surrounding said armature disposed within said housing member, a valve unit including a valve housing connected with said housing member, a diaphragm member disposed at the region of the interface between said housing member and said valve housing, said diaphragm member including an integral extended sleeve portion located within said valve housing and providing a pocket-like compartment into which extends said projecting portion of said armature, at least one valve seat arranged in said valve housing capable of being closed directly by said integral extended sleeve portion of said diaphragm member, said electromagnetic valve construction further including means for manually actuating said armature.

7. An electromagnetic valve construction comprising: electromagnetic actuating means including an armature hingedly mounted for movement, said armature having a projecting portion;

a valve unit comprising at least one valve seat; and a single, one-piece elastic diaphragm member disposed between said valve unit and said electromagnetic actuating means to effect a seal between said valve unit and said electromagnetic actuating means, said single, one-piece elastic diaphragm member incorporating a sleeve portion at the central region thereof, said

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sleeve portion defining a pocket which extends into said valve unit in proximity to said at least one valve seat, said projecting portion of said armature extending into said pocket, said sleeve portion of said one-piece elastic diaphragm member directly effecting a selective seal of said at least one valve seat upon movement of said armature.

8. An electromagnetic valve construction as defined in claim 7, further including a support fitting provided at the central region of said elastic diaphragm member partially extending into said pocket.

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