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W. A. RAY
HOT-AIR FURNACE CONTROL

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FIG. 1.

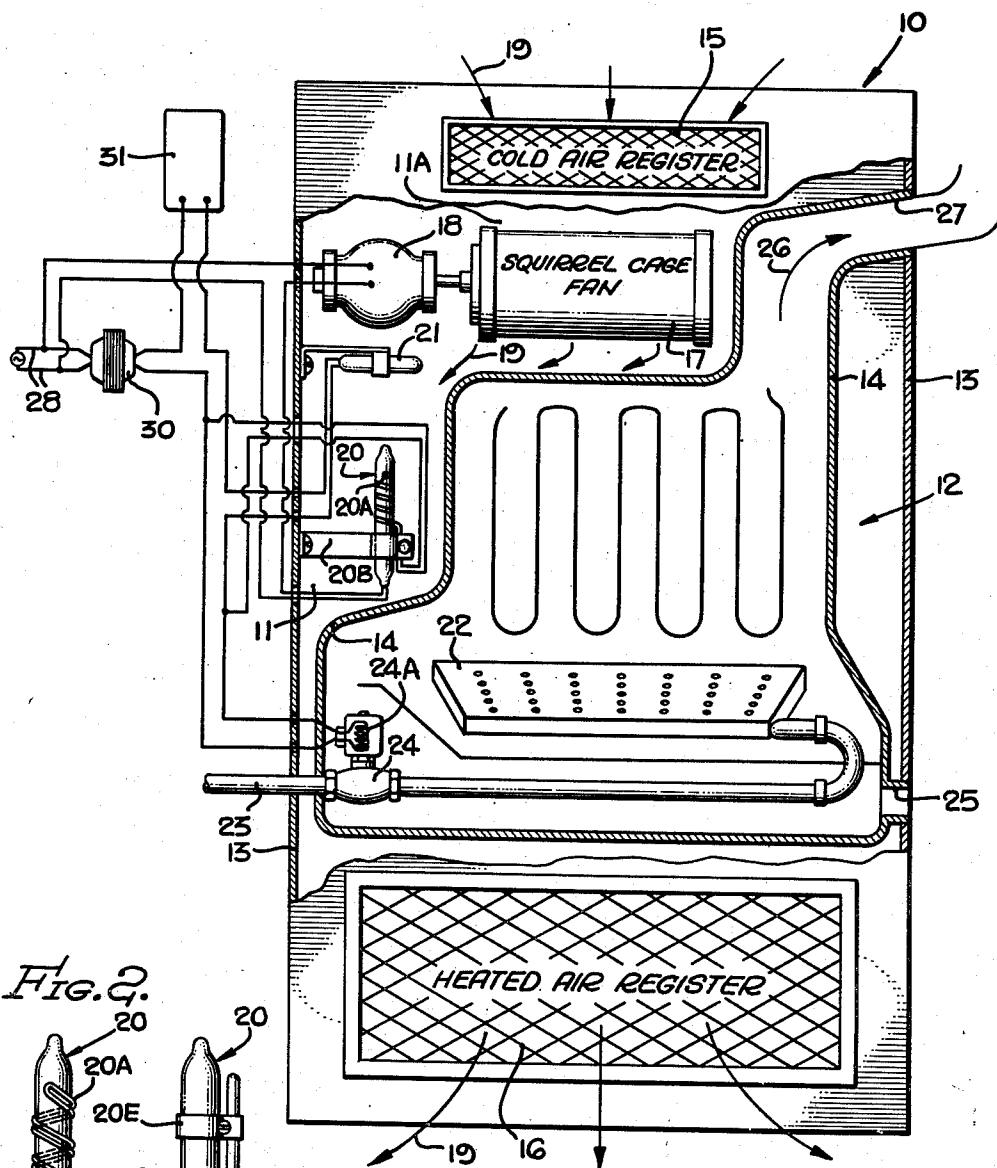


FIG. 2.

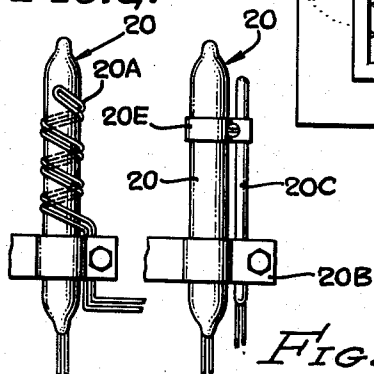


FIG. 3.

WILLIAM A. RAY,
INVENTOR.

BY

Lyon & Lyon
ATTORNEYS

UNITED STATES PATENT OFFICE

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HOT-AIR FURNACE CONTROL

William A. Ray, North Hollywood, Calif., assignor
to General Controls Co., a corporation of California

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The present invention relates to an improved furnace control particularly useful in a so-called reverse or contraflow air heating furnace.

In prior art air heating furnaces of this type a motor driven fan is usually provided to induce a flow of air therethrough in a direction reverse or contra to the normal gravity flow of the heated air. This fan is energized only after the temperature in the air passage reaches a predetermined elevated value; this temperature is reached usually within one to five minutes after the initiation of fuel burning in the furnace. For this purpose, a thermal responsive fan control switch is disposed in the air passage to start the motor driven fan, only when the switch environment temperature is above a predetermined elevated magnitude. While an installation of this type is satisfactory in starting the motor driven fan, difficulty is encountered due to the resulting stream of cold air through the passage induced by the fan. Such stream of air cools the thermal responsive switch to eventually turn the fan off prematurely.

The present invention has as its main object the provision of improved means and technique whereby the aforementioned difficulty may be obviated.

A specific object of the present invention is to provide means whereby the aforementioned thermal responsive switch is so positioned and is heated additionally to prevent premature actuation of the switch.

Another specific object of the present invention is to provide an improved furnace control of this type in which the motor driven fan is controlled, not only in accordance with the temperature of air in the air passage in the furnace, but also in accordance with the actuated condition of the fuel supplying means for the furnace, with the temperature of the resulting air stream producing a control effect which overrides the control effect produced upon actuation of the fuel supply means.

Another specific object of the present invention is to provide an improved system of this character in which heating means are associated with the aforementioned switch to supply sufficient heat to the switch to cause its actuation, in still air, after a time duration of, for example, from one to five minutes measured from the time of actuation of such heating means; but, the effect of such heating means being subordinate to the temperature of the resulting air stream whereby such air stream provides an overriding control effect.

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Another specific object of the present invention is to provide an improved switch for use in a system of this type, characterized by the fact that the switch is actuated, in still air, a time interval of, for example, one to five minutes after actuation of the associated heating means.

Still another specific object of the present invention is to provide improved means for use in a system of this character whereby the fan control switch, located at a relatively low position in the furnace, is effectively raised initially to an elevated position upon actuation of the fuel supplying means, and is then effectively lowered from such elevated position after energization of the associated fan means.

Another object of the present invention is to provide an improved system of this type, characterized by the fact that the fan control switch is located adjacent a substantially vertical heat radiating wall of the furnace and below the upper edge of such wall.

Yet another object of the present invention is to provide an improved switch with associated heating means, the heating means being effective, upon energization, to actuate the switch in still air and with or without heat supplied thereto from the furnace in which it is intended to operate, and without overheating the switch.

Yet a further object of the present invention is to provide an improved system of this type in which "cycling," which might otherwise be produced, is prevented.

Still a further object of the present invention is to provide an improved system of this type in which the fan control switch is responsive to the air temperature in the furnace, the switch being actuated in accordance with the heating effect produced by associated heating means, to cause actuation of the switch in still air, but with the resulting air stream providing a control effect on the switch overriding the previously mentioned heating effect.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. This invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof, may be best understood by reference to the following description taken in connection with the accompanying drawings in which:

Figure 1 is a view, partly structural and partly schematic, of a reverse or contraflow air heating furnace with associated controls embodying features of the present invention.

Figure 2 is an enlarged view of the fan control switch and associated heating means shown in Figure 1.

Figure 3 shows a modified construction with the fan control switch or bulb having mounted adjacent thereto a modified heating element.

Figure 1 shows an air heating furnace 10 in which the air flowing in the passage 11 is arranged to be heated by the fuel unit 12.

This fuel unit 12 is shown herein as being of the gas type, although it is within the scope of the present invention to utilize other types of fuel units for the gas type unit 12. For example, other fuel units 12 may comprise an oil burner or coal stoker. The air passage 11 is defined by the outer wall 13 of the furnace and spaced inner wall 14 of the fuel unit 12, this passage 11 terminating at its upper end at the cold air inlet or register 15 and terminating at its lower end in the heated air outlet or register 16. A squirrel cage type of fan 17 driven by an alternating current type of motor 18 is mounted on and within the walls 13 of the furnace, generally within the plenum or bonnet 11A of the furnace, and is arranged to induce a downward flow of air through the passage 11 to produce a flow of air indicated by the various arrows 19.

A thermal responsive normally open switch 20 is disposed within the passage 11 and may, for example, be mounted on wall 13 of the furnace. Preferably, the thermal responsive switch 20 is located with respect to the unit 12 as shown, i. e., towards the bottom of the fuel unit adjacent the side wall thereof, and below the upper edge of such side wall. This switch is mounted on the side wall of the furnace and spaced therefrom by bracket means 20B as shown in the drawings.

It is understood, of course, that the specific form of the normally open thermal responsive switch 20 may take one of the many different forms which are available in the commercial market. For example, the switch 20 may incorporate helically wound bimetal strips and is commonly referred to as a fan control bulb.

A similar normally closed thermal limit switch 21 may be disposed above the switch 20 for a different purpose as is described hereinafter.

The fuel unit 12 includes the gas burner 22 supplied with gas from the conduit 23 which has interposed therein the normally closed solenoid operated valve 24. Air for combustion is introduced through the air intake channel 25, which extends through both the wall 14 of the fuel unit, as well as the outer wall 13 of the furnace, so that this channel is in direct communication with the surrounding atmosphere. The heated gases in the fuel unit 12 pass upwardly, as indicated by the arrow 26, through the flue 27 defined by the upper annular wall 14 of the fuel unit.

The system is energized with alternating current supplied from the alternating voltage source 28 which may be the household mains. The opposite terminals of source 28 are connected to a series circuit which comprises the electrical fan motor 18 and normally open thermal switch 20, the fan motor 18 being energized only when the switch 20 is closed. The terminals of source 28 are likewise connected to the primary winding of a step down transformer 30 which has its secondary winding connected in a series circuit comprising the thermostat 31 located in the room being heated, the normally closed thermal limit switch 21, and the solenoid winding 24A associated with the valve 24.

In accordance with one of the important features of the present invention, a heater winding 20A encircles the outer wall of the switch 20 to heat the thermal element thereof, opposite terminals of such heater winding 20A being connected in shunt with the solenoid winding 24A, so that heat is supplied by the winding 20A so long as the solenoid is energized.

Thus, the thermal unit of switch 20 is sensitive to the temperature of the stream of air induced by the fan 17, and also is sensitive to the energized condition of the fuel unit 12, and is also sensitive to the heat radiated from the vertical adjacent side wall of the furnace unit 12.

In the event that the air temperature in passage 11 becomes greater than the predetermined value, the normally closed switch 21 opens to deenergize the solenoid winding 24A to in turn cut off the flow of fuel to the unit 12.

The heater winding 20A, when energized, produces sufficient heat to cause the normally open thermal switch 20 to close, in still air and with or without supplementary heat from the furnace unit 12, a time interval of, for example, one to five minutes after energization of the heater winding 20A. Sufficient heat is supplied by the winding 20A to accomplish this purpose, but the heat supplied is not too great to cause overheating of the switch or bulb 20. The heating effect produced by such heater winding 20A, however, is subordinate to the control effect produced by the air stream which results from the actuation of switch 20, i. e., the temperature of the resulting air stream induced by the fan 17 overrides the control effect produced by the heater winding 20A.

The heater winding 20A thus effectively produces a change in position of the switch 20 in accordance with the following concept. Upon initial application of voltage to the winding 20A, the switch 20 is, of course, heated faster than it otherwise would be, and the switch is thus conditioned for operation at a lower air temperature. This is equivalent to raising the switch 20 without the heater winding 20A from its low position shown in Figure 1 to an elevated position wherein the air temperature is higher, such air temperature being higher since the heated air, at this stage, rises up into the bonnet or plenum 11A. By thus raising the switch in accordance with this concept, the switch is actuated at a lower average air temperature in the composite furnace.

Subsequently, when the normally open switch 20 is closed, as a result of the heat supplied thereto, the fan means 17 is energized and the switch 20 tends to be cooled by the induced downward stream of air; but, at this stage, the furnace wall 14 in Figure 1 is hot and radiates heat to the switch to produce a compensating effect for the cooling effect of the induced stream of air. This is equivalent to lowering the switch 20 without winding 20A from its initially assumed elevated position. Thus, summarizing, initially, the switch 20 without winding 20A is effectively raised to an elevated position in the plenum or bonnet or adjacent thereto until the fan means 17 is energized, and thereafter switch 20 is effectively lowered to receive radiated heat from the side wall of the furnace unit.

The drawings, of course, show the switch 20 as being stationary, and the foregoing explanation serves to describe another way in which the inventive concept herein may be practiced. In other words, instead of using a stationary

switch 20 with an associated heater winding 20A, mechanical means may be provided whereby upon actuation of the fuel control means, i. e., energization of solenoid winding 24A, the switch 20 is moved to a position wherein it is heated in greater degree by the heated air in the plenum or bonnet at the top of furnace unit 12, to cause the switch 20 to close at a lower average air temperature after a time interval of, for example, one to five minutes. After the fan means 17 is energized upon actuation of the switch 20, the switch 20 is lowered to its normal position adjacent the heated side wall of the furnace unit which at this time is hot and radiates heat copiously to provide, in effect, a compensatory effect for the resulting induced downstream of air.

Stated in other words, the effect of the heater winding 20A on the switch 20 is to cause the switch 20 to operate at a lower air temperature than would be the case if the heater winding 20A were eliminated. In other words, the heater winding 20A provides a means whereby the thermal switch 20 is conditioned to operate at a lower air temperature.

The heater coil 20A may be affixed to the switch 20, following many different expedients, and many different means may be used to fasten the composite switch 20 and its heater coil 20A in the air passageway or duct 11. For example, the composite switch and heater coil 20A may be fastened as a unit to the furnace wall 13.

While the heater winding 20A in Figures 1 and 2 is shown as consisting of a bifilar type of winding with convolutions which encircle and abut the outside surface of the switch 20, the heater winding 20A may, of course, take different forms and shapes, and another example thereof is shown in Figure 3, wherein the heating element 20C is in the form of a heating tube which extends generally parallel with the axis of the bulb 20 and is spaced therefrom by the bracket means 20B and metallic strap 20E.

Summarizing the operation of the arrangement shown in Figure 1, initially, when the solenoid fuel supply valve 24A is energized, the side wall 14 of furnace unit 12 is relatively cold and the thermal responsive switch 20 is heated mainly by the heat produced in winding 20A, and to a lesser degree by the heated air in air duct 11. This heating action continues in relatively still air for about, for example, one to five minutes during which the side wall 14 of the furnace becomes increasingly hotter and radiates increasingly more heat to the switch 20. After the switch 20 is actuated, the fan means 17 is actuated to cause an induced downward flow of air past the switch 20 to tend to cool the same; however, this tendency of the switch to cool is compensated in large degree by the fact that, at this stage, the furnace unit wall 14 radiates a copious amount of heat. Thereafter, when the supply of fuel is interrupted, as for example, by opening the thermostat switch 31, by opening the switch 21, or upon operation of the associated safety system (not shown), the furnace unit gradually cools off to cause increasingly less heating of the air flowing past switch 21. When the air temperature reaches a predetermined low value the switch 20 automatically opens to deenergize the fan means 17 to interrupt the flow of air.

While the particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects and, therefore, the aim in the appended

claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

I claim:

1. In a contraflow furnace control system of the character described, a furnace having an air duct therethrough in which air is heated, said duct terminating in an upper cold air intake and a lower heated air outlet, a fuel unit supplying heat to the air in said duct, fan means inducing a downward flow of air through said duct, means supplying fuel to said fuel unit, an exposed thermally operated switch in said duct over which air streams for controlling operation of said fan means in accordance with air temperature in said duct, means conditioning said switch for operation at a lower air temperature, and means responsive to operation of said fuel supplying means for operating said conditioning means, the air streaming over said switch providing an effect which overrides the effect of said conditioning means.

2. In a contraflow furnace control system of the character described, a fuel unit having a heat transferring wall, a wall structure spaced from said wall and defining an air duct therewith, a fan inducing a downward flow of air through said duct, a motor driving said fan, means supplying fuel to said fuel unit, an exposed thermal operated switch in said duct influenced by the temperature of the air flow induced therein and streaming over said switch, an exposed heater mounted in proximity to said thermal operated switch to heat the same, means mounting said heater in said duct to allow air in said duct to stream over said heater and means energizing said heater upon operation of said fuel supplying means.

3. In a contraflow furnace control system of the character described, a furnace having an air duct in which air is heated, said duct terminating in an upper cold air intake and a lower heated air outlet, a solenoid valve controlling the flow of fuel to said furnace, an exposed normally open thermal responsive switch sensitive to air temperature in said duct, a fan inducing a flow of air through said duct, means mounting said switch in the air stream passing through said duct, a motor driving said fan, means including said switch controlling the operation of said motor, and a heater connected in shunt with said valve and disposed in proximity to said thermal responsive switch to heat the same.

4. In a contraflow furnace control system of the character described, a furnace having an air duct therein in which air is heated, a fuel unit supplying heat to the air in said duct, said fuel unit having a heat radiating wall which extends generally vertically, means inducing a flow of air through the duct, means supplying fuel to said fuel unit, exposed thermally operated means in said duct adjacent said wall and below the upper edge thereof over which air streams for controlling operation of said air inducing means in accordance with air temperature in said duct, means conditioning said thermally operated means for operation at a lower air temperature, and means responsive to operation of said fuel supplying means for operating said conditioning means.

5. In a contraflow system of the character described wherein there is a furnace unit having a relatively low heat radiating surface and a relatively high air space above the furnace unit in communication with air flow inducing means arranged to induce a reverse or contraflow of air therethrough in a direction opposite to the flow

of the heated air, exposed thermal responsive control means over which air streams for operating said air flow inducing means, said control means being sensitive to air temperature and being positioned adjacent said heat radiating surface below said high air space, fuel supply means, said radiating surface being relatively cold upon actuation of said fuel supply means, means effective when said fuel supply means is operated for conditioning said control means to operate at a lower air temperature, and said heat radiating surface being hot and effective when said air flow inducing means is operated for supplying additional heat to said control means to produce a compensating effect for the induced stream of air.

6. In a contraflow system of the character described wherein there is a furnace unit in communication with an air flow inducing means arranged to induce a reverse or contraflow of air therethrough in a direction opposite to the flow of heated air, exposed thermal responsive control means over which air streams for operating said air flow inducing means, said control means being sensitive to air temperature, fuel supply means, means effective when said fuel supply mean is operated for conditioning said control means to operate at a lower air temperature, and said conditioning means being substantially ineffective when said air flow inducing means is operated.

7. In a contraflow system of the character described wherein there is a furnace unit in communication with air flow inducing means arranged to induce a reverse or contraflow of air therethrough in a direction opposite to the flow

of heated air, exposed thermal responsive control means over which air streams for operating said air flow inducing means, said control means being sensitive to air temperature, means effective for conditioning said control means to operate at a lower furnace temperature, and said conditioning means being substantially ineffective when said air flow inducing means is operated.

8. In a contraflow system of the character described wherein there is a furnace unit in communication with air flow inducing means arranged to induce a reverse or contraflow of air therethrough in a direction opposite to the flow of heated air, exposed thermal responsive control means for operating said air flow inducing means, means effective for conditioning said control means to operate at a lower furnace temperature, said control means being responsive to the temperature of the air induced by said air flow inducing means and streaming over the same, and said induced air exerting a larger control effect on said control means than said conditioning means whereby the induced air provides an overriding control effect on said control means.

WILLIAM A. RAY.

References Cited in the file of this patent

UNITED STATES PATENTS

30	Number	Name	Date
	1,558,848	Doble	Oct. 27, 1925
	1,718,749	Marshall	June 25, 1929
	2,160,592	King	May 30, 1939
	2,363,696	Russel	Nov. 28, 1944
35	2,447,901	De Lancey	Aug. 24, 1948