Oct. 2, 1956 J. A. WOLFF 2,765,029

THERMOELECTRIC SAFETY SHUT-OFF DEVICE

Filed April 5, 1951 2 Sheets-Sheet 1

Fig. 1.

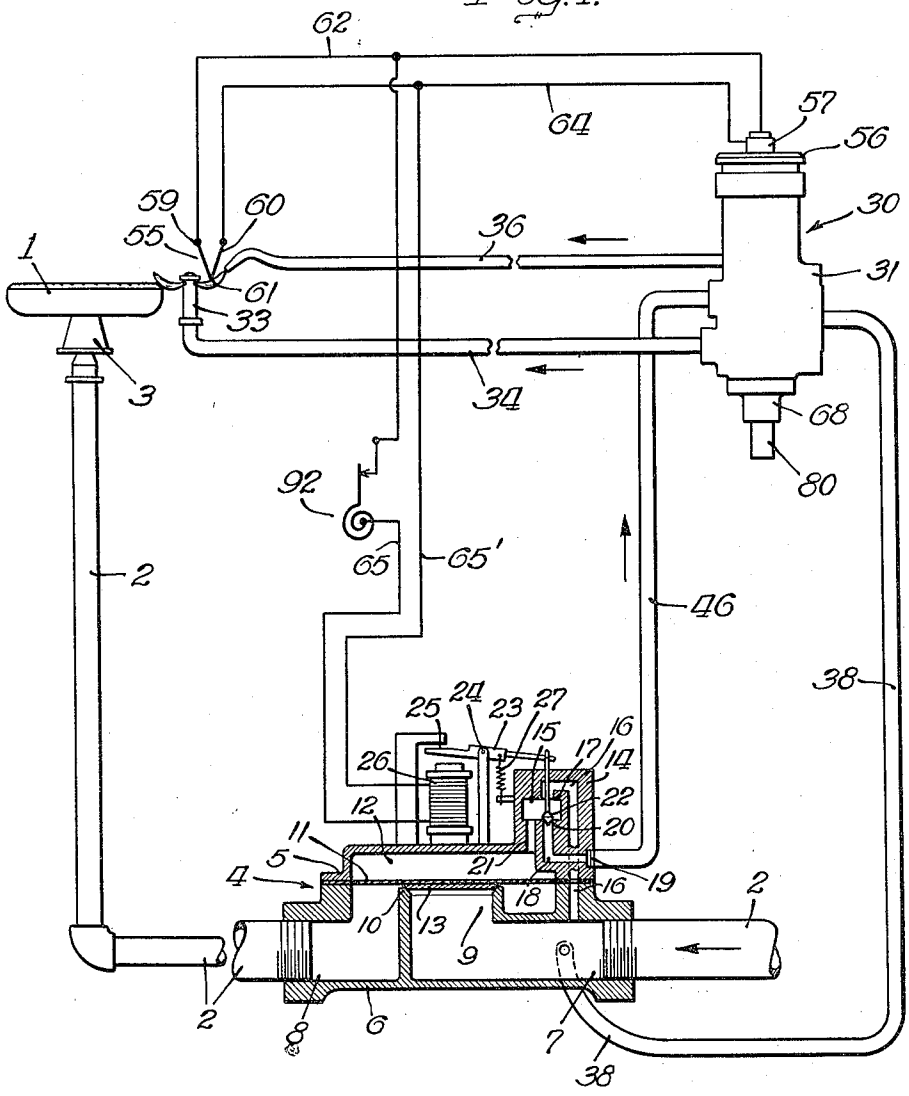
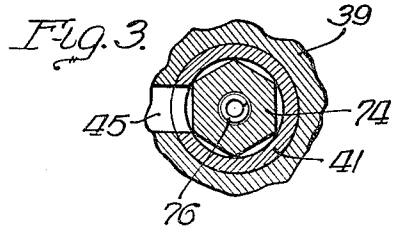


Fig. 3.



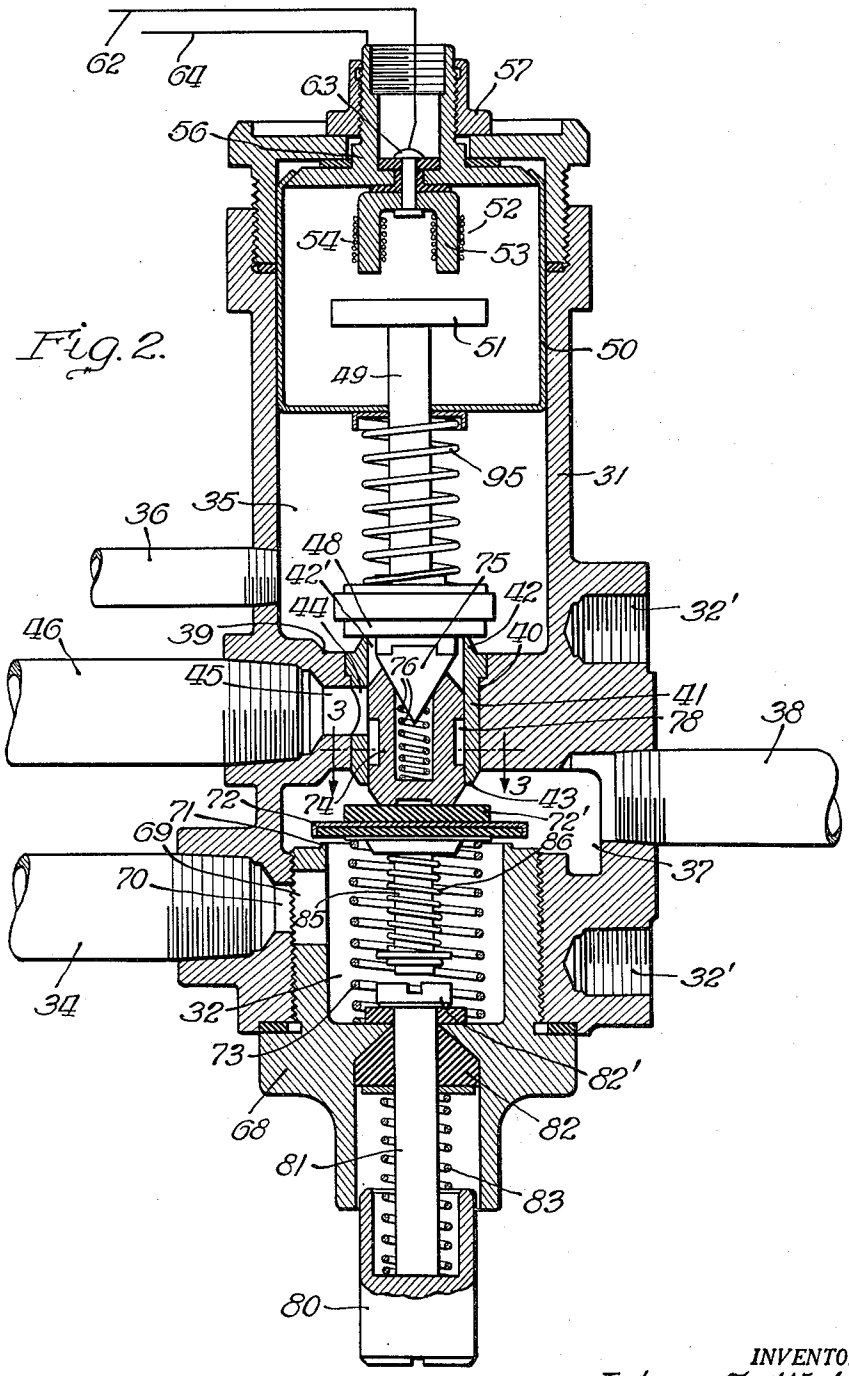
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THERMOELECTRIC SAFETY SHUT-OFF DEVICE

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Fig. 2.



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THERMOELECTRIC SAFETY SHUT-OFF DEVICE

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12 Claims. (Cl. 158—131)

This invention relates, in general, to thermoelectric safety shut-off devices, and has particular relation to an improved thermoelectric safety shut-off device having at least two outlets, and valve means for closing both outlets upon occurrence of a given condition to provide 100% shut-off, for example, of the flow of gaseous fuel.

Thermoelectric safety shut-off devices for maintaining, for example, flow of fuel to a burner as long as a thermoelectric generator is heated by the flame of a pilot burner and for shutting off the flow of fuel to the burner upon extinguishment of the pilot burner flame are known in the art. Due to the inability of the minute thermoelectric current that can be generated by the heat of a pilot burner flame on a thermoelectric generator to open the shut-off valve, it has been previously proposed to employ, for example, a diaphragm valve which operates in conjunction with the thermoelectric generator and its electromagnet to establish a flow of fuel to the burner upon energization of the electromagnet by the heat of the pilot burner flame on the thermoelectric generator.

These latter devices have been automatic or self-operating and are suitable for that purpose, but they have not provided 100% safety shut-off of the fuel upon extinguishment of the pilot burner flame. Heretofore instead there has been a flow of fuel to the pilot burner when it is extinguished as well as when it is ignited. This permits the escape of unburned gas with possible serious consequences.

While the improved thermoelectric safety shut-off device of the present invention has utility in connection with diaphragm or equivalent valves which operate in conjunction with a thermoelectric generator and its electromagnet to provide automatic control of the gaseous fuel supply, it is to be understood that the device according to this invention is not limited to such use but may be employed for all similar or equivalent purposes as suitable or desired; for example, wherever it is desired to provide a safety shut-off of at least two independent gas supplies.

One of the main objects of the present invention is to provide an improved thermoelectric safety shut-off device with which 100% safety shut-off of the fuel for both a main burner and a pilot burner is obtained in case the pilot burner flame is extinguished.

Another and more specific object of the invention is to provide an improved thermoelectric safety shut-off device having incorporated therein a double-faced valve and an additional fuel chamber for securing 100% safety shut-off of the gaseous fuel for the pilot burner as well as 100% safety shut-off of the gaseous fuel for the main burner when the pilot burner flame is extinguished.

Another more specific object of the invention is to incorporate with the double-faced valve for the purposes set forth an additional valve for shutting off the discharge of bleed gas from the diaphragm or equivalent valve when the pilot burner flame is extinguished.

Another more specific object of the invention is to provide an improved thermoelectric safety shut-off device having an improved arrangement of fuel chambers for the reception of the gaseous fuel and for delivering fuel to the pilot burner and discharging bleed gas; also an improved dual valve seat structure between the inlet chamber and the chamber from which bleed gas is discharged, and an improved dual valve arrangement under the control of an electromagnet connected in circuit with the thermoelectric generator for controlling the delivery of gas to the pilot burner and the discharge of bleed gas.

Further objects and advantages and numerous modifications and adaptations of the invention will appear from the following detailed description taken in connection with the accompanying drawings.

In the drawings:

Figure 1 is a more or less diagrammatic view of one illustrative system embodying a thermoelectric safety shut-off device according to the present invention;

Figure 2 is an axial sectional view through the thermoelectric safety shut-off device shown in Figure 1; and

Figure 3 is a transverse sectional view through the valve actuator between the dual valves taken on the line 3—3 of Figure 2.

Referring now to the drawings, the burner shown at 1 in Figure 1 is a main burner. It may be the main burner for a room or space heater, or it may be the burner for a water heater or for a floor furnace, or any other burner and of any suitable construction.

A fuel supply pipe or conduit 2 leads to the burner 1 for delivery of gaseous or other fuel thereto, for example, through a mixing chamber 3 to which air is admitted through adjustable air inlets (not shown) as well understood in the art. The flow of gas through the conduit 2 is controlled by a main valve 4 shown in the form of a diaphragm valve.

The diaphragm valve 4 comprises a pair of valve body parts 5 and 6. The valve body part 6 has a gas inlet 7, a gas outlet 8, and an intermediate passage 9 between the inlet 7 and the outlet 8. Contiguous sections of conduit 2 are connected to inlet 7 and outlet 8. The passage 9 has an annular valve seat 10 at one end thereof.

A diaphragm 11 is secured marginally between the valve body parts 5 and 6 and separates the main flow of gas from inlet 7 to outlet 8 from the diaphragm chamber 12 on the opposite side of the diaphragm. The diaphragm 11 carries a main valve member 13 which is adapted to seat upon valve seat 10 to shut off the flow of fuel to the main burner 1 and for movement to open position away from valve seat 10 for flow of fuel to the main burner.

The valve body part 5 has a valve block or valve body part 14 provided with a relatively small auxiliary valve chamber 15. A passage 16 opens from the inlet or upstream side of the valve 4 into valve chamber 15. The opening of the passage 16 into valve chamber 15 is provided with a valve seat 17. A passage 18 opens from the valve chamber 15 to an outlet 19. The opening of the passage 18 from the chamber 15 has a valve seat 20 which is aligned axially with the valve seat 17. The interior of the valve chamber 15 is connected or in communication with the interior of the diaphragm chamber 12 through a passage 21.

A double-faced valve 22 has reciprocatory movement in valve body part 14, and, when in one position, seats against valve seat 17 to shut off admission of gas to valve chamber 15 through passage 16. In its other position valve 22 seats against valve seat 20 to shut off discharge of gas from diaphragm chamber 12 through chamber 15 and outlet 19. An arm 23, pivoted at 24, has an armature part 25 which when an electromagnet 26 is energized attracts the armature 25 and swings arm 23 counterclockwise about its pivot 24. A spring 27 swings the armature 25 to retracted position, and arm 23 clockwise about its pivot 24 when the electromagnet 26 is deenergized, as will hereinafter appear.

The thermoelectric safety shut-off device according to the present invention is designated in its entirety at 30 and comprises, for example, a valve body 31 having in-

ternally threaded openings 32' for attaching the same to a suitable support.

The valve body 31 has a chamber 32 from which gas is supplied to a pilot burner 33 by a pipe or tube 34; also a chamber 35 from which bleed gas is discharged through a pipe or tube 36 which opens, for example, in close proximity to the flame position of pilot burner 33. Between the chambers 32 and 35 the valve body 31 has an inlet chamber 37 which receives gaseous fuel from the inlet or upstream side of valve 4 through a pipe or conduit 38. The pilot burner 33 is located in juxtaposition or in lighting proximity to the burner 1.

The chambers 35 and 37 are separated by a partition 39 which has an axial opening or passage 40 of cylindrical form. Mounted in the opening 40 is a valve seat member 41 which has at one end a valve seat 42 and, at its opposite end, a valve seat 43. Intermediate its ends, valve seat member 41 has a laterally opening port 44 which registers with a port 45 in partition 39, and thus communicates or is connected with outlet 19 of the diaphragm valve 4 by a pipe or tube 46.

A shut-off valve 48 is adapted to seat upon valve seat 42 to shunt off discharge of bleed gas through port 42' and pipe 36. The valve 48 is secured to one end of a stem 49. The opposite end of stem 49 extends, for example, into a hood or housing 50 and has secured thereon an armature 51. An electromagnet 52 having a magnet frame 53 and a coil 54 is adapted for holding the armature 51 in attracted position and thereby the valve member 48 open when a thermoelectric generator 55 is heated by the flame of pilot burner 33. The magnet frame 53 is carried by a terminal bushing 56 clamped in place by a nut 57. The armature 51 and valve 48 may be attached to the stem 49 in a manner to permit self-accommodation of the armature to the pole faces of the magnet frame 53 and self-accommodation of the valve 48 to its seat 42.

The thermoelectric generator 55 comprises dissimilar thermoelectric generator elements 59 and 60 joined to form a "hot" junction 61 which is positioned to be heated by the flame of the pilot burner 33. One thermoelectric generator element 59 is connected by a conductor 62 and through a terminal tip 63 to one terminal of the coil 54. The other terminal of coil 54 is connected, for example, through terminal bushing 56 and a conductor 64 to the other thermoelectric generator element 60. A thermostat, limit switch, or other condition responsive device 92 is shown connected in circuit with the electromagnet 26. While the thermoelectric generator 55 is shown in the form of a thermocouple, it may be in the form of a thermopile or of other suitable or desired form.

A tubular bushing 68 is screwed into the valve body 31 in axial alignment with the stem 49, and has a laterally opening port 69 which registers with a port 70 opening from valve body 31 for the delivery of fuel for the pilot burner 33 through the pipe 34. The bushing 68 has at its inner end an annular valve seat 71 against which one side of a double-faced valve 72 is adapted to seat to shut off the supply of fuel to the pilot burner 33. The valve 72 is biased to open position with respect to valve seat 71 and to position with its opposite side seated against valve seat 43 by a coiled spring 73, and there is interposed between the valves 48 and 72 a valve actuator 74 for actuating the valve 72 to closed position simultaneously with the operation of valve 48 to closed position when the flame of pilot burner 33 is extinguished.

The valve actuator 74 externally is of hexagonal (Figure 3) or other form to slide in the inner cylindrical opening in the valve seat member 41 and to permit gas flow from the port or inlet 45 between the actuator 74 and the valve seat member 41 and to outlet pipe 36 when valve 48 is in open position and valve 72 is closed against valve seat 43. The valve 48 carries a conical pin 75 which cooperates with a conical recess in the adjacent end of the actuator 74, and a coiled spring 76 is interposed between the conical pin 75 and the closed end of the axial

opening in the actuator 74. The outer periphery of the actuator 74 has an annular groove 78 for providing and maintaining communication with the port 45 when the valve part 72' is unseated from the valve seat 43 whereby upon failure of the ignition burner, gas is permitted to flow from the inlet 38 through the valve seat member 41 around valve actuator 74 to the port 45 and the connected conduit 46 and passage 18 of the diaphragm valve.

A reset button 80 and its stem 81 have sliding movement in the member 68. The opening through which stem 81 reciprocates is sealed against gas leakage by suitable packing 82. The inner end of stem 81 is headed at 82', and a coiled spring 83 interposed, for example, between packing 82 and reset button 80 moves the reset stem and button to their outwardly projected position when the button 80 is released. When the button 80 is engaged with the fingers and depressed, the stem 81 engages a reset pin 85 carried by the valve 72, and, through the pin 85, actuator 74, and pin 75, actuates the valve 48 to open position and armature 51 to attracted position against the pole ends of the magnet frame 53 while at the same time moving the face 72' of the valve 72 into engagement with the seat 43 and moving said valve away from the seat 71. When the reset button 80 is released, the valve member 72 is held by the spring 73 in the position to which it was moved by the resetting operation as the spring 83 returns the reset stem and button to their outwardly projected position.

With the parts of the apparatus positioned as shown in Figures 1 and 2, the following sequence is followed to start the system:

The reset button 80 is engaged with the fingers and pressed inwardly. This moves the armature 51 to attracted position, the valve 48 to open position, the valve part 72' to closed position against its valve seat 43, and the valve 72 to open position away from its valve seat 71. Gas thereupon passes through the pipe 38, inlet chamber 37, through the passage surrounded by valve seat 71, and out through ports 69 and 70 and pipe 34 to the pilot burner 33 which is then ignited, for example, with a taper, match, or otherwise as desired.

Upon ignition of the pilot burner 33, the flame thereof by heating one or more "hot" junctions of the thermoelectric generator 55 energizes the electromagnet 52 to hold the armature 51 in attracted position and the shut-off valve 48 in open position. If there is a thermostat or other condition responsive device in the circuit for the coil of the electromagnet 26 as shown at 92 in Figure 1, and assuming that such device is calling for heat, its switch is closed and the electromagnet 26 is then energized. Energization of electromagnet 26 moves valve 22 against seat 17, which shuts off the delivery of fuel to the diaphragm chamber 12 through passage 16 and opens the port at valve seat 20 for the discharge of bleed gas through passage 21, valve chamber 15, passage 18, pipe 46, ports 45, 44 and 42', and pipe 36 to position adjacent to the flame of the pilot burner 33 where it is burned.

The venting or bleeding of gaseous fuel from the diaphragm chamber 12 as above described provides a preponderance of gas pressure on the under-side of diaphragm 11 at the inlet side of valve 4. The gas pressure thereupon moves the diaphrgam valve 13 to open position, thereby establishing a flow of gaseous fuel to the main burner 1 which is ignited by the pilot burner 33.

When the electromagnet 52 is energized sufficiently to hold armature 51 in attracted position and valve 48 in open position, the reset button 80 may be released. Spring 73 then holds valve 72 in open position with respect to valve seat 71 and closed against valve seat 43, and spring 83 returns reset button 80 to its outwardly projected position. In this position gas continues to flow through the pipe 34 to maintain the flame at the pilot burner 33.

If after the system is started the thermostat or other device at 92 operates to position where no further heat is

desired, it opens the circuit for the coil of the electromagnet 26. As a result, the valve 22 moves against its seat 20 to shut off the discharge of bleed gas through pipe 46 and opens the port at valve seat 17 for delivery of gaseous fuel into the diaphragm chamber 12 from the inlet side of valve 14 through the passage 16.

This results in building up gas pressure in chamber 12 to about the pressure on the other side of the diaphragm, and the diaphragm valve 13, which is weighted (or spring loaded if desired), moves to closed position against its valve seat 10 to shut off the supply of gaseous fuel to the main burner 1. The electromagnet 52, however, continues to be energized for the supply of fuel to the pilot burner 33 as long as the thermoelectric generator 55 is heated by the flame of the pilot burner 33.

If the flame of the pilot burner 33 is extinguished, the armature 51 is moved to retracted position by a spring 95 (Figure 2) with accompanying movement of valve 48 to closed position against its seat 42' to shut-off communication between the port 45 and the outlet pipe 36. At the same time the valve 72 is moved to closed position against its valve seat 71, while the face 72' of the valve 72 is moved away from the seat 43. When the valve 72 is closed against its seat 71 the flow of gaseous fuel to the pilot burner 33 is shut-off, and on movement of the face 72' of the valve 72 away from the seat 43, gas can flow from the inlet 38 to the port 45, and through the conduit 46 to the passage 18 of the diaphragm valve. Thus, when the safety shut-off valve 30 is deenergized, gas under pressure is supplied to the chamber 12 of the diaphragm valve 4 and the valve member 13 thereby held in closed position irrespective of the position of the pilot valve member 22. The valve 48, being now closed, prevents further discharge of bleed gas through the pipe 36. There is thus provided 100% safety shut-off for the gaseous fuel not only for the main burner but also for the pilot burner and for the bleed pipe.

With the safety shut-off valves 48 and 72 open, valve 72' closed and the pilot burner 33 lighted, the thermostat or other condition-responsive means is operable automatically to open and close the diaphragm valve 4 independently of the safety shut-off valves which continue open as long as the flame of the pilot burner 33 is burning and electromagnet 52 is energized sufficiently to hold armature 51 in attracted position.

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 claims for that purpose.

I claim:

1. In control apparatus for fluid fuel burning apparatus having a main burner and an ignition burner, the combination of a fluid pressure operated valve controlling flow of fuel to said main burner and having a pressure chamber provided with a bleed outlet for bleeding fuel therefrom, an inlet passage for admitting fuel to said chamber for operation of said valve to closed position, an electromagnetic operator, pilot valve means under control of said electromagnetic operator and acting to open communication between said inlet passage and said chamber and to close communication between said chamber and said bleed outlet when said electromagnetic operator is deenergized, said pilot valve means acting to close communication between said inlet passage and said chamber and to open communication between said chamber and said bleed outlet when said electromagnetic operator is energized, a safety shut-off valve body having a fuel inlet, a first fuel outlet for supplying fuel to said pilot burner, a port affording an inlet for delivering bleed fuel from said bleed outlet of said fluid pressure operated valve to said safety shut-off valve body and a vent passage for venting bleed fuel from said safety shut-off valve body, a safety shut-off valve biased to closed position shutting off communication between said port and said vent passage, an electromagnet effective when energized to hold said safety shut-off valve in open position, and valve means biased to a first position shutting off communication between the fuel inlet of said safety shut-off valve body and said port and opening communication between said fuel inlet and said first fuel outlet of said safety shut-off valve body when said electromagnet holds said safety shut-off valve open, said last mentioned valve means being operated by the operation of said shut-off valve to closed position to a second position shutting off the delivery of fuel from the fuel inlet of said safety shut-off valve body to said first fuel outlet of said safety shut-off valve body and opening communication between the fuel inlet of said safety shut-off valve body and said port.

2. Control apparatus according to claim 1 wherein there is means for moving said safety shut-off valve to the open position to which it is held by said electromagnet.

3. Control apparatus according to claim 1 wherein there is a thermoelectric generator subject to the heat of the flame of said pilot burner and connected in circuit with said electromagnet to energize the same, and condition responsive means controlling said electromagnetic operator.

4. In a safety shut-off valve, in combination, a valve body having first and second chambers with means defining a connecting passage between said chambers and first and second valve seats at opposite ends of said passage, said valve body having a fluid inlet opening into said second chamber and a first fluid outlet opening from said second chamber with a third valve seat therebetween, a port communicating with said connecting passage between said first and second valve seats, said valve body having a second fluid outlet opening from said first chamber, a safety shut-off valve biased to closed position against said first valve seat to shut off communication between said connecting passage and said first chamber, an electromagnet effective when energized to hold said safety shut-off valve in open position to place said port in communication with said second fluid outlet, and valve means biased to a first position in cooperation with said second valve seat to shut off communication between said fluid inlet and said connecting passage and to position separated from said third valve seat to place said fluid inlet in communication with said first fluid outlet, said last mentioned valve means being operated by the operation of said safety shut-off valve to closed position to a second position cooperating with said third valve seat to close communication between said fluid inlet and said first fluid outlet and to position separated from said second valve seat to place said fluid inlet in communication with said port through said connecting passage.

5. A safety shut-off valve according to claim 4 wherein the operation of said last mentioned valve means by the operation of said safety shut-off valve to closed position is accomplished by a valve actuator slidable in said connecting passage with space between it and the wall of said passage and co-acting at one end with said safety shut-off valve and at its opposite end with said last mentioned valve means.

6. A safety shut-off valve according to claim 4 wherein there is means for moving said safety shut-off valve to the open position in which it is held by said electromagnet and said last mentioned valve means to its first position.

7. A safety shut-off valve according to claim 4 wherein there is a thermoelectric generator subject to the heat of a flame and connected in circuit with said electromagnet to energize the same.

8. In a safety shut-off valve, in combination, a valve body having first and second chambers with means defining a connecting passage between said chambers and first and second valve seats at opposite ends of said passage, said valve body having a fluid inlet opening into said second chamber and a first fluid outlet opening from

said second chamber with a third valve seat therebetween, a port communicating with said connecting passage between said first and second valve seats, said valve body having a second fluid outlet opening from said first chamber, a safety shut-off valve biased to closed position against said first valve seat to shut off communication between said connecting passage and said first chamber, an armature connected to said safety shut-off valve, an electromagnet effective when energized to hold said armature in attracted position and said safety shut-off valve in open position to place said port in communication with said second fluid outlet, and valve means biased to a first position in cooperation with said second valve seat to shut off communication between said fluid inlet and said connecting passage and to position separated from said third valve seat to place said fluid inlet in communication with said first fluid outlet, said last mentioned valve means being operated by the operation of said safety shut-off valve to closed position to a second position cooperating with said third valve seat to close communication between said fluid inlet and said first fluid outlet and to position separated from said second valve seat to place said fluid inlet in communication with said port through said connecting passage.

9. In a safety shut-off valve, in combination, a valve body having first and second chambers with means defining a connecting passage between said chambers and first and second valve seats at opposite ends of said passage, said valve body having a fluid inlet opening into said second chamber and a first fluid outlet opening from said second chamber with a third valve seat therebetween, a port communicating with said connecting passage between said first and second valve seats, said valve body having a second fluid outlet opening from said first chamber, a safety shut-off valve biased to closed position against said first valve seat to shut off communication between said connecting passage and said first chamber, an armature connected to said safety shut-off valve, an electromagnet effective when energized to hold said armature in attracted position and said safety shut-off valve in open position to place said port in communication with said second fluid outlet, valve means biased to a first position in cooperation with said second valve seat to shut off communication between said fluid inlet and said connecting passage and to position separated from said third valve seat to place said fluid inlet in communication with said first fluid outlet, said last mentioned valve means being operated by the operation of said safety shut-off valve to closed position to a second position cooperating with said third valve seat to close communication between said fluid inlet and said first fluid outlet and to position separated from said second valve seat to place said fluid inlet in communication with said port through said connecting passage, and means for moving said armature to attracted position and said safety shut-off valve to the open position in which it is held by said electromagnet and said last mentioned valve means to its first position.

10. In a safety shut-off device for fluid fuel burning apparatus having an ignition burner, a main burner, and diaphragm valve means controlling flow of fuel to said main burner comprising, a valve body having an inlet and a first outlet for supply of fuel to said ignition burner, a port communicating with said diaphragm valve, first valve means controlling flow of fuel from said inlet to said first outlet and to said port, a second outlet, second valve means controlling flow of fuel from said port to said second outlet, and means responsive to burning of fuel at said ignition burner controlling said first and second valve means to permit flow of fuel from said inlet to said first outlet and from said port to said second outlet while fuel is burning at said ignition burner and to prevent flow of fuel from said inlet to said first outlet and from said port to said second outlet but permitting flow of fuel from said inlet to said port when burning of fuel at said ignition burner ceases.

11. Control apparatus for fluid fuel burning apparatus having main and ignition burners comprising, in combination, a fluid pressure operated valve controlling the flow of fuel to said main burner and having a chamber provided with a passage for bleeding of fuel from said chamber for actuation of said valve, pilot valve means for said fluid pressure operated valve controlling the flow of fuel bled from said chamber through said bleed passage, said pilot valve means having control means having a first position permitting fuel to be bled from said chamber through said passage and having a second position preventing fuel from being bled from said chamber through said passage, and a safety shut-off device controlling the flow of fuel through said bleed passage and also controlling the flow of fuel to said ignition burner, said safety shut-off device having movable control means having a normal operating position permitting fuel flow to said ignition burner and permitting the flow of bleed fuel through said bleed passage under the control of said pilot valve means, said last-mentioned control means also having a safety position preventing the flow of fuel to said ignition burner and also preventing the flow of bleed fuel through said bleed passage irrespective of the position of the control means of said pilot valve means.

12. Apparatus for controlling the flow of fluid fuel comprising, in combination, a fluid pressure operated valve connected to a source of fluid fuel under pressure and having a chamber and a bleed passage, pilot valve means for said fluid pressure operated valve connected to said chamber, bleed passage and source, said pilot valve means having control means having a first position preventing communication between said chamber and bleed passage and affording communication between said source and chamber to effect closure of said fluid pressure operated valve by the fluid pressure from said source in said chamber, said control means also having a second position preventing communication between said source and chamber and affording communication between said chamber and bleed passage to normally bleed said chamber and effect opening of said valve, and a safety shut-off device connected to said bleed passage and source and having a vent port, said safety shut-off device having movable control means having a normal operating position affording communication between said bleed passage and said vent port permitting cycling of said fluid pressure operated valve under the control of said pilot valve means, said last-mentioned control means also having a safety position preventing communication between said bleed passage and vent port and affording communication between said bleed passage and source to thereby subject said chamber to fluid pressure from said source when the control member of said pilot valve is in its said second position, wherefore on movement of the control means of said safety shut-off device to its safety position, said chamber is subjected to fluid pressure from said source and said fluid pressure operated valve is held closed thereby irrespective of the position of the control means of said pilot valve means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,288,912	Mears	July 7, 1942
2,290,048	Hildebrecht	July 14, 1942
2,372,564	Engholdt	Mar. 27, 1945
2,379,712	Hildebrecht	July 3, 1945
2,408,883	Rode	Oct. 8, 1946
2,505,432	Sagar	Apr. 25, 1950
2,506,403	Witzel	May 2, 1950
2,512,173	Ray	June 20, 1950
2,557,927	Abrams	June 26, 1951
2,566,372	Ray	Sept. 4, 1951
2,607,406	Caparone	Aug. 19, 1952
2,615,511	Ray	Oct. 28, 1952