United States Patent

Boersma et al.

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[54] METAL CLAD ISOLATOR SWITCHES FOR HIGH TENSION AND DOUBLE INTERRUPTION

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** .....**200/163,** 200/48 R, 200/148 F

[51] **Int. Cl.**.....**H01h 33/42,** H01h 31/32, H01h 3/32

[58] **Field of Search** .....200/163, 148 F, 48 R, 153 H, 200/148 B

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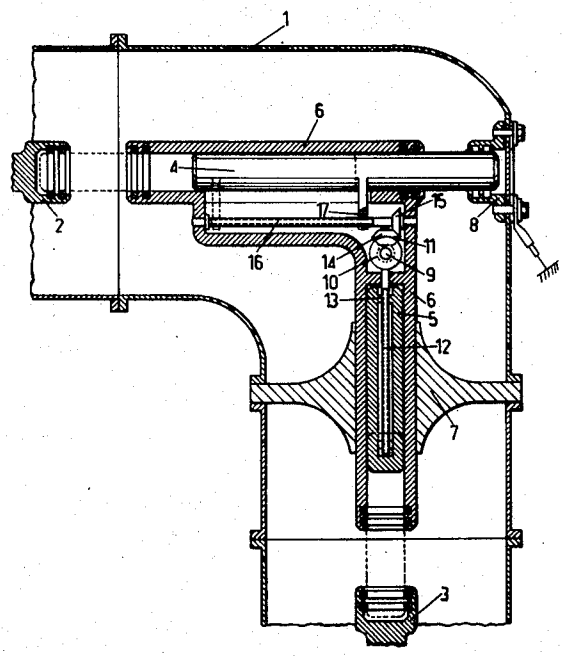
[57] **ABSTRACT**

A metal clad isolator switch for high voltage and double interruption, comprising two permanently electrically interconnected mechanically coupled, axially movable switching rods directed in respect of each other at an angle which is smaller than 180° and each cooperating with their one end portion with an individual one of two insulatedly mounted fixed contacts and at least one of said switching rods cooperating with its other end portion with a third fixed contact.

12 Claims, 9 Drawing Figures



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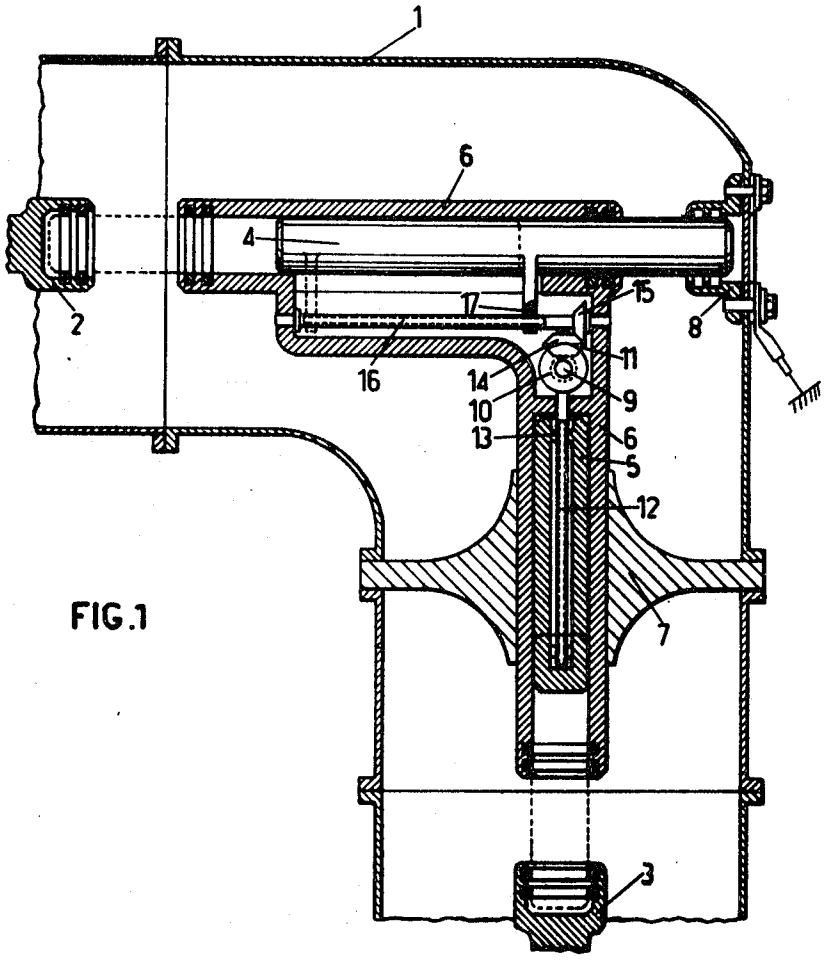

FIG.1

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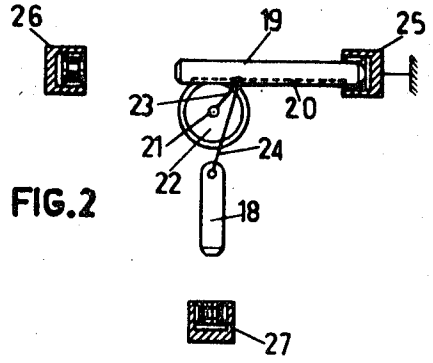

FIG.2

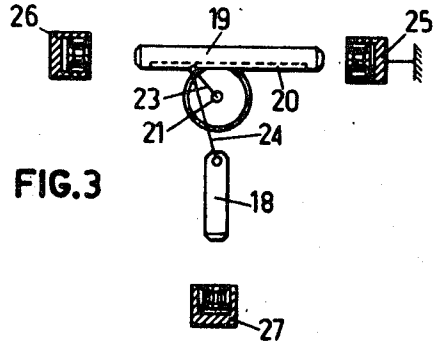

FIG.3

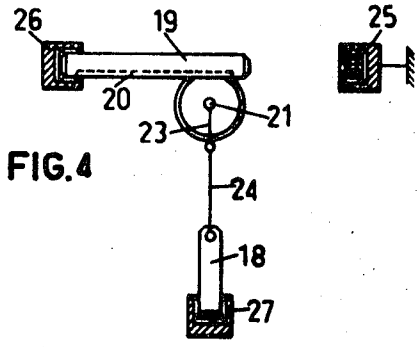

FIG.4

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3 Sheets-Sheet 3

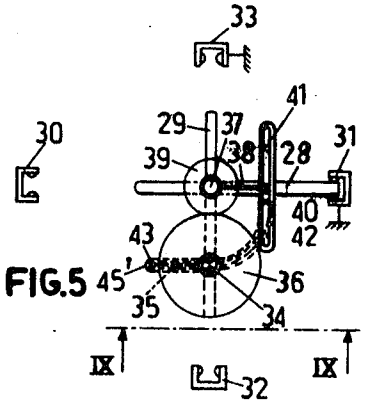

FIG.5

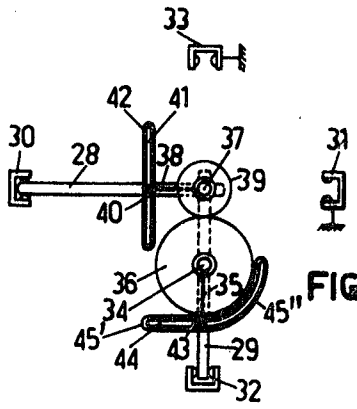

FIG.6

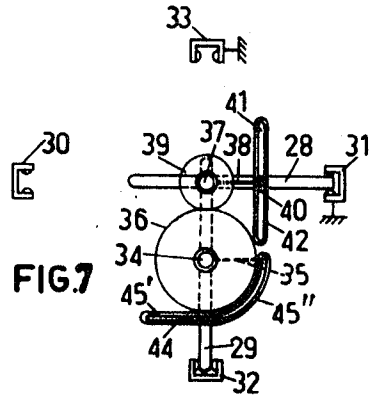

FIG.7

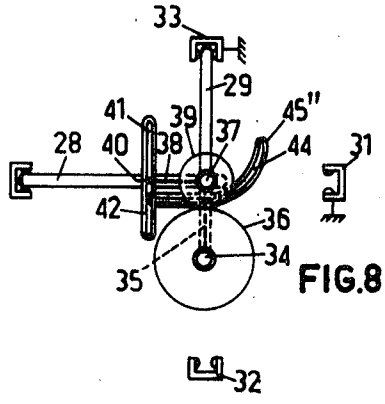

FIG.8

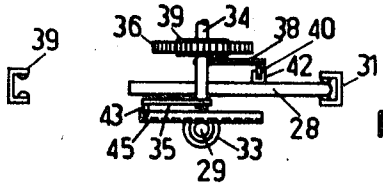

FIG.9

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METAL CLAD ISOLATOR SWITCHES FOR HIGH TENSION AND DOUBLE INTERRUPTION

The invention relates to a metal clad isolator switch for high voltage and double interruption, comprising a metal envelope intended to be connected with earth, within which two spaced apart fixed contacts and two permanently electrically interconnected, mechanically coupled, axially movable switching rods are provided in the space left between the fixed contacts and which are supported by an electrically conductive support within which driving means are insulatedly accommodated, the first one of said switching rods cooperating with one fixed contact and the second one thereof cooperating with the other fixed contact, and a device adapted to earth said support and the switching rods.

In the known double interrupting isolator switches of this kind the switching rods are in alignment with each other and they move in opposite directions. This makes it necessary to use an individually movable switching contact in order to ground the support and the switching rods. Furthermore these isolator switches have in the longitudinal direction of the switching rods a relatively large dimension.

The invention has the object to provide a double interrupting isolator switch, in which an individually movable switching contact for the earthing device and locking means between said switching contact and the switching rods of the isolator switch can be dispensed with and in which a relatively compact construction is possible. This is achieved in that the switching rods are directed in respect of each other at an angle which is smaller than 180°, the path of the first switching rod extending on both sides of the line coinciding with the longitudinal axis of the second switching rod and the first switching rod contacting in its one end position the fixed contact cooperating with said switching rod with its one end portion and in its other end position a third fixed contact with its other end portion. If this third fixed contact is connected with earth the first switching rod forms at the same time the movable switching contact of the earthing device. As one of the two switching rods and the movable earthing contact are formed by one and the same switching rod, locking means between said earthing contact and the switching rods are superfluous.

Preferably the switching rods are directed in respect of each other at right angles. This construction of the isolator switch makes it relatively compact and facilitates the assembly of the isolator switch with other parts of a metal clad switching plant. The most compact construction is obtained, that means the cross dimensions of the earthed envelope can be a minimum, when the longitudinal axes of the switching rods lie in one and the same plane.

In many cases a construction is recommended, in which the paths of the switching rods intercross and the second switching rod contacts in its one end position the fixed contact cooperating with said switching rod with its one end portion and in its other end position a fourth fixed contact with its other end portion. If in that case both the third and the fourth fixed contacts are connected with earth, it will not only be possible to connect the support and the switching rods with earth, when the isolator switch is in its open condition, but also to ground alternately the external conductors of the circuit which are connected to the isolator switch. If, on the other hand, only the third fixed contact is connected with earth, it will be possible to connect the fixed contact of the isolator switch cooperating with the first switching rod and the external conductor connected to said fixed contact either with an external conductor connected to the other fixed contact of the isolator switch or with an external conductor which is connected to the fourth fixed contact. The double interrupting isolator switch then operates as a change-over switch.

The invention will be elucidated with the aid of the drawing; therein show:

FIG. 1 an axial sectional view of a first embodiment of a double interrupting isolator switch according to the invention,

FIGS. 2, 3 and 4 diagrammatical views of three different positions of the cooperating contacts and the driving mechanism of a second embodiment of such an isolator switch,

FIGS. 5, 6, 7 and 8 diagrammatical views of four different positions of the cooperating contacts and the driving mechanism of a third embodiment of such an isolator switch and

FIG. 9 a sectional view in line IX—IX in FIG. 5.

In FIG. 1 an metal envelope connected with earth is designated by 1. Two fixed contacts 2 and 3 and two axially movable switching rods 4 and 5 are insulatedly accommodated in said envelope. These fixed contacts 2, 3 and these switching rods 4, 5 form together the essential part of a double interrupting isolator switch. The switching rod 4 cooperates with the fixed contact 2 and the switching rod 5 cooperates with the fixed contact 3. The switching rods 4, 5 are supported and electrically conductively interconnected by a metal support 6 which is kept in place in the envelope 1 by an insulator 7. The path of the switching rod 4 intersects the extension of the longitudinal axis of the switching rod 5. The switching rod 4 cooperates with its end remote from the fixed contact 2 with a third fixed contact 8, which is directly attached to the envelope 1 and thereby also connected with earth. In the shown position the isolator switch is in its open condition and the support 6 and the switching rods 4, 5 are connected with earth. Consequently, the switching rod 4 of the isolator switch forms at the same time the movable switching contact of the earthing switch 4, 8.

To drive the switching rods the support 6 is provided with a driving mechanism which consists of a rotatable driving shaft 9 adapted to be operated from the outside and carrying a bevel toothed wheel 10 which meshes with a bevel toothed wheel 11 fixed to a screw spindle 12 extending centrally in the switching rod 5. This screw spindle extends through an opening provided with corresponding femal thread of a partition 13 provided in the switching rod 5 and said spindle is coupled through cooperating bevel toothed wheels 14, 15 with a second screw spindle 16 which extends through an opening provided with corresponding femal thread of an arm 17 attached to the switching rod 4. The switching rods 4 and 5 are thus mechanically coupled and they will be moved in their axial directions when the driving shaft 9 is rotated.

The driving mechanism of the isolator switch shown in FIG. 1 comprising screw spindles makes it necessary to move the switching rod 5 through a distance which is equal to the stroke of the switching rod 4. The stroke of each one of the two switching rods is equal to the sum of the stroke, which is necessary to achieve a safe separation between a fixed contact 2, 3 and the switching contact 4, 5 cooperating therewith in the isolator switch, and the stroke, which is necessary to ground the support 6 and the switching rods 4, 5. Thus the stroke of the switching rod 5 becomes unnecessarily large.

The isolator switch illustrated in FIGS. 2, 3, 4 is provided with a driving mechanism restricting the stroke of the switching rod 18 to the dimension which is necessary to achieve said safe separation. In said isolator switch the switching rod 19 is provided with a rack 20 which is engaged by a toothed wheel 22 fixed to the driving shaft 21. Mounted on the driving shaft 21 is also a crank arm 23 which is coupled by a coupling rod 24 with the switching rod 18.

In the position shown in FIG. 2 the isolator switch is in its open condition and the switching rods 18 and 19 are connected with the earthed fixed contact 25. If the switch must be closed the driving shaft is rotated counter-clockwise. During the closing operation the intermediate position shown in FIG. 3 is passed. In this intermediate position the switching rod 19 is free from the contact 25 but it is still at a safe distance from the fixed contact 26 of the switch. The switching rod 18, which during the first part of the closing operation is hardly moved, is then also still at a safe distance from the fixed contact 27 of the switch. Only during the second part of the closing operation the switching rods 18 and 19 are moved towards the fixed contacts 27 and 26 and brought into their closed positions as illustrated in FIG. 4.

In the embodiment of the isolator switch shown in FIGS. 5–9 the two axially movable switching rods **28, 29** intercross. The switching rod **28** cooperates with its one end portion with the fixed contact **30** and with its other end portion with the fixed contact **31**, whereas the switching rod **29** cooperates on one hand with the fixed contact **32** and on the other hand with the fixed contact **33**. In the present embodiment the fixed contacts **31** and **33** are both connected with earth.

The driving mechanism of this isolator switch comprises a driving shaft **34** provided with a crank arm **35** and a toothed wheel **36**, an auxiliary shaft **37** provided with a crank arm **38** and a toothed wheel **39** meshing with the toothed wheel **36**. The crank arms **35** and **38** are of the same lengths and the diameter of the toothed wheel **36** is twice the diameter of the toothed wheel **39**. The crank arm **38** engages with a peg **40** a slot **41** of a transverse beam **42** attached to the switching rod **28** and the crank arm **35** engages with a peg **43** a slot **44** of a beam attached to the switching rod **29** and having a straight portion **45'** which is transversely directed to the switching rod **29** and an other portion **45''** in the form of a quarter of a circle, of which the radius is equal to the crank arm **35**.

In the position shown in FIG. **5** the isolator switch is open and the switching rods **28, 29** are connected with earth through the fixed contact **31**. If the driving shaft **34** is rotated counter-clockwise from the position shown in FIG. **5** through an angle of 90° the position illustrated in FIG. **6** is reached. In said position the switch is closed. A further counter-clockwise rotation of the driving shaft through an angle of 90° puts the switch into the position shown in FIG. **7**, in which the external conductor, e.g., a cable, connected to the fixed contact **32** of the switch is grounded through the contact **31**. If the driving shaft **34** is rotated clockwise from the position shown in FIG. **5** through an angle of 90° the switch will be put into the position shown in FIG. **8**, in which the conductor, e.g., the connecting conductor leading to other parts of the switching plant, connected to the fixed contact **30** of the switch is earthed through the fixed contact **33**.

It is observed that the fixed contact **33** may be connected with a part of the switching plant instead with earth. If, for instance, the fixed contacts **32** and **33** are connected with the conductors of different busbar systems the part of the switching plant which is connected with the fixed contact **30** can be connected by the isolator switch illustrated in FIGS. **5–9** either with one or with the other busbar system.

What we claim is:

1. A metal clad isolator switch for high voltage and double interruption, comprising a metal envelope intended to be connected with earth, at least three spaced apart fixed electrical contacts, two permanently electrically interconnected, mechanically coupled, axially movable switching rods provided in the space left between said fixed contacts, driving means associated with said movable switching rods and an electrically conductive support, said support carrying said switching rods and said driving means, at least two of said fixed contacts, said switching rods, said support and said driving means being insulatedly mounted in said envelope, said switching rods being directed in respect of each other at an angle which is smaller than 180°, at least the path of the first one of said switching rods extending on both sides of the line coinciding with the longitudinal axis of the second one of said switching rods, each switching rod cooperating with an individual one of said insulatedly mounted fixed contacts and said first switching contact cooperating also with said third contact and contacting in its one end position the respective insulatedly mounted fixed contact with its one end portion and in its other end position said third fixed contact with its other end portion.

2. A metal clad isolator switch as claimed in claim **1**, in which the switching rods are directed in respect of each other at right angles.

3. A metal clad isolator switch as claimed in claim **1**, in which the longitudinal axes of the switching rods lie in one and the same plane.

4. A metal clad isolator switch as claimed in claim **1**, in which the paths of the switching rods intercross, a fourth fixed contact is provided and the second switching rod cooperates also with said fourth fixed contact and contacts in its one end position the respective insulatedly mounted fixed contact with its one end portion and in its other end position said fourth fixed contact with its other end portion.

5. A metal clad switch for double interruption of high voltage electrical systems, comprising in combination;

an electrically conductive metal envelope having a first tubular branch and a second tubular branch extending at an angle to said first branch;

means electrically grounding said envelope;

a fixed ground contact mounted within said envelope between said branches aligned with said first branch;

a fixed electrical circuit second contact substantially centered within said first branch so as to be isolated from said envelope, said second contact being aligned with said ground contact and disposed in selected spaced relation thereto;

a fixed electrical circuit third contact substantially centered within said second branch and substantially spaced from the alignment axis between said second contact and said ground contact;

an electrically conductive support disposed within said envelope between said branches and spaced from said ground contact as well as both said second and said third contacts, said support having a first bore extending therethrough aligned with said first branch along the axis of alignment between said second contact and said ground contact and having a second bore aligned with said second branch and said third contact;

a first switching rod slidably received in said first bore and having a length less than said selected spacing but sufficient to bridge between said support and either said second contact or said ground contact;

a second switching rod slidably received in said second bore and having a length sufficient to bridge between said support and said third contact; and

means for simultaneously actuating said first and second switching rods axially between first positions connecting said second and third contacts through said switching rods and said support and second positions in which said first switching rod electrically connects said support to said ground contact and both switching rods are separated from the respective second and third contacts.

6. A metal clad switch as defined in claim **5** wherein said first and second bores extend at right angles to each other within a common plane.

7. A metal clad switch as defined in claim **5** wherein said second bore also extends through said support;

a fourth contact within said envelope in alignment with said second bore and spaced beyond said support on the other side thereof from said third contact;

said second switching rod in said second position thereof bridging between said support and said fourth contact.

8. The metal clad switch as defined in claim **7** wherein said fourth contact is electrically grounded.

9. The metal clad switch as defined in claim **7** wherein said second switching rod in its second position bridges between said support and said fourth contact and said means selectively actuates said switching rods such that (1) said first and second switching rods simultaneously are in their first positions, (2) said first switching rod is in its second position while said second switching rod is in an intermediate position out of contact with both said third and said fourth contacts, (3) said first switching rod is in its second position while said second switching rod is in its first position, and (4) said first switching rod is in its first position while said second switching rod is in its second position.

10. The metal clad switch as defined in claim **9** wherein said fourth contact is electrically grounded.

11. The metal clad switch as defined in claim 9 wherein said means comprises a first rotatable drive element connected to said first switching rod and a second rotatable drive element coupled to said first rotatable drive element and connected to said second switching rod, said second drive element rotating at one-half the rate of said first drive element.

12. The metal clad switch as defined in claim 11 wherein said switching rods are disposed in orthogonal planes.

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