

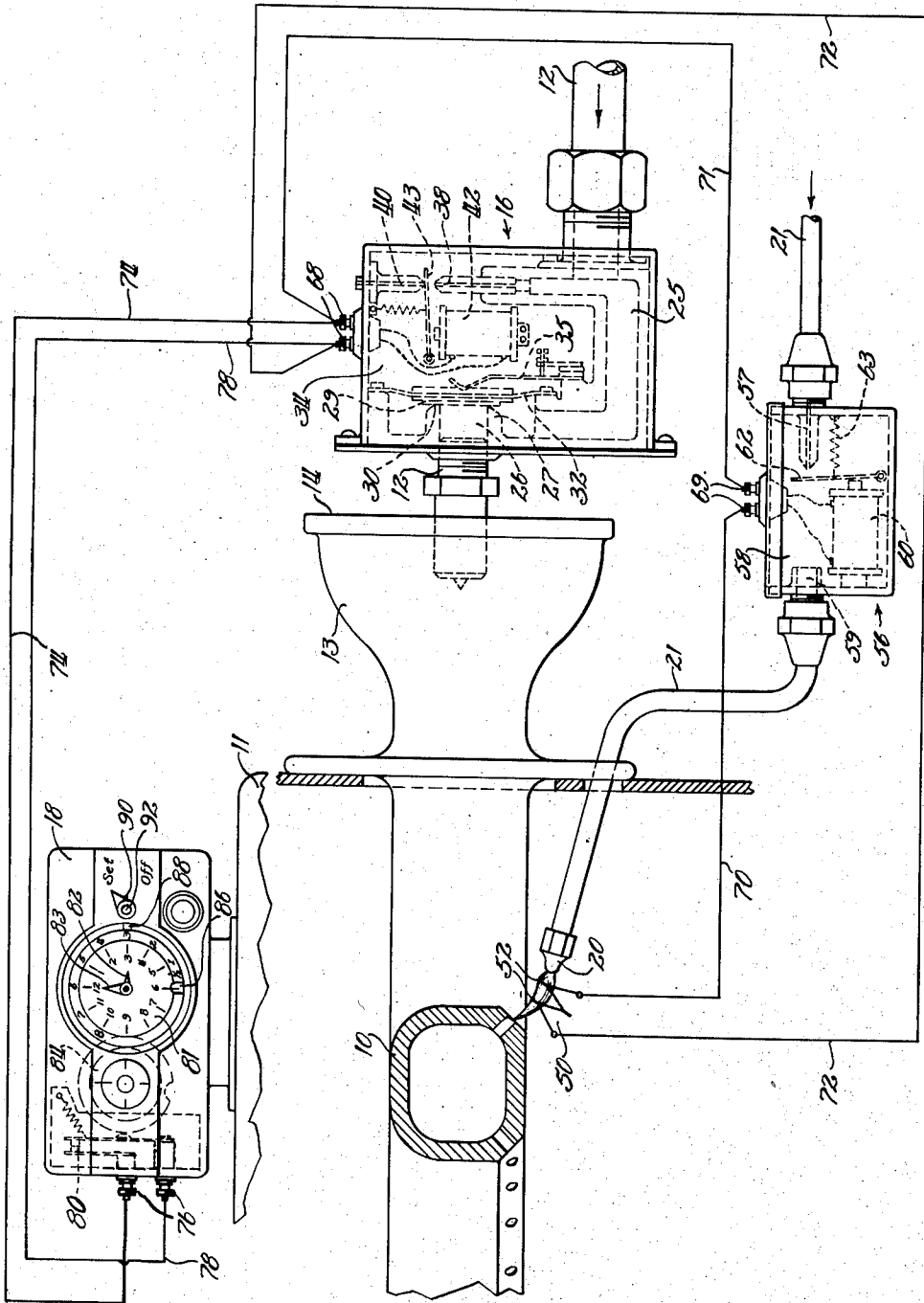
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J. H. THORNBERRY

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BURNER CONTROL APPARATUS

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INVENTOR.

INVENTOR.
John H. Thornbery

BY

B1
Brown, Jackson, Butcher & Nieman
Attys.

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BURNER CONTROL APPARATUS

John H. Thornbery, Milwaukee, Wis., assignor
to Milwaukee Gas Specialty Company, Milwaukee, Wis., a corporation of Wisconsin

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This invention relates to burner control apparatus, and more particularly to an improved time and thermally responsive control and safety shutoff mechanism for burners.

While the invention has particular utility in connection with gas burning cooking ranges in which one or more of the burners, such as the oven burner, is adapted to be placed under automatic time control and wherein a safety shutoff feature is associated with the burner so that it cannot possibly receive fuel if the pilot light associated with the burner is extinguished, it is to be understood that the invention is not limited to such use but may be employed with the burner or burners of a room or space heater, water heater, floor furnace, or any other burner.

One of the main objects of the present invention is to provide an improved apparatus having a time controlled switch for governing the burner, ignition means for igniting the fuel at the burner, and a valve jointly responsive to the time controlled switch and to the ignition means for governing the flow of fuel to the burner.

Another object of the invention is to provide an improved thermally responsive control and safety shutoff and a time control mechanism for burners wherein the thermally responsive control and safety shutoff is operative not only to shut off the supply of fuel to the burner if there is failure or malfunctioning of the apparatus, such as when the pilot light is extinguished, but which is also operative, when the time controlled switch is opened, to establish and maintain the supply of fuel for the burner upon ignition of the pilot light, the time controlled switch being operative to closed and open positions to shut off and establish the flow of fuel to the burner at preselected times when the pilot light is burning.

Another object of the invention is to provide an improved automatic thermoelectric control and safety shutoff and automatic time control which is operative automatically, and preferably without current or power other than the heat of the flame on the thermocouple means; also without cocking or reset buttons or the like.

Another object of the invention is to provide an automatic thermoelectric control and safety shutoff comprising a thermoelectric responsive valve in the fuel supply pipe, a constantly closed thermoelectric circuit for said valve having thermocouple means adapted to be subjected to the heat of a flame and capable, when energized by the heat of the flame on said thermocouple means, of opening said valve and maintaining same open, a shunt circuit for said valve, and

time controlled switch means operative to open said shunt circuit to render said thermoelectric circuit effective to open said valve and to hold same open and operative to close said shunt circuit to render said thermoelectric circuit ineffective to hold said valve open or to open the same.

Another object of the invention is to provide, in burner control apparatus of the class described, an automatic thermoelectric control and safety shutoff which is operative to shut off not only the supply of fuel to the main burner but also the supply of fuel to the pilot burner when the pilot flame is extinguished, and a system of the class described in which the pilot burner valve is opened automatically and the thermoelectric current for opening and holding the main burner valve open is set up by the application of the flame or other ignition means for igniting the pilot burner.

Another and more specific object of the invention is to provide in a burner control apparatus of the class described, a pilot burner valve in closed series circuit relation with the main burner valve, and a timer controlled shunt circuit provided with a time controlled switch for shunting the main burner valve when the switch is closed and in which the main burner valve is self-operating to open position by the thermoelectric current when the time-controlled switch is opened; also a system of the class described in which the pilot burner valve is not only in series circuit relation with the main burner valve so that both valves will close upon extinction of the pilot light, but in which the pilot burner valve is also in series circuit relation with the time controlled shunt circuit so that the timer means may operate to open and close the main valve without opening and closing the pilot valve.

Another object of the invention is to provide an improved automatic thermoelectric control and safety shutoff and automatic time control of relatively simple and inexpensive construction, and which may be installed and operated conveniently and effectively; also a control apparatus of the class described composed of relatively few parts and adapted for convenient and expeditious manufacture and assembly, and which will operate quickly, positively, and effectively, and will fail "safe."

Further features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawing in which the single figure is a fragmentary and more or less diagrammatic view illustrating schematically one form of burner

control apparatus embodying the present invention.

The invention can be embodied in a wide variety of forms for use with a wide variety of devices, but for purposes of illustration the invention has been shown more or less schematically as embodied in connection with a domestic gas range oven burner. It is to be understood that the burner may be any other burner with which the automatic timer and thermally responsive control and safety shutoff apparatus of the present invention is adapted for use—for example, the burner may, as already pointed out, be the burner of a room or space heater, water heater, floor furnace, or any other burner.

In the cooking range adaptation of the invention, the burner 10 represents, for example, a typical oven burner or broiler burner for an oven or broiler 11. A fuel supply pipe 12 leads to the burner 10 for the delivery of gaseous or other fuel thereto—for example, through a mixing chamber 13 to which air is admitted at 14 in the usual way, as well understood in the art.

Interposed in the fuel supply pipe 12 is an automatic or self operating thermally and time controlled shutoff valve 16. This valve is jointly responsive to the time controlled means or timer indicated in its entirety at 18 and to the pilot burner 20.

The pilot burner 20, which is located in juxtaposition to the main burner 10 to maintain a pilot flame for igniting the main burner, is supplied with gaseous fuel by a pilot supply pipe 21 which preferably shunts the valve 16, for example, by having connection with the main fuel supply pipe 12 anterior of the valve 16.

The valve 16 may be of any desired type, preferably capable of being opened and maintained open by the thermoelectric current generated by the heat of the pilot flame on the thermocouple means. The particular valve 16 shown in the drawing is of the gas actuated diaphragm type having an inlet chamber 25 and an outlet 26 separated from the inlet chamber by an annular wall or partition 27. Contiguous sections of the fuel supply pipe 12 are connected in communication with the inlet chamber 25 and outlet 26.

An annular valve seat is provided at 30 upon which a valve member 29 is adapted to seat to shut off communication between the inlet chamber 25 and the outlet 26, and thereby the supply of fuel for the main burner. The valve member 29 is carried by a flexible diaphragm 32, and a diaphragm chamber is provided at 34. A spring 35 or other suitable means may be provided for actuating the valve member 29 to closed position when the pressure on opposite sides of the diaphragm 32 is equalized, or upon a building up of pressure in the diaphragm chamber 34 as will presently appear.

An inlet port or passage 38 is adapted for delivering fuel from the inlet side of the valve 16 into the diaphragm chamber 34. An outlet port or passage 40 is adapted for relieving the pressure in the diaphragm chamber 34 by venting the fuel from the diaphragm chamber to atmosphere, or, if desired, by delivering the fuel from the diaphragm chamber 34 to the outlet side of the valve or to the pilot burner, or elsewhere, so that it does not escape into the air. The valve 16 has an electromagnet 42 provided with an armature 43 which, when the electromagnet is deenergized, is held, for example, by a spring in a first position closing the outlet port or passage 40 and opening the inlet port or passage 38. When the electro-

magnet 42 is energized, the armature 43 is swung or attracted to a second position, in which position it closes the inlet port or passage 38 and opens the outlet or pressure relief port or passage 40.

For purposes of illustration, the thermocouple means is shown in the form of a thermopile 50 comprising two or more thermocouples connected in series, as well understood in the art. It is to be understood that the thermocouple means may be in the form of a single thermocouple. The thermocouple or thermopile is placed in position so that the hot junction, or hot junctions, 52 thereof will be heated by the pilot flame as long as the pilot flame is burning. The two elements of the thermocouple, or, where a thermopile is employed, the two elements of each thermocouple thereof, are of different thermoelectric characteristics.

Interposed in the pilot supply pipe 21 is a thermally controlled safety shutoff valve 56. This valve also is preferably automatic or self-operating, as will hereinafter appear. The valve 56 is responsive to the pilot burner 20 to operate to closed position with the operation of the valve 16 to closed position upon extinction of the pilot flame. The pilot burner valve 56 is not, however, under the control of the timer 18 but remains open to maintain the pilot flame as long as the pilot burner is ignited and regardless of whether the main valve 16 is in open position or is compelled to closed position by the operation of the timer 18.

The valve 56 may be of any desired type, preferably capable of being opened and maintained open by the thermoelectric current generated by the heat of the pilot flame on the thermocouple means. The particular valve shown in the drawing has an inlet 57 opening into the valve chamber shown more or less schematically at 58, and an outlet 59 opening into the pilot supply pipe section 21 leading to the pilot burner. Contiguous sections of the pilot supply pipe 21 are connected in communication with the inlet 57 and outlet 59.

The valve 56 has an electromagnet 60 provided with an armature 62 which, when the electromagnet 60 is deenergized, is held, for example, by a spring 63 in a first position closing the inlet 57. When the electromagnet 60 is energized, the armature 62 is swung or attracted to a second position, in which position it opens the inlet 57 to permit the gas or other fuel for the pilot burner to enter the valve chamber 58 from where it flows out through the outlet 59 to the pilot burner.

The thermally and time controlled main burner valve 16 has a pair of terminals 68 for the coil of the electromagnet 42, and the thermally controlled pilot burner valve 56 has a pair of terminals 69. One terminal of the thermocouple or thermopile 50 is connected by a lead conductor 70 to one of the terminals 69 of the thermoelectric responsive valve 56. The other terminal 69 of this valve 56 is connected by a lead conductor 71 to one of the terminals 68 of the thermoelectric responsive valve 16. The other terminal 68 of the thermoelectric responsive valve 16 is connected by a lead conductor 72 to the other terminal of the thermocouple or thermopile 50, thus connecting the electromagnets 42 and 60 of the thermoelectric responsive valves 16 and 56 in series circuit relation. This circuit may be constantly closed as will presently appear. The combination disclosed provides an automatic timer for the main

burner and a safety shutoff control for both the main burner and the pilot burner.

The time controlled switch or timer 18 has a pair of terminals 76. One of these terminals 76 is connected by the lead conductor 74 to one of the terminals 68 of the valve 16, and the other terminal 76 is connected by a lead conductor 78 to the other terminal 68 of the valve 16, thus connecting the timer 18 in shunt circuit relation with respect to the main burner valve 16 and in series circuit relation with respect to the pilot burner valve 56.

The automatic timer 18 comprises a time controlled switch 80 and any desired mechanism capable of causing the switch 80 to open and close at different times preselected by the housewife or other attendant. As illustrative of one suitable embodiment of the invention, I have shown in general outline and more or less diagrammatically a synchronous motor driven clock including a clock dial 81 and hour and minute hands 82 and 83 and mechanism at 84 under the control of the clock for closing and opening the switch 80 automatically at the different preselected times. The time switch may be of any well known or other form. The clock may be a spring motor driven clock instead of an electric clock, or it may be a spring motor driven clock with an electric winding and setting mechanism as well known in the art, or any other desired form of clock or timer means may be employed.

For purposes of illustration, I have shown a "stop cooking" or "stop heating" ring 86 rotatable concentrically about the outside of the clock dial 81, this ring having an index pointer adapted to be placed in registration with the different hour numerals around the clock dial, the adjustable setting given this ring determining the time when the apparatus will interrupt the cooking or heating operation. Rotatable concentrically around the outside of the adjusting ring 86 is an arm or other adjusting ring member 88 which is adjustable to different positions to predetermine the number of hours, or fractions of an hour, that the cooking or heating operation is to continue. An index pointer on this outer adjusting ring member 88 is adapted to be placed in registration with different hour and fractional hour markings on the adjusting ring 86 in predetermining the length of time of the cooking or heating operation.

The automatic timer 18 is adapted to be placed in its normal position and in its set position through the manipulation of a control knob 90 which is secured to the front end of a control shaft 92. The control shaft 92 may advance clockwise by a step-by-step motion as the timer 18 goes through the cyclical steps of starting the cooking or heating operation, etc. The mechanism 84 is operated by the automatic timer to close and open the time controlled switch 80 at the different preselected times. The switch 80 is shown as connected in series circuit relation in the shunt circuit so that when the pilot flame is burning and the electromagnets 42 and 60 are energized by the thermoelectric current set up by the heat of the flame on the "hot" junction or junctions of the thermocouple means, closing of the switch shunts the thermoelectric current through the shunt circuit with a resulting deenergization of the electromagnet 42, the electromagnet 60 continuing to remain energized as long as the pilot flame is burning. Opening of the switch 80 opens the

shunt circuit around the electromagnet 42 and thereby, assuming that the thermocouple means 50 is heated by the pilot flame, the electromagnet 42 is energized to open the valve 16. When the time controlled switch 80 is opened and the pilot burner is ignited, the heat of the pilot flame on the thermocouple means energizes the electromagnets 42 and 60 to maintain both valves 16 and 56 open, and, in the event the pilot burner is extinguished for any reason, both of the electromagnets 42 and 60 are deenergized with a resulting closing of both the main burner valve 16 and the pilot burner valve 56.

The operation of the apparatus is as follows:

When the pilot burner 20 is lighted and heating the "hot" junction, or junctions, of the thermocouple means 50, a thermoelectric operating current is set up. When the time arrives for the cooking or heating operation to start as predetermined by the setting of the adjustable member 88, the automatic timer operates to open the switch 80. This opens the shunt circuit 74, 78 around the electromagnet 42, and the resulting energization of this electromagnet by the thermoelectric current set up by the heat of the pilot flame on the thermocouple means swings the armature 43 to position closing the opening of the port or passage 38 into the diaphragm chamber 34 and opening the release port or passage 40. The pressure of the fuel on the inlet side of the valve 16 acting against the diaphragm 32 thereupon moves the valve member 29 to open position to allow fuel to flow to the main burner 10 as long as the thermocouple means is heated by the pilot flame and the switch 80 remains open. The main burner is ignited by the pilot burner 20, the pilot valve 56 being maintained open as long as the pilot flame is burning.

At the hour predetermined for stopping the cooking or heating operation (shown by the pointer of the adjustable member as being 6:00 o'clock), the automatic timer operates to close the switch 80 and thereby the shunt circuit 74, 78. As a result, the thermoelectric current is shunted around the electromagnet 42. The resulting deenergization of the electromagnet 42 allows the armature 43 to swing (under the action of spring or other suitable means) to its other position, opening the port or passage 38 into the diaphragm chamber 34 and closing the relief port 40 leading from the diaphragm chamber. The fuel under pressure then flows from the fuel supply pipe 12 on the inlet side of the valve 16 into the diaphragm chamber 34 through the port or passage 38, and the fuel pressure on the opposite sides of the diaphragm becomes equalized. As a result, the valve member 29 moves to closed position—for example, under the action of the spring 35 or other suitable means—engaging the valve seat 30 and thereby shutting off the supply of fuel to the main burner. At this time, the control knob 90 may be in the "off" position, signifying that the thermally and time controlled valve 16 has been turned off or closed for shutting off the supply of fuel to the burner 10.

The series circuit relation of the circuit for the pilot valve 56, not only with respect to the circuit for the main valve 16 but also with respect to the shunt circuit, maintains the valve 16 open not only when the switch 80 and the main burner valve 16 are open but also when the switch 80 is closed with an accompanying closing of the main burner valve 16. Consequently, when the timer 18 operates to open the

switch 80, the valve 16 is opened automatically by the minute or relatively weak thermoelectric current, thereby setting up a supply of fuel to the main burner 10 which is ignited by the pilot burner 20.

If, for any reason, the pilot burner 20 is extinguished when the time controlled switch 80 is open, the resulting discontinuance of the thermoelectric current results in deenergization of the electromagnets 42 and 60, and the armatures 43 and 62 are actuated to attracted positions shutting off the supply of fuel to the main burner and to the pilot burner.

If the pilot burner is extinguished when the time controlled switch is closed, the valve 16 operates to closed position to shut off the supply of fuel to the pilot burner and, at the same time, the thermoelectric current for the main valve 16 is discontinued. Consequently, if the timer operates to open the time controlled switch 80 at a preselected time, this discontinuance of the thermoelectric current upon extinction of the pilot flame prevents the valve 16 from operating to open position to establish a supply of fuel to the main burner. In order to reignite the pilot burner, the thermocouple must first be heated by a match or other suitable heating means in order to establish a thermoelectric current to open the valve 56 so that gas may flow to the pilot burner and there be ignited by the igniting means. The pilot burner flame playing upon the thermocouple will produce sufficient electric current to hold the pilot burner valve open.

The apparatus is so constructed and arranged that in the event of breakage of parts, interruption of the thermoelectric circuit, or other malfunctioning of the apparatus, there will be an inherent tendency for the apparatus to fail "safe," i. e., for the failure of the apparatus to result in closing of the main valve 16 and pilot burner valve 56 to shut off the supply of fuel to both the main burner and the pilot burner.

The embodiment of the invention shown in the drawing is for illustrative purposes only, and it is to be expressly understood that said drawing and the accompanying specification are not to be construed as a definition of the limits or scope of the invention, reference being had to the appended claims for that purpose.

I claim:

1. In burner control apparatus, the combination with a burner and ignition means for igniting the fuel at said burner, of a thermoelectric circuit having a thermocouple subject to the heat of said ignition means, a thermoelectric responsive valve for governing the flow of fuel to said burner, and thermoelectric responsive control means governing said ignition means, said thermocouple, thermoelectric responsive valve, and said thermoelectric responsive ignition control means being connected in series circuit relation, and a timer controlled shunt circuit provided with a time controlled switch for shunting the thermoelectric responsive valve when the switch is closed, said thermoelectric responsive valve being self-operating to open position by the thermoelectric current when the time controlled switch is opened, and said thermoelectric responsive ignition control means being in series circuit relation with said shunt circuit.

2. In burner control apparatus, the combination with a main burner and a pilot burner in position to ignite the main burner, of a thermoelectric circuit having a thermocouple subject to the heat of said pilot burner, a thermoelectric re-

sponsive valve for governing the flow of fuel to said main burner and a thermoelectric responsive valve for governing the flow of fuel to said pilot burner, said thermocouple, thermoelectric responsive main burner valve, and said thermoelectric responsive pilot burner valve being connected in series circuit relation, and a timer controlled shunt circuit provided with a time controlled switch for shunting the thermoelectric responsive main burner valve when the switch is closed, said thermoelectric responsive main burner valve being self-operating to open position by the thermoelectric current when the time controlled switch is open, and said thermoelectric responsive pilot valve being in series circuit relation with said shunt circuit so that both the main burner valve and the pilot burner valve will operate to closed position upon extinction of the pilot flame and at the same time the main burner valve only will be under the control of said time controlled shunt circuit.

3. In burner control apparatus, the combination with a main burner and a pilot burner in position to ignite said main burner, of a thermoelectric circuit having thermocouple means subject to the heat of said pilot burner, a thermoelectric responsive valve connected into said thermoelectric circuit and adapted for governing the flow of fuel to said main burner, a second thermoelectric responsive valve connected into said thermoelectric circuit and adapted for governing the flow of fuel to said pilot burner, said main burner valve and said pilot burner valve being operative to closed positions upon cessation of the heat of said pilot burner on said thermocouple means, and a time controlled switch operative to apply the thermoelectric current in said thermoelectric circuit to said main burner valve and to discontinue the application of the thermoelectric current to said valve at preselected times to open and close said main burner valve and without interrupting the application of the thermoelectric current in said thermoelectric circuit to said pilot burner valve.

4. In burner control apparatus, the combination with a main burner and a pilot burner in position to ignite said main burner, of a thermoelectric circuit having a thermocouple subject to the heat of said pilot burner, a thermoelectric responsive valve connected into said thermoelectric circuit and adapted for governing the flow of fuel to said main burner, a second thermoelectric responsive valve connected into said thermoelectric circuit and adapted for governing the flow of fuel to said pilot burner, said main burner valve and said pilot burner valve being operative to closed positions upon cessation of the heat of said pilot burner on said thermocouple, and a time controlled switch operative to apply the thermoelectric current in said thermoelectric circuit to said main burner valve and to discontinue the application of the thermoelectric current to said valve at preselected times to open and close said main burner valve and without interrupting the application of the thermoelectric current in said thermoelectric circuit to said pilot burner valve, said thermoelectric responsive main burner valve being self-operating to open position by the thermoelectric current upon operation of said time controlled switch to valve opening position.

5. In burner control apparatus, the combination with a main burner and a pilot burner in position to ignite said main burner, of a thermoelectric circuit having a thermocouple subject to

the heat of said pilot burner, a thermoelectric responsive valve connected into said thermoelectric circuit and adapted for governing the flow of fuel to said main burner, a second thermoelectric responsive valve connected into said thermoelectric circuit and adapted for governing the flow of fuel to said pilot burner, said main burner valve and said pilot burner valve being operative to closed positions upon cessation of the heat of said pilot burner on said thermocouple, and a time controlled switch operative to apply the thermoelectric current in said thermoelectric circuit to said main burner valve and to discontinue the application of the thermoelectric current to said valve at preselected times to open and close said main burner valve and without interrupting the application of the thermoelectric current in said thermoelectric circuit to said pilot burner valve, said thermoelectric responsive main burner valve being self-operating to open position by the thermoelectric current upon operation of said time controlled switch to valve opening position and said thermoelectric responsive pilot burner valve being self-operating to open position by the thermoelectric current when heat is applied to said thermocouple means.

6. In combination, a main burner, a fuel supply pipe leading to said burner, a thermoelectric responsive valve in said pipe, a supply pipe for a pilot light in juxtaposition to said burner, a thermoelectric responsive valve in said pilot supply pipe, a thermoelectric circuit for said main burner valve and said pilot burner valve and having thermocouple means placed in position to be heated by said pilot light, and time controlled means governing said main burner valve.

7. In combination, a main burner, a fuel supply pipe leading to said burner, a thermoelectric responsive valve in said pipe, a supply pipe for a pilot light in juxtaposition to said burner, a thermoelectric responsive valve in said pilot supply pipe, a thermoelectric circuit for said main burner valve and said pilot burner valve and having thermocouple means placed in position to be heated by said pilot light, and time controlled means governing said main burner valve, said pilot burner valve being connected so as not to be time operated by said time controlled means.

8. In combination, a main burner, a fuel supply pipe leading to said burner, a thermoelectric responsive valve in said pipe, a supply pipe for a pilot light in juxtaposition to said burner, a thermoelectric responsive valve in said pilot supply pipe, a thermoelectric circuit for said main burner valve and said pilot burner valve and having thermocouple means placed in position to be heated by said pilot light, and additional control means governing only said main burner valve.

9. In burner control apparatus, the combination with a main burner, of a thermoelectric re-

sponsive control valve for governing the flow of fuel to said burner, a pilot burner in position to ignite the main burner, a thermoelectric responsive valve for governing the flow of fuel to said pilot burner and connected in closed series circuit relation with said first thermoelectric responsive valve, thermocouple means in said circuit and subject to the heat of said pilot burner, and time controlled means operative jointly with said thermocouple means to open and close said main burner valve at preselected times, said main burner valve and said pilot burner valve each being operative to open and closed positions when the pilot burner becomes respectively operative and inoperative to light the fuel at the main burner.

10. A control system for a main burner having a fuel supply line and a pilot burner, the system comprising electrically operated valve means for controlling the supply of fuel to the main burner and the pilot burner, an electrical operating circuit for said valve means, a thermoelectric generator energized by the flame of the pilot burner and supplying current to said circuit, switch means in said circuit and operable to control the application of current to said valve means to place the supply of fuel to the main burner only under the control of said switch means, and timer means operable to close the switch means and hold the switch means closed for a given time.

11. A control system for a main burner having a fuel supply line and a pilot burner having a fuel supply line, the system comprising a pair of normally closed valves one in the fuel supply line for the main burner and the other in the fuel supply line for the pilot burner, electrically operated means for reversing said valves, an electrical operating circuit for said means, a thermoelectric generator energized by the flame of the pilot burner for supplying current to said circuit, and a timer connected into said circuit and operable to govern only the valve in the fuel supply line for the main burner.

12. In combination, a main burner, a fuel supply line leading to said burner, a fuel supply line for a pilot light in juxtaposition to said main burner, thermoelectric responsive valve means having a valve portion for governing the supply of fuel through the fuel supply line leading to the main burner and another valve portion for governing the supply of fuel through the fuel supply line for the pilot light, a thermoelectric circuit for said thermoelectric responsive valve means, a thermoelectric generator energized by the pilot flame for supplying current to said circuit, and time controlled means connected into said circuit and governing only the thermoelectric valve portion for the fuel supply line for the main burner.

JOHN H. THORNBERRY.