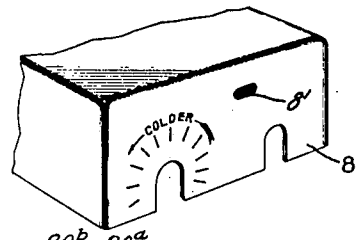
Sept. 25, 1934. L. P. HUTT 1,974,991

COMBINED AUTOMATIC AND MANUAL CIRCUIT CONTROLLER

Filed Feb. 28, 1930

Fig. 1.



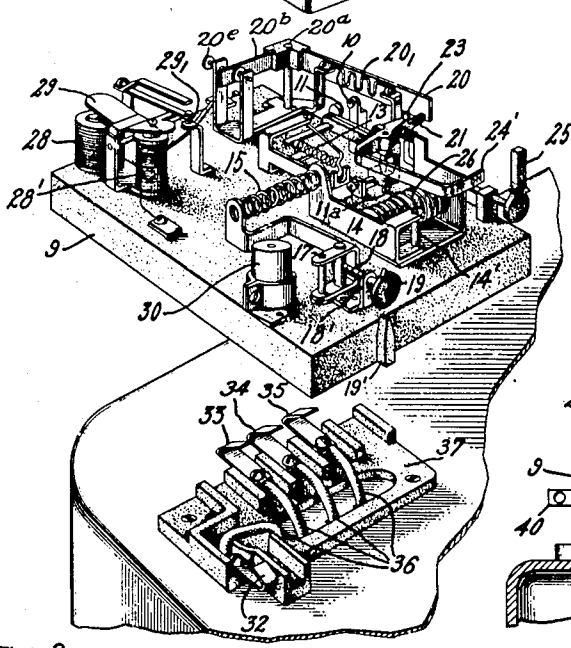


Fig. 3.

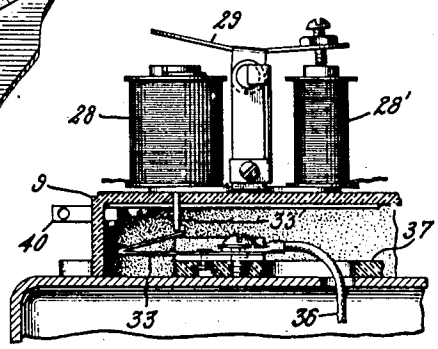


Fig. 2.

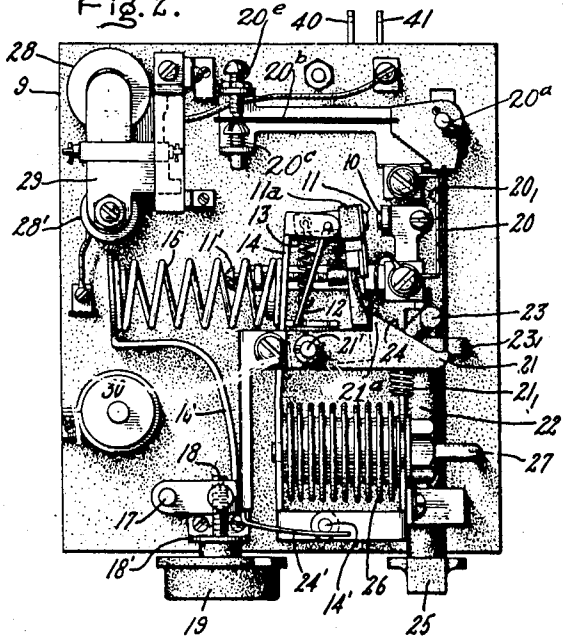


Fig. 4.

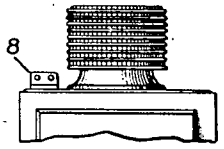
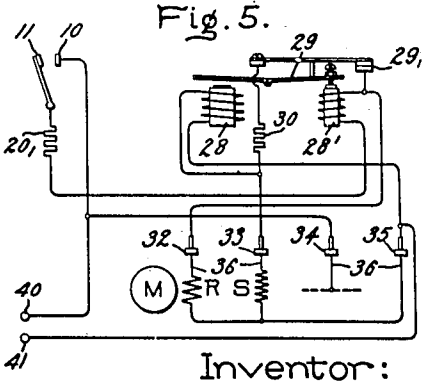


Fig. 5.



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His Attorney.

Patented Sept. 25, 1934

1,974,991

UNITED STATES PATENT OFFICE

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COMBINED AUTOMATIC AND MANUAL CIRCUIT CONTROLLER

Leonard P. Hutt, Schenectady, N. Y., assignor to General Electric Company, a corporation of New York

Application February 28, 1930, Serial No. 432,204

9 Claims. (Cl. 200—81)

My invention relates to circuit controlling devices, particularly circuit controlling devices for controlling electrically operated apparatus, such as domestic electric refrigerators or the like, automatically in response to temperature and overload conditions and which also may be manually operated.

My present invention provides various improvements upon my previous devices described and claimed in Patent No. 1,637,042, issued July 26, 1927 and in Patent No. 1,921,126, issued August 8, 1933.

In refrigerator controlling devices of the character set forth, accessibility and ease of the manual control and the temperature adjustment are important features. Also to avoid a prolonged shutdown of the refrigerator in case of some slight failure of the control device, it is desirable that it be capable of being quickly replaced by another unit.

Furthermore, compactness and neatness are necessary features demanded for pleasing appearance, and hence all of the various elements which make up the device must be placed within as small a space as possible.

It is a general object of my invention to provide an improved refrigerator control having the advantageous features noted above. More specifically, it is an object of my invention to provide an improved means for adjusting the temperature control for such a refrigerator control.

Other objects will appear hereinafter.

In carrying out my invention in one form thereof I provide an automatic switch means responsive to different predetermined temperatures. It consists of an over center snap switch operated by means of a temperature responsive device. A resilient means under compression opposes the temperature responsive device and the compression of this resilient means may be varied to change the temperatures to which the switch will respond. A member biased to open the switch is normally held against its bias by means of a heat responsive device which responds to overload conditions to release the biased member to open the switch. A manual control means is provided for releasing the biased member from the control of the heat responsive device and for placing the biased member under the control of the heat responsive device thus manually controlling the switch. The switch mechanism is provided with a cover through which the adjusting means for the resilient means opposing the temperature responsive device and the means for releasing the biased member from the control of the heat responsive device extend.

In order to permit the refrigerator controlling device to be readily replaced in case of failure, a sub-panel is mounted on the refrigerator with electrical connecting means provided thereon whereby when the controlling device is placed on the sub-panel, the proper electrical circuits will be established to permit control of the refrigerating apparatus by the controlling device. By sealing the cover on the controlling device tampering by unauthorized individuals is prevented. The sub-panel assembly is described and claimed in my divisional application Serial No. 627,590, filed August 5, 1932, entitled "Combined automatic and manual circuit control devices."

In the drawing, Fig. 1 represents an exploded view of the cover, switch mechanism and sub-panel to show their relation and cooperation; Fig. 2 is a plan view of the switch mechanism; Fig. 3 is a section of the switch mechanism and sub-panel; Fig. 4 shows the switch mechanism mounted upon a refrigerator; Fig. 5 shows the refrigerator circuit.

Referring to Fig. 2, the stationary contact 10 of the switch mechanism and the movable contact 11 mounted on a movable element 11a cooperate to open and close a circuit through the refrigerator motor in response to the temperature responsive device 26. The elements 12 and 13 mechanically connecting the element 11a carrying the movable contact 11 and the lever 14, are the pivoted means and spring means for causing the snap action of the movable contact 11. The lever member 14 is operated by means of the temperature responsive device 26 to operate the snapover switch. Urging the switch mechanism to the open position is the resilient means or compression spring 15 in contact with lever 14 and under compression. This resilient means determines the temperatures at which the switch is opened and closed. In contact with the other end of the resilient means is a lever 16 which is pivotally mounted at the point 17. A screw 18 is supported in a bracket 18' and may be adjusted by means of the dial knob 19 to move the lever mechanism 16 about its pivot to vary the compression of spring 15. This lever arrangement multiplies the movement of the screw and results in varying the temperatures to which the switch mechanism responds. A stop 19' is provided for the dial knob 19.

It will be noted that by turning the knob 19 in a counter-clockwise direction to release the screw 18 from the lever 16, the knob and screw

may be withdrawn. This permits the lever 16 to be removed from its pivot 17, and the spring 15 then drops out. This permits ready assembly of the compression spring and its adjusting means, a factor of great importance in the manufacture of the device.

The refrigerator motor control circuit shown in Fig. 5 is set forth in the claims in my copending application, Serial No. 448,731, filed April 30, 1930.

It will be observed that a resistor 20_1 is connected in series with the contacts 10 and 11. The motor current which flows through this resistor generates heat which is conducted and radiated to the heat responsive element 20 causing it to assume a curved shape to the right thereby releasing the pivoted member 21. Member 21 is urged about its pivot 21' in a counterclockwise direction by its spring biasing member 21_1 to open the switch mechanism with a snap action and to lock it in the open position. The manner in which the contacts are opened with a snap action is shown in Fig. 2. For example, the pivoted or movable member 21 is provided with a portion 21*a* which is arranged to engage the element 11*a* to open quickly the contacts independently of the over-center spring 13. The pivoted member 21 has attached thereto an element 24' which carries thereon designations to show when the switch is off and on. These designations appear through a slot 8' of the cover 8 which is provided for the controlling device.

A member 22 rotatably mounted and provided with the extension 23 and the adjusting handle 25 cooperates with the heat responsive element 20 of bimetallic material and the pivoted member 21. By rotating the member 22 in a clockwise direction, the extension 23 moves the heat responsive element to the right, thereby releasing the pivoted member 21 to open the switch. Upon reversing the direction of rotation of the member 22, the extension 23 will contact with the inclined surface 24 of the element 21 to rotate this element 21 in a clockwise direction, permitting the heat responsive element 20 to move to the left and again lock the pivoted member 21 against its spring bias 21_1. A stop member 23_1, is provided on member 22 to limit rotation of member 22 in a clockwise direction to prevent damage to the heat responsive element 20.

The temperature responsive device 26 is of the well known sylphon bellows type. The pipe 27 extends into the refrigerating compartment, and the fluid within the sylphon bellows expands and contracts in response to the temperature changes within the compartment, causing the bellows to expand and contract in response thereto to actuate the switch mechanism.

In Figs. 2 and 3, are shown the contact elements 40 and 41 which are mounted in the base 9 and cooperate with a plug (not shown) connected to the power lines. These contact elements are electrically connected to the apparatus mounted on the base 9 as shown in Fig. 5.

It is understood of course that the refrigerator motor M with its running winding R and starting winding S and the connections for the same are mounted in the refrigerator and are connected to the resilient contact members 32, 33 and 35 on the sub-panel 37 by means of conductors as shown at 36 in Fig. 1 and Fig. 5, the sub-panel 37 being mounted on the refrigerator. Resilient member 34 is connected to apparatus within the refrigerator of no interest to my present invention and does not affect the operation of my device. Rigid contact members such as 33', shown in Fig. 3 serve to make the necessary connections between the resilient contact members on the sub-panel and the apparatus carried by the base 9. The electrical connections between these contact members 33 and the apparatus carried on base 9 is shown in Fig. 5.

For the purposes of this application it is not necessary to go into the discussion of the circuit any further than to show how the connections are made. The theory and operation of the circuit is set forth and the particular apparatus claimed in my copending application, identified above.

Briefly, the coils 28 and 28' cooperate to open the contact 29_1 upon establishing running speed of the motor M to take the starting winding off the line. The resistor 30 is a limiting resistor for starting the motor and the heating resistor 20_1 is for the purpose of tripping the switch in case of overload by causing the bimetallic strip 20 to respond to the temperature of the resistor 20_1 to bend outwardly and release the biased member 21 to open the switch, thus taking the motor M off the lines. The bimetallic strip 20 is supported on a pivot 20*a*. A second bimetallic strip 20*b* extends from the pivot 20*a* at right angles to the bimetallic strip 20 with its outer end located between two stops 20*e* and 20*c*. The thermal or bimetallic strip 20*b* is responsive to ambient temperatures and varies the operation of the strip 20 in accordance with changes in ambient temperature. The stop 20*e* is adjustable while the stop 20*c* is resiliently mounted so as to permit movement of the element 20 from engagement with the member 21.

To remove the control switch from its base, the sylphon tube 27 must be straightened within the refrigerator, it having been bent to fit the interior thereof, and four screws (not shown) which hold the base 9 over the sub-panel must be unscrewed. The base then lifts off with the sylphon tube as a unit, thus making it an easy task to replace it with a new unit and fastening the new unit to the sub-panel.

To be made operative, the switch mechanism carried by the base 9 is placed over the sub-panel 37 and screwed thereon, the sylphon tube 27 extending into the refrigerator and properly adjusted.

The rigid extensions 33' extending through the base 9 contact with the resilient members 33 thus placing the coil 28 in parallel with the starting winding S and the coil 28' in series with the running winding R and the thermostatic switch as shown in Fig. 5.

In operation the contacts 10 and 11 are closed and opened with a snap action in response to the expansion and contraction of the sylphon or expansible bellows 26. As the sylphon bellows expands in response to a rise in temperature in the refrigerator, the force of the spring member 15 is gradually overcome to move the pivoted member 14 to the left. This motion is transmitted to the pivoted member 12 and carries its pivoted end to the left until the spring 13 and member 12 are parallel. At this point the tension in the spring is greatest, and as the pivoted end of the member 12 continues to move to the left, a position of unbalance results and the spring in assuming a position of least tension causes the member carrying the contact 11 to close on the contact 10 with a snap action.

As shown in Fig. 5, this completes a starting circuit through the windings of the motor M to

start the motor. As the refrigerator is cooled, the sylphon bellows contracts and the switch is opened to stop the motor in the reverse manner set forth above.

As pointed out, the compression of the resilient member 15 may be varied by turning the dial knob 19. Rotating the lever 16 in a clockwise direction increases the compression in the spring 15. It will be noted that the spring 15 opposes the action of the sylphon bellows 26. Increase in the compression of the resilient member 15 raises both the opening and closing temperatures of the switch mechanism since with a greater compression in the resilient member 15, a higher temperature is needed to cause the greater pressure in the sylphon bellows 26 necessary to overcome the compression in the spring member 15.

A screw means 11' is provided for rotating the member carrying the contact 11 about its pivot 21'. Moving the contact 11 to the right has the effect of decreasing the temperature necessary to close the switch mechanism, since it will then be necessary for the pivoted end of the element 12 to move a shorter distance to trip the switch than before the adjustment was made. Likewise, when the pivoted member 11 is permitted to rotate in a counter-clockwise direction to move the contact further to the left when the screw means 11' is moved to the left, the pivoted element 12 must move a greater distance before the switch mechanism is closed, thereby increasing the temperature necessary to close the switch mechanism. The shape of the lever mechanism 16 is for the purpose of permitting the adjusting means to be mounted at the end of the switch and to make room for the resistor 30.

It will be noted that by the special construction of the lever 16 for compressing the spring 15, the adjusting knob may be mounted on the side as shown. The shape of the lever provides space for the resistor 30, thus decreasing the space necessary for the apparatus. By making the member 22 perform two functions the number of parts is reduced, thus reducing the space necessary to mount the parts permitting a smaller control device unit. The result is a very compact unit with the controls all on the same side of the device and with fewer adjusting members.

It will thus be seen that I have provided numerous improvements in my automatic switch mechanism including the means for making the various adjustments thereon and for providing the necessary electrical connections thereto.

The embodiment of the invention illustrated and described herein has been selected for the purpose of clearly setting forth the principles involved. It will be apparent, however, that the invention is susceptible of being modified to meet the different conditions encountered in its use, and I therefore aim to cover by the appended claims all modifications within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A control device comprising a stationary contact, a movable element carrying a contact cooperating with the stationary contact, means including an over-center spring for operating said element between predetermined positions with a snap action, a movable member biased for movement into engagement with said movable element to open quickly said contacts against the bias of said over-center spring, thermal responsive means for holding said movable member in a predetermined position out of engagement with said element, and a single means disposed in cooperative relation with said thermal element and said movable member and rotatable in one direction to flex said thermal responsive element to release said member for operation in accordance with its bias and operable in the other direction into engagement with said movable member to return it to said predetermined position.

2. A control device comprising a stationary contact and a pivoted element carrying a contact cooperating therewith movable between open and closed positions, a spring for operating said contacts with a snap action between said positions, a movable member mounted adjacent said element and biased for engagement with said element to operate quickly said contacts to said open position independently of said spring, a locking means rendering said movable member inoperative and a rotating member provided with an extension cooperating with said movable member and said locking means, whereby rotation of said rotating member in one direction will release said movable member from said locking means to open said contacts, and rotation of said rotating member in the other direction will move said movable member under the control of said locking means to render said movable member unresponsive to its bias.

3. A combined automatic and manual circuit controlling device comprising a movable circuit controlling member, automatic operating means therefor including an over-center spring connected to said member for opening and closing said circuit with a snap action, an operating member biased to move quickly said circuit controlling member against the bias of said over-center spring to open said circuit, latching means responsive to the current in the circuit controlling member for holding the operating member against its bias under certain current conditions, and a manually operable member operable in one direction for releasing said latching means and in the other direction for moving the operating member under the control of the latch.

4. A control device comprising a thermostatic switch mechanism a compression spring for determining the temperatures at which said switch operates and connected at one end to said switch mechanism, a lever connected to the other end of said spring, and a screw means provided with a dial knob rigidly attached thereto and connected to said lever, means for pivotally mounting said lever so that said lever multiplies the movement of said screw means to vary the compression in said spring thereby producing relatively large changes in the temperatures to which said switch mechanism will respond for a given movement of said screw means, a stop for said dial knob, said screw, lever and resilient means permitting ready assembly and dismantling thereof by connecting or detaching said screw means from said lever.

5. An electric refrigerator control device comprising a stationary contact, a movable contact cooperating therewith movable between open and closed positions, an over-center spring associated with said contact for operating it with a snap action, a temperature responsive device for moving said movable contact to open and closed positions, a resilient means under compression opposing said temperature responsive means, screw means including an adjusting knob rigidly secured thereto for varying the compression in said resilient means to vary the temperatures to which

said temperature responsive device will respond to move said movable contact, a pivoted member biased to move said movable contact to open position with a snap action independently of said over-center spring, a heat responsive means for holding said pivoted member against its bias, releasing means for releasing said pivoted member from said heat responsive means and to move said pivoted member under the control of said heat responsive means to render the pivoted member unresponsive to its bias, said releasing means being provided with an operating handle, a cover for said control device, said knob and said handle extending through said cover to permit external operation of said control device.

6. A control device comprising an over-center switch, an operating member operable between predetermined positions to cause said switch to open and to close with a snap action, an expansible bellows associated with said operating member to move it between said predetermined positions, a compression spring having one end operatively associated with said member to oppose said bellows, a pivoted lever having one end connected to the other end of said spring, the other end of said lever being pivotally secured in a fixed position, and screw means connected to said lever at a point such that said lever multiplies the movement of said screw means for the adjustment of said spring, the compression of said spring controlling the temperatures at which said switch operates.

7. A control device comprising a pair of contacts, a movable element for supporting one of said contacts, an operating member, an over-center spring extending between said operating member and said movable element for operating said contacts to open and closed positions with a snap action, a movable member, means for mounting said movable member for movement against said movable element, a biasing spring for operating said movable member against said element to open quickly said contacts independently of the bias of said over-center spring, and a bimetallic element normally restraining said movable member out of engagement with said element.

8. A control device comprising a pair of contacts, a movable element for supporting one of said contacts, an operating member, an over-center spring extending between said operating member and said movable element for operating said contacts to open and closed positions with a snap action, a movable member, means for mounting said member for movement against said movable element, a biasing spring for operating said member against said element with a snap action to open quickly said contacts independently of the bias of said over-center spring, a bimetallic element normally restraining said movable member out of engagement with said element, a resetting device movable in one direction to bend said bimetallic element away from said movable member to release it for movement in accordance with its bias, said movable element being provided with an inclined portion arranged to be engaged by said resetting device when moved in the opposite direction to return said movable member to its original position.

9. A control device comprising a pair of contacts, an over-center spring associated with one of said contacts, an operating member operable between predetermined positions to cause said over-center spring to open and to close said contacts with a snap action, an expansible bellows associated with said operating member to move it between said predetermined positions, a compression spring arranged to oppose the movement of said bellows, a movable member, means mounting said movable member for movement against said movable contact, a biasing spring for operating said movable means to open said contacts quickly independently of said over-center spring, and a bimetallic element arranged to hold said movable member against its bias and out of engagement with said movable contact.

LEONARD P. HUTT.