No. 646,691. Patented Apr. 3, 1900.

W. D. GHARKY.

CIRCUIT PROTECTIVE DEVICE.

(Application filed June 16, 1898.)

(No Model.)

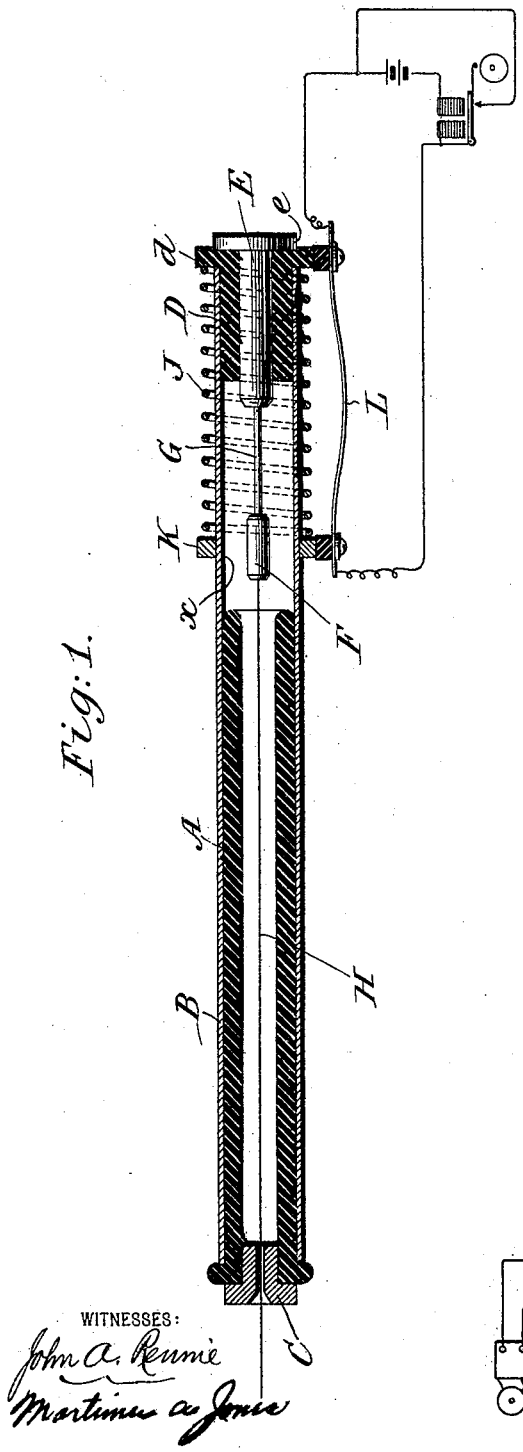

Fig: 1.

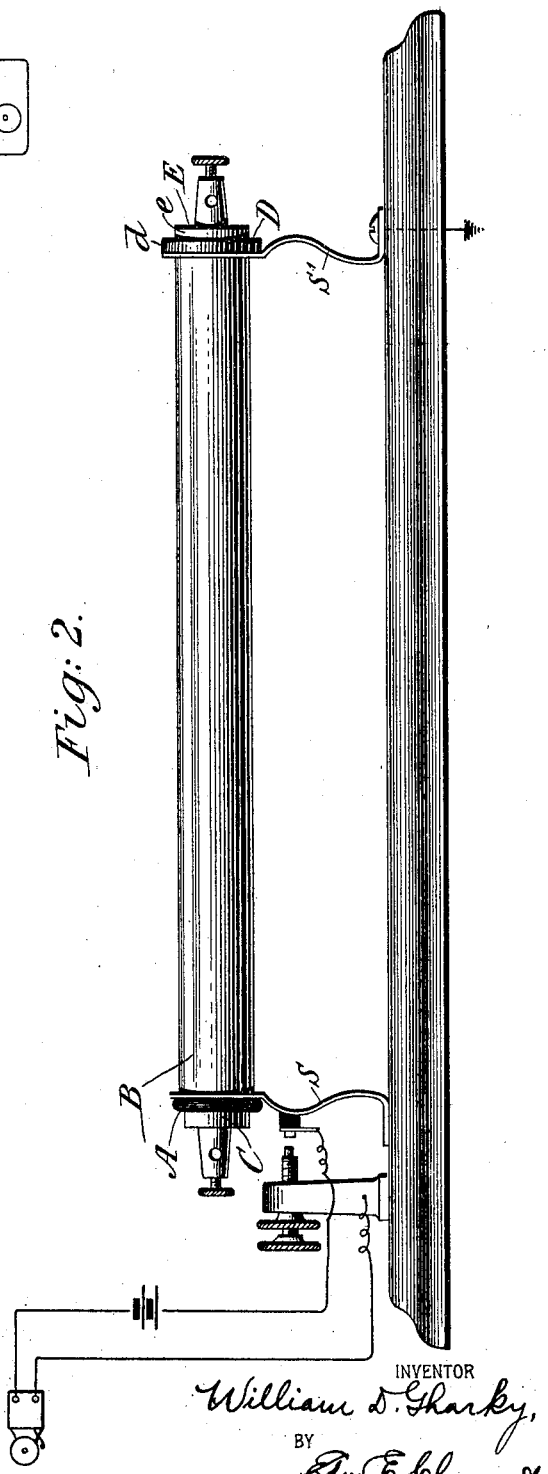

Fig: 2.

WITNESSES:

John A. Rennie

Martimer A. Jones

INVENTOR

William D. Gharky,

BY

Edw. E. Clement.

ATTORNEY.

UNITED STATES PATENT OFFICE.

WILLIAM D. GHARKY, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE SUN ELECTRIC MANUFACTURING COMPANY, OF NEW JERSEY.

CIRCUIT-PROTECTIVE DEVICE.

SPECIFICATION forming part of Letters Patent No. 646,691, dated April 3, 1900.

Application filed June 16, 1898. Serial No. 683,633. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. GHARKY, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a certain Circuit-Protective Device, of which the following is a specification.

My invention relates to devices which are used to protect electric circuits from abnormal conditions produced by atmospheric or accidental causes.

The device is especially intended for use with telephonic circuits, although it will be apparent that it is not necessarily thus limited in its scope.

For the operation of a telephone system currents of comparatively-low potential and volume are employed and the apparatus used is correspondingly designed. It sometimes happens, however, that the lines become accidentally crossed with wires carrying currents of greater magnitude or static charges due to atmospheric disturbance are present on the lines. The delicacy and consequent liability to injury of the telephonic apparatus requires protection which will not only insure its safety against any disturbance of whatever character, but which will be absolutely reliable under all circumstances, and will consequently satisfy the rigid requirements now made by the fire-underwriters. There are three forms of discharge to be provided against in such a device—first, the static or lightning discharge; second, current due to a direct cross with a high-potential circuit; third, a "sneak" current or one which is of such small magnitude as not to blow the lightest sort of fuse, but which when continued for a sufficient length of time will gradually heat the winding of a magnet-spool to the charring-point, finally setting fire to the apparatus. The sneak current is the most difficult to provide against. In designing my protector I have combined the three forms in one piece of apparatus. For the high-potential currents which would find no difficulty in passing through apparatus of medium or low resistance, thereby injuring the same, I provide a fuse, for the static discharges I provide a spark-gap, and for the sneak currents I provide a device which depends for its operation upon what is known as the "Peltier" effect. The operative parts are inclosed within a casing having movable portions which are adapted to be displaced by the sudden expansion of the interior atmosphere, due to the blowing of the fuse by an excessive current. I utilize this displacement to actuate an alarm. The arrangement is such that the same displacement, with the consequent alarm, is caused by the operation of the sneak-current detector or, in fact, by any breaking of the circuit within the tube.

My invention is illustrated in the accompanying drawings, which show the preferred embodiment thereof; but it will be obvious from the above statement that many other forms might be employed without departing from the scope and purview of the invention.

Referring to the drawings, wherein the same letters refer to the same parts throughout, Figure 1 is a longitudinal sectional view of my protector. Fig. 2 is a side view of the same mounted upon a base, showing a modified form of tension-spring.

In the drawings, A is a tube of porcelain or earthenware inclosed within another tube B of brass. Fitted to one end of the porcelain tube, which is provided with a shoulder to rest upon the end of the brass tube, is a brass plug C. This plug is drilled axially to receive the end of a fine brass wire H, the drilled hole being countersunk in order that the outside end of the wire may be soldered to the plug and the solder faced off flush. D is a second and shorter porcelain or earthenware tube, also provided with a shoulder *d* and slipped loosely into the other end of the brass tube B. Upon the outside of the said tube B, I secure an abutment which is shown as a ring or flange K. This furnishes a stop for a spiral spring J, the other extremity of which bears against the shoulder *d* of the tube D, the spring being compressed when the tube D is in place. Fitted within the tube D is a plug E of an alloy to be hereinafter described. This plug is provided with a head *e*, which rests upon the outside of the tube D.

The tubes B, A, and D are of such relative lengths that a space is left within the tube B between the adjacent ends of the two porce-

lain tubes where the brass is internally exposed. I have indicated this exposed portion of the tube by *x*. Within this portion I provide a small cylindrical plug F of the same alloy as plug E. To one end of this plug F is connected the fine brass wire H, while the other end is joined to the plug E by a link or wire G of a material thermo-electrically positive to the alloy of which the plug E and the cylinder F are composed.

With the construction thus far described the operation is as follows, the circuit of the apparatus to be protected being understood to lead into the plug C, through the wire H, the cylinder F, the wire link G, and the plug E: If an excessive current due to a cross between the protected circuit and some wire carrying a high-potential current should enter through this circuit, the wire H will immediately fuse, an arc will be momentarily formed and the expansion of the contained air will blow out one or both of the plugs C and D. This expansion is sufficiently violent to shatter the porcelain tube if it were not reinforced by the inclosing brass tube, and the length of this porcelain tube within the brass tube, which is sufficient almost entirely to close the fuse-wire H, effectually prevents the arc from traveling back along the inside of the brass tube to cause a general fusion. If, on the other hand, a sneak current should enter on the circuit, a separation of the same will take place between the parts F and E. These two parts themselves are formed of an alloy composed of two parts of antimony and one part of zinc. The connecting-link G is of bismuth. Obviously these materials may be relatively interchanged without affecting the result. These parts are secured together by solder and their separation by the passage of a sneak current depends upon the principle known as the "Peltier" effect—that is, when two metals possessing relatively positive and negative thermo-electric values are united in series by solder a current from an external source in passing through the junction from positive to negative metal will cool it. When, however, the current flows in the reverse order—that is, from negative to positive—the junction is heated. This heating is much greater than that traceable to the ordinary Joule effect. Moreover, the heat is concentrated directly at the point of union of the two metals. It is obvious that a sneak current passing in either direction upon the circuit will produce the effect desired, for the reason that I have an electropositive metal inserted between two portions of electro-negative metal, or vice versa. Thus one junction is always certain to be heated until the solder melts and permits a separation under the action of the spring J.

Electrostatic charges are enabled to pass off to ground by means of the tube B, which is grounded. The cylinder or plug F is centered within the exposed portion of this tube, as shown, and the air space or clearance between it and the tube is so proportioned as to constitute a proper gap. It is obvious that other shapes than that shown may be given to the plug or cylinder F, and points or edges may be formed thereon, if desired.

Referring to Fig. 2, my protector is shown mounted upon a base, with the spring J omitted. In order to obtain a constant opposite tension upon the plugs C and D, I make the supports S S′, upon which the tube is mounted, of spring metal, with a strong tendency to move in opposite directions. One or both of these springs S S′ should be connected to the ground. The operation of the device in this form is obviously the same as that described in connection with Fig. 1.

In order that any operation of the protector which results in opening the circuit shall call the attention of the subscriber or the operator, as the case may be, I provide a local-alarm circuit controlled by the movable parts C and D. In Fig. 1 the alarm is a closed-circuit alarm, in which a portion of the alarm-circuit consists of a lead wire L, attached at one end to the insulating-plug D in any suitable manner and at the other end to the tube B, insulation being interposed at one or both of these connections. Obviously when the plug blows or is forced out of the tube the lead wire will be broken, and the signal being thus placed upon an open circuit will operate. In Fig. 2 I have shown an open-circuit alarm, the wires from which are led to contacts carried upon the base and one actuating-spring S of the protector, respectively. Obviously as long as the circuit is intact these are held separated, but the destruction of the integrity of the connecting means between the plugs C and D will permit these contacts to close and sound the local alarm. In mounting the protector, as shown in Fig. 2, I conduct my protected circuit through the tube either by means of binding-posts upon the plugs C and E or light contact-springs or terminal straps attached thereto in any suitable manner.

The structure I have described and the employment of the Peltier effect for this purpose permits an adjustment for any given set of conditions very much more delicate and accurate than any which has heretofore, to my knowledge, been obtained. It is obvious that inasmuch as the increase in heating effect due to a rise in current in the circuit is in very much greater ratio than a similar increase in accordance with the Joule principle ordinarily employed a very satisfactory adjustment of the point at which the parts F, G, and E will separate is possible, and this by simply changing the sectional area of the wire link G at the junctions. So far as I know I am the first person to employ the Peltier effect in apparatus of this character, and I therefore claim the same, broadly, as my invention. Its use enables me to dispense with the heat-coils that are now the only satisfactory agents for the detection of and protec-

tion against sneak currents and to make a complete, simple, and self-contained piece of apparatus that in spite of its simplicity is susceptible of accurate adjustment.

The wire H is included to give length to the entire fuse, as the bismuth or other material employed for the thermo-electric couple has insufficient tenacity to be drawn out in a wire sufficiently fine to insure quick action. This wire H, I make of spring-brass, because that material will fuse on short circuit with less explosive effect than any other metal that I have tried.

Having now described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. A fuse for the protection of electric circuits against disturbing-currents, consisting of a thermo-electric couple, substantially as described.

2. In a circuit-protector, a separable section forming a part of the circuit to be protected and composed of two or more portions of materials that are thermo-electrically positive and negative with relation to each other, substantially as described.

3. In an electric-circuit protector, a casing, and a fuse therein, a portion of the length of the fuse consisting of a thermo-electric couple, substantially as described.

4. In a circuit-protector, an inclosing casing, a fuse contained therein, portions of said fuse being composed of thermo-electrically positive and negative materials connected to form a couple, a part or parts adapted to be displaced, but normally retained in place by the fuse, and an alarm actuated by the said displacement, substantially as described.

5. In an electric-circuit protector, a tubular metallic casing, a fuse axially housed therein, and a non-combustible insulating tubular shield surrounding a portion of the length of the fuse between the fuse and casing, substantially as described.

6. In an electric-circuit protector, a metallic casing connected to ground, a continuous fuse housed therein, part of said fuse composed of a thermo-electric couple, and a spark-gap between a portion of the fuse and the casing, substantially as described.

7. In an electric-circuit protector, a metallic tube connected to ground, a fuse therein consisting in part of thermo-electric elements joined to form a couple, non-combustible insulating material between portions of the tube and fuse, and a spark-gap between the relatively-exposed portions thereof, substantially as described.

In testimony whereof I have hereunto set my hand, this 3d day of June, A. D. 1898, in the presence of two witnesses.

WM. D. GHARKY.

Witnesses:
MORTIMER A. JONES,
CHARLES F. TREGO.