

July 18, 1944.

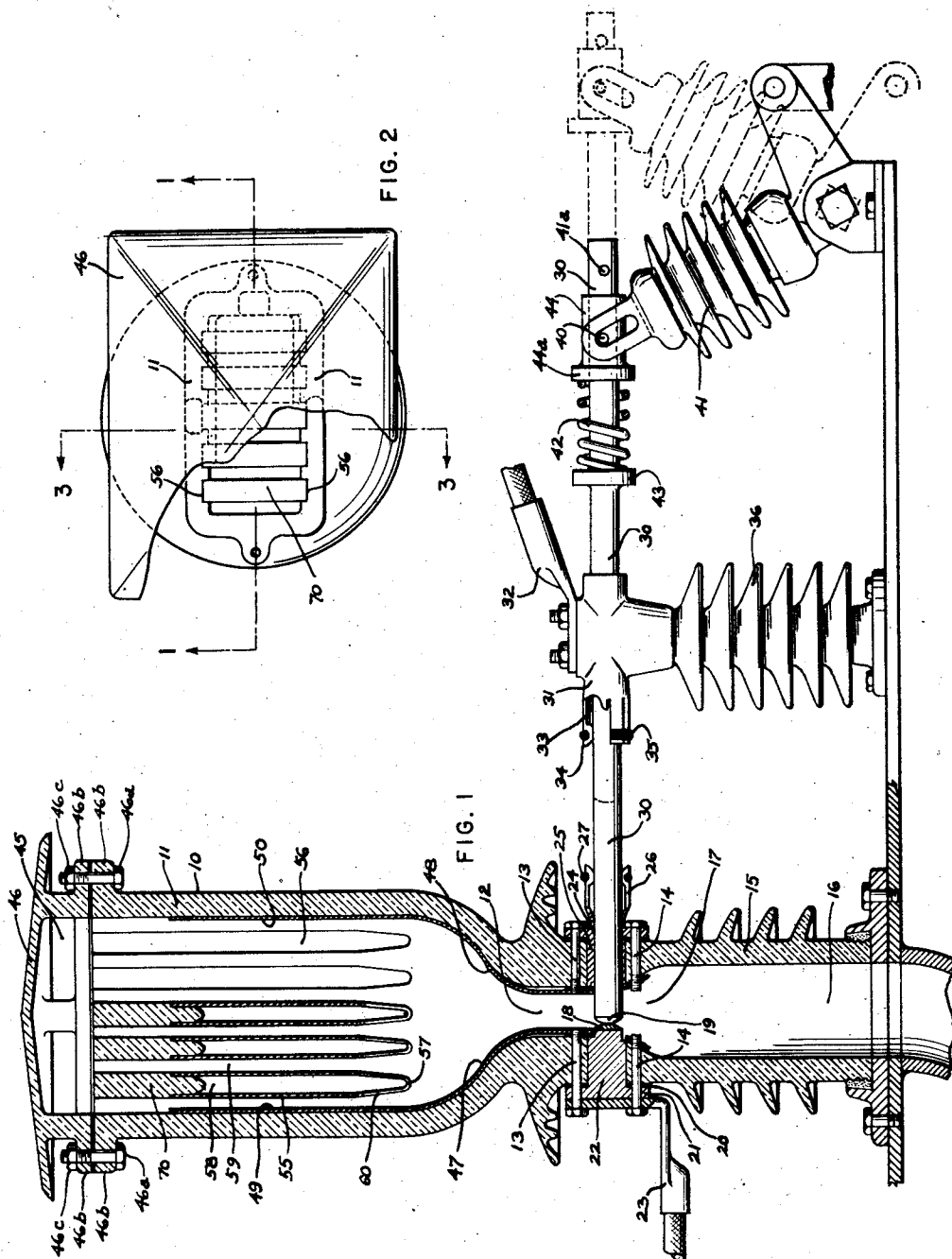
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2,353,729

AIR BLAST ARC CHUTE

Filed Aug. 14, 1941

2 Sheets-Sheet 1



BY

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2 Sheets-Sheet 2

FIG. 5

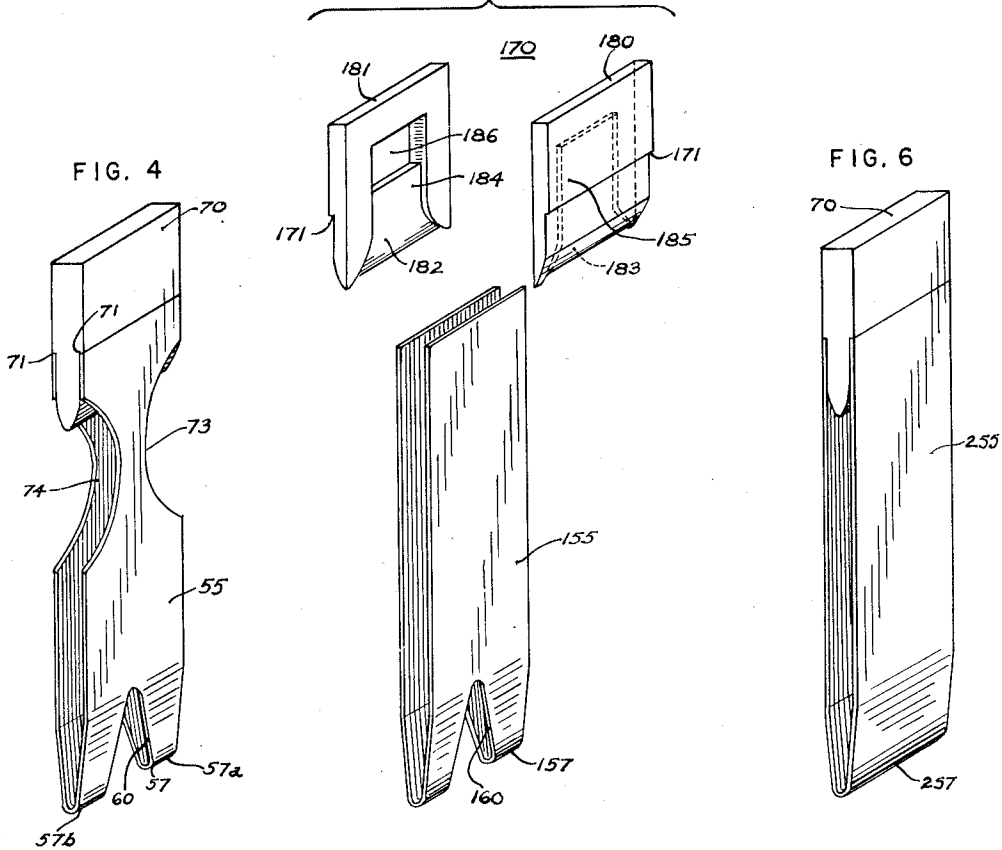
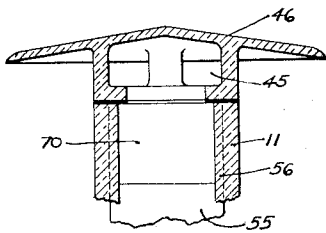


FIG. 4

FIG. 6

FIG. 3



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AIR BLAST ARC CHUTE

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20 Claims. (Cl. 200—148)

This invention relates to arc extinguishing apparatus for use in connection with circuit interrupters and more particularly to the type of arc quencher in which the arc is caused to move away from the separable contacts of the interrupter and into the arc quencher by a blast of air where it is extinguished by the combined effects of cooling plates and the air blast.

An important object of the present invention is the arrangement of an arc quencher of the spaced metallic plate type in such a manner that the arc may be blown onto the plates and may be caused to move thereon by an air blast.

A further object of this invention is the provision of an arc quencher, for an air blast circuit breaker, in which the initial arc is broken up into a plurality of short arcs in series and in which the blast of air is directed upon the roots of each of the short arcs.

An additional object of this invention is to provide an arc extinguisher for an air blast circuit breaker in which an initial alternating current arc is broken up into a plurality of short arcs in series and then metallic conductors are inserted in parallel with alternate short arcs to render them unstable.

It is also an object of this invention to provide for a circuit interrupter, a multiple plate arc extinguisher in which the initial arc is transferred to the plates and moved along them by a blast of air and in which said movement increasingly inserts resistance in series with the circuit.

A further object of this invention is to provide for a circuit interrupter, a multiple plate arc extinguisher in which the initial arc is transferred to the plates, broken up into a plurality of arcs in series, alternate arcs are extinguished so that each plate has an arc terminal upon one side only and in which a blast of cooling air is directed against both sides of the plate.

These and many other objects of the present invention will become apparent in the following description and drawings in which:

Figure 1 is a side view partly in cross-section, taken on line 1—1 of Figure 2 of switch gear utilizing my arc extinguishing apparatus.

Figure 2 is a top view of the arc extinguisher of Figure 1.

Figure 3 is a cross-sectional view of the top of the arc extinguisher taken on line 3—3 of Figure 2.

Figure 4 is a view in perspective of one form of plate construction of the arc quencher of Figures 1 and 2.

Figure 5 is an exploded view of a slightly modified

form of plate structure which may be utilized in the arc chute of Figure 1.

Figure 6 is a view in perspective of another modified form of plate structure for the arc chute of Figure 1.

Referring now to Figure 1, I have here shown an arc chute casing 10 having an inner section 11 and mounted on an insulating support 15. The arc chute casing and its support are preferably formed in one piece and are preferably made of porcelain or other similar insulating ceramic material.

The inner section 11 is preferably of rectangular cross-section down to the throat 12 where the contacts are located, in order that the arcing horns 49 and 50 hereinafter described, may be made of flat strips of metal.

The support 15 contains an air duct 16 for the entrance of compressed air. This duct is restricted to form a nozzle 17 in the vicinity of the contacts 18 and 19 to cause a high air velocity at this point.

The electrical contacts 18 and 19 are preferably of the reciprocating type. The contact 18 may be rigidly mounted as shown or may, if desired, be spring-biased toward engagement. The contact 19 is operable by pneumatic or mechanical means into and out of engagement with the contact 18.

Means are provided for separating the contacts quickly immediately after the existence of air pressure at the contact. The distance between the contacts at full separation is selected so as to prevent a dielectric break-down at the maximum terminal voltage. Hence the plunger 30 withdraws from the block 25 to the dotted line position (hereinafter described) in order to provide a sufficient air gap.

With this type of construction, the moving contact 19 acts as a piston valve so that the initial blast flows across the contact surfaces to exert its full effect upon the roots of the arc.

The actual mounting and operation of the contact may, of course, take any form which may be desired within the limits of the foregoing considerations.

In Figure 1 I have schematically illustrated one form.

Contact block 22 is of rectangular or circular cross-section and is rigidly mounted in a hole in the side of the insulator 15. Its cap screws 13 and 14 pass through suitable openings in the side of the insulator and thread into the lower end 47 of the arcing horn 49. The end 47 of arcing horn 49 is also suitably pierced for the end of

contact 18 which is mounted on the contact block 22 and projects into the throat 12 of the arc extinguisher.

Cushioning material 20 such as cork or a gasket may be placed between the flange 21 of the contact block 22 and the porcelain side of the support 15. A circuit connector 23 is secured to the contact block 22 by screws 13 and 14.

The guide block 25 for the movable plunger 30 is similarly mounted by means of its cap screws 13 and 14 which thread into the lower end 48 of arc horn 50. Guide block 25 has a tubular opening 24 which communicates with a tubular extension 26. Tubular extension 26 is slotted to form a group of flexible fingers which are pressed against the contact rod or plunger 30 by the garter spring 27.

Should it be desirable for manufacturing reasons to make the arc chute 10 and the support 15 separate pieces, then block 22 and guide 25 may be mounted in an intermediate ring or spacer which may be mounted between elements 10 and 15 and which may serve to interconnect them.

The contact 19 is secured on the end of piston rod 30. Rod 30 is slidably mounted in the metallic block or casing 31 to which electrical connection to the terminal or circuit may be made by the circuit connection 32. Block 31 is mounted on an insulating support 36 and has a tubular opening 33 therein in which the piston rod 30 may slide. The end 34 of the tube 33 is also slotted to form a group of flexible fingers which are constricted about the rod by the garter spring 35.

The opposite end of the piston rod 30 is connected to an insulating operating member 41 which may be operated to retract the rod 30 to the position shown by the dotted lines where the contact 19 is completely withdrawn from the arc chamber.

The connection between operating member 41 and rod 30 is a resilient one which ensures maintenance of contact pressure when the breaker is in closed circuit position. Member 41 is engaged with pins 40 of sleeve 44, which is slidable along the rod 30. A spring 42 is compressed between flange 44a of sleeve 44 and flange 43 of the rod thus transmitting the closing movement of member 41 from sleeve 44 to the contact carrying rod. Pins 41a limit the movement of the sleeve on the rod when the contacts are separated and serve to transmit the movement of member 41 from the sleeve 44 to the rod 30 when the switch is opened.

When the interrupter is opened, the rod 30 may have a quick initial movement approximately equal to the width of the blast nozzle and then a slower movement to its final open (dotted line) position. Time is, therefore, allowed for the interruption of the current so that no arc is drawn at the finger contacts.

The speed of opening movement of rod 30 is designed so that contact 19 does not leave the tube 26 until the arc has been extinguished in the manner hereinafter described.

The arc chute 10 is an elongated chamber of generally rectangular cross-section. The throat 12 of the arc chute is of reduced dimensions to correspond to the distance between the arcing horns and to the restricted form of the air ducts at the sides of the moving contact.

The exhaust of the chute is generally open at 45 to the atmosphere. The arc chute may be

provided with means for cooling the hot gases or for reducing the noise.

A roof 46 preferably of the same material as the casing 10 of the arc chute may be provided to form a water-proof drip-proof cover when the circuit interrupter is not otherwise covered or enclosed. This roof may be secured to the top of the extinguisher by means of bolts 46a passing through flanges 46b of the roof and casing and secured by the nuts 46c.

The ends of the arc chute, as seen in the cross-sectional view of Figure 1, are provided with a pair of arcing horns 47 and 48 which are electrically connected to the contacts 18 and 19 by their respective bolts 13 and 14.

The arc horns 47 and 48 diverge into the spaced parallel sections 49 and 50 which follow the shape of the end walls and extend substantially to the discharge opening.

Upon contact separation the arc is transferred from the contacts 18 and 19 to the arcing horns along which it is moved by the air blast. The control of the air flow may be accomplished by any form of valve that is convenient. The mechanism may be operated manually or automatically in response to undesirable electrical or other conditions.

Spaced between the parallel parts 49 and 50 of the arcing horn is a plurality of metal plate structures 55, 55 supported and spaced by recesses 56 in the side walls 11 of the chute in the manner shown in Figure 2.

The material employed for these cross plate structures has relatively high electrical resistance and heat conductivity. It is also relatively resistant to damage by the heat produced at an arc terminal.

Each of the structures 55 consists of a metal plate bent at 57 in to the shape of a U. The width of the air space 58, between the two bent portions of the same structure, is of the same order as that of the space 59 between adjacent structures. The bend 57 of each of the structures 55 is directed toward the separable contacts.

As is seen more particularly in Figure 4, the return bend 57 of each of these structures is provided with a tapered notch 60 between the side edges of the metal, the notch extending a substantial distance along the parallel elements of the structure. The structure, therefore, has a return bend 57a and 57b at each edge which is supported in the notch 56 of the arc chute wall and an open space 60 between them. At least a part of each of the bends 57a and 57b is protected from the arc by resting in the bottom of the slots or notches 56.

The tapered notches 60 of adjacent structures may be aligned or may be offset from each other. With either arrangement, a gradually restricted space is provided so that an arc may be moved into the chute and onto the metal structures without engaging or being restricted by the return bend 57 of the structures 55. This design also provides means so that the blast air may flow between adjacent structures to the exhaust as well as between the parallel metal sections of each of the structures.

At the discharge end of the arc chute, the metal sides of each structure are insulated from each other, the space between them being filled by a piece of arc resistant material 70 which is also positioned by notches 56 and extends a substantial distance above the metal plates. The base of the cover or roof of the arc chute bears

against the members 70 and prevents the plate structures from being blown out of the chute by the blast.

As may be seen in Figure 4, the insulating member 70 is provided with recesses 71, 71 to receive the ends of the plates of the metal structure 55 to ensure accurate positioning thereof. This also provides for a smooth flush surface between the sides of the insulating member and the sides of the metal plates of structure 55.

Within the arc chute, the metal plate structure is provided with openings 73 and 74 just below the insulating member 70 to permit discharge of the air that enters the notches 60 at the return bend.

Instead of providing openings in the metal plate structure for the exhaust of air which flows between the parallel metal walls of the structure, suitable openings for this purpose may be provided in the insulating member 70.

Thus, in Figure 5 I have shown a construction wherein the metal plate structure 155 is bent at 157 to produce a parallel metal plate structure of the general type previously described. This metal plate structure also has a notch 160 at the bend 157 in order to permit the entrance of air between the plates.

But the edges of the plates of the structure are not provided with any openings whatever so that the entire area of the metal plates may be utilized for the purpose of assisting the extinguishment of the arc in the manner hereinafter described.

Instead of openings in the metal plate structure, suitable openings in the insulating block previously described, may be utilized. Such openings may take any suitable form consistent with the quantity of air which is intended to flow through the structure.

In one form of construction shown in Figure 5 I have shown a type of insulating top structure 170 which consists of two members 180 and 181 which are to be placed together to form a single unit. When placed together, these members have substantially the form of the insulating element 70 having, for instance, the recesses or notches 171, 171, in order to receive the ends of the metal plate structure 155.

However, each of the members 180 and 181 is cut out at the lower ends thereof 182, 183 to form a recess or notch in the interior thereof communicating with the passages 184 and 185 respectively.

Passage 185 is incised in only one surface of the member 180 and does not communicate with the opposite surface thereof. However, passage 184 terminates in an opening 186 which is cut through the entire member 181.

When, therefore, the members 180 and 181 are placed together, the cutouts of 182 and 183 form a slot into which the air from the interior of the metal plate structures may flow. The air may then pass up along the ducts created by the matching hollow portions 185 and 184 until the air reaches the cutout or opening 186 through which the air may be exhausted.

A single insulating element such as 70 may have a channel cut in one side from the lower edge to a point above the upper edge of the plate to produce the same result.

In another modified form shown in Figure 6, I have shown a plate structure 255 having the return bend 257, the said plate structure 255 corresponding substantially to the structures 155 and 55 of Figures 5 and 4 respectively. But the

plate structure 255 does not have any notch at its return bend 257 and hence has no interior air circulation whatever.

Accordingly an insulating member 70 exactly like the member of Figure 4 may be utilized in connection with the plate structure 255. And since there is no interior air circulation within the plate structure 255, no exhaust need be provided.

In operation, upon the separation of the contact and the initiation of the air blast, the arc is transferred from the contacts 18 and 19 to the arcing horns 47 and 48. The air flow moves the arc away from the contact and moves its terminals along the divergent portion of the arcing horn onto the parallel portions 49 and 50 thereof.

This action stretches the arc to such a length that it can be extinguished by the metal plate structure.

In its outward movement, the arc enters the notches 57 in the metal plate structure 55 and is brought into contact with the metal plate structure at the apex of the notches 60.

At first, as the arc is blown into the plate structure, it is broken up progressively into a plurality of substantially equal sections in series, the sections alternately consisting of an arc playing in the spaces 59 between the different plate structures and the lower portions of the spaces 58 between the two plates of the same plate structure 55.

However, at the instant of contact with the plate, adjacent arcs (the arcs in alternate spaces 59 and 58 of Figure 1), have different characteristics.

The sections of the arc in the alternate areas 58 (within each plate structure 55) have in parallel with them a conductive path through the return bend 57 of the metal plate.

As is well known, this produces instability in an alternating current arc. For given conditions there is a minimum value of current required to maintain the arc. When the value of the current in a decreasing part of the cycle reaches this critical value the arc within each plate structure will be extinguished and the continued flow of air within the areas 58 will remove the arc products to restore the normal dielectric value of the air within the plates.

The extinction of the arc within each of the metal plate structures increases the overall resistance between the arcing horns as all the return bends of the plate are in series with all the short arcs in the areas 59 between the structures.

As the air blast continues to move these remaining arcs toward the discharge of the chute, the current paths around the return bend 57 become longer and hence increase in resistance.

If the remaining arcs continue to exist after their terminals reach the part of the structures containing the insulating barriers, then they are subjected to the flow of air through the structures 55 as well as to that between them and hence will be extinguished at that point.

The foregoing description of the operation applies whether the structure used is that of Figure 4 or Figure 5.

This explanation of the operation of the invention applies with equal force to the construction of Figure 6 where, however, no air plays within the structure 255 and where no arc exists. In this case, the arc is blown into the plate structures and plays in the spaces 59. The current path from arc horn to arc horn consists of alternate arcs and high-resistance conductive

metallic paths. As the arc is blown up between the plate structures the air blast serves to cool the arc and causes it to travel quickly up on the plate. As the arc moves upwardly the resistance to the flow of current around the bend 257 correspondingly increases, owing to the lengthening of the path, and the arc is normally extinguished before the terminals of the various alternate arcs reach the insulating member 10.

It would be undesirable, and perhaps impossible, to instantly cut off the flow of current. It is much more satisfactory to allow the current to reach its zero value and at that time to restore the dielectric strength of the space between the contacts, so that it is impossible for the current to begin flowing again.

In an alternating current arc, the current and voltage periodically pass through zero. The ionized path, however, has a definite time lag behind the current, due to the thermal capacity and the flow of ions from the core to the radiating surface. As the current is approaching zero, its heat generating ability is also approaching zero, and at zero current there is no heat being generated in the arc itself. It is probable, however, that incandescent electrodes will continue to emanate particles tending to supply ionized material as the metal parts retain heat longer than does the gas. The time lag previously mentioned causes this path to remain an effective conductor some time after current zero. If, before an appreciable voltage appears across the contacts, this ionized path can be sufficiently cooled, so that its dielectric is sufficient to resist the existing voltage, then the current will cease to flow. If, however, this cooling effect is not sufficiently rapid, the current will continue in its next half cycle.

In industrial A. C. power circuits every effort is made to maintain the power factor as close to one hundred percent as possible, or in other words, to keep the current in phase with the voltage. Most power circuits include resistance and a preponderance of inductance over capacity so that the current lags behind the voltage. When a fault occurs, the resistance of the circuit may drop to a very low value. Inductance then dominates the circuit and the current may lag nearly ninety degrees behind the voltage.

Under these conditions it is more difficult to interrupt current flow, for, at the instant the value of the current is zero, there is a relatively high and increasing voltage across the contacts. The air gap, therefore, must be completely deionized to prevent restriking.

One advantage of stretching an A. C. arc, or otherwise introducing resistance in the circuit, is to increase the power factor. The increased resistance reduces the amount of current flowing and hence the volume of ionized gas around the contacts. Consequent proper dielectric strength can be established more easily. Further, at the instant the current reaches the zero value, the voltage across the contacts is very much less, due to the improved power factor.

My present invention provides a simple device which makes full use of these principles in the extinguishment of the arc.

By the use of the foregoing devices, the arc drawn between the contacts is broken up into a series of short arcs so that the sum of the high cathode voltages will resist arc maintenance. An effective air blast on a plurality of short arcs and their terminals is provided. Substantially half of the short arcs are quickly extinguished by inserting resistances parallel with them.

The resistances, in series with the remaining arcs, continually increase as the arc extinguishment process continues. A cooling air blast is provided on both sides of the metal plate, both on the arc terminal face and on the back where there is no arc. Idle air between the plates produces extra chilling for the arc product. A double blast is provided, especially with the constructions of Figures 4 and 5 if the arc reaches the ends of the arc chute. Insulating cross barriers prevent an arcing over or reestablishment of a single arc at the end. The arrangement of spaced metal plate structures in the manner herein described permits the formation of a compact, inexpensive, highly efficient arc extinguisher.

Many modifications of my invention will now be obvious to those skilled in the art. I therefore prefer to be bound not by the specific disclosures herein set forth, but only by the appended claims.

I claim:

1. A plate structure for an arc extinguisher comprising a bent metallic member of a U-shaped cross-section, having a pair of plates integrally interconnected by a strip of material and bent into spaced relation; a notch in said bend said notch extending into said plates adjacent said bend.

2. A plate structure for an arc extinguisher comprising a bent metallic member of a U-shaped cross-section, having a pair of substantially rectangular plates integrally interconnected by a strip of material and bent into spaced parallel relation; a notch in said bend said notch extending into said plates adjacent said bend, said notch tapering in width, being widest at said bend and decreasing to a vanishing point on said plates.

3. A plate structure for an arc extinguisher comprising a bent metallic member of a U-shaped cross-section, having a pair of substantially rectangular plates integrally interconnected by a strip of material and bent into spaced parallel relation; a notch in said bend said notch extending into said plates adjacent said bend, and an exhaust path communicating with the space between said plates adjacent the ends thereof opposite the bend.

4. A plate structure for an air blast extinguisher comprising a bent metallic member of a U-shaped cross-section, having a pair of substantially rectangular plates integrally interconnected by a strip of material and bent into spaced parallel relation; a notch in said bend and in said plates adjacent said bend; an insulating spacer between the plates at the ends opposite the bend, and an exhaust opening in said spacer.

5. An arc extinguisher comprising a pair of substantially parallel arcing horns, means for drawing an arc and means for moving said arc onto said arcing horns and through the arc extinguisher, a metallic plate structure between said arcing horns, said plate structure being parallel to the arcing horns and substantially normal to the arc moving through the arc extinguisher, said plate structure having a U-shaped cross-section and comprising a pair of spaced parallel metallic plates forming the legs of the U integrally connected to each other around the bend of the U, the opposed faces of said U being exposed to each other and the plate structure being so arranged that the bend of each U-shaped member is first presented to the arc as it moves through the arc extinguisher, and a notch in said bend extending up onto said plates, said notch being

widest at said bend and tapering to a vanishing point on said plates.

6. An arc extinguisher comprising a pair of substantially parallel arcing horns, means for drawing an arc and means for moving said arc onto said arcing horns and through the arc extinguisher, a metallic plate structure between said arcing horns, said plate structure being parallel to the arcing horns and substantially normal to the arc moving through the arc extinguisher, said plate structure having a U-shaped cross-section and comprising a pair of spaced parallel metallic plates forming the legs of the U integrally connected to each other around the bend of the U, the metallic faces of said U members being exposed to each other and the plate structure being so arranged that the bend of the U-shaped member is first presented to the arc as it moves through the arc extinguisher, the arc, as it moves through the arc extinguisher being broken into a plurality of short arcs in the spaces outside the plate structure in series with a metallic conductive path in the plate structure from one plate of the plate structure around the bend of said plate structure to the other plate of said plate structure, the length of each of said conductive paths and the resistance thereof increasing throughout the movement of the arc through the extinguisher.

7. An arc extinguisher comprising a pair of substantially parallel arcing horns, means for drawing an arc and means for moving said arc onto said arcing horns and through the arc extinguisher, a plurality of spaced metallic plate structures between said arcing horns, said plate structures being parallel to each other and to the arcing horns, said plate structures being substantially normal to the arc moving through the arc extinguisher, each plate structure having a U-shaped cross-section and comprising a pair of spaced parallel metallic plates forming the legs of the U integrally connected to each other around the bend of the U, the opposed faces of said U-shaped plates being exposed to each other and the plate structures being so arranged that the bend of each U-shaped member is first presented to the arc as it moves through the arc extinguisher, the space between the plates of each plate structure being substantially equal to the spaces between adjacent plates of adjacent plate structures, the arc, as it moves through the arc extinguisher, being broken into a plurality of short arcs in the spaces between the plate structures in series with a plurality of metallic conductive paths in each plate structure from one plate of each plate structure around the bend of said plate structure to the other plate of said plate structure, the length of each of said conductive paths and the resistance thereof increasing throughout the movement of the arc through the extinguisher.

8. An arc extinguisher comprising a pair of substantially parallel arcing horns, means for drawing an arc and means for moving said arc onto said arcing horns and through the arc extinguisher, a metallic plate structure between said arcing horns, said plate structure being parallel to the arcing horns and substantially normal to the arc moving through the arc extinguisher, said plate structure having a U-shaped cross-section and comprising a pair of spaced parallel metallic plates forming the legs of the U integrally connected to each other around the bend of the U, the plate structures being so arranged that the bend of each U-shaped member is first pre-

sented to the arc as it moves through the arc extinguisher and a notch in said bend extending up onto said plates, the arc as it moves through the arc extinguisher being broken into a plurality of short arcs in the spaces on either side of the plate structure in series with a short arc from one plate to the other within the plate structure, the short arc within the plate structure being in parallel with the conductive path from plate to plate of the structure around the bend thereof and being rapidly extinguished, the short arc on either side of the plate structure being then in series with a conductive path in the plate structure from one plate to the other thereof around the bend thereof, the length of the conductive path and the resistance thereof increasing as the arc moves through the arc extinguisher.

9. An arc extinguisher comprising a pair of substantially parallel arcing horns means for drawing an arc and means for moving said arc onto said arcing horns and through the arc extinguisher, a plurality of spaced metallic plate structures between said arcing horns, said plate structures being parallel to each other and to the arcing horns, said plate structures being substantially normal to the arc moving through the arc extinguisher, each plate structure having a U-shaped cross-section and comprising a pair of spaced parallel metallic plates forming the legs of the U integrally connected to each other around the bend of the U, the plate structures being so arranged that the bend of each U-shaped member is first presented to the arc as it moves through the arc extinguisher, and a notch in said bend extending up onto said plates, the space between the plates of each plate structure being substantially equal to the spaces between adjacent plates of adjacent plate structures, the arc as it moves through the arc extinguisher being broken into a plurality of short arcs in the spaces between the plate structures in series with a plurality of short arcs from one plate to the other within each plate structure, the short arc within the plate structure being in parallel with the conductive path from plate to plate of the structure around the bend thereof and being rapidly extinguished, the short arcs between plate structures being then in series with a plurality of conductive paths in each plate structure from one plate to the other thereof around the bend thereof, the length of each conductive path and the resistance thereof increasing as the arc moves through the arc extinguisher.

10. In an arc extinguisher, means for splitting the arc into a plurality of smaller arcing paths, and means for inserting resistance in alternate ones of said smaller arcing paths parallel to said alternate smaller arcing paths, said resistance being less than the resistance of said alternate arcing paths for extinguishing said alternate arcs.

11. In an arc extinguisher, means for splitting the arc into a plurality of smaller arcing paths, and means for inserting resistance in alternate ones of said smaller arcing paths parallel to said alternate smaller arcing paths, said resistance being less than the resistance of said alternate arcing paths for extinguishing said alternate arcs, and means for increasing said resistance in series with the remaining arcs for decreasing the current and extinguishing the remaining arcs.

12. In an arc extinguisher, means for splitting the arc into a plurality of smaller arcing paths, and means for inserting resistance in alternate ones of said smaller arcing paths parallel to said

alternate smaller arcing paths, said resistance being less than the resistance of said alternate arcing paths for extinguishing said alternate arcs, and means including an air blast for blowing said arc further into said arc extinguisher for increasing said resistance in series with the remaining arcs for decreasing the current and extinguishing the remaining arcs.

13. In combination with an arc extinguisher, an air blast for blowing an arc into said extinguisher, means in said arc extinguisher for splitting the arc into a plurality of smaller arcing paths, means for inserting resistance in alternate ones of said smaller arcing paths parallel to said alternate smaller arcing paths, said resistance being less than the resistance of said alternate arcing paths for extinguishing said alternate arcs, and means for increasing said resistance in series with the remaining arcs for decreasing the current and extinguishing the remaining arcs.

14. In an arc extinguisher, means comprising U-shaped metallic members for splitting the arc into a plurality of smaller arcing paths, and means including said U-shaped metallic members for inserting resistance in alternate ones of said smaller arcing paths parallel to said alternate smaller arcing paths, said resistance being less than the resistance of said alternate arcing paths for extinguishing said alternate arcs.

15. In an arc extinguisher, means comprising U-shaped metallic members for splitting the arc into a plurality of smaller arcing paths, and means including said U-shaped metallic members for inserting resistance in alternate ones of said smaller arcing paths parallel to said alternate smaller arcing paths, said resistance being less than the resistance of said alternate arcing paths for extinguishing said alternate arcs, and an air blast for blowing said arc into and along said metallic members.

16. In an arc extinguisher, means comprising

U-shaped metallic members notched at the bend for splitting the arc into a plurality of smaller arcing paths, and means including said U-shaped metallic members for inserting resistance in alternate ones of said smaller arcing paths parallel to said alternate smaller arcing paths, said resistance being less than the resistance of said alternate arcing paths for extinguishing said alternate arcs.

17. In an arc extinguisher, means comprising U-shaped metallic members having a V-shaped notch at the bend for splitting the arc into a plurality of smaller arcing paths, and means including said U-shaped metallic members for inserting resistance in alternate ones of said smaller arcing paths parallel to said alternate smaller arcing paths, said resistance being less than the resistance of said alternate arcing paths for extinguishing said alternate arcs.

18. An arc extinguisher having plates consisting solely of U-shaped members notched at the bend, both the metallic faces of each leg of the plate being separated from the opposite leg, and legs of adjacent U-shaped members being separated from each other solely by air.

19. An arc extinguisher having plates consisting solely of U-shaped members having V-shaped notches at the bend, both the metallic faces of each leg of the plate being separated from the opposite leg, and legs of adjacent U-shaped members being separated from each other solely by air.

20. An arc extinguisher having plates consisting solely of U-shaped members, both the metallic faces of each leg of the plate being separated from the opposite leg, and legs of adjacent U-shaped members being separated from each other solely by space, and an insulating spacer between the plates at the ends opposite the bend.

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