

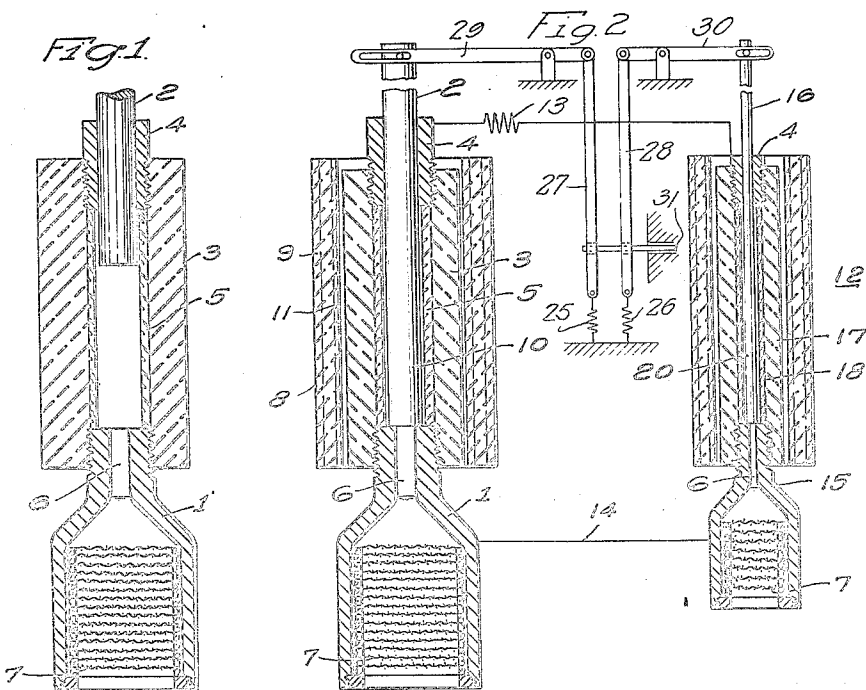
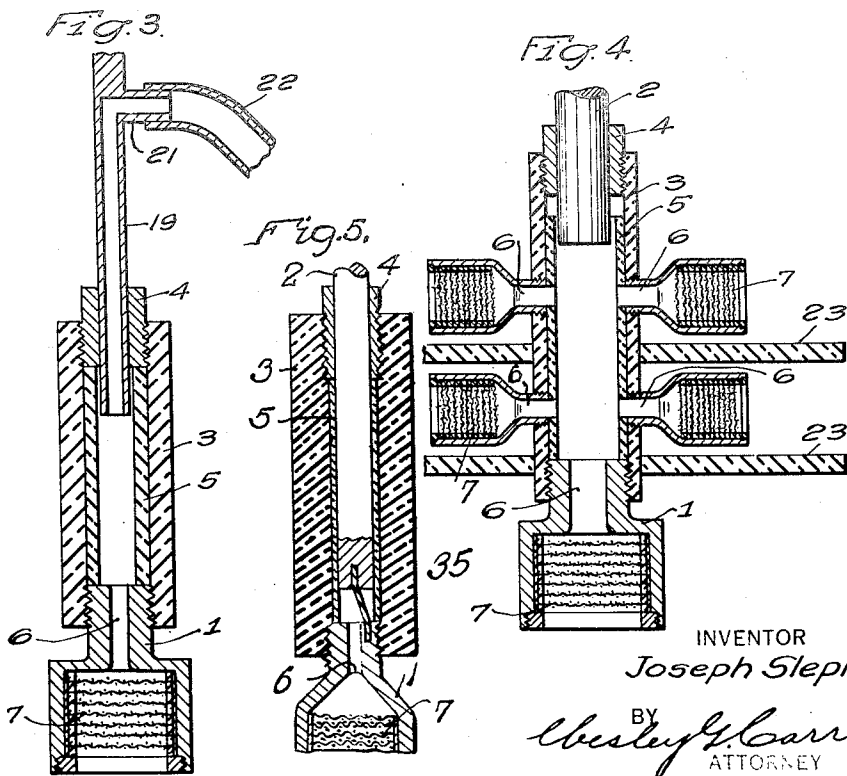
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CIRCUIT INTERRUPTER

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CIRCUIT INTERRUPTER

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pany, a corporation of Pennsylvania

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My invention relates to circuit interrupters and particularly to interrupting devices that establish an arc in a gaseous medium. My application Serial No. 142,360, filed May 13, 1937, is a division of this application.

In my copending application, Serial No. 411,271, filed Dec. 3, 1929, now Patent No. 1,899,643, dated February 28, 1933, I disclosed a device for deionizing the conducting gas path. This device utilized the gases that were generated from the arc quenching liquid which were retained in the vicinity of the arc core. The gas passed turbulently through the arc stream and formed relatively cool centers into which ions, from the current carrying portions of the arc space, diffused and recombined.

While the aforementioned application discloses the benefits derived from the deionizing gas generated from an arc quenching liquid, the present invention relates to apparatus for producing a similar gas that effects recombination of the ions in an arc path that is established in air.

One object of my invention is to provide an arc path, that is established in air or other gaseous medium, with means that shall evolve a deionizing gas in the presence of an arc, throughout the entire length of the arc.

Another object of my invention is to construct the side walls of an arc extinguishing device of such material that a deionizing gas is freely liberated therefrom in the presence of an arc.

A further object of my invention is to provide an arc extinguishing device of the above described type having deionizing material on the side walls thereof, with additional structure that shall be capable of deionizing arcs of small current values.

A still further object of my invention is to provide a circuit interrupting device of the above described type with a venting device comprising cool metal plates or screens upon which the gas escaping therethrough may be further deionized.

A still further object of my invention is to provide a circuit interrupter of the above described type with a static shield that shall uniformly distribute the electric potential along the path between the separated contact members.

For a more complete understanding of the nature and objects of my invention reference should be had to the following description taken in conjunction with the accompanying drawing wherein:

Figure 1 is a sectional view, in elevation, of a circuit interrupter embodying my invention,

Fig. 2 is a sectional view, in elevation, of a com-

bination of a pair of the circuit interrupter structures shown in Fig. 1;

Fig. 3 is a sectional view, in elevation, of the structure shown in Fig. 1 having additional deionizing features associated therewith,

Fig. 4 is a sectional view, in elevation, of the embodiment of my invention shown in Fig. 1 having a plurality of venting means, and

Fig. 5 is a sectional view, in elevation, of a modified form of the invention using a fusible link.

My invention comprises in general a stationary contact member 1, a cooperating movable contact member 2 and a tubular insulating casing 3 that encloses the path between the members 1 and 2 when separated. The casing 3 is threaded internally at each of its ends, the upper end having associated with the threads thereof a bushing 4 that is employed as a guide for the movable contact 2. The lower threaded section cooperates with the threaded end of the stationary contact member 1 and supports a removable insulating tube 5 within the insulating casing 3 directly adjacent to the movable contact member 2.

The removable insulating tube 5 is constructed of a material which will readily decompose when an arc is drawn between the contact members 1 and 2 giving off large volumes of deionizing gas that pass turbulently through the arc stream. Any fibrous material that is affected by an arc to freely liberate gases of low molecular weight may be successfully employed on my structure. Paper was successfully used as well as materials known in the art as "hard fibre." These materials contain a certain percentage of water, the vapors of which are effective in aiding ion recombination. They have the further advantage of being slowly burned away by the arc, leaving clean surfaces which have a high voltage breakdown. The inner cross-sectional area of the tube 5 of gas forming material is approximately the same as the cross-sectional area of the moving contact member 2. This means that the opening of the tube is as small as it can be for the size of contact member which must be used to conduct the current which the contact must normally carry. This small size of the passage through the gas evolving material gives a desirable improvement since the gas evolving material is in close contact with the arc and causes a large volume of gas to be formed to extinguish the arc.

When employed on alternating current circuits the heat stored in the materials causes them to continue to give off the deionizing gases down to and including the time when the current is passing through the zero value of its alternating

cycle. At current zero the arc extinguishes while the gases continue to be turbulently thrown into the space it formerly occupied. The small volumes of cool un-ionized gas scattered through the ionized path as a result of the turbulent motion, causes the ions to very rapidly recombine thereon so that the space between the contacts loses its ions very rapidly. Because the density of ions decreases rapidly, the voltage gradient necessary to restrike the arc increases very rapidly so that the rise of recovery voltage impressed by the external circuit after current zero, will not be rapid enough to cause the reinitiation of the arc between the separated contact members.

While this construction is intended primarily for alternating current circuits for rapidly deionizing the arc path after arc extinguishment, it was also found to successfully extinguish an arc established in a direct current circuit. As the fresh gas is continually being fed into the arc stream, the small volumes thereof, which are scattered through the arc space as a result of the turbulent motion, rapidly abstract ions, which must be reformed by the ionizing processes going on in the arc. Inasmuch as the formation of ions from neutral molecules requires a large amount of energy, far greater than that needed for the usual chemical reactions, it is clear that in order to maintain the arc, a greatly increased energy input from the electric circuit will be necessary, or in other words, to maintain an arc of a given current strength a great increase in the applied voltage is necessary. This aids in the extinction of the arc in a direct current circuit, because in such a circuit, it is necessary to make the arc voltage larger than the generated voltage if the current is to be reduced. Because the arc voltage is so greatly increased by the gas blast, this condition can be realized with a much shorter length of arc than would be necessary without the gas blast.

The large amount of gas that is evolved in the small space occupied by the arc is vented from within the tube 5 as it passes through the arc stream and is expelled into the atmosphere. These gases which are at high temperature, and contain large numbers of ions abstracted from the arc, appear as a flame of considerable extent outside the interrupting structure. This flame is objectionable when other conductors or apparatus are situated nearby as the hot ionized gas forms paths of low dielectric strength which increase the hazard of breakdown.

The contact 1 is provided with an opening 6 that constitutes a vent for the escaping gases which pass through the cooling and deionizing surfaces 7 located adjacent to the opening 6. These cooling and deionizing surfaces may be insulating but are preferably made of metal in the form of plates or screens upon which the hot gases are cooled and the ions thereof recombined. This gas when coming in contact with the outer atmosphere will be completely cooled and deionized. As explained in the paper, "Flames from electric arcs", published in the September, 1929 issue of the A. I. E. E. Journal, the combination of ions upon surfaces takes place with extreme rapidity.

When my circuit interrupting device is employed on alternating current circuits of high potential, the contact members 1 and 2 are arranged to have a large path of separation and the enclosing insulated casing 3 will be of considerable length. In order that the voltage distribution across this length shall be uniform during

the arc extinction period, I provide a static shield 8 shown in Fig. 2 along the length of the arc path. In the figure the shield is shown as an insulating cylinder having layers of tinfoil 9 and 11 embedded therein. The tinfoil comprises bands which overlap and which are so proportioned that the electrostatic field is uniform within the tube. Inasmuch as the proper proportioning of these bands to attain this result is evident to those skilled in the art, I will not describe it here. Other devices, such as resistors or reactors may be substituted for the condenser to produce the same result, that of distributing the potential evenly along the arc path.

The construction shown in Fig. 2 employs two of my arc extinguishing devices herein above described. The cross sectional dimensions of one of these devices are considerably less than that of the other device. It was found that while the single structure operated satisfactorily for interrupting arcs having currents above a predetermined value, it proved insufficiently effective when the current of the arc to be interrupted was below this value. This was found to be caused by the arc's inability, owing to its distance from the sides of the tube 5 to decompose the material rapidly enough to produce a sufficient amount of the deionizing gas. As a result the recombination of the ions did not take place with sufficient rapidity at current zero to withstand the recovery voltage that rises almost immediately thereafter. With a tube of smaller diameter, the small current arcs could be satisfactorily extinguished, because of the increased rate of flow of generated gas through the arc section. When such a smaller tube was used with large currents, however, the rate of evolution of gas in the small space was so great that large pressures developed which burst the tube. It was desirable therefore, to provide a device in which a chamber of large section was present for large currents, and one of small section for the ultimate interruption of currents of small value.

Fig. 2 discloses the arrangement in which a second arc chamber 12 of reduced dimensions is employed, having a resistor 13 connected in series with the main movable contact 2. The arcing chamber 12 is connected in parallel relation with the main chamber by the conductor 14. This chamber comprises a stationary contact member 15 and a movable contact member 16 that are similar to the main contact members 1 and 2 respectively with the exception that they are considerably smaller in cross-sectional dimension. Similarly, the casings 17 and 18 are similar to the casings 3 and 5 respectively, of the main arcing chamber shown in Fig. 1, with the exception that the cross sectional dimensions are also proportionately reduced. The arc established upon the separation of the contact members 15 and 16, when a small current is flowing, will bear the same relation to the adjacent decomposable member 18 as the large arc bears with the decomposable member 5 when established in the main arc chamber.

The movable contact members 2 and 16 are interconnected to be operated in sequence in order that the movable member 16 will draw an arc sometime after an arc has been established by the movement of the contact member 2. This may be accomplished by any suitable type of mechanism, but for purpose of illustration the drawing illustrates the movable contacts as being biased to open position by springs 25 and 26 acting through pull rods 27 and 28 and levers 29

and 30, in the conventional manner. The contacts are held closed by any suitable latching device such as the latch 31 which engages openings in the rods 27 and 28. When the latch 31 is withdrawn it first disengages rod 27 so that contact member 2 is released before contact member 16. The arc in chamber 10 will be extinguished before the contacts 15, 16 separate, regardless of whether the current is large or small. If the current is large, the arc will be extinguished by the intense blast of gas arising from the decomposition of the chamber lining 5. If the current is small, the decomposition of the chamber lining 5, will be too slow to raise the rate of recovery of dielectric strength just after current zero to a high value. When this occurs the reaction of the shunt circuit, through the resistor 13, and the closed contacts 15, 16, upon the supply circuit, which is supplying only a small current, is to so slow down the rate of recovery of the voltage applied to the arc space in chamber 10 just after current zero, so that the arc therein extinguishes even in the absence of the gas blast. Thus in either case the arc in chamber 10 is extinguished. When the contacts 15, 16 do separate, the current is limited to a small value by the resistor 13, so that in spite of the small section of the chamber 20, high pressures are not developed and because of the small section, the small current arc is effectively extinguished.

While I have described and illustrated a circuit interrupting device wherein separable contact members are employed to establish an arc, it is to be understood that other means such as a fusible element 35 shown in Fig. 5 may be employed in lieu of the separable contact members for initiating the establishment of the arc.

Another form of structure that may be utilized for deionizing the arc path of arcs that may have large or small currents flowing therethrough, is disclosed in Fig. 3 of the drawing. The contact 1, the casings 3 and 5, the bushing 4 and the vent and venting structure 6 and 7 shown in Fig. 3 are similar to those disclosed in the structure of Fig. 1. A movable contact member 19, however, that cooperates with the stationary contact member 1, is hollow and is provided with stem 21 that is connected, by means of a flexible tube 22, to a source of compressed air or other gas or deionizing medium that may be passed through the tube 19 into the arc stream and the space occupied by the arc after it is extinguished.

In this construction arcs carrying large currents will be extinguished in the same manner as that hereinabove described for the extinguishment of an arc in the structure disclosed in Fig. 1. When, however, an arc having a small current flowing therethrough is present in the device, the difficulty heretofore pointed out in obtaining its extinguishment, is overcome by the additional deionizing gas that is supplied to the arc and the arc space through the tube 22 and the opening in the contact member 19. The introduction of these gases has no detrimental effect upon the extinguishment of arcs of large currents, so that the gas may be injected into the chamber upon each operation of the circuit interrupter. Arrangement may be made however, under certain circumstances to have the additional gas injected into the chamber only when small current arcs are established.

When the tubes 3 and 5 are of considerable length, to meet the voltage conditions of high powered alternating current circuits, a plurality

of vents 6 and the accompanying deionizing plates 7 may be employed, distributed along the sides of the tubes. The pressures developed within the tubes upon the rapid generation of gases due to the exceptionally long arc, will be relieved at the various points along the arc path as well as at the bottom of the tube and fresh gas may then be turbulently moved into and vented from the arc path at all points along its length. Deionizing plates 7 are employed in conjunction with all of the vents to prevent flame from being ejected into the atmosphere. Barriers 23 are provided between the vent 6 to prevent the intermingling of the vented gas on the outside of the tube 3.

It will thus be seen that I have provided a circuit interrupter that establishes an arc in air, with a material adjacent to the arc path that is affected by the arc to liberate deionizing gases for causing the ions of the space occupied by the arc to rapidly recombine after the arc is extinguished. In order to assure that a sufficient amount of gas will be provided when arcs of low current value are established, I provide additional means whereby the structure is as effective, for preventing arcs of small current values from being reinitiated, as those of large current values.

Although the above-described figures show but a single inlet for gas it will be understood that it may be worth while in some instances to provide inlets for high pressure gas at intervals along the path of the arc; and that under some conditions the provision of passages through which the gas may find vent between each pair of such gas inlets may be warranted. Either the inlet or outlet ducts may be of annular or other form adapted to permit radial movement of the gas with substantially equal facility in any meridian direction about the axis of the arc. Thus for example a hollow stationary duct of insulating material with a plurality of annular orifices may be positioned in the interior of the hollow electrode 19 of Fig. 3, the latter sliding over such duct. Annular vent-ducts may be provided in the wall 5 of Fig. 3, and these may if desired be positioned mid-way between the annular inlet ducts just described. Rotation of the arcs about the insulated inlet duct, for instance by a radial magnetic field, is within the contemplation of my invention under such circumstances. Broadly any arrangement adapted to produce a gas and project it into an arc at a plurality of points along its path, and/or to provide a plurality of outlet paths for such gas is within the purview of my invention. It will also be recognized that the inlet and outlet ducts above described may be interchanged without departing from my invention.

Other means than that specifically described above will be obvious to those skilled in the art for producing a predetermined and desired potential distribution in the electric field traversing the arc path and the deionizing structure and these are likewise within the scope of my invention. It will also be recognized that the distribution of gas sources along the arc is applicable where the arc is surrounded by oils or other insulating liquids as well as by the gaseous atmosphere specifically described herein. Many of the above-described devices are obviously applicable as adjuncts to other forms of arc producing devices as well as in the combination with each other here described. Where the claims state that the cross-sectional area of the conducting

member for drawing the arc is substantially equal to the cross-sectional area of the tubular passage or arc chamber, it is meant that the conducting member may be made smaller than the passage only by an amount sufficient to insure free movement in the passage without binding during the circuit interrupting operation.

While I have described several embodiments of my invention it is to be understood by those skilled in the art that many changes, additions, omissions and substitutions may be made therein without departing from the spirit and scope of my invention, as set forth in the claims.

I claim as my invention:

1. In a circuit interrupter, an arc extinguishing structure having walls defining a chamber, said walls being fixedly mounted during the extinguishing of the arc and being of a material which, when acted upon by the arc, gives off gas to extinguish the arc, and arc drawing means movable within said chamber, the cross-sectional area of said arc drawing means being substantially the same as the cross-sectional area of said chamber, said walls of the chamber extending along the path of the arc for substantially the whole length thereof, and said chamber being open during the extinguishing of the arc at the end away from which said arc drawing member moves to cause the gas to flow through said chamber and out the end thereof.

2. In a circuit interrupter, an arc extinguishing structure having a tubular passage therethrough, the inner walls of said passage being fixedly mounted during the extinguishing of the arc and being of material which evolves a large volume of gas when acted upon by the arc, and separable conducting members one of which is movable through said tubular passage for drawing the arc along said walls of gas evolving material, and the cross-sectional area of a portion of said tubular passage being substantially equal to the cross-sectional area of said movable conducting member, said portion of the tubular passage having a cross-sectional area substantially equal to that of the movable conducting member extending to the end of the arc path to which the end of said movable conducting member moves when drawing the arc.

3. In a circuit interrupter, an arc extinguishing structure including an outer wall member and an inner removable member defining an arc chamber, said inner removable member being fixedly mounted within the outer member during the extinguishing of the arc and being of a material which when acted upon by the arc is partially consumed and gives off gas and separable arc drawing means one of which is movable through said chamber, said removable member extending along substantially the whole length of the space between said arc drawing means when separated, and the cross-sectional area of a portion of said arc chamber being substantially equal to the cross-sectional area of said movable arc drawing means, said portion of the arc chamber having a cross-sectional area substantially equal to that of the movable arc drawing means extending to the end of the arc path to which the end of said movable arc drawing means moves when drawing the arc.

4. In a circuit interrupter, an arc extinguishing structure having walls defining a chamber, said walls being fixedly mounted during the extinguishing of the arc and being of a material which, when acted upon by the arc, gives off gas to extinguish the arc, and arc drawing means

movable within said chamber, said walls of gas evolving material extending along the whole length of the path of movement of said movable arc drawing member, and the cross-sectional area of said arc drawing means being substantially the same as the cross-sectional area of a portion of said chamber, and said chamber being open during the extinguishing of the arc at the end thereof away from which said movable arc drawing means is moved and permitting flow of said gas out of said open end, and the portion of said chamber having substantially the same cross-sectional area as said arc drawing means extending to the end of the arc path toward which the arc drawing member moves.

5. In a circuit interrupter, an arc extinguishing structure having a tubular passage therethrough, the inner walls of said passage being fixedly mounted during the extinguishing of the arc and being of material which evolves a large volume of gas when acted upon by the arc, separable arc drawing means, one part of which is fixed and the other part of which is movable therein, said inner walls extending along substantially the whole path of movement of said movable arc drawing means, and said passage being of small cross-section to restrict the cross-section of the arc and said passage being open at its end adjacent the fixed part of said separable arc drawing means and permitting flow of gas out of said open end.

6. In a circuit interrupter, an arc extinguishing structure having a tubular passage therethrough, the inner walls of said passage being fixedly mounted during the extinguishing of the arc and being of material which evolves a large volume of gas when acted upon by the arc, and separable conducting members one of which is fixed adjacent one end of said tubular passage and the other of which is movable through said tubular passage for drawing the arc along said walls of gas evolving material, the cross-sectional area of said movable conducting member being substantially equal to the cross-sectional area of said tubular passage, said tubular passage being open at its end adjacent said fixed conducting member and permitting flow of gas out of said open end.

7. In a device for interrupting an electrical circuit, rigid means having a pair of elongated openings therethrough, means electrically connected in the circuit to be interrupted for causing an arc in the first of said elongated openings, and means electrically connected in parallel with the arc path through said first elongated opening for causing an arc in said second elongated opening, and the arc extinguishing ability and cross-sectional area of one of said elongated openings being greater than the arc extinguishing ability and cross-sectional area of the other of said elongated openings.

8. In a device for interrupting an electrical circuit, means having a pair of passages therein, said passages each providing a path for an arc and said arc paths being arranged electrically in parallel, means for causing an arc first in one of said passages and then in the other, and the passage in which the arc is caused first having means causing flow of gas through the arc toward one end of the passage and having a greater arc interrupting capacity than the other of said passages.

9. In a device for interrupting an electrical circuit, means having a pair of passages therein,

said passages each providing a path for an arc and having means for causing a blast of fluid through the arc, and said arc paths being arranged electrically in parallel in the circuit to be interrupted and having different arc interrupting abilities, means for causing an arc to occur in the one of said passages having the greater arc interrupting ability, and means for causing a second arc to occur in the other of said passages at a time later than the occurrence of the arc in the first passage.

10. In a device for interrupting an electrical circuit, solid means of gas forming material having a pair of passages therein, said passages each providing a path for an arc and said arc paths being arranged electrically in parallel in the circuit to be interrupted, means for causing an arc to occur in one of said passages, and means for causing a second arc to occur in the other of said passages at a time later than the occurrence of the arc in the first passage, one of said passages being most effective in extinguishing arcs of low current value and the other of said passages being most effective in extinguishing arcs of high current value.

11. In a device for interrupting an electrical circuit, means of gas forming material having a pair of elongated openings therethrough, conducting means electrically connected in the circuit to be interrupted extending through one of said openings for causing an arc therein and another conducting means electrically connected in parallel with the arc path through said first elongated opening extending through said second elongated opening for causing an arc therein, and the impedance of one said conducting means being greater than the impedance of the other of said conducting means.

12. In a device for interrupting an electrical circuit, means having a pair of passages therein, said passages each providing a path for an arc and said arc paths being arranged electrically in parallel in the circuit to be interrupted, means for causing an arc in each of said passages, and each of said passages having the interior thereof of a solid material which when acted upon by the arc gives off a large volume of gas, and one of said passages having a greater cross-sectional area than the other of said passages.

13. In a device for interrupting an electrical circuit, means having a pair of passages therein, said passages each providing a path for an arc and said arc paths being arranged electrically in parallel in the circuit to be interrupted, means for causing an arc in each of said passages, and a resistor connected in series with the current path through one of said passages.

14. In a device for interrupting an electrical circuit, means having a pair of passages therein, said passages each providing a path for an arc and said arc paths being arranged electrically in parallel in the circuit to be interrupted, means for causing an arc in each of said passages, and a resistor connected in series with the current path through one of said passages, and one of said passages having a greater cross-sectional area than the other of said passages.

15. In a device for interrupting an electrical circuit, means having a pair of passages therein, said passages each providing a path for an arc and said arc paths being arranged electrically in parallel in the circuit to be interrupted, conducting means movable through one of said passages for drawing an arc therein and another conducting means extending through the other of said

passages for causing an arc therein, each of said passages having the interior thereof of a material which when acted upon by the arc gives off a large volume of gas and each of said passages having a cross-sectional area only slightly greater than the cross-sectional area of the conducting means extending therethrough, and one of said passages having a greater cross-sectional area than the other of said passages.

16. In a device for interrupting an electrical circuit, means having a pair of passages therein, said passages each providing a path for an arc and said arc paths being arranged electrically in parallel in the circuit to be interrupted, conducting means movable through one of said passages for drawing an arc therein and another conducting means extending through the other of said passages for causing an arc therein, each of said passages having the interior thereof of a material which when acted upon by the arc gives off a large volume of gas and each of said passages having a cross-sectional area only slightly greater than the cross-sectional area of the conducting means extending therethrough, and one of said passages having a greater cross-sectional area than the other of said passages and means for causing the arc to occur in one of said passages after the occurrence of the arc in the other of said passages.

17. In a device for interrupting an electrical circuit, means for defining the walls of a pair of arc passages, one of said arc passages being capable of extinguishing arcs carrying currents of large magnitudes but being incapable of extinguishing arcs carrying currents of small magnitudes, and the other of said passages being capable of extinguishing arcs carrying currents of small magnitudes, and means for causing an arc in each of said passages, said means causing the arc to be initiated in said arc passage capable of extinguishing arcs carrying currents of large magnitude before the initiation of the arc in the passage capable of extinguishing arcs carrying currents of small magnitude.

18. In a circuit interrupter, an arc extinguisher having ability to interrupt low current arcs and including means along the arc path which when acted upon by the arc causes a blast of fluid through the arc, an arc extinguisher having ability to extinguish high current arcs and including means along the arc path which when acted upon by the arc causes a blast of fluid through the arc, means electrically connecting said arc extinguishers in parallel in the circuit, and means for causing an arc to be initiated in said arc extinguisher having ability to extinguish high current arcs prior to the initiation of the arc in said arc extinguisher having ability to extinguish low current arcs.

19. In combination, a tubular casing, a long tubular explosion chamber fixedly disposed coaxially in the casing, a fusible link in the explosion chamber, a terminal for the link disposed at one end of said chamber, a second terminal for the link extending into said long tubular explosion chamber for the major part of the length thereof to a point adjacent the first said terminal, the end of said chamber adjacent the first said terminal being open, the other end of the chamber being substantially closed by said second terminal and means for separating the terminals upon fusing of the link.

20. In combination, a fusible link, two terminals, an arc extinguishing material, means for withdrawing one terminal into this material upon

blowing of the fuse, and a fixed restricting passage having at least one portion of a small diameter only slightly larger than that of said one terminal for the flow of the fluid resulting from the action of the arc upon the arc extinguishing material, said restricting passage being positioned with respect to said terminals so that said one terminal is withdrawn through a major part of the length of the passage in the direction toward said portion of a small diameter only slightly greater than the terminal to restrict the cross-section of the arc as it is drawn therein.

21. In a fuse device, the combination of an elongated tubular fuse housing having a bore, means fixedly supported within said housing, said means comprising an explosion chamber having a bore of a length several times its diameter and its diameter being small and less than that of said bore of the housing, fuse terminals within said housing, one of said terminals extending into the bore of the explosion chamber from one end thereof to a point adjacent the other end thereof, a fusible link connecting said terminals, said fusible link, upon blowing, forming a body of metallic vapor in said bore of the chamber, arc extinguishing material within said housing which is acted upon by the arc to evolve a gaseous medium and to drive out of said explosion chamber the metallic vapors resulting from the arc, and said terminal extending into the bore of the chamber being movable through the major part of the length of said bore of the explosion chamber for bringing the arc into effective relation with said material.

22. In combination, a tubular casing, a long tubular expulsion chamber fixedly disposed in the casing, a fusible link at one end of the expulsion chamber, a terminal for the link disposed at one end of said chamber, a second terminal for the link in the form of a rigid rod extending into said long tubular expulsion chamber for the major part of the length thereof to a point adjacent the first said terminal, the end of said chamber adjacent the first said terminal being open, the other end of the chamber being substantially closed by said rigid rod-like terminal, and said rigid rod-like terminal being movable in said chamber upon the fusing of the link.

23. In combination, a tubular casing, a long tubular expulsion chamber fixedly disposed in the casing, a fusible link at one end of the expulsion chamber, a terminal for the link disposed at one end of said chamber, a second terminal for the link in the form of a rigid rod extending into said long tubular expulsion chamber for the major part of the length thereof to a point adjacent the first said terminal, the end of said chamber adjacent the first said terminal being open, and said rigid rod-like terminal being movable in said chamber and substantially closing the other end of the chamber during at least the major part of its movement.

24. In combination, a tubular expulsion cham-

ber having material which gives off gas when acted upon by an arc along the inside thereof, a fusible link adjacent one end of the expulsion chamber, a terminal for the link at one end of the chamber, a second terminal for the link in the form of a rigid rod extending through said tubular expulsion chamber for a major part of the length thereof to a point adjacent the first said terminal, said rigid rod-like terminal being movable in said chamber and having its end remaining in the chamber when in the open position, and the end of the chamber adjacent the first said terminal being open and the other end of the chamber having a portion with a cross-sectional area not substantially greater than the cross-sectional area of said rigid rod-like terminal so as to be substantially closed thereby when in the open position.

25. In a circuit interrupter, an arc extinguishing structure having walls defining a chamber having at least one portion of small cross-section to restrict the arc, said walls being fixedly mounted during the extinguishing of the arc and being of a material which, when acted upon by the arc, gives off gas to extinguish the arc, and arc drawing means including a fixed contact and an elongated rigid member having a contact surface adjacent the end thereof engageable with the fixed contact, said elongated rigid member being movable within said chamber, the cross-sectional area of said rigid member being substantially the same as the cross-sectional area of said chamber, said walls of the chamber extending along the path of the arc for substantially the whole length thereof, and said chamber being open during the extinguishing of the arc at the end away from which said rigid member moves to cause the gas to flow through said chamber and out the end thereof.

26. In a circuit interrupter, an arc extinguishing structure having a tubular passage there-through, the inner walls of said passage being fixedly mounted during the extinguishing of the arc and being of material which evolves a large volume of gas when acted upon by the arc, and separable conducting members one of which is a fixed contact and the other of which is a long rigid member extending through the passage to engage the fixed contact, said long rigid member being movable through said tubular passage for drawing the arc along said walls of gas evolving material, and the cross-sectional area of a portion of said tubular passage being small to restrict the arc and being substantially equal to the cross-sectional area of said movable conducting member, said portion of the tubular passage having a cross-sectional area substantially equal to that of the movable conducting member extending to the end of the arc path to which the end of said movable conducting member moves when drawing the arc.

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