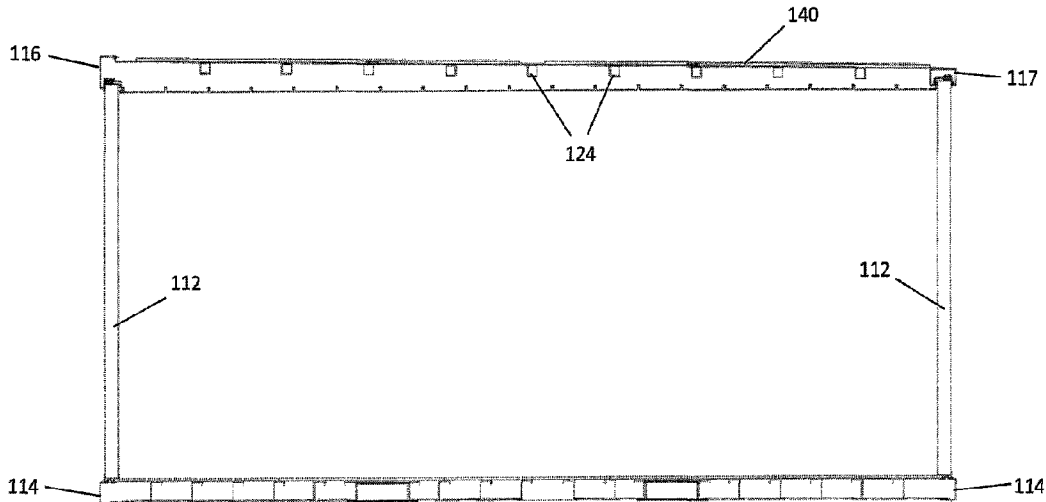




(86) Date de dépôt PCT/PCT Filing Date: 2015/07/17
(87) Date publication PCT/PCT Publication Date: 2016/01/21
(45) Date de délivrance/Issue Date: 2022/09/20
(85) Entrée phase nationale/National Entry: 2017/01/11
(86) N° demande PCT/PCT Application No.: EP 2015/066476
(87) N° publication PCT/PCT Publication No.: 2016/009069
(30) Priorité/Priority: 2014/07/18 (US62/026,249)

(51) Cl.Int./Int.Cl. *E04B 7/00* (2006.01),
E04B 1/348 (2006.01), *E04D 13/04* (2006.01),
E04H 1/12 (2006.01)
(72) Inventeur/Inventor:
BOTTIN, HERVE, FR
(73) Propriétaire/Owner:
WILLIAMS SCOTSMAN, INC., US
(74) Agent: NELLIGAN O'BRIEN PAYNE LLP

(54) Titre : TOIT SOUDE POUR UNITES DE CONSTRUCTION MODULAIRES
(54) Title: WELDED ROOF FOR MODULAR BUILDING UNITS



(57) **Abrégé/Abstract:**

Disclosed is a roof assembly for a modular building unit having a roofing sheet welded to the frame of the modular building unit to form a unitary, continuous sealed weld between the roofing sheet and the horizontal structural frame, and that is pitched to downwardly direct water toward one end of the modular building unit. The welded roof assembly prevents water infiltration into the modular building unit, and such watertight structure may then receive any gutter configuration the user wishes to implement without risking water infiltration into the building unit. The welded roof employs a single slope through the full span of the roof, thus avoiding the need for a centrally pitched roof assembly, and its unitary construction avoids the tiling effect that results from the use of multiple, overlapping roofing sheets.

ABSTRACT

Disclosed is a roof assembly for a modular building unit having a roofing sheet welded to the frame of the modular building unit to form a unitary, continuous sealed weld between the roofing sheet and the horizontal structural frame, and that is pitched to downwardly direct water toward one end of the modular building unit. The welded roof assembly prevents water infiltration into the modular building unit, and such watertight structure may then receive any gutter configuration the user wishes to implement without risking water infiltration into the building unit. The welded roof employs a single slope through the full span of the roof, thus avoiding the need for a centrally pitched roof assembly, and its unitary construction avoids the tiling effect that results from the use of multiple, overlapping roofing sheets.

WELDED ROOF FOR MODULAR BUILDING UNITS

CROSS REFERENCE TO RELATED APPLICATION

This application is based upon and claims benefit of copending U.S. Provisional
5 Patent Application Serial No. 62/026,249 entitled “WELDED ROOF FOR MODULAR
BUILDING UNITS,” filed with the U.S. Patent and Trademark Office on July 18, 2014 by
the inventor herein-

FIELD OF THE INVENTION

10 This invention relates generally to modular building construction, and more
particularly to a welded roof assembly for a modular building unit configured to receive
various gutter system configurations.

BACKGROUND OF THE PRIOR ART

Roofing members for modular buildings are typically attached by way of screws or
15 other fasteners, and are supplied in sheets arranged in a tile configuration with a portion of
one roofing sheet overlapping a portion of an adjacent roofing sheet. In order to channel
rainwater and water from snow and ice melt away from the modular building, gutters may be
provided along the edges of the modular building unit. However, the type of gutter assembly,
and in fact whether a gutter system is required at all, can vary from location to location based
20 upon annual weather patterns, and particularly rain, snow, and ice amounts received in a
given area. Different weather patterns may call for different gutter configurations, and at
times even no gutter. Moreover, even with water diversion and drainage, conditions may
result in water collecting on the roof and leaking into the modular building unit, such as
through gaps between adjacent roofing sheets, gaps between the roofing sheets and the frame
25 of the modular building unit, openings around fasteners, and the like. While silicone or other
fillers may be provided, they are temporary and subject to failure and leakage over time.

While differing gutter configurations may be provided to address different rain, snow, and ice conditions, they will require varied adaptations of the roof structure as well in order to accommodate the varied environmental conditions.

Thus, there remains a need in the art for a roofing configuration for a modular
5 building unit that is able to accept gutters of varied configurations without requiring adaptation or modification of the building unit structure, and that protects against water leakage through the roof in all such gutter configurations, and in the case of no gutter.

DESCRIPTION OF THE INVENTION

Disclosed is a roof assembly for a modular building unit that comprises a roofing
10 sheet that is welded to the frame of the modular building unit so as to form a unitary, continuous sealed weld between the roofing sheet and the structural frame of the modular building unit, and that is pitched to downwardly direct water on the roofing sheet toward one end of the modular building unit. The welded roof assembly prevents water infiltration into the modular building unit, and such watertight structure may then receive any gutter
15 configuration the user wishes to implement without risking water infiltration into the building unit. Further, the welded roof assembly allows the modular building unit to carry a heavy snow load, as the welds attaching the roofing sheet can easily carry heavy loads. The welded roofing sheet avoids the use of screws, and the associated possibility of water leakage around the screws and into the building unit. The welded roof also permits attachment, e.g. via
20 welding, of safety rings or other accessories directly on the roof sheet without need for specialized holes or other configurations or specific location requirements. The welded roof also is able to employ a single slope all of the way through the full span of the roof, thus avoiding the need for a centrally pitched roof assembly, and its unitary construction avoids the tiling effect that results from the use of multiple, overlapping roofing sheets. The welded
25 roof also avoids the need for silicon or other filler agents between the unitary roofing sheet

and the frame of the modular building unit. Still further, the recessed roofing panel within the exterior frame formed by the upper rails of the building unit, along with the horizontal top surfaces of such rails, provided for easy vertical stacking of modular building units atop one another.

5 In accordance with certain aspects of an embodiment of the invention, a roof assembly is provided for a modular building unit, comprising: a first long rail having a top wall, an exterior wall, and an interior wall; a second long rail parallel to the first long rail and having a top wall, an exterior wall, and an interior wall; a first short rail extending between the first and second long rails and having a top wall, an exterior wall, and an interior wall; a
10 second short rail extending between the first and second long rails and having a top wall and an exterior wall, wherein the first and second long rails and the first and second short rails are joined to form a rectangular exterior roof frame of a modular building unit; and a roofing sheet, wherein the roofing sheet is joined to the first short rail at a first elevation below the top wall of the first short rail, the roofing sheet is joined to each of the first and second long
15 rails at a point below the top wall of each of the first and second long rails and extending in a downward slope from the first elevation, and the roofing sheet is joined to the top surface of the second short rail at a lowest elevation of the roofing sheet; and wherein the roofing sheet is joined to the first short rail, each of the first and second long rails, and the top surface of the second short rail by a continuous weld.

20 In accordance with further aspects of an embodiment of the invention, a method of forming a roof assembly for a modular building unit is provided, comprising the steps of: providing a roof frame comprising a first long rail having a top wall, an exterior wall, and an interior wall; a second long rail parallel to the first long rail and having a top wall, an exterior wall, and an interior wall; a first short rail extending between the first and second
25 long rails and having a top wall, an exterior wall, and an interior wall; and a second short rail

extending between the first and second long rails and having a top wall and an exterior wall, wherein the first and second long rails and the first and second short rails are joined to form a rectangular exterior roof frame of a modular building unit; joining a roofing sheet to the first short rail at a first elevation below the top wall of the first short rail; joining the roofing sheet
5 to each of the first and second long rails at a point below the top wall of each of the first and second long rails and extending in a downward slope from the first elevation; and joining the roofing sheet to the top surface of the second short rail at a lowest elevation of the roofing sheet; wherein the steps of joining the roofing sheet to the first short rail, each of the first and second long rails, and the top surface of the second short rail is performed by making a
10 continuous weld.

BRIEF DESCRIPTION OF THE DRAWINGS

The numerous advantages of the present invention may be better understood by those skilled in the art by reference to the accompanying drawings in which:

15 FIG. 1 is a perspective view of a modular building unit in accordance with certain aspects of an embodiment of the invention.

FIG. 2 is a perspective view of a skeletal frame of the modular building unit of FIG. 1.

FIG. 3 is a cross-sectional view of the skeletal frame of FIG. 2.

20 FIGS. 4a through 4d are close-up, cross-sectional views of the lower roof edge of the frame of FIG. 3 with varying gutter configurations.

FIG. 5 is a top view of a roof portion of the modular building unit of FIG. 1.

FIG. 6 is a perspective view of the roof portion of FIG. 5.

FIG. 7 is a close-up, detail cross-sectional view of the frame of FIG. 3.

25 FIG. 8 is a cross-sectional view of a first, higher elevation top short rail of the frame of FIG. 7.

FIG. 9 is a perspective view showing connection of the first top short rail and one of the top long rails of the frame of FIG. 7.

FIG. 10 is a cross-sectional view of a roofing sheet short side mounting bracket of the frame of FIG. 7.

5 FIG. 11 is a perspective view of the roofing sheet short side mounting bracket of FIG. 10.

FIG. 12 is a close-up, detail cross-sectional view of the frame of FIG. 3 along an axis parallel to the first top short rail (showing the long rails in cross-section).

FIG. 13 is a perspective view of a roofing sheet long side bracket for a first long side
10 of the frame of FIG. 7.

FIG. 14 is a rear view of the roofing sheet long side bracket of FIG. 15.

FIG. 15 is a cross-sectional view of the roofing sheet long side bracket of FIG. 14 along section line A-A.

FIG. 16 is a cross-sectional view of the roofing sheet long side bracket of FIG. 14
15 along section line B-B.

FIG. 17 is a cross-sectional view of a second, lower elevation top short rail of the frame of FIG. 7.

FIG. 18 is a perspective view showing connection of the second top short rail and one of the top long rails of the frame of FIG. 17.

20 FIG. 19 shows an external gutter and drain pipe for use with the roof portion of FIG. 6.

FIG. 20 is a cross-sectional view of the gutter and drain pipe of FIG. 19 attached to second top short rail of the frame of FIG. 7.

FIG. 21 shows an external water deflector for use with the roof portion of FIG. 6.

25 FIG. 22 is a cross-sectional view of the water deflector of FIG. 21.

BEST MODE(S) FOR CARRYING OUT THE INVENTION

The following description is of a particular embodiment of the invention, set out to enable one to practice an implementation of the invention, and is not intended to limit the preferred embodiment, but to serve as a particular example thereof. Those skilled in the art should appreciate that they may readily use the conception and specific embodiments disclosed as a basis for modifying or designing other methods and systems for carrying out the same purposes of the present invention. Those skilled in the art should also realize that such equivalent assemblies do not depart from the spirit and scope of the invention in its broadest form.

Figure 1 provides a perspective view of a modular building unit 100 in accordance with certain aspects of an embodiment of the invention. Modular building unit 100 includes a skeletal frame formed by corner support posts 112, bottom rails 114, top long rails 115, a first top short rail 116 (shown in Figure 2), and a second top short rail 117. This skeletal frame provides the key structural integrity for the modular building unit. Positioned between corner support posts 112, bottom rails 114, and top rails 115, 116 and 117 are wall panels 118 that form the wall structures spanning each side of the modular building unit. Other standard building features, such as doors 120 and windows 122, may be provided and integrated with individual wall panels 118.

Figure 2 is a perspective view of the skeletal frame forming the modular building unit of Figure 1. As shown in Figure 2, the skeletal frame comprises four corner posts 112 extending upward from bottom rails 114 and supporting the roof portion of the modular building unit 100. The roof portion includes top long rails 115 extending lengthwise between adjacent corner support posts 112, a first top short rail 116 extending between adjacent corner

supports posts 112 and generally perpendicular to top long rails 115, and a second top short rail 117 extending between adjacent corner support posts 112 and generally perpendicular to top long rails 115. A roofing sheet 140 forms the exterior roof of the modular building unit, and sits within the interior of the frame defined by top long rails 115, first top short rail 116, and second top short rail 117. Roofing sheet 140 may have a thickness of preferably 1 to 3 mm, and more preferably 2 mm, and may either comprise a flat sheet or a corrugated sheet comprised of continuous or segmented ribs as shown in Figure 2. If corrugated (which may be desirable depending upon typical roof rain and snow loads in the locale where the modular building unit is to be installed), ribs from the corrugated sheet may help with drainage of water. The roofing sheet 140 is welded around its entire perimeter to top long rails 115, first top short rail 116, and second top short rail 117, all as discussed in greater detail below, to ensure complete water tightness, particularly in the case of snow and ice. Roofing sheet 140 is also welded, such as by spot welding, to purlins 124 spanning the width of the roof portion and extending between parallel top long rails 115, again as discussed in greater detail below.

Moreover, and as better shown in the cross-sectional view of the skeletal frame of Figure 3, roofing sheet 140 slopes downward from first top short rail 116 to second top short rail 117 so as to direct all water to the lowest elevation of the roof portion of the modular building unit. In order to provide such downward slope, purlins 124 are positioned at progressively lower elevations, with each end of each purlin being rigidly affixed (e.g., welded) to an interior face of each top long rail 115. Such configuration results in roofing sheet 140 realizing a downward slope of preferably between 0.5% and 5% from one end of the module to the other. In certain configurations, roofing sheet 140 may have two, opposite sloping sections (not shown), each having a downward slope of 0.5% to 5% from the middle of the modular building unit to the end of the modular building unit.

Because the modular building unit is configured with a fully welded roof, the modular building unit may be configured with varied gutter options, including no gutter. Those varying gutter options are shown in the exemplary configurations reflected in Figures 4a through 4d. Figure 4a shows the lowest roof edge of modular building unit 100, including roofing sheet 140 welded directly to the top face of second top short rail 117, which in turn is mounted above wall panel 118. In this configuration, no gutter is provided, in which case water from the room will directly flow off of the roof, while the weld around the perimeter of roofing sheet 140 prevents infiltration of water into the modular building unit. Next, Figure 4b shows the same roof edge of modular building unit 100, with a water deflector 200 attached to the exterior face of second top short rail 117, which deflector 200 may aid in directing water flowing from the roof away from the side wall panels 118 of modular building unit 100. Likewise, Figure 4c shows the same roof edge of modular building unit 100, with gutter 190 attached to the exterior face of second top short rail 117, which gutter 190 may receive water flowing from the roof and direct such water to a downspout (not shown) as discussed further below. Similarly, Figure 4d shows the same roof edge of modular building unit 100, with an alternative gutter 119a attached to the exterior face of second top short rail 117, which alternative gutter 119a is attached in the same manner as gutter 119 but embodies a decorative design to improve the overall aesthetic appearance of the modular building unit 100. Those of ordinary skill in the art will recognize that gutter assemblies of other varying configurations may likewise be provided without departing from the spirit and scope of the invention.

Figure 5 provides a top view, and Figure 6 provides a perspective view, of the roof portion of modular building unit 100. Roofing sheets 140 are shown spanning the full length of the roof, and as mentioned above, may optionally include ribs 142 that may aid in directing water toward the lowest elevation point on the roof (i.e., toward second top short rail 117).

Optionally, roofing sheets 140 may be provided in separate sections, in which each of the sections are preferably welded together to form the same waterproof, welded seam that is provided along the perimeter of roofing sheet 140. Mounting brackets are provided at the interior faces of each of first top short rail 116 and the two top long rails 115. More

5 specifically, roofing sheet short side mounting bracket 144 is affixed to and runs parallel to first top short rail 116, and roofing sheet long side brackets 146 are affixed to and run parallel to each top long rail 115. Roofing sheet short side mounting bracket 144 provides a horizontal mounting and welding surface for the highest elevation portion of roofing sheet 140, while roofing sheet long side brackets 146 provide a downwardly angled mounting and

10 welding surface for the long edges of roofing sheet 140, resulting in the roofing sheet 140 following a downward slope from first top short rail 116 to second top short rail 117. The lowest elevation point of roofing sheet 140 is welded directly to the top surface of second top short rail 117, again allowing water on roofing sheet 140 to flow directly onto and over second top short rail 117.

15 Corner boxes 119 may be provided at each corner of the roof portion of modular building unit 100, which corner boxes 119 principally serve as corner elements for joining each perpendicular pair of rails and one of corner support posts 112. Corner boxes 119 may also be provided features, such as openings, in the top and side walls of each corner box 119 to receive a crane hook or other device to aid in lifting the entire modular building unit when

20 necessary for transport or installation.

Figure 7 provides a close-up, detailed cross-sectional view of the skeletal frame of modular building unit 100. First top short rail 116 is shown at the left most portion of Figure 7, with roofing sheet short side mounting bracket 144 extending from the interior face of first top short rail 116 and supporting roofing sheet 140. The underside of roofing sheet 140

25 overlaps a portion of roofing sheet short side mounting bracket 144 and is welded to short

side mounting bracket 144. Likewise, as roofing sheet 140 extends toward second top short rail 117, it rests on and is preferably welded to purlins 124. At the opposite end from first top short rail 116 (i.e., the right edge as viewed in Figure 7), roofing sheet 140 overlaps a portion of second top short rail 117 and is welded to the top of second top short rail 117.

5 Other features, including sealed joints attaching the overall roof portion to wall panels 112, interior ceiling trays, and subfloor construction details, are shown in Figure 7 but are not critical to the roofing structure of the instant invention, and thus are not described further here.

Figure 8 is a cross-sectional view of first top short rail 116, and Figure 9 is a
10 perspective view of first top short rail 116 connecting to one of top long rails 115 through a connecting corner box 119. As shown in Figures 8 and 9, first top short rail 116 has a planar top face 150, a planar outer face 152 that forms a portion of the exterior side wall of modular building unit 100, interior bracket flange 154, and bottom profile 156 to fit with a modular wall panel as shown in Figure 7. Interior bracket flange 154 extends downward from the
15 interior edge of planar top face 150, and provides an attachment surface for roofing sheet short side mounting bracket 144.

Figure 10 provides a cross-sectional view of roofing sheet short side mounting bracket 144, and Figure 11 provides a perspective view of such roofing sheet short side mounting bracket 144. Bracket 144 comprises a back wall 170 configured for attachment, such as by
20 welding, to interior bracket flange 154 of first top short rail 116. Bracket 144 also has a short side roofing sheet support surface 172 which, when bracket 144 is mounted on first top short rail 116, extends generally horizontally and parallel to planar top face 150 of first top short rail 116. Support surface 172 supports the highest elevation end of roofing sheet 140, with the underside of roofing sheet 140 resting on the top side of support surface 172 and the two
25 being joined by a continuous weld. Bracket 144 may also include a top lip 174 extending

generally parallel to short side roofing sheet support surface 172, which top lip 174 limits the opportunity for wind to blow water onto top short rail 116, so that water remains contained on roof sheet 140. Further, corner notches 176 are provided at opposite ends of support surface 172 to allow contact with edges of roofing sheet long side brackets 146, in order to
5 provide a continuous surface to receive a continuous weld around the entire perimeter of roofing sheet 140.

Next, Figure 12 provides a cross-sectional view of the skeletal frame of modular building unit 100 along an axis parallel to first top short rail 116 (showing the top long rails 115 in cross section). Top long rails 115 are of generally the same cross-sectional
10 configuration as first top short rail 116 (although obviously with a longer overall length dimension). Roofing sheet long side mounting brackets 146 are affixed (e.g., welded) to interior bracket flange 154 of long rails 115 and support roofing sheet 140 along its long edge. The underside of the long edge of roofing sheet 140 overlaps a portion of roofing sheet long side mounting brackets 146 and is welded to long side mounting brackets 146. Likewise
15 and as mentioned above, roofing sheet 140 is supported by and is preferably welded to purlins 124 for additional support.

Figure 13 is a perspective view of a roofing sheet long side bracket 146 for attachment to a first one of top long rails 115. Those of ordinary skill in the art will appreciate that the opposite top long rail 115 will receive a similarly configured long side
20 bracket 146 that is the mirror image of the bracket shown in Figure 13. Likewise, Figure 14 is a rear view of roofing sheet long side bracket 146. Further, Figure 15 provides a cross-sectional view of bracket 146 along section line A-A of Figure 14, and Figure 16 provides a cross-sectional view of bracket 146 along section line B-B of Figure 14. As shown in Figures 13 through 16, bracket 146 includes a back wall 180 providing an attachment surface for
25 attaching (e.g., welding) bracket 146 to interior bracket flange 154 of top long rails 115.

Back wall 180 has a generally horizontal top edge and a downwardly sloping bottom edge. Likewise, bracket 146 has a long side roofing sheet support surface 182 which, when each bracket 146 is mounted on its respective top long rail 115, extends outward from back wall 180 and provides a downwardly sloping support surface for the long edge of roofing sheet 140, with the underside of such long edge of roofing sheet 140 resting on the top side of support surface 182 and the two being joined by a continuous weld. Such continuous weld seamlessly extends from the weld joining the highest elevation portion of roofing sheet 140 to short side roofing sheet support surface 172. Bracket 146 may also include a top lip 184 extending generally parallel to top long rails 115, again serving to keep water from being blown off of roofing sheet 140.

Figure 17 shows a cross-sectional view of second top short rail 117, and Figure 18 is a perspective view of second top short rail 117 connecting to one of top long rails 115 through a connecting corner box 119. As shown in Figures 17 and 18, second top short rail 117 has a planar top face 160 configured to directly receive an overlapping portion of the lowest elevation section of roofing sheet 140. As noted above, roofing sheet 140 is welded directly to such planar top face 160 of second top short rail 117, and such weld seamlessly continues from the weld attaching roofing sheet 140 to each of roofing sheet short side mounting bracket 144 and roofing sheet long side brackets 146. Second top short rail 117 also has a planar outer face 162 which is configured to directly receive various gutter configurations as discussed in greater detail below, or alternatively to form a portion of the exterior side wall of modular building unit 100 (in cases where no gutter system is to be used). Second top short rail 117 further includes planar interior face 164 and a bottom profile 166 to fit with a modular wall panel as shown in Figure 7.

Figure 19 shows an external gutter 190 for use with the welded roof described above. External gutter 190 may include a plurality of overflow openings 192 provided on the

outermost wall of gutter 190, and a spigot 194 at one end of gutter 190. Spigot 194 is shaped to fit within a drain pipe 196, which drain pipe may be joined to modular building unit 100 with, by way of non-limiting example, an angle bracket 198, such as to one of corner support posts 112 that is adjacent to second top short rail 117. Likewise, Figure 20 shows a cross-sectional view along section line C-C of Figure 19 of the gutter 190 and drain pipe 196, with
5 external gutter 190 attached to second top short rail 117 with one or more fasteners 199, such as a screw.

Similarly, Figure 21 shows an external water deflector 200 for use with the welded roof described above, and Figure 22 provides a cross-sectional view of such water deflector
10 200. With reference to both Figures 21 and 22, water deflector 200 has a back wall 202 that is configured for facing attachment to planar outer face 162 of second top short rail 117, a plurality of openings 204 for receiving connectors (e.g., screws) for such attachment, and an upper angle 206 configured to direct water outward and away from the edge of the roof of modular building unit 100 as it flows off of the roof.

15 The foregoing configuration results in a modular building unit having a roof structure that may readily receive a variety of gutter configurations, and that is simultaneously effective with no gutter, in an assembly that protects against water infiltration into the modular building unit regardless of the gutter configuration. Thus, a single modular building unit configuration may be provided in geographies having widely varied rain and snow
20 conditions, with gutters being added (or not) depending upon the specific precipitation conditions of that particular environment, saving the user from having to maintain multiple configurations for differing environments.

Having now fully set forth the preferred embodiments and certain modifications of the concept underlying the present invention, various other embodiments as well as certain
25 variations and modifications of the embodiments herein shown and described will obviously

occur to those skilled in the art upon becoming familiar with said underlying concept. It should be understood, therefore, that the invention may be practiced otherwise than as specifically set forth herein.

CLAIMS

1. A roof assembly for a modular building unit, comprising:

a first long rail having a top wall, an exterior wall, and an interior wall;

a second long rail parallel to said first long rail and having a top wall, an exterior wall,
and an interior wall;

a first short rail extending between said first and second long rails and having a top
5 wall, an exterior wall, and an interior wall;

a second short rail extending between said first and second long rails and having a top
wall and an exterior wall, wherein said first and second long rails and said first and second
short rails are joined to form a rectangular exterior roof frame of a modular building unit; and
a roofing sheet;

10 wherein said roofing sheet is joined to said first short rail at a first elevation below
said top wall of said first short rail, said roofing sheet is joined to each of said first and
second long rails at a point below said top wall of each of said first and second long rails and
extending in a downward slope from said first elevation, and said roofing sheet is joined to
said top surface of said second short rail at a lowest elevation of said roofing sheet; and

15 wherein said roofing sheet is joined to said first short rail, each of said first and
second long rails, and said top surface of said second short rail by a continuous weld.

2. The roof assembly of claim 1, wherein said exterior wall of said second short rail
further comprises a planar outer face forming a portion of an exterior facing wall of a
modular building unit.

20 3. The roof assembly of claim 2, further comprising a gutter removably attached to
said planar outer face of said second short rail.

4. The roof assembly of claim 2, further comprising a downwardly and outwardly
angled water deflector removably attached to said planar outer face of said second short rail.

5. The roof assembly of claim 1, said first short rail further comprising a mounting bracket having a horizontal support surface, and wherein said roofing sheet is welded to said horizontal support surface at said first elevation.

6. The roof assembly of claim 1, said roofing sheet having two long edges extending parallel to said first and second long rails and two short edges extending parallel to said first and second short rails, wherein each of said first and second long rails further comprise a mounting bracket having a downwardly angled support surface, and wherein said long edges of said roofing sheet are welded to each of said downwardly angled support surfaces.

7. The roof assembly of claim 1, further comprising a plurality of purlins extending between said first and second long rails.

8. The roof assembly of claim 7, wherein said purlins are positioned at progressively lower elevations along a length of each of said first and second long rails.

9. The roof assembly of claim 8, wherein said roofing sheet is welded to said plurality of purlins.

10. The roof assembly of claim 1, said roofing sheet further comprising a plurality of ribs extending along a longest length dimension of said roofing sheet.

11. The roof assembly of claim 10, wherein said ribs are configured to direct water to said top surface of said second short rail.

12. A method of forming a roof assembly for a modular building unit, comprising the steps of:

providing a roof frame comprising:

a first long rail having a top wall, an exterior wall, and an interior wall;

a second long rail parallel to said first long rail and having a top wall, an exterior wall, and an interior wall;

a first short rail extending between said first and second long rails and having a top wall, an exterior wall, and an interior wall; and

a second short rail extending between said first and second long rails and having a top wall and an exterior wall, wherein said first and second long rails and said first
5 and second short rails are joined to form a rectangular exterior roof frame of a modular building unit;

joining a roofing sheet to said first short rail at a first elevation below said top wall of said first short rail;

joining said roofing sheet to each of said first and second long rails at a point below
10 said top wall of each of said first and second long rails and extending in a downward slope from said first elevation; and

joining said roofing sheet to said top surface of said second short rail at a lowest elevation of said roofing sheet;

wherein said steps of joining said roofing sheet to said first short rail, each of said first
15 and second long rails, and said top surface of said second short rail is performed by making a continuous weld.

13. The method of claim 12, wherein said exterior wall of said second short rail further comprises a planar outer face forming a portion of an exterior facing wall of a modular building unit.

20 14. The method of claim 13, further comprising the step of removably attaching a gutter to said planar outer face of said second short rail.

15. The method of claim 13, further comprising the step of removably attaching a downwardly and outwardly angled water deflector to said planar outer face of said second short rail.

16. The method of claim 12, said first short rail further comprising a mounting bracket having a horizontal support surface, and wherein said step of joining said roofing sheet to said first short rail further comprising welding said roofing sheet to said horizontal support surface at said first elevation.

5 17. The method of claim 12, said roofing sheet having two long edges extending parallel to said first and second long rails and two short edges extending parallel to said first and second short rails, wherein each of said first and second long rails further comprise a mounting bracket having a downwardly angled support surface, and wherein said step of joining said roofing sheet to each of said first and second long rails further comprises welding
10 said long edges of said roofing sheet to each of said downwardly angled support surfaces.

18. The method of claim 12, wherein said roof frame further comprising a plurality of purlins extending between said first and second long rails.

19. The method of claim 18, wherein said purlins are positioned at progressively lower elevations along a length of each of said first and second long rails.

15 20. The method of claim 19, further comprising the step of welding said roofing sheet to said plurality of purlins.

21. The method of claim 12, said roofing sheet further comprising a plurality of ribs extending along a longest length dimension of said roofing sheet.

22. The method of claim 21, wherein said ribs are configured to direct water to said
20 top surface of said second short rail.

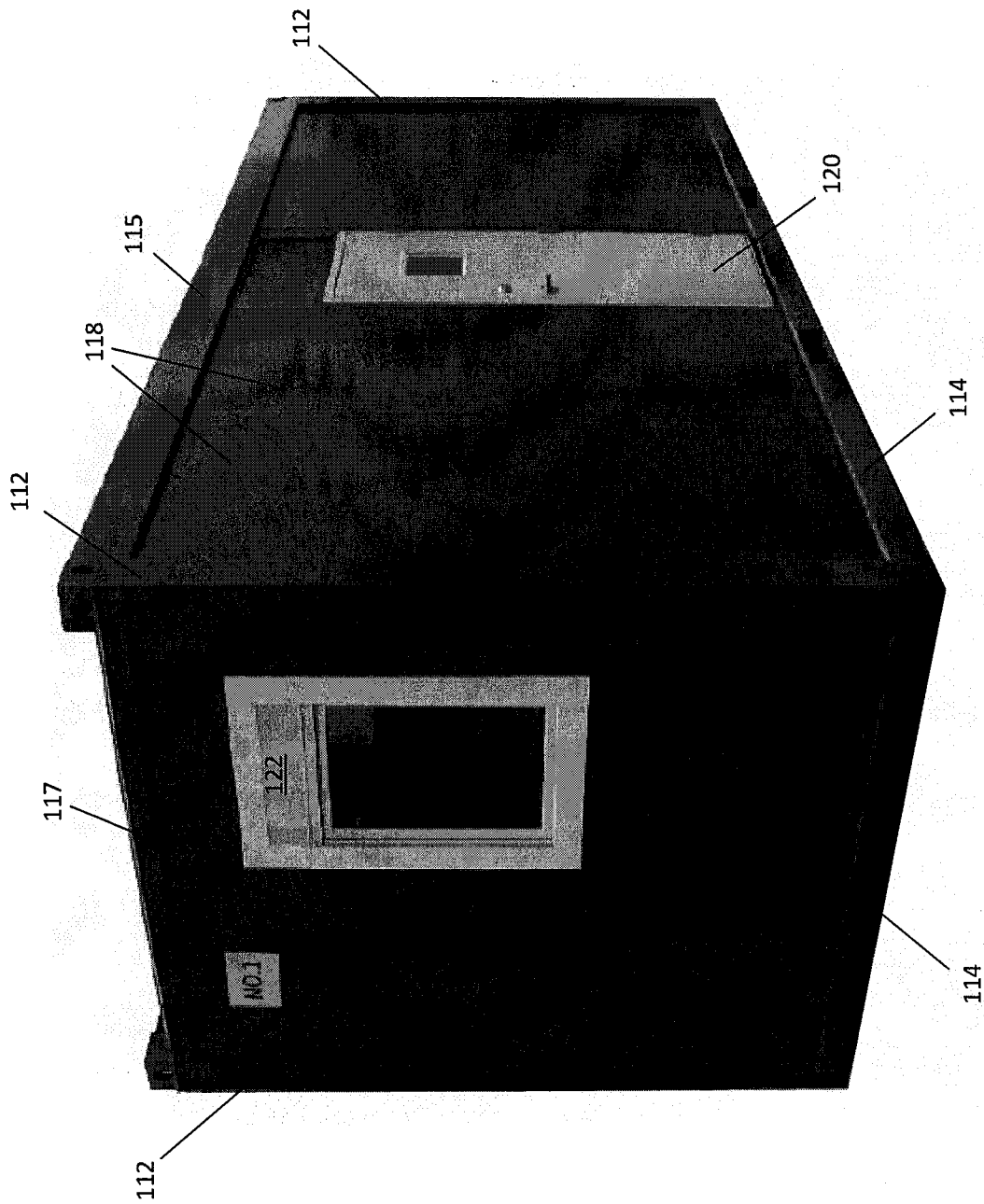
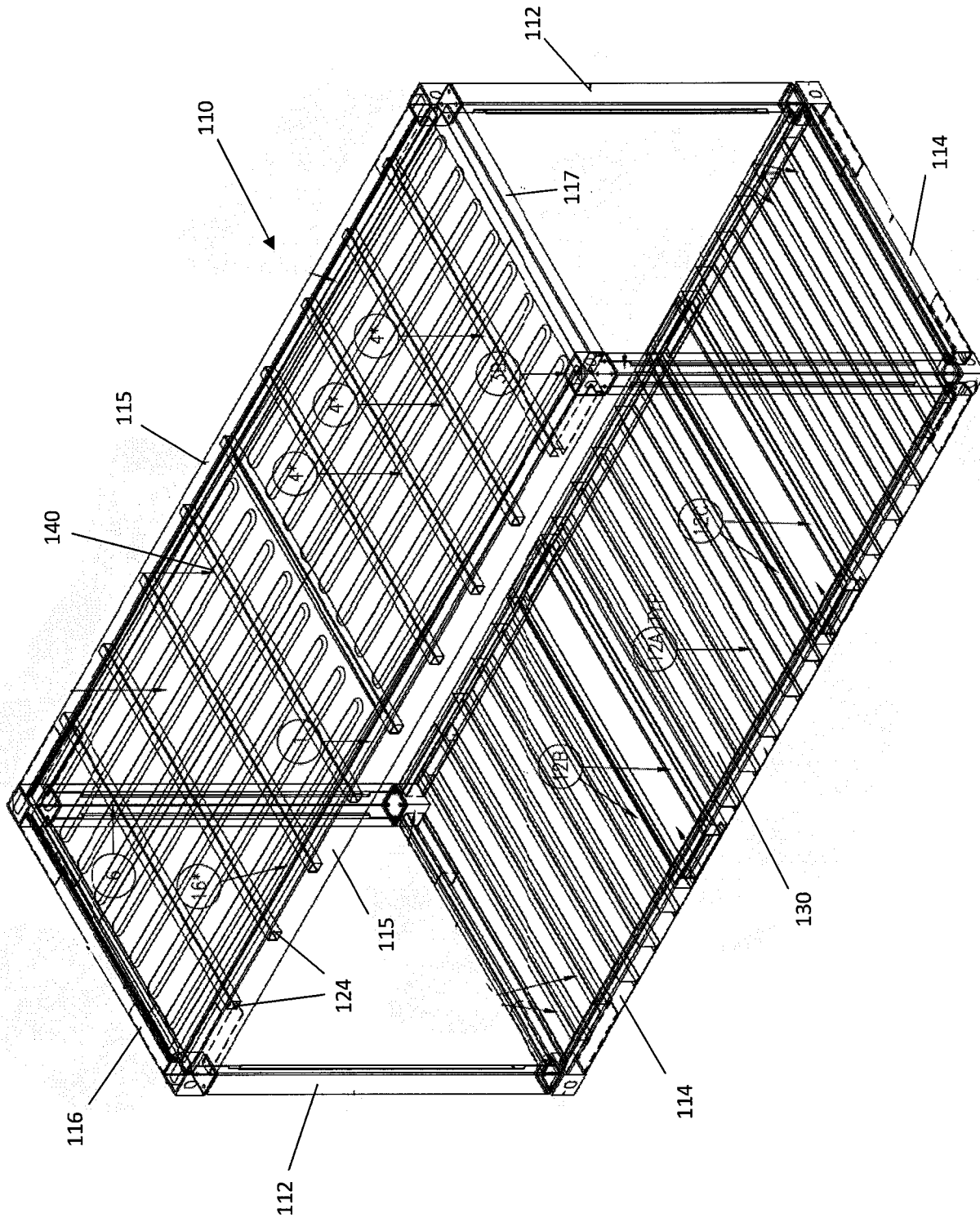


FIGURE 1



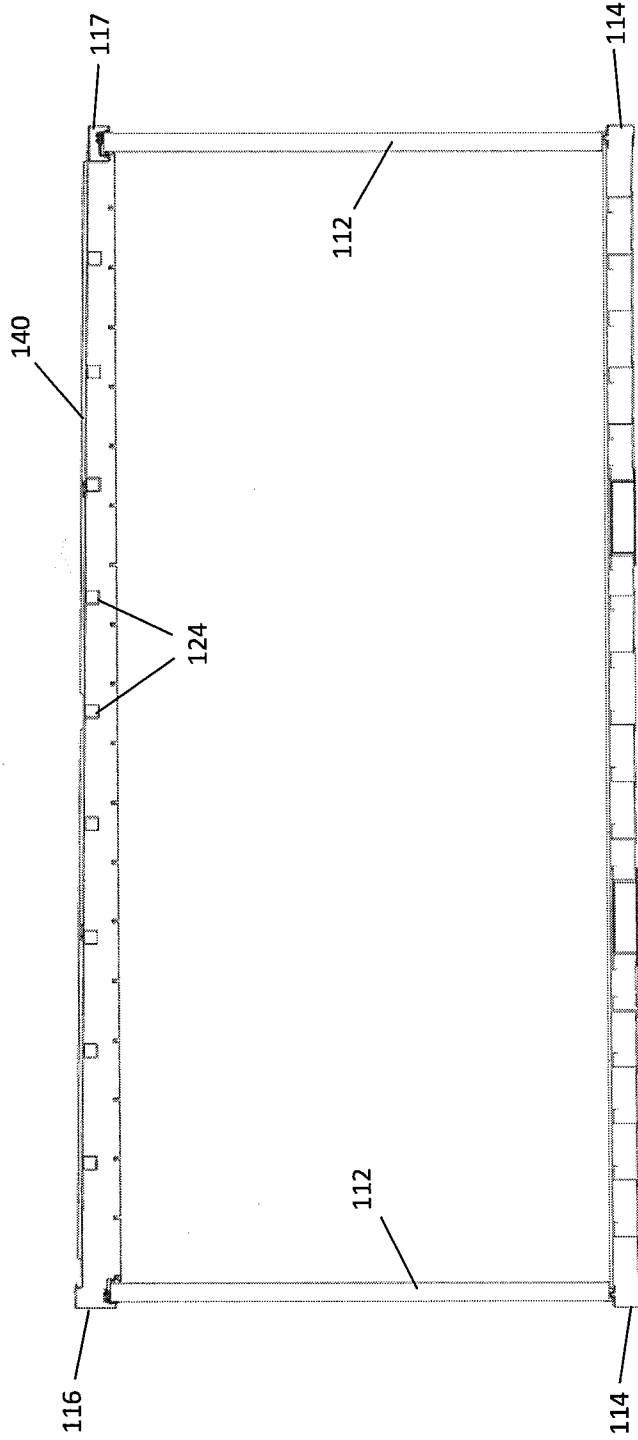


FIGURE 3

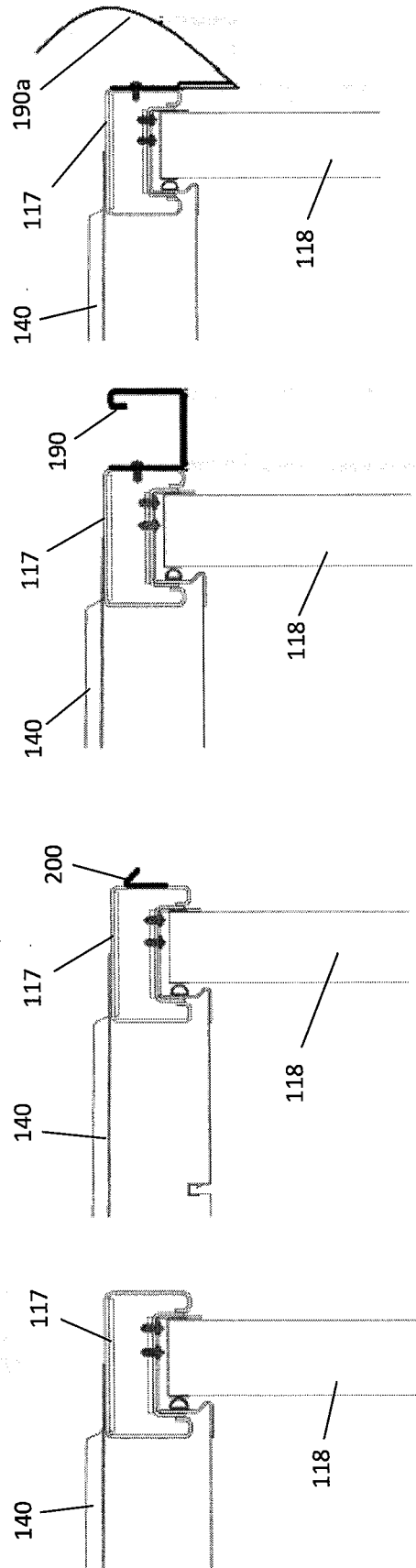


FIGURE 4a

FIGURE 4b

FIGURE 4c

FIGURE 4d

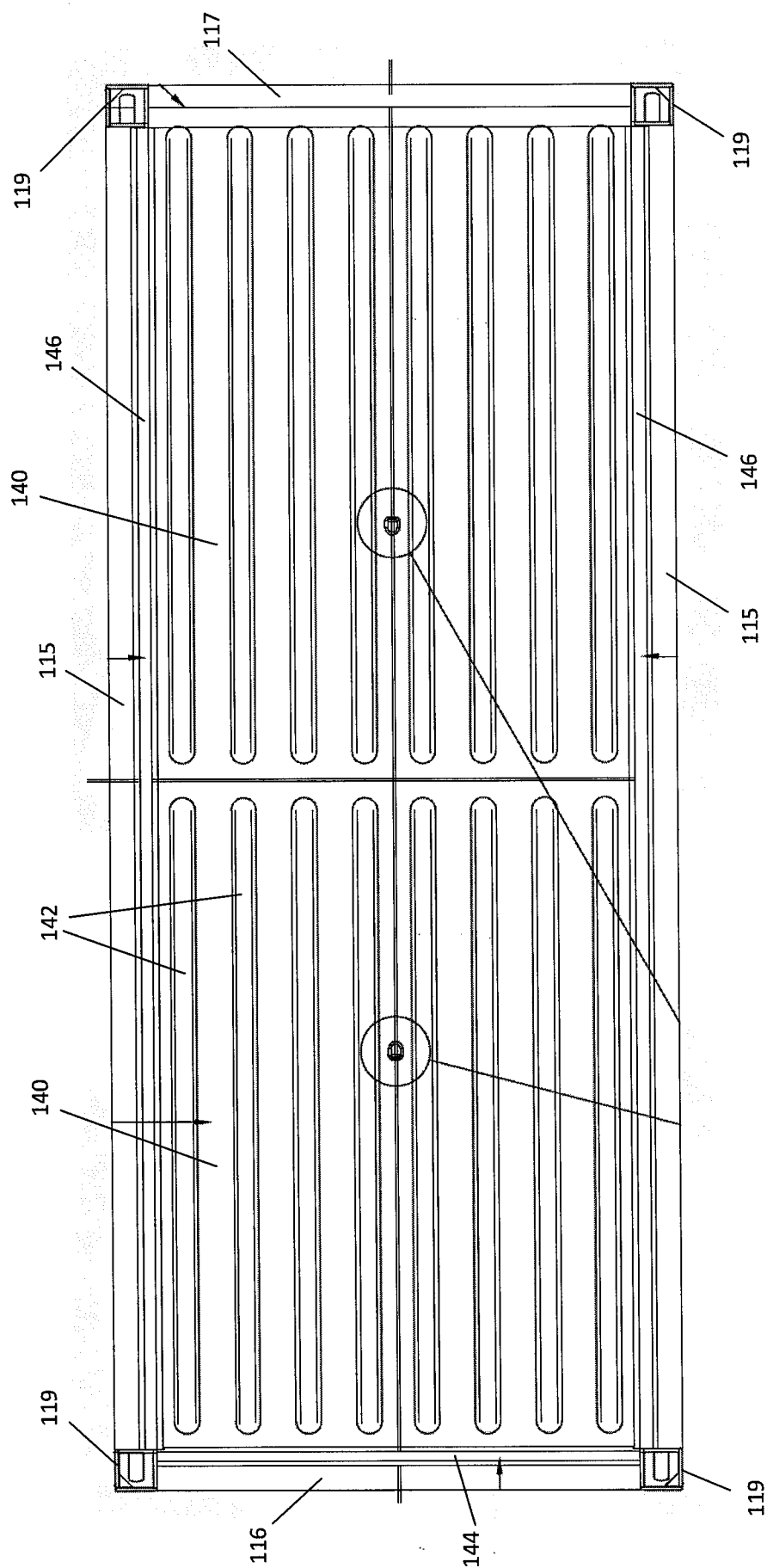


FIGURE 5

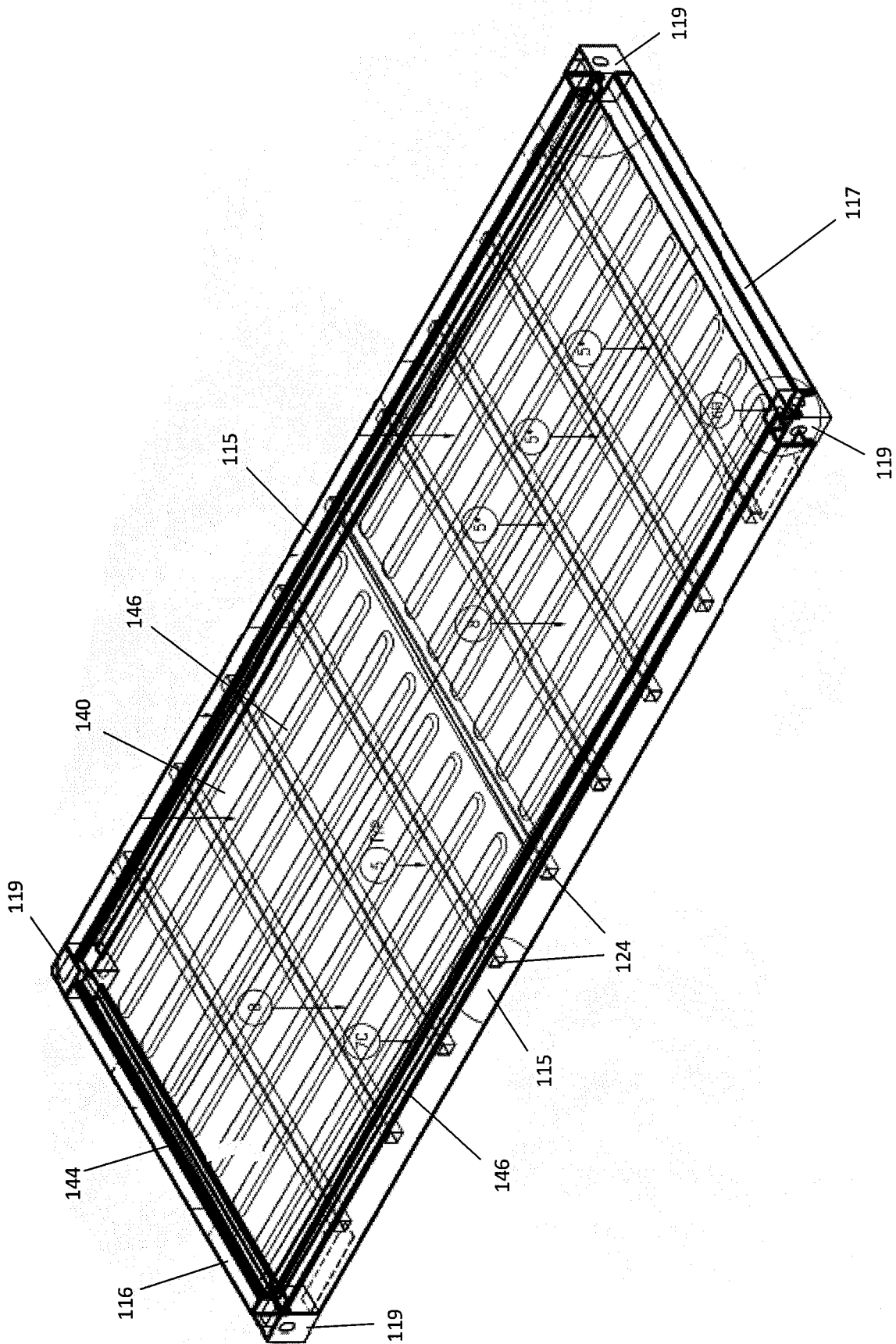


FIGURE 6

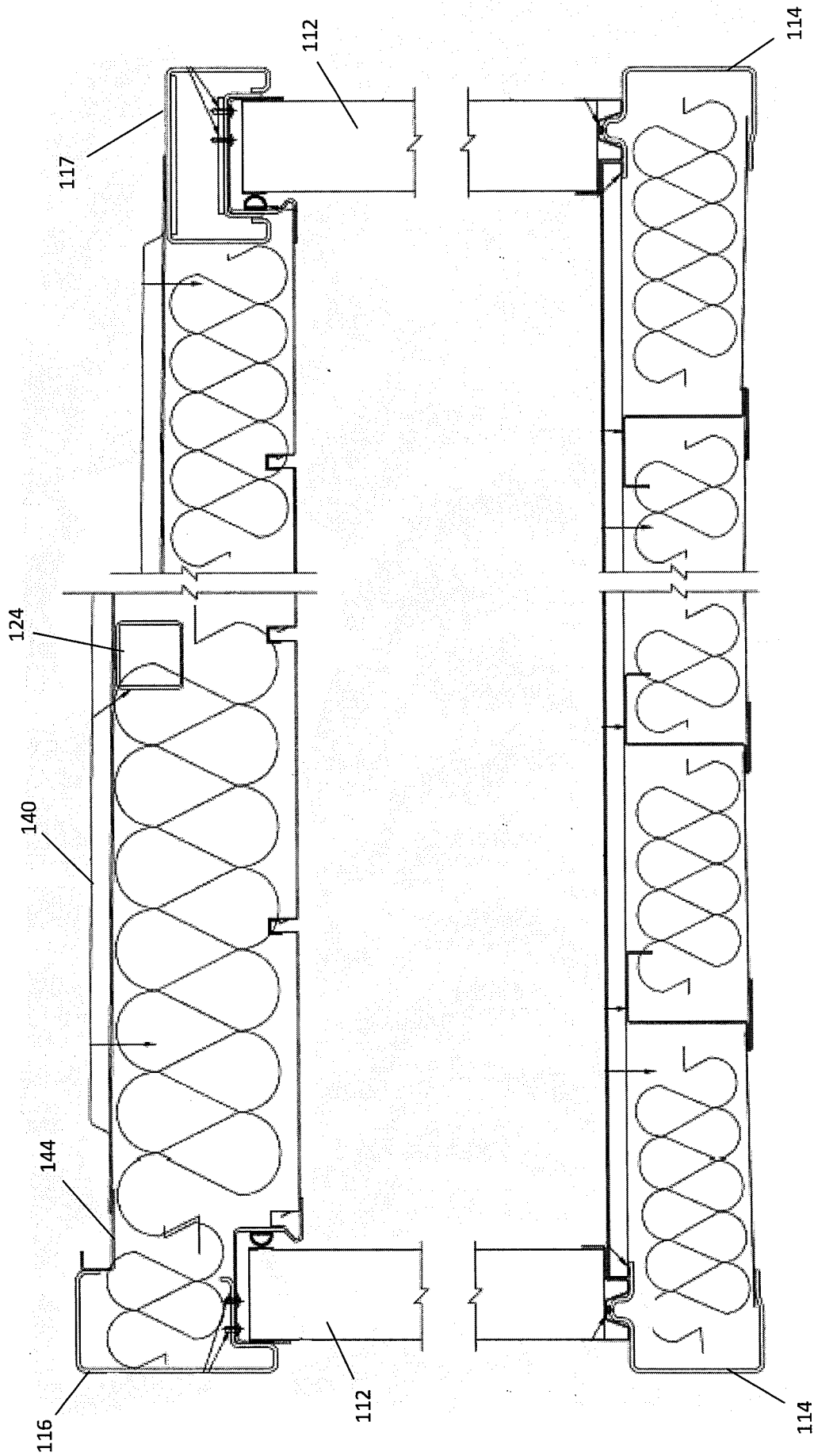


FIGURE 7

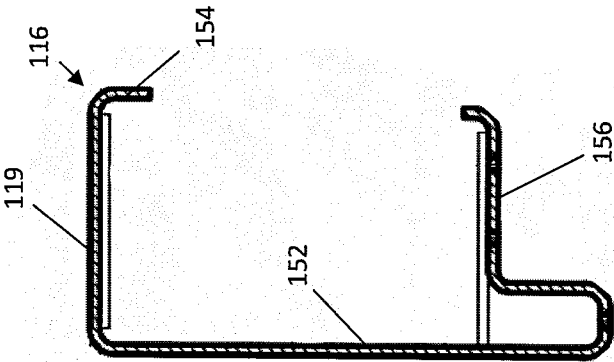


FIGURE 8

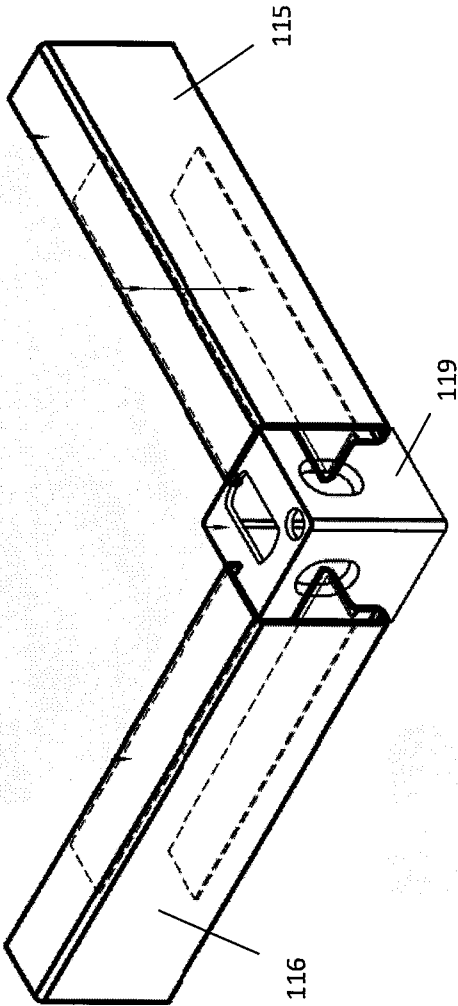


FIGURE 9

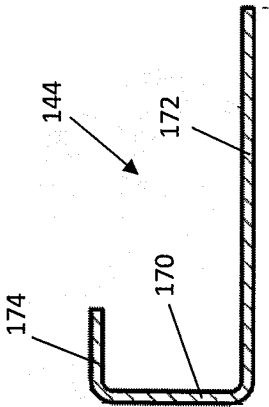


FIGURE 10

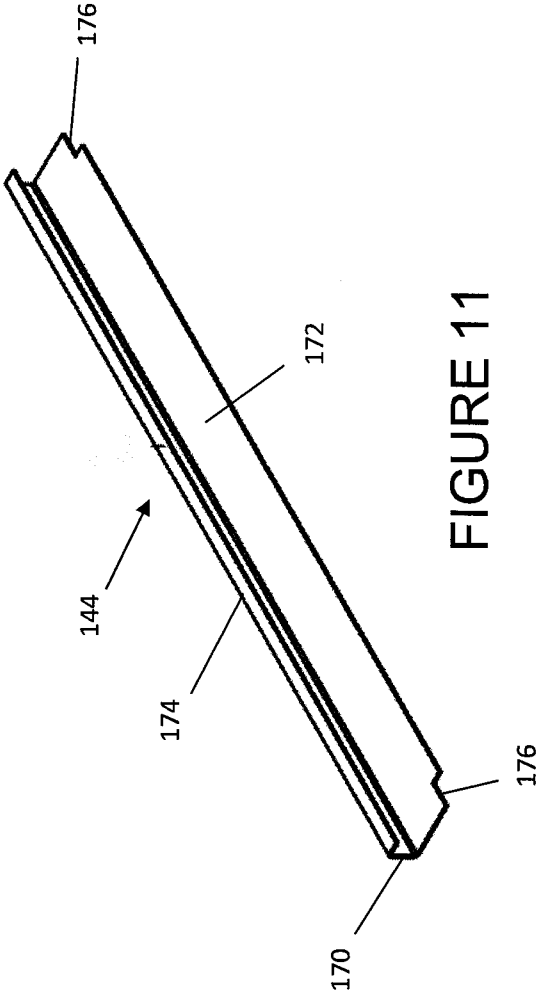


FIGURE 11

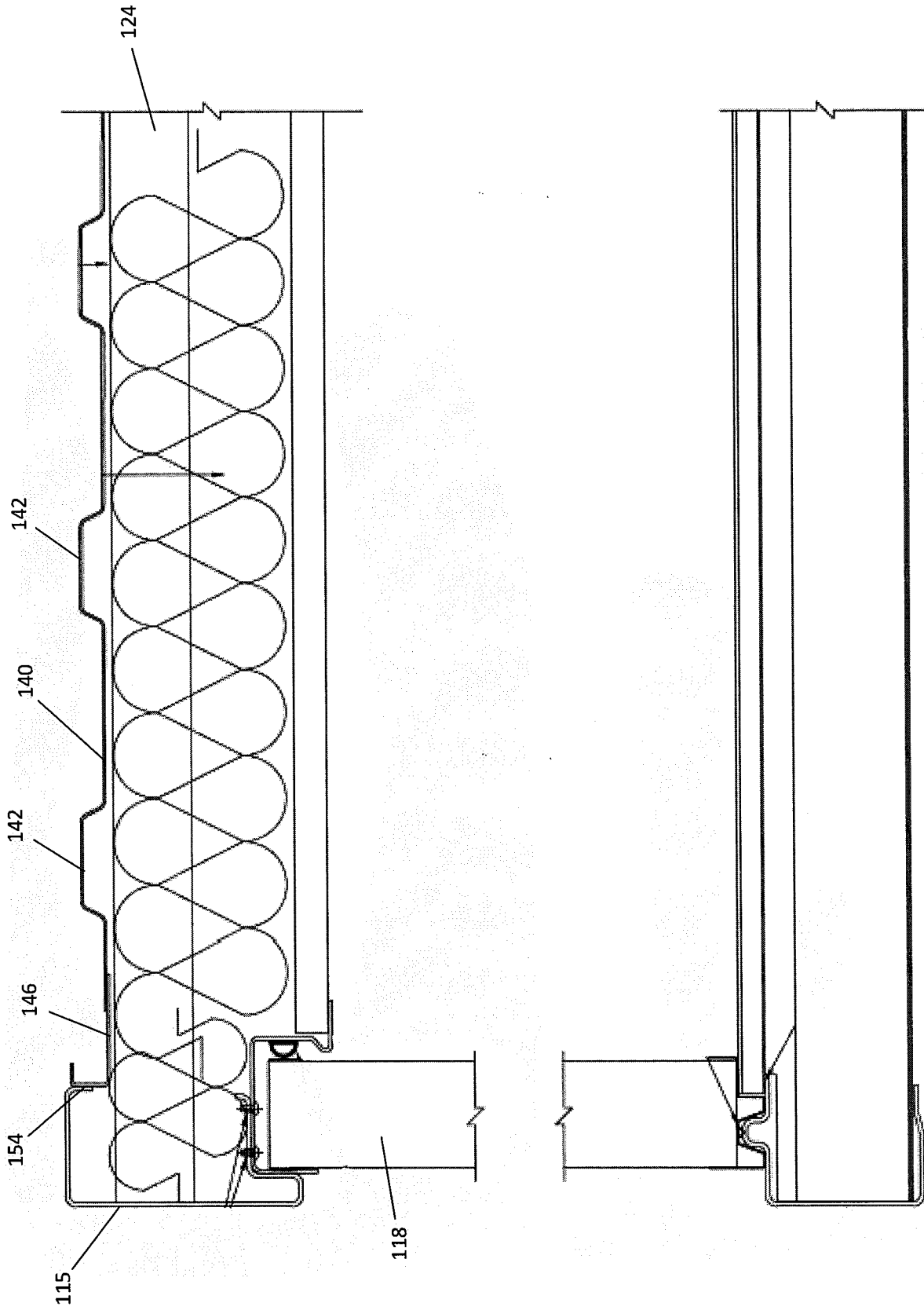


FIGURE 12

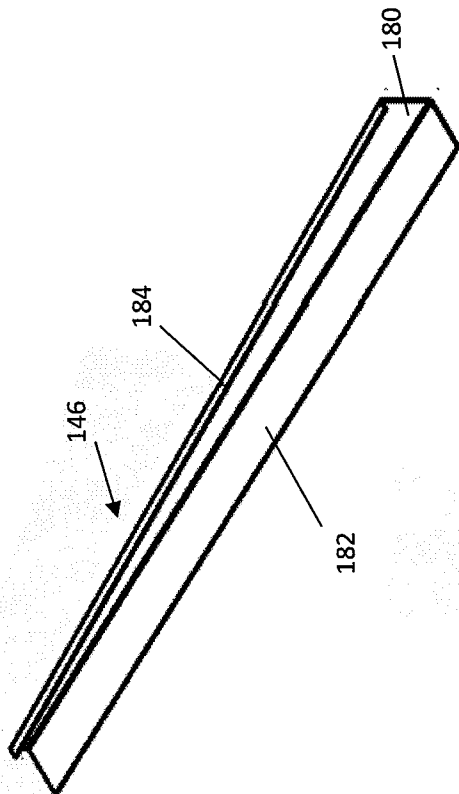


FIGURE 13

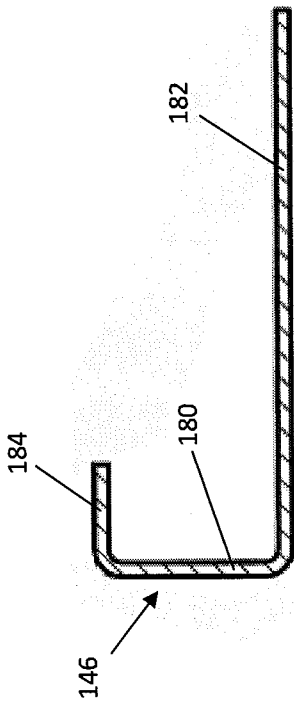


FIGURE 15

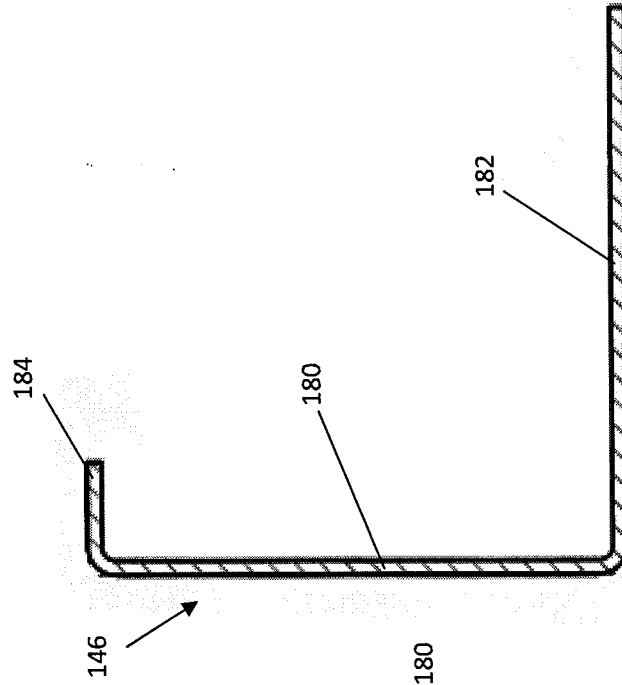


FIGURE 16

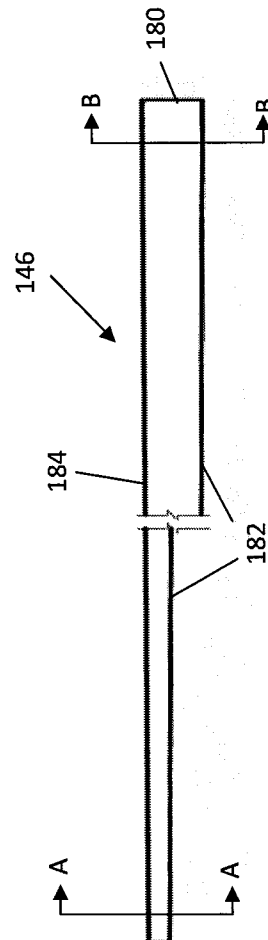


FIGURE 14

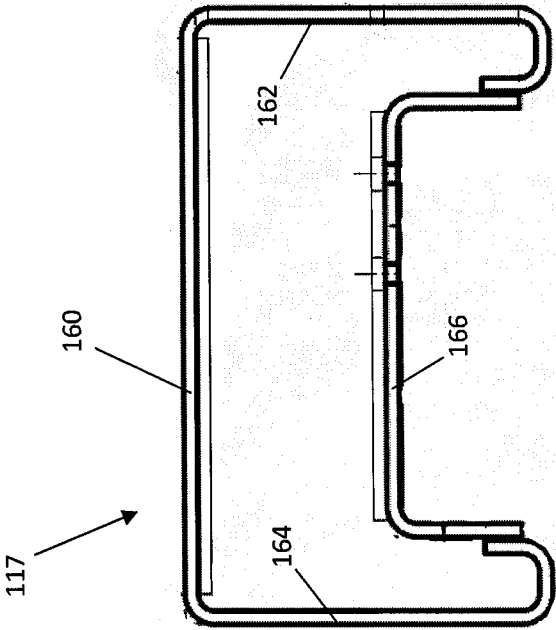


FIGURE 17

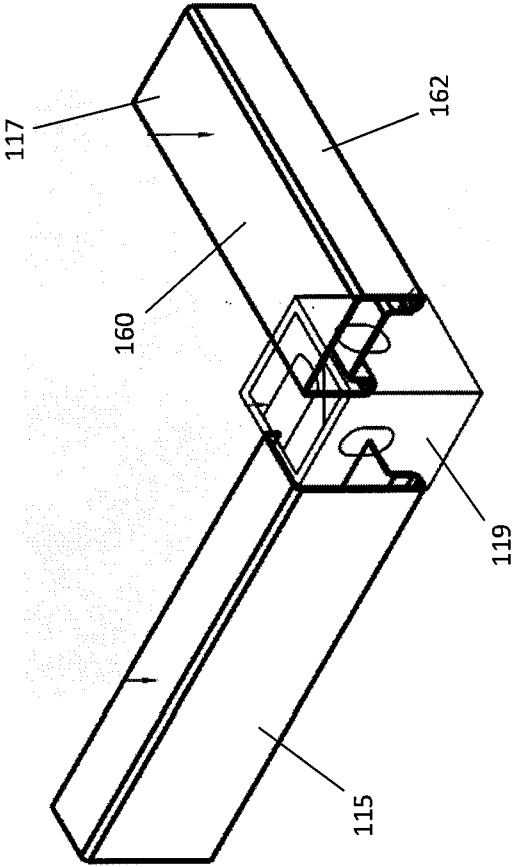
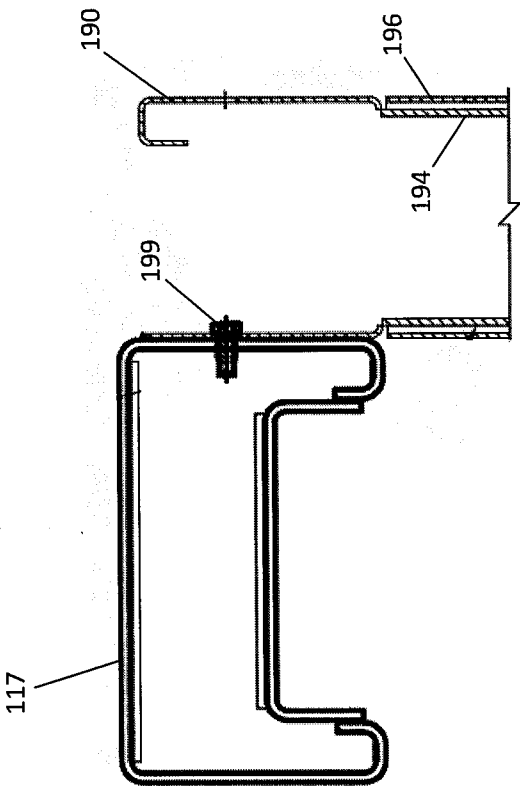
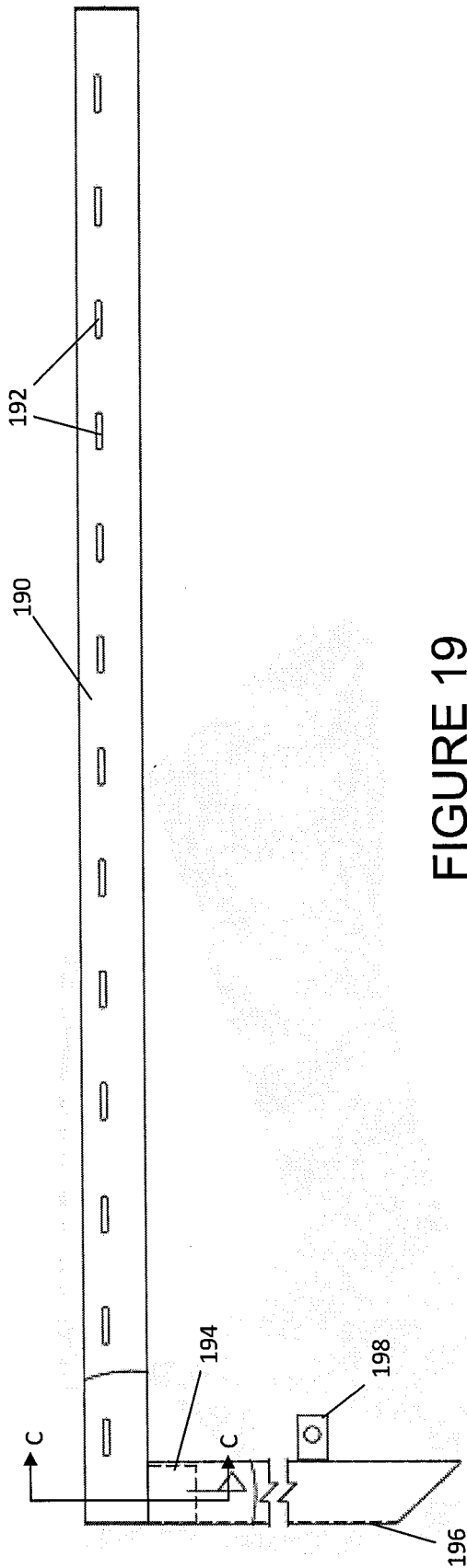


FIGURE 18



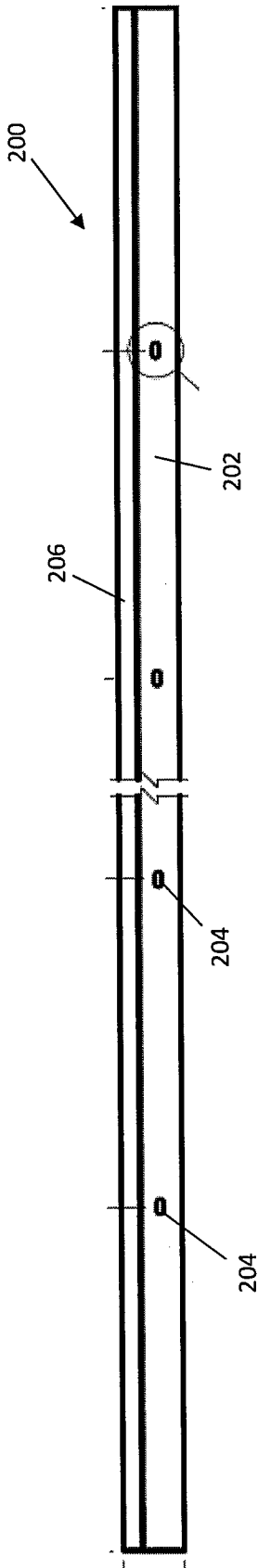


FIGURE 21

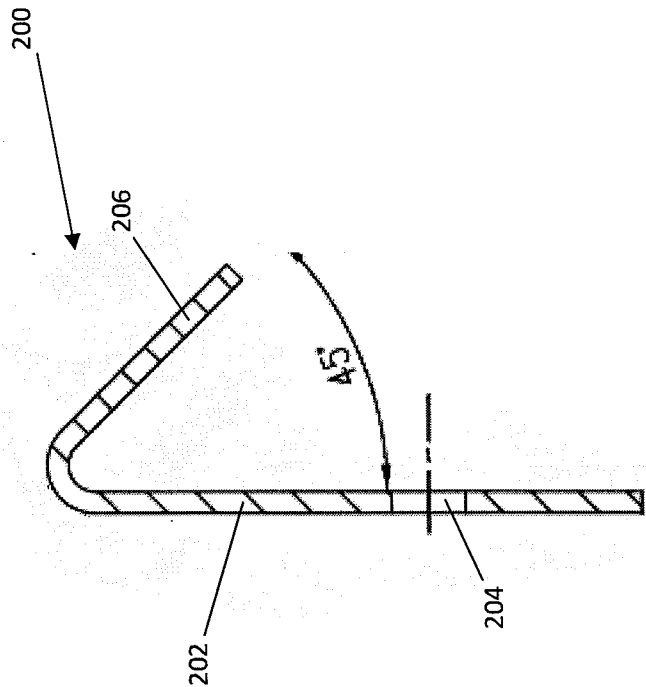


FIGURE 22

