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Adjustable length bus bridge for modular switchboard

Abstract

A modular switchboard provides an adjustable length bus bridge for electrically connecting two adjacent switchboards, where the length of the bus bridge can be adjusted on site if needed. The bus bridge comprises a first set of busbars, each being electrically insulated from one another, and a second set of busbars, each being electrically insulated from one another. The first and second sets of busbars are arranged such that the busbars in the first set of busbars and the busbars in the second set of busbars are slidable relative to one another to adjust a length of the bus bridge. A longitudinal slot is formed in each busbar in either the first or the second set of busbars, or both, to accommodate a through bolt in the bus bridge when the first and second set of busbars slide relative to one another.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) The present application claims the benefit of priority to U.S. Provisional Application No. 63/055,927, entitled “Modular Switchboard,” filed Jul. 24, 2020, which is incorporated herein by reference.

FIELD OF THE INVENTION
(1) The present invention relates generally to apparatuses and methods for providing a modular switchboard and, more particularly, to an apparatus and method for providing a bus bridge having an adjustable length for connecting one modular switchboard to another modular switchboard.
BACKGROUND OF THE INVENTION
(2) Conventional factory-assembled switchboards typically come in a relatively limited number of configurations, and generally such factory assembled switchboards require a significant number of electrical busbars, usually made of copper, which can be very expensive. A fully assembled switchboard can also be very large and very heavy, which means shipping the switchboard to the installation site can be expensive, and maneuvering to its final location at the installation site can be very difficult. A fully assembled switchboard can also be more difficult for installers to wire since some installed components may block or restrict access to areas of the switchboard where electrical connections must be made.
(3) Having the ability instead to assemble the switchboard partly or completely at the installation site provides installers with increased flexibility, for example, to effect recent customer changes or updates. For instance, a switchboard component that can be made to accommodate multiple different types of switchboard configurations or multiple different switchboard size requirements at the installation site would provide additional installation options for installers. Most existing switchboards, however, have components that are fixed and cannot be adjusted on site by the installers.
(4) Thus, a need exists for an improved switchboard having one or more switchboard components that can be adjusted on site if needed.
SUMMARY OF THE DISCLOSED EMBODIMENTS
(5) The embodiments disclosed herein relate to apparatus and method for a modular switchboard having one or more switchboard components that can be adjusted on site if needed. In particular, the apparatus and method provide an adjustable length bus bridge for electrically connecting two adjacent switchboards, where the length of the bus bridge can be adjusted on site if needed. The bus bridge comprises a first set of busbars, each being electrically insulated from one another, and a second set of busbars, each being electrically insulated from one another. Each busbar in the first

set of busbars has a connection end connectable to a first switchboard, and each busbar in the second set of busbars has a connection end connectable to a second switchboard. The first and second sets of busbars are arranged such that the busbars in the first set of busbars and the busbars in the second set of busbars are slidable relative to one another to adjust a length of the bus bridge. A longitudinal slot is formed in each busbar in either the first set of busbars or the second set of busbars, or both, to accommodate a through bolt in the bus bridge when the first set of busbars and the second set of busbars slide relative to one another.

(6) The bus bridge also includes a housing for enclosing the first and second sets of busbars, the housing having a first section and a second section, the first and second sections being configured such that the first section is slidably received within the second section, permitting the housing to expand and contract longitudinally, either the first or second section defining a longitudinal slot therein, the defined slot being positioned to coincide with the longitudinal slot in the first or second set of busbars. The bus bridge further includes a through bolt passing through the longitudinal slot of the first or second housing section and the longitudinal slot of the first or second set of busbars, the bolt, when tightened, compresses the busbars of the first set of busbars with the busbars of the second set of busbars, thereby making a tight electrical connection between the busbars of the first set of busbars with the busbars of the second set of busbars.

(7) In general, in one aspect, the disclosed embodiments relate to a bus bridge for electrically connecting adjacent switchboards and other electrical distribution devices. The bus bridge comprises, among other things, an adjustable length housing, and a plurality of adjustable length phase members housed within the adjustable length housing, each adjustable length phase member spaced apart and parallel to an immediately adjacent adjustable length phase member. The bus bridge further comprises an insulation barrier positioned in between adjacent adjustable length phase members, the insulation barrier electrically isolating adjacent adjustable length phase members from one another. The plurality of adjustable length phase members has a length that is adjustable by up to a predefined minimum amount and a predefined maximum amount.

(8) In general, in another aspect, the disclosed embodiments relate to a modular electrical distribution device for distributing electrical power in a facility. The electrical distribution device comprises, among other things, a generally rectangular frame, a line bus attached to the generally rectangular frame, and a bus bridge connected to the line bus. The bus bridge has a length that is adjustable by up to a predefined minimum amount and a predefined maximum amount.

(9) In general, in still another aspect, the disclosed embodiments relate to a method of electrically connecting adjacent electrical distribution devices. The method comprises, among other things, connecting a bus bridge to a first electrical distribution device, adjusting a length of the bus bridge sufficient to reach a second electrical distribution device adjacent to the first electrical distribution device, and connecting the bus bridge to the second electrical distribution device. The bus bridge comprises an adjustable length housing, and a plurality of adjustable length phase members housed within the adjustable length housing, each adjustable length phase member spaced apart and parallel to an immediately adjacent adjustable length phase member. The bus bridge further comprises an insulation barrier positioned in between adjacent adjustable length phase members, the insulation barrier electrically isolating adjacent adjustable length phase members from one another.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) The foregoing and other advantages of the disclosed embodiments will become apparent upon reading the following detailed description and upon reference to the drawings, wherein:

(2) FIG. **1** is a front view of an exemplary modular switchboard according to some

implementations of the disclosed embodiments;
(3) FIG. **2** is a perspective view of the exemplary modular switchboard according to some implementations of the disclosed embodiments;
(4) FIG. **3** is a perspective view of an exemplary bus bridge according to some implementations of the disclosed embodiments;
(5) FIG. **4** is a perspective view of exemplary busbars according to some implementations of the disclosed embodiments;
(6) FIG. **5** is a top view of the exemplary bus bridge according to some implementations of the disclosed embodiments;
(7) FIG. **6** is a perspective view of an alternative bus bridge according to some implementations of the disclosed embodiments;
(8) FIG. **7** is a perspective view of a modular switchboard showing installation of the alternative bus bridge according to some implementations of the disclosed embodiments;
(9) FIG. **8** is a front view of a modular switchboard showing the alternative bus bridge therein according to some implementations of the disclosed embodiments;
(10) FIG. **9** is a perspective view of the exemplary bus bridge with embedded spring jaws according to some implementations of the disclosed embodiments; and
(11) FIG. **10** is a flowchart for a method of using the exemplary bus bridge to connect adjacent switchboards according to some implementations of the disclosed embodiments.

DETAILED DESCRIPTION OF THE DISCLOSED EMBODIMENTS

(12) As an initial matter, it will be appreciated that the development of an actual, real commercial application incorporating aspects of the disclosed embodiments will require many implementation decisions to achieve the developer's ultimate goal for the commercial embodiment. Such implementation may include, and likely are not limited to, compliance with system related, business related, government related and other constraints, which may vary by specific implementation, location and from time to time. While a developer's efforts might be complex and time consuming in an absolute sense, such efforts would nevertheless be a routine undertaking for those of skill in this art having the benefit of this disclosure.
(13) It should also be understood that the embodiments disclosed and taught herein are susceptible to numerous and various modifications and alternative forms. Thus, the use of a singular term, such as, but not limited to, “a” and the like, is not intended as limiting of the number of items. Similarly, any relational terms, such as, but not limited to, “top,” “bottom,” “left,” “right,” “upper,” “lower,” “down,” “up,” “side,” and the like, used in the written description are for clarity in specific reference to the drawings and are not intended to limit the scope of the invention.
(14) Referring now to FIG. **1**, a front view of an exemplary modular switchboard **100** is shown that may be used to distribute electrical power in a facility, such as a building, a plant, a manufactory, and the like. More specifically, FIG. **1** shows the modular switchboard **100** in a partially assembled state, without an outer covering, so the interior can be viewed. Note that although a switchboard is specifically discussed herein, those having ordinary skill in the art will appreciate that embodiments of the present disclosure may also be used with other types of electrical distribution devices, such as switchgears, distribution panels, and the like.
(15) As can be seen, the modular switchboard **100** has a generally rectangular chassis or frame **102**, a line bus **104**, and a breaker panel **106** installed therein, among other things. The line bus **104** and breaker panel **106** extend generally parallel to a long axis of the frame **102** and are secured to and supported by the frame **102**. The line bus **104** in this example is an I-Line bus of the type available from Schneider Electric USA, Inc., although other types of line buses may be used. The breaker panel **106** is also generally rectangular in this example and has a series of regularly spaced holes (not labeled) formed along a face thereof. One or more circuit breakers **108** or other circuit interrupt devices are mounted on the breaker panel **106** in electrical connection to the line bus **104**. Each circuit breaker **108** in turn can be electrically connected to a respective branch circuit (not

shown) for carrying electrical power from the line bus **104** to a part of the facility.
(16) Depending on the type of facility, several switchboards like the modular switchboard **100** may be needed to meet the electrical power requirements of the facility. In that case, a second modular switchboard **100**′ may be provided in the facility adjacent to the exemplary modular switchboard **100**. The second modular switchboard **100**′ is also shown only partially assembled here, including a generally rectangular chassis or frame **102**′, a line bus **104**′, and a breaker panel **106**′. A bus bridge **110** may then be installed in the exemplary modular switchboard **100** to connect the line bus **104** to the second modular switchboard **100**′. The bus bridge **110**, as the name suggests, provides a pathway that bridges electrical power from the exemplary modular switchboard **100** to the second modular switchboard **100**′.
(17) In accordance with embodiments of the present disclosure, the bus bridge **110** is adjustable, having an overall length that can be made longer or shorter as needed to connect the exemplary modular switchboard **100** to the second modular switchboard **100**′. This adjustability permits the length of the bus bridge **110** to be compressed by up to a preset minimum amount for easy transport and subsequent installation at an installation site. Once at the installation site, the bus bridge **110** can be connected to the exemplary modular switchboard **100**, then expanded as needed by up to a preset maximum amount to connect the exemplary modular switchboard **100** to the second modular switchboard **100**′.
(18) As FIG. **1** shows, the adjustable bus bridge **110** has a generally rectangular housing **112** and a first insulating shroud **114** extending from one end (e.g., right end) of the housing **112**. The insulating shroud **114** is a type often used in the switchboard art to facilitate connection between a line bus and other components commonly found in a switchboard. This connection may be through direct contact with the line bus **104** in some embodiments, or the connection may be through an intermediate interface, such as a joint pack that is then connected to the line bus **104**. In a similar manner, a second insulating shroud **116**, more clearly seen in FIG. **2**, extends from the other end (e.g., left end) of the housing **112** to facilitate connection of the adjustable bus bridge **110** to the line bus **104**′ of the second modular switchboard **100**′. In some embodiments, a support platform **120** is provided in the modular switchboard **100** to support and secure the adjustable bus bridge **110** to the frame **102** of switchboard **100**.
(19) Referring still to FIG. **1**, the housing **112** is an adjustable length housing composed of two juxtaposed sections in some embodiments: a first section **112***a* that is fastened to the first insulating shroud **114**, and a second section **112***b* that is fastened to the second insulating shroud **116**. Any suitable fastening means (e.g., screws, etc.) may be used to fasten the first and second housing sections **112***a*, **112***b* to the first and second insulating shrouds **114**, **116**. The two housing sections **112***a*, **112***b* may have roughly the same length in some embodiments, although this is not strictly required. In either case, the two housing sections **112***a*, **112***b* are arranged so as to be slidable toward and away from each other when assembled, overlapping one another as needed so that one section is received partly in the other section. The ability of the two housing sections **112***a*, **112***b* to slide back and forth relative to each other in an overlapping manner allows the overall length of the housing **112**, and consequently the adjustable bus bridge **110**, to be adjusted.
(20) In the example shown, a longitudinal opening **122** is formed on a front surface of at least one of the housing sections, for example, the second section **112***b*. The longitudinal opening **122** extends parallel to the housing **112** and has a size and shape that can accommodate a through bolt **124** (or top portion thereof) to allow the housing sections **112***a*, **112***b* to slide back and forth with little or no interference from the through bolt **124** (or top portion thereof). A single through bolt **124** may be used in some embodiments, but preferably two such through bolts **124** are used to better clamp or otherwise hold together the various components of the adjustable bus bridge **110**, as explained later herein.
(21) Referring now to FIG. **2**, a perspective view of the interior of the modular switchboard **100** is shown in which the housing **112** has been partially removed to reveal the inside of the adjustable

bus bridge **110**. As can be seen, a plurality of electrically conductive phase members, one of which is indicated at **126**, are enclosed within the adjustable bus bridge **110**. There are four phase members **126** in this example, but fewer or more phase members **126** may be present depending on the number of electrical phases needed at the facility (e.g., 1-phase, 2-phase, 3-phase, etc.). Each phase member **126** is generally planar and spaced apart in parallel from an immediately adjacent phase member **126** by an electrical insulation barrier, better seen in FIG. **5**.

(22) Like the housing **112**, each phase member **126** is an adjustable length phase member composed of two generally rectangular busbars in some embodiment: a first busbar **126***a* proximate to the first housing section **112***a*, and a second busbar **126***b* proximate to the second housing section **112***b*, when assembled. Similar to the housing **112**, the two busbars **126***a*, **126***b* may have roughly equal lengths in some embodiments, although again this is not strictly required. In either case, the two busbars **126***a*, **126***b* are arranged to be slidable toward and away from each other when assembled, with their interior ends overlapping along a middle overlap region (better seen in FIG. **5**) of the phase member **126**. The ability of the busbars **126***a*, **126***b* to slide back and forth relative to each other allows the length of the phase members **126**, and thus the adjustable bus bridge **110**, to be adjusted.

(23) The type of busbars **126***a*, **126***b* shown in FIG. **2** are commonly known as bolt-on busbars in that each busbar has a connection end **128** having a notch **130** formed therein for receiving a bolt. The connection ends **128** of the busbars **126** typically protrude from the insulating shrouds **114**, **116** such that a bolt may be easily inserted through the notches **130** and tightened to clamp the connection ends **128** to the intended connections. Alternatively, plug-on busbars may be used in some embodiments that employ spring jaws embedded in the insulating shrouds to make the intended connections, as discussed later herein.

(24) One or more mounting tabs **132** may be provided on the housing **112** for securing the adjustable bus bridge **110** to the support platform **120**. For example, a mounting tab **132** may be provided close to or flush with the support platform **120** on opposite sides of each housing section **112***a*, **112***b*. A screw, locking pin, or other fastener (not expressly labeled) may then be used with the mounting tabs **132** to secure the housing **112**, and therefore the bus bridge **110**, to the support platform **120**.

(25) FIG. **3** shows a perspective view of an exemplary implementation of the adjustable bus bridge **110**, again with the housing **112** partially removed to expose the interior of the bus bridge **110**. As this view shows, a longitudinal slot **132** is formed in at least one of the busbars **126***a*, **126***b*, for example, the second busbar **126***b*, as shown, for each phase member **126**. The longitudinal slot **132** extends parallel to the busbar **126***b* and has a size and shape that can receive the through bolts **124** (or top portions thereof) therein. The longitudinal slot **132** allows the busbars **126***a*, **126***b* to slide back and forth relative to each other with little or no interference from the through bolts **124** (or top portions thereof). Note that two through bolts **124**, laterally aligned and longitudinally offset from one another, are used in this implementation instead of a single through bolt to better prevent undesirable swiveling of the busbars **126***a*, **126***b* relative to one another.

(26) In some embodiments, a generally rectangular isolation plate **134** is disposed between the nuts on the bolts **124**, better seen in FIG. **5**, and an immediately adjacent (i.e., topmost) phase member **126**. When assembled, the isolation plate **134** extends over the middle overlap region of the phase member **126** where the two busbars **126***a*, **126***b* overlap, and serves to electrically insulate the phase member **126** from the tops of the bolts **124** and any other intervening components (e.g., washers, etc.) that may be present. Although difficult to see in this view, a similar isolation plate may be similarly disposed between each phase member **126** and an immediately adjacent phase member **126**.

(27) In some embodiments, two end clamp assemblies may be provided respectively to support the connection ends **128** of the busbars **126***a*, **126***b*: a first clamp assembly **136** adjacent to the first insulating shroud **114**, and a second clamp assembly **138** adjacent to the second insulating shroud

116. The clamp assemblies **136**, **138** function to secure the connection ends **128** of the busbars **126***a*, **126***b* to the bus bridge **110** and to maintain their separation from each other. A clamp bolt (better seen in FIG. **5**) may then be disposed through each clamp assembly **136**, **138** and tightened to fix the connection ends **128** of the busbars **126***a*, **126***b* in place within the bus bridge **110**.
(28) FIG. **4** shows a perspective view of the individual busbars **126***a*, **126***b* making up a phase member **126**. From this view, the longitudinal slot **132** in the second busbar **126***b* can be seen starting near the interior end **140** and extending longitudinally toward the connection end **128**. The length of the longitudinal slot **132** is predefined and may be selected as needed for a particular application of the bus bridge **110**. An aperture **142** is formed in the second busbar **126***b* near the connection end **128** for receiving the clamp bolt of the second clamp assembly **138** mentioned above. A similar aperture **142** is formed in the first busbar **126***a* near the connection end **128** for receiving the clamp bolt of the first clamp assembly **136**. Two additional apertures **144**, **146** may be formed in the first busbar **126***a* near the interior end **140** for receiving the through bolts **124**. Alternatively, instead of the apertures **144**, **146**, a longitudinal slot may be formed in the first busbar **126***a* similar to the longitudinal slot **132** in the second busbar **126***b* to receive the through bolts **124**, in some embodiments.
(29) When assembled, the busbars **126***a*, **126***b* overlap one another along a middle overlap region "A" of the phase member **126**. This middle overlap region "A" has a minimum size that depends in large part on the longitudinal offset between the two through bolts **124**, and a maximum size that depends in large part on the length of the longitudinal slot **132**. In some implementations, depending on the thickness of the busbars **126***a*, **126***b*, the middle overlap region "A" may cause the two connection ends **128** of the busbars to be non-coplanar (i.e., lie in different planes). To compensate for this difference, if needed, a small bend or ridge **148** roughly equal to the thickness of a busbar may be formed in one of the busbars, for example the second busbar **126***b*, between the longitudinal slot **132** and the aperture **142**.
(30) Turning next to FIG. **5**, a top view of the exemplary adjustable bus bridge **110** is shown, this time with the housing **112** removed entirely. In this view, the busbars **126***a*, **126***b* of the various phase members **126** can be seen overlapping along the middle overlap region "A" of each phase member **126**, with the through bolts **124** extending through the busbars **126***a*, **126***b* within the middle overlap region. The busbars **126***a*, **126***b* are slidable as discussed above, until such time when the through bolts **124** are tightened. This arrangement of the through bolts **124** and the busbars **126***a*, **126***b* together forms a type of slidable joint **150** that allows the length of the bus bridge **110** to be adjusted.
(31) Once the length of the adjustable bus bridge **110** is set to a desired length, the slidable joint **150** may be tightened to prevent further sliding of the busbars **126***a*, **126***b*. Tightening of the slidable joint **150** may be accomplished via nuts, one of which is indicated **152**, on the through bolts **124**. The nuts **152** may be standard bolt nuts in some embodiments, or one or both nuts **152** may be a torque-specific dual-nut arrangement, such as the VISI-TITE® nut available from Schneider Electric USA, Inc. The latter type has a top nut attached to a bottom nut such that turning the top nut also turns the bottom nut until a preset amount of torque is reached, at which point the top nut breaks off, ensuring that the bottom nut has been torqued by the specified amount.
(32) Also seen here is the insulation barrier mentioned in FIG. **1**, indicated at **154**, that electrically separates immediately adjacent phase members **126**. In some embodiments, the insulation barrier **154** may resemble the type of insulation barriers commonly used in joint packs, busways, and the like, to maintain busbar separation. Such an insulation barrier **154** is normally disposed between each set of immediately adjacent phase members **126** to electrically separate the phase members. In the present view, however, the insulation barrier **154** between the topmost phase member **126** and the immediately adjacent phase member **126** has been omitted to better show that an insulated bolt sleeve **156** (dotted lines) extends through the various phase members **126**. Each through bolt **124** (dashed lines) may then be inserted through a respective bolt sleeve **156** to protect and prevent the

bolts **124** from direct contact with any phase member **126**.

(33) An insulated spacer **158** may be disposed between the topmost phase member **126** and the isolation plate **134** to maintain electrical separation therebetween in some embodiments. Conversely, an insulated base **159** may be disposed adjacent to the bottommost phase member **126** to maintain electrical separation between that phase member **126** and other components in the adjustable bus bridge **110**.

(34) A similar arrangement to the above may be used for each of the clamp assemblies **136**, **138** in some embodiments. In particular, an insulation plate **160** is disposed between each set of immediately adjacent phase members **126** to electrically separate the phase members. But in the present view, the insulation plate **160** between the topmost phase member **126** and the immediately adjacent phase member **126** has been omitted to more clearly show that an insulated bolt tubing **162** (dotted lines) extends through the various phase members **126**. A clamp bolt **164** (dashed lines) may then be inserted through the bolt tubing **162** of each clamp assembly **136**, **138** to prevent and protect the bolts **164** from direct contact with any phase member **126**.

(35) An insulated top plate **166** may be disposed between the top of each clamp bolt **164** and the topmost phase member **126** to maintain electrical separation therebetween in some embodiments. An insulated bottom plate **168** may be disposed adjacent to the bottommost phase member **126** to maintain electrical separation between that phase member **126** and other components in the adjustable bus bridge **110** in some embodiments.

(36) The adjustable bus bridge **110** as shown is an example of a kit that is designed to allow easy installation within the modular switchboard **100** at the installation site rather than at a factory. Similar kits may also be provided for other components of the modular switchboard **100**, then assembled at the installation site to complete the modular switchboard **100**. For example, the line bus **104** and the breaker panel **106** may each be in the form of a kit. The use of one or more kits like the adjustable bus bridge **110** beneficially reduces the number of components that have to factory preinstalled in the modular switchboard **100**.

(37) FIG. **6** is a perspective view of an alternative adjustable bus bridge **170** according to embodiments of the present disclosure. The alternative bus bridge **170** is similar in most respects to the adjustable bridge **110** from FIG. **1**, except a different housing **172** is used. The housing **172**, like the one from FIG. **1**, is a non-unitary housing composed of two juxtaposed sections in some embodiments: a first housing section **172***a* and a second housing section **172***b*. The two housing sections **172***a*, **172***b* are arranged so as to be slidable toward and away from each other when assembled, overlapping one another as needed. This slidability allows the overall length of the housing **172**, and thus the adjustable bus bridge **110**, to be adjusted. The two housing sections **172***a*, **172***b* may have roughly the same length in some embodiments, or one may be longer than the other in some embodiments, depending on the particular implementation.

(38) Bolt holes **174** are formed in the first housing section **172***a* in the present example to accommodate the through bolts **124** of the adjustable bus bridge **170**. A longitudinally-extending open-ended slot **176** may also be formed in the first housing section **172***a*, with the open end opening away from the bolt holes **174**. The open-ended slot **176** is in lateral alignment with the clamp bolt **164** protruding from the second housing section **172***b*, and is sized to receive the clamp bolt **164** when the two housing sections **172***a*, **172***b* slide toward each other, thereby avoiding any interference by the clamp bolt **164**. The longitudinally-extending open-ended slot **176** may be formed in the second housing section **172***b* in some embodiments.

(39) In some embodiments, an alignment mechanism **178** is provided on the housing **172** to ensure proper alignment of the alternative adjustable bus bridge **170** within the modular switchboard **110** when installing the bus bridge **170** in the switchboard **110**. The alignment mechanism **178** in the example shown is composed mainly of a guide pin **180** extending from a pin holder **182** generally in parallel to the housing **172**. The pin holder **182** is designed to support and hold the guide pin **180** securely in place while the guide pin **180** is inserted into an alignment hole (shown in FIG. **7**) in the

modular switchboard **110** to properly align the bus bridge **170** in the switchboard **110** (i.e., put the connection ends **128** in position to establish a connection). Other alignment mechanisms may also be used, such as a guide pin mounted directly to the housing, within the scope of the disclosed embodiments.

(40) In some embodiments, a fastening mechanism **184** is provided on the housing **172** to ensure secure fastening of the adjustable bus bridge **170** to the modular switchboard **110** when installing the bus bridge **170** in the switchboard **110**. The fastening mechanism **184** in these embodiments mainly includes a screw or other threaded fastener **186** and a retainer **188** designed to hold the screw **186** generally in parallel to the housing **172**. When the bus bridge **170** is properly seated in the modular switchboard **110** (i.e., the connection ends **128** are positioned to establish a connection), the screw **186** may be screwed into a threaded opening (shown in FIG. **7**) in the switchboard **110** to fasten the bus bridge **170** to the switchboard **110**.

(41) In some embodiments, at least one alignment mechanism **178** is provided on each one of the housing sections **172***a*, **172***b* proximate to the connection ends **128** of the busbars **126***a*, **126***b* to facilitate connecting those ends **128** to the exemplary modular switchboard **100** and the second modular switchboard **100**′. The specific location of the alignment mechanism **178** on the housing sections **172***a*, **172***b* is not overly important so long as there is a corresponding alignment hole on the switchboards **100**, **100**′ for the alignment mechanism **178**.

(42) Similarly, in some embodiments, at least one fastening mechanism **184** is provided on each one of the housing sections **172***a*, **172***b* proximate to the connection ends **128** of the busbars **126***a*, **126***b* to facilitate fastening the bus bridge **170** to the exemplary modular switchboard **100** and the second modular switchboard **100**′. The precise location of the fastening mechanism **184** on the housing sections **172***a*, **172***b* is again not particularly important as long as there is a corresponding threaded opening on the switchboards **100**, **100**′ for the fastening mechanism **184**.

(43) In the example of FIG. **6**, both the alignment mechanism **178** and the fastening mechanism **184** are provided on each one of the housing sections **172***a*, **172***b*, although this is not strictly required. In these embodiments, the alignment mechanism **178** and the fastening mechanism **184** are preferably located near diagonally opposite corners of the housing sections **172***a*, **172***b*. It is also possible to provide two alignment mechanisms **178** and two fastening mechanisms **184** on each one of the housing sections **172***a*, **172***b*, in which case all four corners of each housing section **172***a*, **172***b* would be occupied by one of these mechanisms.

(44) FIG. **7** illustrates an exemplary process of installing the bus bridge **170** in the modular switchboard **100**. As can be seen, a mounting tab **190** having an alignment hole **192** therein is attached to the modular switchboard **100**, for example, to the line bus **104**, for receiving the guide pin **180** of the alignment mechanism **178**. The mounting tab **190** is positioned within the switchboard **100** such that the bus bridge **170** is considered properly seated within the switchboard **100** when the guide pin **180** is inserted into the alignment hole **192**. Similarly, a mounting bracket **194** having a threaded opening **196** therein is attached to the modular switchboard **100** for receiving the screw **186** of the fastening mechanism **184**. The mounting bracket **194** is positioned within the switchboard **100** such that the bus bridge **170** is considered properly seated within the switchboard **100** when the screw **186** is screwed into the threaded opening **196**.

(45) In some embodiments, although not expressly shown, a mounting tab similar to the mounting tab **190**, including a corresponding alignment hole, is provided on the opposite of the line bus **104**. This arrangement allows the modular switchboard **100** to receive a bus bridge connection to the line bus **104** on that side. For the same reason, in some embodiments, the mounting bracket **194** has a threaded opening corresponding to the threaded opening **196** on the opposite side thereof.

(46) FIG. **8** is a front interior view of the modular switchboard **100** with the bus bridge **170** seated therein in some embodiments. As this view shows, the bus bridge **170** rests on a generally rectangular support bar **198** provided in the switchboard **100**. Among other things, the support bar **198** provides stability and helps bear the weight of the bus bridge **170**.

(47) Turning now to FIG. **9**, as mentioned above, plug-on busbars are used in some embodiments that employ spring jaws embedded in the insulating shrouds to make the intended connections. In FIG. **9**, the first and second insulating shrouds **114**, **116** of the adjustable bus bridge **110** each have a spring jaw **131** embedded therein. Such embedded spring jaws **131** are well known in the art and are only described briefly here. In short, the embedded spring jaws **131** provide a plug-on electrical connection by receiving the busbars to which the spring jaws **131** are to be connected into the gap in the embedded spring jaws **131**.

(48) Thus far, a number of specific embodiments have been described with respect to an adjustable bus bridge. Following is a method that may be used with the adjustable bus bridge in some embodiments.

(49) Referring to FIG. **10**, a flowchart **200** is shown for method that may be used with the adjustable bus bridge in some embodiments. The method generally begins at **202** where the length of the adjustable bus bridge is compressed by up to a preset minimum for easy handling. This compression may be accomplished, for example, by moving (e.g., pushing) the two housing sections toward one another. At **204**, a first end of the adjustable bus bridge is positioned within a first switchboard such that the first connection ends of the busbars therein are in position to establish an electrical connection in the first switchboard (e.g., with a line bus or circuit breaker therein). This positioning may be achieved, for example, by using the alignment mechanism discussed above to align the first end of the adjustable bus bridge within the first switchboard.

(50) At **206**, the first end of the adjustable bus bridge is connected to the first switchboard. This connection may be established, for example, by using the fastening mechanism discussed earlier to fasten the first end of the adjustable bus bridge to the first switchboard. Where the bus bridge has plug-on type busbars, the process of fastening the bus bridge via the fastening mechanism also forces the spring jaws of the busbars into the intended connection. On the other hand, where the bus bridge has bolt-on type busbars, an additional step of bolting the connection ends of the busbars to the intended connection is needed.

(51) At **208**, the length of the adjustable bus bridge is expanded by up to a preset maximum until a second end of the adjustable bus bridge can reach a second switchboard. This expansion may be accomplished, for example, by moving (e.g., pulling) the two housing sections away from one another. At **210**, the second end of the adjustable bus bridge is positioned within the second switchboard such that the second connection ends of the busbars therein are in position to establish an electrical connection in the second switchboard (e.g., with a line bus or circuit breaker therein). This positioning may be achieved, for example, by using the alignment mechanism discussed above to align the second end of the adjustable bus bridge within the second switchboard.

(52) At **212**, the second end of the adjustable bus bridge is connected to the second switchboard. This connection may be established, for example, by using the fastening mechanism discussed earlier to fasten the second end of the adjustable bus bridge to the second switchboard. As before, where the bus bridge has plug-on type busbars, the process of fastening the bus bridge via the fastening mechanism also forces the spring jaws of the busbars into the intended connection. But where the bus bridge has bolt-on type busbars, a further step of bolting the connection ends of the busbars to the intended connection is needed.

(53) At **214**, the length of the adjustable bus bridge is set by tightening one or more nuts on a sliding joint of the bus bridge to prevent unintended shifts in the length of the bus bridge. The nuts may be conventional bolt nuts, or they may be torque-controlled nuts similar to the VISI-TITE® nuts mentioned earlier. To uninstall the bus bridge, for example, when maintenance needs to be performed or changes need to be made, the same method described above may be followed in reverse sequence.

(54) While particular aspects of the present disclosure have been illustrated and described, it is to be understood that the present disclosure is not limited to the precise construction and compositions disclosed herein and that various modifications, changes, and variations may be apparent from the

foregoing descriptions without departing from the spirit and scope of the disclosed embodiments as defined in the appended claims.

Claims

1. A bus bridge for electrically connecting adjacent electrical distribution devices, comprising: an adjustable length housing having a first housing section and a second housing section configured to slide toward and away from each other when assembled; a plurality of adjustable length phase members housed within the adjustable length housing, each adjustable length phase member spaced apart and parallel to an immediately adjacent adjustable length phase member and including a first busbar and a second busbar; and an insulation barrier positioned in between adjacent adjustable length phase members, the insulation barrier electrically isolating the adjacent adjustable length phase members from one another; wherein the plurality of adjustable length phase members has a length that is adjustable by up to a predefined minimum amount and a predefined maximum amount; and wherein one of the first housing section or the second housing section is configured to slide back and forth together with one of the first busbar or the second busbar of the plurality of adjustable length phase members.
2. The bus bridge of claim 1, wherein the first and second busbars are configured to slide relative to one another to adjust a length of the adjustable length phase member.
3. The bus bridge of claim 2, wherein the first busbar and the second busbar each have a connection end and an interior end, and the interior end of the first busbar and the interior end of the second busbar overlap as the first and second busbars slide relative to one another.
4. The bus bridge of claim 3, further comprising a bend between the connection end and the interior end in either the first busbar or the second busbar, the bend allowing the connection end of the first busbar and the connection end of the second busbar to be coplanar.
5. The bus bridge of claim 3, further comprising at least one through bolt extending through a middle region of said each adjustable length phase member where the interior ends of the first and second busbars overlap.
6. The bus bridge of claim 5, further comprising a longitudinally extending slot formed in at least one of the first and second busbars, wherein the at least one through bolt extends through the longitudinally extending slot.
7. The bus bridge of claim 5, wherein the middle region of said each adjustable length phase member and the at least one through bolt form a sliding joint within the bus bridge.
8. The bus bridge of claim 1, wherein the one of the first housing section or the second housing section is configured to cause the first busbar or the second busbar of the plurality of adjustable length phase members to slide back and forth together with the one of the first housing section or the second housing section.
9. A modular electrical distribution device for distributing electrical power in a facility, comprising: a generally rectangular frame; a line bus attached to the generally rectangular frame; and a bus bridge connected to the line bus, wherein the bus bridge has a length that is adjustable by up to a predefined minimum amount and a predefined maximum amount; wherein the bus bridge comprises a housing having a first housing section and a second housing section that slide relative to one another to adjust the length of the bus bridge, and a plurality of phase members housed within the housing, each phase member having a first busbar and a second busbar; and wherein sliding one of the first housing section or the second housing section back and forth also slides one of the first busbar or the second busbar of the plurality of adjustable length phase members back and forth together with one of the first housing section or the second housing section.
10. The modular electrical distribution device of claim 9, wherein the first busbar and the second busbar are configured to slide relative to one another to adjust the length of the bus bridge.
11. The modular electrical distribution device of claim 9, further comprising at least one alignment

mechanism provided on the housing, the at least one alignment mechanism ensuring proper alignment of the bus bridge within the modular electrical distribution device.
12. The modular electrical distribution device of claim 9, further comprising at least one fastening mechanism provided on the housing, the at least one fastening mechanism ensuring secure fastening of the bus bridge to the modular electrical distribution device.
13. The modular electrical distribution device of claim 9, further comprising a longitudinally-extending open-ended slot formed in either the first housing section or the second housing section and sized to receive a through bolt of the bus bridge when the first and second housing sections slide relative to one another.
14. A method of electrically connecting adjacent electrical distribution devices, comprising: connecting a bus bridge to a first electrical distribution device; adjusting a length of the bus bridge sufficient to reach a second electrical distribution device adjacent to the first electrical distribution device; and connecting the bus bridge to the second electrical distribution device; wherein the bus bridge comprises: an adjustable length housing having a first housing section and a second housing section configured to slide toward and away from each other when assembled; a plurality of adjustable length phase members housed within the adjustable length housing, each adjustable length phase member spaced apart and parallel to an immediately adjacent adjustable length phase member; and an insulation barrier positioned in between adjacent adjustable length phase members, the insulation barrier electrically isolating the adjacent adjustable length phase members from one another; wherein each adjustable length phase member includes a first busbar and a second busbar that slide relative to one another within the adjustable length housing, and one of the first housing section or the second housing section is configured to slide back and forth together with one of the first busbar or the second busbar of the plurality of adjustable length phase members.
15. The method of claim 14, wherein the first and second busbars are configured to slide relative to one another to adjust the length of the bus bridge.
16. The method of claim 15, wherein the first busbar and the second busbar each have a connection end and an interior end, and the interior end of the first busbar and the interior end of the second busbar overlap as the first and second busbars slide relative to one another.
17. The method of claim 16, further comprising providing a bend between the connection end and the interior end in either the first busbar or the second busbar, the bend allowing the connection end of the first busbar and the connection end of the second busbar to be coplanar.
18. The method of claim 16, further comprising extending at least one through bolt through a middle region of said each adjustable length phase member where the interior ends of the first and second busbars overlap.
19. The method of claim 18, further comprising providing a longitudinally extending slot formed in at least one of the first and second busbars, wherein the at least one through bolt extends through the longitudinally extending slot.
20. The method of claim 18, wherein the middle region of said each adjustable length phase member and the at least one through bolt form a sliding joint within the bus bridge.