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[54] **METAL-CLAD ISOLATOR SWITCHES COMPRISING EARTHING DEVICES**
8 Claims, 1 Drawing Fig.

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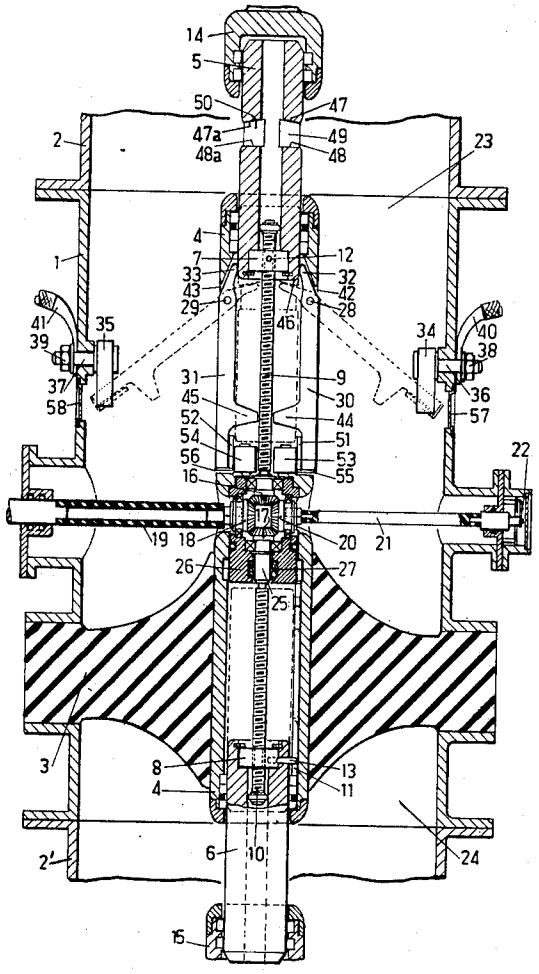
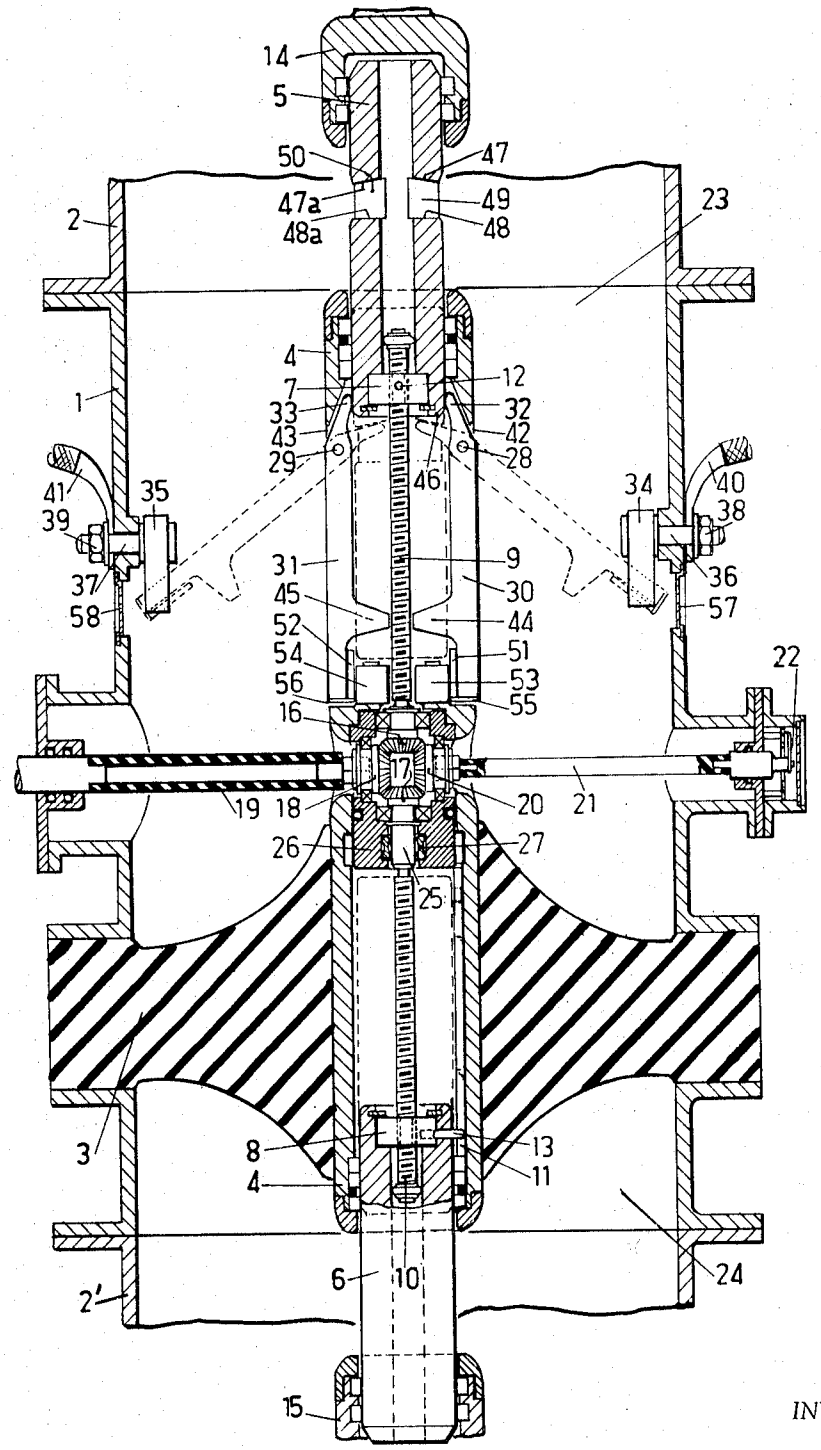
ABSTRACT: A metal-clad isolator switch for high voltage, comprising fixed contacts, movable switching contacts cooperating with said fixed contacts and at least one earthing switch, of which the fixed contact is attached to the envelope of the isolator switch and the movable contact is carried by the holder of the movable switching contacts of the isolator switch, said movable earthing contact being directly mechanically driven and directly mechanically locked in either end position by a movable switching contact of the isolator switch.





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METAL-CLAD ISOLATOR SWITCHES COMPRISING EARTHING DEVICES

BACKGROUND AND SUMMARY OF THE INVENTION

The invention relates to a metal-clad isolator switch for high voltage systems, comprising a metal envelope intended to be connected with earth, in which two axially spaced fixed contacts and two axially movable switching rods are accommodated in but insulated from said envelope. The switching rods are provided in the space between the fixed contacts and are permanently electrically conductively interconnected by an electrically conductive holder provided with driving means. One of said switching rods cooperates with one fixed contact and the other switching rod cooperates with the other fixed contact, said holder being supported by an insulator attached to the envelope, which insulator divides the space inside the envelope into two switching chambers which are separated from one another in a gastight manner, each containing a fixed contact and a switching rod. A device for earthing the holder and the switching rods when the isolator switch is in its opened condition is provided within the envelope.

In isolator switches of this kind the switching rods and the earthing switching contact or contacts must be coupled in such a manner that the earthing switching contact is brought into its closed position. Prior to the time that the switching rods reach said safe distance, the earthing switching contact is locked in its open position. Moreover, there must be such a coupling between the isolator switch and the earthing switch such that the earthing switch is in its closed position with certainty when the isolator switch is in its open position. If the switching rods are not used at the same time as earthing switching contacts, as is often found in rotary switches for double interruption, the switching rods and the earthing switching contact must be so interconnected through their driving mechanisms or through individual locking means as to ensure the right sequence of driving operations of and a safe locking action between said rods and said contact. Consequently, the known devices required are complicated and sensitive to disturbances.

The invention has the object to provide an isolator switch comprising an earthing device, in which the switching sequence and the interlocking of the various switching contacts is achieved in a simple mechanical manner and with great reliability in operation. This is attained in that the earthing device consists of at least one fixed contact attached to the envelope and at least one switching contact cooperating with the fixed contact and pivotally connected to the holder, said switching contact being adapted to be swung about a transverse axis and being directly mechanically driven by one of the switching rods and said switching contact being directly mechanically locked either in its contact-breaking position or in its contact-making end position by said switching rod, when the latter is in its respective contact-making or in its contact-breaking end position. Just like the isolator switches comprising separate earthing switching contacts the isolator switch constructed in accordance with the invention has, in comparison with the mentioned rotary switches, the advantage that the insulating distances within the envelope can be kept small and the provision of a satisfactory seal between the separated switching chambers is possible, which is particularly important with regard to the requirement that one must be able to open either one of the two switching chambers for inspection and repair purposes, while the other switching chamber remains electrically alive and under overpressure. Relative to the isolator switches having separate earthing switching contacts the isolator switch constructed in accordance with the invention has the advantage of a reliable coupling and interlocking of the various movable contacts due to the direct mechanical coupling thereof.

A simple construction is obtained according to the invention by using a switching contact of the earthing device which forms one arm of a two-arm lever and is provided with a cam, the other arm of said lever being in the form of a tail for driving the earthing switching contact and locking same in either one of its end positions. Said cam and said tail cooperate directly with pressure surfaces of one of the isolator switching rods such that just before the switching rod has reached, during its contact-breaking movement, its contact-breaking end position, a first pressure surface of the switching rod engages said cam, whereby the earthing switching contact is swung a little in the contact-making direction and brought with its tail within the reach of a second pressure surface of the switching rod. As a consequence the switching contact is forced by said second pressure surface into and is locked in the contact-making end position, and just after said switching rod has left, during its contact-making movement, its contact-breaking end position a third pressure surface of the switching rod engages the tail of the earthing switching contact, whereby said earthing switching contact is swung back into the contact-breaking end position and, during the further contact-making movement of the switching rod, said earthing switching contact is locked in its contact-breaking end position by said rod. Consequently, in this way the switching rods and the earthing switching contact are coupled without any connecting member, which is of considerable benefit to the reliability and the safety in operation.

The isolator switch may be advantageously constructed in such a manner that the holder is a metal tube which surrounds the switching rods entirely or almost entirely when they are in their contact-breaking end position, said holder being provided with at least one longitudinal slot to receive an earthing switching contact when such contact is in its contact-breaking end position, and two rotatable threaded spindles are provided which extend in the axis of said tube and are coupled both with each other and with a transversely directed driving shaft of insulating material by driving means accommodated in said tube, each spindle extending in a central cavity of a switching rod and cooperating with a nut attached to said switching rod and locked against rotation. The tubular holder then operates at the same time as a screen for the electrical potential distribution when the isolator switch is in its closed condition and the earthing switching contact is in its opened condition. This allows of the radial insulating distance to be decreased, notwithstanding the fact that one or more eccentrically disposed earthing switching contacts are attached to the holder.

A simple driving mechanism, to which also a position indicator may be positively coupled, is obtained by constructing the driving means to consist of two conical toothed wheels, each of which is secured to a threaded spindle, and of a third conical toothed wheel meshing with said two conical toothed wheels and secured to the driving shaft constructed of insulating material, and in which at least a fourth conical toothed wheel forms part of the driving means, said fourth conical wheel also meshing with the two conical toothed wheels of the threaded spindles and being coupled with a position indicator by a shaft of insulating material which is transversely directed to the tubular holder. In this isolator switch the position indicator is coupled with the inner driving means independently of the driving shaft for the transmission of the driving torque, whereby the danger of a faulty indication of the state of the isolator switch is reduced. In order to obtain complete certainty about the conditions of the switches mounted in the envelope it is recommended to let each earthing switching contact cooperate with a device provided on the earthed metal envelope and intended to indicate the contact-making end position of said switching contact. This device may, for instance, be a marked end face of the earthing switching contact which appears behind a window of the envelope, when said switching contact is in its contact-making end position.

The isolator switch provided with the tubular holder can be readily divided into two parts which are separated from each other in a gastight manner. For this purpose the tubular holder is provided with at least one partition, through which a cylindrical end portion forming part of a threaded spindle and facing the driving means extends in a gastight manner. The provision of a rotatable shaft extending through a wall does not

offer great difficulty in sealing even at great differences between the pressures on both sides of said wall. Since only one threaded spindle has to extend through the partition provided in the tubular holder, one switching rod may be provided entirely on one side and the other switching rod may be provided entirely on the other side of said partition. Both switching rods are then pneumatically relieved of stresses, irrespective of whether the gas pressure on both sides of said partition are equal or unequal, so that the driving mechanism need not operate against a pressure difference.

In order to avoid jamming of the switching rods just before they reach their contact-breaking end positions due to the earthing switching contact (which is then still in its contact-breaking end position) becoming loose, it is recommended to provide the holder with a magnet, by means of which the earthing switching contact is kept in its contact-breaking end position until said earthing switching contact is locked in its contact-breaking end position or forced towards its contact-making end position by the switching rod cooperating therewith.

BRIEF DESCRIPTION OF THE DRAWING FIGURE

The drawing is an axial sectional view of an isolator switch comprising an earthing device constructed in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

In the drawing the reference numerals **1**, **2** and **2'** designate parts of a tubular metal envelope intended to be connected to earth and within which a disc-shaped insulator **3** is mounted to separate the chambers on spaces **23** and **24** from each other. Mounted concentrically of the tubular envelope is a tubular metal holder **4** which extends through the insulator **3** in a gastight manner. The holder **4** is provided with two axially movable hollow switching rods **5** and **6**, which mount respective nuts **7** and **8** receiving the respective threaded spindles **9** and **10** which extend in the axis of the holder **4** and the switching rods **5** and **6**. The nuts **7** and **8** and the switching rods **5** and **6** are secured against rotation by respective pins **12** and **13** engaging longitudinal grooves **11** (only one shown) of the holder **4**. The switching rods **5** and **6** are adapted to be axially moved in and out of the tubular holder **4** by means of the threaded spindles **9** and **10** and the switching rods **5** and **6** cooperate with respective fixed contacts **14** and **15** which may be permanently electrically conductively connected with elements (not shown) of a switching installation. The switching rods **5** and **6** which move in opposite directions, and the fixed contacts **14** and **15** constitute together an isolator switch for double interruption of high voltage systems.

For driving purposes the tubular holder **4** contains driving means which consist of two conical toothed wheels **16** and **17** which are secured on the facing end portions of the threaded spindles **9** and **10** and which are coupled by a third conical toothed wheel **18** adapted to be driven from the outside of the metal envelope by means of a driving shaft **19** of insulating material which is directed transversely to the holder **4**. Moreover, the conical toothed wheels **16** and **17** are coupled to each other by a fourth conical toothed wheel **20** which is coupled by means of a shaft **21** of insulating material to a position indicator **22** disposed outside the envelope.

The spindle **10** is provided with a cylindrical end portion **25** which extends in a gastight manner through a partition **26** arranged within the tubular holder **4** and provided with a seal **27**.

The switching rod **5** cooperates with two earthing switching contacts which are each formed as a two-arm lever pivotally connected to the holder **4**. These levers are adapted to be swung about transverse pivots **28** and **29** with the respective long arms **30** and **31** constituting the earthing switching contacts and the short arms **32** and **33** formed as tails intended for driving and locking said switching contacts. Each earthing switching contact **30** and **31** cooperates with a fixed contact **34** or **35** attached to the portion **1** of the metal envelope and connected by a bolt **36** or **37** and a nut **38** or **39** to a cable **40** or **41** connected to earth.

In the condition shown in full lines the isolator switch is in its contact-making end position and the earthing switching contacts **30** and **31** lie respectively in the longitudinal slots **42** and **43** of the holder **4**. The tails **32** and **33** of the earthing switching contacts then rest against the cylindrical outer surface of the switching rod **5**, so that the earthing switching contacts **30** and **31** are locked in their contact-breaking end positions.

Each earthing switching contact **30** and **31** is provided, near its free end, with a cam **44** or **45** and the switching rod **5** has three pressure surfaces for each earthing switching contact of which the first one **46** is the rear end face of the switching rod whereas the second one **47** or **47*a*** and the third one **48** or **48*a*** are formed by walls of holes **49**, **50** provided in the switching rod **5**.

If the isolator switch is opened by the driving shaft **19**, the switching rods **5** and **6** are moved towards each other and drawn into the tubular holder **4**. Just before they reach their contact-breaking end position, the tails **32** and **33** of the earthing switching contacts **30** and **31** come to register with the holes **49** and **50**, whereby said contacts are unlocked from their contact-breaking end positions. Continued movement of the switching rods causes the surface **46** to engage the cams **44** and **45** so that the earthing switching contacts **30** and **31** are swung slightly in the contact-making direction. The result thereof is that the tails **32** and **33** are swung into the holes **49** and **50** so that they may be engaged by the second pressure surfaces **47** and **47*a*** whereby they are swung, during the further contact-breaking movement of the switching rod **5**, in the direction corresponding to the contact-making direction of the earthing switching contacts **30** and **31**, ultimately to force said contacts into their contact-making end positions in which their free end portions engage the fixed earthing contacts **34** and **35** (see the position in dotted lines). When in their contact-making end positions the earthing switching contacts **30** and **31** are locked positively by the tails **32** and **33**.

When the isolator switch is again moved in the closing direction, the third pressure surfaces **48** and **48*a*** force the tails **32**, **33** out of the holes **49** and **50** just after the switching rod **5** has left its contact-breaking end position so that the earthing switching contacts **30** and **31** are then swung back to their contact-breaking end positions in which they lie in the longitudinal slots **42** and **43**. During the further contact-making movement of the switching rod **5** the tails **32** and **33** slide over the cylindrical outer surface of the switching rod **5** so that the earthing switching contacts **30** and **31** are locked in their contact-breaking end positions.

Means is provided to avoid loss of earthing switching contact control during those times in the opening and closing movements of the switching rod **5** when the tails **32** and **33** of the earthing switching contacts **30** and **31** have just reached registry with the holes **49** and **50**. For this purpose each earthing switching contact **30** and **31** is provided with a ferromagnetic armature plate **51** or **52** which is kept in place by one of the magnets **53** or **54** mounted in the holder **4** when said earthing switching contacts are in their contact-breaking end position.

Each earthing switching contact **30** and **31** is provided on its free end face with a plate **55** or **56** having a visible sign which appears, in the contact-making end position of the switching contact, behind a window **57** or **58** formed in the wall of the envelope portion **1** so that a direct indication of the earthed condition of the holder **4** and the switched-off switching rods **5** and **6** is obtained.

Due to the direct coupling and the direct interlocking of the switching rods **5** and **6** and the earthing switching contacts **30** and **31** the risk of dangerous disturbances in the metal clad switch is practically eliminated.

We claim:

1. A metal clad isolator switch for high voltage and double interruption, comprising a metal envelope intended to be connected with earth, two axially spaced fixed contacts and two switching rods movable in axially opposite directions between contact-making and contact-breaking end positions, both said fixed contacts and said switching rods being accommodated in and insulated from said envelope, one of said switching rods cooperating with one fixed contact and the other switching rod cooperating with the other fixed contact, an electrically conductive holder permanently electrically conductively interconnecting said switching rods, and insulator peripherally attached to the envelope between said fixed contacts and supporting said holder, means including said holder and said insulator dividing the space inside the envelope into two switching chambers which are separated from one another in a gastight manner and each of which contains one of said fixed contacts and at least a portion of a cooperating switching rod, driving means with a portion thereof provided in said holder for axially shifting said switching rods in relatively opposite directions, means for earthing the holder and the switching rods when the isolator switch is in its opened condition, said means for earthing including at least a third fixed contact attached to the envelope, and at least one earthing switching contact cooperating with the third fixed contact and pivotally connected to the holder about an axis which is transverse with respect to the axis of the holder for movement between contact-breaking and contact-making end positions, actuating and locking means for swinging said earthing switching contact about said axis in response to axial movement of one of said switching rods and for directly mechanically locking said earthing switching contact in its contact-breaking and in its contact-making end positions when said one switching rod is in its contact-making and its contact-breaking end positions, respectively.

2. A metal clad isolator switch as claimed in claim 1, in which a tail member and a cam are formed on the earthing switching contact of the earthing means, said tail member and a contacting portion of said earthing switching contact constituting together a two-arm lever, said tail member being adapted for causing the driving of the earthing switching contact and the locking of the same in each one of its end positions, pressure surfaces formed on the switching rod which cooperate with the earthing switching contact, said pressure surfaces of the switching rod cooperating directly with said cam and said tail member in such a manner that just before the switching rod has reached its contact-breaking end position during its contact-breaking movement, the first one of said pressure surfaces engages said cam, whereby the earthing switching contact is swung slightly in the contact-making direction to position said tail member within the reach of the second one of said pressure surfaces, so that continued movement of the switching rod toward its contact-breaking end position causes said earthing switching contact to be forced by said second pressure surface into and locked in its contact-making end position, and whereby just after said switching rod has left its contact-breaking end position during its contact-making movement, the third one of said pressure surfaces engages the tail member, whereby the earthing switching contact is swung back towards its contact-breaking end position and, during the further contact-making movement of said switching rod, is locked in its contact-breaking end position by said rod.

3. A metal clad isolator switch as claimed in claim 1, in which the holder is a metal tube which surrounds the switching rods almost entirely, when they are in their contact-breaking end positions, and which in addition accommodates a portion of said earthing switching contact in its contact-breaking end position, and in which the driving means includes two rotatable threaded spindles extending in the axis of said tube, driving mechanism accommodated in said tube, a driving shaft of insulating material directed transversely to said spindles, said driving mechanism coupling said spindles both with each other and with said driving shaft, a central cavity made in each switching rod, said spindles extending in the cavities of said rods and nuts which are locked against rotation, each nut being secured to each switching rod and cooperating with each threaded spindle.

4. A metal clad isolator switch as claimed in claim 3, wherein said driving means comprises two conical toothed wheels, each one of said toothed wheels secured to said threaded spindle, a third conical toothed wheel meshing with said two conical toothed wheels and secured to the driving shaft of insulating material, a fourth conical toothed wheel also meshing with the first mentioned two toothed wheels, a position indicator and a second shaft of insulating material, said position indicator being coupled with said fourth toothed wheel by said second shaft, said four toothed wheels constituting the driving mechanism contained in said tube.

5. A metal clad isolator switch as claimed in claim 3, in which the tubular holder extends through the insulator in a gastight manner and at least one partition is provided in said holder and in which a cylindrical end portion formed at the end of said threaded spindle faces the driving mechanism and extends through said partition in a gastight manner.

6. A metal clad isolator switch as claimed in claim 5, in which one of said switching rods extends entirely on one side and the other one of said switching rods extends entirely on the other side of said partition provided in the tubular holder.

7. A metal clad isolator switch as claimed in claim 1, in which at least one indicating device is provided on the earthed metal envelope which cooperates with the earthing switching contact and is intended to indicate the contact-making end position of said switching contact.

8. A metal clad isolator switch as claimed in claim 1, in which at least one magnet is secured to the holder, said magnet keeping the earthing switching contact in its contact-breaking end position when said earthing switching contact is unlocked during the contact-breaking movement of said one switching rod and before said earthing switching contact is forced towards its contact-making end position by continued movement of said switching rod towards its contact-breaking end position.