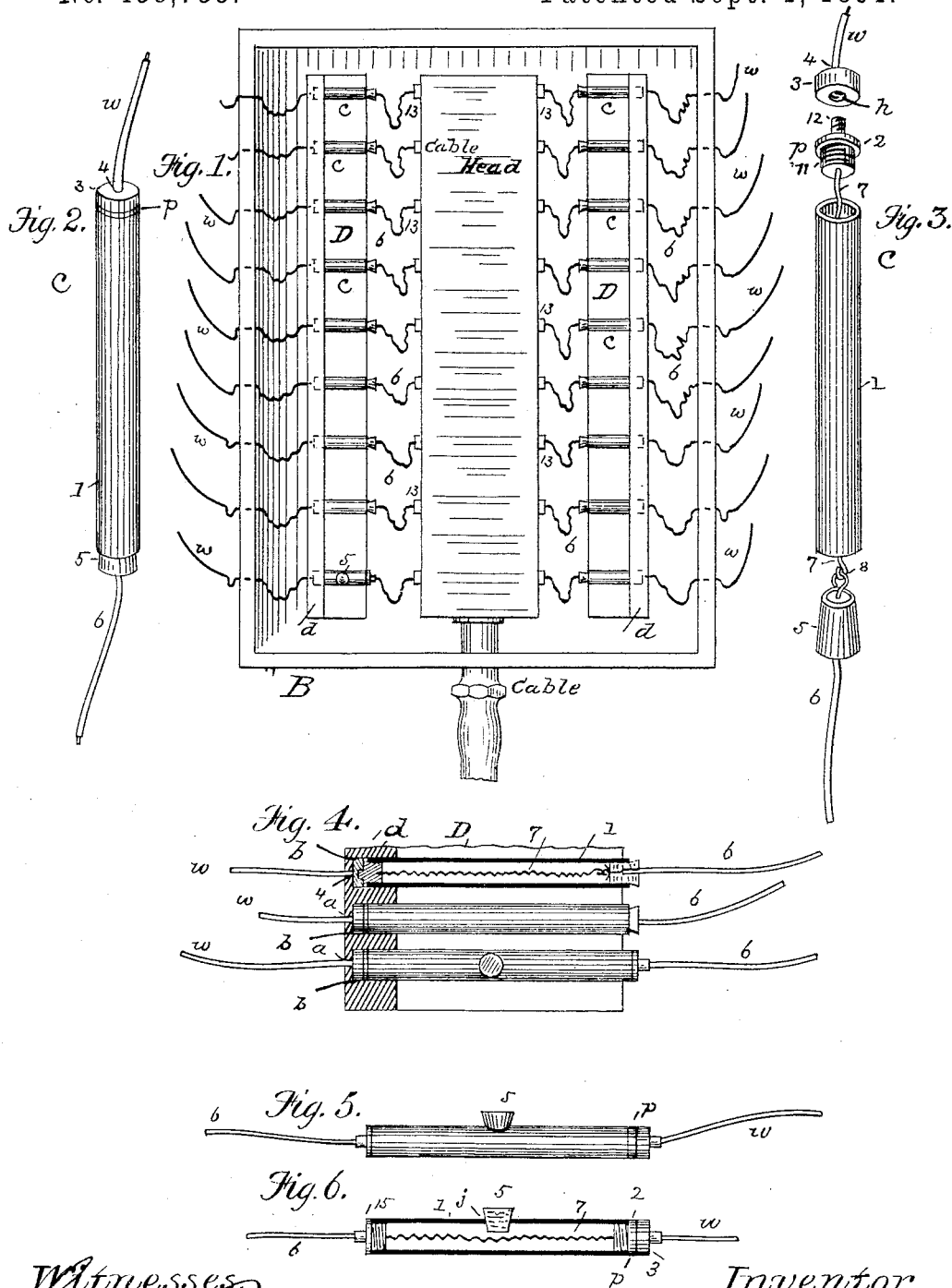


(No Model.)

H. V. HAYES & A. C. WHITE.
PROTECTIVE FUSE.

No. 458,753.

Patented Sept. 1, 1891.



Witnesses,
Orville Pierce
V. M. Barthold

Inventor,
Hammond D. Hayes
Anthony C. White.

UNITED STATES PATENT OFFICE.

HAMMOND V. HAYES, OF CAMBRIDGE, AND ANTHONY C. WHITE, OF BOSTON,
ASSIGNORS TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON,
MASSACHUSETTS.

PROTECTIVE FUSE.

SPECIFICATION forming part of Letters Patent No. 458,753, dated September 1, 1891.

Application filed May 25, 1891. Serial No. 393,983. (No model.)

To all whom it may concern:

Be it known that we, HAMMOND V. HAYES, residing at Cambridge, in the county of Middlesex and State of Massachusetts, and ANTHONY C. WHITE, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Protective Fuses, of which the following is a specification.

This invention relates to protective fuses which are adapted to be used either alone or associated with other appliances for the protection of cables and electrical apparatus from the destructive or injurious effects of any trespassing electric currents of abnormal strength which may temporarily traverse a given circuit by reason of contacts with other circuits or of some other undesigned cause. A protective fuse in practice is required to melt and thereby open the circuit when a sufficiently strong current passes, and is arranged to operate below the point of actual danger.

It has been found that fuses now in use are in some respects imperfect and untrustworthy. Many do not make the gap in the circuit caused by their fusion of sufficient width to be serviceable, while in a majority of cases no way is provided to counteract and render innocuous the strong tendency to establish a dangerous electric arc or flash at the moment of fusion, which is inseparable from the operation of apparatus of this character.

The object of this invention is to provide a protective fuse in which there is no danger of the establishment of an arc or destructive flash between the several wires or between the fittings of one or more fuses.

To this end the said invention comprises a protective appliance having the fusible part fitted in a case, which in operation completely incloses the fuse until it is vaporized or volatilized and until the air contained in said case is intensely heated, means for violently discharging the said mixture of intensely-heated vapor and air at the proper time, whereby an arc is either prevented altogether from forming, or, in case of its incipient formation, is at once blown or sucked out by the violence of said blast, and certain constructive features whereby the desired result of safety under all

circumstances is insured. One of the said features is the arrangement of the appliance in such a way that on the entering side no metal surface is exposed to co-operate with escaping vapor in the formation of an arc; another is the combination, with the fuse-casing, of a projectile adapted to be discharged therefrom upon the vaporization of the fuse and to allow of the forcible escape of the said vapor in a harmless direction; and a third consists in attaching the wire leading from the fuse inwardly to the said projectile, so that when the said projectile is discharged the wire attached thereto shall be propelled to a considerable distance and the danger of forming an arc further minimized.

The several figures of the drawings clearly disclose the characteristic features of the invention.

Figure 1 shows a portion of a cable-terminal box into which a number of circuit-conductors enter, each being provided with a protective fuse. Fig. 2 is a perspective view of one of the said fuse appliances. Fig. 3 is a similar appliance, partly dissected to show its formation. Fig. 4 is a detached view of three of the fuses in position, and Figs. 5 and 6 are respectively a side view and a longitudinal section of a modification of the said fuse appliance.

Referring first to Figs. 1, 2, 3, and 4, which show one form of fuse *c* separately and in place, the fuse wire or strip proper 7, made of any predetermined size to carry a given current and of suitable easily-fusible metal or alloy, is inclosed in a tube 1, of glass, hard rubber, or other suitable non-conducting material, which has a metal plug *p* tightly fitted to its outer end. If the tube be of glass, the plug can be affixed by means of plaster-of-paris; but if made of material which can be threaded it may properly be secured by a screw-thread, as indicated in Fig. 3, where the plug is threaded at 11 to fit a corresponding thread in the end of the tube, is widened out by a collar 2, which screws down upon and closes the end of the tube, and ends outwardly in a threaded projection 12. This plug *p* fits the tube so closely as to be capable of standing great pressure without being detached

therefrom and without allowing the passage of gas from the end of the tube which it closes. To complement the said plug *p*, a cylindrical button of metal is soldered or
 5 brazed at 4 to the end of the incoming bridle-wire *w*, and at its opposite side, which is a plane surface coinciding with the upper surface of the collar 2, a hole *h* is bored, of depth sufficient to take in the whole length of the
 10 plug end 12, and is tapped to fit the screw of the same, so that when the plug *p* is screwed into the button 3 the under surface of 3 closely fits the outer surface of *p*, as shown in Fig. 2. The other end of the fuse 7 is secured
 15 directly by soldering at 8 to a short bridle-wire 6, which may lead directly to the binding-screw, as at 13, on the cable-head, or to any apparatus to be protected. The said bridle-wire 6, which is insulated, passes through an
 20 elastic stopper 5, which fits closely but detachably into the other end of the fuse-tube 1.

In Fig. 3 the several component parts (to facilitate explanation) are shown as pulled apart; but in Fig. 2 the complete appliance *c*
 25 is shown as being put together and fitted at one end with the short bridle-wire 6 and at the other with a fragment of the incoming line-wire *w*.

In practice the wire *w*, representing the
 30 line-wire, might and preferably would extend without splice from the fuse-button 3 through the wall of the distributing-box B and would be insulated. Brass has been found to be a suitable material for the plug *p* and button 3.

A cork of proper size may advantageously
 35 be employed as the elastic stopper 5; or, if desired, a rubber stopper may be used.

The fuse *c*, when mounted as shown in Figs. 1 and 4, is supported with its outer end, including the brass plug and button drawn into
 40 a socket *b*, countersunk into a bar of hard non-conducting material—such as vulcanized fiber, hard rubber, or hard wood—which thus forms an envelope for the metal surfaces, completely inclosing them. The incoming wire
 45 *w* passes through a hole *a*, leading through the non-conducting bar from the said countersink, the said hole being just large enough for its admission. A large number of wires enter
 50 the box B, in which is inclosed the cable-head, and the protective fuses *c* may be arranged in rows, as shown upon the board D, the bar *d* being affixed to one edge of said board. The instrument then, it will appear, is so
 55 arranged that on the entering side no metal whatever is exposed, and the liability of the formation of an arc between these several wires thus is prevented. Such an arc ordinarily will not form unless the vapor of the melting
 60 and volatilizing fuse metal is permitted to have access to the metal portions of incoming conductors. Inasmuch as the incoming bridle-wires are insulated as they pass through the close-fitting fiber-bushing, and as their terminal-plugs and the ends of the fuses attached thereto are completely covered by the
 65 substance of the non-conducting bar, while

the plug in the end of the tube fits so closely that no vapor can escape, the protection afforded by the appliance against the establishment of arcs is very efficient.

In Figs. 5 and 6 the metal plug *p*, having the collar 2 and complementary button 3, is fitted as before in the outer end; but the inner end of the tube 1, instead of having the
 75 elastic plug fitted to it, has another metal screw-plug 15, to which the short bridle-wire 6 may be directly soldered; but in this modification a perforation is made at *j* in the side of the tube 1 at any point about the center,
 80 and in this hole *j* the elastic stopper is tightly fitted. In mounting this form of fuse the hole *j*, with its stopper, should be turned to face the front of the box, for the said stopper
 85 in both forms is blown out when the fuse is burned out or volatilized. As long as the normal current only circulates in the circuit the fuse remains, of course, inoperative. When
 90 an abnormally or dangerously strong trespassing current comes on the line, the fuse-wire is melted and wholly or in part vaporized. Becoming thus volatilized and the air inclosed in the tube becoming heated to a high temperature, considerable expansion
 95 supervenes and the stopper 5 is projected from the end of the tube with considerable violence, in the case of the form first described serving as a projectile to throw the
 100 end of the inner bridle-wire 6 away from the tube, and thus to separate widely the severed ends of the circuit, and in both cases to establish a momentary strong air or vapor
 105 blast, which acts to blow out or suck out any arc, flash, or flame which may tend to form, and also by the same act to discharge the major part of the mixed vapor which tends to sustain such an arc.

I claim—

1. A protective appliance for electric circuits and apparatus, comprising a fuse wire
 110 or strip, a tight non-conducting case therefor, means, as indicated, for including the said fuse in an electric circuit, and a detachable stopper for said fuse-case adapted to be discharged therefrom on the destruction of the
 115 said fuse, substantially as and for the purposes specified.

2. A protective appliance for electric circuits and apparatus, comprising a fuse wire
 120 or strip, suitable connections for including the same in the circuit to be protected, a tight non-conducting case therefor closed at the ends, but adapted to permit the passage of said connections, and a protecting envelope or socket surrounding the outer end of
 125 said case and the electric connecting devices passing therethrough, whereby the exposure of metal surfaces is prevented, substantially as described.

3. In a protecting appliance for electric circuits, the combination of a section of easily-fusible conductor, a sealed inclosing casing
 130 or envelope therefor adapted to completely inclose the said conductor until the same is

vaporized, a metal screw connection closing the said casing at its outer end and uniting the said fuse with the main-circuit conductor, and a detachable stopper normally closing the said casing, but adapted to be forcibly expelled therefrom upon the fusion or vaporization of said fusible conductor, and thereby to permit the escape of the heated vapors in a strong blast, substantially as described, and for the purposes set forth.

4. The combination, in a fusible protector, of a non-conducting casing closed at both ends, a fusible conducting wire or strip inclosed therein and adapted to be included in the circuit, a metal screw-plug constituting the connection between the line conductor and the outer end of the fuse and serving to close the outer end of said casing, and a non-conducting socket for the said screw-plug surrounding the metal surfaces thereof.

5. The combination, in a fusible protector, of a section of conductor adapted to fuse or vaporize upon the passage through it of a current of abnormal strength, a non-conducting casing therefor, a metal screw-plug united to the outer end of said fusible conductor, constituting the connection between it and the line conductor and serving to close the outer end of the casing, a non-conducting socket or envelope for the said screw-plug surrounding the metal surfaces thereof, a stopper for the inner end of said casing, and an electrical conductor connected with the inner end of said fuse and passing therefrom inwardly through the said stopper, substantially as described.

6. In a fusible protector, the combination of the fuse-wire with a non-conducting casing therefor, a metal plug permanently closing the outer end thereof and serving as an intermediate connection between the fuse and the line-wire, and a stopper of cork or similar elastic material normally closing the inner end of said casing, but adapted to be discharged therefrom upon the fusion or vaporization of the said fuse-wire, and by the blast so produced to oppose the formation of arcs and to extinguish promptly any which may form.

7. In a fusible protector, the combination, substantially as hereinbefore described, of the fuse-wire and a non-conducting casing surrounding the same closed permanently at

its outer end by a metal plug serving as a connection between the line-wire and the fuse and at its inner end normally by a cork or similar elastic stopper supporting the inner circuit-wire and permitting the passage thereof into the casing for attachment to the said fuse, the said stopper being adapted to be projected forcibly from the said casing on the operation of said fuse and to carry with it the wire attached thereto, thereby producing a wide separation between the two severed ends of the electric circuit, substantially as described.

8. In a system for protecting electric cables or apparatus from abnormally strong electric currents by means of fuses, the combination of a series of fuses, each surrounded by a separate non-conducting casing closed at its outer end by a metal plug serving also as the connection between the fuse and the line-wire, and a non-conducting supporting-bar for the said casings, the said bar being bored into sockets in which the metal plug ends of the said casings respectively rest, whereby the metal surfaces of each are completely inclosed, substantially as described.

9. A protective fuse appliance consisting of the fusible wire proper, a tubular conducting case therefor, a metal screw-plug permanently closing the outer end thereof, united within the said case to one end of the said fuse, and having externally a screw-threaded projection, a metal button connected with the line-wire and adapted to be screwed to the said projection, a perforated stopper of cork or like material closing the inner end of the said case, an inward-leading circuit-wire passing through the said stopper and uniting within said case to the other end of said fuse, and a non-conducting socket surrounding the metal surface of the screw-plug, closing the outer end of the fuse-casing, substantially as specified.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 22d day of May, 1891.

HAMMOND V. HAYES.
ANTHONY C. WHITE.

Witnesses:

GEO. WILLIS PIERCE,
V. M. BERTHOLD.

It is hereby certified that in Letters Patent No. 458,753, granted September 1, 1891, upon the application of Hammond V. Hayes, of Cambridge, and Anthony C. White, of Boston, Massachusetts, for an improvement in "Protective Fuses," an error appears in the printed specification requiring correction, as follows: In line 80, page 3, the word "conducting" should read *non-conducting*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 22d day of September, A. D. 1891.

[SEAL.]

CYRUS BUSSEY,
Assistant Secretary of the Interior.

Countersigned:

W. E. SIMONDS,
Commissioner of Patents.