Aug. 20, 1935. E. BLETZ 2,011,610

THERMAL SWITCH

Filed Sept. 13, 1934

Fig. 1.

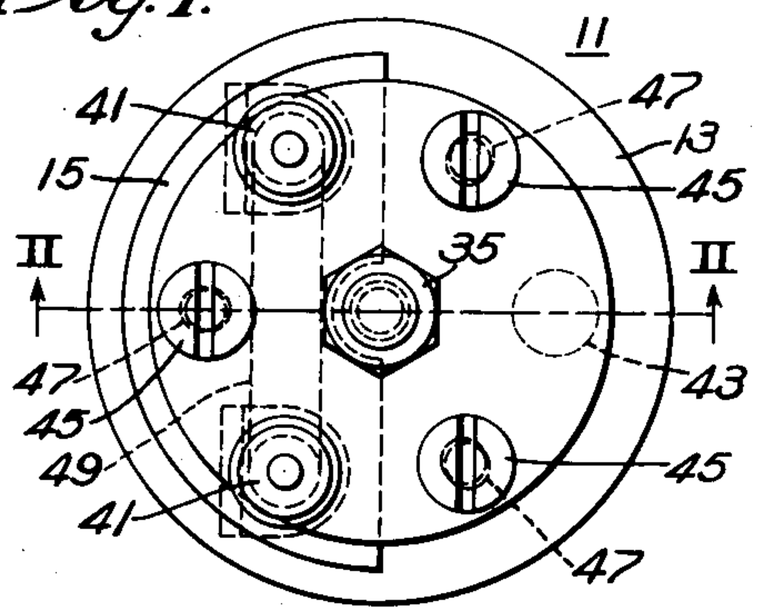


Fig. 5.

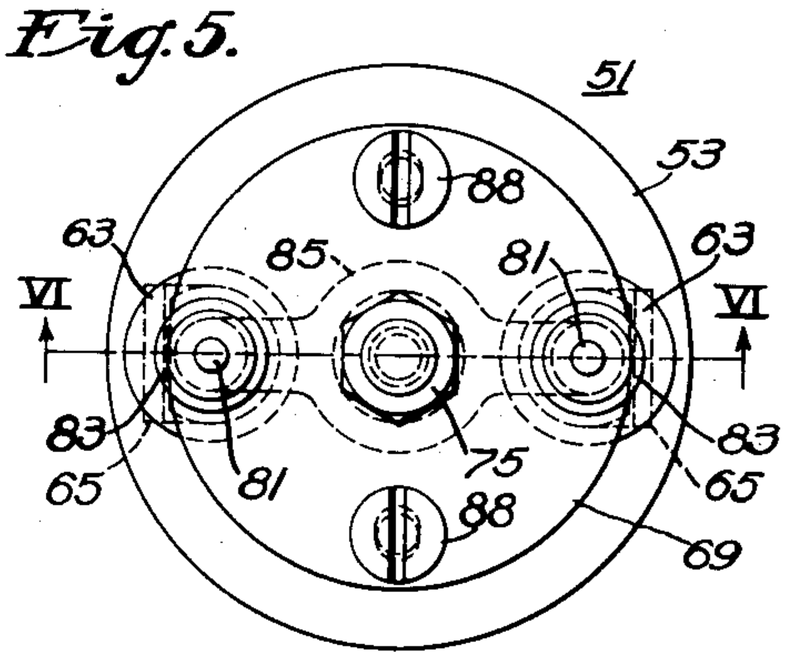


Fig. 2.

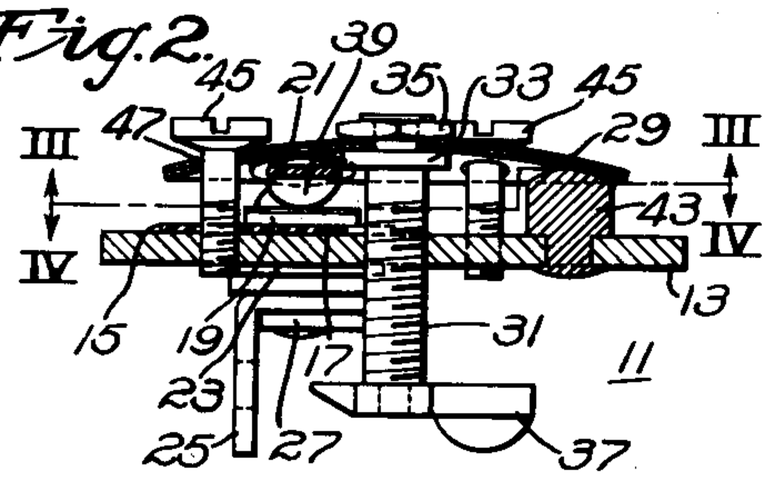


Fig. 6.

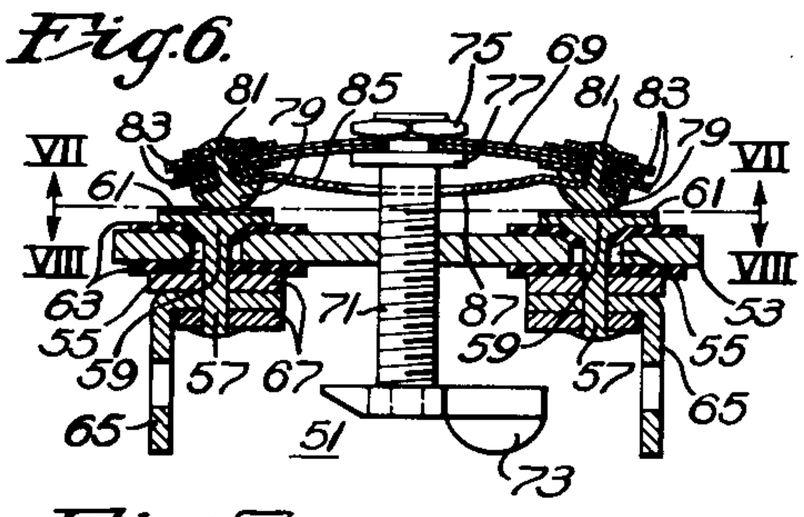


Fig. 3.

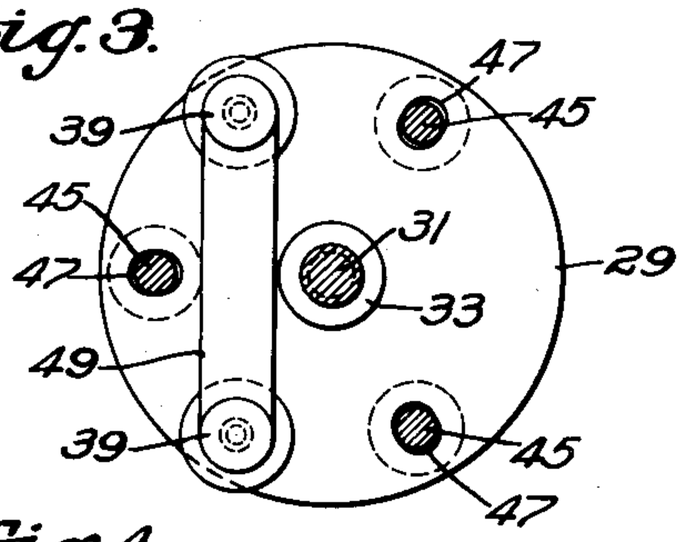


Fig. 7.

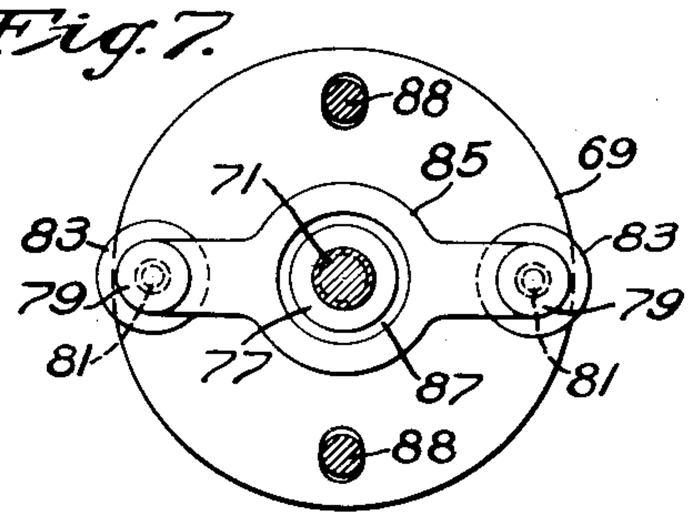


Fig. 4.

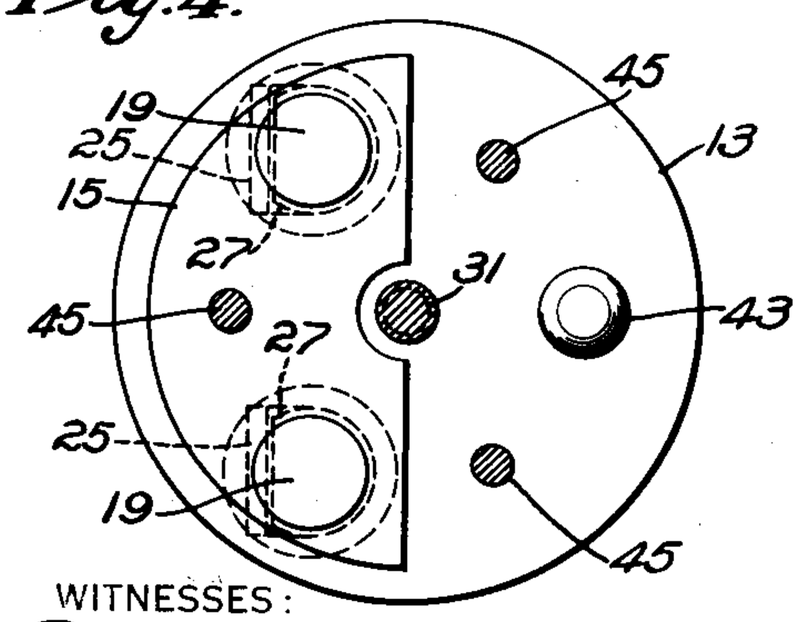
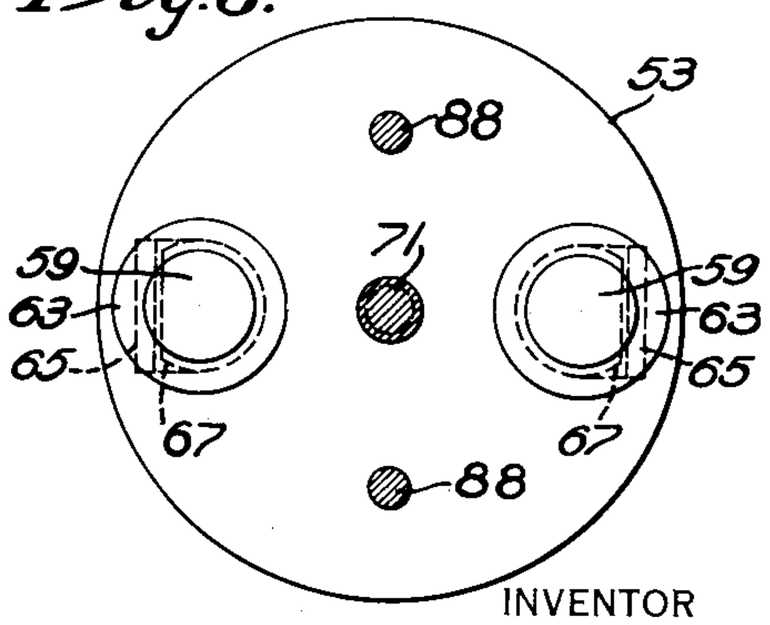


Fig. 8.



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2,011,610

THERMAL SWITCH

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Application September 13, 1934, Serial No. 743,863

9 Claims. (Cl. 200—122)

My invention relates to temperature control devices, and particularly to thermally actuable switches.

An object of my invention is to provide a relatively simple, compact and inexpensive thermally-actuable snap-acting switch.

Another object of my invention is to provide a relatively small thermally-actuable switch that shall provide a relatively large distance between cooperating contact members when moved to open position.

Another object of my invention is to provide a thermally-actuable switch assembly of the snap-acting type that shall provide electric means to reduce the temperature differential of operation of the switch, which means is carried by and movable with the bi-metallic snap-acting element.

Other objects of my invention will either be apparent from the following description thereof, or will be pointed out hereinafter.

In practicing my invention, I provide a base having mounted thereon a plurality of spaced contact members and terminals, and a snap-acting bimetallic disc having two opposed limiting positions and operating from one position to the other with a snap-action and having also a relatively large temperature differential of operation, which disc is adjustably supported on the base. The disc has mounted thereon and insulated therefrom, a corresponding plurality of contact members which are fixed or rigid relatively to the disc, together with an electric connector extending between the contact members on the disc, which connector may be an electric resistor element. Means are further provided to limit the upward dish of the disc, that is, to limit the amount of dishing of the disc when it is moved away from the base to its open position.

In the single sheet of drawings:

Figure 1 is a top plan view of one form of device embodying my invention;

Fig. 2 is a view in lateral section therethrough taken on the line II—II of Fig. 1;

Fig. 3 is a view in section through the structure shown particularly in Fig. 2 of the drawing, and taken on the line III—III thereof;

Fig. 4 is a similar view to that of Fig. 3 but taken on the line IV—IV of Fig. 2;

Fig. 5 is a top plan view of a modified form of device embodying my invention;

Fig. 6 is a view in lateral section through such a device, taken on the line VI—VI of Fig. 5;

Fig. 7 is a view in lateral section through the device shown in Fig. 6, and taken on the line VII—VII thereof; and,

Fig. 8 is a view in lateral section through the device of Fig. 6 and taken on the line VIII—VIII thereof.

The device embodying my invention is shown in several of its preferred forms, and has reference more particularly to a thermostatic snap-acting switch embodying a dished bimetallic disc of the type disclosed and claimed in Patent No. 1,448,240 to J. A. Spencer. Briefly described, the bimetal disc is initially flat and is then given a certain dishing whereby the movement of one part of the disc relatively to a fixed part of the same disc is a discontinuous function of the change of ambient temperature. That is, the disc will, in its normal operating conditions, occupy one of its two limiting positions until the ambient temperature has changed through a relatively very large value when the disc will suddenly move with a snap-action to its other or opposite limiting position.

In all of the structures which have thus far been utilized, the contact members mounted on and movable with the moving part of the disc have included a loosely mounted contact-bridging member movable longitudinally of its axis on a supporting stud in order that proper operative engagement might be effected between the contact bridging member and one or a plurality of fixed contact members mounted on the base. This lost motion of the contact-bridging member insulatedly supported by the disc made it necessary to insure that the disc would move through a relatively large distance in order that the necessary gap or distance between the cooperating fixed and movable contact members in the open position of the switch would be obtained. In contradistinction to this, the contact members, both fixed and movable, in the device embodying my invention are rigidly or fixedly secured to their respective supports, thereby obtaining certain very desirable results which will be set forth more clearly hereinafter.

Referring first to Figs. 1 to 4, inclusive, of the drawing, a snap-acting thermally actuable switch 11 includes a base 13 which is here shown as of substantially circular outline and as made of metal. However, I do not wish to be limited to either the circular outline or contour or to the use of metal. A semi-circular mica sheet 15 is located against one face of base plate 13 and is held in proper operative position thereagainst by the body portions 17 of two contact members whose contact-engaging surfaces are

preferably made flat and of the shape shown in Figs. 2 and 4 of the drawing where the same are designated by the numeral 19. I may make this engaging surface with a relatively thin layer 21 of a non-oxidizing material, such as silver. The body 17 extends through a suitable opening in the base 13, through a small washer 23 of electric-insulating material, through an opening in one arm of a terminal member 25, which may be of substantially L-shape, and also through an opening in a metal washer 27 against which the outer end of a body 17 may be hammered over to support all of these parts in their proper operative positions substantially as shown in the drawing. It will be noted that I provide two such terminal members spaced apart a suitable distance, that is, these contact members are located adjacent to and within the periphery of the disc 13, both of these being located at one side of a diametral line.

A bimetallic disc 29 of the kind mentioned hereinbefore is located adjacent to one side of the base 13 or adjacent to the spaced contact members 19 insulatedly supported on the base 13. The bimetal disc 29 is dished as shown, the initial amount of dishing being relatively large so that the change of ambient temperature necessary to cause the disc to move from one of its fixed positions to its other opposite position will be very large.

An adjustable support for the central part of the disc 29 may comprise a stud 31 having screw-threaded engagement with the base 13 substantially centrally thereof, two collars 33 and 35 being provided at one end of the stud 31 and on opposite sides of the centrally perforated disc 29 to loosely hold the same. Means for turning the stud 31 in order to adjust the disc relatively to the contact members on the base may include an arm 37 which may be turned by an operator.

The disc 29 has two openings or perforations adjacent to but within the outer periphery of the disc and a plurality of contact members 39 are rigidly and insulatedly secured to the disc 29 by body portions of the contact members extending through the opening in the disc and headed or riveted over on the opposite side thereof against metal washers 41 in a manner well known in the art. It will be noted that I thus provide two contact members fixedly insulatedly mounted on and supported by the disc and movable therewith, and since these two contact members are also located at one side of a diametral line, I provide a fixed abutment 43 for the opposite side of the disc, which abutment is in the form of a small stud having a portion extending through and riveted over against the base 13. I provide this abutment for the purpose of ensuring that the disc 29 will be symmetrically stressed when the switch is in its closed position.

By suitable turning movement of the externally screw-threaded stud 31 relatively to the opening in base 13, it is possible to reduce the initial dish of disc 29 so that the temperature value at which it will operate from the position shown in Fig. 2 of the drawing, will be different from that at which the free and unconfined disc would operate. In other words, the temperature differential of operation of the disc has been changed by mechanical means. It is to be further noted that while the temperature differential of operation of the free disc may be on the order of several hundred degrees Fahrenheit, it is usually desirable to have a much smaller temperature differential of operation of the switch in actual operation in order to more closely regulate or control the temperature of an electric device such as an electrically heated or an electric heating appliance which my improved thermal switch is to control.

Let it be assumed for illustrative purposes only, that the high expansion component of bimetal disc 29 is on the underside of disc 29, so that an increase in the ambient temperature is necessary to cause the switch, or more particularly the disc, to operate to open a circuit. A movement of stud 31 to reduce the amount of dishing of the disc will, therefore, result in reducing the high temperature value at which the disc will operate to open the circuit controlled thereby.

Means for raising the low temperature value at which the disc will operate are provided in the shape of a plurality of stop pins 45 screwed into the base 13 and extending through suitable openings 47 in the disc 29, these stop pins being located adjacent to but inside the periphery of the disc.

Another use of the arm 37 mounted on one end of stud 31 is that it permits of manually varying the operating temperatures of the disc, that is, it permits of varying the value of the ambient temperature at which the disc will move from one to the other of its opposing limiting positions with a snap-action, while maintaining a substantially fixed temperature differential of operation. Thus it is possible to so turn the arm 37 that the disc 29 will move by thermal action to open position at 600° F. and return to its closed position at 500° F., or to so adjust arm 37 by a turning movement thereof that disc 29 will open at 300° F., and return at 200° F. It is to be understood, however, that these figures are given for illustrative purposes only, and that they may vary within wide ranges.

I provide an electric conductor 49 in the shape of a thin flat strip of metal extending between the two contact members 39 mounted on the disc 29 but spaced from the inner side of disc 29. In other words, the path of the current through device 11 is from a conductor connected to one of the terminals 25 into and through the body portion 17, into and through the head 19, the non-oxidizing layer 21, into the cooperating engaging contact member 39, which as may be noted, has a small area surface thereof in engagement with the flat contact member on the base, into and through the conductor 49, from there into and through the other contact member 39, through the non-oxidizable layer 21 on the other contact member 19 and from there through the body portion 17 and to the other or out-going terminal member 25.

Referring now to Figs. 5 to 8 inclusive, of the drawing, I have there illustrated a modified form of device embodying my invention which I believe to be somewhat simpler and less expensive. The assembly 51 includes a base plate 53 which is shown as being made of metal but may also be made of a suitable electric-insulating material. The base plate 53 is provided with two diametrally located openings 55 therein near the periphery of the base through which extend the body portions 57 of the two fixed contact members 59 which are also preferably made with a flat outer surface and which may be provided in the manner well known in the art with a thin layer 61 of a non-oxidizing metal. Small plates or washers 63 of electric insulating material, such as mica, are located at each side of the plate 53 around the openings 55 in order to properly in-

sulate the current-conducting portions from the base 53 when the same is made of metal. A terminal member 65, here shown as of substantially L-shape, is associated with the body portion 57, thin layers 67 of metal being provided to permit of riveting over the outer end of body portion 57 against the outer washer 67 to hold the assembly in fixed position on the base 53. A snap-acting bimetal disc 69 of the same type as was hereinbefore described for disc 29 is adjustably mounted on and supported from the base 53 as by an externally screw-threaded stud 71 having a manually actuable arm 73 thereon to effect turning movement of the stud 71 relative to the base. It is to be noted that the stud 71 extends through the base plate 53 centrally thereof and is provided with suitable flanges 75 and 77 to loosely hold and support the disc 69 on the stud 71.

A pair of contact members 79 having rounded engaging surfaces and body portions 81 of reduced diameter are insulatedly mounted on and supported by the disc 69 near the periphery thereof as by the use of small washers 83 of electric insulating material all in the manner known in the art.

Means for electrically connecting the two contact members 79 includes a strip 85 of electric conducting material, the ends of which are located under the heads of contact members 79, the strip 85 extending diametrally of the disc 69, and being provided with an opening 87 therein surrounding the stud 71 with sufficient clearance. A pair of stop pins 88 are provided which are substantially the same as the stop pins 45 hereinbefore described. They alternate with the contacts 59 as to their peripheral position.

It will be noted that the device embodying my invention provides contact members fixedly mounted on the disc 69 but electrically insulated therefrom, the construction being such that there are no loose parts of the contact members on the disc, that is, all parts of the contact structure supported on the disc and movable therewith occupy fixed positions relatively to the disc. It is, therefore, evident that when the snap-acting bimetallic disc is operated, it will move the contact members secured thereto through a distance which is substantially the same as that through which the disc itself moves, so that it is possible to reduce the distance through which the movable part of the disc needs to move to obtain a certain length of gap between the cooperating and initially fixed and movable contact members.

I have already hereinbefore set forth how, by mechanical means, the temperature differential of operation of the disc itself is varied, as by reducing the maximum temperature at which the disc will operate and by increasing the minimum temperature at which the disc will operate. Another important element of my invention consists in the provision of means by which the values of the ambient temperature at which the disc will operate can be varied and this means comprises making the connector 49 or the connector 85 of a resistor material whereby when the same are individually traversed by the circuit current, a small amount of heat will be generated which will affect the disc. In other words, by making the conductor 49 or 85 of a resistor material a small auxiliary heater is provided located inside of the disc and movable therewith to add a small amount of heat to that imparted to the disc by the ambient temperature. It is to be noted, of course, that this resistor conductor (or auxiliary heater) is properly operative only during the time that the circuit is closed, and that it is inoperative to generate heat and impart the same to the disc while the circuit is open as by disengagement of the cooperating fixed and movable contact members.

For illustrative purposes, let it be assumed that the bimetal disc 29 (or 69) is so adjusted that it will move from its closed-circuit position to its open-circuit position when the ambient temperature has reached a value of say 300° F. If now, the resistor conductor 49 (or 85) is such as to cause a temperature rise of 25°, it is evident that the ambient temperature need rise only to a value of 275° F. before the disc moves with a snap-action from its closed circuit to its open circuit position.

In structures of this general kind where the contact member supported by the disc had a loosely mounted part it was highly undesirable to operate the device with the base plate lowermost, since any lost motion resulted in the movable part of the contact member on the disc not moving as far away from the fixed contact member as did corresponding portions of the disc. No such trouble occurs in a device embodying my invention and it is, therefore, immaterial as to whether the disc is mounted above the base or vice versa.

The use of the resistor conductor located closely adjacent to and movable with the movable part of the disc provides a very simple and efficient means for still further reducing the amount of variation in the ambient temperature which it is necessary to effect to cause operation of the disc and still obtain a sufficiently large gap between cooperating contact members.

The device embodying my invention thus provides a compact, simple, and highly efficient snap-acting thermostatic switch effective for the intended purpose of controlling, with little or no arcing, a circuit carrying a current of relatively high value and of relatively high voltage.

Various modifications may be made in the device embodying my invention without departing from the spirit and scope thereof, and I desire, therefore, that only such limitations shall be placed thereon as are imposed by the prior art or are set forth in the appended claims.

I claim as my invention:

1. A quick-acting thermal switch including a base, a plurality of fixed contact members thereon, a snap-acting bimetal disc adjacent to and supported from the base, a corresponding plurality of spaced contact members fixedly and insulatedly mounted on the disc, and an electric conductor electrically connecting the contact members on the disc and movable therewith.

2. A quick-acting thermal switch including a base, a plurality of flat contact members fixedly mounted on the base, a snap-acting bimetal disc adjacent to and supported from the base, a corresponding plurality of spaced contact members fixedly and insulatedly mounted on the disc and having rounded contact surfaces, and an electric conductor connected to and extending between the contact members on the disc and located between the disc and the base.

3. A quick-acting thermal switch adapted to be operated by variations in the ambient temperature including a base, a plurality of spaced contact members on the base, a snap-acting bimetal disc adjacent to and supported by the disc, said disc having predetermined upper and lower operating temperature values, contact members on the disc cooperating with the con-

tact members on the base, and electric means connecting the contact members on the disc and movable therewith for varying one of said ambient temperature values at which the disc operates.

4. A quick-acting thermal switch adapted to be operated by variations in ambient temperature, including a base, a plurality of contact members on the base, a snap-acting bimetallic disc adjacent to and supported by the disc, said disc having a predetermined temperature differential of operation, contact members on the disc, and electric means connecting the contact members on the disc and movable therewith for reducing the variation in the ambient temperature necessary to cause the disc to operate from one to the other of its positions.

5. A quick-acting thermal switch adapted to be operated by variations in ambient temperature, including a base, a plurality of contact members on the base, a snap-acting bimetallic disc adjacent to and supported by the disc, said disc having a predetermined temperature differential of operation, contact members on the disc, and electric means movable with the disc and controlled by the cooperating contact members, for reducing the amount of the change in ambient temperature necessary to cause operation of the disc from one position to another position.

6. In a quick-acting thermal switch responsive to variations in ambient temperature, the combination with a base, a plurality of contact members on the base, a snap-acting bimetallic disc adjacent to the base, cooperating contact members on the disc, adjustable means supporting the disc from the base, said disc-supporting means effecting a variation of an ambient temperature value at which the disc operates, by adjustment thereof relatively to the base, of a current-traversed member supported by the disc and movable therewith for independently effecting a variation of an ambient temperature value at which operation of the disc is effected.

7. In a quick-acting thermal switch, the combination with a base, a plurality of spaced contact members on the base, a snap-acting bimetallic disc adjacent to the contact members, and having a relatively large temperature differential of operation, cooperating contact members rigidly insulatedly mounted on the disc, means supporting the disc from the base and adjustable relatively thereto to vary one of the operating temperature values of the switch, and means on the base and cooperating with the disc to vary the other operating temperature value of the switch, of electric means supported by and movable with the disc for additionally varying the first-mentioned operating temperature value of the switch.

8. In a quick-acting thermal switch, the combination with a base, a plurality of spaced contact members on the base, a snap-acting bimetallic disc adjacent to the contact members and having initially a relatively large temperature differential of operation between its off and on positions, cooperating contact members rigidly and insulatedly mounted on the disc, means supporting the disc from the base and adjustable relatively to the base to vary one of the operating temperature values of the switch to reduce the initial differential, and means on the base cooperating with the disc to vary the other operating temperature value to reduce the initial differential, of an auxiliary heater electrically connecting the contact members on the disc, movable therewith and effective to independently vary the first-named operating temperature value to additionally reduce the temperature differential of operation.

9. In a quick-acting thermal switch operative in response to variations in ambient temperature, the combination with a base, a plurality of spaced contact members on the base, a snap-acting bimetallic disc adjacent the contact members on the base and having initially a relatively large difference between the high temperature at which it snaps to open position and the low temperature at which it snaps to closed position, cooperating contact members rigidly and insulatedly mounted on the disc, means supporting the disc from the base and adjustable relatively thereto to lower the high ambient temperature value at which the disc snaps to open position, and mechanical means on the base and cooperating with the disc to raise the low ambient temperature value at which the disc snaps to closed position, of an auxiliary heater connecting the contact members on the disc and traversed by the current traversing the switch to additionally lower the high ambient temperature value at which the disc snaps to open position.

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