Sept. 11, 1934. W. H. GILLE 1,973,620

PROPORTIONING HIGH LIMIT CONTROL

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Fig. 1.

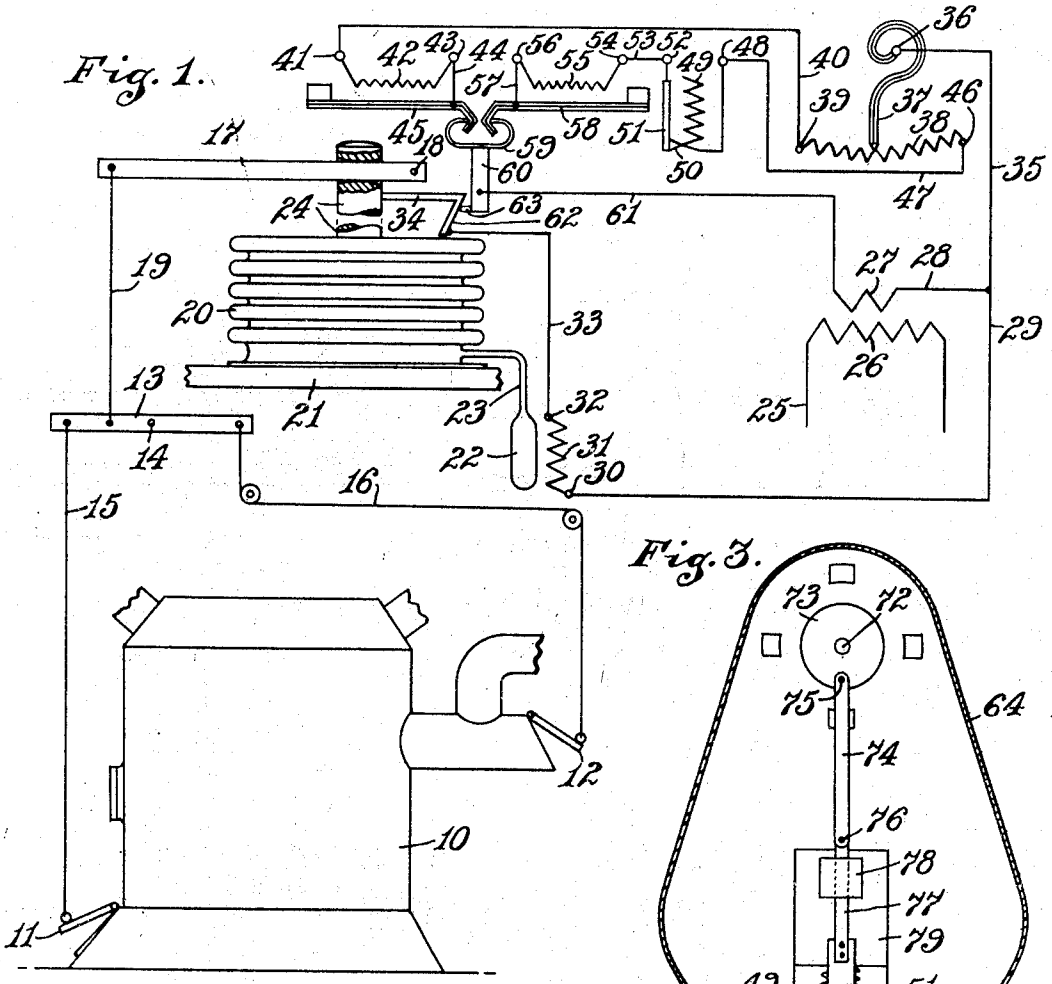
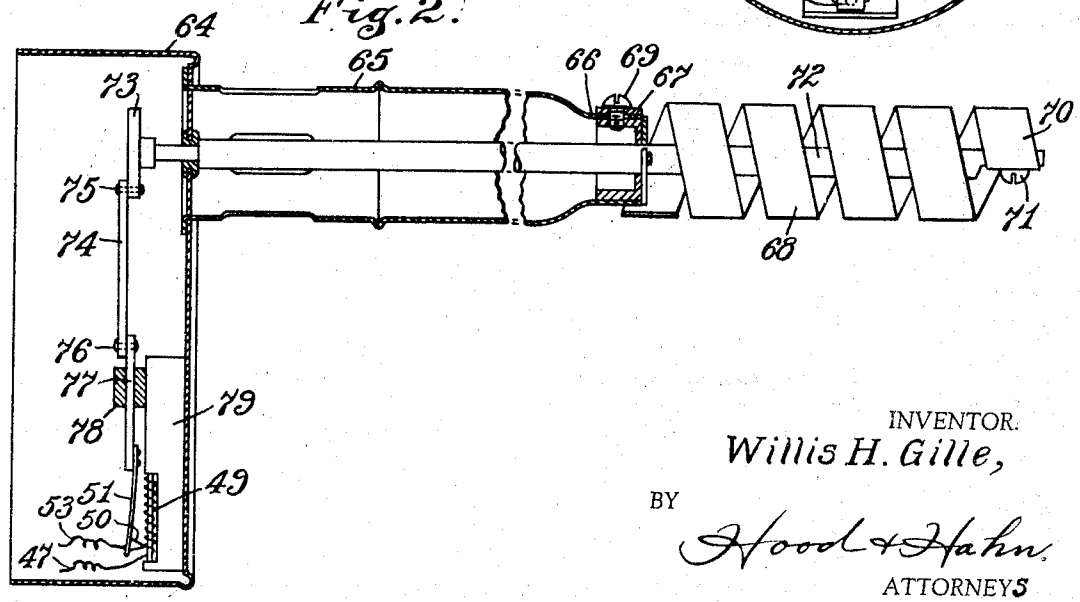


Fig. 3.

Fig. 2.



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PROPORTIONING HIGH LIMIT CONTROL

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19 Claims. (Cl. 236—68)

The present application relates to control mechanism for a heating plant, and more particularly to a proportioning high limit control; that is, a control of such character that the heating plant is placed under the joint influence of the temperature of the space intended to be heated and the temperature at the heater itself.

A primary object of the invention is to provide a control including a temperature-responsive element located in the space intended to be heated and another temperature-responsive element directly associated with the heater unit, together with means primarily dominated by said first-mentioned temperature-responsive element for controlling the operation of the heater, the second-mentioned temperature-responsive element being connected to vary the effect of said first-mentioned temperature-responsive element upon the heater controlling means.

To the accomplishment of the above and related objects, my invention may be embodied in the form illustrated in the accompanying drawing, attention being called to the fact, however, that the drawing is illustrative only, and that change may be made in the specific construction illustrated and described, so long as the scope of the appended claims is not violated.

Fig. 1 is a diagrammatic illustration of a control constructed in accordance with the present invention;

Fig. 2 is a vertical section through an element thereof; and

Fig. 3 is a section of the element disclosed in Fig. 2 taken at right angles to the section of Fig. 2.

Referring more particularly to the drawing, it will be seen that I have illustrated a furnace 10 which, in the illustrated embodiment, is of the hand-fired type, and which forms an element of a hot air heating system. Said furnace is provided with the usual draft door 11 and check draft door 12. A lever 13 is suitably pivoted as at 14, and a cable 15 is connected to one end of said lever and to the door 11; and a second cable 16 is connected to the opposite end of said lever 13 and to the check draft door 12.

A second lever 17 is pivoted at one end as at 18, and a cable 19 is connected to the opposite end of said lever and to the lever 13. It will be obvious that, as the free end of the lever 17 is elevated, the door 11 will be opened and the door 12 will be closed; and as said free end of the lever 17 is depressed, the door 11 will be closed and the door 12 will be opened. In the drawing, the above-described elements are located in a median position.

Any suitable reversible motor may be provided for operating the lever 17. In the present embodiment, such motor comprises a bellows 20 having one end mounted upon a stationary platform 21, together with a capsule 22 communicating with the interior of the bellows through a tube 23. The bellows and the capsule contain a volatile fluid, there being provided a sufficient amount of fluid so that a portion of the fluid in the capsule 22 is always in the liquid phase. The free end wall of the bellows 20 may carry a post 24 operatively associated with the lever 17 whereby, as said bellows 20 is expanded, the free end of the lever 17 will be elevated and as said bellows 20 is contracted the free end of the lever 17 will be depressed.

A source of electrical energy is indicated by the line 25 across which is connected a primary coil 26 of a transformer. The secondary coil 27 of such transformer has its one end connected by a wire 28 to a second wire 29 leading to one end 30 of a heater coil 31, the opposite end 32 of said coil being connected by a wire 33 with an arm 34 carried by the post 24.

Said wire 28 is likewise connected to a wire 35 which leads to a thermostat 36 which, in the illustrated embodiment, is of the well known bi-metallic volute type, and which includes a finger 37 which is mounted to sweep the potentiometer coil 38.

One end 39 of the coil 38 is connected by a wire 40 to one end 41 of a heater coil 42, the opposite end 43 of said coil being connected by a wire 44 to a bi-metallic bar 45. The opposite end 46 of the coil 38 is connected by a wire 47 to one terminal 48 of a rheostat comprising a resistance coil 49 adapted to be swept by a contact 50 carried by a reciprocable bar 51. The opposite terminal 52 of said rheostat is connected by a wire 53 to one end 54 of a heater coil 55, the opposite end 56 thereof being connected by a wire 57 with a bi-metallic bar 58.

The bars 45 and 58 are oppositely mounted with their free ends positioned closely adjacent each other, and said free ends are formed as hooks which are embraced by a yoke 59 carrying a contact arm 60. The bars 45 and 58 are so constructed that, when they are heated, their free ends swing downwardly, and when they are cooled, their free ends swing upwardly.

The yoke 59 is supported by its engagement with the hooked ends of the bars 45 and 58, and, since said yoke 59 and contact arm 60 are metallic, they form a path for electrical current flow from said bars 45 and 58. A wire 61 connects the arm 60 with the opposite end of the secondary coil 27.

The arm 34 is formed with a downwardly and inwardly inclined finger 62 adapted to be contacted by a button 63 carried on the arm 60.

So long as the finger 37 occupies the illustrated median position, and so long as the contactor 50 is in its illustrated position with respect to the resistance 49, the heater coils 42 and 55 will be

correspondingly heated, and the bars 45 and 58 will maintain substantially the illustrated positions. In the drawing, the button 63 is shown in contact with the finger 62, whereby a circuit is established to energize the coil 31 as follows:—27, 28, 29, 30, 31, 32, 33, 62, 63, 60, 61. The coil 31, when energized, heats the capsule 22, thereby changing some of the liquid therein into the gaseous phase and causing expansion of the bellows 20, whereby the post 24 is lifted, and the arm 34 is correspondingly lifted. Such elevation of the arm 34 will obviously break the above-described circuit at 62—63, whereupon the capsule 22 will be permitted to cool and the bellows 20 will be permitted to contract until the finger 62 again comes into contact with the button 63. So long as the above-described conditions are maintained, this fluttering of the bellows will continue, whereby the doors 11 and 12 will be held substantially in the positions illustrated.

If, now, there is a call for heat whereby the thermostatic finger 37 is moved to the right, as viewed in Fig. 1, the resistance to current flow in the circuit 27, 28, 35, 36, 37, 38, 46, 47, 48, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61 is reduced, while the resistance to current flow in the circuit 27, 28, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 59, 60, 61 is increased, whereby the temperature of the coil 55 is increased and the temperature of the coil 42 is decreased. The bars 58 and 45 will thus be moved oppositely to swing the arm 60 in a clockwise direction, whereby the button 63 will be moved to the left to contact the finger 62 at a higher position of the post 24. Obviously, such action will result in maintaining the door 11 in a position of wider opening than that illustrated in the drawing, and maintaining the door 12 more nearly closed.

Conversely, a call for cold will cause the temperature of the coil 42 to be raised and the temperature of the coil 55 to be reduced whereby the doors 11 and 12 will be oppositely positioned.

Suitably mounted in the bonnet of the furnace 10 is an instrument comprising a casing 64 to which is secured a tubular housing 65 projecting inwardly therefrom. One end 67 of a helical temperature-responsive element 68 is secured to the housing end 66 by a screw 69 or other equivalent fastening means; and the opposite end 70 of said element 68 is secured by a screw 71, or the like, to one end of a shaft 72, said shaft extending outwardly through the helix and through the tubular housing 65 into the casing 64. The outer end of the shaft 72 carries a disc 73. One end of a link 74 is eccentrically pivoted to the disc 73 by means of a pin 75, or the like, and the opposite end of said link is pivoted by a pin 76, or the like, to one end of a slide member 77, said member being guided for straight-line movement in a guide block 78 suitably formed on or secured to an insulating block 79 secured in the casing 64. The member 51 is secured to the lower end of the member 77, and the coil 49 may be set in a suitable recess in the block 79.

It will be seen from the above that the member 51 carrying the contactor 50 is movable in response to temperatures within the bonnet of the furnace 10, and the instrument is so constructed that a rise in temperature within said bonnet will result in elevation of the member 51.

Referring, again, to Fig. 1, it will immediately be obvious that, if the member 51 is lifted at a time when the finger 37 occupies the illustrated median position, the resistance to current flow in the energizing circuit for the coil 55 will be increased, whereby the temperature of said coil will be decreased and the bar 58 will be moved to shift the button 63 to the right, whereby the bellows 20 will be permitted to collapse and the door 11 will be moved toward closed position while the door 12 is further opened. It will also be seen that the degree of movement of the button 63 will be directly dependent upon the degree of movement of the member 51, and that movement of the member 51 will vary the effect of the room thermostat 36 upon the motor 20 which controls the doors 11 and 12.

It will be obvious that many modifications may be made in the illustrated structure without departing from the invention, and without departing from the present disclosure. For instance, the rheostat 49—51 might be placed in the line between the potentiometer coil and the heater coil 42 instead of in the illustrated position; or another rheostat might be placed in said line, so that the effect of the room thermostat 36 on the motor 20 will be varied in accordance with the positions of rheostats in both heater circuits. Similarly, any desired type of reversible motor might be substituted for the bellows 20; and other types of actuators such as, for instance, magnetic coils might be substituted for the bars 45 and 58.

I claim as my invention:

1. Circuit-controlling means comprising a contact element, a second contact element associated with said first contact element, a pair of electrically-actuated operating members jointly controlling said second contact element, a potentiometer coil, said operating members being connected to opposite ends of said coil, respectively, and to one side of a source of electrical energy, a contactor associated with said coil and mounted to sweep the same, said contactor being connected to the opposite side of said current source, and a rheostat connected in the circuit between said coil and one of said operating members.

2. In combination, a source of electrical energy, a pair of thermo-responsive elements, an arm movable under the joint influence of said elements, two heater coils, one for each of said elements, one end of each of said coils being connected to one side of said current source, a potentiometer coil, a conductor connecting the opposite end of one of said heater coils to one end of said potentiometer coil, a rheostat, a conductor connecting the opposite end of the other of said heater coils to one terminal of said rheostat, a conductor connecting the other terminal of said rheostat to the opposite end of said potentiometer coil, and a contactor arranged to sweep said potentiometer coil and connected to the other side of said current source.

3. Circuit-controlling means comprising, in combination with a heater, a room thermostat of the potentiometer type, a contactor, means controlled by said thermostat for positioning said contactor, a heater thermostat of the rheostat type connected in series between said room thermostat and said contactor-positioning means for varying the effect of said room-thermostat thereon, and a second contactor associated with said first-named contactor.

4. Circuit-controlling means comprising, in combination with a heater, a room thermostat, a contactor, means including an electric circuit controlled by said thermostat for positioning said contactor, a heater thermostat associated with said room thermostat and with said contactor-positioning means for varying the effect of said room-thermostat thereon, and a second con-

tactor cooperative with said first-named contactor to make or break a circuit, said second contactor being shiftable in response to variations in a condition at the heater.

5. Circuit-controlling means comprising, in combination with a heater, a room thermostat of the potentiometer type, a contactor, means controlled by said thermostat for positioning said contactor, a heater thermostat of the rheostat type associated with said room thermostat and with said contactor-positioning means for varying the effect of said room thermostat thereon, and a second contactor cooperative with said first-named contactor to make or break a circuit, said second contactor being shiftable in response to variations in a condition at the heater.

6. Circuit-controlling means comprising, in combination with a heater, a room thermostat, a contactor, means including an electric circuit controlled by said thermostat for positioning said contactor, a heater thermostat series connected in said circuit for varying the effect of said room-thermostat thereon, and a second contactor associated with said first-named contactor.

7. Circuit-controlling means comprising, switching mechanism; a pair of electrical devices jointly controlling said switching mechanism; a potentiometer coil; a contactor associated with said potentiometer coil and mounted to sweep the same; a source of electrical energy; conductors inter-connecting said potentiometer coil, contactor and electrical devices in such manner that movement of said contactor variably energizes one of said electrical devices with respect to the other; and a rheostat connected in series between the source of electrical energy and one of said electrical devices for varying the energization of the last-mentioned electrical device.

8. Circuit-controlling means comprising, switching mechanism; a pair of electrical devices jointly controlling said switching mechanism; a potentiometer coil; a contactor associated with said potentiometer coil and mounted to sweep the same in response to changes in a variable condition; a source of electrical energy; conductors inter-connecting said potentiometer coil, contactor and electrical devices in such manner that movement of said contactor variably energizes one of said electrical devices with respect to the other; and a rheostat connected in series between the source of electrical energy and one of said electrical devices, for varying the energization of the last-mentioned electrical device in response to changes in a variable condition.

9. Circuit-controlling means comprising, switching mechanism; a pair of electrical devices jointly controlling said switching mechanism; a potentiometer coil; a contactor associated with said potentiometer coil and mounted to sweep the same in response to changes in a variable condition; a source of electrical energy; conductors inter-connecting said potentiometer coil, contactor and electrical devices in such manner that movement of said contactor variably energizes one of said electrical devices with respect to the other; and a rheostat connected in series between the source of electrical energy and one of said electrical devices, and operable, in response to changes in another variable condition, to vary the energization of the last-mentioned electrical device.

10. Circuit-controlling means comprising, switching mechanism; a pair of electrical devices jointly controlling said switching mechanism; a potentiometer coil; an automatic contactor associated with said potentiometer coil and mounted to sweep the same; a source of electrical energy; conductors inter-connecting said potentiometer coil, contactor and electrical devices in such manner that movement of said contactor variably energizes one of said electrical devices with respect to the other; and an automatic rheostat connected in series between the source of electrical energy and one of said electrical devices for varying the effect of said contactor upon the last-mentioned electrical device.

11. Means for controlling a heating plant comprising an element responsive to temperature at a point remote from the plant, a member responsive to temperature at the plant, a motor dominating said plant, electrical means for operating said motor, and means including a potentiometer circuit controlled by said element dominating said electrical means, said member operating a rheostat connected in series with said circuit to vary the effect of said element on said electrical means.

12. Means for controlling a heating plant comprising an element responsive to temperature at a point remote from the plant, a motor dominating said plant, electrical means for operating said motor, a potentiometer circuit controlled by said element dominating said electrical means, and a member responsive to temperature at said plant and operating a rheostat connected in series with said circuit to vary the effect of said element on said electrical means.

13. The combination with a main heater, of means for controlling said heater comprising an expansible and collapsible chamber containing a volatile fluid, means connecting the free wall of said chamber to control said heater, an electrical heater positioned to influence said chamber, an energizing circuit for said electrical heater, and means for controlling said circuit comprising a contactor connected in said circuit, a second contactor associated with said first contactor and connected in said circuit, a pair of electrically actuated operating members jointly controlling said second contactor, circuits for energizing said operating members, respectively, a room thermostat connected to affect said last-mentioned circuits, and a thermostat associated with said main heater and connected to vary the effect of said room thermostat on said second contactor.

14. The combination with a main heater, of means for controlling said heater comprising an expansible and collapsible chamber containing a volatile fluid, means connecting the free wall of said chamber to control said heater, an electrical heater positioned to influence said chamber, an energizing circuit for said electrical heater, and means for controlling said circuit comprising a contactor connected in said circuit, a second contactor associated with said first contactor and connected in said circuit, a pair of electrically actuated operating members jointly controlling said second contactor, circuits for energizing said operating members, respectively, a room thermostat connected to affect said last-mentioned circuits, and a thermostat associated with said main heater and connected to vary the effect of said room thermostat on one of said last-mentioned circuits.

15. The combination with a main heater, of means for controlling said heater comprising an expansible and collapsible chamber containing a volatile fluid, means connecting the free wall of

said chamber to control said heater, an electrical heater positioned to influence said chamber, an energizing circuit for said electrical heater, and means for controlling said circuit comprising a contactor connected in said circuit, a second contactor associated with said first contactor and connected in said circuit, a pair of electrically actuated operating members jointly controlling said second contactor, circuits for energizing said operating members, respectively, a room thermostat connected to affect said last-mentioned circuits, a rheostat connected in one of said last-mentioned circuits, and a thermostat associated with said main heater and connected to control said rheostat.

16. The combination with a main heater, of means for controlling said heater comprising an element movable in response to temperature changes, means connecting said element to control said heater, an electrical heater positioned to influence said element, an energizing circuit for said electrical heater, and means for controlling said circuit comprising a contactor connected in said circuit, a second contactor associated with said first contactor and connected in said circuit, a pair of electrically actuated operating members jointly controlling said second contactor, circuits for energizing said operating members, respectively, a room thermostat connected to affect said last-mentioned circuits, a rheostat connected in one of said last-mentioned circuits, and a thermostat associated with said main heater and connected to control said rheostat.

17. In a heating system, a heater, a motor in control of the output of the heater, electrically controlled interconnected oppositely acting means dominating the motor, a potentiometer type thermostat located in the space to be heated and having each end connected to said motor-dominating means for controlling the energization of said motor-dominating means, and an automatic rheostatic type of control located outside the space to be heated and connected in series between one end of the potentiometer and the motor-dominating means to limit the maximum output of the heater.

18. In a heating system, a heater, a motor in control of the output of the heater, electrically controlled inter-connected oppositely acting means dominating the motor, a potentiometer type thermostat in the space to be heated and having each end connected to said motor-dominating means for controlling the energization of said motor-dominating means according to the temperature of said space, and an automatic rheostatic type of control responsive to a heater condition connected in series between one end of the potentiometer and the motor-dominating means to limit the maximum output of the heater.

19. In a heating system, a heater, a heating medium, a control for the heater, oppositely acting interconnected electrical means for positioning said control, a potentiometer type thermostat located in the space to be heated and having each end electrically connected to the positioning means to position said control according to the temperature of said space, and an automatic rheostatic type of limit control associated with the heater and connected in series between one end of the potentiometer and the positioning means to limit the maximum temperature of the heating medium.

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