April 30, 1940. D. W. FLOTEN 2,198,663

FUSE

Filed Jan. 3, 1938

Fig. 1.

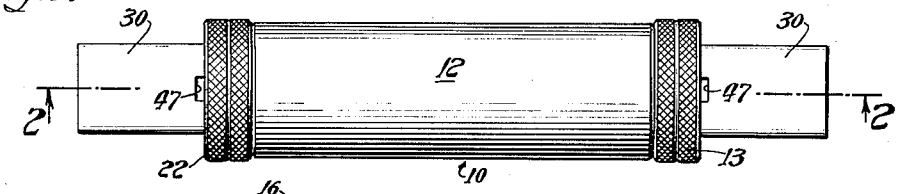


Fig. 2.

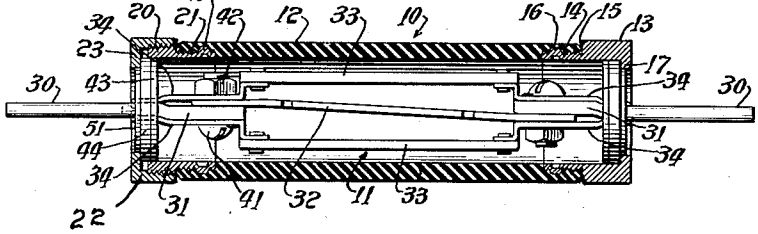


Fig. 3.

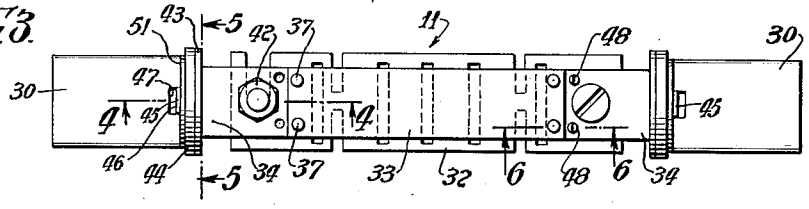


Fig. 4.

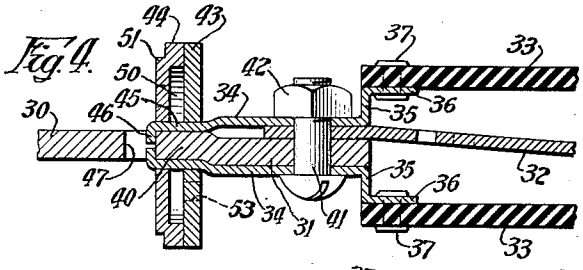


Fig. 5.

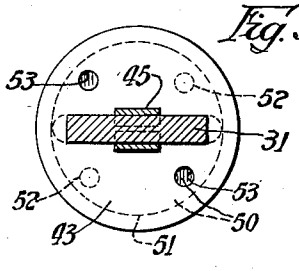


Fig. 6.

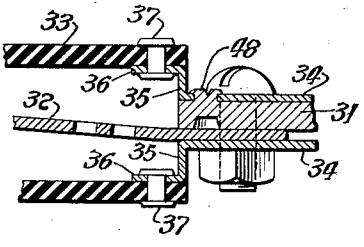


Fig. 7.

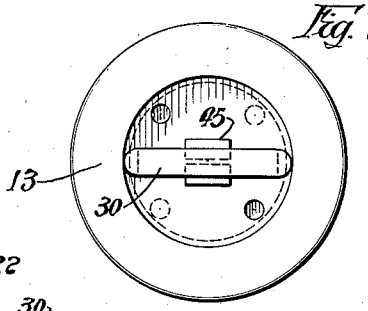
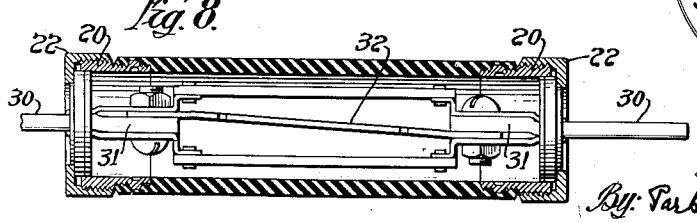


Fig. 8.



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UNITED STATES PATENT OFFICE

2,198,663

FUSE

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Application January 3, 1938, Serial No. 183,037

30 Claims. (Cl. 200—131)

The invention relates generally to electric fuses and more particularly to a fuse of the cartridge type.

The general object of the invention is to provide a fuse of the renewable cartridge type, which may be easily assembled and disassembled, which has relatively few separate parts when disassembled, and which requires but little care in seeing that the parts are assembled in a particular relationship.

It is also a general object to provide a renewable fuse which is so constructed that excessive heating under normal loads is avoided; that the parts other than the fusible portion of the fusible element do not in themselves constitute material sources of heat affecting the operation of the fusible element; and that the fusible element is held without any mechanical strain sufficient to alter the characteristics of the element by expansion and contraction or bending.

Another object is to provide a renewable fuse comprising a casing and a fuse element assembly, the latter being constructed to avoid strain on the element, to hold the terminals in alinement, thereby avoiding dependence upon the casing for this function, and to cooperate with the casing in such a manner as to facilitate assembly of the fuse and avoid complexity of the parts both of the fuse element assembly and of the casing.

A further object is to provide a fuse element assembly which gives the maximum area of contact for the connection between the fuse element and the terminals, thereby avoiding undesirable generation of heat at these points.

Still another object is to provide a renewable fuse construction avoiding the necessity of close accuracy in the making and assembly of the parts and at the same time providing uniform venting of the casing under varied conditions of operation.

A still further object is to provide a renewable fuse comprising a casing and fuse element assembly, in which the fuse element assembly may be inserted into the casing with either end first.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawing, in which:

Figure 1 is a side elevational view of a fuse embodying the features of the invention.

Fig. 2 is a longitudinal section taken on the line 2—2 of Fig. 1.

Fig. 3 is an elevational view of the fuse element assembly of the fuse.

Fig. 4 is an enlarged fragmentary section taken on the line 4—4 of Fig. 3.

Fig. 5 is an enlarged transverse section taken on the line 5—5 of Fig. 3.

Fig. 6 is an enlarged fragmentary section taken on the line 6—6 of Fig. 3.

Fig. 7 is an enlarged end view of the fuse.

Fig. 8 is a longitudinal section similar to Fig. 2 but showing a modified form of the fuse.

For purposes of illustration, a fuse of the knife blade type is shown and described herein but many of the features of the invention are applicable to a ferrule type fuse as well as a knife blade type.

The fuse illustrated herein comprises generally a tubular casing structure, indicated generally at 10, as shown in Fig. 2, and a fuse element assembly, indicated generally at 11, the latter being shown without the casing structure in Fig. 3. The fuse element assembly constitutes a rigid structure capable of relieving the fuse element of such mechanical strain as might affect the electrical characteristics of the fuse element by stretching or bending. Thus, the rating of the fuse element will not change on alternate heating and cooling of the fuse in normal operation. The fuse element assembly is also constructed so that it does not require a particular end-to-end relation with the casing structure. In other words, either end of the fuse element assembly may be inserted into the casing first to fit with either end of the casing structure.

The rigidity of the fuse element assembly also serves to hold the terminals of the assembly accurately alined. In most prior structures, the terminals are held in proper alinement chiefly by cooperation between the fuse element assembly and the casing structure, such as providing a notched interfit between washers on the fuse element assembly and the ends of the casing. The rigidity of the present fuse element assembly eliminates the necessity for such interfit, thereby simplifying the parts and also permitting the fuse element assembly to be turned to any position rotatively of the casing in assembling them. A further advantage resides in the avoidance of the necessity of such an interfit, namely, that the relative lengths of the casing structure and the fuse element assembly do not have to be held to close limits to provide such an interfit.

The fuse element assembly comprises generally a pair of terminals held in alinement by a pair of insulating bridges so positioned relative to the fuse element as to relieve it of mechanical strain due to expansion or when as-

sembled. The insulating bridges are attached to the terminals by metal supports which also serve to clamp the ends of the fuse element against the terminals. Thus, electrical contact is made on both faces of the fuse element at each end, giving the maximum area of contact and hence a minimum tendency to heat at these points. The bridge supports are connected to the terminals in such a manner as to rigidly secure, on the terminals, washers serving as closures for the ends of the casing, the washers in turn rigidly securing the bridge supports to the terminals.

With the structure herein described, the fuse on disassembly comprises three units, namely, a casing structure, a fuse element assembly, and a cap for securing the two together. Thus the operation of renewing the fuse element is relatively simple. Such simplicity is further attained by the fact, as hereinbefore mentioned, that the fuse element assembly may occupy any position rotatively of the casing when assembled.

As shown in the drawing, the preferred construction includes the casing structure 10. This structure comprises a fiber tube 12 provided at its ends with metallic end members. One end (the right-hand end as shown in Fig. 2) is provided with a ferrule 13 having an inner end 14 of reduced diameter threaded into the tube 12. The major portion of the ferrule 13 is of slightly larger diameter than the tube 12 so that a shoulder 15 is provided which abuts against the end of the tube. To hold the ferrule against rotation relative to the tube, the reduced portion 14 may be staked thereto by forcing small indentations 16 outwardly into the fiber. The outer end of the ferrule 13 has an end wall centrally apertured to provide an inwardly turned flange 17.

At the other end of the casing, a ferrule 20 is provided, having an inner reduced portion 21 similarly threaded into the tube and staked thereto. The outer end of the ferrule 20 is externally threaded to receive a cap 22 preferably of the same external diameter and appearance as the ferrule 13 and also provided with an apertured end wall providing an inwardly turned flange 23 similar to the flange 17.

The fuse element assembly comprises a pair of terminals, herein shown as knife blades 30. Each knife blade has an inner end 31 of a reduced width, to which a fuse element 32 is connected at its end. The reduced width thus provides shoulders at each edge of the knife blade to locate washers fitting over the reduced portion 31.

To connect the knife blades 30 and to rigidly hold them in accurate alinement, an insulating bridge structure is provided comprising a pair of fiber bars or strips 33 and bridge supporting members 34. The fiber bridges 33 are located in spaced relation on opposite sides of the fuse element 32 and parallel to the blades 30. Because of such location of the bridges 33, any tendency of the knife blades to bend out of alinement is prevented by the bridges so that the fuse element 32 is prevented from being bent. Thus any bending stress on the fuse element assembly is sustained by the bridges rather than the fuse element.

Each bridge supporting member 34 is shaped so that the major portion thereof lies along the face of the inner portion 31 of the terminal. To space the bridges 33 from the fuse element 32, the inner end of each bridge supporting member 34 is bent laterally, as at 35 (see Fig. 4), and then longitudinally, as at 36, and the end of each bridge is secured to the longitudinally bent portion 36 preferably by a pair of rivets 37.

The present structure provides for a maximum area of contact with each end of the fuse element. To this end, the inner portion 31 of the terminal is laterally offset, as at 40. The bridge supporting members are correspondingly offset so that one of the bridge supporting members on each terminal conforms to the offset of the terminal and the other bridge supporting member bears a spaced relation to the inner end of the terminal. This is illustrated in Fig. 4 where the lower of the two bridge supporting members conforms to the shape of the inner end of the terminal 31, and the upper of the bridge supporting members is spaced relative to the terminal. The space thus provided is utilized to receive the end of the fuse element 32, which end is clamped against the face of the terminal by the adjacent bridge supporting member 34. To clamp the parts together, a screw 41 is inserted through the two bridge supporting members 34, the terminal and the fuse element 32, and a nut 42 is threaded thereon.

The bridge supporting member serving to clamp the element 32 has an electrical contact at its outer end with the terminal or knife blade. Thus when the fuse element is clamped, electrical contact is made on both faces of the end portion of the element. A maximum area of contact is thereby obtained, which decreases the chance of heat being generated at these points.

As mentioned hereinbefore, washers are mounted on the terminals which serve as closures for the ends of the casing. Preferably a flat washer 43 and a dished washer 44 are provided. The present invention provides a simple construction for holding the washers 43 and 44 in place on the reduced inner end 31 of the terminal and against the shoulders at the edges of the terminal. The bridge supporting members 34 are herein utilized for this purpose. To this end, the outer end of the two bridge supporting members 34 extend into abutment with the inner face of the washer 43, thereby holding the washers against the shoulders at the edges of the blade.

The washers in turn serve to hold the bridge supporting members in place. To accomplish this result, each bridge supporting member is provided with a central tongue 45 (see Figs. 3, 4, and 5) extending through the washers 43 and 44, with its outer end bent inwardly as at 46 into an aperture 47 in the knife blade 30. Thus because of the inwardly bent end 46 of the tongue, the outer end of each bridge supporting member is rigidly secured to the knife blade by washers 43 and 44, and in turn the bridge supporting members 34 hold the washers 43 and 44 in place on the knife blade.

By securing the outer end of the bridge supporting member 34, which serves to clamp the fuse element 32, to the terminal, the inner end of the fuse supporting member may yield slightly upon loosening the clamping nut 42 to facilitate insertion of the end of the fuse element. Since the fuse supporting member 34, which conforms to the offset of the terminal, need not be flexed, the inner end of this bridge supporting member is preferably rigidly secured to the terminal. As illustrated herein, the inner end of this bridge supporting member is secured to the terminal by being apertured to receive a lug 48 (see Fig. 6) pressed outwardly from the knife blade and riveted over the bridge supporting member.

In the preferred form of the fuse, the bridge

supporting member which clamps the fuse element at one end is on the opposite face of its terminal from the corresponding supporting member at the other end. Thus as illustrated in Fig. 2, the fuse element has a diagonal relationship to the knife blades.

The washers 43 and 44, in addition to being closures for the casing, serve as means for controlling the escape of gas, generated upon the blowing of the element, from the fuse. With this function in mind, a chamber 50 (see Fig. 4) is provided between two washers. To simplify manufacture, the inner washer 43 is flat, while the outer washer 44 is dished outwardly, as at 51, to provide the chamber 50 therebetween. To permit the gases to escape through the chamber 50, a pair of holes 53 are punched in the inner washer 43 and a corresponding pair of holes 52 are punched in the outer washer 44. Preferably the holes 52 are offset as by an angle of 90° from the holes 53. The gas in escaping from the interior of the fuse thus passes through the holes 53 into the chamber 50, where it is materially cooled and reduced in volume by contact with the metal surfaces of the washers, and thence passes out through the holes 52.

The dished portion 51 of the outer washer 44 serves the further function of centering the fuse within the casing. To this end the portion 51 is made of a diameter to fit snugly within the flange 17 of the ferrule 13 or the flange 23 of the cap 22. The ferrule and the cap 22 thus serve not only to limit longitudinal movement of the fuse element assembly within the casing, but also hold it centered therein.

Because of the rigidity of the fuse element assembly, it is unnecessary to resort to a notched interfit between the washers 43 or 44 and the ferrules 13 or 20, such as are found in prior fuses, to hold the fuse element assembly in proper position, with the knife blades alined. Thus the washers 43 and 44 on both ends of the fuse element assembly may be made of a diameter that will pass freely through the casing. Moreover, since the manner in which these washers interfit with the ferrule 13 and the cap 22 is the same, either end of the fuse element assembly may be inserted into the casing first. This facilitates greatly the assembling of the fuse and avoids any chance of the fuse element assembly and casing being wrongly assembled.

In the modified form of fuse shown in Fig. 8, the structure is the same as in the preferred form, except that both ends of the casing are provided with ferrules 20 and caps 22. In disassembling this form, one cap only need be removed, if desired, so that the structure is the equivalent of that shown in Figs. 1 to 7.

From the foregoing, it will be apparent that I have provided a renewable fuse of the cartridge type which may be easily assembled and disassembled, and which has relatively few parts when disassembled. Thus, in the preferred form, the fuse is disassembled into three units, namely, the casing structure, the fuse element assembly, and a cap. Since the fuse element assembly may be inserted into the casing structure either end first, little care is required to see that the parts properly cooperate. Moreover, since the cap 22 serves to lock the parts together and cooperates with the washer 44 to close the casing, the fuse element assembly may vary slightly in length relative to the casing structure, since the cap 22 may be screwed onto the ferrule 20 by varying amounts to compensate for such differences in length.

The two fiber bridges hold the knife blade in accurate alinement, thereby relieving the fuse element 32 of any strain should there be a tendency to bend the fuse element assembly. Intermittent bowing or bending of the fuse element would have a tendency to gradually weaken the blowing portions thereof. By avoidance of bending, such weakening does not occur and the fuse element maintains its rated capacity. The accuracy of alinement of the terminals brought about by the bridge structure also holds the screw centers for the fuse element accurately spaced and consequently necessitates correct assembly of the fuse element.

The fuse element assembly has a relatively simple structure in that the washers are held in place by the bridge supports and in turn the bridge supports are held in place by the washers. One bridge support on each end further aids in providing a maximum area of contact for the fuse element, whereby the chance of heat generating at such contact points is minimized. The washers at each end provide a gas expansion chamber formed by a part of one of the washers which also functions to accurately center the fuse element assembly within the casing.

I claim as my invention:

1. In a renewable fuse of the character described, a fuse element assembly comprising, in combination, a pair of terminals, a fuse element connected at its respective ends to the terminals, and a pair of rigid supporting members connecting the terminals and offset on opposite sides of the plane of the fuse element.

2. In a renewable fuse of the character described, a fuse element assembly comprising, in combination, a pair of terminals, a fuse element connected at its respective ends to the terminals and comprising a strip of sheet metal, and a pair of rigid supporting members connecting the terminals and laterally spaced from opposite faces of the strip.

3. In a renewable fuse of the character described, a fuse element assembly comprising, in combination, a pair of knife blade terminals, a fuse element connected at its respective ends to the terminals and extending generally in the plane of the terminals, and a pair of rigid supporting members connecting the terminals and laterally spaced on opposite sides of said plane to hold said terminals in alinement.

4. In a renewable fuse of the character described, a fuse element assembly comprising, in combination, a pair of terminals, a fuse element connected at its respective ends to the terminals and comprising a flat strip of metal, and a pair of rigid supporting members connecting the terminals, each member comprising a flat strip of insulating material with the latter strips in face-to-face relation with the fuse strip and spaced on opposite sides thereof.

5. In a renewable fuse of the character described, a fuse element assembly comprising, in combination, a pair of terminals, a fuse element comprising a flat strip connecting said terminals, and means extending between the terminals located in spaced relation to the opposite faces of said strip for holding said terminals in alinement and preventing bending of the strip.

6. A renewable fuse comprising, in combination, a tubular casing, a pair of knife blade terminals projecting from the respective ends of the casing, a fuse element connecting said terminals, washers non-removably mounted on the respective terminals, both of said washers being

of such size that they may be freely passed through the casing, said washers being rigidly secured to said terminals, caps secured to the respective ends of the casing and abutting said washers for holding them against longitudinal movement, and a bridge structure for holding said terminals in alinement.

7. A renewable fuse comprising, in combination, a tubular casing, a fuse element assembly, and a pair of caps for securing the fuse element assembly within the casing, one of said caps being permanently secured to said casing and the other removable therefrom, said fuse element assembly comprising a pair of knife blade terminals, a fuse element connecting said terminals, a bridge structure for holding said terminals in alinement, and washers rigidly mounted on the respective terminals and confined against longitudinal movement relative to the casing by said caps, the washers on both terminals being of such size that they may be freely passed through the tubular casing.

8. A renewable fuse comprising, in combination, a tubular casing, a pair of terminals projecting from the respective ends of the casing, a fuse element connecting said terminals, washers rigidly mounted on the respective terminals, a pair of caps secured to the respective ends of the casing, each cap having an inturned flange extending over the edge of the adjacent washer to confine the washer against longitudinal movement, and a bridge structure rigidly connecting said terminals, whereby said terminals and washers may be rotated to any position relative to the casing in assembly, with the terminals held in alinement solely by said bridge structure.

9. In a renewable fuse of the character described, a fuse element assembly comprising a pair of knife blade terminals, a fuse link connecting said terminals, a pair of bridge members located at opposite sides of said fuse element and a pair of bridge supporting members secured to opposite faces of each terminal for holding said bridge members in spaced relation to each other and parallel to the terminals, whereby the terminals are held in rigid alinement.

10. In a renewable fuse of the character described, a fuse element assembly comprising, in combination, a pair of knife blade terminals, a pair of bridge members extending parallel to and on opposite sides of said knife blades for holding said blades in alinement, a fuse element, and bridge supporting members secured to opposite faces of said terminals, the ends of said fuse element being clamped against the faces of the terminals by the bridge supporting members.

11. In a renewable fuse of the character described, a fuse element assembly comprising, in combination, a pair of knife blade terminals, a pair of insulating bridges extending between the terminals parallel to opposite faces thereof for holding the terminals in alinement, a fuse element, and a pair of metallic bridge supporting members on each terminal, each end of the fuse element being clamped against the face of the adjacent terminal by one of the metallic bridge supporting members to give the maximum area of contact with the fuse element.

12. In a renewable fuse of the character described, a fuse element assembly comprising a pair of knife blade terminals with the inner end of each terminal offset from the plane of the outer end, a pair of insulating bridges extending parallel to the opposite faces of said terminals, a pair of bridge supporting members on each terminal with the outer end of each supporting member offset, whereby one of said supporting members conforms to the offset in the terminal and the other extends in spaced relation to the terminal, a fuse element located between the bridges with its end extending into the space between the supporting member and the terminal, and means for clamping the fuse element therebetween.

13. In a renewable fuse of the character described, a fuse element assembly comprising a pair of terminals, an insulating bridge, a pair of supporting members for securing the bridge to the terminals, the inner end of each terminal being of less width than the outer end to provide a shoulder, and a washer on the inner end of each terminal, the bridge supporting member being secured to the terminal by said washer and holding the washer against said shoulder.

14. In a fuse element assembly a renewable fuse, the combination of a knife blade terminal comprising an outer portion and an inner portion of less width to provide a shoulder, an insulating bridge, a bridge supporting member extending along the face of the inner portion of the terminal, and a washer apertured to fit over the inner portion of the terminal, said terminal having an aperture therethrough and said supporting member having a tongue extending through the washer and bent into the aperture in the terminal, whereby the washer secures the supporting member to the terminal and the supporting member holds the washer on the terminal.

15. In a fuse element assembly for a renewable fuse, the combination of a knife blade terminal provided with shoulders at its side edges, a washer fitting over said terminal and abutting the aforesaid shoulders, said terminal having an aperture therethrough adjacent the outer face of said washer, and a bridge supporting member extending along the face of the terminal and abutting said washer to hold it against said shoulders, said supporting member having a tongue extending through the washer and bent inwardly into the aperture in the terminal, whereby the washer is held rigidly on the terminal by the supporting member and the supporting member is rigidly secured to the terminal by the washer.

16. In a fuse element assembly for a renewable fuse, the combination of a knife blade terminal, a fuse element, a clamping member extending along one face of the terminal for clamping the end of the fuse element therebetween, and a washer mounted on said terminal, said washer being rigidly secured to said terminal by the outer end of said clamping member and rigidly securing the outer end of said clamping member to the terminal.

17. In a renewable fuse of the character described, a fuse element assembly comprising, in combination, a pair of knife blade terminals, a pair of insulating bridges extending parallel to opposite faces of said terminals for holding said terminals in alinement, a pair of bridge supporting members on each terminal for securing the bridges thereto, one of said supporting members on each terminal being secured flat against the face of the terminal, the other bridge supporting member on each terminal being secured to the terminal solely at its outer end, and a fuse element having its ends inserted between the last-mentioned supporting members and the face of the terminals.

18. In a fuse element assembly for a renewable

fuse, the combination of a knife blade terminal, and a pair of bridge supporting members on opposite faces of said terminal, one supporting member being secured to said terminal both at its outer and inner ends, the other bridge supporting member being secured to said terminal solely at its outer end, whereby a fuse element may be clamped between it and the adjacent face of the terminal.

19. In a renewable fuse of the character described, a fuse element assembly comprising a pair of terminals, a fuse element, and a bridge structure for holding the terminals in alinement and for clamping the ends of the fuse element to the terminals.

20. In a renewable fuse of the character described, a fuse element assembly comprising a pair of knife blade terminals, washers mounted on the respective terminals, and a bridge structure for rigidly securing said washers to the knife blades and in turn secured to the knife blades by the washers.

21. In a renewable fuse of the character described, a fuse element assembly comprising, in combination, a pair of knife blade terminals, a bridge structure, and washers on the respective terminals for securing the bridge structure to the terminals.

22. A renewable fuse comprising, in combination, a tubular casing, a rigid fuse element assembly enclosed within the casing and including a pair of terminals with a pair of washers on the respective terminals, the washers being of less diameter than the interior of the casing, and end members secured on the respective ends of the casing, each end member having an end wall which is centrally apertured, each washer having an outwardly dished portion fitting within the aperture of the adjacent end member, the two end members thus cooperating with each other to hold the assembly against longitudinal movement relative to the casing and cooperating with the washers to hold the assembly centered in the casing.

23. A renewable fuse comprising, in combination, a tubular casing, a rigid fuse element assembly mounted within the casing and including knife blade terminals projecting beyond the ends of the casing with a washer mounted on each of said terminals, each washer having a central outwardly dished portion, and caps secured on the casing and each having an end wall which is centrally apertured to permit the terminal to extend therethrough, the end wall of each cap fitting around the dished portion of the washer to force the fuse element assembly against the other cap and thus hold it within the casing and to center it relative thereto.

24. A renewable fuse of the character described comprising on disassembly three major units, one unit being a casing structure, the second unit being a fuse element assembly, and the third unit being a cap screw-threaded onto one end of the casing structure for securing the first two units in assembled relation, said fuse element assembly including a pair of terminals and a bridge structure, the bridge structure being insertable into the casing structure through the cap end thereof, the cap limiting movement of the fuse element assembly relative to the casing structure longitudinally thereof, the bridge structure serving as the sole means for holding the terminals in alinement.

25. A renewable fuse comprising, in combination, a tubular casing, a fuse element assembly enclosed within the casing, means permanently secured on one end of the casing for limiting longitudinal movement of the fuse element assembly relative to the casing in one direction, and removable means on the other end of the casing for limiting such relative movement in the other direction, said fuse element assembly having the same construction at each end whereby either end thereof may be first inserted in the casing on assembly.

26. A renewable fuse comprising, in combination, a tubular casing, a fuse element assembly including a terminal and a pair of washers permanently mounted on the terminal in face-to-face relation, the outer washer having a central outwardly dished portion to provide a chamber between the two washers, apertures in the two washers to provide a passage including said chamber from the interior of the casing to the exterior of the casing, and a cap secured to said casing and having an end wall which is centrally apertured to fit around said dished portion to center the terminal relative to the casing.

27. A renewable fuse comprising, in combination, a tubular casing, a fuse element assembly enclosed within the casing and including a pair of terminals with a pair of washers mounted on each terminal, one of the washers of each pair being dished to provide a chamber therebetween, both washers of each pair being apertured to provide a passage including said chamber from the interior of the fuse to the exterior, all of said washers being of such size that they may freely pass through the casing, and a pair of end members secured to the casing provided with inwardly turned flanges overlying and abutting the edge portion of the outer washers.

28. A renewable fuse comprising, in combination, a tubular casing, a fuse element assembly enclosed within the casing, and a pair of end members secured to the casing for holding the fuse element assembly therein, said fuse element assembly including a pair of washers at each end constructed to provide a gas expansion chamber between each pair, the washers being of such size that they may freely pass through the casing and cooperating with the end members to hold the fuse element assembly centered within the casing.

29. In a renewable fuse of the character described, a fuse element assembly comprising, in combination, a pair of terminals, a pair of insulating bridges extending parallel to opposite faces of the terminals for holding the terminals in alinement, and a pair of bridge supporting members mounted on each terminal for connecting the respective bridges thereto, one of the bridge supporting members on each terminal being yieldably connected thereto, whereby the end of a fuse element may be clamped therebetween.

30. A fuse element assembly for a renewable fuse comprising, in combination, a pair of terminals, a fuse element, a pair of bridge supporting members for each terminal, and a pair of insulating bridges carried by said bridge supporting member, one of the bridge supporting members on one terminal and the opposite bridge supporting member on the other terminal being spaced from the terminals to receive the ends of the fuse element, whereby the fuse element is held in diagonal relation to the terminals.

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