

TITLE OF THE INVENTION

VACUUM SWITCHGEAR

BACKGROUND OF THE INVENTION

(Field of the Invention)

5 [0001]

The present invention relates to a vacuum switchgear used in a power receiving and distribution apparatus such as cubicle-type switchgear, which receives power from a bus and distributes the received power to various types of electric devices.

(Prior Art)

[0002]

A power receiving and distribution apparatus that receives power from a bus and distributes the received power to various types of electric devices, for example, accommodates in a container bus-side conductors connected to the bus, load-side conductors connected to loads, a main circuit switch for connecting the bus-side conductors to the load-side conductors and disconnecting them from the load-side conductors, and earthing switches for grounding the load side conductors.

[0003]

In an exemplary power receiving and distribution apparatus of this type, the above devices etc. are

disposed in a superiorly insulated container under vacuum in order to reduce the size of the apparatus and increase the stability of installation, as disclosed in Patent Document 1.

5 [0004]

 In another power receiving and distribution apparatus, its main circuit switch is configured as a vacuum valve, and the vacuum valve and devices connected to it are molded with epoxy resin or another
10 insulating material in order to reduce the number of parts to be assembled and improve an installation thereof, as disclosed in Patent Document 2.

 [0005]

 Patent Document 1: Japanese Application Patent
15 Laid-open Publication No. 2000-268685

 Patent Document 2: Japanese Application Patent
Laid-open Publication No. 2003-333715

SUMMARY OF THE INVENTION

 (Problems to be Solved by the Invention)

20 [0006]

 Vacuum switchgears as described above are required to be highly reliable, compact, and inexpensive. To meet these requirements, various switchgears as described in Patent Documents 1 and 2 above are
25 proposed.

[0007]

Reliability as well as compactness and
inexpensiveness of the vacuum switchgear are mutually
conflicting requirements. Specifically, if an attempt
5 is made to further increase the reliability (safety),
expensive material have to be used, resulting in a
high cost. Consequently, the problem with the
compactness and inexpensiveness is not solved. If an
emphasis is placed on compactness and inexpensiveness,
10 the quality is lowered and the reliability may be
sacrificed. The vacuum switchgear described in Patent
Document 1 is designed to meet the conflicting
requirements for reliability as well as compactness
and inexpensiveness. However, epoxy resin or another
15 insulating material used for molding may be exposed to
a severe environment, in which case deterioration by
aging is unavoidable.

[0008]

If the insulating material such as epoxy resin is
20 deteriorated as described above, its insulating
property is lowered, possibly causing a ground fault.
To prevent the ground fault, the insulating material
has to be thick enough to withstand years of service.
This increases the amount of insulating material used,
25 resulting in a high cost. Vacuum switchgears at

present still need improvement in terms of reliability, compactness, and inexpensiveness.

[0009]

The present invention addresses the problems
5 described above with the object of providing a compact, inexpensive vacuum switchgear having a further improved reliability.

(Means for Solving the Problems)

[0010]

10 To achieve the above object, a vacuum switchgear according to an aspect of the present invention has a mold section to which conductors connected to fixed electrodes of switches are molded with resin and includes a vacuum container, disposed on the mold
15 section, that accommodates the switches, each of which comprises the fixed electrode and a movable electrode connectable to and disconnectable from the fixed electrode.

[0011]

20 A vacuum switchgear according to another aspect of the present invention has a mold section to which earthing switches and conductors connected to fixed electrodes of switches are molded with resin and includes a vacuum container, disposed on the mold
25 section, that accommodates the switches, each of which

comprises the fixed electrode and a movable electrode connectable to and disconnectable from the fixed electrode.

[0012]

5 A vacuum switchgear according to still another aspect of the present invention has a mold section to which earthing switches and conductors connected to fixed electrodes of switches that function as a circuit breaker and load break switches are molded
10 with resin and includes a vacuum container, disposed on the mold section, that accommodates the circuit breaker and load break switches, each of which comprises the fixed electrode and a movable electrode connectable to and disconnectable from the fixed
15 electrode.

[0015]

 A vacuum switchgear according to yet another aspect of the present invention has a mold section to which earthing switches and conductors connected to
20 fixed electrodes of switches that function as a circuit breaker and disconnecting switches are molded with resin and includes a vacuum container, disposed on the mold section, that accommodates the circuit breaker and disconnecting switches, each of which
25 comprises the fixed electrode and a movable electrode

connectable to and disconnectable from the fixed electrode.

(Effects of the Invention)

[0021]

5 According to the present invention, the mold resin member used as the main insulator between the main circuit and ground can be localized near the conductors connected to the fixed electrodes, which significantly reduces the amount of resin used.

10 Furthermore, the spacing between the main circuit section in the vacuum container and ground is isolated doubly by vacuum and the resin member or air, increasing the insulation reliability.

BRIEF DESCRIPTION OF THE DRAWINGS

15 [0069]

FIG. 1 is a longitudinal front view illustrating an embodiment of the inventive vacuum switchgear.

FIG. 2 is a longitudinal side view of the embodiment of the inventive vacuum switchgear shown in
20 FIG. 1.

FIG. 3 is a plan view of the embodiment of the inventive vacuum switchgear shown in FIG. 1.

FIG. 4 is an electric schematic circuit diagram of a ring main unit configured in the embodiment of the
25 inventive vacuum switchgear.

FIG. 5 is a longitudinal front view illustrating another embodiment of the inventive vacuum switchgear.

FIG. 6 is a side view in which part of the other embodiment of the inventive vacuum switchgear shown in FIG. 1 is omitted.

FIG. 7 is an electric schematic circuit diagram of a cubicle-type switching apparatus configured in the other embodiment of the inventive vacuum switchgear.

FIG. 8 is a front view of an exemplary switching apparatus having the other embodiment of the inventive vacuum switchgear shown in FIG. 5.

FIG. 9 is a cross-sectional view showing section IX-IX of the switching apparatus in FIG. 8.

FIG. 10 is a longitudinal front view illustrating still another embodiment of the inventive vacuum switchgear.

DETAILED DESCRIPTION OF THE INVENTION

(Best Mode for Carrying out the Invention)

[0022]

Embodiments of a vacuum switchgear according to the present invention will be described with reference to the drawings.

FIGS. 1 to 4 illustrate an embodiment of a vacuum switchgear according to the present invention. FIG. 1 is a longitudinal front view illustrating the

embodiment of the inventive vacuum switchgear. FIG. 2 is a longitudinal side view of the embodiment of the inventive vacuum switchgear shown in FIG. 1. FIG. 3 is a plan view of the embodiment of the inventive vacuum switchgear shown in FIG. 1. FIG. 4 is an electric schematic circuit diagram of a ring main unit configured in the embodiment of the inventive vacuum switchgear.

[0023]

10 First, the ring main unit in FIG. 4 generally comprises a vacuum switch which is constituted a circuit breaker (CB), two load break switches (LBSs), earthing switches (ESs), and feeder conductors (Fs) connected to each of the fixed electrodes of the circuit breaker (CB) and the two load break switches (LBSs). The feeder conductors (Fs) and earthing switches (ESs) are molded with resin. A vacuum container 8 is placed on the mold section 7. The vacuum container 8 includes the circuit breaker (CB) and the two load break switches (LBSs). The outer periphery or surface of the vacuum container 8 is covered by a insulating mold case 10 with resin.

[0024]

25 An embodiment of the inventive vacuum switchgear that constitutes the above ring main unit will be

described in detail with reference to FIGs. 1 to 3.

The vacuum switch is constituted a circuit breaker (CB) 1, two load break switches (LBSs) 2, feeder conductors (Fs) 3 connected to each of the fixed electrodes 22 of the circuit breaker (CB) 1 and the two load break switches (LBSs) 2, and earthing switches (ESs) 4 connected to the feeder conductors 3. Current transformers 5 and voltage dividers 6 which are being provided on the feeder conductors 3, are molded with resin and constitute the mold section 7, as shown in FIGs. 1 and 2. The earthing switch 4 has a solid insulating tube 41 made of, for example, ceramic and kept under vacuum, a fixed electrode 42 fixed at the upper part of the solid insulating tube 41 and connected to the feeder conductor 3, and a movable electrode 44 disconnectably connected to the fixed electrode 42 at the lower part of the solid insulating tube 41 through a bellows 43. The movable electrode 44 of the earthing switch 4 is made movable by an earthing switch opening/closing mechanism 45 that comprises a rod, a link, and the like. The movable electrode 44 of the earthing switch 4 is connected to an earthing bus 46.

[0025]

A vacuum container 8 made of stainless or another

material is fixed on the mold section 7 by bolts 9 shown in FIG. 3. The outer periphery or surface of the vacuum container 8 is molded by the insulating mold case 10 with a thermosetting molding material 10a such as unsaturated polyester resin.

[0026]

The circuit breaker 1 disposed in the vacuum container 8 has an insulating tube 11, a fixed electrode 12, a movable electrode 13, an insulating rod 15 and an arc shield 16 disposed on the inner surface of the insulating tube 11; the fixed electrode 12 is fixed in the insulating tube 11 and connected to the feeder conductor 3 brought into the vacuum container 8; the movable electrode 13 is brought into the insulating tube 11 and can be connected to and disconnected from the fixed electrode 12; the insulating rod 15 is connected to the movable electrode 13 through a bellows 14. The insulating rod 15 for the circuit breaker is connected to a circuit breaker opening/closing mechanism 17 that comprises a rod, a link, and the like. The bellows 14 has a bag shape and has less sealing portions, increasing the reliability for vacuum hermeticity.

[0027]

The load break switch 2 disposed in the vacuum

container 8 has an insulating tube 21, a fixed
electrode 22, a movable electrode 23, an insulating
rod 25 and an arc shield 26 disposed on the inner
surface of the insulating tube 21; the fixed electrode
5 22 is fixed in the insulating tube 21 and connected to
the feeder conductor 3 brought into the vacuum
container 8; the movable electrode 23 is brought into
the insulating tube 21 and can be connected to and
disconnected from the fixed electrode 22; the
10 insulating rod 25 is connected to the movable
electrode 23 through a bellows 24.

[0028]

As with the above bellows 14, the bellows 24 has a
bag shape and has less sealing portions, increasing
15 the reliability for vacuum hermeticity. The insulating
rod 25 for the load break switch is connected to a
load break switch opening/closing mechanism 27 that
comprises a rod, a link, and the like.

[0029]

20 The movable electrode 13 for the circuit breaker 1
and one of the movable electrodes 23 for the load
break switch 2 are interconnected by a flexible
conductor 28, and that movable electrode 23 for the
load break switch 2 and the other movable electrode 23
25 for the load break switch 2 are also interconnected by

another flexible conductor 28. The flexible conductor 28 is provided with a flexible conductor shield 29. The flexible conductor 28 is fixed to the movable electrodes 13, 23 by screwing and brazing. When the moving electrode 13, 23 moves, the flexible conductor 28 generates a return force in the lateral direction in FIG. 1, since the flexible conductor 28 is fixed by screws to resist to the return force, so that work involved in the brazing is simplified.

10 [0030]

Each feeder conductor 3 brought into the vacuum container 8 is supported by the vacuum container 8 through a solid insulator 30 made of, for example, ceramic. A side of each of the feeder conductors 3 opposite to its fixed electrode is a cable connection terminal 31.

[0031]

Next, the operation of an embodiment of the inventive vacuum switchgear will be described in detail with reference to FIGs. 1 to 3.

In the circuit breaker 1, the circuit breaker opening/closing mechanism 17 is operated according to a detection signal for an overcurrent, shortcircuit, ground fault, or other failure that is detected on the load side by a detecting means. The movable electrode

13 is then disconnected from the fixed electrode 12 to open the connection circuit.

[0032]

Each of the load break switches 2 is operated by
5 the load break switch opening/closing mechanism 27.
The movable electrode 23 is then disconnected from the fixed electrode 22 to disconnect the connection circuit. This embodiment uses a phase separation construction. For three phases, another unit
10 construction described above may be provided.

[0033]

Since the vacuum container 8 is disposed on the mold section 7, the vacuum container is maintained in a floating voltage state, increasing the insulation
15 performance of the vacuum container 8 with respect to the ground. This reduces the probability of ground faults and improves reliability.

[0034]

In parts at which vacuum sealing is not necessary,
20 such as the insulating rod 15 in the vacuum container 8, swaging or ceramic metallization by use of an active brazing material is eliminated, which enables the use of inexpensive ceramic and reduces the manufacturing cost. In the mold section 7, the feeder
25 conductors 3, earthing switches 4, current

transformers 5, and voltage dividers 6 are molded, so the mold section 7 is compact as compared with the entire vacuum switchgear, which also contributes to the reduction in the manufacturing cost.

5 [0035]

The earthing switches 4 are disposed in the mold section 7, which is outside the vacuum container 8, so the weight and capacity of the vacuum container 8 can be reduced, which significantly reduces the size of the vacuum container 8 having the circuit breaker 1 and load break switches 2 and greatly cuts down the cost. Even if a ground fault occurs in the earthing switch 4, the ground fault current is automatically shut down within one cycle by highly vacuum tight arc-suppressing performance, suppressing the ground fault from spreading.

10

15

[0036]

According to the above embodiment of the present invention, the vacuum container 8 including the circuit breaker 1 and load break switches 2 is disposed on the mold section 7, so the electric potential of the vacuum container 8 is a floating voltage that is approximately equal to the ground potential, thereby increasing the safety and reliability of the vacuum container 8 against ground

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25

faults.

[0037]

The earthing switches 4 disposed outside the vacuum container 8, that is, in the mold section 7, so
5 the structures of the circuit breaker 1, the load break switches 2 and the like in the vacuum container 8 can be simplified, and the vacuum container can be made compact.

[0038]

10 In addition, the feeder conductors 3 are part of the integrated mold section 7, so its molding cost can be reduced and thereby the entire manufacturing cost can also be reduced.

[0039]

15 Although the earthing switches 4 are disposed outside the vacuum container 8 in the above embodiment, it is also possible to dispose them in the vacuum container 8. Even in this case, the electric potential of the vacuum container 8 can be reduced nearly to the
20 ground potential as in the above embodiment, and the safety and reliability of the vacuum container 8 against ground faults can be increased.

[0040]

In the above embodiment, the thermosetting molding
25 material 10a provided on the outer periphery or

surface of the vacuum container 8 such as unsaturated polyester resin is further used to prevent ground faults. Owing to the use of the thermosetting molding material 10a, withstanding the operation voltage for a half cycle is sufficiently in the unlikely event of a discharge between a conductor and the vacuum container 8. It is also possible to coat conductive paint to the inner surface of the thermosetting molding material 10a to prevent corona discharges generated due to small gaps between the vacuum container 8 and thermosetting molding material 10a. Instead of using the thermosetting molding material 10a, a metallic cover may be provided with a spacing from the vacuum container 8 that is just enough to withstand the operation voltage.

[0041]

FIGs. 5 to 7 illustrate another embodiment of a vacuum switchgear according to the present invention. FIG. 5 is a longitudinal front view illustrating the other embodiment of the inventive vacuum switchgear. FIG. 6 is a side view in which part of the other embodiment of the inventive vacuum switchgear shown in FIG. 1 is omitted. FIG. 7 is an electric schematic circuit diagram of a cubicle-type switching apparatus configured in the other embodiment of the inventive

vacuum switchgear. The parts in these drawings are assigned the same reference numerals as the identical or equivalent parts in FIGs. 1 to 4.

[0042]

5 First, the cubicle-type switching apparatus in FIG. 7 generally comprises a vacuum switch which is constituted a circuit breaker (CB), a disconnecting switch (DS), an earthing switch (ES), a feeder conductor (F) connected to a fixed electrode of the
10 circuit breaker (CB), and a branching bus (F1) connected to a fixed electrode of the disconnecting switch (DS). The feeder conductor (F), branching bus (F1), and earthing switch (ES) are molded with resin. A vacuum container 8 is placed on the mold section 7.
15 The vacuum container 8 includes the circuit breaker (CB) and the disconnecting switch (DS). The outer periphery or surface of the vacuum container 8 is covered by an insulating mold case 10 with resin.

[0043]

20 The other embodiment of the inventive vacuum switchgear that constitutes the cubicle-type switching apparatus described above will be described in detail with reference to FIGs. 5 and 6.

The feeder conductor (F) 3 connected to the fixed
25 electrode 12 of the circuit breaker (CB) 1, the

branching bus (F1) 3A connected to the fixed electrode 22 of the disconnecting switch (DS) 2, the earthing switch (ES) 4 connected to the feeder conductor 3, and the voltage dividers 6 provided on the feeder conductor 3 are molded with resin and constitute a mold section 7, as shown in FIG. 5. The earthing switch 4 has a solid insulating tube 41 made of, for example, ceramic and kept under vacuum, a fixed electrode 42 fixed at the lower part of the fixed insulating tube 41 and connected to the feeder conductor 3, and a movable electrode 44 disconnectably connected to the fixed electrode 42 at the upper part of the solid insulating tube 41 through a bellows 43. The movable electrode 44 of the earthing switch 4 is made movable by an earthing switch opening/closing mechanism 45 that comprises a rod, a link, and the like. The movable electrode 44 of the earthing switch 4 is connected to an earthing bus 46.

[0044]

A vacuum container 8 made of stainless or another material is disposed on the mold section 7. The vacuum container 8 has a two-part structure that comprises a lower part 8A and an upper part 8B. The lower part 8A of the vacuum container 8 is disposed on the mold section 7 through a solid insulator 30 made of, for

example, ceramic. The outer periphery or surface of the lower part 8A and upper part 8B of the vacuum container 8 are covered by an insulating mold case 10 with resin that is formed integrally with the mold section 7.

[0045]

After the conductor, bellows, contacts, and other constituting parts are brazed in the lower part 8A of the vacuum container 8, the upper part 8B is fitted onto the lower part 8A and then the joint part is brazed. Finally, the vacuum container is vacuum sealed.

[0046]

The circuit breaker 1 disposed in the vacuum container 8 has a fixed electrode 12 connected to the feeder conductor 3, a movable electrode 13 can be connected to and disconnected from the fixed electrode 12, and an insulating rod 15 connected to the movable electrode 13 through a bellows 14. The insulating rod 15 is connected to a circuit breaker opening/closing mechanism 17 for the circuit breaker that comprises a rod, a link, and the like. The bellows 14 has a bag shape and has less sealing portions, increasing the reliability for vacuum.

[0047]

The disconnecting switch 2 disposed in the vacuum

container 8 has a fixed electrode 22 connected to the
branching bus 3A brought into the vacuum container 8,
a movable electrode 23 connectable to and
disconnectable from the fixed electrode 22, an
5 insulating rod 25 connected to the movable electrode
23 through a bellows 24, and an arc shield 26 disposed
on the inner surface of the vacuum container 8. The
insulating rod 25 is connected to a load break switch
opening/closing mechanism 27 for the disconnecting
10 switch that comprises a rod, a link, and the like. As
with the above bellows 14, the bellows 24 has a bag
shape and has less sealing portions, increasing the
reliability for vacuum hermeticity.

[0048]

15 The arc shield 26 has the same electric potential
as the vacuum container 8. Therefore, the arc shield
26 prevents metallic particles released from the
electrode of the disconnecting switch 2 at the time of
current shutdown from adhering to the electrode and
20 thereby prevents the withstand voltage from being
reduced. Furthermore, when the electrodes of the
disconnecting switch 2 and circuit breaker 1 are both
turned off, the insulation reliability at the time of
disconnection of the disconnecting switch 2 is
25 increased.

[0049]

The movable electrode 13 for the circuit breaker 1 and the movable electrode 23 for the disconnecting switch 2 are interconnected by a flexible conductor 28.

5 The flexible conductor 28 is fixed to the movable electrodes 13, 23 by screwing and brazing. When the moving electrode 13, 23 moves, the flexible conductor 28 generates a return force in the lateral direction in FIG. 1. Since the flexible conductor 28 is fixed by

10 screws to resist to the return force, so that work involved in the brazing is simplified.

[0050]

A side of the feeder conductor 3 opposite to its fixed electrode is a cable connection terminal brought

15 to the lower part of the vacuum container 8. A side of the branching bus 3A opposite to its fixed electrode is a bus connection terminal horizontally brought to the lower part of the vacuum container 8. Bushings of these terminals are provided at the lower part of the

20 vacuum container 8.

[0051]

Next, the operation of another embodiment of the inventive vacuum switchgear will be described in detail with reference to FIGs. 5 and 6.

25 In the circuit breaker 1, the circuit breaker

opening/closing mechanism 27 is operated according to a detection signal for an overcurrent, shortcircuit, ground fault, or other failure that is detected on the load side by a detecting means. The movable electrode
5 13 is then disconnected from the fixed electrode 12 to open the connection circuit.

[0052]

The disconnecting switch 2 is operated by its opening/closing mechanism 27, and disconnects the
10 movable electrode 23 from the fixed electrode 22 to disconnect the connection circuit. This embodiment uses a phase separation construction. For three phases, another unit construction described above may be provided.

15 [0053]

Even if a ground fault occurs in the earthing switch 4, the ground fault current is automatically shut down within one cycle, suppressing the ground fault from spreading.

20 [0054]

Since the vacuum container 8 is constructed as two parts, sealing can be done easily by brazing the joint portion of the lower part 8A and upper part 8B of the vacuum container 8.

25 [0055]

According to the above embodiment of the present invention, the vacuum container 8 including the circuit breaker 1 and disconnecting switch 2 is disposed on the mold section 7, so the electric potential of the vacuum container 8 is a floating voltage, thereby increasing the safety and reliability of the vacuum container 8 against ground faults.

[0056]

The earthing switch 4 is disposed outside the vacuum container 8, that is, in the mold section 7, so the structures of the circuit breaker 1, the disconnecting switch 2, and the like in the vacuum container 8 can be simplified, and the vacuum container can be made compact.

[0057]

Since the main elements of the mold section 7 are the feeder conductors 3 and the branching buses (FIs) 3A, the molding cost can be reduced and thereby the entire manufacturing cost can also be reduced.

[0058]

In the above embodiment, the insulating mold case provided on the outer periphery or surface of the vacuum container 8 is used to prevent ground faults. The insulating mold case is preset so that it can withstand an increase in electric potential that is

caused by arc generation at the time of current shutdown by the circuit breaker 1. When the outer surface of the insulating mold case 10 is coated with paint having conductive material, so the electric potential of the surface of the insulating mold case 10 is fixed to the ground potential, even if a person touches directly the insulating mold case 10, the person can be kept safety.

[0059]

FIGs. 8 and 9 show an exemplary switching apparatus having another embodiment of the vacuum switchgear shown in FIGs. 5 and 6. FIG. 8 is a front view of the switching apparatus, and FIG. 9 is a cross-sectional view showing section IX-IX in FIG. 8. The parts in these drawings are assigned the same reference numerals as the identical parts in FIGs. 5 to 7. A protective relay device 80 is provided above an opening/closing mechanism 17 for the circuit breaker and another opening/closing mechanism 27 for the disconnecting switch 2.

[0060]

Buses 3A extending downward from the mold section 7 are each provided with a bus-side bushing 3B. These bus-side bushings 3B are mutually displaced as shown in FIGs. 5 and 9 and interconnected by a horizontal

bus-side bushing 3C for each phase.

[0061]

Feeder conductors 3 extend horizontally from the mold section 7 as shown in FIGs. 5 and 8. A T-shaped cable head 3D is attached to each feeder conductor 3
5 as shown in FIG. 8, and a conductor 3E extends downward from the T-shaped cable head. The conductor 3E is provided with a current transformer 81.

[0062]

10 According to this embodiment, as in the above embodiments, the electric potential of the vacuum container 8 is a floating voltage, thereby increasing the safety and reliability of the vacuum container 8 against ground faults. The earthing switch 4 is
15 disposed outside the vacuum container 8, that is, in the mold section 7, so the structures of the circuit breaker 1, the disconnecting switch 2, and the like in the vacuum container 8 are simplified, and the vacuum container can be made compact. Since the main elements
20 of the mold section 7 are the feeder conductors 3 and the branching buses (F1) 3A, the molding cost can be reduced and thereby the entire manufacturing cost can also be reduced.

[0063]

25 Since the bus-side bushings and feeder-side

bushings are disposed at the bottom of the mold
section 7, devices for taking countermeasures against
internal arc accompanying short-circuits may be
disposed there, which simplifies maintenance of these
5 devices.

[0064]

Furthermore, in this embodiment, a voltage monitor
to be connected to the current transformer 81 can be
provided on the feeder side, and an interlock can also
10 be provided so as not to permit the earthing switch 4
to be turned on when the voltage monitor detects that
a voltage is present. If a vacuum leakage occurs in
the circuit breaker 1 or disconnecting switch 2, for
example, a voltage develops on the feeder side even
15 when the circuit breaker 1 and disconnecting switch 2
are both shut off. If the disconnecting switch 2 is
turned on in this state, a ground fault will occur.
The interlock suppresses such ground faults.

[0065]

20 In the embodiment described above, an electrode
which can shut off a short-circuit current such as,
for example, a spiral electrode or axial magnetic
field electrode, may be used to the electrode of the
earthing switch 4.

25 [0066]

FIG. 10 is a longitudinal front view illustrating another embodiment of the inventive vacuum switchgear. The parts in this drawing are assigned the same reference numerals as the identical or equivalent parts in FIG. 5. The vacuum switchgear has a plurality of circuit breakers 1 in the vacuum container 8. The electrodes 13 of the plurality of circuit breakers 1 are operated concurrently to enable the use of turned-on, turned-off, and disconnected positions.

10 [0067]

In this embodiment, as in the embodiments described above, the conductor 3 connected to the fixed electrode 12 of the circuit breaker 1, the earthing switch 4 connected to the conductor 3, and the like are resin molded to the mold section 7. A vacuum container 8 is provided on the mold section 7. By this structure, the electric potential of the vacuum container 8 is a floating voltage, thereby increasing the safety and reliability of the vacuum container 8 against ground faults. The earthing switch 4 is disposed outside the vacuum container 8, that is, in the mold section 7, so the vacuum switch structure of the circuit breaker 1 can be simplified, and the vacuum container 8 can be made compact. Since the main elements of the mold section 7 are the conductors 3,

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the molding cost can be reduced and thereby the entire manufacturing cost can also be reduced.

[0068]

In this embodiment, the movable electrodes 13 of
5 the each circuit breakers 1 are operated concurrently.
This eliminates the need to use a flexible conductor
as the conductor for connecting the movable electrodes
13. A copper plate 28A is sufficient. In addition,
the conductors are derived at a small pitch,
10 contributing to making the vacuum switch compact.

WHAT IS CLAIMED IS

[Claim 1]

A vacuum switch gear comprising:

a plurality of vacuum switches including a fixed electrode and a movable electrode, the movable electrode capable of being in contact with or out of contact with the fixed electrode;

a vacuum container in which the plurality of vacuum switches are disposed; and

a ground switch including a fixed electrode and a movable electrode, the movable electrode capable of being in contact with or out of contact with the fixed electrode, the ground switch being covered by an insulation cover;

wherein the plurality of vacuum switches are electrically connected to the ground switch;

characterized in that the ground switch is installed outside the vacuum container, the outer peripheral surfaces of the ground switch and the vacuum container are molded with resin and both of the ground switch and the vacuum container are integrally formed.

[Claim 2]

The vacuum switch gear according to claim 1, characterized in that the vacuum container having an outer peripheral surface molded with resin is disposed above the molded part of the ground switch molded.

[Claim 3]

The vacuum switch gear according to claim 1, characterized in that the ground switch is integrally molded with a conductor connected to the fixed electrode of the vacuum switch and disposed outside the vacuum container, and the vacuum container having its outer peripheral surface molded is disposed above the molded part with which the conductor is molded.

[Claim 4]

The vacuum switch gear according to claim 1 or claim 2, characterized in that the vacuum switch includes a circuit breaker and a load switch disposed in the common vacuum container.

[Claim 5]

The vacuum switch gear according to claim 1 or claim 3, characterized in that the vacuum switch includes a circuit breaker and a disconnect switch disposed in the common vacuum container.

[Claim 6]

The vacuum switch gear according to claim 4, characterized in that a feeder conductor is connected to each of the fixed electrodes included in the circuit breaker and the load switch, and the feeder conductor and the ground switch are integrally molded with resin.

[Claim 7]

The vacuum switch gear according to claim 5,

characterized in that a feeder conductor is connected to the fixed electrode of the circuit breaker and a branched conductor is connected to the fixed electrode of the disconnect switch, and the feeder conductor, the branched conductor and the ground switch are integrally molded with resin.

[Claim 8]

The vacuum switch gear according to claim 1, characterized in that conductive coating material is applied to the outer periphery of the molded part of the vacuum container.

[Claim 9]

The vacuum switch gear according to claim 1, characterized in that the vacuum container is disposed above the molded part of the ground switch molded, and the vacuum container has a potential that is maintained at a floating voltage state.

[Claim 10]

The vacuum switch gear according to claim 1, characterized in that the vacuum switch includes either a load circuit breaker or a vacuum disconnect switch.