June 6, 1950 C. K. STROBEL 2,510,265

IGNITION AND CONTROL SYSTEM FOR FUEL BURNERS

Filed Feb. 5, 1949 2 Sheets-Sheet 1

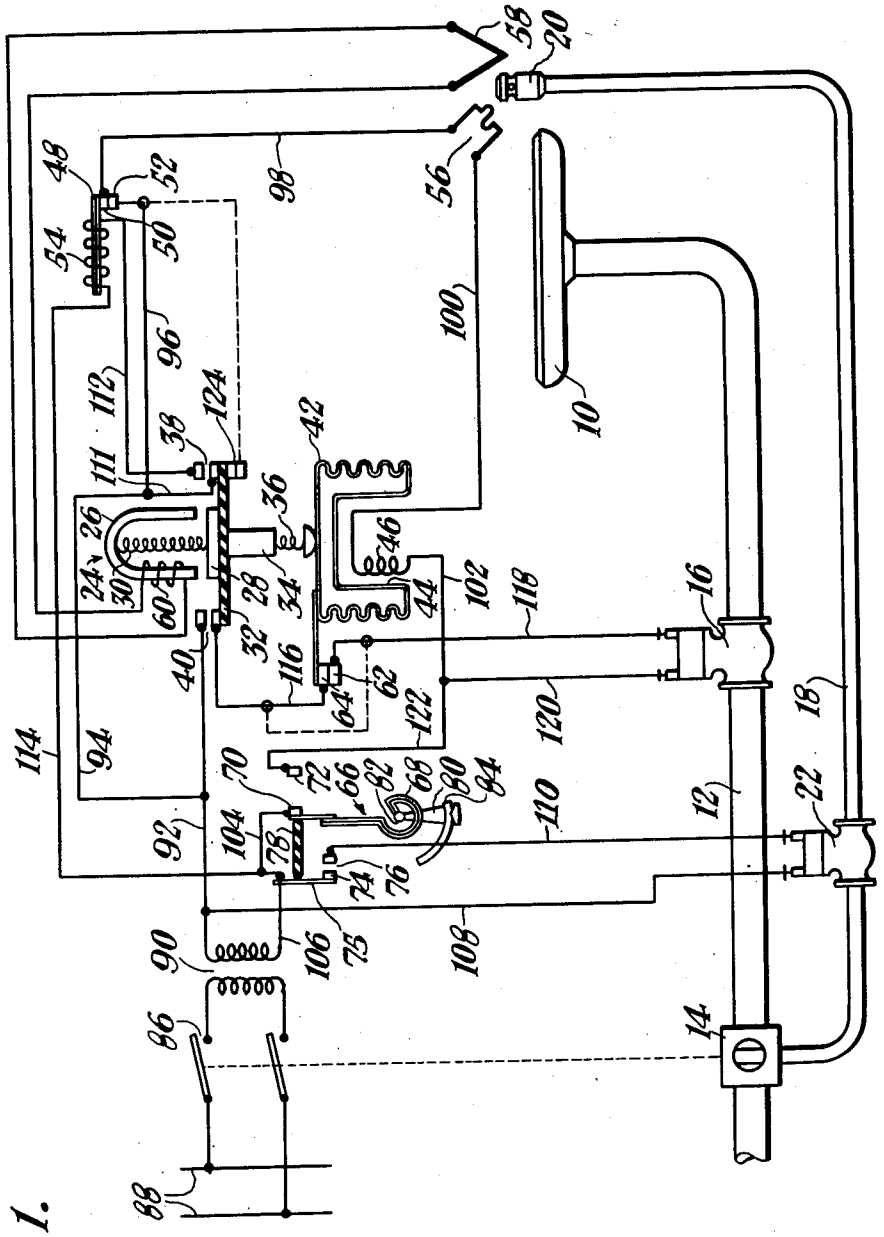

Fig. 1.

INVENTOR.
Charles K. Strobel.
BY
Albert J. Henderson
HIS ATTORNEY

June 6, 1950 C. K. STROBEL 2,510,265

IGNITION AND CONTROL SYSTEM FOR FUEL BURNERS

Filed Feb. 5, 1949 2 Sheets-Sheet 2

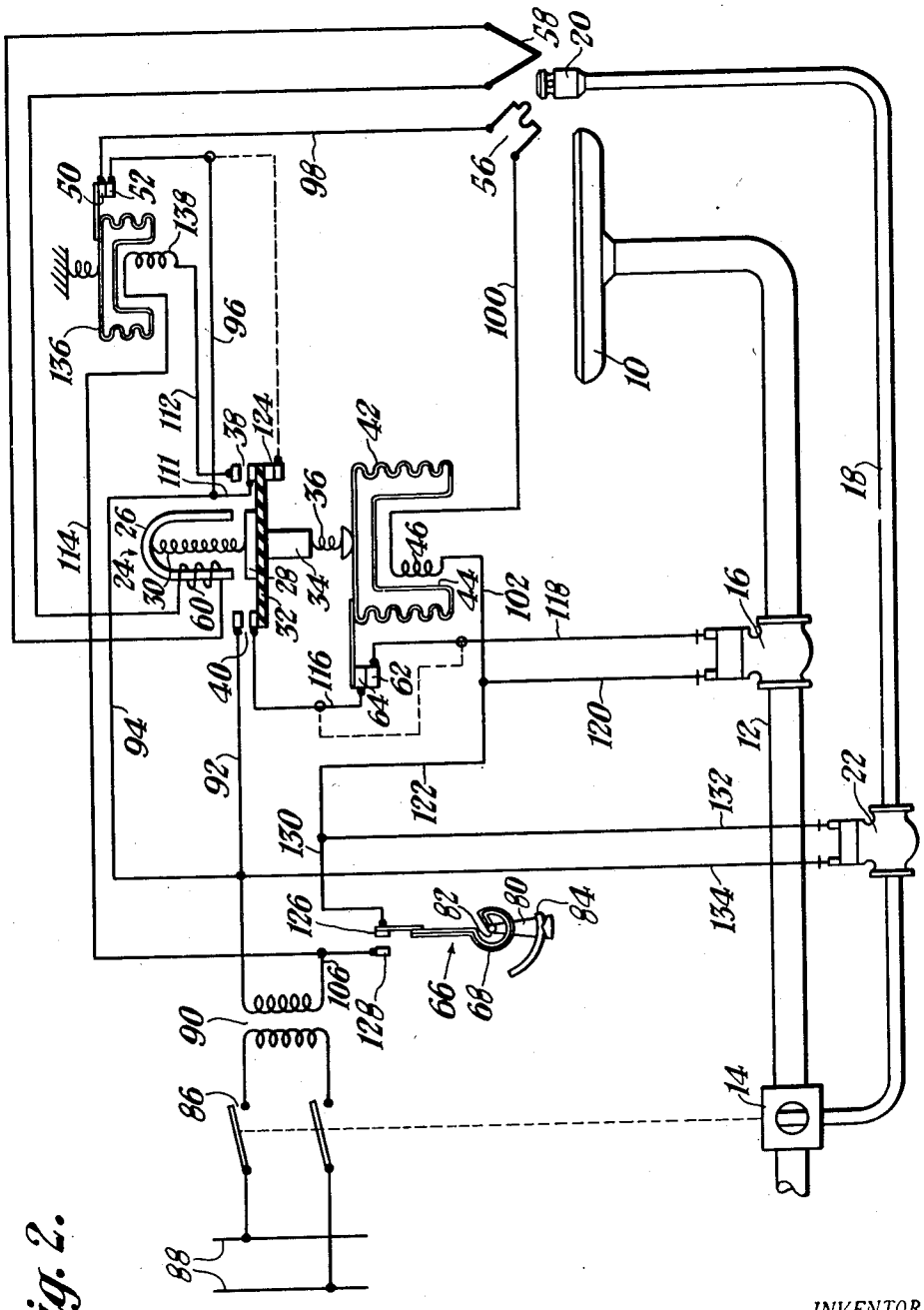

Fig. 2.

INVENTOR.
Charles K. Strobel.
BY
Albert G. Henderson
HIS ATTORNEY

Patented June 6, 1950 2,510,265

UNITED STATES PATENT OFFICE

2,510,265

IGNITION AND CONTROL SYSTEM FOR FUEL BURNERS

Charles K. Strobel, Pittsburgh, Pa., assignor to Robertshaw-Fulton Controls Company, Greensburg, Pa., a corporation of Delaware

Application February 5, 1949, Serial No. 74,773

10 Claims. (Cl. 158—117.1)

1

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

Central heating fuel burner systems may include an automatic pilot control which is supplied with electric current from a thermoelectric device during the normal running period of the burner and which utilizes current from a source of commercial supply for resetting purposes. A system of this type may employ a single control device such as a solenoid valve of any standard form for both automatic shut-off and condition control and this valve may be deenergized whenever the room thermostat or the automatic pilot control requires a shut-off of the main burner.

Such systems may be of the completely recycling type or may utilize a constant burning pilot burner. In a system of the completely recycling type, the fuel flow to both the main and pilot burners is shut off whenever the room thermostat is satisfied and a complete ignition cycle is performed each time the thermostat calls for heat. On the other hand, the normally constant burning pilot burner arrangement does not undergo such a complete recycling, but the system is ordinarily required to perform the ignition cycle only at the beginning of the heating season. It will be understood, however, that this latter system also requires an ignition cycle should the automatic shut-off control operate due to extinguishment of the pilot burner.

In either type of installation, it is of great convenience if the householder or other user can stop and start the heating system by merely operating the room thermostat in a normal manner. Thus, the householder need not visit the burner installation at all to relight or extinguish the pilot burner. Hence, a primary object of this invention is to permit convenient shut down of the system or relighting of the pilot burner to initiate another heating period at any time that the user desires.

Another object of this invention is to utilize a single electromagnetic valve for condition or automatic pilot control in conjunction with a gaseous fuel burner without requiring alteration or modification in standard forms of valves to adapt them for such uses.

Another object of this invention is to utilize the same source of energy for ignition, condition control and resetting purposes in a simple and economical manner.

Another object of the invention is to render the system self-starting and recycling as long as the main fuel and electric control devices are turned on.

2

Another object of the invention is to include an automatic time delay during the resetting operation sufficient to insure reliable ignition of the pilot burner.

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

Fig. 1 is a schematic view of a control and ignition system for a gaseous fuel burner embodying the invention, and

Fig. 2 is a schematic view of a modified form of the system shown in Fig. 1.

Referring more particularly to Fig. 1 of the drawings, a main burner 10 is supplied with fuel by a main fuel pipe 12 in which a main fuel shut-off cock 14 is provided. The flow of fuel in the pipe 12 is also under the control of electrically operable means in the form of an electromagnetic valve 16 which is biased to closed position. A conduit 18 is connected at one end to the main fuel shut-off cock 14 and serves to convey fuel to a pilot burner 20 which is located in lighting proximity to the main burner 10. The flow of fuel in the conduit 18 is under control of a second electrically operated means in the form of an electromagnetic pilot burner valve 22 which is also biased to closed position.

The main burner valve 16 may be provided with a manual setting device for opening purposes in the event of a power failure and an automatic resetting device for superseding the manual control when the power supply is resumed. As such types of manual set automatic reset devices are well known to those skilled in the art, illustration of the details thereof has been omitted and further description is deemed unnecessary. As this description proceeds, it will be apparent that the electromagnet coils (not shown) associated with the main burner valve 16 and the pilot burner valve 22, respectively, are assumed to be either energized or deenergized for the purpose of preventing flow of fuel to the main burner 10 and the pilot burner 20, respectively, and such energization is sufficient to overcome the bias of these valves 16 and 22 to closed position.

The main burner valve 16 is under automatic control of a separate electromagnetic device designated generally by the reference numeral 24. This device comprises a horseshoe magnet 26 having an armature 28 movable between attracted and released positions relative to the pole faces thereof. A coil spring 30 operative between the

magnet 26 and the armature 28 serves to bias the latter to its released position. An insulating contact bar 32 is carried by the armature 28 and has an operating stem or plunger 34 depending therefrom. The plunger 34 embodies an override spring 36 for a purpose which will be apparent hereinafter. When the armature 28 is engaged with the pole faces of the magnet 26 and is, therefore, in its attracted position, then the contact bar 32 is positioned thereby so that first and second switch contact pairs 38 and 40 at opposite ends of the bar 32, respectively, are closed. It will be understood that these contact pairs 38 and 40 comprise the usual fixed and movable contacts.

The resetting movement of the armature 28 to attracted position is under control of temperature responsive means in the form of a heat motor 42 shown as an expansible bellows element. Preferably, the heat motor 42 contains a suitable expansive fluid, including a partial charge of cymene, and no movement of the bellows is adapted to occur below a temperature of 350° F. The heat motor 42 is provided with a central depression 44 on its underside within which a heater in the form of an electric heating coil 46 is adapted to be supported. Movement of the heat motor 42 is transmitted to the contact bar 32 and thus to the armature 28 for resetting purposes by the plunger 34 which engages the operating end of the heat motor 42. The spring 36 serves to prevent damage to the bellows in the event that further expansion thereof occurs after the armature 28 is seated in its attracted position. The electric heating coil 46 is controlled by a thermally responsive timer in the form of a warp switch 48 of bimetal having a pair of contacts 50, 52 and an electric heating coil 54 in heating proximity of the bimetal.

Electric igniting means in the form of a resistance coil 56 is provided adjacent the pilot burner 20 for automatically igniting the fuel issuing therefrom.

Positioned adjacent the pilot burner 20, is a thermoelectric means in the form of the usual thermocouple 58 having its leads connected to a winding 60 for the magnet 26. The thermocouple 58 is thus adapted to have its hot junction exposed to a flame at the pilot burner 20 for generating electric current to energize the electromagnetic device 24. It will be understood that the electromagnetic device 24 does not receive sufficient energy from the thermocouple 58 to attract the armature 28 into engagement with the pole faces of the magnet 26, but that the resetting means, including the heat motor 42, is relied upon for such operation. However, after the armature 28 has thus been reset, the thermocouple 58 will generate sufficient energy to retain the armature in its attracted position provided that the pilot burner 20 is producing a flame. It is apparent that the resetting means being no longer required can then be rendered inoperative as will hereinafter be explained.

In view of the foregoing, upon completion of the resetting operation, the heat motor 42 should return to its initial position ready for another resetting operation. In the event that the bellows element of the heat motor 42 should become bulged or otherwise deformed so as to continue to hold the armature 28 in its attracted position, then the automatic pilot control afforded by the response of the thermocouple 58 to a flame from the pilot burner 20 would be unavailable. Consequently, in this invention, means are provided to prevent energization of the main burner valve 16 should such failure of the heat motor 42 occur. To this end, switching means in the form of a pair of contacts 62, 64 are provided for operation by the heat motor 42 to open position during the resetting operation. As will be more fully explained hereinafter, the main burner valve 16 cannot become energized until the bellows contracts sufficiently to close the contacts 62, 64.

The main burner valve 16 is also under the control of a device responsive to changes in a condition to be controlled. As disclosed in this embodiment, this condition responsive device is designated generally by the reference numeral 66 and takes the form of a room thermostat comprising a bimetallic spiral arm 68 carrying a contact 70 movable toward and away from a fixed contact 72. The thermostat arm 68 also operates a movable contact 74 of a control switch 76 for the pilot burner valve 22. As indicated schematically in the drawing, the control switch 76 is operated by an insulating bar 78 extending between a contact arm 75 carrying the movable contact 74 and the thermostat arm 68. Means are provided for adjusting the thermostat 66 and are shown as including a lever arm 80 secured to the thermostat arm 68. The arm 68 is pivotally mounted at 82 so that rotation occurs upon movement of the lever arm 80 thereby varying the temperature setting at which the engagement of the contact arm 70 with the fixed contact 72 is effective. The lever arm 80 cooperates with a scale 84 carrying suitable indicia to indicate the temperature setting of the thermostat 66 in conjunction with the "Off" position at which the lever arm 80 is shown as positioned in the drawings. It will be understood that commercially available forms of room thermostats will be employed and that the illustrated form is merely exemplary.

Electrical energy from a commercial source of supply is controlled by a double-pole main switch 86 connected to line wires 88 and operable by the main fuel cock 14. Preferably, a transformer 90 of the step-down type is connected in the line to supply low voltage power for operation of the system.

In the operation of the system disclosed in Fig. 1 of the drawings, the manual opening of the main fuel cock 14 simultaneously closes the main switch 86 to connect the primary of the transformer 90 to the line wires 88. As the description proceeds, it will become apparent that during the burner starting period the commercial current is utilized for resetting the automatic pilot control and then dispensed with in this connection when the self-contained energy of the thermocouple becomes available during the running period. The commercial source is, however, still relied upon during the burner running period in connection with the condition control and serves to energize both the main and pilot burner valves and the heating coil for the resetting device.

When the room thermostat 66 is turned from the "Off" position shown to the desired temperature setting, then the contact 70 is moved clockwise to engage contact 72 and, concomitantly, contact 74 is moved to close the control switch 76. It should be observed that the control switch 76 remains closed throughout the heating season, but the contact 70 moves from open to closed position relative to the fixed contact 72 in response to room temperature conditions. A first circuit is now established which may be traced from the upper terminal of the secondary of

transformer 90, wire 92, wire 94, wire 96, contacts 52, 50, wire 98, igniter 56, wire 100, heater coil 46, wire 102, contacts 72, contact 70, wire 104 and wire 106 to the lower terminal of the secondary of transformer 90.

The pilot burner valve 22 has been opened due to energization of its coil which is connected at one end by wire 108 to wire 92 and at the other end by wire 110 through the control switch 76 and contact arm 75 to wire 106. Consequently, the pilot burner valve 22 is opened by closure of the control switch 76 and the fuel issuing from the pilot burner 20 is ignited by the igniter 56 which is energized upon establishment of the first circuit. The flame from the pilot burner 20 commences to heat the thermocouple 58 during the ensuing resetting operation.

The resetting operation now occurs due to energization of the heater coil 46 upon establishment of the first circuit and consequent expansion of the bellows of the heat motor 42. The plunger 34 is moved upwardly, as viewed in the drawing, so as to eventually cause the armature 28 to engage the pole faces of the magnet 26 against the action of the biasing spring 30. If the thermocouple 58 is sufficiently heated at this time, it has generated sufficient electric energy to retain the armature 28 in its attracted position. The contact pairs 38, 40 are now in closed position. Should additional upward movement of the plunger 34 be required by further expansion of the heat motor 42, then the override spring 36 will absorb such movement.

The closing of the contact pair 38 establishes a circuit for the heater coil 54 of the warp switch 48 through a circuit which may be traced as follows: upper terminal of the secondary of transformer 90, wire 92, wire 94, wire 111, contact pair 38, wire 112, heater coil 54, wire 114 and wire 106 to the lower terminal of the secondary of transformer 90. It should be observed that the coil 54 remains energized independently of the subsequent opening and closing of the thermostat contacts 70, 72 provided the contact pair 38 remains closed.

The warp switch 48 becomes sufficiently heated to open the contact pair 50, 52 associated therewith and the first circuit including the igniter 56 and heater coil 46 is effectively deenergized. Consequently, the heat motor 42 moves to its initial position for closing the contact pair 62, 64 as previously described. Assuming that the winding 60 of the magnet 26 is now sufficiently energized for holding the armature 28 in its attracted position, then a circuit is established to the main burner valve 16 which may be traced as follows: upper terminal of the secondary of transformer 90, wire 92, contact pair 40, wire 116, contact pair 64, 62, wire 118, main burner valve 16, wire 120, wire 122, contact pair 72, 70, wire 104 and wire 106 to the lower terminal of the secondary of transformer 90.

As long as the thermocouple 58 remains heated by the flame from the pilot burner 20, then the second circuit just described remains established and the main burner valve 16 is moved to open position to permit flow of fuel to the main burner 10 for ignition by the pilot burner 20. Upon the room thermostat 66 becoming satisfied, then the contact pair 70, 72 is opened and the second circuit for the main burner valve 16 is disestablished causing closure of this valve and consequent shut-off of the fuel supply to the main burner 10. Such opening and closing of the contact pair 70, 72, by operation of the room thermostat 66 will

continue in accordance with the setting of the adjusting means 80 as described during the normal running and shut-off periods of the burner apparatus.

In the event that the flame from the pilot burner 20 is extinguished, then the automatic shut-down feature comes into operation. As thermocouple 58 cools, the winding 60 becomes deenergized and causes release of the armature 28 from the magnet 26. The contact pairs 38 and 40 are then opened by movement of the contact bar 32 under bias of the spring 30. Thus, regardless of the position of the contact pair 70, 72 associated with the room thermostat 66, the opening of the contact pair 40 causes closure of the main burner valve 16 by opening of the second circuit. Moreover, the circuit of the heater coil 54 of the warp switch 48 is also opened due to the opening of the contact pair 38. The period during which the warp switch 48 requires to become cooled and close contact pair 50, 52, is the purge period desired before the igniter 56 should become reenergized. The system then undergoes another starting cycle which need not be repeated in this description.

In the event that the safeguard against a bulged or otherwise damaged heat motor 42 is not required, then the contact pair 62, 64, could be short-circuited as by way of the broken line connection shown in the drawing. The advantage of eliminating the contact pair 62, 64, would obviously be to shorten the time required to open the main burner valve 16. A further modification could be made by eliminating the wire 96 and providing an additional contact pair 124 to be opened and closed by operation of the contact bar 32. The connection of the fixed contact of this contact pair 124 is shown in broken lines in the drawing as being to the contact 52 of the warp switch 48. In this alternative arrangement, the igniter 56 would become deenergized as soon as the contact pair 124 is opened by the upward travel of the contact bar 32. This also shortens to some extent the operating time of the system. However, the opening of the contact pair 124 would also deenergize the heater coil 46 associated with the heat motor 42 so that the latter must be constructed to continue moving upward sufficiently to engage the armature 28 with the pole faces of the magnet 26 after the coil 46 is deenergized. It will further be apparent that a separate switch for the contact pair 74, 76, could be used instead of operation from the room thermostat 66. The advantage of the preferred embodiment is as described in that the system is completely turned off at the end of the heating system by mere manipulation of the room thermostat 66 to the "Off" position shown in the drawing.

In the modified form shown in Fig. 2 of the drawings, a completely recycling type of system is disclosed and which can also be started by manipulation of the room thermostat as in the previously described embodiment of the invention. As the majority of the parts are identical with those previously illustrated and described, similar reference numerals have been employed and further detailed description is omitted.

In the alternative arrangement, Fig. 2, the room thermostat 66 carries a movable contact 126 for cooperation with a relatively fixed contact 128 which is connected directly to the wire 106 from the secondary of the transformer 90. Contact 126 is connected by a wire 130 to the wire 122 to complete the thermostat circuit. Since the con-

tacts 74, 76 are eliminated in this embodiment, the pilot burner valve 22 has one terminal connected by wire 132 to wire 122 while the other terminal thereof is connected by wire 134 to wire 92.

The warp switch 48 of the previously described embodiment could equally well be used in the arrangement of Fig. 2, but a heat motor 136 has been substituted for illustrative purposes. Consequently, a heater coil 138 is arranged in heating proximity of the heat motor 136 and has its opposite ends connected to the wires 114 and 112 respectively as in the case of the coil 54 of the Fig. 1 embodiment. The heat motor 136 operates similarly to the warp switch 48 and likewise causes operation of the normally closed contacts 50, 52 when the heater coil 138 is energized.

In the operation of the system illustrated in Fig. 2, and assuming that the main fuel cock 14 is left open and the main switch 86 left closed, then the room thermostat 66 may be turned to a desired temperature setting. The contacts 126, 128 are closed to cause energization of the igniter 56, heater coil 46 and pilot burner valve 22. The igniter and heater coil circuit may be traced as follows: lower terminal of the secondary of transformer 90, thermostat contacts 128, 126, wire 130, wire 122, wire 102, heater coil 46, wire 100, igniter 56, wire 98, contacts 50, 52, wire 96, wire 94 and wire 92 to the upper terminal of the secondary of transformer 90. It will be noted that the pilot burner valve 22 has its coil connected directly across the secondary of transformer 90 by wires 132, 134 as soon as the thermostat contacts 126, 128 are closed. Consequently, the pilot burner fuel is ignited and the heat motor 42 is actuated concomitantly therewith.

The resetting operation thus occurs and the armature 28 engages the pole faces of the magnet 26 where it is retained by energy supplied by the heated thermocouple 58. The contact pairs 38, 40 are now closed and the contacts 62, 64 are opened. The circuit for the heater coil 138 is now established as follows: upper terminal of secondary of transformer 90, wire 92, wire 94, wire 111, contact pair 38, wire 112, heater coil 138 and wire 114 to the lower terminal of secondary of transformer 90. Opening of the thermostat contacts 126, 128 does not affect the energization of the heater coil 138 as will be apparent.

The heat motor 136 now operates to open the contact pair 50, 52 associated therewith and the igniter and heater coil circuit first traced is effectively deenergized. Consequently, the heat motor 42 returns to its initial position and contact pair 62, 64 is closed to establish the main burner circuit as follows: upper terminal of the secondary of transformer 90, wire 92, contact pair 40, wire 116, contact pair 64, 62, wire 118, main burner valve 16, wire 120, wire 122, wire 130, thermostat contacts 126, 128 to the lower terminal of the secondary of transformer 90.

As long as the thermocouple 58 remains heated, then the second circuit just traced remains established and the system is in full running condition under control of the room thermostat 66. Both the main burner valve 16 and pilot burner valve 22 become closed whenever the thermostat 66 operates to open its contacts 126, 128. Consequently, the thermocouple 58 cools and eventually causes release of the armature 28 from the magnet 26, thus opening the contact pairs 38 and 40. The heater coil 38 becomes deenergized by opening of its circuit when the contact pair 38 is opened. However, during the cooling period of this coil 38 there is a purge period before the contacts 62, 64 become closed to establish the igniter circuit. The purge period permits unburned fuel to flow away from the vicinity of the burners prior to reignition of the pilot burner 20.

In case of flame failure, a recycling operation occurs somewhat similar to the foregoing "Off" cycle, except that the fuel continues to flow to the main burner 10 until the armature 32 is released. However, the fuel flow to the pilot burner 20 continues throughout the recycling operation in the event of flame failure.

As in the previously described embodiment of Fig. 1, the alternative connection shown in broken lines across contact pair 62, 64 could be made to reduce the operating time for turning on the main burner fuel. The other alternative elimination, that is, of wire 96 and utilizing the broken line connection to contact pair 124 also provides for more rapid operation by deenergizing the igniter 56 as soon as contact pair 124 is opened. However, both expedients are subject to the disadvantages previously pointed out, so that the preferred embodiments are probably more useful.

In connection with the substitution of the heat motor 136 for the warp switch of the Fig. 1 embodiment, it is apparent that favorable operating conditions are established should a micro-switch for contacts 50, 52 be used. Either the upstroke or downstroke of the heat motor 136 could be used for operation. Thus, as the usual micro-switch requires a greater force to push the button element than to release it, there is no opportunity for chattering to occur, due to use of the relatively slow acting heat motor 136. Micro-switches may also be substituted for the contact pairs 126, 128 and 62, 64 if desired.

The foregoing and other modifications may be made in the details of construction and arrangement of parts within the scope of the appended claims and the invention is not limited to the precise embodiment shown and described herein.

I claim:

1. In a control system for fuel burners having main and pilot burners and a source of electrical energy, the combination of electrically operable means connected to the source and being movable between positions for controlling the supply of fuel to the main burner, an electromagnetic device having contacts operable for controlling the energization of said electrically operable means, means responsive to a flame at the pilot burner for controlling the energization of said device, means responsive to variations in a temperature condition for movement to a position for resetting said device and causing operation of said contacts, electric heating means connected to the source and located in proximity of said thermally responsive means for varying said temperature condition, a thermally responsive timer controlling said heating means, a heater for said timer, and means responsive to said resetting operation for controlling said heater.

2. In a control system for fuel burners having main and pilot burners and a source of electrical energy, the combination of electrically operable means connected to the source and being movable between positions for controlling the supply of fuel to the main burner, an electromagnetic device having at least two pairs of contacts, one said contact pair being operable for controlling the energization of said electrically operable means, means responsive to a flame at the pilot burner for controlling the energization of said device, means responsive to variations in

a temperature condition for movement to a position for resetting said device and causing operation of said pairs of contacts, electric heating means connected to the source and located in proximity of said thermally responsive means for varying said temperature condition, a thermally responsive timer controlling said heating means, and a second electric heating means adapted for causing operation of said timer and being connected to the other said contact pair for energization during said resetting operation.

3. A control system for fuel burners having main and pilot burners and a source of electrical energy, comprising in combination, an electromagnetic device having two contact pairs biased to an open position, means responsive to a flame at the pilot burner for energizing said device sufficiently to hold said contact pairs in closed position but being incapable of causing operation thereof from said open position, means responsive to variations in a temperature condition for movement to a position for resetting said contact pairs to closed position, electric heating means located in proximity of said thermally responsive means for varying said temperature condition sufficiently to cause said resetting operation, an initially closed warp switch for controlling a first circuit including the source and said heating means, a second electric heating means adapted for causing operation of said warp switch, electrically operable means movable between fuel flow permitting and preventing positions for controlling the supply of fuel to the main burner, a second circuit including the source, said electrically operable means and one of said contact pairs, and a third circuit including the source, said other contact pair and said second heating means for opening said warp switch after a predetermined period of resetting operation.

4. A control system as claimed in claim 3 wherein an electric igniter for the pilot burner is connected in said first circuit and is deenergized with said first heating means upon opening operation of said warp switch.

5. A control system for fuel burners having main and pilot burners and a source of electrical energy, comprising in combination, valve means movable between open and closed positions for controlling a supply of fuel to the main burner and being biased to said closed position, electromagnetic means operatively associated with said valve means, an electromagnetic device having contacts biased to an open position, thermoelectric means located to be heated by the pilot burner and adapted for energizing said device for holding said contacts in a closed position, a heat motor movable between positions for resetting said device and causing movement of said contacts to closed position, electric heating means located for heating said motor for movement thereof in a resetting operation, an initially closed warp switch for controlling a first circuit including the source and said heating means, a second electric heating means adapted for causing operation of said warp switch, a second circuit including the source, said electromagnetic means and said contacts, and a third circuit including the source and said second heating means for opening said warp switch after a predetermined period of resetting operation.

6. A system as claimed in claim 5 having thermostatic means responsive to a heating condition caused by operation of the main burner, and switch means operatively associated with said thermostatic means for controlling said second circuit in accordance with variations in said heating condition.

7. A control system for fuel burners having main and pilot burners and a source of electrical energy, comprising in combination, electrically operable means connected to the source and being movable between positions for controlling the supply of fuel to the main burner, an electromagnetic device having contacts operable for controlling the energization of said electrically operable means, means responsive to a flame at the pilot burner for controlling the energization of said device, a fluid operated bellows expansible when heated to a position for resetting said device and causing operation of said contacts, and switch means operatively associated with said bellows for movement to open position during said resetting operation, said switch means being connected for maintaining said electrically operable means effectively deenergized during said resetting operation.

8. A control system as claimed in claim 7 having electric heating means connected to the source and located in heating proximity of said bellows, a thermally responsive timer controlling said heating means, a heater for said timer, and means responsive to said resetting operation for controlling said heater.

9. A control system for fuel burners having main and pilot burners and a source of electrical energy, comprising in combination, electrically operable means connected to the source and being movable between positions for controlling the supply of fuel to the main burner, electrically operable means connected to the source and being movable between positions for controlling the supply of fuel to the pilot burner, an electromagnetic device having contacts operable for controlling the energization of said electrically operable means for the main burner, means responsive to a flame at the pilot burner for controlling the energization of said device, means responsive to variations in a temperature condition for movement to a position for resetting said device and causing operation of said contacts, electric heating means connected to the source and located in proximity of said thermally responsive means for varying said temperature condition, means responsive to a condition to be controlled for controlling the operation of said electrically operable means for the main burner, means for adjusting the setting of said condition responsive means, and means including a control switch for opening the circuit of said electrically operable means for the pilot burner, said last means being cooperable with said condition responsive means upon said adjusting means being moved to a preselected setting for electrically disconnecting both said electrically operable means to shut off the fuel supply to both the main and pilot burners.

10. A control system for fuel burners having main and pilot burners and a source of electrical energy, comprising in combination, an electromagnetic device having two contact pairs biased to an open position, thermoelectric means located to be heated by the pilot burner and connected for energizing said device to hold said contact pairs in closed position, a heat motor movable between positions for resetting said device and causing movement of said contacts to closed position, electric heating means located for heating said motor for movement thereof in a resetting operation, an initially closed warp switch for controlling a first circuit including the source and

said heating means, a second electric heating means adapted for causing operation of said warp switch, electrically operable means movable between fuel flow permitting and preventing positions for controlling the supply of fuel to the main burner, a second circuit including the source, said electrically operable means and one of said contact pairs, a third circuit including the source, said other contact pair and said second heating means for opening said warp switch after a predetermined period of resetting operation, means responsive to a condition to be controlled for controlling said electrically operable means, means for adjusting the setting of said condition responsive means, electrically operable means connected to the source and being movable between positions for controlling the supply of fuel to the pilot burner, and means including a control switch for opening the circuit of said electrically operable means for the pilot burner, said last means being cooperable with said condition responsive means upon said adjusting means being moved to a preselected setting for electrically disconnecting both said electrically operable means to shut off the fuel supply to both the main and pilot burners.

CHARLES K. STROBEL.

No references cited.