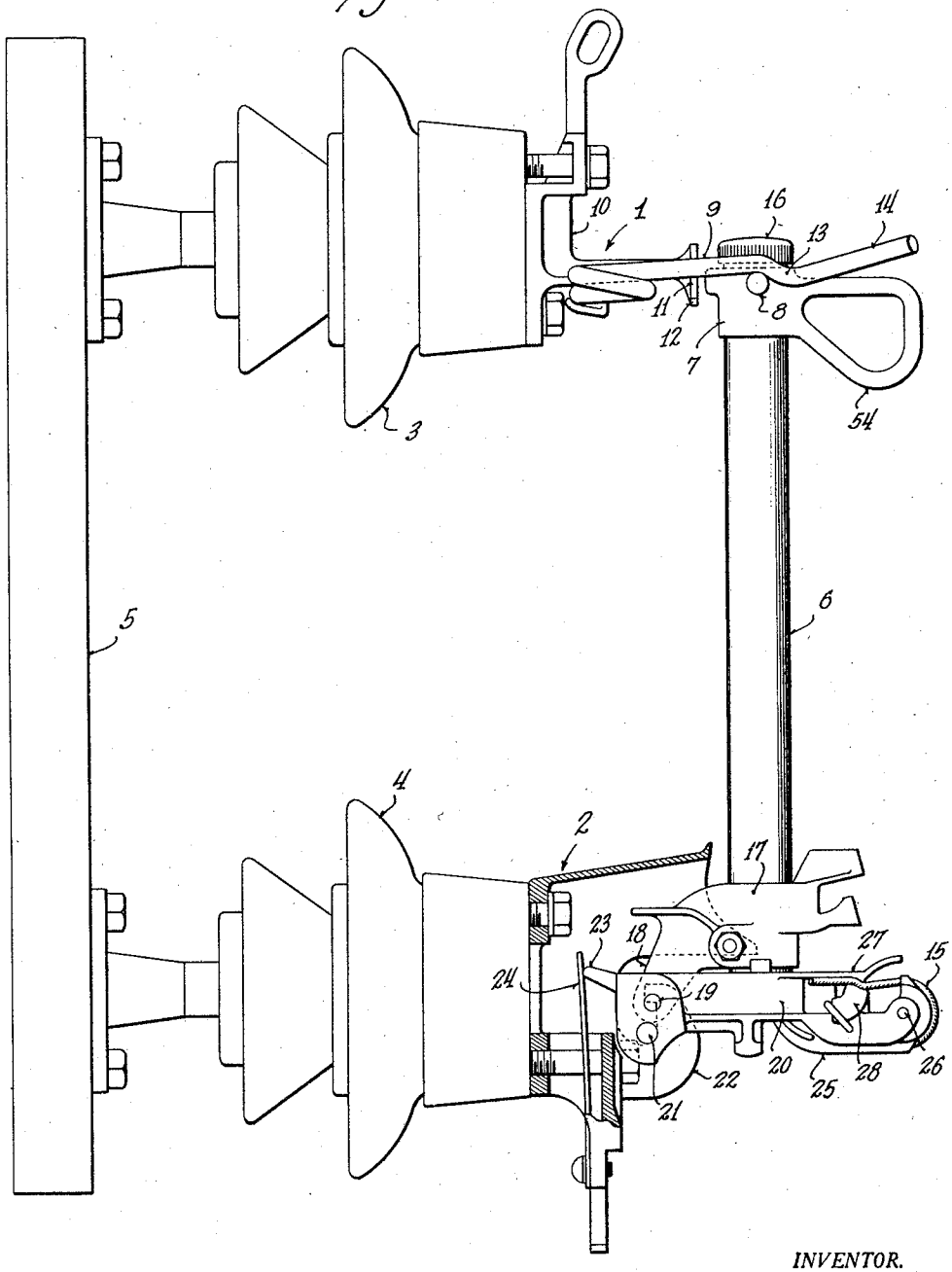
Feb. 3, 1948. R. H. EARLE 2,435,533

HIGH VOLTAGE CIRCUIT INTERRUPTER

Filed March 6, 1944 2 Sheets-Sheet 1

Fig. 1



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HIGH VOLTAGE CIRCUIT INTERRUPTER

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Fig. 2

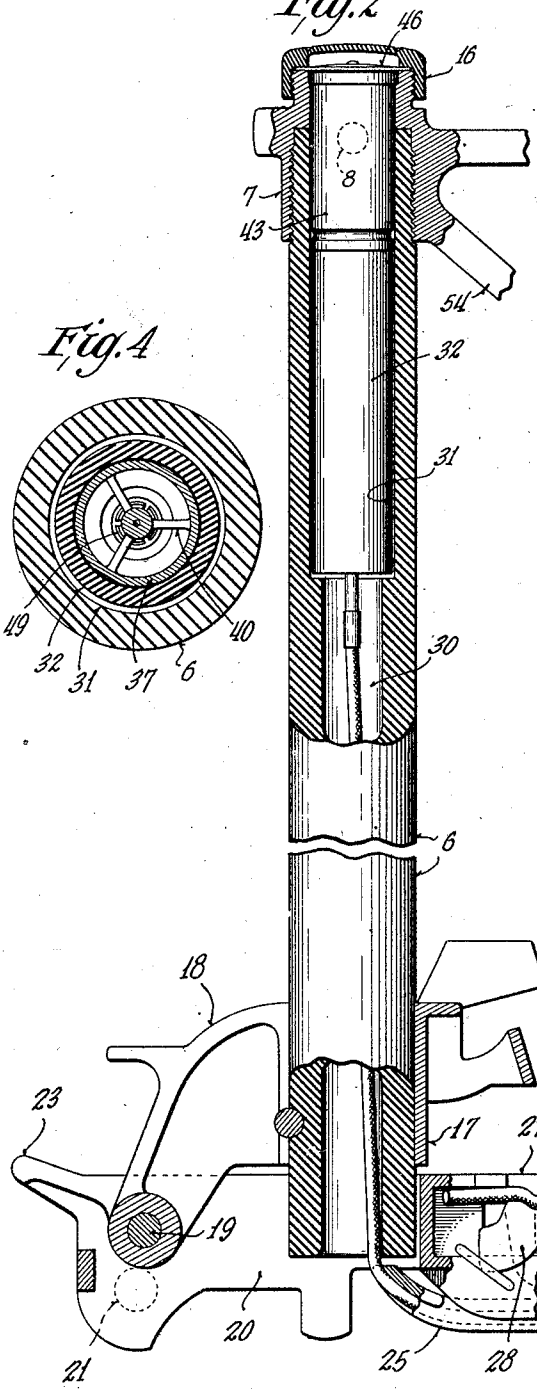


Fig. 3

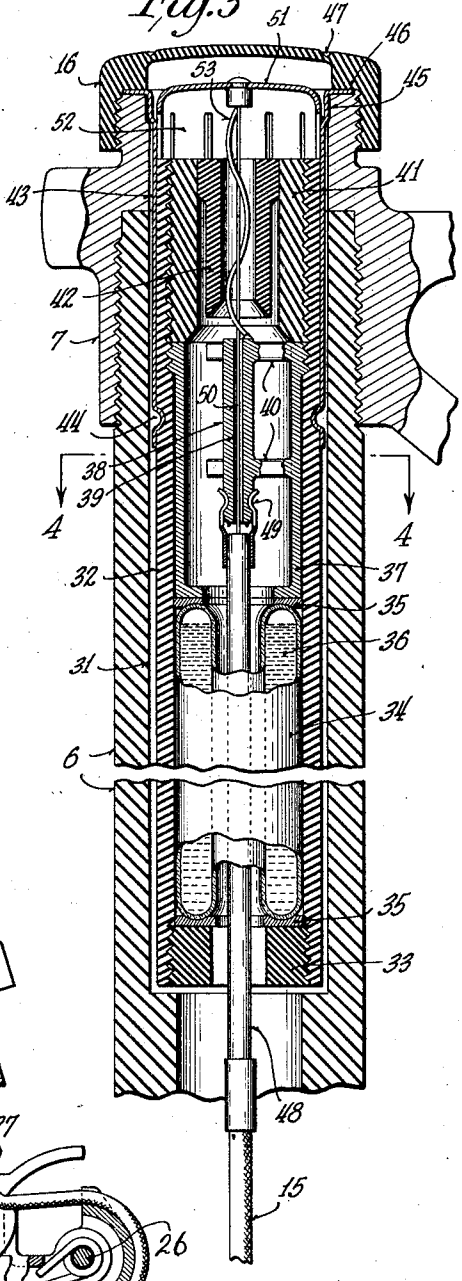


Fig. 4

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Patented Feb. 3, 1948 2,435,533

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2,435,533

HIGH-VOLTAGE CIRCUIT INTERRUPTER

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Application March 6, 1944, Serial No. 525,159

14 Claims. (Cl. 200—120)

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This invention relates to high voltage circuit interrupters.

Objects of this invention are to provide an interrupter which is capable of interrupting high voltage, heavy duty circuits, which rapidly extinguishes the resulting arc in an effective and reliable manner, and which is so constructed that the major portion of the device may be used over and over again.

Further objects are to provide a high voltage, heavy duty drop-out circuit interrupter in which means are employed, such as a fuse tube for instance, to provide an arc channel in which a fusible link is located, and to provide means for forming a power or main arc when the circuit is overloaded and forming an auxiliary arc in series with the main arc and drawing the auxiliary arc into proximity to gas evolving material, the construction being such that a blast of gas is blown axially of the arc channel to extinguish the main arc and to simultaneously elongate the auxiliary arc to prevent the restriking after the main arc has been extinguished.

Further objects are to provide a circuit interrupter which is so constructed that it will effectively interrupt the circuit for a relatively small overload or for a relatively large overload or for any intermediate value of overload with equal certainty of operation in each case, and which is so made that the building up of excessive pressure in the arc channel is prevented.

In greater detail, further objects are to provide a high voltage, heavy duty fuse construction in which an expellable apertured plug is provided in which the main arc is formed and through which a blast of gas is projected to extinguish the main arc upon the rupture of the fuse link on moderate overload, with the plug so arranged that it is expelled on heavy overload to provide a larger discharge passage for the gas to thereby prevent building up of excessive pressure in the device.

Further objects are to provide a fuse construction in which means are provided for liberating arc extinguishing gas in one portion of the fuse tube to provide a violet blast of arc extinguishing gas which passes outwardly from the adjacent end of the fuse tube, and to provide for the normal action of an expulsion fuse construction for the other portion of the fuse device, and in addition to the dual action hereinabove set forth, to provide for the quick mechanical withdrawal of any remaining portion of the fuse link from the fuse tube.

Further objects are to provide a circuit interrupter in which one end of the arc channel is normally closed by a cap weakened along a predetermined zone so that a portion of the cap is freely blown from the remainder of the device to provide free venting means, the portion so

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blown from the device providing an aperture large enough to permit the passage therethrough of the hereinbefore mentioned expellable plug.

Further objects are to provide a drop-out, high voltage, heavy duty fuse construction in which a renewable or refill unit is provided so that the major part of the apparatus may be used repeatedly, the renewable unit being easily installed to replace a previously used unit.

Further objects are to provide a circuit interrupter in which a main arc is formed by the fusing of the fusible section of a fuse link, and in which an auxiliary arc is formed in spaced relation to the main arc between two metal members with one of the metal members interposed between the power arc and the auxiliary arc, means also being provided for elongating the auxiliary arc to prevent restriking after the power arc has been extinguished.

Further objects are to provide a refill unit which is so constructed that it includes a fuse link as a unitary part thereof and which is so formed that it may be inserted in a fuse tube with the same ease as an ordinary type of fuse link without requiring any more skill or care on the part of the lineman than that required for inserting the ordinary type of fuse link.

An embodiment of the invention is shown in the accompanying drawings, in which:

Figure 1 is a side elevation showing the circuit interrupter in operative position, a portion of the lower part of the apparatus being broken away and in section.

Figure 2 is a view of the circuit interrupter removed from the stationary contacts, such view being partly in section and partly broken away.

Figure 3 is an enlarged sectional view through the upper portion of the structure shown in Figure 2.

Figure 4 is a sectional view on the line 4—4 of Figure 3.

Referring to the drawings, it will be seen that the device comprises an upper and a lower stationary terminal indicated generally by the reference characters 1 and 2 which are supported respectively by a pair of insulators 3 and 4 extending from a base or main support 5.

A fuse tube 6 is pivotally supported from the lower terminal 2 in a manner hereinafter described and is provided with an upper terminal 7 having outwardly projecting members or pins 8 on opposite sides thereof. The upper stationary terminal 1 may be constructed as set forth in detail in the patent to William O. Schultz, No. 2,357,772 of September 5, 1944, for Cut-out construction, and may comprise a pair of spring arms 9 which are pivotally supported by a stationary member 10 and bear against oppositely disposed, downwardly slanting cam portions 11 which form a unitary portion of the stationary member 10,

The stationary member 11 is provided with lower stops or outwardly projecting portions 12 to limit the downward motion of the spring arms 9. These spring arms are provided with downwardly depressed portions 13 and with outwardly slanting guiding portions 14. Normally the projections 8 of the terminal 7 of the fuse tube are latched behind the downwardly depressed portions 13 of the spring arms. A composite fuse link is located within the fuse tube 6 and has a leader 15 projecting outwardly through the open lower end of the tube, the upper end of the tube being closed by means of a screw cap 16.

The lower portion of the fuse tube 6 has rigidly clamped thereto a sleeve like member 17 which is provided with a rearwardly and downwardly projecting arm 18 pivoted as indicated at 19 between a pair of arms formed integrally with the main supporting lever 20. This main supporting lever 20 is provided with a pair of trunnions 21 removably supported by the hook like portions 22 of the lower stationary terminal 2 and is provided with a rearwardly projecting portion 23 which normally engages the contact spring 24.

The main lever 20 carries a quick acting flip-out or fuse link extracting lever 25 which is pivotally mounted on a pin 26 carried by the main lever. The main lever has an outwardly extending portion 27. A fuse link clamping lever 28 is also pivoted on the pin 26 and a spring 29 urges the flip-out lever 25 and the fuse link clamping lever 28 in opposite directions. The flexible leader is positioned in a grooved portion of the quick acting fuse link extractor or flip-out lever 25 and passes around the outer end thereof and is clamped between the fuse link clamping lever 28 and the extension 27.

When the fuse link is ruptured, as will be described in greater detail hereinafter, the quick acting flip-out lever 25 extracts any remaining portion of the fuse link in a quick manner and rocks in a counterclockwise direction under the influence of the spring 29. The flip-out lever 25 and the fuse link clamping lever 28 are so constructed that they have interengaging portions which come into engagement when the flip-out lever has rocked a predetermined distance so that thereafter the fuse link clamping lever 28 and the flip-out lever 25 rock as a unit and release the leader 15 of the fuse link.

The particular construction of flip-out lever and fuse link clamping lever forms the subject matter of the copending application of William O. Schultz, Serial No. 465,560, filed November 14, 1942, now Patent No. 2,378,109, issued June 12, 1945, for Fuse constructions.

It is apparent that when the fuse link is ruptured, the main lever 20 is no longer held in the position shown in Figure 1 and it rocks downwardly pivoting about the trunnions 21. This moves the lower end of the fuse tube downwardly and outwardly and allows the projecting portions 8 of the upper terminal 7 of the fuse tube to disengage themselves from the latch spring arms 9, such spring arms, however, following the fuse tube downwardly for a predetermined distance and being arrested in their downward motion by means of the projections 12 at the lower end of the cam portions 11 of the upper stationary terminal 1. The fuse tube thereafter rocks outwardly and downwardly to inoperative position.

The fuse tube 6 may be of Bakelite or fiber or may be of Bakelite lined with fiber in accordance with the usual practice. It is provided with a bore 30 extending therethrough which has an enlarged upper portion 31 adapted to receive a refill unit formed as a unitary structure with the fuse link.

The refill unit comprises a fiber sleeve 32. An apertured fiber plug 33 is screw threaded into and closes the lower end of the fiber sleeve 32. A torus-shaped glass container 34 is supported from the plug 33. Preferably cushioning gaskets 35 are positioned at each end of the container 34. This torus-shaped member contains a material, such as the liquid 36, which is adapted to evolve gas when acted upon by an arc. Above the container 35 a metal sleeve like member 37 is positioned which has a central portion 38 provided with an aperture therethrough indicated at 39 and supported from the walls of the sleeve like member 37 by means of spider like arms 40. The lower end of the member 38 is provided with an annular, externally located groove.

The upper end of the fiber sleeve 32 carries a screw threaded fiber plug 41 which is provided with a relatively large aperture therethrough. Within this large aperture an expellable fiber plug 42 is provided. This expellable fiber plug has a smaller aperture therethrough. The plug 42 is in engagement with the plug 41 only adjacent its enlarged upper end so that it may be readily blown from the plug 41 in the event of heavy overloads in the manner hereinafter to appear to thereby provide a larger opening when very heavy overloads occur. The apparatus is so constructed that on moderate overloads the plug 42 is not blown from the plug 41.

A metal sleeve 43 surrounds the upper part of the fiber sleeve 32 and has a portion 44 spun into an annular groove formed externally of the sleeve 32 to thus permanently lock the metal sleeve 43 to the fiber sleeve 32. The metal sleeve 43 is provided with a slightly larger upper portion 45 and with an outwardly extending annular flange 46 which rests upon the upper edge of the terminal 7 of the fuse tube. It is locked in place by means of the cap 16 hereinbefore mentioned. This cap is formed of Bakelite and is screwed on the terminal 7 and is provided with a weakened portion or zone in the form of an annular cut thereabout as indicated by the reference character 47 so that the central portion of the cap is readily blown from the device when an overload occurs.

The flexible leader 15 is attached to a metal rod 48 which extends through the apertured plug 33 through the torus-shaped container 34 and into the lower portion of the metal sleeve 37. Its upper end carries a plurality of spring fingers 49 which releasably grip the lower end of the portion 38 of the metal sleeve or intermediate member and have rounded portions that fit within an annular groove formed in the lower end of such member 38 so as to have firm electrical contact therewith. The grip of the fingers 49 is not sufficient to prevent the flip-out spring pressed lever 25 from quickly withdrawing the leader 15 and the rod 48. However, the rod 48 is normally held against motion by means of a strain wire 50 whose lower end is attached to the rod 48 and whose upper end is attached to an upper contact cap 51. This upper contact cap 51 is provided with a plurality of spring fingers 52 formed by cutting slots in the flanged portion of the cap 51. These spring fingers slidably and yieldably fit within the metal sleeve 43 and form good elec-

trical contact therewith. It is to be noted that the metal cap 51 rests upon the upper edge of the fiber sleeve 32 and it is to be noted further that both the metal cap 51 and the expellable plug 42 will freely pass through the cap 16 when the central portion thereof is blown off. The fuse link is provided with a fusible section 53 which has its upper end electrically connected to the cap 51 and its lower end electrically connected to the central metal member 38. The fuse link, therefore, includes the fusible section 53, the strain wire 50, the rod 48, and the flexible leader 15.

When an overload occurs, the fusible section 53 of the fuse link is ruptured and immediately thereafter the strain wire is ruptured. The quick acting fuse link extractor 25 or flip-out lever withdraws the rod or plunger 48 downwardly and an auxiliary arc is established extending from the lower end of the metal member 38 to the rod 48 and in series with the power or main arc which extends upwardly from the upper end of the metal member 38. The auxiliary arc is quickly elongated and drawn downwardly into proximity to the gas evolving material and breaks the container and acts on the gas evolving material and causes a violent blast of gas to pass upwardly through the expellable plug 42 and thus provides means for quickly extinguishing the power or main arc. If the overload is of moderate magnitude, the expellable plug 42 remains in place but if the overload is very heavy, the expellable plug 42 is blown from the device and thus a larger vent opening is provided.

It is to be noted that on an overload of any value the weakened central portion of the cap 16 is blown off together with the metal cap 51. It is to be noted particularly that the power arc extends initially from the upper end of the metal member 38 to the metal cap 51 but almost instantly as the metal cap is blown outwardly passes over to the upper end of the metal sleeve 43. The auxiliary arc is formed between the upper end of the plunger or rod 48 and the lower end of the metal member 38 and is in series with the power arc. This auxiliary arc is very quickly extended as explained hereinabove as the gap between the rod 48 and the lower end of the metal member 38 is quickly lengthened, thus preventing restriking after the extinguishing of the power arc has taken place.

It is preferable to flare the open lower ends of both the plugs 42 and 41 to facilitate the flow of gas into the restricted aperture of the plug 42 or the less restricted aperture of the plug 41 in the event the plug 42 has been blown from the device as a result of a heavy overload.

It is to be noted further that in the event the circuit is not interrupted prior to the time the upper end of the rod 48 passes downwardly through the apertured fiber plug 33, the ordinary expulsion action takes places for the lower portion of the fuse tube 6 in addition to the extinguishing action due to the violent blast of gas hereinbefore described from the upper end of the fuse tube.

The material adapted to evolve gas when acted upon by the auxiliary arc and indicated by the reference character 36 may be any suitable liquid, such as carbon tetrachloride, methylene chloride or chloroform. If desired any other suitable material can be used. For example, solid material, such as compressed boric acid disks or powdered boric acid carried in a suitable container may be used. It is obvious also that if desired silicic acid, gunpowder, or any other suitable powdered material could be used, a suitable container being provided for such material. After the circuit interrupter has functioned and the fuse tube has dropped to its lowermost or inoperative position, it may be removed by means of a switch stick in the usual manner and after refusing may be replaced by means of a switch stick and rocked into position, a suitable eyeleted portion 54 being formed integrally with the upper terminal 7 and being adapted to be engaged by the switch stick after the trunnions 21 of the fuse tube have been placed in proper relation to the hook like supports 22 of the lower stationary terminal.

In refusing, a composite renewable unit and fuse link is substituted for the previous unit. The remainder of the cap 16 is unscrewed from the fuse tube and the fiber sleeve 32 is bodily removed through the upper end of the fuse tube 6. Thereafter a new unit is inserted through the upper end of the fuse tube allowing the leader 15 to project downwardly and outwardly from the lower end of the fuse tube. Thereafter a new cap 16 is screwed into place and the leader 15 locked between the fuse link clamping lever and the extension 27 of the main lever 20 after the flip-out device 25 has been rocked back into its initial position.

It will be seen that the composite renewable unit and fuse link may be inserted in the fuse tube with the same facility as an ordinary type of fuse link and that no particular skill is required of the operator. Also it will be seen that the renewable units are relatively inexpensive and may be readily made.

It will be seen that this invention provides a novel form of high voltage, heavy duty circuit interrupter in which provision is made for handling both heavy and light overloads or overloads of all intermediate values. Under a light overload a relatively restricted passage is provided for the blast of arc extinguishing gas, whereas for a relatively heavy overload the expellable plug is expelled and a larger passage is provided for the blast of arc extinguishing gas, thus guarding against the building up of excessive internal pressure.

It will be seen further that a circuit interrupter has been provided in which a main arc is formed at a predetermined definite location and an auxiliary arc is formed in series with said main arc and is elongated while the main arc is being extinguishred due to the violent blast of arc extinguishing gas. This elongation of the auxiliary arc prevents restriking after the main arc has been extinguished.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

I claim:

1. A circuit interrupter comprising a body portion provided with an arc channel, means adapted to interrupt a circuit under overload and form a main arc in said arc channel, gas liberating means adapted to liberate gas when acted upon by an arc, means for forming an auxiliary arc in proximity to said gas liberating means, said gas liberating means being normally out of contact with the means for forming an auxiliary arc, and an expellable apertured plug through which said main arc is formed and through which the liberated gas passes to extinguish said main arc, said plug being normally positioned in said arc channel, said plug remaining in place in said arc

channel for moderate overloads to provide a restricted passage and being expelled on heavy overloads to provide a larger passage.

2. A circuit interrupter comprising a body portion provided with an arc channel, means adapted to interrupt a circuit under overload and form a main arc in said arc channel, gas liberating means located within said arc channel and adapted to liberate gas when acted upon by an arc, biased means for forming an auxiliary arc in proximity to said gas liberating means and for extending said auxiliary arc, said gas liberating means being normally out of contact with the means for forming an auxiliary arc, and an expellable apertured plug through which said main arc is formed and through which the liberated gas passes to extinguish said main arc, said plug being normally positioned in said arc channel, said plug remaining in place in said arc channel for moderate overloads to provide a restricted passage and being expelled on heavy overloads to provide a larger passage.

3. A circuit interrupter comprising a body portion provided with an arc channel, a conducting member within said channel and spaced from one end of said channel, means adapted to interrupt a circuit under overload and form a main arc in said channel extending from said conducting member to adjacent said end of said channel, gas liberating means spaced from said first mentioned means and adapted to liberate a gas when acted upon by an arc, means for forming an auxiliary arc in said channel extending from said conducting member into proximity to said gas liberating means, and means for guiding the liberated gas into said main arc to extinguish said main arc.

4. A circuit interrupter comprising a body portion provided with an arc channel, a conducting member within said channel and spaced from one end of said channel, means adapted to interrupt a circuit under overload and form a main arc in said channel extending from said conducting member to adjacent said end of said channel, gas liberating means spaced from said first mentioned means and adapted to liberate gas when acted upon by an arc, means for forming an auxiliary arc in said channel extending from said conducting member into proximity to said gas liberating means and for elongating said auxiliary arc, and means for guiding the liberated gas into said main arc to extinguish said main arc.

5. A circuit interrupter comprising a body portion provided with an arc channel, a conducting member within said channel and spaced from one end of said channel, means adapted to interrupt a circuit under overload and form a main arc in said channel extending from said conducting member to adjacent said end of said channel, gas liberating means adapted to liberate gas when acted upon by an arc, means normally electrically connected to said conducting member and biased for motion away from said conducting member for forming an auxiliary arc in said channel extending from said conducting member into proximity to said gas liberating means and independent of said main arc, and means for guiding the liberated gas into said main arc to extinguish said main arc.

6. A circuit interrupter comprising a body portion provided with an arc channel, a conducting member within said channel and spaced from one end of said channel, means adapted to interrupt a circuit under overload and form

a main arc in said channel extending from said conducting member to adjacent said end of said channel, gas liberating means adapted to liberate gas when acted upon by an arc, a retractable plunger normally electrically connected to said conducting member and biased for motion away from said conducting member for forming an auxiliary arc in said channel extending from said conducting member into proximity to said gas liberating means and independent of said main arc, and means for guiding the liberated gas into said main arc to extinguish said main arc.

7. A circuit interrupter comprising a body portion provided with an arc channel, an apertured conducting member within said arc channel and spaced from one end of said channel, means adapted to interrupt a circuit under overload and form a main arc in said channel extending from said conducting member to adjacent said end of said channel and including a portion extending through the aperture in said conducting member and adapted to be severed on overload, gas liberating means adapted to liberate gas when acted upon by an arc, a biased plunger normally electrically connected to said conducting member and normally restrained by said severable portion for drawing an auxiliary arc from said apertured conducting member into proximity to said gas liberating means, and means for guiding the liberated gas into said main arc to extinguish said main arc.

8. A circuit interrupter comprising a body portion provided with an arc channel, an apertured conducting member within said arc channel and spaced from one end of said channel, means adapted to interrupt a circuit under overload and form a main arc in said channel extending from said conducting member to adjacent said end of said channel and including a portion extending through the aperture in said conducting member and adapted to be severed on overload, gas liberating means adapted to liberate gas when acted upon by an arc, a biased plunger normally electrically connected to said conducting member and normally restrained by said severable portion for drawing an auxiliary arc from said apertured conducting member into proximity to said gas liberating means and for elongating said auxiliary arc, and means for guiding the liberated gas into said main arc to extinguish said main arc.

9. A high voltage, heavy duty fuse construction comprising a body portion provided with an arc channel and having a terminal adjacent one end of said channel, an apertured conducting member within said arc channel and spaced from the said end of said arc channel, a fuse link including a fusible section electrically connecting one end of said conducting member and said terminal, gas liberating means adapted to liberate gas when acted upon by an arc located adjacent the other end of said conducting member, a plunger normally electrically connected to the last mentioned end of said conducting member and biased for motion away from said conducting member to draw an auxiliary arc from said conducting member into proximity to said gas liberating means, a strain wire attached at one end to said plunger and normally restraining said plunger and extending through the aperture of said conducting member and attached at the other end at a point adjacent the said end of said channel and electrically connected with said terminal, and means for directing the liberated

gas into the area adjacent said fusible section when said fusible section and strain wire are ruptured on overload.

10. A fuse construction comprising a body portion provided with an arc channel, means dividing said arc channel into a first portion adjacent one end of said body portion and a second portion extending from the first portion of said arc channel through to the other end of said body portion, a fuse link in said arc channel having a fusible section located in the first portion of said arc channel and upon rupture on overload adapted to form a main arc in said first portion of said arc channel, said fuse link including a movable portion extending from the first portion through the second portion of said arc channel, and gas liberating means located in said arc channel and spaced axially from said fusible section and adapted to liberate gas when acted upon by an arc, said movable portion of said fuse link being biased for motion outwardly from said arc channel and adapted to form an auxiliary arc and draw said auxiliary arc into proximity to said gas liberating means, means for guiding the liberated gas into said main arc, the second portion of said arc channel having an expulsive action with reference to the auxiliary arc in the event the main arc is not extinguished by the gas in the first portion of said arc channel.

11. A refill unit for a circuit interrupter having a body portion provided with an arc channel and having a terminal adjacent one end and retracting means adjacent the other end, said refill unit comprising a sleeve adapted to be inserted in the arc channel and having conducting means for electrical connection with said terminal and having a retractable portion adapted to be connected to the retracting means, an intermediate stationary conductor within said sleeve, a fusible section joining the said conducting means and one end of said stationary conductor, gas liberating means adapted to liberate gas when acted upon by an arc, means for directing the liberated gas into the main arc incident to rupture of the fusible section on overload, and means normally holding said retractable portion in electrical engagement with the other end of said stationary conductor and releasing said retractable portion on rupture of said fusible section, said retractable portion drawing an auxiliary arc from said stationary conductor into proximity to said gas liberating means when said retractable portion is released.

12. A circuit interrupter comprising a body portion provided with an arc channel and having a terminal adjacent one end and having retracting means located externally of said arc channel adjacent the other end of said arc channel; and a unit comprising a sleeve located within the arc channel, a stationary conductor located within said sleeve, fusible means electrically connecting one end of said stationary conductor to said terminal, a retractable member normally in electrical connection with the other end of said stationary conductor and extending outwardly from said arc channel and connected to said retracting means, gas liberating means located within said sleeve and adapted to liberate gas when acted upon by an arc, and means normally holding said retractable member in electrical connection with said stationary conductor and releasing said retractable member following rupture of said fusible section, said retractable member when released drawing an auxiliary arc from said stationary conductor into proximity to said gas liberating means.

13. A circuit interrupter comprising two main portions, one of said main portions being a body portion provided with an arc channel and having a terminal adjacent one end of said arc channel and retracting means located externally of said arc channel adjacent the other end of said arc channel, the other of said portions comprising an insulating sleeve located within said arc channel and having a terminal connected to the terminal of said body portion, an apertured plug carried within said sleeve adjacent one end of said sleeve, a stationary conductor located within said sleeve intermediate the ends thereof, gas liberating material located within said sleeve adjacent the other end thereof, a retractable member connected to said retracting means and extending into the last mentioned end of said sleeve and being normally electrically connected to said stationary conductor adjacent one end thereof, a fusible section extending through said apertured plug and electrically connecting the other end of said stationary conductor to the terminal of said sleeve, and means normally holding said retractable member in electrical connection with said stationary conductor and releasing said retractable member upon rupture of said fusible section on overload.

14. A circuit interrupter comprising two main portions, one of said main portions being a body portion provided with an arc channel and having a terminal adjacent one end of said arc channel and retracting means located externally of said arc channel adjacent the other end of said arc channel, the other of said portions comprising an insulating sleeve located within said arc channel and having a terminal connected to the terminal of said body portion, a pair of concentrically arranged apertured plugs located in said sleeve adjacent one end of said sleeve, the innermost of said apertured plugs being expellable under high gas pressure, a stationary conductor located within said sleeve intermediate the ends thereof, gas liberating material located within said sleeve adjacent the other end thereof, a retractable member connected to said retracting means and extending into the last mentioned end of said sleeve and being normally electrically connected to said stationary conductor adjacent one end thereof, a fusible section extending through the innermost of said apertured plugs and electrically connecting the other end of said stationary conductor to the terminal of said sleeve, and means normally holding said retractable member in electrical connection with said stationary conductor and releasing said retractable member upon rupture of said fusible section on overload.

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