May 9, 1939. O. B. CURRY 2,157,198

FUSE

Filed July 11, 1935 2 Sheets-Sheet 1

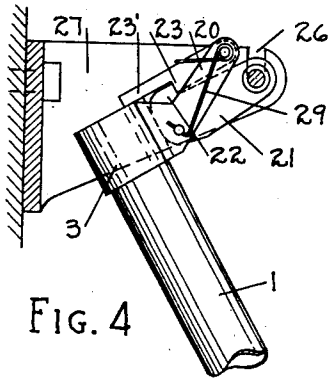


FIG. 4

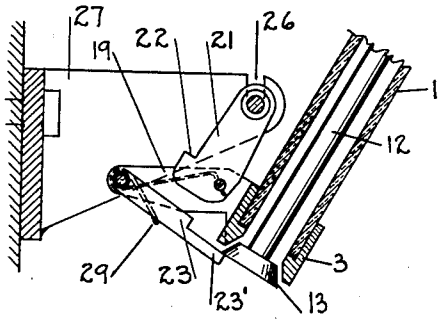
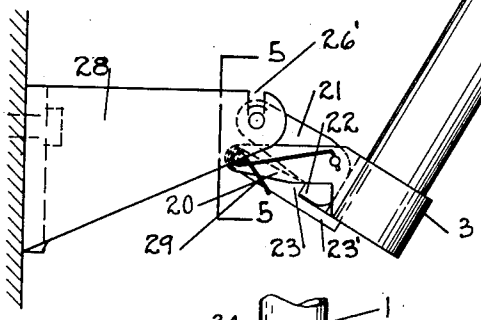


FIG. 3



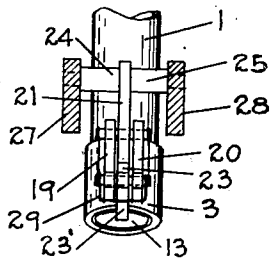


FIG. 5

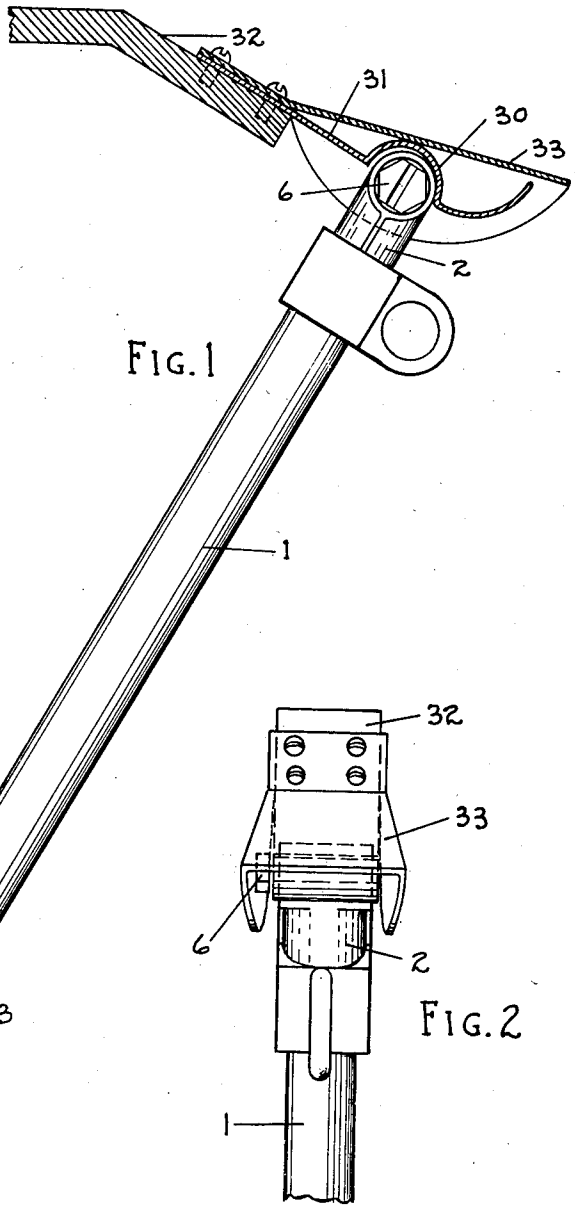


FIG. 1

FIG. 2

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FUSE

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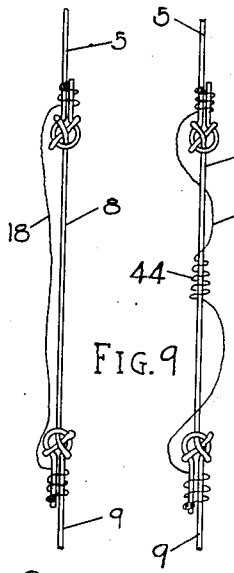


FIG. 8

FIG. 9

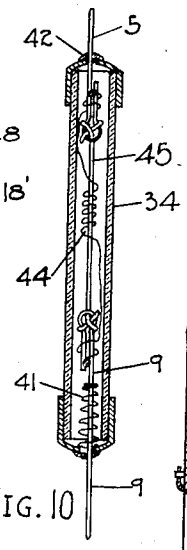


FIG. 10

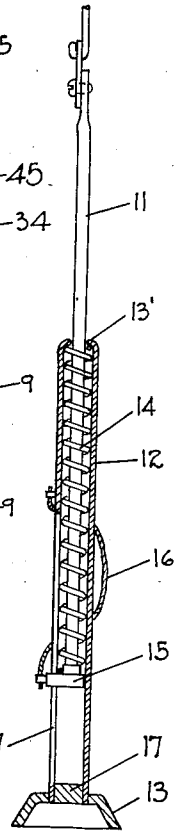


FIG. 7

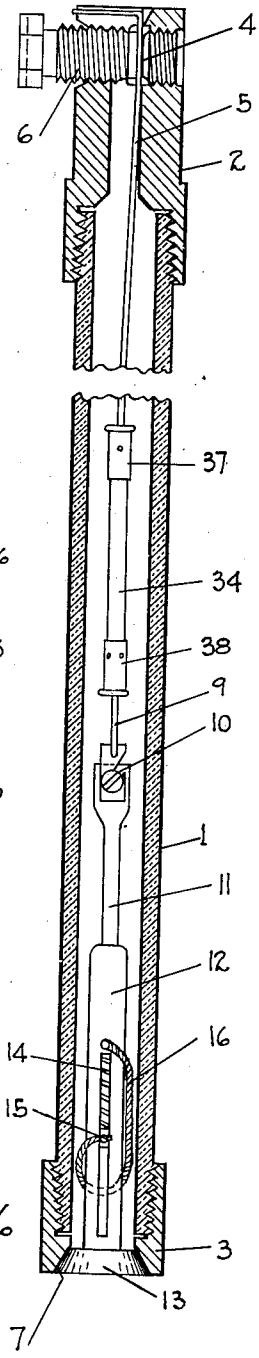


FIG. 6

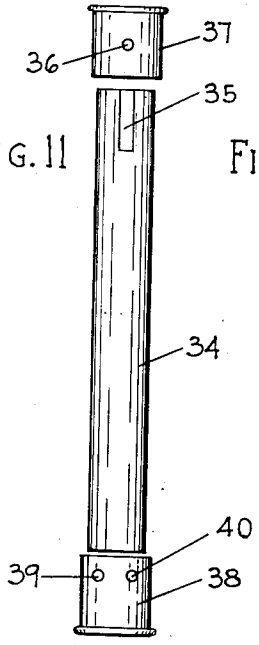


FIG. 11

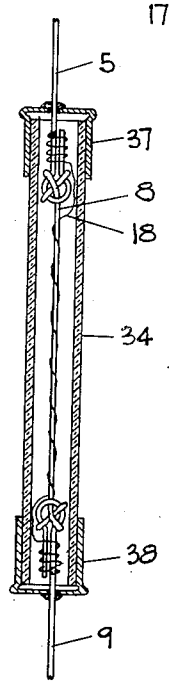


FIG. 12

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UNITED STATES PATENT OFFICE

2,157,198

FUSE

Oliver B. Curry, El Dorado, Kans., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application July 11, 1935, Serial No. 30,772

14 Claims. (Cl. 200—114)

This invention relates to electrical fuses, and more particularly to that class used in connection with high voltage circuits, but I do not wish to be limited in all aspects of the invention to any particular use, for obviously, although the invention is designed to take care of transformers and the like, it is capable of other uses.

One of the objects of my invention is to provide an inexpensive, durable and dependable fuse which will carry the required amperage when in service and which will remain relatively cool when normal current is passing through it, so that danger of charring the surrounding tube will be reduced to a minimum.

Another object of the invention is to provide a fuse link which will be constructed so that the ends of the line wire or conductor will be normally held in position by a fiber connector of low current conductivity, the connector being used so that the strain between the ends of the line wire will be resisted solely by it and the connector will have sufficient tensile strength to hold the ends of the wire in predetermined spaced relation, there being a conductor fuse wire of low tensile strength electrically connecting the two ends of the wire held by the connector, the fuse wire being ineffective to hold the two ends of the conductor wire, but capable of heating under the passage of abnormal currents through it, so that the connector will be charred of disintegrated to reduce its tensile strength whereby it will be incapable of functioning as a connector, therefore a slight pull on the connector after it has been subjected to heat from the fuse wire, will cause it to become broken, and since the fuse wire has no appreciable tensile strength, the disruption of the connector by a spring or other tension device, will cause both the fibre connector and the fuse wire to become broken and to disrupt or break the circuit.

As will be well understood, the fuse wire will heat under abnormal current conditions, as for example, when overload occurs on the line or when abnormal conditions are on the transformer or other electrical device with which the invention is associated.

Another object of my invention is to provide a fuse so constructed that a disconnect switch equipped with my fuse link will operate to cause an appreciable gap between the ends of the line or conductor to extinguish arcing between the ends of the conductor wire.

Other objects and advantages of the invention will become apparent by reference to the following description in connection with the accompanying drawings in which—

Figure 1 is a side elevational view of a fuse constructed in accordance with my invention, the fuse being shown in operative position.

Figure 2 is a fragmentary front view of the upper end of the fuse tube and its protecting hood.

Figure 3 is a view partly in section and partly in elevation of the fuse tube, the impacter, the trigger mechanism and the fuse support.

Figure 4 is a similar view showing the position of the lower end of the fuse tube in its released position.

Figure 5 is a fragmentary view of the hinge and trigger mechanism.

Figure 6 is a vertical, longitudinal, sectional view of the complete fuse, minus the trigger mechanism and the protecting hood.

Figure 7 is an enlarged view of the impacter and spring device for imparting tension to each fuse link.

Figure 8 is a detailed view of one form of fuse link.

Figure 9 is a similar view of a modified form of a fuse link.

Figure 10 is a similar view of a further modified form of fuse link.

Figure 11 is a disassociated view of the fuse link tube parts.

Figure 12 is a vertical longitudinal sectional view of one form of fuse link.

The main fuse tube 1 is constructed of insulating material having a metal cap 2 at one end and a metal collar 3 at the other. The metal cap 2 is provided with a fixed seat 4 to receive a fuse link wire or conductor 5, which may be held in intimate contact therewith by an additional screw 6 threaded into the side of the cap 2. The collar 3 on the tube 1 is provided with a conical seat 7 adapted to receive a complementary trigger actuator to be hereinafter referred to. The wire or conductor 5 is connected to a connector 8 by a knot or other means, the conductor 9 being appropriately fastened at 10 to a stem 11 which slides within a housing 12, provided at its lower end with a conical head 13 adapted to normally seat in the coned shaped opening 7 in the ring 3. Between the upper end 13' of the tubular housing 12 and the end of the stem 11 is an expansion spring 14 which bears against the end 13' and against the head 15 at the lower end of the stem. The head 15 is electrically connected to the housing 12 by a conductor 16, and it should here be observed that the

lower end of the housing 12 is closed at 17. The head 15 slides in the tubular housing 12 and projects through a guiding slot 17' and is adapted to strike the closed end 17 of the housing after the rupture of the connector under certain conditions as hereinafter explained.

The breaking of the connector 8 will depend upon abnormal current conditions, for example, by reference to Figure 8 it will be observed that the conductor 5 and the conductor 9 are secured together by a connector 8 which has low conductivity and which is constructed of suitable non-metallic material, preferably of fibre, such as a string, cord or similar device having sufficient tensile strength to hold the spring 14 under compression during normal operating conditions; and it will also be observed that a fuse wire 18 is fastened to the conductor 5 and conductor 9, so that normal current will pass through it without heating it to a sufficient degree to char or disrupt the connector 8. When the wire 18 becomes hot enough under abnormal conditions, the heat therefrom will char or disintegrate the connector 8 so as to destroy its effective tensile strength, so that the spring 14 under compression will expand and separate parts of connector 8 and break the wire 18 to interrupt the circuit.

In actual practice I have found that if the fiber connector is impregnated with finely divided conductive material it will generate its own heat to cause disruption of the connector in the event of mechanical or other failure of the fuse wire, so even though the fuse wire fails to function as intended, the string will break when abnormal conditions occur. When the connector is broken the impactor head 15 will strike 17 to force the head 13 outwardly, preferably against a trigger mechanism to release the tube 1 so it can drop and thereby make an appreciable gap in the circuit.

In Figure 1 I have shown the tube 1 with a pair of spaced bracket arms 19 and 20, which are rigid with the collar 3. These bracket arms pivotally carry a hinged latch member 21 provided with a shoulder 22 adapted to be engaged by a latch or detent 23, also pivoted between the bracket arms 19 and 20 and adapted to normally engage the latch member 21 to hold it rigid with respect to the arms 19 and 20, and therefore rigid with respect to the tube 1. The latch member 21 is provided with trunnions 24 and 25, which are hingedly received in slots 26 and 26' on the bracket arms 27 and 28. The slots or notches 26 and 26' will normally serve as bearings for the trunnions 24 and 25, but the trunnions may be lifted out of the notches when it is desired to remove the fuse tube 1.

It is to be observed that the detent 23 is provided with a finger 23' which overlaps the head 13 when it is in the ring 3, and said detent is held into latch engagement by the looped spring 29, so that under normal conditions the detent will engage the shoulder 22, as shown in Figure 1, therefore the hinge arrangement will be held rigid and the upper end of the tube 1 will lie in a groove 30 of a flat compression spring 31 which is fastened to a bracket 32, it being understood that the brackets 27 and 32 are connected to conductors and they in themselves are conductors.

The spring 31 will exert downward pressure on the tube 1, but inasmuch as all the parts 21, 23 and the arms 27 and 28 are rigidly held together, there will be no liability of the fuse tube 1 becoming accidentally disassociated with the parts in which it is mounted. If desired, the top end of the fuse tube 1 can be protected from the elements by a weather shielding hood 33 of appropriate construction.

In actual practice I prefer to locate the connector 8 and the fuse wire 18 in a fuse link tube which may conveniently consist of the central tubular member 34, having a groove 35 at one end to receive an indented portion 36 on the cap 37, and the other end may be provided with a cap 38 with punched indentations 39 and 40, to hold cap 38 to 34 so that both caps will be held in place and so that the fuse link, consisting of the members 8 and 18, will be protected by a housing.

The conductor for the top of the fuse link is fastened to the cap 37 and the conductor for the lower end of the fuse link is fastened to the cap 38. When the fuse link breaks the downward pull exerted by the spring for the impacter will pull the central tubular member 34 and the cap 38 as a unit away from the cap 37, so that an appreciable gap will exist between broken ends of the connector and the fuse wire, as will be well understood.

When all of the parts are assembled current will flow in the usual way through the line or conductor wire and the resistance or fuse wire 18 in the fuse link. Under abnormal conditions which are well understood, the wire 18 will heat sufficient to char or disintegrate the connector 8 so that now the tension on connector 8 caused by the spring 14 will be sufficient to overcome the tensile resistance of the connector 8 causing it to break, at the same time breaking the wire 18, which has no appreciable strength. As soon as the connector 8 breaks the head 15 will be forced against the member 17 striking it with sufficient force to move the detent 23 out of engagement with the latch member, as shown in Figure 3. Since there is downward pressure on the tube 1 by the spring 30, it will follow that the tube 1 with all the parts which it carries will move down to the position shown in Figure 3, so now the top end of the tube 1 disengages itself from the spring 31, allowing the tube 1 to swing outwardly downwardly so the parts will be in the position shown in Figure 4 and as soon as the tube 1 starts to swing downwardly the spring 29 will be effective in urging the detent into latching engagement with member 21 so that when the parts are in the position shown in Figure 4 they will all be rigidly connected together, therefore the operator can disengage the tube 1 from the bracket arms 27 and 28, by exerting an upward pressure on the released tube, because the trunnions are held in slots opened at the upper ends.

This easy removal of the tube 1 and its complementary parts expedites the reloading of the main fuse assembly, since no tools are required to remove or attach it.

A by no means unimportant feature of the invention is the provision of means for insuring the rigidity of the trigger mechanism to the tube 1 when tube 1 has dropped to inoperative position. If the hinge members remain loose, difficulty might be encountered in removing the tube from its bracket. At any rate, the convenience of tube removal by lifting the trunnion out of the notches in lower bracket while the parts are rigidly connected to tube 1 will be manifest, and I know of no previous construction in a device of this class where the hinge is restored to rigid association with the fuse tube after the hinge mem-

bers have been released to permit the tube 1 to swing outwardly and downwardly.

In Figure 9 I have shown a slightly modified form of fuse link in which the connector 8 is provided with a resistance wire 18' having a portion wound around it at 44 to concentrate the heat or localize it to facilitate disintegration or breaking down of the fibers. This form of device will also preferably be held in a housing or tube.

In Figure 10 I have shown a slightly modified form of fuse link in which it will be unnecessary to provide a hinge or impacter. In this form the tube 34 may be of any preferred form with a connector 45 for the ends of the wires 5 and 9. The fiber connector 45 may be heated from a fuse wire 44, as heretofore described, so that the connector will be destroyed or its strength reduced whereby a tension spring 41 will pull the link apart. The wire 5 is shown as fastened to the top of the tube as at 42, so that when a downward pull is exerted by the tension spring, the lower part of the link will be separated from the first with a wide enough gap to prevent the current from flowing. The wire 9 in this form can be welded or fastened to the collar 3, or some other conductor on the end of the tube so that the metallic end when received in a conducting socket will permit current flow, and in this form of link the tube 1 will be held stationary under all conditions except when it is removed from appropriate securing brackets. In all forms of the link there is a connector which is constructed of fibrous non-conducting material or material of low conductivity, but of sufficient tensile strength to resist the normal tendency of the parts to separate and a fuse wire of predetermined conductivity, greater than that of the connector, but of low tensile strength, so I do not wish to be limited to the exact details of construction shown since various kinds of materials can be used without departing from the spirit of my invention.

What I claim is:

1. In a device of the class described, a fuse tube of insulating material having metal portions in spaced relation, a fuse link mechanism held within the tube and electrically connected at its respective ends to the spaced metal portions, a hinge mechanism connected to one of the metal portions, receivable in a bracket, said hinge mechanism consisting of movable parts normally rigidly held together, means for exerting longitudinal pressure on the tube and means within the tube controllable by the fuse link mechanism for actuating the hinge parts to releasing position to permit the tube to disengage from said means, the hinge mechanism having inherent tendency to restore the parts in rigid position with themselves and with the tube during the disengaging movement of the tube.

2. In a device of the class described, a fuse tube of insulating material, spaced contacts carried by the tube, a fuse link mechanism connected electrically to the contact members, said fuse link mechanism including an impacter to exert a blow longitudinally of the tube when the fuse link is blown, a bracket carried by the tube, a trigger member carried by the bracket, a trigger member detent pivotally carried by the bracket and yieldingly engaging the trigger member, the detent having a part in the path of movement of the impacter so that the impacter may release the trigger member-engaging detent to release the trigger member and pressure means on the tube for causing releasing movement of the tube after the impacter has caused the trigger member-engaging detent to release the trigger member.

3. In a device of the class described, a fuse tube of insulating material, spaced contacts carried by the tube, a fuse link mechanism connected electrically to the contact members, said fuse link mechanism including an impacter to exert a blow longitudinally of the tube when the fuse link is blown, a bracket carried by the tube, a trigger member carried by the bracket, a trigger member-engaging detent pivotally carried by the bracket and yieldingly engaging the trigger member, the detent having a part in the path of movement of the impacter so that the impacter may release the trigger-engaging detent to release the member and pressure means on the tube for causing releasing movement of the tube after the impacter has caused the trigger-engaging detent to release the trigger member, and means for restoring the trigger member-engaging detent, the trigger member and the bracket in rigid relation during the releasing movement of the tube.

4. A fuse tube having contact members in spaced relation insulated one from the other, a fuse link electrically connected at one end to one of the contacts, a spring actuated impacter connected to the other end of the fuse link, said impacter being normally electrically connected to the other contact member, two spaced brackets, one having a spring to press upon one contact, a normally rigid hinge mechanism associated with the other contact and removably engaging the other bracket, the hinge mechanism having a part adaptable to be impacted by the impacter upon destruction of the fuse link to cause parts of the hinge mechanism to disengage to release the opposite ends thereof.

5. A fuse tube having contact members in spaced relation, insulated one from the other, a fuse link electrically connected at one end to one of the contacts, a spring actuated impacter connected to the other end of the fuse link, said impacter being normally electrically connected to the other contact member, two spaced brackets, one having a spring to press upon one contact, a normally rigid hinge mechanism associated with the other contact and removably engaging the other bracket, the hinge mechanism having a part adaptable to be impacted by the impacter upon destruction of the fuse link to cause parts of the hinge mechanism to disengage to permit downward pressure on the tube to release the upper end thereof and permit the tube to swing outwardly and downwardly, and means associated with the hinge mechanism for restoring the hinge parts rigid with the tube after the upper end of the tube is released.

6. A fuse tube, having contact members in spaced relation, a fuse link electrically connected at one end to one of the contact members, an impacter connected to the other end of the fuse link, said impacter being normally electrically connected to the other contact member, two supports, one having a spring to press upon one contact member, a hinge mechanism associated with tho other contact member and removably engaging the other support, the hinge mechanism having a part adapted to be impacted by the impacter upon destruction of the fuse link, to permit parts of the hinge mechanism to disengage and allow downward pressure on the tube to release the upper end thereof, so that the tube may swing outwardly and downwardly.

7. A fuse tube, having contact members in spaced relation, a fuse link electrically connected

at one end to one of the contacts, an impacter connected to the other end of the fuse link, said impacter being normally electrically connected to the other contact member, two supports, one having a spring to press upon one contact member, a hinge mechanism associated with the other contact member and removably engaging the other support, the hinge mechanism having a part adaptable to be impacted by the impacter upon destruction of the fuse link, to permit parts of the hinge mechanism to disengage and allow downward pressure on the tube to release the upper end thereof, so that the tube may swing outwardly and downwardly, and means for restoring the hinge parts to rigid relation with the tube after the upper end of the tube is released.

8. In a fuse device, a fuse tube, a fusible element within said tube, means for pivotally supporting the lower end of said tube, latching means engaging the upper end of said tube for normally holding said tube in the closed circuit position, said support means comprising relatively movable members and means independent of said fusible element for holding said members in fixed relation with respect to each other to maintain the upper end of said fuse tube in engagement with said latching means, and means responsive to the fusion of said fusible element for causing relative movement between said movable members to enable said fuse tube to disengage from said latching means.

9. In a fuse device, a fuse tube, a fusible element within said tube, a hinge mechanism for pivotally supporting the lower end of said tube, a stationary support engaging the upper end of said fuse tube for normally holding said tube against rotation about its lower end, said hinge mechanism comprising at least one pair of members movable relative to each other for causing limited longitudinal movement of said fuse tube and latch means for holding said members in a fixed relation with respect to each other independently of said fusible element to normally maintain the upper end of said fuse tube in engagement with said stationary support, and means responsive to the fusion of said fusible element for actuating said latch means to cause relative movement between said movable members whereby said fuse tube is moved first longitudinally out of engagement with said stationary support and finally rotatively about its lower end to open circuit position.

10. A fuse link comprising a pair of spaced conductors, a slow burning strain member joining said spaced conductors, said strain member including a flexible element of combustible nonconducting material rendered slightly conducting with finely divided conducting particles and a fusible element also joining said spaced conductors and disposed adjacent to said strain member.

11. A fuse link comprising a pair of spaced conductors, a slow burning strain member joining said spaced conductors, said strain member including a flexible element of combustible nonconducting fibrous material impregnated with finely divided carbon particles to render it slightly conducting and a fusible element also joining said spaced conductors and in part wrapped around said strain member, said fusible element having a greater current carrying capacity than said strain member but less tensile strength.

12. A fuse link comprising a pair of spaced conductors, a slow burning strain member joining said spaced conductors, said strain member including a flexible element of combustible nonconducting organic material impregnated with finely divided conducting particles to render it slightly conducting and a fusible element also joining said spaced conductors and disposed adjacent to said strain member, said fusible element having a greater current carrying capacity than said strain member but less tensile strength, a tubular shield member of insulating material surrounding said strain member and said fusible element and a closure for each end of said shield member and through which one of said spaced conductors extends, and means securing each of said closures to its corresponding conductor, at least one of said closures having releasable engagement with said shield member to permit said conductors to be separated upon rupture of said fusible element and said strain member.

13. In a fuse device, a fuse tube, means for movably supporting one end of said tube, means releasably engaging the other end of said tube, conducting means within said tube including a pair of separable conducting members, spring means within said tube biasing said conducting members apart and a fusible element within said tube normally joining said conducting members, and means actuated by at least one of said conducting members in response to movement thereof by said spring means within said tube following fusion of said fusible element for causing said fuse tube to be released from said engaging means.

14. In a fuse device, a fuse tube, means for pivotally supporting the lower end of said tube, means for releasably engaging the upper end of said tube for normally holding said tube against swinging movement about its pivotal support means, a fuse link within said tube including a conducting member, an impacting member within said tube, spring means within said tube for moving said impacting member and a fusible element joining said impacting and conducting members, said fusible element normally restraining said impacting member against movement by said spring means, and means actuated by movement of said impacting member by said spring means upon fusion of said fusible element for causing the upper end of said fuse tube to be released from said engaging means to enable the tube to swing about its pivotal support.

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