June 21, 1960 E. W. BOEHNE 2,942,084

CIRCUIT BREAKER EMPLOYING PERFORATED FLUE MEANS ADJACENT ARC RUNNERS

Filed Aug. 30, 1957 2 Sheets-Sheet 1

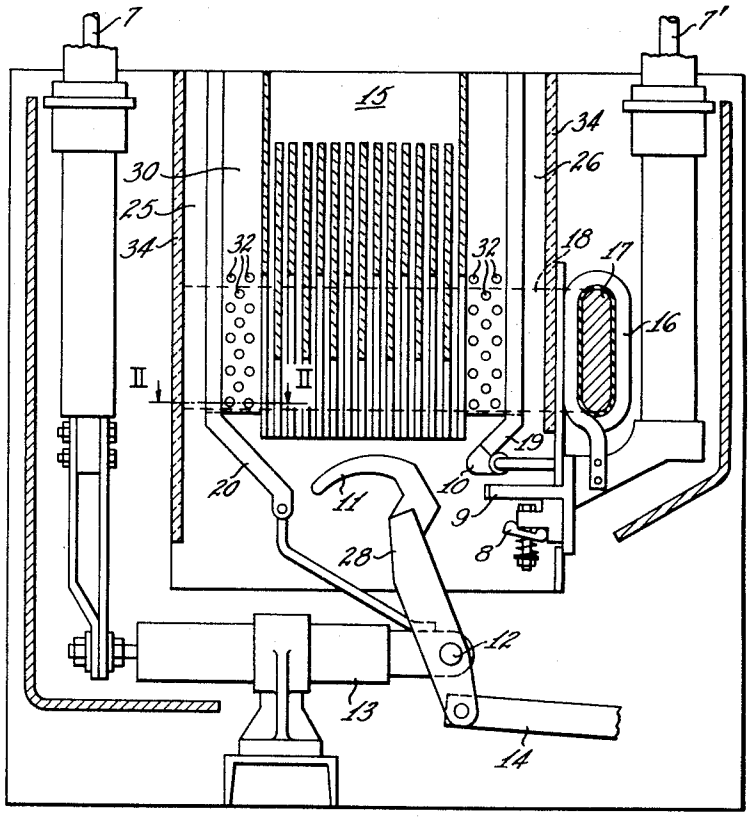

Fig. 1

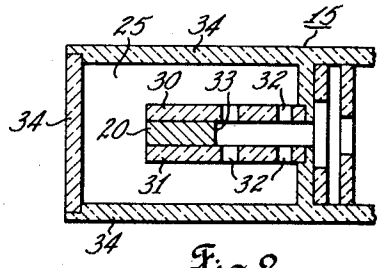

Fig. 2

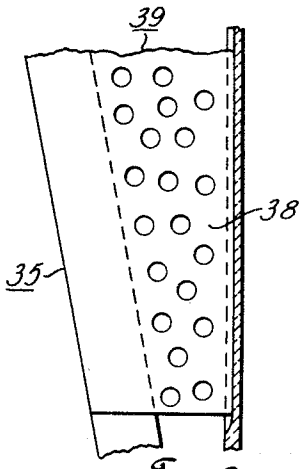

Fig. 3

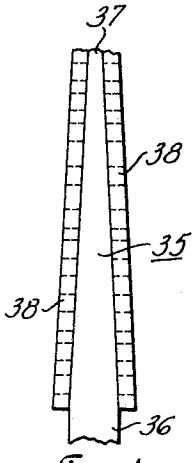

Fig. 4

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CIRCUIT BREAKER EMPLOYING PERFORATED FLUE MEANS ADJACENT ARC RUNNERS

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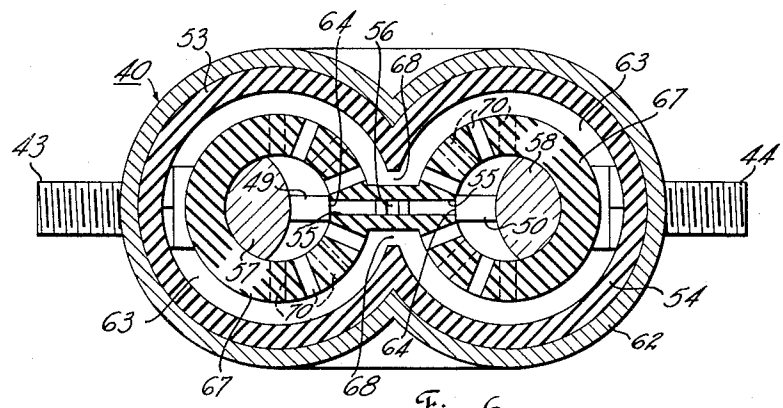

Fig. 6

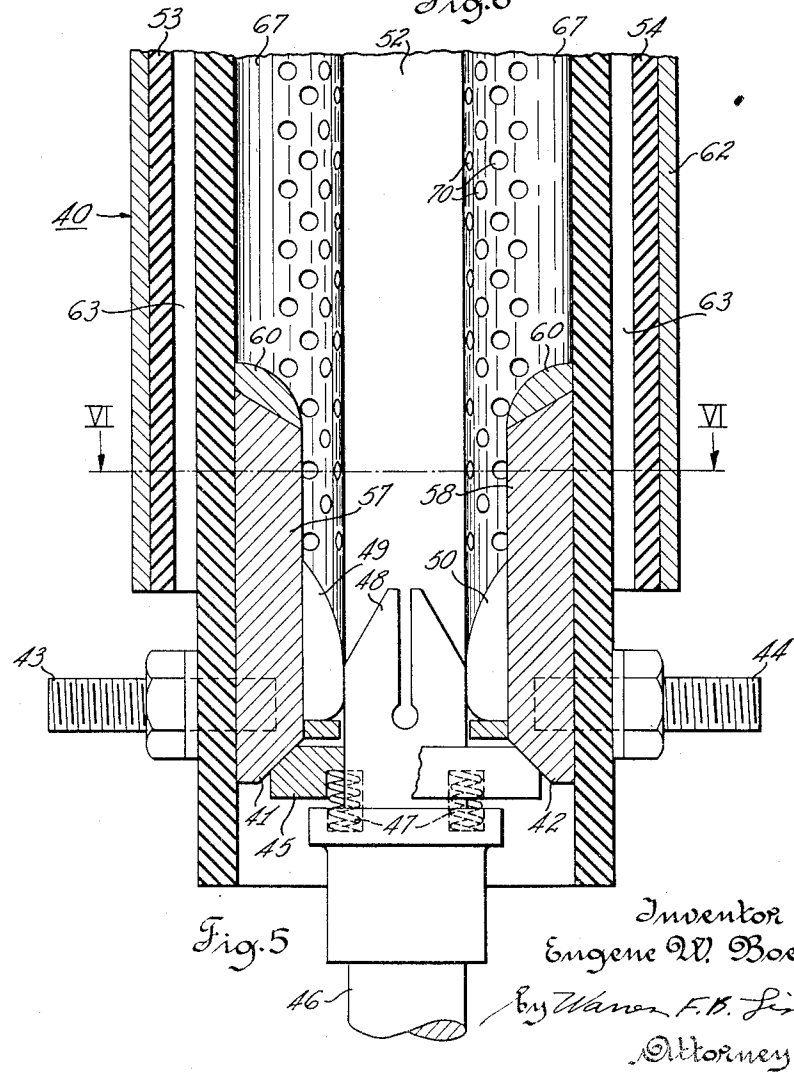

Fig. 5

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CIRCUIT BREAKER EMPLOYING PERFORATED FLUE MEANS ADJACENT ARC RUNNERS

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This invention relates to electric circuit interrupting devices, and more particularly to air circuit breakers of the magnetic blowout type.

It has been known for some time that arc vapor is one of the worst enemies in the performance of alternating or direct current circuit breakers. Vaporized metal in the arc stream tends to maintain and stabilize the arc thus hindering its interruption. In view of the fact that the metallic contents of the arc stream depend principally upon metal vapors or particles derived from the arc runners, it is important that the ends of the arc in contact with the arc runners be kept moving continuously in order to avoid heat concentrations and the consequent high vaporizing action. Inasmuch as arcs effect a vaporizing action of the material used in the construction of an arc extinguishing device and since such vaporization tends to cause reignition of the arc at the contacts, resulting in failure to interrupt the arc at an early current zero and restriking of the arc at the exhaust end of the arc chute it is desirable to not only control the amount of metallic vapors but also its movement through the arc chute structure.

In accordance with the invention claimed, a new and improved compact circuit breaker structure is provided comprising a pair of relatively movable contacts, means for separating the contacts to initiate and elongate an arc therebetween, means for transferring the path of the arc from the region of arc initiation to a region beyond, and flue means enclosing at least a part of the transfer means for exhausting to atmosphere the products of arcing. The flue means comprises an apertured wall arranged adjacent the transfer means for providing a path for the products of arcing from the transfer means into the flue means.

It is, therefore, one object of the present invention to provide a new and improved arc interrupting device.

Another object of this invention is to provide a new and improved arc interrupting device in which the products of arcing are confined before they break down the dielectric strength of the air between the arc runners.

A further object of this invention is to provide a new and improved arc interrupting device in which the metallic vapors generated by the arc terminals are expelled through the walls of an adjacently arranged flue means to the interior thereof for exhaustion to atmosphere.

A still further object of this invention is to provide a new and improved arc interrupting device in which a spaced perforated flue means partly surrounding an arc runner collects, cools and exhausts to atmosphere the products of arcing.

Objects and advantages other than those 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 vertical cross section of a magnetic blowout type of circuit breaker employing the present invention;

Fig. 2 is an enlarged cross sectional view through one of the arc runner and flue means structures of Fig. 1 taken along the line II—II;

Fig. 3 is an enlarged partial front view of a modification of the arc runner and flue means structure illustrated in Figs. 1 and 2;

Fig. 4 is a right end view of Fig. 3;

Fig. 5 is a view in vertical cross section of another circuit breaker structure employing the present invention; and

Fig. 6 is a cross sectional view through the circuit breaker structure of Fig. 5 taken along the line VI—VI.

Referring more particularly to the drawings by characters of reference, Fig. 1 illustrates magnetic blowout type of circuit breaker including as elements thereof a pair of terminal studs 7 and 7^1 for connecting the circuit breaker to line conductors (not shown).

Although in general, circuit breakers of the type considered in Figs. 1 and 2 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 drawings and the circuit breaker will be described in detail as if it were 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 8 and tertiary contact 9, a fixed arcing contact 10, and a movable contact 11 comprising current carrying, tertiary, and arcing contacts combined in a single structure. Arcing contact 11 is mounted on a lever 28 which is pivotally mounted at 12 on an extension 13 of the circuit breaker stud 7 and is operated by means of a reciprocally movable rod 14. The operating rod 14 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 11 in an intermediate position. The arcing contacts are electrically connected to the lower ends of terminal studs 7 and 7^1. 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 15 may be mounted so as to receive the power arc which is under the influence of the magnetic blowout means. The arc chute containing a stack of spaced plates of insulating material having inverted V-shaped slots defining an arc constricting groove 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 comprises a core 17, poles 18, and a coil 16 which is electrically connected to the terminal stud 7^1 and to a metallic arc runner 19 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 the spring biased contact 8. As the movable arcing contact 11 is actuated to open circuit position, current is shunted from fixed contact 8 to fixed contact 9, to fixed arcing contact 10. As the arc is drawn by the movable arcing contact 11, the arc terminal on arcing contact 10 is transferred to arc runner 19 which is usually an extension arm of the fixed arcing contact 10. As the movable arcing contact 11 approaches or reaches its full opening stroke the arc terminal transfers from the movable arcing contact 11 to an arc runner 20 which directs the arc into the arc chute 15. One end of the blowout coil 16 is connected to the arcing contact 10 and the other end to tertiary contact 9. When the

movable arcing contact 11 parts from contact 9, the flow of current is transferred from contact 9 to contact 10 through the blowout coil 16. The movable arcing contact 11 subsequently parts from contact 10 to draw an arc. Accordingly, the blowout coil is already energized at the inception of the arc to influence the arc in a well known manner, i.e., to drive it into the arc chute 15 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 18 so as to cooperate with the blowout coil in the conventional manner outside of the arc chute.

In accordance with the invention claimed, two flue means 25 and 26 are arranged to extend substantially coextensive with at least a part of each of the arc runners 19 and 20, respectively, for reducing the free flow of the products of arcing from the arc runners in the general direction of the arc path. Flue means 25, 26 may, for example, comprise self-contained chimneys which are arranged to extend adjacent to but spaced from arc runners 19 and 20 a small predetermined distance. As noted from Figs. 1 and 2 of the drawings the flue means 25, 26 each comprise inner walls 30 and 31 having formed therein a plurality of perforations or apertures 32 and outer walls 34. Walls 30, 31 and 34 are arranged to extend along the longitudinal axis of arc runners 19 and 20 one adjacent each arc runner. Fig. 2 clearly illustrates that the flue means are separate and distinct from the arc runners and substantially enclose at least a part of the arc runners over substantially the entire length thereof except for their surfaces 33 which form the path for movement thereover of the arc terminals.

Flue means 25, 26 are shown arranged on the ends of the stack of barrier plates forming a part of arc chute 15 although they may be arranged any place in the circuit interrupter adjacent to the arc transfer means usually called arc runners. Arc runners 19 and 20 may be of any flat or tapered design flanked by walls 30 and 31 of flue means 25 and 26, respectively.

Fig. 2 illustrates that flue means 25, 26 may be accurately curved around the arc runners so that any products of arcing emitted from the arcing surfaces 33 will be immediately exhausted along a path through the apertures 32 in walls 30 and 31 of flue means 25, 26 into the chimney and expelled to atmosphere. The chimney effect of flue means 25, 26 forces the products of arcing out of the circuit interrupter without passing through the barrier plates of the arc chute structure. The number and spacing of the apertures 32 in walls 30 and 31 of flue means 25, 26 is a matter of choice and applicant intends to have covered by the claims of this disclosure any workable geometrical configuration.

Figs. 3 and 4 illustrate a modification of the arc runner and flue means structure illustrated in Fig. 1 wherein the arc runner 35 is tapered in a converging manner from its upstream end 36 to its downstream end 37. The wall 38 of flue means 39 diverges from the upstream end to the downstream end of the flue means with the number of apertures in wall 38 increasing in the downstream direction.

Figs. 5 and 6 illustrate another type of circuit interrupting device 40 embodying the invention comprising a pair of stationary current carrying contacts 41 and 42 connected to live terminals 43 and 44, respectively. Stationary contacts 41 and 42 are adapted to be bridged by movable current carrying contacts 45 mounted on a movable operating rod 46. Suitable springs 47 may be provided between rod 46 and movable current carrying contact or bridging member 45 to give the desired contact wipe. Preferably the circuit breaker is provided with arcing contacts comprising a movable arcing contact 48 adapted to engage stationary arcing contacts 49 and 50.

The circuit interrupting device 40 further comprises an arcing chamber 52 comprising a pair of insulating tubular expulsion tubes or enclosures 53, 54. Enclosures

53, 54 are arranged closely adjacent each other in parallel relationship. Each of the enclosures is provided with a narrow, longitudinally extending slot 55. The slot in one enclosure, such as enclosure 53, for example, is arranged to face the slot in the enclosure 54 and to be substantially coplanar therewith so as to define a narrow arc extinguishing passageway 56 between enclosures 53 and 54. As shown in Fig. 6, the width of the longitudinally extending slot 55 is materially less than the width of the opening in enclosures 53 and 54. This passageway is bound by insulating material which may be of the gas evolving type.

In order to accelerate the transfer of the arc drawn at the lower end of the passageway 56 into the circuit interrupting structure arc runners 57 and 58 are arranged in the tubular enclosures 53 and 54. Arc runners 57 and 58 may be integrally formed with their associated stationary current carrying contacts 41 and 42 and stationary arcing contacts 49 and 50 and arranged to extend longitudinally of enclosures 53 and 54. If desired the arc runners may be provided with tips of arc resistant material 60. As noted from the drawings the arc is established near one end of the tubular enclosures between a point on the arc runner or the contacts integral therewith and a point on movable arcing contact 48 external to the enclosure and is extended through slot 55.

For the purpose of producing a magnetic field in the arc space within the tubular enclosures 53 and 54 for assisting electromagnetically the rapid movement upward of the arc in the enclosures, a tube of magnetic material 62 may be arranged to surround each enclosure. Tubes 62 are provided with slots corresponding to the slots in the enclosures 53 and 54 in order to accommodate passageway 56 therebetween.

In accordance with the invention claimed a flue means 63 is arranged within each of the enclosures and is spaced from and substantially surrounds at least a part of arc runners 57 and 58 except for their arcing surfaces 64. Each flue means 63 comprises an apertured wall 67 arranged immediately adjacent the arc runners and the inside walls of the enclosures 53 and 54. As shown in Fig. 6 the flue means 63 are interconnected forming a single chimney structure, however, it is intended to be within the scope of this invention to form two isolated flue means if so desired. This can be readily accomplished by extending the outer walls of the enclosure 54 into fixed engagement with the insulating outer portion of passageway 56 at points 68.

The structure of Figs. 5 and 6 operate in the same general manner as the structures of Figs. 1–4, inclusive. The flue means are intended to exhaust the products of arcing immediately after they have been created through apertures 70 in walls 67 and then expel them to atmosphere. In this manner the products of arcing created at and near the arcing surfaces of the arc runners cannot contaminate the other portions of the interrupting device.

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 without departing from the spirit of the invention or from the scope of the appended claims.

What is claimed is:

1. An electric circuit interrupter comprising a pair of relatively movable cooperating arcing contacts, means for separating said contacts to initiate and elongate an arc therebetween, an arc chute for receiving the arc at one end thereof, an arc runner arranged outside of said arc chute for transferring the path of said arc from the region of arc initiation to a region within said chute, and flue means spaced from and laterally surrounding at least a part of said runner over substantially its entire length for exhausting to atmosphere the products of arcing, said flue means comprising an apertured wall arranged adjacent

said runner for providing a path for the products of arcing from said runner into said flue means.

2. An electric circuit interrupter comprising a pair of relatively movable cooperating arcing contacts, means for separating said contacts to initiate and elongate an arc therebetween an arc chute for receiving the arc at one end thereof, a pair of spaced arc runners arranged outside of said chute for transferring the path of said arc from the region of arc initiation to a region within said chute, and a pair of flue means separate from said arc chute and said runners, each of said flue means at least partly surrounding laterally a different one of said runners for exhausting to atmosphere the products of arcing and comprising an apertured wall arranged adjacent said runners for directing the products of arcing from said surface into said flue means.

3. An electric circuit interrupter comprising a pair of relatively movable cooperating arcing contacts, means for separating said contacts to initiate and elongate an arc therebetween, an arc chute for receiving the arc at one end thereof, a pair of spaced arc runners arranged outside of said chute for transferring the path of said arc from the region of arc initiation to a region within said chute, said runners each comprising a surface forming the path for said arc, and a pair of flue means separate from but each laterally surrounding all of a different one of said runners except said surface over substantially its entire length for exhausting to atmosphere the products of arcing, said flue means comprising an apertured wall arranged adjacent said surface for directing the products of arcing from said surface into said flue means.

4. An electric circuit interrupter comprising an expulsion tube of insulating material, means defining a narrow slot in said tube extending longitutudinally thereof, an arc runner arranged within said tube, means for establishing near one end of said tube an arc between a point on said runner and a point external to said tube and moving said arc through said slot, and flue means arranged within said tube and spaced laterally from said runner for exhausting to atmosphere the products of arcing, said flue means comprising a wall having a plurality of apertures arranged adjacent said arc runner for providing a path for the products of arcing from said runner into said flue means.

5. An electric circuit interrupter comprising an expulsion tube of insulating material, means defining a narrow slot in said tube extending longitudinally thereof, an arc runner arranged within said tube, means for establishing near one end of said tube an arc between a point on said runner and a point external to said tube, and flue means coaxially arranged within said tube and spaced laterally from said runner for exhausting to atmosphere the products of arcing, said flue means comprising a wall having a plurality of apertures arranged adjacent said runner for providing a path for the products of arcing from said runner into said flue means.

6. An electric circuit interrupting device comprising a pair of expulsion tubes of insulating material arranged adjacent one another, means defining a slot in each tube extending longitudinally thereof, said tubes being positioned with their slots opposed, insulating means for providing between said tubes a longitudinally enclosed passageway interconnecting said slots, a pair of arc runners one arranged within each of said tubes, means for establishing near one end of said tubes an arc and transferring the terminals of said arc one to each of said runners, and a pair of flue means one arranged within each of said tubes and being spaced laterally from and surrounding said runners for exhausting to atmosphere the products of arcing, each of said flue means comprising a wall having a pluarlity of apertures arranged adjacent one of said runners for providing a path for the products of arcing from said one of said runners into said flue means.

7. An electric circuit interrupting device comprising a pair of expulsion tubes of insulating material arranged adjacent one another, means defining a slot in each tube extending longitudinally thereof, said tubes being positioned with their slots opposed and substantially coplanar, insulating means for providing between said tubes a longitudinally enclosed passageway interconnecting said slots, a pair of arc runners one arranged within each of said tubes, means for establishing near one end of said tubes an arc and transferring the terminals of said arc one to each of said runners, and a pair of flue means for exhausting to atmosphere the products of arcing, one of said flue means being arranged within each of said tubes and around one of said arc runners, each of said flue means comprising a pair of spaced coaxially arranged tubular walls, each of said arc runners being arranged within the inner wall of one of said flue means, said inner wall of said one of said flue means being provided with a plurality of apertures arranged adjacent one of said arc runners for providing a path for the products of arcing from said one of said arc runners into the space between said coaxially arranged walls.

8. An electric circuit interrupting device comprising a pair of expulsion tubes of insulating material arranged adjacent one another, means defining a slot in each tube extending longitudinally thereof, said tubes being positioned with their slots opposed and substantially coplanar, insulating means for providing between said tubes a longitudinally enclosed passageway interconnecting said slots, a pair of arc runners one arranged within each of said tubes, means for establishing near one end of said tubes an arc and transferring the terminals of said arc one to each of said runners, and a pair of flue means for exhausting to atmosphere the products of arcing, one of said flue means being coaxially arranged within each of said tubes and around one of said arc runners, each of said flue means comprising a pair of spaced coaxially arranged tubular walls, each of said arc runners being arranged within the wall of one of said flue means, at least a part of said inner wall of each of said flue means being laterally spaced from said one of said arc runners and provided with a plurality of apertures for providing a path for the products of arcing from said arc runners into the space between said coaxially arranged walls.

9. An electric circuit interrupter comprising a pair of relatively movable cooperating arcing contacts, means for separating said contacts to initiate and elongate an arc therebetween, an arc chute for receiving the arc at one end thereof, an arc runner arranged outside of said chute for transferring the path of said arc from the region of arc initiation to a region within said chute, said runner comprising a surface forming the path for said arc, and a tubular flue means having spaced inner and outer walls, said inner wall of said flue means comprising a pair of spaced leg portions and a yoke portion, said surface of said arc runner forming at least a part of the surface of said yoke portion of said inner wall, said leg portions of said inner wall providing a plurality of apertures adjacent said runner for providing a path for the products of arcing from said runner into the space between said walls.

10. An electric circuit interrupter comprising a pair of relatively movable cooperating arcing contacts, means for separating said contacts to initiate and elongate an arc therebetween, an arc chute for receiving the arc at one end thereof, a pair of arc runners arranged outside of said chute for transferring the path of said arc from the region of arc initiation to a region within said chute, said runners each comprising a surface forming the path for said arc, and a pair of tubular flue means each having spaced inner and outer walls defining a U-shaped cross section, each of said walls of said flue means comprising a pair of spaced leg portions and a yoke portion, said surface of said arc runners forming at least a part of the surface of said yoke portion of said inner walls facing said leg portions, said leg portions of said inner walls providing a plurality of apertures adjacent said runners

for providing a path for the products of arcing from said runners into the space between said walls.

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