May 20, 1941. A. K. FOULDS 2,242,580

HEATING APPARATUS

Filed Dec. 17, 1937

FIG-1

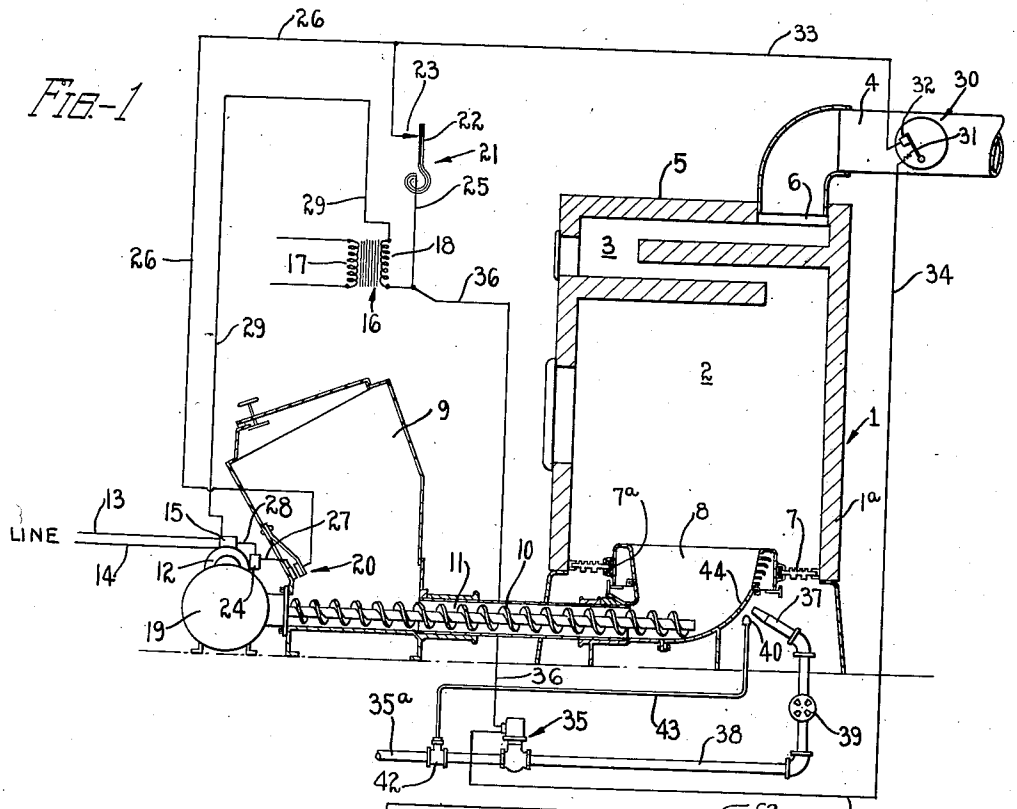


FIG-2

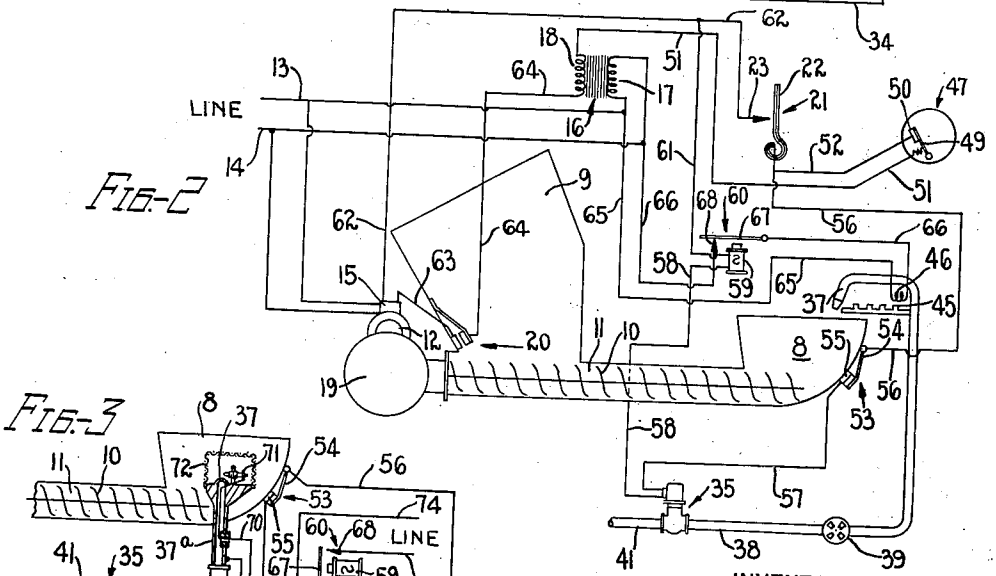


FIG-3

Patented May 20, 1941

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UNITED STATES PATENT OFFICE

2,242,580

HEATING APPARATUS

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14 Claims. (Cl. 110—1)

My invention relates broadly to heating apparatus and to a control system therefor, and more specifically to an apparatus having automatic control of the fuel supply.

An object of my invention is to provide means for relighting or reigniting fuel fed to the burner if the same should for any reason become extinguished.

Another object is to provide means by which the relighting means is rendered fully automatic.

Another object is to provide a system for initially starting operation of the heating apparatus when there has been no fire for a period of time.

Another object is to provide automatic means responsive to a predetermined low temperature of the heating apparatus to render effective the fuel igniting means.

Another object is to provide means to prevent operation of the fuel igniting means in the event the supply of fuel for the heating apparatus becomes exhausted or fails for any reason.

My invention consists in the novel control system and the particular apparatus embodied therein, to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawing, to be taken as a part of this specification, I have fully and clearly illustrated several embodiments of my invention, in which drawing—

Figure 1 is a view showing a heating apparatus in vertical section and showing diagramatically certain control apparatus cooperable therewith and comprising the control system;

Fig. 2 is a diagrammatic view showing a modification of my invention, and

Fig. 3 is a view of a portion of the system showing diagrammatically another form of my invention.

Referring to the drawing by characters of reference the numeral 1 designates generally a heating apparatus having a casing 1a forming a combustion chamber 2 and a baffled passageway 3, the passageway 3 leading from the combustion chamber 2 to an exhaust stack or flue 4. The casing 1a is closed at its upper end by an end wall 5 which has an outlet aperture 6 therethrough through which the products and wastes of combustion escape from the chamber 2 to the flue 4. Within the lower end portion of the casing 1a there is a supporting member 7 which may be a grate structure or a closure plate member extending transversely of said casing and which forms in part the bottom wall of the combustion chamber 2. The member 7 has a central aperture 7a therethrough to receive a fuel burner or fire pot 8 to position the pot in operable communication to the combustion chamber 2. The fire pot 8 fits snugly in the plate aperture 7a. The fuel (not shown), which in this case is coal, is fed from a hopper bin 9 into the fire pot 8 by means of a worm 10 housed within an inlet feed tube 11 for air and fuel. The worm 10 is driven by suitable means which is shown as an electric motor 12 and supplied with electrical energy from a suitable source of supply such as main lines 13 and 14. The motor 12 is started and stopped by a control relay 15 having its operating circuit connected with suitable energy supply means such as a transformer 16 containing primary coil 17 connected to a suitable electrical supply circuit and inducing the control voltage into secondary coil 18. The motor 12 operates a fan 19 which supplies air necessary for correct combustion conditions in the combustion chamber 2. The hopper bin 9 includes a hopper switch 20 so that when coal in said hopper bin falls below a certain predetermined quantity the switch will open and the motor 12 will not operate. The motor circuit 13, 14 may be controlled automatically by switch means, such as a room thermostat 21, having a bimetal strip 22 and a fixed contact member 23, or the switch means may be a manual switch. The motor 12 is provided with a thermal cut-out switch 24 which opens upon predetermined high temperature of the motor and is preferably a switch requiring manual reset. The member or strip 22 closes against member 23 at a predetermined low temperature in the space to be heated, and makes a circuit through lead wire 25 from one side of the transformer secondary 18 to lead wire 26 connected to one side of hopper switch 20. Electrically connecting the other side of switch 20 to one side of the cut-out switch 24 is a lead wire 27, and from the other side of switch 24 a lead wire 28 connects to motor relay 15. The relay 15 is connected by a lead wire 29 to the other side of the transformer secondary 18.

A temperature sensitive switch means 30 is shown carried by flue 4 and is diagrammatically shown having a contact arm 31 and a cooperable contact member 32. At a predetermined low stack temperature, arm 31 will come into contactual relationship with contact member 32 and make a circuit between lead wires 33, 34. The temperature sensitive means 30 is electrically connected to a solenoid valve 35 controlling flow

from a supply line or conduit 35a, and is also connected to the hopper switch 20 and the motor 12. The solenoid coil of valve 35 is connected to lead wire 34 and is also connected by a lead wire 36 to the transformer secondary 18 at the terminal of thermostat lead wire 25. A main gas jet 37 is supplied through a pipe line or conduit 38 leading from valve 35 and communicating therethrough with conduit 35a. The flow of gas to the jet 37 is controlled by means of the remotely operated solenoid valve 35. An air inlet 39 is placed in pipe line 38 on the outlet side of valve 35 to furnish air to provide a combustible mixture at the main jet 37, which in this instance is ignited by a constantly burning pilot 40 which is connected to gas supply conduit 35a in some manner such as by a T fitting 42 and pipe line 43. The main gas jet 37 is directed toward and in close proximity to the fire pot 8 so that the flame from the jet or burner 37 is directed through an aperture 44 in the wall of fire pot 8 for direct impingement of the flame against the fuel.

The operation of the apparatus above described is as follows: Assuming that combustion of the fuel in fuel pot 8 is in an extinguishing condition that is the flame in the pot 8 is either extinguished or so low that upon operation of stoker motor 12, the fan 19 and the feed device 10, 11, the heating device would fail to supply heat as desired, then there will be, or will have been, a decrease in temperature of the heating apparatus and the air or gases issuing to and through the flue 4. At a predetermined low temperature in the apparatus, say 125° F., the means 30 will have operated to close contacts 31, 32. When said fuel is of sufficient quantity to maintain the hopper bin switch 20 in closed position, the motor 12, fan 19 and feeding means 10, 11 will operate under control of the temperature sensitive means 30 which has closed the circuit at the predetermined temperature, furnishing fuel and air to the fire pot 8. The means 30 will also energize the solenoid valve 35, causing the solenoid valve to open and the gas to flow through main gas jet 37. Air for the flame from main jet 37 is furnished by air intake 39. This gas mixture at jet 37 is ignited by means of pilot 40 and the flame is directed through aperture 44 into the fuel contained in fire pot 8 until the fuel in pot 8 is ignited. After the flame from main burner 37 has ignited the solid fuel in fire pot 8 and heat issues from the solid fuel, the temperature of fire pot 8, combustion chamber 2, casing wall 1a, flue 4 and the gases fed thereto are raised; the temperature sensitive element 30 operates to deenergize and shut the solenoid valve 35, thereby extinguishing the flame from main gas burner 37 and also shutting down the stoker motor 12, fan 19 and feed device 10, 11. However, if the room thermostat 21 is calling for heat, the opening of circuit at switch means 30 will not stop the stoker mechanism comprising motor 12, fan 19 and feed device 10, 11 which will continue in operation until the thermostat 21 is satisfied. If the room thermostat 21 is satisfied and not calling for the operation of the heating unit, i. e., bimetal strip 22 not in electrical contact with contact 23, the fire in the stoker unit will remain in readiness until such time as the operation of the furnace to supply heat to the room or space containing thermostat 21, is desired. The hopper bin switch 20 acts as a safety means to prevent operation of the burner 37 in the event the bin 9 is below the switch closing level. It will be apparent from the foregoing description of operation that with such a device as my invention it is never necessary to light or relight the fire by the usual laborious process at any time.

In Fig. 2 I have a somewhat different arrangement of my invention. The main burner or jet 37, controlled by solenoid valve 35, overhangs the pot 8 and is directed downward to discharge the flame against or slightly beneath the top surface of the green fuel bed. The burner 37 is provided with a pilot gas jet 45 which is fed from conduit 38 and has a plurality of adjacent ports so that the pilot flame will run along the burner 45 to the jet 37. The jet 45 is ignited by means of an electrical igniter 46, such as a resistance element. The secondary coil 18 of transformer 16 is connected directly to a stack temperature responsive, high temperature cut-out safety switch, generally designated at 47, and shown diagrammatically as comprising a contact arm member 49 and a fixed contact member 50. The arm member 49 is connected to the secondary 18 by a lead wire 51, and the contact member 50 is connected by a lead wire 52 to the bimetal blade 22 of the room thermostat 21. In this form the fuel pot 8 has a temperature sensitive element 53 sensitive to the temperature of the pot 8 and mounted thereon, and diagrammatically shown as a movable contact arm 54 and a fixed contact member 55. A lead wire 56 connects the arm 54 to the lead wire 52, and a lead wire 57 connects the contact member 55 to solenoid 35, a lead wire 58 connecting solenoid 35 to the coil 49 of a relay 60. The other side of the relay coil 59 is connected by a lead wire 61 to a lead wire 62 connecting room thermostat contact 23 with motor starting relay 15. A lead wire 63 connects the motor starting relay 15 to the hopper switch 20 and a lead wire 64 connects the other side of the switch 20 to the secondary coil 18 of the transformer 16 completing the circuit. The electrical energy for the electrical igniter 46 is supplied by the lead wires 65, 66 and controlled through the magnetic relay 60 by an arm 67 and a contact member 68 in the wire 66. The supply of electrical energy for the lead wires 65, 66 may be common to the motor 12 and transformer 16, as shown from the line supply wires 13, 14.

In Fig. 3 the parts are in a still different arrangement. The main burner or jet 37 is carried by a gas mixture supply tube 37a which extends through the bottom wall of and is positioned within the fire pot 8 so as to direct the flame upward against the coal to ignite the green fuel supplied through the feed tube 11 by means of the worm 10. The jet 37 is ignited by the electric spark plug 71 which in this instance is carried by the tube 37a and is within a screen or foraminate cap member 72 which overlies the jet 37 and is secured on the tube 37a. The electrical energy is supplied to the plug 71 by means of high tension lead wires 69, 70 from the secondary of an ignition type transformer 73 which is fed from a suitable source of supply by lead wires 74, 75. The plug 71 and lead wire 69 are grounded to the tube 37a. The transformer energy supply is controlled by means of the relay contact 68 and armature blade 67. The blade 67 is operated by the magnetic relay coil 59 controlled by the temperature sensitive element 53 and hopper switch 20 as in Fig. 2.

What I claim and desire to secure by Letters Patent of the United States is:

1. An apparatus of the character described,

comprising a heat transfer apparatus including means for generating heat, said generating means including a fuel receiver for holding the burning fuel, means for controlling said generating means to regulate the heat generated, means responsive to a temperature of said apparatus and which temperature is created by said generating means, fuel igniting means, means to render effective said igniting means, said responsive means being operatively connected to and for initiating the operation of said fuel igniting means upon a reduction in temperature thereof indicative of an extinguishing condition of the fuel and independently of said controlling means, and means to supply fuel during the operation of said igniting means.

2. An apparatus of the character described, comprising a heat transfer apparatus having a generating means including a fuel pot for burning fuel, means for controlling said generating means to regulate the heat generated, means to feed solid fuel to said pot, means responsive to a temperature of said apparatus and which temperature is created by said generating means, means for igniting fuel supplied to said pot, means to render effective said igniting means, said responsive means being operatively connected to and for initiating the operation of said fuel igniting means upon a reduction in temperature thereof indicative of an extinguishing condition of the fuel and independently of said controlling means, and means to supply fuel during the operation of said igniting means.

3. An apparatus of the character described, comprising a heat transfer apparatus including means for generating heat by combustion, decrease of said generating means indicative of an extinguishing fire in said generating means independently of said controlling means, and means for supplying fuel to said generating means during operation of said igniting means.

4. An apparatus of the character described, comprising a heat transfer apparatus including a fuel pot, means to feed solid fuel to said pot, means normally controlling said feeding means, means responsive to temperature of said fuel pot, means for igniting fuel supplied to said pot, and means to render effective said igniting means, said responsive means being operatively connected to said last-named means to initiate operation of said igniting means and said fuel feeding means upon decreasing temperature change indicative of an extinguishing fire and operable independently of said normally controlling means.

5. An apparatus of the character described, comprising a heat transfer apparatus having an exhaust stack and including a fuel pot, means to feed solid fuel to said pot, means normally controlling said feeding means, means responsive to temperature of gases passing through said exhaust stack, means for igniting fuel supplied to said pot, and means to render effective said igniting means, said responsive means being operatively connected to said last-named means to initiate operation of said igniting means and said fuel feeding means upon decreasing temperature of the gases in said stack indicative of an extinguishing fire in said pot and independently of said normally controlling means.

6. An apparatus of the character described, comprising a heat transfer apparatus including a combustion chamber and a fuel pot, means to feed solid fuel to said pot, means normally controlling said feeding means, means operative in accordance with changes of temperature of said combustion chamber, means for igniting fuel supplied to said pot, and means to render effective said igniting means, said operative means being operatively connected to said last-named means to initiate operation of said igniting means and said fuel feeding means upon decreasing temperature change indicative of an extinguishing fire in said pot independently of said normally controlling means.

7. An apparatus of the character described, comprising a heat transfer apparatus including a fuel pot, means to feed solid fuel to said pot, means normally controlling said feeding means, means operative in accordance with the temperature of fuel inside said fuel pot, means for igniting fuel in said pot, and means to render effective said igniting means, said operative means being operatively connected to said last-named means to initiate operation of said igniting means and said fuel feeding means upon decreasing temperature change indicative of an extinguishing fire in said pot independently of said normally controlling means.

8. A heating apparatus comprising a casing including a combustion chamber having an outlet passageway for combustion gases, a fire-pot positioned within said casing adjacent the lower end portion of said chamber, a gas burner positioned adjacent said fire-pot and operable to direct a gas flame thereinto, an electrically controlled valve operable to control the gas supply to said burner, a temperature sensitive means responsive to the temperature of said fire-pot and operatively connected to said valve and acting to open said valve upon a predetermined decrease in temperature of said fire-pot indicative of an extinguishing fire thereby to maintain a continual fire in said fire-pot, and means for supplying fuel to said fire-pot during the time said valve is open and supplying gas to said main burner.

9. A heating apparatus comprising a casing including a combustion chamber having an outlet passageway for combustion gases, a fire-pot positioned within said casing adjacent the lower end portion of said chamber, a container for solid fuel, means for supplying fuel from said container to said fire-pot, a gas burner positioned adjacent to and in such a manner as to direct a flame into said fire-pot to ignite solid fuel therein, a valve means controlling said gas burner, a temperature sensitive means responsive to the temperature of the fuel in said fire-pot and operable upon a predetermined low temperature to open said valve for flow of gas to said burner, and fuel operated means actuated upon predetermined reduction in the quantity of fuel in said container, said fuel operated means acting to render said temperature sensitive means ineffective to open said valve means.

10. A heating apparatus, including a casing having inlet and outlet means, a container for solid fuel adjacent said casing, a fuel burner positioned within said casing, means for transferring solid fuel from said fuel container to said fuel burner to be burned therein, fuel igniting means adjacent said burner and operable to ignite fuel transferred to said burner, and means operable automatically at a predetermined low temperature of the fuel in said burner indicative of an extinguishing fire to actuate said igniting means and said fuel transferring means thereby to maintain continually a fire in said burner.

11. A heating apparatus, including a casing having inlet and outlet means, a container for

solid fuel adjacent said casing, a fuel burner positioned within said casing, means for transferring solid fuel from said fuel container to said fuel burner to be burned therein, fuel igniting means adjacent said burner and operable to ignite fuel transferred to said burner, means operable automatically at a predetermined low temperature of the fuel in said burner to actuate said igniting means, and means operable by weight of fuel in said container for controlling said automatic means.

12. An apparatus for heating an enclosed space comprising a heating means, means to feed fuel to said heating means, means responsive to temperature in said space to control the operation of said fuel feeding means, an ignition means for igniting the fuel in said heating means, and means responsive to a heating means temperature indicative of an extinguished or extinguishing fire for initiating the operation of said fuel feeding means and said ignition means independently of said space temperature responsive means.

13. In a heating system, the combination of a combustion chamber, a fire pot for said chamber, a stoker for automatically supplying solid fuel to said pot, room temperature controlling means controlling the operation of said stoker, means for projecting a flame against the fuel in said pot in the event of the extinguishing of the fire, and means responsive to the temperature of combustion gases and operable independently of said room controlling means to maintain said projecting means ineffective during existence of a self-maintaining fire in said pot and to start said stoker during periods of an extinguishing fire in said pot.

14. In a heating system, the combination of a combustion chamber having an outlet flue, a fire pot for said chamber, an underfeed stoker for supplying solid fuel to said pot, said pot having an opening through which fuel in said pot can be ignited, means to project an igniting flame through said opening and against the fuel, a thermostatic switch responsive to gas temperature in said flue, and an electrically operated valve having its circuit controlled by said switch and controlling the projection of flame against the fuel, said switch acting in response to temperature decrease indicative of an extinguishing fire to actuate said valve and to start said stoker thereby to maintain a low fire in said pot.

ANDREW K. FOULDS.

CERTIFICATE OF CORRECTION.

Patent No. 2,242,580 May 20, 1941

ANDREW K. FOULDS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 36, claim 3, after the word and comma "combustion," insert --means for controlling said generating means to regulate the heat generated, means responsive to a temperature of said apparatus and which temperature is created by said generating means, fuel igniting means, a gas pilot burner for igniting said ingiting means, electrically operated means for igniting said gas pilot burner, said responsive means being operatively connected to said igniting means to initiate operation of said igniting means upon a temperature--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of September, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)