Nov. 25, 1941. J. M. WILSON 2,263,822

FUEL BURNER CONTROL SYSTEM

Filed Jan. 28, 1939 2 Sheets-Sheet 1

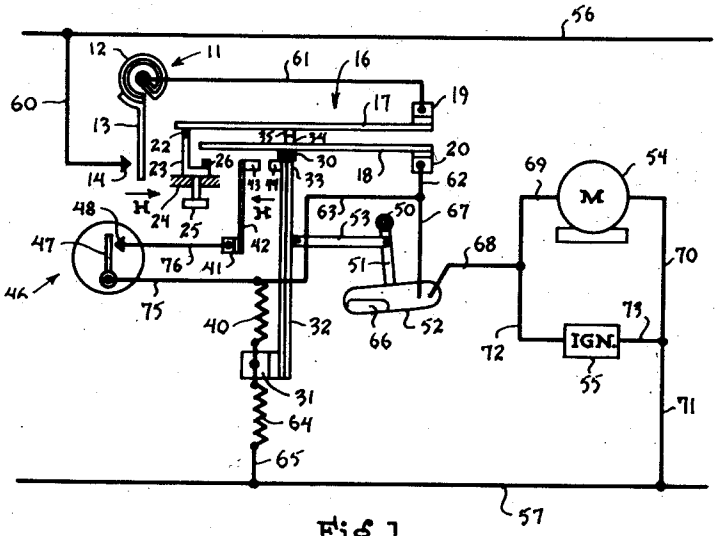


Fig.1

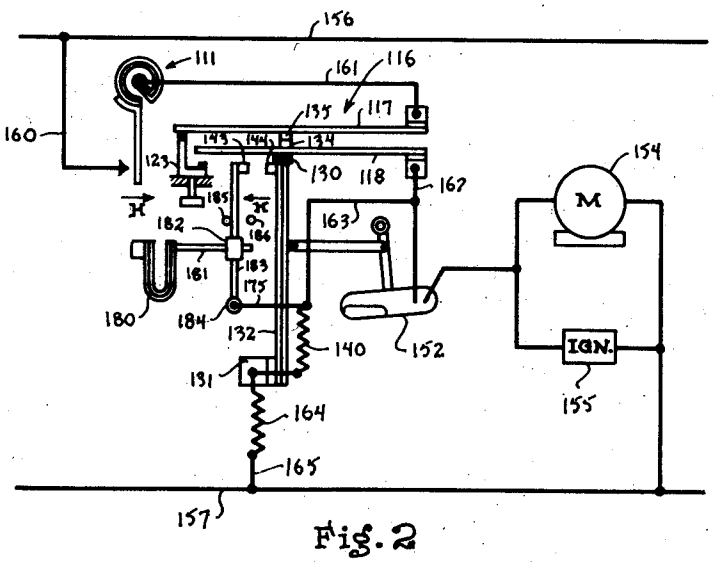


Fig.2

Inventor

John M. Wilson

By

George H. Fisher

Attorney

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Filed Jan. 28, 1939 2 Sheets-Sheet 2

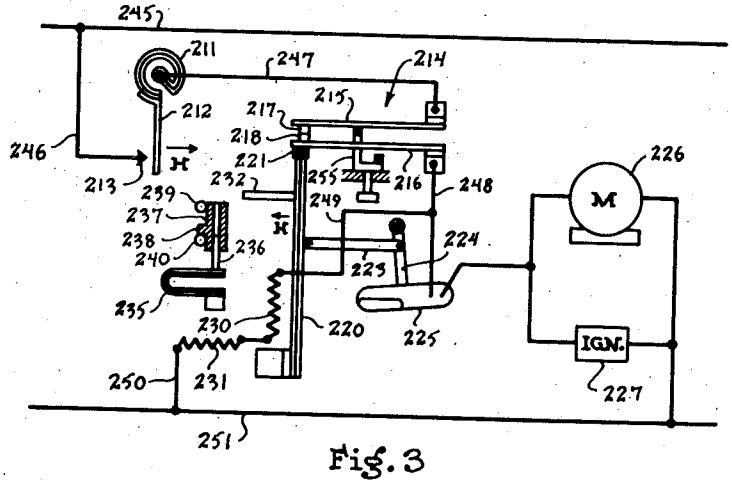


Fig. 3

Inventor
John M. Wilson

By
George H. Fisher
Attorney

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FUEL BURNER CONTROL SYSTEM

John M. Wilson, Minneapolis, Minn., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Application January 28, 1939, Serial No. 253,337

18 Claims. (Cl. 158—28)

This invention relates to an automatic control system for a fuel burner having certain features of safety incorporated therein.

The main object of the invention is to provide a simple and relatively inexpensive control system in which no electromagnetic relays are used and which employs a relatively few number of parts, but yet gives protection against failure to obtain combustion, flame failure after combustion has been established, and power failure.

In many prior art systems it has been customary to have a safety switch, a combustion responsive switch, and at least one electromagnetic relay for operating the motor circuit. It is an object of this invention to simplify this arrangement by having the thermal timer which actuates the safety switch also act as the motive power for closing the burner motor circuit, thereby eliminating the electromagnetic relay.

A further object of the invention is to provide a thermal timer which is under the control of the room thermostat, or any other desired control instrumentality, and which has a cold position in which it holds the burner motor control switch in open position, an intermediate position or range in which it holds the burner motor control switch closed, and a hot position in which it opens the safety switch. A combustion responsive device is added to limit the movement of the thermal timer to its intermediate range if combustion has been established so that the burner motor switch will be held in running position.

A further object is to provide a thermal timer of the above type which locks the system in inoperative condition on flame failure or failure to obtain combustion, thereby requiring a manual resetting operation.

These and other objects will become readily apparent as the following specification is read in the light of the accompanying drawings, in which

Figure 1 is a diagrammatic view of my novel control system,

Figure 2 is a diagrammatic view of the same system using a slightly different type of combustion responsive device, and

Figure 3 is a view of the same system using a third type of combustion responsive device.

Referring now particularly to the drawings, a room thermostat which is generally indicated at 11 comprises a bimetallic coil 12 which actuates a switch arm 13 on variations in temperature in such a manner that on a decrease in temperature beyond a predetermined point the switch arm will engage the stationary contact 14. Although a room thermostat has been disclosed it will be understood that this may be replaced by any type of controlling instrument desired, such as, for example, a boiler thermostat, a boiler pressure responsive device, or outdoor thermostat.

The safety switch which is generally indicated at 16 comprises a pair of resilient contact blades 17 and 18 which are anchored at one end to the brackets 19 and 20, respectively. The free end of the contact blade 17 is adapted to rest on the insulating tip 22 of the manual reset member 23. This reset member is slidably supported in a plate 24 and has a button 25 for manual operation. It is provided also with an insulated tip 26 which is adapted to cooperate with the free end of the contact blade 18 under certain conditions to be described hereinafter. The contact blade 18 carries at its mid portion an insulating block 30.

Anchored to the bracket 31 is one end of a bimetallic timer 32 and in its normal or cold position its free end 33 is adapted to engage under the insulated block 30 to support the contact blade 18 in a position where the contact 34 carried by blade 18 is in engagement with contact 35 carried by the blade 17. The contact blade 18 is normally biased downwardly so that when the bimetallic timer flexes toward the left an amount sufficient for the block 30 to drop off the end 33 of the timer, the blade 18 will drop down until its free end engages the tip 26 on a reset member 23 thus separating the contacts 34 and 35. An electric heating element 40 is provided for heating the bimetal timer 32.

Mounted as shown at 41 is a resilient blade 42 carrying at its free end a contact 43 which is adapted to cooperate with contact 44 carried on the free end of the bimetal timer 32. The contact 43 is so positioned that it will be engaged by contact 44 as the timer flexes toward the left as shown in Figure 1 before the timer moves from beneath the insulated block 30. In other words, these contacts will engage before the switch contacts 34 and 35 are tripped open by the timer. Connected in the circuit with the contacts 43 and 44 is a combustion responsive switch indicated generally at 46 which comprises a switch arm 47 and a stationary contact 48. This switch is of the usual slip friction type and responds to the heat of combustion in such a manner that on an increase in temperature due to the establishment of combustion the

switch arm 47 will engage its contact 48 and on a decrease in temperature due to failure of combustion the switch arm will separate from the contact 48. It is understood that this switch depends for operation on a change in temperature and not on any predetermined temperature.

Pivoted at 50 is an arm 51 which carries a mercury switch 52 and link 53 is connected at one end to the arm 51 and at the other end to the timer 32 so that as the timer flexes back and forth under the influence of the heater 40 it will actuate the mercury switch 52.

Diagrammatically illustrated at 54 is an oil burner motor and the reference numeral 55 indicates the ignition means for igniting the fuel delivered to the combustion chamber by the burner motor 54. The electrical power for operating the above system is supplied in this case by the line wires 56 and 57.

Operation

In considering the operation of this system let it be assumed that the room thermostat 11 is satisfied so that its contact arm 13 is separated from the stationary contact 14 and that this condition has existed for a sufficient period of time for the bimetal timer 32 to have returned to its cold position as shown in Figure 1. Under these circumstances the mercury switch 52 will be in open position so that no current will flow to the burner motor or the ignition means and therefore there will be no heat supplied to the room. Under these circumstances the temperature in the room will fall causing the bimetal element 12 to move the switch arm 13 into engagement with the contact 14 which will establish the following circuit: from line wire 56, conductor 60, contact 14, switch arm 13, bimetal element 12, conductor 61, bracket 19, contact blade 17, contacts 35 and 34, contact blade 18, bracket 20, conductors 62 and 63, electric heater 40, protective resistance 64, and conductor 65 which is connected to line wire 57. This circuit will energize the heater 40 which will raise the temperature of the bimetal timer 32 causing it to flex toward the left as indicated by the arrow in Figure 1. The timer through the link 53 will rotate arm 51 causing the mercury 66 in the tube 52 to flow to the opposite end of the tube closing the following circuit: from line wire 56 through the above traced circuit including the conductors 60, room thermostat 11, conductor 61, safety switch blades 17 and 18 to conductor 62 then through conductor 67, mercury 66, conductor 68, conductor 69, motor 54, conductors 70 and 71 back to line wire 57. A circuit including conductors 72 and 73 connects the ignition means in parallel with the motor 54 from the conductor 68 to the conductor 71. This circuit therefore energizes the burner motor and the ignition means which should produce combustion within the furnace. If combustion is established the combustion responsive device 46 will be heated causing the switch arm 47 to engage the stationary contact 48. Closure of this switch will not have any effect at the present time because the circuit to contact 48 is opened at the contacts 43 and 44. However the bimetal timer 32 is still moving toward the left under the influence of the heater 40 so that eventually contacts 44 and 43 will engage and the engagement of these contacts will set up a shunt circuit around the heater 40 from conductor 63 to the bracket 31 to which the heater 40 is connected. This circuit may be traced as follows: from conductor 63, conductor 75, switch arm 47, contact 48, conductor 76, contact blade 42, contacts 43 and 44, bimetal timer 32 and bracket 31.

The closure of this shunt circuit will deenergize the heater 40 and the bimetal timer will therefore start to cool and as a result will flex toward the right separating the contacts 43 and 44. This in turn breaks the shunt circuit and reenergizes the heater 40 which will cause the bimetal timer to again flex toward the left to remake the shunt circuit. Thus the bimetal timer will continue to oscillate back and forth making and breaking the contacts 43 and 44 as long as the circuit to heater 40 remains closed through the room thermostat and as long as the combustion responsive switch 47, 48 remains closed in the shunt circuit for the heater 40. In this position of the timer 32 the burner motor mercury switch 52 will be maintained in closed position and the system will run normally. The resultant increase in temperature in the room will cause the switch arm 13 to separate from its associated contact 14 thus breaking the circuit to the heater 40 and the bimetal timer will then cool and return to its original position. It will be noted that the current for the burner motor 54 and ignition means 55 is also carried by the room thermostat 11 so that when the switch arm separates from the contact 14 the motor will immediately shut down.

Assuming that the room thermostat calls for heat and for some reason combustion is not established under these circumstances, the combustion responsive switch 47, 48 will remain in open position and as the bimetal timer 32 flexes toward the left under the influence of the heater 40 the shunt circuit for the heater will not be established when the contacts 43 and 44 are made. The bimetal timer will therefore continue to flex to the left pressing back the contact 43 and the resilient blade 42 until the insulated block 30 drops off the end of the timer 32 permitting the contact blade 18 to move downwardly and break the circuit at 34, 35. As these two contacts are in series with the heater, burner motor, and ignition means they will all be immediately deenergized. The bimetal timer will then start to cool but the block 30 will prevent it from flexing toward the right and reclosing the switch 34, 35. In order to accomplish this it is necessary to manually position the restarting member 23 which will first raise the spring blade 17 and then raise the blade 18 lifting it free of the bimetal element 32. If the timer 32 has cooled sufficiently it will move toward the right and open the burner motor switch 52 and the blade 18 will be reset in its contact closed position. It will be noted that as the blade 18 is being reset that the blade 17 is moved out of the path of movement of the blade 18 so that the contacts 34 and 35 can only be engaged if the timer 32 has moved to the right sufficiently to hold the blade 18 in its contact closed position. In other words, this safety switch is trip free. After the system has been manually reset in this manner it is conditioned to restart in the normal manner.

In case the system is in running position and combustion should fail, the contacts 47 and 48 would separate thus breaking the shunt circuit around the heater 40 and the bimetal timer would then continue to flex toward the left tripping the safety switch 16 to open position as described above.

On power failure the bimetal timer 32 would cool and return to its original position opening

the switch 52 so that upon resumption of power the system would recycle normally.

In Figure 2 there is disclosed a system which operates on the same principle as the system shown in Figure 1 except that a slightly different arrangement of the combustion responsive device is disclosed. The room thermostat, safety switch, thermal timer, manual reset member, motor, motor switch, burner motor and ignition means are identical with those in Figure 1 and will not again be described. The heater 140 for the timer 132 is also shunted by the combustion responsive device but in this case the combustion responsive device moves the contact 143 bodily instead of operating a switch in series therewith. This is accomplished by providing a combustion responsive thermostat 180 which longitudinally moves an operating rod 181 which, in turn, is connected through a slip friction 182 with a lever 183 which is shown to be pivoted at 184. The lever 183 carries at its free end the contact 143 and two stops 185 and 186 limit the movement of the lever 183.

When the combustion responsive thermostat 180 is cold the lever 183 is in the position shown in Figure 2 and in this position the contact 143 out of the path of movement of the contact 144 carried by the timer 132. On a call for heat by the room thermostat 111 a circuit is closed from the line wire 156 through conductor 160, room thermostat 111, conductor 161, contact blade 117, contacts 135 and 134, contact blade 118, conductors 162 and 163, heater 140, protective resistance 164 and conductor 165 back to line wire 157. This energizes the heater 140 causing the timer 132 to flex toward the left closing the mercury switch 152 there by energizing the burner motor 154 and the ignition means 155. If combustion is established the combustion responsive thermostat 180 through the slip friction connection 182 will swing the lever 183 to its end position against the stop 186 so that the contact 143 will be placed in position to be engaged by the contact 144 before the bimetallic timer moves from beneath the insulated block 138. Closure of the contacts 143 and 144 sets up the following shunt circuit around the heater 140. Conductor 175, lever 183, contacts 143 and 144, bimetallic timer 132 to bracket 131 to which the heater 140 is connected. This will cause the bimetallic timer 132 to oscillate back and forth making and breaking the contacts 143 and 144 in the same manner as described in connection with Figure 1 and this is the normal running condition of the system.

In case combustion is not established by energiding the motor 154 and ignition means 155 the combustion responsive thermostat 180 will not respond and the lever 183 will remain against the stop 185. With the lever in this position the contact 143 cannot be engaged by the contact 144 and the bimetal timer 132 will trip the safety switch 116 to open position as described in connection with Figure 1. Also if combustion should fail while the system is in running condition the thermostat 180 will rotate the lever 183 counterclockwise until it strikes the stop 185 so that the timer 132 can no longer close the shunt circuit around the heater 140 and again the thermal timer will trip the safety switch 116 to open position. The manual reset member 123 operates in Figure 2 to reset the safety switch in the same manner as described in connection with Figure 1. Power failure will affect this system in the same manner as Figure 1 and will therefore not be again described.

The system disclosed in Figure 3 is different from the systems disclosed in Figures 1 and 2 in that the combustion responsive device provides a mechanical stop for preventing the thermal timer from tripping the safety switch after combustion has been established. This system comprises a room thermostat 211 for operating a switch arm 212 to engage its stationary contact 213 on a decrease in temperature. The safety switch 214 comprises a pair of resilient contact blades 215 and 216 which carry cooperating contacts 217 and 218 in the same manner as in Figures 1 and 2. The bimetal timer 220 carries at its upper end an insulated tip 221 which normally holds the contact blade 216 in closed position. The timer 220 is connected by means of link 223 with a pivoted arm 224 for actuating mercury switch 225 which controls the delivery of electrical energy to the burner motor 226 and the ignition means 227. The timer is provided with an electric heater 230 and a protective resistance 231 is located in series therewith.

In this modification the thermal timer 220 carries a pin 232. The combustion responsive thermostat 235 carries a pin 236 on which is slip frictionally mounted a sleeve 237 having a projection 238 which is adapted to cooperate with a pair of stops 239 and 240 which limit its movement. In the cold position of the combustion responsive thermostat 235 the sleeve 237 is withdrawn into engagement with the stop 240 at which time the bimetal timer 220 may flex to the left under the influence of the heater 230 an amount sufficient to trip the safety switch 214 to open position. The circuit to the heater may be traced as follows: from line wire 245, conductor 246, contact 213, switch arm 212, thermostat 211, conductor 247, contact blade 215, contacts 217 and 218, contact blade 216, conductors 248 and 249, electric heater 230, protective resistance 231 and conductor 250 back to the line wire 251. This will cause the bimetal timer 220 to flex toward the left and close the switch 225 thereby energizing the burner motor and the ignition means as in Figures 1 and 2. If combustion is not established the bimetal timer will continue to flex to the left until the contact blade 216 drops off the end of tip 221 opening the safety switch contacts 217 and 218 which will deenergize the burner motor and the ignition means as well as the heater 230. The safety switch may be reset to closed position by means of the manual reset member 255 in the same manner as in the first two modifications.

If, after the bimetal timer 220 has energized the burner motor and ignition means, combustion is established the combustion responsive thermostat 235 will expand moving the sleeve 237 into engagement with the stop 239 and in this position as the bimetal timer 220 continues to flex toward the left the rod 232 will engage the sleeve 237 whereby the timer will be prevented from further movement so that it cannot trip the safety switch 214 to open position. This is the running condition of this system and the heater 230 will remain continuously energized instead of being alternately energized and deenergized. If a flame failure should occur under these conditions the combustion responsive thermostat 235 would contract and remove the sleeve 237 from engagement with the pin 232 and the timer 220 would then be permitted to flex toward the left sufficiently to trip the safety switch 214 to open position. On power failure the heater 230 would be deenergized and the timer 220 would return to

its cold position so that the system would recycle on resumption of power in the same manner as Figures 1 and 2.

Thus it will be seen that I have provided a relatively simple control system for an oil burner in which a single thermal timer operates to close the motor and ignition circuit and also to actuate the safety switch on failure of combustion and that a combustion responsive device is provided for preventing the timer from tripping the safety switch as long as combustion is present. This system eliminates the use of electromagnetic relays and also provides protection against failure to obtain combustion on starting, flame failure after combustion has once been established, and power failure.

It will be appreciated that these systems have been shown for the purpose of illustration only and that the scope of the invention is to be limited only by the appended claims.

I claim as my invention:

1. In a fuel burning system, in combination, an electrical timing device which moves in a first direction when energized and returns in the opposite direction when deenergized, a main switch for energizing said electrical timing device, means in control of the supplying of fuel, means controlled by said electrical timing device to operate said last named means to supply fuel when said timing device moves to a first position and to stop the supply of fuel when the timer moves to a second position spaced from said first position upon movement of said timer in said first direction, and circuit connections including a contact operated by the timer and a contact controlled by combustion conditions to deenergize said electrical timing device when the same reaches an intermediate position between said first and second positions and to again energize said electrical timing device upon retraction of the same from said intermediate position.

2. In a fuel burning system, in combination, an electrical timing device which moves in a first direction when energized and returns in the opposite direction when deenergized, a main switch for energizing said electrical timing device, means in control of the supplying of fuel, means controlled by said electrical timing device to operate said last named means to supply fuel when said timing device moves to a first position and to stop the supply of fuel when the timer moves to a second position spaced from said first position upon movement of said timer in said first direction, and circuit connections including a closed-when-hot combustion responsive switch, a stationary contact, and a movable contact controlled by said timing device to deenergize said electrical timing device when the same reaches an intermediate position between its first and second positions and to again energize said electrical timing device upon retraction of the same from such intermediate position, said stationary contact being incapable of limiting the movement of said electrical timing device when said combustion responsive switch is open.

3. In a fuel burning system, in combination, an electrical timing device which moves in a first direction when energized and returns in the opposite direction when deenergized, a main switch for energizing said electrical timing device, means in control of the supplying of fuel, means controlled by said electrical timing device to operate said last named means to supply fuel when said timing device moves to a first position and to stop the supply of fuel when the timer moves to a second position spaced from said first position upon movement of said timer in said first direction, circuit connections comprising a switch having first and second contacts, said first contact being controlled by said electrical timing device, and combustion responsive means for moving said second contact to a hot position upon the establishment of combustion to be engaged by said first contact as said electrical timing device reaches an intermediate position between its first and second positions to complete the circuit connections and deenergize said electrical timing means and to again energize the same as it retracts from said intermediate position, said second contact in its cold position being out of the path of movement of said first contact.

4. A fuel supply control system comprising in combination, a timer, an electrical means, a circuit for energizing said electrical means, a condition responsive element in control of said circuit, said electrical means upon energization thereof delivering energy to said timer to produce a timed movement thereof from an original position, said timer upon deenergization of said electrical means having a timed movement back to its original position, fuel supplying means, a circuit therefor, a first switch in said circuit, said timer on movement from its original position closing said first switch to render said fuel supplying means operative, a second normally closed switch in said circuit, said timer upon continued movement from its original position opening said second switch, and means including means responsive to combustion for controlling said electrical means to deliver just sufficient power to said timer whereby it holds said first switch closed and does not open said second switch.

5. A fuel supply control system comprising in combination, a timer, an electrical means, a circuit for energizing said electrical means, a condition responsive element in control of said circuit, said electrical means upon energization thereof delivering energy to said timer to produce a timed movement thereof from an original position, said timer upon deenergization of said electrical means having a timed movement back to its original position, fuel supplying means, a circuit therefor, a first switch in said circuit, said timer on movement from its original position closing said first switch to render said fuel supplying means operative to supply fuel, a second normally closed switch in said motor circuit and also in the circuit to said electrical means, said timer upon continued movement from its original position opening said second switch, means including means responsive to combustion for controlling said electrical means to deliver just sufficient power to said timer whereby it holds said first switch closed and does not open said second switch, means to lock said second switch in open position after it has been opened by said timer due to lack of combustion, and means for manually reclosing said second switch.

6. A fuel supply control system comprising in combination, a timer, an electrical means, a circuit for energizing said electrical means, a condition responsive element in control of said circuit, said electrical means upon energization thereof delivering energy to said timer to produce a timed movement thereof from an original position, said timer upon deenergization of said electrical means having a timed movement back to its original position, fuel supplying means, a circuit therefor, a first switch in said circuit, a circuit for deenergizing said electrical means

comprising a combustion responsive switch which is closed whenever combustion is present and a stationary contact, said timer on movement from its original position first closing said first switch to render said fuel supplying means operative and then engaging said stationary contact completing the deenergizing circuit for said electrical means providing said combustion switch is closed, which causes a reversal in movement of said timer and a reopening of said last mentioned circuit to again reverse movement of said timer, said timer continuing to oscillate back and forth, a second normally closed switch in said fuel supplying means circuit and the circuit for said electrical means, said timer continuing its movement away from its original position if said combustion switch is open to open said second switch, and means to prevent said timer from reclosing said second switch after it has once opened it

7. A fuel supply control system comprising in combination, a timer, an electrical means, a circuit for energizing said electrical means, a condition responsive element in control of said circuit, said electrical means upon energization thereof delivering energy to said timer to produce a timed movement thereof from an original position, said timer upon deenergization of said electrical means having a timed movement back to its original position, fuel supplying means, a circuit therefore, a first switch in said circuit, said timer on movement from its original position closing said first switch to render said fuel supplying means operative, a second normally closed switch in said fuel supplying means circuit and also in the circuit to said electrical means, said timer upon continued movement from its original position opening said second switch, means for deenergizing said electrical means comprising a contact, and a combustion responsive device for moving said contact from a cold position in which it is beyond the path of movement of said timer and a hot position in which it is engaged by said timer before said timer opens said second switch, engagement of said timer and said contact causing deenergization of said electrical means causing said timer to reverse its movement which in turn causes it to disengage said contact and reenergize said electrical means to again cause said timer to move in the original direction, said timer continuing to oscillate back and forth to hold said first switch closed.

8. A fuel supply control system comprising in combination, fuel supplying means, a circuit therefor, a first switch and a normally closed safety switch in said circuit, a thermal timer operatively associated with said first switch, a heater for said timer, a circuit for said heater, a condition responsive switch in control of said heater circuit, said thermal timer under the control of said heater having a cold position in which said first switch is in open position, an intermediate position in which said first switch is in closed position, and a hot position in which said timer trips said safety switch to open position, a shunt circuit for said heater including a closed-when-hot combustion responsive switch, and a second switch in said shunt circuit closed by said timer when it is in its intermediate position whereby said heater is alternately energized and deenergized as said timer alternately opens and closes said second switch while holding said first switch in closed position.

9. A fuel supply control system comprising in combination, fuel supplying means, a circuit therefor, a first switch in said circuit, a normally closed safety switch in said circuit, a thermal timer operatively associated with said first switch, a heater for said timer, a circuit for said heater, a condition responsive switch in control of said heater circuit, said thermal timer under the control of said heater having a cold position in which said first switch is in open position, an intermediate position in which said first switch is in closed position, and a hot position in which said timer trips said safety switch to open position, a shunt circuit for said heater, a switch in said shunt circuit, and a combustion responsive element, one contact of said last named switch being moved by said thermal timer, the other contact being moved by said combustion responsive element in such a manner that when said combustion responsive element is in its cold position the contact moved thereby is out of the path of movement of the contact moved by the thermal timer, and when the combustion responsive element is in its hot position the contact moved thereby is in such a position that it engages the contact moved by the thermal timer when the thermal timer is in its intermediate position thus completing the shunt circuit around said heater, whereby said heater is alternately energized and deenergized as said timer alternately breaks and makes the two contacts.

10. In a fuel burning system, in combination, an electrical timing device which moves in a first direction when energized and returns in the opposite direction when deenergized, means in control of the supplying of fuel, a safety switch in control of said last named means, said safety switch comprising a pair of switch elements biased to open circuit position, said timer in deenergized position engaging beneath one of said elements to mechanically hold said safety switch closed, a main switch for energizing said timing device to cause it to move from its deenergized position to a second position in which it renders said fuel supplying control means operative, continued energization causing said timer to move to a third position in which it releases said one element to permit said safety switch to open, and means responsive to the establishment of combustion to cause intermittent interruption of the flow of power to said timer to limit the power to an amount just sufficient to maintain said timer in its second position.

11. In a fuel burning system, in combination, a timer in the form of a thermal element having a relatively fixed end and a relatively free end, an electrical fuel feeding device, a control switch therefor, a safety switch in control of said fuel feeding device, said safety switch comprising a pair of switch elements biased to open circuit position, one of said elements being mechanically engaged by the free end of said thermal timer and held in closed circuit position thereby, a main switch for energizing said thermal timer to cause it to move from its first cold position to a second position in which it closes the control switch for said electrical feeding device, continued energization of said thermal timer normally causing it to move to a third position in which it releases said one element thereby permitting said safety switch to open and deenergize said fuel feeding device, and means responsive to the establishment of combustion for preventing said thermal timer from moving from its second to its third position.

12. In a fuel burning system, in combination,

a timer in the form of a thermal element having a relatively fixed end and a relatively free end, an electrical fuel feeding device, a safety switch control of said fuel feeding device, said safety switch comprising a pair of switch elements biased to open circuit position, one of said elements being mechanically engaged and held in closed circuit position by said thermal timer, a main switch, a heater for said thermal timer, a control switch, a first circuit including said main switch, safety switch, and heater for said thermal timer, said thermal timer moving as a result of the energization of said heater from its first cold to a second position in which it closes said control switch thereby establishing a second circuit including said main switch, safety switch, control switch, and electrical fuel feeding device, continued energization of said heater causing said thermal timer, after a predetermined period of time, to assume a third position in which it releases said one element and permits said safety switch to open, and means responsive to the establishment of combustion for preventing said thermal timer from assuming its third position.

13. In a fuel burning system, in combination, a timer in the form of a thermal element having a relatively fixed end and a relatively free end, an electrical fuel feeding device, a control switch therefor, a safety switch in control of said fuel feeding device, said safety switch comprising a pair of switch elements biased to open circuit position, one of said elements being mechanically engaged by the free end of said thermal element and held in closed circuit position thereby, a main switch for energizing said thermal timer to cause it to move from its first cold position to a second position in which it closes said control switch for said electrical fuel feeding device, continued energization of said thermal timer normally causing it to move to a third position in which it releases said one element thereby permitting said safety switch to open and deenergize said fuel feeding device, means responsive to the establishment of combustion for preventing said thermal timer from moving from its second to its third position, and means preventing said safety switch from automatically reclosing.

14. In a fuel burning system, in combination, a timer in the form of a thermal element having a relatively fixed end and a relatively free end, an electrical fuel feeding device, a safety switch in control of said fuel feeding device, said safety switch comprising a pair of switch elements biased to open circuit position, one of said elements being mechanically engaged and held in closed circuit position by said thermal timer, a main switch, a heater for said thermal timer, a control switch, a first circuit including said main switch, safety switch, and heater for said thermal timer, said thermal timer moving as a result of the energization of said heater from its first cold to a second position in which it closes said control switch thereby establishing a second circuit including said main switch, safety switch, control switch, and electrical fuel feeding device, continued energization of said heater causing said thermal timer, after a predetermined period of time, to assume a third position in which it releases said one element and permits said safety switch to open, means responsive to the establishment of combustion for preventing said thermal timer from assuming its third position, means locking said safety switch in open position once it has been opened, and means for resetting said safety switch to closed position.

15. In a fuel burning system, in combination, a timer in the form of a thermal element having a relatively fixed end and a relatively free end, an electrical fuel feeding device, a control switch therefor, a safety switch in control of said fuel feeding device, said safety switch comprising a pair of switch elements biased to open circuit position, one of said elements being mechanically engaged by the free end of said thermal timer and held in closed circuit position thereby, a main switch for energizing said thermal timer to cause it to move from its first cold position to a second position in which it closes the control switch for said electrical feeding device, continued energization of said thermal timer normally causing it to move to a third position in which it releases said one element thereby permitting said safety switch to open and deenergize said fuel feeding device, and means moved in response to the establishment of combustion to mechanically engage said thermal timer to prevent it from moving into its said third position.

16. In a fuel burning system, in combination, an electrical fuel feeding device, a control switch therefor, a safety switch, an electrical timing device which moves in a first direction when energized and returns in the opposite direction when deenergized, electrical means for energizing said timer, a main switch, a first circuit including said main switch, safety switch and electrical means, said timer moving, as a result of energization by said electrical means, from a first position to a second position in which it closes said control switch thereby establishing a second circuit including said main switch, safety switch, control switch and electrical fuel feeding device, continuation of said first circuit causing said timer, after a predetermined period of time, to move into a third position in which it opens said safety switch, and means operating in response to the establishment of combustion for preventing said timer from moving into its said third position.

17. In a fuel burning system, in combination, an electrical fuel feeding device, a control switch therefor, a safety switch, an electrical timing device which moves in a first direction when energized and returns in the opposite direction when deenergized, electrical means for energizing said timer, a main switch, a first circuit including said main switch, safety switch and electrical means, said timer moving, as a result of energization by said electrical means, from a first position to a second position in which it closes said control switch thereby establishing a second circuit including said main switch, safety switch, control switch and electrical fuel feeding device, continuation of said first circuit causing said timer, after a predetermined period of time, to move into a third position in which it opens said safety switch, and means moved in response to the establishment of combustion to mechanically engage said thermal timer to prevent it from moving into its said third position.

18. In a fuel burning system, in combination, an electrical timing device which moves in a first direction when energized and returns in the opposite direction when deenergized, means in control of the supplying of fuel, a safety switch in control of said last named means, said safety switch comprising a pair of switch elements biased to open circuit position, said timer in deenergized position engaging beneath one of said

elements to mechanically hold said safety switch closed, a main switch for energizing said timing device to cause it to move from its deenergized position to a second position in which it renders said fuel supplying control means operative, continued energization causing said timer to move to a third position in which it releases said one element to permit said safety switch to open, and means operating in response to the establishment of combustion to limit the flow of electrical energy to said timing device to an amount sufficient to hold it in its second position, but insufficient to cause it to move into its third position.

JOHN M. WILSON.