Nov. 6, 1923. 1,473,284

F. A. FELDKAMP

ELECTRIC FUSE ELEMENT

Filed May 17, 1921

Fig. 1

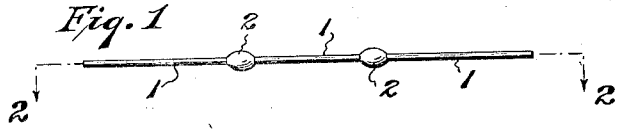


Fig. 2

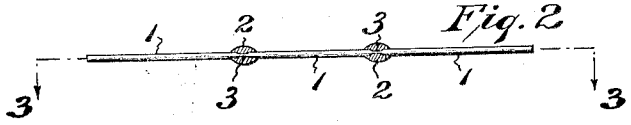
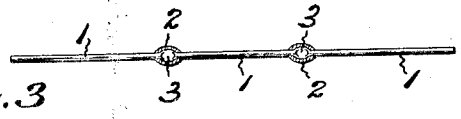


Fig. 3



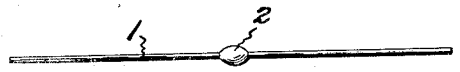


Fig. 4

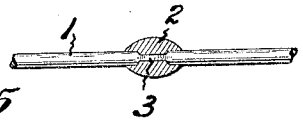
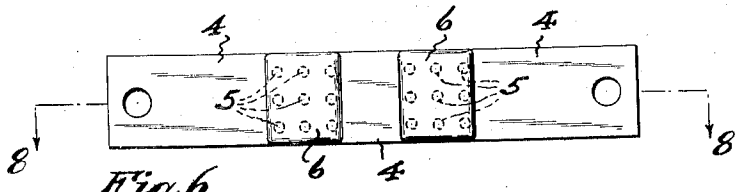


Fig. 5

Fig. 6



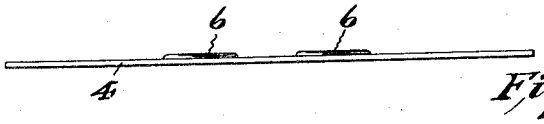


Fig. 7

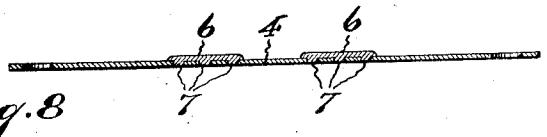


Fig. 8

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UNITED STATES PATENT OFFICE.

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ELECTRIC-FUSE ELEMENT.

Application filed May 17, 1921. Serial No. 470,434.

To all whom it may concern:

Be it known that I, FREDERICK A. FELDKAMP, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Electric-Fuse Elements; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to characters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in electrical fuse mediums; and the invention has reference, more particularly, to a novel electrical fuse medium having characteristics adapted to greatly increase the efficiency of the fuse in carrying out the purposes for which it is employed.

In the first place, the characteristics to be desired in an electrical fuse are, that the same provides a medium of the highest possible conductivity, and that the medium also possesses a comparatively low melting point. Unfortunately said desirable characteristics can not both be provided by any known single elementary metal, nor can the same be provided to the highest degree by any form of metallic alloy. For example, copper, being highly conductive, would answer the first requirement, but copper possesses a comparatively high melting point, not fusing until after it is brought to a bright red heat, its melting point being above 1000° C. Metals or alloys which would answer the second requirement, to wit, possession of a comparatively low melting point, are all comparatively poor conductors. I have found that a fuse medium of a composite nature having its elements relatively disposed in a peculiar intimate combination and manner, serves to best provide, in a high degree, both the desired characteristics of high specific conductivity and comparatively low melting point.

It is, therefore, the purpose and object of this invention to provide a fuse medium of a composite nature, which will best afford, in operation, both high specific conductivity and a comparatively low melting point. To this end the invention comprises a fuse medium consisting of a main metallic body of high specific conductivity, such, for example, as copper, to the surface of which is applied an overlying intimately united portion of another metal or metallic alloy possessing a comparatively low melting point, such, for example, as cadmium or an alloy containing cadmium. I find it preferable to apply the overlying portion to the main body at a point or points intermediate the ends of the latter, although I do not limit myself entirely to such spot or point location thereof. The appearance and mechanical relations of the above mentioned elements making up my novel fuse medium is clearly illustrated in the accompanying drawings, in which:—

Figure 1 is a side elevation of a fuse wire made according to and embodying the principles of this invention; Figure 2 is a longitudinal section of the same, taken on line 2—2 in Figure 1, the main body being shown in elevation with the portions applied thereto shown in section; Figure 3 is a transverse longitudinal section of the same, taken on line 3—3 in Figure 2, the main body being therein also shown in elevation with the portions applied thereto shown in section.

Figure 4 is a side elevation of a slightly modified form of the novel fuse wire embodying the principles of my invention.

Figure 5 is an enlarged detail longitudinal section, showing a portion of the main body in elevation, and the portion applied thereto in section.

Figure 6 is a face view of a fuse strip made according to and embodying the principles of my invention; Figure 7 is an edge view of the same; and Figure 8 is a longitudinal section through the same, taken on line 8—8 in said Figure 6.

Similar characters of reference are employed in all of the above described views, to indicate corresponding parts.

Referring now to the drawings, the reference character 1 indicates the main body of a fuse medium in a wire or cylindrical form. This main body is preferably made of copper, which possesses high specific conductivity. Combined or united with the surface of said main body 1 throughout its length or at one or more points intermediate its ends, is an overlying portion 2 comprised of a metal having the property of readily alloying with copper at comparatively low temperatures, when intimately united with the

surface of the latter; while at the same time being itself possessed of a comparatively low melting point. A metal desirable for use as such overlying portion 2 is cadmium, which may be employed alone in its pure state, but which is preferably formed into an alloy with tin, since the presence of the tin serves to more readily unite the portion 2 to the surface of the body 1 when applied thereto. The operation of application being in the nature of a soldering process, whereby the contiguous surfaces of the copper and overlying cadmium or cadmium alloy are intimately united together. The intimate adherence of one metal with the other thus produced is essential to the carrying out of the principles involved in my invention, since such relation prevents any oxidation or tarnishing of the meeting surfaces, so that when the fuse medium is subjected to excess temperature oxidation is eliminated with the result that the component elements of the fuse medium may alloy together, thereby decreasing the melting point and increasing the resistance of the fuse as a whole, both of which factors tend to accellerate the reduction of the same to the "blowing" point.

Since most fuse wires are usually supported within cartridge containers, which in use occupy a vertical position, so that the fuse wire itself is perpendicularly disposed, it is desirable to provide means for preventing the applied portions 2 from becoming detached or displaced from their position relative to the main body 1, when the same begin to flux or melt in operation. To this end the said main body or wire 1 is provided with a flattened out portion 3 at the point of application of the portion 2, which forms a seat or socket for retaining the latter against dislocation when the same becomes fluid; the retention effect being in the nature of capilarity.

The operation of the composite fuse medium, constructed as above described, is as follows:—

At ordinary current load or permitted overloads, according to the selective capacity and rating of the fuse medium, the overlying portion 2 of cadmium or cadmium alloy, remains inactive and rigid or unfluxed, while the current flows through both elements of the composite fuse. When, however, the fuse is subjected to an excessive current overload, the temperature of the fuse rises accordingly, and the overlying portion 2 of cadmium or cadmium alloy becomes highly active, that is, it fluxes or melts, and while so doing it forms a combination or new alloy by alloying or combining with the copper comprising the main body or wire 1. This alloying reaction between the two elements of the composite fuse medium begins while the copper element is still at a comparatively low temperature. The alloying reaction when set up results in producing, at the point or points occupied by the overlying portions 2, a metallic combination or alloy of copper and cadmium or cadmium alloy which possesses both a lower melting point and a higher resistance than is possessed by the copper alone, consequently after initiation of such alloying reaction there is a tendency to accelerate the "blowing" of the fuse medium at the point or points where such alloying reaction occurs. The reason for this is that the heat generation will be increased at such point or points due to the progressively increasing resistance caused by the progress of the alloying process, until such a state is reached that all of the underlying copper is converted into a lower melting point alloy, whereupon the fuse medium will "blow" at such point or points.

It will thus be apparent that the novel fuse medium provides for a normal condition of high specific conductivity whereby normal current loads and permitted overloads may be conducted therethrough without reaction between the component parts, and yet the same is adapted, under abnormal increases of temperature due to excessive current overload, to melt, fuse or "blow" at a comparatively low temperature, thereby eliminating the danger of carbonizing the cartridge container in which such fuse mediums are usually disposed, due to accumulative excesses of temperature immediately preceding the "blowing" of the same. Another advantage afforded by my novel construction of fuse medium is that it permits, by reason of the high specific conductivity of the main body 1 or copper element, a reduction of the amount or mass of metal required for the fuse and necessary to carry the specified current load, thereby reducing the pressure, within a cartridge containing the fuse medium, at the moment of "blowing", by reason of the correspondingly reduced volume of gases generated by the vaporization of the lesser amount of metal required for my novel fuse medium.

Referring now to Figures 6 to 8 inclusive of the accompanying drawings, I have shown the principles of my invention as applied to a fuse medium of the flat strip type. In said views, the reference character 4 indicates a strip or flat main body of metal possessing high specific conductivity, such as copper. This strip or flat main body 4 is provided at a point or points intermediate its ends with a plurality of perforations 5. The reference character 6 indicates an applied over-lying portion of metal or metallic alloy adapted to combine itself with the main body 4 at the point of application thereto under an excess of normal permitted temperature, at the same time said over-lying portion possesses a comparatively low

melting point, preferably said overlying portion 6 being made of cadmium or cadmium alloy. When applying said over-lying portion 6 to the strip or flat body portion 4, the same is caused to flow over the perforate portion of the latter so that parts thereof, such as the projections 7, enter and imbed themselves in the perforations 5, whereby the said over-lying portion 6 is retained in mechanically secured relation to the strip or main body 4 against dislocation therefrom when fluxing.

In use and operation the above described strip type of fuse medium functions in the same manner and to the same advantage, as does the wire type of fuse medium as heretofore described.

I am aware that besides cadmium or cadmium tin alloys, there are other metals or combinations of metals for use as the overlying portions of low melting point characteristics for the fuse medium which would have the tendency of alloying with copper at a comparatively low temperature, hence, broadly my invention contemplates the employment of any metal or metallic alloy which will thus function.

I am also aware that composite fuse mediums of various kinds have also been heretofore known, but I wish to distinguish my present invention from all such by the principle of its structure which requires the application of the overlying portion of the fuse medium to the main body to be of such character that the meeting surfaces of the two elements unite in that close mutual adherence necessary to prevent oxidation and to permit the alloying reaction above explained to be initiated when the medium is subjected to excessive temperature.

I claim:—

1. An electric fuse of high specific conductivity and comparatively high melting point in intimate closely adhering contact with a superimposed metallic material which under normal temperature is inactive and under excessive higher temperature combines with the fuse material to form an alloy of lower melting point.

2. An electric fuse medium comprising a metallic main body of high specific conductivity and comparatively high melting point having united to its surface a metallic overlying portion possessing a comparatively low melting point and of a character adapted to form an alloy with said main body by the action of heat generated under excessive current overload passing through said fuse medium.

3. An electric fuse medium normally of high specific electrical conductivity, means providing a "blowing" zone intermediate the ends thereof, said means comprising an overlying portion of metallic material united with said fuse medium adapted by the action of heat generated under a current overload to combine with the underlying portion of said fuse medium to form an alloy therewith tending to increasingly reduce the conductivity and lower the melting point thereof.

4. In an electric fuse medium, the combination with a main body of metal of high specific conductivity of an overlying metallic portion united therewith at a point thereof intermediate its ends, said overlying metallic portion being adapted by the action of an excess of heat above a normal permitted temperature to combine with the underlying portion of said main body to form an alloy therewith tending to both increase the resistance and lower the melting point of the fuse at such points.

5. In an electric fuse medium, the combination with a main body of metal of high specific conductivity of an overlying metallic portion united therewith at a point thereof intermediate its ends, said overlying metallic portion being adapted by the action of an excess of heat above a normal permitted temperature to combine with the underlying portion of said main body to form an alloy therewith tending to reduce the conductivity and lower the melting point of the latter, and means for retaining said overlying metallic portion against displacement when fluxed.

6. An electric fuse medium comprising a main body of copper having united therewith at one or more points intermediate its ends an overlying portion of metallic material adapted by the action of abnormal heat to form an alloy with the underlying copper body tending to both increase the resistance and lower the melting point of the latter whereby the "blowing" of the fuse medium rapidly follows and is localized at said point or points thereof.

7. An electric fuse medium comprising a main body of copper having united therewith at one or more points intermediate its ends an overlying portion of metallic material adapted by the action of abnormal heat to form an alloy with the underlying copper body tending to both increase the resistance and lower the melting point of the latter whereby the "blowing" of the fuse medium rapidly follows and is localized at said point or points thereof, and means for retaining said overlying metallic portion against displacement when fluxed.

8. An electric fuse medium comprising a main body of copper having applied thereto an overlying portion of cadmium intimately united with its surface, as and for the purposes set forth.

9. An electric fuse medium comprising a main body of copper having applied thereto an overlying portion of cadmium intimately united with its surface, as and for the pur-

poses set forth, and means for preventing dislocation of said cadmium when fluxed.

10. An electric fuse medium comprising a main body of copper having applied thereto an overlying portion of cadmium alloy intimately united with its surface, as and for the purposes set forth.

In testimony that I claim the invention set forth above I have hereunto set my hand this 16th day of May, 1921.

FREDERICK A. FELDKAMP.

Witnesses:
FRED'K C. FRAENTZEL,
EVA E. DESCH.