

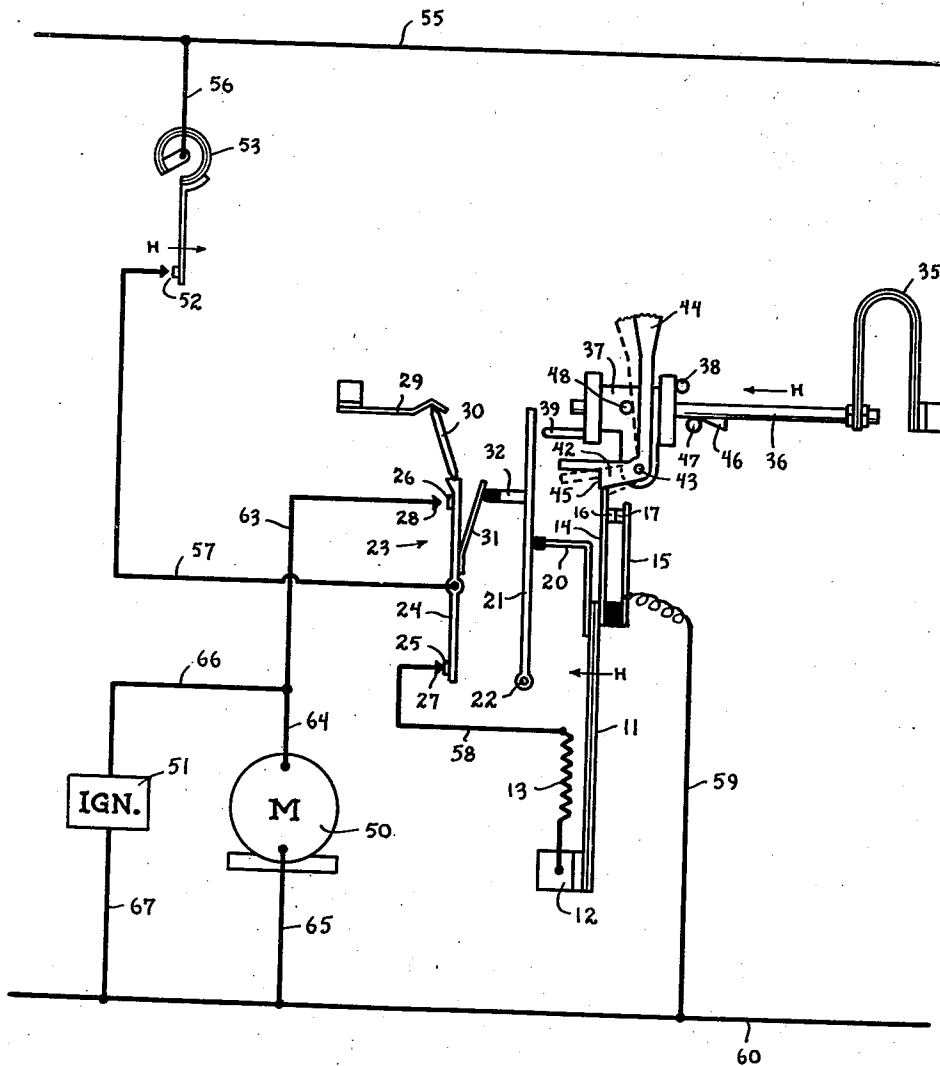
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A. E. BAAK

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FUEL BURNER CONTROL APPARATUS

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Inventor
Albert E. Baak

By *George H. Fisher*
Attorney

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FUEL BURNER CONTROL APPARATUS

Albert E. Baak, Minneapolis, Minn., assignor to
Minneapolis-Honeywell Regulator Company,
Minneapolis, Minn., a corporation of Delaware

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The present invention relates generally to apparatus for automatically controlling devices for feeding fuel to burners, and is particularly adapted to the control of oil burners.

One of the main objects of the invention is to provide a control apparatus which has a minimum number of parts and which is simple in operation.

Another object is to provide a control system in which a timer closes a control switch to render the fuel feeding device operative, said switch being mechanically held closed by a combustion responsive device if combustion is established, otherwise the switch is reopened by said timer which moves out of cooperative relation with said switch. The switch is therefore under the direct control of said combustion responsive device on flame failure.

Another object of the invention is to provide the system with a normally closed safety switch which is carried by the timer, and which is held open if combustion is not established during the return of the timer to its normal position. This prevents reenergization of the timer and the safety switch must be manually reset before the system can make another attempt to start.

Still another object of the invention is to provide a control system in which a timer closes a switch in control of a fuel feeding device, and in which an operating member, which has a slip frictional engagement with a combustion responsive device, holds the switch closed in the presence of combustion, and permits the switch to open and prevents reenergization of the timer in the case of failure to obtain combustion.

Another object is to provide a system as described above wherein a single-pole double-throw switch is operated by the timer to simultaneously close the circuit in control of the fuel feeding device and open another circuit to deenergize the timer.

These and other objects will readily become apparent as the following specification is read in the light of the accompanying drawing in which the single figure shows in diagrammatical form a control system embodying the control device of my invention.

Referring to the drawing, the reference numeral 11 indicates the timer which is in the form of a bimetallic element fixed at its lower end to the bracket 12 and adapted to be heated by means of an electrical heater 13. The upper or free end of the timer carries a pair of resilient blades 14 and 15 which carry the movable safety switch contacts 16 and 17 and are so biased that

these contacts are normally in engagement with each other. The resilient blade 14, it will be noted, is electrically connected to the timer 11 and the blade 15 is insulated with respect to the blade 14 except when the contacts 16 and 17 are in engagement.

The upper end of the timer 11 also carries an L shaped finger 20 which, upon movement of the timer, is adapted to rotate the lever 21 which is pivotally mounted as shown at 22. The lever 21 is adapted to actuate a switching mechanism indicated generally at 23. This switching mechanism is shown as a single-pole double-throw snap action switch of the self return type and although any switching mechanism of this type may be used, I prefer to employ the switch shown in Figures 1 and 2 of my copending application Serial No. 307,991, filed December 7, 1939, now Patent No. 2,318,734, issued May 11, 1943. This switch has been shown more or less diagrammatically and comprises a pivoted lever 24 carrying a pair of movable contacts 25 and 26 which are adapted to cooperate with stationary contacts 27 and 28, respectively. A leaf spring 29 acts through the toggle 30 on the upper end of the lever 24 to bias it for rotation in a clockwise direction. The lever 24 is connected to a resilient operating arm 31 which in turn is engaged by an insulating pin 32. As the timer 11 warps toward the left on being heated, it rotates the lever 21 which in turn builds up a force in the resilient operating member 31 tending to rotate the lever 24 against the force exerted by the leaf spring 29. When the force built up in the member 31 is sufficient to initiate movement of the lever 24, the lever 24 snaps to its actuated position in which the contacts 26 and 28 are in engagement and the contacts 25 and 27 are separated. This snap action takes place as a result of the overcompensation of the spring rates of the operating member 31 and timer 11 by the change in angle between the toggle 30 and the lever 24. For a detailed explanation of this action, reference may be had to my aforementioned copending application.

A combustion responsive device which may take the form of a bimetallic element such as indicated at 35 is placed either in the stack or in the combustion chamber where it may respond conveniently to the presence or absence of combustion within the furnace. This thermostat on being heated expands and moves the rod 36 longitudinally toward the left, as seen in the drawing. An operating member 37 is mounted on the rod 36 and has a suitable slip friction engagement

therewith so that the member normally moves with the rod 36, but if it is prevented from movement the slip frictional connection permits further movement of the rod. In this manner, the member 37 is moved on a rise or fall in the temperature to which the thermostat 35 responds and is not dependent in its movement on any particular temperature value. For instance, it will be seen that upon contraction of the thermostat 35, the member 37 will move toward the right and engage the stop 38 which will limit its movement and after which additional movement of the rod 36 to the right will be permitted. On heating, the thermostat 35 will expand and the member 37 will move toward the left until the switch 23 limits the movement of the member 27 by means of the engagement of the operating finger 39 with the lever 21.

A latch 42 is pivotally mounted on the member 37 as shown at 43 and is provided with a reset handle 44. With the member 37 in its cold position against the stop 38 it will be seen that the latch 42 rests upon the upper end of the resilient contact blade 14 and as the timer 11 warps toward the left the latch will drop off of the blade 14 and rotate until it engages the stop 48 carried by member 37. As the timer returns to its original position, the upper end of the blade 14 will engage the shoulder 45 of the latch 42 and the contacts 16 and 17 will be separated. The contacts 16 and 17 may be reclosed by manually rotating the latch 42 by the reset handle 44 until the shoulder 45 releases the blade 14.

It will be noted further that when the thermostat 35 expands, the cam 46 on rod 36 will ride on the pin 47 thereby raising the rod 36 and the member 37 and lift the latch 42 permitting it to rotate against the stop 48. With the member 37 and latch 42 in this position, the timer 11 may return to its original position without the resilient contact blade 14 engaging the shoulder 45 of the latch 42.

The control system is provided with the usual burner motor 50 which when energized delivers fuel to the combustion chamber of the furnace. The ignition device 51 is supplied for the purpose of igniting the fuel which is delivered by the burner motor 50. A main switch 52 is arranged to be closed by means of a space thermostat 53 on a decrease in temperature.

The system is shown in the drawing in the condition which it will assume after it has been shut down by the room thermostat 53 for a sufficient time to allow the thermostat 35 and the timer 11 to return to their cold positions. On a call for heat, the room thermostat 53 will close the switch 52 and establish the following circuit: from supply line 55, conductor 56, room thermostat 53, main switch 52, conductor 57, lever 24, contacts 25 and 27, conductor 58, electric heater 13, bracket 12, timer 11, resilient blade 14, contacts 16 and 17, resilient blade 15, and conductor 59 to the other supply line 60. As a result of the establishment of this circuit, the timer 11 will be heated and will warp toward the left at which time it releases the latch 42 and snaps the switch 23 to close the contacts 26 and 28 and open the contacts 25 and 27, all as described above. Closure of the contacts 26 and 28 energizes the burner motor 50 and ignition device 51 by means of the following circuit: supply line 55, conductor 56, space thermostat 53, main switch 52, conductor 57, lever 24, contacts 26 and 28, conductors 63 and 64, burner motor 50 and conductor 65 to the other supply line 60. The ignition device is

connected in parallel with the burner motor 50 by means of the conductors 66 and 67 so that the ignition device is energized during the entire time that the burner motor is energized.

Separating the contacts 25 and 27 breaks the circuit to the electric heater 13 and therefore the timer 11 will start to cool and warp toward the right. Energization of the burner motor 50 and ignition device 51, however, will normally produce combustion which will result in the expansion of the thermostat 35 and the resultant movement of the rod 36 toward the left. As this occurs, the member 37 will be raised due to the coaction of the cam 46 and pin 47 and the latch 42 will therefore be positioned so that the safety switch contacts 16 and 17 will not be forced open when the timer 11 returns to its cold position. Also the finger 39 will be moved to the left an amount sufficient to engage the lever 21 and hold the switch 23 in its actuated position independently of the position of the timer 11. It will be clear that the response of the thermostat 35 must come before the timer 11 has returned sufficiently to permit the contacts 26 and 28 to separate. In other words, the trial ignition period is timed by means of the cooling of the timer 11 and if combustion occurs within the time required for the timer to cool sufficiently to open the contacts 26 and 28, the thermostat 35 will expand and hold these contacts closed by means of the member 37 and finger 39. The timer 11 in the meantime will return to its original position with the safety switch contacts 16 and 17 remaining closed. The burner motor 50 and ignition device 51 will therefore remain energized as long as the main switch 52 remains closed and as long as the thermostat 35 maintains the switch 23 in its actuated position.

When the space thermostat 53 becomes satisfied, it will open the main switch 52 and thereby deenergize the burner motor 50 and ignition device 51. As a result, the flame within the furnace will disappear and the thermostat 35 will contract and return the member 37 to its original position, at which time the latch 42 will rest on the upper end of blade 14 as shown in the drawing. The switch 23 will also return to its original position at which time the burner motor control switch 26, 28 will be opened and the switch 25, 27 will be closed ready to reenergize the heater 13 for the timer 11 on a subsequent demand for heat by the space thermostat 53.

If combustion should not be established after the main switch 52 has been closed and the timer 11 has closed switch 26, 28 and opened switch 25, 27 the thermostat 35 will not expand and the member 37 will remain in the position in which it is shown against the stop 38. Due to the fact that switch 25, 27 is open the timer 11 will start to cool and warp toward the right and after a predetermined time the upper end of the blade 14 will engage the shoulder 45 on the latch 42 which has dropped down against the stop 48 and thereby open the safety switch contacts 16 and 17. A slight additional movement of the timer 11 will take up the rest of the differential of the switch 23 and then return to the position shown in the drawing in which the switch 26, 28 is opened and the switch 25, 27 is closed. The heater 13 for the timer 11 will not be reenergized at this time even though the switch 25, 27 is closed and the main switch 52 is closed because the safety switch contacts 16 and 17 are separated and must necessarily remain separated until they have been manually reclosed.

The system will therefore remain locked out until the reset lever 44 is rotated to lift the shoulder 45 out of engagement with the blade 14 allowing the safety switch contacts 16 and 17 to reclose. After the safety switch has been reclosed the system will make another attempt at a normal start.

One of the chief advantages of this system is that although the motor switch is closed by means of a timer, it is placed under the direct control of the combustion responsive thermostat once combustion has been established. When the system is in normal running condition the timer 11 will be in its cold position and the thermostat 35 will be expanded and will be holding the contacts 26 and 28 closed by means of the finger 39 which engages the lever 21. If a flame failure should occur at this time the thermostat 35 will immediately begin to contract and withdraw the finger 39 toward the right permitting contacts 26 and 28 to open and shut down the burner motor and ignition device. At this time if the space thermostat is still calling for heat the original energizing circuit for the heater 13 will be reestablished and the timer 11 will be heated and after a predetermined time will reclose the contacts 26, 28 and open the contacts 25, 27. If combustion is established at this time, the system will return to its normal running condition. If combustion is not established the thermostat 35 will not expand and the timer 11 as it returns to its cold position will after a predetermined time open the safety switch contacts 16 and 17 and the system will remain locked out until manual intervention. In other words, this system will recycle once following a flame failure.

It will therefore be seen that I have provided a simplified control system for fuel burners in which a timer closes the motor switch and in which the motor switch is held closed directly by a combustion responsive thermostat so that a quick shut-down may be obtained in case of a flame failure.

As many changes and modifications of this arrangement may occur to those who are skilled in the art I wish it to be understood that I am to be limited only by the scope of the appended claims and not by the specific embodiment disclosed.

I claim as my invention:

1. A fuel burner control device comprising in combination, a control switch for controlling an electrical fuel feeding device, a normally closed safety switch the opening of which prevents automatic operation of the system until manual intervention, a timer, means for energizing said timer, said timer first closing said control switch so as to energize an electrical fuel feeding device when electrically connected thereto, and a predetermined time thereafter opening said safety switch to deenergize said electrical fuel feeding device, and means adapted to respond to combustion for preventing said timer from opening said safety switch and for maintaining said control switch mechanically disconnected from said timer if subjected to combustion conditions before the elapse of said predetermined time, said last mentioned means including a thermal element and mechanical connections between said thermal element and said control switch whereby the opening of said control switch upon said last named means being no longer subjected to combustion conditions is controlled directly by said thermal element independently of said timer

and takes place without movement of said timer.

2. A fuel burner control system comprising in combination, an electrical fuel feeding device, a biased open switch, a biased closed switch, a timer which moves from a normal position on energization and back to said normal position on deenergization, a main switch, an energizing circuit for said timer including said main switch and said biased closed switch, said timer as a result of energization opening said biased closed switch and closing said biased open switch, closure of said biased open switch causing energization of said electrical fuel feeding device, a normally closed safety switch in control of the energizing circuit for said timer, opening of said biased closed switch causing deenergization of said timer which, a predetermined time thereafter, will open said safety switch and also permit said biased closed and biased open switches to return to closed and open positions respectively, and combustion responsive means having hot and cold positions, said combustion responsive means being operative to prevent the opening of said biased open switch and said safety switch if it moves to its hot position before the elapse of said predetermined time.

3. A fuel burner control system comprising in combination, an electrical fuel feeding device, a control switch therefor, a timer which moves from a normal position on energization and returns to said normal position on deenergization, a main switch for energizing said timer to close said control switch and hence energize said fuel feeding device, said timer deenergizing itself at substantially the same time and then reopening said control switch a predetermined time thereafter to deenergize said fuel feeding device, combustion responsive means for preventing, independently of the timer, the reopening of said control switch if combustion is established before the elapse of said predetermined time, a normally closed safety switch carried by said timer and controlling energization thereof, and a latch released by said timer on energization thereof, said latch opening said safety switch as said timer returns to its normal position, said combustion responsive means removing said latch to prevent the opening of said safety switch upon the establishment of combustion.

4. A fuel burner control system comprising in combination, an electrical fuel feeding device, a control switch therefor, a timer which moves from a normal position on energization and returns to said normal position on deenergization, a main switch for energizing said timer to close said control switch and hence energize said fuel feeding device, said timer deenergizing itself at substantially the same time and then reopening said control switch a predetermined time thereafter to deenergize said fuel feeding device, a thermostat responsive to combustion, an operating member, a slip friction connection between said operating member and said thermostat, a safety switch carried by said timer and controlling the energization thereof, and a latch carried by said operating member, said latch resting on said safety switch when said timer is in its normal position, energization of said timer releasing said latch whereby on return of said timer to normal position said latch holds said safety switch open, said thermostat responding to combustion to prevent, independently of said timer, said control switch from opening, and raising said latch to prevent it from opening said safety switch, all if

combustion is established before the elapse of said predetermined time.

5. An automatic control system comprising a burner motor, a control switch therefor, a timer, an energizing circuit therefor, a safety switch in said circuit, a second switch in said circuit, a main switch for establishing said energizing circuit, said timer upon energization closing said control switch and opening said second switch, and on deenergization opening said safety switch, closing said second switch, and opening said control switch, thereby preventing reenergization of said timer and hence the reclosing of said control switch until after said safety switch has been reclosed, and means responsive to combustion for holding said motor switch closed and preventing said timer from opening said safety switch if combustion is established first.

6. An automatic control system comprising a burner motor, a control switch therefor, a timer, an energizing circuit therefor, a safety switch in said circuit, a second switch in said circuit, a main switch for establishing said energizing circuit, said timer upon energization closing said control switch and opening said second switch, and on deenergization opening said safety switch, closing said second switch, and opening said control switch, thereby preventing reenergization of said timer and hence the reclosing of said control switch until after said safety switch has been reclosed, and means responsive to combustion for holding said motor switch closed and preventing said timer from opening said safety switch if combustion is established first, said control switch and said second switch being in the form of a single pole double throw snap action switch, the common terminal of which is connected to said main switch.

7. A fuel burner control system comprising in combination, an electrical fuel feeding device, a control switch therefor, a timer which when energized closes said control switch and deenergizes itself, and upon deenergization normally causes said control switch to return to open position, a temperature responsive element subject to the heat of combustion, means transmitting a mechanical force from said element to said control switch to prevent it from returning to open position in the event that combustion is established first, a safety switch, and means controlled by said combustion responsive element in the absence of combustion to cause said timer to open said safety switch as it returns to its deenergized position.

8. A fuel burner control system comprising in combination, an electrical fuel feeding device, a control switch therefor, a timer which when energized closes said control switch and deenergizes itself, and upon deenergization normally causes said control switch to return to open position, a temperature responsive element subject to the heat of combustion, means transmitting a mechanical force from said element to said control switch to prevent it from returning to open position in the event that combustion is estab-

lished first, a safety switch carried by said timer, and a latch positioned by said combustion responsive element in the absence of combustion so as to open said safety switch as said timer returns to deenergized position, said latch being moved to inoperative position upon the establishment of combustion whereby said safety switch remains closed as said timer returns to deenergized position.

9. A fuel burner control device comprising in combination, a control switch for controlling an electrical fuel feeding device, a timer positively associated in closing direction only with said switch and which when energized closes said control switch and deenergizes itself, said timer upon deenergization moving to a deenergized position, yieldable means tending to cause said control switch to return to open position as said timer moves to its deenergized position, a temperature responsive element adapted to be subjected to the heat of combustion, means transmitting a mechanical force from said element to said control switch to hold it closed against the action of said yieldable means in the event that said temperature responsive element is subjected to the heat of combustion first without impeding the movement of said timer to its deenergized position, said temperature responsive element removing said mechanical force thereby releasing said control switch and permitting said yieldable means to return it to open position upon said element subsequently being no longer subjected to the heat of combustion, and means actuated upon movement of said timer to energized position and back to deenergized position without said element being subjected to the heat of combustion to prevent the automatic reclosure of said control switch.

10. A fuel burner control system comprising in combination, an electrical fuel feeding device, a control switch therefor, a timer positively associated in closing direction only with said switch and which when energized closes said control switch and deenergizes itself, said timer upon deenergization moving to a deenergized position, yieldable means tending to cause said control switch to return to open position as said timer moves to its deenergized position, a temperature responsive element subject to the heat of combustion, means transmitting a mechanical force from said element to said control switch to hold it closed against the action of said yieldable means in the event that combustion is established first without impeding the movement of said timer to its deenergized position, said temperature responsive element removing said mechanical force thereby releasing said control switch and permitting said yieldable means to return it to open position upon a subsequent failure of combustion, and means actuated upon movement of said timer to energized position and back to deenergized position without combustion being established to prevent the automatic reenergization of said timer.

ALBERT E. BAAK