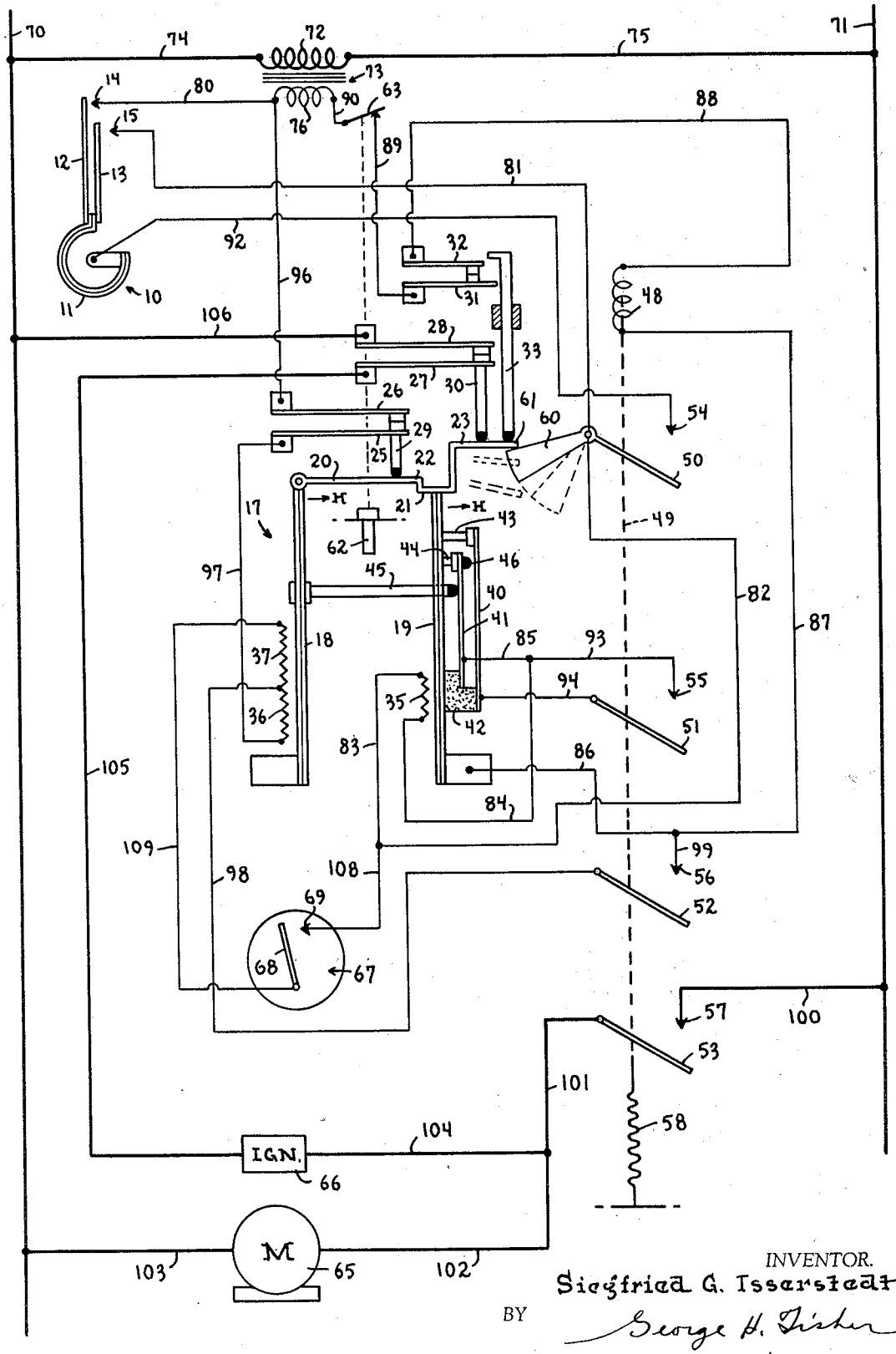
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COMBUSTION CONTROL DEVICE

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COMBUSTION CONTROL DEVICE

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The present invention relates broadly to automatic control devices for systems for controlling the combustion of fluid fuel. More specifically, the invention relates to an automatic control device for use in combination with an extremely sensitive combustion responsive device wherein a timing unit, such as a thermal timer, is utilized for the purpose of timing the trial ignition period, the post ignition timing, and the time required for the system to recycle following a flame failure or a normal shut-down.

It has been found that in order to accurately predetermine the time required for a thermal timer to heat up and perform a control function such as the operation of a switch, that it is necessary to put a relatively large amount of heat into the thermal element. This has an obvious disadvantage where the heat is put into the thermal timer continuously during the running of the system because it will require a very long time for the timer to return to its cold position after the system has been shut down. One of the main objects of this invention is to provide an automatic burner control device with a thermal timer in which a relatively large amount of heat is put into the thermal timer to cause the timer to perform its proper control functions and place the system in running condition, and thereafter reduce the amount of heat put into the timer to an amount just sufficient to cause the timer to take the desired time interval to return to its cold condition after the control system has been shut down. In this way I am enabled to take advantage of the improved operation of the timer due to the large amount of heat put into it and at the same time I do not get the disadvantage of the long time required for the timer to cool down after the system has been shut down.

A further object of the invention is to provide a single thermal timer unit for timing the trial ignition period, the post ignition period, and the scavenger period. A further object of the invention is to make this thermal timer unit in the form of a thermal device and a latch which cooperates therewith, the latch having a starting position, a safety position, and a running position, and to additionally provide an electromagnetic relay which controls the burner motor and which also acts to relatch the latch when it is in its running position but which is inoperative to relatch the latch when it is in its safety position.

A still further object of the invention is to provide the thermal device with a series of heaters for causing the device to move toward its safety position upon an original call for heat and to reverse its movement and move toward its running position following the establishment of combustion, providing combustion takes place before it has reached its position of safety. A further object is to provide the thermal timer unit with a starting switch which is opened when the timer is in its running position and which prevents the reenergization of the burner motor following a shut-down until the timer has had a chance to cool and return to its original position.

These and other objects will readily become apparent as the following specification is read in the light of the accompanying drawing, the single figure of which diagrammatically illustrates an automatic burner control system embodying the various features of my invention.

The reference numeral 10 indicates a thermostat which is adapted to be located in the space being controlled by the burner of my automatic control system. This thermostat is shown as comprising a bimetallic element 11 which is fixed at one end and which carries at its free end a flexible contact blade 12 and a second contact blade 13. Upon a decrease in temperature the resilient contact blade 12 first engages the stationary contact 14 and then on a further decrease in temperature the contact blade 13 engages the stationary contact 15.

The reference numeral 17 indicates generally the thermal timer unit of my invention which is shown as comprising a pair of bimetallic blades 18 and 19 which are fixed at their lower ends and free at their upper ends, the upper ends moving toward the right on heating as indicated by the arrows. The upper end of the blade 18 pivotally carries a latch member 20 which has a latching surface 21 which rests upon the free end of the blade 19 when the two blades 18 and 19 are cold. The latch 20 is provided with a pair of shoulders which form what will be referred to as a running notch 22 and a safety notch 23. It will be seen that if the blade 18 warps more rapidly to the right than the blade 19, that the latch 20 will move to the right with respect to the blade 19 and the running notch 22 will drop down onto the free end of the blade 19. On the other hand, if the blade 19 warps more rapidly than the blade 18, then the latch 20 will move to the left with respect to the blade 19 with the result that the safety notch 23 will drop down onto the free end of the blade 19. The running notch 22 is relatively shallow with

respect to the safety notch 23 and therefore when the blade 19 is in the running notch the latch 20 will drop down a relatively short distance from the position shown in the drawing and when the blade 19 is in the safety notch the latch 20 will drop down a considerably greater distance.

The latch 20 is adapted to control a pair of switches, one of which comprises the two contact blades 25 and 26 and the other of which comprises the two contact blades 27 and 28. Both of these switches are biased to open position but when the latch is in its latched position as shown in the drawing, the stem 29 holds the contact blades 25 and 26 in closed position and the stem 30 holds the contact blades 27 and 28 in closed position. When the free end of the bimetal blade 19 is in either the running notch 22 or the safety notch 23 the latch 20 will drop down far enough to permit the contact blades 25 and 27 to move open circuit position. Therefore, the only time that these two switches are in closed position is when the latch 20 is in its latched position as shown in the drawing with the free end of the blade 19 supporting the latch 20 by means of the latching surface 21.

The latch 20 operates a third switch which is comprised of the resilient contact blades 31 and 32. Unlike the other two switches, this switch is biased to closed position. With the latch 20 in latched position as shown in the drawing, the switch 31, 32 is closed but when the bimetallic blade 19 is in the safety notch 23 the latch drops far enough to permit stem 33 to drop down and engage the extended end of contact blade 31 and move it to open circuit position. When blade 19 is in the running notch 22 the latch 20 does not drop down far enough to permit the stem 33 to open the switch 31, 32. Therefore, this switch is open when the bimetallic blade 19 is in the safety notch but is closed when the blade 19 is in the running notch 22 when the latch 20 is in the latched position as shown in the drawing.

The electric heater 35 is positioned to heat the bimetallic blade 19 and electric heaters 36 and 37 are adapted to heat the bimetallic blade 18. The bimetallic blade 19 carries a pair of resilient contact blades 40 and 41, these blades being insulated from each other and from the bimetallic blade 19 by means of the block of insulation 42. The contact blades 40 and 41 are adapted to cooperate respectively with the two contacts 43 and 44 which are carried by, and electrically connected to, the bimetallic blade 19. The two contact blades 40 and 41 are adapted to be operated by means of a stem 45 carried by the bimetallic blade 18, so that when the two bimetallic blades 18 and 19 move relatively closer together from the position shown in the drawing, the insulated end of the stem 45 will first force the contact blade 41 out of engagement with contact 44 and then the insulated button 46 on the contact blade 41 will force the contact blade 40 out of engagement with contact 43.

My control system is provided with an electromagnetic relay having a relay winding 48 which controls an armature indicated by the dotted line 49. The relay winding 48, when energized, is adapted to raise the armature 49 which in turn moves the switch arms 50, 51, 52 and 53 from the position shown in the drawing, into engagement with the stationary contacts 54, 55, 56 and 57 respectively. When the relay winding 48 is deenergized, this armature moves downwardly again due to the action of gravity and if desired, this movement may be aided by means of a spring diagrammatically illustrated at 58. The pivoted switch arm 50 is provided with an extension 60 which in the "out" position of the relay as shown in the drawing, engages the free end 61 of the latch 20 and holds it in its raised position in which all of the switches controlled by this latch are in closed position and the latching surface 21 is reset on the end of bimetallic blade 19. When the relay winding 48 is energized and the armature 49 pulled in, the extension 60 is withdrawn from the latch 20 and moved to the dotted line position in which the latch 20 is adapted to move either to its running position or to its safety position, depending upon whether the bimetallic blade 19 is in the running notch 22 or the safety notch 23. When the blade 19 is in the running notch 22, the latch 20 moves downwardly only a slight distance so that when the relay 48 is again deenergized, the extension 60 will engage the free end 61 of the latch 20 and return it to the position shown in the drawing so that when the blade 19 returns to its cold position it will again hold the latch 20 in its latched position. However, when the blade 19 is in the safety notch 23 the latch 20 has lowered to such an extent that the extension 60 passes above the free end 61 when the relay winding 48 is energized, therefore, the operation of the relay can have no effect upon the latch under these conditions.

In order to return the latch 20 to its latched position when the bimetallic blade 19 is in the safety notch 23, a manual push button 62 has been provided. If it is desired that this manual reset be made trip-free, the button 62 may be mechanically connected, as shown by the dotted line, to open the switch 63 during the resetting operation of the latch. In this way it will be impossible to manually maintain the burner motor circuit in closed position when it would otherwise be in open circuit position, by means of the manipulation of the manual reset button 62.

Any type of device for delivering fuel to a burner, such as an oil burner motor, has been illustrated diagrammatically at 65. 66 indicates a device for igniting the fuel delivered by the motor 65. Indicated generally at 67 is a device which is adapted to respond to the combustion of the fuel delivered to the burner by motor 65. This device is adapted to operate a switch arm 68 into engagement with a stationary contact 69 upon the establishment of combustion. This combustion responsive device may be the usual slip-friction type of switch mechanism or any other type of mechanism which will close the switch 68, 69 in the presence of combustion and open this switch in the absence of combustion, it being preferred that the switch is not calibrated but will respond to temperature changes.

The control system is powered from the supply lines 70 and 71 to which the primary winding 72 of a step-down transformer 73 is connected by means of the conductors 74 and 75. Transformer 73 is provided with a secondary winding 76.

Operation

The various elements of my control system are shown in the positions which they assume when the room thermostat 10 is satisfied and therefore in open circuit position. It will be noted that the bimetallic blades 18 and 19 are in their cold condition and therefore the latch 20 is in its latched position in which the three switches 25,

26; 27, 28, and 31, 32 are closed. There is no combustion at the burner and therefore the combustion responsive switch 68, 69 is in open circuit position. At this time the relay winding 48, the burner motor 65, and the ignition device 66 will be deenergized.

Under these conditions the temperature in the room in which the thermostat 10 is located will begin to fall and the resilient blade 12 will first engage the stationary contact 14. This will not result in the establishment of any circuit at this time due to the fact that the relay switch arm 50 is separated from its stationary contact 54. A further decrease in room temperature will cause the switch blade 13 to engage its stationary contact 15 and this will result in the energization of the relay winding 48 through the following circuit: from one side of the secondary winding 76 of the transformer 73 to conductor 80, contact 14, switch blades 12 and 13, contact 15, conductors 81, 82 and 83, electric heating element 35, conductors 84 and 85, switch blade 41, contact 44, bimetallic blade 19, conductors 86 and 87, relay winding 48, conductor 88, switch blades 32 and 31, conductor 89, switch 63, and conductor 90 back to the other side of the secondary winding 76. The above circuit not only energizes the relay winding 48 but also energizes the electric heating element 35 which heats the bimetallic blade 19. Energization of the relay winding 48 pulls in the armature 49 which causes the switch arms 50, 51, 52 and 53 to move into engagement with their stationary contacts 54, 55, 56 and 57, respectively, and also causes the extension 60 on the switch arm 50 to move from beneath the end 61 of the latch 20 to place this latch under the control of the relative movements of the two bimetallic blades 18 and 19.

Movement of the relay switch arms 50 and 51 into engagement with their stationary contacts 54 and 55 sets up the following holding circuit for the relay winding 48 and the electric heating element 35: from one side of the secondary winding 76 through conductor 80, contact 14, switch blade 12, bimetallic element 11, conductor 92, contact 54, switch arm 50, conductors 82 and 83, electric heating element 35, conductors 84 and 93, contact 55, switch arm 51, conductor 94, switch blade 40, contact 43, bimetal blade 19, conductors 86 and 87, relay winding 48, conductor 88, switch blades 32 and 31, conductor 89, switch 63 and conductor 90 back to the other side of the secondary winding 76. It will be noted that this holding circuit is independent of the last to close switch 13, 15 on the room thermostat 10 and 41, 44 on the bimetallic blade 19. These switches do not make as firm a contact as the first to close switches 12, 14 and 40, 43, and therefore a holding circuit independent of them is desirable.

Engagement of switch arm 52 with the stationary contact 56 establishes a circuit from one side of the secondary winding 76 through conductor 96, switch blades 26 and 25, conductor 97, electric heating element 36, conductor 98, switch arm 52, contact 56, conductors 99 and 87, relay winding 48, conductor 88, switch blades 32 and 31, conductor 89, switch 63, and conductor 90 back to the other side of the secondary winding 76. It will thus be seen that upon a call for heat by the room thermostat 10, the electric heating elements 35 and 36 which heat the bimetallic blades 19 and 18, respectively, are substantially simultaneously energized. The element 35, however, is adapted to have a greater heating effect than the element 36 with the result that the distance between the free ends of the two bimetallic blades 19 and 18 becomes greater and the free end of the element 19 moves toward the safety notch 23.

Movement of the relay switch arm 53 into engagement with its stationary contact 57 establishes a circuit from the line wire 71 through conductor 100, contact 57, switch arm 53, conductors 101 and 102, burner motor 65 and conductor 103 back to the other line wire 70. This results in the energization of the burner motor 65 which now delivers fuel to the burner. The ignition device 66 is energized simultaneously with the burner motor 65 by means of a circuit extending from the line wire 71 through conductor 100, contacts 57, switch arm 53, conductors 101 and 104, ignition device 66, conductor 105, switch blades 27 and 28 and conductor 106 back to the other line wire 70. The burner motor and ignition device are therefore energized at the same time as the two electric heaters 35 and 36.

At this time, therefore, the free end of bimetallic blade 19 is moving farther and farther away from the free end of the bimetallic blade 18 and at the end of a predetermined time interval, say 90 seconds, it will engage in the safety notch 23 permitting the latch 20 to drop down and open switches 25, 26; 27, 28, and 31, 32. The switch 31, 32 is in series with the relay winding 48 and therefore when this switch opens the relay will be deenergized and all of the circuits of the system will be opened and the burner motor 65 and ignition device 66 will also be deenergized. With the bimetallic blade 19 in the safety notch 23 the deenergization of the relay winding 48 cannot result in the relatching of latch 20 by means of the extension 60, as explained above. Therefore, the system remains effectively locked out until the latch 20 is repositioned by means of the manual reset button 62. It will be appreciated that applicant's showing is quite diagrammatic and that actually some means will have to be provided for permitting the end 61 of the latch 20 to pass the extension 60 during the relatching operation to permit the parts to return to the position shown in the drawing. Any one of a number of obvious expedients for accomplishing this purpose may be used.

Normally combustion will be established before the blade 19 enters the safety notch 23. Under these circumstances, the combustion responsive device 67 will cause the switch arm 68 to engage the stationary contact 69 which will establish a circuit from one side of the secondary 76 through conductor 80, contact 14, switch blade 12, bimetallic element 11, conductor 92, contact 54, switch arm 50, conductors 82 and 109, contact 69, switch arm 68, conductor 109, electric heating element 37, conductor 98, switch arm 52, contact 56, conductors 99 and 87, relay winding 48, conductor 88, switch blades 32 and 31, conductor 89, switch 63, and conductor 90 back to the other side of secondary winding 76. It will be noted that the establishment of this circuit results in the supply of additional heat from the electric heating element 37 to the bimetallic blade 18 and that this blade will now be heated to a greater extent than the blade 19, thereby causing the free end of the blade 18 to approach the blade 19 so that after the elapse of a predetermined period of time the free end of the blade 19 will slip into the running notch 22 of the latch 20. Before blade 19 slips into the running notch 22 however, the two blades 18 and 19 will approach sufficiently to cause the rod 45 to first force the

contact blade 41 from engagement with the contact 44. This will have no effect upon the system but as the blades 18 and 19 come closer to each other, the stem 45 will cause the button 46 on the contact blade 41 to engage the contact blade 40 and separate it from contact 43. This will deenergize the electric heater 35 and permit the blade 19 to cool. This causes it to approach the running notch 22 even more rapidly so that very shortly thereafter the blade 19 will enter into the running notch 22 permitting the latch 20 to drop down slightly and open switches 25, 26 and 27, 28. When switch 25, 26 opens it breaks the circuit to the electric heating element 36 so that the electric heating element 37 is now the only element which is effective to heat the bimetallic blade 18. The combined effect of the two heating elements 36 and 37 is sufficient to cause a fairly rapid warping of the bimetallic blade 18 so that its operation can be definitely and accurately timed, but when the heating element 36 is deenergized the effect of the heating element 37 is to maintain the bimetallic blade 18 slightly heated so as to prevent the reclosure of the switches 41, 44 and 40, 43 until the bimetallic blade 18 has cooled for a predetermined period of time. When the bimetallic blade 19 slips into the running notch 22, it opens switch 27, 28, as stated above, and this results in the deenergization of the ignition device. The relay winding 48 remains energized, however, by means of a circuit extending through the combustion responsive switch 68, 69 and the electric heating element 37. Therefore, the burner motor 65 remains energized. This is the running condition of the system.

The system will continue to run until the circuit to the relay winding 48 is broken. This may be caused by an electrical power failure, a flame failure causing the combustion responsive switch 68, 69 to open, or by an increase in room temperature causing the thermostat 10 to open the switch 12, 14. In any event, the relay winding 48 will be deenergized to break the circuit to the burner motor 65 and to return the latch 20 to its latched position as shown in the drawing. At this time the bimetallic blade 18 will be slightly heated and therefore the stem 45 will be maintaining the switches 41, 44 and 40, 43 in open circuit position. After a predetermined period of time the bimetallic blade 18 will cool and permit the last named switches to close and the parts will then have returned to the position shown on the drawing and the system will be in condition for a restart.

It will therefore be seen that I have designed an automatic control device employing a thermal timer in which heat is originally put into the timer comparatively rapidly in order to obtain the proper timing function and then after the timer has moved to its running position the amount of heat put in is decreased to an amount just sufficient to hold it in running position so that the proper amount of time will be taken for the timer to cool sufficiently to reclose the starting switch placing the system in condition for another operation. It will be seen further that this thermal timing unit times the trial ignition period, the post ignition period, and the time required for the system to recycle.

As many changes and modifications of this system will doubtless occur to those who are skilled in the art, I wish it to be understood that I intend to be limited only by the scope of the appended claims and not by the specific embodiment of my invention which has been disclosed for the purposes of illustration only.

I claim as my invention:

1. A fluid fuel burner control device comprising in combination, timing means including a timer element and a movable control element, said timer element and control element being relatively movable from an original position for placing said control element in a running position or safety position, said running and safety positions being on opposite sides of said original position, means controlled by circuit means adapted to include a device responsive to a condition indicative of the demand for heat and adapted to be associated with a fuel delivery controlling means for simultaneously rendering said fuel delivery controlling means operative and energizing said timing means to cause relative movement between said timer element and control element in a direction to place said control element in its safety position, means operated by said control element and adapted to be so associated with said fuel delivery controlling means that when said control element is in its safety position said last named means is effective to render said fuel delivery means inoperative, and means adapted to be connected to a device responsive to the establishment of combustion for reversing the relative movement between said timer element and control element and causing said control element to move to its running position provided said combustion responsive device is subjected to combustion conditions before it has moved to its safety position.

2. A fluid fuel burner control system comprising in combination, means for delivering fuel to a burner, means for igniting said fuel, timing means including a timer element and a movable control element, said timer element and control element being relatively movable from an original position for placing said control element in a running position or safety position, said running and safety positions being on opposite sides of said original position, means operating in response to a demand for heat for simultaneously rendering said fuel delivery means and ignition means operative and energizing said timing means to cause relative movement between said timer element and control element in a direction to place said control element in its safety position, means operated by said control element when it is in its safety position rendering said fuel delivery means and ignition means inoperative, means responsive to the establishment of combustion for reversing the relative movement between said timer element and control element causing said control element to move to its running position provided combustion is established before it has moved to its safety position, and means operated by said control element when it is in its running position for rendering said ignition means inoperative.

3. A fluid fuel burner control system comprising in combination, means for delivering fuel to a burner, timing means including a timer element and a movable control element, said timer element and control element being relatively movable from an original position for placing said control element in a running position or safety position, said running and safety positions being on opposite sides of said original position, means operating in response to a demand for heat for simultaneously rendering said fuel delivery means operative and energizing said timing means to cause relative movement between said timer ele-

ment and control element in a direction to place said control element in its safety position, means operated by said control element when it is in its safety position rendering said fuel delivery means inoperative, means responsive to the establishment of combustion for reversing the relative movement between said timer element and control element causing said control element to move to its running position provided combustion is established before it has moved to its safety position, and means preventing said heat demand responsive means from rendering said fuel delivery means operative unless said control element and timer element are in their original positions.

4. A fluid fuel burner control system comprising in combination, electrical means which, when energized, causes delivery of fuel to a burner, thermal timing means having a starting position, starting switch means closed by said timing means when it is in its starting position, main switch means, a starting circuit including said main switch means, starting switch means and electrical means, means responsive to combustion operating to set up a holding circuit for said electrical means upon the establishment of combustion which is independent of said starting switch means and also operating to heat said thermal timing means at a relatively high rate causing said timing means to move to a running position, and means actuated by said timing means when it reaches its running position to reduce the rate of heat supply thereto to an amount just sufficient to maintain it in its running position.

5. A fluid fuel burner control system comprising in combination, electrical means which, when energized, causes delivery of fuel to a burner, ignition means for said fuel, said electrical means also energizing said ignition means, thermal timing means having a starting position, starting switch means closed by said timing means when it is in its starting position, main switch means, a starting circuit including said main switch means, starting switch means and electrical means, means responsive to combustion operating to set up a holding circuit for said electrical means upon the establishment of combustion which is independent of said starting switch means and also operating to heat said thermal timing means at a relatively high rate causing said timing means to move to a running position, means operated by said timing means when in running position deenergizing said ignition means, and means actuated by said timing means when it reaches its running position to reduce the rate of heat supply thereto to an amount just sufficient to maintain it in its running position.

6. A fluid fuel burner control system comprising in combination, electrical means which, when energized, causes delivery of fuel to a burner, thermal timing means having a starting position, said thermal timing means having two portions each tending when energized to cause effective movement of said timing means in the opposite direction, starting switch means closed by said timing means when it is in its starting position, main switch means, a starting circuit including said main switch means, starting switch means and electrical means, means in said starting circuit for energizing a first of said portions of said thermal timing means to cause it to move toward a safety position, means operated by said timing means when it is in its safety position for deenergizing said electrical means, means responsive to combustion operating to set up a holding circuit for said electrical means which is independent of said starting switch means, providing combustion is established before said timing means moves to its safety position, means in said holding circuit for energizing the other portion of said timing, means causing it to reverse its movement and move toward a running position on the opposite side of said starting position from said safety position, and means actuated by said timing means when it reaches its running position to reduce the rate of heat supply thereto to an amount just sufficient to maintain it in its running position.

7. A fluid fuel burner control system comprising in combination, electrical means which, when energized, causes delivery of fuel to a burner, thermal timing means having a cold position, starting switch means closed by said timer in its cold position, a first heater associated with one portion of said timing means, second and third heaters associated with a second portion of said timing means, means actuated upon a demand for heat for closing a starting circuit including said starting switch means and electrical means and energizing said first and second heaters, said first and second heaters causing said thermal means to move toward a safety position in which it deenergizes said electrical means, means responsive to combustion for energizing said third heater and setting up a holding circuit for said electrical means independent of said starting switch means providing combustion takes place before said thermal means reaches its safety position, said third heater causing said thermal means to reverse its movement and move to a running position, said thermal means opening said starting switch means and deenergizing said first and second heaters when it reaches said running position, said third heater preventing reclosure of said starting switch means until said third heater is deenergized upon satisfaction of said demand for heat and said thermal means has returned to its cold position.

8. A fluid fuel burner control system comprising in combination, electrical means which, when energized, causes delivery of fuel to a burner, ignition means for the fuel, said electrical means also energizing said ignition means, thermal timing means having a cold position, starting switch means closed by said timer in its cold position, a first heater associated with one portion of said timing means, second and third heaters associated with a second portion of said timing means, means actuated upon a demand for heat for closing a starting circuit including said starting switch means and electrical means and energizing said first and second heaters, said first and second heaters causing said thermal means to move toward a safety position in which it deenergizes said electrical means, means responsive to combustion for energizing said third heater and setting up a holding circuit for said electrical means independent of said starting switch means providing combustion takes place before said thermal means reaches its safety position, said third heater causing said thermal means to reverse its movement and move to a running position, said thermal means opening said starting switch means, deenergizing said ignition means, and deenergizing said first and second heaters when it reaches said running position, said third heater preventing reclosure of said starting switch means until said third heater is deenergized upon satisfaction of said demand for heat and said thermal means has returned to its cold position.

9. A fluid fuel burner control device compris-

ing in combination, an electric relay which is adapted to be connected to means for controlling the delivery of fuel to a burner and which is adapted when so connected and when energized to render said means operative to deliver fuel, a latch having a latching surface and a running notch, thermal timing means including a member which engages said latching surface in the cold position of said thermal means, starting switch means closed by said thermal means in its cold position, circuit means adapted to be connected to a main switch means and when so connected to form a starting circuit including said main switch means, starting switch means and relay, further circuit means adapted to be connected to a device responsive to the establishment of combustion for establishing a holding circuit for said relay and heating said thermal means at a relatively rapid rate thus causing said member to move into said running notch, said thermal means opening said starting switch, means operated by said latch when said member moves into said running notch for reducing the rate of heating said thermal means, the opening of said main switch means causing deenergization of said relay and termination of the heating of said thermal means, and means operated by said relay upon deenergization thereof for relatching said latch on said member.

10. A fluid fuel burner control system comprising in combination, means for delivering fuel to a burner, means to ignite said fuel, an electric relay which, when energized, energizes said ignition means and renders said means operative to deliver fuel, a latch having a latching surface and a running notch, thermal timing means including a member which engages said latching surface in the cold position of said thermal means, starting switch means closed by said thermal means in its cold position, main switch means, a starting circuit including said main switch means, starting switch means and relay, means responsive to the establishment of combustion establishing a holding circuit for said relay and heating said thermal means at a relatively rapid rate thus causing said member to move into said running notch, said thermal means opening said starting switch, means operated by said latch when said member moves into said running notch for deenergizing said ignition means and reducing the rate of heating said thermal means, the opening of said main switch means causing deenergization of said relay and termination of the heating of said thermal means, and means operated by said relay upon deenergization thereof for relatching said latch on said member.

11. A fluid fuel burner control system comprising in combination, means for delivering fuel to a burner, an electric relay which, when energized, renders said means operative to deliver fuel, a latch having a latching surface, a safety notch and a running notch, thermal timing means including a member which engages said latching surface in the cold position of said thermal means, starting switch means closed by said thermal means in its cold position, main switch means, a starting circuit including said main switch means, starting switch means and relay, heating means rendered operative by said starting circuit for causing said member to move into said safety notch after a predetermined period of time, means operated by said latch when said member has moved into said safety notch for deenergizing said relay, means responsive to the establishment of combustion, providing combustion is established before said member moves into said safety notch, for establishing a holding circuit for said relay and heating said thermal means at a relatively rapid rate thus causing said member to move into said running notch, said thermal means opening said starting switch, means operated by said latch when said member moves into said running notch for reducing the rate of heating said thermal means, the opening of said main switch means causing deenergization of said relay and termination of the heating of said thermal means, and means operated by said relay upon deenergization thereof for relatching said latch on said member, said last named means being inoperative to relatch said latch when said member is in said safety notch.

12. A fluid fuel burner control system comprising in combination, means for delivering fuel to a burner, means to ignite said fuel, an electric relay which, when energized, energizes said ignition means and renders said means operative to deliver fuel, a latch having a latching surface, a safety notch and a running notch, thermal timing means including a member which engages said latching surface in the cold position of said thermal means, starting switch means closed by said thermal means in its cold position, main switch means, a starting circuit including said main switch means, starting switch means and relay, heating means rendered operative by said starting circuit for causing said member to move into said safety notch after a predetermined period of time, means operated by said latch when said member has moved into said safety notch for deenergizing said relay, means responsive to the establishment of combustion, providing combustion is established before said member moves into said safety notch, for establishing a holding circuit for said relay and heating said thermal means at a relatively rapid rate thus causing said member to move into said running notch, said thermal means opening said starting switch, means operated by said latch when said member moves into said running notch for deenergizing said ignition means and reducing the rate of heating said thermal means, the opening of said main switch means causing deenergization of said relay and termination of the heating of said thermal means, and means operated by said relay upon deenergization thereof for relatching said latch on said member, said last named means being inoperative to relatch said latch when said member is in said safety notch.

13. A fluid fuel burner control system comprising in combination, means for delivering fuel to a burner, an electric relay which, when energized, renders said means operative to deliver fuel, a latch having a latching surface, a safety notch and a running notch, thermal timing means including a member which engages said latching surface in the cold position of said thermal means, a first heater associated with one portion of said thermal means, second and third heaters associated with another portion of said thermal means, starting switch means closed by said thermal means in its cold position, means responsive to a demand for heat establishing a starting circuit for said relay including said starting switch means, the closure of said circuit resulting in the energization of said first and second heaters which cause said member to move into said safety notch after a predetermined period of time, means operated by said latch when said member is in said safety notch for deenergizing said relay and heaters, means responsive to com-

bustion, providing combustion is established before said member moves into said safety notch, for setting up a holding circuit for said relay independent of said starting switch means, and energizing said third heater causing the relative movement between said member and latch to reverse whereby said member moves into said running notch, means deenergizing said first and second heaters when said member is in said running notch, said heat demand responsive means deenergizing said relay and third heater when said heat demand is satisfied, and means operated by said relay upon deenergization thereof for relatching said latch if said member is in said running notch but not if it is in said safety notch.

14. A fluid fuel burner control system comprising in combination, means for delivering fuel to a burner, means to ignite said fuel, an electric relay which, when energized, energizes said ignition means and renders said means operative to deliver fuel, a latch having a latching surface, a safety notch and a running notch, thermal timing means including a member which engages said latching surface in the cold position of said thermal means, a first heater associated with one portion of said thermal means, second and third heaters associated with another portion of said thermal means, starting switch means closed by said thermal means in its cold position, means responsive to a demand for heat establishing a starting circuit for said relay including said starting switch means, the closure of said circuit resulting in the energization of said first and second heaters which cause said member to move into said safety notch after a predetermined period of time, means operated by said latch when said member is in said safety notch for deenergizing said relay and heaters, means responsive to combustion, providing combustion is established before said member moves into said safety notch, for setting up a holding circuit for said relay independent of said starting switch means, and energizing said third heater causing the relative movement between said member and latch to reverse whereby said member moves into said running notch, means deenergizing said first and second heaters and said ignition means when said member is in said running notch, said heat demand responsive means deenergizing said relay and third heater when said heat demand is satisfied, and means operated by said relay upon deenergization thereof for relatching said latch if said member is in said running notch but not if it is in said safety notch.

15. An intermittent ignition system for a fluid fuel burner comprising in combination, means for delivering fuel to a burner, means to ignite said fuel, an electric relay which, when energized, renders said fuel delivery and ignition means operative, a thermal timer including a latch having a latching surface and a running notch and a member cooperable with said latch and movable relatively thereto, means energizing said relay in response to a demand for heat, means responsive to combustion for energizing said timer to cause said member to move into said running notch, means operable by said latch when said member is in said running notch for deenergizing said ignition means, and means operable by said relay upon deenergization thereof for relatching said latch.

16. An intermittent ignition system for a fluid fuel burner comprising in combination, means for delivering fuel to a burner, means to ignite said fuel, an electric relay which, when energized, renders said fuel delivery and ignition means operative, a thermal timer including a latch having a latching surface, a safety notch and a running notch, and a member cooperable with said latch and movable relatively thereto, means energizing said relay in response to a demand for heat and also energizing said thermal timer in a manner to cause said member to move into said safety notch after a predetermined period of time, means operated when said member is in said safety notch for deenergizing said relay, means responsive to combustion, provided combustion is established before said member moves into said safety notch, for energizing said thermal timer in a manner to cause said member to move into said running notch, means operable by said latch when said member is in said running notch for deenergizing said ignition means, means operable by said relay upon deenergization thereof for relatching said latch if said member is in said running notch but not if it is in said safety notch, and manual means for relatching said latch when said member is in said safety notch.

17. An intermittent ignition system for a fluid fuel burner comprising in combination, means for delivering fuel to a burner, means to ignite said fuel, an electric relay which, when energized, renders said fuel delivery and ignition means operative, a thermal timer including a latch having a latching surface and a running notch and a member cooperable with said latch and movable relatively thereto, starting switch means, means closing said starting switch means when said latch is latched and open when said member is in said running notch, means energizing said relay in response to a demand for heat, said last named means including said starting switch means, means responsive to combustion for energizing said timer to cause said member to move into said running notch, means operable by said latch when said member is in said running notch for deenergizing said ignition means and reducing the energization of said thermal timer, means operable by said relay upon deenergization thereof for relatching said latch, and means terminating energization of said thermal timer upon deenergization of said relay, said timer reclosing said starting switch means after a predetermined time.

18. A fluid fuel burner control system comprising in combination, means for delivering fuel to a burner, a timer unit having a starting condition, a safety condition, and a running condition, means responsive to a demand for heat for rendering said fuel delivery means operative, means preventing said heat demand responsive means from rendering said fuel delivery means operative except when said timer unit is in its starting condition, said timer means being energized substantially simultaneously with said fuel delivery means for movement to its safety condition, means rendering said fuel delivery means inoperative when said timer unit is in its safety condition, means responsive to the establishment of combustion, providing combustion is established before said timer unit moves to its safety condition, for continuously energizing said timer unit in a manner to move to its running condition and to maintain said fuel delivery means operative independently of said timer unit, means operated by said timer unit in its running condition to reduce the energization of said timer unit to a continuous amount just sufficient for it to have the proper timing on returning to its starting

condition following a deenergization thereof by said heat demand responsive means.

19. A fluid fuel burner control system comprising in combination, means for delivering fuel to a burner, means for igniting said fuel, a timer unit having a starting condition, a safety condition, and a running condition, means responsive to a demand for heat for rendering said fuel delivery means and said ignition means operative, means preventing said heat demand responsive means from rendering said fuel delivery means operative except when said timer unit is in its starting condition, said timer means being energized substantially simultaneously with said fuel delivery means for movement to its safety condition, means rendering said fuel delivery means and said ignition means inoperative when said timer unit is in its safety condition, means responsive to the establishment of combustion, providing combustion is established before said timer unit moves to its safety condition, for continuously energizing said timer unit in a manner to move to its running condition and to maintain said fuel delivery means operating independently of said timer unit, means operated by said timer unit in its running condition to deenergize said ignition means and to reduce the energization of said timer unit to a continuous amount just sufficient for it to have the proper timing on returning to its starting condition following a deenergization thereof by said heat demand responsive means.

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