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(71) Applicant: **THE WELLINGTON COMPANY RESEARCH AND DEVELOPMENT LIMITED** [NZ/NZ]; Level 12, 50 Manners Street, Wellington, 6011 (NZ).

(72) Inventors: **DESBOROUGH, Geoffrey**; 190 Main Road North, Paraparaumu, 5036 (NZ). **DESBOROUGH, James**; 190 Main Road North, Paraparaumu, 5036 (NZ).

(74) Agent: **AJ PARK IP LIMITED**; Level 22, Aon Centre, 1 Willis Street, Wellington, 6011 (NZ).

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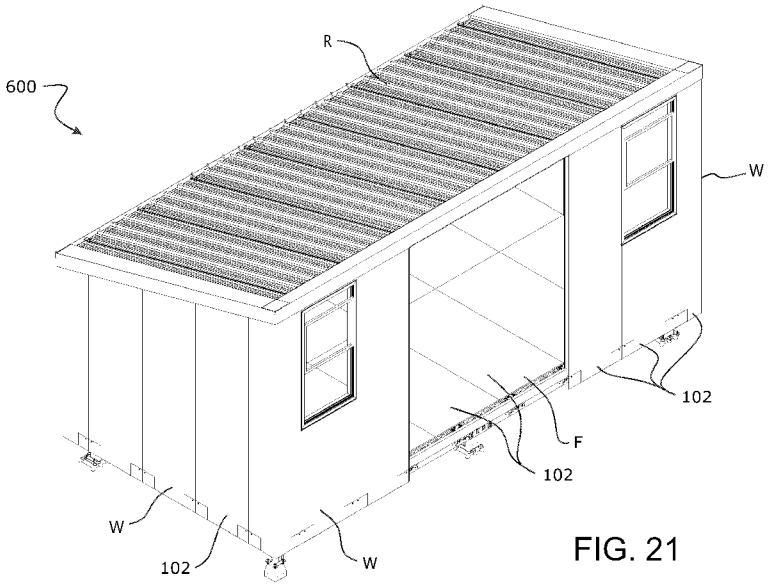

FIG. 21

(57) Abstract: A building panel assembly is provided for a modular building. The panel assembly is configured to provide a structural wall, roof, floor of a building comprising a plurality of panels. Each panel comprises an outer layer, having a first flange extending from a first distal end and a second flange at an opposing end. Each panel comprises an intermediate layer, which may include insulating material, sandwiched between the inner and outer layers. The assembly further comprises a plurality of framing anchors in the form of brackets configured to mount building panels together. The building panels are configured to provide structural support to the building, such that additional framing is not required, the building panels forming a self-supporting structure when connected together.

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A BUILDING PANEL ASSEMBLY, BUILDING AND A LOAD BEARING BUILDING PANEL

Technical field

The disclosure relates to a building panel assembly configured to provide a structural, load bearing wall, roof, floor, or portion thereof, a building comprising a plurality of building panels; a load bearing building panel; and one or more framing anchors used with such building panels.

Background

Various buildings are known in the art including wood framed buildings, steel framed buildings, pre-cast concrete buildings, and cast-in-place concrete buildings. It is common for structural design decisions that are made in convention practice to be cost-driven and there are large commercial pressures to both minimise cost and produce safe structures simultaneously. Prefabricated panels have been used as cladding and/or insulation in some buildings but always in conjunction with some form of load bearing structure or assembly due to the inability for prior art prefabricated panels to be sufficiently load bearing to form a principal structural element of the building.

It is also known to provide load bearing pre-fabricated panels for buildings. However, there are typically difficulties with these in terms of factors such as weight, complexity of construction, expense of construction, and difficulties in securing such panels together and to other parts of the building.

It is therefore an object of the disclosure to provide a building panel assembly, a building panel, and/or a building assembled from such a building panel, and/or one or more framing anchors which overcomes or at least ameliorates one or more disadvantages of the prior art, or alternatively to at least provide the public with a useful choice.

Further objects of the disclosure will become apparent from the following description.

Summary

In accordance with an aspect of the disclosure there is provided a building panel assembly configured to provide a structural wall, roof, floor, or portion thereof, of a building comprising a plurality of panels, each panel comprising an outer layer, having a first flange extending from a first distal end and a second flange at an opposing end, the second flange forming a lip on the outer layer; an inner layer having an end portion with a recess at a first distal end and a protrusion at an opposing end; and an intermediate layer sandwiched between the inner and outer layers; and a framing anchor, the framing anchor including at least two arms inclined to one another; wherein said wall panels are configured to be positioned adjacent one another and connected together by engaging the first

and second flanges of the outer layer with the corresponding recess and protrusion of the inner layer to comprise an interlocking panel structure affixed to a mount of the building by corresponding framing anchor arms of the framing anchor, wherein the interlocking panel structure when so affixed is configured to absorb structural load applied to the panel structure.

In accordance with an aspect of the disclosure, there is provided a building panel assembly configured to provide a structural wall, roof, floor, or portion thereof, of a building comprising

a plurality of panels, each panel comprising

i. an outer layer, having a first flange and a first recess extending from a first distal end and a second flange and second recess at an opposing end;

ii. an inner layer having a third flange and a third recess extending from a first distal end and a fourth flange and fourth recess at an opposing end; and

iii. an intermediate layer sandwiched between the inner and outer layers; and

a framing anchor, the framing anchor including at least one arm configured to engage with the panel;

wherein said wall panels are configured to be positioned adjacent one another and connected together by engaging the flanges at the first ends of the outer and inner layers of one panel with the recesses at the opposing end of the adjacent panel, and the flanges at the opposing ends of the outer and inner layers of one panel with the recesses at the first end of the adjacent panel, to form an interlocking panel structure configured to be affixed to a mount of the building via a framing anchor arm of the framing anchor, wherein the interlocking panel structure when so affixed is configured to absorb structural load applied to the panel structure.

In accordance with an embodiment of the disclosure, adjacent wall panels engage by interposing the first flange towards the opposing end of an adjacent panel, allowing the first flange to receive the lip of the adjacent panel to create a lap joint; wherein the interposition of the first flange and lip creates an over-centre lever force between the adjacent wall panels drawing and retaining the adjacent wall panels; and wherein the recess of the inner layer receives the protrusion of the adjacent wall panel to engage the lap joint between the adjacent wall panels.

In accordance with an embodiment of the disclosure, the wall panels are prefabricated.

In accordance with an embodiment of the disclosure, the outer layer is a weather resistant cladding.

In accordance with an embodiment of the disclosure, the weather resistant cladding is integrally formed into the wall panel.

In accordance with an embodiment of the disclosure, a weather resistant cladding is adhered to the outer layer of the wall panel. For example, the cladding, and/or the outer or inner layer, may have an adhesive applied to it. The adhesive may be heat activated for example. In other examples, the cladding may be auto-adhered.

In accordance with an embodiment of the disclosure, the intermediate layer comprises a thermally insulating material.

In accordance with an embodiment of the disclosure, the intermediate layer comprises an acoustically insulating material.

In accordance with an embodiment of the disclosure, the intermediate layer comprises a polyisocyanurate (PIR) foam.

In accordance with an embodiment of the disclosure, the arms of the plurality of framing anchors are arranged at substantially right angles to one another.

In accordance with an embodiment of the disclosure, the arms of the plurality of framing anchors engage with each of a wall panel and a lower mounting.

In accordance with an embodiment of the disclosure, the lower mounting is a building foundation.

In accordance with an embodiment of the disclosure, the lower mounting is a floor.

In accordance with an embodiment of the disclosure, the arms of the plurality of framing anchors engage with each of a wall panel and an upper mounting.

In accordance with an embodiment of the disclosure, the upper mounting is a roof structure.

In accordance with a further aspect of the disclosure may be said to consist of a load bearing building panel configured to comprise a structurally supporting wall, floor or roof portion of a building, the building panel comprising a structural outer layer; a structural inner layer; an intermediate layer, sandwiched between the outer and inner layers; wherein the outer and inner layers are metal, and the intermediate layer is an insulating layer; the outer and inner layers being secured to the intermediate layer via respective adhesive layers; the metal of the outer and inner layers being configured to form a structurally supporting element of the building panel to enable the panel to absorb structural load applied to the panel such that the panel forms a load bearing structure of the

building; at least one of the outer and inner layers comprising an engaging formation configured to engage with an engaging formation of another building panel such that the engaging formations mount the two building panels together.

In accordance with a further embodiment of the disclosure, the metal layer thickness may be between 0.3mm and 10mm, preferably 0.3mm and 7mm, in some examples between 0.3mm to 3mm, and in some examples 0.4mm and 5mm.

In accordance with a further embodiment of the disclosure, the metal is steel, aluminium, or an aluminium alloy.

In accordance with a further embodiment of the disclosure, the metal is a solid metal sheet of one or more metals.

In accordance with a further embodiment of the disclosure, the intermediate layer thickness may be between 30 and 300mm, and preferably 50mm and 200mm.

In accordance with a further embodiment of the disclosure, the intermediate layer comprises a polyisocyanurate (PIR) foam.

In accordance with a further embodiment of the disclosure, the intermediate layer comprises a thermally insulating material.

In accordance with a further embodiment of the disclosure, the intermediate layer comprises an acoustically insulating material.

In accordance with a further embodiment of the disclosure, the panel is wall panel.

In accordance with a further embodiment of the disclosure, the panel is roof panel.

In accordance with a further embodiment of the disclosure, the panel is floor panel.

In accordance with a further embodiment of the disclosure, the engaging formations are tongue and groove joints.

In accordance with a further aspect of the disclosure may be said to consist of a framing anchor configured to affix a building panel to a mount of the building, the framing anchor comprising at least two arms inclined to one another; at least one aperture positioned on at least one arm; wherein the framing anchor is formed from sheet metal and the arms are integrally formed; and wherein the framing anchor is sufficiently rigid to absorb structural load from the panel to the mount or vice versa; wherein to affix the building panel to the mount at least one of the arms engages the panel and at least one of the arms engages the

mounting, such that the engagement of at least one of the arms may be effected by a fastener positioned through the aperture and into the corresponding panel or mount.

In accordance with a further aspect of this disclosure, there is provided a framing anchor for use with a building panel in accordance with this disclosure, the framing anchor comprising any one or more of any of the following:

a) A floor connection framing anchor for connecting a floor panel to a wall panel.
b) A bottom floor connection framing anchor for connecting a floor panel to a floor joist or bearer.
c) An external roof connection framing anchor for connecting a roof panel to a wall panel.
d) An internal roof connection framing anchor for connecting a roof panel to a wall panel.
e) A sub floor bearer plate framing anchor for connecting two or more floor joists or bearers.
f) A corner pile framing anchor for connecting a corner of a floor joist or bearer to a building pile.
g) A mid pile framing anchor for connecting an intermediate floor joist or bearer to a building pile.

The framing anchor may be substantially as shown in any of Figures 16a to 16i. The framing anchor may be substantially as shown in any of Figure 17a to 17c.

In accordance with another aspect of this disclosure there is provided an adjustable pile framing anchor for connecting a floor joist or bearer to a building pile, the framing anchor comprising a lower component and an upper component;

the lower component comprising a lower portion provided with one or more feet for connection to the pile, and an upper engagement portion configured to engage the upper component;

the upper component comprising an upper portion for connection to a floor joist or bearer, and a lower engagement portion configured to engage with the upper engagement portion of the lower component; wherein

the engagement between the engagement portions is an adjustable engagement being such that the distance between the one or more feet of the lower component and the upper portion of the upper component can be adjusted.

The engagement portions may be configured to be concentric, such that one engagement portion is received at least partly within the other.

The components may be configured such that one component only has one degree of freedom relative to the other, that is a degree of freedom in a adjustment direction.

The engagement portion of one component may be configured to constrain movement of the other component in one or more directions.

One or both components may be elongate, the adjustment being in a direction along a longitudinal axis of the elongate component.

At least one of the engagement portions may be provided with a plurality of engagement formations, each of which may engage with the other engagement portion, adjustment being possible by selecting which engagement formation to engage with the other engagement portion. The engagement formations may comprise a plurality of apertures, spaced apart along the engagement portion, and configured to receive a suitable fixing. Suitable fixings can include a bolt, clip, rod or the like. Both upper and lower components may be provided with a plurality of engagement formations.

The pile framing anchor may comprise a corner anchor for use at a corner of a building, or may a comprise a mid framing anchor for using intermediate the corners of a building.

The lower and/or the upper component may be of bent plate construction, having a non-planar transverse cross section. The transverse cross section may be L or C shaped for example. The transverse cross section of one component may be different from that of the other component.

The plate may be formed from steel, such as carbon steel or stainless steel for example.

The lower component may comprise a plurality of feet for engagement with a pile.

In accordance with a further aspect of the disclosure may be said to consist of a kit of parts for assembly into a building, the kit comprising: a plurality of panels, each panel comprising an outer layer, having a first flange extending from a first distal end and a second flange at an opposing end, the second flange forming a lip on the outer layer; an inner layer having an end portion with a recess at a first distal end and a protrusion at an opposing end; and an intermediate layer sandwiched between the inner and outer layers; and the kit further comprising: at least one framing anchor, the framing anchor including at least two arms inclined to one another and a plurality of apertures positioned on at least one arm; and a plurality of fasteners.

In accordance with a further aspect of this disclosure, there is provided a kit of parts comprising a framing anchor kit, comprising a plurality of framing anchors

for use with a building panel in accordance with this disclosure, the kit of parts comprising any one or more of any of the following:

h) A floor connection framing anchor for connecting a floor panel to a wall panel.
i) A bottom floor connection framing anchor for connecting a floor panel to a floor joist or bearer.
j) An external roof connection framing anchor for connecting a roof panel to a wall panel.
k) An internal roof connection framing anchor for connecting a roof panel to a wall panel.
l) A sub floor bearer plate framing anchor for connecting two or more floor joists or bearers.
m) A corner pile framing anchor for connecting a corner of a floor joist or bearer to a building pile.
n) A mid pile framing anchor for connecting an intermediate floor joist or bearer to a building pile.

In accordance with a further aspect of the disclosure may be said to consist of a method of constructing a building or a portion of a building using the kit of parts outlined above, the method comprising steps of arranging at least two of the panels against a mounting and adjacent to one another; engaging the first and second flanges of the wall panel outer layer with the corresponding recess and protrusion of the inner layer; positioning the at least two arms of the framing anchors such that at least one arm abuts each of the wall panel and the mounting; affixing together the panel and mounting by inserting the fasteners through the apertures and into the corresponding panel and/or mounting; wherein the engagement of corresponding first and second flanges of the panel outer layer with the corresponding recess and protrusion of the inner layer comprise an interlocking panel structure.

In accordance with a further aspect of the disclosure may be said to consist of a method of constructing a building or a portion of a building using a building panel assembly configured to provide a structural wall, roof, floor, or portion thereof, of a building, wherein the building assembly comprises a plurality of panels, each panel comprising an outer layer, having a first flange extending from a first distal end and a second flange at an opposing end, the second flange forming a lip on the outer layer; an inner layer having an end portion with a recess at a first distal end and a protrusion at an opposing end; and an intermediate layer sandwiched between the inner and outer layers; and a plurality of framing anchors, each framing anchor comprising at least two arms inclined to one another; wherein the method comprises steps of: positioning said wall panels adjacent one another; connecting the adjacent wall panels together by engaging the first and second flanges of the outer layer with the corresponding recess and protrusion of the inner layer to comprise an interlocking panel structure; affixing the connected wall panels to a mount of the

building by corresponding framing anchor arms; wherein the interlocking panel structure when so affixed is configured to absorb structural load applied to the panel structure.

In accordance with a further aspect of the disclosure may be said to consist of a building formed from the panel assembly and/or one or more panels of those described above.

In accordance with another aspect of the disclosure there is provided a building comprising a plurality of building panels according to this disclosure, the plurality of building panels comprising a plurality of wall panels comprising inner and outer faces, both of which are planar.

The plurality of building panels may further comprise a plurality of floor and roof panels, the floor and roof panels being of the same construction. The floor and roof panels may comprise inner and outer faces, at least one of which is corrugated.

The building may comprise a support frame comprising a plurality of floor bearers, the floor panels being mounted on the floor bearers using a plurality of framing anchors, the wall panels being mounted on the floor panels and/or floor bearers using a plurality of further framing anchors.

The building may comprise a plurality of pile framing anchors to mount the building on one or more piles.

The pile framing anchors may comprise a plurality of corner pile framing anchors for mounting at corners of the building. The pile framing anchors may comprise a plurality of mid pile framing anchors for mounting intermediate the corners of the building.

The building may comprise one or more lintel framing anchors configured to form one or more lintels over one or more windows and/or door openings of the building.

The building may be configured such that one or more framing anchor extends over a joint between adjacent building panels.

The one or more framing anchor may be configured to pull the adjacent building panels together, as the framing anchor and building panels are connected together.

The one or more framing anchor may be configured such that the amount by which the adjacent building panels are pulled together is adjustable.

Further aspects of the disclosure, which should be considered in all its novel aspects, will become apparent from the following description.

Brief description

A number of embodiments of the disclosure will now be described by way of example with reference to the drawings in which:

Figure 1 is a simplified plan view of an example building panel in accordance with this disclosure, assembled in a building;

Figure 2A is a cross-sectional end view of part of the building panel of Figure 1;

Figure 2B is a cross-sectional view from one end and one side of the building panel of Figure 1;

Figure 2C is a cross-sectional view of an end of the building panel of Figure 1;

Figure 3A is a perspective view of an building in accordance with this disclosure comprising a plurality of the building panels of Figures 1 and 2 interlocked;

Figure 3B is an end view of a building in accordance with this disclosure comprising a plurality of the building panels of Figures 1 and 2 interlocked;

Figure 3C is a cross-sectional side view through a building in accordance with this disclosure comprising a plurality of the building panels of Figures 1 and 2 interlocked;

Figure 3D is a top view of a building in accordance with this disclosure comprising a plurality of the building panels of Figures 1 and 2 interlocked;

Figure 3E is a bottom view of an building in accordance with this disclosure comprising a plurality of the building panels of Figures 1 and 2 interlocked;

Figures 4A and 4B are plan views of three different framing anchors in accordance with this disclosure, each engaged with interlocked building panels of Figures 1 and 2;

Figure 4C is an enlarged part section view of a lower corner of a building in accordance with this disclosure, comprising a plurality of the building panels of Figures 1 and 2, with another framing anchor in accordance with this disclosure.

Figures 5A to 5E are perspective views of five different framing anchors, where the anchor of Figure 5E is the same anchor as that of Figure 4A, and the anchor of Figure 5D is the same anchor as Figure 4B;

Figures 6A to 6C are enlarged perspective views of a building in accordance with this disclosure including the framing anchors of Figures 4 and 5 engaged with interlocked building panels of Figures 1 and 2.

Figure 7A is a perspective view of an internal wall panel in accordance with this disclosure, with **Figures 7B to 7D** being sectional cross sections of such a panel showing different surface configurations.

Figure 8A is a perspective view of an external wall panel in accordance with this disclosure, with **Figures 8B to 8E** being sectional cross sections of such a panel showing different surface configurations.

Figure 9A is a perspective view of an external wall panel in accordance with this disclosure, with **Figures 9B to 9E** being sectional cross sections of such a panel showing different surface configurations.

Figure 10A is a perspective view of an external wall panel in accordance with this disclosure, with **Figures 10B to 10E** being sectional cross sections of such a panel showing different surface configurations.

Figure 11A is a perspective view of a roof panel in accordance with this disclosure, with Figures **11B to 11C** being sectional cross sections of such a panel showing different surface configurations.

Figure 12A is an end view of a building panel assembly in accordance with this disclosure, showing two panels interlocked together, with Figure 12B being an enlarged view of the region labelled A of Figure 12A.

Figure 13 is a table showing example properties of a roof panel in accordance with this disclosure.

Figure 14 is a table showing example properties of an external wall panel in accordance with this disclosure.

Figure 15 is a table showing example properties of an internal wall panel in accordance with this disclosure.

Figures 16a to 16i are perspective views of a kit of framing anchors for connecting to one or more building panel, in accordance with this disclosure. In particular:

Figure 16a shows a floor connection framing anchor configured to connect one or more wall panels with one or more floor panels;

Figure 16b shows an external roof connection framing anchor configured to connect one or more wall panels with one or more roof panels;

Figure 16c shows another external roof connection framing anchor;

Figure 16d shows a further roof connection framing anchor;

Figure 16e shows a bottom floor connection framing anchor configured to connect one or more floor panels with one or more floor joists or bearers;

Figure 16f shows a sub floor bearer plate framing anchor configured to connect one or more floor joists or bearers together;

Figure 16g shows an internal roof connection framing anchor configured to connect one or more wall panels with one or more roof panels;

Figure 16h shows another internal roof connection framing anchor;

Figure 16i shows a further internal roof connection framing anchor;

Figures 17a to 17c are perspective views of different lintel framing anchors.

Figures 18a and 18b are respectively perspective views of a corner pile bracket and a mid-pile bracket, for connection between a pile and a floor joist or bearer.

Figures 19a and 19b are respectively perspective views of an adjustable corner pile bracket comprising a base configured to be mounted on a pile, and a support adjustably mountable on the base and configured to be connected to a floor joist or bearer.

Figures 20a and 20b are two variants of a base of an adjustable mid pile bracket, where the base is configured to be mounted on a pile. **Figure 20c** is a support configured to be adjustably mounted on either mid pile bracket base, and configured to be connected to a floor joist or bearer.

Figure 21 is a perspective view of another building in accordance with this disclosure including the framing anchors of any of the above figures engaged with interlocked building panels of Figures 1 and 2.

Figures 22 and 23 are end views of the building of Figure 21.

Figure 24 is a front view of the building of Figure 21, showing a pair of similarly sized windows mounted to the building, and also showing a central aperture configured to receive a larger window or door (not shown).

Figure 25 is a rear view of the building of Figure 21 showing a pair of differently sized windows mounted to the building.

Figure 26 is a view from underneath the building of Figure 21, excluding the piles on which the building would be mounted, and therefore showing the corner and mid pile brackets, and also the floor connection frame anchors. This particular example also includes an optional mid floor cross member spanning across the centre of the floor of the building.

Figure 27 is a view from above of the building of Figure 21, showing the roof of the building formed from building panels in accordance with this disclosure.

Figure 28 is a front view of the building of Figure 21, with the front wall and front windows removed.

Figure 29 is a sectional end view of the building of Figure 21 with the nearmost end wall removed.

Figure 30 is a perspective sectional view of the building of Figure 21 looking towards one end of the building.

Figure 31 is a perspective sectional front view of the building of Figure 21, looking towards the rear wall of the building.

Figure 32 is an exploded perspective view of the building of Figure 21.

Figure 33 is an exploded perspective view of the floor, pile brackets and floor connection anchors of the building of Figure 21.

Figure 34 is another exploded perspective view of the floor, pile brackets and floor connection anchors of the building of Figure 21, also showing the front wall of the building.

Figure 35 is another exploded perspective view of the floor, pile brackets and floor connection anchors of the building of Figure 21.

Figure 36 is an enlarged exploded perspective view of the floor joists, pile brackets and floor connection anchors of the building of Figure 21.

Figure 37 is an enlarged exploded perspective view of the floor, pile brackets and floor connection anchors of the building of Figure 21.

Figure 38 is an enlarged perspective view of one corner of the floor, pile brackets and floor connection anchors of the building of Figure 21.

Figure 39 is an enlarged perspective view of one corner of the floor, an adjustable corner pile bracket, and floor connection anchors of the building of Figure 21.

Figure 40 is an enlarged perspective view of a mid part of the floor, showing the mid-floor cross member and mid pile bracket and floor connection anchors of the building of Figure 21.

Figure 41 is a perspective view of the rear wall of the building of Figure 21 with the windows removed.

Figure 42 is an enlarged perspective view from above of a corner of the wall of the building of Figure 21.

Figure 43 is an enlarged perspective view of a corner of the building of Figure 21 showing the roof of the building and a number of lintel framing anchors.

Figures 44a and 44b are enlarged sectional end and side views showing detail of how the connections between the floor and wall building panels, the flooring framing anchors and the floor joists. **Figure 45** is an enlarged sectional plan view of a wall joint of a wall of the building of Figure 21 showing the joint between adjacent wall building panels.

Figure 46 is an enlarged sectional side view of a roof joint of the roof of the building of Figure 21 showing the joint between adjacent roof building panels.

Figure 47a is an enlarged sectional side view of an upper part of the building of Figure 21, showing the connections and framing anchors connecting a rear wall panel to a lower end of the inclined roof panel; **Figure 47b** is an exterior front view corresponding to Figure 47a; and **Figure 47c** is a sectional view of the roof along a vertical axis through the wall.

Figure 48a is an enlarged sectional side view of an upper part of the building of Figure 21, showing the connections and framing anchors connecting a front wall panel to an upper end of the inclined roof panel; **Figure 48b** is an exterior front view corresponding to Figure 47a; and **Figure 48c** is a sectional view of the roof along a vertical axis through the wall.

Figure 49a is an enlarged sectional side view of an upper part of the building of Figure 21, showing the connections and framing anchors connecting an end wall panel to an intermediate part of the inclined roof panel; **Figure 49b** is an exterior front view corresponding to Figure 47a; and **Figure 49c** is a sectional view of the roof along a vertical axis through the wall.

Detailed description

Throughout the description like reference numerals will be used to refer to like features in different embodiments. The description below generally uses the example of a building wall. However, the building panels can equally be used for any other desired part of a building.

Referring first to figure 1, illustrated is a building panel assembly 100. In this example, the assembly 100 comprises at least one wall panel 102, upper and lower framing anchors 104, upper mount 106, and lower mounting 108. The panel 102 is affixed to the upper and/or lower mount 106, 108 by the framing anchors 104, the framing anchors 104 engaging both the panel 102 and the upper and lower mounts 106, 108. The mounts 106, 104 comprise structural parts of the building, for example part of a frame of the building. The framing anchors 104 can be secured to the panel 102 and/or the mounts 106, 108 using any suitable method. For example the anchors 104 may engage using an interference fit, adhesive, or by one or more fixings, for example screws (such as countersunk screws), bolts or nails (not pictured). A plurality of panels 102 may be arranged adjacent to one another and interlocked together in any number to form a composite panel, for example a wall, of any desired length.

Referring to figures 2A to 2C, in the embodiment illustrated, each of the wall panels 102 is a sandwich-structured composite, including an inner layer 110 and outer layer 114 sandwiching a thicker intermediate layer 112. In this embodiment illustrated, the inner and outer layers 110, 114 are comprised of one or more metals/metal alloys, more preferably steel, while the intermediate layer 112 is comprised of a foam insulating material. The inner and outer layers 110, 114 may each comprise a single solid metal or metal alloy sheet, or a plurality of such single solid metal or metal alloy sheets bonded or otherwise secured together. The metal or metal alloy sheets thus extend fully between at least two opposed margins of the building panel 102, and preferably extend fully between all opposed margins of the building panel 102. Thus, the metal inner and outer layers preferably closely match the shape and size of the panels 102, when the panels are viewed from the front or rear.

More particularly, the intermediate layer 112 may be a polyisocyanurate (PIR) foam which forms a relatively rigid board and is selected in composition for any desired or required combination of thermal and/or acoustic insulating properties and/or fire retardant properties. PIR may provide enhanced insulating effects compared to other insulating materials such as polyurethane (PUR) and expanded polystyrene (EPS). For example, core comparisons of a 50 mm thermal resistance (R value at 150C) of EPS can be around 1.2 compared to PIR which in some examples in accordance with this disclosure can have a R value of 2.4.

Any suitable method may be used to laminate the panel materials (inner layer 110, intermediate layer 112, and outer layer 114), to achieve the desired lamination strength.

In the embodiment illustrated the inner and outer layers are between 0.3mm and 10mm, preferably 0.3mm to 3mm, in thickness and the intermediate layer is between 50mm and 200mm in thickness. More preferably, the inner and outer layers are substantially 0.6mm in thickness (for example 0.55mm in some examples) and the intermediate layer is substantially 100mm in thickness.

The building panel 102 may include a pre-painted galvanised steel sheet forming either or both of the inner and outer layers 110, 114 with a base metal thickness (BMT) of between 0.25 and 0.75mm, preferably 0.3mm to 3mm, and in some examples 0.55mm. The galvanised steel sheet may include any of a zinc coating, zinc phosphate coating, primer coating and a top (finish) coating.

The building panel 102 may further include one or more additional, preferably non-metal sheet in addition to the inner and outer layers 110, 114. The one or more additional sheets are configured to provide the building panel 102 with a suitable aesthetic finish, to enable the panel 102 to be suitable for use as an interior panel which may not require weather-resistant properties.

The overall width of an example panel 102 may be 1022mm or 1050mm, coverage width 1000mm with a depth ranging of from 50 to 250 mm. The coverage width is the width of the panel 102 that can be seen when adjacent panels 102 are interlocked, thus excluding the interlocking features. The production length may be 30 lineal metres (30 square metres). In this way, the pre-finished panels 102 can be supplied to size and require no finishing. The panel 102 may have any one or more the following dimensions:

- width: 300mm to 3000mm, preferably 450mm to 2000mm
- height: 1000mm to 10000mm, preferably 1000mm to 6000mm, in some examples 1000mm to 4500mm, preferably 2600mm to 3700mm
- thickness: 30mm to 300mm.

The panel 102 may be manufactured and/or supplied as a continuous length and be cut to a desired size and length depending on particular application, either during manufacture, or on site

Details on panel strength such that it enables structural load bearing and forms primary structural element of the building

The panel 102 is thus configured to be connected to one or more other panels 102 to form an interlocking panel structure configured to absorb structural load applied to the panel structure. That structural load can comprise any one or more of:

a) in plane load acting to compress or stretch the panel vertically and/or horizontally in use;
b) torsional load acting to twist the panel in use, about a notional vertical axis, and/or about a notional horizontal axis;
c) axial load through the panel;

d) Bending moment;
e) Density;
f) Compressive strength
g) Shear strength.

The panel 102 may be configured to have one or more further useful properties, selected from any one or more of:

a) water vapour transmission rate;
b) thermal conductivity;
c) dimensional stability;
d) weight;
e) R value;
f) acoustic properties;
g) fire performance properties.

Example values, which are illustrative, of roof, external and internal wall panels are shown in the table below, with further examples being shown in Figures 13 to 15:

PIR Panel Type	*C-Panel*	*External Wall Panel*	*Roof*
External Skin Thickness(mm)/Grade/Profile	0.55/G550/Flat	0.55/G550/1-Rib	0.55/G550/Trapezoidal
Internal Skin Thickness(mm)/Grade/Profile	0.55/G550/Flat	0.55/G550/1-Rib	0.55/G550/Flat
Nominal Thickness(mm)	100	100	150
Panel Mechanical Properties			
PIR Foam Density(kg/m3)	40	40	40
Shear Strength(MPa)	0.11	0.11	0.10
Tensile Strength(MPa)	0.10	0.10	0.09
Compressive strength(MPa)	0.10	0.10	0.10
Bending moment(kN.m) -External skin	10	9	20
Bending moment(kN.m) -Internal skin	6	5	10
Construction system - In-plane(bracing)			
Max Force(kN)/Height(m)	6/2.4		
Max Force(kN)/Height(m)	4/3.5		

The panel mechanical properties were tested to BSEN 14509:2013.

The outer layer 114 may include an intermediate panel portion, spaced from or extending between the margins of the outer layer 114, that may be of substantially planar configuration, but which can take any other suitable form as is desired for aesthetic appearance and utility. For example, the intermediate panel portion may include a series of raised ridges where the area in between the ridges may be a channel for draining water in a roof panel.

With additional reference to Figure 3A, each panel 102, for ease of reference and in this example, is oblong and comprises upper and lower opposed margins U, L, and opposed side margins S. In the single storey building shown in Figure 3A, the building panels 102 are arranged adjacent on another, such that the side

margins S of adjacent panels 102 abut, or at least are adjacent and define a join J between adjacent panels 102. The corners of the building similarly form corner joints CJ.

With particular reference to figure 2C, the outer layer 114 may be provided with an additional feature such as an extended flashing 124 for example, to extend along, and cover, one or more of the joins J, CJ, to weatherproof the joints J, CJ. The additional feature 124 is desirably integral with, and comprises an extension of, the outer layer 114, such that no additional fixings or time are required to secure the flashing in place.

The additional feature may comprise flashing for the joints J, CJ of the building, any oher form of weathertightness feature, spouting or guttering, water draining channels or external conduit tunnels for services or cabling for example.

A panel in accordance with this disclosure may also include internal passageways within the insulation of the intermediate layer 112, along which services may be provided. For example the internal passageways may be configured to received electrical/data cabling, or gas supply conduit. The internal passageways may be formed during manufacture of the panel.

Each panel 102 comprises integral features that enable adjacent panels 102 to be locked together. Figure 12 shows an example panel assembly comprising two panels 102 locked together. One side margin S of the panel 102 comprises a pair of elongate, parallel flanges 116 which are integral with, and project outwardly from, the outer and inner layers 114 of panel 102, when the panel is viewed from the top or bottom as per Figures 2A and 2B. The opposite side margin S of the panel 102 comprises a pair of elongate, parallel slots or recessed 118 adjacent the inner and outer layers 110, 114. The side margin S with the pair of flanges 116 is further provided with a larger flange 117 which extends parallel to the pair of flanges 116, and which projects outwardly from the outer layer 114 substantially in the plane of the outer layer 114. In the example where the panel comprises an external wall panel, the larger flange 117 is spaced from the one of the smaller adjacent flanges 116 to define an elongate channel 117A. The other side margin S, with the pair of slots 118, is also , formed with an elongate recess 119 extending along the side margin S which recesses the side margin of the outer layer 114, and an elongate rib 123. If the panel is an internal panel for example as shown in Figure 7, the larger flange 117 may be omitted, as there is no requirement for that flange to form a flashing that overlaps with the joints between adjacent panels for weathertightness.

The inner and outer layers 110, 114 therefore include a plurality of tongue and corresponding groove formations in the form of interlocking flanges and recesses at each margin of the panel, for connecting adjacent building panels 102 together. Adjacent panels 102 may be interlocked together using these tongue and groove formations. In particular it will be appreciated that the two side

margins of each panel 102 have different formations. To assemble the panels 102 together the side margin of one panel 102 comprising the flanges 116, 117 is placed adjacent the side margin of a second panel 102 that comprises the slots 118 and recess 119. The pair of flanges 116 of the first panel 102 are aligned with the pair of slots 118 of the second panel 102. The larger flange 117 of the first panel 102 is aligned with the recess 119 of the second panel 102 such the rib 123 of the second panel 102 is adjacent the elongate channel 117A of the first panel 102. When all of these formations are so aligned the first and second panels 102 can be forced together, such that the flanges 116 are received in slots 118, the rib 123 in channel 117A, and the larger flange 117 in recess 119. When fully forced together, the formations interlock the first and second panels 102. The tolerances of these formations may be such that there is in interference fit between the features when forced together, sufficient to interlock the two panels 102 without additional fixings, and/or without the use of adhesive or other bonding agent.

Referring to figures 3A to 3E, multiple views of a building 200 in accordance with this disclosure, comprising a plurality of interlocked building panels 102 are illustrated. The interlocked building panels form a panel assembly 300 which may form a sub assembly of the building 200. The panel assembly 300 forms the principal structural element of the building assembly system whereby no additional support or framing is required to enable the panel assembly 300 to provide a load carrying wall structure of the building. The panel assembly 300 does not need reinforcing with other structural elements, and does not need external or internal supplementary framing for example. The panels 102 are secured to the building using suitable mounting anchors. Examples of such anchors are described below with reference to Figures 5 and 6. The mounting anchors mount the panels 102 to a suitable sub-structure of the building 200. In the example of Figure 3A, where the panels 102 are used as wall panels, the lower margins of the panels 102 are mounted to a lower structure of the building 200, which could be a concrete foundation, wooden, concrete or metal piling, or floor joists or bearers forming a flooring sub frame of the building 200. The upper margin of the building panels 102 is mounted to an upper structural part of the building 200, again using suitable mounting anchors.

The side margins of the panels 102 are interlocked together as described above. The combination of the load bearing structure of the panels 102, the interlocking of the panels 102, and the mounting anchors, enables a building to be relatively quickly and easily erected, with minimal or at least significantly reduced bespoke carpentry, load bearing framing, and fixings such as screws, nails.

Due to the panels 102 being configured such that adjacent panels 102 interlock, minimal or no fixings are required and the interlocking panel assembly 300 enables a relatively easy and quick assembly and/or disassembly of the building 200 as desired.

The or each panel 102 may be prefabricated, prior to assembly into the building, such that other sub-features are provided in the panel 102. For example, the panel 102 could be provided with one or more apertures, configured to provide, or receive, a door frame 202 and/or window frame 204. Such apertures may be provided in any one panel 102, or in multiple panels such that an aperture is formed across multiple adjacent panels 102 when interlocked together.

Additional flashing to fit around the door and/or window framing 202, 204 may be provided together or separately, for example as described above, or alternatively the single panel 102 or multiple panels 102 may simply be pre-formed such that the required apertures are provided dependent upon the building 200 requirements.

With particular regard to figure 3E, it can be seen from the lower view of building 200 that a plurality of framing anchors 104 are affixed to lower mount 108 of the building, which may be a floor, a foundation slab, supporting piles, a lower level of building 200 in a multi-storey building example, or other appropriate building structure. Mount 108 could comprise a floor joist or bearer. Framing anchors 104 are positioned such that an appropriate structural load distribution from the panel 102 above is transferred to the mount 108 via the framing anchors 104. In the example given, for a panel 102 having a width less than 1000mm, there are one, two or three anchors 104 per panel. It is envisaged that the interlock between adjacent panels 102 be sufficient that only one lower anchor 104 be provided per building panel 102, or even one anchor for every two panels 102.

Referring to figures 4A to 4C, exploded views of three different framing anchors 104 engaged with interlocked building panels 102 are shown.

A number of different anchors 104 are shown with reference to Figures 4 and 5. Each framing anchor 104 is configured to affix a building panel to a mount of the building, or to connect a number of building panels together, and comprises:

i. a substantially planar anchor body;
ii. at least two arms inclined to one another, and extending from the anchor body;
iii. at least one aperture positioned on at least one arm;

Each framing anchor is formed from sheet metal, such as carbon steel for example, and the arms planar and are integrally formed with the planar body of the anchor. Each framing anchor 104, via its material, shape and construction, is sufficiently rigid to absorb structural load from the panel to the mount or vice versa. Each anchor comprises geometric cut-outs and/or projections. The arm or arms of one or more anchors can vary in shape and/or thickness along their length.

To affix the building panel, or building panel assembly to the mount at least one of the arms engages the panel and at least one of the arms engages the mounting, such that the engagement of at least one of the arms may be effected by a fastener positioned through the aperture and into the corresponding panel or mount. Such fasteners could comprise, as examples only, screws, bolts, nails, staples, pins or any other fixing configured to clamp or affix the anchor to the building structure.

In the embodiments illustrated, one or more framing anchors 104 may be provided with a guide notch 304 positioned in the centre of an arm 300 to aid in aligning the anchor 104 centrally across two adjacent panels 102 as shown, if required.

Figures 4A and 4B illustrate enlarged views of uses of framing anchors 104 configured to engage with upper mounts 106 whereby again fasteners may be affixed through apertures 302 positioned on at least one arm 300 to engage the panel 102 or plurality of panels 102 to the upper mount 106. An upper mount 106 may be a roof structure, ceiling panel arrangement, the floor of an upper level of building 200 in a multi-storey example, or other appropriate support. Wherein framing anchors 104 are positioned such that an appropriate structural load distribution from the panel 102 below is absorbed to the mount 106.

With reference to figure 4C framing anchor 104 is positioned affixed to building mounts 108 such that the appropriate or required, or regulated structural load distribution from the panel 102 is transferred to the mount 108. The arms 300 of the anchors 104 may be affixed to the mounts 108 by fasteners engaged through apertures positioned in at least one of the arms 300 of the anchors 104 (not pictured), wherein at least one of the arms 300 engages the panel 102 and at least one of the arms engages the mounting 108. The arms 300 of anchors 104 are sufficiently rigid such that they resist axial or lateral deformation or movement when engaged, and transfer structural load from the panel to the mount or vice versa. The body and/or any one of the arms of the anchors can comprise bracing, or additional structural support to improve strength and/or rigidity in one or more directions. For example, the body may be provided with perpendicularly extending flaps or folded regions, or other elongate braces that extend in a direction not parallel to the plane of the body.

With reference to figures 5A to 5E are five different framing anchor configurations, each of which is configured to affix a building panel to a mount of the building and comprising at least two arms 300 inclined to one another and at least one aperture 302 positioned on at least one arm. The anchors 104 may be formed from sheet metal and the arms are integrally formed, whereby one singular piece of metal may be folded in multiple configurations specific to the building specifications required and provided therefore with multiple arms to enable engagement between corresponding panel 102 and mount 106, 108 formations. Apertures 302 may be positioned and formed during manufacture of

the anchor 104, or alternatively could be formed during installation with or without prior scoring of the position on the anchor 104, depending on the specification of the building assembly and location of the panel 102 or mount 106, 108 that the anchor is to be engaged with. The sheet metal is preferably steel, but any sufficiently rigid metal could be envisioned for manufacture or suitability. Preferable the thickness of the sheet metal would be between 0.3mm and 10mm, more preferably between 0.3mm and 3mm. This thickness may vary between materials depending on Young's modulus or tensile strength requirements.

Figures 6A to 6C illustrate framing anchors 104 engaged with interlocked building panels in situ. Arms 300 of each framing anchor 104 are affixed to a panel 102 and mount 106, 108 as described above.

Figure 6A shows an exterior anchor 104 configured to rest below a joint J of two adjacent building panels 102, and to mount the panels 102 to a pile or the like.

Figure 6B shows an interior anchor 104 configured to rest below a joint J of two adjacent building panels 102 with the anchor 104 bridging a rib of a corrugated floor structure F, with a pair of arms 300 extending adjacent each side of a corrugation of the floor structure.

Figure 6C shows a floor anchor, configured to rest below panels 102 forming a floor of the building.

Referring to Figures 7 to 11, various different configurations of panel are shown, in accordance with this disclosure. These configurations are example configurations to illustrate some of the variations of finishes and configurations possible for the inner and outer surfaces of the panel.

Figure 7 shows a panel being an internal wall panel, where both outer surfaces are configured to be inside the building. The internal all panel shows a slightly different set of flanges and recesses for interlocking the panels together, where the elongated finger is not required to overlap the joint between panels, there being no weathertightness requirement inside of the building. Figure 7a shows the inner and outer panels being smooth, Figure 7b shows the inner and outer panels being swaged, and Figure 7c shows one panel being smooth, and the other swaged.

Figure 8 shows a panel being an external wall panel. Figure 8b shows an outer, external surface being ribbed so as to define a channel or elongate indent at spaced apart positions along the outer surface. The internal surface is swaged. In Figure 8c, the internal surface is flat. In Figure 8d, the external surface includes the rib of Figure 8b, together with additional waved texture. The inner surface is swaged. In Figure 8e, the external surface is as Figure 8d, with the inner surface smooth.

Figure 9 shows a panel being an external wall panel similar to that of Figure 8, but including multiple ribs on the external surface.

Figure 10 shows a panel being an external wall panel. Figure 8b shows an outer, external surface being smooth, with the internal surface swaged. Figure 8c shows both outer and inner surfaces being flat. Figure 8d shows the external surface comprising a low amplitude waved texture, with the inner surface being swaged. Figure 8e is similar to the panel of Figure 8d but with the internal wall being smooth.

Figure 11 shows a panel being a roof panel. The outer, external surface comprises a plurality of ribs. In this example each rib is trapezoidal, with four ribs being provided per panel, and a fifth 'rib' being an extension of the outer surface to form a flashing that overlaps with the adjacent panel. Figure 11b shows the internal surface being flat, whilst Figure 11c shows the internal surface being swaged.

Figure 12 shows a building panel assembly comprising two of the panels of Figure 7 interlocked together. The engagement of the various flanges and recesses is shown.

Referring to Figure 16, a plurality of framing anchors 104 are shown. Any or all of these framing anchors 104 may be supplied in a framing anchor kit, for use in assembling a building in accordance with this disclosure, or in assembling a sub assembly of a building in accordance with this disclosure. Such a kit may comprise one or more of any, some or all of these anchors 104.

Figure 16a shows a floor connection framing anchor 104A. Anchor 104A is configured to connect a floor panel 102 to a wall panel 102. Anchor 104A is configured to be mounted on:

the exterior vertical margin of a floor panel 102;

the interior upper surface of floor panel 102; and

an exterior vertical surface of a wall panel 102.

Figure 16b shows an external roof connection framing anchor 104B. Anchor 104B is configured to join an upper part of two adjacent wall panels 102 together, and also to connect said wall panels to a roof panel 102. Anchor 104B is configured to be mounted on:

the exterior vertical margin of two adjacent wall panels 102;

the interior upper surface of a roof panel 102.

Figure 16c shows another external roof connection framing anchor 104C. Anchor 104C is configured to join an upper part of two adjacent wall panels 102 together, and also to connect said wall panels to a roof panel 102. Anchor 104C is configured to be mounted on:

the exterior vertical margin of two adjacent wall panels 102;

the interior upper surface of a roof panel 102.

Figure 16d shows a further roof connection framing anchor 104D. Anchor 104D is configured to join an upper part of two adjacent wall panels 102 together, and also to connect said wall panels to a roof panel 102. Anchor 104D is configured to be mounted on:

the exterior vertical margin of two adjacent wall panels 102;

the interior upper surface of a roof panel 102.

Figure 16e shows a bottom floor connection framing anchor 104E. Anchor 104E is configured to connect a floor panel 102 to a floor mount such as floor joist or bearer. Anchors 104E are used around the outer margin of the floor. Anchor 104E is configured to be mounted on:

the exterior vertical margin of a floor joist or bearer;

an exterior lower horizontal surface of a floor panel 102; and

an exterior vertical surface of floor panel 102.

Figure 16f shows a sub floor bearer plate framing anchor 104F. Anchor 104F is configured to connect two adjacent floor mounts, such as floor joists or bearers, together. Anchor 104F may also connect a mid-floor cross joist to the exterior floor joists or bearers. Anchor 104F are used at the outer margin of the floor. Anchor 104F is configured to be mounted on:

the exterior vertical margin of a floor joist or bearer;

and optionally to connect, through the floor joist or bearer, to an end of a mid-floor cross joist.

Figure 16g shows an internal roof connection framing anchor 104G. Anchor 104G is configured to connect a lower end of an inclined roof panel 102 to an upper end of a wall panel, on interior margins of the panels 102. Anchor 104G

can also form a connection between two adjacent wall panels 102. This can also be seen in Figure 47. Anchor 104G comprises two mounting flanges, the flanges being at an obtuse angle to one another. Anchor 104G is configured to be mounted on:

an interior vertical surface of a wall panel 102; and

an interior inclined surface of a roof panel 102.

Figure 16h shows another internal roof connection framing anchor 106H. Anchor 104H is configured to connect an intermediate part of an inclined roof panel 102 to an upper end of a wall panel, on interior margins of the panels 102. Anchor 104H can also form a connection between two adjacent wall panels 102. This can also be seen in Figure 49. Anchor 104H comprises two mounting flanges, the flanges being at 90° to one another. Anchor 104H is configured to be mounted on:

an interior vertical surface of a wall panel 102; and

an interior inclined surface of a roof panel 102.

Figure 16i shows a further internal roof connection framing anchor 106I. Anchor 104H is configured to connect an upper end of an inclined roof panel 102 to an upper end of a wall panel, on interior margins of the panels 102. Anchor 104I can also form a connection between two adjacent wall panels 102. This can also be seen in Figure 48. Anchor 104I comprises two mounting flanges, the flanges being at 90° to one another. Anchor 104I is configured to be mounted on:

an interior vertical surface of a wall panel 102; and

an interior inclined surface of a roof panel 102.

Referring to Figure 17, various embodiments of a framing anchor 104 in the form of a lintel 104J are shown, each comprising a length of material of 'L shaped cross section, comprising two elongate plates at 90° to one another. Each plate is provided with a plurality of mounting apertures, spaced along the length of each plate. The lintel 104 J of Figure 17c) is further provided with a third elongate plate at 90° to the intermediate plate. The lintels 104J are configured to be mounted along the top margin of the window and/or door apertures, and to be affixed to one or more of the building panels 102 using suitable fixings through the apertures. An example application of the lintel 104J of Figure 17 c) can be seen in Figure 43, where the third elongate plate is

parallel with the top face of a building panel 102, the first elongate plate projects into the building.

Figures 18 to 20 show various embodiments of a framing anchor 104 in the form of piling brackets. Each piling bracket is configured such that an upper part of the bracket can be affixed to the underside of the building, for example to the floor joists or bearers. A lower part of each piling bracket is configured to be affixed to a building pile below the building. The building piles are not shown in the figures, but could comprise any suitable pile configured to securely support the building in the desired location. For example, traditional wooden or concrete piles could be used. The Surefoot ® piling system could be used. The lower part of each piling bracket could be affixed to a base plate, the base plate being configured to be suitable for the particular type of pile used.

Figure 18 a) shows a non-adjustable corner piling bracket 404 for use at each corner of the building. Piling bracket 404 comprises two vertical support plates 406 at 90° to one another. An upper part of each plate 406 is provided with a plurality of mounting apertures 408 for affixing the upper part of the plates 406 to an end of a flooring joist or bearer. The lower part of each plate 406 is provided with a respective foot 410, perpendicular to the plates 406, for resting on and being secured to the top of a pile. Each foot 410 is provided with one or more mounting apertures 411 for securing the feet 410 to the pile. Each plate 406 is also provided with a short finger 412, being a portion of the plate 406 which is bent to project perpendicularly out from the plate 406.

Figure 18 b) shows a non-adjustable mid piling bracket 454 for use at a position intermediate the corners of the building. As many mid piling brackets 454 can be used as required, to adequately support the load from the building along its length or width. Each mid piling bracket comprises a U or C shaped section of material comprising a back plate 456 and a pair of opposed side plates 458 extending along each side margin of the back plate 456. An upper part of the back and side plates 456, 458 is provided with mounting apertures 459 to secure the mid piling bracket 454 to a floor joist or bearer. A lower part of each of the back and side plates 456, 458 is provided with respective feet 460, perpendicular to the plates 456, 458, and each provided with one or more mounting apertures 461 for securing the feet 460 to the top of a pile.

Figures 19 a), b) respectively show two slidably adjustable components of a framing anchor comprising an adjustable corner piling bracket 504. Component 504A of Figure 19 a) comprises a base component configured to be mounted on the top of a pile. The base component 504A comprises two vertical support plates 506 at 90° to one another, and each comprising a respective foot 510. Each foot 510 is provided with one or more mounting apertures. An upper part of each vertical support plate 506 is provided with an aperture array comprising a plurality of mounting apertures 508 which are vertically spaced apart. In this

embodiment the mounting apertures 508 of each plate 506 are offset from one another, that is, they do not occupy a single straight line. The apertures 508 are configured to engage with an upper component 504B of the piling bracket 504.

Upper component 504B comprises a pair of upper support plates 516 that are perpendicular to one another. Each upper support plate 516 is provided with an upper array 518 of mounting apertures 520, for affixing an upper part of each upper support plate 516 to an end of a floor joist or bearer. In this example each upper array 518 comprises two vertically spaced mounting apertures 520. A lower part of each upper support plate 516 comprises a lower array 522 of mounting apertures 524. In this example each lower array 522 comprises over five, and preferably over ten apertures 524. In this example the apertures 524 are arranged in a straight line parallel with the longitudinal axis of the plates 516.

In use, upper component 504B can be mated with lower components 504A such that the plates 506, 516 are in contact. The vertical position of the upper component 504B can be adjusted relative to the lower component 504B to adjust the overall height of the piling bracket 504, and in particular to adjust the vertical spacing between the feet 510 and the upper array 518 of mounting apertures 520. The piling bracket 504 can therefore adjustably compensate for variations between the top of a pile, and the floor joists or bearers, to ensure that the floor joists or bearers are horizontal, and adequately supported. Once adjusted to the correct position one or more apertures in the lower array 522 of apertures 524 is aligned with apertures 508 of component 504A, and the two components can then be affixed together using suitable bolts or other fixings passing through the aligned apertures.

Referring to Figure 20 two embodiments of a framing anchor comprising an adjustable mid piling bracket 554 are shown. Figures 20a) and 20 b) show different embodiments of a lower component 554A1, 554A2, whilst Figure 20 c) shows an upper component 554B which can be used with either lower component 554A1, 554A2.

Each lower component 554A1, 554A2 comprises a U shaped section of material comprising a back plate 556 and a pair of opposed side plates 558 extending along each side margin of the back plate 556. An upper part of the back and side plates 556, 558 is provided with mounting apertures 561 to secure the mid piling bracket 554 to a floor joist or bearer. A lower part of each of the back and side plates 556, 558 is provided with respective feet 560, perpendicular to the plates 556, 558, and each provided with one or more mounting apertures 562 for securing the feet 560 to the top of a pile. In both of these examples there are four feet, all inwardly directed toward the notional central vertical axis of the lower component 554A1, 554A2, each foot 560 having a single mounting aperture 562. In the example of lower component 554A1, each side plate 558 is

provided with a triangular cut out 558A. In the example of lower component 554A2, each side plate 558 is provided with a trapezoidal cut out 558A, and also a lower triangular cut out 558B.

Referring to Figure 20c), upper component 554B is of C shaped cross section comprises an upper support plate 556A, and a pair of opposed parallel side plates 556B that are perpendicular to support plate 556A. Each plate 556A, 556B is provided with an upper array 578 of mounting apertures 580, for affixing an upper part of each upper support plate 556 to an end of a floor joist or bearer. In this example each upper array 578 comprises two vertically spaced mounting apertures 580. A lower part of each upper support plate 556 comprises a lower array 582 of mounting apertures 584. In this example each lower array 582 comprises over five, and preferably over ten apertures 584. In this example the apertures 584 are arranged in a straight line parallel with the longitudinal axis of the plates 556.

In use, upper component 554B can be mated with lower components 554A such that the plates of each are in contact. The vertical position of the upper component 554B can be adjusted relative to the lower component 554B to adjust the overall height of the piling bracket 554, and in particular to adjust the vertical spacing between the feet 560 and the upper array 578 of mounting apertures 580. The piling bracket 554 can therefore adjustably compensate for variations between the top of a pile, and the floor joists or bearers, to ensure that the floor joists or bearers are horizontal, and adequately supported. Once adjusted to the correct position one or more apertures in the lower array 582 of apertures 584 is aligned with apertures 560 of component 554A, and the two components 554A, 55B can then be affixed together using suitable bolts or other fixings passing through the aligned apertures.

Figures 21 to 40 show another example of a building 600 constructed using a combination of building panels 102 and framing anchors 104 as described above.

The building 600 comprises a floor F, walls W, and roof R each of which are formed from a plurality of building panels 102 that are affixed together.

We provide some comments on the figures as below.

Figures 22, 23 show an end of the building 600 showing adjustable corner piling brackets at each corner of the building 600.

Figures 24 and 25 show the front and rear of the building 600 showing adjustable corner piling brackets, an adjustable mid piling bracket, and sub floor bearer plate 104F.

Figure 26 shows the underneath of the floor of the building, and the plurality of bottom floor connection framing anchors 104E, equispaced around the margin of the floor, connecting the floor panels 102 to the floor joists or bearers. This can also be seen in Figure 34. Each anchor 104E is positioned adjacent the joint

between panels 102, such that each anchor 104E joins two flooring panels together, the anchor 104E functioning to resit the two adjacent panels from being pulled apart. Indeed, the anchors 104E may be configured to pull the two adjacent floor panels together during assembly, to improve the structure of the building. The mounting apertures of anchors 104E, and the fixings used, may be configured in this way, such that as the fixings are inserted through the apertures, the fixings engage the apertures to pull the adjacent panels 102 together. This could be achieved by suitable dimensioning of the countersink of each aperture, and the corresponding shape of the fixing.

Figure 27 is a view looking down onto the roof R of building 600, showing the corrugated profile of the roof panels 102. It is noted that the floor panels 102 may also have a corrugated profile, and indeed the roof and floor panels 102 may be interchangeable. The corrugated floor panels 102 can be seen in Figure 28 for example.

With reference to the exploded views of the Figure 32 to 35 and 37, the floor construction can be seen in more detail, with the load bearing function of the floor F being provided by the interconnected, corrugated profile floor panels 102, and the interior floor F4 being provided on top of that. This can also be seen in Figure 38. As can be seen in Figure 34, the flooring panels 102 are joined to each other, and to the floor joists or bearers using bottom floor connection framing anchors 104E. The wall panels 102 are jointed to the floor panels using floor connection framing anchors 104A. The upper and lower end of each wall panel 102 may be provided with a recess 102R, dimensioned to receive part of the framing anchor 104A so that the framing anchor 104A is flush with the outer surface of the wall panel 102. Floor F may further comprise outer floor joists F3 at the outer margin of the floor F. Figure 35 shows the sub floor bearer plate framing anchor 104F that joins two adjacent floor joists or bearers F1 together, and also secures the flooring cross member F2 to the outer floor joists or bearer F1.

Figure 36 is an enlarged view showing the supporting structure of the floor F, being the outer floor joists or bearers F1, and the flooring cross member F2. It can also be seen that bottom floor connection framing anchors 104E are configured to sit on top of the bearers F1, such that they can be slid along bearers F1 to the desired position, whilst being prevented from movement away from the longitudinal axis of the bearers F1 by virtue of the downwardly extending parts of the anchors 104E engaging the bearers F1. This ensures that the anchors 104E are in the correct position to locate the floor panels 102 relative to the bearers F1. This can also be seen in Figures 39 and 40.

It will be appreciated from the above that the floor anchors 104A and 104E are constructed so as to be connected to bearers F1 and panels 102 in such a way that the positioning and alignment of the bearers F1, floor panels 102 and wall panels 102 is correct, with no unwanted freedom of movement of the anchors

104A, 104E possible. During construction of the building 600, this means that on site the possibility of human error is minimised, or at least reduced. This also ensures that the floor F and walls W of the building 600 are plumb, and correctly aligned.

Figure 41 shows a view of the rear wall, and part of the end walls, of the building 600, as seen from the inside of the building, and also shows the recesses 102R for the floor anchors 104A.

Figure 42 shows the connection profile of a wall panel 102. It can also be seen that the top and bottom margins of the wall panel 102 are rebated 102S, so that the exterior portion of the wall panel 102 has a greater vertical dimension than the interior portion of the wall panel 102. The rebates 102S are dimensioned to receive timber joist F3, as can best be seen in Figure 44.

Figure 43 shows the interior of the roof R of the building 600, including upper internal roof framing anchors 104G, and also window/door lintel framing anchors 104J.

Figures 44a and 44b are enlarged sectional end and side views showing detail of the connections between the floor and wall building panels. In particular the connection between the bottom floor framing anchor 104E, the bearer F1 and the lower portion of the wall panel 102 can be seen. The connection between floor connection framing anchor 104A and the floor and wall panels 102 can also be seen. Figure 44 also shows flooring F4 on top of the floor panels 102, and an internal plywood wall lining formed as a stud wall against the wall panels 102.

Figure 45 is an enlarged sectional plan view of a wall joint of a wall W of the building 600 showing the joint between adjacent wall panels 102. This view shows the use of a vapour barrier seal VS, and/or the use of silicone sealant in the wall joint.

Figure 46 is an enlarged sectional side view of a roof joint of the roof R of the building 600 showing the joint between adjacent roof building panels 102. This view shows the use of a tape sealant TS in the joint, as well as the corrugated profile of the roof panel 102.

Figure 47 shows an upper part of the building 600, showing the connections and framing anchors connecting a rear wall panel 102 to a lower end of the inclined roof panel 102. In particular, the roof connection anchor 104B, and the internal roof bracket anchor 104G can be seen.

Figure 48 shows an upper part of the building 600, showing the connections and framing anchors connecting a front wall panel 102 to an upper end of the inclined roof panel 102. In particular, the roof connection anchor 104B, and the internal roof bracket anchor 104H can be seen.

Figure 49 shows an upper part of the building of Figure 21, showing the connections and framing anchors connecting an end wall panel 102 to an intermediate part of the inclined roof panel 102. In particular, the roof connection anchor 104D, and the internal roof bracket anchor 104I can be seen.

It can be seen from each of Figures 47 to 49 that the framing anchors 104 extend across the joint between adjacent wall panels 102. As described above, the apertures in these framing anchors 104, and the fixings used, are configured to pull the wall panels 102 together, as the framing anchors are secured in place. This assists in correct alignment and structural properties of the wall, and also assists with weathertightness.

Where a connection is described above comprising an aperture configured to receive an elongate fixing such as bolt or screw, the aperture maybe countersunk so as to receive a countersunk head of the elongate fixing. The size of the countersink on the aperture and the head of the elongate fixing may be configured such that adjacent building panels are pulled together as the elongate fixing is received in the aperture.

The term 'panel assembly' and grammatical variations thereof means any combination of panel, and/or framing anchor, and/or fixing means configured to provide a structurally supporting wall, floor or roof portion of a building as herein described.

The term 'mount' and with particular regard to a building mount, upper or lower mount, and grammatical variations thereof mean a structural portion of the building to which a framing anchor may be affixed. For example, an upper mount may be a roof structure or adjoining upper structure such as the base of a window framing or similar. A lower mount may encompass a floor structure, the foundations of the building, a building pile, floor joists or bearers or similar. Where the panels are assembled in a multi-storey configuration, an upper mount for a panel may also serve as a lower mount for a vertically stacked adjacent panel or panels arranged in the storey above.

Unless the context clearly requires otherwise, throughout the description, the words "comprise", "comprising", and the like, are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense, that is to say, in the sense of "including, but not limited to".

Although this disclosure has been described by way of example and with reference to possible embodiments thereof, it is to be understood that modifications or improvements may be made thereto without departing from the scope of the disclosure. The disclosure may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, in any or all combinations of two or more of said parts, elements or features. Furthermore, where reference has been made to specific components or integers of the disclosure having known

equivalents, then such equivalents are herein incorporated as if individually set forth.

Any comment regarding prior art is not to be taken as an admission or acknowledgement that the prior art forms part of the common general knowledge in the art.

Claims

1. A building panel assembly configured to provide a structural wall, roof, floor, or portion thereof, of a building comprising

a plurality of panels, each panel comprising

i. an outer layer, having a first flange extending from a first distal end and a second flange at an opposing end, the second flange forming a lip on the outer layer;

ii. an inner layer having an end portion with a recess at a first distal end and a protrusion at an opposing end; and

iii. an intermediate layer sandwiched between the inner and outer layers; and

a framing anchor, the framing anchor including at least one arm configured to engage with the panel;

wherein said wall panels are configured to be positioned adjacent one another and connected together by engaging the first and second flanges of the outer layer with the corresponding recess and protrusion of the inner layer to comprise an interlocking panel structure affixed to a mount of the building by corresponding framing anchor arms of the framing anchor, wherein the interlocking panel structure when so affixed is configured to absorb structural load applied to the panel structure.

2. A building panel assembly configured to provide a structural wall, roof, floor, or portion thereof, of a building comprising

a plurality of panels, each panel comprising

i. an outer layer, having a first flange and a first recess extending from a first distal end and a second flange and second recess at an opposing end;

ii. an inner layer having a third flange and a third recess extending from a first distal end and a fourth flange and fourth recess at an opposing end; and

iii. an intermediate layer sandwiched between the inner and outer layers; and

a framing anchor, the framing anchor including at least one arm configured to engage with the panel;

wherein said wall panels are configured to be positioned adjacent one another and connected together by engaging the flanges at the first ends of the outer and inner layers of one panel with the recesses at the opposing end of the adjacent panel, and the flanges at the opposing ends of the outer and inner layers of one panel with the recesses at the first end of the adjacent panel, to form an interlocking panel structure configured to be affixed to a mount of the building via a framing anchor arm of the framing anchor, wherein the interlocking panel structure when so affixed is configured to absorb structural load applied to the panel structure.

3. The assembly of claim 1 wherein the framing anchor includes at least two arms, wherein the at least two arms are inclined to one another.

4. An assembly as claimed in claim 1, wherein adjacent wall panels engage by interposing the first flange towards the opposing end of an adjacent panel, allowing the first flange to receive the lip of the adjacent panel to create a lap joint; wherein

i. the interposition of the first flange and lip creates an over-centre lever force between the adjacent wall panels drawing and retaining the adjacent wall panels;

and wherein

ii. the recess of the inner layer receives the protrusion of the adjacent wall panel to engage the lap joint between the adjacent wall panels.

5. An assembly as claimed in any one of the preceding claims, wherein the wall panels are prefabricated.

6. An assembly as claimed in any one of the preceding claims, wherein the outer layer is a weather resistant cladding.

7 An assembly as claimed in claim 6, wherein the weather resistant cladding is integrally formed into the wall panel.

8. An assembly as claimed in any one of claims 1 to 5, wherein a weather resistant cladding is adhered to the outer layer of the wall panel.

9. An assembly as claimed in any one of the preceding claims, wherein the intermediate layer comprises a thermally insulating material.

10. An assembly as claimed in any one of the preceding claims, wherein the intermediate layer comprises an acoustically insulating material.

11. An assembly as claimed in any one of the preceding claims, wherein the intermediate layer comprises a polyisocyanurate (PIR) foam.

12. An assembly as claimed in any one of the preceding claims, wherein the arms of the plurality of framing anchors are arranged at substantially right angles to one another.

13. An assembly as claimed in any one of the preceding claims, wherein the arms of the plurality of framing anchors engage with each of a wall panel and a lower mounting.

14. An assembly as claimed in claim 13, wherein the lower mounting is a building foundation.

15. An assembly as claimed in claim 13, wherein the lower mounting is a floor.

16. An assembly as claimed in any one of the preceding claims, wherein the arms of the plurality of framing anchors engage with each of a wall panel and an upper mounting.

17. An assembly as claimed in claim 16, wherein the upper mounting is a roof structure.

18. A load bearing building panel configured to comprise a structurally supporting wall, floor or roof portion of a building, the building panel comprising

i. a structural outer layer;

ii. a structural inner layer;

iii. an intermediate layer, sandwiched between the outer and inner layers;

wherein the outer and inner layers are metal, and the intermediate layer is an insulating layer;

the outer and inner layers being secured to the intermediate layer via respective adhesive layers;

the metal of the outer and inner layers being configured to form a structurally supporting element of the building panel to enable the panel to absorb structural load applied to the panel

such that the panel forms a load bearing structure of the building;

at least one of the outer and inner layers comprising an engaging formation configured to engage with an engaging formation of another building panel such that the engaging formations mount the two building panels together.

19. A load bearing building panel as claimed in claim 18, wherein the metal layer thickness may be between 0.3mm and 10mm, preferably 0.3mm and 3mm.

20. A load bearing building panel as claimed in any one of claims 18 or 19, wherein the metal is steel.

21. A load bearing building panel as claimed in any one of claims 18 to 20, wherein the metal is a solid metal sheet of one or more metals.

22. A load bearing building panel as claimed in any one of claims 18 to 21, wherein the intermediate layer thickness may be between 50mm and 200mm.

23. A load bearing building panel as claimed in any one of claims 18 to 22, wherein the intermediate layer comprises a polyisocyanurate (PIR) foam.

24. A load bearing building panel as claimed in any one of claims 18 to 22, wherein the intermediate layer comprises a thermally insulating material.

25. A load bearing building panel as claimed in any one of claims 18 to 22, wherein the intermediate layer comprises an acoustically insulating material.

26. A load bearing building panel as claimed in any one of claims 18 to 25, wherein the panel is wall panel.

27. A load bearing building panel as claimed in any one of claims 18 to 25, wherein the panel is roof panel.

28. A load bearing building panel as claimed in any one of claims 18 to 25, wherein the panel is floor panel.

29. A load bearing building panel as claimed in any one of claims 18 to 28, wherein the engaging formations are tongue and groove joints.

30. A framing anchor configured to affix a building panel to a mount of the building, the framing anchor comprising

i. at least two arms inclined to one another;

ii. at least one aperture positioned on at least one arm;

wherein the framing anchor is formed from sheet metal and the arms are integrally formed; and

wherein the framing anchor is sufficiently rigid to absorb structural load from the panel to the mount or vice versa;

wherein to affix the building panel to the mount at least one of the arms engages the panel and at least one of the arms engages the mounting, such that the engagement of at least one of the arms may be effected by a fastener positioned through the aperture and into the corresponding panel or mount.

31. A kit of parts for assembly into a building, the kit comprising:

a plurality of panels, each panel comprising

i. an outer layer, having a first flange extending from a first distal end and a second flange at an opposing end, the second flange forming a lip on the outer layer;

ii. an inner layer having an end portion with a recess at a first distal end and a protrusion at an opposing end; and

iii. an intermediate layer sandwiched between the inner and outer layers; and

the kit further comprising:

at least one framing anchor, the framing anchor including at least two arms inclined to one another and a plurality of apertures positioned on at least one arm; and

a plurality of fasteners.

32. A method of constructing a building or a portion of a building using the kit of parts of claim 31, the method comprising steps of:

i. arranging at least two of the panels against a mounting and adjacent to one another;

ii. engaging the first and second flanges of the wall panel outer layer with the corresponding recess and protrusion of the inner layer;

iii. positioning the at least two arms of the framing anchors such that at least one arm abuts each of the wall panel and the mounting;

iv. affixing together the panel and mounting by inserting the fasteners through the apertures and into the corresponding panel and/or mounting;

wherein the engagement of corresponding first and second flanges of the panel outer layer with the corresponding recess and protrusion of the inner layer comprise an interlocking panel structure.

33. A method of constructing a building or a portion of a building using a building panel assembly configured to provide a structural wall, roof, floor, or portion thereof, of a building, wherein the building assembly comprises:

a plurality of panels, each panel comprising:

i. an outer layer, having a first flange extending from a first distal end and a second flange at an opposing end, the second flange forming a lip on the outer layer;

ii. an inner layer having an end portion with a recess at a first distal end and a protrusion at an opposing end; and

iii. an intermediate layer sandwiched between the inner and outer layers; and

a plurality of framing anchors, each framing anchor comprising at least two arms inclined to one another;

wherein the method comprises steps of:

i. positioning said wall panels adjacent one another;
ii. connecting the adjacent wall panels together by engaging the first and second flanges of the outer layer with the corresponding recess and protrusion of the inner layer to comprise an interlocking panel structure;
iii. affixing the connected wall panels to a mount of the building by corresponding framing anchor arms;

wherein the interlocking panel structure when so affixed is configured to absorb structural load applied to the panel structure.

34. A building formed from the panel assembly of any one of claims 1 to 17 and/or one or more panels of any one of claims 18 to 29.

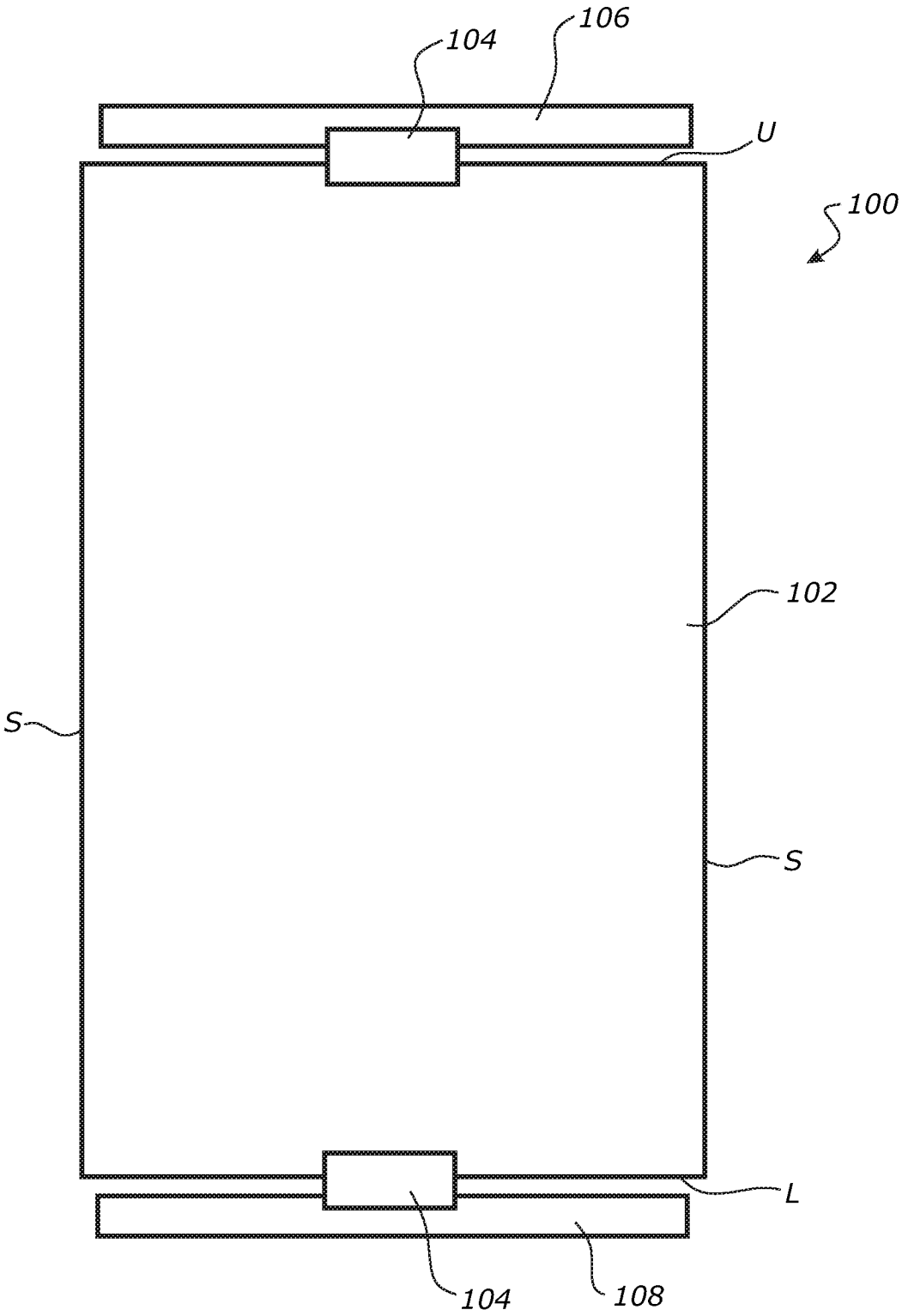


FIG. 1

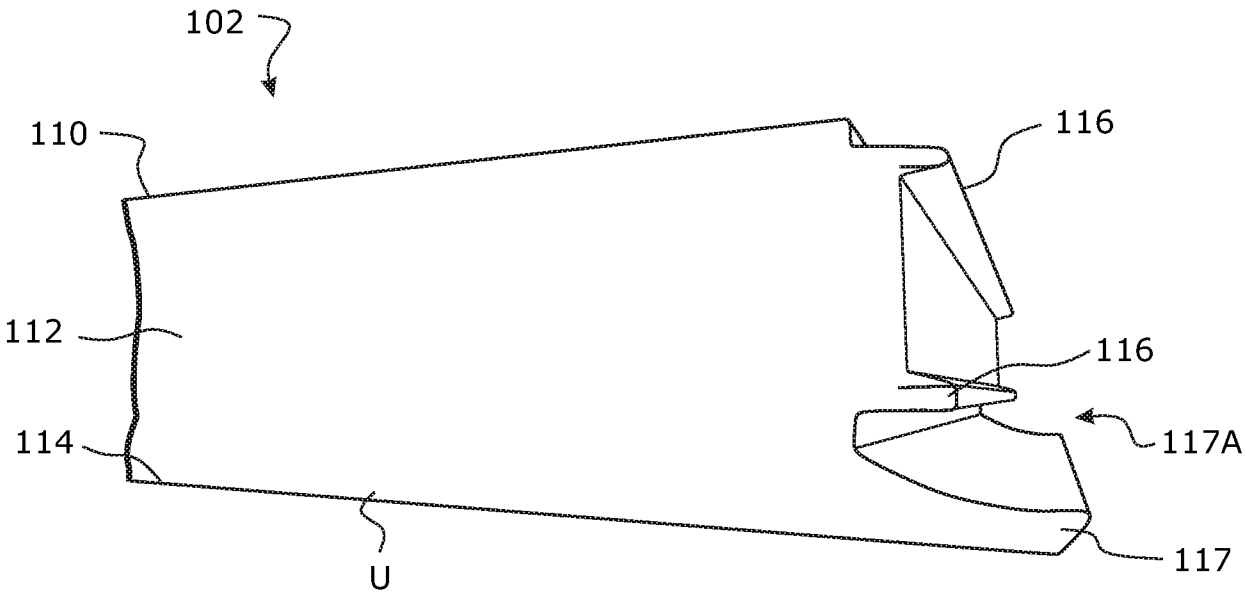

102
110
116
112
116
114
117A
U
117

FIG. 2A

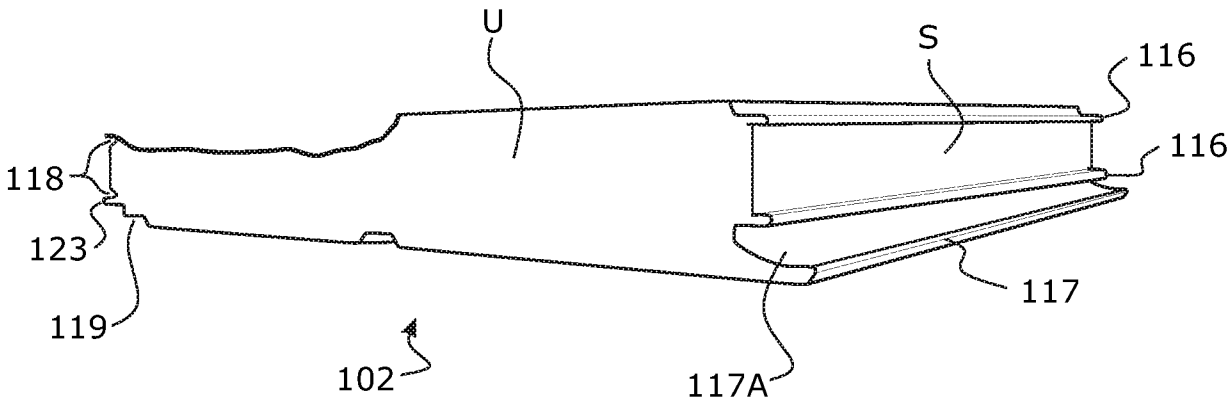

U
S
116
116
118
123
119
117
102
117A

FIG. 2B

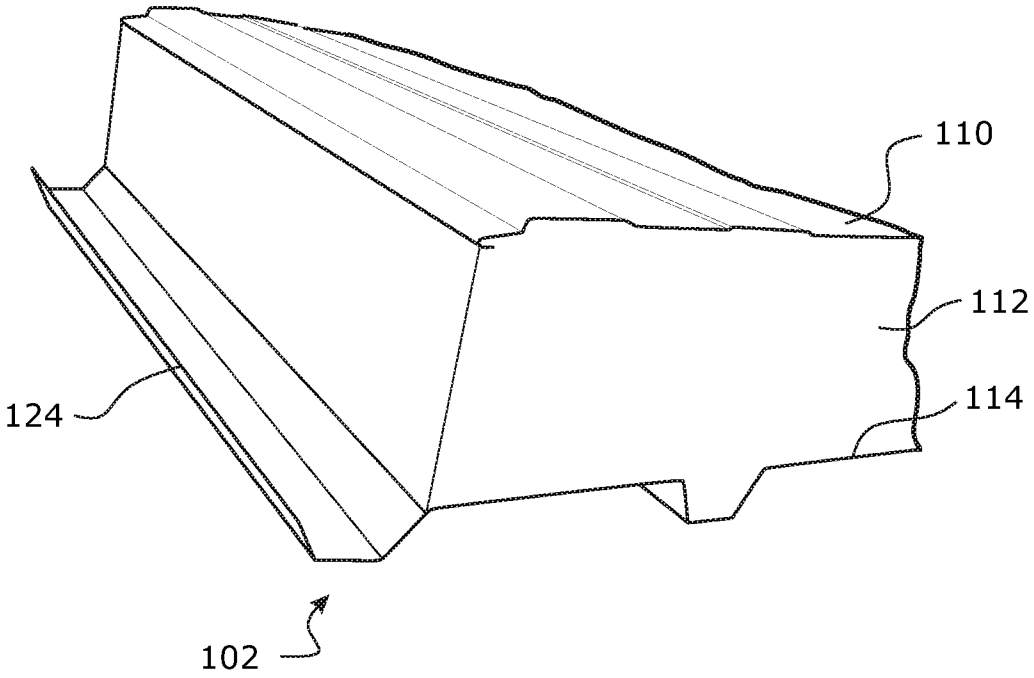


FIG. 2C

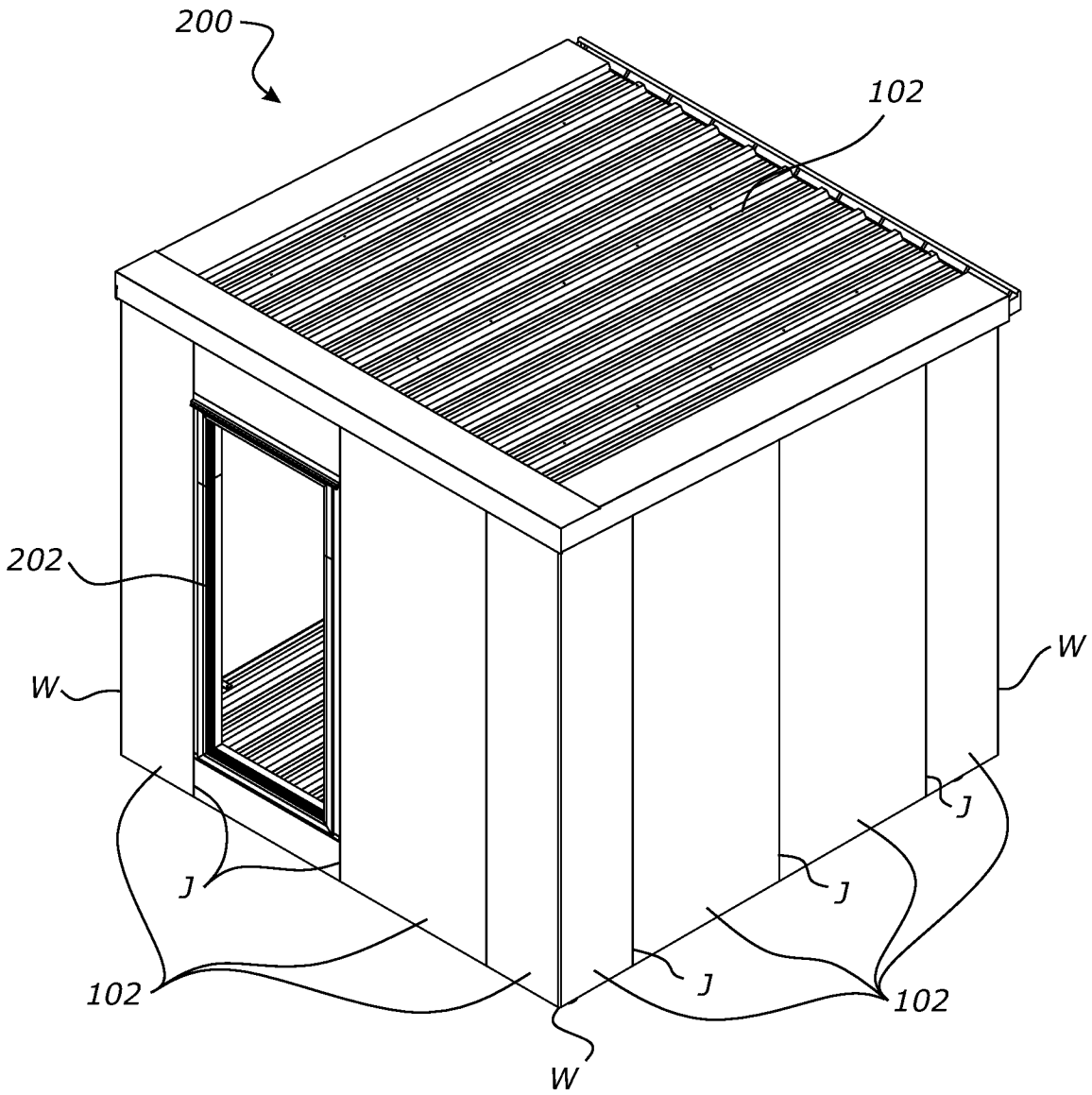


FIG. 3A

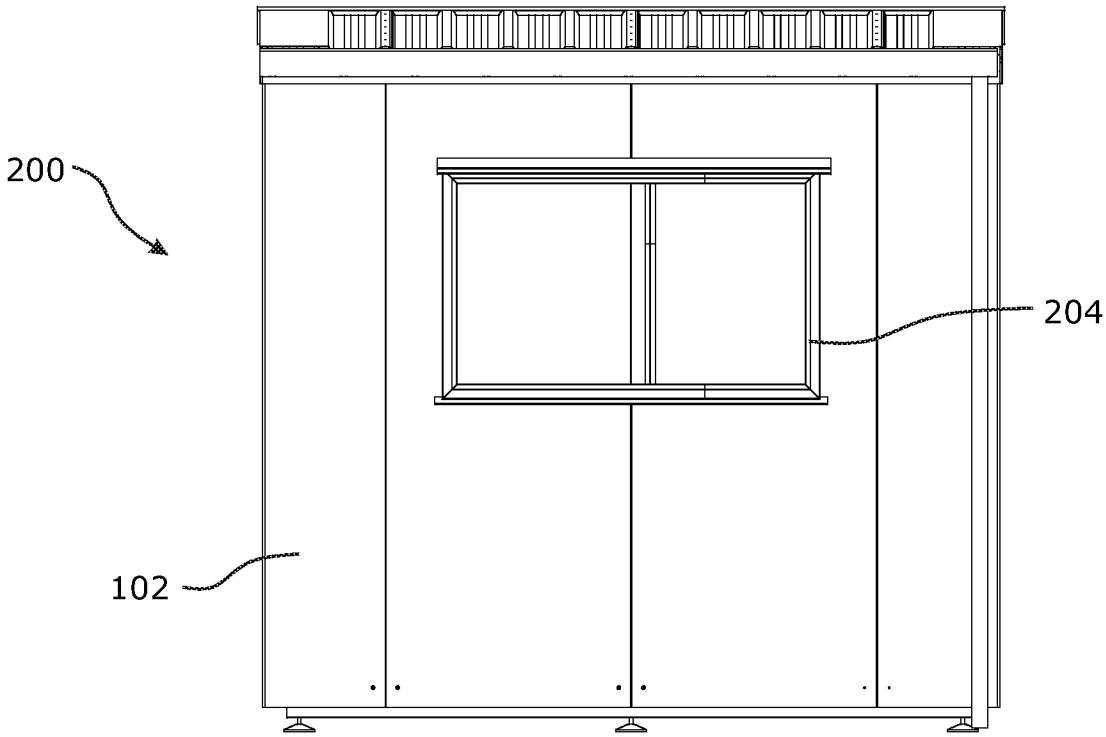


FIG. 3B

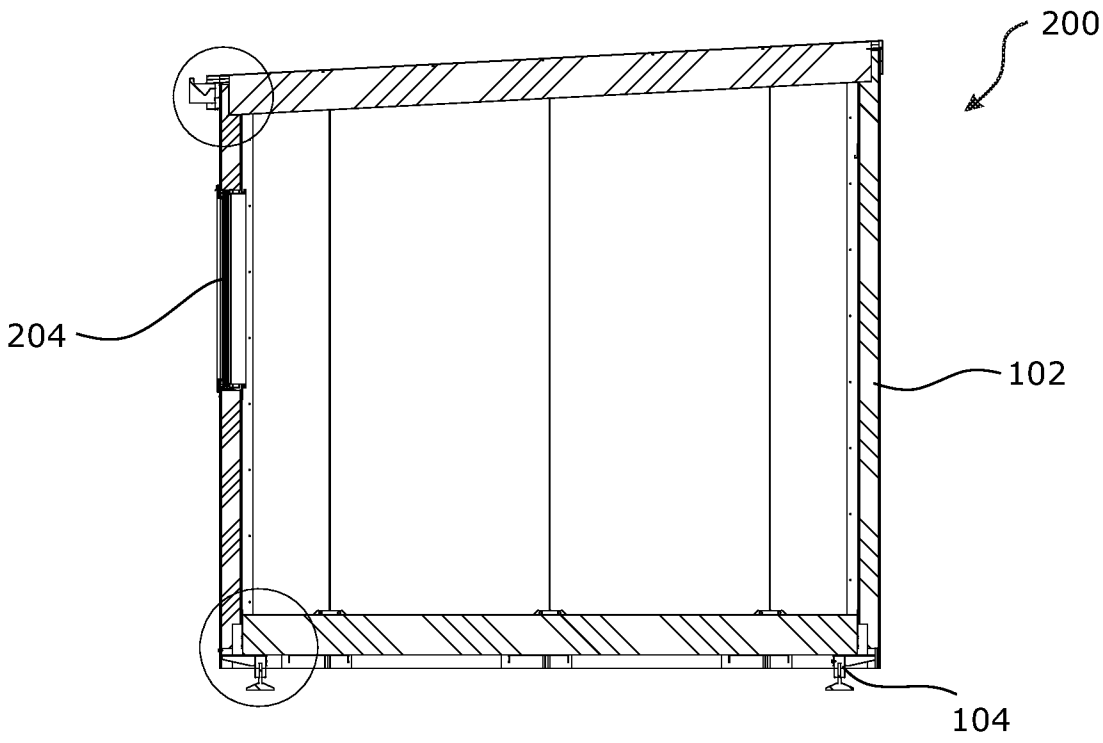


FIG. 3C

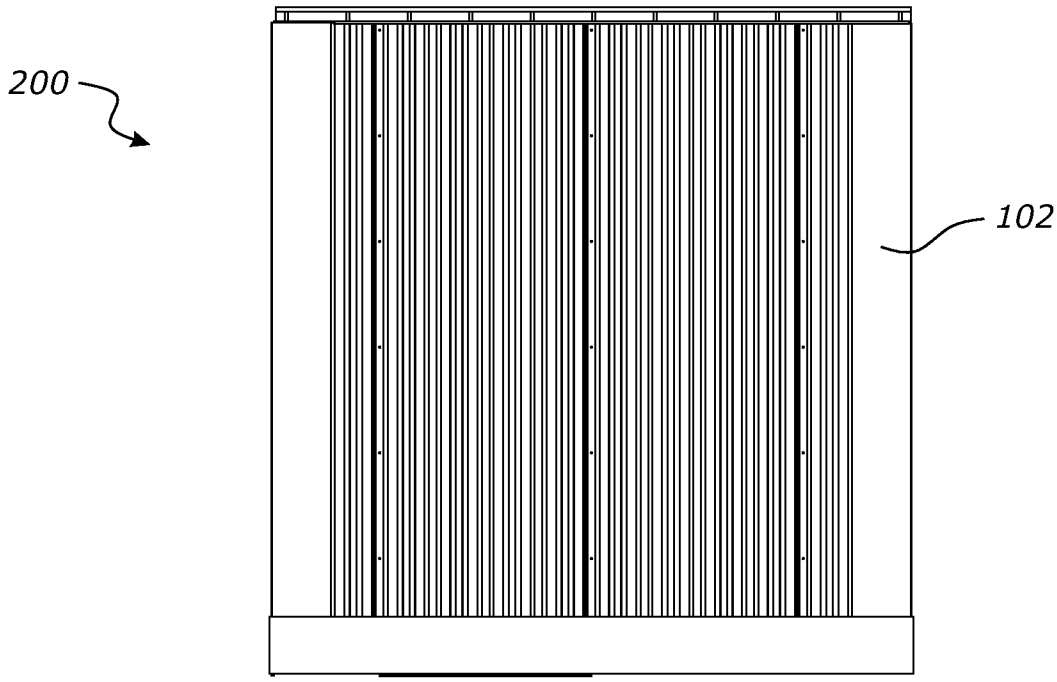


FIG. 3D

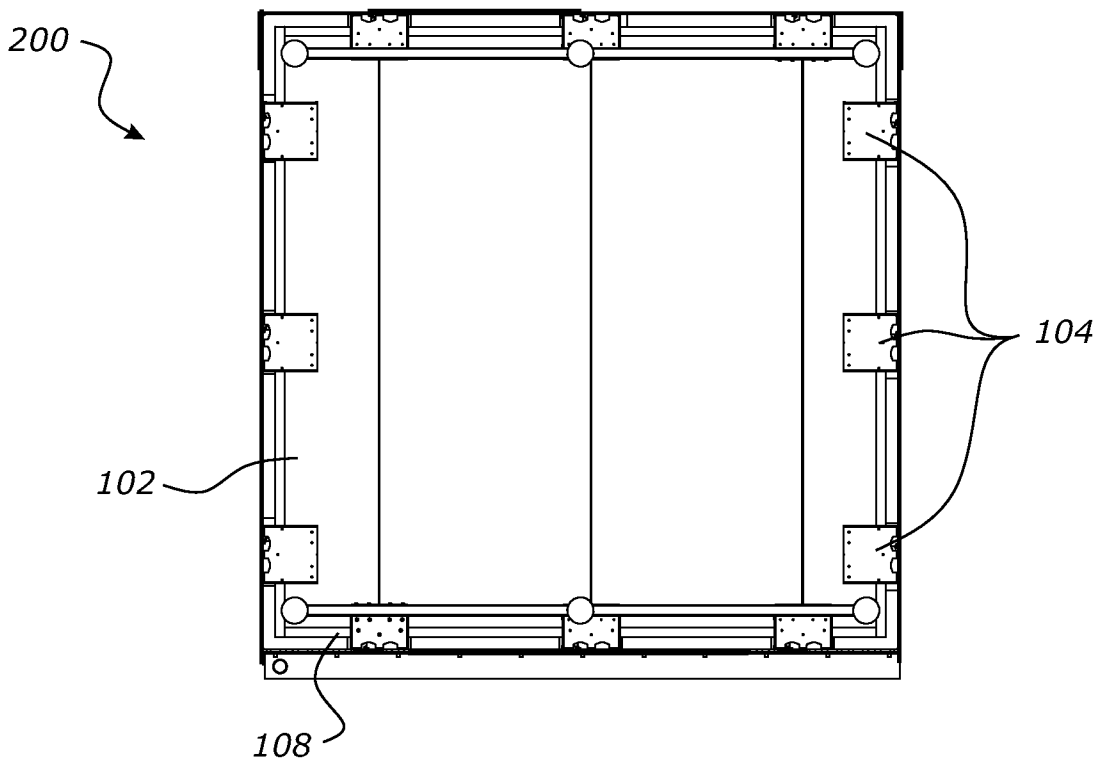


FIG. 3E

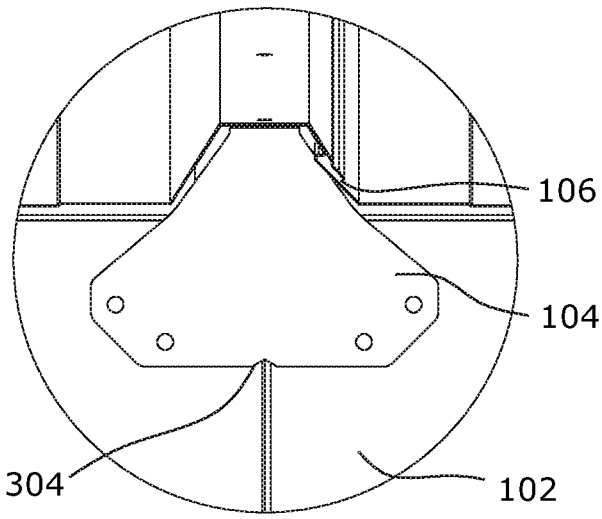


FIG. 4A

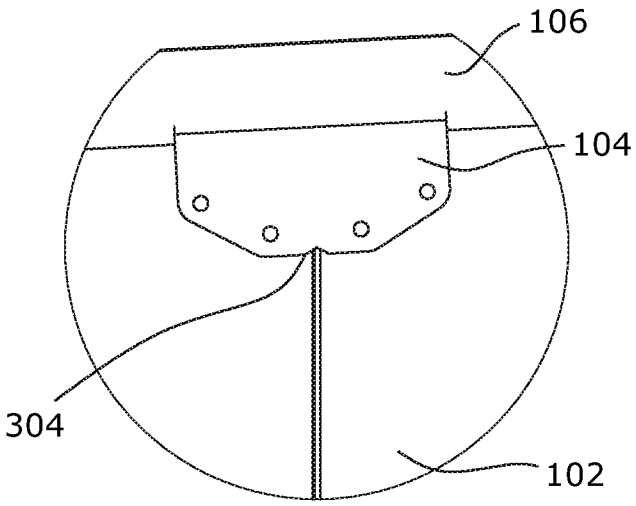


FIG. 4B

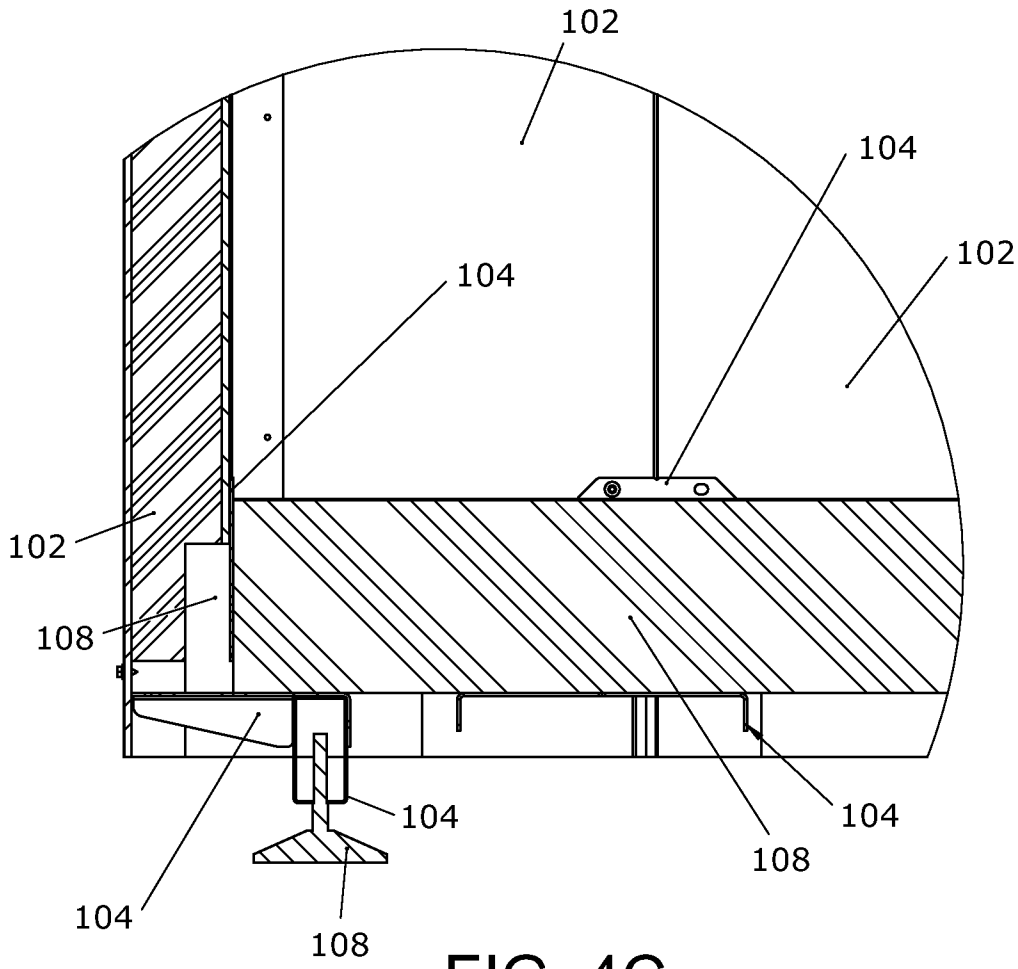


FIG. 4C

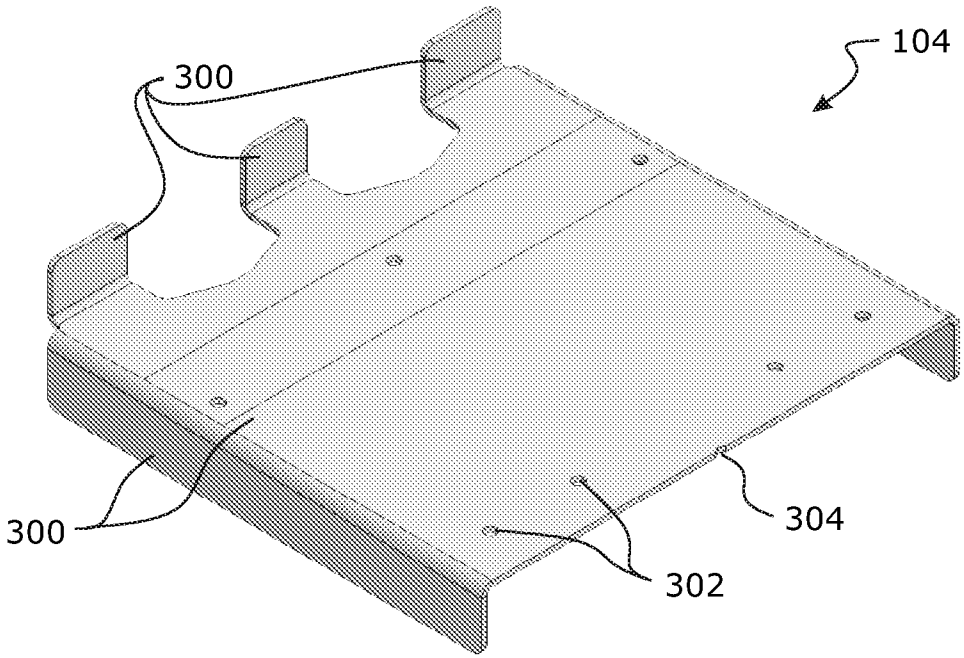


FIG. 5A

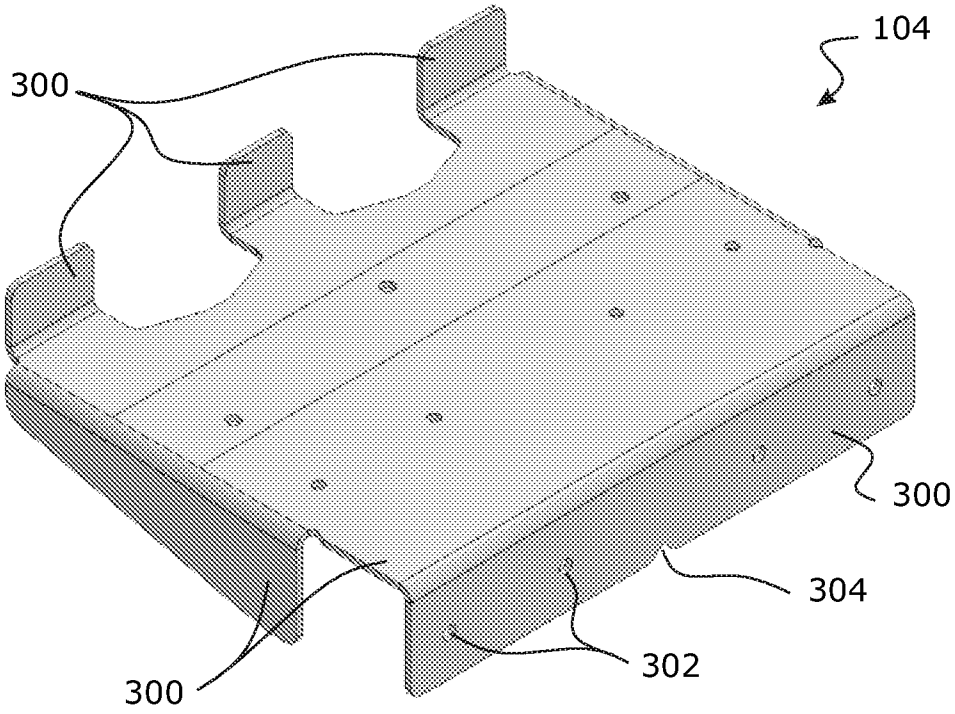


FIG. 5B

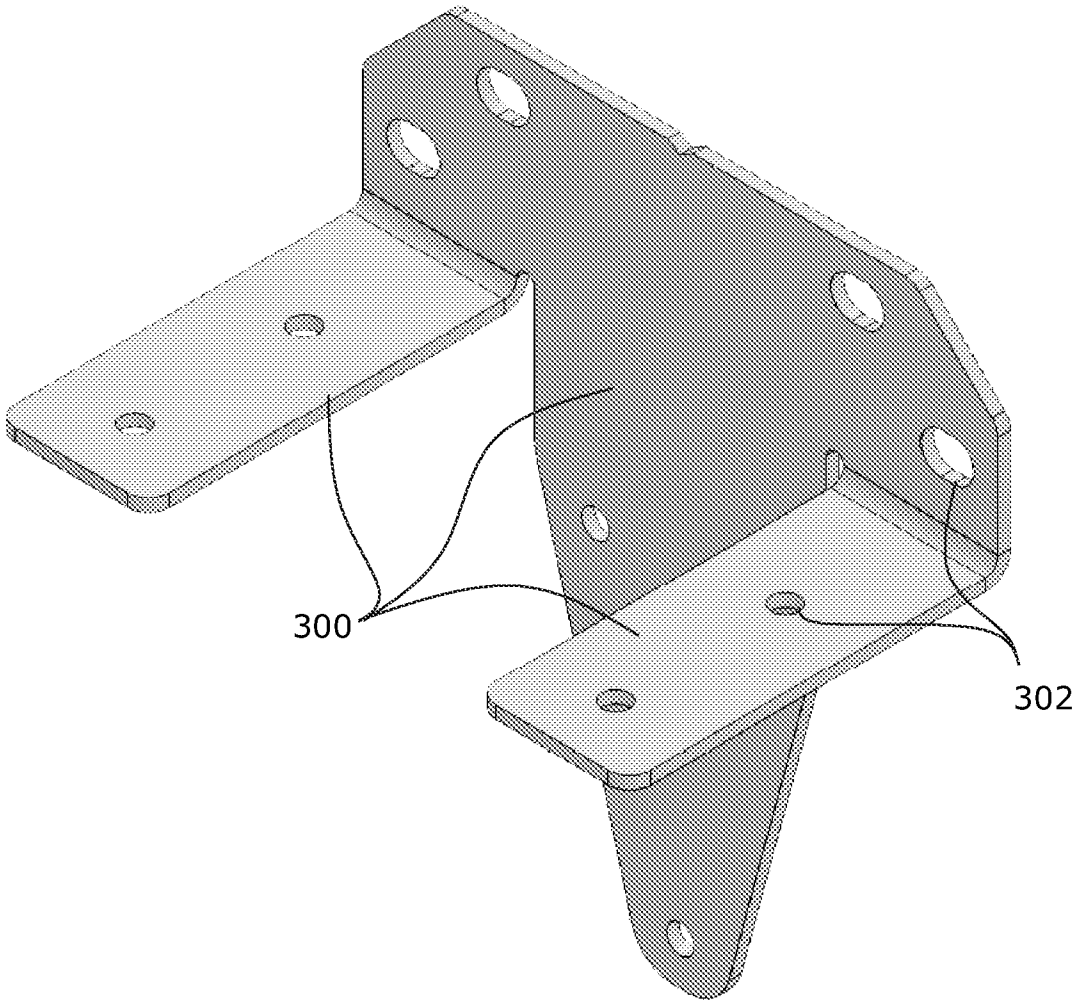


FIG. 5C

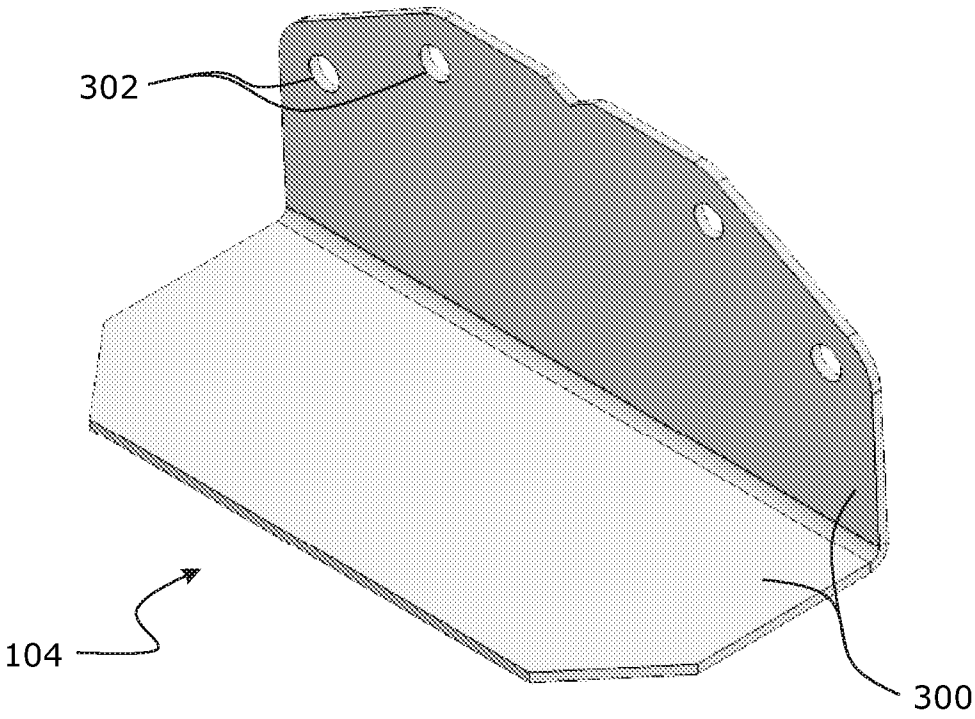


FIG. 5D

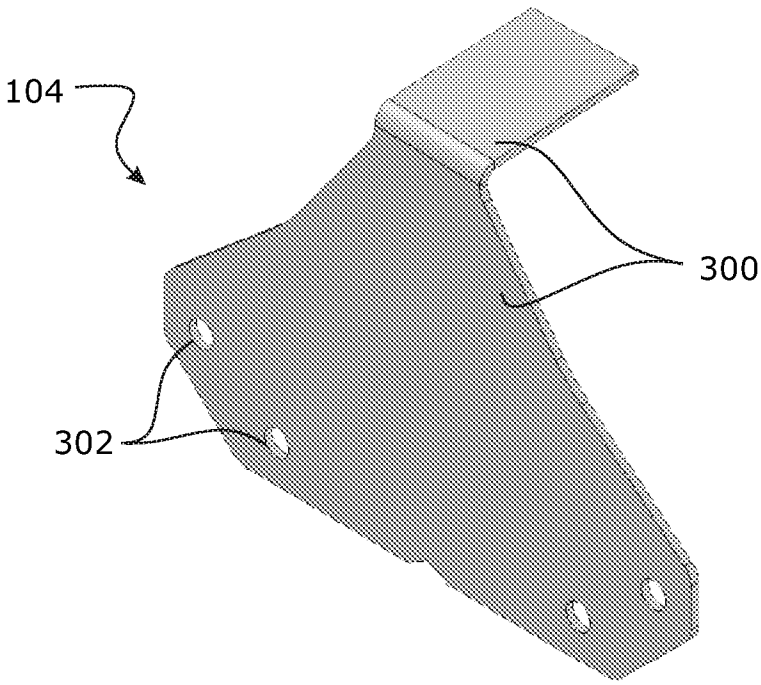


FIG. 5E

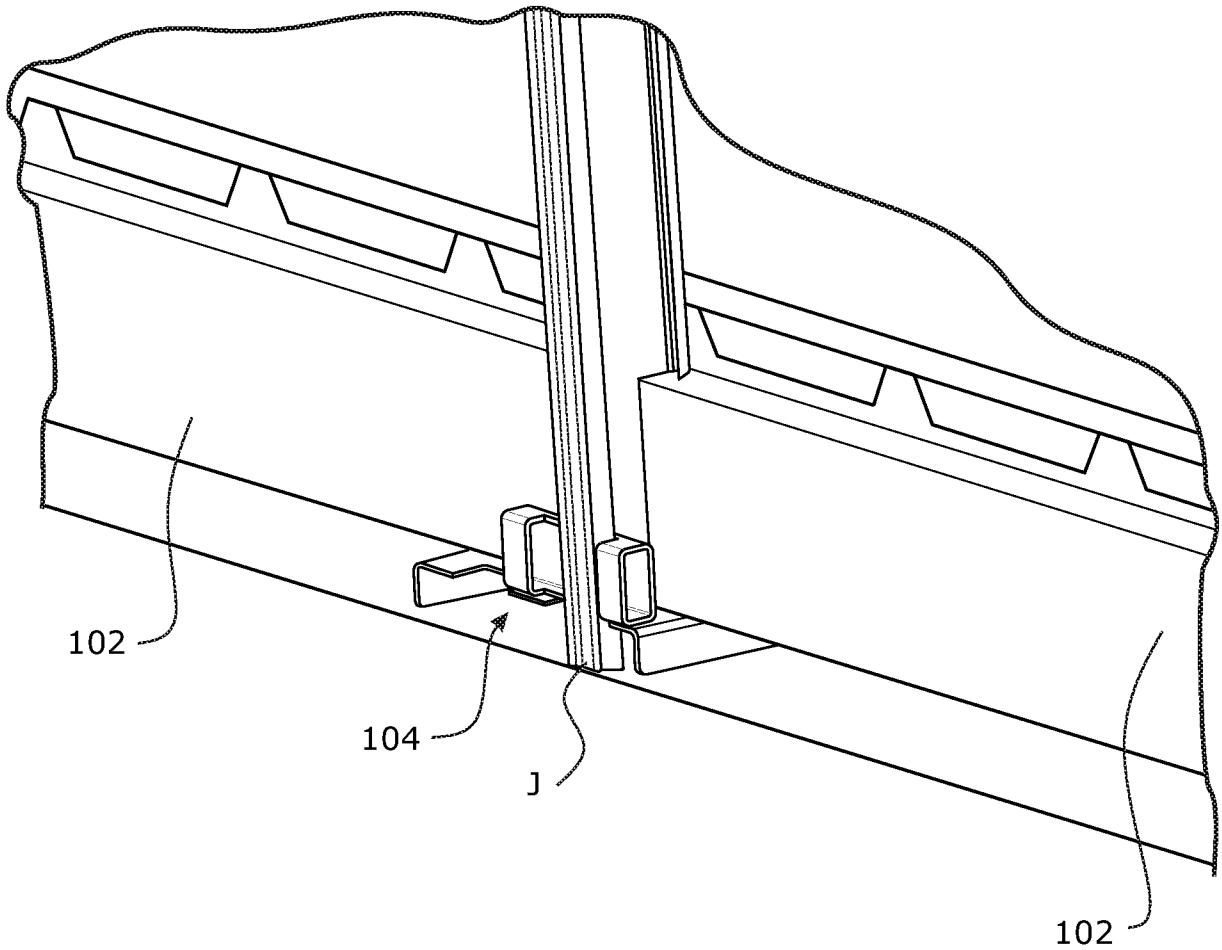


FIG. 6A

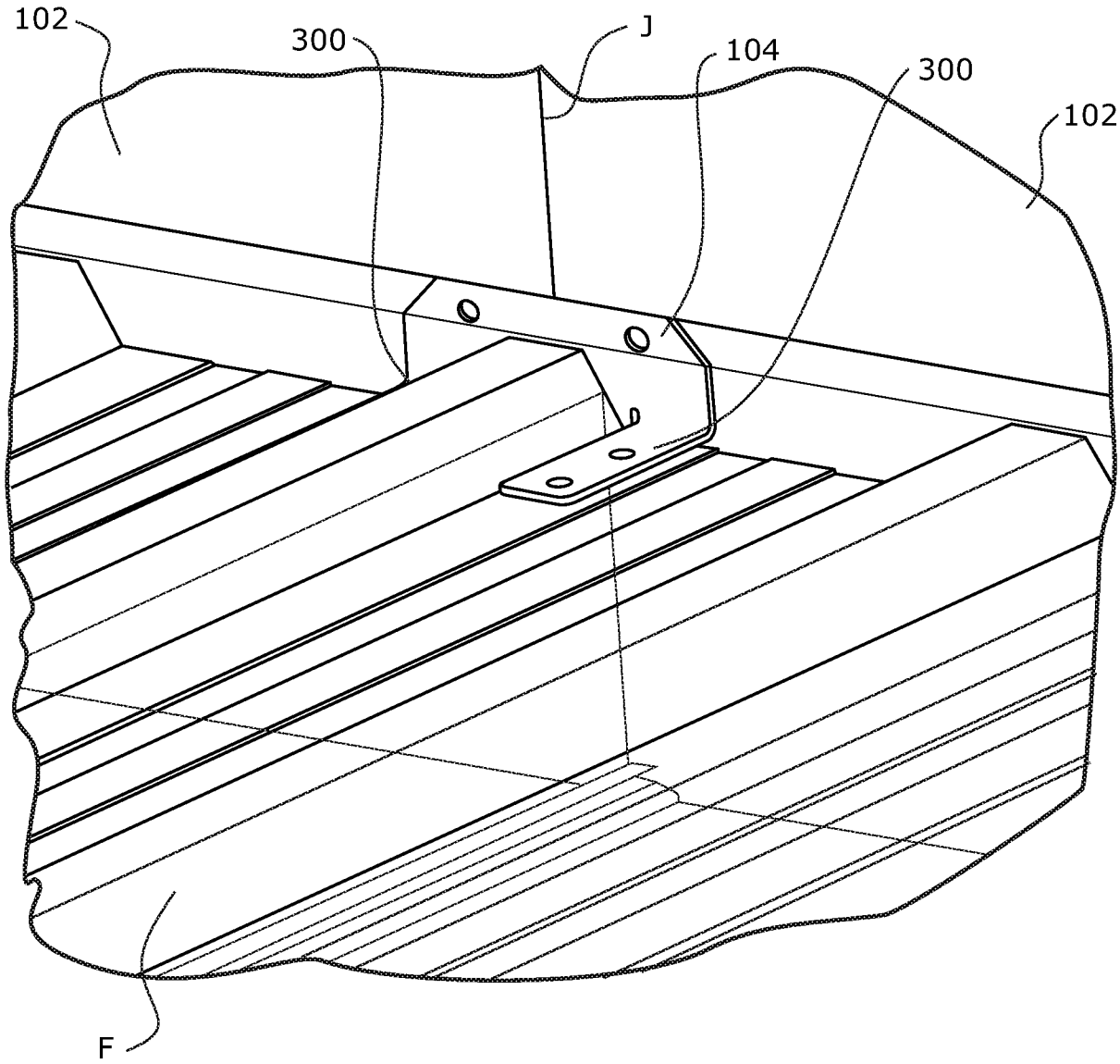


FIG. 6B

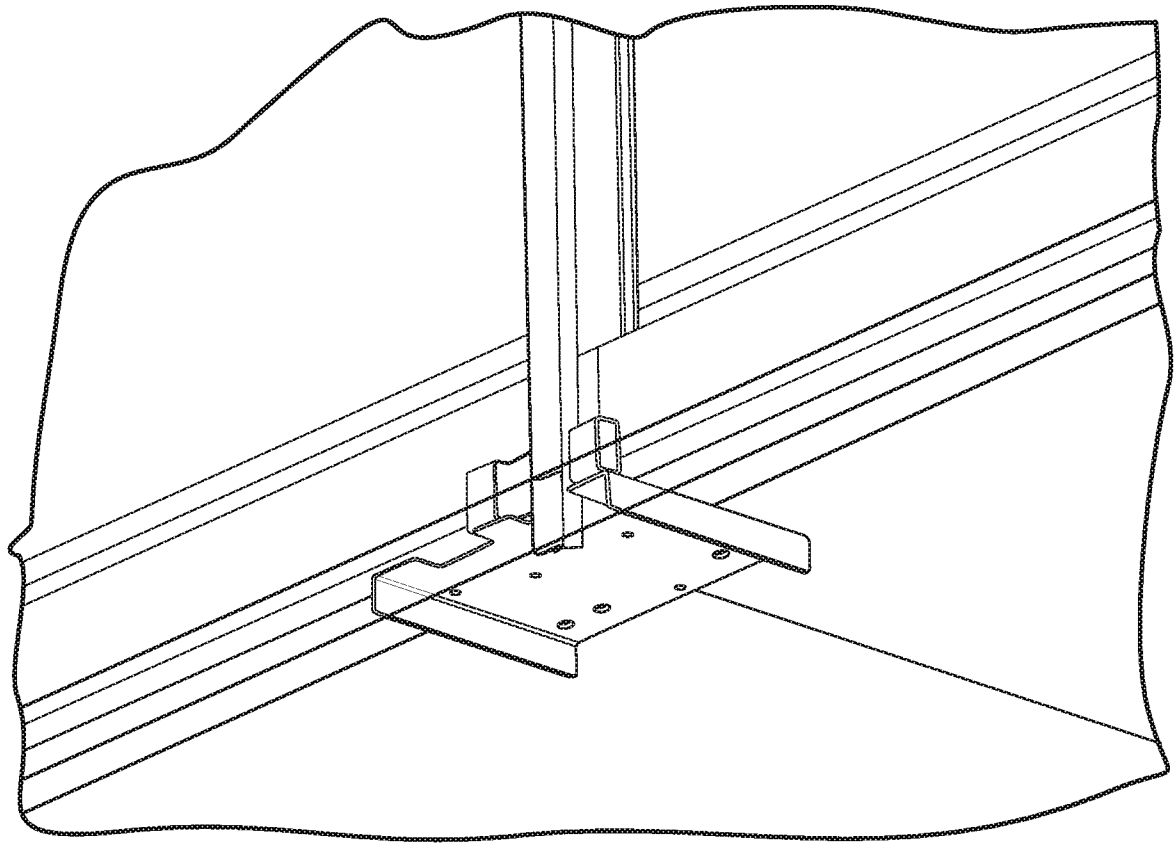
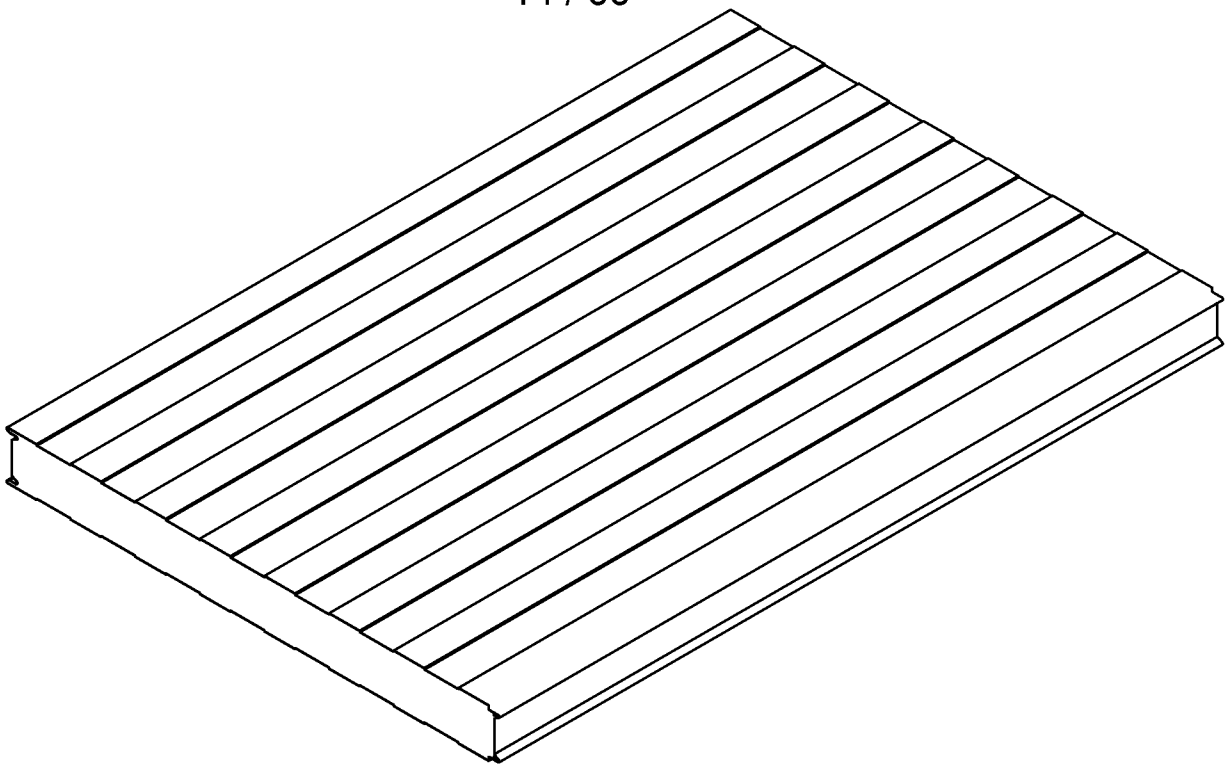
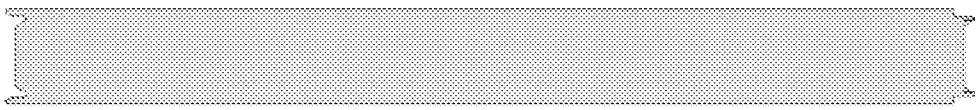


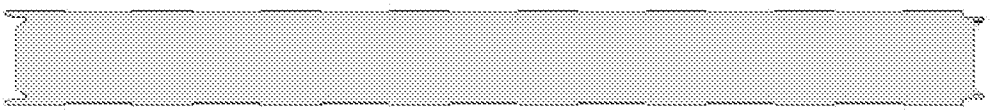
FIG. 6C



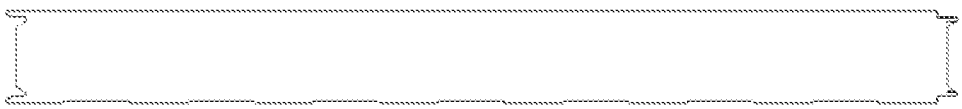
(a)



(b)

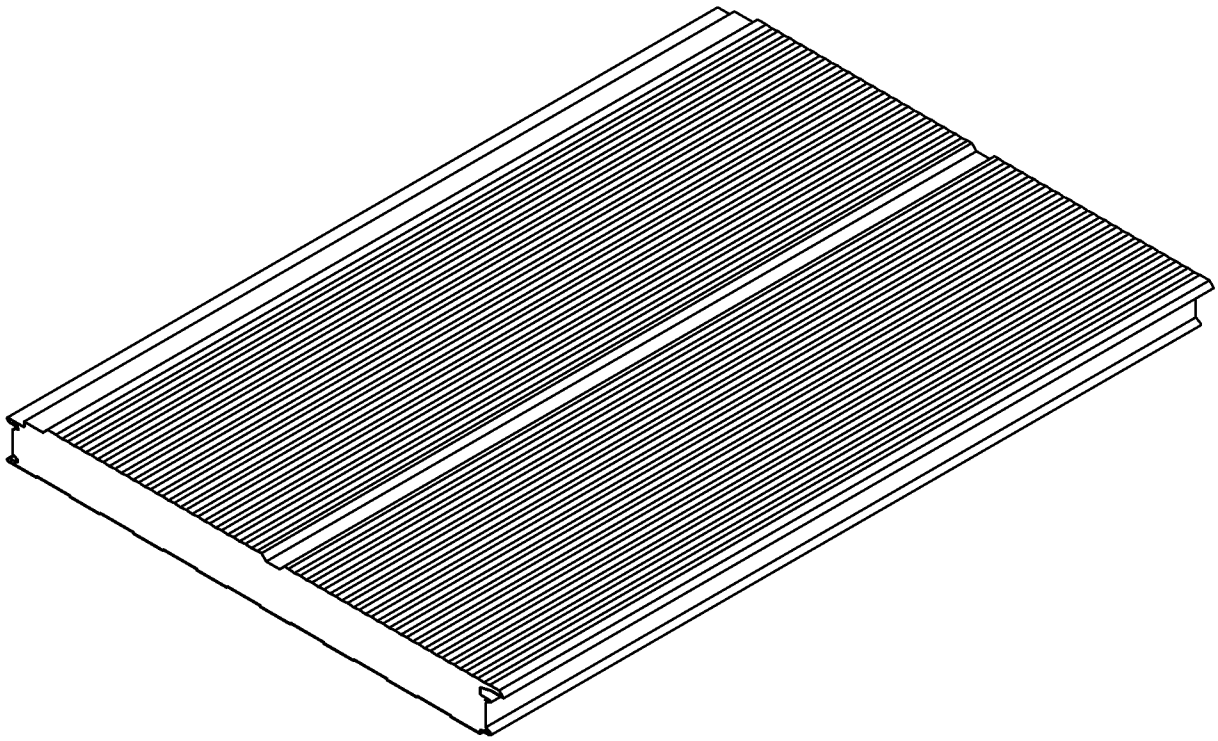


(c)

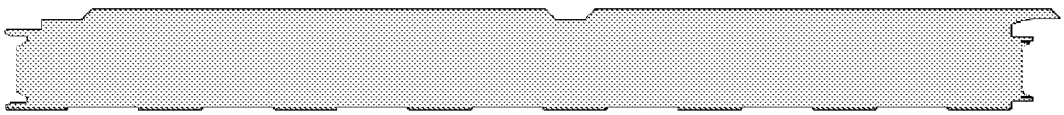


(d)

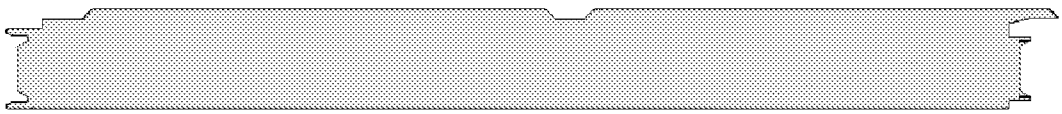
FIG. 7



(a)



(b)



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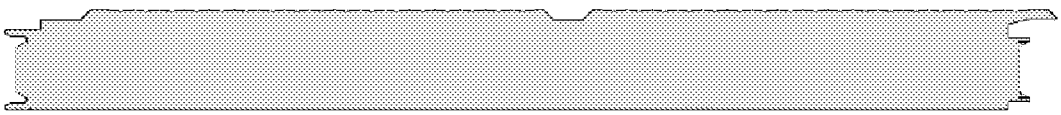
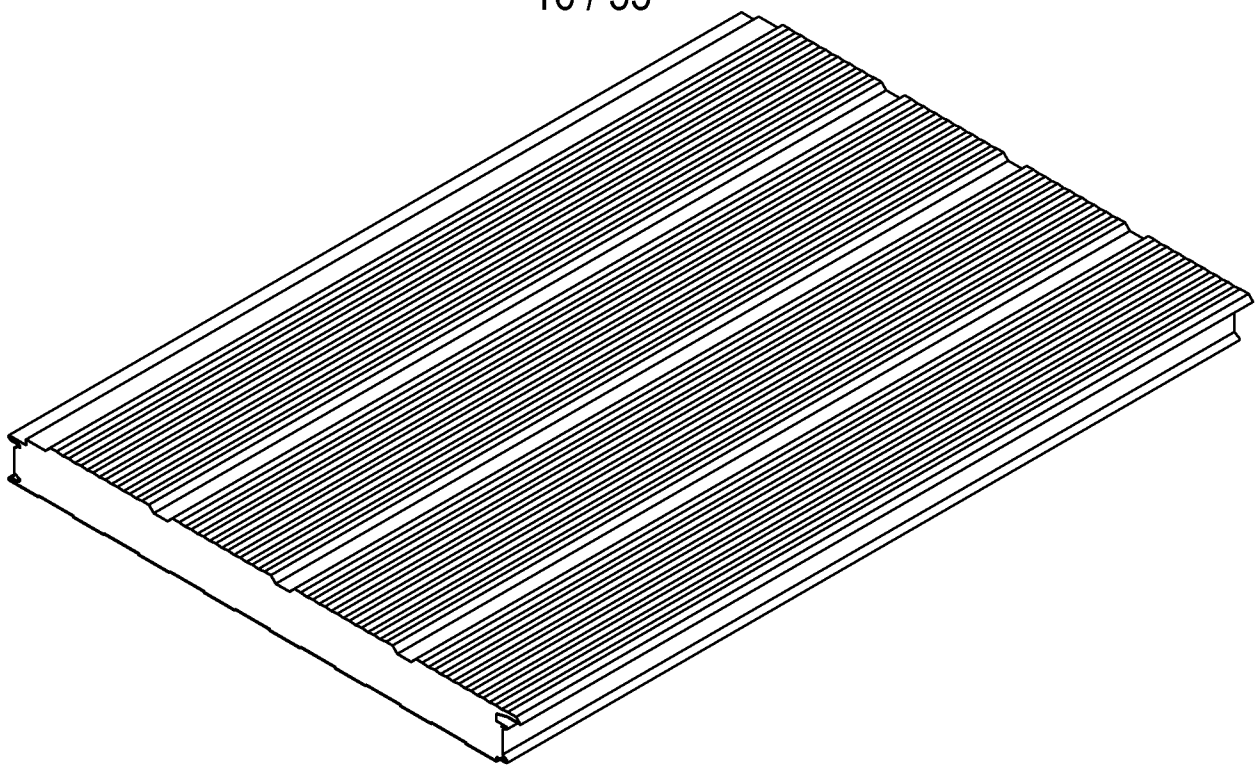
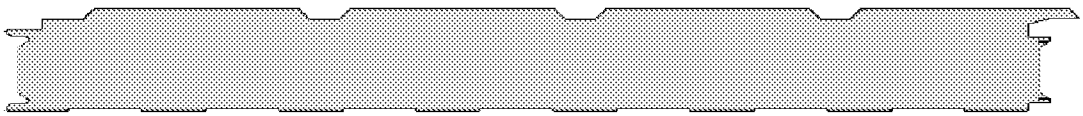


(e)

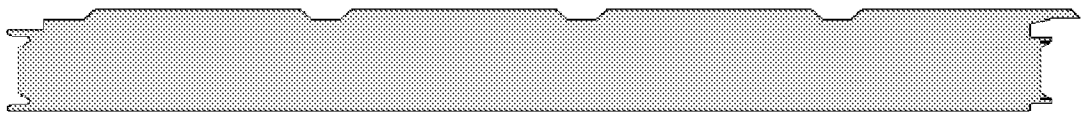
FIG. 8



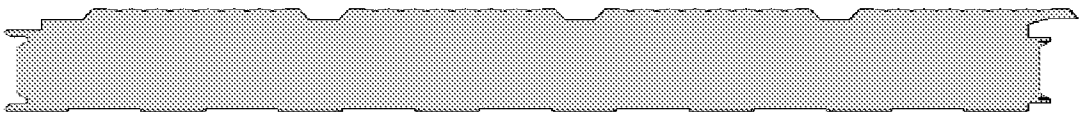
(a)



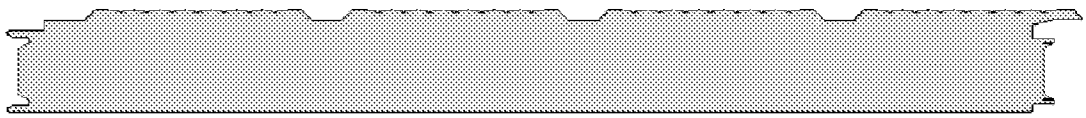
(b)



(c)

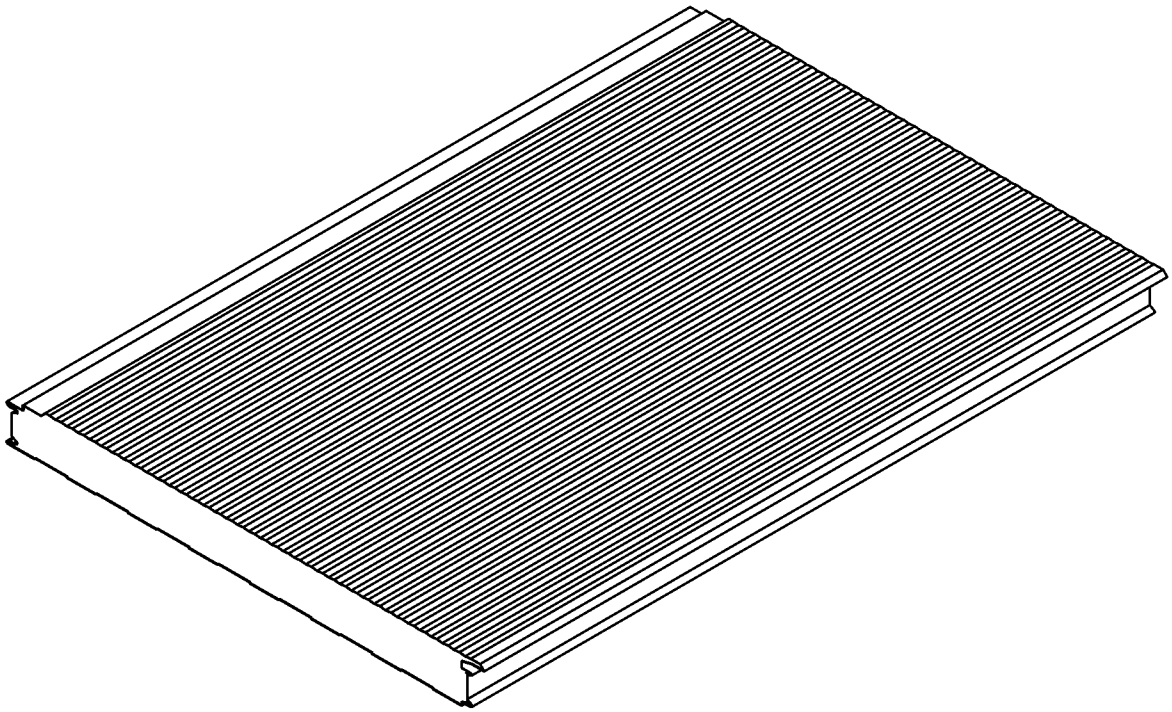


(d)

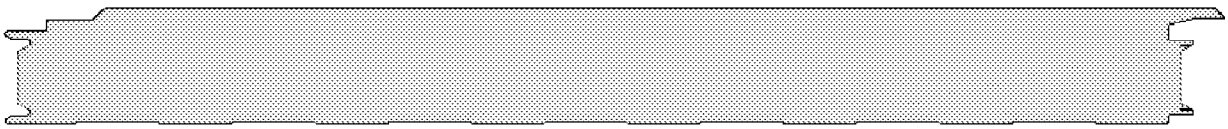


(e)

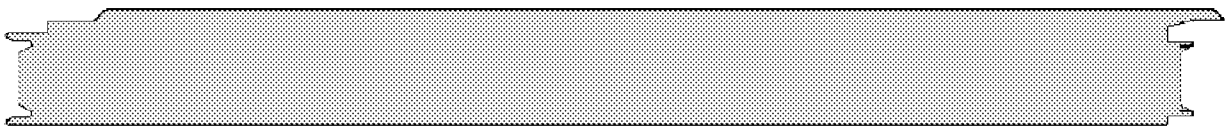
FIG. 9



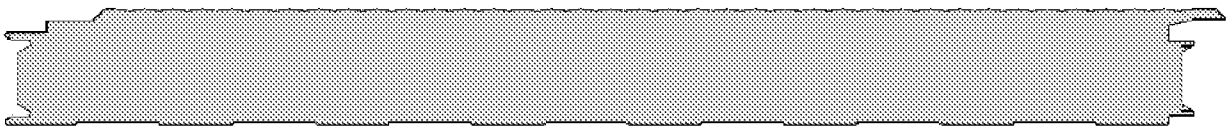
(a)



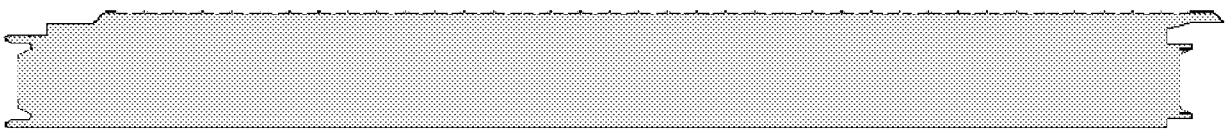
(b)



(c)

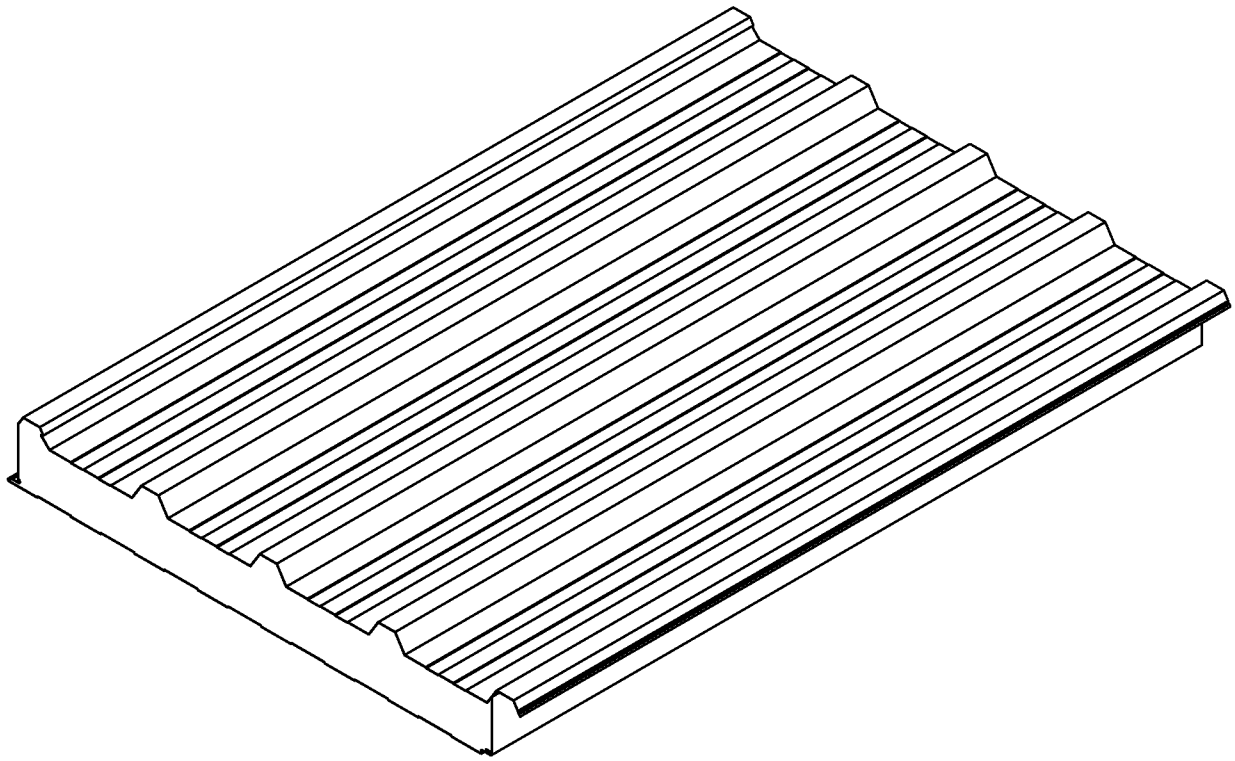


(d)

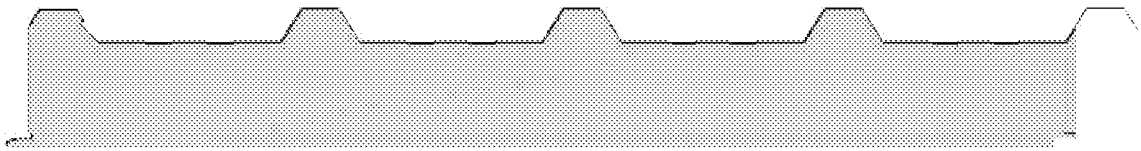


(e)

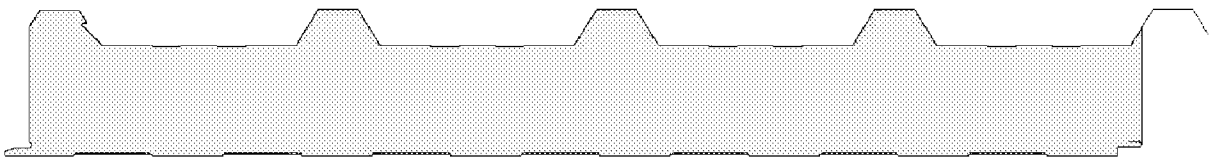
FIG. 10



(a)

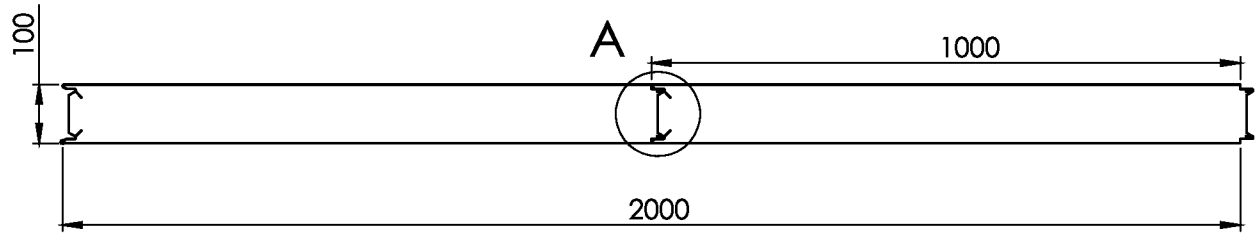


(b)

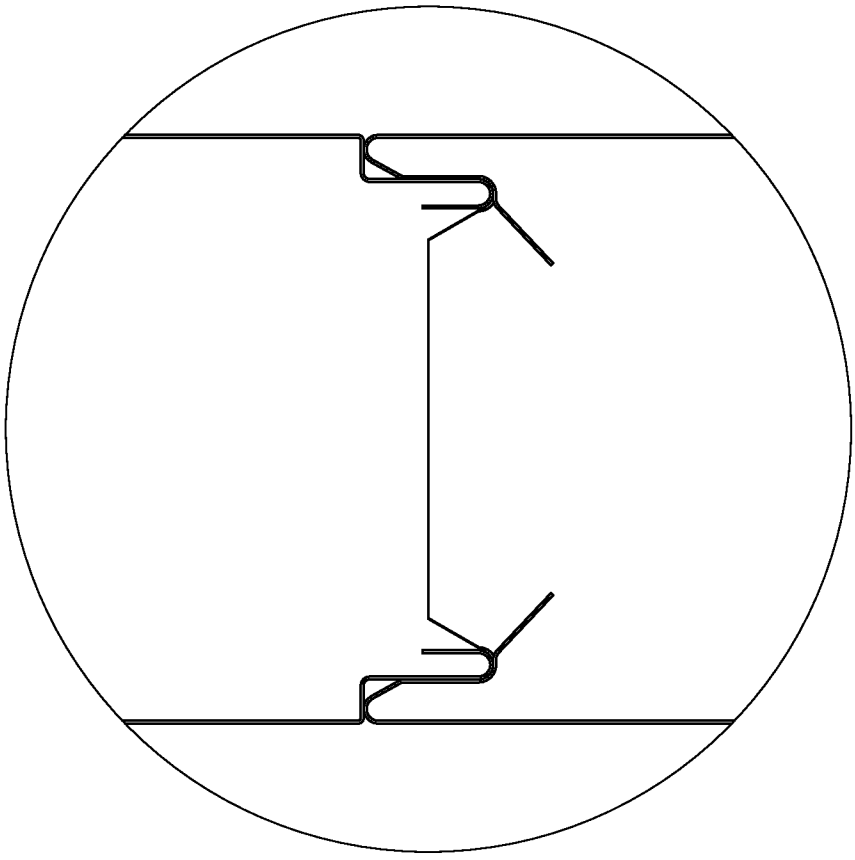


(c)

FIG. 11



(a)



(b)

FIG. 12

PANEL PERFORMANCE

Thickness (mm)	50	75	100	150
R Value (mK/W)	2.3	3.5	4.7	7.0
Weight (kg/m)	11.2	12.2	13.2	15.2
Unsupported Span (m)	3.0	4.3	5.0	4.0

Weight for 0.5/0.5 facings

ACOUSTIC PROPERTIES

Freq	125	250	500	1000	2000	4000	STC	RW
Hz	16.1	17.5	19.2	23	32.2	36.8	20	23

Tested to ISO 10140-2 on 75mm panel.

FIRE PERFORMANCE

AS1530.3 - Group 1-S	
Ignitability Index	0
Spread of Flame Index	0
Heat Evloved Index	0
Smoke Index	1
Foam Plastic Core	
Core meets the requirements of AS1366.2	
External Radiation(ISO 5660-1:2015)	
Total Heat THRR	**Peak Heat PHRR**
34.7 MJ/m2	83.5 kW/m2

PRODUCT PROPERTIES

Core	Fire-retardant (PIR) foam
External facing	0.5mm thick Zinc/Aluminium G300S AZ150 coated steel to AS 1397
Internal Facing	0.5mm thick Zinc/Aluminium G300S AZ150 coated steel to AS 1397
Width	1000mm
Length	As required, 2m - 24m
Undercut Range	75mm - 200mm
Thickness	50mm, 75mm, 100mm and 150mm

FIG. 13

PANEL PERFORMANCE

Thickness (mm)	50	75	100
R Value (mK/W)	2.3	3.5	4.7
Weight (kg/m)	10.8	11.8	12.8
Unsupported Span (m)	3.0	4.3	5.0

Weight for 0.5/0.5 facings

ACOUSTIC PROPERTIES

Freq	125	250	500	1000	2000	4000	STC	RW
Hz	17.2	18.2	19.1	25	37	40	21	24

Tested to ISO 10140-2 on 100mm panel.

FIRE PERFORMANCE

AS1530.3 - Group 1-S	
Ignitability Index	0
Spread of Flame Index	0
Heat Evloved Index	0
Smoke Index	1
Foam Plastic Core	
Core meets the requirements of AS1366.2	
External Radiation(ISO 5660-1:2015)	
Total Heat THRR	**Peak Heat PHRR**
34.7 MJ/m2	83.5 kW/m2

PRODUCT PROPERTIES

Core	Fire-retardant (PIR) foam
External facing	0.5mm thick Zinc/Aluminium G300S AZ150 coated steel to AS 1397
Internal Facing	0.5mm thick Zinc/Aluminium G300S AZ150 coated steel to AS 1397
Width	1000mm
Length	As required, 2m - 24m
Thickness	50mm, 75mm, 100mm and 150mm

FIG. 14

PANEL PERFORMANCE

Thickness (mm)	50	75	100	150
R Value (mK/W)	2.3	3.5	4.7	7.0
Weight (kg/m)	10.3	11.3	12.3	14.3
Unsupported Span (m)	3.0	4.3	5.0	4.0

Weight for 0.5/0.5 facings

FIRE PERFORMANCE

AS1530.3 - Group 1-S	
Ignitability Index	0
Spread of Flame Index	0
Heat Evloved Index	0
Smoke Index	1
Foam Plastic Core	
Core meets the requirements of AS1366.2	

PRODUCT PROPERTIES

Core	Fire-retardant (PIR) foam
External facing	0.5mm thick Zinc/Aluminium G300S AZ150 coated steel to AS 1397
Internal Facing	0.5mm thick Zinc/Aluminium G300S AZ150 coated steel to AS 1397
Width	1000mm
Length	As required, 2m - 24m
Thickness	50mm, 75mm, 100mm and 150mm

FIG. 15

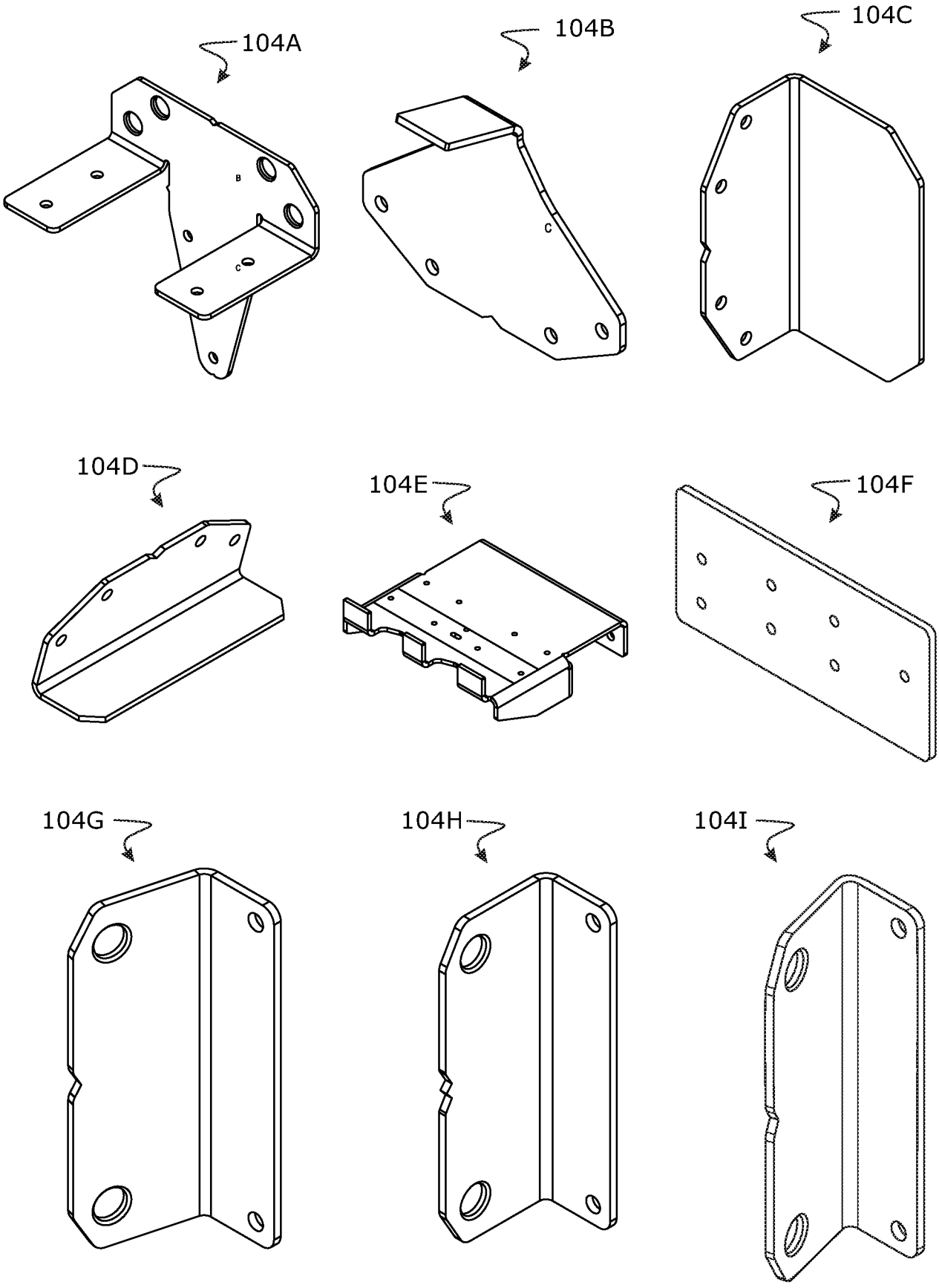


FIG. 16

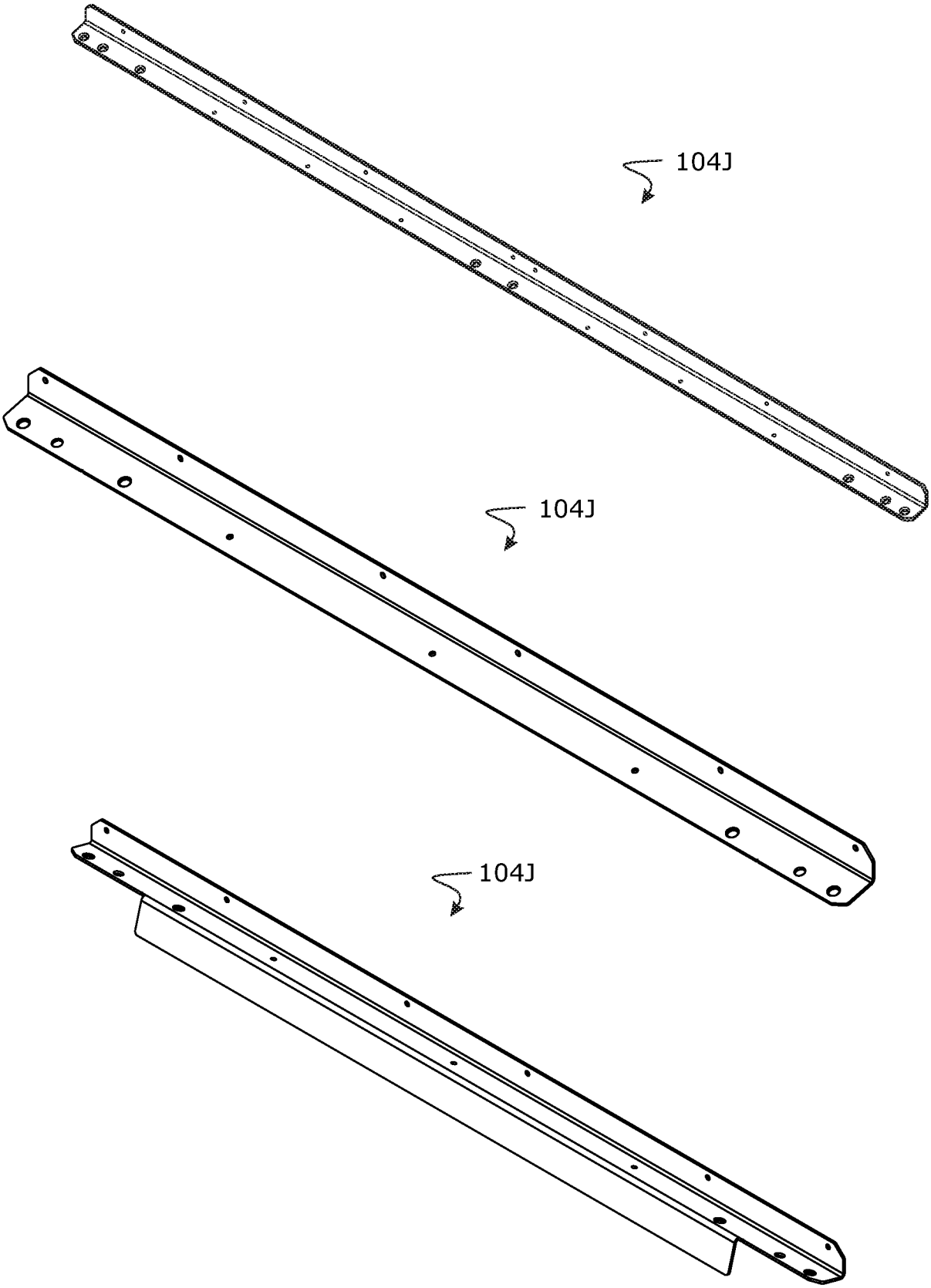
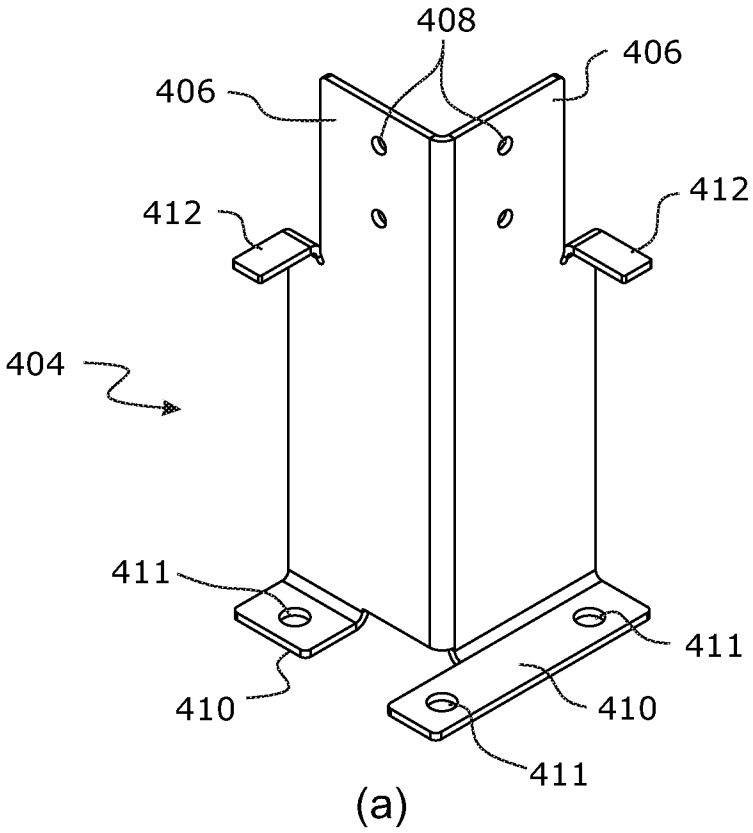
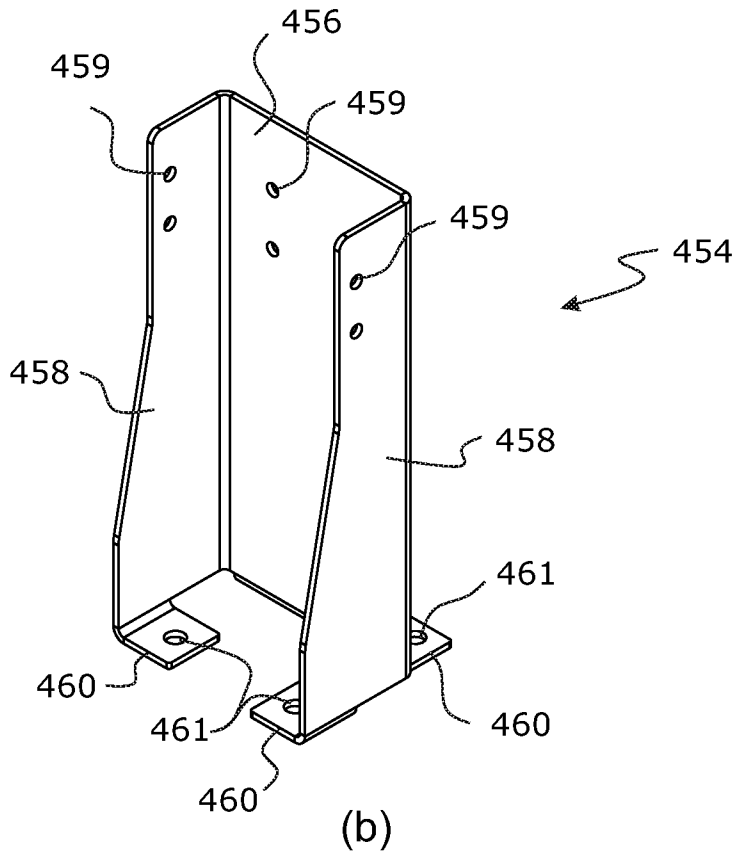


FIG. 17


408
406
406
412
412
404
411
411
410
410
411

(a)


456
459
459
459
454
458
458
461
460
461
460

(b)

FIG. 18

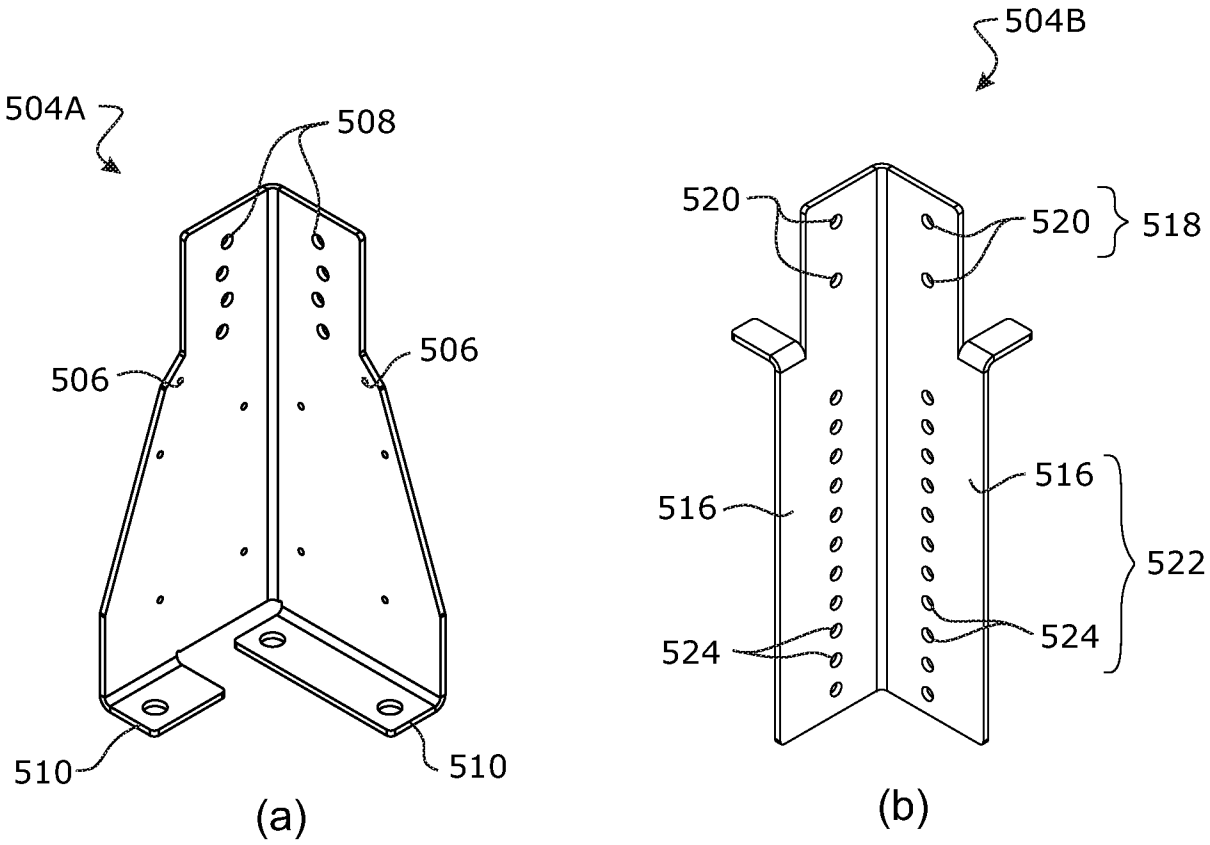

504A
508
506
506
510
510
(a)
504B
520
520
518
516
516
522
524
524
(b)

FIG. 19

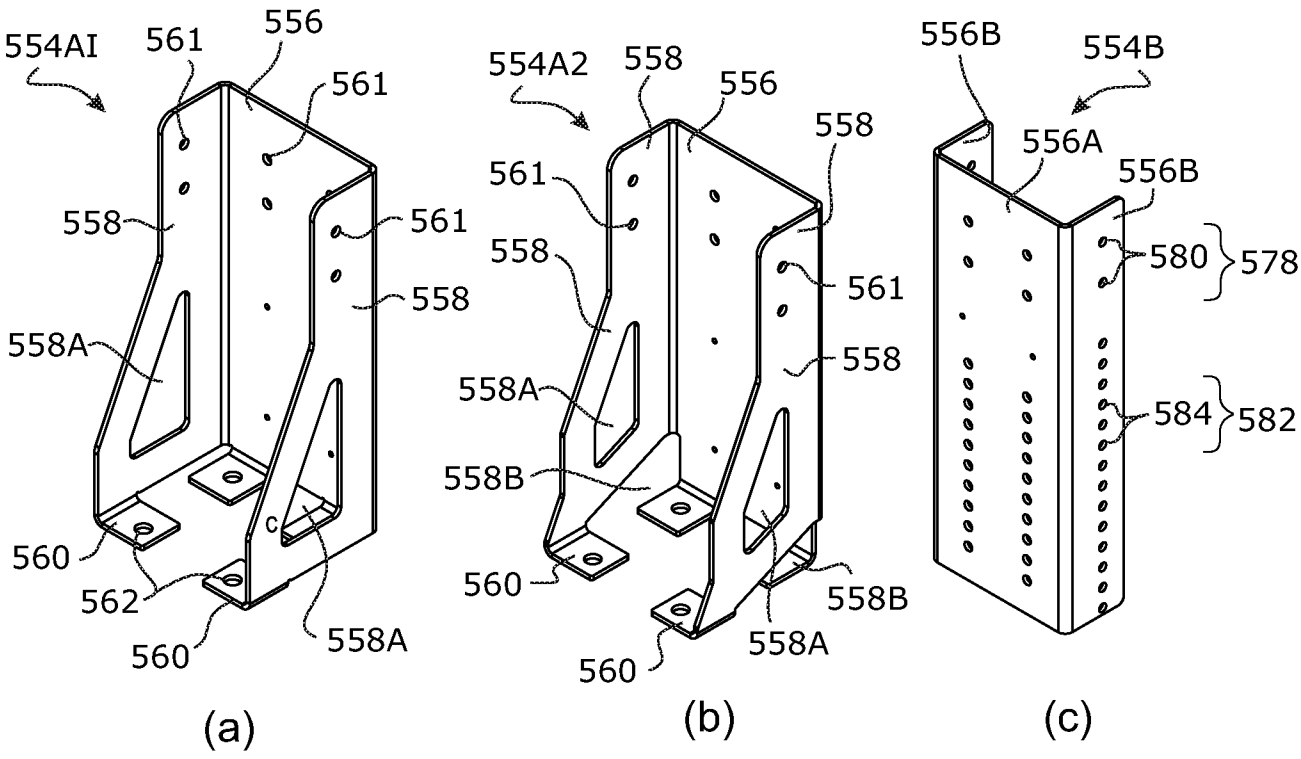

554AI
561
556
561
558
561
558
558A
560
562
560
558A
(a)
554A2
558
556
558
561
558
561
558
558A
558B
560
560
558A
558B
(b)
556B
554B
556A
556B
580
578
584
582
(c)

FIG. 20

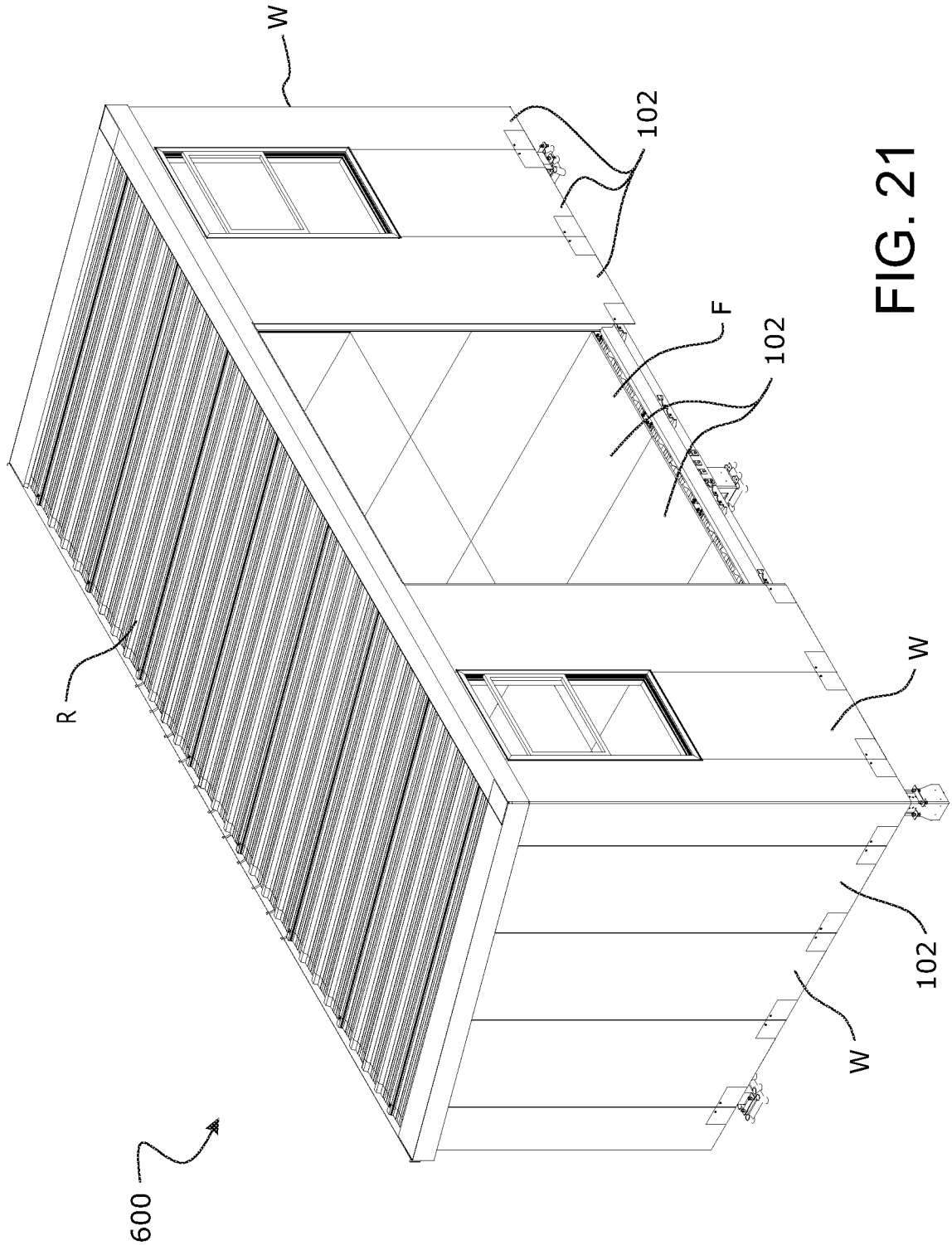


FIG. 21

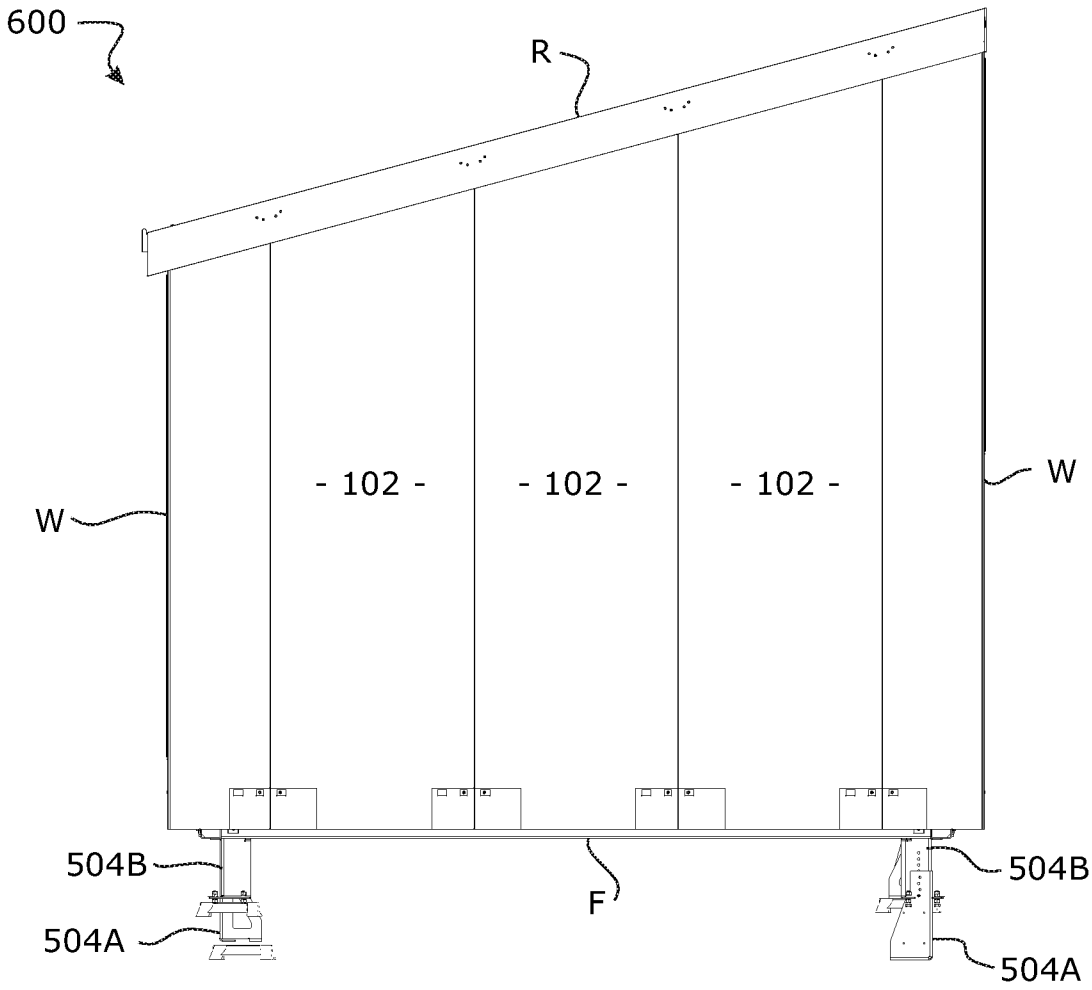


FIG. 22

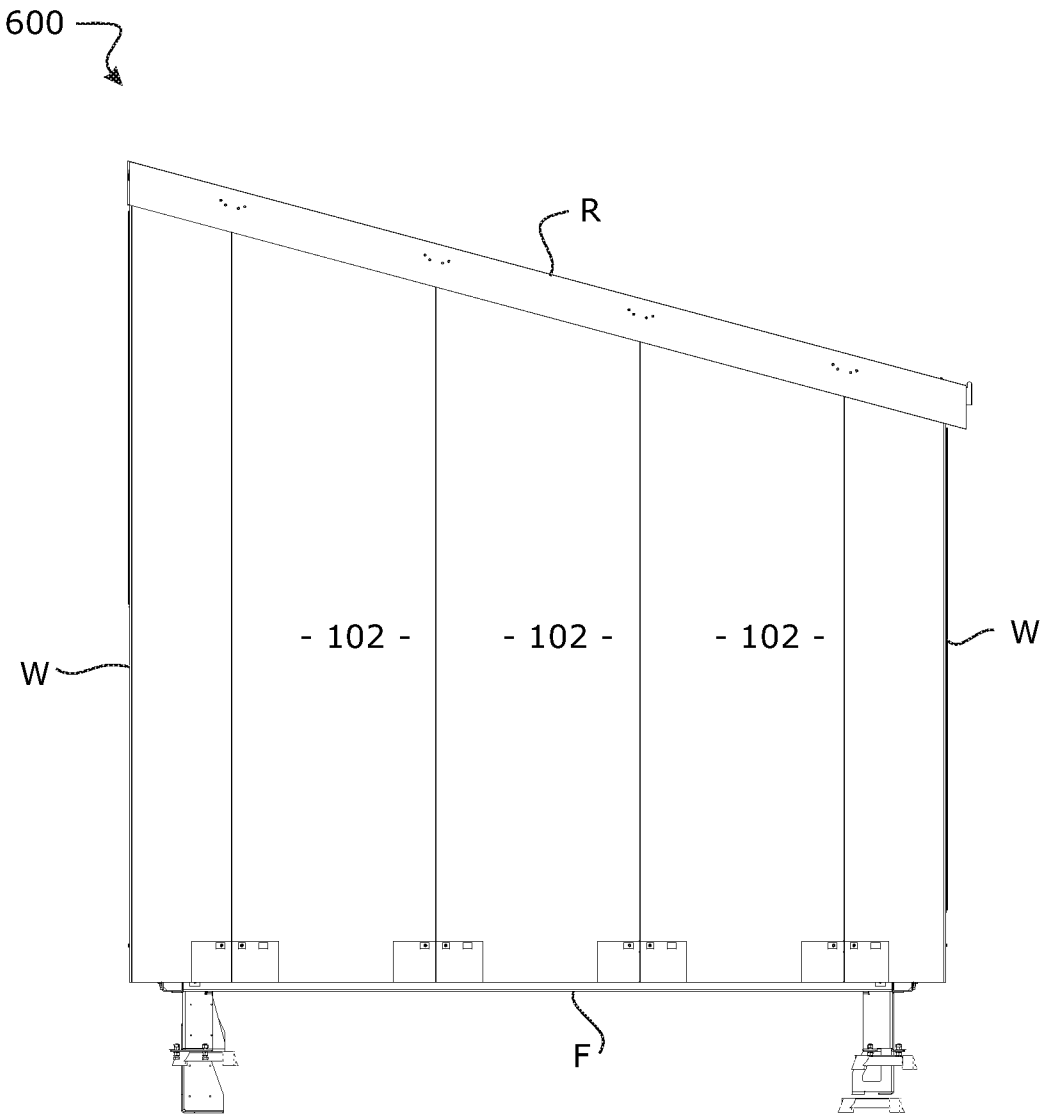


FIG. 23

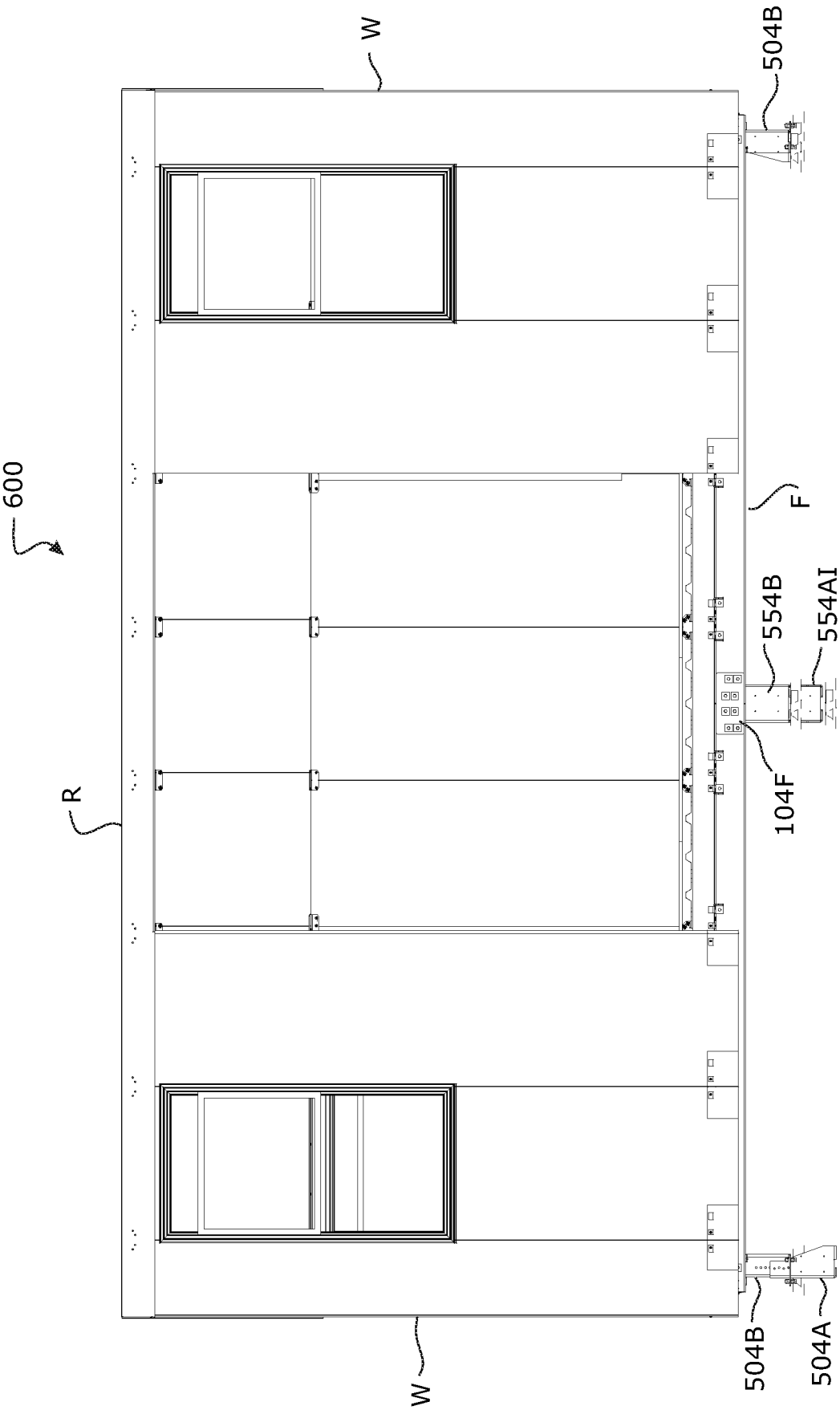


FIG. 24

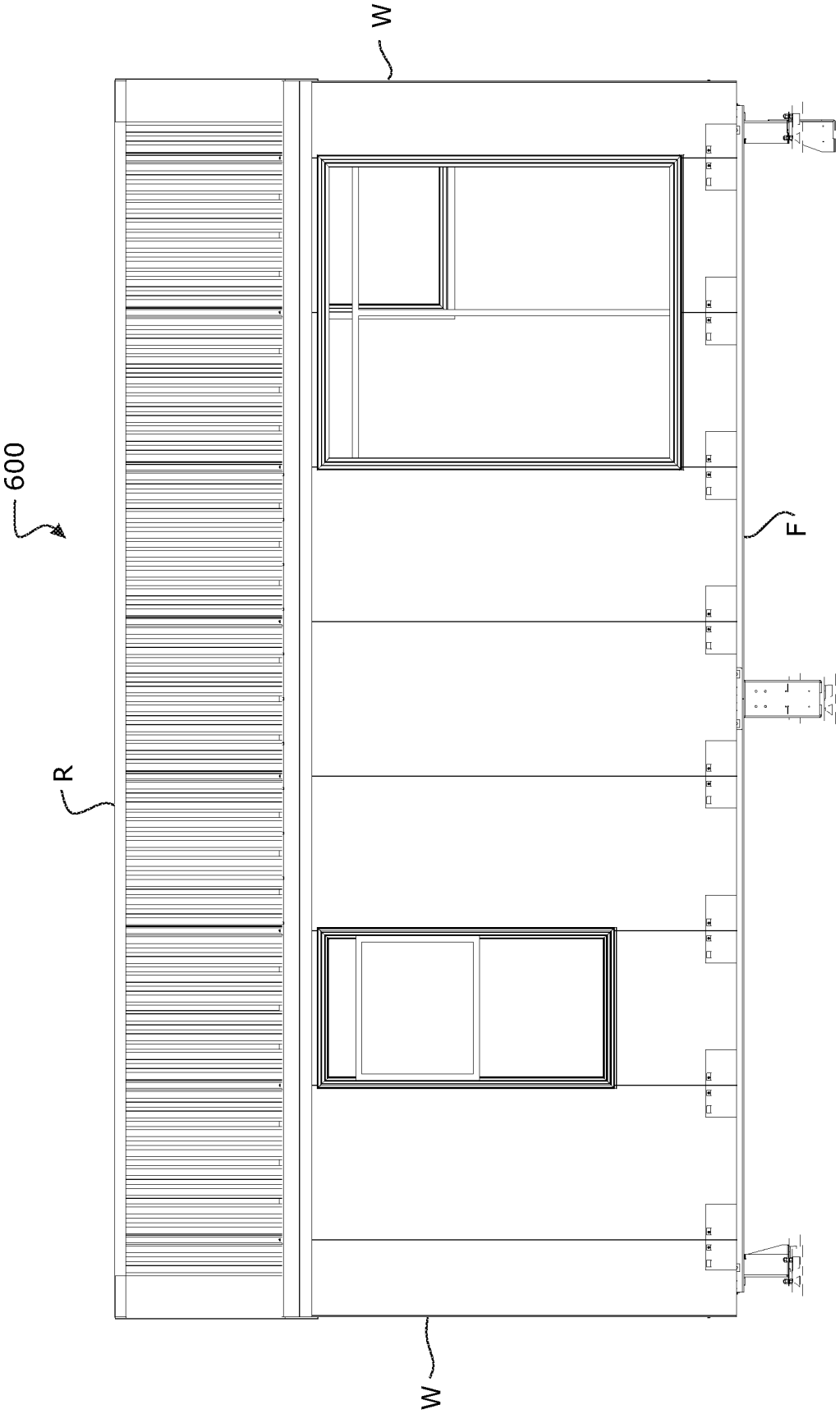


FIG. 25

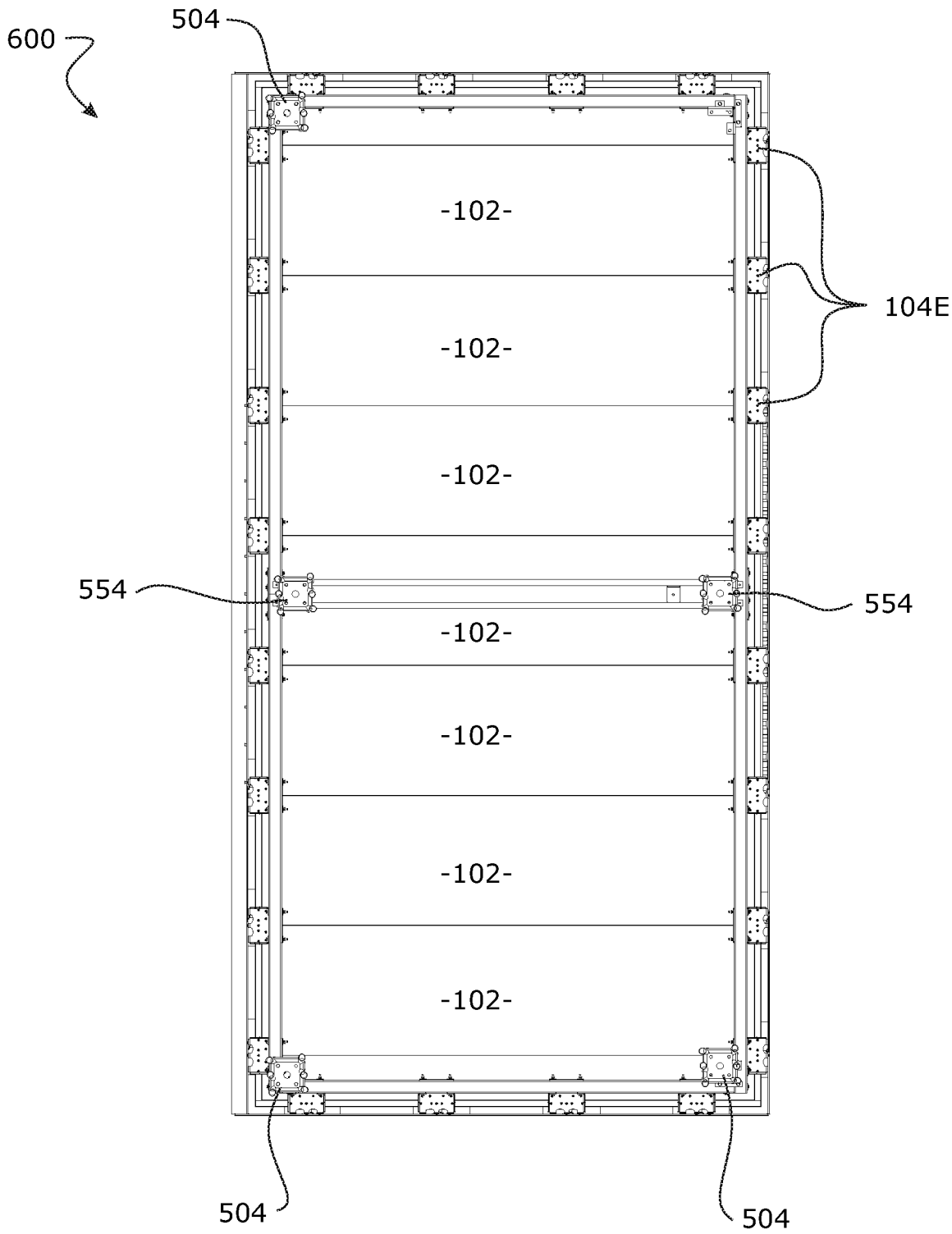


FIG. 26

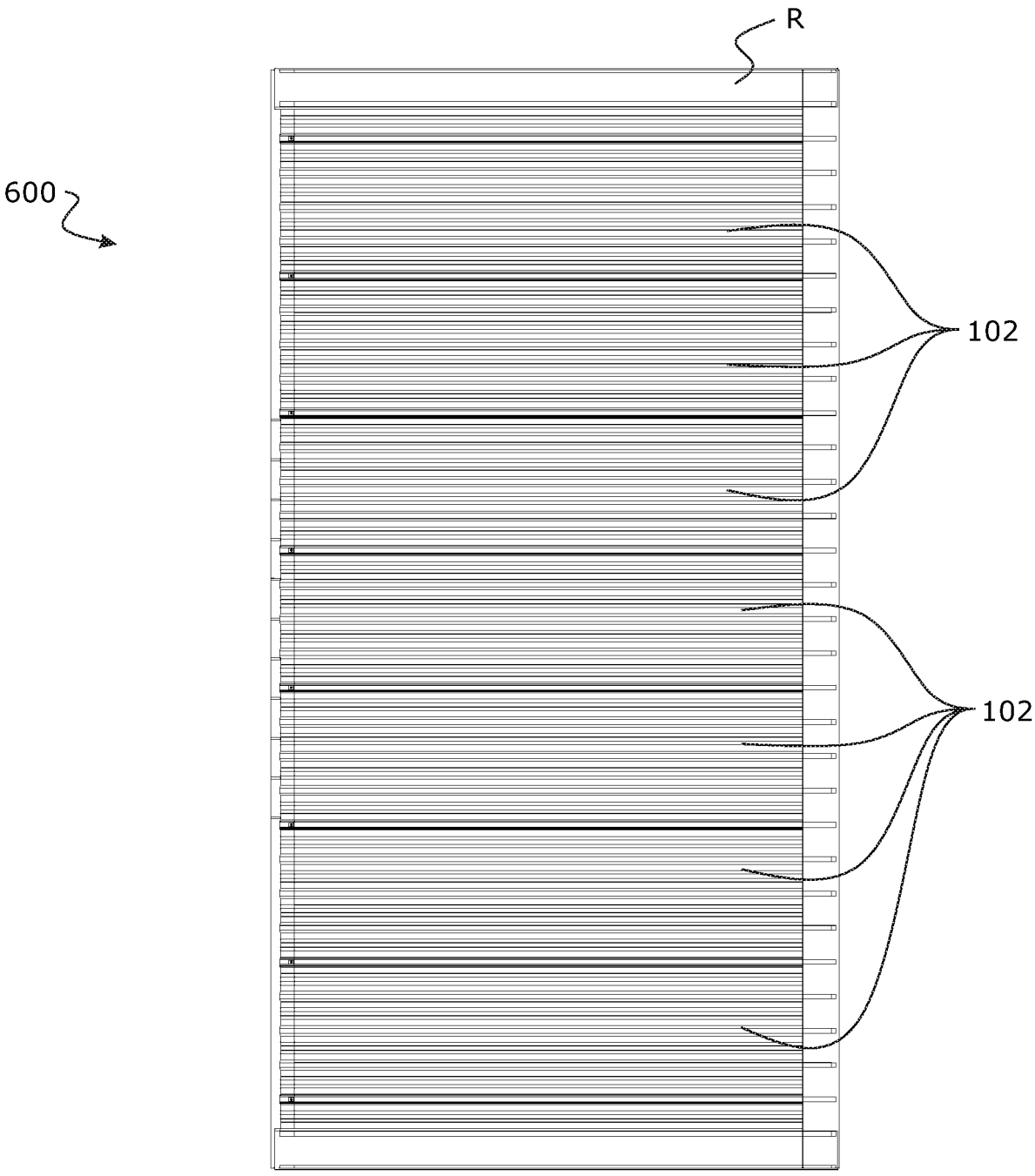


FIG. 27

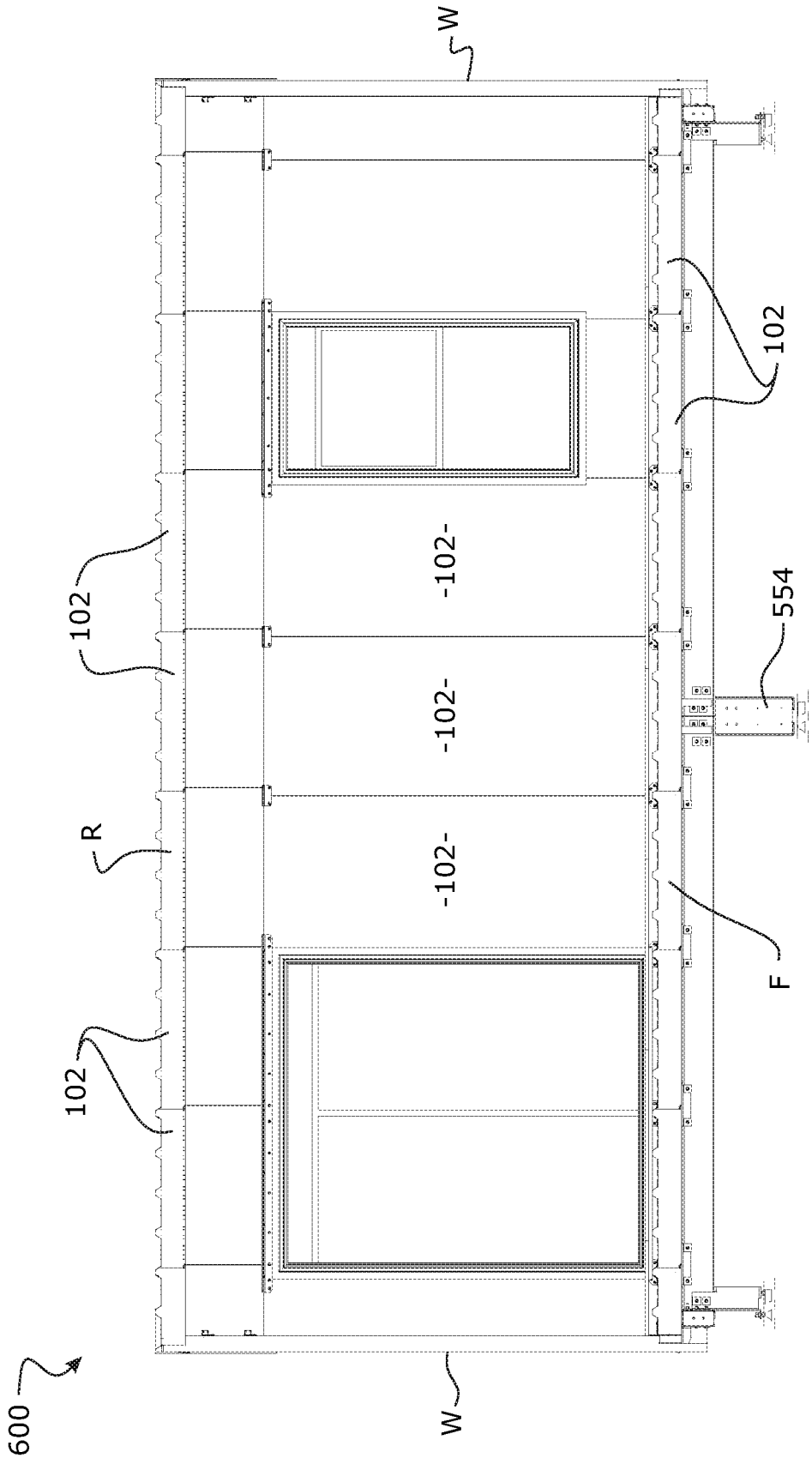


FIG. 28

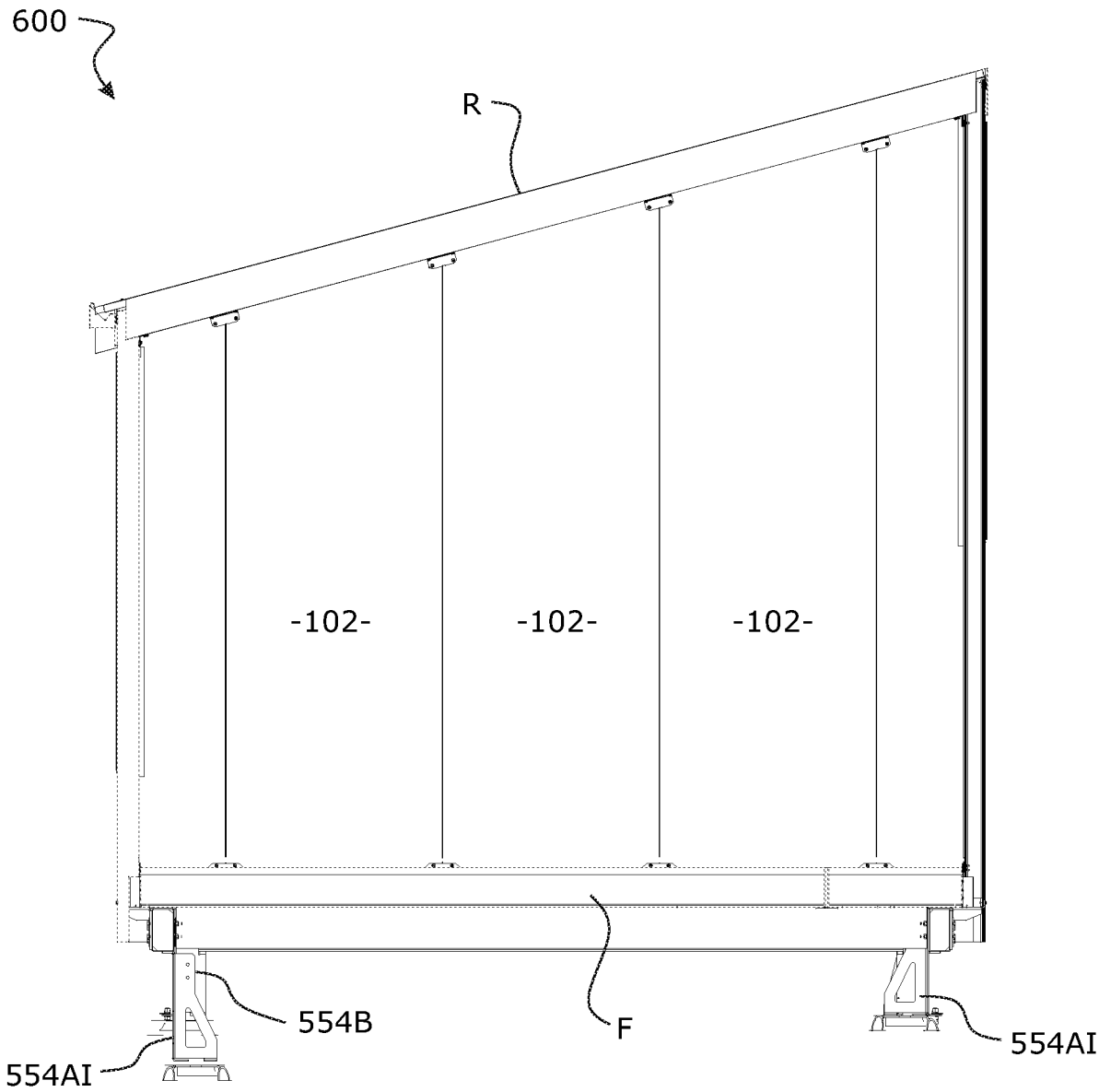


FIG. 29

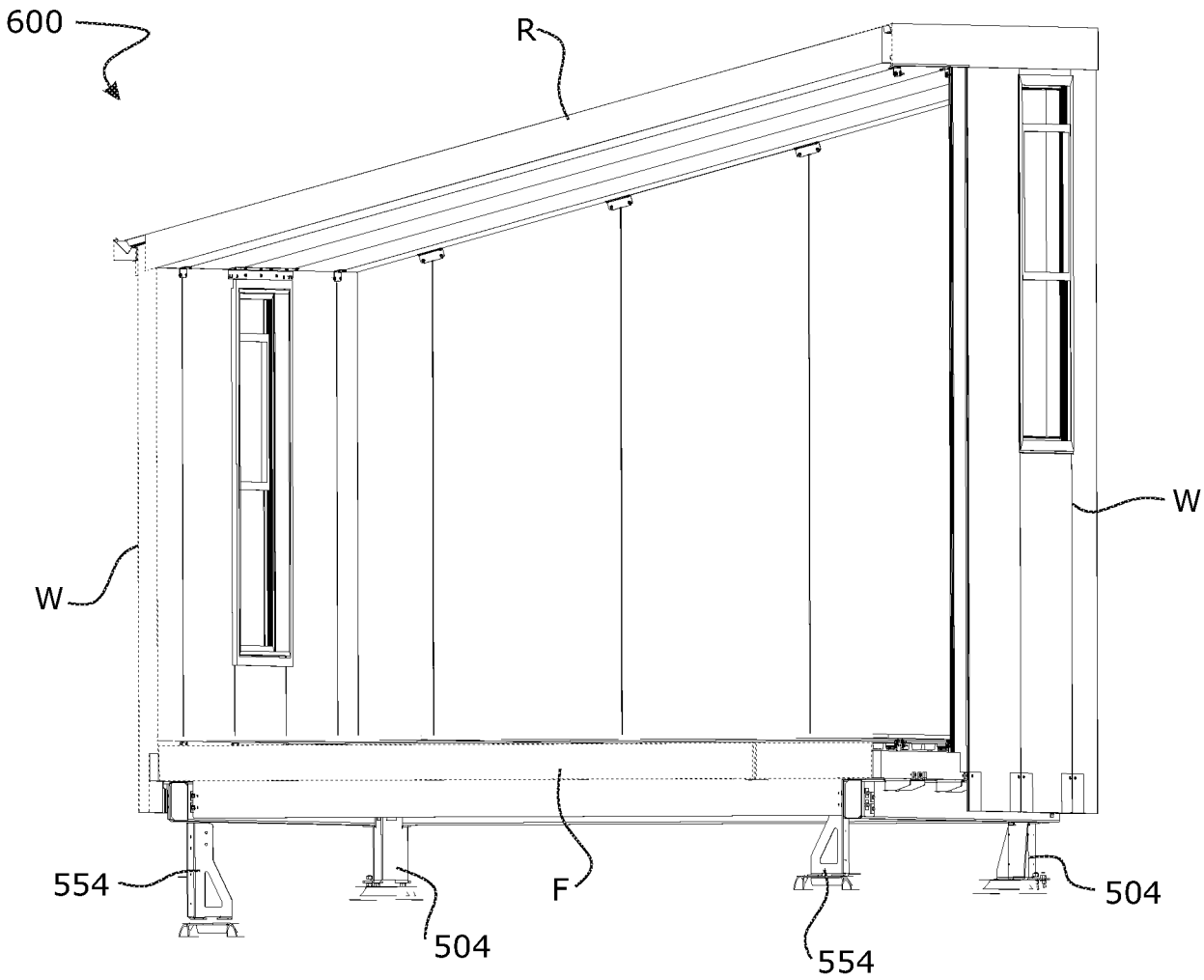


FIG. 30

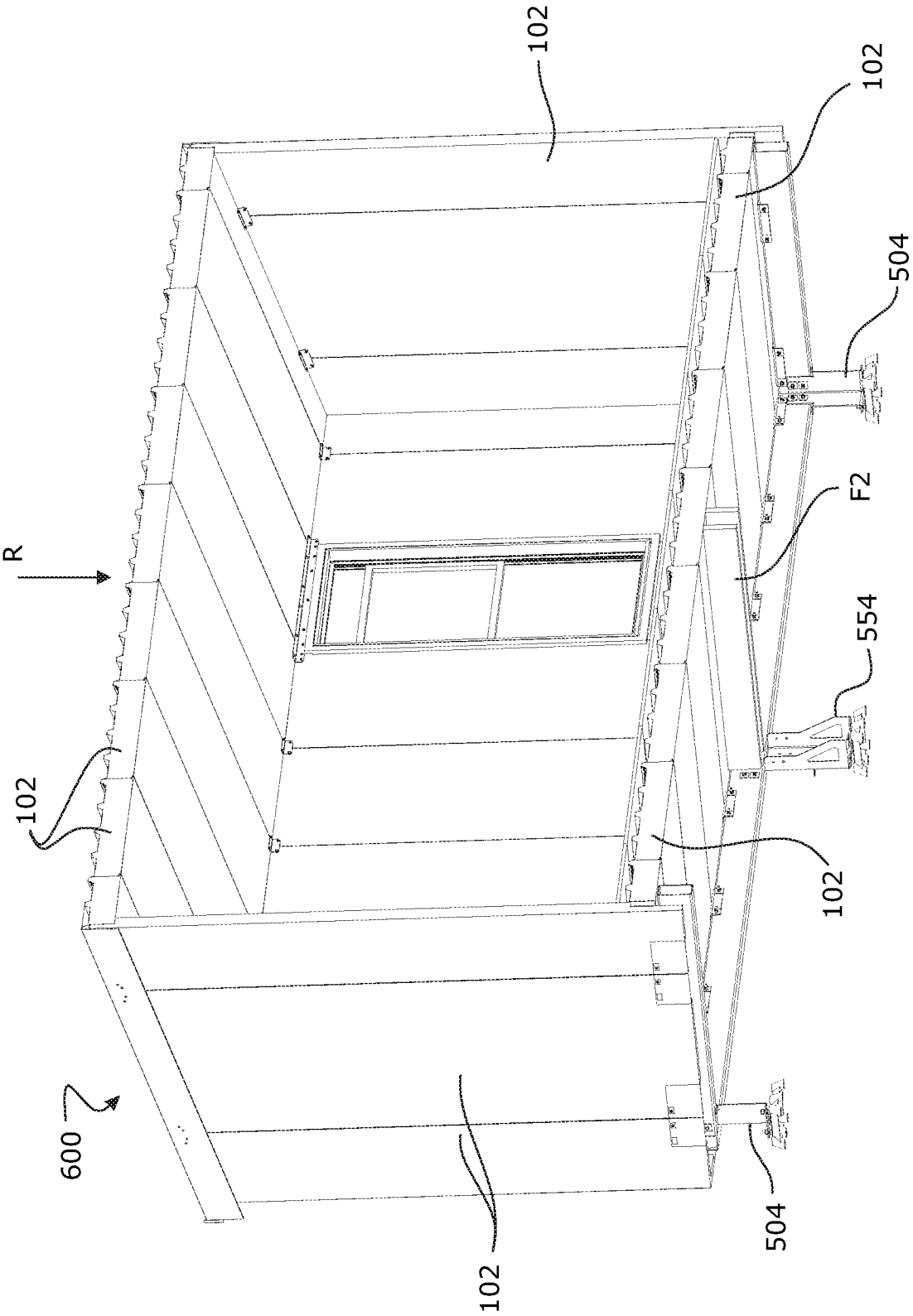


FIG. 31

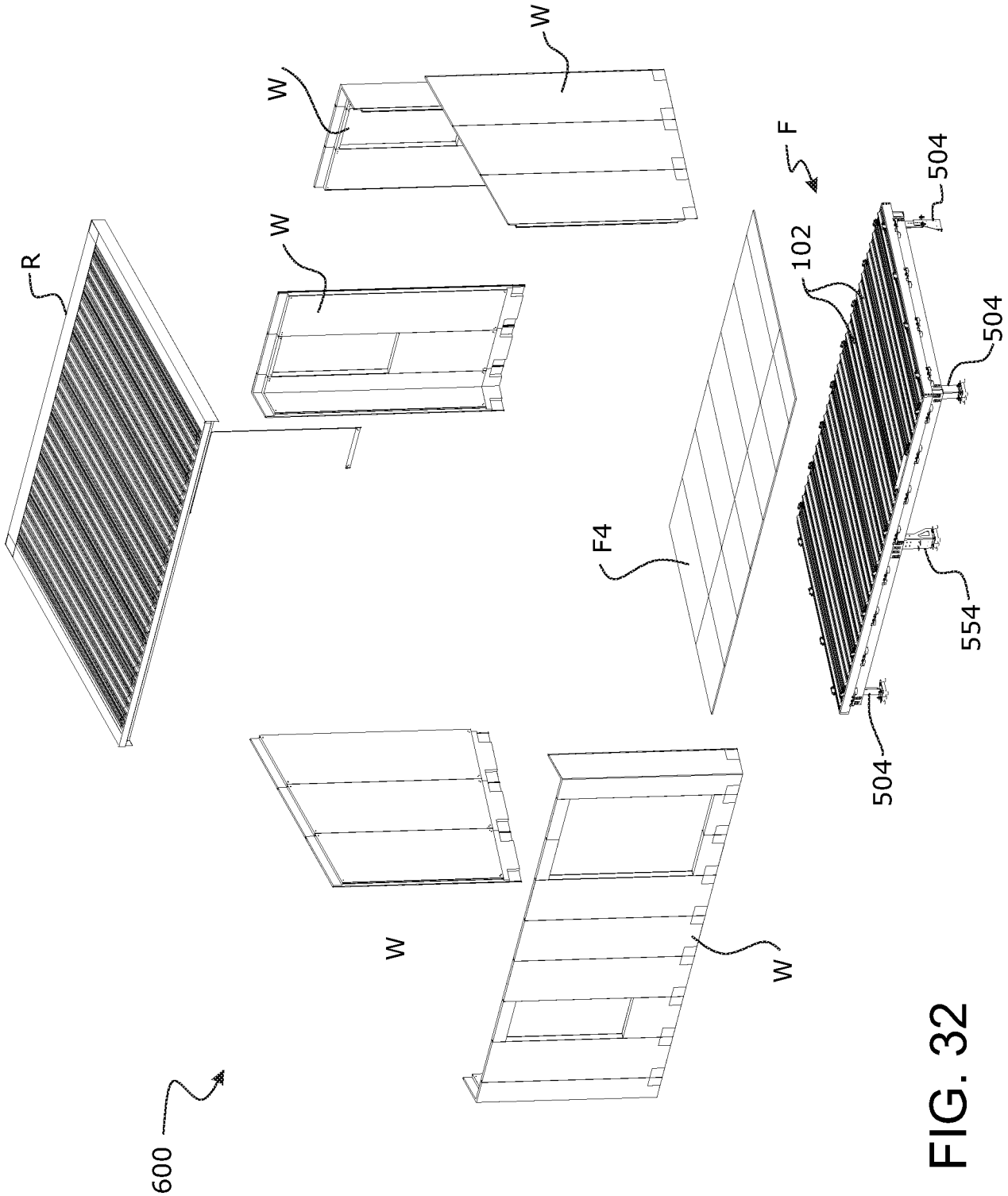


FIG. 32

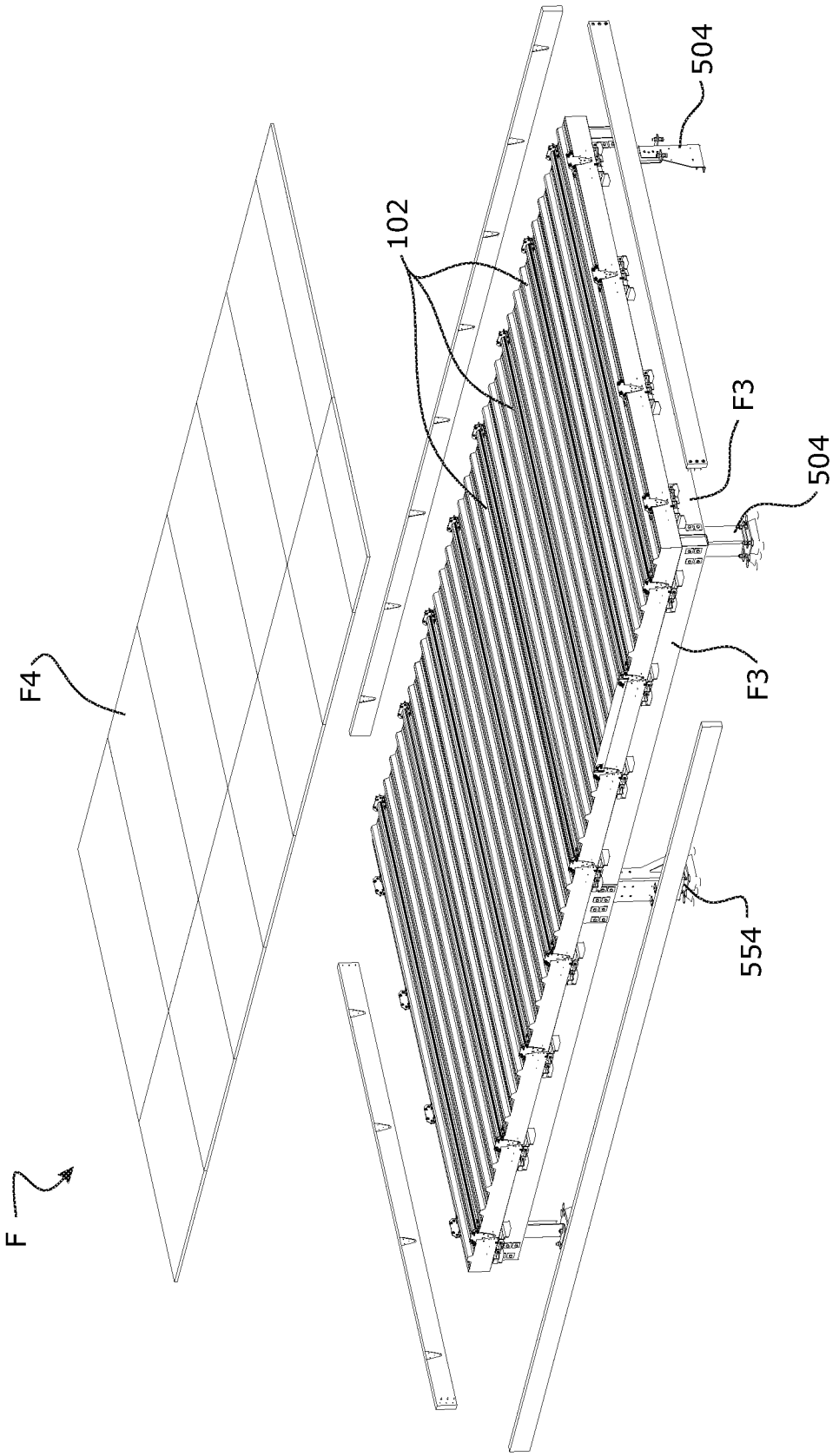


FIG. 33

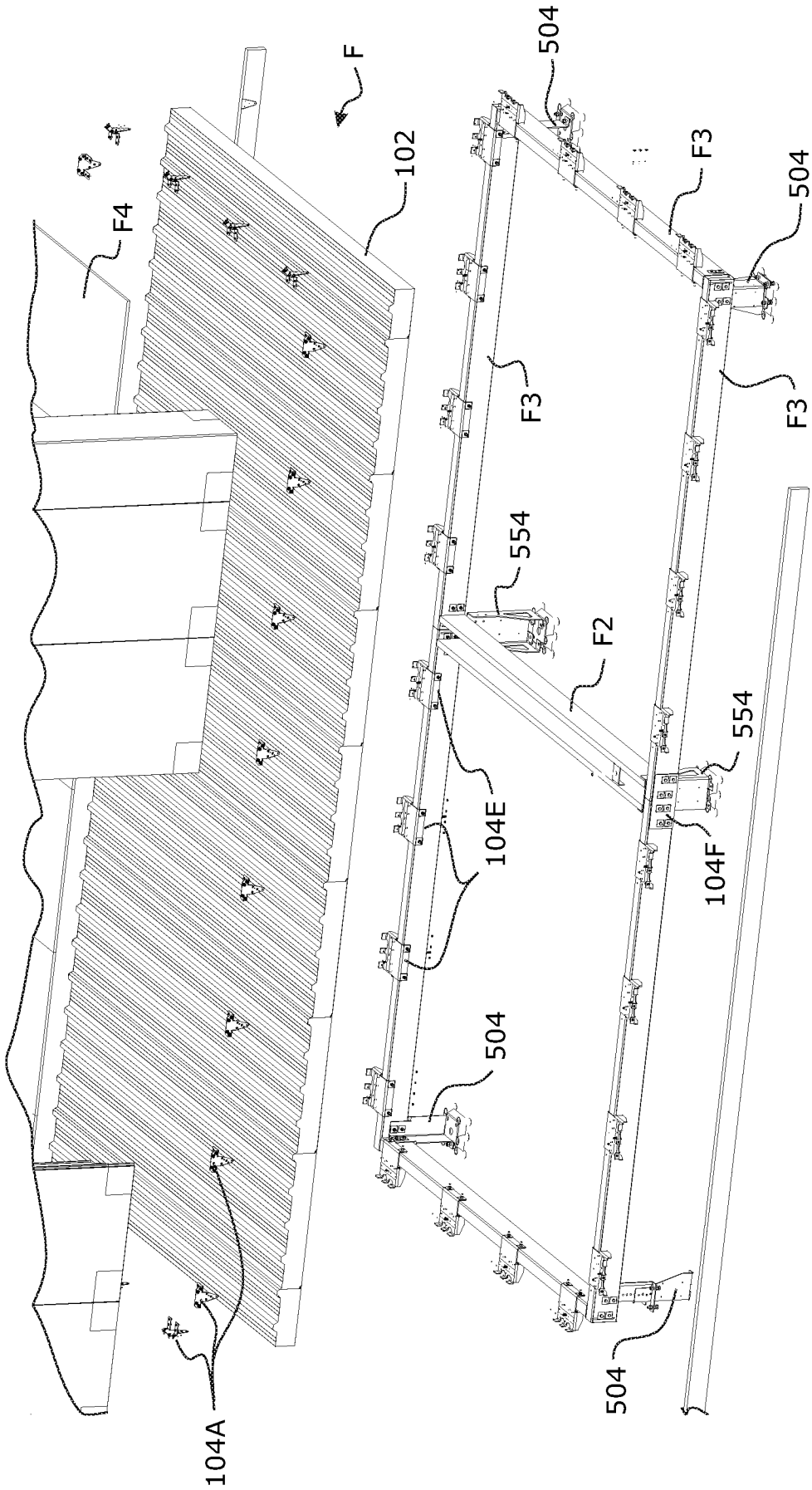


FIG. 34

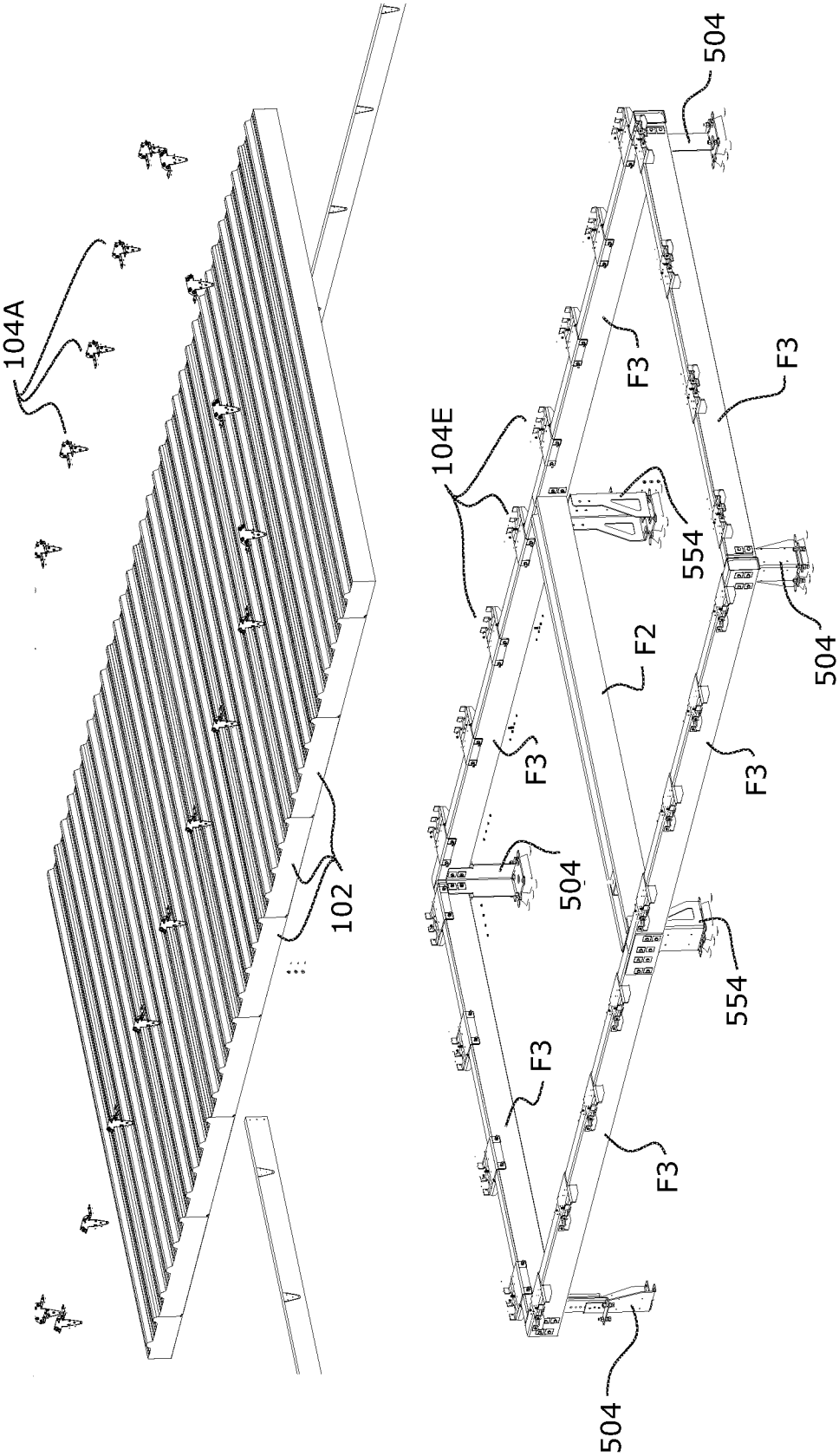


FIG. 35

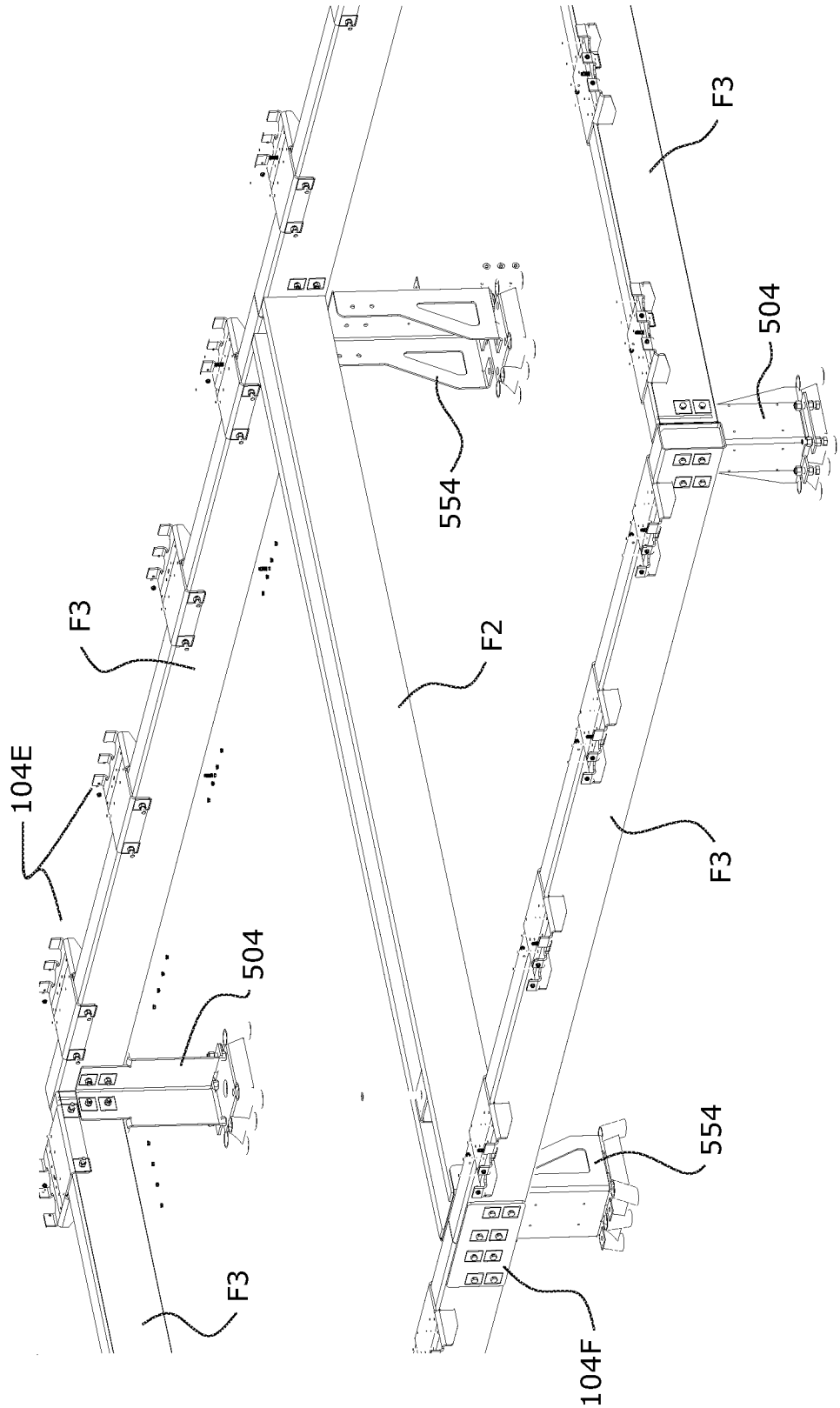


FIG. 36

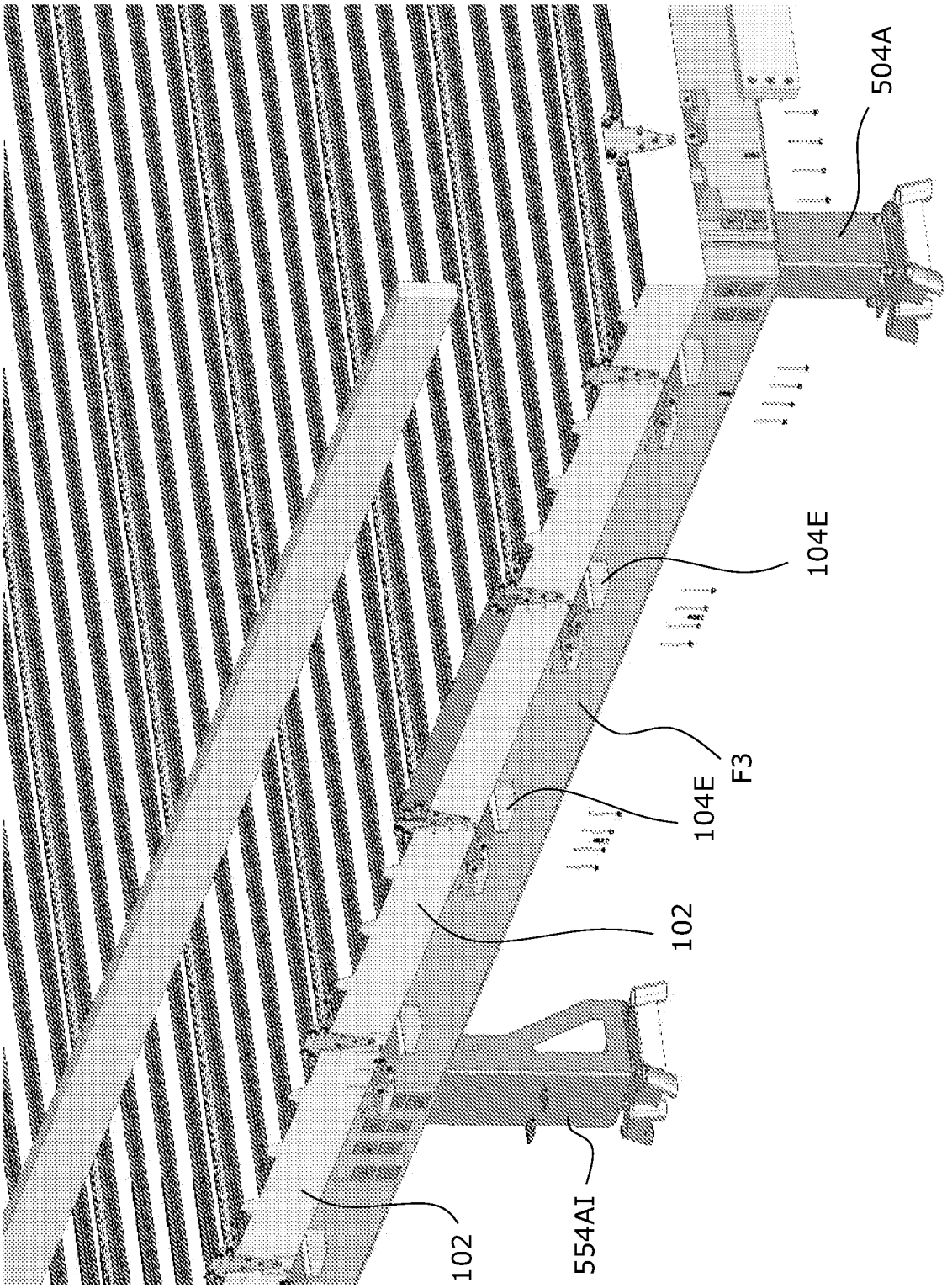


FIG. 37

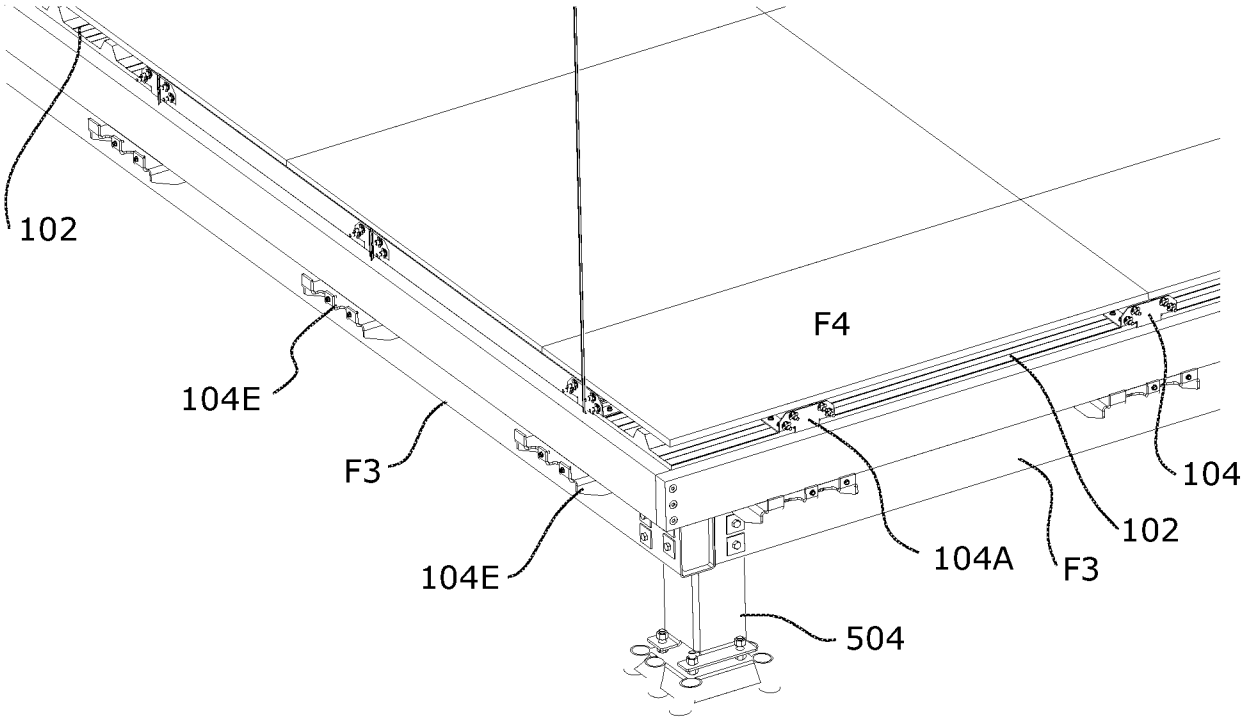


FIG. 38

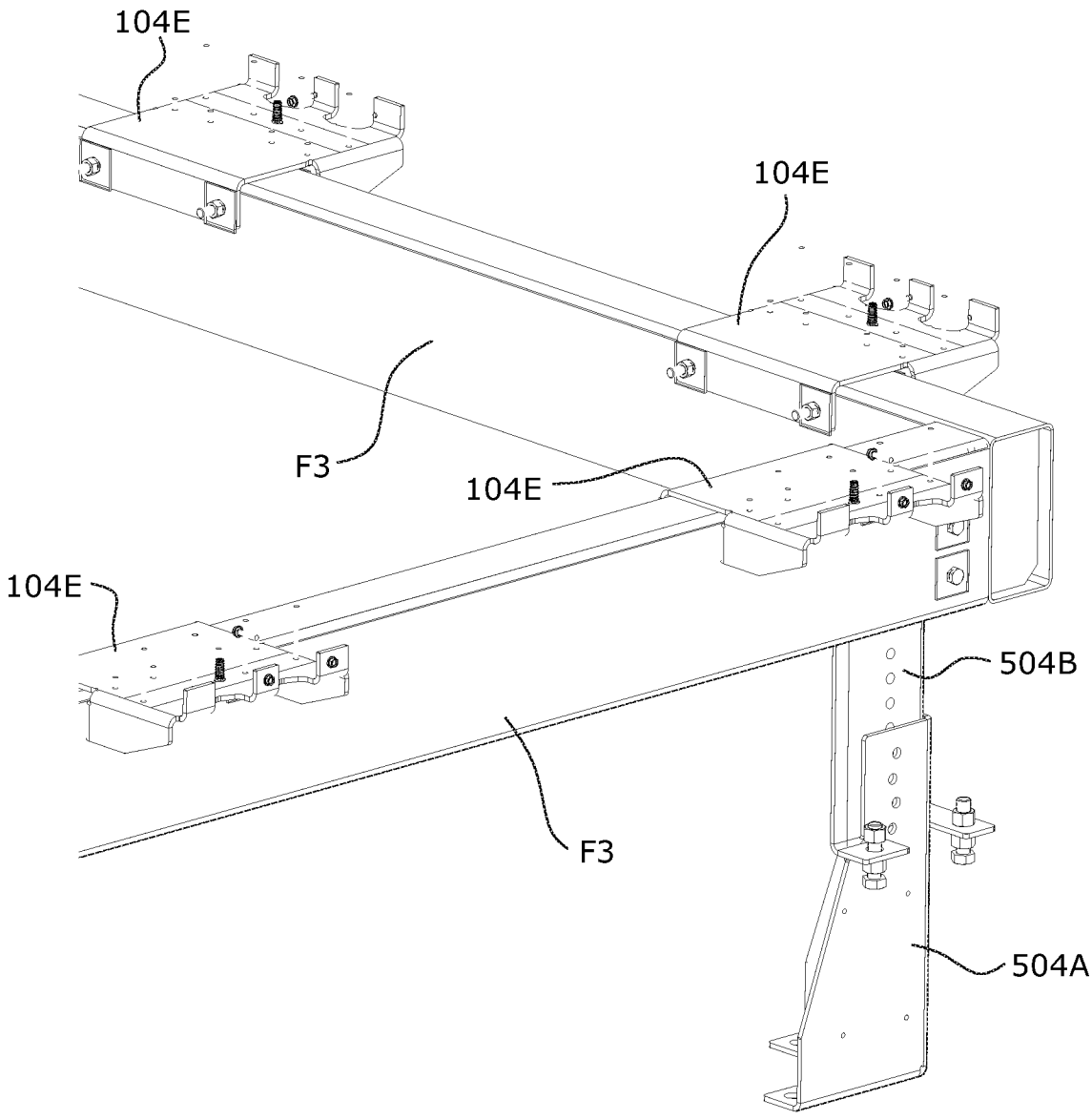


FIG. 39

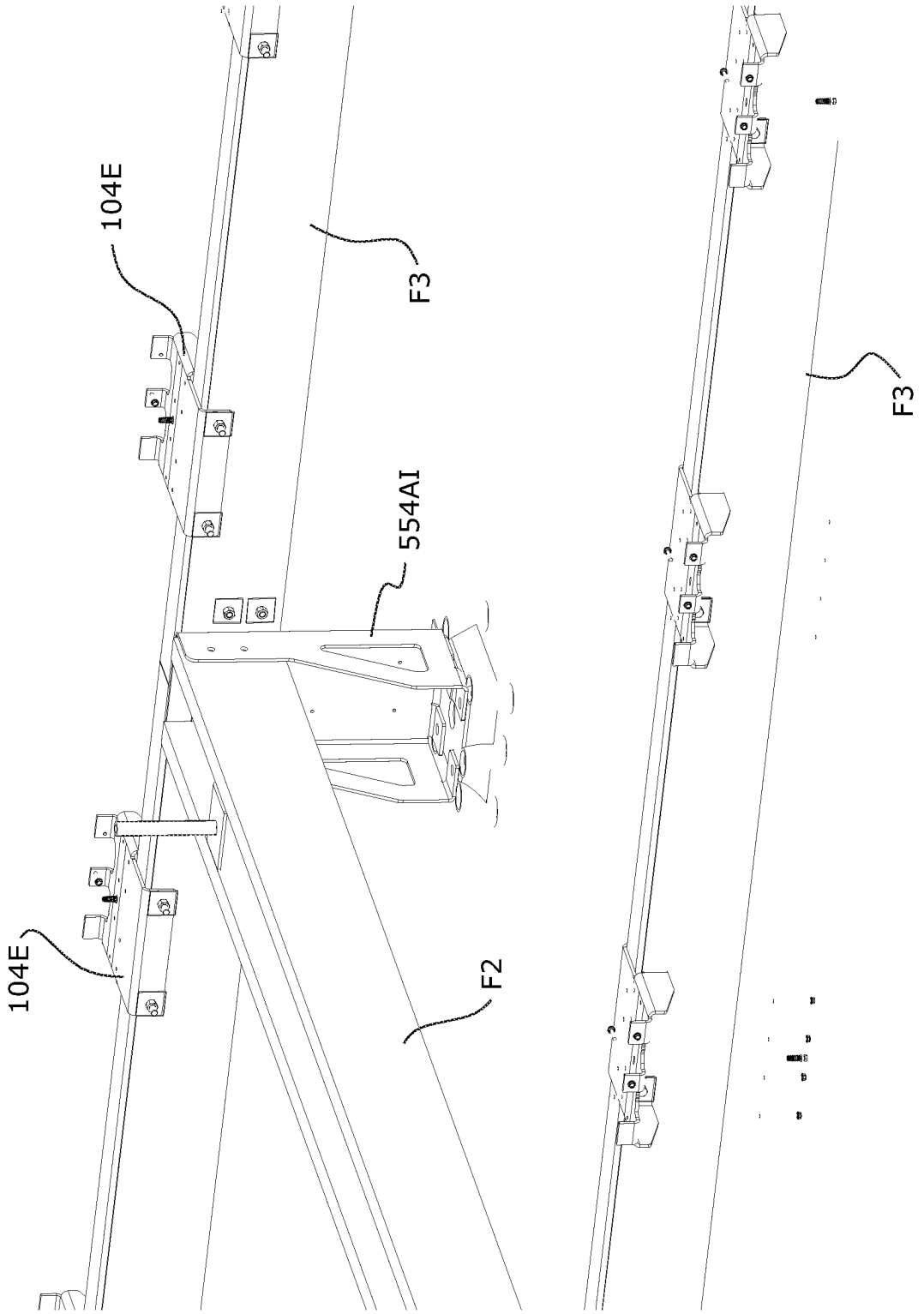


FIG. 40

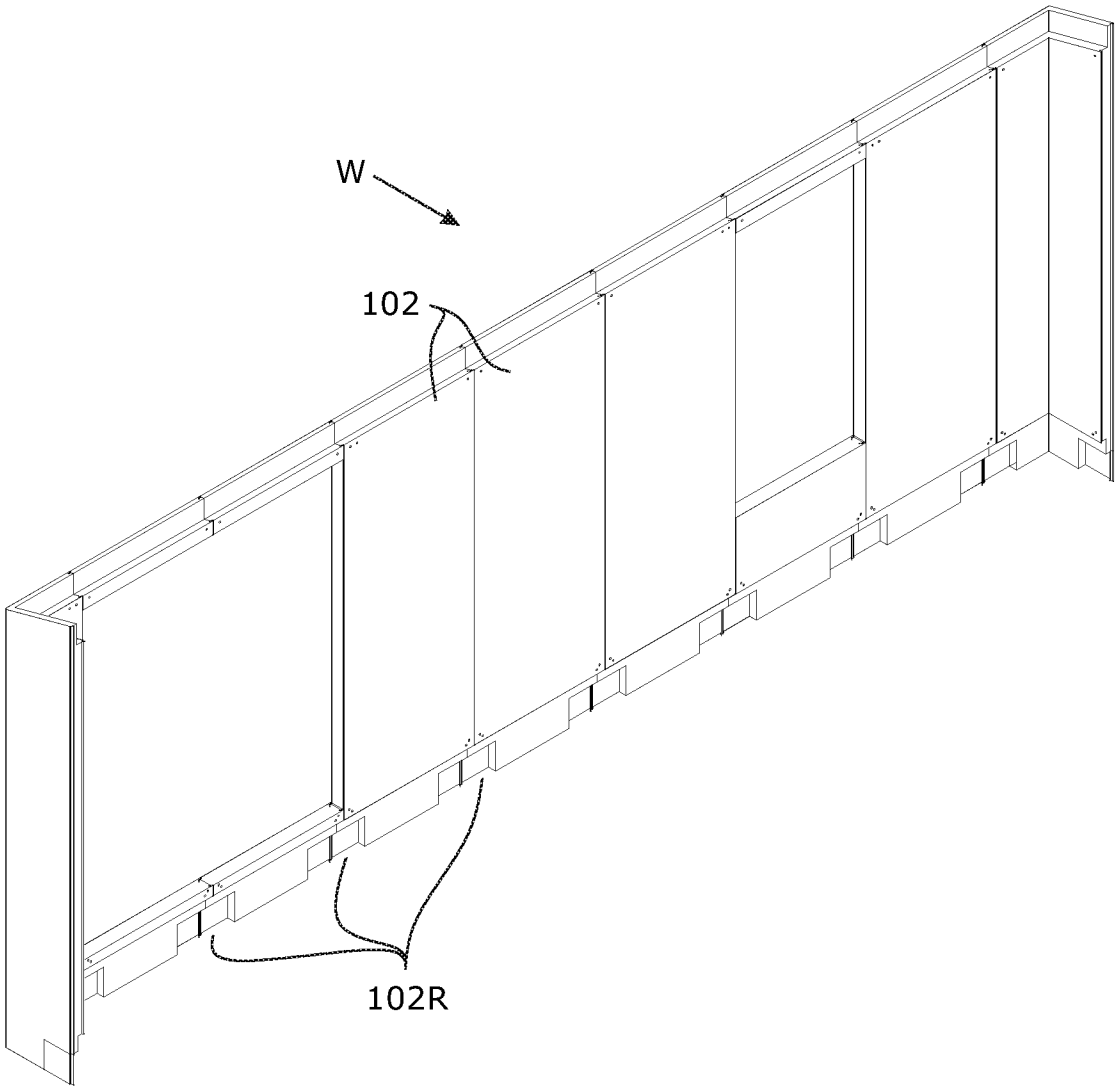


FIG. 41

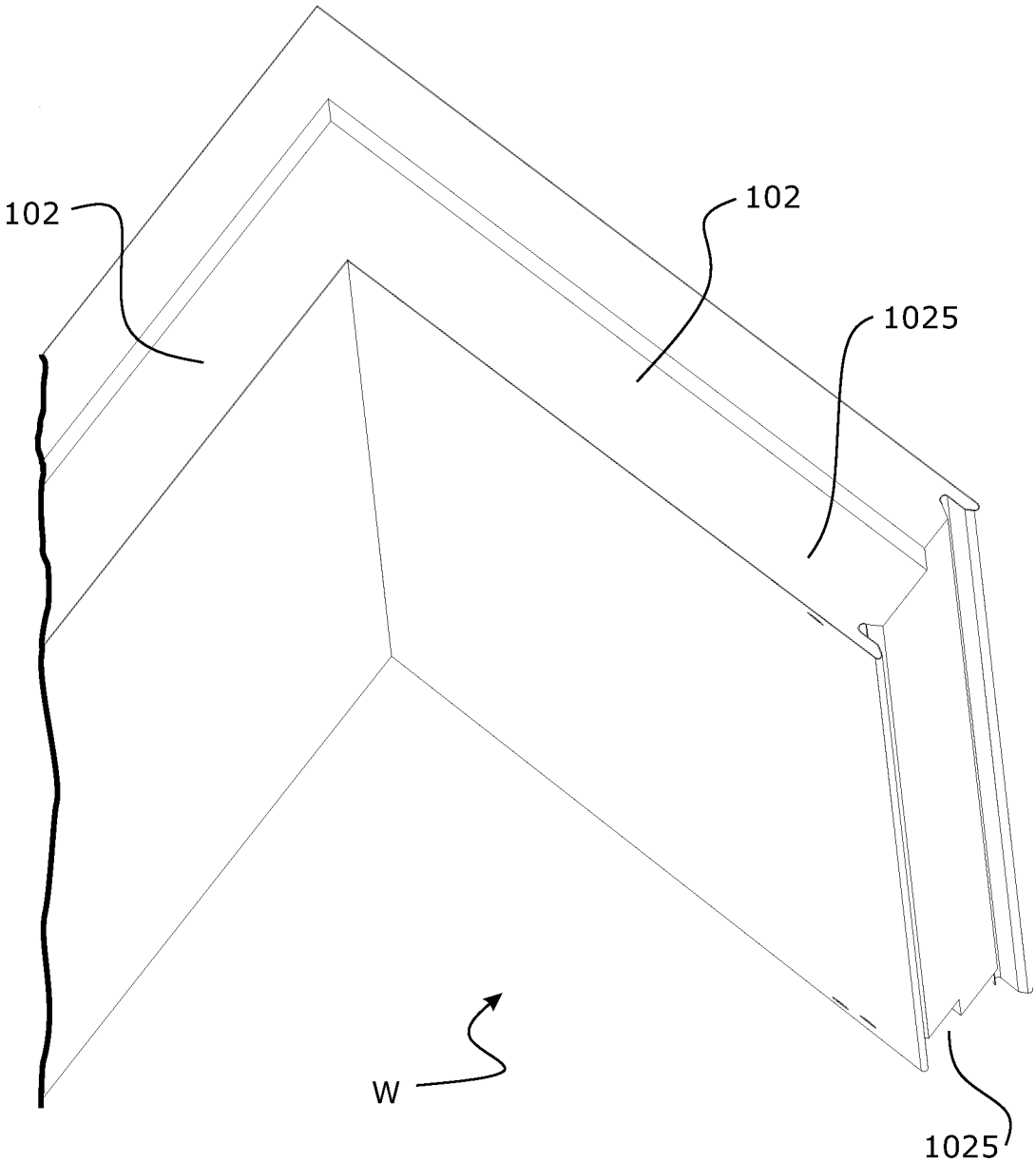


FIG. 42

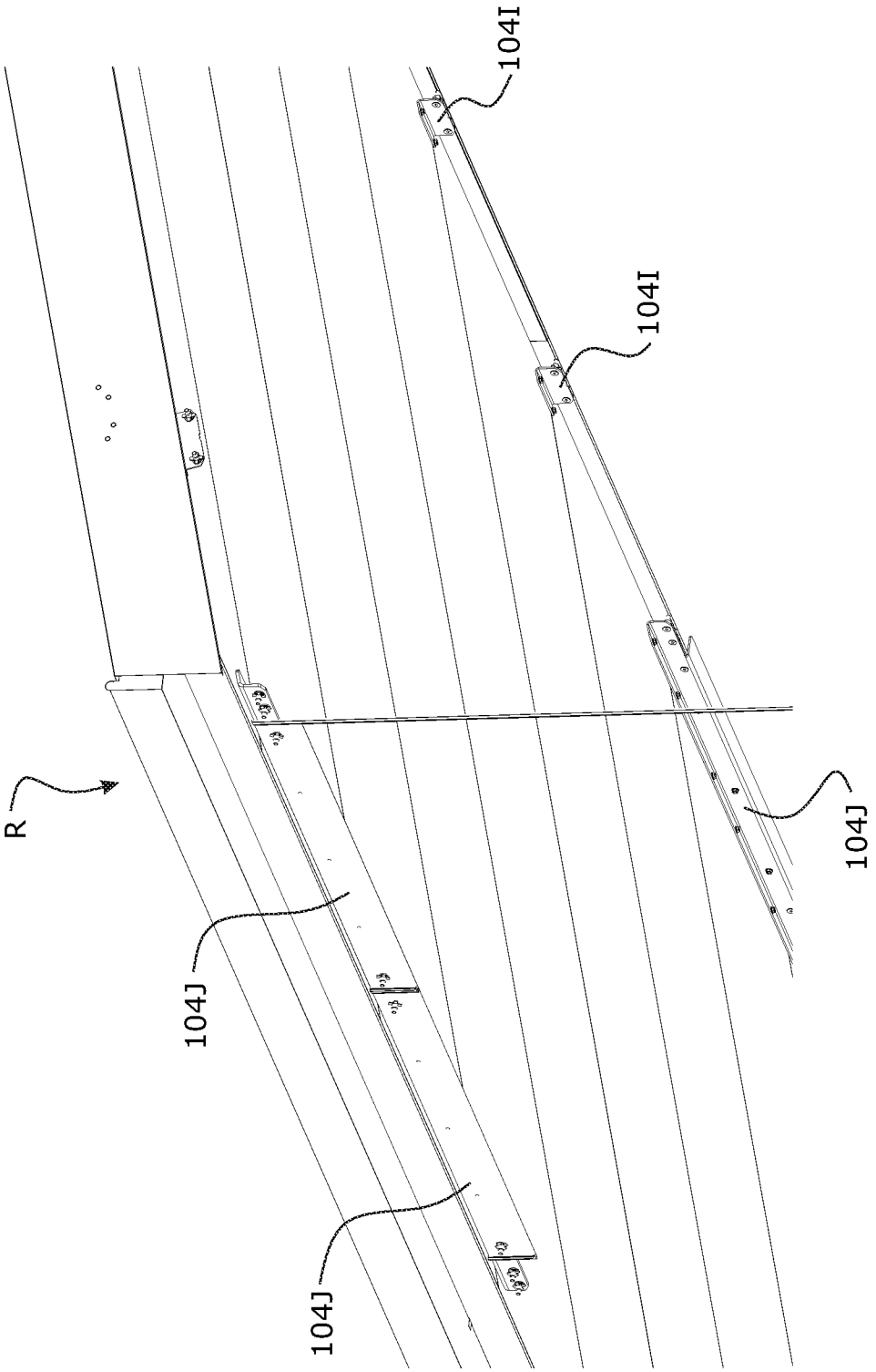


FIG. 43

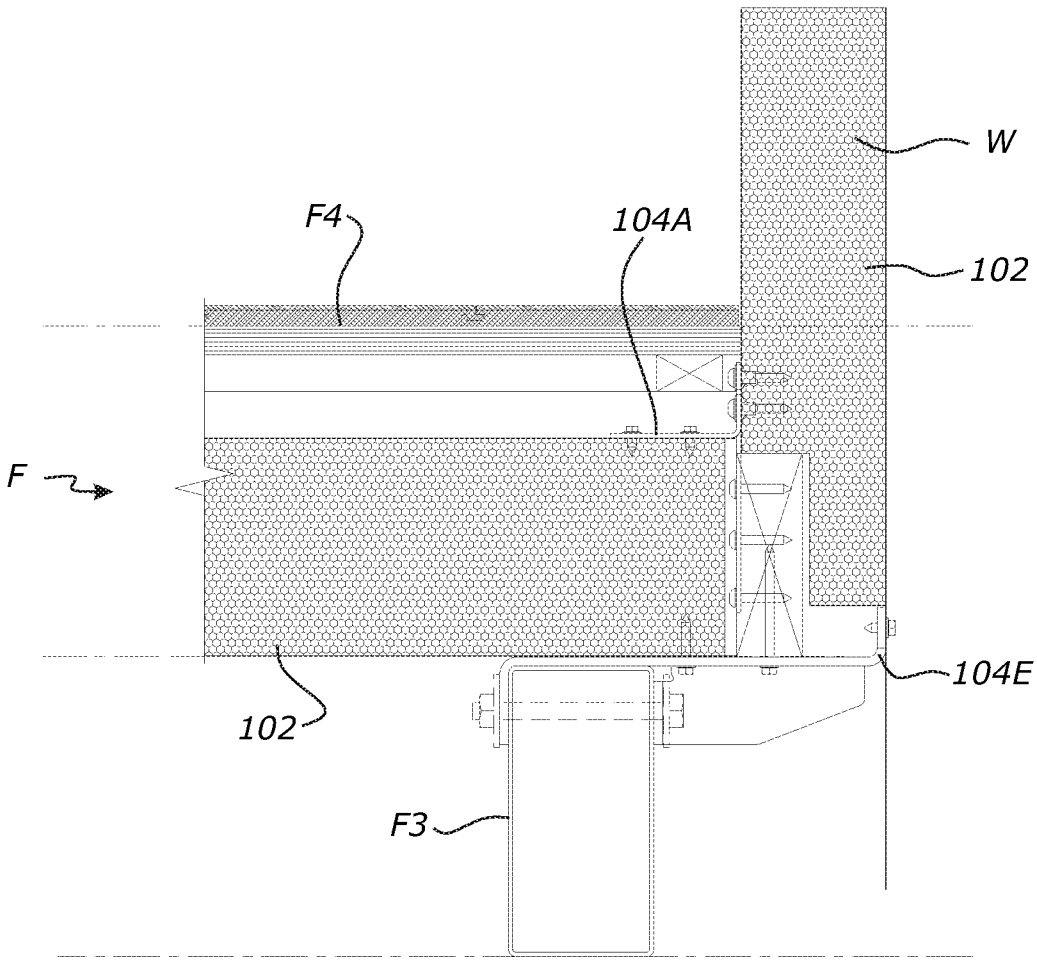


FIG. 44a

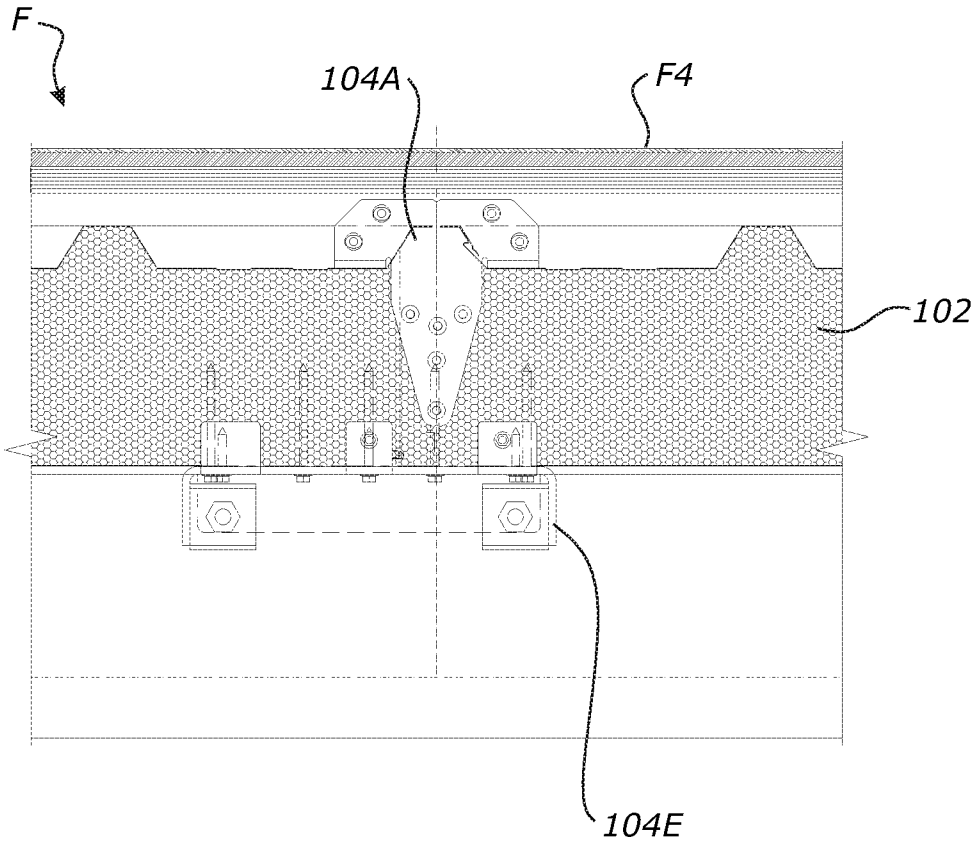


FIG. 44b

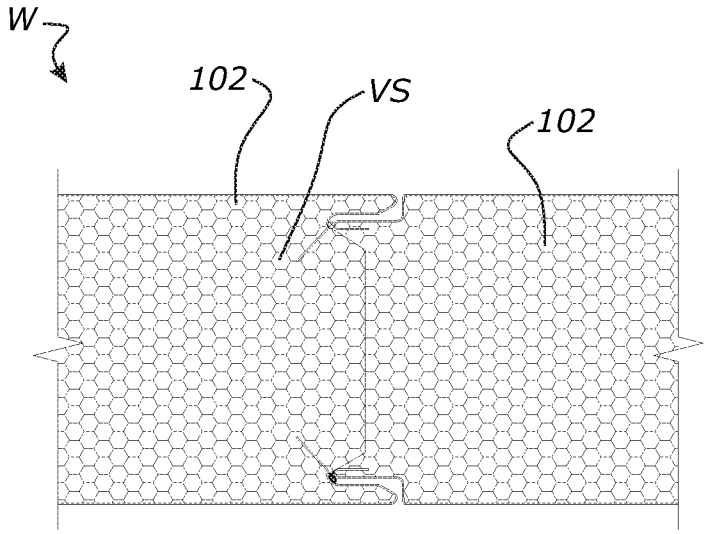


FIG. 45

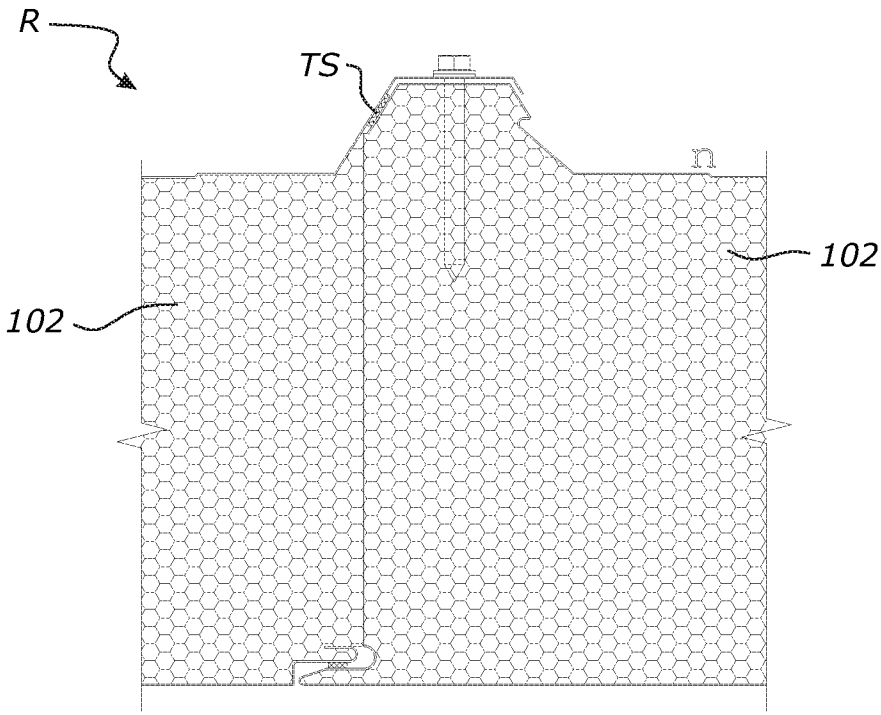
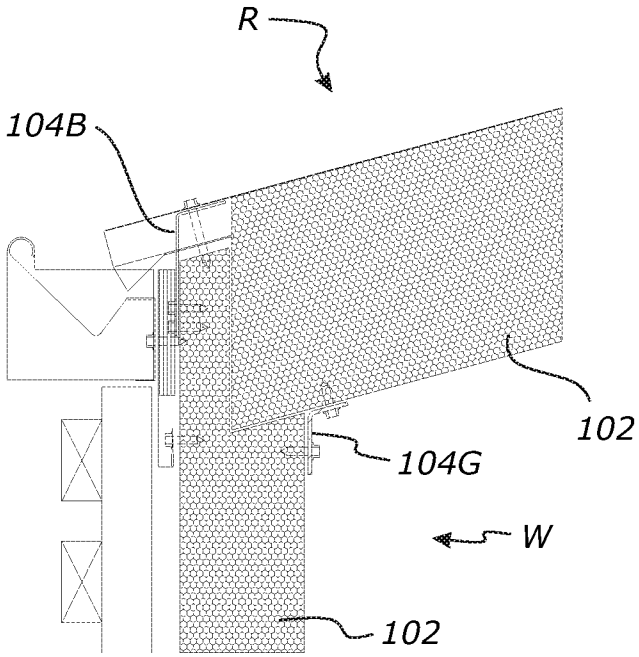
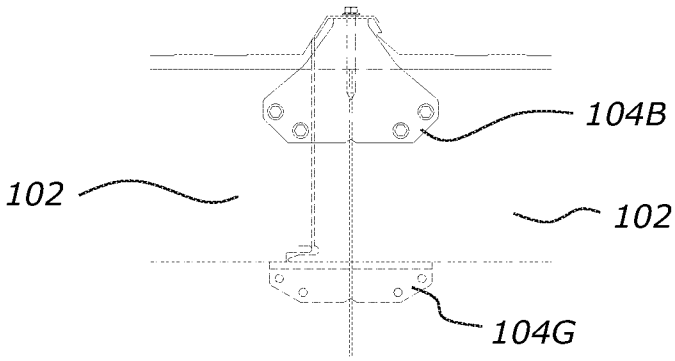


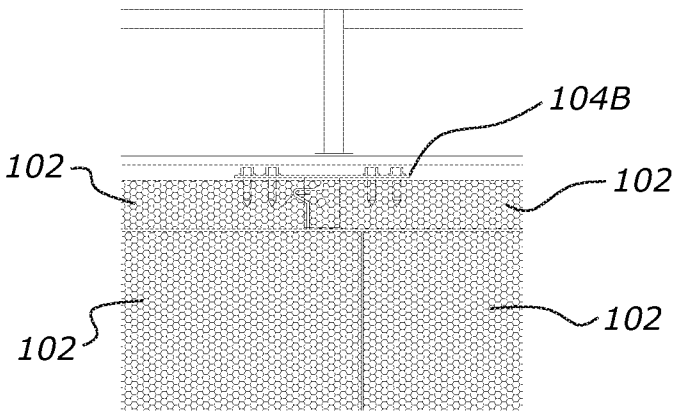
FIG. 46



(a)

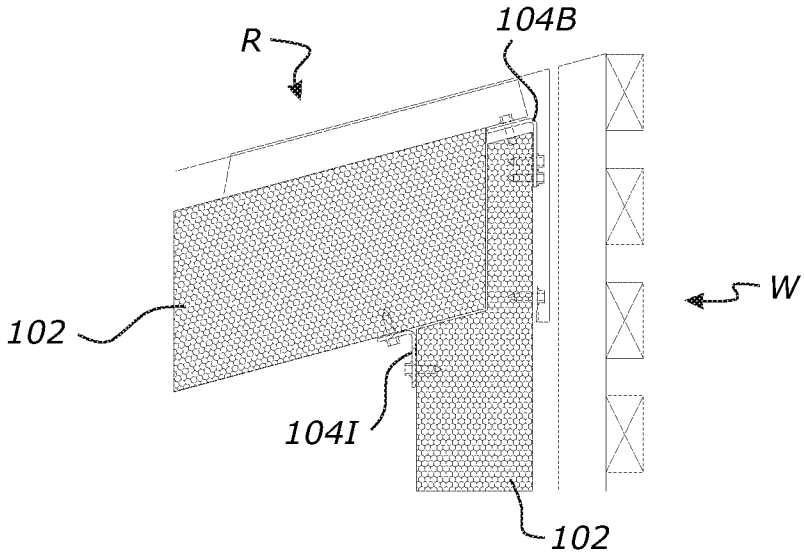


(b)

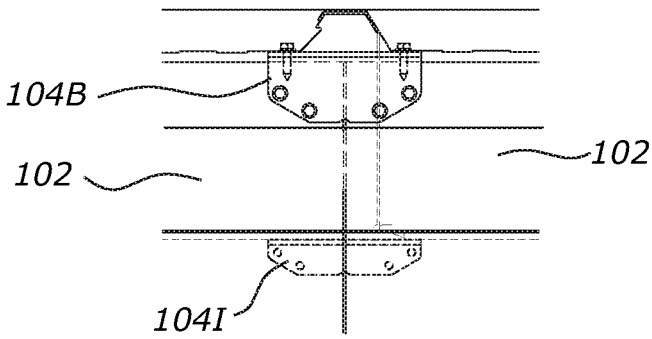


(c)

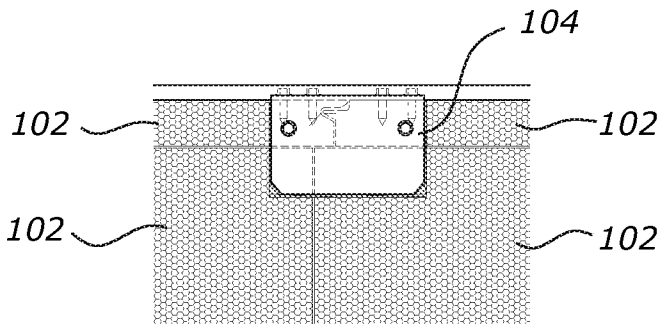
FIG. 47



(a)

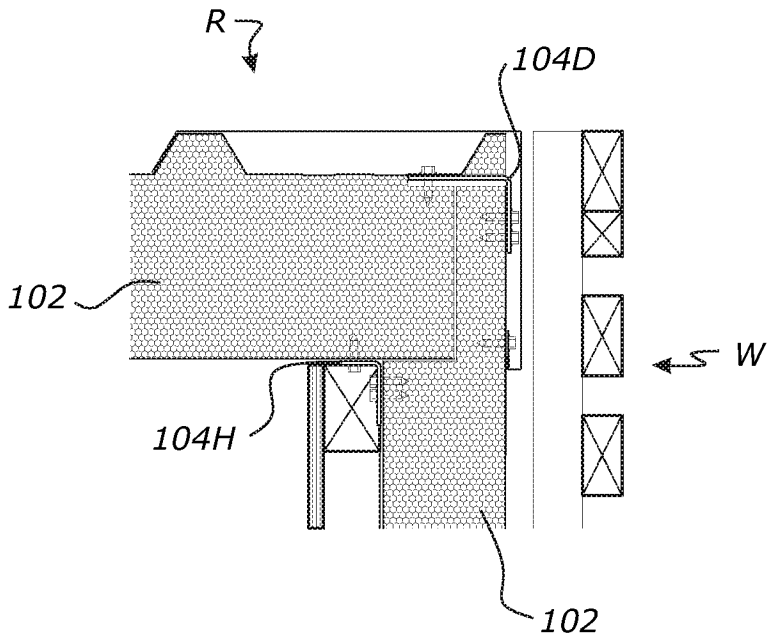


(b)

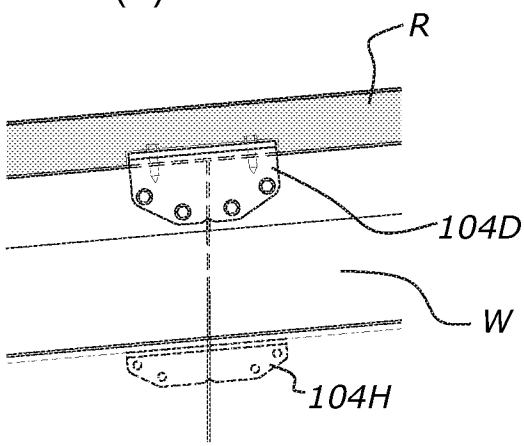


(c)

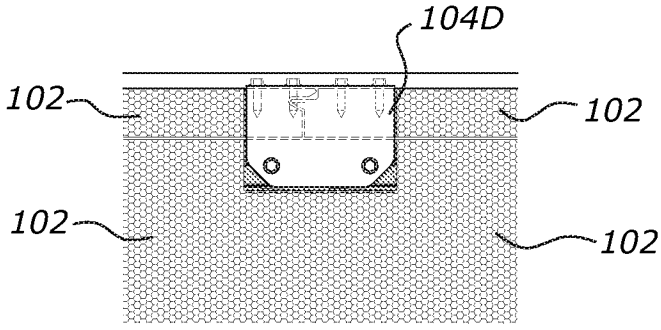
FIG. 48



(a)



(b)



(c)

FIG. 49

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2021/050065

A. CLASSIFICATION OF SUBJECT MATTER

E04C 2/292 (2006.01) ***E04C 2/38 (2006.01)*** ***E04B 1/38 (2006.01)*** ***E04B 1/343 (2006.01)*** ***E04B 2/92 (2006.01)*** ***E04B 5/02 (2006.01)***

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DATABASES: PATENW, GOOGLE PATENTS, ESPACENET
IPC/CPC: E04C2/292, E04C2/38, E04B1/34321, E04B1/343, E04B2/92, E04B1/54, E04B1/6104, E04B2001/6195, B32B
KEYWORDS: (panel, layer, multi, interlock) and like terms in various combinations.
Applicant/Inventor searched in Espacenet, Auspat and IP Australia internal databases.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 August 2021	09 August 2021

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
Email address: pct@ipaustralia.gov.au

Authorised officer

Parminder Singh
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No. +61262256135

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2021/050065

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-17, 33 & 34

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/NZ2021/050065**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4646494 A (SAARINEN et al.) 03 March 1987 See abstract, lines 24 & 25 of column 4 and figures 1-13	1-17, 33 & 34
X	US 6279287 B1 (MEADOWS) 28 August 2001 See abstract and figures 1-3	1-17, 33 & 34

Supplemental Box

Continuation of: **Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

• Claims 1-17, 33 & 34 are directed to a building panel assembly. The feature of inner/outer layers comprising recesses/protrusions for interlocking is specific to this group of claims.

• Claims 18-30 & 34 are directed to a building panel. The feature of inner/outer layers made of metal and layers secured using adhesive layers is specific to this group of claims.

• Claim 30-32 is directed to a framing anchor. The feature of framing anchor comprising at least two arms and made of sheet metal/having apertures is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The only feature common to all of the claimed inventions is a panel/multi-layer panel. However it is considered that this feature is generic in this particular art.

Therefore in this light this common feature cannot be a special technical feature. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied a priori.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/NZ2021/050065**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
US 4646494 A	03 March 1987	US 4646494 A	03 Mar 1987
		AT A98182 A	15 Jun 1991
		AT 393858 B	27 Dec 1991
		AU 8126482 A	23 Sep 1982
		AU 554040 B2	07 Aug 1986
		BR 8201479 A	01 Feb 1983
		CA 1166816 A	08 May 1984
		DD 207412 A1	29 Feb 1984
		DE 3208839 A1	30 Sep 1982
		DK 121582 A	20 Sep 1982
		DK 155372 B	03 Apr 1989
		EG 15701 A	30 Mar 1988
		ES 8303592 A1	01 Feb 1983
		FI 63100 B	31 Dec 1982
		FR 2502215 A1	24 Sep 1982
		FR 2502215 B1	10 Jul 1987
		GB 2095172 A	29 Sep 1982
		GB 2095172 B	24 Oct 1984
		GR 71873 B	22 Jul 1983
		IN 156695 B	19 Oct 1985
		IT 1201066 B	27 Jan 1989
		JP S57169150 A	18 Oct 1982
		LT 2390 B	15 Dec 1993
		NO 163912 B	30 Apr 1990
		SE 450020 B	01 Jun 1987
		YU 58882 A	31 Oct 1984
		YU 44557 B	31 Oct 1990
US 6279287 B1	28 August 2001	US 6279287 B1	28 Aug 2001
		CA 2280077 A1	12 Feb 2000

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.