Sept. 1, 1964 A. HOCHRAINER ETAL 3,147,357

CIRCUIT BREAKER CAPABLE OF SERVING AS A DISCONNECT SWITCH

Filed May 16, 1962

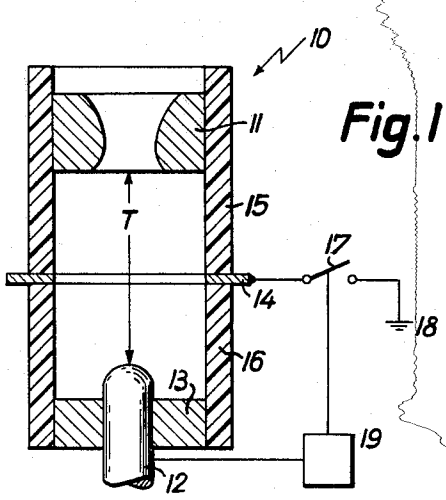


Fig. 1

Fig. 2

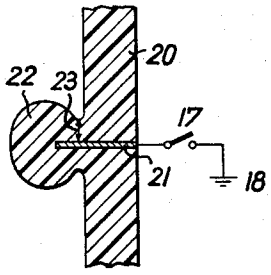


Fig. 3

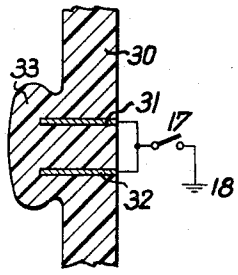


Fig. 4

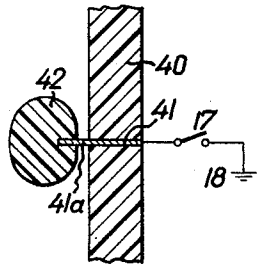
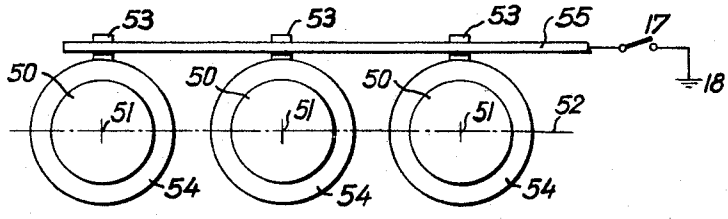


Fig. 5



Inventors:

AUGUST HOCHRAINER

WOLFGANG SCHICK

BY: George H. Spencer

ATTORNEY

United States Patent Office 3,147,357 Patented Sept. 1, 1964

3,147,357

CIRCUIT BREAKER CAPABLE OF SERVING AS A DISCONNECT SWITCH

August Hochrainer, Kassel, and Wolfgang Schick, Kassel-Brasselsberg, Germany, assignors to Licentia Patent-Verwaltungs-G.m.b.H., Frankfurt am Main, Germany

Filed May 16, 1962, Ser. No. 195,065
Claims priority, application Germany May 18, 1961
16 Claims. (Cl. 200—146)

The present invention relates to a switch, and, more particularly, to a circuit breaker which is capable of serving as a disconnect switch as well.

There exist high-voltage circuit breakers which are especially adapted to interrupt the flow of heavy current. Such circuit breakers are generally used in conjunction with so-called disconnect switches whose contacts, when open, are spaced sufficiently far apart to form a spark gap which will prevent arc-over. Such disconnect switches have to meet very rigid design standards because the flow of leakage currents along the surfaces of the insulating parts which separate the two contacts must be prevented, least breakdown of the insulation occur.

It is, therefore, an object of the present invention to provide a circuit breaker which is also capable of serving as a disconnect switch, and, with this object in view, the present invention resides in a switch in which the insulation which separates the open contacts is interrupted by a metallic electrode which, when the circuit breaker is opened, is grounded.

In one embodiment of the present invention involving a high-voltage, high-current circuit breaker having contacts arranged within a switching chamber made of insulating material, the metallic electrode divides this chamber into two parts and is located at a point along the distance by which the switch contacts, in open position, are separated. The electrode may be in the form of a ring which extends in a plane transverse to the mentioned distance. The term "ring" is not to be taken literally, since the actual configuration of the grounding electrode will depend on the cross-sectional configuration of the insulation forming the switching chamber. The "ring" need therefore not be fully closed.

Additionally objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a sectional view of one embodiment of a circuit breaker according to the present invention.

FIGURE 2 is a fragmentary sectional view of a modification of a circuit breaker according to the instant invention.

FIGURE 3 is a fragmentary sectional view of another modification of a circuit breaker according to the present invention.

FIGURE 4 is a fragmentary sectional view of yet another modification of a circuit breaker according to the instant invention.

FIGURE 5 shows the electrode arrangement of a multiple-pole switch arrangement incorporating three circuit breakers according to the present invention.

Referring now to the drawings, the same show, in FIGURE 1, a circuit breaker **10** incorporating a stationary contact **11** and a movable contact **12**, the latter being movable between a closed position in which the two contacts are in engagement with each other and an open position in which the movable contact **12** is spaced a distance T from the stationary contact **11**. The contact **12** passes through a ring **13**, and both the ring **13** and the stationary contact **11** are connected to an insulator whose walls form a closed switching or arc-extinguishing chamber within which the switching action

occurs. As shown in FIGURE 1, the two contacts **11** and **12**, in open position, are thus separated from each other not only by the gaseous medium in the switching chamber, namely, air or an inert gas, but also by the wall of the switching chamber which bridges the distance T. This wall inherently provides a path for leakage currents which, in turn, gives rise to the possibility of electric breakdown and arc-overs. According to the present invention, however, such leakage currents are prevented from causing any arc-over by the presence of a metallic electrode **14** located at approximately the midpoint of the distance T and dividing the switching chamber into two parts **15** and **16**. In the illustrated embodiment, the wall of the switching chamber is cylindrical, and the electrode **14** is in the form of a ring whose width is at least equal to the thickness of the wall; in practice, however, it is desirable to make the ring electrode somewhat wider than the thickness of the wall so that it will project outwardly beyond the outer surface of the wall.

The electrode **14** is connected to a switch **17** which, when closed, connects the electrode **14** to ground, at **18**. The switch **17** is mechanically and/or electrically connected with the moving device which moves the contact **12** so that the switch **17** is closed whenever the main circuit breaker contacts **11**, **12**, are open. The interlock between the contact **12** and the switch **17** is shown schematically at **19**.

The distance T is so selected as to meet the requirements of a high-voltage disconnect switch.

In practice, the circuit breaker device according to the instant invention is incorporated in a multiple-pole switching arrangement comprising a plurality of such circuit breakers. In order to prevent arc-overs between the individual phases during the time when the electrode **14** is not grounded, and in order to make it possible to arrange the circuit breakers as closely together as possible, the projecting portion of the grounding electrode which extends laterally beyond the outer surface of the wall is likewise insulated. This insulation is preferably in the form of a bead. In order to make certain that, despite this bead, the operating standards of the spark gap are maintained, namely, that the grounding electrode will take up leakage currents which may flow along the outside of the insulation due, for instance, to dirt particles which accumulate on the outside of the insulation or to atmospheric influences, the bead is so shaped that an electric breakdown of the insulating material of which the wall is made will cause an arc-over from the outer surface to reach the electrode before it can go past the bead or jump to an adjacent phase.

FIGURE 2 shows such a wall **20** carrying the grounding electrode **21** whose laterally extending projecting portion is embedded within a bead **22**, the latter being integral with the wall **20**. Any breakdown which may occur will take place at the place where the insulation is thinnest, as shown by the distance **23**. Thus, the breakdown will reach the electrode **21** before it can go around the bead **22**.

FIGURE 3 shows an arrangement similar to that of FIGURE 2, except that the wall **30** has two grounding electrodes **31** and **32** which are spaced some distance from each other. The two electrodes are at the same electrical potential and have their projecting portions embedded within a common bead **33**. The advantage of this double electrode arrangement is that the field distribution at the surface of the bead is more favorable for meeting the requirement that breakdown occur to the grounded electrode rather than past the bead. This is so because there is a certain region at the surface of the bead, the size of which region is determined by the distance between the two electrodes **31**, **32**, in which region there is no drop of potential.

FIGURE 4 shows an even more advantageous arrange-

ment in which the wall 40 carries a grounding electrode 41 which is but partly embedded in a bead 42. As is illustrated, only the extreme end of the projecting portion of the electrode 41 is embedded, there thus being a free section 41*a* which is located between the outer surface of the wall 40 and the bead 42. This allows leakage currents flowing along the outside of the wall 40 to reach the electrode 41 just as easily as leakage current flowing along the inside of this wall, without first having to pass through any insulation at all.

FIGURE 5 shows a three-phase switching arrangement incorporating three circuit breakers 50 according to the present invention. The circuit breakers are aligned so that their central axes 51 lie in a common plane 52, and the several grounding electrodes 53 pass through the respective beads 54 only in a direction which is at right angles to the plane 52, it being at these points that the electrodes 53 are connected to a grounding conductor 55.

As stated above, the grounding electrode will be located approximately at the midpoint of the distance T. In the case of multiple-pole switching arrangements incorporating a plurality of individual circuit breakers, the electrodes of the respective circuit breakers are preferably located at different points along the respective distances, i.e., the physical positioning of the respective electrodes will be staggered with respect to each other.

As likewise stated above, the switching chamber may be annular. In that case, the grounding electrode should be made of non-magnetic material, or, if made of magnetic, i.e., magnetizable, material, the electrode should be radially slotted so as to form but an incomplete annulus. The purpose of this is to prevent the ring from acting as a magnetic short-circuit ring.

It will be appreciated that, by virtue of the above-described arrangements, it is no longer necessary to provide a special disconnect switch in conjunction with a high-voltage, high-current circuit breaker. As a result, switching stations may be more compact and thus occupy less space.

It will be understood that the above description of the present invention is susceptible to various modifications, changes, and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is:

1. A circuit breaker capable of serving as a disconnect switch, comprising, in combination:

(*a*) two contact means at least one of which is movable with respect to the other between a closed position wherein said contact means are in engagement with each other and an open position wherein said contact means are spaced a given distance from each other;

(*b*) insulating means bridging said distance and separating said contact means when the same are in their open position;

(*c*) an electrode in said insulating means at a point along said distance; and

(*d*) means for grounding said electrode when said contact means are in their open position.

2. A circuit breaker as defined in claim 1 wherein said insulating means form a switching chamber within which said movable contact means move, and wherein said electrode extends transversely to said distance by which said contact means, when in their open position, are spaced apart.

3. A circuit breaker as defined in claim 2 wherein said switching chamber is composed of two parts which are separated by said electrode.

4. A circuit breaker as defined in claim 2 wherein said electrode is located approximately at the middle of said distance.

5. A multiple-pole switching arrangement comprising a plurality of circuit breakers as defined in claim 2, wherein the electrodes of the respective circuit breakers are located at different points along the respective distances.

6. A circuit breaker as defined in claim 2 wherein said switching chamber is constituted by wall means having an outer surface and wherein said electrode has a projecting portion extending laterally beyond said outer surface.

7. A circuit breaker as defined in claim 6 wherein said projecting portion of said electrode is at least partially embedded within a bead made of insulating material.

8. A circuit breaker as defined in claim 7 wherein said projecting portion of said electrode is embedded entirely within said bead, the latter being integral with said wall means.

9. A circuit breaker as defined in claim 8 wherein said bead is so shaped that an electric breakdown of the insulating material of which said wall means is made will cause an arc-over from said outer surface to reach said electrode before it can traverse said bead.

10. A circuit breaker as defined in claim 7 wherein said bead embeds only the extreme end of said projecting portion of said electrode, there thus being a free section of said projecting portion which is located between said outer surface and said bead.

11. A circuit breaker as defined in claim 2, further comprising at least one additional electrode which is also located in said insulating means at a point along said distance, said additional electrode being spaced from the first-mentioned electrode, and both electrodes being at the same electrical potential.

12. A circuit breaker as defined in claim 11 wherein said switching chamber is constituted by wall means having an outer surface, wherein each of said electrodes has a projecting portion extending laterally beyond said outer surface, and wherein said projecting portions of said two electrodes are embedded in a common bead made of insulating material.

13. A circuit breaker as defined in claim 2 wherein said switching chamber is annular and wherein said electrode is likewise annular.

14. A circuit breaker as defined in claim 13 wherein said electrode is made of non-magnetic material.

15. A circuit breaker as defined in claim 13 wherein said electrode is made of magnetic material and is radially slotted so as to form but an incomplete annulus.

16. A multiple-pole switching arrangement comprising a plurality of circuit breakers as defined in claim 2, said circuit breakers being aligned so that their central axes lie in a common plane, each respective electrode having a free projecting portion extending in a direction which is at right angles to said common plane, and said grounding means being connected to said electrodes at said respective free projecting portions thereof.

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