

June 18, 1935.

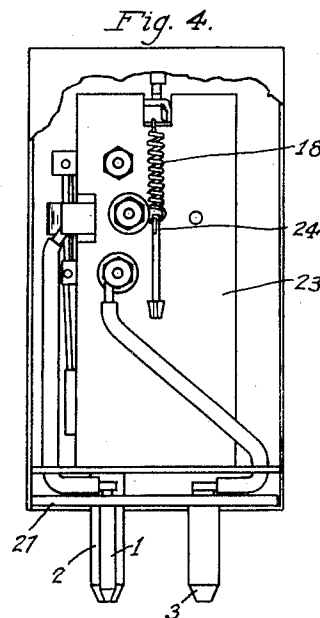
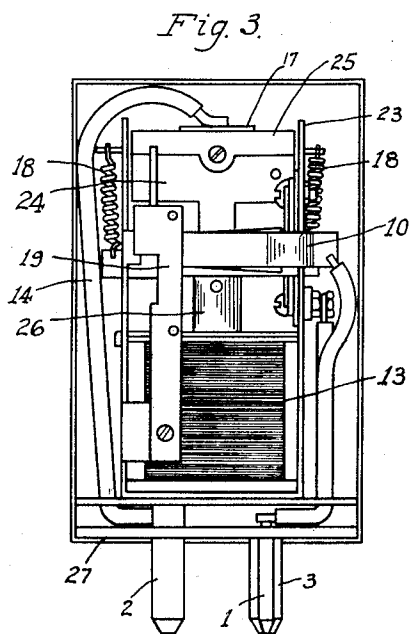
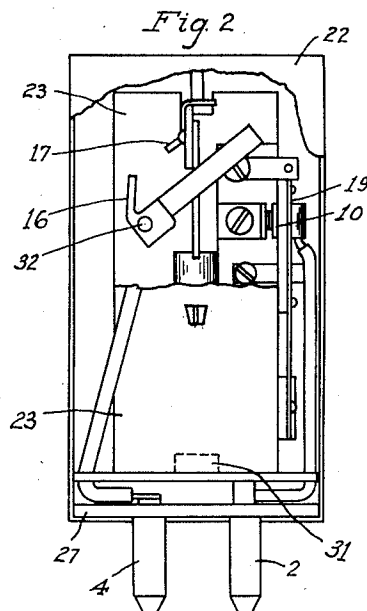
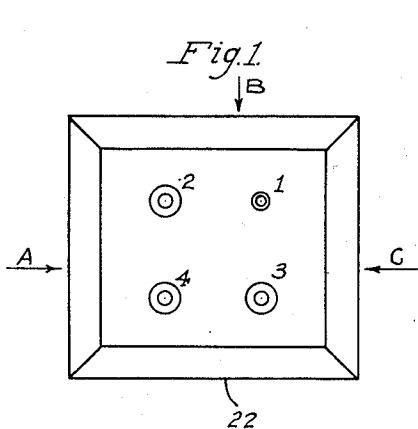
A. H. HEYROTH

2,005,584

TEMPERATURE CONTROLLING DEVICE

Filed Jan. 27, 1932

2 Sheets-Sheet 1



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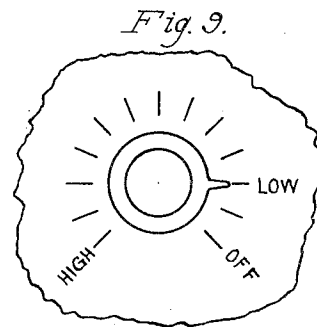
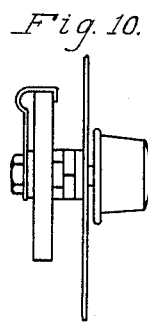
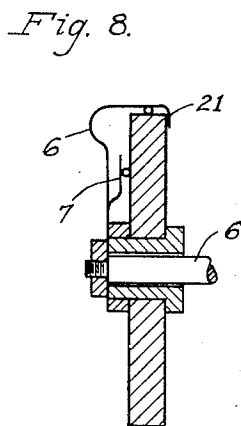
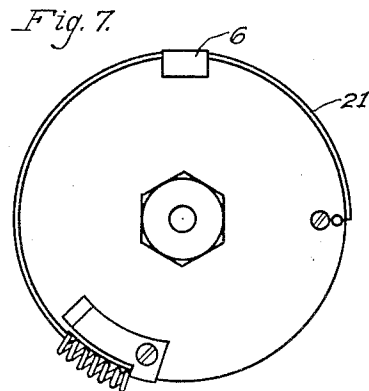
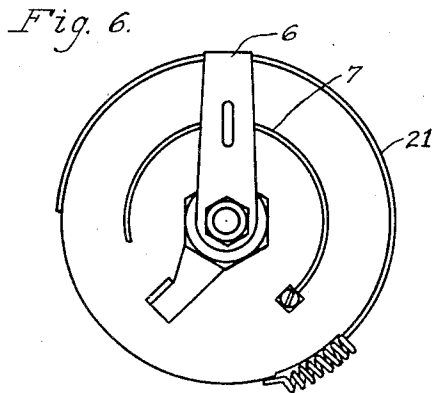
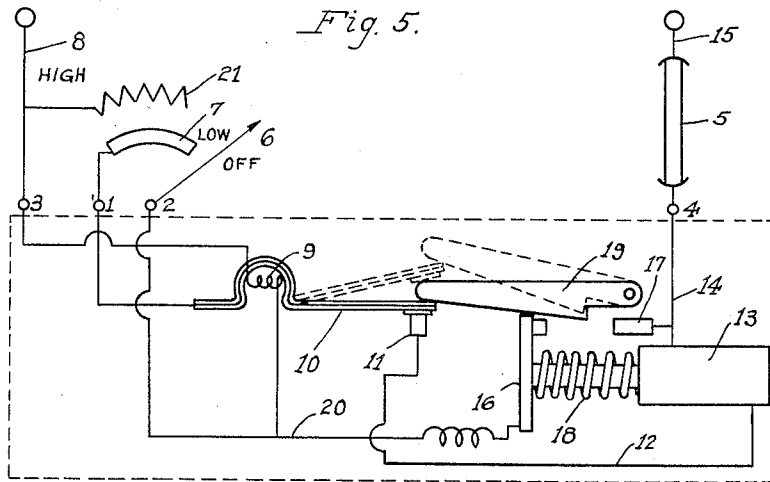
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2,005,584

TEMPERATURE CONTROLLING DEVICE

Filed Jan. 27, 1932

2 Sheets-Sheet 2



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2,005,584

TEMPERATURE CONTROLLING DEVICE

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Application January 27, 1932, Serial No. 589,177

6 Claims. (Cl. 175—375)

The invention relates to an electric current control system whereby the ratio of the on to the off periods may be varied to control the energy in the heat producing apparatus.

5 The invention is particularly adapted for the heat regulation in electric household appliances and will be explained for such use.

10 The ordinary arrangement for controlling temperature in electric heating appliances is by means of a plurality of circuits which are switched into various combinations as series, series parallel, or parallel. Such a system limits the number of temperatures possible with a resulting uneconomical operation of the heating appliance.

15 An object of this invention is to provide a flexible temperature controller for heat producing apparatus by including in the main circuit of the apparatus a make and break switch controlled by a thermo-responsive device. The present invention relates to improvements in a control device of this kind and essentially consists in a particular physical arrangement having certain practical advantages.

20 The invention will be more fully described with reference to the accompanying drawings:

25 Figure 1 is a bottom plan view of a control switch constructed in accordance with the present invention;

30 Figure 2 is an elevation of my control mechanism looking in the direction of the arrow A of Figure 1, the adjacent face of the casing and the upper part of the frame being removed;

35 Figure 3 is a view taken in the direction of the arrow B of Figure 1, the adjacent part of the casing being removed;

Figure 4 is a view taken in the direction of the arrow C of Figure 1, the adjacent part of the casing being removed;

40 Figure 5 is a schematic circuit diagram of the temperature control system of this invention;

Figure 6 is a plan view of the rear of the control rheostat;

Figure 7 is a plan view of the front of the control rheostat;

45 Figure 8 is a section of the control rheostat;

Figure 9 is a conventional view of the control panel; and

Figure 10 illustrates a method of mounting the control rheostat of Figure 8.

50 To facilitate an understanding of the mechanism illustrated in Figures 1-4, 6-9 and of the manner in which it operates, I will first follow the schematic circuit as shown in Figure 5.

55 The reference characters 1, 2, 3, 4 designate the outlet points of the switching mechanism

which is enclosed within case 22, Figure 2. The reference character 5 of Figure 5 indicates the controlled appliance. The reference characters 8 and 15 designate the power leads. The contacts 6, 7 and 21 are incorporated in the control rheostat shown in Figures 7, 8 and 9.

The operation of my invention is as follows:

When the contact arm 6 is moved from the "off" position (shown in the schematic circuit diagram of Figure 5) to the position marked "low" or anywhere between the position marked "low" and the position marked "high", points 1 and 2 will be connected through contact arm 6 and rail 7. The current will then flow from the service line 8 through point 3, heating coil 9, point 2, contact arm 6, rail 7, point 1, bimetal thermostat element 10, contact 11, wire 12, solenoid 13, wire 14, point 4, through element 5 to the service line 15. Since the winding of the solenoid 13 has a relatively very high ohmic resistance, the current is limited to a very small value and does not, at this stage, serve any purpose with respect to the controlled appliance 5. It is sufficient, however, to energize solenoid 13 and to cause it to draw contact arm 16 into electrical contact with contact 17 against the compression of spring 18. In doing so, the operation of the mechanism is such that contact 16 does not engage contact 17 until after 16 has passed the latching position with respect to latch 19. The engagement of 16 and 17 short circuits the winding of solenoid 13 in that it joins wire 14 (one terminal of the solenoid winding) to wire 12 (the other terminal of the solenoid winding) by means of the following connections: lead wire 14, contact 17—16, wire 20, point 2, contact arm 6, rail 7, point 1, bimetal 10, contact 11, and lead wire 12. The current in the solenoid 13 is thereby diminished and the spring 18 will tend to carry contact arm 16 to its initial position. However, since 16 has been carried beyond the latching position with respect to 19, as stated above, 16 can only make a slight return movement before it is stopped by its engagement with the latch on arm 19. It is to be noted that the mechanism is so constructed that the contact between 17 and 16 is not lost during this movement. Contacts 16 and 17 not only serve to deenergize solenoid 13 as described, but also constitute the main switch contacts with respect to appliance 5. The operating current for appliance 5 will now flow through the system as follows: service line 8, point 3, heating coil 9, wire 20, contact 16—17, wire 14, point 4, appliance 5 and service line 15.

It is assumed at this state that the contact

arm 6 is at the position designated as "low", in which position contact between 6 and 7 is established, but contact between 6 and 21 is open. At this setting of contact arm 6 all of the current flowing through controlled appliance 5 will pass through the heating coil 9. Heating coil 9 is therefore now at its highest heating effectiveness. The heating coil 9 is in such a position with respect to the bimetal 10 that a maximum amount of energy radiated from heating coil 9 will be absorbed by the material of bimetal 10. It is to be noted that the heating coil 9 may be of such resistance as to be no appreciable factor in the overall resistance of this circuit. Moreover, the energy dissipated by heating coil 9 at this stage is so low in value that it constitutes a negligible loss with respect to the capacity of the controlled appliance 5. The function of the heating coil 9 is to warm the bimetal 10 and cause it to flex in the direction indicated by the dotted line immediately above, which dotted line designates the unlatching position. The bimetal 10 in flexing opens the contact between 10 and 11. It is to be noted that contacts 10 and 11 are in a branch short line containing the solenoid 13 by virtue of the engagement of 16 and 17. Therefore, very little current is flowing through the solenoid and no spark will result from the opening of contact 10 and 11 through the flexing of bimetal 10. The flexing of bimetal 10 through its mechanical engagement with latch 19 will tend to raise 19 to the unlatching position. At the unlatching position, the contact arm 16 is released from its engagement with latch 19 thereby permitting the spring 18 to return contact arm 16 to its initial position out of engagement with contact 17, the contact 16-17 being, as stated above, the main switch contact with respect to the controlled appliance 5, the opening of contact 16-17 opens the operating circuit of appliance 5.

The sequence of events just described may be designated as those taking place during the "on" period of appliance 5. Hence, during the time required to flex bimetal 10 from its contact position with respect to 11, to its unlatching position with respect to arm 19, the appliance 5 has been receiving energy at its full rated capacity; that is, appliance 5 has been directly across service lines 8-15.

The sequence of events now to be described may be designated as the "off" period with respect to appliance 5, since during this period the contacts 16-17 are out of engagement and the appliance 5 is in open circuit position.

The contacts 16-17 being open, heating coil 9, as well as appliance 5, is deprived of current. The bimetal 10 is therefore free to cool and return from the flexed or unlatching position to its normal position in engagement with contact 11. The "off" period with respect to appliance 5, therefore, embraces the interval of time required for bimetal 10 to return from the unlatching or flexed position to its normal contacting position with respect to 11.

Figures 2 and 3 show the application of my invention in a commercial form. The same numbers for designating corresponding parts are used in these figures as are used in the schematic circuit diagram Figure 5.

The drawings show the manner of housing by means of the shell 22. The prongs 1, 2, 3, 4 which extend through the housing correspond to points 1, 2, 3, 4 on the schematic diagram. To render it impossible to plug the assembly into a socket

in any but the correct manner, one of the four prongs is made smaller in diameter than the other three. Another method of accomplishing the same result is by disposing them asymmetrically so that they can only be inserted into the holes of the socket in the correct manner.

The frame 23 is a sheet iron stamping which forms a magnetic yoke around the solenoid 13, and its extensions above the solenoid 13 serve as the mounting frame or support for the bimetal 10, contact arm 16, latch 19, contact 11, and also provide support for springs 18-18A and the guide slots for stamping 24, which carries the solenoid plunger 26. The frame 23 also provides an anvil within the solenoid 13 in that a button 31 is formed on its lower cross member, which button forms a plug which extends upward into winding 13 and toward which plunger 26 is drawn when the solenoid 13 is energized. This button or anvil 31 is indicated in dotted lines in Figure 2 of the drawings.

The assembly 17-24-25-26 constitutes the moving element of the switch. 26 is an iron plunger, one end of which projects slightly into the solenoid 13, as shown in Figure 2 of the drawings, and to the other end of which is fastened the stamping 24.

Referring to Figure 4 of the drawings, the stamping 24 is shaped so that its lower cross member extends through the guide slots in 23 and is provided with a hole at each end. These holes serve as eyelets in which springs 18-18A are hooked.

The stamping 24 carries on its upper cross member the main switch contact 17 which is insulated from 24 by means of insulating shim 25. The slot between the upper and lower cross arms of 24 guides the contact arm 16, which is actuated by the movement of 24. The latching member of the contact arm 16 extends from the hinge pin of 16 through the slot between the upper and lower cross arms of 24, as shown in Figure 2 of the drawings.

The operation of the switch mechanism is as follows: when the winding 13 is energized by the manual movement of the control (see Figure 3) from off to low, the plunger 26 is drawn downward toward the anvil 31 formed at 23 and situated within the lower end of the solenoid 13. The plunger 26 carries with it the members 24, 25, 17, thereby stretching the springs 18, 18A which connect the stationary frame 23 and moving element 24. Since the contact 17 is part of the assembly 17, 24, 25, 26, it will follow the straight line downward movement of 26. As the cross-arm member 24 moves downward, it engages the latching member of contact 16 causing it to rotate on its hinge pin 32. This movement brings the contacts 16 and 17 into engagement. Through the closing of contacts 16 and 17, the solenoid 13 is deenergized, and with the opening of the contact 11 by the flexing of the bi-metal away from its contacting position, the solenoid circuit becomes disconnected. As no current flows through the solenoid during the "on" period after the closing of the main switch, the plunger 26 can eventually return to its initial position when permitted by the member 19. After a slight movement in this direction, the latching member of contact 16 encounters the latch 19 which stops further movement. Here it remains until bimetal 10 has been heated sufficiently to flex it outwardly, whereupon the latching member of contact 16 is released from engagement with 19.

The springs 18—18A are then free to return the assembly 17, 24, 25, 26 to its initial open position. The last phase of the operating cycle is the time interval required for the bimetal 10 to return from its flexed (or unlatching) position, back to its contacting position with respect to contact 11.

In order to explain the manner in which any temperature control may be obtained in the heating appliance, reference to Figures 6, 7, 8, 9 and 10 will be necessary.

A complete control is effected through the movement of contact arm 6 from the "off" position to the "high" position or vice versa. Referring to Figure 5, it is obvious that, as the outer end of the arm 6 is moved along the slide wire resistance 21 toward the high position, the part of the total current (from the line wire 8) which flows through the resistance 21 will increase, and that the part which flows through the heating coil 9 will decrease. Hence, the movement of the contact arm 6 toward the high position has the effect of increasing the "on" interval of the appliance 5 within the operating cycle with a consequent increase of the resultant temperature of the appliance 5. Incidentally, during the movement of the contact arm 6, the off period of the operating cycle is shortened for the reason that the diminishing radiation from the heating coil 9 diminishes the tendency to move the bimetal 10 to the unlatching position. Hence, the "on" period is increased and the "off" period decreased. A converse effect is produced by moving 6 toward the off position. It is to be noted that the range of control with respect to appliance 5 includes the two extremes—"off" position and "high" position. At the "off" position the solenoid 13 is inoperative in its open circuit position (16—17 being open) due to the interruption of its circuit at the contact 6—7. The appliance 5 therefore remains definitely inoperative as long as the contact arm 6 is in the "off" position. At the other extreme, when contact arm 6 is in the "high" position, solenoid 13 is inoperative in its closed circuit position (16—17 being closed) due to the fact that its winding is short circuited by the engagement of 16—17. At this position of contact arm 6, the engagement of 16 with 17 is maintained because bimetal 10, as described above, will not actuate latch 19 due to the short circuiting of heat coil 9. It is evident that the contact arm 6 may be adjusted between these extremes to a position which will effect the required resultant temperature of appliance 5. It is also evident that the assembly comprising 6, 7 and 21 is exceedingly simple and inexpensive and that this assembly may be remote from the switching mechanism enclosed in the dotted line. For example, just as appliance 5 may be remote from the balance of the circuit by lengthening the lead from it to point 4 as required, the assembly 6, 7, 21 may be remote from the switching mechanism proper by lengthening, to the required degree, its leads to points 1, 2 and 3.

In the particular mechanism, as for example devised for operation with domestic electric ranges, 6, 7, 21 are mounted on an insulating disc 2½" in diameter and ¼" thick. This assembly is mounted in the rear of the range switch panel with the shaft of arm 6 extending through the panel and terminating in front of the panel in a knob with an index finger similar to the knobs employed in volume control rheostats in radio practice. The front of the panel Figure 9 is marked "high", "low" and "off" and has a series

of calibration marks between the "low" position and the "high" position so that the operator can readily set the index finger of the knob in the position required for the purpose at hand.

I claim:

1. A system for varying the ratio of the on and off periods of an intermittently operated electrical device, comprising in combination an electromagnetic switch actuated in one direction by a solenoid and in the reverse direction by mechanical means, holding means for preventing the return movement of the switch after it has been actuated by the solenoid, a mechanical release means adapted to disengage the said holding means, a thermoresponsive element operating between two positions, the thermoresponsive element in one of the said positions making an electrical contact which closes the solenoid circuit and in the other of the said positions actuating the mechanical release to permit the automatic opening of the switch, a shunt circuit by-passing at least a portion of the current around the solenoid when the said switch is closed, means for applying heat to the thermoresponsive element in repetitive cycles dependent upon the on and off positions of the switch, and means for varying the rate of heat supply to the thermoresponsive element.

2. In a mechanism for controlling the on and off periods of an electrical device, a magnetic switch actuated by a solenoid, holding means for retaining the said switch in closed position, a mechanical release means which permits the mechanical opening of the switch, mechanical means for opening the switch when the release is actuated, a bi-metal strip operating between two positions, the bi-metal strip in one of the said positions making an electrical contact which closes the solenoid circuit and in the other of the said positions actuating the said release, a shunt circuit closed by the said switch, the said shunt circuit passing through the bi-metal contact and deenergizing the solenoid when the bi-metal contact and the switch are closed, and a second shunt circuit also closed by the said switch which contains a heating element for the bi-metal strip and which by-passes the current around the contact made by the bi-metal strip when the said contact is open and the magnetic switch is closed.

3. In a mechanism for controlling the on and off periods of an intermittently operated electrical device, a magnetic switch actuated by a solenoid, a holding means adapted to maintain the switch in a closed position, a spring adapted to open the switch when the said holding means is disengaged, a bi-metal strip operating between two positions, the bi-metal strip in one of the said positions making an electrical contact which closes the solenoid circuit and in the other of the said positions disengaging the said holding means, an electric heating element in close proximity to the bi-metal strip and adapted to impart heat thereto, a circuit for the said heating element which is alternately opened and closed with the opening and closing of the said switch, and a shunt circuit closed by the said switch, the shunt circuit by-passing the current around the solenoid and de-energizing the solenoid when the circuit for the device being controlled is closed.

4. The combination described in claim 3, in which the contact closing the solenoid circuit is rigidly attached to the bi-metal strip.

5. The combination described in claim 3, in

which a shunt circuit also by-passes the current around the contact closed by the bi-metal strip when the solenoid circuit is closed.

6. In a mechanism for controlling the on and
5 off periods of an intermittently operated electrical device, a solenoid, a plunger actuated by the solenoid, a contact carried by the plunger and adapted to close the electrical circuit of the device
10 being controlled, mechanical holding means for maintaining the plunger in a fixed position after actuation of the solenoid, mechanical means for moving the plunger in a direction opposite to the direction of movement produced by the solenoid when the said holding means is disengaged,
15 a bi-metal strip operating between two positions,

the bi-metal strip in one of the said positions making an electrical contact which closes the solenoid circuit and in the other of the said positions disengaging the said holding means, an electric heating element in close proximity to the bi-metal strip and adapted to impart heat thereto, a circuit for the said heating element which is alternately opened and closed with the opening and closing of the said switch, and a shunt
10 circuit closed by the said switch, the said shunt circuit by-passing the current around the solenoid and de-energizing the solenoid when the circuit for the device being controlled is closed.

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