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ELECTRIC CIRCUIT INTERRUPTER

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Fig. 1.

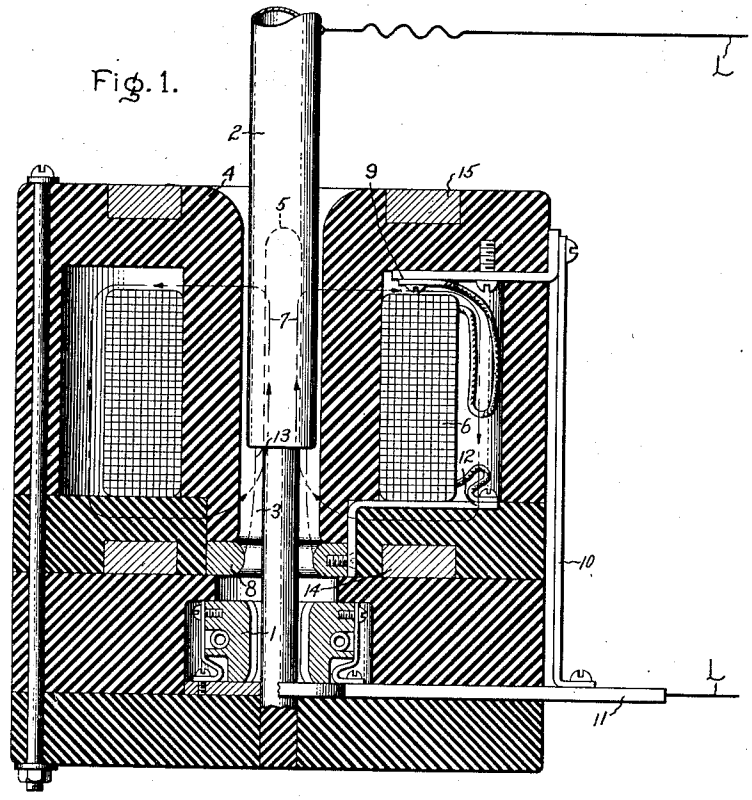
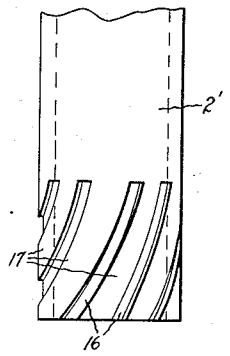


Fig. 2.



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ELECTRIC CIRCUIT INTERRUPTER

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6 Claims. (Cl. 200—147)

This invention relates to electric circuit interrupters, more particularly to the type wherein automatic generation of an arc extinguishing medium takes place in accordance with the circuit opening operation.

The principal object of the invention is the provision of an improved circuit interrupter of the aforesaid type which is efficient and reliable in operation, durable in construction and designed so as to provide an adequate amount of arc extinguishing fluid during the circuit opening operation.

Our invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize our 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 interrupter embodying the present invention, and Fig. 2 illustrates a modified form of the contact structure shown in Fig. 1.

The circuit interrupter illustrated by Fig. 1 comprises relatively movable contact structure including a fixed segmental type contact 1 and a coacting movable tubular contact 2 operable within a restricted or closely confining arc chamber 3. The arc chamber in the present case is of annular sleeve-like form and is defined by insulating structure comprising a main cylindrical portion 4 and a spaced concentrically arranged central pin 5 which is in registry with the bore of the tubular contact so as to guide the same.

In switches of this type it has been proposed that the insulating walls of the annular arc chamber be composed of a material, such as fiber for example, adapted to emit gas when acted upon by the arc during separation of the contacts for the purpose of extinguishing the arc. In such switches there is the possibility that the switch may be inaccurately assembled with respect to alinement for example with the result that the arc upon opening of the circuit has a tendency to act on but a limited portion of the arc chamber walls nearest the arc. This not only results in excessive deterioration of the arc chamber at such portions but also may result in limited generation of gas for interrupting the arc. Such unequal deterioration of the arc chamber walls necessarily results in premature overhauling of the switch and changing of parts, particularly in the case where the arc tends to cut deep grooves in certain sections of the chamber walls. The operation of the switch is likewise adversely affected when this condition obtains since the rate of generation of gas for extinguishing the arc is decreased as the distance between the arc and the surrounding chamber walls is increased.

In order to avoid the disadvantages referred to in this type of switch, there is provided in accordance with the present invention, electromagnetic means for acting upon and moving the arc within the arc chamber with respect to the insulating walls. The magnetic field in moving the arc not only equalizes the deterioration due to gas emission at the insulating walls and sets up a turbulent condition in the arc path tending to interrupt the arc but also effects lengthening of the arc so that the effective contact between the arc and the gas emitting walls is increased. In addition, the movement of the arc lengthens the life of the contacts due to equalizing of the burning effect of the arc.

Referring again to Fig. 1, the electromagnetic means for producing the field acting on the arc comprises a coil 6 which surrounds the arc chamber in generally concentric relation thereto and is suitably housed within part of the insulating structure 4. As shown the coil when energized produces a radial field as indicated by the flux lines 7 within the arc chamber tending to rotate the arc and cause it to assume a generally spiral or helical shape.

The coil is energized in accordance with the circuit opening movement through an arcing contact 8 which is formed as a ring through which the contact 2 is operable. The arcing contact is spaced above the fixed contact 1 so as to be intermediate the fixed and movable contacts in the open circuit position as shown. One terminal of the coil at 9 is electrically connected to a conductor 10 to the fixed contact terminal 11, and the other coil terminal at 12 is suitably connected to the arcing contact 8.

Accordingly, when the contact 2 is raised to open the line circuit indicated at L the arc is transferred from the fixed contact 1 to the arcing contact 8 and the coil, which is now in series with the arc is energized to project a magnetic field into the arc chamber. As the arc is lengthened between the arcing contact 8 and the tubular contact 2, the radial field tends to spin or rotate the arc rapidly within the annular arc chamber so that the arc tends to assume a helical elongated path about the central insulating pin 5. This action tends to increase the effective contact area between the arc and the gas emitting walls with the result that an effective gas blast is obtained from the arc chamber when the contact 2 is

withdrawn. While the contact 2 is still within the arc chamber the gas is generated at increasing pressure which by itself tends to interrupt the agitated arc.

For the purpose of concentrating the magnetic field produced by the coil 6 at a limited or predetermined section of the arc generally designated at 13, there is provided a short-circuited conducting ring 14 which surrounds the arc chamber and is generally concentrically positioned with respect thereto. The ring 14 is spaced from the coil 6 and is adjacent the arcing contact 8 so that the coil flux is confined to a path between the ring 14 and the coil 6. Accordingly, the magnetic field is concentrated on the arc adjacent the arcing contact 8, the application of a strong magnetic field at this base point being particularly effective.

It will be apparent that under certain conditions it may be desirable to combine the arcing contact 8 and the short-circuited ring 14 as a single member.

In order to suppress leakage flux at the upper part of the coil and to concentrate the magnetic field within the arc chamber at that point, there is also provided a second short-circuited ring 15 above the coil. The rings 14 and 15 may be composed of a suitable conducting metal such as copper.

It shall be understood that the arc interrupting principle above described is not limited to the use of a single electromagnetic means as illustrated. For example, the circuit interrupter may comprise a multiple arrangement wherein the arc is drawn through an arc chamber and is subjected successively to a plurality of magnetic fields. In this case the coils would be successively cut in the circuit as the movable contact assumed a position adjacent the corresponding arcing contact.

Fig. 2 illustrates a modified form of the movable contact rod for producing a magnetic disturbance within the arc chamber upon opening of the circuit tending to move the arc with respect to the insulating walls. For this purpose, the tubular contact 2' is notched or grooved as indicated at 16 so that at the contact end the current is divided into a plurality of conducting paths indicated at 17. The grooves assume a generally spiral form for accentuating the magnetic effect above referred to.

Since the application of the magnetic field on the arc is particularly effective at one or both bases or roots of the arc, it will be apparent that the arc base at the movable contact is subjected to a magnetic field throughout its range of opening movement between the arcing ring 8 and the upper short-circuited ring 15. As above pointed out the arc also passes through a concentrated field between the coil and the short-circuited ring 15. The lower base of the arc at the arcing contact 8 is, of course, constantly subjected to a strong magnetic field throughout the circuit opening operation.

It shall be understood that the arrangement shown in Fig. 2 may, if desired, be used in combination with the arrangement shown in Fig. 1, or it may be used independently.

It should be understood that our 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 our invention.

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

1. An electric circuit interrupter comprising relatively movable contacts, insulating structure defining an arc chamber within which said contacts are separable, a short circuited conducting ring having a resistance comparable with that of copper surrounding said chamber at a predetermined point along the arc path and electromagnetic means disposed adjacent said chamber and magnetically related to said short circuited ring so that the magnetic field produced by said electromagnetic means is concentrated on a limited section of said arc within said chamber.

2. An electric circuit interrupter comprising a fixed contact, a coacting movable rod contact, insulating means forming a restricted arc chamber for said contacts, an arcing contact spaced with respect to said fixed contact so as to be intermediate said fixed and rod contacts in the open circuit position, a coil surrounding said arc chamber, the terminals of said coil being connected respectively to said fixed and arc contacts so that said coil is energized in accordance with the circuit opening operation and a short-circuited conducting ring having a resistance comparable with that of copper surrounding said arc chamber and spaced with respect to said coil so that the magnetic field produced by said coil is concentrated on the arc at said arcing contact.

3. An electric circuit interrupter comprising a fixed contact, a coacting movable rod contact, insulating means forming an annular arc chamber for said contacts comprising a centrally disposed insulating pin and spaced concentrically arranged wall structure forming with said pin a sleeve-like annular arc chamber, an arcing contact spaced from said fixed contact so as to be intermediate said fixed and rod contacts in the open circuit position, a coil surrounding said annular arc chamber, the terminals of said coil being connected respectively to said fixed and arcing contacts so that said coil is energized in accordance with the circuit opening operation, and a short circuited conducting ring surrounding said arc chamber and disposed with respect to said coil and arcing contact so that the magnetic field produced by said coil is concentrated on that portion of the arc between said arcing contact and rod contact.

4. An electric circuit interrupter comprising insulating structure forming a restricted arc chamber, relatively movable contacts including a rod contact separable within said chamber, the walls of said arc chamber being adapted to emit gas when acted upon by the arc formed between said contacts upon opening of the circuit, said rod contact at its contact end forming conducting paths in parallel for causing a magnetic field at said contact end tending to move the arc upon opening of the circuit with respect to said gas emitting walls.

5. An electric circuit interrupter comprising insulating structure forming a restricted arc chamber, relatively movable contacts including a hollow rod contact separable within said chamber, the inner walls of said arc chamber being adapted to emit gas when acted upon by the arc formed between said contacts upon opening of the circuit, said hollow rod contact at its contact end having generally spiral-shaped slots for causing a magnetic field at said contact end within said chamber tending to move the arc upon opening the circuit with respect to said gas emitting walls.

6. An electric circuit interrupter comprising relatively movable contacts, an arcing contact spaced with respect to one of said contacts so as to be intermediate said relatively movable contacts in the open circuit position, electromagnetic means associated with said arcing contact for projecting a magnetic field across the arc upon opening of the circuit and coacting magnetic means for establishing a modifying flux for concentrating said magnetic field upon that portion of the arc between said arcing contact and one of said relatively movable contacts.

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