June 13, 1950 C. W. KUHN 2,511,640

CIRCUIT CONTROLLING DEVICE

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Fig. 1

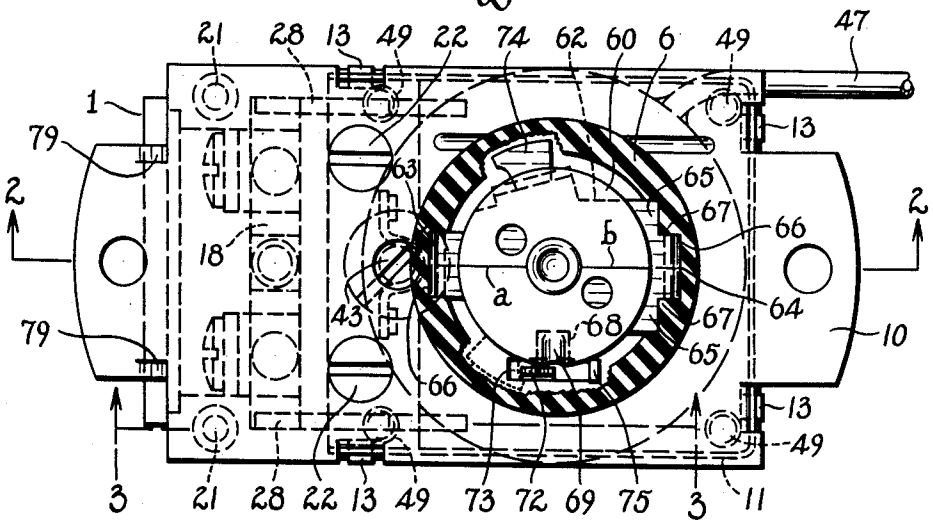


Fig. 2

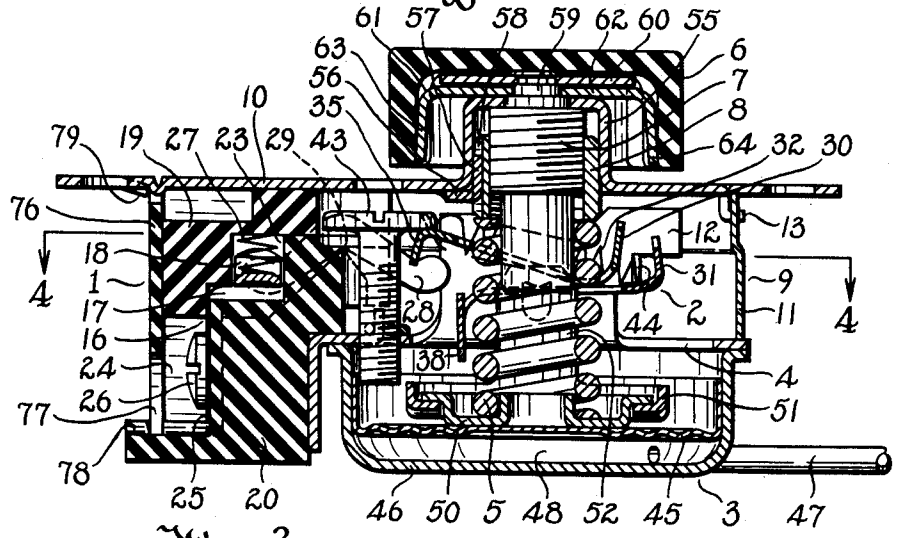
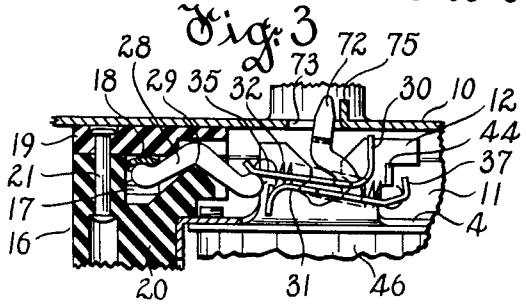


Fig. 3



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Fig. 4

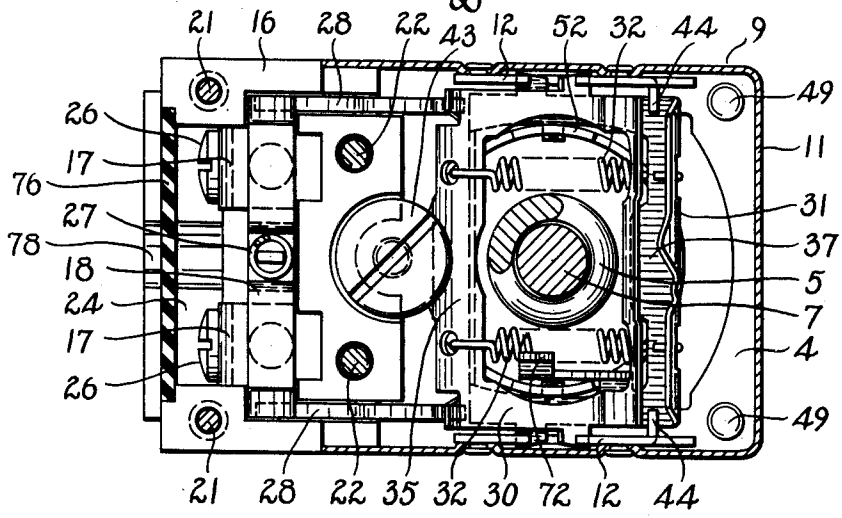


Fig. 5

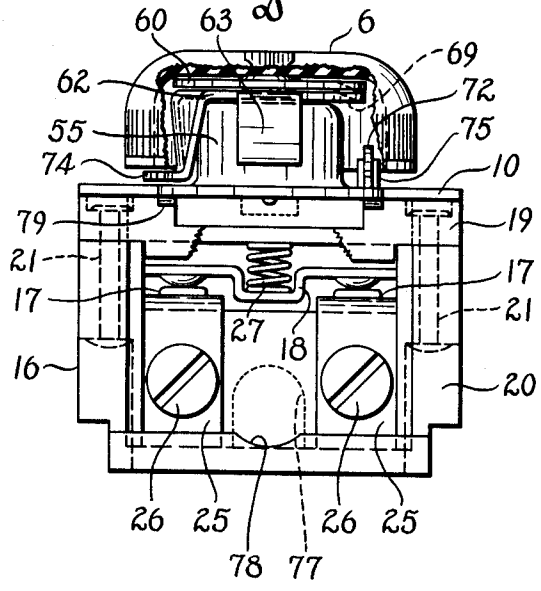
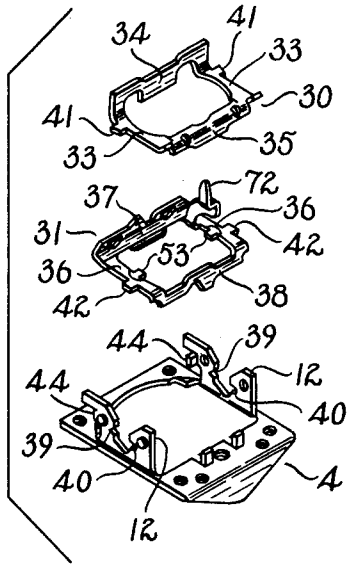


Fig. 6



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CIRCUIT CONTROLLING DEVICE

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10 Claims. (Cl. 200—83)

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This invention relates to circuit controlling devices and is particularly applicable to automatic temperature control switches for use in connection with electric refrigerators.

The invention has among its objects to provide an improved refrigerator control switch of the type including a front adjusting knob which is rotatable in opposite directions between given limits to effect what is commonly known as "cold control," and which operates in one of said limits to stop the refrigerator for "defrosting."

Another object is to provide a compact, rugged and reliable control switch of the aforesaid type which is exceedingly thin from front to back and is formed largely of sheet metal parts capable of being readily manufactured and assembled at low cost.

Another object is to provide a refrigerator control switch of the aforesaid type having improved temperature adjusting mechanism associated therewith.

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 front elevational view of a switch embodying the invention, the adjusting knob therefor being shown in section;

Fig. 2 is a sectional view on line 2—2 of Fig. 1 illustrating the switch in closed position;

Fig. 3 is a fragmentary sectional view taken substantially on line 3—3 of Fig. 1 illustrating the switch in circuit opening position;

Fig. 4 is a sectional view on line 4—4 of Fig. 2;

Fig. 5 is an end elevational view of the switch with a portion of the switch insulating base broken away and with a cover therefor removed; and

Fig. 6 is an exploded perspective view of certain of the parts shown in Figs. 1 and 2.

The refrigerator control switch illustrated in the drawings includes a switch unit 1 and a unitary operating assembly therefor, including a snap operating mechanism 2 and a pressure responsive device 3. The snap operating mechanism 2 and pressure responsive device 3 are mounted upon a rectangular base plate 4 and said pressure responsive device has a loading spring 5 associated therewith which is adjustable by a knob 6 through the medium of a screw 7 and an associated nut 8.

More specifically, the snap operating mechanism 2 is enclosed within a casing 9 having an opening in one end thereof for receiving the switch unit 1. As illustrated in Figs. 1 and 2, base plate 4 forms the rear wall of said casing and the other walls thereof are formed by a front

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mounting plate 10 and a U-shaped sheet metal cover 11 which is located between said plates. Cover 11 is secured by riveting to forwardly extending projections 12—12 formed on opposite sides of an opening in base plate 4. Also cover 11 is secured to front plate 10 by projections 13 (Fig. 1) which are formed on said plate and engage within openings in cover 11.

The switch unit 1 includes an insulating base assembly 16 which carries a pair of stationary contacts 17—17 and a cooperating bridging contact 18. Base assembly 16 comprises two molded insulating parts 19 and 20 which are secured together by a pair of rivets 21. These insulating parts are formed to fit within the end opening in casing 9 and are secured therein by screws 22 which extend through openings in front plate 10 and thread into tapped openings in base plate 4. Insulating parts 19 and 20 are also formed to provide a contact-receiving recess 23 and a terminal receiving recess 24. As shown in Fig. 2, the stationary contacts 17 are clamped between the insulating parts 19 and 20 to hold the same in assembled position within recess 23 and each of said contacts is provided with a terminal portion 25 which extends into terminal recess 24 and is provided with a binding screw 26. Bridging contact 18 is slidably supported within the recess 23 and is normally held in engagement with stationary contacts 17 by a compression spring 27. Said bridging contact has a pair of operating levers 28 associated with opposite ends thereof for moving the same into circuit opening position. As shown in Fig. 3, the operating levers 28 extend inwardly beyond the base assembly 16 and each is fulcrumed at a point intermediate its ends upon a knife edge bearing 29 formed upon the base part 20.

The snap operating mechanism 2 is of the type disclosed in the patent to C. F. Robbins, No. 2,375,387, issued May 8, 1945. Said mechanism comprises an operating lever 30, a control lever 31 and a pair of over-center springs 32. As shown in Fig. 6, operating lever 30 comprises a rectangular sheet metal stamping which is shaped to provide spaced side arms 33 and connecting end cross bars 34 and 35, and control lever 31 also comprises a sheet metal stamping which is shaped to provide spaced side arms 36 and connecting end cross bars 37 and 38. Also as shown in Fig. 6, the side projections 12—12 on base plate 4 are each formed to provide a pair of oppositely disposed V-shaped bearing notches 39 and 40. The side arms 33 of operating lever 30 are provided with ear projections 41 which engage within the bearing notches 39 and the side arms 36 of control lever 31 are provided with ear projections 42 which engage within the bearing notches 40. Operating lever 30 and control lever 31 are held in assembled position within their associated bearing notches by the over-center springs 32 and as shown in Figs. 3 and 4

each of said springs has one end attached to end bar 35 of operating lever 30 and its opposite end attached to end bar 37 of control lever 31. As shown in Fig. 2, the end bar 35 of operating lever 30 is disposed in front of the switch operating levers 28 and rotative movement of said operating lever in a clockwise direction is limited by engagement of said end bar with the head of an adjustable screw stop 43 carried by base plate 4. Also as shown in Fig. 2, control lever 31 is located to the rear of operating lever 30 and rotation of said lever in a counterclockwise direction is limited by inwardly extending stop projections 44 formed on the side arms 12 of base plate 4.

The operation of the aforedescribed snap operating mechanism is as follows. Normally the axes of springs 32 are located forwardly with respect to the bearing notches 39 and 40 so that control lever 31 is normally held in engagement with its associated stops 44 and operating lever 30 is normally held in engagement with its associated screw stop 43. Upon a given degree of clockwise rotation of control lever 31 out of the position shown in Fig. 2 the axes of springs 32 are moved rearwardly across the bearing notches 39 and operating lever 30 is then moved with a snap action from the position shown in Fig. 2 into the position shown in Fig. 3. Upon movement of operating lever 30 into the position shown in Fig. 3 the cross bar 35 thereof operates switch levers 28 for movement of bridging contact 18 into circuit opening position against the action of its associated spring 27. Rotation of control lever 31 in a clockwise direction (Fig. 3) is limited by engagement of said lever with the front surface of base plate 4 and upon movement of said control lever into said limit the axes of springs 32 are still located in front of the bearing notches 40. The over-center springs 32 thus act upon release of control lever 31 to return the same to the position shown in Fig. 2. Upon return of control lever 31 to the position shown in Fig. 2 the axes of springs 32 are moved forwardly across the bearing notches 39 to effect snap movement of operating lever 28 into the position shown in Fig. 2 for return of bridging contact 18 to circuit closing position under the action of spring 27.

Control lever 31 of the aforedescribed snap operating mechanism is operated by the pressure responsive device 3 and as shown in Fig. 2 said device includes a flexible metal diaphragm 45 which is sealed within a rigid cup member 46 having a closed tube extension 47 connected to one side thereof. Diaphragm 45 is spaced with respect to the bottom wall of cup member 46 to provide a sealed chamber 48 and said chamber and the tube extension 47 are filled with a thermal responsive fluid such as methyl chloride. The open end of cup member 46 is provided with an outwardly extending flange of rectangular form and said flange is secured to the under side of base plate 4 by screws 49 which are illustrated by dotted lines in Fig. 1.

The loading spring 5 associated with pressure responsive device 3 is of coil form and extends upwardly from diaphragm 45 through the opening in base plate 4 and through the openings in levers 30 and 31. The rear end of loading spring 5 has a circular cup washer 50 associated therewith which bears against the front face of diaphragm 45 and is operatively connected to the control lever 31 of the snap operating mechanism through the medium of a stirrup 51. Cup washer 50 and stirrup 51 are formed of sheet metal and said stirrup is interposed between said cup washer and the diaphragm 45 and is provided with forwardly extending arms 52 which are operatively connected to inwardly extending ears 53 (Fig. 6) formed on the side arms 36 of control lever 31.

The above described switch may be used to control starting and stopping of an electric refrigerator and in such installations the tube extension 47 is usually secured to the evaporator of the refrigerator so that the pressure of the fluid in chamber 48 of pressure responsive device 3 varies in accordance with changes in temperature of the evaporator. Thus upon warming of the evaporator the pressure of the fluid in chamber 48 will increase to effect expansion of diaphragm 45 against the action of loading spring 5. During expansive movement of diaphragm 45 stirrup 51 is maintained in engagement with washer 50 under the action of springs 32 and at a predetermined high temperature determined by the opposing force of loading spring 5 control lever 31 is moved by said springs into circuit closing position to effect starting of the refrigerator. Upon starting of the refrigerator the pressure of the fluid in chamber 48 will decrease due to cooling of the evaporator and diaphragm 45 contracts under the action of loading spring 5. Upon contraction of diaphragm 45 the stirrup 51 moves therewith and upon a predetermined temperature drop control lever 31 is moved into circuit opening position to effect stopping of the refrigerator. As is apparent, variation of the degree of compression of loading spring 5 varies the temperature values at which the refrigerator is started and stopped. Also adjustment of screw stop 43 varies the position of operating lever 30 to vary the point at which said lever is operated during movement of control lever 30 out of the position shown in Fig. 2. Adjustment of screw stop 43 therefore varies the degree of temperature drop which is required to effect stopping of the refrigerator.

As hereinbefore stated, loading spring 5 is adjustable by a knob 6 through the medium of a screw 7 and an associated nut 8. As shown in Fig. 2, nut 8 engages the front end of loading spring 5 and is movable axially within a forwardly extending cup projection 55 formed on front plate 10. Front plate 10 has a stop plate 56 welded to the rear face thereof, and as shown in Fig. 2 said stop plate is provided with a tongue projection 57 which engages within a slot 58 in nut 8 to hold said nut against rotative movement. The front end of screw 7 abuts the front wall of cup projection 55, and as is apparent upon rotation of said screw nut 8 is adjusted axially to vary the degree of compression of loading spring 5. Screw 7 has an extension 59 formed on the front end thereof which extends through an opening in the front end of cup projection 55 and knob 6 is detachably and adjustably secured to said extension through the medium of a washer 60 and a coupling member 61.

Washer 60 comprises a sheet metal stamping which is fixed to the front end of screw extension 59 and coupling member 61 also comprises a sheet metal stamping having a flat circular body portion 62 which is rotatably supported upon said screw extension. As shown in Figs. 1 and 2, the body portion 62 of coupling member 61 has a pair of rearwardly extending finger projections 63 and 64 formed on opposite sides thereof and said body portion is also shaped to provide

shoulders 65 on opposite sides of finger projection 64. Knob 6 is cup shaped to fit over the coupling member 61 and as shown in Fig. 1 said knob is detachably secured to said coupling member by engagement of the finger projections 63 and 64 within recesses 66 formed on the inner surface of said knob. Also as shown in Fig. 1, the inner surface of knob 6 is shaped to provide projections 67 which cooperate with the shoulders 65 to insure that said knob is always mounted in a given angular position upon coupling member 61. As shown in dotted lines in Fig. 1, the body portion 62 of coupling member 61 is provided with a slot 68 and washer 60 is provided with an indented portion 69 which engages within said slot to lock said coupling member in a selected angular position with respect to screw 7.

Prior to locking of coupling member 61 to screw 7 said screw is shop adjusted for a given normal setting of loading spring 5 and a line *a*—*b* (Fig. 1) is scribed on the face of washer 60 in a direction corresponding to the normal setting of knob 6. Coupling member 61 is then set in the position shown in Fig. 1 so that the finger projections 63 and 64 thereof are alined with the scribed line *a*—*b* and washer 60 is indented at 69 to lock said coupling member against rotation with respect to screw 7.

As shown in Fig. 6, one of the side arms 36 of control lever 31 is provided with an arm 72 and as shown in Figs. 1 and 3 said arm extends forwardly through a slot 73 formed in front plate 10. Coupling member 61 has a rearwardly extending finger 74 formed on one side thereof, and upon counterclockwise rotation of knob 6 into a given limit said finger is moved into engagement with arm 72 to move control lever 31 from the position shown in Fig. 2 into the position shown in Fig. 3. Bridging contact 18 is thus moved out of engagement with its associated stationary contacts 17 to stop the refrigerator for defrosting thereof. As shown in Fig. 3, front plate 10 is provided with a forwardly extending stop projection 75 which is located at one end of the slot 73. As is apparent from Fig. 1, clockwise rotation of knob 6 is stopped by direct engagement of finger 74 with one side of stop projection 75 and counterclockwise rotation thereof is stopped when arm 72 is moved by said finger into engagement with the opposite side of said stop projection.

Switch unit 1 is provided with a removable insulating cover plate 76 having a wiring opening 77 therein which communicates with the terminal recess 24 in base assembly 16. As shown in Fig. 2, the insulating part 20 of base assembly 16 is provided with a grooved projection 78 for receiving the rear edge of cover plate 76 and said cover plate is held in assembled position within said groove by a catch 79 formed on the rear face of front plate 10. The left hand end of front plate 10 can be sprung forwardly to release catch 79 from cover plate 76 and as is apparent said cover plate can then be removed from the base assembly 16.

What I claim as new and desire to secure by Letters Patent is:

1. In combination, a thermal responsive switch mechanism having a helical loading spring associated therewith, a housing for said switch mechanism including a front mounting plate, said loading spring being located within said housing with its front end adjacent said mounting plate and with its axis substantially perpendicular to the rear face of said plate, a non-rotatable adjusting nut engaging the front end of said spring, an adjusting screw supported within an opening in said plate and rotatable to move said nut axially for variation of the loading effect of said spring, and a manual adjusting mechanism associated with the front end of said screw, said adjusting mechanism including a coupling element rotatably mounted upon the front end of said screw and having means associated therewith for securing the same in a selected angular position with respect to said screw, and a manual adjusting knob detachably secured to said screw by engagement of said coupling element within a recess formed in the rear face of said knob.

2. In combination, a thermal responsive switch mechanism having a loading spring associated therewith, a housing for said switch mechanism including a front mounting plate, said loading spring being located within said housing and having an adjusting screw associated therewith which is supported within an opening in said mounting plate, and a manual adjusting mechanism associated upon the front end of said screw, said manual adjusting mechanism including a coupling element rotatably mounted upon the front end of said screw and having means associated therewith for securing the same in a selected angular position with respect to said screw, and a manual adjusting knob detachably secured to said screw through the medium of said coupling element said coupling element having resilient parts which engage within a recess formed in said knob.

3. In combination, a thermal responsive switch mechanism having a helical loading spring associated therewith, a housing for said switch mechanism including a front mounting plate, a non-rotatable adjusting nut engaging the front end of said spring, and slidably supported within a forwardly extending cup projection formed on said mounting plate, an adjusting screw for said nut supported within an opening in the front end of said cup projection and rotatable to move said nut axially for variation of the loading effect of said spring, and a manual adjusting mechanism associated with the front end of said screw, said adjusting mechanism including a coupling member rotatably mounted upon the front end of said screw and having means associated therewith for securing the same in a selected angular position with respect to said screw, and a manual adjusting knob secured to said screw through the medium of said coupling element, said adjusting knob being recessed to receive said cup projection and said coupling element having resilient parts which engage within said recess to detachably hold said knob in assembled position upon said screw.

4. In a circuit controlling device, the combination with a housing open at one end and including a front mounting plate, a rear base plate and a U-shaped cover member mounted between said plates, of a unitary control switch having an insulating support mounted within the open end of said housing, a pressure responsive device mounted upon said base plate and having a loading spring associated therewith, a snap operating mechanism mounted within said housing and operable by said pressure responsive device to effect opening and closure of said control switch, and an adjusting mechanism for said loading spring including a non-rotatable nut engaging said spring and slidably supported within a forwardly extending cup projection formed in said mounting plate, an adjusting screw for said nut

rotatably supported within an opening in the front end of said cup projection and an adjusting knob detachably secured to the front end of said screw.

5. In a circuit controlling device, in combination, a housing open at one end and comprising a front mounting plate, a rear base plate and a U-shaped cover member mounted between said plates, a unitary control switch including an insulating support mounted within the open end of said housing, a pressure responsive device mounted upon said base plate and having a loading spring associated therewith, a snap operating mechanism mounted within said housing and operable by said pressure responsive device to effect opening and closure of said control switch, and a screw adjusting mechanism mounted upon said mounting plate for adjusting said loading spring to vary the pressure values at which said control switch is opened and closed by said device, said screw adjusting mechanism being provided with a front adjusting knob and said snap operating mechanism having a part extending through an opening in said mounting plate and operable by said adjusting knob to effect opening and closure of said control switch.

6. In a circuit controlling device, the combination with a housing open at one end and including a front mounting plate, a rear base plate and a U-shaped cover member mounted between said plates, of a unitary control switch having an insulating support mounted within the open end of said housing, a cover member associated with said insulating support and detachably held in position thereon through the medium of said front mounting plate, a pressure responsive device mounted upon said base plate and having a loading spring associated therewith, a snap operating mechanism mounted within said housing and operable by said pressure responsive device to effect opening and closure of said control switch, and an adjusting mechanism for said loading spring including a screw extending into a forwardly extending cup projection formed in said plate and rotatably supported within an opening in the front end of said cup projection, and an adjusting knob detachably secured to the front end of said screw and having a recess therein for receiving said cup projection.

7. In a thermal responsive switch mechanism, the combination with an enclosing casing including a front mounting plate, of a thermal responsive switch operating mechanism mounted within said casing and having an associated loading spring of coil form extending forwardly toward said plate, a non-rotatable adjusting nut engaging the front end of said spring, said nut being supported within a forwardly extending cup projection formed in said plate to reduce the overall dimension of said enclosing casing rearwardly of said plate, an adjusting screw for said nut rotatably supported within an opening in the front end of said cup projection, a coupling element mounted upon the front end of said screw and having means associated therewith for varying the angular position thereof with respect to said screw and an adjusting knob detachably secured to said screw through the medium of said coupling element, said knob being recessed to receive said coupling element and said coupling element having resilient parts associated therewith for engaging within said recess to detachably hold said knob in assembled position upon said screw.

8. In a circuit controlling device, the combination with a housing having an end opening and including a front mounting plate, a rear base plate and a U-shaped side wall mounted between said plates, of a unitary control switch having an insulating support mounted upon the open end of said housing, a pressure responsive device secured to said base plate and having an associated loading spring located within said housing, a snap operating mechanism mounted within said housing and operable by said pressure responsive device to effect opening and closure of said control switch, and an adjusting mechanism for said loading spring carried by said front mounting plate and including a rotatable adjusting part extending forwardly through an opening in said mounting plate and a manual adjusting knob detachably secured to the front end of said adjusting part.

9. In a circuit controlling device, the combination with a housing having an end opening and including a front mounting plate, a rear base plate and a U-shaped side wall mounted between said plates, of a unitary control switch including an insulating support having one end secured to the open end of said housing and having exposed terminal portions on the opposite end thereof, a terminal cover member associated with said insulating support and detachably held in assembled position thereon by latching engagement with said front mounting plate, a pressure responsive device mounted upon said base plate and having a loading spring extending into said housing, a snap operating mechanism mounted within said housing and operable by said pressure responsive device to effect opening and closure of said control switch, and an adjusting mechanism for said loading spring including a rotatable adjusting part extending forwardly through an opening in said mounting plate and having a manual adjusting knob detachably secured to the front end thereof.

10. In a circuit controlling device, in combination, a housing having an end opening and comprising a front mounting plate, a rear base plate and a U-shaped side wall mounted between said plates, a unitary control switch including an insulating support mounted upon the open end of said housing, a pressure responsive device mounted upon said base plate and having a loading spring extending into said housing, a snap operating mechanism mounted within said housing and operable by said pressure responsive device to effect opening and closure of said control switch, an adjusting mechanism for said loading spring including a manual adjusting member extending through an opening in said front mounting plate and rotatable in opposite directions between given extreme positions for adjustment of said loading spring, and means operable during final movement of said adjusting member into one of its extreme positions to effect operation of said snap operating mechanism for opening of said control switch.

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

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