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(71) Applicant: AUTOSTORE TECHNOLOGY AS
[NO/NO]; Stokkastrandvegen 85, N-5578 Nedre Vats
(NO).

(72) Inventor: AUSTRHEIM, Trond; Silde, N-5590 Etne
(NO).

(74) Agent: ONSAGERS AS; P. O. Box 1813 Vika, N-0123
Oslo (NO).

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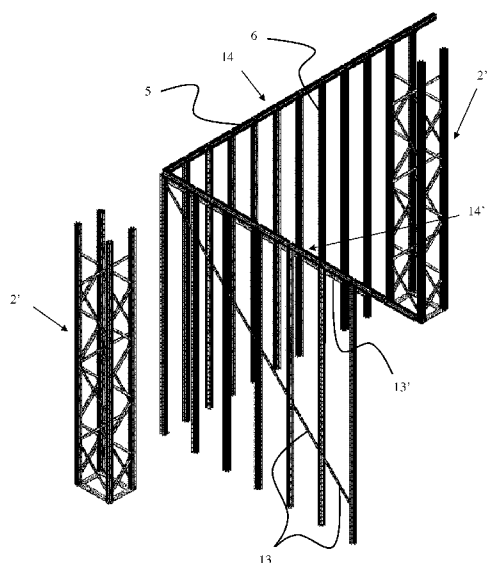


Fig. 10

(57) Abstract: The present invention provides a storage system (10) comprising a storage grid structure (20) and multiple bin handling vehicles (40), the storage grid structure comprises a first and a second type of vertical storage column profiles (1,6,6') defining multiple storage columns (2), wherein the first type of storage column profiles (1) has a cross-section comprising a hollow centre section (7) and four corner sections (8), each corner section comprises two perpendicular bin guiding plates (9) for accommodating a corner (11) of a storage bin (30), and the second type of storage column profiles (6,6') has a cross-section comprising a hollow centre section (7) having at least two connecting elements (12,28), and at least one corner section (8), the corner section comprises two perpendicular bin guiding plates (9) for accommodating a corner (11) of a storage bin (30), wherein the storage grid structure comprises a grid supporting structure (14, 14', 2') comprising at least some of the second type of storage column profiles (6,6') interconnected, via their connecting elements (12,28), by vertically inclined support struts (13, 13', 29).

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STORAGE SYSTEM

Technical field

The present invention relates to the field of automated storage systems.

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Background

The Applicant's already known AutoStore system is an automated storage system comprising a three-dimensional storage grid structure wherein storage
10 bins/containers are stacked on top of each other to a certain height. Such a prior art system is shown in fig. 1.

The storage system is disclosed in detail in for instance NO317366, WO 2014/090684 A1 and WO 2015/193278 A1.

The storage system 10 comprises a grid structure 20, see fig. 2, constructed of
15 aluminium profiles/uprights 1 interconnected by top rails 5. The profiles define multiple storage columns 2, in which the storage bins 30 may be stacked vertically one on top of another.

A cross-sectional view of a prior art profile 1 is shown in fig. 3 and a cross-sectional view of a storage column 2 for accommodating a stack of storage bins 30
20 is shown in fig. 4.

A number of remotely operated vehicles 40, or robots, are arranged on the top rails 5 and may move horizontally on top of the storage grid.

Each vehicle is equipped with a lifting device for picking up, carrying, and placing storage bins 30 that are stored in the storage grid.

25 The system also comprises picking and/or supply stations 60, where one or several product items are picked out from the storage bin 30 or where one or several product items are placed into the storage bin 30.

When a product item stored in a storage bin is to be picked from the storage grid, the robot is arranged to pick up the storage bin containing that product type and
30 then transport it to a bin lift 50. The bin lift transports the storage bin to the picking and/or supply station 60, where the item of the product type is retrieved from the storage bin. The storage bin with the remaining product items is thereafter returned to the storage grid by means of a bin lift and a robot. The picking and/or supply station 60 illustrated in fig. 1 is only shown schematically as a simple table upon
35 which the storage bin is arranged.

The same procedure is used for supplying product items into the storage grid. First, items are supplied into a storage bin at a picking and/or supply station. The bin lift

then lifts the storage bin up to the upper level where a robot transports the storage bin to its correct position within the storage grid.

A storage control and communication system is used to monitor inventory, to keep track of the location of respective storage bins (within storage grid and/or during transport), the content of each storage bins etc. Further, the storage control and communication system may also comprise, or may be provided in communication with, a control system for controlling the robots to pick a desired storage bin and to deliver it at the desired location at the desired time – without colliding with other robots.

To ensure sufficient stability of the grid structure 20, the prior art storage systems are dependent on an auxiliary grid supporting structure (not shown) arranged at least partly along the periphery of the grid. The requirement of having an auxiliary grid supporting structure is disadvantageous for a number of reasons. The supporting structure occupies space/area which could otherwise be utilized by the storage grid, i.e. it prevents optimum use of available space/area for storage; the need of a supporting structure may limit the available options for positioning of the storage system, i.e. the supporting structure may prevent the optimum positioning of the storage system since the auxiliary grid supporting structure often requires connection to a surrounding structure, such as the inner walls of a building; and the requirement of a supporting structure is not cost efficient.

In view of the prior art, the purpose of the present invention is to provide a storage system having a storage grid structure that is not as dependent on an auxiliary grid supporting structure, i.e. to provide a free-standing storage grid or at least a storage grid requiring a less extensive auxiliary grid supporting structure.

Summary of the invention

The present invention is defined by the attached claims and in the following:

In a first aspect, the present invention provides a storage system comprising a storage grid structure and multiple remotely operated storage bin handling vehicles, the storage grid structure comprises a first and a second type of vertical storage column profiles defining multiple storage columns in which storage bins are stored one on top of another in vertical stacks, the storage column profiles are interconnected at their top ends by rails forming a horizontal rail grid upon which the bin handling vehicles may move in two perpendicular directions, wherein

- the first type of storage column profiles has a cross-section comprising a hollow centre section and four corner sections, each corner section

comprises two perpendicular bin guiding plates (i.e. comprises two bin guiding plates being perpendicular to each other) for accommodating a corner of a storage bin, and

- the second type of storage column profiles has a cross-section comprising a hollow centre section having at least two connecting elements, and at least one corner section, the corner section comprises two perpendicular bin guiding plates for accommodating a corner of a storage bin,

wherein the storage grid structure comprises a grid supporting structure comprising at least some of the second type of storage column profiles interconnected via their connecting elements by vertically inclined support struts.

In an embodiment of the storage system, the first type of storage column profiles comprises at least two connecting elements similar to the second type of storage column profiles. In an embodiment the first type and the second type of storage column profiles have the same cross-section. In embodiments, wherein the first and the second type of storage column profiles are the same, i.e. both types of profiles comprise at least two connecting elements, the inventive storage system may be defined as a storage system comprising a storage grid structure and multiple remotely operated storage bin handling vehicles, the storage grid structure comprises vertical storage column profiles defining multiple storage columns in which storage bins are stored one on top of another in vertical stacks, the storage column profiles are interconnected at their top ends by rails forming a horizontal rail grid upon which the bin handling vehicles may move in two perpendicular directions, wherein

- the storage column profiles have a cross-section comprising a hollow centre section having at least two connecting elements, and at least one corner section, the corner section comprises two perpendicular bin guiding plates for accommodating a corner of a storage bin,

wherein the storage grid structure comprises a grid supporting structure comprising at least some of the storage column profiles interconnected via their connecting elements by vertically inclined support struts.

When any of the first or second type of storage column profiles comprises four corner sections, the corner sections are evenly distributed around the centre section, such that multiple profiles may provide multiple storage columns, wherein each profile may be common for four separate storage columns.

In an embodiment of the storage system, the support struts have a width allowing them to be connected to a connecting element without crossing a plane of an

adjacent bin guiding plate, such that any support strut connected to a second type of storage column profile will not interfere with a storage bin whose corner is accommodated by a corner section comprising the adjacent bin guiding plate.

- 5 In an embodiment of the storage system, the support struts have a width allowing them to be connected to a connecting element without crossing a plane extending from a bin guiding plate of one column profile and a corresponding bin guiding plate of an adjacent column profile, such that any support strut connected to a second type of storage column profile will not interfere with a storage bin whose
10 corners on one side are guided by the bin guiding plates.

- In other words, the width of the support struts is such that no support strut will extend into a bin-shaped or rectangular space delimited by four corner sections, each corner section belonging to one of four separate storage column profiles
15 forming a storage column.

- In an embodiment of the storage system, the second type of storage column profiles comprises at least two corner sections, wherein two bin guiding plates, one of each of the two corner sections, are parallel and extend in the same direction forming a
20 recess delimited by the two bin guiding plates and an external surface of the centre section, and the recess has a width (i.e. the distance between the parallel bin guiding plates) suitable for accommodating one of the inclined support struts.

- In an embodiment of the storage system, one of the at least two connecting elements
25 is arranged in, or at, the external surface of the centre section delimiting the recess.

- In an embodiment of the storage system, the second type of storage column profiles comprises four connecting elements, and four corner sections, each of the connecting elements is arranged in a recess delimited by two parallel bin guiding
30 plates, and each recess has a width suitable for accommodating an inclined support strut.

- In an embodiment of the storage system, each of the support struts comprises a first connecting end and a second connecting end for interconnecting two separate
35 second type of storage column profiles via their connecting elements. Each of the connecting ends comprises a surface inclined with respect to a longitudinal centerline of the support strut, such that the support strut is inclined when interconnecting two storage column profiles.

- 40 In an embodiment of the storage system, each of the support struts has a cross-section which extends more in the vertical direction than in a horizontal direction. In one embodiment, the support strut comprises two perpendicular plate elements

and has an L-shaped cross-section, such that the support capacity of the strut is not restricted by the maximum width of the strut. In other words, the cross-section of the strut may have a height larger than the width of the recess.

5 In an embodiment of the storage system, a first wall-shaped framework of the storage grid structure comprises at least some of the second type of storage column profiles interconnected via their connecting elements by vertically inclined support struts; the support struts are arranged in line and extend from a position at an upper corner of the first framework and towards a base of the storage grid structure. The
10 support struts are arranged in line such that the upper corner is prevented from tilting in the vertical plane of the first framework in a direction away from the base. Alternatively, the wall-shaped framework may be termed a planar vertical framework.

15 In an embodiment of the storage system, a second wall-shaped framework of the storage grid structure, being perpendicular to the first wall-shaped framework, comprises at least some of the second type of storage column profiles interconnected via their connecting elements by vertically inclined support struts; the support struts are arranged in line and extend from a position at an upper corner
20 of the second framework and towards the base of the storage grid structure, and the first and second wall-shaped framework have one of the second type of storage column profiles in common (i.e. such that the upper corner is prevented from tilting in a direction away from the base). In other words, the combination of the first and second wall-shaped framework ensures that the upper corner is prevented from
25 tilting.

In an embodiment of the storage system, the second type of storage column profile common for the first and second wall-shaped framework has a top end at the upper corner of the first and second wall-shaped framework, respectively.

30 In an embodiment of the storage system, the storage grid structure has at least one storage column comprising two to four, preferably four, of the second type of storage column profiles interconnected by multiple vertically inclined support struts.

35 In an embodiment of the storage system, the connecting elements are attachment grooves or attachment ribs.

40 In an embodiment of the storage system, the attachment ribs comprise a flared connecting portion distal to an external surface of the centre section. When the second type of storage column profile comprises attachment ribs, each connecting end of the support struts preferably comprises a clamp assembly for connecting the

end to an attachment rib. In a further embodiment, the flared connecting portion is forked to provide a resilient interaction with the clamp assembly.

5 In an embodiment of the storage system, each of the at least two attachment grooves comprises (or is flanked by) parallel lips/flanges extending from an external surface of the centre section. In other words, each attachment groove comprises a lip along each longitudinal edge of the groove. Preferably, each lip comprises a strut abutting surface for interaction with any of a first and second connecting end of a support strut. When the second type of storage column profile comprises attachment
10 grooves, each connecting end of the support struts has preferably a hole for connecting the end to an attachment groove, preferably by use of a T-bolt.

15 In a second aspect, the present invention provides a storage column for a storage system according to the first aspect, comprising four of the second type of storage column profiles interconnected via their connecting elements by vertically inclined support struts. The storage column of the second aspect may advantageously comprise four of the storage column profiles according to the third aspect below.

20 In a third aspect, the present invention provides a storage column profile for a storage system according to any of the embodiments of the first aspect, wherein the cross-section of the storage column profile comprises a hollow centre section, at least two connecting elements, and at least one corner section, wherein

- 25 - the connecting elements are arranged in, or at, the centre section; and
- the corner section comprises two perpendicular bin guiding plates for accommodating a corner of a storage bin.

30 In an embodiment, the storage column profile comprises four connecting elements and four corner sections, wherein each of the connecting elements is arranged in a recess delimited by two of the corner sections.

35 In an embodiment of the storage column profile, each recess is delimited by two parallel bin guiding plates, one bin guiding plate from each of the two corner sections delimiting the recess.

In an embodiment of the storage column profile, the connecting elements are attachment grooves or attachment ribs.

40 In an embodiment of the storage column profile, the attachment ribs comprise a flared connecting portion distal to an external surface of the centre section. In yet an embodiment, the flared connecting portion is forked.

In an embodiment of the storage column profile, each of the at least two attachment grooves comprise (or is flanked by) parallel lips/flanges extending from an external surface of the centre section. In other words, each attachment groove comprises a lip/flange along each longitudinal edge of the groove. Preferably, each lip
5 comprises a strut abutting surface for interaction with any of a first and second connecting end of a support strut.

The corner sections of the storage column profile according to the third aspect, when featuring four corner sections, are evenly arranged around the centre section,
10 i.e. each corner section centered in a direction staggered 90 degrees in relation to a neighboring corner section.

The term «storage column profile» is intended to mean a longitudinal metal element having the same cross-section over its whole length. The cross-section of the
15 storage column profile is the cross-section transverse to the longitudinal direction of the profile. The storage column profile may be made by extrusion, for example, of a lightweight material like aluminium.

The term “grid supporting structure” is intended to mean a structure able to stabilize
20 a storage grid structure against horizontal components of an applied force. In the present invention, a grid supporting structure is an integral part of the storage grid structure.

25 **Short description of the drawings**

Embodiments of the invention will now be described in greater detail by way of example only and with reference to the following drawings:

30 Fig. 1 is a perspective view of a prior art storage system.

Fig. 2 is a perspective view of the grid structure of the prior art storage system in fig. 1.

35 Fig. 3 is a cross-sectional view of a prior art storage column profile.

Fig. 4 is a cross-sectional view of a prior art storage column made up of four storage column profiles as shown in fig. 3.

40 Fig. 5 is a cross-sectional view of an exemplary storage column profile according to the invention.

Fig. 6 is a perspective view of two exemplary support struts for use with the storage column profile in fig. 5.

5 Fig. 7 is a perspective view of an exemplary storage column according to the invention.

Fig. 8 is a perspective view of a grid supporting structure for an exemplary storage system according to the invention.

10 Fig. 9 shows a detail of the supporting structure in fig. 8.

Fig. 10 is a perspective view of an assembly of the supporting structure in fig. 8 and two storage columns as shown in fig. 7.

15 Fig. 11 is a sideview of the assembly in fig. 10.

Fig. 12 is a topside view of the assembly in fig. 10.

20 Fig. 13 is a cross-sectional view B-B of the assembly in fig. 11 showing a storage column profile connected to two support struts.

Fig. 14 is a cross-sectional view C-C of one of the storage columns of the assembly in fig. 11.

25 Figs. 15a and 15b are cross-sectional views of further exemplary storage column profiles according to the invention.

30 Fig. 16 is a cross-sectional view of an exemplary storage column profile according to the invention.

Figs. 17 and 18 are perspective views of the storage column profile in fig. 16 and further exemplary support struts connected thereto.

35 Fig. 19 is an exploded view of the exemplary support struts in figs. 17 and 18.

Detailed description of the drawings

40 As discussed above, the prior art storage system shown in fig. 1 is dependent on having an auxiliary grid supporting structure (not shown), since the grid structure itself is not sufficiently stable towards forces having a substantial horizontal component. Such forces may be present, in particular as a result of movement and

acceleration of the remotely operated vehicles 40, or robots, arranged on the grid of rails 5 on top of the grid structure.

5 The grid structure 20 of the prior art storage system in fig. 1 is made up of multiple vertical profiles 1 (i.e. a first type of storage column profiles), see fig. 3, interconnected at their top ends 4 by rails 5. Four profiles 1 make up a storage column 2, in which multiple storage bins may be stacked. The profiles 1 have a cross-section featuring a hollow centre section 7 and four corner sections 8, wherein each corner section comprises two perpendicular bin guiding plates 9. The two
10 perpendicular bin guiding plates 9 are arranged to accommodate a corner 11 of a storage bin 30 (or a corner of a stack of storage bins). In other words, each of the corner sections 8 defines two sides of a substantially triangular area (or a triangular space considering the longitudinal dimension of the profile) which may accommodate a storage bin corner 11, see fig. 4. The corner sections 8 are evenly
15 arranged around the centre section 7, such that multiple profiles may provide multiple adjacent storage columns 2, wherein each profile may be common for up to four separate storage columns.

20 A cross-sectional view of a storage column 2, made up of four prior art profiles 1, is shown in fig. 4. The cross section of the profile is constant over the whole length of the profile. The horizontal periphery of a storage bin 30 having four corners 11 is shown to illustrate how the storage bin (or stack of storage bins) is arranged in the storage column 2. The four corner sections 8, one from each of the four profiles 1, ensure that a storage bin 30 introduced into the storage column 2 is guided into a
25 correct position relative to both any storage bin already present in the storage column and the stacks of storage bins in the surrounding storage columns.

To obtain a storage system which is independent of having an auxiliary grid supporting structure, the applicant has developed a new, or second, type of profile 6
30 (i.e. a second type of storage column profile), see fig. 5. The embodiment shown in fig. 5 has a cross-section featuring a hollow centre section 7, having four attachment grooves 12 (i.e. connecting elements), and four corner sections 8, wherein each corner section 8 comprises two perpendicular bin guiding plates 9. The function of the corner sections 8 are as described above for the prior art profile. The corner
35 sections 8 and the attachment grooves 12 are alternately and evenly arranged around a longitudinal centreline C of the centre section 7. In this manner, each of the attachment grooves 12 in the centre section 7 is arranged in a recess/space formed by two parallel bin guiding plates 9 of two adjacent corner sections 8. The recesses have a width W1.

40 The attachment grooves allow multiple second type of profiles to be interconnected by inclined support struts, see fig. 6. The support struts 13,13' have a width W2 (see

- fig. 13) narrower than the width W1 of the recesses of the profiles 6, thus allowing them to be inserted into the recesses and into contact with the attachment grooves 12. The disclosed support struts have a first connecting end 21 and a second connecting end 22, each connecting end having a hole through which the support struts may be connected to an attachment groove 12 by use of for instance T-bolts, see fig. 13. The connecting ends 21,22 are inclined with respect to a longitudinal centerline of the support strut, such that the support strut is inclined in a vertical direction when interconnecting two of the second type of profile. The angle in which the support struts are inclined is commonly between 30-60 degrees, preferably about 45 degrees. Preferred storage systems commonly feature storage bins having a rectangular cross-section. Consequently, the support struts 13, 13' are provided in two different lengths to allow for interconnection of the second type of profiles 6 at two different distances.
- 15 The attachment grooves 12 have lips 19 extending from the longitudinal edges of the grooves to obtain a secure connection of the support struts 13,13' by use of T-bolts. The lips have a substantially L-shaped cross-section. T-bolts, see fig. 13, have a neck section 25 (i.e. a longitudinal section without a thread) which requires a certain minimum distance D between an internal surface 26 of the attachment
- 20 groove 12 and a strut abutting surface 27 (i.e. a surface on the profiles for interaction with the first or second connecting end of a support strut) on the second type of profiles 6. The distance D is required to obtain a sufficient tightening of the T-bolt connection. In this embodiment, the strut abutting surface 27 is arranged on the lips 19, ensuring that the distance D is adequate without having to increase the
- 25 thickness F of the walls making up the hollow centre section. Thus, by featuring the lips 19, the second type of profiles 6 is as light as possible. A further advantageous effect of the lips is that that they reinforce the edges of the attachment grooves, providing an increased torsional strength.
- 30 By use of the second type of profiles it is possible to construct storage systems having a storage grid with an integrated grid supporting structure, which supporting structure does not compromise the storage capacity of the storage grid 20. Thus, the requirement of an auxiliary or external grid supporting structure is avoided.
- 35 Exemplary grid supporting structures for integration in the storage grid structure 20 of an automated storage system are shown in figs. 7-14.
- A grid supporting structure arranged as a storage column 2' is shown in fig. 7. The storage column is made up of four second type profiles 6 interconnected by multiple
- 40 vertically inclined support struts 13,13'. By using support struts having a width which allows them to fit in between two parallel bin guiding plates 9, the ability of the storage column to accommodate a stack of storage bins is not compromised. In

other words, the support struts 13,13' do not intersect/cross the plane P in which an adjacent bin guiding plate 9 of a corner section 8 is arranged, see fig. 13. A cross-sectional view of the storage column 2' is shown in fig. 14, wherein the horizontal periphery of a storage bin 30 is shown in a dashed line for illustrative purposes. The cross-sectional view shows how the present invention provides a storage column 2' having both a full storage bin capacity and at the same time being able to provide support to a storage grid structure.

A grid supporting structure arranged as two wall-shaped frameworks 14,14' using a second type of profile 6 at a common corner is shown in fig. 8 and 9. A combination of two such wall-shaped frameworks 14,14' and a storage column 2' for a grid supporting structure is shown in figs. 10-12.

The first framework 14 comprises ten second type of profiles 6 interconnected by multiple vertically inclined support struts 13'. The support struts 13' are arranged in line to provide a brace extending from a position at an upper corner 15 of the framework 14 towards a base 16 upon which the grid supporting structure is arranged (i.e. the base of a storage grid structure 20 in which the framework is integrated). The second framework 14' is arranged perpendicular to the first framework and comprises seven second type of profiles 6 (including the profile in common with the first framework) interconnected by multiple vertically inclined support struts 13. The support struts 13 are arranged in line to provide a brace extending from a position at an upper corner 15 of the second framework 14' towards the base 16. In other embodiments, the number of support struts interconnecting the frameworks will depend on the angle at which the struts are inclined and the size, i.e. width and height, of the frameworks.

When being part of a wall-shaped framework structure as described above, wherein the frameworks 14,14' form a part of two perpendicular external sidewalls of a storage grid structure, i.e. the frameworks form an integral part of the sidewall, the second type of profiles 6 may alternatively be a simplified version of the profile shown in fig. 5. That is, the profile being common to both of the wall-shaped frameworks, i.e. a common corner profile, requires only a single corner section 8 and two attachment grooves 12, the attachment grooves arranged in two directions, being perpendicular to each other, and on opposite sides of the corner section 8, see fig. 15b. Further, the remaining profiles 6 of a wall-shaped framework 14,14' forming a part of an external sidewall of a storage grid structure will require two corner sections 8 and two attachment grooves 12, wherein the attachment grooves 12 are arranged in two opposite directions and the two corner section are arranged on the side of the profile facing into the storage grid structure, i.e. both of the two corner sections 8 are positioned on one side of a plane in which the two attachment grooves are arranged, see. fig. 15a.

Thus, the wall-shaped frameworks 14,14' may in some embodiments be part of the external sidewalls of a storage grid structure to provide a horizontally stable storage grid. Depending on the specific location of the storage grid structure, the number and position of grid supporting structures integrated in the storage grid structure may vary. In some embodiments, for instance when one side of the storage grid structure may be supported by an external structure, like an inner wall of a building, only parts of the storage grid structure is supported by the integrated grid supporting structure. In an exemplary storage system, a cuboid storage grid may for instance comprise a grid supporting structure in the form of two wall-shaped frameworks 14,14', as described above, arranged at each vertical corner. This would provide a freestanding storage grid not requiring any external support.

In alternative embodiments, the wall-shaped frameworks may advantageously be arranged as an internal part of a storage grid structure.

A cross-sectional view of a further exemplary embodiment of a second type of profile 6' is shown in fig. 16. In this further embodiment, the attachment grooves 12 of the second type of profiles 6 described above is replaced by attachment ribs 28 (i.e. a connecting element), while the remaining features are the same. The rib features a connecting portion 30 distal to the center section 7. The connecting portion have a wider cross-section than the remaining part of the attachment rib, i.e. is flared, and is arranged for interaction with a corresponding recess 31 at the connecting ends 21,22 of the support struts 29, 32, see figs. 17-19. The support struts 29 are vertically inclined, while the support struts 32 are horizontal. The recess 31 is formed by a clamp assembly 33 at each of the connecting ends. The clamp assembly 33 comprises a fastening plate 34 connected to a connecting end of the support strut 29,32 by two bolts 35. The fastening plate and the connecting end comprises cooperating recess halves 36 providing the recess 31 in which the connecting portion of the attachment rib is clamped.

To improve the connection to the clamp assembly, the connecting portion 30 is preferably resilient. In this embodiment, this is obtained by having a forked connecting portion.

It is noted that the second type of profiles 6' are suitable for constructing grid supporting structures, such as the storage column 2' and the wall-shaped frameworks 14,14' disclosed above.

The present detailed description of the invention shows embodiments of the invention wherein the second type of profiles 6 is described in detail for use in grid supporting structures for integration in a typical prior art storage grid structure 20

comprising prior art profiles (i.e. the first type of profiles). Using a combination of the first and second type of profiles in a storage grid structure is the most cost-efficient solution, since the second type of profiles is more expensive to manufacture. Further, the second type of profile is slightly heavier than a
5 corresponding first type of profile (i.e. a profile having four corner sections). However, the presence of the prior art profiles 1 in a storage grid structure is not a requirement, and in further embodiments, the second type of profiles 6 may also be used as the only type of profile in a storage grid structure.

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Claims

1. A storage system (10) comprising a storage grid structure (20) and multiple remotely operated storage bin handling vehicles (40), the storage grid structure comprises a first and a second type of vertical storage column profiles (1,6,6') defining multiple storage columns (2) in which storage bins (30) can be stored one on top of another in vertical stacks (3), the storage column profiles are interconnected at their top ends (4) by rails (5) forming a horizontal rail grid upon which the bin handling vehicles (40) may move in two perpendicular directions, wherein
- the first type of storage column profiles (1) has a cross-section comprising a hollow centre section (7) and four corner sections (8), each corner section comprises two perpendicular bin guiding plates (9) for accommodating a corner (11) of a storage bin (30), and
 - the second type of storage column profiles (6,6') has a cross-section comprising a hollow centre section (7) having at least two connecting elements (12,28), and at least one corner section (8), the corner section comprises two perpendicular bin guiding plates (9) for accommodating a corner (11) of a storage bin (30),
- wherein the storage grid structure comprises a grid supporting structure (14, 14', 2') comprising at least some of the second type of storage column profiles (6,6') interconnected, via their connecting elements (12,28), by vertically inclined support struts (13,13',29).
2. A storage system according to claim 1, wherein the support struts (13,13',29) have a width (W2) allowing them to be connected to a connecting element (12,28) without crossing a plane (P) of an adjacent bin guiding plate (9), such that any support strut connected to a second type of storage column profile (6,6') will not interfere with a storage bin (30) whose corner (11) is accommodated by a corner section (8) comprising the adjacent bin guiding plate (9).
3. A storage system according to claim 1 or 2, wherein the second type of storage column profiles (6,6') comprises at least two corner sections (8), wherein two bin guiding plates (9), one of each of the two corner sections (8), are parallel and extend in the same direction forming a recess (18) delimited by the two bin guiding plates (9) and an external surface of the centre section (7), and the recess has a width (W1) suitable for accommodating one of the inclined support struts (13,13',29).

4. A storage system according to claim 3, wherein one of the at least two connecting elements (12,28) is arranged in, or at, the external surface of the centre section (7) delimiting the recess (18).
5. A storage system according to any of claims 1 to 4, wherein the second type of storage column profiles (6,6') comprises four connecting elements (12,28), and four corner sections (8), each of the connecting elements (12,28) is arranged in a recess (18) delimited by two parallel bin guiding plates (9), and each recess has a width (W1) suitable for accommodating one of the inclined support struts (13,13',29).
6. A storage system according to any of the preceding claims, wherein each of the support struts (13,13') comprises a first connecting end (21) and a second connecting end (22) for interconnecting two separate second type of storage column profiles (6,6') via their connecting elements (12,28).
7. A storage system according to claim 6 wherein each connecting end has a hole (23) for connecting the end to a connecting element of a second type of storage column profile, preferably by use of a T-bolt (24).
8. A storage system according to any of the preceding claims, wherein the support struts (13,13',29) have a cross-section which extends more in the vertical direction than in a horizontal direction.
9. A storage system according to any of the preceding claims, wherein a first wall-shaped framework (14) of the storage grid structure (20) comprises at least some of the second type of storage column profiles (6,6') interconnected, via their connecting elements (12,28), by vertically inclined support struts (13,13',29); the support struts are preferably arranged in a line and extending from a position at an upper corner (15) of the first framework (14) towards a base (16) of the storage grid structure (20).
10. A storage system according to any of the preceding claims, wherein a second wall-shaped framework (14') of the storage grid structure (20), being perpendicular to the first wall-shaped framework (14), comprises at least some of the second type of storage column profiles (6,6') interconnected, via their connecting elements (12,28), by vertically inclined support struts (13,13',29); the support struts are preferably arranged in a line and extending from a position at an upper corner (17) of the second framework (14') towards the base (16) of the storage grid structure, and the first and second wall-shaped framework have one of the second type of storage column profiles in common.

11. A storage system according to any of the preceding claims, wherein the storage grid structure (20) have at least one storage column (2') comprising four of the second type of storage column profiles (6,6') interconnected by multiple vertically inclined support struts (13,13',29).
12. A storage system according to any of the preceding claims, wherein the connecting elements are attachment grooves (12) or attachment ribs (28).
13. A storage system according to claim 12, wherein the attachment grooves (12) comprise parallel lips (19) extending from an external surface of the centre section (7).
14. A storage system according to claim 12, wherein the attachment ribs (28) comprise a flared connecting portion (31) distal to an external surface of the centre section (7).
15. A storage column for a storage system according to any of the preceding claims, comprising four of the second type of storage column profiles (6,6') interconnected, via their connecting elements (12,28), by vertically inclined support struts (13,13',29).
16. A storage column profile for a storage system according to any of claims 1-14, wherein the cross-section of the storage column profile (6,6') comprises a hollow centre section (7), at least two connecting elements (12,28), and at least one corner section (8), wherein
- the connecting elements (12,28) are arranged in, or at, the centre section; and
 - the corner section comprises two perpendicular bin guiding plates (9) for accommodating a corner (11) of a storage bin (30).
17. A storage column profile according to claim 16, comprising four connecting elements (12,28) and four corner sections (8), wherein
- each of the connecting elements (12,28) is arranged in a recess (18) delimited by two of the corner sections.
18. A storage column profile according to claim 17, wherein each recess (18) is delimited by two parallel bin guiding plates (9), one bin guiding plate from each of the two corner sections delimiting the recess.

19. A storage column profile according to any of claims 16-18, wherein the connecting element is an attachment groove (12) comprising parallel lips (19) extending from an external surface of the centre section (7).

5 20. A storage column profile according to any of claims 16-18, wherein the connecting element is an attachment rib (28).

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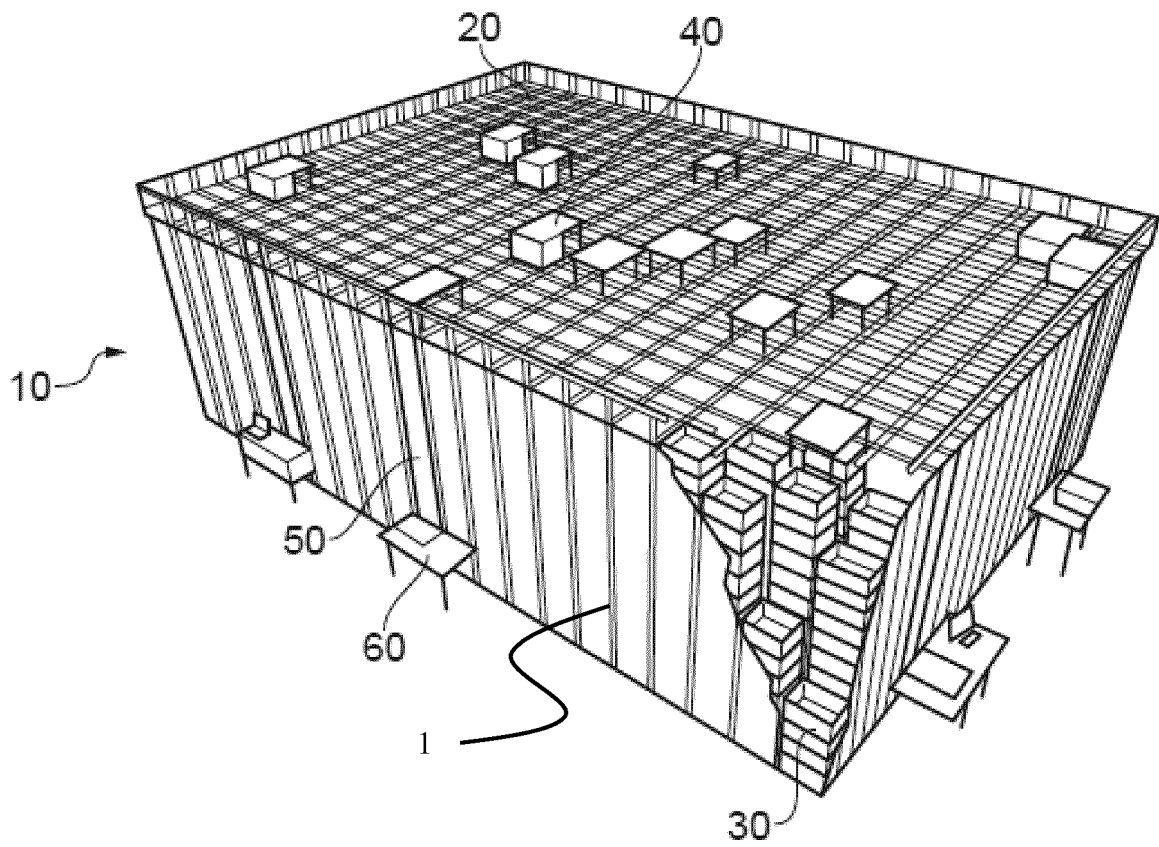


Fig. 1 (prior art)

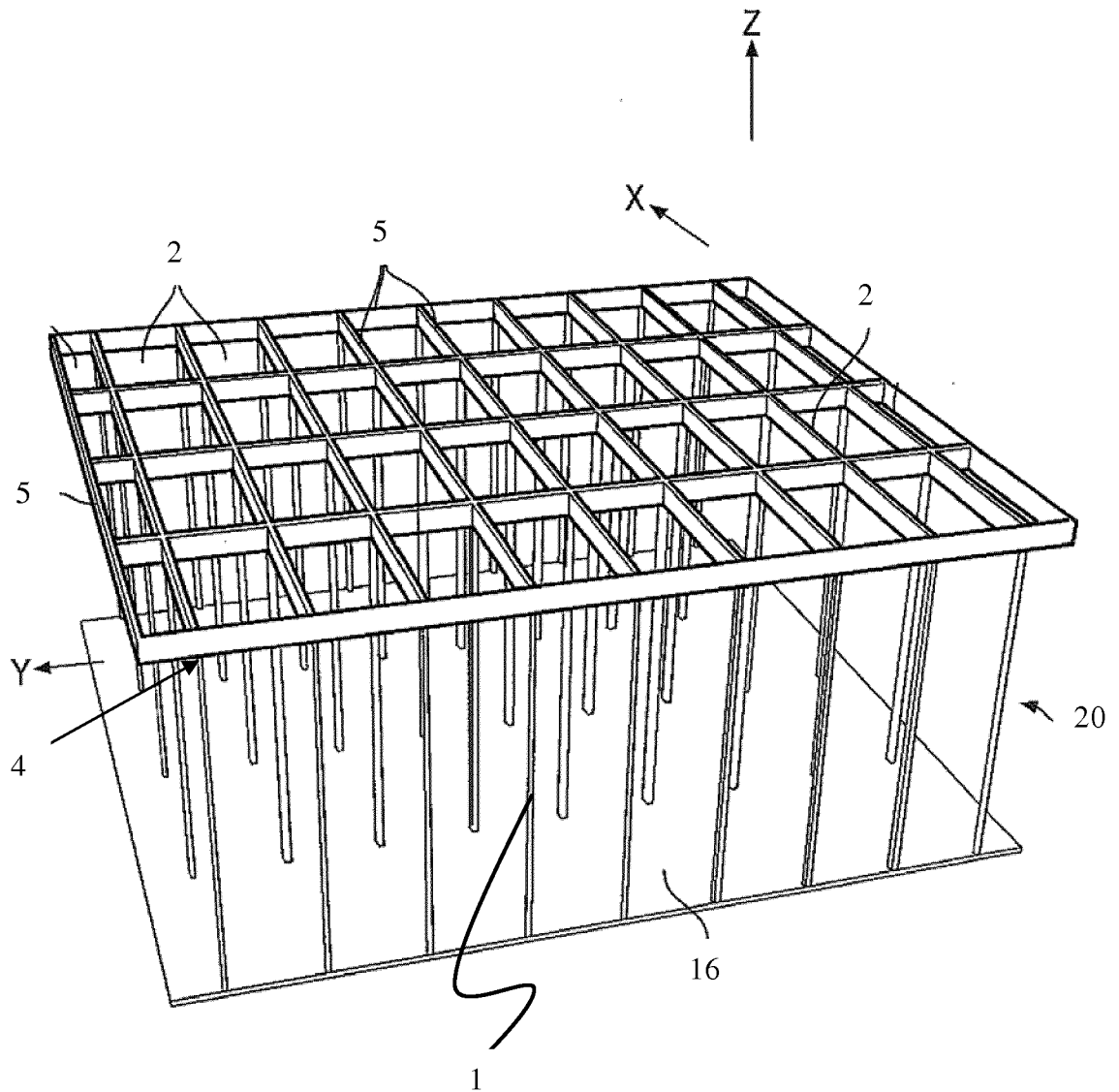


Fig. 2 (prior art)

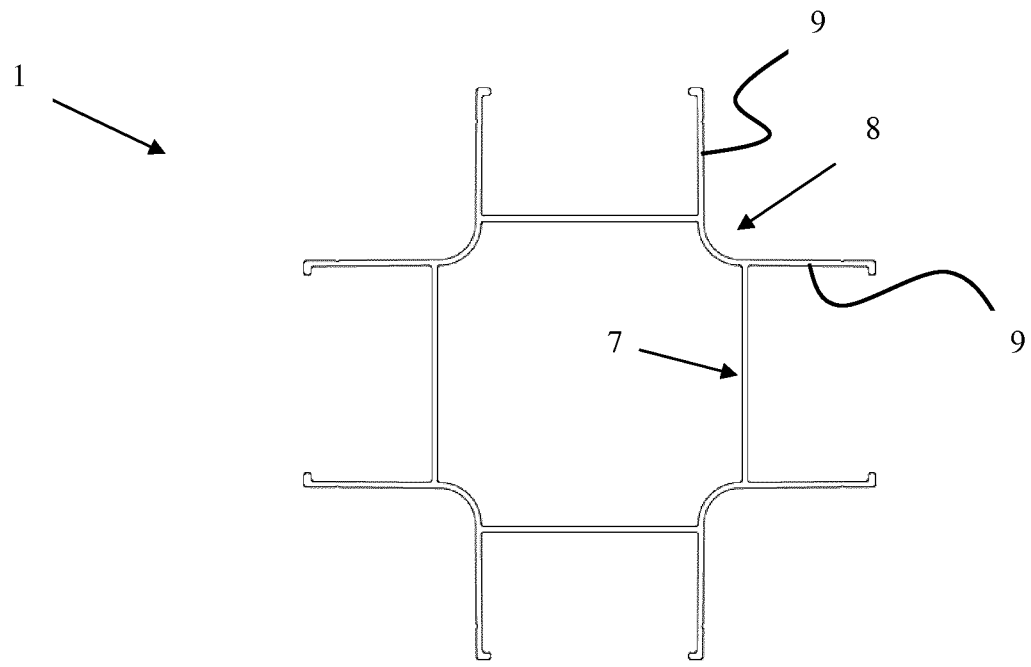


Fig. 3 (prior art)

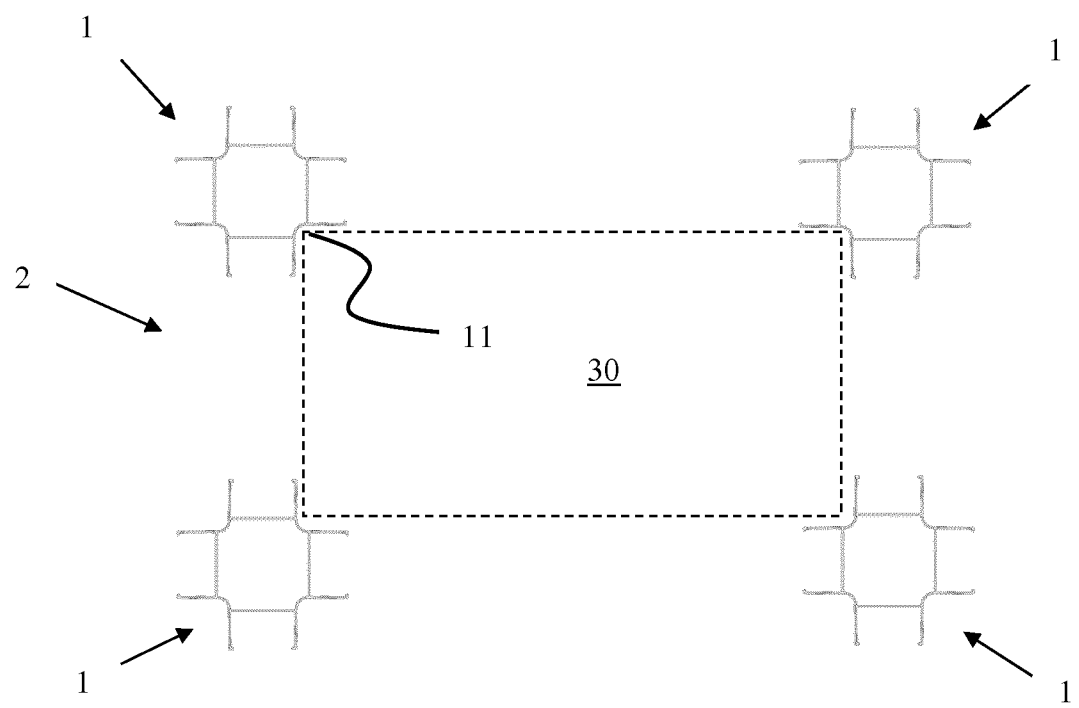


Fig. 4 (prior art)

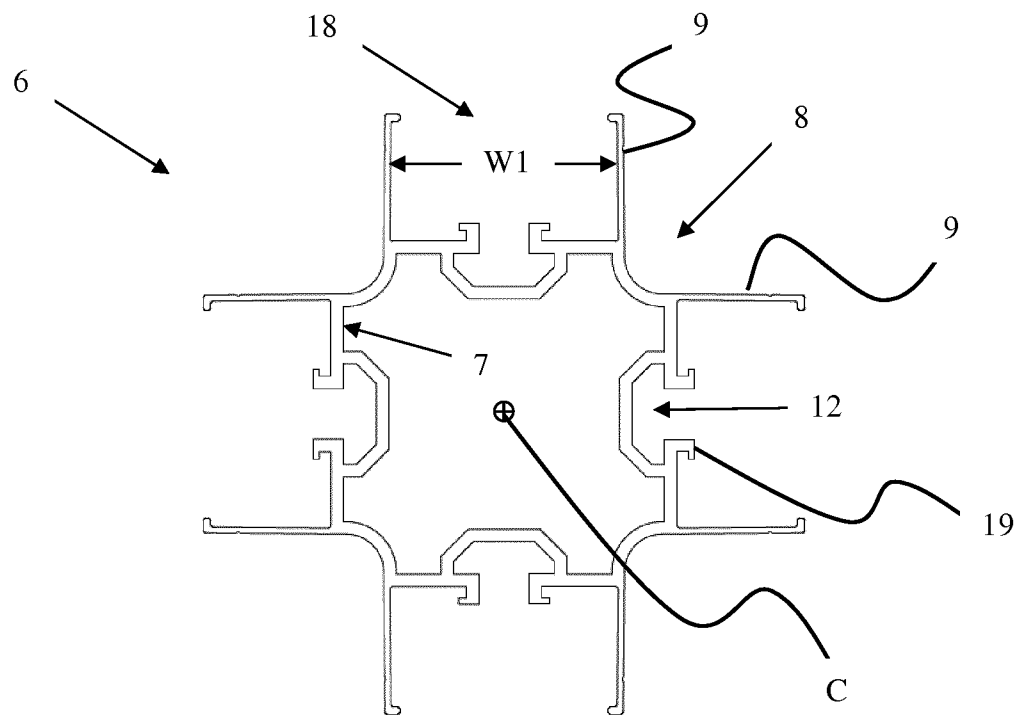


Fig. 5

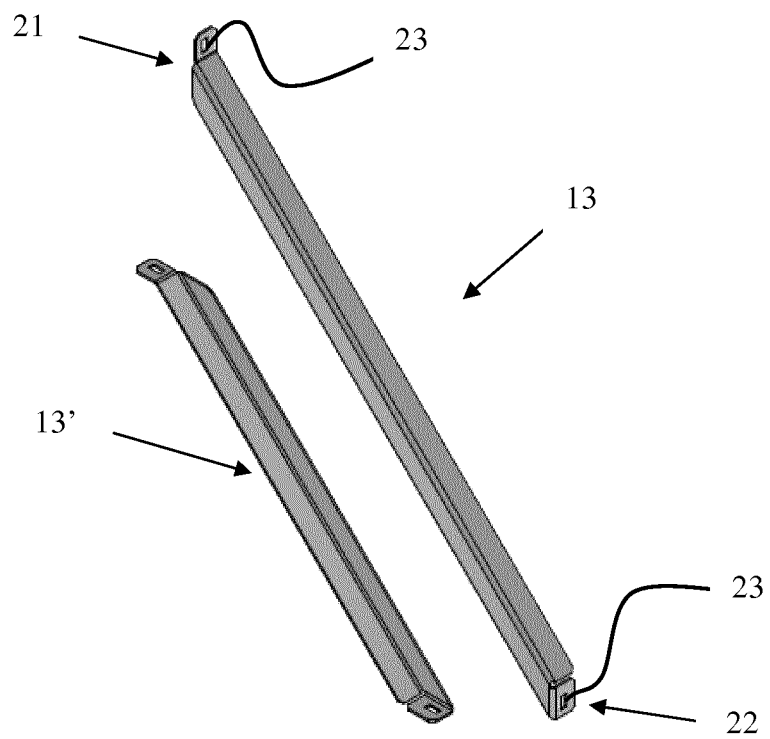


Fig. 6

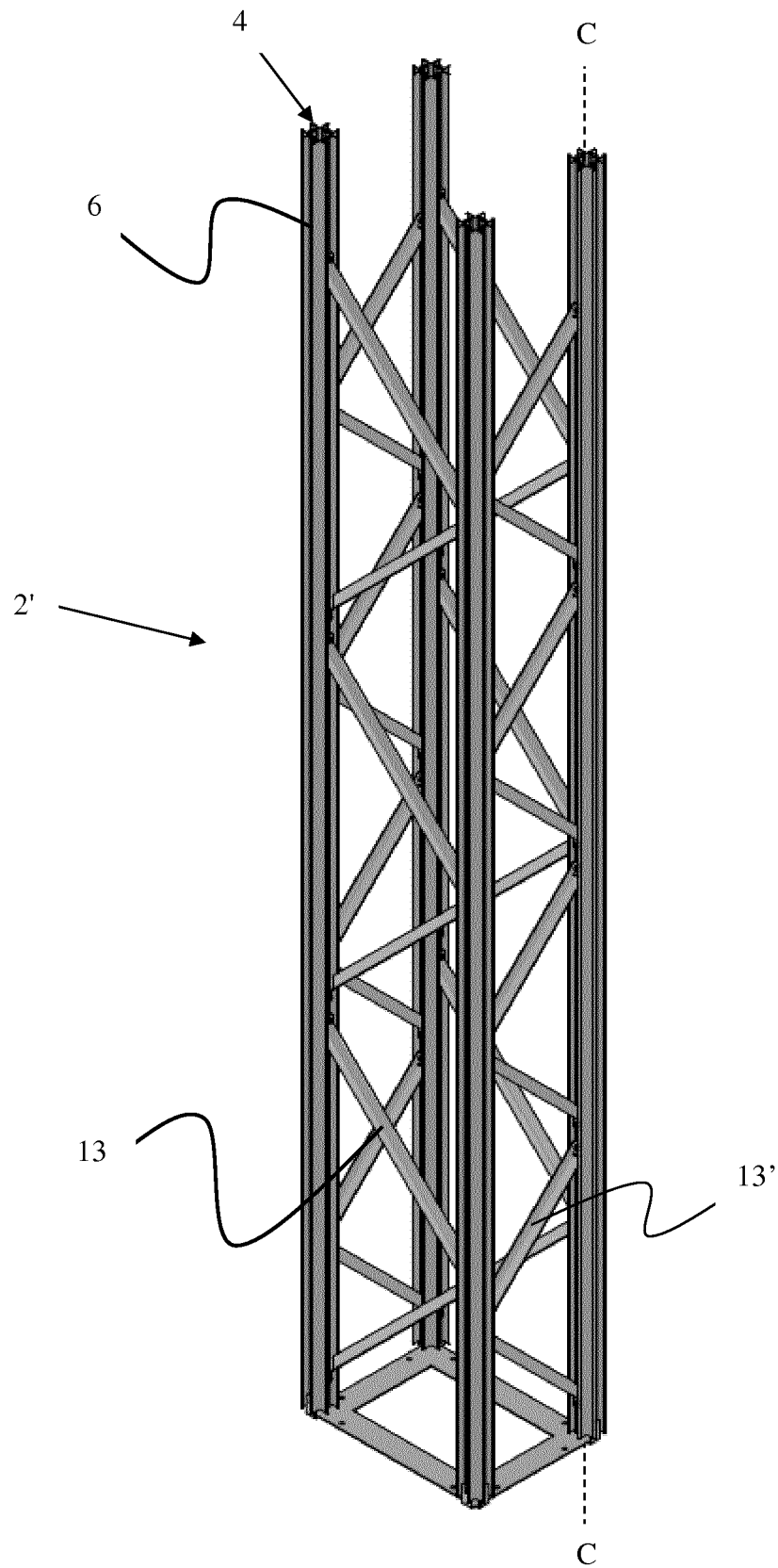


Fig. 7

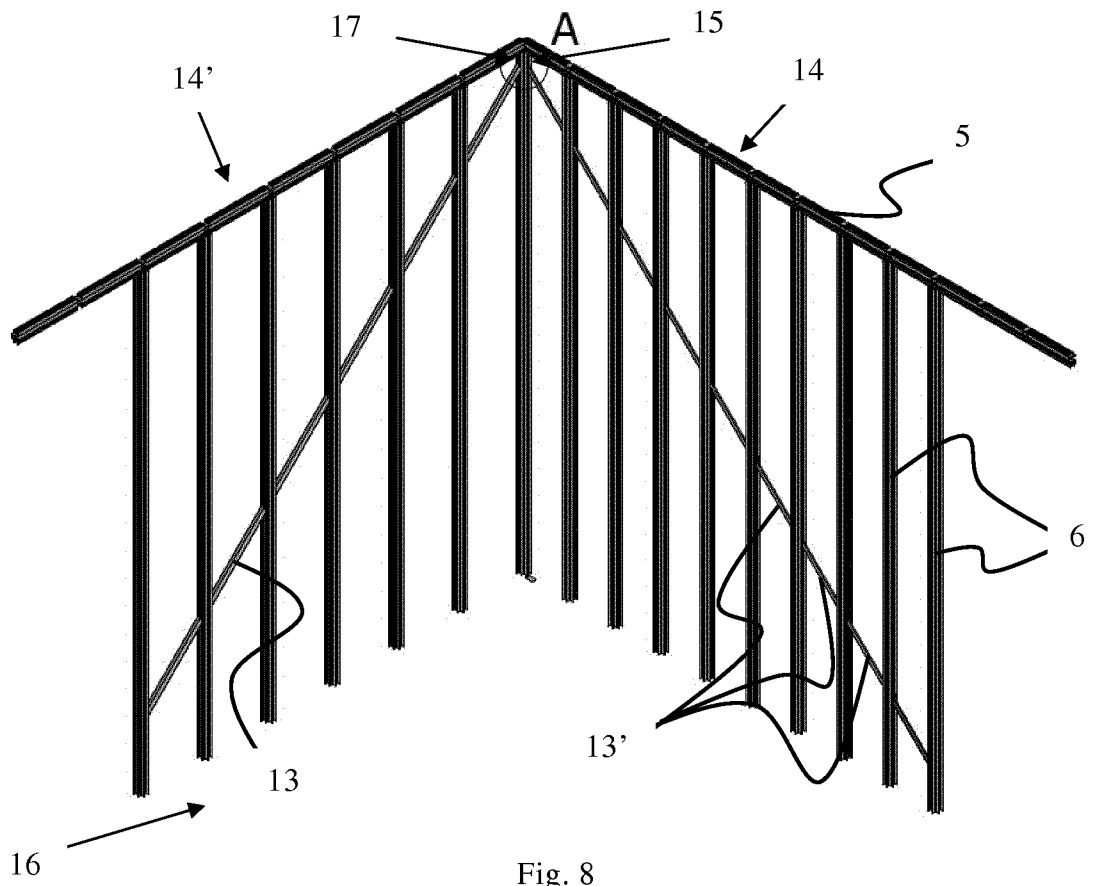


Fig. 8

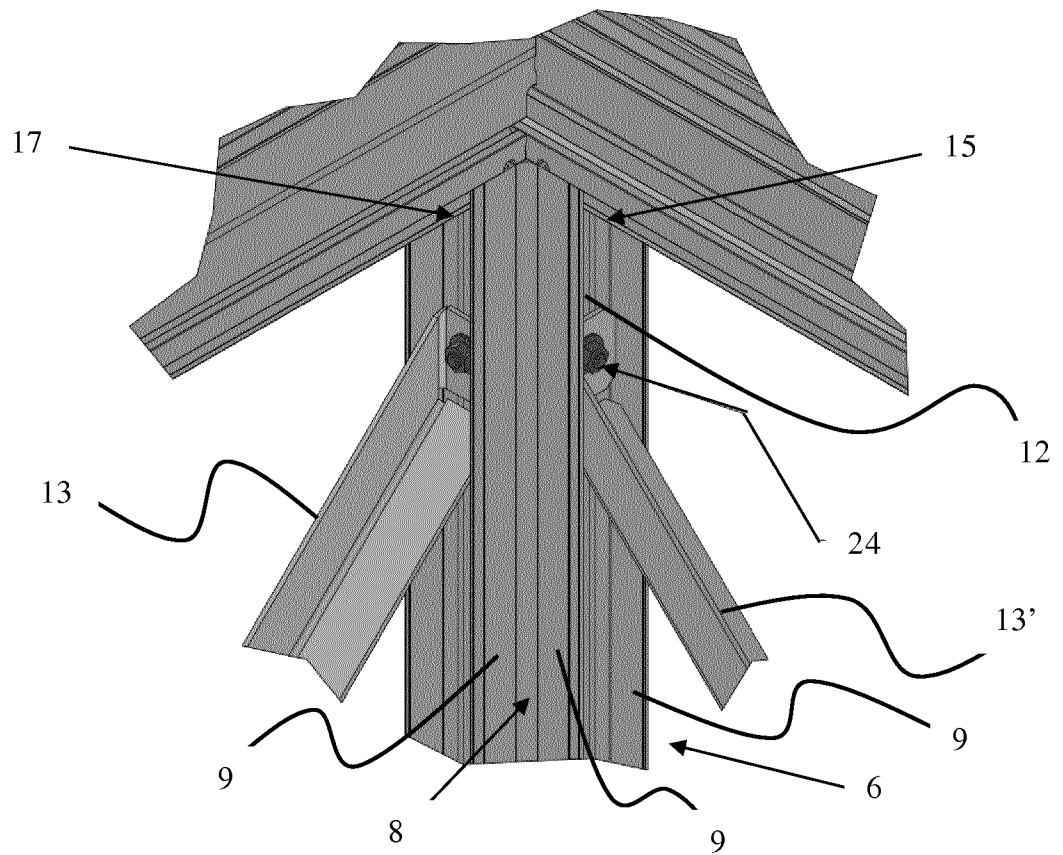


Fig. 9 (Detail A)

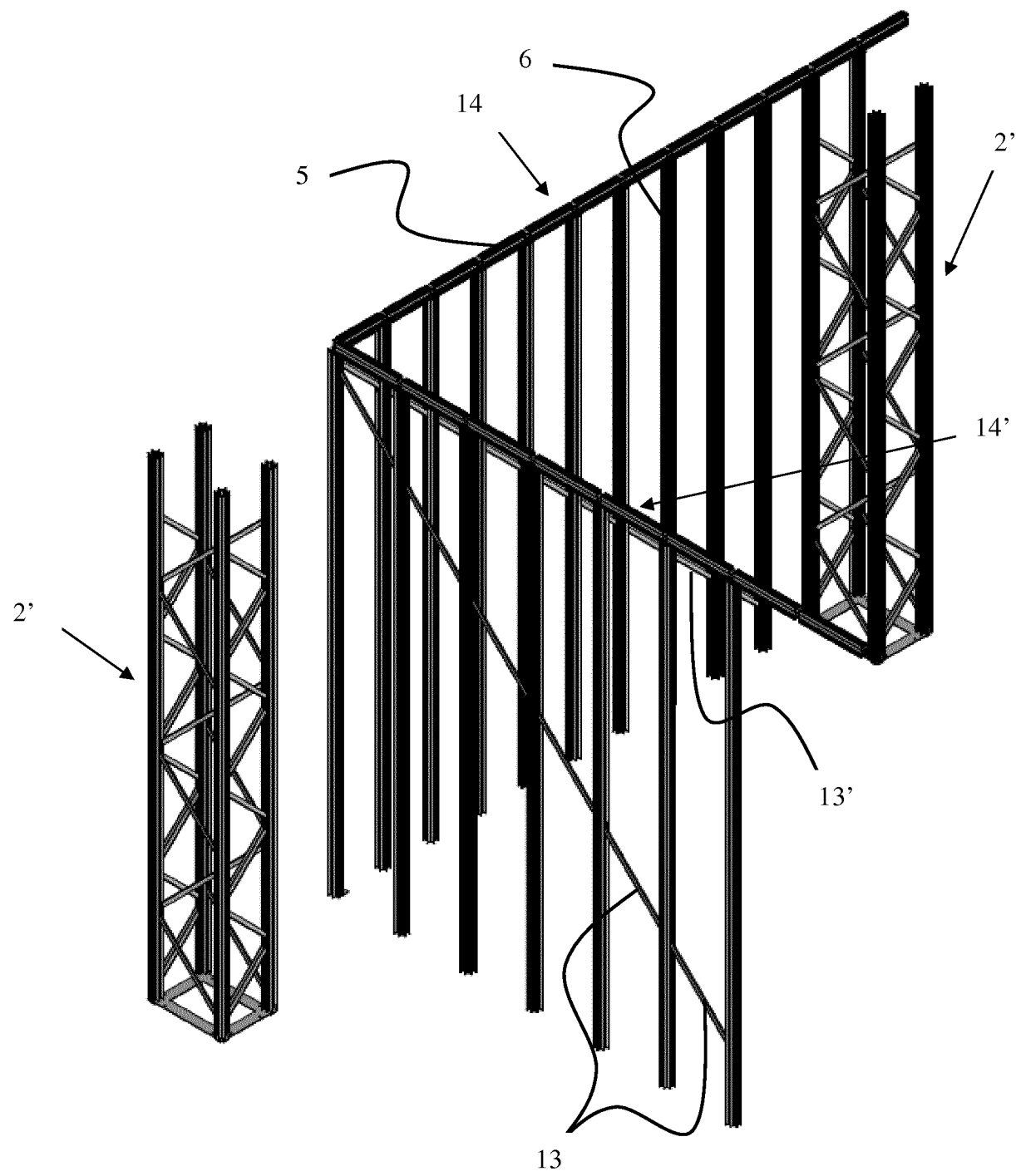


Fig. 10

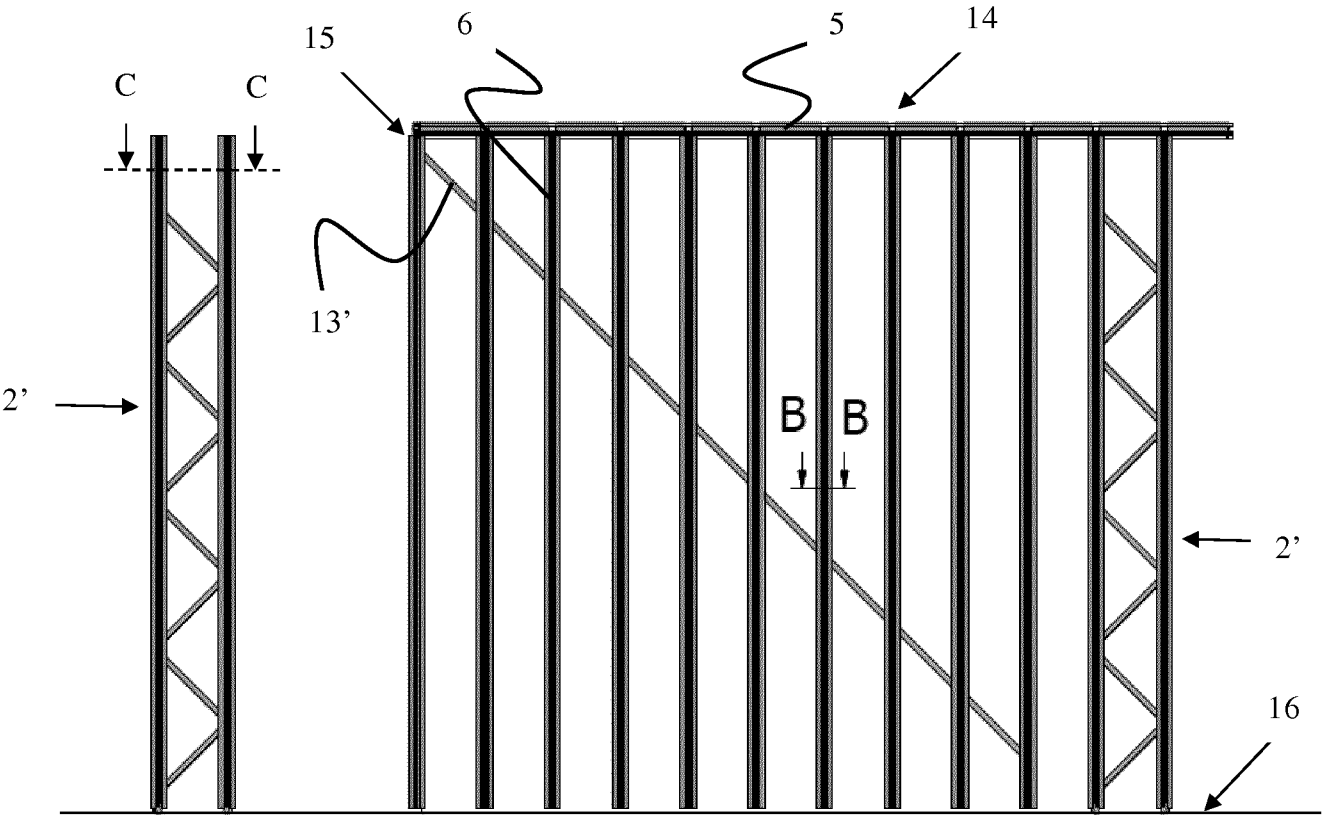


Fig. 11

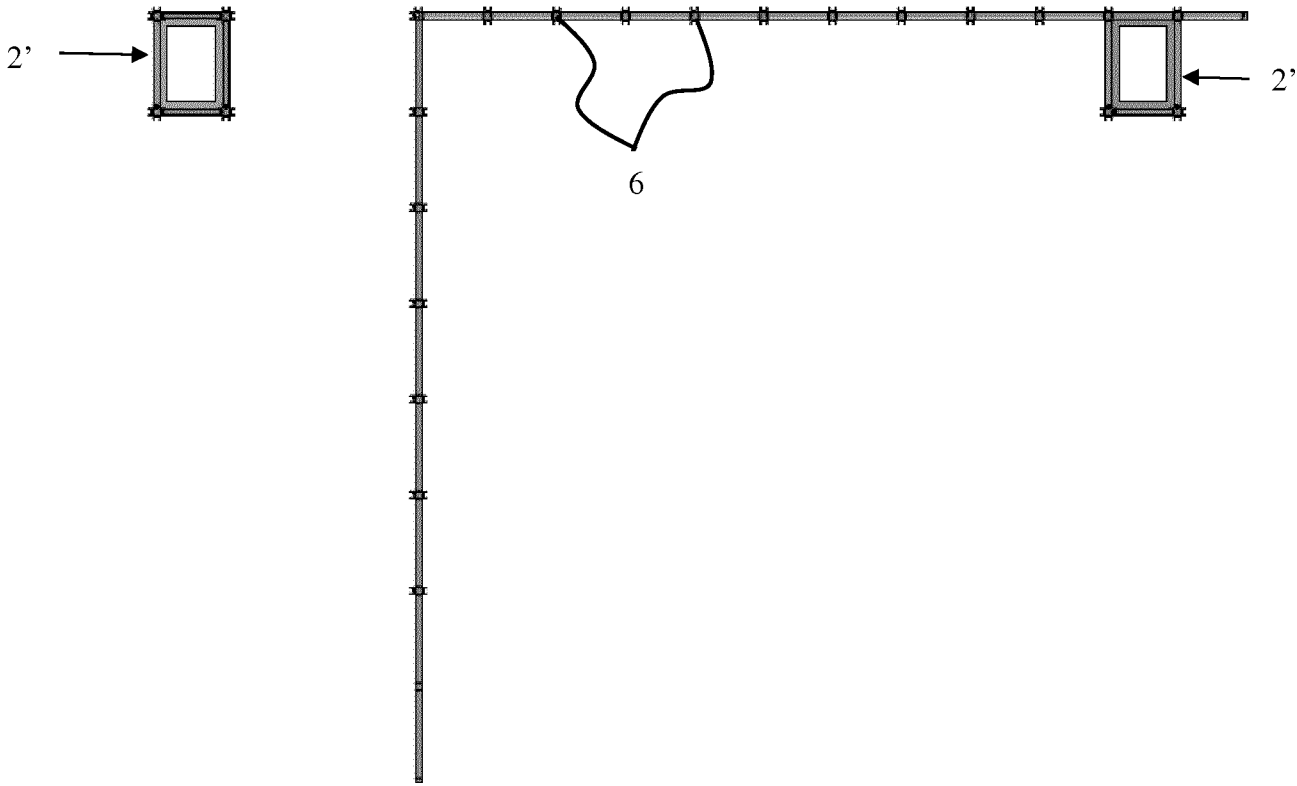
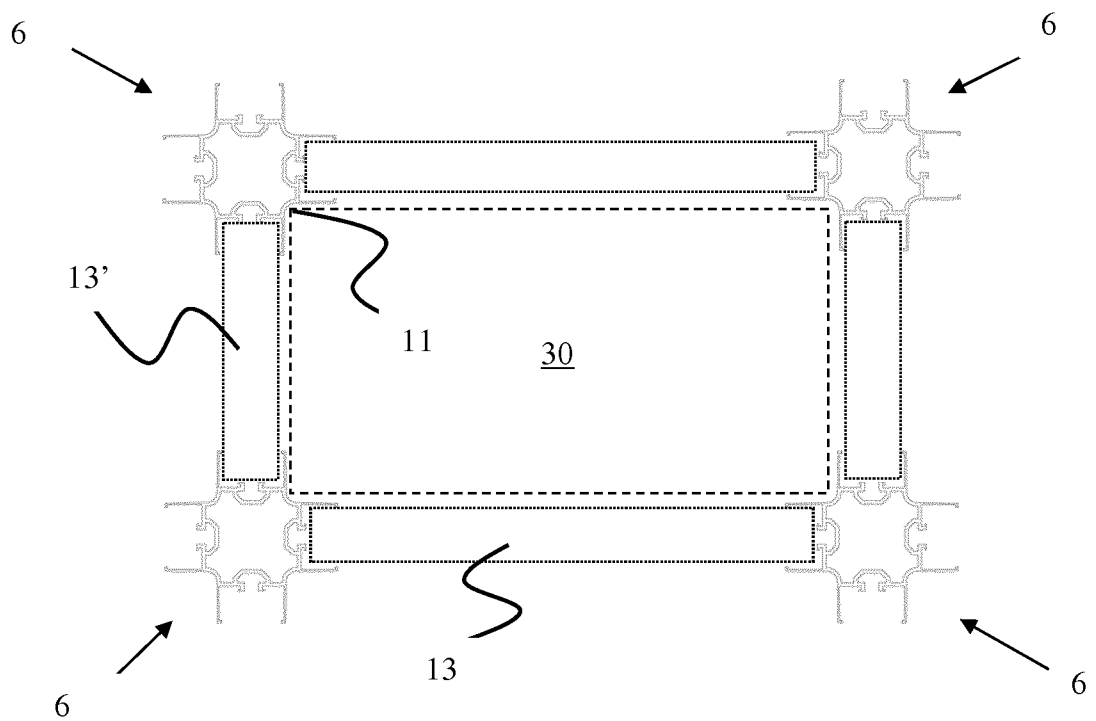
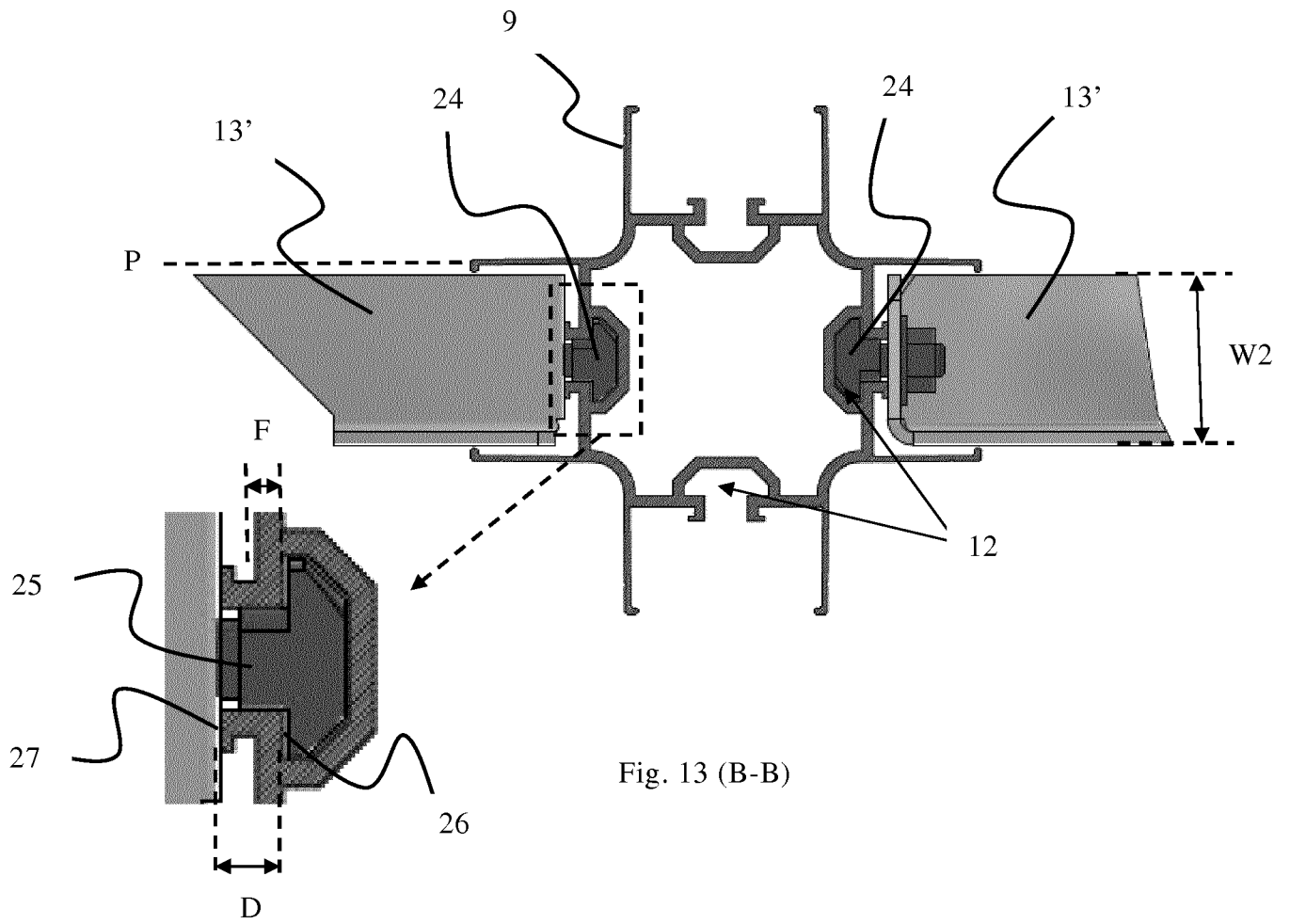


Fig. 12



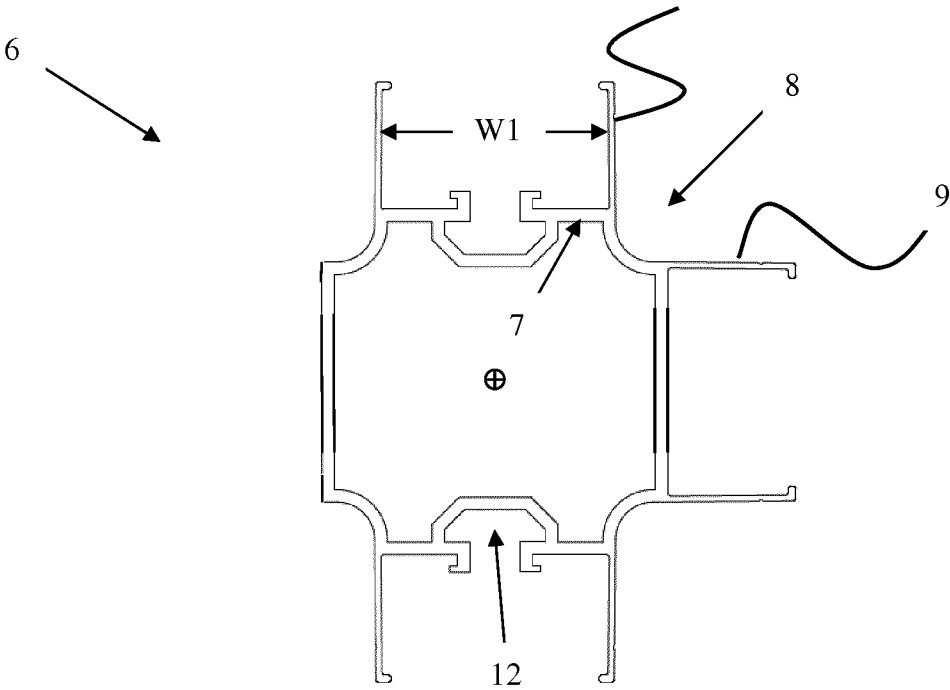


Fig. 15a

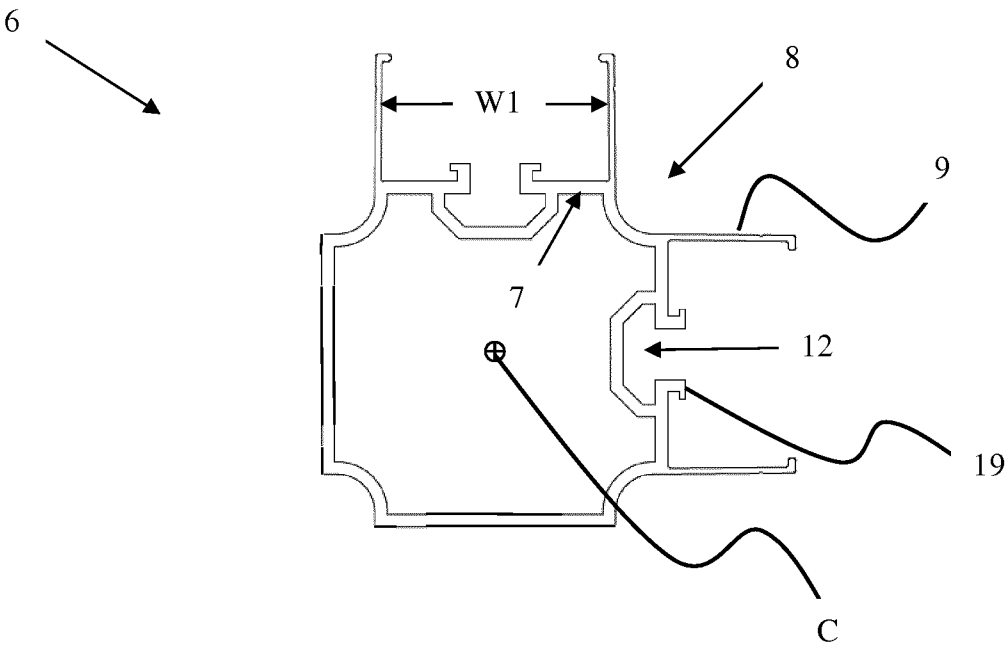


Fig. 15b

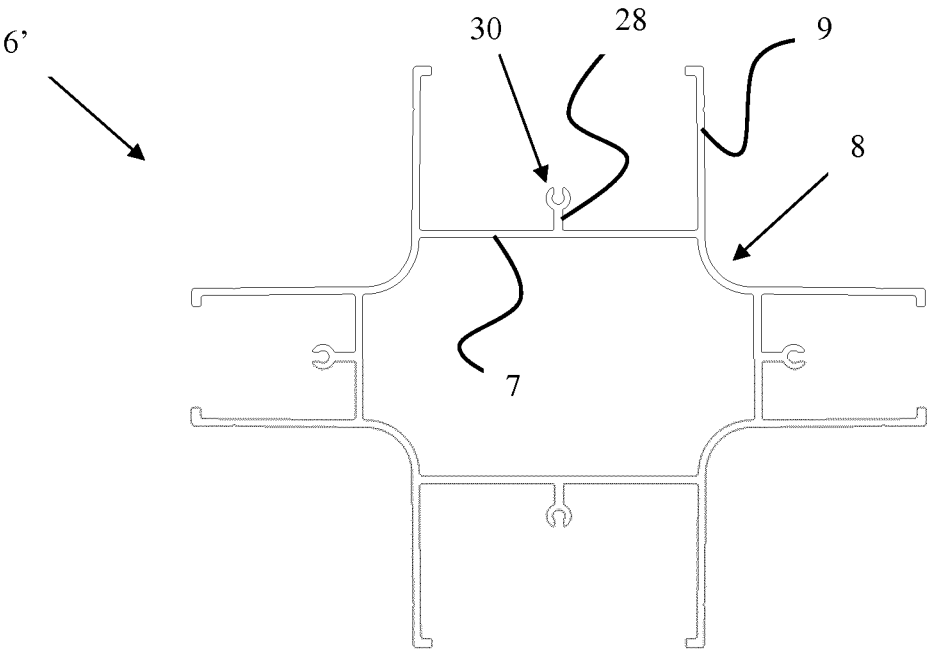


Fig. 16

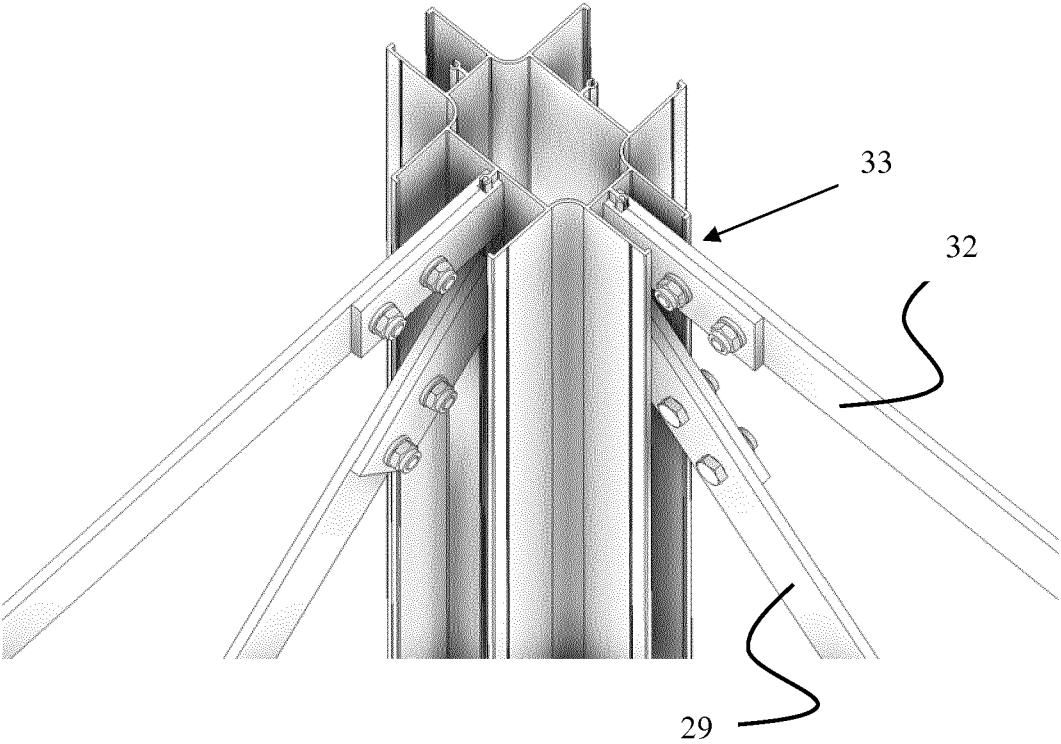


Fig. 17

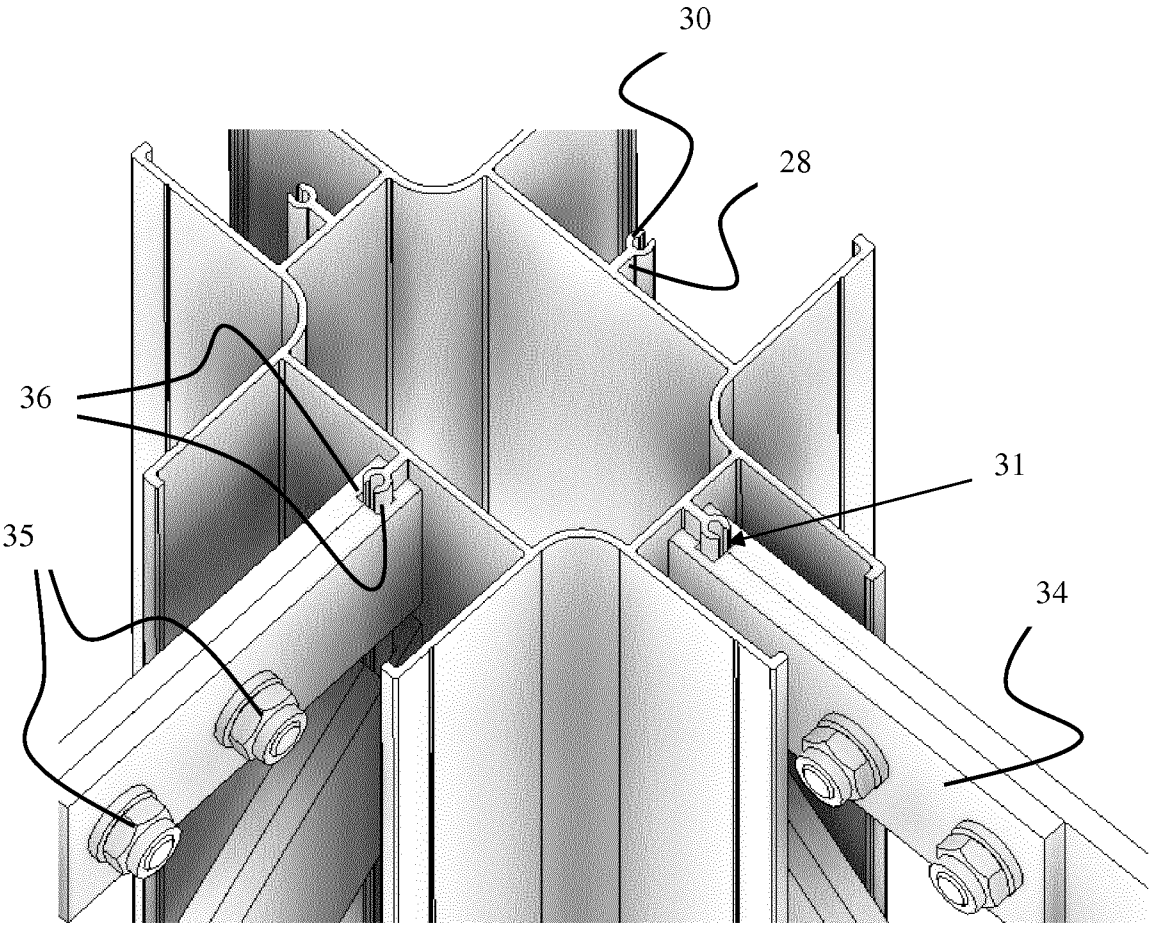


Fig. 18

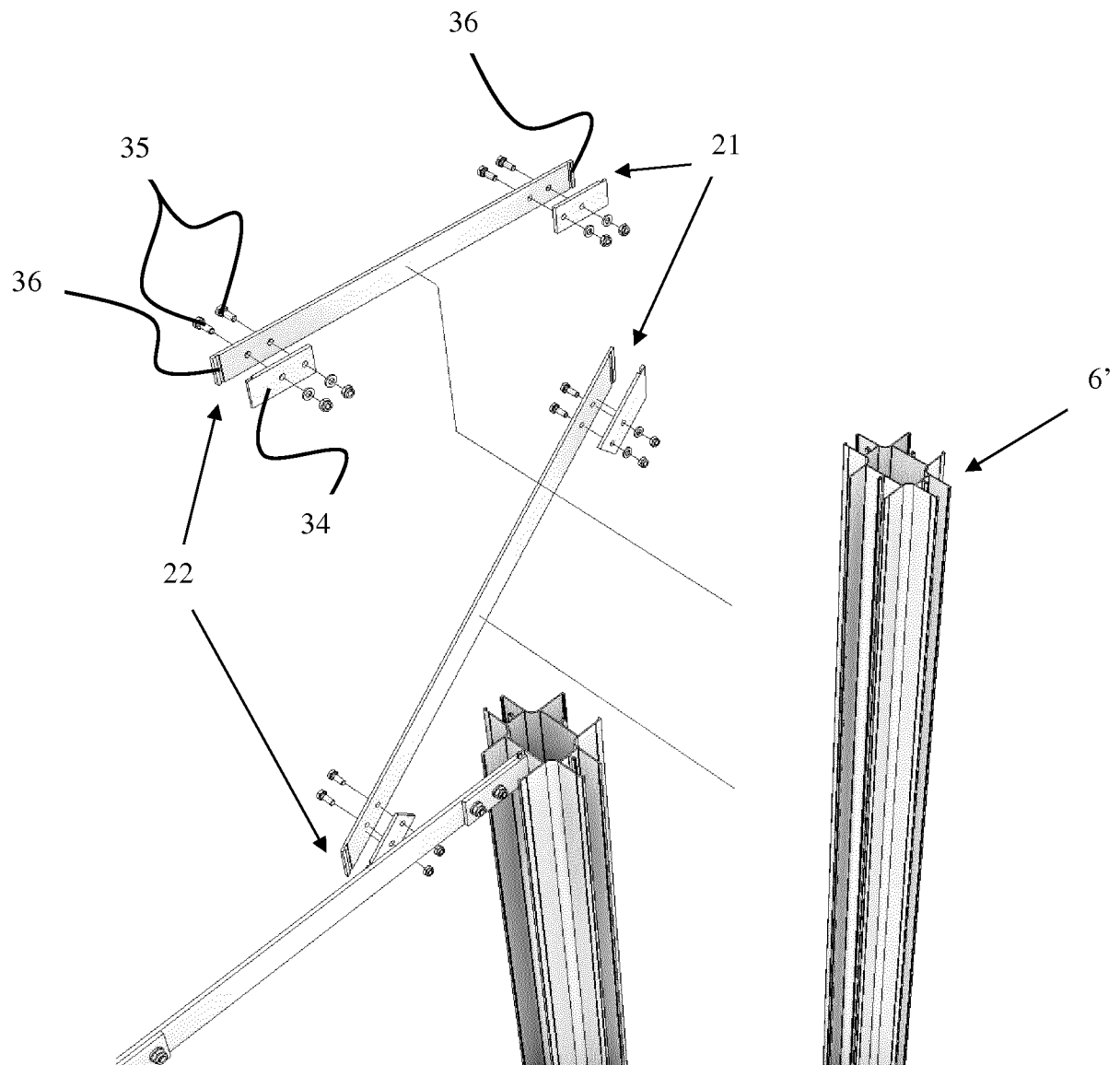


Fig. 19

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/058871

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65G1/02 B65G1/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65G E04B A47B F16B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 503 588 A (PROFILES & TUBES DE L EST; RECH ARCHITECT URBANISME) 15 March 1978 (1978-03-15)	15-20
Y	claim 1 figures 1-17 page 1, line 14 - line 81 page 2, line 31 - line 75	1-7,9-13
X	KR 2013 0052642 A (UCHIDA YOKO KK [JP]) 22 May 2013 (2013-05-22)	15-20
Y	claim 1 figures 1-3, 36, 40	1-7,9-13
	----- -/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search

10 August 2018

Date of mailing of the international search report

21/08/2018

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Thibaut, Charles

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/058871

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2017/153563 A1 (OCADO INNOVATION LTD [GB]) 14 September 2017 (2017-09-14) claim 1 figures 1-7 page 1, line 1 - page 2, line 31 page 3, line 20 - page 8, line 24 -----	1-14
Y	CA 2 574 745 A1 (DION DANY [CA]) 22 July 2008 (2008-07-22) claim 1 figures 1-6 page 1, line 1 - line 4 page 2, line 17 - page 4, line 15 page 5, line 8 - page 6, line 21 -----	1-7,9-11
X	EP 0 823 229 A1 (GS SCAFFALATURE ENGINEERING S [IT]) 11 February 1998 (1998-02-11) claim 1 figures 1-12 column 1, line 3 - column 2, line 2 column 2, line 27 - column 4, line 25 -----	16,18-20
Y	WO 2011/015799 A1 (SPECIALIST STRUCTURES LTD [GB]; LEWCOCK KEITH [GB]; BAILEY PETER [GB]) 10 February 2011 (2011-02-10) claim 1 figures 1-7 page 1, line 1 - page 3, line 10 page 3, line 30 - page 7, line 33 -----	1-6,8-13
X	WO 2011/015799 A1 (SPECIALIST STRUCTURES LTD [GB]; LEWCOCK KEITH [GB]; BAILEY PETER [GB]) 10 February 2011 (2011-02-10) claim 1 figures 1-7 page 1, line 1 - page 3, line 10 page 3, line 30 - page 7, line 33 -----	15-18,20
Y	Radwell International: "Radwell Swisslog AutoStore Time Lapse", youtube, 7 December 2016 (2016-12-07), page 1 pp., XP054978568, Retrieved from the Internet: URL: https://www.youtube.com/watch?v=Am00RbAfrTo [retrieved on 2018-08-09] 1:31; 1:43, 1:52 -----	1-12,14
Y	Radwell International: "Radwell Swisslog AutoStore Time Lapse", youtube, 7 December 2016 (2016-12-07), page 1 pp., XP054978568, Retrieved from the Internet: URL: https://www.youtube.com/watch?v=Am00RbAfrTo [retrieved on 2018-08-09] 1:31; 1:43, 1:52 -----	1-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2018/058871

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 1503588	A	15-03-1978	AU 510160 B2 12-06-1980
		BE 831866 A 17-11-1975	
		CH 592789 A5 15-11-1977	
		DE 2551564 A1 26-05-1977	
		GB 1503588 A 15-03-1978	
		HK 26883 A 19-08-1983	
		LU 73109 A1 24-03-1977	
		MY 8000195 A 31-12-1980	
		OA 5095 A 31-01-1981	
		TR 18868 A 17-10-1977	
		US 4073113 A 14-02-1978	
KR 20130052642	A	22-05-2013	CN 102409765 A 11-04-2012
			CN 102493551 A 13-06-2012
			EP 1947264 A1 23-07-2008
			HK 1171798 A1 05-12-2014
			KR 20080073378 A 11-08-2008
			KR 20130051008 A 16-05-2013
			KR 20130051009 A 16-05-2013
			KR 20130052642 A 22-05-2013
			MY 144643 A 31-10-2011
			TW I381085 B 01-01-2013
			US 2008110127 A1 15-05-2008
			WO 2007055039 A1 18-05-2007
WO 2017153563	A1	14-09-2017	GB 2549595 A 25-10-2017
			WO 2017153563 A1 14-09-2017
CA 2574745	A1	22-07-2008	NONE
EP 0823229	A1	11-02-1998	EP 0823229 A1 11-02-1998
			IT PD960205 A1 09-02-1998
WO 2011015799	A1	10-02-2011	CA 2770184 A1 10-02-2011
			EP 2462290 A1 13-06-2012
			US 2012216479 A1 30-08-2012
			WO 2011015799 A1 10-02-2011