No. 830,391. PATENTED SEPT. 4, 1906.

C. E. WHITE.

ELECTROTHERMAL DEVICE.

APPLICATION FILED JUNE 22, 1903.

Fig. 1.

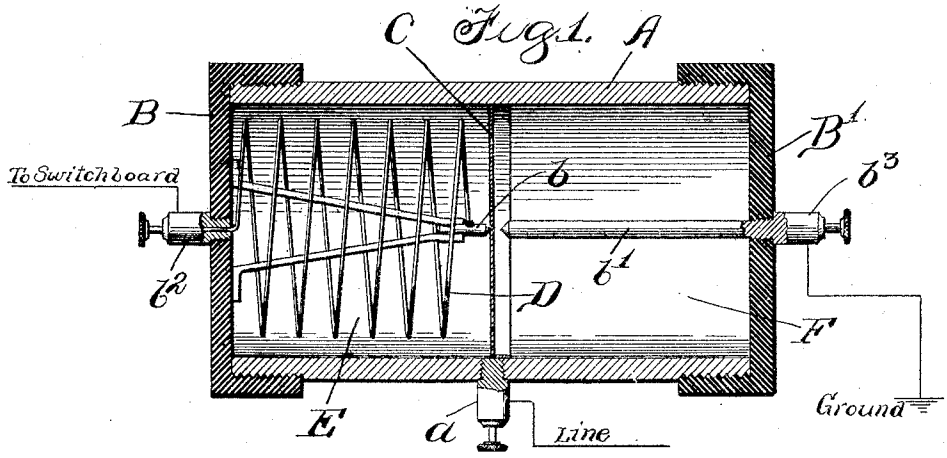


Fig. 2.

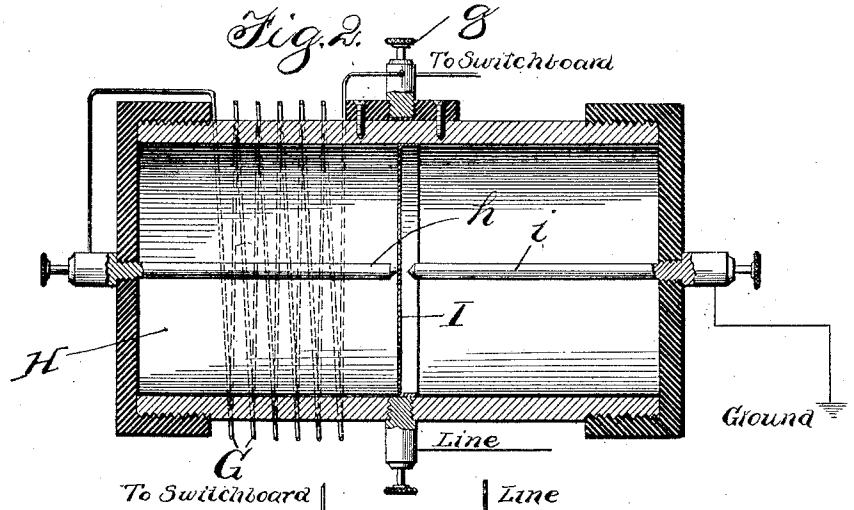
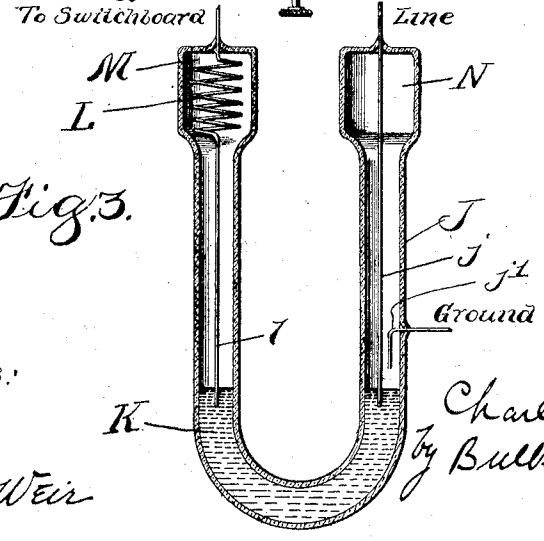


Fig. 3.



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ELECTROTHERMAL DEVICE.

No. 830,391. Specification of Letters Patent. Patented Sept. 4, 1906.

Application filed June 22, 1903. Serial No. 162,469.

To all whom it may concern:

Be it known that I, CHARLES E. WHITE, a citizen of the United States of America, and a resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Electrothermal Devices, of which the following is a specification.

My invention contemplates an improved electrothermal device consisting of a high-resistance or heat-concentrating member and an expansible medium and means whereby the expansion of said medium is capable of producing the desired result.

As herein shown and described, my invention is embodied in a heat-coil for protecting electrical apparatus against the intrusion of abnormally strong currents. For this particular purpose my invention, as herein described and illustrated, preferably comprises a hermetically-sealed chamber containing a heat-coil or other heat-concentrating member. A shifting medium, such as a body of mercury or a thin flexible diaphragm, is arranged to be subject to the pressure of the air in said chamber when the same is expanded by the heat resulting from the passage of an abnormally strong current through the said heat-coil or heat-concentrating member. The said diaphragm or mercury is included in the main circuit and is adapted when shifted slightly by the expanding air to open the said circuit. Also, if desired, the said diaphragm or mercury can be arranged to close a connection to ground at the same time that it opens the main circuit. Preferably the internally-arranged switch-contacts are combined with a confined body of air adapted to counteract the effects of atmospheric changes of temperature on the body of air which is employed for shifting the diaphragm or mercury. In other words, the switch-contacts, the air or other fluid, and the diaphragm or mercury, as the case may be, can all be advantageously inclosed or sealed up in the same inclosure. If a diaphragm is employed, a confined body of air is arranged at each side of such diaphragm. With this provision atmospheric changes of temperature have no tendency to alter the normal condition of the device. The same is true, of course, with the provision of a counterbalancing medium in connection with mercury.

The nature and advantages of my invention will, however, hereinafter more fully appear.

In the accompanying drawings, Figure 1 is a longitudinal section through a heat-coil or thermal protector embodying the broad idea of my invention. Fig. 2 is a similar view showing a slightly different construction. Fig. 3 is a sectional view of a thermal protector involving the use of mercury instead of a diaphragm.

Referring to Fig. 1, my improved heat-coil, or "thermal protector," as they are sometimes called, comprises a metallic cylinder A, provided at its ends with air-tight rubber caps B and B′. At a point preferably midway between its ends the interior of the said cylinder is divided into two compartments by a flexible metallic diaphragm C. The cap B carries a contact b, adapted to normally make contact with the metallic diaphragm C. A metallic contact b' is mounted on the cap B′ and arranged just out of contact with the said diaphragm. A binding-post b^2 on the cap B is connected with the contact b by means of a heat-coil or coil of high resistance D. A binding-post b^3, mounted on the cap B′, is electrically connected with the contact b'. Another binding-post a, mounted on the metallic cylinder A, is electrically connected with the diaphragm C. Thus the said coil or heat-concentrating member D is arranged in a hermetically-sealed chamber E, and this chamber is separated from a similar chamber F by means of the springy or flexible metallic diaphragm C.

In use the line-wire can be connected with the binding-post a, while the switchboard connection, or connection leading to the instruments to be protected, can be connected with the binding-post b^2. The ground conductor can be connected with the binding-post b^3. With this arrangement all currents traversing the main circuit will pass through the diaphragm C and the heat-coil D, the two being connected in series in the said circuit. In case an abnormally strong current should show its presence in the circuit the heat generated by such current while passing through the coil D will be sufficient to expand the air contained in the chamber E and to thereby subject the diaphragm C to pressure. A very

slight degree of pressure will be sufficient to cause the said diaphragm to move out of contact with the projection or contact-piece *b* and into contact with the other contact-piece *b'*. Thus the flexing of the diaphragm under the air-pressure serves to both open the line-circuit and to connect the line with ground. In this way the instruments or apparatus to be protected are cut off from the circuit, and the trespassing current is afforded a path to ground.

With the provision of a chamber at each side of the diaphragm C it will be observed that changes in temperature of the surrounding atmosphere will have no effect whatever upon the said diaphragm, the two chambers tending always to equalize the pressure at opposite sides of the diaphragm.

In Fig. 2 the construction is substantially the same as that shown in Fig. 1 with the exception that a heat-coil G is arranged upon the outside of the casing rather than within the same, and with the further exception that an insulated binding-post *g* is provided for completing the connection between the said heat-coil and the switchboard-wire. An abnormally strong current in passing through this coil G, which is preferably of insulated German-silver wire, will heat the chamber II at one side of the diaphragm I, thereby causing the latter to move out of contact with the contact-piece *h* and into contact with the projection or contact-piece *i*. In this way the line-circuit is broken and the connection to ground is completed, the operation being the same as that already described in connection with Fig. 1, and the two constructions, as stated, being substantially the same, except that in Fig. 1 the coil is inside of the casing, while in Fig. 2 the said coil is wrapped around the outside of the casing.

In Fig. 3 the construction involves a U-shaped tubular casing J, preferably of glass, and containing a sufficient quantity of mercury K. One leg of the said casing contains a heat-coil L, which can be connected with the switchboard and which is provided with a downwardly-extending contact *l*, the latter just entering the surface of the mercury. The other leg of the casing is provided with a contact *j*, normally just touching the surface of the mercury and adapted at its upper end to be connected with the line-wire. Another contact *j'*, normally just out of engagement with the surface of the mercury, is adapted to be connected with a ground conductor. With this arrangement all currents traversing the line-circuit will pass through the wire or contact *j*, thence through the mercury, through the contact *l*, and, finally, through the heat-coil L to the switchboard conductor. Consequently should an abnormally strong current be developed in the circuit the heat generated by the coil L will expand the surrounding body of air contained in the glass casing, and thereby cause the body of mercury to shift out of contact with the wire or contact-piece *l* and into contact with the third contact-piece *j'*. This, as in the other constructions, serves to close or open the line-circuit and simultaneously therewith connect the line with ground. Changes in atmospheric temperature will not cause a bodily shift of the mercury one way or the other, inasmuch as this construction, like the other two, involves a couple of equalizing-chambers M and N, similar to the chambers E and F of the construction shown in Fig. 1.

My improved electrothermal device is not only very sensitive and responsive to currents only slightly in excess of normal, but is also of a self-restoring character—that is to say, it is capable of restoring the circuit to its normal condition upon the cessation of abnormal current—if used as a thermal protector for protecting electrical circuits and apparatus.

It will be observed that the broad idea of my invention is adapted for various purposes and is not necessarily limited to heat-coils or thermal protectors. For example, a heat-concentrating member, a body of expansible fluid, and means responsive to the expansion of said fluid can be employed in various connections—such as relays, circuit closing or opening devices adapted to be controlled at will, and other similar devices. Again, a heat-concentrating member and an expansible medium can be employed as the essential elements of instruments for measuring electrical currents. Broadly considered, my invention contemplates an improved electrothermal device for any and all purposes for which it may be found useful.

In each case it will be seen that I provide a hermetically-sealed chamber containing normally closed contacts. In Figs. 1 and 2 the center of the diaphragm serves as one contact, while in Fig. 3 the surface of the body of mercury is one of the contacts. It will be readily seen that the diaphragm need not necessarily be constructed entirely of conducting material and that various modifications may be adopted without departing from the spirit of my invention. Thus it will be seen that I provide an improved construction involving an advantageous combining of counterbalancing-chambers or bodies of air with internally-arranged switch-contacts, the same all being preferably inclosed or sealed up together in the same inclosure. Also it will be seen that I employ the feature of a chamber divided into two counterbalancing-compartments or bodies of air by a flexible diaphragm. Moreover, my improved arrangement combines the features of internally-arranged contacts and a flexible circuit opening and closing diaphragm, together with a suitable resistance for generating the heat necessary for actuating the diaphragm.

What I claim as my invention is—

1. An electrothermal device for use in protecting electrical apparatus against abnormally strong currents, comprising a flexible metallic diaphragm, a confined body of air adapted to act on said diaphragm, a switch-contact engaging said diaphragm, a heat-concentrating member for heating said body of air, and means for connecting said diaphragm, contact and heat-concentrating member in series in a circuit.

2. An electrothermal device for use in protecting electrical apparatus against abnormally strong currents, comprising a shifting conducting medium, a confined body of fluid adapted to act on one side of said shifting medium, another confined body of fluid adapted to act on the other side of said shifting medium, a contact normally engaging said shifting medium, a heat-concentrating member associated with one of said confined bodies of fluid, means for connecting said heat-concentrating member, contact and shifting conducting medium in series in a circuit, and a ground connection having a contact adapted to engage said shifting conducting medium upon the passage of an abnormal current through said heat-concentrating member, and upon the consequent expansion of the body of fluid associated with said member.

3. An electrothermal switch comprising a flexible metallic diaphragm, a confined body of air adapted to act on one side of said diaphragm, a confined body of air at the other side of said diaphragm, a contact normally engaging said diaphragm, a heat-concentrating member for heating said first-mentioned body of air, and means for connecting said diaphragm, contact and heat-concentrating member in series in a circuit.

4. An electrothermal switch comprising a flexible metallic diaphragm, a confined body of air adapted to act on one side of said diaphragm, a contact inclosed in said body of air and normally engaging said diaphragm, a heat-concentrating member for heating said body of air, and means for connecting said diaphragm, contact and heat-concentrating member in series in a circuit.

5. An electrothermal switch comprising a flexible metallic diaphragm, a metal tube having its interior divided transversely into two compartments by said diaphragm, means for closing the ends of said tube, so as to provide a confined body of air at each side of said diaphragm, an insulated contact normally engaging said diaphragm, a high resistance for heating the air at one side of the diaphragm, and means for connecting said diaphragm, contact and high resistance in series in a circuit.

6. An electrothermal switch comprising a metal tube, a metallic diaphragm dividing the interior of said tube transversely into two compartments, means for sealing the ends of said tube, so as to provide a confined body of air at each side of said diaphragm, insulated contacts mounted at either side of said diaphragm, one of said contacts normally engaging the diaphragm, the other contact being normally out of engagement with the diaphragm, a high resistance wound at or near the part of the tube which incloses the contact normally in engagement with the diaphragm, and means for connecting said diaphragm, normally engaging contact and high resistance in series in a circuit.

7. An electrothermal switch comprising a metallic casing, a flexible diaphragm dividing the interior of said casing into two compartments, insulated contacts suitably mounted at opposite sides of said diaphragm those at one side being normally closed, a high resistance wound at or near and associated with the compartment containing the normally closed contacts, and means for connecting said normally closed contacts in series in a circuit.

Signed by me at Chicago, Illinois, this 19th day of June, 1903.

CHARLES E. WHITE.

Witnesses:

CHAS. HICKOK,

WM. A. HARDERS.