

April 28, 1936.

H. A. MANTZ

2,038,748

DIAPHRAGM VALVE

Filed Sept. 24, 1932

2 Sheets-Sheet 1

Fig. 1

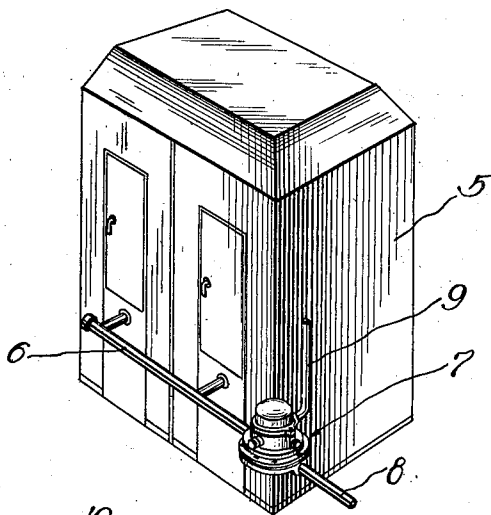
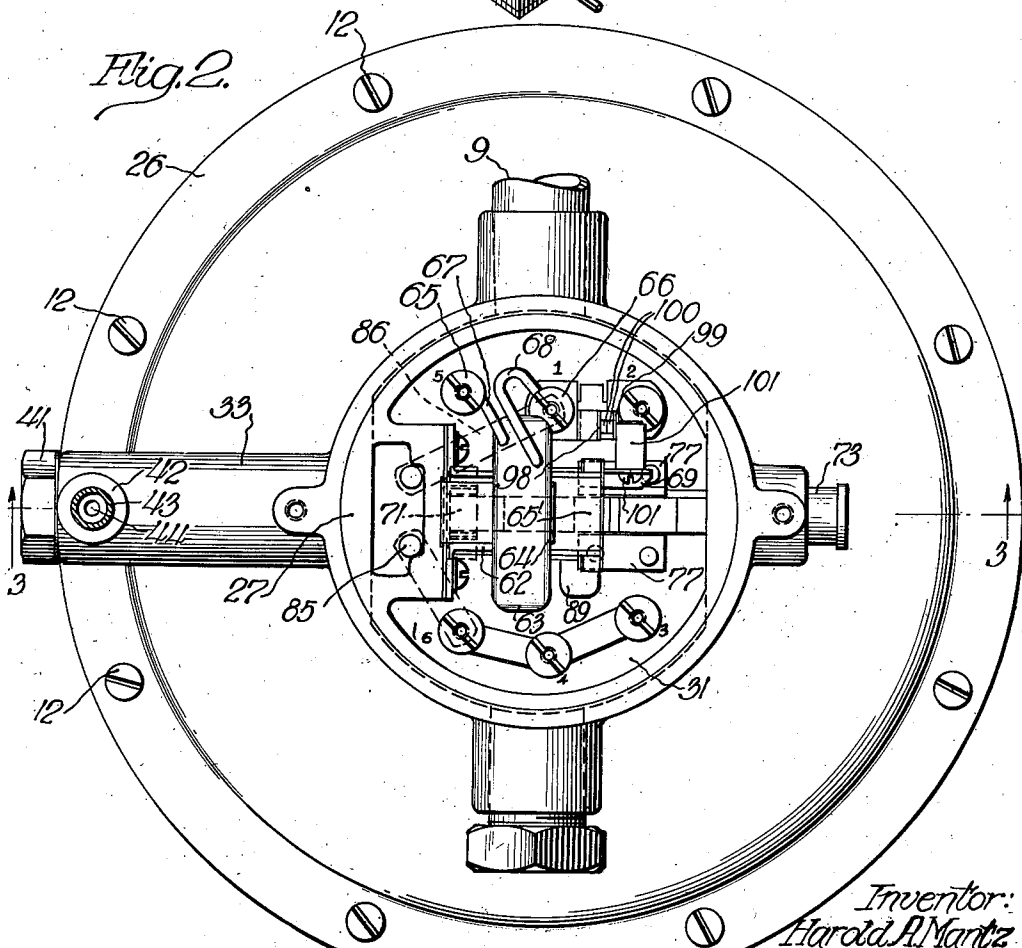


Fig. 2



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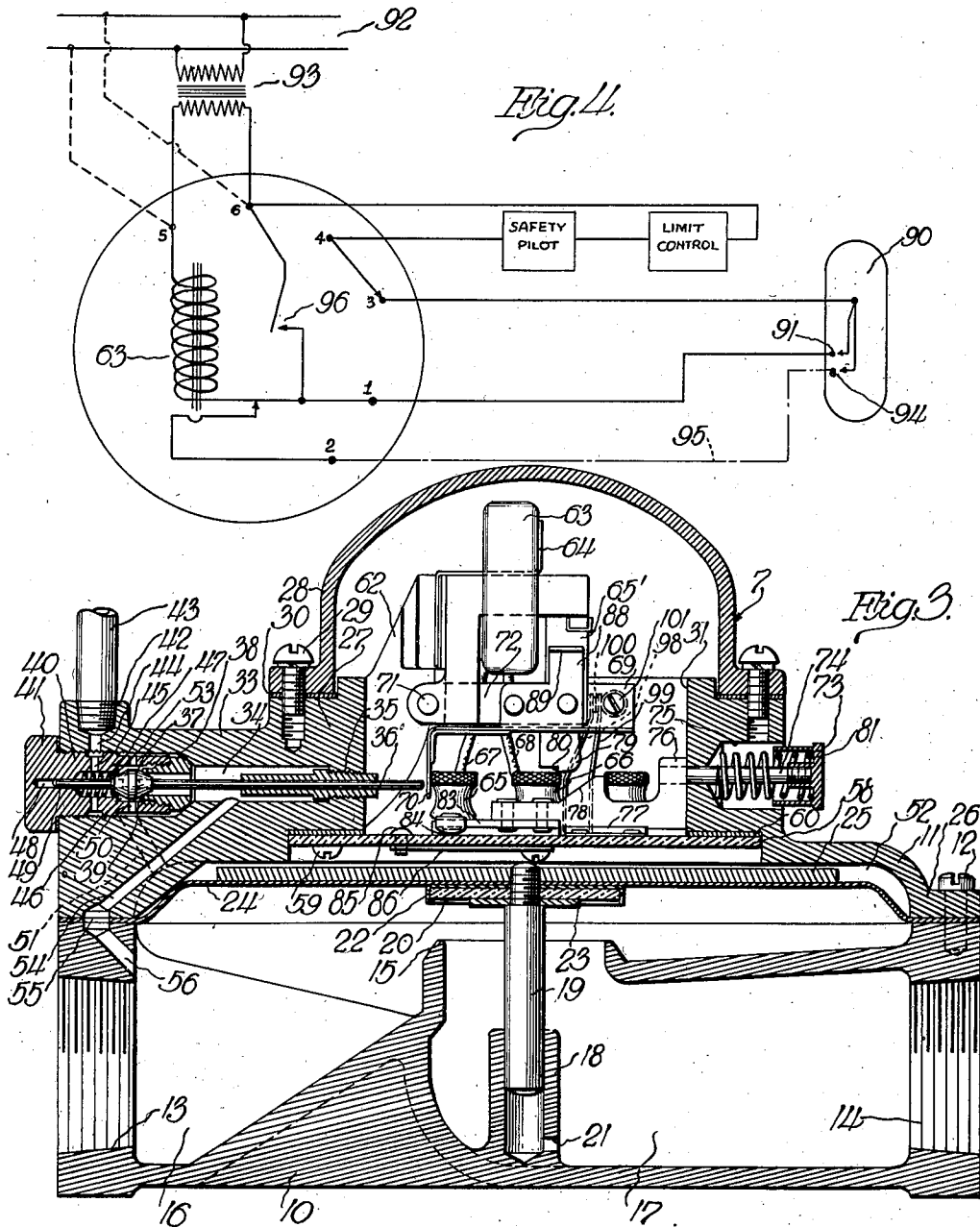
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UNITED STATES PATENT OFFICE

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DIAPHRAGM VALVE

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11 Claims. (Cl. 236—84.)

This invention relates to diaphragm valves, and more particularly to diaphragm valves for controlling the flow of gaseous fuel to a furnace or similar appliance.

5 In the preferred embodiment of the invention, I provide a diaphragm valve interposed in a fuel supply line, and operated by electrical actuating means. The valve is opened and closed in accordance with the demand for heat in a remotely
10 located room, a suitable thermostat being provided for transmitting the heat demand to the diaphragm actuating means. The valve is entirely controlled by electrical energy during the period in which it is in operation, and it may be
15 used in conjunction with the usual type of electrically operated safety pilot and limit control devices, in which the energy for actuating the valve is cut off automatically upon extinguishment of the pilot flame, or upon the passing of
20 a certain limiting temperature point.

The valve is primarily of the weighted diaphragm type, and is provided with a valved by-pass leading from the chamber above the diaphragm, this chamber receiving the full pressure
25 of the fluid in the supply line as long as the valved by-pass is opened. However, upon actuation of a relay or magnetic coil, the by-pass is closed, shutting off the supply of fluid thereto, and the fluid already in this chamber escapes
30 through an exhaust port opened by the closing of the valved by-pass. The pressure in the supply line is then sufficient to raise the weighted diaphragm and open the valve, permitting flow of fuel to the furnace or other appliance.

35 The diaphragm valve of the present invention is characterized by its positive action, its compact assembly, with the electrical actuating means positioned directly above the diaphragm, and the provision of a manual control for opening the valve, inasmuch as failure of the electrical energy for the valve actuating mechanism will close the valve. Further, if after manual
40 control has been effected, the electrical connection is again restored, the manual control is automatically released, and the valve continues to be operated through the actuation of the magnetic coil.

Other objects and advantages of the invention will appear more fully from the following detailed description, which, taken in connection
50 with the accompanying drawings, will disclose to those skilled in the art the particular construction and operation of a preferred embodiment of the invention.

55 In the drawings:

Figure 1 is a perspective diagrammatic view showing the interposition of the diaphragm valve in a fuel supply line to a furnace or the like;

Figure 2 is a plan view of the diaphragm valve, with the cover member for the actuating means
5 removed;

Figure 3 is a sectional horizontal view, taken substantially on the line 3—3 of Figure 2, showing the operating mechanism for the valve; and

Figure 4 is a diagrammatic circuit illustrating
10 the manner of connecting the valve to the room thermostat or the like.

Referring now in more detail to the drawings, in Figure 1 I have disclosed a substantially diagrammatic illustration of a furnace or similar
15 appliance, indicated by the reference numeral 5. The burner of the furnace 5 is supplied with fuel through the burner manifold 6, which manifold is connected through the diaphragm valve indicated generally at 7, to the gas or other fuel supply line 8 leading from any suitable source of
20 fluid fuel.

The diaphragm valve 7 has an electrical conduit 9 leading therefrom, this conduit conducting the electrical conductors from the room thermostat and the electrical current supply line to
25 the valve actuating connection. It is to be understood that the valve 7 may be placed in any convenient position along the fuel supply line 8, but it is preferably disposed adjacent the manifold 6 of the furnace 5.

Referring now in detail to the valve disclosed in Figures 2 and 3, this valve comprises the lower valve housing 10, and the upper valve housing
35 11, the housings being secured together by means of a plurality of screws 12 spaced about the periphery of the housings. The lower valve housing 10 is provided with the inlet opening 13 and the outlet opening 14, and has formed centrally therein a valve seat 15, providing communication
40 between the inlet chamber 16 and the outlet chamber 17.

Disposed concentric with the valve seat 15 is a guide 18 adapted to receive the stem 19 of a weighted diaphragm valve, the valve proper being
45 indicated at 20. The guide 18 is provided with a vent 21 for venting the guide when the stem 19 is moved downwardly therein.

The valve 20 is preferably formed of leather, hard rubber, or the like, and is securely held in
50 position about the stem 19 by means of the cup-shaped retainer 22 and the washer 23 which are positioned upon the reduced and threaded upper end of the valve stem 19. This threaded end of
55

the valve stem extends through a suitable diaphragm member 24, which is formed of any suitable material which can be flexed upon pressure changes, such as light weight sheet metal, leather or the like. A suitable weight, comprising a concentric metallic disc 25, is disposed upon the upper surface of the diaphragm 24, and normally urges the diaphragm downwardly to close the valve 20 on the valve seat 15. The threaded end 10 of the valve stem 19 is screwed into the weight 25, clamping the valve 20 and the diaphragm 24 between the weight 25 and the adjacent end of the enlarged portion of the stem 19. The diaphragm 24 is provided with an extending edge 15 concentric with the valve housings 10 and 11, which edge is securely gripped between the housings and is held in position by means of the bolts 12.

Considering now in detail the upper valve housing 11, this housing comprises the extending flange portion 26 which engages the upper surface of the lower valve housing 10, and is provided with an extending cylindrical portion 27 adapted to receive a dome-shaped cover member 28, this cover member being secured to the cylindrical extending portion 27 by means of a plurality of cap screws 29 disposed about the periphery thereof. A suitable gasket 30 is disposed between the contacting edges of the portion 27 of the housing 30 and the dome 28.

The cylindrical portion 27 of the housing is provided with a central recess 31 adapted to receive the operating mechanism for the valve, and the housing has a laterally extending projection 35 33 adapted to house the pilot valve cage, the valve, and associated apparatus. This lateral extending portion 33 of the housing 11 is provided with a suitable channel 34, which has the bearing sleeve 35 threaded in the inner end thereof. The bearing sleeve 35 is adapted to receive the stem 36 of the pilot valve, this stem acting as a push rod for opening or closing the pilot valve. The pilot valve is indicated at 37, and at one end thereof receives the threaded end of the push rod 45 36, although it is to be understood that this end may be formed integral with the push rod if desired. A pilot valve cage nut 38 is seated in the enlarged outer end of the channel 34, and is provided with an internal cylindrical opening 50 adapted to receive the push rod 36. The outer end of the nut 38, as indicated at 39, acts as a valve seat for the pilot valve 37.

A pilot valve cage 40 is threaded into the enlarged portion of the recess or channel 34, and has an enlarged head portion 41, which may be gripped by a suitable wrench for securing the valve cage in position. The nut 38 is threaded into the inner end of the valve cage 40, as shown.

An upwardly extending boss 42 is provided on the lateral extension 33, and is threaded to receive an exhaust pipe 43 leading from the exhaust port 44 formed in the extension 33. This exhaust port 44 communicates, through the channel 45 formed in the cage 40, with the enlarged recess portion 65 46 formed in the cage member, and in which the valve 37 is adapted to reciprocate.

The other end of the valve 37 is provided with an extending stem 49, which slides in a suitable guide-way 48 formed in the cage 40, the valve 70 being normally urged into closed position against the valve seat 39 by means of a spring 47 encircling the stem 49.

The valve 37 permits communication, when in the position shown in Figure 3, between the cross 75 hole 50 leading from the diaphragm chamber ex-

haust channel 51, which communicates at its other end with the exhaust chamber 52 disposed above the diaphragm 24, and the channel 45 formed in the valve cage and leading to the exhaust port 44 of the extension 33.

In its other position, the valve 37 is engaged against the valve seat 53, thereby closing the exhaust port 44 from communication with the exhaust chamber 52 above the diaphragm. Thus, actuation of the pilot valve 37 will permit opening 10 and closing of the exhaust connection between the pipe 43 and the chamber 52.

Leading from the channel 34 formed in the extension 33 is an obliquely drilled channel 54, which continues through the opening 55 formed at the junction point of the upper housing and lower housing and which extends through the diaphragm extending flange portion, communicating with the channel 56 leading into the inlet chamber 16 of the valve. When the valve is in 20 the position shown in Figure 3, fluid pressure from the chamber 16 will be prevented from entering the chamber 52, since the valve is closed against the valve seat 39, and therefore the fluid passing upwardly through the channels 56 and 25 54 will be retained in the chamber 34 of the extension, and any fluid under pressure in the diaphragm chamber 52 will escape through the exhaust port. However, when the valve is moved to its other position, seating against the valve seat 30 53, pressure from the chamber 16 will pass through the channels 56 and 54 and pass through the valve cage 38 and downwardly through the channel 51 into the chamber 52 above the diaphragm valve. This equalizes the pressure and 35 the weight closes the valve. The pressure is retained in the chamber 52, this chamber being closed from communication with the recess 31 by means of the panel member 58, which is secured against the shoulder of the housing 11 by 40 means of screws 59, there being a gasket 60 interposed between the panel and the shoulder.

Disposed within the space provided by the dome-shaped cover 28 and the recess 31 of the upper valve housing 11 is the electrical operating 45 mechanism for securing actuation of the pilot valve 37. A bracket 62 extending from the inner surface of the cylindrical portion 27 of the upper valve housing 11 is adapted to support the electric relay magnet coil 63, the coil being held in 50 position by means of the retaining clip 64. The coil is connected to the terminals 65 and 66 by means of the conductors 67 and 68, respectively. An armature 65' is adapted to be actuated by the coil 63, and is raised or lowered thereby, and 55 connected to the armature 65' is a pilot valve operating arm 69, which arm has the depending portion 70 adapted to be engaged with the inwardly extending end of the valve push rod 36. The armature 65' is pivoted about a suitable pivot 60 pin 71 extending through the bracket 62, the armature having the arm 69 connected therewith. Thus, when current flows through the coil 63, the armature 65' pivots about the pin 71 and is raised, thus releasing engagement between the depend- 65 ing portion 70 of the pilot valve operating arm 69 and the push rod 36, which results in the spring 47 forcing the pilot valve 37 to the position shown in Figure 3.

A manual control is also provided, this manual 70 control comprising the push button 73, which is adapted to receive the operating rod 74, the push button being movable into and out of a recess 75 formed in the housing 11. The rod 74 extends through the housing and is secured to a manual 75

control slide 76, which slide is prevented from having lateral movement by a pair of guides 77 riveted or otherwise suitably secured upon the panel 58.

5 The manual control slide 76 is provided with a camming surface 78 adapted to engage the depending manual control latch 79 carried by the armature 65'. When the control button 73 is pushed inwardly, the latch 79 rides upon the cam surface 78, forcing the armature upwardly, which releases the engagement between the push rod 36 and the control arm 70 therefor, thus allowing the valve 37 to assume the position shown in Figure 3. The latch 79 is provided with a latching edge 80, adapted to be engaged over the upper portion of the cam surface 78 for holding the armature in raised position, and for holding the sliding guide 76 in inwardly extending position against the tension of the spring 81.

20 It will be noted that the slide 76 carries, at its inner end, an extending arm 83, which may be riveted or otherwise suitably secured to the slide, and which arm 83 is provided with a contact 84 which closes a connection between the stud contact 85 and the terminal 66, by means of the connecting strip 86 disposed upon the under side of the panel 58, which panel is preferably formed of insulating material. This switch is so arranged that on the return of electrical energy a slight movement of the armature will release the manual control and the spring 81 will force it outwardly, and thus return the device to automatic electrical operation. A hand operating handle 88 is provided which has an extending lateral portion 89, this handle being secured to the armature 65' by means of rivets or the like, and which is adapted to be manually engaged for lifting the armature in order to unlock the latching means 79 when it is desired to close the valve without the application of electrical energy.

40 Considering now the diagrammatic circuit shown in Figure 4, the terminals 1 and 5 correspond to the terminals 66 and 65 respectively. A room thermostat is diagrammatically indicated at 90, and, upon suitable temperature changes, acts to close a contact at 91 to provide a connection between the contact numbers 1 and 5 in the circuit. This causes current to flow from the line indicated at 92 through the transformer 93 and through the terminal number 6 to the room thermostat and from the thermostat to the contact number 1, and through this contact and the armature coil 63 back to the line 92. If desired, a safety pilot control, for positively closing the valve by opening the circuit when the pilot flame in the furnace is extinguished, may be inserted between the contact terminals numbers 6 and 4, and a limit control or a time control may also be inserted in series with the above mentioned control, in order to open the circuit when a certain maximum temperature has been reached, or in order to open the circuit at a certain predetermined time. The safety pilot and limiting controls are correspondingly marked in Figure 4.

65 As shown in Figure 2 the terminals No. 5 and No. 6 are connected to the electric power supply, and between the terminals No. 6 and No. 4 may be inserted the connection to the safety pilot and the limit control devices. The terminal No. 3 is connected to the room thermostat 90, and the return from the thermostat 90 is lead to the terminal No. 1. If a time delay circuit is to be employed, the room thermostat 90 may have a secondary contact point 94, which leads through

a conductor 95 to the terminal 2, which terminal is also connected to the coil 63. When the manual control is being used, the automatic releasing contact 85 corresponds to the switch point 96 of Figure 4, and provides a direct connection between the side of the line coming from terminal No. 6, to terminal No. 1. When the electrical current is renewed and the armature 65' is slightly actuated, the contact at 96 is broken by the return of the manual control slide to normal position, and the current must then pass through terminals Nos. 6, 4, and 3 and through the room thermostat 90 to terminal No. 1.

15 In the operation of the diaphragm valve, when the terminals Nos. 1 and 3 are connected by the room thermostat, current flows through the coil 63, and raises the armature 65' to provide disengagement between the push rod control arm 70 and the push rod 36, the pilot valve 37 thus seating against the valve seat 39. This permits any gas pressure existing in the chamber 52 above the diaphragm 24 to be exhausted from the chamber, and the pressure of the gas in the inlet side of the lower valve housing forces the weighted diaphragm valve 20 upwardly from the valve seat 15, allowing flow of gas past the valve seat and out through the outlet 14 to the manifold 6 of the furnace 5. When the room thermostat breaks the circuit between contact terminals Nos. 1 and 3, the coil is deenergized, and the armature 65' drops downwardly, the engagement between the arm 70 and the push rod 36 forcing the pilot valve 37 to seat against valve seat 53. This permits gas from the inlet side of the valve or inlet chamber 16 to pass through channels 56 and 54 and through channel 51 to the chamber 52 above the diaphragm, the gas pressure being equal to the pressure existing in the gas in the inlet chamber 16. However, because of the weight 25, the valve is forced downwardly, against the valve seat 15, and closes off flow of fuel through the valve. Thus, the room thermostat controls the opening and closing of the fuel supply to the furnace.

45 If manual control is desired, the manual control button 73 is pushed inwardly, and the slide 76 raises the armature, permitting the pilot valve 37 to open the exhaust port and thus raise the valve 20 from seat 15. Fuel will now pass through the valve until the armature 65' is either automatically or manually returned to lowered position. This may be manually accomplished by removing the dome shaped cover 28 and raising the armature by means of the latch 89 in order to disconnect the latching means 80 of the depending latch member 79, allowing the manual slide 76 to return to normal position, after which the armature will return to lowered position. However, this may also be done automatically, since the contact shoe 84 carried by the slide 76 engages the contact stud 85 to provide electrical connection between terminals Nos. 6 and 1, so that upon return of electrical energy the coil 63 will raise the armature to automatically release the latching means, after which the valve will be under full electrical control again.

60 If a time delay circuit is desired, I have provided the two spring contact fingers 98 and 99, which are connected to the time delay circuit. Each of these contact fingers carries a contact button 100 at the upper end thereof, the contact buttons 100 being spaced apart when the armature is in lowered position. However, the pilot valve operating arm 69 carries a cam pin 101, which rides upon the outer surface of one of the

contact fingers 99, and as the armature is raised, this cam pin 101 forces the finger 99 toward the finger 98, thus forcing the contact buttons 100 into abutting engagement to close a contact for the time delay circuit. The provision of this circuit, however, is optional.

It is thus apparent that I have provided a diaphragm valve which is positive in operation, and which may be either automatically or manually operated, and which, in manual operation, may be so connected as to be automatically disengaged by the return of electrical current to the circuit.

I do not intend to be limited to the exact details shown and described in the preferred embodiment of my invention, but only insofar as defined by the scope and spirit of the appended claims.

I claim:

1. In a valve of the class described, diaphragm valve means for controlling flow of fluid through said valve, means for actuating said diaphragm valve means including a pressure chamber, a slidable valve member adapted, in one position, to admit fluid under pressure to said chamber, and in a second position to provide for escape of fluid from said chamber, spring means normally tending to maintain said valve in said second position, a magnetically operated lever for forcing said valve to said first position, latching means carried by said lever, and a spring pressed latch member adapted to engage said lever for releasing said valve to said second position irrespective of the position of said lever, said latching means holding said latch member in engaged position when said lever is not magnetically actuated.
2. In a valve of the class described, pressure responsive valve means, means for controlling the admission of fluid under pressure to said valve means, means for operating said controlling means, electrical responsive means actuating said operating means, a latch member for moving said operating means into actuated position to maintain said valve means open when said electro responsive means is unenergized, contacts in said valve connected to said electroresponsive means, means carried by said latch member for engaging said contacts when said latch member is in operating position, and means carried by said actuating means for releasing said latch member upon reenergization of said electroresponsive means.
3. In combination, a valve housing, a diaphragm valve therein, a pressure chamber on one side of said valve, means for admitting fluid under pressure to said chamber and providing for escape of fluid therefrom, automatic means for actuating said last named means including an armature, a magnetic coil and an electrical supply circuit connected to said coil and in series connection with a thermally sensitive member, said armature in energized position providing for escape of fluid from said chamber, means for manually holding said armature in energized position when said circuit is disconnected to provide for venting of said pressure chamber, and means carried by said last named means providing for direct connection of said circuit through said coil independently of said thermally sensitive member when said circuit is reconnected to energize said armature and release said manual holding means.
4. In combination, a diaphragm valve, electrical actuating means for said valve including

a horizontally pivoted armature, manually operable means disposed above and extending normal to the axis of said valve for rotating said armature into valve actuating position when said electrical means is deenergized, spring means normally urging said manually operable means out of engaged position with respect to said armature, and latching means carried by said armature and operative only when said electrical actuating means is deenergized for holding said manual means in engaged position.

5. In combination, a valve housing having a valve seat therein, a second housing secured thereto, said second housing having a plurality of concentric bores, a pressure chamber formed in one of said bores, an electrical insulating panel secured in another of said bores and defining a wall of said pressure chamber, electrical actuating means for said valve mounted on said panel, and electrically responsive pressure control means connected to said electrical actuating means and disposed in another of said bores and supported by said second housing and said panel.

6. In combination, a pair of housings, a valve seat in one of said housings, a diaphragm valve secured between said housings, a pressure chamber formed in the other housing, a longitudinal bore in said other housing extending substantially parallel to the plane of said valve, opposed valve means in said bore, duct means leading into said bore, said valve means controlling fluid flow through said duct means, and electrically responsive means disposed centrally within said other housing and engaging said valve means to control the pressure in said pressure chamber.

7. In combination, a pair of housings, a valve seat in one of said housings, a diaphragm valve secured between said housings, a pressure chamber formed in the other housing, valve means extending substantially parallel to the plane of said valve and reciprocable to control the pressure in said chamber, automatic thermally responsive means for reciprocating said valve means, and means extending substantially axially of said valve means for manually operating said valve means when said automatic means is rendered inoperative.

8. In combination, a pair of housings, a valve seat in one of said housings, a diaphragm valve secured between said housings, a pressure chamber formed in the other housing, valve means extending substantially parallel to the plane of said valve and reciprocable to control the pressure in said chamber, automatic thermally responsive means for reciprocating said valve means, means extending substantially axially of said valve means for manually operating said valve means when said automatic means is rendered inoperative, and means carried by said automatic means and engaging said manually operable means only when said automatic means is deenergized for holding said manually operable means in engaged position.

9. In combination, a diaphragm valve having inlet and outlet openings, a pressure chamber above said valve, means providing communication between said inlet opening and said pressure chamber, exhaust means for said pressure chamber, valve means between said communicating means and said exhaust means, automatically operable means connected to a source of power for actuating said valve means, remotely disposed thermally sensitive means for controlling said automatic means from said source of power,

and independent manually operable means for operating said valve means to maintain said exhaust means open, and having means for shunting said thermally sensitive means to connect
5 said source of power directly to said automatically operable means.

10 10. A control circuit for a heating system comprising an electrical supply line, a thermostat connected to said supply line, a diaphragm valve for controlling the fuel supply to said heating system, means for opening said valve including a
15 coil connected to said thermostat, means for maintaining said valve open when said line is unenergized including a contact member engaging a pair of contacts for shunting said thermostat, and means for releasing said last-named
means upon reenergization of said supply line.

11. A control circuit for a heating system comprising an electrical supply line, a thermo-

stat connected to said supply line, a fuel supply line, a diaphragm valve disposed in said fuel supply line, means for controlling said diaphragm valve including means providing for admission
5 and escape of fluid under pressure on one side of said valve, a coil, an armature adapted to actuate said controlling means, said coil being electrically connected to and energized by movement of said thermostat, switch contacts directly connecting said coil with said electrical supply line,
10 means for moving said armature into energized position when said electrical supply line is unenergized and for simultaneously closing said switch contacts, and means for releasing said last-named means upon reenergization of said
15 electrical supply line to reactuate said coil through said thermostat.

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