

VACUUM INSULATED SWITCHGEAR

Background of the Invention

The present invention relates to a vacuum insulated switchgear in which functions each are collected and sectionalized.

Vacuum insulated switchgears are next generation switchgears of an environmentally suited type because of no use of SF₆ gases which exhibit the global warming potential of about 23900 times as high as that of CO₂ as compared with conventional SF₆ gas insulated switchgears.

Here, as a vacuum insulated switchgear, there is, for example, one described in JP-A-2008-104338. JP-A-2008-104338 discloses a vacuum insulated switchgear, in which metallic earth plates, respectively, sectionalize a switch section, a bus-bar section positioned above the switch section, a cable section positioned laterally of the switch section, and a low voltage control section arranged on a door back side of a housing of the vacuum insulated switchgear and in a position opposed to the bus-bar section.

However, JP-A-2008-104338 describes only a vacuum insulated switchgear, in which respective spaces are divided by metallic earth plates but the spaces do not have an independent construction as a box. Accordingly, when a portion of the vacuum insulated switchgear suffers damages or the like in parts thereof, it is not possible to replace only the portion or parts associated therewith and so it is necessary to replace a whole panel, which imposes a large load on a consumer. Also, since vacuum insulated switchgears are conventionally constructed in an integral manner, they are required to move up and down as a whole in adjustment of a bus-bar connection position, which imposes a load at the time of work.

Summary of the Invention

Here, it is a first object of the invention to provide a vacuum insulated switchgear, which affords replacement of a part or parts. Also, it is a second object of the invention to provide a method of manufacturing a vacuum insulated switchgear, which affords replacement of a part or parts. Further, it is a third object of the invention to provide a method of replacement of a part or parts of a vacuum insulated switchgear. In addition, it is a fourth object of the invention to provide a method of adjusting a bus-bar connection position of a vacuum insulated switchgear, in which the bus-bar connection position is adjusted by moving a portion of the vacuum insulated switchgear up and down.

In order to solve the above-described first problem, a vacuum insulated switchgear according to the invention comprises a switch section including at least a vacuum switch, which performs closing and opening of an electric current, and containing an actuator, which operates the vacuum switch, wherein the switch section is made into a box-like module
5 constructed so as to be capable of being assembled into the vacuum insulated switchgear.

In order to solve the above-described second problem, a method of manufacturing a vacuum insulated switchgear comprising a switch section containing a switch, which performs closing and opening of an electric current, and an actuator, which operates the switch, a cable connection section containing a cable for supply of an electric power to a load side, a low
10 voltage control section containing a protective relay, and a wiring connection section through which wirings for connection among parts pass, the respective sections being combined to form the vacuum insulated switchgear, said manufacturing method according to the invention comprising the steps of: putting a portion of the cable connection section on the switch section after the switch section is arranged; putting a portion of the low voltage control section on the
15 switch section, and arranging the wiring connection section between the cable connection section and the low voltage control section.

In order to solve the above-described third problem, a replacement method of a switch section in a vacuum insulated switchgear, which comprises a switch section sectioned into a box-like configuration, a cable connection section, a low voltage control section and a wiring
20 connection section, according to the invention comprises the steps of: making a switch in the switch section into a disconnection position by operating the switch; removing the cable in the cable connection section; opening a front door and a rear door of the low voltage control section; removing a bus-bar; removing a connector between the low voltage control section and the cable connection section; and replacing the switch section.

In order to solve the above-described fourth problem, a method of adjusting a bus-bar connection position in a vacuum insulated switchgear, which comprises a switch section, a cable connection section, a low voltage control section and a wiring connection section, the respective sections being respectively sectioned into box-like, comprising the steps of: adjusting
25 a bus-bar connection position by moving a base provided on a bottom of the switch section up and down; and thereafter, joining together the switch section, the cable connection section, the
30 low voltage control section and the wiring connection section.

According to the invention, it becomes possible to provide a vacuum insulated switchgear of which parts can be replaced.

Further, according to the invention, it becomes possible to manufacture a vacuum

insulated switchgear of which parts can be replaced.

Further, according to the invention, it becomes possible to replace parts of a vacuum insulated switchgear.

Further, according to the invention, it becomes possible to adjust a bus-bar
5 connection position by moving up and down a part of a vacuum insulated switchgear.

Brief Description of the Drawings

Fig. 1 is a perspective view of a vacuum insulated switchgear according to a first embodiment of the invention.

Fig. 2 is a partially sectioned side view of the vacuum insulated switchgear
10 according to the first embodiment of the invention.

Fig. 3 is a partially sectioned front view of a switch section, which constitutes the vacuum insulated switchgear according to the first embodiment of the invention.

Fig. 4 is a partially sectioned front view of the switch section, which constitutes the vacuum insulated switchgear according to the first embodiment of the invention.

Fig. 5 is a partially sectioned side view of the vacuum insulated switchgear
15 according to the first embodiment of the invention, showing a state, in which lengths of cable are pulled upward.

Fig. 6 is a partially sectioned side view of the vacuum insulated switchgear
according to the first embodiment of the invention showing a state, to which a ventilator is
20 applied.

Fig. 7 is a partially sectioned side view of a vacuum insulated switchgear according to a second embodiment of the invention.

Description of the Embodiments

A first embodiment will be described with reference to Figs. 1 to 6. A vacuum
25 insulated switchgear 1 according to the embodiment comprises four sections, that is, a switch section 1b, a cable connection section 1c, a low voltage control section 1d and a wiring connection section 1e, and the four functions each are collected and made into modules in the form of boxes. For four respective sections, the switch section 1b is arranged on a front, lower side of the vacuum insulated switchgear 1 and the cable connection section 1c is arranged on a
30 back side of the vacuum insulated switchgear 1 with a part thereof put on the switch section 1b through a spacer 6c. Here, the spacer 6c has such a length as to enable the cable connection section 1c to be supported by the switch section 1b. The low voltage control section 1d is

arranged on a front, upper side of the vacuum insulated switchgear 1 with a part thereof being put on through a spacer 6d. Here, the spacer 6d has such a length as to enable the low voltage control section 1d to be supported on the switch section 1b. The wiring connection section 1e is arranged between the cable connection section 1c and the low voltage control section 1d on a centrally upper portion of the vacuum insulated switchgear 1. Bolts are used to mechanically connect between the respective sections. The two sections, that is, the switch section 1b and the low voltage control section 1d are enclosed by metallic earth plates 2b, 2d to be made airtight.

The respective sections will be described hereinafter.

Arranged in the switch section 1b are a vacuum two-points off and three-positions switch 8, in which two contacts arranged in parallel perform on-operation, off-operation and disconnecting-operation under the condition of vacuum insulation in a vacuum insulated switch, a vacuum earthing switch 9 connected to a load side of the vacuum two-points off and three-positions switch 8 to perform earthing-operation under the condition of vacuum insulation in the vacuum insulated switch, a voltage detector 10 arranged on a cable side to measure a quantity of electric power supplied to the load side, a three-phase bus-bar connection bushing 5a connected to a bus-bar side to supply an electric power to the vacuum two-points off and three-positions switch 8, and a three-phase cable connection bushing 20a connected to the cable side, and the vacuum two-points off and three-positions switch 8, the vacuum earthing switch 9, the voltage detector 10, the bus-bar connection bushing 5a, and the cable connection bushing 20a are molded integrally by an epoxy resin 12 to constitute a mold switch 1ba. The bus-bar connection bushing 5a protrudes into a bus-bar connection section 1a, which is present above the vacuum two-points off and three-positions switch 8 and existent as a space above the switch section 1b, and when a metallic earth plate 2d described later and positioned at a boundary between the low voltage control section 1d and the bus-bar connection section 1a is removed, a hand can reach the bus-bar connection section 1a from the front face of the low voltage control section 1d to enable a bus-bar connection work. The cable connection bushing 20a protrudes into the cable connection section 1c. Further, arranged in the switch section 1b are an operation device 11, which drives the vacuum two-points off and three-positions switch 8 and the vacuum earthing switch 9, and a control device 11a for the operation device, and arranged in a location opposed to the low voltage control section 1d is a connector 1bg. Also, in order to ensure the stiffness for the switch section 1b, the metallic earth plate 2b are made thick in plate thickness and many bends are applied thereto.

Arranged in the cable connection section 1c are a T-type cable head 20 provided rotatable relative to the cable connection bushing 20a protruding from the switch section 1b, a

cable 3 connected to the T-type cable head 20 to supply an electric power to the load side, and a current transformer (CT) 4 for detecting an accident current.

Arranged in the low voltage control section 1d are a protective relay 1db arranged on a back side of a door 1da on the front side of the panel and a connector 1dd in a location
5 opposed to the switch section 1b, and the connector is caused to fit with the connector 1bg at the time of assembly to provide for electric connection between the switch section 1b and the low voltage control section 1d. Also, an alarm display 1dc for display of earth, short-circuit accident, abnormal vacuum pressure, or the like is arranged on a front side (that is, outside the panel) of the door 1da on the front side. These parts are held on the back side of the door 1da
10 on the front side of the low voltage control section 1d and pulled outside the vacuum insulated switchgear 1 together with the door upon opening of the door 1da. Further, the metallic earth plate 2d positioned at the boundary between the low voltage control section 1d and the bus-bar connection section 1a is made to be a removable cover.

Wirings for connection between the respective parts pass through an interior of
15 the wiring connection section 1e.

Here, the mold switch 1ba described above will be described in detail with reference to Fig. 4. The vacuum two-points off and three-positions switch 8 comprises a vacuum insulation switch 80 comprised of an insulated cylinder 80a and a metallic end plate and made vacuum in an interior thereof, two pairs of stationary contacts 81a, 81b arranged in the
20 vacuum insulation switch 80, movable contacts 82a, 82b arranged in opposition to the stationary contacts 81a, 81b, a movable conductor 85 connecting between the both movable contacts 82a, 82b, being moved upon driving of the operation device 11, and being reinforced by such metal as stainless steel, or the like, which will not be annealed even at high temperature, a vacuum insulated operating rod 86 connected to the movable conductor 85 and arranged in the vacuum
25 insulation switch 80, a connecting rod 86a to connect between the vacuum insulated operating rod 86 and a side of an actuator 8, an aerial insulated operating rod 88 to connect between the connecting rod 86a and the operation device 11, a bellows 87 formed of rubber or metal to enable the connecting rod 86a to move while maintaining vacuum seal, a bellows 89 formed of rubber or metal to cover the periphery of a connection between the aerial insulated operating rod
30 88 and the connecting rod 86a, and an arc shield 90 arranged in the vacuum insulation switch 80 to prevent arc occurring at the time of opening and closing of contacts from adhering to the insulated cylinder 80a.

One 81a of the stationary contacts is connected to a bus bar 5 through a feeder 83 and the other 81b of the stationary contacts is connected to the T-type cable head 20 through a

feeder 84.

The vacuum earthing switch 9 comprises a vacuum insulation switch 91 comprised of an insulated cylinder 91a and a metallic end plate and made vacuum in an interior thereof, a stationary contact 92 arranged in the vacuum insulation switch 91, a movable contact 93 arranged in opposition to the stationary contact 92, a vacuum insulated operating rod 94 connected to the movable contact 93, a metallic bellows 95, which enables the vacuum insulated operating rod 94 to move while maintaining vacuum seal, and an arc shield 97 arranged in the vacuum insulation switch 91 to prevent arc occurring at the time of opening and closing of contacts from adhering to the insulated cylinder 91a.

Subsequently, the operation device 11 operates through the medium of levers 201, 401 to perform changeover to three positions, that is, a closing position for current-carrying in the vacuum two-points off and three-positions switch 8, an opening position for interruption of load current or accident current, and a disconnecting position for safety ensuring of an inspection worker against surge voltage such as lightning or the like, and opening and closing of the vacuum earthing switch 9. As shown in Fig. 3, the operation device 11 comprises a first operating mechanism 200 of a solenoid operation type for general changeover operation of a movable contact of a switch between a closing position and an opening position, a second operating mechanism 300 of a solenoid operation type for changeover operation of a movable contact of a switch between an opening position and a disconnecting position, a third operating mechanism 400 of a manual operation type for changeover operation of a movable contact of an earthing switch, and the control device 11a for electrical operation of the first and second operation devices. The control device 11a comprises a control substrate 11aa and a capacitor 11ab.

In addition, it is possible to appropriately change the arrangement of the first operating mechanism 200 and the third operating mechanism 400. Further, while the first operating mechanism 200 is of a solenoid operation type, it can be of other operation types such as an electrically-driven spring type or the like.

Here, an explanation will be given to a method of assembling the vacuum insulated switchgear 1. As an assembling method, there are mainly listed a method, in which a finished product of the vacuum insulated switchgear 1 is fabricated in a factory and the finished product is transported to an actual place, and a method, in which parts made into modules per compartment are fabricated and the compartments are joined together at an actual place to fabricate a finished product.

First, an explanation will be given to the method, in which the vacuum insulated

switchgear 1 according to the embodiment is manufactured in a factory and a finished product is transported to an actual place to be assembled. Initially, respective compartments described above are manufactured as parts made into modules in respective processes. Subsequently, the cable connection section 1c is mounted to the switch section 1b as manufactured. At this time, as shown in Fig. 1, a portion of the cable connection section 1c is made to be put on an upper portion of the switch section 1b through the spacer. Thereafter, the wiring connection section 1e is mounted to the cable connection section 1c and finally the low voltage control section 1d is mounted to the switch section 1b and the wiring connection section 1e. At this time, a portion of the low voltage control section 1d is made to be put on the upper portion of the switch section 1b through the spacer. When the switch section 1b and the low voltage control section 1d are mounted, electrical connection therebetween is also performed through a connector together with their mechanical mounting. The vacuum insulated switchgear 1 thus finished by joining the parts made into modules is transported to an actual place. After such transportation, the switch section 1b is fixed to a base for installation. After such fixation, the base is adjusted whereby the whole panel is adjusted in height and a bus-bar connection position is decided. After the bus-bar connection position is decided, a front door of the low voltage control section 1d is opened, a bus-bar chamber side cover present on a back side of the low voltage control section 1d is removed, and a bus bar is connected. After such connection of the bus bar, the bus-bar chamber side cover is again mounted. At this time, instead of removing the bus-bar chamber side cover, the low voltage control section 1d itself having been once mounted may be once removed and again mounted after connection of the bus bar. Subsequently, a back side cover of the cable connection section 1c is removed, a cable is connected and further parts such as an electric power supply, CT or the like and wirings are connected to perform assembling.

In addition, while the above explanation has been given to an example of mounting to the switch section 1b the modular parts in the order of the cable connection section 1c→the wiring connection section 1e→the low voltage control section 1d, it is possible to change the order of mounting.

Next, an explanation will be given to the method of performing fabrication every compartment, joining parts, which are made into modules, together at an actual place, and fabricating a finished product. In this case, respective compartments are initially manufactured in respective processes in the same manner as in the method described above. The respective compartments are transported per compartment to an actual place. Initially, the switch section 1b out of the respective compartments is fixed to a base. After such fixation, the base is adjusted whereby the switch section 1b is adjusted in height and a bus-bar connection position is

adjusted. After the bus-bar connection position is decided, the bus bar is connected. After such connection of the bus bar, the vacuum insulated switchgear 1 is assembled by connecting the cable connection section 1c, a wiring connection section 1e, and a low voltage control section 1d, which are made into modules, respectively, to the switch section 1b. At this time, as shown in Fig. 1, a portion of the cable connection section 1c is made to be put on an upper portion of the switch section 1b through the spacer and a portion of the low voltage control section 1d is made to be put on the upper portion of the switch section 1b through the spacer. In mounting the switch section 1b and the low voltage control section 1d, electrical connection is also performed through a connector together with mechanical mounting. The cable connection section 1c, the wiring connection section 1e, and the low voltage control section 1d can be mounted to the switch section 1b in an arbitrary order. Thereby, assembling at the actual place is completed.

Here, an explanation will be given to a method of replacement per compartment.

Initially, an explanation will be given to a method of replacement of the switch section 1b. At the time of replacement of the switch section 1b made into a module, a switch is put in a state of disconnection, it is detected whether an electric voltage is not applied to a circuit, and a control electric source is changed over to be off. Subsequently, a back side cover for the cable connection section 1c connected to the switch section 1b is removed and a cable is removed. At this time, in case of CT or the like having been connected, it is necessary to remove the CT or the like. Subsequently, a front door of the low voltage control section 1d is opened, a bus-bar chamber side cover present on a back side of the low voltage control section 1d is removed, and a bus bar is removed. Subsequently, a connector which connects between the low voltage control section 1d and the switch section 1b is removed, and when a panel is installed next to adjacent panels, the panels are removed. Thereafter, bolts having fixed between the low voltage control section 1d and the switch section 1b are removed and bolts having fixed between the low voltage control section 1d and the switch section 1b are likewise removed. Thereafter, a lowermost, decorative plate out of decorative plates provided on a front side of the switch section 1b described below is removed so that a pawl of a lifter can be inserted into a lifter pawl insertion part 1bf. The pawl of the lifter is inserted into the lifter pawl insertion part 1bf and the switch section made into a module is pulled out from the front side. At the time of insertion, it suffices to insert a repaired part or a new part in a reverse procedure to the above-described procedure.

In addition, although the work in removing the bus bar is performed in the above procedure without removing the low voltage control section 1d itself, the low voltage control

section 1d made into a module may be once removed in removing the bus bar, and after the switch section 1b is pulled out, the low voltage control section 1d may be again mounted, or after the switch section 1b is replaced by a new switch section 1b, the low voltage control section 1d may be mounted.

5 Next, an explanation will be given to a method of replacement of the low voltage control section 1d. In this case, like the switch section 1b, at the time of replacement of the switch section 1b, a switch is put in a state of disconnection, it is detected whether an electric voltage is not applied to a circuit, and a control electric source is changed over to be off. Subsequently, a front door of the low voltage control section 1d is removed and wirings and a
10 connector or connectors connected to the low voltage control section 1d are removed. Thereafter, bolts fixed between the switch part and the wiring connection part are removed and when a panel is installed next to adjacent panels, it is necessary to remove bolts for installation together. After such procedures, the low voltage control section 1d is pulled out from the front side. At the time of insertion, it suffices to insert a repaired part or a new part in a reverse
15 procedure to the above-described procedure.

 An explanation will be given to a method of replacement of the cable connection section 1c. In this case, like the switch section 1b, at the time of replacement of the switch section 1b, a switch is put in a state of disconnection, it is detected whether an electric voltage is not applied to a circuit, and a control electric source is changed over to be off. Subsequently, a
20 back side cover of the cable connection section 1c is removed and a cable is removed. At this time, in case of CT or the like having been connected, it is necessary to remove the CT or the like. Subsequently, bolts fixed between the switch part and the wiring connection part are removed and when a panel is installed next to adjacent panels, it is necessary to remove bolts for installation together. After such procedures, the cable connection section 1c made into a
25 module is pulled out from the back side. At the time of insertion, it suffices to insert a repaired part or a new part in a reverse procedure to the above-described procedure.

 Also, by using a resin to provide for mold insulation between respective phases, providing for vacuum insulation between contacts and varying dimensions between poles and the number of poles, it is possible to set the relationship of "an interphase insulation > an interpole
30 insulation at the time of disconnection > an interpole insulation at the time of interruption > an interpole insulation of earthing switches", whereby coordination of interphase insulation is accomplished. Thereby, failure is at most limited to one line earth circuit, so that it is possible to prevent transmission of the failure. Also, since the aerial insulated operation rod 88 described above is covered by the bellows 89 formed of rubber or metal to be cut off from the

outside air, reliability of insulation during the long-term use is ensured.

Also, as shown in Fig. 1, the decorative plate on the front side of the switch section 1b is divided into three parts every function. That is, an upper part is a state display portion 1bc, which displays that the switch section 1b is in a closing state, an opening state, a
5 disconnecting state or an ear thing state, and a manual operation portion 1bd for operation of the third operation mechanism 400 of a manual operation type. A part below the upper part is an emergency operation portion 1be for manual tripping of the first operation mechanism 200 at the time of emergency. A part below said part is the lifter pawl insertion part 1bf, into which a
10 pawl of a lifter can be inserted in order to use the lifter for transportation when a panel is to be transported. These parts are capped except in use. In this manner, the decorative plate can be divided into parts, which are different in state of use, and the respective parts can be left capped except in use. Thereby, it is possible to prevent malfunctioning due to erroneous contact or the like and decrease the risk of damage to the remaining portion of the decorative plates at the time of transportation with the use of the lifter. In addition, by providing the lifter pawl insertion
15 part 1bf in a lower, empty space of the panel instead of a floor board, there is no need of upward lifting by a height of the lifter pawl insertion part as compared with the case where the lifter pawl insertion part is provided on the floor board, so that stability at the time of transportation is improved. Further, since the provision of the lifter pawl insertion part 1bf in the lower, empty space of the panel makes it possible to connect the respective sections together while the lifter is
20 left inserted (that is, in a state, in which fine adjustment is possible), the work of position aligning of the respective sections to connect the same is remarkably facilitated.

In the embodiment 1 described above, four sections, that is, the switch section 1b, the cable connection section 1c, the low voltage control section 1d, and the wiring connection section 1e, which sections constitute the vacuum insulated switchgear 1, are made functionally
25 aggregate and individual every section to make modular boxes. As a result, the sections can be assembled in parallel every section, so that it is possible to achieve an improvement in working efficiency and productivity.

Also, since it is necessary to change an arrangement of parts or the like according to a customer's request, it is usually necessary to fabricate a switchgear from the first after receipt
30 of the customer's request, but by aggregating and dividing the parts as in the embodiment, it becomes possible to beforehand assemble the switch section 1b, which is hard to change every customer, thus enabling a rapid manufacture. Further, a section or sections susceptible to no change afford mass-production, thus enabling a remarkable decrease in production cost. Also, conventionally, in the case where a panel is partly damaged, the panel should be replaced as a

whole, which imposes a great burden on a consumer, but supply every section is made possible whereby replacement every section can be promoted. Further, when sectioning, if all of a switch, an actuator, a control substrate of the actuator and a capacitor, which are close to one another in service life, are received in the switch section 1b, replacement can be completed by replacement of only the switch section 1b, which leads to a decrease in burden on a consumer.

Also, by performing final assembling at an actual place, it becomes possible to transport for every section which is small in size as compared with the size of a whole panel, whereby the work of transportation is remarkably facilitated, for example, in case of installation in a small building, or the like.

Also, since a portion being fixed to a base is limited to the switch section 1b, the base is decreased in area as compared with the case where a base is fixed to a whole panel, thus enabling achieving a decrease in cost that much.

While two kinds of methods have been described for a method of assembling the vacuum insulated switchgear 1 at an actual place, it suffices, in a method of performing connection between compartments at an actual place, to adjust the height of only the switch section 1b made into a module, and therefore, the height adjustment of a bus-bar connection position by means of a base has a remarkable advantage in terms of weight and positioning accuracy, or the like in comparison with a case where a whole panel has to be moved up and down. Further, in the method of performing connection between compartments at an actual place, the low voltage control section 1d is not present at the time of connection of a bus bar, thus enabling ensuring a large work space for connection of the bus bar, which achieves a remarkable improvement in working efficiency. Also, in the case of transportation per compartment made into a module, freedom in transportation is increased in terms of, for example, a manner of loading, stability, etc., thus enabling a decrease in transportation cost itself.

Also, when a part or parts are constructed per section, it becomes difficult to ensure strength, but by aggregating the mold switch 1ba and the actuator, which are heavy, into the switch section 1b, making the metallic earth plate 2b large in plate thickness and subjecting the metallic earth plate to much bending in order to ensure strength for the switch section 1b, strength demanded for the cable connection section 1c, the low voltage control section 1d and the wiring connection section 1e, which constitute other sections than the switch section 1b, is decreased, that is, it becomes possible to thin sheets enclosing the sections and to decrease bending. In this manner, those sections, which require strength, are aggregated into the switch section 1b to enable a decrease in number of parts as a whole, thinning of sheets, and a decrease in size and weight with respect to other sections than the switch section 1b. As a result,

miniaturization and lightening of the vacuum insulated switchgear 1 as a whole are accomplished to enable a decrease in manufacturing cost.

Also, according to the embodiment, the cable connection section 1c and the low voltage control section 1d are partly put on the switch section 1b and besides weights of the cable connection section 1c and the low voltage control section 1d are imposed on the switch section 1b, which is a heaviest section. Thereby, it is possible to achieve a further decrease in strength for other sections than the switch section 1b.

Also, the switch section 1b, in which the mold switch 1ba being a current-carrying part and the operation device 11 are received, the bus-bar connection section 1a and the low voltage control section 1d being susceptible to influences of outside noise and temperature are enclosed by the metallic earth plates 2b, 2d to be made airtight, whereby even if an accident occurs on the switch section 1b or the low voltage control section 1d, transmission of the accident to other sections can be prevented. Further, by shielding those precision equipments in the low voltage control section, which are susceptible to influences of surrounding magnetic fields, from an environment by means of the metallic earth plate 2d, it becomes possible to prevent invasion of magnetic intensity, with the result that it becomes possible to prevent failure of the precision equipments.

Also, according to an embodiment of the invention, in addition to the above arrangement, mechanical connection among the respective sections is accomplished by bolt connection and electrical connection between the switch section 1b and the low voltage control section 1d is accomplished by connection between the connector 1bg and the connector 1dd whereby mounting and dismounting are made easy. As a result, dismounting at the time of maintenance becomes easy and change in arrangement among the sections becomes easy, so that it is possible to flexibly conform to various specifications requested by customers, thus enabling advancing the appointed date of delivery. Also, since change in arrangement is simplified, it is possible to achieve a decrease in manufacturing cost.

As shown in Fig. 6, a mesh ventilator 1ea may be mounted on a ceiling of the wiring connection section 1e. Thereby, it is possible to achieve an increase in quantity of draft to the bus-bar connection section 1a whereby it becomes possible to suppress temperature rise of the bus-bar connection section 1a when an electric current carried to a bus bar increases.

Also, since the protective relay 1db and the alarm display 1dc are pulled outside the switchgear by opening the door 1da and besides the metallic earth plate between the low voltage control section 1d and the bus-bar connection section 1a is a removable cover, it is possible to ensure a work space for the work of connection of a bus bar even in a state, in which

the low voltage control section 1d is mounted, with the result that it is possible to readily perform the work of connection of a bus bar.

Since the bus bar 5 and the bus-bar connection section 1a are arranged above the vacuum two-points off and three-positions switch 8, they are positioned in a level around a
5 worker's breast, thus enabling a reduction of workload on a worker.

According to the embodiment, while all the switch section 1b, the cable connection section 1c, the low voltage control section 1d and the wiring connection section 1e are made into modules in the form of boxes, even only any one of the sections, which is made into a module in the form of a box, enables replacement of only the section to advantage. In
10 particular, making the switch section 1b, which is high in the risk of damage due to repeated opening and closing operations, modular in the form of a box satisfies customer's needs.

A second embodiment will be described with reference to Fig. 7. The embodiment adopts that construction, in which a vacuum one-point off and three-positions switch 108 is applied as a switch. In this manner, it is possible to use a vacuum one-point off
15 and three-positions switch for a switch to achieve compartmentalization.

In addition, while the respective embodiments described above use the vacuum two-points off and three-positions switch 8 or the vacuum one-point off and three-positions switch 108, it goes without saying that other ones than them can be applied to the respective constructions described above.

CLAIMS:

1. A vacuum insulated switchgear comprising a switch section including at least a vacuum switch for performing closing and opening of an electric current and containing an actuator for operating the vacuum switch, wherein the switch section is made into a box-like module constructed so as to be capable of being assembled into the vacuum insulated switchgear.
2. The vacuum insulated switchgear according to claim 1, wherein the switch section is arranged on a lower portion of the vacuum insulated switchgear.
3. The vacuum insulated switchgear according to claim 2, further comprising a low voltage control section, which contains a protective relay, the low voltage control section being put on the switch section.
4. The vacuum insulated switchgear according to claim 2 or 3, further comprising a cable connection section, which contains a cable for supply of an electric power to a load side, the cable connection section being put on the switch section.
5. A vacuum insulated switchgear comprising:
 - a switch section containing a switch, which performs closing and opening of an electric current, and an actuator, which operates the switch;
 - a cable connection section containing a cable for supply of an electric power to a load side;
 - a low voltage control section containing a protective relay; and
 - a wiring connection section, through which wirings for connection among parts pass,wherein the switch section, the cable connection section, the low voltage control section and the wiring connection section are respectively made into box-like modules which are independent of each other.
6. The vacuum insulated switchgear according to claim 3 or 5, wherein the switch section and the low voltage control section are respectively made to be airtight by metallic earth plates.
7. The vacuum insulated switchgear according to claim 5 or 6, wherein bolts connect among the switch section, the cable connection section, the low voltage control section and the wiring connection section to fix the same, and a connector electrically connects between the switch section and the low voltage control section.
8. A vacuum insulated switchgear comprising:
 - a switch section containing a mold switch part, which performs closing, opening, disconnecting and earthing of an electric current and is covered by a solid insulator, an actuator,

which operates the mold switch part, and a control device, which contains an operation device for controlling a connector in the switch section and a mold switch and is arranged on a front, lower side of the vacuum insulated switchgear;

a cable connection section containing a cable for supply of an electric power to a load side and being arranged on a back side of the vacuum insulated switchgear;

a low voltage control section containing a protective relay, an alarm display for display of an abnormal state of the vacuum insulated switchgear and a connector arranged in the low voltage control section to be electrically connected to the connector in the switch section, the low voltage control section being arranged on a front, upper side of the vacuum insulated switchgear; and

a wiring connection section, through which wirings for connection among parts pass and which is arranged a central, upper side of the vacuum insulated switchgear; and

a bus-bar connection section arranged above the switch section, and

wherein the switch section, the cable connection section, the low voltage control section and the wiring connection section are respectively made into box-like modules which are independent of each other.

9. The vacuum insulated switchgear according to any one of claims 1 to 8, wherein a decorative plate is mounted on a front of the switch section, and the decorative plate is provided with a state display portion for showing state of the switch section, an operation portion for operating a manual operation device, an emergency operation portion for operating the manual operation device at the time of emergency to cut off an electric current and a pawl insertion portion for permitting a pawl of a carrying implement to be inserted therein when the vacuum insulated switchgear is transported, and

wherein the state display portion and the operation portion are arranged on an upper portion of the decorative plate, the emergency operation portion is arranged on an intermediate portion of the decorative plate, the pawl insertion portion is arranged on a lower portion of the decorative plate, and the state display portion and the operation portion includes a cover, and the emergency operation portion and the pawl insertion portion includes a cover.

10. The vacuum insulated switchgear according to any one of claims 1 to 9, wherein the switch section comprises a vacuum insulated three-positions switch, which switches to three positions of closing, opening and disconnecting in vacuum insulation and comprises a plurality of contacts, and a vacuum earthing switch, which comprises a contact in a vacuum insulation switch and performs earthing.

11. A method of manufacturing a vacuum insulated switchgear comprising a switch

section containing a switch, which performs closing and opening of an electric current, and an actuator, which operates the switch, a cable connection section containing a cable for supply of an electric power to a load side, a low voltage control section containing a protective relay, and a wiring connection section through which wirings for connection among parts pass, the respective sections being combined to form the vacuum insulated switchgear, said manufacturing method comprising the steps of:

making the switch section, the cable connection section, the low voltage control section and the wiring connection section into box-like modules which are independent of each other;

putting a portion of the cable connection section on the switch section after the switch section is arranged;

putting a portion of the low voltage control section on the switch section, and arranging the wiring connection section between the cable connection section and the low voltage control section.

12. A replacement method of a switch section of a vacuum insulated switchgear, which comprises a switch section, which performs closing, opening and disconnecting of an electric current, a cable connection section containing a cable for supply of an electric power to a load side and a low voltage control section, the respective sections being combined to form the vacuum insulated switchgear, the switch section, the cable connection section and the low voltage control section being respectively made into box-like modules which are independent of each other, comprising the steps of:

disconnecting an electric current in the switch section;

removing the cable in the cable connection section; and

removing a bus bar as connected; and

pulling out the switch section and inserting the switch section as repaired or a fresh switch section, thereby accomplishing replacement of the switch section made into a module.

13. A replacement method of a switch section in a vacuum insulated switchgear, which comprises a switch section, which performs closing, opening and disconnecting of an electric current, a cable connection section containing a cable for supply of an electric power to a load side and a low voltage control section, the respective sections being combined to form the vacuum insulated switchgear, the switch section, the cable connection section and the low voltage control section being respectively made into box-like modules which are independent of each other, comprising the steps of:

- disconnecting an electric current in the switch section;
- removing the cable in the cable connection section;
- removing a connector between the low voltage control section and the cable connection section;
- removing the low voltage control section;
- inserting a lifter pawl into a lifter pawl insertion part provided on one surface of the switch section and pulling out a lifter to thereby pull the switch section out; and
- inserting the switch section as repaired or a fresh switch section to thereby accomplish replacement of the switch section made into a module.

14. A replacement method of a low voltage control section of a vacuum insulated switchgear, which comprises a switch section containing a switch for performing closing and opening of an electric current and an actuator for operating the switch, a cable connection section containing a cable for supply of an electric power to a load side, and a low voltage control section containing a protective relay, the respective sections being combined to form the vacuum insulated switchgear, the switch section, the cable connection section and the low voltage control section being respectively made into box-like modules which are independent of each other, comprising the steps of:

- making a switch in the switch section into a disconnected position by operating the switch;
- removing a connector between the low voltage control section and the cable connection section; and
- replacing the low voltage control section made into a module by a repaired one or a fresh one.

15. A replacement method of a cable connection section of a vacuum insulated switchgear, which comprises a switch section containing a switch for performing closing and opening of an electric current and an actuator for operating the switch, a cable connection section containing a cable for supply of an electric power to a load side, and a low voltage control section, the respective sections being combined to form the vacuum insulated switchgear, the switch section, the cable connection section and the low voltage control section being respectively made into box-like modules which are independent of each other, comprising the steps of:

- making a switch in the switch section into a disconnected position by operating the switch;
- removing the cable in the cable connection section; and

replacing the cable connection section made into a module by a repaired one or a fresh one.

16. A method of adjusting a bus-bar connection position in a vacuum insulated switchgear, which comprises a switch section containing a switch for performing closing and opening of an electric current and an actuator for operating the switch, a cable connection section containing a cable for supply of an electric power to a load side, and a low voltage control section, the respective sections being combined to form the vacuum insulated switchgear, the switch section, the cable connection section and the low voltage control section being respectively made into box-like modules which are independent of each other, comprising the steps of:

adjusting a bus-bar connection position by moving a base provided on a bottom of the switch section up and down; and

thereafter, joining together the switch section, the cable connection section and the low voltage control section, each of which is made into a module.

17. A method of adjusting a bus-bar connection position in a vacuum insulated switchgear, which comprises a switch section containing a switch for performing closing and opening of an electric current and an actuator for operating the switch, a cable connection section containing a cable for supply of an electric power to a load side, and a low voltage control section, the respective sections being combined to form the vacuum insulated switchgear, the switch section, the cable connection section and the low voltage control section being respectively made into box-like modules which are independent of each other, a bus bar of the vacuum insulated switchgear being made contactable from outside the vacuum insulated switchgear by opening and closing a door provided on the low voltage control section, comprising the step of adjusting a bus-bar connection position by moving a base provided on a bottom of the switch section up and down after the switch section, the cable connection section and the low voltage control section are joined together.