

Nov. 21, 1944.

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2,363,073

VALVE STRUCTURE

Filed Jan. 19, 1942

2 Sheets-Sheet 1

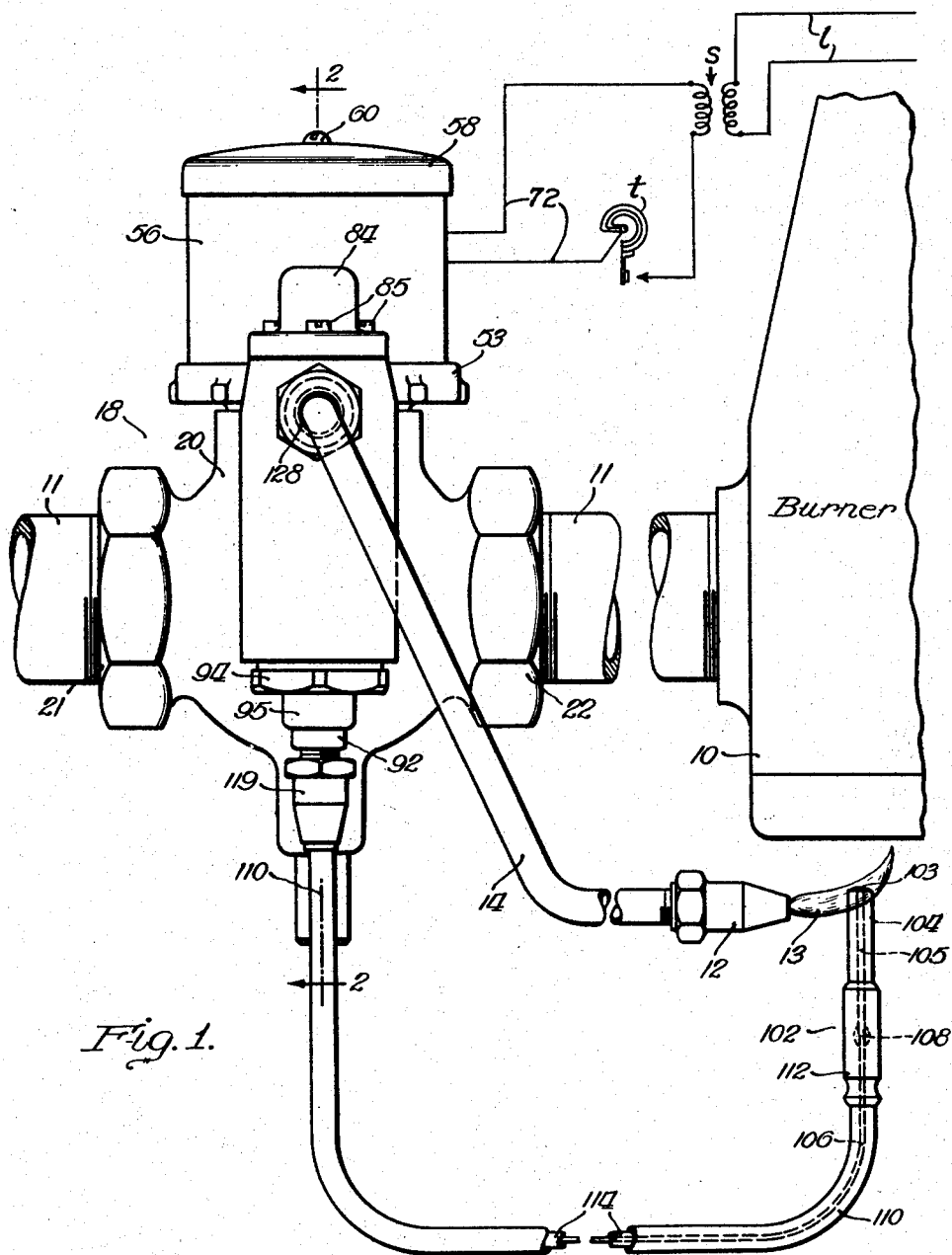


Fig. 1.

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2 Sheets-Sheet 2

Fig. 2.

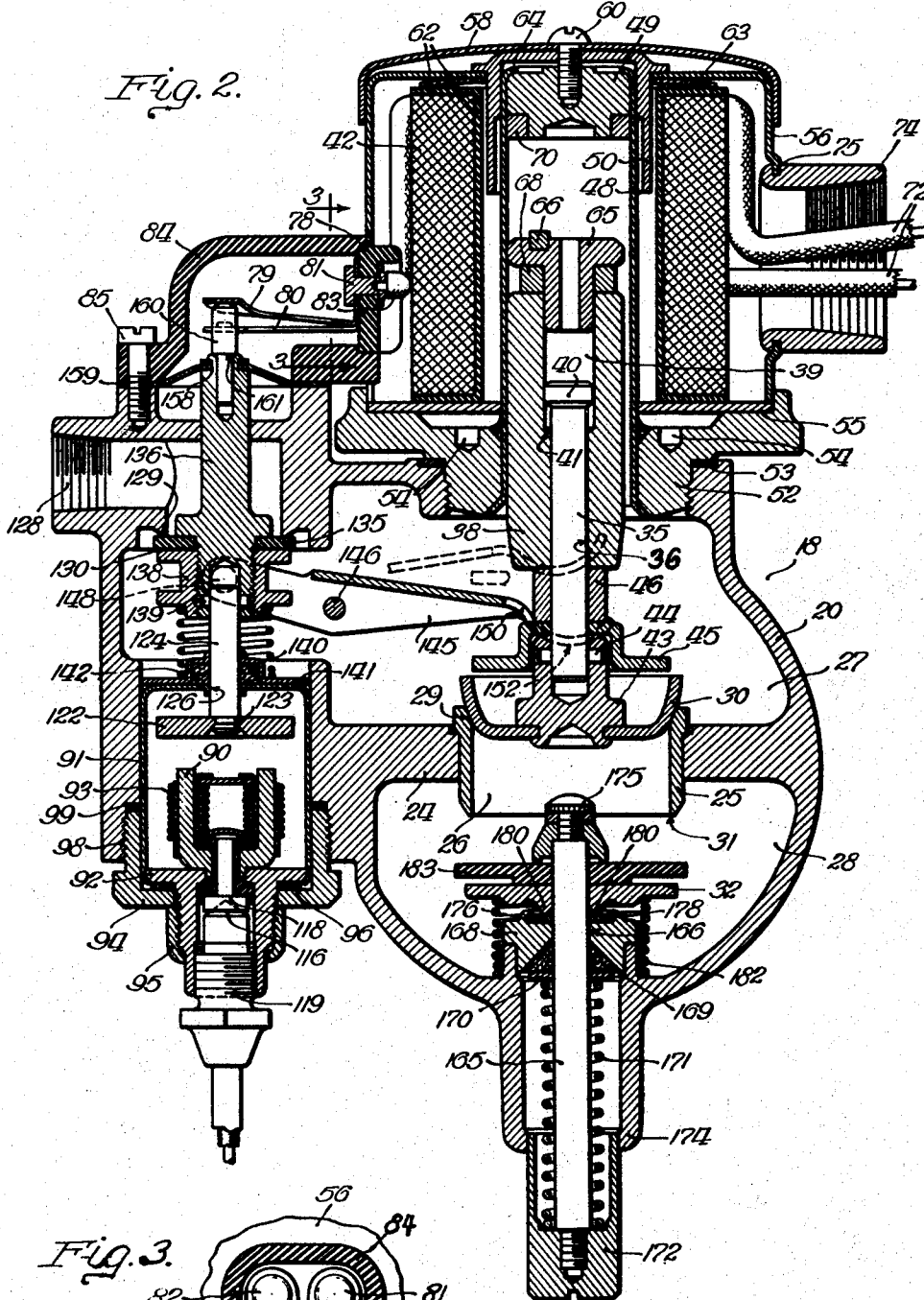
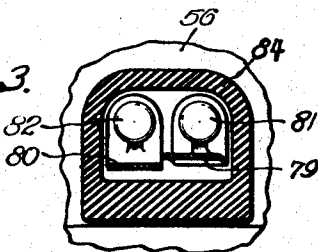


Fig. 3.



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UNITED STATES PATENT OFFICE

2,363,073

VALVE STRUCTURE

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Application January 19, 1942, Serial No. 427,339

9 Claims. (Cl. 137—144)

This invention relates to burner control apparatus and has particular reference to an improved form of combined thermoelectric safety shutoff and electroresponsive valve.

While the invention has particular utility in connection with a burner or combination of burners which it is desired to place under automatic control and wherein a safety shutoff is desired for shutting off the supply of fuel in the event the pilot light or other flame is extinguished, it is to be understood that the invention is not limited to the particular use herein set forth but may be employed for all similar purposes as suitable or desired.

The burner may be the burner for a water heater, or any other burner or combination of burners, as, for example, the burner for a room or space heater, or floor furnace, or an oven burner or the like.

Due to the minute character of the electromotive force that can be generated by the heat of a pilot light or other flame or source of heat on a thermoelectric generator, and the inability of this minute electromotive force to actuate the safety shutoff means to open or operating position, thermoelectric safety shutoff and control devices of the type to which this invention particularly appertains usually require reset or cocking means for resetting or cocking the armature to attracted position and the valve or other safety shutoff means to open or operating position.

One of the main objects of the present invention is to provide means which will permit resetting and holding the armature of the thermoelectric safety shutoff portion of the device in attracted position without setting up the supply of fuel to the burner, and particularly, means which will permit resetting and holding the armature in attracted position without setting up the supply of fuel to the burner until the pilot burner has been lighted and a thermoelectric current set up to hold the armature in attracted position.

Another object of the invention is to provide an improved form of combined thermoelectric safety shutoff and electroresponsive valve which is operable automatically to shut off the supply of fuel for the burner whenever, for instance, a pilot light or other flame is extinguished and also having electroresponsive means for shutting off the fuel supply upon opening of the circuit for the electroresponsive part of the device. The opening and closing of the circuit for the electroresponsive part of the device may be done, for instance, by a manually controlled switch, or

automatically by a switch controlled by an abnormal, defective, or insufficient functioning or non-functioning of the apparatus, such as a switch controlled by a thermostat subject to the temperature of the water in the tank of a water heater, or subject to the temperature of a room or other space heated by the apparatus, or by a pressure switch controlled, for instance, by the pressure of the water in the tank of a water heater.

Another object of the invention is to provide a combined thermoelectric safety shutoff and electroresponsive valve of relatively simple and inexpensive construction, and which may be installed and operated conveniently and effectively; also a device of this character composed of relatively few parts and adapted for convenient and expeditious manufacture and assembly.

Another object of the invention is to provide a combined thermoelectric safety shutoff and electroresponsive valve in which a single main shutoff valve member constitutes both the thermoelectric safety shutoff valve and the electroresponsive valve and, more specifically, a device of this character having in addition a safety pilot shutoff valve under the control of the thermoelectric safety means and so arranged that the main safety shutoff valve may operate under the control of the electroresponsive means independently of the safety pilot shutoff valve.

The thermoelectric safety shutoff is preferably of a character to shut off the flow of fuel to both the main burner and the pilot burner when the pilot light or other flame is extinguished, but the use of the invention with burner systems having constantly burning pilot lights and with the thermoelectric safety shutoff arranged to shut off only the flow of fuel to the main burner is contemplated within the scope of the broader of the appended claims.

Further features and advantages of the invention will be apparent from the following detailed description, taken in connection with the accompanying drawings in which:

Figure 1 is a more or less diagrammatic view showing a combined thermoelectric safety shutoff and electroresponsive valve embodying the present invention as applied to a burner equipped with a pilot burner;

Figure 2 is a vertical section through the combined thermoelectric safety shutoff and electroresponsive valve taken on the line 2—2 of Figure 1; and

Figure 3 is a fragmentary detail section taken on the line 3—3 of Figure 2.

Referring to the drawings, the burner shown fragmentarily at 10 is any suitable or preferred main burner, by way of example for a water heater, or for a room or space heater, or it may be an oven burner or any other main burner.

A pipe, indicated fragmentarily at 11, supplies gaseous or other suitable fuel to the burner 10, and disposed in juxtaposition to the burner 10 is a pilot burner 12 which maintains a pilot light 13 for igniting the main burner. The pilot burner 12 is supplied with fuel by a tube 14 connected to the body of the combined thermoelectric safety shutoff and electroresponsive valve, as will be hereinafter described, or in any other suitable manner.

The combined thermoelectric safety shutoff and electroresponsive valve, designated in its entirety at 18, comprises a valve body 20 having an inlet 21 and an outlet 22 which are connected in communication with contiguous sections of the fuel supply pipe 11, the pipe section connected to the inlet 21 being adapted for delivering gas or other fuel from a suitable source of fuel supply, and the pipe section connected to the outlet 22 being adapted to deliver the fuel to the burner 10.

The valve body 20 has a wall or partition 24 provided with an opening in which is mounted a tubular valve seat member 25 defining a valve opening 26 through which the inlet chamber 27 is adapted to be placed in communication with the outlet chamber 28. The inlet 21 opens into the inlet chamber 27, and the outlet chamber 28 opens out through the outlet 22. The valve seat member 25 is provided at one end with an annular valve seat 29 for a combined thermoelectric safety shutoff and electroresponsive valve 30 shown as of generally cup-shaped form. At the opposite end of the valve seat member 25 is an annular valve seat 31 for a flow interrupter valve disc 32.

The particular electroresponsive valve shown in the drawings is in the form of a solenoid valve in general of the character disclosed and claimed in Theodore A. Wetzel Patent No. 2,111,232, granted March 15, 1938, and in the copending application of Henry F. Alfery, Serial No. 303,602, filed November 9, 1939, now Patent No. 2,297,854, granted October 6, 1942. The particular form of this electroresponsive valve may, of course, vary within the scope of the present invention.

The stem 35, which is preferably non-magnetic, is slidable in a bore 36 extending longitudinally through the solenoid plunger or armature 38. The plunger 38 is counterbored at 39, and the stem 35 has a head 40 outwardly beyond the shoulder 41 with the parts positioned as shown. Upon outward movement of the plunger 38 in response to energization of the magnet coil 42, the shoulder 41 engages the head 40 with an impact or hammer-like blow positively to release the valve 30 from its seat 29, and thereupon the continued outward movement of the plunger 38 lifts the valve 30 to open position.

The valve 30 is carried by a valve hub 43 which fits telescopically over the inner end of the stem 35 and is secured thereto by a pin 44. The pin 44 is restrained against displacement by the hub-like portion of an abutment member 45. A spacer sleeve 46 is positioned between the abutment member 45 and the adjacent end of the plunger 38 and surrounds the stem 35.

The armature or plunger 38 is slidable in a solenoid guide tube 48 preferably of non-magnetic material, which tube is closed at its outer

end by a plug 49 preferably of magnetic material. The magnet coil 42 surrounds the upper or outer portion of the tube 48, and, upon energization, draws the plunger 38 outwardly toward the plug 49. The outward attraction imposed on the armature or plunger 38 upon energization of the coil 42 may be augmented by a magnetic or flux sleeve 50 which surrounds the outer end of the tube 48.

The tube 48 is preferably closed and sealed at its outer end, and thereby serves as a sealing tube to prevent leakage from the valve body 20. The lower or inner end of the tube 48 is fixed in a tube support 52 threaded into the valve body 20. A gasket may be provided at 53, and the support has diametrically opposite openings 54 for engagement by a spanner wrench or other suitable tool to screw the support 52 into and out of place. A magnetic or flux washer is provided at 55, and an enclosing hood is provided at 56. The hood 56 is surmounted by a cover 58 which may be in the form of a name plate, and this cover and the hood 56 are held in place by a hood retaining screw 60 threaded into the plug 49, or by through screws (not shown) threaded at their inner ends into the valve body 20, or in any other suitable or desired manner. The flux washer 55 may be fastened in place by additional screws (not shown), or, if desired, said washer may be held in place by the screw or screws which fasten the hood 56 in place.

The flux sleeve 50 is shown as carried by the outer end of the hood 56. Insulation, in the form of an insulating spool, is provided for the coil 42 as indicated at 62, and, if desired, a suitable wrapping may be provided around the outer periphery of the coil 42. A spring washer 63 is preferably interposed between the under side of the top of the hood 56 and the outer end of the insulating spool 62. The outer end of the tube 48 is preferably peened over the outer end of the plug 49 at 64. A solenoid plunger plug 65 is secured in the outer end of the plunger 38, and a stop 66 which is preferably non-magnetic prevents the armature or plunger 38 from directly contacting the plug 49, thereby precluding residual magnetism in the armature from holding the valve 30 open after deenergization of the coil 42.

As more fully disclosed in the copending application of Henry F. Alfery above identified, the armature 38 preferably comprises a body of magnetic material of irregular but generally triangular cross section. The unbalanced or eccentric distribution of the mass in the plunger 38 gives the same a relatively low magnetic reluctance along the side of greatest mass, so that upon energization of the coil 42 the armature 38 not only rises to open the valve and to enter the enclosure defined by the magnetic sleeve 50, but is drawn sidewise and held against the inner surface of the guide tube. This hugging of the armature against the inner surface of the guide tube prevents lateral or sidewise vibration and rattling of the armature in the guide tube.

Near the outer end the armature 38 is provided with an encircling shading ring 68 of copper or other suitable metal. The plug 49 is also shown as provided with a shading ring 70 of copper or other suitable metal.

Power for energization of the coil 42 is supplied by insulated conductors 72 which may be connected to any suitable source of electric current, for example, through step down trans-

formers to the usual line wires 7 adjacent where the device is installed. These conductors 72 extend through a sleeve or grommet 74 secured at 75 to the wall of the hood 56. The sleeve 74 is illustrated as internally threaded to receive a suitable closure plug (not shown).

Mounted on an insulating member 78 are a pair of spring contacts 79 and 80 secured to the insulating member 78 by terminal posts 81 and 82, respectively, as shown in Figures 2 and 3. One conductor 72 is connected to one end of the coil 42, and the other conductor 72 is connected to the terminal post 82. The other terminal post 81 is connected, for example, at 83 to the other end of the coil 42. The contacts 79 and 80, with the actuating member therefor, constitute a switch for opening and closing the circuit for the coil 42 according to whether the pilot light 12 or other flame is burning or extinguished as will presently appear. The contacts 79 and 80, and the adjacent end of the switch actuator means are enclosed in an insulating housing 84 secured by screws 85 to the valve body 20. The attachment of the housing 84 to the body 20 is adapted to clamp the insulating member 78 in place as shown.

The electromagnet responsive to the pilot flame is shown as comprising a generally U-shaped magnet frame 90 positioned within a magnet housing 91 which seals the magnet and armature from the fuel and other matter that might act deleteriously thereon. The magnet frame 90 is secured to a terminal bushing 92, for example, in the manner more fully disclosed in the copending application of Richard K. Engholdt, Serial No. 328,923, filed April 10, 1940. The coil 93 of the electromagnet is wound around the legs of the magnet frame 90.

The bushing 92, the shank of which extends through an opening in a magnet mounting nut 94, is shown as externally threaded for threaded engagement with a nut 95 by means of which the bushing 92 is clamped to the magnet mounting nut 94. A gasket 96 is preferably placed between the flanged or headed inner end of the bushing 92 and the magnet mounting nut 94. The magnet mounting nut 94 has threaded engagement at 98 in the valve body 20, a sealing gasket 99 being preferably placed between the inner end of the nut 94 and a cooperating annular shoulder in the valve body 20. The outer end of the generally cup-shaped magnet housing 91 is preferably peened over or secured to the flange or head at the inner end of the terminal bushing 92.

A thermoelectric generator shown in the form of a thermocouple 102 is placed in position so that the hot junction 103 thereof will be heated by the pilot flame 13 as long as the pilot flame is burning. The thermocouple and leads therefor may be similar to the thermocouple and leads more fully disclosed in Oscar J. Leins Patent No. 2,126,564, granted August 9, 1938, or the thermocouple and leads may be of any other suitable or preferred form.

For the purpose of the present description, suffice it to state that the particular thermocouple selected for illustration comprises an outer tubular metallic thermocouple element 104 and an inner metallic thermocouple element 105 of different thermoelectric characteristics. The inner thermocouple element 105 is joined at one end to the outer end of the outer thermocouple element 104 to form the thermojunction 103 which is placed in position to be heated by the pilot

flame 13. An inner lead conductor 106 is joined to the inner thermocouple element 105 to form an internal thermojunction 108, and an outer tubular lead conductor 110 surrounds the inner lead conductor and is connected to the outer thermocouple element, for instance, through a sleeve 112 to form a third thermojunction. The inner lead conductor 106 is insulated from the outer lead conductor 110, for instance by a wrapping of insulation 114 on the inner lead conductor.

A quick detachable or removable connection is preferably provided between the pilot responsive electromagnet and the ends of the leads 106 and 110 opposite the ends which are connected to the thermocouple elements. This removable lead connection may be of the form disclosed in the copending application of Richard K. Engholdt above identified, and is illustrated in that form, it being understood that the connection may be of any other suitable or preferred form. Suffice it for purposes of this description to state that the inner lead 106 has a connector cone 116 which seats in the correspondingly recessed outer end of the terminal tip 118 and is clamped in contact therewith by a connector sleeve 119. The adjacent end of the outer tubular lead conductor 110 is connected in circuit with one side of the coil 93 through the connector sleeve 119 and bushing 92 to which one end of the coil is connected. The other end of the coil 93 is connected to the terminal tip 118, and through this tip 118 and the connector cone 116 with the inner lead conductor 106, the terminal tip 118 being insulated from the bushing 92.

The armature 122 is disposed in the armature and electromagnet housing 91 and is adapted to be held in attracted position against the pole ends of the magnet frame 90 as long as the electromagnet is thermoelectrically energized by the heat of the pilot or other flame on the thermoelectric generator. The armature 122 is shown of disc-like form and is secured at 123 to the armature stem 124. The attachment of the armature to the stem at 123 is preferably sufficiently loose, as indicated, to permit self-accommodation of the armature to the pole ends of the magnet frame by a generally universal movement of the armature upon the end of the stem 124. The stem 124 is disposed generally concentrically of the housing 91 and extends inwardly for reciprocatory movement through an opening 126 in the inner end of the housing 91.

The valve body 20 has a pilot outlet 128 through which fuel is adapted to be delivered to the tube 14 for delivery to the pilot burner 12. The inner end of the outlet 128 is provided with an annular valve seat 129 for a safety pilot shutoff valve 130. The valve 130 is preferably provided with a valve gasket or yielding facing 135 secured in place upon a pilot valve stem 136, for example by a grooved collar 138 threaded upon the inner end of the stem 136. The adjacent end of the armature stem 124 fits telescopically in the inner end of the stem 136 and is fixed therein by a pin 139 restrained against displacement by the collar 138. Packing 140 is preferably interposed between the inner end of the housing 91 and a valve spring seating member 141.

The valve spring 142 is in the form of a coiled compression spring interposed between the collar 138 and the extending flange of the valve spring seating member 141, and centered, if desired, as shown. The spring 142 resiliently moves the armature 122 to retracted position and the pilot

safety shutoff valve 130 into closed position seating upon the valve seat 129, when the pilot responsive electromagnet is deenergized.

The outer end of the pilot valve stem 136 is secured at 158 to a flexible diaphragm 159 clamped marginally between the insulating switch housing 84 and the adjacent part of the valve body 20. A pin 160 fits telescopically in the outer end of the valve stem 136. This pin operates within the switch housing 84 and has abutting engagement at 161 with the valve stem 136. The outer end of the pin 160 has abutting engagement with the spring contact 79 to move this contact out of engagement with the contact 80, thereby opening the circuit for the solenoid coil 42 upon movement of the armature 122 to retracted position, as shown in Figure 2. Upon movement of the armature 122 to attracted position, the pin 160 frees the contact 79 for movement, for example, by its own resiliency into contact with the spring contact 80 to complete the circuit for the coil 42.

The heat of the pilot light upon the thermocouple is sufficient to hold the armature 122 in attracted position and the pilot valve 130 in open position when the armature is engaged with the pole ends of the magnet frame, but this thermoelectric current is not capable of moving the armature to attracted position and the valve member 130 to open position. In order, therefore, to provide for opening the pilot valve 130 and for setting the armature 122 to attracted position upon initial operation of the device and to reset the device after the same closes to shut off the supply of fuel to the main burner 10 and to the pilot burner 12 when the pilot light is extinguished, reset means is provided. This reset means comprises a reset stem 165 coaxial with the main shutoff valve 30 and mounted for sliding or rectilinear movement.

The reset stem 165 is guided at 166 in the member 168 and the opening through which the stem extends is sealed by suitable packing 169. A packing washer is provided at 170 and a reset spring 171 is coiled about the reset stem and interposed between this packing washer and a reset button 172. The reset button 172 is secured to the outer end of the reset stem and is guided for rectilinear movement in the boss 174 on the valve body 20. The inner end of the reset stem 165 is headed at 175 for abutting engagement with the hub 43 for the shutoff valve 30.

A reset gasket 176 is held in place in the member 168, for example, by peening the member 168 over at 178. The flow interrupter disc 32, which is slidable on the reset stem 165, has rib means at 180 which cooperates with the gasket 176 when the flow interrupter disc is in the position shown in the drawings. The cooperation of the rib means 180 with the gasket 176 tends to prevent the escape of gas or other fuel from the interior of the valve body 20 through the reset means. A coiled flow interrupter spring 182 is interposed between the flow interrupter disc 32 and the valve body 20. The flow interrupter disc 32 preferably has a valve gasket or yielding facing 183 for cooperation with the valve seat 31.

For the purpose of actuating the safety pilot shutoff valve 130 to open position and the armature 122 to attracted position by the opening movement imparted to the main valve 30 by the reset stem 165, I provide an actuating lever 145 pivoted at 146. One end of the lever 145 has pin or other means 148 engaging in the groove in the collar 138 whereby swinging movement of the

lever 145 in a counterclockwise direction (Figure 2) will impart rectilinear movement to collar 138 in a direction to move the valve 130 to open position and the armature 122 to attracted position. The other end of the lever 145 is bifurcated at 150 freely to straddle the sleeve 48 and the hub of the abutment member 45.

The bifurcated end of the lever 145 is formed at 152 to be engaged by the flange of the abutment member 45 to actuate the valve 130 to open position and the armature 122 to attracted position upon pressing the reset stem 165 inwardly. The bifurcation 150 in the lever 145 permits the main shutoff valve 30 to be opened and closed automatically or, if desired, manually independently of the armature 122 and the pilot shutoff valve as long as the pilot shutoff valve 130 is in open or operating position. Thus, with the armature 122 in attracted position and the pilot shutoff valve 130 open, the main valve 30 may be opened and closed responsive to a thermostat *t*, timer, pressure switch, manual switch, or other control in the circuit for energizing the coil 42 of the solenoid valve without disturbing the attracted position of the armature 122 or the open position of the pilot valve 130. Automatic opening and closing of the main shutoff valve is thus permitted while maintaining the pilot valve open and thereby the supply of fuel for the pilot light.

The operation of the device is as follows:

When the pilot light is burning, the heat thereon upon the thermojunction 103 produces a thermoelectric current in the coil 93. The magnet frame 90 and armature 122 are preferably formed of an alloy of relatively low magnetic reluctance and, as a result, the minute or relatively weak electromotive force produces a magnetic field of sufficient strength so that when the armature 122 is placed in attracted position by pushing the reset button 172 inwardly, the magnetic attraction holds the armature in attracted position with a force greater than the force exerted by the spring 142, thereby holding the pilot valve 130 in open position as long as the pilot flame is burning.

Assuming that the main shutoff valve 30 is held open by the solenoid coil 42, if the pilot flame is extinguished the holding action of the pilot responsive electromagnet ceases to be sufficient to hold the armature 122 in attracted position and the pilot valve 130 in open position, and the spring 142 moves the armature 122 to retracted position with an accompanying movement of the pilot valve 130 to closed position. In the movement of the pilot valve 130 to closed position the pin 160 separates the contact 79 from the contact 80. This opens or disables the circuit for the coil 42 and the main valve 30 drops to closed position by gravity, although spring means may be provided for moving the main valve to closed position at this time.

When it is desired to reset the device, the reset button 172 is pressed inwardly. The reset stem in its inward movement abuts the hub 43 of the main shutoff valve and moves this valve to open position. At the same time, the abutment of the abutment member 45 with the bifurcated end 150 of the lever 145 swings this lever in a counterclockwise direction about its pivot 146 thereby, through the cooperation of the pin or other means 148 at the opposite end of the lever with the grooved collar 138, moving the armature 122 to attracted position and the pilot valve 130 to open position. Just prior to abutment of the inner end of the reset stem 165 with the hub 43 of the shutoff valve 30, the yielding facing 183

of the flow interrupter disc 32 seats upon the valve seat at 31 to shut off the supply of fuel to the main burner during the resetting operation. A supply of fuel is thus set up to the pilot burner, but there is not at this time any flow of fuel to the main burner where it could escape and collect unburned.

If the pilot burner is lighted and sets up a thermoelectric current to hold the armature in attracted position and the pilot valve 130 in open position, the pilot valve 130 will remain in open position, and when the reset button 172 is released, the spring 171 returns the reset button and reset stem to their outwardly projected position as shown in Figure 2 and opens the flow interrupter valve 32. If the circuit for the solenoid valve is closed, the main shutoff valve 30 will remain open and, as a result, fuel will flow to the main burner and be ignited by the pilot light. If the pilot burner is not lighted to produce the thermo-electric current for holding the pilot valve 130 open, this valve will move to closed position upon release of the reset button 172.

When the circuit through the coil 42 is closed, the armature 38 is drawn upwardly and actuates the valve 30 to open position where it remains as long as the coil 42 is energized. Upon deenergization of the coil 42, as, for example, upon opening of the thermostat *t* in the circuit for this coil, the armature 38 is released and drops by gravity, closing the valve 30 with impact or with a hammer-like blow and, except for the resetting as described, holding the valve closed as long as the coil 42 is deenergized. As long as the safety pilot shutoff valve 130 is in open position and the armature 122 in attracted position, the main shutoff valve 30 is operable to open and closed positions independently of the safety pilot shutoff valve, for example under the control of condition responsive means in the energizing circuit for the coil 42.

As already described, upon movement of the armature 122 to retracted position and the safety pilot shutoff valve 130 to closed position, for example, upon extinguishment of the pilot light, the pin 160 separates the contact 79 from the contact 80, thereby opening or disabling the circuit for the coil 42 and releasing the armature 38 for movement of the main shutoff valve to closed position. Upon resetting of the armature 122 to attracted position and the safety pilot shutoff valve 30 to open position, the pin 160 moves inwardly with the pilot valve and armature and releases the spring contact 79 which moves, for example, under its inherent resilience into contact with the spring contact 80, thereby closing the circuit for the coil 42 so that the main shutoff valve will be electroresponsive to the condition responsive or other control means in the energizing circuit for the coil 42.

While the opening of the switch at 79, 80 has been described as the means for accomplishing closing of the main valve 30 upon movement of the pilot valve 130 to closed position, it is to be understood that the lever 145 may be arranged to close the main valve upon movement of the pilot valve to closed position. In either case, the opening of the circuit for the electroresponsive valve at the switch 79, 80 will prevent opening of the main valve under the influence of the operating circuit for the coil 42 while the pilot valve 130 is closed.

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 combination, thermoelectric safety means comprising a controlling member having a connected armature and an electromagnet connected in circuit with a thermoelectric generator adapted to be subjected to the heat of a flame, a main electroresponsive valve, an electrical operating circuit for said valve, reset means cooperable with said main valve in the opening movement thereof for resetting the thermoelectric safety device through said main valve, and a switch for disabling the electrical operating circuit for said main valve as long as the controlling member of said thermoelectric safety device is in safety position, said switch being operable to position enabling the electrical operating circuit for said electroresponsive valve upon movement of the controlling member of said thermoelectric safety means to operating position.

2. In combination, electroresponsive main valve means having substantially rectilinear movement into open and closed positions, an electrical operating circuit for said main valve means, a safety pilot shutoff valve, means for enabling and disabling said circuit responsive to opening and closing of said pilot valve, and reset means for resetting said pilot valve to open position comprising means for opening said main valve means and a resetting lever disposed to be contacted by the main valve means in the opening movement thereof and otherwise free therefrom for automatic closing and opening of said main valve means independently of said pilot valve when the latter is in its reset open position.

3. In combination, electroresponsive main valve means having substantially rectilinear movement into open and closed positions, an electrical operating circuit for said main valve means, a safety pilot shutoff valve, means for enabling and disabling said circuit responsive to opening and closing of said pilot valve, and reset means for resetting said pilot valve to open position comprising means for opening said main valve means and a resetting lever extending between and straddling the respective valve means disposed to be contacted by said main valve means in the opening movement thereof and otherwise free therefrom for automatic closing and opening of said main valve means independently of said pilot valve when the latter is in its reset open position.

4. In combination, a valve body having a main fuel supply opening, an electroresponsive main valve for said opening, an electrical operating circuit for said main valve, a safety pilot shutoff valve, means for enabling and disabling said circuit responsive to opening and closing of said pilot valve, and reset means comprising means for opening said main valve and connections between said valves for resetting said pilot valve to open position in the opening movement of said main valve, said reset means comprising means for closing said main fuel supply opening during the resetting operation, said connections being of a character to permit said main valve to remain open upon completion of the resetting operation while also permitting automatic closing and opening of said main valve independently of said pilot valve when the latter is in open position.

5. In combination a valve body having a main

fuel supply opening, a main valve for said fuel supply opening, a safety pilot shutoff valve, an armature for said safety pilot shutoff valve, an electromagnet for holding said armature in attracted position and said safety pilot shutoff valve in open position, a thermoelectric generator connected in circuit with said electromagnet, reset means comprising means for opening said main valve and connections between said valves whereby movement of the main valve to open position opens the pilot shutoff valve and moves said armature to attracted position and said main valve is free to move between open and closed positions while the pilot shutoff valve remains open, and valve means for preventing the flow of fuel through said main valve supply opening during the resetting operation.

6. In combination, a valve body having a main fuel supply opening, main valve means comprising a main valve for said fuel supply opening, safety pilot shutoff valve means comprising a safety pilot shutoff valve, an armature for said safety pilot shutoff valve, an electromagnet for holding said armature in attracted position and said safety pilot shutoff valve in open position, a thermoelectric generator connected in circuit with said electromagnet, and reset means comprising means for opening said main valve and connections between said valves whereby movement of the main valve to open position opens the pilot shutoff valve and moves said armature to attracted position and said main valve is free to move between open and closed positions while the pilot shutoff valve remains open, said reset means including means whereby supply of fuel through said opening is shut off during the resetting operation.

7. In combination, an electroresponsive main valve and an operating circuit therefor, a safety pilot shutoff valve, means for enabling and disabling said circuit responsive to opening and closing of said pilot valve, and reset means comprising means for opening said main valve and connections between said valves whereby movement of the main valve to open position opens the pilot valve and said main valve is free to move between open and closed positions while the pilot valve remains open.

8. In combination, an electroresponsive main valve having rectilinear movement to open and closed positions, an electrical operating circuit for said valve, a safety pilot shutoff valve, means for enabling and disabling said circuit responsive to opening and closing of said pilot valve, and reset means comprising means for opening said main valve and connections between said valves whereby movement of the main valve to open position opens the pilot valve and said main valve is free to move between open and closed positions while the pilot valve remains open.

9. In combination, a valve body having a main fuel supply opening, an electroresponsive main valve controlling said opening, an electrical operating circuit for said main valve, a safety pilot shutoff valve, means for enabling and disabling said circuit responsive to opening and closing of said pilot valve, and reset means comprising means for opening said main valve and connections between said valves whereby movement of the main valve to open position opens the pilot valve and said main valve is free to move between open and closed positions while the pilot valve remains open.

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