June 28, 1938. R. E. NEWELL 2,121,977

TEMPERATURE CONTROL SYSTEM

Filed Aug. 24, 1935

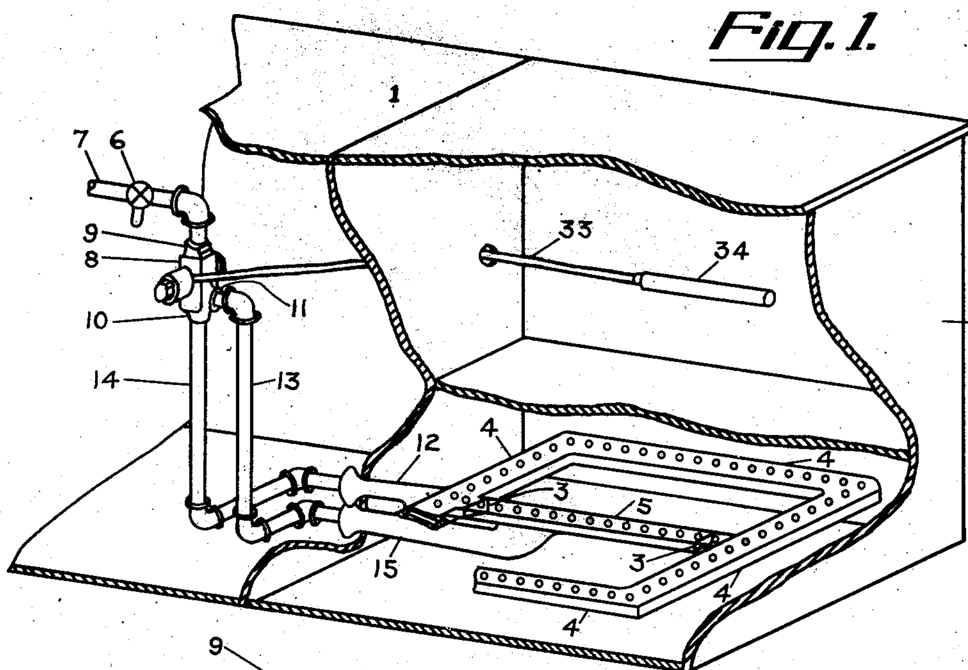

Fig. 1.

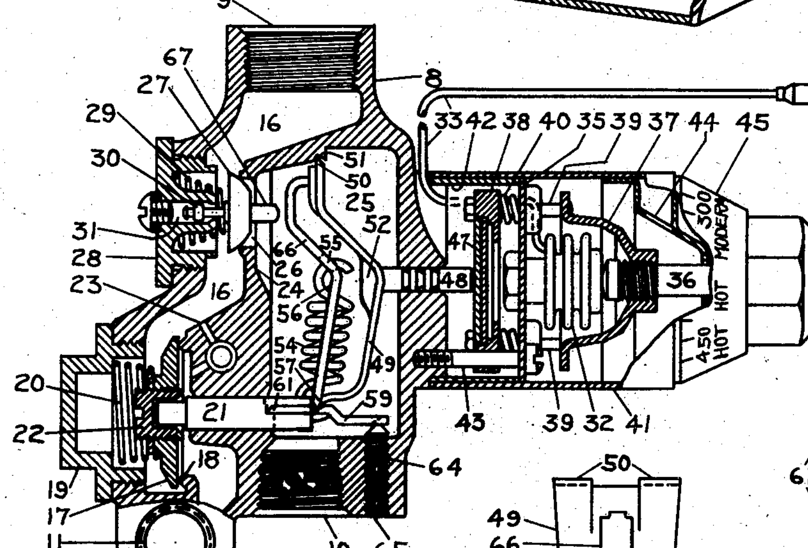

Fig. 2.

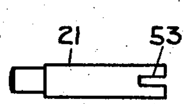

Fig. 3.

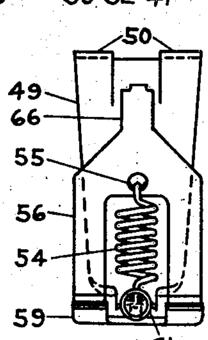

Fig. 4.

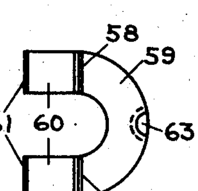

Fig. 5.

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TEMPERATURE CONTROL SYSTEM

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6 Claims. (Cl. 236—15)

This invention relates to a method of controlling the temperature of a medium or a chamber heated by a fluid fuel heater, using a thermostat and a novel valve structure operated thereby for regulating the supply of fuel to the heater.

In ovens, space heaters and the like, it has been the usual practice heretofore to have a thermostat operate a gradually acting valve for increasing or decreasing the flow of fuel to the burner. Thus as the temperature of the medium or the chamber gradually increased, the valve would be gradually closed until finally, when the desired temperature was reached, the valve would be completely closed and fuel supplied to the burner through a by-pass which maintained a low flame over the entire burner.

There are several objections to this system, among them being the fact that the burners necessarily are designed to operate with maximum efficiency at full capacity and since in this system the burners are at full capacity but a short time, they suffer a loss in efficiency. It is also easily seen that because of the gradual decrease of fuel supply with the gradual increase in temperature, the time required to originally heat the medium or the chamber is unnecessarily long. Another objection applicable in connection with domestic ranges having well-insulated ovens, is that if it is desired to have the oven at a low constant heat such as 300°, even a low flame over the entire burner, such as provided by the by-pass, tends to raise the well-insulated oven to a temperature above that desired.

Attempts have been made to overcome these objections by operating the valve with a snap action and having a small pilot flame for ignition, eliminating the bypass. However, the sudden blasts of heat upon the opening of the valve are not conducive to maintaining a uniform temperature after the medium or the chamber has been originally heated.

By my invention, I provide a method and apparatus for overcoming the aforementioned difficulties. In accordance with my invention, the heating burner is divided into two independent sections, with fuel supplied thereto through two pipes which lead from the two outlets of a valve casing whose single inlet is attached to the fuel supply line. A valve is provided for each outlet, both valves being actuated by the same thermally responsive means, but the valves being arranged to be operated in succession, one with a snap movement and the other with a gradual movement. This arrangement allows both burner sections to burn at full capacity to originally heat the medium or the chamber and thereafter one section is snapped off and the remaining burner serves to maintain the medium or chamber at the desired uniform temperature.

Although hereinafter described in connection with an oven of a domestic gas range, it is to be understood that my invention is not limited thereto, as it may be advantageously embodied in various other temperature control systems, especially in a space heater control. The detailed operation and construction, as well as the particular advantages of my invention, will be described with reference to the accompanying drawing wherein;

Figure 1 is a perspective view showing the installation of the burner and the dual valve structure on a gas range, a portion of the range being broken away;

Figure 2 is a section view of the dual valve with thermostat attached;

Figure 3 is a plan view of the valve stem of the gradual acting valve;

Figure 4 is a view showing the assembled relation of the levers of the snap acting mechanism of the dual valve structure; and

Figure 5 is a plan view of the bridge member of the snap acting mechanism.

As shown in this drawing, the member 1 indicates generally a domestic gas range which has an insulated oven 2. Within the oven is located a hollow casting which is divided by plugs 3, into two independent sections forming a large main burner 4 and a small auxiliary burner 5. Gas is supplied to the burners past the oven gas cock 6, through pipe 7 and the dual valve casing 8 with an inlet 9 and two outlets 10 and 11. The outlet 10 is connected to the mixer 12 of the main burner 4 by pipe 14 while pipe 13 connects the outlet 11 with the mixer 15 of the auxiliary burner 5.

A passage 16 in the casing 8 leads from the inlet 9 to the outlet 11. Located in this passage near the outlet 11 is a valve 17 arranged to cooperate with a valve seat 18 to control the flow of gas to the auxiliary burner. A removable gas tight cap 19 is provided in the casing 8 adjacent the valve 17 to permit the removal of said valve for cleaning or adjusting purposes. Situated between cap 19 and the valve 17 is a spring 20 which constantly urges said valve towards its seat. A valve stem 21 on the opposite side abuts against an adjustable screw 22 in the head of valve 17 so that movement of the valve stem to the left as viewed in Figure 2 will gradually open the valve 17. The screw 22 is for the purpose of adjusting the position of the valve with respect to the thermostat. A by-pass 23 around the valve 17 allows enough gas to pass from the outlet 11 to keep the flame of the small auxiliary burner from going completely out when the valve is closed. This by-pass is necessary because if the flame is allowed to go completely out while maintaining the oven at a uniform temperature, a pilot flame or other means must be provided for re-igniting the burner. The provision of re-ignition means is very impractical because in systems using a gradual acting control, particularly when using artificial gas, the gradual opening of the valve causes the flame to flash back into the mixer when re-ignition is attempted, which is quite undesirable.

A wall 24 separates the passage 16 from a larger chamber 25 which is open to outlet 10. Near the upper end of the chamber is an opening 26 which connects said chamber with the passage 16 between the inlet 9 and the valve 17. A second valve 27 controls the flow of gas through this opening 26. Another removable, gas tight valve cap 28 is provided in casing 8 adjacent the valve 27 to permit removal thereof. A spring 29 is located between the cap 28 and the valve 27 and constantly urges said valve towards its seat. This valve is arranged to be operated with a snap movement as will be hereinafter described and has a guide pin 30 which slides back and forth in bore 31 in cap 28.

The two valves 17 and 27 are so designed and their lifts or amounts of opening movement are so adjusted that when both are opened, the gas will be divided between the two outlets in such a manner that both the small and the large burner will operate at full capacity flame.

Mounted on the exterior of the casing 8 is a bellows assembly similar to that described in U. S. Patent No. 1,998,818 issued to Robert E. Newell, Clarence W. Robertshaw and William B. Mackintosh on April 23, 1935. The expansible bellows 32 is connected by means of a capillary tube 33 to a bulb 34, which is conveniently located within the oven 2. The bellows, tube, and bulb are filled with a thermally responsive fluid, preferably a suitable liquid. The fluid in the bulb expands and contracts in accordance with the rise and fall of the oven temperature, and this movement is transferred to the bellows 32, one end of which is secured to a stationary baseplate 35 while the other end remains free to move. This movable end of the bellows bears against the end of the adjusting shaft 36 which has a threaded portion engaging the head of a yoke 37. The yoke extends around the bellows and is connected to a movable plate 38 located on the opposite side of the baseplate 35, by bolts 39. Load springs 40 surround the bolts 39 between the stationary baseplate 35 and the movable plate 38 and serve to keep the adjusting shaft 36 in constant engagement with the bellows.

Surrounding the bellows and yoke and secured to the casing 8, is a tubular bellows casing 41. Within casing 41 and abutting against casing 8, is a shorter tube 42 against the edge of which the stationary baseplate 35 is held by screws 43. A center guide 44 for the adjusting shaft is located near the outer end of casing 41. A dial 45 is secured to the end of the adjusting shaft 36 and carries appropriate indicia arranged to cooperate with a pointer on the casing 41.

Carried by the movable plate 38 is a bimetal disc 47 which bears against an actuating pin 48. This bimetal disc is designed to compensate for the effects of local, extraneous temperatures upon the bellows by flexing in the opposite direction from the bellows expansion upon application of local heat to the assembly. Pin 48 is movable with said disc and projects through the wall of casing 8 into chamber 25. This expansion of the bellows by an increase in oven temperature allows movement of pin 48 to the right and contraction of the bellows will move the pin to the left. Rotation of the adjusting shaft 36 will also move the pin 48 because of the threaded connection between the shaft and the yoke, the dial and shaft being so arranged that when the dial is set to a temperature above that of the oven, the pin 48 will be moved to the left and vice versa.

Within the chamber 25 of the casing 8 is a snap acting mechanism somewhat like that disclosed in the U. S. Patent No. 2,006,930 issued to Robert E. Newell and David R. Drylie on July 2, 1935. A main lever 49 is mounted substantially vertically within the chamber. The upper end of this main lever is provided with knife edges 50 for cooperation with bearings 51 in the wall of the chamber. A recessed portion 52 is provided in approximately the middle of the main lever for receiving the end of pin 48, movement of which will rotate said main lever about its bearings 51. The lower or movable end of said main lever is operatively engaged with the valve stem 21 of valve 17 in such a manner that gradual movement of the actuating pin to the left, rotating the main lever a short distance clockwise about its bearings, will gradually open the valve 17.

The end of the valve stem 21 bearing against the lower end of the main lever 49 has a slot 53 therein. One end of a tension spring 54 passes through this slot and is hooked over the lower end of the main lever. The other end of the spring is hooked through an opening 55 in the secondary lever 56. The secondary lever is also mounted substantially vertically and has its lower end forked to receive the spring 54. The forked end of the secondary lever 56 is provided with knife edges 57 for cooperation with bearings 58 formed in a bridge member 59. The bridge member is substantially U-shaped and the arms 60 thereof are also provided with knife edges 61 which rest in bearings formed in the wall of chamber 25. The bridge extends horizontally across the bottom of the chamber and the curved portion is recessed as at 63 to cooperate with the end of the adjusting screw 64 which extends into the casing through a threaded opening 65 therein.

The upper end 66 of the secondary lever is located adjacent the upper bearing of the main lever and is arranged to operate the valve 27 with a snap action. When the bellows contracts and moves the actuating pin to the left, the main lever will be rotated clockwise about its bearings. The tension spring, the lower end of which is carried by said main lever, will also be rotated clockwise about its upper end which is hooked to the secondary lever at 55. As soon as the center of this spring crosses to the left of the plane formed by the points 55 and 57, the spring will snap the free end 66 of the secondary lever to the left. The end 66 upon snapping will strike the projection 67 of valve 27 and open said valve.

The secondary lever is so designed that when its end 66 is snapped to the left, the point 55 at which the tension spring is connected to said lever will remain on the right of the line between the bearings 51 of the main lever and 58 of the secondary lever. Thus, when end 66 is as far to the left as it can move, the tension spring will tend to rotate the main lever counterclockwise.

As soon as the bellows expands to permit movement of the actuating pin to the right, the main lever will then be rotated counterclockwise, the lower end of the tension spring will pass to the right of the plane of points 55 and 57, and the end 66 will be snapped to the right and the valve 27 closed by the valve spring.

As will be apparent from the above, the snap acting mechanism is floatably mounted, being held together on knife edges by the tension spring. In manufacturing such springs in quantities it is practically impossible to make each one exactly the same. Also it has been found that any variation in the tension of the spring will result in a large variation in the action of the device. For this reason I provide the adjusting screw 64 which permits raising or lowering of the end of the bridge 59 and the bearings of the secondary lever carried thereby. Such movement of the bearings results in an increase or decrease in the tension of the spring. This feature and its advantages are more fully discussed in the aforementioned Patent No. 2,006,930.

The valve structure and thermostat hereinbefore described are so arranged and adjusted that when the oven is cold and the dial set at the desired temperature, the bellows will be in a contracted state and the actuating pin moved to the left and both valves open to allow fuel to be supplied to the full capacities of both burners. As the oven heats, the bellows will expand and allow the main lever to be rotated counterclockwise. When the oven temperature nears the desired temperature, the main lever will have been rotated far enough to cause the secondary lever to be snapped and permit quick and complete closing by the valve spring of the valve controlling the large or main burner. Although the rotation of the main lever has permitted a slight movement of the auxiliary burner valve, this valve is so designed and adjusted that at the time of the snapping shut of the large burner valve, it is still open enough to supply fuel to the full capacity of the auxiliary burner. As the oven temperature approaches still closer to that desired, the small auxiliary burner valve will be gradually closed until upon reaching the desired oven temperature, the small burner has a flame just large enough to keep the oven at that temperature. If the oven temperature for any reason, begins to decrease, the small burner valve will be opened to increase the flame sufficiently to maintain a constant temperature.

Of course, the number of degrees difference in the temperatures at which the main burner valve snaps shut and the auxiliary burner valve is to be closed is to be considered in conjunction with the proposed use of the structure, the size of the valves, the amount of movement per degree temperature change which is available in the thermostatic means, and other questions of design. However, after the structure has been designed and the parts manufactured and assembled, the temperature interval between successive operations of the valves may be adjusted to a particular number of degrees in the following manner:— The bulb of the thermostat is placed in a temperature approximately the average of that in which it is to be used, the dial is rotated from high toward low temperature readings until the main valve snaps shut and thereafter rotation is continued in the same direction for the number of degrees more, on the dial temperature scale, that is desired for the temperature interval. At this point the screw 22 in the head of the gradual acting valve is adjusted until the valve is completely closed. Then the dial should be recalibrated so that at that particular thermostat setting, the dial reading is the same as the actual temperature surrounding the bulb.

This method of controlling the temperature of an oven or other chamber results in a saving of fuel by a great increase in the efficiency of the burning thereof. Both burners operate at full capacity and therefore maximum efficiency to quickly heat the chamber to within a few degrees of the desired temperature. The large or main burner is then shut off with a quick action while the small burner continues to operate to raise the temperature the few remaining degrees. As the desired temperature is reached the auxiliary burner has a flame only large enough to keep the chamber at the desired temperature. Since this auxiliary burner is primarily for the purpose of maintaining a uniform temperature after the desired temperature is reached, it may be much smaller than a burner for originally heating the chamber. Therefore the heat required from this small burner necessitates its operating at a greater percentage of full capacity and therefore greater efficiency than would a single burner serving both to originally heat the chamber and to maintain the uniform temperature after heating. Such an auxiliary burner is also small enough that when keeping a small well-insulated chamber at a relatively low temperature, the flame can be reduced sufficiently to avoid overheating.

Since the flame on the auxiliary burner must necessarily be higher than that of the usual large single burner to provide the same amount of heat, it is not as liable to be blown out by drafts. Also, if for any reason the temperature of the chamber should drop to such an extent as to cause the main burner to be snapped on, to be later snapped off as the temperature increases, the auxiliary burner would have, at the time of both the snapping on and off, a maximum flame which would not be extinguished, as would a small pilot flame as usually provided for a snap controlled burner, by the explosion, vacuum, or other disturbance created within the chamber by such action of the main burner.

Another feature of my invention is that though the system gives the advantages of the quick, efficient heating of the snap acting valve control, it does not have the unwanted overshooting or over-running of the desired temperature which is characteristic of snap acting valve control. This is prevented by snapping off the main supply of heat slightly before the desired temperature is reached, to allow the tremendous heat immediately surrounding the large burner to be dissipated throughout the chamber and thus use that heat, which formerly caused overshooting, to aid the small burner in bringing the chamber up to exactly the desired temperature.

My invention has an additional advantage over the single snap acting valve control in that since the gradual acting valve of my structure serves primarily in the maintaining of the uniform temperature and the snap acting valve is open only during the original heating and, under normal conditions, will not be reopened during the rest of the operating period, it is not necessary to have an extremely small temperature differential between the snapping open and the snapping closed of the snap valve as is necessary in a single snap valve control and which is a particularly difficult problem for the control manufacturer.

The unitary dual valve structure which I provide lends itself extremely well to this method of temperature control. The novel arrangement of parts whereby a single thermostat operates the valves in succession, one with a snap action and one with a gradual action, affords a small and compact valve structure which is accurate and positive in operation.

I have illustrated and described a preferred embodiment of my invention but other embodiments thereof may be made within the scope of the appended claims.

I claim:

1. In a temperature control system, a main heating burner, an auxiliary burner, a dual valve structure comprising a casing having one inlet and two outlets, a snap acting valve arranged to control the flow of fuel through one outlet to said main burner and a gradual acting valve arranged to control the flow of fuel through the second outlet to the auxiliary burner, and a thermostat for operating said valves and arranged as the temperature increases to first close said snap acting valve and thereafter to close said gradual acting valve.

2. In a temperature control system, a medium the temperature of which is to be controlled, a main burner for originally heating said medium, an auxiliary burner designed to maintain said medium at various uniform temperatures after said main burner has functioned, a snap acting valve for controlling the flow of fuel to said main burner, a gradual acting valve for controlling the flow of fuel to said auxiliary burner, a by-pass around said gradual acting valve to permit a constant passage of sufficient fuel to said auxiliary burner to maintain at least a minimum flame thereon, and a thermostat responsive to the temperature of said medium for operating said valves, whereby said main burner is either fully on or completely off and said auxiliary burner is operating continuously, being varied between its maximum and minimum flame.

3. In a temperature control system, a medium the temperature of which is to be controlled, first and second burners therefor, a first valve for controlling the flow of fuel to said first burner, a second valve for controlling the flow of fuel to the second burner, and a thermostat mechanically connected with said valves and arranged to close said first valve with a snap action as the temperature of the medium approaches that desired and to thereafter close and open said second valve with a gradual action to maintain the desired temperature.

4. In a temperature control system, a medium the temperature of which is to be controlled, a main burner for originally heating said medium, an auxiliary burner designed to maintain said medium at various uniform temperatures after said main burner has functioned, a first valve for controlling the flow of fuel to said main burner, a second valve for controlling the flow of fuel to said auxiliary burner, a gradual moving thermostat, mechanical means for transforming gradual movement of said thermostat into a snap movement for operating said first valve and means connected with said first mentioned means for transmitting gradual movement from said thermostat to said second valve.

5. In a temperature control system, a main heating burner, an auxiliary burner, a first valve for controlling the flow of fuel to said main burner, a second valve for controlling the flow of fuel to said auxiliary burner, a gradual moving thermostat, mechanical means for transforming gradual movement of said thermostat into a snap movement for operating said first valve, means connected with said first-mentioned means for transmitting gradual movement from said thermostat to said second valve, said valves being so arranged that the first valve will be closed before the second valve, and an adjusting screw associated with said second valve for setting the temperature interval between the successive closing of said valves.

6. In a temperature control system, a main heating burner, an auxiliary heating burner, a thermostat, a valve for controlling the main burner, a second valve for controlling the auxiliary burner, a by-pass around said second valve to constantly supply sufficient fuel to said auxiliary burner to maintain a minimum flame thereon, mechanical means actuated by said thermostat and arranged as the temperature increases, to close the first valve with a snap action to shut off the main burner and to thereafter gradually move said second valve toward closing with complete closure taking place after a predetermined temperature interval to reduce the auxiliary burner flame to a minimum, and manual means for accurately setting said temperature interval.

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