April 21, 1953 J. B. CATALDO 2,636,098

THERMOSTATIC SWITCH

Filed May 1, 1950

2 SHEETS--SHEET 1

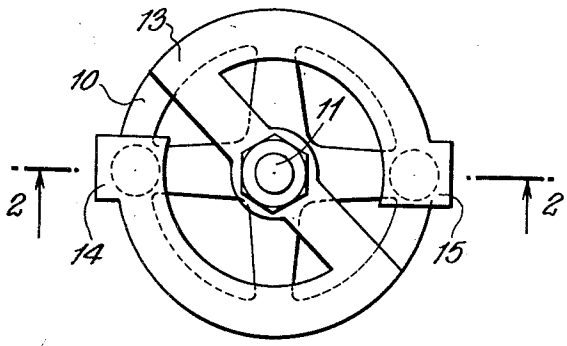


Fig. 1.

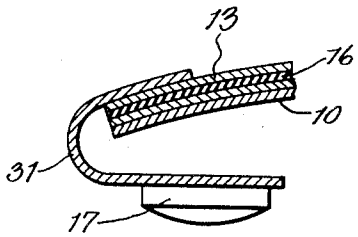


Fig. 5.

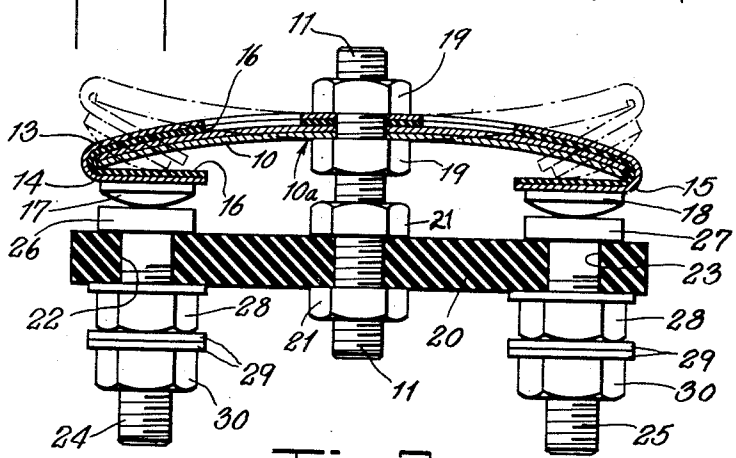


Fig. 2.

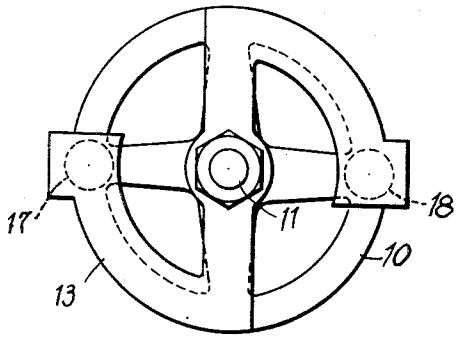


Fig. 3.

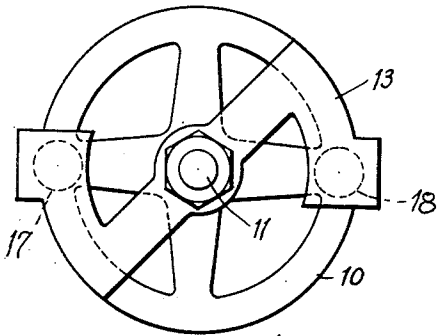


Fig. 4.

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2 SHEETS—SHEET 2

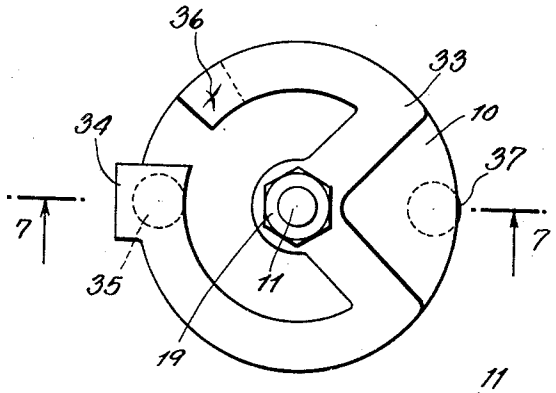


Fig. 6.

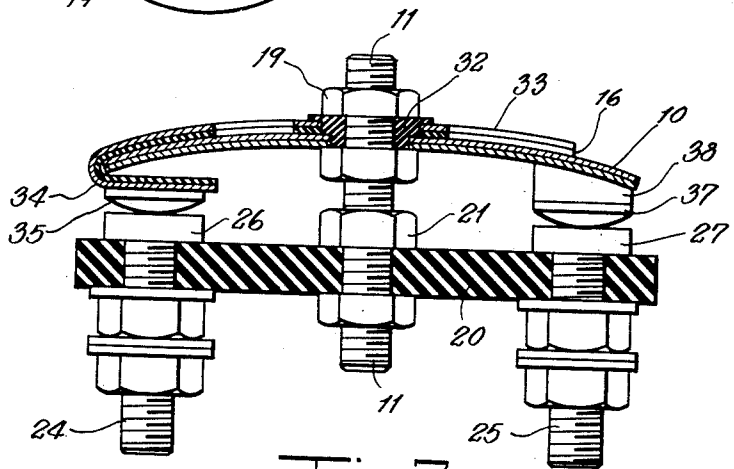


Fig. 7.

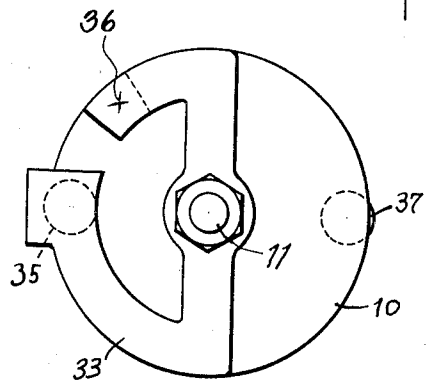


Fig. 8.

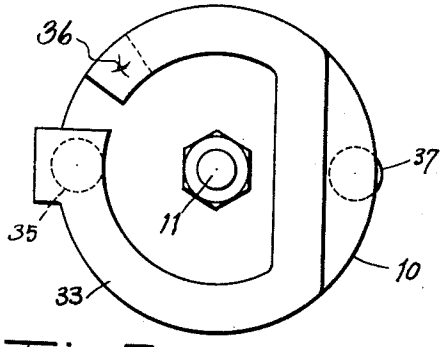


Fig. 9.

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UNITED STATES PATENT OFFICE

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THERMOSTATIC SWITCH

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Application May 1, 1950, Serial No. 159,250

9 Claims. (Cl. 200—122)

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This invention relates to thermoresponsive switch devices and more particularly to improved thermostats and circuit breakers utilizing snap spring members.

In a conventional thermoresponsive snap switch or circuit breaker assembly affording snap control, the thermoresponsive member is mounted adjacent an electrical resistance heater designed to carry a current which is a function of a load current. Preferably the heater element is spaced from the thermoresponsive element in order that the heater might not interfere mechanically with the action of the snap element. In such case the rate of heat transfer to the snap element is limited by this spaced relationship and, in addition, the size of the assembly is increased because of the extra depth required to house the spaced elements.

It is also conventional to pass load currents directly through a thermoresponsive snap member as a means of heating the member to induce snapping. Because the resistance value of the snap member is inherently low, units of this design necessarily have high current ratings or low sensitivity. Moreover, a snap spring member may not be made to provide any given resistance value over a wide range without impairing the snapping properties thereof.

It is accordingly an object of this invention to provide a thermostat switch which is designed to provide greater sensitivity as a circuit breaker and also to provide an economical and integrated unit whereby various trip ratings may be attained over a wide range without jeopardizing the snap characteristics of the thermoresponsive member.

It is another object of the invention to provide a thermoresponsive snap switch assembly which may be adapted to meet either high or low load current ratings within close tolerances.

It is still another object of the invention to provide a thermostat or a circuit breaker device affording snap control action wherein the rate of heat transfer between the heating element and the snapping element is greatly increased.

According to the invention a bimetallic snap disc or other thermoresponsive snap element is formed as an integrated unit with a heater element, the snap element and heater being separated by suitable insulating means to define the electric circuit. The electric circuit may be formed either independently of or in combination with the bimetallic snap member as may be required to achieve various rating characteristics. In one embodiment of the invention a

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series circuit is established including the heater strip and the snap member, thus assuring a current path of maximum length through both components. The heater element is preferably formed of a flat strip material which, as compared to conventional heater wire, affords greater heat transfer from the heater to the disc. Hence, lower current ratings may be attained than would be possible using heater wire of the same electrical characteristics.

The above and other objects of the invention will be apparent from the following detailed description of thermoresponsive devices formed according to the invention taken in conjunction with the accompanying drawings, in which

Fig. 1 is a plan view of a thermoresponsive snap switch assembly;

Fig. 2 is a view in cross-section of the switch assembly shown in Fig. 1 taken on the line 2—2 thereof looking in the direction of the arrows;

Figs. 3 and 4 are plan views of slightly modified forms of the thermoresponsive device shown in Fig. 1;

Fig. 5 is a fragmentary view in cross-section of an alternative method for affixing electrical contact elements to the moving or snapping portion of the assembly;

Fig. 6 is a plan view of a modified thermoresponsive device embodying the invention;

Fig. 7 is a view in cross-section of the assembly shown in Fig. 6 taken on the line 7—7 and looking in the direction of the arrows, and

Figs. 8 and 9 are plan views of possible modification of the switch assembly shown in Fig. 6.

Referring to Figs. 1 and 2 of the drawing, the invention will be seen as embodied in a thermoresponsive snap switch assembly comprising a conventional bimetallic four-legged snap disc 10 centrally mounted on a stationary post 11 by means of a central aperture formed in hub portion 10a of the disc. Surmounted upon the snap disc 10 is a strip resistor element 13 having a flat cross-sectional contour and an S configuration in plan view, the strip being formed on its extremities with turned or folded ears 14 and 15 underlying the periphery of the disc 10.

The resistor or heater strip 13 is insulated from the disc 10 by a relatively thin insulating sheet 16 formed generally in the same configuration as the heater strip 13 and made of coarsely woven glass mesh or other suitable non-conducting material. The insulating sheet 16 also underlies the snap disc 10 in the vicinity of the turned ears 14 and 15 in order to prevent contact between the disc and heater at those points. Secured on the

under surface of the ears 14 and 15 respectively are a pair of electrical contact elements 17 and 18.

The laminated assembly, comprising the snap disc 10, the strip heater element 13 and the insulating strip 16, is centrally apertured and received on the post 11 where it is embraced by a pair of lock-nuts 19 threaded on the post. The resulting integrated assembly is such that its peripheral portions may partake of snap action under the influence of heat on the thermoresponsive snap disc, the latter being adapted to snap between two configurations of equilibrium as shown in full and dotted lines in Fig. 2, carrying with it the flexible heater strip and insulating sheet in concurrent movements.

For detailed disclosures of thermoresponsive snap members of the type contemplated in this invention reference may be had to the following pending U. S. patent applications: Serial No. 628,447 filed November 14, 1945, entitled Toggle Springs, now Patent No. 2,571,170, dated October 16, 1951; Serial No. 635,956 filed December 19, 1945, entitled Snap Disc Springs, now Patent No. 2,604,316, dated July 22, 1952 and Serial No. 139,182, filed January 18, 1950, entitled: Snap Springs and Methods of Manufacture.

The post 11 is rigidly supported in a mounting plate 20 formed of insulating material, the plate being centrally apertured to receive the post and a pair of lock-nuts 21 being provided as a convenient means for anchoring the latter therein. The mounting plate 20 is also formed with apertures 22 and 23 underlying the respective electrical contacts 17 and 18 carried adjacent the periphery of the snap disc, and a pair of terminal bolts 24 and 25 are received in the apertures 22 and 23 respectively. The bolts 24 and 25 are formed with enlarged head portions 26 and 27 respectively which comprise stationary electrical contacts, the upper surfaces of which are adapted to be engaged by the movable contacts 17 and 18 respectively. Nuts 28 are threaded onto each bolt 24 and 25 to secure each of the latter in the plate 20. Suitable terminal assemblies comprising a pair of washers 29 and a nut 30 follow the anchoring nuts 28 on the shank of each bolt to form suitable terminal connectors for receiving lead wires (not shown).

An electrical circuit is established between the terminal posts including the stationary contact 26, the engaged movable contact 17, the heater strip 13, movable contact 18 and stationary contact 27, this circuit being closed at such times as the snap disc member 10 is disposed in its configuration of equilibrium as shown in full lines in Fig. 2 and hereinafter termed "cold" position.

In operation the current passing through the heater strip 13 will result in the generation of heat which will be efficiently radiated to the snap disc 10 to induce snapping of the latter into its second configuration of equilibrium, thereby opening the electrical circuit. The design of the assembly may be such that this action occurs at any one of a wide range of predetermined current values. With the circuit opened the snap disc is permitted to cool, after which it may return automatically to the cold or circuit closed position. If preferred however, the characteristics of the snap disc may be such that it will not return to its circuit-closed position within the ambient temperature range in which the unit is to be operated, in which case a manual reset operation is required.

In order to vary the calibration characteristics of the unit the heater strip 13 may be varied in its configurations as shown in Figs. 3 and 4 wherein the total length of the strip element is changed to vary the resistance value thereof.

If desired the movable contact assembly may be modified as shown in Fig. 5 wherein the heater strip 13 terminates on the upper surface of the snap disc adjacent the periphery thereof. In such case supplementary conductive lugs 31 may be welded, riveted or otherwise secured to terminal ends of the resistor strip 13, with the movable contact 17 being affixed to the supplementary member 31 as shown.

In order to increase the sensitivity or decrease the load current rating of a unit formed according to the invention, the embodiment thereof as shown in Figs. 6 through 9 may be utilized. As shown in Fig. 7, the mounting plate 20 and stationary contact assemblies 26 and 27 as well as the mounting post 11 are all substantially similar to the structure shown in Fig. 2 and described above. The snap spring disc and heater assembly however are modified to provide an electrical circuit in which the heater strip and snap spring disc are connected in a series circuit so that the load current may flow through each in series, thereby to increase the heating efficiency of the unit. The modified assembly includes a snap spring disc 10 of the same type disclosed above centrally apertured and received on a shouldered insulating washer 32, which is in turn fitted over the mounting post 11. A heater strip 33 is surmounted on the disc 10 for flexing movement in unison therewith, the heater strip 33 being apertured at its central portion to abut the outermost shoulder of the insulating washer 32 and with the insulating sheet 16 being sandwiched between the disc and the heater as described above. One terminus of the heater strip is formed with a turned-under ear portion 34 carrying a movable contact 35, while the other terminus of the heater 33 is spot-welded at 36 (Fig. 6) to form an electrical connection with the snap disc 10.

The shouldered insulating washer 32 insulates the resistance strip heater 33 from the post 11 to prevent an electrical short-circuit between the disc and heater through the center post 11. A movable contact element 37, having an extended shank portion 38 to bring it into alignment with contact 35, is secured to the disc 10. In this embodiment of the invention, an electrical circuit is set up between the stationary contacts 26 and 27 including, in series, the E-shaped resistor strip 33, the weld-connection 36, the snap disc 10 and the contact 37. In this fashion the heating efficiency of the load current is increased, thereby to provide a thermoresponsive unit of lower current rating.

In order to vary the effective heating properties of the assembly the plan view configurations of the heater strip 33 may be varied as shown in Figs. 8 and 9, these variations affording different resistance values for the circuit and hence changing the operating or response characteristics of the assembly.

Changes may be effected in the ratings of the various assemblies disclosed herein by (1) changing the basic trip temperature of the bimetallic snap discs 10, all as set forth in the copending U. S. applications above referred to; (2) changing the width, thickness and length of the strip heater members, and (3) changing the proximity of the heater strip of the snap disc in order to vary the heat transfer characteristics therebetween. In general, an increase of the opposing

surface areas between the heating strip and disc will facilitate more rapid transfer of heat and will decrease the current rating of the assembly.

From the foregoing disclosure it will be apparent that numerous modifications may be made in the various units formed according to the invention without departing from the spirit and scope of the invention, and accordingly the invention should not be limited save as set forth in the following claims.

I claim:

1. In a thermoresponsive snap switch assembly, a thermoresponsive snap spring member adapted to snap between two configurations under the influence of heat, a flat flexible strip heater element having a given electrical resistance value disposed in close proximity to said snap member for flexing movement in unison therewith, said strip heater being substantially rectangular in cross section and having its large area opposing the surface of the said snap spring member, means insulating said snap spring member from said heater element at at least one terminus of the heater strip and throughout the length of the heater strip between the termini thereof, and a plurality of electrical contact means electrically connected respectively to the termini of said heater strip.

2. A thermoresponsive snap switch assembly including in combination a thermoresponsive snap spring member adapted to snap between two configurations of equilibrium under the influence of heat, a heater strip comprising a flat strip element superimposed on said disc in close proximity thereto for flexing movement in unison therewith, means supporting said heater and snap member to afford snap movement between said configurations, means providing an electrical connection between one terminus of said strip and said snap member, first contact means electrically connected to the other terminus of said heater strip adjacent a moving portion of said disc, a second electrical contact mounted on said disc and electrically connected thereto at a point of movement of said disc and spaced from the first contact means, means providing electrical insulation between said strip and disc at all points except the electrical connection therebetween and stationary contact means positioned to be engaged by the contact means on the snap member and the contact means on the heater strip to provide a series circuit therebetween including the heater strip and at least a portion of the snap member.

3. A thermoresponsive snap switch assembly including in combination, a bimetallic snap spring member adapted to snap between two configurations of equilibrium under the influence of heat, a flat resistance strip heater formed of flexible material and overlying said snap spring member in close proximity thereto, a thin insulating strip disposed between said strip heater and said member, means securing said strip heater and said member for unison movement relatively to said mounting post, and electrical contact means movable with said snap member and electrically connected to said heater strip at its respective termini, at least one of said contact means comprising an extension portion adjacent one terminus of the heater strip and adjacent the periphery of said snap spring member, said extension portion being looped over the periphery of the snap member.

4. A thermoresponsive snap switch assembly including in combination a mounting plate, a post carried by said mounting plate, a bimetallic snap spring member centrally mounted on said post and adapted to have its peripheral portions snapped between two configurations of equilibrium under the influence of heat, a flat strip heater disposed in laminated relationship to said snap member for movement in unison therewith, insulating means separating said heater strip and said member, a looped portion formed at one end of said heater strip to overlie the periphery of said snap member and a looped portion formed on the other end of the heater strip to overlie the periphery of said snap member at a point spaced from said first looped portion, and electrical contact means carried by said looped portions.

5. In a thermoresponsive snap switch assembly including in combination a mounting plate, a post carried by the plate, a bimetallic snap spring member adapted to snap between two configurations of equilibrium under the influence of heat and centrally apertured to receive said post, a flat resistance heater strip formed of flexible material and overlying said snap spring member in close proximity thereto, a thin insulating strip disposed between said heater strip and said snap spring member, means securing the heater strip and snap spring member for unison movement relatively to said mounting post, electrical contact means movable with said snap spring member and electrically connected to said heater strip adjacent its respective termini, stationary contact means carried by said mounting plate and adapted to be engaged by said movable contact means when the snap spring member is in one configuration of equilibrium, said heater strip and snap spring member are formed with aligned apertures to receive said mounting post, and clamping means for securing said heater strip and snap spring member rigidly with respect to said post adjacent said apertures.

6. In a thermoresponsive snap switch assembly, a mounting plate, a supporting post carried by said mounting plate, a snap member formed of bimetallic material and adapted to snap between two configurations of equilibrium centrally mounted on said post, a flat resistance strip heater disposed in laminated relationship to said member for movement in unison therewith and insulated from said snap member at all points except one terminus of the latter, means forming an electrical connection between said one terminus of the heater strip and said member, a contact element carried by said member and electrically connected thereto, and a second contact element connected electrically to said heater strip, and insulated from said member to establish a series circuit between said contacts including the strip heater and at least a portion of said member.

7. In a thermoresponsive snap switch assembly as set forth in claim 6 including clamping means carried by said supporting post for securing the said flat resistance strip heater thereto adjacent the center of said snap member, said strip heater and member being electrically insulated at said supporting post.

8. A thermoresponsive assembly comprising a bimetallic snap spring member adapted to snap between two configurations under the influence of heat, a flexible heater element, first means attaching said heater element to the snap member adjacent the termini of the heater element, second means attaching said heater element to the snap member at at least one point between

the heater termini, said heater element thereby being mounted for flexing movement in unison with said snap member, means insulating said heater element from said snap spring member at at least one terminus of the heater strip and throughout substantially the full length of the heater element between its termini, and electrical contact means electrically connected to the heater element adjacent the respective termini thereof.

9. A thermoresponsive assembly comprising a bimetallic snap spring member adapted to snap between two configurations under the influence of heat, a flat, flexible heater strip element attached to said member and disposed in close proximity thereto for flexing movement in unison therewith, means insulating said heater element from said snap spring member at at least one terminus of the heater element and throughout substantially the full length of the heater element between its termini, and electrical contact means electrically connected to the termini of said heater element, at least one of said contact means comprising an assembly including an extension portion adjacent one terminus of the heater element and adjacent the periphery of said snap spring member, said extension portion being looped over the periphery of the snap member.

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