Sept. 5, 1939. S. R. SMITH 2,172,226

FUSE

Filed Nov. 10, 1937

Fig. 1.

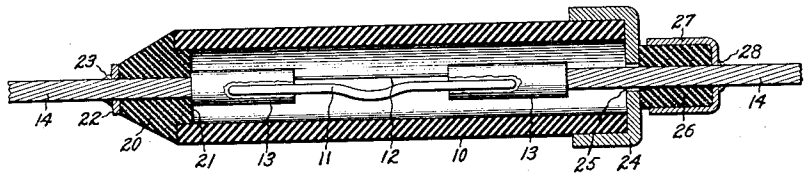


Fig. 2.

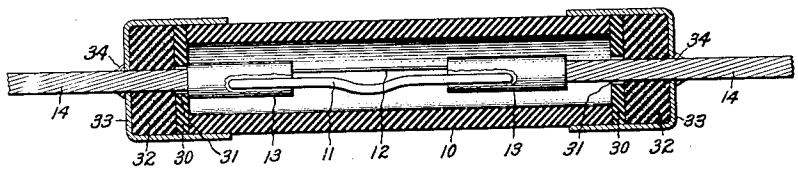


Fig. 3.

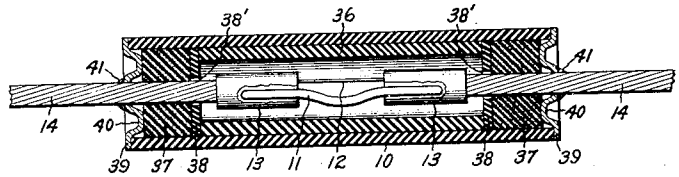


Fig. 4.

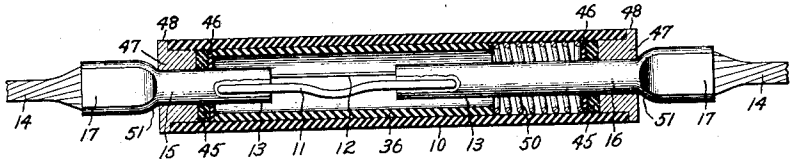
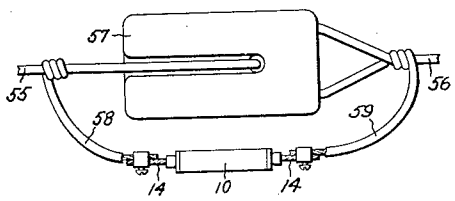


Fig. 5.



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FUSE

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16 Claims. (Cl. 200—117)

The present invention relates to fuses and has for an object the provision of an improved simple and low cost fuse construction particularly suited for, but not necessarily limited to, outdoor installations such as on overhead secondary distribution lines.

A further object is the provision of a fuse device having a weather-tight housing which may be installed in any position without danger of moisture entering thereinto to cause corrosion and damage to the internal parts of the fuse device.

Other objects and the details of that which I believe to be novel and my invention will become apparent from the following description and the claims appended thereto, taken in conjunction with the accompanying drawing in which Figs. 1 to 4 illustrate exemplary fuse constructions embodying the present invention; and Fig. 5 illustrates diagrammatically one way in which fuses of the type illustrated in Figs. 1 to 4 may be mounted.

Referring to the drawing, 10 designates an open-ended tubular casing of insulating material, preferably weatherproof, which is adapted to form part of an enclosing housing for a fuse link. One suitable form of fuse link is illustrated in Figs. 1, 2 and 3. This fuse link has a fusible section which is disposed within casing 10 and is comprised of a relatively low melting point wire 11 and a strain wire 12 connected to and extending between a pair of terminals 13, and has a pair of flexible connection leads 14 extending outwardly respectively from the terminals 13 through the opposite ends of the casing. Another form of fuse link which may be employed in the carrying out of the present invention is illustrated in Fig. 4 and in this case the left and right-hand terminals 13 have relatively stiff elongated shank portions 15 and 16 respectively which are adapted to project from the opposite ends of the casing, the right-hand shank extension 16 being somewhat longer than the left-hand shank extension 15. In this latter form of fuse link, the flexible leads 14 are connected respectively to the outer ends of the shank extensions 15 and 16 by crimping or swaging as indicated at 17.

In the embodiment of Fig. 1, the left-hand end of casing 10 is closed by means of a substantially frustro-conical, washerlike closure element or stopper 20 through which the left-hand connection lead 14 extends. This stopper is comprised of deformable resilient material such as rubber and the base of the stopper has a round boss 21 which fits into the bore of the casing. The outer end of the stopper is flat so as to provide a bearing surface for a relatively stiff metal capping disk or washer 22 which is connected to the left-hand connection lead in any suitable manner, as for example by soldering as indicated at 23, so as to press against the outer end of the stopper and force the outer portion of the base of the stopper, around boss 21, into tight engagement with the left-hand end of casing 10.

The right-hand end of casing 10 in the construction of Fig. 1 is provided with a metal closure cap 24 which fits snugly over the right-hand end of the casing and has in its end wall a centrally located opening 25 for the passage therethrough of the right-hand connection lead 14. Externally of cap 24 is a washerlike packing or sealing element 26 which surrounds the right-hand connection lead 14 and is comprised of deformable resilient material such as rubber. The packing element or washer 26 is arranged to be pressed against the outer face of cap 24 by means of a cup-shaped metal reinforcing cap 27 which surrounds the lacking washer and is connected to the right-hand connection lead 14 in a suitable manner, as for example by soldering, as indicated at 28.

In the assembly of the device of Fig. 1, the component elements above described are arranged as illustrated and then capping disk 22 and cup-shaped cap 27, while being pressed with considerable force toward the respective adjacent ends of casing 10, are secured to the connection leads passing therethrough in the manner set forth. Thus, the outer portion of the base of stopper 20 around boss 21 is forced into moisture-tight sealing engagement with the left-hand end of the casing and the peripheral surface of boss 21 is forced into moisture-tight sealing engagement with the inner wall of the casing, while the inner face of packing washer 26 is forced into moisture-tight sealing engagement with the outer face of cap 24 around opening 25. The resultant compression of the two washerlike elements 20 and 26 also causes deformation thereof into moisture-tight sealing engagement with the connection leads respectively extending therethrough, the frusto-conical shape of element 20 preventing its outward buckling and reinforcing cap 27 preventing outward buckling of element 26. As a result of this method of assembly, the portion of the fuse link within casing 10 is subjected to tension by the expansive force of element 20 and element 26 against capping disk 22 and cap 27 respectively. The tension on the fuse link is

then operative normally to maintain the elements 20 and 26 under compression.

In the construction of Fig. 2, both ends of casing 10 are closed by means of disks 30 which have centrally located openings 31 for the outward extension therethrough of the connection leads 14 of the fuse link. These disks are relatively stiff and preferably are comprised of fibrous insulating material although they may be comprised of metal. Surrounding the connection leads exteriorly of disks 30 are packing elements or washers 32 of deformable resilient material which are disposed within cup-shaped metal caps 33 snugly fitted respectively over the opposite ends of casing 10 and having openings in their end walls for the passage therethrough of the connection leads. A material such as soft spongy rubber is particularly suitable for the construction of the packing elements in the embodiment of Fig. 2 as well as in the other embodiments illustrated and described herein. In the assembly of the device of Fig. 2, the caps 33 are pressed inwardly with considerable force toward the respective adjacent ends of casing 10 so as to compress the packing elements or washers 32, and the caps 33 are then secured to the connection leads passing therethrough in any suitable manner as for example by soldering as indicated at 34. This compression of the packing washers by caps 33 results in deformation of the washers into moisture-tight sealing engagement with the connection leads 14 passing therethrough and results also in moisture-tight sealing engagement between the adjacent faces of disks 30 and washers 32, disks 30 being at the same time pressed firmly against the ends of casing 10. The resultant expansive force of the packing washers against caps 33 imposes tension upon the portion of the fuse link within casing 10 and the tensioned fuse link is then operative to maintain the packing washers compressed.

In order to secure an even more effective weather-tight sealing of the fuse enclosing housing of the present invention, the packing elements or washers may be disposed within casing 10 as in the constructions illustrated in Figs. 3 and 4. In both of these constructions there is disposed within casing 10 an inner tubular casing 36 which is comprised of insulating material and which is shorter than casing 10 so that the outer ends of casing 36 are spaced inwardly from the adjacent outer ends of casing 10. The inner casing may be slidable relative to the outer casing or may be fixed, as desired. The two packing elements or washers 37 of the device of Fig. 3 are disposed respectively at the opposite ends of the inner casing between disks 38 and closure caps 39. As will be seen from the drawing, the connection leads 14 of the fuse link extend respectively at the opposite ends of casing 10 through the disks 38, packing washers 37, and end caps 39. End caps 39 have inwardly projecting annular ridges 40 arranged to bear against the outer faces of the packing washers. With the component parts of the device of Fig. 3 assembled as illustrated, end caps 39 are pressed inwardly so that their outer rim portions press tightly against the respective opposite ends of casing 10 and the end caps are then secured to the connection leads passing therethrough in any suitable manner, as by soldering as indicated at 41. Thus, the packing washers 37 are compressed between the disks 38 and the inwardly projecting ridges 40 of end caps 39 and the inner faces of the packing washers are forced into moisture-tight sealing engagement with the outer faces of disks 38 around the centrally located openings 38' therein through which the connection leads extend. Also, the compression of the packing washers causes deformation thereof into moisture-tight sealing engagement with the connection leads extending therethrough and with the surrounding inner walls of casing 10. The portion of the fuse link within the fuse housing is subjected to tension by the expansive force of the packing washers against the end caps 39 and the tensioned fuse link portion serves to maintain the packing washers under compression.

The sealing of the left-hand end of casing 10 in the embodiment of Fig. 4 is accomplished in a manner similar to that just described in connection with the embodiment of Fig. 3. However, a smaller packing washer 45 to toroidal shape is employed in the construction of Fig. 4 and this washer is compressed against the disk 46 at the left-hand end of inner casing 36 by means of an end cap 47 which has a round body portion fitting into the bore of casing 10 and which has also a peripheral flange 48 which bears against the left-hand end of casing 10. At the right-hand end of the device of Fig. 4 a similar form of disk 46, torodial packing washer 45, and end cap 47 are employed but a coil spring 50 is inserted between the right-hand disk 46 and the right-hand end of inner casing 36. In the assembly of the device of Fig. 4, the end caps 47 are pressed inwardly so that their flanged rims 48 press tightly against the opposite ends of casing 10, and the outer ends of the fuse link terminal shanks 15 and 16 are then crimped or swaged around connection leads 14 in such manner that the shoulders 51 formed in the terminal shanks by the crimping or swaging engage the outer faces of the end caps 47 so as to hold these caps in place. Thus, the left-hand packing washer 45 is compressed between the left-hand end cap 47 and the disk 46 which bears against the left-hand end of inner casing 36, while the right-hand packing washer 45 and spring 50 are compressed between the right-hand end cap 47 and the right-hand end of inner casing 36. The packing washers thereby are forced into moisture-tight sealing engagement with the outer face of disks 46 around the openings therein through which the fuse link terminal shanks extend, and, due to their compression, are deformed into moisture-tight sealing engagement with the terminal shanks and with the surrounding inner walls of outer casing 10. As in the previously described embodiments, the expansive force of the packing washers against the end caps imposes tension upon the fuse link and the tensioned fuse link in turn maintains the packing washers under compression. The round cross-section of the toroidal packing washers 45 facilitates deformation and radial expansion thereof into sealing engagement with the fuse link terminal shanks and the inner walls of the outer casing. Spring 50 serves to maintain substantially constant tension on the fusible section of the fuse link regardless of any setting of the packing washers and of any creeping or stretching which may occur in the fusible section.

The constructions hereinbefore described provide extremely low cost fuse units which may be supplied to operating companies for quick and easy installation on over-load lines in various ways, one of which is illustrated for example in Fig. 5. In the arrangement shown in Fig. 5, line conductors 55 and 56 are fastened to a strain in-

sulator 57 in a well-known manner so as to leave the ends 58 and 59 respectively of the conductors free for connection to the opposite leads 14 of a fuse device which is diagrammatically illustrated and labeled with the casing designation 10. As will be evident from the foregoing descriptions, the fuse devices of the present invention are of such weather-tight construction that they may be installed in any position without danger of entrance of moisture into the enclosing housings thereof to cause corrosion and damage of the internal fuse parts. Also, the construction and arrangement of the packing elements or washers is such that they serve not only to provide the desired weather-tight sealing but also as fuse tensioning and retracting means. In case one of the fuse devices of the present invention is subjected to a fault current of relatively low value while it is installed as above set forth, the expansive force of the compressed packing elements or washers insures separation of the fusible section of the fuse link so that the fusible section will not remain on the line in intact but damaged condition, and with a device of the type shown in Fig. 4, the expansive force of spring 50 also is operative to insure separation of the fusible section. On the other hand, if the fuse device is subjected to a fault current of a high value, such as on a short circuit, the expulsion force of the gases within the fuse housing will produce the separation of the fusible section of the fuse link. In either case, upon release of the fuse link tension due to rupture of the fusible section, the end closures of the fuse housing are released so that the casing may drop, thus effecting further separation of the fuse link terminals to aid in the interruption of the fault current. Subsequent to the operation of the fuse device, the absence of the enclosing casing and the downward hanging of the ends of the line conductors with the fuse link connection leads and terminals fastened thereto provides clear indication of fuse operation.

As will be evident to one skilled in the art, the present invention is not limited to the specific details of the illustrated constructions. For example, the sealing or packing elements or washers of the several embodiments may assume various forms and, if desired, a plurality of such sealing or packing elements or washers may be employed at one or both ends of all of the illustrated devices instead of the single packing element or washer illustrated. Also, a fuse link of the type illustrated in Fig. 4 may be employed in the embodiments of Figs. 1, 2 and 3, or vice versa, a fuse link of the type illustrated in Figs. 1, 2 and 3 may be employed in the embodiment of Fig. 4, or other suitable forms of fuse link may be employed in one or all of the embodiments. It will be evident also that different closure means may be employed at the two opposite ends of the fuse housing, as for example as illustrated in Fig. 1, and that different combinations of the herein-before described sealing and closing means may be employed in an individual device.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a fuse device, the combination with a fuse link and an enclosing housing therefor having an opening through which extends outwardly a connection portion of the fuse link, of means including a packing element of resilient material substantially moisture-tightly sealing said opening around said portion of the fuse link and means normally maintaining said packing element under compression and utilizing the expansive force of the compressed packing element for imposing tension on the fuse link.

2. In a fuse device, a housing, a fuse link having a fusible section in said housing and a connection portion extending outwardly through an opening in the housing, a packing washer of deformable resilient material surrounding said connection portion adjacent said opening, and means tensioning said fusible section and utilizing the tension on the fusible section for maintaining said washer in substantially moisture-tight sealing relation with said opening.

3. In a fuse device, a housing, a tensioned fuse link in said housing having a connection portion extending outwardly through an opening in said housing, a packing washer of deformable resilient material surrounding said connection portion adjacent said opening and means cooperative with said fuse link under the influence of the tension on the fuse link to compress and deform said washer into tight engagement with said connection portion and with the walls of said housing around said opening, thereby to effect a substantially moisture-tight sealing of the opening.

4. In a fuse device, an enclosing housing having an opening in one end thereof, a packing element for said opening comprised of deformable resilient material, a tensioned fuse link having a fusible section in said housing and a connection portion extending outwardly through said packing element, said connection portion having a pressure exerting element engaging said packing element, and means including said pressure exerting element cooperative with said fuse link under the influence of the tension on the fuse link for maintaining said packing element under compression and in substantially moisture-tight sealing relation with said opening.

5. In a fuse device, a housing, a fuse link having a fusible section in said housing and a portion extending outwardly through an opening in the housing, means for closing said opening including an element surrounding said outwardly extending portion of the fuse link exteriorly of the opening and comprised of resilient deformable material, a member connected with said portion of the fuse link exteriorly of and pressing against said element, and means including said member utilizing the tension of said fuse link for compressing said element into substantially moisture-tight sealing engagement with the wall of said housing around said opening.

6. In a fuse device, a housing, a fuse link in said housing having a portion extending outwardly through an opening in the housing, an element of deformable resilient material surrounding said outwardly extending fuse link portion exteriorly of said opening, a cup-shaped cap surrounding said element and connected with said outwardly extending portion of the fuse link exteriorly of the said element, and means including said cap cooperative with said fuse link for compressing said element into tight engagement with the wall of said housing around said opening, said compressed element serving normally to maintain said fuse link under tension.

7. In a fuse device, a fuse link, means providing an enclosing housing for said link having an opening for the outward extension therethrough of a connection portion of the fuse link and having an outwardly facing abutment adjacent the opening, a bearing element on said connection portion of the fuse link exteriorly of said abutment, and a packing washer of deformable re-

silient material for said opening normally compressed between said abutment and said bearing element and operative to impose tension on said fuse link.

8. In a fuse device, a tubular casing having an open end, a packing element of deformable resilient material in said casing adjacent said open end thereof, a tensioned fuse link in said casing having a portion extending through said element, and means utilizing the tension of said fuse link for normally maintaining said element compressed and in substantially moisture-tight sealing engagement with the surrounding walls of said casing.

9. In a fuse device, a fuse link, a housing therefor including an outer tubular casing and an inner tubular casing arranged within the outer casing with one end of the inner casing spaced inwardly from the corresponding end of the outer casing, a packing washer comprised of deformable resilient material disposed within said outer casing intermediate the said ends of said two casings, said fuse link having a connection portion extending outwardly through said washer, a bearing cap connected with said connection portion of the fuse link exteriorly of said washer for pressing against the exterior of the washer, and means including said link for effecting compression of said washer between said cap and the said one end of said inner casing to force the washer into substantially moisture-tight sealing engagement with the surrounding inner walls of said outer casing.

10. In a fuse device, a fuse link, means providing a housing therefor having an opening for the outward extension of a connection portion of the fuse link, a packing washer for said opening disposed around said connection portion and comprised of deformable resilient material, means including a coiled compression spring operatively connected for imposing tension on said fuse link and means cooperative with said spring for compressing said washer into substantially moisture-tight sealing engagement with the walls of said housing around said opening.

11. In a fuse device, a tubular casing having an open end, means providing an abutment in said casing spaced from said open end thereof, a helical spring in the casing intermediate said abutment and said open end of the casing, a washer-like element of resilient deformable material in said casing at one end of said spring, a fuse link in said casing having a portion extending outwardly through said washer-like element, and means utilizing the tension of said fuse link for maintaining said spring and said washer-like element compressed against said abutment with said washer-like element in substantially moisture-tight engagement with the surrounding inner walls of the casing.

12. In a fuse device for outdoor installation, a weatherproof tubular casing having openings respectively at opposite ends thereof, a fuse link in said casing having connection portions extending out respectively through said openings, means weather-tightly sealing the opening at one end of the casing around the fuse link connection portion extending therethrough, a compressed packing washer of deformable resilient material tightly surrounding the other of said fuse link connection portions and weather-tightly sealing the opening in the other end of said casing through which said other fuse link connection portion extends, and means normally utilizing the expansive force of said compressed washer for imposing tension on said fuse link.

13. In a fuse device, a housing, a fuse link having a fusible section in said housing and a stiff shank portion extending outwardly through an opening in said housing, a compressed packing member of resilient material surrounding said shank portion adjacent said opening for substantially moisture-tightly sealing the opening, and means including said compressed member tending to force said shank portion longitudinally outward to impose tension on the portion of said fuse link within the housing.

14. In a fuse device, a casing having an opening for discharge of gases therefrom, a tensioned fuse link having a fusible section in said casing, closure means for said opening including a packing of deformable resilient material, and means operative under the influence of the tension of said fuse link to maintain said packing normally compressed in substantially moisture-tight sealing relation to said opening, said closure means being releasable upon rupture of said fusible section to permit discharge of gases from said casing.

15. In a fuse device, a casing having an opening for discharge of gases therefrom, a fuse link having a fusible section in said casing and a connection portion extending outwardly through said opening, means including a spring operative normally to tension said fuse link, closure means for said opening including a packing of deformable resilient material in surrounding relation to said connection portion, and means operative under the influence of the tension of said fuse link to maintain said packing normally compressed in substantially moisture-tight sealing relation to said opening, said closure means being releasable upon rupture of said fusible section to permit discharge of gases from said casing.

16. In a fuse device for outdoor installation, a weatherproof tubular casing, a fuse link having a fusible section in said casing and connection portions extending outwardly respectively through openings at opposite ends of the casing, means operative normally to tension said fusible section and operative upon rupture of the fusible section to effect relative movement apart of said connection portions and widening of the gap between the ruptured ends of the fusible section, means weather-tightly closing the opening at one end of said casing around the corresponding one of said connection portions and means providing a releasable weather-tight seal for the opening at the other end of the casing around the other of said connection portions, which said last means is releasable upon fuse operation to permit discharge of gases from the casing.

SIDNEY R. SMITH.