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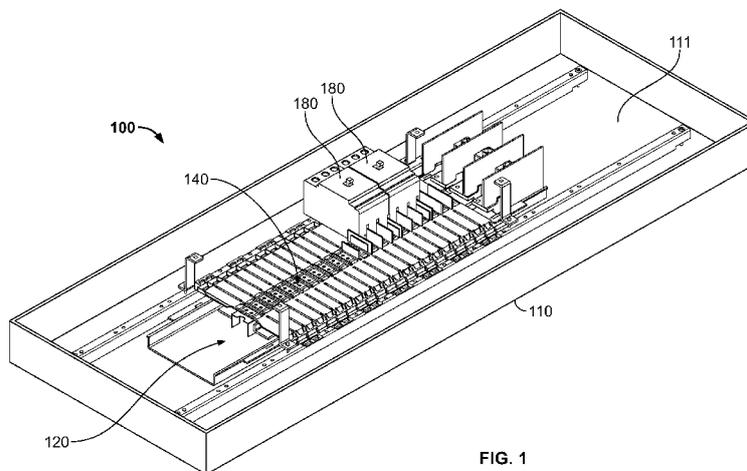


FIG. 1

(57) Abstract: A load center includes a pair of generally parallel busbars for distributing a single phase of electricity to circuit breakers through a multitude of stabs that form respective bridges between the pair of busbars to provide respective bidirectional paths for dissipating heat from each of the stabs to both of the busbars and to provide a connection point for a pair of circuit breakers installed into the load center.

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PANELBOARD HAVING A PARALLEL FEEDER BARS DISTRIBUTION**FIELD OF THE INVENTION**

[0001] The present invention relates generally to electrical equipment and, more particularly, to electrical enclosures having a parallel feeder bars distribution.

BACKGROUND OF THE INVENTION

[0002] Electrical enclosures, such as, for example, load centers, typically house multiple circuit breakers and/or related electrical accessories. Load centers typically include one main feeder bar or busbar per phase of electricity. To accommodate single and/or multi-phase circuit breakers, most load centers include multiple stabs, where each stab is configured to connect two branch circuit breakers with one of the busbars. This connection inherently creates a thermal limitation because the heat contributed by the two circuit breakers for each stab has to be dissipated through a single dissipation path, from the stab itself to the main feeder busbar, which creates a localized temperature rise. To combat these temperature rises, busbars have been oversized to allow temperature rises to remain lower than maximum allowed levels per safety regulations. However, busbars are typically made of copper, which is an expensive metal, so increasing the size of the busbars increases the costs of manufacturing the load center.

[0003] Thus, a need exists for an improved apparatus. The present invention is directed to satisfying one or more of these needs and solving other problems.

SUMMARY OF THE INVENTION

[0004] The present disclosure is directed to providing a load center, which can also be known as a panelboard. The load center can be configured to accept different makes, models, sizes, and types of circuit breakers and related electrical accessories. The load center includes an outer housing for mounting the load center into a building, such as a residential house. The housing has various inputs/outputs to receive electrical wires. For a load center in a typical single family home, the housing is mounted between two studs in a wall. The housing receives one or more live electrical lines from an electrical utility company. Each live electrical line electrically couples with a respective pair of generally parallel busbars. The pairs of generally parallel busbars are insulated from the housing and are rigidly positioned within the housing. Each of the pairs of generally parallel busbars supplies one

phase of electricity to circuit breakers and/or related electrical accessories that are plugged into the load center.

[0005] The present disclosure includes a first set or plurality of stabs that is connected between a first pair of generally parallel busbars such that each one of the first set of stabs forms a bridge between a first one of the first pair of generally parallel busbars and a second one of the first pair of generally parallel busbars. For a load center configured to distribute two or more phases of electricity, the present disclosure further provides a second pair of generally parallel busbars and a second set of stabs that is connected between the second pair of generally parallel busbars such that each one of the second set of stabs forms a bridge between a first one of the second pair of generally parallel busbars and a second one of the second pair of generally parallel busbars. For a load center configured to distribute three phases of electricity, the present disclosure further provides a third pair of generally parallel busbars and a third set of stabs that is connected between the third pair of generally parallel busbars such that each one of the third set of stabs forms a bridge between a first one of the third pair of generally parallel busbars and a second one of the third pair of generally parallel busbars. The first, the second, and the third pairs of generally parallel busbars are arranged within the housing such that the first, the second, and the third set of stabs are staggered along a central axis of the load center. Additionally, each of the first, the second, and the third set of stabs includes a circuit breaker connecting surface. The circuit breaker connecting surfaces of each of the first, the second, and the third set of stabs can be coplanar. Each of the stabs of the present disclosure provide a respective bidirectional path for dissipating heat to the two generally parallel busbars connected thereto. Such bidirectional heat dissipation allows for a reduction in the size of busbars, which can result in material cost savings.

[0006] According to some embodiments a load center includes a housing, a first busbar, a second busbar, and a set of stabs. The first busbar is positioned within the housing for distributing a first phase of electricity entering the load center. The second busbar is positioned within the housing for distributing the first phase of electricity. The second busbar is generally parallel to the first busbar and electrically connected thereto. Each of the set of stabs is electrically connected to the first busbar and the second busbar.

[0007] According to some embodiments, a load center includes a housing, a first pair of generally parallel busbars, a first set of stabs, a second pair of generally parallel

busbars, a second set of stabs, and a first insulating layer. The first pair of generally parallel busbars is positioned within the housing for distributing a first phase of electricity. The first set of stabs is physically and electrically connected between the first pair of generally parallel busbars. The second pair of generally parallel busbars is positioned within the housing for distributing a second phase of electricity. The second set of stabs is physically and electrically connected between the second pair of generally parallel busbars. The first insulating layer is positioned between the first pair of busbars and the second pair of busbars to electrically insulate the first phase of electricity from the second phase of electricity. The first and the second pairs of busbars are arranged within the housing such that the first set of stabs and the second set of stabs are staggered.

[0008] The foregoing and additional aspects and embodiments of the present invention will be apparent to those of ordinary skill in the art in view of the detailed description of various embodiments and/or aspects, which is made with reference to the drawings, a brief description of which is provided next.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The foregoing and other advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings.

[0010] FIG. 1 is a perspective view of a load center according to some aspects of the present disclosure;

[0011] FIG. 2 is a top view of the load center of FIG. 1 according to some aspects of the present disclosure;

[0012] FIG. 3A is a perspective view of three pairs of generally parallel busbars and three sets of stabs from FIGS. 1 and 2 with a housing and all insulating layers removed according to some aspects of the present disclosure;

[0013] FIG. 3B is a cross-sectional front view of the three pairs of generally parallel busbars and the three sets of stabs from FIG. 3A;

[0014] FIG. 4A is a partial perspective view of a first pair of generally parallel busbars and a first set of stabs according to some aspects of the present disclosure;

[0015] FIG. 4B is the partial perspective view of FIG. 4A having a first insulating layer overlaid thereon according to some aspects of the present disclosure;

[0016] FIG. 4C is the partial perspective view of FIG. 4B having a second pair of generally parallel busbars and a second set of stabs overlaid thereon according to some aspects of the present disclosure;

[0017] FIG. 4D is the partial perspective view of FIG. 4C having a second insulating layer overlaid thereon according to some aspects of the present disclosure;

[0018] FIG. 4E is the partial perspective view of FIG. 4D having a third pair of generally parallel busbars and a third set of stabs overlaid thereon according to some aspects of the present disclosure;

[0019] FIG. 4F is a partial perspective view a load center including the components of FIGS. 4A-4E having a third insulating layer overlaid thereon according to some aspects of the present disclosure; and

[0020] FIG. 4G is a partial perspective view of the load center of FIG. 4F having two multiphase circuit breakers coupled thereto.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0021] Although the invention will be described in connection with certain aspects and/or embodiments, it will be understood that the invention is not limited to those particular aspects and/or embodiments. On the contrary, the invention is intended to cover all alternatives, modifications, and equivalent arrangements as may be included within the spirit and scope of the invention as defined by the appended claims.

[0022] Referring to FIG. 1, an electrical enclosure or a load center 100 is shown according to the present disclosure. The load center 100 includes a housing 110. The housing 110 can be made of a variety of materials including metal, plastic, fiberglass, and the like. The housing 110 can include a hinged door (not shown) or other means of sealing and/or covering the contents of the load center 100. The housing 110 can also include an insulating base or pad 111 to cover all of or a portion of an interior surface of the housing 110. The insulating base 111 is configured to electrically insulate the contents of the load center 100 from electrically conductive items outside the housing 110 (*e.g.*, metal wall studs, screws, wires, *etc.*).

[0023] The load center 100 includes three pairs of generally parallel busbars 120 and three corresponding sets of stabs 140 (shown in more detail in FIG. 3A, discussed below), which are implemented to distribute three-phase power in the load center. That is,

each pair of busbars and corresponding set of stabs are provided to supply a separate and distinct phase of electricity to one or more circuit breakers 180 coupled to the load center 100. By generally parallel, it is meant that each pair of busbars 120 is designed and installed to be substantially parallel to one another, understanding that the practical limitations of mechanical and human imperfections can cause the busbars to be slightly skewed. As shown in FIG. 1, the circuit breakers 180 coupled with the load center 100 are three-phase circuit breakers; however, it is contemplated that the load center 100 can receive and supply power to single-phase circuit breakers, dual-phase circuit breakers, three-phase circuit breakers, or a combination thereof.

[0024] While specific numbers of pairs of busbars 120 and corresponding stabs 140 are described herein and shown in the Figures, it is contemplated that the load center 100 can include any number of pairs of busbars 120 and corresponding stabs 140. For example, in some embodiments, the load center 100 is a single-phase load center that includes only one pair of busbars 120 and one corresponding set of stabs 140. For another example, the load center 100 is a dual-phase load center that includes two pairs of busbars 120 and two corresponding sets of stabs 140. For yet another example, the load center 100 is a three-phase load center that includes three pairs of busbars 120 and three corresponding sets of stabs 140.

[0025] Referring to FIG. 2, a top view of the load center 100 is shown. As shown in FIG. 3A, the pairs of busbars 120 are formed from any electrically conducting material, as is known in the art, such as copper. The pairs of busbars 120 are positioned within the housing 110 such that each of the pairs of busbars 120 are electrically insulated from the housing 110 and from each other. The busbars 120 can be positioned between and held rigidly in place by a first block 112 and a second block 114. The first and the second blocks 112 and 114 are attached or coupled to the housing 110 and/or the insulating base 111 such that the first and the second blocks 112 and 114 aid in electrically insulating the pairs of busbars 120 from the housing 110. The first block 112 includes a first terminal 112a, a second terminal 112b, and a third terminal 112c. Each of the first, the second, and the third terminals 112a,b,c is configured to be electrically connected with a respective one of the pairs of busbars 120.

[0026] Referring to FIGS. 2 and 3A, a first pair of generally parallel busbars 120a is configured to be coupled with the first terminal 112a through a first attachment member

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121a. The first attachment member 121a can be integral with, or attached to, one end of one or both of the first pair of generally parallel busbars 120a. Similarly, a second pair of generally parallel busbars 120b is configured to be coupled with the second terminal 112b through a second attachment member 121b. The second attachment member 121b can be integral with, or attached to, one end of one or both of the second pair of generally parallel busbars 120b. Similarly, a third pair of generally parallel busbars 120c is configured to be coupled with the third terminal 112c through a third attachment member 121c. The third attachment member 121c can be integral with, or attached to, one end of one or both of the third pair of generally parallel busbars 120c.

[0027] Referring specifically to FIG. 2, the housing 110 includes one or more apertures positioned adjacent to the terminals 112a,b,c and configured to receive electrical supply lines 119a,b,c. The first, the second, and the third terminals 112a,b,c include respective attachment means, such as, for example, a lug, screw, or bolt to aid in the electrical coupling and physical attachment of the electrical supply wires 119a,b,c. The electrical supply wires 119a,b,c are electrically and physically coupled with the respective terminals 112a,b,c via the screws or the like to supply distinct and separate phases of electricity to the first pair of busbars 120a, the second pair of busbars 120b, and the third pair of busbars 120c, respectively. For example, the first electrical supply wire 119a supplies a first phase of electricity to the first pair of generally parallel busbars 120a via the first terminal 112a; the second electrical supply wire 119b supplies a second phase of electricity to the second pair of generally parallel busbars 120b via the second terminal 112b; and the third electrical supply wire 119c supplies a third phase of electricity to the third pair of generally parallel busbars 120c via the third terminal 112c.

[0028] Referring specifically to FIG. 3A, the three pairs of generally parallel busbars 120a,b,c and corresponding set of stabs 140a,b,c are shown with the housing 110 removed and all insulating layers removed to illustrate a stacked and staggered configuration of the pairs of busbars 120a,b,c and the corresponding set of stabs 140a,b,c. That is, the first, the second, and the third pairs of generally parallel busbars 120a,b,c are stacked relative to each other such that at least a portion of each pair of busbars lies in a different vertical plane. Additionally, the first, the second, and the third pairs of generally parallel busbars 120a,b,c are staggered such that the first, the second, and the third pluralities of stabs 140a,b,c, respectively, alternate along a coinciding central axis as described below.

[0029] The first pair of generally parallel busbars 120a is shown on the top of the stack. The first pair of busbars 120a includes a first busbar 120a₁ that is parallel with and coplanar with a second busbar 120a₂. The first busbar 120a₁ and the second busbar 120a₂ are shown as resembling flat sheets, although it is contemplated that, alternately, the first busbar 120a₁ and/or the second busbar 120a₂ can have an “L” configuration and/or a “C” configuration. The first busbar 120a₁ and the second busbar 120a₂ are physically and electrically connected by the first set of stabs 140a₁₋₇. While FIG. 3A illustrates seven stabs 140a, the first set of stabs 140a can include any number of stabs, such as, for example, 1, 3, 5, 7, 10, 100, *etc.*, to accommodate a variety of different numbers of circuit breakers within the load center 100. While the first set of stabs 140a is shown as having an open trapezoidal shape, it is contemplated that each one of the first set of stabs 140a can have a “C” shape, a substantially flat sheet shape, or an “L” shape.

[0030] The second pair of generally parallel busbars 120b is shown on the bottom of the stack. The second pair of busbars 120b includes a first busbar 120b₁ that is parallel with and at least partially coplanar with a second busbar 120b₂. In other words, major corresponding surfaces 122b₁, 122b₂ (shown in FIG. 3B) of each of the second pair of busbars 120b share a common plane. The first busbar 120b₁ and the second busbar 120b₂ are shown as having an “L” configuration, although it is contemplated that in some alternative embodiments the first busbar 120b₁ and/or the second busbar 120b₂ can have a flat sheet configuration like the first pair of busbars 120a and/or a “C” configuration. The first busbar 120b₁ and the second busbar 120b₂ are physically and electrically connected by the second set of stabs 140b₁₋₇. While FIG. 3A illustrates seven stabs in the second set of stabs 140b for connecting up to 14 circuit breakers, it is contemplated that the second set of stabs 140b can include any number of stabs that corresponds with the number of stabs in the first set of stabs 140a, such as, for example, 1, 3, 5, 7, 10, 100, *etc.* While the second set of stabs 140b is shown as having a “C” shape, it is contemplated that each one of the second set of stabs 140b can have a trapezoidal shape, a substantially flat sheet shape, or an “L” shape.

[0031] The third pair of generally parallel busbars 120c is shown between the first and the second pairs of generally parallel busbars 120a,b in the stack. The third pair of busbars 120c includes a first busbar 120c₁ that is parallel with and at least partially coplanar with a second busbar 120c₂. In other words, major corresponding surfaces 122c₁, 122c₂ (shown in FIG. 3B) of each of the third pair of busbars 120c share a common plane. The first

busbar 120c₁ and the second busbar 120c₂ are shown as having an “L” configuration, although it is contemplated that the first busbar 120c₁ and/or the second busbar 120c₂ can alternately have a flat sheet configuration like the first pair of busbars 120a and/or a “C” configuration. The first busbar 120c₁ and the second busbar 120c₂ are physically and electrically connected by the third set of stabs 140c₁₋₇. While FIG. 3A illustrates seven stabs in the third set of stabs 140c, it is contemplated that the third set of stabs 140c can include any number of stabs that corresponds with the number of stabs in the first set of stabs 140a, such as, for example, 1, 3, 5, 7, 10, 100, *etc.* While the third set of stabs 140c is shown as having a “C” shape, it is contemplated that each one of the third set of stabs 140c can have a trapezoidal shape, a substantially flat sheet shape, or an “L” shape.

[0032] The first pair of generally parallel busbars 120a has a first central axis 125a that is located equidistantly between the first busbar 120a₁ and the second busbar 120a₂. Similarly, the second pair of generally parallel busbars 120b has a second central axis 125b that is located equidistantly between the first busbar 120b₁ and the second busbar 120b₂ and the third pair of generally parallel busbars 120c has a third central axis 125c that is located equidistantly between the first busbar 120c₁ and the second busbar 120c₂. According to some embodiments, the first central axis 125a, the second central axis 125b, and the third central axis 125c, all coincide with each other or are one and the same. That is, the first central axis 125a coincides with the second central axis 125b and the third central axis 125c.

[0033] Referring to FIG. 3B, a cross-sectional front view of the stacked and staggered configuration of busbar pairs 120a,b,c of FIG. 3A is shown. As shown in FIG. 3B, the first pair of busbars 120a is stacked above the third pair of busbars 120c, both of which are stacked on top of the second pair of busbars 120b. As described herein in reference to FIGS. 4A-G, each of the pairs of busbars 120a,b,c is separated and electrically insulated using insulating layers (not shown in FIG. 3B) that are sandwiched between the pairs of busbars 120a,b,c.

[0034] Referring generally to FIGS. 4A-4G, the pairs of busbars 120 and the sets of stabs 140 are described according to an implementation of the present disclosure. Referring specifically to FIG. 4A, a partial perspective view of the second pair of busbars 120b and the second set of stabs 140b is shown. The first busbar 120b₁ of the second pair of generally parallel busbars 120b has a substantially flat major surface 122b₁ and opposing edge surfaces 123b₁, 123b₂. Similarly, the second busbar 120b₂ of the second pair of

generally parallel busbars 120b has a substantially flat major surface 122b₂ and opposing edge surfaces 124b₁, 124b₂.

[0035] The second pair of generally parallel busbars 120b is positioned within the housing 110 such that the substantially flat major surface 122b₁ of the first busbar 120b₁ is coplanar with the substantially flat major surface 122b₂ of the second busbar 120b₂. As described above, the second pair of generally parallel busbars 120b has a second central axis 125b that is located equidistantly between the first busbar 120b₁ and the second busbar 120b₂. Additionally, the opposing edge surfaces 123b₁ and 123b₂ of the first busbar 120b₁ and the opposing edge surfaces 124b₁ and 124b₂ of the second busbar 120b₂ are parallel with the second central axis 125b.

[0036] The second set of stabs 140b is positioned along the second central axis 125b to physically and electrically connect the first busbar 120b₁ with the second busbar 120b₂. That is, each one of the second set of stabs 140b physically and electrically couples the first busbar 120b₁ with the second busbar 120b₂. As shown in FIG. 4A, each one of the second set of stabs 140b, such as, for example, the second stab 140b₂, is coupled with the first busbar 120b₁ via a first screw 143b and the second busbar 120b₂ via a second screw 143b. It is contemplated that each of the second set of stabs 140b can be coupled with the first and/or the second busbars 120b₁, 120b₂, via screw(s), nuts and bolts, welds, snap-fit connection, or a combination thereof.

[0037] Each of the second set of stabs 140b has a circuit breaker connecting surface 145b that is configured to be coupled with corresponding electrical connectors (not shown) of two separate and distinct circuit breakers. As shown, each of the second set of stabs 140b includes two apertures 141b. Each of the apertures 141b is configured to receive a screw, bolt, or the like to physically and/or electrically couple a circuit breaker, as shown in, for example, FIG. 4G, with the second pair of busbars 120b. The circuit breaker connecting surfaces 145b of each one of the second set of stabs 140b are coplanar with one another. That is, for example, the circuit breaker connecting surface 145b of the first stab 140b₁ is coplanar with the circuit breaker connecting surface 145b of the second stab 140b₂, the third stab 140b₃, the fourth stab 140b₄, the fifth stab 140b₅, *etc.* The coplanar circuit breaker connecting surfaces 145b of the second set of stabs 140b provide a uniform platform for coupling circuit breakers. As will be explained below, the first and the third sets of stabs 140a,c also include circuit breaker connecting surfaces 145a,c that are coplanar with the

circuit breaker connecting surfaces 145b of the second set of stabs 140b such that multiphase circuit breakers, such as, for example, the circuit breakers 180, shown in FIG. 1, can be physically and electrically connected with the first, the second, and the third phases of electricity entering the load center 100.

[0038] As described above, each of the second set of stabs 140b forms a bridge between the first busbar 120b₁ and the second busbar 120b₂ to (1) physically and electrically connect the first busbar 120b₁ and the second busbar 120b₂ and (2) provide a circuit breaker connecting surface 145b that is configured to be coupled with corresponding electrical connectors of two separate and distinct circuit breakers. In addition, each of the second set of stabs 140b forms a bridge between the first busbar 120b₁ and the second busbar 120b₂ to (3) provide a bidirectional path for dissipating heat generated by electrical current conducted between the busbars and the attached circuit breakers from each one of the second set of stabs 140b to the first busbar 120b₁ and to the second busbar 120b₂.

[0039] For example, as shown in FIG. 1, circuit breakers 180 can be connected with one or more of the second set of stabs 140b. During operation of the load center 100 in, for example, a residential house, electrical current passes through the circuit breakers 180, which creates heat in the circuit breakers 180. Heat is dissipated from the circuit breakers 180 to the second pair of busbars 120b in a bidirectional manner via the second set of stabs 140b. That is, heat can travel from each one of the second set of stabs 140b in one of two directions as each one of the second set of stabs 140b is physically and electrically connected to the first busbar 120b₁ and to the second busbar 120b₂. In other words, heat can travel from, for example, the second stab 140b₂ in a first direction to the first busbar 120b₁ or in a second direction to the second busbar 120b₂.

[0040] Now referring to FIG. 4B, the second pair of generally parallel busbars 120b and the second set of stabs 140b of FIG. 4A are shown having a second insulating layer 150b overlaid thereon. Only a portion of the second insulating layer 150b is shown to illustrate how the second pair of busbars 120b extends beneath the second insulating layer 150b. The second insulating layer 150b can be a single part or multiple parts. For example, the second insulating layer 150b can be broken into sections that electrically insulate respective portions of the second pair of busbars 120b. It is contemplated that the second insulating layer 150b is made of any electrically insulating material, such as, for example, plastic, rubber, *etc.*

[0041] The second insulating layer 150b includes an insulator base 151b, phase barriers 153b, and apertures 155b. Each of the phase barriers 153b extends perpendicularly from the insulator base 151b to aid in electrically insulating the second phase of electricity entering the load center 100 through the second electrical supply line 119b from the first phase of electricity entering the load center 100 through the first electrical supply line 119a and from the third phase of electricity entering the load center 100 through the third electrical supply line 119c. The phase barriers 153b are configured to be received between circuit breakers and/or within respective slots in a multiphase circuit breaker, such as, for example, as shown in FIG. 1.

[0042] Each of the apertures 155b is positioned to allow access to a respective underlying stab. For example, the first aperture 155b₁ is positioned to provide access to the first stab 140b₁ of the second set of stabs 140b. Similarly, the second aperture 155b₂ is positioned to provide access to the second stab 140b₂, and the third aperture 155b₃ is positioned to provide access to the third stab 140b₃. That is, the apertures 155b provide a path for circuit breakers to physically and/or electrically couple with one of the underlying stabs, such as, for example, one of the second set of stabs 140b.

[0043] The insulator base 151b forms a substantially flat major surface 152b that at least partially rests on the substantially flat major surface 122b₁ of the first busbar 120b₁ of the second pair of busbars 120b and on the substantially flat major surface 122b₂ of the second busbar 120b₂ of the second pair of busbars 120b, which provides a portion of the stacked and staggered configuration of busbars and stabs described herein.

[0044] Referring specifically to FIG. 4C, the second pair of generally parallel busbars 120b, the second set of stabs 140b, and the second insulating layer 150b of FIG. 4B are shown having the third pair of generally parallel busbars 120c and the third set of stabs 140c overlaid thereon. The first busbar 120c₁ of the third pair of generally parallel busbars 120c has a substantially flat major surface 122c₁ and opposing edge surfaces 123c₁, 123c₂. Similarly, the second busbar 120c₂ of the third pair of generally parallel busbars 120c has a substantially flat major surface 122c₂ and opposing edge surfaces 124c₁, 124c₂.

[0045] The third pair of generally parallel busbars 120c is positioned within the housing 110 in the stacked and staggered configuration such that the substantially flat major surface 152b of the insulator base 151b is sandwiched between the substantially flat major surfaces 122b₁ and 122b₂ of the second pair of generally parallel busbars 120b and the

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substantially flat major surfaces $122c_1$ and $122c_2$ of the third pair of generally parallel busbars 120c. Additionally, the third pair of generally parallel busbars 120c is positioned within the housing 110 such that the substantially flat major surface $122c_1$ of the first busbar $120c_1$ is coplanar with the substantially flat major surface $122c_2$ of the second busbar $120c_2$. As described above, the third pair of generally parallel busbars 120c has a third central axis $125c$ that is located equidistantly between the first busbar $120c_1$ and the second busbar $120c_2$. Additionally, according to some embodiments, the opposing edge surfaces $123c_1$ and $123c_2$ of the first busbar $120c_1$ and the opposing edge surfaces $124c_1$ and $124c_2$ of the second busbar $120c_2$ are parallel with the third central axis $125c$.

[0046] The third set of stabs 140c is positioned along the third central axis $125c$ to physically and electrically connect the first busbar $120c_1$ with the second busbar $120c_2$. That is, each one of the third set of stabs 140c physically and electrically couples the first busbar $120c_1$ with the second busbar $120c_2$. As shown in FIG. 4C, each one of the third set of stabs 140c, such as, for example, the fifth stab $140c_5$, is coupled with the first busbar $120c_1$ via a first screw $143c$ and the second busbar $120c_2$ via a second screw $143c$. It is contemplated that each of the third set of stabs 140c can be coupled with the first and/or the second busbars $120c_1$, $120c_2$, via screw(s), nuts and bolts, welds, snap-fit connection, or a combination thereof.

[0047] Each of the third set of stabs 140c has a circuit breaker connecting surface $145c$ that is configured to be coupled with corresponding electrical connectors of two separate and distinct circuit breakers. As shown, each of the third set of stabs 140c includes two apertures $141c$. Each of the apertures $141c$ is configured to receive a screw, bolt, or the like to physically and/or electrically couple a circuit breaker, as shown in, for example, FIG. 4G, with the third pair of busbars 120c. The circuit breaker connecting surfaces $145c$ of each one of the third set of stabs 140c are coplanar. That is, for example, the circuit breaker connecting surface $145c$ of the first stab $140c_1$ is coplanar with the circuit breaker connecting surface $145c$ of the second stab $140c_2$, the third stab $140c_3$, the fourth stab $140c_4$, the fifth stab $140c_5$, *etc.* The coplanar circuit breaker connecting surfaces $145c$ of the third set of stabs 140c provide a uniform platform for coupling circuit breakers as described above in reference to FIG. 4A.

[0048] As described above, each of the third set of stabs 140c forms a bridge between the first busbar $120c_1$ and the second busbar $120c_2$ to (1) physically and electrically

connect the first busbar 120c₁ and the second busbar 120c₂ and (2) provide a circuit breaker connecting surface 145c that is configured to be coupled with corresponding electrical connectors of two separate and distinct circuit breakers. In addition, each of the third set of stabs 140c forms a bridge between the first busbar 120c₁ and the second busbar 120c₂ to (3) provide a bidirectional path for dissipating heat from each one of the third set of stabs 140c to the first busbar 120c₁ and the second busbar 120c₂, in the same, or similar, manner as described above in reference to the second set of stabs and FIG. 4A.

[0049] As described above, the third set of stabs 140c is positioned along the third central axis 125c, which coincides with the second central axis, such that the third set of stabs 140c is staggered with respect to the second set of stabs 140b. That is, the second set of stabs 140b and the third set of stabs 140c are staggered such that respective portions of the second set of stabs 140b and respective portions of the third set of stabs 140c alternate along the second central axis and the third central axis. The respective portions are respective circuit breaker connection surfaces 145b,c of the second and the third sets of stabs 140b,c.

[0050] Now referring to FIG. 4D, the third pair of generally parallel busbars 120c, the third set of stabs 140c, the second insulating layer 150b, the second pair of generally parallel busbars 120b, and the second set of stabs 140b of FIG. 4C are shown having a third insulating layer 150c overlaid thereon. The third insulating layer 150c is the same as, or similar to, the second insulating layer 150b in that, the third insulating layer 150c can be a single part or multiple parts. It is contemplated that the third insulating layer 150c is made of any electrically insulating material, such as, for example, plastic, rubber, *etc.*

[0051] The third insulating layer 150c includes an insulator base 151c, phase barriers 153c, and apertures 155c. Each of the phase barriers 153c extends perpendicularly from the insulator base 151c to aid in electrically insulating the second phase of electricity entering the load center 100 through the second electrical supply line 119b from the first phase of electricity entering the load center 100 through the first electrical supply line 119a and from the third phase of electricity entering the load center 100 through the third electrical supply line 119c in the same or similar manner as described above in reference to the phase barriers 153b and FIG. 4B. Alternately, the third insulating layer 150c does not include phase barriers, and the phase barriers 153b of the second insulating layer 150b provide sufficient electrical insulation between phases.

[0052] Each of the apertures 155c is positioned to allow access to a respective underlying stab. For example, the first aperture 155c₁ is positioned to provide access to the first stab 140b₁ of the second set of stabs 140b. Similarly, the second aperture 155c₂ is positioned to provide access to the first stab 140c₁ of the third set of stabs 140c. That is, the apertures 155c provide a path for circuit breakers to physically and/or electrically couple with one of the underlying stabs, such as, for example, one of the second and/or the third sets of stabs 140b,c.

[0053] The insulator base 151c forms a substantially flat major surface 152c that at least partially rests on the substantially flat major surface 122c₁ of the first busbar 120c₁ of the third pair of busbars 120c and on the substantially flat major surface 122c₂ of the second busbar 120c₂ of the third pair of busbars 120c, which provides a portion of the stacked and staggered configuration of busbars and stabs described herein.

[0054] Referring specifically to FIG. 4E, the third insulating layer 150c, the third pair of generally parallel busbars 120c, the third set of stabs 140c, the second insulating layer 150b, the second pair of generally parallel busbars 120b, and the second set of stabs 140b of FIG. 4D are shown having the first pair of generally parallel busbars 120a and the first set of stabs 140a overlaid thereon. The first busbar 120a₁ of the first pair of generally parallel busbars 120a has a substantially flat major surface 122a₁ and opposing edge surfaces 123a₁, 123a₂. Similarly, the second busbar 120a₂ of the first pair of generally parallel busbars 120a has a substantially flat major surface 122a₂ and opposing edge surfaces 124a₁, 124a₂.

[0055] The first pair of generally parallel busbars 120a is positioned within the housing 110 in the stacked and staggered configuration such that the substantially flat major surface 152c of the insulator base 151c is sandwiched between the substantially flat major surfaces 122c₁ and 122c₂ of the third pair of generally parallel busbars 120c and the substantially flat major surfaces 122a₁ and 122a₂ of the first pair of generally parallel busbars 120a. Additionally, the first pair of generally parallel busbars 120a is positioned within the housing 110 such that the substantially flat major surface 122a₁ of the first busbar 120a₁ is coplanar with the substantially flat major surface 122a₂ of the second busbar 120a₂. As described above, the first pair of generally parallel busbars 120a has a first central axis 125a that is located equidistantly between the first busbar 120a₁ and the second busbar 120a₂. Additionally, the opposing edge surfaces 123a₁ and 123a₂ of the first busbar 120a₁ and the

opposing edge surfaces 124a₁ and 124a₂ of the second busbar 120a₂ are parallel with the first central axis 125a.

[0056] The first set of stabs 140a is positioned along the first central axis 125a to physically and electrically connect the first busbar 120a₁ with the second busbar 120a₂. That is, each one of the first set of stabs 140a physically and electrically couples the first busbar 120a₁ with the second busbar 120a₂. As shown in FIG. 4E, each one of the first set of stabs 140a, such as, for example, the third stab 140a₃, is coupled with the first busbar 120a₁ via a first screw 143a and the second busbar 120a₂ via a second screw 143a. It is contemplated that each of the first set of stabs 140a can be coupled with the first and/or the second busbars 120a₁, 120a₂, via screw(s), nuts and bolts, welds, snap-fit connection, or a combination thereof.

[0057] Each of the first set of stabs 140a has a circuit breaker connecting surface 145a that is configured to be coupled with corresponding electrical connectors of two separate and distinct circuit breakers. As shown, each of the first set of stabs 140a includes two apertures 141a. Each of the apertures 141a is configured to receive a screw, bolt, or the like to physically and/or electrically couple a circuit breaker, as shown in, for example, FIG. 4G, with the first pair of busbars 120a. The circuit breaker connecting surfaces 145a of each one of the first set of stabs 140a are coplanar. That is, for example, the circuit breaker connecting surface 145a of the first stab 140a₁ is coplanar with the circuit breaker connecting surface 145a of the second stab 140a₂, the third stab 140a₃, the fourth stab 140a₄, the fifth stab 140a₅, *etc.* The coplanar circuit breaker connecting surfaces 145a of the first set of stabs 140a provide a uniform platform for coupling circuit breakers as described above in reference to FIG. 4A.

[0058] As described above, each of the first set of stabs 140a forms a bridge between the first busbar 120a₁ and the second busbar 120a₂ to (1) physically and electrically connect the first busbar 120a₁ and the second busbar 120a₂ and (2) provide a circuit breaker connecting surface 145a that is configured to be coupled with corresponding electrical connectors of two separate and distinct circuit breakers. In addition, each of the first set of stabs 140a forms a bridge between the first busbar 120a₁ and the second busbar 120a₂ to (3) provide a bidirectional path for dissipating heat from each one of the first set of stabs 140a to the first busbar 120a₁ and the second busbar 120a₂, in the same, or similar manner as described herein in reference to the second set of stabs and FIG. 4A.

[0059] As described above, the first set of stabs 140a is positioned along the first central axis 125a, which coincides with the second, and the third central axes, such that the first set of stabs 140a are staggered with respect to the second set of stabs 140b and with respect to the third set of stabs 140c. That is, the first set of stabs 140a, the second set of stabs 140b, and the third set of stabs 140c are staggered such that respective portions of the first set of stabs 140a, respective portions of the second set of stabs 140b, and respective portions of the third set of stabs 140c alternate along the first, the second, and the third central axes.

[0060] Now referring to FIG. 4F, a partial perspective view of the load center 100 is shown. The load center 100 is shown as having the first pair of generally parallel busbars 120a, the first set of stabs 140a, the third insulating layer 150c, the third pair of generally parallel busbars 120c, the third set of stabs 140c, the second insulating layer 150b, the second pair of generally parallel busbars 120b, and the second set of stabs 140b of FIG. 4E with a first insulating layer 150a overlaid thereon. The first insulating layer 150a is similar to the second insulating layer 150b and the third insulating layer 150c in that, the first insulating layer 150a can be a single part or multiple parts. It is contemplated that the first insulating layer 150a is made of any electrically insulating material, such as, for example, plastic, rubber, *etc.*

[0061] The first insulating layer 150a includes an insulator base 151a and apertures 155a. Each of the apertures 155a is positioned to allow access to a respective underlying stab. For example, the first aperture 155a₁ is positioned to provide access to the first stab 140a₁ of the first set of stabs 140a. Similarly, the second aperture 155a₂ is positioned to provide access to the first stab 140b₁ of the second set of stabs 140b and the third aperture 155a₃ is positioned to provide access to the first stab 140c₁ of the third set of stabs 140c. That is, the apertures 155a provide a path for circuit breakers to physically and/or electrically couple with one of the underlying stabs, such as, for example, one of the first, the second, and/or the third sets of stabs 140a,b,c. According to some alternative embodiments, the stabs protrude through the apertures 155a.

[0062] The first insulating layer 150a does not include phase barriers. The phase barriers 153b, 153c of the second and the third insulating layers 150b,c protrude through the apertures 155a. The first insulating layer 150a can further include phase barriers the same as, or similar to, the phase barriers 153b, 153c described above in reference to FIGS. 4B and 4D.

[0063] The insulator base 151a forms a substantially flat major surface 152a that at least partially rests on the substantially flat major surface 122a₁ of the first busbar 120a₁ of the first set of busbars 120a and on the substantially flat major surface 122a₂ of the second busbar 120a₂ of the first set of busbars 120a, which provides a portion of the stacked and staggered configuration of busbars and stabs described herein.

[0064] Now referring to FIG. 4G, the partial perspective view of the load center 100 of FIG. 4F is shown having two multi-phase circuit breakers 180a,b coupled thereto. Each of the circuit breakers 180a,b includes a first electrical connector 182a, a second electrical connector 182b, and a third electrical connector 182c. The electrical connectors 182a,b,c of each circuit breaker 180a,b correspond with respective stabs for receiving respective phases of electricity. For example, the first electrical connector 182a of the first circuit breakers 180a corresponds with the second stab 140a₂ of the first set of stabs 140a to receive the first phase of electricity; the second electrical connector 182b of the first circuit breakers 180a corresponds with the second stab 140b₂ of the second set of stabs 140b to receive the second phase of electricity; and the third electrical connector 182c of the first circuit breakers 180a corresponds with the second stab 140c₂ of the third set of stabs 140c to receive the third phase of electricity. The first, the second, and the third electrical connectors 182a,b,c are positioned to be fixedly connected with the corresponding stabs via, for example, a screw.

[0065] The first, the second, and the third electrical connectors 182a,b,c can be configured to snap-on corresponding stabs such that each of the first, the second, and the third electrical connectors 182a,b,c is physically and electrically connected to a respective stab.

[0066] It is contemplated that bidirectional heat dissipation, as described herein, allows for a reduction in a size or thickness of the pairs of busbars 120 as compared with prior art load centers that have stabs with unidirectional heat dissipation that are physically and/or electrically coupled with only one busbar for each phase of electricity being distributed in the load center. A reduction in a thickness of the busbars results in a reduction of copper needed to produce a load center, such as the load center 100. It is contemplated that bidirectional heat dissipation, as described herein, also provides load centers that have an increased efficiency as compared with prior art load centers that have stabs with

unidirectional heat dissipation that are physically and/or electrically coupled with only one busbar for each phase of electricity being distributed in the load center.

[0067] A load center having bidirectional heat dissipation, as described herein, can be made with 20 percent to 35 percent less copper compared to prior art load centers that have stabs with unidirectional heat dissipation that are physically and/or electrically coupled with only one busbar for each phase of electricity being distributed in a load center. A load center having bidirectional heat dissipation, as described herein, can be made with 25 percent to 30 percent less copper compared to prior art load centers that have stabs with unidirectional heat dissipation that are physically and/or electrically coupled with only one busbar for each phase of electricity being distributed in a load center.

[0068] For example, a three-phase, low-amperage (e.g., 250 Amps) prior art load center having three busbars that are each 0.187 inches thick by 1.5 inches wide and fifteen stabs that are 0.187 inches thick by 0.5 inches wide, requires a total of about 2.69 kilograms of copper to produce such a load center. However, a three-phase, low-amperage (e.g., 250 Amps) load center according to aspects of the present disclosure having three pairs of busbars, where each one of the busbars in each pair of busbars is 0.062 inches thick by 1.5 inches wide and fifteen stabs that are 0.125 inches thick by 0.5 inches wide, requires a total of about 1.97 kilograms of copper to produce such a load center. That is, a three-phase, low-amperage (e.g., 250 Amps) load center according to aspects of the present disclosure can be produced with about 0.72 kilograms (26.7%) less of copper than a comparable prior art load center have the same circuit breaker capacity.

[0069] A load center according to the aspects of the present disclosure having bidirectional heat dissipation, as described herein, can be made with less copper and be more efficient (e.g., lose less heat) compared to prior art load centers that have stabs with unidirectional heat dissipation that are physically and/or electrically coupled with only one busbar for each phase of electricity being distributed in a load center.

[0070] Instead of including the apertures 141a,b,c, each one of the first, the second, and the third sets of stabs 140a,b,c can be configured to physically and electrically connect with one or more circuit breakers via a weld connection or a snap-fit connection. For a snap-fit connection, the circuit breakers include one or more jaw members configured to clamp or snap onto a portion of the circuit breaker connecting surface 145a,b,c.

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[0071] While particular aspects, embodiments, and applications of the present invention have been illustrated and described, it is to be understood that the invention 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 invention as defined in the appended claims.

What is claimed is:

1. A load center, comprising:
a housing;
a first busbar, positioned within the housing, for distributing a first phase of electricity entering the load center;
a second busbar, positioned within the housing and physically separated from the first busbar, for distributing the first phase of electricity, the second busbar being generally parallel to the first busbar and electrically connected thereto; and
a plurality of stabs, each of the plurality of stabs being electrically connected to the first busbar and the second busbar.
2. The load center of claim 1, wherein the first and the second busbars distribute the same phase of electricity within the load center to a plurality of circuit breakers electrically connected to the first and the second busbars through the plurality of stabs.
3. The load center of claim 1, wherein each of the plurality of stabs is configured to electrically connect with two circuit breakers within the load center.
4. The load center of claim 1, wherein the plurality of stabs are attached to the first and the second busbars via a screw, nuts and bolts, welds, snap-fit connection, or a combination thereof.
5. The load center of claim 1, wherein the first busbar and the second busbar each has a substantially flat major surface and two opposing edge surfaces, the first busbar and the second busbar being positioned within the housing such that (i) the two opposing edge surfaces of the first busbar are parallel with the two opposing edge surfaces of the second busbar and (ii) the substantially flat major surface of the first busbar is coplanar with the substantially flat major surface of the second busbar.
6. The load center of claim 1, wherein each of the plurality of stabs includes two apertures for physically coupling with corresponding electrical connectors of two separate and distinct circuit breakers.
7. The load center of claim 1, wherein each of the plurality of stabs is configured to be coupled with corresponding electrical jaw connectors of two separate and distinct circuit breakers.
8. The load center of claim 5, wherein each of the plurality of stabs forms a bridge between the first busbar and the second busbar to provide a bidirectional path for

dissipating heat from each one of the plurality of stabs to the first busbar and to the second busbar.

9. A load center, comprising:

a housing;

a first pair of generally parallel busbars, positioned within the housing, for distributing a first phase of electricity, each of the first pair of busbars being physically separated from each other;

a first plurality of stabs physically and electrically connected between the first pair of busbars;

a second pair of generally parallel busbars, positioned within the housing, for distributing a second phase of electricity, each of the second pair of busbars being physically separated from each other;

a second plurality of stabs physically and electrically connected between the second pair of busbars;

a first insulating layer positioned between the first pair of busbars and the second pair of busbars to electrically insulate the first phase of electricity from the second phase of electricity,

wherein the first and the second pairs of busbars are arranged within the housing such that the first plurality of stabs and the second plurality of stabs are staggered.

10. The load center of claim 9, wherein each of the first pair of busbars and each of the second pair of busbars have a respective substantially flat major surface and respective opposing edge surfaces, the first pair of busbars and the second pair of busbars being positioned within the housing such that (i) the respective opposing edge surfaces of the first pair of busbars are parallel with the respective opposing edge surfaces of the second pair of busbars and (ii) the respective substantially flat major surfaces of each of the first pair of busbars are coplanar with the respective substantially flat major surfaces of each of the second pair of busbars.

11. The load center of claim 10, wherein the first pair of busbars has a first central axis located equidistantly between the first pair of busbars and the second pair of busbars has a second central axis located equidistantly between the second pair of busbars, the first central axis coinciding with the second central axis.

12. The load center of claim 11, wherein the first plurality of stabs and the second plurality of stabs are staggered such that respective portions of the first plurality of stabs and the second plurality of stabs alternate along the first central axis.

13. The load center of claim 12, wherein each of the first plurality of stabs and each of the second plurality of stabs have a circuit breaker connecting surface that is configured to couple with corresponding electrical connectors of two circuit breakers, each of the circuit breaker connecting surfaces being coplanar.

14. The load center of claim 9, wherein each of the first plurality of stabs and each of the second plurality of stabs are configured to be coupled with corresponding electrical connectors of two separate and distinct circuit breakers.

15. The load center of claim 9, wherein each of the first plurality of stabs forms a bridge between the first pair of busbars to provide a bidirectional path for dissipating heat from each one of the first plurality of stabs to each one of the first pair of busbars, and each of the second plurality of stabs forms a bridge between the second pair of busbars to provide a bidirectional path for dissipating heat from each one of the second plurality of stabs to each one of the second pair of busbars.

16. The load center of claim 10, wherein the first insulating layer includes a base portion and a plurality of phase barriers extending perpendicularly from the base portion, the base portion forming a substantially flat major surface that is sandwiched between the substantially flat major surfaces of the first pair of busbars and the substantially flat major surfaces of the second pair of busbars.

17. The load center of claim 16, wherein each of the phase barriers aids in electrically insulating the first phase of electricity from the second phase of electricity in response to one or more circuit breakers being electrically connected to the first plurality of stabs, the second plurality of stabs, or both.

18. The load center of claim 9, further comprising a third pair of generally parallel busbars, positioned within the housing, for distributing a third phase of electricity and a third plurality of stabs physically and electrically connected between the third pair of busbars, each of the third pair of busbars being physically separated from each other and having a respective substantially flat major surface and respective opposing edge surfaces, the third pair of busbars being positioned within the housing such that (i) the respective opposing edge surfaces of the third pair of busbars are parallel with the respective opposing edge surfaces of

the first and the second pairs of busbars and (ii) the respective substantially flat major surfaces of each of the third pair of busbars are coplanar with the respective substantially flat major surfaces of each of the first and the second pairs of busbars.

19. The load center of claim 18, further comprising a second insulating layer, the second insulating layer including a base portion and a plurality of phase barriers extending perpendicularly from the base portion, the base portion of the second insulating layer forming a substantially flat major surface that is sandwiched between the substantially flat major surfaces of the second pair of busbars and the substantially flat major surfaces of the third pair of busbars to electrically insulate the second phase of electricity from the third phase of electricity.

20. The load center of claim 19, further comprising a third insulating layer positioned adjacent to the respective substantially flat major surfaces of the third pair of busbars, the third insulating layer being coupled with the housing and configured to physically connect with corresponding connectors of a plurality of circuit breakers.

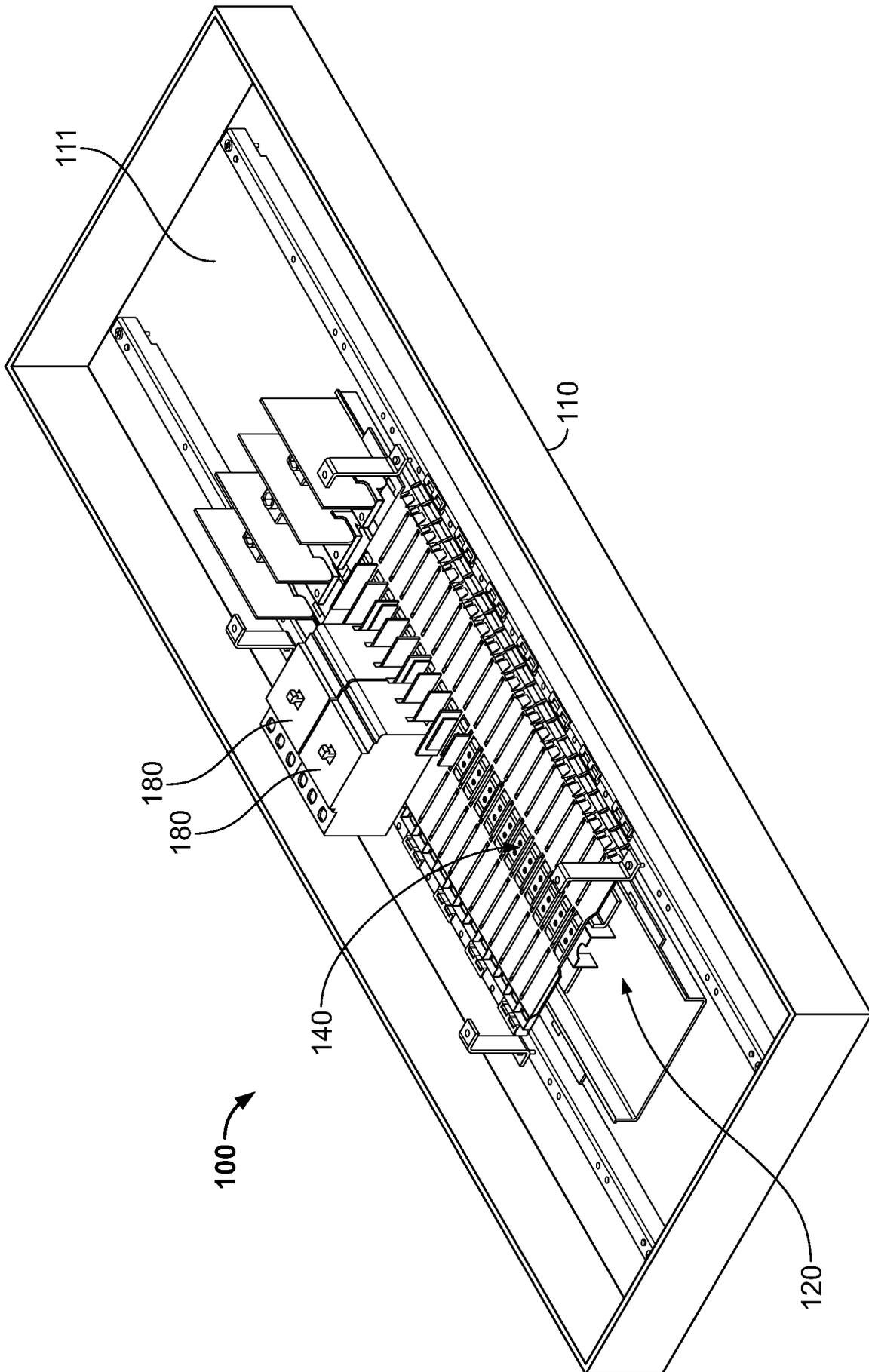


FIG. 1

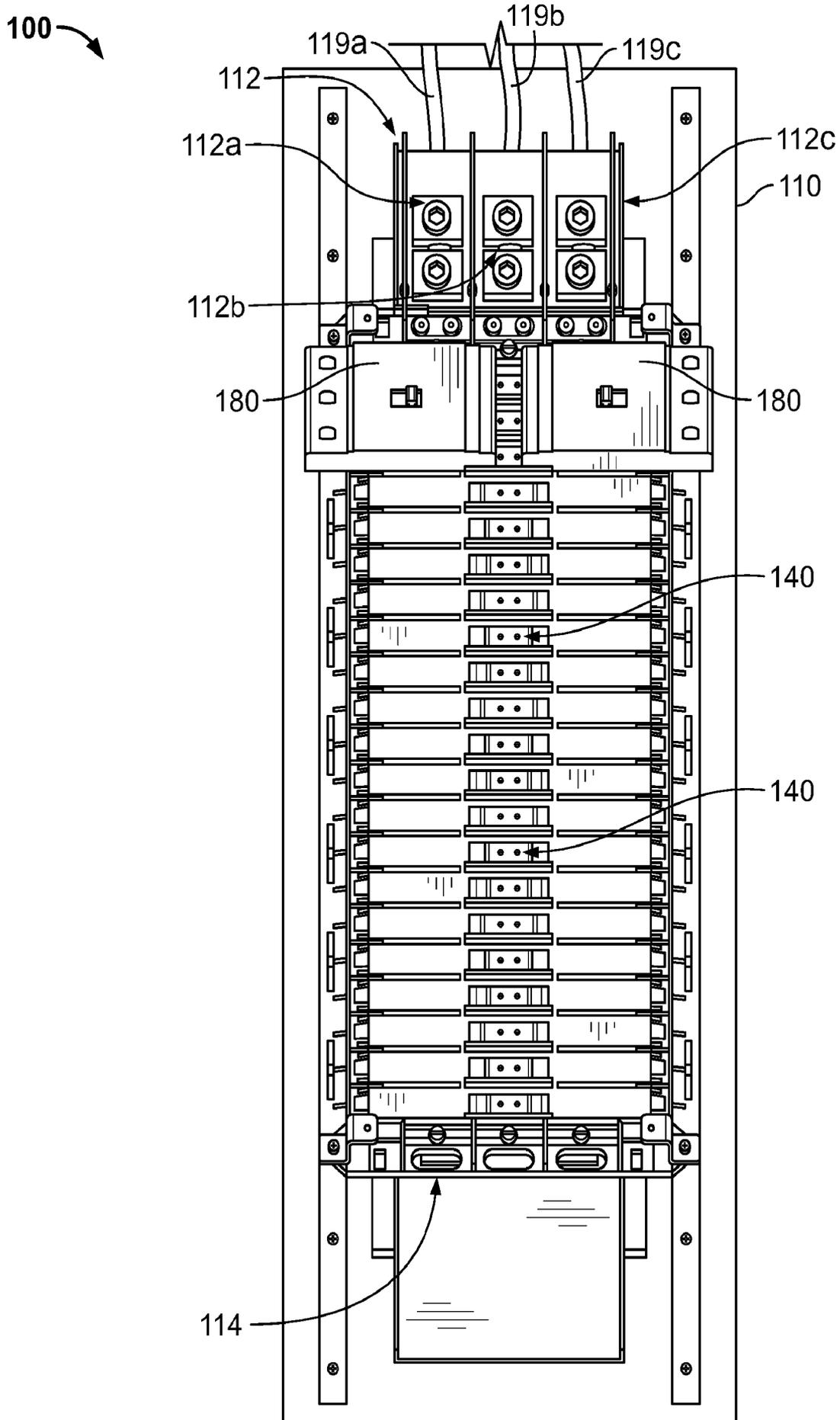
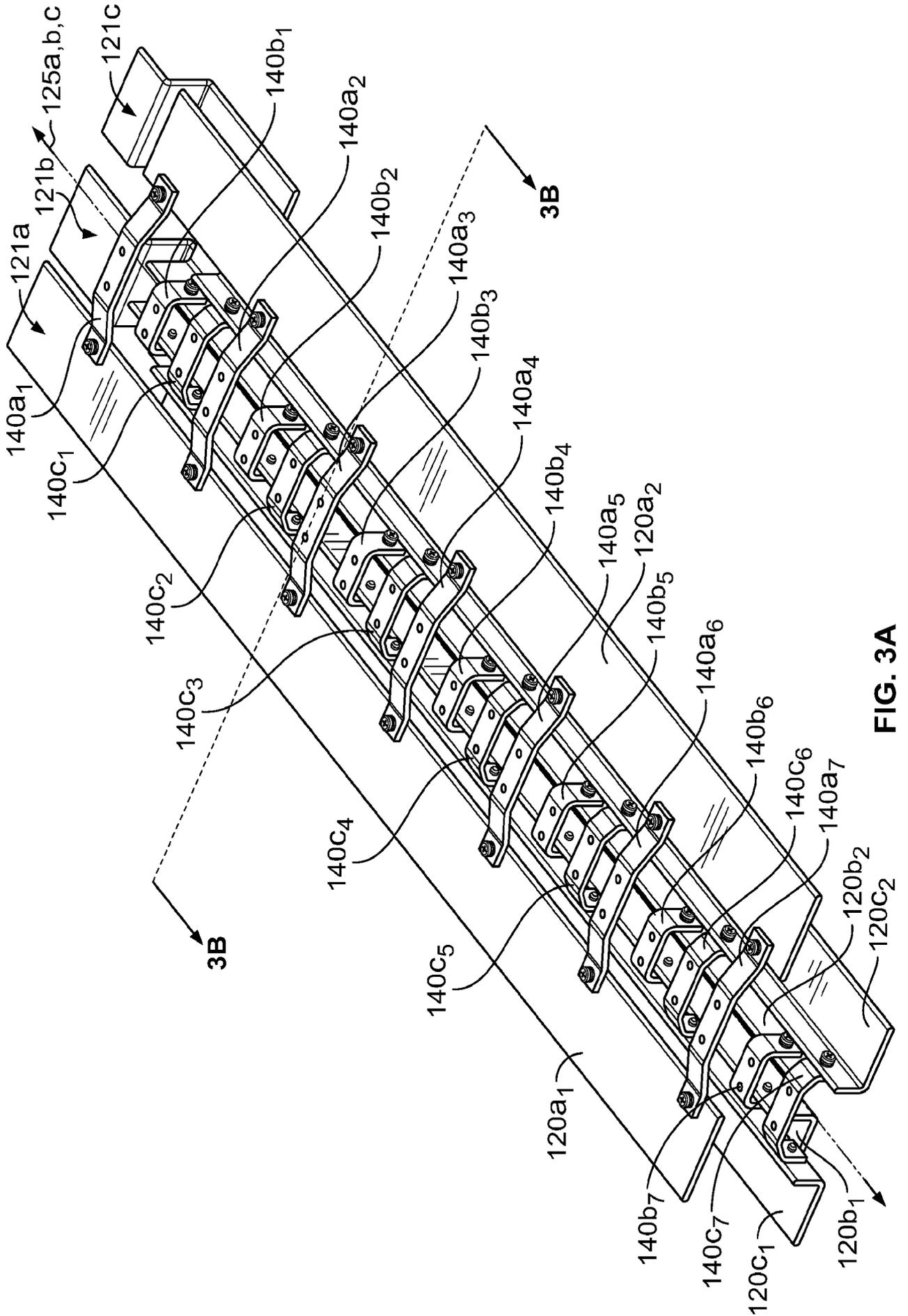


FIG. 2

INCORPORATED BY REFERENCE (RULE 20.6)



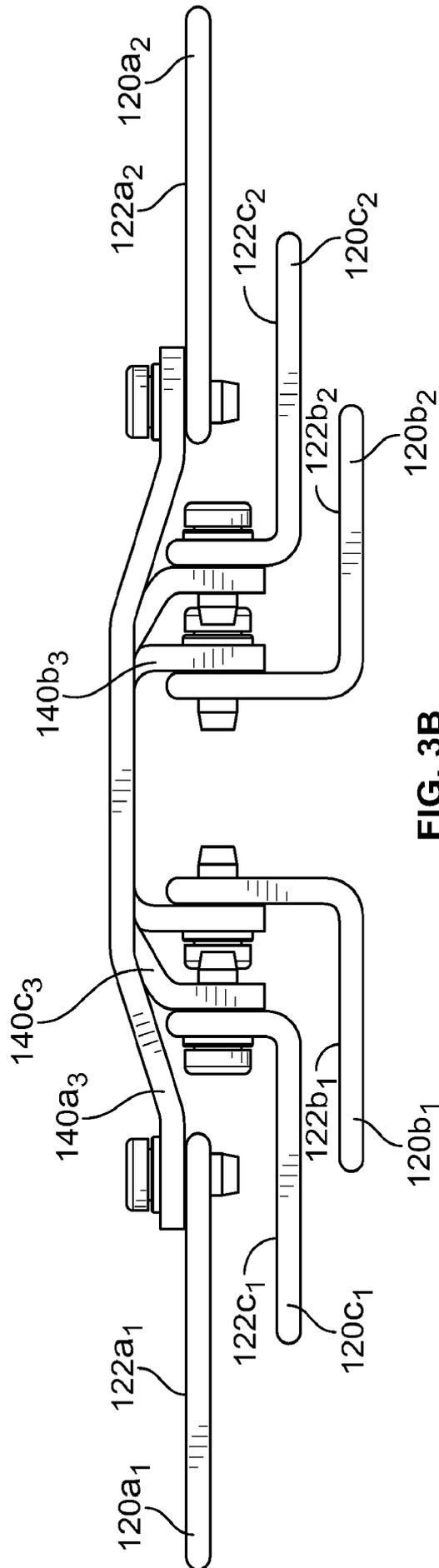
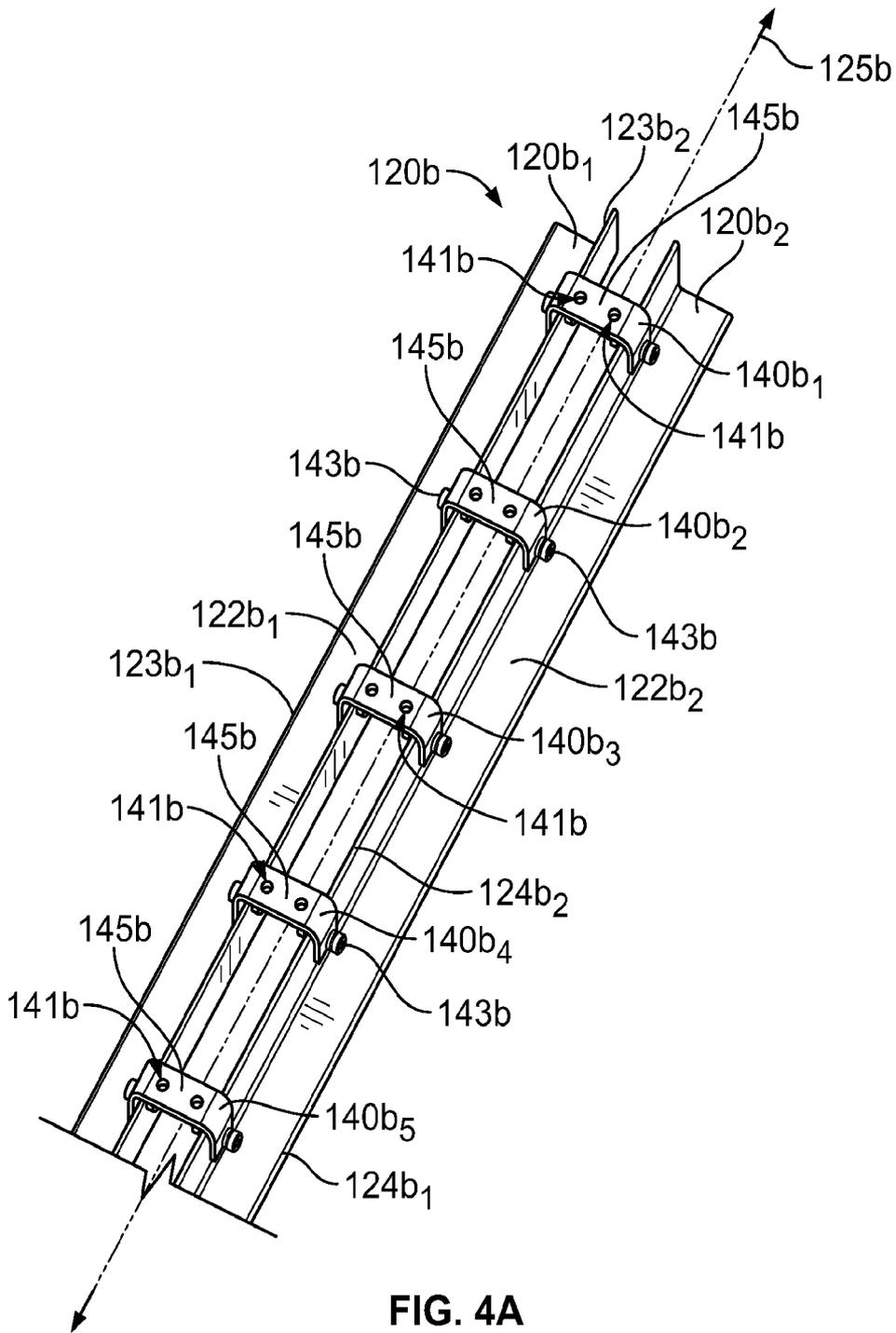


FIG. 3B



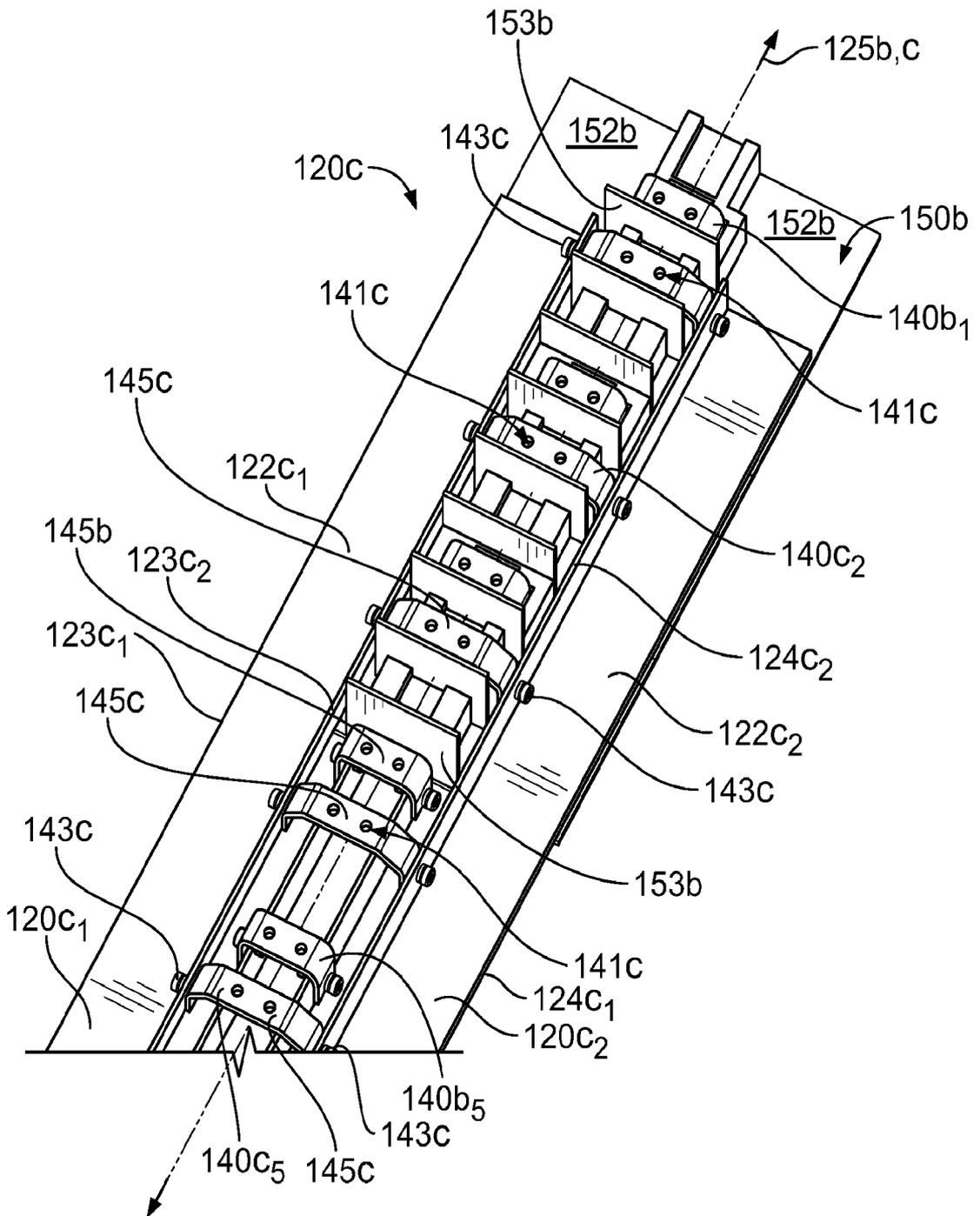


FIG. 4C

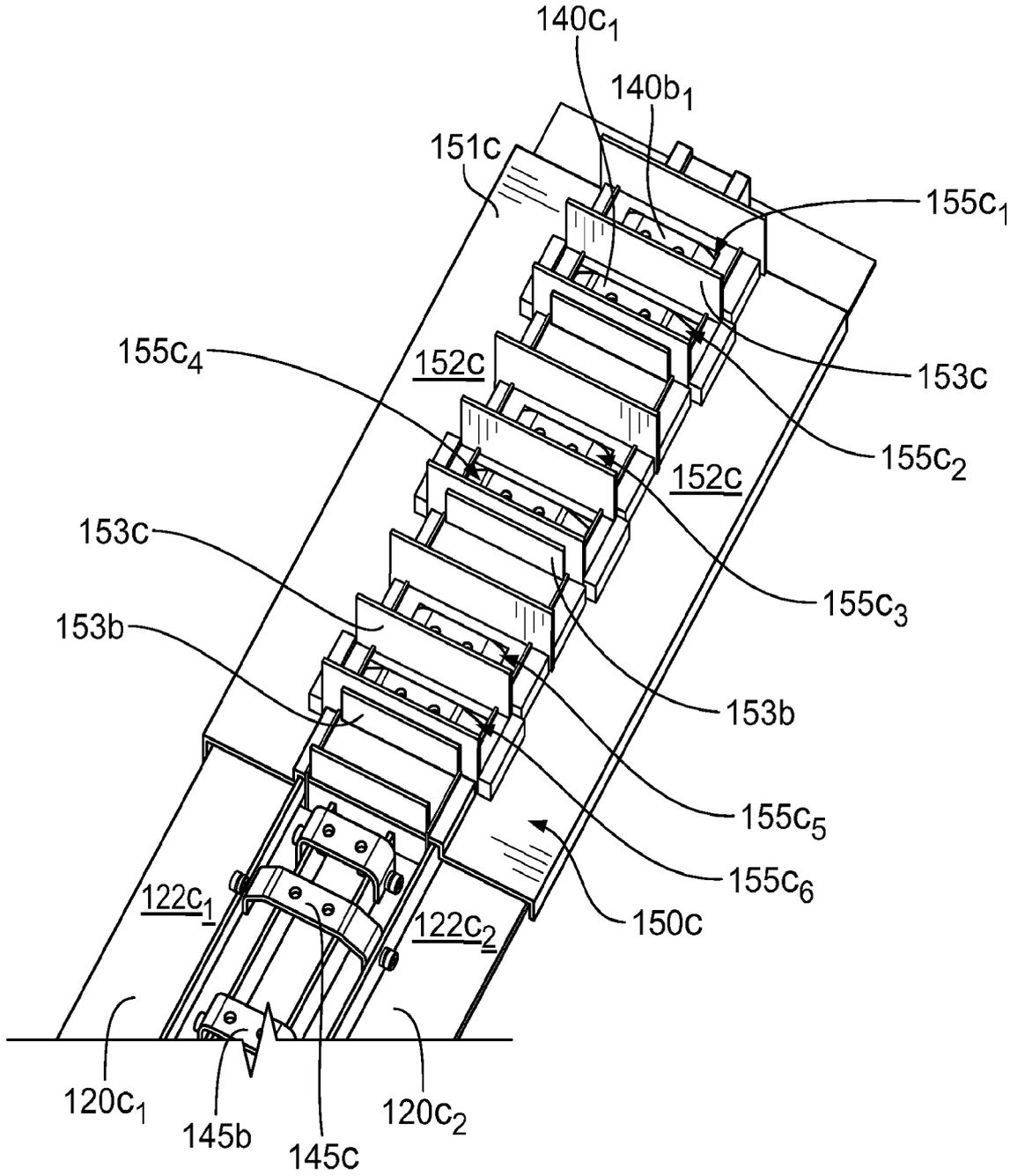


FIG. 4D

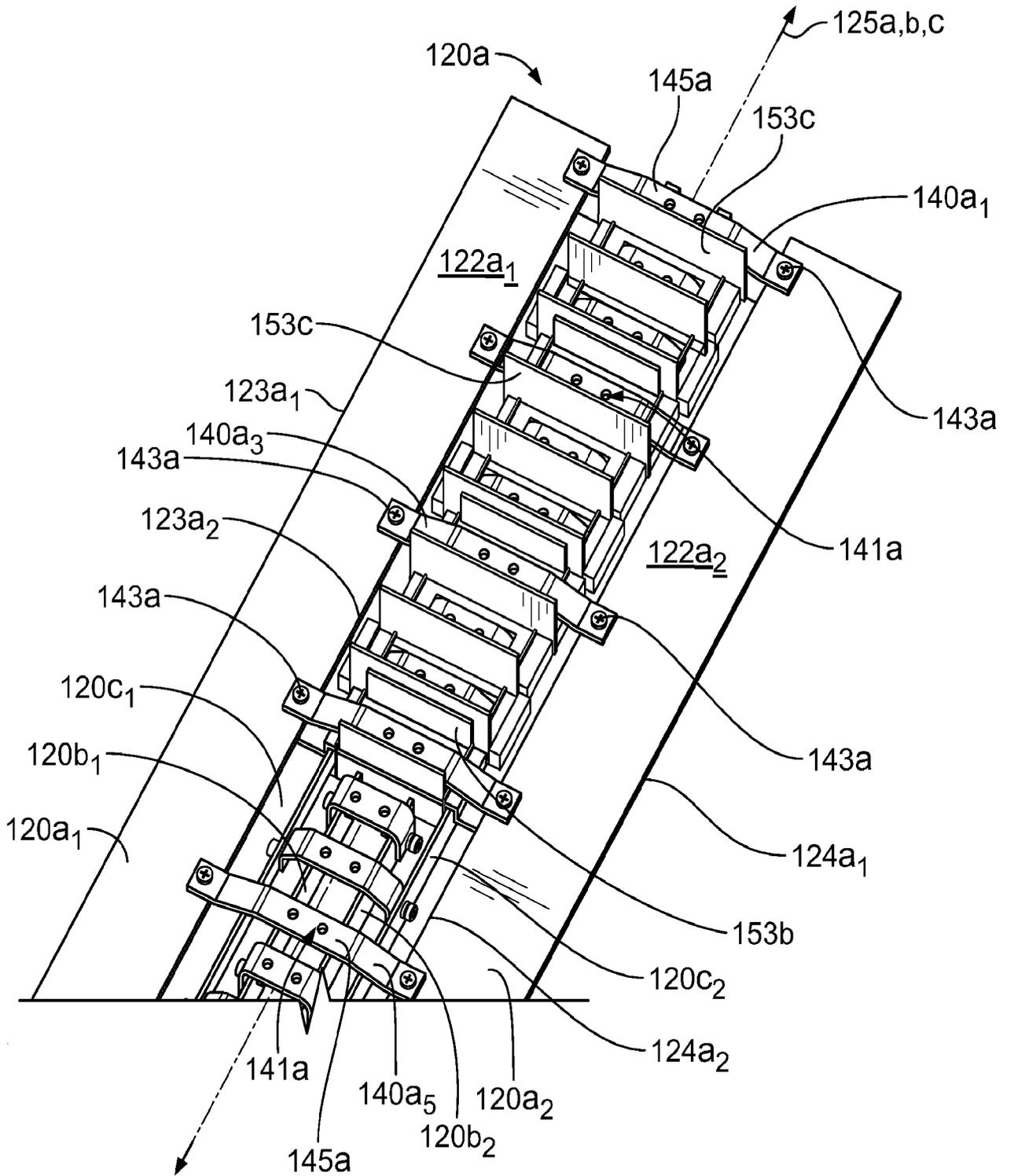


FIG. 4E

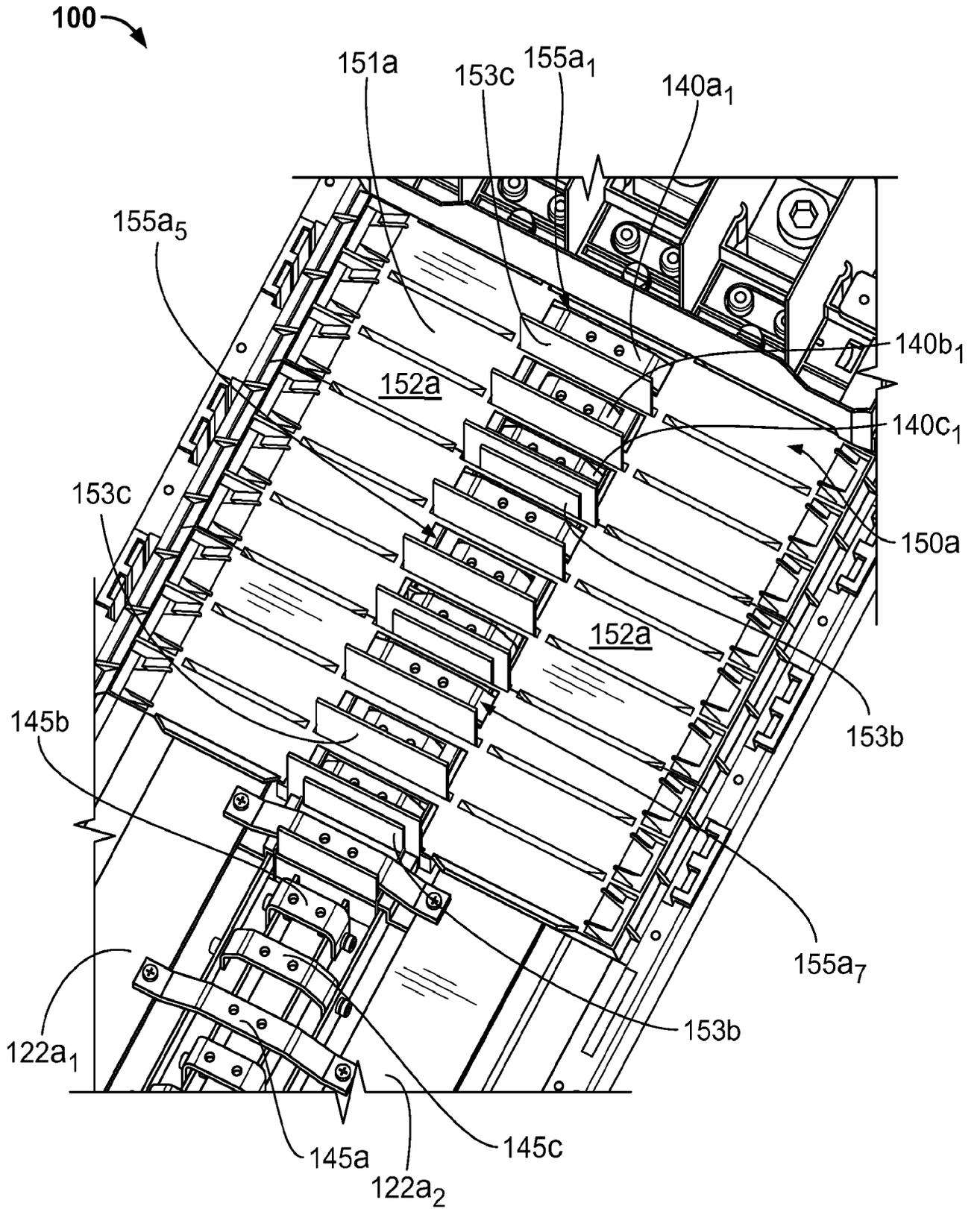


FIG. 4F

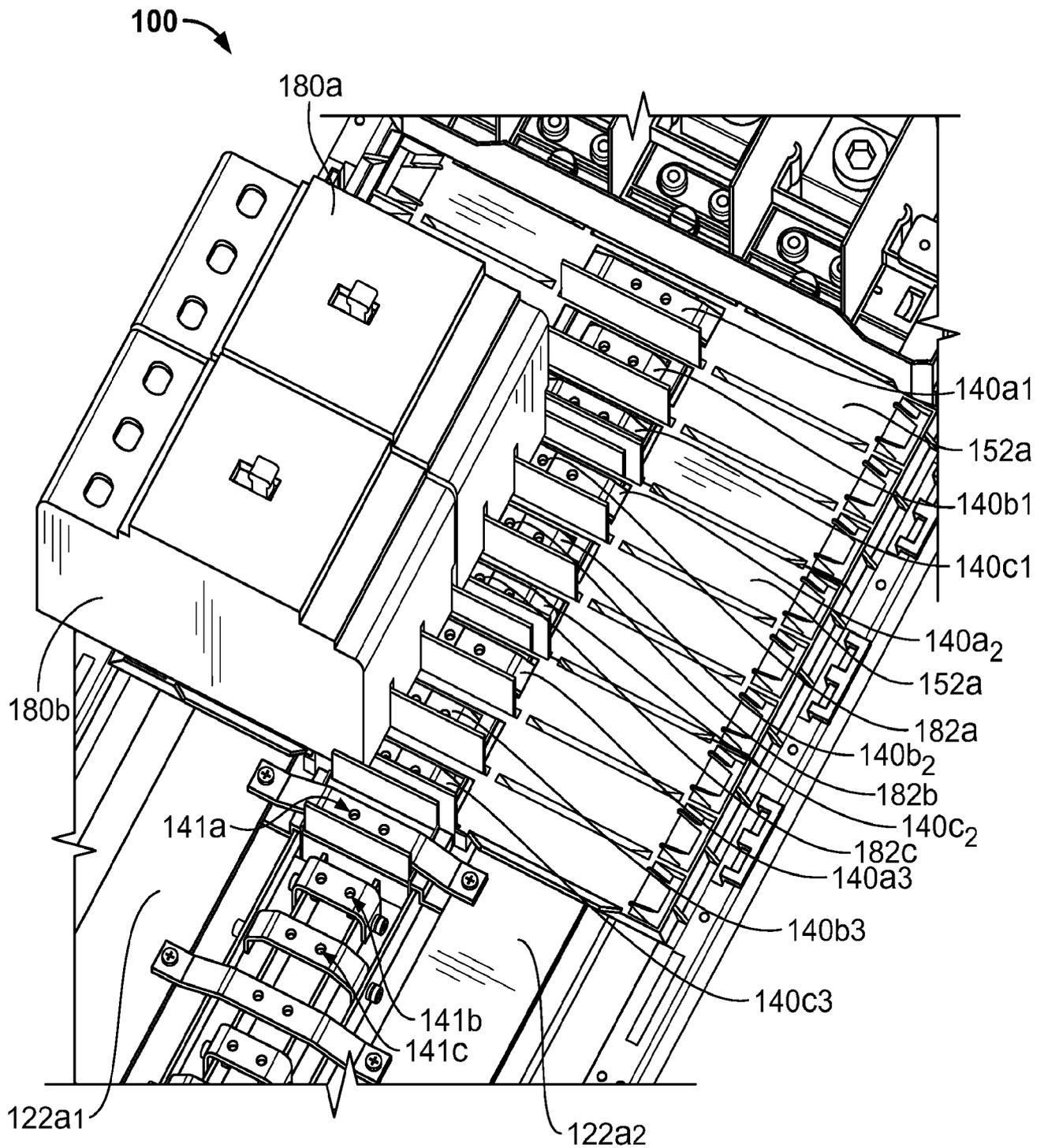


FIG. 4G