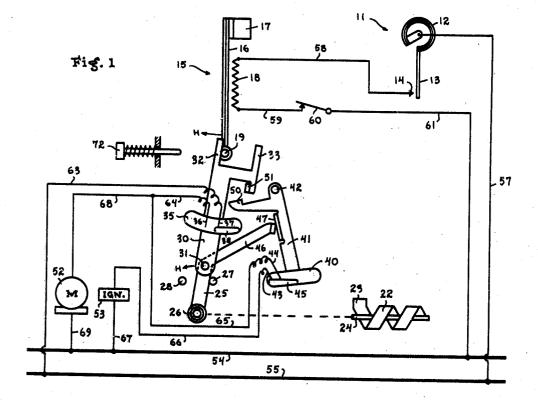
### Nov. 4, 1941.

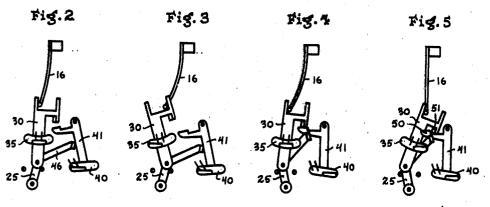
# W. L. MOGRATH

2,261,586

CONTROL SYSTEM FOR FLUID FUEL BURNERS

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#### CONTROL SYSTEM FOR FLUID FUEL BURNERS

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### 17 Claims. (Cl. 158-28)

This invention is directed broadly to control systems for fluid fuel burners, such as the usual oil burner, and more specifically to systems which are relatively simple and inexpensive and include a minimum number of parts.

One of the principal objects of the invention is to provide a control system in which a timer or power device is energized in response to a demand for heat for energizing the fuel burner for a predetermined period of time and then 10 deenergizing it again, and in which a device responsive directly to combustion acts mechanically to prevent the deenergization of said fuel burner if combustion is established within said predetermined period.

A further object is to obtain intermittent ignition by connecting the combustion responsive device to an ignition switch so as to open it in the presence of combustion.

A still further object is to provide a mechan- 20 ical interlock for preventing the power device from initiating operation of the fuel feeding device unless the combustion responsive device is in its cold position at which time the ignition 25 switch is closed.

Reference is made to my copending application Serial No. 280,302 filed June 21, 1939, which covers a control system of the same general type as the one disclosed in the present application, but which has constant ignition.

This invention will be more clearly understood when the following specification is read in the light of the accompanying drawing, in which

Figure 1 is a diagrammatic showing of my control system; and

Figures 2, 3, 4, and 5 are detail views showing certain parts of the system in various positions of operation.

Referring now to Figure 1 of the drawing the 40 reference numeral 11 indicates a space thermostat including a bimetallic coil 12 and a switch arm 13. The bimetallic coil is so arranged that on a decrease in temperature it causes the switch arm 13 to engage the stationary contact 14. A 45 timer or power device indicated generally at 15 comprises a bimetallic blade is connected at its upper end to the bracket 17. This timer is adapted to be heated by means of the electric heating element 18. The lower end of the blade 16 carries a pin 19 which may if desired be rotatably mounted with respect to the blade 16. Blade 16 is adapted to warp in a direction to move its lower end toward the left as seen in Figure 1 upon energization of the heater 18. If 55 with a lateral projection 50 which under certain

desired stops may be added to limit the warping movement of this blade.

A coiled bimetallic combustion responsive thermostat is indicated at 22. This coil is adapted to be relatively fixed at 23 and in response to the combustion to rotate the rod 24. Lever 25 is connected to rod 24 by means of a slip fric-tion connection 26. Stops 27 and 28 limit the rotation of the lever 25 and the slip friction connection 26 permits over travel of the rod 24 in response to further temperature variation at the thermostat 22. It will therefore be seen that due to the slip friction connection and the stops 27 and 28 the lever 25 will be rotated in response 15 to changes in temperature at the thermostat 22 rather than in response to any predetermined degree of temperature. The result is that the lever 25 rotates in a counter-clockwise direction in response to the establishment of combustion and in a clockwise direction upon the extinguishment of the flame.

A switch lever 30 is loosely pivotally connected to the lever 25 as shown at 31. The upper end of this lever is provided with two arms 32 and 33 with which the pin 19 is adapted to cooperate. Normally the arm 32 rests by gravity against the pin 19. The upper end of the lever 30 is therefore positioned by means of the bimetal 16 and the lower end of the lever 30 is positioned by means of the combustion responsive lever 25. A motor control switch 35 in the form of a curved glass tube is mounted at an intermediate point on the lever 30. A pair of electrodes 36 and 37 extend into the tube at its midpoint so that when the tube is in a horizontal or nearly hori-35 zontal position the mercury 38 will bridge the two electrodes but when it is tipped either one way or the other the electrodes will be unbridged. A mercury ignition switch 40 is connected to the lower end of a lever 41 which is in turn pivotally suspended from the fixed pin 42. Electrodes 43 and 44 extend into one end of the mercury switch tube 40 and are adapted to be bridged by means of the mercury 45. An arm 46 on the lever 25 is adapted to engage a projection 41 on the lever 41 to hold the mercury switch 40 in closed position as long as the lever 25 is abutting the stop 27 indicating the absence of combustion in the furnace. When the lever 25 is rotated in re-50 sponse to combustion the arm 46 releases the lever 41 and gravity is permitted to rotate the lever in a direction to open the circuit through the switch 40.

The upper portion of the lever 41 is provided

circumstances is adapted to latch against projection 51 on the lever 36 to prevent the bimetal 16 from moving the upper end of the lever 30.

This control system is provided with the usual burner motor 52 and ignition device 53 for igniting the fuel delivered by the motor 52. The electrical power for operating the above system is supplied by the line wires 54 and 55.

#### Operation

Assume that the temperature in the space to be controlled is above the control point and that the switch 13-14 is therefore open. Assume also that this condition has obtained for a sufficient length of time for the bimetal 16 to assume its cold position as indicated in Figure 1. Assume also that the absence of combustion in the combustion chamber of the furnace has caused the thermostat 22 to rotate the lever 25 against the stop 27. Under these conditions the electrodes 36 and 37 of the motor control switch 35 will be unbridged and the electrodes 43 and 44 of the ignition switch 40 will be bridged. Inasmuch as the switch 35 is in series with both the burner motor 52 and the ignition device 53 they will both be deenergized.

On a decrease in space temperature the switch arm 13 will be brought into engagement with the stationary contact 14 completing a circuit from line wire 55, conductor 57, bimetal 12, switch arm 13, contact 14, conductor 58, electric heater 30 18, conductor 59, switch 60, and conductor 61, back to the other line wire 54. The closure of this circuit will energize the heater 18 which will raise the temperature of the bimetal 15 and cause it to warp to the left in the direction indicated by the arrow in Figure 1. This movement will rotate the lever 30 in a counter-clockwise direction about the pin 31 causing the mercury 38 to bridge the electrodes 36 and 37. This will establish the following circuit: from line wire 55 through a conductor 63, electrode 37, electrode 36, conductors 64 and 85, electrodes 44 and 43, conductor 66, ignition device 53, and conductor 67 back to the line wire 54. This circuit ener-4.5 gizes the ignition device 53. The burner motor 52 is connected in parallel with the ignition switch 40 and ignition device 53 by means of the conductors 58 and 59. Therefore the closure of the switch 35 simultaneously energizes the burner motor 52, and ignition 53. The position of the bimetal 16 and the two switch operating levers 30 and 41 is shown in Figure 2 under these conditions. It will be understood that as the mercury switch tube 35 is curved the electrodes 36 and 37 will be bridged for a definite time in-55 terval as the lever 30 is slowly rotated by bimetal 16.

Let it be assumed that combustion does not take place. Under these circumstances there will be no change in temperature in the thermo- 60 stat 22 and therefore no movement of the lever 25. As the bimetal 16 continues to heat it will continue rotating the lever 30 in a counterclockwise direction until this lever passes over center with respect to the pin 31 upon which 65 it is freely pivoted, at which time it will drop until the arm 33 engages the pin 19 on the bimetal 16 as shown in Figure 3. At this time the switch 35 will be open thereby deenergizing the burner motor 52 and the ignition device 63. The 70 parts will remain in this position as long as the space thermostat II is calling for heat until manual intervention takes place. In order to reset the device for a restart it is necessary first to open the switch 60 until the bimetal 16 has 75

had an opportunity to return to its cold position. Due to the spacing between the arms 33 and 32 this movement cannot move lever 30 to reclose the switch 35. In order to accomplish this it is 5 necessary to push in the reset button 72 and manually rotate the lever 30 to the position which it occupies in Figure 1. The switch 60 may then be reclosed and the system is in a condition to make another attempt at a normal 10 start.

If the switch 13-14 is still closed by the bimetal 12 the bimetal 16 will again be heated and the parts will return to the position shown in Figure 2 at which time the burner motor and 15 ignition device are energized. If combustion is established the thermostat 22 will be heated and will rotate the lever 25 in a counter-clockwise direction. The thermostat 22 and bimetal 16 must be so related that the lever 25 will keep 20 in step with the lever 30 and maintain the control switch 35 in closed position. When the lever 25 has been rotated against the stop 28 and the bimetal 16 has warped to its full extent the parts will assume the positions shown in Fig-

25 ure 4 at which time the switch 35 will be closed thereby maintaining the burner motor 52 energized. It will be noted that as the lever 25 rotates counter-clockwise it releases the lever 41 and permits it to swing in a clockwise direction by gravity to open the ignition switch 40 thereby deenergizing the ignition device 53 as shown in Figure 4. This is the running condition of the system.

In the event that the space thermostat 11 becomes satisfied the bimetal 12 separates the 25 switch arm 13 from the contact 14 and deenergizes the electric heater 18. This permits the bimetal 16 to cool and warp toward the right thereby permitting the lever 30 to rotate in a clockwise direction and open the switch 35. Opening of switch 35 deenergizes the burner motor so that the flame within the combustion chamber is extinguished, and the thermostat 22 will then cause lever 25 to rotate in a clockwise direction. It will be noted in Figure 5 that when the bimetal 15 has returned to its cold position that the projection 51 on the lever 30 latches over the projection 50 on the lever 41 so that if the heater 18 should be energized at this time the bimetal 16 would be mechanically held and hence incapable of warping to the left and rotating the lever 30. This prevents the switch 35 from being closed and energizing the burner motor 52 unless the ignition switch 40 has been closed by the lever 25. When the lever 25 returns to its cold position against the stop 27 the arm 46 engages projection 47 on the lever 41 and rotates this lever in a counter-clockwise direction thereby closing the ignition switch 40 and removing the projection 50 from the projection 51 freeing the lever 30 for movement by the bimetal 16. The parts at this time have returned to the positions shown in Figure 1.

If the system should be in running condition as shown in Figure 4 and a flame failure should occur then the thermostat 22 would immediately rotate the lever 25 against the stop 27 and the lever 30 would consequently be rotated by the lever 25 in a counter-clockwise direction and would pass over center with respect to the pin 31 and drop into the position shown in Figure 3 thereby opening the switch 35. As in the case of original ignition failure the lever 30 would remain in this position until manual intervention. 5

It will therefore be seen that I have designed a relatively simple and inexpensive control system which uses a single timer or power device and a single switch for controlling the burner motor and ignition switch. It will also be seen that the system comprising the above parts operates safely in the event of an initial ignition failure or a subsequent flame failure.

Various changes and modifications of the above invention will doubtless occur to those who 10 are skilled in the art and I therefore desire that it be understood that I intend to be limited only by the scope of the appended claims and not by the specific embodiment of the invention disclosed.

I claim as my invention:

1. A control system comprising in combination, an electrical fuel feeding device, a control switch therefor, a timer which moves in one direction in response to a demand for heat and in 20 switch for a predetermined period of time and the opposite direction when there is no demand for heat, said timer first closing said control switch for a predetermined period of time and then reopening said switch as said timer moves in response to a demand for heat, and means 25 movable in timed relation to said timer in response to the establishment of combustion for preventing said timer from reopening said switch as long as there is a demand for heat, the movement of said timer being unaffected by said 30 last mentioned means.

2. A control system comprising in combination, an electrical fuel feeding device, a control switch therefor, a timer which moves in one direction in response to a demand for heat and in the oppo- 35 site direction when there is no demand for heat, said timer first closing said control switch for a predetermined period of time and then reopening said switch as said timer moves in response to a demand for heat, and means movable in timed 40 relation to said timer in response to the establishment of combustion for preventing said timer from reopening said switch as long as there is a demand for heat, the movement of said timer being unaffected by said last mentioned means, and means preventing the reclosure of said switch, except upon manual intervention, once it has been opened by said timer during a demand for heat.

3. A control system comprising in combina- 50 tion, an electrical fuel feeding device, a control switch therefor, a timer which moves in one direction in response to a demand for heat and in the opposite direction when there is no demand for heat, said timer first closing said control switch for a predetermined period of time and then reopening said switch as said timer moves in response to a demand for heat, means mechanically associated with said control switch, a thermal element responsive to the heat of com-60 bustion, and mechanical connections between said last mentioned means and said thermal element, said thermal element acting in response to the establishment of combustion to keep said means in step with said timer to pre-65 vent said timer from reopening said switch while there is a demand for heat.

4. A control system comprising in combination, an electrical fuel feeding device, a control switch therefor, a timer which moves in one di-70 rection in response to a demand for heat and in the opposite direction when there is no demand for heat, said timer first closing said control switch for a predetermined period of time and then reopening said switch as said timer moves 75 fuel feeding device in response to a demand for

in response to a demand for heat, means mechanically associated with said control switch, a thermal element responsive to the heat of combustion, mechanical connections between said last mentioned means and said thermal element, said thermal element acting in response to the establishment of combustion to keep said means in step with said timer to prevent said timer from reopening said switch while there is a demand for heat, and means preventing the reclosure of said switch, except upon manual intervention, once it has been opened by said timer during a demand for heat.

5. A control system comprising in combina-15 tion, an electrical fuel feeding device, a control switch therefor, a timer which moves in one direction in response to a demand for heat and in the opposite direction when there is no demand for heat, said timer first closing said control then reopening said switch as said timer moves in response to a demand for heat, means movable in timed relation to said timer in response to the establishment of combustion for preventing said timer from reopening said switch as long as there is a demand for heat, an ignition device for igniting the fuel fed by said fuel feeding device, and an ignition switch in control of said ignition device, said combustion responsive means closing said switch in cold position and opening said switch in response to the establishment of combustion.

6. A control system comprising in combination, an electrical fuel feeding device, a control switch therefor, a timer which moves in one direction in response to a demand for heat and in the opposite direction when there is no demand for heat, said timer first closing said control switch for a predetermined period of time and then reopening said switch as said timer moves in response to a demand for heat, means movable in timed relation to said timer in response to the establishment of combustion for preventing said timer from reopening said switch as long as there is a 45 demand for heat, an ignition device for igniting the fuel fed by said fuel feeding device, an ignition switch in control of said ignition device, said combustion responsive means closing said switch in cold position and opening said switch in response to the establishment of combustion, and means preventing said timer from closing the control switch for the fuel feeding device unless the combustion responsive means is in its cold position.

7. A control system comprising in combination, an electrical fuel feeding device, a control switch therefor, a timer which moves in one direction in response to a demand for heat and in the opposite direction when there is no demand for heat, said timer first closing said control switch for a predetermined period of time and then reopening said switch as said timer moves in response to a demand for heat, means movable in timed relation to said timer in response to the establishment of combustion for preventing said timer from reopening said switch as long as there is a demand for heat, an ignition device for igniting the fuel fed by said fuel feeding device, an ignition switch in control of said ignition device, said combustion responsive means closing said switch in cold position and opening said switch in response to the establishment of combustion, and a latch for mechanically preventing said timer from closing the control switch for the

heat, said combustion responsive means releasing said latch when it closes the control switch for the ignition device.

8. In a control system of the class described, an electrical fuel feeding device, a control switch 5 therefor, a lever adapted to actuate said switch, a timer, said timer, upon energization in response to a demand for heat, moving said lever to close said switch for a predetermined period of time and then open it again, and means acting in 10 response to the establishment of combustion for moving said lever in a direction to maintain said switch closed if it has not already been opened by said timer.

9. In a control system of the class described, an 15 electrical fuel feeding device, a control switch therefor, a lever adapted to actuate said switch. a timer, said timer, upon energization in response to a demand for heat, moving said lever to close said switch for a predetermined period of time 20 and then open it again, means acting in response to the establishment of combustion for moving said lever in a direction to maintain said switch closed if it has not already been opened by said timer, and means preventing the reclosure of said 25 switch by said lever, except upon manual intervention, once it has been opened by said timer during a demand for heat.

10. In a control system of the class described, an electrical fuel feeding device, a control switch 30 therefor, a lever adapted to actuate said switch, a timer, said timer, upon energization in response to a demand for heat, moving said lever to close said switch for a predetermined period of time and then open it again, means acting in response 35 to the establishment of combustion for moving said lever in a direction to maintain said switch closed if it has not already been opened by said timer, an ignition device for igniting the fuel fed by said fuel feeding device, and an ignition 40 switch in control of said ignition device, said combustion responsive means maintaining said ignition switch closed when cold and opening said switch in response to combustion.

11. In a control system of the class described, 45 an electrical fuel feeding device, a control switch therefor, a lever adapted to actuate said switch, a timer, said timer, upon energization in response to a demand for heat, moving said lever to close said switch for a predetermined period of time 50 and then open it again, means acting in response to the establishment of combustion for moving said lever in a direction to maintain said switch closed if it has not already been opened by said timer, an ignition device for igniting the fuel fed 55 electrical fuel feeding device, a power device by said fuel feeding device, an ignition switch in control of said ignition device, said combustion responsive means maintaining said ignition switch closed when cold and opening said switch in response to combustion, and a latch engaging 60 said lever to prevent said timer from closing said control switch on a demand for heat, said combustion responsive means releasing said latch when it is in cold position.

12. In a control system of the class described, 65 a floating lever, a mercury switch carried by said lever, said mercury switch comprising an elongated tube and electrodes extending into said tube at a mid point, mercury within said tube, combustion producing means including an elec- 70 tric fuel feeding device, a circuit therefor including said electrodes, a timer operatively associated with said lever at one point, combustion responsive means operatively associated with said lever

timer in response to a demand for heat to cause said timer to rotate said lever in a direction to cause the mercury to bridge said electrodes, further rotation of said lever causing said mercury to unbridge said electrodes again after a predetermined length of time, said combustion responsive means acting to move said lever in a manner to prevent the timer from rotating it far enough to unbridge the electrodes again, providing combustion occurs first.

13. In a control system of the class described, a floating lever, a mercury switch carried by said lever, said mercury switch comprising an elongated tube and electrodes extending into said tube at a mid point, mercury within said tube, combustion producing means including an electric fuel feeding device, a circuit therefor including said electrodes, a timer operatively associated with said lever at one point, combustion responsive means operatively associated with said lever at a second point, and means energizing said timer in response to a demand for heat to cause said timer to rotate said lever in a direction to cause the mercury to bridge said electrodes, further rotation of said lever causing said mercury to unbridge said electrodes again after a predetermined length of time, said combustion responsive means acting to move said lever in a manner to prevent the timer from rotating it far enough to unbridge the electrodes again, providing combustion occurs first, said switch requiring manual intervention to return it to its original position once it has been opened by the timer on a failure of combustion.

14. A fuel burner control system comprising an electrical fuel feeding device, a power device which when energized renders said fuel feeding device operative to deliver fuel to a point of combustion for a predetermined period of time and then renders said fuel feeding device inoperative again, means for energizing said power device, an ignition device for igniting the fuel, combustion responsive means preventing said power device from rendering said fuel feeding device inoperative if combustion is established during said predetermined period of time, means deenergizing said ignition device after combustion is established, and means mechanically preventing said power device upon energization from rendering said fuel feeding device operative unless said ignition deenergizing means has returned to a position where it is operative to energize said ignition device.

15. A fuel burner control system comprising an which when energized renders said fuel feeding device operative to deliver fuel to a point of combustion for a predetermined period of time and then renders said fuel feeding device inoperative again, means for energizing said power device, an ignition device for igniting the fuel, an ignition switch, combustion responsive means preventing said power device from rendering said fuel device inoperative if combustion is established during said predetermined period of time, said combustion responsive means opening said ignition switch upon the establishment of combustion, and means controlled by said combustion responsive means preventing said power device upon energization from rendering said fuel feeding device operative unless said ignition switch is closed.

16. A control system comprising in combination, an electrical fuel feeding device, a power at a second point, and means energizing said 75 device which slowly moves from a first to a second

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position upon energization and slowly returns to said first position upon deenergization, means for energizing said power device to first render said fuel feeding device operative for a predetermined period of time and then render it inoperative again as it moves into said second position, an ignition device, an ignition switch in control thereof, a combustion responsive device for preventing said power device from rendering said fuel feeding device inoperative as it moves into 10 said second position in the event that combustion has been established, said combustion responsive device also opening said ignition switch, and means preventing the energization of said power position.

17. A control system comprising in combination, an electrical fuel feeding device, a power device which slowly moves from a first to a second position upon energization and slowly re- 20

turns to said first position upon deenergization, means for energizing said power device to first render said fuel feeding device operative for a predetermined period of time and then render it inoperative again as it moves into said second position, an ignition device, an ignition switch in control thereof, a combustion responsive device for preventing said power device from rendering said fuel feeding device inoperative as it moves into said second position in the event that combustion has been established, said combustion responsive device also opening said ignition switch, and latch means controlled by said combustion responsive device for preventing movedevice unless said ignition switch is in closed 15 ment of said power device upon energization thereof unless said combustion responsive device is in cold position at which time it has closed said ignition switch.

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