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2,905,792

ARC CHUTE CONSTRUCTION HAVING RESILIENT SPACING MEANS

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2 Sheets-Sheet 1

FIG. 1 FIG. 2

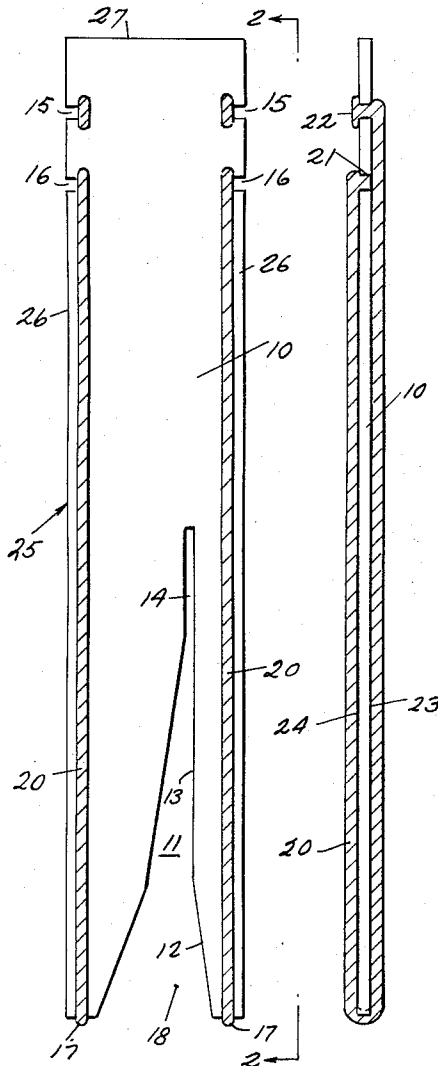


FIG. 4A

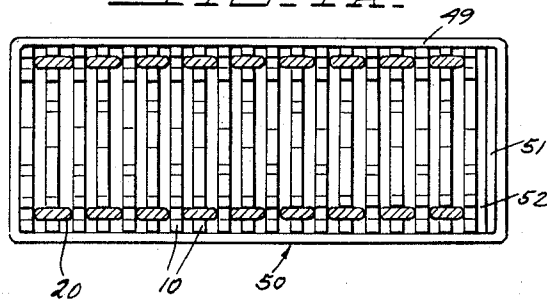


FIG. 3A

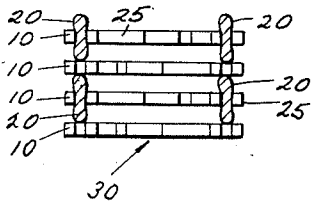
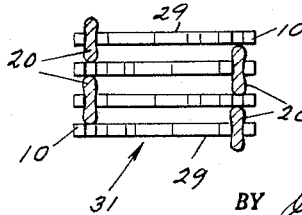


FIG. 3B



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FIG. 4

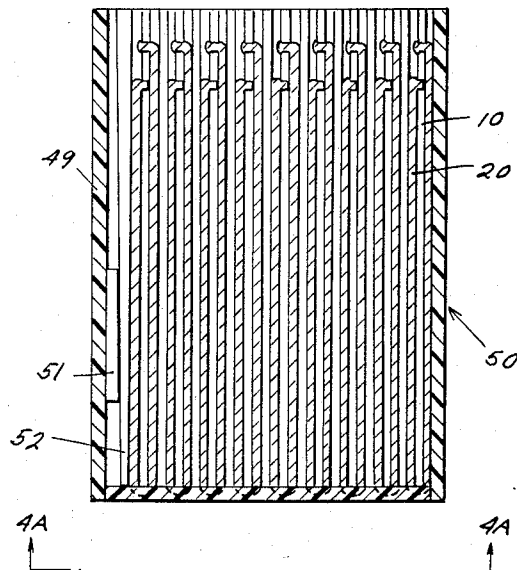


FIG. 5

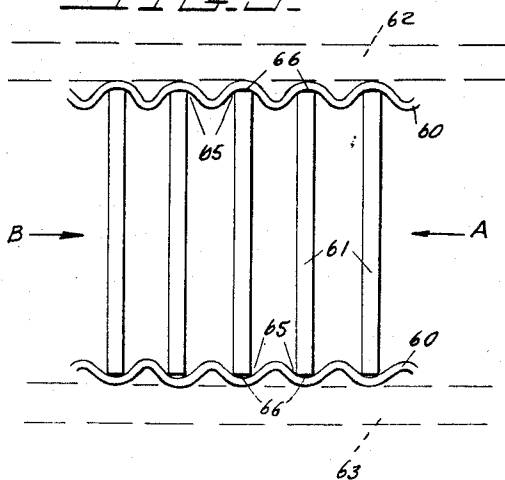
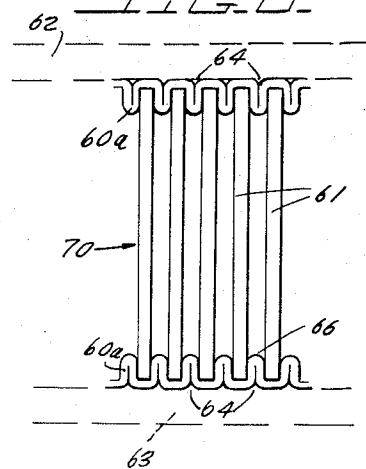


FIG. 6



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ARC CHUTE CONSTRUCTION HAVING RESILIENT SPACING MEANS

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17 Claims. (Cl. 200—144)

This invention relates to arc chutes for the extinction of electrical current arcs formed between the cooperating contacts of power circuit interrupters when the contacts are disengaged and more particularly to arc chutes wherein the ceramic arc plates of the arc chute are spaced from each other by resilient means having high dielectric strength.

One prior art method of spacing arc plates consists of nesting the plates within slots cut in the opposed inner side surfaces of the arc chute shell. A second method of spacing consists of molding arc plates having integrally formed ribs on each of the long sides of the plate. While a third means of spacing consists of running asbestos rope along both long edges between the plates and then compressing the stack until the proper spacing has been achieved.

In each of the aforesaid methods the long edges of the arc plates are rigidly fixed in position and because of this the thin unsupported body portion of the arc plate would often be fractured by the mechanical forces accompanying the arc formation upon separating the cooperating contacts of the circuit interrupter. Furthermore, the rigid spacing means results in a high reject rate of the arc plates because of warpage and camber.

This invention provides a resilient spacing means between the plates of the arc chute and by so doing overcomes the prior art disadvantages especially insofar as high breakage rate and high rejection rate of arc plates. The resilient spacing means acts as a shock absorber and permits movement of the arc plates during the arcing period. After the arc has been extinguished the plates will, because the spacers are resilient, once again assume their original spacing.

Since the resilient means is yielding, it serves as a cushion which absorbs the arc forming shock forces and thereby diverts these forces from the arc plates thus preventing the plates from being cracked or broken. The resilient spacing means also compensates for warpage of the plates and surface irregularities along the edges thus permitting large tolerances which lowers the number of manufacturing rejects. A resilient spacing means also forms an excellent seal between the plates to prevent ionized gases from leaking out past the sides of the plates and shorting out parts of the arc chute which would result in the failure of the chute.

In addition to being resilient, the spacing means must be capable of withstanding high arcing temperatures; it must have a high dielectric strength; it should be inorganic and non-carbonizing; and it should have low moisture absorption qualities. Suitable materials possessing the above qualities are fibers of aluminum silicate ceramic or glass either spun into rope or calendered into sheets. Latex or its equivalent may be used as a binder for the aluminum silicate ceramic fibers while sodium silicate or other refractory cement binders may be used with the glass fibers.

A first embodiment of my invention utilizes the re-

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silient material in rope form and a flat arc plate having an off center tapered slot comprising one or more connected sections with the slot sections tapering more gradually as their distances from the arc entrance increases.

One end of the rope is anchored in a first notch cut in the long edge of the plate near the end opposite the arc entrance. The rope is tensioned and brought down the long edge on one side of the plate around the narrow end having the slot entrance, up the long edge on the opposite side of the plate, and is then anchored in a second notch similar to the first notch and located in close proximity thereto. A plurality of these arc plates with the rope attached are stacked in staggered relationship. The parallel plate stack is partially compressed and placed in a shell. Pressure and spacing between plates is finally set and maintained with the aid of wedge shaped adjusting shims.

A second resilient rope spacer may be installed on the other long edge of the arc plates in the same manner as was the first spacer. In this event every other plate in the stack need not have resilient rope spacers secured thereto.

In another embodiment of my invention the resilient material is in the form of corrugated sheets. Two corrugated sheets are retained in a jig, in spaced parallel relationship. Arc plates are inserted between the corrugated sheets with the thin edges of the long sides positioned within the troughs of the corrugations. The sheets are then compressed so that a double thickness of the previously corrugated sheet now provides the spacing cushion between arc plates. A cement binder is applied to the compressed corrugations and allowed to set. This forms an assembly which may be placed in the arc chute shell as a unit. As an alternative, the assembly of collapsed corrugated sheets and arc plates may be inserted into the shell without using cement, with the spacing between plates being set and maintained by wedges.

Accordingly a primary object of my invention is to provide a resilient spacing means between the arc plates of arc chute used in circuit interrupting equipment which will prevent breakage of the arc plates by absorbing some of the arcing shock.

Another object is to provide an economical construction for an arc chute by permitting greater manufacturing tolerances for the plates of the chute.

Still another object is to provide a resilient spacing means that also acts as a seal between arc plates to block possible ionized gas leakage paths which would parallel the arcing slots of the plates.

A further object is to provide a construction which simplifies the use of separate spacing means for each arc plate by accepting wide variations in plate thickness.

A still further object is to provide a separate spacing means which can be used with a wide variety of shapes and types of arc plates.

Another object is to provide an arc chute construction wherein a resilient rope acts as the spacing means for the arc plates.

Another object is to provide an arc chute construction wherein a resilient, once corrugated, sheet is formed to provide the spacing means for the arc plates.

Another object is to provide an arc chute construction wherein the resilient spacing means between the arc plates is comprised of aluminum silicate ceramic or glass fibers.

Another object is to provide an arc chute construction wherein latex or a refractory cement binder such as sodium silicate is utilized.

These and other objects of my invention will become apparent after reading the following description in connection with the accompanying drawings in which:

Figure 1 is a plan view of a ceramic arc plate having resilient rope spacing means secured thereto,

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Figure 2 is a side elevation taken in the direction of the arrows 2—2 of Figure 1.

Figure 3A is an end view of a small stack of arc plates wherein alternate plates of the stack have resilient rope spacing means running along each of the long sides thereof as illustrated in Figures 1 and 2.

Figure 3B is an end view of a small stack of arc plates wherein each plate has but one resilient rope spacing means secured thereto.

Figure 4 is a side elevation of an assembled arc chute, with the side of the chute cut away, wherein the arc plates are spaced from each other and cushioned against shock by resilient means.

Figure 4A is an end view of Figure 4 looking in the direction of arrows 4A.

Figure 5 is a side elevation of another embodiment of my invention in the preliminary stage, wherein a corrugated sheet of resilient material is utilized.

Figure 6 is a side elevation of the embodiment of Figure 5 after the corrugated sheet has been compressed.

Referring to Figures 1—4A, an arc plate assembly 25 comprises a thin flat arc plate 10 having resilient rope spacers 20 secured thereto. The arc plate 10 includes a three section arc slot 11 consisting of a first section 12 which is sharply tapered and includes a wide mouth 18 at the front edge of arc plate 10 to provide a free entrance for the arc; a second section 13 communicating with the first section more gradually tapered, and offset from the centerline of the arc plate 10 to thereby shift, elongate and compress the arc; and a third section communicating with the second section, is offset from the centerline, and comprises straight closely spaced sides to further compress the arc and lead it through a tortuous path. The three section arc slot 11 is more fully discussed in United States Patent 2,759,073, entitled, "High Voltage Arc Extinguishing Means," to Joseph D. Wood, and assigned to the assignee of the instant invention.

Front notches 17 are cut in the front short side of arc plate 10 near the long sides 26 thereof and side notches 15 and 16 are cut in the long sides 26 toward the back short side. First one end 21 of the resilient rope spacer 20 is secured in side notch 16. The rope spacer 20 is then run along the top surface 24 of the arc plate 10 parallel to long side 26 through front notch 17, along the bottom surface 23 parallel to long side 26 and the other end 22 is secured in side notch 15. Arc plate assembly 25 includes resilient rope spacers 20 along both long sides 26 while arc plate assembly 29 includes a resilient rope spacer 20 along but one side 26.

The arc plates 10 preferably comprise a ceramic insulating material while the resilient rope spacer is preferably spun of glass fibers or aluminum silicate ceramic fibers, both of which are inorganic, non-carbonizing, having high dielectric strength, and are capable of withstanding high temperatures. A material possessing these characteristics is Fiberfrax which comprises aluminum silicate ceramic fibers with a latex binder or equivalent up to a maximum of three percent (3%), all or part of which can be baked out.

Arc plate stack 30 comprises a plurality of arc plate assemblies 25 and a plurality of arc plates 10 stacked alternately with the arc slots 11 being in staggered relationship to provide the most tortuous path for the arc. Resilient rope spacers 20 of arc plate assemblies 25 serve as spacing and supporting means between adjacent arc plates 10 along substantially the full length of both long sides 26.

Arc plate stack 31 comprises a plurality of arc plate assemblies 29 each of which comprise an arc plate 10 having a resilient rope spacer 20 secured to but one long side 26 thereof. The arc plate assemblies 29 are stacked with the resilient rope spacers 20 being on alternate sides of the arc plate stack 31 and the arc slots 11 being in staggered relationship. It is readily

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seen that arc plate stack 31 is the electrical and mechanical equivalent of arc plate stack 30.

Arc chute 50 is formed by placing either arc plate stack 30 or 31 in shell 49. For purposes of illustration only, the arc chute 50 includes only the arc plate stack 30. The arc plate stack 30 is compressed and then placed in the shell 49 along with wedges 51 and 52 which act as shims to secure the arc plate assemblies 25 in the shell 49 and as a fine adjustment to set the spacing and pressure between arc plates 10.

When arc chute 50 is used to extinguish an arc, the arc forces hitting the arc plates 10 will be absorbed by the resilient rope spacers 20 which will be compressed. After the arc has been extinguished, the resilient rope spacers 20 will expand to the size as established by the wedges 51 and 52 and the arc plates 10 will be properly spaced to await the next arc. Thus the resilient rope spacers 20, by absorbing the arcing forces prevent the breakage of the thin arc plates.

In addition to acting as a spacing and support means, the resilient rope spacers 20 act as seals along the long sides 26 so that hot gases are prevented from escaping along the sides of shell 49 to thereby short circuit the arc chute 50. Furthermore, since the rope spacers 20 are resilient they will readily adapt and compensate for defects in the arc plates 10 such as warpage, camber, and surface irregularities.

A second embodiment of my invention illustrated in Figures 5 and 6 discloses an arc plate stack 70, including resilient spacing means 60, which is easily and quickly assembled. Corrugated members 60 comprising glass fibers or aluminum silicate fibers calendered into sheet form are placed along walls 62 and 63 of a suitable jig in spaced relationship. Arc plates 61, which may be of a design similar to arc plates 10, are placed between the corrugated members 60, with long edges 66 nesting in the troughs 65. Pressure is then applied end to end on the corrugated members 60 in the directions of arrows A and B so that the corrugated member 60 is collapsed to the shape 60a (Fig. 6).

The arc plates 61 are now in parallel relationship spaced by a slightly compressed double thickness 66 of the corrugated member 60. The arc plate stack in this condition may be placed in shell 49 with the final spacing being set by wedges 51 and 52.

In the alternative, a suitable refractory cement may be applied to the corrugated sheets 60 before they are collapsed or the refractory cement may be placed in the end regions 64 after the corrugated sheets 60 have been collapsed and secure the corrugated members in the end to end collapsed state to form arc plate stack 70 which is then placed in shell 49 to form an arc chute. Since the corrugated sheets 60 comprise a resilient material, an arc chute including arc plate stack 70 will react in the same manner as arc chute 50 in extinguishing the arc of a circuit interrupter.

In the foregoing, I have described my invention only in connection with preferred embodiments thereof. Many variations and modifications of the principles of my invention within the scope of the description herein are obvious. Accordingly, I prefer to be bound not by the specific disclosure herein but only by the appending claims.

I claim:

1. An arc chute for a circuit interrupter comprising a shell, a plurality of arc plates, a resilient means; said plurality of arc plates being disposed within said shell; said resilient means supporting said plurality of arc plates in spaced parallel relationship to thereby prevent breaking and cracking of said arc plates during arcing between cooperating contacts of said circuit interrupter.

2. An arc chute for a circuit interrupter comprising a shell, a plurality of arc plates, a resilient means; said plurality of arc plates being disposed within said shell; said resilient means supporting said plurality of arc plates

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in spaced parallel relationship to thereby prevent breaking and cracking of said arc plates during arcing between cooperating contacts of said circuit interrupter; said resilient means comprising two corrugated sections collapsed end to end.

3. An arc chute for a circuit interrupter comprising a shell, a plurality of arc plates, a resilient means; said plurality of arc plates being disposed within said shell; said resilient means supporting said plurality of arc plates in spaced parallel relationship to thereby prevent breaking and cracking of said arc plates during arcing between cooperating contacts of said circuit interrupter; said resilient means comprising at least one resilient rope spacer for each of said plurality of arc plates.

4. An arc chute for a circuit interrupter comprising a shell, a plurality of arc plates, a resilient means; said plurality of arc plates being disposed within said shell; said resilient means supporting said plurality of arc plates in spaced parallel relationship to thereby prevent breaking and cracking of said arc plates during arcing between cooperating contacts of said circuit interrupter; said resilient means comprising ceramic fibers.

5. An arc plate assembly comprising a thin flat arc plate of inorganic material and at least one resilient rope spacer secured thereto.

6. An arc plate assembly comprising a thin flat arc plate of inorganic material and a resilient rope spacer; said arc plate including two long sides; said resilient rope spacer being positioned adjacent to one of said long sides along the top and bottom surfaces of said arc plate.

7. An arc plate assembly comprising a thin flat arc plate of inorganic material and two resilient rope spacers; said arc plate including two long sides; each of said resilient rope spacers being positioned adjacent to each of said long sides along the top and bottom surfaces of said arc plate.

8. An arc chute for a circuit interrupter comprising a shell and an arc plate stack disposed within said shell; said arc plate stack comprising a plurality of flat arc plates and a plurality of arc plate assemblies stacked in alternate layers; each of said plurality of arc plate assemblies comprising a thin arc plate having two long sides and resilient rope spacers positioned adjacent to each of said long sides along the top and bottom surfaces of said arc plate.

9. An arc chute for a circuit interrupter comprising a shell and an arc plate stack disposed within said shell; said arc plate stack comprising a plurality of flat arc plates and a plurality of arc plate assemblies stacked in alternate layers; each of said plurality of arc plate assemblies comprising a thin arc plate having two long sides and resilient rope spacers positioned adjacent to each of said long sides along the top and bottom surfaces of said arc plate; a shim means operatively positioned at one end of the arc plate stack to partially compress said resilient rope spacers and thereby adjust the spacing between the arc plates and secure the arc plate stack in the shell.

10. An arc chute for a circuit interrupter comprising a shell and an arc plate stack disposed within said shell; said arc plate stack comprising a plurality of arc plate assemblies comprising a thin flat arc plate of inorganic material and a resilient rope spacer; said arc plate including two long sides; said resilient rope spacer being positioned adjacent to one of said long sides along the top and bottom surfaces of said arc plate; said arc plate assemblies being stacked with said arc plates in spaced parallel relationship with the resilient rope spacers of adjacent arc plate assemblies being positioned on alternate sides of said arc plate stack.

11. An arc chute for a circuit interrupter comprising a shell and an arc plate stack disposed within said shell; said arc plate stack comprising a plurality of arc plate assemblies comprising a thin flat arc plate of inorganic

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material and a resilient rope spacer; said arc plate including two long sides; said resilient rope spacer being positioned adjacent to one of said long sides along the top and bottom surfaces of said arc plate; said arc plate assemblies being stacked with said arc plates in spaced parallel relationship with the resilient rope spacers of adjacent arc plate assemblies being positioned on alternate sides of said arc plate stack; a shim means operatively positioned at one end of the arc plate stack to partially compress said resilient rope spacers and thereby adjust the spacing between the arc plates and secure the arc plate stack in the shell.

12. An arc plate stack comprising a plurality of flat arc plates and two parallel spaced corrugated members of resilient material in an end to end collapsed state; each of said plurality of arc plates including two long edges positioned within troughs of said corrugated members; said plurality of arc plates being positioned and secured in spaced parallel relationship by said corrugated members; a refractory cement applied to said corrugating members to secure said corrugated members in said end to end collapsed state; said corrugated members serving as resilient supporting and spacing means for said plurality of arc plates.

13. An arc chute for a circuit interrupter comprising a shell, a plurality of arc plates, a resilient means, a shim means; said plurality of arc plates being disposed within said shell and being supported in spaced parallel relationship by said resilient means; said shim means being operatively positioned to force said resilient means to a partially compressed state and thereby adjust the spacing between said arc plates, and secure said arc plates within said shell; said resilient means being further compressed upon the occurrence of an arc between cooperating contacts of said circuit breaker to thereby prevent cracking and breaking of said arc plates; said resilient means returning to the partially compressed state after said arc has been extinguished.

14. An arc chute for a circuit interrupter comprising a shell, a plurality of arc plates, a resilient means; said plurality of arc plates being disposed within said shell; said resilient means supporting said plurality of arc plates in spaced parallel relationship to thereby prevent breaking and cracking of said arc plates during arcing between cooperating contacts of said circuit interrupter; said plurality of arc plates being separable from said resilient means.

15. An arc chute for a circuit interrupter comprising a shell, a plurality of arc plates, a resilient means; said plurality of arc plates being disposed within said shell; said resilient means supporting said plurality of arc plates in spaced parallel relationship to thereby prevent breaking and cracking of said arc plates during arcing between cooperating contacts of said circuit interrupter; said resilient means comprising two corrugated sections collapsed end to end; said plurality of arc plates being separable from said resilient means.

16. An arc plate assembly comprising a thin flat arc plate of inorganic material and at least one resilient rope spacer removably secured thereto.

17. An arc plate assembly comprising a thin flat arc plate of inorganic material and at least one resilient rope spacer secured thereto; said arc plate having side notches cut therein; said resilient rope spacer having compressed portions thereof disposed within said notches to removably secure said rope spacer to said arc plate.

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