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- (73) Patenthaver: **Preston, John, 196 Silverwater Road, Silverwater, New South Wales 2128, Australien**
- (72) Opfinder: **Preston, John, 196 Silverwater Road, Silverwater, New South Wales 2128, Australien**
- (74) Fuldmægtig i Danmark: **Budde Schou A/S, Dronningens Tværgade 30, 1302 København K, Danmark**
- (54) Benævnelse: **Modulær bygningskonstruktion, som anvender komposite indbyrdes forbundne rammepaneller**
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US-A1- 2011 271 613
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DESCRIPTION

BACKGROUND

[0001] The present invention relates to a walkway, stairwell or other like structure according to the preamble of claim 1.

PRIOR ART

[0002] Large building sites at which heavy construction takes place require walkways and stairwells for workers and other related personnel to navigate across a site elevated from the potentially unsafe building areas. Walkways and stairways provide protection for workers moving from one location to the other especially when ground conditions are hostile.

[0003] Typically a walkway would have a through passage with a required height 2-3 meters and a width of 1-2 metres. Gangway and walkways must have high bending, shear and torsional load resistance. Essentially they carry self weight and live loads - mainly personnel. Carrying self weight allows scope to increase span but as span increases, a greater load is placed on connections and load transmission points which transfer load back to primary supports. There are a variety of gangway types currently used in construction environments. One example comprises a truss space frame which is supported along its length on standard I beams sized according to the required span. The combination of the truss and supporting beams allows long spans which are often required to traverse relatively long distances on building sites.

[0004] Walkways are typically not bolted nor use separate modules but have been manufactured as a Universal Beam or Rolled Steel Joist or fabricated as a manufactured beam about double the size of a UB or RSJ. There is currently no very large beam component that can be assembled by bolting of sections and having the versatility of modularity such that modules can be added depending upon the length of the structure required.

These are strong beams capable of relatively long spans when the web is deep enough. A conventional truss or space frame which is made from a series of struts are arranged to transmit loads through the beam. Truss frames and beam combinations have a high strength to weight ratio. The current truss walkways have been effective for their purposes but there is always a need to further improve the versatility of walkway structures and to provide an alternative to the known methods and which is economic to manufacture, has a high strength to weight ratio and is versatile enough to enable the advantages of modularity and bolt together construction.

[0005] US 2013/048430 A1 discloses a structure with the features of the preamble of claim 1.

INVENTION

[0006] The present invention provides a walkway, stairwell or other like structure according to claim 1. Although the invention will be described hereinafter with reference to its application in construction of building site walkways, it should be appreciated that the invention is not limited to this particular field of use or application. For example, the present invention is capable of use in footbridge, stairwell or viewing platform constructions in environments including but not limited to building sites.

[0007] The present invention provides an alternative to the known prior art and the shortcomings identified. The foregoing and other objects and advantages will appear from the description to follow. In the description reference is made to the accompanying representations, which forms a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. These embodiments will be described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilised and that structural changes may be made without departing from the scope of the invention. The following detailed description is, therefore, not to be taken as limiting the scope of the present invention, which is only defined by the appended claims.

[0008] According to claim 1, the present invention comprises:

a walkway, stairwell or other like structure (1) comprising at least a primary frame (2) formed from at least two box frame modules (3, 4, 5, 6) and a plurality of building modules which primary frame and building modules together form at least part of the structure (1); each building module comprising;

a first peripheral frame (19) of a first area size defining a space which includes a layer of barrier material, a second peripheral frame (20) of an area size different from the frame of the first area size and, defining a space which includes a layer of barrier material and which is joined at a first junction (24) to the first peripheral frame of the first size in abutting end to end relationship to form a first auxiliary module;

a third peripheral frame (30) having the same size as the second peripheral frame (20) and which defines a space which includes a layer of barrier material, a fourth peripheral frame (29) having the same size as the first peripheral frame (19) and which defines a space which includes a layer of barrier material and which is joined at a second junction (34) to the third peripheral frame (30) of the first area size in abutting end to end relationship to form a second auxiliary module; characterised in that the first and second auxiliary modules are attached on opposing sides of the primary frame of the structure whereby the first and second auxiliary modules are arranged in opposing relationship to form said building module; and the first and second junctions (34, 24) of respective first and second auxiliary modules are staggered along the length of the structure relative to an end to end join (15) between two of said at least two

box frame modules (3, 4, 5, 6).

[0009] Not forming part of the present invention is: a frame module for use in the construction of a structure formed using a plurality of like modules, the module comprising a first peripheral frame of a first size defining a space which receives a layer of barrier material, a second peripheral frame of a second size defining a space which receives a layer of barrier material and which is joined at a first junction to the first peripheral frame of the first size in abutting end to end relationship; each said frames including separate bracing; the frame module comprising part of the structure.

[0010] Not forming part of the present invention is:

a walkway bridge including a mainframe having a base, top and sides; the mainframe constructed from primary modules each abutting a like primary module and forming a junction between the primary modules; the modules sized so that the junctions are equidistant;

at least two auxiliary modules engaging each side of the main frame and each frame comprising a top, a base and side members; wherein each said auxiliary modules is formed from two primary frames of different sizes and is connected to the main frame so that a junction between the auxiliary modules does not align with a junction between the primary modules.

[0011] The junctions between the auxiliary modules [modular] frames are staggered in relation to the junctions formed by abutting primary frames. This arrangement reinforces the total bridge structure and places joins in the primary modules closer to the joins of the auxiliary modules and reinforces the sides of the primary modules. The walkway is a beam manufactured in the form of a frame with reinforced walls formed by frame modules bolted together.

[0012] Not forming part of the present invention is: a walkway constructed from a plurality of main frames, a first type of said frames comprising a box section space frame having a top, bottom and sides; a second type of frame module comprising a frame having a top bottom and sides defining an internal space, and attachable to the first type of frame; wherein a plurality of the second frame type is connected to a plurality of the first frame type such that joins formed by connection of the first frame type and joins formed by connection of the second frame type are staggered along the length of the walkway. Preferably the box frame and second frame type (auxiliary frame) are manufactured from bolt together angle sections.

[0013] Not forming part of the present invention is: a structural walkway of substantially rectangular cross-section manufactured from modules comprising bolt together angle sections; the walkway including a primary module type defining a box section space frame and an

auxiliary module comprising a generally planar frame; wherein the walkway is constructed from a plurality of said primary modules and a plurality of said auxiliary modules each formed by two primary frames of different sizes; wherein the modules are arranged such that when the auxiliary modules are connected to the primary modules a join formed between primary modules is staggered relative to a location of joins formed by the auxiliary modules.

[0014] Not forming part of the present invention is a method of construction of a walkway including a primary module type defining a box section space frame and an auxiliary module comprising a generally planar frame; the method comprising the steps of;

1. a) constructing a plurality of box section primary space frames and joining the space frames end to end such that an internal passage passes therealong;
2. b) constructing a plurality of auxiliary modules formed from abutting primary frames of different sizes and attaching the frames to the primary frames;
3. c) arranging joins formed between the primary frames and joins between the auxiliary frames such that they are staggered along the length of the walkway so formed.

[0015] The examples referred to herein are illustrative and are not to be regarded as limiting the scope of the invention. While various embodiments of the invention will be described herein, it will be appreciated that these are capable of modification, and therefore the disclosures herein are not to be construed as limiting of the precise details set forth, but to avail such changes and alterations as fall within the purview of the description. It is an object of the present invention to substantially overcome or at least ameliorate one or more of the above prior art disadvantages. In attempting to ameliorate or eliminate the prior art limitations and to provide a useful alternative to the known structural walkways, the present invention seeks to provide a more efficient alternative which due to its modularity has the capability of reinforcing the composite structure as a result of staggered locations of module joins.

[0016] It is one object of the present invention to increase the efficiency of modular construction and to enable increased versatility in the use and modularity of walkways, stairwells and the like and improving strength depending upon the selection of inter engagements of one module with another.

[0017] The present invention provides an alternative to the known prior art and the shortcomings identified. The foregoing and other objects and advantages will appear from the description to follow. In the description reference is made to the accompanying representations, which forms a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. These embodiments will be described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilised and that structural changes may be made without departing from the scope of the invention. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is only

defined by the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The present invention will now be described in more detail according to a preferred but non limiting embodiment and by way of example only with reference to the accompanying drawings wherein;

[0019] Preferred embodiments of the invention will now be described, in relation to the accompanying drawings in which:

Figure. 1 shows a perspective exploded view of the walkway assembly according to a preferred embodiment.

Figure 2 shows a perspective view of the assembly of figure 1 partially constructed with auxiliary frames attached to the primary frame box sections.

Figure 3 shows an elevation view of auxiliary frames joined together and the relationship with joins of the primary frames..

Figure 4 shows a top view of the auxiliary frames of figure 3.

Figure 5 shows a side elevation view of the auxiliary frames of figure 4.

Figure 6 shows a perspective view of the typical auxiliary frames of figure 3 interconnected.

Figure 7 shows an enlarged elevation view of a half size auxiliary frame module in isolation.

Figure 8 shows an enlarged elevation view of a full size auxiliary frame module in isolation.

Figure 9 shows an enlarged perspective view of a half size auxiliary frame module in isolation.

Figure 10 shows an enlarged perspective view of a full size auxiliary frame module in isolation.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] The examples referred to herein are illustrative and are not to be regarded as limiting the scope of the invention. While various embodiments of the invention have been described herein, it will be appreciated that these are capable of modification, and therefore the disclosures herein are not to be construed as limiting of the precise details set forth. Although the apparatus aspects of the invention will be described with reference to their application to heavy and light building construction, it will be appreciated that the invention has alternative applications.

[0021] Referring to **Figure 1** there is shown a perspective exploded view of a walkway assembly 1 according to a preferred embodiment. Assembly 1 comprises a primary frame 2 which includes primary box frame modules 3, 4, 5 and 6. Frame modules 3, 4, 5 and 6 are a series of box frames which are bolted together end to end to define an internal passage to become a walkway 39. Primary box frame 3 is formed as a series of rectangular cube space frames joined end to end and proportioned to accommodate personnel walking through the walkway assembly 1 along walkway 39. Module 3 comprises a bottom 7, sides 8 and 9 and a top 10. Module 4 likewise comprises a bottom 11, sides 12 and 13 and top 14. Modules 3 and 4 are arranged in abutting relationship and form join 15. Similarly module 5 joins module 4 to form join 16 and module 6 joins module 5 to form join 17. Joins 15, 16 and 17 are evenly spaced. Typically each box frame module is bolted to an adjacent module via abutting opposing module faces. Assembly 1 further comprises a wall 18 of auxiliary modules 19, 20, 21, 22 and 23. Auxiliary modules 19 and 20 form joint 24. Modules 20 and 21 form joint 25. Frames 21 and 22 form joint 26 and frames 22 and 23 form joint 27. Primary frames 19 and 23 are half sized primary frames and primary frames 20, 21 and 22 are full sized. Thus primary frames 19 and 23 define an area which is approximately half the area defined by frames 20, 21 and 22.

[0022] Assembly 1 further comprises a wall 28 of secondary /auxiliary modules 29, 30, 31, 32 and 33. Auxiliary modules 29 and 30 form joint 34. Primary frames 30 and 31 form joint 35. Frames 31 and 32 form joint 36 and frames 32 and 33 form joint 37. Frames 29 and 33 are half frames and frames 30, 31 and 32 are all full sized frames. The combination of frame 32 and half frame 33 allows versatility of construction in that the use of half frames allows joints 34, 35, 36 and 37 to be staggered relative to joints 15, 16 and 17 of box modules 3, 4, 5 and 6. Walls 18 and 28 in use engage box frame modules in frame 2 and allow staggering of the wall joints and main box frame joints to thereby impart additional strength compared to the strength of a structure using the same components if the joints were not staggered - for instance if the joint 35 was in alignment with joint 15.

[0023] **Figure 2** shows with corresponding numbering a perspective view of the assembly 1 of figure 1 partially constructed with auxiliary modules attached to opposing walls 18 and 28 of the main frame. It can be seen from this partially completed walkway that the joints of the main frame 2 and the joints of auxiliary walls 18 and 28 are laterally out of alignment or in other words staggered along the length of the structure. The staggered alignment of the mainframe joints and panels is best shown with reference to join 17 of frame 2. Join 17 aligns about midway along frame 32. Joint 37 between primary frame members 32 and 33 locates midway between joint 17 and end 40 of frame 2. The staggering of joints 17 and 37 imparts a reinforcing effect on the structure including improved shear, torsional and bending strength.

[0024] **Figure 3** shows an elevation view of primary frames 29, 30 and 31 joined together and the relationship with joints 15 and 16 of the primary frames. Half frame 29 forms a joint 34 with full frame 30. Full frame 30 forms a joint 35 with full frame 31. It can be seen that joints 34, 15, 35 and 16 are staggered along the length of the frame modules. This provides reinforcing

strength intermediate the primary frame module joins 15 and 16 and generally reinforces the composite structure along the length of the walkway so formed. This allows an increased span and high strength. Preferably, each frame member includes a plurality of bolt holes 41 which enable mutual connection of modules to each other and connection of modules to the primary frame. Half frame 29 is constructed preferably using angle iron. Frame 29 comprises top and bottom members 45 and 46 and side members 47 and 48 which define a rectangular space. Variations in the shape of each frame is feasible but square and rectangular shapes are preferred. Each frame members 45, 46, 47 and 48 are adapted with spaced apart bolt holes 53 along the length of each member allowing bolting on opposing faces of the members when frame 29 abuts another auxiliary module such as full frame 30 and the primary box frame 2. Frame 29 also includes a weld mesh inlay 50 which provides a protective cover for users of the walkway. Diagonal bracing members 51 and 52 which are preferably external, are provided to brace frame 29.

[0025] Similarly full frame 30 comprises top and bottom members 55 and 56 and side members 57 and 58 which define a square space. Each frame member 55, 56, 57 and 58 are adapted with spaced apart bolt holes 60 along the length of each member allowing bolting on opposing faces of the members when frame 30 abuts auxiliary module formed by primary frames 29 and 31. Frame 30 also includes a weld mesh inlay 61 which provides a protective cover for users of the walkway. Diagonal bracing members 62 and 63 are provided to brace frame module 30. Frame module 31 is constructed in a similar manner to that described for frame 31.

[0026] **Figure 4** shows with corresponding numbering a top view of the auxiliary and primary frames of figure 3. **Figure 5** shows with corresponding numbering a side elevation view of the auxiliary frame and primary frame 31 and primary frame 2. **Figure 6** shows with corresponding numbering an opposite perspective view (to that shown in figure 3) of auxiliary frame modules 29, 30 and 31 of figure 4 joined together.

[0027] **Figure 7** shows an enlarged elevation view of a half size primary frame module 70 in isolation. Half frame 70 is constructed preferably using angle iron. Frame 70 comprises top and bottom members 71 and 72 and side members 73 and 74 which define a rectangular space. Each frame member 71, 72, 73 and 74 are adapted with spaced apart bolt holes 75 along the length of each member allowing bolting on opposing faces of the members when frame 70 abuts another primary frame. Frame 70 also includes a weld mesh inlay 76 which provides a protective cover for users of the walkway. Diagonal bracing members 77 and 78 which are preferably external, are provided to brace frame module 70.

[0028] **Figure 8** shows an enlarged elevation view of a full size auxiliary frame module 80 in isolation. Similarly full frame 80 comprises top and bottom members 81 and 82 and side members 83 and 84 which define a square space. Each frame member 81, 82, 83 and 84 are adapted with spaced apart bolt holes 90 along the length of each member allowing bolting on opposing faces of the members when frame 80 abuts an auxiliary modules the primary box frame. Module 80 also includes a weld mesh inlay 85 which provides a protective cover for

users of the walkway. Diagonal bracing members 86 and 87 are provided to brace frame module 80. **Figure 9** shows an enlarged perspective view of the full size auxiliary frame module 80 of figure 8 in isolation. **Figure 10** shows an enlarged perspective view of the half size auxiliary frame module 70 in isolation.

[0029] According to one embodiment the auxiliary frames can be connected back to back to increase module strength. In this embodiment a first frame is connected to a second frame in axial alignment to form a first auxiliary module. A third frame is connected to a fourth frame which forms a second auxiliary module. The first and second frames are connected so that the joint between the first and second frame is staggered relative to the joint formed between the third and fourth frames. As the second frame is about half the area of the first frame and the fourth frame is about half the area of the third frame, this improves the strength of the composite frame and also improves the strength when the composite is connected to a primary box frame such as one half frame is connected to a full frame. In one embodiment, the junction of a half frame and full frame is opposed by a full frame_such that the join locates at a mid point of the opposing full module. Each auxiliary module join is therefore staggered.

[0030] When used with a box space frame, the box frame is prefabricated according to selected lengths required. This may be dictated by site or transport considerations. The bolted together box frames are preferably for use in long span applications creating effectively a box beam. A perimeter frame beam is made of flat steel sections preferably angles with multiple holes in each angle or frame so that each end faces have 18mm holes at preferably 80mm centres for a 16mm bolts so that each face when bolted to another face or frame beam is staggered to form a superior larger beam. Preferably the measurements for the box frame beam are 2240mm x 2160mm square with a half frame beam of 1120mm x 2160mm. This allows staggering of the beams relative to the joints positions. This results in each joint being reinforced by another member bolted adjacent but staggered, so the opposite joints are not in lateral alignment. Preferably two flat faces of the frame beam are bolted together to stagger the joint and form a larger stronger frame. Bolt openings are placed every 80mm to connect the adjacent frame on any face with holes at any location preferably half way. The invention also incorporates a two way brace so the beam can be rotated, so one of the braces is always in tension.

[0031] The Auxiliary module half size frame 70 (figure 10) and full size frame 80 (figure 9) co operate to enable various configurations of walkway bridge construction depending upon particular site and builder's requirements. According to one embodiment box frame modules are sandwiched between an outer single layer of auxiliary frames on either side. At least one half auxiliary frame module is used to ensure that auxiliary frame joins and box frame joins are staggered on both sides of the box frames. This places joins of the box frames and auxiliary modules formed by the frames closer together and contributes to increased strength of the overall bridge structure in bending, torsion and shear. According to another embodiment, box frame modules are sandwiched between an outer single layer of auxiliary frames on one side and a double layer of staggered join auxiliary modules on an opposite side. In a further embodiment, box frame modules are sandwiched between two layers of back to back auxiliary

modules either side of the box frames to form a double strength truss like structure. Figures 3, 4, 5 and 6 show the two layered panels fixed back to back. In a further embodiment, a bridge structure is constructed using two panels as side panels and a decking with no roof. Thus it can be seen that the auxiliary module full and half frame panels can be arranged in a variety of configurations to increase the strength of a walkway bridge formed from a structure of box frames or open channel frames having no roof..

[0032] The walkway composite beam assembly is able to span long distances have improved torsional rigidity compared to the known beams of a corresponding size. They can be produced off site or on site by with low labour costs, lower plant costs and reduced manual handling. The beams can be produced from a variety of materials, including aluminium, steel, pre coated metal products which require no further surface finishing. Although the invention has been described with reference to specific examples, it would be appreciated by those skilled in the art that the invention may be embodied in many other forms.

[0033] Preferably, the plates used to construct the beam are equal angle sections, although beams constructed from unequal angles are feasible. The angle sections are arranged so that beam width is dictated by the length of one of the legs of the angle sections. The top and bottom plates sizes can be of any practical length and depth according to particular structural requirement of the beam including those dictated by span and loads. Bolted connectors are preferred, with the bolt numbers dependent upon shear and other loadings to be resisted. Bracing of each module can be introduced as required. The modules beams can also be assembled from a kit to form frame modules which can then be connected to the primary beam assembled from a kit then joined to the primary box frames as required.

[0034] The present invention provides a useful alternative to the known walkways and provides additional choice for customers. Although the apparatus aspects of the invention have been described with reference to their application to walkways and gantries used on construction sites, it will be appreciated that the invention has alternative applications.

[0035] The beam modules described herein are preferably manufactured from steel but other materials may be employed such as heavy duty plastics materials and aluminium. One advantage of the invention described herein is that the staggered connecting joint methodology imparts high strength with shear bolts which also provide high resistance to shear bending and torsion. Although the drawings show bolt holes according to a particular size, it will be appreciated that a variety of bolt sizes (length and diameters) and bolt configurations can be employed depending upon frame member sizes and design loading requirements.

[0036] It should be understood that various changes and modifications to the presently preferred embodiments described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the scope of the present subject matter and without diminishing its intended advantages. For example the frame sizes can be altered according to requirements as with bolt sizes and member sizes. Also frame shapes can be altered as required. It is therefore intended that such changes and

modifications be covered by the invention, which is only defined by the appended claims.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US2013048430A1 [0005]

PATENTKRAV

1. Løbegang, trappeskakt eller lignende struktur (1), omfattende i det mindste én primær ramme (2) udformet af i det mindste to kasserammemoduler (3, 4, 5, 6) og adskillige bygningsmoduler, hvilke primærramme og bygningsmoduler tilsammen danner i det mindste en del af strukturen (1); hvor hvert bygningsmodul omfatter:
 - en første perifer ramme (19) med en første arealstørrelse, som definerer et rum, som omfatter et lag af barrieremateriale, en anden perifer ramme (20) med en arealstørrelse, som er forskellig fra rammen med den første arealstørrelse og, som definerer et rum, som omfatter et lag af barrieremateriale og som er forbundet ved en første forbindelse (24) med den første perifere ramme med den første størrelse, i imod hinanden stødende ende til ende relation, for dannelse af et første hjælpemodul;
 - en tredje perifer ramme (30) med samme størrelse som den anden perifere ramme (20) og som definerer et rum, som omfatter et lag af barrieremateriale, en fjerde perifer ramme (29) med samme størrelse som den første perifere ramme (19), og som definerer et rum, som omfatter et lag af barrieremateriale og som er forbundet med en anden forbindelse (34) med den tredje perifere ramme (30) med den første arealstørrelse, i imod hinanden stødende ende til ende relation, for dannelse af et andet hjælpemodul;
 - kendetegnet ved, at** det første og andet hjælpemodul er forbundet på modstående sider af den primære ramme af strukturen, hvorved det første og andet hjælpemodul er anbragt modstående i forhold til hinanden for dannelse af bygningsmodulet; og den første og anden forbindelse (24, 34) af respektive første og andet hjælpemodul er forskudt langs længden af strukturen i forhold til en ende til ende forbindelse (15) imellem to af de i det mindste to kasserammemoduler (3, 4, 5, 6).
2. Struktur ifølge krav 1, hvor de perifere rammer (20, 19, 29, 30) er dannede af vinkelsektioner.
3. Struktur ifølge krav 2, hvor rammen med den anden størrelse har omtrent halvdelen af arealstørrelsen for den første ramme.
4. Struktur ifølge krav 3, hvor den tredje ramme har omtrent to gange arealstørrelsen af den fjerde ramme.
5. Struktur ifølge krav 4, hvor hver af den første, anden, tredje og fjerde ramme omfatter diagonalt placerede tværstræbere.

6. Struktur ifølge krav 5, hvor det første og andet hjælpe modul er forbundet via overfor hinanden liggende vinkelsektioner.
7. Struktur ifølge krav 6, hvor det første og andet hjælpe modul er forbundet idet den første forbindelse i det første hjælpe modul ligger overfor den tredje ramme.
8. Struktur ifølge krav 7, hvor den anden forbindelse mellem den tredje og fjerde ramme ligger overfor den første ramme.
9. Struktur ifølge krav 8, hvor den første forbindelse i det første hjælpe modul er forskudt i forhold til den anden forbindelse i det andet hjælpe modul.
10. Struktur ifølge krav 9, hvor den første og tredje ramme er kvadratiske; hvor den første og anden forbindelse eventuelt er placeret vertikalt; hvor de adskillige primære moduler eventuelt danner i det mindste én sidevæg i en struktur.
11. Struktur ifølge krav 10, hvor barrierematerialet er stålfløt.
12. Struktur ifølge krav 11, hvor strukturen, som dannes under anvendelse af de adskillige bygningsmoduler er en fodgænger-løbegang.
13. Struktur ifølge krav 12, hvor hver kasseramme har en top, bund og sider; som definerer et indvendigt rum.
14. Struktur ifølge krav 1, hvor strukturen, som er dannet af de adskillige bygningsmoduler, er en trappeskakt.

DRAWINGS

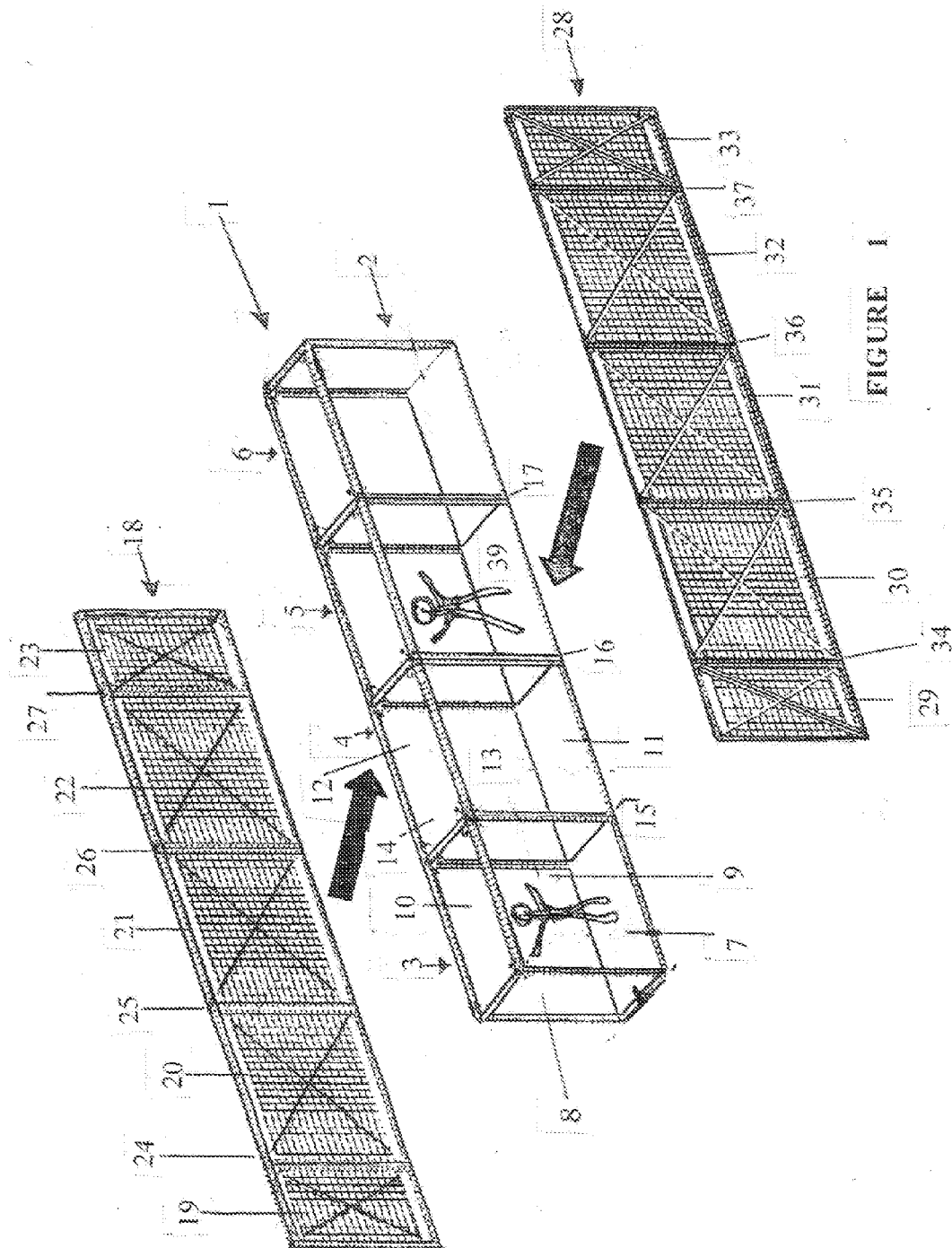


FIGURE 1

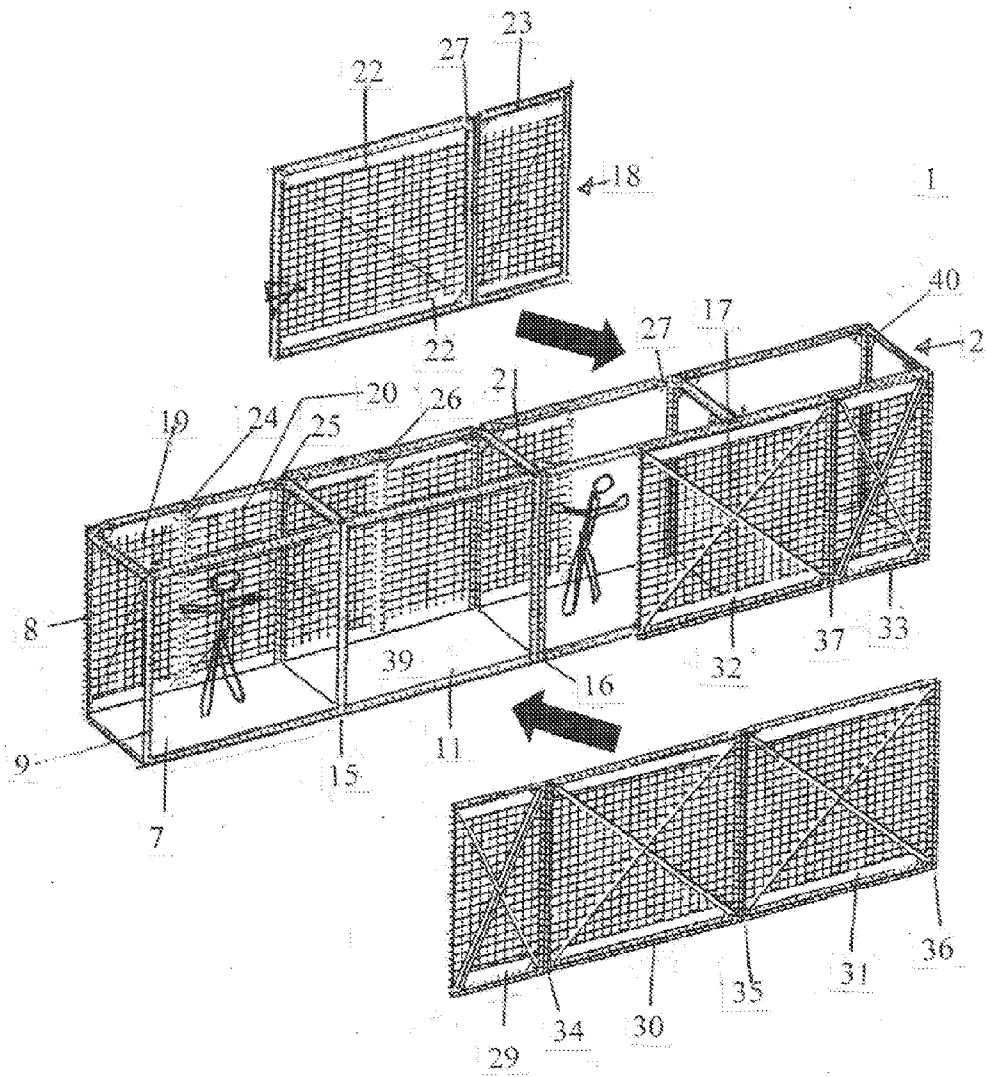


FIGURE 2

FIGURE 4

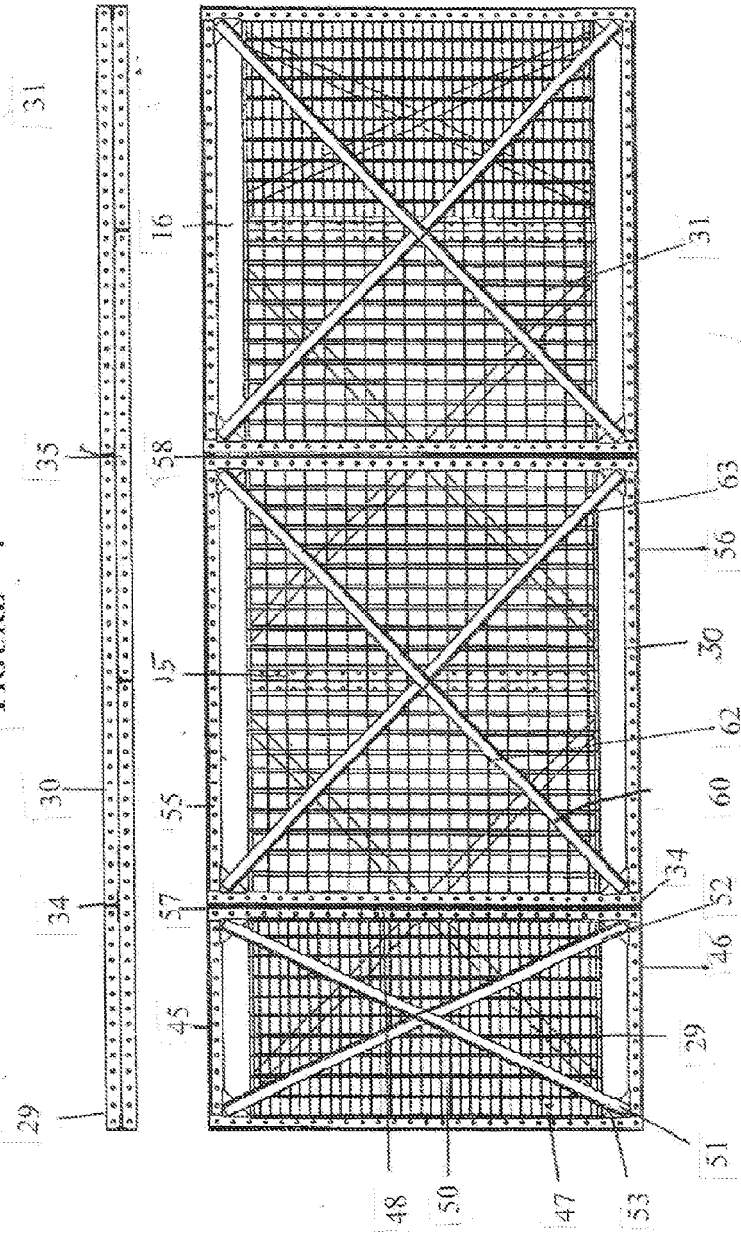


FIGURE 5

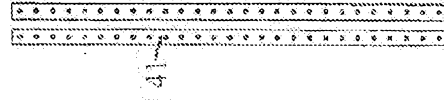


FIGURE 3

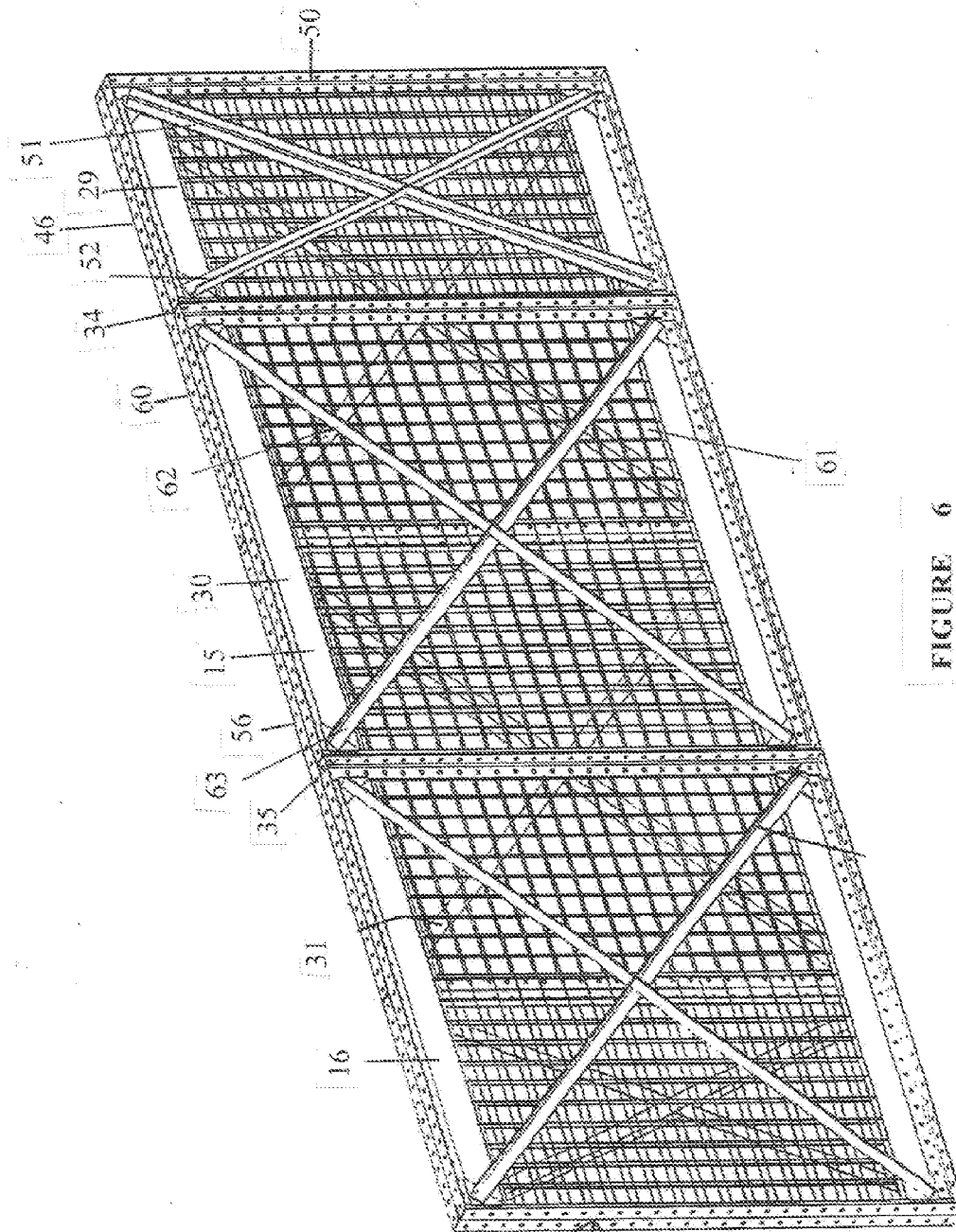


FIGURE 6

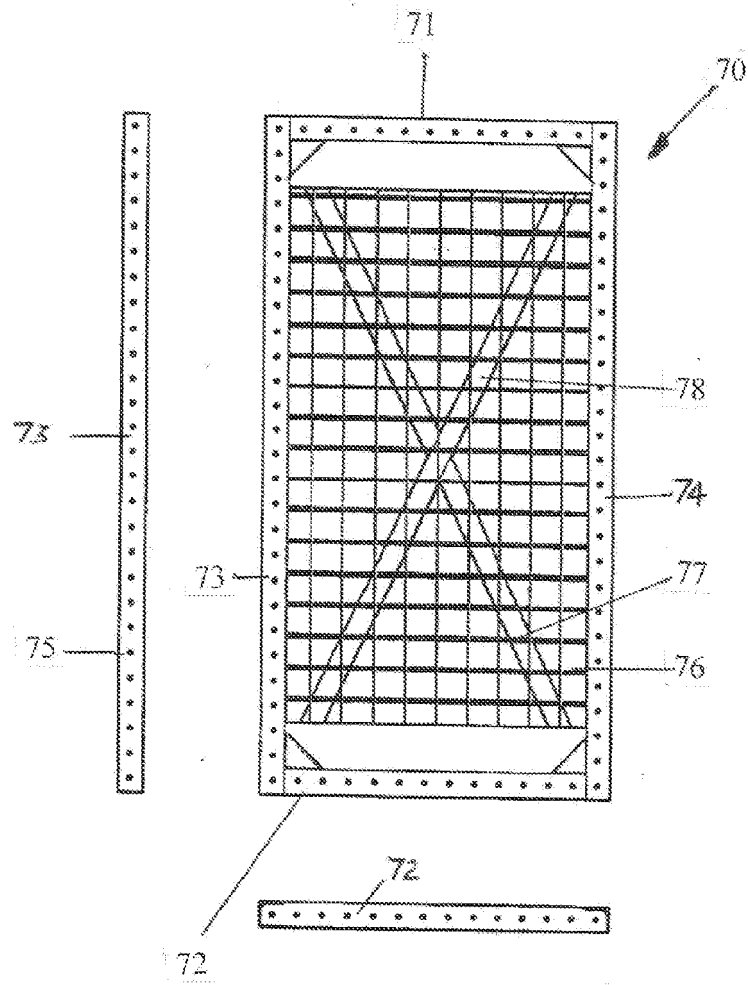


FIGURE 7

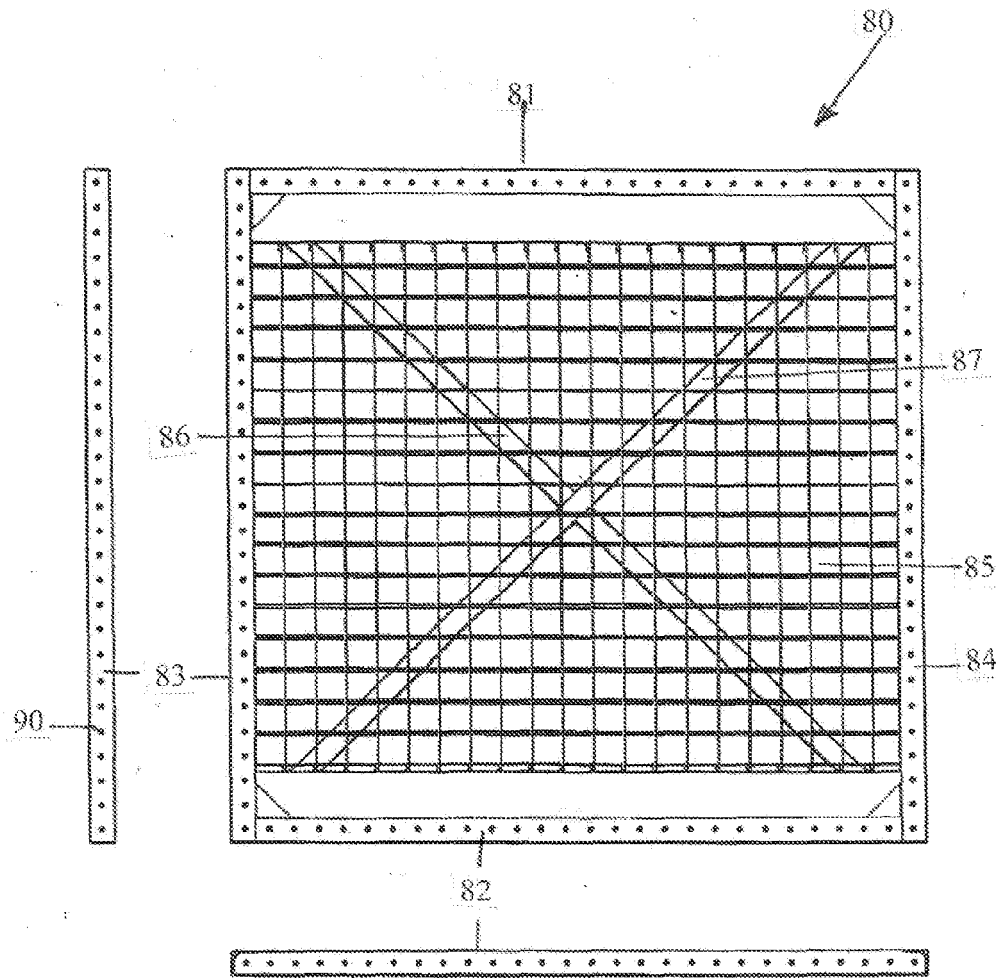


FIGURE 8

