



(11)

**EP 3 144 437 A1**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**22.03.2017 Bulletin 2017/12**

(51) Int Cl.:  
**E04B 1/344<sup>(2006.01)</sup> E04B 2/74<sup>(2006.01)</sup>**

(21) Application number: **16189386.2**

(22) Date of filing: **19.09.2016**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**  
Designated Validation States:  
**MA MD**

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(30) Priority: **17.09.2015 GB 201516513**

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(54) **MODULE ASSEMBLY FOR A BUILDING**

(57) A building module (100) and building (14) constructed therefrom is provided, the modules (100) comprising a frame (102) and two side panels (104, 106), the panels being sealable to each other in an end-to end fashion to effect an inter-module seal.

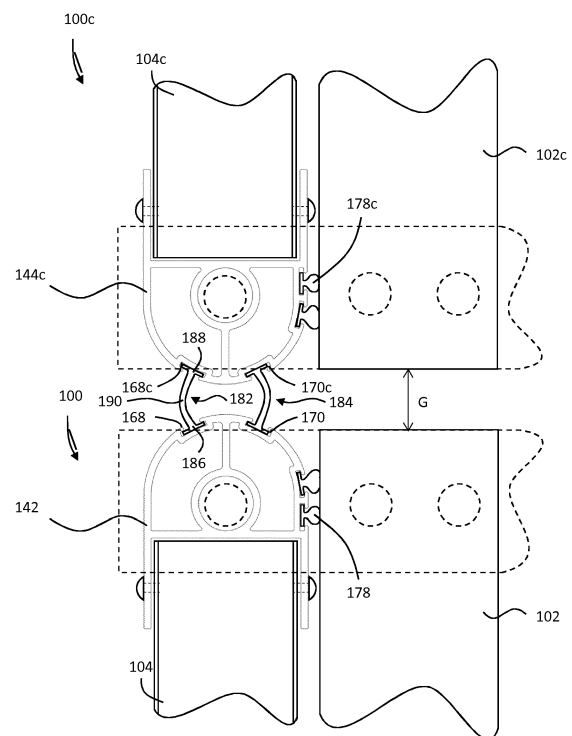


Fig.9D

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## Description

**[0001]** The present invention relates to module assemblies for the construction of modular buildings. More specifically, the present invention relates to assemblies of modules for modular buildings for human occupancy, which modules can be transported in a collapsed configuration and erected at a desired site.

**[0002]** Modular buildings are known in the art, and are used in a wide range of situations. Such buildings are usually employed where temporary use is desirable. For example, in a building site it is often useful to set up temporary offices and premises where work can be undertaken whilst the permanent building is being constructed. Similarly in military environments, temporary construction of offices and dwellings for military personal is desirable.

**[0003]** There are various advantageous features which this type of building should exhibit.

**[0004]** Firstly, the buildings need to be easily transported taking up the minimum amount of space. Known temporary buildings are therefore constructed of several fold-flat modules which can be assembled together in at least one configuration.

**[0005]** Secondly, the buildings need to be easily erected and dismantled, using the minimum number of tools. Preferably, no specialist tools should be required.

**[0006]** Thirdly, the buildings need to be well sealed, in the event that the environment is hostile (for example sandy), or in the event that heating or air conditioning is to be used. Therefore the ability to made as air- and water-tight as possible is desirable.

**[0007]** Fourthly, the buildings need to be modular in nature- that is the sub-assemblies should be suitable for assembly in a variety of different configurations. In this manner, part count is reduced, and the modules can be used to construct a variety of buildings, from small stores, to offices, to officers' quarters, to full barracks as required.

**[0008]** A known modular building is disclosed in GB2286337A. The building comprises at least three side members connected by pin and slot joints. The building is configurable between a collapsed and erected configuration.

**[0009]** A further known modular building is disclosed in US5904005. The building comprises a plurality of modular units, each of which has a central frame and four walls arranged in opposing pairs to give an I-shaped configuration. One pair of walls may be extended with the other flat against the frame to provide a [or] shaped configuration.

**[0010]** A disadvantage of the modules of US'005 is that they can only be arranged in an end-to-end formation-i.e. where the central frames are spaced apart and offset from each other. Therefore the user is constrained as to the configuration of the buildings which can be constructed. The only option is to form buildings with an Nx1 module arrangement. The only way to make the building larger is to make it longer, which may a problem considering

the intended use and / or external space restrictions.

**[0011]** What is required is a building module which can easily be configured to provide more flexible configurations- i.e. NxM configurations (i.e. N modules long by M modules wide).

**[0012]** It is an aim of the present invention to provide such a module.

**[0013]** According to a first aspect of the invention there is provided a modular building assembly comprising:

a first module having a first module frame and a first module first side panel mounted on a side of the first module frame, the first module first side panel being moveable between a stowed position parallel to and adjacent the first module frame and a deployed position in which the first module first side panel projects from the first module frame, the first module first side panel defining an inter-panel seal engaging formation on at least one side;

a second module having a second module frame and a second module first side panel mounted on a side of the second module frame, the second module first side panel being moveable between a stowed position parallel to and adjacent the second module frame and a deployed position in which the second module first side panel projects from the second module frame, the second module first side panel defining an inter-panel seal engaging formation on at least one side;

an inter-panel seal having a first panel engaging formation and a second panel engaging formation;

in which when the first and second modules are placed with their respective frames in an adjacent and co-planar relationship, the seal can be simultaneously engaged with the seal engaging members of each first side panel to seal the first and second modules together.

**[0014]** This allows the panels of the modules to be sealed together in an end-to-end fashion (i.e. with the frames adjacent and co-planar) which increases the number of building configurations the module can be used for.

**[0015]** Preferably, the inter-panel seal engaging formations and the inter-panel seal are configured such that the inter-panel seal can only be inserted and removed in a direction parallel to the side of each first side panel on which the inter-panel seal receiving formation is defined. In use, this is the vertical direction. Advantageously, this inhibits seal opening by accidental impact, building movement etc. and provides for a better seal.

**[0016]** Preferably each inter-panel seal receiving formation defines an undercut recess in the respective first side panel, and in which the inter-panel seal defines a flange at either end for engagement in the undercut re-

cess. Advantageously, this prevents pull-out of the seal from the formation (apart from in the intended axial direction).

**[0017]** Preferably the flanges of the inter-panel seal are joined by a seal body, in which the flanges are stiffer than the seal. This provides the dual functionality of providing secure engagement with the panels, but provides a flexible seal which allows for inter-panel movement in use.

**[0018]** Preferably the inter-panel seal engaging formation of the first module first side panel and the inter-panel seal engaging formation of the second module first side panel are configured to have an uninterrupted line of sight there between before the inter-panel seal is inserted. Advantageously, this allows easy assembly and disassembly of the seal.

**[0019]** Preferably each first side panel defines an adjacent pair of inter-panel seal engaging formations, and in which two adjacent inter-panel seals are provided between each first side panel. This provides redundancy, and a better seal. Preferably each of the pair of inter-panel seal engaging formations is positioned either side of a central plane of the respective first side panel.

**[0020]** Preferably each first side panel further defines a frame seal engaging formation facing the respective first or second module frame. This allows the panel to seal against the frame as well (when required).

**[0021]** Preferably the frame seal engaging formations face in a direction normal to the respective inter-panel seal engaging formations.

**[0022]** Preferably each of the first and second module first side panels is pivotably mounted to the respective frame. This allows for easy opening and closure.

**[0023]** Preferably:

the first module has a first module second side panel mounted on a side of the first module frame opposite to the first module first side panel, the first module second side panel being moveable between a stowed position parallel to and adjacent the first module frame and a deployed position in which the first module second side panel projects from the first module frame; and,

the second module has a second module second side panel mounted on a side of the second module frame opposite to the second module first side panel, the second module second side panel being moveable between a stowed position parallel to and adjacent the second module frame and a deployed position in which the second module second side panel projects from the second module frame.

**[0024]** This configuration allows for a wide range of building formations.

**[0025]** Preferably each of the second side panels is identical to each of the first side panels.

**[0026]** Preferably each first and second side panels is

rotatable about a respective first and second panel axis, in which the first panel axis is at a first end of the frame, and the second panel axis is at a second end of the frame such that the respective frame and panels can form a "Z" shape. This configuration allows for a wide range of building formations.

**[0027]** Preferably each of the side panels comprises a panel member and an edge member attached to opposite edges of the panel member, which edge members define the inter-panel seal engaging formation or formations. This allows the load bearing / seal bearing parts of the panel to be stiff, and the main panel to be light.

**[0028]** Preferably the edge members are extrusions defining the inter-panel seal engaging formation or formations parallel to an axis of extrusion. Extrusions are inexpensive to manufacture, and such formations are well suited to aluminium which is an ideal material due to its strength and low density.

**[0029]** Preferably the edge members define one side of a rotational joint to facilitate rotation of the side panel from the stowed and deployed positions.

**[0030]** Preferably the side panels comprise a cellular core with an outer skin, which provides a stiff but light structure.

**[0031]** Preferably the cellular core and outer skin are constructed from a thermally bonded polymer material.

**[0032]** According to a second aspect of the invention there is provided a method of constructing a modular building comprising the steps of:

providing a first module having a first module frame and a first module first side panel mounted on a side of the first module frame, the first module first side panel being moveable between a stowed position parallel to and adjacent the first module frame and a deployed position in which the first module first side panel projects from the first module frame;

providing a second module having a second module frame and a second module first side panel mounted on a side of the second module frame, the second module first side panel being moveable between a stowed position parallel to and adjacent the second module frame and a deployed position in which the second module first side panel projects from the second module frame; aligning the first and second module frames in an adjacent and co-planar relationship;

providing an inter-panel seal;

using the inter-panel seal to seal the first and second module first side panels together.

**[0033]** An example module and modular building according to the present invention will now be described with reference to the accompanying figures in which:

Figures 1A to 1C are elevations of a module accord-

ing to the present invention;

Figure 2 is a perspective view of a frame of the module of Figures 1A to 1C;

Figure 3 is a side view of a panel assembly of the module of Figures 1A to 1C;

Figure 4 is a plan view of the panel assembly of Figure 3;

Figure 4A is a detail view of the region A of Figure 4;

Figure 5 is a plan view of the module of Figures 1A to 1C;

Figure 5A is a detail view of the region A of Figure 5;

Figure 6A is a detail side view of region A of Figure 1B in a first configuration;

Figure 6B is a detail side view of region A of Figure 1B in a second configuration;

Figure 7 is a plan view of the module of Figures 1A to 1C;

Figures 8A to 8C are detail plan views of the articulation of a part of the module of Figures 1A to 1C;

Figures 9A to 9C are plan views of modular buildings constructed using the modules of Figures 1A to 1C;

Figures 9D and 9E are detail views of regions D and E of Figures 9A to 9C; and,

Figure 9F is a section detail view of a part of the modular building of Figure 9C.

**[0034]** Referring to Figures 1A to 1C there is shown a module 100 generally comprising a frame 102, a first panel assembly 104 and a second panel assembly 106 mounted on either side of the frame 102. The module 100 is generally rectangular and planar, and is shown in Figures 1A to 1C in a folded, flat configuration for storage and transportation in which the first and second panel assemblies 104, 106 overlie opposite sides of the frame 102.

**[0035]** Referring to Figure 2, the frame 102 is shown without the panel assemblies 104, 106. The frame 102 is a generally rectangular endless loop in shape, comprising horizontal top and bottom members 108, 110 respectively and vertical side members 112, 114. The top and bottom members 108, 110 are closed section rectangular steel tubes. The side members are rectangular steel tubes with internally-facing channels 116, the channels 116 running longitudinally along the members 112, 114. The channels 116 can be used for routing e.g. elec-

trical cables. A frame plane FP lies halfway through the thickness of the frame 102.

**[0036]** At the corners where the bottom member 110 and the side members 112, 114 meet there are provided first and second fixed hinge plates 120, 122 respectively. The hinge plates 120, 122 are flat rectangular plates which extend normal to the frame plane FP outwardly from the frame 102 on both sides. Each hinge plate 120, 122 is provided with two vertically extending hinge pins 123, 124 one on each side of the frame 102 (see the lower part of Figure 6A). The first hinge pin 123 is longer than the second hinge pin 124. The hinge plates 120, 122 are permanently attached- specifically welded- to the frame 102. The plates 120, 122 are welded to the frame 102 such that the first pin 123 of the first plate 120 is on the same side of the frame 102 as the second pin 124 of the second plate 122 and vice versa.

**[0037]** At the corners where the top member 108 and the side members 112, 114 meet there are provided two pairs of spaced apart bores 126.

**[0038]** The frame 102 further comprises a first and second removable hinge plate 128, 130 respectively. The removable hinge plates 128, 130 are identical and are more clearly shown in Figure 6A. Each comprises a plate member 132, with two central pins 134 of equal length extending therefrom. On a first side of the central pins 134 there is provided a first hinge pin 136 which is shorter than the central pins 134. On a second side of the central pins 134 there is provided a second hinge pin 138 which is shorter than the first hinge pin 136.

**[0039]** Turning to Figures 3, 4 and 4A, the first panel assembly 104 is shown. It will be understood that the second panel assembly 106 is identical to the first panel assembly 104.

**[0040]** The first panel assembly 104 comprises a rectangular panel core 140 having a panel plane PP halfway through its thickness. The panel core 140 is a thermally fused polypropylene panel having a honeycomb polypropylene core 141 sandwiched between two planar sheets 143 of glass fibre reinforced polypropylene. Such panels are sold under the brand name MONOPAN (RTM) by Wihag Composites GmbH & Co. KG (although alternatives are available). These panels are strong, light, and have excellent thermal insulation properties.

**[0041]** At each vertical end of the panel core 140 there are provided a first and second extrusion 142, 144 respectively. The extrusions 142, 144 are constructed from aluminium. A section through the extrusion 142 is shown in detail in Figure 4A. The extrusion 144 is identical to the extrusion 142.

**[0042]** The extrusion 142 is prismatic. The section of the extrusion 142 comprises a central cylinder 146 defining a bore 148 having an axis X1 and an inner radius R1. A cross-member 150 extends tangentially either side of the cylinder 146. A first and second flange 152, 154 extend in a first direction from opposite ends of the cross-member 150 and define spaced apart screw bores 156 along the extrusion 142. Opposite the flanges, 152, 154,

a hollow closed section 158 extends from the cross-member 150 to contain the cylinder 146. The closed section 158 is defined by first and second straight walls 160, 162 extending opposite the flanges 152, 154. The first and second straight walls extend into a semi-circular wall section 164 having outer radius R2 and prescribing a 180 degree arc to join the walls 160, 162. A stiffener 166 extends radially from the central cylinder 146 to the inside of the semi-circular wall section 164.

**[0043]** The geometric centre of the semi-circular wall section 164, axis X2, is offset from axis X1 by offset distance OD. The axis X2 is offset towards the semi-circular wall section 164, and away from the flanges 152, 154.

**[0044]** The flanges 152, 154 define a panel receiving formation (as will be described below) facing in a panel direction P. The end of the extrusion 142 opposite the panel receiving formation is known as the free end 172 which faces in a free end direction F. First and second sideward facing directions S1 and S2 are also defined in Figure 4A and are generally perpendicular to the directions P and F.

**[0045]** The extrusion 142 defines two pairs of seal receiving formations in the form of outwardly facing slots. A first and second seal receiving formation 168, 170 are defined on the outer free end facing surface of the semi-circular wall section 164. The seal receiving formations 168, 170 are positioned symmetrically at either side of the extrusion and face in the free end direction F. The extrusion further comprises a third and fourth seal receiving formation 174, 176. The third seal receiving formation 174 is defined in the second straight wall 162, and the fourth seal receiving formation 176 is defined proximate the third seal receiving formation 174 in the semi-circular wall section 164 where it joins the second straight wall 162. The third and fourth seal formations 174, 176 face in the second sideways direction S2, substantially perpendicular to the first and second seal formations 168, 170.

**[0046]** Each of the seal receiving formations 168, 170, 174, 176 is identical in shape. The formation 168 is shown in more detail in Figure 9F and comprises an undercut elongate slot 169 of width W1 arranged to receive a flange of a seal. The seal receiving formation 168 defines a mouth 171 in communication with the slot 169 having width W2 < W1. The seals 178 are identical and are of the foam type, in this embodiment Q-LON (RTM) 69950 sold by Schlegel Systems, Inc.

**[0047]** Because the axis X2 of the semi-circular wall section 164 is offset from the axis X1 of the bore 148, the first and second seal receiving formations 168, 170 are further from the axis X1 than the third and fourth seal formations 174, 176.

**[0048]** The modules are assembled as follows.

**[0049]** The first panel assembly 140 is assembled as follows. The extrusions 142, 144 are attached to either side of the panel core 140. The end of the panel core is received within the panel receiving formation defined by the flanges 152, 154 and abuts the cross-member 150.

The panel core 140 and respective extrusion 142, 144 are then attached using screws 180. The extrusions 142, 144 are oriented such that the third and fourth seal receiving formations 174, 176 of each extrusion face in the same direction (S2). With the exception of the presence of the third and fourth seal receiving formations 174, 176, the extrusion is symmetrical about the panel plane PP.

**[0050]** The seals 178 can be slid down the respective first pair of seal receiving formations 168, 170 and / or second pair of seal receiving formations 174, 176 as required by the application (as will be explained below).

**[0051]** One both panel assemblies 104, 106 are assembled in this way, they can be attached to the frame 102. In the folded configuration, the first panel assembly 104 is mounted parallel to and adjacent the frame by placing the respective bores 148 in the extrusions 142, 144 over the hinge pins 123, 124 in the hinge plates 120, 122 respectively. The third and fourth seal receiving formations 174, 176 face the frame 102. Similarly, the second panel assembly 106 is mounted to the hinge pins 123, 124 on the opposite side of the frame 102 with the third and fourth seal receiving formations facing the frame.

**[0052]** Once in position, the removable hinge plates 128, 130 can be put in place. The removable hinge plates are assembled with the central pins 134 engaging the bores 126 in the frame 102. The hinge plates 128, 130 are oriented in opposite directions- specifically the first hinge pin 136 of the second removable hinge plate 132 is on the same side of the frame as the second hinge pin 138 of the first removable hinge plate 130 and vice versa. Also, the first hinge pins 136 of the removable plates 128, 130 are always aligned with the first hinge pins 123 of the fixed plates 120, 122, and the second hinge pins 138 of the removable plates 128, 130 are always aligned with the second hinge pins 124 of the fixed plates 120, 122.

**[0053]** Therefore for the panel assembly 104, the first extrusion 142 is pivoted on a pair of second hinge pins 124, 138, and the second extrusion 144 is pivoted on a pair of first hinge pins 123, 136, in which the first hinge pins 123, 136 are shorter than the second hinge pins 123, 136.

**[0054]** Once the removable hinge plates 128, 130 are in place, the panel assemblies 104, 106 are secured in position and the module 100 is formed in a folded or stowed position.

**[0055]** Referring to Figure 5A, when the panel assembly 106 is in the folded / stowed position, the seals 178 in the third and fourth seal receiving formations 174, 176 seal against the side member 114 of the frame 102 to provide an air- and water-tight seal. The use of two seals provides redundancy and improves the sealing capability of the arrangement.

**[0056]** Either or both of the panel assemblies 104, 106 can be moved from the folded position to an extended position as shown in Figure 7. Starting with the first panel assembly 104, and referring to Figure 6B, the second removable hinge plate 130 can be lifted to free the second

hinge pin 138 from the first panel assembly 104. The panel assembly 104 can then be lifted off the second hinge pin 124. Because the first hinge pins 123, 136 are longer than the second hinge pins 124, 138, the other end of the panel assembly is still captured, and can be rotated about a first panel axis PA1 as shown in Figure 7. The same applies for panel assembly 106, being selectively rotatable about a second panel axis PA2 at the opposite end and side of the frame 102 to the first panel axis PA1.

**[0057]** It will be understood that in addition to the foregoing articulation, the panel assemblies can also be completely removed if required by one of the applications described below.

**[0058]** Referring to Figures 8A to 8C, the movement of the extrusion 144 of the second panel assembly 106 during rotation about the second panel axis PA2, which coincides with the axis X1 of the extrusion 144.

**[0059]** Figure 8A shows the clearance C between the extrusion 144 and the frame 102. Because of the offset distance OD between the axes X1 and X2, as the second panel assembly 106 rotates from the folded / stowed condition to the extended position perpendicular to the frame 102, the clearance C decreases by distance OD. This takes account of the fact that the seals (not shown) in the third and fourth seal receiving formations 176, 178 are set further back into the extrusion 144 than the seals in the first and second seal receiving formations 172, 174.

**[0060]** Referring to Figures 9A to 9E, various examples of modular buildings which can be constructed with the module 100 are shown.

**[0061]** Figure 9A shows a building 10 having a simple 1x1 module arrangement comprising the module 100, and a second module 100a, which is identical to module 100. Features of module 100a equivalent to module 100 are denoted by the same reference numerals suffixed by a.

**[0062]** The first panel assembly 104 of the first module 100 forms an end wall in the folded / stowed condition. The second panel assembly 106 of the first module 100 has been rotated about its axis by 90 degrees to form a side wall. The first panel assembly 104a of the second module 100a has been rotated about its axis by 90 degrees to form a side wall. The second panel assembly 106a of the second module 100a remains in the folded / stowed condition to form an end wall. Thus the two modules have been combined with the end of the panel assembly 106 of the module 100 sealing against the side of the frame 102a of the module 100a. Similarly, the panel assembly 104a of the module 100a seals against the side of the frame 102 of the module 100. The joint at region E is shown in more detail in Figure 9E with the seals 178a of the extrusion 142a of the panel assembly 104a abutting and sealing against the frame 102 of the module 100. The first hinge pins 124, 138 retain the extrusion 142a of the panel assembly 104a by engaging the bore 148a.

**[0063]** Figure 9B shows a second building 12 having a 2x1 arrangement comprising the module 100, the sec-

ond module 100a and a third module 100b which is identical to module 100. Features of module 100b equivalent to module 100 are denoted by the same reference numerals suffixed by b.

**[0064]** Module 100 is configured as per the building 10, with the first panel assembly 104 stowed to form an end wall, and the second panel assembly 106 rotated through 90 degrees to form a sidewall sealing against the frame 102a of the module 100a.

**[0065]** The second module 100a has both panel assemblies 104a, 106a rotated through 90 degrees such that the first panel assembly 104a extends to seal against the frame 102a of the first module 100, and the second panel assembly 106a extends to seal against the frame 102b of the third module 100b.

**[0066]** The third module 100b is configured such that the first panel assembly 104b is rotated by 90 degrees to seal against the frame 102a of the second module 100a. The second panel assembly 106b is kept in the folded / stowed position to form an end wall opposite and parallel to the first panel 104 of the first module 100.

**[0067]** Again, the joint at region E is shown in more detail in Figure 9E.

**[0068]** Turning to Figure 9C, a 2x2 module building 14, the construction of which is made possible by the present invention, is shown in plan. The building comprises six modules, 100, 100a, 100b, 100c, 100d, 100e. Features of modules equivalent to module 100 are denoted by the same reference numerals suffixed by a, b, c etc.

**[0069]** Modules 100, 100a, 100b are in the same configuration as in the building 12 with the exception that the second panel assemblies 106a and 106b have been removed completely. Three further modules 100c, 100d, 100e are provided.

**[0070]** The module 100c is configured such that the frame 102c is adjacent to and coplanar with the frame 102 of the module 100. The first panel assembly 104c is folded and as such is adjacent to and coplanar with the first panel assembly 104. The second panel assembly 106c is rotated through 90 degrees to form a sidewall, and seals against the frame 102d of the module 100d.

**[0071]** The module 100d is provided with a frame 102d and a second panel assembly 106d only. The frame 102d is positioned adjacent to, and coplanar with, the frame 102a of the module 100a. The second panel assembly 106d is rotated through 90 degrees to seal against the frame 102e of the module 100e.

**[0072]** The module 100e is provided with a frame 102e and a second panel assembly 106e only. The frame 102e is in its folded / stowed condition to form an end wall adjacent to, and coplanar with, the second panel assembly 106c of the module 100c.

**[0073]** The region D of Figure 9C is shown in more detail in Figure 9D. There is a gap G between the frames 102 and 102c, which is problematic for all of the reasons discussed in the introduction. The panel assemblies 104 and 104c can be sealed together however to seal the end wall of the building.

**[0074]** It will be noted that the first seal receiving formation 168 of the extrusion 144 of the first panel assembly 104 of the module 102 has a direct, uninterrupted line of sight to the first seal receiving formation 168c of the extrusion 144c of the first panel assembly 104c of the module 102c. In fact, the seal receiving formations 168, 168c are mirror images of each other.

**[0075]** Similarly, the second seal receiving formation 170 of the extrusion 144 of the first panel assembly 104 of the module 102 has a direct, uninterrupted line of sight to the second seal receiving formation 170c of the extrusion 144c of the first panel assembly 104c of the module 102c. In fact, the seal receiving formations 170, 170c are mirror images of each other.

**[0076]** A first gap seal 182 is provided simultaneously engage with the seal receiving formations 168, 168c. A second gap seal 184 is provided simultaneously engage with the seal receiving formations 170, 170c. The gap seals 182, 184 are identical foam seals, and are shown in section detail in Figure 9F. The gap seal 182 defines a first and second flange 186, 188 joined by a seal body 190 which extends between, and normal to, the flanges 186, 188. The flanges 186, 188 are constructed from a solid plastics material, whereas the seal body 190 is flexible, having a foam core 191 and membrane skin 193. Therefore the portions of the seal 182 (i.e. flanges 186, 188) which engages the seal receiving formations 168, 168c are unable to pass through the gap 171.

**[0077]** The fact that the seal pairs have a direct, uninterrupted line of sight to each other allows a simply unitary seal component (like seals 182, 184) to bridge the gap simply and effectively. Further, because the seal receiving formations are undercut, the flanges 186, 188 of the gap seals can only be inserted from the ends of the extrusions 142, 144 (i.e. from the top or bottom of the walls). The seals 182, 184 are fed in at the end of the extrusion and pulled along the extrusion until they extend the full length of the panel assemblies 104, 104c. Because of the co-operating shape of the flanges and the undercut seal receiving formations, the seals cannot be pulled out in the free end direction F of the extrusions.

**[0078]** The presence of two gap seals 182 (facilitated by two pairs of facing seal receiving formations 168, 168c; 170, 170c) provides a water- and air-tight seal for the building 14.

**[0079]** In all buildings 10, 12, 14 floor and roof panels are provided, the provision of which can be effected by the skilled person without further description here.

**[0080]** Variations of the above embodiments fall within the scope of the present invention.

**[0081]** The seal receiving formations may be any kind of seal engaging formations capable of holding a seal in place. For example, although in the above embodiment the seal members are male and the seal receiving formations female, the seals may define a female formation to receive part of the panel assembly.

**[0082]** Although the above embodiments provides separate extrusions defining panel-end features, it is en-

visaged that the panel assembly may instead be a unitary member constructed from e.g. additive layer manufacturing.

**[0083]** The modules 100 can be used to create NxM configuration buildings.

## Claims

### 1. A modular building assembly comprising:

a first module having a first module frame and a first module first side panel mounted on a side of the first module frame, the first module first side panel being moveable between a stowed position parallel to and adjacent the first module frame and a deployed position in which the first module first side panel projects from the first module frame, the first module first side panel defining an inter-panel seal engaging formation on at least one side;

a second module having a second module frame and a second module first side panel mounted on a side of the second module frame, the second module first side panel being moveable between a stowed position parallel to and adjacent the second module frame and a deployed position in which the second module first side panel projects from the second module frame, the second module first side panel defining an inter-panel seal engaging formation on at least one side;

an inter-panel seal having a first panel engaging formation and a second panel engaging formation;

in which when the first and second modules are placed with their respective frames in an adjacent and co-planar relationship, the seal can be simultaneously engaged with the seal engaging members of each first side panel to seal the first and second modules together.

2. A modular building assembly according to claim 1, in which the first module first side panel and the second module first side panel have an uninterrupted line of sight therebetween.

3. A modular building assembly according to claim 2, in which the inter-panel seal engaging formation of the first module first side panel and the inter-panel seal engaging formation of the second module first side panel are configured to have an uninterrupted line of sight therebetween before the inter-panel seal is inserted.

4. A modular building assembly according to any preceding claim, in which each first side panel defines an adjacent pair of inter-panel seal engaging forma-

tions, and in which two adjacent inter-panel seals are provided between each first side panel.

5. A modular building assembly according to claim 4, in which each of the pair of inter-panel seal engaging formations is positioned either side of a central plane of the respective first side panel. 5
6. A modular building assembly according to any preceding claim, in which each first side panel further defines a frame seal engaging formation facing the respective first or second module frame. 10
7. A modular building assembly according to claim 6, in which the frame seal engaging formations face in a direction normal to the respective inter-panel seal engaging formations. 15
8. A modular building assembly according to any preceding claim, in which each of the first and second module first side panels is pivotably mounted to the respective frame. 20
9. A modular building assembly according to any preceding claim, in which: 25  
the first module has a first module second side panel mounted on a side of the first module frame opposite to the first module first side panel, the first module second side panel being moveable between a stowed position parallel to and adjacent the first module frame and a deployed position in which the first module second side panel projects from the first module frame; and, 30  
the second module has a second module second side panel mounted on a side of the second module frame opposite to the second module first side panel, the second module second side panel being moveable between a stowed position parallel to and adjacent the second module frame and a deployed position in which the second module second side panel projects from the second module frame. 35  
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10. A modular building assembly according to claim 9, in which each first and second side panels is rotatable about a respective first and second panel axis, in which the first panel axis is at a first end of the frame, and the second panel axis is at a second end of the frame such that the respective frame and panels can form a "Z" shape. 50
11. A modular building assembly according to any preceding claim, in which each of the side panels comprises a panel member and an edge member attached to opposite edges of the panel member, which edge members define the inter-panel seal en- 55

gaging formation or formations.

12. A modular building assembly according to claim 11, in which the edge members are extrusions defining the inter-panel seal engaging formation or formations parallel to an axis of extrusion.
13. A modular building assembly according to claim 11 or 12, in which the edge members define one side of a rotational joint to facilitate rotation of the side panel from the stowed and deployed positions.
14. A modular building assembly according to any preceding claim, in which the side panels comprise a cellular core with an outer skin preferably constructed from a thermally bonded polymer material.
15. A method of constructing a modular building comprising the steps of:  
providing a first module having a first module frame and a first module first side panel mounted on a side of the first module frame, the first module first side panel being moveable between a stowed position parallel to and adjacent the first module frame and a deployed position in which the first module first side panel projects from the first module frame;  
providing a second module having a second module frame and a second module first side panel mounted on a side of the second module frame, the second module first side panel being moveable between a stowed position parallel to and adjacent the second module frame and a deployed position in which the second module first side panel projects from the second module frame;  
aligning the first and second module frames in an adjacent and co-planar relationship;  
providing an inter-panel seal;  
using the inter-panel seal to seal the first and second module first side panels together.



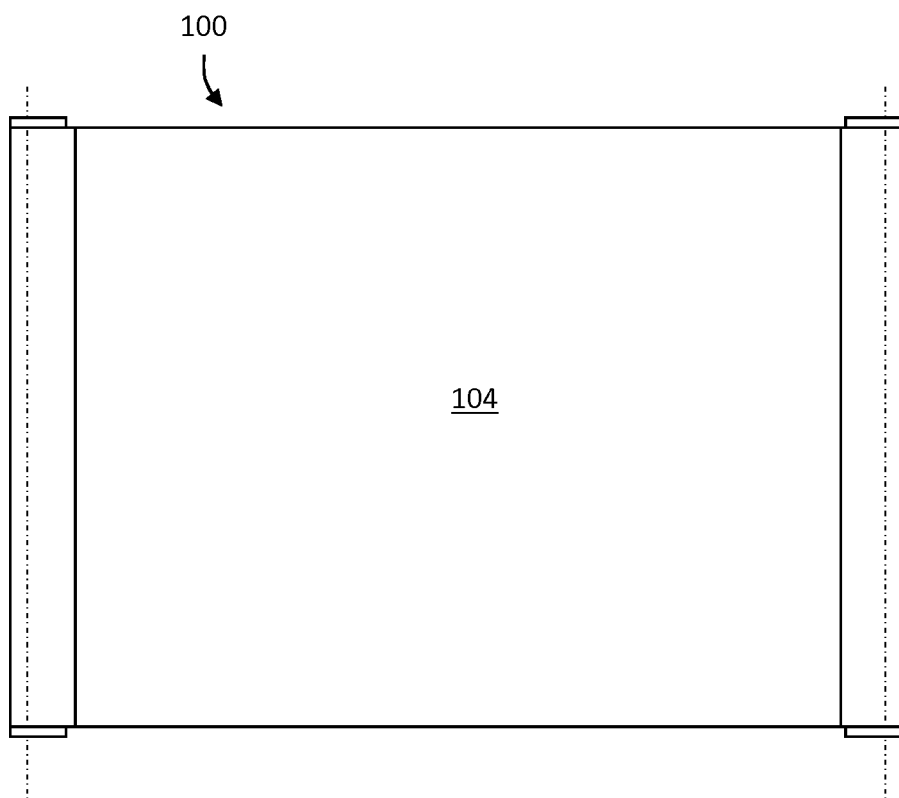


Fig.1A

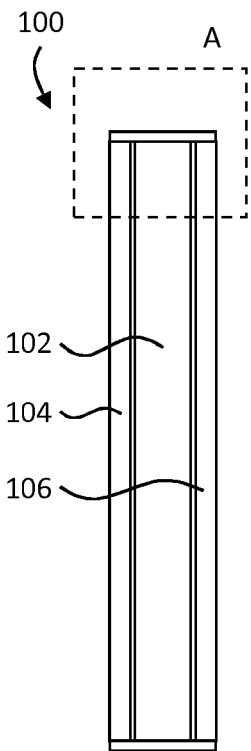


Fig.1B

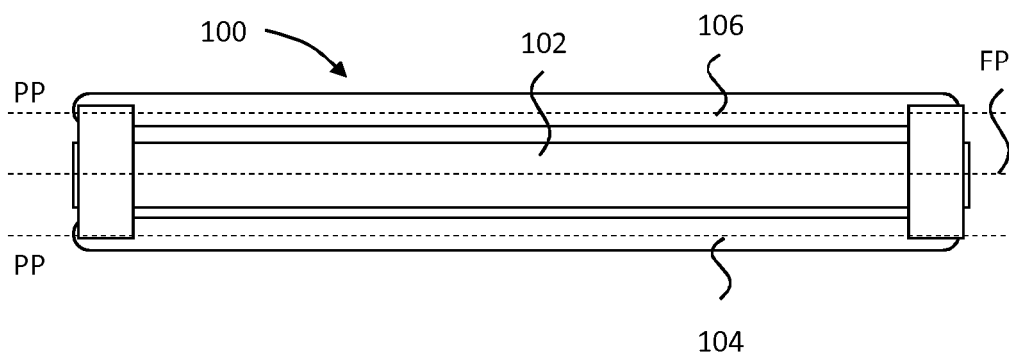


Fig.1C

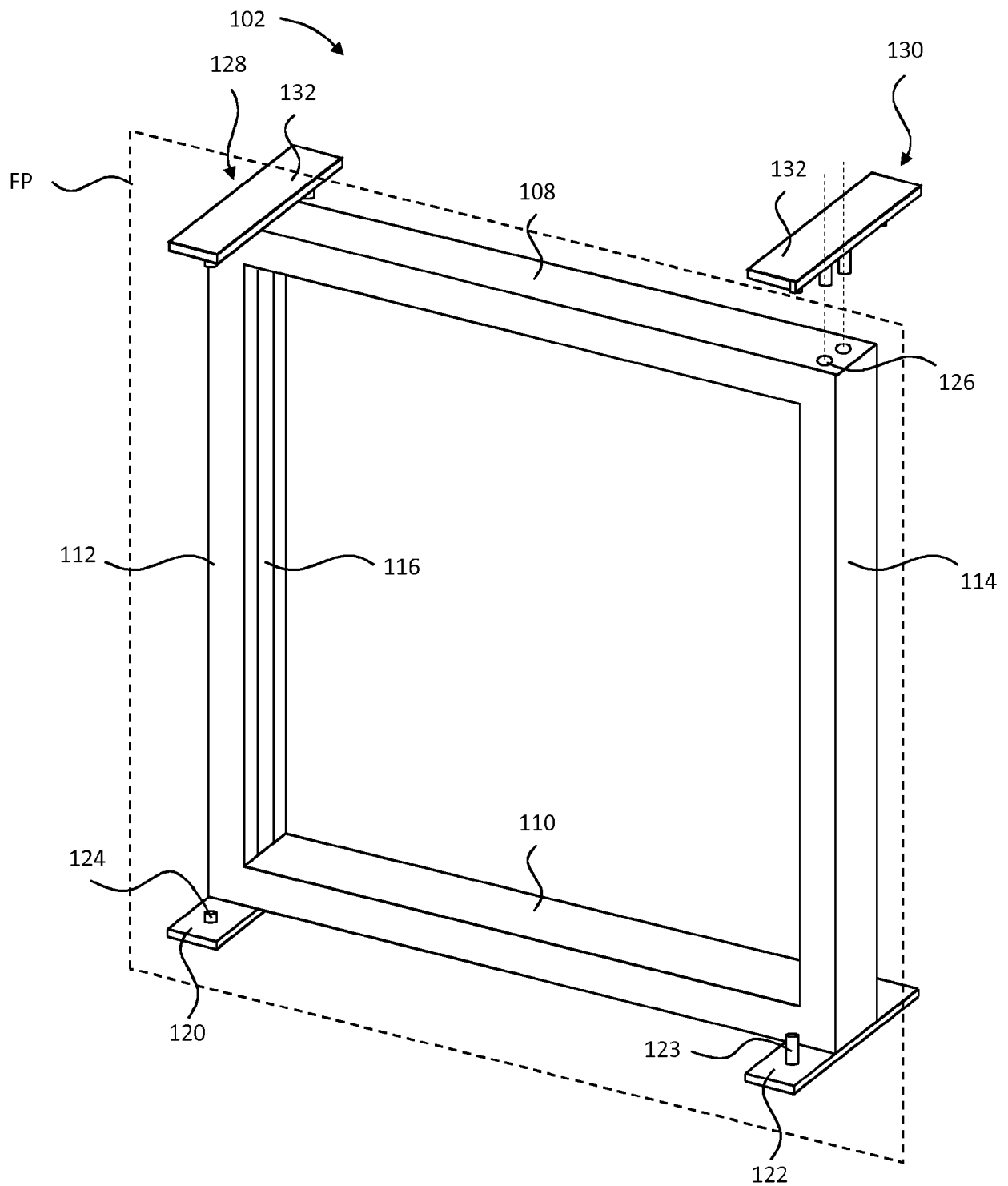


Fig.2

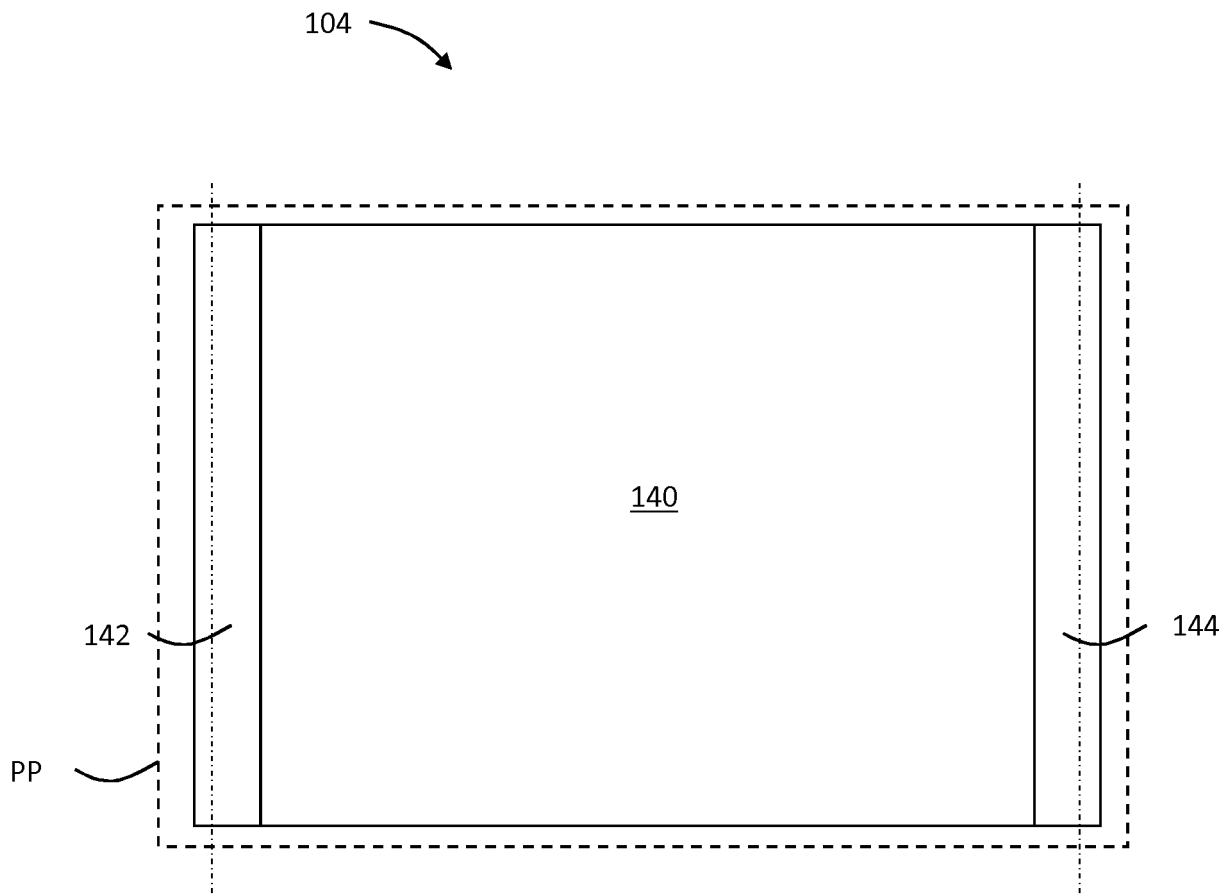


Fig.3

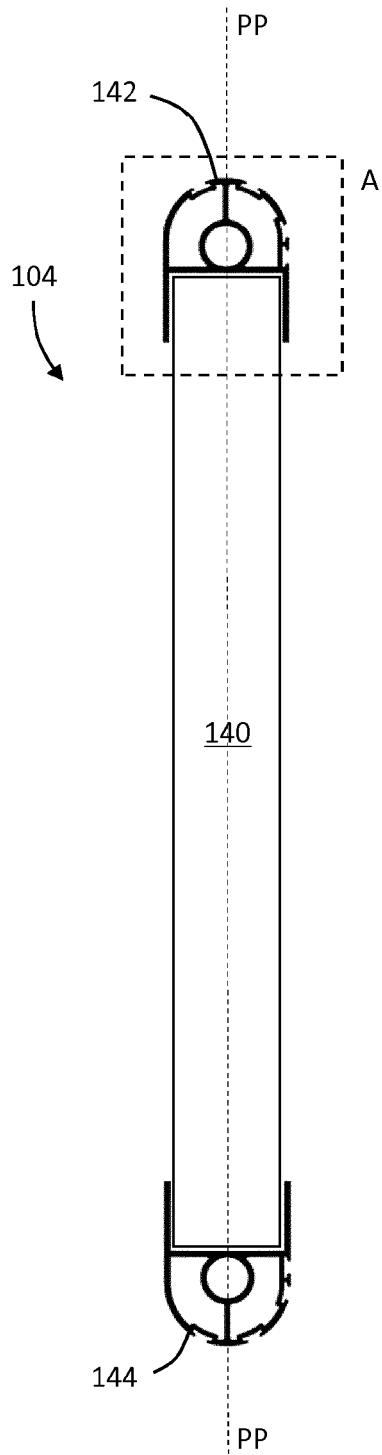


Fig. 4

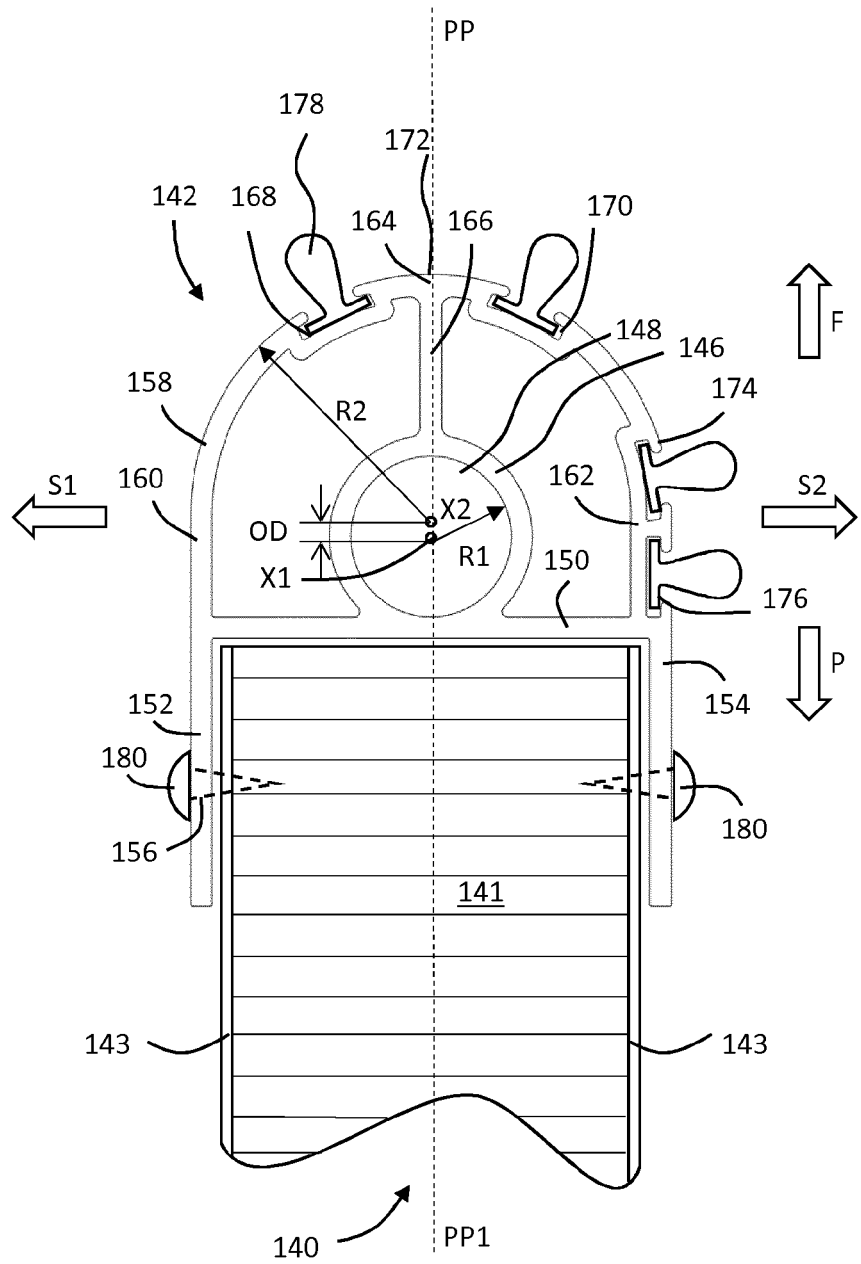


Fig. 4A

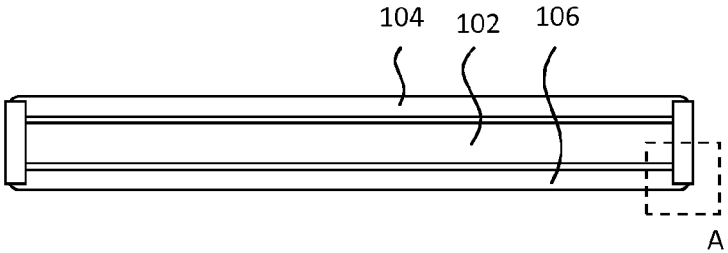


Fig.5

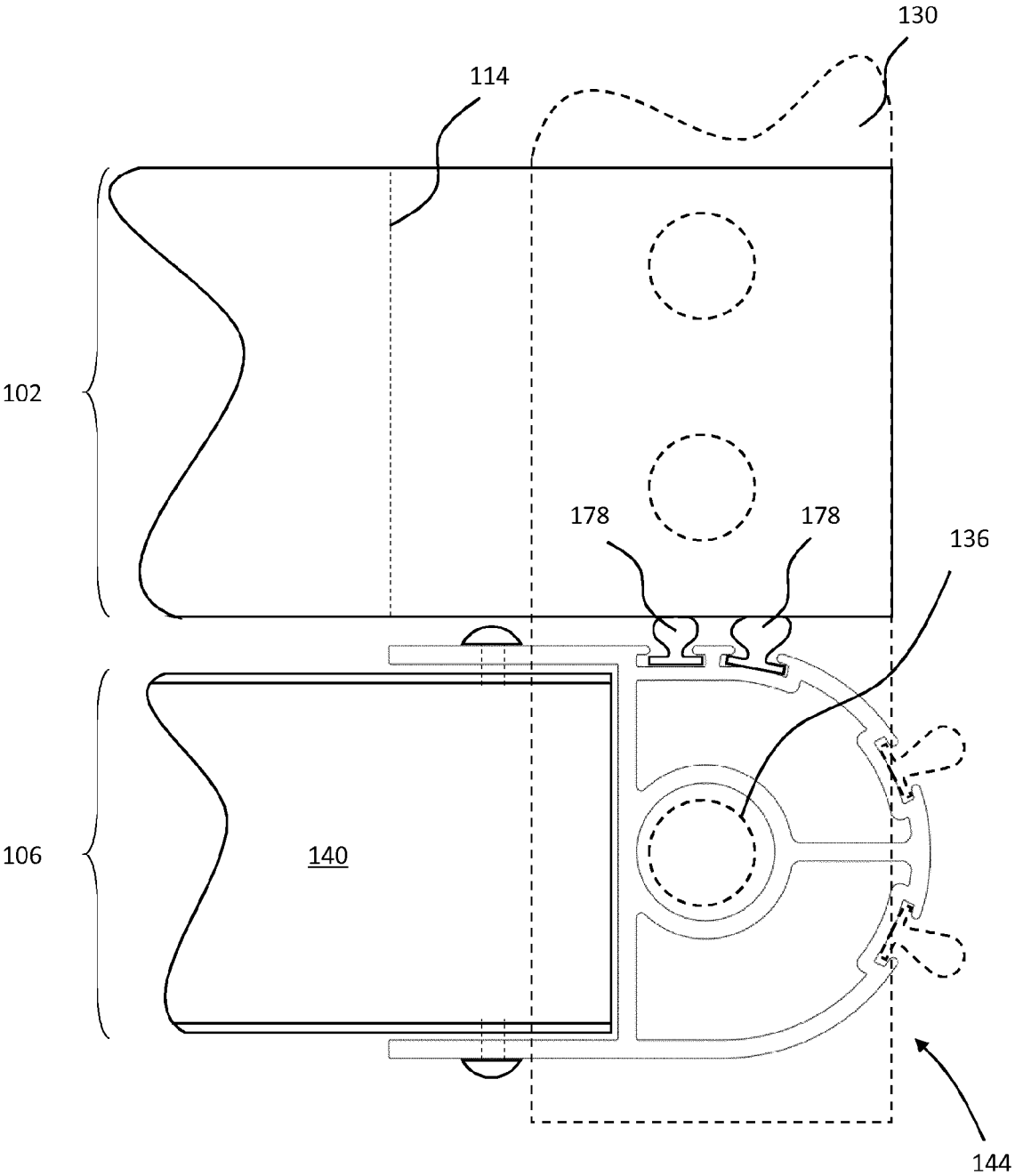


Fig.5A

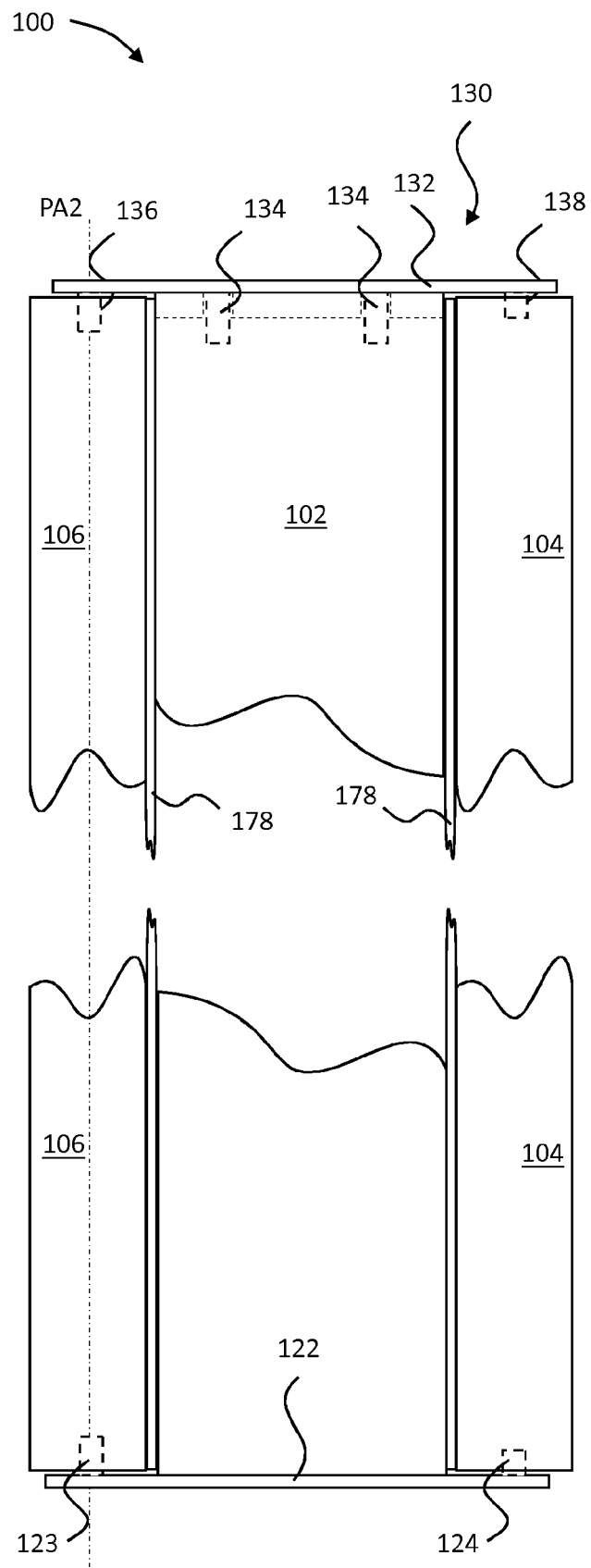


Fig.6A

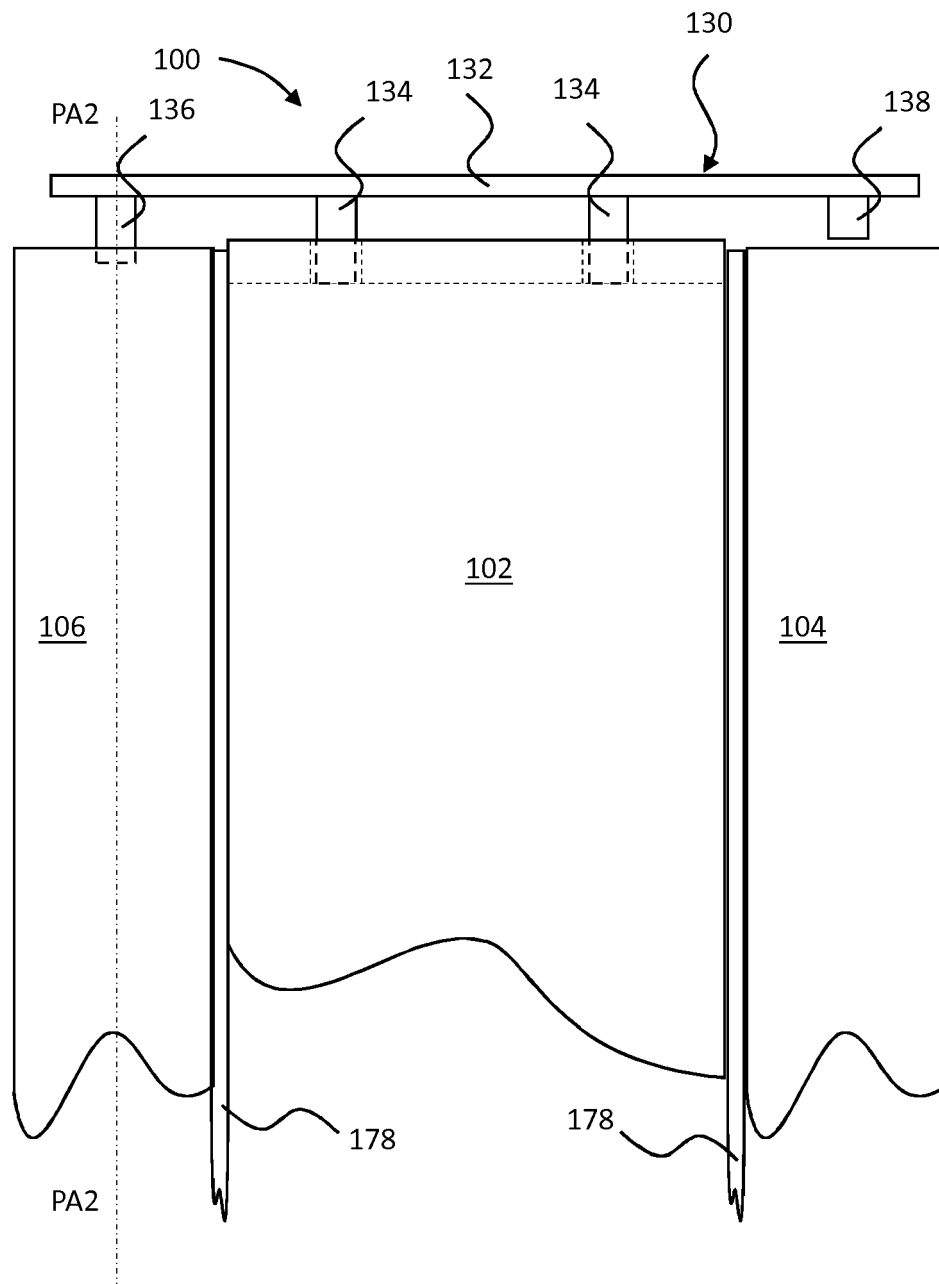


Fig.6B

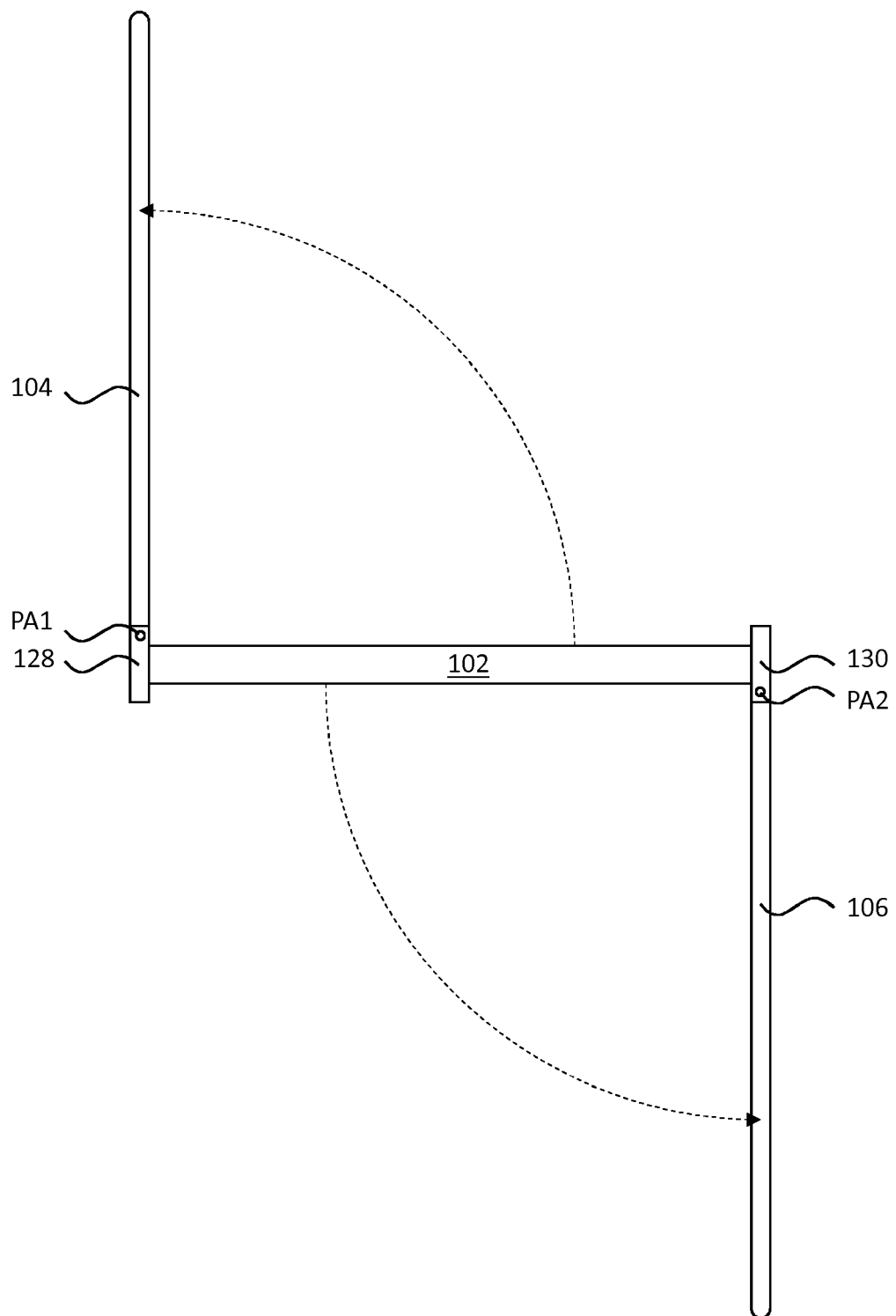


Fig.7



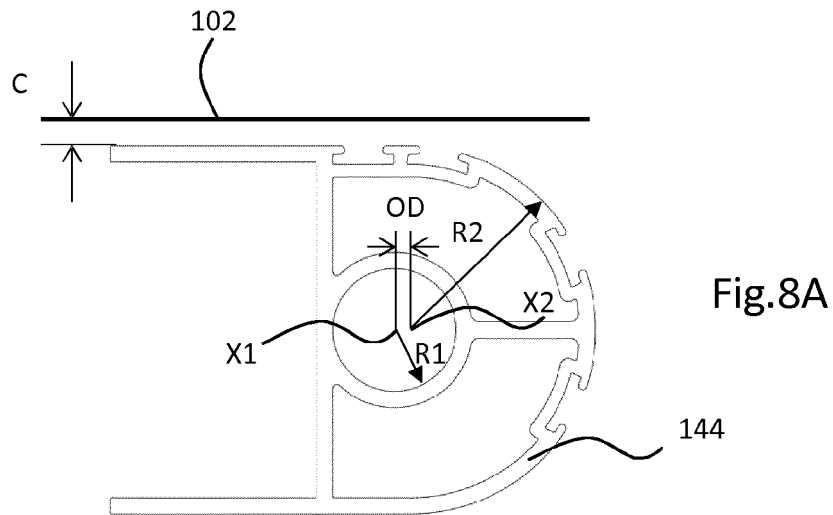


Fig. 8A

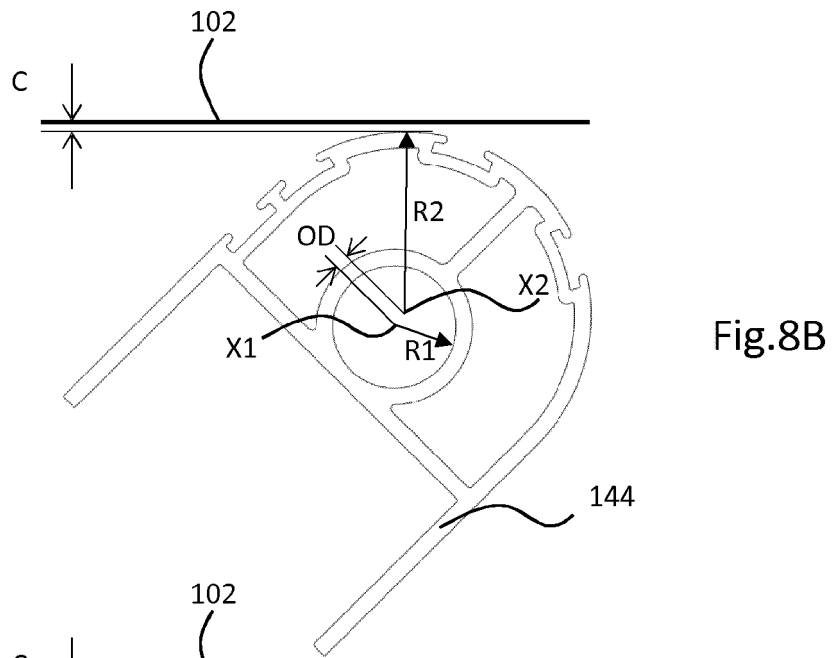


Fig. 8B

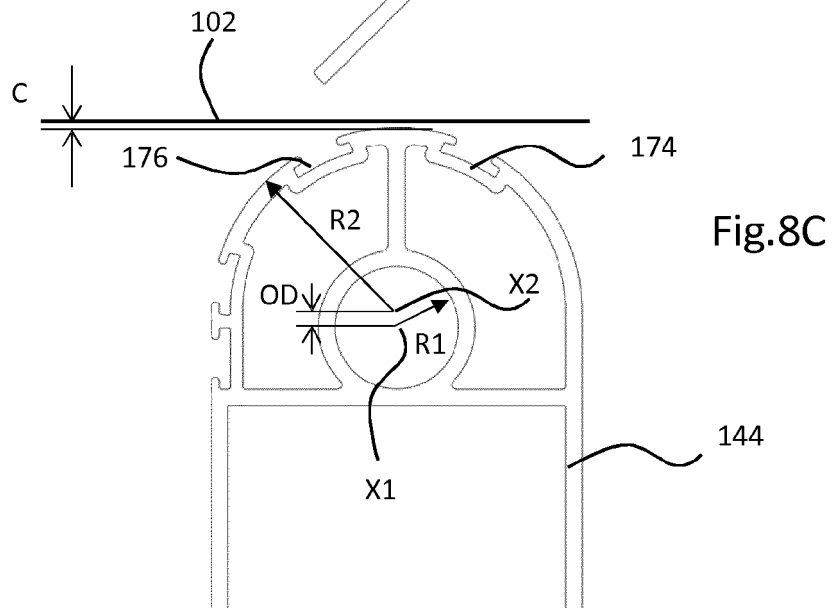


Fig. 8C

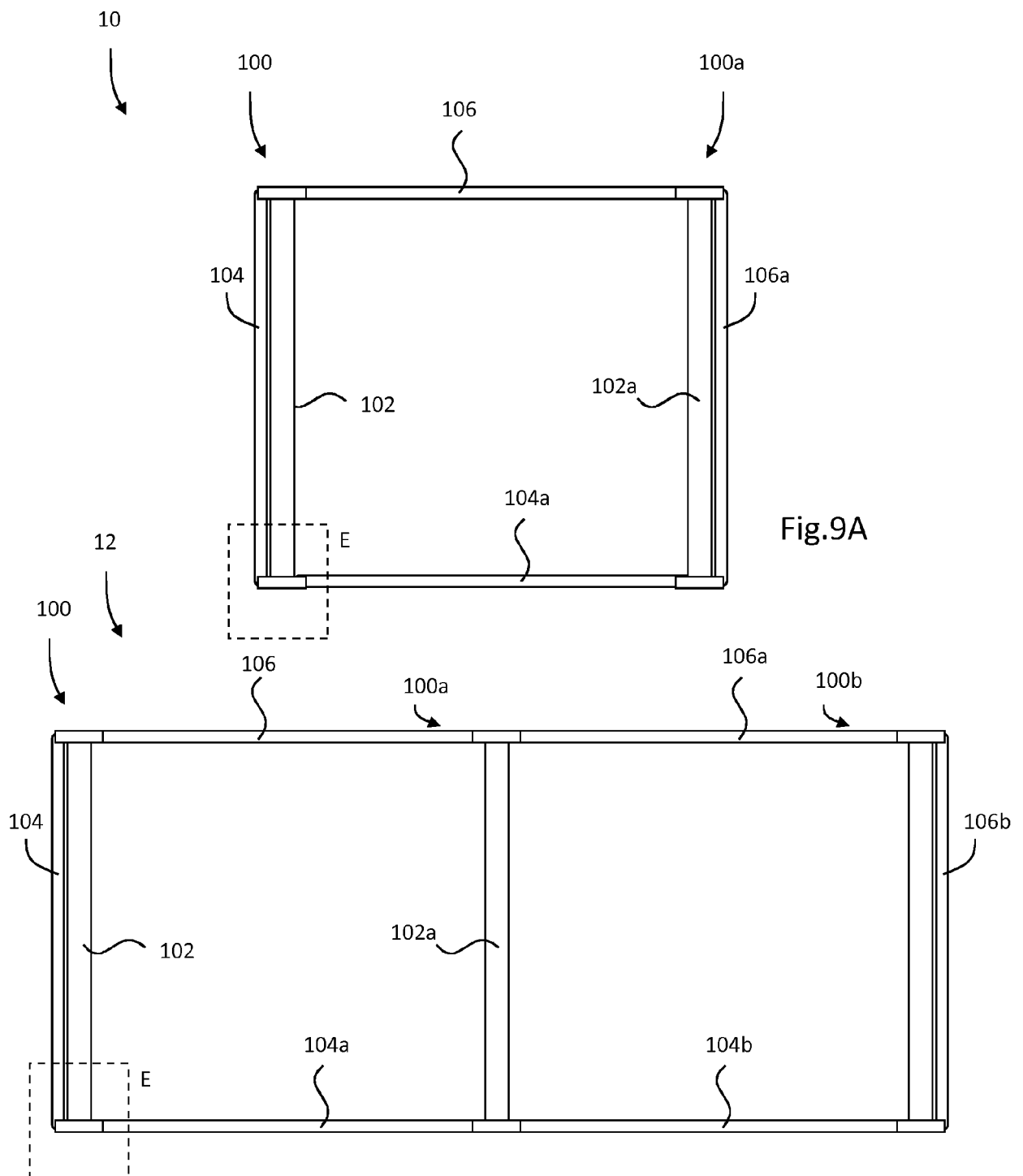


Fig.9B

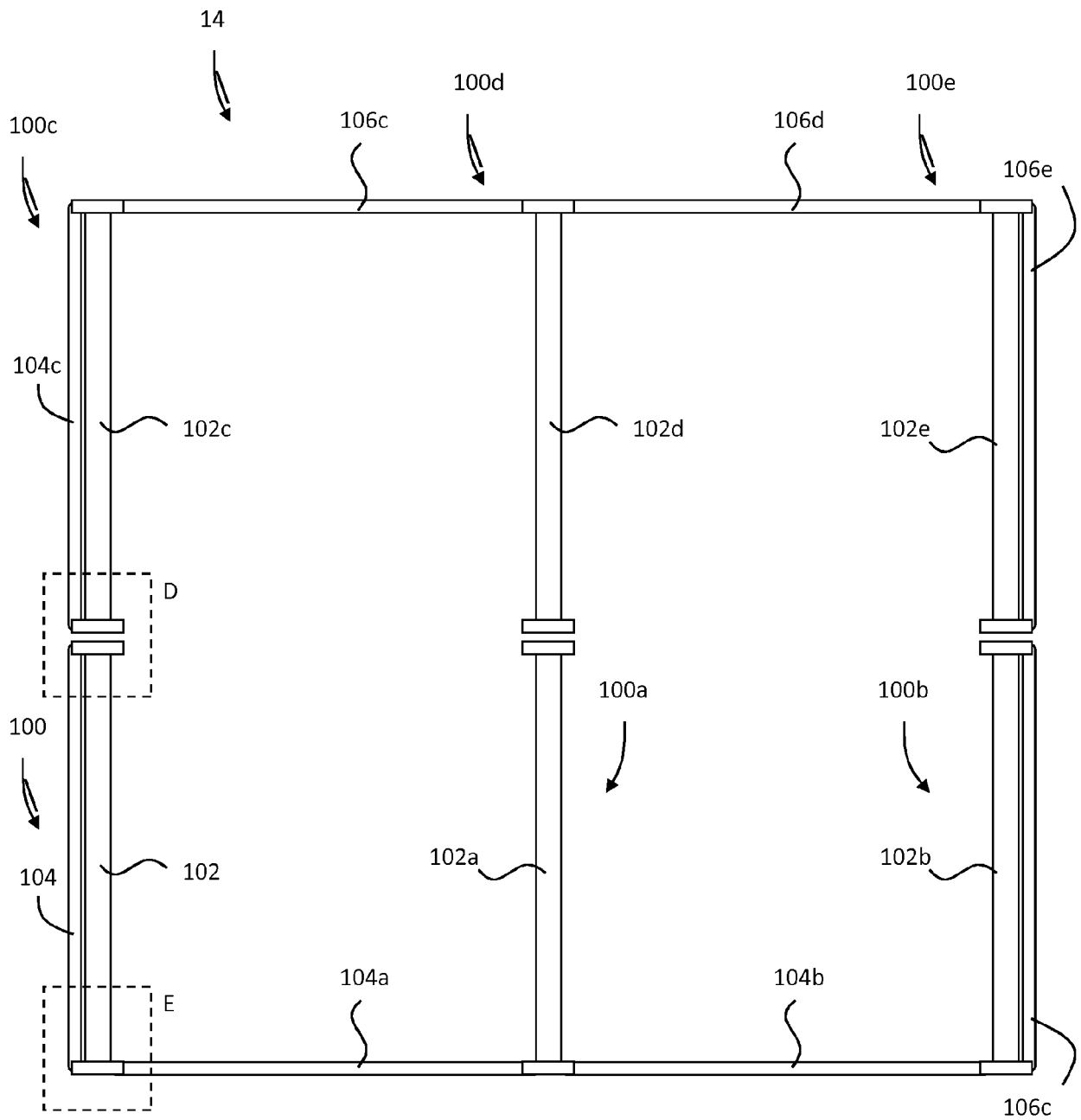


Fig.9C

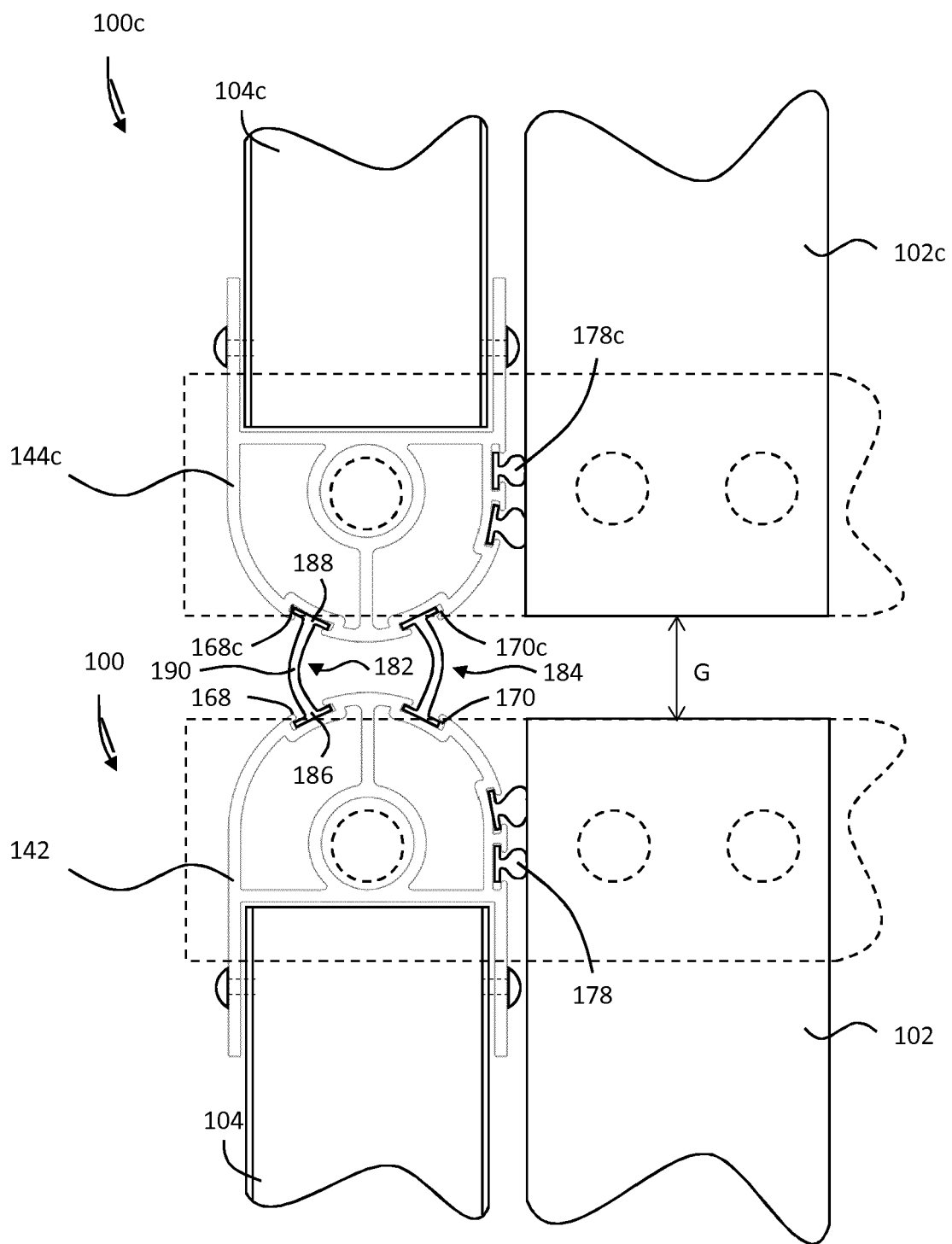
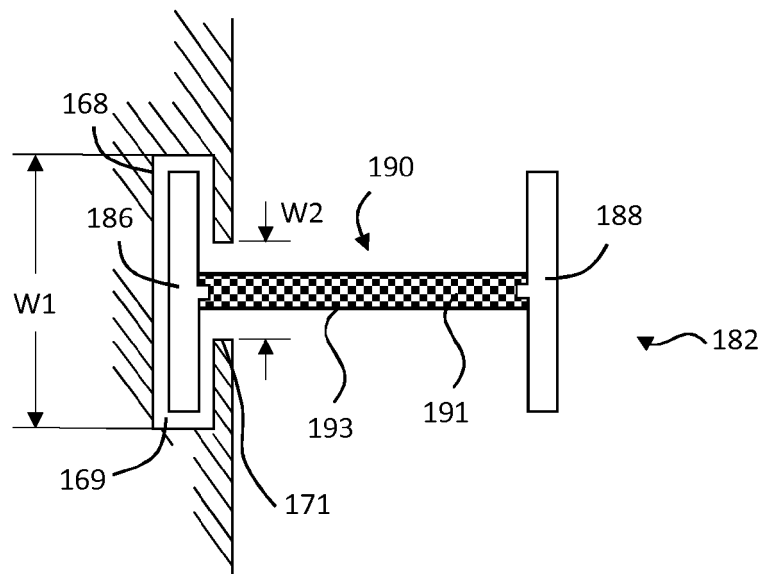
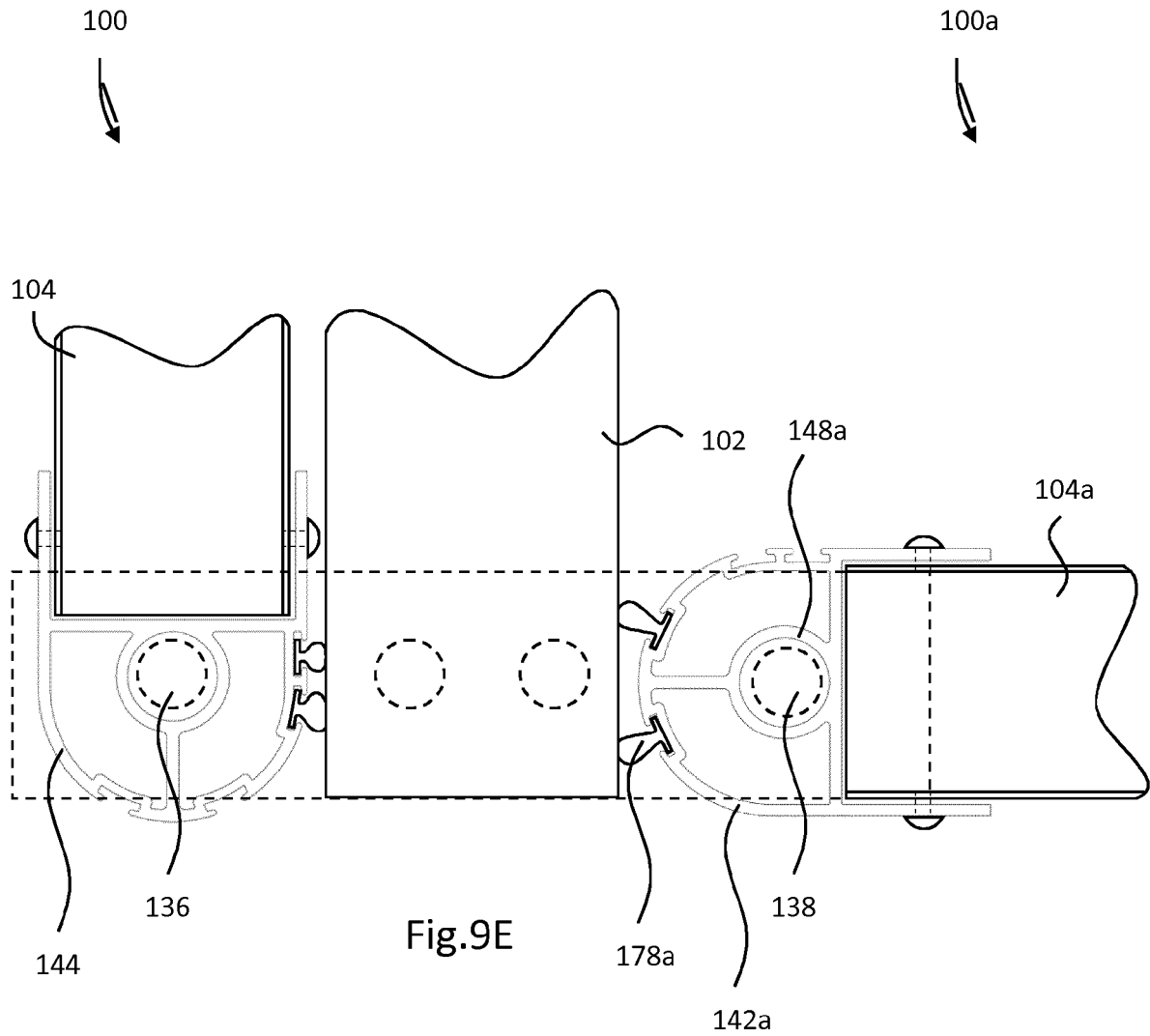


Fig.9D





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A	WO 97/30257 A1 (INNOVATION DEV ENTERPRISE I ST [SE]; GYLLENHAMMAR THORBJOERN [SE]) 21 August 1997 (1997-08-21) * page 1, line 1 - page 3, line 7; figures 1-4 *	1-15	
A,D	US 5 904 005 A (DYER DAVID CHARLES [GB] ET AL) 18 May 1999 (1999-05-18) * column 1, line 3 - column 6, line 21; figures 1-31 *	1-15	
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			E04B
The present search report has been drawn up for all claims			
Place of search <b>The Hague</b>		Date of completion of the search <b>20 January 2017</b>	Examiner <b>Dieterle, Sibille</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

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