May 27, 1952 R. L. KONLE ET AL 2,598,563

CIRCUIT CONTROLLING DEVICE

Filed Oct. 16, 1950 2 SHEETS—SHEET 1

Fig. 1

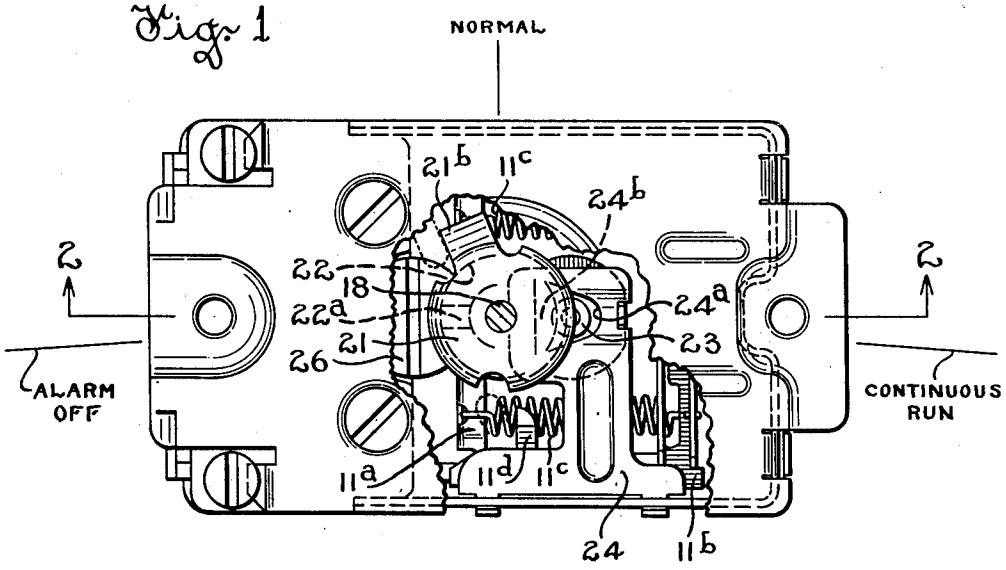


Fig. 2

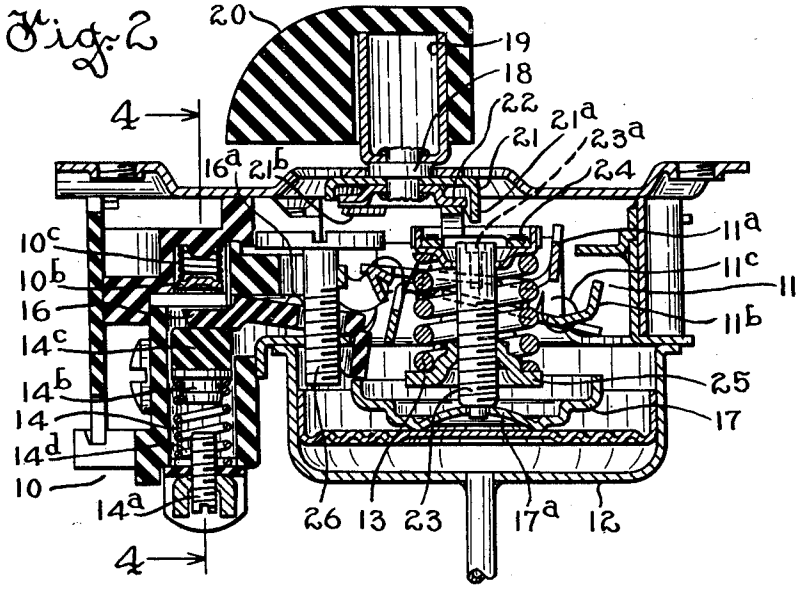
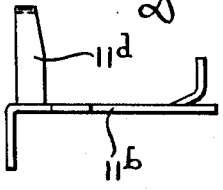


Fig. 3



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Fig. 4

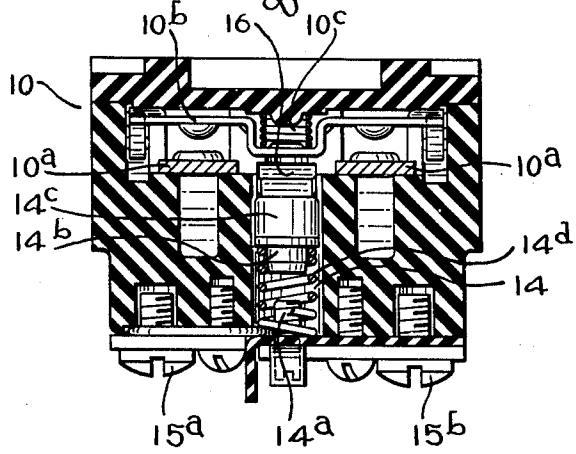


Fig. 4a

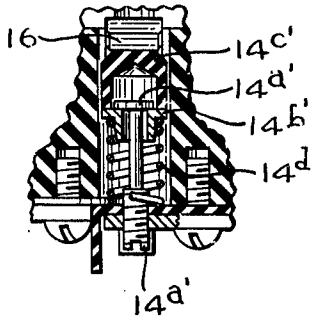


Fig. 5

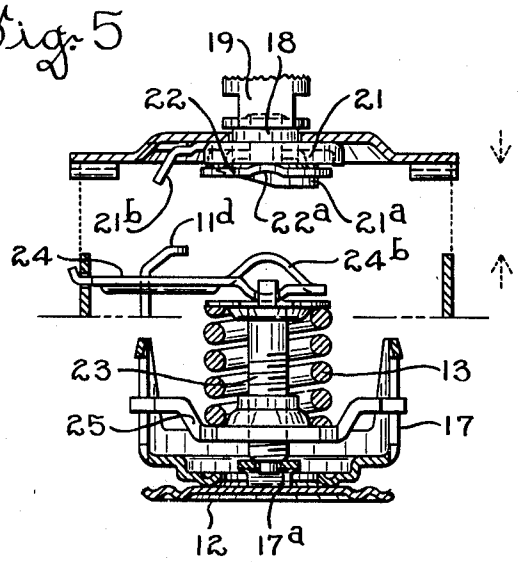


Fig. 6

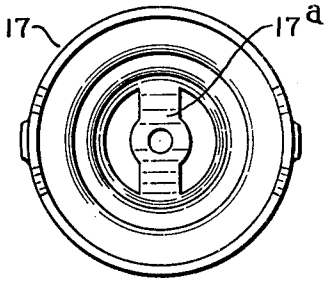
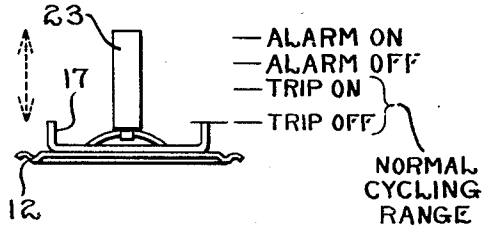


Fig. 7



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UNITED STATES PATENT OFFICE

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CIRCUIT CONTROLLING DEVICE

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5 Claims. (Cl. 200—140)

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This invention relates to circuit controlling devices and more particularly to automatic temperature control switches for use in connection with electric refrigerators to control a plurality of circuits, one of which is adapted to control an alarm device to indicate abnormal temperatures within the refrigerator.

The invention has among its objects the provision in a switch of the aforementioned character of a single manual setting means affording in the switch the three-way function of "normal cycling," "continuous run," and "alarm off" positions.

Another object of the invention is the provision of novel manual switch setting means for controlling all of the switch functions and more particularly provision of a manual switch setting means having operating positions as follows: (1) a "normal" position wherein the switch functions normally to govern the supply of energy to the refrigerator to maintain the same within a predetermined temperature range, but permits commutation of an alarm circuit at a predetermined abnormal temperature; (2) a "continuous run" position wherein the main switch contacts are biased to closed position regardless of temperature, but the alarm circuit contacts function to commutate an alarm circuit at essentially the same predetermined abnormal temperature as in the first position; and (3) an "alarm off" position wherein the switch is free to function as in the first position, but the contacts in the alarm circuit are biased to a given position regardless of temperature.

Another object is to provide switch setting means affording the aforementioned functions which are simple and rugged in construction and which may be incorporated in a switch of relatively small proportions, particularly with respect to its front to back dimension, without increase in the size of the switch, thereby affording an exceedingly thin switch from front to back adapted for mounting in the wall of a refrigerator.

Various other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate an embodiment of the invention which will now be described, it being understood that various modifications may be made in the embodiment illustrated without departing from the spirit and scope of the appended claims.

In the drawings,

Figure 1 is a top plan view of the control switch embodying the invention, with operating parts

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removed and the cover partially broken away;

Fig. 2 is a center line section taken substantially on line 2—2 of Fig. 1, with the switch parts shown in "alarm off" position;

Fig. 3 is a detail side elevation of one of the switch levers;

Fig. 4 is a lateral section taken substantially on line 4—4 of Fig. 2;

Fig. 4ª is a fragmentary section illustrating a modified form of alarm contacts;

Fig. 5 is a fragmentary sectional view, with the cover and operating parts spaced away from certain of the other switch parts for clarity of illustration;

Fig. 6 is a detail top plan view of the cup member; and

Fig. 7 is a schematic illustration showing the range of movements.

The refrigerator control switch illustrated in the drawings includes a switch unit 10 and a unitary operating assembly therefor, including a snap acting operating mechanism 11 and a pressure responsive device 12, all of substantially the type disclosed in the Kuhn Patent No. 2,511,640 to which reference may be had for the details of construction and operation thereof. It is deemed desirable here to note merely that the switch unit 10 includes stationary contacts 10ª to be connected in circuit with the supply of electrical energy for the refrigerator motor for control thereof in the usual manner, said circuit to be opened and closed by bridging of contacts 10ª by a contactor 10ᵇ normally biased to closed circuit position by a spring 10ᶜ.

The snap acting mechanism under the control of the pressure responsive device 12 is of the type disclosed in the patent to C. F. Robbins, No. 2,375,387, to which reference may be had for the details of its construction and operation, it being here necessary merely to note that contactor 10ᵇ is actuated by pressure responsive device 12 through the snap acting mechanism 11 consisting generaly of an operating lever 11ª, a control lever 11ᵇ, and over-center springs 11ᶜ.

As will be apparent, expansion of the pressure responsive device 12 is opposed by a loading spring 13 associated therewith, the snap acting means 11 being responsive to expansion and contraction of the pressure responsive device 12 for actuation of the main contactor 10ᵇ in the usual manner.

Additionally, the switch unit 10 is provided with a set of auxiliary contacts 14 (Figs. 2 and 4) for controlling a circuit to an alarm device (not shown) utilized in the refrigerator to indi-

cate abnormal or dangerous temperatures therein. Such an alarm device may be a bell, a buzzer, a light, or the like, and if the latter, might be connected to light up to indicate abnormal refrigerator conditions, or to go out upon the incidence of abnormal refrigerator conditions. The auxiliary contacts 14 may therefore be of the normally open type as illustrated in Fig. 4 or of the normally closed type as illustrated in Fig. 4a.

More specifically, the auxiliary contacts 14 of the normally open type shown in Fig. 4 comprise an adjustable stationary contact 14a and a movable contact 14b carried by an insulating member 14c adapted to reciprocate within a recess in the base of switch unit 10, a helical spring 14d positioned within the same recess biases the member 14c and contact 14b carried thereby upwardly and additionally spring 14d serves to carry current from a terminal screw 15a (Fig. 4), to which it is electrically connected, to the contact 14b. The stationary contact 14a, as best shown in Fig. 4, is electrically connected to terminal screw 15b.

As best illustrated in Fig. 2, member 14c carrying the contact 14b is movable downwardly against its bias into contact with stationary contact 14a by a lever 16 pivoted as at 16a, one end of said lever extending into the switch operating compartment to engage a cup 17 (to be hereinafter described) movable upwardly in response to expansion of the pressure responsive means 12.

In the modification of the auxiliary contacts 14 to afford a normally closed relationship as illustrated in Fig. 4a, the stationary contact 14a' is formed with an enlarged head at the upper end thereof, and the insulating member 14c' is provided with a downwardly opening recess in which the head of contact 14a' is free to reciprocate. A washer-like annular member 14b' serving as the movable contact is carried by the spring 14d and affords clearance for the contact 14a', the head of which overlies member 14b'. As will be apparent, the spring 14d normally maintains the contact members 14a' and 14b' in engagement, but when member 14c' is moved downwardly by action of lever 16, the member 14c' forces contact 14b' downwardly against the bias of spring 14d to effect disengagement of contacts 14b' and contact 14a', the recess in member 14c' affording clearance for the head of contact 14a' as aforementioned.

The control device aforedescribed is further provided with a single manual setting means affording a three-way function as hereinafter described, said setting means comprising a shaft 18 (Fig. 2) rotatably mounted on the cover member of the switch mechanism and extending both internally and externally thereof. Rigidly affixed to the external end of shaft 18 is a coupling member 19 carrying a molded operating knob 20; while rigidly attached to the opposite end of the shaft 18 inside of the cover member are a cam member 21 and a washer member 22, the latter two members being jointly rotatable upon rotation of knob 20.

As best shown in Figs. 2 and 5, cam member 21 has a downwardly extending cam surface 21a to coact with a pin 23 movable with cup 17, which cam surface in one of the extreme operative positions of the manual setting means serves to block upward movement of the pin 23 as will hereinafter be described.

The cam member 21 additionally has a downwardly extending lug 21b, which, as best shown

in Fig. 5, is adapted in the other extreme position of the manual setting means, to engage a tail extension 11d on control lever 11b of the snap acting mechanism 11 to prevent movement of the latter permitting opening of the main contacts 10a, 10b, thereby affording a "continuous run" position as will hereinafter be described.

Pivotally attached to the enclosing casing of the switch is a lever 24 best shown in Figs. 1 and 5 overlying loading spring 13 and having a clearance hole 24 affording projection therethrough of pin 23. As best shown in Fig. 5, lever 24 is additionally provided with an upwardly extending boss 24b for engagement with a detent 22a (Figs. 1, 2 and 5) in member 22 when the manual setting means is moved to the "continuous run" position, such engagement restraining movement of the setting means out of that position when moved thereto.

As aforementioned, the cup 17 is movable upwardly and downwardly with expansion and contraction of the temperature responsive means carrying pin 23 through a corresponding range of movement. Referring to Figs. 2, 4 and 7, upward movement of the cup 17 with expansion of temperature responsive means 12, due to increase of temperature in the refrigerator, first causes movement of snap acting means 11 to actuate main contacts 10a, 10b to closed circuit position, the temperature at which such closure is effected being the "trip-on" temperature of the switch (Fig. 7). Assuming the temperature in the refrigerator then to decrease, the temperature responsive means will again contract and cup 17 will move downwardly under the bias of loading spring 13. Upon a given degree of downward movement, the snap acting mechanism 11 will again open the main switch contacts, the temperature at which such opening takes place being the "trip-off" temperature of the switch (Fig. 7). This automatic recurring operation of the switch with changes in temperature is termed the normal cycling of the switch.

If, however, after the "trip-on" temperature has been reached and the temperature in the refrigerator still continues to rise thereby resulting in further upward movement of cup 17, the latter, upon a given degree of overtravel will move lever 16 with which it is in engagement to effect actuation of the auxiliary contacts 14, thereby affording an indication of the abnormal temperature in the refrigerator. In this connection it will be noted that the stationary contact 14a is in the form of a screw permitting adjustment of the point of over-travel of cup 17, hence the temperature, at which the contacts 14a, 14b will engage.

The foregoing description of operation of the control mechanism of course, obtains only if cup 17 and pin 23 carried thereby are free to move through the entire range of movement as indicated in Fig. 7, and if the snap acting mechanism 11 is free to respond as intended. Such freedoms are, however, governed by the setting of the manual setting means, and only in the intermediate or "normal" position thereof are both the snap acting mechanism and the cup 17 permitted complete freedom of movement throughout their entire range.

As best shown in Fig. 5, when the manual setting means are in the "continuous run" position, the snap acting mechanism is not free to operate because of the engageemnt of lug 21b with the tail extension 11d of operating lever 11b, thereby preventing opening of the main contacts 10a, 10b. As aforementioned, the boss 24b on lever 24 en-

gages the detent 22a of member 22 in this position of the manual setting means to insure maintenance of the setting means in this position regardless of the movement of cup 17 and pin 23. As will be apparent, the latter are free to move throughout their full range in response to movement of pressure responsive means 12 with changes in temperature in the refrigerator. Therefore, should the refrigerator temperature rise to an abnormal degree, the auxiliary contacts 14 may be actuated to cause indication of such abnormal temperature. Since the loading of spring 13 has remained substantially the same, such abnormal temperature will be the temperature predetermined for operation of the auxiliary or alarm contacts 14 when the manual setting means is in "normal" position.

If, however, the manual setting means is moved to the "alarm off" position, as best shown in Fig. 2, the cam surface 21a of member 21 will be in position to block over-travel of cup 17 and pin 23 by engagement of the latter with the cam surface 21a, thereby preventing actuation of the auxiliary or alarm contacts 14. As will be apparent, such blocking of the parts to prevent alarm indication is necessary to prevent such indication when the refrigerator is pulling down from an abnormal temperature, as for example when the refrigerator is first put into operation. It will be noted, however, that while cam surface 21a prevents over-travel of cup 17 and pin 23, as aforementioned, it permits movement of those parts freely between the "trip-on" and "trip-off" points of the main contacts, as shown in Fig. 7, thus permitting the refrigerator to cycle within its normal temperature range.

As will be apparent, the foregoing requires close control over the distance between the cup 17 (or top of pin 23 carried thereby) and the cam surface 21a. Since maintenance of such close control is beyond the normal tolerances of these parts, it has been found desirable to make cup 17 of special design. As best shown in Fig. 6, cup 17 is formed with a bendable web 17a in which the pin 23 rides (Fig. 2). This web is bent in a fixture during assembly in order to produce the desired relationship, in so far as spacing is concerned, between the pin 23 and cam surface 21a in order to effectively block alarm contact action without interfering with normal cycling of the main contacts.

Referring to Figs. 2 and 5, it will be seen that pin 23 is threaded and carries a nut 25 upon which the loading spring 13 rides, and that pin 23 is recessed at the upper end thereof as at 23a to afford a socket for a suitable wrench. The loading of spring 13 may be adjusted by turning pin 23 to run nut 25 up or down, as the case may be, to change the range of normal cycling of the switch. The differential between the "trip-on" and "trip-off" points of the switch may be adjusted by means of a differential screw 26 limiting movement of the lever 11a of the snap acting mechanism 11 in the usual manner.

As will be apparent, neither of the aforementioned adjustments, either of range or differential, affect the spacing of pin 23 and cam surface 21a, while the point of engagement of the alarm contacts 14 may be adjusted by turning the screw forming the contact 14a as aforedescribed.

We claim:

1. In combination, a thermal responsive switch having a set of main contacts, an actuating mechanism therefor and pressure responsive means controlling said actuating mechanism to close or open said main contacts at predetermined temperatures, a set of auxiliary contacts actuated by said pressure responsive means upon over-travel thereof, a single manual switch setting means having a plurality of operative positions, said manual setting means including means which in a first position of the setting means block movement of said actuating mechanism to maintain said main contacts in a given position but afford freedom of movement of said pressure responsive means throughout its full range, and means blocking over-travel of said pressure responsive means but permitting normal movement of said actuating mechanism in a second position of said manual setting means, the latter in a third operative position permitting complete freedom of movement of both said actuating mechanism and said pressure responsive means for normal cycling of the switch and actuation of said auxiliary contacts upon over-travel of said pressure responsive means.

2. In combination, a thermal responsive switch having a set of main contacts, an actuating mechanism therefor and pressure responsive means controlling said actuating mechanism to close or open said main contacts at predetermined temperatures, a set of auxiliary contacts actuated by said pressure responsive means upon over-travel thereof, a single manual switch setting means having a plurality of operative positions, said manual setting means including means which in a first position of said manual setting means block movement of said actuating mechanism to maintain said main contacts in a given position but afford freedom of movement of said pressure responsive means throughout its full range, means for maintaining said manual setting means in said first position regardless of response of said pressure responsive means, and means blocking over-travel of said pressure responsive means but permitting normal movement of said actuating mechanism in a second position of said manual setting means, the latter in a third operative position permitting complete freedom of movement of both said actuating mechanism and said pressure responsive means for normal cycling of the switch and actuation of said auxiliary contacts upon over-travel of said pressure responsive means.

3. In combination, a thermal responsive switch having a set of main contacts, a snap acting actuating mechanism therefor and pressure responsive means controlling said mechanism to open and close said main contacts at predetermined cut-in and cut-out temperatures, a set of auxiliary contacts actuated by said pressure responsive means upon travel thereof beyond said predetermined temperatures, a single manual switch setting means having at least three operative positions, said manual setting means including means for blocking movement of said snap acting mechanism to maintain said main contacts closed to afford a continuous run position of the switch but affording freedom of movement of said pressure responsive means throughout its full range to actuate said auxiliary contacts upon over-travel of said pressure responsive means, means blocking over-travel of said pressure responsive means to prevent actuation of said auxiliary contacts but permitting normal movement of said snap acting mechanism and commutation of said main contacts in a second position of said manual setting means, the latter in a third operative position permitting complete freedom of movement of both said snap acting mechanism and said

pressure responsive means for normal cycling of the switch and actuation of said auxiliary contacts upon over-travel of said pressure responsive means.

4. In combination, a thermal responsive switch having a set of main contacts, an actuating mechanism therefor and pressure responsive means controlling said actuating mechanism to close or open said main contacts at predetermined temperatures, a set of auxiliary contacts actuated by said pressure responsive means upon over-travel thereof, a single manual switch setting means having a plurality of operative positions, said manual setting means including an adjusting member having a cam surface and a lug extension, said lug extension in a first operative position of said manual setting means coacting with said actuating mechanism to move the latter to a given position but permitting movement of said pressure responsive means throughout its full range, means for maintaining said given position, said cam surface of said adjusting member in a second operative position of said manual setting means blocking over-travel of said pressure responsive means to prevent actuation of said auxiliary contacts but permitting normal movement thereof for operation of said actuating mechanism to open or close said main contacts, said lug and said cam surface in an intermediate position of said manual setting means being disengaged from their aforementioned coacting parts to permit free movement of both said actuating mechanism and said pressure responsive means for normal cycling of the switch and actuation of said auxiliary contacts upon over-travel of said pressure responsive means.

5. In combination, a thermal responsive switch having a set of main contacts, a snap acting actuating mechanism therefor and expandible pressure responsive means for actuating said mechanism to open and close said main contacts at predetermined cut-in and cut-out temperatures, a set of auxiliary contacts actuated by said pressure responsive means upon over-travel thereof beyond said cut-in temperature, a single manual switch setting means having three operative positions, said switch setting means including a rotatable adjusting member having a cam surface and a lug extension, said lug extension in a first operative position of said switch setting means coacting with said snap acting mechanism to lock the latter in a given position to maintain said main contacts closed, said cam surface in a second operative position of said switch setting means coacting with said pressure responsive means to block over-travel thereof beyond said cut-in temperature thereby preventing actuation of said auxiliary contacts, said lug and said cam surface in an intermediate position of said switch being disengaged from their aforementioned coacting parts to permit free movement of said pressure responsive means and said snap acting mechanism thereby affording opening and closing of said main contacts at said cut-in and cut-out temperatures and commutation of said auxiliary contacts at a predetermined temperature above said cut-in temperature.

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The following references are of record in the file of this patent:

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