

Title of the invention: Dual Bus-bar type Switchgear

Field of the invention:

The present invention relates to a dual bus-bar type
5 switchgear, and more particularly to a dual bus-bar type
switchgear, wherein the bus-bars are insulated with a solid
insulator having earthed surface coating thereon.

Background art:

10 In facilities such as factories for producing devices for
computers and hospitals, an increase in reliability of power
sources is demanded more and more because a stable power supply
to various loads is required.

As switchgears of electric switchboard equipments for such
15 facilities, there are dual bus-bar type switchgears, which can
make short the interruption time to supply power to loads so
as to increase reliability of power supply as disclosed by
patent document No. 1. In this system, one of the bus-bars is
charged with power received from an electric power company and
20 the other bus bar is charged with electric power supplied from
a private power generator so that even if power supply from the
electric power company is interrupted due to flash-to-ground,
stable power supply to loads is continued by switching the
interrupted bus-bar to the other bus-bar.

Prior art:

Patent document: Japan Patent laid-open No. H06-311614

The switchgears mentioned above comprises an upper
disconnecter one end of which is connected to an upper bus-bar,
5 a lower disconnecter one end of which is connected to a lower
bus-bar, and a circuit breaker being connected to the other end
of the upper disconnecter and lower disconnecter. Since the
circuit breaker is disposed between the upper disconnecter and
lower disconnecter, power supply can be continued through the
10 lower disconnecter, lower bus-bar and circuit breaker even when
failure happens in the upper disconnecter and/or the upper
bus-bar. As a result, it is possible to reduce the failure time
of power supply to loads in accidents in one of the
disconnecters and/or bus-bars.

15 However, permanent release (recovery) work of the failed
bus-bar or disconnecter must be done after switching-off of the
upper bus-bar and lower bus-bar during the night time where
loads are stopped or during a periodic check so as to secure
safety for workers.

20 That is, power supply to the loads must be cut-off, which
makes difficult to shorten the cut-off time.

In such the switchgears of dual bus-bar type, it has been
desired to carry out the permanent release work of the failed
portions without stopping power supply to the loads and check
25 devices in the casing of the switchgear.

Summary of the invention:

The present invention was made based on the above mentioned problems and provides a dual bus-bar type switchgear, which makes it possible to carry out the check of the devices in the casing and work relating to one of the bus-bars and/or the disconnectors without stopping power supply to the loads.

In order to solve the above problems, the present invention provides a dual bus-bar type switchgear comprising a casing accommodating the following elements and a constituted by earthed metal plate, a bus-bar room located at the rear side of the casing, a device room located next to the bus-bar room and partitioned from the bus-bar room with the earthed metal plate 12, and an upper bus-bar and a lower bus-bar disposed in the casing each having a conductor, an upper switch unit 19A having a circuit breaker one end of which is connected to the upper bus-bar, a lower switch unit 19B one end of which is connected to the lower bus-bar, the upper switch unit and lower switch unit being disposed in the switch room, a extending bus-bar 33, which is disposed in the bus-bar room and solid-insulated, one end of which is connected to one end of the upper switch unit and one end of the lower switch unit, a circuit breaker of the upper switch unit and a circuit breaker of the lower switch unit electrically connected in series between the upper bus-bar and lower bus-bar, wherein each of the conductor 8 of the bus-bars is covered with a solid insulator

9 having an electrically conductive coating 10 to be earthed.
A conductor (cable) 8 of the extending bus-bar 33 should
preferably be solid-insulated with a sold insulator 9 having
an electrically conductive coating to be earthed, as shown in
5 Fig. 3. The casing may further comprises a control room next
to the device room and partitioned from the device room with
the earthed metal plate, in addition to the device room and the
bus-bar room.

The earthed metal plate 12 may exist between the device
10 room and the control room, in addition to the earthed metal plate
12 between the bus-bar-room and the device room.

Another aspect of the present invention is to provide the
dual bus-bar type switchgear mentioned above, wherein the
circuit breakers of the upper switch units are connected in
15 series with the upper bus-bars, and the circuit breakers of the
lower switch units are connected in series with the lower
bus-bars.

Yet another aspect of the present invention is to provide
the dual bus-bar type switchgear defined above, wherein the
20 solid insulator is made of epoxy resin or silicone rubber.

According to the present invention, it is possible to down
size the dual bus-bar type switchgear and cut down a cost thereof
and inspection or check or work on the bus-bar and or devices
in the casing can be done without stopping power supply to the
25 loads, because one of the solid-insulated and earthed bus-bars

is disposed in the upper position and the solid-insulated and earthed other bus-bar is disposed at the lower position in the casing, wherein the upper bus-bars are electrically connected to the upper switch unit and the lower bus-bars are electrically
5 connected to the lower switch unit.

Brief description of the drawings:

Fig. 1 is a connection diagram of a switchgear of panel rowing constitution type of the present invention.

Fig. 2 is a vertical sectional view from a side view of a
10 switchgear unit 1 shown in Fig. 1 according to one embodiment of the present invention.

Fig. 3 is a perspective cross sectional view of an earthed solid-insulated conductor employed in the embodiment of the present invention.

15 Fig. 4 is a connection diagram of a unit panel of the embodiment of the present invention.

Fig. 5 is a plan view of the bus-bar room from the rear side of the casing, where the cable and cable head are omitted for simplicity.

20 Fig. 6 is a side view of a switch unit employed in the embodiment of the present invention.

Fig. 7 is a connection diagram for explaining inspection work of the switchgear of the embodiment.

25 Detailed description of the embodiment:

According to the present invention, the following embodiments are provided.

(1) A switchgear unit comprising a casing accommodating the following elements and including a bus-bar room located in a rear side of the casing, a device room in front of the bus-bar room and a control room located at the front side of the casing;

a lower main bus-bar (16B) and an upper main bus-bar (16A), separately disposed in the bus-bar room (16);

a lower switch unit and an upper switch unit, separately disposed in the device room (15),

a lower controller (26B) and upper controller (26A) for controlling the switchgear disposed in the control room (17),

a lower connecting bus-bar (31B) connecting a lower interrupter (21b) and an upper connecting bus-bar (31A) connected to an upper interrupter or a breaking portion (21a), an extending bus-bar (39) connected to the connecting bus bar (31) and a cable through a cable head (38), and an auxiliary connecting bus-bar (32) connecting the upper switch unit and the lower switch unit, disposed in the bus-bar room, wherein each of the main bus-bars, extending bus-bar, connecting bus-bar and auxiliary connecting bus-bar is insulated with a solid insulator having a conductive coating thereon, the conductive coating of the bus-bars being earthed.

(2) The switchgear unit according to (1), wherein the solid insulator is made of epoxy resin or silicone rubber.

(3) The switchgear unit according to (1), wherein each of the upper switch unit and the lower switch unit, each including a vacuum circuit breaker mounted on a carriage, which is movable to a disconnection position.

5 (4) The switchgear unit according to (3), wherein both of the vacuum circuit breakers of the upper switch unit and the lower switch unit are surrounded with frames on the carriages.

(5) The switchgear unit according to claim 4, wherein the frames located at both sides of each of the circuit breakers
10 have cut-away portion.

(6) A panel rowing type switchgear comprising at least two of the switchgear units defined in (1), wherein the switchgear units are arranged side by side, the adjacent switchgear units being connected by upper main bus bars and lower main bus-bars.

15 (7) The switchgear unit according to claim 2, wherein the solid insulator is made of epoxy resin or silicone rubber.

(8) The switchgear unit according to (6), wherein each of the upper switch unit and the lower switch unit, each including a vacuum circuit breaker mounted on a carriage, which is movable
20 to a disconnection position.

(9) The switchgear unit according to (8), wherein both of the vacuum circuit breakers of the upper switch unit and the lower switch unit are surrounded with frames on the carriages.

(10) The switchgear unit according to (9), wherein the frames
25 located at both sides of each of the circuit breakers have

cut-away portion.

In the following, the embodiment of the switchgear of the present invention will be explained in detail by reference to drawings. Fig. 1 is a connection diagram of a panel rowing constitution-dual bus-bar type switchgear to which the present invention is applied. In Fig. 1, the switchgear is constituted by a row of a plurality of feeder panels 1 for supplying power to loads, wherein bus-bars are arranged as two layers, i.e. dual bus-bar type. Each of the feeder panels 1 comprises a first bus-bar 2 that communicates with adjacent feeder panels at its upper portion, a second bus-bar 3 that communicates with the adjacent feeder panels at its lower portion, an upper circuit breaker 4 one end of which is connected to the first bus-bar 2, a lower circuit breaker 5 one end of which is connected to the second bus-bar 3, a third bus-bar 6 connected to the other end of the upper circuit breaker 4 and the other end of the lower circuit breaker 5, and a power cable 7 connected to the third bus-bar for supplying electric power to loads. Electrically, the upper circuit breaker 4 and the lower circuit breaker 5 are connected in series between the first bus-bar and the second bus-bar to constitute a panel rowing constitution so that a plurality of upper circuit breakers 4, 4, ... are connected to the first bus-bar 2 and a plurality of lower circuit breakers 5, 5, ... are connected to the second bus-bar 3 in parallel.

In an ordinary operation, the first bus-bar 2 and the third

bus-bar 3 are charged with electric power from different power sources, and one of the circuit breakers 4 and 5 is on to supply electric power to loads. If electric power supply from one of the power sources is stopped, one of the bus-bars is cut-off, but the power supply to loads is continued by releasing the circuit breaker connected to the cut-off bus-bar and putting the circuit breaker connected to the other bus-bar on.

In the above embodiment, the first bus-bar 2, second bus-bar 3 and third bus-bar 6 are solid-insulated with solid insulators, which are earthed to make the ground potential.

Next, the embodiment of the switchgear of the present invention will be explained by reference to Figs. 2 to 4. Figs. 2 to 4 show the embodiment of the switchgear. Fig. 2 shows a vertical sectional view from the side view, Fig. 3 shows a connection diagram of the embodiment shown in Fig. 2 and Fig. 4 shows a rear view of the embodiment shown in Fig. 2, wherein cable 39 and cable head 38 are omitted.

In Figs. 2 and 3, the casing 11 is partitioned with earthed metal plates 12 to form a bus-bar room 16 in the rear side (left side in Fig. 2), a device room in a middle 15, and a control room 17 in the front side (right side in Fig. 2), wherein an upper bus-bar room 16A and lower bus-bar room 16B are formed with covers 13A, 13B. The device room 15 has an upper device room 15A and lower device room 15B with upper sealing cover 14A and lower sealing cover 14B. The sealing covers 14A, 14B are

made of an electrical conductor for protecting persons from electric shock from charged portions such as the circuit breakers.

Packing may be provided to the sealing covers 14A, 14B to
5 protect the device rooms 15A, 15B from dust. As a result, labor saving for cleaning of the device rooms may be achieved.

In the front side of the casing, a front door 11A is disposed, and in the rear side, a rear door 11B is disposed. The front door 11A and the rear door 11B are capable of opening and closing.
10 The control room 17 is disposed in front of the device rooms 15A, 15B. Protecting controllers 16 are fixed to the front door 11A.

At the bottoms of the device rooms 15A, 15B, supporting bases 18, 18 are disposed, wherein the bases 18, 18 are fixed
15 to the partition metal plate 12 and side plates of the casing 11. An upper switch unit 19A and lower switch unit 19B are supported on the bases 18, 18. Each of the switch units 19A, 19B comprises an interrupter 21a of a vacuum circuit breaker 20A (VCB) for interrupting current of the power source circuit,
20 an operator 21A for opening and closing the interrupter 21a of the vacuum circuit breaker 20A, a current transformer (CT) 22A connected to a terminal of a load side of the vacuum circuit breaker 20A, and a zero phase current transformer (ZCT) 23A connected to a terminal of the power source side of the vacuum
25 circuit breaker 20A.

Each of the switch units 19A, 19B is provided with a front cover 41A, which has a handle 25A for extending the interrupter 21a at the center of the front cover 41A. The switch units 19A, 19B are mounted on the carriages 24A, respectively. Each of the
5 carriages has upright frames 27A on both sides and the front edge thereof to cover the vacuum circuit breaker 20A and the operator 21A. The frames 27A is provided with the current transformer 22A and the zero phase current transformer 23A.

The vacuum circuit breaker 20A, the current transformer
10 22A and the zero phase current transformer 23A are connected in series to constitute the switch units 19A, 19B as shown in Fig. 3. The zero-phase current transformer 23A is disposed at the power source side of the vacuum circuit breaker 20A, and the current transformer 22A is disposed at the loads of the
15 circuit breaker 20A.

At the rear side of the switch units 19A, 19B, there are disposed a terminal 18A connected to a movable electrode of the vacuum circuit breaker 20A and a terminal 29A connected to a fixed electrode of the vacuum circuit breaker 20A as shown in
20 Fig. 2. The terminals 28A, 29B are connected to the connecting bus-bars 31A connected to the main bus-bar 30A in the bus-bar room 16A or 16B and auxiliary connecting bus-bars 32A by means of a bushing for an air disconnecter.

In Fig. 2, the upper main bus-bar 30A and lower main bus-bar
25 30B are disposed in the upper bus-bar room 16A and lower bus-bar

room 16B in parallel with the front side (In Fig. 2. in a direction perpendicular to the paper) by means of connecting adapters 34A, 34B as connecting members. The upper main bus-bar 30A and the lower main bus-bar 30B are connected with one end
5 of the connecting bus-bar 31A, 31B by means of the connecting adapters 34, 34. The other end of the connecting bus-bars 31, 31 are branched into connecting terminals 31a and 31b. The other end of the connecting terminal 31a of the connecting bus-bar 31A connected to the upper main bus-bar 30A is introduced into
10 the device room 15A in such a manner that it is capable of being in contact with or separable from the a terminal 29 of the upper switch unit 19A. The connecting terminal 31b of the connecting bus-bar connected to the lower main bus-bar 30B is introduced into the lower device room 15B in such a manner that it is capable
15 of being in contact with or separable from the terminal 28A of the lower switch unit 19A. The one end of each of the connecting bus-bars 31A, 31B fixed to the earthed metal plate 12 is solid-insulated.

The solid-insulated auxiliary connecting bus-bar 32 is
20 disposed above the lower bus-bar room 16B, which is located below the upper bus-bar room 16A. The auxiliary connecting bus-bar 32A has a connecting portion 32a to be connected with the terminal 33a of the extending bus-bar 33A at an intermediate thereof, and the auxiliary connecting bus-bar 32A has
25 connecting terminals 32b, 32c being capable of contacting with

or separable from the terminals of the switch units 19A and 19B.

The connecting terminals 32b, 32c of the auxiliary connecting bus-bar 32 are introduced into the device rooms 15A, 15B in such a manner that the terminals 32b, 32c are capable
5 of contacting with or separable from the lower terminal 28 of the lower terminal 28A of the upper switch unit 19A and the upper terminal 29A of the lower switch unit 19B. The extending bus-bar 33A is disposed at the rear side of the auxiliary connecting bus-bar 32A. One end of the extending bus-bar 33A has a
10 connecting terminal 33a, which is connected to the auxiliary connecting bus-bar at the connecting portion 32a. The other end of the extending bus-bar 33 is connected to the cable head 38A to which one end of the cable 39 is connected. The other end of the cable 39 is withdrawn through the casing 11 and connected
15 to loads.

Conductors 8 of the upper main bus-bar 30A, lower main bus-bar 30B, connecting bus-bar 31B, auxiliary connecting bus bar 32B and extending bus-bar are covered with solid insulators 9, which has a conductive coating 10 to be earthed, as shown
20 in Fig. 3. These bus-bars are free from gas so that maintenance of gas is not necessary. Even if dust or foreign substances enter into the bus-bar rooms 16A, 16B, reliable insulation is secured, and maintenance labor is saved. The solid insulator 9 should preferably be epoxy resin or silicone rubber. The conductive
25 coating may be conventional conductive paints.

In this embodiment, the upper switch unit 19A and the lower switch unit 19B are disposed between the upper main bus-bar 30A and the lower main bus-bar 30B. Therefore, it is possible to carry out repairmen or check of the switchgear even if failures
5 happen in the upper main bus-bar, lower main bus-bar and/or switch units, while the power supply to the loads is continued.

Fig. 5 shows a plane view of the rear side of the switchgear, wherein the cable head and cable are omitted. There are rows of panels constituting the switchgear, the solid-insulated
10 upper main bus-bar 30A, solid-insulated lower main bus-bar 30B, connecting bus-bars 31A, 31B, auxiliary connecting bus-bars 32A, 32B and the extending bus-bar 33. Fig. 6 shows connection between the various bus-bars and the device rooms 15.

A width (in horizontal direction of Fig. 5) of the casing
15 11 is as small as about 600 mm. Connection between the upper main bus-bar 30A and the lower main bus-bar 30B is performed by connecting adapters 34, which connect one ends of the main bus-bars 30A, 30B. The insulation specification of the solid insulation 9 meets the rated voltage of 24 kV to eliminate
20 cleaning job of the bus-bars, as well as securing safety and reliability thereof.

Next, the switch unit 19A or 19B will be explained in detail by reference to Fig. 6. Fig. 6 is a vertical sectional view of the switch unit. In Fig. 6, the same reference numerals as
25 those in Figs. 2 to 4 mean the same elements, and detailed

explanations are omitted, accordingly.

The vacuum circuit breakers 20 constituting the switch unit 19A, 19B mounted on the carriages 24A, 24B each having 4 wheels together with operators 21A, 21B placed at the front side of
5 the carriages and the interrupters 21a having insulating three cylinders 40. In front of the operators 21A, a front cover 41, and a rod handle 25A, 25B for extending the circuit breakers 20A, 20B are disposed.

Each of the interrupters 21a of the circuit breakers is
10 provided with three fixed electrode side terminals 29A, 29B at the upper side and three movable electrode side terminals 28A, 28B at the lower side in each switch unit, the terminals 29A, 29B, 28A, 28B being arranged in a horizontal direction.

The current transformers 22A, 22B covering two fixed side
15 electrode side terminals 29A, 29B of three phases are disposed at the upper position of the frame 27A, 27B, and a race track type zero phase current transformers 23A, 23B that covers the movable electrode terminal 28A, three phases with one iron core are disposed at the lower position. The side frames 27A, 27B
20 have cut-away portions 46 so as to avoid reduction in insulating performance due to frames.

Next, repair or inspection of the devices in the casing of the switchgear will be explained by reference to Fig. 7. Fig. 7 shows a connection diagram of the switchgear at the time of
25 repair or inspection. In Fig. 7, the same reference numerals

as those in Figs. 2 to 4 mean the same elements, and detailed explanations are omitted, accordingly.

Inspection procedures for the upper main bus-bars 30A over the row of the switchgear and the upper switch units 19A comprise the following steps. It is possible to carry out the checking of the lower bus-bar 30B and lower switch unit 19B in accordance with the following manner wherein the upper circuit breakers are changed to the lower circuit breakers.

(1) A circuit is constituted for power supply to the respective loads by means of the lower vacuum circuit breakers 20B, 20B... from the lower main bus-bars 30B.

(2) The upper vacuum circuit breakers 20A, 20A... are opened, and the upper main bus-bars 30A are made in a power failure status.

(3) The upper switch units 19A having the upper circuit breakers 20A are withdrawn from the casing to place them in a disconnection position. The block lines indicate the circuits are alive, and thin lines indicate the circuits are dead.

(4) Inspection of the upper main bus-bars 16A is conducted after the cover 13 shown in Fig. 2. During the inspection, the lower main bus-bars 19B and lower switch units 19B are kept on, and power supply to the loads is continued.

(5) After the inspection is over, the cover 13A of the upper main bus-bar 16A is put on in a regular position.

(6) The switch units 19A are returned to the original positions in the casing.

(7) The vacuum circuit breakers 20A are brought into a closed status and the upper main bus-bars 30A are in a charged status or alive status to recover the circuit.

The solid insulation is composed of a solid insulator
5 covering a conductor of the various bus-bars, and the surface of the solid insulator is coated with a conductive paint. The conductive coating is earthed so that if a person touches the bus-bars, the person is free from electrical shock. In other words, there is no high voltage points exposed in the switchgear
10 of the present invention.

As having discussed, it is possible to carry out the inspection or repair of the devices or element of the upper switchgear units without opening the lower switchgear units. That is, the repair or inspection can be conducted while keeping
15 current supply to the loads without opening the lower vacuum interrupters. Although the conventional dual bus-bar type switchgear needs a long insulation distance between the bus-bars, which was difficult to make a space for the switchgear small, the switchgear of the present invention does not need
20 a large space for installation because of the solid insulation of the various bus-bars.

The embodiment of the switchgear of the present invention is featured by a down-sized volume and light weight, high safety and high reliability because of solid-insulated dual bus-bar
25 system.

Since the upper switch units 19A and lower switch units 19B are disposed between the upper main bus-bars 30A and the lower main bus-bars 30B, release work (recovery work) of the switchgear can be carried out even when one of the upper main bus-bars and the lower main bus-bars are in a failure, while keeping the power supply to the load by a group of the main bus-bars and switch units.

Reference numerals

1: feeder panel, 2: first main bus-bar, 3: second main bus-bar, 4: upper circuit breaker, 5: lower circuit breaker, 6: third bus-bar, 7: power cable, 8: conductor, 9: solid insulator, 10: conductive coating, 11: casing, 11B: rear door, 12 partition metal plate, 13: bus-bar cover, 14: sealing cover, 15: device room. 15A: upper device room, 15B: lower device room, 16: bus-bar room, 16A: upper bus-bar room, 16B: lower bus-bar room, 17: control room, 18: supporting member, 19A: upper switch unit, 19B: lower switch unit, 20A: upper vacuum circuit breaker, 20B: lower vacuum circuit breaker, 21a: interrupter or a breaking portion, 22A, 22B: current transformer, 23A, 23B: zero phase current transformer, 24A, 24B: carriage, 25A, 25B: extending handle, 26A, 26B: protecting controller, 27A, 27B: frame, 28: terminal, 29A, 29B terminal. 30A: upper main bus-bar, 30B: lower main bus-bar, 31a: connecting terminal, 31b: connecting terminal, 32: auxiliary connecting bus-bar, 32a: connecting

portion, 32b: connecting terminal, 32c: connecting terminal,
33: extending bus-bar, 33a: connecting terminal, 34: connecting
adapter, 38: cable head, 39: cable, 40: insulating cylinder,
41: front cover, 46: cut-away portion

5 We claim:

1. A switchgear unit comprising a casing accommodating the
following elements and including a bus-bar room located in a
rear side of the casing, a device room in front of the bus-bar
room and a control room located at the front side of the casing;

10 a lower main bus-bar and an upper main bus-bar, separately
disposed in the bus-bar room;

a lower switch unit and an upper switch unit, separately
disposed in the device room,

a lower connecting bus-bar connecting a lower interrupter
15 and an upper connecting bus-bar connected to an upper
interrupter, an extending bus-bar connected to the connecting
bus bar and a cable through a cable head, and an auxiliary
connecting bus-bar connecting the upper switch unit and the
lower switch unit, disposed in the bus-bar room,

20 characterized in that each of the main bus-bars, extending
bus-bar, connecting bus-bar and auxiliary connecting bus-bar
is insulated with a solid insulator having a conductive coating
thereon, the conductive coating of the bus-bars being earthed.

25 2. The switchgear unit according to claim 1, wherein the solid

insulator is made of epoxy resin or silicone rubber.

3. The switchgear unit according to claim 1, wherein each of the upper switch unit and the lower switch unit, each including
5 a vacuum circuit breaker mounted on a carriage, which is movable to a disconnection position.

4. The switchgear unit according to claim 3, wherein both of the vacuum circuit breakers of the upper switch unit and the
10 lower switch unit are surrounded with frames on the carriages.

5. The switchgear unit according to claim 4, wherein the frames located at both sides of each of the circuit breakers have cut-away portion.

15

6. A panel rowing type switchgear comprising at least two of the switchgear units defined in claim 1, wherein the switchgear units are arranged side by side, the adjacent switchgear units being connected by upper main bus bars and lower main bus-bars.

20

7. The switchgear unit according to claim 2, wherein the solid insulator is made of epoxy resin or silicone rubber.

8. The switchgear unit according to claim 6, wherein each of the upper switch unit and the lower switch unit, each including
25 a vacuum circuit breaker mounted on a carriage, which is movable

to a disconnection position.

9. The switchgear unit according to claim 8, wherein both of
the vacuum circuit breakers of the upper switch unit and the
5 lower switch unit are surrounded with frames on the carriages.

10. The switchgear unit according to claim 9, wherein the frames
located at both sides of each of the circuit breakers have
cut-away portion.

10

11. The switchgear unit according to claim 1, wherein the casing
comprises a lower controller and upper controller for
controlling the switchgear disposed in the control room, in
addition to the device room and the bus-bar room.

15

20

25