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SAFETY CONTROL SYSTEM FOR FUEL BURNERS

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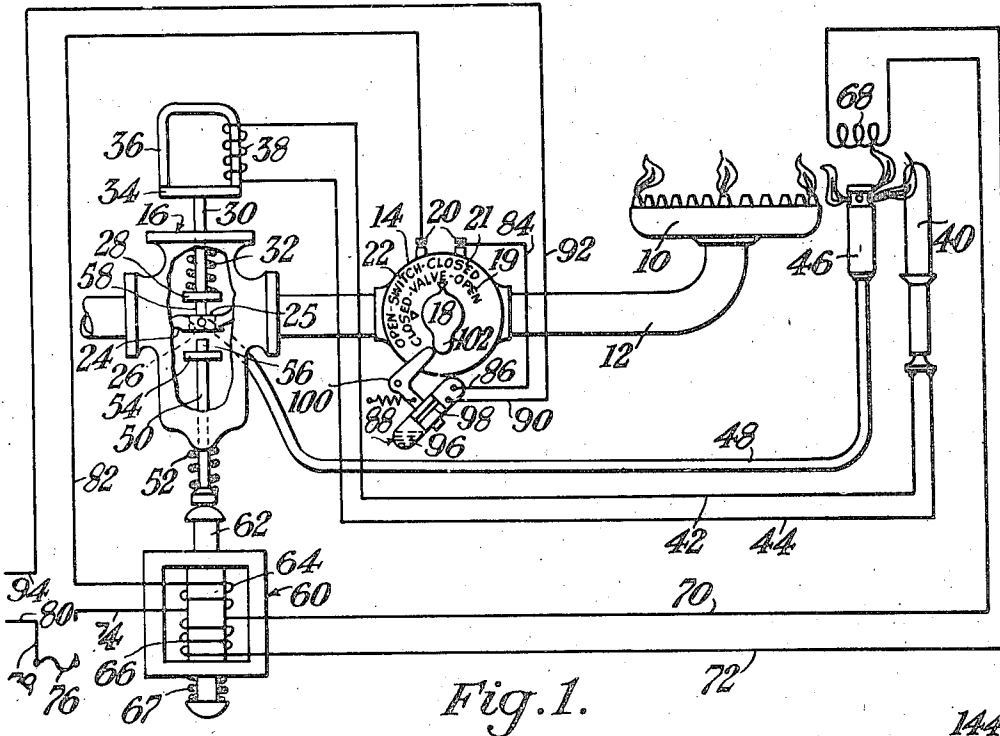


Fig. 1.

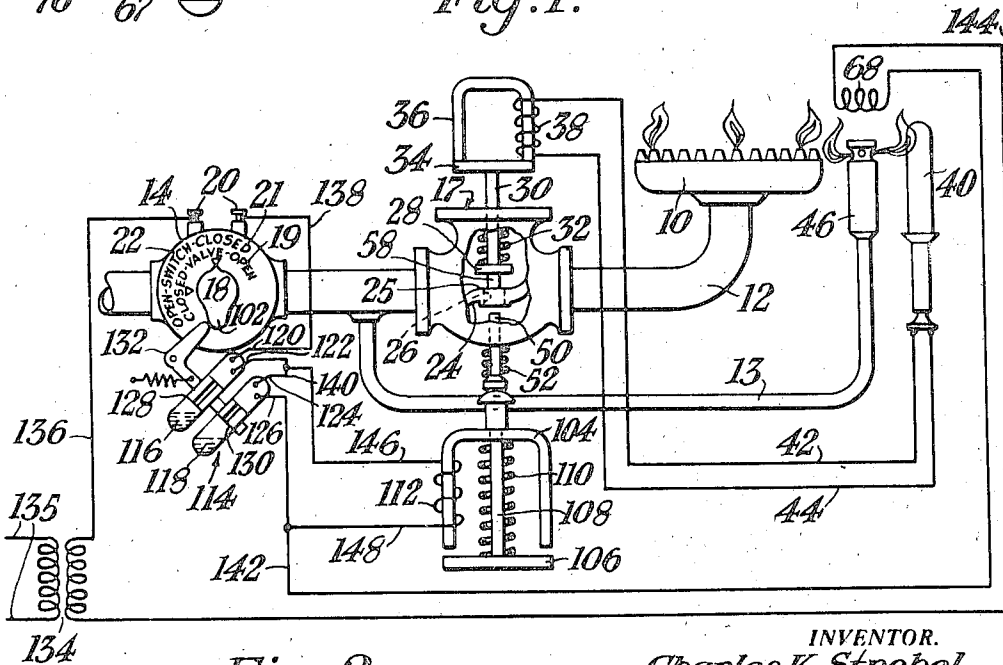


Fig. 2.

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## UNITED STATES PATENT OFFICE

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## SAFETY CONTROL SYSTEM FOR FUEL BURNERS

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This invention relates to safety control and ignition systems for gaseous fuel burners and, more particularly, to electrical systems therefor.

In apparatus of this general character, the flow of fuel to a main burner may be controlled by an electromagnetic control device which is energized by the current generated by a thermocouple or thermopile responsive to the heat of a flame at the pilot burner. Means are employed for placing the armature of the electromagnet in attracted position and the fuel control device in a flow permitting position such operation being generally termed "resetting." The means employed for resetting may be electrically operated from a source of current separate from that generated by the thermocouple. It is apparent that once the resetting operation is completed the current from this separate source is no longer required and the system may be left under the sole control of the thermoelectric current which is generated as long as the pilot burner produces a flame.

An object of this invention is to reset an electromagnetic device by electrically operated means which are automatically rendered inoperative upon completion of the resetting operation.

Another object of the invention is to energize an electric igniter for the pilot burner from the same source of current as is used for energizing the resetting means.

Another object of the invention is to associate various elements of the control system in compact units requiring a minimum number of operations to place the system in running condition.

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

Fig. 1 is a schematic embodiment of the safety control and ignition system of this invention in conjunction with the main and pilot burners of a gaseous fuel burning apparatus; and

Fig. 2 is a similar schematic embodiment of a modified form.

Referring more particularly to Fig. 1 of the drawings, a main burner 10 is supplied with fuel by a main fuel pipe 12 and the flow of fuel therein is under the separate control of a main control device, shown as a valve 14, and of a safety valve 16. The main valve 14 is manually operable by the handle or dial 18 between the closed and open positions indicated by the legend 19. A pair of terminals 20 is carried on the body of the main valve 14 and the legend 21 indicates the open and closed positions of a main switch 22

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incorporated in the main valve 14. As indicated by the legends 19 and 21, when the dial 18 is moved to a position in which the main valve 14 is open, then the main switch 22 is closed. When the dial 18 is moved to a position substantially 90 degrees from that described, then the main valve 14 is closed and the main switch 22 is open. It will be apparent, moreover, that the main valve 14 could embody a thermostatically operated valve (not shown). Further details of a suitable form of combined main valve, thermostatic valve and electric switch are disclosed in Weber Patent No. 2,276,751, March 17, 1942.

The safety valve 16 is an electromagnetic control means for the fuel flow in pipe 12. This valve is provided with a partition 24 having a valve seat 25 with an opening 26 therethrough controlled by a valve member 28. A valve stem 30 for the valve member 28 projects exteriorly of the safety valve 16 and carries a coil spring 32 serving to bias the valve member 28 toward the valve seat 25. An armature member 34 is carried on the exterior end of the valve stem 30 for co-operation with a horseshoe magnet 36. When the valve member 28 is in the open position shown in the drawing, the armature 34 is in its attracted position against the pole faces of the magnet 36. A suitable coil or winding 38 is provided for the magnet 36 and connected in circuit with a thermocouple 40 by wires 42 and 44.

The thermocouple 40 is located in proximity to the flame of a pilot burner 46 and is adapted to be heated thereby. The pilot burner 46 receives gaseous fuel from a conduit 48 connected with the valve seat opening 26 in the safety valve 16. In the arrangement shown the safety valve is provided with a reset stem 50 extending from adjacent the underside of the partition 24 to the exterior of the safety valve 16 and being biased outwardly therefrom by a coil spring 52. The reset stem 50 and valve stem 30 are preferably in axial alignment and extend in opposite directions from the valve seat opening 26 which is axially aligned therewith.

The reset stem 50 carries a closure member 54 for the valve seat opening 26. Formed on the reset stem 50 beyond the closure member 54 is a projection 56 which is engageable with a projection 58 formed on the valve stem 30 beyond the valve member 28. When the reset stem 50 is moved inwardly toward the valve seat 25 and the valve member 28 is seated thereon, the engagement of the projections 56 and 58 will serve to force the valve member 28 away from the valve seat 25 and position the armature 34 in engage-

ment with the pole faces of the magnet 36. At the same time, the closure member 54 will close off the valve seat opening 26 thus preventing flow of fuel through the main fuel pipe 12 to the main burner 10, but permitting fuel to flow in the conduit 48 to the pilot burner 46. It will be apparent that the closure member 54 could be dispensed with and the resetting operation just described be conducted while fuel flows simultaneously in both the main fuel pipe 12 and the pilot conduit 48.

The reset stem 50 is adapted to be moved inwardly against the bias of the spring 52 by electrically operable means now to be described. This means comprises a transformer 60 combined with an electromagnetically operated plunger 62 which is positioned in axial alignment with the reset stem 50. Thus, the primary coil 64 of the transformer 60 serves to energize the electromagnet causing movement of the plunger 62 into operative engagement with the end of the reset stem 50 projecting from the safety valve 16. The plunger movement serves to operate the reset stem 50 in its resetting operation, previously described, when the coil 64 is energized. A coil spring 67 carried by the plunger 62 serves to retract the latter when the coil 64 is inoperative.

Associated with the primary coil 64 is a secondary coil 66 connected in circuit with an electric igniter 68 for the pilot burner 46 by means of the wires 70 and 72. It will be apparent that the safety valve 16 and its associated operating magnet 36 together with the transformer 60 could be combined in a unitary construction and these elements have been shown schematically in Fig. 1 of the drawings for illustrative purposes without intending any limitation to the exact form shown.

The electric circuit for the parts so far described may be traced from one end of the primary coil 64 which is connected by a wire 74 to one terminal of a cutout 76, the other terminal of which is connected by a wire 78 to one wire 80 of a source of current supply. This source may be alternating current as supplied for domestic consumption. The cutout 76 is preferably of the thermal type having time-delayed operation and is adapted to open the circuit upon passage of overcurrent occurring as will be hereinafter described. The opposite end of the primary coil 64 is connected by a wire 82 to one terminal 20 of the main switch 22. The other terminal 20 is connected by a wire 84 to one electrode 86 of an initially closed switching means 88 having the other electrode 90 thereof connected by a wire 92 to the other wire 94 of the source of current supply.

The switching means 88 embodies a timing element 96 of well-known form usually comprising a tube containing a pool of mercury and a restricted orifice device 98 through which the mercury may flow when the timing element 96 is tilted. Such tilting action may be performed through the employment of a bell-crank lever 100 carrying the timing element 96 on one arm thereof and adapted to be moved by engagement of the opposite arm thereof with a cam element 102 carried by the dial 18.

Thus, when the dial 18 is moved to the position shown in the drawing (Fig. 1) with the main switch 22 closed and the main valve 14 open, then the cam 102 has effected movement of the bell-crank lever 100 to move the switching means 88 to its open position. However, due to the time-delay incorporated in the switching means 88, as described, the circuit through the electrodes 86 and 90 is not immediately opened. When, however, the dial 18 is being operated to open the main

switch 22 and close the main valve 14, then the switching means 88 is preferably closed substantially instantaneously. This instantaneous resetting of the switching means 88 to initial closed position may be arranged by providing a relatively unobstructed path for flow of the mercury around the orifice 98 to its initial position bridging the electrodes 86 and 90. It is to be understood that this is merely a diagrammatic illustration of a time-delay switch having instantaneous reset action and that the switching means 88 is not necessarily limited to the mercury tube type or, if of this type, need not be tilting, so long as the delayed opening and substantially instant closing features are incorporated.

When the dial 18 is moved to the position shown in Fig. 1 of the drawings to close the main switch and open the main valve 14, the switching means 88 is thereupon moved from its initially closed position to the open position shown in the drawing. Line voltage is then applied to the primary 64 of the transformer 60 through the circuit hereinbefore described causing the plunger 62 to be moved against the bias of the spring 67 into operative engagement with the reset stem 50. The valve member 28 is consequently moved to its open position and the armature 34 is moved into engagement with the pole faces of the magnet 36.

The opening of the valve member 28 of the safety valve 16, together with the previously opened condition of the main valve 14, would allow fuel to flow to both the main burner 10 and the pilot burner 46 unless the closure member 54 is incorporated in the safety valve 16. In the latter event, the flow of fuel between the safety valve 16 and the main valve 22 would be cut-off and only the pilot burner 46 would receive fuel.

The igniter 68 which is energized through the circuit described from the secondary of the transformer 60 ignites the fuel flowing from the pilot burner 46 and produces a flame at this burner. At the end of the time delay period of the switching means 88, which may be 18 seconds, the circuit to the transformer 60 is opened by operation of this means, the plunger 62 is released by deenergization of the coil 64 and the igniter 68 is also deenergized by the consequent deenergization of its circuit including the secondary coil 66.

The armature 34 is no longer held against the pole faces of the magnet 36 by the mechanical action of the plunger 62 but is now held open electrically by the action of the thermocouple 40 which is generating current for the coil 38 due to the heating effect of the pilot burner flame. Consequently, the armature 34 is retained in attracted position against the pole faces of the magnet 36. The closure member 54, if included in the structure, no longer prevents the flow of fuel to the main burner 10 and such fuel is ignited by the flame from the pilot burner 46. The system is then in steady state operation under the control of the thermocouple 40 alone.

In the event that the flame of the pilot burner 46 is extinguished, the thermocouple 40 cools and ceases to generate sufficient current to maintain the armature 34 in attracted position. The valve member 28 of the safety valve 16 thereupon closes and shuts off the flow of fuel to both the main burner 10 and the pilot burner 46. Since the switching means 88 is open-circuited the system will remain shut-off until the dial 18 is manually operated, first to close the main valve 14 and open the switch 22 associated therewith, and then back to the position shown in the drawing wherein the main valve 14 is opened and the switch 22 closed.

The system is thus of the non-recycling type with provision for complete shut-off of fuel to both the main and pilot burners upon cessation of the pilot burner flame and consequent operation of the safety valve 16.

In the event that the switching means 88 fails to open the circuit controlled thereby and the igniter 68 simultaneously fails, then the cut-out 78 would operate to open the circuit after a short time, thus causing the safety valve 16 to close.

In the embodiment shown in Fig. 2 there are various parts which may be identical with those shown and described in the previous embodiment and similar reference numerals have been applied thereto. Generally, the system disclosed in Fig. 2 differs from that disclosed in Fig. 1 in that in the former there is no secondary winding on the plunger magnet, a separate transformer is used and the switching means is provided with a double time-delay instead of the single delay previously described. As will be apparent hereinafter, this modified arrangement permits ignition of the pilot burner fuel before the main burner fuel is turned on without resorting to the use of a special closure member for the safety valve, as at 54 in the previously described embodiment.

Referring now more particularly to Fig. 2 of the drawing, the main burner 10 receives gaseous fuel from a main fuel pipe 12 having a pilot conduit 13 connected thereto. A safety valve 17 is interposed in the main fuel pipe 12 between the connection for the pilot conduit 13 and the main burner 10. The safety valve 17 embodies a partition 24 having a valve seat 25 and a valve seat opening 26 controlled by a valve member 28.

A valve stem 30 is provided for the valve member 28 and a coil spring 32 serves to bias the valve member 28 to closed position. An armature 34 is carried on the projecting end of the valve stem 30 and is movable thereby into attracted relation with the pole faces of a horseshoe magnet 36 having a coil 38 associated therewith. A thermocouple 40 is located in proximity of the pilot burner 46 to be heated by the flame thereof and is connected in circuit with the coil 38 by the wires 42 and 44.

The safety valve 17 is provided with a reset stem 50 movable into and out of the valve seat opening 26 from the underside thereof for engagement with a projection 58 of the valve stem 30. The reset stem 50 is biased away from the valve seat 26 by a coil spring 52 as in the previous embodiment.

The operating means for the reset stem 50 comprises electromagnetic means in the form of a horseshoe magnet 104 having an armature 106 movable into and out of attracted relation with the pole faces thereof by an armature stem 108 which projects through the magnet into operative engagement with the reset stem 50 and being axially aligned therewith. A coil spring 110 carried by the armature stem 108 serves to bias the armature 106 and stem 108 to the armature disengaged position. A winding or coil 112 is provided for the magnet 104.

The main valve 14 of this embodiment may be identical with that disclosed in connection with Fig. 1 of the drawing but is located in the main fuel pipe 12 on the side of the pilot conduit 13 opposite the safety valve 17. The switching mechanism 114 which, as previously indicated, incorporates a double time-delay includes a pair of timing elements 116 and 118 in the form of mercury-containing tubes having separate pairs

of electrodes 120—122 and 124—126, respectively. The restricting orifice 128 of the timing element 116 differs from the restricting orifice 130 of the element 118 in that a longer time-delay period is provided for the element 116. Such longer delay period may be approximately three times that of the short delay which is about six seconds. A suitable bell-crank lever 132 supports the timing elements 116 and 118 on one arm thereon and has its opposite arm extending into the path of movement of the cam 102 carried by the dial 18.

The electrical circuit for the reset means of this embodiment may be connected through a transformer 134 to a suitable source 135 of electric alternating current and may be traced by wire 136 connected at one end to the secondary of the transformer 134 and at the opposite end to one terminal 20 of the electric switch 22 associated with the main valve 14. The other terminal 20 is connected by a wire 138 to the electrode 120 and a common wire 140 connects the electrodes 122 and 124. Electrode 126 is connected by a wire 142 to one end of the igniter 68, the opposite end of the igniter being connected by a wire 144 to the secondary of the transformer 134.

The coil 112 of the resetting electromagnet is connected at one end by a wire 146 to the common wire 140 of the switching means 114 and the opposite end of the coil 112 is connected by a wire 148 to the wire 142. It is apparent, therefore, that a short-circuit will be established on the coil 112 by the shorter time delay element 118 of the switching means 114 during the initial closed position.

The operation of the system disclosed in Fig. 2 of the drawing is as follows: When the dial 18 is rotated to the position shown in Fig. 2 to open the main valve 14 and close the main switch 22 associated therewith, the fuel flows through the pilot conduit 13 to the pilot burner 46 but is prevented from flowing to the main burner 10 by the engagement of the valve member 28 of the safety valve 17 with the valve seat 25. The igniter 68 is energized in the electrical circuit consisting of the secondary of transformer 134, wire 136, terminals 20, wire 138, electrodes 120—122, common wire 140, electrodes 124—126, wire 142, igniter 68 and wire 144 back to the secondary of transformer 134. The fuel flowing from the pilot burner 46 is ignited by the igniter 68 and the thermocouple 40 becomes heated by the pilot burner flame.

At the end of the first time-delay period fixed by operation of the timing element 118, the short-circuit is removed from the coil 112 and the current then flows by way of the wire 146, coil 112 and wire 148 instead of by way of the electrodes 124—126. The armature stem 108 moves upwardly when the armature 106 is attracted by the energized magnet 104 and forces the reset stem 50 into operative engagement with the valve stem 30. The valve member 28 is moved off the valve seat 25 by this engaging action and the armature 34 is moved into engagement with the pole faces of the magnet 36. The opening of the safety valve 17 permits fuel to flow to the main burner 10 where it is ignited by the flame of the pilot burner 46.

At the expiration of the longer time-delay period fixed by operation of the timing element 116, both the igniter 68 and the coil 112 are de-energized by the opening of the circuit previously traced. Thus, the forced pick-up condition of

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the safety valve 17 is eliminated but the valve 28 is held open as the armature 34 remains in attracted position with the pole faces of the magnet 36 due to the current generated by the thermocouple 40 which serves to energize the coil 38 of the magnet 36. The system is now in steady state operation under control of the thermocouple 40.

In the event that the flame of the pilot burner is extinguished, then the thermocouple ceases to generate current and the coil 38 becomes de-energized releasing the armature 34 and closing the safety valve 17 by movement of the valve member 28 to its seat. As such movement of the valve member 28 controls only the flow of fuel to the main burner 10, the flow of fuel through the pilot conduit 13 continues. The system is restarted as in the previously described embodiment by rotating the dial 18 to the valve-closed, switch-open position and then back to the valve-open, switch-closed position illustrated in Fig. 2. This system is thus of the non-recycling type and does not provide a complete shut-off of fuel to both main and pilot burners by operation of the safety valve.

The invention described herein provides a relatively simple manner of safety control and ignition for gaseous fuel burners. The main burner fuel is ignited within a few seconds of turning on the system which is advantageous in oven installations. In steady state operation there is no possibility of disturbance due to line voltage variations or large starting currents of other equipment connected to the same power supply line as a separate thermoelectric current supply is relied upon. It will be apparent that many changes can be made in the arrangement and combination of parts and in the details of construction herein disclosed within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. A safety control system for fuel burners having main and pilot burners, comprising in combination, electromagnetic control means biased to a position for preventing flow of fuel to at least the main burner, electromagnetic reset means operable when energized for overcoming said bias and resetting said control means in a fuel flow permitting position, means for establishing an energizing circuit means for said reset means, means responsive to the presence of a flame at the pilot burner for energizing said control means sufficiently to hold the same in said fuel flow permitting position thereof after the same has been reset by said reset means, and switching means having a timing element connected in said circuit means for rendering the same inoperative upon expiration of a predetermined period following establishment thereof and during which said control means has had time to become energized.

2. A safety control and ignition system for fuel burners having main and pilot burners, comprising in combination, an electric igniter for the pilot burner, electromagnetic control means biased to a position for preventing flow of fuel to at least the main burner, electromagnetic reset means operable when energized for overcoming said bias and resetting said control means in a fuel flow permitting position, means for establishing an energizing circuit means including said igniter and said reset means, means responsive to the presence of a flame at the pilot burner for energizing said control means sufficiently to

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hold the same in said fuel flow permitting position thereof after the same has been reset by said reset means, and switching means having a timing element connected in said energizing circuit means for rendering the same inoperative upon expiration of a predetermined period following establishment thereof and during which said control means has had time to become energized.

3. A safety control and ignition system for fuel burners having main and pilot burners, comprising in combination, an electric igniter for the pilot burner, electromagnetic control means biased to a position for preventing flow of fuel to at least the main burner, electromagnetic reset means operable when energized for overcoming said bias and resetting said control means in a fuel flow permitting position, means for establishing an energizing circuit means including said igniter and said reset means, means responsive to the presence of a flame at the pilot burner for energizing said control means sufficiently to hold the same in said fuel flow permitting position thereof after the same has been reset by said reset means, and initially closed switching means having a timing element connected in said energizing circuit means, said switching means being operable for causing said timing element to open said circuit and rendering the same inoperative upon expiration of a predetermined period following establishment thereof and thereby causing deenergization of said reset means and igniter while said control means has had time to become energized.

4. A safety control and ignition system for fuel burners having main and pilot burners and means for supplying fuel thereto, comprising in combination, a main control device operable between fuel flow preventing and permitting positions for controlling the fuel supply from the supply means to at least the main burner, an electric igniter for the pilot burner, electromagnetic control means also controlling the fuel supply from the supply means to at least the main burner and being biased to a fuel flow preventing position, electromagnetic reset means operable when energized for overcoming said bias and resetting said control means in a fuel flow permitting position, means for establishing an energizing circuit means including said igniter and said reset means, means responsive to the presence of a flame at the pilot burner for energizing said control means sufficiently to hold the same in said fuel flow permitting position thereof after the same has been reset by said reset means, initially closed switching means having a timing element connected in said energizing circuit means for rendering the same inoperative upon expiration of a predetermined period following operation of said switching means, an initially open main switch for said circuit means, and means associated with said control device for operating the same to fuel flow permitting position and concomitantly closing said main switch and operating said switching means to cause deenergization of said reset means and igniter upon expiration of said period during which said control means has had time to become energized.

5. A safety control and ignition system for fuel burners having main and pilot burners, comprising in combination, electromagnetic control means biased to a position for preventing flow of fuel to at least the main burner, reset means including a transformer having a coil and a plunger

operable when energized for overcoming said bias and resetting said control means in a fuel flow permitting position, means for establishing an energizing circuit means for said reset means, an electric igniter for the pilot burner including a secondary coil of said transformer, means responsive to the presence of a flame at the pilot burner for energizing said control means sufficiently to hold the same in said fuel flow permitting position thereof after the same has been reset by said reset means, and switching means having a timing element connected in said energizing circuit means for rendering the same inoperative upon expiration of a predetermined period following establishment thereof and during which said control means has had time to become energized.

6. A safety control and ignition system for fuel burners having main and pilot burners and means for supplying fuel thereto, comprising in combination, electromagnetic control means operable between fuel flow preventing and permitting positions for controlling the fuel supply from the supply means to the burners and being biased to a fuel flow preventing position, a main control device interposed between said control means and the main burner for controlling the fuel supply to the main burner, reset means including a transformer having a coil and a plunger operable when energized for overcoming said bias and resetting said control means in a fuel flow permitting position, means for establishing an energizing circuit means for said reset means, an electric igniter for the pilot burner including a secondary coil of said transformer, means responsive to the presence of a flame at the pilot burner for energizing said control means sufficiently to hold the same in said fuel flow permitting position thereof after the same has been reset by said reset means, initially closed switching means having a timing element connected in said energizing circuit means for rendering the same inoperative upon expiration of a predetermined period following operation of said switching means, an initially open main switch for said circuit means, and means associated with said control device for operating the same to fuel flow permitting position and concomitantly closing said main switch and operating said switching means to cause deenergization of said reset means and igniter upon expiration of said period during which said control means has had time to become energized.

7. A safety control and ignition system for fuel burners having main and pilot burners, comprising in combination, an electric igniter for the pilot burner, electromagnetic control means for the main burner biased to a fuel flow preventing position, electromagnetic reset means operable when energized for overcoming said bias and resetting said control means in a fuel flow permitting position, means for establishing an energizing circuit means including said igniter and said reset means, means responsive to the presence of a flame at the pilot burner for energizing said control means sufficiently to hold the same in said fuel flow permitting position thereof after the same has been reset by said reset means, and switching means having a pair of timing elements connected in said energizing circuit means, one said element establishing a short-circuit on said reset means for a predetermined period following establishment of said circuit means and during which said control means has time to become energized, and the other said element rendering said energizing circuit inoperative upon expiration of a further predetermined period following establishment of

said circuit means and during which said resetting operation is completed.

8. A safety control and ignition system for fuel burners having main and pilot burners, comprising in combination, an electric igniter for the pilot burner, a thermocouple located to be heated by a flame at the pilot burner, electromagnetic control means connected in circuit with said thermocouple and adapted to prevent supply of fuel to the main burner when said flame is extinguished, means for establishing an energizing circuit means from a source other than said thermocouple, means in said energizing circuit means and operable when energized for resetting said control means to supply fuel to the main burner, and switching means in said energizing circuit means adapted to render said reset means inoperative for a predetermined period following establishment of said circuit means and during which said control means has time to become energized and thereafter render said energizing circuit means inoperative upon completion of said resetting operation.

9. A safety control and ignition system for fuel burners having main and pilot burners and means for supplying fuel thereto, comprising in combination, a main control device operable between fuel flow preventing and permitting positions for controlling the fuel supply from the supply means to the burners, an electric igniter for the pilot burner, electromagnetic control means operable between fuel flow preventing and permitting positions for controlling the fuel supply from said main control device to the main burner, said control means being biased to said fuel flow preventing position, electromagnetic reset means operable when energized for overcoming said bias and resetting said control means in a fuel flow permitting position, means for establishing an energizing circuit means including said igniter and said reset means, means responsive to the presence of a flame at the pilot burner for energizing said control means sufficiently to hold the same in said fuel flow permitting position thereof after the same has been reset by said reset means, initially closed switching means having a pair of timing elements connected in said energizing circuit means, one said element being operable for establishing a short-circuit on said reset means for a predetermined period following establishment of said circuit means and during which said control means has time to become energized, and the other said element being operable for rendering said energizing circuit inoperative after a further predetermined period following establishment of said circuit means and during which said resetting operation is completed, an initially open main switch for said energizing circuit means, and means associated with said control device for operating the same to fuel flow permitting position and concomitantly closing said main switch and operating said switching means.

10. A safety control system for fuel burners having main and pilot burners, comprising in combination, electromagnetic control means biased to a position for preventing flow of fuel to at least the main burner, reset means including a transformer having a plunger operable when energized for overcoming said bias and resetting said control means in a fuel flow permitting position, means for establishing an energizing circuit means for said reset means, means responsive to the presence of a flame at the pilot burner for energizing said control means sufficiently

to hold the same in said fuel flow permitting position thereof after the same has been reset by said reset means, and switching means having a timing element connected in said energizing circuit means for rendering the same inoperative upon expiration of a predetermined period following establishment thereof and during which said control means has had time to become energized.

11. In a control system for fuel burning apparatus having a source of electrical energy, the combination with electromagnetic control means biased to a fuel flow preventing position, thermoelectric means located to be heated by the burning fuel for energizing said control means sufficiently to hold the same in a fuel flow permitting position but being incapable of actuating the same to said position, of means for establishing a circuit means connected to said source and including electromagnetic reset means operable when energized for overcoming said bias and actuating said control means to said fuel flow permitting position, and initially closed switching means having a timing element connected in said circuit means, said switching means being operable for causing said timing element to open said circuit means upon expiration of a predetermined period following establishment thereof and during which said control means has had time to become energized.

12. In a control system for fuel burning apparatus having a source of electrical energy, the combination with electromagnetic control means biased to a fuel flow preventing position, thermoelectric means located to be heated by the burning fuel for energizing said control means sufficiently to hold the same in a fuel flow permitting position but being incapable of actuating the same to said position, of means for establishing a circuit means connected to said source and including electromagnetic reset means operable when energized for overcoming said bias and actuating said control means to said fuel flow permitting position, and manually operable switching means having a timing element connected in said circuit means and adapted for delayed action to open position but substantially instantaneous action to closed position, said switching means being initially closed and being operable for causing said timing element to open said circuit means upon expiration of a predetermined period following establishment thereof and during which said control means has had time to become energized.

13. In a safety control system for fuel burners having main and pilot burners and a source of electrical energy, the combination with electromagnetic control means biased to a position for preventing flow of fuel to both the main and pilot burners, thermoelectric means located to be heated by a flame at the pilot burner for energizing said control means sufficiently to hold the same in a fuel flow permitting position but being incapable of actuating the same to said position, of a means for establishing a circuit means connected to the source and including electromagnetic reset means operable when energized for overcoming said bias and actuating said control means to said fuel flow permitting position, means operatively associated with said reset means for interrupting the flow of fuel to the main burner during the resetting operation, and initially closed switching means having a timing element connected in said circuit means,

said switching means being operable for causing said timing element to open said circuit upon expiration of a predetermined period following establishment thereof and during which said control means has had time to become energized, said flow interrupting means being rendered inoperative when said circuit means is opened and said control means is in position to shut-off the flow of fuel to both the main and pilot burners upon cessation of said flame.

14. In a safety control system for fuel burners having a source of electrical energy, the combination with a main control device operable between fuel flow preventing and permitting positions, electromagnetic control means also operable between said positions and being biased to a fuel flow preventing position, thermoelectric means located to be heated by the burning fuel for energizing said control means sufficiently to hold the same in a fuel flow permitting position but being incapable of actuating the same to said position, of means for establishing a circuit means connected to said source and including electromagnetic reset means operable when energized for overcoming said bias and actuating said control means to said fuel flow permitting position, initially closed switching means having a timing element connected in said circuit means and adapted for delayed action to open position but substantially instantaneous action to closed position, said switching means being operable for causing said timing element to open said circuit means upon expiration of a predetermined period following establishment thereof and during which said control means has had time to become energized, an initially open main switch for said circuit, and means associated with said control device for operating the same to fuel flow permitting position and concomitantly closing said main switch and operating said switching means.

15. In a control device, the combination with electromagnetic means having an armature and magnet, holding means operative for energizing said magnet sufficiently to retain said armature in attracted position relative to said magnet but insufficiently to cause said armature to assume said position, of means to reset said armature in said position and thereafter become inoperative while said holding means is operative, said reset means comprising a source of electrical energy, a transformer having primary and secondary coils, reciprocable means operable in response to energization of said transformer for causing said armature to assume said attracted position, means for establishing a circuit means including said source and one of said coils, and initially closed switching means having a timing element connected in said circuit means and operable for opening the same upon expiration of a predetermined period following establishment thereof and during which said holding means has had time to become operative.

CHARLES K. STROBEL

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