June 16, 1936. J. F. FRESE 2,044,678

THERMALLY CONTROLLED SWITCH MECHANISM

Filed Feb. 21, 1935

FIG. 1.

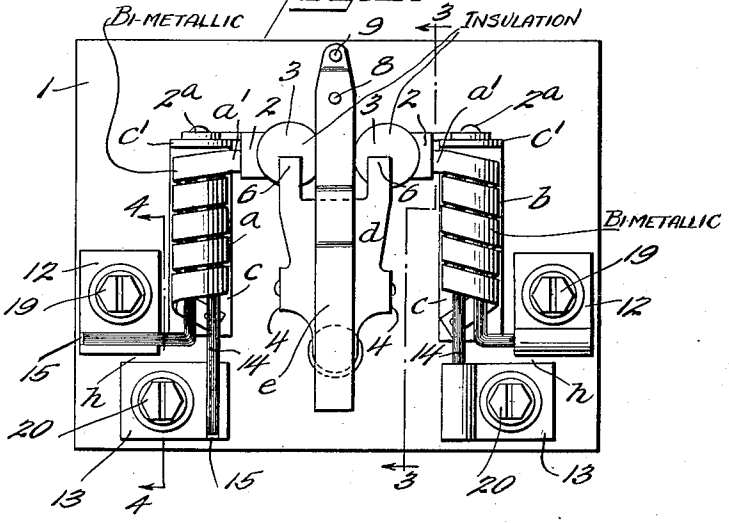


FIG. 3.

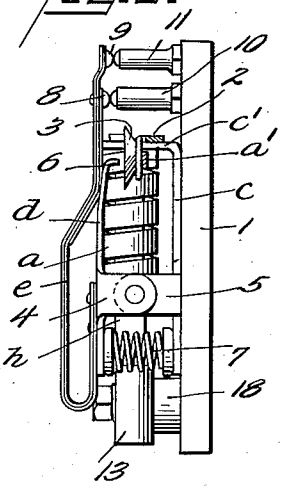


FIG. 2.

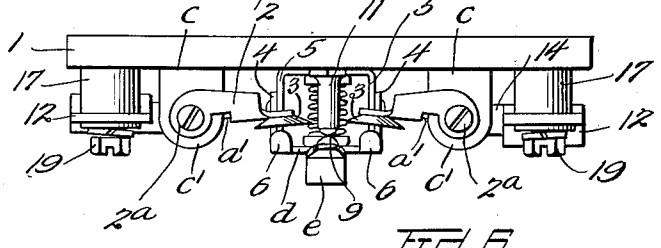


FIG. 4.

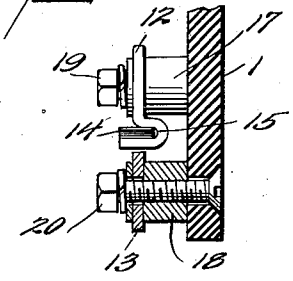


FIG. 6.

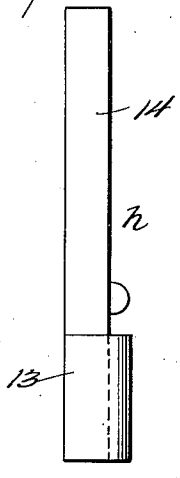


FIG. 5.

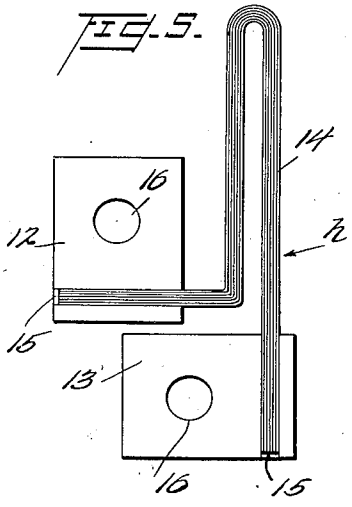
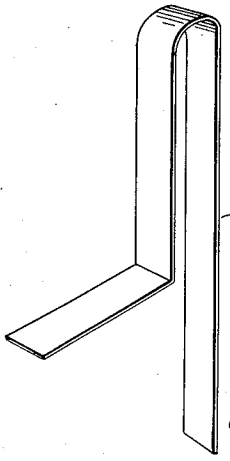


FIG. 7.



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THERMALLY CONTROLLED SWITCH MECHANISM

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Application February 21, 1935, Serial No. 7,607

6 Claims. (Cl. 200—122)

This invention relates to thermally operated circuit controlling devices, and particularly to the heater elements thereof. The type of circuit controlling device to which my present improvements are peculiarly applicable is illustrated in patent to G. H. Whittingham Number 1,718,017 and also in my Patent Number 1,956,346, in which a bi-metallic strip wound helically into tubular form, and containing a heating element, operates to cause the interruption of the circuit in which the heating element is included when the current flow in the latter circuit exceeds a predetermined value. The heating element in the patents referred to is indicated as a wire coiled or doubled upon itself. This is practicable for limited ranges of current values in heaters used in a thermally responsive helix of given size, but for a wide range of current values an assortment of wires of different diameters and resistances are necessary and also helical tubes of larger diameters are required for the wires of larger diameters than for those of smaller diameters.

The object of the present invention is to provide heaters of a standard size for a wide range in current values and adapted for use in connection with a thermally responsive helix of a standard size. To accomplish this each heater element is composed of a number of thin metal strips or ribbons of substantially the same length, width and thickness connected at their ends to suitable terminals and forming a laminated structure, the resistance of the heater as a whole being determined by selecting strips or laminæ having the same or different specific resistances.

Referring to the drawing,

Fig. 1 is a front elevation of a thermally controlled switch mechanism embodying the improved heaters;

Fig. 2 is a top plan view of the same;

Fig. 3 is a section on the line 3—3 of Fig. 1;

Fig. 4 is a section on the line 4—4 of Fig. 1;

Fig. 5 is a front elevation of one of the heaters, on an enlarged scale;

Fig. 6 is a side view of the same, looking from right to left in Fig. 5, and,

Fig. 7 is a perspective view of one of the metal strips or laminæ composing the heater, on an enlarged scale.

The switch mechanism shown in the drawing is mounted upon a suitable base 1 of insulating material and comprises two oppositely wound helical coils *a* and *b*, composed of bimetallic strips, the lower end of each helix being secured to a flat metal plate *c* vertically arranged on the base and having a forwardly projecting upper end *c'*. The upper end of each helix is bent radially outward, as shown at *a'*, and riveted to an arm 2 which is mounted on a pivot pin 2ª on the end *c'* of the plate *c* in line with the axis of the helix. The arms 2 project toward one another and each carries a disc of insulating material 3. A metal plate *d* having inwardly turned ears 4, which are pivotally connected to a bracket 5 on the base, has arms 6 which extend in front of the discs 3. A spring 7 interposed between the lower end of the plate and the base constantly presses the arms toward the discs. A bi-metallic strip *e*, fastened to the plate *d* near its center and projecting downwardly and thence bent upwardly upon itself, forming a loop, carries at its upper end switch contacts 8 and 9 which are normally held in engagement with stationary contacts 10 and 11, respectively, by spring 7. This switch normally closes the circuit of a relay, not shown, which in turn controls the circuits in which the heater elements hereinafter described are included. The ends of the arms 6 are normally close to but out of contact with the discs 3. When either of the helixes *a* or *b* becomes sufficiently heated, disc 3 engages the adjacent arm 6 and rocks the plate *d* and switch member *e* to open the switch. The U-shaped bi-metallic arm *e* adjusts the arms of the plate *d* with reference to the discs 3 to compensate for changes in the positions of said discs occasioned by the coiling and uncoiling of the helixes due to atmospheric temperature. This compensating means is shown and described in my Patent Number 2,013,628, dated September 3, 1935 and no claim is made herein for the mechanism thus far described.

Heaters *h* included in the circuits which are to be controlled, such as the circuits of a multiphase motor, are associated with the thermally responsive helixes. Each heater is composed of terminals 12 and 13 and a plurality of thin metal strips or ribbons 14, each of the same width and thickness and approximately of the same length, lying in close contact with one another and bent into U-form so as to fit within a thermally responsive helix, the ends of the strips fitting within grooves 15 in the terminals and being soldered therein. One of the strips is shown at 14ª in Fig. 7, on an enlarged scale. The terminals are alike, each formed with the groove 15 near one edge and having a central opening 16. One leg of each heater element is straight and its end fits in the groove in the terminal 13 and the end of the

other leg of the heater element is bent outward at a right angle and fits in the groove in the terminal 12. The terminals 12 and 13 rest on metal collars 17 and 18, respectively, which space them from the base, and binding screws 19 and 20, respectively, extend through the base, the collars and the terminals and secure the latter in fixed positions. The structure is such that any heater may be used with either of the thermally responsive helices. Thus, for instance, the heater shown at the left, in Fig. 1, may be applied to the helix shown at the right, by turning the heater about a vertical axis through an angle of 180°, so that its terminals will rest upon the collars and be engaged by the binding screws at the right of said figure. Similarly the heater at the right may be turned over and used with the helix at the left of Fig. 1.

In practice, for currents varying from 30 amperes to 200 amperes, six metal strips, approximately 3/8" wide and .01" thick, are used to form the heating element, and these strips lie close together, forming a laminated structure. A heater adapted to operate the switch at 200 amperes will be composed entirely of copper strips, which have very low resistance, while a heater adapted to operate the switch at 30 amperes will be composed entirely of copper-nickel or other alloy strips having a relatively high resistance, and for operation of the switch at intermediate current values, the heater will be composed wholly of strips of one intermediate resistance, or of strips having different resistances. Thus, representing the strips having successively higher specific resistance by r', r^2, r^3, r^4, r^5 and r^6, the heater may be composed of a group of strips each having the same low resistance r', or each having the same relatively high resistance r^6, or each having the same intermediate resistance r^2, r^3, r^4 or r^5, or each having a different resistance, or a large number of groupings may be made, according to the resistance desired in the heater as a whole, by selecting and combining one or more strips of one specific resistance with a complementary number of strips of another specific resistance or of several different resistances. Thus, for illustration, the heater may be composed of six laminae each having the low specific resistance r'; or it may consist of five laminae having the resistance r' and one having the next higher resistance r^2; or four having resistance r' and two having resistance r^2; or three having resistance r' and three having resistance r^2; or two having resistance r' and four having resistance r^2, or one having resistance r' and five having resistance r^2. The heaters thus formed will have successively higher resistances. It will be evident that a very large number of groupings are possible with a limited number of laminae having different specific resistances, to form heaters having different resistances intermediate those formed exclusively of laminae having the highest or those formed of laminae having the lowest specific resistance.

Thus by selecting the strips from a limited number of ribbons having different specific resistances, heaters of uniform size having a wide range of resistances and current capacities may be formed. As the ribbons or laminae in a heater lie in close contact with one another the heat transference through the mass is substantially the same as though the heater were made of a solid conductor.

In practice the heaters made from the selected ribbons are marked on their terminals with figures representing the amperage at which the standard helix with which it is used will operate to open the switch.

While I have described and illustrated a heater comprising six laminae of certain dimensions and composed of copper or copper-nickel or other alloy, either or both, it will be understood that the invention is not limited to any particular number of laminae, or to any particular dimensions thereof, or to the use of any particular metals or alloys.

What I claim is:

1. A laminated heater for the purpose described comprising a plurality of metal ribbons and a terminal at each end thereof, said ribbons being selected from ribbons of substantially uniform dimensions but varying in specific resistance.

2. A laminated heater for the purpose described comprising a plurality of metal ribbons of standardized dimensions, said ribbons bent to form a longitudinally extended U-shaped body, and a terminal integral with each end thereof, certain of said ribbons differing in specific resistance from others.

3. In an overload protective device of the type having a thermostat and a load current carrying heater associated therewith to heat the same, said heater comprising a U-shaped body consisting of a plurality of metallic ribbons of similar dimensions, certain of said ribbons differing in specific resistance from others, said ribbons being integrated at each free end thereof, and a current carrying terminal integral with each free end thereof.

4. In a circuit controlling device of the type having a movable switch, a helical bimetallic thermostat operable to move said switch, and a current carrying heater disposed within said thermostat, the heater comprising a plurality of closely assembled metallic ribbons and a terminal carried by each end of said assembly, certain of said ribbons differing in specific resistance from others.

5. In a circuit controlling device of the type having a movable switch, a helical bimetallic thermostat operable to move said switch, and a current carrying heater disposed within said thermostat, the heater comprising a plurality of closely assembled metallic ribbons of substantially the same dimensions and a terminal carried by each end of said assembly, certain of said ribbons differing in specific resistance from others.

6. A laminated heater for the purpose described comprising a plurality of closely assembled metal ribbons and a terminal at each end thereof, certain of said ribbons differing in specific resistance from others.

JOSEPH F. FRESE.