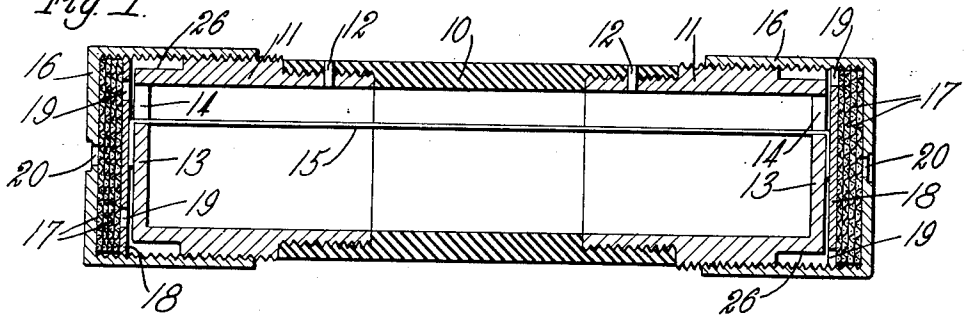
July 18, 1939. L. R. POPP 2,166,174

FUSE

Filed April 26, 1934

Fig. 1.



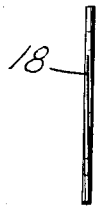


Fig. 2.

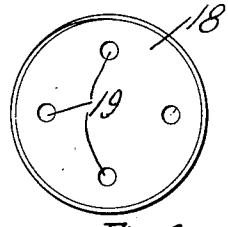


Fig. 3.

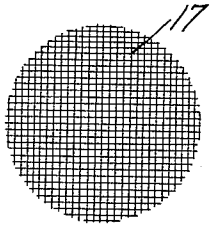


Fig. 4.

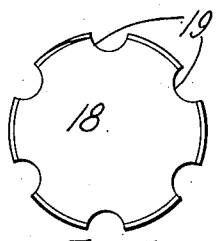


Fig. 5.

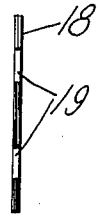


Fig. 6.

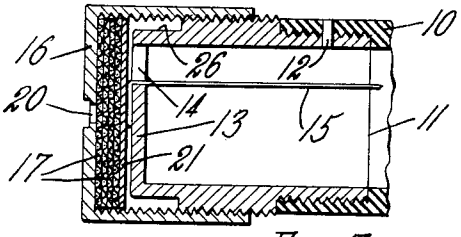


Fig. 7.

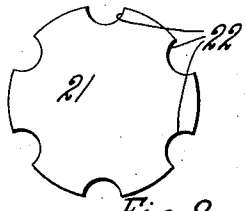


Fig. 8.

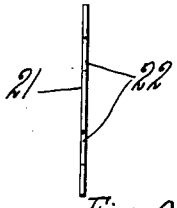


Fig. 9.

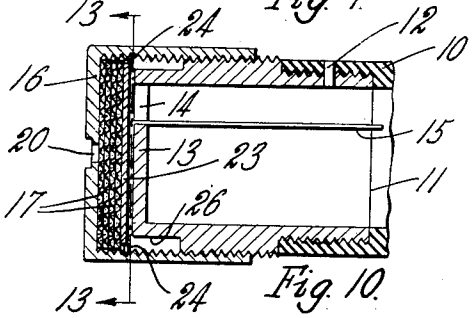


Fig. 10.

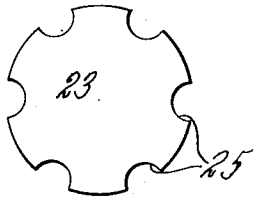


Fig. 11.

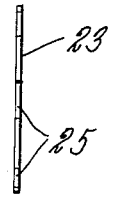


Fig. 12.

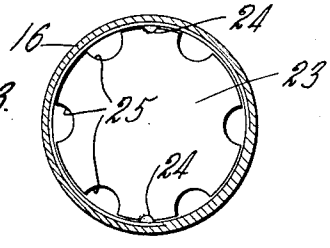


Fig. 13.

INVENTOR
Louis R. Popp
by Parker, Prichard & Hamer
ATTORNEYS.

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2,166,174

FUSE

Louis R. Popp, Buffalo, N. Y., assignor to Pierce Renewable Fuses, Inc., Buffalo, N. Y.

Application April 26, 1934, Serial No. 722,528

5 Claims. (Cl. 200—131)

This invention relates to refillable fuses of the type in which a fuse link is removably secured in a substantially closed casing. When a fuse link in such a casing is blown, gases are generated, and the liberation of such gases without danger of fire is very desirable. Heretofore, such gases have been vented through porous masses of heat conducting material of considerable thickness, or through wire gauze of either a single thickness, or of a large number of layers arranged face to face, and with the gases escaping through the layers in a direction approximately normal to their faces.

The use of a single layer of gauze is insufficient to effect the desired cooling of the escaping gases, and the use of a large number of layers of wire gauze is objectionable because it necessitates an objectionable increase in the overall length of the fuse, or else the length of the fuse link must be shortened which is also objectionable. The outside diameters of refillable fuses are standardized for the different fuse capacities, and the overall lengths must be standard within very small limits. The gap or space in the fuse which is spanned by the fuse link must also be substantially unchanged from standard sizes, in order that fuse links may be interchanged in the different makes of fuse casings.

An object of this invention is to provide an improved, refillable fuse which will have standard dimensions and handle standard sizes of fuse links, and with which the liberation of gases generated in the blowing of a fuse link will be effectively and safely accomplished in a manner that meets the approval of the underwriters' laboratories.

Another object of the invention is to provide improved means for ventilating the casing of a refillable fuse, without objectionally increasing the overall length of the casing, or substantially increasing the cost of the fuse, with which the means for liberating and cooling the escaping gases is carried entirely in the removable caps which clamp the terminals of the fuse link and complete the electrical circuit thereto, and which is relatively simple and inexpensive in construction.

Another object of the invention is to provide an improved refillable fuse, with which the arc gases are liberated and cooled in a simple and safe manner; with which repeated blowing of the fuse will not foul or damage the gas cooling means, and with which the cooling means may be renewed in a simple manner.

Various other objects and advantages will be apparent from the following description of several embodiments of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawing:

Fig. 1 is a longitudinal sectional elevation of a refillable fuse constructed in accordance with this invention;

Fig. 2 is an edge elevation of a disk utilized as a part of the complete fuse of Fig. 1, at the left-hand end thereof;

Fig. 3 is a face elevation of the same disk;

Fig. 4 is a face elevation of a steel wire gauze or screen which is utilized in the refillable fuse of Fig. 1 to cool the escaping arc gases;

Fig. 5 is a face elevation of another form of disk utilized in Fig. 1 at the right-hand end thereof, and illustrating a slight modification of the disk of Figs. 2 and 3;

Fig. 6 is an edge elevation of the same;

Fig. 7 is a longitudinal sectional elevation of part of a refillable fuse, also constructed in accordance with the invention, and having a clamping disk of modified construction incorporated therein;

Fig. 8 is a face elevation of this modified disk;

Fig. 9 is an edge elevation of the same;

Fig. 10 is a sectional elevation, similar to Fig. 7, of part of a fuse, but illustrating a different manner of confining the disk in position in the cap thereof;

Fig. 11 is a face elevation of the clamping disk used in Fig. 10;

Fig. 12 is an edge elevation of the same; and

Fig. 13 is a transverse sectional elevation of the fuse shown in Fig. 10, the section being taken approximately along the line 13—13 of Fig. 10.

In the embodiment of the invention illustrated in Figs. 1 to 6, the refillable fuse includes a tubular shell 10 of insulating material, such as fiber, and, for convenience, it is usually cylindrical in shape. Tubular end members 11 are usually secured to the ends of the shell 10 so as to form endwise extensions thereof. These end members 11 are of suitable metal, and are attached to the ends of the shell 10 in any suitable manner, such as by threading reduced end portions thereof into recesses provided in the ends of the shell, as shown in Fig. 1. If desired, locking pins 12 may be passed through the threaded portions of the shell 10 and members 11 so as to prevent unscrewing of the end members. The outer ends of members 11 are partially closed by end walls 13 provided with apertures 14.

A fuse link 15 is passed through the shell 10 and

the apertures 14 in the end walls 13, and the ends of the fuse link are then bent over against the outer end faces of the end walls 13. The shell 10 and the end members 11 together form what may be considered as a casing which houses the replaceable fuse link 15. A cup-shaped cap 16 is connected to each end member 11 for adjustment, in telescoping relation therewith, in a direction endwise of the casing, and this adjustment is conveniently obtained by threading the open end of each cup to the metallic end members 11, as shown in Fig. 1. Preferably the caps 16 are internally threaded so as to engage with the threaded outer peripheries of the end members 11.

Against the inner end face of each cap 16, I place a plurality of layers 17 of mesh-like or reticulated screens, with the layers arranged face to face and flat against one another and the inner end face of the cap. These screens 17 are made of good heat conducting material that will withstand the relatively high temperatures of the escaping arc gases, and for this purpose they are preferably of steel wire gauze or mesh, one of such screens being shown in Fig. 4. A disk 18, having a threaded periphery, is threaded into the interior of each cap 16 so as to lie flat against the screen layers and clamp them against the inner end face of the cap 16.

Each disk 18 is of metal, and by being threaded into a cap 16 it will remain attached thereto when the cap is removed from the casing and will confine the screens within the cap, yet the disk may be unscrewed and removed to release the screens and enable cleaning and replacement of the screens. Each disk, when confined within a cap, abuts against a bent over end of the fuse link 15 and clamps it firmly against the adjacent end wall 13, merely by threading the cap 16 as far as possible upon the casing. Each disk 18 is provided with a number of apertures 19, which are disposed adjacent, but spaced slightly from, the periphery of the disk in the type of disk shown in Figs. 2 and 3 and at the left-hand end of Fig. 1, and which are in the nature of notches in the periphery of the disk in the form of the disk shown in Figs. 5 and 6 and at the right-hand end of Fig. 1. Each cap 16 is provided with a central aperture 20.

The gases generated by the blowing of the fuse link 15 may escape through the openings 19 in the disks 18 at both ends of the casing, and after passing through the openings 19 will pass radially of the screens to approximately the center thereof, and then will escape through the openings 20 in the ends of the caps 16. It will be observed that the escaping gases, in their movement through the screens, will travel approximately radially thereof or approximately parallel with the faces of the screens, with the result that the gases have a length of travel through the screens which is equivalent to the distance between the openings 19 and 20 in each cap, and which is also the equivalent of the passage of the gases through a plurality of layers of the screens, in a direction normal to the faces thereof, which have a combined thickness equal to the distance between the openings 19 and 20.

By having the gases travel through the screens in directions approximately parallel to the faces thereof, it is only necessary to employ a very few layers of the screen, which does not materially increase the overall length of the fuse. Since the screens are clamped flat against the inner face of the disk 18 and the end wall of the cap 16, there will be maximum heat and electrical conductivity between the screen layers, across their entire face area and over both faces thereof, and the disk and the end wall of the cap, so that efficient cooling of the screens is obtained.

Any other relative arrangement of the openings 19 and 20 may be employed, so long as the escaping gases travel through the screens in a direction approximately parallel to the faces of the screens, but the arrangement illustrated is very satisfactory because the plurality of the openings 19 may be more easily punched in the disks and at a very low cost, and the hole 20, which is more frequently drilled than punched, is provided in the cap 16 at the center thereof where one hole will suffice.

The number of screens, or layers of wire gauze or mesh, employed in each cap 16 may vary to some extent, but for a 250 volt fuse of from 3 to 30 amperes capacity, three screens or pieces of steel wire gauze may be satisfactorily employed. Such a wire gauze may be of .008 gage and woven 60 strands to the inch in one direction and 40 strands to the inch in the other direction. Fuses of these sizes and capacities and utilizing in each cap, three pieces of steel wire gage of the size and character just given hereinabove, have satisfactorily passed the severe tests of the Underwriters' Laboratories and received the approval of those laboratories. More than three screens, or pieces of steel wire gauze, may be employed if desired as an extra safety factor, especially where gauze formed of a different gage wire and mesh are employed.

The embodiment of the invention illustrated in Figs. 7 to 9 is similar to that shown in Figs. 1 to 6, except that the disk 21 which replaces the disk 18 in the cap 16 is a simple stamping of sheet metal with an unthreaded peripheral edge, and with the openings or apertures 22 in the nature of notches in the periphery of the disk, so that the disk will really have a plurality of radially extending tongues on its periphery. This disk 21 is of a diameter and thickness such that it may be forced into a cap 16 and against the screens, under pressure, during which the outer ends of the tongues or peripheral projections on the disk will be sprung slightly in passing the threads on the inner periphery of the cap 16, and the disk will be held in position in the cap by the tight engagement between its periphery and the inner circumference of the cap 16.

In the embodiment of the invention illustrated in Figs. 10 to 13, the construction is the same as in the Figs. 7 to 9, except that the disk 23, which replaces the disk 21, is of slightly smaller diameter than the disk 21, so that it enters the cap 16 without difficulty and without force. By the use of a suitable upsetting tool, such as a prick punch, portions of the periphery of the disk 23 may be upset and deformed or swaged outwardly in a radial direction against the inner periphery of the cap 16, such deformation or upsetting being shown at 24 in Figs. 10 and 13. The upsetting of portions of the periphery of the disk 23 is produced at any desired number of points, two of such points being shown in Fig. 13. The disk 23 may have its openings or apertures 25 in the interior of the disk and spaced from the periphery thereof as in Fig. 3, or as notches in the periphery, as shown in Figs. 10 to 13.

In each embodiment of the invention the periphery at the outer end of each end member 11 is preferably reduced as at 26, so that if there is any mutilation of the threads in any cap 16 at the point engaged by the clamping disk, this will

not prevent the cap 16 from being threaded fully upon the end member 11 and firmly clamping a bent over end of the fuse link.

In the use of a refillable fuse of this type, the screens are clamped in the caps 16 by the clamping disks, so as to be manipulated as a unit therewith. A fuse link, such as 15, is inserted in the casing and the ends of the link bent over against the end walls 13 of the casing, as shown in Fig. 1. The caps 16 are then threaded upon the ends of the casing until the disks engage and clamp the bent over ends of the fuse link firmly against the end walls 13. The fuse is then ready for use. The current from the fuse link passes through the end walls 13 directly to the telescoping portions of the cap, and also through the clamping disks and the wire screens to the caps, so that a good electrical circuit of ample current carrying capacity is always available between each cap 16 and the adjacent clamped end of the fuse link.

When a fuse of this type is placed in service, and subjected to an overload sufficient to rupture or blow the fuse link 15, the electrical circuit between the caps 16 at opposite ends of the fuse will be broken by the fusing of the link 15, and gases will be generated within the casing. Such arc gases generated in this manner will escape through the screens in the caps, as hereinabove explained, and in so escaping will be cooled to such an extent that danger from fire will be eliminated.

It will be observed that the overall length of this fuse is not materially increased, and by no more than the thickness of a few layers of wire gauze and of a pair of clamping disks, and, therefore, such a fuse is interchangeable with those of other makes, and standard fuse links may be used therewith. By pressing the wire mesh or screens between the clamping disk or washer and the end of the cap, a good current path is established to the cap, which makes it possible to use notches in the peripheries of the clamping disks for the gas passage, without unduly decreasing the current carrying capacity of the disks. It will also be observed that in this improved fuse, the gases escape in a direction radially of the screens, or parallel to their faces, which provides the cooling effect of a thick layer of screens, without an objectionable increase in overall length of the fuse and without the extra cost of a thick stack of screens.

It will be understood that various changes in the details, materials and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

I claim:

1. A refillable fuse comprising a tubular shell of insulating material having tubular metallic end members attached to and extending from the ends of said shell and forming therewith a tubular casing, a cap adjustable on each metallic end member for clamping thereto, the end of a fuse link that may connect said end members, one of said caps being cup-shaped, a disk within said one cap and disposed approximately parallel to but spaced slightly from the end of said one cap, a plurality of layers of metal screen disposed face to face within said one cap between the inner end face thereof and said disk, with said disk abutting flat against said layers and confining them flat against the inner end face of said one cap, said disk and said one cap being apertured, one near the periphery of the screen layers and the other spaced substantially therefrom in a direction approximately parallel to the planes of the layers, a distance greater than the combined thickness of the layers, whereby gases generated in said casing when the fuse link therein is blown, may escape therefrom through said one cap by passing through said disk and said one cap and travelling a substantial distance through said layers in a direction approximately parallel to the planes of those layers, the periphery of said disk being engageable with the inner periphery of said one cap, by which the disk is held in position in its cap when said one cap is removed from said casing.

2. A refillable fuse comprising a tubular shell of insulating material with tubular metallic extensions on the ends thereof and forming with the shell a tubular casing in which a fuse link to be blown is disposed, a cup-shaped cap adjustable along and telescoping with one end of said casing, a disk disposed across the interior of said cap and approximately parallel to but spaced from the inner end of said cap, a plurality of layers of metal screen confined flat against the inner end face of said cap by said disk and with the disk fitting flat against said layers, said disk being engageable with the adjacent end of said casing when the cap is adjusted along said casing, and clamping the adjacent end of said fuse link between it and the adjacent end of said casing, at the same time pressing said layers against the end of said cap, said disc and cap being apertured, one adjacent the periphery of said disc and the other spaced well therefrom in a direction along the faces of said layers, at a distance greater than the combined thickness of said layers whereby the gases generated in said casing, when said fuse link is blown, may escape from said casing by passing through the apertures in the disc and cap and through the layers a substantial distance in a direction along the faces of the layers.

3. A refillable fuse comprising a tubular casing in which a fuse link is disposed, a cap attached to one end of said casing and adjustable therealong in telescoping relation, said cap having metal screening within said cap and disposed flat against the inner end face thereof, and a disk in said cap fitting flat against said screening and confining the latter flat against the inner end face of said cap, said disk having a notched periphery engageable with the inner periphery of the cap and retained in position in the cap thereby, said cap having an approximately central opening, whereby gases generated in said casing, when the fuse link is blown, may escape therefrom through said cap by passing through the notches in the periphery of said disk, then radially through said screening and out through the central aperture in said cap.

4. A refillable fuse comprising a tubular casing in which a fuse link may be placed, a cup-shaped cap removably attached to one end of said casing for closing the same, a plurality of layers of steel wire gauze in said cap and disposed face to face with one another and flat against the inner end face of said cap, a disk within said cap and abutting flat against said layers for confining them flat against the end of said cap, but engageable against the end of said casing when the cap is applied to the casing, said end face of said cap and said disk being apertured, one near the periphery of the layers and the other a substantial distance therefrom in a direction approximately

parallel to the planes of the layers, whereby gases generated when the fuse link is blown may escape through said cap by passing through said layers in a direction approximately parallel to the planes of those layers.

5. A fuse comprising a tubular housing in which a fuse link may be placed and having a metallic wall, a plurality of layers of metal screen within said housing and forming a stack in which the screen layers abut face to face to one another in superposed relation and also face to face against said metallic wall over substantially its entire face area covered by said stack, a metallic element bearing face to face against said stack of screen layers over substantially the entire face area of said layers and confining said stack in abutting relation to said wall, said element and wall having gas passages from face to face thereof, and with the passage in said element a substantial distance from the passage in said wall, measured in a direction along the faces of said layers, whereby gases generated in said housing by the blowing of said link may escape through said element, screen layers and wall, and in passing through said layers will be forced to pass along paths generally parallel to the faces of said layers.

LOUIS R. POPP.