

DESCRIPTION

SWITCHING APPARATUS COMPONENT CONNECTING DEVICE

TECHNICAL FIELD

This invention relates to a switchgear component connecting device and, more particularly, to a device for connecting electrical components used in relation to a switching apparatus such as a metal enclosed switchgear including a gas-insulated switchgear. The switching apparatus component in this application refers to an electrical device used together with a switching apparatus, including related devices directly connectable to a switchgear such as bus conductors and power cables for connecting the switching apparatus to an external circuit.

BACKGROUND ART

In a conventional switching apparatus component connecting device as a connecting structure for a component in a gas-insulated switchgear, a shunt conductor, for example, disposed within a tank in which an electrically insulating gas is filled is used in order to connect bus bars which are solid insulated conductors to an electrical component such as a potential transformer. Shunting bushings are disposed on the bus bar side of the tank and connected at their outer ends to the bus bars, and component connecting bushings are disposed on the component side of the tank to extend through the tank wall and are connected at their outer ends to the electrical component. Shunting conductors are connected between these shunting bushings and the component connecting bushings so that the bus bars and the electrical component are electrically connected.

Therefore, according to the conventional component mounting structure, the shunting conductors, the bushings and the gas tank and the like have been needed and an insulating space with respect to the another electrical components has been required because of the provision of the shunting

conductors, thus resulting in a cause of impeding miniaturization of the switching apparatus. Also the cost for mounting them has been necessary, thus there has been a demand for making this portion to less expensive.

DISCLOSURE OF INVENTION

According to the present invention, a switching apparatus component connecting device for connecting a switching apparatus including bus bars to a related electrical component comprises a first contact terminal electrically connected to a first electric component, an electrically insulating tubular member attached to the first electric component and having an inner circumferential wall surface surrounding said first contact terminal and having a diameter gradually decreasing from an open end toward a closed end, a second contact terminal connected to a second electric component, and an electrically insulating column member attached to the second electric component and supporting said second contact terminal at its tip, having an outer circumferential wall surface having a diameter gradually decreasing toward the tip in correspondence with said inner circumferential wall surface of said insulating tubular member for causing said first and second contact terminals to be brought into an electrical contact with each other with said outer circumferential wall surface intimately contacting with said inner circumferential wall surface.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partially sectional front view illustrating the first embodiment of the switching apparatus component connecting device of the present invention.

Fig. 2 is an exploded perspective view showing the connecting terminal assembly of the switching apparatus component connecting device shown in Fig. 1.

Fig. 3 is an enlarged partial sectional view of the second connecting terminal of the switching apparatus component connecting device shown in Fig. 1.

Fig. 4 is a partially sectional front view illustrating the second embodiment of the switching apparatus component connecting device of the

present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Embodiment 1

Fig. 1 illustrates a structure for mounting a component to a bus bar conductor connecting portion which is one embodiment of a switching apparatus component connecting device of the present invention, the switching apparatus component connecting device in this embodiment being a structure for electrically connecting and supporting a second electric component 2 such as a potential transformer or a lightning arrester to a first electric component 1 which is a bus bar conductor (solid-insulated conductor) of a switching apparatus. Although not all of them are illustrated in Fig. 1, three sets of first and second electric components 1 and 2 as well as the switching apparatus component connecting device for connecting them to each other are provided in relation to three phases.

In Fig. 1, the switching apparatus has mounted on its tank or frame 3 a substantially cross-shaped support insulator 5 made of resin fixed at the flange portion 4 in a elected position for supporting the solid insulated conductor. The support insulator 5 may be made of a suitable material having a necessary strength and insulating performance such as epoxy resin. The support insulator 5 comprises a column-shaped portion 6 vertically extending from the flange portion 4, and a hollow cylindrical support portion 7 formed in one piece in a unitary structure so that their axes cross each other at the middle of the length of the column-shaped portion 6, for supporting the solid-insulated conductor 1.

The solid-insulated conductor 1 is a bus conductor in which a cylindrical conductor 8 is coated with a solid insulator 9 and is supported by being extended through the horizontally extended, cylindrical support portion 7 of the support insulator 5. The solid-insulated conductor 1 is provided at a position corresponding to the hollow portion of the column-shaped portion 6 with a portion 11 from which the solid-insulator 9 is eliminated to expose the conductor surface. In this exposed conductor surface, a bolt hole 10 vertically extending therethrough is provided and a connecting terminal assembly 12 as shown in

Fig. 2 is mounted.

In Fig. 2, the connecting terminal assembly 12 comprises a first and a second half-pipe conductors 13 and 14 surrounding and contacting upper and lower sides of the exposed portion 11 of the solid-insulated conductor 1 from which the solid insulator 9 is eliminated.

The second half pipe conductor 14 has provided at its central portion with a bolt hole 15, through which the lower end of the through bolt 16 extending through the bolt hole 10 of the solid-insulated conductor 1 extends and fixed by a stop nut 17.

The first half-pipe conductor 13 is provided at its central portion with a mounting bed 18 having a flat surface slightly elevated from the cylindrical surface of the half-pipe conductor 13, and a bolt hole 19 is formed in the center of the mounting bed so that, when assembled, the upper end of the bolt 16 extending through the bolt hole 10 of the solid-insulated conductor 1 project upwardly therefrom. A ring-shaped washer or a contact piece 20 made of a suitable terminal material such as copper or the like is placed over the projected upper end of the through bolt 16, and a nut 21 is tightened on the contact terminal 20 to firmly secure it in place and establish an electrical contact between the bus conductor 1 and the conductor 8. The through bolt 16 may be a stud bolt planted on the second half-pipe conductor 24, for example.

The contact terminal 20 is positioned within the substantially cylindrical column-shaped portion 6 of the support insulator 5, so that the internal space within the column-shaped portion 6 is substantially closed by the solid-insulated conductor 1 at the portion where the conductor 8 extends. Therefore, the portion of the support insulator 5 above the conductor 8 is a cup-shaped insulating tubular member 21 having an open end and a closed end and defining a space accommodating the contact terminal 20. The inner circumferential wall surface 22 of this insulating tubular member 21 is tapered to have a diameter gradually decrease from the open end toward the closed end, so that the space defined by the inner circumferential wall surface 22 is in a shape of a truncated cone.

The insulating tubular member 21 is provided at its outer circumference of the tip with a flange 23 so that it can be connected by unillustrated bolts or the like to a flange 24 (which will be described later) of a second electrical

component to be connected. Such mounting flanges 23 and 24 may be disposed not only in the illustrated position, but also in other different positions.

While the potential transformer 2 itself which is the second electric component may be a known type, but it comprises, as shown in Fig. 3, a flange 24 which corresponds and is connectable to the flange 23 of the insulating tubular member 21 of the bus conductor 1 or the first electric component. On the bottom surface of the flange 24, an insulating column member 26 internally containing a terminal conductor 25 of the potential transformer 2 and extending downwardly is provided.

The insulating column member 26 is in a shape of a truncated cone having a tapered outer circumferential wall surface 27 that becomes gradually thin toward the tip, the taper configuration is complementary in shape with the taper configuration of the inner circumferential wall surface 22 of the insulating tubular member 6 of the support insulator 5 previously described, so that the outer circumferential wall surface 27 may be snugly fitted to the inner circumferential wall surface 22. The insulating column member 26 is made of an electrically insulating elastic material such as rubber when the insulating tubular member 6 is made of a hard material such as epoxy resin or the like, but it may be made of a hard material such as epoxy resin or the like when the insulating tubular member 6 is made of an elastic material such as rubber. That is, it is preferable to make at least one of the insulating tubular member 6 and the insulating column member 26 with an elastic electrically insulating material. Also, since the outer diameter of the tapered outer circumferential wall surface 27 is slightly larger than the inner diameter of the inner circumferential wall surface 22 of the insulating tubular member 6 and at least one of them is made of an elastic member such as rubber, so that the outer circumferential wall surface 27 and the inner circumferential wall surface 22 can come into an intimate contact with each other under pressure, establishing an electric insulation at the interface between them.

A cup-shaped cavity 28 is defined in the tip portion of the insulating column member 26, and within this cavity 28, a ring-shaped contact terminal 30 supported by a cup-shaped member 29 is electrically connected and supported at the tip of the terminal conductor 25 of the potential transformer 2. When such the insulating column member 26 is inserted into the insulating tubular

member 6 of the first electric component 1, the contact piece 20 which is the first contact terminal and the second contact terminal 30 are brought into contact with each other under pressure with the outer circumferential wall surface 27 intimately contacting with the inner circumferential wall surface 22. Such the relationship between the insulating column member 26 and the insulating tubular member 6 may be referred to as the male and female relationship, and the relationship of male and female may be partially or totally inverted.

By firmly and rigidly connecting the mounting flange 23 disposed on the support insulator 5 supporting the bus bar 1 or the first electric component 1 to the mounting flange 24 disposed to the potential transformer 2 or the second electric component 2 by means of mounting bolts 31, the electric components including the bus conductors which are the electric components of the switching apparatus can be connected to each other. Also, the distance between the first and the second electric components 1 and 2 can be reliably maintained at a desired value.

Embodiment 2

Fig. 4 is a sectional view similar to Fig. 1 and illustrating a second embodiment of the switching apparatus component connecting device of the present invention, in which the switching apparatus component connecting device is used to connect the same first electric component 1 as that shown in Fig. 1 to the second electric component 32 which is an adaptor in this example, and this second electric component 32 is further connected to a third electric component 33 such as potential transformer or a lightning arrester, wherein the second electric component 32 is an adapter for connecting the first and the third electric components 1 and 33 to each other.

The first electric component 1 comprises the first contact terminal 20 disposed and electrically connected to the component, and the insulating tubular member 6 having an inner circumferential wall surface 22 gradually decreasing in diameter toward the closed end, and other structures are the same as those illustrated in Fig. 1.

The second electric component 32 is the same as the potential transformer shown in Fig. 1 in that it comprises the insulating column member

26 having a tapered outer circumferential wall surface 27 formed to be able to be snugly inserted into the insulating tubular member 6 of the first electric component 1, and the second contact terminal 30 supported by the insulating column member 26 and contacting the first contact terminal 20 of the first electric component 1. However, in this embodiment, the second electric component 32 is the adapter that comprises a third contact terminal 35 disposed on the male insulating column member 34 similar to that shown in Fig. 3 on the other end the terminal conductor 25. The second electric component 32 is also provided with a mounting flange 36.

In the illustrated embodiment, the third electric component 33 that is a potential transformer comprises a fourth contact terminal 37 brought into electrical contact with the third contact terminal 35 of the second electric component 32, and an insulating tubular member 39 having a tapered inner circumferential wall surface 38 having a diameter gradually decreases from the open end toward the closed end. The fourth contact terminal 37 may have a similar structure as that of the first, but the insulating tubular member 39 has the similar structure to that of the insulating tubular member 6 disposed on the first electric component 1 and is male. The mounting flange 40 disposed to the tip portion of the insulating tubular member 39 can be fastened to the similar flanges 23 and 36 by bolts.

Other structures are similar to that illustrated in Figs. 1 to 3, and the connection between the first and the second electric components 1 and 32 as well as the connection between the second and the third electric components 32 and 33 can be achieved as described in connection with Figs. 1 to 3, allowing a reliable compact electrical connection without using shunt conductors requiring a space for ensuring the insulation and a simple connecting work. Also, by utilizing the adapter 32 as the second electric component, two electric components that cannot be directly connected to each other such as the first and the third electric components 1 and 33 or the like can be connected with a simple structure with a sufficient insulation maintained. Further, by suitably changing the connection terminal of the adapter between male and female, the structure can be adapted to a variety of connection configurations.

INDUSTRIAL APPLICABILITY

In the device of the present invention, components can be connected to a conductor without the use of shunt conductors or the like and the insulating space between the shunt conductors and other component is not necessary, allowing the component to be small-sized. Also, the cost for mounting the shunt conductors is eliminated, thus the invention is useful particularly in power distribution facilities in that an inexpensive apparatus can be obtained.

CLAIMS

1. A switching apparatus component connecting device for connecting electric components of a switching apparatus including a bus conductor, comprising;

a first contact terminal electrically connected to a first electric component;

an electrically insulating tubular member attached to the first electric component and having an inner circumferential wall surface surrounding said first contact terminal and having a diameter gradually decreasing from an open end toward a closed end;

a second contact terminal connected to a second electric component; and

an electrically insulating column member attached to the second electric component and supporting said second contact terminal at its tip, having an outer circumferential wall surface having a diameter gradually decreasing toward the tip in correspondence with said inner circumferential wall surface of said insulating tubular member for causing said first and second contact terminals to be brought into an electrical contact with each other with said outer circumferential wall surface intimately contacting with said inner circumferential wall surface.

2. The switching apparatus component connecting device as claimed in claim 1, further comprising a mounting flange disposed to said first electric component, a mounting flange disposed to said second electric component, and a mounting bolt for connecting said mounting flanges to each other, and wherein said insulating column member is held within said insulating tubular member.

3. The switching apparatus component connecting device as claimed in claim 1, wherein said first electric component is a solid insulated conductor and said second electric component is a potential transformer or a lightning arrester.

4. The switching apparatus component connecting device as claimed in claim 1, wherein at least one said insulating tubular member or said insulating column member is an electrically insulating material having an elasticity.

5. The switching apparatus component connecting device as claimed in claim 1, wherein said second electric component comprises a third contact terminal to be connected to the third electric component and an insulating column member supporting said third contact terminal and having an outer circumferential wall surface that has a diameter gradually decreasing toward the tip; and

wherein said third electric component comprises a fourth contact terminal electrically connectable to said third electric component, and an insulating tubular member surrounding said fourth contact terminal and having an inner circumferential wall surface that has a diameter gradually decreasing from an open end toward a closed end.