Oct. 13, 1953 T. G. A. SILLERS 2,655,578

ARC CHUTE WITH NOTCHED BARRIER PLATES

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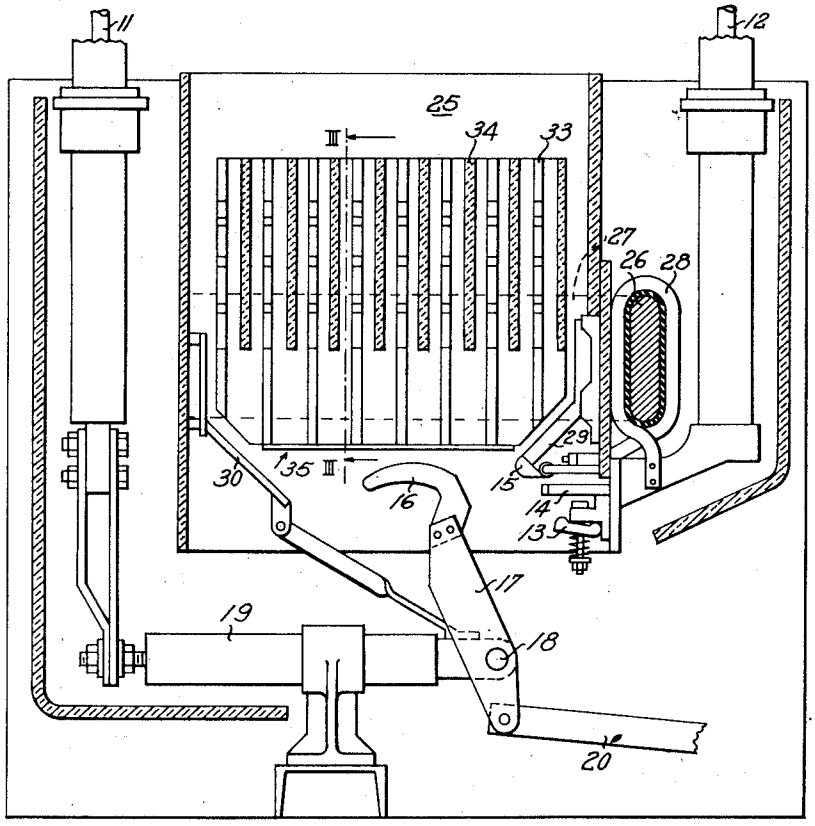


Fig. 1

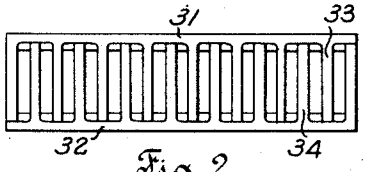


Fig. 2

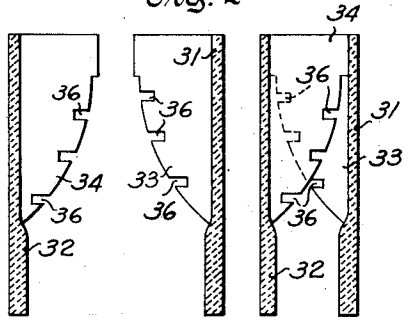


Fig. 4 Fig. 5 Fig. 3

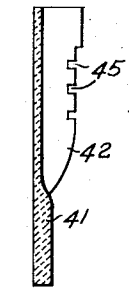


Fig. 8

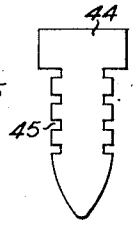


Fig. 9

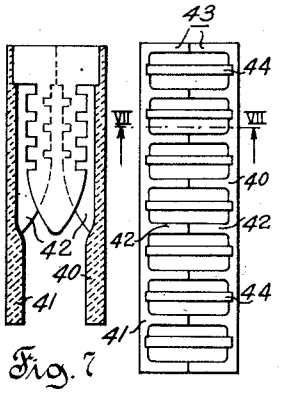


Fig. 7 Fig. 6

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ARC CHUTE WITH NOTCHED BARRIER PLATES

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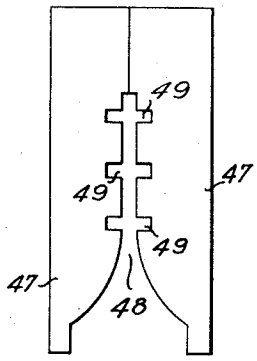


Fig. 10

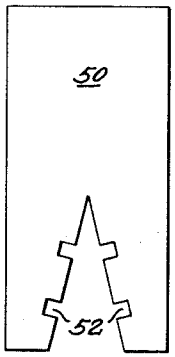


Fig. 11

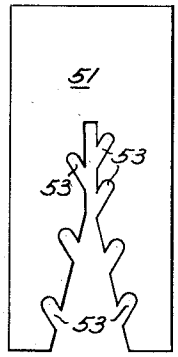


Fig. 12

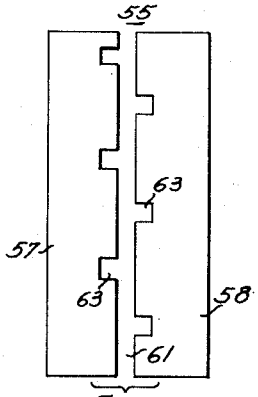


Fig. 13

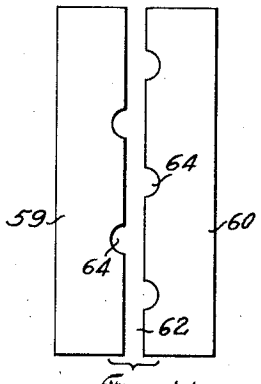


Fig. 14

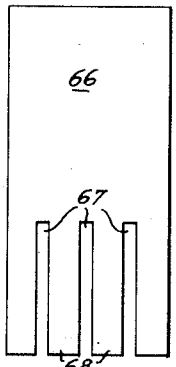


Fig. 15

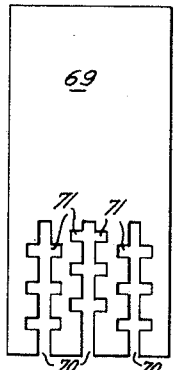


Fig. 16

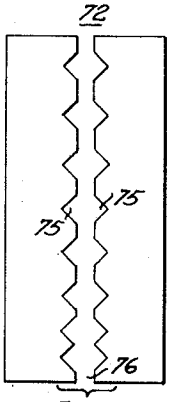


Fig. 17

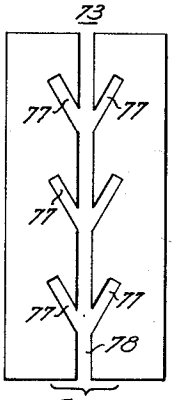


Fig. 18

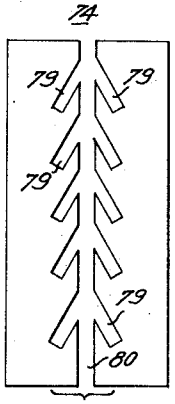


Fig. 19

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ARC CHUTE WITH NOTCHED BARRIER PLATES

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Application October 2, 1950, Serial No. 187,955

13 Claims. (Cl. 200—144)

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This invention relates to circuit interrupting devices and more particularly to arc extinguishing means for use in connection therewith.

In the construction and operation of circuit interrupters, it is frequently necessary to provide means for extinguishing quickly the arc which is drawn between separable arcing contacts. This arc is usually directed by blowout means, such as a magnetic blowout coil or an air blast, or both, into an arc chute which is arranged to quench the arc by lengthening it, cooling it, or a combination of both.

Arc chutes having spaced insulating plates to lengthen the arc or squeeze the arc into narrow slots have been used to rapidly increase the arc resistance, decrease the arc current and greatly improve the power factor, thereby facilitating interruption of the arc at a current zero. However, it has been found in many cases that the arc moves rapidly through the arc chute and the highly heated arc gases expelled from the chute form a conducting path at the chute exhaust through which the arc may restrike after it has been interrupted within the chute. Such restriking or flashover at the chute exhaust usually results in failure of the circuit breaker to clear the circuit and damage to other equipment associated therewith.

In accordance with the invention claimed an arc chute is provided adjacent a pair of arcing contacts for receiving the arc at one end thereof and exhausting the arcing products at the other end thereof. The arc chute employs an arc extinguishing device comprising a plurality of barriers or fins extending from the side walls of the arc chute longitudinally of the arc chute in a direction generally transversely of the movement of the arc.

The barriers or fins are provided with a plurality of notches or serrations which retard and cool the arc as it moves through the arc chute. Portions of the fins in some applications of this invention may be interleaved and overlapped with respect to each other so as to form a narrow zigzag arc passage therebetween. Each fin may be tapered in height toward the arc receiving end of the arc chute along its overlapping edge, and the tapered edge is notched to retard the movement of the arc through the arc chute.

In other applications of this invention the fins may cooperate in pairs to form a split barrier plate extending in a common plane transversely to the direction of movement of the arc. The inner edges of each fin are provided with a plurality of notches which retard the arc as it moves through the barrier plates.

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It is, therefore, one object of the present invention to provide a new and improved arc interrupting device in which the movement of the arc through the device is retarded so that the arc may be exposed to the cooling surfaces of the arc chute for a longer period of time.

Another object of this invention is to provide a new and improved arc interrupting device in which the arc is retarded and cooled at predetermined points in the arc chute.

A further object of this invention is to provide a new and improved interrupting device which distorts the arc, splits the arc into a plurality of arc segments, and retards the movement of the arc segments through the arc chute to expose the arc to the cooling surfaces of the arc chute for a longer period of time.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawings, in which:

Fig. 1 is a view in cross section, of a magnetic blowout type of circuit breaker employing the present invention;

Fig. 2 is a plan view of the arc chute shown in Fig. 1;

Fig. 3 is a cross sectional view through the arc chute of Fig. 1 taken along the line III—III;

Figs. 4 and 5 are end views of the individual barrier plates illustrated in Fig. 3;

Fig. 6 is a plan view of a modification of the arc chute shown in Fig. 1;

Fig. 7 is a cross sectional view through the arc chute of Fig. 6 taken along the line VII—VII;

Fig. 8 is an end view of one of the abutting fins illustrated in Fig. 7;

Fig. 9 is an end view of the interleaving and overlapping barrier plate illustrated in Fig. 7; and

Figs. 10 to 19 are end views of modifications of the barrier plate structure shown in Figs. 1 to 5.

Referring more particularly to the drawings by characters of reference, Fig. 1 illustrates a magnetic blowout type of circuit breaker including as elements thereof a pair of terminal studs 11 and 12 for connecting the circuit breaker to line conductors (not shown). Although in general, circuit breakers of the type considered in Fig. 1 are provided with a plurality of similar pole structures, one for each phase of a polyphase electric circuit, only one such pole structure is shown in the drawing and the circuit breaker will be described in detail as if it was of the single pole unit type.

The circuit interrupter or breaker in Fig. 1

comprises essentially means for opening the circuit to form the interrupting arc and an arc extinguishing structure. Specifically, the circuit opening means comprises fixed current carrying contact 13 and tertiary contact 14, a fixed arcing contact 15, and a movable arcing contact 16. Arcing contact 16 is mounted on a lever 17 which is pivotally mounted at 18 on an extension 19 of the circuit breaker stud 11 and is operated by means of a reciprocally movable rod 20. The operating rod 20 is suitably connected to an actuating mechanism (not shown) for operating the movable contact between closed and open circuit positions. Fig. 1 illustrates the movable contact 16 in an intermediate position. The arcing contacts are electrically connected to the lower ends of terminal studs 11 and 12. Accordingly, when the breaker is connected in series in a power circuit and the arcing contacts are separated, an arc may form across the gap indicated.

For the purpose of interrupting this power arc, an arc extinguishing structure, such as an arc chute 25, may be mounted so as to receive the power arc which is under the influence of a magnetic blowout means. The arc chute preferably is disposed directly above the arcing contacts, as shown, when the blowout means act upward, but may be mounted in any other suitable location when the blowout means act in other directions. The switch or arcing contacts and the magnetic blowout structure can assume any preferred form so that a brief description thereof will be sufficient. The magnetic blowout means may comprise a core 26, poles 27, and a coil 28 which is electrically connected to the terminal stud 12 and to a metallic arc runner 29 so that the arc current (as the arc travels along the runner) flows through the blowout coil in a manner well known in the art.

Normally the current is carried in the closed circuit position of the breaker by contact 16 and the spring biased contact 13. While the movable arcing contact 16 is actuated to open circuit position, current is shunted from fixed contact 13 first to fixed contact 14 and then to fixed arcing contact 15. As the arc is drawn by the movable arcing contact 16, the arc terminal on arcing contact 15 is transferred to arc runner 29, which is usually an extension arm of the fixed arcing contact 15. As the movable arcing contact 16 approaches or reaches its full opening stroke the arc terminal transfers from the movable arcing contact 16 to an arc runner 30 which directs the arc into the arc chute 25. One end of the blowout coil 28 is preferably connected to the arcing contact 15 and the other end to tertiary contact 14. When the movable arcing contact 16 parts from contact 14, the flow of current is transferred from contact 14 to contact 15 through the blowout coil 28. The movable arcing contact 16 subsequently parts from contact 15 to draw an arc. Accordingly, the blowout coil is already energized at the inception of the arc interruption to influence the arc in a well known manner, i. e. to drive it into the arc chute 25 in an expanding loop. It will be apparent to one skilled in the art that the blowout field can be utilized in the most efficient manner by disposing the iron poles 27 so as to cooperate with the blowout coil in the conventional manner outside of the arc chute.

In accordance with the invention claimed, arc chute 25 illustrated in Figs. 1 to 5 comprising spaced insulating side walls 31 and 32 is provided with a plurality of spaced insulating interleaving and overlapping tapered fins or barrier plates 33 and 34. Fins or barrier plates 33 extend from the side of side wall 31 facing side wall 32, and fins or barrier plates 34 extend from the side of side wall 32 facing side wall 31. Barrier plates 33 and 34 are arranged in spaced relation longitudinally of arc chute 25 in a direction generally transverse of the direction of movement of the arc. The barrier plates 33 and 34 are tapered in height along the edges thereof extending away from side walls 31 and 32 toward the arc receiving end 35 of arc chute 25. The overlapping edges of barrier plates 33 and 34 are provided with a plurality of serrations or notches 36 which are spaced at varying distances from the arc receiving end of arc chute 25.

Under normal interrupting conditions an arc is initiated immediately upon separation of the arcing contacts 15 and 16. The terminal of the arc on fixed arcing contact 15 is driven over arc runner 29 by the magnetic blowout means and the thermal effect of the arc. As movable arcing contact 16 nears its fully open position the other terminal of the arc is moved from contact 16 to arc runner 30 and is also driven by the blowout means and the thermal effect of the arc toward the exhaust end of arc chute 25.

As the arc terminals move along the arc runners 29 and 30 toward the exhaust end of arc chute 25, the arc is driven into a narrow zigzag passage formed between the spaced overlapping fins or barrier plates 33 and 34.

The arc rises in this zigzag passage under the influence of the blowout means and the thermal effect of the arc until it is extinguished. In passing through the barrier plates the arc is retarded by notches 36. Notches 36 provide a means for the arc to cling to the barrier plates and momentarily hesitate as it moves through the arc chute. The diameter of the arc section situated between the surfaces bounding the notches is relatively small, while the diameter of the arc section in the space between adjacent plates is relatively large. Therefore, the arc spreads around the closed end of the notches and is cooled and deionized by the surface action of the barrier plates. By providing notches 36, the surface exposed to the arc and arc products is materially increased, thus increasing the cooling effect of the barrier plates.

As illustrated in Figs. 1 to 5 the arc chute 25 may be made of two substantially identical halves comprising side wall 31 and barrier plates 33 and side wall 32 and barrier plates 34. The two halves are symmetrical so that when nested together, as shown, they provide an arc chute structure having two side plates with a plurality of barrier plates arranged in between. Fig. 3 shows an end view of the arc chute barrier plate structure and the manner in which the barrier plates, by reason of the fact that they vary in width, serve to lengthen the distance in arc travel from one end of the arc chute to the other end thereof as the arc rises in the chute. The smooth zigzag paths around the barrier plates are interlaced with pockets or notches throughout the arc chute for retarding and cooling the arc as it moves through the arc chute.

Figs. 6 to 9 illustrate an arc chute structure comprising spaced insulating side walls 40 and 41 having extending from the sides facing each other a plurality of fins 42 which cooperate in pairs to form a plurality of split barrier plates 43 extending longitudinally of the arc chute in a direction generally transversely of the movement

of the arc. Each fin of each pair forming a barrier plate **43** is tapered in height toward the arc receiving end of the arc chute to provide a narrow arc passage therebetween for restricting the arc. The tapered edges of the fins are provided with a plurality of notches **45** which momentarily trap the arc as it moves through the arc chute. Between each pair of fins, which together form a barrier plate **43**, is arranged an arrow shaped barrier plate **44**. The tapered edges of the barrier plate **44** extend toward the arc receiving end of the arc chute, as shown, with the point of the barrier plate extending substantially midway between the side walls **40** and **41**.

As the arc rises in the arc chute and hits the arrow shaped barrier plates **44** it may follow along the left or right edges of the barrier plate **44**, or subdivide so that part of the arc follows along one side of the arrow shaped barrier plate **44** and part of the arc follows along the other side of the arrow shaped barrier **44**. In this manner the arc may be subdivided and lengthened as it follows the zigzag path through the arc chute. Each of the fins **42** and the tapered edges of barrier plates **44** are provided with suitably disposed pockets or notches **45** which tend to retard the arc as it moves through the arc chute.

In some applications of this invention it is desirable to provide (as shown in Fig. 10) a plurality of pairs of abutting tapered fins **47** which form a narrow slot like passage **48** for the arc to travel during its movement through the arc chute. Each fin **47** is provided along its tapered edge with a plurality of notches or pockets **49** which permit a temporary expansion of the arc during its passage through the arc chute. Pockets **49** may retard the movement of the arc enough to permit the arc to restrike after a current zero through a relatively cool arc path formed by notches downstream of the former arc path.

Fig. 11 illustrates an example of a V-shaped slotted insulating barrier plate **50** which may be arranged in groups to extend longitudinally of the axis of an arc chute with the slots adjacent the arcing contacts. Barrier plate **50** is provided with rectangular notches **52** along the slotted edges thereof to retard the movement of the arc as it passes through the slots and to expose the arc to a larger cooling surface than heretofore possible with a V-shaped slot.

Fig. 12 illustrates a barrier plate **51** similar to barrier plate **50** but having round bottomed notches **53**.

Fig. 13 illustrates an example of split barrier plate **55**, comprising spaced fins **57**, **58**. Fins **57** and **58** are spaced apart to provide an arc passage **61**. A plurality of rectangular notches **63** are provided along the edges of the fins forming arc passage **61** to effectively cool and retard the arc as it passes through the arc chute.

Fig. 14 illustrates a barrier plate **56** similar to barrier plate **55** but comprising fins **59**, **60** provided with semicircular notches **64** and defining an arc passage **62**.

Fig. 15 illustrates a slotted barrier plate **66** which may be arranged in groups to extend longitudinally of the axis of an arc chute with slots **67** adjacent the arcing contacts. Slots **67** are provided to cool and retard the arc as it moves through the arc chute. The arc may overlap the webb **68** between slots **67** of plate **66** and expand into two or more slots, or the arc may be constricted and cooled by only one slot of each barrier plate **66**. Additional cooling surface is provided by the multiple slots.

Fig. 16 illustrates a barrier plate **69** which is a modification of the barrier plate illustrated in Fig. 15. The slots **70** of Fig. 16 are provided with a plurality of notches **71** which provide additional cooling surface for rapidly deionizing the arc as it passes through the arc chute.

Figs. 17, 18 and 19 illustrate split barrier plates **72**, **73** and **74**, respectively, which may be used in arc chutes of the type shown in Fig. 1 for retarding and cooling the arc as it moves through the arc chute. Barrier plate **72** is provided with saw tooth notches **75** along the edges forming arc passage **76**; a barrier plate **73** is provided with downstream extending notches **77** along the edges forming arc passage **78**; and barrier plate **74** is provided with upstream extending notches **79** along the edges forming arc passage **80**.

The barriers shown in Figs. 10 to 19 may be used in groups. Each group may consist of identical barriers in which the notches are in alignment. A group may also consist of barriers differing only in the location of the notches to cause the notches of adjacent barriers to be staggered. A group may also comprise any combination of the barriers illustrated in Figs. 10 to 19.

Although but a few embodiments of the present invention have been illustrated and described it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising spaced insulating side walls having extending from the sides facing each other a plurality of fins which extend longitudinally of said chute in a direction generally transversely of the movement of said arc, said fins being tapered in height along the edges thereof extending away from said side walls toward the arc receiving end of said chute to provide an arc passage, said tapered edges being provided with a plurality of serrations for cooling and retarding said arc as it moves through said chute.

2. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising spaced insulating side walls having extending from the sides facing each other a plurality of fins, said fins of one side being arranged to cooperate with said fins from the opposite side to provide a plurality of barriers extending longitudinally of said chute in a direction generally transversely of the movement of said arc, said fins being tapered in height toward the arc receiving end of said chute to provide a narrow arc passage between cooperating fins and notched along said tapers to retard the movement of said arc as it passes through said passage.

3. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising spaced insulating side walls having extending from the sides facing each other a plurality of abutting fins which extend longitudinally of said chute in a direction generally transversely of the movement of said arc, said fins being tapered in height along at least a part of the abutting edges of said fins toward the arc receiving end of said chute for providing a narrow arc passage, the tapered edges of said fins

being provided with a plurality of notches which retard the arc as it moves through said passage.

4. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising spaced insulating side walls having extending from the sides facing each other a plurality of fins which extend longitudinally of said chute in a direction generally transversely of the movement of said arc, each of said fins of one side of said chute abutting edge to edge a different one of said fins on said other side of said arc chute, said fins being tapered in height along at least a part of the abutting edges toward the arc receiving end of said chute for providing a narrow arc passage and notched along said tapered edges for retarding the arc as it moves through said passage.

5. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising spaced insulating side walls having extending from the sides facing each other a plurality of fins which cooperate in pairs to form a plurality of split barrier plates extending longitudinally of said chute in a direction generally transversely of the movement of said arc, each fin of said pairs being tapered in height toward the arc receiving end of said chute to provide a narrow arc passage between cooperating fins and notched along said taper to retard the movement of said arc as it passes through said passage, and a tapered barrier plate extending longitudinally of said chute inserted between each pair of fins with the tapered ends of said plate extending toward the arc receiving end of said chute for distorting said arc as it moves through said chute.

6. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising spaced insulating side walls having extending from the sides facing each other a plurality of fins which cooperate in pairs to form a plurality of split barrier plates extending longitudinally of said chute in a direction generally transversely of the movement of said arc, each fin of said pairs being tapered in height toward the arc receiving end of said chute to provide a narrow arc passage between cooperating fins and notched along said taper to retard the movement of said arc as it passes through said passage, and a notched tapered barrier plate extending longitudinally of said chute inserted between each pair of fins with the tapered ends of said plate extending toward the arc receiving end of said chute for distorting and dividing said arc into a plurality of arc sections.

7. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising spaced insulating side walls having extending from the sides facing each other a plurality of fins which cooperate in pairs to form a plurality of split barrier plates extending longitudinally of said chute in a direction generally transversely of the movement of said arc, each fin of said pairs being tapered in height toward the arc receiving end of said chute to provide a narrow arc passage between cooperating fins and notched along said taper to retard the movement of said arc as it passes through said passage, and a tapered barrier plate extending longitudinally of said chute inserted between each pair of fins with the tapered ends of said plate extending toward the arc receiving end of said chute for distorting, retarding and dividing said arc into a plurality of arc sections as it moves through said chute.

8. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising a plurality of spaced interleaved overlapping tapered barrier plates arranged to extend longitudinally of the axis of said chute with the tapered ends of said plates extending toward the arc receiving end of said chute, said plates having their flat surfaces provided with a generally polygonal convex outline broken by notches cut into the edge traversed by the arc to cool and retard the arc as it passes through said chute.

9. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising a plurality of spaced interleaved overlapping tapered barrier plates arranged to extend longitudinally of the axis of said chute with the tapered ends of said plates extending toward the arc receiving end of said chute, said plates having their flat surfaces provided with a generally polygonal convex outline broken by notches cut into the edge of said plates traversed by the arc for cooling the arc and retarding the movement of the arc as it passes through said chute, said notches of adjacent said plates being spaced at unequal distances from the arc receiving end of said chute.

10. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising spaced insulating side walls, each wall having extending from its side facing the other wall a plurality of fins extending in spaced relation longitudinally of said chute in a direction generally transversely of the movement of said arc, portions of said fins being interleaved and overlapped so as to form a narrow zigzag arc passage between the spaced overlapped fins, said fins having their flat surfaces provided with a generally polygonal convex outline broken by notches cut into the edge of said fins traversed by the arc to retard and cool the arc as it passes through said chute.

11. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising a plurality of barrier plates extending longitudinally of said chute in a direction generally transversely of the movement of said arc, a number of said barrier plates having their flat surfaces provided with a generally polygonal convex outline broken by notches cut into the edge traversed by the arc to cool the arc as it moves through said chute.

12. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising a plurality of slotted spaced barrier plates arranged to extend longitudinally of said chute with the slots adjacent the zone of arc initiation to form an arc passage, a number of said barrier plates providing slots having a generally polygonal convex outline broken by notches cut into the edges of said slots to retard and cool the arc as it moves through said chute.

13. An electric circuit interrupter comprising means for drawing an arc and an arc chute for receiving and extinguishing the arc, said chute comprising spaced insulating side walls having extending from the sides facing each other a plurality of cooperating fins, said fins extending

longitudinally of said chute in a direction generally transversely of the movement of said arc and providing a narrow arc passage therebetween, said fins having their flat surfaces provided with a generally polygonal convex outline broken by notches cut into the edge traversed by the arc for cooling the arc as it moves through said chute.

THOMAS G. A. SILLERS.

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