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(72) Inventor: **Pircher, Christian**
39034 Dobbiaco (BZ) (IT)

(74) Representative: **Germinario, Claudio**
Società Italiana Brevetti S.p.A.
Stradone San Fermo, 21 sc. B
37121 Verona (VE) (IT)

(71) Applicant: **Pircher Oberland S.p.A.**
39034 Dobbiaco (BZ) (IT)

(54) **Building construction and method of designing**

(57) A modular building construction (10), such as a dwelling, a structure for commercial use, and alike building constructions, comprising one, or more, modules (12, 13, 14) having a substantially parallelepiped shape, wherein the module (12, 13, 14) comprises a frame (11) including a floor wall (18), a ceiling wall (19), and at least

one, or more, column elements (30) constituting support for the ceiling wall (19). The module (12, 13, 14) includes an assortment of covering elements (15, 34, 40, 44, 50, 55), wherein each of the covering elements (15, 34, 40, 44, 50, 55) is adapted to cover a corresponding portion of the frame (11).

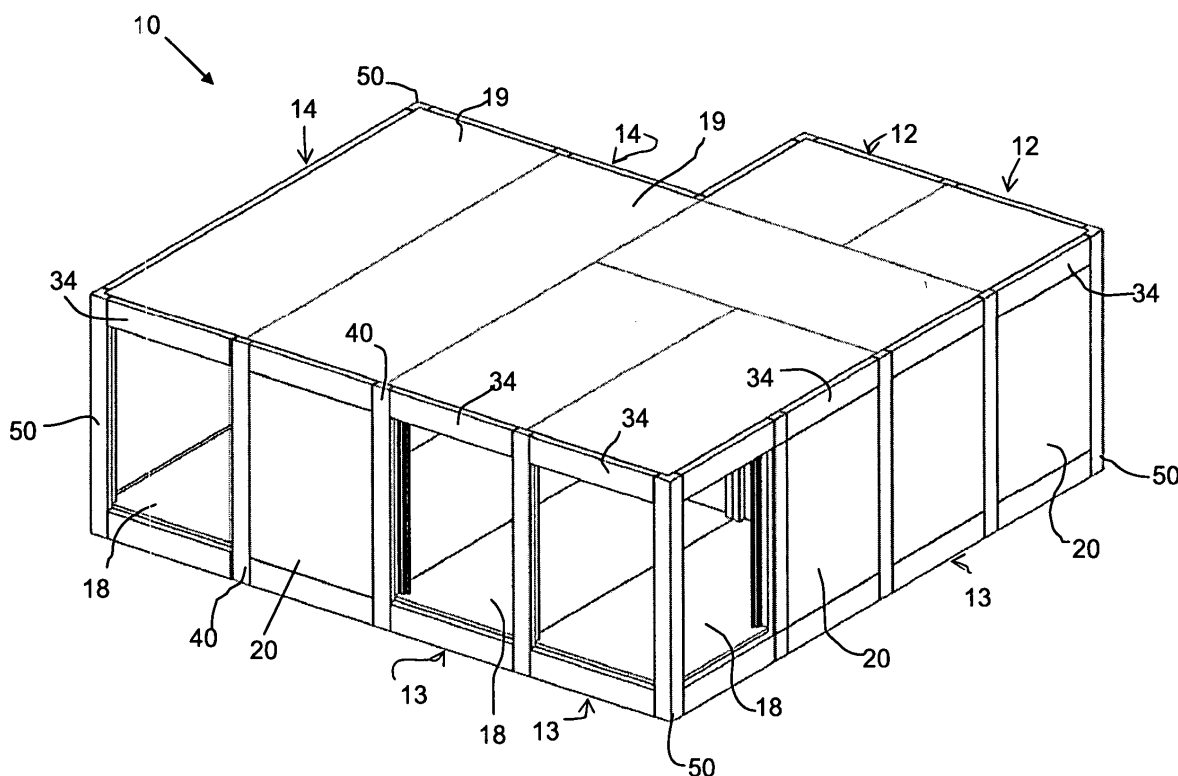


Fig. 1

Description

[0001] The present disclosure relates, in its most general aspect, to the building field, and more specifically to a building construction for dwelling or commercial use.

[0002] Even more specifically, the building construction according to the present disclosure is of modular type, i.e., it comprises a plurality of modules or basic units apt to be placed side-by-side and stacked at will to obtain a building construction of given size and shape.

[0003] A building construction by modules is already known since long time, both in the field of cement building and in metal constructions. In such known building construction the existing modules have a container-like shape; namely, it is a container-like construction system, in which each module already includes in advance all of the six walls (floor wall, ceiling wall, and four side walls).

[0004] Such a modular building construction, though advantageous under a plurality of standpoints, entails several drawbacks.

[0005] A drawback lies in the fact that a limited versatility was found in the design and manufacturing modes of such modular building constructions. In fact, the configuration of a modular building construction can be selected only on the basis of the number of modules and the side-by-side placing/stacking modes of the modules, thereby causing a certain rigidity in the option of a selection in advance, that is to say, *a priori*, of the finishing, like e.g. the position of windows, walls, terraces or balconies, porches and alike finishings. In other words, in known building construction, versatility offered by the modular system is applicable only to the ways with which the individual modules are placed side-by-side and/or stacked. It is therefore a limited modularity.

[0006] A further drawback lies in the fact that it is moreover necessary to separately design all hydraulic and electric systems for the building construction, only after the final shape of the building construction has been selected.

[0007] A technical problem underlying the present disclosure lies in providing a modular building construction allowing to overcome the drawbacks of the known art, i.e. whose structure allows a high versatility of design, as well as providing a related method of designing.

[0008] Said technical problem is solved by a modular building construction according to claim 1, and by a method of designing a building construction according to claim 19.

[0009] Secondary features of the building construction and of the related method according to the present disclosure are defined in the corresponding dependent claims thereof.

[0010] The present building construction provides several relevant advantages.

[0011] A first advantage lies in the fact that each module can, in turn, be disassembled into individual pieces (frame and covering elements) structurally independent thereamong, and selectively associable in a predeter-

mined way, therefore *a priori*, in particular depending on the final building construction that is to be obtained.

[0012] In fact, the modular building structure is obtained by modules, each of which is in turn conceived as a plurality of structurally independent elements, i.e., a frame and the assortment of covering elements, associable thereamong.

[0013] Preferably, in order to facilitate construction modes, each covering element has a coupling profile adapted to be placed matching with a corresponding coupling profile of another covering element of said assortment and/or of said frame lying adjacent thereto in the modular building construction.

[0014] Even more preferably, the modular building construction comprises at least one side wall adapted to be interposed between the floor wall and the ceiling wall, and constituting a side of the parallelepiped, and said side wall includes a coupling profile adapted to be placed matching with a corresponding coupling profile of one or more covering elements lying adjacent to the side wall in the modular building construction, and/or of said frame.

[0015] Thanks to this possibility of dis-assembly it is possible to rapidly design modular building constructions including a single module, as well as modular constructions including plural modules.

[0016] In fact, for instance, if the building construction is made up of one module, a designer may include in the design only the frame and those pieces or covering elements that serve to obtain the individual module in a complete form.

[0017] In a preferred embodiment, the frame includes four column elements arranged at the four corners of the parallelepiped, to the advantage of constructive simplicity of the entire modular building construction.

[0018] In this latter preferred embodiment, in case the building construction comprises one module, the assortment of covering elements comprises one or more first plane external covering element adapted to be horizontally placed on an external side, at a side of said floor wall and/or said ceiling wall, and one or more angular external covering element adapted to be vertically placed on an external side, at a respective column element.

[0019] If instead the building construction should comprise two or more modules side-by-side, a designer may include in the design only two frames, and those covering elements selected from the assortment that are needed for the desired configuration of the building construction to be obtained.

[0020] In fact, preferably, the assortment of covering elements comprises one or more first plane external covering element adapted to be horizontally placed on an external side, at a side of said floor wall and/or said ceiling wall, one or more first angular external covering element adapted to be vertically placed on an external side, at a respective column element, one or more second plane external covering element adapted to be vertically placed on an external side, at two adjacent column elements, and a plane internal covering element adapted to be ver-

tically placed on an internal side, at the two adjacent column elements.

[0021] Essentially, such covering elements include plate-shaped pieces, therefore plane elements, adapted to be placed on the sides of the frame, at the ceiling wall and floor wall, or at connecting zones between side walls, or angular covering elements adapted to be placed at the corners of the frame.

[0022] Thanks to the fact of having a frame (floor wall, ceiling wall, and said one or more column elements) structurally independent from the covering elements, it is possible to modularly conceive the entire building construction, also as to hydraulic and electric systems for the air-conditioning of the building construction.

[0023] In fact, it is possible to associate in advance to each frame a portion of the hydraulic and electric system (ducts, service pipes, wirings and the like).

[0024] Thus, upon selecting the number of frames, and their mutual arrangement, also the cost both of the whole building construction and of the hydraulic and electric system associated thereto can easily be estimated *a priori*.

[0025] In this regard, preferably, the ceiling wall and/or the floor wall include predefined housings for receiving portions of hydraulic and electric installations that, once connected thereamong, allow to obtain an entire hydraulic or electric system of the building construction.

[0026] A further advantage lies in the fact of knowing *a priori* where the electric and hydraulic installations of the building construction lie, for any repairs and/or replacements.

[0027] In other words, the disassembling of the module into frame and covering elements allows to design "on paper" costs, materials and pieces of the entire building construction, also with regard to electric and hydraulic installations.

[0028] Preferably, the entire building construction is of wood, and each element of the construction (frame and covering elements) has a multilayer structure of wood and wood-based composites, such as to obtain, post-assembly, a high thermal insulation of the building construction. Moreover, the use of a multilayer wood structure allows to control in a targeted manner, by layer selection, the desired thermal insulation of the building construction.

[0029] Therefore, it is obtained a building construction modular and compatible with the actual needs of reduction of energy consumptions, whose manufacturing can easily be estimated *a priori* "on paper".

[0030] Further advantages and features according to the present disclosure will be made apparent to those skilled in the art from the following non-limiting detailed description of an embodiment thereof.

[0031] However, it is evident how each embodiment of the present disclosure could have one or more of the advantages listed above; anyhow, it is not required for each embodiment to concomitantly have all of the advantages listed.

[0032] Reference will be made to the figures of the annexed drawings, wherein:

- Figure 1 is a perspective view of a building construction according to the present disclosure;
- Figure 2 is a top view of a first step of designing the building construction of Figure 1;
- Figure 3 is a perspective view of the building construction after the first step of Figure 2;
- Figure 4 is a top view of a second step of designing the building construction of Figure 1;
- Figure 5 is a perspective view of the building construction after the second step of Figure 4;
- Figure 6 is a top view of a third step of designing the building construction of Figure 1;
- Figure 7 is a top view of the building construction of Figure 1, obtained after the third step of Figure 6;
- Figure 8 is a perspective view of a first-type module of the building construction of Figure 1;
- Figure 9 is a perspective view of a second-type module of the building construction of Figure 1;
- Figure 10 is a perspective view of a third-type module of the building construction of Figure 1;
- Figure 11 is a view of an assortment of covering elements of the building construction of Figure 1;
- Figure 12 is a front view of a ceiling wall or a floor wall of the building construction of Figure 1;
- Figure 13 is a side view of the ceiling wall or the floor wall of Figure 12;
- Figure 14 is a vertical sectional view of the ceiling wall of Figure 12;
- Figure 15 is a vertical sectional view of the floor wall of Figure 12;
- Figure 16 is a front view of a column element of the building construction of Figure 1;
- Figure 17 is a top view of the column element of Figure 16;
- Figure 18 is a front view of a side wall of the building construction of Figure 1;
- Figure 19 is a top view of the side wall of Figure 18;
- Figure 20 is a vertical sectional view of the side wall of Figure 18;
- Figure 21 is a front view of a first plane external covering element of the building construction of Figure 1;
- Figure 22 is a top view of the first plane external covering element of Figure 21;
- Figure 23 is a front view of a second plane external covering element of the building construction of Figure 1;
- Figure 24 is a top view of the second plane external covering element of Figure 23;
- Figure 25 is a front view of a plane internal covering element of the building construction of Figure 1;
- Figure 26 is a top view of the plane internal covering element of Figure 25;
- Figure 27 is a front view of a first angular external covering element of the building construction of Figure 1;

- Figure 28 is a top view of the first angular external covering element of Figure 27;
- Figure 29 is a horizontal sectional view of the first angular external covering element of Figure 27;
- Figure 30 is a front view of a second angular external covering element of the building construction of Figure 1;
- Figure 31 is a top view of the second angular external covering element of Figure 30;
- Figures 32-44 show respective sectional views of parts of the building construction of Figure 1 during subsequent assembling steps.

[0033] Referring to the annexed figures, by reference number 10 it is indicated a building construction according to the present disclosure.

[0034] In particular, the building construction 10 is of modular type, and comprises a plurality of modules or basic units 12, 13, 14, structurally independent and self supporting, which can be placed side-by-side and mutually stacked, according to a high number of possible configurations. Moreover, as will be better described hereinafter, the building construction 10 is wood-based and wood composite-based, and it is a construction having high thermal insulation features.

[0035] Therefore, each module 12, 13, 14 constitutes for the building construction 10 a unit that can be brought near and connected to another module, alike or having multiple dimensions with respect to the former module, so as to obtain a preset final shape of the modular building construction 10.

[0036] In the example illustrated in Figures 1 to 10, it is possible to observe that the building construction 10 comprises a first-type module 12, a second-type module 13 and a third-type module 14, wherein the modules 13 and 14, second-type and third type respectively, have multiple dimensions with respect to the first-type module 12.

[0037] More specifically, each module 12, 13, 14 has a parallelepiped shape, and certain dimensions of length L1, L2, L3, width L' and height H, in which first-type 12, second-type 13 and third-type 14 modules differ thereamong only in length dimensions L1, L2, L3, the lengths L2 and L3 being a multiple integer of the respective length dimensions L1. In practice, in the illustrated example the first-type modules 12, the second-type modules 13 and the third-type modules 14 differ only in the different length dimension L1, L2, L3. Even more specifically, the first-type module 12 has the following dimensions (in length L1 $\times$ width L' $\times$ height H) of 250 cm $\times$ 250 cm $\times$ 270 cm, the second-type module 13 has the following dimensions (in length L2 $\times$ width L' $\times$ height H) of 500 cm $\times$ 250 cm $\times$ 270 cm, whereas the third-type module 14 has the following dimensions (in length L3 $\times$ width L' $\times$ height H) of 750 cm $\times$ 250 cm $\times$ 270 cm, respectively.

[0038] In all cases, nothing prevents the building construction 10 from being made only of first-type 12, second-type 13 or third-type 14 modules, all modules being,

as mentioned above, units that can be brought near and connected thereamong.

[0039] The height H of 270 cm is consistent with current regulations for the height of rooms for household use. In case of rooms for commercial use the height H is modified in accordance with laws in force, to a height, e.g., of 300 cm.

[0040] In the building construction 10 there are singled out an external side and an internal side, that is to say, a side facing a zone included inside each module 12, 13, 14, and a side facing the external zone that is not included in the module 12, 13, 14. In this regard, hereinafter in the description, the wording "external", "external side", "externally", "from the external portion" and the like, and, on the other hand, "internal", "internal side", "internally", "from the internal portion" and the like, are to be understood respectively in connection to the external and internal sides as defined above.

[0041] Though taking into consideration the difference among each module 12, 13, 14, first-type, second-type and third-type, respectively, for simplicity of exposition the following description, concerning the building construction 10, will indistinctly and overall refer to the one or the other module, generally denoted by reference numbers 12, 13, 14, it being understood that the same description is valid also for a building construction including only one type of module, or two types of modules.

[0042] In particular, the module 12, 13, 14 comprises

- a frame 11 including a floor wall 18, a ceiling wall 19, and one or more column elements 30, in the example four column elements 30; and
- an assortment 15 of covering elements 34, 40, 44, 50, 55, having each a respective predefined profile for coupling with a corresponding portion of said frame 11.

[0043] In the example, the assortment 15 includes a limited number of elements, for instance five elements 34, 40, 44, 50, 55 (Figure 11) which will be detailed hereinafter.

[0044] This means that the building construction 10 according to the present disclosure comprises a plurality of modules 12, 13, 14 which can be placed side-by-side and connected according to several possible configurations; moreover, each module 12, 13, 14 in turn can be disassembled into a framework or fixed and predefined frame 11, and various covering elements selectively couplable with the frame 11.

[0045] In other words, each module 12, 13, 14 is made of individual pieces, structurally independent and removably couplable thereamong according to needs, in particular depending on the number of modules placed side-by-side and on the side-by-side placing modes, in light of the desired final building construction 10 that is to be obtained.

[0046] This disassembling for each module 12, 13, 14 between frame 11 and finishing elements 15 allows to

design "on paper" costs, materials and pieces of the entire building construction 10.

[0047] Moreover, thanks to the fact of having, on the one hand, a frame made of a floor wall 18, a ceiling wall 19, and column elements 30 and, on the other hand, covering elements 15, it is possible to modularly conceive the entire building construction 10, also concerning hydraulic and electric systems for the air-conditioning of the building construction 10.

[0048] In this regard, it is in fact possible to associate in advance a portion of hydraulic and electric system to each frame 11, so that, after having connected all frames 11, an entire hydraulic or electric system of the building construction 10 can be designed *a priori*.

[0049] In particular, in this regard, as will be illustrated hereinafter, the floor wall 18 and the ceiling wall 19 of each module 12, 13, 14 include housings predefined for receiving installations of hydraulic or electric type that, once coupled, allow to obtain an entire hydraulic or electric system of the building construction 10.

[0050] Specifically, the floor wall 18 and the ceiling wall 19, whose contour or outline is schematically illustrated in Figure 12 and Figure 13, are alike therebetween and comprise a rectangular panel of preset length L1, L2, L3, depending on the selected length of the respective module 12, 13, 14, as mentioned of 250 cm, 500 cm and 750 cm, respectively, of width L', in the example of 250 cm, and of thickness S of 48 cm. More specifically, in Figure 12 it is illustrated the floor wall 18 or the ceiling wall 19 for the third-type module 14.

[0051] In practice, the dimensions of length L1, L2, L3 and of width L' of each module 12, 13, 14 are determined by the respective dimensions of length L1, L2, L3 and of width L' of the floor wall 18 and the ceiling wall 19.

[0052] Even more specifically in the example, the floor wall 18 and the ceiling wall 19 are each a multilayer body including channels or passages for the housing of ducts and hydraulic pipes and electric cables needed for the respectively hydraulic and electric systems of the building construction 10.

[0053] In fact, as mentioned, the inclusion in the floor wall 18 and ceiling wall 19 of such channels and passages for hydraulic and electric systems allows to adapt and conform in the concept of module 12, 13, 14 also the air-conditioning systems of the building construction 10. In other words, a designer of the building construction 10 can design and count in an *a priori* predefined way the hydraulic and electric systems of the building construction 10 already from the number of floor walls 18 and ceiling walls 19 that the building construction 10 contains.

[0054] The channels and passages of the floor walls 18 and of the ceiling walls 19 of each module 12, 13, 14 are suitably connected in the manufacturing stage of the building construction 10, to obtain one or more hydraulic circuits and a given electric network.

[0055] In addition, the floor wall 18 has a structure adapted to guarantee a satisfactory thermal insulation of the floor wall 18 with respect to the outside.

[0056] In particular, referring to Figures 15 and 32, the floor wall 18 comprises, from the bottom, i.e. from the external side of the floor wall 18, a support base 118a, including a first panel 119 of OSB (Oriented Strand Board, i.e. a panel of wood material manufactured with synthetic resins and thin veneers, called "strands"), a first set of beams 120 of laminated wood, arranged parallel at a suitable mutual distance, a second panel 121 of OSB, and a filling panel 128 of wood fibre placed between the beams 120 and the two OSB panels 119 and 121.

[0057] The first panel 119 serves to close and protect the entire floor wall 18 from a ground or bottom.

[0058] The floor wall 18 further comprises a partially hollow portion, including a recess 118b intended for housing the hydraulic and/or electric systems. In said portion it is provided a second set of parallel beams 122, placed above the second panel 121 at a given mutual distance, a third panel 123 of OSB, a layer 124 of wood fibre having a thermoinsulating function, and a coating layer 125. The beams 122 of the second set are arranged along a direction parallel to the direction of the beams 120 of the first group.

[0059] Each floor wall of each module 12, 13, 14 is connected to a floor wall of an adjacent module 12, 13, 14 by conventional connecting means used in the building and woodworking fields, like, e.g., screws.

[0060] As it is possible to observe in Figures 32 to 44, the entire floor wall 18 rests on height-adjustable brackets 21.

[0061] In particular, in Figures 32 to 44 it is illustrated, in a small-sized constructive model, a construction mode of the building construction 10 from the floor wall 18, as will be illustrated more clearly hereinafter.

[0062] In case the floor wall 18 has a side placed at the external periphery of the building construction 10, it is provided an interconnecting element 126 (visible both in Figure 15 and in Figures 32 to 44) of laminated wood, which is placed on said side of the floor wall 18 for interconnection with a first plane external covering element 34, which will be described hereinafter. The interconnecting panel 126 is connected to the beams 120 of the first set by a male/female or tenon/mortise connection 126a, as visible in Figure 32.

[0063] The floor wall 18 further comprises one or more impressions 27 obtained according to needs in the two layers 124, 125 for housing a partition or internal wall 80, which will be described hereinafter.

[0064] Similarly to the floor wall 18, the ceiling wall 19 (Figure 14) includes, from the bottom, i.e. from the internal side of the ceiling wall 19, a panel 131 of gypsum fibre, a layer 132 of wood fibre having a thermoinsulating function, a first panel 133 of OSB, and a recess 134 intended for housing hydraulic ducts and electric cables. The recess 134 is defined between a first set of beams 135 of laminated wood, placed at a suitable mutual distance. Above the recess 134, the ceiling wall 19 comprises a second panel 136 of OSB, a second set of beams 137 of laminated wood, placed parallel, a third panel 138

of OSB and a filling panel 139 of wood fibre, interposed between the second set of beams 137, and the second panel 136 and the third panel 138.

[0065] Also the ceiling wall 19 includes an impression 28 for housing a partition 80.

[0066] In case the ceiling wall 19 has a side placed at the external periphery of the building construction 10, an interconnecting element 126 of laminated wood (Figure 15, and Figures 36 to 44) is provided which is placed on said side of the ceiling wall 19 for interconnection with the first plane external covering element 34, which, as mentioned above, will be described hereinafter.

[0067] The column element 30 of frame 11, illustrated in detail in Figures 16, 17, comprises an elongate body having the shape of a substantially square-section parallelepiped, in the example having a side L'_{30} of 12 cm.

[0068] The column element 30 has a length dimension L_{30} equal to 277.5 cm, said length being selected depending on the height H to be obtained inside the module 12, 13, 14. The column element 30 is interposed between the floor walls 18 and the ceiling walls 19, and constitutes a load-bearing element for supporting the ceiling wall 19. In Figure 2 and in Figure 3 it is visible the column element 30 interposed between the floor wall 18 and the ceiling wall 19. The column element 30 is connected to the two floor 18 and ceiling 19 walls with means of a type known in the woodworking field, like e.g. screws.

[0069] In the example, the column element 30 is made of laminated wood.

[0070] Besides the above-mentioned covering elements 15, the building construction 10 comprises a side wall 20, whose contour or outline is schematically illustrated in Figure 18 and in Figure 19, which constitutes a front for the building construction 10, and allows to laterally close the space comprised between consecutive column elements 30.

[0071] The side wall 20 comprises a panel having a generally rectangular shape, of width dimension L'_{20} equal to 226 cm, length L_{20} equal to 289.5 cm or 373.5 cm, said length being selected depending on the height H to be obtained inside the room of the module 12, 13, 14, and a thickness S_{20} of 24 cm.

[0072] From an analysis of the width L'_{20} of the side wall 20, it is found that the side wall 20 has dimensions such as to cover each side of width L' and length L1 of the first-type module 12, whereas two side walls 20 and three side walls 20 are needed to cover a long side of length L2 and L3, of the second-type module 13 and third-type module 14, respectively.

[0073] In practice, in the example, the side wall 20 is an element suitable for any module 12, 13, 14 without distinction.

[0074] Even more specifically, referring to Figure 19, the side wall 20 has a side profile 22, at the sides of the side wall 20, provided with a plurality of shoulders and recesses. In particular, on each side, the side profile 22 comprises a first recess 23, in the example obtained on the external corner of the side wall 20, a shoulder 24, a

second recess 25, in the example deeper than the first recess 23, and a third slight recess 26.

[0075] Second recess 25 and third recess 26 are intended to face the inside of the building construction 10.

5 **[0076]** The above-mentioned side profile 22 of the side wall 20 is adapted to be placed matching with other covering elements 15 of the building construction 10 which lie adjacent to the side wall 20, as will be explained hereinafter.

10 **[0077]** The side wall 20 is completed by a projection 142a lying at a top edge (said projection 142a is also visible in Figures 20, 34, and 38), and another projection 143a obtained on an opposite bottom side (visible in the drawings of figures 20, 34, and 38). Also such projections 142a, 143a allow a connection of the side wall 20 with other elements of the building construction 10 that lie adjacent thereto.

15 **[0078]** Also the side wall 20 has a structure such as to allow to obtain a high thermal insulation. In particular, in the side example the side wall 20 has the following multilayer wood structure.

In particular, referring to Figure 20 or to Figure 34, the side wall 20 includes, from the outside, a wood chipboard 140, known e.g. under the trade name of DWD AGE PAN, useful for strengthening and resistance to wind, as well as for protection from atmospheric agents in the construction stage, and a pair of horizontally arranged transversal elements 142, 143 having a supporting function, two panels 144 of flexible wood fibre, e.g. known under the trade name of Thermoflex, a panel 145 of OSB, in the example a panel comprised of pine wood veneer strips having a length of from 120 to 150 mm that, as is the case for plywood, are overlapped and oriented at 90° one another, having high stability and sturdiness. The side wall 20 further comprises a flexible wood fibre panel 146 as further thermal insulation / acoustic insulation, a PVC duct 147 for various installations, and a gypsum fibre and cellulose panel 148 as support for internal side plaster.

30 **[0079]** It may be observed that the transversal elements 142, 143 have a substantially L-shaped section and define the above-mentioned bottom and top projections 142a, 143a of the side wall 20.

35 **[0080]** Moreover, it may be observed that the above-mentioned side profile 22 of the side wall 20 may be obtained by suitably sizing the width of the individual panels and layers constituting the multilayer structure of the side wall 20.

40 **[0081]** The above-mentioned covering elements 15 comprise the first plane external covering element 34, mentioned above and seen in detail in Figures 21 and 22, adapted to be horizontally placed on a respective side of the ceiling and floor elements 18, 19 at the external periphery of the building construction 10, with a protecting function. Essentially, the covering element 34 is placed so as to cover the thickness S of the ceiling and floor elements 18, 19, along the external periphery of the building construction 10. This function of the covering

element is clearly seen in Figures 32 to 44, where the connection with the above-mentioned interconnecting element 126 is visible.

[0082] Moreover, in Figures 4 and 5 it is possible to observe the coupling of each first plane external covering element 34 on a respective side of the ceiling and floor elements 18, 19.

[0083] The first plane external covering element 34 has a variable length L_{34} , in the example of 223, 423, 723 cm depending on the module 12, 13, 14 to which it is associated, i.e. if placed at the width L' and length $L1$, or at the length $L2$, or the length $L3$ of each module 12, 13, 14, so as to fit all modules. Moreover, the covering element 34 has a height H_{34} of 42 cm.

[0084] The first plane external covering element 34 has a mainly rectangle-like section (see Figures 21 and 22), and comprises, at two consecutive corners of a long side 34a of the rectangle, two opposite notches 36, 37.

[0085] In particular, the first plane external covering element 34 is placed on the external side of the floor and ceiling elements 18, 19, so that such notches 36, 37 are on the external side of the building construction 10. Said notches 36, 37 define a coupling profile of the covering element 34 with remaining elements of the building construction 10 which lie adjacent thereto, as will be described hereinafter.

[0086] Referring to Figures 32 to 44, and in particular as is visible in figure 32, the first plane external covering element 34 has the following multilayer wood structure, guaranteeing high thermal insulation. In particular, the first plane external covering element 34 comprises a wood chipboard 150, known e.g. under the trade name of DWD AGEPAN, a pair of laminated wood beams 151, 152 with a supporting function, a laminated wood post 153 and a wood fibre layer 154 comprised between the pair of beams 151, 152 and the post 153.

[0087] The first plane external covering element 34 further comprises a plurality of notches, generally denoted by reference number 155, in which are adapted to be housed corresponding pegs, not visible in the drawings, projecting from the interconnecting element 126 of the floor wall 18, and of the ceiling wall 19, respectively.

[0088] The above-mentioned covering elements 15 further comprise a second plane external covering element 40, visible in Figures 23, 24, which is adapted to be interposed, on the external side of the building construction 10, between adjacent side walls 20 of two modules 12, 13, 14 which lie side-by-side (see Figures 4 to 7).

[0089] The second plane external covering element 40, having a substantially rectangle-shaped section, has a width L'_{40} equal to 12 cm, and a length L_{40} of 277.5 cm. The second plane external covering element 40 comprises, at two consecutive corners, two opposite appendages 41, 42 extending parallelly to a long side 40a of the rectangle, respectively each at one of the two short sides 40b, 40c of the rectangle.

[0090] Each appendage 41, 42 is intended to be placed matching, substantially by juxtaposition, with a respec-

tive notch 36, 37 of the covering element 34 lying adjacent thereto in the building construction 10, and to a respective first recess 23 of the side wall 20.

[0091] In Figure 4 and Figure 5, it is illustrated a step of designing the building construction 10 in which the second plane external covering element 40 is associated to the floor wall 18 and ceiling wall 19, and to the related covering elements 34. In particular, in Figure 5 it may be observed that the second plane external covering element 40 has a length L_{40} such as to be connected both to the first plane external covering element 34 placed at the floor element 18, and to that placed at the floor element 19. On the internal side of the building construction 10, the second plane external covering element 40 simply rests onto two side-by-side first column elements 30, lying adjacent thereto in the building construction 10. The result is shown from the top in Figure 6.

[0092] The second plane external covering element 40 is also made with a wood-based multilayer structure, not shown in the drawings, including an OSB layer and a layer of tarred cardboard.

[0093] The above-mentioned covering elements 15 comprise a first angular external covering element 50 (illustrated in detail in Figures 27, 28 and 29) adapted to be vertically placed on the external side of the building construction 10, at external corners thereof, to cover a corner junction (connection) zone between adjacent side walls 20, as is visible from Figure 4 in the constructing step, and from Figures 5, 6 and 7 at the end of the constructing step.

[0094] Referring to Figures 27, 28 and 29, the first angular external covering element 50 has an overall width L'_{50} , in the example of 29 cm, and a length L_{50} of 373.5 cm, such as to be connected both to the first plane external covering element 34 placed at the floor element 18 and to that placed at the floor element 19.

[0095] More specifically, the first angular external covering element 50 has an L-shaped section; that is to say, it comprises two flanges 51, 52 placed at a right angle. Each flange 51, 52 comprises, on the external side, at a respective corner, a projection 53, 54. Each projection 53, 54 is intended to be placed matching, substantially by juxtaposition, with a respective notch 36, 37 of the first plane external covering element 34 lying adjacent thereto in the building construction 10, and to a respective first recess 23 of the side wall 20.

[0096] The first angular external covering element 50 (Figure 29) has the following structure, including two wood chipboards 160, 161, known e.g. under the trade name of DWD AGEPAN, arranged at a right angle, two OSB panels 162, 163, arranged at a right angle on the internal side of the corner, four vertical posts 164, 165, 166, 167 of laminated wood, and two filling panels 168, 169 of wood fibre.

[0097] The first angular external covering element 50 further comprises protection elements, of laminated wood, generally denoted by reference number 170, visible in Figure 40, placed at the end of the first angular

external covering element 50.

[0098] The above-mentioned covering elements 15 further comprise a plane internal covering element 44 (visible in detail in Figures 25, 26) adapted to be vertically placed on the internal side of the building construction 10, to cover an internal junction zone between adjacent side walls 20. In figure 6 it is illustrated a step of constructing the building construction 10 in which the first plane internal covering element 44 is associated, together with the side wall 20, to the floor wall 18 and the ceiling wall 19, and to the related covering elements 34, 40, and column elements 30.

[0099] The first plane internal covering element 44 is also visible in detail, as anticipated, in Figure 25 and in Figure 26. In particular, the first plane internal covering element 44 has a substantially rectangle-shaped section, with a width L'_{44} of 49.5 cm and a length L_{44} of 277.5 cm, and it has a stepped contour at the two short sides 44a, 44b of the rectangle.

[0100] Even more specifically, in the example the first plane internal covering element 44 comprises, at the four corners of the rectangle, two opposite projections 45, 46 extending parallelly to a long side 44c (which actually is the internal side of the second covering element 44), each at one of the two short sides 44a, 44b of the rectangle, and two opposite recesses 48, 49, obtained at the other long side 44d, which actually is the external side of the second covering element 44.

[0101] Projections 45, 46 and recesses 48, 49 are adapted to be placed matching with the respective internal recesses 25, 26 of each of the side walls 20 that lie side-by-side to the first plane internal covering element 44, as is visible in Figure 6. The long side 44d is intended to be placed matching with the first column elements 30, as is visible from Figure 6 in an exploded condition, and from Figure 7.

[0102] The plane internal covering element 44 is also made with a wood-based multilayer structure, not visible in the drawings, including an OSB layer, an insulating layer, and a plasterboard layer.

[0103] The above-mentioned covering elements 15 comprise a second angular external covering element 55 (visible in detail in Figures 30, 31) adapted to be vertically placed on the external side of the building construction 10, at internal corners thereof, to cover a junction zone between adjacent side walls 20.

[0104] In particular, as visible in Figures 1-7, the modular construction 10 forms an internal angle of 90° , denoted by A in Figure 4, and said second angular external covering element 55 is intended to be placed to externally cover said internal angle A.

[0105] Therefore, the second angular external covering element 55 acts as further insulation/protection for the building construction 10, and has a length L_{55} of 373.5 cm and a width L'_{55} of 15.5 cm.

[0106] The second angular external covering element 55 has a mainly rectangle-like section, and comprises a projection 56 at one of the four corners.

[0107] The second angular external covering element 55 is adapted to be placed matching with the second recess 25 of the side wall 20, so that the projection 56 be placed matching with the slight recess 26 of the side wall 20, and the notch 36, 37 of the first plane external covering element 34.

[0108] The second angular external covering element 55 is made of laminated wood.

[0109] Referring to Figures 2 to 7 it is presently illustrated a method of designing a building construction 10 according to the present disclosure, having a given number of modules 12, 13, 14, in the example seven modules 12, 13, 14.

[0110] For each module 12, 13, 14, a plurality of basic frames 11 are placed side-by-side. In particular, seven floor walls 18 are associated, at the four corners of each floor wall 18, to respective column elements 30, and on such column elements 30 seven respective ceiling walls 19 are placed.

[0111] As mentioned above, the floor walls 18 and the ceiling walls 19 of each frame are connected therebetween by conventional connecting means.

[0112] In a second step, the external-side sides, i.e. the sides at the periphery, of each frame 11, at the floor walls 18 and ceiling walls 19, are covered with respective first covering elements 34 of adequate length, as illustrated in Figure 4.

[0113] In a third step, on the external side of the building construction 10 at the connecting zones between the first covering elements 34, where there are pairs of side-by-side column elements 30, there are placed the third covering elements 40, which as mentioned above have a contour intended to be placed matching with the first column elements 30, the first covering elements 34 and the side walls 20.

[0114] Likewise, on the external side of the building construction 10, at the corner zones thereof, there are arranged and fastened the first external angular elements 50 and the second external angular element 55, each of which, as mentioned above, has a contour intended to be placed matching with a column element 30, the first covering elements 34 and the side walls 20 lying adjacent thereto.

[0115] Then, in a next step, as illustrated in Figure 6 and 7, the side walls 20 and the third covering elements 44 are fastened.

[0116] As it is possible to observe from the drawings, the side walls 20 may be placed at will on all sides of the modules 12, 13, 14, or a side wall 20 may be replaced by a window element, not visible in the drawings, having the same size and the same coupling profile of the side wall 20.

[0117] The building construction 12 may be completed by partitions 80 for partitioning internal rooms.

[0118] From this sequence of operative steps, it may be reckoned that the main advantage of the building construction according to the present disclosure lies in the fact that all of the constituent parts of the building con-

struction can be connected thereamong in various ways, that is to say, they can be assembled in alternative configurations.

[0119] By using the same pieces (i.e., floor wall, ceiling wall, column elements and covering elements) it is possible to obtain building constructions having different shapes and dimensions, from a single module to a plurality of modules side-by-side or stacked.

[0120] This building construction can be designed very easily in advance before installation, the component pieces thereof being easily singled out *a priori*; this allows to quickly estimate costs as well.

[0121] A further advantage of the building construction according to the present disclosure lies in the option of considering from a modular viewpoint also hydraulic and electric systems needed to complete the services of the building construction, like e.g. heating, cooling or connection to an electric network.

[0122] Moreover, the making of the walls and the covering elements with respective multilayer wood structures, and their one-way coupling, allows to obtain a high control of the thermal insulation of the building construction.

[0123] In addition, the use of modules of different types allows to increase the possible combinations of shapes and configurations of the building construction 10 to be obtained.

[0124] Referring to Figures 32 to 44, herein it is illustrated a sequence of operating steps of assembling of some pieces, sectionally shown, of the building construction 10 according to the present disclosure, in order to highlight both the coupling of the parts, and the multilayer structure of the building construction.

[0125] In particular, in Figure 32 and in Figure 33 it is illustrated a first operating step in which to a corner portion of a floor wall 18 two first covering elements 34 are connected. Moreover, in the impression 27 of the floor wall 18 an internal wall 80, or partition, is also positioned. In particular, the partition 80 has a sandwich-like multilayer structure including two opposed panels 180, 185 of gypsum fibre, between which there are comprised two internal OSB panels 181, 184 respectively, posts and beams 183, 182 of laminated wood and a filling panel 186 of wood fibre.

[0126] In Figure 34 and in Figure 35 it is shown the coupling of a portion of side wall 20. In particular, it is possible to observe that the side wall 20 has beams 142, 143 with the respective projections 142a, 143a coupled by matching with respective recesses 34' of the first bottom covering elements 34 (Figure 33) and of the first top covering elements 34 (Figure 37).

[0127] In figure 36 and in Figure 37 it is illustrated a next step of coupling of a corner portion of a ceiling wall 19. As it is possible to observe from these figures, the ceiling wall 19 has the interconnecting element 126 that couples by matching with a respective recess 20' of the side wall 20.

[0128] In Figure 38 and in Figure 39 it is illustrated the

coupling of the first covering elements 34 with the ceiling wall 19.

[0129] In Figure 40 and in Figure 41 it is illustrated the coupling of the first covering elements 34 with the first angular external covering element 50, which, in said figures, is associated to a gutter element 90 intended for conveying rainwater.

[0130] In a next step, as is visible in Figure 42, Figure 43 and Figure 44, there are prearranged further covering elements, having a mainly aesthetic character, like e.g. a wall finishing element 82, in the example made of a plate comprising a plurality of laths, and a roof finishing element 83, in the example comprising an OSB panel 84, supported on laminated wood beams 85, which rest directly on the ceiling wall 19, and by further beams 86 arranged at an angle, placed above the panel 84.

[0131] The subject of the present disclosure has been hereto described with reference to preferred embodiments thereof. It is understood that other embodiments might exist, all falling within the concept of the same invention, and all comprised within the protective scope of the claims hereinafter.

Claims

1. A modular building construction (10), such as a dwelling, a structure for commercial use, and alike building constructions, comprising one, or more, modules (12, 13, 14) having a substantially parallelepiped shape, wherein said module (12, 13, 14) comprises a frame (11) including a floor wall (18), a ceiling wall (19), and at least one or more column elements (30) constituting support for said ceiling wall (19), and wherein said module (12, 13, 14) includes an assortment of covering elements (15, 34, 40, 44, 50, 55), wherein each of said covering elements (15, 34, 40, 44, 50, 55) is adapted to cover a corresponding portion of said frame (11).
2. The modular building construction (10) according to claim 1, wherein each of said covering elements (15, 34, 40, 44, 50, 55) has a coupling profile adapted to be placed matching with a corresponding coupling profile of another covering element (15, 34, 40, 44, 50, 55) of said assortment lying adjacent thereto in the modular building construction (10) and/or with a corresponding coupling profile of said frame (11).
3. The modular building construction (10) according to claim 1 or 2, made of wood and/or wood-based composites.
4. The modular building construction (10) according to any one of the preceding claims, wherein said floor wall (18) and/or said ceiling wall (19) include respective housings (118b, 134) for receiving installations of hydraulic and/or electric type.

5. The modular building construction (10) according to any one of the preceding claims, comprising at least one side wall (20) adapted to be interposed between the floor wall (18) and the ceiling wall (19), and constituting a side of the parallelepiped, said side wall (20) including a coupling profile (20', 22, 23, 24, 25, 26) adapted to be placed matching with a corresponding coupling profile of one or more covering elements (15, 34, 40, 44, 50, 55) lying adjacent to the side wall (20) in the modular building construction (10) and/or with a corresponding coupling profile of said frame (11). 5
6. The modular building construction (10) according to any one of the preceding claims, wherein said frame (11) includes four column elements (30) arranged at the four corners of the parallelepiped. 10
7. The modular building construction (10) according to claim 6, wherein said modular building construction (10) comprises a single module (12, 13, 14), and wherein said assortment of covering elements (15, 34, 40, 44, 50, 55) comprises one or more plane external covering element (34) adapted to be horizontally placed on an external side at a respective side of said floor wall (18) and/or of said ceiling wall (19), and one or more first angular external covering element (50) adapted to be vertically placed on an external side at a respective column element (30). 15
8. The modular building construction (10) according to claim 6, wherein said modular building construction (10) comprises at least two modules (12, 13, 14) side-by-side, and wherein said assortment of covering elements (15, 34, 40, 44, 50, 55) comprises one or more first plane external covering element (34) adapted to be horizontally placed on an external side at a respective side of said floor wall (18) and/or of said ceiling wall (19), one or more first angular external covering element (50) adapted to be vertically placed on an external side at a respective column element (30), one or more second plane external covering element (40) adapted to be vertically placed on an external side at two adjacent column elements (30), and a plane internal covering element (44) adapted to be vertically placed on an internal side at the two adjacent column elements (30). 20
9. The modular building construction (10) according to claim 8, wherein said first plane external covering element (34) includes a coupling profile (36, 37) adapted to be placed matching with both a corresponding coupling profile (41, 42) of said second plane external covering element (40), at a connection zone between the two modules (12, 13, 14) side-by-side, and with a corresponding coupling profile (53, 54) of said first angular external covering element (50), at an angle of said modules (12, 13, 14). 25
10. The modular building construction (10) according to claim 9, when dependent from claim 5, wherein said coupling profile (22, 23, 24, 25, 26) of the side wall (20) is adapted to be placed matching both with a corresponding coupling profile (41, 42, 45, 46, 48, 49) of said second plane external covering element (40), of said column elements (30) and of said plane internal covering element (44), respectively, at a connection zone between the two modules (12, 13, 14) side-by-side, and with a corresponding coupling profile (53, 54) of said first angular external covering element (50), at an angle of said modules (12, 13, 14). 30
11. The modular building construction (10) according to claim 5 or 10, wherein the side wall (20) has a multilayer wood structure including at least one housing (147) for receiving hydraulic and/or electric systems. 35
12. The modular building construction (10) according to claim 10, wherein said second plane external covering element (40) has side appendages (41, 42) intended to be placed matching, substantially by juxtaposition, with a respective notch (36, 37) of the first covering element (34) and with a respective recess (23) of the side wall (20). 40
13. The modular building construction according to claim 10 or 12, wherein said first angular external covering element (50) has an L-shaped section comprising two flanges (51, 52) placed at a right angle, wherein each flange (51, 52) comprises a projection (53, 54) intended to be placed matching, substantially by juxtaposition, with a respective notch (36, 37) of the first covering element (34), and with a respective recess (23) of the side wall (20). 45
14. The modular building construction according to claim 10, 12, or 13, wherein said second plane internal covering element (44) has a mainly rectangle-like section, and comprises, at the four corners of the rectangle, two opposite projections (45, 46) extending parallelly to a long side (44c) of the rectangle, and two opposite recesses (48, 49), obtained at the other long side (44d) of the rectangle, said projections (45, 46) and recesses (48, 49) being adapted to be placed matching with respective recesses (25, 26) of each of the adjacent side walls (20). 50
15. The modular building construction (10) according to any one of the claims 8 to 14, wherein said modules (12, 13, 14) are arranged at an angle, with the forming of an internal angle (A) of at least 90°, and wherein said assortment of covering elements (15, 34, 40, 44, 50, 55) comprises a second angular external covering element (55) adapted to be vertically placed on the external side of the building construction (10) at said respective internal angle (A). 55

16. The modular building construction (10) according to claim 15, wherein said second angular external covering element (55) has a mainly rectangle-like section, and comprises a projection (56) projecting from one of the four corners of the rectangle. 5
17. The modular building construction (10) according to any one of the preceding claims, wherein said module (12, 13, 14) has given dimensions of length (L1, L2, L3), width (L'), and height (H), and wherein said modular building construction (10) comprises a plurality of modules (12, 13, 14) selected from a group comprising at least one first-type module (12) and at least one second-type module (13), wherein the length dimensions (L2) of said second-type module (13) are a multiple integer of the respective length dimensions (L1) of the first-type module (12). 10
18. The building construction according to claim 17, comprising at least one third-type module (14) wherein the length dimensions (L3) of said third-type module (14) are a multiple integer of the respective length dimensions (L1) of the first-type module (12). 15
19. A method of designing a modular building construction (10) including one or more modules (12, 13, 14) of substantially parallelepiped shape and wherein said method provides at least of 20
- predefining for each of said module/s (12, 13, 14) a frame (11) comprising a floor wall (18), a ceiling wall (19), one, or more, column element (30) for supporting said ceiling wall (19), 25
 - defining the final shape of the building construction (10) to be obtained and the number of modules (12, 13, 14) contained therein; 30
 - placing side-by-side the basic frames (11) of the individual modules (12, 13, 14) on the basis of the final shape of building construction (10) to be obtained, 35
 - providing for each of said module/s (12, 13, 14) an assortment of covering elements (15), wherein each of said covering elements (15) is placed to cover a corresponding portion of said frame (11). 40
20. The method according to claim 19, comprising the further step of interposing a side wall (20) between the ceiling wall (19) and the floor wall (18), wherein said side wall (20) constitutes a side of the parallelepiped, and wherein said side wall (20) includes a coupling profile (22, 23, 24, 25, 26) adapted to be placed matching with a corresponding coupling profile of one or more covering elements (15, 34, 40, 44, 50, 55) lying adjacent to the side wall (20) in the modular building construction (10) and/or with a corresponding coupling profile of said frame (11). 45
21. The method according to claim 19 or 20, wherein said modular building construction (10) comprises a single module, and wherein from said assortment of covering elements (15, 34, 40, 44, 50, 55) it is selected one or more first plane external covering element (34) adapted to be horizontally placed on an external side at a respective side of said floor wall (18) and/or of said ceiling wall (19), and one or more first angular external covering element (50) adapted to be vertically placed on an external side at a respective column element (30). 50
22. The method according to claim 19 or 20, wherein said modular building construction (10) comprises at least two modules (12, 13, 14), and wherein from said assortment of covering elements (15, 34, 40, 44, 50, 55) it is selected one or more first plane external covering element (34) adapted to be horizontally placed on an external side at a respective side of said floor wall (18) and/or of said ceiling wall (19), one or more first angular external covering element (50) adapted to be vertically placed on an external side at a respective column element (30), one or more second plane external covering element (40) adapted to be vertically placed on an external side at two adjacent column elements (30), and a plane internal covering element (44) adapted to be vertically placed on an internal side at the two adjacent column elements (30). 55

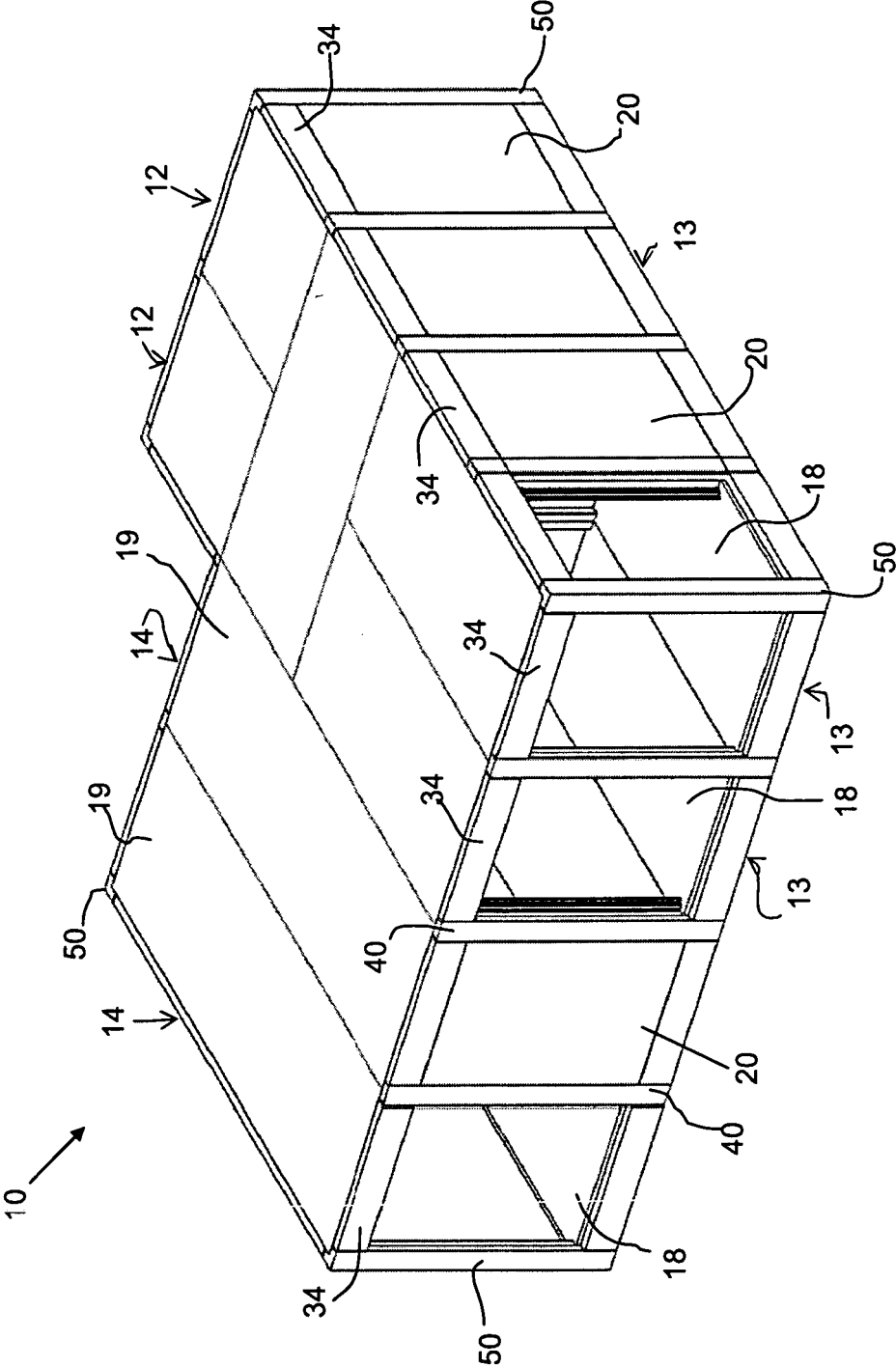


Fig. 1

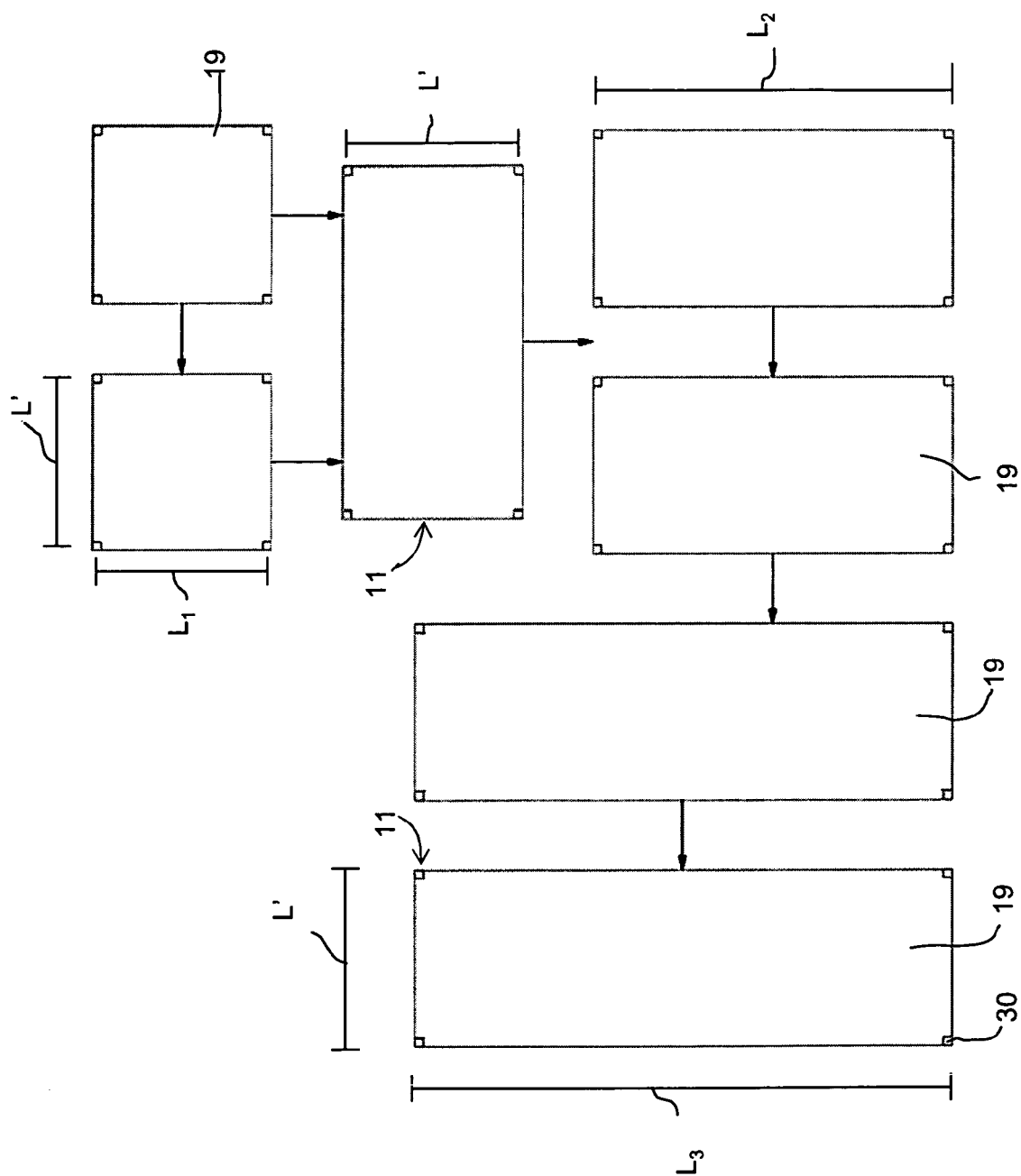


Fig. 2

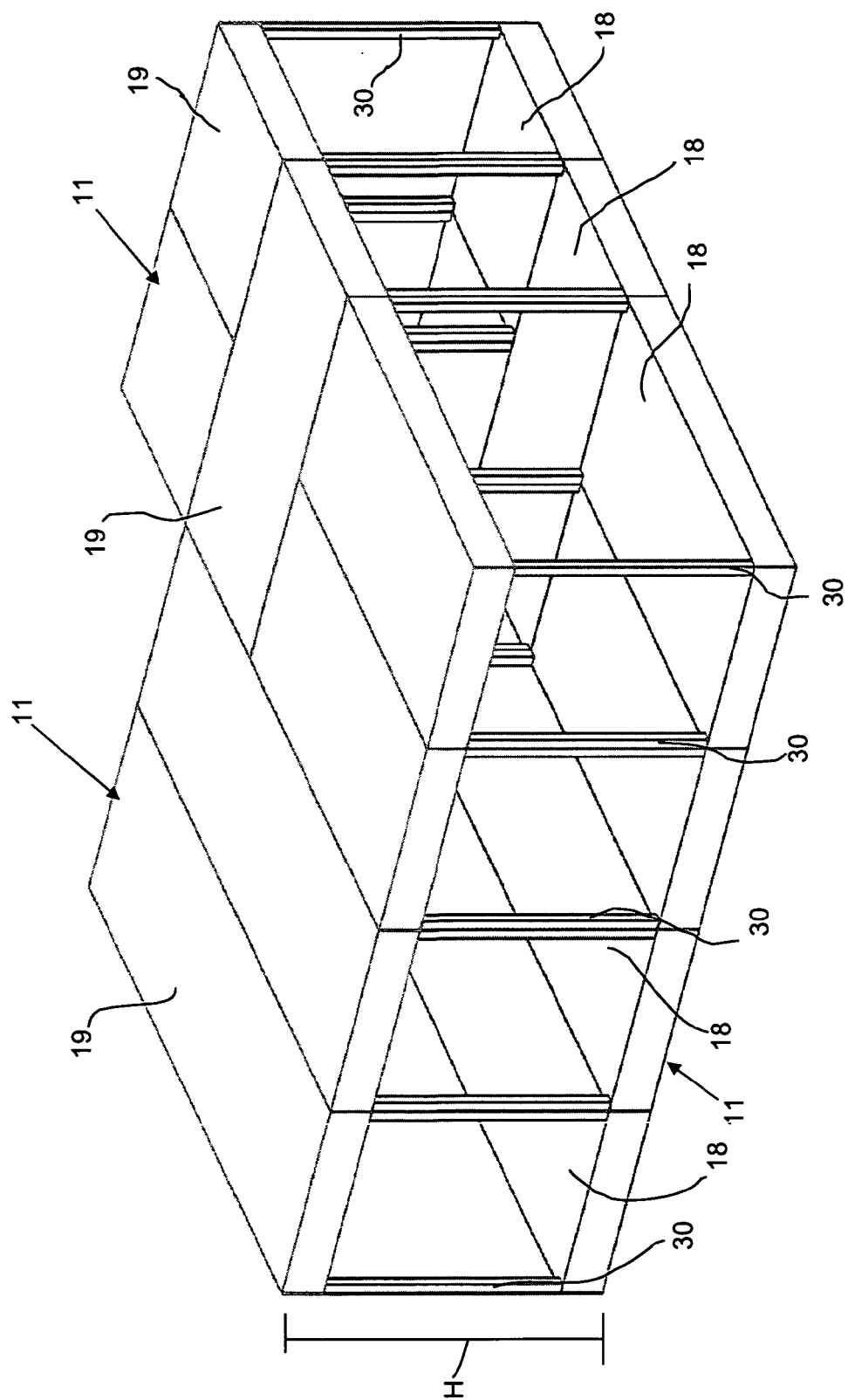


Fig.3

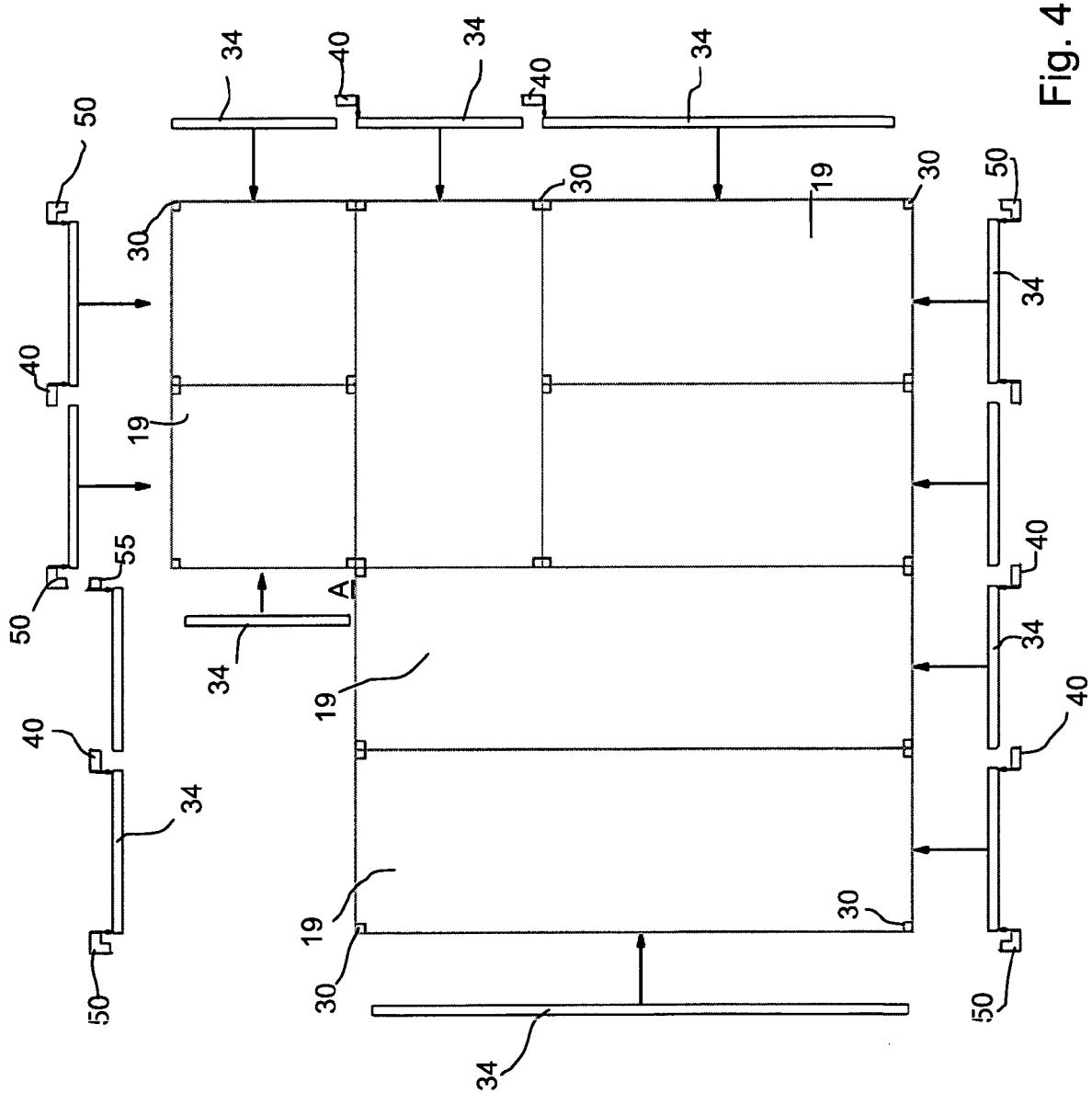


Fig. 4

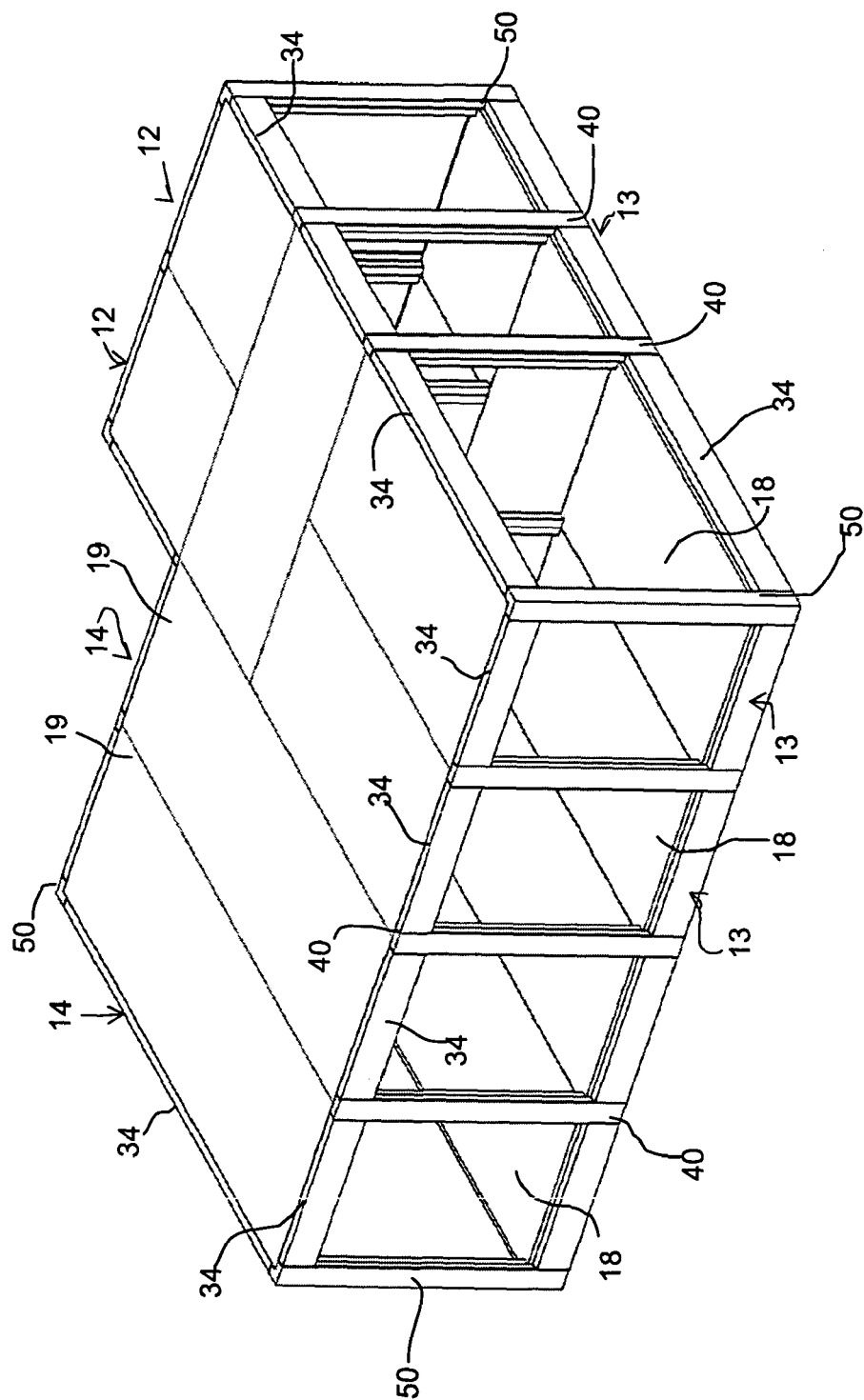


Fig. 5

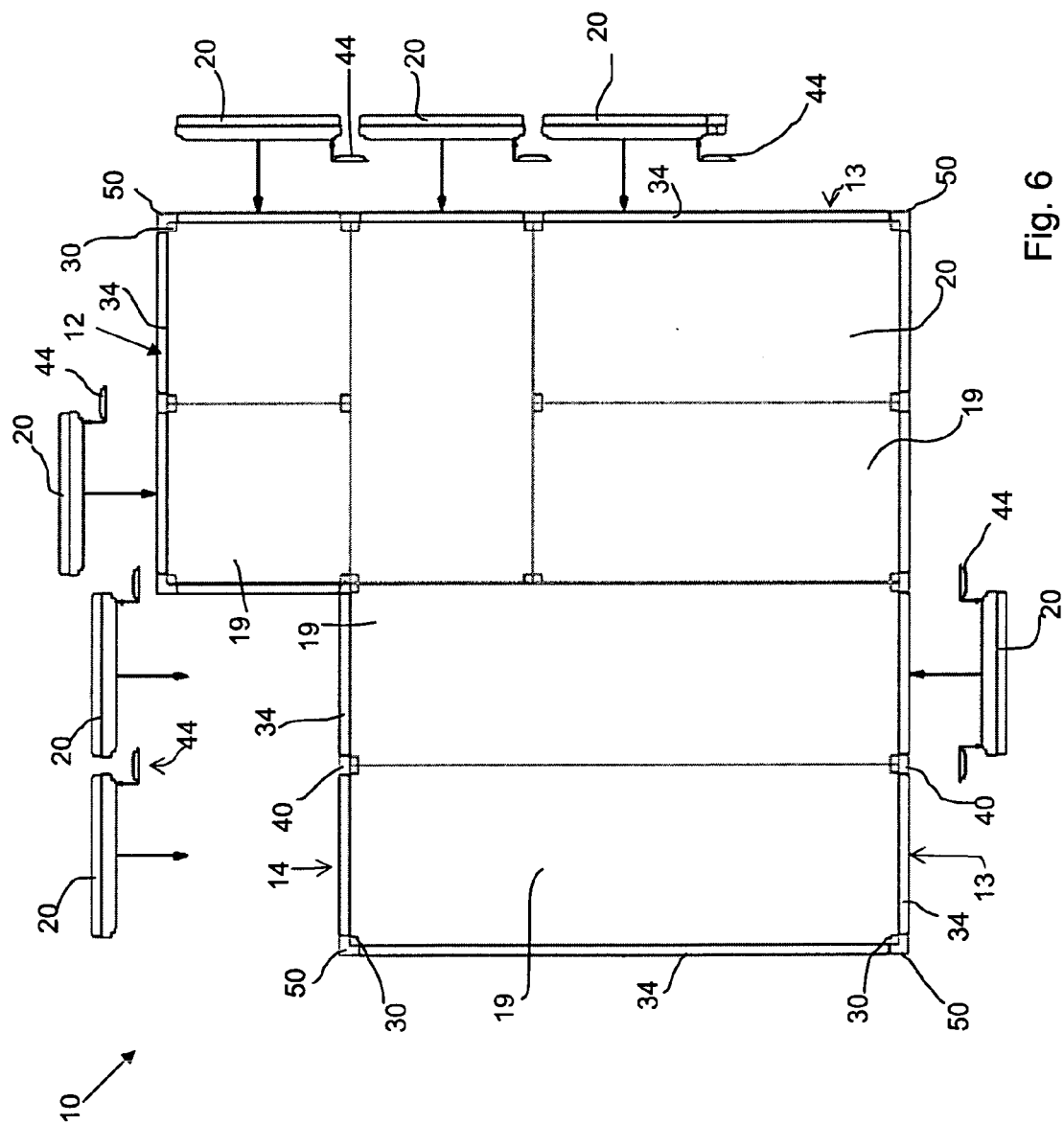


Fig. 6

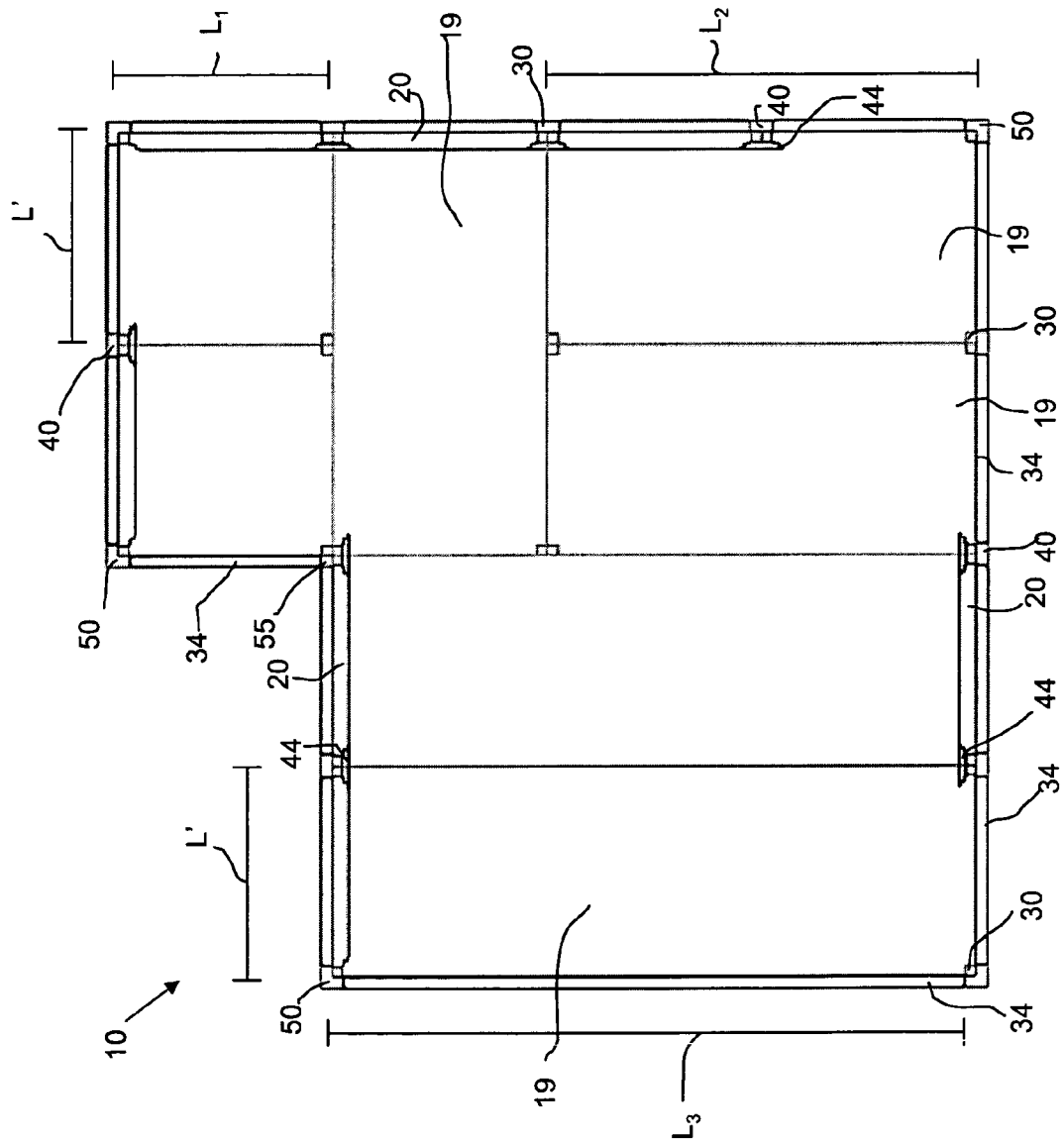
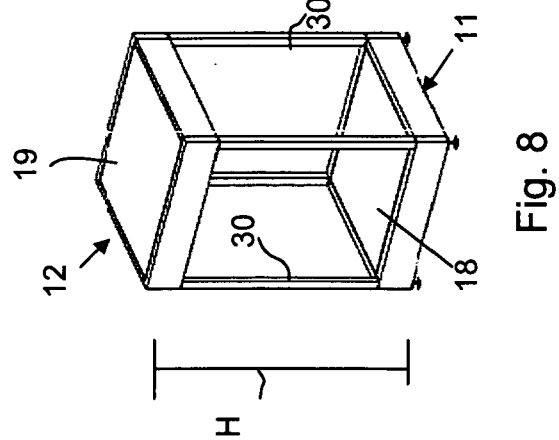
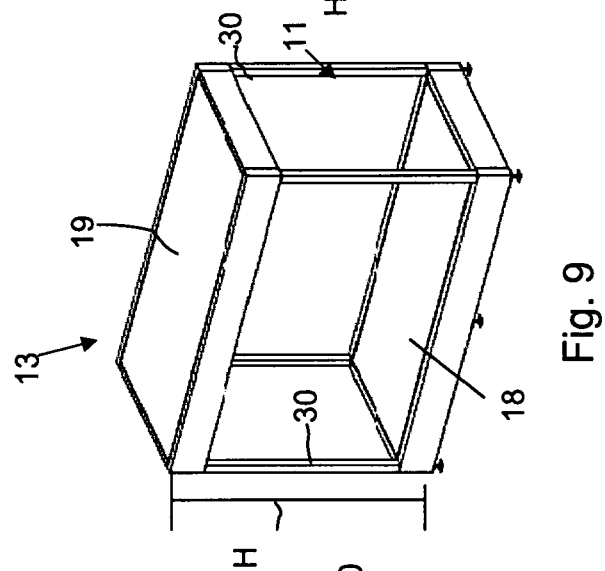
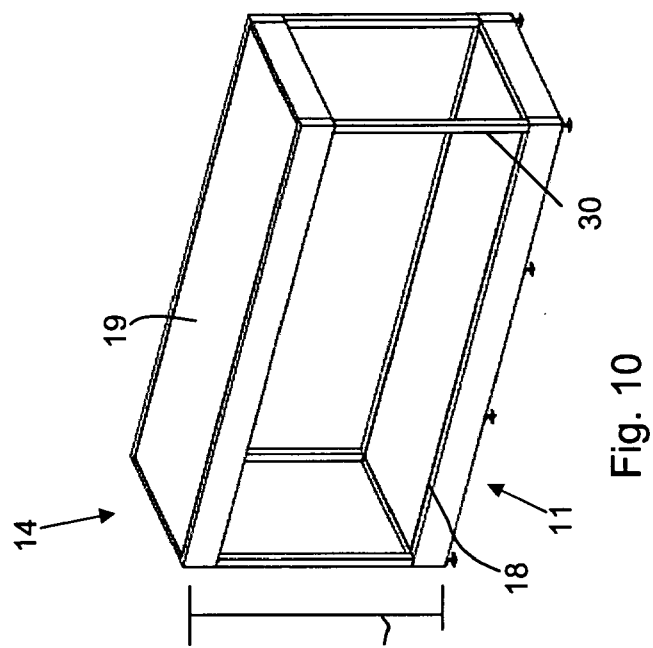


Fig. 7



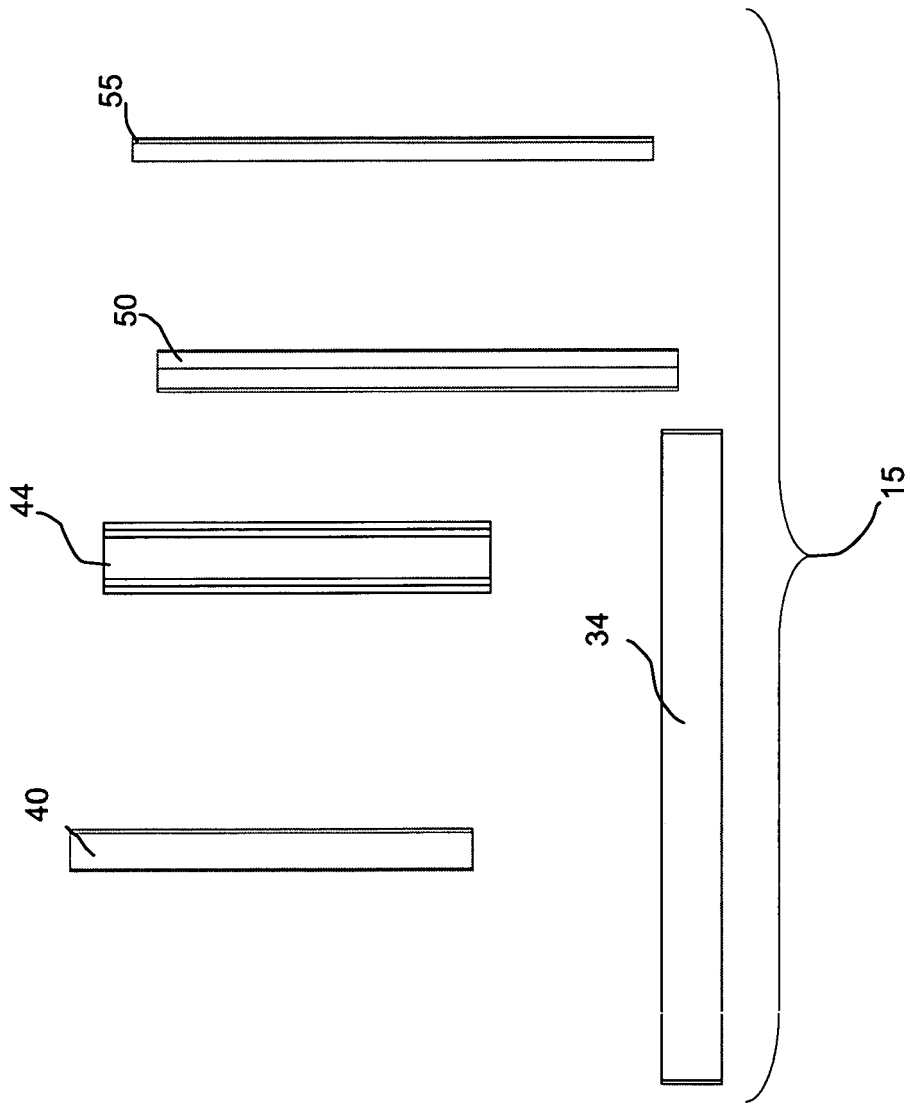


Fig. 11

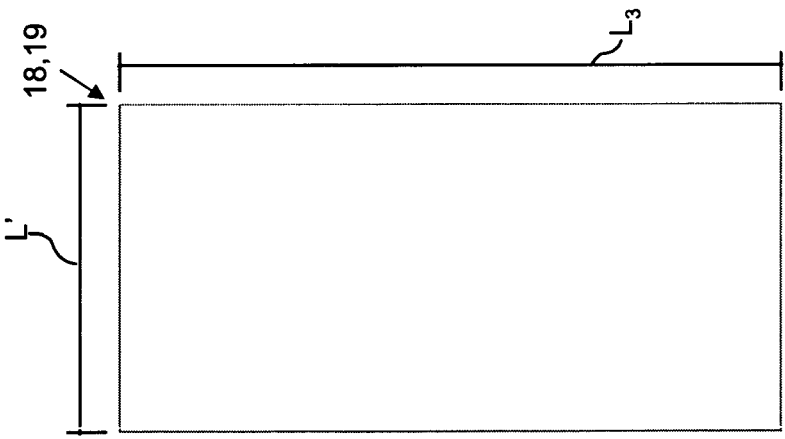


Fig. 12

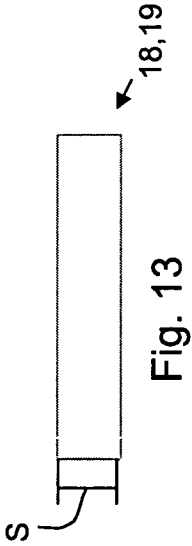


Fig. 13

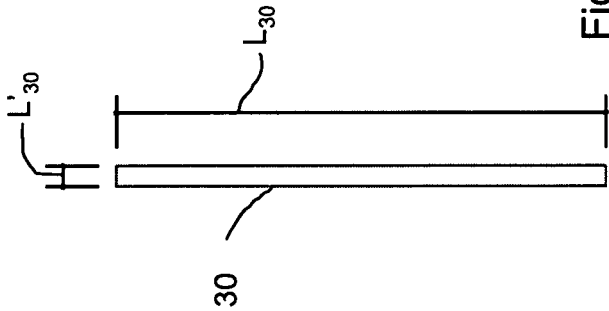


Fig. 16

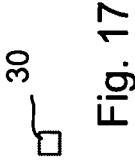


Fig. 17

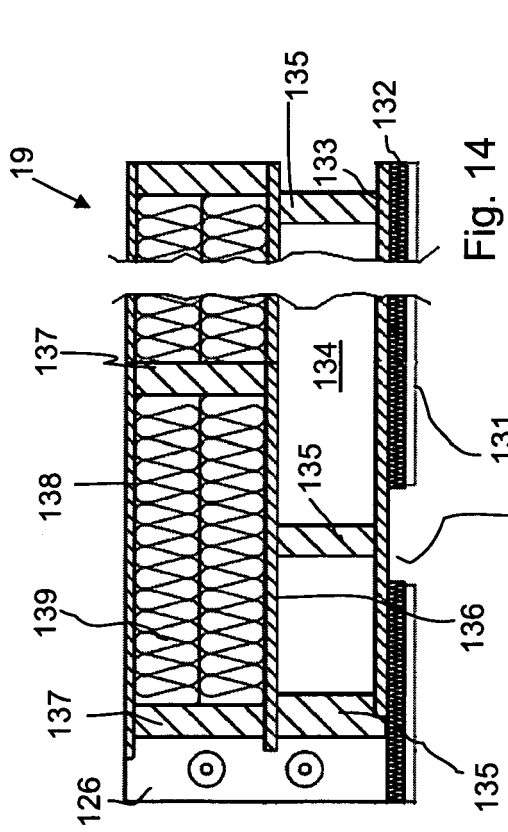


Fig. 14

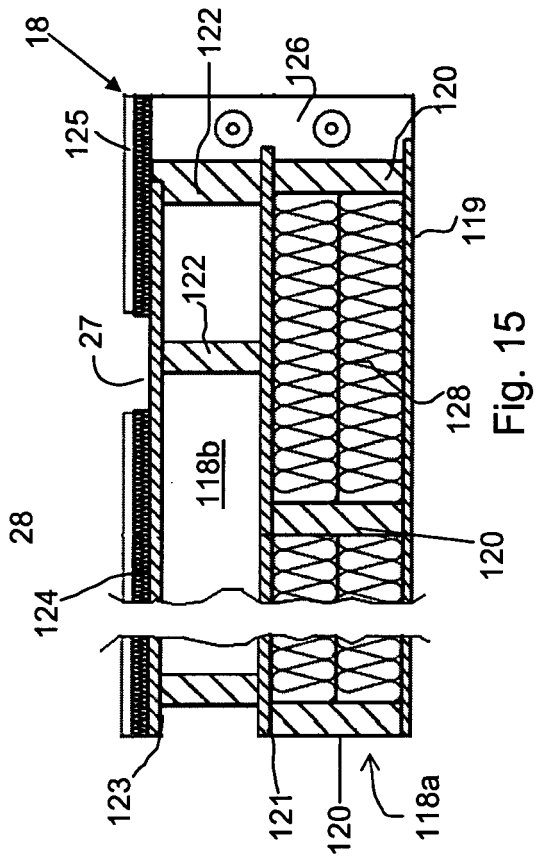


Fig. 15

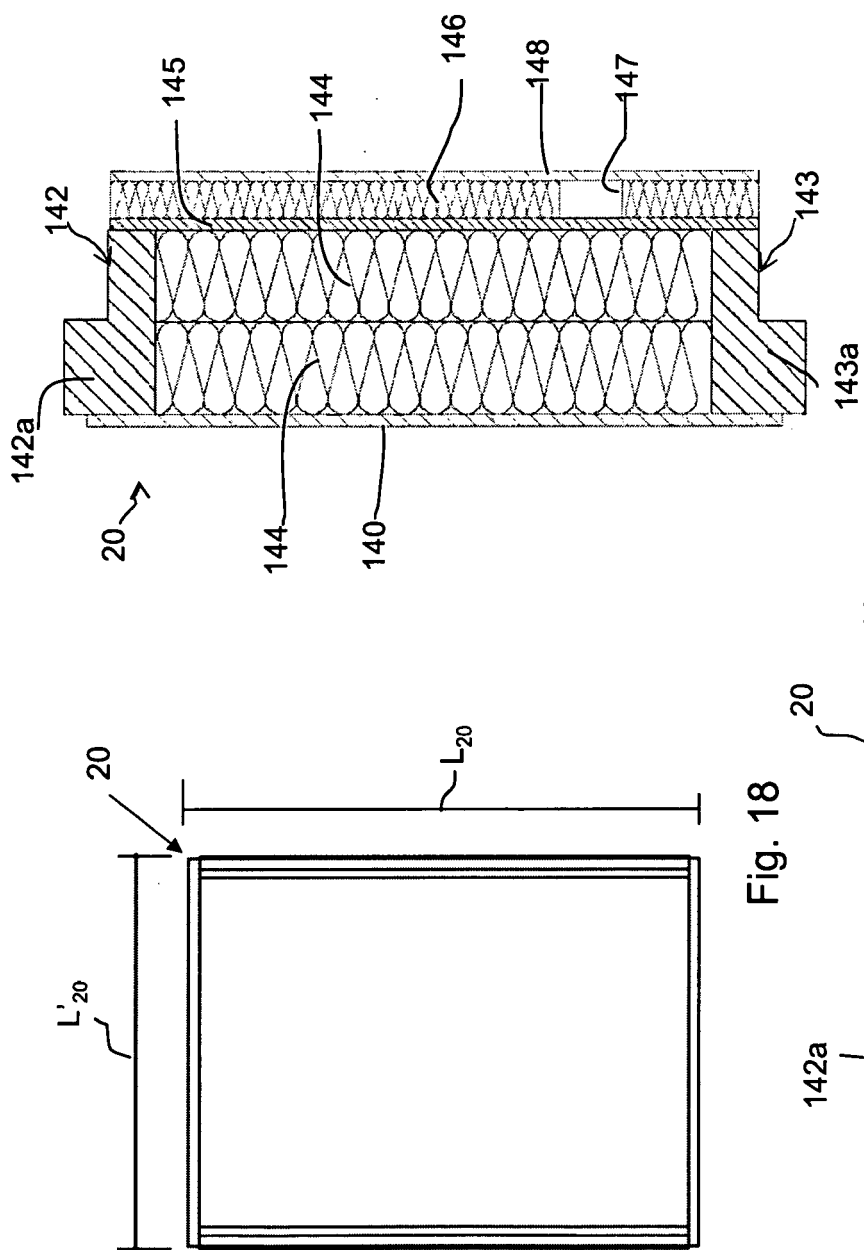


Fig. 20

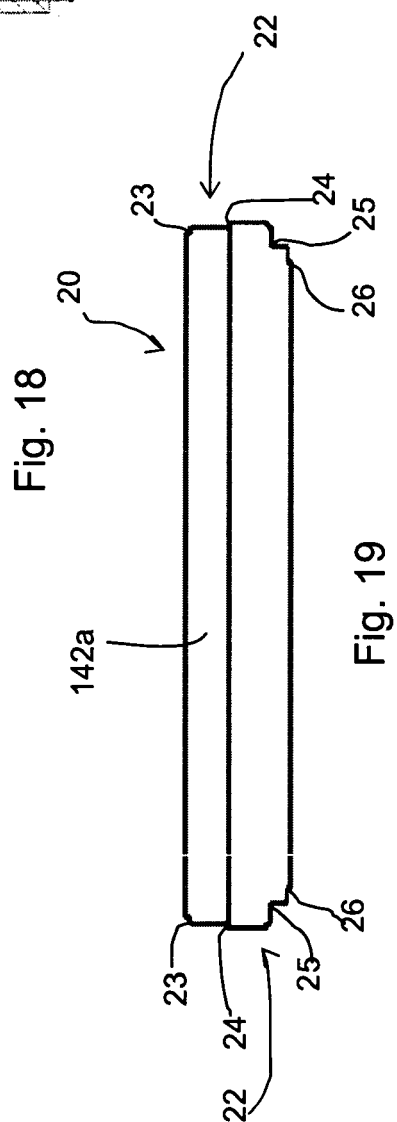
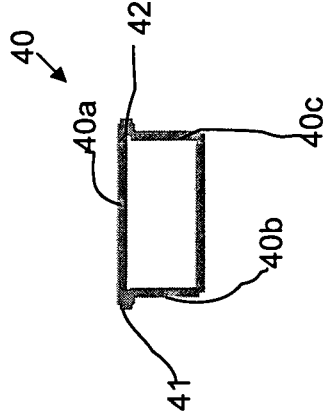
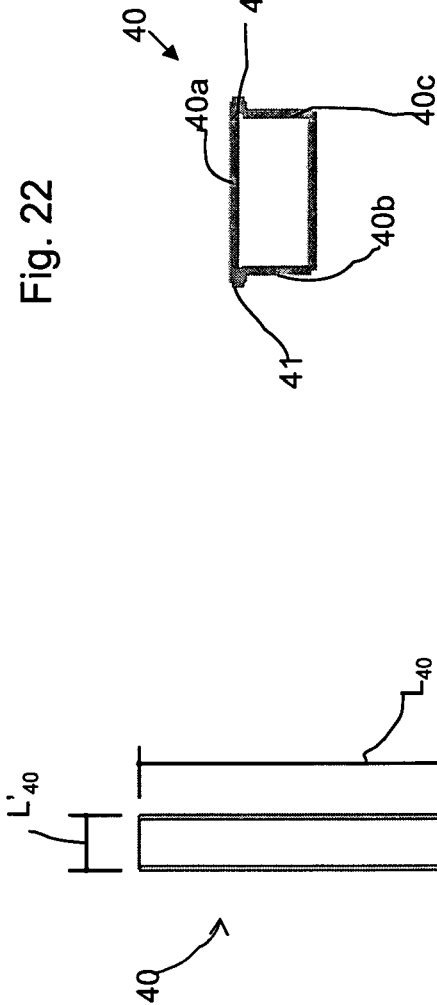
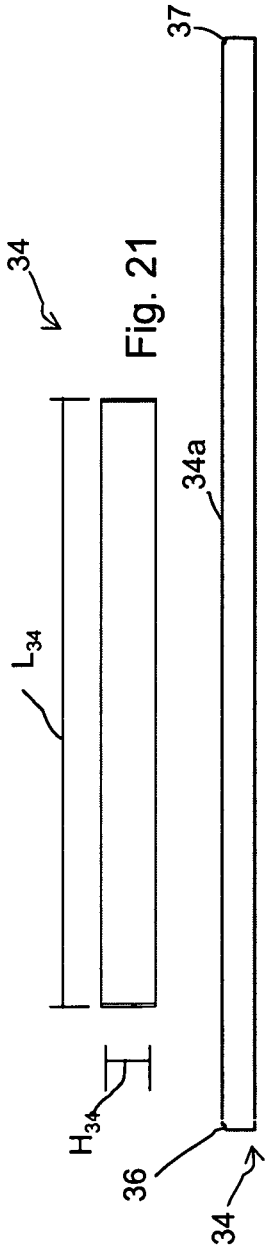


Fig. 18

Fig. 19



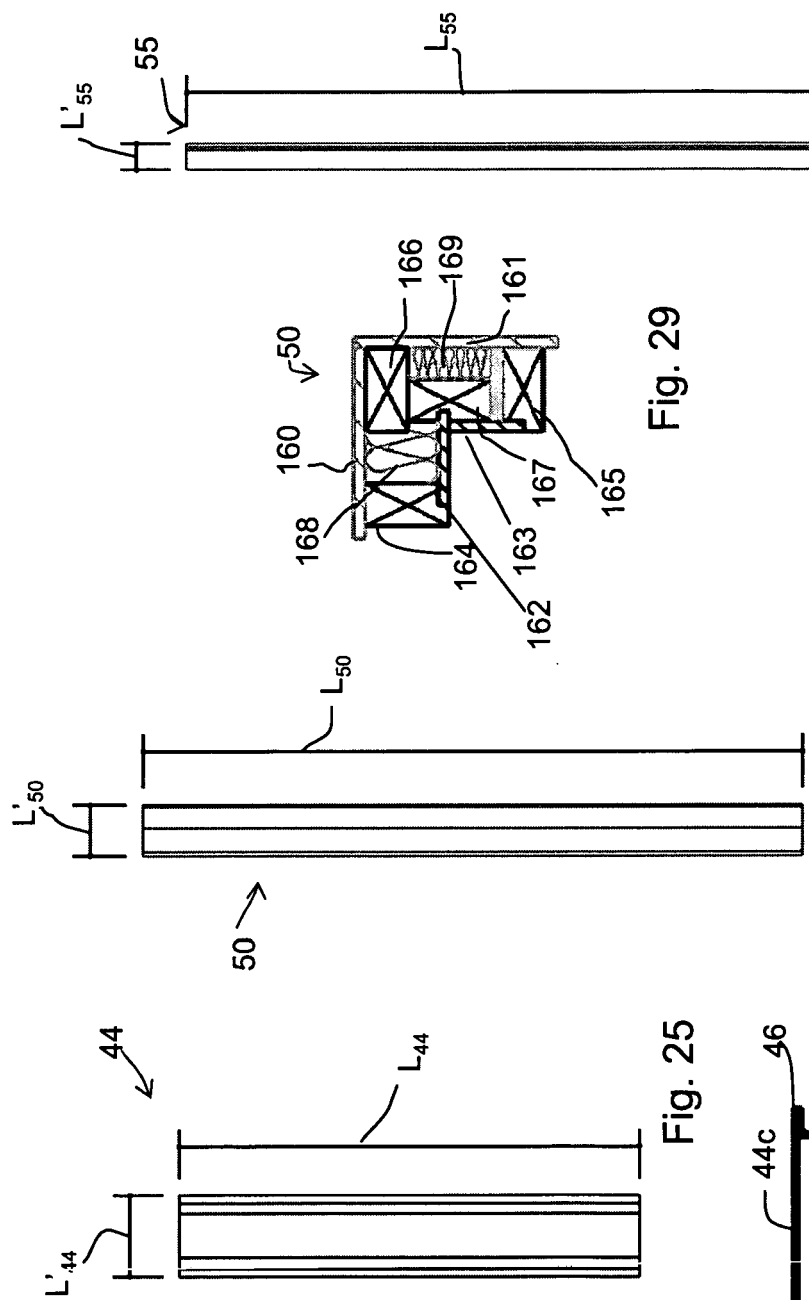


Fig. 25

Fig. 27

Fig. 29

Fig. 30

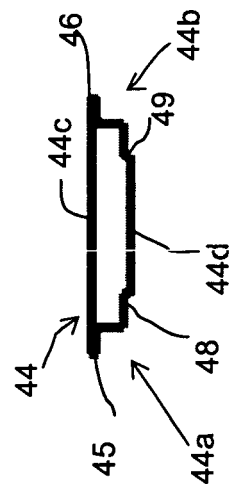


Fig. 26

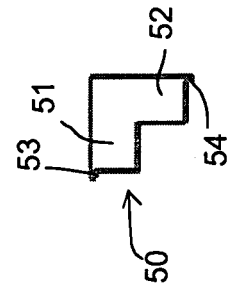


Fig. 28

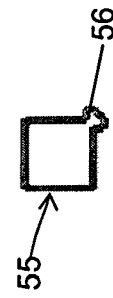
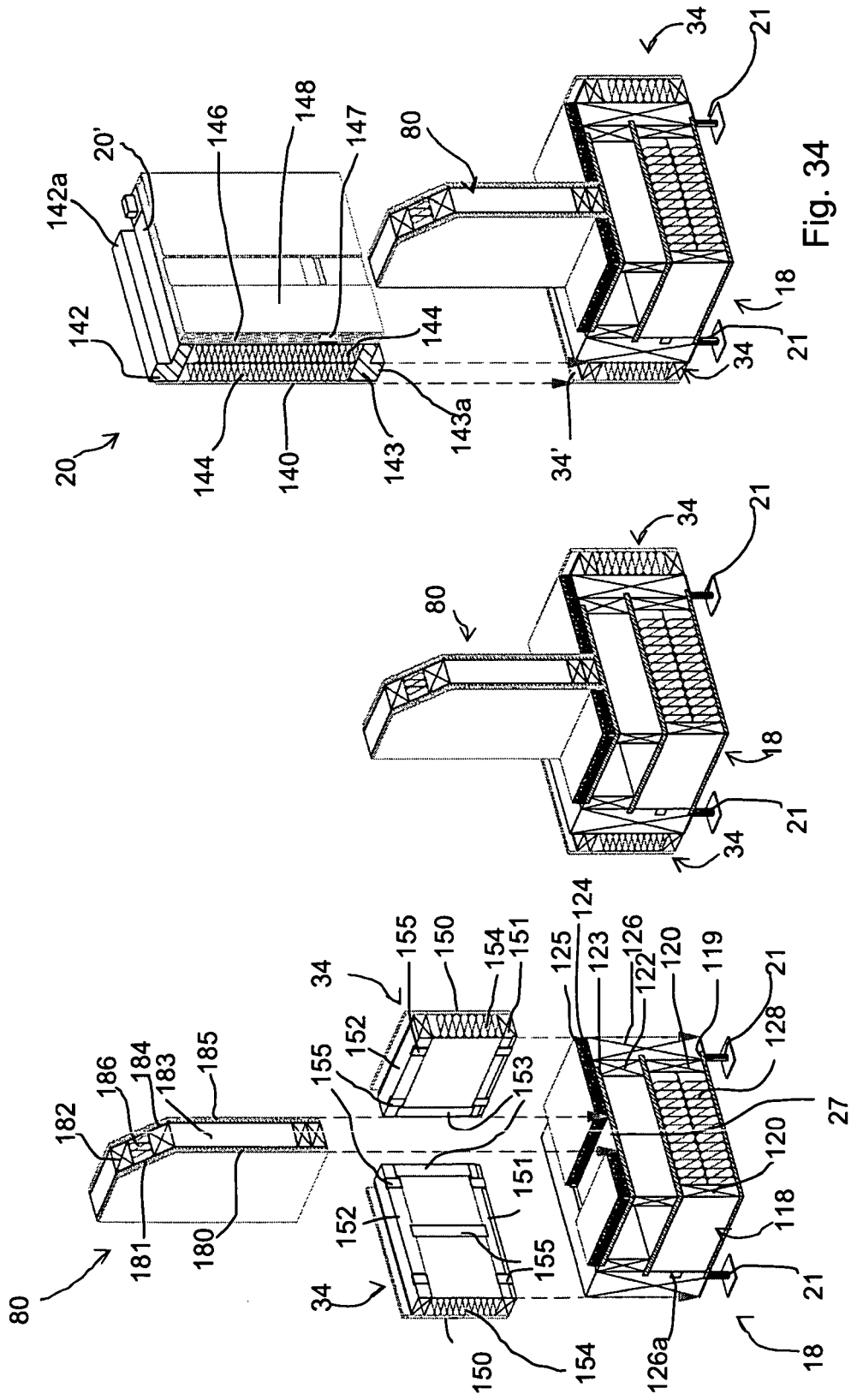


Fig. 31



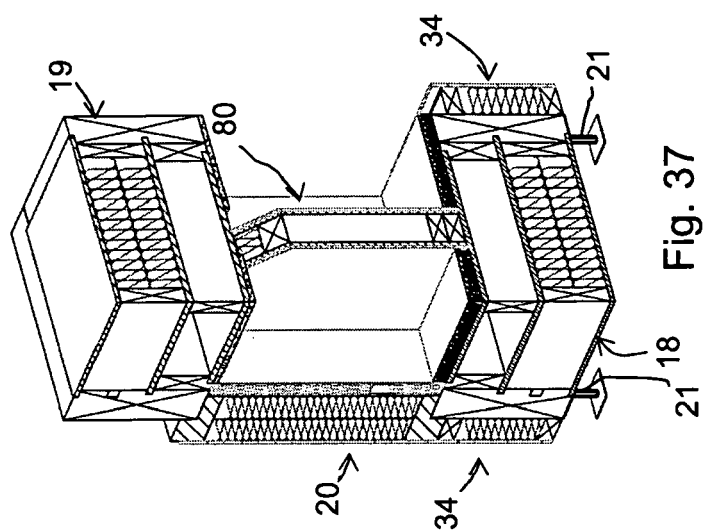


Fig. 37

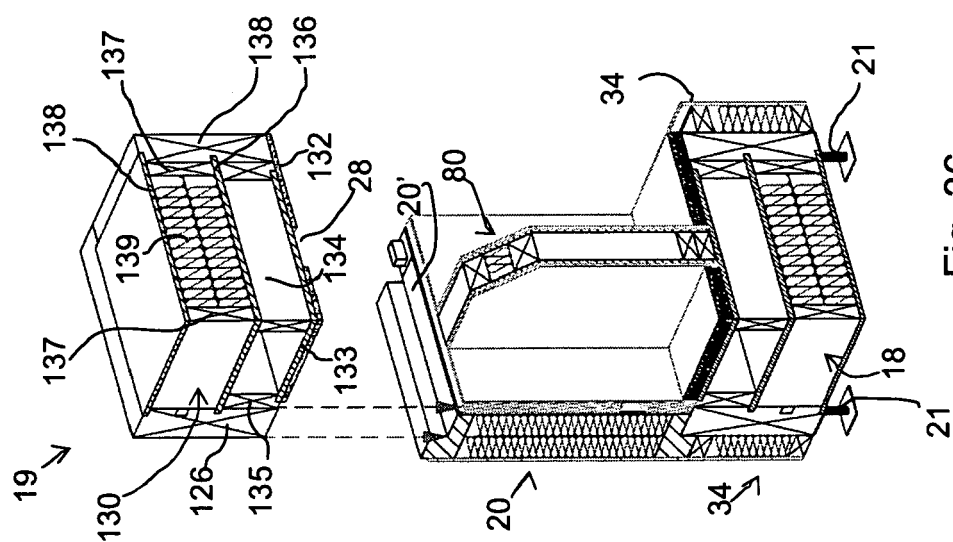


Fig. 36

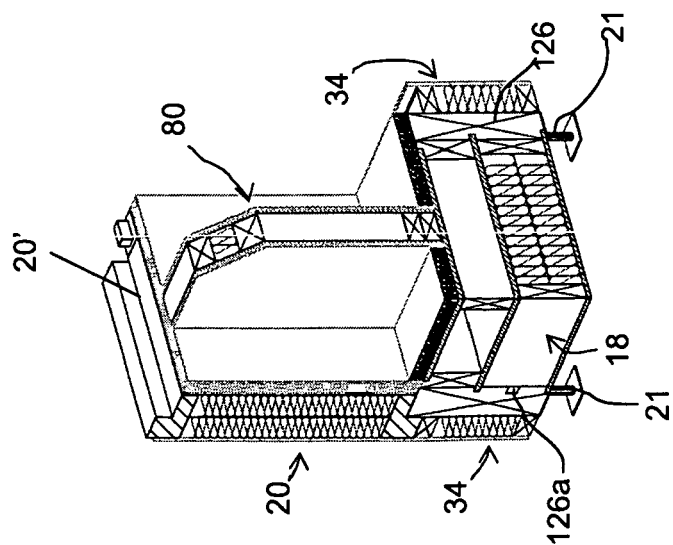
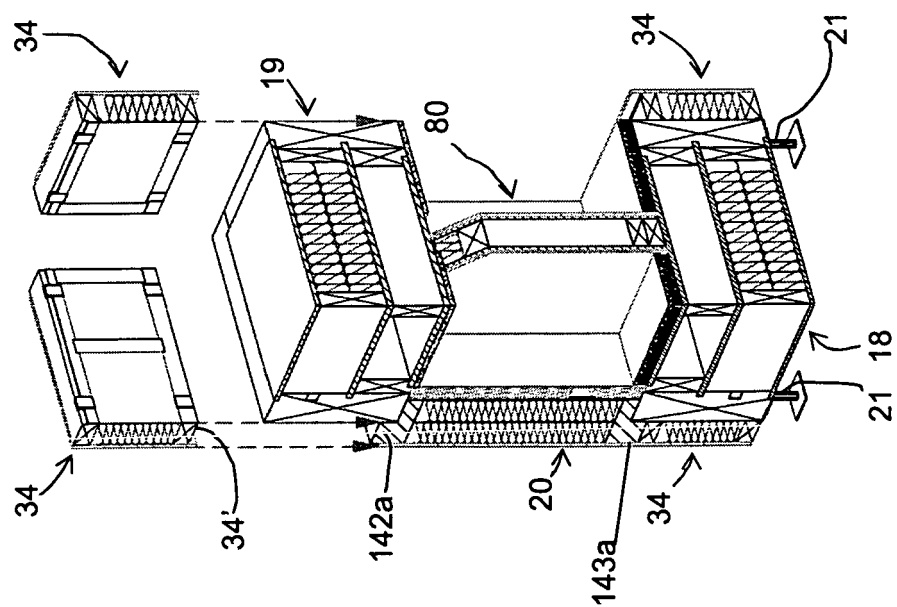
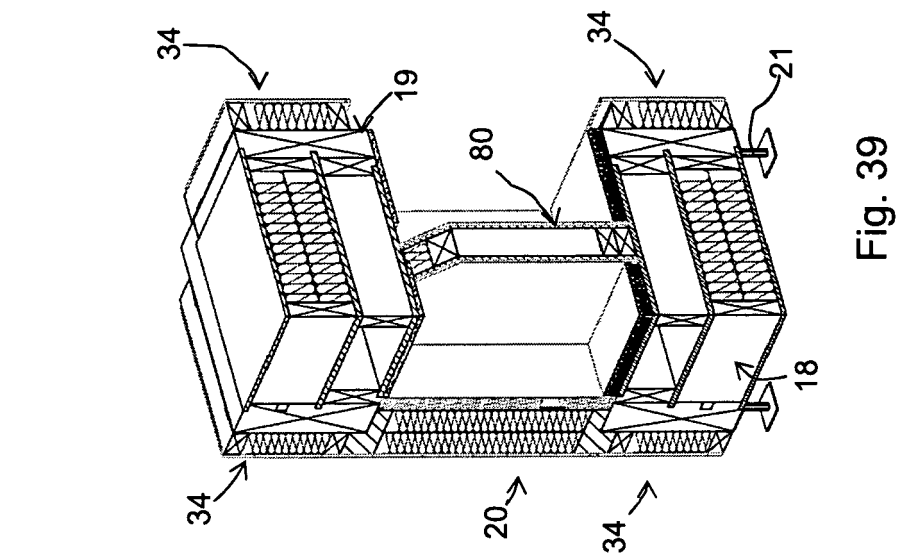


Fig. 35



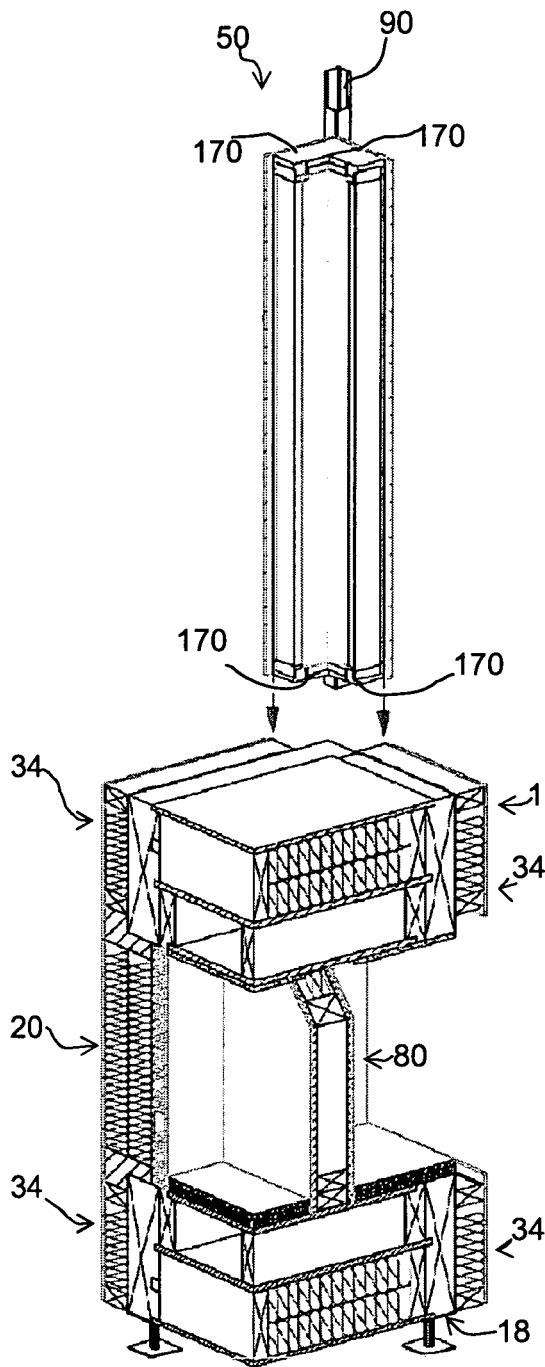


Fig. 40

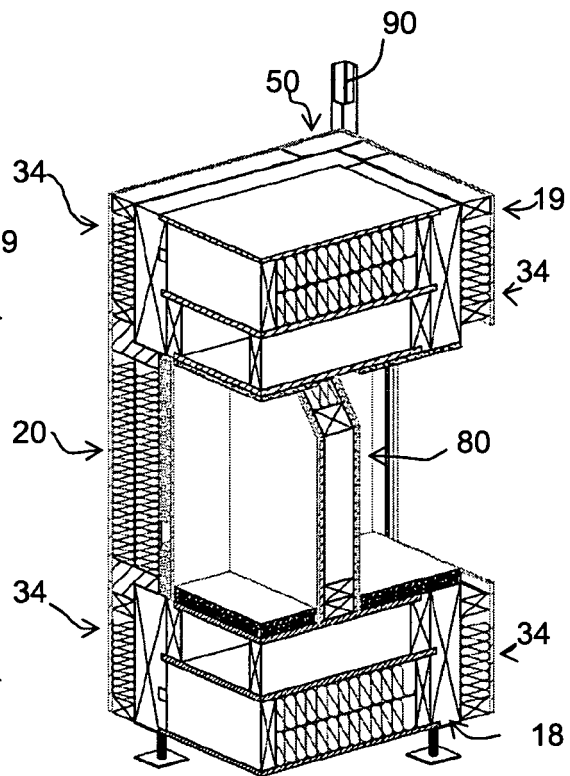


Fig. 41

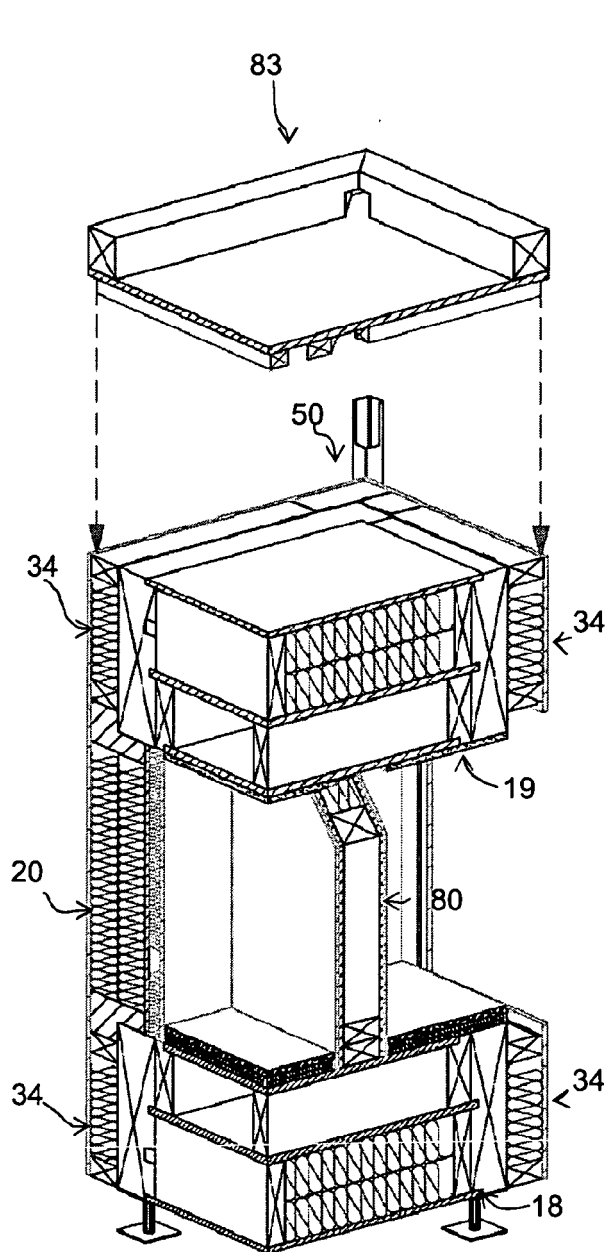


Fig. 42

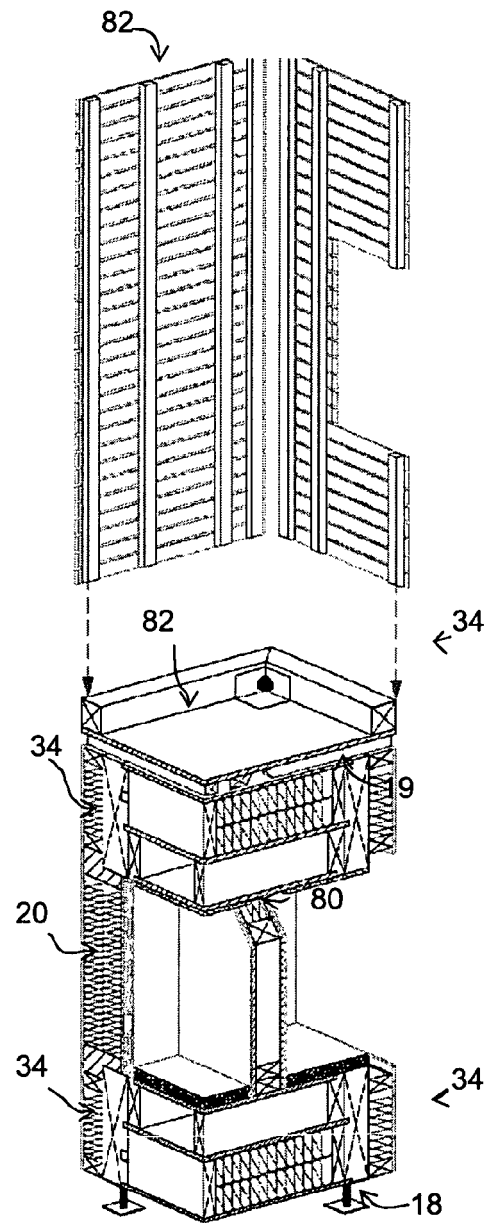


Fig. 43

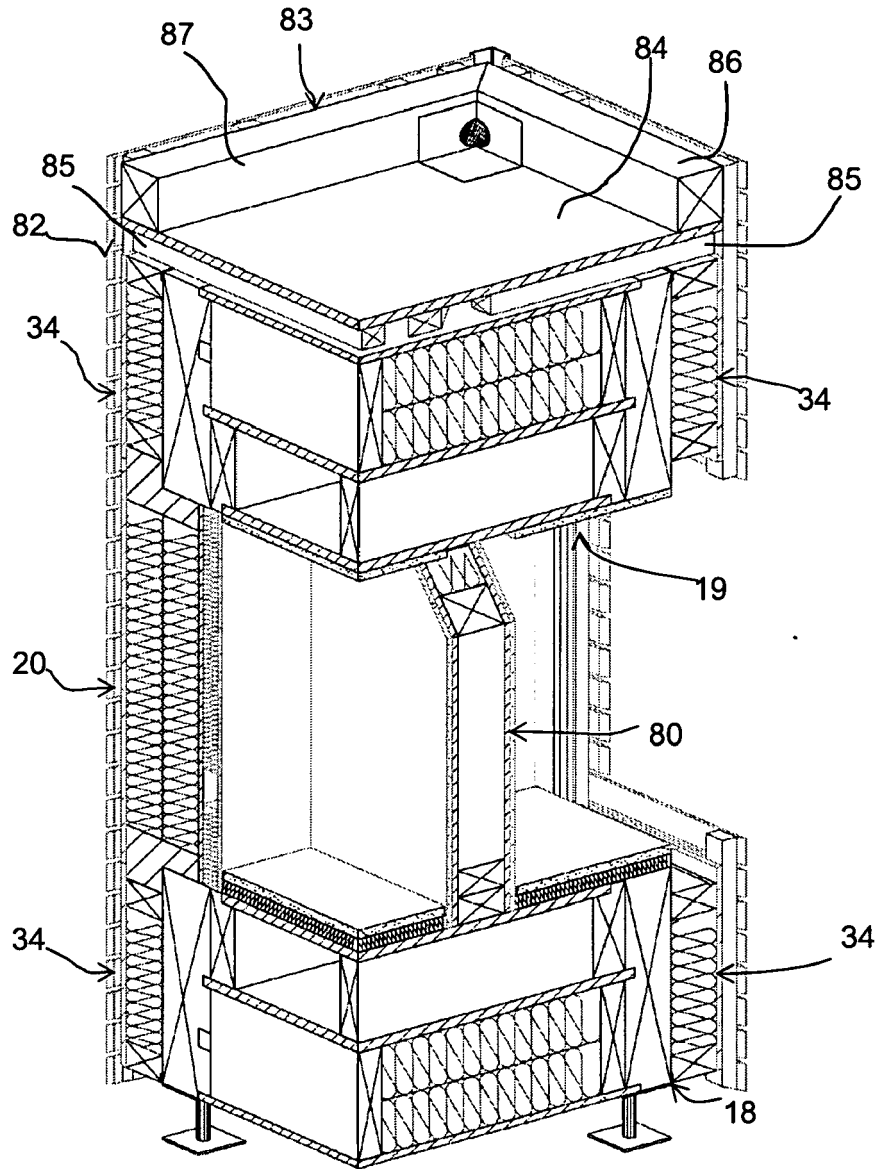


Fig. 44



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Application Number
EP 09 42 5085

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			TECHNICAL FIELDS SEARCHED (IPC)
			E04B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 29 October 2009	Examiner Rosborough, John
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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The members are as contained in the European Patent Office EDP file on
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29-10-2009

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82