June 23, 1953 C. J. RIDGLEY 2,643,314

ARC CHUTE

Filed May 20, 1950 3 Sheets-Sheet 1

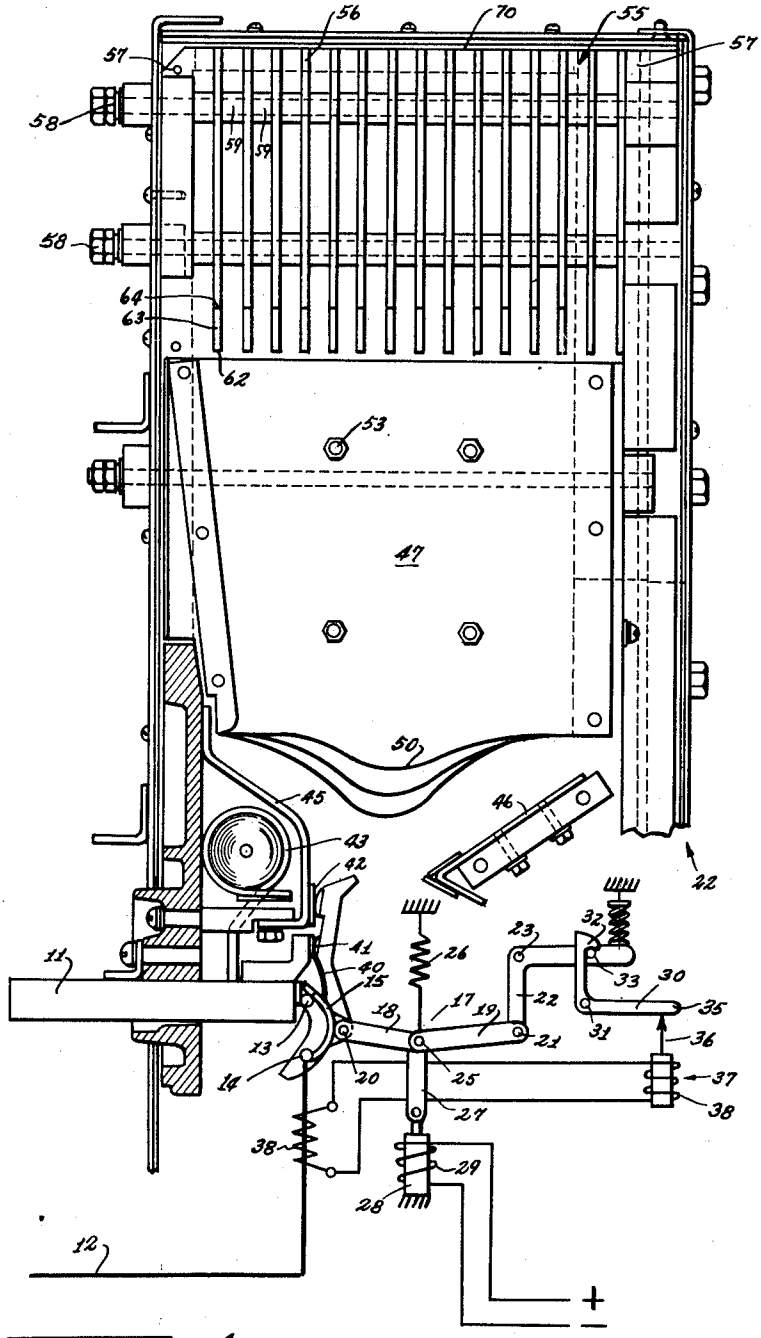

FIG-1

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ARC CHUTE

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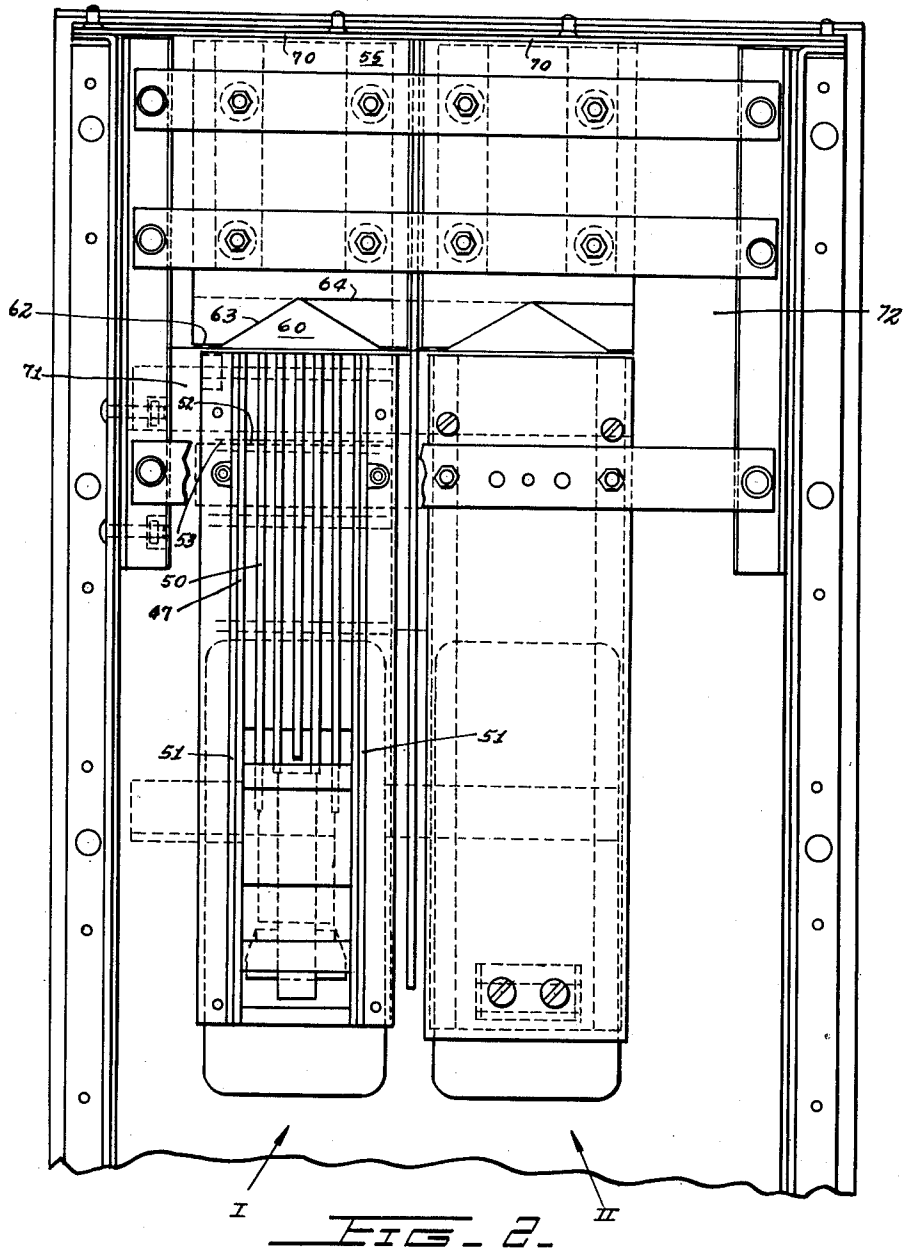

FIG. 2.

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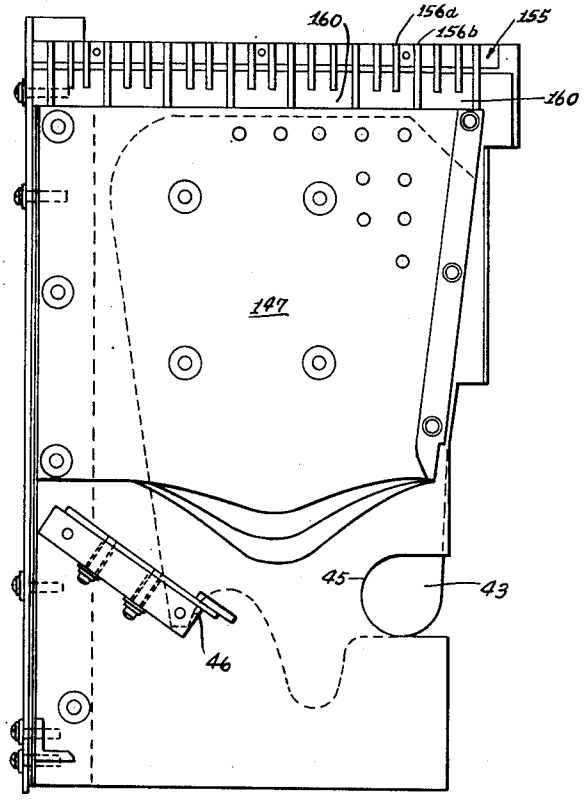

FIG. 3

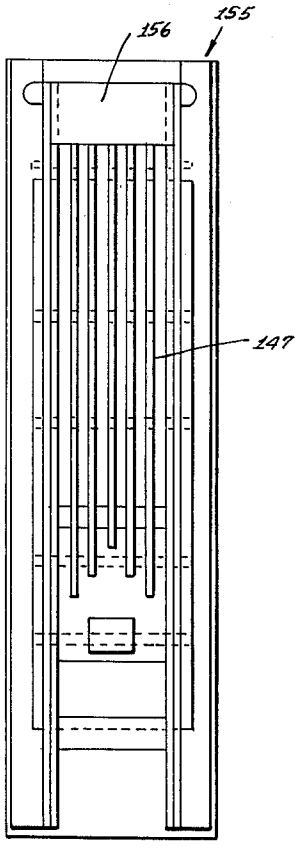

FIG. 4

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Patented June 23, 1953

2,643,314

UNITED STATES PATENT OFFICE

2,643,314

ARC CHUTE

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Application May 20, 1950, Serial No. 163,216

7 Claims. (Cl. 200—144)

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My present invention relates to circuit breakers, and more particularly to arc chutes incorporated therein for the purpose of rapidly extinguishing any arc which may be formed on the occurrence of a circuit interruption.

Still more specifically, my invention is directed to the addition of a cross-insulating plate arc suppressor to a conventional parallel plate arc chute.

Particularly in the case of high voltage D. C. arcs, the arc has a tendency to expand within the conventional arc chute if there is sufficient magnetic force directed in the proper direction, and the arc may tend to exist outside the arc chute until the circuit to the supply feeding the fault current has been opened by other means. The utilization of the cross plates assists in reducing the effects of the stored energy of the system without excessive burning.

Thus, the primary object of my present invention is the provision of a novel arc chute adapted to rapidly extinguish the arc, particularly in direct current applications of a circuit breaker.

Another object of my invention is the provision of cross insulating plates above the spaced parallel plate arc chute in order to assist in the extinction of the arc.

Still another object of my invention is the provision of a novel chamber adjacent the arc chute in order to guide the escaping arc gases.

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

Figure 1 is a partially schematic side view of a circuit breaker embodying my novel arc chute.

Figure 2 is a front view of my novel circuit breaker's arc extinguishing means.

Figure 3 is a side view corresponding to that of Figure 1 showing a modified arrangement of arc extinguishing plates as exhibited in Figures 1 and 2.

Figure 4 is a front view of the modified form of Figure 3.

Referring first to Figures 1 and 2, the circuit breaker there shown is provided with an upper back connection stud 11, a lower back connection stud schematically shown at 12, stationary contacts 13 and 14 bridged by the movable bridging contact 15.

The bridging contact 15 is operated by the toggle member 17 comprising the links 18 and 19, link 18 being pivotally connected by pin 20 to the bridging contact 15, link 19 being pivotally connected by the pin 21 to the bell crank

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latch lever 22 which in turn is pivotally mounted on pin 23.

Toggle member 17 is so arranged that its knee pin 25 is subject to upward opening force by the tension spring 26. Link 27 connected to the solenoid plunger 28 of the closing electromagnetic solenoid 29 may be pulled down by energization of the closing solenoid 29 to close the circuit breaker.

The bell crank latching lever arm 30 is pivotally mounted at 31 and is provided with the latching surface 32 engaging the latch pin 33 mounted on the bell crank latch member 22.

Extension 35 of the bell crank lever arm 30 is arranged to be engaged by armature 36 of the tripping device 37 which is energized from coil 38 electrically integral with the circuit of the back connection stud 12.

When the current reaches a predetermined value, armature 36 of the tripping device 37 is moved upwardly so as to rotate lever 30 clockwise thereby disengaging the latching surface 32 from the latch pin 33 and permitting the toggle 17 to collapse upwardly opening the circuit breaker.

Where the movable contact 15 is a bridged contact, then the circuit breaker opens in such manner that the contact is pivotally maintained at stationary contact 14 until the resultant arc is totally extinguished.

Preferable, bridging member 15 is a contact arm pivotally mounted at 14 so that the only place where an electric arc is drawn is at stationary contact 13.

The arc is transferred upwardly by means familiar to those versed in the art to the moving arcing contact 40 which cooperates with the stationary arcing contact 41 on the back connection stud 11.

As the contacts separate, the electric arc is transferred to the uppermost arcing contact 42 which connects the blow-out coil 43 in series with the arc, thereby providing a blow-out effect in a manner well known in the art and requiring no further description here.

The arc is then forced electromagnetically up on the arc horns 45 and 46 into the composite arc chute 47. The arc chute 47 is generally of the type described in Patents Nos. 2,390,735; 2,311,690; 2,348,228; 2,311,701; 2,375,328; and 2,338,715.

The arc chute 47 comprises a plurality of spaced arc extinguishing insulating plates 50 supported between insulating side plates 51 and spaced from each other by appropriate bushings 52 on the connecting and integrating bolts 53. The arc extinguishing plates 50 are mounted par-

allel to the axis of the arc formed between the uppermost arcing contact **42** and the moving arc contact **40**. These plates **50** are effective in extinguishing the arc by virtue both of its cooling properties and of its longitudinal sectionalizing of the ionized gas formation within the chute **47**.

My invention further contemplates, as previously pointed out, the utilization of an auxiliary arc chute member **55** comprising a plurality of insulating plates **56** mounted between a pair of end plates **57, 57** and held in position by a plurality of bolts **58, 58** on which are mounted separate insulating bushings **59, 59** in order to space the insulating plates **56** from each other.

In order to permit the arc gases rapidly to leave the top of the arc chute **47** and enter the upper auxiliary arc chute **55**, I have found it desirable and in fact necessary for maximum efficiency that the insulating cross plates **56** of auxiliary arc chute **55** be spaced somewhat above the top of the arc chute **47** in order to provide an open area **60** into which the arc gases may rise preliminary to their entry into the auxiliary arc chute.

Preferably this open space is obtained by shaping each plate **56** so that it has a lower edge **62** to be positioned just above the top of arc chute **47**. The lower edge **62** connects with inclined edge **63** and then connects with raised lower edge **64** as shown particularly in Figure 2 to create the open space.

By reversing adjacent plates **56**, a V-shaped chamber **60** as viewed from the front is provided as shown in Figure 2 between the upper auxiliary arc chute **55** and the lower arc chute **47**. The same result can be achieved by placing a V-shaped notch in each of the plates **56**. A better flow of arc gases is obtained by the reversed arrangement shown.

The auxiliary arc chute member **55** affords a "chopping-up" of the arc lengthwise as said arc progressively enters the auxiliary chute **55**. The "chopping-up" of this arc is accomplished more efficiently with the lower potential gradient of the greatly extended arc length. The cross plates **56** also afford more efficient cooling at the greater arc length.

The auxiliary arc chutes **55** as shown in Figure 2 in adjacent circuit breakers are covered over and fully enclosed at the top by the closing plates **70** which are preferably of insulating material.

The arc extinguishing gases are, therefore, directed laterally through the plates **56** of the auxiliary arc chute **55** into the downwardly directed exhaust chamber **72, 71** on each side as shown in Figure 2.

Thus, in a two-pole arrangement as shown in Figure 2, the arc gases from pole I pass upwardly through the arc chute **47** to be cooled and possibly extinguished thereby and then pass upwardly through the cross plate arc chute **55** further to be cooled and extinguished thereby.

The arc gases are then directed to the left for pole I and downwardly in chamber **71** to be further cooled prior to their exit into the atmosphere.

Similarly, for pole II the exhaust from the auxiliary arc chute **55** is to the right into chamber **72** and then downwardly.

Various arrangements of arc chute may be used. Thus, as shown in the slightly modified form of Figure 3, the principal arc chute **147** is relatively smaller while the auxiliary arc chute **155** is also relatively smaller.

The plates **156** thereof in this case all have a linear lower edge, but plates **156***a* have a lower edge which terminates at a level higher than that of plates **156***b* to produce the stepped arrangement shown in Figure 3, thereby providing a plurality of small chambers **160** in which the arc gases may have free passage from the lower arc chute to the upper arc chute. The exhaust to the left or right is in the same manner as that previously described.

Actually, the relative dimensions shown in Figures 3 and 4 are preferably dimensions for good operation of an arc chute in the field and for the purpose herein described.

Thus, in an actual unit intended to have an interrupting capacity of 75,000 amperes at 1000 volts, the lower arc chute **147** is preferably ten inches high, while the upper arc chute **155** is preferably of the order of four inches high.

By this means, therefore, a simplified arc extinguishing device is provided which will ensure that especially in the case of a direct current unit the arc, should it leave the lower arc chute **47** or **147**, will be fully extinguished in the upper arc chute **55** or **155** so that the flame or heat of an actual arc will not rise above or out of the composite arc chute.

In the foregoing I have described my invention solely in connection with specific illustrative embodiments thereof. Since many variations and modifications of my invention will now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosures herein contained but only by the appended claims.

I claim:

1. In a circuit breaker having a pair of cooperable contacts, one of said contacts being movable with respect to the other of said contacts, an arc chute comprising a first plurality of spaced parallel insulating plates mounted parallel to the axis of the arc formed between the contacts when they separate, said plates forming a notch at their lower edges in which relative movement of said cooperable contacts occurs, an auxiliary arc chute comprising a second plurality of parallel insulating plates extending transversely of said first parallel plates for lengthening the arc path, the lower edges of at least some of said second plates being spaced above the top edges of said first plates, a portion of the lower edges of each of said second plates being inclined to meet another lower portion of its associated plate so that when said second inclined portions of plates are inverted with respect to each other, a space transverse to the parallel direction of said first plates is formed, a closing insulating plate across the top of said second plates for fully enclosing the top of said auxiliary arc chute and vertically extending exhaust chambers for each side of said space for directing exhaust gases downwardly and opening into the atmosphere.

2. In a circuit breaker having a pair of cooperable contacts, one of said contacts being movable with respect to the other of said contacts, an arc chute comprising a first plurality of spaced parallel insulating plates mounted parallel to the axis of the arc formed between the contacts when they separate, an auxiliary arc chute comprising a second plurality of parallel insulating plates extending transversely of said first parallel plates for lengthening the arc path, the lower edges of

at least some of said second plates being spaced above the top edges of said first plates, a portion of the lower edges of each of said second plates being inclined to meet another lower portion of its associated plate so that when said second inclined portions of plates are inverted with respect to each other, a space transverse to the parallel direction of said first plates is formed, a closing insulating plate across the top of said second plates for fully enclosing the top of said auxiliary arc chute and vertically extending exhaust chambers for each side of said space for directing exhaust gases downwardly and opening into the atmosphere.

3. In a circuit breaker having a pair of cooperable contacts, one of said contacts being movable with respect to the other of said contacts, an arc chute comprising a first plurality of spaced parallel insulating plates mounted parallel to the axis of the arc formed between the contacts when they separate, said plates forming a notch at their lower edges in which relative movement of said cooperable contacts occurs, an auxiliary arc chute comprising a second plurality of parallel insulating plates extending transversely of said first parallel plates for lengthening the arc path, the lower edges of at least some of said second plates being spaced above the top edges of said first plates, to form a space transverse to the parallel direction of said first plates, a closing insulating plate across the top of said second plates for fully enclosing the top of said auxiliary arc chute and vertically extending exhaust chambers for each side of said space for directing exhaust gases downwardly and opening into the atmosphere.

4. In a circuit breaker having a pair of cooperable contacts, one of said contacts being movable with respect to the other of said contacts, an arc chute comprising a first plurality of spaced parallel insulating plates mounted parallel to the axis of the arc formed between the contacts when they separate, an auxiliary arc chute comprising a second plurality of parallel insulating plates extending transversely of said first parallel plates for lengthening the arc path, the lower edges of at least some of said second plates being spaced above the top edge of said first plates to form a space transverse to the parallel direction of said first plates, a closing insulating plate across the top of said second plates for fully enclosing the top of said auxiliary arc chute and vertically extending exhaust chambers for each side of said space for directing exhaust gases downwardly and opening into the atmosphere.

5. In a circuit breaker having a pair of cooperable contacts, one of said contacts being movable with respect to the other of said contacts, an arc chute comprising a first plurality of spaced parallel plates mounted parallel to the axis of the arc formed between the contacts when they separate, said plates forming a notch at their lower edges in which relative movement of said cooperable contacts occurs, an auxiliary arc chute comprising a second plurality of parallel plates extending transversely of said first parallel plates for lengthening the arc path, the lower edges of at least some of said second plates being spaced above the top edges of said first plates, a portion of the lower edges of each of said second plates being inclined to meet another lower portion of its associated plate so that when said second inclined portions of plates are inverted with respect to each other, a space transverse to the parallel direction of said first plates is formed, a closing plate across the top of said second plates for fully enclosing the top of said auxiliary arc chute and vertically extending exhaust chambers for each side of said space for directing exhaust gases downwardly and opening into the atmosphere.

6. In a circuit breaker having a pair of cooperable contacts, one of said contacts being movable with respect to the other of said contacts, an arc chute comprising a first plurality of spaced parallel plates mounted parallel to the axis of the arc formed between the contacts when they separate, an auxiliary arc chute comprising a second plurality of parallel plates extending transversely of said first parallel plates for lengthening the arc path, the lower edges of at least some of said second plates being spaced above the top edge of said first plates to form a space transverse to the parallel direction of said first plates, a closing plate across the top of said second plates for fully enclosing the top of said auxiliary arc chute and vertically extending exhaust chambers for each side of said space for directing exhaust gases downwardly and opening into the atmosphere.

7. In a circuit breaker having a pair of cooperable contacts, one of said contacts being movable with respect to the other of said contacts, an arc chute comprising a first plurality of spaced parallel insulating plates mounted parallel to the axis of the arc formed between the contacts when they separate, said plates forming a notch at their lower edges in which relative movement of said cooperable contacts occurs, an auxiliary arc chute comprising a second plurality of parallel insulating plates extending transversely of said first parallel plates for lengthening the arc path, the lower edges of some of the second plates being closer to the top edges of the first plates to form a plurality of spaces transverse to the parallel direction of said first plates, a closing insulating plate across the top of said second plates for fully enclosing the top of said auxiliary arc chute and vertically extending exhaust chambers for each side of said space for directing exhaust gases downwardly and opening into the atmosphere.

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