

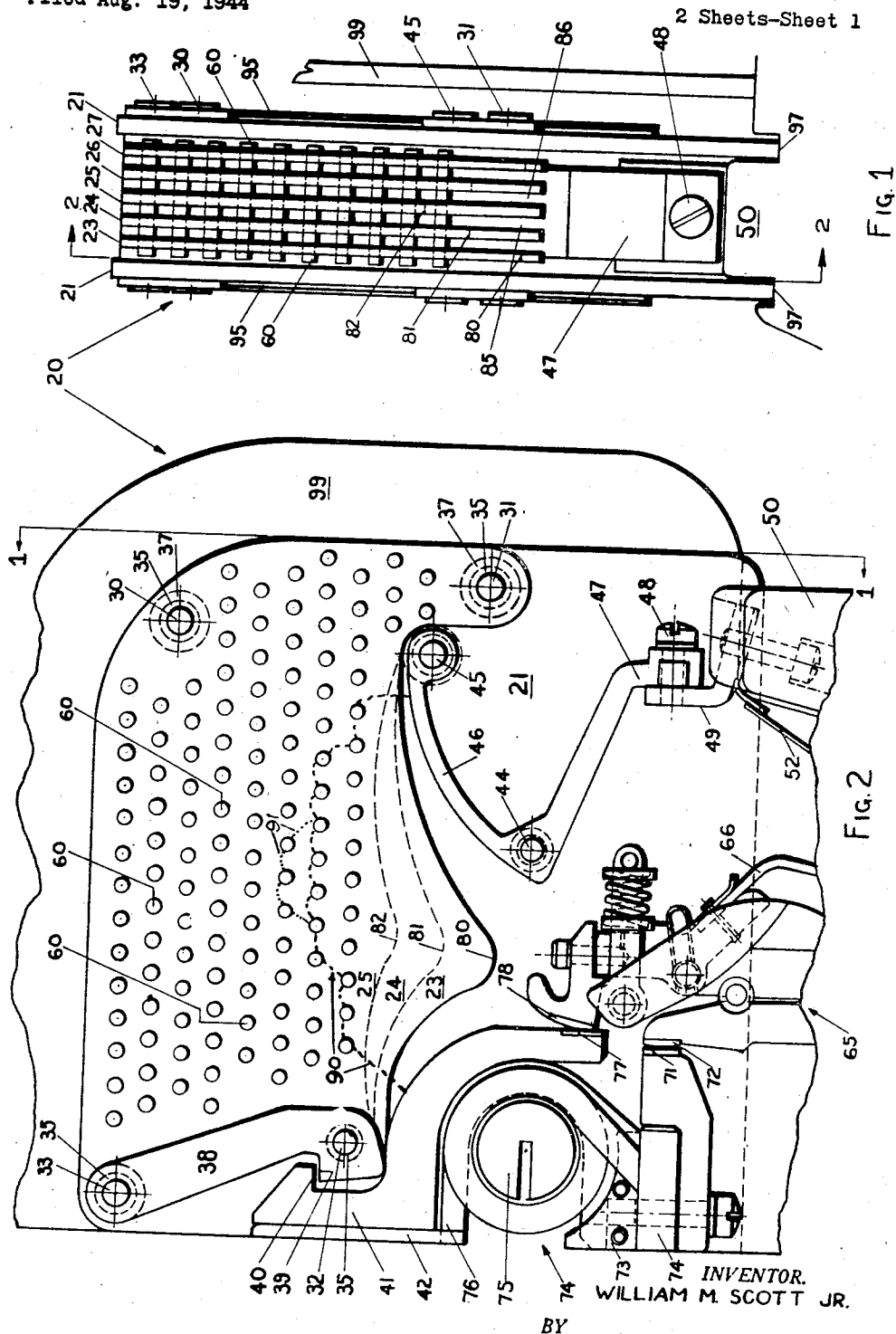
July 27, 1948.

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2,446,027

ARC CHUTE

Filed Aug. 19, 1944



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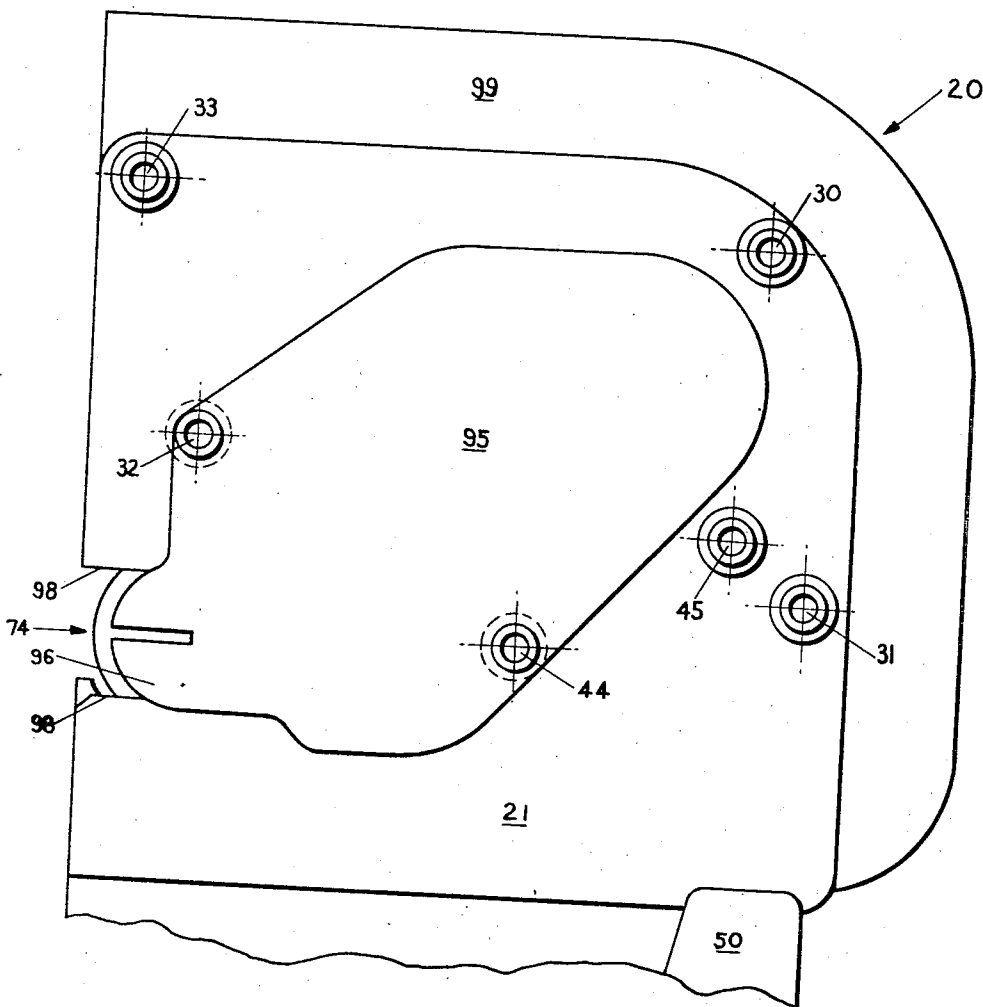


Fig. 3

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2,446,027

ARC CHUTE

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Application August 19, 1944, Serial No. 550,179

2 Claims. (Cl. 200-147)

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My present invention relates to circuit interrupters and more particularly to a novel arc quencher therefor comprising a plurality of spaced plates of insulating material arranged above and parallel to the arc, the said plates being intersected by a number of transverse metallic rods.

In the construction and operation of circuit interrupters, it is frequently necessary to provide means for extinguishing quickly the arc which is drawn between the contacts as they separate. Such circuit interrupters, which may be tripped open on the incidence of high currents, comprise a pair of main contacts (to carry the full current during normal operation), which are arranged to make after and break before a pair of parallel arcing contacts so that any arcing which may occur will not pit or otherwise destroy the contact surfaces of the main contacts.

The arc which is drawn between the arcing contacts when they separate under over-current conditions is blown upwardly by blow-out means, such as a magnetic blow-out or air blast (both well known in the art) into an arc chute which is arranged to quench the arc by lengthening the same or cooling it, by a combination of these methods or in many other ways.

Arc chutes having spaced insulating plates to lengthen the arc or squeeze the arc into narrow slots are well known. Arc chutes which consist of spaced metallic plates or their equivalent which break the arc up into a number of small arcs in series and move the arc rapidly across cooling surfaces, are also well known.

My invention contemplates as its essential function the provision of an arc chute which utilizes both the principle of spaced insulating plates to lengthen and squeeze the arc, together with a series of metallic surfaces with which the arc is brought into contact and broken up into a series of small arcs and cooled.

More specifically, my invention contemplates a plurality of spaced insulating plates extending in a direction parallel to the path of the arc into which the arc is forced by blow-out means, the said spaced insulating plates being used in combination with a series of transverse metallic members which will break the arc into a plurality of arcs in series and will also further cool the same.

Still more specifically, my invention contemplates that these metallic surfaces be formed by a series of transverse pins, each of which extends through all of the insulating plates and each of which furnishes a conductive path between the

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various slots defined by the spaced insulating plates.

Accordingly the primary object of my invention is the formation of a novel arc chute comprising spaced insulating plates together with spaced metallic members, the said plates and members extending in planes substantially normal to each other.

Another object of my invention is the provision of an arc chute having spaced insulating plates and extending in planes substantially parallel to that in which the arc is drawn, said plates being intersected by a plurality of transverse metallic pins of highly conductive material.

The use of transverse pins generally is known; such pins have however been used by themselves and in complex arrangements remote from the arc. Such pins also presented distinct problems in the mounting and insulation thereof.

Accordingly, still another object of my invention is the mounting of the transverse pins by means of insulating plates, where said pins need not be supported by the side walls of the arc chute and may even be spaced therefrom, and the mounting of the pins, so that they are closely adjacent to the arc.

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

Figure 1 is a cross-sectional view taken on line 1-1 of Figure 2, looking in the direction of the arrows.

Figure 2 is a front view of the unit of Figure 1, taken from line 2-2 of Figure 1.

Figure 3 is a side view of the unit of Figures 1 and 2.

Referring now to Figures 1 and 2, there is here shown an arc quencher 20 having generally the construction and operation of the arc quencher shown in my Patent No. 2,348,228 dated May 9, 1944, assigned to the assignee of the present invention. The arc chute 20 comprises a pair of side supporting plates 21, 21 of insulating material, between which are mounted a number of spaced arc extinguishing plates 23, 24, 25, 26, 27, also of insulating material. The plates are integrated as a single unit by the transverse bolts 30, 31, 32, 33, which are provided with insulated bushings 35, 35.

Bolts 30 and 31 are also provided with individual insulating washers or spacers 37, 37 to maintain the spacing between the insulating plates at the front of the arc quencher. Bolts 32 and 33 carry a set of insulating spacers 38 between each pair of plates which serve to space the back

ends of the plates from each other; the said spacers 38 also each having a hook-shaped extension 39 to engage a hook 40 on the upper end of the arcing horn 41, which is secured to the back panel 42 on which the circuit breaker is mounted. The plates 23-27 are accordingly insulated from each other and from the side plates 21.

The side plates 21, 21 also carry between them on the transverse bolts 44 and 45 for the opposite arcing horn 46. The said arcing horn 46 has an extension 47 carrying a bolt 48 which may be secured to the stationary flange member 49 carried by the transverse insulating bridging support 50 in order to secure the arc chute in position. A conductive connection is made to the arcing horn 46 through the flange member 49 and the pigtail 52.

The arc quencher 20 is particularly characterized by a large number of transverse copper pins 60, 60 which pass through perforations in the plates 23, 24, 25, 26, 27, as shown in Figures 1 and 2, and which are supported thereby. The pins 60 preferably do not contact the opposite supporting insulating members 21, 21. This will facilitate assembly and adjustment of the unit, permits the pins to be brought down close to the contacts which form the arc, removes the possibility of breakdown or creepage along the supporting plates 21, 21. The remainder of the structure shown corresponds to the circuit breaker shown in my Patent No. 2,348,228.

Essentially the circuit breaker here shown comprises a lower back connection stud (not shown) to which the main movable contact 72 (on the contact arm 65), the arcing horn 46-47, and the arcing contact 78 are connected respectively by a pigtail (not shown), pigtail 52, and pigtail 66. The circuit breaker also comprises an upper back connection stud 70 to which is secured the main stationary contact 71, which engages the main movable contact 72 mounted on the contact arm 65 to complete a circuit from the upper to the lower connection studs.

Also mounted on the upper back connection stud 70 is the terminal 73 of blow-out magnet 74 which has iron core 75. When the main contacts 71 and 72 have separated while the arcing contacts hereinafter described are engaged, current flows from the back connection stud 70 through the terminal 73 to blow-out magnet 74 to the upper magnet terminal 76; then through the arcing horn 41 to the stationary arcing contact 77, then to the movable arcing contact 78 mounted on the contact arm 65, and then through the pigtail 66 to the lower back connection stud.

As arcing contacts 77 and 78 separate, an arc is drawn therebetween. As the opening movement is completed, the root of the arc at contact 77 is blown upwardly along the arcing horn 41 while the root of the arc at movable arcing contact 78 is transferred to arcing horn 46 and blown upwardly thereon. The blow-out means hereinafter more specifically described, blows the center of the arc upwardly into the center of the plates 23 to 27. The plates 23 to 27 are longest in a vertical direction at plates 23 and 27; that is, the downwardly extending cusps 80 thereof extend further downwardly in the case of these plates. The center plate 25 has the shortest cusp 82. The intermediate plates 24 and 26 have cusps 81 of intermediate length, as shown more particularly in Figure 2 and in dotted lines in Figure 1.

Thus, in a transverse direction, the plates of the arc chute present a V-shape which tends to guide the arc toward the center of the chute. The downwardly extending cusps 80, 81 and 82 intercept the center of the arc and tend to guide the arc in its upward movement to squeeze into the confined space between the plates.

The arc in being driven upwardly tends to be squeezed into but one of the spaces, for instance in the space 85 between plates 24 and 25 or in the space 86 between plates 25 and 26. It is not necessarily confined to either or both of these spaces but may be broken up into a plurality of parallel arcs in separate spaces.

While this type of arc chute having only the spaced insulating plates 23 to 27 has been effective in use, it has been found that perhaps only one or two of the spaces, and usually only one, are actually effective in extinguishing the arc. That is, the arc is forced up into but one of the four spaces which it may normally enter, is squeezed between the surfaces of the plates defining the space, and is extinguished therein.

The arc in addition to being initially compressed in one or two of the slots or spaces between the plates is intercepted transversely by the plurality of metallic surfaces which define the pins 60. These pins 60 which are of highly conductive material, preferably copper, tend to break the arc up in series among them. That is, should the arc be squeezed say into the slot 85, it will encounter a number of pins 60, as shown by the dotted line 90, and will be broken up into a series of small arcs between these pins.

In addition, as the arc is driven upwardly, the initial small series arcs will go out and new arcs, as indicated at 91, will be established across other pins, which effect a new cooling action on the arc. As the arc moves still further upwardly, it will encounter still more pins and be broken up into a larger number of small arcs in series. This continuous tearing of the roots of the small arcs from the lower pins and re-establishing the small arcs above the small arcs which have been extinguished, will render the arcs unstable and lead to quick extinguishment.

The surfaces of the pins 60 will tend further to cool the arc while the arc roots move along from pin to pin, and will result in quick extinguishment of the arc. Not only does this action take place within the principal slot (for instance 85) into which the arc is first squeezed, but by reason of the fact that the pins extend through all of the slots, arcs may be set up in adjacent slots. Thus, for instance, when a small series arc is drawn between any two of the pins, the current in that arc may flow transversely through the chute (longitudinally through the pins) into adjacent slots. The pins are sufficiently close for the particular voltage for which the circuit breaker is rated so that at the substantial interrupting currents involved, new arcs may flash over between the adjacent pins in other slots when the arc roots are torn away from the pins in the original slot, thus transferring a portion of the arc to another and cooler slot and rendering the arc as a whole even more unstable.

By this structure, therefore, the arc is first squeezed into one or more slots which extend parallel to the arc path and into which the arc as a whole is squeezed between insulating plates. When squeezed into the slots between these insulating plates, the arc encounters a large number of spaced transverse pins. These pins break the arc up into a series of small arcs between

them and by reason of the rapid movement of the arc with respect to the surfaces of these pins and upwardly from pin to pin, tend to cool the roots of the small series arcs. This tends quickly to extinguish the arc.

Furthermore, since each pin extends through all of the slots, there is a tendency for the current to flow along the pins and for a small arc to strike over between closely adjacent pins of another slot when the arc roots are torn from the same pins in the original slot, thus forming some of the series arcs in a cooler slot, again rendering the arcs highly unstable and tending quickly to extinguish them.

This combination of squeezing the arc between insulating plates, intercepting the arc by metallic members or pins, breaking the arc up into a plurality of small arcs in series with each other and causing some of the small arcs to strike over in adjacent slots, results in a very quick extinguishing action.

A great amount of back pressure often develops owing to the gases under high pressure which are confined in the narrow space. This back pressure has been to some extent alleviated by providing communicating holes between the plates.

I have found that, in addition to their primary function of breaking the arc into a series of small arcs, the metallic pins 60 provide a conductive path between the spaces between the various plates, and aids materially in the extinguishing of the arc.

As will be obvious from the figures, the insulating supporting plates 21, 21 carry on their outer surfaces iron plates 95, 95 (Figures 2 and 3), the said iron plates 95 having extensions 96 which register with the iron core 75 of the blow-out magnet 74 and thus establish a U-shaped magnetic unit surrounding the arc chute, which according to principles which are well known, drives the arc upwardly with great rapidity. Plates 21, 21 are cut out at 98 so that the extensions 96 of plates 95 may register with the ends of the core 75 which ends extend outwardly to the outer surface of supporting plates 21.

Interphase barriers 99 may be provided between adjacent poles which usually have individual arc chutes. Such interphase barriers will prevent any flash over of the arc from one pole to the other. The arc chute is supported at the front of the circuit breaker by the front lower edges of plates 21 which rest in the slots 97, 97 of the supporting bridge 50. The back of the arc chute is supported by the hook 39 which engages the hook 40 of the arcing horn 41.

The arc chute 20 is locked in place by the bolt 48 which engages the flange 49. The arc chute may be readily removed for inspection and repair, or for replacement of other elements of the circuit breaker simply by rotating bolt 48 so that it will disengage flange 49. Upon such disengagement, the arc chute may simply be pulled forward and removed. The pins 60 and plates 23 to 27 are preferably assembled together

first as a unit and then assembled with the arc chute by placing the plate and pin assembly between the plates 21 and passing the bolts 30 to 33 through aligned openings in the plates.

In the foregoing I have described my novel arc chute in connection with a preferred embodiment thereof and mounted on a typical circuit breaker structure. It will be obvious of course that both the insulating plates and the pins may be varied in shape, location and in their relative positions with respect to each other within the principles of my invention.

In view therefore of the many modifications and variations of my invention which may be made by those skilled in the art, I prefer to be bound not by the specific disclosures herein, but only by the appended claims.

I claim:

1. An arc chute comprising means for drawing an arc, means for moving the arc into the chute, and arc extinguishing means within the arc chute, said arc extinguishing means having a pair of flat side walls, a plurality of flat perforated plates of insulating material located between and parallel to said walls and squeezing said arc, and a plurality of metallic members for breaking said arc into a plurality of arcs in series, each of said metallic members extending through the perforations in the plates of insulating material and into the spaces therebetween transverse to said arc path.

2. An arc chute comprising means for drawing an arc, means for moving the arc into the chute, and arc extinguishing means within the arc chute; said arc extinguishing means having a plurality of flat plates of perforated insulating material extending parallel to said arc path, the edges of said plates intercepting said arc, and a plurality of metallic members extending between said plates through the perforations in said plates at right angles to the plan of any of said plates and into the spaces therebetween transverse to said arc path and forming a conducting path between the spaces formed by said plates.

WILLIAM M. SCOTT, JR.

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