June 15, 1943. W. A. RAY 2,321,853

VALVE STRUCTURE

Filed Feb. 9, 1942

Fig. 1

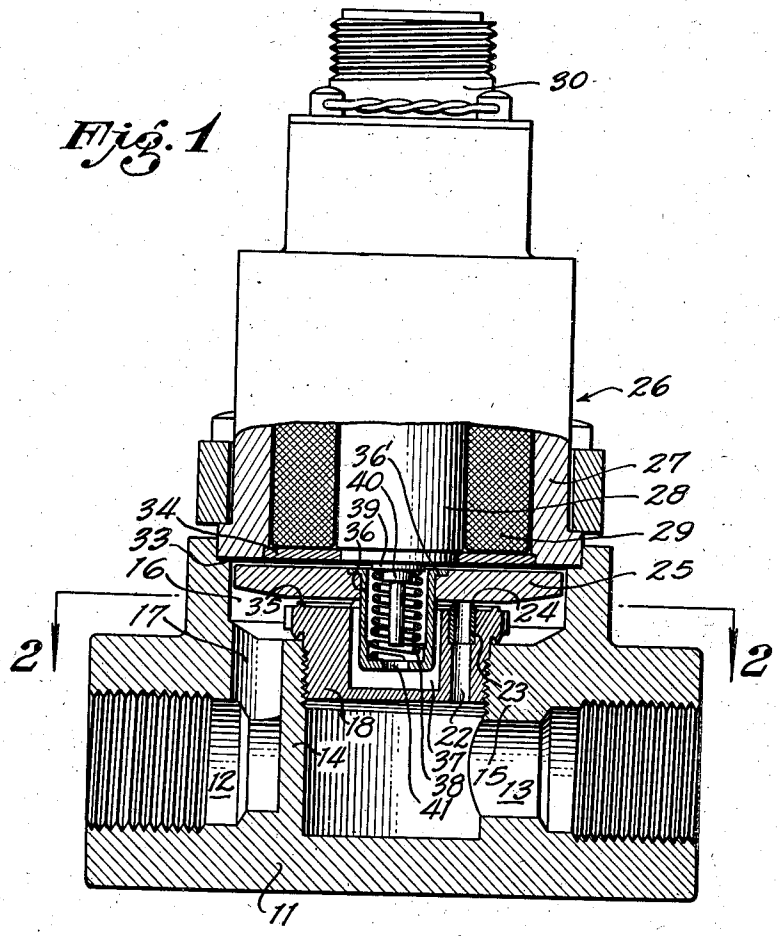
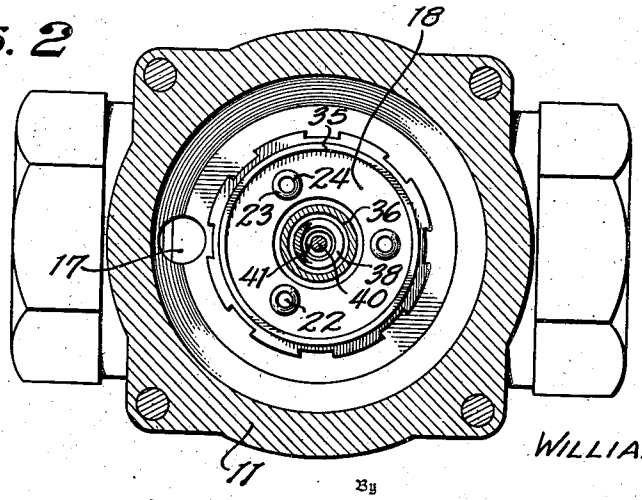


Fig. 2



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VALVE STRUCTURE

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5 Claims. (Cl. 137—139)

My present invention relates to improvements in electro-magnetically-operated fluid-control valves, and particularly to those of the type employing a disk-shaped closure member, spring biased to closed position; the closure member being of magnetic material so that it also serves as the movable element, or armature, in the electromagnetic system.

It is desirable to incorporate, in a valve of the type indicated, means for sealing the electromagnet from the fluid controlled by the valve. Such sealing means may conveniently be in the form of a thin flat diaphragm of non-magnetic material arranged to cover the pole face of the electromagnet so that it also serves as means for preventing magnetic "sticking" of the armature-closure-member to the pole face when the electromagnet is deenergized. Such a construction is disclosed in my copending application, Serial No. 342,493, filed June 25, 1940. The diaphragm is preferably not more than 0.005 inch in thickness and hence must be solidly and uniformly backed up, or reinforced, by the electromagnet to prevent its flexure and consequent rupture by engagement of the armature therewith. In such a valve, it has been the practice to utilize a contractile armature-biasing spring (connected to the side of the armature away from the electromagnet) rather than a spring of the compression type, because of the difficulty of applying the latter. This difficulty arises, both because the armature is usually too thin to permit recessing of the same for a compression spring, and also because the presence of the diaphragm prohibits similar recessing of the electromagnet core. However, a compression spring has certain distinct advantages, such as its ease of placement in assembly, and it is therefore a main object of this invention to provide means whereby a compression spring can be utilized in connection with an electromagnetically operated valve of the type indicated.

Another object is the provision of means for receiving the biasing spring, which means is associated with the armature-closure-member but does not require rigid attachment thereto.

Other objects and advantages will be found in the description, the drawing and the appended claims; and for complete understanding of the invention reference may be had to the following detailed description and accompanying drawing, wherein:

Figure 1 is a longitudinal view, mainly in section, of a valve embodying my invention; and

Figure 2 is a transverse section taken along the line 2—2 of Fig. 1.

In the drawing, the numeral 11 indicates a valve casing having an inlet 12 and an outlet 13 separated by a vertical partition 14 which integrally connects the bottom wall of the casing with a horizontal partition 15. The top surface of the partition 15 forms the bottom of a chamber 16 which is fluidly connected with the inlet 12 by a passage 17. Threaded in an opening through the horizontal partition 15, which opening interconnects the chamber 16 and the outlet 13, is a member 18 having a plurality of port openings 22 therethrough. Pressed in the enlarged upper ends of the openings 22 are tubular inserts 23 providing at their upper ends knife-edged valve seats 24, all of which terminate in a single plane spaced above the top surface of the member 18. A disk-like metallic closure member 25, cooperable with the seats 24, controls fluid flow through the valve.

Mounted on the top wall of the casing 11, and closing the open upper end of the chamber 16, is an electromagnet 26 having a cup-shaped outer core 27 and a solid cylindrical inner core 28, between the adjacent walls of which cores is an energizing coil 29. On the top end of the core 27 is mounted a socket 30 for connecting the electromagnet to a source of energy. The closure member 25 is of magnetic material and is adapted to be attracted to its open position by the electromagnet. A thin non-magnetic metallic diaphragm 33 is clamped at its margin between the lower end of the outer core 27 and the casing 11 to seal the parts of the electromagnet from the fluid controlled by the valve, and also to provide an air gap between the closure member and the electromagnet which serves to prevent magnetic sticking of these parts when the electromagnet is deenergized. A ring 34, of non-magnetic metal, is set in the shouldered lower ends of both the inner and outer cores to provide, with these parts, an unbroken plane surface abutting the top surface of the diaphragm 33 to prevent flexure and consequent rupture thereof.

A raised, annular portion 35 of the member 18 encompasses the valve seats 24, the top surface of the annular portion being positioned slightly below, but closely adjacent, the plane of the seats 24 to minimize uneven wear of the seats by limiting the degree of tilt that the closure member can assume in its engagement therewith. This feature is fully described and claimed in my copend-

ing application, Serial No. 418,707, filed November 12, 1941.

Extending through a central opening in the armature 25, and supported on the armature by a flange 36' formed at its upper end, is a cup-shaped metallic receptacle, or shell 36, the lower portion of which extends loosely into a cylindrical recess 37 formed in the upper portion of the member 18. The flange 36' rests in an enlargement of the closure member opening and is flush with the top surface thereof. Within the receptacle 36, and compressed between the lower wall thereof and that portion of the diaphragm 33 abutting the inner core 28, is a helical spring 38 adapted to exert a constant force urging the closure member toward the seats 24. The upper end of the spring is provided with a diaphragm-protecting head 39, the underside of the head being reduced in diameter so that it fits within the spring coils. An opening 41 in the lower wall of the receptacle 36 permits escape of fluid that otherwise might cause a dash-pot effect in the upward movement of the closure member.

While I have herein shown and described, by way of illustration, a specific embodiment of my invention, I wish it to be understood that modifications may be made without departing from the spirit of the invention, and that I intend therefore to be limited only by the scope of the appended claims.

I claim as my invention:

1. In a fluid control valve: a casing having an inlet and an outlet separated by a ported partition providing a valve seat, a movable disk-like closure member cooperable with said seat and constructed wholly or in part of magnetic material, an electromagnet mounted on said casing and having a pole face closely adjacent the side of said closure member away from said seat and adapted when energized to attract the closure member, said closure member having an opening therethrough, a compression spring biasing the closure member toward closed position, said spring extending through said opening and having one end in engagement with said pole face, and means mounted in said opening and forming an abutment for the other end of the spring.

2. In a fluid control valve: a casing having an inlet and an outlet separated by a ported partition providing a valve seat, a movable disk-like closure member cooperable with said seat and constructed wholly or in part of magnetic material, an electromagnet mounted on said casing and having a pole face closely adjacent the side of said closure member away from said seat and adapted when energized to attract the closure member, the closure member having an opening centrally therethrough, a shell secured in said opening and so positioned that an open end thereof is substantially flush with the surface of said closure member adjacent said pole face, a helical spring in said shell, and an abutment in said shell between which and said pole face said spring is compressed.

3. In a fluid control valve: a casing having an inlet and an outlet separated by a ported partition providing a valve seat, a movable disk-like closure member cooperable with said seat and constructed wholly or in part of magnetic material, said casing having an opening in a wall thereof opposite said seat, an electromagnet supported exteriorly of said casing on a portion thereof encompassing said opening, a thin flat diaphragm of non-magnetic material extending across said opening and separating the interior of said casing from said electromagnet, the margin of said diaphragm being secured between the casing and said electromagnet, the electromagnet having a pole face abutting a central portion of said non-magnetic partition and being adapted when energized to move the closure member away from its seat, the closure member having a central aperture therethrough, a cup-shaped member secured in said aperture and so positioned that its open end is substantially flush with the surface of said closure member adjacent said pole face, and a helical spring within said cup-shaped member and compressed between the end wall thereof and said pole face.

4. In a fluid control valve: a casing having an inlet and an outlet separated by a ported partition providing a valve seat, a movable disk-like closure member cooperable with said seat and constructed wholly or in part of magnetic material, an electromagnet mounted on said casing having a pole face closely adjacent the side of said closure member away from said seat and adapted when energized to attract said closure member, the closure member having a central opening therethrough, a cup-shaped member in said opening having a flanged open end adjacent said pole face, the portion of the closure member around said opening and adjacent said pole face being recessed to receive said flanged end, and a helical spring within said cup-shaped member and compressed between the end wall thereof and said pole face.

5. In a fluid control valve: a casing having an inlet and an outlet separated by a ported partition providing a valve seat, a movable disk-like closure member cooperable with said seat and constructed wholly or in part of magnetic material, said casing having a wall-opening opposite said seat, an electromagnet supported exteriorly of said casing on the portion thereof encompassing said opening, a thin partition of non-magnetic material extending across the opening and between the closure member and the electromagnet, the margin of said non-magnetic partition being secured between said casing and said electromagnet, the electromagnet having a pole face abutting a central portion of said non-magnetic partition and being adapted when energized to move said closure member away from said seat, said closure member having an aperture centrally therethrough, a cup-shaped member in said aperture having a flanged open end adjacent said pole face, the portion of said closure member around said aperture and adjacent said pole face being recessed to receive said flanged end, and a helical spring within said cup-shaped member and compressed between the end wall thereof and said pole face.

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