Nov. 14, 1939. W. HÖPP 2,180,147

ELECRIC CIRCUIT INTERRUPTER

Filed June 3, 1937

Fig. 1.

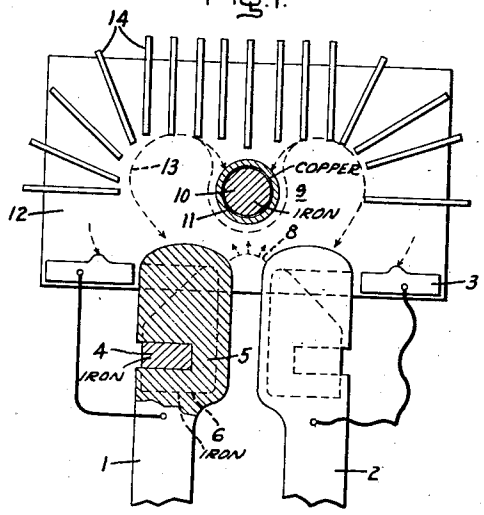


Fig. 2.

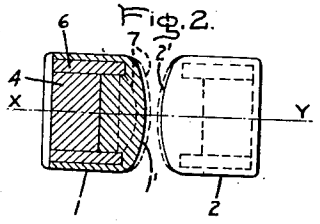
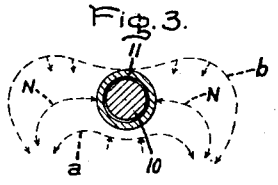


Fig. 3.



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Patented Nov. 14, 1939

2,180,147

UNITED STATES PATENT OFFICE

2,180,147

ELECTRIC CIRCUIT INTERRUPTER

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Application June 3, 1937, Serial No. 146,183
In Germany July 21, 1936

3 Claims. (Cl. 200—147)

My invention relates to electric circuit interrupters of the magnetic blowout type, and has for its principal object the provision of an improved circuit interrupter of the aforesaid type which is effective to interrupt the arc without involving high induced voltages, flashover or reignition of the arc and excessive deterioration of the interrupter structure.

Magnetic blowout circuit interrupters, such as air circuit breakers for example, have been proposed wherein a strong blowout field is utilized to extend and lengthen the arc rapidly into an arc cooling structure, such as arc splitters for example. In certain instances the magnetic blowout field may be so powerful that the arc, referring specifically to an inductive alternating current circuit, is extended to such length and ruptured so suddenly that high flashover voltages are induced causing damage to the installations and under certain circumstances flashover or reignition of the arc.

In the case of alternating current it is particularly important that the blowout field be controlled, since a comparatively powerful blowout and leakage field may extend the arc to such length before rupture that the large quantities of ionized gases formed by the arc tend to cause reignition after interruption at the current zero.

In accordance with the present invention a comparatively powerful blowout field acts locally on the arc so as to cause high acceleration of the extending movement thereof, and the field is weakened or opposed after predetermined extension of the arc so as to maintain the arc or at least a portion thereof at a substantially predetermined position. Interruption of the arc takes place at the preferred extended length thereof so that dangerous flashover voltages and reignition of the arc are substantially precluded.

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 a magnetic blow-out circuit breaker embodying the present invention; Fig. 2 is a plan view, partly in section, of the electrode or contact structure of Fig. 1, and Fig. 3 is a diagrammatic illustration of the action of the blow-out field on the arc.

The circuit interrupter illustrated comprises relatively movable contacts or electrodes 1 and 2 between which an arc is formed upon opening of the circuit. Each contact is electrically connected to an arcing horn 3. For the purpose of concentrating a magentic blow-out field at a localized region between the contacts, magnetic core material, such as iron, is inserted at 4 in each contact so as to restrict the contact cross-section at 5. The cores 4 are provided with iron pole pieces 6 which are also set in recesses in the opposite sides of the contacts as illustrated by Fig. 2.

When the contacts are separated to open the circuit, an arc is formed in the space between the contacts. The blow-out field, which is created in a well-known manner by the electromagnetic means above described, extends from the pole pieces into the arc gap, as indicated by the flux lines 7 (Fig. 2), and rapidly moves the arc to the top of the contacts at 8 as illustrated by Fig. 1. This part of the movement of the arc is very rapid as a comparatively strong magnetic field is concentrated on the arc during its initial extension. As the arc continues to extend under influence of the field, it travels over the contact surfaces to the arcing horns 3 as indicated.

For the purpose of limiting extension of the arc beyond a predetermined length or position, there is provided electromagnetic means at 9 for creating an opposing field. In the present instance, this means comprises a core 10 of magnetic material, such as iron, and a conducting ring 11 composed of copper for example forming a short-circuited conductor about the core. The core 10 is of appreciable mass as illustrated so that it occupies an appreciable part of the arc chamber and is located in the usual arc chute 12 transversely of the direction of extension of the arc and intermediate the ends thereof. The spacing of the core from the initial arc position at 8 depends on the interrupting requirements of the breaker and, in certain cases, may be comparatively close thereto.

As above pointed out, separation of the contacts 1 and 2 to open the circuit causes formation of an arc therebetween which is driven rapidly by the concentrated field to the upper position at 8 and from there by the leakage field toward the core structure 10 as indicated by the direction arrows. The movement of the arc roots along the upper surfaces of the contacts is slower by reason of the reduction in strength of the blow-out field, and the arc is extended to the position indicated at 13 wherein the core limits further appreciable extension of the central part of the arc.

Referring to Fig. 3, the function of the core structure 10 is described as follows: When the central part of the arc is beneath the neutral zone of the core N—N as indicated at *a*, it is driven upward also by the field which the arc itself induces in the core. Immediately it has passed the neutral zone N—N to position *b*, however, the reversed blow-out field tends to drive it downward as indicated by the direction arrows. The central part of the arc, therefore, tends to adjust itself to an intermediate position with respect to the core, so that it is not further extended by the blow-out field. The end portions and extremities of the arc are, however, still subject to the weakened blow-out field and are extended a limited distance toward the arc splitters 14 as indicated where the arc is interrupted at a current zero. The arc in this position, i. e. 13, can oscillate due to the pulsations of the A. C. blow-out field and at each oscillation will be driven into the arc splitters, if not interrupted at the first current zero.

For the purpose of maintaining the arc in the central plane of the contacts and centrally of the arc chute, the arc surfaces 1' and 2' of the contacts are symmetrical with respect to the magnetic blow-out field. That is, the surfaces can be mutually convex so as to conform generally to the flux paths at each contact. Accordingly, the arc, if originating at one side of the contacts, is acted on by a force component tending to drive it toward the central axes indicated at X—Y. The arc, therefore, is also in a concentrated blow-out field when initially formed.

It should be understood that my invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of my invention.

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

1. An electric circuit interrupter of the magnetic blowout type comprising electrodes between which an arc is formed upon opening of the circuit, an arc-extinguishing chamber, magnetic blowout means for extending said arc into said chamber, and electromagnetic means positioned in said chamber substantially transversely of the arc path for creating an opposing field in accordance with the current of said arc and thereby preventing extension of said arc beyond the limits defined by said opposing field, said electromagnetic means comprising an iron core of appreciable size as compared with the size of said chamber and a short-circuited conductor surrounding said core.

2. An electric circuit breaker comprising relatively movable contacts between which an arc may form upon opening of the circuit, means for creating a magnetic field for rapidly extending said arc beyond said contacts, an arc extinguishing chamber into which said arc is extended, and means located in said chamber transversely of the path of extension of said arc for creating an opposing field tending to limit extension of said arc beyond a predetermined position, said means comprising a metallic core of magnetic material occupying an appreciable part of said chamber and extending between side walls thereof, and a short circuiting conductor surrounding said core.

3. An electric circuit breaker comprising relatively movable contacts between which an arc may form upon opening of the circuit, means for creating a magnetic field for rapidly extending said arc beyond said contacts, an arc extinguishing chamber into which said arc is extended, and means located in said chamber transversely of the path of extension of said arc for creating an opposing field tending to limit extension of said arc beyond a predetermined position, said means comprising an iron cylinder extending between side walls of said chamber, and a short circuiting copper sleeve surrounding said cylinder.

WILHELM HÖPP.