G. H. WHITTINGHAM.

THERMAL CUT-OUT DEVICE.

APPLICATION FILED MAY 17, 1921.

1,422,802. Patented July 11, 1922.

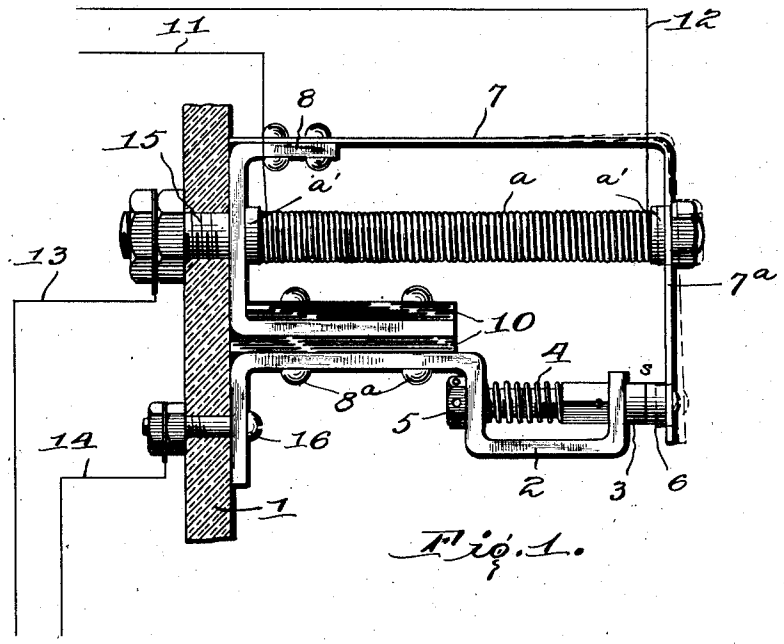

Fig. 1.

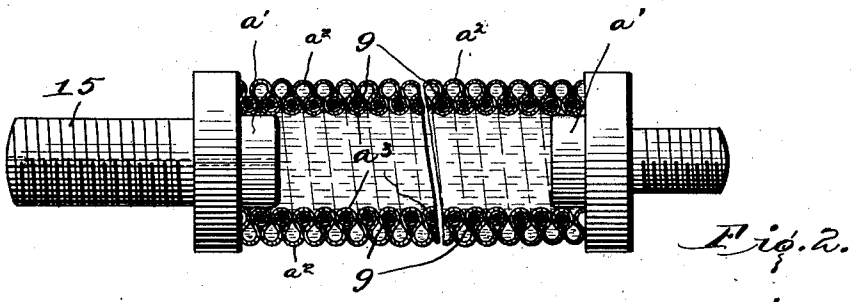

Fig. 2.

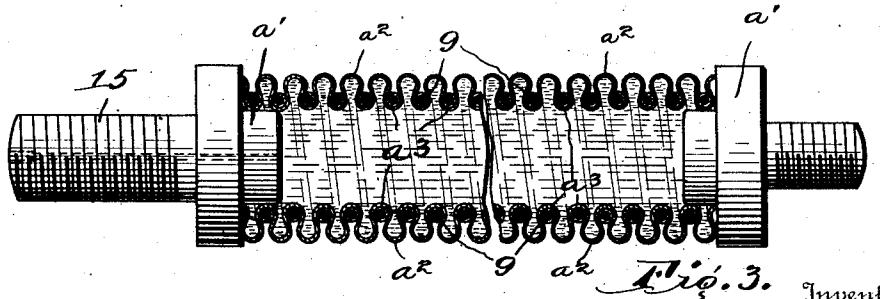

Fig. 3.

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THERMAL CUT-OUT DEVICE.

1,422,802. Specification of Letters Patent. Patented July 11, 1922.

Application filed May 17, 1921. Serial No. 470,274.

To all whom it may concern:

Be it known that I, GEORGE H. WHITTINGHAM, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Thermal Cut-Out Devices, of which the following is a specification.

This invention relates to electro-thermal cut-out devices adapted particularly for controlling electric circuits, but useful for other purposes. The cut-out comprises a tube of relatively thin metal having its wall corrugated so that the tube may expand and contract axially to a considerable extent, the ends of the tube being closed to retain an expansible fluid, such as alcohol or ether, which will forcibly expand the tube when heated. The corrugation in the wall of the tube is helical, and in the helical recess formed by the corrugation, I wind a heating coil, of thinly insulated wire, which supplies heat to the wall of the tube and, through the wall of the tube, to the fluid, when the coil is traversed by an electric current. The corrugation in the wall of the tube is preferably sinuous or serpentine in cross-section, and the raised portions of the adjacent convolutions of the corrugation overlie and partially or wholly enclose the intervening recessed portions, so that when the heating coil is in the recess it is practically surrounded by the metal of the tube and by the fluid within the tube. This latter arrangement is very efficient, because practically all the heat in the coil passes directly to the fluid which is relied upon to furnish the expansible force for operating the cut-out.

In the accompanying drawing,

Fig. 1 is a side elevation of a cut-out switch embodying my invention;

Fig. 2 is a central longitudinal section through the tube illustrated in Fig. 1, partly broken away, showing the tube contracted; and,

Fig. 3 is a similar view, showing the tube expanded.

Referring to Fig. 1 of the drawing, which shows a practical application of the invention, 1 represents a suitable base of insulating material having mounted thereon a peculiarly bent strip of metal 2, which forms a support for an electric contact member 3, which is pressed yieldingly outward from the base by a spring 4 and limited in its outward movement by a stop 5. Co-acting with the contact member 3 to form a switch *s*, is a contact 6 upon a spring arm 7 which is attached to a U-shaped strip of metal 8, also mounted upon the base. As shown, the metal strips 2 and 8 are connected together by rivets 8^a and electrically separated by strips of insulation 10. The spring arm 7 as shown extends outwardly from the supporting strip 8 and has an arm 7^a bent at right angles to the main part of the spring and carrying the contact 6. Between the arm 7^a and the base of the U-shaped strip 8 is arranged a thin tube *a*, having a helically corrugated wall, and within the helical recess formed by the corrugation is wound a heating coil 9, (see Figs. 2 and 3), the terminals of which are connected by conductors 11 and 12 to any suitable source of electric power. The current flowing in this circuit controls the opening and closing of the switch *s*, and this switch controls another circuit, the terminals of which are shown at 13 and 14, one terminal 13 being connected to the contact 6 through a threaded bolt 15, which connects the tube *a* and the metal strip 8 to the base, and from this bolt the current may flow through the spring arm 7 to contact 6. The other terminal of the circuit is connected to the contact 3 through a screw 16, which connects the strip 2 to the base and the current flows through said strip to the contact 3.

The ends of the tube are closed by plugs *a'*, one of which is integral with the bolt 15, and the tube contains a fluid, such as alcohol or ether, which will expand when heated and cause a forcible expansion of the tube. When the tube is heated to a predetermined degree by the current in the heating coil, the tube expands and the spring arm 7 is rocked to open the switch, as indicated in dotted lines in Fig. 1. When the tube cools, the tube contracts by reason of the partial vacuum formed in the tube and also by reason of the pressure of the spring arm 7.

The spiral corrugation in the tube may take various forms, in cross section, but the form shown in Figs. 2 and 3 is most effective and is preferred. In this form of tube the successive convolutions of the corrugation are sinuous in cross-section, the raised portions a^2 of the adjacent convolutions approaching or contacting with one another and partly or wholly enclosing the intervening recessed portions a^3, when the tube is

contracted. Within the recessed portions the heating coil 9 is wound, this coil consisting of a wire having suitable resistance for the purpose and having a thin covering of insulating material to insulate it from the metal of the tube. When no current is flowing through the coil, the raised portions a^2 of the corrugation are close together, as shown in Fig. 2; but when the tube is heated by current flowing in the coil, the tube expands as indicated by the distance between the raised portions of the corrugation in Fig. 3. It will be seen that the coil is closely surrounded by the metal of the tube, and also by the liquid in the tube which extends into the raised portions of the corrugation. Thus, the heat of the coil is quickly transferred to the liquid, the expansible force of which is relied upon to expand the tube. It will also be evident that there can be but little loss of heat by radiation directly from the coil because of its enclosure in the helical recess.

The heating coil can be readily applied to the tube by winding it about the tube and applying sufficient force to cause the wire to slip between the adjacent raised portions of the corrugation into the helical recess.

What I claim is:

1. An electro-thermal cut-out comprising a thin helically corrugated metal tube, closed at its ends and containing an expansible fluid, and an electric heating coil wound on the body of the tube within the helical recess formed by the corrugation.

2. An electro-thermal cut-out comprising a thin helically corrugated metal tube, closed at its ends and containing an expansible fluid, the successive convolutions of the corrugation being sinuous in cross-section and the adjacent raised portions of the corrugation overlying the intervening recessed portions, and an electric heating coil wound on the body of the tube within the recess formed by the corrugation.

In testimony whereof I affix my signature.

GEORGE H. WHITTINGHAM.