July 28, 1942. C. H. BUCK 2,291,145

METHOD OF FLEXIBLE HEATING IN INTERMITTENTLY OPERABLE SYSTEMS

Filed April 13, 1940

FIG. 1

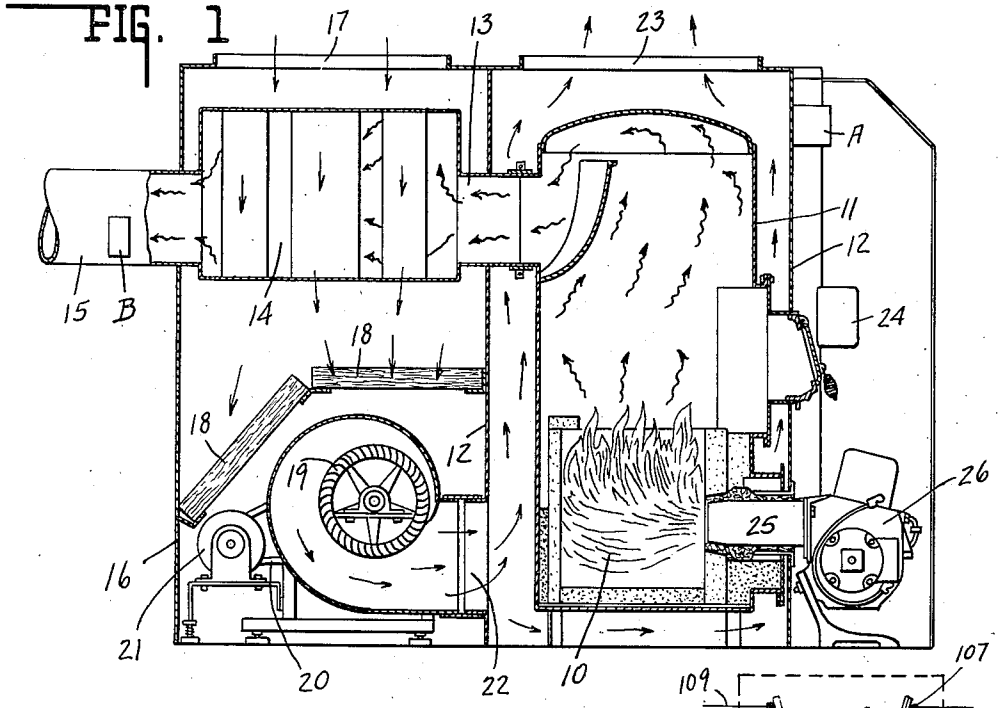


FIG. 2

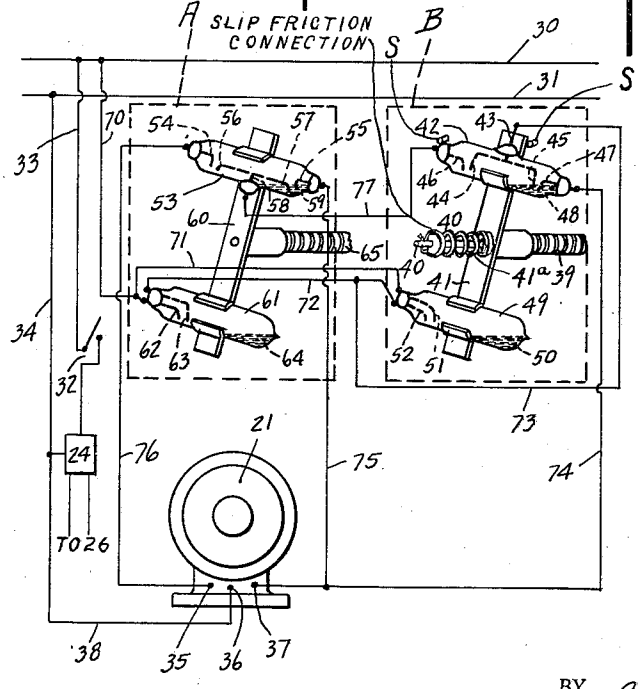


FIG. 3

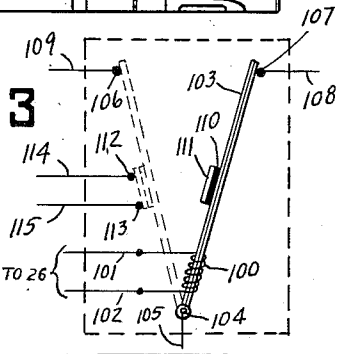
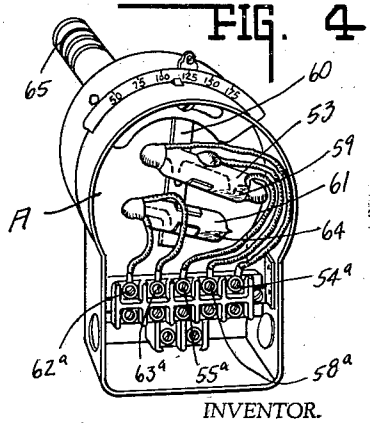


FIG. 4



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METHOD OF FLEXIBLE HEATING IN INTERMITTENTLY OPERABLE SYSTEMS

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Application April 13, 1940, Serial No. 329,433

1 Claim. (Cl. 236—9)

This invention relates to means for and a method of obtaining what is generally known as flexible firing effect from an intermittently operable combustion source.

The chief object of this invention is as suggested above, to-wit; to provide means for an intermittently operable combustion source and to so control the operation of said combustion source and the heat transferring medium and means that a flexible firing effect is obtained from an installation of the intermittent type.

The chief feature of the invention consists in operating such an intermittent combustion source and controlling the medium and means associated therewith so that when heat is desired for household or like heating purposes, as soon as the combustion source produces an initial amount of heat, the heat transferring medium is initially circulated and at a lower rate than at the rate which is utilized when the combustion source is operating at maximum capacity and the transfer of heat is being rapidly effected, coupled with the further provision that when heat is no longer demanded for such household heating, the heat stored in a portion of the heat transferring mechanism is slowly dissipated into the heat transferring medium as distinguished from the present and prior practice of rapidly transferring the same with the result that the effect of flexible firing is obtained and with the further result that "high over-run" operation is either very materially reduced or substantially eliminated.

For a complete understanding of the invention, it should be noted that for household heating there is generally provided one or more "room" thermostats in the desired location or locations, each of which is adapted to control the combustion source. This combustion source may be a gas fired furnace, an oil fired furnace, or a stoker fed furnace, as applied to hot air heating. If applied to hot water or steam heating, the same type of fuel may be utilized. Since the problems sought to be solved by this invention and solved thereby are more particularly acute in hot air heating installations, the following description and the drawing describe and illustrate, respectively, a hot air embodiment of the invention.

In hot air heating, the same may be of two types; the gravity type or the forced warm air type. In connection with the gravity type, it is well known that when the intermittently operable combustion source supplies heat that the air in contact with the bonnet and the like and included as a part of the circulating system for the air medium, immediately becomes heated and to a corresponding proportional degree and immediately starts to circulate and as the source of heat supplies additional heat to the bonnet, the rate of the circulation increases.

Then when the thermostat opens the circuit controlling the heat source, the heat previously stored in the bonnet and the like continues to dissipate or transfer to the circulating air in a decreasing amount of heat following cessation of heat supplied to the bonnet, until the heat is exhausted from the bonnet, whereupon the circulating medium, the air, ceases circulation.

It has been ascertained that the public is demanding clean heating equipment with the result that the circulation of air as aforesaid requires cleaning of the air which may be of two characters, either by washing or by filtering. Washing of the air is needlessly expensive. Filtering of the air is relatively inexpensive and practically all hot air installations, at the present time, are of the forced warm air character for the reason that the filter arrangement, when introduced into the gravity type system, practically prohibits gravity flow. Consequently, the necessity for filtering being paramount, there is provided a means for positively circulating the air in the system. In almost all instances, the cold air return discharges to a filter arrangement and a fan or blower draws the cold air through the filters which are replaceable and then forces the filtered air around and over the bonnet and other heating surfaces of the combustion source, and thence into the several pipes leading into the rooms to be heated.

The present invention is applied to the last mentioned type of system, although modifications thereof may be applied to other types of systems previously mentioned, with but slight change.

The present invention contemplates the utilization of a multi-speed motor for operating a fan or blower and, preferably, the motor has two speeds—the high and the low speed. The household "room" thermostat is the master control. When heat is required, it, through appropriate control means, insures the initiation of heat supply to the bonnet by automatically opening the gas valve in a gas fired furnace, etc.

The types of fuel are solid, liquid or vapor, to-wit: coal or coke, oil or gas. Usually there is no forced supply of air for a gas unit. There is a forced supply of air for oil and solid fuel consuming units. Generally, this forced supply of air is operated simultaneously with fuel supply. The fuel supply proper, as well as the air supply, is customarily provided with a safety arrange-

ment which, in the event that combustion cannot take place or does not occur, the fuel and air supply, while initiated, immediately ceases to function. This is the safety or protective factor which is standard in all intermittently operable combustion sources, more especially in gas and oil fired arrangements, but is also included in solid fuel fired arrangements in that unless the solid fuel initially supplied does not immediately continue to burn and to the desired amount, a thermally responsive element immediately cuts off continued fuel and air supply so that such solid fuel arrangement does not continue operation without combustion occurring simultaneously therewith. Since these types of controls and safety elements are standard equipment, as stated, no further detailed description nor any specific illustration thereof is believed necessary.

Also, old and well known is the operation which follows: When the room thermostat no longer calls for heat, the respective motors or controls are deenergized or rendered inoperative and further fuel and air supply is discontinued.

In such operation, it will be noted that for some interval following initial combustion the heat produced initially must heat all of the adjacent and surrounding parts in the combustion chamber, bonnet, etc. Thus, these types of heat sources differ from the more flexible type wherein there is resident as in a hand fired furnace a relatively large body of fuel, that is relatively slowly burning at all times. The latter type of construction is what is generally considered a flexible supply.

Returning to the intermittent type, following the initial heating of the parts in the combustion chamber which sometimes, particularly in gas and oil fired furnaces, includes heat absorbing refractories are employed to radiate heat combustion and such refractories have a heat absorbing capacity the aforesaid must be satisfied before the bonnet is in condition to supply heat to the air adjacent thereto.

Following satisfaction of this condition, additional heat then must be supplied to raise the bonnet temperature until such time as the heat therein is sufficient to heat the air in contact with the bonnet and the like, so that when the air is sufficiently heated it can be circulated for heating purposes. It is customary in installations of this character to provide a bonnet thermostat which, when the bonnet attains a certain temperature, say for example 125° to 165°, a circuit is closed by that thermostat and through the fan motor which insures positive circulation of the heated air.

It will thus be noted that from the time the combustion source starts to supply heat until the time that heat is adequately supplied to the circulating air, there is an appreciable time lag. Then, it is evident that as long as the room thermostat calls for heat, the combustion source will supply heat. When the room thermostat is thermally actuated to open the control circuit to the combustion source, no further heat is supplied by that combustion source, or more particularly, the primary supply.

However, there is a large amount of heat stored in the bonnet and refractories which, upon cessation of combustion, still is in condition to discharge and transfer heat so that long after the room thermostat shuts off, the bonnet thermostat still holds the circulating fan motor circuit closed until such time as the bonnet thermostat opens that circuit incident to the cooling of the bonnet by reason of the forced circulation of the cooler air from the several rooms to and over the bonnet and back to said rooms.

The resulting condition is this. If the thermostat is set, for example, to supply heat at a predetermined temperature and is adjusted to cut off heat supply at several degrees thereabove, this so-called intermittent heating results in what is known as a "high over-run" and this is because the bonnet thermostat continues fan operation. The resulting action in the rooms to be heated is that there is at each cycle a relatively wide fluctuation between the actual room temperature when heat is supplied in response to room thermostat demand for heat and the final room temperature effected, long after the room thermostat has been satisfied. These are always considerably below and above the temperatures for which the room thermostat demands or causes a cessation of operation at the primary source.

Insofar as forced feed hot air heating is concerned, therefore, the problem is emphasized many times when such heating system is associated with an intermittently operable source of heat.

The present invention contemplates the employment of a multi-speed motor for the air circulating fan or blower and having the former so controlled that when the primary heat source is conditioned to supply heat and is not otherwise inoperable, the fan motor shortly after such conditioning, operates at low speed and then when the bonnet temperature increases to the proper amount the low speed motor operation is discontinued and high speed motor operation of the fan is effected which is continued so long as the room thermostat calls for heat.

Immediately upon the room thermostat shutting off, the air circulating fan motor, or rather shortly thereafter, ceases to operate at high speed, but is then operated at low speed and this low speed operation is continued until the bonnet temperature has sufficiently decreased whereupon cessation of all forced feeding of air is effected.

From the foregoing, therefore, it will be understood that during the fire build-up period and during the fire dying period, corresponding to a hand-fired furnace, the air circulating fan motor operates at slow speed while during the maximum or full draft period of a comparable hand fired furnace, the air circulating fan motor operates at high speed. Thus, there is obtained with this invention that condition comparable to a flexible firing effect by utilizing as a primary source of heat, an intermittently operable combustion source.

The objective result is that the so-called high over-run heretofore inherent in intermittently operable combustion source systems, together with other inherent difficulties or objections are eliminated.

One of the latter is the elimination of so-called air stratification common to such intermittently operable systems and not generally present, unless there is an air locking or binding, in a gravity system. It may be noted, also, that when the latter condition occurs in a gravity system, practically the only solution to that problem is to apply a forced circulating arrangement by installing a fan or blower to positively insure proper circulation.

The basic invention, therefore, it will be appreciated from the foregoing, relates primarily to the cycle of control for obtaining flexible firing effect from an intermittently operable combus-

tion source. Certain phases of the invention are equally advantageously applicable to certain other types of combustion sources, such as those known as high-low firing systems and those known as flexible flame firing systems, although specific mention hereof of the same is not to be construed as excluding others to which the present invention might also be applied with the same advantages attendant upon such application.

The problems inherent in heating system constructions are well known and attempts have been made to solve the same by utilizing time controls which have definite time factor applications, regardless of the temperature difference between the interior of the house to be heated and the exterior, so that such time controls, while seeking to accomplish substantially the same objective, to-wit: the solution of these problems fail to accomplish the same over a wide range of conditions because the adjustments must be so made that they only apply to the average temperature difference condition.

The present invention, therefore is universally flexible since, as will be hereinafter pointed out more fully, it operates solely upon temperature difference and, therefore, regardless of the temperature difference between the interior of the house to be heated and the exterior or outside air, the system always properly functions and the problems previously inherent in intermittently operated combustion sources, time lag responsive control systems are not present.

Having thus described the cycle of operations, the problem and the solution effected by such cycling reference will now be had more particularly to apparatus capable of effecting such cycling.

It is to be understood, however, that while the several parts of this apparatus are illustrated as of mercury switch character they may be of snap switch character or of relay switch type. Mercury switches are notoriously effective and safe, the circuit being made and broken within a sealed chamber, thereby reducing fire hazard to a minimum hence the preferred form of the apparatus invention is illustrated and described as including mercury switches.

The full nature of the invention will be understood from the accompanying drawing, the following description and claim:

In the drawing, Fig. 1 is a diagrammatic sectional view through a forced air heating system including the invention applied thereto, the latter being more or less illustrated diagrammatically.

Fig. 2 is a wiring diagram of connections showing mercury switch applications throughout.

Fig. 3 is a diagram of a warp switch modification of a portion of the switching arrangement shown in Fig. 2.

Fig. 4 is a perspective view of a temperature responsive switch arrangement.

In Fig. 1 of the drawing, there is indicated a combustion chamber **10** surrounding a bonnet **11**, in turn surrounded by the furnace casing **12**, the air space therebetween being included in the hot air heating circulatory system. The combustion chamber is herein shown discharging as at **13** to a super-heater **14** in turn discharging to a smoke pipe **15** leading to a chimney or stack. The letter B designates the so-called stack switch arrangement to which reference will be had more fully hereinafter and to its equivalent warp switch construction, see Fig. 4.

A casing **16** has one or more cold air inlets **17**, the other ends of which are connected to registers and the like by cold air ducts. These registers are positioned, usually, in the floor of one or more rooms in the lower floor of a multi-floor building. The relatively cool air entering the intake **17** passes through the super-heater and is initially heated. It then passes through the filter structures **18** being drawn therethrough by a fan structure **19** herein shown belt-driven as by the belt **20** from the fan motor **21** which, preferably, is of multi-speed character. This arrangement, however, can be direct drive or can be two motors with slip clutches, if desired. The fan discharges as at **22** to the chamber between the outer part of the furnace and the dome and bonnet arrangement.

The hot air discharges from the furnace by one or more outlets **23** which, through suitable conduits, discharge to the several rooms. These conduits usually are valve controlled.

Associated with the bonnet and dome is what might be termed the bonnet switch, herein designated by the letter A. Also carried externally of the furnace proper is another motor controller arrangement **24** to which reference will be had hereinafter.

The present form of the invention illustrated includes a tubular structure **25** adapted to supply both air and oil to the combustion chamber **10** and this air and oil is supplied by a combination unit including a motor and fan arrangement, together with all the customary safety devices, valves and pipe, and the same is designated generally by the numeral **26** in Fig. 1.

Reference will now be had to Fig. 2. Herein is illustrated the power supply mains **30** and **31**. In the event the room thermostat **32** is of 110 volt character, it is included in series for direct control and operation of the controller arrangement **24** which, as before stated, controls the air and fuel supply motor combination **26**. As long as this thermostat **32** is closed, air and fuel will be supplied for combustion purposes, providing the controller **24** is properly conditioned.

Usually the controller **24** includes a safety device which prevents the supply of fuel if the device is not conditioned for proper operation.

Herein line **33** includes a supply line to the controller **24** and line **34** includes the return. It, of course, is obvious that the thermostat switch may be of a remote control character, that is, close a switch that in turn controls the supply of energy that is supplied to the controller mechanism included in the controller **24**.

Furthermore, it is quite apparent that the room thermostat in the latter instance also may be of low voltage type and then would derive its voltage supply from a small transformer. All of these are conventional variations and are well known in standard practice.

In Fig. 2, the motor **21** is provided with terminals **35**, **36** and **37**. The terminal **36** is connected by line **38** to one of the mains, which is the ground main. The motor is so arranged that when current is supplied to terminal **35**, the motor operates at high speed, and when current is supplied to terminal **37** the motor operates at low speed. Thus, the fan operates at high or low speed, respectively, depending upon to which motor terminal current is supplied.

Included in the dotted lines indicated by the letter A in Fig. 2, is the bonnet switch and included within the dotted lines B in Fig. 2, is the stack switch.

Since certain of the parts hereinafter to be

described, are conventional and well known constructions, only brief reference will be had thereto. For example, incorporated as a part of the stack switch is a bi-metallic helix 39, which upon being sufficiently heated has one end arranged to cause rotational movement. This rotating end is indicated by the numeral 40 and carries a support 41 that is tiltable clockwise and anticlockwise to certain stops which limit the extent of the movement, regardless of the changes of temperature.

Carried by the member 41 is a single pole double throw mercury tube switch indicated generally by the numeral 42 and included therein is a central terminal 43 and two oppositely directed contact terminals 44 and 45. Extending into each end of the tube is a contact member such as 46 and 47. The mercury 48 is adapted to bridge alternately the switch contacts 45 and 47 and 44 and 46, depending upon the position of the member 41.

The member 41 also mounts another mercury switch indicated generally by the numeral 49 and including mercury 50 therein and having two terminals 51 and 52 at one end. As shown in Fig. 2, which represents the dormant condition, the mercury 50 in switch 49 does not close the circuit across the contacts 51 and 52 and the mercury 48 in the other switch 42 does not close the circuit across the contacts 44 and 46, but does close the circuit across the contacts 45 and 47.

When there is an increase in temperature in the stack incident to initial combustion and long prior to any appreciable rise in temperature to which the bonnet switch arrangement A is susceptible, the helix 39 is affected and the member 41 is tilted, counter-clockwise so as to close the circuit across contacts 51 and 52 in switch 49 and across 44 and 46 in switch 42, and simultaneously open the circuit across 45 and 47 in the last mentioned switch.

These are the two positions assumed by this switch arrangement. The last mentioned is what might be termed, active combustion position, and the former, as shown in the drawing, is the so-called "dormant position." It is to be understood that the helix 39 is operatively connected to the member 40 such that there is a slip engagement connection effected so that member 41 is operated by metal helix 39 on a change in temperature of a predetermined amount, regardless of the starting or stopping points of the structure.

Since this helix and its slip connection to a switch carrier is well known in the heating and ventilating control art, no specific description is believed necessary.

The bonnet switch structure A, see Figs. 2 and 4, includes a mercury switch 53 which at opposite ends includes a contact 54 and 55. Adjacent each contact is a contact 56 and 57, respectively the two latter being connected together and having a common terminal connection 58. The mercury 59 in the tube is adapted to close the circuit across the contacts 57 and 55 when the bonnet switch structure is in the inactive or fire build-up position. The tiltable member 60 supports said switch 53. It also supports another mercury switch 61 which at one end has two terminals 62 and 63. The mercury 64 in said mercury switch is adapted, during the active combustion period or after the fire has been built up sufficiently to close the circuit across contacts 62 and 63. An element similar to element 39 and indicated by the numeral 65 is exposed or responsive to bonnet temperatures. This switch arrangement A is of the slow acting type as compared to the switch B. This switch arrangement A is not of the slip character whereas switch arrangement B is of that character so that as the bonnet temperature gradually rises, the member 60 will gradually rotate counter-clockwise so that the circuit will be closed across contacts 54 and 56 and across contacts 62 and 63 and will be opened across contacts 55 and 57.

This tilted position of the bonnet switch in the counter-clockwise direction is maintained from the time that the switch becomes operative, that is, responds to an increase in bonnet temperature sufficient to cause the switches to be tilted, until such time as the temperature of the bonnet drops. This, as previously set forth, occurs a considerable period after the fuel supply has been rendered inoperative by the room thermostat due to the storage of heat as before set forth.

A line 70 connects the main 30 to the switch contact 62. The line 71 connects that same switch contact to the switch contact 51. The line 72 connects switch contact 52 to switch contact 63 and the line 72 is also connected by line 73 to the common switch terminal 43 of the switch 42. The switch contact 47 is connected by line 74 to the terminal 37 or low speed terminal of the motor 21. The line 75 also connects thereto and to the switch contact 55 in the switch 53. The switch contact 54 in the switch 53 is connected by line 76 to the terminal 35 or the high speed terminal of the motor 21. The terminal 46 of switch 42 is connected by line 77 to the common terminal 58 of the mercury switch 53. In Fig. 2 stops S limit the actual throw of the switch carrier 40. However, the spring 41a permits the bi-metallic helix 39 to coil and uncoil as required by temperature conditions and there is thus insured proper switch carrier movement in the ranges permitted by said stops S.

Having thus described the various connections, the circuits will be set forth briefly as follows:

When the room thermostat 32 calls for heat, the control 24 is suitably energized as before described. After a very slight interval, it will be obvious that the products of combustion escape through the smoke pipe and in so doing the temperature in the smoke pipe increases. When a predetermined amount of temperature difference has been obtained, member 39 responsive to such temperature, responds thereto which tilts the mercury switches 42 and 49 counter-clockwise. In so doing, it will be noted that current then is supplied to low speed motor terminal 37 as follows:

Current from the main 30 is supplied by line 70 to line 71 to the terminal 51 through the mercury 50 to the terminal 52 and thence by way of lines 72 and 73 to the common terminal 43, thence by contact 44 through the mercury 48 of switch 42 to the terminal 46, thence by line 77 to the common terminal 58 of the switch 53 through the contact 57 and mercury 59 to contact 55 and thence by line 75 and 74 to the low speed terminal 37.

Thus, until the stack switch structure B has responded to a predetermined temperature in the stack, the fan motor 21 is not energized even

after the cycle has been initiated by the room thermostat 32, but upon attainment of that predetermined temperature difference the low speed portion of the motor 21 is energized for low speed fan operation, thereby insuring relatively slow speed forced air operation. This is during the fire build-up period and before the bonnet has attained a sufficiently high temperature to cause rapid circulation of the air.

When the bonnet has been sufficiently heated the bi-metallic helix 65 of switch A becomes operative to rotate member 60 counter-clockwise so as to tilt the mercury switches 61 and 53. When this occurs, the circuit is as follows:

The current is again supplied from line 30 by means of line 70 to terminal 62. The mercury 64 in switch 61 then bridges the contacts 62 and 63 so that if current is supplied to line 72 and by mercury 50 to contact 51 and thence to line 71 it is carried back to the contact 62. It will be noted that this in effect has no circuit effect, but this false circuit condition is pointed out so that the real circuit condition arrangement will be understood.

Current from line 70, as stated, through the mercury 64 passes from terminal 62 to terminal 63 of switch 61 and thence by lines 72 and 73, it passes to the common terminal 43 of switch 42 and the mercury 48 therein bridges contacts 44 and 46 completing the circuit to line 77 connected to the common terminal 58. The mercury 59 in the switch 53 now completes the circuit across the contacts 54 and 56 so that the line 76 is in series with the line 70 so that current is supplied to motor 21 through the high speed terminal 35 for high speed operation of the motor. Therefore, high speed operation of the fan 19 insures rapid circulation of the heated air between the bonnet and dome and the furnace casting wall. This condition or circuit arrangement is maintained as long as the control 24 is energized combustion continues in the firebowl.

It is to be noted that if, for any reason, the control 24 fails to function due to mechanical or other failure when the room thermostat calls for heat, the switch arrangement B does not function. Therefore no operation of the fan motor occurs upon combustion source failure.

When the room thermostat responds to the heated condition caused by the operation of the heating system being activated, it opens the circuit to the control 24 and combustion ceases. Within a relatively short time following such cessation of combustion, the bi-metallic helix 39 again becomes operative but in a reverse direction and upon the predetermined temperature drop the switches 42 and 49 are tilted clockwise from their previous counter-clockwise tilted position. In so doing, the circuits are conditioned through these two switches as shown in Fig. 2.

It is, however, to be noted that due to the residual heat in the bonnet, firebowl, refractories, etc., the switch structure A is not positioned as shown in Fig. 2 but remains positioned in the tilted position as last described. The circuits then are as follows: Current is supplied by line 30 to line 70 to contact switch 62 of switch 61 and since the mercury 50 is now remote from the two switch points 51 and 52 of switch 49, no circuit is completed through the switch 49 by line 71. The circuit, however, is completed by the mercury 64 across contact 62 and 63 and thence by lines 72 and 73 to the common switch terminal 43 of the switch 42.

The mercury 48 now bridges the two contacts 45 and 47 so that current is supplied by line 74 from contact 47 to the low speed terminal 37 and thus substantially upon cessation of combustion or following the same, at a very short interval, air circulating fan high speed motor operation ceases and low speed motor operation thereof occurs. This continues until the bonnet temperature has dropped sufficiently so that bi-metallic helix 65 again becomes operative in the opposite direction in an amount sufficient to tilt the switches 61 and 53 clockwise to the position shown in Fig. 2. Thereupon, since both switches 61 and 49 are in the clockwise tilted or dormant position, as shown in Fig. 2, no current is supplied to either the high or low speed terminals 35 or 37 of the motor.

Reference will now be had to Fig. 3. In said figure there is indicated a heating device 100 supplied by lines 101 and 102 and these lines are connected to the electrical power supply and are responsive to the operative condition of the controller 24 and associated mechanisms. In other words, if proper combustion cannot be effected when the thermostat 32 calls for heat, this heating element 100 will not be energized for heating purposes or heated, at least if there be a safety control incorporated in the controller 24, to such degree as to effect thermally a thermally responsive element, to-wit: a warp switch controller. This warp switch controller is diagrammatically indicated in Fig. 3 as a bi-metallic warp switch 103 mounted at 104 connected to a line 105 which, in effect, is the line 73 in Fig. 2.

The bi-metallic warp switch member 103 is positioned between the contacts 106 and 107 which are comparable respectively to switch contacts 46 and 47 respectively of switch 42. A line from contact 107 indicated by numeral 108 is the same as the line 74 of Fig. 2 and leads to the low speed terminal 37. A line 109 from contact 106 is the same as line 77 of Fig. 2 to common terminal 58 of switch 53.

As shown in Fig. 3, member 103 contacts the contact 107 and this is the dormant position. Upon the predetermined temperature difference occurring incident to the operation of the heating means 100 as beforementioned, member 103 moves counter-clockwise and contacts the contact 106. The bi-metallic strip 103 supports in insulated relation as at 110, a bridging contact member 111 adapted to contact two contacts 112 and 113 to which is connected lines 114 and 115. The contacts 112 and 113 correspond to the switch points 51 and 52 of switch 49 in Fig. 2 and the lines 114 and 115 thereto and therefrom correspond to the lines 71 and 72 respectively, of Fig. 2.

The operation of this switch structure shown in Fig. 3 is functionally identical to that illustrated in Fig. 2 and represented therein and designated as the stack switch B.

In this connection, it should be noted that the switch arrangement shown in Fig. 3 does not require that the switch arrangement be subjected to stack temperature differences or the like. In other words the basic invention comprehends a switch arrangement which is responsive to combustion per se, that is, switch B or the switch arrangement shown in Fig. 3, tilts counter-clockwise when combustion starts or shortly thereafter and when combustion stops or shortly

thereafter this switch arrangement is tilted in the reverse direction.

Other electrically operable means may be utilized in lieu of either of the two specific switch arrangements disclosed herein.

While the invention has been illustrated and described in great detail in the foregoing description, the same is to be considered as illustrative and not restrictive in character.

The several modifications described herein, as well as others which will readily suggest themselves, to persons skilled in this art, are all considered to be within the broad scope of the invention, reference being had to the appended claim.

The invention claimed is:

A method of obtaining flexible firing effect in a heating system having a conventional source of heat intermittently operable in response to room thermostat demand, a fan and motor operable at selective speeds for forcing the flow of the heating medium of the system, and a pair of thermally responsive controls for the motor arranged for subjection to two different thermal conditions, one thermal responsive control being directly responsive to predetermined change in the active temperature of the heat source and the other being responsive to a predetermined temperature of the heating medium when subjected to the heat effect of the heat source, said method including automatically forcing the flow of the heating medium at a relatively slow rate and in response to the first mentioned thermal control immediately or comparatively shortly after room thermostat calls for heat, continuing that forced flow during the heat build up period of the system until terminated by the second thermal control, then forcing the flow of the heating medium at a much greater rate when the second mentioned control becomes effective incident to heating medium increased temperature to the predetermined temperature, continuing the second mentioned flow until the room thermostat no longer calls for heat, and then continuing the forced flow of the heating medium at the slower rate from immediately or comparatively shortly after room thermostat demand is satisfied and until the source of heat has sufficiently cooled as determined by the first mentioned control becoming ineffective for fan operation.

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