

AN APPARATUS FOR CONTROLLING POWER DISTRIBUTION

FIELD OF INVENTION

The present invention relates to an apparatus for controlling and protect power distribution,
5 more particularly the present invention relates to a withdrawable tray for a motor control center
that is safe to operators.

BACKGROUND ART

A motor control center is an assembly of one or more enclosed sections, wherein the assembly
10 contains motor control units which share one common power bus for motors. This is to
centralize control and the distribution of power to motors.

The modern motor control centers have several motor starters and may include operating
modules such as variable frequency drives, programmable controllers, and metering. The
15 motor starters are able to control motors and provide circuit protection. A motor control unit
can be either a fixed compartment or a withdrawable tray. The withdrawable tray facilitates
maintenance, testing and modification. Mainly, the withdrawable tray engages with a busbar
for electric connection, power distribution and controlling of motors. The withdrawable tray
comprises a mechanism for connecting a control unit within the withdrawable tray to the
20 busbar, which can be a clip device, a plugging device or a locking device. In the conventional
mechanism, the devices for connecting the control unit to the busbar are complex and the
devices are compromised between reliability, maintainability and costs.

KR20100091042 discloses a motor control center to improve usability convenience and
25 stability by connecting or disconnecting a clip device without drawing out a unit device from a
case, wherein the case includes a power converter and a load converter. A unit is stored in
the case and controls connection between a power side and a load side, and the unit includes

a power terminal and a load terminal. A clip unit reciprocates in the storing or drawing-out direction of the unit and the clip unit interlinks the power converter and the power terminal, as well as the load converter and the load terminal.

- 5 EP3123565A1 discloses a plug contact for connecting a first contact to a second contact comprising a first contact finger comprising a first surface, a second contact finger comprising a second surface, the second surface facing the first surface. The plug contact receives the first contact between a first supply end of the first surface and a second supply end of the second surface and receives the second contact between a first load end of the first surface
10 and a second load end of the second surface, wherein the first contact finger and the second contact finger connect the first contact to the second contact characterized by the distance between the first surface and the second surface being smaller at a middle area between the first supply end and the first load end than at the first supply end and the first load end.
- 15 US4781627 discloses a bus bar stab and insulator assembly for a motor controller which has a two-piece housing and a three-piece stab finger clip, wherein the housing base has a number of partitions which define pathways for the stab fingers and the housing cover is slidably mateable with the base and has a tab for receiving a self tapping screw. The stab fingers extend from the housing for making contact with bus bars and the stab finger clip has two
20 fingers, constructed by copper alloy, with interlocking tabs secured together with a screw which also connects one or more connector cables to the clip.

However, none of the prior art addresses the problem of alignment of the contact devices during installation or during replacement, as well as contact repulsion under short circuit
25 conditions, which are also reliable and easy to maintain and safe to operators.

SUMMARY OF INVENTION

The present invention aims to provide an apparatus for controlling and protecting power distribution, wherein the apparatus is capable of addressing problem of alignment of the contact devices and contact repulsion under short circuit conditions.

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It is an object of the present invention to provide an apparatus for controlling power distribution comprising an input unit for receiving power from a busbar contact, a control unit connected to the input unit for controlling power, and an output unit for distributing power to a load.

- 10 It is another object of the present invention to provide an apparatus for controlling power distribution comprising an input unit for receiving power from a busbar contact, a control unit connected to the input unit for controlling power, and an output unit for distributing power to a load via an outgoing terminal, wherein said input unit comprises at least a first connector for connecting with at least a first contact device coupled to the busbar contact, and that said
- 15 output unit comprises at least a second connector for connecting with at least a second contact device coupled to the outgoing terminal for distributing power to a load.

- It is yet another object of the present invention to provide an apparatus for controlling power distribution comprising an input unit for receiving power from a busbar contact, a control unit
- 20 connected to the input unit for controlling power, and an output unit for distributing power to a load via an outgoing terminal, wherein said first contact device is configured for aligning at least a first connector through connection with said first contact device and said second contact device is configured for aligning at least a second connector through connection with said second contact device coupled to the outgoing terminal for distributing power to a load.

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The present invention is able to address the problem of alignment of the contact devices during installation or during replacement, as well as preventing contact repulsion under short circuit conditions, without compromising reliability and maintainability and safety of operators.

5 **BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS**

To further clarify various aspects of some embodiments of the present invention, a more particular description of the invention will be rendered by references to illustrations in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be
10 described and explained with additional specificity and detail through the accompanying drawings in which:

Figure 1 illustrates a top view of an apparatus for controlling power distribution in accordance with the present invention.

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Figure 2 illustrates a perspective view of a portion of an apparatus for controlling power distribution showing at least a busbar contact, at least a first contact device, at least a first connector, at least a second contact device, at least a second connector and an outgoing terminal in accordance with the present invention.

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Figure 3 illustrates an apparatus for controlling power distribution showing at least a busbar contact, at least a first contact device and at least a first connector in accordance with the present invention.

25 Figure 4a illustrates part of an apparatus for controlling power distribution showing a busbar contact and a covered first contact device in accordance with the present invention.

Figure 4b illustrates part of an apparatus for controlling power distribution showing a busbar contact and a first contact device in accordance with the present invention.

Figure 5a illustrates an input unit in accordance with the present invention.

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Figure 5b illustrates a first contact device connected to a first connector in accordance with the present invention.

Figure 5c illustrates a first connector in accordance with the present invention.

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Figure 5d illustrates a cross-sectional view of a first contact device connected to a busbar contact in accordance with the present invention.

Figure 5e illustrates a cross-sectional view of a first contact device connected to a first connector in accordance with the present invention.

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Figure 6a illustrates an input unit in accordance with the present invention.

Figure 6b illustrates a first contact device connected to a first connector in accordance with the present invention.

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Figure 6c illustrates a first connector in accordance with the present invention.

Figure 6d illustrates a cross-sectional view of a first connector in accordance with the present invention.

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Figure 6e illustrates a first contact device in accordance with the present invention.

Figure 6f illustrates a cross-sectional view of a first contact device connected to a busbar contact in accordance with the present invention.

Figure 6g illustrates a cross-sectional view of a first contact device connected to a first
5 connector in accordance with the present invention.

Figure 7a illustrates an output unit in accordance with the present invention.

Figure 7b illustrates an apparatus for controlling power distribution showing at least a second
10 contact device, at least a second connector and an outgoing terminal in accordance with the present invention.

Figure 8a illustrates an output unit in accordance with the present invention.

15 Figure 8b illustrates an apparatus for controlling power distribution showing at least a second contact device, at least a second connector and an outgoing terminal in accordance with the present invention.

Figure 9a illustrates an outgoing terminal block in accordance with the present invention.

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Figure 9b illustrates an outgoing terminal block in accordance with the present invention.

Figure 9c illustrates an outgoing terminal block in accordance with the present invention.

25 DETAILED DESCRIPTION OF THE INVENTION

Reference will now be made in detail to the preferred embodiments of the present invention, and results of which are illustrated in the accompanying drawings.

Referring to Figure 1 and Figure 2, the figures respectively illustrate a top view of an apparatus for controlling power distribution, and a perspective view of a portion of an apparatus for controlling power distribution in accordance with the present invention.

5 In the preferred embodiment of the present invention as shown in Figure 1 and Figure 2, the apparatus for controlling power distribution comprises an input unit (11) for receiving power from a busbar contact (12), a control unit (13) connected to the input unit (11) for controlling power, and an output unit (14) for distributing power to a load via an outgoing terminal (15). In the preferred embodiment of the present invention, said input unit (11) comprises at least a
10 first connector (16) for connecting with at least a first contact device (17) coupled to the busbar contact (12), and that said output unit (14) comprises at least a second connector (18) for connecting with at least a second contact device (19) coupled to the outgoing terminal (15).

Referring to Figure 3, the figure illustrates a top view portion showing a busbar contact (12), a
15 first connector (16) and a first contact device (17).

In the preferred embodiment of the present invention, the apparatus for controlling power distribution is characterized in that said first contact device (17) is configured for aligning said first connector (16) through connection with said first contact device (17). As shown in Figure
20 2, said second contact device (19) is configured for aligning said second connector (18) through connection with said second contact device (19). In the preferred embodiment of the present invention, said at least a first contact device (17) and said at least a second contact device (19) are configured for preventing contact repulsion and said first contact device (17) is configured for preventing contact welding at the busbar contact (12).

The apparatus for controlling power distribution is preferably but not limited to a withdrawable tray within a motor control center withdrawable panel and said first connector (16) and said second connector (18) are preferably but not limited to connecting pins.

5 Referring to Figure 4a and Figure 4b, the figures respectively illustrate part of an apparatus for controlling power distribution showing a busbar contact (12) and a covered first contact device (17), and part of an apparatus for controlling power distribution showing a busbar contact (12) and a first contact device (17) in accordance with the present invention.

10 The material or a housing covering the first contact device (17) is configured for holding the first contact device (17) in place with a fastening feature that facilitates easy installation and replacement of the first contact device (17). There is also provided a protective shield (51), preferably a IP2X cover is configured to assist the first contact device (17) to be aligned in the connect position with the protective shield (51) during replacement process.

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Referring to Figure 5a, the figure illustrates a top view of an input unit (11) in accordance with the present invention, wherein the input unit (11) is for receiving power from a busbar contact (12) comprising at least a first connector (16) for connecting with at least a first contact device (17) and spring mechanism (22) coupled to the busbar contact (12). In the preferred
20 embodiment of the present invention, said first contact device (17) is configured for aligning said first connector (16) through connection with said first contact device (17), and configured for preventing contact repulsion. In this preferred embodiment, said first connector (16) is preferably but not limited to a connecting pin comprising a polygonal cross section area having a rectangular surface area.

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Said first contact device (17) comprises a mechanism for receiving and clamping the busbar contact (12) at one end of said first contact device (17), and for receiving and clamping said

first connector (16) at another end of said first contact device (17). The mechanism provides that said first contact device (17) acts as an interconnecting bridge between the busbar contact (12) and said first connector (16), and in the event said first connector (16) is received by the receiving end of said first contact device (17), while being in a closed position, the receiving
5 end is exerted by an expansion force to open the receiving end so as to receive said first connector (16). The exertion of the expansion force causes the opposite end, being coupled to a busbar contact (12), to be compressed by the reaction force and provides higher contact pressure onto the busbar contact (12). In the preferred embodiment, the mechanism facilitates self-aligning of said first connector (16) to said first contact device (17) with greater contact
10 precision and stability, thus increasing the flow of currents, and preventing contact repulsion under short circuit conditions. Also, said first contact device (17) comprises a spring mechanism (22) which is located between the connection of said first contact device (17) to the busbar contact (12), and the connection of said first contact device (17) to said first connector (16) for providing stability to the connections.

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Referring to Figure 5b, the figure illustrates a perspective view of a first contact device (17) connected to a first connector (16) in accordance with the present invention. Said first contact device (17) is shown receiving and clamping said first connector (16). Said first contact device (17) is configured with flat surface portion at both contact ends for engaging with the busbar
20 contact (12) and first connector (16) as shown in Figure 5a, wherein the flat surface of said first contact device (17) at the busbar contact (12) is greater than that of said connector (16) for preventing contact welding at the busbar contact (12) during an electrical short-circuit condition. In the configuration of the present invention, the greater contact surface area at the busbar contact (12) will have lesser temperature rise in view of weaker point at the contact
25 during short circuit compared to the contact surface area at said first connector (16).

Referring to Figure 5c, the figure illustrates a perspective view of a first connector (16) in accordance with the present invention, wherein said first connector (16) is shown as a connecting pin comprising a polygonal cross section area having a rectangular surface area.

- 5 Referring to Figure 5d and Figure 5e, the figures illustrate a cross-sectional view of a first contact device (17) connected to a busbar contact (12) and connected to a first connector (16) respectively in accordance with the present invention. It is shown in the figures that the contact surface of said first contact device (17) connected to the busbar contact (12) is greater than the contact surface of said first contact device (17) connected to said first connector (16).

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Referring to Figure 6a, the figure illustrates a top view of an input unit (11) of another preferred embodiment in accordance with the present invention, wherein the input unit (11) is for receiving power from a busbar contact (12). In the preferred embodiment of the present invention, said input unit (11) comprises at least a first connector (16) for connecting with at
15 least a first contact device (17) and spring mechanism (22) coupled to the busbar contact (12).

In the preferred embodiment of the present invention, said first contact device (17) is configured for aligning said first connector (16) through connection with said first contact device (17), and configured for preventing contact repulsion. In this preferred embodiment,
20 said first connector (16) is preferably but not limited to a connecting pin comprising a polygonal cross section area having a hexagonal surface area

Said first contact device (17) comprises a mechanism for receiving and clamping the busbar contact (12) at one end of said first contact device (17), and for receiving and clamping said
25 first connector (16) at another end of said first contact device (17). The mechanism provides that said first contact device (17) acts as an interconnecting bridge between the busbar contact (12) and said first connector (16), and in the event said first connector (16) is received by the

receiving end of said first contact device (17), while being in a closed position, the receiving end is exerted by an expansion force to open the receiving end so as to receive said first connector (16). The exertion of the expansion force causes the opposite end, being coupled to a busbar contact (12), to be compressed by the reaction force and provides higher contact pressure onto the busbar contact (12). In the preferred embodiment, the mechanism facilitates self-aligning of said first connector (16) to said first contact device (17) with greater contact precision and stability, thus increasing the flow of currents, and preventing contact repulsion under short circuit conditions. Also, said first contact device (17) comprises a spring mechanism (22) which is located between the connection of said first contact device (17) to the busbar contact (12), and the connection of said first contact device (17) to said first connector (16) for providing stability and maintaining contact precision.

Referring to Figure 6b, the figure illustrates a perspective view of a first contact device (17) connected to a first connector (16) in accordance with the present invention. Said first contact device (17) is shown receiving and clamping said first connector (16). Said first contact device (17) is configured with at least two flat surface portion for engaging with the busbar contact (12), said first contact device (17) is configured with at least four flat surface portion for engaging with first connector (16) as shown in Figure 6a, wherein the two flat surfaces of said first contact device (17) at the busbar contact (12) is greater than that of said connector (16) for preventing contact welding at the busbar contact (12) during an electrical short-circuit condition. The greater contact surface area at the busbar contact (12) will have lesser temperature rise in view of weaker point at the contact during short circuit compared to the contact surface area at said first connector (16).

Referring to Figure 6c, the figure illustrates a perspective view of a first connector (16) in accordance with the present invention, wherein said first connector (16) is shown as a connecting pin comprising a polygonal cross section area having a hexagonal surface area.

Referring to Figure 6d, the figure illustrates a cross-sectional view of a first connector (16) in accordance with the present invention, wherein said first connector (16) is shown as a connecting pin comprising a polygonal cross section area having a hexagonal surface area.

- 5 Referring to Figure 6e, the figure illustrates a perspective view of a first contact device (17) in accordance with the present invention having quadruple fingers for providing clamping.

Referring to Figure 6f and Figure 6g, the figures illustrate a cross-sectional view of a first contact device (17) connected to a busbar contact (12) and connected to a first connector (16) respectively in accordance with the present invention. It is shown in the figures that the contact surface of said first contact device (17) connected to the busbar contact (12) is greater than the contact surface of said first contact device (17) connected to said first connector (16).. It is shown in the Figure 6g that the quadruple fingers of said first contact device (17) ~~is~~ are configured to provide effective clamping effect on said first connector (16) having a hexagonal surface area.

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Referring to Figure 7a and Figure 7b, the figures illustrate a second contact device (19) having a double layer protrusion which is bent and terminated at an outgoing terminal (15) block.

- 20 In the preferred embodiment of the present invention, said second contact device (19) comprises a mechanism for receiving and clamping said second connector (18) at one end of said second contact device (19), and at another end of said second contact device (19), said second contact device (19) comprising a double layer protrusion which is bent and terminated at said outgoing terminal (15). Also, said second contact device (19) is provided with a spring mechanism (23) which is located between the connection of said second contact device (19) to said second connector (18), and the connection of said second contact device (19) to the outgoing terminal (15) for providing stability and maintaining contact precision. Essentially,
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said second contact device (19) is configured for aligning said second connector (18) through connection with said second contact device (19).

Referring to Figure 8a and Figure 8b, the figures illustrate a second contact device (19) in
5 another preferred embodiment having a single layer protrusion which is bent and terminated at an outgoing terminal (15) block.

In this preferred embodiment of the present invention, said second contact device (19) comprises a mechanism for receiving and clamping said second connector (18) at one end of
10 said second contact device (19), and at another end of said second contact device (19), said second contact device (19) comprising a single layer protrusion which is bent and terminated at said outgoing terminal (15). Also, said second contact device (19) is provided with a spring mechanism (23) which is located between the connection of said second contact device (19) to said second connector (18), and the connection of said second contact device (19) to the
15 outgoing terminal (15) for providing stability and maintaining contact precision. Essentially, said second contact device (19) is configured for aligning said second connector (18) through connection with said second contact device (19).

It should be noted that said second contact device (19) is configured in the described
20 embodiments for receiving various polygonal cross section area having either a rectangular or hexagonal surface area.

Referring to Figure 9a, Figure 9b and Figure 9c, the figures illustrate an outgoing terminal block in accordance with the present invention. It is shown in Figure 9a that the terminal block
25 is provided with a breakable barrier (31) which has a link between the compartments for increasing Ampacity. It is shown in Figure 9b that the terminal block is provided with a breakable barrier (31) which the link between the compartments is removed. It is shown in

Figure 3 that the terminal block is provided phase barriers (33) which may be added or removed. Also, the figures show that there is a cable clamp (32) which may be replaced with varying sizes of the cable clamp (32).

- 5 In the preferred embodiment of the present invention, the terminal block is universally applicable to all ratings from 0.2A to 630A, and terminal block is capable of accommodating outgoing external power cables from 2.5mmsq up to 240mmsq by modifying different sizes of cable clamps and copper links.
- 10 The present invention may be embodied in other specific forms without departing from its essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore indicated by the appended claims rather than by the foregoing description. All changes, which come within the meaning and range of equivalency of the claims, are to be embraced within their scope.

CLAIMS

1. An apparatus for controlling power distribution comprising:
 - an input unit (11) for receiving power from a busbar contact (12);
 - 5 a control unit (13) connected to the input unit (11) for controlling power; and
 - an output unit (14) for distributing power to a load via an outgoing terminal (15);
 - wherein said input unit (11) comprises at least a first connector (16) for connecting with
 - at least a first contact device (17) coupled to the busbar contact (12), and that said output
 - unit (14) comprises at least a second connector (18) for connecting with at least a second
 - 10 contact device (19) coupled to the outgoing terminal (15);
 - characterized in that said first contact device (17) is configured for aligning said first
 - connector (16) through connection with said first contact device (17) and said second
 - contact device (19) is configured for aligning said second connector (18) through
 - connection with said second contact device (19).
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2. An apparatus for controlling power distribution according to claim 1, wherein said at least
- a first contact device (17) and said at least a second contact device (19) are configured
- for preventing contact repulsion.
- 20 3. An apparatus for controlling power distribution according to claim 1, wherein said first
- contact device (17) is configured for preventing contact welding at the busbar contact
- (12)..
4. An apparatus for controlling power distribution according to claim 1, wherein said first
- 25 connector (16) and said second connector (18) are connecting pins.

5. An apparatus for controlling power distribution according to claim 4, wherein said connecting pins comprise a polygonal cross section area.
6. An apparatus for controlling power distribution according to claim 1, wherein said first
5 contact device (17) comprises a mechanism for receiving and clamping the busbar contact (12) at one end of said first contact device (17), and for receiving and clamping said first connector (16) at another end of said first contact device (17).
7. An apparatus for controlling power distribution according to claim 1, wherein said second
10 contact device (19) comprises a mechanism for receiving and clamping said second connector (18) at one end of said second contact device (19).
8. An apparatus for controlling power distribution according to claim 7, wherein another end
15 of said second contact device (19) comprises single layer protrusion which is bent and terminated at said outgoing terminal (15).
9. An apparatus for controlling power distribution according to claim 7, wherein another end
20 of said second contact device (19) comprises double layer protrusion which is bent and terminated at the outgoing terminal (15).
10. An apparatus for controlling power distribution according to claim 1, wherein said first
25 contact device (17) and said second contact device (19) comprise a spring mechanism.