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Description

Field of Disclosure

[0001] This invention relates to a joined member, particularly in relation to freight containers.

Background

[0002] Freight containers are used for transferring goods from one location to another location. Freight containers may be transferred via a number of different modes such as, overseas transfer, rail transfer, air transfer, and tractor trailer transfer.

[0003] To help improve efficiencies freight containers that are used to transfer goods have been standardized. One such standardization is overseen by the International Organization for Standardization, which may be referred to as "ISO." The ISO publishes and maintains standards for freight containers. These ISO standards for freight containers help provide that each freight container has similar physical properties. Examples of these physical properties include, but are not limited to, width, height, depth, base, maximum load, and shape of the cargo containers.

[0004] US2008029508 discloses a stackable and collapsible container having at least four non-collapsible, load bearing vertical support members attached to vertical walls of the container and capable of supporting the weight of other containers. A top surface is included having a number of sections which include a pivotal connection to one another and which are collapsible about the pivotal connection to an interior of the container. A bottom surface is included having a number of sections which include a pivotal connection to one another and which are collapsible about the pivotal connection to an interior of the container. The top and the bottom surfaces of the container can be fixedly positioned in a number of collapsed states

The present invention provides a joined member, comprising:

a first elongate section having a first surface defining a first oblong opening, a first end and a second end opposite the first end, the second end joined to a first hinge;

a second elongate section having a second surface defining a second oblong opening, a first end and a second end opposite the first end, the second end joined to a second hinge;

a fastener passing through the first oblong opening and the second opening to connect the first elongate section and the second elongate section; and an abutment joint having a first abutment member and a second abutment member, where the first abutment member forms a part of the first elongate section, the first abutment member having a projection that extends from first abutment member shoulders,

the projection having a distal end from which a first surface and a second surface extend towards the first abutment member shoulders at an acute angle; and where the second abutment member forms a part of the second elongate section, the second abutment member having a socket into which the projection of the first abutment member releasably seats, the socket having a first surface and a second surface that extend away from a first end of the second abutment member at an acute angle and the first end of the second abutment member includes second abutment member shoulders that extends from the socket such that when the projection of the first abutment member seats in the socket of the second abutment member the second surface of the projection and the second surface of the socket touch, and the second abutment member shoulders and the first abutment member shoulders touch, and where the first oblong opening and the second oblong opening move relative each other and the fastener as the joined member transitions from a first predetermined state having a minimum overlap of the first oblong opening and the second oblong opening and the projection of the first abutment member seated in socket of the second abutment member towards a second predetermined state having a maximum overlap of the first oblong opening and the second oblong opening relative the minimum overlap and the projection of the first abutment member un-seated from the socket of the second abutment member and where in the first predetermined state the first abutment member and the second abutment member are under a compressive force against each other while the first surface defining the first oblong opening and the second surface defining the second oblong opening apply a shearing stress to the fastener.

Brief Description of the Figures

[0005]

Figs. 1A-1D illustrate a perspective view (Figs. 1A and 1B) and a planar view (Fig. 1C and Fig. 1D) of a first member (Fig. 1A) and a second member (Fig. 1B) of an abutment joint.

Fig. 2 illustrates a perspective view of a first member and a second member of an abutment joint.

Figs. 3A-3D illustrate a perspective view of a first member and a second member of an abutment joint.

Figs. 4A and 4B illustrate a perspective view of a joined member that includes a first elongate section, a second elongate section and the abutment joint according to an embodiment of the present disclosure.

Figs. 5A and 5B illustrate a perspective view of a joined member that includes a first elongate section, a second elongate section and the abutment joint

according to an embodiment of the present disclosure.

Figs. 6A and 6B illustrate a perspective view of the jointed member according to an embodiment of the present disclosure.

Fig. 7 illustrates a perspective view of the jointed member according to an embodiment of the present disclosure.

Fig. 8 illustrates a planar view of the jointed member according to an embodiment of the present disclosure.

Figs. 9A and 9B illustrate a reversibly foldable freight, where portions of the reversibly foldable freight container have been removed to show detail.

Fig. 10 illustrates an end view of a freight container shown in partial view.

Figs. 11A-11E illustrate a jointed member according to the present disclosure.

Fig. 12 illustrates a portion of the jointed member according to the present disclosure.

Fig. 13 provides an exploded view of a freight container according to the present disclosure.

Fig. 14 provides a perspective view of a freight container according to the present disclosure.

Figs. 15A and 15B provide a perspective view of a door assembly with locking rods in the first predetermined position (Fig. 15A) and the second predetermined position (Fig. 15B) according to the present disclosure.

Fig. 16 provides a perspective view of the door assembly according to the present disclosure.

Fig. 17 provides a perspective view of a hinge according to the present disclosure.

Fig. 18 provides a planar view of the hinge fastened to a corner post of a freight container according to the present disclosure.

Fig. 19 provides a planar view of the hinge fastened to a corner post of a freight container according to the present disclosure.

Fig. 20 provides a perspective view of a freight container according to the present disclosure.

Figs. 21A-21C provide a perspective view of an embodiment of a front wall of a foldable freight container taken along the view lines 18-18 shown in Fig. 13.

Figs. 22A-22D provide a perspective view of an embodiment of a foldable freight container according to the present disclosure.

Figs. 23A-23B provide a perspective view of an anti-racking support according to the present disclosure.

Figs. 24A-24B provide a perspective view of an anti-racking block for the doors of a freight container according to the present disclosure.

Figs. 25A-25B provide a perspective view of a hinge for the doors of a freight container according to the present disclosure.

Detailed Description

[0006] As used herein, "a," "an," "the," "at least one," and "one or more" are used interchangeably. The term "and/or" means one, one or more, or all of the listed items. The recitations of numerical ranges by endpoints include all numbers subsumed within that range (e.g., 1 to 5 includes 1, 1.5, 2, 2.75, 3, 3.80, 4, 5, etc.). The figures herein follow a numbering convention in which the first digit or digits correspond to the drawing figure number and the remaining digits identify an element in the drawing. Similar elements between different figures may be identified by the use of similar digits. For example, 354 may reference element "54" in Fig. 3, and a similar element may be referenced as 1454 in Fig. 14. It is emphasized that the purpose of the figures is to illustrate and the figures are not intended to be limiting in any way. The figures herein may not be to scale and relationships of elements in the figures may be exaggerated. The figures are employed to illustrate conceptual structures and methods herein described.

[0007] Angle measurements discussed herein are measured as either acute angles (angles smaller than 90 degrees (less than 90°) or obtuse angles (angles greater than 90° but less than 180°) where the measurements of the surfaces discussed herein are taken so as to exclude values that are reflex angles (those angles from 180° to 360°).

[0008] Figs. 4A and 4B show an embodiment of the jointed member 474 according to the present invention. The jointed member 474 includes the abutment joint 400, as discussed herein, where the abutment joint includes the first abutment member 402 and a second abutment member 404. The jointed member 474 also includes a first elongate section 476 and a second elongate section 477. The first elongate section 476 has a first end 478 and a second end 480 opposite the first end 478, where the second end 480 is connected to a first hinge 482. The second elongate section 477 has a first end 486 and a second end 488 opposite the first end 486, where the second end 488 is connected to a second hinge 490.

[0009] The first hinge 482 is also connected to a first side rail 489 and the second hinge 490 is connected to a second side rail 491. The first side rail 489 and the second side rail 491 can have a variety of configurations. For example, the first side rail 489 and the second side rail 491 can have a tubular configuration, such as a length of square tubular or a length of rectangular tubing. Alternatively, the first side rail 489 and the second side rail 491 can have a contiguous solid structure. The first side rail 489 and the second side rail 491 could also have a planar truss and/or a space truss configuration.

[0010] The first elongate section 476 and the second elongate section 477 of the jointed member 474 each also include a first end connector 492 and a second end connector 493. The first end connector 492 helps to join the second end 480 of the first elongate section 476 to the first hinge 482, and the second end connector 493

helps to join the second end 488 of the second elongate section 477 to the second hinge 490.

[0011] The first abutment member 402 and the first end connector 492 can be integrally formed with the first elongate section 476. Similarly, the second abutment member 404 and the second end connector 493 can be integrally formed with the second elongate section 477. Alternatively the first elongate section 476 and second elongate section 477 can have a tubular configuration. For this configuration a portion of the first abutment member 402 and a portion of the first end connector 492 can be inserted into the first end 478 and the second end 480, respectively, of the tubular structure of the first elongate section 476. The first abutment member 402 and the first end connector 492 can then be secured to the tubular structure of the first elongate section 476 (e.g., by welding and/or a nut and bolt assembly that is used to join the first elongate section 476 and the portions of the first end connector 492 and first abutment member 402 inserted into the tubular structure). Similarly, a portion of the second abutment member 404 and a portion of the second end connector 493 can be inserted into the first end 486 and the second end 488, respectively, of the tubular structure of the second elongate section 477. The second abutment member 404 and the second end connector 493 can then be secured to the tubular structure of the second elongate section 477 (e.g., by welding and/or a nut and bolt assembly that is used to join the second elongate section 477 and the portions of the second end connector 493 and second abutment member 404 inserted into the tubular structure).

[0012] The first side rail 489 and the second side rail 491 can further include structures 495 and 497, respectively. Structures 495 and 497 can be, but are not limited to, vertical wall members (e.g., wall studs, header structures, etc.), and/or siding structures (sheets of siding that can be attached to the vertical wall members, sidewall structures, etc.) among other structures.

[0013] Figs. 5A and 5B illustrate the embodiment where the first elongate section 576 and second elongate section 577 have a tubular configuration. As illustrated in Fig. 5A, a portion of the first abutment member 502 is inserted into the first end 578 of the tubular structure of the first elongate section 576 and a portion of the first end connector 592 is inserted into the second end 580 of the tubular structure of the first elongate section 576. Fig. 5B illustrates a portion of the second abutment member 504 that is inserted into the first end 586 of the tubular structure of the second elongate section 577 and a portion of the second end connector 593 that is inserted into the second end 588 of the tubular structure of the second elongate section 577. The first abutment member 502, the second abutment member 504, the first end connector 592 and the second end connector 593 are secured to their respective tubular structure by welding and/or a nut and bolt assembly that passes through the respective structures.

[0014] Referring again to Figs. 4A and 4B, the first

abutment member 402 forms a part of the first elongate section 476, where the first abutment member 402 has the projection 406 that extends from first abutment member shoulders 408, the projection 406 having the distal end 410 from which the first surface 412 and the second surface 414 extend towards the first abutment member shoulders 408 at an acute angle, as discussed herein.

[0015] The second abutment member 404 forms a part of the second elongate section 477. The second abutment member 404 has the socket 418 into which the projection 406 of the first abutment member 402 releasably seats. The socket 418 has a first surface 420 and a second surface 422 that extend away from the first end 424 of the second abutment member 404 at an acute angle. The first end 424 of the second abutment member 404 includes second abutment member shoulders 428 that extends from the socket 418 such that when the projection 406 of the first abutment member 402 seats in the socket 418 of the second abutment member 404 the second surface 414 of the projection 406 and the second surface 422 of the socket 418 touch, and the second abutment member shoulders 428 and the first abutment member shoulders 408 touch.

[0016] In one embodiment, when the socket 418 having the first surface 420 and the second surface 422 that extend away from the first end 424 of the second abutment member 404 have an acute angle that is equal to the acute angle of the first surface 412 and the second surface 414 of the first abutment member 402 the projection 406 of the first abutment member 402 can seat in the socket 418 of the second abutment member 404 such that the first surface 412 of the projection 406 and the first surface 420 of the socket 418 touch, the second surface 414 of the projection 406 and the second surface 422 of the socket 418 touch, and the second abutment member shoulders 428 and the first abutment member shoulders 408 touch.

[0017] With the projection 406 of the first abutment member 402 seated in the socket 418 of the second abutment member 404, an example of which is seen in Fig. 4A, the weight of a mass applied to the abutment joint 400 at an upper surface 494 is at least partially carried by the interaction of the projection 406 and the socket 418 and the shoulders 408 and 428. In carrying the weight of this mass the projection 406 and the socket 418 and the shoulders 408 and 428 help to redirect the weight along the first elongate section 476 and a second elongate section 477. The projection 406 and the socket 418 also help to "lock out" the abutment joint 400 in the down direction 498, but also allows the abutment joint 400 to release in the upward direction 499, with the first and second side rails 489 and 491 limiting the amount of movement along the longitudinal axis 466.

[0018] In Fig. 4A, the abutment joint 400 has one degree of freedom (when the projection 406 of the first abutment member 402 is seated in socket 418 of the second abutment member 404) along which the first abutment member 402 and the second abutment member 404 can

move relative to each other (e.g., movement of the first abutment member 402 and the second abutment member 404 in opposite directions along the longitudinal axis 466). When seated relative each other (e.g., Fig. 4A), the first abutment member 402 and the second abutment member 404 cannot initially travel in an arcuate travel path 469 (as at least partially seen in Figs. 4A and 4B). In other words, when seated relative each other (e.g., Fig. 4A), the first abutment member 402 and the second abutment member 404 must first move relative each other along the longitudinal axis 466 before they can move relative each other along the arcuate travel path 469.

[0019] As the first abutment member 402 and the second abutment member 404 move in opposite directions along the longitudinal axis 466 the projection 406 of the first abutment member 402 un-seats from the socket 418 of the second abutment member 404. As this occurs, a second degree of freedom develops, as discussed herein, for the first abutment member 402 and the second abutment member 404. The two degrees of freedom allow the first elongate section 476 and the second elongate section 477 of the jointed member 474 to travel along the arcuate path 469 as the first elongate section 476 and the second elongate section 477 pivot on the first hinge 482 and the second hinge 490, respectively. Fig. 4B also illustrates that the first side rail 489 and the second side rail 491 can maintain their same relationship with the longitudinal axis 466 as seen in Fig. 4A. For example, the first side rail 489 and the second side rail 491 can move along the longitudinal axis 466 (as shown in Figs. 4A and 4B) where an upper surface 4101 of each of the first side rail 489 (4101-1) and the second side rail 491 (4101-2) remain essentially parallel or co-planar to each other as they move along the longitudinal axis 466. In addition, the structures 495 and 497 remain parallel to each other as the first side rail 489 and the second side rail 491 move along the longitudinal axis 466. The structures 495 and 497 can also remain parallel to each other as the first elongate section 476 and the second elongate section 477 of the jointed member 474 travel along the arcuate path 469 (seen in Fig. 4B).

[0020] The jointed member 474 of the present disclosure can be made of a variety of materials. Such materials include, but are not limited to, a metal, a metal alloy, a polymer (e.g., a thermoset polymer or a thermoplastic polymer) and a composite material (e.g., a material made from two or more constituent materials with significantly different physical properties which remain separate and distinct within the finished structure). Examples of the metal include, but are not limited to, steel such as 'weathering steel' specified within standard BS EN 10025-5:2004, which is also known as CORTEN steel. Other examples include, but are not limited to, those provided herein

[0021] Referring now to Figs. 6A and 6B, there is shown an additional embodiment of the jointed member 674 according to the present disclosure. As discussed herein, the jointed member 674 includes the abutment

joint 600, as discussed herein, where the abutment joint 600 includes the first abutment member 602 and a second abutment member 604. The jointed member 674 also includes the first elongate section 676 having the first end 678 and the second end 680 opposite the first end 678 with the second end 680 connected to the first hinge 682, as discussed herein. The jointed member 674 also includes the second elongate section 677 having the first end 686 and the second end 688 opposite the first end 686 with the second end 688 connected to the second hinge 690, as discussed herein.

[0022] The first hinge 682 is also connected to the first side rail 689 and the second hinge 690 is connected to the second side rail 691, as discussed herein. The first elongate section 676 and the second elongate section 677 of the jointed member 674 each also include the first end connector 692 and the second end connector 693. The first side rail 689 and the second side rail 691 can further include structures 695 and 697, respectively, as discussed herein.

[0023] The jointed member 674 can further include a fastener 6100 that passes through a portion of both the first elongate section 676 and the second elongate section 677. As illustrated, the portion of the first elongate section 676 and the second elongate section 677 through which the fastener 6100 passes extends from the portion of the first elongate section 676 and the second elongate section 677 that include the abutment joint 600. For example, the first elongate section 676 and the second elongate section 677 can include the tubular structures, as discussed herein. These tubular structures of the first elongate section 676 and the second elongate section 677 include the first abutment member 602, the first end connector 692, the second abutment member 604 and the second end connector 693, as discussed herein. The first elongate section 676 and the second elongate section 677 also include a first beam 6102 and a second beam 6104. The first beam 6102 extends away from the tubular structure of the first elongate section 676 and the second beam 6104 extends away from the tubular structure of the second elongate section 677.

[0024] The first beam 6102 and the second beam 6104 of the jointed member have surfaces that define oblong openings through which the fastener 6100 passes. Referring now to Fig. 7, there is shown an, in an exploded view, the jointed member 774. As illustrated, the jointed member 774 includes the first elongate section 776 and the second elongate section 777. Each of the first elongate section 776 and the second elongate section 777 can have a length that is equal. Alternatively, one of the first elongate section 776 and the second elongate section 777 can be longer than the other elongate section.

[0025] In one or more embodiments, each of the first elongate section 776 and the second elongate section 777 has an oblong opening 7106 through each of the first beam 7102 and the second beam 7104. As discussed herein, an oblong opening, such as 7106 among the others discussed herein, can have an obround shape or a

double D shape. As such, the word oblong, as used herein, can be replaced with either the word "obround" or "double D" as so desired. Obround is defined as consisting of two semicircles connected by parallel lines tangent to their end points. Double D is defined as consisting of two arcs connected by parallel lines tangent to their end points. As used herein, an obround or double D shape does not include a circular shape.

[0026] As illustrated, the first beam 7102 of the first elongate section 776 has a first surface 7108 defining a first oblong opening 7110 through the first beam 7102 of the first elongate section 776, and the second elongate section 777 has a second surface 7112 defining a second oblong opening 7114 through the second elongate section 777. As illustrated, each of the surfaces 7108 and 7112 has a first end 7116 (marked as 7116-A for the first oblong opening 7110, and marked as 7116-B for the second oblong opening 7114) and a second end 7118 (marked as 7118-A for the first oblong opening 7110, and marked as 7118-B for the second oblong opening 7114), where the second end 7118 is opposite the first end 7116 along a longitudinal axis 7120 of each of the first oblong opening 7110 and the second oblong opening 7114.

[0027] The joined member 774 also includes the fastener 7100, a portion of which passes through the first and second oblong opening 7110 and 7114 to connect the first elongate section 776 and the second elongate section 777. As will be discussed more fully herein, the fastener 7100 passes through the first oblong opening 7110 and the second oblong opening 7114. The fastener 7100 is secured in position to help hold the first elongate section 776 and the second elongate section 777 together (e.g., the fastener 7100 mechanically joins the first elongate section 776 and the second elongate section 777).

[0028] While the fastener 7100 mechanically joins the first elongate section 776 and the second elongate section 777, the first elongate section 776 and the second elongate section 777 are also able to slide relative to each other and to rotate about the fastener 7100. This ability of the first elongate section 776 and the second elongate section 777 to slide relative each other allows for a change in the length of the hypotenuse as the joined member 774 folds, thereby preventing damage to the joined member, associated hinges and structures, as discussed herein. This ability to both slide relative each other and to rotate about the fastener 7100 provides at least two of the features that allow the joined member 774 to overcome the hypotenuse issue. This aspect of the invention will be discussed more fully herein.

[0029] In addition, the ability of the first elongate section 776 and the second elongate section 777 to slide relative each other, as discussed herein, allows for the gap(s) (e.g., first gap 370 and second gap 372 as discussed in Fig. 3B) to develop in the first abutment member 702 and the second abutment member 704, thereby allow for the second degree of freedom for the abutment joint 700 to travel in an arcuate path, as discussed herein.

[0030] The use of a variety of fastener 7100 is possible. For example, the fastener 7100 can be in the form of a bolt or a rivet. The bolt can have a threaded portion at or adjacent a first end for receiving a nut and a head at a second end opposite the first end. The nut and the head of the bolt can have a diameter relative the first oblong opening 7110 and the second oblong opening 7114 that prevents either from passing through the openings 7110 and 7114 (e.g., only the body of the bolt passes through the openings 7110 and 7114). A washer can also be used between the head and nut of the bolt to help prevent either from passing through the openings 7110 and 7114.

[0031] Examples of bolts can include, but are not limited to, structural bolts, hex bolts, or carriage bolts, among others. The nut used with the bolt can be a locknut, castellated nut, a slotted nut, a distorted thread locknut, an interfering thread nut, or a split beam nut, among others. A jam nut can also be used with the nut if desired. Examples of a rivet include a solid rivet having a shaft that can pass through and a head that does not pass through the openings 7110 and 7114. A shop head can then be formed on the rivet that fastens the first elongate section 776 and the second elongate section 777. Regardless of which fastener is used, however, the fastener 7100 is not tightened so much as to prevent the first elongate section 776 and the second elongate section 777 of the joined member 774 from sliding relative to each other and rotating about the fastener 7100.

[0032] As discussed herein, the fastener 7100 passes through the first oblong opening 7110 and the second oblong opening 7114 to connect the first elongate section 776 and the second elongate section 777. For one or more of the embodiments, the first oblong opening 7110 and the second oblong opening 7114 move relative each other and relative the fastener 7100 as the joined member 774 transitions from a first predetermined state to a second predetermined state. For the present disclosure, the first predetermined state can be the unfolded state of the joined member 774. In the unfolded state the joined member 774 can only move towards its second predetermined state. In the first predetermined state the first oblong opening 7110 and the second oblong opening 7114 have a minimum overlap and the projection 706 of the first abutment member 702 is seated in the socket 718 of the second abutment member 704. Fig. 8 provides an illustration of this first predetermined state. From the first predetermined state, the first oblong opening 7110 and the second oblong opening 7114 can move towards a second predetermined state in which the first oblong opening 7110 and the second oblong opening 7114 have a maximum overlap relative the minimum overlap and the projection 706 of the first abutment member 702 is un-seated from the socket 718 of the second abutment member 704.

[0033] As illustrated herein, the fastener 7100 has an axial center 7122 (e.g., a longitudinal axis around which the fastener 7100 can rotate) that moves along (e.g., essentially parallel with) the longitudinal axis 7120 of the

first oblong opening 7110 and the second oblong opening 7114 as the jointed member 774 transitions from a first predetermined state to a second predetermined state. The cross-sectional shape of the fastener 7100 is of a size and a shape that allows the fastener 7100 to travel along the longitudinal axis 7120 of the first oblong opening 7110 and the second oblong opening 7114 as the jointed member 774 transitions from a first predetermined state to a second predetermined state without any significant amount of travel along the minor axis 7124 of the first oblong opening 7110 and the second oblong opening 7114. So, for example, the distance between the parallel lines tangent to the end points of the two semicircles of the first and second obround openings 7110 and 7114 is approximately the diameter of the portion of the fastener 7100, illustrated herein, that passes through the first and second obround openings 7110 and 7114.

[0034] Referring now to Fig. 8, there is illustrated the first elongate section 876 and the second elongate section 877 of the jointed member 874 in the first predetermined state. In the first predetermined state the first oblong opening 8110 and the second oblong opening 8114 have a minimum overlap relative to the second predetermined state (an embodiment of the second predetermined state is shown in Fig. 12 and discussed more fully herein) of the jointed member 874 and the amount of overlap in the positions between the first and second predetermined states.

[0035] Specifically, the amount of overlap shown in Fig. 8 for the first predetermined state is approximately the cross sectional area of the portion of the fastener 8100, shown from an end view, that passes through the openings 8110 and 8114. In one embodiment, the area of the overlap is equal to the cross sectional area of the portion of the fastener 8100 that passes through the openings 8110 and 8114. For either embodiment discussed in this paragraph, the first oblong opening 8110 and the second oblong opening 8114 when in their first predetermined state also define a shape that corresponds to the cross sectional shape of the portion of the fastener 8100 that passes through the openings 8110 and 8114.

[0036] Referring again to Fig. 7, the first surface 7108 defining the first oblong opening 7110 and the second surface 7112 defining the second oblong opening 7114 each include the first end 7116 and the second end 7118 opposite the first end 7116. The first end 7116 and the second end 7118 are each in the shape of an arc that helps the surfaces 7108, 7112 to form a circular shape when in the first predetermined state (seen in Fig. 8). For other embodiments, the first end 7116 and/or the second end 7118 may include one or more shapes including but not limited, a polygonal shape, a non-polygonal shape, and combinations thereof. In addition, the first oblong opening and the second oblong opening, as discussed herein, can be positioned at a number of different locations along a height 7126 and/or a width 7128 of the first end 7130 of the first elongate section 776 and a first end 7132 of the second elongate section 777.

[0037] So, as illustrated in Fig. 8, in the first predetermined state the first oblong opening 8110 and the second oblong opening 8114 provide a circular shape that corresponds to a circular cross sectional shape of the portion of the fastener 8100 that passes through the openings 8110 and 8114. In addition to have the same shape, the area defined by the first oblong opening 8110 and the second oblong opening 8114 in the first predetermined state is the cross sectional area of the portion of the fastener 8100 that passes through the openings 8110 and 8114. As appreciated and as will be discussed herein, both the cross sectional area of the portion of the fastener 8100 that passes through the openings 8110 and 8114 and the area defined by the first oblong opening 8110 and the second oblong opening 8114 in the first predetermined state are not so exacting that the first elongate section 876 and the second elongate section 877 bind so as to be unable to slide relative to each other and to rotate about the fastener 8100.

[0038] In the first predetermined state a portion of the first surface 8108 and a portion of the second surface 8112 are in physical contact with the fastener 8100 that passes through the openings 8110 and 8114. In other words, a portion of the surface 8108 and a portion of the surface 8112 sit or rest against a portion of the fastener 8100 that passes through the openings 8110 and 8114 when in the first predetermined state.

[0039] As illustrated in Fig. 7, the first elongate section 776 includes the first abutment member 702 and the second elongate section 777 includes the second abutment member 704, as discussed herein. In the first predetermined state the first abutment member 702 and the second abutment member 704 are in physical contact and a portion of the first surface 7108 and a portion of the second surface 7112 are in physical contact with the fastener 7100. In other words, the first abutment member 702 and the second abutment member 704 abut, or are seated, when the jointed member 774 is in the first predetermined state. Fig. 8 provides an illustration of the first abutment member 802 and the second abutment member 804 in the first predetermined state, where the abutment members 802 and 804 are seated against each other, as discussed herein.

[0040] Referring again to Fig. 7, when the jointed member 774 is in the first predetermined state, or the unfolded state, and a structural load 7134 is applied to the jointed member 774 causes the first abutment member 702 and the second abutment member 704 to come under compression (e.g., each abutment member 702 and 704 applies a compressive force to the other). At the same time a portion of the surface 7108 of the first oblong opening 7110 and the surface 7112 of the second oblong opening 7114 apply a shearing stress to the portion of the fastener 7100 that passes through the openings 7110 and 7114. For example, the shearing stress in the first predetermined state is applied to the fastener 7100 by the first end 7116 of both the first surface 7108 (7116-A) and the second surface 7112 (7116-B). As such, in the first pre-

determined state the fastener 7100 is not free to move along the longitudinal axis 7122 of the first oblong opening 7110 and the second oblong opening 7114. As a result, the structural load 7134 is held in the first predetermined state on the jointed member 774, which has the compressive forces of the first abutment member 702 and the second abutment member 704 helping to offset the shear stress applied to the portion of the fastener 7100 that passes through the openings 7110 and 7114.

[0041] As illustrated in Fig. 7 the first oblong opening 7110 and the second oblong opening 7114 have an obround shape each with the longitudinal axis 7120 (a major axis) that is longer than a minor axis 7124. The longitudinal axis 7120 and the minor axis 7124 can each have symmetry relative to each other. The longitudinal axis 7120 is longer than the minor axis 7124. For example, a ratio of a length of the longitudinal axis 7120 to a length of the minor axis 7124 are in a range of 10.0:1.0 to 1.1 to 1.0, 8.0:1.0 to 1.1:1.0, or 5.0:1.0 to 1.1:1.0. As used herein, "axis" does not necessarily imply symmetry, although for one or more embodiments the oblong opening may be symmetric about the major axis, the minor axis, or both axes. As used herein, "axis" refers to a straight line about which a geometric feature, e.g. an oblong opening, may be thought of as rotatable.

[0042] The size and the shape of the first oblong opening 7110 and the second oblong opening 7114 and the size and the shape of the fastener 7100 can be selected based on the size and/or amount of the structural load 7134 that the jointed member 774 or jointed members 774 (e.g., more than one of the jointed members 774) are intended to carry.

[0043] As illustrated in Fig. 7, the first end 7130 of the first elongate section 776 further includes a surface 7136 defining an arc, in this case a semi-circle, and the first end 7132 of the second elongate section 777 further includes a surface 7138 defining an arc, in this case a semi-circle. The surfaces 7136 and 7138 in the shape of an arc allow either the first end 7130 of the first elongate section 776 or the first end 7132 of the second elongate section 777 to move relative each other without interfering with either abutment member 702 or 704 or flooring that might be mounted on the elongate sections 776 and/or 777. For example, as the jointed member 774 transitions from the first predetermined state towards the second predetermined state the first end 7130 of the first elongate section 776 can move relative the second abutment member 704 on the second elongate section 777. The shape of the surface 7136 accommodates a travel path that does not come into contact with the second abutment member 704 on the second elongate section 777. Shapes other than an arc are possible and include, but are not limited to a polygonal shape, a non-polygonal shape, and combinations thereof.

[0044] As discussed herein, Fig. 8 illustrates an embodiment of the first elongate section 876 and the second elongate section 877 of the jointed member 874 in the first predetermined state, which may be referred to as an

unfolded state. In the first predetermined state the first oblong opening 8110 and the second oblong opening 8114 have a minimum overlap relative to the second predetermined state (shown in Fig. 12 and discussed more fully herein) of the jointed member 874 and the amount of overlap in many of the positions between the first and second predetermined states. Specifically, the amount of overlap shown in Fig. 8 for the first predetermined state is approximately the cross sectional area of the portion of the fastener 8100 (shown in cross section) that passes through the openings 8110 and 8114. In one embodiment, the area of the overlap is equal to the cross sectional area of the portion of the fastener 8100 that passes through the openings 8110 and 8114. For either embodiment discussed in this paragraph, the first oblong opening 8110 and the second oblong opening 8114 when in their first predetermined state also define a shape that corresponds to the cross-sectional shape of the portion of the fastener 8100 that passes through the openings 8110 and 8114.

[0045] Fig. 8 also illustrates the relative position of the first abutment member 802 and the second abutment member 804 as being seated in the first predetermined state. As illustrated, in the first predetermined state the first elongate section 876 of the jointed member 874 includes a first member end 8140 that is opposite the first abutment member 802. Similarly, the second elongate section 877 of the jointed member 874 includes a second member end 8142 that is opposite the second abutment member 804. In the first predetermined state, as shown in Fig. 8, a distance between the first member end 8140 of the first elongate section 876 and the second member end 8142 of the second elongate section 877 provides the defined maximum length 8144 of the jointed member 874. As discussed with respect to Fig. 11A-11E, the distance between the first member end 8140 of the first elongate section 876 and the second member end 8142 of the second elongate section 877 does not exceed the defined maximum length 8144 as the jointed member 874 transitions from the first predetermined state towards the second predetermined state.

[0046] First hinge 882 connects the first member end 8140 of the first elongate section 876 to the first side rail 889. Similarly, the second hinge 890 connects the second member end 8142 of the second elongate section 877 to the second side rail 891. Fig. 8 also shows the defined maximum length 8144 of the jointed member 874. As illustrated in Figs. 11A-11C, the jointed member transitions from its first predetermined state (e.g., unfolded state) towards its second predetermined state (e.g., folded state) without having any portion of the jointed member extending beyond its defined maximum length 8144 as defined in its first predetermined state.

[0047] Fig. 8 illustrates that when the jointed member 874 supports a structural load 8134 the forces are distributed so as to cause the first abutment member 802 and the second abutment member 804 to be in compression and the surfaces 8116 of the first and second oblong

openings 8110 and 8114 to apply a shearing stress to the fastener 8100. It is also possible that the ends 8140 and 8142 of the first elongate section 876 and the second elongate section 877, respectively, can apply a compressive force against their respective side rails 889 and 891 as a result of the jointed member 874 supporting the structural load 8134.

[0048] Fig. 8 further illustrates that as the structural load 8134 is held in the first predetermined state on the jointed member 874 the first abutment member 802 and the second abutment member 804, under a compressive force, and the surfaces 8108 and 8112 applying the shearing stress to the fastener 8100, with help from the hinges 882 and 890, prevent the jointed member 874 from bending or deflecting to any significant degree.

[0049] The static interaction of the first abutment member 802 and the second abutment member 804, under a compressive force, and the surfaces 8108 and 8112 applying the shearing stress to the fastener 8100, with help from the hinges 882 and 890, allow the jointed member 874 of the present disclosure to carry the structural load 8134 (e.g., as prescribed in ISO standard 1496).

[0050] Figs. 9A and 9B illustrate a reversibly foldable freight container 9150, in partial view, according to one or more embodiments of the present disclosure. In Figs. 9A and 9B portions of the reversibly foldable freight container 9150 have been removed (e.g., portions of the roof structure, portions of the sidewall structures, portions of the floor structure, portions of the front wall and rear wall, portions of the door assembly, etc.) to allow the location and relative position of the jointed member 974, which in this embodiment acts as a cross member of the reversibly foldable freight container 9150, to be more clearly seen. The reversibly foldable freight container 9150 illustrated in Fig. 9A is shown in an unfolded state.

[0051] As illustrated in Fig. 9A, the reversibly foldable freight container 9150 includes a first corner post 9152-1, a second corner post 9152-2, a third corner post 9152-3, and a fourth corner post 9152-4. The corner posts 9152-1 through 9152-4 are load bearing vertical support members that are both rigid and unfoldable. In addition, the corner posts 9152-1 through 9152-4 are of sufficient strength to support the weight of a number of other fully loaded freight containers stacked upon the reversibly foldable freight container 9150. Each of the corner posts 9152-1 through 9152-4 includes a corner fitting 9154 (9154-1 through 9154-8). The corner fittings 9154-1 through 9154-8 may be employed for griping, moving, placing, and/or securing the reversibly foldable freight container 9150. In one embodiment, the corner posts 9152-1 through 9152-4 and the corner fittings 9154-1 through 9154-8 comply with the ISO standards for freight containers, such as ISO standard 688 and ISO standard 1496 (and the amendments to ISO standard 1496), among others. In the unfolded state a predefined maximum width 9155 of the reversibly foldable freight container 9150 is eight (8) feet (measured from the corner fittings) as provided in ISO 668 Fifth Edition 1995-12-15.

[0052] The reversibly foldable freight container 9150 also includes a first bottom side rail 9156-1 and a second bottom side rail 9156-2. As illustrated, the first bottom side rail 9156-1 is located between the first corner post 9152-1 and the second corner post 9152-2, and the second bottom side rail 9156-2 is located between the third corner post 9152-3 and the fourth corner post 9152-4. The reversibly foldable freight container 9150 further includes a first upper side rail 9158-1 and a second upper side rail 9158-2. The first upper side rail 9158-1 may be located between the first corner post 9152-1 and the second corner post 9152-2. The second upper side rail 9158-2 may be located between the third corner post 9152-3 and the fourth corner post 9152-4.

[0053] The reversibly foldable freight container 9150 further includes a jointed member 974 according to the present disclosure. As illustrated, the first and second bottom side rails 9156-1 and 9156-2 are joined by two or more of the jointed members 974. The jointed member 974 acts as a "cross member" in the reversibly foldable freight container 9150 when the reversibly foldable freight container 9150 is in an unfolded state. Functioning as a cross member, the jointed member 974 acts as a beam to help carry a structural load placed on a floor structure of the reversibly foldable freight container 9150. To this end, the jointed member 974 of the present disclosure can help carry a structural load as prescribed in ISO standard 1496. Unlike a typical cross member, however, the jointed member 974 of the present disclosure can then be used to help the reversibly foldable freight container 9150 to reversibly fold in a lateral direction 9160, relative a longitudinal direction 9162 of the upper and bottom side rails 9156 and 9158.

[0054] Referring now to Fig. 9B, there is shown the reversibly foldable freight container 9150 in at least a partially folded state. As illustrated in Fig. 9B, the jointed member 974 of the reversibly foldable freight container 9150 folds into a volume 9164 defined by the reversibly foldable freight container 9150. As the jointed member 974 folds, the corner posts 9152-1 through 9152-4 and the corner fittings 9154-1 through 9154-8 are drawn closer together laterally. Once again, this reduction in the volume 9164 and the "foot-print" (e.g., area) of the reversibly foldable freight container 9150 from an unfolded state (e.g. Fig. 9A) can be accomplished, as least in part, due to the presence of the jointed members 974.

[0055] As discussed more fully herein, one major obstacle overcome by the jointed member 974 of the present disclosure is its ability to not only act as a structural member or beam capable of helping to support a load as prescribed in ISO standard 1496 when in an unfolded state, but also its surprising ability to transition to a folded state without having any portion of the jointed member 974 extending beyond its defined maximum length 9144 as defined in an unfolded state. This defined maximum length 9144 of the jointed member 974 can be the defined maximum length of the jointed member in an unfolded state. So, the jointed member of the present disclosure

can transition from an unfolded state to a folded state without causing any portion of the jointed member (e.g., the ends of the jointed member that help define the defined maximum length) to extend beyond its defined maximum length. As a result, the reversibly foldable freight container can transition from the unfolded state towards the folded state without any portion of the reversibly foldable freight container extending beyond its predefined maximum width 9155 measured at a predetermined point on each of two of the rear wall corner posts 9152. The predetermined point on each of the rear corner posts 9152 can be the corner fittings 9154 (e.g., maximum width as measured between the outer surface of corner fittings 9154-4 and 9154-2). This issue is presented as follows.

[0056] Referring to Fig. 10, there is shown an end view of a freight container 10166. The freight container 10166 is shown in a partial view, where portions of the floor structure (e.g., the wood flooring), sidewall structure, end frames (e.g., front wall and rear wall) and door assembly have been removed to better illustrate the issues encountered with trying to fold the freight container 10166. The freight container 10166 does not include the jointed member of the present disclosure, but rather is shown with hinges 10168-1 through 10168-3 that connect two portions (e.g., halves) of a cross member 10170. Conventional thinking would dictate that the hinges 10168-1 through 10168-3 should act as a bearing that not only connects the halves of the cross members 10170 together and to the bottom side rails 10156-1 and 10156-2 of the freight container 10166, but also allows for the cross member 10170 to fold into a volume 10164 of the freight container 10166.

[0057] The cross members 10170 can have a variety of cross sectional shapes. Such cross-sectional shapes can include box (e.g. rectangular or square), C-channel, Z-beam and I-beam cross sectional shapes. As illustrated, these cross-sectional shapes allow for surfaces 10172 of the cross members 10170 to abut each other when in the unfolded state. When abutted, the surfaces 10172 of cross member 10170 come under compression, with help from the hinge 10168-1 to prevent the upper surface 10174 of the cross member 10170 from extending below a plane 10716 when a structural load is placed on the floor of the freight container 10166. The plane 10716 is an imaginary flat surface on which a straight line joining any two points would wholly lie. So, in the present embodiment, any two points on the upper surface 10174 of the cross member 10170 would lie in the plane 10716.

[0058] As illustrated, the placement of the hinges 10168-1 through 10168-3 would appear to allow for the floor structure of the freight container 10166 to fold within the predefined maximum width 10155. This, however, is not the case. As illustrated, the cross member 10170 of the freight container 10166 is in the unfolded state and has a predefined maximum width 10155. Also illustrated in freight container 10166 are three hinges 10168-1

through 10168-3 which appear to allow for the cross member 10170 of the freight container 10166 to fold up into the volume 10164 defined by the freight container 10166. Examining the relative location of the three hinges 10168-1 through 10168-3 the corners of a right triangle 10178 (shown with shading) are present. The right triangle 10178 includes a hypotenuse 10180 that is longer than either of a first leg 10182 or a second leg 10184 of the right triangle 10178. As appreciated, the greater the length of the second leg 10184 the longer the hypotenuse 10180.

[0059] It can also be seen that in the unfolded state the length of two of the first legs 10182 helps to define the predefined maximum width 10155 of the freight container 10166. Now, as the freight container 10166 begins to fold from an unfolded state the width of the freight container 10166 will have to become greater than the predefined maximum width 10155 to accommodate the length of the hypotenuse 10180. So, if the cross member 10170 were to move along the direction of travel 10186 there would not be enough width available for the two portions that makes up the cross member 10170 to move from or return to the unfolded state (e.g., the condition where the floor of the freight container 10166 is parallel with the plane 10716). This issue is referred to herein as "the hypotenuse issue."

[0060] If the two portions that makes up the cross member 10170 were to be forced to move along the direction of travel 10186 the overall width of the freight container 10166 will have to increase beyond its predefined maximum width 10155. Therefore, when transitioning a container from an unfolded state to a folded state it may be desirable to provide that the width of the container does not expand beyond its predefined maximum width 10155 in the unfolded state.

[0061] If the two portions that makes up the cross member 10170 were to be forced to move along the direction of travel 10186 at least one of following may happen: (1) the overall width of the freight container 10166 will have to increase beyond its predefined maximum width 10155; (2) the portions that make up the cross member 10170 will have to bend or deform (elastically or non-elastically); and/or (3) the first, second and/or third hinge 10168-1, 10168-2, 10168-3 will deform and/or break. The issues become more apparent when a structure 10188 is used with the freight container 10166, such as a roof structure and/or a lateral bracing member, each having a fixed length and/or width that cannot, or should not, be extended beyond the predefined maximum width 10155 of the freight container 10166. Examples of such lateral bracing members can includes, but are not limited to, cables, structural beams, rods and/or tubes that can be used to help brace and support the freight container 10166 in an unfolded state. As will be appreciated, one or more of these structures (e.g., the roof structure, a lateral bracing member, one or more of the hinges, and/or the cross member 10170, among other structures) could be damaged as the freight container 10166 folds from an unfold-

ed state.

[0062] Regardless of what does happen one thing is almost certain, due to the hypotenuse issue discussed herein expanding the freight container 10166 beyond its predefined maximum width 10155 may result in weakening of the freight container 10166 (e.g., the hinges 10168-1 through 10168-3 and/or the cross member 10170) such that it would no longer be able to support a load (e.g. no longer be in compliance with the ISO standards) thus rendering the freight container 10166 unfit for its intended purpose. Therefore, when transitioning a container from an unfolded state to a folded state it may be desirable to provide that the width of the container does not expand beyond its predefined maximum width 10155 in the unfolded state.

[0063] The joined member used in the reversibly foldable freight container of the present disclosure helps to address the hypotenuse issue discussed herein. The joined member, as disclosed herein, allows the reversibly foldable freight container to transition from an unfolded state to a folded state without expanding beyond the predefined maximum width of the container in the unfolded state. As discussed herein, the joined member is configured in such a way that during the folding process the length of the hypotenuse changes (e.g., is accommodated). From the folded state the container may transition back to the unfolded state, and is thus reversibly foldable.

[0064] In addition, when a structure is used with the reversibly foldable freight container (e.g., such as a roof structure and/or a lateral bracing member) the joined member allows the reversibly foldable freight container to reversibly fold within a fixed length and/or width of the structure. Examples of such structures can include, but are not limited to, cables, structural beams, rods and/or tubes that can be used to help brace and support the reversibly foldable freight container in an unfolded state. As will be understood reading the present disclosure these structures (e.g., the roof structure, a lateral bracing member, one or more of the hinges, and/or the joined member, among other structures) will not be damaged as the reversibly foldable freight container folds from an unfolded state.

[0065] As discussed herein, the joined member is configured in such a way that during the folding process the length of the hypotenuse changes (e.g., is accommodated) thereby preventing damage to the joined member, associated hinges and structures (e.g., 143). From the folded state the reversibly foldable freight container may transition back to the unfolded state, and is thus reversibly foldable.

[0066] As used in the reversibly foldable freight container 9150, the joined member 974 can act as a beam. As used herein, a beam is a structural element that is capable of withstanding a load primarily by resisting bending. For various embodiments, the joined member 974 can be configured as a beam, or as part of a beam, for the reversibly foldable freight container 9150. In addition to acting as a beam, however, the joined member

974 of the present disclosure also allows for the reversibly foldable freight container 9150 to fold. When in a folded state, the reversibly foldable freight container occupies a volume that is less than that of the reversibly foldable freight container in an unfolded state. So, when in the folded state the structure occupies a volume and/or an area that is less than that of the structure in an unfolded state.

[0067] Another significant advantage of the joined member 974 used in the reversibly foldable freight container 9150 of the present disclosure is its surprising ability to fold within a defined maximum length of the joined member, (e.g., the defined maximum length can be a maximum length of the joined member). This defined maximum length of the joined member 974 can be the defined maximum length of the joined member 974 in an unfolded state. So, the joined member of the present disclosure can transition from an unfolded state to a folded state without causing any portion of the joined member 974 (e.g., the ends of the joined member that help define the defined maximum length) to extend beyond its defined maximum length. The following discussion will help to further clarify the problem that the joined member of the present disclosure has helped to overcome.

[0068] Referring now to Figs. 11A-11E there is shown the joined member 1174 transitioning from the first predetermined state towards the second predetermined state without any portion of the joined member 1174 extending beyond its defined maximum length 11144. During this transition the first oblong opening, the second oblong opening, and the fastener can move relative each other as does the first abutment member 1102 and the second abutment member 1104. This relative movement helps to provide that the joined member 1174 transitions from the first predetermined state towards the second predetermined state (e.g., a folded state) without expanding beyond either the defined maximum length 11144 or the predefined maximum width provided in the first predetermined state, while neither bowing or damaging the joined member, a pivotal connection (e.g., a hinge) or a structure of a container, as discussed herein. In other words, this relative movement has an effect of overcoming the hypotenuse issue discussed herein.

[0069] The joined member 1174 can fold in a way that the components of the reversibly foldable freight container do not extend beyond their predefined maximum width (e.g., ISO standard width). The joined member 1174 has the attributes of a compound hinge. Specifically, the joined member 1174 has two distinct and separate axes of rotation that are used during the folding and/or the unfolding of the joined member 1174.

[0070] Figs. 11A-11C illustrate the first elongate section 1176 connected to the first bottom side rail 11156-1 by the first hinge 1182-1 and the second elongate section 1177 connected to a second bottom side rail 11156-2 by the second hinge 1182-2. Figs. 11A-11C also illustrate the first beam 11102 and the second beam 11104 joined by the fastener 11100 that passes through the first and

second oblong opening 11110 and 11114, respectively. The fastener 11100 is shown in cross-section in Fig. 11A-11C to better illustrate its relationship to the first and second oblong opening 11110 and 11114 as the jointed member 1174 moves from the first predetermined, or unfolded, position towards the second predetermined, or the folded position.

[0071] In Fig. 11A the jointed member 1174 is shown in its first predetermined state having its defined maximum length 11144. In this first predetermined state: the first and second abutment members 1102 and 1104 are in contact; the overlap of the first and second oblong openings 11110 and 11114 is at a minimum relative the second predetermined state (seen in Fig. 12); and the surfaces 11108 and 11112 of the first beam 11102 and the second beam 11104 define the cross-sectional shape of the portion of the fastener 11100 passing through the first and second oblong openings 11110 and 11114. Fig. 11A also shows an upper surface 11192 of the first and second beams 11102 and 11104.

[0072] As the jointed member 1174 begins to fold different portions of the jointed member 1174 move so as to rotate around predefined points of rotation (e.g., a first axis of rotation), to slide relative one or more of the other parts of the jointed member 1174 and/or to shift relative positions at different stages of the folding process. Referring now to Fig. 11B, the jointed member 1174 is shown beginning to fold from its first predetermined state, as seen in Fig. 11A, towards the second predetermined state, as seen in Fig. 12. As illustrated in Fig. 11B, the first abutment member 1102 and the second abutment member 1104 define a first point of rotation around a first axis of rotation for the first elongate section 1176 and the second elongate section 1177. In other words, the first point of rotation around which the first elongate section 1176 and the second elongate section 1177 rotate is defined at the point of contact between the first abutment member 1102 and the second abutment member 1104. Rotation about this first point of rotation may be caused, at least in part, to a force applied to the jointed member in the direction 11202.

[0073] As the first elongate section 1176 and the second elongate section 1177 rotate around the first point of rotation defined by the first abutment member 1102 and the second abutment member 1104 the surfaces 11108 and 11112 defining the first oblong opening 11110 and the second oblong opening 11114 move relative each other. The fastener 11100 can also move (e.g., laterally) within the first oblong opening 11110 and/or the second oblong opening 11114 as the jointed member 1174 transitions from the first predetermined state towards the second predetermined state. In transitioning towards the second predetermined state the fastener 11100 is mobile within the first oblong opening 11110 and/or the second oblong opening 11114. As discussed herein, the axial center 11122 of the fastener 11100 moves along (e.g., essentially parallel with) the longitudinal axis 11120 of the first oblong opening 11110 and

the second oblong opening 11114 as the jointed member 1174 transitions from a first predetermined state to a second predetermined state. The cross-sectional shape of the fastener 11100 is of a size and a shape that allows the fastener 11100 to travel along the longitudinal axis 11120 of the first oblong opening 11110 and the second oblong opening 11114 as the jointed member 1174 transitions from a first predetermined state to a second predetermined state without any significant amount of travel along the minor axis 11124 of the first oblong opening 11110 and the second oblong opening 11114. So, for example, the distance between the parallel lines tangent to the end points of the two semicircles of the first and second oblong openings 11110 and 11114 is approximately the diameter of the portion of the fastener 11100, illustrated herein, that passes through the first and second oblong openings 11110 and 11114.

[0074] As illustrated in Fig. 11B, the fastener 11100 has moved laterally (e.g. in a direction coincident with the longitudinal axis 11120) within the first oblong opening 11110. Likewise, the fastener 11100 may move laterally within the second oblong opening 11114 (e.g. in a direction coincident with the longitudinal axis 11120).

[0075] Fig. 11B shows how a gap 1182 develops between the fastener 11100 and the first end 1116 of the surfaces defining the first oblong opening 11110 (11116-A) and the second oblong opening 11114 (11116-B). The jointed member 1174 can rotate around a point of contact (e.g., a predetermined point of contact) between the first abutment member 1102 and the second abutment member 1104 until the second ends 11118 of the first oblong opening 11110 (11118-A) and the second oblong opening 11114 (11118-B) contact the fastener 11100, for example.

[0076] This embodiment, where the second ends 11118 of the first oblong opening 11110 (11118-A) and the second oblong opening 11114 (11118-B) contact the fastener 11100, is illustrated in Fig. 11C. Fig. 11C also illustrates that the point of rotation now shifts from the first point of rotation, defined by the first abutment member 1102 and the second abutment member 1104, to a second point of rotation on a second axis of rotation that is formed by the second end 11118 of both the first surface 11108 of the first oblong opening 11110 (11118-A) and the second surface 11112 of the second oblong opening 11114 (11118-B) when positioned against the fastener 11100. This second point of rotation around a second axis of rotation for the first abutment member 1102 and the second abutment member 1104 is different than the first point of rotation discussed herein. As before, the rotation about this second point of rotation may be caused, at least in part, to a force applied to the jointed member in the direction 11202.

[0077] As illustrated in Figs. 11A-11C, the first elongate section 1176 and the second elongate section 1177 rotate around (e.g., turn on) the first point of rotation prior to rotating around (e.g., turning on) the second point of rotation as the jointed member 1174 transitions from the

first predetermined state towards the second predetermined state. Also, as illustrated in Fig. 11C the first end 11116 of each of the first surface 11108 (11116-A) and the second surface 11112 (11116-B) does not contact the fastener 11100 when the second end 11118 of both the first surface 11108 (11118-A) and the second surface 11112 (11116-A) are seated against the fastener 11100.

[0078] As seen in Figs. 11A-11C, as the first elongate section 1176 and the second elongate section 1177 rotate around (e.g., turn on) the first point of rotation the first abutment member 1102 and the second abutment member 1104 can initially separate, or move, from their seated position along the longitudinal axis 1166. As this happens, the first gap 1170 is formed between the distal end of the projection 1106 and the second end of the socket 1118 of the second abutment member 1104. The second gap 1172 also forms between the first surface of the projection 1106 and the first surface of the socket 1118. This combination of the first gap 1170 and the second gap 1172 for the given configuration of the abutment joint 1100 allows for the first abutment member 1102 and the second abutment member 1104 to travel along the arcuate travel path as the jointed member 1174 rotates around the second point of rotation.

[0079] In shifting from the first point of rotation to the second point of rotation the length of the hypotenuse of the jointed member 1174 changes from an initial value when the jointed member 1174 is in the first predetermined state (as discussed herein) to a shorter value, relative the initial value, such as when the point of rotation shifts to the point of contact between the second end 11118 of the first oblong opening 11110 (11118-A) and the second oblong opening 11114 (11118-B) and the fastener 11100.

[0080] Figs. 11D and 11E can be used to illustrate this change in the length of the hypotenuse of the jointed member 1174. The broken lines 11204 and 11206 in Figs. 11D and 11E show the hypotenuse of jointed member 1174 when the jointed member is at either the first point of rotation or the second point of rotation. In Fig. 11D, there is shown the first elongate section 1176, where in the first predetermined state the fastener 11100, the first abutment member 1102 and the second end 1180, all in a common plane, can define a right triangle 11208 of the first elongate section 1176. Specifically, the hypotenuse of the right triangle 11208 is between the fastener 11100 and the second end 1180, a first leg 11209 of the right triangle 11208 is defined by the second end 1180 and the perpendicular intersection of a first line 11212 extending from the second end 1180 and a second line 11213 extending from the geometric center of the fastener 11100, where the first and second lines 11212 and 11213 are in the common plane.

[0081] As illustrated in Fig. 11D, when in the first predetermined state broken line 11204 shows the hypotenuse of jointed member 1174. When the point of rotation shifts to the second point of rotation the broken line 11206 shows the now shortened hypotenuse, relative the hy-

potenuse in the first predetermined state. In addition to being shorter than broken line 11204, the hypotenuse shown by broken line 11206 can be equal to or shorter than the first leg 11209 of the right triangle 11208 of the first elongate section 1176 when the jointed member is in the first predetermined state. In this way, the jointed member 1174 having the now shortened hypotenuse can pass through, for example, the defined maximum length 11144, as discussed herein.

[0082] Similarly, in Fig. 11E there is shown the second elongate section 1177, where in the first predetermined state the fastener 11100, the second abutment member 1104 and the second end 1188 of the second elongate section 1177, all in a common plane, define a right triangle 11208 of the second elongate section 1177. Specifically, the hypotenuse of the right triangle 11208 is between the fastener 11100 and the second end 1188, a first leg 11209 of the right triangle 11208 is defined by the second end 1188 and the perpendicular intersection of a first line 11212 extending from the second end 1188 and a second line 11213 extending from the geometric center of the fastener 11100, where the first and second lines 11212 and 11213 are in the common plane.

[0083] As illustrated in Fig. 11E, when in the first predetermined state broken line 11204 shows the hypotenuse of jointed member 1174. When the point of rotation shifts to the second point of rotation the broken line 11206 shows the now shortened hypotenuse, relative the hypotenuse in the first predetermined state. In addition to being shorter than broken line 11204, the hypotenuse shown by broken line 11206 can be equal to or shorter than the first leg 11209 of the right triangle 11208 of the second elongate section 1177 when the jointed member is in the first predetermined state. In this way, the jointed member 1174 having the now shortened hypotenuse can pass through, for example, the defined maximum length 11144, as discussed herein.

[0084] As illustrated in Figs. 11D and 11E, the first predetermined state the hypotenuse has a length that is greater than a length of the first leg 11209. However, as the first abutment member 1102 and the second abutment member 1104 rotate about the first point of rotation the length of the first leg 11209 of the right triangle 11208 changes by a length 11230, which is the length the geometric center of the fastener 11100 travels between the first predetermined state and the second predetermined state. The change in the first leg 11209 also changes the length of the hypotenuse so that it is no longer greater than the length of the first leg 11209 as measured in the first predetermined position. This change in the effective length of the hypotenuse allows the jointed member 1174 to fold towards the second predetermined state without extending beyond the defined maximum length 11144 defined in the first predetermined state. For un-folding of the jointed member 1174 a force opposite the force 11202 may be applied to the folded jointed member to cause the jointed member 1174 to return to its first predetermined state as seen in Fig. 11A. In returning to its first

predetermined state the defined maximum length 11144 is not exceeded.

[0085] Referring now to Fig. 12, there is shown an embodiment of the jointed member 1274 in the second predetermined state in which the first oblong opening 12110 and the second oblong opening 12114 can have a maximum overlap relative the minimum overlap (e.g., the first predetermined state), as discussed herein. In the embodiment illustrated in Fig. 12 the fastener 12100 is free to move along the longitudinal axes 12120 of the first oblong opening and the second oblong when the first oblong opening and the second oblong opening are in the second predetermined state.

[0086] In the second predetermined state, Fig. 12 shows the first oblong opening 12110 completely overlapping the second oblong opening 12114. While Fig. 12 illustrates a complete overlap of the first oblong opening 12110 and the second oblong opening 12114 it is intended that the overlap may be substantially complete, e.g. due to machine tolerances and so forth. This relationship between the first oblong opening 12110 and second oblong opening 12114 may be considered the maximum overlap of the first oblong opening and the second oblong opening relative the minimum overlap, as discussed herein. In other words a value of an area of the maximum overlap cannot be further increased by repositioning either the first elongate section or the second elongate section.

[0087] Freight containers (also known as containers, ship containers, intermodal containers and/or ISO containers, among other names) can be transported by rail, air, road and/or water. Freight containers are often times transported empty. Because the freight container occupies the same volume whether it contains goods or not, the cost (both financial and environmental) to transport an empty freight container can be equivalent to the cost of transporting a full freight container. For example, the same number of trucks (e.g., five) would be needed to transport the same number of empty freight containers (e.g., five). In addition, freight containers often times sit empty at storage facilities and/or transportation hubs. Regardless of where the freight container is located (in transit or in storage) the volume an empty freight container occupies is not being used to its full potential.

[0088] One solution to these issues would be a reversibly foldable freight container. Having a reversibly foldable freight container would allow for an "empty" freight container to be folded to achieve a volume that is smaller than its fully expanded state. The extra volume acquired by at least partially folding the reversibly foldable freight container could then be used to accommodate other at least partially folded reversibly foldable freight containers, provide additional volume for unfolded (e.g., regular) freight containers and/or reversibly foldable freight containers in their fully expanded state. So, for example, a number of reversibly foldable freight containers that are empty (e.g., five) could be folded and nested in such a way that one truck could transport the number of empty

reversibly foldable freight containers. As a result the environmental and cost savings are expected to be significant.

[0089] A reversibly foldable freight container may include a plurality of the joined members discussed herein. The reversibly foldable freight container may conform to the International Organization for Standardization (ISO) standard. For example, the reversibly foldable freight container, as disclosed herein, conforms to ISO standard 688 and ISO standard 1496 (and the amendments to ISO standard 1496). As discussed herein, the commercial standards for freight containers are set by the ISO. The ISO sets the commercial standards for almost every aspect of the freight container. Such commercial standards include, but are not limited to, the design, dimensions, dimensional tolerances, freight transport, ratings, weight (mass), center of gravity, load capacity, hoisting tests, symbols, marking, position, stacking tests, weather resistance, and mechanical testing of the freight container, among others.

[0090] The reversibly foldable freight container, as discussed herein, includes a plurality of the jointed member, as disclosed herein. The reversibly foldable freight container of the present disclosure can transition from an unfolded state to a folded state without expanding the reversibly foldable freight container beyond a predefined maximum width of the unfolded state. The reversibly foldable freight container may transition from the folded state back to the unfolded state, and is thus reversibly foldable. As used herein a "folded state" of the reversibly foldable freight container is a state that does not include the unfolded state, as discussed herein. The folded state can include, but is not limited to, the second predetermined state of the reversibly foldable freight container.

[0091] As discussed the jointed member may employed for a reversibly foldable freight container, as is discussed herein. The jointed member, as disclosed herein, may however be employed for various applications that include a transition from an unfolded state to a folded state without expanding beyond the defined maximum length of the jointed member in the unfolded state, while neither bowing or damaging the jointed member, a pivotal connection (e.g., a hinge) or a structure, (as discussed herein), of the container.

[0092] Fig. 13 illustrates an exploded view of a reversibly foldable freight container 13500. The reversibly foldable freight container 13500 includes a floor structure 13502, a roof structure 13504 opposite the floor structure 13502, a first sidewall structure 13506-1 and a second sidewall structure 13506-2, where both the first sidewall structure 13506-1 and the second sidewall structure 13506-2 join the floor structure 13502 and the roof structure 13504. Each of the sidewall structures 13506-1 and 13506-2 has an exterior surface 13508 and an interior surface 13511, where the interior surface 13511 of the sidewall structures 13506-1 and 13506-2, the floor structure 13502 and the roof structure 13504 at least partially defines a volume 13512 of the reversibly foldable freight

container 13500.

[0093] The first sidewall structure 13506-1 includes a first sidewall panel 13514-1 that is joined to a first upper side rail 13516-1 and a first bottom side rail 13518-1. The second sidewall structure 13506-2 includes a second sidewall panel 13514-2 that is joined to a second upper side rail 13516-2 and a second bottom side rail 13518-2. The floor structure 13502 includes flooring 13520 that is attached to jointed members 13510 according to the present disclosure, where a portion of the flooring 13520 has been removed to show the jointed members 1374. One or more of a hinge 13513 joins the first member end of each of the plurality of jointed members 1374 to the first bottom side rail 13518-1 and the second member end of each of the plurality of jointed members 1374 to the second bottom side rail 13518-2. The bottom side rail 13518 can further include forklift pockets 13524.

[0094] The reversibly foldable freight container 13500 further includes a rear wall 13526 and a front wall 13528. Each of the rear wall 13526 and the front wall 13528 include an end frame 13530 joined with the roof structure 13504, the floor structure 13502 and the sidewall structures 13506-1 and 13506-2. The end frame 13530 includes corner posts 13532, corner fittings 13534, a header 13536 and a sill 13538. The end frame 13530 for the rear wall 13526 is referred to herein as the rear wall end frame 13531 and the end frame 13530 for the front wall 13528 is referred to herein as the front wall end frame 13533. The corner posts 13532 for the rear wall 13526 are referred to herein as the rear wall corner posts 13532-1 and 13532-2 and for the front wall 13528 are referred to herein as the front wall corner posts 13532-3 and 13532-4.

[0095] The rear wall 13526 includes a door assembly 13540. The door assembly 13540 can include a door 13542 attached to the rear wall end frame 13531 of the rear wall 13526 with hinges 13544, as will be discussed more fully herein. The rear wall end frame 13531 includes the header 13536, which is also referred to as a rear wall header member 13546 for the door assembly 13540, and the sill 13538, which is also referred to as a rear wall sill member 13548 for the door assembly 13540. The rear wall corner posts 13532-1 and 13532-2 extend between and couple the rear wall sill member 13548 and the rear wall header member 13546.

[0096] Fig. 13 provides an embodiment of the door assembly 13540 that includes two of the doors 13542, where one of each door 13542 is attached by the hinges 13544 to one of each of the rear wall corner posts 13532-1 and 13532-2. Each door 13542 has a height 13550 and a width 13552 that allows the door 13542 to fit within an area 13554 defined by the rear wall end frame 13531. The door 13542 can further include a gasket 13556 around a perimeter of the door 13542 to help provide weatherproofing on the exterior portion of the rear wall 13526.

[0097] The door 13542 further includes a locking rod 13558 having a cam 13560 and a handle 13562. The

locking rod 13558 can be mounted to the door 13542 with a bearing bracket assembly 13564, where the locking rod 13558 turns within and is guided by the bearing bracket assembly 13564 to engage and disengage the cam 13560 and a cam keeper 13566. The cam keeper 13566 is mounted on the rear wall end frame 13531. In one embodiment, the cam keeper 13566 is mounted on the rear wall header member 13546 and the rear wall sill member 13548 of the rear wall end frame 13531 of the rear wall 13526.

[0098] The locking rod 13558 mounted to the door 13542 can move between a first predetermined position where the cam 13560 is aligned with and can engage the cam keeper 13566, as discussed above, and a second predetermined position. In the second predetermined position the cam 13560 is disengaged from the cam keeper 13566 and has a position relative the rear wall end frame 13531 that allows the cam 13560 and the door 13542 to travel through the area 13554, past the rear wall end frame 13531 and the cam keeper 13566 of the rear wall 13526, and into the volume 13512 of the reversibly foldable freight container 13500. In other words, in the second predetermined position portions of the locking rod 13558 have been moved, as described herein, so as to position the cam 13560 directly adjacent the surface of the door 13542 so that the door 13542 can be opened into the volume 13512 of the reversibly foldable freight container 13500. As discussed herein, opening the door 13542 into the volume 13512 of the reversibly foldable freight container 13500 is accomplished, in addition to having the locking rod 13558 in the second predetermined position, with the use of the hinge 13544 of the present disclosure, as will be more fully discussed herein.

[0099] The first predetermined position is shown in Fig. 13, where the cam 13560 and the cam keeper 13566 are positioned relative each other so the cam 13560 can engage and disengage the cam keeper 13566 positioned on the rear wall end frame 13531.

[0100] Fig. 14 provides an illustration of the cam 14560 in at least one embodiment of the second predetermined position relative the cam keeper 14566. As illustrated in Fig. 14, the cam 14560 has been positioned, relative the first predetermined position, so that the cam 14560 is no longer aligned so as to engage and/or disengage the cam keeper 14566. The cam 14560 is also positioned relative the rear wall end frame 14530 such that the cam 14560 can pass through the area 14554 defined by the rear wall end frame 14530 as the door 14542 travels into the volume 14512 of the reversibly foldable freight container 14500, where the volume 14512 can be defined, at least in part, by the floor structure 14502, the roof structure 14504, the sidewall structures 14506-1 and 14506-2 and the rear wall 14528 (shown with cutaways to help better illustrate the position of the doors 14542 in the volume 14512 defined by the reversibly foldable freight container 14500).

[0101] Moving the cam 14560 between the first prede-

terminated position and the second predetermined position can be accomplished in a number of different ways. For example, the locking rod 14558 can have two or more portions that can telescope along a longitudinal axis 14568 of the locking rod 14558. The locking rod 14558 can include a first portion 14570 and a second portion 14572 joined to the first portion 14570 with a connection shaft 14574. The first portion 14570 and the second portion 14572 can telescope relative the connection shaft 14574 to change a length 14576 of the locking rod 14558. For example, the first portion 14570 and the second portion 14572 can travel along the connection shaft 14574 between the first predetermined position and the second predetermined position.

[0102] As illustrated, the connection shaft 14574 can be held in place on the door 14542 with a combination of the bearing bracket assembly 14564 and an anti-rack ring 14578. The anti-rack ring 14578 can be joined to the connection shaft 14574 on either end of the bearing bracket assembly 14564 such that the shaft 14574 can rotate in the bearing bracket assembly 14564 by turning handle 14584, but will not pass vertically, relative the floor structure 14502 and/or the roof structure 14504, through the bearing bracket assembly 14564 (e.g., the connection shaft 14574 will not move up and/or down relative the bearing bracket assembly 14564) due to the presences of the anti-rack ring 14578.

[0103] Referring now to Figs. 15A and 15B there is shown the door assembly 15540 with the locking rods 15558 in the first predetermined position (e.g., the cam 15560 aligned with and can engage the cam keeper 15566 as illustrated in Fig. 15A) and the second predetermined position (e.g., the cam 15560 disengaged from the cam keeper 15566 and has a position relative the rear wall end frame 15530 that allows the cam 15560 and the door 15542 to travel into the volume of the reversibly foldable freight container 155 (as illustrated in Fig. 16). As illustrated, the door assembly 15540 includes doors 15542, hinges 15544, rear wall header member 15546, rear wall sill member 15548, locking rod 15558, cam 15560, handle 15562, bearing bracket assembly 15564 and cam keeper 15566, as discussed herein. The embodiments illustrated in Figs. 15A and 15B also include each of the first portion 15570 and the second portion 15572, where each of the portions 15570 and 15572 include a socket 15586 for receiving at least a portion of the connection shaft 15574. It is along and through the socket 15586 that each of the first portion 15570 and the second portion 15572 can travel relative the connection shaft 15574 as the locking rod 15558 telescopes to change the length of the locking rod 15558 between the first predetermined position as illustrated in Fig. 15A and the second predetermined position as illustrated in Fig. 15B.

[0104] The socket 15586 and the connection shaft 15574 can have a cross-sectional shape that does not allow the connection shaft 15574, the first portion 15570 and/or the second portion 15572 to rotate relative to each

other to any significant degree. Such cross-sectional shapes can include, but are not limited to, non-circular cross sectional shapes such as oval, elliptical, or polygonal, such as triangular, square, rectangular, or higher polynomial such as pentagonal, hexagonal, etc. The connection shaft 15574 can further include a bearing bracket assembly, as discussed herein, in which to rotate and to provide support for the connection shaft 15574 in its position relative the first and second portions 15570 and 15572. It is possible that the socket 15586 may also include a bushing positioned between the connection shaft 15574 and each of the first and second portions 15570 and 15572. The bushing can be made of a polymer, such as polytetrafluoroethylene.

[0105] The first portion 15570 and the second portion 15572 can be mounted to the door 15542 with a combination of the bearing bracket assembly 15564 and the anti-rack ring 15578. For example, each of the first portion 15570 and the second portion 15572 can have bearing bracket assembly 15564 and anti-racking ring 15578 joined to each portion 15570 and 15572 that allows the portions 15570 and 15572 to rotate in the bearing bracket assembly 15564 by turning the handle 15562. The second portion 15572 can include the handle 15562. The door 15542 further includes a retainer plate 15588 and a retainer catch 15590 to receive and releasably hold the handle 15562 against the door 15542.

[0106] As illustrated, the anti-racking ring 15578 on each of the first portion 15570 and the second portion 15572 of the locking rod 15558 is positioned between the bearing bracket assembly 15564 for the connection shaft 15574 and the bearing bracket assembly 15564 for the respective portion 15570 and 15572. This configuration allows each of the first portion 15570 and/or the second portion 15572 to telescope, relative the floor structure and roof structure, between the first predetermined position (Fig. 15A) and the second predetermined position (Fig. 15B), discussed herein. The anti-racking rings 15578 can also act as stops that limit the degree of travel of the first and second portions 15570 and 15572 of the locking rod 15558.

[0107] The locking rod 15558 also includes an adjustment member 15580 that can releasably join the first portion 15570 and the second portion 15572 of the locking rod 15558. The adjustment member 15580 includes a first end 15582 and a second end 15583, with surfaces defining a first opening 15587 adjacent the first end 15582 and a second opening 15589 between the first opening 15587 and the second end 15583 of the adjustment member 15580. The adjustment member 15580 can be non-releasably, but pivotally, attached to the first portion 15570 at or adjacent the first end 15582. The first and second openings 15587 and 15589 can then be used to releasably couple the first and second portions 15570 and 15572 of the locking rod 15558 in either one of the first predetermined position (seen in Fig. 15A) and/or the second predetermined position (seen in Fig. 15B).

[0108] The adjustment member 15580 can be a forged

metal bar that is non-releasably, but pivotally, attached by a hub mount bracket 15592 to the first portion 15570. A rivet can be used to couple the adjustment member 15580 to the hub mount bracket 15592. The second portion 15572 can also include a mounting bracket 15594 that can receive and releasably couple the adjustment member 15580. In one embodiment, the mounting bracket 15594 can include a pin or a shaft over which either one of the first opening 15587 or the second opening 15589 on the adjustment member 15580 can be positioned. The pin or shaft on the mounting bracket 15594 can have a surface that defines an opening through the pin or shaft. The opening through the pin or shaft can be located such that when either one of the first opening 15587 or the second opening 15589 is positioned over the pin or shaft the opening can releasably receive an R-pin or R-clip. Once in position, the R-pin or R-clip can hold the adjustment member 15580 so as to keep the locking rod 15558 rigid (e.g., rigid along the longitudinal axis of the locking rod 358). The locking rod 15558 in its first predetermined position can perform an anti-racking function, as is known in the art. As appreciated, other structures besides R-pins or R-clips can be used to releasably secure the adjustment member 15580 between the first portion 15570 and the second portion 15572.

[0109] The adjustment member 15580 can also be used to telescope (e.g., move) the first portion 15570 of the locking rod 15558 between the first predetermined position and the second predetermined position. Similarly, the handle 15562 can be used to telescope (e.g., move) the second portion 15572 of the locking rod 15558 between the first predetermined position and the second predetermined position.

[0110] Referring now to Fig. 16, there is shown an embodiment of the door assembly 16540. As illustrated, only one door 16542 is shown so as to better illustrate the following embodiment. The door assembly 16540 includes the components as discussed herein for Figs. 13 through 15B. For the various embodiments, the door 16542 illustrated in Fig. 16 further includes a wheel 16596 positioned between the door 16542 and the floor structure 16502. For the various embodiments, more than one wheel 16596 can be used with the door 16542 (e.g., two of wheel 16596, three of wheel 16596, etc. could be used with the door 16542).

[0111] The wheel 16596 can help to support the weight of and guide the door 16542 as it travels into the volume 16512 of the reversibly foldable freight container 16500. The wheel 16596 includes an axle 16598 on which the wheel 16596 rotates. For the various embodiments, the axle 16598 can be fixed to the wheel 16596 where the axle 16598 is supported by and rotates on a bracket housed within the door 16542 structure. Alternatively, the axle 16598 can be fixed to the door 16542, where the wheel 16596 includes a bearing or bushing that allows the wheel 16596 to rotate around the axle 16598.

[0112] Referring now to Fig. 17, there is shown an embodiment of the hinge 17544. As illustrated, the hinge

17544 includes a first wing 17601 and a second wing 17603, where the first wing 17601 and the second wing 17603 are pivotally connected by a first hinge pin 17605. The second wing 17603 includes a first planar portion 17607 with a first end 17609 and a second end 17611 and a second planar portion 17613 that extends perpendicular from the first end 17609 of the first planar portion 17607. The first hinge pin 17605 pivotally connects the first wing 17601 to the second end 17611 of the first planar portion 17607. As illustrated, a portion of the first planar portion 17607 of the second wing 17603 passes through an opening defined in the first wing 17601 so as to allow the second end 17611 of the first planar portion 17607 of the second wing 17603 to pivotally connect to the first hinge pin 17605 and the first wing 17601.

[0113] The hinge 17544 also includes a pair of hinge lugs 17615 that extend from the second planar portion 17613 of the second wing 17603. Each of the hinge lugs 17615 has a first set of surfaces 17617 defining openings 17619 through which a second hinge pin 17621 passes. For the various embodiments, at least one of the pair of hinge lugs 17615 has a surface 17623 defining an opening 17625 through which a locking pin 17627 travels. The locking pin 17627 can reversibly travel through the opening 17625, where in a first position with the locking pin 17627 positioned completely outside the opening 17625 the second wing 17603 is unlocked relative the first wing 17601, and when the locking pin 17627 is at least partially, or completely, positioned through the opening 17625 the second wing 17603 is locked relative the first wing 17601.

[0114] The second planar portion 17613 of the second wing 17603 includes a first major surface 17629 and a second major surface 17631 opposite the first major surface 17629. The pair of hinge lugs 17615 extends from the first major surface 17629 of the second planar portion 17613. The first wing 17601 has a first major surface 17633 and a second major surface 17635 opposite the first major surface 17633. In a first predetermined position the first wing 17601 is perpendicular to the first planar portion 17607 of the second wing 17603 and the first major surface 17633 of the first wing 17601 is directly opposite and parallel with the second major surface 17631 of the second planar portion 17613. As will be discussed more fully herein, the first predetermined position can occur with the first wing 17601 attached to a corner post of the reversibly foldable freight container and the second wing 17603 of the hinge 17544 is positioned against (e.g., adjacent to and in at least partial contact with) the corner post.

[0115] The first wing 17601 has a first end 17637 and a second end 17639, and where the first hinge pin 17605 pivotally connects the first end 17637 of the first wing 17601 to the second end 17611 of the first planar portion 17607 of the second wing 17603. The second planar portion 17613 has an end 17643 that is distal to the first end 17609 of the first planar portion 17607 and the pair of hinge lugs 17615 extending from the second planar portion

tion 17613 have a first peripheral edge 17645, where the end 17643 of the second planar portion 17613 and the first peripheral edge 17645 of the hinge lugs 17615 lay in a common plane.

[0116] Referring now to Fig. 18, there is shown a top down view of the hinge 18544 that has been mounted on a rear wall corner post 18532 of a reversibly foldable freight container 18500. Only a portion of the reversibly foldable freight container 18500 is illustrated in Fig. 18 to allow for a better view and understanding of the operation of the hinge 18544. The corner posts of the reversibly foldable freight container are formed from a "J" bar 18547 and a "U"-channel 18549, where the J-bar 18547 and the U-channel 18549 are welded together to form the corner post of the reversibly foldable freight container 18500. A "U"-channel 18549 is also known as an "inner post." This construction of the corner post is applicable to the both the front wall corner posts and the rear wall corner posts discussed herein.

[0117] As illustrated, the first wing 18601 is fastened to a portion of the U channel 18549. The first wing 18601 can be fastened to the portion of the U channel by a welding (e.g., arc-welding) process. The second wing 18603 (illustrated in multiple positions in Fig. 18 as the second wing 18603 pivots about the first hinge pin 18605) is free to pivot around the first hinge pin 18605. The travel path 18651 of the second wing 18603 shown in Fig. 18 is into the volume 18512 of the reversibly foldable freight container 18500 (as partially defined by the interior surface 18510 of the side wall structure 18506 of the reversibly foldable freight container 18500).

[0118] Referring now to Fig. 19, there is shown the hinge 19544 in the first predetermined position (as illustrated in Fig. 17) on the reversibly foldable freight container 19500 as viewed along lines 7-7 in Fig. 18. The embodiment illustrated in Fig. 19 also includes the locking pin 19627 and the second hinge pin 19621 as illustrated in Fig. 17. As illustrated, the second wing 19603 includes hinge lugs 19615 that extend from the second planar portion 19613, and which hinge lugs 19615 include the first set of surfaces 19617 defining openings 19619 through which the second hinge pin 19621 passes and is seated. As will be discussed more fully herein, the door of the freight container pivots (e.g., swings) about second hinge pin 19621. The hinge lugs 19615 also include the surface 19623 defining the opening 19625 through which the locking pin 19627 travels. Fig. 19 also shows the hinge 19544 having a pair of seating blocks 19655 fastened to the rear wall end frame 19530 (only a portion of which is shown) of the reversibly foldable freight container to form a socket 19657 that receives and seats the second planar portion 19613 and at least a portion of the pair of hinge lugs 19615. As illustrated, the U-channel 19549 of rear wall end frame 19530 helps to form a portion of the socket 19657. A portion of the J-bar 19547 is removed so as to create a volume into which the second wing 19603 can reside and so as to allow the hinge 19653 to pivot such that door can swing towards the exterior

surface of the sidewall structure (a feature that is more fully illustrated and discussed herein). At least one of the pair of seating blocks 19655 has a surface 19659 defining an opening 19661 through which the locking pin 19627 travels to lock and un-lock the second wing 19603 from the corner post of the reversibly foldable freight container. As discussed herein, the locking pin 19627 reversibly travels to lock and un-lock the second wing 19603 from the corner post of the freight container. The door is joined to the pair of hinge lugs 19615, as illustrated herein, with the second hinge pin 19621 where the door pivots on the second hinge pin 19621 relative the pair of hinge lugs 19615 when the hinge lugs 19615 are locked to the corner post of the reversibly foldable freight container. This allows the door to extend adjacent the exterior surface of the sidewall structure. In addition, the door and the second wing 19603 can pivot on the first hinge pin when the hinge lugs 19615 are un-locked to the corner post of the reversibly foldable freight container to allow the door to travel into the volume of the reversibly foldable freight container and extend adjacent the interior surface of the sidewall structure. These embodiments will be illustrated and further discussed herein.

[0119] The pair of seating blocks 19655 can include a lower seating block 19663 and an upper seating block 19665. The pair of hinge lugs 19615 includes a lower hinge lug 19667 and an upper hinge lug 19665. The lower hinge lug 19667 can releasably seat, or rest, on the lower seating block 19663. The upper seating block 19669 can have the surface 19659 defining the opening 19661 through which the locking pin 19627 travels through the opening 19623 of the hinge lug 19669 to lock and un-lock the second wing 19603 from the corner post of the reversibly foldable freight container. The lower hinge lug 19667 can also include a surface 19669 defining an opening 19697 through which the locking pin 19627 travels. Each of the lower seating block 19663 and the upper seating block 19665 also include a surface defining an opening through which the locking pin 19627 travels to lock and un-lock the second wing 19603 from the corner post of the reversibly foldable freight container (for this embodiment, the locking pin 19627 would be of sufficient length to travel through the opening 19623 of the hinge lug 19669 and the opening 19697 in the lower hinge lug 19667 and the lower seating block 19663 to lock and un-lock the second wing 19603 from the corner post of the reversibly foldable freight container).

[0120] As illustrated in Fig. 19, the lower seating block 19663 can include a first surface 19671, on which the lower hinge lug 19667 seats or rests, a second surface 19673 substantially perpendicular to the first surface 19671, and a third surface 19675 that slopes between the first surface 19671 and the second surface 19673 of the lower seating block 19663. The lower hinge lug 19667 travels along the third surface 19675 as the second wing 19603 pivots around the first hinge pin relative the first wing. The upper seating block 19665 includes a first surface 19677, a second surface 19679 substantially per-

pendicular to the first surface 19677, and a third surface 19681 that slopes between the first surface 19677 and the second surface 19679, where the upper hinge lug 19669 can travel along the third surface 19681 as the second wing 19603 pivots around the first hinge pin relative the first wing.

[0121] The end frame can also include a locking pin travel stop 19685 to limit a travel distance of the locking pin 19627. The locking pin 19627 can also include a surface 19693 defining a structure on which, or into which, a tool can be used to cause the locking pin to travel. For example, the structure can be a notch or a recess formed in the locking pin 19627 that can accommodate a pry bar or other prying tool that would help in moving the locking pin 19627. The locking pin 19627 can secure the hinge 19544 perpendicular to an axis 19691 of rotation of the second hinge pin 19621.

[0122] Referring now to Fig. 20, there is shown an embodiment of the reversibly foldable freight container 20500 of the present disclosure where one of the door 20524 is positioned within the volume 20512 of the reversibly foldable freight container 20500, and the other of the door 20524 is positioned along the exterior surface 20508 of the sidewall structure 20506-1. As illustrated, the reversibly foldable freight container 20500 includes the roof structure 20504, the floor structure 20502 opposite the roof structure 20504, and the sidewall structures 20506-1 and 20506-2 between the floor structure 20502 and the roof structure 20504, as discussed herein. Each of the sidewall structures 20506-1 and 20506-2 have the exterior surface 20508 and the interior surface 20510, where the interior surface 20510 at least partially defines the volume 20512 of the reversibly foldable freight container 20500.

[0123] The reversibly foldable freight container 20500 includes the rear wall end frame 20530 joined with the roof structure 20504, the floor structure 20502 and the sidewall structures 20506-1 and 20506-2, where the rear wall end frame 20530 has the rear wall sill member 20548, the rear door header member 20546 and the rear wall corner posts 20532-1 and 20532-2 between the rear wall sill member 20548 and the rear door header member 20546. The door assembly 20540 also includes the hinge 20544 on each of the corner posts 20532-1 and 20532-2, where the hinge is as discussed herein. The first wing of the hinge 20544 is fastened to the corner posts 20532-1 and 20532-2. The first hinge pin pivotally connects the first wing fastened to the corner posts 20532-1 and 20532-2 to the second end of the first planar portion of the second wing 20603, as discussed herein.

[0124] The locking pin 20627 can travel through the at least one of the pair of hinge lugs having the surface defining the opening(s) through which the locking pin travels. The reversibly foldable freight container 20500 further includes the pair of seating blocks 20655, as discussed herein, fastened to the rear wall end frame 20530 to form the socket 20557 that receives and seats the hinge lugs of the hinge 20544. As discussed herein, once

the hinge 20544 is seated on the seating blocks 20655 in the socket 20557 the locking pin 20627 can travel (e.g., be moved up and/or down) to lock and un-lock the second wing of the hinge 20544 from the corner posts 20532-1 and 20532-2 of the reversibly foldable freight container 20500.

[0125] The reversibly foldable freight container 20500 further includes two of the door 20524 that are joined to the pair of hinge lugs of the hinge 20544 with the second hinge pin. Each of the doors 20524 pivots on the second hinge pin relative the pair of hinge lugs when the hinge lugs are locked to the corner posts 20532-1 and 20532-2 of the reversibly foldable freight container 20500 to allow the doors 20524 to extend adjacent the exterior surface 20508 of the sidewall structures 20506-1 and 20506-2. The door 20524 and the second wing of the hinge 20544 can also pivot on the first hinge pin when the hinge lugs are un-locked to the corner posts 20532-1 and 20532-2 of the reversibly foldable freight container 20500 to allow the door 20524 to travel into the volume 20512 of the reversibly foldable freight container 20500 and extend adjacent the interior surface 20510 of the sidewall structure 20506. Both of these embodiments are illustrated in Fig. 17.

[0126] The sidewall structures 20506-1 and 20506-2 of the reversibly foldable freight container 20500 further includes a latch 205100, where the latch 205100 can be used to engage and releasable hold the door 20524 adjacent the interior surface 20510 of the sidewall structures 20506-1 and 20506-2. The door 20524 is also shown with the locking rod 20558, as discussed herein, mounted to the door 20524. As illustrated in Fig. 20, the locking rod 20558 is shown in the first predetermined position on the door 20524 positioned along the exterior surface 20508 of the sidewall structures 20506 and the second predetermined position on the door 20524 positioned within the volume 20512 of the reversibly foldable freight container 20500.

[0127] Referring now to Figs. 21A-21C there is shown the front wall 21528 of the reversibly foldable freight container. The view of the front wall 21528 illustrated in Figs. 21A-21C is taken along the view lines 18-18 shown in Fig. 13. As illustrated, the front wall 21528 is joined with the roof structure, the floor structure and the sidewall structures, as illustrated in Fig. 13 and Fig. 17.

[0128] As illustrated, the front wall 21528 includes the front wall end frame 21533 having the front wall corner posts 21532-3 and 21532-4, a front door hinge 21400 on the front wall corner post 21532-3 and a front door 21402 joined to the front door hinge 21400. The front door 21402 can pivot on the front door hinge 21400 into the volume of the reversibly foldable freight container and extend adjacent the interior surface of the sidewall structure (as seen in Fig. 13).

[0129] The front wall end frame 21533 also includes the front wall sill member 21538 and a front wall header member 21536, where the front wall sill member 21538 and the front wall header member 21536 extend between

the front wall corner posts 21532-3 and 21532-4. The front wall sill member 21538 is connected to a first of the front wall corner post 21532 with a sill hinge 21710 that allows at least a portion of the front wall sill member 21538 to fold towards a second of the front wall corner post 21532. Similarly, the front wall header member 21536 is connected to the second of the front wall corner post 21532 with a header hinge 21712 that allows at least a portion of the front wall header member 1836 to fold towards the first of the front wall corner post 21532.

[0130] This ability of both the front wall header member 18236 and the front wall sill member 21538 to fold is illustrated in Figs. 21B and 21C. A pivot pin 21714 is used in the header hinge 21712 and the sill hinge 21710 to connect and allow for the rotation of the front wall sill member 21538 relative the first of the front wall corner post 21532, and the front wall header member 21536 relative the second of the front wall corner post 21532.

[0131] A first of a latch 21760-1 is used to releasably connect the front wall sill member 21538 to the first of the front wall corner post 21532-3. Similarly, a second of the latch 21760-2 is used to releasably connect the front wall header member 21536 to the second of the front wall corner post 21532. When in a locked position, the latch 21760 helps to prevent the front wall sill member 18236 and the front wall header member 21536 from moving relative their respective front wall corner posts 21532-3 and 21532-4. When in an unlocked position, the front wall header member 21536 and the front wall sill member 21538 can be folded towards their respective front wall corner posts 21532-3 and 21532-4 (illustrated in Figs. 21B and 21C).

[0132] For example, the latch 21760-1 and 21760-2 can releasably connect these structures via a bolt or a fastener, where the bolt or fastener may be removed to allow the front wall header member 21536 to pivot substantially ninety degrees so that the front wall header member 21536 is adjacent (e.g. is substantially parallel to, the front wall corner post 21532-3). Likewise, the bolt or fastener that releasably connects the front wall sill member 21538 and the front wall corner post 21532-3 may be removed to allow the front wall sill member 21538 to pivot substantially ninety degrees so that the front wall sill member 21538 is adjacent (e.g. is substantially parallel to, the front wall corner post 21532-4).

[0133] As illustrated in Fig. 21A, the front door 21402 further includes a planar truss 21406. The planar truss 21406 in its seated and locked position helps to provide an anti-racking function for the reversibly foldable freight container 1800.

[0134] As illustrated, the planar truss 21406 releasably seats against and extends from the front wall corner posts 21532-3 and 21532-4 across the front door 21402. The planar truss 21406 includes straight members 21410. As illustrated, the planar truss 21406 forms a triangle, as this shape will not change shape when the lengths of the sides of the front door 21402 are fixed. As illustrated, the straight members 21410 and the corner post 21532 form

nodes 18414 of the planar truss 21406 is all lie within a two dimensional plane of the front door 21402. The planar truss 21406 can be in the form of beam having a number of different cross-sectional profiles. Such cross-sectional profiles include, but are not limited to, I-beam, tubular, rectangular, triangular, and square, among others.

[0135] The front wall corner post 21532-4 also includes a socket 21420 in which an end portion 21422 of the planar truss 21406 releasably seats when the front door 21402 is in a first predetermined position. In the present embodiment, the first predetermined position is when the front door 21402 is seated within the front wall end frame 21533, where the front wall end frame 21533 includes the corner posts 21532, corner fittings 21534, the front wall header member 21536 and the front wall sill member 21538.

[0136] The socket 21420 can be formed from an extension 18450, such as a plate, that is applied to the surface of the front wall corner post 21532, a locking plate 21456, and a portion of the corner fitting 21534. When the end portion 21422 of the planar truss 21406 is seated in the socket 21420 the locking plate 21456 can be reversibly slid over the end portion 21422 to lock the planar truss 21406. From the locked position, the locking plate 21456 can be slid in an opposite direction of travel 21460 to unlock the end portion 21422 of the planar truss 21406.

[0137] When in the first predetermined position, a portion of the planar truss 21406 abuts a portion of the front door corner post 21532. As illustrated, this portion of the planar truss 21406 that abuts a portion of the front door corner post 21532 can be the end portion 21422. When abutted in the first predetermined position the planar truss 21406 can act in conjunction with the front wall end frame 21533 to minimize transverse racking of the reversibly foldable freight container.

[0138] Fig. 21A illustrates the front wall corner post 21532-3 on which the front door hinge 21400 is mounted also includes a seating block 21700 on which at least a portion of the front door hinge 21400 can seat when the door 21402 is in the first predetermined position. The seating block 21700 can help to support the weight of the front door 21402 when in the first predetermined position. The front wall 21528 further includes door locks 21716. The door locks 21716 include a bracket 21718 mounted to the front wall corner post 21532-4 and a slide member 21720. The bracket 21718 can be in the shape of a "C" that helps define a socket into which an extension member 21722 mounted to the front door 21402 can releasably seat.

[0139] When the slide member 21720 is in an open position the socket defined by the bracket 21718 can receive the extension member 21722. Once the extension member has been received in the socket, the slide member 21720 can be slid over at least a portion of the extension member 21722 so as to help "lock" the front door 21402 in its first predetermined position. When the front door 21402 is to be moved from its first predetermined position, the slide member 21720 and the locking

plate 21456 the can be slid so as to open their respective sockets thereby allowing the front door 21402 to rotate on the door hinge 21400.

[0140] Figs. 21A-21C show positioning the door 21402 of the front wall 21528 of a reversibly foldable freight container so that it can be inside a volume defined by the reversibly foldable freight container. As discussed herein, positioning the door 21402 of the front wall 21528 of the reversibly foldable freight container inside the volume defined by the reversibly foldable freight container includes unlocking the door 21402, and a portion of the door truss 21406, from the front wall end frame 21533. Once unlocked the door 21402 can pivot on the door hinge 21400 so as to position the door 21402 inside the volume defined by the reversibly foldable freight container. Fig. 21B illustrates this state. Fig. 21B also shows that once the door 21402 has swung clear of the front wall header member 21536 and the front wall sill member 21538, these members 21536 and 21538 can be folded towards their respective front wall corner post 21532. Fig. 21C illustrates the front wall header member 21536 and the front wall sill member 21538 folded relative their respective front wall corner post 21532.

[0141] Referring now to Figs. 22A-22D there is shown the rear wall 22526 of the reversibly foldable freight container 22500. As illustrated, the rear wall 22526 is joined with the roof structure 22504, the floor structure 22502 and the sidewall structures 22506-1 and 22506-2, where the roof structure 22504, the floor structure 22502, the interior surface 22511 of the sidewall structures 22506-1 and 22506-2 and the rear wall 22526 define a volume 22512 of the reversibly foldable freight container 22500.

[0142] As illustrated, the rear wall 22526 includes rear wall corner posts 22532-1 and 22532-2, a hinge 22344, as discussed herein, on the rear wall corner posts 22532-1 and 22532-2 and a rear wall door 22542 joined to the hinge 22344. Figs. 22A-22D show the hinge 22344 un-locked to the rear wall corner post in the second predetermined position so that the rear wall door 22542 can pivot into the volume 22512 of the reversibly foldable freight container 22500 and extend adjacent the interior surface 22511 of the sidewall structures 22506-1 and 22506-2.

[0143] Fig. 22A shows the reversibly foldable freight container 22500 in an unfolded state having a defined maximum width 22501 measured at a predetermined point on each of two of the rear wall corner posts 22506-1 and 22506-2. Specifically, the predetermined points on each of two of the rear wall corner posts 22506-1 and 22506-2 are defined by an external surface 22499 of the corner fittings 22534 and 22534 as provided in ISO 668 Fifth Edition 1995-12-15. For the various embodiments, in the unfolded state the defined maximum width 22501 of the reversibly foldable freight container 22500 is eight (8) feet as provided in ISO 668 Fifth Edition 1995-12-15.

[0144] The rear wall 22526 includes a rear wall end frame 22531 having two of the rear wall corner posts 22532-1 and 22532-1, a rear wall sill member 22548 and

a rear wall header member 22546. The rear wall sill member 22548 and the rear wall header member 22546 extend between the two of the rear wall corner posts 22532-1 and 22532-1. The rear wall sill member 22548 is connected to a first of the rear wall corner post 22532-2 with a sill hinge 22750 that allows at least a portion of the rear wall sill member 22548 to fold towards the first of the rear wall corner post 22532-1. The rear wall header member 22546 is connected to a second of the rear wall corner post 22532-1 with a header hinge 22752 that allows at least a portion of the rear wall header member 22546 to fold towards the second of the rear wall corner post 22532-1.

[0145] This ability of both the rear wall header member 22546 and the rear wall sill member 22548 to fold is illustrated in Figs. 22A and 22B. A pivot pin 22756 is used in the header hinge 22752 and the sill hinge 22750 to connect and allow for the rotation of the rear wall sill member 22548 relative the first of the rear wall corner post 22502-2, and the rear wall header member 22546 relative the second of the rear wall corner post 22536-2.

[0146] A first of a latch 22760-1 is used to releasably hold the rear wall sill member 22548 to the first of the front wall corner post 22532-1. Similarly, a second of the latch 22760-2 is used to releasably hold the rear wall header member 22546 to the second of the rear wall corner post 22532-2. When in a locked position, the latch 22760-1 and 22760-2 helps to prevent the rear wall sill member 22548 and the rear wall header member 22546 from moving relative their respective rear wall corner posts 22532-1 and 22532-2. When in an unlocked position, the rear wall header member 22546 and the rear wall sill member 22548 can be folded towards their respective rear wall corner post 22532-1 and 22532-2 (illustrated in Figs. 22A and 22B).

[0147] Figs. 22A-22D show positioning the rear doors 22542 of the rear wall 22526 of a reversibly foldable freight container 22500 so that it can be inside the volume 22512 defined by the reversibly foldable freight container 22500. As discussed herein, positioning the rear doors 22542 of the front wall 22526 of the reversibly foldable freight container 22500 inside the volume 22512 defined by the reversibly foldable freight container 22500 includes moving the locking rod 22558 into its second predetermined position where the cam 22560 is disengaged from the cam keeper 22566 and has a position relative the rear wall end frame 22531 that allows the cam 22560 and the door 22542 to travel through the area 22554, past the rear wall end frame 22531 and the cam keeper 22566, and into the volume 22512 of the reversibly foldable freight container 22500. Figs. 22A and 22B show that once the rear doors 22542 have swung clear of the rear wall header member 22546 and the rear wall sill member 22548, these members 22546 and 22548 can be folded towards their respective rear wall corner posts 22532-1 and 22532-2. Fig. 22B illustrates the rear wall header member 22546 and the rear wall sill member 22548 folded relative their respective front wall corner

posts 22532-1 and 22532-2.

[0148] Fig. 22A also illustrates that the floor structure 22502 includes the bottom side rails 22518-1 and 22518-2, where the plurality of jointed members in the floor structure 22502 are joined to the bottom side rails 22518-1 and 22518-2 with a hinge 22020. This structure will be more fully discussed with respect to Fig. 20. The reversibly foldable freight container 22500 also includes a beam box 22600. As illustrated, the beam box 22600 can be located in the bottom side rails 22518-1 and 22588-2, where the beam box includes surfaces defining an opening through which a lateral lock member 22602 can pass. For the present embodiment, the lateral lock member 22602 and the roof structure 22504 provide examples of structures, as discussed herein, that have a fixed length and/or width that cannot, or should not, be extended beyond the defined maximum width 22501 of the freight container 22500 due to the jointed member 2250 extending beyond its defined maximum length as defined in an unfolded state.

[0149] The lateral lock member 22602 can pass through the beam box 22600 in the bottom side rails 22518-1 and 22518-2 when the reversibly foldable freight container 22500 is in a folded state (e.g., the second predetermined state). An example of this is illustrated in Figs. 22C and 22D. The lateral lock member 22602 can have surfaces defining openings at predetermined locations along the lateral lock member 22602 through which a pin 22610 can be releasably seated. In one embodiment, the surfaces defining the openings through the lateral lock member 22602 allow for the lateral lock member 22602 to help maintain the reversibly foldable freight container 22500 in an unfolded state with the defined maximum width 22501 of eight (8) feet as provided in ISO 668 Fifth Edition 1995-12-15.

[0150] The roof structure 22504 of the reversibly foldable freight container 22500 further includes the beam box 22600 having surfaces defining an opening through which the lateral lock member 22602 can pass. The beam box 22600 of roof structure 22504 and the bottom side rails 22518-1 and 22518-2 help to define a minimum width of the reversibly foldable freight container 22500 when in its second predetermined state. An example of this second predetermined state is illustrated in Fig. 22D.

[0151] The roof structure 22504 may include a first roof panel section 22261, a second roof panel section 22263, and a third roof panel section 22265. The roof structure 22504 is reversibly foldable, as discussed herein. For example, as the joined member folds into the reversibly foldable freight container 22500, the roof panel sections 22261, 22263, 22265 may also fold into the reversibly foldable freight container 22500. The roof 22264 may be connected by one or more hinges to the first upper side rail 22516-1 and the second upper side rail 22516-2.

[0152] The third roof panel section 22265 can be positioned between the first roof panel section 22261 and the second roof panel section 22263. The third roof panel section 22265 is connected to the first roof panel section

22261 and the second roof panel section 22263 by one or more hinges. For one or more embodiments, the one or more hinges can be a flexure bearing (e.g. a living hinge) that extends along a longitudinal axis of the roof structure.

[0153] In the unfolded state, each of the roof panel sections 22261, 22263, 22265 may be substantially parallel to one another (e.g. each roof panel section may be substantially parallel to the jointed members in the first predetermined state). In the unfolded state the roof may be referred to as flat. In the second predetermined state, roof panel sections 22261, 22263 may be substantially parallel to one another, while each of the roof panel sections 22261, 22263 is substantially perpendicular to the roof panel section 22265. In the second predetermined state, the roof may be referred to as a partial rectangle.

[0154] The reversibly foldable freight container may include a flooring surface 22266. The flooring surface 22266 may include a first floor section 22267 and a second floor section 22269. The flooring surface 22266 is reversibly foldable, as discussed herein. For example, as the joined member folds into the reversibly foldable freight container 22500, the floor sections 22267, 22269 may also fold into the reversibly foldable freight container 22500. The flooring surface 22266 may be connected to a number the plurality of jointed members (e.g. adjacent the first bottom side rail 22506-1 and/or the second bottom side rail 22506-2). The reversibly foldable freight container 22500 also includes forklift pockets 22524. The forklift pockets 22524 may each be a respective opening in the first and second bottom side rails 22518-1 and 22518-2.

[0155] As discussed the reversibly foldable freight containers transition from the unfolded state to the second predetermined state without expanding the container beyond the unfolded state. In the unfolded state the reversibly foldable freight containers may be considered to be in its defined maximum width (e.g. an unfolded width) as seen in Fig 13. In the second predetermined state the reversibly foldable freight containers may have a width that is less than 60 percent of the defined maximum width. For example, in the second predetermined state the reversibly foldable freight containers may have a width that is 50 percent of the defined maximum width, 40 percent of the defined maximum width, 30 percent of the defined maximum width, 25 percent of the defined maximum width, or 20 percent of the defined maximum width. In the example where the reversibly foldable freight container has a width, in the second predetermined state, which is 25 percent of the defined maximum width, four folded reversibly foldable freight containers may be stored in the space of one unfolded container.

[0156] Freight containers can be exposed to a variety of forces when on a ship and/or vehicle. For example, on a ship they can be exposed to movement in six degrees of freedom: rolling, pitching, heaving, swaying, surging and yawing. These motions can impart transverse racking forces on the freight container, especially when they

are in a stacked configuration (e.g., fully loaded freight containers stacked ten high). These transverse racking forces can act to distort the walls and the end frames of the container. Referring now to Figs. 23A and 23B, there is shown an anti-racking support 23800 that can be used with the doors 23542 of the freight container (to be illustrated more fully herein). The anti-racking support 23800 includes a first lug 23802 and a second lug 23804, both of which extend from a mounting support 23806 in a common direction. The mounting support 23806 can have an elongate configuration with a square or rectangular cross-sectional shape (as seen). The mounting support 23806 can be welded and/or fastened (e.g., bolted or screwed) to the door 23542 (e.g., an inside surface as illustrated in Fig. 22A) of the freight container to mount the anti-racking support 23800 in such a way that the first lug 23802 and the second lug 23804 of the anti-racking support 23800 extend from a peripheral edge 23809 of the door 23542 of the freight container.

[0157] The first lug 23802 and the second lug 23804 each have a first surface 23810 that defines a recess 23812 relative a second surface 23814. The first surfaces 23810 and the second surfaces 23814 of each of the first lug 23802 and the second lug 23804 can be parallel to each other. When mounted to the door 23542 of the freight container, the recess 23812 of the first lug 23802 and the second lug 23804 can receive and straddle at least a portion of the second wing 23603 of the hinge 23544, as provided herein, when the door is in a closed and/or locked (cams of door engaged with the cam keepers) position. The first surface 23810 of the first lug 23802 and the second lug 23804 can also be directly adjacent to (e.g., no intervening structures) and/or make physical contact with the at least a portion of the second wing 23603 of the hinge when the door is in a closed and/or locked (cams of door engaged with the cam keepers) position. Similarly, the second surface 23814 of the first lug 23802 and the second lug 23804 can also be directly adjacent to and/or make physical contact with the "U"-channel 23549 of the corner post 23532 of the freight container when the door is in a closed and/or locked (cams of door engaged with the cam keepers). As a result, the anti-racking support 23800 can be directly adjacent to and/or in contact with both the hinge 23544 and the corner post 23532 when the cam is engaged with the cam keeper.

[0158] Each of the first lug 23802 and the second lug 23804 also include a third surface 23816 that extends between the first surface 23814 and the second surface 23810. The third surface 23816 helps to define the recess 23812. The third surface 23816 also can be directly adjacent to and/or make physical contact with at least a portion of the second wing 23603 of the hinge 23544 when the door 23542 is in a closed and/or locked (cams of door engaged with the cam keepers) position.

[0159] One of the anti-racking support 23800 can be mounted to the door 23542 of the freight container relative to each hinge 23544 (e.g., one anti-racking support

23800 for each hinge 23544). When the door 23542 of the freight container is closed and locked (cams of door engaged with the cam keepers) the anti-racking support 23800 can help to impede transverse racking of the freight container. For example, the anti-racking support 23800 can make contact with the U-channel 23549 during racking so as to help the doors 23542 keep parallel to the plane of the corner posts. The anti-racking support 23800 can also help to minimize mechanical stresses on the hinge 23544 of the door 23542 of the freight container when it is closed and locked (cams of door engaged with the cam keepers). One way this is accomplished is by the anti-racking support 23800 making contact with the hinge 23544 (e.g., the second wing 23603) and pressing the hinge 23544 against the U-channel 23549 so as to keep the hinge 23544 in its same relative position under non-racking conditions.

[0160] The use of the anti-racking support 23800 on the door 23542, as discussed herein, helps to limit the impact of racking forces the freight container. When in their closed and locked configuration, the anti-racking support 23800 and the locking rods help to maintain the relative perpendicular position of the doors 23542 under racking conditions (e.g., maintain their rectangular shape against the external racking forces). When racking is occurring the anti-racking support 23800 can provide a "node" through which racking forces (e.g., lateral forces) can be transferred through the doors 23542. These racking forces can be absorbed through either the anti-racking supports 23800 on the adjacent door and/or locking rods via the cam, cam keepers and end frame of the freight container. The use of the anti-racking support 23800 in conjunction with the hinge and freight container of the present discloser can allow a freight container, as provided herein, to meet the requirements of ISO 1496 (fifth edition 1990-08-15) and its amendments.

[0161] Referring now to Figs. 24A and 24B there is shown an embodiment of a door 24542 (as viewed from the "inside" of the freight container) with the anti-racking support 24800 positioned adjacent the hinge 24544 mounted to the corner post 24532. Figs. 24A and 24B also provide an illustration of an anti-racking block 24820 mounted to the doors 24542-1 and 24542-2. The anti-racking block 24820 includes a tab 24822 and a slot 24824 to releasably receive the tab 24822. As illustrated, the tab 24822 extends from the first of the door 24542-1 and the slot 24824 extends from the second of the door 24542-2 such that the tab 24822 can seat within the slot 24824 (e.g., completely within the slot 24824) when the cam 24560 of each of the first of the door 24542-1 and the second of the door 24542-2 are engaged with their respective cam keeper.

[0162] The anti-racking block 24820 helps to limit the impact of racking forces the freight container. The anti-racking block 24820 also helps to maintain the perpendicular symmetry of the end frame and the doors 24542 of the freight container during transverse racking. As illustrated, the anti-racking block 24820 can transfer forc-

es in both the horizontal and vertical planes (e.g., via all three sides of the slot 24824). This helps to keep the doors 24542-1 and 24542-2 in a common plane and helps to maintain the perpendicular symmetry of the end frame and the doors 24542 of the freight container during transverse racking. This also helps to make the two doors (24542-1 and 24542-2) act as one large structure instead of two independent structures.

[0163] So, the anti-racking block 24820 used in conjunction with the anti-racking support 24800 and the locking rods helps to maintain the relative symmetrical position of the doors 24542 under racking conditions (e.g., maintain their rectangular shape against the external racking forces). For example, when racking is occurring the anti-racking support 24800 and the anti-racking block 24820 can provide the "nodes" through which racking forces (e.g., lateral forces) can be transferred through the doors 24542. These racking forces can be absorbed through either the anti-racking supports 24800 on the adjacent door and/or locking rods via the cam, cam keepers and end frame of the freight container.

[0164] Referring now to Figs. 25A-25B, there is shown an additional embodiment of the hinge 25544 and corner post 25532 of the present disclosure. Fig. 25A shows an exploded partial view of the corner post 25532, an "H"-Block 25830 and the hinge 25544 of the present disclosure. As illustrated, the H-Block 25830 can be positioned between J-Bar 25547 and the U-Channel 25549 of the corner post 25532. The H-Block 25830 can be fastened (e.g., welded) to the corner post 25532. Specifically, the H-Block 25830 can be welded to the J-Bar 25547 of the corner post 25532. To accommodate the H-Block 25830 portions of the U-Channel 25549 are removed, where the edges of the U-channel 25549 can abut and, if desired, be welded to the H-Block 25830. H-Blocks 25830 located at the top and bottom of the corner post 25532 can also be welded directly to the top and bottom corner fittings.

[0165] When the hinge 25544 is secured to the U-channel 25549, as discussed herein, the H-Block 25830 can help to protect the hinge 25544 from forces (e.g., stacking forces) that are transmitted through the corner post 25532. Specifically, the H-Block 25830 can help to transmit the forces around the hinge 25544. The H-Block 25830 also serves as a seating block for the hinge 25544 (e.g., the hinge 25544 can rest in the opening of the H-Block 25830 on one end and the other end of the H-Block 25830 provides an open space for a locking pin 25832, as discussed herein. As such, the H-Block 25830 can help to protect both the locking pin 25832 and the hinge 25544. The H-Block 25830 also includes notches 25834 that extend in from the legs of the "H," where these notches 25834 help to relieve stresses formed when the freight container is stacked (confirmed by Finite Element Analysis modeling).

[0166] Both the U-Channel 25549 and the H-Block 25830 also include a surface 25836 that defines a hole 25840 through the U-Channel 25549 and the H-Block

25830. The hole 25840 is sized to receive and reversibly pass at least a portion of a locking pin 25832. The locking pin 25832 is used to releasably lock the second wing 25603 of the hinge 25544 to both the corner post 25532 and the H-Block 25830. The locking pin 25832 is manipulated from the inside of the freight container.

[0167] The locking pin 25832 can be positioned through the hole 25840 so as to releasably lock the second wing 25603 of the hinge 25544 to both the corner post 25532 and the H-Block 25830, and removed from the hole 25840 so as to unlock the second wing 25603 of the hinge 25544 from both the corner post 25532 and the H-Block 25830. Specifically, the locking pin 25832 can be retracted from the hole 25840 so as to release the second wing 25603 of the hinge 25544 from the corner post 25532 and the H-Block 25830. Once released, the second wing 25603 can rotate around first hinge pin 25605. To lock the second wing 25603 to the corner post 25532 and the H-Block 25830, the locking pin 25832 is aligned and reinserted through the hole 25840 of the corner post 25532 and the H-Block 25830. As discussed herein, the first wing 25601 can be fastened to the portion of the U channel 25549 and the H-Block 25830 by a welding (e.g., arc-welding) process.

[0168] Fig. 25B provides an exploded view of the hinge 25544. As illustrated, the hinge 25544 includes the first wing 25601 and the second wing 25603, where the first wing 25601 and the second wing 25603 are pivotally connected by the first hinge pin 25605. For the various embodiments, the second wing 25603 includes the first planar portion 25607 with the first end 25609 and the second end 25611 and the second planar portion 25613 that extends perpendicular from the first end 25609 of the first planar portion 25607. The first hinge pin 25605 pivotally connects the first wing 25601 to the second end 25611 of the first planar portion 25607. As illustrated, a portion of the first planar portion 25607 of the second wing 25603 passes through an opening defined in the first wing 25601 so as to allow the second end 25611 of the first planar portion 25607 of the second wing 25603 to pivotally connect to the first hinge pin 25605 and the first wing 25601.

[0169] The hinge 25544 also includes a pair of hinge lugs 25615 that extend from the second planar portion 25613 of the second wing 25603. Each of the hinge lugs 25615 has a first set of surfaces 25617 defining openings 25619 through which the second hinge pin 25621 passes. For the various embodiments, the first wing 25601 and the second planar portion 25613 of the second wing 25603 include a surface 25640 that defines an opening 25642 through which the locking pin 25832 reversibly travels.

[0170] The second planar portion 25613 of the second wing 25603 includes the first major surface 25629 and the second major surface 25631 opposite the first major surface 25629. The pair of hinge lugs 25615 extends from the first major surface 25629 of the second planar portion 25613. The first wing 25601 has the first major surface 25633 and the second major surface 25635 op-

posite the first major surface 25633. In a first predetermined position the first wing 25601 is perpendicular to the first planar portion 25607 of the second wing 25603 and the first major surface 25633 of the first wing 25601 is directly opposite and parallel with the second major surface 25631 of the second planar portion 25613. As discussed herein, the first predetermined position can occur with the first wing 25601 attached to the corner post 25532 of the freight container and the second wing 25603 of the hinge 25544 positioned against (e.g., adjacent to and in at least partial contact with) the corner post.

[0171] The first wing 25601 has a first end 25637 and a second end 25639. The first hinge pin 25605 pivotally connects the first end 25637 of the first wing 25601 to the second end 25611 of the first planar portion 25607 of the second wing 25603. The second planar portion 25613 has an end 25643 that is distal to the first end 25609 of the first planar portion 25607 and the pair of hinge lugs 25615 extending from the second planar portion 25613 have a first peripheral edge 25645, where the end 25643 of the second planar portion 25613 and the first peripheral edge 25645 of the hinge lugs 25615 lay in a common plane.

[0172] The hinge 25544 further includes a support block 25650. Support block includes a surface 25652 that defines an opening 25654. Support block 25650 can be positioned against the second planar portion 25613 of the second wing 25603, where the opening 25654 concentrically aligns with the opening 25642 through which the locking pin 25832 travels. Support block 25650 can be welded to the second planar portion 25613 of the second wing 25603. Support block 25650 can also be chamfered so as to allow the door of the freight container to swing unencumbered.

[0173] The components of the reversibly foldable freight container provided herein can be formed of materials suitable for and built so as to comply with ISO standard 1496-1 (fifth edition 1990-08-15) and its amendments. For the various embodiments, the components of the reversibly foldable freight container discussed herein can be formed of steel. Examples of such steel include, but are not limited to, 'weathering steel' as specified within standard BS EN 10025-5:2004, which is also known as CORTEN steel. For the various embodiments, the floor of the reversibly foldable freight container can be made of planking wood or plywood. In addition, gaskets as are known to be used with freight containers can be used with the reversibly foldable freight container of the present disclosure as needed.

Claims

1. A joined member (474, 674, 774, 874, 974, 1174, 1274, 1374), comprising:

a first elongate section (476, 576, 676, 776, 876, 1176) having a first surface (7108, 8108) defin-

ing a first oblong opening (7110, 8110, 11110, 12110), a first end (478) and a second end (480) opposite the first end (478), the second end (480) joined to a first hinge (482, 682, 882, 1182);

a second elongate section (477, 577, 677, 777, 877, 1177) having a second surface (7114, 8114) defining a second oblong opening (7114, 8114, 11114, 12114), a first end (486) and a second end (488) opposite the first end (486), the second end (488) joined to a second hinge (490, 690, 890, 1182);

a fastener (6100, 7100, 8100, 11100, 12100) passing through the first oblong opening (7110, 8110, 11110, 12110) and the second oblong opening (7114, 8114, 11114, 12114) to connect the first elongate section (476, 576, 676, 776, 876, 1176) and the second elongate section (477, 577, 677, 777, 877, 1177); and

an abutment joint (100, 300, 400, 600, 700) having a first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) and a second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104), where the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) forms a part of the first elongate section (476, 576, 676, 776, 876, 1176), the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) having a projection (106) that extends from first abutment member shoulders (108), the projection (106) having a distal end (110) from which a first surface (112) and a second surface (114) extend towards the first abutment member shoulders (108) at an acute angle; and where the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) forms a part of the second elongate section (477, 577, 677, 777, 877, 1177), the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) having a socket (118) into which the projection (106) of the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) releasably seats, the socket (118) having a first surface (120) and a second surface (122) that extend away from a first end (124) of the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) at an acute angle and the first end (124) of the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) includes second abutment member shoulders (428) that extends from the socket (118) such that when the projection (106) of the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) seats in the socket (118) of the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) the second surface (114) of the projection (106) and the second surface (122) of the socket (118) touch, and the

- second abutment member shoulders (428) and the first abutment member shoulders (108) touch, and where the first oblong opening (7110, 8110, 11110, 12110) and the second oblong opening (7114, 8114, 11114, 12114) move relative each other and the fastener (6100, 7100, 8100, 11100, 12100) as the joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) transitions from a first predetermined state having a minimum overlap of the first oblong opening (7110, 8110, 11110, 12110) and the second oblong opening (7114, 8114, 11114, 12114) and the projection (106) of the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) seated in socket (118) of the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) towards a second predetermined state having a maximum overlap of the first oblong opening (7110, 8110, 11110, 12110) and the second oblong opening (7114, 8114, 11114, 12114) relative the minimum overlap and the projection (106) of the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) unseated from the socket (118) of the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) and where in the first predetermined state the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) and the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) are under a compressive force against each other while the first surface (7108, 8108) defining the first oblong opening (7110, 8110, 11110, 12110) and the second surface (7114, 8114) defining the second oblong opening (7114, 8114, 11114, 12114) apply a shearing stress to the fastener (6100, 7100, 8100, 11100, 12100).
2. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 1, where the socket (118) having the first surface (120) and the second surface (122) that extend away from the first end (124) of the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) has an acute angle that is equal to the acute angle of the first surface (112) and the second surface (114) of the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) and when the projection (106) of the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) seats in the socket (118) of the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) the first surface (112) of the projection (106) and the first surface (120) of the socket (118) touch, the second surface (114) of the projection (106) and the second surface of the socket (118) touch, and the second abutment member shoulders (428) and the first abutment member shoulders (108) touch.
 3. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 1, where in the first predetermined state a distance between the second end (480) of the first elongate section (476, 576, 676, 776, 876, 1176) and the second end (488) of the second elongate section (477, 577, 677, 777, 877, 1177) provides a defined maximum length of the joined member (474, 674, 774, 874, 974, 1174, 1274, 1374), where the distance between the second end (480) of the first elongate section (476, 576, 676, 776, 876, 1176) and the second end (488) of the second elongate section (477, 577, 677, 777, 877, 1177) does not exceed the defined maximum length as joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) transitions from the first predetermined state towards the second predetermined state.
 4. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 1, where the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) and the second abutment member define a first point of rotation for the first elongate section (476, 576, 676, 776, 876, 1176) and the second elongate section (477, 577, 677, 777, 877, 1177); and a second end (7118, 11118) of both the first surface (7108, 8108) and the second surface (7114, 8114), when positioned against the fastener (6100, 7100, 8100, 11100, 12100), define a second point of rotation for the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) and the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) that is different than the first point of rotation.
 5. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 4, where the first elongate section (476, 576, 676, 776, 876, 1176) and the second elongate section (477, 577, 677, 777, 877, 1177) turn on the first point of rotation prior to turning on the second point of rotation as the joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) transitions from the first predetermined state towards the second predetermined state.
 6. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 4, where a first end (1116, 7116, 8116) of each of the first surface (7108, 8108) and the second surface (7114, 8114) does not contact the fastener (6100, 7100, 8100, 11100, 12100) when the second end (7118, 11118) of both the first surface and the second surface are seated against the fastener (6100, 7100, 8100, 11100, 12100).
 7. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 3, where in the first predetermined state the fastener (6100, 7100, 8100, 11100, 12100), the first abutment member (102, 202, 302, 402, 502, 602, 702, 802, 1102) and the second end

- (480) of the first elongate section (476, 576, 676, 776, 876, 1176), all in a common plane, define a right triangle of the first elongate section (476, 576, 676, 776, 876, 1176), where a hypotenuse of the right triangle is between the fastener (6100, 7100, 8100, 11100, 12100) and the second end (480) of the first elongate section (476, 576, 676, 776, 876, 1176), and a first leg of the right triangle is defined by the first abutment member end and a perpendicular intersection of a first line extending from the second end (480) of the first elongate section (476, 576, 676, 776, 876, 1176) and a second line extending from a geometric center of the fastener (6100, 7100, 8100, 11100, 12100), where the first and second lines are in the common plane.
8. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 7, where in the first predetermined state the fastener (6100, 7100, 8100, 11100, 12100), the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) and the second end (488) of the second elongate section (477, 577, 677, 777, 877, 1177), all in a common plane, define a right triangle of the second elongate section (477, 577, 677, 777, 877, 1177), where a hypotenuse of the right triangle is between the fastener (6100, 7100, 8100, 11100, 12100) and the second end (488) of the second elongate section (477, 577, 677, 777, 877, 1177), and a first leg of the right triangle is defined by the second abutment member end and a perpendicular intersection of a first line extending from the second end (488) of the second elongate section (477, 577, 677, 777, 877, 1177) and a second line extending from a geometric center of the fastener (6100, 7100, 8100, 11100, 12100), where the first and second lines are in the common plane.
9. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 1, where the distal end (110) of the projection (106) defines a planar surface that forms an obtuse angle with the first surface (112) of the projection (106) and where the planar surface forms a ninety degree angle with the second surface (114) of the projection (106).
10. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 9, where the socket (118) of the second abutment member (104, 204, 304, 404, 504, 604, 704, 804, 1104) includes a second end having a planar surface that is a mirror image of the planar surface of the distal end (110) of the projection (106).
11. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 1, where the first abutment member shoulders (108) include a first shoulder surface (138) that extends from the first surface (112) of the projection (106) and a second shoulder sur-

face (140) that extends from the second surface (114) of the projection (106).

12. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 11, where the second shoulder surface (140) and the second surface (114) of the projection (106) form a ninety degree angle.
13. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of claim 11, where the first shoulder surface (138) and the first surface (112) of the projection (106) form an obtuse angle.
14. The joined member (474, 674, 774, 874, 974, 1174, 1274, 1374) of any one of the preceding claims, where the first oblong opening (7110, 8110, 11110, 12110) and the second oblong opening (7114, 8114, 11114, 12114) have an obround shape.

Patentansprüche

1. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374), umfassend:
- einen ersten länglichen Abschnitt (476, 576, 676, 776, 876, 1176) mit einer ersten Oberfläche (7108, 8108), die eine erste längliche Öffnung (7110, 8110, 11110, 12110), ein erstes Ende (478) und ein zweites Ende (480) gegenüber dem ersten Ende (478) definiert, wobei das zweite Ende (480) mit einem ersten Scharnier (482, 682, 882, 1182) verbunden ist;
- einen zweiten länglichen Abschnitt (477, 577, 677, 777, 877, 1177) mit einer zweiten Oberfläche (7114, 8114), die eine zweite längliche Öffnung (7114, 8114, 11114, 12114), ein erstes Ende (486) und ein zweites Ende (488) gegenüber dem ersten Ende (486) definiert, wobei das zweite Ende (488) mit einem zweiten Scharnier (490, 690, 890, 1182) verbunden ist;
- ein Befestigungselement (6100, 7100, 8100, 11100, 12100), das durch die erste längliche Öffnung (7110, 8110, 11110, 12110) und die zweite längliche Öffnung (7114, 8114, 11114, 12114) verläuft, um den ersten länglichen Abschnitt (476, 576, 676, 776, 876, 1176) und den zweiten länglichen Abschnitt (477, 577, 677, 777, 877, 1177) zu verbinden; und
- eine Anlageverbindung (100, 300, 400, 600, 700) mit einem ersten Anlageteil (102, 202, 302, 402, 502, 602, 702, 802, 1102) und einem zweiten Anlageteil (104, 204, 304, 404, 504, 604, 704, 804, 1104), wobei das erste Anlageteil (102, 202, 302, 402, 502, 602, 702, 802, 1102) einen Teil des ersten länglichen Abschnitts (476, 576, 676, 776, 876, 1176) bildet, wobei das erste Anlageteil (102, 202, 302, 402, 502,

602, 702, 802, 1102) einen Vorsprung (106) aufweist, der sich von den Schultern des ersten Anlageteils (108) erstreckt, der Vorsprung (106) ein distales Ende (110) aufweist, von dem sich eine erste Oberfläche (112) und eine zweite Oberfläche (114) in einem spitzen Winkel zu den Schultern des ersten Anlageteils (108) erstrecken; und wobei das zweite Anlageteil (104, 204, 304, 404, 504, 604, 704, 804, 1104) einen Teil des zweiten länglichen Abschnitts (477, 577, 677, 777, 877, 1177) bildet, das zweite Anlageteil (104, 204, 304, 404, 504, 604, 704, 804, 1104) eine Buchse (118) aufweist, in die der Vorsprung (106) des ersten Anlageteils (102, 202, 302, 402, 502, 602, 702, 802, 1102) lösbar sitzt, wobei die Buchse (118) eine erste Oberfläche (120) und eine zweite Oberfläche (122) aufweist, die sich von einem ersten Ende (124) des zweiten Anlageteils (104, 204, 304, 404, 504, 604, 704, 804, 1104) in einem spitzen Winkel weg erstrecken, und das erste Ende (124) des zweiten Anlageteils (104, 204, 304, 404, 504, 604, 704, 804, 1104) Schultern des zweiten Anlageteils (428) umfasst, die sich von der Buchse (118) erstrecken, so dass, wenn der Vorsprung (106) des ersten Anlageteils (102, 202, 302, 402, 502, 602, 702, 802, 1102) in der Buchse (118) des zweiten Anlageteils (104, 204, 304, 404, 504, 604, 704, 804, 1104) sitzt, sich die zweite Oberfläche (114) des Vorsprungs (106) und die zweite Oberfläche (122) der Buchse (118) berühren, und sich die Schultern des zweiten Anlageteils (428) und die Schultern des ersten Anlageteils (108) berühren, und wobei sich die erste längliche Öffnung (7110, 8110, 11110, 12110) und die zweite längliche Öffnung (7114, 8114, 11114, 12114) relativ zueinander und zum Befestigungselement (6100, 7100, 8100, 11100, 12100) bewegen, wenn das verbundene Element (474, 674, 774, 874, 974, 1174, 1274, 1374) von einem ersten vorbestimmten Zustand mit einer minimalen Überlappung der ersten länglichen Öffnung (7110, 8110, 11110, 12110) und der zweiten länglichen Öffnung (7114, 8114, 11114, 12114) und des in der Buchse (118) des zweiten Anlageteils (104, 204, 304, 404, 504, 604, 704, 804, 1104) sitzenden Vorsprungs (106) des ersten Anlageteils (102, 202, 302, 402, 502, 602, 702, 802, 1102) zu einem zweiten vorbestimmten Zustand mit einer maximalen Überlappung der ersten länglichen Öffnung (7110, 8110, 11110, 12110) und der zweiten länglichen Öffnung (7114, 8114, 11114, 12114) relativ zur minimalen Überlappung und dem von der Buchse (118) des zweiten Anlageteils (104, 204, 304, 404, 504, 604, 704, 804, 1104) gelösten Vorsprung (106) des ersten Anlageteils (102, 202, 302, 402, 502, 602, 702,

802, 1102) übergeht, und wobei im ersten vorbestimmten Zustand das erste Anlageteil (102, 202, 302, 402, 502, 602, 702, 802, 1102) und das zweite Anlageteil (104, 204, 304, 404, 504, 604, 704, 804, 1104) unter einer Druckkraft gegeneinander stehen, während die erste Oberfläche (7108, 8108), die die erste längliche Öffnung (7110, 8110, 11110, 12110) definiert, und die zweite Oberfläche (7114, 8114), die die zweite längliche Öffnung (7114, 8114, 11114, 12114) definiert, eine Scherspannung auf das Befestigungselement (6100, 7100, 8100, 11100, 12100) ausüben.

2. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 1, wobei die Buchse (118) mit der ersten Oberfläche (120) und der zweiten Oberfläche (122), die sich vom ersten Ende (124) des zweiten Anlageteils (104, 204, 304, 404, 504, 604, 704, 804, 1104) weg erstrecken, einen spitzen Winkel aufweist, der gleich dem spitzen Winkel der ersten Oberfläche (112) und der zweiten Oberfläche (114) des ersten Anlageteils (102, 202, 302, 402, 502, 602, 702, 802, 1102) ist, und wenn der Vorsprung (106) des ersten Anlageteils (102, 202, 302, 402, 502, 602, 702, 802, 1102) in der Buchse (118) des zweiten Anlageteils (104, 204, 304, 404, 504, 604, 704, 804, 1104) sitzt, die erste Oberfläche (112) des Vorsprungs (106) und die erste Oberfläche (120) der Buchse (118) sich berühren, die zweite Oberfläche (114) des Vorsprungs (106) und die zweite Oberfläche der Buchse (118) sich berühren, und die Schultern des zweiten Anlageteils (428) und die Schultern des ersten Anlageteils (108) sich berühren.
3. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 1, wobei im ersten vorbestimmten Zustand ein Abstand zwischen dem zweiten Ende (480) des ersten länglichen Abschnitts (476, 576, 676, 776, 876, 1176) und dem zweiten Ende (488) des zweiten länglichen Abschnitts (477, 577, 677, 777, 877, 1177) eine definierte maximale Länge des verbundenen Elements (474, 674, 774, 874, 974, 1174, 1274, 1374) bereitstellen, wobei der Abstand zwischen dem zweiten Ende (480) des ersten länglichen Abschnitts (476, 576, 676, 776, 876, 1176) und dem zweiten Ende (488) des zweiten länglichen Abschnitts (477, 577, 677, 777, 877, 1177) die definierte maximale Länge nicht überschreitet, wenn verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) vom ersten vorbestimmten Zustand zum zweiten vorbestimmten Zustand übergeht.
4. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 1, wobei das erste Anlageteil (102, 202, 302, 402, 502, 602, 702, 802,

- 1102) und das zweite Anlageteil einen ersten Drehpunkt für den ersten länglichen Abschnitt (476, 576, 676, 776, 876, 1176) und den zweiten länglichen Abschnitt (477, 577, 677, 777, 877, 1177) definieren; und
ein zweites Ende (7118, 11118) sowohl der ersten Oberfläche (7108, 8108) als auch der zweiten Oberfläche (7114, 8114), wenn es gegen das Befestigungselement (6100, 7100, 8100, 11100, 12100) positioniert ist, einen zweiten Drehpunkt für das erste Anlageteil (102, 202, 302, 402, 502, 602, 702, 802, 1102) und das zweite Anlageteil (104, 204, 304, 404, 504, 604, 704, 804, 1104) definieren, der anders als der erste Drehpunkt ist.
5. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 4, wobei der erste längliche Abschnitt (476, 576, 676, 776, 876, 1176) und der zweite längliche Abschnitt (477, 577, 677, 777, 877, 1177) den ersten Drehpunkt einschalten, bevor der zweite Drehpunkt eingeschaltet wird, wenn das verbundene Element (474, 674, 774, 874, 974, 1174, 1274, 1374) vom ersten vorbestimmten Zustand zum zweiten vorbestimmten Zustand übergeht.
6. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 4, wobei jeweils ein erstes Ende (1116, 7116, 8116) der ersten Oberfläche (7108, 8108) und der zweiten Oberfläche (7114, 8114) das Befestigungselement (6100, 7100, 8100, 11100, 12100) nicht berührt, wenn das zweite Ende (7118, 11118) sowohl der ersten Oberfläche als auch der zweiten Oberfläche gegen das Befestigungselement (6100, 7100, 8100, 11100, 12100) sitzt.
7. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 3, wobei im ersten vorbestimmten Zustand das Befestigungselement (6100, 7100, 8100, 11100, 12100) das erste Anlageteil (102, 202, 302, 402, 502) ist 602, 702, 802, 1102) und das zweite Ende (480) des ersten länglichen Abschnitts (476, 576, 676, 776, 876, 1176) alle in einer gemeinsamen Ebene ein rechtwinkliges Dreieck des ersten länglichen Abschnitts (476, 576, 676, 776, 876, 1176) definieren, wobei sich eine Hypotenuse des rechtwinkligen Dreiecks zwischen dem Befestigungselement (6100, 7100, 8100, 11100, 12100) und dem zweiten Ende (480) des ersten länglichen Abschnitts (476, 576, 676, 776, 876, 1176) befindet, und ein erstes Bein des rechtwinkligen Dreiecks durch das erste Ende des Anlageteils und einen senkrechten Schnittpunkt einer sich vom zweiten Ende (480) des ersten länglichen Abschnitts (476, 576, 676, 776, 876, 1176) erstreckenden ersten Linie und einer sich von einem geometrischen Zentrum des Befestigungselements (6100, 7100, 8100, 11100, 12100) erstreckenden zweiten Linie definiert wird, wobei die erste und zweite Linie in der gemeinsamen Ebene liegen.
8. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 7, wobei im ersten vorbestimmten Zustand das Befestigungselement (6100, 7100, 8100, 11100, 12100) das zweite Anlageteil (104, 204, 304, 404, 504) ist 604, 704, 804, 1104) und das zweite Ende (488) des zweiten länglichen Abschnitts (477, 577, 677, 777, 877, 1177) alle in einer gemeinsamen Ebene ein rechtwinkliges Dreieck des zweiten länglichen Abschnitts (477, 577, 677, 777, 877, 1177) definieren, wobei sich eine Hypotenuse des rechtwinkligen Dreiecks zwischen dem Befestigungselement (6100, 7100, 8100, 11100, 12100) und dem zweiten Ende (488) des zweiten länglichen Abschnitts (477, 577, 677, 777, 877, 1177) befindet, und ein erstes Bein des rechtwinkligen Dreiecks durch das zweite Ende des Anlageteils und einen senkrechten Schnittpunkt einer sich vom zweiten Ende (488) des zweiten länglichen Abschnitts (477, 577, 677, 777, 877, 1177) erstreckenden ersten Linie und einer sich von einem geometrischen Zentrum des Befestigungselements (6100, 7100, 8100, 11100, 12100) erstreckenden zweiten Linie definiert wird, wobei die erste und zweite Linie in der gemeinsamen Ebene liegen.
9. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 1, wobei das distale Ende (110) des Vorsprungs (106) eine ebene Oberfläche definiert, die mit der ersten Oberfläche des Vorsprungs (106) einen stumpfen Winkel bildet (112), und wobei die ebene Oberfläche einen Winkel von neunzig Grad mit der zweiten Oberfläche (114) des Vorsprungs (106) bildet.
10. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 9, wobei die Buchse (118) des zweiten Anlageteils (104, 204, 304, 404, 504, 604, 704, 804, 1104) ein zweites Ende mit einer ebenen Oberfläche umfasst, die ein Spiegelbild der planaren Oberfläche des distalen Endes (110) des Vorsprungs (106) ist.
11. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 1, wobei die Schultern des ersten Anlageteils (108) eine sich von der ersten Oberfläche (112) des Vorsprungs (106) erstreckende erste Schulterfläche (138) und eine sich von der zweiten Oberfläche (114) des Vorsprungs (106) erstreckende zweite Schulterfläche (140) aufweisen.
12. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 11, wobei die zweite Schulterfläche (140) und die zweite Oberflä-

che (114) des Vorsprungs (106) einen Winkel von neunzig Grad bilden.

13. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) nach Anspruch 11, wobei die erste Schulterfläche (138) und die erste Oberfläche (112) des Vorsprungs (106) einen stumpfen Winkel bilden. 5
14. Verbundenes Element (474, 674, 774, 874, 974, 1174, 1274, 1374) eines der vorhergehenden Ansprüche, wobei die erste längliche Öffnung (7110, 8110, 11110, 12110) und die zweite längliche Öffnung (7114, 8114, 11114, 12114) eine länglich runde Form aufweisen. 10 15

Revendications

1. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374), comprenant : 20
 - une première section allongée (476, 576, 676, 776, 876, 1176) ayant une première surface (7108, 8108) définissant une première ouverture oblongue (7110, 8110, 11110, 12110), une première extrémité (478) et une seconde extrémité (480) opposée à la première extrémité (478), la seconde extrémité (480) étant articulée à une première charnière (482, 682, 882, 1182) ; 25 30
 - une seconde section allongée (477, 577, 677, 777, 877, 1177) ayant une seconde surface (7114, 8114) définissant une seconde ouverture oblongue (7114, 8114, 11114, 12114), une première extrémité (486) et une seconde extrémité (488) opposée à la première extrémité (486), la seconde extrémité (488) étant articulée à une seconde charnière (490, 690, 890, 1182) ; 35 40
 - une attache (6100, 7100, 8100, 11100, 12100) traversant la première ouverture oblongue (7110, 8110, 11110, 12110) et la seconde ouverture oblongue (7114, 8114, 11114, 12114) pour relier la première section allongée (476, 576, 676, 776, 876, 1176) et la seconde section allongée (477, 577, 677, 777, 877, 1177) ; et 45 50
 - une articulation de butée (100, 300, 400, 600, 700) ayant un premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) et un second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104), où le premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) fait partie de la première section allongée (476, 576, 676, 776, 876, 1176), le premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) ayant une saillie (106) qui s'étend depuis les épaulements du premier élément de butée (108), la saillie (106) ayant une extrémité distale (110) à partir de laquelle une 55

première surface (112) et une seconde surface (114) s'étendent vers les épaulements du premier élément de butée (108) selon un angle aigu ; et où le second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104) fait partie de la seconde section allongée (477, 577, 677, 777, 877, 1177), le second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104) ayant une douille (118) dans laquelle la saillie (106) du premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) est logée de manière amovible, la douille (118) ayant une première surface (120) et une seconde surface (122) qui s'étendent à distance d'une première extrémité (124) du second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104) selon un angle aigu et la première extrémité (124) du second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104) comporte des épaulements du second élément de butée (428) qui s'étendent depuis la douille (118) de sorte que lorsque la saillie (106) du premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) est logée dans la douille (118) du second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104), la seconde surface (114) de la saillie (106) et la seconde surface (122) de la douille (118) se touchent, et les épaulements du second élément de butée (428) et les épaulements du premier élément de butée (108) se touchent, et où la première ouverture oblongue (7110, 8110, 11110, 12110) et la seconde ouverture oblongue (7114, 8114, 11114, 12114) se déplacent l'une par rapport à l'autre et l'attache (6100, 7100, 8100, 11100, 12100) en tant qu'élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) passe d'un premier état prédéterminé ayant un chevauchement minimal de la première ouverture oblongue (7110, 8110, 11110, 12110) et de la seconde ouverture oblongue (7114, 8114, 11114, 12114) et de la saillie (106) du premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) logée dans la douille (118) du second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104) vers un second état prédéterminé ayant un chevauchement maximal de la première ouverture oblongue (7110, 8110, 11110, 12110) et de la seconde ouverture oblongue (7114, 8114, 11114, 12114) par rapport au chevauchement minimal et à la saillie (106) du premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) délogée de la douille (118) du second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104) et où dans le premier état prédéterminé, le premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) et le

- second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104) sont soumis à une force de compression l'un contre l'autre tandis que la première surface (7108, 8108) définissant la première ouverture oblongue (7110, 8110, 11110, 12110) et la seconde surface (7114, 8114) définissant la seconde ouverture oblongue (7114, 8114, 11114, 12114) appliquent une contrainte de cisaillement à l'attache (6100, 7100, 8100, 11100, 12100).
2. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 1, où la douille (118) ayant la première surface (120) et la seconde surface (122) qui s'étendent à distance de la première extrémité (124) du second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104) a un angle aigu qui est égal à l'angle aigu de la première surface (112) et de la seconde surface (114) du premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) et lorsque la saillie (106) du premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) est logée dans la douille (118) du second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104), la première surface (112) de la saillie (106) et la première surface (120) de la douille (118) se touchent, la seconde surface (114) de la saillie (106) et la seconde surface de la douille (118) se touchent, et les épaulements du second élément de butée (428) et les épaulements du premier élément de butée (108) se touchent.
 3. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 1, où dans le premier état prédéterminé, une distance entre la seconde extrémité (480) de la première section allongée (476, 576, 676, 776, 876, 1176) et la seconde extrémité (488) de la seconde section allongée (477, 577, 677, 777, 877, 1177) fournit une longueur maximale définie de l'élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374), où la distance entre la seconde extrémité (480) de la première section allongée (476, 576, 676, 776, 876, 1176) et la seconde extrémité (488) de la seconde section allongée (477, 577, 677, 777, 877, 1177) ne dépasse pas la longueur maximale définie lorsque l'élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) passe du premier état prédéterminé au second état prédéterminé.
 4. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 1, où le premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) et le second élément de butée définissent un premier point de rotation pour la première section allongée (476, 576, 676, 776, 876, 1176) et la seconde section allongée (477, 577, 677, 777, 877, 1177); et une seconde extrémité (7118, 11118) à la fois de la première surface (7108, 8108) et de la seconde surface (7114, 8114), lorsqu'elle est positionnée contre l'attache (6100, 7100, 8100, 11100, 12100), définit un second point de rotation pour le premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) et le second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104) qui est différent du premier point de rotation.
 5. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 4, où la première section allongée (476, 576, 676, 776, 876, 1176) et la seconde section allongée (477, 577, 677, 777, 877, 1177) activent le premier point de rotation avant d'activer le second point de rotation lorsque l'élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) passe du premier état prédéterminé au second état prédéterminé.
 6. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 4, où une première extrémité (1116, 7116, 8116) de chacune de la première surface (7108, 8108) et de la seconde surface (7114, 8114) n'entre pas en contact avec l'attache (6100, 7100, 8100, 11100, 12100) lorsque la seconde extrémité (7118, 11118) à la fois de la première surface et de la seconde surface s'appuie contre l'attache (6100, 7100, 8100, 11100, 12100).
 7. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 3, où dans le premier état prédéterminé, l'attache (6100, 7100, 8100, 11100, 12100), le premier élément de butée (102, 202, 302, 402, 502, 602, 702, 802, 1102) et la seconde extrémité (480) de la première section allongée (476, 576, 676, 776, 876, 1176), tous dans un plan commun, définissent un triangle rectangle de la première section allongée (476, 576, 676, 776, 876, 1176), où une hypoténuse du triangle rectangle se trouve entre l'attache (6100, 7100, 8100, 11100, 12100) et la seconde extrémité (480) de la première section allongée (476, 576, 676, 776, 876, 1176), et un premier segment du triangle rectangle est défini par la première extrémité de l'élément de butée et une intersection perpendiculaire d'une première ligne s'étendant depuis la seconde extrémité (480) de la première section allongée (476, 576, 676, 776, 876, 1176) et d'une seconde ligne s'étendant depuis un centre géométrique de l'attache (6100, 7100, 8100, 11100, 12100), où les première et seconde lignes sont dans le plan commun.
 8. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 7, où dans le premier état prédéterminé, l'attache (6100, 7100, 8100, 11100, 12100), le second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104) et la seconde extrémité (488) de la seconde section allon-

gée (477, 577, 677, 777, 877, 1177), tous dans un plan commun, définissent un triangle rectangle de la seconde section allongée (477, 577, 677, 777, 877, 1177), où une hypoténuse du triangle rectangle se trouve entre l'attache (6100, 7100, 8100, 11100, 12100) et la seconde extrémité (488) de la seconde section allongée (477, 577, 677, 777, 877, 1177), et un premier segment du triangle rectangle est défini par la seconde extrémité de l'élément de butée et une intersection perpendiculaire d'une première ligne s'étendant depuis la seconde extrémité (488) de la seconde section allongée (477, 577, 677, 777, 877, 1177) et d'une seconde ligne s'étendant depuis un centre géométrique de l'attache (6100, 7100, 8100, 11100, 12100), où les première et seconde lignes sont dans le plan commun.

forme arrondie.

9. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 1, où l'extrémité distale (110) de la saillie (106) définit une surface plane qui forme un angle obtus avec la première surface (112) de la saillie (106) et où la surface plane forme un angle de quatre-vingt-dix degrés avec la seconde surface (114) de la saillie (106). 5
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10. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 9, où la douille (118) du second élément de butée (104, 204, 304, 404, 504, 604, 704, 804, 1104) comporte une seconde extrémité ayant une surface plane qui est une image miroir de la surface plane de l'extrémité distale (110) de la saillie (106). 20
25
30
11. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 1, où les épaulements du premier élément de butée (108) comportent une première surface d'épaulement (138) qui s'étend depuis la première surface (112) de la saillie (106) et une seconde surface d'épaulement (140) qui s'étend depuis la seconde surface (114) de la saillie (106). 35
40
12. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 11, où la seconde surface d'épaulement (140) et la seconde surface (114) de la saillie (106) forment un angle de quatre-vingt-dix degrés. 45
13. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon la revendication 11, où la première surface d'épaulement (138) et la première surface (112) de la saillie (106) forment un angle obtus. 50
14. Élément articulé (474, 674, 774, 874, 974, 1174, 1274, 1374) selon l'une quelconque des revendications précédentes, où la première ouverture oblongue (7110, 8110, 11110, 12110) et la seconde ouverture oblongue (7114, 8114, 11114, 12114) ont une 55

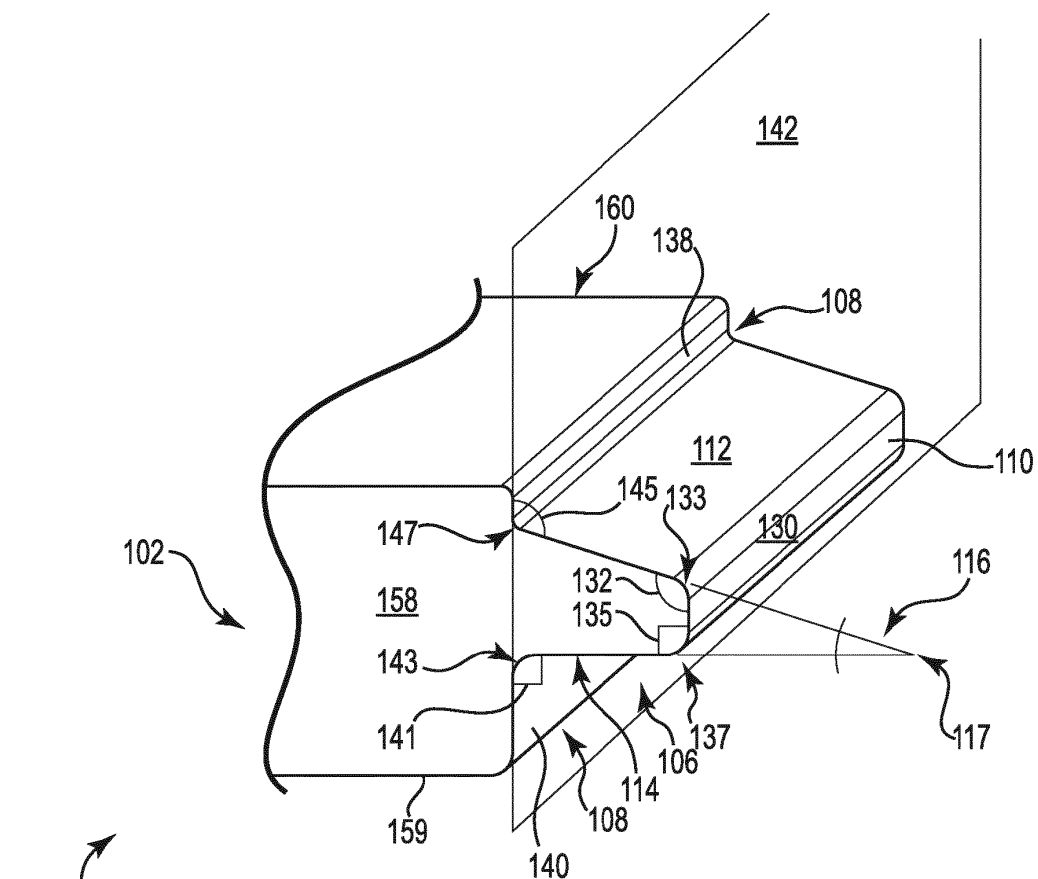


Fig. 1A

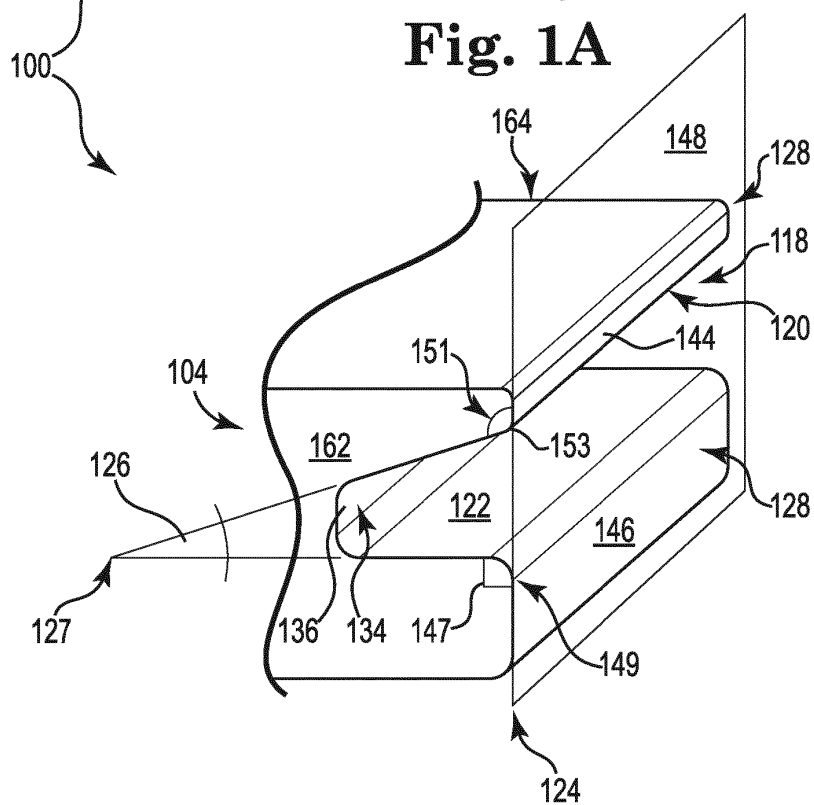


Fig. 1B

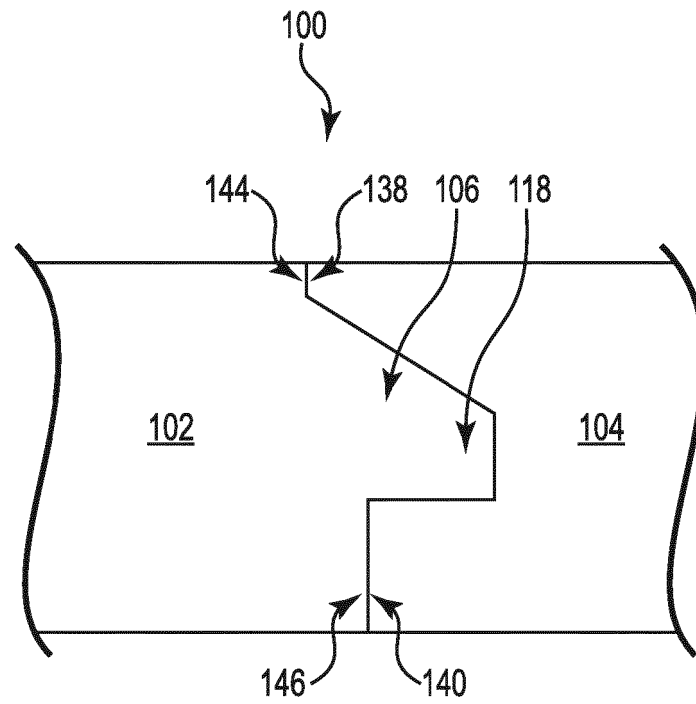


Fig. 1C

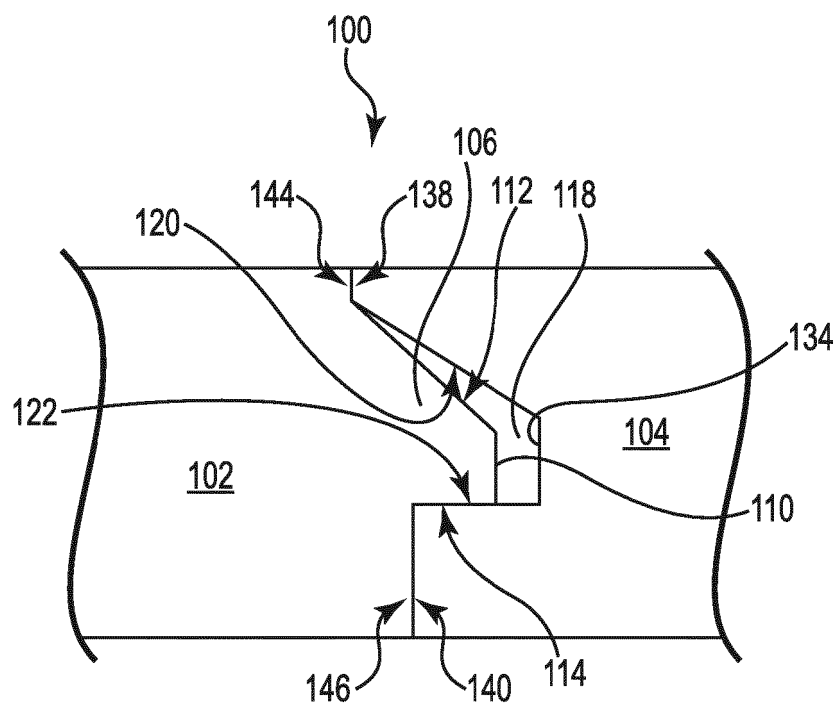


Fig. 1D

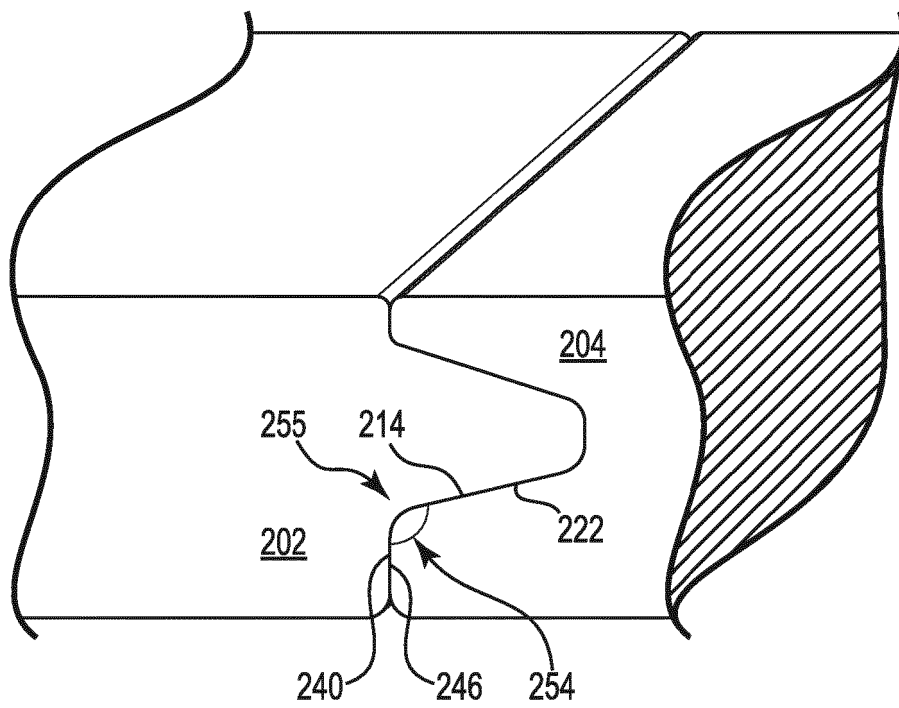


Fig. 2

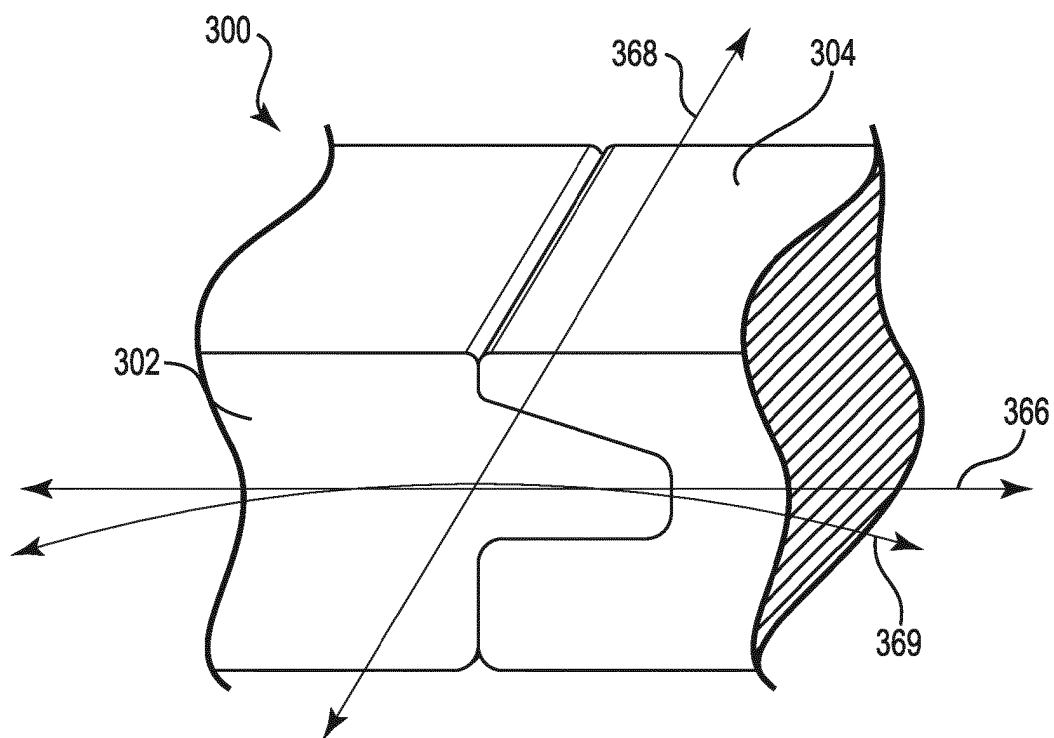


Fig. 3A

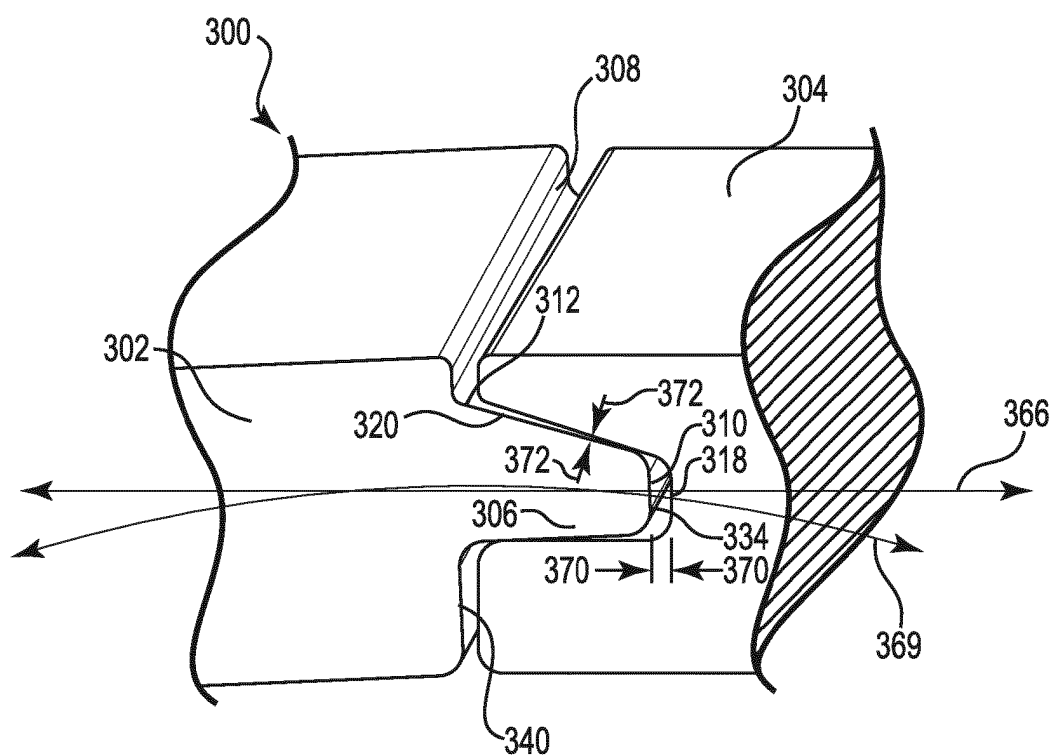


Fig. 3B

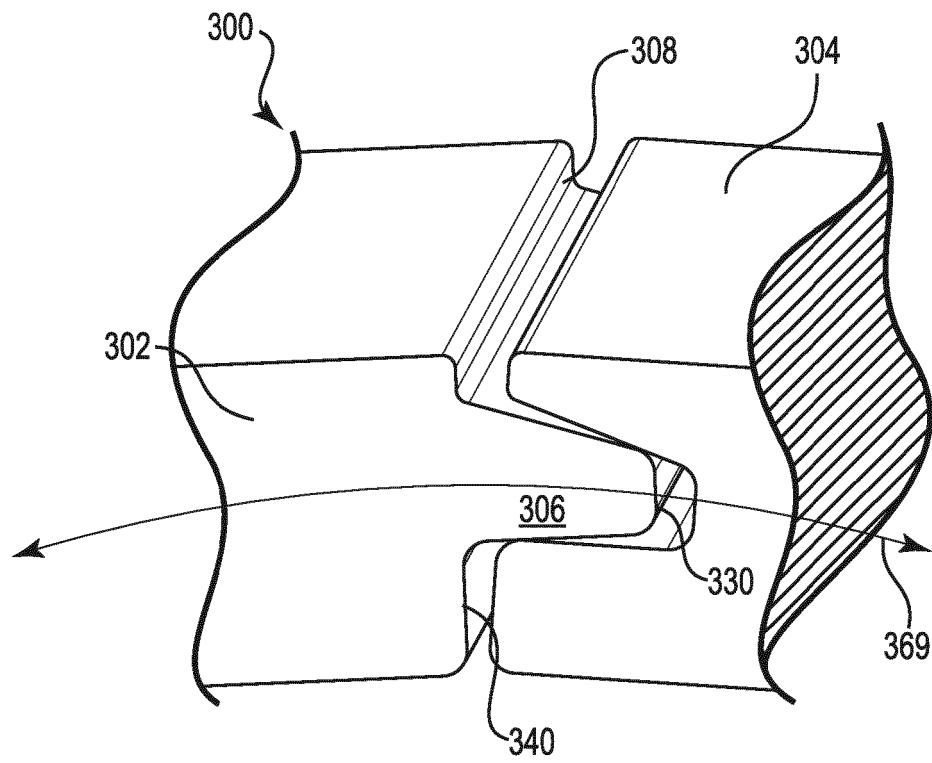


Fig. 3C

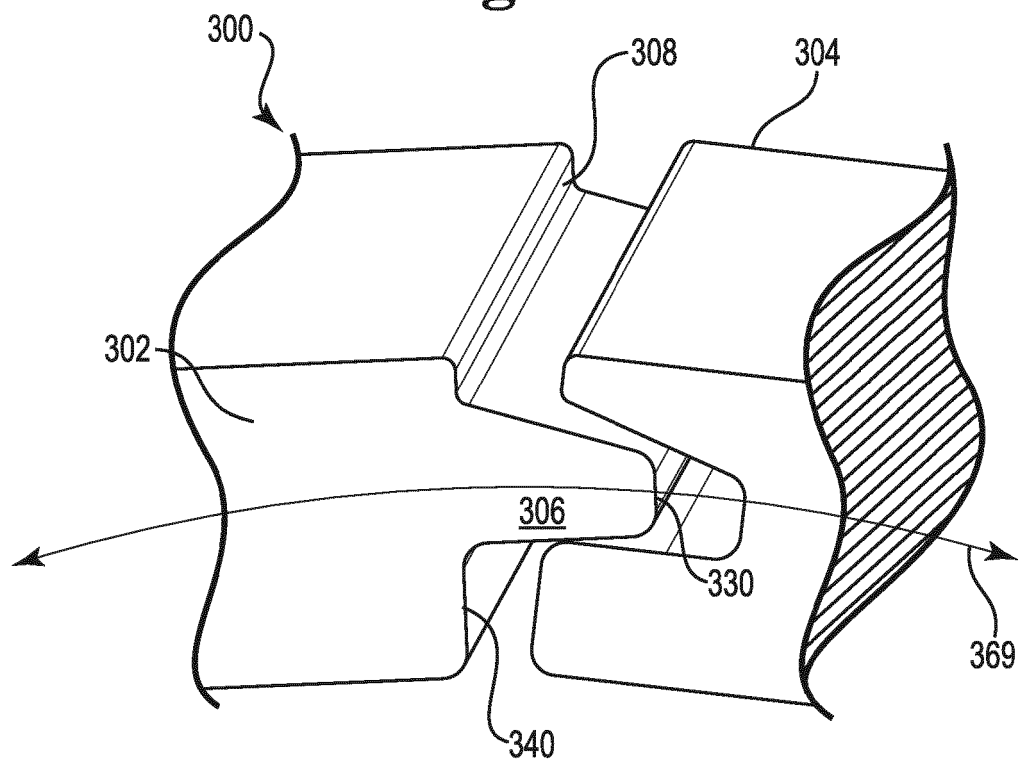


Fig. 3D

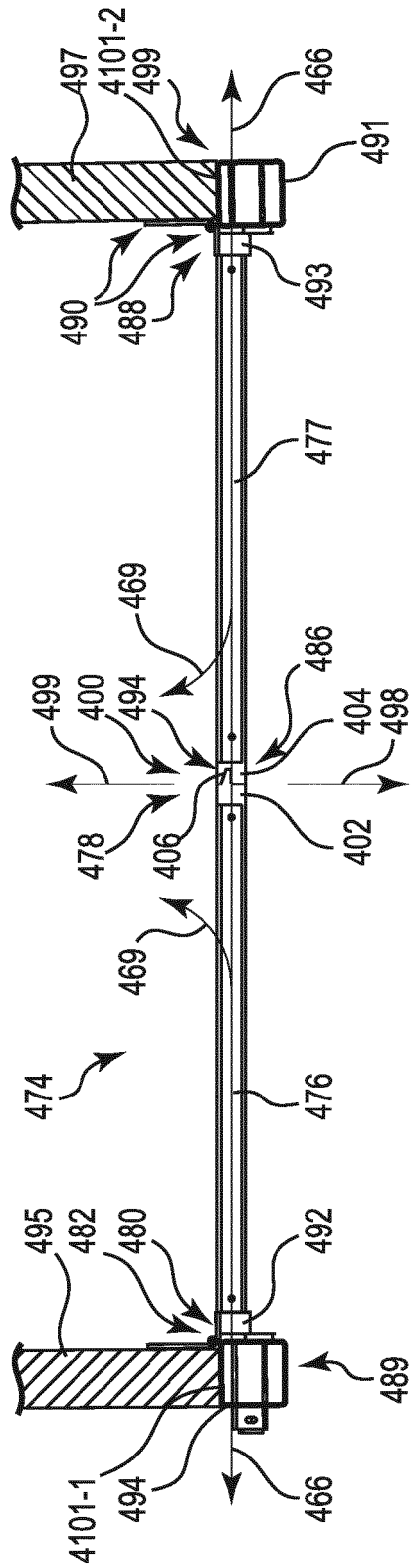


Fig. 4A

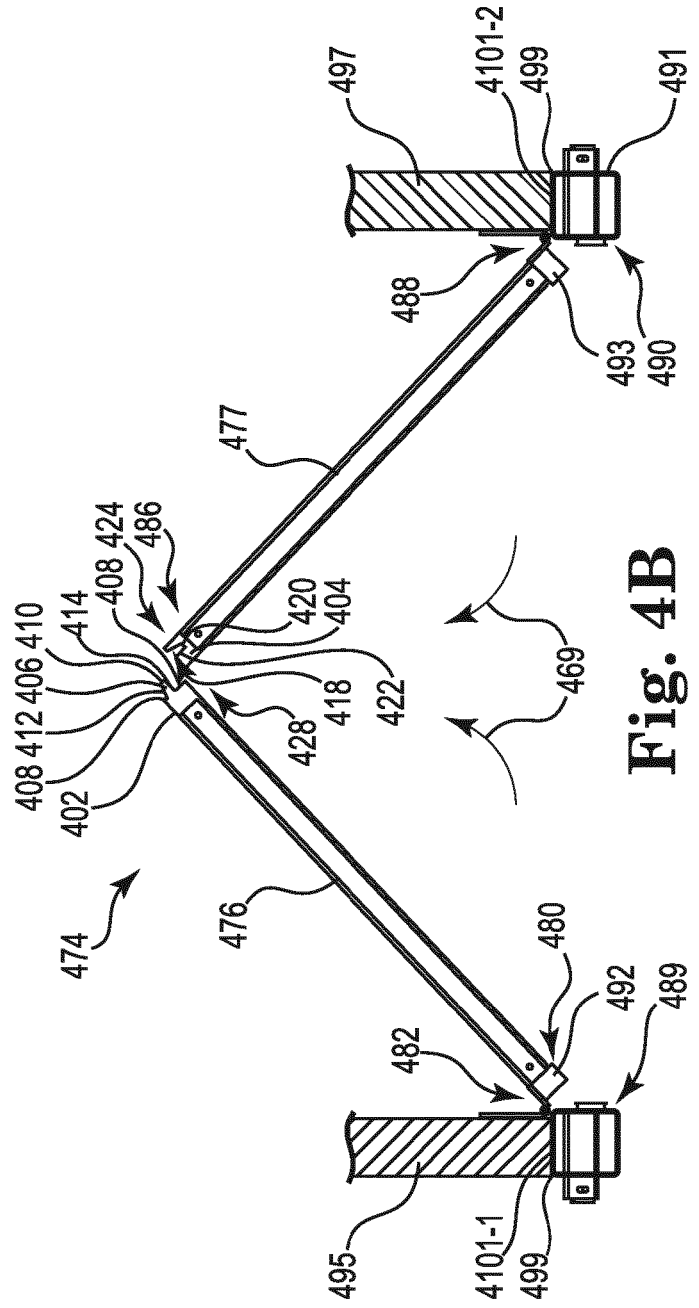


Fig. 4B

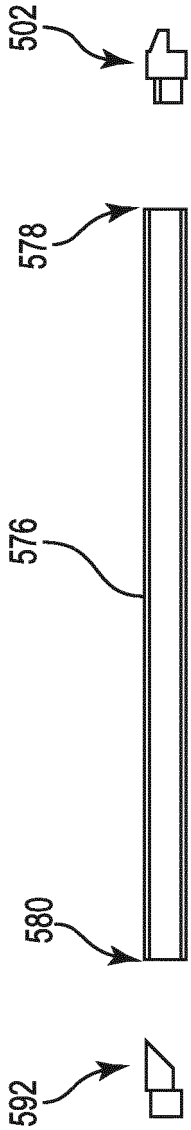


Fig. 5A

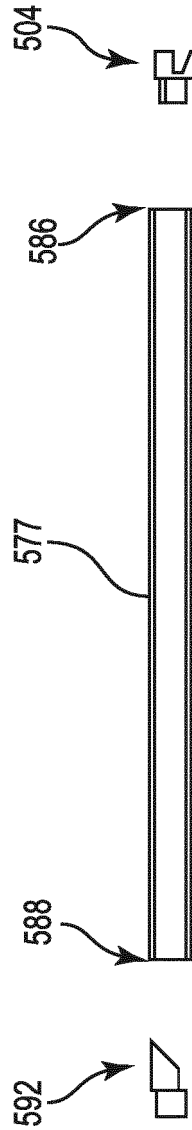


Fig. 5B

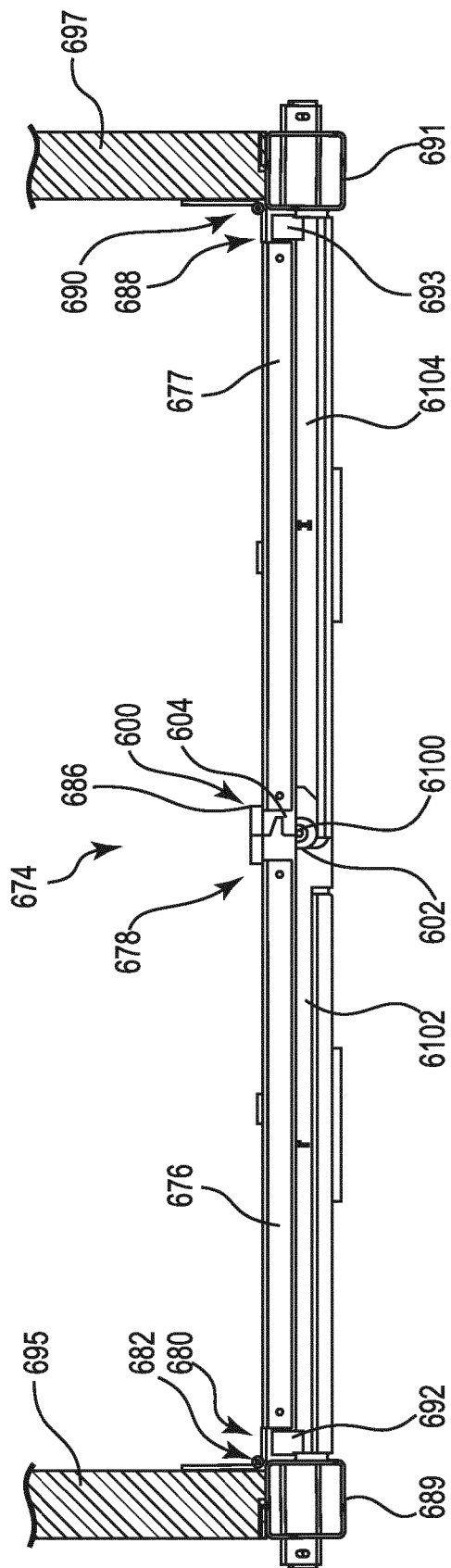


Fig. 6A

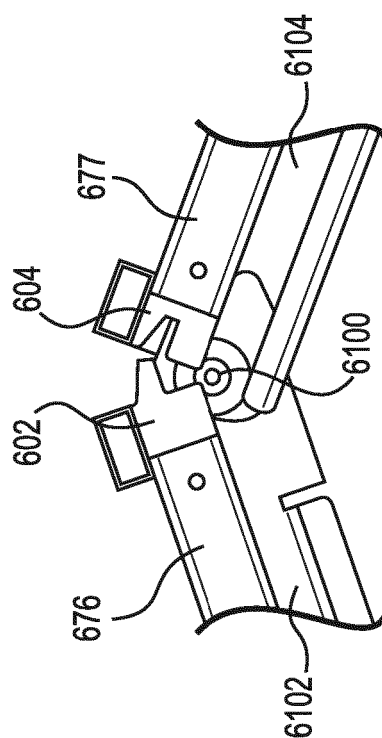


Fig. 6B

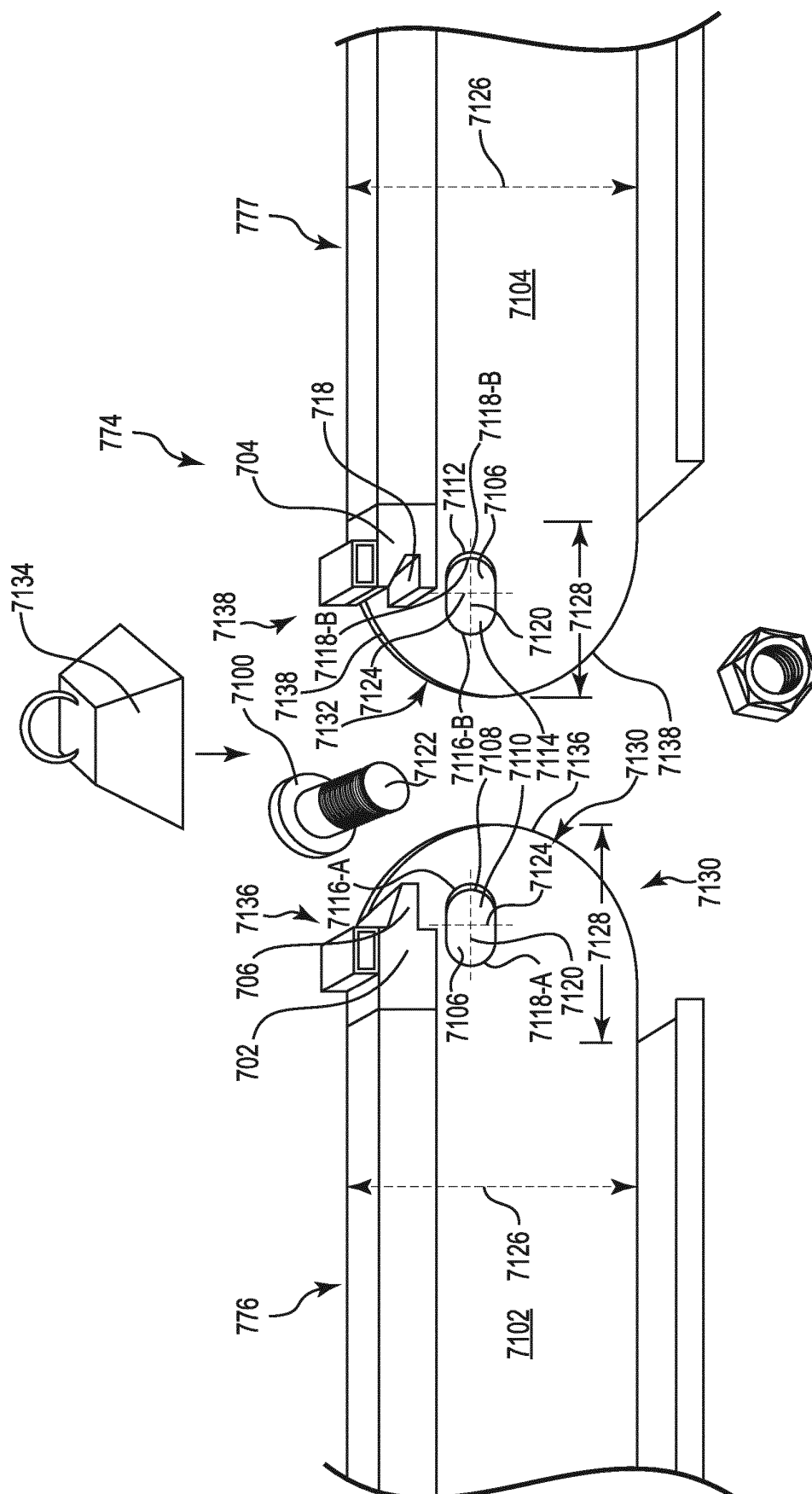


Fig. 7

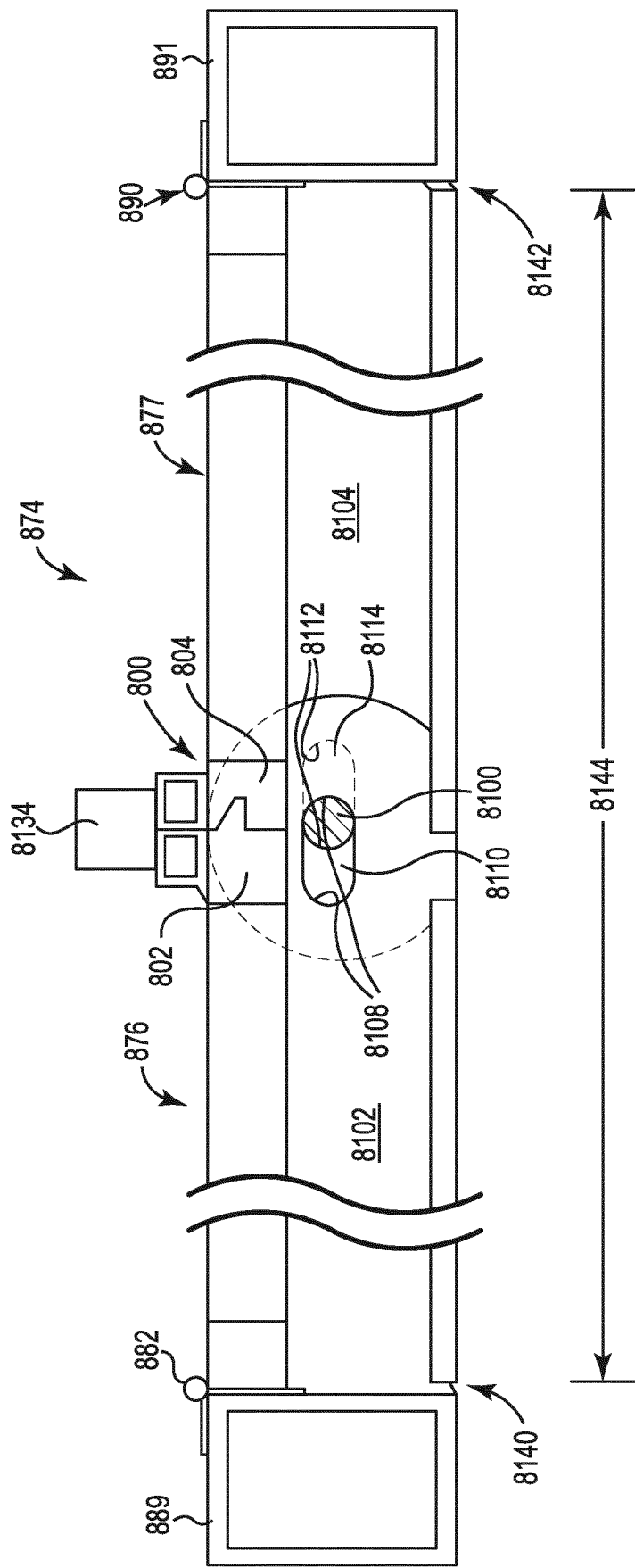


Fig. 8

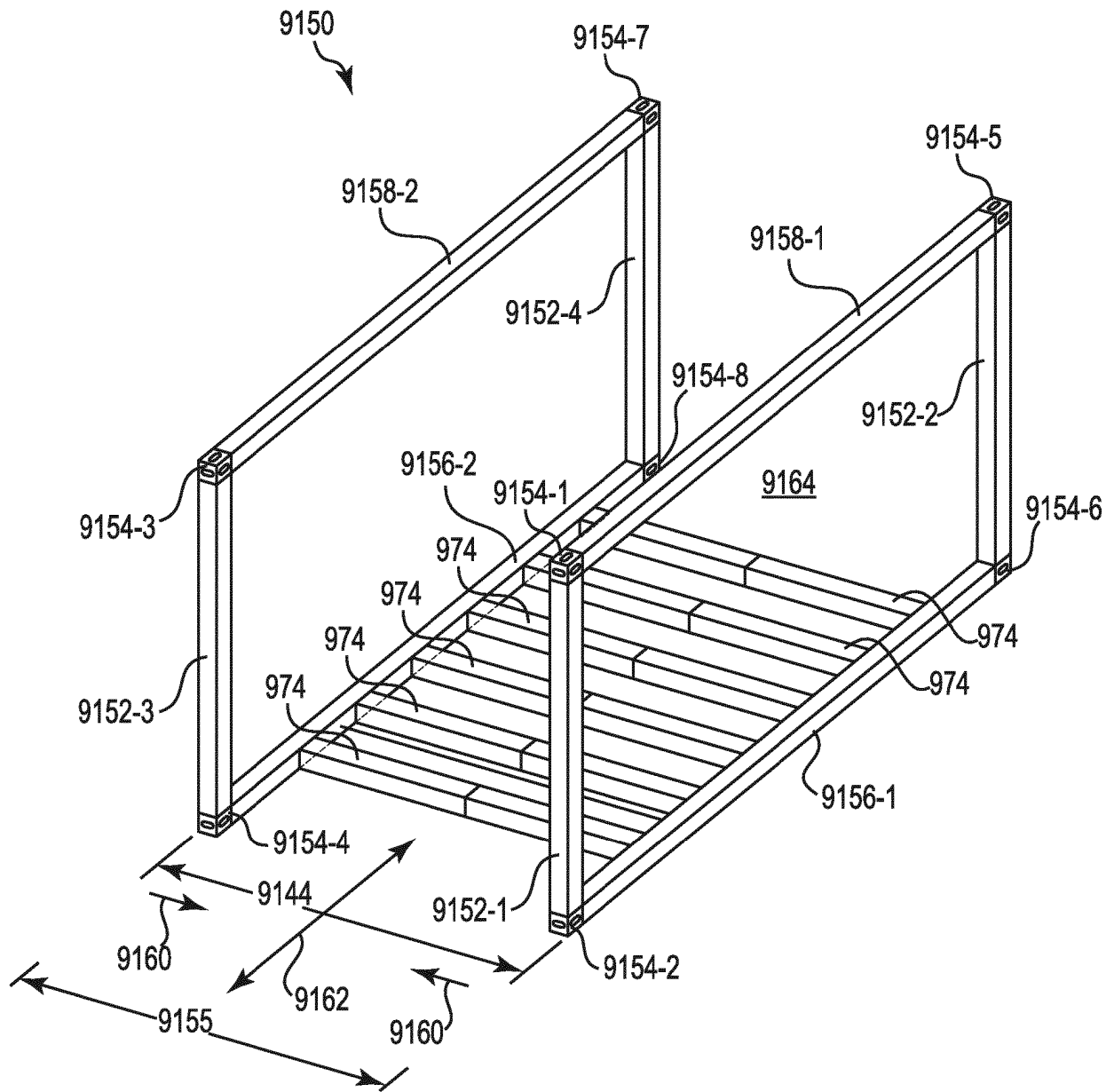


Fig. 9A

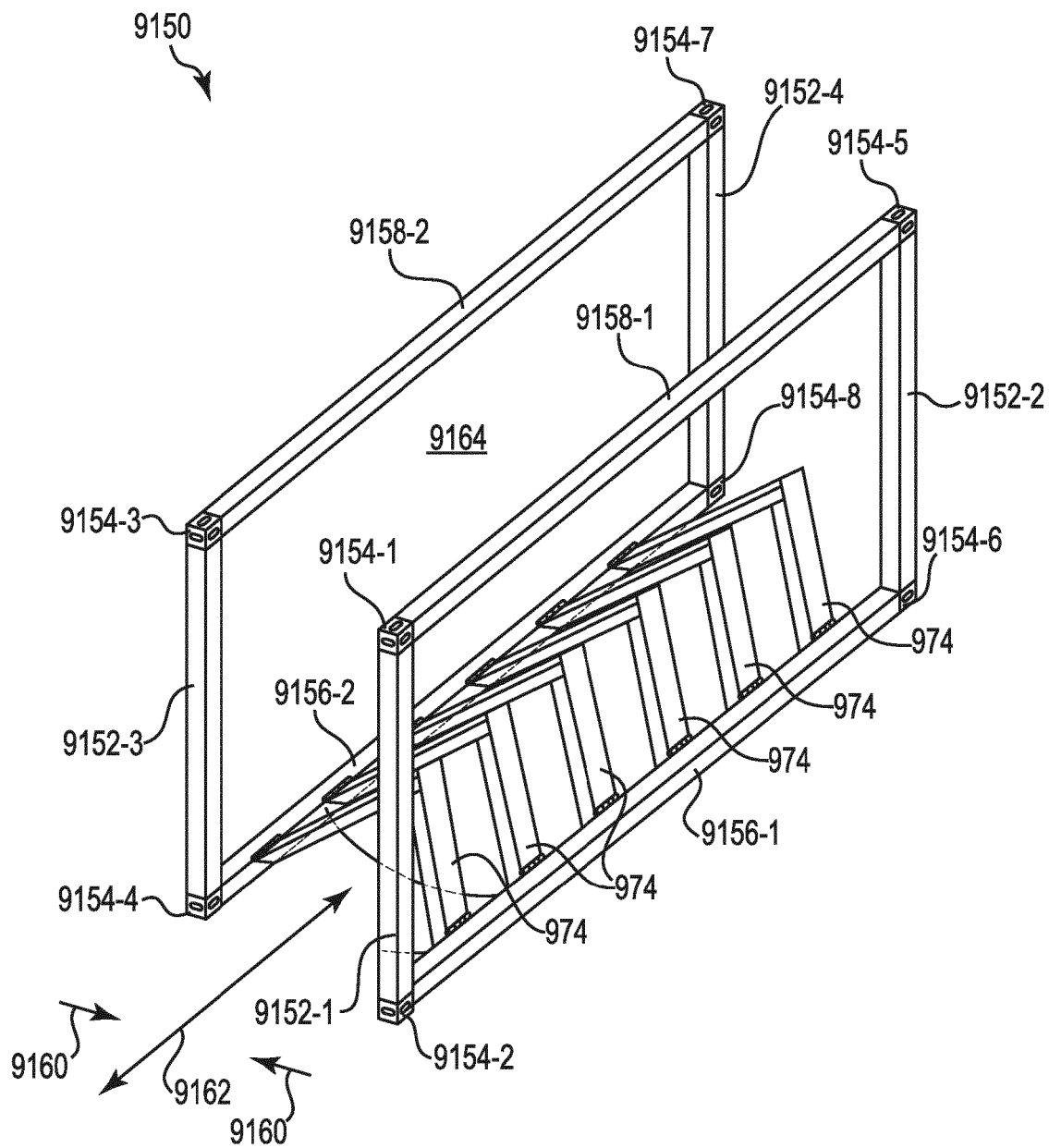


Fig. 9B

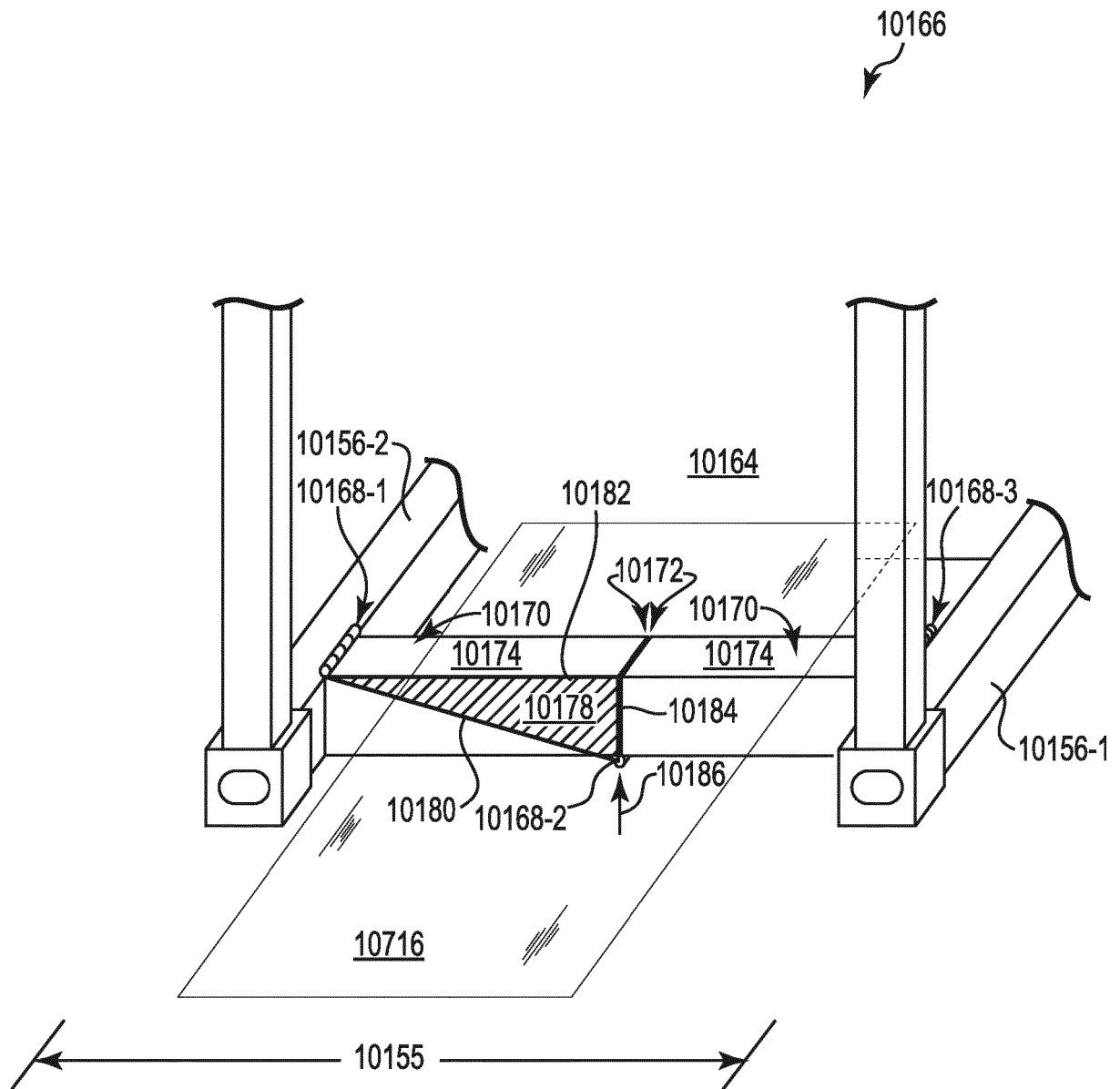


Fig. 10

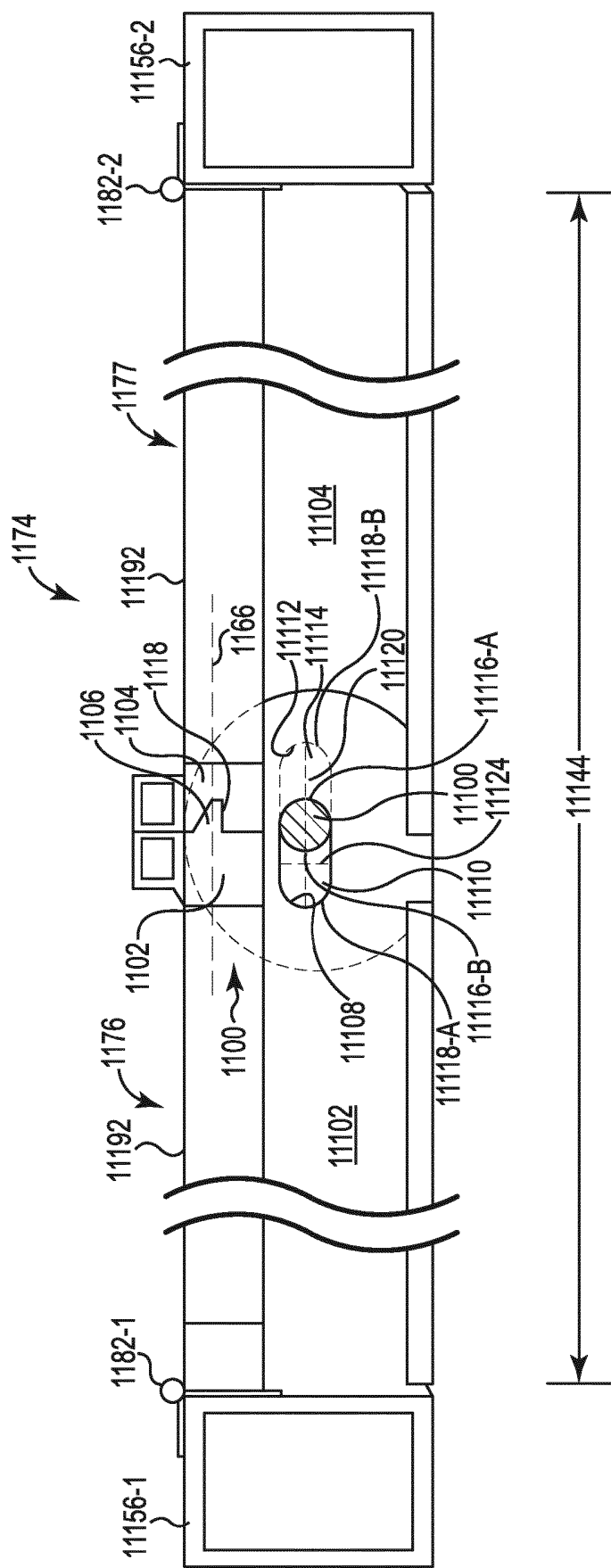


Fig. 11A

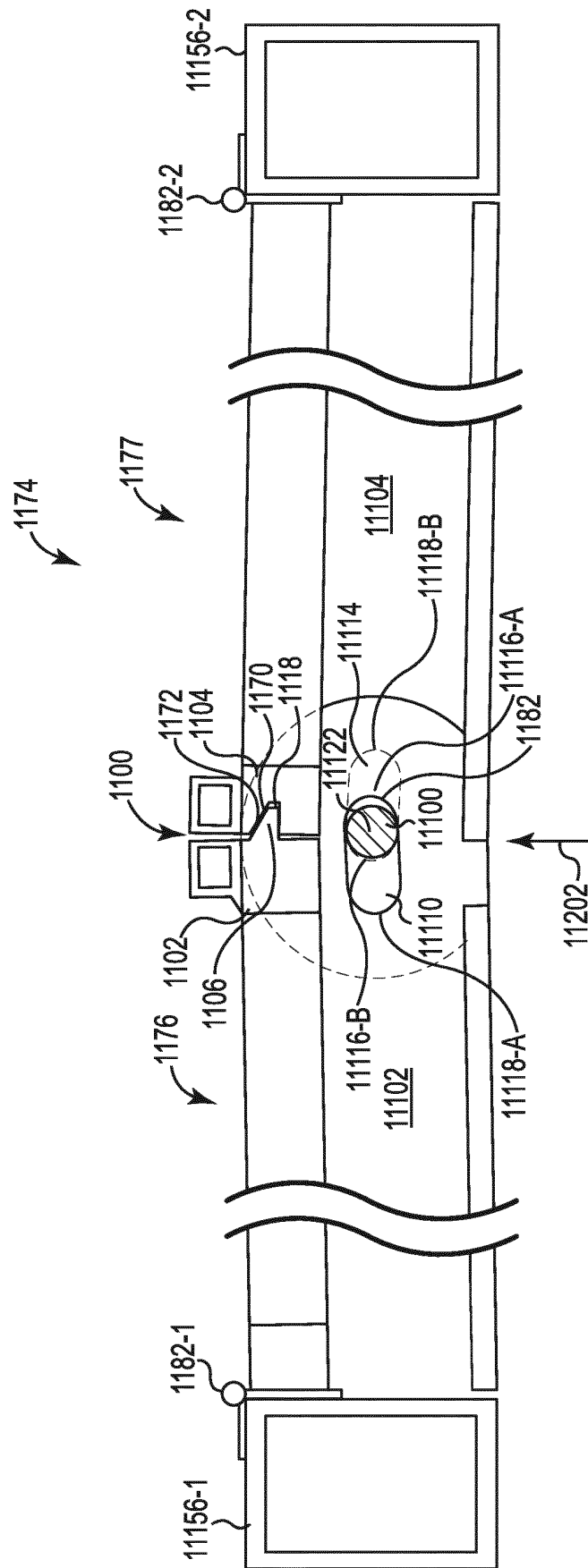


Fig. 11B

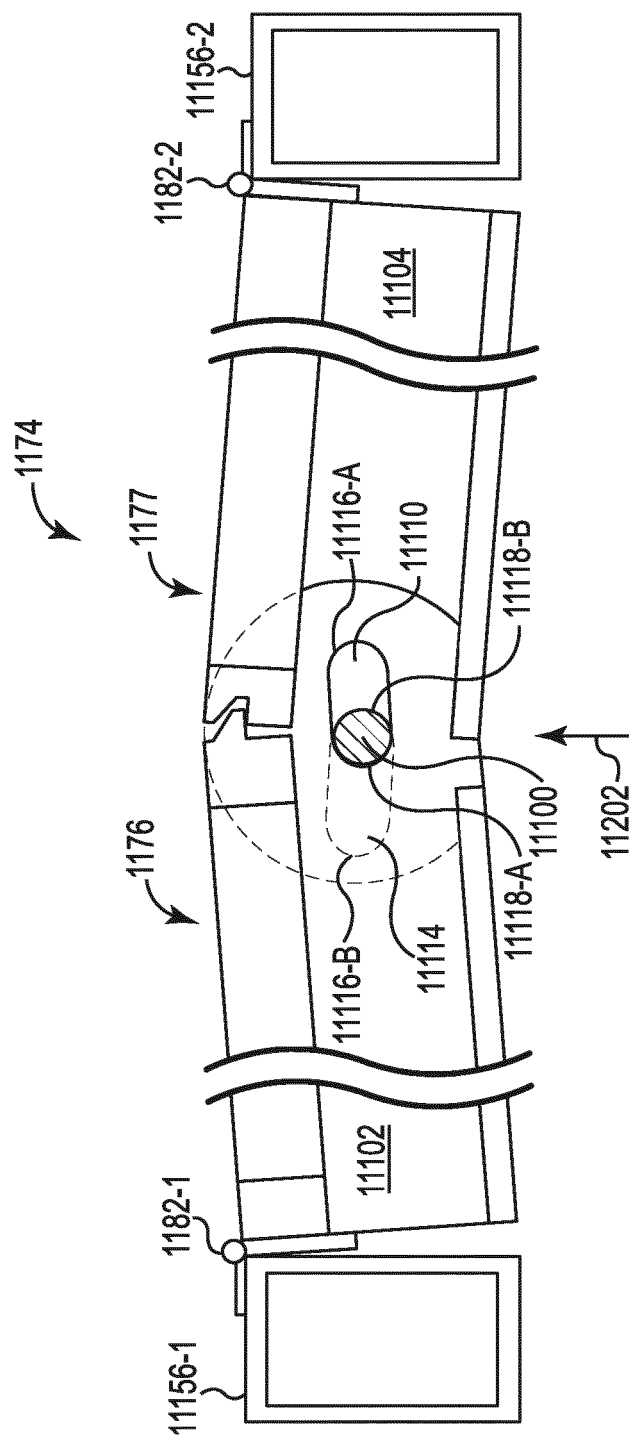
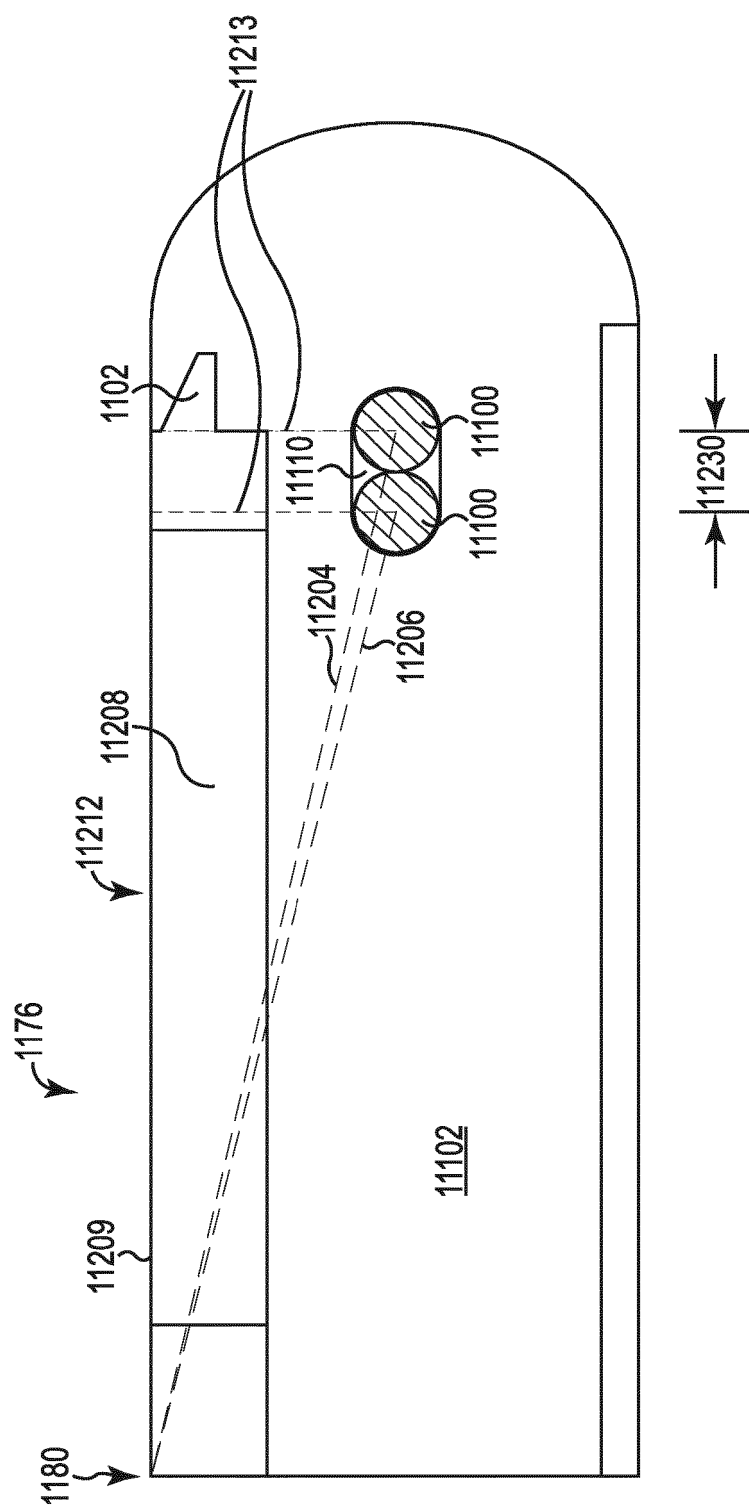


Fig. 11C



Find

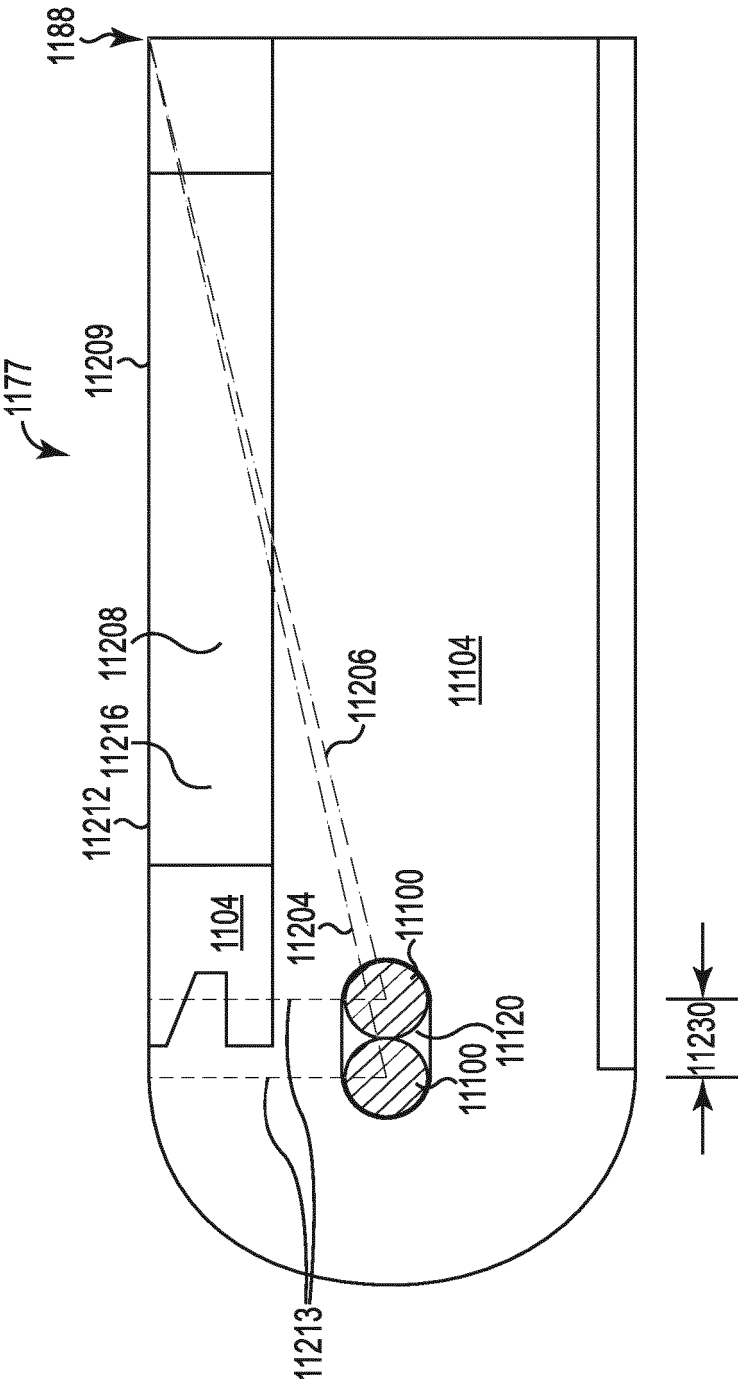


Fig. 11E

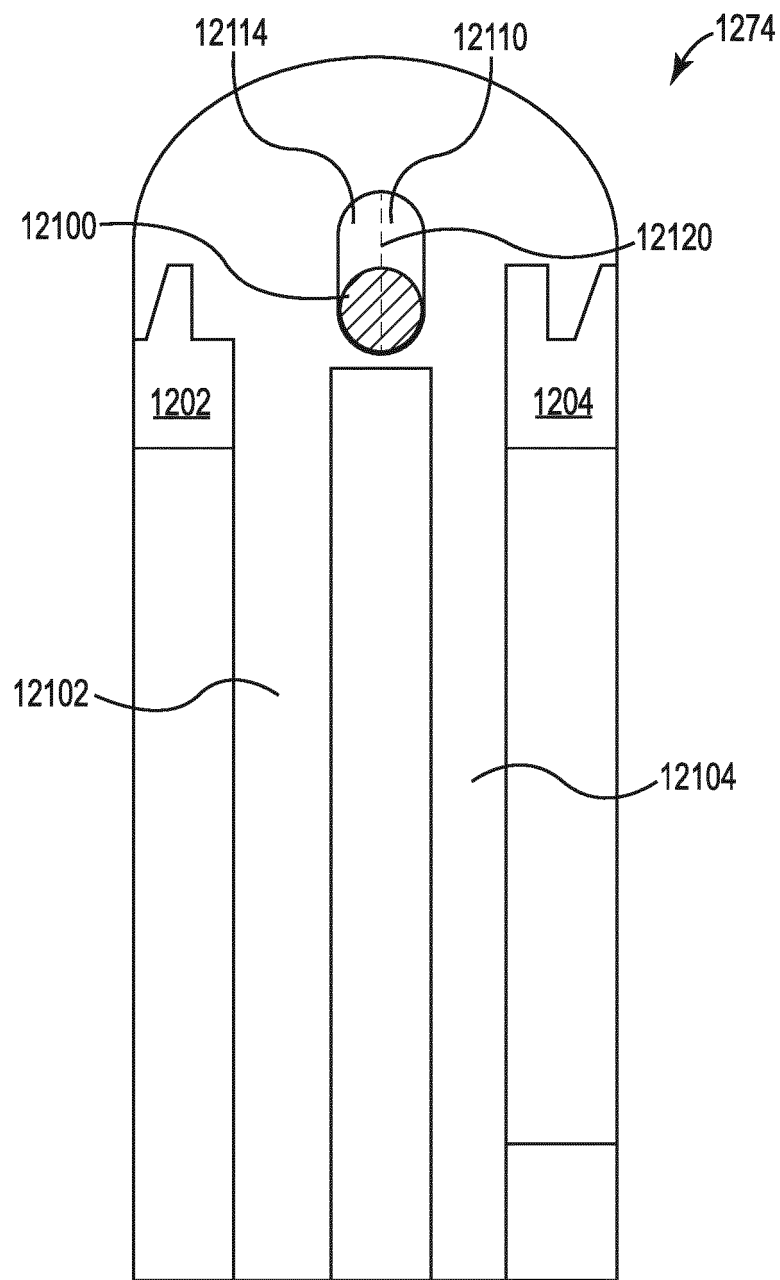


Fig. 12

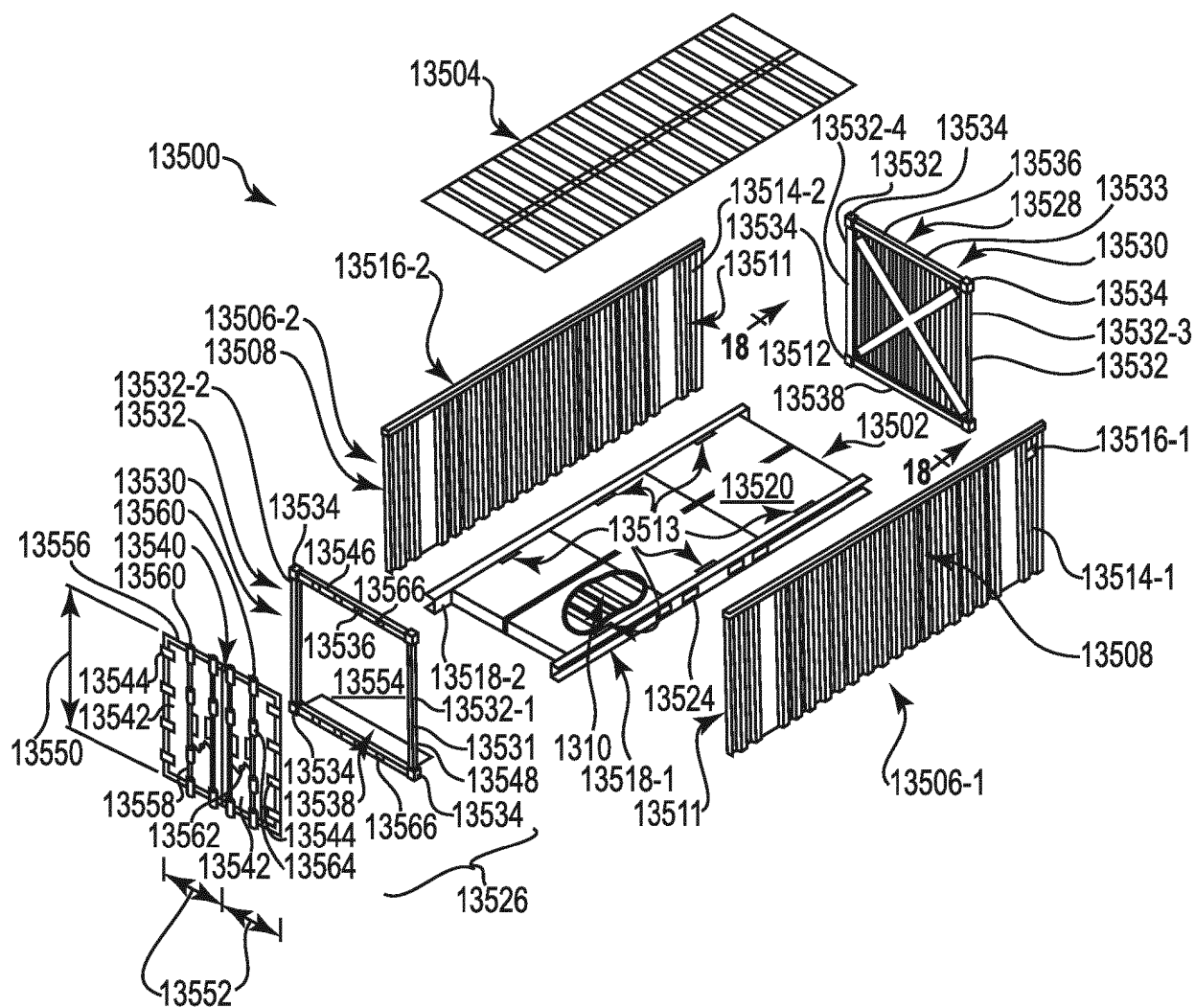


Fig. 13

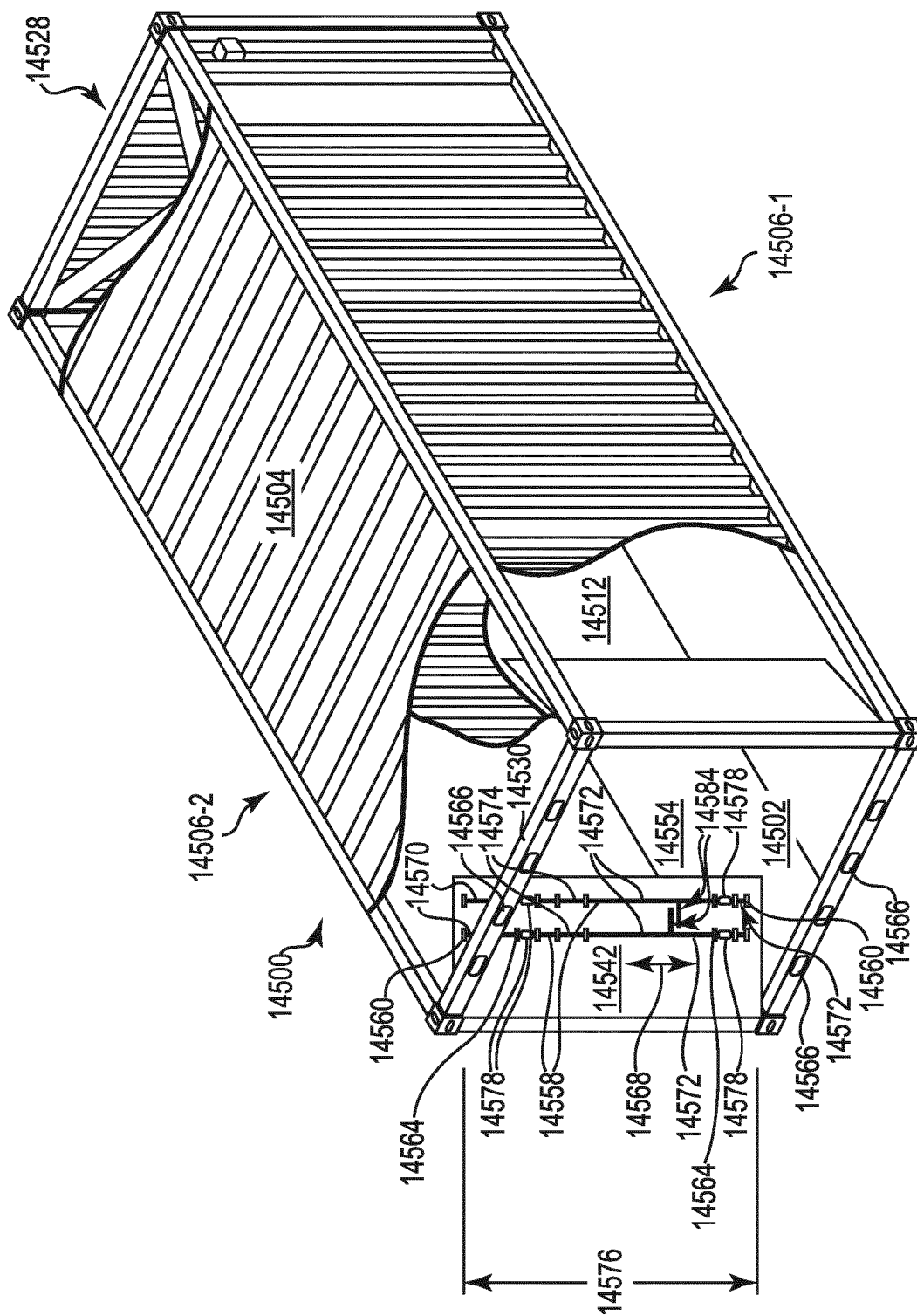
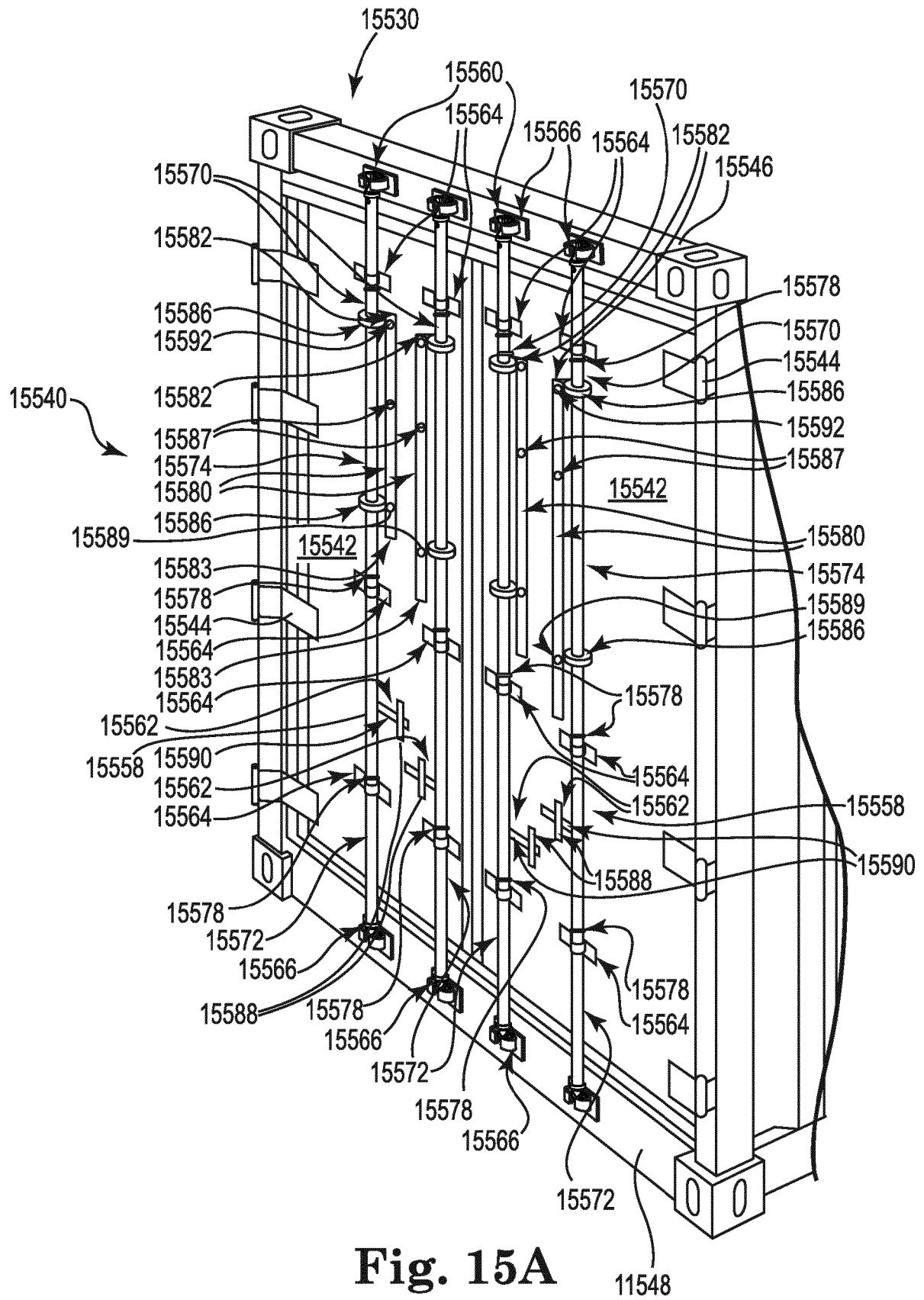


Fig. 14



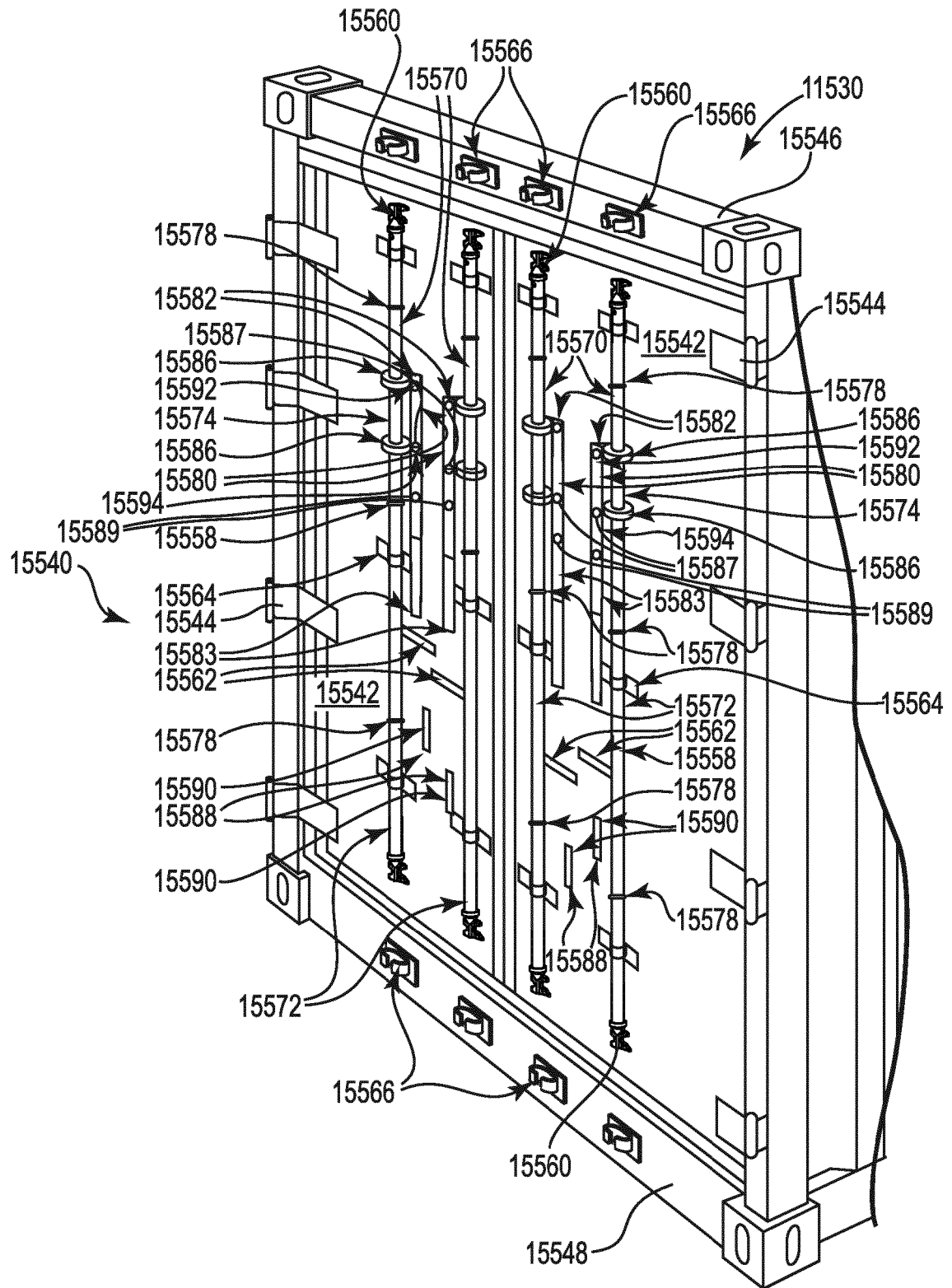


Fig. 15B

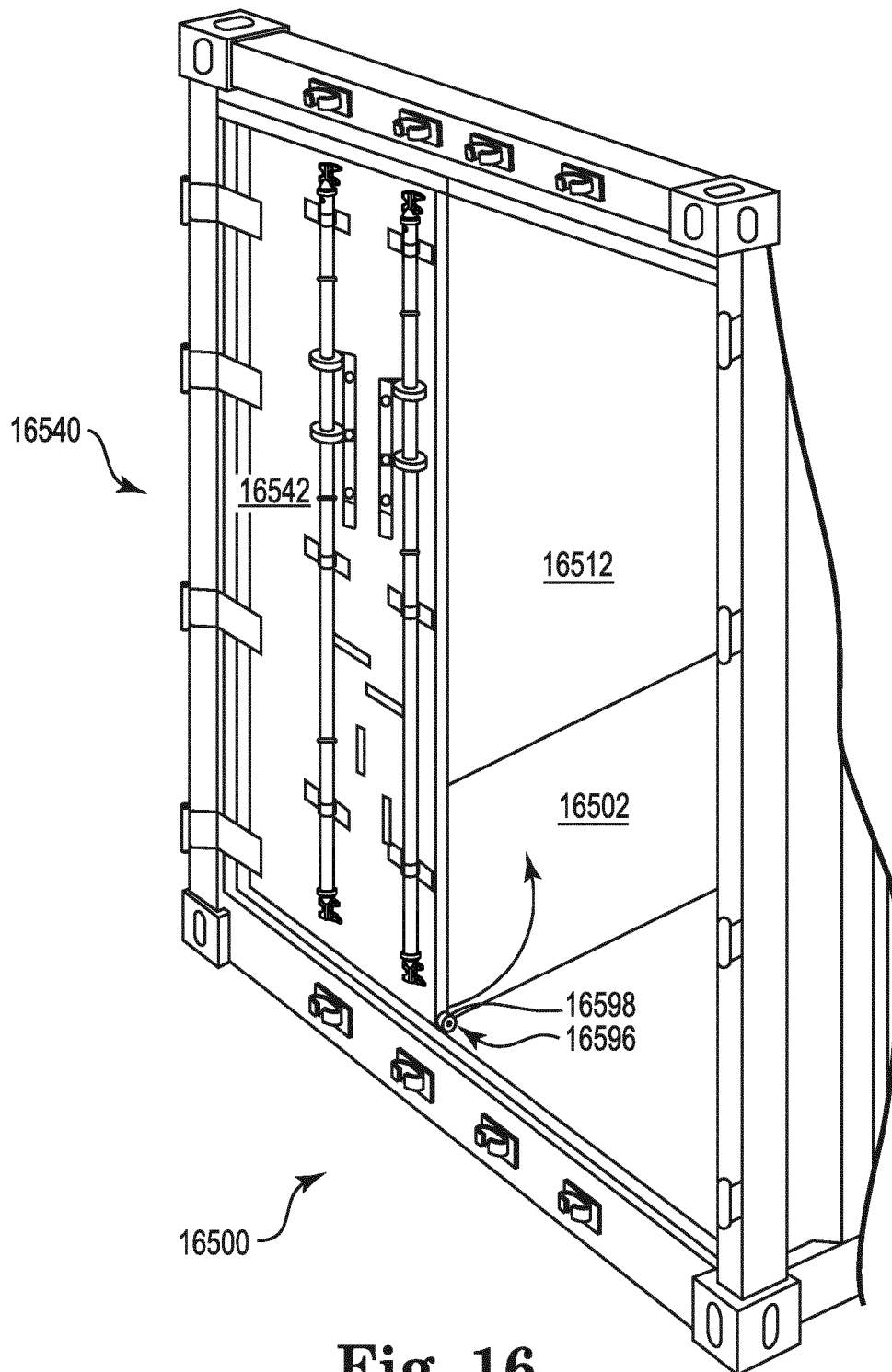


Fig. 16

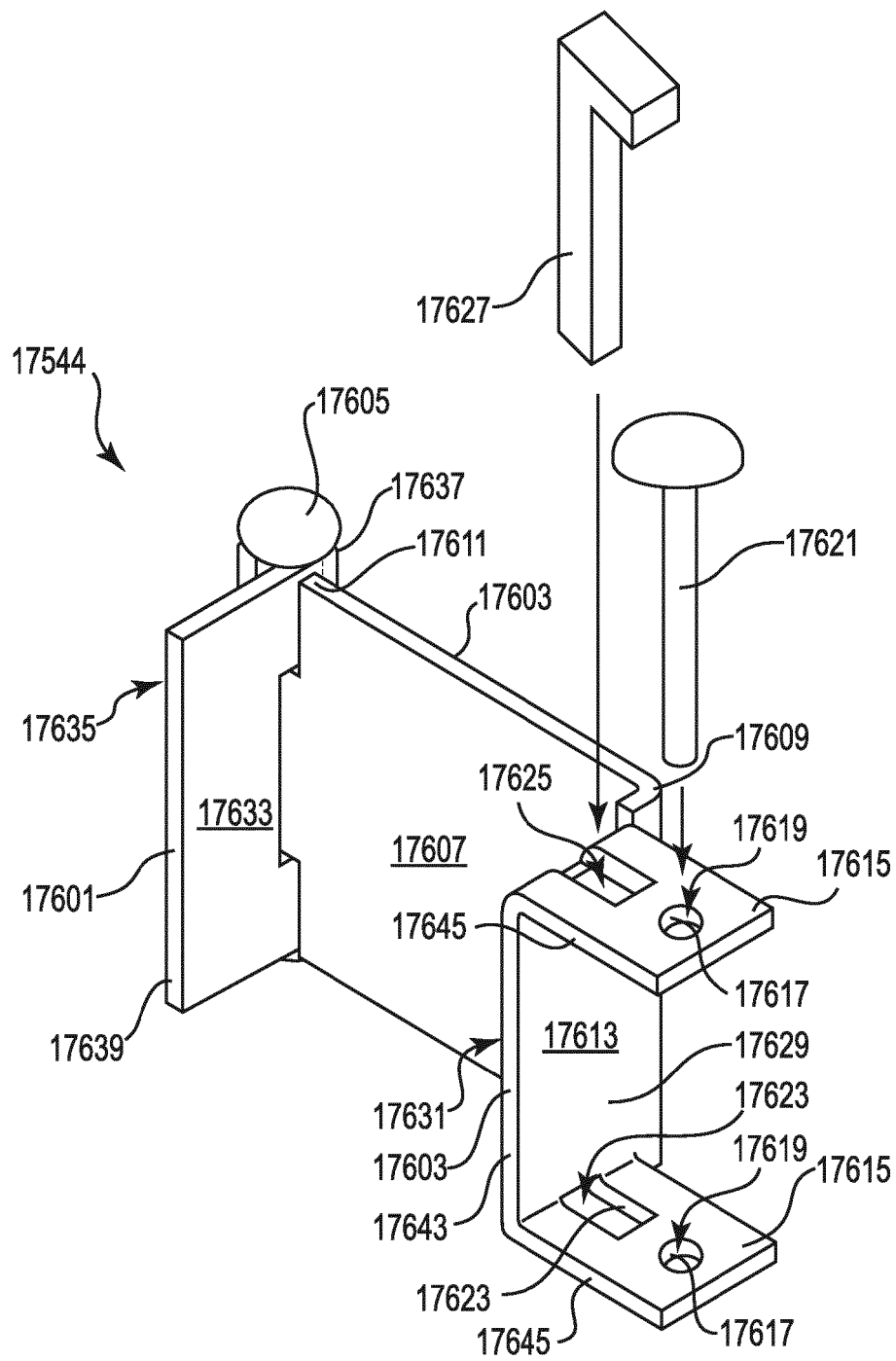


Fig. 17

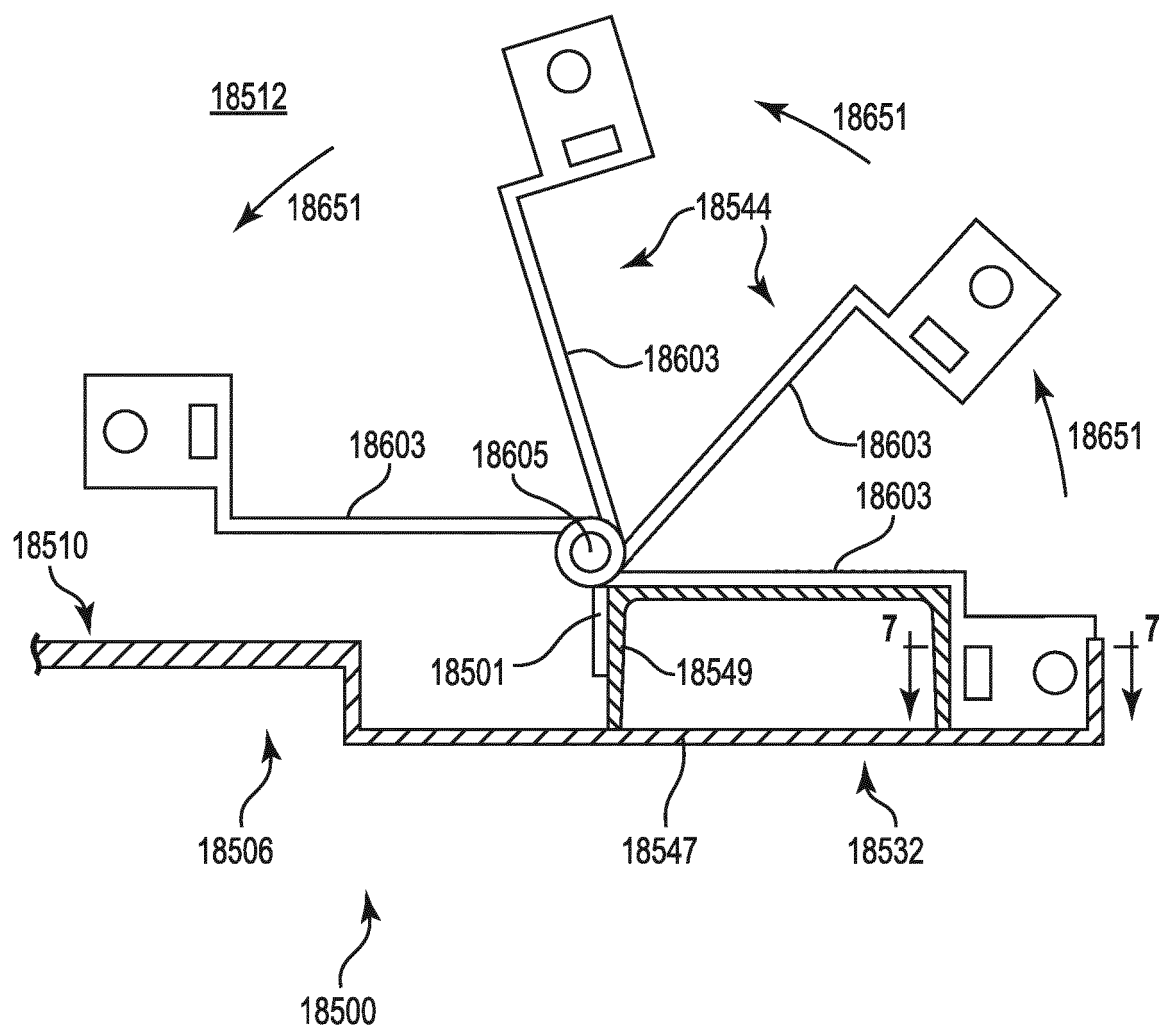


Fig. 18

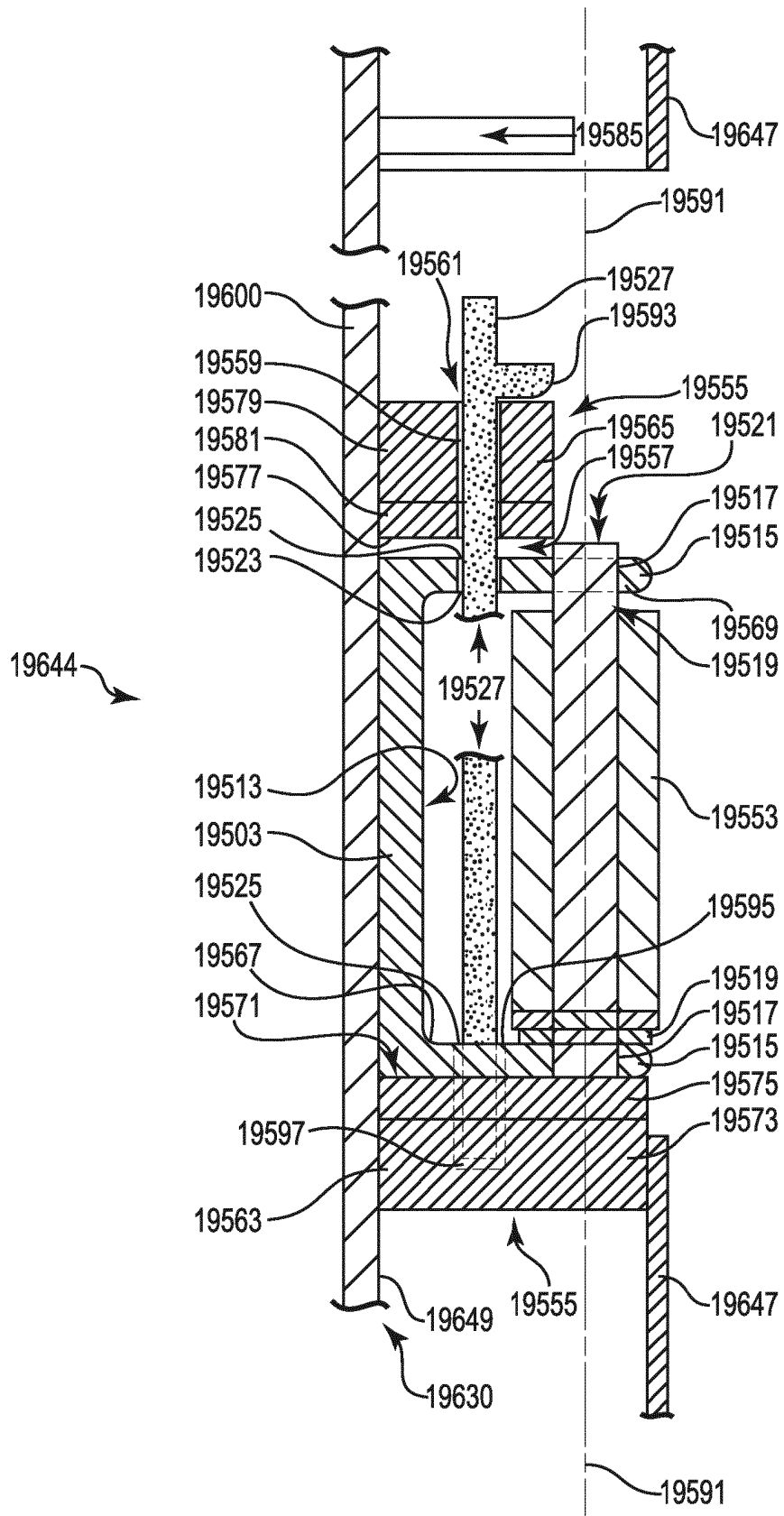


Fig. 19

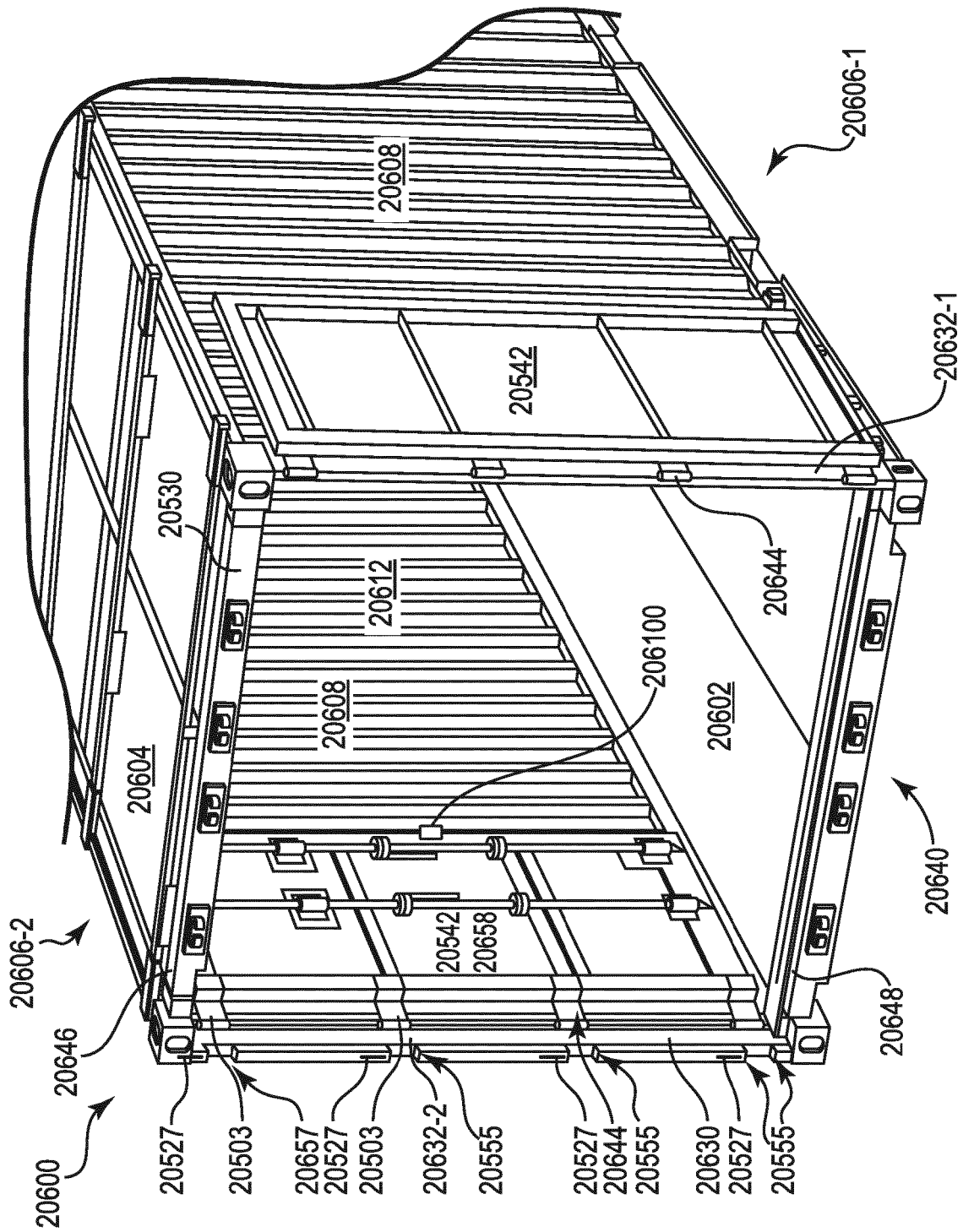


Fig. 20

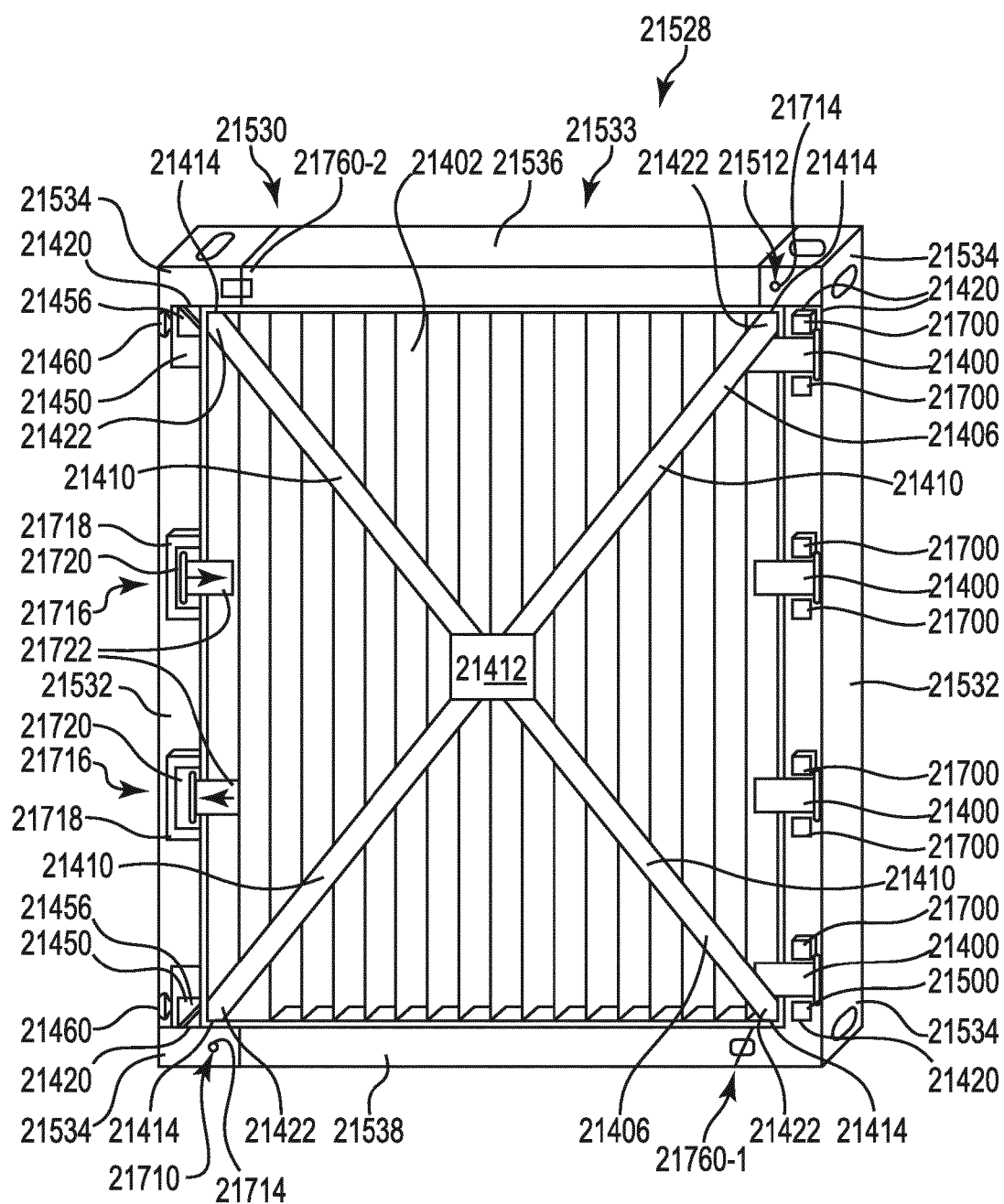


Fig. 21A

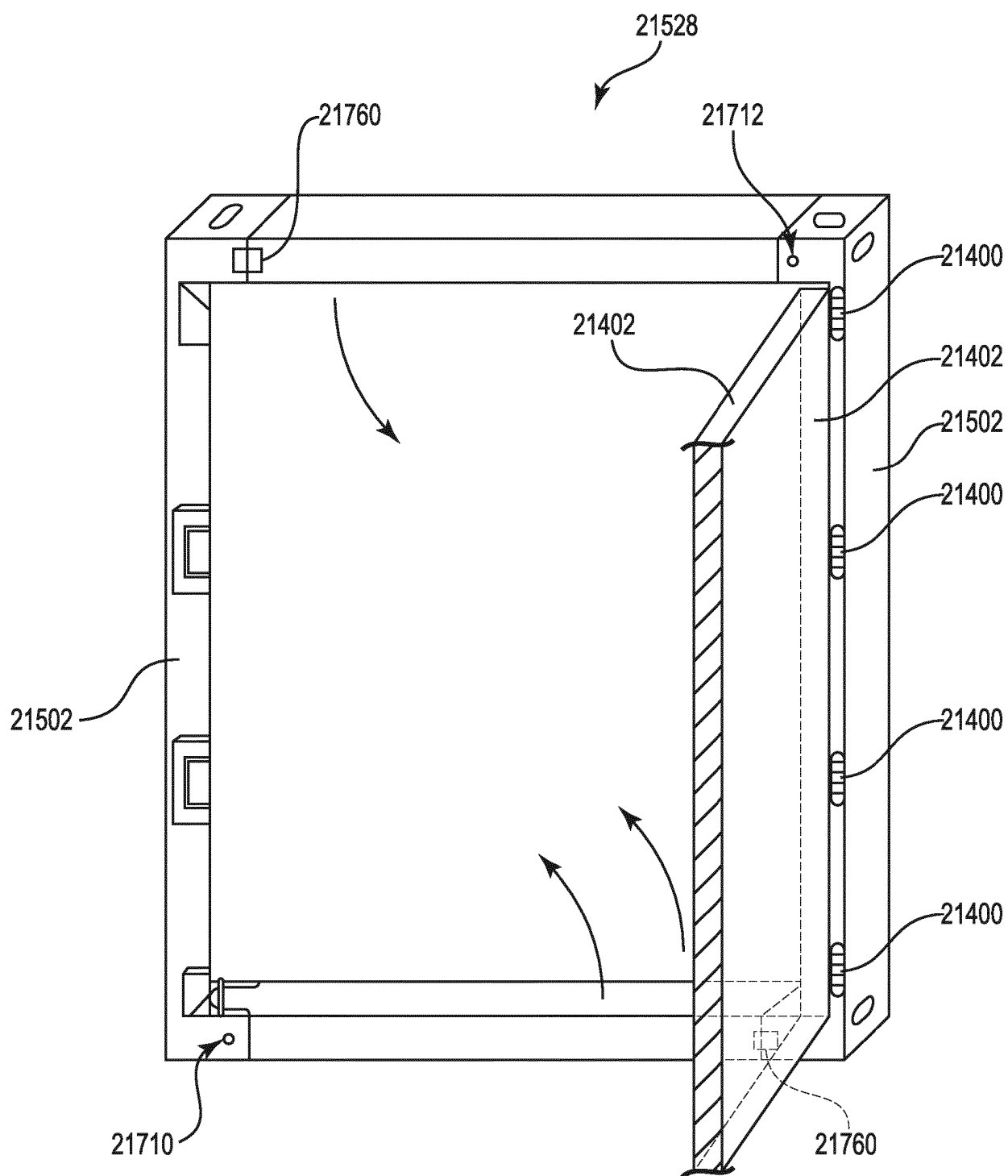


Fig. 21B

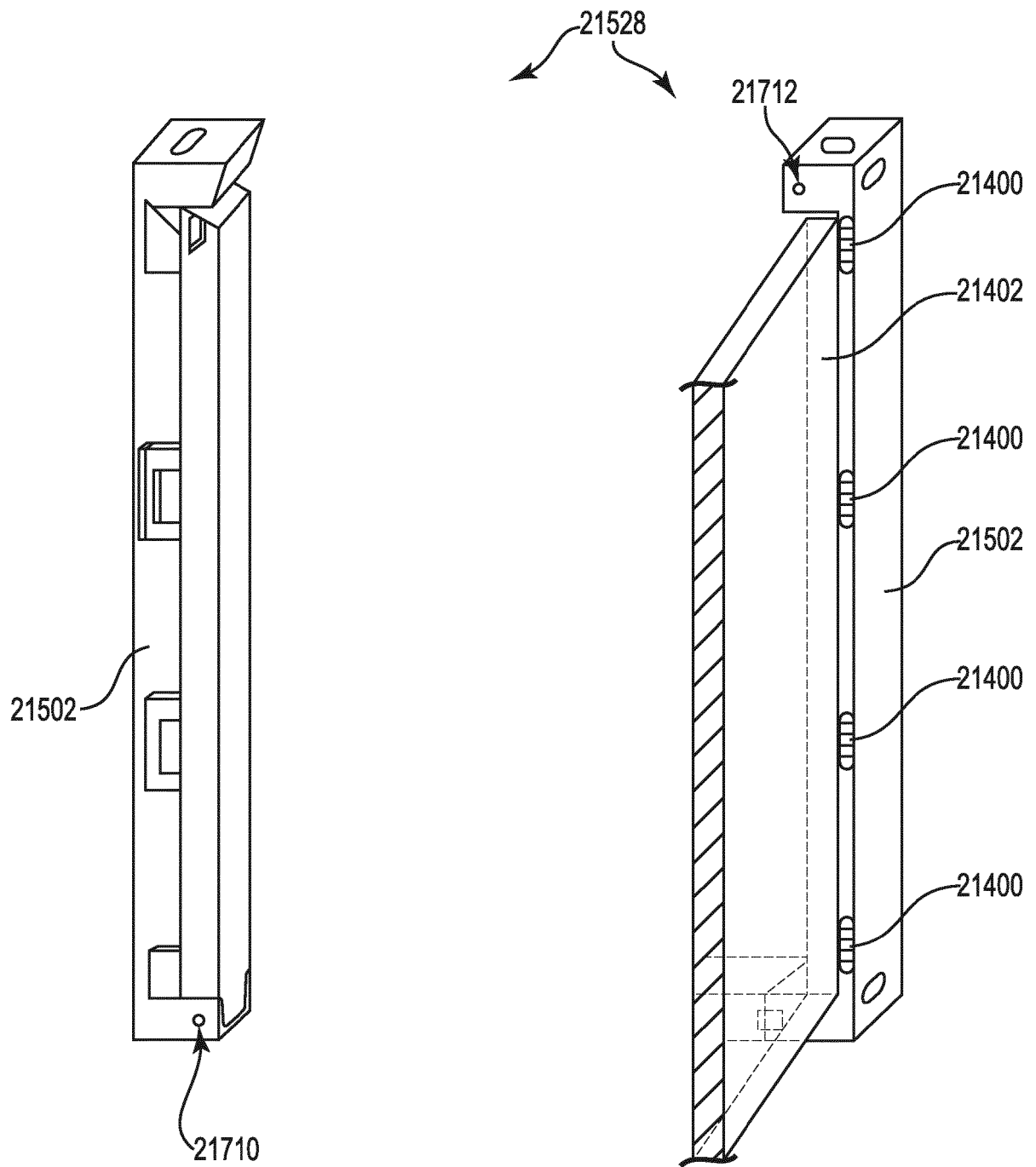


Fig. 21C

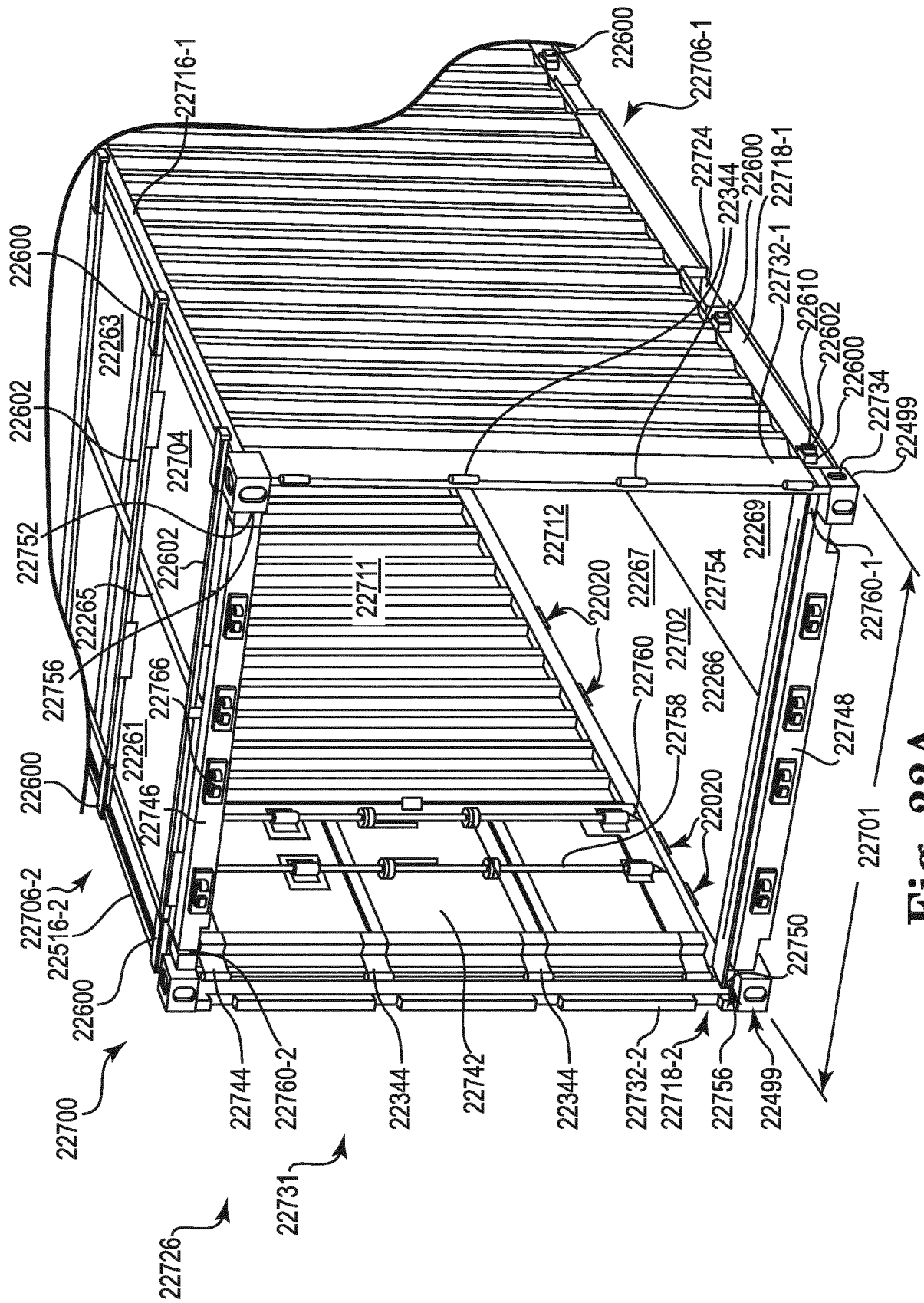


Fig. 22A

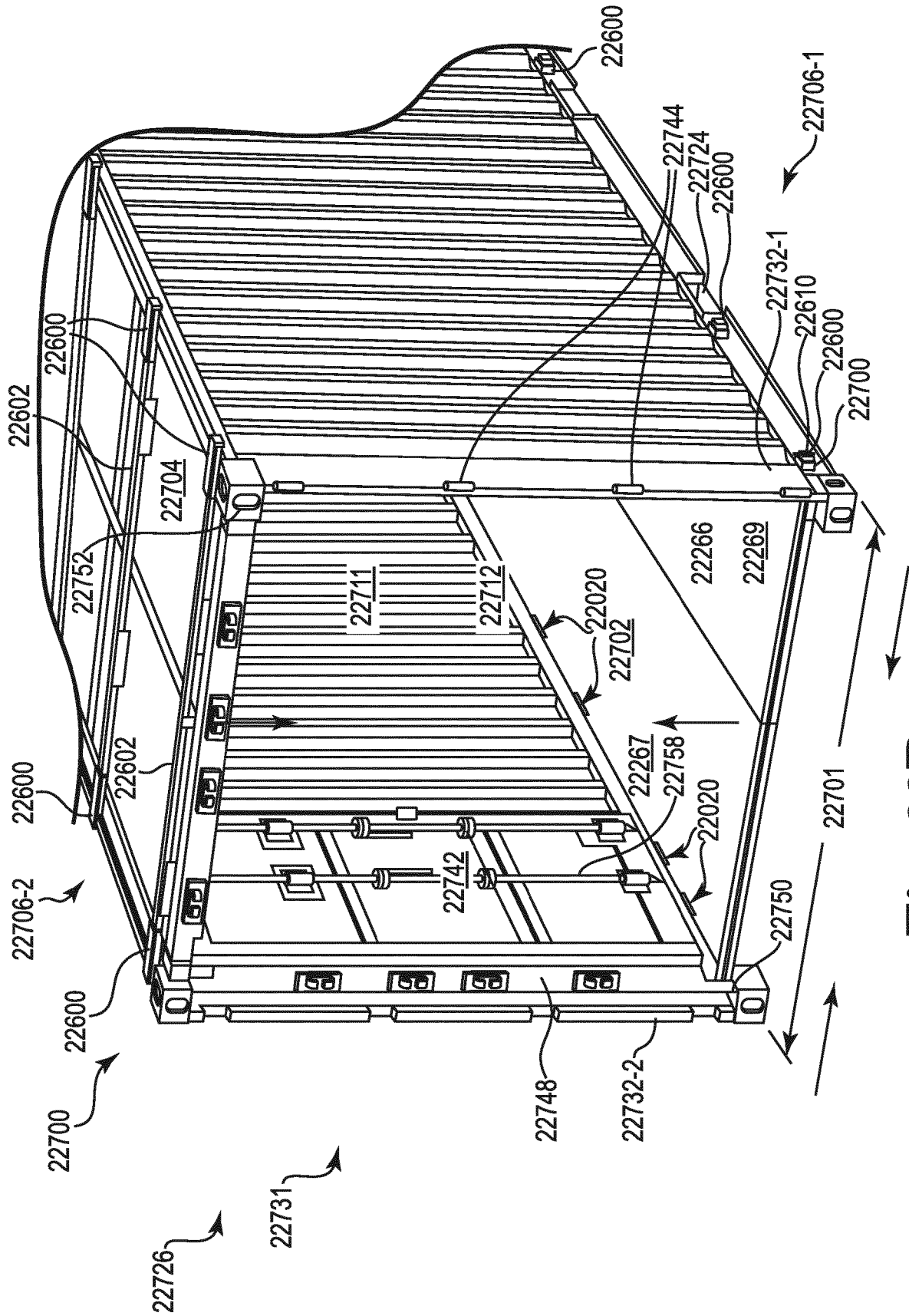


Fig. 22B

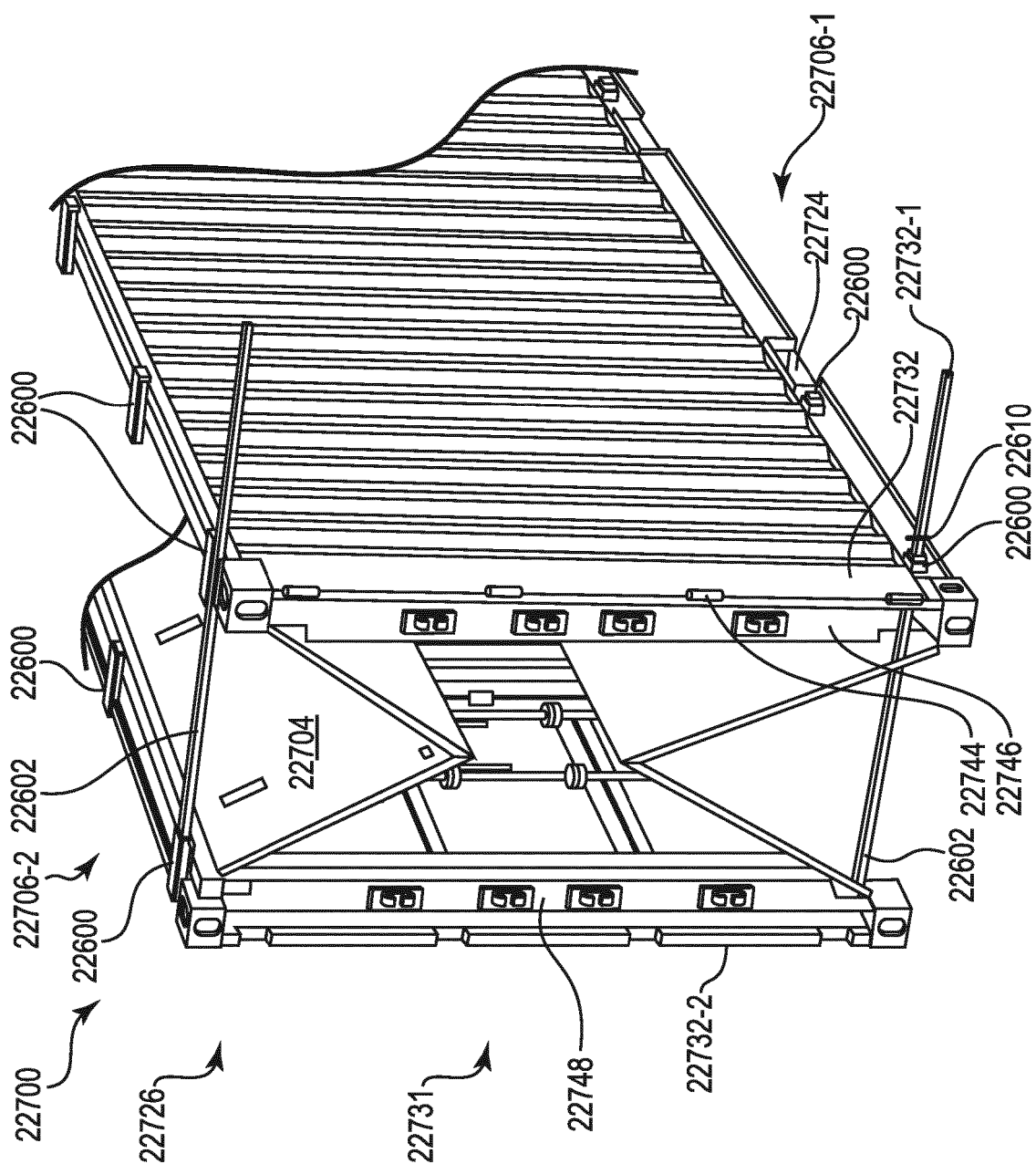


Fig. 22C

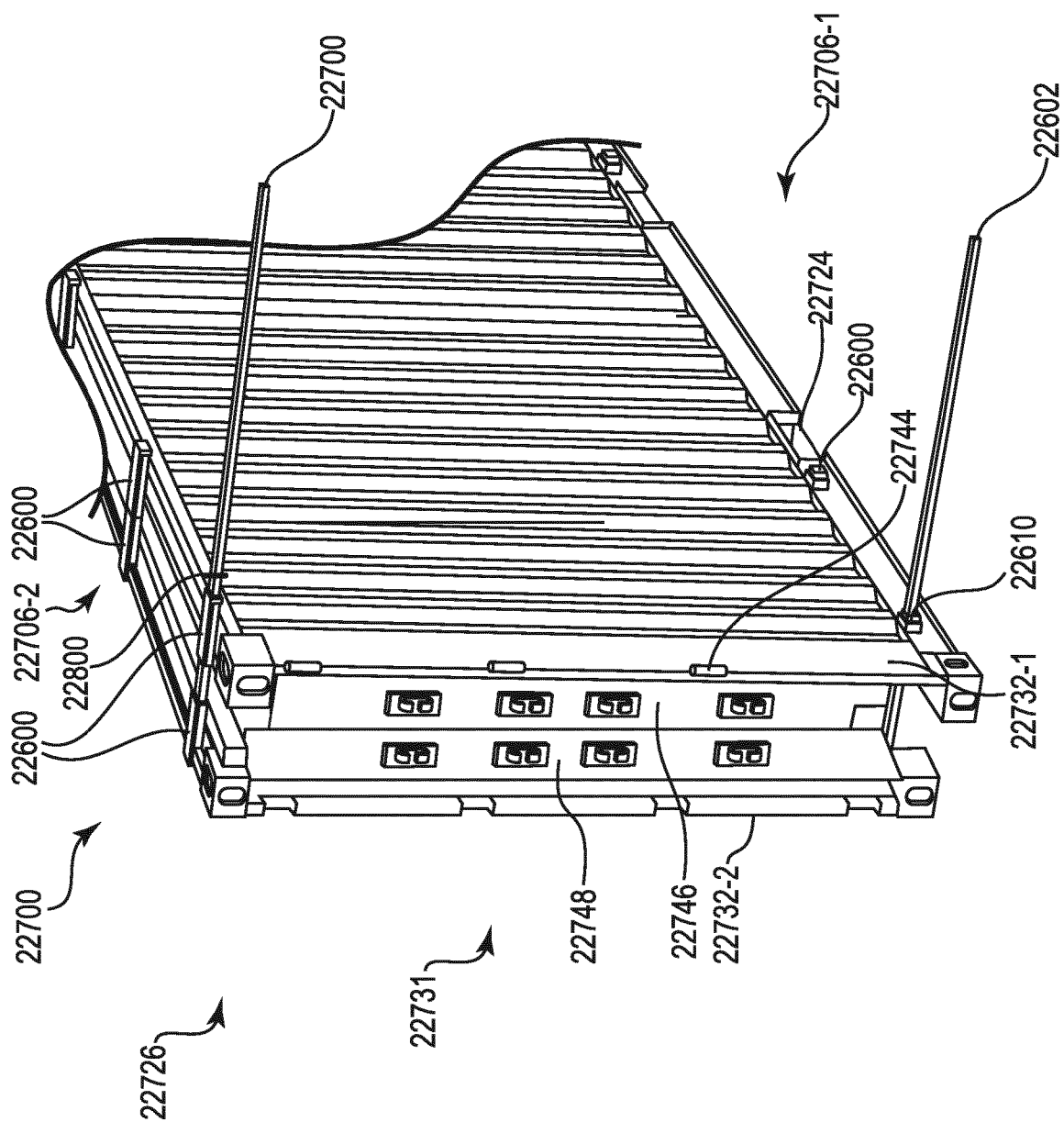


Fig. 22D

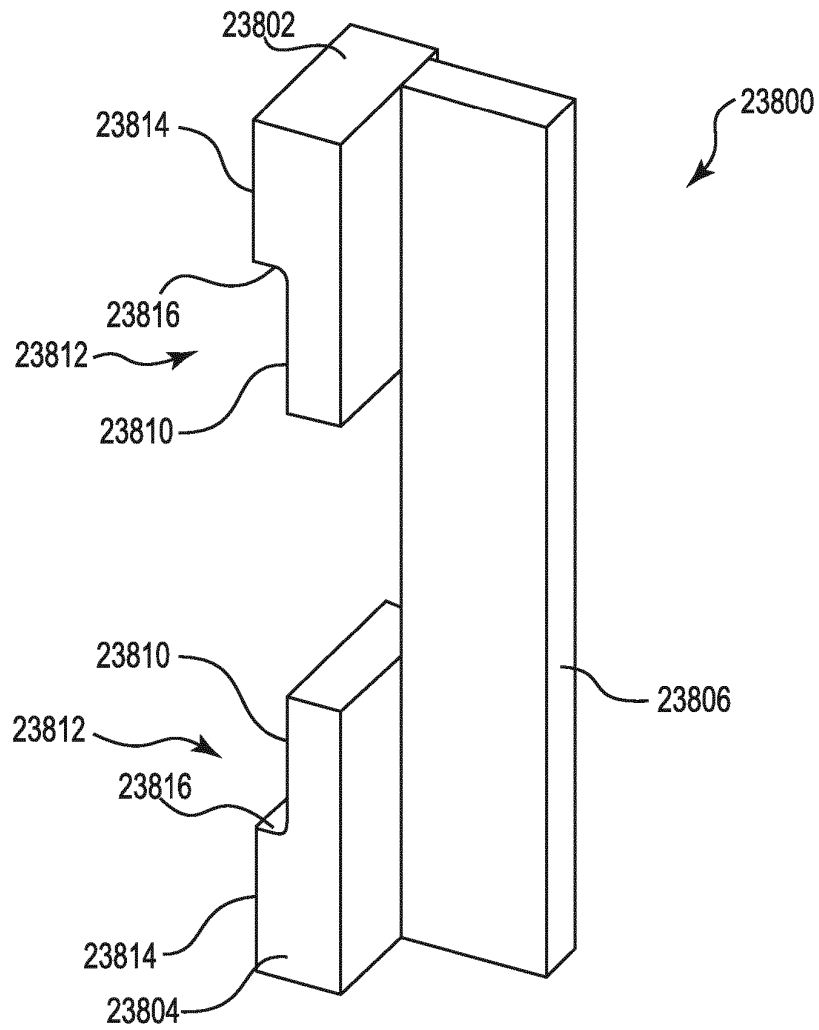


Fig. 23A

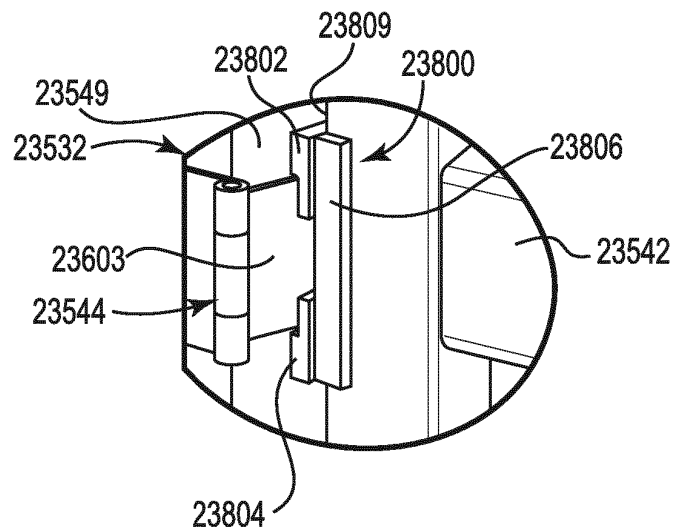


Fig. 23B

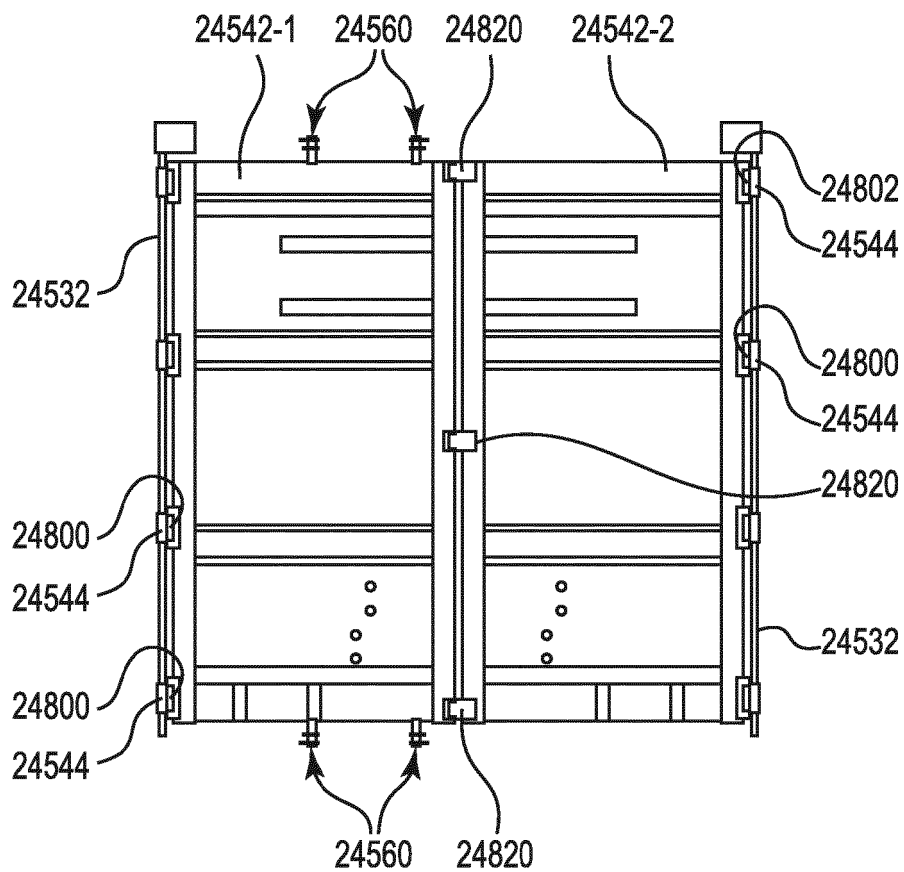


Fig. 24A

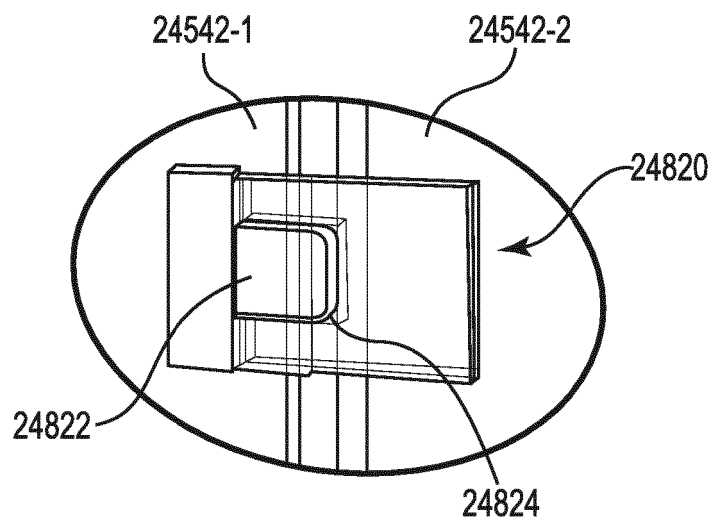
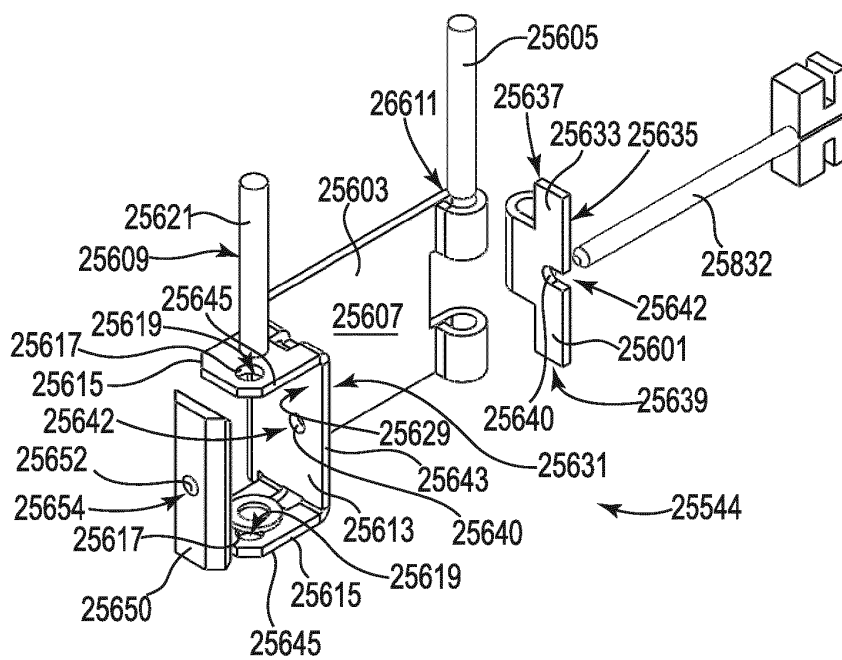
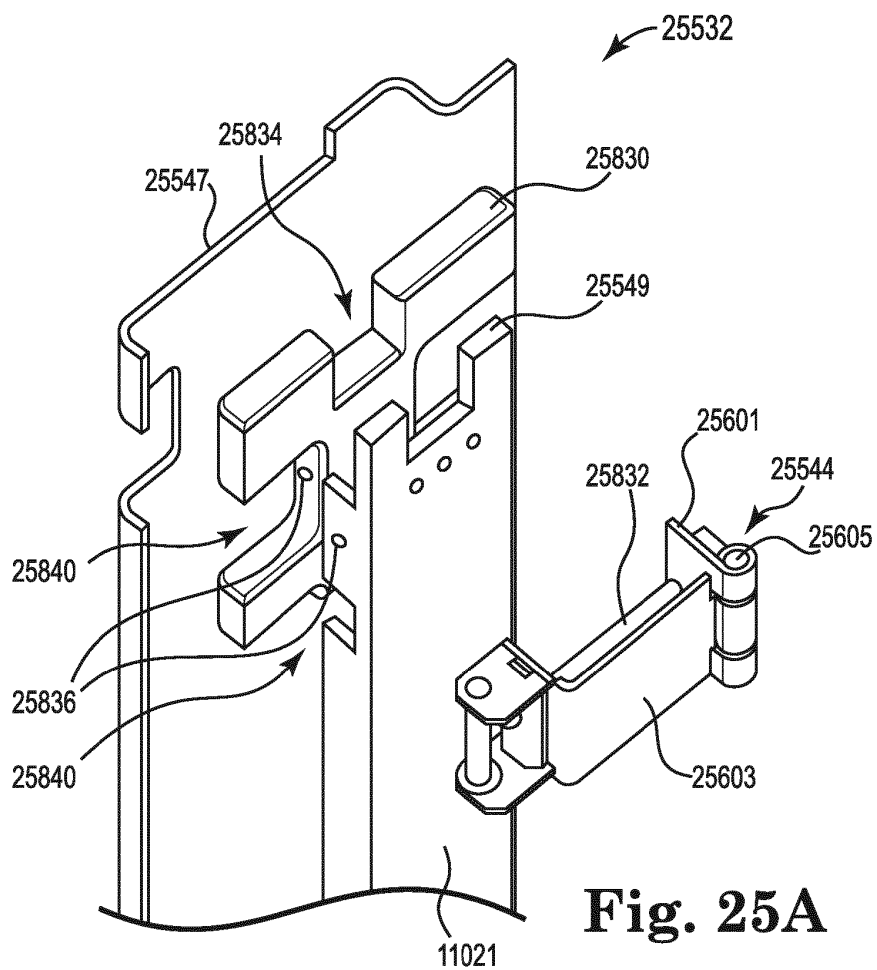


Fig. 24B



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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