No. 736,019. PATENTED AUG. 11, 1903.

W. L. RICHARDS.

PROTECTIVE FUSE APPARATUS.

APPLICATION FILED JULY 26, 1902.

NO MODEL.

Fig. 1.

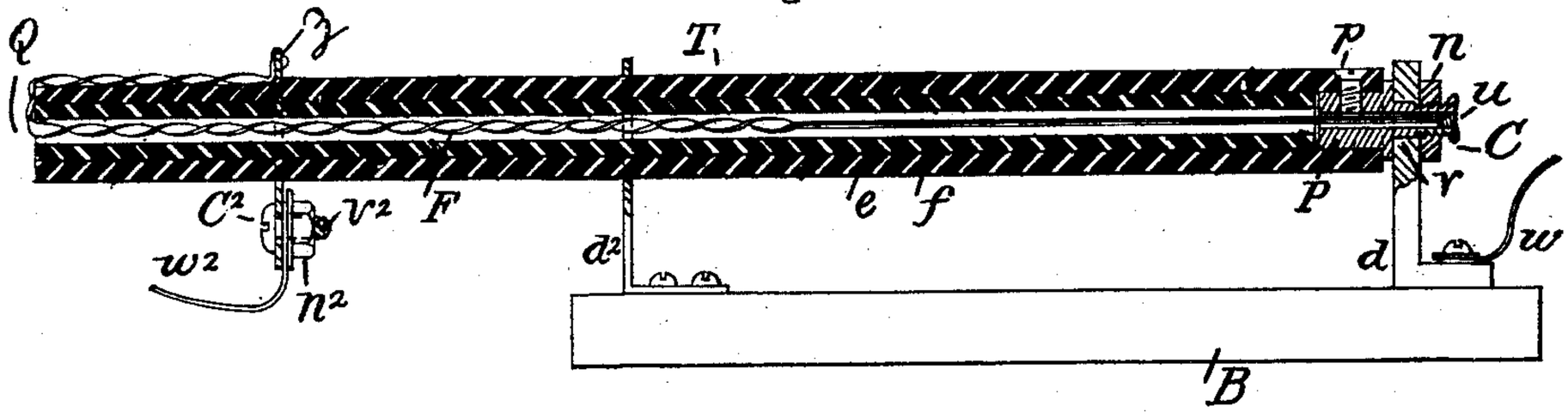


Fig. 2.

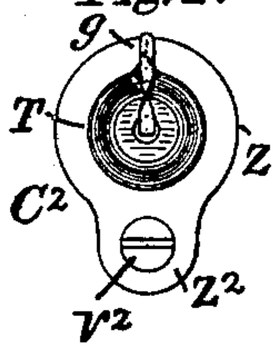


Fig. 3.

Fig. 4.

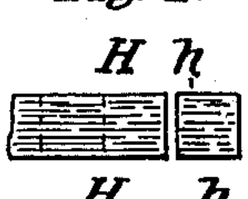


Fig. 5.

Fig. 6.

Fig. 7.

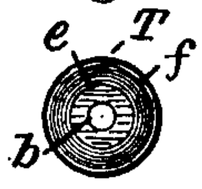


Fig. 3ª.

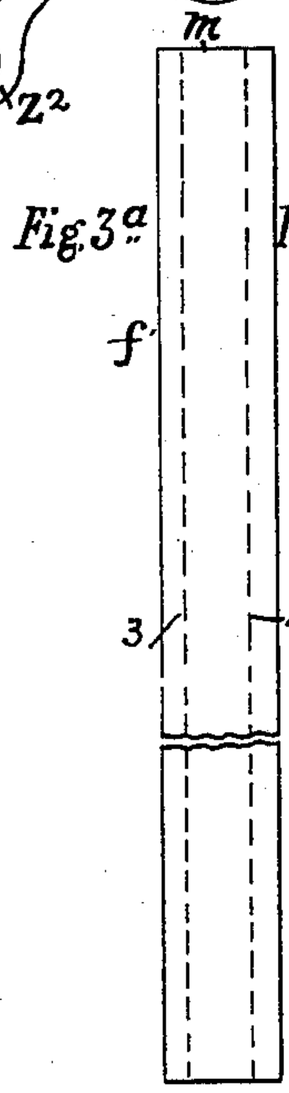


Fig. 4ª.

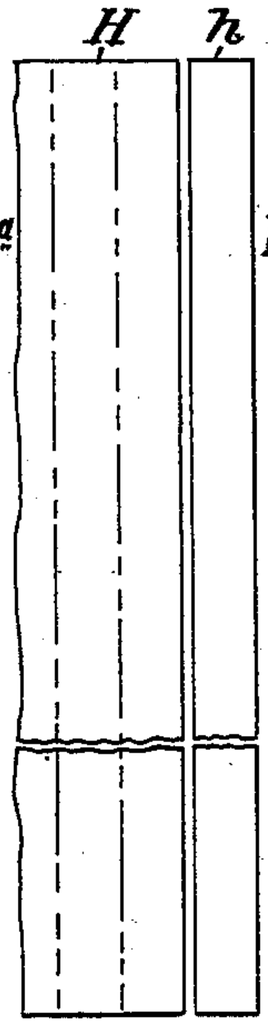
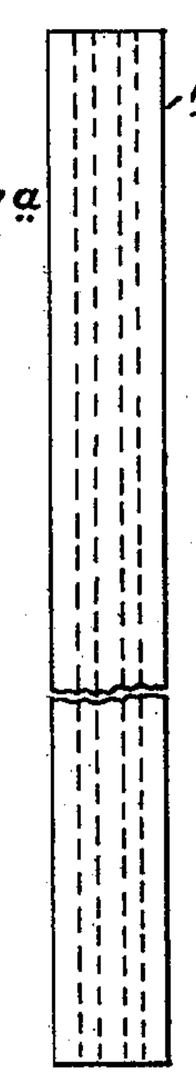


Fig. 5ª.

Fig. 6ª.

Fig. 7ª.



WITNESSES:

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No. 736,019. Patented August 11, 1903.

UNITED STATES PATENT OFFICE.

WILTON L. RICHARDS, OF MALDEN, MASSACHUSETTS, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

PROTECTIVE FUSE APPARATUS.

SPECIFICATION forming part of Letters Patent No. 736,019, dated August 11, 1903.

Application filed July 26, 1902. Serial No. 117,098. (No model.)

To all whom it may concern:

Be it known that I, WILTON L. RICHARDS, residing at Malden, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Protective Fuse Apparatus, of which the following is a specification.

This invention relates to protective fuses which are adapted to be employed either alone or in association with other appliances for the protection of cables and electrical apparatus from the destructive or damaging effects of any trespassing electric currents of abnormal strength which may temporarily traverse a given circuit by reason of crosses or contacts with other circuits or of some other undesigned cause. It is necessary that fuse-protectors thus employed shall be of such length that on their fusion or vaporization there shall not be any liability to the formation or persistency of an arc and highly desirable that the containing or inclosing tube or tubular casing thereof shall be strong enough to successfully resist the stress of the melting or vaporization of the fuse, so that it will not break or be shattered when the said fuse is operated, since the breaking of the casing into fragments at the moment of fusion is liable to reintroduce destructive or alarming effects identical with or similar to those which the protective device is intended to forestall. Heretofore and prior to this invention it has not been difficult to meet these requirements in a fuse device for telephone-circuits, since the heavy currents to which reference has been made have been developed under moderate potentials, and it has been sufficient to provide a fuse of, say, four inches long in an insulating or inclosing tube of vulcanized fiber regardless generally of the thickness of the walls or the size of the bore of said tube. The employment of extremely high potential or voltage on lighting and power circuits ranging, say, from thirteen to fifteen thousand volts has, however, lately become quite general, and the problem of providing a suitable and efficient protecting-fuse meeting the requirements has thus been reopened under new and changed conditions, it having become evident that a much longer fuse inclosed in a tube adapted to successfully resist much greater lateral strains or stresses has become essential. The mere elongation of the fuse proper constitutes an obvious step in the required direction; but the production of a tube of insulating fiber not materially larger externally, but with walls sufficiently thick and strong to successfully resist the lateral thrust or strain accompanying the disruption of a circuit conducting a heavy current under the said high potentials, and therefore a tube with thick walls and a small bore, was found to be a very difficult matter. It was found that a vulcanized-fiber fuse-tube of the type previously associated with the four-inch fuse was entirely too fragile and could not be relied upon for successful employment in telephone-circuits exposed to the attacks of the high voltages mentioned above. It was also found impracticable to form vulcanized-fiber fuse-tubes with walls of the thickness and bore of the smallness required by the mode in which fiber tubes had previously been made—viz., by rolling or winding thin strips or sheets of fiber on a mandrel of the requisite small size—for the reason that after several turns had been made the said strips or sheets invariably developed a marked tendency to roll or wind unevenly, so as to preclude the formation of a compactly-constituted structure, and would inevitably buckle or crinkle, producing a non-uniform succession of partly-corrugated layers and a lack of homogeneity throughout, which utterly prevented the manufacture of a regularly-formed, strong, and trustworthy tube. Under these conditions it was sought to make tubes of proper size, bore, wall thickness, and lateral strength by cutting suitably-thick sheets of vulcanized fiber into stout rods and by drilling a hole of the size required longitudinally through said rods. When, however, these rods were made into fuse-tubes and subjected to a practical test, they proved to be entirely devoid of strength laterally, so that on the operation of the fuse they were violently shattered into fragments or burst open laterally, it becoming then evident that

this mode of formation could not be successfully employed, since the original sheets being made up of successive thin sheet-layers the slicing of such original sheets into rods so greatly reduced the width of the successive layers as to deprive them of mutual coherency and bring them into a condition where, being without external support, they are easily and violently thrust apart by the forces causing and consequent upon the operation of the fuse-strip.

The object of the present invention is to provide protective fuses of great length with inclosing tubes or tube-casings of small bore and of sufficient strength to resist the lateral and other strains resulting from the operation of the fuse under high-potential conditions, and thereby to increase the efficiency of protective fuse apparatus designed to guard cables and apparatus against the destructive effects of heavy currents developed under such high potentials.

To this end the invention consists in a fuse-tube or tubular casing of vulcanized or insulated fiber with thick walls and small bore, the same being built up or composed of two component tubes tightly fitted one within the other, the inner tube having the small bore desired, and in a method of manufacturing such double-wall vulcanized-fiber tubes.

It also consists in a protective fuse appliance wherein a long fuse strip, ribbon, or wire is combined with a double-wall vulcanized-fiber fuse-tube or tubular casing open at one end and closed at the other, the said fuse-wire being thinner at or near the closed than at the open end and being turned back over the exterior of the casing at the said open end thereof to a terminal mounted on said external surface at some distance back from said open end, so as to be out of the line of discharge from the said open end accompanying the operation of the fuse.

In the drawings, which accompany and illustrate this specification, Figure 1 is a longitudinal section of a fuse appliance containing the invention, the same being mounted upon a suitable base or support. Fig. 2 is a representation of the open end of the appliance shown in Fig. 1. Figs. 3 and 3ª are end and side views, respectively, of the outer member of the tubular fuse-casing shown in Fig. 1. Figs. 4 and 4ª, respectively, are end and side views of a piece of vulcanized insulating fiber of which the inner tube may be made and, taken in connection with Figs. 5 and 5ª, which are end and side views of the rod cut from said fiber sheet after it has been rounded, and with Figs. 6 and 6ª, which are similar views of said rod with a hole or bore drilled through it, illustrate the method of forming the inner tube described herein. Figs. 7 and 7ª represent end and side views of the finished compound fuse-tube formed by tightly fitting one tube within the other.

As hereinbefore indicated, the employment of inclosing tubes of vulcanized fiber with thick and strong walls and a bore of small internal diameter has recently become desirable. When it was attempted to make them in the ordinary and well-known way of winding or rolling a strip or sheet of fiber, it was found that the difficulties of making a practically satisfactory tube by such a method were apparently insuperable. By my invention, however, which provides that the fuse-tube T shall be built up or composed of two distinct vulcanized-fiber tubes *e* and *f*, the inner tube *e* having a bore of the small size required and the outer tube *f* being externally of convenient size—say one-half of an inch in diameter—the said difficulties are overcome.

The outer tube has a comparatively large bore, one with a diameter of one-quarter of an inch, or thereabout, being convenient. With a bore of this size there is no particular difficulty in rolling or winding fiber into a tube of ordinary size. Accordingly Figs. 3 and 3ª represent the exterior tube *f*, so made by winding or rolling the fiber strip or sheet around a mandrel until a tube of substantially the dimensions shown is produced. The bore *m* and its size and the thickness of the wall of the tube are indicated in Fig. 3ª by broken lines 3 and 4.

In forming the smaller tube *e* a rod *h* of approximately square cross-section is cut from a sheet or strip H of vulcanized fiber of appropriate thickness, and after being rounded by a circular cutting-machine in a manner well understood is driven or forced into the bore *m* of the outer tube *f*. The small inner bore is then made by drilling longitudinally through the said rod thus placed within the tube *f*. If desired, the rod *h*, rounded as shown in Figs. 5 and 5ª, might be drilled through, as shown in Figs. 6 and 6ª, before being forced into the exterior tube. In Fig. 6ª the bore *b* of the tube *e* is indicated, as in the case of the larger tube, by broken lines.

Figs. 7 and 7ª show the interior and exterior tubes disposed concentrically, the one tightly fitted within the other, forming conjointly the finished compound fuse-holding tube or tubular casing T, which has the thick and strong walls and small bore desired.

I have found a fuse-tube seven inches long and formed of component tubes having external diameters of one-half and one-quarter inch, respectively, with an internal diameter of about one-eighth of an inch to answer well.

In Fig. 1, B represents a base-board, of wood, hard rubber, insulating fiber, or like material, upon which the fuse protective apparatus may be mounted. T is the fuse-tube, supported on said base-board by means of brackets *d* *d*², the same being formed, as described,

of the interior and exterior tubes *e* and *f*, concentrically arranged and fitting tightly together one within the other. F is the fuse ribbon, strip, or wire (a ribbon cross-section being preferred) inclosed in the tube T and connected with the circuit-wires *w* w^2 by means of terminal connections presently to be described. The fuse-tube T is closed at one end by the metal plug P, secured in any desired manner, as by a set-screw *p*, and is open at its other end Q. The metal plug P has a screw-threaded extension *v*, which passes through the bracket *d*, being secured on the other side thereof by a nut *n*, and may have its end upset, as at *u*, to prevent the detachment of said nut. The said metal plug, its extension *v*, and nut *n* together constitute one terminal connection C for the fuse, and the circuit-conductor *w* may be attached either, as shown, to the bracket *d* or directly to said screw extension by being placed between the upper end of said bracket and the nut *n*. The other terminal connection, C^2, for the fuse-conductor is set back a short distance, as shown, from the open end of the tubular casing and is altogether on the outside of the insulating-tube. It may be made in various ways, a satisfactory form being indicated in Figs. 1 and 2. Here a thin plate *z*, with a central hole adapted to tightly encircle the fuse-tube and originally split at *g*, so that it can readily be sprung upon said tube, is shown as being employed. When placed in position, the sides of the split may be joined by a drop of solder, and a screw v^2 and nut n^2, passing through a small hole in the projecting portion z^2, afford facilities for the attachment of the circuit-conductor w^2. One end of the fuse F is conductively attached within the tube to the metal plug P, and thereby to terminal connection C, and the other end passing out of the open end of said tube is led back therefrom over the exterior surface of the tube T and is conductively attached in any preferred manner, as by soldering, to the second or complementary terminal connection C^2. The fuse-ribbon is thinner or is of lesser cross-section in that portion of its length extending from its connection at the closed end of the tube for a distance of three inches or thereabout, but is thicker for the remainder of its length. This is conveniently arranged by providing that the fuse-conductor shall consist of a single ribbon-section of appropriate area for the said desired distance from the closed end of the tube, but shall be formed of two such ribbons twisted together from the end of such single section to the complementary terminal connection. The effect of this feature of construction is that the fuse will operate first at the attenuated portion or at that portion of the tube near its closed end and will thus develop a strong blast, discharging through the open end of said tube with very considerable propulsive force, discouraging the formation of an arc and tending to extinguish any arc which momentarily may be formed.

The position of the complementary terminal fuse connection on the outside of the casing and some distance back from the end thereof is also of advantage, for should any arc be formed for an instant when the fuse operates it will have little or no tendency to follow the fuse-conductor around the sharp turn to the said outer terminal, where it might establish itself between the two terminals, but will readily yield to the propulsive force of the discharge, which is exerted in a straight line, constituting a continuation of the line of the bore of the inclosing tube.

Having now fully described the invention, the same is claimed as follows:

1. As a new article of manufacture, a non-conducting fuse-tube or tubular casing having a small bore and comparatively thick walls, comprising an exterior tube made of a wound or rolled strip of suitable insulating material and an inner separately-formed tube of suitable insulating material closely and securely fitting within the exterior tube and having the desired small bore.

2. A compound cylindrical tube for the purpose specified formed with a small central bore, and comparatively thick walls, and composed of an outer tube made of a wound strip of insulating fiber, and an inner tube of like insulating material, within and tightly fitting the said first-named tube.

3. In a fuse device for electric circuits, a compound cylindrical fuse-inclosing tube having a small central bore and comparatively thick walls, and comprising an exterior tube made of a wound or rolled strip of vulcanized fiber, and an inner vulcanized-fiber tube with the said small central bore forced into the said exterior tube and tightly fitted thereto, substantially as set forth.

4. A non-conducting fuse-tube or tubular casing having a small bore and comparatively thick walls, comprising an exterior tube made of a wound or rolled strip of suitable insulating material and an inner tube cut from a block or piece of suitable insulating material fitted closely and securely within the exterior tube and having the desired small bore.

5. In a protective device for electrical circuits, the combination with a fuse wire or ribbon having a relatively attenuated portion near one of its ends; with a double-wall inclosing tube or tubular casing of vulcanized fiber formed of two distinct tubes one within the other, the said casing being open at one end, closed at the other by a conducting-plug forming a terminal connection, and having a complementary terminal connection upon its outside for the said open end but at a short distance therefrom; the said fuse wire or ribbon being mounted within said tube with its attenuated portion at the closed end thereof,

and conductively attached to the said plug terminal connection within the said tube; and its thicker portion extending from the attenuated portion to the open end of said tube, turned back over the exterior thereof and attached to the said complementary terminal connection, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 21st day of July, 1902.

WILTON L. RICHARDS.

Witnesses:
GEORGE P. BARTON,
HAROLD J. WRIGHT.