Dec. 31, 1940. E. HARA 2,227,134

ELECTRIC CIRCUIT INTERRUPTER

Filed Dec. 20, 1938

Fig. 1.

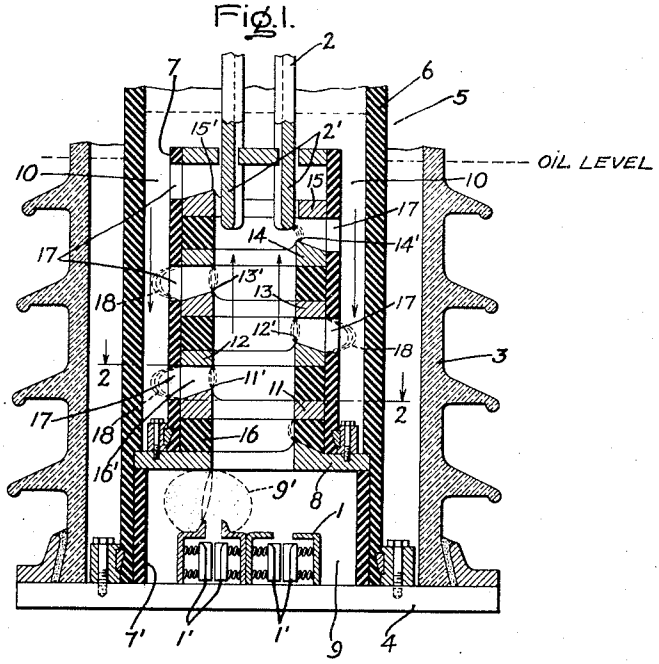


Fig. 2.

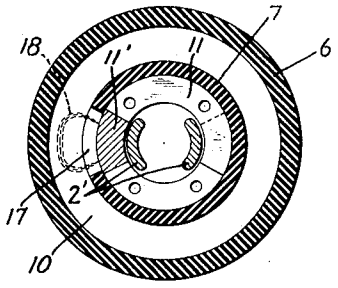
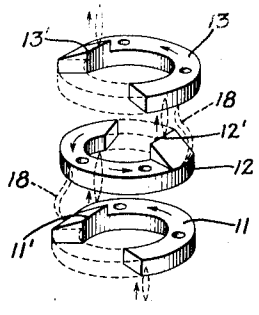


Fig. 3.



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ELECTRIC CIRCUIT INTERRUPTER

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7 Claims. (Cl. 200—150)

My invention relates to electric circuit interrupters, more particularly to those of the multiple break type and has for its principal object the provision of an improved circuit interrupter that is effective to utilize magnetic forces of the arc current for aiding arc interruption at a plurality of breaks.

A more specific object of my invention is the provision of magnetic blow-out means in a circuit interrupter of the character above referred to in combination with another arc extinguishing agent, such as a fluid or oil blast for example.

In accordance with my invention an arc interrupting device is constituted of a plurality of spaced conductors so arranged as to be interconnected adjacent the extremities thereof by sections of the arc that is formed upon opening of the circuit. The conductors which are preferably of arcuate or horseshoe shape establish with said arc sections an electric circuit of generally helical form so that the magnetic flux produced by the helical circuit may intersect said arc sections to establish a magnetic blow-out action.

My invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawing, Fig. 1 is an elevational view, partly in section of an electric circuit breaker of the fluid blast multiple break type embodying my invention; Fig. 2 is a plan view taken along the sectional line 2—2 of Fig. 1; and Fig. 3 is a detailed perspective view of part of the arcuate conductors shown in Fig. 1 for establishing with the serially related arc sections a generally helical current path.

The circuit breaker illustrated by Fig. 1 is of the so-called oil blast type and comprises arc forming means such as separable contacts including a fixed contact structure 1 and movable rod contact structure 2. The fixed contact 1 includes spring-biased contact segments 1' for coating with the bifurcated end 2' of the rod contact. The contacts 1 and 2 are suitably connected to the breaker terminals, not shown.

The contacts are normally immersed in an arc extinguishing liquid, such as oil, contained within the insulating casing 3. The casing 3 which is of a ceramic material such as porcelain, is closed at its lower end by a metallic terminal base plate 4 which supports both the fixed contact structure and an arc extinguishing device generally indicated at 5 through which the movable contact 2 operates. The arc extinguishing device comprises a pair of concentrically disposed insulating cylinders 6 and 7, the inner cylinder 7 being supported by a sleeve 7' and metallic plate 8 a predetermined distance from the base plate 4 to form an arc chamber 9. The cylinder 7 is likewise spaced from the inner walls of the cylinder 6 to form venting passages 10 for the arc gases formed during circuit interruption.

For the purpose of providing multiple breaks within the interrupting device 5 and for interrupting the arcs at said breaks, there is provided a plurality of horseshoe-like conductors 11, 12, 13, 14 and 15 spaced longitudinally along the arc path, that is, the path of movement of the movable contact 2. As illustrated by Fig. 3, the spaced conductors are in superposed relation along and enclose the arc path so that the discontinuous portions are staggered with respect to opposite sides of the arc path. That is, the broken-away portion of one arcuate or horseshoe conductor is positioned above the continuous part of the conductor beneath the same. The arcuate conductors are positioned within the cylinder 7 by means of insulating spacing rings 16.

It will, therefore, be apparent from the above description that as the arc initially formed between the contacts 1 and 2 is lengthened, the arc will transfer automatically to the closely adjacent conductors along the side walls of the contact passage so that the arc is divided into a number of serially related sections. That is, in the position shown, the arc sections will form progressively between fixed contact 1 and conducting plate 8, plate 8 to conductor 11, conductor 11 to conductor 12, and so on to the final section between conductor 15 and the contact 2.

For the purpose of insuring formation of the arc sections between the extremities of adjacent conductors so as to establish a substantially helical composite path of arc sections and arcuate conductors for the arc current, the conductors as best illustrated by Fig. 3 are provided with arcing portions or tips 11', 12', and 13', etc. respectively, for shortening the arc path at those points. It will, therefore, be clear that the arcuate conductors, when interconnected by the arc sections as diagrammatically illustrated by Fig. 3, form a current path as indicated by the directional arrows that is generally helical in form. Accordingly, the well-known magnetic loop effect that is inherent in a coil of helical shape tends to extend and blow out the serially related arc sections.

The magnetic blow-out effect is preferably augmented by another arc extinguishing agent such as an oil blast, and to this end the cylinder 7 is provided with pressure relief or exhaust ports 17 opposite the respective arcing tips 11', etc. The insulating spacing rings 16 are also cut away at 16' so as to register with the exhaust ports 17. Accordingly, as the arc is initially drawn at 9' within the chamber 9, the arc pressure established therein tends to blast the arc sections as they are formed outwardly through the exhaust ports 17, as diagrammatically illustrated. As each arc section is looped outwardly, the magnetic effect due to the helical circuit is further increased since the upper and lower parts of the arc loop will both intersect the flux produced by the helical circuit. This in turn produces a twisting action on the arc, diagrammatically illustrated at 18 in Fig. 3, which also tends to extinguish the same in combination with the fluid blast. The fluid blast can obviously be created by piston means or the like and, therefore, need not be dependent on the arc energy.

It should be understood that my invention is not limited to specific details of construction and arrangment thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of my invention. For example, the arc-drawing means can obviously assume various forms. As an illustration, the arcuate conductors can be relatively movable so as to form the serially related arc sections above referred to independently of a movable contact such as 2.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an electric circuit interrupter, means for forming an arc and a plurality of conductors spaced along and around the longitudinal axis of said arc for dividing the same into sections, said conductors being so arranged with respect to each other and said arc sections that the composite arc current path follows the form of a helix, said arc sections being at the outer side of said helix whereby said arc sections are subjected to a magnetic blow-out in a direction substantially tranversely of the longitudinal axis of said helix.

2. In an electric circuit interrupter, means for forming an arc and a plurality of arcuate conductors positioned between the extremities of and around said arc in superposed relation, said arcuate conductors being arranged to divide said arc into sections and to form with said arc sections a substantially helical composite path for the arc current whereby said arc sections are subjected to magnetic forces of the arc current in a direction substantially transversely of the longitudinal axis of said helix.

3. In an electric circuit interrupter, means for forming an arc and a plurality of arcuate conductors individually spaced along the longitudinal axis of said arc so as substantially to surround said arc forming means, said conductors being insulated from each other and arranged to divide said arc into sections so as to form with said arc sections a substantially helical path for the arc current.

4. In an electric circuit interrupter, means for forming an arc and a plurality of arcuate conductors spaced along the longitudinal axis of said arc, said arcuate conductors substantially surrounding said arc forming means and having the discontinuous portions thereof staggered with respect to opposite sides of said longitudinal axis, said arc forming means being arranged to transfer the arc to said arcuate conductors for dividing the arc into a plurality of sections whereby said sections form with said arcuate conductors a substantially helical path for utilizing for arc interruption magnetic forces of the arc current.

5. In an electric circuit breaker, separable contacts between which an arc is drawn upon opening of the circuit, and a plurality of spaced arcuate conductors arranged to form around the longitudinal axis of said arc a discontinuous conducting path approaching the form of a helix, said arcuate conductors having arcing portions adjacent said discontinuous sections to which the arc is transferred by said separable contacts for dividing said arc into a plurality of sections, said arc sections forming with said arcuate conductors a composite path of helix-like form for the arc current whereby said arc sections are subjected to magnetic blow-out forces of the arc current in a direction substantially transversely of the longitudinal axis of said helix.

6. An electric circuit breaker comprising separable contacts, arc interrupting structure associated with said contacts comprising an insulating arc chamber in which the arc is drawn upon separation of said contacts, a plurality of individual conductors disposed within said casing and adjacent the arc path so as to approach the form of a helix having a longitudinal axis substantially parallel to said arc path, said conductors dividing the arc into a plurality of sections between said conductors, said sections forming with said conductors a substantially helical path for the arc current whereby said arc sections are subjected to magnetic blow-out forces, said casing having openings adjacent said arc sections respectively for permitting lateral extension of the separate arcs, and means for creating fluid pressure within said casing for aiding extension of said separate arcs at said openings.

7. An electric circuit breaker comprising separable contacts, arc interrupting structure associated with said contacts comprising an insulating pressure confining arc chamber, a plurality of arcuate conductors spaced in superposed relation along the arc path formed upon separation of said contacts so as substantially to surround said arc path, means for separating and insulating said arcuate conductors from each other, the discontinuous portions of said arcuate conductors being staggered with respect to opposite sides of said arc path, arcing tips connected to said conductors at said discontinuous portions to which the arc is transferred from said contacts so that the arc is divided between said conductors into a plurality of arc sections, pressure relief ports in said arc chamber opposite said arcing tips, said arc sections forming with said conductors a path of generally helical form whereby magnetic forces of the arc current tend to produce magnetic blow-out action at said arc sections, and means for creating fluid pressure within said arc chamber tending in addition to expel said arc sections through said ports.

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