

Title of the Invention

Switchgear

Field of the Invention

The present invention relates to a switchgear capable of
5 disconnecting and earthing an electric current.

Background Art

The switchgear is a device for receiving an electric current
from a bus bar side and feeding it to a load-side. The switchgear
10 is equipped with a circuit breaker, a disconnecting switch and
an earthing switch in order to feed a current, break and
disconnect the current respectively, and earth the current at
the time of inspection or the like.

In the switchgear, when the main circuit is not in a
15 disconnection state, that is, when the switchgear is in a
switch-on state where the main circuit is energized or when
the switchgear is in a breaking state where voltage is applied
to a load side although the current itself is in a breaking
(shut off) state, in case that the earthing switch becomes a
20 closing (switch-on) state by mistake, a ground fault accident
may occur on the bus bar side. Also, when the earthing switch
is in the closing-state, in case that the disconnecting switch
becomes a closing state where a movable contacts thereof is
connected to a fixed contact thereof, a ground fault accident
25 also may occur. Therefore, when a disconnection is not made

in the switchgear, it is necessary to prevent the earthing switch from being closed, or when the earthing switch is in the closing-state, it is necessary to prevent the disconnecting switch from being closed.

5 For example, as a conventional technical matter, JP-A-Hei 9 (1997)-154208 describes preventing the earthing switch from being closed when the switchgear is not in disconnection and preventing the disconnecting switch from being closed when the earthing switch is in the closing state. JP-A-Hei 9
10 (1997)-154208 discloses a metal enclosed switchgear in which, in a closing state of the earthing switch, a locking plate protrudes through a surface of a lock mechanism-mounting plate to lock the clockwise pivotable movement of a link lever and shutter used for inserting a disconnecting switch-operation
15 handle, thereby the handle insertion becomes impossible and it is possible to prevent the disconnecting switch from being closed. In addition, JP-A-Hei 9 (1997)-154208 discloses that, when the disconnecting switch is in a closing state, another locking plate protrudes through the surface of the lock
20 mechanism-mounting plate to lock the clockwise pivotable movement of a shutter used for inserting the earthing switch-operation handle, thereby the handle insertion becomes impossible and it is possible to prevent the earthing switch from being closed. (Paragraphs [0060] to [0062] of JP-A-Hei
25 9 (1997)-154208).

Summary of the Invention

However, in the switchgear described in Patent Document 1, a link mechanism is complicated, and if maintenance and cost are taken into account, it is more preferable that the switchgear should be implemented by a simplified construction.

Accordingly, a main object of the present invention is to provide a switchgear capable of preventing an earthing switch from being closed when the switchgear is not in a disconnection state (namely a disconnecting switch is in a closing state), and capable of preventing the disconnecting switch from being closed when the earthing switch is in a closing state, with a simplified construction of an interlock mechanism.

[Means for Solving the Problems]

For achieving the main object, a switchgear of the present invention comprises a switch with at least a disconnecting function of a main circuit and an earthing switch for earthing a load side of the main circuit, wherein the earthing switch includes an earthing switch-operating section covered with a slide type cover section; and the switchgear further comprises a slide-blocking section for blocking the movement of the slide-type cover section, wherein the slide-blocking section is configured to block the slide type cover section's movement when the switch having the disconnecting function is not in a disconnecting position, and configured to release blocking

of the slide type cover section's movement when the switch having the disconnecting function is in a disconnecting position and thereby to make the slide type cover section slidable and make the earthing switch-operating section operable.

5 Optionally, by using a lock mechanism for a main circuit operation section, the main circuit switch operation section may be configured to prevent the main circuit switch from switching from the disconnecting position to a position other than the disconnecting position when the earthing switch is
10 in the closing position.

Advantages of the Invention

According to the switchgear of the present invention, by simplified construction thereof, it can prevent the earthing
15 switch from being closed when the switchgear is not in a disconnection state. Furthermore, optionally, it may be able to prevent the disconnecting switch from being closed when the earthing switch is in a closing state.

20 Brief Description of the Drawings

Fig. 1 is a sectional side view of a switch gear.

Fig. 2 is a diagram for explaining a disconnection operating unit and an earthing operating unit.

Fig. 3 is a diagram for explaining an interlocking mechanism
25 using a door.

Fig. 4 is a diagram for explaining interlocking between a breaking operating unit and an earthing operating unit both assuming a disconnecting position and an earthing position respectively.

5 Fig. 5 is a diagram for explaining interlocking between the breaking operating unit and the earthing operating unit both assuming a non-disconnecting position and a non-earthing position respectively.

Fig. 6 is a plan view of the earthing operating unit and
10 the disconnection operating unit, which is for explaining electrical interlocking.

Fig. 7 is a diagram for explaining an earthing operating mechanism.

Fig. 8 is a diagram showing a stopper mechanism in the
15 disconnection operating unit.

Detailed Description of the Embodiments

Embodiments of the present invention will be described below.

20 [First Embodiment]

A first embodiment of the present invention will be described with reference to Figs. 1 to 6. As shown in Fig. 1, a switchgear 1 of the first embodiment is mainly composed of: a vacuum double-break three-position type switch 2 capable
25 of switching among three positions , i.e., a closing position,

a breaking position and a disconnecting position (namely the vacuum double-break three-position type switch 2 having three functions of a closing function, a disconnecting function, a breaking function), in a vacuum-insulated state, the switch
 5 (namely, main circuit switch) 2 including a main circuit with two electrodes arranged side by side as a double-break configuration; an earthing switch 5 connected to a load side of the vacuum double-break three-position type switch 2 to earth the load side of the main circuit; a bus bar 3 for feeding electric
 10 power to the vacuum double-break three-position type switch 2; and a cable 4 for feeding electric power from the vacuum double-break three-position type switch 2 to the load side.

The vacuum double-break three-position type switch 2 includes a breaking operating unit 6 for switching between the
 15 closing position and the breaking position (closing position ↔ breaking position) of the main circuit and a disconnection operating unit 7 for switching between the breaking position and the disconnecting position (breaking position ↔
 disconnecting position) of the main circuit. As shown in Fig.
 20 2, the disconnection operating unit 7 is provided with an interlocking lever 11. The interlocking lever 11 is one of a second member, a slide-blocking section or a first interlocking mechanism in claims. The interlocking lever 11 is fixed to a pivot 21 at a central point of the lever 11. The pivot 21
 25 is supported by a lever support portion 22 which is fixed to

a body of the disconnection operating unit 7 as shown in Figs. 2 and 3, so that the lever 11 can make a lever motion. One end side of the interlocking lever 11 is linked to an upper rod 23 projecting upward from the disconnection operating unit 7 so as to be a point where force is applied. The upper rod 23 is movable vertically so that its most part can get into an inner side of the disconnection operating unit 7 as in Fig. 4 when the main circuit is in the disconnecting position and so that it can be positioned in an upward projecting position from the disconnection operating unit 7 as in Fig. 5 when the main circuit is in a non-disconnecting position. As described above, the interlocking lever 11 since is fixed to the pivot 21 at the central point of the lever and one end thereof is linked to the upper rod 23, as the upper rod 23 changes its position vertically depending on the closing position, the breaking position, or the disconnecting position of the main circuit, a rotational position of the interlocking lever 11 can be changed as follows. The lever 11 is directed in a nearly horizontal direction as shown in Fig. 5 when the main circuit is in the non-disconnecting position (namely closing position and breaking position); the lever 11 is positioned so that an action point (another end side opposite to the one end side linked to the upper rod 23) of the lever 11 rotates upward as shown in Fig. 4 when the main circuit is in the disconnecting position. A voltage sensor 16 is installed on the load side

within the vacuum double-break three-position type switch 2.
A load-side voltage in the main circuit can be sensed by the
voltage sensor 16.

As shown in Fig. 1, the earthing switch 5 includes an
5 earthing operating unit 24 for switching between a closing state
as earthing state and an opening state as non-earthing state
(closing state ↔ breaking state) of the earthing switch 5 as
shown in Fig. 3, the earthing switch 5 is operated with the
earthing operating unit 24 through an operating section 25
10 provided at a front portion of the earthing operating unit 24.
The front portion is covered with a slide type door (it's also
called as a first member) 10 as a slide type cover section lest
the earth operating section 25 should be operated by mistake,
and thereby so as not to cause a ground fault accident. The
15 door 10 is provided with a guide rail (not shown in drawings)
so that the door 10 can slide in a lateral direction (in the
direction of the arrow X) to be opened and closed. For making
the action of the earthing operating unit 24 it is necessary
to open the door 10 and operate the earthing switch 5 through
20 the operating section 25. The operating section 25 is formed
as a handle insertion hole. With the door 10 open, a handle
(not shown in drawings) can be inserted into the handle insertion
hole to make the action of the earthing operating unit 24. Lest
the door 10 should continue to open when it becomes open by
25 mistake, a return spring 13 fixed to a panel is connected to

the door 10 so that a spring force acts on the door 10 in a door closing direction when the door slides in a door opening direction. As shown in Fig. 2, the door 10 used in this embodiment has a jutting portion 26 which is provided on a back side of the door 10 so as to jut inside of the switchgear 1. The jutting portion 26 and the interlocking lever 11 as a door slide-blocking section are configured so that, even if the slide force acts on the door 10 by mistake when the main circuit is in closing position or the breaking position (namely non-disconnecting state), just then the door 11 begins sliding, the jutting portion 26 comes in contact with the interlocking lever 11. Thereby, the sliding motion of door 10 is blocked anymore.

As shown in Fig. 6, the door 10 is provided with a push portion 14 like a projection on an inside surface of the door, and the interior of the switchgear 1 is provided with a closing /breaking inoperable mechanism 15. The closing /breaking inoperable mechanism 15 is configured to be pushed by the push portion 14 upon sliding of the door 10 thereby to issue a command for making the vacuum double-break three-position type switch 2 inoperable. The door 10 is also provided with a through hole 17, and the interior of the switchgear 1 is provided with a solenoid type locking switch 18. The locking switch 18 is configured to be operated so as to get into the through hole 17 on the basis of a voltage sensing output signal provided

from the voltage sensor 16. An interlocking pin 12 (it's one of a first member or a second inter locking mechanism in claims) is jutted from the earthing operating unit 24 toward the interlocking lever 11-side of the vacuum double-break

5 three-position type switch 2. When the earthing switch 5 is in a closing state (earthing state), the interlocking pin 12 moves in a left lower direction as in Fig. 4, while when the earthing switch 5 is in a breaking state (non-earthing state), the interlocking pin 12 moves in a right upper direction as

10 in Fig. 5. The interlocking pin 12 is configured so that it can move in the left lower direction on Fig. 4 only when the action point of the interlocking lever 11 has been moved (rotated) upward as in Fig.4. Conversely, the interlocking lever 11 can be rotated so as to be directed in the horizontal

15 direction only when the interlocking pin 12 is in a right upper position (thereby, only when). That is, the interlocking lever 11 and the interlocking pin 12 have an interlocking function as a mutually operating function, so that, only when the earthing switch 5 is in the closing state (earthing state) as shown in

20 Fig. 4, the interlocking lever 11 is blocked by the interlocking pin 12 so as not to move in the horizontal direction. Thereby it is possible to prevent the main circuit switch from becoming non-disconnecting state (closing state and breaking state) by mistake during the earthing switch's closing (earthing state).

25 Furthermore, as shown in Fig. 7, an earth operating rod

27 is configured to act on operation of the earthing operating unit 24, and the operating rod 27 is provided with a fitting 20 for an indicator. When the earthing switch 5 is in the closing position, a closing /breaking preventing switch 19 is operated to prevent the main circuit switch from moving to the closing position or the breaking position of the main circuit switch of the vacuum double-break three-position type switch 2.

A description will now be given about the operation performed by each of the above operating units. The breaking operating unit 6 supplies operating forces in the operation among the closing position, breaking position, the disconnecting position (closing ↔ breaking ↔ disconnecting) to the vacuum double-break three-position type switch 2, and it has an operating force sufficient enough to disconnect electrodes at a time from the closing position up to the disconnecting position of the switch 2 (main circuit switch). However, such a movement from the closing position to the disconnecting position without stopping at the breaking position may lead to a possibility that the disconnecting position is reached without the electric current being broken. Therefore, lest the main circuit switch moves at a time from the closing position to the disconnecting position without stopping at the breaking position, a stopper 9 as a breaking position-keeping member provided in the disconnecting operating unit 7 is positioned at a chain double-dashed line

position in Fig. 8 to keep an electrode-to-electrode distance of the main circuit switch 2 at the breaking position to break the electric current positively. After that, at the time of operation from the breaking position to the disconnecting position (breaking position → disconnecting position), the stopper 9 is rotated up to a solid line position in Fig. 8 to release from the breaking keeping state, whereupon the operation can be made from the breaking position to the disconnecting position under the operating force of the breaking operating unit 6. At this time, the interlocking lever 11 rotates so that its action point moves upward in interlock with the movement of the stopper 9. This rotating motion of the stopper 9 is illustrated in Fig. 8.

On the other hand, on condition that the breaking operating unit 6 exerts its operating force in the disconnecting direction, operation from the disconnecting position to the breaking position (disconnecting position → breaking position) of the main circuit switch 2 is performed with the operating force of the disconnecting operating unit 7. More specifically, since the breaking operating unit 6 exerts its operating force in the disconnecting direction, the disconnection operating unit 7 exerts an operating force larger than that of the breaking operating unit 6 to actuate the stopper 9 for movement to the breaking position (from the solid line position to the chain double-dashed line position in Fig. 8). At this time, the

interlocking lever 11 rotates nearly horizontally (as Fig. 5) in interlock with the movement of the stopper 9.

A switching operation from breaking to closing (breaking → closing) of main circuit switch 2 is performed with the
 5 operating force of the breaking operating unit 6.

A switching operation between closing and opening (closing ↔ opening) of the earthing switch 5 is performed with the operating force of the earthing operating unit 24.

According to the switchgear of this embodiment, only when
 10 the main circuit switch 2 is in disconnecting position, the earthing switch is closed to prevent the occurrence of a ground fault accident on the bus bar side. On this regard, concrete means will be described below. According to the following concrete means, plural mechanisms are provided to prevent the
 15 occurrence of a ground fault accident. This is because the occurrence of a ground fault accident on the bus bar side in the switchgear is a very serious problem and hence must be prevented by all means.

First, with reference to Figs. 4 and 5, a slide blocking
 20 mechanism for the door 10 will be described, which mechanism uses the interlocking lever 11. As described above, for operating the earthing switch 5 it is necessary to open the door 10 and operate the operating section 25 provided in the front portion of the earthing switch 5. In this connection,
 25 when the vacuum double-break three-position type switch 2 is

in its closing position or breaking position, the interlocking lever 11 is directed in a nearly horizontal direction as in Fig. 5, and the sliding path of the door 10 is obstructed by the jutting portion 26 (which is a part of the door 10) coming
5 into contact with the interlocking lever 11, thereby it is possible to block sliding of the door 10. At this time, the interlocking lever 11 acts as a slide blocking mechanism against the door 10. Even if a door opening force is exerted on the door 10 while the interlocking lever 11 is directed in a nearly
10 horizontal direction, the jutting portion 26 comes into contact with the interlocking lever 11 to obstruct the sliding motion of the door, so that the door cannot be opened.

On the other hand, when the vacuum double-break three-position type switch 2 is in its disconnecting position
15 as in Fig. 4, the action point of the interlocking lever 11 has been moved upward and the interlocking lever 11 can release the rock against the sliding motion of the door 10. In this case, the interlocking lever 11 does not obstruct the sliding path of the door 10.

20 In the switchgear 1 of this embodiment, by satisfying the above-mentioned relationships, the operating section 25 becomes operable and the earthing switch 5 can be operated to close on only when the vacuum double-break three-position type switch 2 is in its disconnecting position. Such a mechanism
25 will be referred to herein as a mechanical interlocking

mechanism.

Next, a description will be given about a slide preventing mechanism for the door 10 with the solenoid type locking switch 18. As in the case of the interlocking lever 11 described above, for operating the earthing switch 5 it is necessary to open the door 10 and operate the operating section 25 provided in the front portion of the earthing switch 5. In this connection, when the voltage sensor 16 is sensing a positive or negative voltage not zero, the solenoid type locking switch 18 operates and its part gets into the through hole 17 formed in the door 10 thereby to prevent sliding of the door 10. By the case where the voltage sensor 16 is sensing a positive or negative voltage not zero, it means that the main circuit is in a power application state, that is, the main circuit is not in a disconnected state. Therefore, in the switchgear 1 of this embodiment, only when the vacuum double-break three-position type switch 2 is in its disconnected state, the door 10 can open and it is possible to operate the operating section 25, thus permitting the earthing switch 5 to be closed. Such a mechanism will be referred to herein as an electrical interlocking mechanism.

The above-mentioned mechanical and electrical interlocking mechanisms operate as independent and different mechanisms from each other. That is, only when the vacuum double-break three-position type switch 2 is in its disconnecting position, the mechanical interlocking mechanism

permits opening of the door 10, resulting in that the earthing switch 5 can be operated. On the other hand, in the case of the electrical interlocking mechanism, whether the main circuit is in a power application state or not is determined using the voltage sensor 16, and only when the main circuit is not in the power application state, that is, only when it is in the disconnection state, the electrical interlocking mechanism permits opening of the door 10, resulting in that the earthing switch 5 can be operated. By thus providing plural interlocking mechanisms independent of each other, it is possible to make a state where even in the event of malfunction on one of the two interlocking mechanism, the other side operates. Thus, there is implemented a fail-safe function capable of surely preventing the occurrence of a ground fault accident.

According to the above-mentioned mechanisms, by preventing opening of the door 10, the operability of the earthing switch 5 is guaranteed only when the main circuit is in its disconnecting position and is disconnected. Further, in the switchgear 1 of this embodiment, even in the event the door 10 should open for some reason, the occurrence of a ground fault accident can be prevented by providing a third interlocking mechanism using the interlocking lever 11 and the interlocking pin 12. This mechanism will be described below.

As described above, the interlocking lever 11 is directed in the horizontal direction when the main circuit switch 2 is

not in its disconnecting position. On the other hand, the interlocking pin 12 moves to a left lower position of Fig. 4 upon the closing position of the earthing switch 5. In this case, the interlocking pin 12 can move to the left lower position only when the action point of the interlocking lever 11 has been moved upward. As a result, the movement of the interlocking pin 12 can be done only when the vacuum double-break three-position type switch 2 is disconnected. That is, the closing operation of the earthing switch 5 can be done only when the vacuum double-break three-position type switch 2 is in its disconnecting position. Consequently, a new fail-safe function can act in addition to the above fail-safe idea.

The above-mentioned explanation has been made to the mechanisms wherein the earthing switch 5 is made incapable of being closed when the main circuit switch is not disconnected, thereby preventing the occurrence of a ground fault accident. However, a ground fault accident can occur also when the vacuum double-break three-position type switch 2 is shifted from the disconnecting to the breaking or switch-on position in an already closing state (earthing state) of the earthing switch 5. Therefore, it is necessary to prevent the occurrence of a ground fault accident also in such a form of the same accident. Reference will be made below to the mechanism concerned.

First, a description will be made about the closing/breaking operation preventing mechanism for preventing

closing and breaking operations of the vacuum double-break three-position type switch 2 when the earthing switch 5 is closing with the door 10. In the switchgear 1 of this embodiment, when the earthing switch 5 is in the closing state, the door 10 of Fig. 6 is in an opening state. The door 10 is provided with the push portion 14, and with the door 10 opening, the closing/breaking inoperable mechanism 15 is pushed by the push portion 14. When the closing/breaking inoperable mechanism 15 is pushed with the push portion 14, it outputs a command for making the breaking operating unit 6 and the disconnection operating unit 7 unable to operate, thereby making the vacuum double-break three-position type switch 2 unable to operate. Then, when the earthing switch 5 is in the closing state, namely, when the door 10 is open, the vacuum double-break three-position type switch 2 becomes unable to operate and cannot move to the closing and breaking positions, so that the occurrence of a ground fault accident can be prevented.

Next, a description will be given about the interlocking mechanism using the interlocking pin 12. First, as shown in Fig. 4, when the earthing switch 5 is in the closing state (earthing state), the interlocking pin 12 is shifted to a left lower position. For the vacuum double-break three-position type switch 2 to move from the disconnecting position to the closing or breaking position, it is necessary that the interlocking lever 11 is in the horizontal direction, as shown

in Fig. 5. The interlocking lever 11 is configured so as to be movable in the horizontal direction only when the interlocking pin 12 is in a right upper position. However, when the earthing switch 5 is in the closing state, the interlocking pin 12 is since shifted in the left lower position, the interlocking lever 11 cannot move in the horizontal direction. Thus, when the earthing switch 5 is in the closing state, the vacuum double-break three-position type switch 2 cannot be moved from the disconnecting position to the closing and breaking positions.

Further, a description will now be given about another closing/breaking preventing mechanism for the vacuum double-break three-position type switch 2, which mechanism uses the closing/breaking preventing switch 19 provided on the operating rod 27 which is connected with the earthing switch 24. As shown in Fig. 7, the operating rod 27, which operates upon operation by the earthing operating unit 24, is provided with the indicator metal fitting 20, and the closing/breaking preventing switch 19 is provided at a fixed position with respect to the operating rod 27. Upon closing of the earthing switch 5, the operating rod 27 moves down and pushes the closing/breaking preventing switch 19. When the closing/breaking preventing switch 19 is pushed, a command for fixing at the disconnecting position is transmitted from the switch to the vacuum double-break three-position type switch

2, thereby making the closing and breaking operations impossible.

With the above mechanisms, when the vacuum double-break three-position type switch 2 is in the closing state or the breaking state, the earthing switch 5 can be prevented from being closed, whereby it becomes possible to prevent the occurrence of a ground fault accident. According to the switch gear of this embodiment described above, by a simplified construction with reduced number of parts, the making operation of the earthing switch can be prevented when the electric current in the switchgear is not disconnected, and the closing operation of the disconnecting switch can be prevented when the earthing switch is in the closing state. Moreover, since the voltage sensor 16 is installed and electrical interlocking is effected using the solenoid type locking switch 18 and on the basis of voltage sensed by the voltage sensor 16, if voltage remains on the load side, it is possible to prevent closing of the earthing switch 5 even when the main circuit switch is in its disconnecting position.

In this embodiment, by blocking the slide motion of the door 10 itself which covers the earthing operating unit 24, it is possible to prevent the occurrence of a ground fault accident and there is no special increase in the number of parts for interlocking. As to the interlocking mechanism, the interlocking function can be fulfilled by newly providing a

slide type cover section which covers the earthing operating unit 24 in addition to the door which covers the earthing operating unit 24. In this case, the number of parts increases as compared with the case where the door 10 is endowed with the interlocking function, but the mechanism is simplified like the door 10 and the increase in the number of parts is kept to a minimum. Thus, the mechanism can be prevented from becoming complicated in construction.

Although in this embodiment reference has been made above to a rotational lever as the interlocking lever 11, no limitation is made thereto. Any other type may be adopted insofar as the sliding of the door can be done only at the disconnecting position of the main circuit switch in the switchgear and can be prevented at the closing and breaking positions of the main circuit switch. According to a more concrete example, at the closing or breaking position of the main circuit switch, the door slide blocking means is located at a position obstructing an advancing path of the sliding door, while only at the disconnecting position the door slide blocking means is located at a position not obstructing the advancing path of the door.

In this embodiment a double-break type is used as the switch, which is advantageous in that the electrode-to-electrode distance can be shortened and hence it is possible to attain the reduction in size of the switchgear. However, the interlocking mechanisms described above are applicable

irrespective of whether the switch is a double-break type or not.

Since the return spring 13 is used in this embodiment, a resilient force acting in the direction to cover the operating section is developed in the door 10, whereby the door 10 is prevented from being kept open. However, it goes without saying that no limitation is made to the return spring and that there may be used any other resilient member capable of implementing such an effect.

Although in this embodiment electrical interlocking is effected by inserting the solenoid type locking switch 18 into the door 10 to make the sliding of the door impossible on the basis of the voltage sensed with the voltage sensor 16, there may be adopted a construction using means for determining whether voltage is applied or not on the load side and wherein when it is determined by the means that voltage is applied, the closing operation of the earthing switch 5 is made impossible on the basis of a command provided from the means. It goes without saying that the contents disclosed in this embodiment are a mere example.

In this embodiment, the interlocking lever 11 and the interlocking pin 12 can mutually obstruct the operation of each other. Thus, they can be used as an interlocking mechanism which exhibits an interlocking function for the operation of each operating unit in the earthing switch 5 or the vacuum

double-break three-position type switch 2, thereby restricting the operation of a movable electrode on the mating side. Consequently, it is possible to reduce the number of parts. In addition to the interlocking mechanism of the interlocking lever and interlocking pin, there may be further provided means, that is, means which operates in response to the motion of the switch (with at least a disconnecting function, also in the following) and which, when the switch is not disconnected, makes the interlocking pin 12 of the earthing switch 5 unable to move to its earth closing position; and means which operates in response to the motion of the earthing switch and which, when the earthing switch is in the closing position, makes the interlocking lever 11 unable to move to its closing or breaking position of the main circuit switch. Even with the provision of these means, it is possible to implement the above embodiment's interlocking mechanism. Also as to the interlocking lever 11, no limitation is made thereto. There may be used any other member which operates in response to the motion of the vacuum double-break three-position type switch 2 and which, when the switch 2 is not in the disconnecting position, prevents the interlocking pin 12 from moving the position where the earthing switch is permitted to operate from the breaking position to the closing position as the earthing position. Also as to the interlocking pin 12, there may be used any other member which, at the time of switching from the closing (earthing)

position to the breaking position or from the breaking position to the closing position of the earthing switch 5, operates together with the switching operation of the earthing switch 5 and which, when the earthing switch 5 is in the closing position, prevents the interlocking lever 11 from moving the position where the vacuum double-break three-position type switch 2 is permitted to operate from the disconnecting position to the non-disconnecting position.

In this embodiment reference has been made above to an example in which the door 10 is provided with the push portion 14, and with the door 10 open, the closing/breaking inoperable mechanism 15 is pushed with the push portion 14, resulting in the vacuum double-break three-position type switch (main circuit switch) 2 becoming inoperable. However, no limitation is made to such an example, that is, no limitation is made to the use of such a door as described above, insofar as there is provided means which responds to the movement of the slide type cover section as the door and which, when the slide type cover section slides and is in a state of being able to operate the earthing switch 5, issues a command for making the main circuit switch 2 unable to be in the closing state.

[Second Embodiment]

Although in the above first embodiment reference has been made to an example of using the vacuum double-break three-position type switch 2 also having a breaking/

disconnecting function, there may be adopted a construction wherein the circuit breaker and the disconnecting switch are separated from each other. In this case, the interlocking mechanisms described in the first embodiment may be constructed
5 between the disconnecting switch and the earthing switch 5. Illustration of this second embodiment is omitted.

More specifically, the earthing switch 5 is prevented from being closed when the disconnecting switch is not disconnected. That is, when the disconnecting switch moves from the
10 disconnecting position to the closing position, the interlocking lever of the disconnecting switch moves in a nearly horizontal direction to inhibit opening of the door 10 which is for operating the earthing switch 24-operating section. In the case where a voltage sensor is disposed on the load side
15 of the disconnecting switch and a positive or negative voltage is sensed with the voltage sensor, it is determined that the disconnecting switch is not disconnected; and for preventing the closing (earth) operation of the earthing operating unit 24, the solenoid type locking switch 18 is inserted through
20 hole 17 formed in the door 10 to inhibit opening of the door 10 which is for operating the operating section of the earthing operating unit 24. Further, even in the event the door 10 should open when the disconnecting switch is not in the disconnecting position for some reason, since the interlocking lever lies
25 in a nearly horizontal direction, the left downward movement

of the interlocking pin 12 is inhibited and hence it is possible to prevent the closing of the earthing switch 5.

Next, when the earthing switch 5 is in the closing state, the closing operation of the disconnecting switch should be prevented. More specifically, with the door 10 open, the closing/breaking inoperable mechanism 15 is pushed by the push portion 14 provided in the door 10, making the vacuum double-break three-position type switch 2 inoperable. As a result, when the earthing switch 5 is in the closing state, that is, when the door 10 is open, the vacuum double-break three-position type switch 2 becomes incapable of being operated and can no longer move to the closing and breaking positions, thus making it possible to prevent the occurrence of a ground fault accident. Besides, since the interlocking pin can shift to the left downward position like Fig. 4 when the earthing switch 5 is in the closing position, the interlocking lever cannot direct in a nearly horizontal direction. Thus, when the earthing switch 5 is in the closing state, it is possible to prevent movement of the vacuum double-break three-position type switch 2 from the disconnecting position to the closing or breaking position. Further, as in the first embodiment, the operating rod provided in the earthing switch 5 is provided with the closing/breaking preventing switch 19, which switch operates when the earthing switch 5 is in the closing position. As a result, when the earthing switch 5 is in the closing position,

it is impossible to perform the closing or breaking operation of the vacuum double-break three-position type switch 2.

Thus, also when the circuit breaker and the disconnecting switch are separated from each other, it is possible to apply
5 the interlocking mechanisms described in the first embodiment. Also in the switchgear of this second embodiment, like the switchgear of the first embodiment, by a simplified construction with reduced number of parts, the closing operation of the earthing switch can be inhibited when the switchgear is not
10 disconnected and the closing operation of the disconnecting switch can be inhibited when the earthing switch is in the closing (earthing) state. Moreover, since the voltage sensor is installed and interlocking is performed with the solenoid type locking switch 18 on the basis of the voltage detected by the
15 voltage sensor, the making operation of the earthing switch 5 can be inhibited if voltage remains on the load side.

Claims

1. A switchgear comprising a switch having at least a disconnecting function of a main circuit and an earthing switch for earthing a load side of the main circuit,
5 wherein the earthing switch includes an earthing switch-operating section covered with a slide type cover section; and the switchgear further comprises a slide-blocking section for blocking the movement of the slide type cover section, wherein the slide-blocking section is configured to block the
10 slide type cover section's movement when the switch having the disconnecting function is not in a disconnecting position, and configured to release blocking of the slide type cover section's movement when the switch having the disconnecting function is in a disconnecting position and thereby to make the slide type
15 cover section slidable and make the earthing switch-operating section operable.
2. The switchgear according to claim 1, wherein the slide-blocking section is linked to the switch having the
20 disconnecting function.
3. The switchgear according to claim 1 or claim 2, wherein the slide type cover section is configured so that a resilient force is applied to the slide type cover section in a direction
25 that covers the earthing switch-operating section when the slide

type cover section is in a position where the earthing switch-operating section is operable.

4. The switchgear according to anyone of claims 1 to 3, wherein
5 the switch having the disconnecting function includes a disconnection operating unit, the earthing switch includes an earthing switch-operating unit, the slide-blocking section is linked to the disconnection operating unit, the slide type cover section is constituted by a slide type door covering the
10 earthing switch-operating section, and the slide-blocking section prevents the movement of the slide type door by receiving the push of the slide type door.

5. The switchgear according to anyone of claims 1 to 4, wherein
15 the switch having the disconnecting function is for switching among three positions of a closing position, a breaking position, and a disconnecting position, the switch includes a stopper adapted to be operated when the switch moves from the breaking position to the disconnecting position, and the slide-blocking
20 section operates in interlock with the operation of the stopper when the switch moves from the breaking position to the disconnecting position.

6. A switchgear comprising a main circuit switch having at
25 least a disconnecting function of a main circuit, an earthing

switch for earthing a load side of the main circuit, and a voltage sensor for sensing voltage on the load side of the main circuit, the switchgear further comprising a closing preventing means for preventing a closing operation of the earthing switch when
5 a positive or negative voltage is sensed with the voltage sensor.

7. The switchgear according to claim 6, wherein the earthing switch includes an earth switch-operating section covered with a movable cover section, and the closing preventing means is
10 configured to prevent movement of the cover section.

8. The switchgear according to claim 7, wherein the movement of the movable cover section is a sliding movement, and when a positive or negative voltage is sensed with the voltage sensor,
15 the closing preventing means prevents the sliding movement of the cover section.

9. A switchgear comprising a main cuicuit switch having at least closing and disconnecting positions of a main circuit,
20 an earthing switch for earthing a load side of the main circuit, the earthing switch for switching between a closing position and a breaking position as to earth, a first member provided to operate together with a switching operation between the closing position and the breaking position of the earthing switch
25 at the time of the switching operation of the earthing switch,

and a second member adapted to operate in response to the movement of the main circuit switch so as to , when the main circuit switch is not in a disconnecting position, block the first member's operation needed for a closing operation of the earthing switch.

10. The switchgear according to claim 9,
wherein the main circuit switch has a breaking position in addition to the closing position and the disconnecting position,

wherein the second member operates together with a switching operation from closing/breaking to disconnecting or from disconnecting to closing/breaking of the main circuit switch at the time of the switching operation of the main circuit switch, and

wherein the second member is configured to be prevented from doing the second member's operation needed for the main circuit switch's operation from the disconnecting position to a position other than the disconnecting position when the earthing switch is in the closing position.

11. A switchgear comprising a main circuit switch having at least a disconnecting function of the main circuit, an earthing switch for earthing a load side of the main circuit, and a voltage sensor for sensing voltage on the load side of the main circuit,

the earthing switch including an earthing switch-operating section covered with a slide type cover section, the switchgear further comprising a slide-blocking section for blocking sliding of the cover section, and a closing preventing means
5 for preventing the cover section's sliding movement to prevent a closing operation of the earthing switch when a positive or negative voltage is sensed with the voltage sensor,

wherein the slide-blocking section is configured to release blocking of the cover section's sliding on when the
10 switch is in the disconnecting position, and

wherein the closing preventing means is configured to release the preventing of the cover section's sliding movement when the positive or negative voltage is not sensed with the voltage sensor thereby to make the earthing switch-operating
15 section operable.

12. A switchgear comprising a main circuit switch having at least closing and disconnecting positions of a main circuit , an earthing switch for earthing a load side of the main circuit,
20 the earthing switch for switching between a closing position and a breaking position as to earth,

wherein the earthing switch includes an earthing switch-operating section covered with a slide type cover section,

25 wherein the switchgear further comprises a slide-blocking

section for blocking the movement of the slide type cover section,
a first member adapted to operate together with a switching
operation from closing to breaking or from breaking to closing
of the earthing switch at the time of the operation of the earthing
5 switch, and a second member adapted to operate in response to
the movement of the main circuit switch so as to, when the main
circuit switch is not in the disconnecting position, prevent
the first member's operation needed for a closing operation
of the earthing switch, and

10 wherein the slide-blocking section is configured to be
released so as to make the cover section slidable when the main
circuit switch is in the disconnecting position.

13. A switchgear comprising a main circuit switch having at
15 least closing and disconnecting positions of a main circuit,
an earthing switch for earthing a load side of the main circuit,
the earthing switch for switching between a closing position
and a breaking position as to earth, and a voltage sensor for
sensing voltage on the load side of the main circuit,

20 wherein the switchgear further comprising a first member
provided to operate together with a switching operation between
the closing position and the breaking position of the earthing
switch at the time of the switching operation of the earthing
switch, a second member adapted to operate in response to the
25 movement of the main circuit switch so as to , when the main

circuit switch is not in a disconnecting position, block the first member's operation needed for a closing operation of the earthing switch, and an earth switch-closing preventing means which is connected to the voltage sensor to prevent a closing
5 operation of the earthing switch when a positive or negative voltage is sensed by the voltage sensor.

14. A switchgear comprising a vacuum-insulated double-break switch having at least closing and disconnecting positions of
10 a main circuit, an earthing switch for earthing a load side of the main circuit, the earthing switch having closing and breaking positions as to earth, and a voltage sensor for sensing voltage on the load side of the main circuit, the earthing switch including an earth switch-operating section covered with a slide
15 type door,

wherein the switchgear further comprises an interlocking lever for blocking slide of the slide type door, an interlocking pin adapted to operate together with a switching operation between closing and disconnecting of the earthing switch at
20 the time of the switching operation of the earthing switch, and a solenoid type locking switch connected to the voltage sensor to prevent the movement of slide type door thereby not to prevent a closing operation of the earthing switch when a positive or negative voltage is sensed by the voltage sensor,
25 wherein the interlocking lever is configured to operate in

response to the movement of the double-break switch so as to,
when the double-break switch is not in the disconnecting position,
prevent the interlocking pin's operation needed for a closing
operation of the earthing switch, and is configured to be
5 released so as to make the door slidable when the double-break
switch is in the disconnecting position.

15. A switchgear comprising a main circuit switch, the switch
having at least closing and disconnecting positions of a main
10 circuit and including a fixed electrode and a movable electrode,
and an earthing switch for earthing a load side of the main
circuit, the earthing switch having closing and breaking
positions as to earth which is switched from one to the other
by breaking or closing between an earthing fixed electrode and
15 an earthing movable electrode,

wherein the main circuit switch includes a first
interlocking mechanism for restricting the operation of the
earthing movable electrode in the earthing switch,

wherein the earthing switch includes a second interlocking
20 mechanism for restricting the operation of the movable electrode
in the switch,

wherein the first interlocking mechanism restricts the
operation of the earthing movable electrode in the earthing
switch by preventing the operation of the second interlocking
25 mechanism, and the second interlocking mechanism restricts the

operation of the movable electrode in the main circuit switch by preventing the operation of the first interlocking mechanism.

16. The switchgear according to any one of claims 1 to 5,
5 7, 8 and 11 to 14, further comprising a command issuing means adapted to respond to movement of the slide type cover section and issue a command to make a closing operation of the earthing switch impossible when the earthing switch-closing operating section can be operated by movement or sliding of the cover
10 section.

17. The switchgear according to claim 16, wherein the command issuing means comprises a push portion provided in the cover section and a command issuing portion associated with the push
15 portion.

18. The switchgear according to any one of claims 1 to 17, wherein the earthing switch includes an operating rod adapted to operate between enclosing and breaking positions as to earth,
20 wherein the operating rod includes a command switch adapted to switch from one to the other by depending on the closing and breaking positions of the earthing switch,
the command switch issues a command for fixing the main circuit switch of the switchgear at the disconnecting position
25 when the earthing switch is in the closing position as earth.