July 22, 1941. E. C. RANEY 2,250,274

CONTROL APPARATUS

Filed March 1, 1938 3 Sheets-Sheet 1

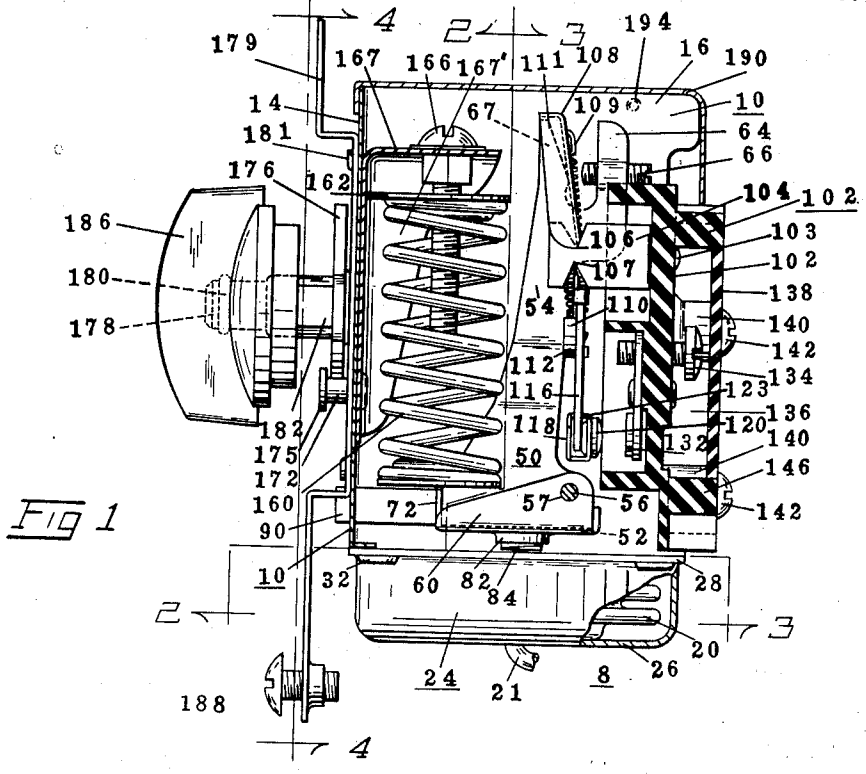


Fig 1

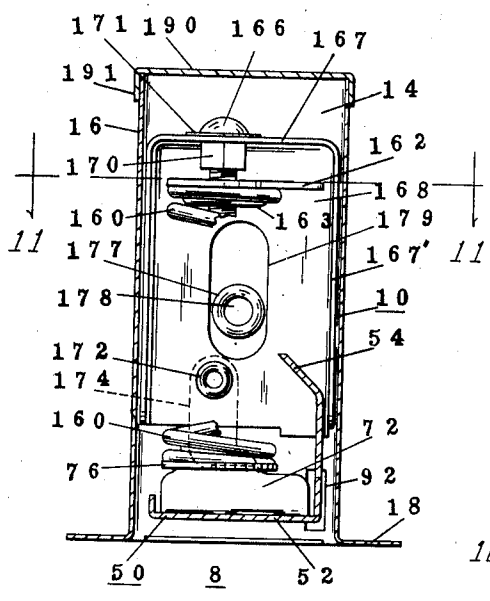
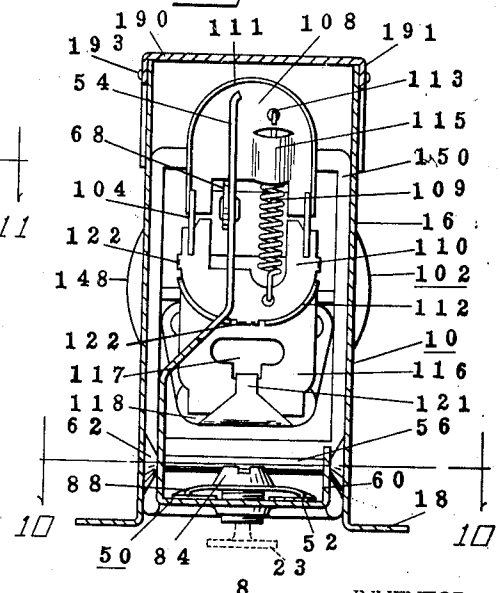


Fig 2

Fig 3



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July 22, 1941. E. C. RANEY 2,250,274

CONTROL APPARATUS

Filed March 1, 1938 3 Sheets-Sheet 2

Fig 4

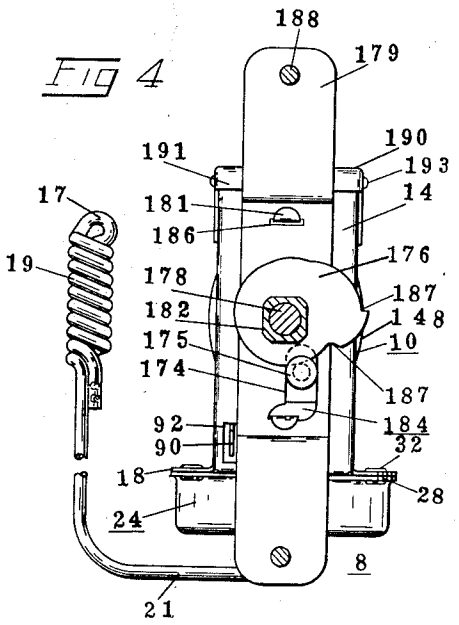


Fig 5

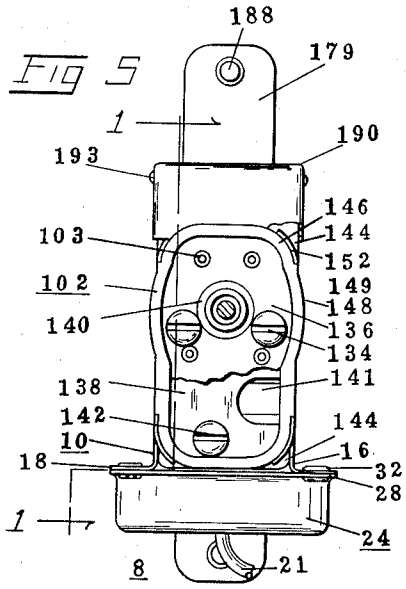


Fig 6

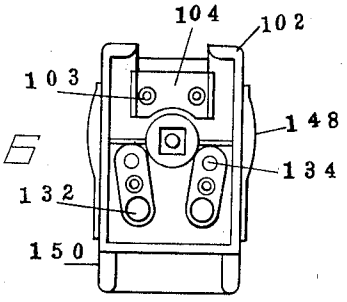


Fig 7

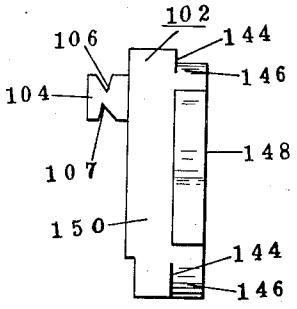


Fig 8

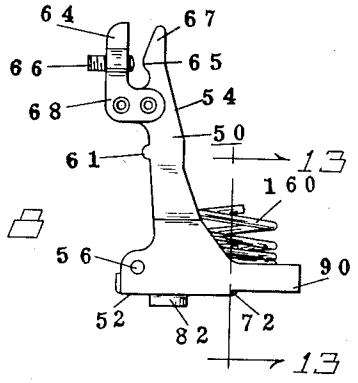
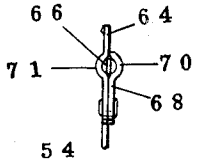


Fig 9



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July 22, 1941. E. C. RANEY 2,250,274

CONTROL APPARATUS

Filed March 1, 1938 3 Sheets-Sheet 3

Fig 10

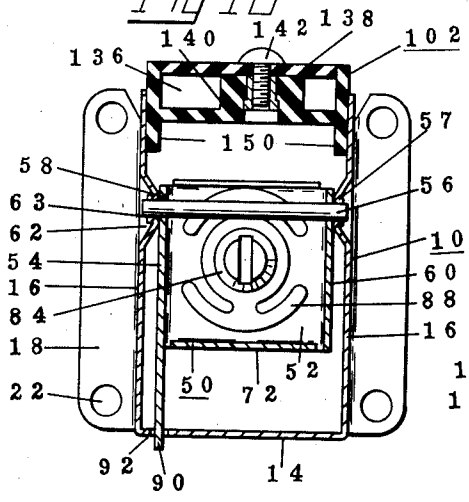
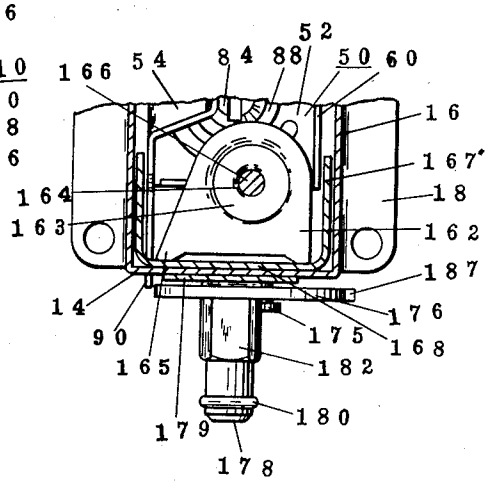


Fig 11



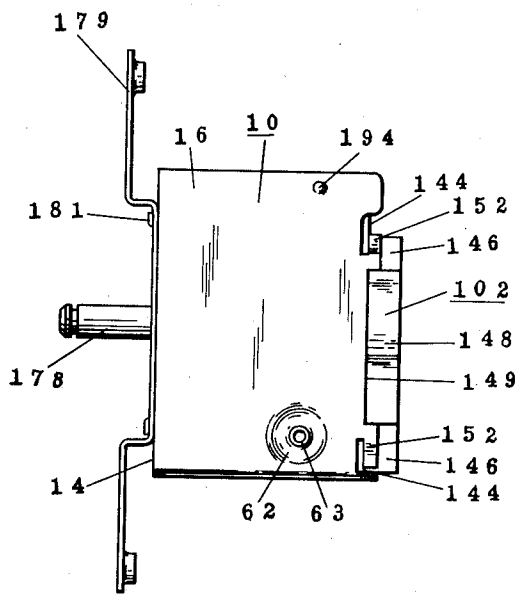
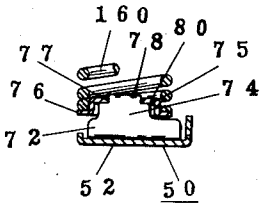


Fig 12

Fig 13



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Patented July 22, 1941

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UNITED STATES PATENT OFFICE

2,250,274

CONTROL APPARATUS

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Application March 1, 1938, Serial No. 193,324

4 Claims. (Cl. 297—3)

This invention relates to control apparatus, and particularly to temperature control apparatus for household refrigerators.

An object of the invention is to provide a temperature responsive device for control apparatus comprising an expansible member having a tube attached thereto, the tube and member being filled with a temperature responsive fluid, and a section of the tube being wound in a helix with another section of the tube, whereby the adjacent convolutions of the resulting helix are of different sections of the tube so that a relatively lengthy portion of the capillary tube may be placed in a relatively short clamp, attached to the part of an apparatus controlled by the control device, and the helix will be resistant to axial stresses.

Other and further objects and advantages will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is an enlarged view of the control apparatus taken on line 1—1 of Fig. 5;

Fig. 2 is a view of the apparatus taken on line 2—2 of Fig. 1;

Fig. 3 is a view of the apparatus taken on line 3—3 of Fig. 1;

Fig. 4 is a front view of the apparatus taken on line 4—4 of Fig. 1;

Fig. 5 is a rear view of the apparatus;

Fig. 6 is a view of the insulating block showing the fixed contact member and the toggle switch pivoting member mounted on the block;

Fig. 7 is a side view of Fig. 6;

Fig. 8 is a view of the switch actuating member;

Fig. 9 is a partial view of the member shown in Fig. 8;

Fig. 10 is a view taken on line 10—10 of Fig. 3;

Fig. 11 is a partial view taken on line 11—11 of Fig. 2;

Fig. 12 is a side view of the frame member, with the insulating block in position, and,

Fig. 13 is a view taken on line 13—13 of Fig. 8.

A control apparatus similar to that described and claimed in my copending application Serial Number 351,009, filed August 3, 1940, and indicated generally at 8, comprises a frame 10 preferably of a single section of sheet metal formed in a U shape, forming a front wall 14 and side walls 16 for supporting and inclosing the control mechanism. The side walls 16 each have a laterally extending flange 18, which is provided with two openings 22, at either end thereof, for connecting a power element 24 to the frame.

The power element 24, in the present form of disclosure, consists of a metal bellows 20 enclosed within a shell 26 and having a closed tube 21 connected thereto. The bellows and tube are filled with a thermal responsive fluid, such as methyl chloride, so that the fluid pressure will cause variations in pressure within the bellows according to the variations of temperatures to which a part of the tube is subjected. A section of the tube 21 adjacent the end thereof is reversed as at 17 and the doubled tube then formed into a closely wound helix as shown at 19.

The helix 19 may then be secured to the evaporator of a refrigerator apparatus by a thermal conducting clamping device (not shown) attached to the evaporator. Such clamping devices are cylindrical in form and tightly embrace the helix so that the temperature of the helix will correspond to the temperature of the evaporator. The helix provides means for presenting a lengthy section of tube for contact with the clamp so that a relatively large volume of the enclosed fluid will be affected by the temperatures in the evaporator. It will be noted that every other convolution of the helix is formed of the reversed section of the tube, thereby reenforcing the helix against axial stress which may be caused by accidental pulling of the tube.

A push rod 23 is connected to the movable end of the bellows 20 and engages a switch actuating member 50 for actuating the switch by the expansion and contraction of the bellows 20, as will be described later. The shell 26 is provided with a flange 28, having squared corners thereon which register with the corners of the flanges 18. Openings are provided adjacent each corner of the flange, which register with the openings 22 in the flanges 18, and the shell 26 is connected to the frame 10 by rivets 32. Thus the power element 24 provides a rigid reinforcing base for maintaining the side walls rigid.

A toggle switch mechanism is mounted on a block 102 preferably formed of a dielectric material, such as Bakelite, and the block is attached to the frame 10 between the side walls 16. The block 102 is formed with two oppositely disposed side walls 150 which are adapted to fit between the side walls 16 of the frame 10, and maintain the walls rigidly spaced from one another. A pair of bosses 148 are formed on the side walls 150 and are adapted to engage the edges of the side walls 16 for locating the block with respect to the edges of the walls. The side walls are

formed with ears 152 which, after the block 102 is inserted in position, are turned to conform to the curved corners of walls 146, formed on the insulating block. When the ears 152 are turned, the inside edges engage shoulders 144 formed at each corner of the block 102. Thus the block is locked in engagement with the side walls 16 of the frame 10. The bosses 148 are adapted to engage in a shallow offset 149, formed in the edge of the side walls 16 to prevent movement of the block with respect to the upper and lower edges of the side walls. Thus the insulating block 102, carrying the switch mechanism may be easily and securely attached to the frame, further reenforcing the walls and forming a closing wall for the control apparatus.

A U shaped bracket 104 is secured to the insulating block 102 by rivets 103 extending through the yoke and block. The legs of the U shaped bracket 104 are provided with two pairs of V shaped notches or pivots 106 and 107 for pivoting the ends of a pair of toggle members therein. The pivots 106 are offset with respect to the pivots 107 and are disposed closer to the block 102 for reasons which will appear hereinafter. The moving parts of the switch mechanism comprises two U shaped toggle members 108 and 110, which are preferably formed of sheet metal stampings and reenforced by the upturned edges 111 and 112 respectively. The ends of the legs of each of the members 108 and 110 are adapted to engage in the pivots 106 and 107 respectively, and are yieldingly retained in their respective pivots by a tension spring 109, connected in holes 113 formed in the yoke of the members, and carried between the legs thereof. The ends of the legs of the members are beveled to form knife edged bearings. The yoke of the member 108 has a semicylindrical section 115 formed therein for reenforcing the member and to allow space for the spring 109 to move between the legs thereof. The member 110 is adapted to carry an insulating member or strip 116, preferably of fiber, on the free end thereof. The strip 116 is connected to the member 110 by three ears 122, formed on the member 110, two of which are crimped over the side edges of the strip and the third of which extends through an opening in the strip and is crimped over the surface of the strip adjacent the opening. A contact bar 118 is secured on the end of the strip 116 and is adapted to bridge a pair of fixed contacts 132 mounted on the insulating block 102. A T shaped opening 117 is provided in the strip 116 through which a part of the contact bar 118 extends. The contact bar 118 is preferably formed of a copper sheet having the general shape of a triangle, having a lug 121 formed at the apex and a similar lug 123 formed at the center of the base thereof. The sheet is loosely formed over the end of the member 116 as shown in Fig. 1, and the lug 123 is turned to extend into one end of the opening 117 for holding the contact member 118 in place on the strip. A pair of contacts 120 are riveted to the wide part of the contact member 118, and are spaced to engage the fixed contacts 132 when the switch is closed. The contacts 132 are suitably mounted each on one of a pair of terminal bars 130 riveted to the block. The circuit wires for the device to be controlled may be connected to the terminal members 130, by terminal screws 134 threaded in the terminal members from the opposite side of the insulating block through suitable openings in the block. A chamber 136 is formed in the block 102 by walls 146 for accommodating the wire leads from the circuit. A plate 138, preferably of insulating material, is provided for inclosing the chamber. The plate 138 is secured over the chamber opening by screws 142, which are threaded in a pair of bushings 140, formed integral with the insulating block 102. The bushings 140 serve as supports for the cover. The plate 138 is provided with an opening 141 to admit the line wires to the chamber 136. Thus the switch mechanism may be completely assembled on the insulating block 102, and the block then secured to the walls of the frame, as a unit.

The switch mechanism is adapted to be operated by the power element 24 through the switch actuating member 50. The member 50 is preferably formed of heavy sheet metal and comprises a base 52 and an arm 54 formed integral therewith, and is pivotally supported between the side walls 16 by a pin 56. The pin 56 is tightly pressed in holes 57 and 58, formed in an upturned ear 60 of the base 52 and at the base of the arm 54, respectively, so that the pin 56 is substantially an integral part of the actuating member 50. The length of the pin 56 is such that a relatively short section of the pin will extend beyond either side of the member 50 when the pin is in place. The side walls 16 each have a circular indentation 62, formed therein, each of which is provided with a bearing 63 for receiving an end of the pin 56. The bearings 63 are formed by lancing a circular opening in the indented part of the wall so that the metal adjacent the opening is extended to present a substantial bearing surface. Thus the ends of the pin 56 may extend through the bearings 63, without extending beyond the plane of the surface of the side walls 16. In the assembly of the control device, the actuating member 50 is secured in position between the walls of the frame 10 prior to the connection of the power element 24 to the frame so that the walls may be spread and the ends of the pin 56 slipped into the bearing 63. When the power element is attached to the frame, the walls are then held rigid, and the pin 56 will be locked in the bearings. The arm 54 is provided with fingers 64 and 67 formed at the end thereof. The fingers are provided with a lug 65 and an engaging screw 66 which engage the toggle member 108 when the switch is operated. The screw 66 is adapted to be held between a member 68, riveted to the arm 54, and the finger 64. The member 68 and the finger 64 are each formed with curved portions 70 and 71 respectively for receiving the adjusting screw 66. The member 68 is preferably formed of resilient material so that the screw 66 will be pressed in the curved sections 70 and 71 for preventing change in the adjustment of the screw. The arm 54 is provided with a lug 61 formed thereon for engaging the switch member 110 for limiting the opening movement of the switch member. The base 52 of the member 50, has one end upturned, as at 72, which is formed with a neck 74 and shoulders 75. A washer 76, having an opening 77 of substantially the same shape as the cross section of the neck 74, is loosely carried on the shoulders 75, and held on the neck 74 by mutilations 78 at the top of the neck. The washer 76 has a circular embossed part 80 for centering a compression spring 160 thereon. A screw 84 having an indented part (not shown) in one end thereof for receiving the end of the thrust rod 23, is threaded in a lanced opening 82, formed in the base 52. The screw 84 is locked in position by a lock washer 88 after it is once adjusted to a proper operating position with respect to the

push rod 23. An arm 90, formed on the member 50 extends at substantially right angles with the arm 54, and is adapted to move in a rectangular opening 92, formed in the front wall 14 for limiting the movement of the actuating member 50 within a definite range to prevent distortion of the parts of the control apparatus if the helix 19 should be subjected to warm atmospheric temperatures.

When the block 102 with the toggle switch mechanism assembled thereon is attached to the frame 10, the yoke of the toggle member 108 is first slid between the fingers 64 and 67 of the arm 54 and the block 102 is then secured to the side walls 16 as described above. Thus the actuating member 50 is adapted to engage the member 108 and move it about its pivot to operate the switch, as will be described hereinafter.

The top of the frame is closed, after the block 102 is attached thereto, by a cover 190 having one end of the cover turned at right angles and the end edge of the turned portion shaped to conform with the top side of the block 102 to effectively enclose the switch apparatus in the frame. The cover 190 is formed with turned edges 191, which fit over the ends of the frame walls, and detents 193 are provided in the edges 191, which engage with similar detents 194 formed in the side walls 16 adjacent the top thereof for frictionally holding the cover on the frame.

The spring 160 is provided for controlling the temperatures at which the switch is operated. One end of the spring 160 is adapted to engage the washer 76, as described above, and thereby transmit a load on the bellows through the member 50. The other end of the spring is engaged by a plate 162, having a circular centering boss 163 and a threaded hole 164 through the center thereof for receiving a screw 166. The plate is formed with a pair of ears 165, which engage the wall of a slide or member 168, to prevent rotation of the plate. The plate is connected to the slide 168 by the screw 166, which is threaded in the hole 164, and supported on a bracket 167 formed on the slide. The bracket 167 is provided with a hole through which the screw 166 is extended and rigidly fixed thereto by a nut 170 and washer 171. Thus the spring 160 may be adjusted at the factory by turning the screw 166 one way or the other to change the distance of the end of the spring 160 from the bracket 167 and establish the proper adjusting range of the control apparatus by the user thereof.

The slide 168 is formed of sheet metal and comprises a wall part having a turned end which comprises the bracket 167. The bracket and wall part are reenforced by web parts 167' formed thereon. A lug 172 is riveted adjacent one end of the wall part of the slide 168 and extends through a slit 174 formed in the wall 14 for engagement with the periphery of a cam 176. The lug is cylindrical in shape and is provided with a flange 175 on the end thereof which engages the outside surface of the cam 176 to hold the adjusting member 168 against the wall 14. The spring 160 yieldingly engages the lug 172 with the periphery of the cam. The width of the slide 168 is such that the sides thereof engage the walls 16 and when the slide is moved by the cam, the walls guide the member in a direction of the axis of the spring 160.

The cam 176 includes a hub 182 formed integral therewith which is adapted to be axially supported on a post 178 secured to the wall 14, such as by extending a hollowed neck part on the post through a hole in the wall 14 and then rolling the neck outwardly and against the wall as indicated at 177. A slot 179' is provided in the wall part of the slide 168 to accommodate the turned part 177 and permit the slide 168 to move against the inside surface of the wall 14. The hub 182 is square in cross section so that a knob 186 provided with a squared recess may be fitted on the hub whereby the cam can be rotated by the knob. Circular grooves are provided adjacent the end of the hub 182 and in the recess in the cap, so that a split ring spring 180 may be interposed between the two grooves and thereby hold the knob on the shaft.

When the cam 176 is rotated by the knob, the periphery thereof is in engagement with the lug 172, and translates the slide 168 in a direction of the axis of the spring 160. The cam 176 is provided with detents 187 on the periphery thereof which are adapted to engage the lug 172 and limit the rotation of the cam member in either direction. Thus when it is desirable to increase the pressures or temperatures at which the switch is operated the cam is rotated counterclockwise, as viewed in Fig. 4, which moves the slide 168 downwardly thereby compressing the spring 160, to increase load upon the bellows. When it is desired to decrease the pressures or temperatures at which the switch operates, the cam is rotated clockwise which permits the spring 160 to raise the slide 168 upwardly and decrease the tension of the spring 160.

Assuming that the control apparatus is to be operated in the circuit of the refrigerating system, the operation is as follows: When the bulb 19, which is responsive to the chilled part of the refrigerating system, becomes warmed the gas therein causes expansion of the bellows 20 to rotate the member 50 clockwise, as viewed in Fig. 1. The finger 64 is in engagement with the member 108 and the lug 61 is in engagement with the member 110, and these two members are moved to the right and about their pivots 106 and 107. The pivots 106 and 107 are offset from one another as described above, so that the center of the spring 109 will pass to the right of the pivot 107 prior to passing to the right of pivot 106, and in so doing will cause the member 110 to be snapped to the switch closing position, which causes the spring 109 to pass to the right of pivot 106 and snap the member 108 against the screw 66. The refrigerating apparatus is thus energized and the coil 19 will then be cooled and cause the gas pressure in the bellows 20 to decrease. The spring 160 will then cause the member 50 to be rotated counterclockwise and the finger 67 will move the member 108 and the spring 109 to the left of the pivot 106 and cause the member 108 to be snapped to the lug 65. The spring 109 is then carried to the left of the pivot 107 and snaps the member 110 against the stop 61 on the arm 54 to open the switch and deenergize the refrigerating apparatus.

The control apparatus may be attached to the refrigerator by a sheet metal bracket 179 secured to the frame wall 14. The bracket 179 is secured to the wall by ears 181, formed on the wall 14, which extend through openings 174 and 186 in the bracket member 179 and are crimped over the edges of the opening. The opening 174 has an elongated part 184 for permitting movement of the lug 172 therein when the control apparatus is adjusted. The bracket 179 is also provided with an opening, not shown, through which the post 178 extends. Holes are provided adjacent

either end of the bracket 179 through which suitable bolts 183 may extend for securing the bracket to any convenient mounting frame, such as for example, the baffle plate on an electric refrigerator.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

I claim:

1. A temperature responsive element including, a fluid containing tube, a section of said tube being reversed upon itself and said reversed section and adjacent tube section being formed in a helix, the convolutions of the helix substantially touching one another.

2. A temperature responsive device including, a pressure responsive member; a tube connected to the member, said tube having a section thereof reversed upon another section of the tube and having the two sections formed in a helix, the convolutions of the helix being relatively close to one another.

3. A temperature responsive device, including a pressure responsive member; a tube connected to the member, said tube having a section thereof formed in a helix, and the convolutions of the said helix having another section of the tube interposed there between for reenforcing the said helix against axial stresses.

4. A temperature responsive device, including a pressure responsive member; a tube connected to the member, the said tube having a section thereof formed in a helix, and the convolutions of the helix having a helical formed member interposed therebetween for reenforcing the said helix against axial stresses.

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