

Nov. 3, 1964

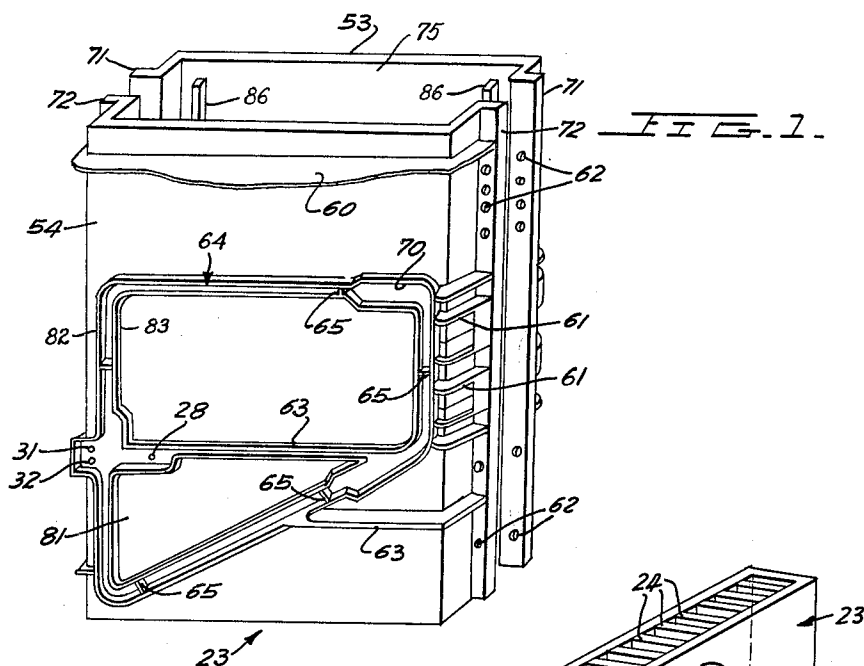
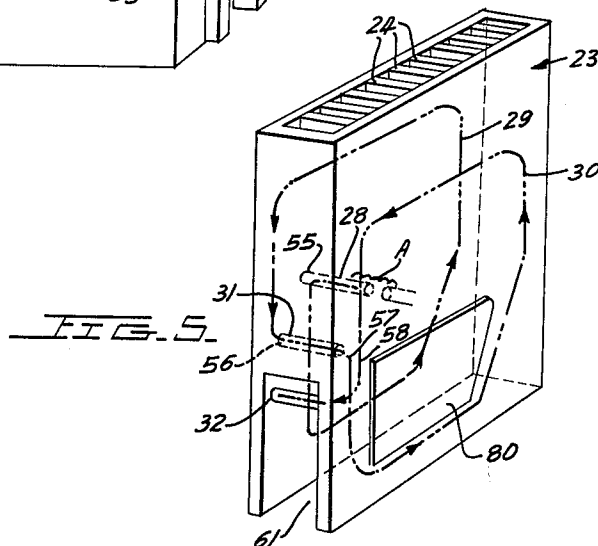
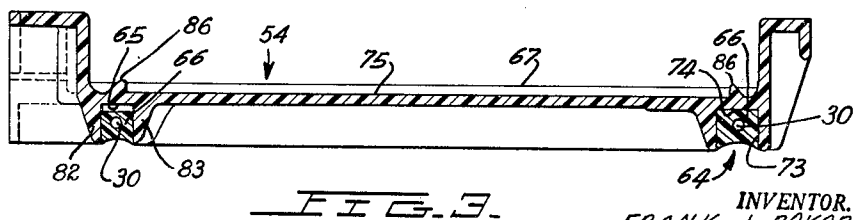
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3,155,801

ARC CHUTE SIDE WITH ENCAPSULATED FACE WOUND BLOWOUT COIL

Filed Dec. 21, 1960

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

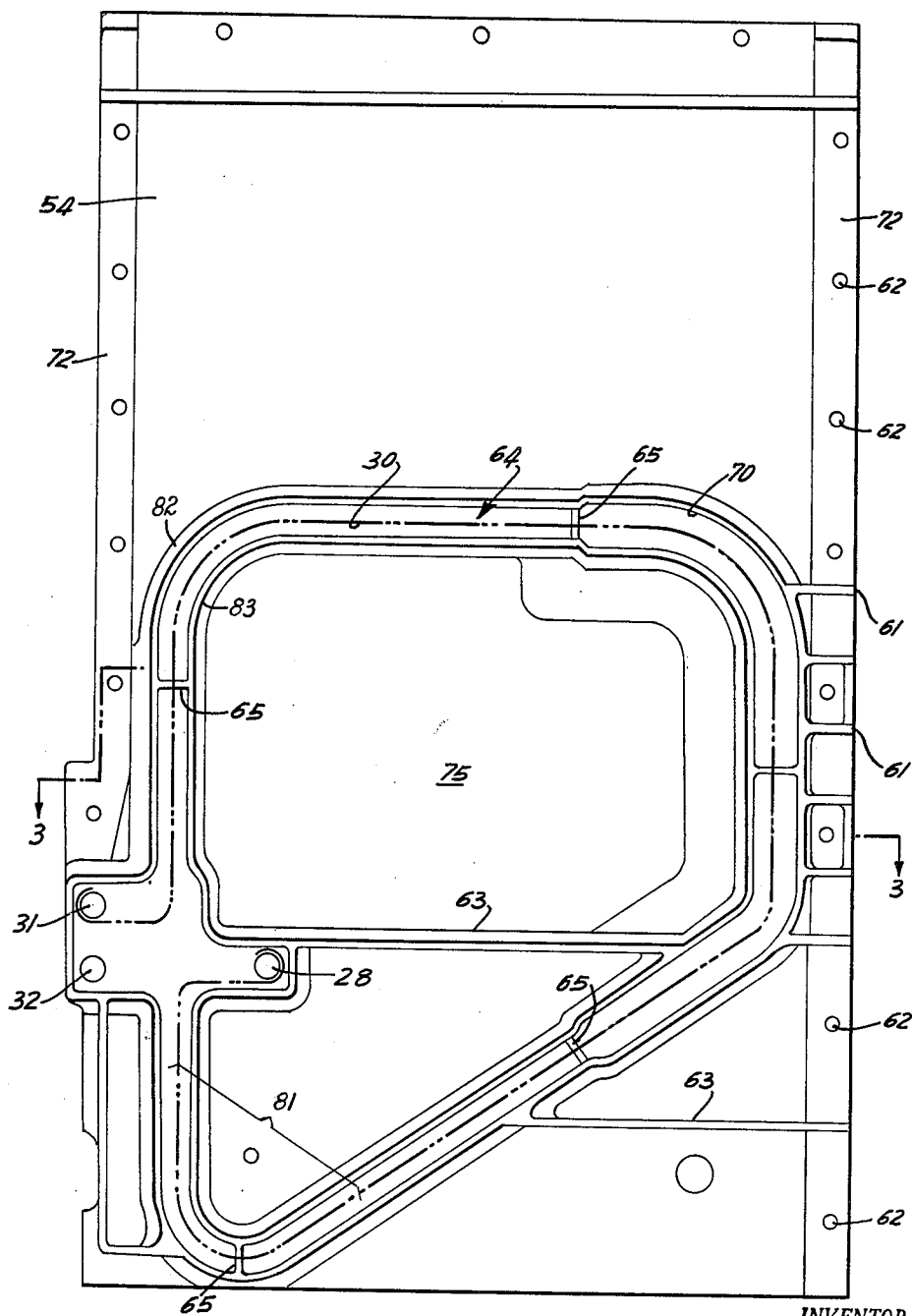


FIG. 2

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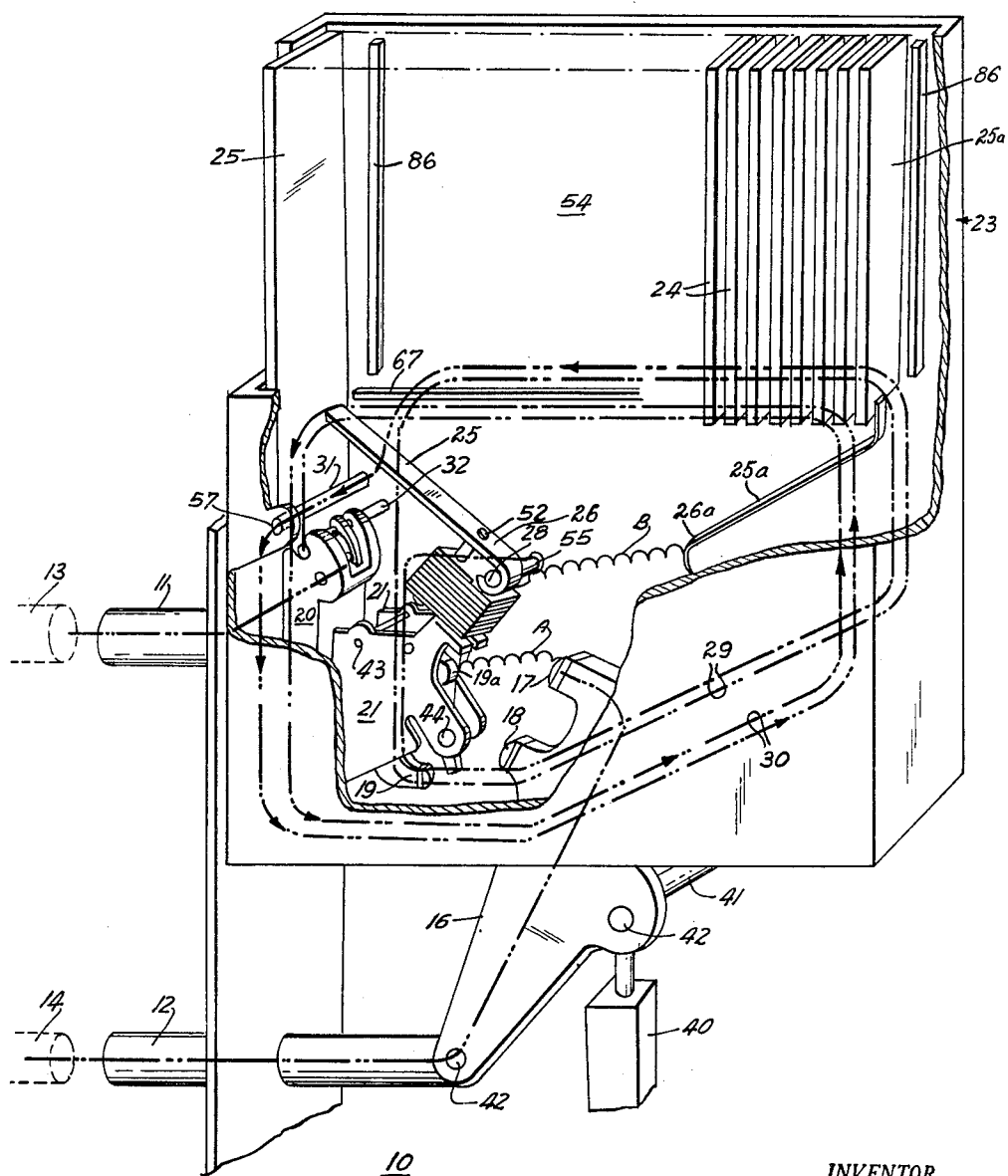
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FIG. 4.

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ARC CHUTE SIDE WITH ENCAPSULATED FACE WOUND BLOWOUT COIL

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4 Claims. (Cl. 200-147)

My invention relates to circuit breakers and more particularly to a circuit breaker arc chute having a novel arrangement for encapsulating a blowout coil.

It is well known in the power distribution field to provide circuit breakers for system protection. Circuit breakers presently in use are designed to interrupt the circuit being protected within a few cycles.

When the contacts of the circuit breaker start to disengage, the voltage drop between the separating contacts causes an arcing condition which delays interruption time, effects the power factor of the system and vaporizes the separating contacts. For this reason circuit breakers have been provided with accompanying arc chutes to cause a rapid extinguishment of the arc.

The arc chutes of the prior art are provided with: blowout means to urge the arc drawn between the beaker contacts deeply into the arc chute; arc plates which subject the arc to a tortuous path for rapid extinguishment of the arc; and arc runners to which the arc is transferred from the separating contacts under the influence of the blowout means. The arc chute must be built to withstand conditions of severe heat and the impact of expanded gases which are generated by the tripping operation of the circuit breaker. The arc chute must also be designed to provide adequate support for the blowout coil, the arc plates and the arc runners. In order to embody these features into the arc chute, prior art devices required separate means for positioning retaining and isolating the blowout coil, the arc plates and the arc runner. The blowout means of the prior art further required U-shaped iron cores to concentrate the magnetic field generated by the blowout coil in the region of the separating breaker contacts. Additional means then had to be included with the arc chute to give the arc chute adequate mechanical strength to withstand the stress imposed on the arc chute. Construction of such arc chutes, therefore, required a great deal of material and expense.

My invention consists of two lightweight shells which, when fastened together, form the arc chute. Each shell is molded of a material having high dielectric and mechanical strength. Integral with the outer face of each shell is an annular shaped trough in which the blowout coil is embedded. A plurality of supporting ribs positioned a spaced distance apart within the trough act to separate the blowout coil from the basin of the trough. An insulating filler material is poured into the trough to cement the coil firmly into place. A plurality of spaced horizontal ribs secured to the outer surfaces of each shell and adjacent the trough lend added mechanical strength to the trough. This added reinforcement is necessary to rigidly secure the blowout coil due to the extremely large magnitude force of the magnetic field generated by the blowout coil during short circuit or overload conditions.

The inner face of each shell contains two spaced parallel ribs which are vertically aligned and integrally mounted to the inner face. The vertically aligned ribs act to position the arc plates of the arc chute. A horizontal ledge integral with the inner face of each shell serves to support the arc plates.

The blowout coils mounted in each trough are electrically connected in series aiding fashion by means of conductive pins, which pins are secured by the inner walls of the shells. The magnetic fields generated by

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the blowout coils aid one another thereby generating a magnetic field of great strength.

The shells are secured to one another by inserting fastening means through vertically aligned apertures on each shell to form a sturdy arc chute housing.

Due to the manner in which the blowout coils are secured in my novel arc chute, there is no need for an iron core for the purpose of concentrating the magnetic field, thus resulting in an arc chute which is lighter in weight and which does not require the mechanical strength that is needed in arc chutes presently in use.

However, iron may be used in my novel arc chute where it is desired to strengthen the magnetic field or to concentrate the magnetic field in a portion of the area described by the blowout coil. Due to the novel configuration of my arc chute the iron may be incorporated into the arc chute without changing the present configuration of the arc chute.

It is, therefore, one object of my invention to provide a novel arc chute requiring fewer parts than arc chutes presently being used.

Another object of my invention is to provide a novel arc chute having face wound blowout coils.

Another object of my invention is to provide an arc chute with a novel means for encapsulating a blowout coil.

Still another object of my invention is to provide an arc chute housing having a novel trough for positioning and securing the blowout means.

Another object of my invention is to provide a novel light-weight arc chute which has great mechanical strength.

These and other objects will become apparent in the following disclosure and drawings of which:

FIGURE 1 is a perspective view of my novel arc chute showing the cooperating shells in disconnected position.

FIGURE 2 is a side plan view of the front shell shown in FIGURE 1.

FIGURE 3 is a cross-section taken along phantom line 3-3 of FIGURE 2.

FIGURE 4 is a schematic view showing the novel arc chute of my invention mounted to a circuit breaker.

FIGURE 5 is a perspective schematic view of my novel arc chute showing the electrical connections of the face-wound blowout coils.

Referring now to FIGURES 1, 2 and 3, the arc chute designated as 23 comprises two shells 53 and 54. The shells 53 and 54 are molded of a material having high dielectric and mechanical strength. The outer face of shell 54 has an irregularly shaped trough 64 formed between portions 82 and 83 which extend outward from the face of plate 54. A blowout coil 30 is seated in the trough as shown in FIGURES 2 and 3. Although coil 30 is shown as having only one turn, it should be understood that a greater number of turns may be used. One terminal of coil 30 is electrically connected to a pin 28, while the other terminal of winding 30 is electrically connected to pin 31. The functions of pin 28 and 31 will be more fully described in connection with FIGURES 4 and 5.

The floor 74 of trough 64 contains a number of supporting ribs 65 which serve to elevate coil 30 a small distance above the floor of trough 64. A filler material 66 (see FIGURE 3) is then poured into the trough. A filler material 66 having excellent insulating and binding characteristics, such as a high dielectric epoxy, is used to rigidly secure winding 30 within trough 64. Reinforcing ribs 61 and 63 which are formed integrally with shell 54 aid trough 64 in rigidly securing coil 30 during the tripping operation. Reinforcing ribs 61 and 63 extend in a horizontal direction as viewed in FIGURES 1 and 2. Coil 30 carries several thousand amperes during an over-

load or short circuit condition which current generates an intense magnetic field. The magnetic field urges coil 30 outward against the outer wall 70 of trough 64. Reinforcing ribs 61 and 63 provide adequate strength to trough 64 to prevent the coil from changing its configuration under the influence of the magnetic field. The outer face of shell 53 has a configuration which is the mirror image of the outer face of shell 54. That is, the outer face of shell 53 contains a trough (not shown in the drawings) having the same shape as trough 64. The outer face of shell 53 also has reinforcing ribs which are mirror images of reinforcing ribs 61 and 63 of shell 54.

Shells 53 and 54 each have a plurality of apertures 62 spaced along outwardly turned flanges 71 and 72, respectively. The apertures 62 of shell 53 are in alignment with the corresponding apertures 62 of shell 54 to permit fasteners such as bolts to be inserted therethrough and secured with associated nuts to form a rigid arc chute housing 23.

FIGURE 3 is a cross-section of shell 54 taken along the line 3—3 of FIGURE 2. FIGURE 3 shows coil 30 positioned in trough 64 and resting on ribs 65, only one of which is shown in FIGURE 3. The filler material 66 is permitted to surround coil 30, thereby supporting and positioning it from the side walls 73 and floor 74 or rib 65 of trough 64. A pair of vertical ribs 86 are positioned along the inner face 75 of shell 54. Ribs 86 position a plurality of spaced parallel arc plates 24 (see FIGURE 4) as will be more fully described. A horizontal ledge 67 which is integral with inner face 75 acts as the support means for the arc plates 24.

The plurality of spaced parallel arc plates 24, as best seen in the schematic view of FIGURE 5, are positioned between the two shells 53 and 54 between the right and left vertical ribs 86, and on the horizontal ledge 67. Thus, shells 53 and 54 prevent the arc plates 24 from moving laterally with respect to the arc chute 23. The vertical ribs 86 limit the movement of the arc plates 24 in the extreme right or left direction, and the horizontal ledge 67, on which the arc plates 24 can rest, limits the downward movement of the plates 24.

Referring now to the schematic views of FIGURES 4 and 5, the arc chute 23 is shown operatively positioned upon a circuit breaker. Arc chute 23 is supported upon a circuit breaker by means of connector pin 32 secured to arc chute 23 and seated in support bracket 20 which bracket is electrically connected to upper terminal 11. The mechanical electrical connecting bracket 20 is described in detail in my copending U.S. application Serial No. 77,433, filed December 21, 1960, entitled Mechanical and Electrical Pivot Between Removable Arc Chute and Stationary Contact Structure, and assigned to the same assignee as the instant application. It should be understood, however, that the arc chute of this application does not rely upon the structure of bracket 20 for its novelty but the bracket 20 is set forth merely as one manner of connecting the arc chute to a circuit breaker.

The circuit breaker consists of main 19 and arcing 19a contacts which are secured to upper terminal 11 by means of side plates 21. A movable bridge 16 is pivotally connected to lower terminal 12 at pivot 42 and operated between its open and closed positions by push rod 40. Mounted upon bridge 16 are butt contacts 18 and 17 which engage main 19 and arcing 19a contacts, respectively, when movable bridge 16 is in the closed position (not shown in the drawings).

Blowout coils 29 and 30 (shown by phantom lines) are embedded in the faces of side walls 53 and 54, respectively, as described in the description of FIGURES 1 and 2. Terminal 55 of blowout coil 29 is electrically connected to conductive pin 28; the ends of pin 28 are embedded in the inner faces of side walls 53 and 54. A rear arc runner 25 having its upper portion secured to arc chute 23 in any well-known manner, is electrically connected to pin 28 at its lower portion 26. The other

terminal 56 of coil 29 is electrically connected to conductive pin 31 the ends of which are secured by the inner walls of faces 53 and 54. Blowout winding 30 embedded in face 54 of arc chute 23 has one terminal 57 electrically connected to pin 31 and the other terminal 58 electrically connected to conductive pin 32 which is secured to arc chute 23 in the same manner as pins 28 and 31 described above. Arc plates 24 are supported by horizontal ledge 67 and are restrained from lengthwise movement by vertical ribs 86. The mounting of arc runners 25, 25a and arc plates 24 plays no part in the novelty of this invention and may be carried out in any well known manner such as, for example, as set forth in U.S. Patent No. 2,761,934 entitled "High Voltage Circuit Breakers" issued September 4, 1956, to J. D. Wood et al. or U.S. Patent No. 2,941,060 entitled "Arc Extinguishing Means for High Voltage Circuit Breakers," issued June 14, 1960, to A. S. Caswell, the assignee of both patents being the same as the assignee of the instant application.

Upon the occurrence of a short circuit or overload condition, movable bridge 16 rotates clockwise about pivot 42 under control of push rod 40. Due to the voltage drop across arcing contacts 17 and 19a, an arc A is formed therebetween. The heat generated by the arc, combined with the blow-off effect causes arc A, which is drawn between arcing contacts 17 and 19a, to transfer to the lower portion 26 of rear arc runner 25 and the lower portion 26a of front arc runner 25a. The arc now assumes position B shown in FIGURE 4.

The current path at this instant is: lower terminal 12, conductive strap 41, arc runner 25a, arc B, conductive pin 28, coil 29, conductive pin 31, coil 30, conductive pin 32, conductive support 20 and upper terminal 11. In tracing this path it can be seen that coils 29 and 30 are connected in serial fashion so that the magnetic fields generated by coils 29 and 30 will aid one another to produce a resultant magnetic field tending to urge the arc B deeply into arc chute 23.

It should be noted that the configurations of blowout coils 29 and 30 are such that a non-homogeneous magnetic field is generated by the coils 29 and 30 during the tripping operation initiated by either an overload or short circuit condition. Referring to FIGURE 2, it can be seen that area 81 within coil 30 forms an acute angle which serves to concentrate a large amount of magnetic flux in this area. It can be seen in FIGURE 4 that this portion of greater flux density is in the immediate region of arcing contacts 17 and 19a. The high density magnetic field generated in the region of arcing contacts 17 and 19a by coils 29 and 30 serves to transfer the arc as shown in position A of FIGURE 4 upward along arc runners 25 and 25a at a very rapid rate.

The arc, under the influence of the magnetic field generated by coils 29 and 30, moves upward along arc runners 25 and 25a into the region of arc plates 24. Arc plates 24 provides a tortuous path for the upward moving arc, causing it to be extinguished very rapidly.

Iron may be used in cooperation with the arc chute in order to strengthen the flux density of the magnetic field generated by the blowout coil. FIGURE 5 shows an iron plate 80 having the configuration of the blowout coil. The iron plate 80 causes the magnetic flux to be concentrated in the lower half of the blowout coil loop thus increasing the magnetic force impressed upon an arc drawn in the region of separating contacts 17 and 19a causing the arc to be urged rapidly into the arc chute 23. The iron plate 80 may be mounted to the arc chute 23 by placing iron plate 80 in the area 81 (see FIGURES 1 and 2) between the trough 64 and rib 63. The iron is rigidly held in place by using filler material (not shown) of the same type used to encapsulate blowout windings 29 and 30. An iron plate may also be mounted on the outer face of side wall 53 of the arc chute 23. The filler material avoids the need for bolts or other fastening means.

It can be seen from the foregoing description that I have provided an arc chute which is simple in design and which requires fewer parts, thereby simplifying its fabrication and reducing its cost of production. The novel manner in which the blow-out coils are positioned and secured completely avoids the need for the iron core guide paths necessary in the prior art.

Although I have described preferred embodiments of my novel invention, many variations and modifications will now be obvious to those skilled in the art, and I prefer therefore to be limited not by the specific disclosure herein but only by the appended claims.

I claim:

1. An arc chute for interrupting an electric arc comprised of a pair of shells; each of said shells being made of a material having high dielectric strength and having a plurality of apertures spaced along its perimeter; fastening means inserted through said apertures for securing said shells to one another to thereby form a partially enclosed substantially rectangular housing; each of said shells having an inner and outer face; said outer faces of each of said shells having first and second extending portions projecting outward from said outer face of said shells; said first and second extending portions forming an annular shaped trough therebetween; blowout means for urging an electric arc into said housing; said blowout means including first and second coils each having at least one turn; said first coil being positioned in said trough of one of said shells and said second coil being positioned in said trough of the other of said shells; each of said coils formed to generate magnetic flux in both the region of cooperating contacts and substantially the entire region of said arc chute; said inner face of each of said shells having a pair of spaced parallel ribs vertically aligned in said shell; a plurality of spaced parallel arc plates; said arc plates being positioned between said ribs and within the housing formed by said pair of shells; filler material contained in each of said troughs to rigidly secure said coils to their associated said shells.

2. The device of claim 1 having a horizontal ledge on said inner face of said shells for supporting said arc plates within said housing.

3. An arc chute for interrupting an electric arc comprised of a pair of shells; each of said shells being made of a material having high dielectric strength and having a plurality of apertures spaced along its perimeter; fastening means inserted through said apertures for securing said shells to one another to thereby form a partially enclosed substantially rectangular housing; each of said shells having an inner and outer face; said outer faces of each of said shells having first and second extending portions projecting outward from said outer face of said shells; said first and second extending portions

forming an annular shaped trough therebetween; blow-out means for urging an electric arc into said housing; said blowout means including first and second coils each having at least one turn; said first coil being positioned in said trough of one of said shells and said second coil being positioned in said trough of the other of said shells; each of said coils formed to generate magnetic flux in both the region of cooperating contacts and substantially the entire region of said arc chute; filler material contained in each of said troughs to rigidly secure said coils to their associated shells; said annular shaped trough forming a depressed area at the lower portion thereof on said outer face of said shells; an iron plate; said iron plate positioned in said depressed area to strengthen the flux density of the magnetic field generated by said first and second coils; filler material contained in said depressed area to rigidly secure said iron plates.

4. In combination, a pair of cooperating contacts; an arc chute positioned to interrupt an electric arc drawn between said pair of cooperating contacts upon separation thereof; said arc chute comprising a partially enclosed housing; blowout means on said housing operatively positioned for urging said arc into said arc chute; said blowout means including a coil having a configuration to generate a non-homogeneous magnetic field; an outer surface of said housing having first and second extending portions projecting outward from said outer surface of said housing; said first and second extending portions forming an annular shaped trough therebetween for securing said coil to the said outer surface of said housing and for positioning said coil to generate a magnetic field in the region of both said cooperating contacts and substantially the entire region of said arc chute and further to concentrate the portion of said magnetic field having the greatest flux density in the immediate region of said cooperating contacts to transfer said arc rapidly from said cooperating contacts to said arc chute; filler material contained in said trough to rigidly secure said coil to said housing; an iron plate positioned within the inner periphery defined by said trough for concentrating the magnetic field generated by said coil in the region of said cooperating contacts; filler material contained in the region defined by the inner periphery of said trough to rigidly secure said iron plate to said housing.

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