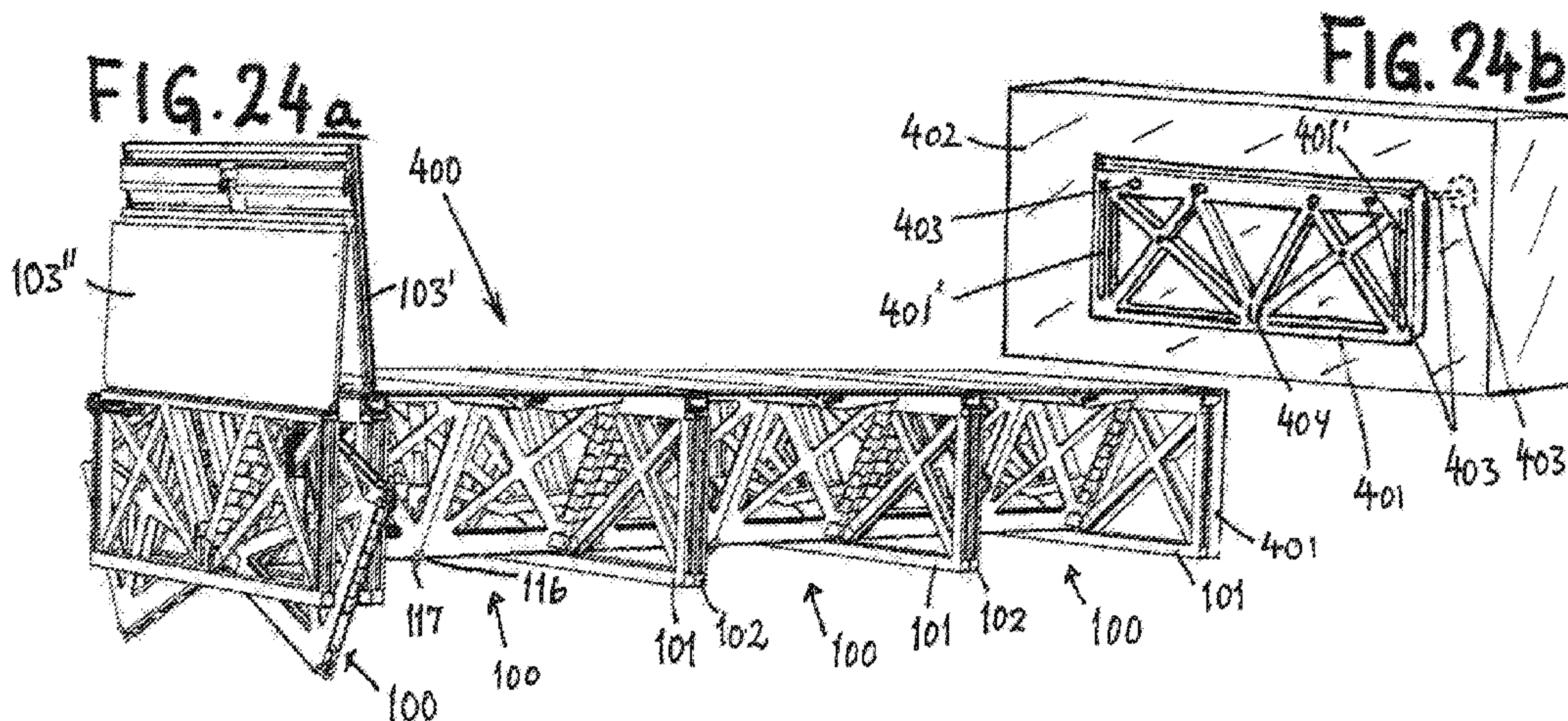




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(54) **Titre : MODULE DE STRUCTURE DE SUPPORT ET STRUCTURE DE POUTRE MODULAIRE**
(54) **Title: SUPPORT STRUCTURE MODULE AND MODULAR BEAM STRUCTURE**



(57) **Abrégé/Abstract:**

A modular beam structure (400) consisting of one or more collapsible, lockable and interconnectable support structure modules (100), and any transition module (200) to change longitudinal direction of the structure. In addition, it is possible to attach onto one or more support structure modules a collapsible platform (300) and/or wall or fence (500). The structure is at an upstream end or start end attachable, via a module end element (101), onto an attachment device (402), e.g. a wall or attachment block, via a support frame (401) which is fixedly attached to the attachment device (402).



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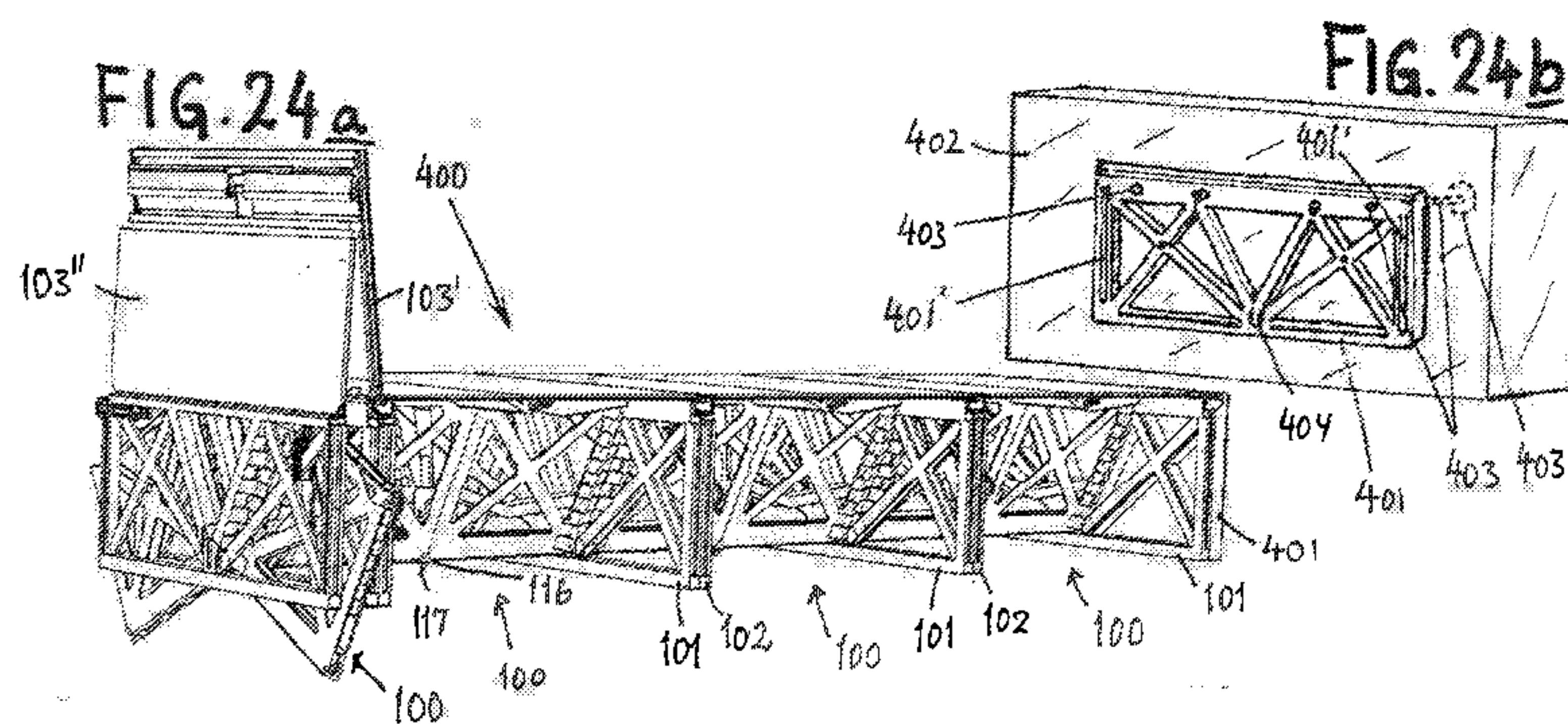
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(54) Title: SUPPORT STRUCTURE MODULE AND MODULAR BEAM STRUCTURE



(57) Abstract: A modular beam structure (400) consisting of one or more collapsible, lockable and interconnectable support structure modules (100), and any transition module (200) to change longitudinal direction of the structure. In addition, it is possible to attach onto one or more support structure modules a collapsible platform (300) and/or wall or fence (500). The structure is at an up-stream end or start end attachable, via a module end element (101), onto an attachment device (402), e.g. a wall or attachment block, via a support frame (401) which is fixedly attached to the attachment device (402).

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SUPPORT STRUCTURE MODULE AND MODULAR BEAM STRUCTURE

Background of the Invention

The present application relates to a collapsible, elongate support structure module, wherein the module is configured to form a beam or part of a modular beam structure, the module having an uppermost side element comprising a first element part and a second element part which between extreme ends of said uppermost side element are hinge connected to each other via a hinge connection, the two element parts being located in a common plane when the module is completely unfolded and stretched out, wherein the module has a) first and second upright, rigid module end elements, and b) in addition to said uppermost located side element at least two further side elements, and wherein said uppermost side element and said at least two further side elements extend between said module end elements and form mutual angle with each other, each module side element in longitudinal direction having a first extreme end and second extreme end which are hinge connected to said first and second module end elements, respectively, and each of said at least two further side elements being constituted by a first element part and a second element part which midway between said extreme ends are hinge connected to each other via a respective hinge connection to enable rotation of said first and second element parts toward or away from one another, the two element parts of each of these further side elements being located in a common plane when the module is completely unfolded and stretched-out, as indicated in the preamble of attached claims 1 and 8.

Further, as indicated in the preamble of claim 10, the invention relates to a collapsible, elongate modular beam structure comprising in its longitudinal direction, a plurality of interconnectable support structure modules which are configured as stated as in any one of claims 1 - 9.

Brief description of prior art

It is previously known collapsible, elongate structure modules intended for use as load supporting column which is exposed to vertical loading. Norwegian Patent 322174 describes such a solution.

5 Use of collapsible, elongate structure modules in modular beam structures presents, relative to use of such modules in columns, substantial challenges as regards tensional and compressive forces, and torsional forces about the longitudinal direction of the beam. The solution as shown in Norwegian Patent 322174 is not directly applicable as a lying beam structure.

10 To further elucidate prior art, it is referred to JP S532159 A, GB 1576479 A, JP 2,870,688-B, US 2010/0269446-A1, WO 2013/086422-A1, US 2006/0107611-A1, EP 0288323-B1 and US 4587777. More general background prior art is found in WO 1999/06654 A1, EP0144471 A1, FR 2898374 A1, JP H10192092 A, US 4026221 A, JP H1117558 A and JP S5443500 U.

15 Object of the invention

The present invention therefore aims at finding a solution to these challenges.

Abstract of the invention

According to the invention said module mentioned in the introduction is characterized in

- 20 – that any adjacent side elements of other two side elements abut each other and make co-operating engagement along one or a plurality of locations thereof, and
– that a releasable locking device is provided at said one location or at least at one of said plurality of locations to interlock adjacent edges of said at least two adjacent side elements of said side elements.

25

Further embodiments of the module appear from the attached sub-claims 2 – 7.

A variant of the first mentioned support structure module is in a beam structure intended to serve as a transition module to change the longitudinal direction of the structure, and this module variant is, according to the invention, wherein:

- 30 – the uppermost located side element of the module has opposite edges of its two element parts configured at said hinge connection with co-operating male and female members said hinge connection being configured as a dead centre mechanism, char-

acterized in that two side element parts of the uppermost located side element each having approximately shape of a truncated wedge face, and
 – that the at least two further side elements of the module have different lengths in unfolding direction of the module, and wherein the module end elements constitute a
 5 mutual angle which is selectable in the range 5° - 45° .

Further embodiment of this transition module appears from claim 9.

Said beam structure mentioned in the introduction is, according to the invention,
 10 characterized in that in successive pairs of the modules a second upright, rigid module end element on one module is attachable to a first, upright, rigid module end element on a neighbouring, next module of the structure by use of a male-female connection and/or bolt connection to make co-operating engagement along one or a plurality of locations of the structure, and that said releasable locking device is provided in any
 15 used module of the structure to interlock adjacent edges of said at least two adjacent side elements of said side elements of said any used module.

Further embodiments of the beam structure appear from the attached claims 11 - 13.

Brief description of the drawings

20

The invention is now to be further described with reference to the attached drawings which exhibit preferred examples of embodiments which are non-limiting to the invention.

25 Fig. 1 shows in perspective view and from above a structure module, according to the invention, in a folded state.

Fig. 2 shows the structure module in a perspective view from above, from a first side and in partly unfolded state.

30 Fig. 3 shows the structure module in perspective view from a first end and said first side, and in partly unfolded state.

Fig. 4 shows the structure module in perspective view from a second, opposite end and a second side, and in partly unfolded state.

35 Fig. 5 shows the structure module in perspective view from below, from said second end and in partly unfolded state.

Fig. 6 shows the structure module in perspective view from below, from said second side thereof, and in partly unfolded state.

Fig. 7 shows the structure module in perspective view from below, from the first end thereof and the second side, and in partly unfolded state.

5 Fig. 8 shows in plan view the structure module viewed from below, and in partly unfolded state.

Fig. 9 shows the structure module in vertical view and viewed from said second end thereof, and in partly unfolded state.

10 Fig. 10 shows the structure module viewed from the first side, and in partly unfolded state.

Fig. 11 shows the structure module in perspective view from above, from the first end and the first side, and in partly unfolded state.

Fig. 12 shows the structure module in slight perspective view from below and from said first side, and in approximately completely unfolded state.

15 Fig. 13 shows the structure module in perspective view from the second end and the second side, and in approximately completely unfolded state.

Fig. 14 shows the structure module in plan view from below, and in completely unfolded state.

20 Fig. 15 shows a modified structure module in perspective view from above, from a first end and a first side thereof, and completely unfolded, configured as a transition module which is intended to change the direction of a beam structure.

Fig. 16 shows the transition module in perspective view from above, from a second end and a second side, and in partly unfolded state.

25 Fig. 17 shows the transition module in perspective view from above, from the second end, and in partly unfolded state.

Fig. 18 shows the transition module in perspective view from below and from the first end and the first side thereof, and in completely unfolded state.

- Fig. 19 shows the transition module in perspective view from below and from the second side thereof.
- Fig. 20 shows the transition module in perspective view from below and from the first end, and in partly unfolded state.
- 5 Fig. 21 shows in perspective view and partly unfolded state a platform which is hookable onto side portions of end elements of a module or onto a module end element of an unfolded module.
- Fig. 22 shows the platform viewed in perspective from below and from one side thereof in completely unfolded state.
- 10 Fig. 23 shows the platform in perspective view from above and from said one side thereof in completely unfolded state.
- Fig. 24a shows a modular beam structure, according to the invention, in perspective view from above, one side and an end which is ready to be expanded, and
- 15 Fig. 24b shows a support frame for a beam structure, the support frame being anchored to a securing device.
- Fig. 25 shows the modular beam structure in perspective view from above, a second side and an end which is ready to be expanded.
- Fig. 26 shows the beam structure in perspective view from above, said second side and an end which is intended to be attached to an anchoring device, e.g. a wall.
- 20 Fig. 27 shows the beam structure in perspective view from below, from said one side and from an end which is ready to be expanded.
- Fig. 28 shows the beam structure in perspective view from below, from said second side, from an end which is ready to be expanded, and with an end connected to a support frame for attachment to an attachment device, e.g. a wall or a securing block, the structure being provided foot-path walls.
- 25 Fig. 29 shows the beam structure on Fig. 28 in perspective view from said second side and an end which is ready to be expanded.
- 30

Fig. 30 shows the beam structure on Fig. 28 viewed in isometric perspective view from an end having support frame installed thereon.

Fig. 31 shows the beam structure on Fig. 28 in perspective view from above, from said second side and from an end which is attached to the support frame.

Fig. 32 shows a modular, modified beam structure in perspective view from above and from one end intended for fixed installation onto an anchoring device, e.g. a wall, where a module has installed thereon a wall and a platform, and where there is included a transition module for changing the structure in longitudinal direction.

Fig. 33 shows the beam structure in perspective view from above and from the second side.

Fig. 34 shows the beam structure in perspective view from below and from the second side.

Fig. 35 shows the beam structure in perspective view from below and from the first side.

Figs. 1 - 14 show a collapsible, elongate support structure module 100, the module being configured to constitute a beam or part of a modular beam structure, as shown on Figs. 24 - 35.

The module has first and second upright, rigid module end elements 101 and 102. The module has in addition at least three side elements 103, 104 and 105 which extend between said module end elements 101, 102 and make mutual angle with each other.

In the description to follow and in the claims the module elements 101 and 102 are indicated as being upright. This implies that they may also have an orientation other than being vertical if the beam or beam structure to be formed is not horizontal. In the description to follow and in the claims there is described the use of at least three side elements 103, 104, 105, and the side element 103 is described as an uppermost side element which thereby appears as a foldable and lockable top element. The side element 103 will in use usually have a lying posture, although not necessarily horizontal posture, as the beam or beam structure can be sloping, be inclined or for certain use, be horizontal. In addition to the uppermost side element, there is addi-

tionally at least two further side elements, i.e. the side elements **104** and **105**. These side elements **104** and **105** are also foldable and preferably lockable, and will act as supportive elements. The module elements **101** and **102**, together with the side elements **103**, **104** and **105** jointly constitute co-operating structure elements in a module **100** which is included in a beam or beam structure, as will clearly appear from the detailed description and the drawings.

Each side element **103**; **104**; **105** has in longitudinal direction a first extreme end **106**; **108**; **110** and second extreme end **107**; **109**; **111**, respectively, being hinge connected to said first and second module elements **101**, **102**, respectively.

Each side element **103**; **104**; **105** is formed by a first element part **103'**; **104'**; **105'** and a second element part **103''**; **104''**; **105''** which at a location **112**; **113**; **114** midway between said extreme ends **106**; **108**; **110** and **107**; **109**; **111**, are hinge connected to each other to enable the respective first and second element parts to be pivoted toward and away from one another, as shown on drawing Figs. **1** - **14**, the two element parts **103'**; **104'**; **105'** and **103''**; **104''**; **105''** of each side element **103**; **104**; **105** being located in a common plane when the module is fully unfolded and stretched-out.

As will appear from Fig. **14**, adjacent edges of the side elements **104**; **105** abut or form co-active engagement along one or more locations **115** thereof. The location **115** will serve for engagement with a releasable locking device, preferably configured as a locking peg **116** at said one or more locations **115** to interlock adjacent edges of said at least two adjacent side elements **104**; **105**.

From Figs. **12** and **13**, and from e.g. Figs. **27**, **32** and **33** it will appear that the uppermost one **103** of said at least three side elements **103** - **105** with its extreme ends **106** and **107** makes hinge connection to a respective end element **101**; **102** and has an upper surface level with an upper edge face of said respective end element **101**; **102**. Correspondingly, the side elements **104** and **105** have said extreme ends **108**, **109** and **110**, **111** which form respective hinge connection with the module end elements **101**, **102**.

The module end elements **101**; **102** are on upright side faces in the unfolding direction of the module and transversely of the unfolding direction provided with engagement elements **101'**; **101''**; **102'** configured for engagement with co-acting engagement elements on:

a) a corresponding module **100** which is arranged to extend in longitudinal direction of a beam structure or laterally, transverse of longitudinal direction of the structure, or

b) a transition module **200** which is insertable into a beam structure **400** and configured to change direction of length extent of the structure **400**, or

c) a platform **300** which is configured to extend out from one end of the beam structure **400** or transverse of longitudinal direction of the structure, or

d) posts for railing or fence **500** for placing along one or more modules in longitudinal direction of the beam structure.

10

The uppermost located side element **103** of the module **100** has said midway located hinge connection **112** preferably configured as a dead centre mechanism, and where the opposite edges of the side elements **103'**; **103''** at the hinge connection are configured with co-operative male and female members **112'**; **112''**.

15 It will be observed that the hinge connection **112** has a hinge leaf **112'''** which is mounted in an extension of the part **103''** and to an underside of the part **103'**, respectively. It will be appreciated that when these male/female members **112'**; **112''** engage, they will strengthen the hinge connection **112** and prevent the parts **103'**; **103''** to move apart when a beam structure **400** in which the module **100** is included,
20 is bent downwards.

In the shown solution there is created a "dead centre mechanism" and force will be required, e.g. from a tool, to pass the hinge over the dead centre for possible folding together of the module. This is due to that a first pivot point **124** on the hinge (see Fig. **10**), when the parts **103'** and **103''** are in the same plane, will be located closer
25 to the underside of the part **103'** than the distance of the second pivot point **124'** of the hinge **112** from the underside of the part **103'**.

There is on the underside of the two parts **103'**; **103''** associated with the uppermost located side element **103** arranged downward protruding engagement pieces **117** configured for engagement with at least one side face portion of respective adjacent
30 part **104'**; **104''** and **105'**; **105''** of adjacent lower side element **104**; **105**, located on the underside of the uppermost located side element **103**. This engagement will cause that upper portion of the side elements **104**; **105** is not bent laterally outwards when exposed to loading or downward bending of a support beam structure **400**.

The releasable locking device is, as mentioned, preferably configured as a locking peg
35 **116**. As shown on e.g. Figs. **3**, **4**, **6**, **7**, **10** and **13** it is articulated via a link **118** with

said midway hinge connection 112 between uppermost located side element parts 103'; 103" and with one of the module end elements 101 via a link 119.

The locking peg 116 is configured for co-operative engagement with respective locking ear 115'; 115" arranged at a lower edge on the midway located hinge connection 113; 114 between the hinged parts 104'; 104"; 105'; 105" of the two lower side elements 104; 105, respectively. Simultaneously with the parts 103'; 103" at their opposite ends being brought into engagement with each other, the lower edges of the side elements 104; 105 are brought into engagement and contact with each other, yielding that the locking ears 115'; 115" are lying one above the other and being co-axial, whereby the locking peg 116 can enter into controlled engagement with these locking ears, to prevent mutual movement of the side elements 104; 105 during loading of a beam structure 400 in which the module is present. The simultaneous engagement of the side elements 104; 105 with the engagement pieces 117 contribute to structural stability of the module 100 in stretched-out, locked state.

The locking peg 116 will thus yield that the module 100 cannot collapse as long as it is in engagement with the ears 115', 115". The peg 116 does not enter into engagement with the ears 115', 115" without the side elements 104, 105 being in contact with each other at lower edges thereof, and that the upper side element 103 simultaneously assumes a completely flat, single-plane posture. The advantage this locking methodology is that there is not required any particular tool in order to carry out the locking. The links 118, 119 safeguards that the locking peg does not move out of its position.

It will be seen from Figs. 1 - 14 that a cross-section of the side elements assembly consisting of the side elements 103 - 105 or a cross-section of an area of a side element 103 together with remaining side elements 104; 105 of the side elements assembly in fully stretched-out state of the module 100 has a polygonal shape which in the shown embodiment is triangular, but may be squared or rectangular, dependent on number of used side elements. Currently, a preferred embodiment consist of three side elements 103; 104; 105.

When it is desired to build a beam structure using interconnected modules 100 there may arise need for one or more changes in direction of the extent of the beam in longitudinal direction. For this purpose it is proposed to provide a transition module 200, configured as a collapsible, elongate support structure module as show on Figs. 15 -

20, the module proper capable of forming a beam, but in the discussion of the beam structure 400 shown on Figs. 32 and 33 forming part of a modular beam structure.

The transition module 200 has first and second upright, rigid module end elements 201; 202, and at least three side elements 203; 204; 205 which extend between
 5 said module end elements and form mutual angle with each other. Each side element 203; 204; 205 has in longitudinal direction a first extreme end 206; 208; 210 and a second extreme end 207; 209; 211 being hinge connected thereat to said first and second module end elements 201; 202, respectively. Each side element 203; 204; 205 is constituted by a first element part 203'; 204'; 205' and a second element part
 10 203"; 204"; 205" which at a respective location midway between said extreme ends 206; 208; 210 and 207; 209; 211 are hinge connected to each other and thereat form a respective hinge connection 212; 213; 214 to enable the first and second element parts to be pivoted toward or away from one another, as shown on Figs. 15 -
 20, the two element parts 203', 203"; 204', 204"; and 205', 205" of each side element 203; 204; 205 being located in a respective common plane when the module
 15 is completely unfolded and stretched-out.

In the description to follow and in the claims the module elements 201 and 202 are indicated as being upright. This implies that they also may exhibit a different orientation than being vertical if the beam or beam structure to be formed is not horizontal.
 20 In the description to follow and in the claims, the side element 203 is recited as an uppermost side element of the at least three side elements 203, 204 and 205. The side element 203 thereby appears as a top element. As will be described, it is foldable and lockable. The side element 203 will usually have a lying posture when used, although not necessarily horizontal posture, as the beam or the beam structure in which
 25 the transition module 200 is included can be sloping, be inclined or, for certain use, be horizontal. In addition to the uppermost side element there are at least two further side elements, i.e. the side elements 204 and 205. These side elements 204 and 205 are also foldable and preferably lockable, and will function as supportive elements. The module elements 201 and 202, together with the side elements 203, 204 and
 30 205 jointly constitute co-operating structure elements of the module 200 which is included in a beam or beam structure, as will clearly appear from the detailed description and drawings.

The uppermost located side element 203 of the module has said midway located hinge connection 212 preferably configured as a dead centre mechanism, wherein
 35 opposite edges of the parts at the hinge connection are configured with co-operable

male and female members **212'**; **212''**, and wherein the two side element parts **203'**; **203''** have approximately truncated wedge face shape.

If the hinge connection **212** is configured as a dead centre mechanism, it may preferably be of same type as shown and described for the module **100**. In order to prevent that the transition module **200** unintentionally becomes unlocked, it is similar to that for the module **100** possible on the underside of the parts **203'** and **203''** to arrange respective engagement pieces or studs **215** (see Fig. 16) and **216** (see Fig. 17) which prevent the side elements **204** and **205** from turning inwards when the side element **203** with its parts **203'**, **203''** is in a flat, closed posture as shown on Fig. 15.

In order to obtain intended angled transition, i.e. a change of direction of the beam structure **400**, then the other two side elements **204**; **205** must have unequal lengths in the unfolding direction of the module **200**. Dependent on the mutual length dimension of the side elements, the module end elements **201**; **202** may thereby be able to form a mutual angle which is e.g. selectable in the range 5° - 45° .

This possible angular range is not in any way to be conceived as limiting to aspects of the transition module **200**, as the range can be smaller or larger, or have another lower and/or upper angle value.

The modules **100** and **200** have in the shown embodiment module end elements which each have a rectangular or squared configuration. It is also possible to imagine that they could have triangular configuration, but that may complicate solutions in which a beam structure has a need for laterally extending elements. Rectangular or squared configuration are the currently preferred solutions.

By using the shown module solutions, there is obtained structurally torsion stable and strong modules. When exposed to heavy loads or where a modular beam has substantial length, i.e. consisting of a plurality of interconnected modules, it may be required to provide for suspension points, and for this purpose each module can be provided with a pair of suspension brackets **120**. This is in particular of interest if there is present a roof or the like (not shown) above the structure **400** where such suspension points (not shown) are possible to arrange or where it is possible between mounting locations to attach one or two wires or chains (not shown) which the brackets can be connected to via adjustable stays, wires or chains. The brackets **120** will normally hang downwards, but may upon demand be swung 90° so that they become horizontal and the bracket suspension ear **120'** protrudes outside the side of the module. If there is a stable area below the structure, e.g. a floor, a stable terrain or the like, it

will be possible to arrange supporting devices, e.g. posts, which engage a plurality of module end elements.

The module end elements **101**; **102** have, as mentioned, on upright side faces in the unfolding direction of the engagement elements **101"**; **102'** and transverse of the unfolding direction, engagement elements **101'**; **102'** which are configured for engagement with co-operating engagement elements on adjacent module or a platform. More specifically, on the side faces which face in the unfolding direction, the engagement elements **101"** preferably have a male wedge configuration, whereas the engagement elements **102'** preferably have female wedge track configuration, and the engagement elements **101'**; **102'** on the side faces facing in the transverse direction of the module preferably have female wedge track configuration. In the case that some modules are to be easily releasable from each other, it may preferable to let the female wedge tracks **101'**; **102'** in the bottom have an abutment for a lower end of the elements **101"**, to avoid a materials setting which renders such releasing difficult. An alternative to this may possibly be to let the female wedge tracks have an anti-friction means added thereto, possibly in fluid form before joining with other modules. The engagement elements **101'**; **101"**; **102'** can advantageously have dovetail shaped cross-section, although other cross-sections may be envisaged.

Although not shown on the drawings, it is of course possible to provide extra securing between interconnected modules by using bolt connections or setscrews.

On Fig. **10** it will be noted that the side element part **103'** at the end which is closest to the module end element **101** has an upward facing hook shaped edge **121**, and that the side element part **103"** at the end which is closest to the module end element **102** has a downward facing hook shaped edge **122**. This safeguards that when the parts **103'** and **103"** lie in the same plane, i.e. that the module **100** is fully stretched-out and locked, then these edges **121** and **122** engage each other. This engagement is essential for the rigidity of a beam structure **400**, as the hook shaped edges **121**, **122** thereon are used for engagement with a neighbouring edge **122** on an upstream located module and engagement with a neighbouring edge **121** on a downstream located module. By upstream and downstream is in this context or other places in the description conceived that upstream refers to module which is start module or module which is closer to the start module in the created beam structure, and correspondingly that downstream is related to a module which is present in the beam structure after the start module or after currently described module in the beam structure.

The longitudinal edges of the side elements **103'** and **103"** can on the underside of a module **100** in longitudinal direction of a beam structure **400** have downward facing hooks **123, 123'** (see Figs. 6, 10, 12 and 14) to create engagement with e.g. an edge **121** on another module which is to be installed laterally relative to longitudinal direction of the structure **400**.

A platform **300** which functions either as a side extender or an end extender associated with a specific module or in conjunction with a beam structure **400** is shown on Figs. 21 - 23. Such a platform **300** may be useful where there is a demand for a larger surface of fuse at some locations along a structure **400**, but where it will be unnecessary or impractical to attach a complete module. The platform has a start frame **301** which is compatible with configuration of a module, so that engagement elements **302, 303** having male-configuration can make engagement with female engagement elements **101', 102'** on longitudinal side of a module, or female engagement elements **102', 102'** on transverse end of a module **100**. The platform has two inclined stays **304, 304'** which support the platform floor **305**. The floor **305** makes connection with the frame **301** via a hinge **306**. The platform **300** can be tilted to an upright posture such that the stays and the floor stand parallel for easier displacement of the platform to a required location of installation, or from a location of installation and to another one when required. It will be observed that the edge of the floor **305** which is closest to the frame **301**, and the hinge **306** have a configuration like an upward facing hook **307**, in order that this hook will make engagement with the hooks **123, 123'** when the floor is in plane with the module side element **103**.

On Figs. 1, 3, 6, 7, 10 and 11 there is shown an engagement peg **125** which is intended to make engagement with an engagement slot **126** as shown on Figs. 4, 5, 9 and 13. Engagement between the peg **125** and the slot **126** safeguards that the module end elements **101, 102** which are interconnected, obtain an additional anchoring to each other in addition to the co-operation between the engagement elements **101"; 102'**. In addition, it is also limited to a certain extent how far down the male engagement element **101"** can extend down into the female engagement element **102'**.

The modules **100** have normally a low weight and will thereby be light and simple to handle, in such a way that they can be installed by one person, possibly by two persons. Because the modules can efficiently be interconnected, in addition to having a

framework configuration, there is thus obtained excellent structural rigidity, not only against downward bending forces, but also against torsional forces.

Each module can typically have, seen from above, a dimension equal to 1 x 1 meter, although neither quadratic configuration or dimensions must be conceived as a limitation for the use of the invention. Other configurations and dimensions are of course imaginable.

The hook shaped edges 121, 122 of the uppermost side element 103 engage into respective corresponding ends of uppermost adjacent side elements of modules 100, and these hook shaped edges 121, 122, together with the side element parts 103', 103'' and interconnection hinge 112 will in those cases where the module 100 or the beam structure 400 is only mounted at one end, themselves thereby pick up tension forces on the top face of the module 100 or the modular beam structure 400.

It will be observed inter alia on Fig. 8 that the lowermost edge of the side elements 104; 105 are provided with pegs 127; 127' engaging into voids 128; 129, respectively, on adjacent side element 105; 104. This contributes also to an improved structural stability, as it is with application of force on the structure thereby prevented mutual sliding of the side elements 104, 105 and thereby extra stress on the connection between the locking peg 116 and the locking ears 115', 115''.

By letting the module end elements 101, 102 having a framework configuration, as shown, there is obtained elements 101, 102 which are satisfactorily braced.

It is possible to imagine that for a structure 400, where it is not required to have laterally attached modules or platforms or railing, use of module end elements 101, 102 may be dropped in order to reduce weight and volume. This will then demand some changed way of interconnection of modules, and will also for some embodiments yield reduced rigidity of such a structure relative to using module end elements as shown and described.

The collapsible, elongate, modular beam structure 400 is now to be further described with primary reference to Figs. 24a - 27, secondly with reference to Figs. 28 - 31, and further in an additional modification with reference to Figs. 32 - 35.

As it appears primarily from Figs. 24a - 27 it is there, only as example, shown a beam structure 400 which consists of three interconnected modules 100, and an additional

attached, but not yet unfolded and locked module **100**. Interconnection has been made as explained in connection with functionalities of the module **100**. Thus, the beam structure comprises an arrangement in longitudinal direction of interconnectable support structure modules **100** configured as previously described.

5 The interconnection is made by having a second upright, rigid module end element **102** on one module **100** attached to a first upright, rigid module element **101** on an adjacent, next module **100** in the arrangement by use of male-female connection and/or bolt connection. Bolt connection is normally not required, but may be made available due to possible extra security considerations or due to other reasons.

10 In order to render possible suspension of such a beam structure onto an attachment device **402**, e.g. a vertical or inclined wall or satisfactory anchored support block, there is provided a support frame **401** having a pair of female engagement elements **401'**, such as e.g. wedge shaped tracks, intended to receiving wedge shaped male engagement elements **101"** on the module end element **101** which becomes adjacent
15 the location of suspension or the attachment device **402**, i.e. for example the wall or the support block. The support frame **401** is attached to the suspension location by means of e.g. a plurality of bolts **403** which are satisfactorily anchored, e.g. with cast-in or attached anchors **403'**.

It will be noted that the support frame **401** has an engagement track **404** which is
20 intended to co-operate with the engagement peg **125** (see Figs.1, 3, 6, 7, 10, 11 and 12) which is on the module end element **101** which is the one most adjacent to the support frame **401**.

As it clearly appears from Figs. 25 - 27, the uppermost **103** of the side elements of the respective modules **100** in the beam structure **400** will have a surface which can
25 be configured so that it e.g. can support a movable vehicle or support human beings or animals which are present on the upward facing surface of the two element parts **103'**, **103"** of the side element **103**. In order to safeguard that neither human beings, nor animals, nor vehicles skid on the surface, the surface can exhibit friction coating, ribs in a grid net, or other suitable anti-skid means.

30 By letting the structure **400** at one end thereof (upstream end) be attached in the manner shown to an attachment device **402**, e.g. attachment block or wall, via a module end element **101** being attached to the support frame **401**, the structure **400** will constitute a cantilevered beam.

It is also possible to envisage that the beam structure also at an opposite end (down-stream end) is attached to an upright attachment device, e.g. an attachment block or a wall, via a module end element. In such a case it must be certain that the outermost end of the support structure obtains a stable attachment, and in this case there may
5 be a need for a transition frame (not shown) with male engagement elements on both sides thereof, partly for engagement with female engagement elements 102' on a module element 102 of an outermost module 100 and female engagement elements 401' on a support frame 401. In addition there may be a need for additional securing by use of bolts or setscrews. It is also possible to imagine at a respective end of the
10 beam structure 400 to let a module end element 101, 102, respectively, rest thereat and be in engagement with a fixed foundation (not shown). It is also possible to imagine that the beam structure 400 can be attached to an upright attachment device at one end via a module end element (e.g. 101) thereat and at another end via module end element (e.g. 102) resting on and engaging a fixed foundation.

15 Although there is in the figures indicated that the beam structure in stretched-out posture is substantially parallel with a horizontal plane, it should be appreciated that the beam structure in stretched-out posture alternatively could be arranged at an angle to the horizontal plane.

Figs. 28 - 31 illustrate how a structure 400 as shown on Figs. 24a - 27 can be provided with side walls 500 and which through use of male engagement elements (not
20 visible on the figures) on wall post 501 can be hooked into engagement with female engagement elements 101', 102' on the laterally outward facing sides on the module end elements 101, 102. The posts 501 are suitably divided in two in post parts 501', 501". The wall panels can e.g. consist of complete plates 502 or plate parts, possibly
25 netting or expanded metal. The post parts 501', 501" and the wall 502 which is related to the individual module 100 is suitably uppermost connected to a stay 503 and lowermost correspondingly connected to a stay 504. Stays 505 between the post parts may also be arranged on the rear side of the wall.

The post parts, the wall and the stays will together contribute to increased structural
30 rigidity and extra securing against the individual module, upon unintentional incorrect loading, steps out of self-locking (inter alia the engagement parts 115, 116).

In addition, the railing or the fence will yield traffic or staying on the surface of the structure 400 to become safe and that there is prevented falling of any loose objects, e.g. tools or other equipment. Such railings can also function as connection locations
35 for safety line for persons who are on the top face of the structure.

There is on Figs. 32 - 35 shown a modified beam structure in which at least at one transition location between two modules in the structure 400, there is installed, in longitudinal direction of the structure, an angled transition module 200 of a type as shown and explained in connection with Figs. 15 - 20, whereby a change of the longitudinal direction of the structure is enabled.

It is also seen from Figs. 32 - 35 that the structure 400 can be extended transverse of its longitudinal direction by hooking onto side portions of a module 100, i.e. in longitudinal direction of the structure, the collapsible platform 300. As indicated above, it is also possible to let the structure be extended laterally by at least one module 100 which is attached to longitudinally extending side of a module 100 arranged in longitudinal direction of the structure.

The uppermost of the side elements 103', 103"; 203', 203" on the respective modules 100; 200 in the beam structure can be configured to support devices which conduct fluid and/or electricity. However, this is not shown on the drawing figures.

Although the transition module is shown for making an angle in longitudinal direction of the beam structure, it is also in certain cases possible to imagine that the transition module is configured without angle between the module end elements 201; 202. It will, however, be observed that the transition module 200 does not exhibit the same locking possibilities as for the module 100, i.e. locking peg 116 in co-operation with locking ears 115', 115". When using such a transition module 200 it may therefore be important to cause that it is supported or has suspension (like e.g. suspension 120), possibly that neighbouring modules have such support or such suspension, in order that there cannot by accident occur an unexpected collapse of the transition module, even though the engagement pieces or pegs 215; 216 and the dead centre mechanism 212 normally will prevent that this will occur.

Although the beam structure 400 as an outset is considered to be a cantilevered beam, a beam which is supported or suspended at one or more locations along its length, and where the beam can form base for a place to stay or a path for movement, it is also possible to imagine that the beam structure can e.g. be used as support beam for a roof structure. In reality, the fields of use are numerous both for the modules and the beam structure, and accessories like platform and/or fence/railing. An expert in the art will therefore easily find other fields of use than those indicated here.

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P a t e n t c l a i m s

1. A collapsible, elongate support structure module (100), wherein the module (100) is configured to form a beam (400) or part of a modular beam structure (400), the module (100) having an uppermost side element (103) comprising a first element part (103') and a second element part (103'') which between extreme ends of said uppermost side element (103) are hinge connected to each other via a hinge connection (112), the two element parts (103', 103'') being located in a common plane when the module (100) is completely unfolded and stretched-out,

wherein the module has:

- a) first and second upright, rigid module end elements (101; 102), and
- b) in addition to said uppermost located side element (103) at least two further side elements (104; 105), and
- wherein said uppermost side element (103) and said at least two further side elements (104; 105) extend between said module end elements (101; 102) and form mutual angle with each other, each module side element (103; 104; 105) in longitudinal direction having a first extreme end and second extreme end which are hinge connected to said first and second module end elements (101; 102), respectively, and each of said at least two further side elements (104; 105) being constituted by a first element part (104'; 105') and a second element part (104''; 105'') which between said extreme ends are hinge connected to each other via a respective hinge connection (113; 114) to enable rotation of said first and second element parts (103'; 103'') toward or away from one another, the two element parts (104', 104''; 105', 105'') of each of these further side elements (104; 105) being located in a common plane when the module is completely unfolded and stretched-out, characterized in
 - that any adjacent side elements (103, 104; 103, 105; 104, 105) of other two side elements (103; 104; 105) abut each other and make co-operating engagement (115', 115'', 116; 104, 117; 105, 117) along one or a plurality of locations thereof, and
 - that a releasable locking device (115, 116) is provided at said one location or at least at one of said plurality of locations to interlock adjacent edges of said at least two adjacent side elements (103, 104; 103, 105; 104, 105) of said side elements (103; 104; 105).

2. The module (100) according to claim 1, wherein the uppermost (103) of said at least three side elements (103; 104; 105) at its hinge connections (106; 107) to a respective end element (101; 102) has an upper surface being level with an upper edge face of said respective end element (101; 102).
3. The module (100) according to claim 1 or 2, wherein the module end elements (101; 102) on upright side faces in the unfolding direction of the module (100) and transversely of the unfolding direction have engagement elements (101'; 101"; 102') configured for engagement with co-operating engagement elements on:
 - a) a corresponding module (100) which is arranged to extend in longitudinal direction of a beam structure or laterally, transverse of longitudinal direction of the structure, or
 - b) a transition module (200) which is insertable in a beam structure (400) and configured to change direction of length extent of the structure (400), or
 - c) a platform (300) which configured to extend out from one end of the beam structure (400) or transverse of longitudinal direction of the structure, or
 - d) posts of railing or fence (500) for placing along one or more modules in longitudinal direction of the beam structure (400).
4. The module (100) according to any one of claims 1 - 3, wherein the uppermost located side element (103) of the module (100) has said hinge connection (112) located midway configured as a dead centre mechanism, and wherein opposite edges of said first and second element parts (103', 103") of this uppermost side element at the hinge connection (112), is configured with co-operating male and female members (112'; 112").
5. The module (100) according to any one of claims 1 - 4, wherein on the underside of the two element parts (103', 103") associated with the uppermost located side element (103) there is arranged downward protruding engagement pieces (117) configured for engagement with at least one side face portion of respective adjacent element part (104', 104"; 105', 105") of neighbouring lower located side element (104; 105) on the underside of the uppermost side element (103).
6. The module (100) according to any one of claims 1 - 5, wherein said releasable locking device is a locking peg (116) which is hinge connected (118, 119) to said midway hinge connection (112) between the uppermost located side element parts (103', 103") and with one (101) of the module end elements

(101; 102), and wherein the locking peg (116) is configured for co-operating engagement with respective locking ear (115', 115'') arranged at a lower edge on the midway located hinge connection (113; 114) between respective element parts (104', 104''; 105', 105''), hinged together, of the two lower side elements (104; 105).

7. The module (100) according to claims 1 - 6, wherein either a cross-section of the side elements assembly or a cross-section of a part of a side element together with remaining part of the side element assembly in fully stretched-out state of the module, has polygonal configuration which is triangular, squared or rectangular.
8. A collapsible, elongate support structure module (200), wherein the module is configured to form a part of a modular beam (400), and wherein the module (200) has an uppermost side element (203) comprising a first element part (203') and a second element part (203'') which between extreme ends of said uppermost side element (203) are hinge connected to each other via a hinge connection (212), the two element parts (203', 203'') being located in a common plane when the module (200) is completely unfolded and stretched-out, and wherein the module (200) has:
 - a) first and second upright, rigid module end element (201; 202), and
 - b) in addition to said uppermost located side element (203) at least two further side elements (204; 205) which extend between said module end elements (201; 202) and form mutual angle with each other, each module side element (203; 204; 205) in longitudinal direction having a first extreme end (206; 208; 210) and second extreme end (207; 209; 211) which are hinge connected thereat to said first and second module end elements (201; 202), respectively, and each of said at least two further side elements (204; 205) being constituted by a first element part (204'; 205') and a second element part (204''; 205'') which between said extreme ends (208; 210 and 209; 211) of these further side elements (204; 205) are hinge connected to each other via a respective hinge connection (213; 214) to enable rotation of said first and second element parts (203', 203'') toward or away from one another, the two element parts (204', 204''; 205', 205'') of each of said at least two further side elements (204; 205) are located in a common plane when the module (200) is completely unfolded and stretched-out, wherein
 - the uppermost located side element (203) of the module (200) has opposite edges of its two element parts (203', 203'') configured at said hinge

connection (212) with co-operative male and female members (212'; 212"),
 said hinge connection (212) being configured as a dead centre mechanism,
characterized in that two side element parts (203'; 203") of the uppermost
 located side element (203) each having approximately shape of a truncated
 wedge face, and

– that the at least two further side elements (204; 205) of the module (200)
 have different lengths in unfolding direction of the module (200) and wherein
 the module end elements (201; 202) constitute a mutual angle which is se-
 lectable in the range 5° - 45°.

9. The module (100; 200) according to any one of claims 1 - 8, wherein the
 module end elements (101; 102; 201; 202) each have a rectangular, triangu-
 lar or squared configuration.

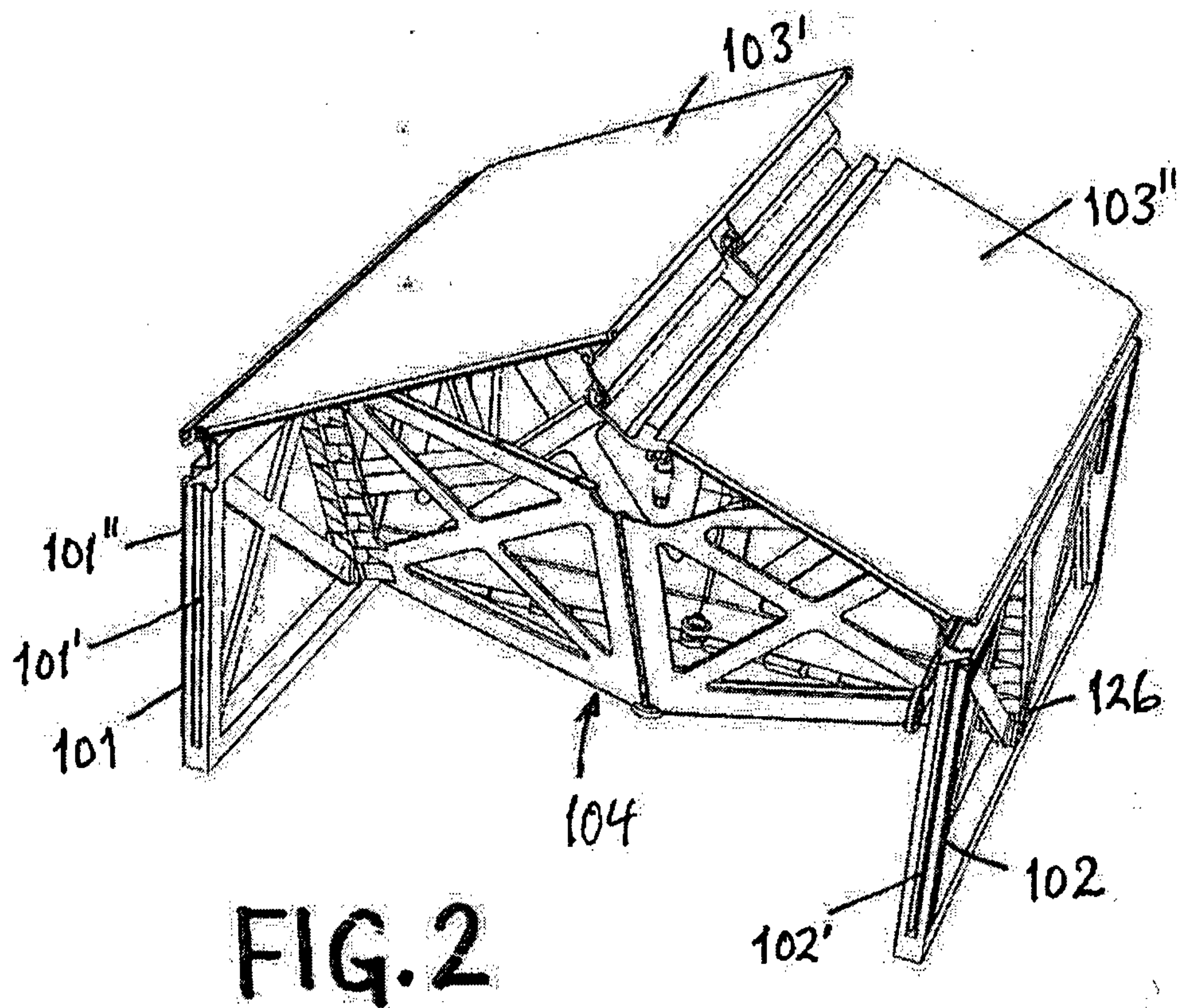
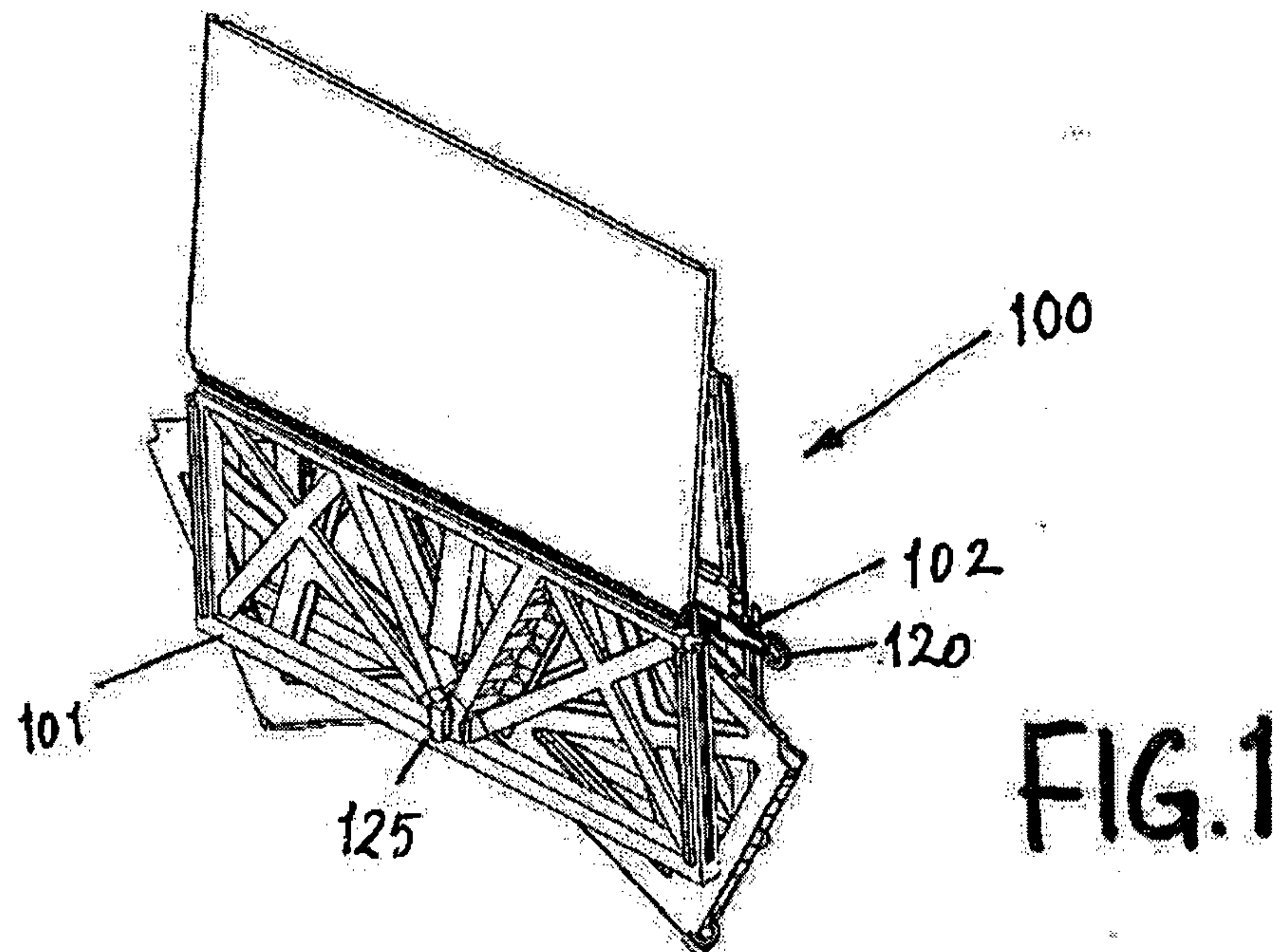
10. A collapsible, elongate modular beam structure (400), comprising in its longi-
 tudinal direction a plurality of interconnectable support structure modules
 (100; 200) which are configured as stated in any one of claims 1 - 7 or op-
 tionally together with claims 8-9, **characterized in** that in successive pairs of
 the modules a second upright, rigid module end element (102; 202) on one
 module is attachable to a first, upright, rigid module end element (101; 201)
 on a neighbouring, next module (100; 200) of the structure (400) by use of a
 male-female connection and/or bolt connection to make co-operating engage-
 ment along one or a plurality of locations of the structure (400), and that said
 releasable locking device (115, 116) is provided in any used module (100) of
 the structure (400) to interlock adjacent edges of said at least two side ele-
 ments (103, 104; 103, 105; 104, 105) of said side elements (103; 104;
 105) of said any used module (100).

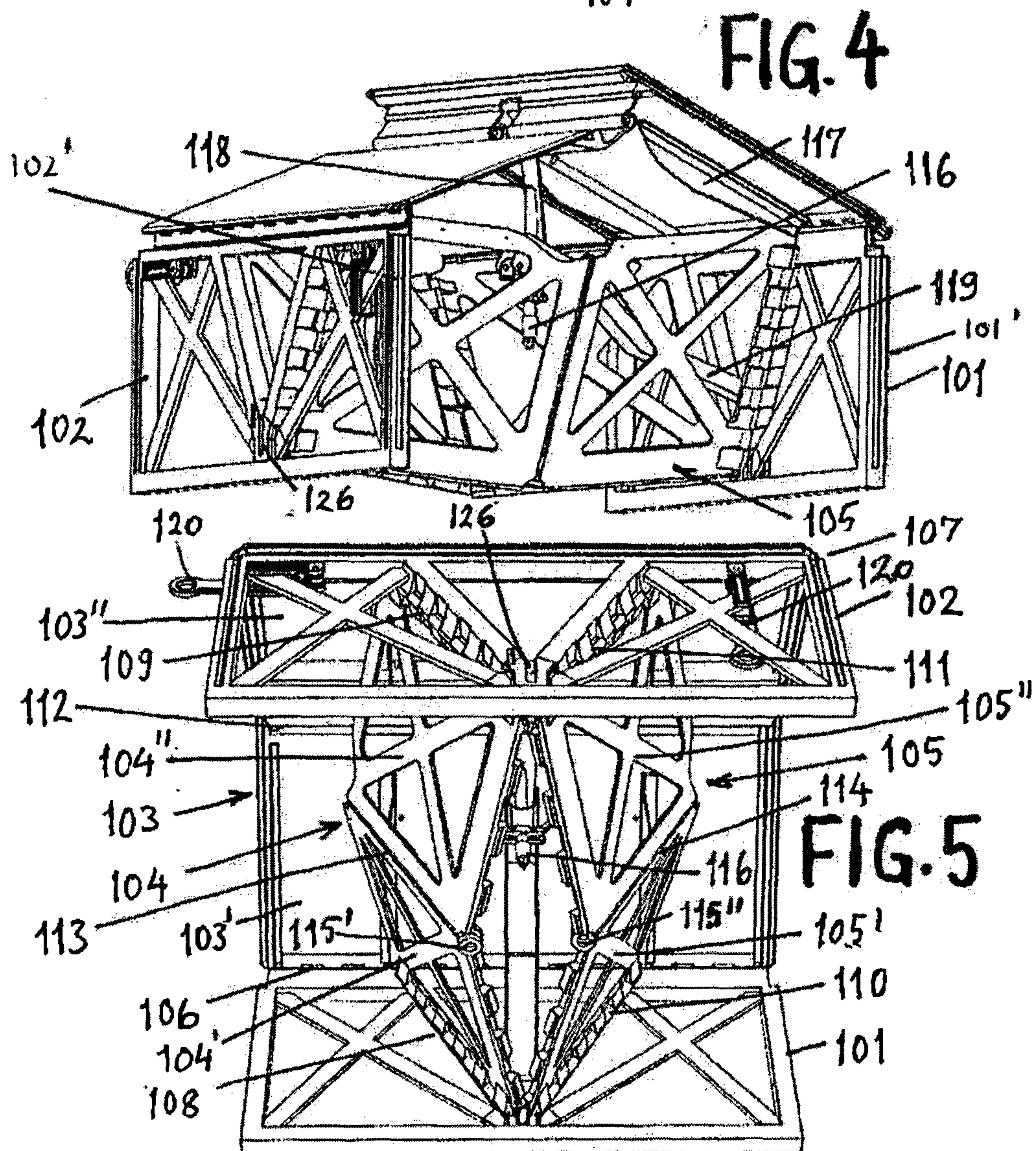
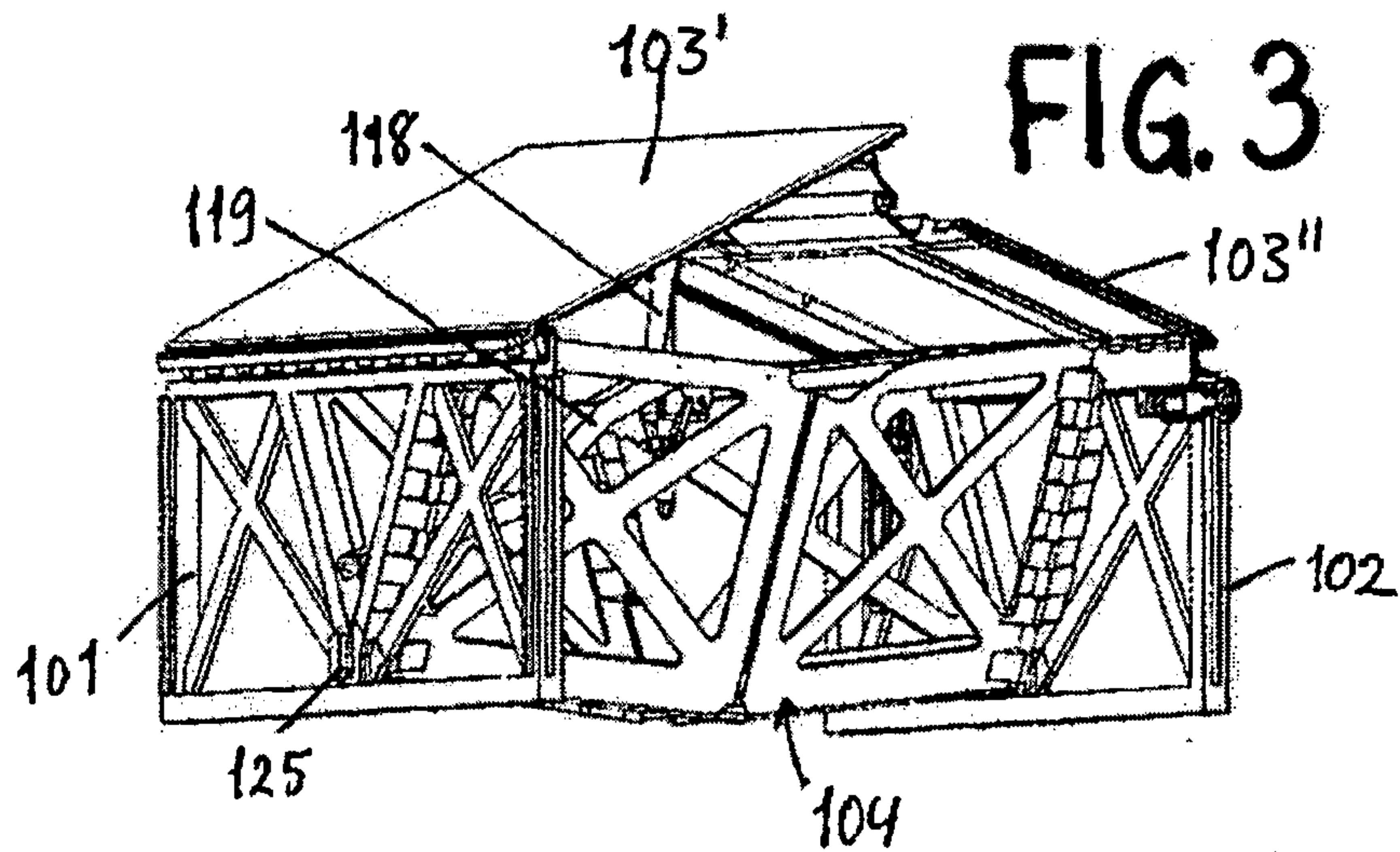
11. The beam structure (400) according to claim 10, wherein the structure (400)
 at one end thereof is attachable to an upright attachment device (402), e.g.
 attachment block or wall, via a module end element (101) and a support frame
 (401) attached to the attachment device (402), such that the structure forms
 a cantilevered beam.

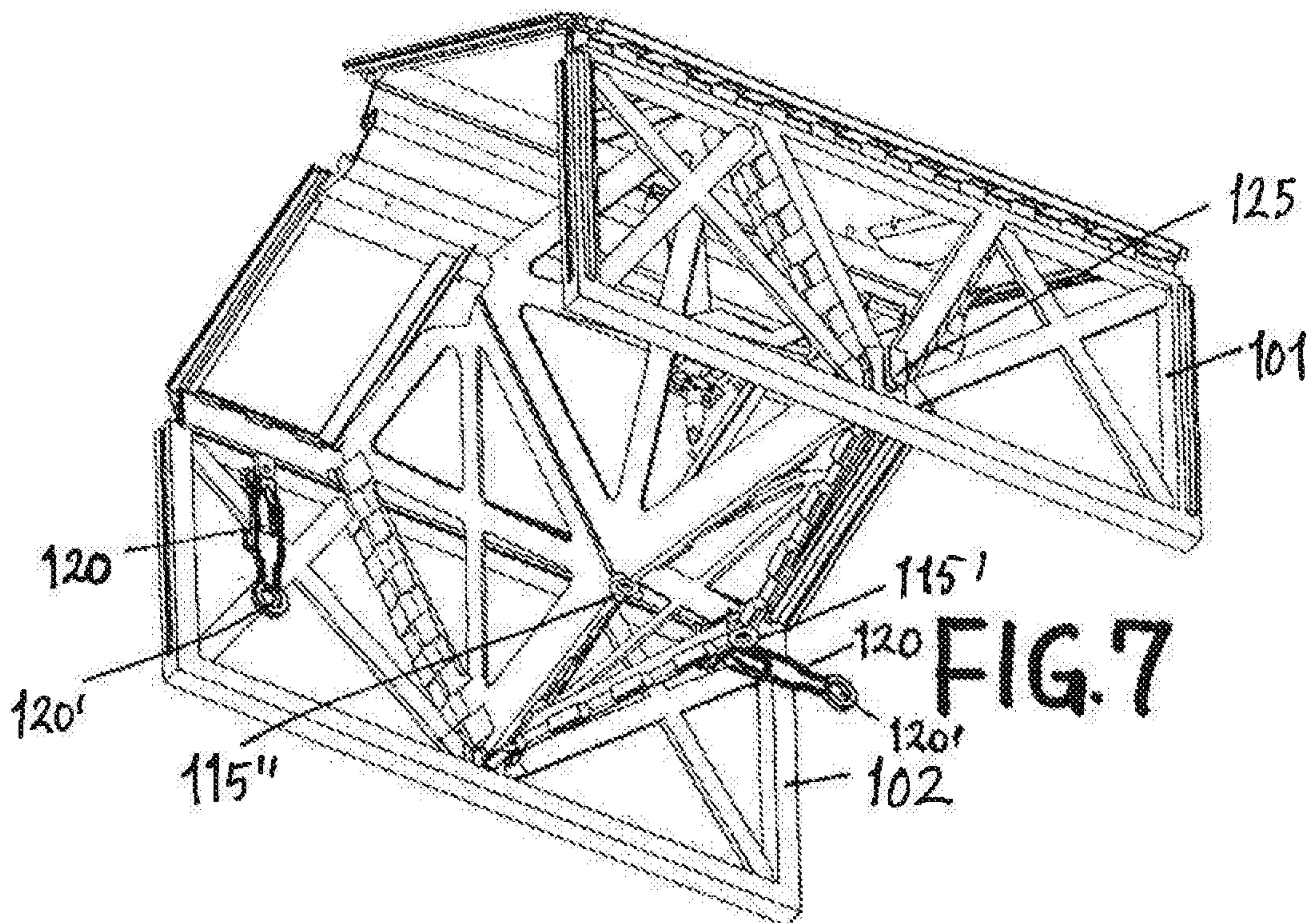
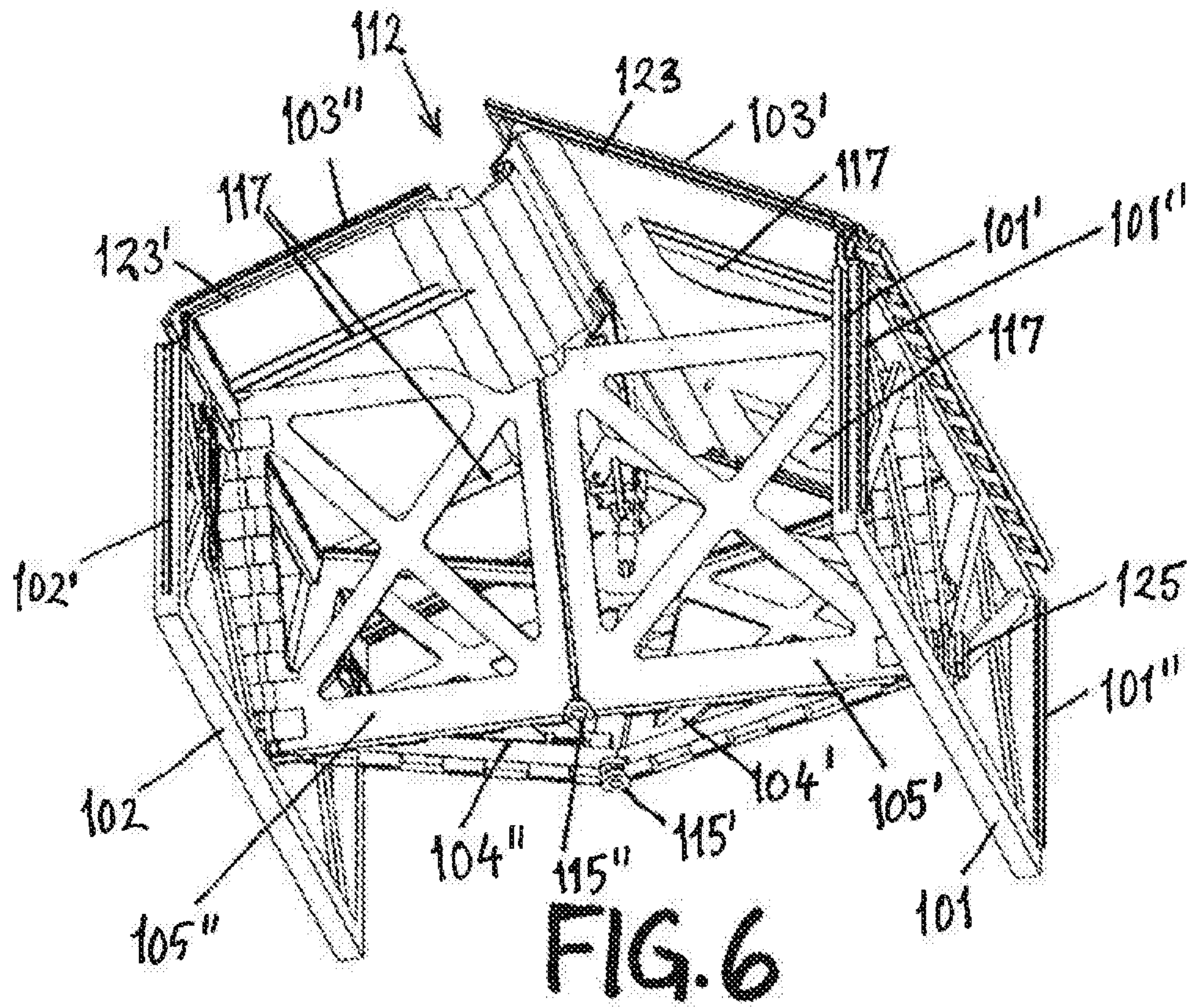
12. The beam structure (400) according to claim -10 or 11, wherein at least at
 one transition location between two modules of the structure there is fixedly in-
 sertable, in the longitudinal direction of the structure, an angled transition
 module (200) for changing the longitudinal direction of the structure.

13. The beam structure (400) according to any one of claims 10 - 12, wherein the structure is expandable transverse of its longitudinal direction by hooking a collapsible module (100; 200) according to any one of claims 1 - 9 or a collapsible platform (300) onto a module side portion of the structure.

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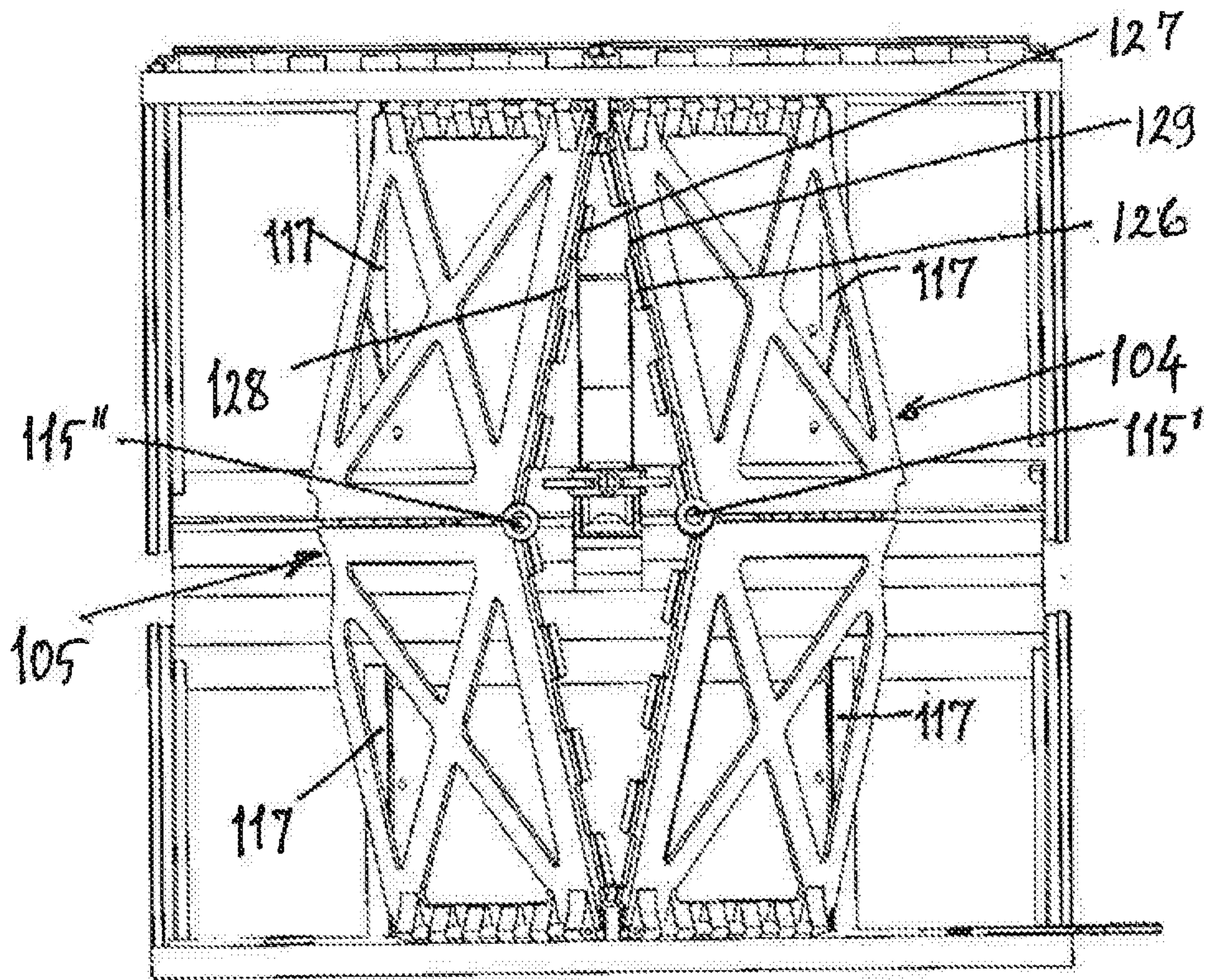


FIG. 8

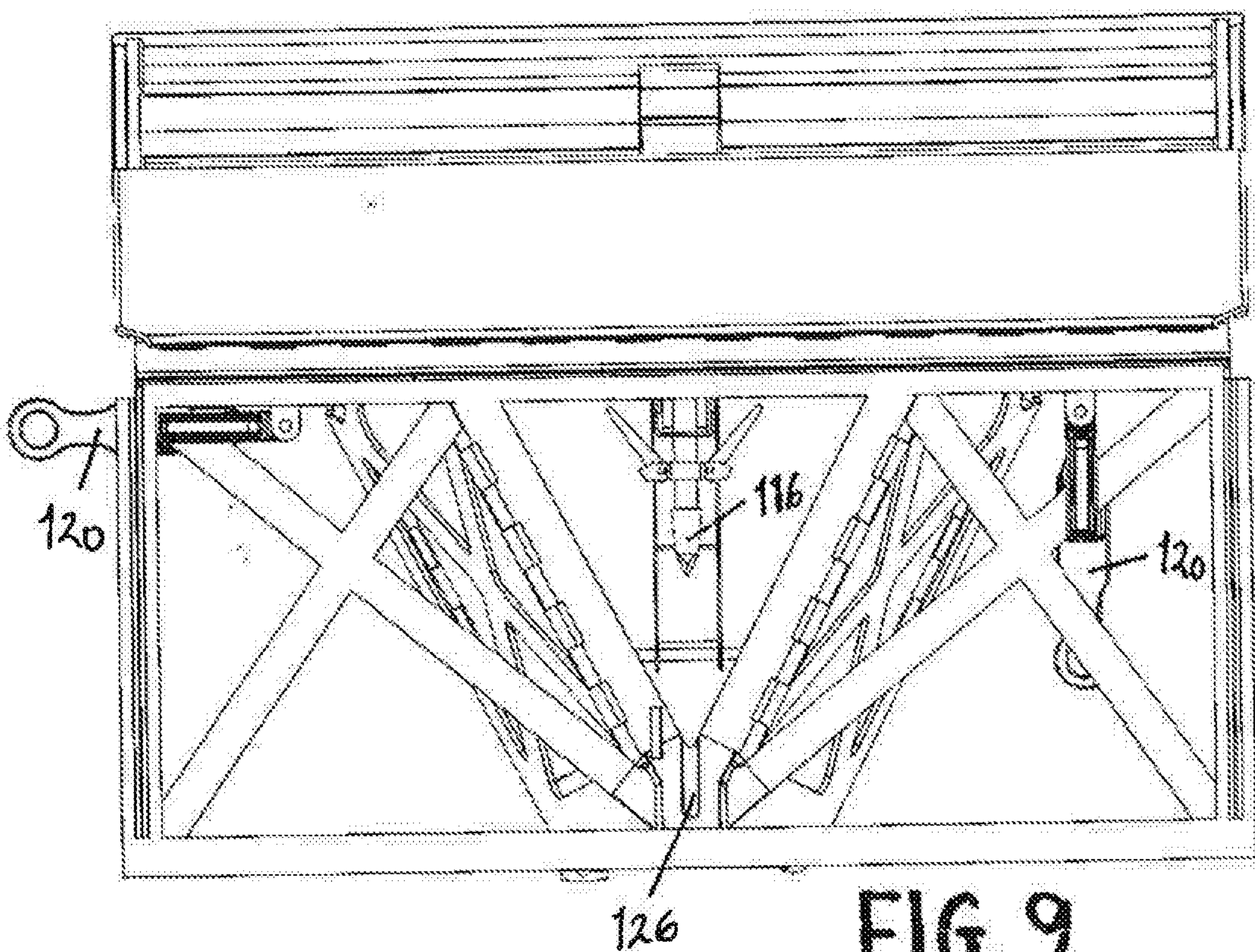
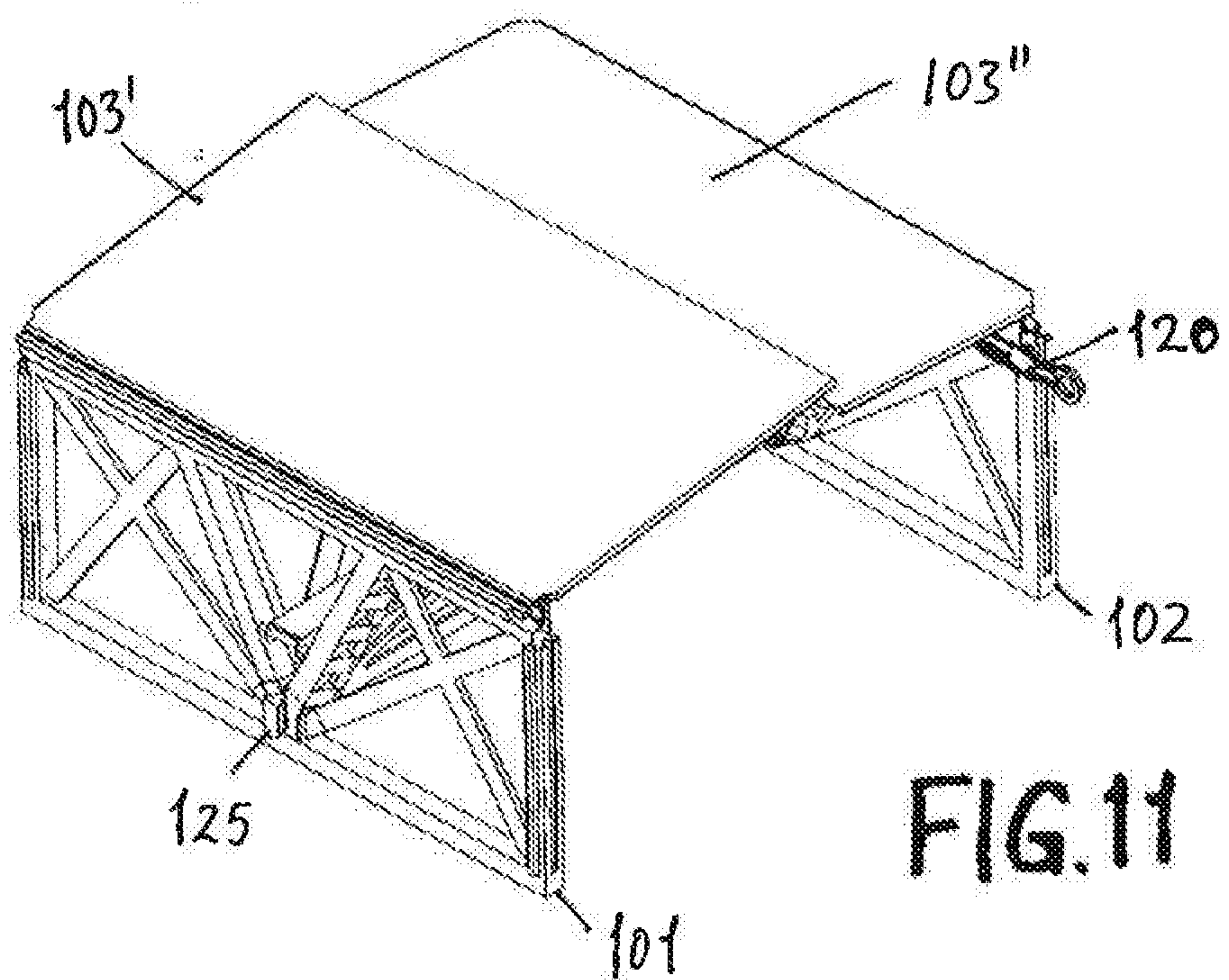
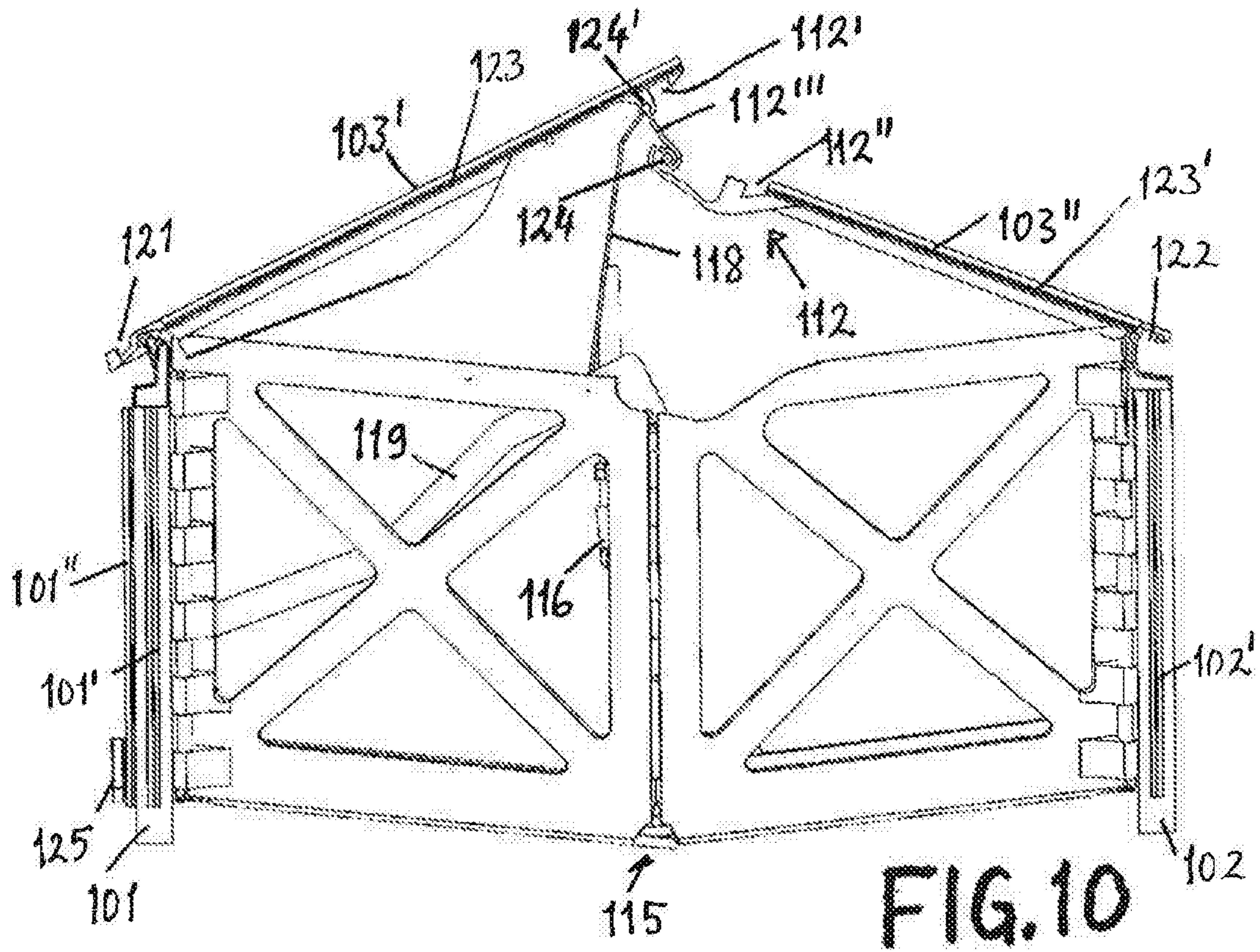
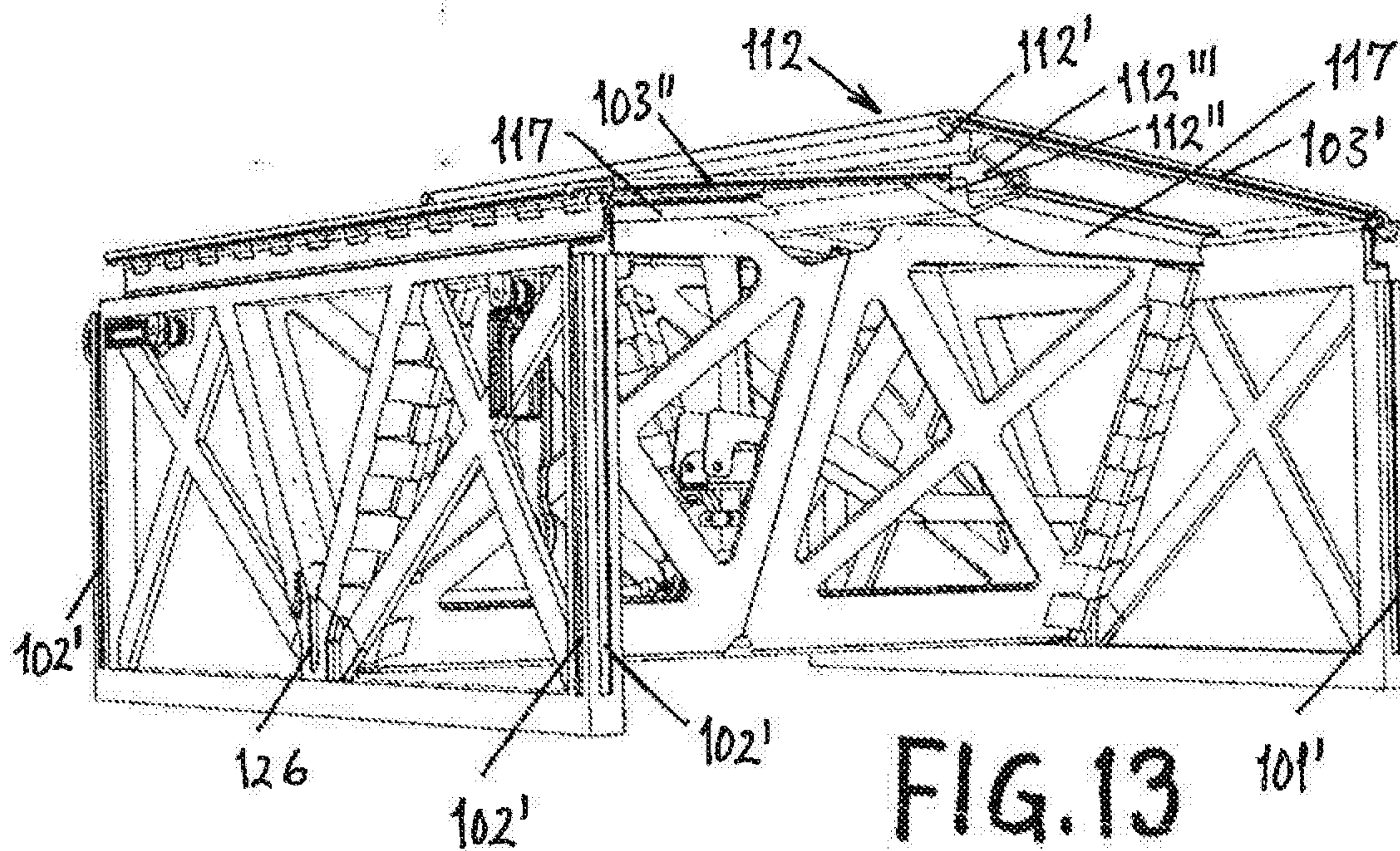
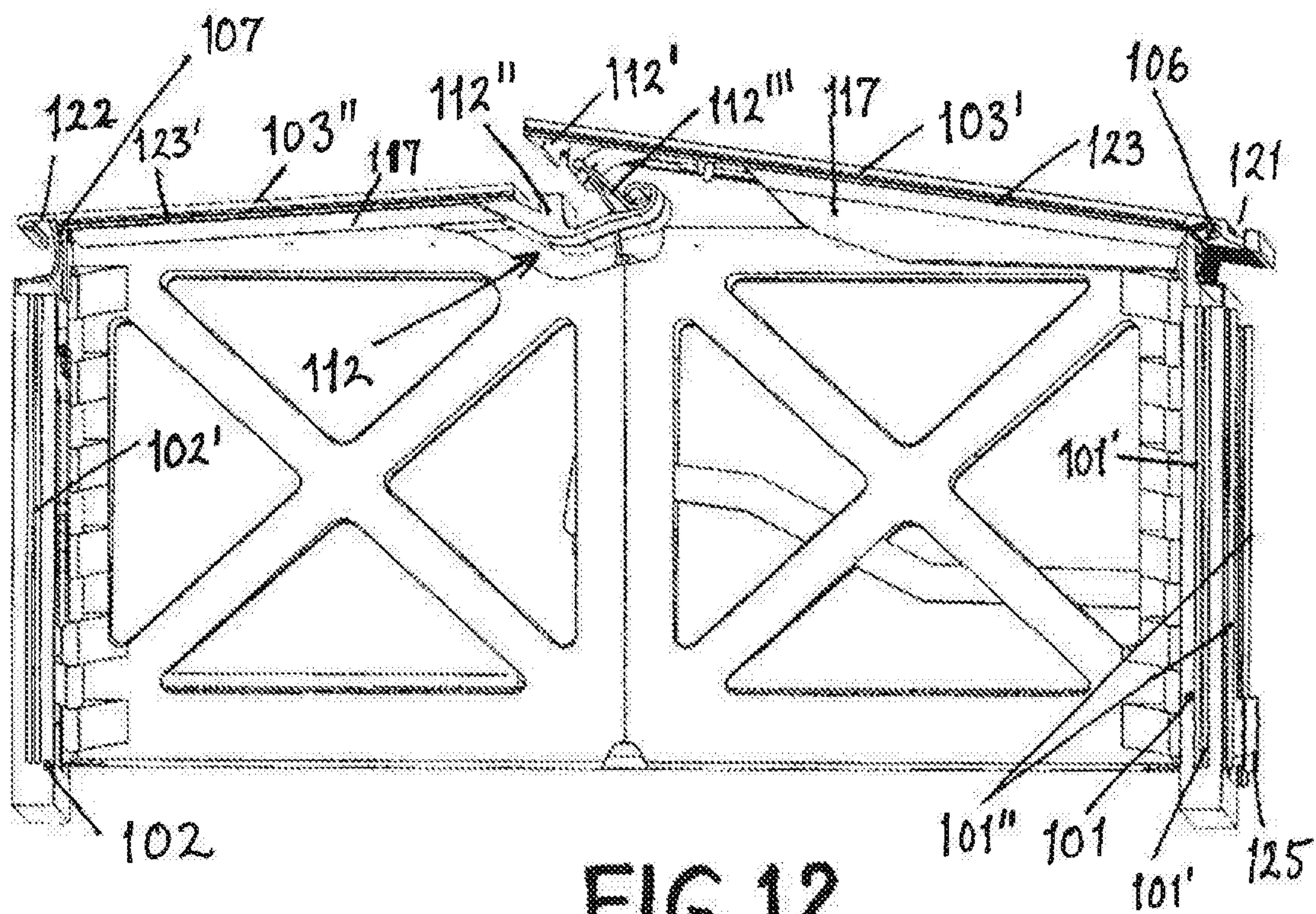


FIG. 9





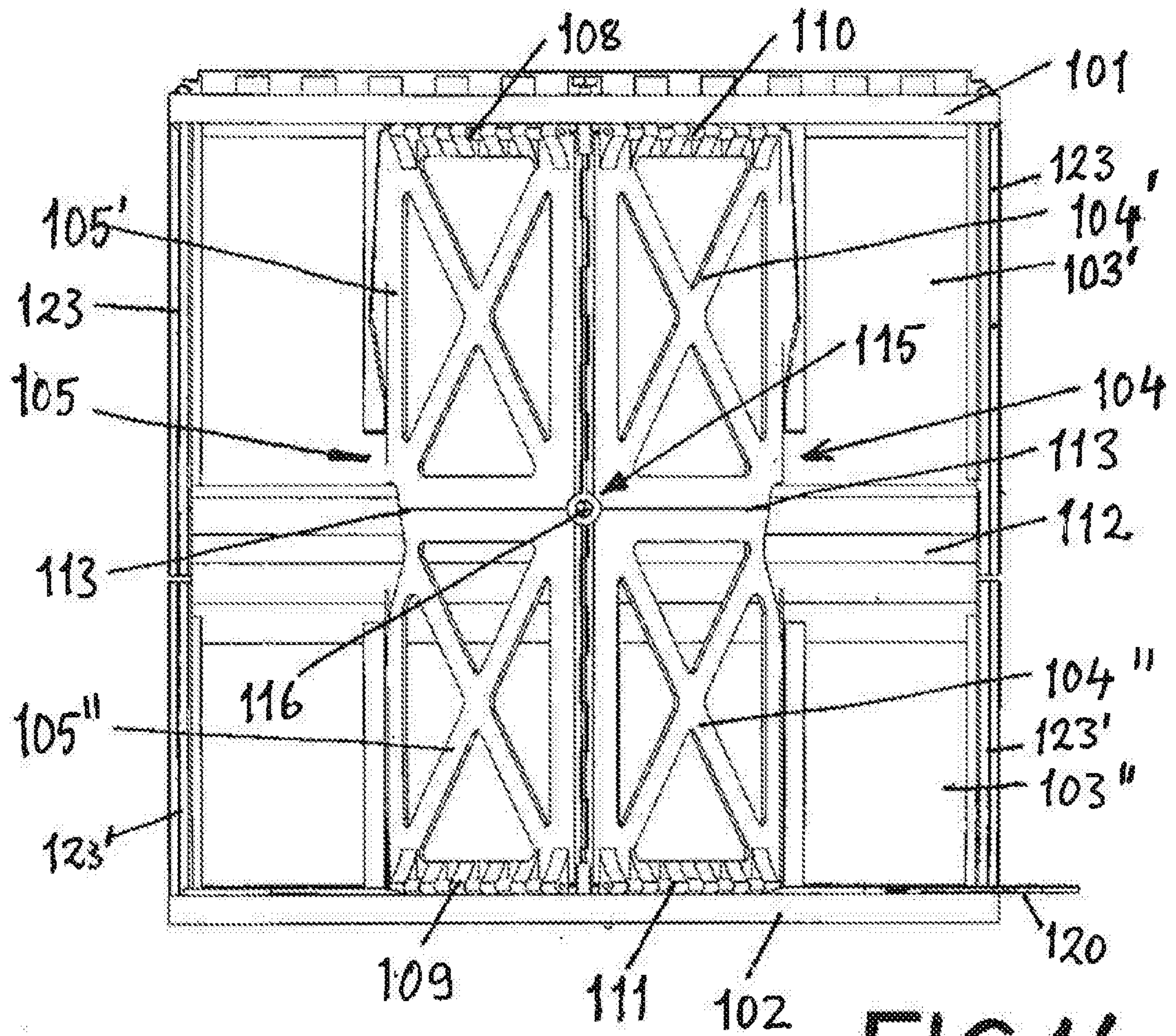


FIG. 14

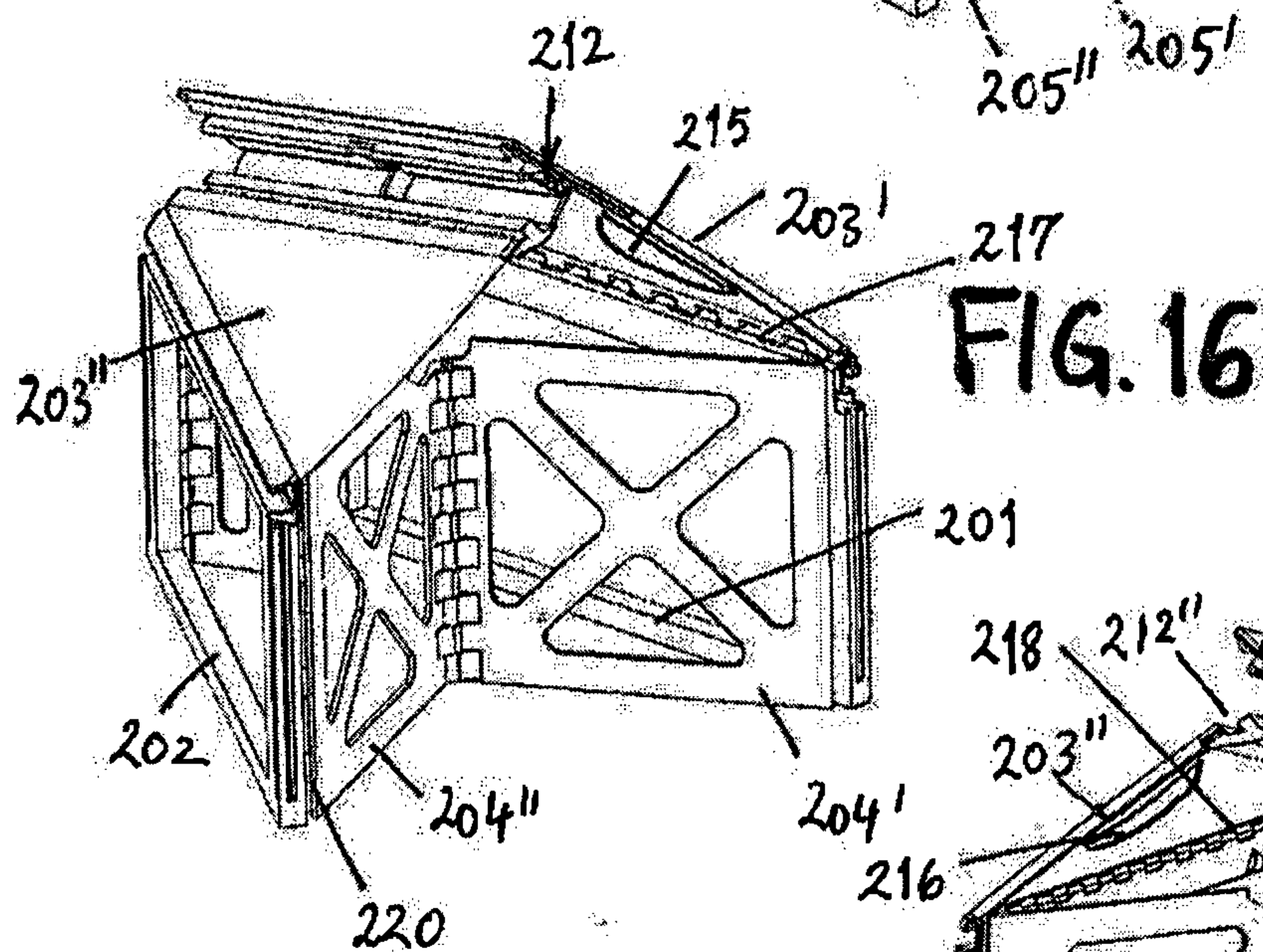
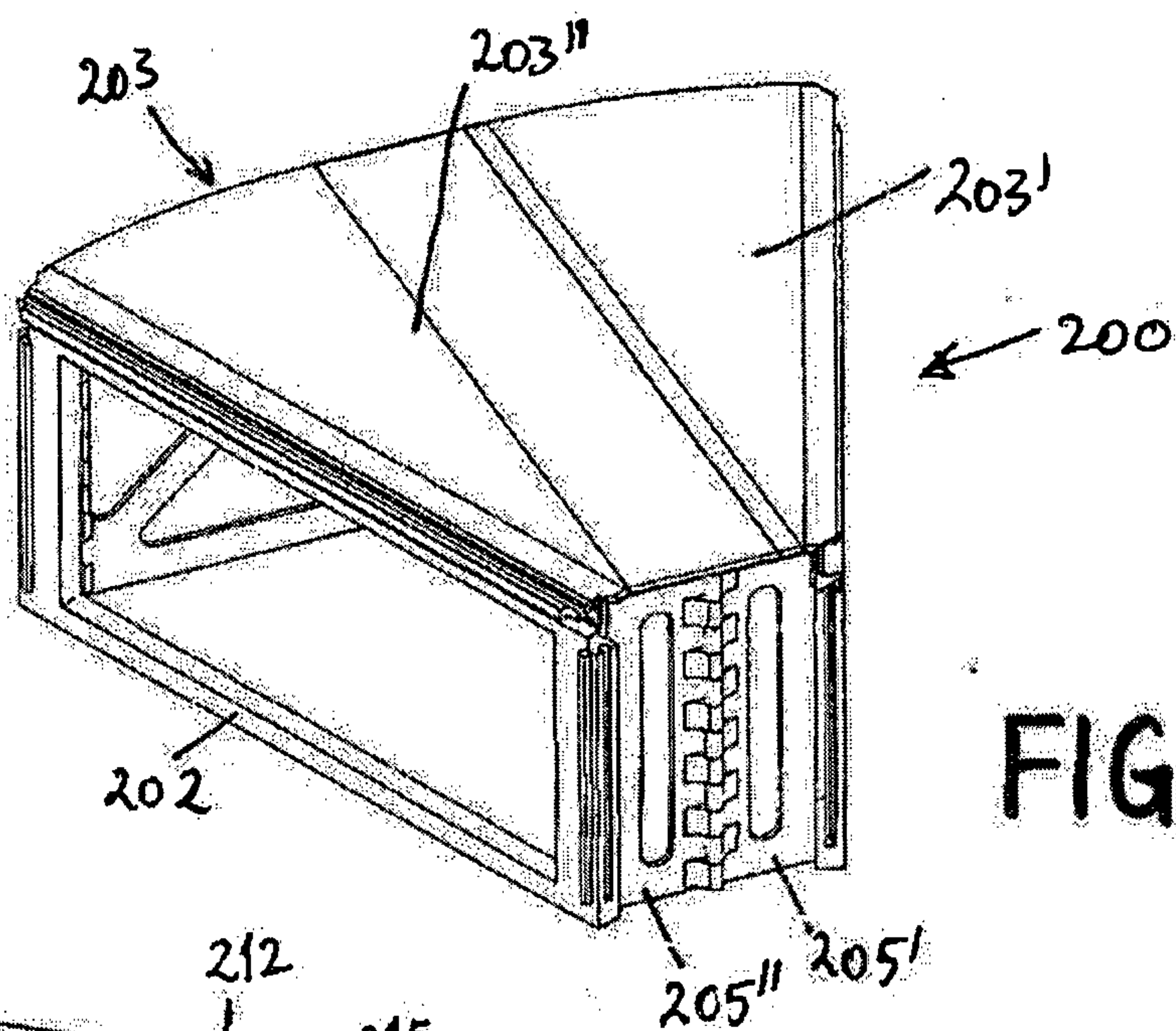
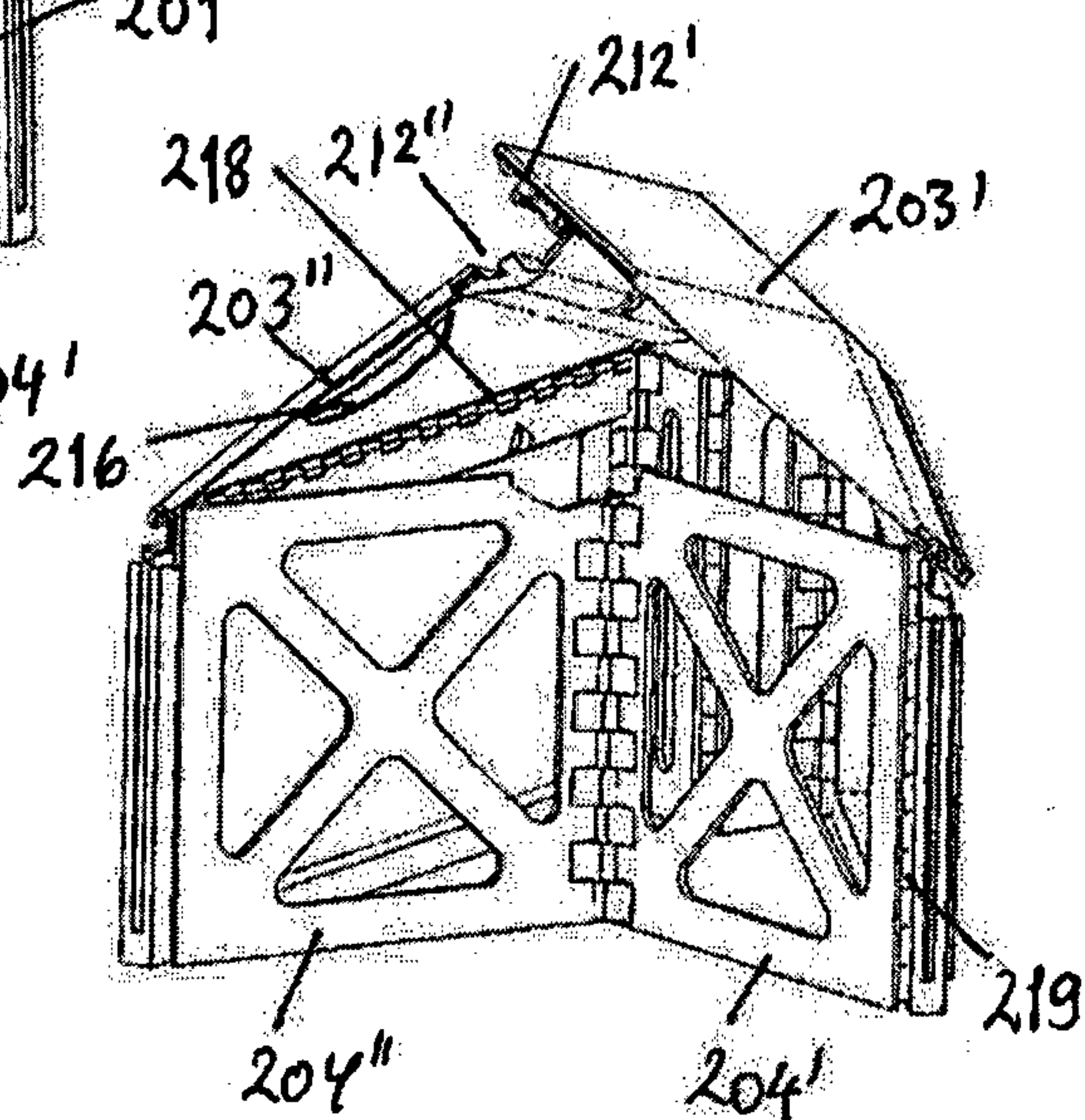
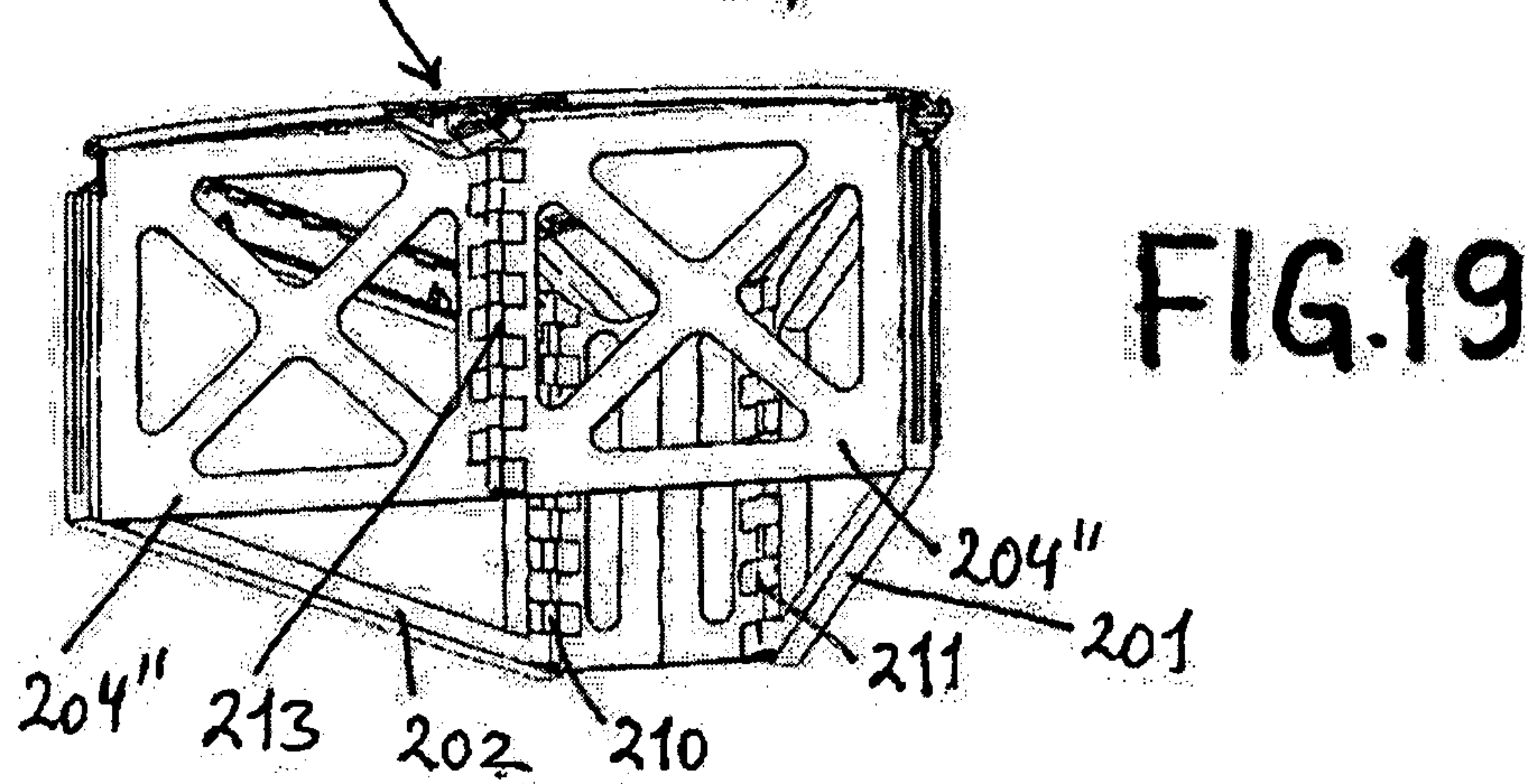
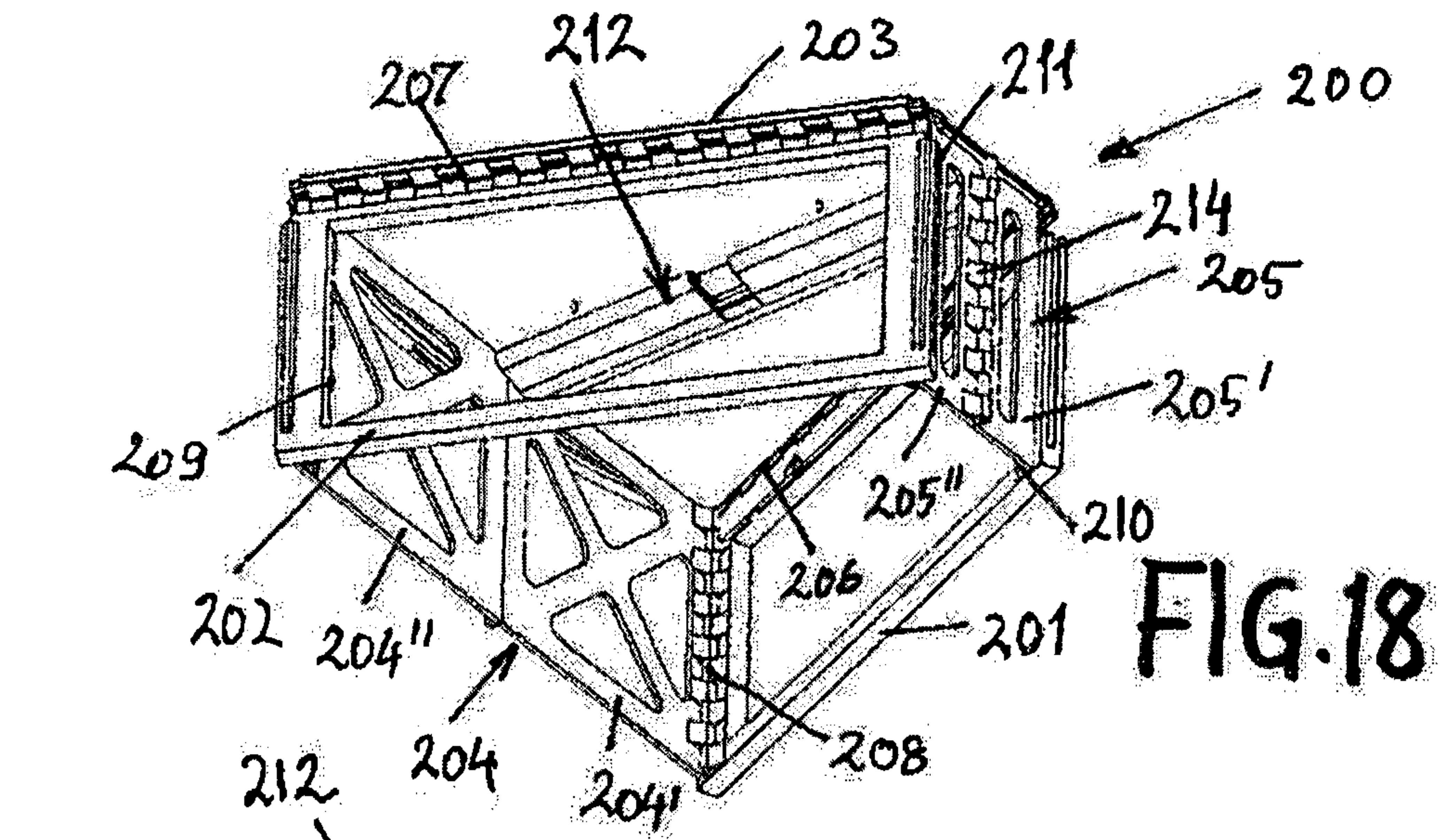
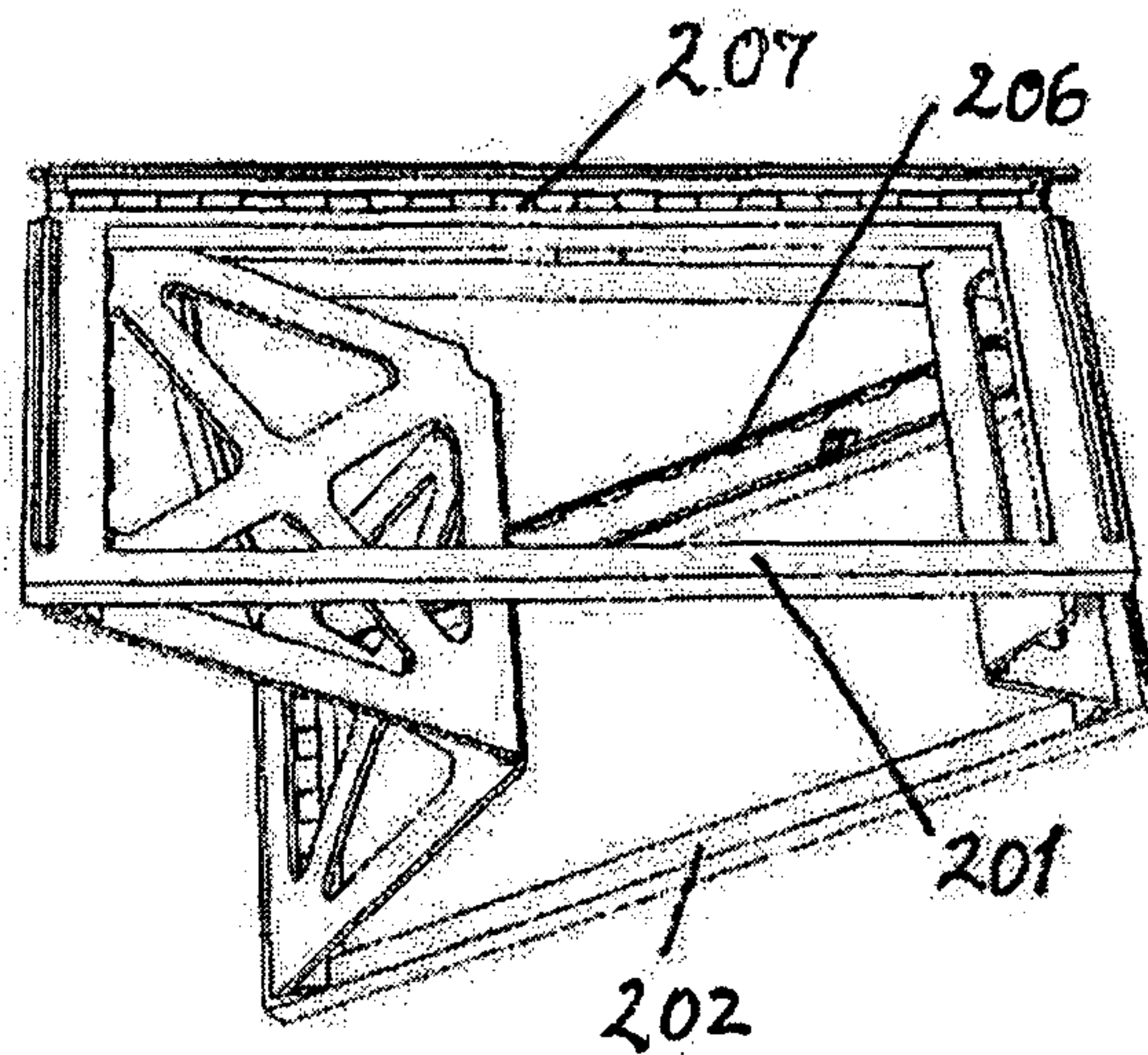
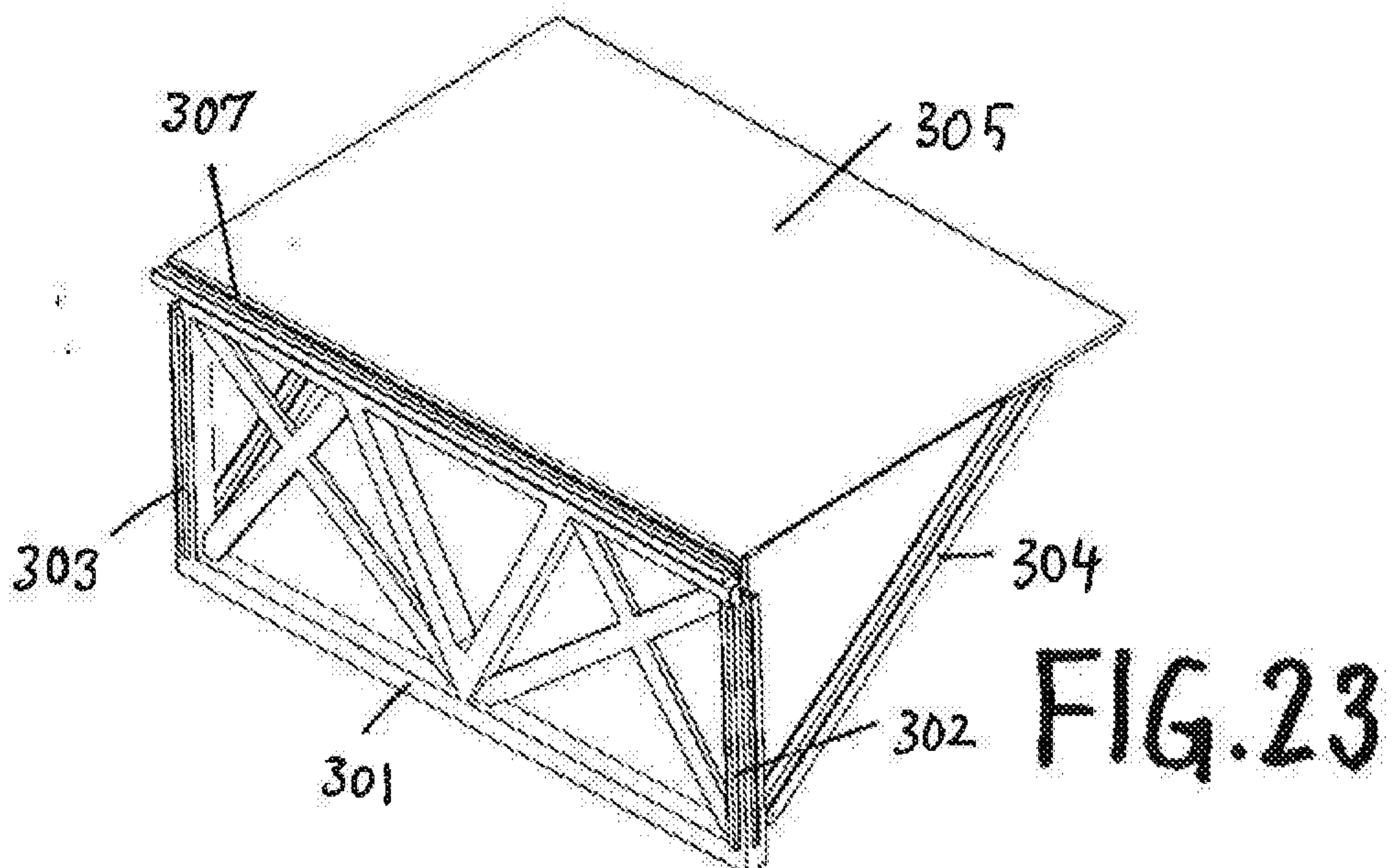
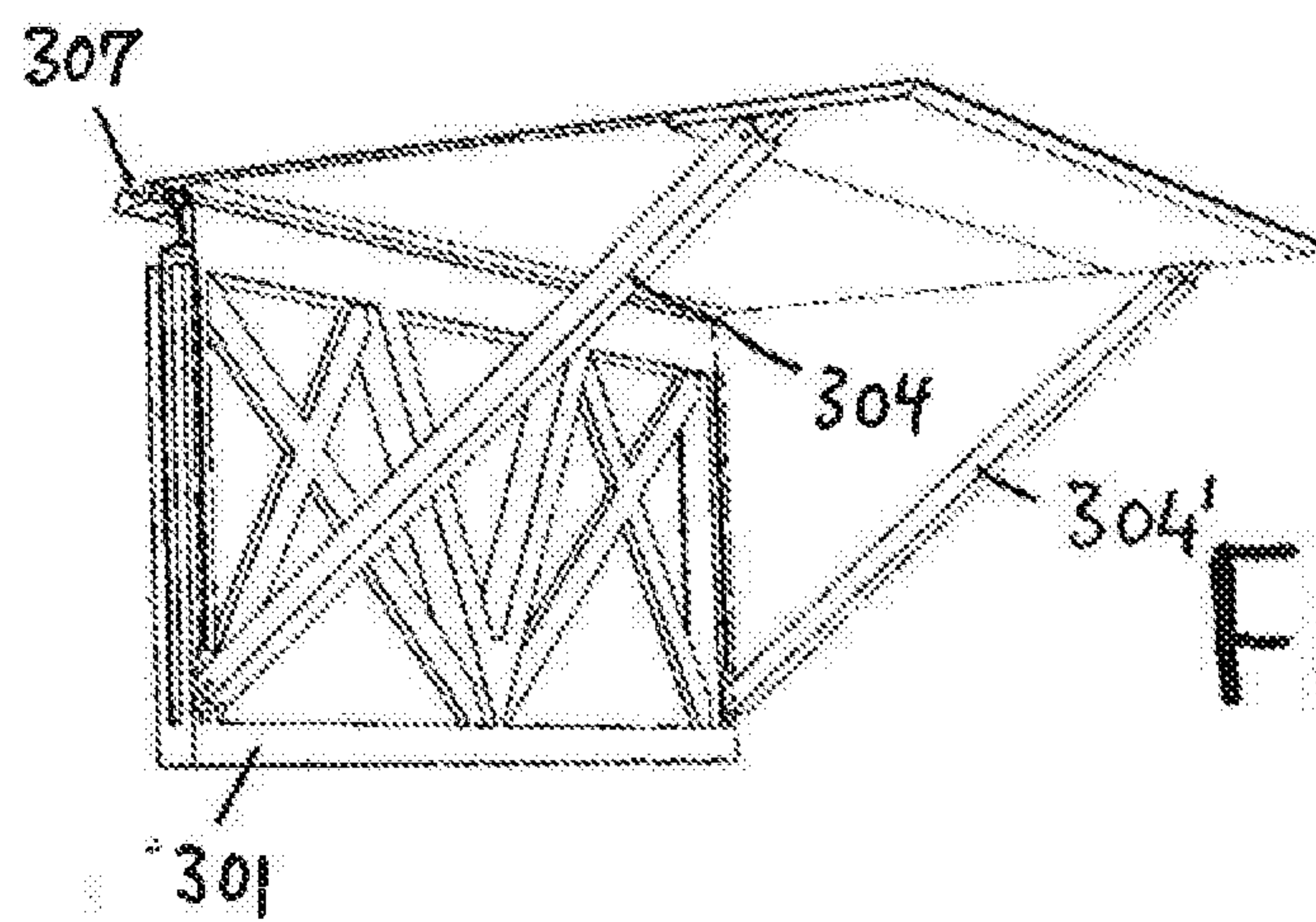
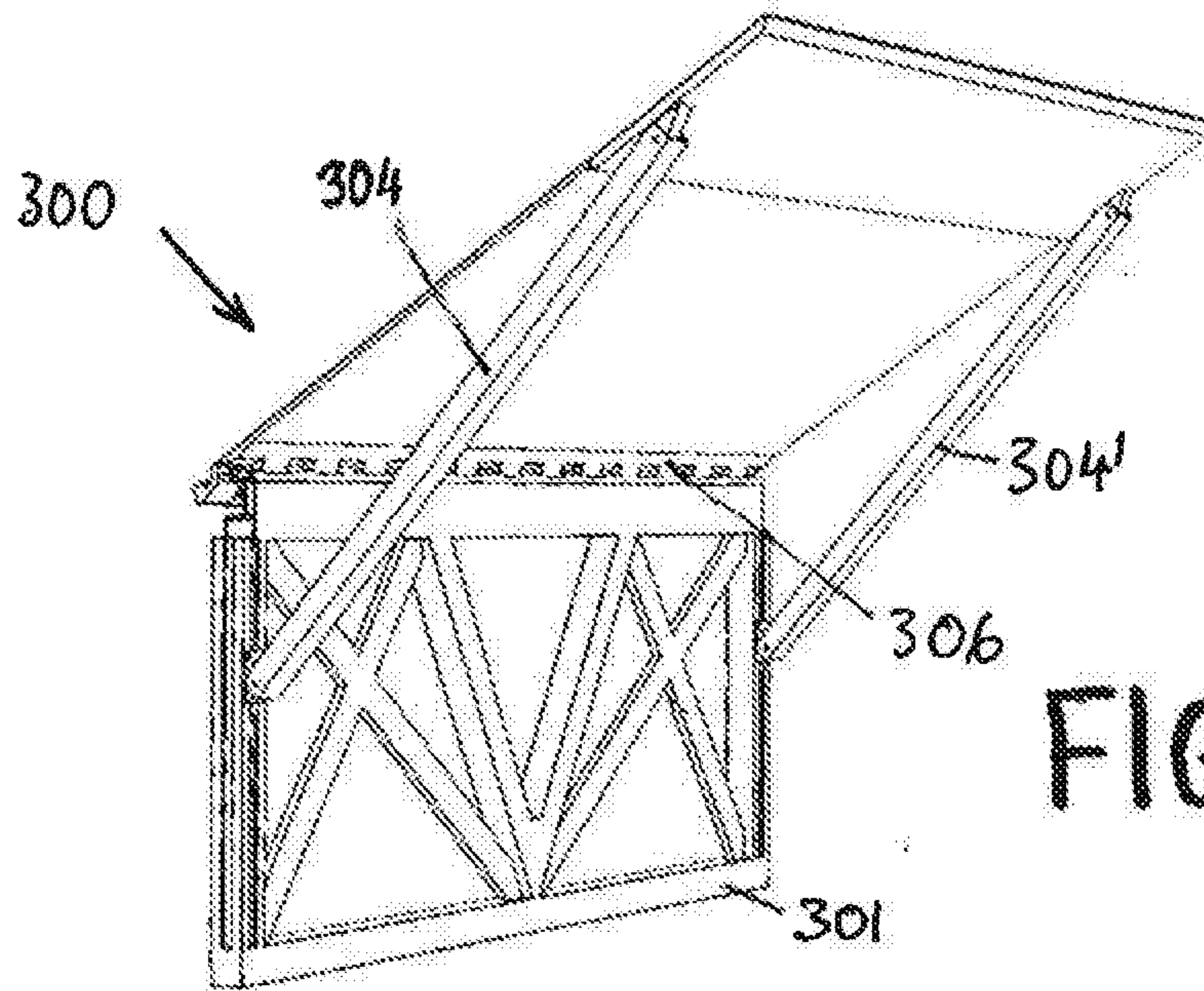
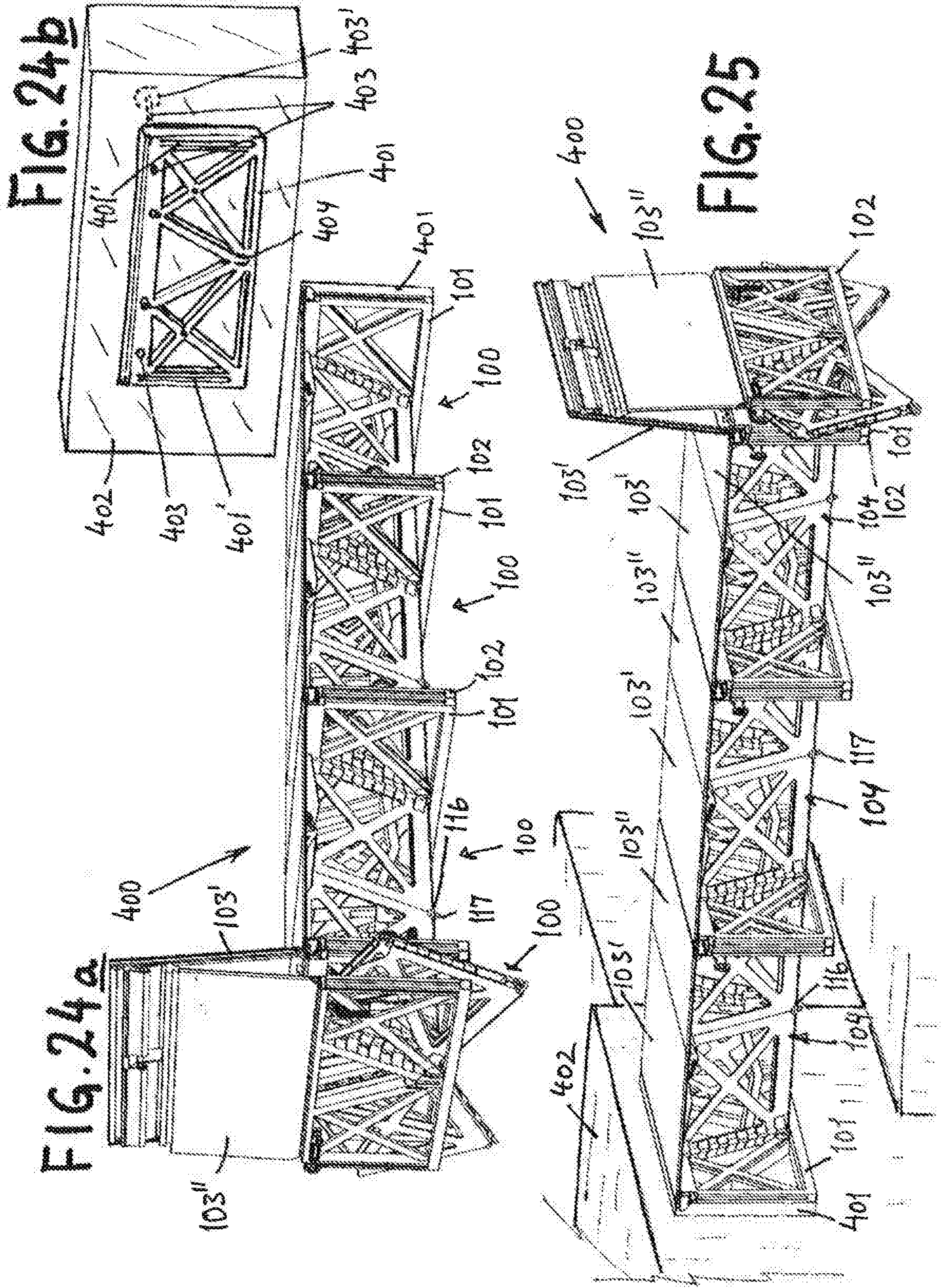


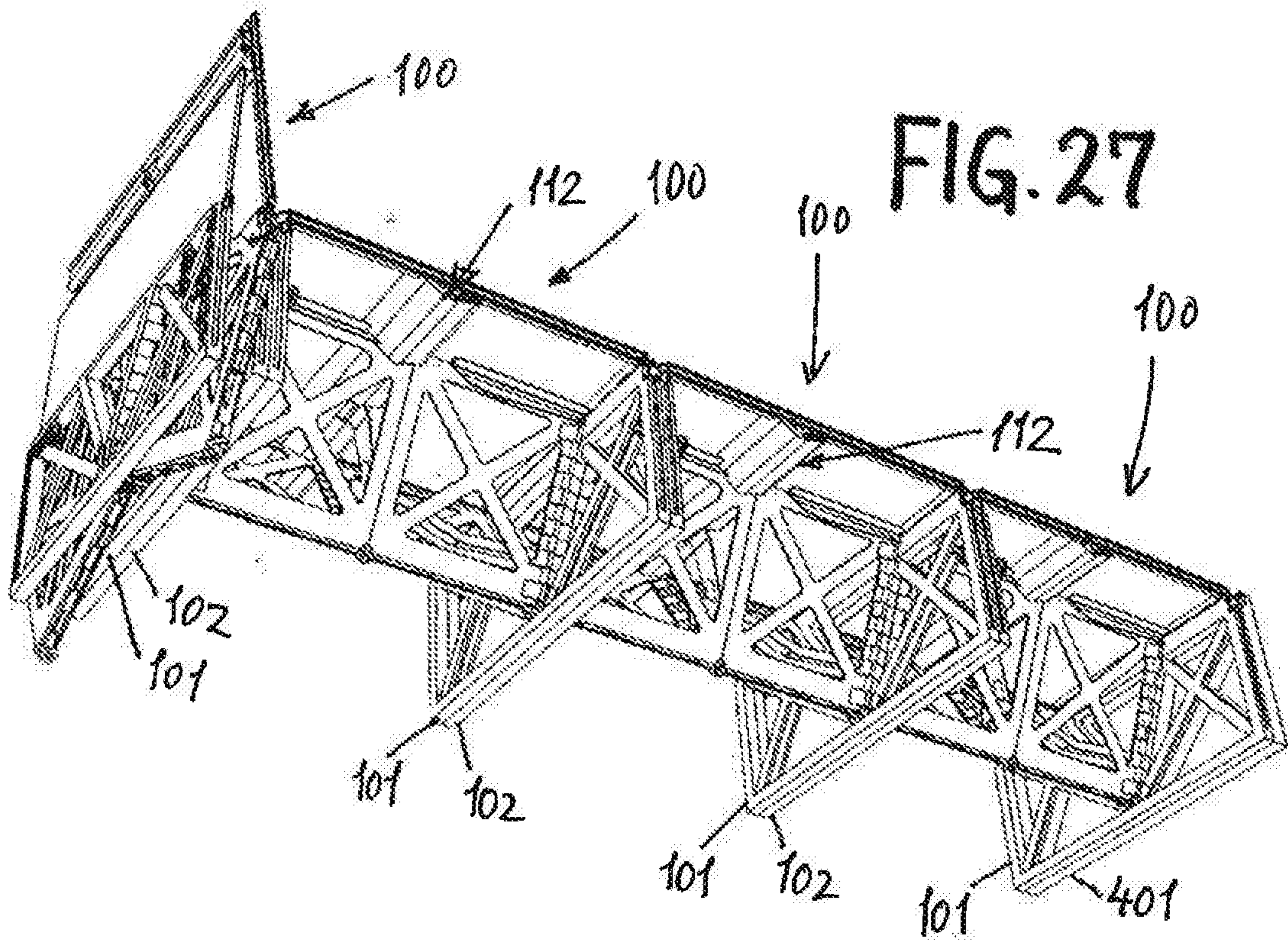
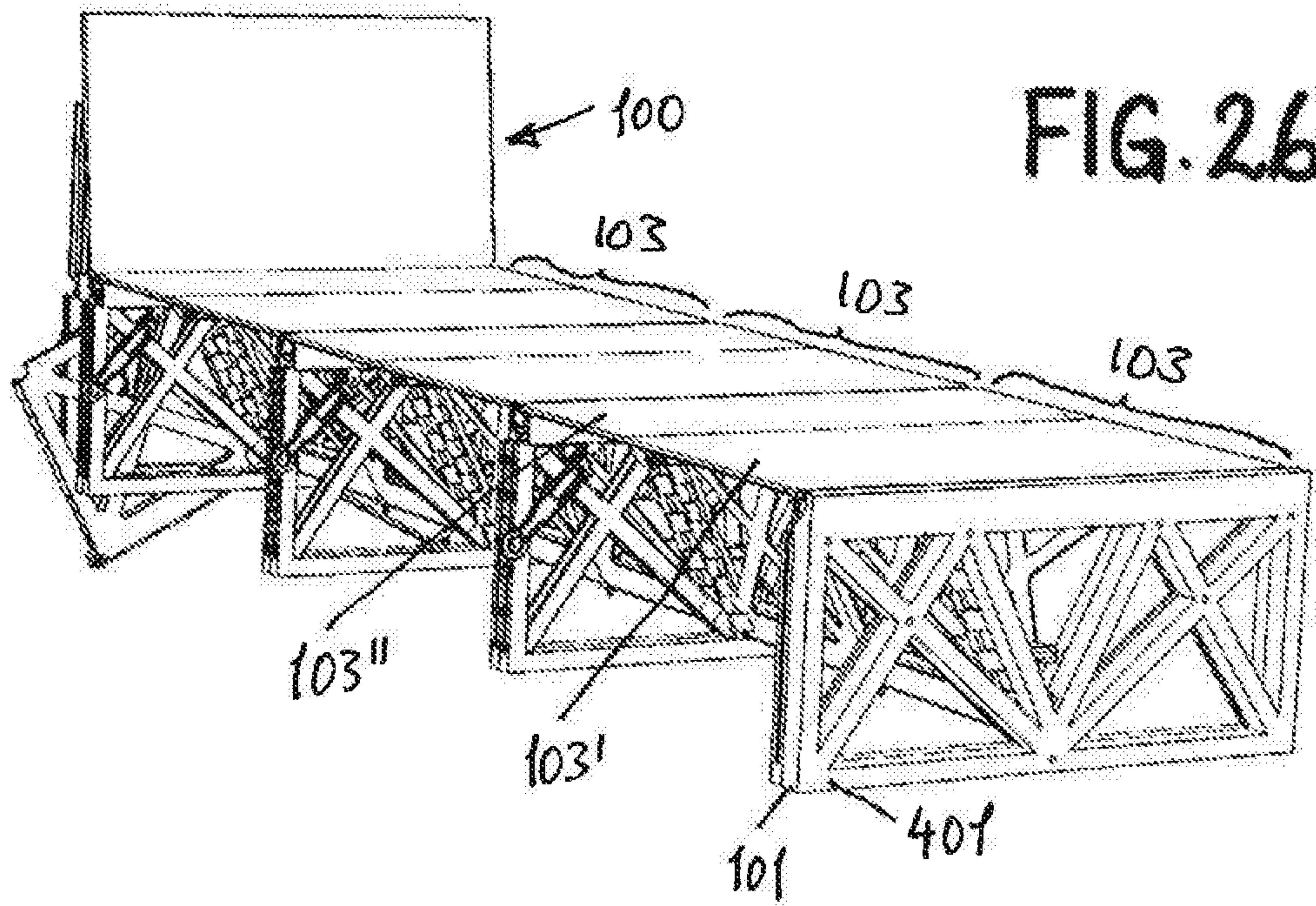
FIG. 17

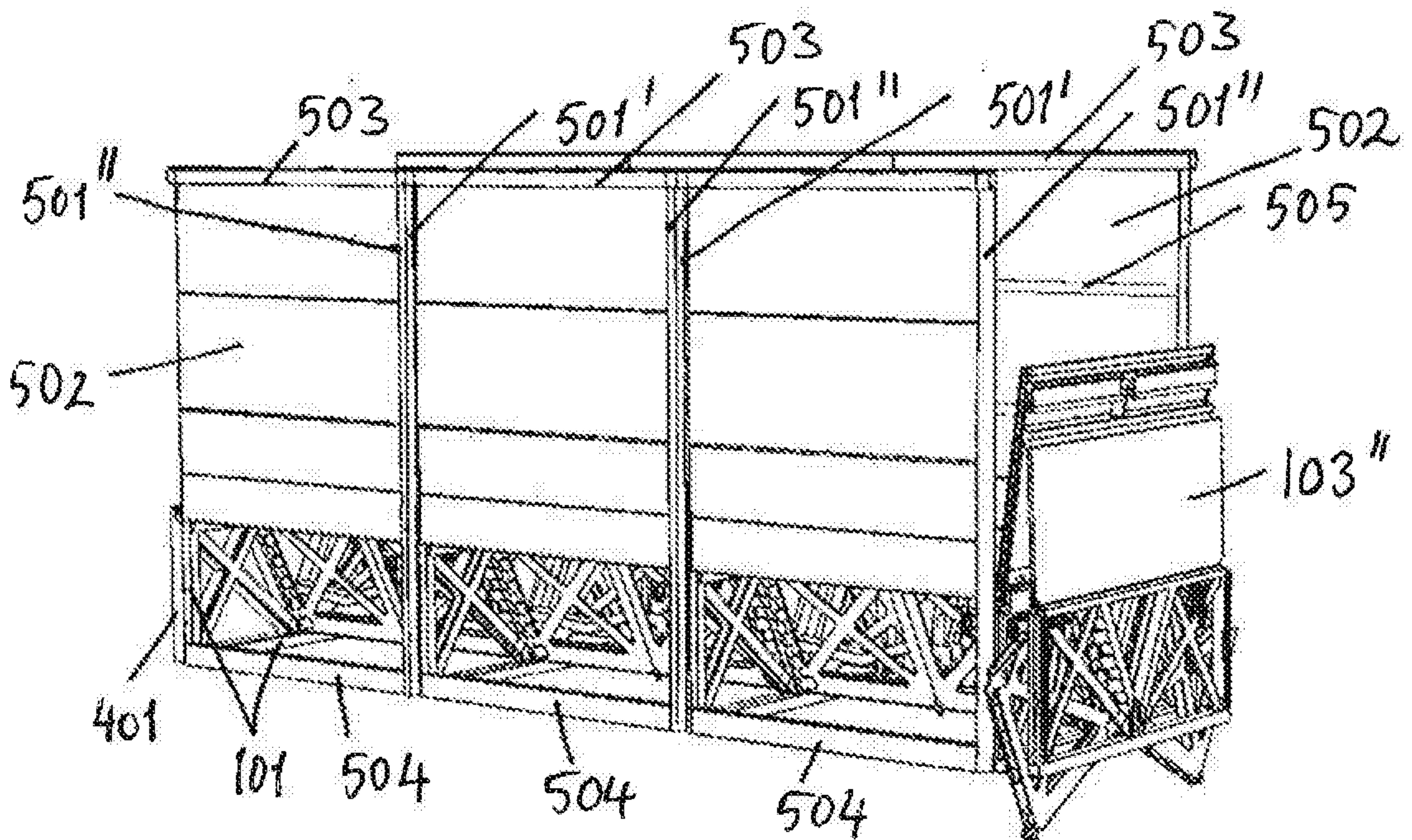
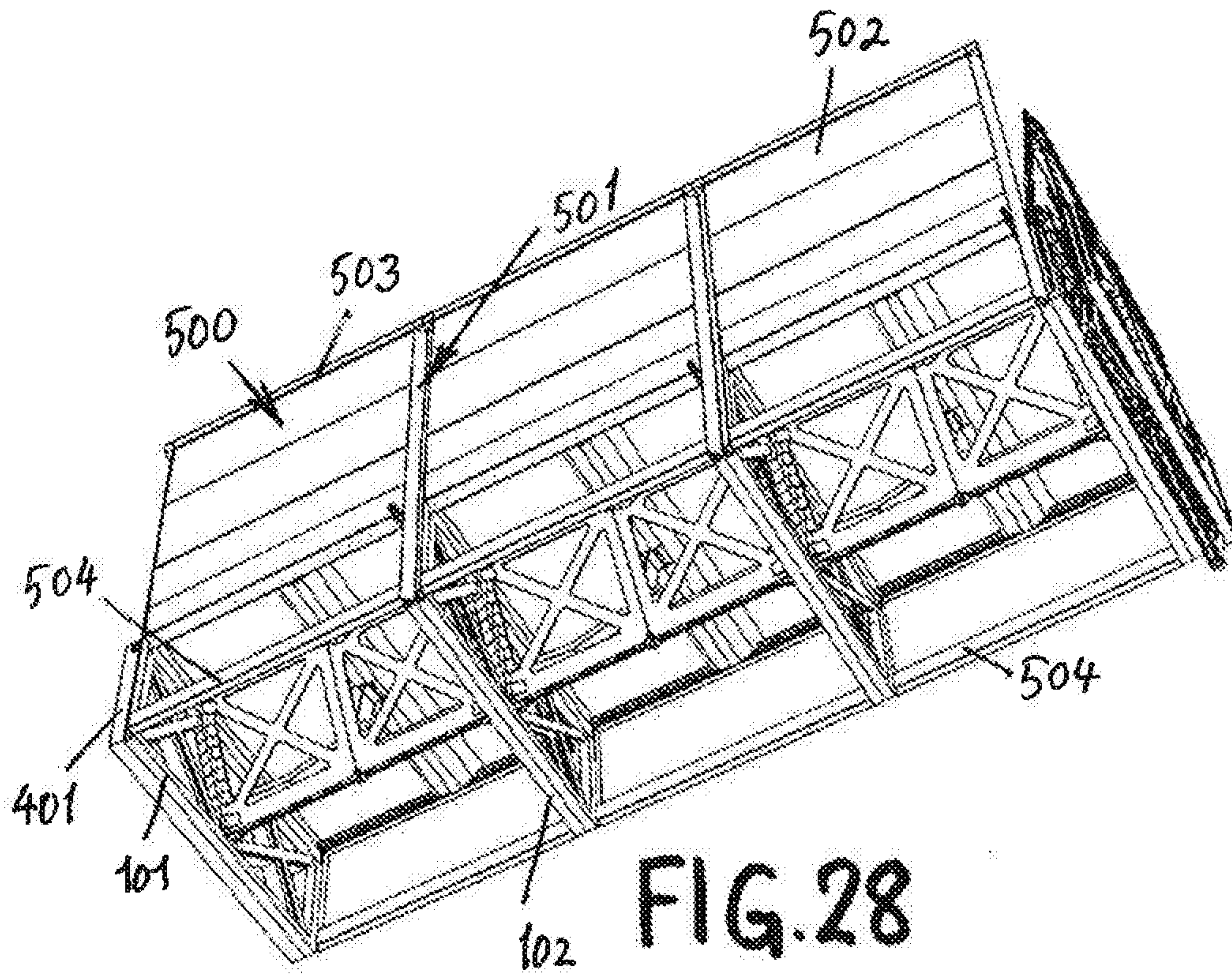


**FIG. 20**









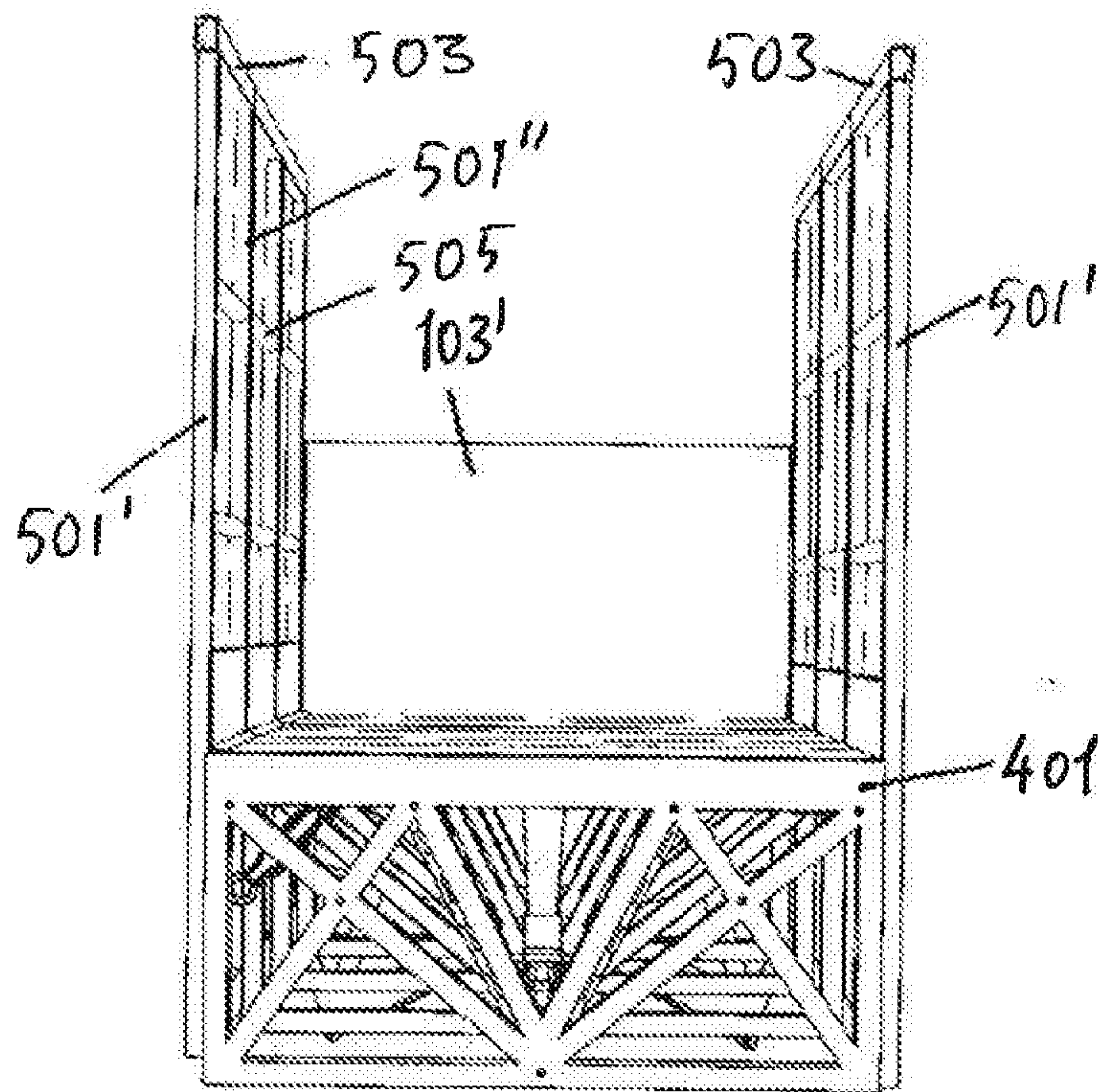


FIG. 30

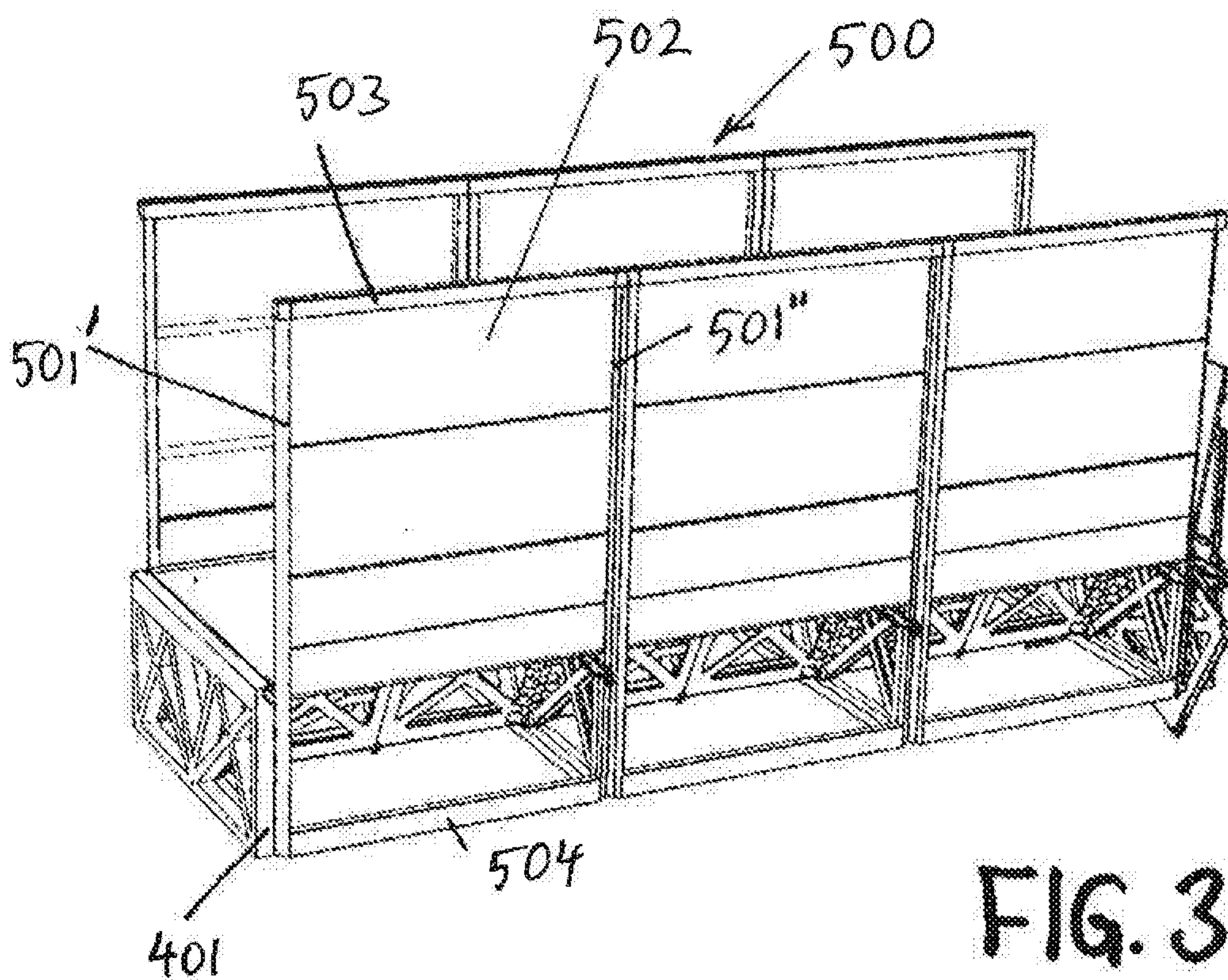


FIG. 31

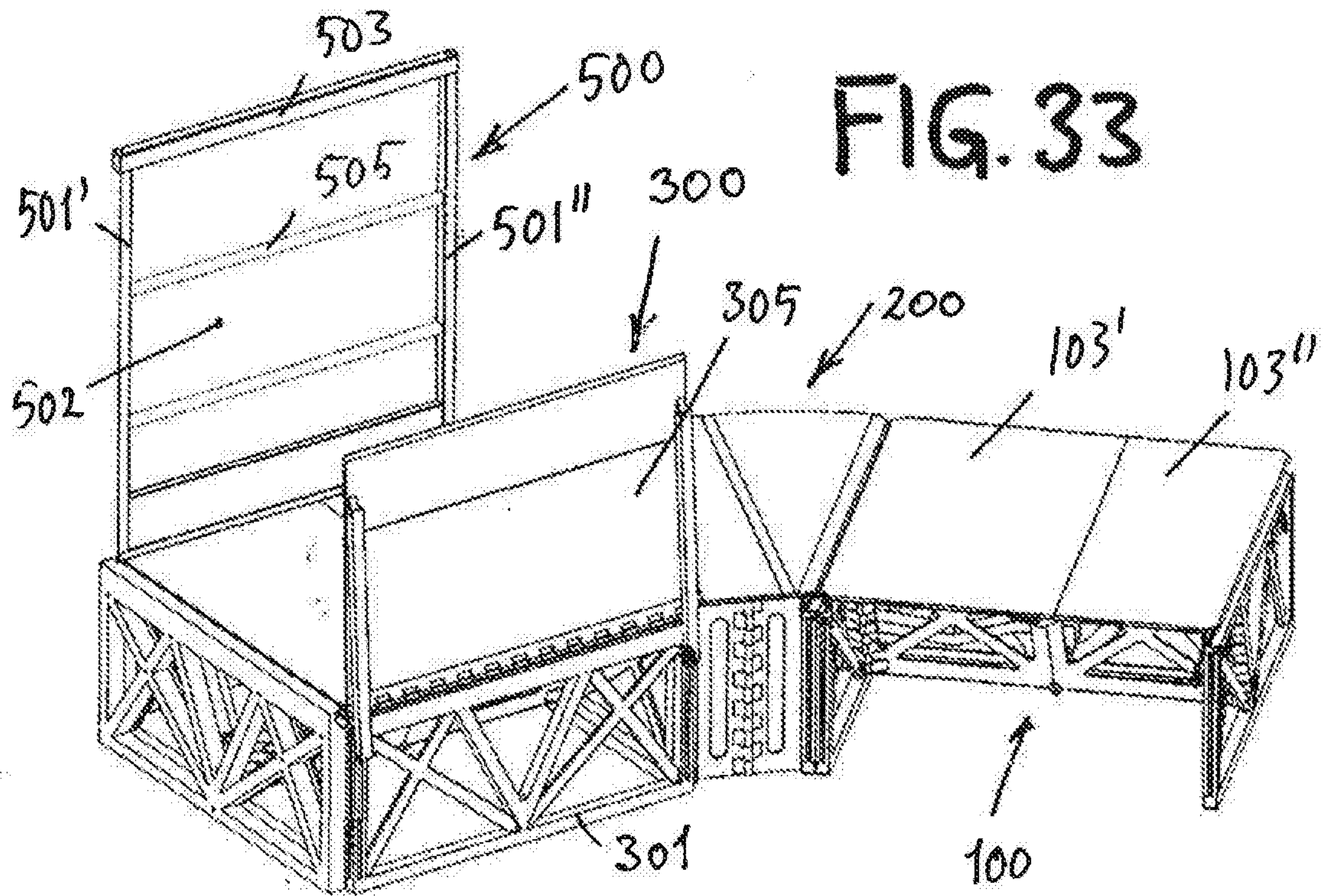
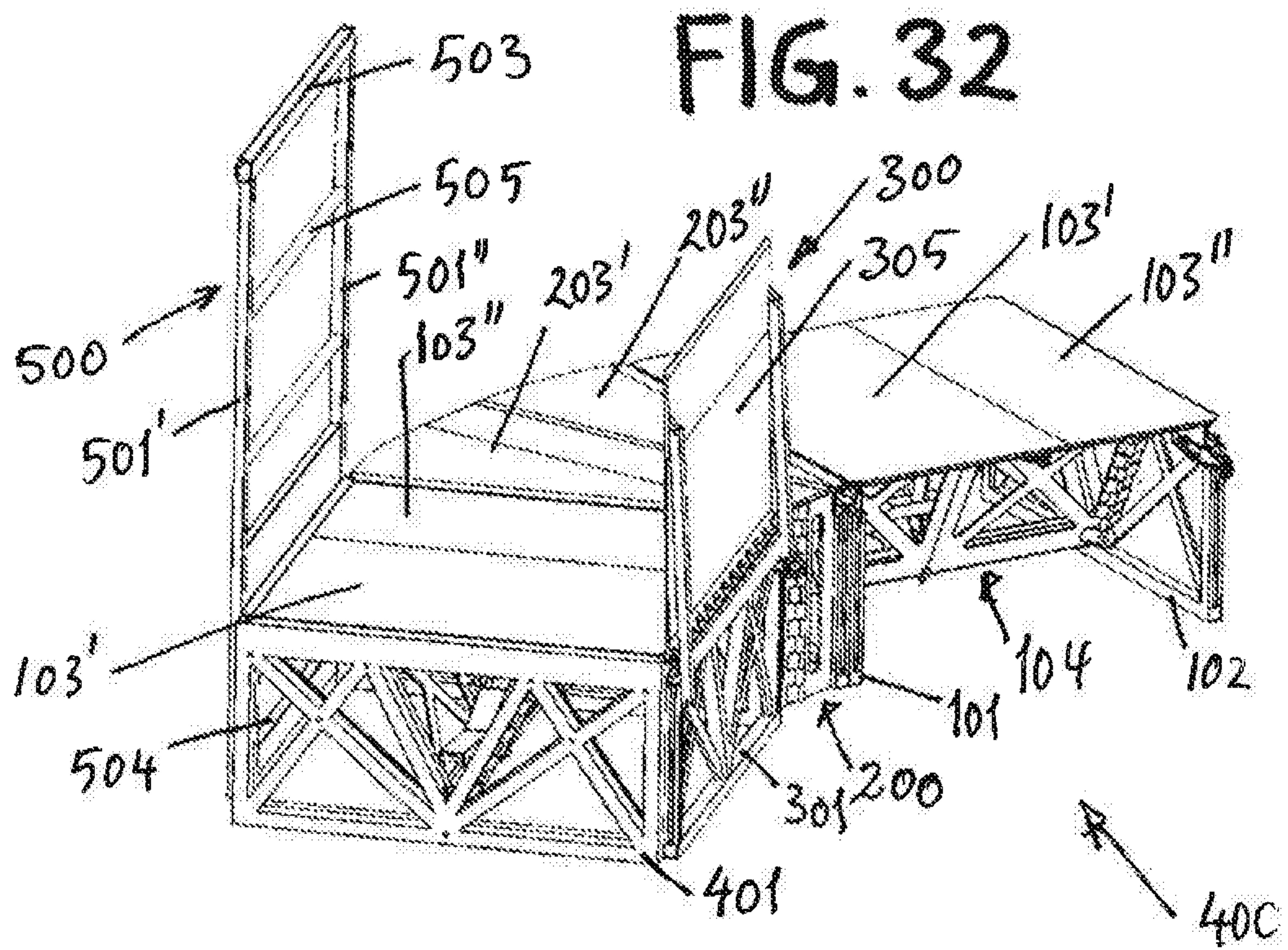


FIG. 34

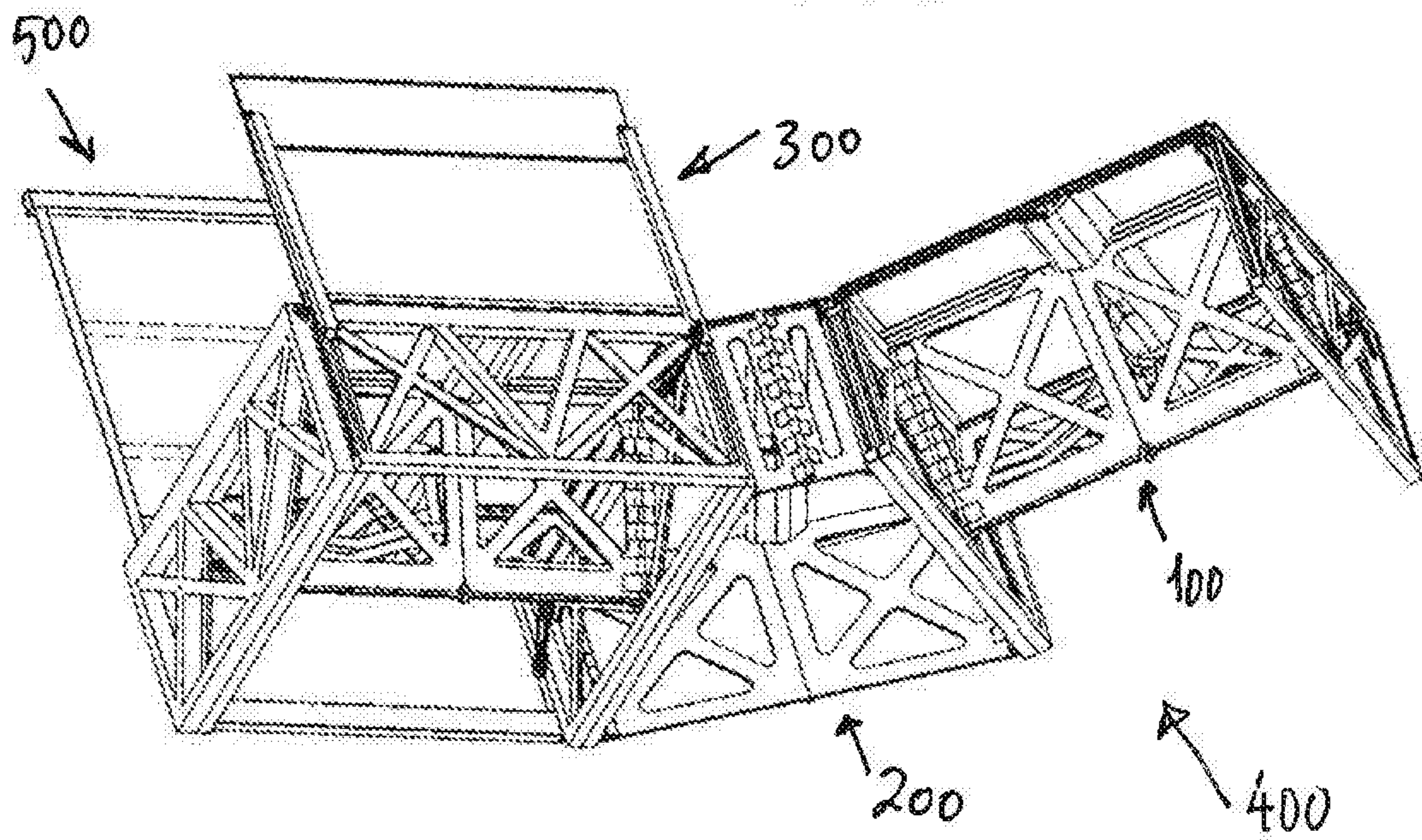


FIG. 35

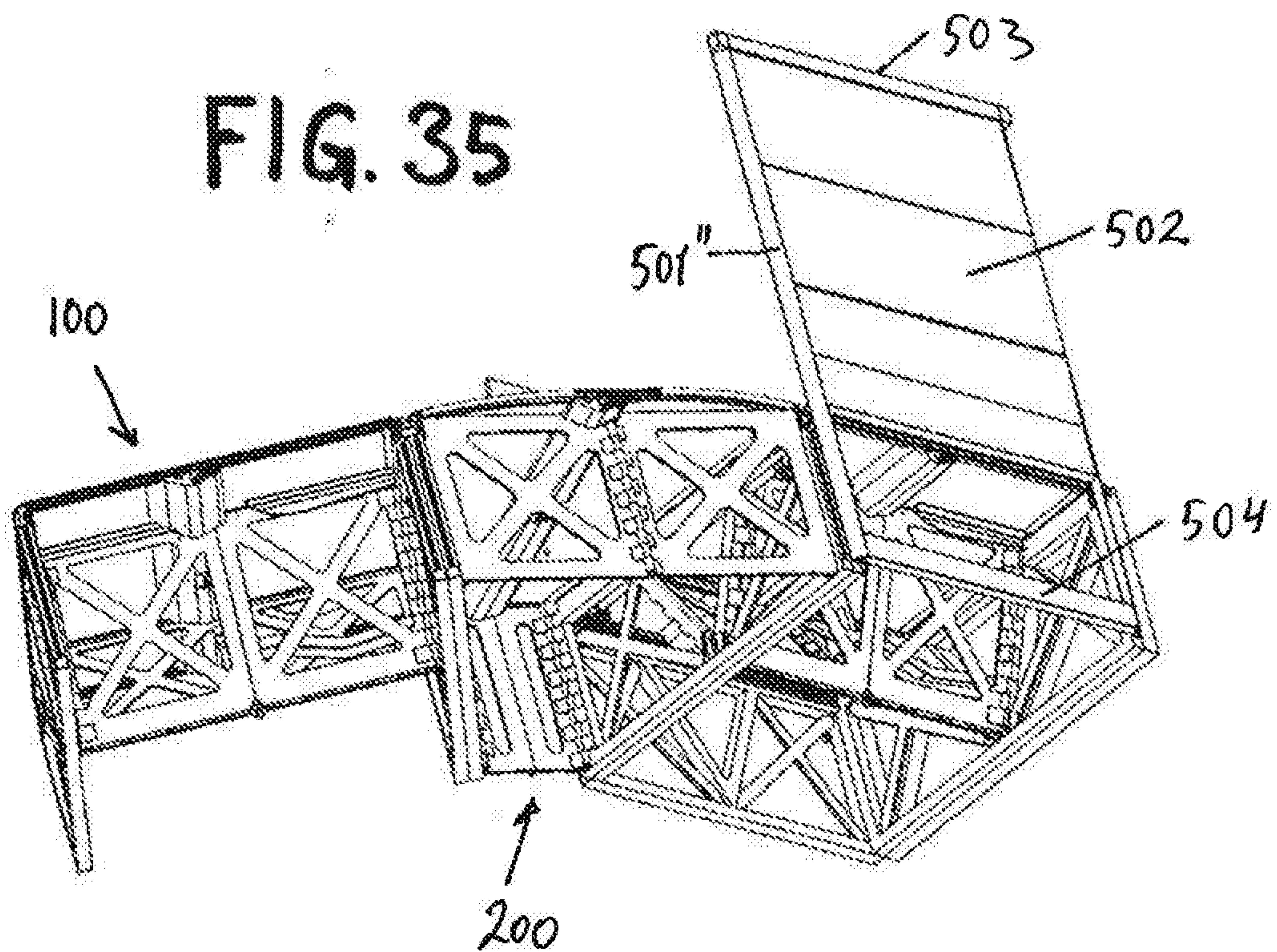


FIG. 24a

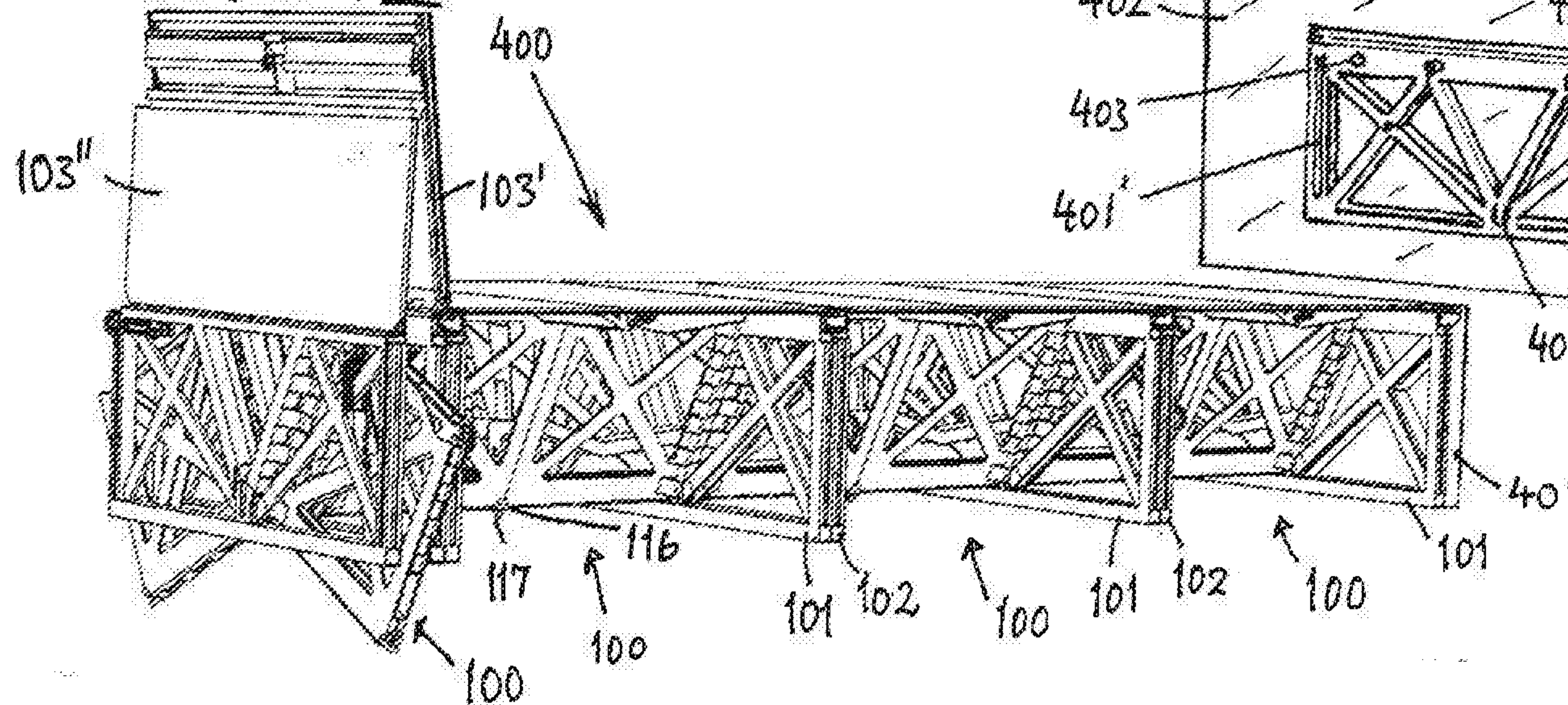


FIG. 24b

