

SWITCHING DEVICE

The present invention relates to a switching device, and, more specifically, to a switching device accommodating a plurality of switches in a casing.

Conventional switching devices have a structure, for example, as shown in Japanese Patent Application Laid-open (Kokai) 60-261312. Figure 7 is a schematic diagram showing a conventional switching device and Figures 8 and 9 are elevational and side views respectively of the conventional switching device. Figure 10 is a perspective view of a casing of the switching device. In the figures, denoted 1 are vacuum switches, 2a, 2b, and 2c are switches having rotatable moving-contact assembly. Denoted 3 is a casing for accommodating these switches 1, 2a, 2b, and 2c in insulating gas atmosphere. This casing forms a T-shaped cylindrical portion with three-way openings, as shown in Figure 10. Reference numerals 4a, 4b, and 4c are bushings supported by the casing 3 and used for electrically connecting one end of each switch 2a, 2b, and 2c to equipment located out of the casing.

In the switching device having the structure as described above, closing switches 2a and 2c causes bushings 4a and 4c to be electrically connected each other. Further, closing switches 1 and 2b causes bushing 4b to be connected to the bushings as a branch circuit. As a result, power is supplied to electric equipment which is connected to the bushing 4b, such as transformer not shown.

With the conventional switching device thus far described, since it is difficult to assemble electrical equipment as described above in the

casing, a large casing is required to carry out the assembly work with ease. Moreover, there is another drawback that since a plurality of switches are accommodated in one casing, it is not possible to add more switches and the orientation of the bushings is restricted to one direction.

Objects of the described embodiment of the invention are to provide a switching device in which the casing is miniaturized; addition of switches is carried out with ease; and the orientation of the bushing is flexibly selected.

According to the present invention, there is provided a switching device comprising a plurality of interengagable switch units, each switch unit comprising:

- a cylindrical casing having flanges at the open ends thereof, said switch units being interengagable in a plurality of stages by being interconnected at said flanges; and

- a plurality of switches provided within the cylindrical casing, each switch including a first terminal to which an electrical connection can be made from outside of the casing, and a second terminal arranged to be connected to a respective bus bar within the casing, said individual second terminals in one switch unit being connected via the respective bus bars to corresponding second terminals in the or each other switch unit, wherein each of said second terminals of said plurality of switches is arranged to lie substantially in a plane including the axial centre line of the cylindrical casing and lying on different axial lines of said plane.

Further, the casing preferably comprises a cylindrical portion with a notched body and a rectangular casing which is inserted in the notch and has flat mounting surfaces provided on at least two surfaces thereof.

The second terminal of each of the plurality of switches is arranged substantially on a plane including the axial centre line of the cylindrical body.

The foregoing objects and advantages will be better understood from the following description with reference to the accompanying drawings, in which:

Figure 1 shows a structure of the switching device according to an embodiment of the present invention;

Figures 2 and 3 show elevational and side views of principal parts of the switching device;

Figures 4A, 4B, 4C, and 4D are an elevational view, a left side view, a right side view, and a bottom view of a casing of the switch unit;

Figure 5 is a single line diagram electrically describing the configuration of the switching device shown in Figure 1;

Figure 6 shows the rough structure of the switching device according to another embodiment of the present invention;

Figure 7 shows a rough structure of the conventional switching device;

Figures 8 and 9 are elevational and side views illustrating detailed structure of the switching device described in Figure 7; and

Figure 10 is a perspective view of the casing of the conventional switching device.

A preferred embodiment of the present invention will now be described with reference to accompanying figures. Figure 1 shows a structure of the switching device according to an embodiment of the present invention. Figures 2 and 3 are elevational and side views of principal part of the switching device. Figures 4A, 4B, 4C, and 4D are elevational view, left side view, right side view, and bottom view of a casing of the switch unit shown in Figures 2 and 3 respectively. In the figures, denoted 5 is the casing which comprises a cylindrical portion 7 having flange 6 at each end thereof, and a rectangular casing 8 having flat mounting portions 8a formed on two surfaces inserted in a notch provided on the casing body, as shown in Fig. 4. Reference numeral 9 shows a mounting frame 9 for mounting bushings 10 described below. Denoted 10 are bushings mounted on the mounting frame 9 and penetrating the rectangular casing 8, and one end thereof is to be connected by a connector to a cable out of the casing. Numeral 11 show three vacuum valve circuit breakers which are connected by fixed terminals 11a to the other end of the bushings and are arranged substantially parallel to the surface of the flange. The vacuum valve circuit breakers each include a movable contact and a fixed contact. The movable contact is connected to an insulating rod 13 via movable terminal 11b arranged substantially on a diametrical line passing through the centre of the cylindrical casing 7 as shown in dashed line in Figure 2. Numeral 14 shows an operation mechanism, which is connected to

the insulating rod 13 via an operation rod 15, a link 16 and a main shaft 17. Further, the components 5 to 17 described above form a vacuum valve circuit breaker unit 20. A switching device 30 is formed by combining the vacuum switch units 20 in a plurality of stages as shown in Figure 1. When the movable contacts are connected to each other with a resilient conductor, a system of which configuration is described in a single line diagram shown in Figure 5 is obtained. The vacuum valve circuit breaker unit 20 has a function as a three phase vacuum valve circuit breaker. That is, the operation rod 15 rotates in accordance with the movement of the operation mechanism 14, link 16 and shaft 17 transmitting the motion to the rod 13 to lift and drop the insulating rod 13 to operate the switch.

The switching device 30 comprising the vacuum valve circuit breaker units 20 as shown in Figure 1 is capable of being connected to remaining vacuum valve circuit breaker units between the vacuum valve circuit breaker units 20 at both ends, as illustrated in Figure 5.

Further, the bushing has a function as a disconnecting switch as being connected with connector to a cable.

With the switching device according to one embodiment of the present invention as described above, since three vacuum valve circuit breakers 11 are accommodated in each casing 5 and are arranged substantially parallel to the surface of the flanges provided on the opening of the casing at both ends thereof, working space properly secured makes assembly work in the casing 5 easier than before to assemble the vacuum valve circuit breaker unit 20, preventing the casing 5 from being bulky. When the vacuum valve circuit breaker unit 20 assembled by the

above method is combined in a required number to form the switching device 30, as shown in Figure 1, increasing or decreasing the number of vacuum valve circuit breaker units becomes easy. Besides, the orientation of the bushing is flexibly selected.

Further, since the casing 5 is fabricated by combining, at the notched portion, the cylindrical portion 7 of which body is notched and a rectangular casing 8 having flat mounting surfaces 8a on at least two surfaces, assembly work for each casing 5 can be carried out with ease and reliable sealing characteristics of the casing is expected.

In the above embodiment, although a vacuum valve circuit breaker 11 is used as a switch as an example, a similar effect may be expected for other switches besides the vacuum valve circuit breaker, such as load switches, disconnecting switch and the combination of a vacuum valve circuit breaker 11 and a disconnecting switch 19 as exemplified in Figure 6.

Further, in the above embodiment, the vacuum valve circuit breakers 11 are arranged on one line parallel to the surface of the flange 6.

However, similar effect may be expected in case that even the vacuum valve circuit breakers deviate in front of and behind each other as long as the movable contacts 11b do not overlap when viewed from the flange side, the contacts 11b being arranged substantially on a plane including the axial centre line of the cylindrical casing 5.

In addition to the above, when the casing 5 is fabricated in such a manner that the length of the cylindrical portion thereof is less than one-half of the diameter of the cylindrical portion, flat surfaces of the

rectangular casing 8 need not to be reinforced to resist pressure applied, resulting in reduction in its weight.

As described above, the present invention described in Claim 1 provides a switching device which is formed by combining switch units comprising: a cylindrical casing having flanges at both end thereof; and a plurality of switches accommodated in the casing as being parallel to the surface of the flange, one terminal of the switch being introduced out of the casing through bushing. As a result, assembling work is performed with ease; the casing of the unit is miniaturized; and increasing or decreasing numbers of the units is carried out with ease.

Further, in the invention of Claim 1, since the second terminal of each of the plurality of switches is arranged on a plane including the axial centre line of the cylindrical casing, the orientation of the bushing is flexibly selected during assembly and the bushings are arranged with ease in consideration with erection location.

Further, in the invention according to Claim 2, the casing comprises a cylindrical portion with notched body, and a rectangular casing inserted in the notch and having a flat mounting surface on at least two surfaces of the casing, permitting easier fabrication works for each casing and reliable sealing characteristics.



CLAIMS

1. A switching device comprising a plurality of interengagable switch units, each switch unit comprising:
 - a cylindrical casing having flanges at the open ends thereof, said switch units being interengagable in a plurality of stages by being interconnected at said flanges; and
 - a plurality of switches provided within the cylindrical casing, each switch including a first terminal to which an electrical connection can be made from outside of the casing, and a second terminal arranged to be connected to a respective bus bar within the casing, said individual second terminals in one switch unit being connected via the respective bus bars to corresponding second terminals in the or each other switch unit, wherein each of said second terminals of said plurality of switches is arranged to lie substantially in a plane including the axial centre line of the cylindrical casing and lying on different axial lines of said plane.
2. A switching device as claimed in Claim 1, wherein said casing comprises a cylindrical portion with notched body; and a rectangular casing being inserted in the cylindrical casing and having flat mounting surfaces provided on at least two surfaces thereof.
3. A switching device substantially as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawings.
4. A switch unit for use in a switching device of the type claimed in any one of Claims 1 to 3.