(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 553 254 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
16.10.2019 Bulletin 2019/42

(21) Application number: **18166923.5**

(22) Date of filing: **12.04.2018**

(51) Int Cl.:
E04H 1/12 *(2006.01)* ***B63B 7/00*** *(2006.01)*
B63B 35/34 *(2006.01)* ***E01D 15/00*** *(2006.01)*
E04B 1/343 *(2006.01)*

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

(71) Applicant: **Kavitat UG mbH**
14797 Kloster Lehnin (DE)

(72) Inventor: **Pollard, James**
14797 Kloster Lehnin (DE)

(74) Representative: **Gulde & Partner**
Patent- und Rechtsanwaltskanzlei mbB
Wallstraße 58/59
10179 Berlin (DE)

(54) MODULAR STRUCTURE

(57) The present invention relates to a modular structure including at least two construction modules. Each construction module is a hollow body of cuboid or rhombohedron shape with four side walls and open front sides, wherein at least one of the side walls includes an attachment slot extending longitudinally along the sidewalls. The attachment slot is opening into an enlarged cavity of constant cross-section in longitudinal direction of the side wall.

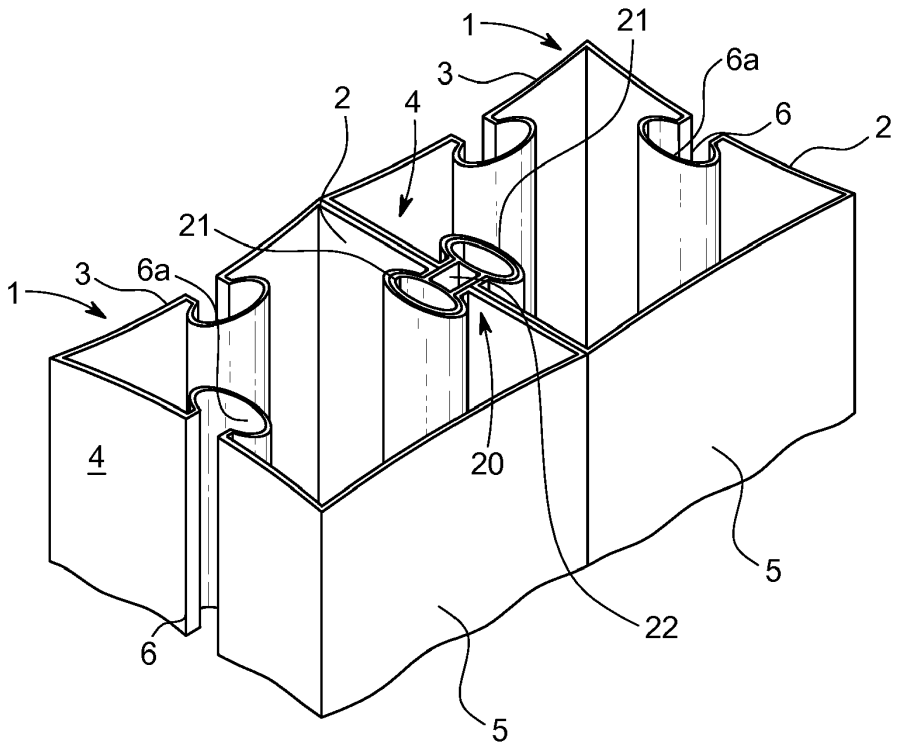

FIG. 4

EP 3 553 254 A1

Description

[0001] The present invention relates to modular structures, and particularly to modular structures for use as housing, assembled from modules which are inexpensive structural elements which may be easily produced from recycled materials.

[0002] The present invention arises from an attempt to address the problem of providing low-cost temporary accommodation, for example for refugees and other displaced persons. The most common current solution to the problem is a tent, made from a single skin of flexible material such as canvas, supported by poles and guy ropes. A disadvantage of the tents is that they are unsuitable for medium to long-term use, and perform poorly in terms of thermal insulation to maintain the temperature within the tent at an acceptable level.

[0003] The present invention seeks to provide a construction module, and a modular structure assembled from the construction module which is easily erected to form a dwelling or shelter, with improved robustness and thermal insulation properties.

Summary of Invention

[0004] One or more of the drawbacks of the prior art could be avoided or at least reduced by means of the present invention. In particular, a modular structure is provided including at least two construction modules. Each construction module is a hollow body of cuboid or rhombohedron shape with four side walls and open front sides, wherein at least one of the side walls includes an attachment slot extending longitudinally along the sidewalls. The attachment slot is opening into an enlarged cavity of constant cross-section in longitudinal direction of the side wall.

[0005] Thus, the inventive modular structure includes a plurality of thin-walled construction modules, which are assembled easily to for example walls, a floor or a roof of housings by means of specific connecting members. More specifically, these connecting members include a longitudinal attachment slot at the outer surface of the construction module. The slot opens out inwardly the hollow construction module so as to form a longitudinal cavity of equal cross-section. The geometry and dimension of the cavity is set to be such that a rigid joining element introduced from an upper or lower end of the connecting member into the cavity cannot be pull out through the attachment slot. A cross-sectional plane surface of the interior space of the cavity may be of for example elliptic shape. The attachment slot preferably extends longitudinally along the centre of the sidewall. Since the attachment slots and cavities are an integral part of the connecting members, mounting of the modular structure is easy.

[0006] The construction module is a body of (generally) cuboid or rhombohedron shape. A cuboid is a polyhedron bounded by six quadrilateral faces and a rhombohedron is a three-dimensional figure like a cuboid, except that four of its faces are not squares or rectangular but rhombi. Preferably, the construction module has the shape of a right rectangular-sided prism or a right square-sided prism. Both front sides of the construction modules are open and the side walls form a common (one-pieced) circumferential wall.

[0007] The modular structure is an affordable and general light construction and may be in particular useful in emergency cases for building temporary and semi-permanent shelter. The modular structure allows to easily adapting the internal architecture of the shelter, for example by setting of dividing walls. Furthermore, a shelter or housing based on the inventive modular structure shows improved noise reduction and thermal properties compared to tents. The modular structure may be further useful for pop up of small movable businesses. Another field of application may be smart farming indoor or outdoor, movable flora or fauna growing, and agriculture production systems, like vertical or horizontal hydroponics and aeroponics growing systems. Furthermore, the modular structure may be applicable for building marine engineering sea defense, water channels, and buoyant food production platforms. Further applications and advantages of the modular structure are:

- low to zero impact building due to its ability to be wrapped with custom vinyl coatings;
- recreation, small scales childrens play houses/cabins;
- water catchment and channeling;
- bioculture, the production of bio fuels from micro algae;
- agriculture storage and extreme climate livestock housing; and
- tanking and underground biomass extraction from household waste.

[0008] According to one embodiment, two opposite side walls of the hollow body each includes the attachment slot and the enlarged cavity. Therefore, the construction of a panel or wall is simplified by assembling a number of construction modules side-by-sides such that the slots are on adjacent side walls and introducing of a common joining element. According to another embodiment, three side walls of the hollow body each include the attachment slot and the enlarged cavity, which allows fixing of up to three construction modules to one construction module.

[0009] The construction module may further be a one-piece body made of plastics material, in particular extruded high-density polyethylene (HDPE), polypropylene (PP) or polyethylene terephthalate (PET).

[0010] Preferably, the sidewalls including the attachment slot are concave, i.e. these side walls are curving in or hollowed inward the interior space of the construction module. In that case, the engagement between the joining element and the cavities draws the sidewalls into

a flat rather than concave configuration, so that pressure is exerted at the corners of the construction modules to bring them into a tight sealing engagement.

[0011] Further, the sidewalls of the construction module preferably have a wall thickness t of from 1 to 5 millimetres. In alternative or in addition, the wall thickness at corners where adjacent sidewalls meet is reduced compared to the wall thickness in other parts of the construction module and/or the wall thickness at the edges of the slots is increased compared to the wall thickness in other parts of the construction module.

[0012] The joining slots of adjacent sidewalls of two construction modules may be in alignment and the modular structure may then further include a joining element. The joining element comprises two locking elements joined by a bridging element, wherein the locking elements of the joining element are inserted into respective cavities of the adjacent sidewalls and the bridging element extends through the slots.

[0013] Furthermore, the modular structure may further include a filler element, which comprises a locking part and a filler part having a flat external face. The filler element is inserted into a cavity of a construction module so that the filler part occupies the slot with the face being flush with the outer surface of the respective sidewall.

[0014] According to another preferred embodiment, the modular structure further includes an end plug for closing one or both open front sides of the construction module. The end plug may include an end plate and a skirt extending perpendicularly to the end plate and being shaped so as to correspond to the internal form and dimensions of the construction module. The skirt being formed with internal formations which are shaped and dimensioned so as to fit closely round the ends of the walls of the cavities of the construction module.

[0015] The end plug may further include an air valve being in communication with an interior space of the construction module. In particular, a depression may be formed in the end plate to accommodate the air valve, which is in communication with the underside of the end plate by means of an opening formed in the base of the depression.

[0016] An attachment button is preferably mounted centrally in the end plate. The attachment button has a stem and a head. The stem of the attachment button is dimensioned so as to be receivable in the slot of the sidewalls of a construction module and the button being shaped to be co-operable with the parts of an internal face of the cavity of the construction module. Specifically, the stem may be circular in cross-section.

[0017] Another aspect of the present invention refers to the use of the before mentioned modular structure for forming a dwelling or shelter, a floating or floatable structure, a raft, a pontoon, a bridge, a storing device for water, or a pipe for transporting water.

[0018] Further aspects of the present invention could be learned from the dependent claims or the following description.

Brief Description of the Drawings

[0019] An embodiment of the present invention will now be described in detail with reference to the accompanying figures, in which:

Figure 1 is a perspective view of a construction module according to the invention;

Figure 2 is a perspective view of a joining element for use with the construction modules of Figure 1;

Figures 3A, 3B and 3C are perspective views from underneath and from above, and a side view, respectively of an end plug for use with the construction module of Figure 1;

Figure 4 is a perspective view showing two construction modules joined together by a joining element;

Figure 5 is a perspective view of a filler element;

Figure 6 is a vertical sectional view of part of a structure assembled from the construction modules and end plugs;

Figure 7 is a perspective view of the structure shown in Figure 6;

Figure 8 is a perspective view similar to Figure 7, showing an additional wall in place in the structure;

Figure 9 is a view showing a third wall in place in the structure of Figures 7 and 8, and the positioning of a construction module as a roof beam;

Figure 10 illustrates a structure in which roof beams and wall sections are moved to form a door opening; and

Figure 11 illustrates an alternative manner in which the construction modules may be assembled to form a shelter.

Detailed Description of the Invention

[0020] Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings. Effects and features of the exemplary embodiments, and implementation methods thereof will be described with reference to the accompanying drawings. In the drawings, like reference numerals denote like elements, and redundant descriptions are omitted. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. Further, the use of "may" when describing embodiments of the present invention refers to "one or more embodiments of the present invention."

[0021] It will be further understood that the terms "include," "comprise," "including," or "comprising" specify a property, a region, a fixed number, a step, a process, an element, a component, and a combination thereof but do not exclude other properties, regions, fixed numbers, steps, processes, elements, components, and combinations thereof.

[0022] It will also be understood that when a film, a region, or an element is referred to as being "above" or "on" another film, region, or element, it can be directly on the other film, region, or element, or intervening films, regions, or elements may also be present.

[0023] Herein, the terms "upper" and "lower" are defined according to the z-axis. For example, the upper cover is positioned at the upper part of the z-axis, whereas the lower cover is positioned at the lower part thereof. In the drawings, the sizes of elements may be exaggerated for clarity. For example, in the drawings, the size or thickness of each element may be arbitrarily shown for illustrative purposes, and thus the embodiments of the present invention should not be construed as being limited thereto.

[0024] Construction modules according to the present invention, and structures formed therefrom will now be described with reference to the Figures. The construction elements are generally elongate, and are joined side-by-side to form panels which may then be used to form walls, floors and roofs of shelters.

[0025] Referring now to Figure 1, the construction module 1 is an elongate, hollow, generally square-section component. The module has four side walls 2, 3, 4 and 5. The sidewalls 2, 3 and 4 are generally concave, while the side wall 5 is generally planar. Three attachment slots 6 extend longitudinally along the centres of the sidewalls 2, 3 and 4, respectively. Internally of the construction module, each attachment slot 6 opens into an enlarged cavity 6a of generally elliptical cross-section, running along the length of the construction module 1.

[0026] The construction module 1 is preferably formed by extrusion from a plastics material such as high-density polyethylene (HDPE), but may be formed from other suitable plastics materials such as polypropylene or PET. The plastics material may be opaque, translucent or transparent, and may be coloured. The generally square cross-section construction module of Figure 1 may have sidewalls of approximately 22 centimetres in width, but the sidewalls may be of greater or lesser widths, as convenient. The sidewalls 2, 3, 4 and 5 of the construction module 1 may have a wall thickness t of from 1 to 5 millimetres, preferably about 2.8 millimetres. The wall thickness may be reduced to about 1.8 millimetres at the corners where adjacent sidewalls meet, and may be increased at the edges of the slots 6 for added strength at these areas. The construction modules may be extruded in any convenient length, and standard lengths may be extruded in particular colours for ease of identification. The construction modules may be manufactured in lengths of 1 metre, 3 metres, or in any other suitable and convenient length.

[0027] Figure 2 shows a joining element 20 used to join two of the construction modules 1 together in side-by-side relationship. The joining element 20 comprises two locking elements 21 joined by a bridging element 22. In the present embodiment each locking element 21 is an elliptical tubular structure, and the bridging element 22 comprises a pair of libs 22a. Embodiments in which the bridging element 22 is a single solid rib are also envisaged, and the locking elements 21 may also be either filled with a filler material, or may be formed as solid rods instead of tubes.

[0028] In order to join two construction modules 1 together as illustrated in Figure 4, the two construction modules 1 are placed side-by-side. In Figure 4, the sidewall 4 of one construction module 1 (the further as seen in the Figure) is positioned adjacent the sidewall 2 of the other construction module 1 (the nearer as seen in the Figure) with their edges in contact. The slots 6 of adjacent sidewalls 2 and 4 of the construction modules 1 are in alignment, but are slightly spaced one from the other by the concave nature of the sidewalls 4 and 2. To join the two construction modules together, the sidewalls 2 and 4 of the construction modules are pinched together at one end to bring the two slots 6 into contact, and the end of a joining element 20 is then inserted so that the locking elements 21 of the joining element 20 enter respective cavities 6a of the sidewalls 2 and 4, and the bridging element 22 extends through the slots 6.

[0029] The joining element 20 is then urged longitudinally into the cavities 6a and the slots 6. The length of the bridging element 22 is so arranged that as the joining element 20 advances, the engagement between the locking elements 21 and the cavities 6a draws the sidewalls 2 and 4 into a flat rather than concave configuration, so that pressure is exerted at the corners of the construction modules 1 to bring them into a tight sealing engagement.

[0030] The joining element 20 may have a length equal to the lengths of the two construction modules 1 to be joined. Alternatively, discreet shorter lengths of the joining element 20 may be driven or drawn into the cavities 6a by an elongate application tool, to fix the two construction modules 1 together at discrete locations along their respective lengths.

[0031] The joining element 20 may, like the construction modules 1, be extruded from plastics materials, or from natural or synthetic rubber, from metal or from any other suitable material. As will be readily appreciated, further construction modules may be attached using the slots 6 and cavities 6a in longitudinal extension of the assembly of the two construction modules 1 so that the generally tubular construction modules form a generally flat panel which may serve as a wall, a floor or a roof of a shelter. Likewise, if the panel is to form a wall then further construction modules may be joined using the slots and cavities in the sidewalls 3 adjacent to the sidewalls 2 and 4 of the two construction modules 1 joined together, so that two panels may be joined together at

right angles, for example to form internal walls in a shelter. Other alternatives will be readily apparent to those skilled in the art.

[0032] It will be appreciated that, if a flat panel of construction elements is formed by joining a number of the elements side-by-side as shown in Figure 4, the slots 6 at the edges of the panel will be exposed. The filler element 25 illustrated in Figure 5, which comprises a generally elliptical locking part 26 and a filler part 27 having a flat external face 27a, may be inserted into the cavities 6a at each end of the panel so that the filler parts 27 occupy the slots 6 at the ends of the panel with the face 27a of the filler element 25 flush with the outer surface of the respective sidewall.

[0033] Referring now to Figures 3A to 3C, there is shown an end plug 30 which is insertable into an end of the construction module 1. The end plug 30 includes a generally square end plate 31. A skirt 32 extends perpendicularly to the end plate 31, and is shaped so as to correspond to the internal form and dimensions of the construction module 1. The walls of the skirt 32 are, however, not concave but are straight, so that insertion of the end plug 30 into the construction module 1 will cause the concave sidewalls 2, 3 and 4 of the construction module 1 to flex so as to conform to the straight sides of the skirt 32. This flexing will increase the pressure between the sidewalls 2, 3 and 4 and the skirt 32, providing a tight frictional fit for the end plug 30 within the construction module 1. The skirt 32 is formed with internal elliptical formations 33 which are shaped and dimensioned so as to fit closely round the ends of the elliptical walls of the cavities 6a of the construction module 1.

[0034] The external surface of the skirt 32 may be formed with ribs, or otherwise textured, to improve the frictional fit of the end plug 30 into the construction module 1.

[0035] Figure 3B shows the external surface of the end plate 31. A depression 34 is formed in the end plate 31 to accommodate an air valve 35, which may be a valve similar to that found in vehicle tyres. The valve 35 is in communication with the underside of the end plate 31 by means of an opening 36 formed in the base of the depression 34. The air valve 35 is placed in the depression 34 so that it does not protrude above the external surface of the end plate 31.

[0036] Mounted centrally in the end plate 31 is an attachment button 37, seen in Figures 3B and 3C. The attachment button 37 has a stem 38 and a head 39. The stem 38 of the attachment button 37 is dimensioned so as to be receivable in the slot 6 of the sidewalls 2, 3 and 4 of a construction module 1. The stem 38 is preferably circular in cross-section, but may be of square cross-section with the faces of the stem 38 aligned parallel to the sides of the square end plate 31. The button 39 is generally circular in plan, and in side view is semi-elliptical so as to be co-operable with the parts of the internal face of a cavity 6a of a construction module 1 which are adjacent to the slot 6. One purpose of the end plug 30 is to provide for a joint between two construction modules which are aligned perpendicularly to each other, with the end of one module contacting a side wall 2, 3 or 4 of the other. The end plug 30 may also serve to form an airtight seal at the end of the construction module 1, particularly if an adhesive or sealant is applied to the external faces of the skirt 32, or to the internal surfaces of the construction module 1, prior to inserting the end plug 30. The application of two end plugs 30 to a construction module may therefore provide an elongate sealed unit which may serve as part of a floating or floatable structure.

[0037] The construction of a shelter using the construction modules of the invention will now be described, with reference to Figures 6 to 10.

[0038] Figure 6 shows a cross-sectional view, and Figure 7 shows a schematic perspective view, of a wall 60 and a floor 61 of a shelter.

[0039] The wall 60 is formed from eight construction modules 1 joined side-by-side by joining elements 20. The planar sidewalls 5 of the construction modules 1 are arranged to form the external face of the wall 60, and optionally the exposed slots 6 at the ends of the wall 60 may be filled using filler elements 25. The wall 60 is erected by firstly joining the required number of construction modules 1 together as described above, then digging a foundation trench 64, inserting the lower ends of the construction modules 1 forming the wall 60 into the trench 64, and backfilling the trench with aggregate 65. Preferably, the construction modules 1 of the wall 60 are buried to a depth of up to 1 fifth or more of the length of each construction module 1.

[0040] A floor 61 for the shelter is formed from six construction modules 1 joined side- by-side with joining elements 20. Each of the construction modules 1 forming the floor is placed with its sidewall 5 uppermost, to provide a substantially continuous flat floor surface. Each of the construction modules 1 forming the floor 61 has an end plug 30 inserted into its end for attachment to the wall 60, the attachment button 37 of each end plug 30 engaging with the slot 6 and cavity 6a of one of the central six construction elements 1 of the wall 60, so as to fix the floor 61 and wall 60 together and leave one of the construction elements 1 of wall 60 free at each end of the wall.

[0041] Preferably, the attachment buttons 37 of the end plugs 30 of the floor 61 are inserted into the respective slots 6 and cavities 6a of the construction modules 1 of the wall before the lower ends of the construction modules 1 of the wall 60 are buried in the foundation trench 64.

[0042] Construction of the shelter may now proceed to the second wall 62, as shown in Figure 8. The second wall 62 is likewise constructed from seven vertically-oriented construction modules 1, joined together by joining elements 20, and with their lower ends sunk into a foundation trench 64 as described in relation to the wall 60. Since the modules 1 of the floor 61 are fixed in position relative to the wall 60 by end caps 30 fitted to the modules 1 of the floor 61, and the leftmost module of the second wall 62 (as seen in the Figure) is attached to the end

module 1 of the wall 60 which extends beyond the floor 61, is not necessary to fix the modules 1 of the wall 62 to the adjacent module 1 of the floor 61. However, if such a fixing is required, then fixing elements may be provided having the form of two attachment buttons 37 joined end to end by their stems 38. These fixing elements may be placed at the intersections of the slots six of the vertical modules 1 forming the wall 62, and the horizontal slot 6 of the adjacent module 1 of the floor 61.

[0043] The upper ends of the modules 1 of the wall 62 and the wall 60 are provided with end caps 30, as illustrated in Figure 8, for the attachment of roof beams.

[0044] Construction then moves to the phase shown in Figure 9 where a third wall 63 is added, the third wall 63 being formed by assembling eight construction modules 1 in a manner similar to wall 60. The ends of the modules 1 forming the floor 61 are provided with end caps 30, to attach the floor 61 to the wall 63. The upper ends of the modules 1 of the wall 63 are provided with end caps 30. The eight modules 1 of the wall 63 are arranged such that the central six modules are each attached to the end of a module of the floor 61, the furthest (as seen in the Figure) module is attached to the end module of the wall 62, and the closest (as seen in the Figure) module 1 of the wall 63 is positioned beyond the nearest edge of the floor61.

[0045] To form the fourth wall of the shelter (not shown) a wall of seven modules 1 is assembled as described above, and is then placed between the end modules 1 the wall 60 and the wall 63, adjacent the edge of the floor 61. As before, the lower edge of the fourth wall may be received in a foundation trench. The modules of the fourth wall may be fixed to the slot 6 in the edge of the floor 61, by fixing elements as described above. Preferably, the modules 1 forming all of the four walls are substantially the same length, and are assembled so that at least their upper ends are aligned horizontally.

[0046] To form a roof on the shelter, roof beams 70, which in this arrangement are construction modules 1 of a length greater than the length of the modules forming the floor 61, are laid between wall 60 and wall 63, the attachment buttons 37 of the end caps 30 of the modules 1 forming the walls 60 and 63 being engaged by a slot 6 and cavity 6a of the roof beams 70. The roof beams 70 are preferably placed with their plain sidewall 5 uppermost, to provide a smooth surface to the exterior of the roof. This orientation of the roof beams 70 provides a slot 6 and cavity 6a on the underside of each roof beam, from which articles such as lamps, curtains or other items may be suspended.

[0047] Further roof beams 70 are provided to extend between each of the modules 1 of the wall 60 and its counterpart module 1 in wall 63. The roof beams 70 may be joined to each other by inserting joining elements 20 into the adjacent slots 6 and cavities 6a of each adjacent pair of roof beams 70, and end plugs 30 may be inserted in the respective ends of the roof beams 70.

[0048] It will be understood that instead of aligning the roof beams 70 parallel to the construction modules 1 of the floor 61, the roof beams 70 may extend from the top of wall 62 to the top of the fourth wall, perpendicularly to the direction of the modules 1 of the floor 61.

[0049] Figure 10 is a schematic illustration of how an access opening may be provided in the shelter. Figure 10 shows the shelter with the roof beams 70 extending between the wall 60 and the wall 63. By sliding two of the roof beams 70A and 70B to the left (as shown in the Figure) the ends of the roof beams 70A and 70B can be disengaged from the wall 63. The corresponding modules 1A and 1B may then be slid upwardly, creating an opening D adjacent the floor 61. The opening D may be closed by reversing the process and moving the modules 1A and 1B downward until their upper ends are aligned with the upper ends of the adjacent modules 1 in wall 63, and then sliding the roof beams 70A and 70B to re-engage with the buttons 37 of the end caps 30 of modules 1A and 1B.

[0050] Locking means such as conventional bolts may be provided between the modules 1 and the roof beams 70, to deny access from outside the building.

[0051] Figure 11 shows an alternative method of constructing a shelter using the construction modules 1. In this structure, the roof of the structure is formed by a number of roof beams 70 arranged parallel one to another. An end wall of the structure is formed from a plurality of modules 1 laid horizontally and joined together by means of joining elements 20 running horizontally between each adjacent pair of modules 1. A front wall F of the structure is formed partially by a number of horizontally-laid modules 1h, and partially by a number of vertically oriented modules 1v. In the structure shown, the front wall F is formed from eight horizontally-laid modules 1h arranged one on top of another, and six vertically laid modules 1v arranged side-by-side. End caps (not shown) on the ends of the horizontally-laid modules 1h connect them to their adjacent vertically-laid module 1v. An access opening D has been created in the illustrated embodiment by sliding two of the roof beams 70A and 70B away from the front wall F, and lifting the central two of the vertical modules 1v to create the opening D.

Alternative Embodiments

[0052] While an exemplary embodiment of the invention has been described above, numerous alternative arrangements are foreseen by the present inventors. The cross-section of the construction module, although shown as generally square in the illustrated embodiments, may be rectangular. The plain (i.e. non-slotted) sidewall may be one of the longer sides of the rectangle. In a further alternative, the construction module may have a rhombus or diamond cross-section, and may be thinned at the comers to render them more flexible. Such a construction module may be flattened by bringing the obtuse-angled corners of the rhombus together, to reduce the volume of the module for shipping.

[0053] Slots 6 and cavities 6a are formed on three sides of the construction module illustrated in the example. It will be appreciated that construction modules of square or rectangular cross-section may be provided with a slot 6 and cavity 6a on all sides or on only two opposing sides.

[0054] While the construction modules 1 described above comprise slots and cavities in their faces, it is further foreseen that one or more of the faces of the construction module 1 may include a protrusion in the form of an undercut ridge, shaped so as to be corporate wall with a slot 6 and cavity 6a of an identical module. Preferably the ridge is formed on a face opposite to a face of the module which has a slot 6 and cavity 6a, so that a number of identical modules may be joined side-by-side by sliding the ridge of one module into the slot of another. In this embodiment, the shelter may be is constructed from fewer components as the joining elements would not be needed.

[0055] To facilitate joining to modules together when the modules have slots and cavities formed in a concave face of the module, the module may be first provided with end plugs 30 and pressurised air may be introduced through the valve 25 to inflate the module so that the faces of the module assume a substantially flat or possibly even convex shape. This will allow the slots 6 of two modules to be aligned and position side-by-side, without having to pinch the slots together. The joining element may then be easily introduced into the cavities 6a and the aligned and adjacent slots 6, to join the two modules together. After the joining element 20 has been positioned, air may be released from the modules 1, causing them to return to their original unstressed curvature in so far as is possible against the resistance of the joining element 20. A tight engagement between the modules 1 and the joining elements 20 may thus be provided, without excessive physical force being required to insert the joining elements 20.

[0056] The joining elements 20 may be provided with substantially rigid locking elements 21 and an elastic or flexible bridging element 22. By using such joining elements 20, a flexible structure may be achieved. Such a flexible structure may be useful when the modules 1 are sealed by the provision of end caps 30, and the resultant buoyant modules are joined together by flexible joining elements to form a raft, pontoon or bridge or other floating structure.

[0057] When a shelter has been formed from hollow construction modules 1, additional strength and weight may be added to the shelter by filling the constructional modules 1 with available material, such as earth, gravel, rock or the like. Modules filled with earth may have openings formed in them so that plants may be grown in the modules forming the walls of a shelter.

[0058] The hollow nature of the modules allows them to be used also for storing water, or as pipes for transporting water.

Claims

1. Modular structure including:
at least two construction modules (1), each construction module (1) being a hollow body of cuboid or rhombohedron shape with four side walls (2, 3, 4, 5) and open front sides, wherein at least one of the side walls (2, 3, 4) includes an attachment slot (6) extending longitudinally along the sidewalls (2, 3, 4, 5), the attachment slot (6) opening into an enlarged cavity (6a) of constant cross-section in longitudinal direction of the side wall (2, 3, 4).

2. The modular structure of claim 1, wherein two opposite side walls (2, 4) or three side walls (2, 3, 4) of the hollow body each include the attachment slot (6) and the enlarged cavity (6a).

3. The modular structure of claim 1 or 2, wherein the construction module (1) is a one-piece body made of plastics material, in particular extruded high-density polyethylene (HDPE), polypropylene (PP) or polyethylene terephthalate (PET).

4. The modular structure of any one of the preceding claims, wherein the sidewalls (2, 3, 4) including the attachment slot (6) are concave.

5. The modular structure of any one of the preceding claims, wherein the attachment slot (6) extends longitudinally along the centre of the sidewall (2, 3, 4).

6. The modular structure of any one of the preceding claims, wherein the sidewalls (2, 3, 4, 5) of the construction module (1) have a wall thickness t of from 1 to 5 millimetres; and /or
the wall thickness at corners where adjacent sidewalls (2, 3, 4) meet is reduced compared to the wall thickness in other parts of the construction module (1); and/or
the wall thickness at the edges of the slots (6) is increased compared to the wall thickness in other parts of the construction module (1).

7. The modular structure of any one of the preceding claims, wherein the joining slots (6) of adjacent sidewalls (2, 4) of two construction modules (1) are in alignment and the modular structure further includes a joining element (20), the joining element (20) comprising two locking elements (21) joined by a bridging element (22), wherein the locking elements (21) of the joining element (20) are inserted into respective cavities (6a) of the adjacent sidewalls (2, 4) and the bridging element (22) extends through the slots (6).

8. The modular structure of any one of the preceding claims, wherein the modular structure further includes a filler element (25), which comprises a lock-

ing part (26) and a filler part (27) having a flat external face (27a), the filler element (25) being inserted into a cavity (6a) of a construction module (1) so that the filler part (27) occupies the slot (6) with the face (27a) being flush with the outer surface of the respective sidewall (2, 3, 4).

9. The modular structure of any one of the preceding claims, wherein the modular structure further includes an end plug (30) for closing one or both open front sides of the construction module (1).

10. The modular structure of claim 9, wherein the end plug (30) includes an end plate (31) and a skirt (32) extending perpendicularly to the end plate (31) and being shaped so as to correspond to the internal form and dimensions of the construction module (1), the skirt (32) being formed with internal formations (33) which are shaped and dimensioned so as to fit closely round the ends of the walls of the cavities (6a) of the construction module (1).

11. The modular structure of claim 9 or 10, wherein the end plug (30) includes an air valve (35) being in communication with an interior space of the construction module (1).

12. The modular structure of claim 11, wherein a depression (34) is formed in the end plate (31) to accommodate the air valve (35), which is in communication with the underside of the end plate (31) by means of an opening (36) formed in the base of the depression (34).

13. The modular structure of claim 10, wherein an attachment button (37) is mounted centrally in the end plate (31), the attachment button (37) having a stem (38) and a head (39), the stem (38) of the attachment button (37) being dimensioned so as to be receivable in the slot (6) of the sidewalls (2, 3, 4) of a construction module (1) and the button (39) being shaped to be co-operable with the parts of an internal face of the cavity (6a) of the construction module (1).

14. The modular structure of claim 13, wherein the stem (38) is circular in cross-section.

15. Use of the modular structure of any of the preceding claims for forming a dwelling or shelter, a floating or floatable structure, a raft, a pontoon, a bridge, a storing device for water, or a pipe for transporting water.

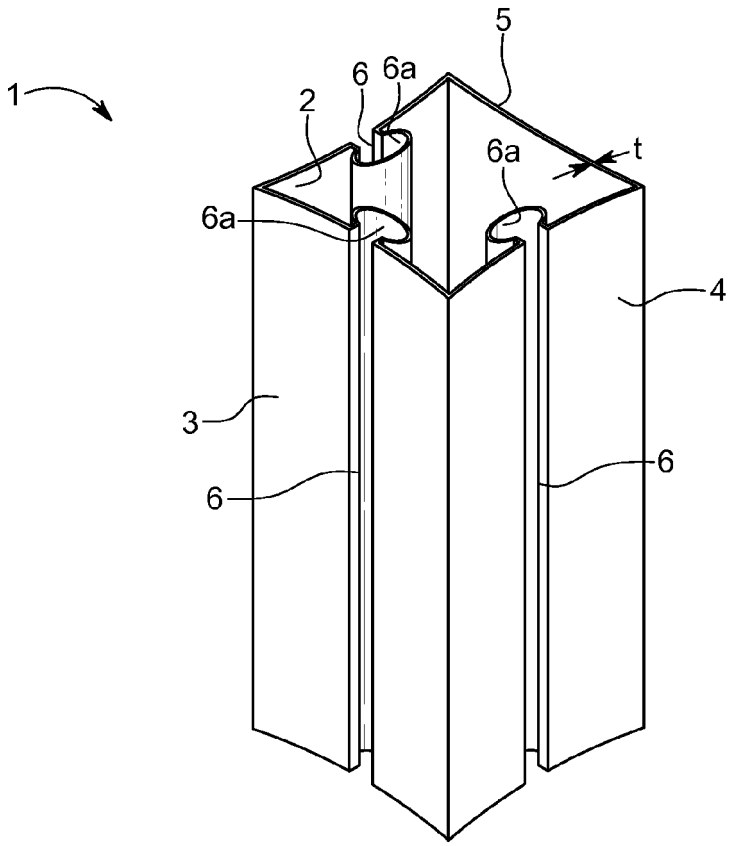

FIG. 1

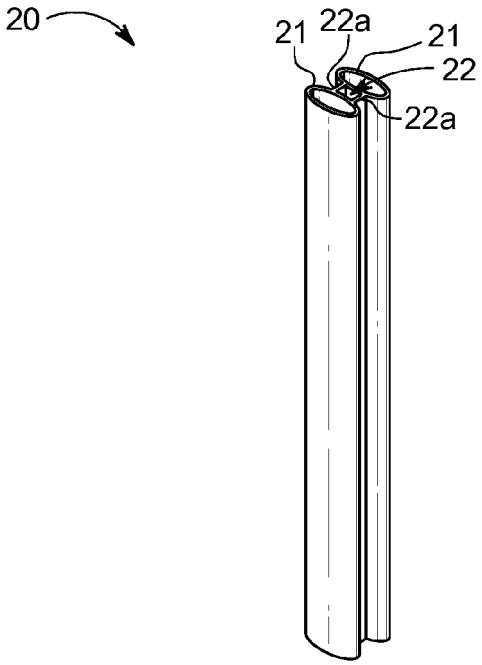

FIG. 2

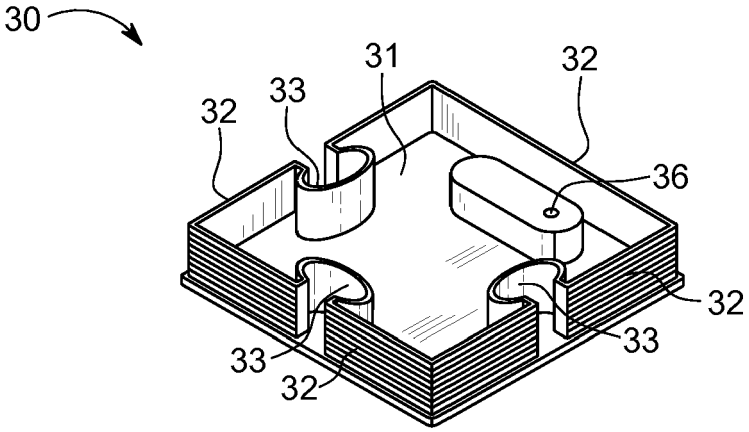

FIG. 3A

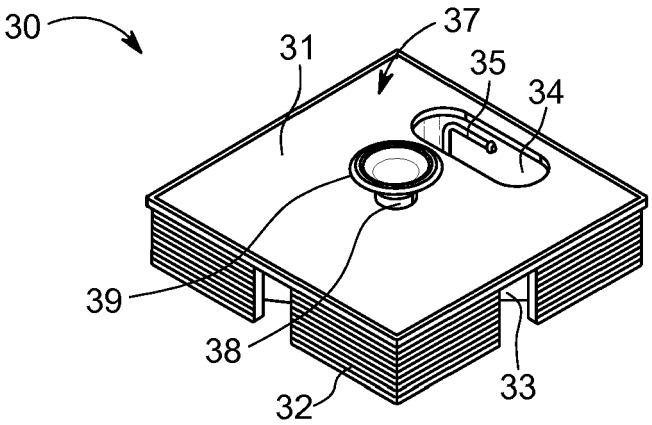

FIG. 3B

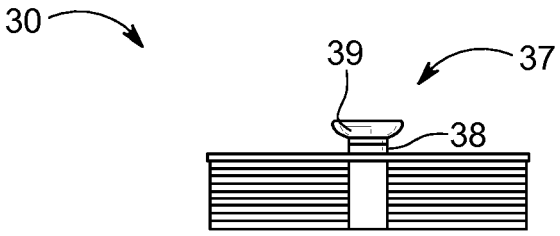

FIG. 3C

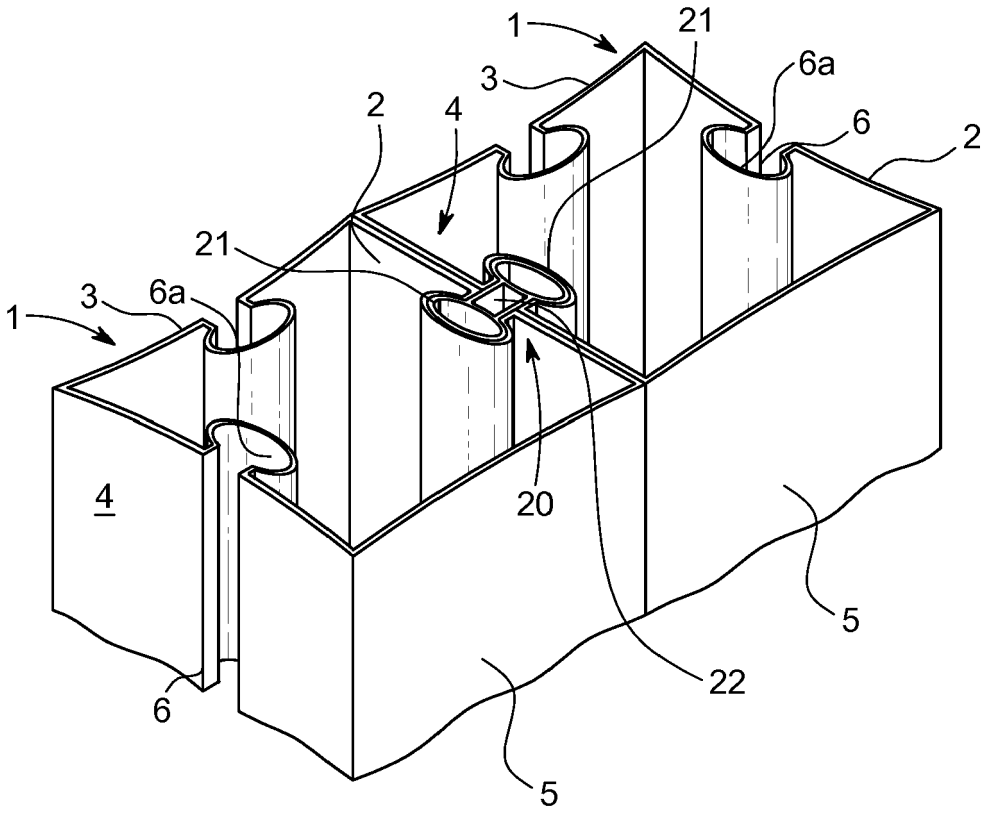

FIG. 4

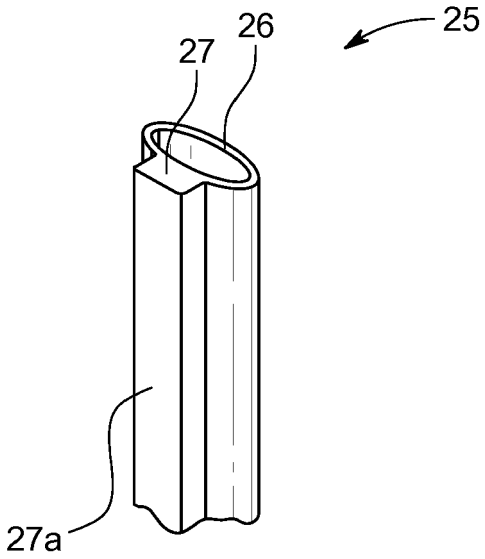

FIG. 5

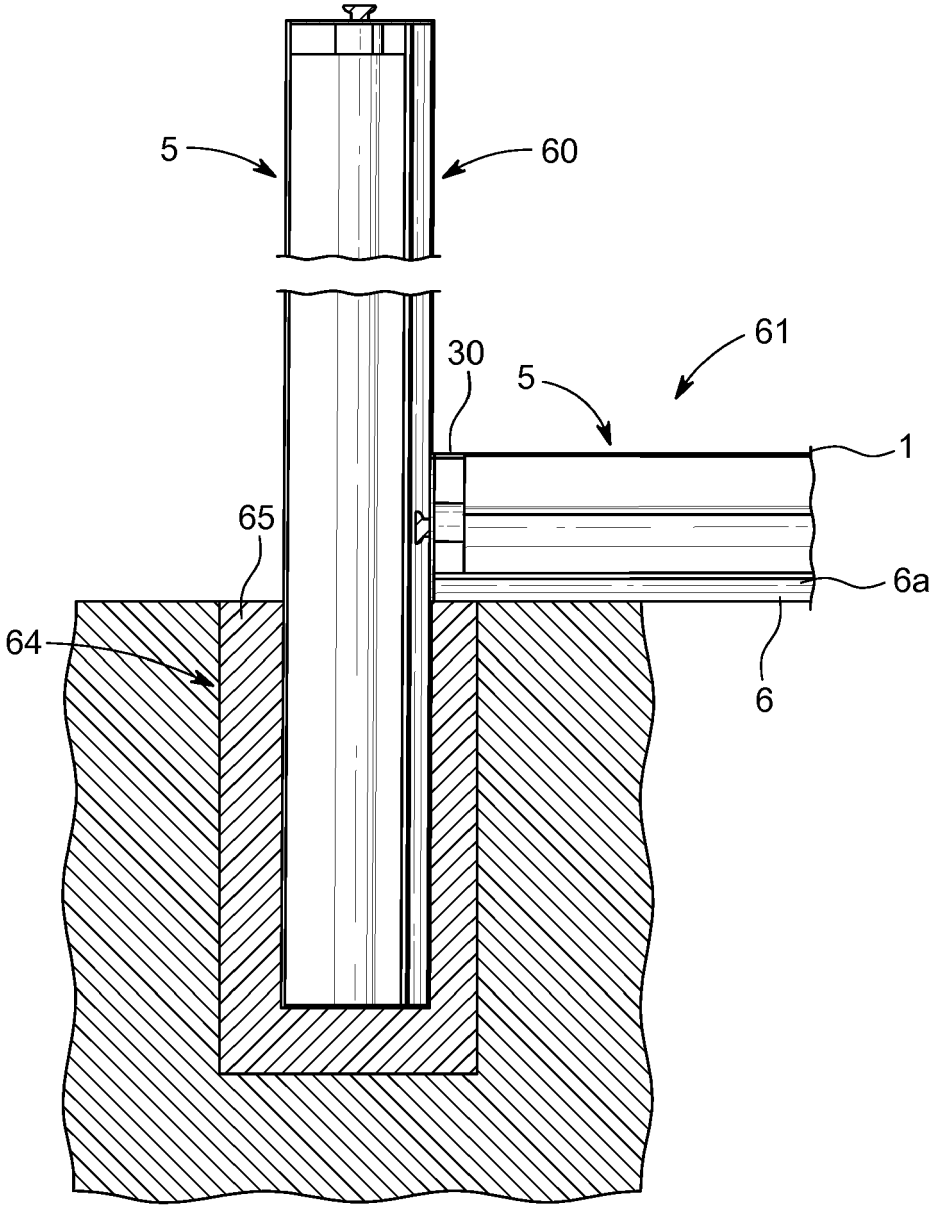

FIG. 6

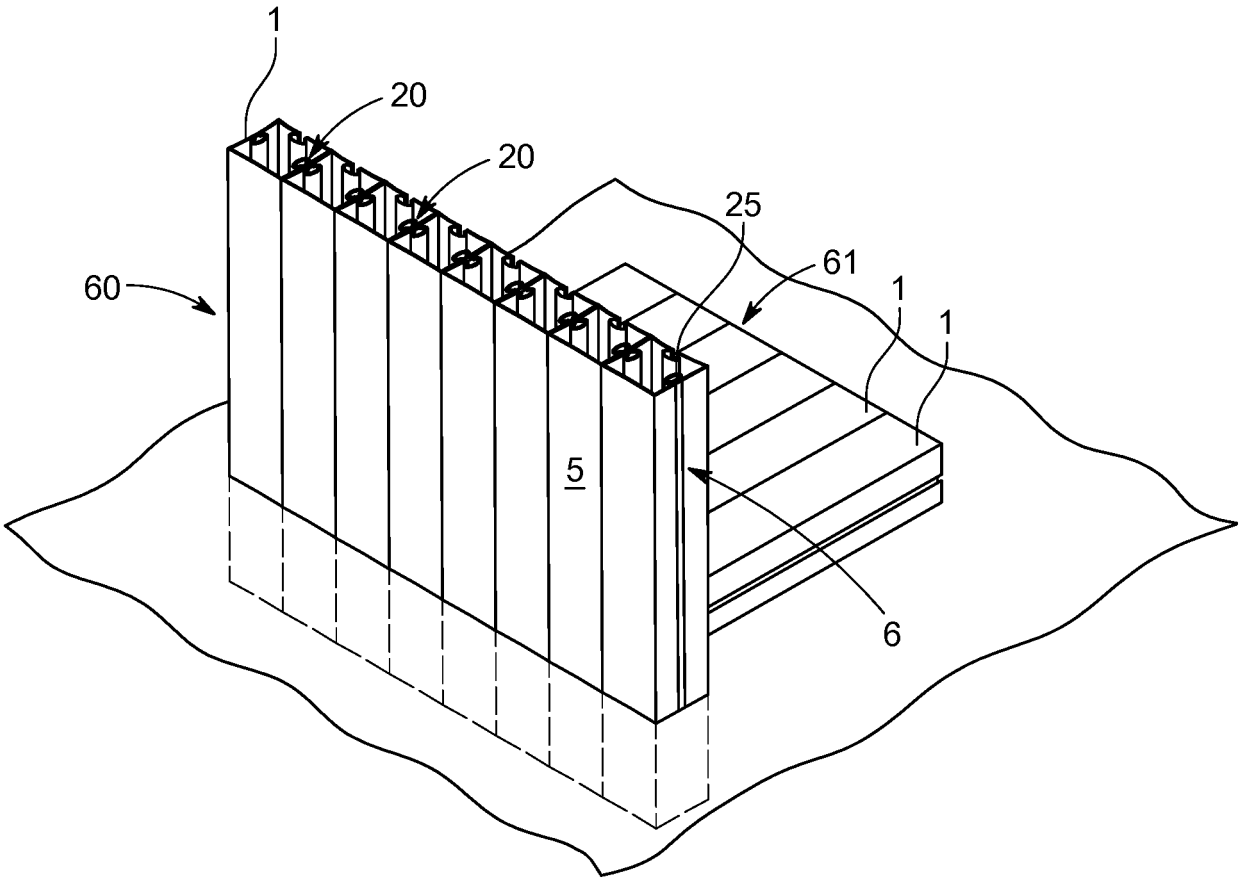

FIG. 7

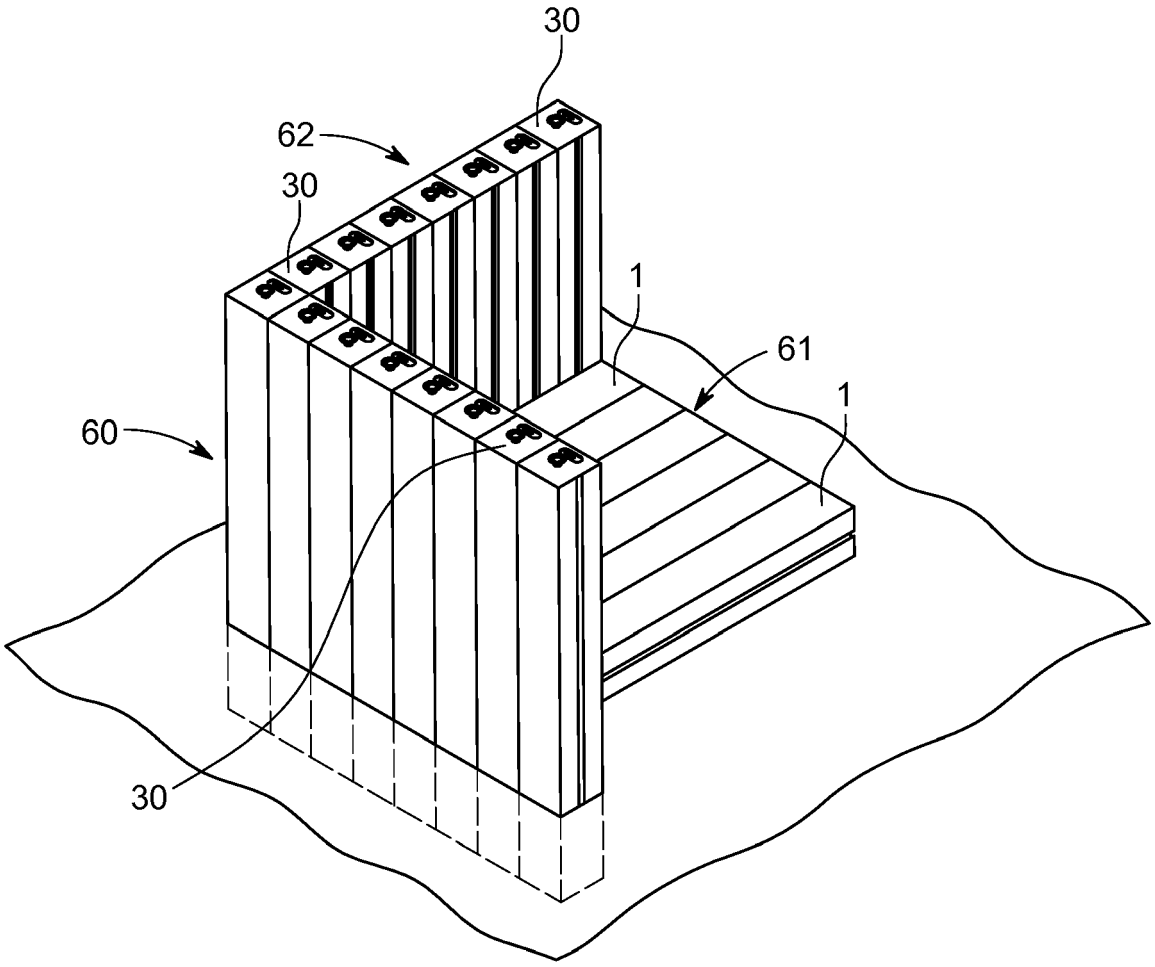

FIG. 8

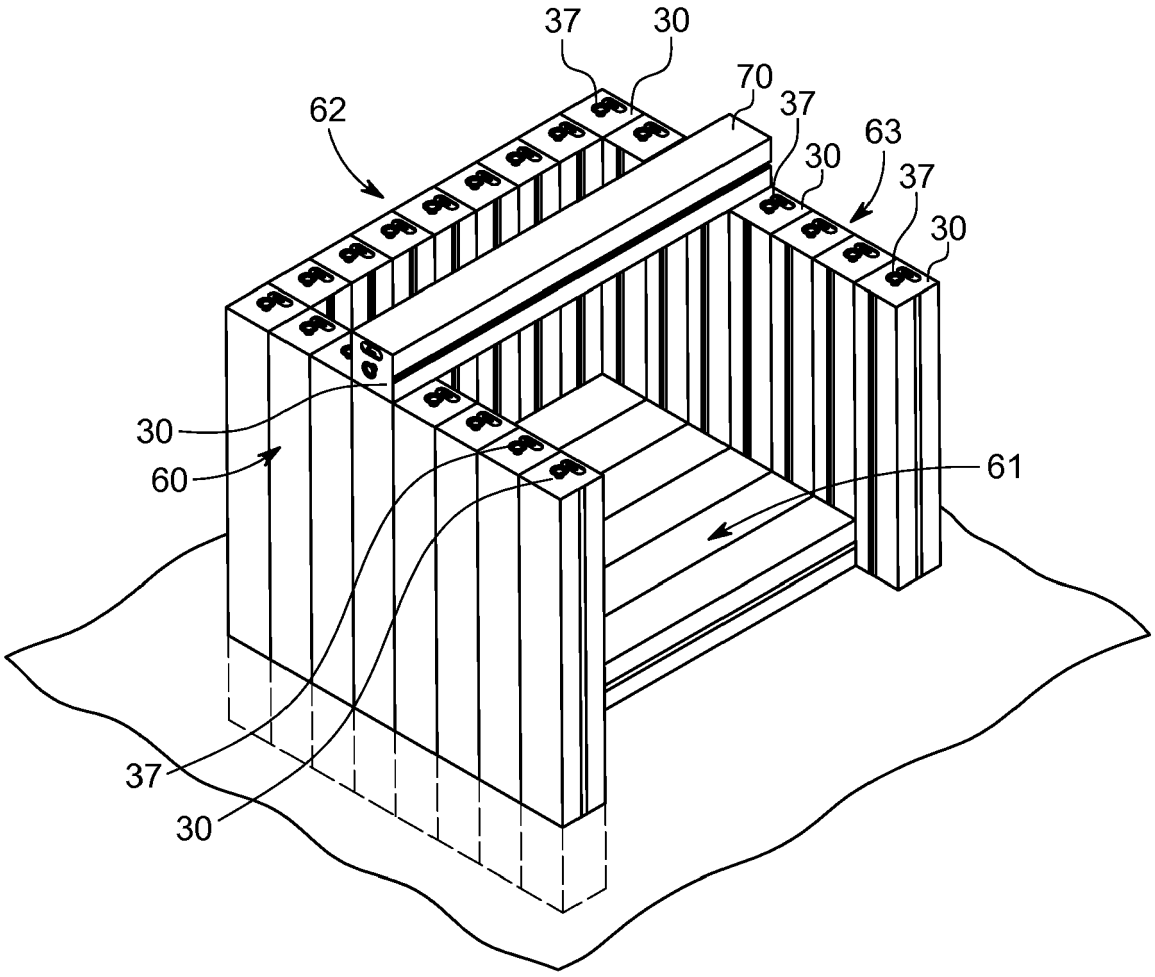

FIG. 9

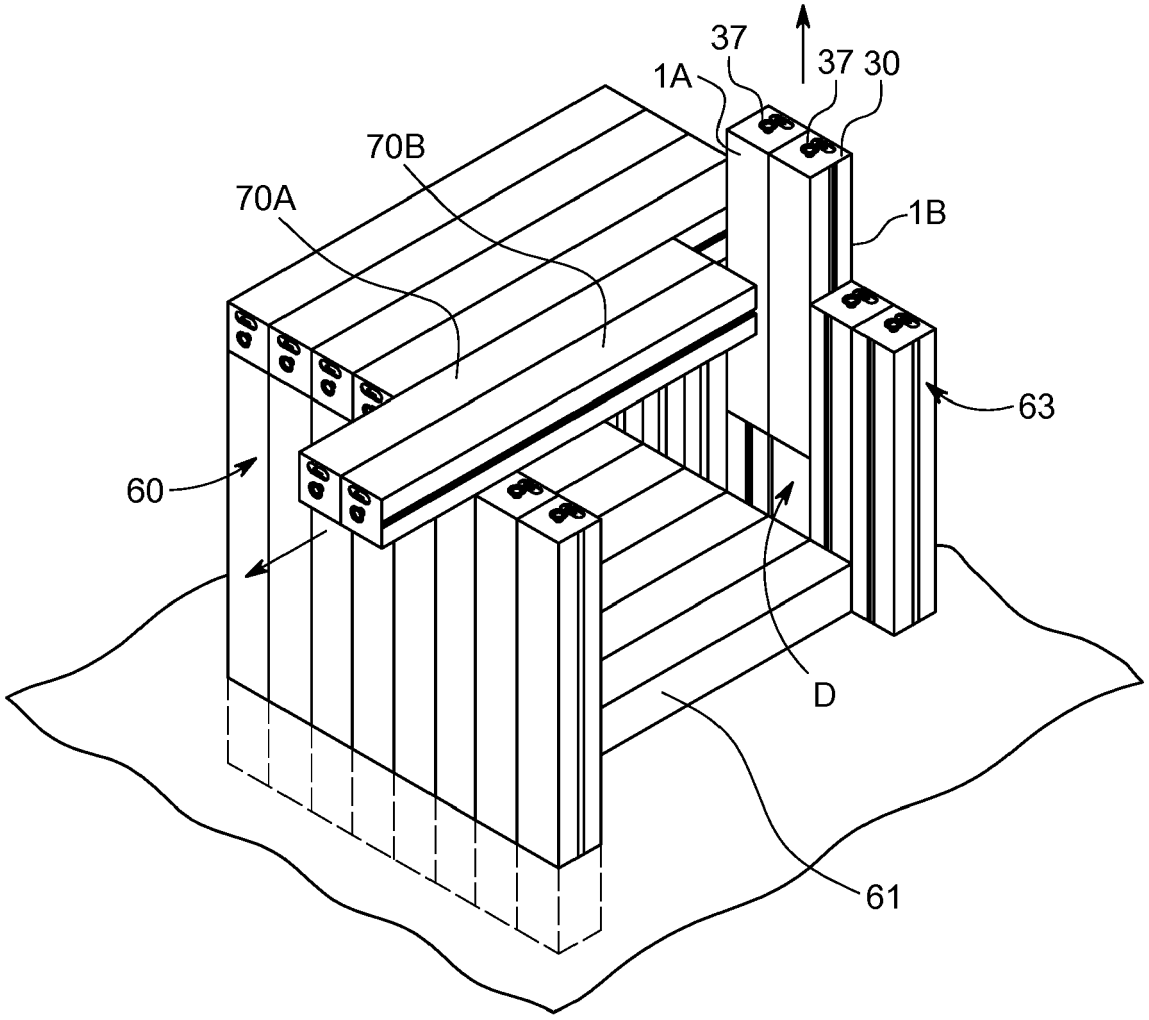

FIG. 10

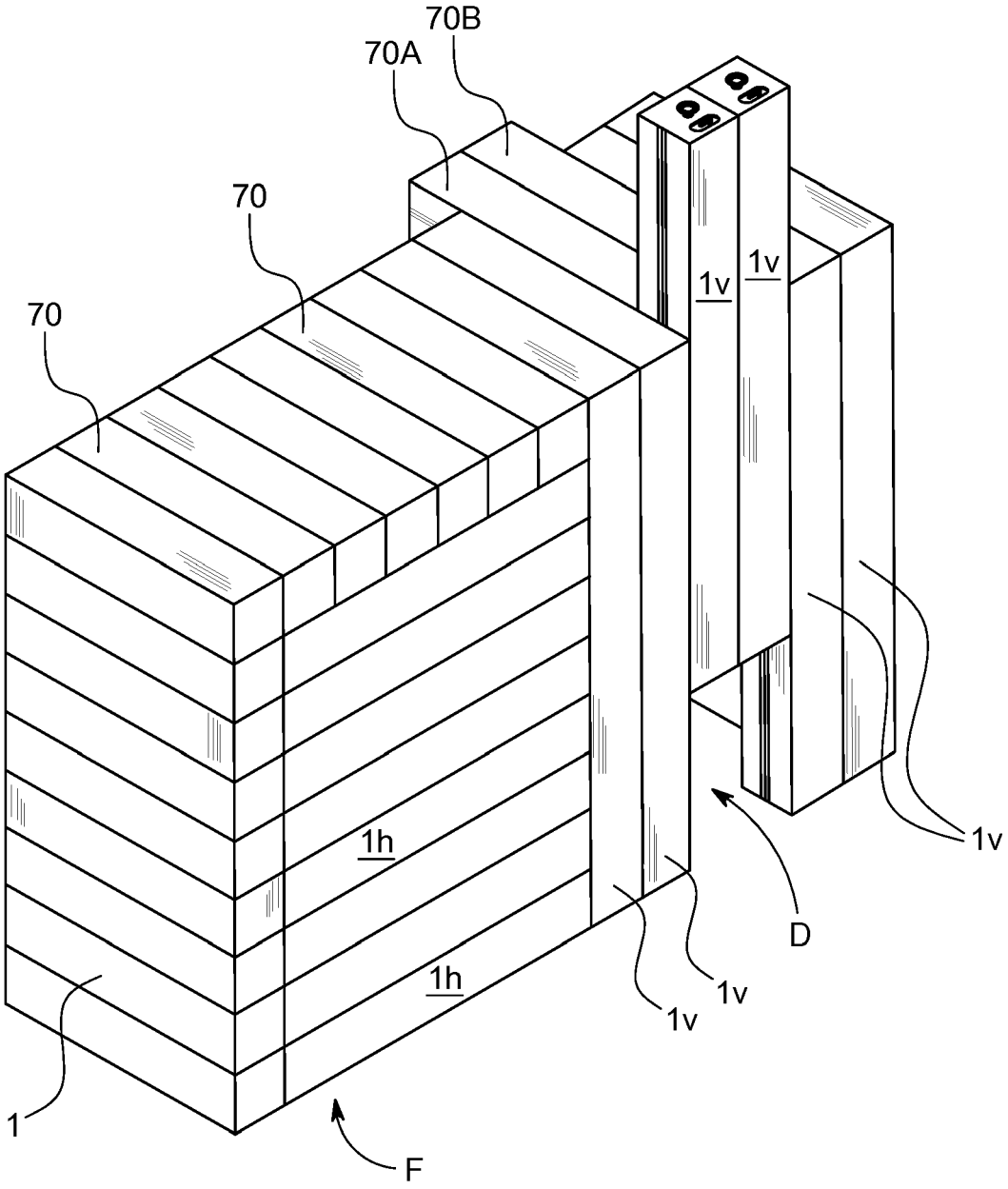

FIG. 11

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 16 6923

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y A	US 3 370 389 A (JOSEPH MACALUSO) 27 February 1968 (1968-02-27) * figures 1-3 *	1-10,15 13,14 11,12	INV. E04H1/12 B63B7/00 B63B35/34 E01D15/00
X	US 3 751 865 A (BRIGHAM G) 14 August 1973 (1973-08-14) * figures 1, 2 * * column 8 *	1,15	E04B1/343
Y	AU 2010 200 477 A1 (INSTANT STRUCTURES PTY LTD) 9 September 2010 (2010-09-09) * figure 5 *	13,14	
A	CA 2 307 524 A1 (BENNETT WAYNE [CA]) 4 November 2001 (2001-11-04) * figure 1 *	11,12	
A	US 9 856 674 B1 (POND TAWNY [US]) 2 January 2018 (2018-01-02) * figures 1, 3 *	11,12	
			TECHNICAL FIELDS SEARCHED (IPC)
A	EP 2 264 323 A2 (REITER KLAUS [AT]) 22 December 2010 (2010-12-22) * figures 1-3 *	7	E04B E04H B63B F16B E04C E01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 October 2018	Brucksch, Carola

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 16 6923

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

05-10-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3370389 A	27-02-1968	NONE	
US 3751865 A	14-08-1973	NONE	
AU 2010200477 A1	09-09-2010	NONE	
CA 2307524 A1	04-11-2001	NONE	
US 9856674 B1	02-01-2018	NONE	
EP 2264323 A2	22-12-2010	AT 12597 U1 EP 2264323 A2	15-08-2012 22-12-2010

EPO FORM P0459

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