Nov. 14, 1939. E. C. RANEY 2,179,599

REFRIGERATOR CONTROL SWITCH

Original Filed April 29, 1932 2 Sheets-Sheet 1

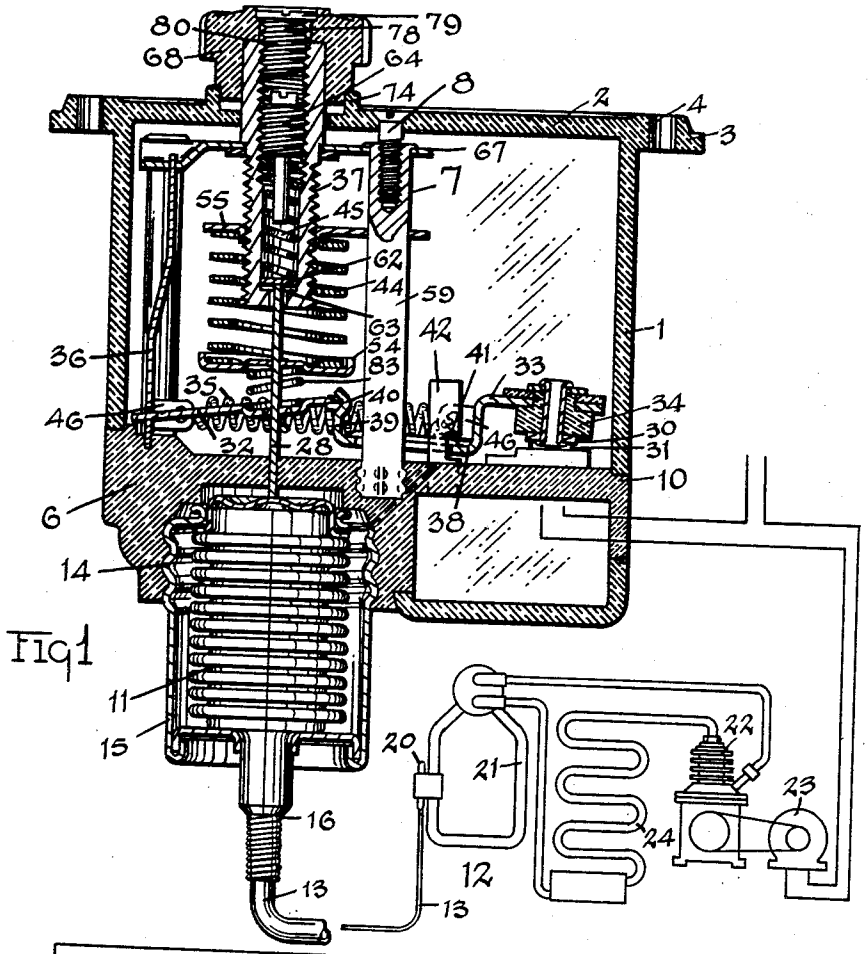


Fig 1

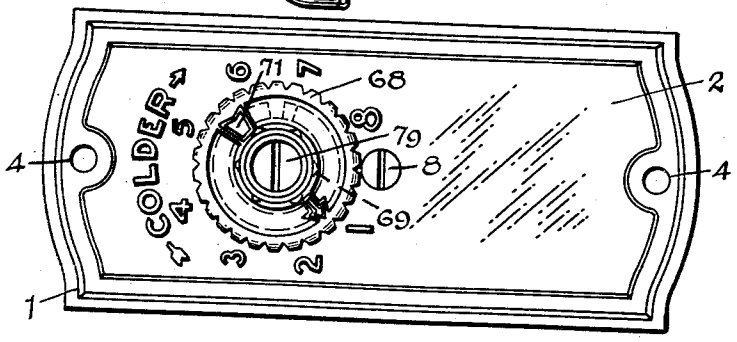


Fig 2

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REFRIGERATOR CONTROL SWITCH

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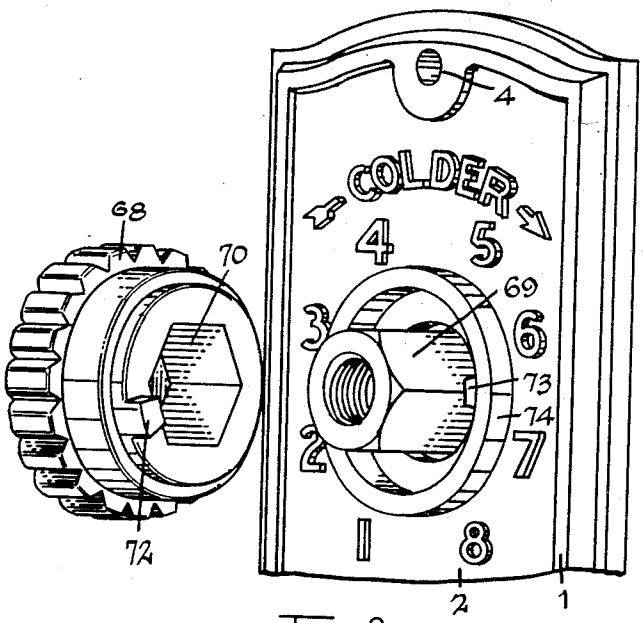
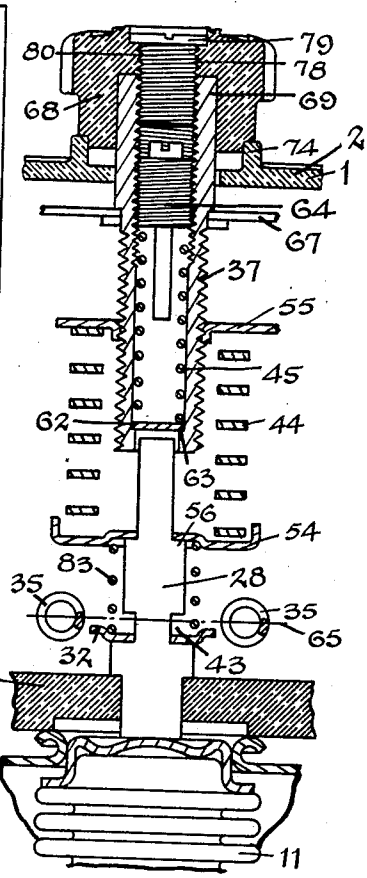
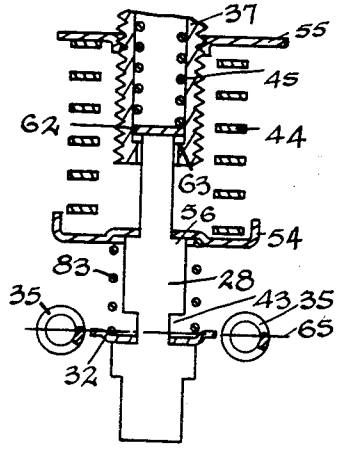


Fig 3



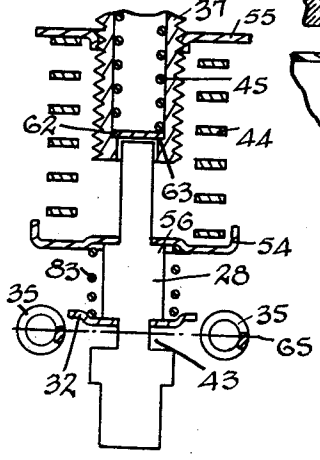
SWITCH OPEN

Fig 4



SWITCH ABOUT TO CLOSE

Fig 5



SWITCH ABOUT TO OPEN

Fig 6

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REFRIGERATOR CONTROL SWITCH

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Original application April 29, 1932, Serial No. 608,319, now Patent No. 2,138,509, dated April 29, 1938. Divided and this application December 11, 1933, Serial No. 701,887

10 Claims. (Cl. 200—83)

My invention has for its object to provide a refrigerator control switch operable automatically to produce adjustable temperatures in a refrigerator. The invention is particularly advantageously used in connection with refrigerating apparatus having motor driven compressors whose operations are controlled by opening and closing a switch in response to thermic conditions within the refrigerator or in response to refrigerant pressures produced within a part of the refrigerating apparatus.

The invention particularly has for its object to provide means for enabling ready adjustment by the user within a limited range of temperatures that, however, may be raised or lowered by adjustment of the control device by those who are expert in matters pertaining to refrigerating apparatus, such as by adjusting at the factory where the refrigerators are manufactured or by a service man either in installing the control or in raising or lowering the range of control, as may be desired by the user. Thus the invention provides a means for maintaining the range of adjustment of the user within a more efficient operative region by limiting the range of adjustment that may be made by the user and leaving the more extended adjustment to the refrigerator expert.

The invention also provides means for adjusting the temperature differential between the closing and opening temperatures of the refrigerator to produce more efficient operation of the refrigerating apparatus, and it particularly provides means for adjustably increasing the differential between the switch opening and closing temperatures by adjustably increasing the closing temperature relative to the switch opening temperature.

The invention consists in other features and advantages which will appear from the following description and upon examination of the drawings. Structures containing the invention may partake of different forms and may be varied in their details and still embody the invention. To illustrate a practical application of the invention, I have selected a refrigerator control switch embodying the invention as an example of the various structures and details of such structures that contain the invention and shall describe the selected structures hereinafter, it being understood that variations may be made and that certain features of my invention may be used to advantage without corresponding use of other features of the invention, and without departing from the spirit of the invention. The particular structure selected is shown in the accompanying drawings.

The application for United States Letters Patent is a division of my application Ser. No. 608,319, filed in the United States Patent Office, April 29, 1932, now Patent No. 2,138,509, April 29, 1938, for Multiple control switch.

Fig. 1 illustrates a view of a section of refrigerator control switch selected as an example of structures containing my invention together with a conventional diagram of a refrigerating apparatus that may be controlled by the switch. Fig. 2 is a face view of the shell containing the switch. Fig. 3 is a composite view and illustrates adjustment parts and a fragmentary view of a part of the shell. Fig. 4 illustrates diagrammatically, the relative location of parts when the movable contact of the switch is in an open position. Fig. 5 is a view similar to that of Fig. 4 and illustrates the relative positions of parts of the switch when the switch is about to close. Fig. 6 is a view similar to that shown in Figs. 4 and 5, and illustrates the relative positions of parts when the switch is about to open.

The control switch, illustrated in the drawings, is contained within a shell 1 that may be formed of a suitable composition. The shell has a face plate or end part 2 provided with switch control members. The shell 1 has end flanges 3 having suitable holes 4 through which screws may be inserted for securing the switch in position in a refrigerator.

The shell is provided with a suitable base 6 for closing the end of the shell. The base 6 forms a support for parts of the switch and a frame 7 to which some of the parts are connected, or by which some of the movable parts are guided.

The shell body fits a shoulder 10 formed in the edge of the base. The base is removably connected to the shell by a screw 8 that extends through the end of the shell and into a part of the frame 7. Thus, the parts of the switch are rendered readily accessible, for, by unscrewing the screws 8, the base 6 and the frame 7, together with the switch parts, may be removed from the shell and at the same time from the part of the refrigerator on which the shell is supported.

The switch is controlled by a pressure device such as a bellows that is caused to expand or contract by pressure conditions produced by either heat transmission or by pressure conditions occurring in a part of the refrigerating apparatus 12. The pressure is transmitted to the bellows through a suitable pipe 13 to cause

the switch to respond to the temperature or pressure conditions in the operation of the refrigerator.

The base 6 is provided with a socket 14 for receiving a shell 15 in which the bellows 11 may be located. In the form of construction shown, the walls of the socket and the shell have a screw formation whereby the shell 15 may be rotatably secured in the socket of the base 6. Preferably, the pipe 13 is connected to the end of the bellows through the end of the shell 15 by a suitable connector 16, and the parts are formed to enable rotatable movements of the shell 15 relative to the pipe and the bellows to enable ready insertion of the shell 15 into the socket and connection of the bellows to the switch by rotation of the shell 15.

One end of the bellows 11 protrudes through one end of the shell 15 and is mechanically connected to the switch. The other end of the bellows is seated on the other end of the shell and is connected to the pipe 13 whereby expansive and contractive movements induced by changes in pressure in the bellows produces corresponding opening and closing movements of the switch.

Replaceability of the bellows renders the switch usable with a variety of forms or capacities of refrigerators by the use of bellows of different sizes. It also enables operation of bellows having pipe connections that may be connected to refrigerators wherein the switch is to respond directly to pressure existing in the low pressure side of the apparatus.

A suitable thermic expansible liquid having a low boiling point may be inserted in the bellows and pipe, and its pressure will operate the bellows. Or, if the bellows is connected to the low pressure side of the refrigerating apparatus, the refrigerant fluid used in the refrigerating apparatus will be introduced into the pipe and the bellows and will vary the volume of the bellows according to the pressure within the part of the apparatus at which the pipe is connected, and consequently according to the temperature of the chilling unit of the refrigerator.

Where the bellows is operated by pressures produced by heat transmission, the pipe 13 may be closed at its end or may be connected to a bulb 20. The end of the pipe or the bulb, if a bulb is used, is connected to the chilling unit 21 of the refrigerating apparatus by a suitable bracket so as to position the bulb in contact with the chilling unit or in close heat conductive relation therewith to maintain the bulb 20 at a temperature substantially the same as that of the chilling unit 21 to produce a volume of liquid and gas within the bellows that corresponds to the temperature of the chilling unit 21. As the pressure and temperature rise, the bellows closes the switch. The switch closes the circuit of the motor 23 that operates the compressor 22 to draw the refrigerant gas from the chilling unit 21 and introduce it into the condenser 24 where it is converted into a liquid. The refrigerant is thus introduced periodically into the chilling unit 21. When the bellows contracts, due to reduction in pressure and temperature of the fluid within the bulb, the bellows contracts and operates to open the switch and cause cessation of the operation of the compressor in the manner well known in the art.

The bellows is connected to the switch by means of the rod 28. One end of the rod is spring pressed against the end of the bellows 11, and the rod is moved as the bellows expands and contracts and consequently operates to move the switch to close or open the switch according to the expansive or contractile movements of the bellows.

The switch has a movable contact member 30 that is adapted to complete the circuit between a pair of fixed contacts 31. The movable contact member 30 is insulatingly supported on a jointed switch arm formed of a pair of relatively movable plates 32 and 33. It is insulated from the plates by means of the insulating block 34. The plate 33 is spring pressed endwise against the end of the plate 32 by means of the springs 35. The plate 32 is in turn suitably supported for oscillatory movements by means of the strip 36 into which it extends and against which it is pressed by the springs 35. The strip 36 forms a part of the frame 7 that is connected to the base 6.

The movable plate 33 that carries the movable contact member 30 of the switch has a depressed portion 38 and an upwardly extending flange portion 39 having a substantially V-shaped slot 40. The end of the plate 33 abuts the end of the plate 32 and engages it in the V-shaped slot 40, and the end of the plate 32 is provided with a pair of shoulders that abut against the end of the strip 36, the plates being yieldingly held in these positions for short, angular movements by the springs 35, as determined by suitable limiting stops as are provided by the notch 41 in the strip 42 that extends through an opening formed in the plate 33 and by the notches 43 in the rod 28 that extends through an opening in the plate 32.

The end portions of the plate 32 may be beveled or knifed to reduce friction between the plate 32 and the strip 36 and the plates 32 and 33. The springs 35 extend along opposite side edges of the plates and are connected to ears 46 that protrude from the plate 33 and the strip 36. Thus, the springs 35 cause endwise pressure between the plates 32 and 33 and a pressure component at the joint between the plates in a direction substantially at right angles to the line of direction of the pressure exerted by the springs 35 and a corresponding pressure component in the opposite direction at the contact 30, either to close or open the contact pressure. The plates 32 and 33 are thus moved by the bellows operating through the rod 28 to locate the joint between the plates either above or below the plane of the axes of the springs to produce a corresponding change in the direction of the lateral components to produce corresponding opening or closing movements of the switch.

The temperatures at which the switch is closed and opened are adjusted by means of the screws that adjust the pressure of the spring 44 that counteracts the pressure of the fluid within the bellows. Preferably, the adjusting screw 37 is bored and contains an adjustable differential spring 45 that is engaged by the rod 28 as the switch is closed.

The spring 44 is located intermediate a flanged or concave disc 54 and a plate 55. The disc 54 is supported on the rod 28. The rod 28 is provided with a pair of shoulders 56, and the end of the rod extends through an opening formed in the disc 54, being pressed against the shoulders 56 by the spring 44. The plate 55 has a threaded opening and the screw 37 extends into the threaded opening of the plate 55 and adjusts the location of the plate 55 and consequently adjusts the pressure of the spring 44 against the disc 54 and the pressure of the rod 28 against the end of

the bellows 11. If desired, rotation of the plate 55 with the screw 37 may be prevented by means of a rod 59 that extends through the plate.

The spring 45, which is located within the bore formed in the rod 37, presses against a disc 62 that normally rests against a circular shoulder 63 formed inside the screw 37 and adjacent the lower end thereof. The spring 45 is adjustably pressed against the disc 62 by means of a threaded stud 64 located within the screw 37.

The parts are so arranged that the end of the rod 28 comes in contact with the disc 62 just previous to the closing movement of the switch as the rod 28 is raised upon expansion of the bellows. As the bellows contracts, due to the operation of the compressor while the switch is closed, the rod 28 leaves the disc 62, and as the rod descends under the pressure of the spring 44, due to decrease in temperature of the refrigerator, the rod 28 eventually opens the switch. Thus, the pressure against the expansion of bellows is increasingly resisted just before the switch closes by the presure of the spring 45, which, during this operation of the device, coacts with the spring 44. The rod 28 is relieved from the pressure of the spring 45 during other movements of the bellows, and, consequently, the switch opening movement is not affected by the pressure of the spring 45. Increase of the tension of the spring 45 by the means of the threaded stud 64 operates to adjustably increase the temperature differential between the opening and closing temperatures of the switch above that which would normally be produced by the spring 44.

This is illustrated in Figs. 4, 5, and 6 and is due to the relative movement of the plate 32 to the rod 28 as defined by the width of the notches 43 and the change in the lines of direction of the pressure of the springs 35 relative to the plate 32 and the consequent movement of the plate as the switch is closed. Assume the switch in its normal open position as shown in Fig. 4. The end of the rod 28 is not in contact with the disc 62. When the rod 28 is moved by the bellows to locate the joint between the plates 32 and 33 near the plane of the axes of the springs 35, as indicated by the line 65, the end of the rod 28 is brought into contact with the disc 62 and during the continued movement of the rod 28, the joint of the switch arm approaches the plane of the axes of the springs 35, and during this continued movement, the spring 45 is compressed, as indicated in Fig. 5, by the pressure within the bellows 11.

Upon slight further movement of the rod 28, the movable contact quickly closes by the operation of the springs 35. The plate 32 moves the width of the notches 43 and the plane of the springs 35 is lowered by the downward switch-closing movement.

When the pressure in the bellows 11 decreases, the rod 28 moves downward due to the loading of springs 44 and 45 and the load of spring 45 is removed therefrom when the disc 62 engages the shoulder 63. As shown in Fig. 6, the disc 62 engages the shoulder 63 before the plate 32 is moved below the plane of the axis of the springs 35, i. e., prior to the opening of the switch. Thus the spring 45 affects only the opening operation of the switch.

The screw 37 is rotatably supported in a plate 67 that forms a part of the frame 7. It is provided with suitable shoulder and washer for preventing longitudinal movements of the screw by reason of the spring 44. The screw 37 extends to the end of the shell 1 and in position to enable adjustment of the spring 44 by the expert. Also, the stud 64 is accessible for adjustment of the spring 45 to adjust the temperature differential, by the expert. A suitable knob 68, or other dial pointer, may be adjustably connected to the end of the screw 64 to enable ready adjustment of the temperature of the refrigerator by the user.

The adjustment that may thus be made by the user, however, is limited to a definite range by suitable stops for limiting the rotation of the screw by the operation of the knob 68 or other dial pointer. The end of the screw 37 and the knob 68 are so formed as to enable connection of the knob at a plurality of points as regularly measured about the axis of the screw and thus enable adjustment of the screw 37, when the knob 68 is removed, to raise or lower the range of adjustability by the use of the knob as determined by the stops and enable reconnection of the knob to locate the pointer at any part of the dial.

In the form of construction shown, the end 69 of the screw 37 is formed hexagonal, and the hub of the knob 68 is formed to have a hexagonal socket 70 for receiving the end 69 of the screw 37 and thus may be placed on the end of the screw at any one of the relatively short angular positions, as determined by registration of corresponding sides of the end 69 of the screw 37 and the socket 70. The number of angularly disposed positions, however, may be suitably increased by increasing the number of sides of the head of the screw and the sides of the socket, or by the use of fluted parts, or by any other means suitable for connecting the knob 68 in any one of the plurality of positions relative to the end of the screw. Thus, the screw may be adjusted by an expert in refrigeration, and the knob 68 may be connected to locate its pointer 71 at any desired position relative to the screw for limited adjustment.

The limited range of adjustment through the use of the knob is produced by the stops 72 and 73, one located on the knob 68, and the other located on the end of the shell 1. If desired, the end of the shell 1 may be provided with a suitable protruding flange 74 that surrounds a part of the hub of the knob 68 and within which the stop 73 is located so as to be engaged by the stop 72 and limit the movement of the knob 68 to slightly less than a single rotation. The range of adjustment available to the user may be raised or lowered by the adjustment of the screw 37 when the knob 68 is disconnected from the screw, and the knob 68 may then be connected to the screw to locate the pointer 71 in the desired position relative to the dial. Adjustments may then be made by the user either above or below the adjustment made by the expert, but within the range determined by the stops 72 and 73 to produce desired refrigerating temperatures.

The knob 68 may be secured in its position on the end of the screw 37 by means of a screw 78 having a head 79 that engages the top of the knob and a threaded shank 80 that may be screwed into the threaded bore of the screw 37.

In order to maintain the contact pressure of the switch materially above the zero pressure, viz., that pressure that would be caused if the joint between the plates 32 and 33 was maintained in the plane of the axes of the springs 35, I have provided means for quickly moving the joint through the plane of the springs during the switch opening movement of the jointed switch arm. A spring 83 is located intermediate the

flanged disc 54 and the plate 32. The spring 83 is a comparatively light pressure spring, and its function is to move the joint of the switch arm through the plane of the lines of pressure produced by the springs 35 before the lateral component at the joint becomes zero. As described, the notches 43 provide a short floating movement of the plate 32 relative to the rod 28 when the plate 32 is moved into switch opening and closing positions. When the notches 43 approach the plane of the axes of the springs 35 in a switch opening movement, the lateral pressure component, which is exerted in the direction to maintain the switch closed, reduces until it exerts a pressure counter to the spring 83 that is slightly less than the pressure of the spring 83. The spring 83 snaps the joint through the plane of the springs 35 to reverse the lateral components causing them to be exerted in directions to open the switch. This maintains the contact pressure materially above zero and thus prevents burning or oxidizing of the surfaces of the switch contacting area, that would otherwise result from low contact pressure.

I claim:

1. In a switch, a shell for containing the switch, a pressure bellows for operating the switch, a spring for yieldingly resisting movement of the switch by the bellows, a member extending through one end of the shell for adjusting the spring to cause varying operation of the switch, a handle removably connected to the said member, a second spring resistant to one movement of the switch and non-effective in the opposite movement of the switch and supported by the said member, the member including means for adjusting the second named spring.

2. In an adjustable control switch, a pressure operated element, a switch element operated thereby, means for adjusting the range of said pressure operated element comprising a rotatable member, said member being rotatable in one direction for progressively raising the pressures at which the switch element is operated, and rotatable in the opposite direction for progressively lowering the pressures at which the switch is operated, a control element for said rotatable member and normally meshing therewith, said control element being movable to non-meshing positions whereupon said control element may be rotated to a different relative position and then said control element may be again meshed with said rotatable member.

3. In an adjustable control switch, a pressure operated element, a snap acting element associated therewith for operation thereby, a switch element operated by said snap acting element, resilient means opposing said pressure operated element and means for adjusting said resilient means comprising a rotatable element for changing the adjustment upon rotation thereof, said rotatable element being rotatable in one direction for increasing the opposition of the resilient means, and rotatable in the opposite direction for decreasing the opposition of the resilient means, a knob element for rotating said rotatable element and normally meshing therewith, said rotatable element being movable to non-meshing position, whereupon said knob element may be rotated to a different relative position and then said rotatable element may again be meshed therewith.

4. In an adjustable control switch, a pressure operated element, a snap acting element associated therewith for operation thereby, a switch element operated by said snap acting element, resilient means opposing said pressure operated element and means for increasing or decreasing the tension in said resilient means comprising an element rotatable in one direction to its limit of rotation for increasing the tension of the resilient means, and rotatable in the opposite direction to its limit of rotation to decrease the tension in the resilient means, a knob element for rotating said rotatable element and means of operative connection between said knob element and said rotatable element, said means of operative connection comprising a non-circular socket in one of said elements and a similarly shaped portion on the other element to fit therein, said portion being disassociable from said socket, said knob element having an opening through which disassociability can be performed.

5. In an adjustable control switch, a pressure operated element, a snap acting element associated therewith for operation thereby, a switch element operated by said snap acting element, adjustable resilient means opposing said pressure operated element, a knob element for said adjustable resilient means and a differential adjusting element for said snap acting element, said knob element having an opening through which said differential adjusting element is accessible.

6. In an adjustable control switch, a pressure operated element, a snap acting element associated therewith for operation thereby, a switch element operated by said snap acting element, adjustable resilient means opposing said pressure operated element, a knob element for said adjustable resilient means and a differential adjusting screw, said differential adjusting screw being carried by said knob element and adjustable relative thereto, said knob element having an opening through which said differential adjusting screw is accessible.

7. In a control switch structure, a casing, a switch mechanism therein including an automatically operable switch element to make and break an electric circuit, normal range, additional range and differential adjusting mechanism for said switch element and a control knob exterior of said casing for changing said normal range adjusting mechanism, said control knob having an opening through which said additional range and differential adjusting mechanism are accessible.

8. In a control switch structure, a casing, a switch mechanism therein including an automatically operable switch element to make and break an electric circuit, normal range and additional range adjusting mechanism for said switch element and a control knob exterior of said casing for changing the normal range adjusting mechanism, said control knob having an opening through which said additional range adjusting mechanism is accessible.

9. In a refrigerator switch, an expansible pressure device responsive to refrigerating operations of the refrigerator for operating the switch, a spring for counteracting the expansion of the pressure device, a member for varying the tension of the spring, said member throughout its entire movement in one direction increasing the tension of the spring, and throughout its entire reverse movement decreasing the tension of the spring, a handle part connected to the member for operating the member, means for limiting the movement of the handle part and the member, the member adapted to be freely moved to adjust the

tension of the spring when the handle part is disconnected from the member.

10. In a refrigerator switch, a pressure device responsive to the refrigerating conditions of the refrigerator for operating the switch, a spring for counteracting the expansion of the pressure device, a member for varying the tension of the spring, said member throughout its entire movement in one direction increasing the tension of the spring and throughout its entire reverse movement decreasing the tension of the spring, a shell for enclosing the switch, a handle part located on the outside of the shell for operating the member, means for limiting the movement of the handle part and the member, the member adapted to be freely moved to adjust the spring when the handle part is disconnected from the member, and means for connecting the handle part to the member at a plurality of positions spaced angularly with respect to each other to enable a change in the location of the temperature range by the member as defined by the limitations in the rotative movements of the handle part.

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