

June 22, 1948.

M. J. CAPARONE
SAFETY CONTROL AND IGNITION APPARATUS
FOR GASEOUS FUEL BURNERS

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3 Sheets-Sheet 1

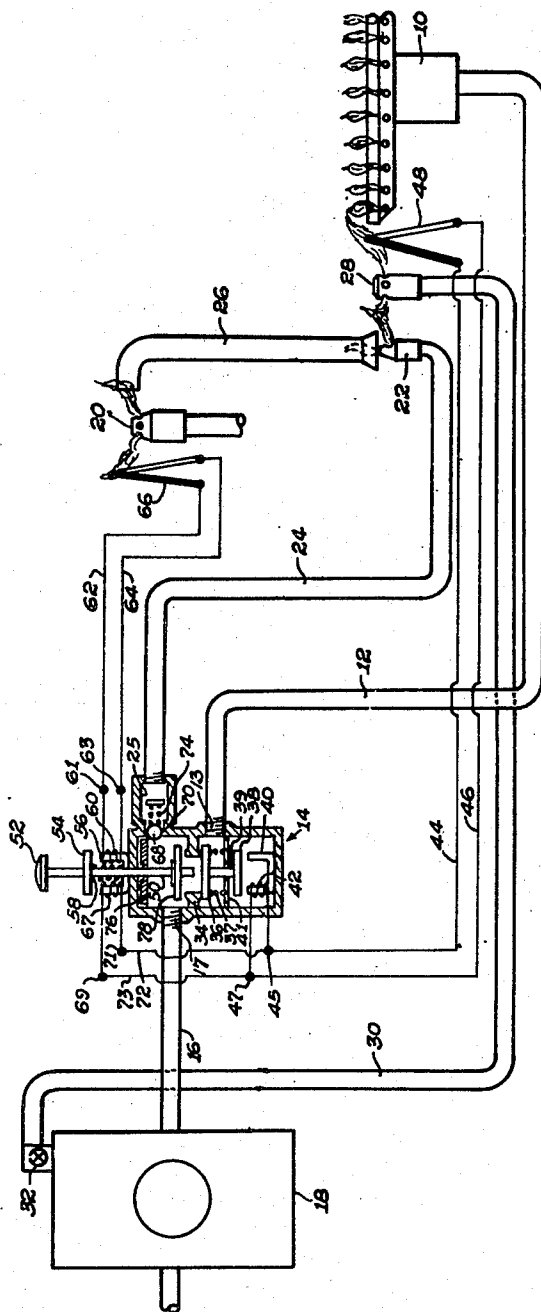


Fig. 1.

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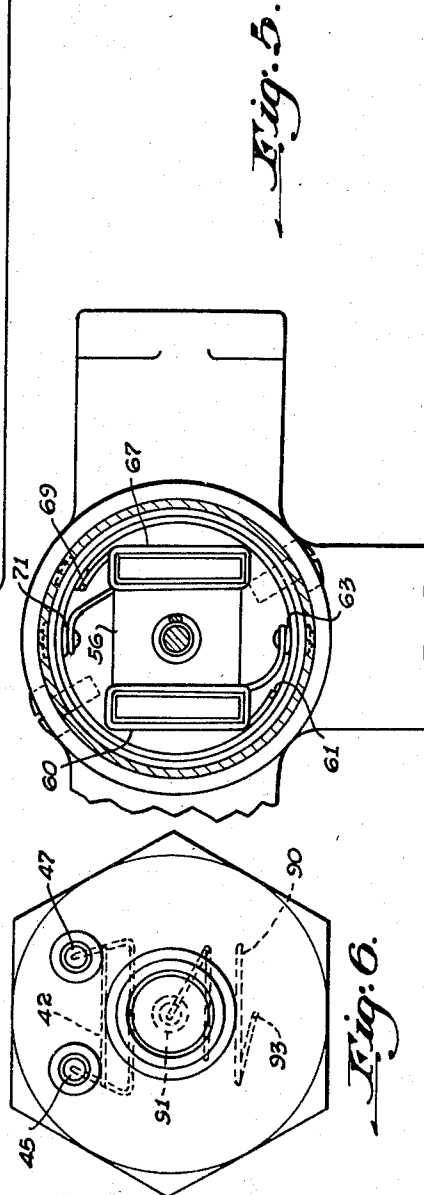
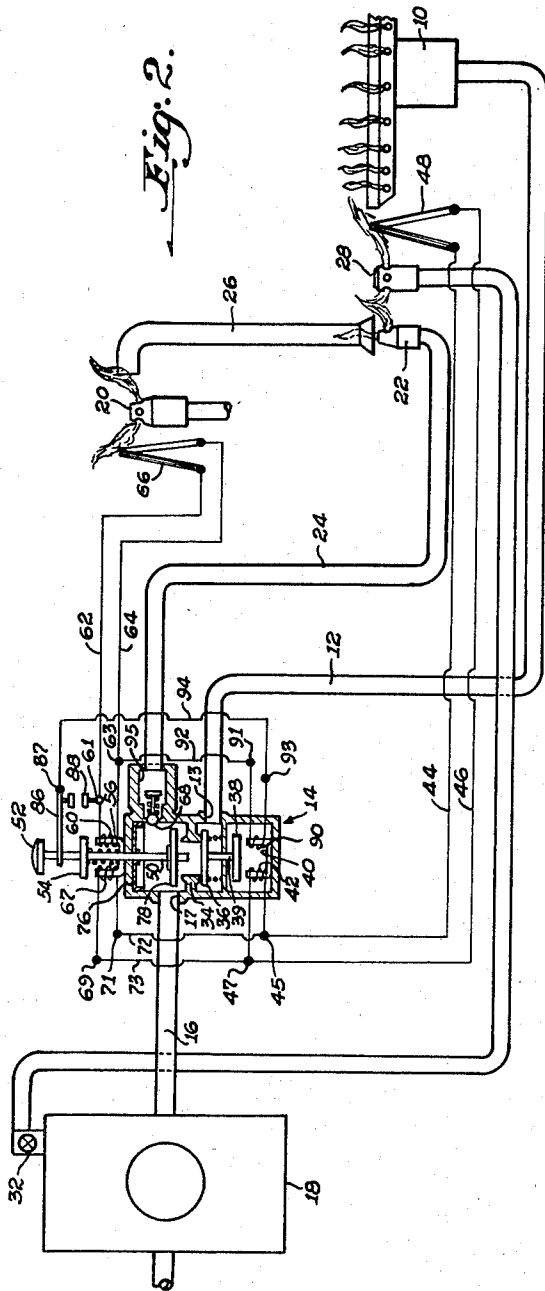
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

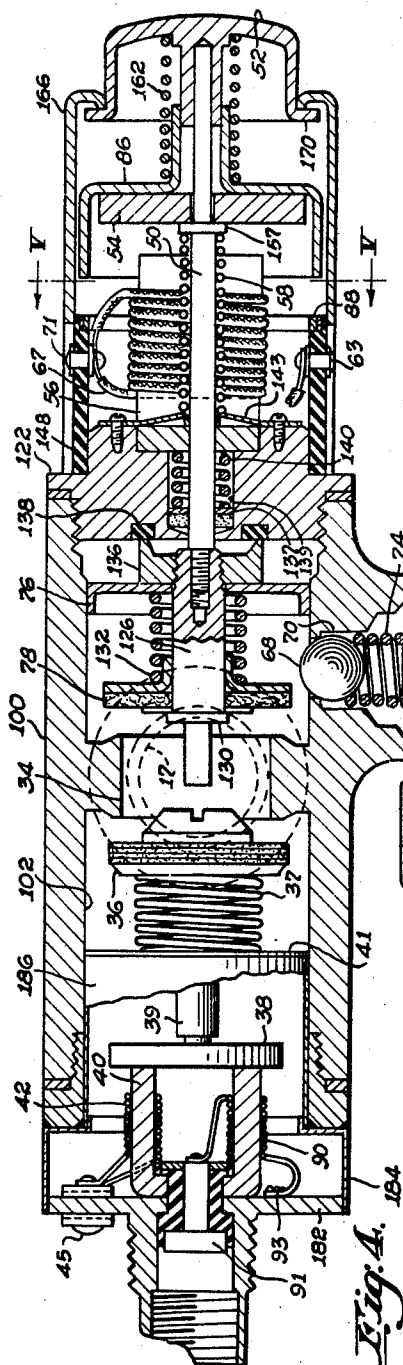


Fig. 4.

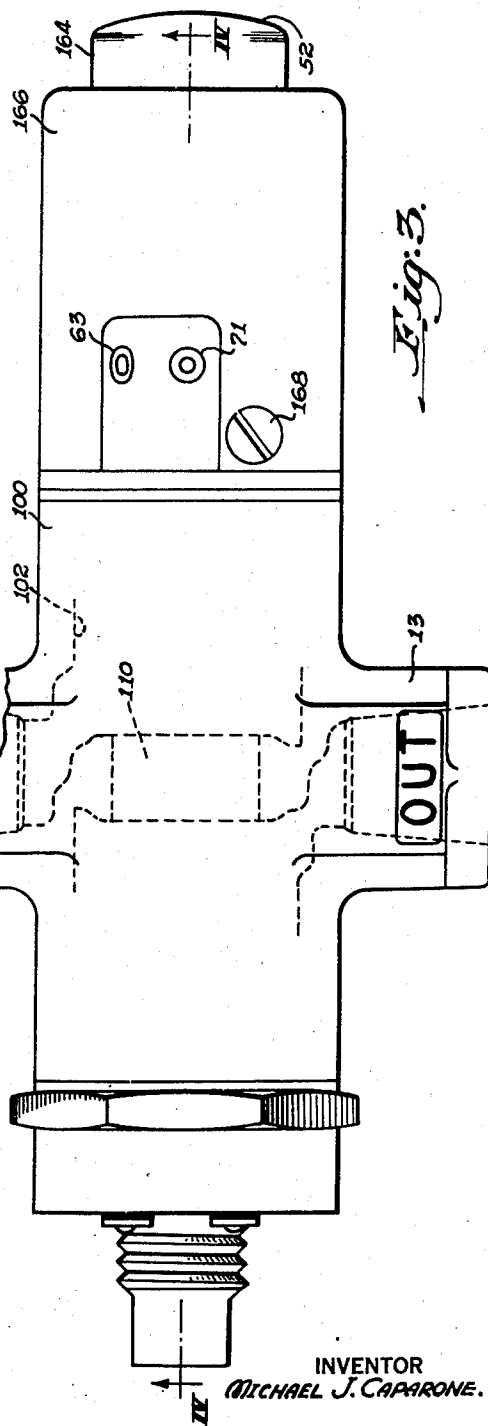


Fig. 3.

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SAFETY CONTROL AND IGNITION APPARATUS FOR GASEOUS FUEL BURNERS

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20 Claims. (Cl. 158—117.1)

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This invention relates to safety control and ignition apparatus for gaseous fuel burners and, more particularly, to thermomagnetic controls therefor.

Apparatus of this general character has been subject to the disadvantage of requiring manual effort to reset the thermomagnetic control device in operating position due to the relatively weak thermoelectric current available for holding purposes only. It has been proposed to utilize automatic resetting devices energized from sources extraneous of the apparatus itself, but such energy is not always available or its use is undesirable.

The thermomagnetic system of safety control finds a wide field of usefulness in domestic cooking ranges where control of the oven burner is desired. It is apparent, however, that the elimination of commercial sources of electrical energy also deprives the system of a convenient means of automatic ignition for the oven burner by resistance coil or spark. Nevertheless, as the top burners of ranges are usually ignited from a constant burning top pilot burner, the installation of a flash tube provides the required automatic ignition of the oven burner by gaseous means.

One of the objects of this invention is to utilize the resetting operation as a means for effecting ignition of the oven burner.

Another object of the invention is to automatically discontinue the flow of fuel for igniting purposes after ignition has occurred.

Another object of the invention is to control the entire safety and ignition apparatus by self-contained thermoelectric means.

Another object of the invention is to reduce the manual effort required during the resetting operation to a minimum.

Another object of the invention is to prevent flow of fuel to the oven burner until safety conditions have been established and to discontinue such flow at any time that such conditions do not exist.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawings, wherein:

Fig. 1 is a schematic view, partly in section, of a safety control and ignition apparatus for gaseous fuel burners embodying the present invention;

Fig. 2 is a similar view of another embodiment of the invention;

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Fig. 3 is a plan view of a thermomagnetic control valve illustrated schematically in Fig. 2;

Fig. 4 is a section taken on the line IV—IV of Fig. 3;

Fig. 5 is a section taken on the line V—V of Fig. 4; and

Fig. 6 is an end elevation.

Referring more particularly to the embodiment illustrated in Fig. 1 of the drawings, a main burner 10 of a domestic range oven is supplied with gaseous fuel by a pipe 12 connected to the outlet 13 of a fuel control device 14 constructed in accordance with the principles of this invention and described more fully hereinafter. A main fuel supply pipe 16 is connected to the inlet 17 of the control device 14 and the flow of fuel in the main fuel pipe 16 is under control of a main fuel cock 18. If desired, the main fuel cock 18 may embody thermostatic control means of any known form responsive to the oven temperature for controlling the flow of fuel in the main fuel pipe 16.

The main burner 10 is adapted to be ignited from a constant burning top pilot burner 20 which may be supplied with fuel from the main fuel pipe 16 anterior of the main fuel cock 18. A flash pilot burner 22 is located in proximity of the main burner 10 and is supplied with fuel by a pipe 24 connected to an auxiliary outlet 25 in the control device 14. A flash-tube 26 extends between the top pilot burner 20 and the flash pilot burner 22 for causing ignition of the latter. If desired, an ignition pilot burner 28 may also be located in proximity of both the main burner 10 and the flash pilot burner 22 and be supplied with fuel by a pipe 30 connected to a by-pass 32 controlled by the main fuel cock 18 in order that fuel will be supplied to the ignition pilot burner 28 when the thermostat has operated to discontinue flow of fuel to the main burner 10.

The control device 14, as shown schematically in Fig. 1, includes a valve seat 34 having a safety shut-off valve member 36 biased by a spring 37 into engagement with one side thereof for controlling flow of fuel between the pipes 16 and 12. The valve member 36 is connected by a stem 39 to an armature 38 which is movable into attracted position with the pole faces of a horseshoe magnet 40 when the valve member 36 is disengaged from its seat 34. The electromagnetic means may be protected against entrance of fuel, when the valve member 36 is open, by a partition formed by an end wall 41 of a suitable housing for the magnet parts. One leg of the

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magnet 40 is provided with a coil 42 connected at its opposite ends to terminals 45 and 47 respectively and by wires 44 and 46 from the terminals 45, 47 to the terminals of a thermocouple 48 located to be heated by a flame at the main burner 10 and the ignition pilot burner 20. The thermocouple 48 forms a thermo-electric generator for supplying energy to the electromagnet comprising coil 42, magnet 40 and armature 38 and rendering the same effective for retaining the valve member 36 disengaged from the valve seat 34.

The armature 38 is moved into engagement with the pole faces of the magnet 40 by a manually operable resetting means comprising a reset stem 50 extending coaxial with the valve member 36 from adjacent the side of the valve seat 34 opposite that engaged by the valve member 36. The reset stem 50 is spaced from the valve member 36 when the latter is seated. The stem 50 projects exteriorly of the control device 14 and terminates in push-button 52 to which manual pressure may be applied for moving the reset stem 50 into operative engagement with the valve member 36. The projecting portion of the reset stem 50 carries an armature 54 which is movable into attracted relation with the pole faces of a horseshoe magnet 56. A coil spring 58 located between the armature 54 and the magnet 56 serves to bias the reset stem 50 outwardly of the control device 14 and the armature 54 away from the pole faces of the magnet 56.

One leg of the magnet 56 is provided with a coil 60 which is connected at its opposite ends to terminals 61 and 63 respectively and by wires 62 and 64 from terminals 61, 63 to the terminals of a thermocouple 66 located to be heated by a flame at the top pilot burner 20. The thermocouple 66 forms a thermoelectric generator for supplying energy to the electromagnet comprising coil 60, magnet 56 and armature 54.

The other leg of the magnet 56 is provided with a trip coil 67 which is connected at opposite ends to terminals 69 and 71 respectively and in parallel circuit with the coil 42 by a wire 72 from terminal 71 to terminal 45 and a wire 73 from terminal 69 to terminal 47. The magnetic flux produced in magnet 56 upon energization of the trip coil 67 is opposed to that produced in this magnet by energization of the coil 60 and will cause release of the armature 54 from attracted position.

The control device 14 also includes an auxiliary valve 68 which is cooperable with a valve seat 70 formed in the control device 14 on the inlet side of the valve seat 34. Communication between the pipe 24 for the flash pilot burner 22 and the main fuel pipe 16 is provided by the outlet 25 in the control device 14 when the valve member 68 is disengaged from its seat. A spring 74 positioned in the outlet 25 between the auxiliary valve member 68 and a suitable abutment serves to bias the valve member 68 toward its seat 70. The auxiliary valve member 68 may be in the form of a ball and the bias of the spring 74 holding the ball to its seat 70 is overcome by force exerted directly on the ball by a cup-shaped member 76 which is mounted on the reset stem for slidable movement in the control device 14. Hence, the cup-shaped member 76 is moved into operative engagement with the auxiliary valve member 68 during the resetting operation.

The flow of fuel between the main fuel pipe 16 and the main burner supply pipe 12 is caused to be interrupted during the resetting operation, although this feature may be dispensed with if de-

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sired. The flow interrupting means comprises a closure disc 78 yieldably mounted on the reset stem 50 adjacent the valve seat 34 for operative engagement with the side thereof opposite the valve member 36 when the latter is disengaged from the valve seat 34 during the resetting operation.

The alternative embodiment shown in Fig. 2 of the drawings contains many parts which have been described in connection with the embodiments shown in Fig. 1. Accordingly, similar reference numerals have been applied thereto and further description is deemed unnecessary. The essential distinction between the embodiments is that in Fig. 2 the reset stem 50 has mounted thereon, between the push-button 52 and the armature 54, a movable member carrying a contact element 80 which is adapted to operatively engage a relatively fixed contact element 88 during the resetting operation. As shown schematically in Fig. 2 the contact element 80 is connected to a terminal 87 and the contact element 88 is connected to the terminal 61. The engagement between contacts 80 and 88 serves to close a circuit for a coil 90 mounted on the other leg of the horseshoe magnet 40, this coil being shown as connected at opposite ends to terminals 91 and 93 respectively and in parallel with the coil 60 of magnet 56 by wires 92 and 94 extending from the terminals 91, 93 to the terminal 63 and the terminal 87 respectively.

In the operation of the apparatus shown in Figs. 1 and 2, the main fuel cock 18 is first turned to the "on" position permitting fuel to flow to the control device 14 through the main fuel pipe 16 and also to the ignition pilot burner 20 through the fuel pipe 30. As the safety shut-off valve member 36 is biased by spring 37 into engagement with the seat 34, the flow of fuel through pipe 12 to the main burner 10 is prevented. Also, as the auxiliary valve 68 is biased by spring 74 into engagement with the seat 70, the flow of fuel through the pipe 24 to the flash pilot burner 22 is prevented. It may be assumed, however, that fuel is flowing to the top pilot burner 20 and that this burner is producing a flame.

The push-button 52 is now depressed and the bias of the spring 58 is overcome to seat the closure disc 78 on the valve seat 34. Further movement of the reset stem 50, which can occur due to the yieldable mounting of the closure disc 78, is effective for engaging this stem with the valve member 36. The resetting operation so accomplished causes the bias of spring 37 to be overcome and the valve member 36 to become disengaged from the valve seat 34. Simultaneously, the armatures 38 and 54 are moved into attracted relation with the pole faces of the magnets 40 and 56 respectively.

As the first thermoelectric generator comprising thermocouple 66 is being heated by the flame from the top pilot burner 20, there is sufficient current generated and conducted through the described circuit to retain the armature 54 in engagement with the pole faces of the magnet 56 with which the coil 60 is associated. It will further be observed that in the case of the embodiment shown in Fig. 2 the concurrent closure of the contact elements 80 and 88 by operation of reset stem 50 will serve to close the described circuit of the coil 90 and energize the associated electromagnet sufficiently to cause the armature 38 thereof to be retained in attracted position. The push-button 52 may now be released without causing any change in the position of the re-

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set stem 50 or associated parts due to the energization of the electromagnet or electromagnets. It will be appreciated that this manual operation of the reset stem 50 is of short duration and no extended manual effort is required to effect the resetting operation.

As the auxiliary valve member 68 has become disengaged from its seat 70 due to the force exerted by the cup-shaped member 76, the fuel from the main fuel pipe 16 flows through the outlet 25 and fuel pipe 24 to the flash pilot burner 22. The fuel issuing from the flash pilot burner 22 is conducted by the flash-tube 26 to the top pilot burner 28 where it is ignited and the flame is then conducted by the flash-tube 26 to the flash pilot burner 22 to produce a flame at this burner. The fuel issuing from the ignition pilot burner 28, disclosed in this embodiment of the invention, is now ignited by the flame of the flash pilot burner 22. The second thermoelectric generator comprising thermocouple 48, which is positioned in proximity of the main burner 10, now becomes sufficiently heated by the flame from the ignition pilot burner 28 to generate a current which is conducted through the described circuits for energizing the coil 42 and the trip coil 67 associated with the magnets 40 and 56, respectively. Since the magnetic flux produced in the magnet 56 by the trip coil 67 is opposed to that produced in this magnet by the coil 60, then the armature 54 is released. It is apparent, therefore, that one function of the second thermoelectric generator is for neutralizing the energy supplied to the magnet 56 by the first thermoelectric generator and rendering the same ineffective to retain the armature 54.

At the same time, however, that the trip coil 67 is energized, the coil 42 associated with the magnet 40 also becomes energized by the current supplied from the thermocouple 48. Thus, the armature 38 is retained in engagement with the magnet 40 and the valve member 36 is held in the open position. The reset stem 50 is retracted under bias of the spring 58 when armature 54 is released so that the closure disc 78 becomes disengaged from the valve seat 34 while the auxiliary valve 68 ceases to be held open by the cup-shaped member 76. Thus, fuel may flow from the main fuel pipe 16 through the pipe 12 to the main burner 10 where it is ignited by the flame from the ignition pilot burner 28. The flow of fuel in the pipe 24 is cut off by closure of the auxiliary valve 68 and the flash pilot burner 22 ceases to produce a flame.

It will be noted that the switch comprising contact elements 86 and 88, as disclosed in connection with the embodiment shown in Fig. 2, becomes opened when the armature 54 is released by operation of the trip coil 67. Hence, the coil 90 associated with the magnet 40 is no longer energized but the armature 38 will be retained in the attracted position due to the energization of the coil 42 of the magnet 40 by the thermocouple 48. Thus, in both embodiments the valve member 36 controlling flow of fuel to main burner 10 will be held open by its associated electromagnet as long as the ignition pilot burner 28 remains lighted or until this burner is turned off by means of the main fuel cock 18 being operated to closed position. The thermostat where provided in conjunction with the main fuel cock will close and open the fuel supply pipe 16 and thus control the main burner 10 during the cooking cycle.

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In the event that an attempt is made to start the system when the top pilot burner 28 is not burning, then the thermocouple 66 will be unheated and the coil 60 (Fig. 1) and the coils 60 and 60 (Fig. 2) will be deenergized. Thus, when the push-button 52 is depressed neither of the armatures 54 nor 38 will be retained in attracted position and consequently the valve members 36 and 68 will close when the push-button is released.

If, however, the top pilot burner is lighted and the system is placed in operation by opening the main fuel cock 18 and depressing the push-button 52 but no flame is produced by the flash pilot burner 22, then the ignition pilot burner 28 will not become ignited. Hence, the trip coil 67 and the coil 42 associated with the magnets 56 and 40, respectively, will not become energized. Both of the armatures 54 and 38 will be retained by their respective magnets and valve member 36 will remain in the open position with closure disc 78 in position to interrupt the flow of fuel in the fuel pipe 12 to the main burner 10. Since the auxiliary valve member 68 is being held away from its seat by the cup-shaped member 76 there will be an escape of a small amount of unburned fuel from the flash pilot burner 22 and from the ignition pilot burner 28 until the main fuel cock 18 is operated to closed position.

It will be apparent that the ignition pilot burner 28 could be dispensed with and the flash pilot burner 22 utilized to directly ignite the main burner 10. Moreover, the flash-tube 26 could be dispensed with where automatic ignition of the main burner pilot is not required. Such modifications are intended to be included in the scope of the invention without departing from the spirit thereof.

Referring now more particularly to Figs. 3, 4, 5 and 6, the control device 14 may take the form shown in detail therein. Where possible, similar reference numerals have been used to denote parts corresponding to those described in the schematic forms of Figs. 1 and 2. In this embodiment the control device comprises a casing 100 provided with a chamber 102 therein having an inlet opening 17 and an outlet opening 13 intermediate the ends thereof and disposed on opposite sides. Passage of fuel between the inlet 17 and the outlet 13 for a main burner is controlled by a safety shut-off valve member 36 which is cooperable with a valve seat 34 disposed between the inlet 17 and outlet 13. An auxiliary outlet 25 is located in the chamber 102 on the inlet side of the valve seat 34 and is provided with suitable connection 114 for conveying fuel to a pilot burner. The auxiliary outlet 25 is controlled by an auxiliary valve 68 in the form of a ball movable in a path normal to the safety valve member 36 and which is biased into engagement with a valve seat 70 adjacent the wall of the chamber 102 by a coil spring 74 operative between the valve 68 and the connection 114.

A threaded cap 122 is mounted on one end of the casing 100 and forms a closure for the chamber 102 on the inlet side of the valve seat 34. The cap 122 supports a reset stem 50 which is reciprocable therein axially of the safety valve member 36. The reset stem 50 is provided with an extension 126 on the inner end thereof which moves into operative engagement with the safety valve member 36 for opening the same when the reset stem 50 is moved toward the valve seat 34.

The reset stem extension 126 carries a closure disc 78 which is yieldably urged toward an en-

largement 130 on the extension 126 by a spring 132 which engages at its opposite end with a cup-shaped element 76 mounted on the extension 126 for slidable movement therewith. The cup-shaped element 76 engages the walls of the chamber 10 and is slidable axially of the safety valve 36 into operative engagement with the auxiliary valve 68 for opening the same against the bias of the spring 74. The closure disc 78 serves to interrupt the flow of fuel between the inlet 17 and the outlet 13 by engaging the valve seat 34 on the side opposite the safety valve member 36 when the latter is disengaged from the seat by operation of the reset stem 50.

The cup-shaped element 76 is retained against movement relative to the extension 126 by a nut 136 thereon which has its opposite face provided with an annular lip for engagement with a yieldable ring 138 in the adjacent face of the cap 122. A sealing device is provided for the chamber 102 beyond the cup-shaped element 76 to prevent leakage along the reset stem 50. This device comprises a sealing washer 137 on the reset stem and housed within a chamber 139 in the cap 122 under bias of a spring 140.

A first electromagnetic means is positioned on one side of the safety valve member 36 and includes a horseshoe magnet 56 mounted on the cap 122 to form an abutment for the opposite end of the spring 140. The magnet 56 is held yieldingly in position by a flexible element 143 which is secured to the cap 122 and is provided with an opening for the reset stem 50. One leg of the magnet carries a trip coil 67 having its opposite ends secured to terminals 69 and 71 respectively. The terminals 69, 71 are circumferentially spaced in an insulating sleeve 148 projecting from the cap member 122 around the magnet 56. The projecting end of the sleeve 148 carries a metal contact ring 88 for a purpose which will hereinafter be apparent.

The other leg of the magnet 56 is provided with a coil 60 (see Fig. 5) having one end secured to a terminal 61 on the ring 88 and the other end secured to a terminal 63 on the sleeve 148 diametrically opposite the terminal 71. An armature 54 is cooperable with the pole faces of the magnet 56 and is mounted upon the reset stem 50 abutting one side of a shoulder 157 thereon. The opposite side of the shoulder 157 abuts a coil spring 58 extending along the reset stem 50 to the flexible element 143 and serving to bias the armature 54 away from the pole faces of the magnet 56. It may be noted that the armature spring 58 exerts a stronger bias than the spring 132 associated with the closure disc 78 so that the latter is also biased away from the valve seat 34.

The side of the armature 54 opposite the reset stem shoulder 157 is maintained in engagement with the inner face of a cup-shaped contact element 86 by the bias of a spring 162 which engages at one end with the element 86 and at its opposite end with a reset button 52. The reset button 52 projects from an end casing 166 which is mounted upon the insulating sleeve 148 and is secured to the cap 122 by means of screws 168 which also serve to hold the insulating sleeve 148 in position. The end casing 166 is provided with a flanged end for engagement with a flange 170 formed on the reset button 52 and serving to limit the movement thereof outwardly of the end casing 166 under the bias of the spring 162.

A second electromagnetic means is positioned in the casing on the opposite side of the safety valve 36 from the first electromagnetic means

and is adapted when energized for retaining the safety valve in open position while rendering the first electromagnetic means ineffective for this purpose. In this embodiment, the second electromagnetic means comprises a horseshoe magnet 40 provided on one leg with a coil 42 and on the other leg thereof with a coil 90. As shown more clearly in Fig. 6, one end of the coil 42 is connected to a terminal 45 and the opposite end of the coil 42 is connected to a terminal 47. Both terminals are carried in spaced arrangement on an end plate 182 having an extension sleeve 184 secured to the casing 100 and forming a closure for a magnet housing 186 which engages the walls of the chamber 102 and is provided with an end wall 41. The coil 90 has one end secured to a terminal 93 on the end cap 182 and the opposite end is secured to an insulated terminal 91 disposed axially of the end cap 182 and projecting through the base of the magnet 40.

An armature 38 is provided for cooperation with the pole faces of the magnet 40 and is supported upon a connecting stem 39 which extends therefrom through the end wall 41 of the magnet housing 186 and serves to connect the armature 38 and valve member 36 together. A coil spring 37 operative between the end wall 41 of the magnet housing 186 and the safety valve 36 serves to bias the valve to closed position relative to the valve seat 34 and the armature 38 away from the pole faces of the magnet 40.

When the control device of the embodiment of Figs. 4, 5 and 6 is in the position shown in the drawing, then the main burner is receiving fuel and may be assumed to be in operation. When the safety control is in the "off" position then the armature 38 of the second electromagnetic means will be disengaged from the pole faces of magnet 40 and the safety valve 36 will be in closed position relative to the valve seat 34.

The safety control device may be placed in operation by manually depressing the reset button 52 to move the armature 54 into engagement with the pole faces of the magnet 56 and also the armature 38 into engagement with the pole faces of the magnet 40. During this action, the reset stem extension 126 engages the safety valve 36 and disengages it from the valve seat 34 immediately after the closure disc 78 has likewise been moved into engagement with the opposite side of the valve seat 34. The cup-shaped element 76 then moves slidably relative to the walls of the chamber 102 and exerts a force upon the auxiliary valve 68 to move it in a path normal to the axis of the safety valve 36 and away from its seat 70. The cup-shaped contact element 86 and the metal contact ring 88 are now brought into engagement and a circuit for one coil of each of the first and second electromagnetic means is provided as described in connection with Fig. 2. Thus, the coils 60 and 90 may be connected in a parallel circuit as described in connection with Fig. 2 and the control will remain in the reset position when the reset button 52 is released due to energization of both magnets 40 and 56.

If the trip coil 67 is now energized as by a thermocouple heated by a pilot burner, then the armature 54 will be released, the auxiliary valve 68 will close and the closure disc 78 will be disengaged from the valve seat 34. At the same time, the cup-shaped contact element 86 will become disengaged from the metal contact ring 88 to cause opening of the circuit to the coil 90.

However, due to the continued energization of the coil 42 associated with the magnet 40, the armature 38 thereof is retained against the pole faces of the magnet 40 and the safety valve 36 remains open. Thus, the "on" position of the control shown in Fig. 4 is reached and the fuel to the oven burner is under control of the second electromagnetic means as long as the pilot burner remains lighted as previously described.

It will be apparent that a self-contained system for safety control and ignition of a domestic oven burner has been provided and that the control device of Figs. 3-6 finds a peculiar field of usefulness in connection with the flash-tube ignition and safety control system disclosed in Figs. 1 and 2. The cup-shaped contact 86 and contact ring 88 which are equivalent to the switching means comprising contacts 86 and 88 of the Fig. 2 embodiment may be dispensed with as disclosed in the Fig. 1 embodiment. The coil 90 may also be dispensed with as in the Fig. 1 embodiment. It is understood, therefore, that various changes may be made in the details and arrangement of parts within the scope of the appended claims without departing from the spirit of this invention.

I claim:

1. Safety control apparatus for fuel burners having main and pilot burners comprising, means movable between positions for controlling the fuel supply to the main burner and being normally biased to a position in which said fuel supply is prevented, an electro-responsive device for controlling said movable means and including a pair of electromagnets, a first thermoelectric generator adapted when heated by a flame at the pilot burner for supplying energy to at least one of said electromagnets and rendering the same effective for retaining said movable means in a position where fuel is supplied to the main burner, and a second thermoelectric generator adapted when heated by a flame at the main burner for supplying energy to both the one and the other of said electromagnets, said second generator being arranged for rendering the other said electromagnet effective for retaining said movable means in the fuel supply position while rendering said one electromagnet ineffective.

2. Safety control apparatus for fuel burners having main and pilot burners comprising, means movable between positions for controlling the fuel supply to the main burner and being normally biased to a position in which said fuel supply is prevented, an electro-responsive device for controlling said movable means and including a pair of electromagnets, a first thermoelectric generator adapted when heated by a flame at the pilot burner for supplying energy to at least one of said electromagnets and rendering the same effective for retaining said movable means in a position where fuel is supplied to the main burner, and a second thermoelectric generator adapted when heated by a flame at the main burner for supplying energy to both the one and the other of said electromagnets, said second generator being arranged for rendering the other said electromagnet effective for retaining said movable means in the fuel supply position while neutralizing the energy supplied to said one electromagnet and rendering the same ineffective.

3. Safety control apparatus for fuel burners having main and pilot burners comprising means movable between positions for controlling the fuel supply to the main burner and being normally biased to a position in which said fuel

supply is prevented, an electro-responsive device for controlling said movable means and including a pair of electromagnets having separate operating coils associated therewith, a first thermoelectric generator adapted when heated by a flame at the pilot burner for supplying energy to at least one of said coils and rendering its associated electromagnet effective for retaining said movable means in a position where fuel is supplied to the main burner, a second thermoelectric generator adapted when heated by a flame at the main burner for supplying energy to another of said coils and rendering its associated electromagnet effective for retaining said movable means in the fuel supply position independently of the electromagnet associated with said one coil, and a trip coil operatively associated with the last said electromagnet and in circuit with said second thermoelectric generator for neutralizing the energy supplied to said one coil and rendering its associated electromagnet ineffective.

4. Safety control apparatus for fuel burners having main and pilot burners comprising, means movable between positions for controlling the fuel supply to the main burner and being normally biased to a position in which said fuel supply is prevented, an electro-responsive device for controlling said movable means and including a pair of electromagnets having a plurality of separate operating coils associated therewith, means operative in one direction for transmitting movement between said electromagnets and movable means, a first thermoelectric generator adapted when heated by a flame at the pilot burner for supplying energy to two of said coils and rendering said pair of electromagnets effective for retaining said movable means in a position where fuel is supplied to the main burner, switching means controlling the circuit of one of said two coils and being operable to closed position by operation of said movement transmitting means in said one direction thereof, a second thermoelectric generator adapted when heated by a flame at the main burner for supplying energy to another of said coils and rendering one of said pair of electromagnets effective for retaining said movable means in the fuel supply position independently of the other said electromagnet, a trip coil operatively associated with said other electromagnet and in circuit with said second thermoelectric generator for neutralizing the energy supplied to the other one of said two coils and rendering said other electromagnet ineffective, said switching means being operable to open position by operation of said movement transmitting means in another direction to discontinue the energy supply from said first thermoelectric generator to said one of said two coils.

5. Safety control and ignition apparatus for fuel burners having main and a pair of pilot burners comprising, means movable between positions for controlling the fuel supply to the main and one of the pilot burners and being normally biased to a position in which said fuel supply is prevented, an electro-responsive device for controlling said movable means and including a pair of electromagnets, a first thermoelectric generator adapted when heated by a flame at the other pilot burner for supplying energy to at least one of said electromagnets and rendering the same effective for retaining said movable means in a position where fuel is supplied to both the main and said one pilot burner, and a second thermoelectric generator adapted when heated by a flame

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at said one pilot burner for supplying energy to both the one and the other of said electromagnets, said second generator being arranged for rendering the other said electromagnet effective for retaining said movable means in the fuel supply position while rendering said one electromagnet ineffective.

6. Safety control and ignition apparatus for fuel burners having main and a pair of pilot burners comprising, means movable between positions for controlling the fuel supply to the main and one of the pilot burners and being normally biased to a position in which said fuel supply is prevented, an electro-responsive device for controlling said movable means and including a pair of electromagnets, a first thermoelectric generator adapted when heated by a flame at the other pilot burner for supplying energy to at least one of said electromagnets and rendering the same effective for retaining said movable means in a position where fuel is supplied to both the main and said one pilot burner, means for conducting fuel between said pilot burners for causing ignition of said one pilot burner from the other, and a second thermoelectric generator adapted when heated by a flame at said one pilot burner for supplying energy to both the one and the other of said electromagnets, said second generator being arranged for rendering the said other electromagnet effective for retaining said movable means in the fuel supply position while rendering said one electromagnet ineffective.

7. Safety control and ignition apparatus for fuel burners having a main burner, an ignition pilot burner in proximity thereto, and a source of fuel supply, comprising means movable between positions for controlling the fuel supply from the source to the main burner and being normally biased to a position in which said fuel supply is prevented, an electro-responsive device for controlling said movable means and including a pair of electromagnets, means operative in one direction for transmitting movement between said electromagnets and movable means, a first thermoelectric generator adapted when heated for supplying energy to at least one of said electromagnets and rendering the same effective for retaining said movable means in a position where fuel is supplied to the main burner, a second thermoelectric generator adapted when heated by a flame at the ignition pilot burner for supplying energy to both the one and the other of said electromagnets, said second generator being arranged for rendering the other said electromagnet effective for retaining said movable means in the fuel supply position while rendering said one electromagnet ineffective and causing operation of said movement transmitting means in another direction, a constant burning pilot burner located remote from said ignition pilot burner and connected to the source for heating said first thermoelectric generator, a flash pilot burner located in proximity to said ignition pilot burner and connected to the source, a flash tube extending between said constant burning pilot burner and said flash pilot burner for causing ignition of the latter, and means responsive to operation of said movement transmitting means in said other direction for discontinuing the fuel supply to said flash pilot burner.

8. Safety control and ignition apparatus for fuel burners having a main burner, a pilot burner in proximity thereto, and a source of fuel supply, comprising means movable between positions for controlling the fuel supply from the source to the

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main burner and being normally biased to a position in which said fuel supply is prevented, reciprocable means having lost motion connection with said movable means and being manually operable for moving said moving means between said positions, flow interrupting means responsive to said operation of said reciprocable means for preventing flow of fuel to the main burner, an electroresponsive device for controlling said movable means and including a pair of electromagnets, a first thermoelectric generator adapted when heated by a flame at the pilot burner for supplying energy to at least one of said electromagnets and rendering the same effective for retaining said movable means in a position to which it has been moved by said reciprocable means, and a second thermoelectric generator adapted when heated by a flame at the main burner for supplying energy to both the one and the other of said electromagnets, said second generator being arranged for rendering the other said electromagnet effective for retaining said movable means in said moved position while rendering said one electromagnet ineffective, said flow interrupting means being rendered ineffective by return of said reciprocable means to unoperative position.

9. Safety control and ignition apparatus for fuel burners having a main burner, an ignition pilot burner in proximity thereto, and a source of fuel supply, comprising means movable between positions for controlling the fuel supply from the source to the main burner and being normally biased to a position in which said fuel supply is prevented, reciprocable means having lost motion connection with said movable means and being manually operable for moving said movable means between said positions, flow interrupting means responsive to said operation of said reciprocable means for preventing flow of fuel to the main burner, an electro-responsive device for controlling said movable means and including a pair of electromagnets, a first thermoelectric generator adapted when heated for supplying energy to at least one of said electromagnets and rendering the same effective for retaining said movable means in a position to which it has been moved by said reciprocable means, a second thermoelectric generator adapted when heated by a flame at the ignition pilot burner for supplying energy to both the one and the other of said electromagnets, said second generator being arranged for rendering the other said electromagnet effective for retaining said movable means in said moved position while rendering said one electromagnet ineffective, said flow interrupting means being rendered ineffective by return of said reciprocable means to unoperated position, a constant burning pilot burner located remote from said ignition pilot burner and connected to the source for heating said first thermoelectric generator, a flash pilot burner located in proximity to said ignition pilot burner and connected to the source, a flash tube extending between said constant burning pilot burner and said flash pilot burner for causing ignition of the latter, and means responsive to said return of said reciprocable means for discontinuing the fuel supply to said flash pilot burner.

10. Safety control and ignition apparatus for fuel burners comprising in combination, a main burner, a fuel supply pipe connected to the main burner, means for igniting said main burner including a flash pilot burner in proximity of the main burner and having separate connection

with said fuel supply pipe, a constant burning pilot burner positioned remote from said flash pilot burner, a flash tube extending between said pilot burners for conducting a flame therebetween, a safety shut-off valve yieldingly urged closed for controlling flow of fuel to said main burner, means operable for opening said safety valve including electromagnetic means effective when energized for holding said safety valve open, a thermoelectric generator adapted to be heated by a flame produced by said means for igniting the main burner for energizing said electromagnetic means, an auxiliary valve yieldingly urged closed for controlling flow of fuel to said flash pilot burner, and means, responsive to operation of said means for opening said safety valve, for holding said auxiliary valve open.

11. Safety control and ignition apparatus for fuel burners comprising in combination, a main burner, a fuel supply pipe connected to the main burner, means for igniting said main burner including a flash pilot burner in proximity of the main burner and having separate connection with said fuel supply pipe, a constant burning pilot burner positioned remote from said flash pilot burner, a flash tube extending between said pilot burners for conducting a flame therebetween, a safety shut-off valve yieldingly urged closed for controlling flow of fuel to said main burner, electromagnetic means effective when energized for holding said safety valve open, a thermoelectric generator adapted to be heated by a flame produced by said means for igniting the main burner for energizing said electromagnetic means, an auxiliary valve yieldingly urged closed for controlling flow of fuel to said flash pilot burner, manually operable means for opening said safety valve, and means responsive to operation of said manually operable means for holding said auxiliary valve open.

12. Safety control and ignition apparatus for fuel burners comprising in combination, a main burner, a fuel supply pipe connected to the main burner, means for igniting said main burner including a flash pilot burner in proximity of the main burner and having separate connection with said fuel supply pipe, a constant burning pilot burner positioned remote from said flash pilot burner, a flash tube extending between said pilot burners for conducting a flame therebetween, a safety shut-off valve yieldingly urged closed for controlling flow of fuel to said main burner, electromagnetic means having an armature connected to said safety valve, a thermoelectric generator adapted to be heated by a flame produced by said means for igniting the main burner for energizing said electromagnetic means and holding said armature in attracted position and said safety valve open, a reset stem manually operable for placing said armature in attracted position and opening said safety valve, means carried by said stem for interrupting flow of fuel through said main burner supply pipe during the resetting operation, an auxiliary valve yieldingly urged closed for controlling flow of fuel to said flash pilot burner, and means carried by said stem for actuating said auxiliary valve to open position during said resetting operation.

13. A safety control for gaseous fuel burners comprising a casing having a chamber therein, inlet and outlet openings communicating with said chamber and providing passage for fuel to a main fuel burner, a safety shut-off valve controlling flow of fuel between said openings and

being normally biased to a closed position, an auxiliary valve in said casing for controlling passage of fuel from said inlet to a pilot burner, means biasing said auxiliary valve to closed position, electromagnetic means positioned in said casing and connected to said safety valve for holding the same in open position but being incapable of moving said safety valve to open position, a manually operable reset stem mounted in said casing and reciprocable into operative engagement with said safety valve for opening the same and resetting said electromagnetic means, and means mounted on said stem for slidable movement in said casing into operative engagement with said auxiliary valve for opening the same during the resetting operation.

14. A safety control for gaseous fuel burners comprising a casing having a chamber therein, inlet and outlet openings communicating with said chamber and providing passage for fuel to a main fuel burner, a safety shut-off valve controlling flow of fuel between said openings and being normally biased to a closed position, an auxiliary valve in said casing movable in a path normal to said safety valve for controlling passage of fuel from said inlet to a pilot burner, means biasing said auxiliary valve to closed position, electromagnetic means positioned in said casing coaxial with said safety valve and connected to said safety valve for holding the same in open position but being incapable of moving said safety valve to open position, a manually operable reset stem mounted in said casing and reciprocable axially of said safety valve into operative engagement with said safety valve for opening the same and resetting said electromagnetic means, and means mounted on said stem for slidable movement in said casing axially of said safety valve into operative engagement with said auxiliary valve for opening the same during the resetting operation.

15. A safety control for gaseous fuel burners comprising a casing having a chamber therein, inlet and outlet openings communicating with said chamber and providing passage for fuel to a main fuel burner, a safety shut-off valve controlling flow of fuel between said openings and being normally biased to a closed position, an auxiliary valve in said casing movable in a path normal to said safety valve for controlling passage of fuel from said inlet to a pilot burner, means biasing said auxiliary valve to closed position, electromagnetic means positioned in said casing coaxial with said safety valve and connected thereto for holding the same in open position but being incapable of moving said safety valve to open position, a manually operable reset stem mounted in said casing and having lost-motion connection with said safety valve, said reset stem being movable into operative engagement with said safety valve for opening the same and resetting said electromagnetic means, flow interrupting means mounted on said reset stem for preventing flow of fuel between said inlet and outlet openings to the main burner, and means mounted on said stem for slidable movement in said casing axially of said safety valve into operative engagement with said auxiliary valve for opening the same during the resetting operation.

16. A safety control for a gaseous fuel burner comprising a casing having a chamber therein, inlet and outlet openings communicating with said chamber intermediate the ends thereof and providing passage for fuel to the burner, a safety shut-off valve controlling flow of fuel between

said openings and being normally biased to a closed position, means operable for opening said safety valve and being normally biased to an inoperative position, said means including first electromagnetic means positioned in said casing on one side of said safety valve and adapted when energized for retaining said safety valve in open position, a second electromagnetic means positioned in said casing on the opposite side of said safety valve and adapted when energized for retaining said safety valve in open position, means for rendering said first electromagnetic means ineffective when said second electromagnetic means is energized, and means controlled by said first electromagnetic means for preventing passage of fuel between said inlet and outlet openings until said first electromagnetic means is rendered ineffective.

17. A safety control for a gaseous fuel burner comprising a casing having a chamber therein, inlet and outlet openings communicating with said chamber intermediate the ends thereof and providing passage for fuel to the burner, a safety shut-off valve controlling flow of fuel between said openings and being normally biased to a closed position, means operable for opening said safety valve and being normally biased to an inoperative position, said means including first electromagnetic means positioned in said casing on one side of said safety valve and including a magnet and coil adapted when energized for retaining said safety valve in open position, a second electromagnetic means positioned in said casing on the opposite side of said safety valve and including a magnet and coil adapted when energized for retaining said safety valve in open position, a trip coil for the first said magnet for neutralizing the energy supplied to the first said coil when said second coil is energized, and means connected to the first said magnet for preventing passage of fuel between said inlet and outlet until said first coil is neutralized.

18. A safety control for a gaseous fuel burner having separate sources of electrical energy associated therewith, comprising a casing having a chamber therein, inlet and outlet openings communicating with said chamber intermediate the ends thereof and providing passage for fuel to the burner, a safety shut-off valve controlling flow of fuel between said openings and being normally biased to a closed position, means operable for opening said safety valve and being normally biased to an inoperative position, said means including first electromagnetic means positioned in said casing on one side of said safety valve and including a magnet and coil adapted to be energized from one source for retaining said safety valve in open position, a second electromagnetic means positioned in said casing on the opposite side of said safety valve and including a magnet and coil adapted to be energized from another source subsequent to energization of the first said coil for retaining said safety valve in open position, and a trip coil for the first said magnet adapted to be energized from said other source and connected in parallel with said second coil for neutralizing the energy supplied to the first said coil simultaneously with the energization of said second coil.

19. A safety control for a gaseous fuel burner having separate sources of electrical energy associated therewith, comprising a casing having a chamber therein, inlet and outlet openings communicating with said chamber intermediate the ends thereof and providing passage for fuel to

the burner, a safety shut-off valve controlling flow of fuel between said openings and being normally biased to a closed position, means operable for opening said safety valve and being normally biased to an inoperative position, said means including first electromagnetic means positioned in said casing on one side of said safety valve and including a magnet and coil adapted to be energized from one source, a second electromagnetic means positioned in said casing on the opposite side of said safety valve and including a magnet and a pair of coils, one of said pair being adapted to be energized from another source subsequent to energization of the first said coil for retaining said safety valve in open position, the other of said pair being connected in parallel with said first coil for energization simultaneously therewith for retaining said safety valve in open position until said one coil of said pair is energized, a switch operable in said casing for controlling said parallel connection, and a trip coil for the first said magnet connected in parallel with said one coil of said pair for neutralizing the energy supplied to said first coil simultaneously with the energization of said one coil of said pair and operation of said switch to discontinue said parallel connection.

20. A safety control for gaseous fuel burners having main and pilot burners and separate sources of thermoelectric energy associated therewith, comprising a casing having a chamber therein, inlet and outlet openings communicating with said chamber intermediate the ends thereof and providing passage for fuel to the burner, a safety shut-off valve controlling flow of fuel between said openings and being normally biased to a closed position, a duct in said casing on the inlet side of said safety valve providing communication between said chamber and the pilot burner, first electromagnetic means positioned in said casing on one side of said safety valve and including a magnet and coil adapted to be energized from one source for retaining said safety valve in open position but being incapable of moving said safety valve to said position, manually operable reset means mounted in said casing and having lost motion connection with said safety valve, said reset means being normally biased to an inoperative position and being operable for resetting said first electromagnetic means while preventing flow of fuel between said inlet and outlet, a second electromagnetic means positioned in said casing on the opposite side of said safety valve and including a magnet and coil adapted to be energized from another source responsive to a flame at the pilot burner subsequent to energization of the first said coil for retaining said safety valve in open position, and a trip coil for the first said magnet adapted to be energized from said other source and connected in parallel with said second coil for neutralizing the energy supplied to the first said coil simultaneously with the energization of said second coil.

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