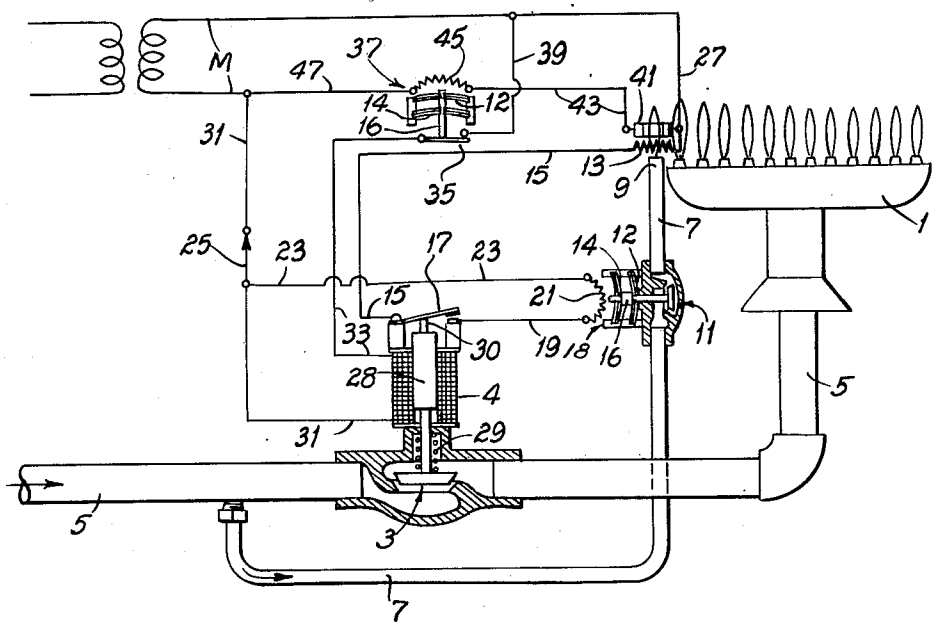
April 17, 1951 J. OTTMAR 2,549,633

GAS BURNER IGNITION AND SAFETY CONTROL SYSTEM

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FIG. 1.



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FIG. 2.

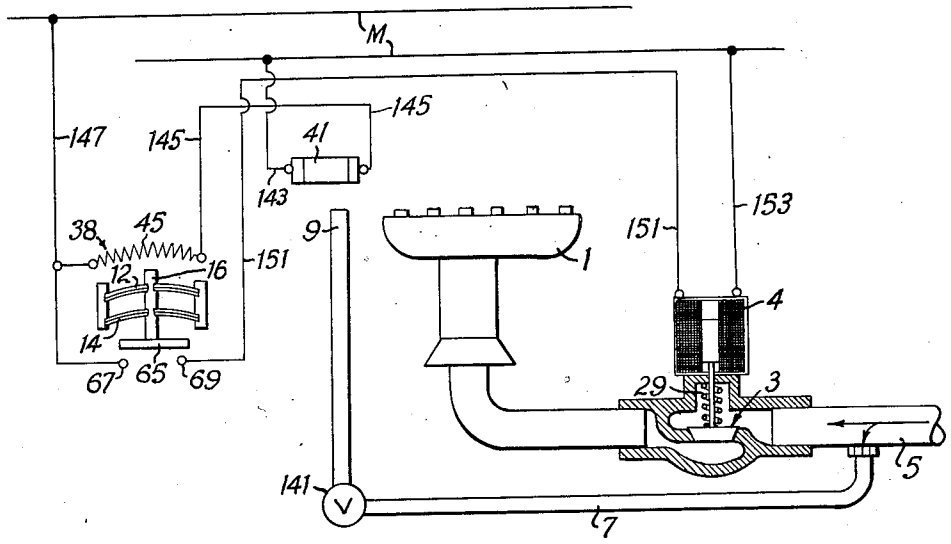
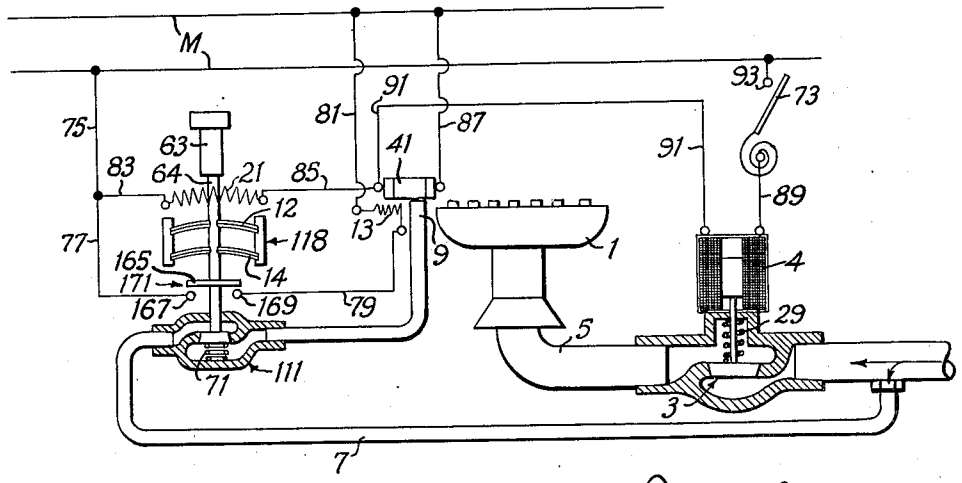


FIG. 3.



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GAS BURNER IGNITION AND SAFETY CONTROL SYSTEM

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7 Claims. (Cl. 158—117.1)

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This invention relates to gas burner control systems and more particularly to safety control systems for gas burners.

Among the various objects of the invention are the provision of gas burner control systems providing a time delay between pilot ignition and main burner ignition; the provision of a control system which avoids chattering of the main fuel supply valve in case of flame failure; the provision of a control system which automatically shuts off the flow of gas upon flame failure; the provision of a control system which upon flame failure recycles to relight the flame; the provision of a control system which affords multiple recycling; and the provision of a control system of the type referred to which is sturdy, reliable and constructed of few parts. Other objects will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, in which several of various possible embodiments of the invention are illustrated,

Fig. 1 is a diagram of a control system of the present invention;

Fig. 2 is a diagram of an alternative system; and

Fig. 3 is a diagram of a further alternative system.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to Fig. 1, a gas burner control of this invention is shown to include a main gas burner 1. Flow of gas to the main burner is under control of a solenoid valve 3 in a main burner gas supply line 5. A branch line 7 is connected into supply line 5 ahead of valve 3 for supplying gas to a pilot burner 9, the latter being located in position to ignite the main burner 1. Flow of gas to the pilot burner 9 is under control of a pilot valve 11 in branch line 7. An electrical igniter 13, of the conventional hot wire type, is positioned to ignite gas flowing from the pilot burner when energized.

The main burner valve 3 includes a solenoid coil 4, which when energized, operates upon a plunger 28 to open the valve. The valve is biased to closed position by a spring 29. Plunger 28 also controls a secondary switch 17 associated

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with valve 3, a stem 30 on the plunger opening this switch in response to opening of the valve and closing the switch upon closure of the valve.

The pilot burner valve 11 is controlled by a thermal relay, generally designated 18, of the type disclosed in Wilson Patent 2,203,558. Generally, the relay comprises a pair of snap-acting thermostatic discs 12 and 14 confined at their edges and centrally attached to a stem 16 for actuating the valve. These discs are controlled by an electrical resistance heating element 21 so as to snap from one position of curvature to an opposite position of curvature. When heater 21 is deenergized and the discs cool, they snap to a position wherein valve 11 is closed. When heater 21 is energized and the discs are thereby heated, they snap to the opposite position and open the valve.

The solenoid coil 4 is connected across the wires 27 and 47 of a power supply circuit M. This is done by means of a circuit including a main control switch 25 and the contacts 35 of a thermal time-delay relay 37, to be described. As illustrated, one terminal of the coil is connected by a line 31 including the main control switch 25 to line 47. The other terminal of the coil is connected by a line 33 to one of the terminals for contacts 35. The other terminal for contacts 35 is connected by a line 39 to line 27 of the power supply circuit. The main control switch 25 may be either manually or automatically controlled. The circuit is such that when switch 25 and contacts 35 are closed, current flows from power supply line 47 through line 31, solenoid coil 4, line 33, contacts 35 and line 39 to the other power supply line 27 to energize the solenoid 4 and open valve 3. This also opens switch 17.

The switch 17, the heater 21 and the hot wire igniter 13 are connected in series with one another and across lines 31 and 27, being under primary control of main control switch 25. As illustrated, one terminal of heater 21 is connected by a line 23 to line 31 between switch 25 and solenoid coil 4. The other terminal of the heater is connected to one terminal of switch 17 by a line 19. A line 15 including the igniter 13 is connected between the other terminal of switch 17 and power line 27. The circuit is such that with switches 25 and 17 closed, current flows from line 31 through line 23, heater 21, line 19, switch 17, line 15 and igniter 13 to line 27.

The thermal time-delay relay 37, like relay 18, is also of the type disclosed in Wilson Patent 2,203,558. It comprises a pair of snap-acting

thermostatic discs 12 and 14 confined at their edges and centrally attached to a stem 16 for actuating the contacts 35. The discs are controlled by an electrical resistance heating element 45 to snap from one position of curvature to an opposite position of curvature. The relay 37 is so constructed that when heater 45 is deenergized and the discs cool, they snap to a position wherein contacts 35 are open. When heater 45 is energized, and the discs are thereby heated, they snap to the opposite position and close the contacts. Fig. 1 illustrates the latter condition.

The heater 45 is connected in series with a flame-sensitive current controller 41 in the power circuit M. As illustrated, line 47 of the power circuit is connected to one terminal of the heater. The other terminal of the heater is connected to one terminal of current controller 41 by a line 43. Line 27 is connected to the other terminal of controller 41. The flame-sensitive current controller 41 is of the type which is normally substantially non-conductive but which becomes conductive when heated in the reducing atmosphere of a flame, reverting to its normal non-conductive condition when the flame is out. Such a current controller is fully disclosed in Hower Patent 2,106,249. Controller 41 is so positioned that both the pilot and main burner flames will act upon it. Thus, when either pilot burner 9 or main burner 1 is ignited, controller 41 will be heated in a reducing atmosphere to cause it to become conductive. When both pilot burner 9 and main burner 1 are extinguished, controller 41 is non-conductive. Since heater 45 will not be energized to close contacts 35 unless controller 41 is conductive, solenoid coil 4 will not be energized and valve 3 will not open unless the pilot burner 9 is ignited at the initiation of a cycle.

Operation of the Fig. 1 control is as follows:

Assuming that main burner valve 3 is closed, that pilot valve 11 is closed and main control switch 25 is open, switch 17 will be closed since valve 3 is closed and contacts 35 will be open with heater 45 cold. To start the burner, switch 25 is closed. This closes a circuit through line 23 to heater 21 of pilot relay 18, and through line 19, switch 17, line 15, pilot igniter 13 and line 27 back to the supply circuit. After a predetermined period of time (preferably about 5 seconds), igniter 13 has become heated and heater 21 causes discs 12 and 14 of relay 18 to snap open pilot burner valve 11. This lights the pilot burner and its flame plays on flame-sensitive current controller 41 which thereupon becomes conductive and permits current to pass through it and energize heater 45 of time-delay relay 37. After a period of time, heater 45 causes discs 12 and 14 of relay 37 to snap to their opposite position of curvature and close contacts 35. This closes a circuit through solenoid coil 4 which moves plunger 28 to its Fig. 1 position to open main valve 3.

Gas flowing through valve 3 into the main burner 1 is ignited by the pilot flame and the flame from burner 1 then also plays upon flame-sensitive current controller 41. As valve 3 opens, switch 17 is opened, thereby breaking the circuit to igniter 13 and to heater 21. After a predetermined time thermostatic discs 12 and 14 of relay 18 cool and snap to their position of opposite curvature closing pilot valve 11. This turns off the pilot but does not affect the conductivity of flame-sensitive current controller 41 as it is now heated by the main burner flame.

To extinguish the main burner flame, switch 25 is opened to break the circuit through line 31, solenoid 4, line 33, contacts 35 and line 39 from the supply circuit M. This releases plunger 28, and spring 29 thereupon biases valve 3 to cut off further flow of gas to main burner 1. This also closes switch 17. As soon as flame-sensitive current controller 41 reverts to its non-conducting state, it breaks the circuit to heater 45 of time-delay relay 37. After a predetermined period of time thermostatic discs 12 and 14 in relay 37 snap to their position of opposite curvature opening contacts 35.

All the contacts are thus reset to the "off" condition described above by the opening of switch 25 and the device is ready for recycling.

In case the main burner is blown out, flame-sensitive current controller 41 will revert to its non-conducting condition and will not pass current to heater 45 of time-delay relay 37 which will subsequently open contacts 35. This breaks the circuit to solenoid coil 4 permitting spring 29 to close valve 3. Closing valve 3 closes switch 17 so that, since switch 25 is still closed, the control will recycle in an attempt to relight main burner 1.

If hot-wire igniter 13 should rupture, causing a break in the circuit, heater 21 of pilot relay 18 will receive no current, pilot valve 11 will not open and the cycle described will not occur.

Fig. 2 illustrates another embodiment of the invention. As in the Fig. 1 embodiment, the gas burner control is shown to include a main gas burner 1 and a solenoid valve 3 in the main gas burner supply line 5. A branch line 7 is again connected into the supply line 5 ahead of valve 3 for supplying gas to a pilot burner 9 located in position to ignite the main burner. Flow of gas to the pilot burner, however, is under control of pilot valve 141 in line 7, rather than under control of relay-operated valve 11. With valve 141 open, pilot burner 9 is ignited in any desired manner.

The solenoid coil 4 of solenoid valve 3 is connected across power supply circuit M under control of a thermal time-delay relay 38 like relay 37 of Fig. 1. As illustrated, relay 38 comprises a pair of snap-acting thermostatic discs 12 and 14 attached to a stem 16 carrying a contactor bar 65. These discs are controlled by an electrical resistance heating element 45 to snap from one position of curvature wherein bar 65 bridges contacts 67 and 69 to an opposite position of curvature wherein these contacts are open. When heater 45 is deenergized and the discs cool, they snap to a position wherein the contacts are open, as illustrated in Fig. 2. When heater 45 is energized and the discs are thereby heated, they snap to the opposite position and move bar 65 to bridge the contacts. A line 147 connects one side of the power supply circuit M and contact 67. A line 151 connects contact 69 and one terminal of solenoid coil 4. The other terminal of coil 4 is connected by a line 153 to the other side of the power supply circuit.

The relay heater 45 is connected across the power supply circuit M in series with the flame-sensitive current controller 41. As illustrated, heater 45 is in a line 145 connected between line 147 and one terminal of controller 41. A line 143 connects the other terminal of the controller to the other side of the power supply circuit. The controller 41 in this instance is positioned to be acted upon only by the flame of the pilot burner.

The operation of the Fig. 2 control is as follows:

Initially, valve 141 is closed and the pilot burner 9 and main burner 1 are not ignited. Since the pilot burner is extinguished, flame-sensitive current controller 41 is non-conductive and heater 45, connected in series therewith, is deenergized. Discs 12 and 14 of relay 38 are therefore cool and in their Fig. 2 position, having moved bar 65 away from contacts 67 and 69.

To start the burner, valve 141 is opened and the pilot burner 9 ignited in any suitable way. The controller 41 is thereupon acted upon by the pilot burner flame to become conductive. This completes a circuit from one side of supply circuit M through line 147, relay heater 45, line 145, controller 41 and line 143 to the other side of the supply circuit. Thus, heater 45 is energized.

After a predetermined interval, heater 45 heats discs 12 and 14 of relay 38 until they snap to their opposite position wherein bar 65 bridges contacts 67 and 69. This closes a circuit from one side of supply circuit M through line 147, contact 67, bar 65, contact 69, line 151, solenoid coil 4 and line 153 to the other side of the supply circuit. This opens valve 3, admitting gas to main burner 1, which is ignited by pilot burner 9.

When the main burner 1 is to be extinguished, valve 141 is closed to turn off the pilot 9. Flame-sensitive current controller 41 thereupon becomes non-conductive and heater 45 is deenergized. After a predetermined interval, discs 12 and 14 cool sufficiently to snap to their normal position, moving bar 65 away from contacts 67 and 69. This breaks the circuit through solenoid coil 4, whereupon spring 29 closes valve 3, shutting off the flow of gas to burner 1.

Fig. 3 illustrates another and third embodiment of the invention including a main gas burner 1 and a solenoid valve 3 in the main burner supply line 5. A branch line 7 is again connected into supply line 5 ahead of valve 3 for supplying gas to pilot burner 9. The latter is located in position to ignite the main burner 1. As in the Fig. 1 form, flow of gas to the pilot burner is under control of a relay-operated pilot valve 111 corresponding to valve 11 of Fig. 1.

An electrical igniter 13 is provided, as in Fig. 1, to ignite the pilot burner. The igniter is connected across the power supply circuit in series with a switch 171 associated with the valve. As illustrated, discs 12 and 14 of a thermal relay 118 for the valve are attached to a stem 64 carrying a contactor bar 165 adapted to close and open contacts 167 and 169 of switch 171. Stem 64 has a knob 63 to facilitate manual actuation thereof. The discs are controlled by electrical resistance heating element 21 to snap from one position of curvature to an opposite position of curvature. When heater 21 is deenergized and the discs cool, they snap to a position wherein valve 111 is closed, as in the case of valve 11 in Fig. 1. When heater 21 is energized and the discs are thereby heated, they snap to a position wherein valve 111 is opened. When valve 111 is closed, bar 165 is disengaged from contacts 167 and 169 (Fig. 3). When valve 111 is open, bar 165 bridges the contacts. The valve 111 is biased closed by a spring 71. When the valve is open, a circuit is completed from one side of the power supply circuit M through lines 75, 77, contact 167, bar 165, contact 169, line 79, igniter 13 and line 81 to the other side of the supply circuit.

The relay heater 21 is connected across the power supply circuit M in series with flame-sensitive current controller 41, the latter being so

positioned that both the main burner and pilot burner flames will act upon it. As illustrated, a line 83 connects one terminal of heater 21 and line 75. A line 85 connects the other terminal of heater 21 and one terminal of controller 41, the other terminal of controller 41 being connected by line 87 to the other side of the power supply circuit.

The coil 4 of solenoid valve 3 is connected in series with controller 41 and with a room thermostat 73. As illustrated, a line 91 connects the terminal of controller 41 to which line 85 is connected and one terminal of the solenoid coil 4. The other terminal of this coil is connected by a line 89 including thermostat 73 and its stationary contact 93 to the side of the supply circuit M other than that to which line 87 is connected.

The operation of the Fig. 3 embodiment is as follows:

Upon a demand for heat, room thermostat 73 closes. This does not establish a circuit through solenoid coil 4, since flame-sensitive current controller 41 is not being acted upon by a flame and is non-conductive. If knob 63 is now pushed down and held for a few seconds, a circuit is completed from one side of supply circuit M through lines 75 and 77, contact 167, bar 165, contact 169, line 79, igniter 13 and line 81 to the other side of the supply circuit. Valve 111 is also manually opened against the bias of spring 71, admitting gas to pilot burner 9. As soon as igniter 13 heats sufficiently, it will ignite the pilot burner. The flame of the pilot burner then acts upon controller 41 to cause it to become conductive. This completes a circuit from one side of supply circuit M through lines 75 and 83, heater 21, line 85, controller 41 and line 87 to the other side of the supply circuit. Simultaneously, a circuit is completed from one side of supply circuit M through room thermostat 73, line 89, solenoid coil 4 of valve 3, line 91, controller 41 and line 87 to the other side of the supply circuit. Solenoid valve 3 thereupon opens, permitting gas to flow to burner 1 where it is ignited by pilot 9.

As soon as controller 41 becomes conductive and closes the circuit which includes heater 21, this heater takes over the holding of discs 12 and 14 in the position to which they were pushed against the resistance of spring 71. Knob 63 can therefore be released at this point.

If now room thermostat 73 is satisfied it moves away from its stationary contact 93 and breaks the circuit through solenoid 4. This permits spring 29 to close valve 3 to shut off the flow of gas to burner 1. Pilot 9, however, remains lighted so that controller 41 remains conducting and valve 3 will promptly reopen when room thermostat 73 subsequently calls for heat.

If now the flames of both pilot 9 and burner 1 are extinguished, controller 41 will become non-conducting and the circuits through solenoid 4 and through heater 21 are each broken. This permits spring 29 to close valve 3 immediately and after a predetermined time interval, discs 12 and 14 will cool sufficiently to snap to their position of opposite curvature. This will close valve 111, aided by spring 71, cutting off the flow of gas to pilot 9. It also breaks the circuit to igniter 13. The device is thereupon in condition to recycle, but will not do so until knob 63 is again pushed down and held as described above.

It will be clear that in each embodiment of the invention, the valve 3 does not open to admit gas to the burner until the flame-sensitive cur-

rent controller 41 has become conductive due to ignition of the pilot burner 9. In the event of flame failure, controller 41 becomes non-conductive and valve 3 closes to shut off the flow of gas to the main burner. Controller 41 is not merely heat-sensitive, but becomes conductive only in response to flame, hence will not become conductive because of residual heat in the absence of ignition of one or the other of main burner 1 or pilot burner 9.

Each embodiment of the invention also includes a thermal time-delay relay for delaying the opening of the valve 3 for a substantial interval after initiation of operation of the system. Thus, in Fig. 1, relay 37 does not close contacts 35 immediately upon closure of switch 25, but delays closure of these contacts until controller 41 has become conductive and heater 45 has been energized long enough to heat discs 12 and 14 to cause them to snap. In Fig. 2, relay 38 does not move bar 65 to close contacts 67 and 69 immediately upon ignition of the pilot burner, but delays closure of the contacts until controller 41 has become conductive and heater 45 has been energized long enough to heat discs 12 and 14 to cause them to snap. In Fig. 3, valve 3 does not open immediately upon closure of room thermostat 73, but opens after the period of time required for controller 41 to become conductive. This period is in turn determined by the length of time it takes heater 21 of thermal relay 118 to heat discs 12 and 14 sufficiently to cause them to snap to and remain in the position wherein bar 165 bridges contacts 167 and 169. The provision for delayed action of the main burner valve 3 in each instance prevents chattering of the valve in the event of any current leakage through controller 41.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A gas burner control system comprising a main gas burner and a pilot burner for igniting said main burner, a gas supply line for said main burner, a main valve in said line, a gas supply line for said pilot burner, a pilot valve in said pilot supply line, a main control switch, a thermal time-delay relay including contacts and a heater which, when energized, closes said contacts after a time delay, electrically controlled means for operating said main valve connected in a circuit in series with said main control switch and the contacts of said time-delay relay, a flame-sensitive current controller positioned to be acted upon at least by the flame of the pilot burner, said controller being normally non-conductive but adapted to become conductive when acted upon by said flame, said heater being connected in a circuit in series with said controller whereby said heater is energized in response to ignition of the pilot burner and closes said contacts after a time delay thereby to open said main valve, a thermal pilot relay for operating said pilot valve, said pilot relay including a heater which when energized actuates the pilot relay to open the pilot valve, a secondary switch, said pilot relay heater being connected in a circuit under control of said main control switch in series with said secondary switch, and means for opening said secondary switch in response to opening of said main valve and for closing it in response to closure of said main valve.

2. A gas burner system as set forth in claim 1, further including an electrical igniter for the pilot burner in series with the pilot relay heater and secondary switch.

3. A gas burner control system comprising a main gas burner and a pilot burner for igniting said main burner, a gas supply line for said main burner, a main valve in said line, a gas supply line for said pilot burner, a pilot valve in said pilot supply line, a main control switch, a normally non-conductive flame-sensitive current controller, the latter being positioned to be acted upon at least by the flame of the pilot burner and adapted to become conductive when acted upon by the flame, electrically controlled means for operating said main valve connected in a circuit in series with said main control switch and said current controller, a thermal time-delay relay controlling said pilot valve having a cold position wherein it closes said pilot valve and a hot position wherein it holds said pilot valve open, said relay including a heater for heating it to hold said pilot valve open, said heater being connected in a circuit in series with said flame-sensitive current controller whereby it is energized only when said controller is conductive, and said relay being manually movable to its hot position to open said pilot valve to admit gas to the pilot burner until said controller becomes conductive and said heater is energized long enough to heat said relay to hold said pilot valve open.

4. A burner control system as set forth in claim 3, further including a pilot burner igniter connected in a circuit in series with a set of contacts controlled by said pilot valve, said contacts being open when said pilot valve is closed, and closed when said pilot valve is open.

5. A gas burner control system comprising a main gas burner and a pilot burner for igniting said main burner, a gas supply line for said main burner, a valve in said line, electrically controlled means for opening and closing said valve, a flame-sensitive current controller which is normally non-conductive but which becomes conductive when acted upon by a flame, said controller being positioned to be acted upon by the flame of the pilot burner, a thermal time-delay relay comprising normally open thermostatically controlled contacts and an electrical heater which after being energized for a time delay interval acts to hold said contacts closed, and a circuit system including said electrically operated means, current controller and relay with the heater of the relay and the current controller being connected in series in a circuit in the system so that the heater is energized whenever the controller has been rendered conductive due to being acted upon by the flame of the pilot burner, and with the contacts of the relay connected in another circuit in the system controlling the operation of the burner so that there is a time delay between initiation of operation of the burner and opening of the valve.

6. A gas burner control system comprising a main gas burner and a pilot burner for igniting said main burner, a gas supply line for said main burner, a valve in said line, electrically controlled means for opening and closing said valve, a flame-sensitive current controller which is normally non-conductive but which becomes conductive when acted upon by a flame, said con-

troller being positioned to be acted upon by the flame of the pilot burner, a thermal time-delay relay comprising normally open thermostatically controlled contacts and an electrical heater which after being energized for a time delay interval acts to hold said contacts closed, said heater and current controller being connected in series in a circuit so that the heater is energized whenever the controller has been rendered conductive due to being acted upon by the flame of the pilot burner, said contacts and electrically controlled means being connected in series in a circuit with said means being adapted to hold said valve open only upon closure of said contacts.

7. A gas burner control system comprising a main gas burner and a pilot burner for igniting said main burner, a gas supply line for said main burner, a valve in said line, electrically controlled means for opening and closing said valve, a flame-sensitive current controller which is normally non-conductive but which becomes conductive when acted upon a flame, said controller being positioned to be acted upon by the flame of the pilot burner, a thermal time-delay relay comprising contacts, snap-acting thermostatic means

controlling said contacts, said thermostatic means, when cold, holding said contacts open, and an electrical heater which after being energized for a time delay interval heats said thermostatic means to cause it to snap to a position wherein it holds said contacts closed, said heater and current controller being connected in series in a circuit so that the heater is energized whenever the controller has been rendered conductive due to being acted upon by the flame of the pilot burner, said contacts and electrically controlled means being connected in series in a circuit with said means being adapted to hold said valve open only upon closure of said contacts.

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