Nov. 30, 1937. A. G. STEINMAYER 2,100,413

FUSE LINK FOR EXPULSION FUSES

Filed March 21, 1936 2 Sheets-Sheet 1

Fig. 2

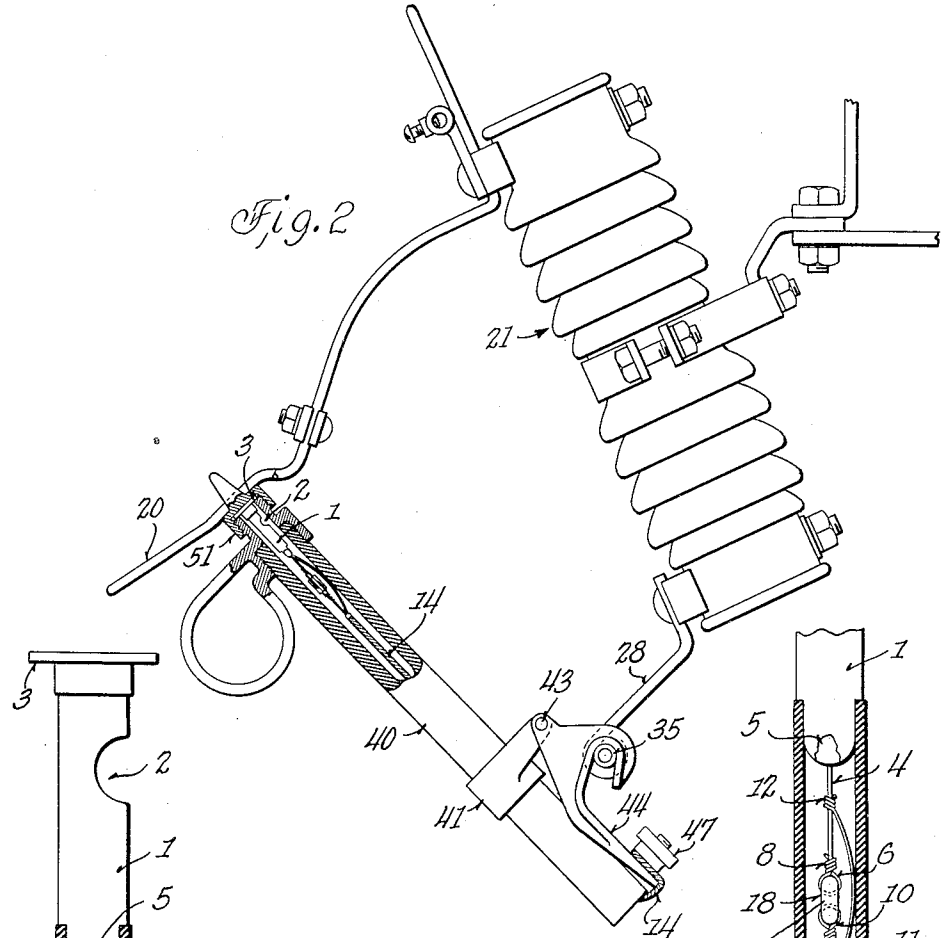


Fig. 1

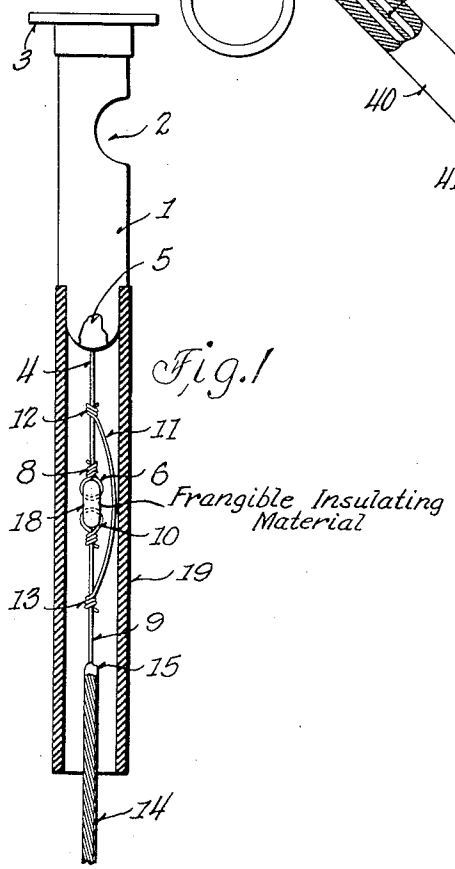
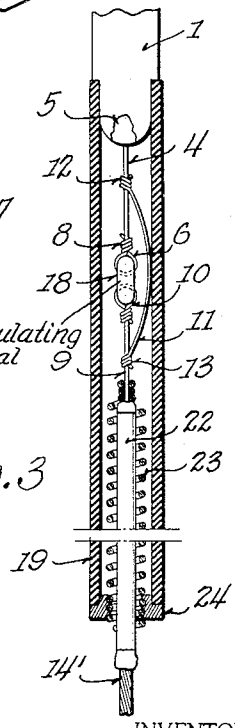


Fig. 3



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Fig. 4

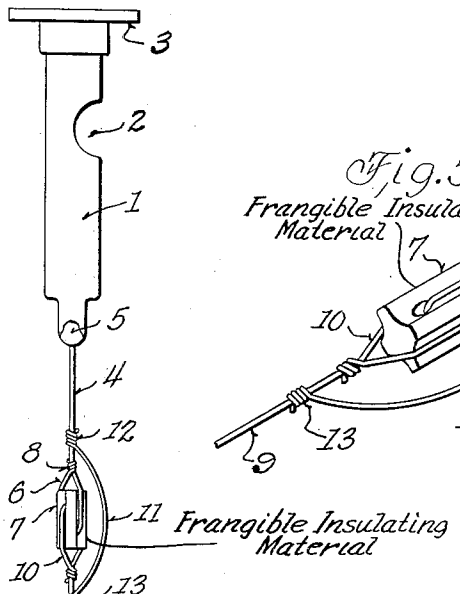


Fig. 5

Fig. 7

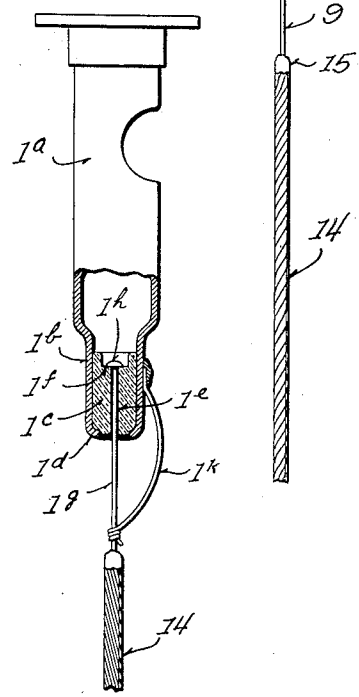
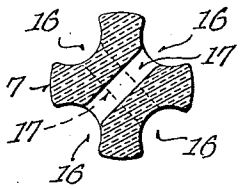


Fig. 6



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Patented Nov. 30, 1937

2,100,413

UNITED STATES PATENT OFFICE

2,100,413

FUSE LINK FOR EXPULSION FUSES

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Application March 21, 1936, Serial No. 70,117

14 Claims. (Cl. 200—135)

This invention relates to improvements in fuse links for expulsion fuses.

In so-called drop-out fuses of the type disclosed in my Patent 2,028,421 issued January 21, 1936, the fuse link is placed under stress by reason of the fact that it holds the pivot lever supporting the tube in relatively rigid relationship to the tube when the fuse is in operative position.

So-called spring tensioned fuse links are also provided in which the fusible section of the link is placed under stress to provide a quick and wide separation of the fusible section when subjected to an overload. My application Serial Number 753,358 filed November 16, 1934, illustrates embodiments of spring tensioned fuse links commonly in use.

In fuse links which are subjected to tension, the fusible section usually comprises a strain wire of high resistance and high melting point and also a fusible portion in parallel with the strain wire and comprising material having a low tensile strength and a low melting point. Other types of tensioned fuse links provide only a very small strain wire in the fusible section where the link is designed to carry a low amperage and high voltages.

In tensioned fuse links designed to carry low amperage, the wire or fusible section is so small in cross-sectional area that they frequently break under the stress imposed thereon. Consequently, it is the principal object of this invention to provide fuse links in which the strain wire may be of sufficient cross-sectional area to successfully withstand stresses placed thereon, but which will not under normal conditions carry any destructive current, the current being passed through a low-melting fusible element or a very fine wire of high melting point which is not subjected to any of the stresses imposed upon the fuse link.

More specifically, it is an object of this invention to provide a strain section for tensioned fuse links in which two relatively large strain wires are connected by means of an insulating block designed to withstand the stresses imposed upon the fuse link and to normally insulate the two wires from each other, and in which the fusible section comprises a wire of low melting point electrically connecting the two tensioned wires but subjected to no injurious stresses.

From the foregoing, it will be apparent that it is an object of this invention to provide a tensioned fuse link of exceedingly high mechanical strength without sacrificing accurate calibration of the fusible section. It will also be apparent that it is an object of this invention to provide a tensioned fuse link in which exact calibration of the fusible section may be attained without sacrificing the mechanical strength of the fuse link.

In the drawings:

Fig. 1 illustrates a fuse link embodying this invention.

Fig. 2 is a side elevation of a drop-out fuse illustrating the fuse link in Fig. 1 as applied to drop-out fuses.

Fig. 3 illustrates a spring tensioned fuse link for expulsion fuses embodying this invention.

Fig. 4 is a view illustrating a fuse link embodying a modified form of this invention.

Fig. 5 is a fragmentary view in perspective of a portion of the fuse link shown in Fig. 1.

Fig. 6 is a cross-sectional view of the strain insulator shown in Figs. 1 and 2.

Fig. 7 is a view illustrating a further modified form embodying this invention.

Figs. 1, 3, 4, 5, 6 and 7 are views drawn on an enlarged scale, while Fig. 2 is drawn on a reduced scale.

Like parts are identified by the same reference characters throughout the several views.

The fuse link illustrated in Figs. 1 and 2 comprises an upper terminal member 1 notched at 2 and provided with a cap 3, and a strain wire 4 secured at 5 to the terminal 1 and looped at 6 through the insulating bead 18. The loop 6 is secured to the strain wire 4 by twisting at 8. The fuse link further comprises a second strain wire 9 spaced from the strain wire 4 and looped at 10 through the insulating bead 18, this strain wire 9 to be secured to the bead in a similar manner to that in which the strain wire 4 is secured to the bead. The lower end of the strain wire 9 is secured at 15 to the flexible leader 14. Surrounding the strain wires, insulating bead, and the upper portion of the flexible leader, is an insulating tube 19 secured in any suitable manner to the upper terminal 1. Electrically connecting the strain wires 4 and 9, is a fuse wire 11 coiled at 12 about the strain wire 4 and at 13 about the strain wire 9. This fusible wire 11 may be composed of a metal having a low melting point or it may be composed of a very fine wire of high melting point.

As will be noted, the loops 6 and 10 pass through the same aperture in the insulating bead 18 but are electrically disconnected at the looped portions of the strain wires. Preferably, the space between the adjacent portions of the loops 6 and 10 should be approximately one-thirty-second of an inch in order to insure that an arc will be

established between the loops and cause them to be burned when the fuse wire 11 has been fused.

The tube 19 serves to increase the pressure of the gases, either generated or expanded therein, when the fuse wire 11 is fused. This increased pressure will assist in causing a quick and wide separation of the strain wires when they have been burned sufficiently to release them from the insulating block 18.

In Fig. 2, the fuse link illustrated in Fig. 1, is mounted within the tube 40 with its contact cap 3 electrically connected to the terminal cap 51. As shown, the flexible leader 14 of the fuse link extends through the lower open end of the tube 40 and is secured to the tube supporting lever 44 by means of the clamping nut 47.

The supporting lever 44 is pivotally mounted on pivot tube 35 and pivotally connected at 43 to the block 41 on the tube 40. At the upper end the terminal cap 51 contacts the resilient prongs 20 which are mounted in any suitable manner, such as illustrated in my Patent 2,028,421, upon insulator 21.

The pivot tube 35 is supported upon the arm 28 which in turn is secured in any suitable manner to the insulator 21. Insulator 21 is supported in any suitable fashion, such as for example, is more specifically illustrated in my Patent 2,028,421. I have not described in detail the supporting structure for the tube 40 in this specification because such is more particularly described in the foregoing noted patent.

From the foregoing description of Fig. 2, it will be seen that the fuse link is placed under stress by reason of the pressure of the resilient contact arms 20 at the upper end of the tube and that when the strain wires and fuse wires have been burned, the lower strain wire 9 and flexible leader 14 will be withdrawn through the lower open end of the tube 40 by the lever 44 as it pivots about the pivot tube 35 and the pivot connection 43.

The spring tensioned fuse link illustrated in Fig. 3 comprises a similar combination to that illustrated in Fig. 1, excepting that the strain wire 9 is secured to a rod 22 which in turn is secured to a flexible leader 14'. Disposed about the rod 22 is a tensioned spring 23 engaging the upper end of the rod 22 and secured at its lower end to the washer 24 which is held by the spring against the lower end of the tube 19. Thus the spring 23 subjects the insulator block 18 to tension. When the fuse wire 11 is melted, an arc will be established between the strain wires 4 and 9 which will be burned thereby and permitted to separate under the influence of the spring 23.

From the foregoing disclosure, it will become evident that I have provided a fuse link which may be subjected to any desired tension without sacrificing accuracy in calibrating the fusible section or mechanical strength of the strain receiving elements which are designed to assume all of the stresses to which the fuse link is subjected.

The strain in tensioned fuse links heretofore provided, is frequently sufficiently great to cause separation of the fusible sections long before they are affected by an overload. This invention permits the use of much stronger strain wires and accordingly, it is suggested that the strain wires 4 and 9 may be made of chrome-nickel wire or Monel metal and it is noted that a wire of a size No. 26 will withstand successfully a strain in the neighborhood of 25 pounds. In determining the size of the strain wire, it should be borne in mind that its diameter should not be any greater than will insure that it will be burned in a comparatively short period of time.

While I have indicated that the fuse wire 11 may be of low melting point and low tensile strength, it, nevertheless, will be understood that such wire may be composed of a very fine wire of high melting point and high tensile strength. In either case, this fuse wire should not be subjected to any mechanical strain.

In Fig. 4, the fuse link comprises a terminal section 1 notched at 2 and provided with a contact cap 3, a strain wire 4 connected to the terminal section at 5 and having a looped portion 6 passing through the insulator block 7 and coiled about the wire 4 at 8 to prevent withdrawal of the loop from the insulator block 7, a strain wire 9 secured to the insulator block 7 by means of a looped portion 10 passing through the insulator block 7 and coiled about the body of the strain wire 9, a fuse wire 11 coiled at 12 about the strain wire 4 and coiled at 13 about the strain wire 9, thus electrically connecting the strain wires, and a flexible lead wire 14 secured to the strain wire 9 at 15.

As will be observed in Fig 5, the loops 6 and 10 pass through each other and are held in spaced relation by means of the material of the block 7 between the respective apertures through which the loops pass. As clearly illustrated in Figs. 4 to 6, inclusive, the insulator block 7 is provided with longitudinal grooves 16, each diametrically opposite a corresponding groove and registering with an aperture 17 extending laterally through the block. Thus, when the loops 6 and 10 are secured to the insulator block, they pass through corresponding apertures 17 and lie within diametrically opposite grooves 16.

It will be understood that Figs. 4, 5 and 6 illustrate the fuse link and its several elements in enlarged views. In actual practice, the strain insulator 7 will be much smaller than shown and should preferably be so constructed as to bring the loops or some portion thereof to within one-thirty-second ($\frac{1}{32}$) of an inch of each other, thereby to permit the formation of an arc between the strain wires 4 and 9 when the circuit through the fusible wire 11 is interrupted. For example, suppose the fuse wire has melted at about the time that an A. C. wave is going through the zero point, then the arc caused by the melting of the fuse wire 11 may go out and, unless the strain wires 4 and 9 are close enough to permit reestablishment of the arc between them, the object of providing a strain fuse link would be defeated.

It is especially desirable to have the distance between the strain wires 4 and 9 within one-thirty-second ($\frac{1}{32}$) of an inch of each other when they are surrounded by a small tube as shown in Fig. 1. The tube 19 causes a rapid rise in pressure of gases therein when the fuse wire 11 is melted and this pressure tends to blow the arc out before the wires 4 and 9 have been burned. If the wires 4 and 9 are close enough to each other, the pressure in the circuit will cause an arc to form between them after the arc formed by the melting of the fuse wire has been blown out. Consequently, the wires 4 and 9 will be released from the strain insulator.

I have also illustrated in Fig. 7 a further modified form of the invention disclosed herein. In this embodiment shown, the terminal member comprises a tube flattened at (1a) for the major portion of its length but providing at its lower

end a tubular portion (1b) within which an insulating tube (1c) is disposed and projecting slightly from the end thereof. The lower end of the tubular portion (1b) is crimped at (1d) into the insulating tube to firmly hold the latter against withdrawal.

The insulating tube (1c) is provided with a bore (1e) which is enlarged at its upper end to provide a shoulder (1f). Extending into the bore is a strain wire (1g) having a head (1h) which rests on the shoulder (1f). A fuse wire (1k) electrically connects the tubular portion (1b) and the strain wire (1g) which is secured to the lead wire 14.

It is preferred that the distance between the lower end of the tubular portion (1b) and the strain wire (1g) be sufficiently small to permit an arc to be established therebetween when the fuse wire (1k) has melted. Generally, this distance should be less than one-thirty-second ($\frac{1}{32}$) of an inch.

As previously stated, the foregoing noted fuse link is especially designed for high voltage circuits in which the current flow is a fraction of an ampere. When an overload occurs in such a circuit, the fuse wire 11 will melt and cause an arc, and it is preferred that the distance between the looped portions of the strain wires be not more than a thirty-second ($\frac{1}{32}$) of an inch in order to insure that an arc will be established between the strain wires when the fuse wire 11 has been melted; thus a continuation of the arc will burn the strain wires and permit wide separation thereof sufficiently to extinguish the arc.

Preferably, the insulator bead or block should comprise a non-carbonizing insulating material such as glass, porcelain, lava, etc. It has been found that if a carbonizing insulating block is provided, leakage occurs across the block and destroys its structure so that in the embodiment of the fuse link illustrated in Fig. 4, there will be a tendency for the strain wires 4 and 9 to contact at their looped portions. If a non-carbonizing block is used, the strain wires will always be held in their original relationship until the arc has been established between them.

The type of strain insulator illustrated in Fig. 4 may be used in low voltage circuits, but there will be no separation of the strain wires other than that provided by the insulator block, because in low voltage circuits, an arc will not be established between the strain wires. While this fuse link has been designed primarily for high voltage circuits, I do not wish to be limited to its use in such circuits.

Although I have stressed the use of a strain fuse link embodying this invention, it will be obvious that the combinations disclosed may be utilized in expulsion tubes where no mechanical strain is placed thereon. However, the insulating block and the strain wires will make a sturdy construction which will permit the use of mechanically weak fuse wires that will not withstand ordinary stresses to which they might be subjected if the relatively heavy strain wires and insulation block were not provided. Therefore, it will be understood that the claims are not to be limited to fuse links which are subjected to tension, except where specifically so limited.

I claim:

1. A fuse link including an insulated strain section shunted by a fuse wire, said section including a frangible insulator, in combination with an insulating tube mounted on said link and surrounding said strain section and fuse wire, said tube being secured to said fuse link, whereby said fuse wire is not subjected to destructive mechanical stresses.

2. A fuse link comprising a terminal section, a flexible section, a frangible insulating strain member, means connecting the terminal section and the flexible leader to said strain member in insulated relation, and a fuse wire electrically connecting said terminal member and flexible leader at points remote from said member, whereby said means at the point of engagement with said member carries no current until the fuse wire is destroyed and the arc established thereby is extinguished.

3. A fuse link comprising a terminal section, a leader, a frangible insulating strain member, a pair of strain wires connected to said strain member in insulated relation and having a relatively high melting point, one of said wires being connected to said terminal section and the other being connected with said conductor, and a fuse wire electrically connecting said terminal section and leader at points remote from said member, whereby said wires at the point of engagement with said member carry no current until the fuse wire is destroyed and the arc established thereby is extinguished.

4. A fuse link comprising a terminal section, a leader, a frangible insulating strain member having an aperture therethrough, a pair of strain wires threaded through said aperture in spaced relation and each forming a loop securing it to said strain member, said strain wires having a relatively high melting point, one of said wires being secured to said terminal section and the other being secured to said leader, and a fusible conductor electrically connecting said terminal section and leader at points remote from said member, whereby said wires at the point of engagement with said member carry no current until the fusible conductor is destroyed and the arc established thereby is extinguished.

5. A fuse link comprising a terminal section, a leader, a frangible insulating strain member having a relatively small aperture therethrough, a pair of strain wires threaded through said aperture in spaced relation and each forming a loop securing it to said strain member, said strain wires having a relatively high melting point, one of said wires being secured to said terminal section and the other being secured to said leader, adjacent portions of said strain wires being approximately one-thirty-second of an inch from each other, a fusible conductor electrically connecting said terminal section and leader at points remote from said member, whereby said wires at the point of engagement with said member carry no current until the fusible conductor is destroyed and the arc established thereby is extinguished, and an insulating tube secured to said terminal section and surrounding said insulating strain member and fuse wire, said tube being carried by said link.

6. A unitary spring tensioned fuse link for mounting in an expulsion fuse tube, said link comprising a terminal section, a leader, a frangible insulating strain member having a relatively small aperture therethrough, a pair of strain wires threaded through said aperture in spaced relation and each forming a loop securing it to said strain member, said strain wires having a relatively high melting point, one of said wires being secured to said terminal section and the other being secured to said leader, adjacent portions of said wires being spaced approximately

one-thirty-second of an inch, a fusible conductor electrically connecting said terminal section and leader at points remote from said member, whereby said wires at the point of engagement with said member carry no current until the fusible conductor is destroyed and the arc established thereby extinguished, a tube surrounding said strain member and carried by said link, and a tensioning spring held in stressed condition between said leader and said insulating tube, whereby said strain member is placed under stress and said fusible conductor is relieved of strain.

7. A unitary spring tensioned fuse link for mounting in an expulsion fuse tube, said link comprising a terminal section, a leader, a frangible insulating strain member, a pair of strain wires threaded through said strain member in spaced relation and each forming a loop securing it to said strain member, said strain wires having a relatively high melting point, one of said wires being secured to said terminal section and the other being secured to said leader, a fusible conductor electrically connecting said strain wires at points remote from said member, whereby said wires at the point of engagement with said member carry no current until the fusible conductor is destroyed and the arc established thereby is extinguished, a tube surrounding said insulating strain member and fuse wire and carried by said link, and a spring held under stress between said leader and tube, whereby said strain member is placed under stress and said conductor is relieved of strain.

8. A unitary spring tensioned fuse link for mounting in an expulsion fuse tube, said link comprising a terminal section, a relatively rigid leader, a frangible insulating strain member, a pair of strain wires threaded through said member in spaced relation and each forming a loop securing it to said strain member, said strain wires having a relatively high melting point, one of said wires being secured to said terminal section and the other being secured to said relatively rigid leader, a fusible conductor electrically connecting said terminal section and leader at points remote from said member, whereby said wires at the point of engagement with said member carry no current until the fusible conductor is destroyed and the arc established thereby is extinguished, a tube surrounding said strain wires and member and said fuse wire, said tube being carried by said link, and a spring placed under stress between said relatively rigid leader and said tube, whereby to tension said strain wires and said conductor is relieved of strain.

9. A unitary spring tensioned fuse link for mounting in an expulsion fuse tube, said link comprising a terminal section, a relatively rigid leader, a frangible insulating strain member having an aperture therethrough, a pair of strain wires threaded through said aperture in spaced relation and each forming a loop securing it to said strain member, said strain wires having a high melting point, one of said wires being secured to said terminal section and the other being secured to said leader, a fusible conductor electrically connecting said terminal section and leader at points remote from said member, whereby said means at the point of engagement with said member carries no current until the fuse wire is destroyed and the arc established thereby is extinguished, a tube surrounding said strain wires and fuse wire and carried by said link, and a spring disposed in said tube and held under tension between said leader and tube, whereby to tension said strain wires and relieve said conductor of strain.

10. A fuse link for expulsion fuses, said fuse link comprising a terminal section, a leader, a frangible insulating block, a pair of wires having interlooped ends in spaced relation, said block being interposed between said interlooped ends to be subjected to compression forces, and a fusible element electrically connecting said terminal section and leader at points remote from said block, whereby said wires at the point of engagement with said block carry no current until the fusible section element is destroyed and the arc established thereby is extinguished.

11. A fuse link comprising a terminal member having a tubular end, an insulator tube secured in said tubular end, a strain wire passing through said insulator tube and secured against withdrawal therefrom, a leader connected to said strain wire, and a fusible element connecting said strain wire and terminal member, said strain wire being otherwise insulated from said terminal member.

12. In a fuse link, a terminal portion, a frangible insulator, a strain wire connecting said terminal portion and insulator, a flexible conductor connected to said insulator in spaced relation to said strain wire, and a fusible element electrically connecting said flexible conductor and said terminal portion at a point remote from the point of engagement of said wire and insulator.

13. In a fuse link, a terminal portion, a frangible insulator, an elongated conductor connected to said insulator, releasable electrically conductive means connecting said terminal and frangible element and disposed in spaced relation to said conductor, and a fusible element electrically connected to said conductor and to said terminal at a point remote from said insulator, whereby an arc established by the fusing of said element will be extinguished and a second arc established between said means and conductor and thereafter extinguished by the separation of said means and frangible insulator.

14. In a fuse link, an electrically conductive tubular portion, an insulating tubular member in said tubular portion, a strain wire extending through said member and having an enlarged end within said tubular portion holding said wire against withdrawal and spaced from said tubular portion by means of said member, and a fusible conductor electrically connected with said tubular portion and with said wire at a point remote from said portion.

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