March 10, 1931. W. E. PAUL 1,796,160

CIRCUIT INTERRUPTER

Filed July 23, 1926

Fig. 1.

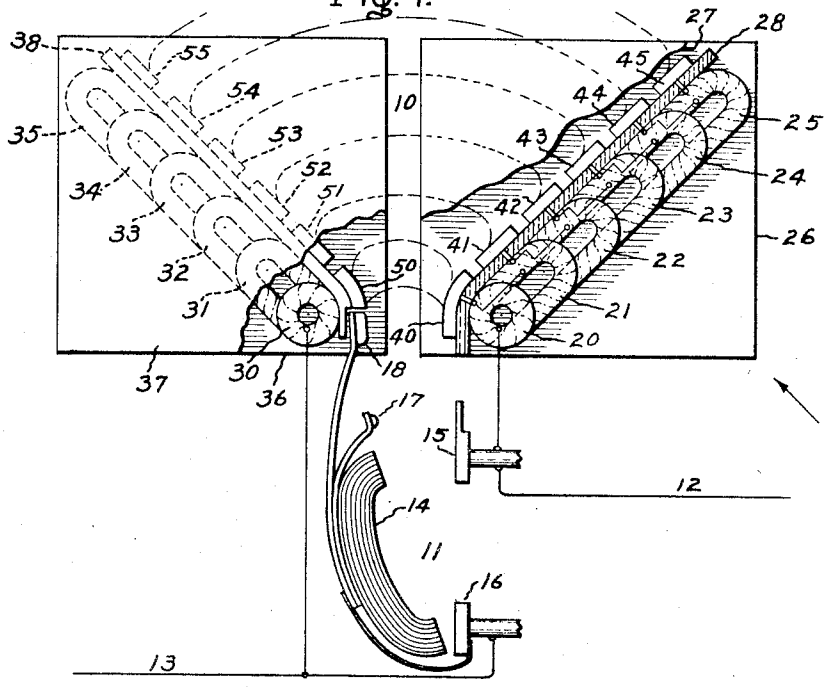
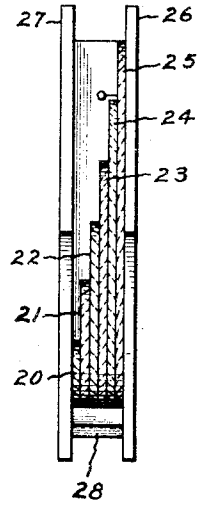


Fig. 2.



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UNITED STATES PATENT OFFICE

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CIRCUIT INTERRUPTER

Application filed July 23, 1926. Serial No. 124,505.

The invention relates to circuit interrupters, particularly circuit interrupters having magnetic blowouts for extinguishing the arcs occurring upon the interruption of the circuit, and the object of the invention is to provide an improved form of magnetic arc blowout capable of successfully interrupting the arcs encountered in high voltage power circuits.

In order to successfully effect the interruption of circuits of the above character, my improved magnetic arc blowout is arranged to attenuate the high voltage arc stream to the breaking point and at the same time reduce the amount of energy released in the arc. Furthermore, special provision is made for overcoming the inherent tendency of the high voltage power arc to reestablish itself through the ionized gases or vapors left in the path of the elongated arc stream.

In accordance with the preferred form of the invention the magnetic blowout is arranged to receive the ends of an arc upon operation of a switch or other circuit opening device and is provided with a series of blowout coils which are arranged to be successively inserted in the arc circuit as the arc is lengthened by the magnetic blowout flux of the coils. Preferably the series of coils have blowout flux openings of progressively increasing area and are overlapped so that the coils jointly produce a magnetic field of graded intensity. In this way the arc is lengthened and attenuated by the magnetic blowout field and at the same time the reactance of the coils which are successively inserted in circuit with the arc decreases the energy thereof until the arc is finally extinguished. Furthermore, the magnetic blowout field is maintained at a sufficiently high intensity to prevent effectively the reestablishment of the arc even in high voltage circuits.

The accompanying drawing illustrates a preferred embodiment of the invention in a magnetic blowout arranged to receive and dissipate the arc from an air break type of circuit interrupter. Fig. 1 is a plan view of the magnetic blowout, as well as the circuit interrupter, with certain parts of the blowout broken away to more fully reveal the construction thereof, and Fig. 2 is a longitudinal view of the magnetic arc blowout shown in Fig. 1, looking in the direction of the arrow.

Referring to Fig. 1 of the drawing, the magnetic arc blowout 10 in the preferred form shown, is arranged to receive the arc occurring upon the opening of the circuit interrupter 11, which controls the opening and closing of the circuit including the high voltage power lines 12 and 13. While the particular form of the circuit interrupter or other device for initially producing the arc, such as a fuse or the like is immaterial as far as my present invention is concerned, the circuit interrupter 11 is shown as of the usual air break type, in which the movable contact member 14 bridges the stationary contact terminals 15 and 16, to which the high voltage power lines 12 and 13 are connected. The movable contact 14 of the circuit interrupter preferably is provided, in accordance with the usual practice, with the primary and secondary arcing contacts 17 and 18.

The magnetic blowout 10 embodying the preferred form of my invention is composed of the two cooperating series of blowout coils 20 to 25 and 30 to 35, which are connected respectively to the power lines 12 and 13 to be inserted in the arc circuit upon the opening of interrupter 11, as indicated diagrammatically in the drawing. The series of blowout coils 20 to 25 are suitably supported to supply a blowout flux transverse the path of the arc, preferably being enclosed between the walls 26 and 27 of suitable arc resisting material which, as indicated in Fig. 2, form a restricted chute for the arc with the series of coils disposed adjacent the path of the arc. The coils are protected from the arc by means of a suitable arc resisting baffle 28. Each of the coils in the series is provided with a corresponding one of the arcing terminals 40 to 45 located in alignment upon the baffle 28 to successively receive the end of the arc. In the preferred arrangement shown the series of blowout coils, excepting initial coil 20, are wound in an elongated form with the blowout flux openings of the successive coils of progressively increasing area. Moreover, the

coils in the series preferably are wound with a progressively increasing number of turns in the successive coils. Thus, the initial coil 20 is wound with a low number of turns of large size conductor so as to have a relatively low impedance while the number of turns in the successive coils is increased and the size of conductor is decreased. The blowout ampere turns of the initial coil 20 is sufficiently high to produce an effective blowout action due to the fact that the initial current in the arc is of relatively large value. However, as the current in the arc circuit is decreased by the reactance of the successive coils in the series, it will be clear that the increased number of turns of the successive coils overlapping coil 20 serves to maintain the blowout flux thereof substantially constant.

The series of blowout coils 30 to 35 likewise are enclosed within the arc resisting walls 36 and 37 and located behind the barrier 38 adjacent the path of the arc. Also each of these blowout coils has a corresponding one of the arcing terminals 51 to 55 arranged in the same way as the terminals of blowout coils 20 to 25. In this way the blowout coils in each series are successively inserted in series circuit with the arc as the arc lengthens and the flux of each coil serves to drive the end of the arc to the terminal of the next successive coil in the series. Consequently the arc is elongated and attenuated and at the same time the value of the current in the arc is decreased due to the increasing amount of reactance included in the arc circuit as the blowout coils are successively inserted therein.

It will be observed that each series of blowout coils as shown is composed of coils having flux openings of progressively increasing area and that the flux opening of each coil overlaps that of all the succeeding coils in the series. By the term flux opening, I mean the area surrounded by the coil. Furthermore, the flux opening of all of the coils in the series overlaps the flux opening of the first coil in the series. This insures that the magnetizing effect of each successive coil augments that of the preceding coils and thereby produces a graded magnetic blowout field with the region of highest intensity at the first coil. By this arrangement the initial intensity of the magnetic blowout field of each of the blowout coils may be maintained substantially constant, even though the current in the arc circuit is progressively decreased as the succeeding coils are included in the circuit. This is due to the fact that the successive blowout coils act cumulatively to supply at least a portion of their blowout flux through the flux openings of the preceding coils. Thus, as the ends of the arc are rapidly driven along the successive arcing terminals 40 to 45 and 50 to 55, the central portion of the arc is driven upwards simultaneously until the arc is finally attenuated to such a degree and the energy therein is reduced sufficiently that the arc is completely extinguished.

From the foregoing, the operation of the interrupter provided with my improved form of magnetic blowout in rupturing high voltage circuits will be readily understood. Upon the opening operation of the switch 11 the main bridging contact 14 first disengages the stationary contacts 15 and 16 with the primary and secondary arcing members 17 and 18 remaining in engagement with the contact 15 and the arcing terminal 40 respectively. As soon as the primary arcing contact 17 leaves the contact 15 all of the current in the circuit including the high voltage power lines 12 and 13 then passes through the blowout coil 20 of the arcing terminal 40 and the secondary arcing contact 18. The blowout coil 20, having a relatively low initial impedance, offers very little resistance to the flow of current through the coil and hence materially reduces the tendency of arcing at the primary arcing contact 17 when the coil 20 is inserted in the circuit. The energization of coil 20 sets up a magnetic field which is concentrated upon the arc that is drawn by the disengagement of the arcing contact 18 from the arcing terminal 40. The reaction of the current in the arc upon this magnetic blowout field tends to rapidly move the right hand end of the arc from the arcing terminal 40 to the adjacent arcing terminal 41.

At the same time the auxiliary arcing terminal 18 is carried into proximity to the arcing terminal 50 as shown in the drawing, thereby transferring the left hand end of the arc to the terminal 50. This results in the energization of the blowout coil 30. This coil also is of relatively low initial impedance so as to readily permit the transfer of the end of the arc from the secondary contact 18 to the arcing terminal 50. The blowout action of coil 30 functions in substantially the same manner as previously described to drive the left hand end of the arc from the arcing terminal 50 to the next succeeding arcing terminal 51.

Since one end of the blowout coils 21 and 31 are connected to the arcing terminals 41 and 51 respectively and the other end of the coils are connected in series circuit with the blowout coils 20 and 30 respectively, the blowout coils 21 and 31 are inserted in the arc circuit when the ends of the arc engage the arcing terminals 41 and 51. Although the reactance of the blowout coils 21 and 31 serves to effect a reduction of the current in the arc, the cumulative magnetizing effect of the coils 21 and 31 upon the common blowout flux path extending through the opening in the coils 20 and 30 serves to maintain the magnetic blowout field therein at a high intensity as previously pointed out. Likewise, as the ends of the arc are successively driven along the remaining arcing terminals 42 to 45 and

52 to 55, the remaining blowout coils in each series are successively included in the arc circuit and each functions to cumulatively magnetize the flux path of the preceding coils. In the arrangement shown each coil also functions to supply blowout flux directly adjacent the end of the arc which serves to rapidly drive the arc to the next succeeding arcing terminal. Thus, with my improved magnetic arc blowout arrangement the arcs of even high voltage power circuits may be rapidly and effectively extinguished.

While I have shown and described the magnetic blowout as composed of two separate series of coils, it will be apparent that a single series of coils may be employed to draw out only one end of the arc with quite satisfactory results. Furthermore, the arc chute construction may be materially varied and other changes made in the arrangement shown without departing from the spirit and scope of my invention as set forth in the appended claims.

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

1. A magnetic arc blowout for interrupting an electric circuit comprising a series of blowout coils disposed along the path of the arc and interconnected to be successively included in the arc circuit as the arc lengthens, with the successive coils in the series arranged to encircle the flux path of one of the coils so as to concentrate therein at least a portion of the blowout flux of the remaining coils.

2. A magnetic arc blowout for interrupting electric circuits comprising a blowout coil disposed adjacent the path of the arc to be included in the arc circuit and arranged to set up a magnetic field transverse the arc path to drive the arc therealong, and a series of additional blowout coils disposed adjacent the arc path and connected with said first coil to be successively included in the arc ciruit as the arc lengthens, each of said additional coils being disposed in overlapping relation with said first coil to strengthen the magnetic field of the first coil as the additional coils are successively connected in the arc circuit.

3. A magnetic arc blowout for interrupting electric circuits comprising a magnetic blowout coil disposed adjacent the path of the arc and arranged to be connected in circuit therewith to set up a magnetic field transverse the arc path to drive the arc therealong, and a plurality of additional blowout coils disposed eccentrically about the axis of said first coil and interconnected therewith to be successively included in the arc circuit as the arc lengthens.

4. A magnetic arc blowout for interrupting electric circuits comprising a plurality of elongated blowout coils, disposed in overlapping relation adjacent the path of the arc and each provided with an arcing terminal, the said arcing terminals being disposed in alignment along the path of the arc to insert the coils successively in the arc circuit as the arc lengthens.

5. A magnetic arc blowout for interrupting an electric circuit comprising a series of blowout coils having blowout flux openings of progressively increasing area, said coils being interconnected to be included successively in the arc circuit as the arc lengthens, and disposed with the opening of each coil overlapping the openings of the successive coils in the series so as to thereby set up a composite magnetic arc blowout field of graduated intensity along the path of the arc.

In witness whereof, I have hereunto set my hand this 22nd day of July, 1926.

WILLIAM E. PAUL.