Feb. 2, 1943. H. H. FAHNOE 2,310,069

CIRCUIT INTERRUPTER

Filed June 23, 1939 2 Sheets-Sheet 1

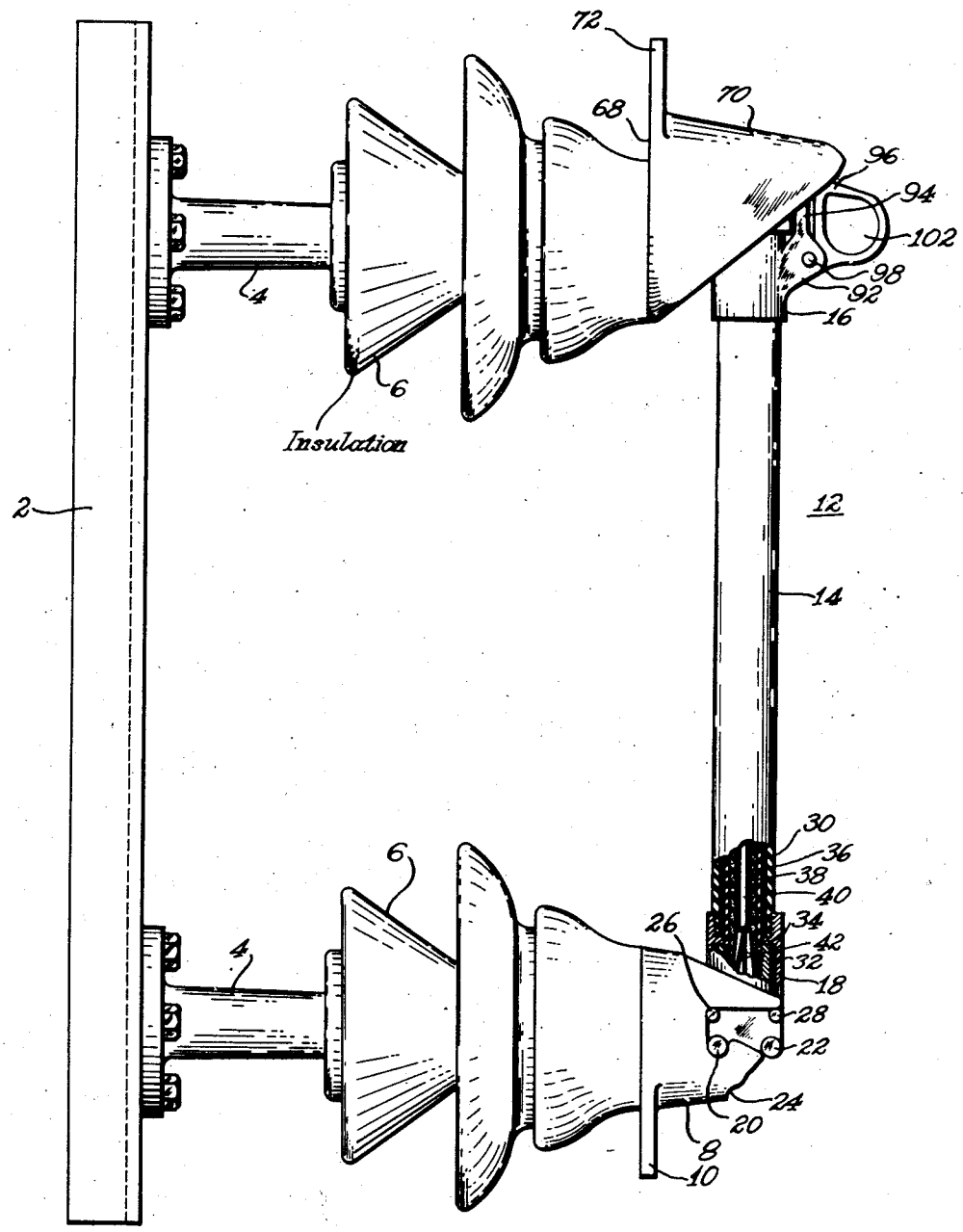


Fig. 1.

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CIRCUIT INTERRUPTER

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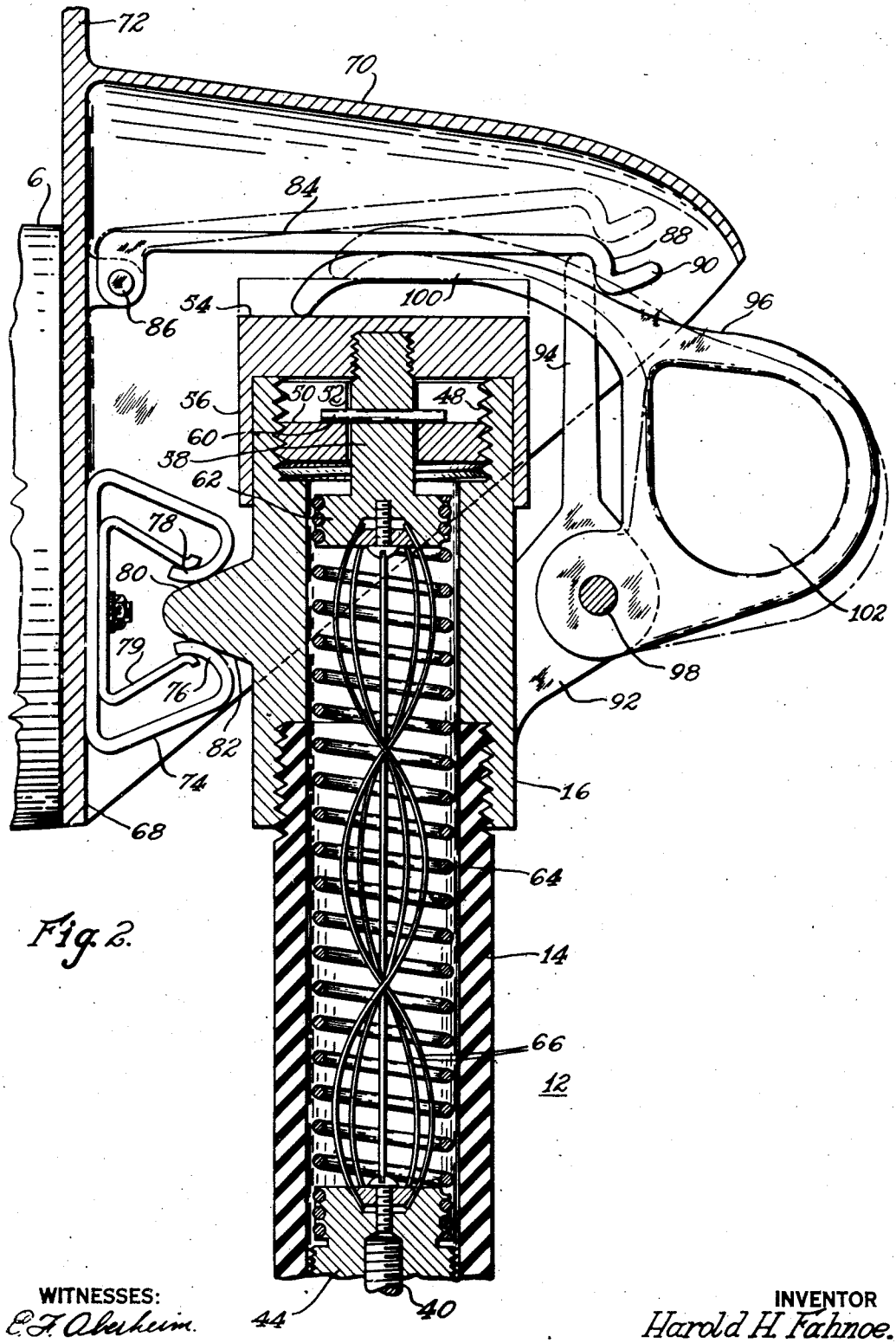


Fig. 2.

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UNITED STATES PATENT OFFICE

2,310,069

CIRCUIT INTERRUPTER

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Application June 23, 1939, Serial No. 280,694

22 Claims. (Cl. 200—116)

My invention relates generally to circuit interrupters and particularly to high voltage fuses.

It is an object of my invention to provide a high voltage fuse which will afford readily visible indication of a blown fuse.

It is a further object of my invention to provide a high voltage fuse having simple yet efficient means for removing the fuse from a circuit after the fuse has operated to interrupt the circuit.

The advantages of this type of fuse are numerous. Inasmuch as the fuse is removed from the circuit after operation, it does not have to withstand restored voltage, and hence cheaper insulation can be employed, as well as a lighter construction throughout. This will also enable a higher voltage class of fuse to be economically constructed, as well as reduce the cost of existing types.

It is a further object of my invention to provide a high voltage expulsion type fuse with positive means for removing it from a circuit after the fuse has interrupted the circuit and extinguished the resulting arc.

A further object of my invention is to provide a high voltage expulsion type fuse with a mechanical means for removing the fuse from a circuit, responsive to, and operable after the fuse has operated to open the circuit and extinguished the resulting arc.

A further object of my invention is to provide a novel releasable holding means for retaining a high voltage fuse in engagement with fixed contacts.

A still further object of my invention is to provide in connection with a releasable holding means for a high voltage fuse, a means to move the fuse away from its associated fixed contacts upon release of said holding means.

It is a still further object of my invention to provide a high voltage fuse having means movable therein and operable in response to operation of the fuse to interrupt the circuit therethrough, to operate a fuse release or signalling means.

These and other objects of my invention will become more apparent upon consideration of the following specification and attached drawings, in which:

Fig. 1 is a side view of my fuse showing its mounting and with a portion of the lower part of the fuse broken away to show the interior construction.

Fig. 2 is a vertical sectional view taken through the upper portion of the fuse and parts immediately associated therewith.

In the embodiment of my device illustrated there is provided a vertical base member 2 having fixed thereto vertically spaced insulator supporting members 4 which, in turn, carry insulators 6 at their outer ends. The lower insulator 6 has at its outer end a fixed contact member 8 provided with a downwardly extending terminal part 10. The fuse proper is designated 12 and comprises an outer elongated tubular casing or support 14 of insulating material such as fiber and is provided with an upper ferrule 16 threadedly engaged therewith and a lower terminal cap 18 likewise threadedly mounted on the tube. The lower terminal cap is provided with pins 20, 22, 26 and 28 projecting outwardly from at least one side thereof and engaging in a slot in the lower fixed contact 8.

Thus, it will be seen that when the upper end of the fuse is moved outwardly away from its fixed contact, the lower end of the fuse will pivot on the pin 20 until the pin 22 engages a fixed stop 24 on the fixed contact member 8, thus limiting the opening movement. With the fuse in this stopped position, it will be apparent that a readily visible indication is given to indicate that the circuit is open. From this position the fuse may be readily removed from the slot in the fixed contact 8. The fuse 12 is provided with a refill element in its lower portion which is similar in construction to that disclosed in my prior Patent No. 2,095,736, granted October 12, 1937. The refill element comprises, in general, a fiber tube 30 secured to a ferrule 32 at its lower end which ferrule engages a shoulder 34 provided on the lower terminal cap 18. The tube 30 is provided with a lining 36 of a material capable of evolving an arc extinguishing gas upon being placed in intimate contact with an electric arc. As disclosed in said patent, this material is preferably boric acid.

The fuse tube 14 obviously acts as a support for the various parts of the fuse including ferrule 16, terminal cap 18 and the refill element referred to above.

A rod or plunger element 40 is located in the passage 38 provided through the boric acid liner and has fuse elements 42 secured to its lower end, which fuse elements are, in turn, secured to the ferrule 32. The upper end of the rod or plunger 40 is threadedly engaged with a piston member 44 (Fig. 2) loosely received in the insulating tube 14. The ferrule 16 at the upper end of the fuse is provided with a threaded

counter-bored portion 48 at its open end for threadedly receiving a plug 50 having a central aperture 52. An operating member or cap is provided for the open end of the ferrule 16, which cap is provided with a depending flange 56 closely but slidably engaging the outer surface of the ferrule. The operating member or cap 54 is provided with a short depending rod portion 58 extending slidably through the aperture 52 and provided therebelow with an enlarged head 62.

A coil spring 64 is connected at its lower end to the piston member 44 and at its upper end to the enlarged head 62. The spring is maintained in stretched condition under considerable tension and acts through the piston 44, its associated rod 40, ferrule 32, to maintain the ferrule against the terminal cap shoulder 34. At its other end the spring acts to maintain the cap 54 seated on the upper end of ferrule 16. The rod element 58 on the cap 54 is keyed to the plug 50 by virtue of a pin 60 provided through the rod engaging a slot provided in the plug. Within the convolutions of the spring 64 are provided flexible shunts 66 electrically connecting the piston 44 with the cap 54.

The upper fixed contact is supported on a vertical plate member 68 secured to the upper insulator 6, which plate is provided with an outwardly and downwardly extending hood member 70 which acts to protect the upper contact, latch and other associated parts from the elements. The support 68 is provided with a terminal part 72 and has a fixed contact 74 located beneath the hood 70. The fixed contact 74 is a substantially U-shaped piece of conducting material having its base secured to the support 68 and embodying the contact parts 76 and 78 for engaging opposite inclined sides 80 and 82 of a terminal provided on the ferrule 16. A resilient member 79 of substantial U shape is provided within the fixed contact 74 for urging the contact portions 76 and 78 towards each other. Thus it will be seen that the resilient fixed contact parts 76 and 78 engaging the terminal portion of the ferrule have a cam action on the inclined sides 80 and 82 thereof, continually tending to urge the fuse away from the fixed contact.

A latch 84 is pivotally mounted on a pivot pin 86 on the fixed support 68 and extends over the top of the fuse and has at its outer end a depending part 88 terminating in an outwardly extending portion 90. A bracket 92 is provided on the upper fuse ferrule 16 and has upwardly extending spaced parallel catch members 94 which are positioned to be engaged by the depending part 88 of latch 84, to lock the fuse with its upper terminal 80 in engagement with the upper fixed contact and with the contact spring 79 in a stressed condition so that when the latch is released the upper end of the fuse will be moved outwardly by the upper fixed contact. A lever 96 is pivotally mounted on the pin 98 provided on the bracket 92 and includes a portion 100 extending between the catch members 94, over the top of the fuse and beneath the latch member 84. The lever 96 is provided with an aperture 102 for receiving a hook stick. In operation, upon the occurrence of a short circuit or overload in the associated circuit, the fusible elements 42 will be fused, and an arc will be established from the ferrule 32 to the lower end of the rod element 40; the fusing of fuse elements 42 will release the spring 64 and allow it to draw the rod 40 up through the passage provided in the boric acid; thus drawing out the arc established past the boric acid material which will evolve an arc extinguishing gas to extinguish the established arc by the time the rod 40 reaches the end of its movement under influence of the spring 64. The spring, the plunger element 44 and parts associated therewith have considerable mass and when the parts are moved by the spring the momentum of these parts is likewise considerable and will be absorbed by the enlarged head 62 with a considerable impact, moving the same upwardly with sufficient force to jar it loose even under severe conditions of corrosion or ice. The upward movement of the enlarged head 62 and the cap or operating member 54 will move the end 100 of the lever 96 upwardly. Since the end 100 of the lever 96 is located beneath the latch 84, the latch 84 will also be moved upwardly to the dotted line position shown in Fig. 2 away from the catch members 94, thus releasing the fuse and permitting the resilient fixed contact 74 to forcibly move the fuse element away therefrom and pivot it about its lower terminal cap to an open position.

It is, therefore, apparent that I have provided a drop-out type high-voltage fuse which on an overload first operates to fuse a fusible element and establish an arc, the arc is then drawn out and extinguished, and a latch retaining the fuse in circuit closing position is then released, whereupon the fuse is forced away from its associated fixed contacts to open the circuit. The fact that the cap 54 is not actuated until the spring and plunger are substantially at the end of their movement insures opening the circuit only after the circuit has first been interrupted within the fuse structure by the fuse element and the arc drawing and extinguishing means.

This structure insures that the circuit will be opened only after interruption of the circuit within the fuse structure, thus preventing any arcing at the separable contacts when the fuse is removed. This type of fuse, which is removed from the circuit enables the use of cheaper insulating materials such as fiber since the fuse is not subjected to restored voltage on the line after it has blown and hence weather-proof porcelain or glass insulation is not required.

In accordance with the patent statutes, I have described in detail one embodiment of my invention. It will be obvious, however, particularly to persons skilled in the art, that many changes and modifications may be made in this particular structure within the spirit of my invention. I, therefore, desire that my claims be construed as broadly as possible in view of the state of the art.

I claim as my invention:

1. In a device for interrupting an electric circuit, a tubular enclosure having a fuse element therein, a cap member telescopically engaging over one end of said enclosure and movable away from the enclosure in response to fusing of said fuse element, an operating member movably mounted on said enclosure and having a part overlying said cap so as to be operated thereby.

2. In an electric cutout device, a fuse support, fixed contacts for engaging fuse terminals on the support, a latch means pivoted on a fixed base and releasably engageable with the support for retaining the support in engagement with the contacts, a fuse element on the support, and means movable independently of said terminals responsive to the fusing of said fuse element and

operable a predetermined time thereafter to release said latch means.

3. In an electric cutout device, a fuse support spaced fixed contacts for engaging spaced fuse terminals on the support, pivotal supporting means adjacent one end of said support, latch means adjacent the opposite end of said support for retaining the support in engagement with the contacts, a fuse element on the support, means having appreciable mass spaced from the latch means and including resilient means maintained in stressed condition by said fuse element, and means movable independently of said terminals operated by impact of said second means at the end of its path of movement after release of the resilient means from said fuse element, to release said latch means.

4. In an electric cutout device, a movably mounted fuse holder including means for interrupting an electric circuit and spaced terminals therefor, stationary contacts for engaging said terminals, at least one of said contacts being of resilient material constructed to constantly urge its associated terminal away therefrom, latch means engaging said holder to maintain it in engagement with said contacts, said latch means comprising a latch member pivotally mounted on a fixed base for movement toward and away from a catch member fixed on said holder, a latch release member pivotally mounted on said holder to disengage said latch member from said catch, and means responsive to operation of said circuit interrupting means to move said latch release member to disengage said latch member.

5. In an electric cutout device, a fuse holder including means for interrupting an electric circuit and spaced terminals therefor, stationary contacts for engaging said terminals, spaced catch members projecting from one end of said holder, a movable latch adapted to engage said members to maintain the fuse terminals in engagement with said contacts, a latch release member movably mounted on said holder and having a part extending between said catch members and adapted to engage said latch.

6. In a circuit interrupting device, a tubular interrupter support, a terminal ferrule on one end of said support, a flanged cap telescopically engaging over said ferrule, circuit interrupting means in said support, stressed means in said support releasable in response to an interrupting operation of said interrupting means to cause movement of said cap, and means limiting movement of said cap to the extent of its flange, whereby said cap always serves as a closure for said one end of said support.

7. In a circuit interrupting device, a tubular interrupter support, a flanged cap telescopically engaging over one end of said support, circuit interrupting means in said support, stressed means releasable in response to an interrupting operation of said interrupting means to cause movement of said cap, an apertured plug in said one end of said support for freely receiving a stem on said cap, and means on the inner end of said stem for limiting outward movement of said cap to no more than the extent of its flange.

8. In an electric cutout device, a movably mounted fuse holder including means for interrupting an electric circuit and spaced terminals therefor, stationary contacts for engaging said terminals, latch means engaging said holder to maintain it in engagement with said contacts, said latch means comprising a latch member pivotally mounted on a fixed base for movement toward and away from a catch member fixed on said holder, a latch release member pivotally mounted on said holder to disengage said latch member from said catch, and means responsive to operation of said circuit interrupting means to move said latch release member to disengage said latch member.

9. In an electric cutout device, a movably mounted fuse holder including means for interrupting an electric circuit and spaced terminals therefor, stationary contacts for engaging said terminals, latch means engaging said holder to maintain it in engagement with said contacts, said latch means comprising a latch member pivotally mounted on a fixed base for movement toward and away from a catch member fixed on said holder, a latch release member pivotally mounted on said holder to disengage said latch member from said catch, means responsive to operation of said circuit interrupting means to move said latch release member to disengage said latch member, and said latch release member being movable independently of said last-mentioned means to permit manual release of said latch member.

10. In an electric cutout device, a tubular fuse holder including means for interrupting an electric circuit and spaced terminals therefor, spaced stationary contacts, means adjacent one of said contacts mounting said holder solely for pivotal movement, another of said contacts being resilient and constructed to constantly exert a force on another of said terminals to move the holder about its pivot out of engagement with the second mentioned contact, latch means to retain the holder in engagement with the contacts, means including a relatively movable part of said holder for releasing said latch means, and means mounted on said holder for movement independent of said movable part for releasing said latch means.

11. In a device for interrupting an electric circuit, means for drawing an arc, an enclosure therefor, operating means limitedly movably mounted on said enclosure, and a single means operable solely in response to the termination of operation of said arc-drawing means to move said operating means relative to said enclosure, whereby said operating means is moved relative to said enclosure only after the arc has been drawn out to substantially the full extent of which said interrupter is capable.

12. In a device for interrupting an electric circuit, a support, means for drawing an arc along said support, means positioned along the path of movement of said arc drawing means for extinguishing said arc, operating means movably mounted on said support, and a single means operable solely in response to movement of said arc drawing means to a position adjacent the end of the path of movement thereof for moving said operating means relative to said support, whereby said operating means is moved only after said arc has been subjected to substantially the full arc extinguishing capacity of said interrupting device.

13. In a device for interrupting an electric circuit, a support, a fuse element on said support adjacent one end thereof, a movable operating element on said support adjacent the opposite end thereof, a rod-like terminal for said fuse element resiliently urged for relative movement toward said operating element but maintained in spaced relation with respect to said operating element by said fuse element, means of a mate-

rial capable of evolving an arc extinguishing gas when in proximity to an electric arc forming a passage for receiving said rod-like terminal, whereby upon fusing of said fuse element said terminal is first moved through said passage prior to engagement with said operating element, and said terminal constituting the sole actuating means for said operating element in response to fusion of said fuse element, whereby the arc drawn by said rod-like terminal upon fusion of said fuse element is subjected to substantially the full arc extinguishing ability of said interrupting device before said operating element is moved.

14. In a device for interrupting an electric circuit, a tubular support, terminal means secured in one end of said support and adapted to be released upon the passage therethrough of a current of predetermined magnitude, an operating member supported for movement toward and away from the opposite end of the support, stressed resilient means connecting said member and means, means of a material capable of evolving an arc extinguishing gas when in proximity to an electric arc forming a passage for receiving said terminal means, whereby upon release of said means said released terminal means will be moved through said passage prior to engagement with said operating member to actuate the latter, there being no other means for actuating said operating member in response to fusion of said fuse element, whereby the arc drawn by said terminal means upon fusion of said fuse element is subjected to substantially the full arc extinguishing ability of said interrupting device before said operating element is moved.

15. In a device for interrupting an electric circuit, a tubular support, a fuse element secured in one end of said support, a cap slidably engaging the other end of said support, a plunger member in said support and secured to said fuse element, a mass of material surrounding said plunger element which is capable of emitting an arc extinguishing gas when placed in proximity to an arc, stressed resilient means connecting said cap and plunger element whereby when the fuse is blown, the plunger will be released and moved by the resilient means past the arc extinguishing material and subsequently move the cap away from the tube, and said resilient means constituting the sole means for actuating said cap in response to fusion of said fuse element, whereby the arc drawn by said plunger member upon fusion of said fuse element is subjected to substantially the full arc extinguishing ability of said interrupting device before said operating element is moved.

16. In an electric cutout device, a fuse support, fixed contacts for engaging fuse terminals on the support, means adjacent one end of said support mounting said support for movement of at least one of said terminals into and out of engagement with respect to at least one of said contacts, latch means adjacent the opposite end of said support for retaining the support in engagement with the contacts, a fuse element on the support, means secured to said fuse element and resiliently urged away from the fuse element to draw an arc when the fuse element is blown, and latch release means located adjacent the end of the path of movement of said arc-drawing means, said resiliently urged means constituting the sole actuating means for said latch release means whereby said latch means is released in response to fusion of said fuse element only after the fuse has blown and the resulting arc drawn out and subjected to the full arc extinguishing capacity of said device.

17. In an electric cutout device, a fuse support, fixed contacts for engaging fuse terminals on the support, latch means for retaining the support in engagement with the contacts, a fuse element on the support, means secured to said fuse element and resiliently urged away from the fuse element to draw an arc when the fuse element is blown, material surrounding the path of movement of said last-mentioned means and being capable of evolving an arc extinguishing gas when placed in close proximity to an arc, and latch release means located adjacent the end of the path of movement of said arc-drawing means, said resiliently urged means constituting the sole actuating means for said latch release means, whereby said latch means is released in response to fusion of said fuse element only after the fuse has blown and the resulting arc drawn out and subjected to the full arc extinguishing capacity of said device.

18. In an electric circuit interrupting device, the combination of a tubular fuse enclosure having spaced terminals, stationary contacts for engaging said terminals, latch means for maintaining said enclosure terminals in engagement with said contacts, a fuse element in said enclosure connected to one of said terminals, an arc drawing member movably mounted in said enclosure connected to another of said terminals and secured to said fuse element, a mass of material closely surrounding the path of movement of said member which is capable of emitting an arc extinguishing gas when in close proximity to an electric arc, a latch release member movably mounted on said enclosure at a point spaced from said arc drawing member, resilient means for moving said arc drawing member toward said latch release member to draw an arc upon fusing of said fuse element past said material and to thereafter engage said latch release member, said resilient means and arc drawing member constituting the sole means for actuating said latch release member, whereby said fuse enclosure is released from the contact in response to fusing of said fuse element only after an arc has been drawn out and extinguished.

19. In a fuse, a fuse tube having terminals adjacent opposite ends thereof, conducting means in said tube connecting said terminals and including fusible means connected between one of said terminals and an arcing contact, means responsive to fusion of said fusible means for moving said arcing contact to elongate the arc formed, means of a material capable of evolving an arc extinguishing gas when in proximity to an electric arc forming a passage for movement of said arcing contact, latch release means on said tube positioned to be actuated only in response to predetermined arc-drawing movement of said arcing contact, there being no other means for actuating said latch release means in response to fusion of said fusible element, whereby said arc is subjected to the full arc extinguishing ability of said fuse before actuation of said latch release means.

20. In a fuse, a fuse tube having terminals adjacent opposite ends thereof, spaced contacts, means mounting said tube for movement of at least one terminal thereof into and out of engagement with one of said contacts, latch means for maintaining said one terminal and contact

in engagement, conducting means in said tube connecting said terminals and including fusible means connected between one of said terminals and an arcing contact, means responsive to fusion of said fusible means for moving said arcing contact to elongate the arc formed, means of a material capable of evolving an arc extinguishing gas when in proximity to an electric arc forming a passage for movement of said arcing contact, latch release means on said tube positioned to be actuated only in response to predetermined arc-drawing movement of said arcing contact to release said latch means and permit movement of said one terminal away from said one contact, there being no other means for actuating said latch release means in response to fusion of said fusible element, whereby said arc is subjected to the full arc extinguishing ability of said fuse before actuation of said latch release means.

21. Circuit interrupting apparatus comprising, in combination, solid arc extinguishing material having a bore from the inner wall of which a relatively large quantity of arc extinguishing gas is evolved when in proximity to an electric arc, terminals adapted to be moved relatively apart to draw an arc therebetween within said bore, one of said terminals being rod-like in character and disposed within said bore and movable relative thereto, and disconnecting means operable only in response to an amount of relative movement apart of said terminals substantially equal to the length of said bore for providing an air gap in the circuit in addition to the gap provided therein between said terminals after the arc is extinguished, there being no other means for actuating said disconnecting means in response to separation of said terminals, whereby said arc is subjected to substantially the entire arc extinguishing ability of said apparatus prior to operation of said disconnecting means.

22. Circuit interrupting apparatus comprising, in combination, solid arc extinguishing material having a bore at least the inner wall portions are capable of evolving a relatively large quantity of arc extinguishing gas when in proximity to an electric arc, terminals adapted to be moved relatively apart and to draw an arc therebetween within said bore, one of said terminals being rod-like in character and disposed within said bore and movable relative thereto, disconnecting means, and means operable only in response to separation of said contacts substantially the entire length of said bore to actuate said disconnecting means for providing an air gap in the circuit in addition to the gap provided therein between said terminals so that said disconnecting means is actuated only after the arc between said terminals has been subjected to substantially the entire arc extinguishing capabilities of said apparatus.

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