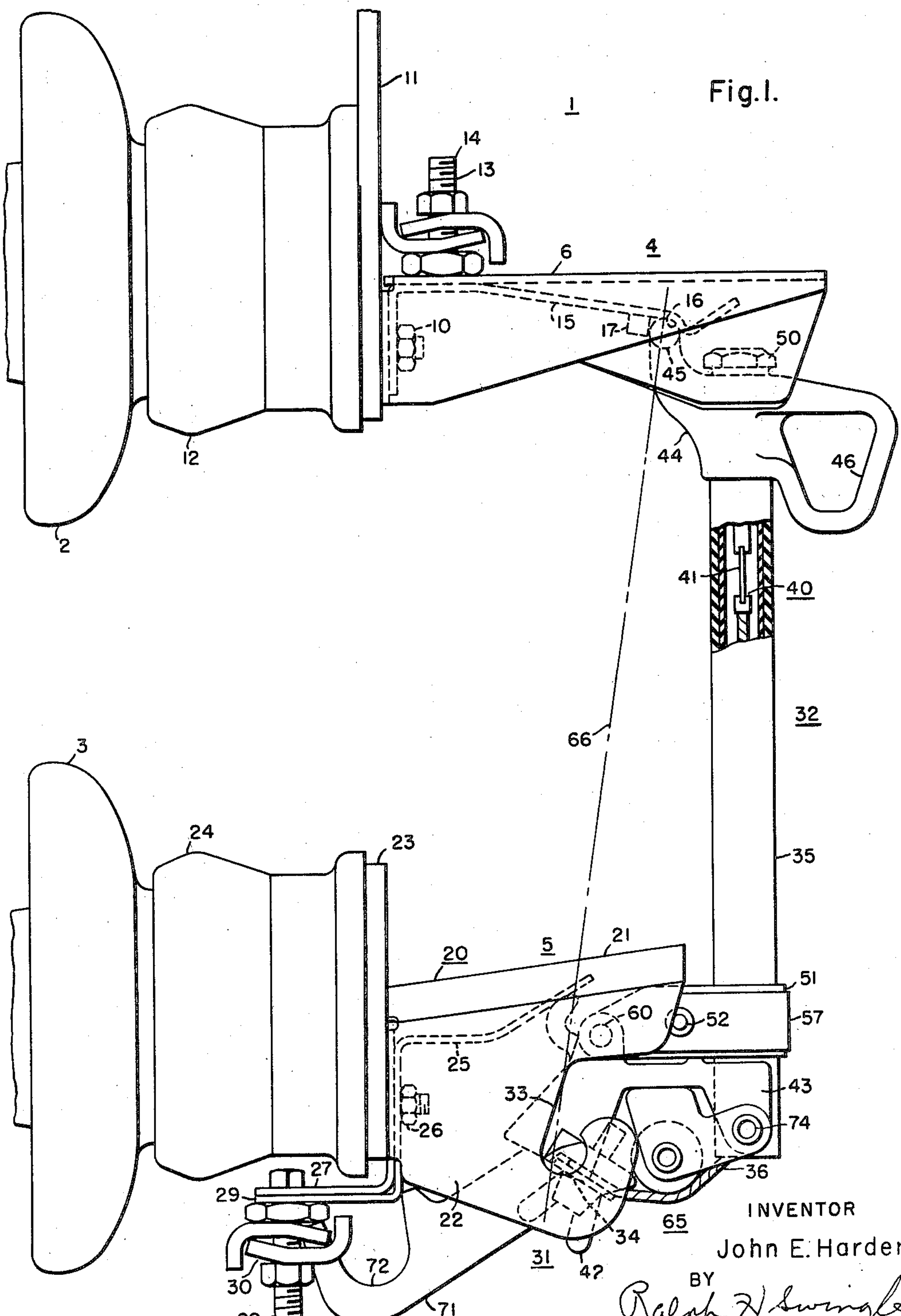
April 1, 1958 J. E. HARDER 2,829,218

CIRCUIT INTERRUPTER

Filed May 26, 1955 3 Sheets-Sheet 1

Fig. I.



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CIRCUIT INTERRUPTER

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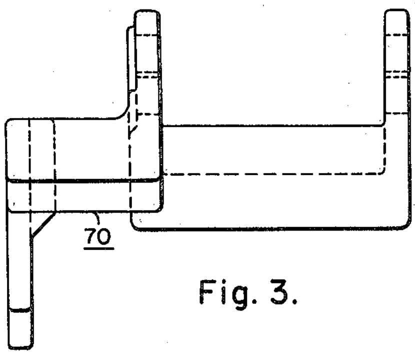

Fig. 3.

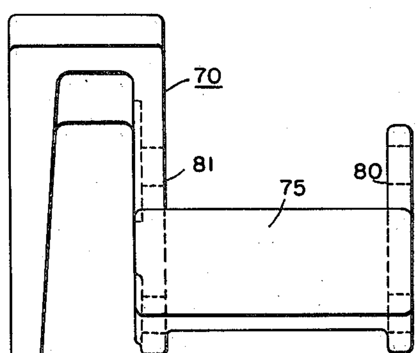

Fig. 4.

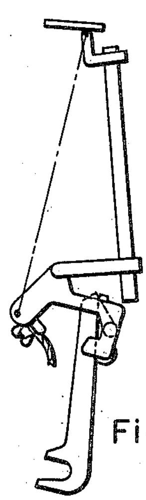

Fig. 11.

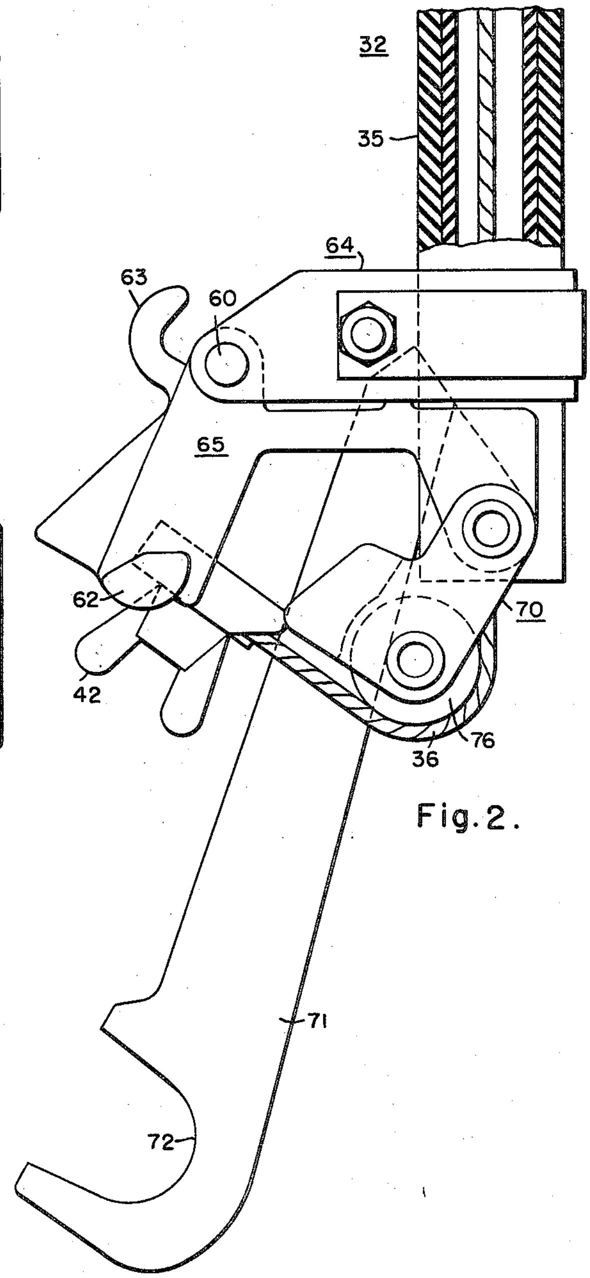

Fig. 2.

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CIRCUIT INTERRUPTER

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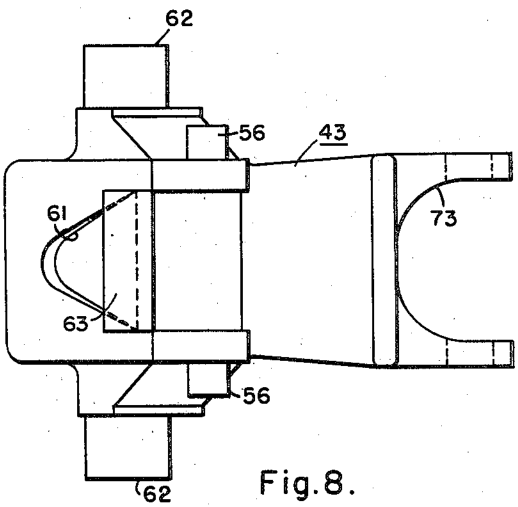

Fig. 8.

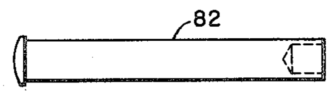

Fig. 5.

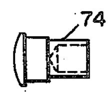

Fig. 6.

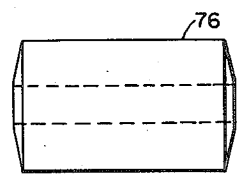

Fig. 7.

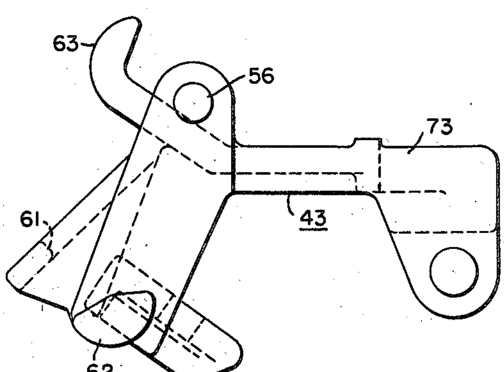

Fig. 9.

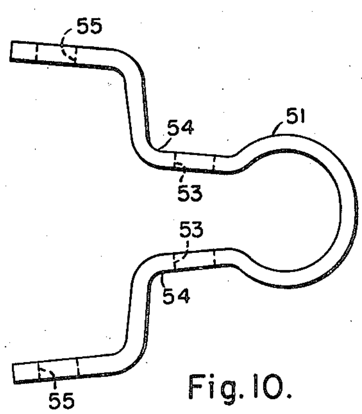

Fig. 10.

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2,829,218

CIRCUIT INTERRUPTER

John E. Harder, Swissvale, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application May 26, 1955, Serial No. 511,200

4 Claims. (Cl. 200—114)

This invention relates to circuit interrupters in general, and, more particularly to load-break fuse cutouts.

At certain locations on distribution systems it is desirable to have an inexpensive switch for occasional operation. At many of these same locations it is necessary to have fault-current protection. For this reason, a fuse cutout with load-break ability would be very desirable.

Fuse cutouts have fault-current interrupting ability. Normally speaking, they do not have load-current interrupting ability. In order to obtain this ability it is necessary to devise some special arrangement. One such scheme is to provide mechanical means for breaking the fuse link at its fusible section. A number of manufacturers have exploited various means for breaking the fuse link. In general, many of these arrangements have been complicated, flimsy, and difficult to operate.

It is a general object of my invention to provide an improved mechanical arrangement for accomplishing the task of rupturing the fuse link at its fusible section.

Another object of my invention is to provide an improved arrangement for breaking the fuse link in a fuse cutout, which will be simple, sturdy, sure and will not impair the fault-current operation of the cutout.

Another object of my invention is to provide a load-break fuse cutout such that operation thereof is easy and easily understood, with the fusing thereof also being easy of accomplishment. In addition, the mechanism of my invention is coordinated with the design such as to completely eliminate any fouling with the other mechanism occurring.

Another object is to provide a load-break fuse cutout with a manually operable load-break lever, which will be sturdy enough to stand the abuses a load-break cutout will receive, and will withstand the ravages of the elements in the open. The load-break structure will break the strongest links within its rating, and will withstand the large jet forces during fault-current interruption.

An additional object of the invention is to provide an improved load-break arrangement for a fuse cutout, in which the direction of pull is generally downward to facilitate operation, and is also in a direction about the hinge point to maintain the fuse contacts closed prior to fuse-link rupture.

Still a further object of my invention is to provide an improved roller arrangement for a manually operable load-break attachment for a fuse cutout in which any uneven stress along the fuse link cable is eliminated, and only the fusible section of the fuse link will be broken.

An ancillary object of my invention is to provide an improved load-break lever for a fuse cutout having an open-hook portion so that the prong of the switch stick may slip therefrom during manual rupturing of the fuse link, so that the hook will come free from the handle after the handle has been pulled far enough to insure that the arc has been extinguished. This, of course, minimizes the jar to the cutout and any probable associated damage.

In general, it is an object of my invention to provide a

sturdy load-break lever of such construction that nothing can go wrong, and that there will be no question concerning its proper assembly.

Further objects and advantages will readily become apparent, upon reading the following specification, taken in conjunction with the drawings, in which:

Figure 1 is a side elevational view of a load-break fuse cutout embodying the principles of my invention, and shown in the closed-circuit position;

Fig. 2 is an enlarged, fragmentary side elevational view, partly in section, of a portion of the fuse holder assembly, indicating the relative position of the parts during manual operation of the load-break lever, following rupture of the fuse link;

Fig. 3 is a top plan view of the load-break lever illustrated in detail in Fig. 4;

Fig. 4 is a side elevational view of the load-break lever in detail;

Fig. 5 is a side elevational view of the pin for mounting the roller in the load-break attachment;

Fig. 6 is a side elevational view of one of the rivet pins for securing the load-break lever to the toggle-link hinge member;

Fig. 7 is a side elevational view of the roller utilized in the load-break attachment to insure equal stress along the fuse cable;

Fig. 8 is a top plan view of hte toggle-link hinge member;

Fig. 9 is a side elevational view of the toggle-link hinge member of Fig. 8;

Fig. 10 is a detail view of the clamping collar; and

Fig. 11 is a diagrammatic view, in side elevation, of the fuse-holder assembly indicating the partially collapsed condition of the toggle immediately prior to contact separation at the upper fuse contact.

Referring to the drawings, and more particularly to Fig. 1 thereof, there is illustrated a circuit interrupting device 1, being illustrated in the closed-circuit position. As shown, the circuit interrupting device 1 is mounted upon a pair of insulator supports 2, 3. Although in this particular instance being illustrated as mounted upon insulator supports 2, 3, it is to be clearly understood that the interrupting device 1 may be clamped to a generally vertically upstanding elongated insulator. Any suitable mounting, of course, may be employed, and that shown is merely by way of illustration.

Jutting laterally outwardly from the upper insulator support 2 is an upper stationary contact assembly 4. Also associated with the lower insulator support 3, and extending laterally therefrom, is a lower stationary contact assembly 5.

Referring more particularly to the upper end of the interrupting device 1, it will be observed that the upper stationary contact assembly 4 includes an inverted U-shaped channel member 6, which may be of steel plate and suitably configured. One or more nuts and bolts 10 secure inward portions of the channel member 6 to a metallic base plate 11, the latter being suitably secured by any suitable means to an adapter 12 affixed to the outer end of the insulator support 2.

A line terminal 13 is associated with the channel member 6 and has a terminal bolt 14 associated therewith, which extends through the top portion of the channel member 6 and rigidly secures a resilient contact plate 15 into position. Adjacent the outer end of the contact plate 15 is a detent portion 16, which serves to latch the upper contact of the fuse holder in place, as more fully described hereinafter. Also the contact plate 15 has a suitable post 17 secured thereto, which limits the inward travel of the fuse holder.

The lower stationary contact assembly 5 comprises a suitably configured steel plate 20 having a top wall portion 21 and side wall portions 22. The side wall portions 22 are bent inwardly toward each other at the base of the assembly 5 and are secured to a base plate 23 by one or more nuts and bolts 26. The nuts and bolts 26 also rigidly secure a flexible contact plate 25 into place. The base plate 23 is secured by any suitable means to an adapter 24, which, in turn, is affixed to the outer end of the insulator support 3.

Preferably a laterally extending portion 27 of the configured plate 20 supports a line terminal 30 by a terminal bolt 28, the latter also passing through an extension 29 of the contact plate 25.

The lower hood 20 has provided on its side walls 22 means providing a hinge pivot 31 for a switch element or fuse tube 32. More specifically, trunnion guide slots 33 are provided in the side wall portions 22 of the lower metallic hood 20, and have offset trunnion bearings or seats associated therewith.

The switch element 32 comprises a fuse tube 35, at least the inner wall thereof being formed of a gas-evolving insulating material, so that arc extinction will be facilitated. Extending out of the lower, open end of the fuse tube is a fuse link cable extension 36. This cable extension 36 is a portion of the fuse link, generally designated by the reference numeral 40, and enclosed within the fuse tube 35, having at the upper end thereof a fusible portion 41, as well understood by those skilled in the art.

The end of the fuse-link cable extension is secured by a wing bolt 42 to a toggle-link hinge member 43, shown more in detail in Figs. 8 and 9 of the drawings.

Disposed at the upper end of the fuse tube 35 is a metallic terminal ferrule 44, which has integrally formed therewith a contact latching portion 45, which latches under the contact plate 15, as shown in Fig. 1, against the stop 17 in the closed-circuit position of the device.

Integrally formed with the metallic terminal ferrule 44 is an operating ring 46 to render the device suitable for switch-stick operation. Threaded into the upper end of the terminal ferrule 44 is an externally threaded cap 50, which secures the upper end of the fuse link 40 into place, as well understood by those skilled in the art.

Disposed adjacent the lower end of the fuse tube 35 is a clamping collar 51, shown more clearly in detail in Fig. 10 of the drawings. The clamping collar 51 encircles the fuse tube 35, and is clamped thereto by a clamping bolt 52, which passes through suitable apertures 53 provided in the leg portions 54 of the clamping collar 51. Additional apertures 55 are provided at the extreme ends of the leg portions 54 to encircle trunnions, or stub shafts 56, integrally formed with the toggle-link hinge member 43. This provides a pivot connection 60 between the toggle-link hinge member 43 and the clamping collar 51 with the fuse tube 35, which together constitute a unitary assembly. A name plate 57 may be secured externally of the clamping collar 51, and likewise secured into place by the clamping bolt 52.

Referring more specifically to Figs. 8 and 9, which illustrate the toggle-link hinge member 43 in detail, it will be observed that an eyelet 61 is provided, enabling the prong of a switch stick to be inserted therein so that the switch element 32 may be bodily lifted out of the trunnion bearings 34 following fuse operation and drop-out action for a re-fusing operation. Also the toggle-link hinge member 43 is provided with trunnions, or stub shafts 62, which cooperate with the trunnion bearings 34 provided in the side wall portions 22 of the lower hood 20. A contact portion 63, more clearly shown in Fig. 9 of the drawings, cooperates with the flexible contact plate 25 in a manner more clearly shown in Fig. 1 of the drawings.

In the closed-circuit position of the device, as illustrated in Fig. 1, the circuit extending through the device includes, briefly, line terminal 13, upper contact plate 15, contact 45, terminal ferrule 44, fuse link 40, toggle-link hinge member 43, contact portion 63, flexible contact plate 25 to lower line terminal 30. The fuse tube 35 and the clamping collar 51 rigidly secured thereto constitute a unitary assembly, which may be considered as a toggle link, generally designated by the reference numeral 64 and cooperating with the toggle-link hinge member 43 to form a toggle, generally designated by the reference numeral 65, which is in the slightly underset position, as indicated in Fig. 1. A line of action 66 interconnecting the hinge pivot 31 and the contacts 45 indicate the underset condition of the toggle 65 in the closed-circuit position of the device, as illustrated in Fig. 1.

As more fully explained in U. S. patent application Serial No. 261,686, filed December 14, 1951, now United States Patent 2,734,964, issued February 14, 1956, to Andrew W. Edwards and William J. Paxton, and assigned to the assignee of the instant application, upon overload or fault current passing through the device 1, fusing the fusible section 41, the cable extension 36 will become slack and will enable the toggle 65 to collapse, as indicated in Fig. 11, thereby permitting the fuse-holder assembly 32 to drop downwardly and outwardly about the hinge pivot 31 to the fully open disconnected position. An operator must then remove the fuse-holder assembly 32 from the trunnion seats 34 by insertion of the prong of a switch stick into the eyelet 61 and removing the fuse-holder assembly 32 to a safe position, where re-fusing may take place. Upon reassembly, using the same eyelet 61, the operator may then remove the prong of the switch stick from the eyelet 61 and place it in the operating ring 46, swinging the fuse assembly about the hinge pivot 31 in a counterclockwise direction to the closed position, as shown in Fig. 1.

For certain infrequent operations, it may be desirable to open the connected circuit when there is no overload or fault current existing on the line. Previously, it has been customary for an operator to simply insert the prong of his switch stick into the eyelet 46 and yank the fuse-holder assembly 32 forcibly open about the hinge pivot 31. However, as the power requirements increase, with the device 1 carrying the higher current ratings at higher voltage, the resulting arc between the separated contacts 15, 45 under such circumstances is hazardous. Such an arc not only damages the contact surfaces, but is liable to be blown by the wind to adjacent apparatus and cause a fault on the apparatus.

Consequently, it is desirable to break such a load current of value insufficient to effect fusion of the fusible section 41 by a mechanical arrangement, so that the fusible section 41 will be broken interiorly of the fuse tube 35 and arc extinction will occur interiorly of the fuse tube 35 and not between the contacts 15, 45.

Certain arrangements have been proposed heretofore, but they have either been complicated, flimsy, or have not been operable in a direction convenient for an operator. In certain of the devices proposed, the load-break lever has even had portions extending over the open, lower end of the fuse tube to interfere with the escape of arc gases from the fuse tube during a fault operation. In addition, certain of the prior art devices have not had an adequate mechanical advantage for the operation of their load-break lever.

In the load-break arrangement of the present invention, there is provided a load-break lever 70, more clearly shown in detail in Figs. 3 and 4 of the drawings. The load-break lever has a handle portion 71 with an open hook portion 72, which is a distinct advantage inasmuch as it immediately disconnects the prong of the switch stick, manipulated by the operator, from the device 1 following fuse rupture, so that no shock is exerted upon the interrupting device 1 at the end of the pull exerted by the operator. The load-break lever 70 of the device is pivotally connected to a laterally extending U-shaped portion 73 of the toggle-link hinge member 43. Rivet pins 74, shown in detail in Fig. 6 of the drawings, pivotally connect a bifurcated portion 75 of the load-break lever into place. A roller 76, shown in detail in Fig. 7 of the drawings, is positioned between the legs 80, 81 of the bifurcated portion 75 of the load-break lever 70 by a rivet pin 82, more clearly shown in Fig. 5.

The load-break lever 70 does not interfere in any way with normal fault-current operation of the device 1. When, however, an operator desires to open the circuit at a time when the current passing therethrough is insufficient to result in fusion of the fuse link 40, he merely needs to put the prong of his switch stick into the open hook portion 72 of the load-break lever 70 and pull downwardly until the slack is out of the fuse-link cable 36. The operator then gives a good hard pull in a downward direction following through with the motion. As shown in Fig. 2 of the drawings, the downward pull on the load-break lever causes the roller 76, which extends over the cable extension 36, to forcibly pull downwardly on the cable extension 36 to physically rupture the fusible section 41 of the fuse link 40. This condition is illustrated in Fig. 2 of the drawings, where the toggle 65 is still in its stiff-leg position, and where the load-break lever has been moved far enough down so that an arc gap of say an inch, or an inch and a half, exists within the fuse tube 35. Further downward travel of the load-break lever 70, as exerted by the operator, rapidly elongates the arc gap within the fuse tube 35, facilitating arc extinction. Consequently, by the time that the toggle 65 collapses, as shown in Fig. 11, the arc has already been extinguished within the fuse tube 35, and there is no possibility of any arcing occurring between the contacts 15, 45 of the device.

It will be noted that the fuse cutout is assembled in its customary fashion, and that the cutout will carry continuous current in the normal manner. Fault current can be interrupted and dropout action is similar to a standard type of fuse-holder assembly. It will be observed that as the load-break lever 70 is pulled downwardly the roller 76 is pushed in a general downward direction. The fuse link, which is fastened rigidly at the top of the fuse tube 35 and rigidly under the wing nut 42, is elongated by the downward motion of the roller 76. This motion continues in this direction until the fuse link 40 is ruptured. The fuse link 40 always ruptures at the fusible section 41, inasmuch as the relatively large radius of the roller 76 exerts a uniform even tension along the fuse link cable extension 36.

It is also to be noted that in pulling in the downward direction on the handle 71, the moment of forces around the hinge pivot 31 is in the proper direction to keep the fuse holder 32 in place as long as the fuse link 40 has not been broken. The moments on the handle 71 and on the hinge 43 are such that the bottom contact pressure between the trunnions 62 and the trunnion bearings 34 will also be maintained until after the fuse link 40 is broken.

After the fuse link 40 is broken, the handle 71 continues to rotate about the pivot 74, but the motion becomes complicated some by the motion of the toggle-link hinge member 43 itself. As the tension in the fuse link 40 has become very small, the motion is now governed by the laws of dynamics rather than by the laws of statics. That is to say, an analysis of the motion statically, increment by increment, no longer adequately describes the motion. All parts of the fuse-holder assembly 32 are now in motion. The toggle-link hinge member 43 is rotating in a clockwise direction about the hinge pivot 31. The handle 71 is rotating in a counterclockwise direction about the pivot 74, which in turn is revolving in a clockwise direction about the hinge pivot 31. In other words, it is a part of the hinge element 43. The fuse tube 35 and the clamp assembly 51 stays in a generally vertical position because of its high moment of inertia around the hinge point 60. Because the hinge point 60 is part of the toggle-link hinge member 43, the fuse tube 35 and the clamp assembly 51 is also moving in a generally downward direction.

Because of the force which must be exerted on the handle 71 in order to break the fuse link 40 in the first place, this dynamic part of the motion, which follows rupture of the fuse link 40, is very fast. This causes rapid elongation of the arc within the fuse tube 35 and subsequent quick interruption of the load current.

The roller 76 is incorporated in the assembly because it is necessary that the greatest force exerted on the fuse link 40 be exerted in the fusible section 41 of the link 40. If a roller 76 were not used, there would be a stress concentration in the link 40 between the roller and the wing bolt 42. This would be a very undesirable situation because rupture of the fuse link 40 in this section would mean failure of the device to interrupt load current. Since the fusible element 41 is normally the weakest section of the link 40, even tension throughout the length of the link 40 will cause rupture at the fusible element 41 resulting in proper load-break operation.

Throughout its construction this device does not subject the link to any radius less than ½ inch except in the clamping device. This is done to eliminate bending stresses, or any stress concentration, in the length of the link, and subsequent probability of damage to the link.

In the illustrated design the handle 71 is hinged to the hinge element 43 instead of to the fuse tube and clamp assembly, as in some of the prior art. The advantage of this is that the bottom hinge 43 is subject to a moment in a counterclockwise direction while the fuse link is being ruptured. This counterclockwise moment assures maximum contact pressure at both top and bottom contacts during the break operation.

The open end handle 71 permits a good strong pull with follow-through, because the hook will come free from the handle 71 after the handle 71 has been pulled far enough to assure that the arc has been extinguished. This minimizes the jar to the cutout and any possible associated damage.

A large wing bolt 42 has been provided as a clamping mechanism on this load-break cutout to assure that the lineman can make the bottom end of the fuse link good and tight. The serrated base under the wing bolt 42 assures that if the wing bolt has been properly tightened, the fuse link cable 36 will not slip during the load-break operation.

From the foregoing description of the invention it will be apparent that a strong, sturdy, load-break mechanism is provided as a part of the fuse-holder assembly 32, and not as a flimsy attachment which may be secured to existing fuse-holder assemblies. The roller 76 assures even tension along the fuse-link cable 36 so that rupture always occurs at the fusible section 41. Also the roller 76 and all parts of the load-break arrangement are disposed away from the lower, open end of the fuse tube 35 in the closed-circuit position of the device, as illustrated in Fig. 1. There is no portion of the load-break attachment which is directly under the lower, open end of the fuse tube 35 as exists in some of the prior art arrangements. In addition, by having the pivot point 74 of the load-break lever 70 substantially along the axis of the fuse tube 35, as illustrated in Fig. 1, and not in front of the fuse tube 35, or to the right of the fuse tube 35, with reference to Fig. 1, a considerable mechanical advantage is obtained, which would not be obtained should the pivot location 74 be moved toward the right, as viewed in Fig. 1.

Although there is shown and described a specific load-break structure, it is to be clearly understood that the same was merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art without departing from the spirit and scope of the invention.

I claim as my invention:

1. A load-break fuse cutout including a pair of spaced contact assemblies, a collapsible fuse holder assembly electrically bridging said spaced contact assemblies in the closed circuit position thereof, said fuse holder assembly including a toggle-link hinge member, one of said contact assemblies pivotally supporting said toggle-link hinge member, said fuse holder assembly also including a fuse tube and a clamping member thereabout, means pivotally mounting said clamping member to said toggle-link hinge member, a fuse link extending through said fuse tube, a manually operable load-break lever pivotally mounted on said toggle-link hinge member and having an engaging portion for said fuse link to tension the latter and so effect its rupture, fastening means on said toggle link hinge member, and the fuse link extending out of said fuse tube around the engaging portion of said load-break lever and secured to said fastening means.

2. A load-break fuse cutout including a pair of spaced contact assemblies, a collapsible fuse holder assembly electrically bridging said spaced contact assemblies in the closed circuit position thereof, said fuse holder assembly including a toggle-link hinge member, one of said contact assemblies pivotally supporting said toggle-link hinge member, said fuse holder assembly also including a fuse tube and a member secured thereto, means pivotally mounting said member to said toggle-link hinge member to form thereby a collapsible toggle, a fuse link extending through said fuse tube, a manually operable load-break lever pivotally mounted on said toggle-link hinge member at a point off of the pivot axis of said one contact assembly, and said load-break lever having an engaging portion for said fuse link to tension the latter and so effect its rupture.

3. A load-break fuse cutout including a pair of spaced contact assemblies, a collapsible fuse holder assembly electrically bridging said spaced contact assemblies in the closed circuit position thereof, said fuse holder assembly including a toggle-link hinge member, one of said contact assemblies pivotally supporting said toggle-link hinge member, said fuse holder assembly also including a fuse tube and a member secured thereto, means pivotally mounting said member to said toggle-link hinge member to form thereby a collapsible toggle, a fuse link extending through said fuse tube, a manually operable load-break lever pivotally mounted on said toggle-link hinge member at a point off of the pivot axis of said one contact assembly, and said load-break lever having a roller to engage said fuse link to tension the latter and so effect its rupture.

4. A load-break fuse cutout including a pair of spaced contact assemblies, a collapsible fuse holder assembly electrically bridging said spaced contact assemblies in the closed circuit position thereof, said fuse holder assembly including a toggle-link hinge member, one of said contact assemblies pivotally supporting said toggle-link hinge member, said fuse holder assembly also including a fuse tube and a member secured thereto, means pivotally mounting said member to said toggle-link hinge member to form thereby a collapsible toggle, a fuse link extending through said fuse tube, said toggle-link hinge member having a bifurcated portion forming legs which straddle said fuse tube, a manually operable load-break lever pivotally mounted to the legs on said toggle-link hinge member at a point off of the pivot axis of said one contact assembly, and said load-break lever having an engaging portion for said fuse link to tension the latter and so effect its rupture.

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