April 24, 1951 C. M. WHEELOCK 2,549,952

HEATING DEVICE AND AUTOMATIC CONTROL MEANS THEREFOR

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Fig. 1.

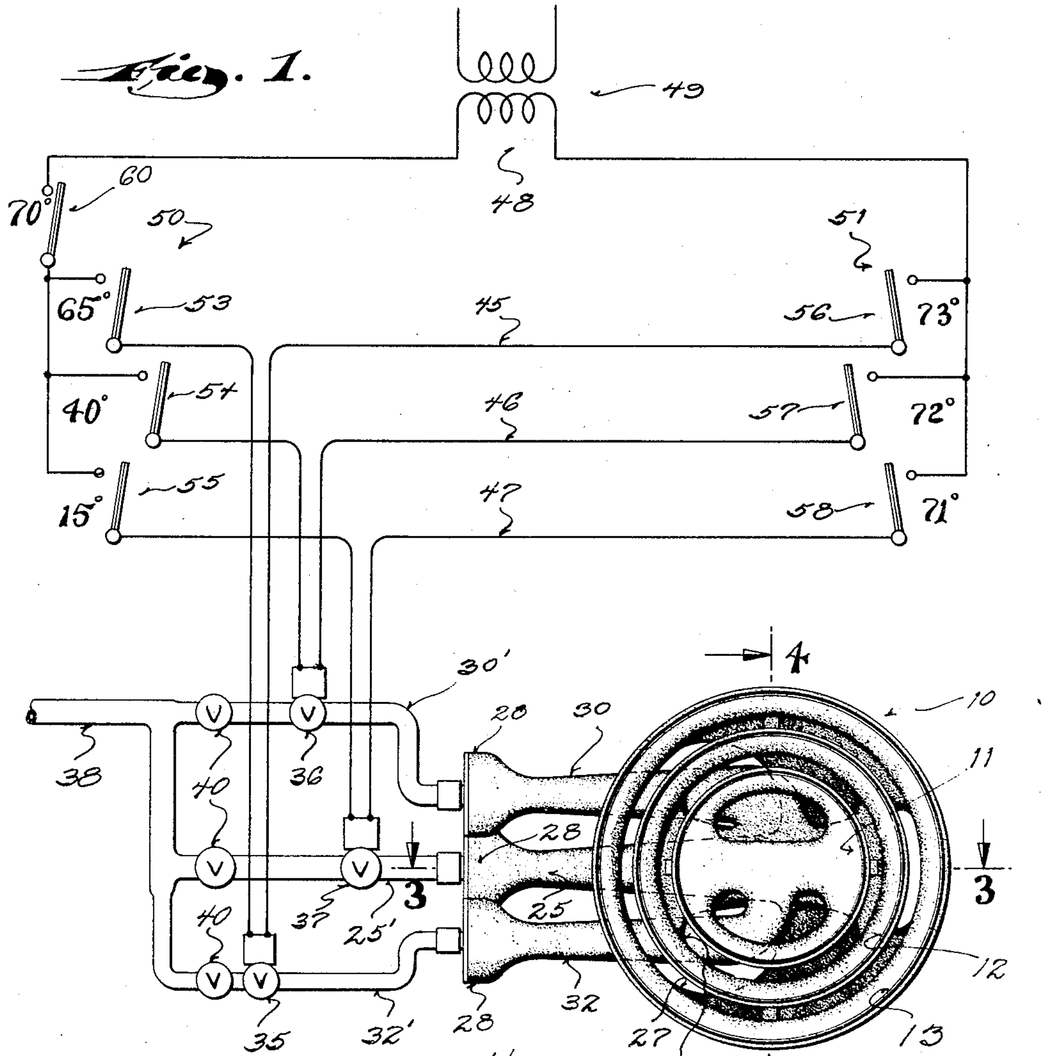

Fig. 2.

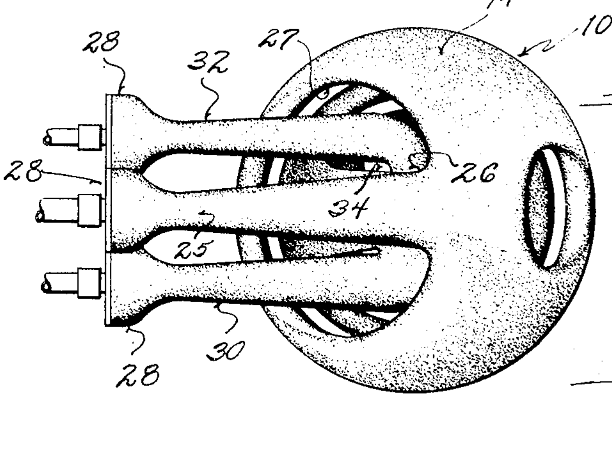

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Fig. 3.

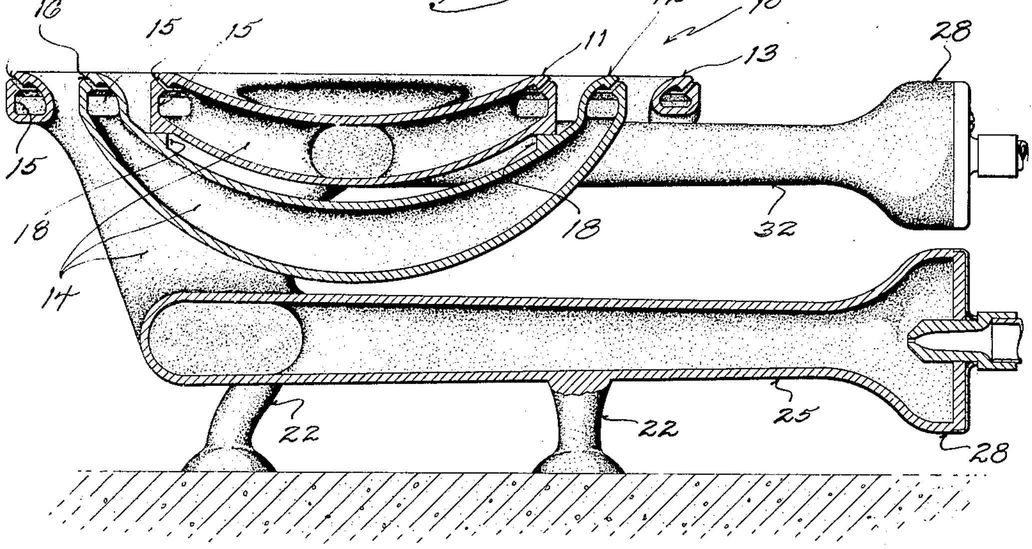

Fig. 4.

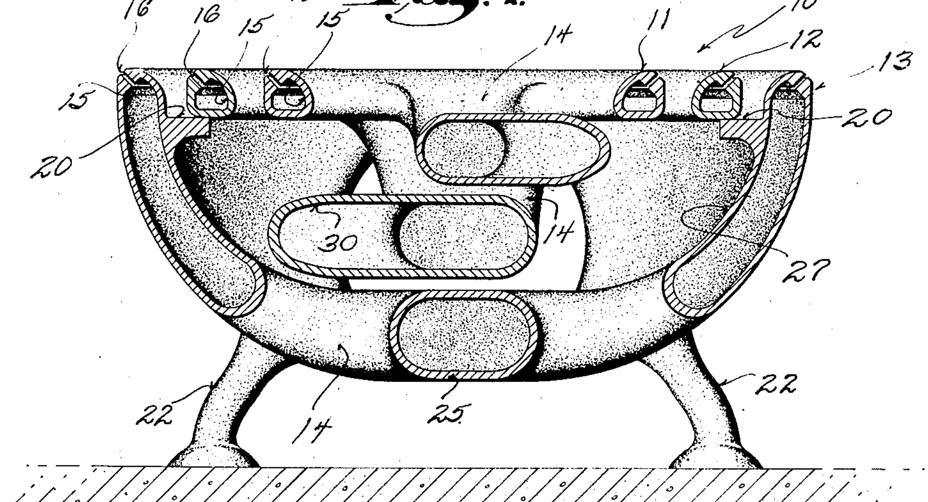

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Fig. 5.

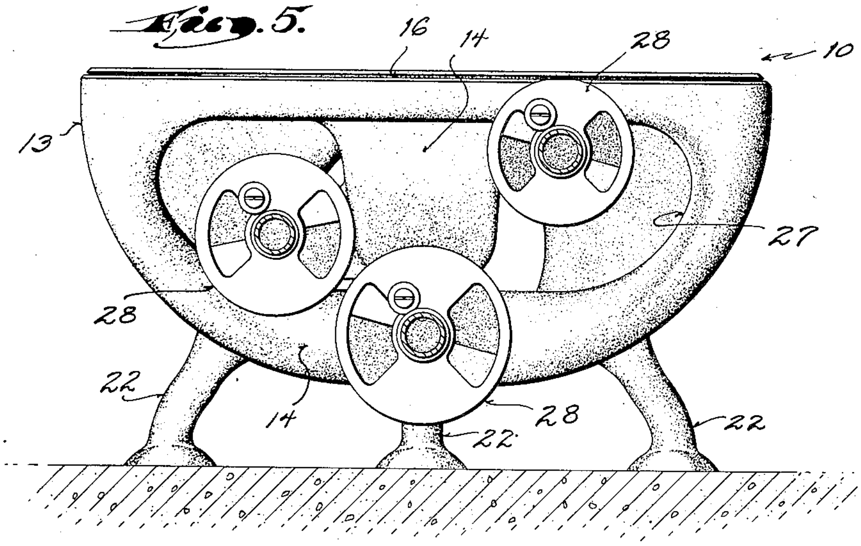
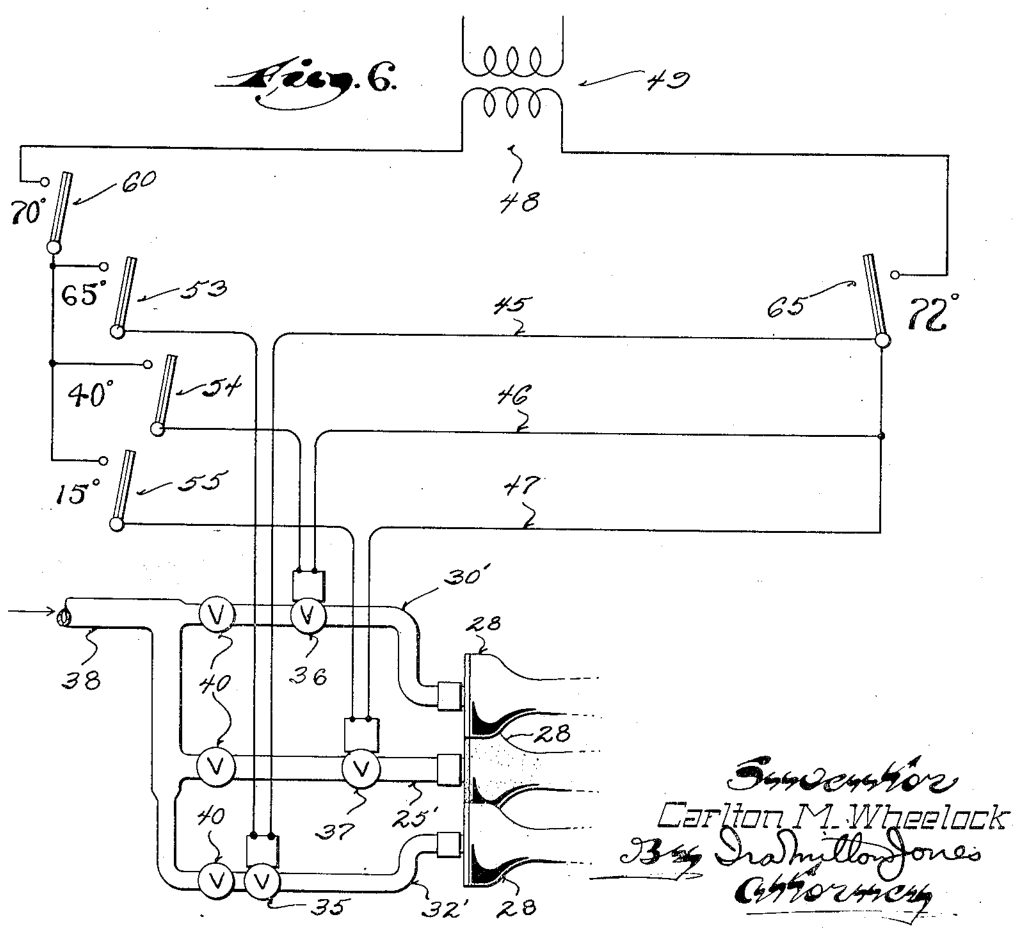


Fig. 6.



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HEATING DEVICE AND AUTOMATIC CONTROL MEANS THEREFOR

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Application July 10, 1947, Serial No. 760,060

2 Claims. (Cl. 236—1)

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This invention relates to heating plants and has more particular reference to heating plants of the type having a combustion chamber in which fluid fuel is burned to provide a source of heat.

In a more specific sense this invention concerns gas fired furnaces, and it is the primary object of this invention to provide an improved burner unit for such furnaces along with a novel electrical control system for automatically controlling the supply of fuel to the burner unit in a manner which assures a substantially continuous supply of heat to an enclosure such as a room heated by the furnace whenever heating of the room is required.

In order to assure a substantially constant supply of heat to the room whenever heating is required, it has previously been suggested to provide the combustion chamber of the furnace with a burner controlled by temperature responsive devices which act to regulate the quantity of fuel fed to the burner so as to vary the height of the flame produced by the burner unit in accordance with the demand for heat. While heating in this manner presented an advantage over the conventional types of gas fired furnaces wherein the supply of fuel to the burners is controlled in such a manner that the burner is either on or off, it was nevertheless objectionable since it was inevitable that the regulation of the supply of fuel to the burner unit made it impossible to operate the burner unit at a uniform high level of efficiency.

With these objections to past furnace systems in mind, it is another object of the present invention to provide a heating plant with a plurality of individual burner elements each of which is controlled separately by an electrical control system which is in part responsive to the temperature obtaining outdoors and in part to the temperature obtaining in the room or other enclosure heated by the furnace, with the control system operating to maintain at least one burner element operative during cold weather conditions.

A further object of this invention resides in the provision of an exceptionally compact burner unit comprising a number of individual burner elements nested one within the other.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

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The accompanying drawings illustrate several complete examples of the physical embodiment of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a combined plan view of the burner unit of this invention, and electrical diagram illustrating the automatic control means for governing the supply of fuel to said burners;

Figure 2 is a bottom view of the burner unit shown in Figure 1;

Figure 3 is a sectional view through the burner unit taken on the plane of the line 3—3 of Figure 1;

Figure 4 is a sectional view through the burner unit taken on the plane of the line 4—4 in Figure 1;

Figure 5 is a front elevation of the burner unit; and

Figure 6 is a diagrammatic view illustrating a slightly modified electrical control system for the burner unit of this invention.

Referring now more particularly to the accompanying drawings in which like numerals indicate like parts, the numeral 10 generally designates the burner unit of this invention. The unit comprises a plurality of bowl-shaped burner elements, in the present instance three, the smallest burner element 11 nesting within a larger element 12 and the nesting elements 11 and 12 being nested in the largest element 13.

Each of the bowl-shaped burner elements has a hollow wall 14 and a hollow rim 15 extending continuously around the upper edge of the wall with its interior communicating with the interior of the wall. All of the rims have ports 16 in upper surfaces thereof through which gas delivered or distributed into the interior of the rims from their hollow walls is adapted to issue to burn in a flame.

Cooperating feet 18 on the underside of the rim of the innermost burner element and the upper side of the wall for the intermediate burner unit 12 are provided to support the smallest burner element on the intermediate burner element; while ledges 20 projecting inwardly from the wall of the largest burner element just beneath the rim thereof provide supports upon which the rim of the intermediate burner element 12 rests. It is important to note that the cooperating feet 18 and the ledge 20 position the rims of the two inner burner elements on a level with the rim of the largest burner element.

A plurality of legs 22 extending downwardly from the outer surface of the wall on the largest burner element provide for supporting the entire burner unit on a fire brick bed or an equivalent support in a combustion chamber of a heating plant such as a furnace or boiler unit.

A combustible mixture of gas and air is adapted to be fed into the interior of the hollow wall of the largest burner element 13 for distribution into the interior of the hollow rim thereon by means of a manifold tube 25. The inner end portion of the tube 25 connects with a bottom portion of the wall of the burner element 13 as at 26, substantially at the common axis of the concentric rims, and the tube extends forwardly from the burner unit at right angles to said axis to pass beneath the rims 15 a substantial distance therebeneath.

Referring to Figures 2 and 5, it will be seen that the wall 14 of the largest burner element 13 has a relatively large aperture 27 therein beneath the rim 16 and extending a substantial distance to either side of the manifold tube.

The outer end portion 28 of the manifold tube is of substantially conventional construction and shape and need not be specifically described herein. It is sufficient to note that the outer end 28 of the tube is adapted to connect with a source of gas under pressure, the injection of gas into the tube drawing in air for admixture with the gas in the usual manner. The resulting combustible mixture is delivered into the interior of the hollow wall 14 and thence into the interior of the hollow rim on the largest burner where it may issue through the ports 16 to burn in a flame.

The intermediate burner element 12 is likewise provided with a manifold tube 30, the inner end portion of which connects with a bottom portion of the wall of the element 12 with the tube extending forwardly therefrom above and to one side of the tube 25 but in substantially parallel relationship therewith. The tube 30 projects through the aperture 27 in the wall 14 of the largest burner element and extends forwardly in the same direction as the tube 25 so as to likewise pass beneath the rims but at a spacing therebeneath less than that of the tube 25.

The manifold tube 32 for the smallest burner element has its inner end portion connected with the bottom portion of the wall of the element 11 with the tube lying at the side of the centrally disposed manifold tube 25 remote from the tube 30 for the intermediate burner element. The tube 32 likewise projects through an aperture 34 in the wall of the intermediate burner element 12 in line with the aperture 27 of the largest burner element, and through the latter aperture so as to lie directly beneath the rims at an elevation above the remaining two manifold tubes but in substantially parallel relationship therewith.

The outer ends 28 of the tubes 30 and 32 are in all respects similar to that of the tube 25 hereinbefore referred to.

The nested together burner elements described provide a compact burner unit wherein all of the manifold tubes have their forward ends conveniently grouped and accessible for connection with individual gas supply ducts diagrammatically illustrated in Figure 1 and numbered 25′ for the largest burner element, 30′ for the intermediate burner element and 32′ for the smallest burner element.

In accordance with this invention the supply of fuel to the different burner elements of the burner unit is adapted to be individually controlled automatically partly in accordance with outdoor temperature and partly in accordance with the temperature obtaining within the room or enclosure heated by the burner unit. Electrical instrumentalities now about to be described are provided for this purpose.

These instrumentalities include electromagnetic valves 35, 36, and 37 connected in the ducts 32′, 30′ and 25′ for the small burner element, the intermediate burner element and the largest burner element respectively, and the valves are positioned between the inlets to the manifold tubes and a main gas duct 38 with which all of the supply ducts connect.

The main gas supply duct 38 is adapted to deliver gas under pressure to the individual supply duct for each of the burner elements through manually operable valves 40 in the individual supply ducts which enable the supply of gas to any or all of the burner elements to be closed off at will. In practice, it is to be understood that by-pass connections would be provided leading around each of the electromagnetic valves to enable manual operation of the burner unit in case of electric power failure.

Separate energizing circuits 45, 46, and 47 are provided for the electromagnetic valves 35, 36 and 37 respectively. These energizing circuits include a common source of E. M. F., in the present case the secondary 48 of a step-down transformer 49, and two groups 50 and 51 of thermostatically operated switches. The group of switches 50 comprises three thermostatically operated switches 53, 54 and 55, one for each of the individual burner elements, and all adapted to be subjected to the temperature obtaining outdoors. The group 51 likewise comprises three thermostatically operated switches 56, 57 and 58, one for each of the individual burner elements, and all adapted to be subjected to the temperature obtaining in the room or enclosure heated by the burner unit.

The energizing circuit 45 for the valve 35 controlling the supply of fuel to the smallest burner elements 11 leads from one side of the secondary 48 of the transformer and continues serially through the switch 53, the coil of the valve 35 and the switch 56 in the order named, and is completed at the opposite side of the secondary 48. Hence when both the outdoor thermostatic switch 53 and the indoor thermostatic switch 56 are closed, the valve 35 is caused to open to enable fuel to flow into the smallest burner element 11.

In like manner, the switches 54 and 57, when closed, cause opening of the electromagnetic valve 36 to effect delivery of fuel to the intermediate burner 12; with closure of the switches 55 and 58 causing the valve 37 to be opened to effect the delivery of gas to the largest burner 13.

It will be obvious, therefore, that when either of the pair of thermostatic switches of each circuit is open the electromagnetic valve in said circuit will remain closed precluding the delivery of fuel to its burner element.

It is also to be understood that the burner elements are provided with one or more pilot burners, and that conventional electrical equipment is employed to close the main supply duct 38 in the event of pilot failure.

In order that the room or other enclosure being heated by the burner unit may receive a substantially constant supply of heat whenever the outdoor temperature drops below a predetermined value at which heating of the enclosure is necessary, this invention contemplates setting all of the thermostatic switches of the two groups 50 and 51 to close at different temperatures. The following is given as an example of the manner in which the thermostatic switches may be set.

The outdoor thermostatic switch 53 for the smallest burner element 11 may be set to close upon a drop in outdoor temperature to 65° F.; the outdoor thermostatic switch 54 for the intermediate burner 12 may be set to close when the outdoor temperature drops to 40° F.; and the outdoor thermostatic switch 55 for the largest burner 13 may be set to close when the outdoor temperature drops to 15° F.

It will now become apparent that the smallest burner element 11 should have a heating capacity such as to provide all of the heat necessary to maintain the room or other enclosure heated by the burner unit at a comfortable value as long as the outdoor temperature does not drop below the 40° setting for the thermostatic switch 54; that the intermediate burner element 12 should have a heating capacity such that it and the smallest burner element 11 are capable of furnishing all of the heat required to maintain the temperature of the room or other enclosure at a comfortable value as long as the outdoor temperature does not drop below the 15° setting for the thermostatic switch 55; and that the largest burner element 13 should have a heating capacity such that it and the other two burner elements are capable of furnishing all of the heat necessary to maintain the room or enclosure at a comfortable value for any outdoor temperature below 15° F.; or in other words, in relatively cold weather.

The indoor thermostatic switch 56 may be set to close upon a drop in room temperature to 73°; the switch 57 set to close at 72°, and the switch 58 set to close at 71°. These temperatures at which the indoor thermostatic switches close, though slightly different, may yet be considered to be comfortable room temperatures, and it will be noted that there is only a 2° differential between the settings for the switches controlling the largest and smallest burners. If there is noticeable lag in the critical responding temperatures for the switches 56, 57 and 58, these switches may be set to close over an expanded range presenting a greater differential in degrees between the settings of the switches for the largest and smallest burner elements, as for instance, 74°, 72°, and 70° for the switches 56, 57 and 58 respectively.

Operation

Assume that on a relatively cool day the outdoor temperature drops to 60° F., which is a value sufficiently low to effect closure of the outdoor thermostatic switch 53. Energization of the electromagnetic valve 35 may not necessarily occur immediately upon closure of the switch 53 unless the indoor temperature is below 73°. However, it is conceivable that the room temperature may be slightly above 73° but that loss of heat shortly lowers the room temperature to 73° or a bit lower. Such drop in room temperature causes the indoor thermostatic switch 56 to close, and with both switches 53 and 56 closed the energizing circuit 45 is completed to the solenoid of the valve 35 to cause the same to open. Opening of the valve 35 effects the delivery of gas (and air) to the small burner element 11 from whence the combustible mixture distributed to the hollow rim 15 thereof issues to be ignited by the pilot flame, not shown, and the element 11 is now in operation.

If there is no further drop in outdoor temperature the smallest burner element 11 has sufficient heating capacity to supply all the heat necessary to return the room temperature to the value at which the thermostatic switch 56 opens, namely 73° or slightly thereabove if the instrument lags. Immediately upon opening of the switch 56, the small burner element 11 is rendered inoperative by closure of the valve 35.

In the event the temperature outdoors drops to below 40° but remains above 15° F., both outdoor switches 53 and 54 will be caused to close, and when the room temperature drops to 72° or slightly below, the indoor switch 57 also closes. Both energizing circuits 45 and 46 for the valves 35 and 36 are now completed by the pairs of thermostatic switches therein, and both the smallest burner 11 and the intermediate burner element 12 are rendered operative by opening of the valves 35 and 36 so that the heating capacity of the two burner elements is additive.

The temperature of the room or enclosure is thus shortly restored to the 72° value or a slight amount thereover so as to cause the switch 57 to open and render the intermediate burner element 12 inoperative by closure of its valve 36. The smallest burner element 11 will remain operative, however, since its indoor thermostatic switch 56 will remain closed by reason of the room temperature being less than 73°.

If the outdoor temperature remains at a value above 15° but less than 40°, the smallest burner will remain on continuously since it cannot supply sufficient heat for the room at such outdoor temperatures. The intermediate burner 12, however, will be turned on and off intermittently by the control system as the room temperature fluctuates to values slightly above and slightly below the 72° setting for the thermostatic switch 57.

In like manner, if the temperature drops to below the 15° setting for the outdoor switch 55, the smallest and the intermediate size burner elements will not have a sufficient heating capacity to supply all of the heat necessary to maintain the room at a comfortable room temperature, and will remain "on" continuously. In this case the room thermostatic switch 58 will close to render the largest burner element effective as the room temperature drops to 71° or slightly less, and will be periodically opened and closed as the temperature in the room or enclosure fluctuates between values slightly above and slightly below the 71° setting for the switch 58 by the intermittent operation of the largest burner element 13 controlled by the switch 58.

If desired, a master thermostatic switch 60 may be connected ahead of the group 50 of outdoor switches between them and the secondary of the transformer and is preferably set to open upon a rise in outdoor temperature to a value approaching comfortable room temperature, as for instance 68° to 70°. With the switch 60, the supply of gas to all of the burners is shut off whenever the outdoor temperature rises sufficiently to effect opening of the switch 60, as this switch when opened, causes simultaneous deenergization and closure of all of the valves 35, 36 and 37.

In the control system diagrammatically illustrated in Figure 6, separate outdoor thermostatic switches similar to those previously described are provided for each of the burner elements, but only one indoor thermostatic switch 65 is provided for all of the elements. With this system it is assumed that the indoor thermostat 65 will be set to maintain a comfortable room temperature as for instance 72°. Whenever it closes upon a drop in room temperature below the desired value, those burner elements whose outdoor thermostatic switches are closed will be set into operation to return the indoor temperature to the desired value. In this instance, however, none of the burner elements will be operated continuously but heat roughly proportional to the degree of cold obtaining outdoors will be supplied to the room or enclosure.

In both systems, the individual control of the burner elements in the manner described enables the different burner elements to be adjusted to operate at maximum efficiency. This is possible because of the fact that the burner elements are either fully "on" or fully "off," and are never operated "partially on."

From the foregoing description taken together with the accompanying drawings, it will be apparent that this invention provides an exceptionally compact burner unit comprised of nesting burner elements and that the control system for automatically governing the operation of the individual burner elements functions to assure a nearly constant supply of heat to a room or enclosure whenever heating is required.

What I claim as my invention is:

1. In combination with a plurality of fluid fuel burners each having a separate supply duct, an electrical control system for governing the supply of fuel to said burners comprising: an electromagnetic valve in the supply duct for each of said burners; an energizing circuit for each of said electromagnetic valves, each of said circuits including a thermostatically operated switch adapted to be subjected to the temperature obtaining outdoors and a second thermostatically operated switch adapted to be subjected to the temperature obtaining indoors in the space heated by the burners, closure of both of said thermostatically operated switches being required to effect energization of the electromagnetic valve controlled thereby, the thermostatically operated switches subjected to indoor temperature being set to close successively upon a drop in indoor temperature of a relatively few degrees, and the thermostatically operated switches subjected to outdoor temperature being set to close successively upon a drop in outdoor temperature covering a relatively large number of degrees, the indoor thermostatically operated switches being set to close at different temperatures which are substantially higher than their associated outdoor thermostatically operated switches.

2. In combination: a pair of fluid fuel burners having independent fluid fuel supply ducts leading thereto; an electromagnetic valve in each of said supply ducts for controlling the supply of fuel to the burners; an energizing circuit for the electromagnetic valve controlling the supply of fuel to one of said burners including a pair of thermostatically operated switches one of which is subjected to the temperature obtaining outdoors and the other of which is subjected to the temperature obtaining indoors in the space heated by the burners, the indoor switch being set to close at a predetermined room temperature which it is desired to maintain and the outdoor switch being set to close at a predetermined temperature which is substantially less than the critical responding temperature of the indoor switch, closure of both of said switches being required to effect energization of the electromagnetic valve associated therewith; and an energizing circuit for the electromagnetic valve controlling the supply of fuel to the other of said burners, said last named circuit likewise including a pair of thermostatically operated switches one of which is subjected to outdoor temperature and the other of which is subjected to the temperature obtaining within the space heated by the burners, said last named outdoor switch being set to close at a temperature substantially less than the first named outdoor switch, and said last named indoor switch being set to close at a room temperature relatively close to but less than the critical responding temperature of the first named indoor switch, closure of both switches in said last named energizing circuit being required to effect energization of the electromagnetic valve controlling the flow of fuel to said other burner.

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