April 7, 1959 G. E. DIETZ 2,881,366

MAGNETIC CONTROL STRUCTURE

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Fig. 1.

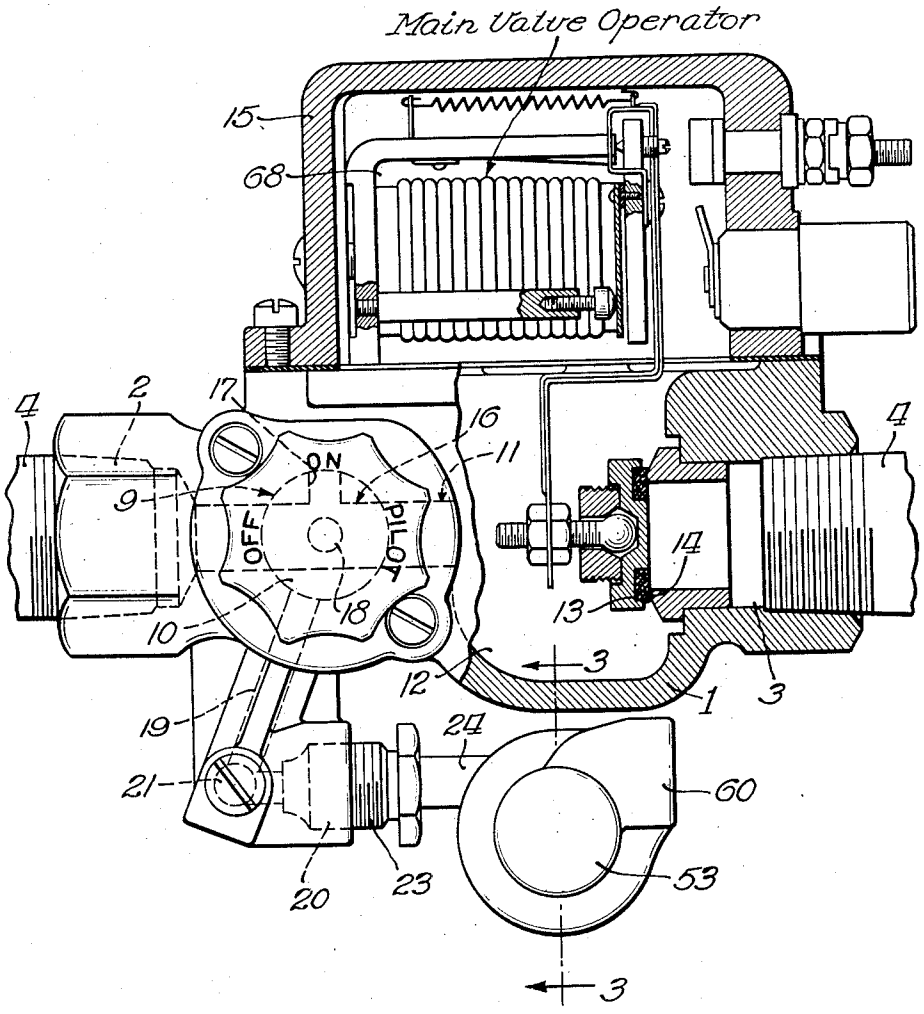

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Fig. 2.

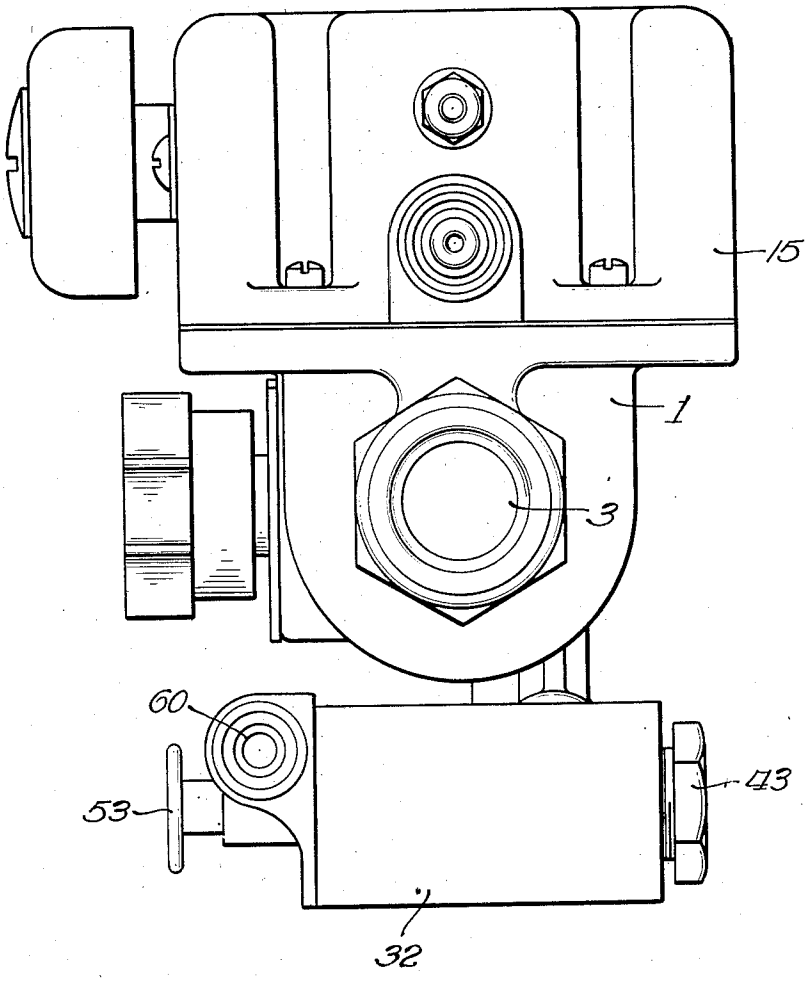

Fig. 6.

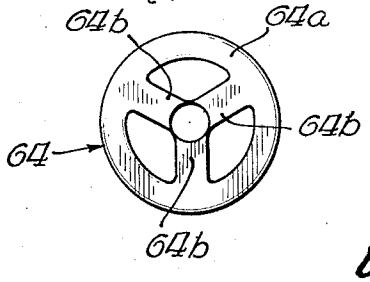

Fig. 8.

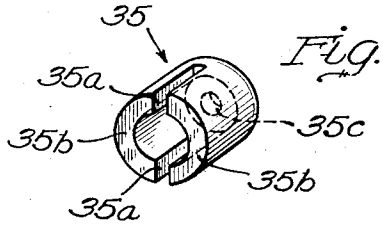

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Fig. 3.

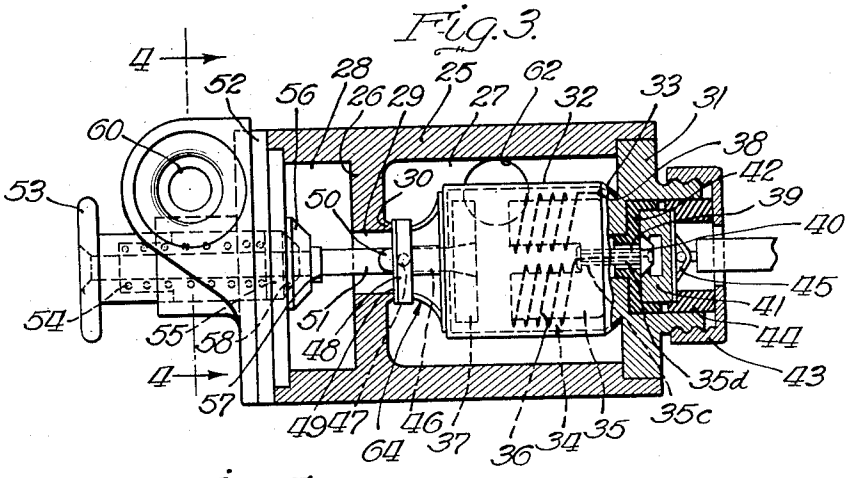


Fig. 4.

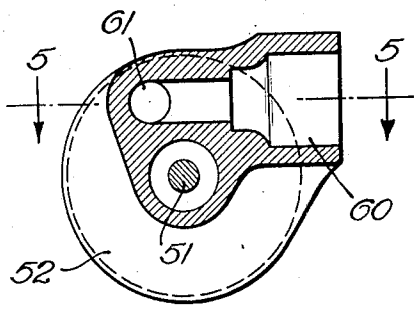


Fig. 5.

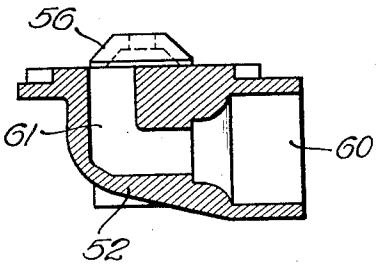
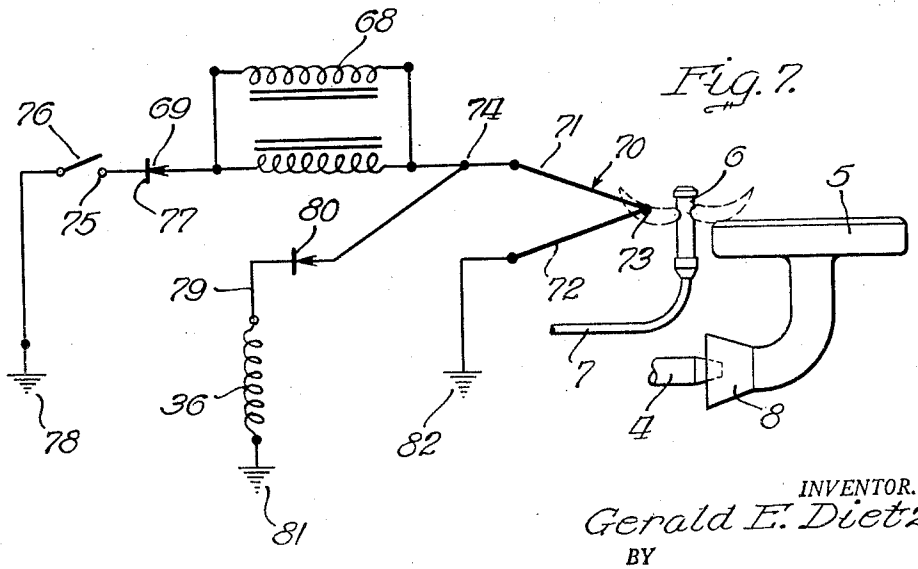


Fig. 7.



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United States Patent Office 2,881,366
Patented Apr. 7, 1959

2,881,366

MAGNETIC CONTROL STRUCTURE

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Application July 2, 1952, Serial No. 296,831

1 Claim. (Cl. 317—198)

This invention relates, in general, to thermoelectric safety shut-off devices, and more particularly, to a thermoelectric safety shut-off valve having particular utility as a pilot burner shut-off valve for use with automatic condition responsive valves where 100% safety shut-off is desired upon extinguishment of a pilot burner flame.

One of the main objects of the invention is to provide an improved safety shut-off valve for pilot burners which may be readily applied to the pilot burner fuel outlet of an automatic temperature responsive main burner valve and which is interchangeable with the usual form of pilot burner fuel supply pipe connection so that the automatic temperature responsive main burner valve may be used selectively with or without the pilot burner safety shut-off valve.

Another object is to provide a pilot burner safety shut-off valve of small, simple and compact construction and which may be installed and operated conveniently and effectively to provide safety shut-off for the small amount of fuel for a pilot burner where 100% safety shut-off is desired.

Another object is to provide a pilot burner safety shut-off valve having a small tubular valve body with a cover for one end of the same through which the reset stem has reciprocatory movement and which cover has a fuel passage opening therethrough in communication with one of a pair of chambers within the valve body.

Another object is to provide for closing the opposite end of such a valve body by a terminal bushing having in insulated relation therein a terminal tip provided with means for detachably connecting a conductor in circuit with the electromagnet of the safety shut-off means.

Another object is to provide in a pilot burner safety shut-off valve a cup carried by the terminal bushing at one end of the tubular body which encloses the electromagnet and armature of the safety shut-off means and is disposed within one of the chambers within the valve body with an annular space between it and the tubular body which constitutes a part of the chamber within which the cup is disposed.

Further objects and advantages of the invention will appear from the following detailed description taken in connection with the accompanying drawings in which:

Figure 1 is a view partially in section and partially in elevation of the body of an automatic condition responsive valve showing in end elevation a pilot burner shut-off valve embodying the present invention as applied to the pilot burner fuel outlet thereof;

Figure 2 is a fragmentary end view of the body of the automatic condition responsive valve showing the pilot burner shut-off valve in side elevation;

Figure 3 is a longitudinal axial section through the safety shut-off valve for the pilot burner taken on the line 3—3 of Figure 1;

Figure 4 is a detail section taken on the line 4—4 of Figure 3;

Figure 5 is a detail section taken on the line 5—5 of Figure 4;

Figure 6 is a plan view of the spring for actuating the shut-off valve member to closed position and the armature to retracted position when the pilot burner flame is extinguished;

Figure 7 is a circuit diagram which includes a diagrammatic showing of the main burner and the pilot burner; and

Figure 8 is a perspective view of the cup-shaped magnet frame.

Referring to the drawings, the numeral 1 indicates a main valve body of an automatic condition responsive valve of the form illustrated and described in the copending application of Gerald E. Dietz and Adolph J. Hilgert, Serial No. 292,488, filed June 9, 1952, now Patent No. 2,822,984. The details of the valve may be ascertained more fully by reference to the aforementioned copending application. Suffice it for purposes of the present application to state that the valve body 1 has a gaseous fuel inlet 2 and a gaseous fuel outlet 3. Contiguous sections of gaseous fuel supply pipe 4 are connected to the inlet 2 and outlet 3. The section connected to the outlet 3 leads to a main burner (Figure 7) which may be located, for example, in the fire box of a space heater or other heater. A pilot burner 6 is located in juxtaposition to the main burner 5 to maintain a pilot burner flame for igniting the main burner. The pilot burner is supplied with gaseous fuel by a pilot burner fuel supply pipe 7 which is connected to the valve body 1 either directly or through a thermoelectric safety shut-off device as will presently appear. The positions of the pilot burner flames are shown in dotted lines.

The delivery of gaseous fuel from the pipe 4 to the burner 5 is preferably by way of a mixing chamber 8 to which air is admitted through adjustable air inlets (not shown) as well understood in the art.

As shown, in general, in dotted lines in Figure 1 the inlet 2 opens into a truncated hollow bore 9 in which a truncated conical plug 10 is seated for turning movement. A passage 11 opens from the bore 9 into the valve chamber 12 and a main valve member 13 cooperates with a valve seat 14 at the inner end of the fuel outlet 3 automatically to control the flow of fuel to the main burner 5 under control of an electromagnetic operator, for example, within the cover 15 and which is under control of temperature responsive means as more fully disclosed in the hereinbefore identified copending application of Gerald E. Dietz and Adolph J. Hilgert.

The plug 10 has a passage 16 opening diametrically therethrough; also a pilot fuel supply passage 17 opening radially from the passage 16 and a second pilot fuel supply passage 18 opening axially from the passage 16 through the inner end of the plug 10. The passage 18 opens into a passage 19 which is disposed at the back of the control and leads to a fuel outlet 20 for the pilot burner. The passage 19 may contain a pilot adjustment screw 21 for adjusting the flow of fuel for the pilot burner. The pilot fuel outlet 20 is internally threaded to receive a coupling sleeve or compression nut 23 for connecting the pilot fuel supply pipe 7 directly to the outlet 20 where a safety shut-off for the pilot burner is not required or for connecting the inlet 24 of the valve body 25 of the thermoelectric safety shut-off device for the pilot burner to the outlet 20.

The valve body 25 is of tubular form and has an internal transverse wall 26 dividing the interior of the body into a fuel inlet chamber 27 and a fuel outlet chamber 28. The wall 26 has a port 29 for placing the chambers 27 and 28 in communication and there is an annular valve seat 30 at the inlet end of the port 29.

One end of the body 25 is closed by a terminal bushing 31 secured in the end of the valve body, for example, by pressed fit. An electromagnet and armature cup 32

is secured to the inner side of the bushing 31, for example, by spinning it over into engagement with the bushing 31 at 33. The cup 32 is disposed within the chamber 27 with an annular space between the cup and the body 25 which constitutes at least a part of the chamber 27. The cup 32 encloses an electromagnet comprising a frame 35 and a coil 36 wound around the legs thereof; also an armature 37.

As shown in Figure 8, the magnet frame 35 is preferably of cup-shaped form having a diametrically disposed and longitudinally extending slot 35*a* forming arcuate arms 35*b* around which the coil 36 is wound. The base of the cup-shaped magnet frame 35 has an axial aperture 35*c* through which a terminal tip 35*d*, for example, extends for attachment of the magnet frame to the bushing 31. The slotted cup-shaped form of the magnet frame 35 affords the same or greater pole face area for a given diameter as compared with a U-shaped magnet frame which is of importance in the small and compact device of the present invention.

One end of the coil 36 is grounded, for example, at 38 to the bushing 31 and the opposite end of the coil extends out through the bushing 31 being insulated therefrom at 39 and is connected at 40 to a terminal tip 41. The tip 41 is insulated from the bushing 31 by an insulating sleeve 42. A terminal bushing nut 43 is screwed on the bushing 31 and an insulating ring 44 is interposed between it and the terminal tip 41. A suitable connector is provided on the terminal tip 41 at 45 for connecting the terminal tip in circuit with a thermocouple, thermopile or other source of small electric energy as will hereinafter appear.

The armature 37 is mounted preferably for relative movement on the inner end of an armature stem 46 which extends for reciprocatory movement through an opening in the end wall at the inner end of the cup 32. The outer end of the stem 46 is pivoted at 47 to a cup-shaped valve disc or shoulder means 48 internally thereof. The outer end of the valve disc 48 has a yielding valve facing or control member 49 secured thereto by rivet 50. The head of the rivet 50 is rounded and the inner end of a reset stem 51 has a conical depression for abutting engagement with the head of the rivet 50.

The reset stem 51 extends for reciprocatory movement out through a cover 52 which has, for example, pressed fit in the valve body 25 at the outer end of the chamber 28. The outer end of the reset stem 51 is provided with a reset button 53 and a spring 54 coiled about the stem 51 and interposed between the button 53 and a washer 55 acts to move the reset stem to its outwardly projected position when released. The cover 52 has an axial inwardly extending projection 56 which has an opening through which the reset stem reciprocates. A valve member 57 on the reset stem seats against the inner end of the projection 56 to close this opening when the reset stem is in its outwardly projecting position. Packing 58 is positioned about the reset stem and interposed between the washer 55 and the inner end of the tapered projection 56.

The cover 52 has an outlet 60 for connection to the pilot fuel supply pipe 7 for supplying fuel to the pilot burner 6. A passage 61 leads from the chamber 28 and through the cover 52 to the outlet 60. The inlet 24 opens into the valve chamber 27 through a port in the wall of the valve body 25 as shown at 62 in Figure 3. A spring 64 of the form shown, for example, in Figure 6 is interposed between the valve disc 48 and the adjacent end of the cup 32. The spring 64 which may be formed, for example, of beryllium copper or other spring material comprises an annular ring-like portion 64*a* having a plurality of radial spring arms 64*b* (three being shown). The ring-like portion 64*a* is adapted to bear, for example, against the adjacent end of the cup 32 and the inner ends of the fingers 64*b* press yieldingly against the valve disc 48. The spring fingers 64*b* are compressed or tensioned to substantially flat form (i.e., substantially into the plane of the ring-like portion 64*a*) by movement of the armature 37 to attracted position and act when the electromagnet is deenergized or has its energization reduced sufficiently to move the armature 37 to retracted position and the valve disc 48 to closed position seating against the valve seat 30.

The spring 64 due to its flat form occupies much less linear or axial space than the helical type of springs ordinarily used. Moreover, when compressed the spring 64 occupies little or substantially no space. This contributes to compactness and with the other features makes the safety shut-off device of the present application not only extremely small but very compact.

As shown in Figure 7, the automatic electric operator 68 for the main valve 13 and the coil 36 of the electromagnet 34 are both adapted to be powered by a thermocouple 70 although a thermopile or other source of small electric energy may be employed. The thermocouple 70 comprises dissimilar thermocouple elements 71 and 72 joined at 73 to form a "hot" junction which is heated by the pilot burner flame.

As shown more or less diagrammatically in Figure 7, the electric circuit may be from the thermocouple element 71 to a connector 74, to operator 68, to an insulated terminal 69, for example, in the valve body cover 15. Terminal 75 of the thermostat 76 is connected to a terminal 77 which makes contact with the terminal 69. The other contact of the thermostat is grounded at 78. A single conductor 79 connects one end of the coil 36 to a terminal 80 which is connected to the connector 74. The other end of the coil 36 is grounded at 81 and the thermocouple 72 is grounded at 82.

The operation of the aforedescribed embodiment of the invention is as follows:

Gas enters at 2 and with the cock 10 turned to pilot position the port 17 is in register with the inlet 2 and allows gas to flow through the gas cock passage 18 to the back of the control and through passage 19 to the pilot fuel outlet 20.

With the button 53 pressed inwardly the gas passes into the chamber 27 and thence through the port 29, chamber 28, outlet passage 60 and pilot fuel supply pipe 7 to the pilot burner 6 where it is ignited. Upon energization of the electromagnet 34 by the heat of the pilot burner flame on the thermocouple 70, the armature 37 is held attracted to the electromagnet and the valve member 48 is held in open position. The button 53 may then be released and the spring 54 moves the reset stem to its outwardly projecting position. If the thermostat is calling for heat, the operator 68 is energized sufficiently to move the main valve member 13 to open position. Turning the gas cock 10 to "On" position places the port 16 in register with the inlet 2 and passage 11 allowing gas to flow out through the outlet 3 to the main burner where it is ignited by the pilot burner. When the ambient temperature surrounding the thermostat 76 reaches a point where the energization of the operator 68 is insufficient to hold the main valve member 13 open, this valve is released and moves to closed position shutting off the flow of fuel to the main burner.

If at any time the flame of the pilot burner 6, which should burn constantly, becomes extinguished thereby creating an unsafe condition, the thermocouple 70 will be deenergized or at least will not energize the operator 68 and the electromagnet 34 sufficiently to hold the main valve 13 and the pilot burner valve 48 in their open positions. When this occurs the main valve 13 and the pilot burner valve 48 move to their closed positions to provide 100% shut-off of the fuel.

The embodiment of the invention shown in the drawings is for illustrative purposes only and it is to be expressly understood that said drawings and the accompanying specification are not to be construed as a definition of the limits or scope of the invention, reference being had to the appended claim for that purpose.

I claim:

A compact magnetic control structure comprising, a cylindrical protective housing having an end wall with a coaxial opening therein, a cylindrical cup-shaped magnet coaxially mounted within said housing having a diametrical slot extending axially inwardly from the end thereof adjacent said end wall and imparting thereto a generally U-shape including opposing arms of C-shaped cross-section each terminating in a C-shaped pole face, a circular armature having a diameter corresponding substantially to the outer diameter of said magnet coaxially mounted in said housing for coaction with said pole faces and movement to attracted and retracted positions with respect thereto, said pole faces being shaped for coaction with peripheral surface portions of said armature only, said armature having a stem portion extending through said end wall opening and adapted for connection to a member to be controlled, shoulder means on said stem, a spring member having a flat annular portion mounted on said end wall coaxial with and in a plane normal to the axis of said stem, said spring also having a plurality of spring arms which are normally axially bowed with respect to the plane of said annular portion into engagement with said shoulder means to bias the latter axially away from said end wall and hence the armature to retracted position, said spring arms being deformable substantially into the plane of said annular portion by disposition of said armature in attracted position, thereby affording said control structure relatively small axial dimensions, the cylindrical cup-shape of said magnet permitting the use of a reduced diameter magnet for a given magnet strength and hence a control structure of relatively small diametrical as well as axial dimension.

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