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MODULE BUILDING FRAME AND MODULE BUILDING SYSTEM

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Abstract

A module frame 30 comprises a generally rectangular horizontal base frame 32 and a generally rectangular horizontal upper frame 34 which are connected by spaced vertical members 36 therebetween. The base frame 32 comprises base side chords 40 and base end chords 42. Similarly, the upper frame 34 comprises upper side chords 50 and upper end chords 52. The base side chord comprises spaced coupling plates 86. The upper side chord 50 comprises spaced attachment cleats 96. The attachment cleats 96 are disposed to be respectively vertically aligned with the coupling plates 86 of the base side chord 40.

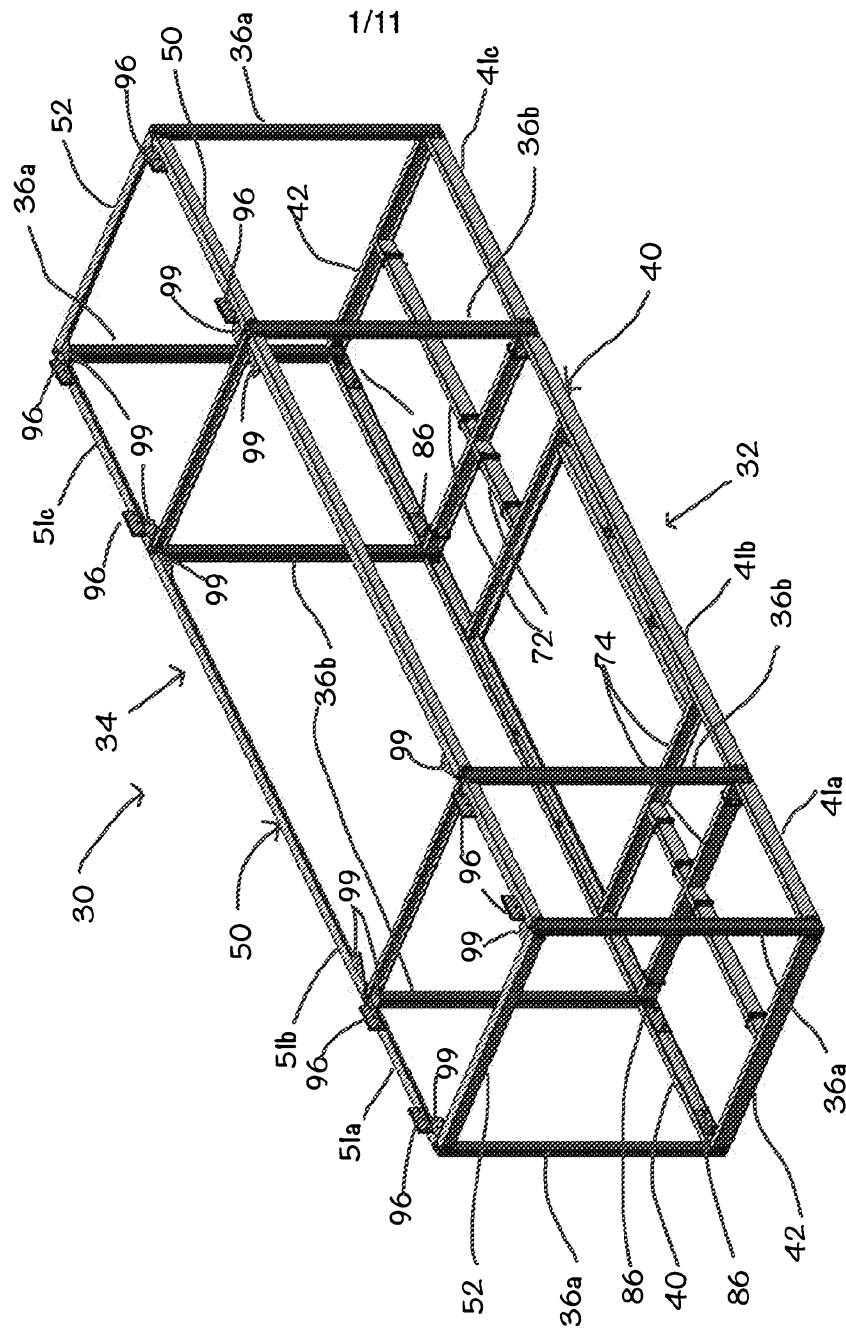


Figure 1

MODULE BUILDING FRAME AND MODULE BUILDING SYSTEM

Field of the Invention

[1] The present invention relates to a module building frame and a module building system.

Background of the Invention

[2] There are presently a number of steel-frame module building systems on the market. Whilst some are approved for single level accommodation, many are not approved for building multi-level structures particularly in Australia and New Zealand, which have some of the higher standards of fire proofing

[3] The present invention seeks to overcome or substantially ameliorate at least some of the deficiencies of the prior art, or to at least provide an alternative.

[4] It is to be understood that, if any prior art information is referred to herein, such reference does not constitute an admission that the information forms part of the common general knowledge in the art, in Australia or any other country.

Summary of the Invention

[5] According to a first aspect, the present invention provides a module frame comprising:
an upper frame having a first attachment means extending upwardly from the upper frame; and

a base frame having a second attachment means adapted to be attachable to the first attachment means of another module frame.

[6] In a preferred embodiment, the first and second attachment means of the module frame are respectively attachable to the first and second attachment means of another laterally disposed module frame.

[7] In another preferred embodiment, the module frame comprises a generally rectangular prism structure.

[8] In another preferred embodiment, the module frame comprises a generally rectangular base frame and a generally rectangular upper frame which are connected by vertical members therebetween.

[9] In another preferred embodiment, the second attachment means comprises spaced coupling plates in the base frame.

[10] In another preferred embodiment, the base frame comprises C-section beams having a main side web and lower and upper side webs, wherein the coupling plates extend between distal edges of the side webs.

[11] In another preferred embodiment, the first attachment means comprises spaced attachment cleats in the upper frame.

[12] In another preferred embodiment, the attachment cleats are disposed at an upper surface of the upper frame

[13] In another preferred embodiment, each attachment cleat is disposed adjacent an inner edge of the upper frame and defines a seat on the upper surface between the attachment cleat and an outer edge of the upper frame. .

[14] In another preferred embodiment, the upper frame further comprises spaced support tabs which extend inwardly and horizontally.

[15] In another preferred embodiment, the upper frame further comprises spaced mount brackets which extend generally downwardly.

[16] In another preferred embodiment, the module frame further comprises a floor panel system secured to the base frame above the second attachment means.

[17] In another preferred embodiment, the floor panel system is secured to an upper surface of the base frame.

[18] In another preferred embodiment, the floor panel system further includes a removable access panel.

[19] In another preferred embodiment, the floor panel system is a fireproof panel system.

[20] In another preferred embodiment, the module frame further comprises a ceiling panel system secured to the upper frame below the first attachment means.

[21] In another preferred embodiment, the module frame further comprises a ceiling panel system secured to the mount brackets.

[22] In another preferred embodiment, the ceiling panel system includes a removable access panel.

[23] In another preferred embodiment, the ceiling panel system is a fireproof panel system.

[24] In another preferred embodiment, the module frame further comprises side wall panel systems extending between the upper frame and the base frame.

[25] In another preferred embodiment, the side wall panel systems comprise an internal skin, an external skin and a middle insulating and/or fireproofing layer

[26] In another preferred embodiment, the first and second attachment means comprise attachment plates having at least one aperture for receiving a respective bolt or elongate fastening means.

[27] The present invention in another aspect provides a building comprising
a lower module frame according to any one of the above; and
an upper module frame according to any one of the above disposed above the lower module frame, wherein the base frame of the upper module frame is attached to the upper frame of the lower module frame via the adjacent first and second attachment means.

[28] In a preferred embodiment, the first attachment means of the lower module frame substantially prevents lateral movement of the upper module frame prior to attachment of the adjacent first and second attachment means.

[29] In another preferred embodiment, each module frame comprises a floor panel system secured to the base frame above the second attachment means, and a ceiling panel system secured to the upper frame below the first attachment means, wherein the respective adjacent floor panel and ceiling panel systems form therebetween a services cavity.

[30] In another preferred embodiment, the building further comprises insulation means mounted in the services cavity.

[31] The present invention in another aspect provides a building comprising
a first module frame according to any one of the above; and
a second module frame according to any one of the above disposed laterally adjacent the first module frame, wherein the adjacent first and second attachment means of the first and second module frames are attached to each other.

[32] The present invention in another aspect provides a building comprising
a first module frame according to any one of the above;
a second module frame according to any one of the above disposed laterally adjacent the first module frame;
a third module frame according to any one of the above disposed above the first module frame; and
wherein the adjacent first and second attachment means at the junction between the first to third module frames are attached to each other.

[33] In another preferred embodiment, the building further comprises a fourth module frame according to any one of the above disposed above the second module frame, wherein the adjacent first and second attachment means at the junction between the first to fourth module frames are attached to each other.

[34] In a preferred embodiment, a single fastener can extend through each set of adjacent first and second attachment means.

[35] In another aspect, the present invention provides a module frame comprising:

an upper frame,

a base frame,

vertical members extending between the upper and base frames, and

at least one vertical connector for connecting the vertical member to the vertical member of another module frame disposed on top of the module frame.

[36] In a preferred embodiment, the vertical connector comprises a vertical connection bar extending through an aperture formed in the upper frame.

[37] In another preferred embodiment, the vertical connector comprises a vertical connection bar extending through an aperture formed in the base frame.

[38] In a preferred embodiment, the module frame further comprises at least one horizontal connector for connecting the vertical member to the vertical member of another module frame disposed adjacent the module frame.

[39] In another preferred embodiment, the horizontal connector comprises a horizontal plate extending through an aperture formed in the vertical member.

[40] Other aspects of the invention are also disclosed.

Brief Description of the Drawings

[41] Notwithstanding any other forms which may fall within the scope of the present invention, preferred embodiments of the present invention will now be described, by way of examples only, with reference to the accompanying drawings in which:

[42] Fig. 1 is an isometric view of a module frame in accordance with a first preferred embodiment of the present invention;

[43] Fig. 2 is an isometric close-up view showing a base chord of an upper module frame being disposed over and joined to an upper chord of a lower module frame;

[44] Fig. 3 (a) to (c) illustratively show in schematic cross-section the steps in joining the base chord of the upper module frame to the upper chord of the lower module frame of Figure 2;

[45] Fig. 4 is a schematic cross section showing external walls added to the upper and lower module frames of Figures 2 and 3;

[46] Fig. 5 shows a modified embodiment of the assembly shown in Figures 2 and 3;

[47] Fig. 6 (a) and (b) illustratively shows in schematic cross-section a junction between four adjacent module frames and the steps in joining the base chord of two adjacent upper module frames to the respective upper chords of two adjacent lower module frames;

[48] Fig. 7 is another schematic cross-section view of the junction shown in Figure 6;

[49] Fig. 8 (a) to (c) show alternative embodiments of the module frame;

[50] Fig. 9 is a schematic perspective view showing a possible arrangement of a plurality of module frames according to the present invention;

[51] Fig. 10 is a top view of a section of the assembly of Figure 9;

[52] Fig. 11 is a perspective view of a lower corner of a module frame showing an alternative connection means; and

[53] Fig. 12 shows (a) end cross-section view and (b) side view of the connection of modules using the modified version shown in Figure 11.

Description of Embodiments

[54] It should be noted in the following description that like or the same reference numerals in different embodiments denote the same or similar features.

[55] Figure 1 shows a module frame 30 according to a first preferred embodiment of the present invention. The module frame 30 is a steel frame of a hollow generally rectangular prism structure and comprises a generally rectangular horizontal base frame 32 and a generally rectangular horizontal upper frame 34 which are connected by eight spaced vertical members 36 therebetween.

[56] The vertical members 36 comprise corner four vertical members 36a and four intermediate vertical members 36b, two on each side of the module frame 30.

[57] The base frame 32 comprises base side chords 40 and base end chords 42. Similarly, the upper frame 34 comprises upper side chords 50 and upper end chords 52.

[58] In the embodiment, each base side chord 40 comprises separate members 41a, 41b and 41c, with respective ends of the members 41 being connected to lower ends 37 of

respective vertical members 36. In the embodiment, the member 41a is the shortest, the member 41b is the longest and the member 41c has a length in between the members 41a and 41b. The member 41a extends from a corner vertical member 36 to a first intermediate vertical member 36b, the member 41b extends between the first and second intermediate vertical members 36b, and the member 41c extends from the second intermediate vertical member 36b to the other corner vertical member 36a.

[59] Each end of the members 41 is attached to its adjacent vertical member 36 via a suitable means such as an attachment plate and/or by welding. Similar attachment configurations are provided between the base end chords 42 and the corner vertical members 36a.

[60] Similarly, the upper side chords 50 comprise separate members 51a, 51b and 51c which are respectively of similar lengths to the members 41a, 41b and 41c. The members 51 are connected to upper ends 38 of the respective vertical members 36 in a similar manner. Similar attachment configurations are provided between the upper end chords 52 and the corner vertical members 36a.

[61] The base side chords 40 and the upper end chords 50 can alternatively be single length continuous members.

[62] The base frame 32 further comprises intermediate longitudinal members 72 and intermediate cross members 74, the configuration of which depends on the application requirements of the module frame 30.

[63] As shown in Figures 1 and 3, the base side chords 40 are C-section beams having a main web 82 and first and second side webs 84a and 84b extending perpendicularly from respective longitudinal edges of the main web 82. The main webs 82 are disposed to form the external face of the lower side chords 40 with the side webs 84 extending internally. The first side web 84a thus becomes a lower side web and the second side web 84b becomes an upper side web.

[64] Each of the members 41a and 41c of the base side chord 40 further comprises spaced coupling plates 86 disposed at an inner portion thereof, extending between distal edges of the side webs 84a and 84b. In each of the members 41a and 41c, a first coupling plate 86 is disposed adjacent a corner vertical member 36a and a second coupling plate 86 is disposed adjacent an intermediate vertical member 36b. The coupling plates 86 each comprise bolt apertures 87 which are respectively aligned with bolt apertures 45 formed in the main web 82 (see Fig. 2).

[65] As also shown in Figures 1 and 3, the upper side chords 50 are L-section beams having a first web 92 and a second web 94 extending perpendicularly from a longitudinal edge of the first web 92. The first web 92 is disposed to form the upper face of the upper side chord 50 with the second webs 94 extending downwardly and forming the outer face of the upper side chord 50.

[66] Each of the members 51a and 51c of the upper side chord 50 further comprises spaced attachment cleats 96 disposed at an upper surface of the first web 92 with each attachment cleat 96 extending upwardly. Thus, each attachment cleat 96 extends upwardly from the upper surface of the module frame 30. Each attachment cleat 96 is disposed adjacent a distal edge of the first web 96, thus defining a seat 98 on the upper surface of the first web 92 between the attachment cleat 96 and the second web 94.

[67] In each of the members 51a and 51c, a first attachment cleat 96 is disposed adjacent a corner vertical member 36a and a second attachment cleat 96 is disposed adjacent an intermediate vertical member 36b. The attachment cleats 96 are disposed to be respectively vertically aligned with the coupling plates 86 of the base side chord 40. As shown in Figure 2, each attachment cleat 96 comprises bolt apertures 97.

[68] As shown in Figures 1 and 2, the upper frame 34 further comprises spaced support tabs 99 which extend inwardly and horizontally from the first web 92 of the upper side chord 50. The support tabs 99 are disposed in the junctions between the members 51 of the upper side chord 50 and the vertical members 36. Each support tab 99 has at least one attachment aperture therein.

[69] As shown in Figure 3, the upper frame 34 further comprises spaced mount brackets 102 attached to an inner surface of the second webs 94, at a lower portion of the second webs 94. The mount brackets 102 comprise a lower section 104 which extends below the lower end of the second web 94.

[70] Still referring to Figure 3, in use, building panels 110 and 120 as needed are secured to the module frame 30. Floor panels 110 are secured to the base frame 32 at the upper surface of the base side chords 40 and base end chords 42. The floor panels 110 are thus secured to the upper side web 84b, and the coupling plates 86 extend downwardly relative to the floor panels 110. Ceiling panels 120 are secured to the mount brackets 102 of the upper frame 34. The ceiling panels 120 are secured to the lower section 104 of the mount brackets 102 and extend between upper side chords 50 and upper end chords 52, and thus below the attachment cleats 96.

[71] Figures 2 and 3 illustratively show the steps in joining the base chord 40 of an upper module frame 30b to the upper chord 50 of a lower module frame 30a. The upper module

frame 30b is lowered onto the lower module frame 30a, such that on each lateral side of the modules 30, the base chord 40 is disposed over the seat 98 of the upper chord 50. This positions each attachment cleat 96 of the lower module frame 30a adjacent a respective coupling plate 86 of the upper module frame 30b, with the attachment cleats 96 substantially preventing lateral movement of the upper module frame 30b. The bolt apertures 87 and 97 of the coupling plate 86 and attachment cleat 96 are then respectively aligned, and a nut and bolt fastener 130 is inserted therethrough to attach each coupling plate 86 to its adjacent attachment cleat 96. This secures the upper module frame 30b to the lower module frame 30a.

[72] An additional module frame 30 can be mounted to the upper module 30b and a plurality of module frames 30 can be stacked to each other in a similar manner.

[73] The joining procedure described above can be performed with the building panels 110 and 120 already secured to the module frame 30. The joining means, being the coupling plates 86 which extend downwardly relative to the floor panels 110 and the attachment cleats 96 which extend upwardly relative to the ceiling panels 120, allow the building panels 110 and 120 to not interfere in the joining procedure between the upper and lower modules 30b and 30a. The ceiling panel 120 can further include a removable access panel 122 which will allow a worker to access the joining means – being each pair of coupling plate 86 and attachment cleat 96 for joining them to each other, from within the module frame 30.

[74] These features provide a significant advantage to the speed and ease of joining module frames 30 compared to the prior art. One such advantage is that the building panels 110 and 120 can be pre-installed and pre-finished onto the module frame 30 and do not have to be installed and finished on-site. This significantly reduces transport and assembly time of the module frames 30, particularly for high rise building applications. Also, the worker joining the module frames 30 can access the joining means from within the lower module 30. This means the worker does not have to access the joining means externally of the building being built and his safety is significantly improved.

[75] Fig. 4 is a schematic cross section showing external side walls 140 added to each module frame 30 of Figure 3. Each external side wall 140 extends between the base frame 32 and the upper frame 34 of the respective module frame 30, and is attached to external surfaces thereof. The external side wall 140 can be configured as desired, and in the embodiment includes an internal skin 142, an external skin 144 and a middle layer 146 which can be an insulating and/or fireproofing layer. The external side walls 140 can be configured as a fire rated wall, strata wall, party wall or common wall system

[76] The external side walls 140 can also be pre-installed to the module frames 30 similar to the building panels 110 and 120, as the external side walls 140 will not interfere in the joining procedure of the module frames 30.

[77] Fig. 5 shows a modified embodiment of the assembly shown in Figures 2 and 3, which shows other possible configurations. Similar parts are referred to with similar reference numerals. In this configuration shown, the floor panel 110 is provided with a removable access panel 112 for accessing the joining means. The floor panel 110 is also shown with skirting 116 and an acoustic insulator 114 disposed on the underside of the floor panel 110. The ceiling panel 120 is shown with a cornice 124.

[78] The floor panel 110 and ceiling panel 120 can alternatively be formed as composite systems, being fire rated and/or insulated similar to the external side walls 140.

[79] The floor panel 110 and ceiling panel 120 form therebetween a services cavity 160 within which services can be run and the insulator 114 can be mounted.

[80] Figure 5 also shows the fastener 130 can alternatively be longer for joining laterally adjacent modules as described below.

[81] Fig. 6 and 7 illustratively shows in schematic cross-section a junction between four adjacent module frames 30a to 30d, and the steps in joining the base chords 40 of two adjacent upper module frames 30b and 30d to the respective upper chords 50 of two adjacent lower module frames 30a and 30c.

[82] As shown, lower module frames 30a and 30c can initially be laid side by side, with the external side walls 140 of the module frames 30a and 30c facing and generally parallel to each other. A first upper module frame 30b can then be disposed over the module frame 30a. A second upper module frame 30d can then be disposed over the module frame 30b.

[83] The bolt apertures 87 and 97 of the coupling plates 86 and attachment cleats 96 for all four module frames 30a to 30d at the junction are then respectively aligned, with a longer single attachment bolt 130b inserted therethrough. An intumescent sleeve is inserted into the aligned holes prior to insertion of the bolt 130b for providing a seal. The bolts 130b secure the upper module frame 30b to the lower module frame 30a, the upper module frame 30d to the lower module frame 30c, as well as secure each respective upper and lower pair 30b, 30a and 30d, 30c to each other.

[84] The bolts 130b extend through the external side walls 140 and bolt apertures 45 formed in the main web 82 of the base side chord 40. If the side walls 140 are fire rated composite systems, this assembly provides a dual fire rated common or strata wall. The side walls 140 for example shown in Figure 7 provides dual insulation layers.

[85] The spaced support tabs 99 of the upper frame 34 are utilised as required such as for supporting ceiling panels or roofing structures.

[86] Fig. 8 (a) to (c) show alternative embodiments of the module frame 30. Fig. 8 (a) shows a module frame 30f which is similar to the module frame 30 above, but without ancillary provision 171 and having a reduced balcony portion 173. Fig. 8 (b) shows a module frame 30g with ancillary provision 171 and having a cantilevered deck 172. Fig. 8 (c) shows a module frame 30h without ancillary provision 171 and having the cantilevered deck 172.

[87] Figures 9 and 10 show a possible arrangement 200 of a plurality of module frames 30 according to the present invention. The module frames 30 can be arranged as required to provide studio, or one bedroom or more apartments, hotels, offices or other accommodation or building type as required.

[88] The preferred embodiments of the present invention thus provide one or more of the following advantages:

- a) Fixing of two, three or four or more modules together in either a combination of a horizontal or vertical stack or both at the same time.
- b) Fixing at one plane to provide both a horizontal and vertical tie. This allows for modular construction for heights greater than one level in Class 2 or 3 and other classes up to 50 stories whilst still remaining code compliant to Australian Building codes and it also reduces the necessity of scaffolding and exposing workers to fall from height as the fixings are accessed internally.
- c) utilization of the frame system to provide in compilation of the top system in the module and the floor/bottom system module to create a composite compliant solution for fire separation between floors
- d) utilization of two separate modules being joined together side and side to create a composite compliant strata/party wall system
- e) stacking of the modules to provide continuity in vertical fire and acoustic separation
- f) utilization of the perimeter frame/chord to provide support for wall systems which are non-load bearing which provides a deemed to satisfy solution in Australia, New Zealand and elsewhere
- g) a single point of fixing at each cleat which is also the lifting lug for installation
- h) Module-fixing - Utilization of a single cleat system to tie together units in the both the horizontal and vertical planes in steel framed fully welded or bolted modular unit which also provide locational set out for ease of assembly

- i) Perimeter Wall Fixing - based on perimeter fixings through top and bottom chords / perimeter frames (and columns as required) to light weight wall systems
- j) Vertical Fire and acoustic where required separation between floors is achieved by use of discrete components to the top of the Module Unit (which forms the fire and acoustic barrier to the unit or roof system above) and the non-combustible floor sheeting
- k) Load bearing columns - are isolated from fire source features and remote from external walls. To maximise floor use, columns can be at the perimeter of the frame and elsewhere where required for structural and space efficiency.
- l) Building bracing - to the module area is fully integrated into each module either between the top chords or the bottom chords or both
- m) Structural fixings can be accessible from the inside of the units either through removable floor fire rated access panels or ceiling fire rated panels.
- n) Deemed To Satisfy modular steel frame system in Australia and Code Compliant solution internationally
- o) Reduces the complexity of bracing within the building envelop
- p) Provides a single level of fixing to join the vertical and horizontal planes in modular construction
- q) Provides for a curtain wall and/or panel wall solution for exterior, strata/party/common walls
- r) Provides an access for fire compliance audits
- s) Can be utilized in Type A, B or C requirements under Australian Building Codes in a variety of classes including Class 2, 3, 5, 9 and other classes including but not limited to residential, low, medium and high rise construction
- t) Is code compliant
- u) Is deemed to satisfy under building requirements in Australia
- v) Is flexible in terms of wall construction and materials
- w) Can facilitate sprinklers
- x) Reduces on site Quality Risk
- y) Reduces on site construction time and cost
- z) Is flexible in terms of modular construction being either welded or bolted
- aa) No additional testing is required to comply with Australian Standards

- bb) Provides access for annual audits for fire and structural sufficiency
- cc) Provides for simple dismantling at the end of the need for the facility
- dd) Reduces dismantling cost
- ee) Improves recycling of product
- ff) Improves upgrade in situ to facades
- gg) Allows for expansion of the building without significant rebuilding
- hh) Improves greenhouse position in substantial reduction in site waste streams to less than 1 percent
- ii) Reduces construction time by not less than 50 % in some instances,
- jj) construction time is reduced to 30 to 40 % of traditional built time
- kk) Reduces risk of lack of co-ordination and quality of control on site due to the majority of work being carried out in the factory
- ll) Reduces on site labour costs
- mm) Reduces on site emissions by reduction in site plant requirements
- nn) Because the wall system for the party/common/strata and external is a curtain wall and/or pane wall, it is extremely flexible in terms of providing for a variety of products and wall systems can be utilized
- oo) The bolted version of the frame is capable of being transported more efficiently to remote areas and can be assembled by semi-skilled labour
- pp) Floor to floor heights are flexible
- qq) Internal layouts are flexible
- rr) By the utilization of lightweight fire resistant floor linings and ceiling linings which are installed to the lower module, it improves Acoustic performance. There is no need to install support framework from the floor to the ceiling and to use acoustic support slips from the floor framing over
- ss) It provides flexibility in ceiling heights
- tt) And flexibility in floor to floor heights
- uu) Sprinklers can be readily installed from above the ceiling in the factory
- vv) Modular components can be installed including bathrooms, ceilings floors and internal walls

- ww) Module perimeter chord/frame and bolt (or tie clamp in bolt position) to adjacent structure is achieved through fire rated access hatches or retrofitting of floor or ceiling material
- xx) the provision of a capacity to accept either a prefabricated wall, floor and ceiling and services systems and roof systems or a piecemeal constructed in situ in the factory or on site process
- yy) the provision in the fixing system to enable it to be directly supported on substructure and to accept either prefabricated or site roof assemblies "
- zz) load bearing walls and structural flooring and ceiling lining can be incorporated if required
- aaa) the removal of the need to provide a complex series of individual shaped walls within the module frame perimeter. Cross bracing in vertical planes can be oriented in use. Additional linings can be added.

[89] The above features provide efficiency in overall assembly to suit regional requirements and to manage the capacity and availability of materials and skills.

[90] Whilst preferred embodiments of the present invention have been described, it will be apparent to skilled persons that modifications can be made to the embodiments described.

[91] The frame members, beams and columns can be of any cross-section shape, such as C-shaped, H-shaped, L-shaped, U-shaped, Square or rectangular sections, circular-sections, etc. The floor and ceiling panels can be integrated into the structural module frame system or can be retrofitted after erection of the modules.

[92] The preferred embodiment provides flexibility for the module system to be utilised as a structural component in the frame of a building, joining of containers, cages or in other process of integration of components into a three dimensional assembly utilising the points of fixing to achieve jointing in the vertical and horizontal planes and inclined planes if required.

[93] Figures 11 and 12 show a modified version of the attachment of the module frames to each other. Instead of the coupling plates 86 and attachment cleats 96 connecting the horizontal chords 42, this embodiment connects the vertical members 36 via vertical connection bars 210 and horizontal connection plates 220.

[94] The base side chords 40 and upper side chords 50 in this embodiment comprises apertures 212. The vertical connection bars 210 are initially mounted to the lower portions of an upper module frame, and when lowered onto a lower module frame, the vertical connection bars 210 extend downwardly into the aperture of the lower module frame. In the example

shown, the vertical connection bar 210 is mounted to the upper vertical member 36, and is then connected to the lower vertical member 36h after insertion into the aperture formed in the chord 50h. Any number of bolts can be used to secure the vertical connection bar 210 to the vertical members 36.

[95] Alternatively, the vertical connection bar 210 can be initially mounted to the lower frame module for attachment to the upper module. The vertical connection bars 210 will thus initially extend upwardly for connection to an upper frame module.

[96] Similarly, the vertical members 36 comprise apertures 222 through which the horizontal connection plates 220 extend through. The horizontal connection plates 220 extend and connect horizontally adjacent vertical members 36 to each other for connecting adjacent frame modules. The apertures 222 can be formed at desired sections of the vertical members 36, such as at upper and lower ends thereof, as well as intermediate sections therebetween.

[97] The vertical connection bars 210 and horizontal connection plates 220 can be attached to the frame modules by any suitable means, such as bolts, welding, or other means.

[98] The floor and ceiling panels in these embodiments are mounted to brackets attached to the chords 40 and 50. The attachment points of the vertical connection bars 210 and the horizontal connection plates 220 are disposed above and below these floor and ceiling panels which will allow a worker to attach the modules from within.

[99] The modified embodiment also shows the C-section beams used for the horizontal chords facing each other.

Claims

The claims defining the invention are as follows:

1. A module frame comprising:
an upper frame having a first attachment means extending upwardly from the upper frame; and
a base frame having a second attachment means adapted to be attachable to the first attachment means of another module frame.
2. The module frame of claim 1 wherein the first and second attachment means of the module frame are respectively attachable to the first and second attachment means of another laterally disposed module frame.
3. The module frame of claim 1 wherein the module frame comprises a generally rectangular prism structure.
4. The module frame of claim 3 wherein the module frame comprises a generally rectangular base frame and a generally rectangular upper frame which are connected by vertical members therebetween.
5. The module frame of claim 1 wherein the second attachment means comprises spaced coupling plates in the base frame.
6. The module frame of claim 5 wherein the base frame comprises C-section beams having a main side web and lower and upper side webs, wherein the coupling plates extend between distal edges of the side webs.
7. The module frame of claim 1 wherein the first attachment means comprises spaced attachment cleats in the upper frame.
8. The module frame of claim 7 wherein the attachment cleats are disposed at an upper surface of the upper frame
9. The module frame of claim 8 wherein each attachment cleat is disposed adjacent an inner edge of the upper frame and defines a seat on the upper surface between the attachment cleat and an outer edge of the upper frame. .
10. The module frame of claim 7 wherein the upper frame further comprises spaced support tabs which extend inwardly and horizontally.
11. The module frame of claim 7 wherein the upper frame further comprises spaced mount brackets which extend generally downwardly.

12. The module frame of claim 1 further comprising a floor panel system secured to the base frame above the second attachment means.
13. The module frame of claim 12 wherein the floor panel system is secured to an upper surface of the base frame.
14. The module frame of claim 12 wherein the floor panel system further includes a removable access panel.
15. The module frame of claim 12 wherein the floor panel system is a fireproof panel system.
16. The module frame of claim 1 further comprising a ceiling panel system secured to the upper frame below the first attachment means.
17. The module frame of claim 11 further comprising a ceiling panel system secured to the mount brackets.
18. The module frame of claim 16 wherein the ceiling panel system includes a removable access panel.
19. The module frame of claim 16 wherein the ceiling panel system is a fireproof panel system.
20. The module frame of claim 1 further comprising side wall panel systems extending between the upper frame and the base frame.
21. The module frame of claim 18 wherein the side wall panel systems comprise an internal skin, an external skin and a middle insulating and/or fireproofing layer
22. The module frame of claim 1 wherein the first and second attachment means comprise attachment plates having at least one aperture for receiving a respective bolt or elongate fastening means.
23. A module frame comprising:
an upper frame,
a base frame,
vertical members extending between the upper and base frames, and
at least one vertical connector for connecting the vertical member to the vertical member of another module frame disposed on top of the module frame.
24. The module frame of claim 23 wherein the vertical connector comprises a vertical connection bar extending through an aperture formed in the upper frame.

25. The module frame of claim 23 wherein the vertical connector comprises a vertical connection bar extending through an aperture formed in the base frame.
26. The module frame of claim 24 further comprising at least one horizontal connector for connecting the vertical member to the vertical member of another module frame disposed adjacent the module frame.
27. The module frame of claim 23 wherein the horizontal connector comprises a horizontal plate extending through an aperture formed in the vertical member.
28. A building comprising
 - a lower module frame according to any one of claims 1 to 22; and
 - an upper module frame according to any one of claims 1 to 22 disposed above the lower module frame, wherein the base frame of the upper module frame is attached to the upper frame of the lower module frame via the adjacent first and second attachment means.
29. The building of claim 23 wherein the first attachment means of the lower module frame substantially prevents lateral movement of the upper module frame prior to attachment of the adjacent first and second attachment means.
30. The building of claim 23 wherein each module frame comprises a floor panel system secured to the base frame above the second attachment means, and a ceiling panel system secured to the upper frame below the first attachment means, wherein the respective adjacent floor panel and ceiling panel systems form therebetween a services cavity.
31. The building of claim 23 further comprising insulation means mounted in the services cavity.
32. A building comprising
 - a first module frame according to any one of claims 1 to 22; and
 - a second module frame according to any one of claims 1 to 22 disposed laterally adjacent the first module frame, wherein the adjacent first and second attachment means of the first and second module frames are attached to each other.
33. A building comprising
 - a first module frame according to any one of claims 1 to 22;
 - a second module frame according to any one of claims 1 to 22 disposed laterally adjacent the first module frame;

a third module frame according to any one of claims 1 to 22 disposed above the first module frame; and

wherein the adjacent first and second attachment means at the junction between the first to third module frames are attached to each other.

34. The building of claim 29 further comprising a fourth module frame according to any one of claims 1 to 22 disposed above the second module frame, wherein the adjacent first and second attachment means at the junction between the first to fourth module frames are attached to each other.
35. The building of any one of claims 23 to 29 wherein a single fastener can extend through each set of adjacent first and second attachment means.

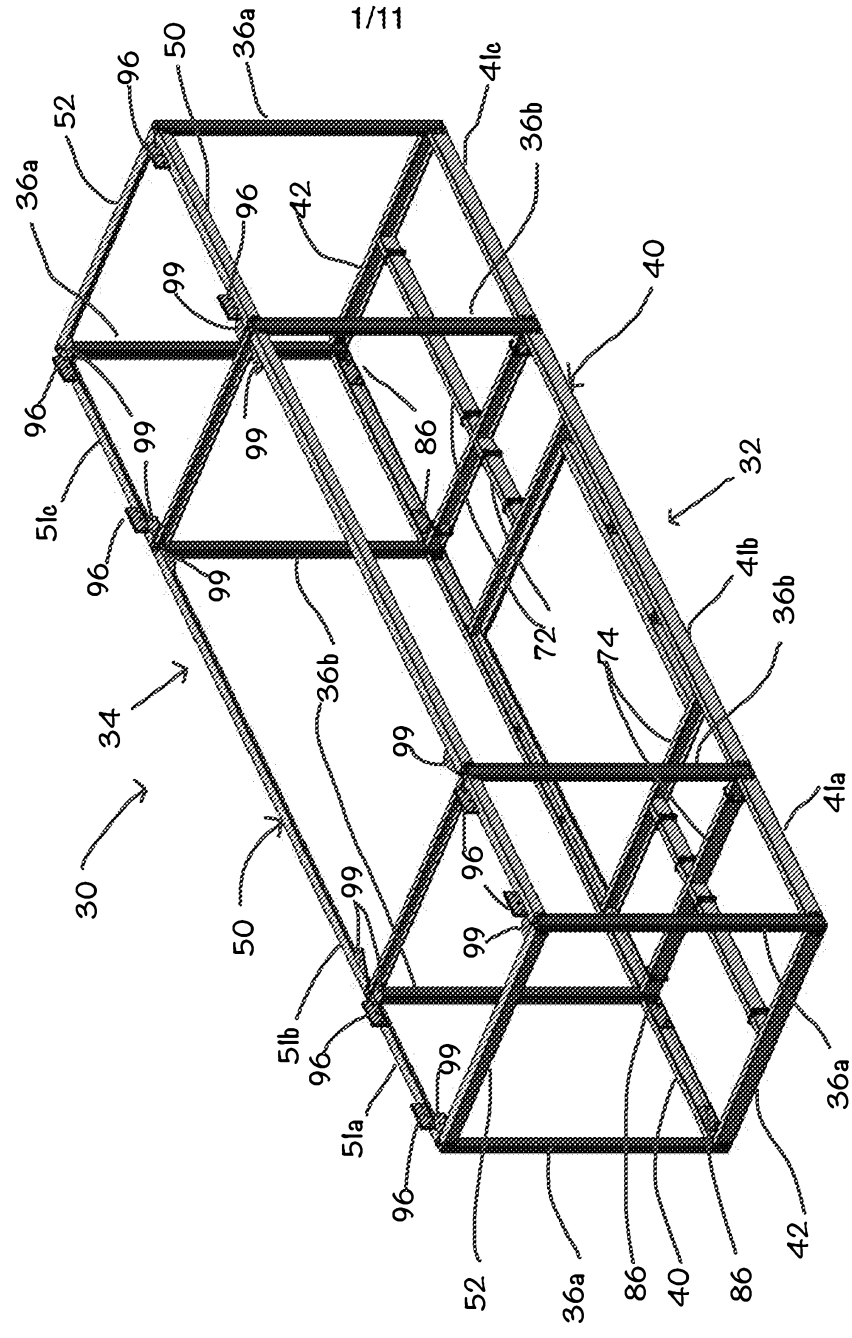


Figure 1

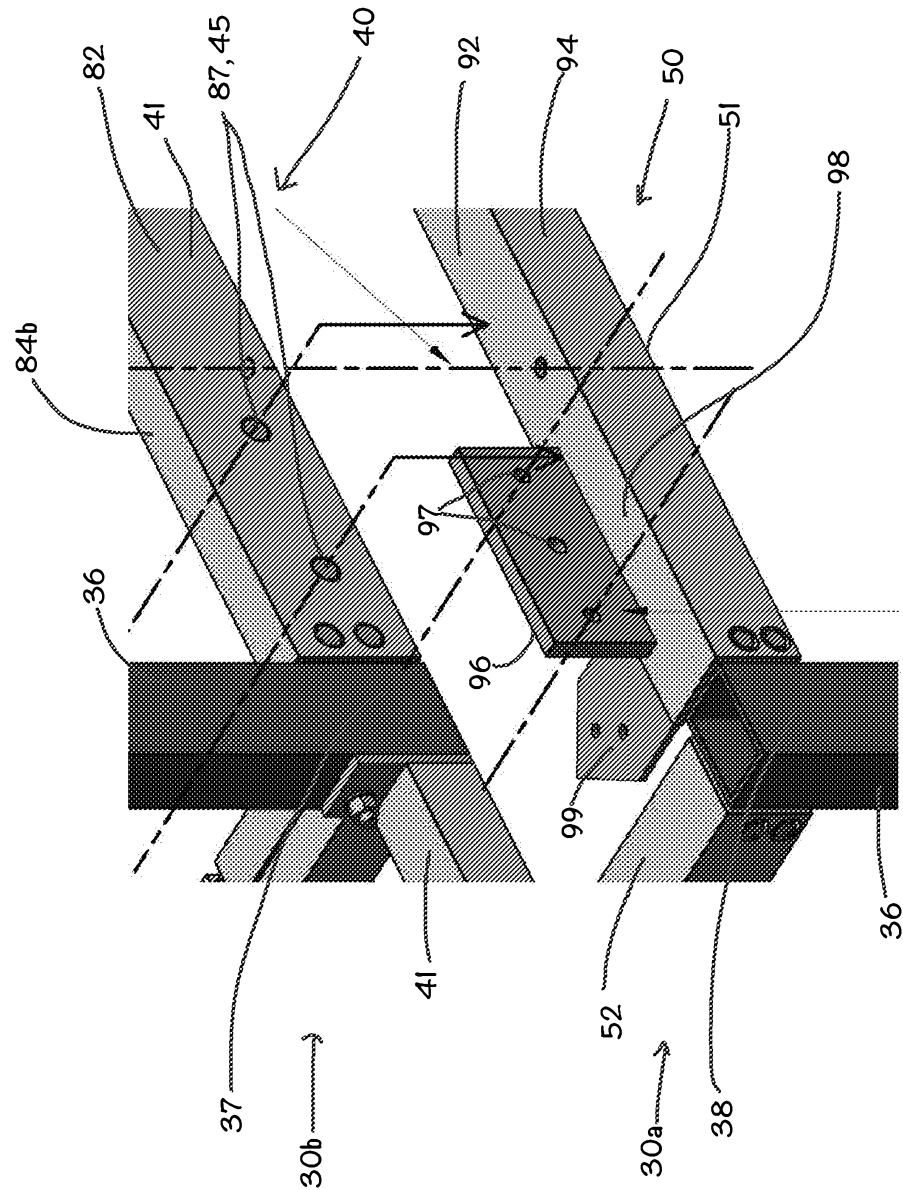


Figure 2

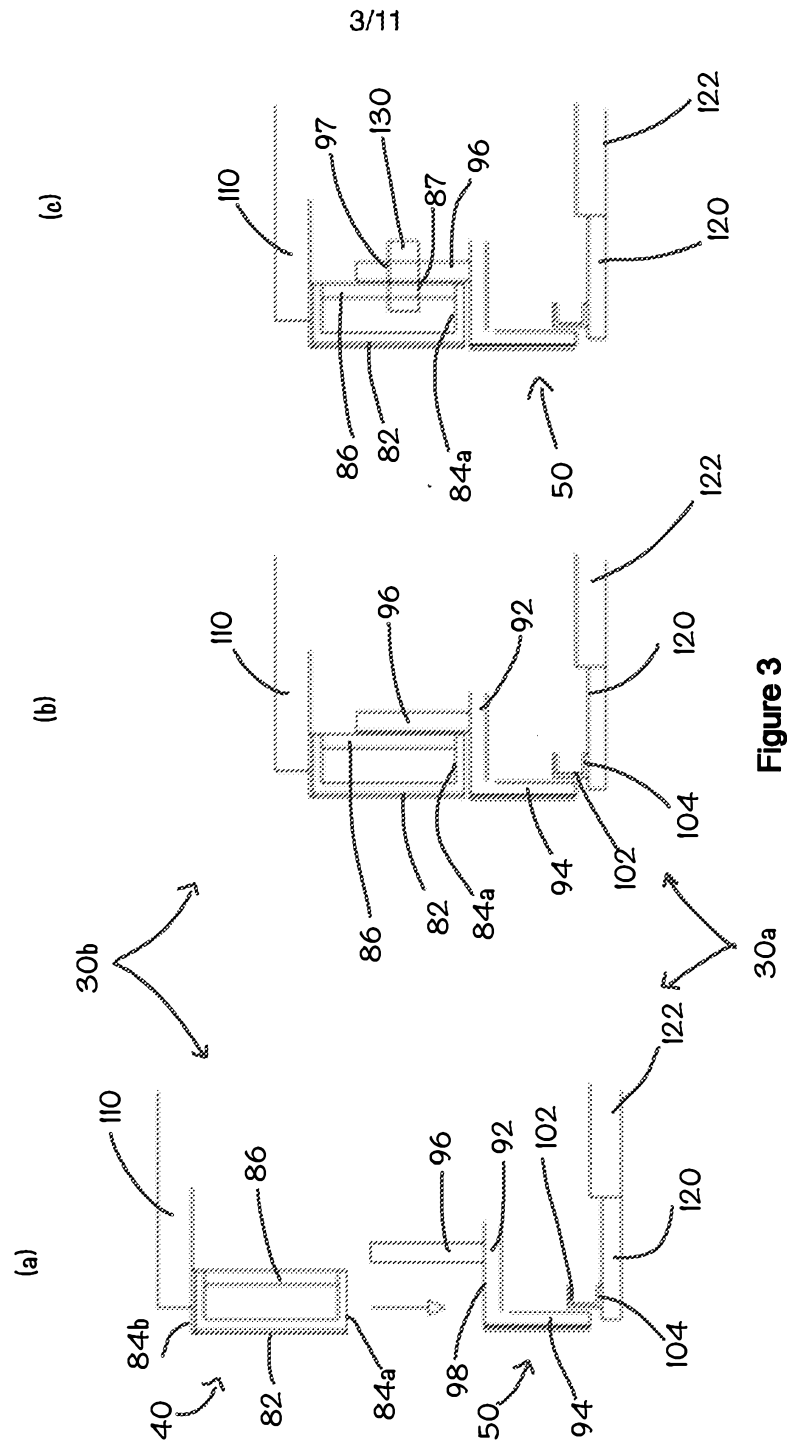


Figure 3

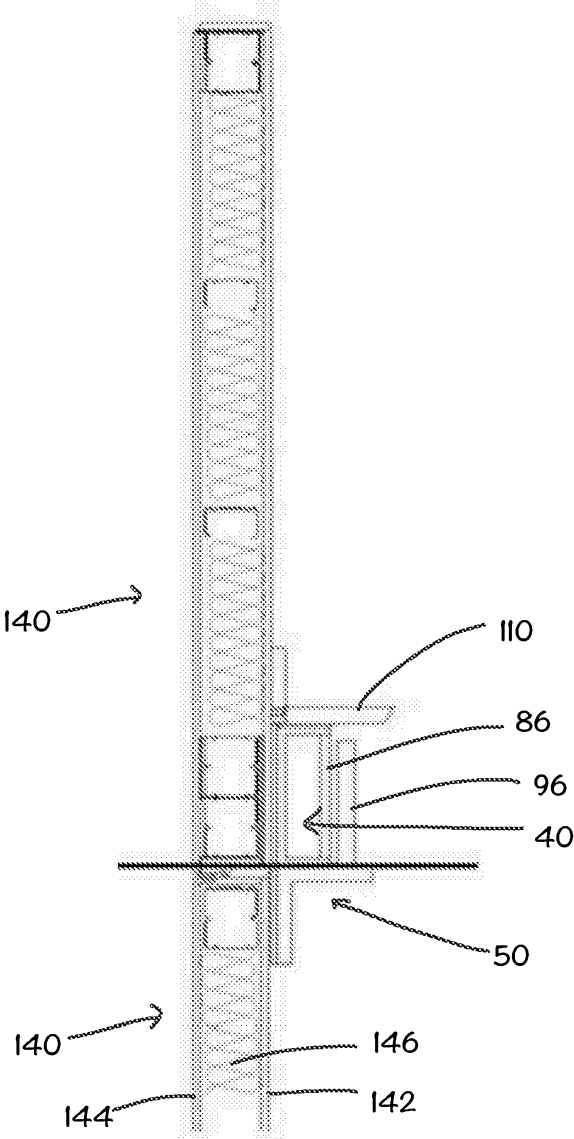


Figure 4

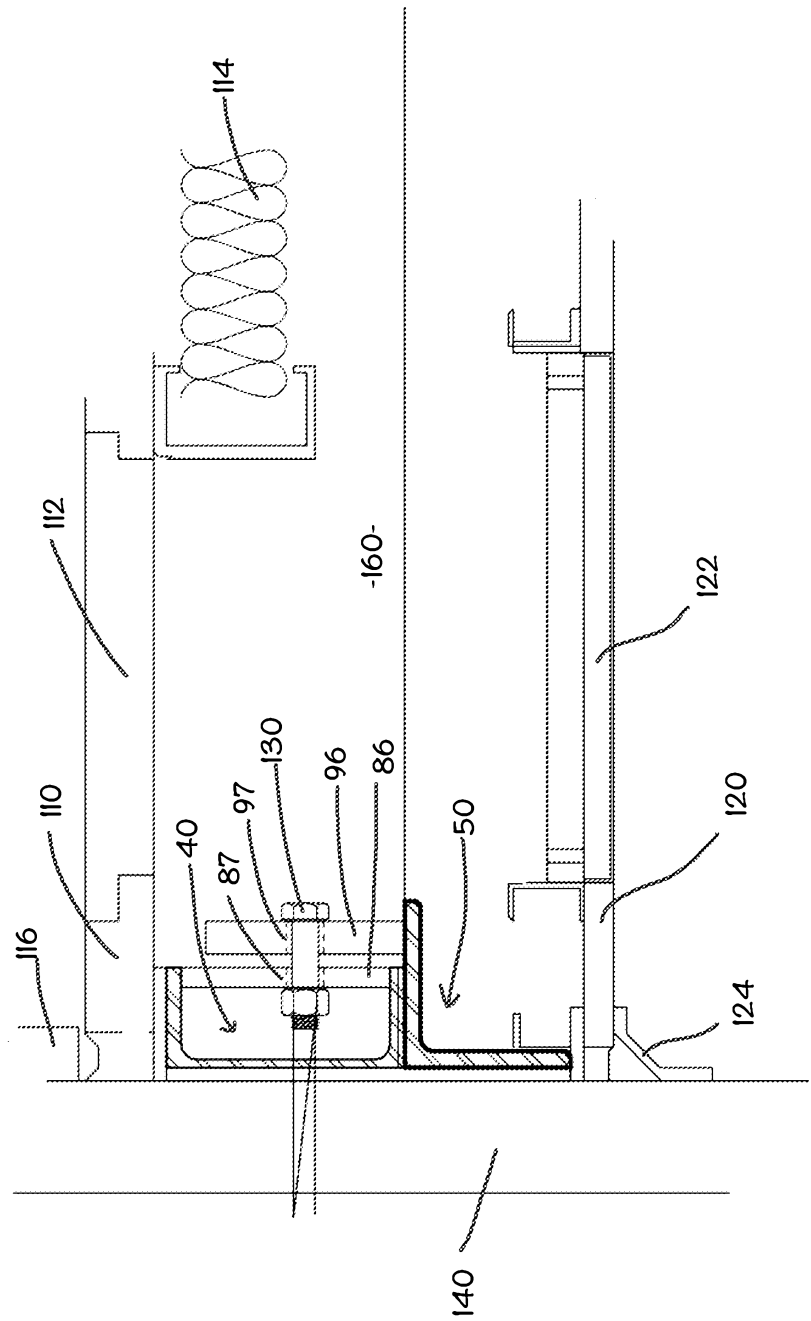


Figure 5

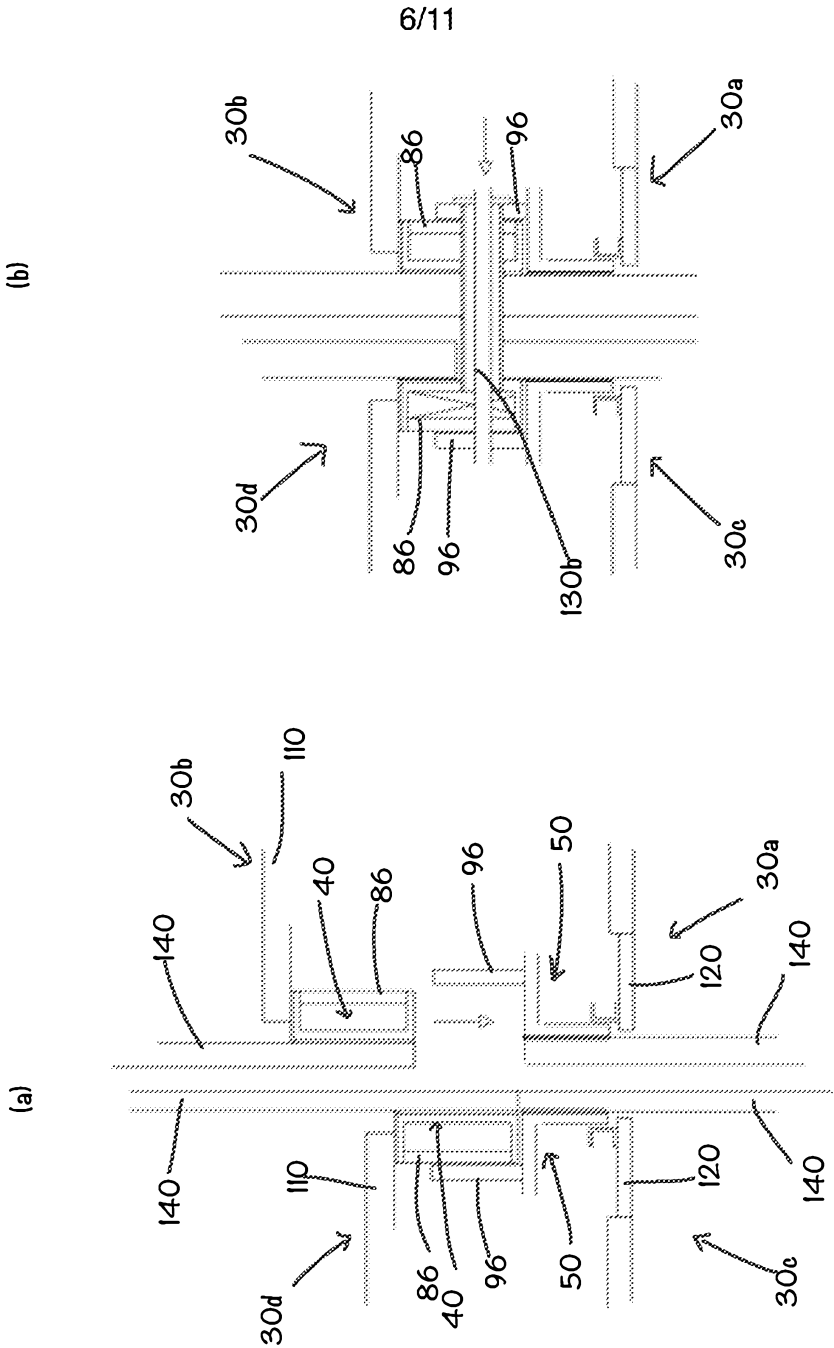


Figure 6

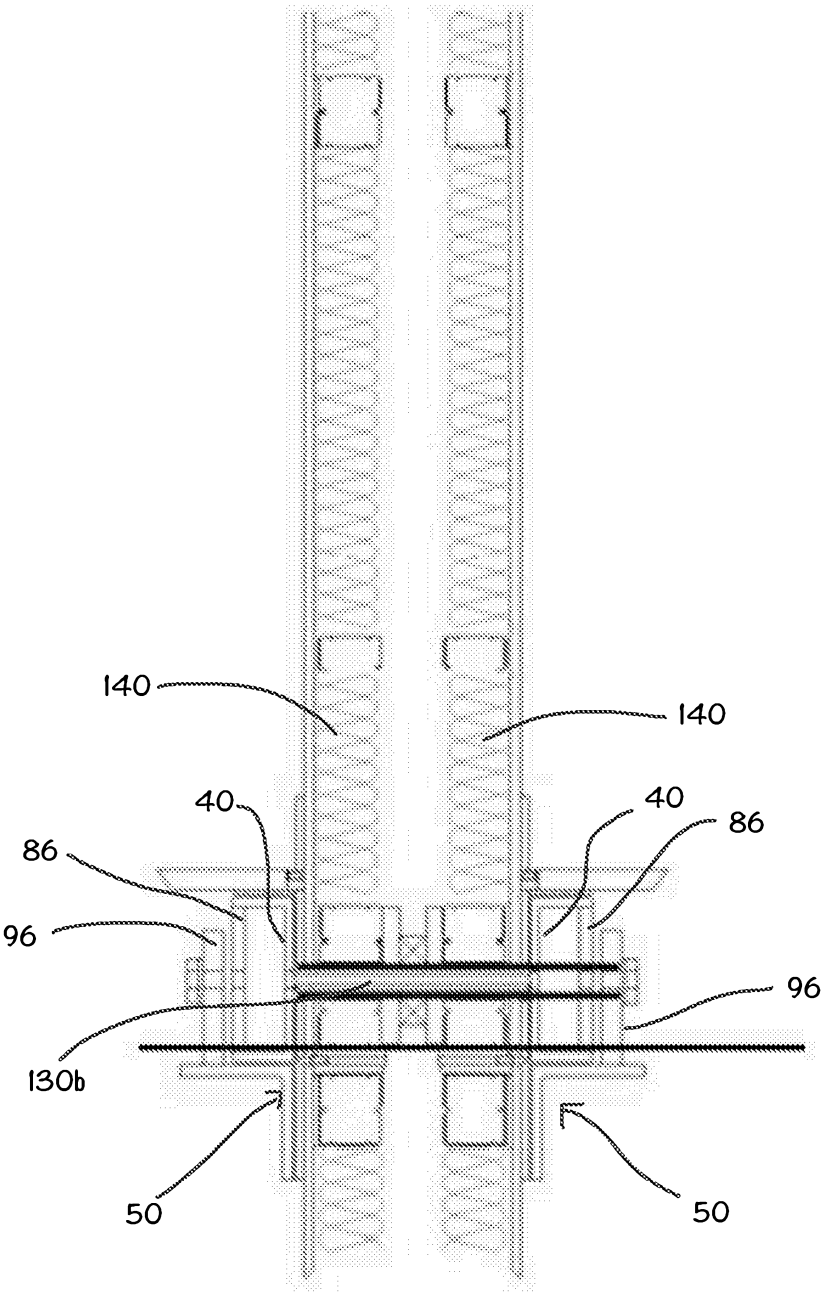


Figure 7

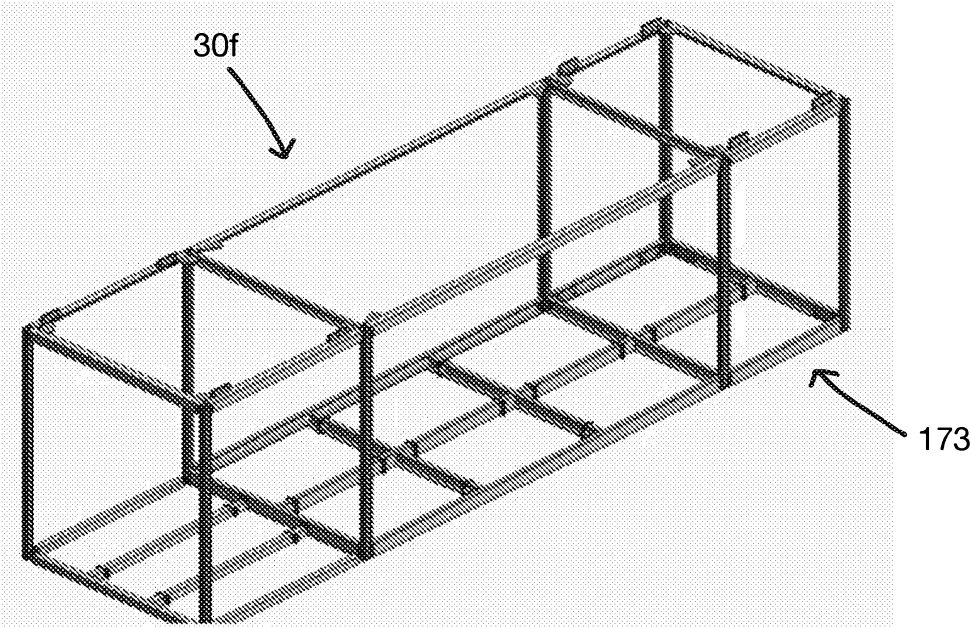


Figure 8 (a)

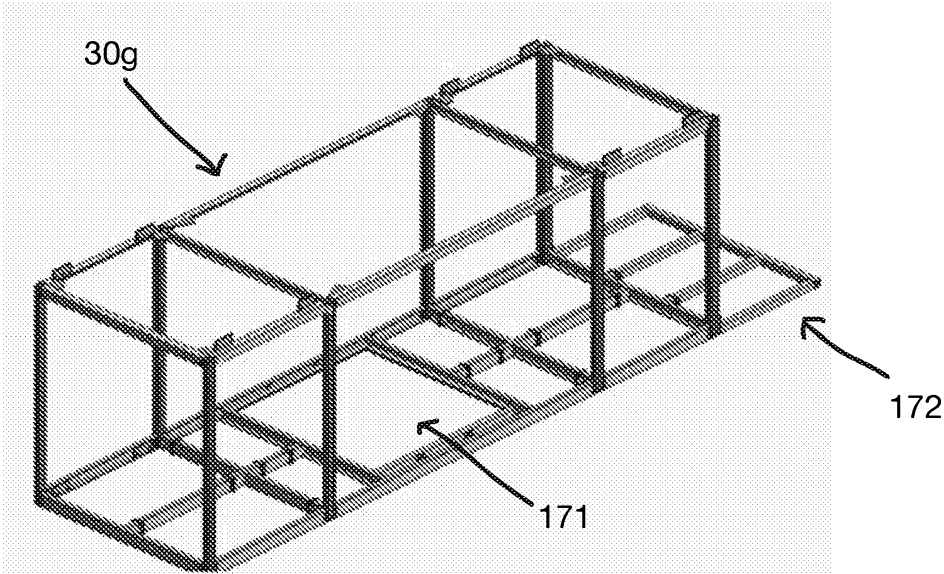


Figure 8 (b)

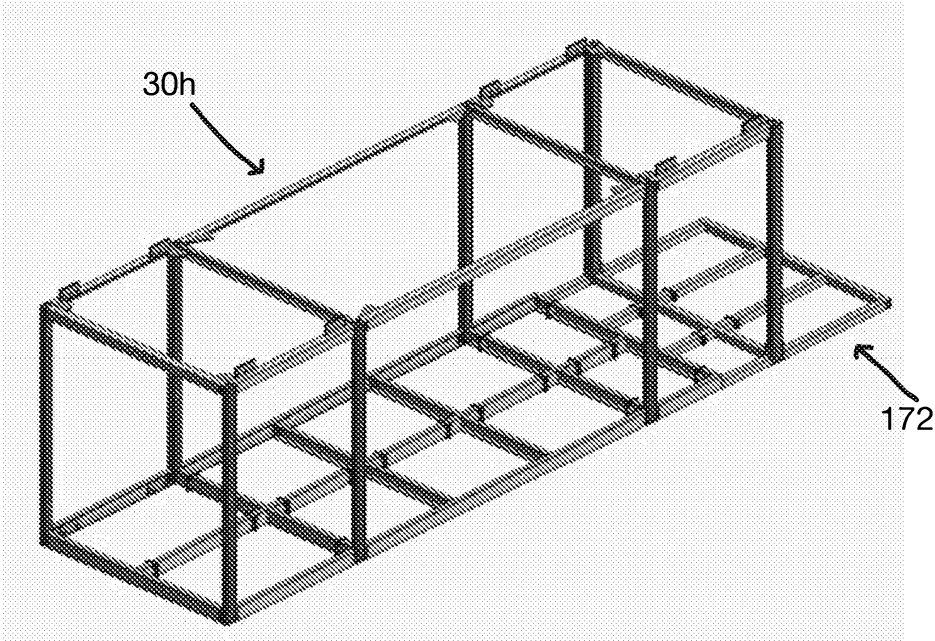


Figure 8(c)

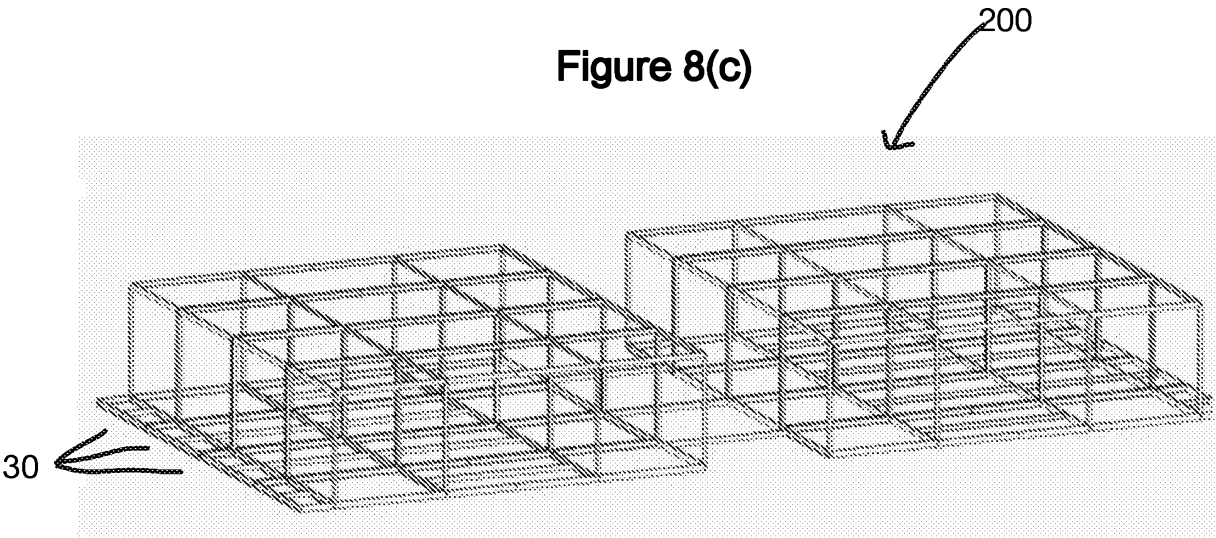


Figure 9

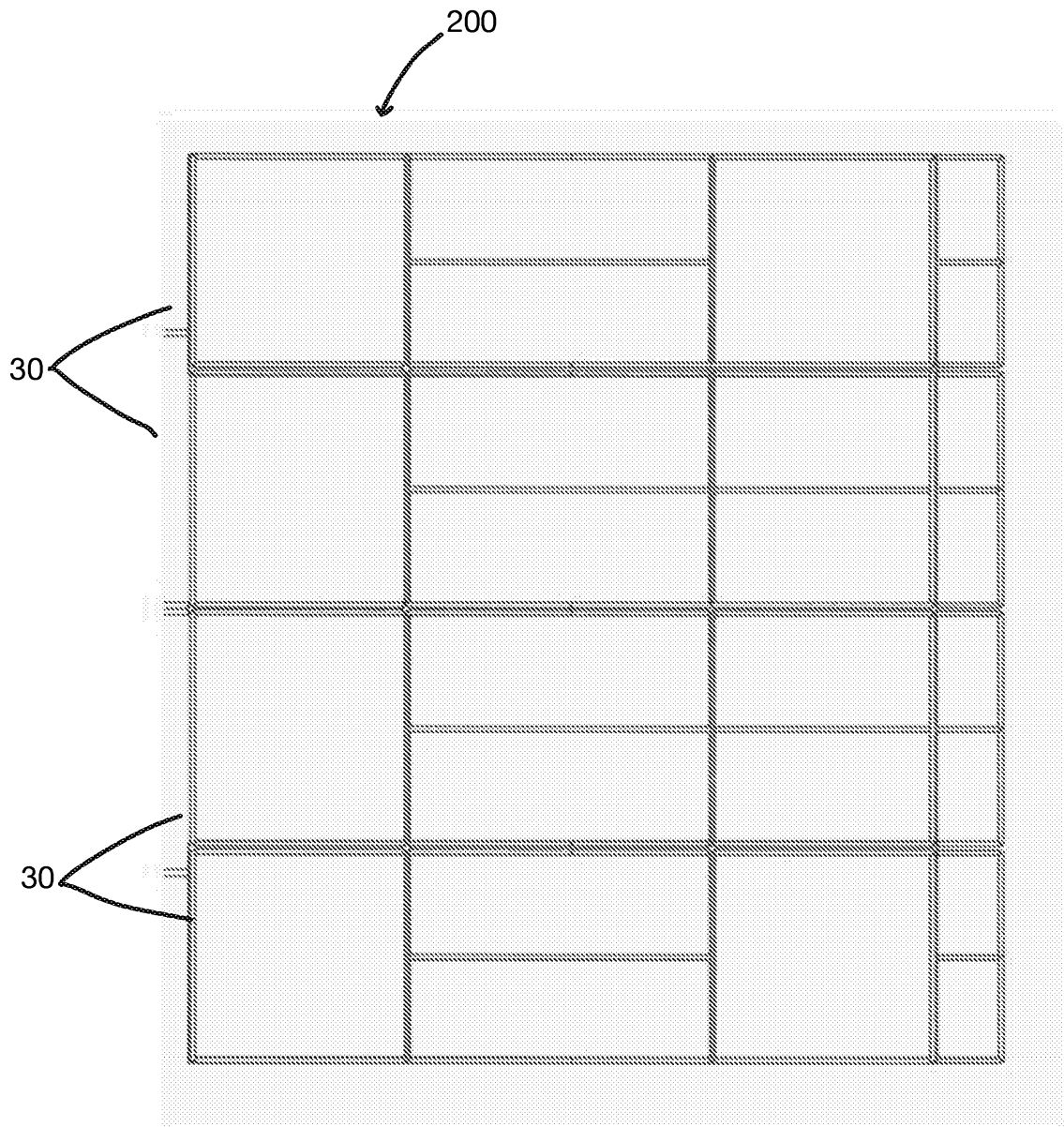


Figure 10

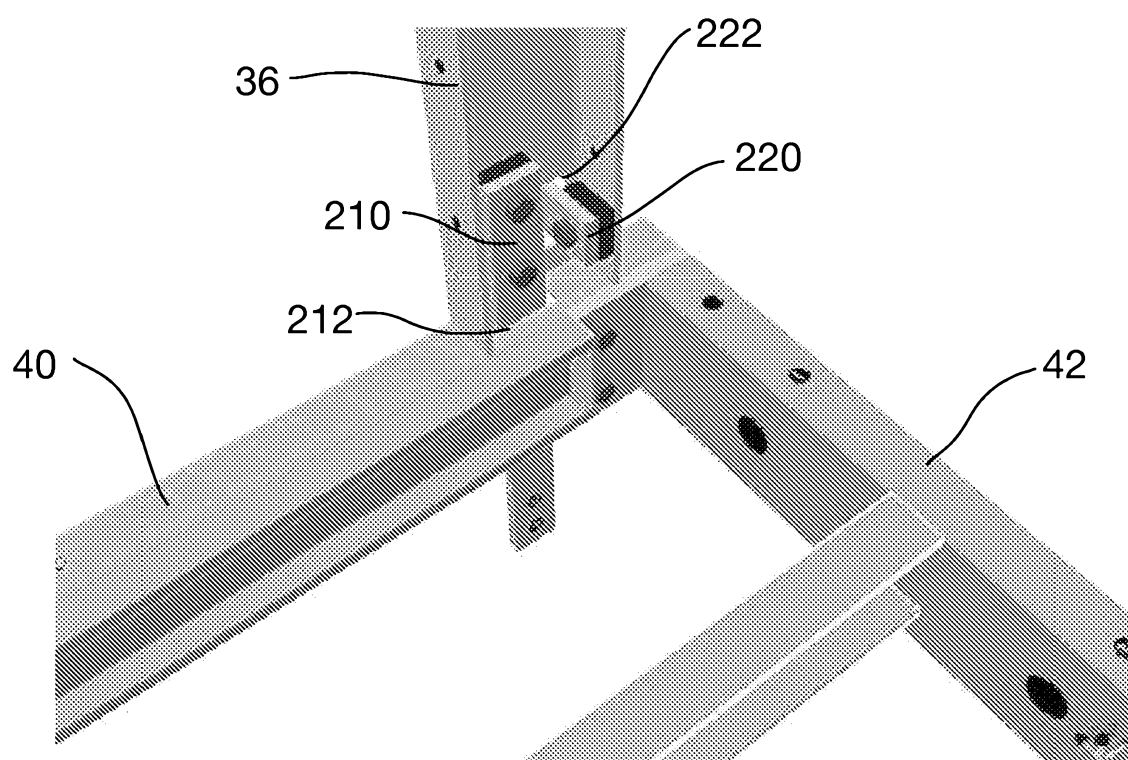


Figure 11

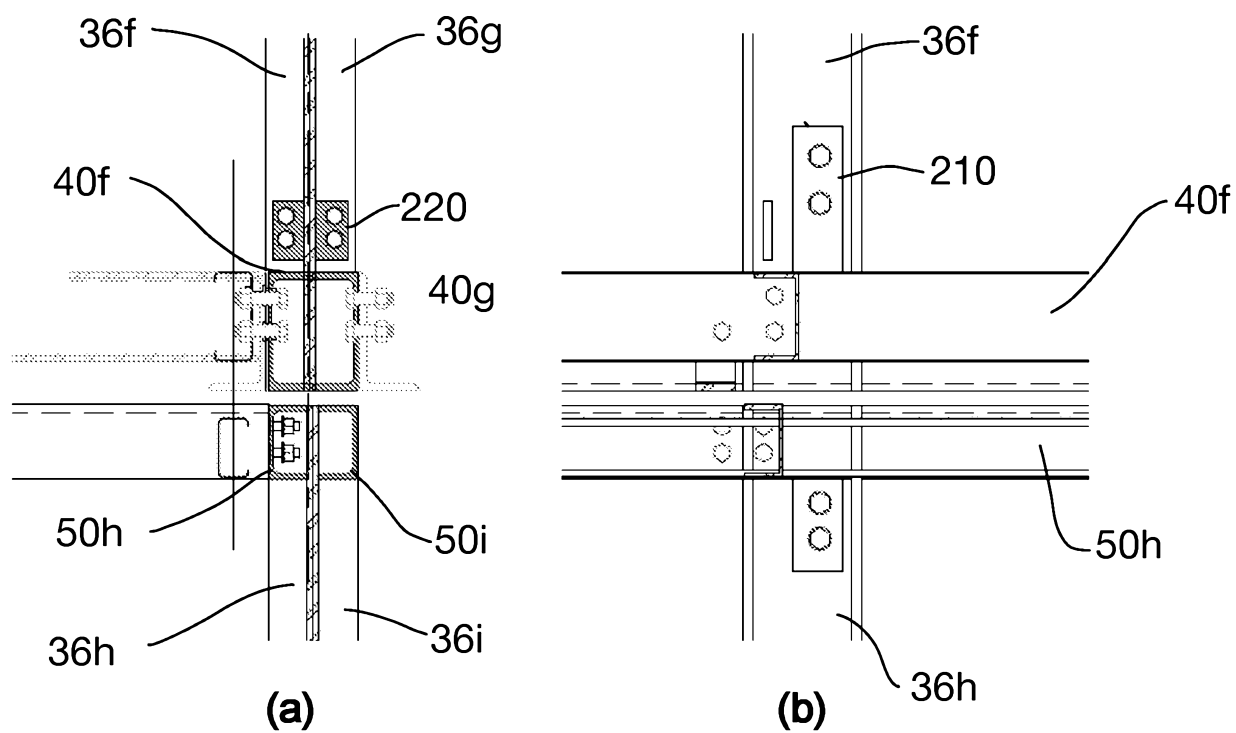


Figure 12