

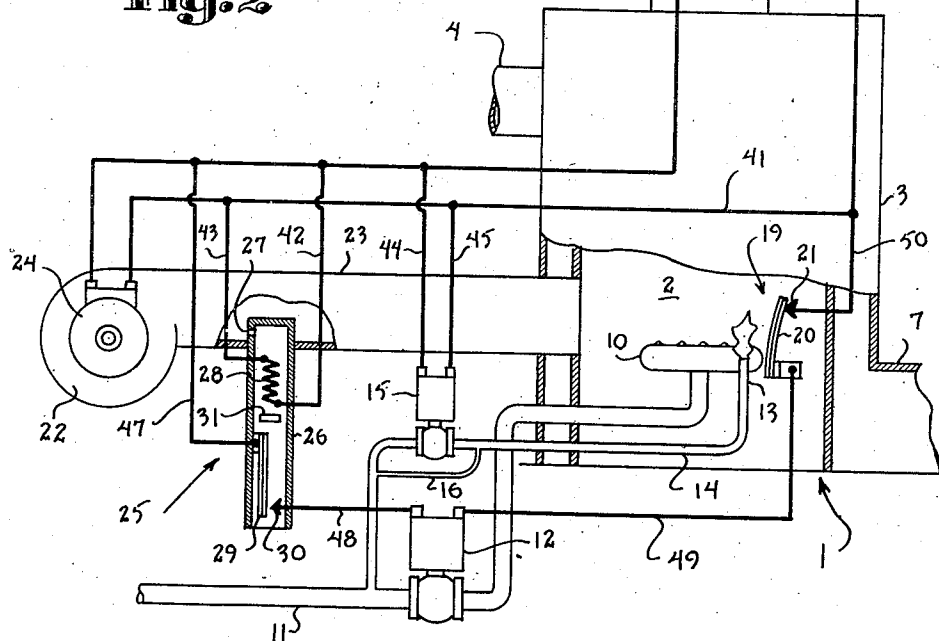
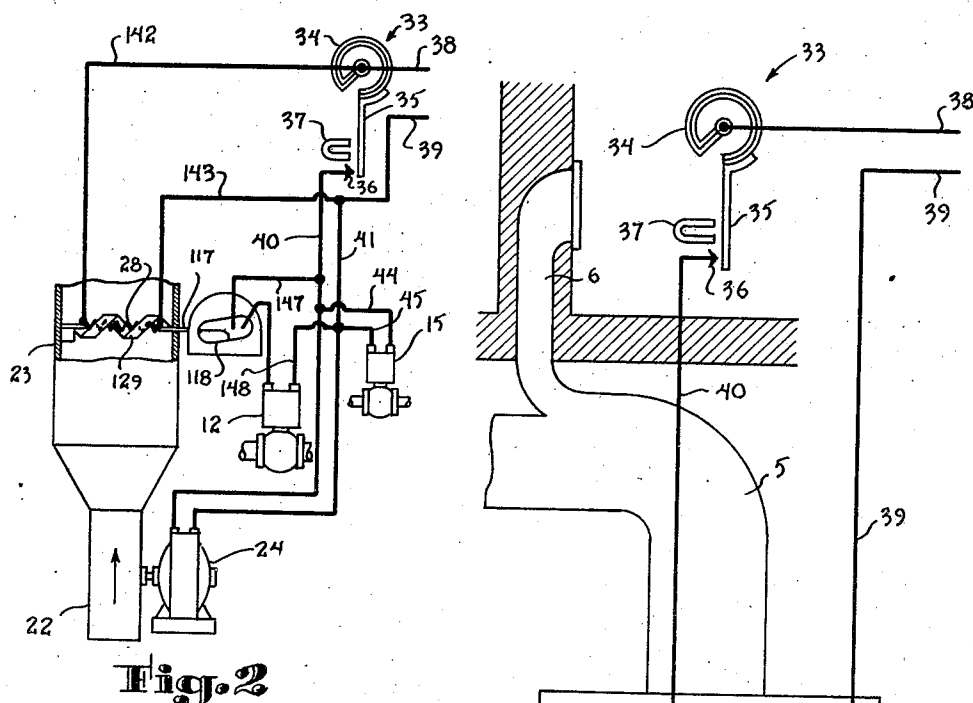
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COMBUSTION CONTROL SYSTEM

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COMBUSTION CONTROL SYSTEM

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My invention relates to the control of heating apparatus employing forced draft and is particularly concerned with improved safety devices for controlling draft in relation to fuel supply in a manner to insure that those practicing my invention will be exempt from the usual hazards attendant to the use of gas and oil fired heating equipment and various other types of equipment fired with fuel burned under forced draft. Most important among these hazards is, of course, the danger of introducing an igniter such as a spark or flame into a combustion chamber which has not been properly scavenged and which may be filled with explosive material in the form of gas fumes or air laden with minute particles of pulverized solid fuel suspended therein.

The primary object of my invention is to provide improved apparatus for insuring that the draft is always initiated ahead of the fuel supplying means in equipment of the above type and is always properly maintained while fuel is being supplied to the equipment.

Another object is to provide an improved device for insuring that the proper sequence and maintenance of draft and fuel supply are effected and which can only fail safe, that is, in the event of any casualty to the device itself or otherwise resulting in draft failure, shut down of the system is always effected in a manner and according to a sequence maintaining immunity from various dangers and hazards usually characteristic of the type of equipment to which my invention relates.

A further object is the provision of a fuel supply control device responsive to draft comprising a heat actuated switch arranged to shut off the fuel supply in the event of draft failure or of a contingency otherwise changing the amount of heat reaching the switch.

A further object is the provision of a draft responsive device comprising a draft tube having a heater and a heat actuated switch therein arranged so that the draft carries heat to the switch for actuating it.

Another object is the provision of a temperature control system wherein the fuel supply means are controlled by a heat actuated switch, heat for actuating the switch being carried to it by draft so that if draft fails the fuel supply means are shut down.

Another object is the provision of a fuel control system having a draft responsive fuel control device actuated by heat and arranged so that

draft air conveys heat away from the device for actuating it.

Other objects and advantages of my invention will become apparent from the accompanying drawing and detailed specification following.

Figure 1 of the drawing represents a gas fired warm air heating system having a preferred form of my improved control arrangement embodied therein.

Figure 2 is a modified form of my invention.

Referring to Figure 1 of the drawing, at 1 I have indicated a warm air furnace having a combustion chamber 2 and a jacket 3 forming a bonnet for the furnace within which air is heated for use in rooms or spaces being served. A stack or flue 4 communicates with the combustion chamber 2 and an air distributing duct 5 connects with the bonnet 3 for conveying air to various spaces or rooms to be heated, the distributing duct 5 having branch ducts or passages such as the duct 6 communicating with the individual rooms. Air is returned from the rooms or spaces and recirculated through the furnace by means of a return air duct 7 communicating with the lower part of the jacket 3.

Disposed within the combustion chamber 2 is a conventional gas burner 10 and fuel is supplied thereto through a conduit 11 which may be connected to a gas supply main. Interposed in the conduit 11 is a fuel control valve 12 which may be an electric solenoid type valve as I have shown, or it may take the form of other known fuel control valves now in use. For igniting fuel supplied to the burner 10 is a constantly burning pilot burner 13 which may be supplied with fuel through a tube 14 connected to the conduit 11 ahead of the valve 12. Interposed in the tube 14 is a small electric solenoid type valve 15 and connected to the tube 14 in by-pass relation with the valve 15 is a small by-pass tube 16. Fuel is continually supplied to the valve 13 through the conduit 11 through the tube 14, the by-pass 16 and the continuation of the tube 14. Whenever heat within the combustion chamber 2 is to be initiated as will presently be described, the valve 15 is opened so that fuel may be supplied directly through the tube 14 to the pilot burner as well as through the by-pass 16. The tube 14 is larger than the by-pass 16 so that when the valve 15 is open the size of the pilot flame is augmented to insure that it will be sufficiently large to ignite the fuel supplied to the burner 10.

Arranged adjacent the flame of the pilot burner 13 is a safety pilot 19 which may be of conventional type comprising a bimetal blade 20 which

is normally heated by the flame of the pilot burner and engages a fixed electrical contact 21.

Draft for combustion and for scavenging the combustion chamber is supplied by a draft fan 22, the discharge of which communicates with the combustion chamber by means of a conduit 23. The fan 22 is driven by an electric motor 24. Numeral 25 indicates generally a draft responsive control device for controlling the valve 12. The device 25 in the form in which I have chosen to disclose it comprises a Pitot tube 26 having an orifice 27 in a portion of the tube extending within the conduit 23, the tube and orifice being so arranged that when the fan 22 is in operation, draft air is forced through the orifice 27 and into the tube 26. Disposed within the tube 26 is an electric heating resistance 28 and a bimetal switch blade 29 cooperating with a fixed electrical contact 30. Between the heater 28 and thermal switch formed by switch blade 29 is a small baffle 31 interposed in the path of air flowing downwardly through the tube 26. Whenever the heater 28 is energized and draft is being properly supplied through the conduit 23, air will be forced downwardly through the tube 26 and will carry sufficient heat from the heater 28 to the bimetal blade 29 to cause the blade to flex into engagement with the contact 30 and complete an electrical circuit therethrough. Upon failure or discontinuance of the supply of draft through the conduit 23 the downward circulation of air through the tube 26 will stop and heat will no longer be carried to the blade 29 so that it will assume its original position and break contact with the fixed contact 30. At times when there is no pressure in the conduit 23, that is, when the draft fan 22 is not operating, the chimney effect of the tube 26 will cause air to circulate upwardly therethrough rather than downwardly as takes place when the fan 22 is operating. The natural tendency of warm air to rise will cause an upward circulation of air in tube 26 by reason of the heat at heater 28 when there is no pressure in conduit 23 for enforcing a downward circulation through tube 26.

Primary control of my system is exercised by a space thermostat 33 which may be of conventional type comprising a bimetal element 34 arranged to actuate a switch blade 35 cooperating with a fixed electrical contact 36. The blade 35 cooperates with a permanent magnet 37 which imparts snap opening and closing movements to the switch formed by the blade 35 and contact 36.

In operation when the temperature of the space being heated falls to a predetermined value, the blade 35 of thermostat 33 engages with fixed contact 36 and completes electrical circuits energizing the fan motor 24, the heater 28 and the small pilot control valve 15. Numerals 38 and 39 designate line conductors connected to a suitable source of external power and when the thermostat closes, the electrical circuit for the fan motor 24 is as follows: from line conductor 38 through the thermostat blade 35, fixed contact 36 wire 40, fan motor 24, wire 41, back to line conductor 39. The circuit for the heater 28 is from line conductor 38 through the thermostat blade 35, fixed contact 36, wire 40, wire 42, heater 28, wire 43, and wire 41 back to line conductor 39. The circuit for the small valve 15 is from line conductor 38 through thermostat blade 35, fixed contact 36, wire 40, wire 44, valve 15, wire 45, wire 41 back to line conductor 39. Upon completion of the circuits just described the fan 22 is started in operation for enforcing a circulation

through the combustion chamber 2 for scavenging it to remove any combustible gases which may have accumulated therein and which may have remained in an unburned state while the apparatus was not in operation. Opening of the small valve 15 admits an additional quantity of gas to the burner 13 for increasing the size of the pilot flame to insure ignition at the burner 10 when gas is supplied thereto. If operation of the fan 22 is properly initiated and heater 28 is properly energized as described, heat will be carried from the heater downwardly through tube 26 and switch blade 29 will be flexed into engagement with fixed contact 30. Upon this occurring a circuit for energizing and opening the valve 12 is completed as follows: from line conductor 38 through thermostat blade 35, fixed contact 36, wire 40, wire 47, blade 29, fixed contact 30, wire 48, valve 12, wire 49, safety pilot 19, wire 50 back to line conductor 19. Upon completion of this latter circuit, the main valve 12 opens admitting gas to the burner 10 which is ignited by the flame of the pilot burner 13 and heating is initiated within the combustion chamber 2. Heating will continue under the control of thermostat 33 and the draft responsive device 25. If draft should fail for any reason whatever while the heating apparatus is in operation, the draft responsive device 25 will operate to deenergize the valve 12 and shut down the system. For example, if the motor 24 driving the fan 22 should fail causing the pressure within conduit 23 to drop, sufficient heat would no longer be carried to the blade 29 for causing it to flex into engagement with the fixed contact 30. Thus the above described circuit for valve 12 would be interrupted and the supply of gas to burner 10 would be discontinued so as to safely shut down the system. If for some reason the heater 28 should become defective so that it should fail to properly supply heat, the blade 29 would flex away from the contact 30 in the same manner and also shut down the system. Thus it is to be seen that the draft responsive device 25 is arranged so that in the event of any type of failure or the occurrence of any exigency as might otherwise bring about a dangerous condition, the draft device 25 will bring about shut-down of the system in a safe manner. This represents an improvement in the art inasmuch as in known devices certain types of failure of the apparatus will cause the safety switch to assume a closed rather than an open position which is undesirable.

Whenever the thermostat 33 becomes satisfied, all of the above described circuits will be interrupted thus closing both the valves 15 and 12 and stopping the fan 22 and deenergizing the heater 28. It is to be seen that when heating is initiated the valve 12 is not opened until after draft has properly been established through the combustion chamber 2 but when heating is to be terminated the valve 12 is immediately closed in response to the opening of thermostat 33. At times when the apparatus is not in operation, the valve 15 is closed and only a very small amount of gas is supplied to the burner 13 through the by-pass 16. Thus the amount of fuel consumed when heating is not required is very small and economical.

Referring to Figure 2 of the drawing wherein I have disclosed a second form of my invention, the elements of the combination correspond generally to those of Figure 1 and are numbered the same but the draft responsive device is of

a slightly different character and operates in a slightly different manner. The elements of Figure 2 which differ from the disclosure of Figure 1 are numbered with numbers greater than 100. It will be noted that in Figure 2 the draft responsive device comprises a mercury switch 118 actuable by a helical thermostatic element 129 disposed in the path of draft air in the conduit 23. Arranged within the helical thermostatic element 129 is the electrical heating resistance 28 which in this form of the invention is continuously energized through an electrical circuit from line conductor 38, wire 142, heater 28, wire 143 back to line conductor 39. In operation, when the thermostat 33 of Figure 2 closes indicating a need for heating, a circuit for energizing the fan motor 24 is completed as follows: from line conductor 38 through thermostatic blade 35, fixed contact 36, wire 40, motor 24, wire 41 back to line conductor 39. At the same time a circuit for energizing the small electric valve 15 is completed as follows: from line conductor 38 through thermostatic blade 35, fixed contact 36, wire 40, wire 44, valve 15, wire 45, and wire 41 back to line conductor 39. Upon completion of the above circuits the draft fan 22 is started in operation and the small fuel valve 15 is opened, it being understood that the switch 118 controls the valve 12 and is normally in an open position under the influence of heat from heater 28 acting upon element 129. As soon as draft has properly been established through conduit 23 and the combustion chamber of the furnace a large part of the heat generated by element 28 will be carried away by the draft air and the draft air will thus cause cooling of the thermostatic element 129 which will move the switch 118 to a closed position. Upon closure of switch 118 a circuit for energizing and opening the main fuel valve 12 will be completed as follows: from line conductor 38 through thermostatic blade 35, fixed contact 36, wire 40, wire 147, switch 118, valve 12, wire 148, wire 41 back to line conductor 39. As soon as valve 12 opens heating is initiated and proceeds in the same manner as described in connection with Figure 1. Should now at any time there be a failure of the draft within conduit 23 so as to cause the air therein to become more or less stagnant the heat from heater 28 will no longer be carried away and element 129 will not be cooled and it will cause switch 118 to assume open position thereby terminating heating. Upon thermostat 33 becoming satisfied the fan immediately stops and both valves close.

From the foregoing it is apparent that the modification of my invention shown in Figure 2 provides a correspondingly inexpensive but effective system for controlling the fuel valve or the like in such a manner that scavenging of the combustion chamber is always assured and moreover that safety of operation which is always a prerequisite of such systems is assured as well.

My invention is particularly adapted to a combustion control system in combination with which I have disclosed it but it is to be understood that it is adaptable to other uses and to use in other combinations and arrangements. Therefore my disclosure is to be interpreted as illustrative only and I am to be limited only as determined by the appended claims.

I claim as my invention:

1. In a control system, in combination, heating means, fuel supply means cooperating with

said heating means, an energizing circuit for said fuel supplying means, draft supplying means for said heating means, means controlling said draft means and a draft responsive device controlling the fuel supply means, said device comprising means forming a passageway arranged to divert draft air from said draft supplying means, a heater and a heat actuated switching means in control of said circuit for said fuel supplying means arranged so that the draft through said passageway carries heat from the heater to the switching means for actuating the switching means to one position, the switching means being actuated to another position when not heated and said passageway forming means being so arranged that air is blown therethrough in one direction when the draft supplying means is operating and air is drawn therethrough in the opposite direction when the draft supplying means is not operating.

2. In a control system, in combination, heating means, fuel supply means cooperating with said heating means, draft supplying means for said heating means, means controlling said draft means and a draft responsive device for energizing the fuel supply means only when said draft supplying means is in operation, said device comprising means forming a passageway adapted to have draft air pass therethrough, a heater arranged in the path of air passing through said passageway and heat actuated switch means responsive to heat from said heater, said heater being so positioned that said draft supply means is effective to cause heat from said heater to be carried away from the switch means tending to cool said switch means and thereby cause energization of said fuel supplying means.

3. In an air flow responsive apparatus in combination, means forming a continuously open passageway, means for producing a circulation of fluid through said passageway at a substantially constant rate, means comprising a heat actuated device and a heat source in said passageway, said device and source being so relatively disposed that said device is substantially unaffected by radiant heat from said heat source and when said circulation producing means is in operation said fluid passes first over the heat source and then over the device, and said passageway forming means being so arranged and disposed that when said circulation producing means is not in operation said heat source induces a rising convection circulation of fluid through said passageway forming means with the fluid passing first over said device and then the heat source tending to carry heat away from the device, and a control device actuated to one position by said heat actuated device when said fluid passes first over said heater and then over said device, and to another position when said fluid passes first over said device and then over said heater, the flow of fluid through said passageway being unaffected by said control device.

4. In a heating system, in combination, a combustion chamber, a burner positioned to supply fuel to said combustion chamber, a fuel valve in control of flow of fuel to said burner, a blower for supplying air to said combustion chamber to support combustion, a heater positioned to be subject to flow of air from said blower, means including a thermostat in heat transfer relation to said heater for maintaining said fuel valve in closed position when no air from said blower is passing over said heater and for opening said

valve when air from said blower is passing over said heater, and a condition responsive means in control of said blower for starting operation of said blower to supply substantially full delivery capacity of said blower to said combustion chamber when heat is required in said combustion chamber and for stopping operation of said blower when no heat is required in said combustion chamber, whereby full air capacity of said blower is forced through said combustion chamber during the time interval between start of operation of said blower and actuation of said thermostat to open said fuel valve.

5. In a heating system, in combination, a combustion chamber, a burner positioned to supply fuel to said combustion chamber, a fuel valve in control of flow of fuel to said burner, a blower for supplying air to said combustion chamber to support combustion, a heater positioned to be subject to flow of air from said blower, means including a thermostat in heat transfer relation to said heater for maintaining said fuel valve in closed position when no air from said blower is passing over said heater and for opening said valve when air from said blower is passing over said heater, a condition responsive means in control of said blower for starting operation of said blower to supply substantially full delivery capacity of said blower to said combustion chamber when heat is required in said combustion chamber and for stopping operation of said blower

when no heat is required in said combustion chamber, and an electric circuit passing in series through said fuel valve, said thermostat and said condition responsive device, whereby a time interval will elapse between the starting of operation of said blower and the opening of said fuel valve but said fuel valve will close simultaneously with stopping of said blower due to the action of said condition responsive means.

6. In a heating system, in combination, a combustion chamber, a burner positioned to supply fuel to said combustion chamber, a fuel valve in control of the flow of fuel to said burner, a blower for supplying air to said combustion chamber to support combustion, means forming a passageway having upper and lower ends, the upper end being in communication with said blower, said means being so disposed that one end of the passageway is higher than the other end thereof, a heater positioned within the passageway, means in control of said valve including a thermostat located within the passageway at a point between said heater and the lower end of the passageway for maintaining said fuel valve in closed position when no air is passing over said heater due to the action of said blower and for opening said fuel valve when action of said blower transfers heat from said heater to said thermostat.

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