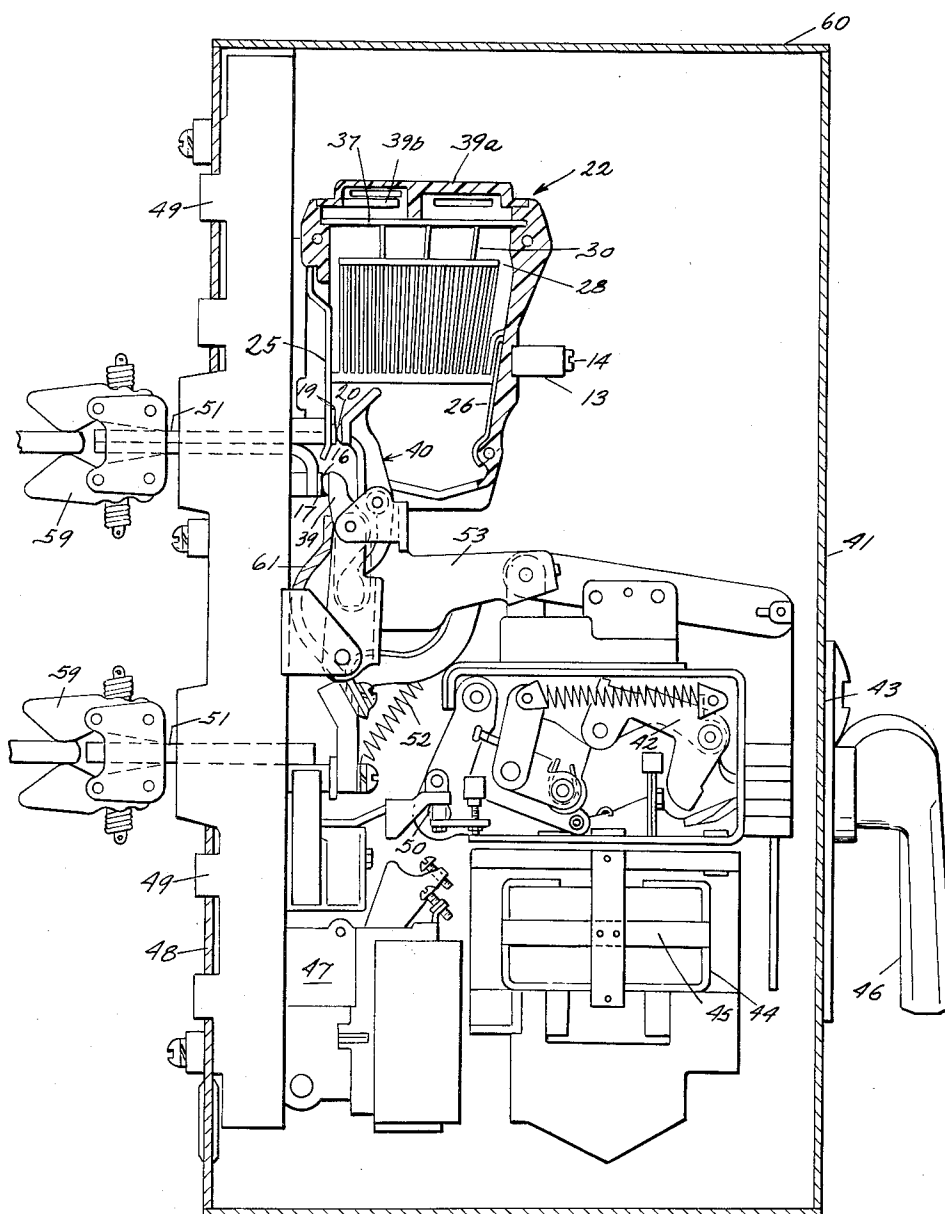


Filed May 13, 1958

ARC CHUTE FOR CIRCUIT BREAKERS

2 Sheets-Sheet 1

FIG. 1.



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2 Sheets-Sheet 2

FIG. 2

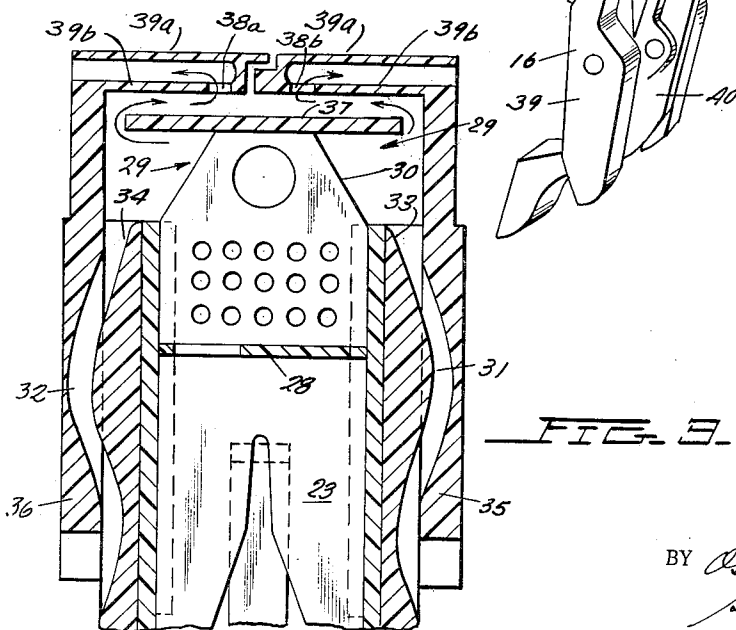
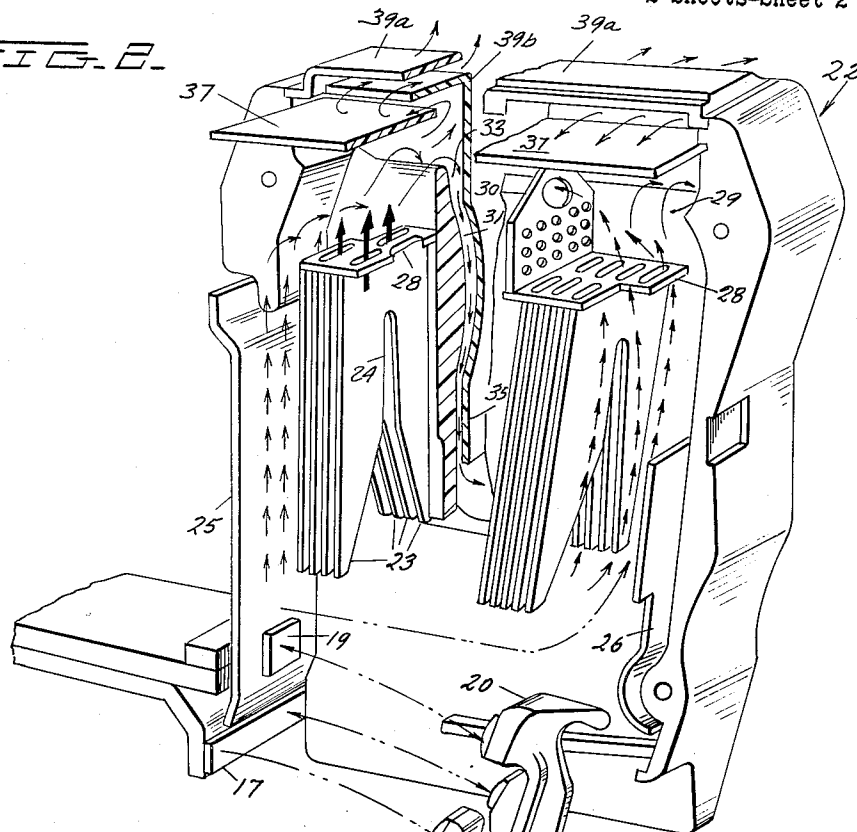


FIG. 3

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ARC CHUTE FOR CIRCUIT BREAKERS

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9 Claims. (Cl. 200-144)

My invention relates to an arc chute for air-immersed circuit breakers, and more particularly is directed to a dual-flow arc chute having a gas mixing chamber and elongated gas discharge paths for discharging gases caused during arc conditions from the chamber.

Specifically, my invention is an improvement over the arc chute described in my copending application Serial No. 647,095, filed March 19, 1957, and entitled "Arc Chute Design for Circuit Breakers." In my above noted copending application I provide an arc chute structure in which ionized gas created during arcing conditions is conducted over alternative paths to a mixing chamber and is mixed by imparting substantial turbulence to the gas within the chamber so as to cause rapid cooling and de-ionizing thereof. The gas, after being so de-ionized, may then be safely discharged from the arc chute confines without the prior existing danger of a phase-to-ground flashover through the ionized gas to structures external of the circuit breaker at ground potential.

The turbulence achieved in the above noted system was forced by baffling means which was positioned within the mixing chamber and interposed between various points of gas entrance to the chamber from the arcing space. The turbulence is desirable, since a greater amount of gas will thereby come into contact with the relatively cool surface of the chamber so as to be cooled thereby. Hence, by cooling the gas, the degree of ionization of the gas is decreased and may be safely discharged from the chamber.

However, since substantial baffling is required in this type of system, a back pressure is built up which prevents a rapid scavenging of gas from the arcing area. Because of this, a sufficient amount of ionized gas may be left within the arcing area after extinguishing the arc so that an arc restrike is possible.

The essence of my present invention is to provide a relatively unrestricted path from the arcing space to the exterior of the arc chute while still achieving substantial de-ionization of the gas through mixing thereof and cooling. To this end, I provide a plurality of serpentine paths for conducting the gas from a mixing chamber which is substantially free of baffling means to the exterior of the arc chute. Since the path is serpentine, which is meant here to be a path of relatively long distance when compared to the distance between the beginning and end of the path, the gas is moved over relatively long areas of cooling surface. Thus, it is possible to cool the gas in a much more efficient manner than is possible when the baffling structure is used, as in my copending application.

Furthermore, the serpentine paths, while providing a relatively large cooling area for the gas, provide a relatively small resistance to the gas movement. Accordingly, the back pressure on the gas will be low so that extremely rapid scavenging of the area adjacent the co-operating contacts is achieved, and the danger of re-striking an arc is substantially lessened.

Thus, the primary object of my invention is to provide a circuit breaker arc chute having a novel deionizing means.

Another object of my invention is to provide a novel arc chute for a circuit breaker in which the ionized gas generated during arcing conditions is rapidly de-ionized and discharged into the external space at such a rapid rate that a restrike of an arc due to the presence of ionized gas in the arcing chamber is prevented.

Another object of my invention is to provide a novel

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arc chute for an air-immersed circuit breaker wherein ionized gas is conducted to a mixing chamber over a plurality of paths, and is thereafter rapidly de-ionized and discharged to the external space over one or more serpentine paths, thus exposing a relatively large cooling area to the gas being discharged.

These and other objects of my novel invention will become apparent from the following description when taken in connection with the drawings, in which:

FIGURE 1 is a side view of a typical air circuit breaker adapted with the arc chute of my novel invention.

FIGURE 2 is an exploded perspective view of the arc chute illustrated in FIGURE 1 and presents clearly the details of my invention.

FIGURE 3 is a partial side cross-sectional view of FIGURE 2.

In FIGURE 1, I have illustrated a side view of one pole of a circuit breaker in which my instant invention can be used. However, it will be apparent to those skilled in the art that my novel arc chute could be used on any number of circuit breakers and is not limited to the structure shown in FIGURE 1. Furthermore, I have only illustrated a single pole of a circuit breaker although it will be apparent that the breaker represents only one pole of a three pole breaker. Furthermore, since the particular circuit breaker forms no part of my instant invention, the details of the operating and trip mechanism are not described in detail herein since a thorough description thereof can be found by reference to my copending application, Serial No. 647,095 filed March 19, 1957 entitled Arc Chute Design for Circuit Breakers and assigned to the assignee of the instant invention.

The novelty of my instant invention is contained within the arc extinguisher or arc chute which is usually contained within a circuit breaker, such as that illustrated in FIGURE 1, having stationary main contact 17, a movable main contact 16, a stationary arcing contact 19 and a movable arcing contact 20. The movable arcing contact 20 is contained on the contact arm 40 and the main movable contact is contained on the movable arm 39.

The entire circuit breaker is positioned within a housing 60 having a front door 41 and a metal back base 48. The circuit breaker is automatically and manually operated through the operating mechanism 42 and is provided with an escutcheon assembly 43 to which the manual operating handle 46 can open and close the breaker. The solenoid assembly 44 contains a closing coil 45 which when energized will automatically close the breaker through the operating mechanism 42. The breaker can be automatically tripped by means of the dual overcurrent device 47. The dual overcurrent device 47 is operative to simultaneously trip all poles of the breaker through the common tripper bar 50.

The circuit breaker is energized through the main separable contacts 59 to which the current studs 51 are connected. A common opening spring 52 is utilized to provide the opening force through the contact arm path 53 to simultaneously open all three poles of the breaker when it is either automatically tripped by means of the dual overcurrent device 47 or manual operating device 46. The arc chute assembly is maintained in the circuit breaker by means of the support clamp 13 and the screw 15.

A detailed representation of the novel arc chute 10 is seen in the partial perspective view of FIGURE 2. The arc chute 10 is comprised of an insulating housing 22, one half of which is illustrated in FIGURE 2, it being understood that the remaining half of the structure is substantially the same as illustrated, as indicated in FIGURE 3. The insulating housing contains a plurality of arc plates 23 which are placed in a spaced relation with respect to each other and can be supported in any

desirable means as, for example, by being positioned within slots contained within the side of the insulated housing 22. The arc plates 23 are preferably made of iron so as to provide a magnetic assist once the arc is drawn between the cooperating contacts 19, 20. In addition, the arc plates 23 are preferably provided with a center slot such as 24 which is above and adjacent to the cooperating contacts 19, 20.

The stationary arcing contact 20 is provided with a back arc runner 25, and a front arc runner 26 in the well known manner.

As seen in FIGURE 2, the back arc runner 25 forms one wall of a chamber having its other wall defined by the last or most rearward arc plate of arc plates 23 and the chamber communicates between the arcing area and a mixing chamber 29 positioned above baffle plate 28 which lies across the top of the arc plates 23.

In a similar manner, the front arc runner 26 defines a wall of a communicating chamber from the arcing area to the upper mixing chamber 29 whose other wall is defined by the first or most forward arc plate of arc plates 23.

Within chamber 29, and as best seen in FIGURE 3, additional baffling means such as baffle 30 having relatively large openings therein may be provided to impart a degree of turbulence to gas entering chamber 29. Note further that gas can enter chamber 29 from either of the chambers defined by arc runners 25 or 26 as well as gas which rises upwardly and through the baffle 28.

The chamber 29 communicates with areas external to housing 22 through a plurality of serpentine paths so that the gas is exposed to a relatively large cooling area. Two of these paths 31 and 32 are formed within the molded housing and are curved in shape, as shown in FIGURES 2 and 3, so that gas within the chamber 29 will flow over molded sections such as sections 33 and 34 along the paths 31 and 32 until they reach the end of cover members 35 or 36 respectively to be discharged into the area external of the housing 22. This path is clearly shown in FIGURE 2 for the case of serpentine path 31 by the arrows which indicate the flow of gas created by the disengagement of contacts 19 and 20.

Alternative serpentine paths are similarly provided by means of the member 37 positioned at the top of chamber 29 and spaced from either side wall, as best seen in FIGURE 3. Member 37 will force gas in chamber 29 to flow outwardly toward the sides and around it until the gas reaches openings, such as openings 38a and 38b in upper portion 39 of the molded housing. The gas then is sidewardly directed again by the hood portions 39a and 39b and directed to an area external of the arc chute.

The arrows in the upper serpentine path of FIGURE 2 indicate the manner in which ionized gas will have to flow for the case of the right-hand portion of the breaker of FIGURE 3. Clearly, the gas must come into contact with a relatively large cooling area which includes two halves of the surface of barrier 37, the lower half of the surface of member 39b, the upper half of the surface of member 39b, and the under surface of hood 39a.

If desired, members 37, 39 and 39a may be integral components of a molded housing. However, they could be individual members secured in the positions shown, in any desired manner.

FIGURE 1 illustrates the condition of the cooperating contacts when the breaker is in the closed position and carrying normal load current. At this time, the current will flow from the main upper separable contact assembly 59 through the current stud 51 and out through the lower main separable contact assembly 59. When the contacts separate, as for example on the occurrence of an overload current condition resulting in the operation of the dual overload trip device 47, the main contacts 16, 17 will initially disengage while the arcing contacts 19, 20 remain engaged. Thus, all of the current will initially flow through the cooperating arcing contacts 19, 20. Sub-

sequently, the arcing contacts 19, 20 are separated, thereby drawing an arc therebetween.

The system is designed so that the arc will rise into the arc chute. That is, the arc itself will tend to rise with the hot gases created thereby and also will be forced into the arc chute due to the magnetic forces created from the magnetic field of the arc in the magnetic plates 23 of the arc chute. The ends of the arc will move upward on both the back and front arc runners 25, 26 and the arc plates 23 will be effective in extinguishing the arc. The arc chute is designed so that the arc will not exist above the top of the arc plates 23. That is, the baffle 28 will relieve the high pressure hot gases from the chamber which contains the arc plates, and will prevent the arc from passing therethrough.

However, the gases passing through the openings in the baffle plate 28 have a large degree of ionization, and in the absence of applicant's novel cooling and deionizing system, these hot gases would be vented out of the arc chute area and could possibly create a conductive path from an energized component of the circuit breaker to the grounded housing 60 of the breaker, thereby resulting in a phase-to-ground fault.

However, with the novel construction of my arc extinguisher, I have provided a plurality of paths by which the gases can move into the mixing chamber 29. Thus, some of the gases will travel up the chambers defined by arc runners 25 and 26 to enter the mixing chamber with considerable velocity. These gases will mix with the other ionized gases which have reached the mixing chamber 29 through the usual means, such as the spaces adjacent the arc plates and through the openings in baffle 28. The impingement of the high velocity gases entering the mixing chamber 29 with those entering the mixing chamber through the baffle 28 will result in a high degree of turbulence which is emphasized by the additional baffles, such as baffle 30 of FIGURES 2 and 3, which are positioned in the chamber.

As is well known in the circuit interruption art, the mere increase in turbulence will in itself result in a larger degree of de-ionization of the gases within the chamber by increasing the possibility of recombination of positive ions and free electrons.

Further, the increased turbulence of the hot gases will cause them to come into contact with a larger surface in the mixing chamber to thereby substantially increase the cooling effect or de-ionization of the gases. That is, since the molecular velocity increases with the square of the temperature, at high temperatures the molecular velocity is high enough to cause ionization and thus make the gas conductive. By cooling the gas, it is apparent that the ionization process will be impeded and the gases rendered less conductive.

This effect is further emphasized in the instant invention by forcing the gases, after leaving chamber 29, to travel a tortuous serpentine path which will expose them to a relatively large cooling area so that upon their discharge into the external atmosphere, the degree of ionization will be relatively small and the danger of a phase-to-ground fault will be substantially eliminated.

Furthermore, since the gases travel over a relatively unimpeded path, the back pressure on the gas will be substantially negligible so that ionized gas in the area of the cooperating contacts may be rapidly scavenged from the area to thereby quickly re-establish a high dielectric in that area because of the replacement of the hot ionized gases by cool un-ionized air.

Although I have described preferred embodiments of my novel invention, many variations and modifications will now be obvious to those skilled in the art, and I prefer therefore to be limited not by the specific disclosure herein but only by the appended claims.

I claim:

1. An arc extinguisher comprising an insulating housing and a plurality of arc plates; said plurality of arc

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plates supported within said housing and being positioned in spaced relation with each other along a line extending between ends of said housing; each of said plurality of arc plates having a center slot and being positioned above and adjacent cooperable contacts of a circuit breaker; said insulating housing containing a mixing chamber immediately above said plurality of arc plates; a passage within said housing and located at one end thereof communicating at one end with said cooperable contacts and the other end with said mixing chamber; said passage being adapted to guide substantially greater quantities of gas into said mixing chamber than each of the spaces between adjacent arc plates, a discharge passage leading from said mixing chamber to an area external of said insulating housing at a side thereof; said passage having a length substantially longer than the distance between its input end at said mixing chamber and its output end externally of said insulating housing.

2. An arc extinguisher comprising an insulating housing and a plurality of arc plates positioned within said housing in spaced relation with each other along a line extending between ends of said housing; said plurality of plates having a center slot and being positioned above and adjacent to cooperable contacts of a circuit interrupter; a baffle plate immediately above said plurality of arc plates and extending in a direction perpendicular thereto; said insulating housing containing a mixing chamber above said arc plates and being partially defined by said baffle; a passage within and at one end of said housing extending from said cooperable contacts directly to said mixing chamber; said passage being adapted to guide substantially greater quantities of gas into said mixing chamber than each of the spaces between adjacent arc plates, said passage by-passing said baffle plate and being defined on one side by an end arc plate and on the other side by said insulating housing; a discharge passage leading from said mixing chamber to an area external of said insulating housing at a side thereof, said passage having a length substantially longer than the distance between its input end at said mixing chamber and its output end externally of said insulating housing.

3. An arc extinguisher comprising an insulating housing and a plurality of arc plates positioned within said housing in spaced relation with each other along a line extending between ends of said housing; said plurality of plates having a center slot and being positioned above and adjacent to cooperable contacts of a circuit interrupter; a baffle plate immediately above said plurality of arc plates and extending in a direction perpendicular thereto; said insulating housing containing a mixing chamber above said arc plates and being partially defined by said baffle; a passage within and at one end of said housing extending from said cooperable contacts directly to said mixing chamber; said passage by-passing said baffle plate and being defined on one side by an end arc plate and on the other side by said insulating housing; said passage being adapted to guide substantially greater quantities of gas into said mixing chamber than each of the spaces between adjacent arc plates, a plurality of discharge passages leading from said mixing chamber to an area external of said insulating housing at a side thereof, said passages having a length substantially longer than the distance between their respective input ends at said mixing chamber and their respective output ends externally of said insulating housing.

4. An arc extinguisher comprising an insulating housing and a plurality of arc plates positioned within said housing in spaced relation with each other along a line extending between ends of said housing; said plurality of plates having a center slot and being positioned above and adjacent to cooperable contacts of a circuit interrupter; a baffle plate immediately above said plurality of arc plates and extending in a direction perpendicular thereto; said insulating housing containing a mixing chamber above said arc plates and being partially defined

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by said baffle; a passage within and at one end of said housing extending from said cooperable contacts directly to said mixing chamber; said passage by-passing said baffle plate and being defined on one side by an end arc plate and on the other side by said insulating housing; said passage being adapted to guide substantially greater quantities of gas into said mixing chamber than each of the spaces between adjacent arc plates, some gases generated by the arc drawn by the separation of the cooperable contacts reaching said mixing chamber by passing through said spaced arc plates, other gases generated by the arc drawn by the separation of the cooperable contacts reaching said mixing chamber by passing through said passage; said gases passing through said passage resulting in a large degree of turbulence in said mixing chamber to thereby aid in the de-ionization of the gases; a vent from said mixing chamber to the area surrounding said arc extinguisher at a side of said housing said vent having a serpentine shape.

5. An arc extinguisher comprising an insulating housing and a plurality of arc plates positioned within said housing in spaced relation with each other along a line extending between ends of said housing; said plurality of plates having a center slot and being positioned above and adjacent to cooperable contacts of a circuit interrupter; said arc plates being positioned transverse to the arc drawn between the cooperable contacts; a baffle plate immediately above said plurality of arc plates extending in a direction perpendicular thereto; said insulating housing having a mixing chamber located above said baffle plate; said baffle plate having a plurality of openings communicating with said mixing chamber to thereby provide a path for arc gases created by separation of the cooperable contacts through the spaced arc plates into said mixing chamber; a passage within and at one end of said housing extending from the cooperable contacts directly to said mixing chamber; arc gases created by the separation of said cooperable contacts passing through said passage to said mixing chamber without passing through the openings in said baffle plate; said passage being adapted to guide substantially greater quantities of gas into said mixing chamber than each of the spaces between adjacent arc plates, some gases generated by the arc drawn by the separation of the cooperable contacts reaching said mixing chamber by passing through said spaced arc plates, other gases generated by the arc drawn by the separation of the cooperable contacts reaching said mixing chamber by passing through said passage; said gases passing through said passage resulting in a large degree of turbulence in said mixing chamber to thereby aid in the de-ionization of the gases; a vent from said mixing chamber to the area surrounding said arc extinguisher at a side of said housing; said vent having a serpentine shape.

6. An arc extinguisher comprising an insulating housing and a plurality of arc plates; said plurality of arc plates supported within said housing and being positioned in spaced relation with each other along a line extending between ends of said housing; each of said plurality of arc plates having a center slot and being positioned above and adjacent cooperable contacts of a circuit breaker; said insulating housing containing a mixing chamber immediately above said plurality of arc plates; a passage within said housing and located at one end thereof communicating at one end with said cooperable contacts and the other end with said mixing chamber; said passage being adapted to guide substantially greater quantities of gas into said mixing chamber than each of the spaces between adjacent arc plates, a discharge passage leading from said mixing chamber to an area external of said insulating housing at a side thereof; said passage having a length substantially longer than the distance between its input end at said mixing chamber and its output end externally of said insulating housing; said passage from

said housing to said mixing chamber being positioned at one end of said housing.

7. An arc extinguisher comprising an insulating housing and a plurality of arc plates; said plurality of arc plates supported within said housing and being positioned in spaced relation with each other along a line extending between ends of said housing; each of said plurality of arc plates having a center slot and being positioned above and adjacent cooperable contacts of a circuit breaker; said insulating housing containing a mixing chamber immediately above said plurality of arc plates; a passage within said housing and located at one end thereof communicating at one end with said cooperable contacts and the other end with said mixing chamber; said passage being adapted to guide substantially greater quantities of gas into said mixing chamber than each of the spaces between adjacent arc plates, a discharge passage leading from said mixing chamber to an area external of said insulating housing; said passage having a length substantially longer than the distance between its input end at said mixing chamber and its output end externally of said insulating housing at a side thereof; said passage from said housing to said mixing being positioned at one end of said housing and being defined on at least one side by an arc runner extending into said housing.

8. An arc extinguisher comprising an insulating housing and a plurality of arc plates positioned within said housing; said plurality of plates having a center slot and being positioned in spaced relation above and adjacent to cooperable contacts of a circuit interrupter; a baffle plate immediately above said plurality of arc plates and extending in a direction perpendicular thereto; said insulating housing containing a mixing chamber above said arc plates and being partially defined by said baffle; a passage within and at one end of said housing extending from said cooperable contacts directly to said mixing chamber; said passage by-passing said baffle plate and being defined on one side by an end arc plate and on the other side by said insulating housing; said passage being adapted to guide substantially greater quantities of gas into said mixing chamber than each of the spaces between adjacent arc plates, barrier means having openings, disposed within said chamber and positioned transverse to said baffle plate thereby dividing said mixing chamber into a plurality of sections; a discharge passage leading from said mixing chamber to an area external of said housing; said passage having a length substantially

longer than the distance between its input end at said mixing chamber and its output end externally of said housing.

9. An arc extinguisher comprising an insulating housing and a plurality of arc plates positioned within said housing; said plurality of plates having a center slot and being positioned in spaced relation above and adjacent to cooperable contacts of a circuit interrupter; a baffle plate immediately above said plurality of arc plates and extending in a direction perpendicular thereto; said insulating housing containing a mixing chamber above said arc plates and being partially defined by said baffle, a passage within and at one end of said housing extending from said cooperable contacts directly to said mixing chamber; said passage by-passing said baffle plate and being defined on one side by an end arc plate and on the other side by said insulating housing; said passage being adapted to guide substantially greater quantities of gas into said mixing chamber than each of the spaces between adjacent arc plates, barrier means having openings, disposed within said chamber and positioned transverse to said baffle plate thereby dividing said mixing chamber into a plurality of sections; a discharge passage leading from said mixing chamber to an area external of said housing; said passage having a length substantially longer than the distance between its input end at said mixing chamber and its output end externally of said housing; said output end of said discharge passage positioned at a side of said housing.

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