

Busbar joint.

This invention relates to improvements in or relating to busbars and is more particularly concerned with the manner in which lengths of busbar conductors are connected
5 together in end-to-end relationship.

Various designs of busbar are in operation and these may consist of trunking having an extruded aluminium alloy channel shaped housing defining a base and sidewalls and an
10 interlocking top cover strip made of Noryl (insulating material). One such form of busbar is in use by the Applicant Company, and four elongate conductors, for example of aluminium or copper extend side by side within the housing. In order to join the elongate conductors
15 together joints known as "joint packs" are utilised consisting of a number of flat metal conductor plates mounted on a central bolt with spring means extending in between the plates around the bolt. The metal plates are divided into pairs with plates of insulation material being
20 provided in between each pair of metal plates. Adjacent ends of each pair of metal plates form a slot for reception of an associated one of the elongate conductors on one busbar length. The opposing ends of each said pair of metal plates form an opposing slot for receiving an
25 associated elongate conductor of a second length of busbar having elongate conductors to be joined in end-to-end relationship with the conductors of the first busbar length. Thus, each conductor of the first length can be joined in end-to-end relationship with an associated

conductor of the second length. Once the conductors of one length of busbar have been aligned in end-to-end relationship with associated conductors of a second length of busbar within the slots formed by the metal plates and
5 pushed firmly into the slots, the central bolt can be tightened pulling all the metal plates together closing the slots firmly on their respective conductors. The ends of the conductors themselves may need to be splayed apart from one another in order to be received in the slots of the
10 joint pack.

There tend to be disadvantages involved in the manner of use and construction of such joint packs. Firstly, usually, the design of a joint pack will suit only one type
15 of busbar or narrow rating range of busbars, other busbars or ranges requiring different sizes or types of joint pack. Secondly, the metal plates themselves may be prone to some deformation particularly at the ends which define the receiving slots for the conductors so that the slots may
20 not always be of constant width (more particularly at the opening of the slot which may be narrowed) when the joint pack is ready for assembling to lengths of busbar. This may possibly lead to fouling of the plates or difficulty in introducing the elongate conductor into the slots. Also, it
25 is possible that the conductors may be pushed too far in the slots engaging the bolt or spring means perhaps causing fouling of the conductors or other disadvantageous effects. Additionally, in known designs, there is no indication given by the joint pack as to when the correct torque has

been reached for tightening the bolt on the joint pack.

It is an object of the present invention to at least alleviate one or more of the aforementioned, or other, problems associated with "joint packs" or in joining
5 elongate conductors together in end-to-end relationship.

According to the present invention there is provided a joint for joining together elongate conductors of a first
10 length of busbar to elongate conductors of a second length of busbar, said elongate conductors being joined together in end-to-end relationship, said joint having pairs of conductor plates defining slots for receiving the elongate
conductors, and insulation plates between said pairs, the
15 arrangement being such that the ends of the conductor plates are spring-loaded or urged against associated ones of the insulation plates to thereby alleviate narrowing of the slots.

20 Preferably, the conductor plates of each pair are compressed together to spring the ends of the plates of the pair apart from one another. The central regions of each conductor plate may have a channel or recess, preferably with the conductor plates of each pair overlying one
25 another such that the channels or recesses extend in opposed directions with the bottoms of the channels or recesses being adjacent one another (in order to define central gaps in between the conductor plates and the insulation plates). Providing recesses or channels in the

conductor plates in this manner is advantageous since it allows a bottom or base to be provided for each slot to snugly receive an associated elongate conductor. Additionally, the gaps may accommodate bushes that provide
5 said spring-loading which may compress the central regions of the plates of each pair together.

Said bushes may each be comprised of two interfitting bush components. Each bush component may have an external
10 flange and a tubular portion which in use surrounds a central bolt of the joint (or insulation sleeve surrounding the bolt) and the tubular portion of one of the components may fit inside a tubular portion of the other bush component engaging an internal flange thereof to set a gap
15 between the flanges of the bush, which gap may be slightly less than the combined thickness of the conductor plates of one pair in order to compress the plates together in central regions thereof.

20 The joint may be provided with a double-headed torque bolt.

One embodiment of the present invention comprises a joint having at least four pairs of generally rectangular
25 conductor plates, mounted on a central bolt preferably surrounded by an insulation sleeve, said pairs of plates being separated from one another by insulation plates, and each plate of each pair of conductor plates being provided with a (central) channel or recess for reception of an

associated flange of a double flanged spool-form bush, the bush having a tubular portion passing through aligned holes of the plates of the pair and the gap between the flanges receiving bottom portions of the channels or recesses, the
5 flanges acting to compress the channelled or recessed portions of said plates of the pair together and to spring the ends of said plates thereapart, each flange being in contact with an associated one of the insulation plates.

10 Further according to the present invention there is provided a joint for joining together elongate conductors of a first length of busbar to elongate conductors of a second length of busbar, said joint having one or more of the following features:

- 15 (a) metal conductor plates which are recessed or channelled, preferably in central regions thereof, said plates preferably being divided into pairs in which the depth of the channels or the recesses oppose one another so that bottoms or bases of the
20 channels lie adjacent one another;
- (b) metal conductor plates being shaped to provide slots and a bottom or base to each slot;
- (c) metal conductor plates being provided with recesses or channels receiving spring means preferably in the
25 form of bushes preferably comprising two interfitting bush components defining a gap slightly less than the thickness of two adjoining plates in order to compress two adjoining plates together in central regions thereof and thereby spring apart flat





portions and/or end portions of adjacent plates;

- (d) a double-headed torque bolt;
- (e) a central bolt arranged to tighten the metal plates of the joint pack around elongate conductors with only one or two turns of the bolt;
- (f) conductor plates sprung or urged into contact with associated insulation plates;
- (g) conductor plates connected together in pairs by double-flanged or spool bushes compressing the conductor plates together.

Further according to the present invention there is provided a kit of parts comprising a plurality of busbar lengths and at least one busbar joint in accordance with either of the preceding statements of invention and still further according to the present invention there is provided a busbar assembly comprising at least two busbar conductor lengths assembled together in end-to-end relationship with a joint in accordance with any one of the preceding statements of invention joining together the conductors of each busbar conductor length in end-to-end relationship.

Further according to the present invention there is provided a method of assembling together the conductors of two busbar lengths in end-to-end relationship using a joint in accordance with any of the preceding statements of invention.



Further advantageous apparatus and method features will be apparent from the following description and drawings.

5 Although, known "joint packs" may include a spring or spring means around the central bolt such spring or spring means only acts to hold the assembly together and does not act to bias or spring load the conductor plates (and in particular the ends of said plates) into contact with
10 adjacent insulation plates. Rather the spring or spring means may have the converse effect of spacing the conductor plates slightly from the adjacent insulation plates.

 An embodiment of a joint in the form of a joint pack
15 for a busbar and method of joining busbar elongate conductors together will now be described by way of example only, with reference to the accompanying simplified drawings in which:

20 FIGURE 1 shows a front view of a joint pack in accordance with the present invention;

FIGURE 2 shows a view of the joint pack looking in direction of arrow A of FIGURE 1;

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FIGURE 3 shows a view similar to FIGURE 1, being a central sectional view taken on the line III-III of FIGURE 2;

FIGURE 4 shows a front view with hidden detail of a length

of busbar cut-away to show four conductor lengths engaging the joint pack;

FIGURE 5 shows a sectional view of the busbar itself taken 5 on line V-V of FIGURE 4;

FIGURE 6 shows orthographic and isometric views of a bush component of the joint pack, and

10 FIGURE 7 shows orthographic views and isometric views of a bush component which mates with the bush component shown in FIGURE 6.

FIGURES 1 and 2 of the drawings show front and side 15 elevational views of a joint pack 1 which is used for joining elongate conductors L1,L2,L3,N of a busbar conductor length 2 (see FIGURE 4) in end-to-end relationship with associated elongate conductors (not shown) of an aligned busbar length (not shown).

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The general form of the joint pack 1, having a series of phase fishplates or metal conductor plates 3,4,5,6,7,8,9,10, pairs of which are spaced apart by phase insulator sheets or plates 10a,11,12,13,14, is already 25 known and so this description will be concerned mainly with the differences in the joint pack over known arrangements.

The general assembly of metal conductor plates 3 to 10 with insulation plates 10a to 14 mounted on a central

bolt 15 is known per se. However, the known metal conductor plates are generally flat and similar to the insulation plates 10a to 14. Each pair of metal conductor plates 3,4; 5,6; 7,8; 9,10 is provided with a central collar or spool bush 16,17,18,19 made up from two interengaging or interlocking bush components a,b as shown more particularly in FIGURE 3 and FIGURES 6 and 7. The combination of the bushes 16 to 19 mounted on the central bolt 15 in association with the recessed or channelled configuration of the metal conductor plates 3 to 10 spring-load each pair of plates 3,4; 5,6; 7,8; 9,10 in such a manner that the ends of the plates firmly engage associated insulation plates 10a to 14 thereby advantageously maintaining the correct slot widths w for the slots S defined by respective pairs of conductor plates 3,4; 5,6; 7,8; 9,10. Indeed, the flat lengths of the plates 3,4; 5,6; 7,8; 9,10 are firmly urged into contact with adjacent insulation plates 10a to 14 rather than being held relatively loosely as in prior art arrangements.

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A further difference in the joint pack 1 and prior art joint packs resides in the provision of the bolt 15 which is a double-headed torque bolt (unlike prior art arrangements) such that the outer head 15a can be tightened up to the particular required torque at which point the shaft 15b breaks; the head 15a breaks off leaving the inner end 15c securing the joint pack onto elongate conductors of two busbar lengths in end-to-end relationship under the correct levels of pressure and stress in a manner

which should be self-evident. It is believed that this is an important improvement over the previous method of assembly of a joint pack using a single bolt head that could be tightened using a torque wrench. Utilising the
5 double-headed torque bolt reduces installation time since the tightening required may only be one or two turns of the bolt 15 unlike in prior art arrangements where a considerable number of turns might be necessary.

10 The joint pack 1 comprises outer joint side packer plate 20 which is parallel to outer joint side packer plate 21, washers 22 and 23 are provided on either side of plates 20 and 21 adjacent nut 24 and the inner bolt head 15c respectively in a manner which should be evident from
15 FIGURE 1. A thicker phase insulator plate 25 is provided in between insulation plate 14 and the joint side packer plate 21. An insulator sleeve or tube 26 (see FIGURE 3) is provided on the bolt 15.

20 FIGURE 4 shows a cut-away end of a busbar 2 which is a 2,500 amp busbar including an H-shaped section of aluminium trunking 2a carrying front and rear sets of busbar conductor lengths L1, L2, L3 and N in back-to-back relationship in a manner which should be generally self-
25 explanatory. Reference is made to Patent Application No. 2189070B of the Applicant which shows a busbar having elongate conductors provided in back-to-back relationship. The ringed detail X in FIGURE 4 shows the joint pack 1 corresponding to the view shown in FIGURE 1. It is to be

noted that the ends of the busbar conductor lengths L_1, L_2, L_3 and N are splayed apart in order to be received in the respective slots S formed by the associated pairs of conductor plates 3,4; 5,6; 7,8; 9,10 in a manner as 5 previously described.

As shown in FIGURE 4, part of a trunking connection cover j has been cut-away to reveal the joint pack 1. Slots 27,28 defined between packer plate 20 and plate 10a 10 and between packer plate 21 and plate 25, respectively, receive side plates 29,30 of a trunking joint.

FIGURES 6 and 7 show the bush components a, b that cooperate with one another to form the bushes 16,17,18 and 15 19.

FIGURE 6 shows bush component a having an upper annular flange a_1 and a tubular portion a_2 which in use with bush component b (see FIGURES 3 and 7) slidably 20 interfits into the tubular portion b_2 of bush component b (with bottom annular edge a_3 engaging inner annular rim b_3 and upper annular edge b_4 engaging outer annular rim a_4). The depths of the tubular portions a_2 and b_2 are similar so that they fit together to define an annular gap which 25 receives annular portions for example 5',6';7',8' (see FIGURE 3) of associated pairs of conductor plates 3,4; 5,6; 7,8; 9,10 in a tight-fitting stressed relationship. Thus, the annular receiving gap defined in each collar 16,17,18,19 is slightly less than the combined thickness of

an associated pair of conductor plates 3,4; 5,6; 7,8; 9,10 so that the central regions of said pairs of plates surrounding the bolt 15 will be under an axial compression force. Said axial compression force will act to spring each pair of plates 3,4; 5,6; 7,8; 9,10 apart from one another and (owing to the unique tapering or channelling of each pair of plates in their central regions towards one another creating central trapezoidal shaped ditches or gaps in between the insulation plates 10a to 14 and associated conductor plates 3 to 10) the straight or flat portions of the conductor plates 3 to 10 will rest very firmly in contact with their adjacent insulation plates 10a to 14, thereby reliably maintaining the slot widths w at an accurate width ready for assembly onto associated conductor lengths L_1, L_2, L_3, N of a busbar. In practice, the depth a_5 of flange a_1 is slightly greater than the channel or joggle depth of the associated conductor plate 3,5,7,9 so that the flange is compressed in between the bottom of the associated channel and associated insulation plate 10a,11,12,13. Similarly, depth b_5 is slightly greater than the channel or joggle depth of the associated conductor plate 4,6,8,10 so that the flange b_1 is compressed in between the bottom of the associated channel and associated insulation plate 11,12,13,14. Thus the conductor plate pairs (3,4;5,6;7,8;9,10) are held firmly together by the compressed flanges a_1, b_1 taking up any slack.

Additionally, it is believed that the narrowing of the pairs of metal plates (3,4 to 9,10) in their central

regions is advantageous in itself since tapered portions t of each respective pair of plates define a bottom or base to each slot s for the conductors preventing aligned conductors, disadvantageously, engaging the central bolt 15 5 or insulator tube 26.

Thus, it is believed that the arrangement as aforescribed offers many advantages over prior art joint packs.

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Although the present invention has been described in relation to a four slot joint for busbars each having four conductor lengths engaging in the slots, the present invention may provide a similar joint having five slots at 15 each side for busbars having housings carrying five conductors or other numbers of slots may be provided to suit the particular busbar concerned.

In some cases, the bolt 15 may require loosening 20 prior to assembly of the joint pack 1 onto elongate conductors L1, L2, L3, N, in which case the conductor plates 3 to 10 may lose contact with their associated insulation plates 10a - 14. Even so the flanges a_1 , b_1 of the bush will slightly expand to take up the slack so that 25 the conductor plates pairs 3 to 10 will still be held tightly in the joint. It is an advantage of embodiments of the present invention that any loosening of the bolt will be much less than required with known joint packs in which the conductor plates are held much more loosely.

Therefore, still further according to the present invention there is provided a joint for joining together elongate conductors of a first length of busbar to elongate conductors of a second length of busbar, said elongate
5 conductors being joined together in end-to-end relationship, said joint having pairs of conductor plates defining slots for receiving the elongate conductors (preferably with each plate of the pair held fixed relative to the other plate of the pair), and insulation plates
10 between said pairs, the arrangement being such that the ends of the conductor plates are spring-loaded or urged apart from one another (against associated ones of the insulation plates at least in use of the joint) to provide a set slot opening width, the joint preferably being
15 provided with means to retain the conductor plates and insulation plates together under a variable loading force and the slot opening width remaining substantially unchanged over different values of the loading force.

20 Where the slot opening width remains the same under a variable loading force, the distance between the insulation plates may vary but the slot opening may remain unchanged until the ends of the conductor plates contact their associated insulation plates, when any further loading
25 force may slightly deform ends of the plates compressing them together to firmly clamp onto associated conductor plates.

The conductor plates of each pair may be compressed

or held together firmly at or near central regions thereof to spring the ends of the plates of each pair apart from one another.

- 5 Thus each pair of plates may effectively be sprung or able to float as a unit from associated opposing insulation plates.

Still further according to the present invention
10 there is provided a joint for joining together elongate conductors of a first length of busbar to elongate conductors of a second length of busbar, said joint having one or more of the following features:

- 15 a) conductor plates connected together in pairs at central regions thereof with ends of the conductor plates being splayed or sprung apart a set opening slot width, the pairs of conductor plates preferably being sprung as units in between associated opposing
20 insulation plates;
b) conductor plates having channels or recesses receiving bush flanges of a depth greater than the associated channel or recess, said flanges being compressible until end regions of the plates contact
25 associated insulation plates.

In a preferred embodiment of the present invention, prior to assembly on a busbar, there will be a small gap of e.g. .5 mm between the conductor plates and their

associated insulation plates and the set slot opening width will be .5 mm. The slot opening width is maintained by the spring pressure of the conductor plate pair, the plates of pair being firmly held together at central regions thereof.

5 The elongate conductors will have a slightly greater thickness than the set slot opening width and may be e.g. 6 mm thickness. Thus, on insertion of the 6 mm thick conductor plates into a slot opening of 5 mm, the conductor plates of the associated pair will grip firmly onto the
10 elongate conductor and be slightly deformed to take up the .05 mm gaps, thus firmly contacting the associated insulation plates. Thus the joint is held in the correct position and any alignment adjustments can be made without the necessity of having to immediately tighten the torque
15 bolt.

Therefore, further according to the present invention there is provided a joint for joining together elongate conductors of a first length of busbar to elongate
20 conductors of a second length of busbar, said elongate conductors being joined together in end-to-end relationship, said joint having pairs of conductor plates defining slots for receiving the elongate conductors, and insulation plates between said pairs, the arrangement being
25 such that the ends of the conductor plates are spring-loaded or urged apart from one another to provide a set slot opening width.

The set slot opening width will usually be

independent of the spacing of the insulation plates as long as the insulation plates do not contact the conductor plates.

5 Preferably, the conductor plates of each pair are compressed or held together at central regions thereof to spring the ends of the plates of the pair apart from one another.

10 Small gaps (e.g. .05 mm) may be provided between the pairs of the conductor plates and their associated insulation plates, to allow movement of the ends of the plates outwardly into contact with their associated insulation plates as elongate conductors of a busbar are
15 inserted into the slots.

It is to be understood that the scope of the present invention is not to be unduly limited by the particular choice of terminology and that a specific term as used
20 herein may be replaced or supplemented by an equivalent or generic term. Further it is to be understood that the individual features, method or function relating to the joint pack, shape of the conductor plates and/or spring-loading or assembly thereof and/or bush components might be
25 individually patentably inventive. The singular may include the plural or vice versa. Moreover, any disclosure in this specification of a range for a variable or parameter shall be taken to include a disclosure of any selectable or derivable sub-range within that range and



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shall be taken to include a disclosure of any value for the
variable or parameter within or at an end of a range.

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CLAIMS

1. A joint for joining together elongate conductors of a first length of busbar to elongate conductors of a second length of busbar, said elongate conductors being joined together in end-to-end relationship, said joint having pairs of conductor plates defining slots for receiving the elongate conductors, and insulation plates between said pairs, the arrangement being such that the ends of the conductor plates are spring-loaded or urged apart from one another to provide a set slot opening width.
2. A joint as claimed in Claim 1 in which the set slot opening width is independent of the spacing of the insulation plates as long as the insulation plates do not contact the conductor plates.
3. A joint as claimed in Claim 1 or Claim 2 in which the conductor plates of each pair are compressed or held together at or near central regions thereof to spring the ends of the plates of each pair apart from one another.
4. A joint as claimed in any one of the preceding claims in which small gaps (e.g. .05 mm) are provided between the pairs of the conductor plates and their associated insulation plates, sufficient to allow movement of the ends of the plates outwardly into contact with their associated insulation plates as elongate conductors of a busbar are inserted into the slots.

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5. A joint as claimed in any one of the preceding claims in which each plate of each pair is held fixed relative to the other plate of the pair.
- 5 6. A joint as claimed in any one of the preceding claims in which the conductor plates are spring-loaded or urged apart from one another against associated ones of the insulation plates at least in use of the joint.
- 10 7. A joint as claimed in any one of the preceding claims provided with means to retain the conductor plates and insulation plates together under a variable loading force and the slot opening width remaining substantially unchanged over different values of the loading force.
- 15 8. A joint as claimed in Claim 7 in which the distance between the insulation plates varies with varying loading force but the slot opening remains unchanged until the ends of the conductor plates contact their associated insulation
20 plates, when any further loading force slightly deforms ends of the plates compressing them together to firmly clamp onto associated conductor plates, in use.
9. A joint as claimed in Claim 3 or any claim dependent
25 therefrom in which the central regions of each conductor plate has a channel or recess.
10. A joint as claimed in Claim 9 in which the conductor plates of each pair overlies one another such that the

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channels or recesses extend in opposed directions with the bottoms of the channels or recesses being adjacent one another (in order to define central gaps in between the conductor plates and the insulation plates).

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11. A joint as claimed in Claim 10 in which the gaps accommodate bushes that provide said spring-loading or urging apart which may compress the central regions of the plates of each pair together.

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12. A joint as claimed in Claim 11 in which said bushes each comprise two interfitting bush components.

13. A joint as claimed in Claim 12 in which each bush
15 component has an external flange and a tubular portion which in use surrounds a central bolt of the joint (or insulation sleeve surrounding the bolt).

14. A joint as claimed in Claim 13 in which the tubular
20 portion of one of the components fits inside a tubular portion of the other bush component engaging an internal flange thereof to set a gap between the flanges of the bush.

25 15. A joint as claimed in Claim 14 in which the gap is slightly less than the combined thickness of the conductor plates of one pair.

16. A joint as claimed in any one of the preceding claims





having a double-headed torque bolt.

17. A joint as claimed in Claim 1 having at least four pairs of generally rectangular conductor plates, mounted on a central bolt, said pairs of plates being separated from one another by insulation plates, and each plate of each pair of conductor plates being provided with a channel or recess for reception of an associated flange of a double flanged spool-form bush, the bush having a tubular portion passing through aligned holes of the plates of the pair and the gap between the flanges receiving bottom portions of the channels or recesses, the flanges acting to compress the channelled or recessed portions of said plates of the pair together and to spring the ends of said plates thereapart.

18. A joint as claimed in Claim 17 in which, in use, each flange is in contact with an associated one of the insulation plates.

19. A joint for joining together elongate conductors of a first length of busbar to elongate conductors of a second length of busbar substantially as herein described with reference to the accompanying FIGURES of the drawings.

20. A kit of parts comprising a plurality of busbar lengths and at least one busbar joint in accordance with any of the preceding claims.



21. A kit as claimed in Claim 20 in which the elongate conductors have a thickness of 6 mm and the set slot opening width is 5 mm.

5 22. A busbar assembly comprising at least two busbar conductor lengths assembled together in end-to-end relationship with a joint in accordance with any one of the Claims 1 to 19 joining together the conductors of each busbar conductor length in end-to-end relationship.

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23. a joint for joining together elongate conductors of a first length of busbar to elongate conductors of a second length of busbar, said joint having one or more of the following features:

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a) conductor plates connected together in pairs at central regions thereof with ends of the conductor plates being splayed or sprung apart a set opening slot width, the pairs of conductor plates preferably being sprung as units in between associated opposing insulation plates;

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b) conductor plates having channels or recesses receiving bush flanges of a depth greater than the associated channel or recess, said flanges being compressible until end regions of the plates contact associated insulation plates.

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24. A joint for joining together elongate conductors of a first length of busbar to elongate conductors of a second





length of busbar, said joint having one or more of the following features:

- 5 (a) metal conductor plates which are recessed or channelled, preferably in central regions thereof, said plates preferably being divided into pairs in which the depth of the channels or the recesses oppose one another so that bottoms or bases of the channels lie adjacent one another;
- 10 (b) metal conductor plates being shaped to provide slots and a bottom or base to each slot;
- 15 (c) metal conductor plates being provided with recesses or channels receiving spring means preferably in the form of bushes preferably comprising two interfitting bush components defining a gap slightly less than the thickness of two adjoining plates in order to compress two adjoining plates together in central regions thereof and thereby spring apart flat portions and/or end portions of adjacent plates;
- (d) a double-headed torque bolt;
- 20 (e) a central bolt arranged to tighten the metal plates of the joint pack around elongate conductors with only one or two turns of the bolt;
- (f) conductor plates sprung or urged into contact with associated insulation plates;
- 25 (g) conductor plates connected together in pairs by double-flanged or spool bushes compressing the conductor plates together.





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25. A method of assembling together the conductors of two busbar lengths in end-to-end relationship using a joint in accordance with any one of Claims 1 to 19, 23 or 24.

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