Aug. 10, 1948. T. J. MESH 2,446,778

CONTROL FOR AUTOMATIC BURNERS

Filed March 15, 1945

Fig. 1.

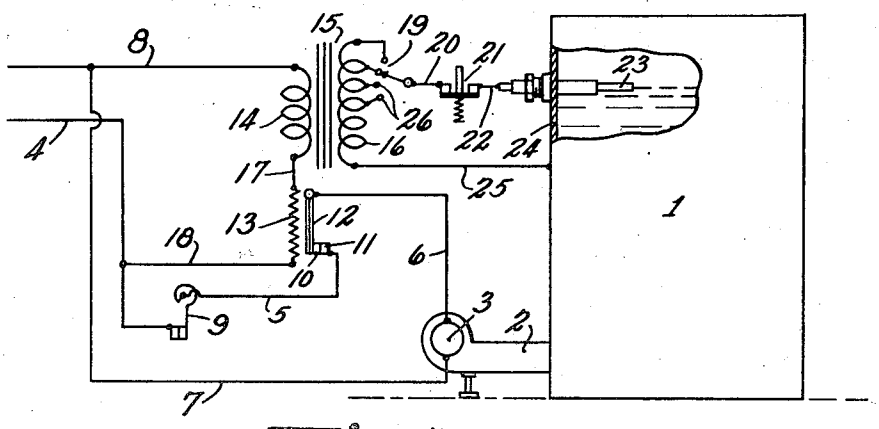


Fig. 2.

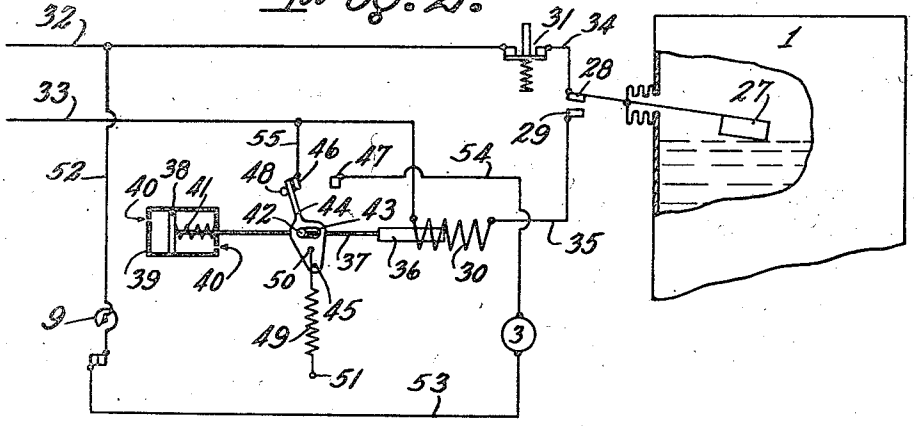
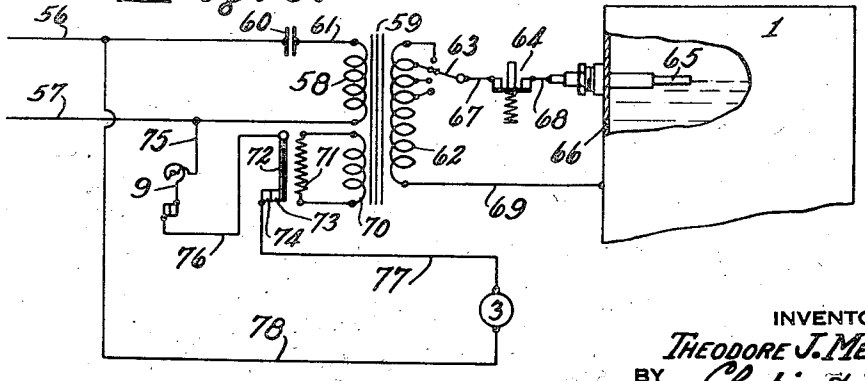


Fig. 3.



INVENTOR
THEODORE J. MESH
BY Chapin & Neal
ATTORNEYS

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CONTROL FOR AUTOMATIC BURNERS

Theodore J. Mesh, Easthampton, Mass., assignor to Gilbert & Barker Manufacturing Company, West Springfield, Mass., a corporation of Massachusetts

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9 Claims. (Cl. 122—504)

1

This invention relates to improvements in controls for automatic burners.

The invention has for its object to provide a safety control for a burner, which is arranged to fire a boiler and which is automatically started and stopped by a normal control, such as a thermostat for example, accordingly as there is a demand for heat or as such demand is satisfied, such safety control arranged to prevent operation of the burner under the normal control when the water in the boiler drops below a predetermined level and is maintained there for a predetermined time.

The invention provides a safety, water-level control which will prevent automatic shut down of the burner under momentary fluctuations of the water level in the boiler but which will positively cause a shut down, when the variations in water level become excessive.

As distinguished from safety, water-level controls of the prior art, the control of this invention provides for a definite time delay between the initiating action of the level-responsive means and the final action of the safety device which shuts down the burner.

The invention may be embodied with the electrode form of water-level control or with the float type of control. The invention, however, provides embodiments which are especially suitable for use with the electrode type of control because they are of an electrical nature.

The invention has for a further object to provide a control of the character described which may be made up of standard parts which are obtainable in the open market at low unit cost and which may be made up at relatively low cost because no parts need be specially manufactured for the control.

The invention will be disclosed with reference to the accompanying drawing, in which,

Fig. 1 is a diagrammatical view of an electrode type of water level control embodying the invention;

Fig. 2 is a diagrammatical view showing a float type of water level control embodying the invention; and

Fig. 3 is a diagrammatical view of a modified form of the electrode type of control.

Referring to these drawings; there is shown conventionally in Fig. 1, a boiler 1 and an automatic burner 2 of any suitable type for firing the boiler. The burner may, for example, be an oil burner, operated by an electric motor 3, although other kinds of automatically-operated burners may equally well be used, actuated by an electric

2

motor or otherwise as desired. In the illustrative example herein shown, the motor 3 is arranged in an electric circuit comprising the wires 4, 5, 6, 7 and 8, of which the wires 4 and 8 are adapted for connection to a suitable source of electricity, such as a 115 volt alternating current supply circuit, for example. In said circuit, the motor 3 is interposed between the wires 6 and 7; a normal control, such as a room thermostat switch 9 for example, is interposed between the wires 4 and 5; and a safety switch, which includes contacts 10 and 11, is interposed between the wires 5 and 6, the contacts 10 and 11 being respectively connected to the wires 6 and 5. There may be, in addition, any other of the usual controls or safety devices used with oil burners but illustration or description of these is thought unnecessary to an understanding of the present invention and the disclosure has been confined to a normal control and a safety water-level control in an electrically-actuated automatic burner. Of course, the normal control 9 need not necessarily be a room thermostat although that is the form commonly used.

This invention is concerned with various means for automatically stopping the burner in the event that the water in the boiler is maintained at a low level for longer than a predetermined time. The purpose is not to stop the burner each time the water drops below a predetermined level because there may be fluctuations in water level due to priming or other causes, which may momentarily carry the water below the predetermined level and the burner need not be stopped unless the low level condition is maintained for a predetermined time.

In Fig. 1, the contacts 10 and 11 are movable into engagement by a bi-metallic thermostat 12 which is heated by a coil 13. When sufficient current flows through coil 13 for a sufficient length of time, the thermostat 12 will move contact 10 into engagement with contact 11 and close the safety switch. When the current through coil 13 is insufficient, the contacts open and the circuit to the burner motor is opened, whereby the burner will be prevented from operating.

The heating coil 13 is connected in series with the primary 14 of a transformer, the core of which is marked 15 and the secondary 16. One terminal of primary 14 is connected to wire 8 and the other is connected by a wire 17 to one terminal of coil 13, the other terminal of the latter being connected by a wire 18 to wire 4. The secondary 16 is connected in a circuit which includes a selector switch 19, a wire 20, a switch 21, a wire 22, an insulated electrode 23, mounted in a wall of the

boiler and extending inside the same into the water in the boiler, the water in the boiler, a grounded electrode which may be the boiler wall 24 and a wire 25. The selector switch 19 is movable to engage any one of a plurality of contacts 26 connected to different taps on the secondary 16, whereby to vary the voltage impressed on the secondary circuit described. The switch 21 is of the spring-closed, push button type. It normally remains closed but may be manually opened to simulate the effect of low water condition for the purpose of testing the control.

The impedance of the primary winding 14 is high enough, when the secondary circuit is open, to prevent the flow through coil 13 of enough current to cause operation of the thermostat 12 and the resulting closure of the contacts 10 and 11. When, however, the secondary circuit is closed by the water path between the electrodes 23 and 24, the impedance of the primary 14 is reduced to a relatively low value and enough current will flow through coil 13 to heat the thermostat 12 and actuate it in a predetermined time to close the contacts 10 and 11. Thus, the burner will be permitted to start under the normal control 9 on the existence of a demand for heat. If the water level falls below electrode 23, the shunt is removed from the secondary 16 and the impedance of the primary then rises to a relatively high value, reducing the current through coil 13 with the result that the thermostat 12 will cool and move to separate contacts 10 and 11 after a predetermined time, say for example, ten seconds. If the water level fluctuates during operation of the burner, the current flow through coil 13 will be intermittent and the thermostat 12 will cool but at a slower rate. The contacts 10 and 11 will open but only after a longer time interval than before and provided that the electrode 23 is uncovered for an appreciable part of the time, say 50% or more.

As an illustrative example and without imposing limitations, the transformer may be of 5 volt-ampere size and the ratio of its windings 14 and 16 may be 1 to 2¼. The impedance across the secondary will vary say between 50 and 500 ohms, depending on the purity and temperature of the water, size of the electrode, and spacing of the electrodes. Assuming the highest value, likely to be encountered, say 500 ohms for example; the turns ratio of the transformer is such as to transform this resistance so that it appears as a relatively low value across primary winding 14, say 100 ohms for example (the impedance ratio varying with the square of the turns ratio and thus in approximately the ratio of 5 to 1). This low value of impedance (100 ohms), when connected in series with a small relay having a coil rated at 100 volts and drawing about 2.5 watts, has no appreciable effect on its operation. When the electrode 23 is uncovered, the shunting resistance is removed from winding 16 and thus also from winding 14 leaving the normal impedance of winding 14 in series with the relay coil 13. The normal impedance of winding 14 may be approximately 10,000 ohms. Voltage on the electrodes when electrode 23 is uncovered, will be about 200 volts but when electrode 23 is covered with water, the voltage will drop to about 10 volts. In practice, the selector switch 19 would be adjusted to operate the control with as low a voltage as possible when the boiler water is cold. Since heating the water improves its conductivity, reliable operation can then be expected under all conditions normally encountered.

In Fig. 2, the invention has been shown as embodied with a float switch as the boiler control. The float 27, located in the water in boiler 1 is arranged to move a contact 28 into and out of engagement with a contact 29 accordingly as the water in the boiler is above or below a predetermined level. The switch, comprising the contacts 28, 29, is arranged in series with the coil 30 of a solenoid and a switch 31 in a circuit including the 115 volt supply wires 32 and 33 and wires 34 and 35. The switch 31 is like switch 21 and serves the same purpose. The solenoid 30 when energized, is arranged to draw a plunger 36 to the right. Connected to the plunger is a rod 37 having on its left hand end a piston 38, which is reciprocable in a cylinder 39. In the heads of this cylinder are small openings 40, which permit slow inflow and outflow of air and thereby cause rod 37 to move slowly. A spring 41 tends to move piston 38 to the left. A roll 42 on rod 37 rides in an elongated slot 43 in a switch lever 44 pivoted at 45. This lever carries a contact 46 insulated therefrom and adapted to engage a fixed contact 47, which also serves as a stop for the lever. A fixed stop 48 limits the movement of the switch lever in a counterclockwise direction. A toggle spring 49 is connected to the switch lever and, with the parts positioned as illustrated, tends to hold the switch lever against stop 48 and in open position. When solenoid 30 is energized it will pull plunger 36 and rod 37 to the right against the force of spring 41. The plunger and rod will move slowly because of the dashpot action. The movement of rod 37 will not move lever 44 until the roll 42 engages the right hand end of slot 43 and moves the lever far enough to carry the end 50 of spring 49 to the right of a line connecting the pivot 45 and the end 51 of the spring. Then the spring will suddenly move lever 44 ahead of roll 42 and engage the contacts 46 and 47. Thus, the contacts 46, 47 will be closed only after the lapse of a predetermined time interval after the closing of the float switch contacts 46 and 47. When the solenoid is deenergized, the spring 41 will move rod 37 slowly to the left. The roll 42 will initially be located in the right hand end of slot 43 and, accordingly it will not move lever 44 until the roll has engaged the left hand end of the slot and moved the lever far enough to carry the end 50 of the toggle spring to the left of a line which connects the pivot 45 and the spring end 51. Then the spring will move lever 44 ahead of roll 42 and against the stop 48, whereby the contacts 46 and 47 will be separated. The arrangement described constitutes a time delay relay and its contacts 46 and 47 form a safety switch which is located as heretofore in the circuit of the automatic burner. This circuit may be traced as follows—from supply wire 32, wire 52, normal control 9, wire 53, motor 3, wire 54, contacts 47, 46 and wire 55 to supply wire 33.

When the water in the boiler is at or above the predetermined level, the contacts 28 and 29 are closed and the relay coil 30 is energized, thereby slowly actuating rod 37 and after a predetermined time moving lever 44 to close the contacts 46 and 47 of the burner circuit. The latter is thereby rendered operable and the burner may be operated under the normal control, such as the thermostat 9. When the water in the boiler falls below the predetermined level, the float switch will open and deenergize coil 30, whereupon spring 41 will start to move rod 37 to the left. Such movement of the rod will not open the safety switch 46, 47 until a predetermined time. Mean-

while, if the level in the boiler rises, the float switch will again close and energize coil 30 to draw rod 37 to the right. It will therefore be necessary for the low level condition to be maintained for a substantial time before the safety switch will open.

The time delay relay of Fig. 2 may equally well be used in place of the time delay relay shown in Fig. 1 or vice versa.

Both the time delay relays described are arranged to fail safe. That is, the level-control means must positively close the contacts of the relay before the burner can operate. Any failure of the level-control means will result in the relay contacts remaining open. Thus the failure is a safe one because operation of the burner is prevented.

The arrangements shown in Figs. 1 and 2 require the continuous expenditure of a small amount of power because of the "fail safe" feature. When such feature is not necessary or desired, a control may be had which requires almost no power under normal conditions. One such control is shown in Fig. 3.

In this figure, the alternating current supply wires are 56 and 57. In circuit with these wires is a winding 58 of a transformer, the core of which is designated 59, and a capacitor 60, the later being connected to said winding by a wire 61. In the secondary winding 62 of this transformer is a selector switch 63, a test switch 64, an insulated boiler electrode 65 and a grounded electrode 66. The secondary circuit also includes wires 67, 68 and 69 and is completed through the water in the boiler in the same manner as in Fig. 1. The various elements in the secondary circuit of Fig. 3 are the same as those of the secondary circuit of Fig. 1 and function in the same way. The transformer has a third winding 70 and in parallel with this winding is the heating coil 71 of a time delay relay. The coil 70 heats a bi-metallic thermostat 72 which carries a contact 73 into engagement with a contact 74. A wire 75 connects power wire 57 to the normal control 9 and the latter is connected by a wire 76 to contact 73. Contact 74 is connected by a wire 77 to the motor 3. The motor is connected by a wire 78 to power wire 56. Thus, the contacts 73 and 74 form a safety switch in the control circuit of the burner.

The turns ratio of the windings 70 and 58 is such that the resistance of the heater 71 is made to appear across the winding 58 as the optimum value of impedance necessary to secure maximum pore input to the circuit. The turns ratio of the windings 62 and 58 is such that the resistance of the circuit, which includes the electrode 65, is made to appear as a very low resistance across the winding 58. The effect is to practically short circuit the winding 58, leaving only the capacitor 60 in the circuit. Since a capacitor, when connected across an alternating current supply, such as that herein described, has an extremely low power factor, the power loss will be substantially zero. When however, the boiler water is below the electrode 65, the circuit which includes the winding 62, is open and produces no effect on the winding 58. Hence, there will be maximum power input into this circuit and current will flow in the heating coil 71 to heat thermostat 72 and cause contacts 73 and 74 to separate. This system of Fig. 3 is thus characterized by using power only when the safety device operates to stop the burner and during the interval when the burner is stopped by the action of the safety device.

As an illustrative example and without imposing limitations, the capacitor 60 may be of 1.0 mfd. size and coil 71 may have a resistance of 15 ohms. If the turns ratio between the windings 58 and 70 is 13.3 to 1, the resistance of coil 71 will appear across winding 58 as a resistance of 2650 ohms, which is the optimum value of resistance in the circuit of such winding necessary in order to secure maximum power input. For example, at 115 volts and 60 cycles, the power input will be 2.4 watts. The turns ratio between the windings 62 an 58 is 2.25 to 1. Thus, with the resistance in the circuit of the electrodes taken at its maximum of 500 ohms, this will appear in the circuit of winding 58 as 100 ohms. The power input to the circuit of winding 58, when the electrodes are connected by the boiler water, is only .25 watt and with a lower value of resistance in the circuit of the electrodes, this small consumption of power may be made even less. Thus, the Fig. 3 provides a control system in which the stand-by power loss is so small as to be negligible.

I claim:

1. The combination with a boiler and a burner for firing the same, of a normal control means for respectively starting and stopping the burner when there is a demand for heat and when such demand is satisfied, a safety control mechanism including an electrical member operable when energized for a predetermined time to prevent operation of the burner under the control of said normal control means, and means responsive to the level of water in said boiler and operable to energize said member when the water falls below said level and while the water remains below said level.

2. The combination with a boiler and a burner for firing the same, of a normal control means for respectively starting and stopping the burner when there is a demand for heat and when such demand is satisfied, a safety control mechanism for the burner including a member operable when moved in one direction from an initial position for a predetermined time to prevent operation of the burner under the control of the normal control means, means responsive to the level of water in the boiler for moving said member in said direction when and while the water is below a predetermined level, and means for moving said member toward its initial position operable when the water is at or above said level.

3. The combination with a boiler and a burner for firing the same, of a normal control means for respectively starting and stopping the burner when there is a demand for heat and when such demand is satisfied, a safety control mechanism for the burner including a member operable when moved in one direction from an initial position for a predetermined time to prevent operation of the burner under the control of the normal control means, means responsive to the level of water in the boiler for moving said member in said direction when and while the water is below a predetermined level, and means for moving said member at substantially the same rate toward its initial position operable when the water is at or above said level.

4. The combination with a boiler and an electrically-operated burner for firing the same, of a control circuit for the burner including a normal control switch for starting and stopping the burner accordingly as there is a demand for heat or the demand for heat is satisfied, a safety switch in said circuit, time delay means operable in a predetermined time after it is set into action to

actuate the safety switch and stop the burner, and means responsive to the level of water in the boiler and operable when the water falls below such level to initiate the action of the time delay means.

5. The combination with a boiler and an electrically-operated burner for firing the same, of a control circuit for the burner including a normal control switch for starting and stopping the burner accordingly as there is a demand for heat or the demand for heat is satisfied, a safety switch in said circuit, time delay means for actuating the safety switch and including a coil, a transformer having one winding connected in series with said coil in an alternating current circuit, electrodes for connection to the water in the boiler and connected by the water when the water is at or above a predetermined level, a circuit including said electrodes and a second winding of the transformer, the normal impedance of the first winding being sufficiently great to prevent energization of said coil when the second circuit is open, closure of the second circuit causing the impedance of the first winding to be lowered sufficiently to enable energization of said coil.

6. A safety control mechanism for a burner for firing a boiler, comprising, a time delay relay having an actuating coil and switch contacts for inclusion in the control circuit of the burner, a transformer, a circuit including one winding of the transformer and said coil and adapted for connection to a source of alternating current, a circuit including a second winding of the transformer and adapted to be connected to the boiler water to be opened and closed as such water falls below or rises to a predetermined level, the normal impedance of the first winding being sufficiently high to prevent energization of said coil when the second circuit is open, the turns ratio between the windings being such that the impedance of the second circuit when closed is transformed to a low enough value in the first winding to enable energization of said coil.

7. A safety control mechanism for a burner for firing a boiler, comprising, a transformer having first, second and third windings; a capacitor, a first circuit including the first winding and said capacitor and adapted for connection to a source of alternating current, electrodes adapted for connection to the boiler water and to be respectively electrically disconnected and connected as the water falls below or rises to a predetermined level, a second circuit including said electrodes and the second winding, a relay including an actuating coil and switch contacts for inclusion in the control circuit of the burner, said contacts being normally closed and adapted to be opened when said coil is energized, and a third circuit including the third winding and said coil, the turns ratio between the first and third windings being such that the resistance of said coil appears in the first circuit as a resistance of such value as will secure with relation to the capacity of said capacitor substantial power input in the first circuit, the turns ratio between the second and first windings being such that when the second circuit is closed the resistance of the second circuit appears in the first circuit as a resistance of low value acting substantially as a short circuit across the first winding and also across the third winding, whereby the relay coil in the third circuit will not be energized and whereby the power loss in the first circuit will be substantially zero when the second circuit is closed, opening of the second circuit enabling adequate power input into the first circuit and energization of the relay coil in the third circuit to cause the opening of said contacts.

8. A safety control mechanism for a burner for firing a boiler, comprising, a transformer having first, second and third windings; a capacitor, a first circuit including the first winding and said capacitor and adapted for connection to a source of alternating current, electrodes adapted for connection to the boiler water and to be respectively electrically disconnected and connected as the water falls below or rises to a predetermined level, a second circuit including said electrodes and the second winding, a time delay relay including an actuating coil and switch contacts for inclusion in the control circuit of the burner, said contacts being normally closed and adapted to be opened when said coil is energized for a predetermined time, and a third circuit including the third winding and said coil, the turns ratio between the first and third windings being such that the resistance of said coil appears in the first circuit as a resistance of such value as will secure with relation to the capacity of said capacitor substantial power input in the first circuit, the turns ratio between the second and first windings being such that when the second circuit is closed the resistance of the second circuit appears in the first circuit as a resistance of low value acting substantially as a short circuit across the first winding and also across the third winding, whereby the relay coil in the third circuit will not be energized and whereby the power loss in the first circuit will be substantially zero when the second circuit is closed, opening of the second circuit enabling adequate power input into the first circuit and energization of the relay coil in the third circuit to cause the opening of said contacts.

9. A safety control mechanism for a burner for firing a boiler, comprising, a relay having an actuating coil and switch contacts for inclusion in the control circuit of the burner, a transformer having first and second windings, a first circuit including the first winding and said coil and adapted for connection to a source of alternating current, electrodes adapted for connection to the boiler water and to be respectively electrically disconnected and connected by the water as it falls below or rises to a predetermined level, a second circuit including the second winding and electrodes, the normal impedance of the first winding being sufficiently high to prevent energization of said coil when the second circuit is open, the turns ratio between the windings being such that the impedance of the second circuit when closed is transformed to a low enough value in the first winding to enable energization of said coil, and means for varying said turns ratio.

THEODORE J. MESH.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,924,907	Bower	Aug. 29, 1933
2,129,094	Lake	Sept. 6, 1938
2,207,189	Austin et al.	July 9, 1940
2,335,655	Dickey	Nov. 30, 1943
2,358,432	Wolfner, 2d.	Sept. 19, 1944