

[54] **METHOD AND MEANS FOR BREAKING A HIGH-POWER CIRCUIT**

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[51] Int. Cl. .... **H01h 33/12**

[58] Field of Search ..... **200/146 R, 153 L**

[56] **References Cited**

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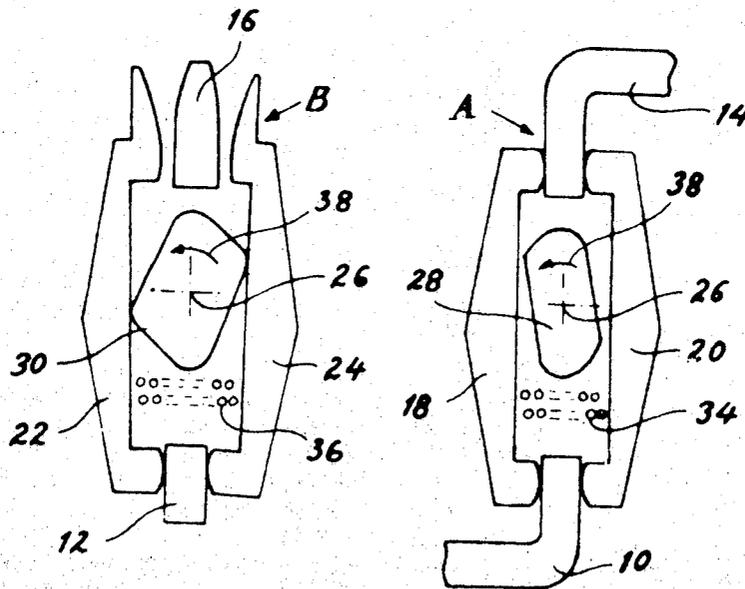
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[57] **ABSTRACT**

A method of breaking a high-power current passing through a switch is characterized by transferring the current to a contact member which is then opened. The switch includes two groups of stationary contact members and a movable contact member, cams being provided to vary the opening and closing positions of the groups.

**5 Claims, 8 Drawing Figures**



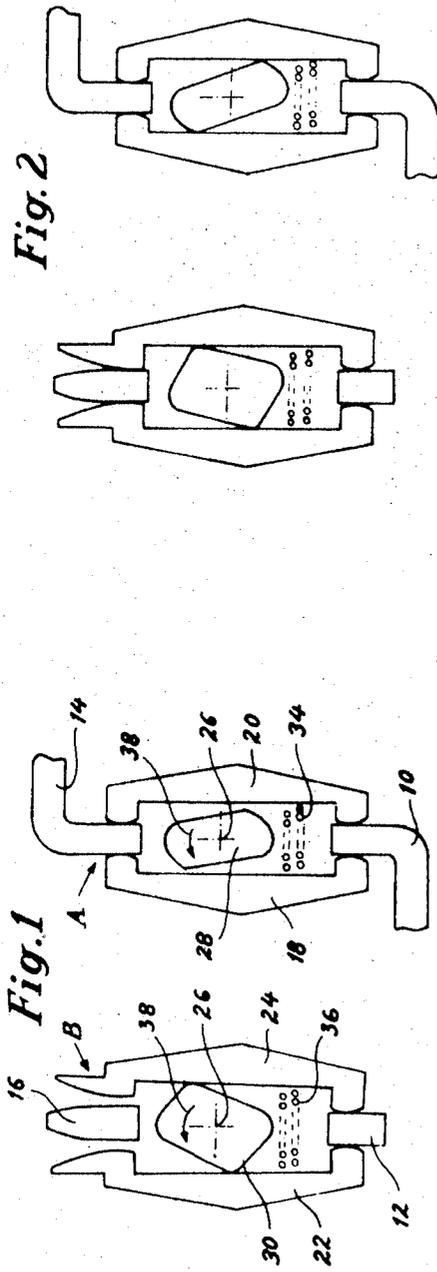


Fig. 2

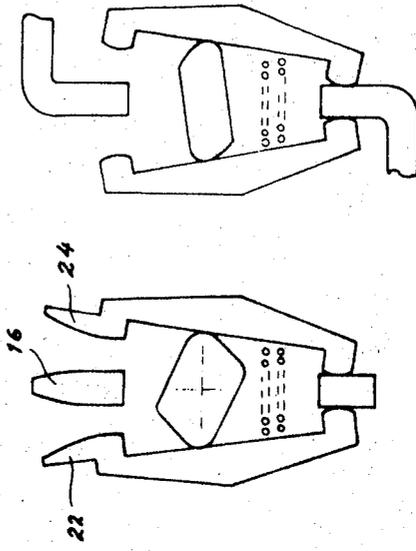
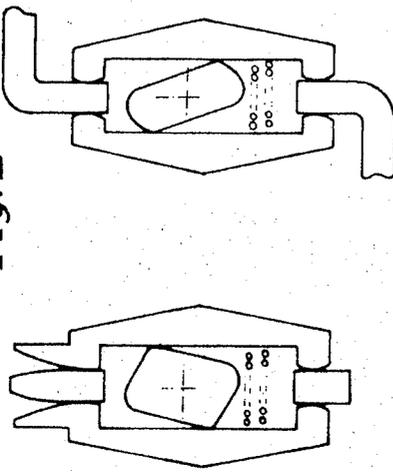


Fig. 4

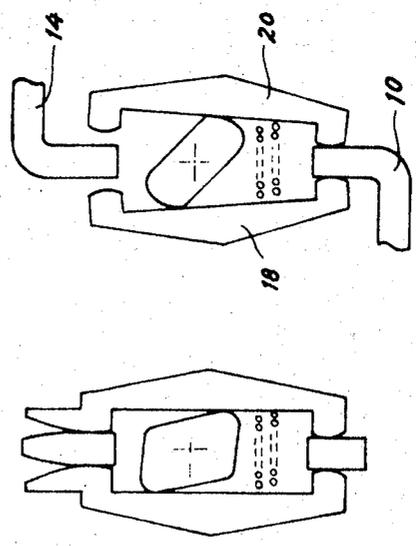
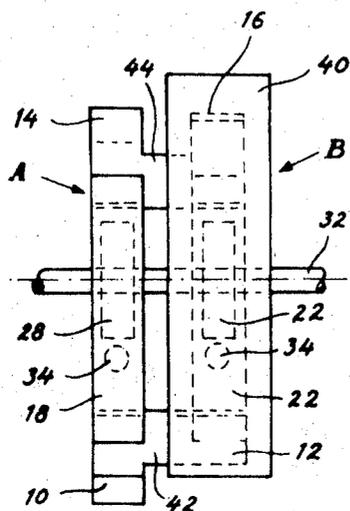
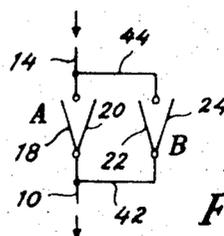


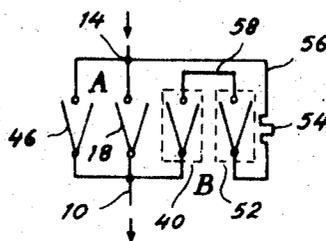
Fig. 3



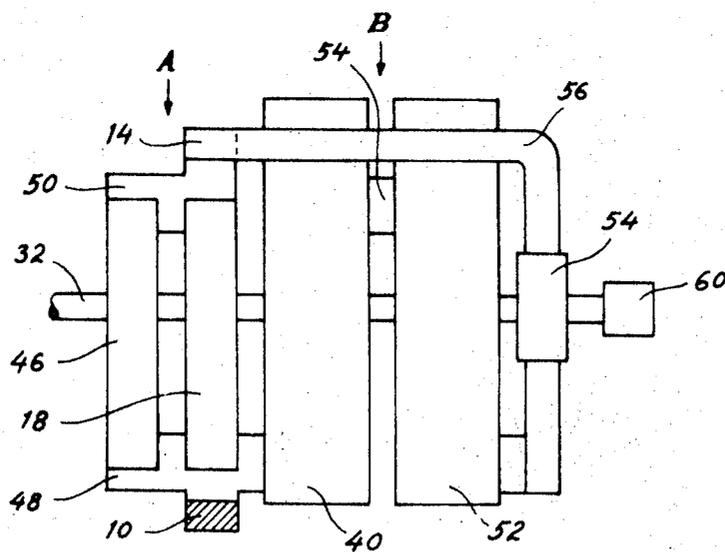
**Fig. 5**



**Fig. 6**



**Fig. 8**



**Fig. 7**

## METHOD AND MEANS FOR BREAKING A HIGH-POWER CIRCUIT

The invention relates to a method of breaking a high power circuit and a circuit breaker used to carry out this method. The circuit breaker includes two spaced stationary contact members and a movable contact which engages one contact member and which is adapted to engage the other contact member when the device is closed and to move away from it when the device is opened.

Known methods and existing current breakers for breaking very high currents and voltages have the drawback that the current breakers are quite bulky since its contact members are used both for permanent current passage and for the breaking of the high current. The breaking chamber encloses both the main current and the breaking current means and for high nominal currents it must be made quite voluminous. Furthermore, when the arc voltage and power become high, the material of the breaker is exposed to very high thermal stresses. Moreover, in existing breakers there is the risk of back ignition at the quenching courses. It often happens that contact surfaces are welded together at contact closing due to the high current density at the moment when the contacts touch each other. Very often the contact surfaces are burned away during the breaking so that they must be replaced after a short time. Furthermore, in existing circuit breakers there is no way of knowing if the contact members of a power switch have been welded together at the contact closing for high currents. This may damage the switchboard in which the circuit breaker is installed, particularly if the breaker will not function at the intended moment and in the desired manner because the surfaces of the contacts have been welded together.

An object of the present invention is to eliminate these drawbacks of existing methods and devices.

In the accomplishment of the objectives of the present invention it was found desirable to provide a method wherein the current immediately before the breaking is transferred from the current breaker to a breaking contact member specially designed for current breaking. This contact member is opened along with the current breaker. For that purpose the current breaker includes a further group of stationary contact members and a movable contact member. The two groups of contact members are interconnected in parallel; they are connected to synchronously controlled cam members during the opening of the current breaker. During the initial phase one group is held in the closing position and the other group in the opening position while during the following preparation phase one group is held in the closing position while the other group is brought into the closing position. Then follows the first contact opening phase wherein the first group is brought to an opening position while the second group is held in the closing position, while during the next contact opening phase the first group is held in the opening position while the second group is brought into the opening position.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings showing by way of example only, preferred embodiments of the inventive idea.

In the drawings:

FIG. 1 is a diagrammatic view of a current breaker of the present invention.

FIGS. 2, 3 and 4 show the same current breaker in three following phases.

FIG. 5 is a side view of the current breaker shown in FIGS. 1-4.

FIG. 6 is a circuit diagram of the same current breaker.

FIG. 7 is a side view of a differently constructed current breaker.

FIG. 8 is a circuit diagram of the current breaker shown in FIG. 7.

The current breaker of FIGS. 1 to 5 is intended for high currents and high voltages. It includes two contact groups A and B. A stationary contact member 10 of group A is coupled in parallel to the stationary contact member 12 of group B. Similarly, a stationary contact member 14 of group A is coupled in parallel to the stationary contact member 16 of group B. Stationary contact members 10 and 14 of group A cooperate with movable contact members 18 and 20. In the closing position shown in FIG. 1 the ends of the contact members 18 and 20 engage the stationary contact members 10 and 14. The contact members 18 and 20 are swingable about their point of engagement with the stationary contact member 10 so that in the operating position shown in FIG. 3 their other ends are spaced from the stationary contact member 14. Group A which includes the contact members 10, 14, 18 and 20 constitutes the main contact arrangement and its members do not have any breaking functions.

In group B stationary contact members 12 and 16 cooperate with swingable contact members 22 and 24. The contact members 16, 22 and 24 serve as breaking contact members and their upper ends having cross sections decreasing from the breaking point so that the end surfaces are directed away from each other. This facilitates quenching of the arcs between the stationary contact member and the movable contact members. Group B which includes contact members 12, 16, 22 and 24 constitutes the breaking contact arrangement which cooperates with the main contact arrangement of group A.

For better illustration contact groups A and B have been shown side by side in FIGS. 1 to 4. However, actually they are located one behind the other, as shown in FIG. 5 and have a common axis 26 (FIG. 1). A rotatable cam member 28 of group A cooperates with the movable contact members 18 and 20, which the rotatable cam member 30 of group B cooperates with movable contact members 22 and 24. The two cam members 28 and 30 are mounted on a common axle 32 (FIG. 5). A spring 34 engages the contact members 18 and 20 and tends to press them against the stationary contact member 14 and the cam member 28. A similar spring 36 engages the contact members 22 and 24 and tends to press them against the stationary contact member 16 and the cam member 30.

The axle 32 carrying the cam members 28 and 30 can be rotated manually, by magnetic means or by a motor in the direction of the arrow 38 (FIG. 1).

Group A which is the main contact arrangement and group B which is the breaking contact arrangement constitute jointly a single current breaker the different coupling positions of which are shown in FIGS. 1 to 4.

FIG. 1 shows the rest position, namely, when the current breaker is closed. Then the main current arrange-

ment A is closed while the breaking current arrangement B is open and thus does not carry any current. Then the main current arrangement A will be subjected to a certain amount of heating due to the flow of the permanent current while the breaking contact arrangement will remain cold.

If it is desired to open the current breaker the axle 32 is turned with a specific speed to the extent of 90 degrees. During this turning the parts of the current breaker undergo consecutively phases which are shown in FIGS. 2 to 4. In the beginning of the turning movement, namely, when the axle 32 has been turned approximately to the extent of 15°, the position shown in FIG. 2 is reached, namely, the breaking contact arrangement B is closed so that the current flows through both groups. After the axle 32 has been further turned to the extent of 30°, the position shown in FIG. 3 is reached, wherein the main current arrangement A is opened, so that the entire current flows through the breaking contact arrangement B. Since the opening contact points of the main current arrangement A are bridged over or short circuited by the breaking contact arrangement B, the main contact arrangement A will have no opening spaces. During the last phase, namely, when the axle 32 has been further turned by 50°, the position of FIG. 4 is reached wherein the breaking process takes place. When the two contact arrangements A and B are in the position of FIG. 4 the current breaker is open. The closing of the current breaker takes place in the same manner but in the reverse sequence.

The arc arising during the opening of the breaking contact arrangement is driven upwardly and out of the gap between the contact member 16 and the movable contact members 22 and 24. The lengthening of the arc path by the aid of the electrodynamic power development of the current is utilized. This self-quenching effect should not be influenced, however, in a detrimental way by blowing coils or electromagnetic coils and no ferro-magnetic material should be present in the surroundings of the arc. The quenching effect is further promoted by arranging a breaker chamber 40 (FIG. 5) only around the breaking contact arrangement B. The chamber 40 contains plate laminae which have a cooling effect upon the ionized gases of the arc. Surfaces of the contact members 16, 22 and 24 are plated with tungsten or other material having a high gas temperature so as to raise the breaking security of the contact members and diminish the risk that the contact surfaces may be welded together. By suitably shaping the cam members 28 and 30 it is possible to adjust the various lengths of time for the phases of the breaking process so as to produce the best possible results.

In prior art, a current breaker had contact surfaces which were both current carrying when the current breaker was closed and circuit breaking during the breaking process. An important advantage of the circuit breaker of the present invention is that it includes members which are used and dimensioned merely for carrying the current and do not participate in the breaking process. Contact transition surfaces can consist of a material which conducts current in the best possible way, such as copper or silver. Some members are dimensioned for current carrying and high current load taking place for a very short time (the entire load time approximately ranging between 10 ms and 15 ms) without regard to the resistivity of the material.

As shown in FIG. 5 the stationary contact members 10, 12 and 14, 16 respectively, are interconnected by bar parts 42 and 44 to provide a coupling parallel to the main contact arrangement A and breaking contact arrangement B.

FIG. 6 shows diagrammatically the connections of the contacts of FIGS. 1 to 5.

FIG. 7 and 8 show another embodiment of the circuit breaker of the present invention which has two main contact arrangements A coupled in parallel with each other and also with a breaking group also consisting of two breaking contact arrangements B coupled in series. A main contact arrangement A (similar to that of FIG. 5) consists of contact numbers 10, 18 and 14 and is coupled in parallel with another main contact unit having contact members 46, 48 and 50, so as to increase the nominal power of the current breaker. Obviously, a further increase in the breaking effect can be attached by coupling a plurality of units in parallel. FIG. 7 shows breaking chambers 40 and 52 of the two breaking contact units B. The cam axle 32 is driven by a driving member 60 which may consist of an electromagnetic mechanism or an electric motor provided with a speed control so as to produce a regulated breaking process of the movable breaking contact members, such as the members 22 and 24. Since small mechanical powers are used to drive the cam axle, the circuit breaker can be actuated in a simple manner, as compared to actuating appliances of existing high power current breakers.

In order to somewhat decrease the breaking effect and thereby increase breaking security the circuit breaker of FIGS. 7 and 8 is provided with a resistance 54 inserted into the series coupled breaking contact branch B. The member 54 may be also a capacitor. The current which is to be broken passes from the stationary terminal contact member 14 through the current bar 56, the resistance 54, the contact unit within the chamber 52, the current bar 58, the contact member within the chamber 40 and to the stationary contact member 10. It is apparent that the resistance 54 can be inserted between the contact units in the two chambers 40 and 52, instead of being coupled with the current bar 58. In case of higher nominal voltages, for example, voltages up to 20 Kv, more than two breaking contact units B are used which are coupled in series, each connecting line between two breaking contact units being provided with a resistance 54.

I claim:

1. A device for breaking a high power current, comprising a switch dimensioned for permanent current carrying, a breaking contact member dimensioned solely for current breaking, a rotary axle, cam members carried by said axle and connected with said switch and said member, means actuating said axle and said cams for transferring the current flowing through said switch to said member and immediately thereafter actuating said member to open it and break the current, wherein said switch and said member consist of similar groups of contact members, each group comprising two spaced stationary contact members and a movable contact member engaging one stationary contact member and adapted to move in and out of engagement with the other stationary contact member, and means interconnecting said groups in parallel, said cam members being adapted to hold one group in a closing position and the other group in the open position during the ini-

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tial phase of current breaking, to hold both groups in the closing position during the following phase, to hold said one group in the open position in the following phase and to hold both groups in the open position during the final phase.

2. A device in accordance with claim 1, comprising a resistance connected in series with said other group.

3. A device in accordance with claim 1, comprising

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a capacitor connected in series with said other group.

4. A device in accordance with claim 1, wherein said other group comprises a plurality of contact members connected in series.

5 5. A device in accordance with claim 1, wherein said one group comprises a plurality of contact members connected in series.

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