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Kishi et al.

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[54] **GROUNDED TANK CIRCUIT BREAKER**

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[52] **U.S. Cl.** ..... **200/148 A**; 200/148 D

[51] **Int. Cl.** **H01h 33/88**

[58] **Field of Search** ..... 200/148 B, 148 D, 148 A, 200/148 R

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[57] **ABSTRACT**

A circuit breaker with multiple breaking points which has at least two breaking sections with movable portions respectively connected to a couple of link devices for driving the movable portions, the two breaking sections being enclosed within a tank which is grounded and filled with an insulating medium for quenching the arc; characterized by the provision of a shield device covering the link devices thereby to reduce the effect of disturbance of electric field due to the formation and positioning of levers of the link devices, thus preventing dielectric breakdown of the insulating medium.

6 Claims, 3 Drawing Figures

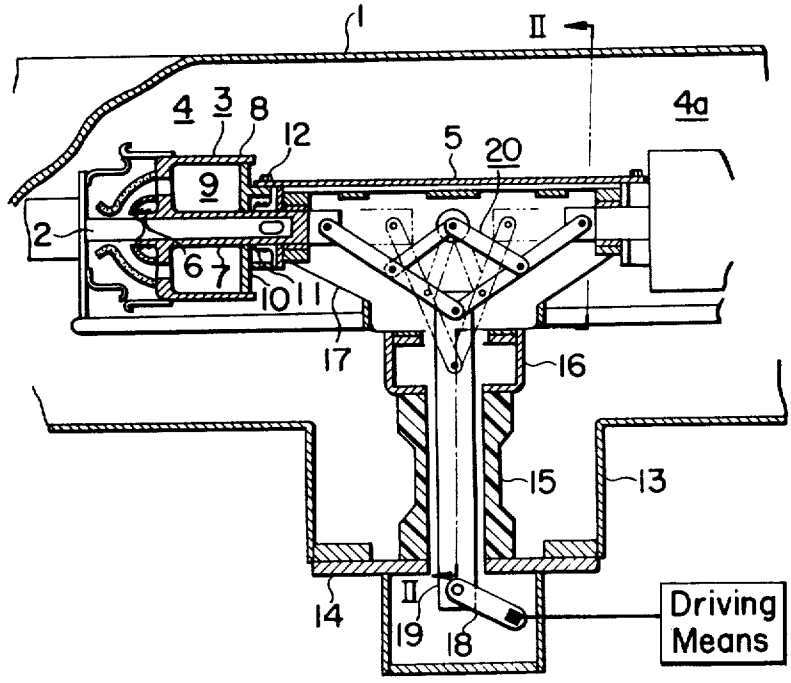


FIG. 1

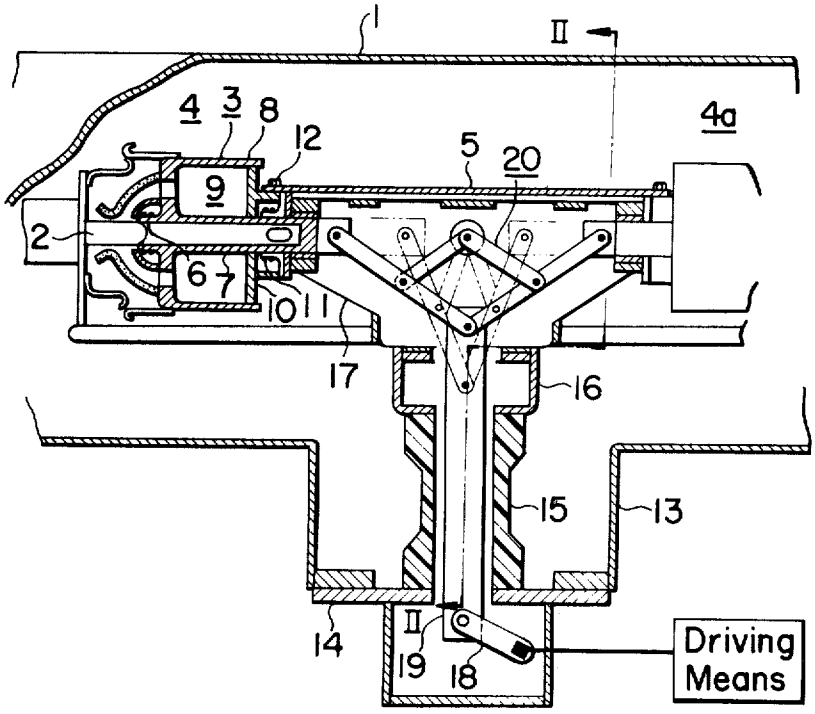


FIG. 2

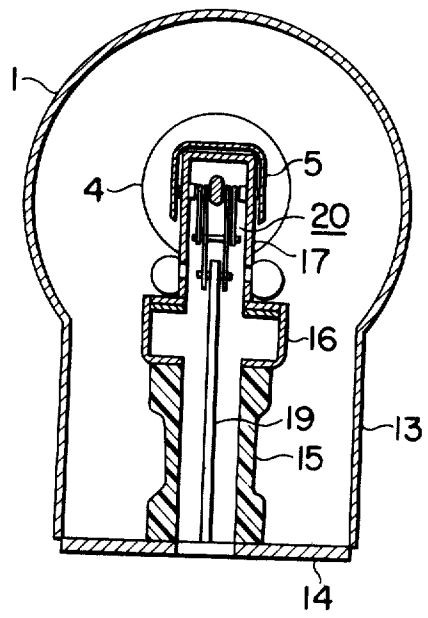
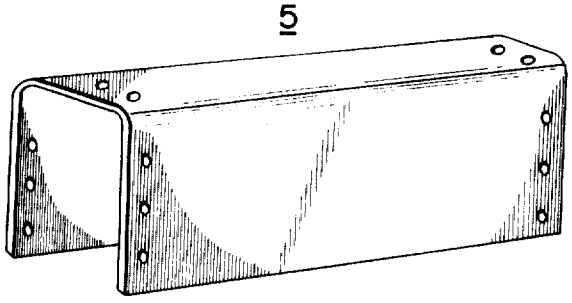


FIG. 3



GROUNDED TANK CIRCUIT BREAKER

The present invention relates to an improved grounded tank circuit breaker in which at least two series-connected breaking sections are arranged in a tank at earth potential and filled with an arc extinction medium such as SF_6 gas, and the movable part of each breaking sections is driven to open or close the breaker by a link device for transmitting the driving force from a driving unit.

In order to meet the increasing demand for a high-voltage large-capacity circuit breaker, circuit breakers recently developed are so arranged that a plurality of breaking sections are connected in series to form a series-connected multiple breaking arrangement.

The circuit breakers are roughly divided into two types: one is the porcelain insulator type and the other the grounded tank type. In the porcelain insulator type of circuit breaker, a multiple breaking arrangement is provided on porcelain porcelain erected on the ground and movable portions of adjacent breaking sections are electrically connected by a metal tank containing a transmission mechanism which connects an insulator rod coupled to a driving means on the ground with the movable portions of the breaking sections to transmit the driving force from the driving means to the movable portions of the breaking sections. The grounded tank type of circuit breaker, on the other hand, comprises a grounded tank filled with an arc extinction medium which contains not only breaking sections insulated from the breaker tank by the extenction medium but a transmission mechanism for connecting an insulator rod driven by a driving means with the movable portions of the breaking sections to transmit the motion of the driving means to the movable portions. The present invention is intended to be applied to the grounded tank type of circuit breaker.

The circuit breaker of grounded tank type, with its transmission mechanism at the same potential as the breaking section, can be made in small size so far as the insulation between the tank and the transmission mechanism is ensured. Further, in the gas circuit breaker, the use of an arc extinction gas such as SF_6 which has an excellent insulation characteristic in uniform electric field permits further reduction of the diameter of the breaker tank, although care must be taken to prevent concentration of electric field caused by protruded parts of the transmission mechanism which greatly deteriorates the insulation characteristic of the arc extinction gas.

In the circuit breaker of puffer type where an arc extinction gas compressed into high pressure with the operation of the movable portions of the breaking section is blown to the arc to quench the same, the necessity for strong operative force for compression of the arc extinction gas makes indispensable a link mechanism for imparting the required force to the movable portions of the breaking section.

In the case where the link device is used for the transmission mechanism of the grounded tank type circuit breaker, electric field tends to be concentrated at the joints between the levers and at similar uneven portions, and also a change in the formation of the link with the operation of the device disturbs the electric field between the link device and the tank, thus making it difficult to effectively utilize the insulation characteristic of the arc extinction gas.

The present invention is intended to obviate the above-mentioned problems and an object thereof is to provide a simple and low-cost circuit breaker of grounded tank type with small diameter of the tank, which is characterized in that the electric field between the tank and the link device for imparting the driving force from the driving means to the movable portions of the breaking section insulated therefrom is soothed by providing a shield means between the link device and the wall of the tank.

The other objects, features and advantages of the present invention will be made apparent by the detailed description taken in conjunction with the accomapnying drawings, in which:

FIG. 1 is a longitudinal sectional view showing an embodiment of the circuit breaker of the grounded tank type according to the present invention;

FIG. 2 a sectional view taken on line II—II of FIG. 1; and

FIG. 3 a perspective view of the essential part of the circuit breaker according to the present invention.

An embodiment of the present invention as applied to the gas-filled breaker of puffer type will be explained below.

Referring to FIGS. 1 and 2 showing the general construction of the circuit breaker, reference numeral 1 shows a tank at earth potential and filled with an arc extinction gas such as SF_6, numeral 2 a stationary contact electrically connected to a not-shown terminal, numeral 3 a movable breaking portion, and numerals 4 and 4*a* breaking sections each comprising the movable breaking portion 3 and the stationary contact 2. The breaking sections 4 and 4*a* of puffer type are arranged insulated from the tank 1 by arc extinction gas, whereas a connecting conductor 5 connects the movable breaking portions 3 to each other, thus making up a series-connecteed two breaking points.

Each of the breaking sections 4 and 4a of pufer type comprises the movable breaking portion 3 including a movable contact 6 opposed to the stationary contact 2, a conductive member 7 and a puffer cylinder 8, and a puffer chamber 9 formed by the puffer cylinder 8 and a puffer piston 10.

The connection between the movable breaking portion 3 and the connecting conductor 5 may be accomplished by electrically connecting the conductive member 7 with the puffer piston 10 through a collector 11 and connecting the puffer piston 10 with the conductor 5 by bolts 12.

Therefore, between not-shown breaker terminals, a current path is established through the stationary contact 2, the movable contact 6, the conductive member 7, the collector 11, the puffer piston 10, the connecting conductor 5, and the corresponding parts of the movable portions of the opposite breaking section 4*a* and further the stationary contact of the breaking section 4*a*.

At the bottom of the middle portion of the breaker tank 1 is connected a cylinder 13, which has a bottom plate 14 to hermetically seal the tank interior. On the bottom plate 14 is erected an insulating cylinder 15 which supports the puffer piston 10 by the aid of a ring bracket 17 and an intermediate metal member 16.

The connection between the not-shown driving means and the movable portions 3 of the breaking section is accomplished through a lever 18 arcuately moved by the driving means, an insulating bar 29 ex-

tending through the insulating cylinder **15** from the lever **18** and the link device **20** connecting the upper end of the insulating bar **19** to the movable portions **3** of the breaking section.

The connecting conductor **5** is made of a U-shaped thin plate of copper or aluminum, and as shown in FIG. **3** has corner and end portions with moderate curvature to avoid concentration of electric field. Thus, the link device **20** is covered with the connecting conductor **5** placed over it within the tank **1**.

The breaking operation of the circuit breaker according to the invention will be briefly explained below. Starting from the closed state of FIG. **1**, the lever **18** is rotated counterclockwise by the not-shown driving means to thereby drive the insulating bar **19** downward, so that the movable portions **3** of the breaking sections are driven by the link device **20** in such a direction that the breaking sections **4** and **4***a* approach each other. Finally, the link device is positioned as shown by the two-dot and dash lines to complete the breaking process.

With the actuation of the movable portions **3** of each breaking section, the arc extinction gas in the puffer chamber **9** is compressed and the resulting high pressure gas is blown to the arc generated between the contacts **2** and **6**, whereby the arc is extinguished and so-called "series-connected two-point breaking operation" is achieved.

Incidentally, the closing operation is performed by rotating the lever **18** clockwise by the driving means.

Although the joint portions between the levers of the link device often provide the cause of concentration of electric field during the closing and breaking operations, the fact that uniform electric field is established between the link device **20** and the wall of the tank **1** by means of the connecting conductor **5** allows effective utilization of the superior insulation characteristic of the arc extinction gas.

In place of the arrangement of the above-described embodiment in which the connecting conductor **5** serves both as an electric path and as a shield means, the electric conduction may be accomplished mainly by the link bracket **17**. In other words, the link bracket **17** may function also as a connecting conductor, while the shield means without any conductive functions is provided separately. In that case, it is not necessary to maintain the shield means at the same potential as the breaking sections which is at the potential of the power line, although it should not be at the earth potential. Also, it may take other shapes and structures than that described above.

In the event that the connecting conductor **5** serves also as the shield device, the link bracket **17** only has to fulfil the mechanical requirements, thereby making it possible to apply a bracket of the same type commonly to a circuit breaker with different capacity. Alternatively, the circuit breaker according to the invention may be so arranged that mechanical support thereof and electrical connection between the two breaking sections are undertaken by the link bracket **17** and the connecting conductor **5** respectively, and that the shielding of the link device from the tank is accomplished by a separate shield device.

The present invention is not limited to the gas circuit breaker of puffer type, but it may be applied also effectively to other types of grounded tank circuit breakers including oil circuit breakers, air circuit breakers or double pressure type gas circuit breakers.

It will be noted from the above explanation that the circuit breaker according to the present invention is provided with a shield means between the tank wall and a link device for conveying driving force from the driving means to the movable portions of the breaking sections and therefore concentration of electric field which otherwise might occur due to the protruded formation of the link device as a result of operation of the breaker, is effectively prevented, thus eliminating the need for a greater diameter of the tank. Further, the fact that the shield device can be utilized also as a connecting conductor simplifies the construction of the breaker, resulting in a low-cost circuit breaker of grounded type.

What we claim is:

1. A circuit breaker of a grounded tank type comprising:

a. a grounded tank containing an arc-extinguishing gas;

b. first and second breaking sections disposed in the grounded tank, each of said breaking sections including

a stationary contact,

a movable contact opposed to the stationary contact,

a movable cylinder integral with the movable contact,

and a fixed piston cooperating with the moveable cylinder to produce a pressurized arc-extinguishing gas;

c. a link device interposed between said first and second breaking sections for transmitting driving force from a driving source to the respective movable cylinders of said first and second breaking sections;

d. supporting means which supports said first and second breaking sections in the grounded tank through the respective fixed piston; and

e. conductive means electrically connecting said first and second breaking sections in series and substantially enclosing said link device for shielding said link device from the grounded tank.

2. A circuit breaker of a grounded tank type according to claim **1**, in which a cross section of said conductive means is "U" shaped.

3. A circuit breaker of a grounded tank type according to claim **1**, in which said conductive means is made of copper.

4. A circuit breaker of a grounded tank type according to claim **1**, in which said conductive means is made of aluminum.

5. A circuit breaker of a grounded tank type according to claim **1**, wherein said movable cylinder is mounted to be movable relative to said fixed piston such that during an opening movement of said first and second breaking sections by said link device said arc-extinguishing gas is compressed in said movable cylinder to a pressure sufficiently high to be blown between said stationary contact and said movable contact.

6. A circuit breaker of a grounded tank type according to claim **1**, wherein said supporting means also acts to electrically connect said first and second breaking sections.

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