

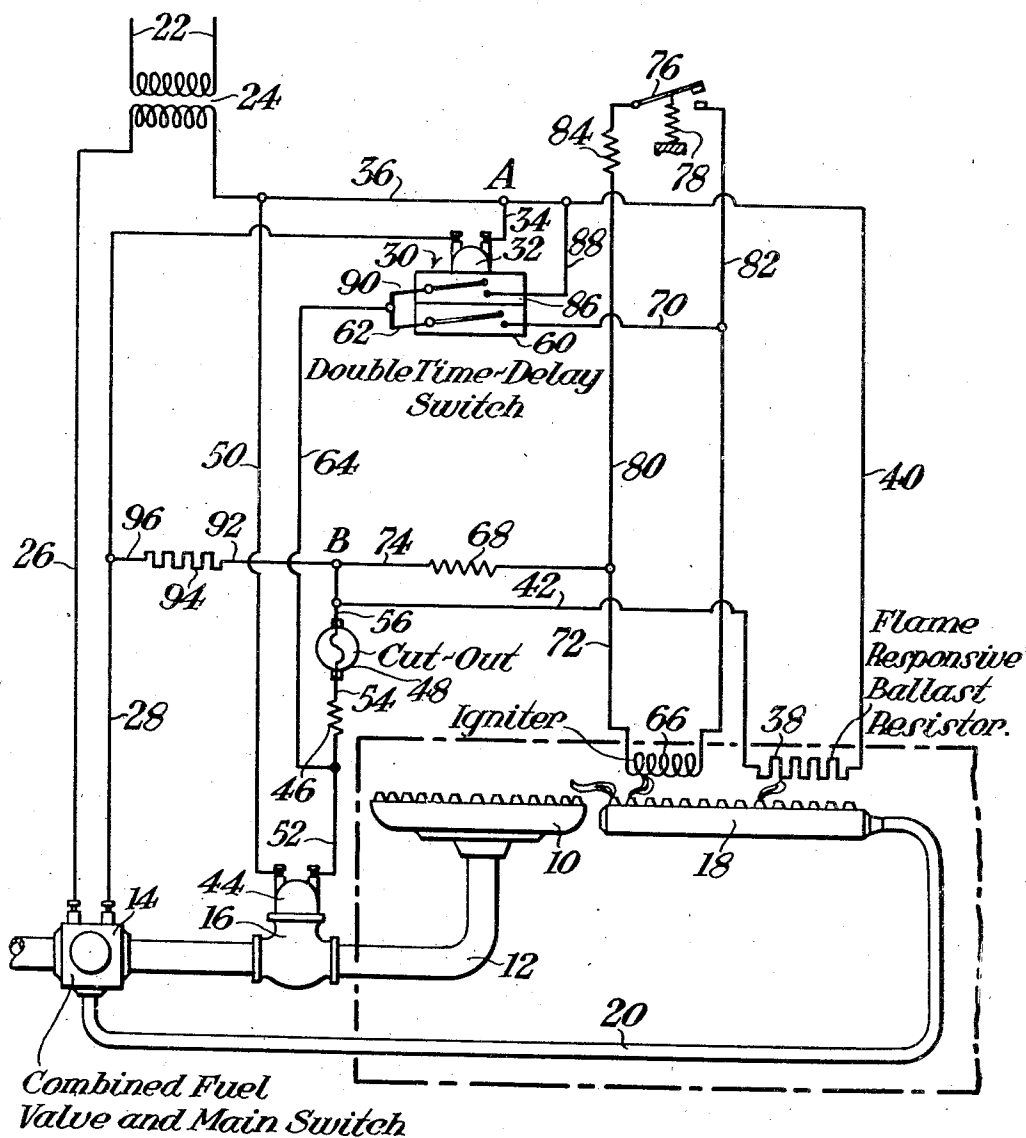
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SAFETY CONTROL APPARATUS FOR FUEL BURNERS

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SAFETY CONTROL APPARATUS FOR FUEL
BURNERS

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1 This invention relates to safety control systems for fuel burners and, more particularly, to electrically operated controls therefor.

Safety control systems of the electrically operated type may be arranged to include a starting period during which the circuit conditions are such that sufficient current is supplied to the fuel controlling means to actuate it to a position in which fuel is supplied to the burner. Thereafter, the normal running period is initiated and the circuit conditions automatically reduce the current supplied to the fuel controlling means to holding value. The fuel controlling means does not move from the fuel supply position providing the burner is producing a flame. However, subsequent extinguishment of the burner flame will result in a prompt response of the circuit elements to further reduce the current supplied to the fuel controlling means below the holding value. This causes the fuel controlling means to assume a position in which the fuel supply to the burner is prevented.

The means for determining whether the fuel controlling means remains in fuel supply permitting position may take the form of a thermal resistance element located in proximity of the burner flame and arranged to vary the electrical resistance value of the circuit in which the fuel controlling means is connected, according to the presence or absence of said flame. As fully described and claimed in my copending application Serial No. 430,002, filed February 9, 1942, now Patent No. 2,379,114, granted June 26, 1945, a protective device is therefore required in the event that the thermal resistance element becomes open-circuited. In this prior invention a cutout was employed to interrupt the circuit of the fuel controlling means upon the occurrence of an open circuit in the thermal resistance element. However, this cutout was connected in the circuit to receive current of a sufficient value during the starting period as would cause it to operate. Consequently, it was necessary in this prior disclosure to provide a special type of cutout having a combined time delay mechanism to avoid undesired interruption of the circuit during the starting period.

An object of the present invention is to afford the required protection in safety systems of the type described without the use of a time delay cutout.

Another object of the invention is to retain all the safety features of the prior invention while substituting the improved arrangement of this invention.

2 Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawing, wherein is shown a schematic view of a safety control apparatus for a gaseous fuel burner embodying the invention.

Referring more particularly to the drawing, a main fuel burner 10 is supplied with gaseous fuel by a main fuel pipe 12. The fuel supply in the pipe 12 is controlled by a main valve 14 which, in this instance, is adapted for manual operation but which may be arranged for thermostatic operation if desired. Interposed in the fuel supply pipe 12 between the main valve 14 and the burner 10 is an electromagnetic or solenoid gas valve 16 of any known type which may be arranged, as in this instance, to be opened when current of sufficient energizing value is supplied to the solenoid and closed by gravity upon a reduction of the current value thereto below holding value.

A pilot burner 18 is provided for igniting the main burner 10 and is supplied with fuel from a conduit 20 connected to the main fuel pipe 12 under control of the main valve 14. It will be understood, however, that the pilot burner 18 could be dispensed with without affecting the essential principles of this invention and is included for the purpose of facilitating combustion at the main burner and the installation of the various elements of the system in their relative positions of use.

Electric current for the operation of the apparatus is supplied by the line wires 22 connected to the primary of a transformer 24. It is desirable in such apparatus that the supply of electric current cease when the main valve 14 is closed to terminate the supply of fuel. Accordingly, a main switch for the electric current from the transformer 24 may be incorporated in the main valve 14 with suitable arrangements for causing closure of the main switch when the main valve 14 is actuated to open position.

The main switch of valve 14 has one terminal connected by a wire 26 to one terminal of the secondary of the transformer 24. The other terminal of the main switch of valve 14 is connected by a wire 28 to one terminal of the operating coil 32 of a control relay 30. The other terminal of the coil 32 is connected by a wire 34 to one junction A of a parallel mesh which is connected to the other terminal of the secondary of the transformer 24 by a wire 36. The main switch of valve 14 and the operating coil 32 are thus in series circuit with the secondary of transformer 24.

One branch of the parallel mesh consists of a

thermal resistor 38 having a preselected temperature coefficient of resistance and located in proximity of the flame from the pilot burner 18. The thermal resistor 38 is preferably in the form of a coil of wire of material having normally a relatively low resistance and a positive temperature coefficient of resistance. While being thermally responsive to the passage of current there-through the thermal resistor 38 is primarily responsive to the heat of the flame of the pilot burner 18. It will be apparent that other types of temperature responsive, flame sensitive elements or so-called ballast resistors could be substituted for the thermally responsive resistor disclosed herein. The branch consisting of the thermal resistor 38 is connected at one end by a wire 40 to the junction A and at the other end by a wire 42 to the opposite junction B of the parallel mesh.

The other branch of the parallel mesh consists of an operating coil 44 for the electromagnetic valve 16, a first constant resistor 46 and a cutout 48. These elements are connected in series circuit in the other branch by a wire 50 connecting one terminal of the coil 44 to wire 36 at junction A, a wire 52 connecting the opposite terminal of coil 44 to one end of the resistor 46, a wire 54 connecting the opposite end of the resistor 46 to one terminal of the cutout 48, and a wire 56 connecting the opposite terminal of the cutout 48 to wire 42 at junction B of the parallel mesh.

As previously indicated herein, the cutout 48 is of the simple renewable type and will operate to interrupt the flow of current to the coil 44 of the electromagnetic valve 16 upon the occurrence of an open circuit in the thermal resistor 38. As will appear hereinafter, no time delay or other special construction is required in connection with the cutout 48 due to the circuit arrangements of this invention. The first constant resistor 46 serves to adjust the current value to the cutout 48 so that during the starting period it is less than the steady operating value of the current supplied thereto and is of suitable resistance value for this purpose. It is apparent that during the starting period of the burner if current of sufficient value to actuate the electromagnetic valve 16 to open position is supplied to the coil 44 thereof, then the cutout 48 which is in series circuit with the coil 44 would also receive sufficiently large current to cause it to operate and open the circuit of the electromagnetic valve 16. Means are provided in this invention to prevent this undesired operation of the cutout 48 as will now be described.

The control relay 30 embodies switching means including a timing element 60 which is initially closed and has a specified time delay of eighteen seconds before opening. Any suitably type of timing element may be used and, in this instance, the mercury tube arrangement well known to those skilled in the art is preferred. One electrode of the timing element 60 is connected by a wire 62 and a common wire 64 of the relay to the wire 52. The other electrode of the timing element 60 is connected by a wire 70 to one end of an electric resistance igniter 66 for the pilot burner, the opposite end of which is connected by a wire 72 to one end of a second constant resistor 68. The opposite end of the second resistor 68 is connected by a wire 74 to junction B of the parallel mesh. Thus, timing element 60, igniter 66 and resistor 68 are in series circuit and jointly establish a parallel circuit with cutout 48 and

the first resistor 46 when the timing element is closed.

The second constant resistor serves to adjust the current value to the igniter 66. It is apparent, therefore, that in addition to opening and closing the parallel circuit for the cutout 48, the timing element 60 will simultaneously open and close the circuit of the igniter 66. Should the igniter 66 become burnt out or otherwise damaged so that an open circuit occurs therein, then means provided herein may be operated manually to complete the circuit of the igniter. This means takes the form of a manually operated switch 76 which is normally held open by a spring 78 and is connected in parallel circuit with the igniter 66. The connection may be traced by way of a wire 80 connected at one end to the wire 72 and at the other end to one terminal of the switch 76, and by a wire 82 extending from the other terminal of the switch 76 to the wire 70. A suitable constant resistor 84 may be included in the wire 80 in series with the switch 76 to compensate for the loss of the resistance value of the igniter 66 should it become open-circuited.

The operating coil 44 of the electromagnetic valve 16 is arranged to be short-circuited for a predetermined period of time during the initial or starting period in order to permit the igniter 66 to produce a flame at the pilot burner 18 before the main burner 10 is supplied with fuel. The short-circuit for the coil 44 is established by switching means in the form of a second timing element 86 in the control relay 30. As in the case of the timing element 60 the second timing element 86 may be of the mercury tube type and arranged to open from its initially closed position after a predetermined time delay following energization of the coil 32 but after a delay period of only six seconds. Preferably, both the timing elements 60 and 86 close instantaneously upon deenergization of the coil 32, it being noted, however, that it is not essential that the timing element 60 have an instantaneous closing action as long as it assumes a closed position before reopening of the timing element 86. Thus, where such a short time delay as six seconds is established for the timing element 86, then the timing element 60 would almost necessarily have an instantaneous action also. A wire 86 connected one electrode of the timing element 86 to wire 40 and a wire 90 connects the other electrode to the common wire 64.

The circuit from junction B of the parallel mesh to the transformer secondary is completed by a wire 92 connecting one end of a variable resistor 94 to junction B and a wire 96 connecting the other end of the resistor 94 to the wire 28. The variable resistor is similar to the thermal resistor 38 in having a positive temperature coefficient of resistance and normal low resistance but is responsive only to the heating effect of the current flow therein. The resistor accelerates the closing of the electromagnetic valve 16 as disclosed in Patent No. 2,366,774 and is termed a valve control resistor.

The operation of the device is as follows: Manual or thermostatic closing of the main switch of valve 14 effects opening of this valve, as described, and permits fuel to flow in the main fuel pipe 12 as far as the electromagnetic valve 16 which is initially closed. Electric energy from the transformer 24 is conducted from the secondary thereof by the wire 36 to junction A of the parallel mesh and by the wire 26, main switch of valve 14, wire 28, wire 96, valve control resistor

94 and wire 92 to junction B of the parallel mesh. Although the operating coil 32 of the control relay 30 is energized by the connection of one terminal thereof to the junction A by wire 34 and the opposite terminal to the main switch by wire 28, the delay periods of the timing elements 60 and 86 maintain the circuits which they are connected closed. Consequently, the coil 44 of the electromagnetic valve 16 remains short-circuited for six seconds by the shorter time delay element 86 and no fuel is supplied to the main burner 10 during the starting period.

The igniter 66 is energized through the circuit from transformer secondary, wire 26, main switch of valve 14, wire 96, valve control resistor 94, wire 92, junction B, wire 74, second resistor 68, wire 72, igniter 66, wire 70, timing element 60, wires 62 and 90, timing element 86, wire 88, junction A, and wire 96 back to the transformer 24. During this starting period, the fuel flowing from the pilot burner 18 is ignited by the igniter 66 but this period is too short for the thermal resistor 38 to become appreciably heated by the pilot burner flame and increase its relatively low resistance. At the end of the shorter time delay period the timing element 86 opens and removes the short-circuit from the operating coil 44 of the electromagnetic valve 16 and this valve is actuated to open position. It will be observed that the coil 44 thus receives current of sufficient value to cause opening of the electromagnetic valve 16 although the parallel circuit established by the thermal resistor 38 across junctions A and B of the parallel mesh still exists. Such forced pick-up of the electromagnetic valve 16 is due to the combined resistance values of the valve control resistor 94, second resistor 68 and igniter 66 being low enough for such pick-up to occur. Consequently, fuel then flows through the fuel pipe 12 to the main burner 10 where it is ignited by the pilot burner 18.

Upon the expiration of the longer time delay period of the timing element 60 which, as stated, may be eighteen seconds, the circuit of the igniter 66 is discontinued causing deenergization thereof. In addition, the parallel circuit is removed from the cutout 48 and first resistor 46 by this opening operation of the timing element 60. The total circuit resistance is thus increased sufficiently to reduce the value of the current to the operating coil 44 of the electromagnetic valve 16 and cause this valve to close, unless the thermal resistor 38 is heated by the flame from the pilot burner 18 and its resistance increased sufficiently to compensate for this increase in total circuit resistance. If at any time during the operation of the apparatus the flame of the pilot burner 18 becomes extinguished, then the thermal resistor 38 will cool and its resistance be decreased sufficiently to render the value of the current to the valve coil 44 insufficient to maintain the electromagnetic valve 16 in open position, whereupon this valve will close to terminate the supply of fuel to the main burner 10.

It is apparent that the temperature condition of the thermal resistor 38 does not influence the actuation of the electromagnetic valve 16 to open position, but does control the holding and release of the valve. Should this thermal resistor 38 become open-circuited and discontinue its branch of the parallel mesh, then the provision of the cutout 48, which would consequently receive current of operating value, serves to open the circuit of the operating coil 44 in the other branch of the mesh. Hence, this safety feature

provided by the cutout 48 is required only during the running period of the burner, that is, while the thermal resistor 38 is controlling the electromagnetic valve 16, and the parallel circuit or shunt provided for the cutout 48 during the starting period does not interfere with its essential function.

The circuit arrangement described and shown herein permits considerable variation in the value of the respective resistances without detracting from the desired operating characteristics. Moreover, while the preferred arrangement of parts has been illustrated and described it will be apparent that the apparatus is not limited to this particular embodiment but various changes may be made within the scope of the appended claims.

I claim:

1. A safety control system for fuel burners having a source of electrical energy, comprising electrically operable means movable between positions for controlling the supply of fuel to a fuel burner, a thermal resistor having a preselected temperature coefficient of resistance located in proximity of the burner so as to be heated by the flame produced by the burner and connected in parallel circuit with said controlling means for varying the energy value supplied thereto upon variations in the resistance of said thermal resistor due to the presence or absence of said flame, current responsive means in said circuit and operative for causing movement of said controlling means to a position in which said fuel supply is prevented upon the occurrence of an open circuit in said thermal resistor, and means electrically connected to said current responsive means and effective for preventing operation thereof for a predetermined period during which said thermal resistor has time to become heated, said last means including a timing element operable upon expiration of said period for rendering said last means ineffective.

2. A safety control system for fuel burners having a source of electrical energy, comprising electrically operable means for controlling the supply of fuel to a burner and being actuable to a fuel supplying position when energy of sufficient value is supplied thereto and being movable to a position for preventing said fuel supply when energy of insufficient value is supplied thereto, a thermal resistor having a preselected temperature coefficient of resistance located in proximity of the burner so as to be heated by the flame produced by the burner and connected in a parallel circuit with said controlling means for varying the energy value supplied thereto upon variations in the resistance of said thermal resistor due to the presence or absence of said flame, current responsive means in said circuit and operative for causing movement of said controlling means from fuel supplying to fuel supply preventing position upon the occurrence of an open circuit in said thermal resistor, and means electrically connected to said current responsive means and effective for preventing operation thereof for a predetermined period during which said thermal resistor has time to become heated, said last means including a timing element operable upon expiration of said period for rendering said last means ineffective and increasing the total circuit resistance to cause energy of said insufficient value to be supplied to said controlling means unless said thermal resistor has varied due to the presence of the burner flame.

3. A safety control system for fuel burners hav-

ing a source of electrical energy, comprising electrically operable means for controlling the supply of fuel to a burner and being actuable to a fuel supplying position when energy of sufficient value is supplied thereto and being movable to a position for preventing said fuel supply when energy of insufficient value is supplied thereto, a thermal resistor having a preselected temperature coefficient of resistance located in proximity of the burner so as to be heated by the flame produced by the burner and connected in a parallel circuit with said controlling means for varying the energy value supplied thereto upon variations in the resistance of said thermal resistor due to the presence or absence of said flame, current responsive means in series circuit with said controlling means and operable for causing movement thereof from fuel supplying to fuel supply preventing position upon the occurrence of an open circuit in said thermal resistor, and means electrically connected to said current responsive means for short-circuiting the same for a predetermined period during which said thermal resistor has time to become heated, said last means including a timing element operable upon expiration of said period for discontinuing the said short-circuit and increasing the total circuit resistance to cause energy of said insufficient value to be supplied to said controlling means unless said thermal resistor has varied due to the presence of the burner flame.

4. A safety control and ignition system for fuel burners having a source of electrical energy, comprising electrically operable means for controlling the supply of fuel to a burner and being actuable to a fuel supplying position when energy of sufficient value is supplied thereto and being movable to a position for preventing said fuel supply when energy of insufficient value is supplied thereto, an electric igniter adapted when energized to ignite the fuel and cause the same to produce a flame at the burner, means establishing a first circuit for supplying energy of said sufficient value from the source to said controlling means and including said controlling means, said igniter, and a control device having a timing element operable after a predetermined period for electrically disconnecting said igniter from said circuit, a thermal resistor having a preselected temperature coefficient of resistance located in proximity of the burner so as to be heated by the flame produced by the burner and electrically connected in parallel with said first circuit for varying the energy value supplied to said controlling means upon variations in the resistance of said resistor due to the presence or absence of said flame, current responsive means

in series circuit with said controlling means for causing movement thereof from fuel supplying to fuel supply preventing position upon the occurrence of an open circuit in said thermal resistor, said current responsive means being short-circuited by said timing element and igniter for said predetermined period, and means cooperable with said current responsive means for establishing a second circuit for said controlling means upon operation of said timing element to discontinue said short-circuit and increase the total circuit resistance to cause energy of said insufficient value to be supplied to said controlling means unless said thermal resistor has varied due to the presence of the burner flame.

5. A safety control and ignition system for fuel burners having a source of electrical energy, comprising a parallel mesh circuit connected to said source, a thermal resistor in one branch of said mesh having a preselected temperature coefficient of resistance and located in proximity of a burner flame for varying in resistance due to the presence or absence of said flame, electrically operable means in another branch of said mesh for controlling the burner fuel supply and being actuable to a fuel supplying position when energy of sufficient value is supplied to said controlling means and being movable to a position for preventing said fuel supply when energy of insufficient value is supplied thereto, a cutout operative to open said other branch and cause movement of said controlling means from fuel supply to fuel supply preventing position upon the occurrence of an open circuit in said one branch, a first resistor in said other branch for adjusting the energy value to said cutout, an electric igniter adapted when energized to ignite the fuel and cause the same to produce a flame at the burner, a second resistor for adjusting the energy value to said igniter, and a control device having a timing element for connecting said igniter and second resistor in parallel circuit with said cutout and first resistor for a predetermined period in which said thermal resistor has time to become heated and cause the supply of energy to said other branch to decrease to a value insufficient to operate said cutout, said timing element being operable upon expiration of said period for electrically discounting said igniter and said second resistor and thereby increasing the total circuit resistance to cause energy of said insufficient value to be supplied to said controlling means unless said thermal resistor has increased in resistance due to the presence of said burner flame.

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