Oct. 21, 1947. R. H. EARLE ET AL 2,429,347

HIGH VOLTAGE CIRCUIT INTERRUPTER

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Fig. 1

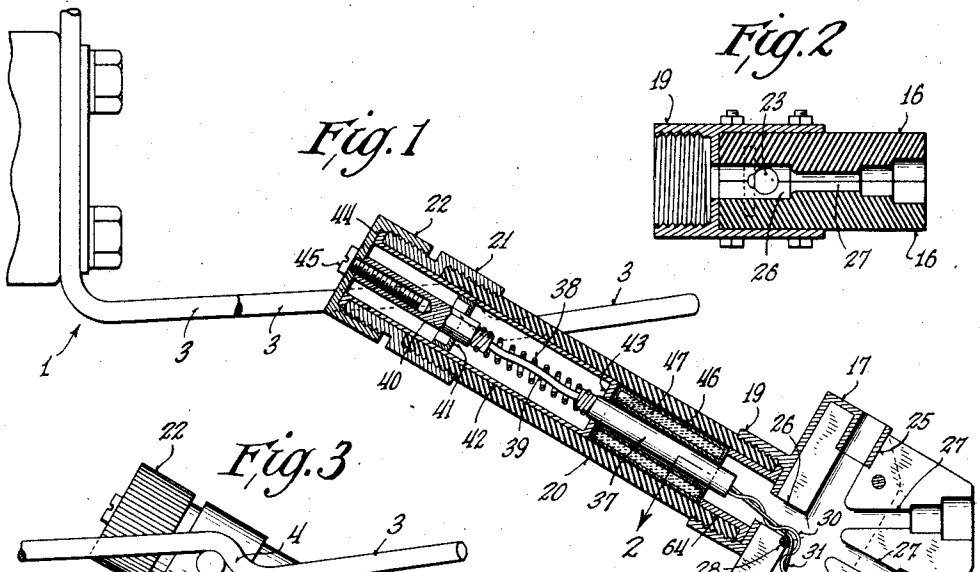


Fig. 2

Fig. 3

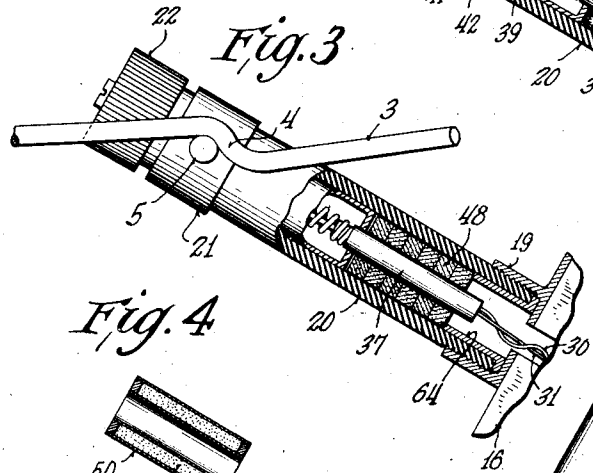
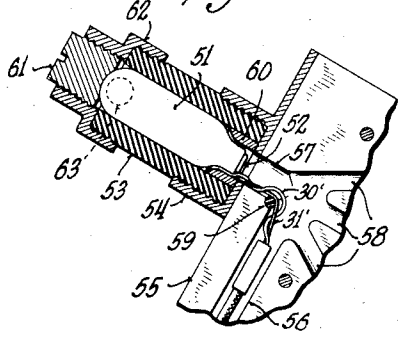
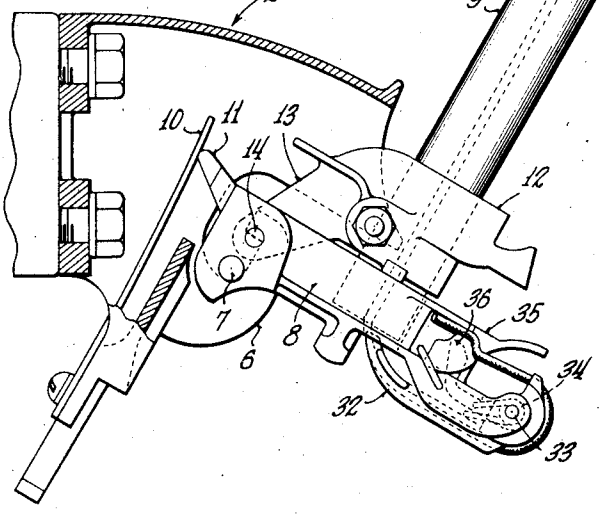


Fig. 4

Fig. 5





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HIGH-VOLTAGE CIRCUIT INTERRUPTER

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16 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.

Further objects are to provide a high voltage circuit interrupter which utilizes an expulsion fuse construction but does not rely upon the normal expulsive action of the device but brings into play an additional effect whereby the normal expulsive action is not hampered but in which the main arc or power arc is interrupted by means much more effective than the normal expulsion action.

Various types of circuit interrupters have heretofore been constructed in which material which evolves gas when acted upon by the arc has been employed and in which the evolved gas commingles with the gases incident to the arc and is blown downwardly and outwardly. With the prior constructions, however, the evolved gases are distributed throughout substantially the entire length of the main arc channel or passageway and are not concentrated at any one point but are diffused or mixed with the ionized gases produced by the arc. The gas evolved from the material acted upon by the arc materially increased the pressure in the arc channel, in the prior devices, with consequent danger of bursting the devices.

Objects of this invention are to provide a high voltage circuit interrupter in which the expulsive action for the main or power arc takes place and is supplemented by a powerful cross blast passing transversely across the main arc so that the normal expulsive action is not interfered with in any manner and so that the pressure inside of the fuse tube is not increased over that due to the gases generated by the power arc itself, but in which the powerful blast of arc extinguishing gases is discharged laterally of the main arc channel, thereby concentrating the arc extinguishing effect at a certain predetermined portion of the path of the arc as distinguished from commingling the arc extinguishing gases with all of the ionized gas generated by the arc as in the prior devices, and thus producing a more concentrated and direct effect at a localized and predetermined point in the arc.

In greater detail further objects of this invention are to provide a circuit interrupter in which, on interruption of the circuit, an arc is formed in the main arc channel and is led into a cross

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channel and into a pressure chamber into proximity to material which evolves arc extinguishing gas when acted upon by an arc so that gas is generated in the pressure chamber and such gas is projected in the form of a violent blast across the main arc channel and across the main arc and outwardly laterally of the main arc channel thus blowing the ionized gases at a localized point of the main arc laterally from the main arc path without increasing the pressure in the main arc channel and, additionally, allowing the expanding gas to cool and interrupt the main or power arc at such localized point, the total length of the path traversed by the cross blast being very short and the transverse blast of gases thereby acquiring an extremely high velocity and effectively breaking the main arc, the transverse channel being preferably formed larger than the main arc channel so as to prevent the main arc from finding a path around the cross blast and, instead, having the cross blast completely overlap the main arc channel and extend beyond the sides of the main arc channel at least a small amount so as to insure the complete interruption of the main arc as hereinabove set forth.

Further objects are to provide a drop-out fuse construction for high voltage, heavy duty circuit interruption which is so made that on overload an arc is formed in a main arc channel and is led through a cross channel laterally of the main arc channel into proximity to material adapted to evolve gas when acted upon by an arc, in which, in one form of the invention, the arc in the main arc channel is automatically switched to a terminal so as to place the main arc squarely across the cross channel and which provides a second arc distinct from the main arc for acting upon the gas evolving material.

Further objects are to provide a simple type of high voltage, heavy duty circuit interrupter which may be economically manufactured and which is reliable in operation.

Embodiments of the invention are shown in the accompanying drawings, in which:

Figure 1 is a side elevation, partly in section, showing one form of the invention.

Figure 2 is a sectional view on the line 2—2 of Figure 1.

Figure 3 is a fragmentary view, partly in section, showing a further form of the invention.

Figure 4 shows a further form in which the gas evolving material may be used.

Figure 5 is a fragmentary view showing a further form of the invention.

Referring to Figures 1 and 2, it will be seen

that the circuit interrupter comprises an upper stationary contact indicated generally by the reference character 1 and a lower stationary contact indicated generally by the reference character 2. The upper stationary contact is provided with a pair of spaced spring arms 3 which, as may be seen most clearly from Figure 3, are provided with shouldered portions 4 behind which projecting portions 5 of the drop-out circuit interrupter are normally held.

The lower stationary contact 2 is a hood like structure provided with a pair of spaced hook like members 6 which support the main trunnions 7 of a main lever 8. The main lever is provided with a pair of spaced arms located on opposite sides of the tubular insulating body portion 9. The lower contact is provided with a relatively heavy contact spring 10 which bears against projecting portions 11 formed on the main lever 8.

The body portion of the apparatus consists of the fuse tube 9 which may be formed with a fiber inner lining and a Bakelite exterior, as shown in Figure 1. A lower sleeve like member 12 is rigidly secured to the lower portion of the tube 9 and is provided with a pair of outwardly and downwardly projecting fingers 13 which are pivoted as indicated at 14 to the main lever 8.

The upper end of the tube 9 is screw threaded into a metal fitting 15 which receives a pair of fiber blocks 16 and which is clamped thereto by means of bolts as indicated. The fiber blocks 16 are also clamped together by means of bolts extending through an upper metal fitting 17. It is to be noted that the tube 9 has a reduced portion 18 which fits in a gas tight manner within a bored out portion formed in the block 16. The fitting 17 is provided with a laterally projecting threaded extension 19 into which the pressure chamber or pressure tube 20 is screwed. This pressure tube is formed of fiber and has screwed thereon at its rear end an internally threaded terminal portion 21. This terminal portion has an externally threaded reduced portion which receives the internally threaded closure cap 22. The terminal portion 21 is provided with the projections 5 shown in dotted lines in Figure 1 and shown more clearly in Figure 3, the projections, as stated, normally hooking behind the downwardly depressed portions 4 of the spring arms 3 of the upper stationary terminal. The fiber blocks 16 are provided with a channel 23 which forms a continuation of the channel 24 in the tube 9.

The channels 23 and 24 are the main arc channels. The channel 23 may extend upwardly and outwardly and may be opened at the upper end so that the main arc channel 23, 24 is open at both ends. If desired, the upper end may be closed as shown in the form of the invention illustrated in Figure 5. However, it is preferable to have the upper end open as shown in Figure 1 and to provide an upper terminal 25 which is integral with the fitting 17 and which is annular in shape.

The fiber blocks 16 are provided with a transverse or cross blast channel 26 which is larger than the main arc channel as shown in Figure 2. The cross channel continues directly across the main arc channel and is provided with a plurality of venting channels 27 which may, if desired, have expanding outer portions. At the point where the cross channel 26 intersects the channel 23 and at the lower side thereof, a porcelain or steatite pin 28 is provided and is carried by the fiber blocks 16, as shown in Figures 1 and 2.

A fuse link is provided and is positioned partly in the main arc channel and partly in the cross

channel as shown in Figure 1. The fuse link comprises the flexible leader 29 and a fusible section 30 and a strain wire 31. Other types of fuse links could be employed. It is to be noted that the fusible section is located partly in the main channel and partly in the cross channel and rests upon the insulating pin 28 as shown. Preferably the strain wire is arranged to bear on the pin 28 and the fusible section may be out of contact with the pin if desired. The flexible leader extends downwardly through the tube 9 outwardly through the lower open end and is looped around a flip-out or throw-out lever 32 which is pivoted as indicated at 33 to the main lever 8 and which is spring urged downwardly by means of the spring 34. The main lever has a projecting portion 35 below which the leader 29 of the fuse link is positioned and against which it is clamped by means of a clamping lever 36. The spring 34 is interposed between the clamping lever 36 and the throw-out or flip-out lever 32. This particular construction, however, is the subject matter of the copending application of William O. Schultz Serial No. 465,560 for Fuse constructions, filed November 14, 1942.

It is apparent that when the fuse link is ruptured, on overload, the flip-out lever 32 will suddenly draw the flexible leader 29 downwardly and extract any remaining portion of the fuse link and that the main lever 8 will then be released from restraint by the fuse link and will rock the lower end of the tube 9 downwardly and outwardly, thus detaching the projections 5 from the spring arms 3 of the upper stationary contact, thus allowing the device to drop out to inoperative position.

The fusible section 30 and strain wire 31 extend through the cross blast opening 26 and are attached to a retractable metal plunger 37. This plunger 37 is urged inwardly by means of a spring 38 and is connected by means of the spring and by means of a flexible leader 39 with a polygonal-shaped rod 40. This rod 40 loosely slides through a polygonal opening formed in a web 41 rigid with the inner metal tube 42 positioned within the pressure chamber 20 and terminating at one end in a shouldered portion 43 and at its other end in a flange 44. The flange 44 is normally locked against the end of the tube 20 by means of the screw cap 22. The rod 40 is internally threaded and receives the elongated screw 45 which is used to draw the rod 40 to the left as viewed in Figure 1 for ease in assembly of the apparatus.

The retractable plunger 37 is adapted, when released upon rupture of the fuse link, to be drawn inwardly into an annular glass container 46 which is broken by the arc and within which gas evolving material 47 is positioned. This material is adapted to evolve an arc extinguishing gas when acted upon by an arc and to generate gas pressure within the pressure chamber 20 to thereby produce a transverse blast of gas through the transverse channel 26 and outwardly through the vent portions 27 to extinguish the arc in the main arc channel by means of a transverse blast.

The material 47 which evolves gas when acted upon by an arc may be a liquid. For instance it may be carbon tetrachloride, methylene chloride or chloroform and is preferably contained in the annular glass container.

Solid material can be used for the gas evolving material. For example boric acid, silicic acid or gunpowder have been found satisfactory. When solid material is employed, it may be in the form of compressed rings as indicated by the reference

character 48 in Figure 3. On the other hand, if the material is used in the powdered form as indicated at 49 in Figure 4, it may be carried in a waxed paper or other container 50. In addition to this, the material may be in the form of a gas, for example carbon dioxide, nitrous oxide or even air if desired, such gases being held under pressure in a suitable container, for example the metal bulb 51, see Figure 5. The bulb 51 may be an ordinary sparklet bulb if desired and is provided with a relatively softer and more easily fusible end portion 52. The bulb 51 is carried in a relatively short chamber 53 formed of fiber and secured to the fitting 54. The fitting 54 replaces the fitting 17 heretofore described and differs from the fitting 17 in that it does not have the upper annular terminal 25 as in Figure 1. Instead the fiber blocks 55, which correspond to the fiber blocks 16 of Figure 1, do not have an upper aperture. In other words, the main arc channel indicated at 56 is closed at its upper end.

The chamber 53 communicates with the main arc channel 56 by means of a tranverse blast channel 57 which terminates in exhaust or vent channels 58 so that the blast of gases is projected transversely of the arc across the main channel. The fusible section 30' and strain wire 31' are passed over a porcelain or steatite pin 59 as previously explained and extend into the chamber 53. The ends of the fusible section and strain wire may be clamped between a metal sleeve 60 having a tapered rear portion conforming to the shape of the adjacent portion of the metal bulb 51. When the screw plug 61 threaded into the rear fitting 62 is tightened, it holds the bulb rigidly in place and clamps the fusible section and strain wire in place adjacent the end of the bulb. The end fitting 62 is provided with projecting portions 63 corresponding to the portions 5.

When the fuse link of Figure 5 is ruptured on overload, the arc is lead to the portion 52 of the bulb 51 and melts such portion and liberates the compressed gas in the bulb. The gas rushes through the transverse channel 57 transversely of the main arc channel 56 and crossways of the arc formed in the main channel 56 and blows out the resulting arc.

Returning to Figure 1 it will be seen that when an overload occurs, the fuse is ruptured and the arc extends from the main channel into the cross channel and to the plunger 37. This rupturing of the fuse link generates a considerable amount of gas in the main channel which blows the main arc upwardly to the terminal 25 so that the main arc is now switched to the terminal 25. The arc leading to the plunger 37 continues as it is established either from the adjacent portion of the metal part 19 of the fitting 17 or from the internal metal spacing sleeve 64, such sleeve normally serving to hold the container 46 in position. The plunger 37 is retracted and leads the arc into proximity to the material 47, the arc breaking the container 46 and acting upon the material 47 and causing the material to evolve a large volume of gas. A violent cross blast takes place through the cross blast channel 26 transversely of the main channel and transversely of the arc and is vented through the vent openings 27. A plurality of openings 27 have been shown but it is obvious that a single opening can be employed if desired, in which case the single opening would be materially larger than the openings 27. If desired, the upper end of the channel 23 could be closed, as in Figure 5, but it has been found that with the main arc channel open at both ends, venting can take place at each end and consequently a larger rupturing capacity is obtained.

It will be seen that the main arc in the form shown in Figure 1 is switched to the upper terminal 25 due to the upward blast upon the initiation of the arc and it will be seen that in all forms of the invention the main arc is elongated due to the expulsive action through the tube 9 and also due to the fact that the flip-out or throw-out mechanism draws any remaining portion of the fuse link outwardly from the tube 9. In all forms of the invention the cross blast is transversely of the arc in the main arc channel and is a violent cross blast, and it is to be noted that the effect of the cross blast is not distributed throughout the whole length of the main arc channel but is confined to a limited transverse portion thereof so that the cooling effect of the expanding gases and the sweeping out of the ionized gases obtained as a result of the blast is highly localized and concentrated to interrupt the main arc at the predetermined selected portion of its path.

It will be seen that the arc is quickly interrupted even though the interrupter is installed in a high voltage, heavy duty circuit, and it will be seen further that this interruption of the arc occurs very quickly. After the flip-out or throw-out lever 32 has operated, the main lever 8 rocks downwardly and rocks the lower end of the fuse tube downwardly and outwardly, thus detaching the upper end from the upper stationary contact and allowing the apparatus to execute drop-out motion, thus removing the apparatus from the circuit.

Although the fiber blocks 16 or 55, Figures 1 and 5, have been shown as two blocks to facilitate refusing, nevertheless it is within the province of this invention to form the two blocks as a single unitary structure.

It is to be noted that in the form of the invention shown in Figure 1, there is an automatic switching of the arc to the annular terminal 25 and that the arc initially existing as a single arc breaks into two arcs as an auxiliary arc is formed between the plunger 37 and the metal sleeve 64, or that part of the metal portion 19 adjacent the transverse blast opening 26. The auxiliary arc acts upon the arc evolving material and causes a violent evolution of gas which is projected transversely of the main arc in the main arc channel and extinguishes the main arc.

In the form of the invention shown in Figure 5 there is no automatic switching of the arc and there is no formation of an auxiliary arc, but nevertheless the blast of gases is projected transversely across the main arc channel and blows the main arc out by means of this transverse blast of arc extinguishing gas.

It is to be noted that in all forms of the invention the gases from the cross blast have a very short path of travel and consequently acquire a high velocity. They are not caused to commingle with the ionized gases throughout the length of the main arc channel but instead are concentrated at a localized point in the path of the main arc. The result of this is that they sweep the ionized gases out of the main arc path at a localized point and in addition to this, the expanding gases cool the arc at this localized point and thus further assist in extinguishing the arc. It is to be noted that the transverse channel is larger than the main arc channel so as to prevent the main arc from finding a path around the cross blast.

Instead the cross blast completely overlaps the main arc channel and extends beyond the sides of the main arc channel at least a small amount so as to insure the complete interruption of the main arc.

It will be seen that a novel form of circuit interrupter has been provided in which there is a main arc channel and a cross blast channel opening transversely through the main arc channel for conducting a violent blast of arc extinguishing gas transversely across the main arc channel to extinguish the arc.

It will be seen further that the device is very simple and is easy and economical to produce and is reliable in operation.

It is to be noted that in all forms of the invention means has been provided which is adapted to liberate a quantity of gas when acted upon by an arc. This means may be in the form of a liquid which evolves gas when acted upon by an arc or a solid which evolves gas when acted upon by an arc, or the means may be a capsule containing gas under pressure and having a portion adapted to fuse or rupture when acted upon by an arc. All of these means will liberate a quantity of gas when acted upon by an arc and the invention contemplates the provision of additional means for conducting or leading this gas transversely across the arc to extinguish the arc by the resulting violent cross blast.

It is to be understood that the expression "gas" is intended to cover either a true gas or a vapor or any mixtures that may be formed.

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.

We claim:

1. A circuit interrupter comprising means providing an arc channel, circuit interrupting means in said channel adapted to form an arc in said channel, material adapted to evolve gas when acted upon by an arc, means for directing said arc into proximity to said material, and means for directing the evolved gas transversely across said arc to extinguish said arc.

2. A circuit interrupter comprising means providing a main channel and a cross channel opening transversely through said main channel, means providing a chamber communicating with said cross channel at one side of said main channel, material located in said chamber adapted to evolve gas when acted upon by an arc, circuit interrupting means in said main channel adapted to form an arc in said main channel, and means for leading said arc into proximity to said material, whereby a blast of gas is projected transversely of said arc to extinguish said arc.

3. A circuit interrupter comprising means providing a main channel and a cross channel opening transversely through said main channel, means providing a chamber communicating with the cross channel at one side of the main channel, material located in said chamber adapted to evolve gas when acted upon by an arc, and conducting means in said main and cross channels having normally electrically connected portions adapted to be electrically disconnected on overload and adapted to form an arc in said main channel and in said cross channel, one of said conducting means being biased for motion to lead said arc into proximity to said material, whereby a blast of gas is projected from said chamber

through said cross channel across said main channel to extinguish the arc.

4. A circuit interrupter comprising means providing a main channel open at both ends, means providing a pressure chamber at one side of the main channel, material located in said pressure chamber adapted to evolve gas when acted upon by an arc, said interrupter having a cross channel extending from said pressure chamber transversely across said main channel and having a venting portion located at the side of said main channel, means including a fuse link adapted to rupture on overload and located in both said main channel and in said cross channel and adapted to form an arc in said main channel and in said cross channel in proximity to said material, whereby the arc in said main channel is extinguished by a blast directed transversely thereacross.

5. A circuit interrupter comprising means providing a main channel open at one end and closed at the other end, means providing a pressure chamber at one side of the main channel, material located in said pressure chamber adapted to evolve gas when acted upon by an arc, said interrupter having a cross channel extending from said pressure chamber transversely across said main channel and having a venting portion located at the side of said main channel, means including a fuse link adapted to rupture on overload and located in both said main channel and in said cross channel and adapted to form an arc in said main channel and in said cross channel in proximity to said material, whereby the arc in said main channel is extinguished by a blast directed transversely thereacross.

6. A circuit interrupter comprising means providing at least two intersecting channels arranged at an angle to each other, a fuse link having a fusible section extending from one channel into the other channel, material adapted to evolve gas when acted upon by an arc, means for extending the arc upon rupture of said fuse link into proximity to said material, and means for causing the evolved gas to be projected from one channel transversely of the arc in the other channel.

7. A circuit interrupter comprising means providing an arc channel, circuit interrupting means in said channel adapted to form an arc in said channel, means adapted to liberate a quantity of gas when acted upon by an arc, said interrupter including means for directing said arc into proximity to said last mentioned means, and means for directing the liberated gas transversely across said arc to extinguish said arc.

8. A circuit interrupter comprising means providing a main channel and a cross channel, means providing a chamber communicating with said cross channel at one side of said main channel, means adapted to liberate a quantity of gas when acted upon by an arc located in said chamber, a fuse link in said main channel adapted to form an arc in said main channel on overload, said interrupter including means for leading said arc into proximity to said last mentioned means, whereby a blast of gas is projected transversely of said arc to extinguish said arc.

9. A circuit interrupter comprising means providing a main channel and a cross channel opening transversely of said main channel, means providing a chamber communicating with said cross channel at one side of said main channel, material located in said chamber adapted to liberate gas when acted upon by an arc, a single fuse link having portions located in both of said

channels, said fuse link being adapted to rupture and form an arc in both of said channels on overload, and means including retractable plunger means for elongating the arc and leading the arc into proximity to said material, whereby a blast of gas is projected transversely of the arc in said main channel to extinguish said arc.

10. A circuit interrupter comprising means providing a main channel and a cross channel opening transversely of said main channel, means providing a chamber communicating with said cross channel at one side of said main channel, material located in said chamber adapted to liberate gas when acted upon by an arc, a single fuse link having portions located in both of said channels, said fuse link being adapted to rupture and form an arc in both of said channels on overload, means including retractable plunger means adjacent one end of said fuse link for elongating the arc and leading the arc into proximity to said material, whereby a blast of gas is projected transversely of the arc in said main channel to extinguish said arc, and means adjacent the other end of said fuse link for elongating the arc in said main channel.

11. A circuit interrupter comprising means providing a main channel and a cross channel opening transversely through said main channel, said cross channel being larger than said main channel, means providing a chamber communicating with said cross channel at one side of said main channel, material located in said chamber adapted to evolve gas when acted upon by an arc, circuit interrupting means in said main channel adapted to form an arc in said main channel, and means for leading said arc into proximity to said material, whereby a blast of gas is projected transversely of said arc to extinguish said arc.

12. A circuit interrupter comprising means providing a main channel and a cross channel opening transversely through said main channel, means providing a chamber communicating with said cross channel at one side of said main channel, material located in said chamber adapted to liberate gas when acted upon by an arc, a fuse link having portions located in both channels adapted to rupture on overload and form an arc extending from the main channel into the cross channel into proximity to said material, and means adapted to cause said arc to form two arcs in series with one arc in said main channel and the other arc in said cross channel.

13. A circuit interrupter comprising means providing a main channel and a cross channel opening transversely through said main channel, means providing a chamber communicating with said cross channel at one side of said main channel, material located in said chamber adapted to liberate gas when acted upon by an arc, a fuse link having portions located in both channels adapted to rupture on overload and form an arc extending from the main channel into the cross channel into proximity to said material, and terminal means adapted to cause said arc to form two arcs in series with one arc in said main channel and the other arc in said cross channel, said terminal means having a portion located adjacent one end of said main channel to provide a conducting portion for the arc in said main channel.

14. A circuit interrupter comprising means providing a main channel and a cross channel opening transversely through said main channel, means providing a chamber communicating with said cross channel at one side of said main channel, material located in said chamber adapted to liberate gas when acted upon by an arc, a fuse link having portions located in both channels adapted to rupture on overload and form an arc extending from the main channel into the cross channel into proximity to said material, and terminal means adapted to cause said arc to form two arcs in series with one arc in said main channel and the other arc in said cross channel, said terminal means having a portion located adjacent one end of said main channel to provide a conducting portion for the arc in said main channel and having a portion adjacent said cross channel to provide a conducting portion for the arc in said cross channel.

15. A circuit interrupter comprising means providing an arc channel, circuit interrupting means in said channel adapted to form an arc in said channel, material adapted to liberate gas when acted upon by an arc, means for directing said arc into proximity to said material, means for directing the liberated gas transversely across said arc to extinguish said arc, and means for elongating the arc in said arc channel.

16. A circuit interrupter comprising means providing a main channel and a cross channel opening transversely through said main channel, means providing a chamber communicating with said cross channel at one side of said main channel, material located in said chamber adapted to liberate gas when acted upon by an arc, circuit interrupting means in said main channel adapted to form an arc in said main channel, means for leading said arc into proximity to said material, and means for elongating the arc in said main channel.

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