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SAFETY CONTROLS FOR GASEOUS FUEL BURNERS

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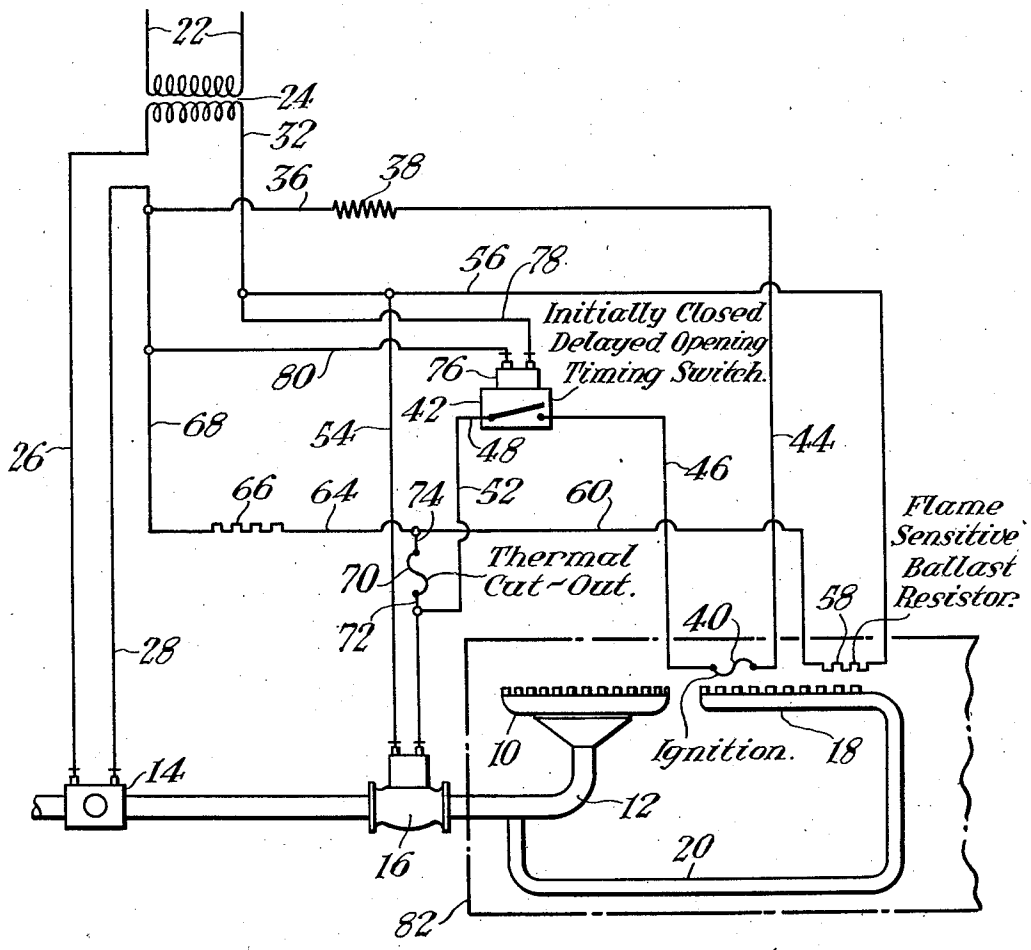


Fig. 1.

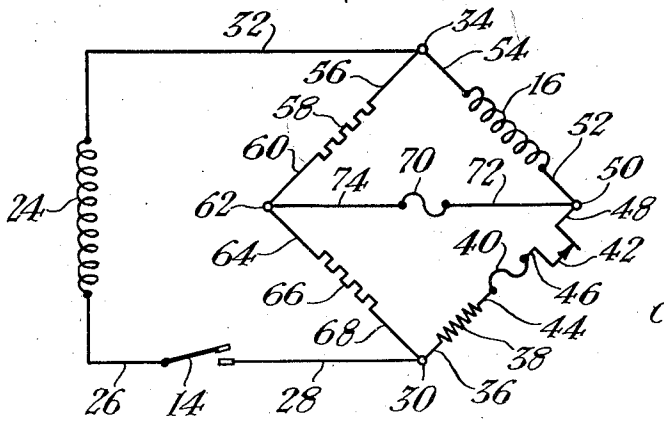


Fig. 2.

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SAFETY CONTROLS FOR GASEOUS FUEL BURNERS

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7 Claims. (Cl. 158—117.1)

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

In my copending application, Serial No. 460,456, filed October 1, 1942 and which has matured into Patent No. 2,380,125 dated July 10, 1945, there is disclosed an ignition and safety control system wherein a pilot burner may be used for lighting the main burner after the main fuel supply valve is opened. In this prior application an automatic safety valve is adapted to shut off the flow of fuel to the main burner under certain conditions, but not to the pilot burner which is controlled solely by the main fuel valve.

In numerous instances, and particularly where expensive fuels are used, it is advantageous to extinguish both the burners when the safety valve operates. Such 100 per cent shut-off is necessary and is required for all gases heavier than air. This can be accomplished in the system of the aforesaid disclosure in a simple manner by connecting the fuel supply pipe for the pilot burner to the outlet side of the safety valve. However, with this alteration it is apparent that the fuel cannot flow to the pilot burner unless the safety valve has first opened. The time delay so enforced between energizing of the igniter and flow of fuel therearound introduces objectionable features which this invention seeks to overcome.

It has been found that with the system altered as described the useful life of the electric resistance igniter for the burner is greatly shortened. The operating conditions in this system are generally harmful to prolonged life of the resistance igniter. As the usefulness of the entire system depends upon a proper functioning of the igniter, it is apparent that the importance of arrangements for extending the life thereof cannot be too greatly emphasized.

An object of this invention is to secure favorable conditions in an ignition and safety control system for the life of the igniter element while affording the desired complete shut-off of the fuel supply.

Another object of the invention is to accomplish a simplification of existing circuit arrangements while retaining the full advantages thereof.

Another object of the invention is to avoid an overload on the safety devices of the system.

Another object of the invention is to permit ignition to occur under unusual conditions at the start of operation of the system.

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

Fig. 1 is a schematic view of a safety control apparatus for a gaseous fuel burner embodying this invention; and

Fig. 2 is a circuit diagram showing the electrical connections at the start of operation of the system.

Referring more particularly to the drawing, a gaseous fuel burner 10 is shown in Fig. 1 as being supplied with fuel by a main fuel pipe 12. The fuel supply 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 between the main burner 10 and the electromagnetic valve 16. It will be observed, therefore, that the electromagnetic valve 16 controls the flow of fuel to both the main burner 10 and the pilot burner 18. However, should the throttling of the pilot burner fuel be objectionable, the combined gas cock and thermostat arrangement could be placed in the pipe 12 between the main burner 10 and the conduit 20.

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 sometimes desirable that the flow of electric current be terminated when the main valve 14 is closed to shut off the supply of fuel to both the main and pilot burners. However, for house heating applications the current flow may be controlled by a room temperature thermostat (not shown) which is not controlled in any way by the main fuel valve 14. In this embodiment, a main switch for the electric current from the transformer 24 is incorporated in the main fuel valve 14 with suitable arrangement for causing closure of the main switch when the main valve 14 is actuated to open position. It will be apparent that this switch might be connected in the primary circuit without disturbing the operation of the system, or, if the disclosed combination with a room temperature thermostat is used, then the switch

could be operated through a relay to avoid using large lead wires to the thermostat.

The electrical circuit for the safety control and ignition system of this invention is shown more particularly in Fig. 2 and includes the main switch of valve 14 which has one terminal connected by a wire 26 to one terminal of the secondary of the transformer 24 and the other terminal thereof connected by a wire 28 to a junction 30. The other terminal of the secondary of the transformer 24 is connected by a wire 32 to a junction 34. It may be noted that the various electrically operated elements of the system are connected upon initial closure of the main switch of valve 14 in a bridge type of circuit.

Connected to the junction 30 are series resistor 38, an electric resistance igniter 40 for the pilot burner 18 in the form of a coil of suitable wire, and the normally closed switch 42 of a control relay having time delayed operation, all of which form one arm of the aforesaid bridge circuit. These elements are connected in series circuit which may be traced by the wire 36 from junction 30 to the resistor 38, wire 44 connecting the resistor 38 to the electric resistance igniter 40 and a wire 46 connecting the igniter 40 to the switch 42 which is connected by a wire 48 to a junction 50. A wire 52 extending from the junction 50 serves to connect one terminal of the electromagnetic valve 16 thereto, the other terminal of this valve being connected by a wire 54 to the junction 34. The electromagnetic valve 16 and the connections described thus form the second arm of the aforementioned bridge circuit.

Connected by a wire 56 to the junction 34 is a ballast resistor 58 which forms a control resistor for the electromagnetic valve 16 for reasons which will appear hereinafter. The ballast resistor 58 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 and is thermally responsive to the passage of current therethrough. Primarily, however, this element is responsive to the heat of the flame of the pilot burner 18, to which it is exposed as shown in Fig. 1, and will vary in resistance in response thereto. The opposite end of the ballast resistor 58 is connected by a wire 60 to a junction 62 and forms the third arm of the aforementioned bridge circuit.

Connected by wire 64 to junction 62 is a second ballast resistor 66 which is also formed from a coil of wire having normally a relatively low resistance and a positive temperature coefficient of resistance. As indicated in Fig. 1, the second resistance element 66 is not, however, exposed to the flame of any burner and is adapted to vary its resistance only due to the passage of current therethrough. The opposite end of the ballast resistor 66 is connected by a wire 68 to the junction 30 and forms the fourth arm of the aforementioned bridge circuit.

A cut-out 70 having one terminal thereof connected by a wire 72 to the junction 50 and the other terminal thereof connected by a wire 74 to the junction 62 is included in the circuit. Preferably, the cut-out 70 is of the thermal type having time-lag operation for a purpose which will appear hereinafter. Such devices are constructed with predetermined time current characteristics and usually contain a heater element in addition to and affecting a fusible member which opens the circuit by passage of over-current. The cut-out 70, connected as described, forms the detector arm of the bridge circuit.

The control switch 42 is provided with an actuating coil 76 having one terminal thereof connected by a wire 78 to the wire 32 and the other terminal thereof connected by a wire 80 to the wire 68. Preferably, the switch 42 has a delayed opening of eighteen seconds following closure of the main switch of valve 14 and has an instantaneous closing upon opening of this switch. Switches of this type are well known to the art and may be in the form of the mercury tube switches disclosed in Patent No. 1,778,439 W. R. Walker, October 14, 1930 and Patent No. 2,224,873 C. H. Larson, December 17, 1940, among others, to which reference may be had for a fuller description.

As indicated by the broken lines, Fig. 1, the chamber 82 of an oven or like device is adapted to contain the main burner 10, pilot burner 18, electric resistance igniter 40 and ballast resistor 58. Both the igniter 40 and ballast resistor 58 are exposed to the flame of the pilot burner 18 and the latter is arranged in proximity to the main burner 10 to serve its intended purpose of igniting fuel flowing therefrom. It will be apparent, however, that as the pilot burner 18 merely aids in installation of the device to ensure ignition of the main burner 10, this auxiliary burner can be omitted when desired. In such event the igniter 40 and ballast resistor 58 would be arranged to be exposed to the flame of the main burner 10 as is apparent.

The operation of the device is as follows: Manual or thermostatic closing of the main switch of valve 14 is effective upon opening of this valve as described and permits fuel to flow in the main fuel pipe 12. The value of the current supplied to the electromagnetic valve 16 through the connections described is sufficient during the first eighteen seconds, following closure of the main switch of valve 14, to cause this valve to move to open position. Consequently, fuel is admitted to both the main burner 10 and the pilot burner 18 substantially simultaneously with energization of the igniter 40. The fuel flowing from the pilot burner 18 is ignited by the igniter 40 and, in turn, ignites the fuel flowing from the main burner 10. This operation occurs within a few seconds of operation of the main switch of valve 14.

If the cut-out 70 is considered of negligible impedance it is apparent that, during the eighteen seconds starting period, the circuit consists of two parallel meshes connected in series with the secondary of the transformer 22. The impedance of this circuit is relatively low and sufficient current flows through the coil of the electromagnetic valve 16 to open this valve regardless of whether or not the ballast resistor 58 is heated by the flame from the pilot burner 18. Moreover, it will be apparent that the cut-out 70 which is connected in the detector arm of the bridge circuit shown in Fig. 2 receives current which is maintained below its steady state operating value at all times during the starting period due to the various arms of the bridge being in substantial balance.

At the end of eighteen seconds the delay period of the switch 42 is terminated and the igniter 40 becomes deenergized by opening of this switch. In effect, this will cause a reduction in the value of the current flowing through the coil of the electromagnetic valve 16 sufficient to cause this valve to close. However, the ballast resistor 58 has now become heated by the flame of the pilot burner 18 so that sufficient current flows through the coil of

the electromagnetic valve 16 to maintain the valve in open position. The heating of the ballast resistor 58 therefore serves to raise the resistance of the shunt established thereby around the coil of the valve 16 and cut-out 70. This increase of resistance will compensate for the increase in total circuit resistance due to removal of the igniter 40 if the circuit constants are effectively arranged. However, if at any time during operation of the apparatus, the flame of the pilot burner 18 should cease, then the resistance of the ballast resistor 58 will be reduced by cooling and the current to the valve 16 rendered insufficient to retain this valve in open position. Flow of fuel to both burners will then cease.

The electromagnetic valve 16 will also close in the event that the resistor 58 fails through fracture or other destructive means. This additional safety feature, disclosed as the cut-out 70, will operate on the increase in current through the electromagnetic valve circuit which would occur upon failure of the resistor 58. The time-lag incorporated in the cut-out 70 renders it inoperable for the purpose described during that part of the starting period when the inrush current may be large.

Due to the provision for simultaneous energizing of the igniter 40 and flow of fuel thereabout, the igniter life is not reduced even though a 100 percent shut-off feature is included in the system. The circuit is made considerably simpler than those heretofore known by the provision for forced pick-up of the electromagnetic valve as soon as the main switch is operated. This also eliminates any overload on the cut-out at any time during normal operation.

The use of the single time delay switch does not reduce the igniter current by a circuit change until it is deenergized. This allows time for ignition even if there should be some delay in fuel flow at the start of operations. However, usually the fuel impinges on the igniter as soon as it is energized so that the operating conditions for the igniter are generally in conformity with those which have been found to prolong igniter life.

It will be understood that various changes can be made in the arrangement and combination of parts and in the form of the elements herein disclosed within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. An ignition and safety control system for fuel burners energizable from a source of current supply and comprising an electric igniter for the burner connected in a first arm of an electrical bridge circuit, a control device in said first arm and operable after a time delay following energization of said circuit for rendering said igniter inoperable, an electrically operable fuel control device for the burner in a second arm of said bridge and operable to supply fuel when current of sufficient value is supplied thereto, a pair of resistors in the third and fourth arms respectively of said bridge, one of said resistors being exposed to a flame at the burner for varying in resistance when heated thereby, said variation in resistance causing variation in said current value, and means for connecting the source across opposite junctions of said bridge arms with said first and second arms and said third and fourth arms in series circuit respectively and in multiple across said junctions for energizing said igniter and supplying current of said sufficient value to said fuel control device, said current value being rendered insufficient upon expiration of said time delay unless said one resistor is heated.

2. An ignition and safety control system for fuel burners energizable from a source of current supply and comprising an electric resistance igniter for the burner connected in a first arm of an electrical bridge circuit, a control switch in said first arm and operable after a time delay following energization of said circuit to cause deenergization of said igniter, an electrically operable fuel control device for the burner in a second arm of said bridge and operable to supply fuel when current of sufficient value is supplied thereto, a pair of ballast resistors in the third and fourth arms one of which is exposed to a flame at the burner for varying in its resistance when heated thereby, said variation in resistance causing variation in said current value, and means for connecting the opposite junctions of said first and fourth arms and said second and third arms to the current source for energizing said igniter and supplying current of said sufficient value to said fuel control device, said current value being rendered insufficient upon operation of said switch unless said one resistor is heated.

3. An ignition and safety control system for fuel burners energizable from a source of current supply and having main and pilot burners, an electric resistance igniter for the pilot burner connected in a first arm of an electrical bridge circuit, a control switch in said first arm and operable after a time delay following energization of said circuit to cause deenergization of said igniter, an electrically operable fuel control device in a second arm of said bridge and controlling the fuel supply to both the main and pilot burners, said fuel being supplied when current of sufficient value is supplied to said device, a pair of ballast resistors in the third and fourth arms one of which is exposed to a flame at the pilot burner for varying in its resistance when heated thereby, said variation in resistance causing variation in said current value, and means for connecting the opposite junctions of said first and fourth arms and said second and third arms to the current source for energizing said igniter and supplying current of said sufficient value to said fuel control device, said current value being rendered insufficient upon operation of said switch unless said one resistor is heated.

4. An ignition and safety control system for fuel burners energizable from a source of current supply and having main and pilot burners, an electric resistance igniter for the pilot burner connected in a first arm of an electrical bridge circuit, a control switch in said first arm and operable after a time delay following energization of said circuit to cause deenergization of said igniter, an electrically operable fuel control device in a second arm of said bridge and controlling the fuel supply to both the main and pilot burners, said fuel being supplied when current of sufficient value is supplied to said device, a ballast resistor in a third arm of said bridge and being exposed to a flame at the pilot burner for increasing in resistance when heated thereby, a second ballast resistor in a fourth arm of said bridge and being adapted to increase in resistance when heated by passage of current therethrough, a thermal cut-out connected across the opposite junctions of said first and second arms and said third and fourth arms, said bridge being converted upon operation of said switch to a circuit containing the first said resistor in parallel with

said device and cut-out in series, said cut-out having time delayed action sufficient to prevent operation thereof upon initial energization of said circuit, and means for connecting opposite junctions of said first and fourth arms and said second and third arms to the current source for energizing said igniter and supplying current of said sufficient value to said device, said current value being rendered insufficient upon operation of said switch unless said first resistor is heated.

5. An ignition and safety control system for fuel burners energizable from a source of current supply and comprising an electrically operable fuel control device movable between fuel flow permitting and preventing positions, switching means for controlling energization of said fuel control device from the source and operative to cause said movement thereof, means responsive to a condition caused by combustion of the fuel and electrically connected to said fuel control device for reducing the current value supplied thereto sufficiently to cause movement thereof to flow preventing position in the absence of said combustion, an electric resistance igniter for the fuel, control means responsive to operation of said switching means for rendering said condition responsive means ineffective to cause said movement for a predetermined period during which said condition responsive means has time to become responsive, said control means comprising switch contacts adapted to be closed for establishing a circuit from the source including said fuel control device, said igniter, and said condition responsive means of sufficient energizing value to cause said movement to fuel flow permitting position, and means effective upon expiration of said period to cause opening of said switch contacts for disconnecting said igniter and rendering said condition responsive means effective if combustion does not exist.

6. An ignition and safety control system for fuel burners energizable from a source of current supply and comprising an electric resistance igniter for the burner connected in a first arm of an electrical bridge circuit, a control switch in said first arm and operable after a time delay following energization of said circuit to cause deenergization of said igniter, an electrically operable fuel control device for the burner in a second arm of said bridge and operable to supply fuel when current of sufficient value is supplied thereto, a pair of ballast resistors in the third and fourth arms one of which is exposed to a flame at the burner for varying in its resistance when heated thereby, said variation in resistance causing variation in said current value, electromagnetic means for operating said control switch and connected to opposite junctions of said first and fourth arms and said second and third arms, and means for connecting said opposite junctions to the source for energizing said igniter and said electromagnetic means and for supplying current of said sufficient value to said fuel control device, said current value being rendered insufficient upon operation of said switch unless said one resistor is heated.

7. An ignition and safety control system for fuel burners energizable from a source of current supply and comprising an electrically operable fuel control device movable between fuel flow permitting and preventing positions, a main fuel cock, switching means for controlling energization of said fuel control device from the source and operative when closed to cause said movement thereof to fuel flow permitting position, means for concurrently opening said main fuel cock and closing said switching means, means responsive to a condition caused by combustion of the fuel and electrically connected to said fuel control device for reducing the current value supplied thereto sufficiently to cause movement thereof to flow preventing position in the absence of said combustion, an electric resistance igniter for the fuel, control means responsive to said closing of said switching means for rendering said condition responsive means ineffective to cause said movement for a predetermined period during which said condition responsive means has time to become responsive, said control means comprising switch contacts adapted to be closed for establishing a circuit from the source including said fuel control device, said igniter, and said condition responsive means of sufficient energizing value to cause said movement to fuel flow permitting position, means effective upon expiration of said period to cause opening of said switch contacts for disconnecting said igniter and rendering said condition responsive means effective if combustion does not exist, and electromagnetic means in circuit with the source and said switching means for rendering said contact opening means effective.

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