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MAGNETICALLY-CONTROLLED VALVE

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Fig. 1.

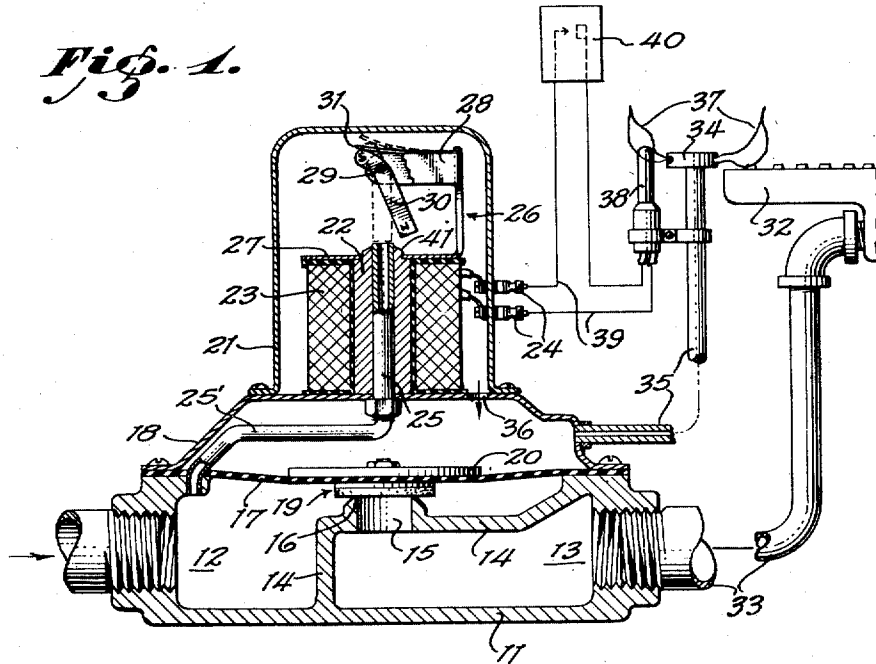
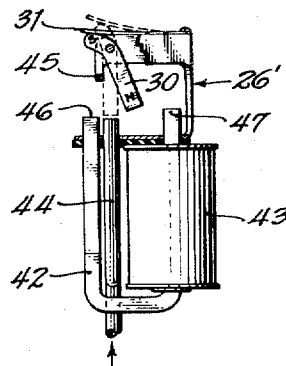


Fig. 2.



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MAGNETICALLY-CONTROLLED VALVE

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8 Claims. (Cl. 138—25)

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This invention relates to magnetically operated valves, and more particularly to a valve adapted to be operated between an open and a partially-closed, as distinguished from fully-closed, position. Such a valve has particular utility as a pilot valve for controlling supply of pressure fluid to a motor which comprises a pressure chamber continuously vented through a restriction; the valve being so arranged that when fully-open its flow capacity is greater than that of the restriction so that pressure is then built-up in the chamber, and substantially the same as or slightly less than that of the restriction when in said partially-closed position so that the pressure in the chamber is reduced.

An object of this invention is to provide a pilot valve of the character described which, while very simple and easily constructed, is so sensitive that it can be operated by the small amount of electrical energy (5–20 milliwatts) generated by a conventional thermocouple or thermopile heated by a small flame such as that of a pilot burner. This object is accomplished by so arranging the swingable armature of an electromagnet that when the armature is in attracted position an end of the same is closely adjacent, but out of engagement with, the mouth of a pilot-jet member so that the flow capacity thereof is substantially reduced.

A further object is to increase the sensitivity of the pilot valve by forming the armature as a permanent magnet adapted to swing freely into alignment with the lines of force of the electromagnet.

For full understanding of the invention, and further appreciation of its features and advantages, reference is to be had to the following detailed description and accompanying drawing, and to the appended claims.

In the drawing:

Figure 1 is a sectional view of a diaphragm valve which includes a pilot valve embodying features of this invention; and

Figure 2 is a view, in elevation, of a modified form of pilot-valve operator according to the invention.

Referring first more particularly to Fig. 1 of the drawing, the numeral 11 indicates a valve casing having an inlet 12 and an outlet 13 separated by a partition 14 having a port 15 which terminates at its upper end in a valve seat 16. Covering the open top of the casing 11 is a flexible diaphragm 17, of material such as leather or rubber, which is clamped at its margin between the rim of the casing and the flange of a sub-

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housing 18 secured to the casing. Carried by the diaphragm is a closure member 19 cooperable with the seat 16; a disk 20 serving as a gravity bias for the diaphragm and closure.

Supported on top of the sub-housing 18, and encompassed by a housing 21, is an electromagnetically-operated pilot-valve assembly. This assembly includes an electromagnet consisting of a cylindrical core 22 around which is a coil 23 whose leads are connected to terminal posts 24 insulatingly mounted in the side wall of the housing. Fitting tightly in a central opening through the core 22 is a pipe 25 whose mouth is substantially flush with the top of the core, the pipe being in communication with the inlet 12 of the valve casing by way of an extension 25' sealingly secured at its lower end in a hole through an inward extension of the rim of the casing. On top of the electromagnet is a bracket 26, of non-magnetic metal, the lower horizontal portion 27 of which has an opening tightly fitting the reduced upper end of the core. The top portion of the bracket is formed to provide a pair of spaced-apart horizontal arms 28 between which, and pivotally mounted thereon by a pin 29, is an armature 30 of permanently magnetized metal and conveniently square in cross-section. The armature is biased to an inclined position, as shown in solid lines, by a light leaf-spring 31 secured to the bracket 26 and bearing against the rounded extremity of the bent upper portion of the armature.

The diaphragm valve is shown associated with a gas-burner system comprising a main burner 32 connected by a pipe 33 to the outlet 13 of the valve casing, and a pilot burner 34 which is connected by a pipe 35 to the pressure chamber defined by the diaphragm 17, the sub-housing 18, and the housing 21; the interior of these housings being in continuous communication by way of an opening 36 through the top wall of the sub-housing. The flames 37 of the pilot burner serve to ignite the main burner and also to heat a thermocouple or thermopile 38 of conventional construction and adapted to generate electricity in a well-known manner; the thermocouple being connected by wires 39 to the terminals 24 of the electromagnet in series with an automatic switching device or thermostat 40.

With the parts in the positions shown in Fig. 1, and assuming that the inlet 12 of the valve casing is connected to a supply of fuel-gas under pressure, the main closure 19 is seated by gravity inasmuch as the gas pressure on both sides of the diaphragm is then substantially the

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same; the capacity of pipe 25-25' being, as shown in the drawing, considerably greater than that of pipe 35 so that the flow of gas to the pilot burner does not substantially reduce the pressure in the chamber above the diaphragm.

The energizing circuit of the electromagnet 22-23 is so arranged that when the thermostat 40 is closed the pole 41 of the core has a polarity opposite to that of the adjacent pole of the permanently-magnetized armature 30 so that the same is attracted and assumes the position shown in broken lines wherein it is so closely adjacent the mouth of the jet or pipe 25 that flow therethrough is restricted to an amount only sufficient to maintain flame at the pilot burner; the gas pressure in the chamber above the diaphragm consequently being so reduced that the diaphragm is forced upwardly by the pressure acting on its underside and the main closure 19 is opened.

The sensitivity of operation of the pilot valve is due mainly to the fact that the armature is arranged to swing relatively freely into alignment with the force-lines of the electromagnet, generally in the same manner as a magnetic compass; and very little power is required to hold the armature in attracted position against the pressure of the gas flowing through the jet since that pressure is applied symmetrically to the armature and therefore has little tendency to disturb it. To avoid the possibility of the armature being retained in attracted position by the linkage of its lines of permanent-magnetic force with the core, the armature is so arranged that it is relatively-widely spaced from the pole-face 41 of the core; the pole-face being preferably tapered as shown to increase this effect, as well as to concentrate the lines of force along the axis of the armature when the electromagnet is energized. The jet 25 is preferably of non-magnetic material.

The modified form of pilot valve shown in Fig. 2 is substantially identical in operation with the pilot valve of Fig. 1, and comprises a U-shaped core 42 having around one of its side arms a coil 43. The jet or pipe 44 is arranged closely adjacent the other side arm of the core, the pipe being bent at its lower end so that its top or mouth is on a line directly between the side arms. The bracket 25' is modified to provide an abutment 45 for stopping the armature 30, when it is attracted against the bias of spring 31 upon energization of the electromagnet, in the position shown in broken lines wherein it is in alignment with the jet and adjacent the pole-face 46 of the core; the proximity of the repelling pole 47 increasing the sensitivity of operation.

The specific embodiments of my invention herein shown and described are obviously susceptible of modification without departing from the spirit of the invention, and I intend therefore to be limited only by the scope of the appended claims.

I claim as my invention:

1. In a valve operator: an electromagnet, an armature member attractable by said electromagnet and biased therefrom, and a jet member so disposed that when said armature member is attracted the same is brought into alignment with the jet member and is then spaced by a small distance from the mouth thereof so that the flow capacity of the jet member is substantially reduced.

2. In a valve operator: a jet member; an elec-

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tromagnet; and an elongated armature member attractable by said electromagnet and biased therefrom; said armature member being pivoted at a point substantially on the axis of said jet member and swingable, when attracted, to a position wherein it is aligned with the jet member and so closely adjacent the mouth thereof as to substantially reduce flow therethrough.

3. In a valve operator: an electromagnet an elongated armature member, permanently magnetized longitudinally, so mounted relative to said electromagnet that when the same is energized the armature member is attracted from a biased position to another position wherein it is out of engagement with the electromagnet but substantially aligned with the lines of force thereof; and a jet member so disposed that its mouth is closely adjacent but out of engagement with said armature member when the same is in said attracted position, so that the flow capacity of the jet member is then substantially reduced.

4. In a valve operator: an electromagnet comprising a core and a coil for energizing said core; an elongated armature member, permanently magnetized longitudinally, so pivotally mounted on said electromagnet that when the same is energized the armature member swings from a biased position to another position wherein an end thereof is adjacent but spaced from a pole-face of said core; and a jet member mounted adjacent said pole-face so that, when the armature member is attracted, the mouth of the jet member is so closely adjacent said end of the armature member that the flow capacity of the jet member is substantially reduced.

5. In a valve operator: an electromagnet comprising a core and a coil for energizing said core; an elongated armature member, permanently magnetized longitudinally, so pivotally mounted on said electromagnet that when the same is energized the armature member swings from a biased position to another position wherein an end thereof is adjacent but spaced from a pole-face of said core; and a jet member mounted adjacent said pole-face so that, when the armature member is attracted, the mouth of the jet member is so closely adjacent said end of the armature member that the flow capacity of the jet member is substantially reduced; said mouth of the jet member being substantially in the plane of said pole-face.

6. In a valve operator: an electromagnet comprising a core having a portion defining at its end a pole-face; an elongated armature member, permanently magnetized longitudinally, pivoted at a point substantially on the axis of said core-portion and attractable, when the electromagnet is energized, so that it swings from a biased position inclined from said axis into substantial alignment therewith so that an end of the armature member is adjacent said pole-face but spaced by such a distance therefrom that the permanent flux of the armature member is ineffective to retain the same in said attracted position when the electromagnet is deenergized; and a jet member also substantially aligned with said axis and so disposed that when said armature member is in said attracted position an end of the same is so closely adjacent the mouth of the jet member that flow therethrough is substantially reduced.

7. In a valve operator: an electromagnet comprising a core having a portion defining at its end a pole-face; an elongated armature member, per-

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manently magnetized longitudinally, pivoted at a point substantially on the axis of said core-portion and attractable, when the electromagnet is energized, so that it swings from a biased position inclined from said axis into substantial alignment therewith so that an end of the armature member is closely adjacent said pole-face but spaced by such a distance therefrom that the permanent flux of the armature member is ineffective to retain the same in said attracted position when the electromagnet is deenergized; and a jet member also substantially aligned with said axis and so disposed that when said armature member is in said attracted position an end of the same is so closely adjacent the mouth of the jet member that flow therethrough is substantially reduced; said mouth of the jet member being substantially in the plane of said pole-face.

8. In a valve operator: an electromagnet comprising a core having a portion defining at its end

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a pole-face; and an elongated armature member, permanently magnetized longitudinally, pivoted at a point substantially on the axis of said core-portion and attractable, when the electromagnet is energized, so that it swings from a biased position inclined from said axis into substantial alignment therewith so that an end of the armature member is then closely adjacent said pole-face but spaced therefrom so that the permanent flux of the armature member is ineffective to retain the same in said attracted position when the electromagnet is deenergized; said core-portion being bored to constitute the same a jet member having its mouth located in said pole-face, so that when the armature member is in said attracted position flow through the jet member is substantially reduced.

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No references cited.