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FUSE LINK CONSTRUCTION
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Fig. 1

Fig. 2

Fig. 3

Fig. 4

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FUSE LINK CONSTRUCTION

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This invention relates to improvements in tension type fuse links.

It is an object of this invention to provide for expulsion fuses, a fuse link comprising a combination of assembled tensioned elements which are, by reason of the tension, substantially instantaneously separable when the fusible section of the fuse link fuses.

It is a further object to provide a fuse link assembled as aforesaid prior to its insertion in an expulsion fuse tube, whereby the tension of the fuse link may be set at a standard value prior to its incorporation into a fuse tube.

Another object is to provide a factory tensioned fuse link for replacement in an expulsion tube which will be expelled from the tube by the tensioning spring when the fusible section of the fuse link is severed.

A still further object is to provide a factory tensioned fuse link in which the fuse link is provided with means for guiding the spring which tension the fusible section of the link.

It is also a further object to provide a fuse link having a tensioned fusible section and a rigid section expellable from an expulsion fuse cartridge by means of the tension spring when the fusible section is severed, the rigid section serving as a guide to the spring and maintaining its direction of movement from the cartridge substantially unchanged and thereby compelling the flexible portion of the link to move from the cartridge.

It is still another object to provide an elongated rigid section which may be actuated, when the fusible section of the link is severed, to a velocity greater than would be possible with the flexible section alone.

It is also another object to provide a flexible fuse link with a portion adjacent the fusible section and which is less fusible than the flexible portion of the link, thereby keeping the metallic gases generated by the arc at a minimum and consequently shortening the time during which the arc will continue.

It also is an object to provide an assembled tensioned fuse link in combination with an arc suppressing material which will destroy or interrupt an arc created after the fusible sections of the link have been separated. This last named object embodies the invention disclosed in the co-pending application of Ralph H. Earle, Serial No. 754,944, filed November 21, 1934, for Arc extinguishing fuse links, and this invention is an improvement thereon.

In the drawings:

Fig. 1 is a view in side elevation of a fuse tube with a portion broken away to show a fuse link embodying this invention mounted therein.

Fig. 2 is a view in side elevation of the fuse link shown in Fig. 1 and embodying this invention, portions being broken away to show the inner elements.

Fig. 3 is a view similar to Fig. 2 showing a modified form embodying this invention.

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3.

Fig. 5 is a view similar to Fig. 2 showing a further modified form.

Fig. 6 is a fragmentary sectional view in side elevation of a fuse link showing a modified detail.

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 6.

Fig. 8 is a view similar to Fig. 6 showing a modified form.

Fig. 9 is a view in vertical section showing a tensioned and arc extinguishing fuse link embodying this invention.

Fig. 10 is a view illustrating one form of the invention shown in the co-pending application previously referred to.

Throughout the several views, like parts are referred to by the same reference characters.

The expulsion fuse cartridge shown in Fig. 1, comprises an electrically non-conductive tube 1, an upper tubular contact terminal 2 to which the tube 1 is threaded, a closure cap 3 threaded to the terminal 2, and a lower contact terminal 4 through which the tube 1 extends and to which it is secured. The lower contact is provided with a link engaging clamping bolt 5 threaded into the boss 6 on the terminal 4. This boss is slotted transversely relative to the bolt 5 to receive the flexible end of the fuse link, as will more particularly be described hereafter.

The fuse link shown in Figs. 1, 2 and 3, comprises an upper contact cap 7 seated on the upper terminal 2 and connected by the portion 8 to the strip 9 which is notched at 10 to provide an area that may be easily severed to adapt it for insertion in other types of fuse tubes than that shown. The strip 9 is secured by means of solder 11 to a strain wire 12 having a high melting point and to a fuse wire 13 having a low melting point. Both of these wires 12 and 13 are secured by solder 14 to the flexible wire 21, as shown in Fig. 2, and to a flexible wire 16, as shown in Fig. 3.

As illustrated in Fig. 2, the strip 9 has an area reduced in width to be received in the insulating tube 15 which surrounds the strain wire 12, fusible wire 13, and flexible wire 21. In Figs. 1 and 2, a coil spring 35 engages the lower end of the tube 10 by means of a nut washer 37 threaded on the spring and is coaxial with the flexible wire 21. The upper end of the spring 35 is cramped into engagement with the upper end of the flexible wire 21 to exert a pull on the strain wire 12, thus maintaining the strain wire under tension. The flexible wire 21 extends to the lower opening of the tube 1 and is bent back upon the outer
side of the tube to position the end 23 in the slotted lug 6 on lower contact terminal 4 to be clamped by means of the clamping bolt 5.

In Fig. 3, the strip 9 is provided with a reduced end 17 having lugs 25 at its lower end projecting laterally into apertures of the bottom of the tube 26. Intermediate the ends of the tube 26, the wall is punched to provide lugs 27 upon the inner face of the tube and against which the spring 28 is seated. This spring extends from the tube and is held under compression by the strip wire 12. The flexible wire 18 is run through the slit in the washers 29 and is clamped by means of the spring 29 to hold the device shown in Fig. 9 because the insulating tube 50, cap 5, and plug will confine the arc extinguishing material.

In Fig. 5, the rod 15 is secured in any suitable manner (such as soldering) at 33 to the flexible wire 34. A tube 18 surrounds the rod 15 and spring 35 which is coaxial with the rod and is engaged with the upper end thereof at 36. Seated on the lower end of the tube is a nut washer 37 threaded on the lower end of the spring and holding the spring under tension. The arrangement of the elements in Fig. 5 is similar as that in Fig. 2, except that the rod 15 in Fig. 5 is substituted for that portion of the flexible wire 21 which extends into the tube 18 in Fig. 2.

In the modified form of fuse link illustrated in Figs. 6 and 7, the tube wall is slotted or forced in to provide tongues 40 within the tube 26 and again, which the spring 28 seats. The shape of these tongues is such that they will tend to be forced inwardly of the tube by the spring 28 and thus make the seating arrangement of the spring more secure.

In the modified form illustrated in Fig. 8, the seat for the spring 20 comprises a second coil spring 42 which is expanded peripherally into contact with and frictionally engages the inner wall of the tube 26.

The fuse link shown in Fig. 10 comprises a contact cap 45 secured to the flexible section 46 which is also secured to the flexible section 47. Surrounding the fusible section is a cylinder of material 48 which may comprise a binder such as fuller's earth containing a quantity of suitable salts which has water of crystallization in it. The water of crystallization is vaporizable under the influence of an arc and thereby offers an impedance to the arc. However, this is more fully disclosed in the application previously referred to. The illustration, Fig. 10, is given to more clearly show how the fuse link shown in Fig. 10 operates before it is combined as shown in Fig. 9, the spring 52 substantially instantaneously separates the fused sections and the arc is almost as quickly extinguished by the moisture which is given off by the salts under the influence of the heat of the arc.

Fig. 9 illustrates the invention disclosed in Figs. 1 to 8 inclusive combined with the invention shown in Fig. 10. The fuse link comprises, a contact cap 45, a fusible section 46 secured to the cap and to the rod 49. Surrounding the fusible section is a compound of arc extinguishing material 48 which is enclosed by the insulating tube 50. A cap or plug 51 closes the bottom of the tube and serves as a seat for the spring 52 and is centrally apertured to receive the rod 49. The plug 51 also serves to retain the material 48 in the tube if such material is made in powder form. In other words, in this form of the invention, the binder required in Fig. 10 is not required in the device shown in Fig. 9 because the insulating tube 50, cap 45, and plug 51 will confine the arc extinguishing material.

The spring 52 is held under compression between the plug 51 and washer 53 by means of the wire 46 and rod 49 to which the washer 53 is secured by soldering. The rod 49 is likewise secured to the flexible section 54 of the fuse link.

From the description it will be observed that each of the embodiments of the invention disclosed herein is provided with guiding means for the fuse tensioning springs. In Figs. 5 and 9 the guiding means comprises respectively, the rod 15 in Fig. 5 and rod 49 in Fig. 9. The guide on the spring 52 is under compression and therefore, the rod 49 holds the spring from lateral movement intermediate the ends.

In Fig. 5 the spring 35 is elongated so that it is pulling on the upper end of the rod 15. In this latter form, the spring naturally will tend to remain coaxial with the spring link. However, when the fuse wire 13 and tension wire 12 are severed, the spring impels the rod 15 toward the lower end of the tube 18. If the rod 15 is not provided, there would be some tendency for the spring to jam within the walls of the tube 18, although this would not be a carefully constructed fuse link such as shown in Fig. 5. As a matter of fact, the tube 18 itself will produce to a considerable extent the foregoing noted results produced by the rod 15.

In Figs. 2, 3, 6 and 8 I have not illustrated guiding means constituting a portion of the fuse link proper. However, I have shown the tension springs disposed in the tubes enclosing the fusible sections of the fuse links. In each of these cases the portion of the tube surrounding the spring acts as the guide for the spring and holds the spring throughout its length substantially coaxial with the fuse link.

When the fuse wire 13 and tension wire 12 are severed, the spring in each of the forms illustrated will cause the link to move relatively downward with respect to the tubes and toward the open end of the cartridge 1. The impetus attained through the action of the spring will be manifested in a very high velocity of the severed end of the link toward the open end of the fuse cartridge 1. Even after the spring has spent its energy, the kinetic energy of motion of the fuse link will cause the link to move until it has been expelled from the fuse cartridge.

Thus, it will be seen that a fuse link has been provided in which the tension exerted on the fusible section may be set at a predetermined value prior to its insertion in a fuse cartridge and in which the expulsion action is positive and not dependent upon any possible expelling effect that may arise from the arc. As a matter of fact, the tendency is to extinguish the arc much quicker than it would ordinarily be extinguished in a non-tensioned fuse link.

The operation of the device shown in Fig. 9, when expelling the fuse link from a fuse cartridge, is substantially like the action of the device illustrated in Fig. 2. However, there is an added feature to the form illustrated in Fig. 9 which embodies a material surrounding the fusible section of the fuse link and which contains material from which water vapor or other arc extinguishing gases may be evolved under the influence of an arc to impose in the path of the arc the equivalent of a resistance to the flow of current and prefer materials such as boric acid which give off water vapor under the heat of the arc for the reason that it has been found that water vapor is extremely ef-
fective in extinguishing an arc. Thus, it will be seen that in the form illustrated in Fig. 9, I obtain a separation of the fuse sections in a minimum space of time and also secure the extinguishing of the arc much sooner than it would be extinguished without the evolution of water vapor. While I have stated that I prefer material such as boric acid, it will be understood that I may use other materials which will evolve water vapor or gases such as hydrogen which will effectively destroy an arc.

It will be noted that in the construction illustrated in Fig. 9, the material 48 provides the equivalent of a small bore of substantially the same size as and enclosing the fusible section 46 of the link. The effect produced by this small bore upon an arc is to confine the arc to a limited space and consequently greatly increase the resistance to flow of current through the bore when the fusible section has separated. While I have indicated that I prefer boric acid as an arc extinguisher, it will be obvious from the foregoing, that a sleeve of electrically non-conductive material may be used for the sole purpose of restricting the arc path and thereby suppress the arc sooner than the arc would normally be suppressed if the sleeve is not provided. There conceivably arc conditions under which a restricted path will serve to suppress an arc just as satisfactorily as water vapor or other fluids. For this reason, I do not restrict all of the claims to the use of boric acid or other volatile material. Fig. 9 illustrates a novel method of suppressing an arc at the same time that the fused sections of the link are being separated by the spring. Therefore, claims predicated upon the invention disclosed in Fig. 9 are intended to cover any equivalent arrangement producing the same results.

When this invention is used without arc suppressing material, I prefer the arrangement shown in Fig. 5 or its equivalent. In the links illustrated in Figs. 5 and 9, I have provided a rod section 45 and 49, respectively, each provided with an expansion spring concentric therewith. In the Fig. 5 link, the spring 35 is under tension while in the Fig. 9 link, the spring is under compression.

One of the advantages of having a portion of the link constructed of a solid rod is in the fact that the possibility of the metal being vaporized by the arc between separated portions of the link, is reduced to a minimum. It has been found that the fine strands of a flexible conductor will heat more readily and accordingly vaporize more freely than a single large conductor, such as illustrated in Figs. 5 and 9. Therefore, it is desirable to place a single solid conductor in the link between the flexible section and the fusible section. The solid conductor spaces the flexible section of the link from the fusible section and prevents the arc from reaching the more easily fusible strands of the flexible section.

A further function of the rods 45 and 49 is to serve as supports when the fuse link is being positively and quickly impacted and which will tend to maintain a substantially straight line movement after motion has been imparted thereto by their respective springs. In those modifications of fuse links which are not provided with rod or rigid conducting section, the remaining portion of the fuse link tends to interfere with the springs when the latter are relieved of their tension. While I have indicated that the use of a rigid section in the fuse link is desirable, nevertheless, those fuse links which are not provided with rigid sections in the link, give satisfactory service, because I have provided a rigid member in the form of an insulating tube which guides the spring and the flexible section of the link and thereby assists the spring in imparting a maximum velocity to the link in the quickest possible time. The rod section of the link gives the added feature of protecting the flexible section against fusion.

I claim:

1. A fuse link comprising a terminal portion, a fusible section, a flexible section, an insulating tube surrounding the fusible section and a portion of the flexible section, said tube being engaged with the terminal portion, a helical spring concentrically related to said flexible section and having one end engaging the flexible section and the other end engaging the tube at a point intermediate the ends thereof, thereby to tension the fusible section.

2. A renewable fuse link comprising, a fuse tube, a first fuse terminal at one end of said fuse tube, a conductor including a second fuse terminal and a flexible lead extending outward from the other end of said fuse tube, fusible means interconnecting said fuse terminals, and a spring carried by the link and tensioning said fusible means said spring being substantially housed by said fuse tube and said flexible lead having carried thereby an abutment positioned at the lower extremity of said tube through which the force of said spring is transmitted to said lead in the placing of said fusible means under tension.

3. A renewable fuse link comprising, a fuse tube, a first relatively fusible terminal at one end of said fuse tube, a second relatively fusible terminal within said fuse tube, a fuse wire interconnecting said terminals, a flexible lead connected to said second terminal and extending out of the other end of said fuse tube, and a coil spring carried by the link and biasing said terminals apart, said coil spring having a substantially portion of its length inside of said tube and having a lower end adjacent the lower extremity of said tube applying a spring force to an abutment carried by said lead in the placing of said fusible means under tension.

4. As a matter of manufacture, a self-contained fuse link comprising a fusible element, a first terminal for said element comprising a relatively rigid member, a tube of insulating enclosing said element and resting endwise against said first terminal, anchor means for the remote end of said tube, a flexible lead having an extension passing through said anchor means and forming a second terminal for said element, and a spring connected between said anchor means and said second terminal for placing said element under tension said anchor means including an abutment carried by said flexible lead and movable with said flexible lead in a direction away from the tube upon blowing of the fuse link, said first terminal and tube being interlocked so that in use said tube will be prevented from rotating relative to the lower terminal and lead are being expelled after fusion.

5. The method of assembling a helical spring on a terminal member for use inside of a fuse tube of the expulsion type which comprises reducing an end convolution of the spring about the periphery of the terminal member to a diameter less than the outside diameter of the spring in non-rotative engagement therewith.

6. A fuse device comprising, in combination, a tubular fuse housing closed at one end and open
at the other and having external terminals adjacent its ends, a conductor within said housing for interconnecting said terminals including a terminal portion connected to the external terminal at the closed end of said housing and a flexible lead portion extending out of the open end of said housing and connected to the external terminal thereof, a spring within said housing biasing said terminal and flexible lead portions apart, fusible means interconnecting said terminal and flexible lead portions, an insulating sleeve surrounding said fusible means and spaced from the inner surface of said housing, and a filling of solid arc extinguishing material within said insulating sleeve and embedding said fusible means.

7. A fuse device of the air explosion type comprising, in combination, a fuse link housing, a replaceable fuse link in said housing including a fusible element surrounded by a filling of inorganic arc extinguishing material, and spring means in said housing tensioning said fuse link, the combined action of said filling of arc extinguishing material and said spring effecting rapid interruption of relatively small fault currents.

8. A fuse device of the air explosion type comprising, in combination, a tubular fuse housing closed at one end and open at the other and having external terminals adjacent its ends, a conductor within said housing for interconnecting said terminals including a terminal portion connected to the external terminal at the closed end of said housing and a flexible lead portion extending out of the open end of said housing and connected to the external terminal thereof, a spring within said housing biasing said terminal and flexible lead portions apart, fusible means interconnecting said terminal and flexible lead portions, an insulating sleeve surrounding said fusible means, and a filling of solid arc extinguishing material within said insulating sleeve and embedding said fusible means.

9. A replaceable fuse link for interconnecting a pair of line terminals comprising, a fuse tube, a first relatively insubfluable terminal at one end of said fuse tube for connection to one line terminal, a conductor including a second relatively insubfluable terminal and a flexible lead extending out of the other end of said fuse tube for connection to the other line terminal, fusible means interconnecting said terminals, said conductor being freely movable out of said fuse tube on blowing of said fusible means, and a spring anchored at the other end of said fuse tube and arranged to bias said terminals apart, the anchor for said spring comprising an abutment attached to and carried by the flexible lead and spaced from said other end of the tube.

10. A replaceable fuse link for interconnecting a pair of line terminals comprising, a fuse tube, a first relatively insubfluable terminal at one end of said fuse tube for connection to one line terminal, a conductor including a second relatively insubfluable terminal and a flexible lead extending out of the other end of said fuse tube for connection to the other line terminal, fusible means interconnecting said terminals, said conductor being freely movable out of said fuse tube on blowing of said fusible means, and a spring anchored at the other end of said fuse tube and arranged to bias said terminals apart, the anchor for said spring including an abutment attached to said flexible lead beyond and spaced from the other end of said fuse tube and said spring comprising a coil expansion spring engaging and interposed between said abutment and said fuse tube about said flexible lead.

11. A renewable fuse link comprising, a fuse terminal at one end of said fuse tube, a conductor including a second fuse terminal and a flexible lead extending out of the other end of said fuse tube, fusible means interconnecting said fuse terminals, and a spring carried by the link and tensioning said fusible means, said spring bearing at one end against a portion of the tube and at its other end against an abutment fastened to the flexible leader beyond said other end of the fuse tube.

12. A renewable fuse link comprising, a fuse tube, a first fuse terminal at one end of said fuse tube, a conductor including a second fuse terminal and a flexible lead extending out of the other end of said fuse tube, fusible means interconnecting said fuse terminals, and a spring carried by the link and tensioning said fusible means, said flexible leader having fastened thereto an abutment spaced longitudinally from the other end of the fuse tube and said spring extending between said tube and said abutment so as to exert an expulsive force between the tube and the abutment tending to force the flexible lead and said second fuse terminal out of said other end of the fuse tube.

13. A renewable fuse link comprising, a fuse tube, a first relatively insubfluable terminal at one end of said fuse tube, a second relatively insubfluable terminal within said fuse tube, a fuse wire interconnecting said terminals, a flexible lead connected to said second terminal and extending out of the other end of said fuse tube, and a coil spring carried by the link and biasing said terminals apart, said flexible lead having fastened thereto beyond said other end of the fuse tube an abutment and said spring bearing at one end against said abutment and against a portion of the tube at its other end for exerting a force tending to move the abutment away from said other end of the fuse tube.

14. A renewable fuse link comprising a tubular structure, a conductor including a first fuse terminal at one end of said tubular structure, a conductor including a second fuse terminal and a flexible lead extending out of the other end of said tubular structure, fusible means interconnecting said fuse terminals in said tubular structure, and a spring carried by the tubular structure and comprising a part of the link for tensioning said fusible means, said spring being at least partially housed by said tubular structure and being interposed between a portion of said tubular structure, and said abutment attached to and carried by one of said conductors.

15. A renewable fuse link comprising a tubular structure, a conductor including a first fuse terminal at one end of said tubular structure, a conductor including a second fuse terminal and a flexible lead extending out of the other end of said tubular structure, fusible means interconnecting said fuse terminals in said tubular structure, and a spring carried by the tubular structure and comprising a part of the link for tensioning said fusible means, said spring being at least partially housed by said tubular structure and being interposed between a portion of said tubular structure, and an abutment attached to and carried by one of said conductors, said spring being in the form of a coil spring and being normally held under compression so as to exert upon blowing of the fusible means a force tending to separate said terminals.

ALWIN G. STEINMAYER.
Certificate of Correction


ALWIN G. STEINMAYER

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows: Page 4, second column, line 1, claim 11, after the word "fuse" second occurrence, insert "tube, a first fuse"; lines 22 and 23, claim 12, for "expensive" read "expansive"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of April, A. D. 1947.

[Seal]

LESLIE FRAZER,
First Assistant Commissioner of Patents.
Certificate of Correction


ALWIN G. STEINMAYER

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LESLIE FRAZER,
First Assistant Commissioner of Patents.