

DESCRIPTION

TITLE OF THE INVENTION: SWITCH GEAR AND INTERLOCK DEVICE

TECHNICAL FIELD

5 [0001] The present invention relates to an interlock device provided to a switch gear, and to a mechanical interlock device in the connection position of a connector on a breaker side and a breaker.

BACKGROUND TECHNOLOGY

[0002] A switch gear is provided with a breaker body and a housing for
10 accommodating the breaker body detachably. With this, the operation of an electric circuit on the side of a breaker (for example, a vacuum circuit breaker (VCB)) used in the switch gear becomes possible by connecting a connector provided to the electric circuit to a connector provided to a control circuit on the housing side. Consequently, when the operation of the switch
15 gear is started in a state in which the connector on the breaker side is not connected to the connector on the housing side, the switch gear does not function, and it causes a trouble.

[0003] In a switch gear used overseas, to avoid such a trouble, there is a case where an interlock mechanism is required in which a breaker cannot be
20 moved to a connection position when the connector on the breaker side is not connected to the connector on the housing side (see, for example, patent documents 1 and 2).

PRIOR ART REFERENCE(S)

PATENT DOCUMENT(S)

[0004] Patent Document 1: Japanese Patent Application Publication
2007-312526

Patent Document 2: Japanese Patent Application Publication 2011-200113

Patent Document 3: Japanese Utility Model S55-163717

5 Patent Document 4: Japanese Utility Model S59-97518

SUMMARY OF THE INVENTION

[0005] When a return spring is used to such an interlock mechanism, as compared with a case where a return spring is not used, the number of components increases, and a failure rate might be high.

10 [0006] In addition, when a link mechanism is adopted to an interlock mechanism, a mechanism part becomes complicated, and there is possibility that manufacturing costs increase.

[0007] The present invention is made one in consideration of such a problem, and an object of the present invention is to provide an interlock
15 device having a simple structure and a switch gear provided with the interlock device.

[0008] One aspect of a switch gear of the present invention to achieve the above object is one comprising: a breaker body; a housing including an accommodation part in which the breaker body is detachably accommodated;
20 a first connector provided to the breaker body; a second connector provided on an upper side of the accommodation part of the housing, and to be electrically connected to the first connector; and an interlock device provided on an upper side of the accommodation part of the housing, and hindering a

movement of the breaker body to the accommodation part when the first connector is not connected to the second connector.

[0009] A feature of the interlock device includes: a bar-shaped interlock pin supported movably in an axial direction by its own weight; and a control
5 pin provided to the interlock pin, and capable of hindering a connection of the first connector and the second connector, wherein when the first connector is connected to the second connector, the control pin comes in contact with and stopped by an upper part of the first connector connected to the second connector, and the interlock pin is supported at a position at
10 which the movement of the breaker body to the accommodation part can be carried out, and wherein when the first connector is not connected to the second connector, the control pin is supported at a position facing a connection part of the second connector to which the first connector is connected, and the interlock pin is supported such that a lower end portion of
15 the interlock pin extends into the accommodation part.

[0010] In addition, in a feature of the switch gear of the present invention to achieve the above object, the switch gear further comprises: an operation pin provided to the interlock pin, and extending in a vertical direction to an axis of the interlock pin; a guide plate supporting the interlock pin slidably
20 in the axial direction; a frame body to which the guide plate is fixed; and a protective frame attached to the frame body so as to cover the interlock pin, wherein the protective frame is formed with a long hole to which the operation pin is inserted.

[0011] In addition the interlock device of the present invention to achieve the above object is one provided to a switch gear including a breaker body, a housing including an accommodation part in which the breaker body is detachably accommodated, a first connector provided to the breaker body, and a second connector provided on an upper side of the accommodation part of the housing and to be electrically connected to the first connector, wherein when the first connector is not connected to the second connector, the interlock device hinders a movement of the breaker body to the accommodation part.

10 [0012] In a feature of this interlock device, the interlock device comprises: a bar-shaped interlock pin supported movably in an axial direction by its own weight; and a control pin provided to the interlock pin, and capable of hindering a connection of the first connector and the second connector, wherein when the first connector is connected to the second connector, the control pin comes in contact with and stopped by an upper part of the first connector connected to the second connector, and the interlock pin is supported at a position at which the movement of the breaker body to the accommodation part can be carried out, and wherein when the first connector is not connected to the second connector, the control pin is supported at a position facing a connection part of the second connector to which the first connector is connected, and the interlock pin is supported such that a lower end portion of the interlock pin extends into the accommodation part.

[0013] According to the present invention shown above, the structure of the interlock device becomes simple.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a schematic diagram of a switch gear according to an embodiment of the present invention, and FIG. 1(a) is a drawing showing an interlock device when a control plug is not connected to a receptacle and FIG. 1(b) is a drawing showing an interlock device when a control plug is connected to a receptacle.

FIG. 2(a) is a perspective view of an interlock device, FIG. 2(b) is a perspective exploded view of the interlock device, and FIG. 2(c) is a perspective view of an interlock pin.

MODE FOR IMPLEMENTING THE INVENTION

[0015] A switch gear and an interlock device according to an embodiment of the present invention will be explained in detail based on the drawings. In the explanation of the embodiment, although, as an example, a switchboard accommodating a vacuum circuit breaker will be explained, the switch gear and the interlock device of the present invention can be applied to various kinds of switch gears.

[0016] As shown in FIG. 1, a switch gear 1 according to an embodiment of the present invention is provided with a breaker body 2, a housing 3 that accommodates the breaker body 2, and an interlock device 4.

[0017] The breaker body 2 is provided with a vacuum circuit breaker 2a that opens and closes a charging circuit. The vacuum circuit breaker 2a is provided with, for example, a fixed electrode and a movable electrode, and

the movable electrode is, by being driven with an operation rod, brought into contact with and separated from or opened to and closed to the fixed electrode. For example, an operation part for driving the operation rod drives, by flowing control current to a control unit for an electromagnet for operation, the operation rod with the electromagnetic force of the excited electromagnet such that the movable electrode is brought into contact with and separated from the fixed electrode, so as to electrically open and close a power source side and a load side. The breaker body 2 is provided with a load-side contact and a power-source-side contact (not shown) pulled toward the housing 3 side, and is moved in and from the housing 3.

[0018] The housing 3 is provided with an accommodation part 3a in which the breaker body 2 is accommodated. The accommodation part 3a of the housing 3 is provided with a power-source-side disconnecter and a load-side disconnecter (not shown) so as to face the power-source-side contact and the load-side contact of the breaker body 2. The breaker body 2 is moved from the housing 3, and the power-source-side contact and the load-side contact become an electrically non-connected state to the power-source-side disconnecter and the load-side disconnecter. In addition, the breaker body 2 is moved in the housing 3, and the power-source-side contact and the load-side contact become an electrically connected state to the power-source-side disconnecter and the load-side disconnecter. In the following, the position at which the breaker body 2 becomes the non-connected state is referred to as a disconnection position, and the

position at which the breaker body 2 becomes the connected state is referred to as a connection position.

[0019] The electrical opening and closing of the power source side and the load side performed by bringing and separating the movable electrode into
5 contact with and from the fixed electrode at the connection position is carried out based on a control signal input to the control unit of the operation part. The breaker body 2 is therefore provided with a control plug 5 connected to the control unit of the operation part. The control plug 5 is a connector (first connector) provided to the breaker body 2. In addition, the housing 3
10 is provided with a receptacle 6 into which the control plug 5 is inserted. The receptacle 6 is a connector (second connector) electrically connected to the control plug 5. The receptacle 6 is provided on the upper side of the accommodation part 3a of the housing 3, and is connected to the control unit for controlling the vacuum circuit breaker 2a. The operation rod is driven
15 by the electromagnetic force of the electromagnet excited with the control current from the control unit, and the movable electrode is brought into contact with the fixed electrode so as to turn on the vacuum circuit breaker 2a. In addition, the energy of a breaking spring which has been stored at the time of the tuning on is released, and the movable electrode is separated
20 from the fixed electrode, so as to carry out the cutoff operation of the vacuum circuit breaker 2a.

[0020] The interlock device 4 hinders the breaker body 2 from being moved to the connection position in a state in which the control plug 5 is not inserted into the receptacle 6. The interlock device 4 is provided inside the

housing 3. For example, the interlock device 4 is provided on the upper side of the accommodation part 3a of the housing so as to be close to the receptacle 6.

[0021] As shown in FIG. 2(a) and FIG. 2(b), the interlock device 4 is provided with an interlock pin 7, a control pin 8 and an operation pin 9 provided to the interlock pin 7, a guide plate 10 for supporting the interlock pin 7, and a frame part 11 to which the guide plate 10 is fixed.

[0022] As shown in FIG. 2(c), the interlock pin 7 has a bar shape such as a square bar shape, and is provided at a position at which the connection of the receptacle 6 and the control plug 5 is not hindered. The interlock pin 7 is supported by the guide plate 10 so as to be movable in the axial direction (for example, Y-axis direction in FIG. 2(c)) by its own weight.

[0023] The control pin 8 is a member capable of hindering the connection of the control plug 5 and the receptacle 6. The control pin 8 is provided to the interlock pin 7 so as to extend in the vertical direction to the axis of the interlock pin 7 (X-axis direction in FIG. 2(c)). For example, the control pin 8 is provided so as to extend in the parallel direction to the connection surface of the receptacle 6 to which the control plug 5 is inserted.

[0024] The operation pin 9 is a member for moving the interlock pin 7 in the axial direction. The operation pin 9 is provided to the interlock pin 7 so as to extend in the vertical direction to the axis of the interlock pin 7 (Z-axis direction in FIG. 2(c)). For example, the operation pin 9 is provided so as to extend in the vertical direction to the connection surface of the receptacle 6 to which the control plug 5 is inserted.

[0025] The guide plate 10 is a member for supporting the interlock pin 7 so as to be movable in the axial direction. For example, as shown in FIG. 2(b), the guide plate 10 is a plate having a U shape in cross section, and is provided with an upper plate 10a and a lower plate 10b. The upper plate 10a and the lower plate 10b are provided so as to extend in the substantially vertical direction from the respective upper and lower ends of an intermediate plate 10c. Each of the upper plate 10a and the lower plate 10b is formed with a hole having the same shape as the cross-sectional surface of the interlock pin 7. The interlock pin 7 is inserted into those holes, and thereby the interlock pin 7 is slidably supported on the guide plate 10.

[0026] The frame part 11 is provided with a frame body 12 to which the guide plate 10 is fixed, a side section frame 13 and a protective frame 14 provided to the respective side portions of the frame body 12. The frame part 11 is attached to, for example, the ceiling part of the housing 3.

[0027] The frame body 12 is, for example, a rectangular parallelepiped box body, and is provided with an attachment plate 12a to which the guide plate 10 is attached, an upper plate 12b and a pair of side plates 12c and 12d provided so as to substantially vertically extend from the attachment plate 12a. The surface facing the attachment plate 12a of the frame body 12 is formed with an opening portion. The attachment plate 12a is formed with holes to which the guide plate 10 is attached, and the upper plate 12b is formed with a hole used for fixing the frame body 12 to the ceiling part of the housing 3. In addition, the side plates 12c and 12d are each formed with

holes to which the side section frame 13 and the protective frame 14 are attached.

[0028] The side section frame 13 is provided with a side plate 13a fixed to the frame body 12, and an upper plate 13b fixed to the housing 3. The
5 upper plate 13b is provided so as to extend from the upper end portion of the side plate 13a in the substantially vertical direction to the side plate 13a.

[0029] The protective frame 14 is provided with a protective plate 14a fixed to the frame body 12, an upper plate 14b fixed to the housing 3, a first bent part 14c substantially perpendicular to the protective plate 14a, and a
10 second bent part 14d substantially perpendicular to the first bent part 14c. The protective plate 14a is provided so as to extend from the side end portion of the attachment plate 12a of the frame body 12 in the vertical direction to the surface of the attachment plate 12a. The upper plate 14b is provided so as to extend from the upper end portion of the protective plate 14a in the
15 substantially vertical direction to the protective plate 14a. The first bent part 14c is formed by being bent, in the horizontal direction to the surface of the attachment plate 12a, from the end portion of the protective plate 14a extending from the side end portion of the attachment plate 12a. The first bent part 14c is formed with a long hole 14e extending in the vertical
20 direction, and the operation pin 9 is equipped so as to be inserted into the long hole 14e. The first bent part 14c extends so as to cover the guide plate 10, and the end portion of the first bent part 14c is bent in the direction of the side section frame 13 so as to form the second bent part 14d.

[0030] As shown in FIG. 2(a), the operation pin 9 is provided so as to be inserted into the long hole 14e formed to the protective frame 14. In addition, a gap 15 is formed between the distal end portion of the second bent part 14d and the end portion of the side section frame 13, and the control pin 8 is provided so as to protrude from the gap 15.

[0031] When the operation pin 9 is moved along the long hole 14e, the interlock pin 7 and the control pin 8 are moved in the axial direction (vertical direction) of the interlock pin 7. In addition, the operation pin 9 engages with the lower end portion of the long hole 14e, and thereby suppressing the interlock pin 7 from falling off from the guide plate 10 by its own weight.

[0032] In case where the operation pin 9 engages with the lower end portion of the long hole 14e, the lower end portion of the interlock pin 7 extends into and is held in the accommodation part 3a of the housing 3. Consequently, the breaker body 2 comes in contact with the lower end portion of the interlock pin 7, and thereby the movement of the breaker body 2 to the connection position is hindered. On the other hand, the control pin 8 is held so as to extend to the position facing the connection surface of the receptacle 6 to which the control plug 5 is connected (that is, the connection portion of the control plug 5). In this state, the control plug 5 cannot be connected to the receptacle 6. Therefore, when the control plug 5 is connected to the receptacle 6, it is necessary to lift the operation pin 9 (that is, the control pin 8), such that the control pin 8 is moved to the position at which the connection of the control plug 5 and the receptacle 6 is not hindered.

[0033] Next, the operation of the switch gear 1 and the interlock device 4 according to an embodiment of the present invention will be explained.

[0034] As shown in FIG. 1(a), in case where the control plug 5 is not connected to the receptacle 6, the interlock pin 7 falls off by its own weight, and the operation pin 9 engages with the lower end portion of the long hole 14e (not shown) formed to the protective frame 14. Consequently, the lower end portion of the interlock pin 7 extends into and is held in the accommodation part 3a of the housing 3, and the interlock pin 7 becomes a state in which the lower end portion of the interlock pin 7 extends to the position at which the movement of the breaker body 2 to the connection position is hindered. In this way, in a state in which the operation pin 9 engages with the lower end portion of the long hole 14e, the lower end portion of the interlock pin 7 interferes with the frame of the breaker body 2, and the breaker body 2 cannot be moved to the connection position (shown by an arrow A in FIG. 1(a)). In addition, in a state in which the operation pin 9 engages with the lower end portion of the long hole 14e, the control pin 8 extends to the position facing the connection part of the receptacle 6, and the connection of the control plug 5 is hindered (shown by an arrow B in FIG. 1(a)). Therefore, in case where the control plug 5 is inserted into the receptacle 6, it is necessary to always lift the interlock pin 7 and the control pin 8.

[0035] If, in a state in which the interlock pin 7 falls off, the breaker body 2 is forcibly pushed in, there is possibility that the interlock device 4 is broken. Therefore, by providing the frame part 11 to the interlock device 4,

the deformation of the interlock pin 7 and the guide plate 10 is suppressed by the frame part 11, and thereby suppressing the deformation of the interlock device 4.

[0036] Specifically, by supporting the interlock pin 7 between the upper
5 plate 10a and the lower plate 10b, the deformation of the interlock pin 7 can be suppressed. Moreover, when the interlock pin 7 is brought into slidable contact with the intermediate plate 10c of the guide plate 10, the force applied to the interlock pin 7 is received by the whole of the guide plate 10, and thereby the deformation of the interlock pin 7 and the deformation of the
10 guide plate 10 can be suppressed. Furthermore, by protecting the guide plate 10 with the protective frame 14, the deformation of the guide plate 10 can be suppressed.

[0037] As shown in FIG. 1(b), when the operation pin 9 is lifted with a hand along the long hole 14e (not shown) formed to the protective frame 14,
15 the control pin 8 is moved upward, and the control plug 5 can be inserted to the receptacle 6. The direction in which the operation pin 9 is lifted is shown by an arrow C in FIG. 1(b). When the control plug 5 is inserted to the receptacle 6, the control pin 8 rides on the body of the control plug 5, and the interlock pin 7 is kept more on the upper side than the state shown in
20 FIG. 1(a). In this state, the lower end portion of the interlock pin 7 is moved to the position at which the movement of the breaker body 2 to the connection position is not hindered. That is, the interlock pin 7 is supported in a state in which the lower end portion of the interlock pin 7 does not extend into the accommodation part 3a of the housing 3. As a result of this,

it becomes possible to move the breaker body 2 to the connection position (shown by an arrow D in FIG. 1(b)).

[0038] The switch gear 1 and the interlock device 4, shown above, according to the embodiment of the present invention have a configuration in which the interlock pin 7 falls off by its own weight, and a spring component is not needed. Therefore, the number of parts of the interlock device 4 is small, and an interlock control can be carried out with a simple structure, as a result of which failures can be reduced as compared with an interlock device using a link mechanism or a spring.

10 [0039] In addition, by providing the interlock device 4 on the housing 3 side, even if the failure of the interlock device 4 occurs, it is possible to replace the interlock device 4 easily. Moreover, by fixing the interlock device 4 to a predetermined position, an interlock function can be realized. Therefore, as needed, the interlock device 4 can be easily added to the switch gear afterward.

[0040] As the above, although, while showing a specific embodiment, the switch gear and the interlock device of the present invention have been explained, the switch gear and the interlock device of the present invention are not limited to those in the embodiment, and design change can be appropriately performed in a range not impairing its characteristic, and one in which the design change has been performed belongs to the technical scope of the present invention.

[0041] For example, the operation pin 9 can be formed so as to extend in the opposite direction side of the extending direction of the control pin 8. In addition, the control pin 8 can be used as the operation pin 9.

[0042] In addition, the interlock pin 7 can be used as the control pin 8.

5 In this case, when the control plug 5 is not connected to the receptacle 6, the interlock pin 7 is supported so as to face the connection part of the receptacle 6, and the lower end portion of the interlock pin 7 is provided so as to extend into the accommodation part 3a of the hosing 3. Moreover, when the control plug 5 is connected to the receptacle 6, the lower end portion of the interlock
10 pin 7 comes in contact with and stopped by the body of the control plug 5.

CLAIMS

1. A switch gear comprising:
 - a breaker body;
 - 5 a housing including an accommodation part in which the breaker body is detachably accommodated;
 - a first connector provided to the breaker body;
 - a second connector provided on an upper side of the accommodation part of the housing, and to be electrically connected to the first connector;
 - 10 and
 - an interlock device provided on an upper side of the accommodation part of the housing, and hindering a movement of the breaker body to the accommodation part when the first connector is not connected to the second connector,
 - 15 wherein the interlock device includes:
 - a bar-shaped interlock pin supported movably in an axial direction by its own weight; and
 - a control pin provided to the interlock pin, and capable of hindering a connection of the first connector and the second connector,
 - 20 wherein when the first connector is connected to the second connector, the control pin comes in contact with and stopped by an upper part of the first connector connected to the second connector, and the interlock pin is supported at a position at which the movement of the breaker body to the accommodation part can be carried out, and

wherein when the first connector is not connected to the second connector, the control pin is supported at a position facing a connection part of the second connector to which the first connector is connected, and the interlock pin is supported such that a lower end portion of the interlock pin
5 extends into the accommodation part.

2. The switch gear according to claim 1, further comprising:

an operation pin provided to the interlock pin, and extending in a vertical direction to an axis of the interlock pin;

10 a guide plate supporting the interlock pin slidably in the axial direction;

a frame body to which the guide plate is fixed; and

a protective frame attached to the frame body so as to cover the interlock pin,

15 wherein the protective frame is formed with a long hole to which the operation pin is inserted.

3. An interlock device configured to be provided to a switch gear including a breaker body, a housing including an accommodation part in

20 which the breaker body is detachably accommodated, a first connector provided to the breaker body, and a second connector provided on an upper side of the accommodation part of the housing and to be electrically connected to the first connector, wherein when the first connector is not

connected to the second connector, the interlock device hinders a movement of the breaker body to the accommodation part, comprising:

a bar-shaped interlock pin supported movably in an axial direction by its own weight; and

5 a control pin provided to the interlock pin, and capable of hindering a connection of the first connector and the second connector,

wherein when the first connector is connected to the second connector, the control pin comes in contact with and stopped by an upper part of the first connector connected to the second connector, and the interlock pin is
10 supported at a position at which the movement of the breaker body to the accommodation part can be carried out, and

wherein when the first connector is not connected to the second connector, the control pin is supported at a position facing a connection part of the second connector to which the first connector is connected, and the
15 interlock pin is supported such that a lower end portion of the interlock pin extends into the accommodation part.