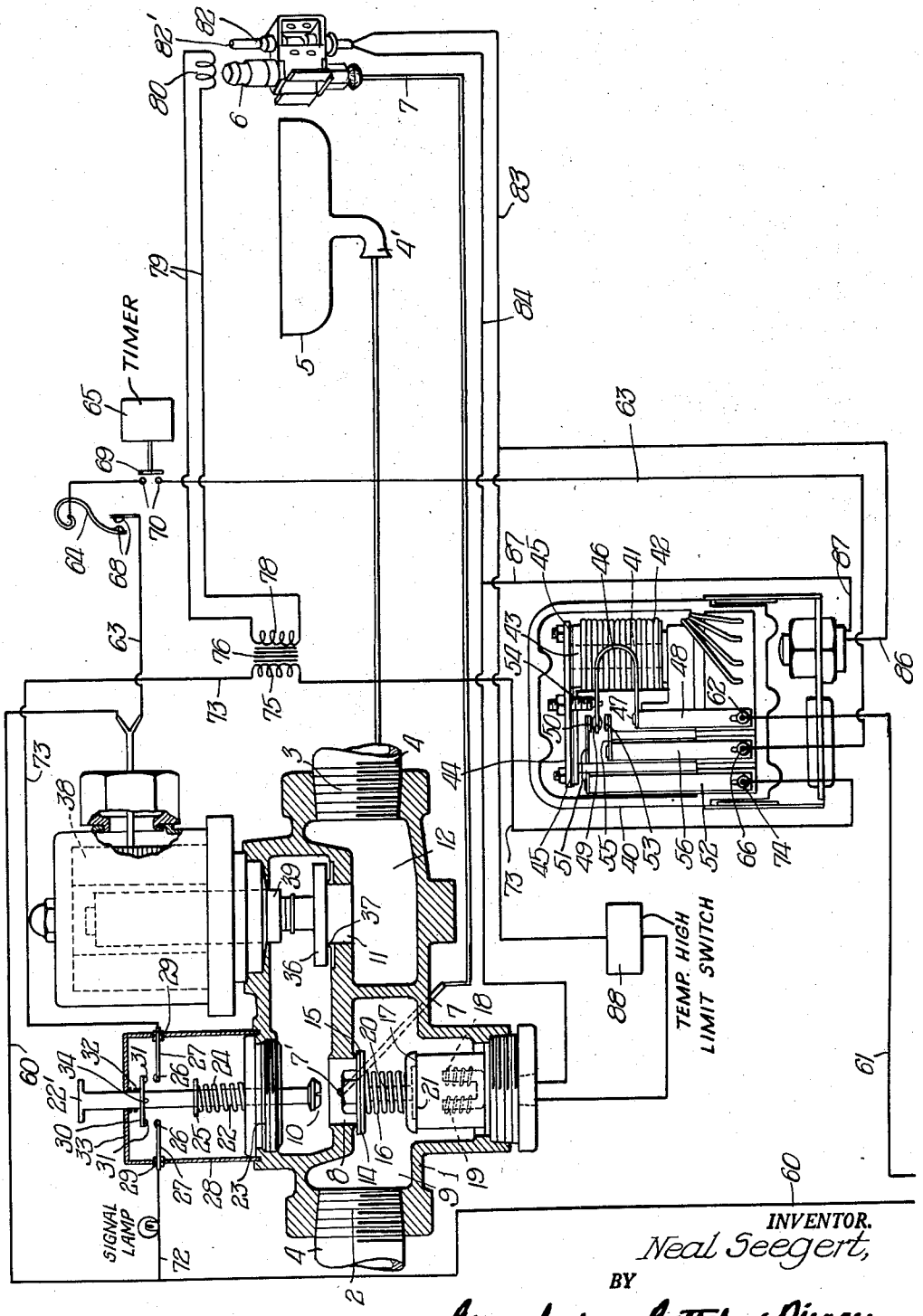
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CONTROL APPARATUS FOR FLUID FUEL BURNING APPARATUS AND THE LIKE

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CONTROL APPARATUS FOR FLUID FUEL BURNING APPARATUS AND THE LIKE

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This invention relates, in general, to control apparatus, and has particular relation to apparatus for controlling flow of fuel to fluid fuel burning apparatus having a main burner, a pilot burner, and an igniter for the pilot burner.

The embodiment of the invention illustrated and described herein has particular utility for controlling the supply of fuel, for example, to a gas burning heater responsive to the presence and absence of a pilot burner flame, and also responsive to variations in the temperature, for example, of the space to be heated, it being understood that other embodiments are contemplated within the scope of the appended claims.

One of the main objects of the present invention is to provide apparatus of the character set forth wherein the igniter and the fuel supply for the pilot burner are interlocked at the outset to provide flow of fuel to the pilot burner with energization of the igniter in initiating the cycle.

Another object is to provide apparatus wherein during initiation of the cycle and by the function of a relay energized by a thermocouple or other thermoelectric generator, pilot burner and main burner valves are interlocked to provide a flow of fuel to the pilot burner, but no flow of fuel to the main burner. When the relay is energized, however, the main burner valve, which may be in the form of a solenoid or other electroresponsive valve, is free to cycle under control of a thermostat or other condition-responsive control or combination thereof, while the thermoelectrically responsive valve remains open.

Another object is to provide apparatus wherein a thermoelectrically energized relay interlocks an electric circuit for the igniter and an electric circuit for the main (electroresponsive) valve so that both of these circuits cannot be energized at the same time.

Another object is to provide apparatus wherein the relay automatically opens or disables the ignited circuit and closes the circuit for the main valve regardless of how long the reset means for resetting the apparatus for flow of fuel to the pilot burner is held in resetting position, thereby prolonging the life of the igniter coil.

Another object is to provide apparatus wherein, if the pilot burner fails (i.e., if the pilot burner flame is extinguished), the thermocouple or other thermoelectric generator ceases to generate thermoelectric current and the relay is deenergized, opening the circuit for the main (electro-responsive) valve and setting up the igniter circuit for restarting.

Another object is to provide apparatus wherein the rellay and the valve which controls the flow of fuel to the pilot burner are powered from the same thermoelectric generator so that if the pilot burner, to the heat of which the thermoelectric generator is responsive, fails, both the main (electro-responsive) valve and the valve controlling the flow of fuel to the pilot burner operate to closed position to provide 100% shut-off of the fuel flow for the main burner and the pilot burner, the thermoelectrically

responsive and main (electro-responsive) valves being thus interlocked in this respect.

Another object is to provide apparatus wherein if attempt is made to re-ignite the pilot burner upon failure thereof and while the thermoelectric generator is still hot and energizing the relay sufficiently to maintain the main valve open, the igniter circuit cannot be closed. In other words, the igniter cannot be energized while the main valve is open.

Another object is to provide apparatus wherein if the relay has dropped out, fuel will flow to the pilot burner and the igniter circuit will be completed in initiating the cycle but a time delay will take place before the main valve opens. This time delay is due to the inherent difference in current values required to pick up the relay as compared to the value at which it drops out, and the time delay is extended by the time it takes the igniter to heat and relight the pilot burner.

Another object is to provide apparatus wherein, for example, a high limit switch may be placed in the thermoelectric circuit to drop out a valve for shutting off all gas to both the pilot burner and the main burner without waiting for the thermoelectric generator to cool.

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 drawing in which the single figure shows more or less diagrammatically one illustrative embodiment of the invention.

In the drawing the numeral **1** indicates a valve body having a gaseous fuel inlet **2** and a gaseous fuel outlet **3**. Contiguous sections of a gaseous fuel supply pipe **4** are connected to the inlet **2** and outlet **3**. The section connected to the outlet leads to a main burner **5** which may be located, for example, in the firebox of a space heater or other heater. A pilot burner **6** is located in juxtaposition to the main burner **5** to maintain a pilot burner flame for igniting the main burner. The pilot burner **6** is supplied with gaseous fuel by a pilot fuel supply pipe **7** which is connected, for example, and leads at **7'** from the port or passage **8** for placing the inlet chamber **9** in communication with an intermediate chamber **10**. A port or passage **11** is also provided for placing the intermediate chamber **10** in communication with the outlet chamber **12**.

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

Flow of gaseous fuel through the passage **8** is under the control of a thermoelectric safety shut-off valve having a valve member **14** which in closed position seats against an annular valve seat **15** at the inlet end of the passage **8** to shut off the flow of fuel from the inlet chamber **9** to the intermediate chamber **10**. The valve member **14** is biased to closed position by a coiled spring **16** interposed between the valve member and the inner end of the magnet hood or cup **17**. Within the hood **17** is an electromagnet comprising a magnet frame **18** having a coil **19** wound around the legs thereof. The valve member **14** is carried by a stem **20** which extends for reciprocatory movement into the cup **17** and carries thereon an armature **21** which is adapted to be held attracted to the electromagnet to hold the valve member **14** in open position when the electromagnet is energized as will presently appear. Upon deenergization of the electromagnet, the spring **16** closes the valve member **14** against its seat **15**.

A reset stem **22** slidable through a nut **23** screwed into the valve body has a reset button **22'** at its outer end which is adapted to be engaged by the hand or fingers and manually pressed inwardly. This inward movement of the reset stem **22** engages the inner end thereof with

the assembly which includes the valve member 14 and presses the valve member 14 to open position and the armature 21 to attracted position, as well understood in the art. The reset stem 22 is biased to its outwardly projecting position as shown in the drawing by a coiled spring 24 acting, for example between a flange or abutment 25 fixed to the stem 22 and packing (not shown) around the stem 22 and within the nut 23.

The stem 22 has reciprocatory movement between a pair of ignition circuit contacts 26, carried for example, by contact arms 27. The contact arms 27 may be carried, for example, by a cover, frame or hood 28 which may enclose the contact 26 as well as the spring 24 and the adjacent portion of the stem 22. The contact arms 27 are insulated from the hood 28 at 29. The stem 22 is slidable through a bridging contact member 30 having contacts 31 for contact with the contacts 26. A coiled spring 32 is interposed between the bridging contact member 30 and the outer end wall 33 of the hood 28 and yieldingly forces the contact member 30 to circuit closed position with its contacts 31 in contact with the contacts 26 when the stem 22 is pressed inwardly in initiating the cycle as will presently appear. A pin 34 fixed to the stem 22 and extending diametrically therefrom engages the bridging contact member 30 and separates the contacts 31 from the contacts 26 to open the ignition circuit as the stem 22 is moved to its outwardly projecting or retracted position by the spring 24.

An electroresponsive main valve member 36 seats in closed position against an annular valve seat 37 at the inlet end of the passage 11 to shut off the flow of fuel from the intermediate chamber 10 to the outlet chamber 12. The valve 36 may be of the solenoid actuated type, or it may be of any other suitable form. Suffice it for purposes of the present description to state that the particular solenoid valve selected for illustration has a coil 38 which when energized draws an armature 39 upwardly as the device is shown in the drawing and actuates the valve member 36 to open position. When the coil 38 is deenergized, the valve member 36 closes against its valve seat 37.

The relay 40 may be of the form more fully illustrated and described in the copending application of Gerald E. Dietz and Adolph J. Hilgert, Serial No. 302,346, filed August 2, 1952, now Patent No. 2,787,739. Suffice it to state that the relay has a power unit comprising a pair of core pieces 41 (one is shown) with coils 42 (one is shown) wound around the core pieces. The core pieces may have enlarged pole pieces 43 and an armature 44 pivoted at 45 at its rear end as shown in the drawing (the side presented to view being considered the front end) is biased to retracted position by a contact spring 46. The spring 46 is shown of U-shaped form with one end connected at 47 in circuit with a lead-in terminal 48. The other end of the spring 46 carries a contact 49 which is biased into contact with a contact 50 carried by a contact spring 51 connected in circuit with a lead-in terminal 52. When the coils 42 are energized, by current afforded by the thermoelectric generator 82, hereinafter described, the armature 44 is drawn to attracted position separating the contact 49 from the contact 50 and moving it into engagement with a contact 53 through an insulating pin 54 carried by the armature 44. The contact 53 is carried by a contact spring 55 connected in circuit with a lead-in terminal 56.

An external source of current supply such, for example, as a 110 volt circuit or any other suitable circuit has one lead 60 extending and connected to one lead or terminal of the coil 38 of the solenoid valve. The other lead 61 of the aforementioned external circuit extends and is connected at 62 to the lead-in terminal 48 of the relay. The other lead or terminal of the coil 38 is connected to a conductor 63 which leads through an automatic type thermostat 64 such, for example, as a room thermostat, and, if desired, through a clock control 65 and is connected at 66 to the lead-in terminal 56 of the relay. The thermostat 64 and where desired the other control 65 are thereby disposed in the circuit for the coil 38 of the electroresponsive valve and this circuit is thus connected to the relay 40 to provide results which will be presently described.

The thermostat 64 has contacts 68 at least one of which separates from the other upon rise in the temperature, for example, of a space heated by the burner 5 to or above a predetermined setting. This opens the circuit of the solenoid valve with resulting operation of this valve to closed position against its seat 37. The clock control 65 or other control which is shown in series with the thermostat 64 has a bridging contact 69 which separates from the contacts 70 at a predetermined time or upon the occurrence of some other condition. This opens the circuit of the solenoid valve with resulting operation of this valve to closed position regardless of whether the thermostat 64 is open or closed and thus calling for heat.

The ignition circuit comprises a conductor 72 connecting the external circuit conductor 60 to one of the contact arms 27 and a conductor 73 connected to the other contact arm 27 and extending and connected at 74 to the lead-in terminal 52 of the relay 40. The conductor 73 has the primary winding 75 of a transformer 76 in circuit therewith. The secondary winding 78 of the transformer 76 is connected by conductors 79 to an igniter coil 80 located in juxtaposition to the pilot burner 6 for igniting the pilot burner.

A thermocouple 82 or other suitable thermoelectric generator is disposed in juxtaposition to the pilot burner 6 so that its one or more "hot" junctions 82' will be heated by the pilot burner flame when the pilot burner is ignited. One side or terminal of the thermocouple 82 is connected by a lead conductor 83 to one terminal of the coil 19 of the thermoelectric safety shut-off valve. The other side or terminal of the thermocouple 82 is connected to the other terminal of the coil 19, for example, by a lead conductor 84 grounded at the safety shut-off device, the other terminal of the coil 19 being also grounded at the safety shut-off device, all as well understood in the art.

The coils 42 of the relay 40 are connected in circuit with the thermocouple 82 by conductors 86 and 87 connected, for example, to the thermocouple lead conductors 83 and 84, respectively. If desired, a high limit switch 88 or other control may be provided in the thermocouple or thermoelectric generator circuit 83, 84.

With the parts of the apparatus in the positions shown in the drawing (i.e., with the valve members 14 and 36 closed and shutting off the flow of fuel to both the main burner 5 and the pilot burner 6 and the relay 40 deenergized so that the armature 44 is in retracted position with the contact 49 biased into contact with the contact 50) the operation of the aforedescribed embodiment of the invention is initiated by manually engaging the reset button 22' and pressing the reset stem 22 inwardly.

The inward movement of the reset stem 22 causes engagement of the contacts 31 on the bridging contact member 30 with the contacts 26 to complete the igniter circuit and energize the igniter 80 and also actuates the valve member 14 to open position to establish a flow of pilot burner fuel to the pilot burner 6. The stem 22 is held pressed inwardly until the igniter coil 80 heats and ignites the pilot burner 6. If desired, a lamp or other suitable signal may be provided in the igniter circuit to light up or signal when the igniter circuit is energized and to go out or discontinue to signal when this circuit is broken or disabled either automatically at the relay (thereby informing the operator whether the apparatus is functioning) or when the circuit is broken or disabled, for example, by releasing the reset button before ignition takes place.

It will thus be apparent that the igniter and the fuel

supply for the pilot burner are interlocked at the outset to provide flow of pilot burner fuel with energization of the igniter circuit in initiating the cycle. During this period, the pilot burner fuel valve **14** and the main burner fuel valve **36** are interlocked so as to provide flow of fuel to the pilot burner **6** but no flow of fuel to the main burner **5** since the main burner valve circuit **60, 63** is open at the contacts **49, 53** of the relay **40**. Flow interruption is thus provided for the main burner fuel during the resetting operation without flow interrupter means other than the function of the thermocouple energized relay.

When the pilot burner flame has heated the thermocouple **82** sufficiently to energize the electromagnet for holding the valve member **14** open the reset button **22'** may be released and the reset stem **22** moves to retracted position with accompanying opening of the igniter circuit. The energization of the coils **42** of the relay **40** by the thermocouple **82** draws the armature **44** to attracted position which separates the contact **49** from the contact **50** and moves said contact **49** into contact with the contact **53**. This closes the main (solenoid) valve circuit at the relay **40** and opens the igniter circuit at the relay. The thermocouple energized relay **40** thus interlocks the igniter circuit and the main (solenoid) valve circuit so that both of these circuits cannot be energized at the same time. Moreover, the relay thus automatically opens the igniter circuit and closes the solenoid circuit at the relay regardless of how long the reset button is held down, thereby prolonging the life of the igniter coil.

With the main (solenoid) valve circuit thus closed at the contacts **49, 53** of the relay, the solenoid valve is under control of the thermostat **64** and the clock or other control **65**. With the contacts **49, 53** closed and the contacts **69, 70** of the control device **65** also closed when the thermostat calls for heat it closes the contacts **68** thereby completing the solenoid circuit with accompanying actuation of the main valve **36** to open position for flow of fuel to the main burner **5** which is ignited by the pilot burner. When the contacts **68** or the contacts **69, 70** or the contacts **49, 53** open, the solenoid is deenergized and the main valve **36** closes to shut off the flow of fuel to the main burner.

If the pilot burner flame fails, for example, by extinguishment thereof, the thermocouple **82** ceases to generate thermoelectric current and the coils **42** of the relay **40** are deenergized. The armature **44** then moves to retracted position and the contact **49** separates from the contact **53** and moves into contact with the contact **50**. This opens the main (solenoid) valve circuit at the contacts **49, 53** and sets up the igniter circuit at the contacts **49, 50** for restarting. The electromagnet for the valve member **14** being powered from the same thermocouple is also denergized and the valve member **14** closes to shut off the supply of fuel for the pilot burner. The safety shut-off device and the relay are thus interlocked and 100% fuel shut-off is provided when the pilot burner flame is extinguished.

Even if an attempt is made to re-ignite after pilot burner failure and while the thermocouple is still hot, if the relay is still energized, the igniter circuit cannot be closed because the contacts **49, 50** will be separated. Hence, the igniter circuit cannot be completed while the main (solenoid) valve is open. If the relay has dropped out, pilot burner fuel will flow and the igniter circuit will be completed, but a time delay will take place before the main valve opens. Obviously, this time delay is due to the inherent difference in current values required to pick up the relay as compared to the value at which it drops out. This time delay is further extended by the time it takes the igniter coil to heat and relight the pilot burner.

Where a high limit switch **88** or other control is provided in the thermocouple circuit, it operates upon occurrence of the high limit or other condition to cause the electromagnet for the valve member **14** to be deenergized and the valve **14** closes to shut off all fuel to both the pilot burner **6** and the main burner **5** without waiting for the thermocouple to cool.

It is contemplated within the scope of the present invention that the thermoelectric safety shut-off valve **14** may control only the pilot fuel supply in which case the operation will be substantially the same except that the solenoid valve would then be the only valve for shutting off the flow of fuel to the main burner. If the high limit device is in the thermoelectric circuit to the electromagnet for the valve **14**, it will cause shut-off of the pilot burner fuel, cooling of the thermocouple with deenergization of the relay and consequent closure of the solenoid valve. In such case, however, the high limit device may be placed in the relay circuit or solenoid valve circuit merely to close the main valve but allow cycling on the high limit switch. This may be desirable under some circumstances.

The embodiment of the invention shown in the drawing is for illustrative purposes only and it is to be expressly understood that said drawing 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 fuel burning apparatus including main and pilot burners, safety shut-off fuel control and ignition apparatus comprising in combination, main burner fuel flow control means having flow-preventing and flow-permitting positions, a safety shut-off valve biased toward closed position and resettable to open position, said valve comprising electromagnetic holding means operable when energized to hold said valve open when reset to said position but incapable of moving said valve to open position, means for manually resetting said safety shut-off valve to open position, ignition means for said pilot burner energizable to afford ignition of fuel at said pilot burner, electroresponsive interlock means comprising first and second substantially stationary contacts and a movable contact biased into engagement with said first stationary contact to permit energization of said ignition means and prevent disposition of said main burner fuel control means in its flow-permitting position, energization of said interlock means moving said movable contact against its bias into engagement with said second stationary contact to prevent energization of said ignition means and permit disposition of said main burner fuel control means in its flow-permitting position, energizing means for said igniter comprising switch means in circuit with said first stationary contact and operatively associated with said reset means to afford energization of said igniter during resetting but only if said movable contact is in engagement with said first stationary contact, and thermoelectric generator means connected to energize said interlock means and said safety shut-off valve holding means, said generator means being subject to the flame at said pilot burner, said generator means, on ignition of fuel at said pilot burner following initiation of a resetting operation, directly energizing said holding means and said interlock means to effect holdng open of said safety shut-off valve and movement of said movable contact against its bias into engagement with said second stationary contact to terminate energization of said ignition means irrespective of the position of said switch means and to permit disposition of said main burner fuel control means in flow-permitting position, said generator means, on subsequent pilot burner outage, terminating its energization of said holding means and said interlock means to permit closure of said safety shut-off valve as well as return of said movable contact into engagement with said first stationary contact under its bias to terminate disposition of said main burner fuel control means in its flow-permitting position and to set up the energizing circuit of said igniter for subsequent energization of the latter upon resetting.

2. In fuel burning apparatus including main and pilot

burners, safety shut-off fuel control and ignition apparatus comprising in combination, a cycling electroresponsive main burner fuel flow control valve having deenergized closed and energized open positions, a main and pilot burner fuel safety shut-off valve upstream of said cycling valve biased toward closed position and resettable to open position, said valve comprising electromagnetic holding means operable when energized to hold said valve open when reset to said position but incapable of moving said valve to open position, means for manually resetting said safety shut-off valve to open position, ignition means for said pilot burner energizable to afford ignition of fuel at said pilot burner, electroresponsive interlock means comprising first and second substantially stationary contacts and a movable contact biased into engagement with said first stationary contact to permit energization of said ignition means and prevent energization of said cycling valve, energization of said interlock means moving said movable contact against its bias into engagement with said second stationary contact to prevent energization of said ignition means and permit energization of said cycling valve, energizing means for said igniter comprising switch means in circuit with said first stationary contact and operatively associated with said reset means to afford energization of said igniter during resetting but only if said movable contact is in engagement with said first stationary contact, and thermoelectric generator means connected to energize said interlock means and said safety shut-off valve holding means, said generator means being subject to the flame at said pilot burner, said generator means, on ignition of fuel at said pilot burner following initiation of a resetting operation, directly energizing said holding means and said interlock means to effect holding open of said safety shut-off valve and movement of said movable contact against its bias into engagement with said second stationary contact to terminate energization of said ignition means irrespective of the position of said switch means and to permit energization of said cycling valve, said generator means, on subsequent pilot burner outage, terminating its energization of said holding means and said interlock means to permit closure of said safety shut-off valve as well as return of said movable contact into engagement with said first stationary contact under its bias to terminate energization of said cycling valve and to set up the energizing circuit of said igniter for subsequent energization of the latter upon resetting.

3. In fuel burning apparatus including main and pilot burners, safety shut-off fuel control and ignition apparatus comprising in combination, a cycling electroresponsive main burner fuel flow control valve having deenergized closed and energized open positions, a main and pilot burner fuel safety shut-off valve upstream of said cycling valve biased toward closed position and resettable to open position, said valve comprising electromagnetic holding means operable when energized to hold said valve open when reset to said position but incapable of moving said valve to open position, means for manually resetting said safety shut-off valve to open position, ignition means for said pilot burner energizable to afford ignition of fuel at said pilot burner, electroresponsive interlock means comprising first and second substantially stationary contacts connected in circuit with said ignition means and said cycling valve respectively, a movable contact connected to a source of electrical energy and biased into engagement with said first stationary contact and out of engagement with the second stationary contact to permit energization of said ignition means and prevent energization of said cycling main burner fuel valve, and an electromagnetic operator for said movable contact operable when energized to move said movable contact against its bias out of engagement with the first stationary contact and into engagement with said second stationary contact to prevent energization of said ignition means and permit energization of said cycling main burner fuel valve, switch means in circuit with said first stationary contact and operatively associated with said reset means to afford energization of said igniter during resetting but only if said movable contact is in engagement with said first stationary contact, and thermoelectric generator means connected to energize said electromagnetic operator and said safety shut-off valve holding means, said generator means being subject to the flame at said pilot burner, said generator means, on ignition of fuel at said pilot burner following initiation of a resetting operation, causing said generator means to directly energize said holding means and said electromagnetic operator to effect holding open of said safety shut-off valve and movement of said movable contact against its bias out of engagement with said first stationary contact and into engagement with said second stationary contact to terminate energization of said ignition means irrespective of the position of said switch means and to permit energization of said cycling main burner fuel valve, said generator means, on subsequent pilot burner outage, terminating its energization of said holding means and of said electromagnetic operator to effect closure of said safety shut-off valve as well as return of said movable contact into engagement with said first stationary contact and out of engagement with said second stationary contact under its bias to terminate energization of said cycling main burner fuel valve and to set up the energizing circuit of said igniter for subsequent energization of the latter upon resetting.

References Cited in the file of this patent

UNITED STATES PATENTS

2,270,722	Beam	Jan. 20, 1942
2,390,172	Ray	Dec,. 4, 1945
2,454,848	Strobel	Nov. 30, 1948
2,501,850	Kunzler	Mar. 28, 1950
2,520,961	Ray	Sept. 5, 1950
2,601,321	Ray	June 24, 1952
2,607,406	Caparone	Aug. 19, 1952
2,607,415	Jordan	Aug. 19, 1952
2,678,814	Geldhoff et al.	May 18, 1954
2,687,738	Thornbery	Aug. 31, 1954
2,730,169	Deubel	Jan. 10, 1956