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Contact separation device of a distribution box of an energy distribution system

The present invention relates to a distribution box of an energy distribution system including a base element, which can be mounted on a busbar channel of the energy distribution system and which can be closed by means of a cover attached to the base element in a swivelling way, including also a contact separation device as well as a procedure allowing the interruption and the establishment of the power supply connection of a distribution box to the busbars of an energy distribution system during the opening or, respectively, closing of the cover.

Energy distribution systems are mainly used in workshops, laboratories, exhibition rooms, hospitals, greenhouses and in similar facilities in which power consumption exceeds the level of a normal household. For this reason, the energy distribution systems dealt with in this context are designed for a current of 40 A and more.

In energy distribution systems, the current is carried by means of so-called busbars that are arranged in busbar channels. In known energy distribution systems, four busbars are provided in every busbar channel with every busbar carrying the energy of in a different phase in such a way that one busbar channel presents an L1, an L2, an L3 and an N conductor.

Distribution points at which so-called distribution boxes can be fixed are located at regular intervals along the busbar channels in order to allow current drain. According to their purpose, these distribution boxes present switching or protection devices,

safety fuses, magnetic circuit breakers or commercially available protective contact sockets. These distribution boxes can be detached individually and they can be fastened at the points of distribution desired according to the conditions in the respective case.

The current to be distributed in the energy distribution system is fed into the busbar channels via so-called feeder boxes. In this context, both the feeder and the distribution boxes can be mounted and dismounted individually on the busbar channels, thus allowing also the later displacement of these boxes.

The known distribution boxes consist of a base element which is used to fasten the distribution box at the busbars, and of a cover that closes the base element and that is fixed to the base element in a turnable way. Both the base element and the cover are made of synthetic material.

A distribution box of the type described above is known from DE-PS 11 09 758 and from FR 1.247.444, and it also presents a contact separation device. The contact separation device cuts the current flow between the cable reception and the busbars in the busbar channel in order to allow maintenance, repair or assembly work at the distribution box.

The distribution box known from these two publications presents busbar terminals which are clamped to the busbars in the busbar channel. These busbar terminals are connected to a contact terminal which is freely accessible at the upper side of the base element.

An additional terminal is provided inside the distribution box. It is located at a distance and insulated from the contact terminal, and it is connected to the cable reception via a safety fuse.

Neither safety fuse nor cable reception carry current as long as the cover of the distribution box is open, since the current flow between the contact terminal and the terminal is interrupted. A contact piece with two contact fingers projecting vertically from the cover is arranged for every phase at the inside of the cover. After the cover has been closed, these contact fingers engage in the contact terminal on the one side, and in the terminal on the other side in such a way that the cable reception is connected to the busbar in an electrically conductive way via the safety fuse.

Although the power supply line is cut after the cover has been opened as the contact piece has been withdrawn from the terminal or, respectively, from the contact terminal, the openly accessible contact terminal still carries current. The mechanic working on the distribution box can be hurt severely if he touches this openly accessible contact terminal by mistake. It is also possible that a short-circuit may be brought about in the energy distribution system when a conductive metal instrument, a wire or something else falls into two contact terminals by mistake in a very unhappy coincidence.

These contact terminals have a design that protects them against finger contacts according to the regulations in force but even the best protective device can be circumvented.

In order to overcome this drawback, DE-AS 11 31 769 has proposed to create a distribution box in which the entire contact separation device is withdrawn from the busbars when the cover is opened. Although this guarantees that no device or cable located in the distribution box carries current when the cover is opened, but the design used in this case is too complicated and expensive for its manufacture to be economically feasible.

Starting from this point, it is an object of the present invention to create a distribution

box for an energy distribution system in which the busbar terminals are withdrawn from the busbars when the cover is opened and which can be manufactured in a cost-effective way.

The technical solution proposed to achieve this object in accordance with the invention is to develop the distribution box of the type mentioned at the beginning in such a way that the contact separation device presents a tapping unit fixed to the base element and a blocking unit fixed to the cover, and that the tapping unit comprises a cutting slider that is supported in a displaceable way and that includes busbar terminals and cable receptions, while the busbar terminals extend around corresponding busbars when the cover is closed, and are separated from the busbars by a distance when the cover is opened.

A distribution box of an energy distribution system designed according to this technical principle presents the advantage that it consists of a small number of component parts but still guarantees that no component of the distribution box carries current when the cover is opened.

In a preferred embodiment, a catching fork is hinged upon the blocking unit and extends around a pin formed at the cutting slider when the cover is closed in order to displace the cutting slider toward the busbars.

In an analogous process, the catching fork engaged at the pin withdraws the cutting slider away from the busbars when the cover is opened.

In an especially preferred embodiment, the catching fork is inclined by an angle of 10° to 45° and preferably by an angle of 30° with regard to the blocking unit. In this arrangement, the catching fork is pretensioned in this position by means of a spring.

At its narrow side, the cover of the distribution box is hinged upon the base element. In this way, a circular movement is made by the cover side which is located opposite of the hinge and to which the blocking element is fixed. The catching fork fastened at the blocking element and extending away from it is placed in this inclined position for the catching fork that also follows a circular movement to hit the cutting slider in a precise way when the cover is being closed.

In another preferred embodiment, the tapping unit presents at least one securing element which is supported in a movable way and secures the cutting slider in its position at a distance from the busbars. This makes certain that the cutting slider and its busbar terminals can not be pushed on the busbars again when the cover is opened.

In an additional and especially preferred embodiment, at least one securing web is provided at the cutting slider, and engages into a retaining sheet metal element of the holding device when the cover is closed. This holding device is used to fix the base element and thus the distribution box at the busbar channel of the energy distribution system.

The retaining sheet metal element of the holding device is secured by means of the securing web when the cover is closed in order to prevent the entire distribution box from being withdrawn from the busbar channel while busbar terminals and busbars are still connected electrically. In this condition, it is impossible to withdraw the distribution box from the busbar channel without destroying it in the process.

When the cover of the distribution box according to the invention is being closed, the catching fork displaces the securing elements in such a way that the cutting slider is released. Continuing the turn of the cover, the cutting slider is displaced by the

closing movement in such a way that the busbar terminals are pushed onto the busbars, thus establishing the electrical contact.

At the same time, the securing webs mounted on the cutting slider are introduced into a retaining sheet metal element of the holding device in such a way that this latter is secured when the cover is closed. Because of this, the distribution box fixed to the busbar channel can not be dismounted from the latter as long as the cover is closed.

In order to interrupt the current connection by opening the cover, the catching fork comes to rest upon the pin and the catching fork draws the cutting slider away from the busbars as the cover is opened further until the busbar terminals are withdrawn from the busbars. When the cover is opened even further, the catching fork is withdrawn from the pin and the access box can be opened completely.

As soon as the catching fork is no longer in contact with the securing elements, these elements are moved back into their initial position by means of a spring, and they engage below and secure the cutting slider which is now in a position in which the busbar terminals are placed at a distance from the busbars.

This means that the distribution box according to the invention uses a small number of components to create a safe contact separation device in which the busbar terminals mounted on the cutting slider are withdrawn from the busbars during the opening of the cover in such a way that no component of the opened distribution box carries current. For this reason, the distribution box according to the invention more than fully complies with the required safety regulations, and it can be manufactured economically since the components can be made in a cost-effective way and since the number of required components is small.

Additional advantages of the device according to the invention and of the process according to the invention result from the description of the embodiments and the accompanying drawing. The characteristics mentioned above and those listed below can also be implemented individually or in any combination according to the invention. The embodiments mentioned are not deemed to form an exhaustive list but rather serve as examples. An embodiment of the invention will now be described in detail with reference to the figures 1 through 6a of the accompanying drawing in which:

Figure 1 is a perspective view of a distribution box according to the invention and fastened to a busbar channel;

Figure 2 is an exploded perspective view of the distribution box according to figure 1;

Figure 3 is a front view of a contact separation device in the open condition;

Figure 3a is a side view of the contact separation device according to figure 3 showing a section along the line IIIa - IIIa of figure 3;

Figure 4 is a view of the contact separation device according to figure 3 in a partially opened condition;

Figure 4a is a side view of the contact separation device according to figure 4 showing a section along the line IVa - IVa of figure 4;

Figure 5 is a view of the contact separation device according to figure 3 in a partially closed condition;

Figure 5a is a side view of the contact separation device according to figure 5 showing a section along the line Va - Va of figure 5;

Figure 6 is a view of the contact separation device according to figure 3 in the closed condition; and

Figure 6a is a side view of the contact separation device according to figure 6 showing a section along the line Va - Va.

The object according to invention is presented in a very schematic way in the individual figures of the drawing and these are not deemed to be to correct scale. The objects represented by the individual figures are enlarged beyond proportion in order to show their setup in a better way.

Figure 1 is a perspective view of a part of an energy distribution system. This energy distribution system will now be explained in detail: The busbars enclosed toward the outside are located in busbar channels 2 which are fastened to a wall or to a ceiling. At regular distances, the busbar channel 2 provides distribution points at which distribution boxes 4 can be attached in order to draw current from the busbars. The distribution box 4 represented in **figure 1** is fastened to the busbar channel 2 by means of holding devices 6 and it is shown with a cover 8 being open. Switches 12 and fuses 14 are fixed to a base element 10 of the distribution box 4 and integrated into the power supply lines.

A contact separation device 20, consisting of a tapping unit 16 and a blocking unit 18, is situated at the head end of the distribution box 4.

The contact separation device 20 separates the outgoing power supply lines from

the busbars as soon as the cover 8, belonging to the distribution box 4 and swivelling at an end part 22 of the base element 10, is being opened.

A device box 24 is flush mounted along the end part 22, and it is also fixed to the busbar channel 2 by means of holding devices 6. This device box 24 can hold additional devices such as, e.g., contactors, safety fuses, magnetic circuit breakers, protective contact sockets, or switches which are required for the control and protection of the lines leading out of the busbar channel 2.

Figure 2 is an exploded perspective view of the distribution box 4. The base element 10 is assembled using three components in the same way as for the cover 8. The base element 10 consists of an aluminium profile 26 which is made by extrusion with the tapping unit 16 being screwed to its head side and a base end part 28 being screwed to its end side. In an analogous way, the cover 8 consists of an aluminium profile 30 which is also made by extrusion moulding with the blocking unit 18 being screwed to its head side and a cover end part 32 being screwed to its end side. Base end part 28 and cover end part 32 are designed as hinges upon which the cover 8 swivels.

A cutting slider 34 is inserted into the tapping unit 16 and it will be described in detail in figures 3 through 6a in the same way as the entire contact separation device 20.

Figures 3 through 6 are front views of the contact separation device 20 with every figure showing a different stage of the process. **Figures 3a through 6a** are side views of the corresponding contact separation device 20 in the same way as figures 3 through 6.

In figures 3 and 3a, the blocking unit 18 has not engaged into the tapping unit 16

yet. In this condition, i.e., when the cover 8 is open, the cutting slider 34 is in an engaged position with the two securing elements 36 which retain the cutting slider 34 and the busbar terminals 38 located on it in a position at a distance from the busbars 40.

In this condition, leaf springs 42 press the securing elements 36 against the cutting slider 34 in such a way that the edge 42 of the latter comes to rest upon a projection 44 of the securing element 36.

Two securing rods 46 formed at the cutting slider 34 are also withdrawn from a retaining sheet metal element 48 in the holding device 6 in this position in such a way that the retaining sheet metal element 48 is released and can move freely. The retaining sheet metal element 48 of the holding device 6 engages into a corresponding groove in the busbar channel 2 and thus retains the distribution box 4 in a tight and reliable way at the busbar channel 2.

A catching fork 50 is supported in a turnable way at the blocking unit 18, and it engages in the cutting slider 34 as soon as the cover 8 is being closed in order to bring the cutting slider 34 into the desired position. The catching fork 50 can swing by up to 30° since the blocking unit 18 fixed to the cover 8 moves on a circular track followed by the turning movement of the cover. This guarantees that the catching fork 50 hits the opening provided for this purpose in the cutting slider 34. The catching fork 50 is subjected to a pretension exerted by a spring 52 in order to prevent it from swinging back and forth in a random fashion.

During its engagement into the cutting slider 34, the catching fork 50 hits a pin 53 formed at the cutting slider 34. As the cover 8 is being closed further by pressure, the two prongs of the catching fork 50 are pushed apart by the pin 53 until the

projections located on the prongs have passed the pin 53. At this time, the two prongs snap back and grasp the pin 53 in such a way that the catching fork 50 can move the cutting slider 34 up and down by means of the pin 53. The prongs will only be pushed apart by the pin 53 again and the catching fork 50 will only be withdrawn from the pin 53 when the cover is opened by applying a great force.

In figures 4 and 4a, the catching fork 50 already engages into the cutting slider 34 and moves the securing elements 36 away from the cutting slider 34 and against the force exerted by the leaf springs 54 in such a way that the projection 44 releases the edge 42 and thus the cutting slider 34. When the cover is being closed even further at this time, the cutting slider 34 is moved further in the direction of the busbars 40 as shown in figures 5 and 5a. The busbar terminals 38 are pushed onto the busbars 40 and establish an electrically conductive connection when the cover 6 is completely closed as shown in figures 6 and 6a. At the same time, the securing webs 46 engage into corresponding openings in the retaining sheet metal elements 48 and secure the retaining sheet metal elements 48 in this position in such a way that the distribution box 4 can not be detached from the busbar channel 2 while the cover 8 is closed.

During the opening of the cover 6, the catching fork 50 comes to rest upon the pin 53 and withdraws the cutting slider 34 and the busbar terminals 38 away from busbar channel 2 in such a way that the busbar terminals 38 are placed at a distance from the busbars 40 and that the electrical connection is cut.

At the same time, the securing webs 46 are withdrawn out of the retaining sheet metal element 48 and the retaining sheet metal element 48 can be moved freely again.

The securing elements **36** will be pushed back into their initial position as shown in **figure 3** by means of the leaf springs **54**, and secure the cutting slider **34** against displacement as soon as the catching forks **50** have withdrawn the cutting slider **34** over such a distance that it is in its spaced position.

By the further opening of the cover **8**, the catching fork **50** will be withdrawn from the pin **53**, and the cover **8** can be opened completely. This makes it possible to carry out the required maintenance, repair and/or modification work as the position of the busbar terminals **38** at a distance from the busbars **40** makes certain that no component in the distribution box **4** carries current any longer.



Claims:

1. Distribution box of an energy distribution system comprising a base element (10) which can be fixed to a busbar channel (2) of the energy distribution system, which can be closed by means of a cover (8) hinged on the base element (10), and which has a contact separation device (20), **characterized in that** the contact separation device (20) comprises a tapping unit (16) fixed to the base element (10) and a blocking unit (18) fixed to the cover (8), and that the tapping unit (16) comprises a cutting slider (34) that is supported in a displaceable way, and that comprises busbar terminals (38) and cable receptions, while the busbar terminals (38) extend around corresponding busbars (40) when the cover (8) is closed, and while they are placed at a distance from the busbars (40) when the cover (8) is open.
2. Distribution box as claimed in claim 1, **characterized in that** a catching fork (50) is mounted on the blocking unit (18) and cooperates with a pin (53) formed at the cutting slider (34).
3. Distribution box as claimed in claim 2, **characterized in that** the catching fork (50) extends around the pin (53) in order to displace the cutting slider (34).
4. Distribution box as claimed in at least one of the claims 2 to 3, **characterized in that** the catching fork (50) is supported in a turnable way at the blocking unit (18).
5. Distribution box as claimed in claim 4, **characterized in that** the catching fork



(50) is inclined at an angle of between 10° and 45°, and preferably at an angle of 30°, with regard to the blocking unit (18) by means of a spring (52).

6. Distribution box as claimed in at least one of the above-mentioned claims, **characterized in that** the tapping unit (16) presents at least one securing element (36) which is supported in a movable way, and which secures the cutting slider (34) in the position in which the busbar terminals (38) are situated at a distance with regard to the busbars (40) when the cover (8) is open.
7. Distribution box as claimed in claim 6, **characterized in that** the securing element (36) presents a projection (44) against which an edge (42) of the cutting slider (34) comes to rest.
8. Distribution box as claimed in at least one of the claims 6 to 7, **characterized in that** the securing element (36) is spring-loaded.
9. Distribution box as claimed in at least one of the above-mentioned claims, **characterized in that** the cutting slider (46) provides for at least one securing web (46) which extends into a retaining sheet metal element (48) of a holding device in order to secure the latter when the cover (8) is closed.
10. Procedure to establish the power supply connection of a distribution box as claimed in at the least one of the above-mentioned claims, using the busbars of an energy distribution system when the cover is closed, **characterized in that** the closure of the cover (8) makes the catching fork (50) engage around the pin (53) and subsequently displace the securing elements (36) in such a



way that the cutting slider (34) is released and that the cutting slider (34) is displaced after this in such a way that the busbar terminals (38) are pushed onto the busbars (40).

11. Procedure as claimed in claim 10, **characterized in that** a securing web (46) mounted on the cutting slider (34) engages into a retaining sheet metal element (48) in order to secure them during the establishment of the power supply connection.
12. Procedure to interrupt the power supply connection of a distribution box as claimed in at least one of the above-mentioned claims to busbars of an energy distribution system during the opening of the cover, **characterized in that** the opening of the cover (8) brings the catching fork (50) to rest upon the pin (53) and to entrain the cutting slider (34) until the busbar terminals (38) are withdrawn from the busbars and until the catching fork (50) is withdrawn from the pin (53) after this.
13. Procedure as claimed in claim 12, **characterized in that** the securing elements (36) extend below the cutting slider (34) and secure the latter as soon as the cutting slider (34) has reached the position in which the busbar terminals (38) are situated at a distance from the busbars (40).