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(54) **RECONFIGURABLE PREFABRICATED BUILDING WITH STEEL STRUCTURE**

(57) A reconfigurable prefabricated building with the steel structure, including building assemblies, each of the building assemblies includes a connector, at least one column and one column. The connector includes sidewalls and two end walls, with the sidewalls connected sequentially, and the two end walls arranged along a first direction, both connected to the sidewalls; at least one beam, the beam is detachably connected to one of the sidewalls. At least one column, the column is detachably connected to one of the end walls. The reconfigurable prefabricated building with the steel structure solves multiple technical bottlenecks in traditional prefabricated buildings through standardized design, simplified installation process, weld-free connections, high-precision assembly, excellent transportation efficiency, flexible expandability, and low-threshold construction requirements, providing a more efficient, cost-effective, and environmentally friendly building solution.

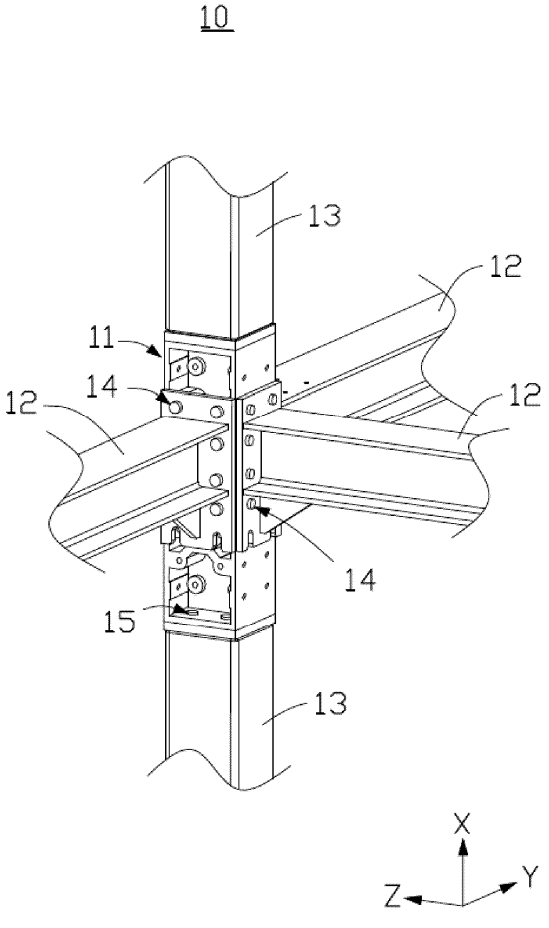


FIG. 2

EP 4 818 427 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to the technical field of architectural engineering technology, in particular to a reconfigurable prefabricated building with a steel structure.

BACKGROUND

[0002] As global demand, especially in China, for low-cost, high-speed, and green sustainable construction continues to rise, reconfigurable prefabricated buildings have gained increasing attention in the global construction industry. However, the vast majority of existing prefabricated buildings, starting from the design phase, suffer from low product standardization and component versatility, long production cycles, and low precision. Furthermore, their installation requires higher and more specialized technical personnel. As a result, not only is the delivery speed not improved, but the costs are generally higher than traditional construction, severely limiting their widespread adoption and disclosure.

[0003] Firstly, existing prefabricated buildings have very low standardization of architectural units and components, especially for the core structural elements related to building safety, such as beams, columns, and connectors, which are designed in various forms and connection methods. The large number of non-standard and customized components results in the following drawbacks: long design cycles and complex production processes; the need for professionals to mark, identify, and sort components on-site, making on-site management complicated; the necessity for pre-installation training and the ongoing need for skilled personnel during construction; increased overall installation time and higher costs, making it impossible to meet the expectations and requirements of high-speed and low-cost delivery for reconfigurable prefabricated buildings; and non-standard components cannot be effectively pre-stocked, creating significant obstacles to rapid delivery.

[0004] Secondly, existing prefabricated buildings, especially steel-structured reconfigurable prefabricated buildings, still rely heavily on on-site welding, particularly during the installation of complex connection nodes. Welding not only requires specialized workers but also faces quality control issues due to the uncertainty of the on-site environment. This leads to welding errors or quality problems, which increase uncertainty during the construction process, lengthen the construction cycle, and further raise labor costs and total project costs.

[0005] Thirdly, non-standard customized components in traditional prefabricated buildings, due to their lack of versatility, result in poor reconfigurability of the buildings and fail to achieve the green sustainability needed for building height. When buildings need to be renovated, expanded, or dismantled for relocation, they must be redesigned, produced, and reinstalled. After demolition, most materials and components cannot be reused, leading to significant resource waste and large amounts of solid waste that are difficult to handle. Customizing new connection nodes leads to unnecessary delays and high costs.

[0006] These technical flaws and management challenges make the promotion and widespread adoption of current reconfigurable prefabricated buildings face tremendous obstacles, especially in the context of rising labor costs and increasing demand for green buildings. traditional prefabricated building technologies cannot meet the higher demands of society and the market.

[0007] To address these issues, there is an urgent need for a new reconfigurable prefabricated building technology that, based on the fundamental logic of productization, designs and produces standardized building assemblies and components. This would not only support and meet various building functions and scenario needs but also offer quick production, delivery, and installation, with high quality, safety, and cost control.

SUMMARY

[0008] The present disclosure provides a reconfigurable prefabricated building with a steel structure, aimed at improving connector design, simplifying component types, and reducing construction requirements to solve various problems of existing prefabricated building, thereby enhancing overall engineering efficiency, building quality, and economic value.

[0009] The reconfigurable prefabricated building with the steel structure, including one or more building assemblies, each of the building assemblies includes: a connector, the connector includes sidewalls and two end walls, with the sidewalls connected sequentially, and the two end walls arranged along a first direction, both connected to the sidewalls; at least one beam, the beam is detachably connected to one of the sidewalls; at least one column, the column is detachably connected to one of the end walls.

[0010] Furthermore, each of the sidewalls is defined with a first hole, and the beam is defined with a second hole; when any one of the sidewalls and the beams are interconnected, the first hole on the sidewall is communicated with the second hole on the beam; the reconfigurable prefabricated building with the steel structure further includes a first connecting

component, the first connecting component is passed through the first hole and the second hole, and securely connected with interconnected sidewall and beam.

[0011] Furthermore, the first hole is a threaded hole, and the second hole is a through hole, the first connecting component includes a first bolt, the first bolt is configured to pass through the second hole and threaded into the first hole.

[0012] Furthermore, the second hole and the second hole are both through holes; the first connecting component includes the first bolt and a first nut; the first bolt is configured to pass through the first hole and the second hole, and the first bolt is locked and connected to the first nut.

[0013] Furthermore, each of the end walls is provided with a third hole, and the column is provided with a fourth hole; when each of the end walls is connected with the column, the third hole is communicated with the fourth hole; the reconfigurable prefabricated building with the steel structure further includes a second connecting component, the second connecting component is configured to pass through the third hole and the fourth hole, thus to securely connect the end walls and the column.

[0014] Furthermore, the third hole and the fourth hole are both through holes; the second connecting component includes a second bolt and a second nut, the second bolt is passed through the third hole and the fourth hole, and the second bolt is locked with the second nut.

[0015] Furthermore, at least one of the sidewalls is defined with a groove.

[0016] Furthermore, each of the sidewalls includes a first sidewall, a second sidewall, a third sidewall, and a fourth sidewall; wherein the first sidewall and the third sidewall are arranged along a second direction, and the second sidewall and the fourth sidewall are arranged along a third direction, wherein the second direction is perpendicular to the first direction, and the third direction is perpendicular to both the second direction and the first direction; the first sidewall is defined with a first groove, which is recessed towards the third sidewall; the third sidewall is defined with a second groove, which is recessed towards the first sidewall.

[0017] Furthermore, the connector further includes a first connecting wall, which is located between the first groove and the second groove along the second direction, and between the two end walls along the first direction, connecting the second sidewall, the fourth sidewall, and the two end walls.

[0018] Furthermore, the connector is integrally formed by casting.

[0019] Furthermore, projections of the sidewalls, along a direction perpendicular to the first direction, form a rectangle; an accommodating chamber is formed by the sidewalls and the end walls.

[0020] Furthermore, the connector further includes a second connecting wall, which is located inside the accommodating chamber, with the second connecting wall positioned between the two end walls along the first direction, and connecting at least two sidewalls.

[0021] Furthermore, the connector further includes a third connecting wall, which is located inside the accommodating chamber, the third connecting wall is positioned between the second connecting wall and one of the end wall along the first direction, and the third connecting wall is connected with the second connecting wall and at least one of the sidewalls.

[0022] Furthermore, the sidewalls and the end walls are connected by welding.

[0023] Furthermore, further includes a multiple of the building assemblies, and the multiple of the building assemblies are detachably connected.

[0024] Furthermore, in two interconnected building assemblies, the beam of one building assembly is connected to the sidewall of the connector of the other building assembly.

[0025] Furthermore, in two interconnected building assemblies, the column of one building assembly is connected to the end wall of the connector of the other building assembly.

[0026] In summary, the reconfigurable prefabricated building with the steel structure in the present disclosure achieves high-precision assembly through standardized connectors and simplified assembly methods. This avoids the accumulation of errors caused by welding and ensures assembly accuracy. The reconfigurable prefabricated building with the steel structure's components are designed to be simple and linear, improving transportation efficiency and reducing transportation costs. The connectors are designed to be compatible with various standard steel profiles on all six sides, making renovation, expansion, and rebuilding flexible and convenient. Existing components can be reused without the need to redesign or re-customize all components. The reduction in the variety of components lowers design, production, and assembly costs. The simplified installation process and foolproof design reduce the technical requirements for installers, improving installation efficiency. Moreover, the reconfigurable prefabricated building's flexibility and reconfigurability allow it to quickly respond to market demands and adapt to changes in building functions, greatly enhancing the economic viability and sustainability of construction projects.

[0027] Additionally, the reconfigurable prefabricated building with the steel structure can be assembled without welding, which helps to reduce the difficulty of construction for workers, improves assembly efficiency, significantly lowers labor costs, and minimizes the adverse effects of welding errors. Furthermore, the connectors, beams, and columns are standardized and interchangeable components that can be used to build different buildings through various designs and combinations. These components can also be disassembled and reused, which helps to reduce resource waste.

BRIEF DESCRIPTION OF DRAWINGS

[0028]

FIG. 1 is a schematic structural diagram of a reconfigurable prefabricated building with the steel structure according to an embodiment of the present disclosure.
FIG. 2 is a partial schematic structural diagram of a building assembly according to an embodiment of the present disclosure.
FIG. 3 is a exploded diagram of the building assembly in FIG. 2.
FIG. 4 is a schematic structural diagram of a connector in FIG. 2.
FIG. 5 is a schematic structural diagram of the connector in FIG. 4 from another view.
FIG. 6 is a section view of the connector in FIG. 4 along A-A line.
FIG. 7 is another partial schematic structural diagram of the building assembly in FIG. 2 from another view.
FIG. 8 is an exploded diagram of the building assembly in FIG. 7.
FIG. 9 is a schematic structural diagram of the connector in FIG. 4 from another view.
FIG. 10 is a section view of the connector in FIG. 4 along B-B line.
FIG. 11 is a section view of the connector in FIG. 4 along C-C line.

Description of the reference numeral

[0029]

Description	Reference numeral	Description	Referenc e numeral
reconfigurable prefabricated building with a steel structure	100	building assembly	10
connector	11	first sidewall	111
second sidewall	112	third sidewall	113
second groove	1131	fourth sidewall	114
end wall	115	first hole	1161
third hole	1162	first connecting wall	1171
second connecting wall	1172	third connecting wall	1173
accommodating chamber	118	beam	12
second hole	121	column	13
fourth hole	131	first groove	1111
first connecting component	14	first bolt	141
first nut	142	second connecting component	15
second bolt	151	second nut	152
first direction	X	second direction	Y
third direction	Z		

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0030] The technical solutions in the embodiments of the present disclosure will be described clearly and completely with reference to the accompanying drawings in the embodiments of the present disclosure. Obviously, the described embodiments are only a part of the embodiments of the present disclosure rather than all of them. Based on the embodiments in the present disclosure, all other embodiments obtained by those skilled in the art without creative work shall fall within the scope of protection of the present disclosure.

[0031] It should be noted that when a component is considered to be "connected" to another component, it may be directly connected to the other component or may be indirectly connected via a centrally positioned component. When a component is considered to be "set" on another component, it can be directly set on the other component or may be placed

with a centrally positioned component. In this disclosure, unless otherwise specifically stated and limited, terms such as "install", "connected", "connection", "fixed," etc., should be broadly understood. For example, it could mean a fixed connection, a detachable connection, or an integral connection; it could be a direct connection, or it could be indirectly connected through an intermediate medium; it could also refer to the internal communication between two components. For a person skilled in the art, the specific meaning of these terms in this disclosure can be understood according to the specific situation. The term "and/or" as used herein includes any and all combinations of one or more of the related listed items.

[0032] **In** the description of the embodiments of this disclosure, technical terms such as "first", "second" etc., are used merely to distinguish different objects and should not be understood as indicating or implying relative importance or implicitly specifying the quantity, specific order, or hierarchical relationship of the technical features indicated. In the description of the embodiments of this disclosure, the term "plurality" means more than two, unless otherwise specifically defined.

[0033] In the description of the embodiments of this disclosure, the term "vertical" is used to describe the ideal state between two components. In the actual manufacturing or use state, there may be an approximate vertical state between the two components. For example, in terms of numerical description, "vertical" may refer to an angle range between two straight lines of 90°±10°, or it may refer to the dihedral angle range between two planes of 90°±10°, or the angle range between a straight line and a plane of 90°±10°. The two components described as "vertical" may not be absolute straight lines or planes; they may approximately be straight lines or planes. From a macroscopic perspective, as long as the overall direction of extension is a straight line or plane, the component can be considered a "straight line" or "plane".

[0034] The term "embodiment" as referred to herein means that the specific features, structures, or characteristics described in conjunction with the embodiments may be included in at least one embodiment of this disclosure. The use of this phrase in different parts of the description does not necessarily refer to the same embodiment, nor is it intended to indicate mutually exclusive or alternative embodiments. Where there is no conflict, the various embodiments in this disclosure can be combined with each other.

[0035] It should be noted that the thickness, length, width, and other dimensions of the various components shown in the drawings of the embodiments of this disclosure, as well as the overall thickness, length, and width of the integrated device, are for exemplary purposes only and should not be considered as limitations of this disclosure.

[0036] The following provides further explanation of the embodiments of this disclosure in conjunction with the accompanying drawings.

[0037] As shown in FIGs. 1 to 3, the embodiment of this disclosure provides a reconfigurable prefabricated building with a steel structure 100, which includes at least one building assembly 10. It can be understood that the reconfigurable prefabricated building with the steel structure 100 may include only one building assembly 10 or multiple building assemblies 10. When the reconfigurable prefabricated building with the steel structure 100 includes multiple building assemblies 10, the multiple building assemblies 10 are detachably connected to each other, facilitating installation and dismantling at the construction site. Furthermore, by dismantling the reconfigurable prefabricated building with the steel structure 100, the building assemblies 10 can be reused, reducing resource waste and thereby effectively improving the building's sustainability and environmental friendliness.

[0038] In one embodiment, each of the building assemblies 10 includes a connector 11, at least one beam 12, and at least one column 13, where the beam 12 and the column 13 are detachably connected to the connector 11. Specifically, the connector 11 includes four sidewalls and two end walls 115. The four sidewalls are sequentially connected, and the two end walls 115 are arranged along a first direction X and connected to the four sidewalls. The sidewalls are used to connect the beams 12, and the end walls 115 are used to connect the columns 13, with the first direction X possibly being the length direction of the connector 11. Through this structure, the connector 11 provides high flexibility and modularity, making it extremely simple and convenient to design and construct the slab reduction required for indoor wet areas, balconies, and height differences in traditional modular buildings, thus meeting the layout requirements of various building designs.

[0039] In one embodiment, any one of the beams 12 can be detachably connected to one of the sidewalls, and any one of the columns 13 can be detachably connected to one of the end walls 115, making the building assembly 10 a detachable device. At the construction site, the beams 12 and columns 13 can be detachably connected to the connector 11 by relevant tools, making the building assemblies 10 a reconfigurable structure. Further, by detachably connecting multiple building assemblies 10 together, a reconfigurable reconfigurable prefabricated building with the steel structure 100 can be obtained. Additionally, by increasing or decreasing the number of building assemblies 10 or adjusting the assembly positions of the building assemblies 10, the reconfigurable prefabricated building with the steel structure 100 can be flexibly constructed, which helps reduce manufacturing costs and adapts to the rapid changes in building scale and requirements.

[0040] In the reconfigurable reconfigurable prefabricated building with the steel structure 100, the same connector 11 can be applied to connect joints in various scenarios, which reduces the variety of required components for the reconfigurable prefabricated building with the steel structure 100, offering several advantages.

[0041] During the design phase: a reduced variety of components allows designers to quickly design based on

standardized parts, reducing design time and labor costs, while avoiding the need for customized designs for multiple components, which significantly saves on design costs.

[0042] During the production phase: the reduced variety of components allows for efficient mass production on the production line, minimizing resource waste during production, significantly improving production efficiency, and reducing production costs.

[0043] During the storage phase: fewer component types make inventory management simpler, enabling timely delivery through bulk stocking, reducing inventory buildup, and easing management challenges.

[0044] During the assembly phase: fewer component types help reduce the difficulty of identifying parts for construction workers, decreasing reliance on highly skilled workers. Workers can quickly get started after basic training, improving construction efficiency and reducing risks from human errors.

[0045] Additionally, the reconfigurable reconfigurable prefabricated building with the steel structure 100 can be assembled without the need for welding, which is an innovative design that reduces construction difficulties, greatly enhances assembly efficiency, lowers labor costs, and minimizes the adverse effects caused by welding errors. Through the standardized connectors 11, beams 12, and columns 13, the assembly and disassembly of building assemblies 10 can be quickly completed, reducing potential technical challenges and construction time. Moreover, the connectors 11, beams 12, and columns 13 can be standardized, general-purpose components that can be used to construct different reconfigurable prefabricated building with the steel structures 100 through various design and combination methods. These components can also be disassembled and reused, further reducing resource waste and providing significant economic value and sustainability.

[0046] In one embodiment, the number of beams 12 in one building assembly 10 can be one, two, three, or four, and the number of columns 13 can be one or two. Different quantities of beams 12 and columns 13 can be assembled through a single specification of connector 11, which can serve as a standardized general part suitable for various scenarios, helping reduce the types of connectors 11, facilitating on-site assembly, and simplifying the production and inventory management of the connectors 11.

[0047] It can be understood that the number of beams 12 and columns 13 in one building assembly 10 can be determined based on the component's position in the reconfigurable prefabricated building with the steel structure 100. For example, when the building assembly 10 is located on the top or bottom floor of the reconfigurable prefabricated building with the steel structure 100, the number of columns 13 can be one. When the building assembly 10 is located in the middle area of the reconfigurable prefabricated building with the steel structure 100, the number of beams 12 can be four, and the number of columns 13 can be two. When the building assembly 10 is located at the edge of the reconfigurable prefabricated building with the steel structure 100, the number of beams 12 can be two or three.

[0048] In one embodiment, among two interconnected building assemblies 10, a beam 12 of one building assemblies 10 is connected to the sidewall of the connector 11 of another building assemblies 10. In the two interconnected building assemblies 10, a column 13 of one building assemblies 10 is connected to the end wall 115 of the connector 11 of another building assemblies 10.

[0049] As shown in FIGs. 2 to 4, in one embodiment, each sidewall is defined with a first hole 1161, and each beam 12 is defined with a second hole 121. When the any of the sidewalls and beams 12 are interconnected, the first hole 1161 on the sidewall and the second hole 121 on the beam 12 are communicated and aligned with each other. The reconfigurable prefabricated building with the steel structure 100 also includes a first connection component 14, where at least part of the first connection component 14 passes through the first hole 1161 and the second hole 121 and securely connects the interconnected sidewall and beam 12. By passing the first connection component through the aligned first hole 1161 and second hole 121, the sidewall and the beam 12 are detachably connected. This assembly process does not require welding, which helps reduce the difficulty of on-site construction, minimizes the skill requirements for construction workers, improves assembly efficiency, and positions the beam 12 and connector 11 through the alignment of the first hole 1161 and second hole 121, thereby improving the dimensional accuracy of the reconfigurable prefabricated building with the steel structure 100. Additionally, by disassembling the first connection component, the reconfigurable prefabricated building with the steel structure 100 can be split, allowing for the reconfigurability of the reconfigurable prefabricated building with the steel structure 100 and the reuse of components.

[0050] In one embodiment, the second holes 121 is a through hole, and the first hole 1161 is a threaded hole. The first connection component may include a first bolt 141, where the first bolt 141 passes through the second hole 121 and enters a corresponding first hole 1161, engaging with the thread of the corresponding first hole 1161. This connection method is simple and reliable, with low assembly and disassembly difficulty, which benefits the improvement of assembly or disassembly efficiency.

[0051] In one embodiment, both the first hole 1161 and the second hole 121 are through holes, and the first connection component may include the first bolt 141 and the first nut 142. The first bolt 141 passes through the aligned first hole 1161 and second hole 121, and then locks with the first nut 141. This connection method is simple and reliable, with low assembly and disassembly difficulty, improving the efficiency of assembly or disassembly.

[0052] In one embodiment, when both the first hole 1161 and the second hole 121 are through holes, the first connection

component may include a pin (not shown) or a pin plate (not shown). After the pin or pin plate is inserted into the first hole 1161 and the second hole 121, the sidewall and the beam 12 are fixedly connected. This connection method is simple and reliable, with low assembly and disassembly difficulty, improving the efficiency of assembly or disassembly.

[0053] In one embodiment, multiple first holes 1161 are provided on a same sidewall, with the first holes 1161 arranged along the first direction X. In the interconnected sidewall and beam 12, by moving the beam 12 relative to the connector 11 along the first direction X, the second hole 121 can align with different first holes 1161. Then, by using the first connection component 14 to secure the connection, the lateral position adjustment along the first direction X of the connector 11 can be achieved to meet different construction and assembly requirements. This helps improve the versatility of the reconfigurable prefabricated building with the steel structure 100 and reduces the specifications of the connector 11, reducing the variety of components used in the reconfigurable prefabricated building with the steel structure 100.

[0054] In one embodiment, multiple second holes 121 are provided on the same beam 12, with the second holes 121 arranged along the first direction X. In the interconnected sidewall and beam 12, by moving the beam 12 relative to the connector 11 along the first direction X, the first hole 1161 can align with different second holes 121. Then, by using the first connection component 14 to secure the connection, the lateral position adjustment along the first direction X of the connector 11 can be achieved to meet different construction and assembly requirements. This also contributes to the versatility of the reconfigurable prefabricated building with the steel structure 100.

[0055] In one embodiment, multiple first holes 1161 are provided on the same sidewall, with the first holes 1161 arranged along the first direction X, and multiple second holes 121 are provided on the same beam 12, with the second holes 121 also arranged along the first direction X. Additionally, along the first direction X, the distance between adjacent first holes 1161 and the distance between adjacent second holes 121 are equal. In the interconnected sidewall and beam 12, by moving the beam 12 relative to the connector 11 along the first direction X and aligning different first holes 1161 with different second holes 121, then securing the connection with the first connection component, the lateral position adjustment along the first direction X of the connector 11 can be achieved to meet different construction and assembly requirements. This improves the versatility of the reconfigurable prefabricated building with the steel structure 100, reduces the specifications of the connector 11, and reduces the variety of components used in the reconfigurable prefabricated building with the steel structure 100.

[0056] In one embodiment, multicolumn of first holes 1161 are provided on the same sidewall, with multicolumn first holes 1161 in each column arranged along the first direction X. The multicolumn first holes 1161 are arranged along the width direction of the sidewall. Corresponding multicolumn of second holes 121 are provided on the beam 12 connected to the sidewall. By providing multicolumn of first holes 1161 on the sidewall and multicolumn of second holes 121 on the beam 12, when the sidewall and beam 12 are interconnected, the first holes 1161 and second holes 121 are aligned with each other, and the connection is secured using multiple first connection components. This improves the stability of the connection between the sidewall and beam 12, enhancing the structural stability of the reconfigurable prefabricated building with the steel structure 100.

[0057] In one embodiment, each of the end walls 115 is provided with a third hole 1162, and each column 13 is provided with a fourth hole 131. In the interconnected end wall 115 and column 13, the third hole 1162 on the end wall 115 and the fourth hole 131 on the column 13 are aligned and connected. The reconfigurable prefabricated building with the steel structure 100 further includes a second connection component (not shown), which passes through the aligned third hole 1162 and fourth hole 131 and fixes the connection between the end wall 115 and the column 13. By inserting the second connection component through the aligned third hole 1162 and fourth hole 131, the end wall 115 and the column 13 can be detachably fixed together. This assembly process does not require welding, reducing the difficulty of on-site construction, and the engagement between the third hole 1162 and the fourth hole 131 enables precise positioning of the column 13 and the connector 11, which is beneficial for improving the dimensional accuracy of the reconfigurable prefabricated building with the steel structure 100.

[0058] In one embodiment, one of the third hole 1162 and fourth hole 131 is a through hole, and the other is a threaded hole. For example, if the third hole 1162 is a threaded hole and the fourth hole 131 is a through hole, the second connection component can include a second bolt, which passes through the fourth hole 131 and into the third hole 1162, and is threaded into the third hole 1162.

[0059] In one embodiment, both the third hole 1162 and the fourth hole 131 are through holes, and the second connection component includes a second bolt 151 and a second nut 152. After the second bolt 151 passes through the aligned third hole 1162 and fourth hole 131, it is fastened with the second nut 152. In one embodiment, when both the third hole 1162 and the fourth hole 131 are through holes, the second connection component can be replaced with a pin component (not shown) or a shear pin component (not shown). The pin or shear pin is inserted into the third hole 1162 and the fourth hole 131 to fixedly connect the end wall 115 and the column 13.

[0060] In one embodiment, the same end wall 115 has four third holes 1162, and the four third holes 1162 are arranged in a rectangular shape. The end of the column 13 that connects to the end wall 115 is correspondingly provided with four fourth holes 131. When the end wall 115 and the column 13 are interconnected, the four third holes 1162 and the four fourth holes 131 are aligned and connected, and four second connection components 15 are used for fastening the connection.

This enhances the stability of the connection between the end wall 115 and the column 13 and improves the structural stability of the reconfigurable prefabricated building with the steel structure 100.

[0061] In one embodiment, the sidewalls include a first sidewall 111, a second sidewall 112, a third sidewall 113, and a fourth sidewall 114. The first sidewall 111 and third sidewall 113 are arranged along the second direction Y, and the second sidewall 112 and fourth sidewall 114 are arranged along the third direction Z. The second direction Y is perpendicular to the first direction X, and the third direction Z is perpendicular to both the second direction Y and the first direction X.

[0062] In one embodiment, the first sidewall 111 is provided with a first groove 1111, which is recessed from the surface of the first sidewall 111 towards the direction of the third sidewall 113. The provision of the first groove 1111 helps reduce the weight of the connector 11, thus reducing the impact of the connector's weight on the assembly process and on the reconfigurable prefabricated building with the steel structure 100.

[0063] In one embodiment, the third sidewall 113 is defined with a second groove 1131, which is recessed from the surface of the third sidewall 113 towards the direction of the first sidewall 111. The provision of the second groove 1131 helps reduce the weight of the connector 11, thereby reducing the impact of the connector's weight on the assembly process and on the reconfigurable prefabricated building with the steel structure 100.

[0064] As shown in FIG. 6, in one embodiment, the first sidewall 111 is defined with a first groove 1111, the third sidewall 113 is provided with a second groove 1131, and the connector 11 further includes a first connecting wall 1171. The first connecting wall 1171 is located between the first groove 1111 and the second groove 1131 along the second direction Y, positioned between the two end walls 115 along the first direction X, and connects the second sidewall 112, fourth sidewall 114, and two end walls 115. By reducing weight through the first groove 1111 and second groove 1131, the inclusion of the first connecting wall 1171 enhances the structural stiffness and reliability of the connector 11, reducing the risk of deformation or damage due to stress.

[0065] In one embodiment, some of the first holes 1161 on the first sidewall 111, second sidewall 112, third sidewall 113, and fourth sidewall 114 are through holes, and some are threaded holes. Moreover, among the multiple first holes 1161 on the same sidewall, some may be through holes, and some may be threaded holes.

[0066] In one embodiment, the first hole 1161 on the first sidewall 111 may be a threaded hole, some of the first holes 1161 on the second sidewall 112 may be through holes, and others may be threaded holes, the first hole 1161 on the third sidewall 113 may be a threaded hole, and some of the first holes 1161 on the fourth sidewall 114 may be through holes while others are threaded holes.

[0067] In one embodiment, the connector 11 is integrally formed by casting, which helps improve the structural stiffness and reliability of the connector 11, simplifies the manufacturing process, and reduces the manufacturing cost of the connector 11.

[0068] As shown in FIGs. 1, 7 to 10, in one embodiment, in a projection along a direction perpendicular to the first direction X, the projections of the four sidewalls form a rectangle, and the four sidewalls and two end walls 115 form an accommodating chamber 118. Designing the connector 11 with a hollow structure having the accommodating chamber 118 helps reduce the weight of the connector 11 and simplifies its manufacturing process.

[0069] In one embodiment, the sidewalls include the first sidewall 111, the second sidewall 112, the third sidewall 113, and the fourth sidewall 114, with the first sidewall 111 and third sidewall 113 arranged along the second direction Y and the second sidewall 112 and fourth sidewall 114 arranged along the third direction Z. The second direction Y is perpendicular to the first direction X, and the third direction Z is perpendicular to both the second direction Y and the first direction X.

[0070] In one embodiment, both the first hole 1161 and the second hole 121 are through holes, and the first connecting component 14 may include a first bolt 141 and a first nut 142. The first bolt 141 passes through the first hole 1161 and the second hole 121 that are connected to each other and is locked to the first nut 142. This connection method is simple and reliable, and the difficulty of assembly and disassembly is low, which is conducive to improving the efficiency of assembly or disassembly.

[0071] In one embodiment, the first nut 142 can be welded to the side wall facing the receiving chamber 118, which is beneficial for improving the efficiency of on-site assembly.

[0072] In one embodiment, when both the first hole 1161 and the second hole 121 are through holes, the first connecting component 14 may include a pin or a locking piece (not shown), which is inserted into the first hole 1161 and the second hole 121 to fixedly connect the side wall and the beam 12. This connection method is simple and reliable, and the difficulty of assembly and disassembly is low, which is conducive to improving the efficiency of assembly or disassembly.

[0073] As shown in FIGs. 9 and 10, in one embodiment, the connector 11 further includes a second connecting wall 1172, which is located within the accommodating chamber 118. The second connecting wall 1172 is positioned along the first direction X between the two end walls 115 and connects at least two sidewalls. The addition of the second connecting wall 1172 within the accommodating chamber 118 enhances the structural stiffness and reliability of the connector 11 and reduces the risk of deformation or damage due to stress.

[0074] In one embodiment, the second connecting wall 1172 connects the first sidewall 111 and the third sidewall 113. In another embodiment, the second connecting wall 1172 connects the second sidewall 112 and the fourth sidewall 114. In yet another embodiment, the second connecting wall 1172 connects the first sidewall 111, the second sidewall 112, the

third sidewall 113, and the fourth sidewall 114. In one embodiment, the second connecting wall 1172 is connected to the sidewalls by welding.

[0075] As shown in FIGs. 9 and 11, in one embodiment, the connector 11 also includes a third connecting wall 1173, which is located within the accommodating chamber 118. The third connecting wall 1173 is positioned along the first direction X between the second connecting wall 1172 and one of the end walls 115, and is connected to the second connecting wall 1172 with at least one sidewall.

[0076] In one embodiment, the third connecting wall 1173 is connected to the second connecting wall 1172, the first sidewall 111, and the third sidewall 113. In another embodiment, the third connecting wall 1173 is connected to the second connecting wall 1172, the second sidewall 112, and the fourth sidewall 114. In yet another embodiment, the third connecting wall 1173 not only connects the second connecting wall 1172 and at least one sidewall but also connects an adjacent end wall 115.

[0077] The inclusion of the third connecting wall 1173 is advantageous in further improving the structural rigidity and reliability of the connector 11, reducing the risk of deformation or damage due to stress.

[0078] In one embodiment, the connection between any sidewall, any connecting wall, and any end wall 115 of the connector 11 can be made by welding.

[0079] In one embodiment, the four sidewalls may be welded from four plates, or alternatively, formed by bending a larger single plate.

[0080] In conclusion, the reconfigurable prefabricated building with the steel structure 100 in this disclosure provides an efficient, precise, flexible, and cost-controlled assembly solution through innovative design. The core innovation of the reconfigurable prefabricated building with the steel structure 100 lies in the use of standardized connectors 11, which allow for detachable connections between the beams 12 and columns 13 using related tools, enabling the building assemblies 10 to have a reconfigurable structure. The reconfigurable prefabricated building with the steel structure 100 offers the following advantages.

[0081] High precision assembly, reducing cumulative tolerance. Traditional assembly techniques, such as welding, cause gradually accumulated errors that affect assembly precision and lead to mismatches in later expansions. The reconfigurable prefabricated building with the steel structure 100 eliminates the potential for error accumulation during welding by using welding-free connectors 11, which significantly improves assembly precision and reduces errors that impact building integrity and consistency. It ensures accurate and efficient assembly during future expansions and adjustments, ensuring the stability of the building structure and long-term precision.

[0082] High transportation efficiency, reducing transportation costs. The connectors 11 and profiles in the reconfigurable prefabricated building with the steel structure 100 are designed with simple straight lines, without complex shapes or unnecessary additional parts, greatly improving the utilization of transportation space. Traditional modular buildings often have complex components of varying shapes and sizes, which waste transportation space and increase costs and difficulties. The standardized design of the reconfigurable prefabricated building with the steel structure 100 allows components to be arranged more compactly, reducing space waste during transportation, improving efficiency, and significantly reducing transportation costs. This design is especially advantageous for large-scale projects and cross-regional transportation, reducing logistics costs and transportation time.

[0083] Flexible expansion, high adaptability. The connector 11 design, which allows for the connection of profiles on six sides, makes building expansion more flexible. When there is a need to expand an existing building, it can be done by directly adding connectors 11 and profile units, enabling quick expansion without the need for redesigning or custom connectors. This flexibility makes the building highly adaptable to functional changes and space extensions, reducing design and construction complexity during expansion and significantly lowering expansion costs.

[0084] Reduced number of components, lowering design, production, assembly, and inventory management costs. Due to the standardized components in the reconfigurable prefabricated building with the steel structure 100, the number of required parts is significantly reduced, eliminating the need for custom components for each project, saving design time and labor costs. Production efficiency is also increased through standardized design, reducing manufacturing costs. In inventory management, fewer types of components make inventory management more efficient and simpler, preventing stockpile issues due to excessive parts, thus improving storage efficiency. On the construction site, workers can quickly identify and assemble standardized parts, reducing assembly errors and improving overall efficiency.

[0085] Foolproof installation design with low skill requirements. The design of the reconfigurable prefabricated building with the steel structure 100 fully considers a foolproof mechanism, ensuring that the connectors 11 and components are designed according to universal principles to minimize installation errors. This design reduces the risk of problems during installation due to incorrect use or installation of components, enhancing accuracy and safety. Installation personnel do not need high skill levels, as any construction worker can easily master the installation process after simple training, significantly reducing the reliance on skilled workers, lowering technical barriers, and improving work efficiency while reducing construction costs.

[0086] High installation efficiency, reducing construction time. With standardized connectors 11 and a simplified assembly process, construction workers can quickly and intuitively assemble components, significantly improving

assembly efficiency. Traditional modular buildings often require workers to recognize and install components of various shapes, while the uniform and simple design of components in the reconfigurable prefabricated building with the steel structure 100 eliminates the need for excessive adjustment, greatly shortening construction time. In large building projects, this improvement in installation efficiency not only shortens project duration but also reduces labor costs and project risks caused by delays.

[0087] Resource conservation, reducing waste. The reconfigurable and modular design of the reconfigurable prefabricated building with the steel structure 100 significantly improves the resource utilization efficiency in construction. All parts can be reused, dismantled, reassembled, and recombined to meet different building needs, reducing construction waste. Particularly during demolition and reconstruction, the reuse of connectors 11 and profiles can significantly reduce material waste, aligning with the green and environmentally friendly design concept, and further promoting sustainable construction.

[0088] Adaptability to market demands, flexible adjustments. The reconfigurable prefabricated building with the steel structure 100 can quickly adjust building structures based on market demands, fulfilling the need for fast response to changing market conditions and flexible expansion for different functional needs. For buildings of different scales and functions, components 10 can be flexibly added or reduced according to actual conditions, and space layouts can be quickly adjusted. This feature makes the reconfigurable prefabricated building with the steel structure 100 particularly suitable for commercial buildings, residential complexes, temporary buildings, and other areas where efficient and flexible expansion is required, meeting the construction industry's ability to respond to rapidly changing needs.

[0089] In summary, the reconfigurable prefabricated building with the steel structure 100 in this disclosure provides a more efficient, economical, and environmentally friendly building solution by addressing multiple technical bottlenecks in traditional modular buildings through standardized design, simplified installation processes, welding-free connections, high-precision assembly, excellent transportation efficiency, flexible expansion, and low construction requirements.

[0090] The above description is merely one of the embodiments of this disclosure, and the scope of protection of this disclosure is not limited to this. Any variations or substitutions within the technical scope disclosed in this disclosure should be included within the scope of the disclosure.

Claims

1. A reconfigurable prefabricated building with a steel structure (100), comprising one or more building assemblies (10), **characterized in that** each of the building assemblies (10) comprises:

   a connector (11), the connector (11) comprises sidewalls and two end walls (115), with the sidewalls connected sequentially, and the two end walls (115) arranged along a first direction (X), both connected to the sidewalls;
   at least one beam (12), the beam (12) is detachably connected to one of the sidewalls;
   at least one column (13), the column (13) is detachably connected to one of the end walls (115).

2. The reconfigurable prefabricated building with the steel structure (100) according to claim 1, **characterized in that** each of the sidewalls is defined with a first hole (1161), and the beam (12) is defined with a second hole (121);

   when any one of the sidewalls and the beams (12) are interconnected, the first hole (1161) on the sidewall is communicated with the second hole (121) on the beam (12);
   wherein the reconfigurable prefabricated building with the steel structure (100) further comprises a first connecting component (14), the first connecting component (14) is passed through the first hole (1161) and the second hole (121), and securely connected with interconnected sidewall and beam (12).

3. The reconfigurable prefabricated building with the steel structure (100) according to claim 2, **characterized in that** the first hole (1161) is a threaded hole, and the second hole (121) is a through hole, the first connecting component (14) comprises a first bolt (141), the first bolt (141) is configured to pass through the second hole (121) and threaded into the first hole (1161).

4. The reconfigurable prefabricated building with the steel structure (100) according to claim 2, **characterized in that** the first hole (1161) and the second hole (121) are both through holes; the first connecting component (14) comprises the first bolt (141) and a first nut (142); the first bolt (141) is configured to pass through the first hole (1161) and the second hole (121), and the first bolt (141) is locked and connected to the first nut (142);

   each of the end walls (115) is provided with a third hole (1162), and the column (13) is provided with a fourth hole (131);

when each of the end walls (115) is connected with the column (13), the third hole (1162) is communicated with the fourth hole (131);
wherein the reconfigurable prefabricated building with the steel structure (100) further comprises a second connecting component (15), the second connecting component (15) is configured to pass through the third hole (1162) and the fourth hole (131), thus to securely connect the end walls (115) and the column (13).

5. The reconfigurable prefabricated building with the steel structure (100) according to claim 4, **characterized in that** the third hole (1162) and the fourth hole (131) are both through holes;
the second connecting component (15) comprises a second bolt (151) and a second nut (152), the second bolt (151) is passed through the third hole (1162) and the fourth hole (131), and the second bolt (151) is locked with the second nut (152).

6. The reconfigurable prefabricated building with the steel structure (100) according to claim 1, **characterized in that** at least one of the sidewalls is defined with a groove.

7. The reconfigurable prefabricated building with the steel structure (100) according to claim 6, **characterized in that** each of the sidewalls comprises a first sidewall (111), a second sidewall (112), a third sidewall (113), and a fourth sidewall (114);

wherein the first sidewall (111) and the third sidewall (113) are arranged along a second direction (Y), and the second sidewall (112) and the fourth sidewall (114) are arranged along a third direction (Z), wherein the second direction (Y) is perpendicular to the first direction (X), and the third direction (Z) is perpendicular to both the second direction (Y) and the first direction (X);
the first sidewall (111) is defined with a first groove (1111), which is recessed towards the third sidewall (113);
the third sidewall (113) is defined with a second groove (1131), which is recessed towards the first sidewall (111);
the connector (11) further comprises a first connecting wall (1171), which is located between the first groove (1111) and the second groove (1131) along the second direction (Y), and between the two end walls (115) along the first direction (X), connecting the second sidewall (112), the fourth sidewall (114), and the two end walls (115).

8. The reconfigurable prefabricated building with the steel structure (100) according to claim 1, **characterized in that** the connector (11) is integrally formed by casting.

9. The reconfigurable prefabricated building with the steel structure (100) according to claim 1, **characterized in that** projections of the sidewalls, along a direction perpendicular to the first direction (X), form a rectangle;
an accommodating chamber (118) is formed by the sidewalls and the end walls (115).

10. The reconfigurable prefabricated building with the steel structure (100) according to claim 9, **characterized in that** the connector (11) further comprises a second connecting wall (1172), which is located inside the accommodating chamber (118), with the second connecting wall (1172) positioned between the two end walls (115) along the first direction (X), and connecting at least two sidewalls.

11. The reconfigurable prefabricated building with the steel structure (100) according to claim 10, **characterized in that** the connector (11) further comprises a third connecting wall (1173), which is located inside the accommodating chamber (118), the third connecting wall (1173) is positioned between the second connecting wall (1172) and one of the end wall (115) along the first direction (X), and the third connecting wall is connected with the second connecting wall (1172) and at least one of the sidewalls.

12. The reconfigurable prefabricated building with the steel structure (100) according to claim 11, **characterized in that** the sidewalls and the end walls (115) are connected by welding.

13. The reconfigurable prefabricated building with the steel structure (100) according to claim 1, **characterized in that** further comprises a multiple of the building assemblies (10), and the multiple of the building assemblies (10) are detachably connected.

14. The reconfigurable prefabricated building with the steel structure (100) according to claim 13, **characterized in that** in two interconnected building assemblies (10), the beam (12) of one building assembly (10) is connected to the sidewall of the connector (11) of the other building assembly (10).

15. The reconfigurable prefabricated building with the steel structure (100) according to claim 13, **characterized in that** in two interconnected building assemblies (10), the column (13) of one building assembly (10) is connected to the end wall (115) of the connector (11) of the other building assembly (10).

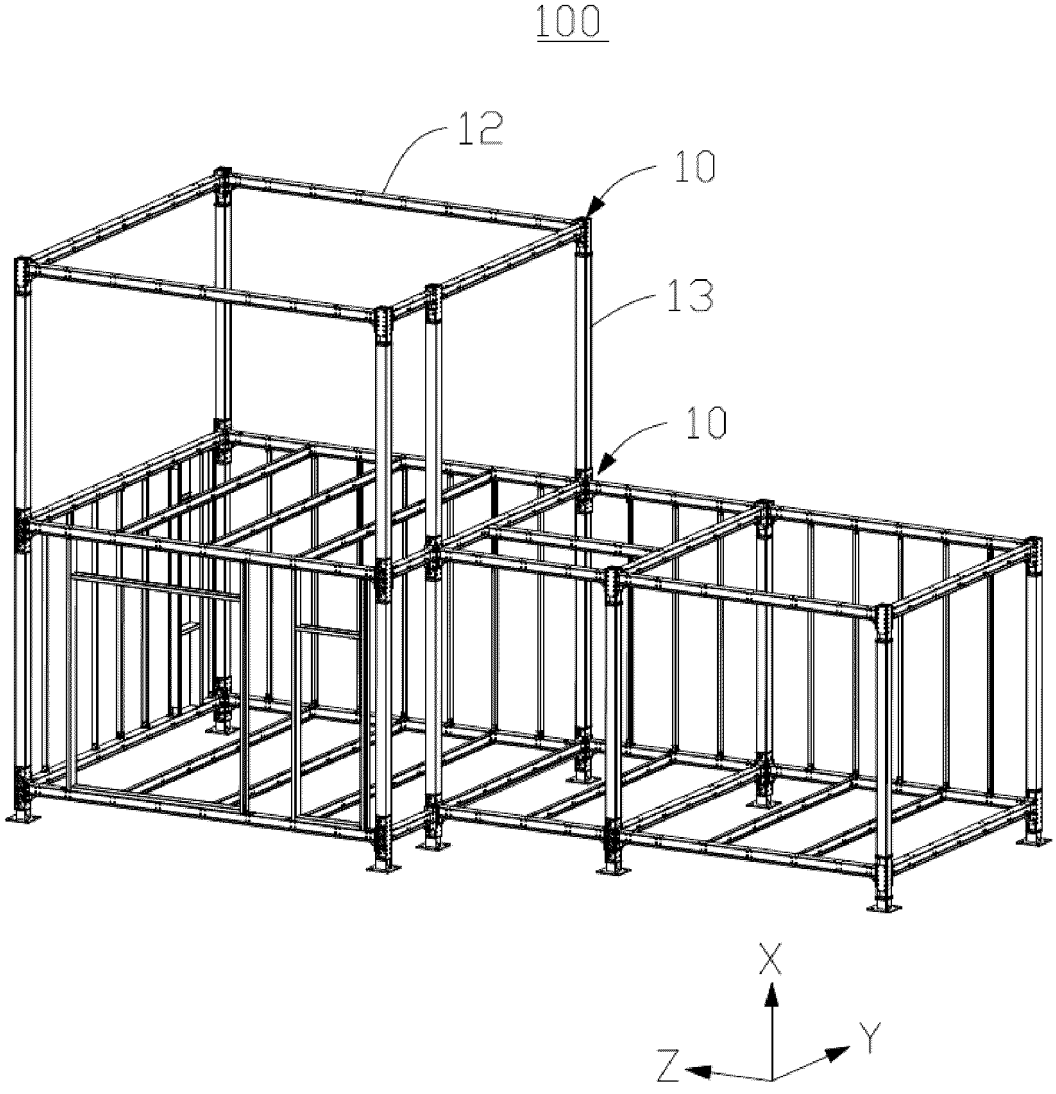


FIG. 1

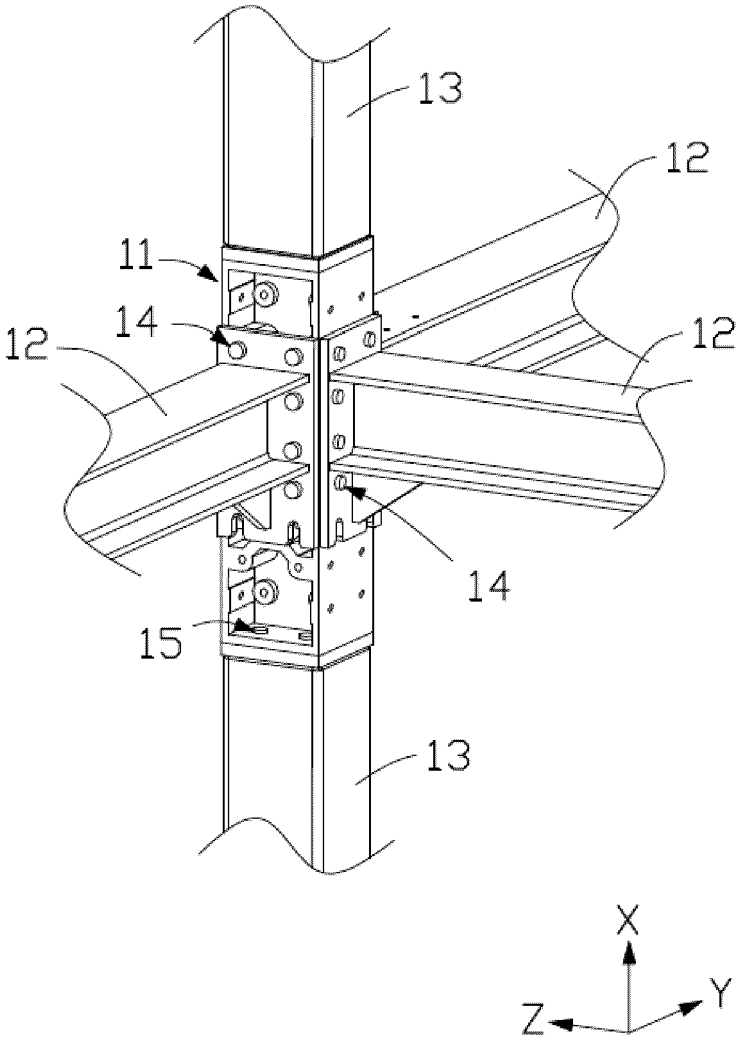


FIG. 2

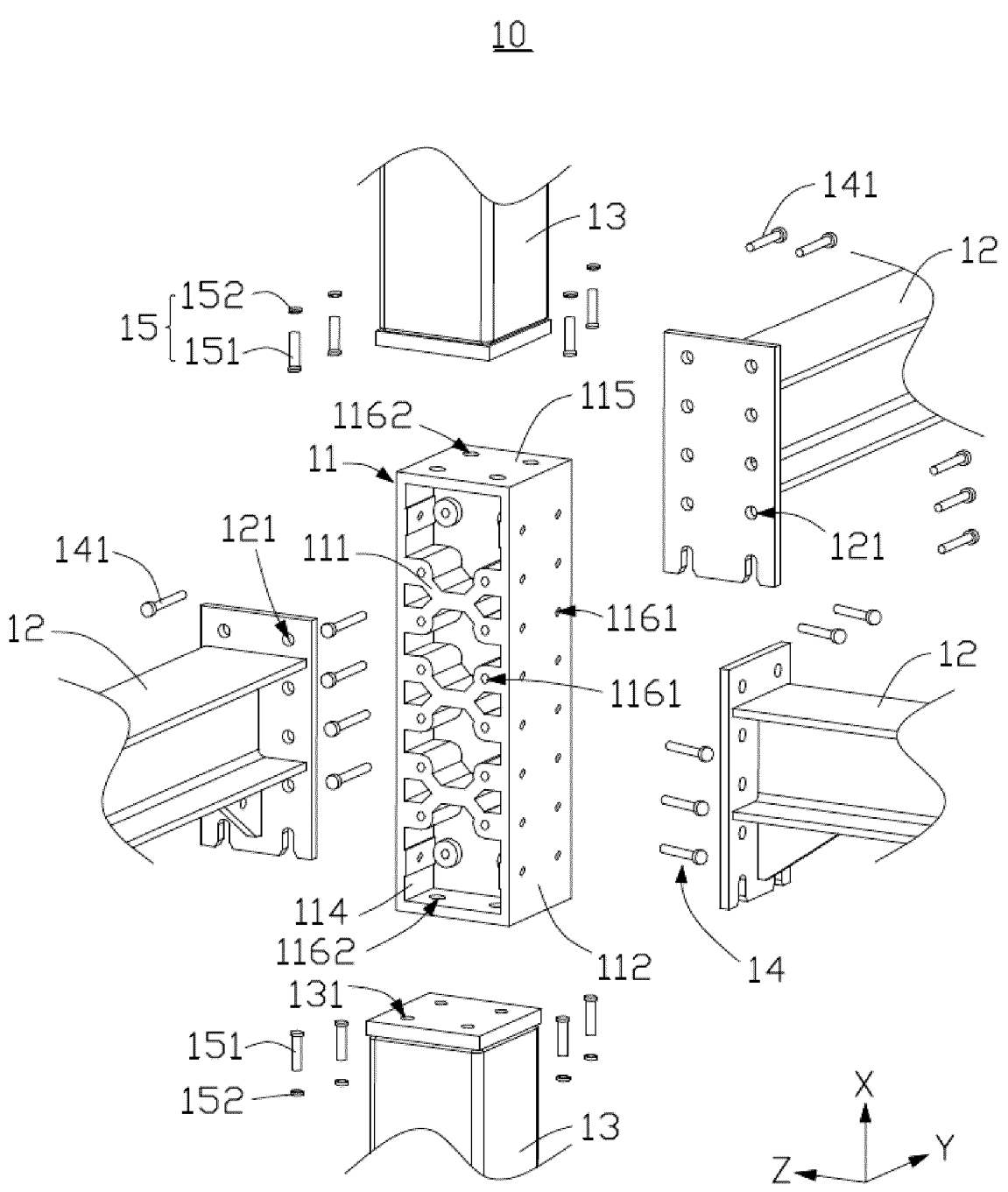

10
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15
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12
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121
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13
X
Z
Y

FIG. 3

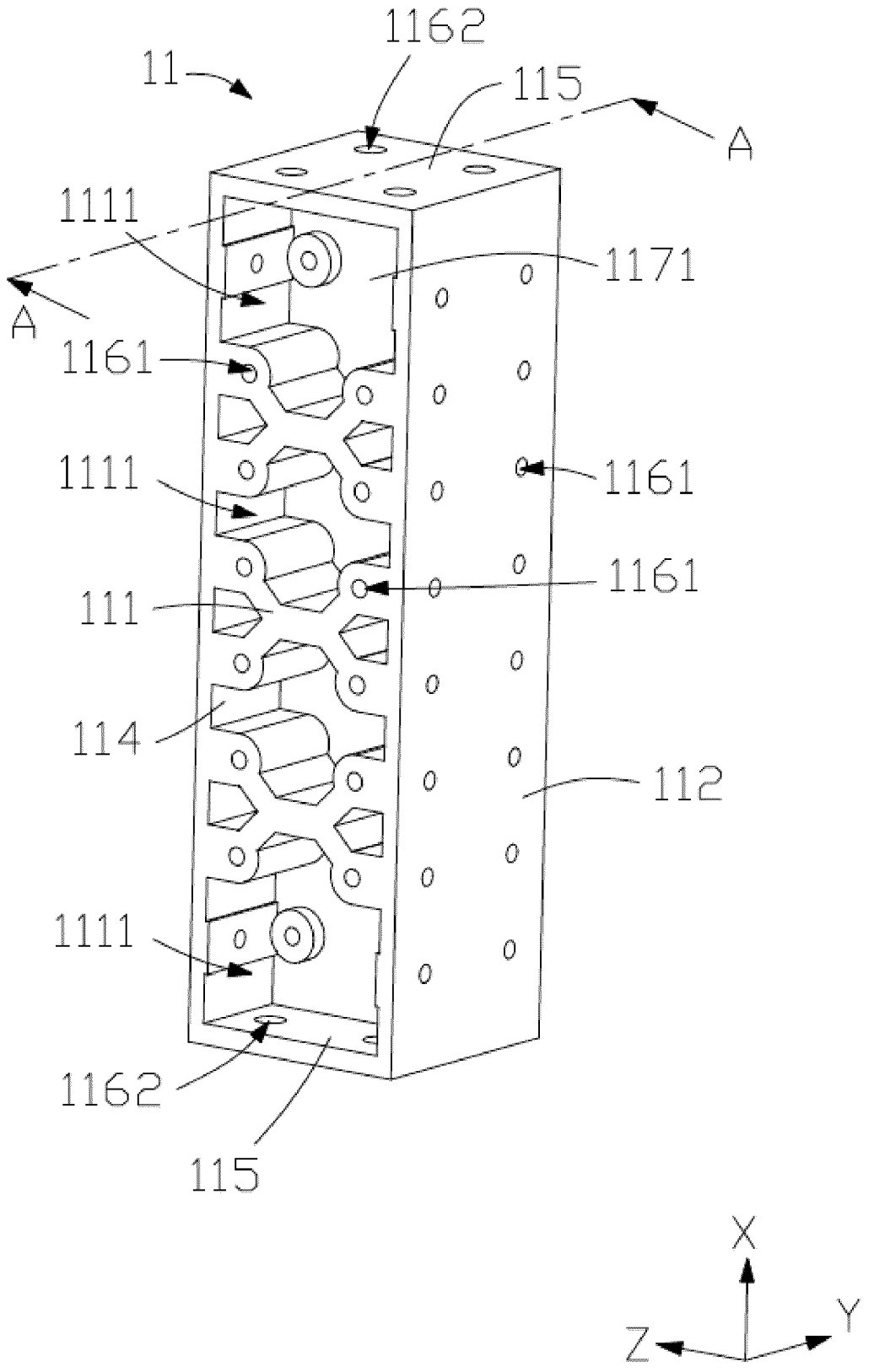

1162
11
115
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1111
1171
A
1161
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1161
111
1161
114
112
1111
1162
115
X
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Y

FIG. 4

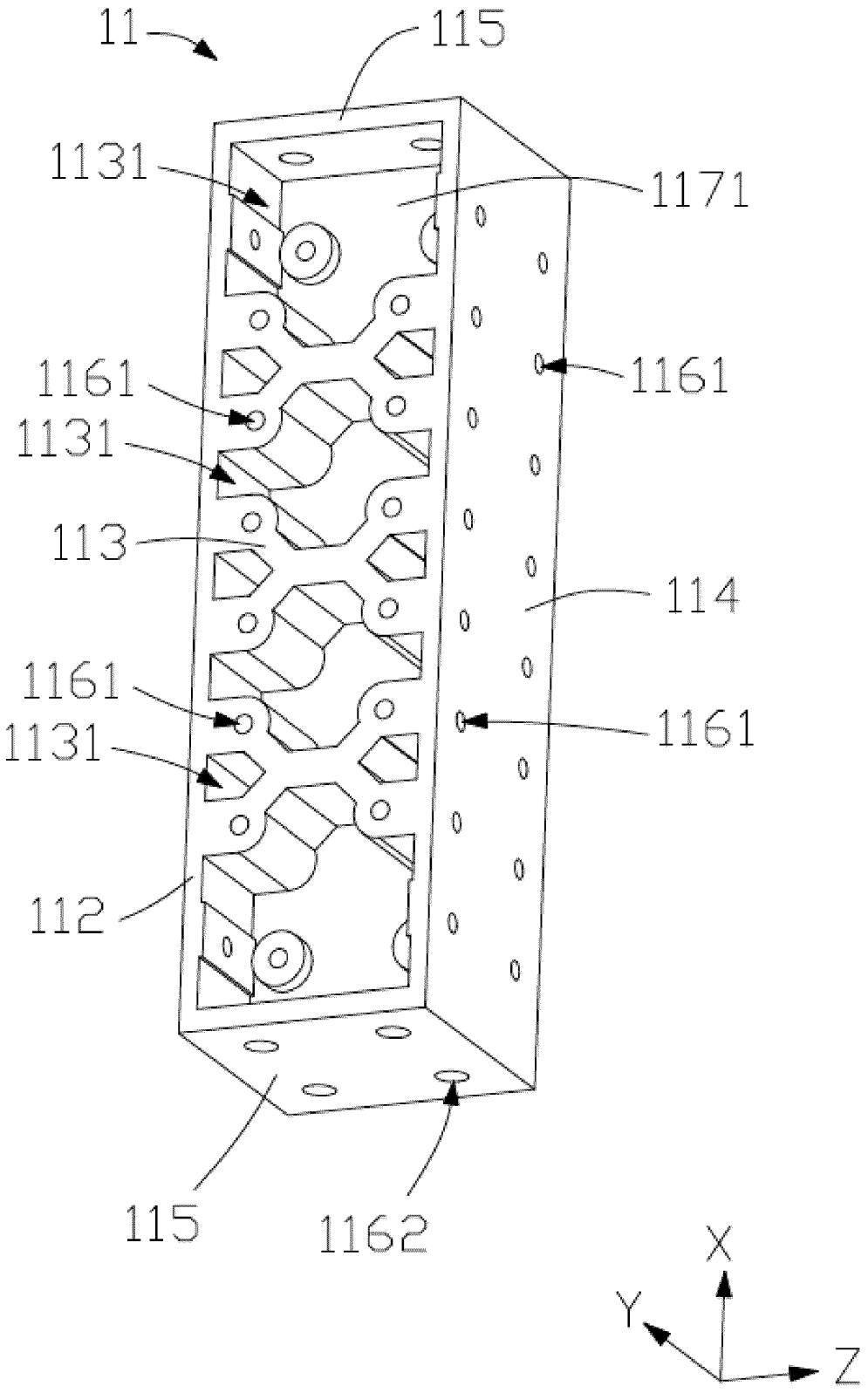

11
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FIG. 5

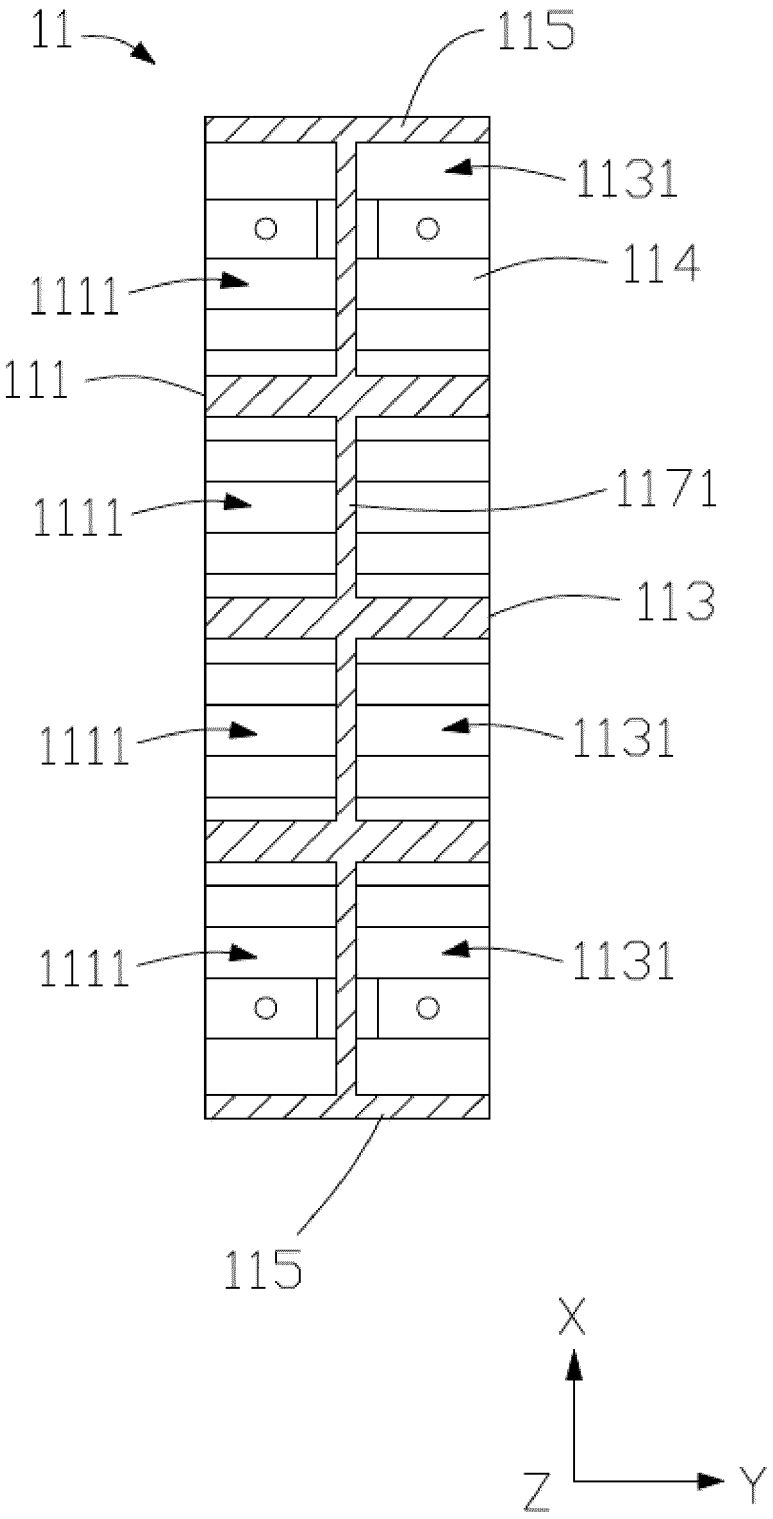

11
115
1131
114
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111
1171
1111
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1111
1131
1111
1131
115
X
Z
Y

FIG. 6

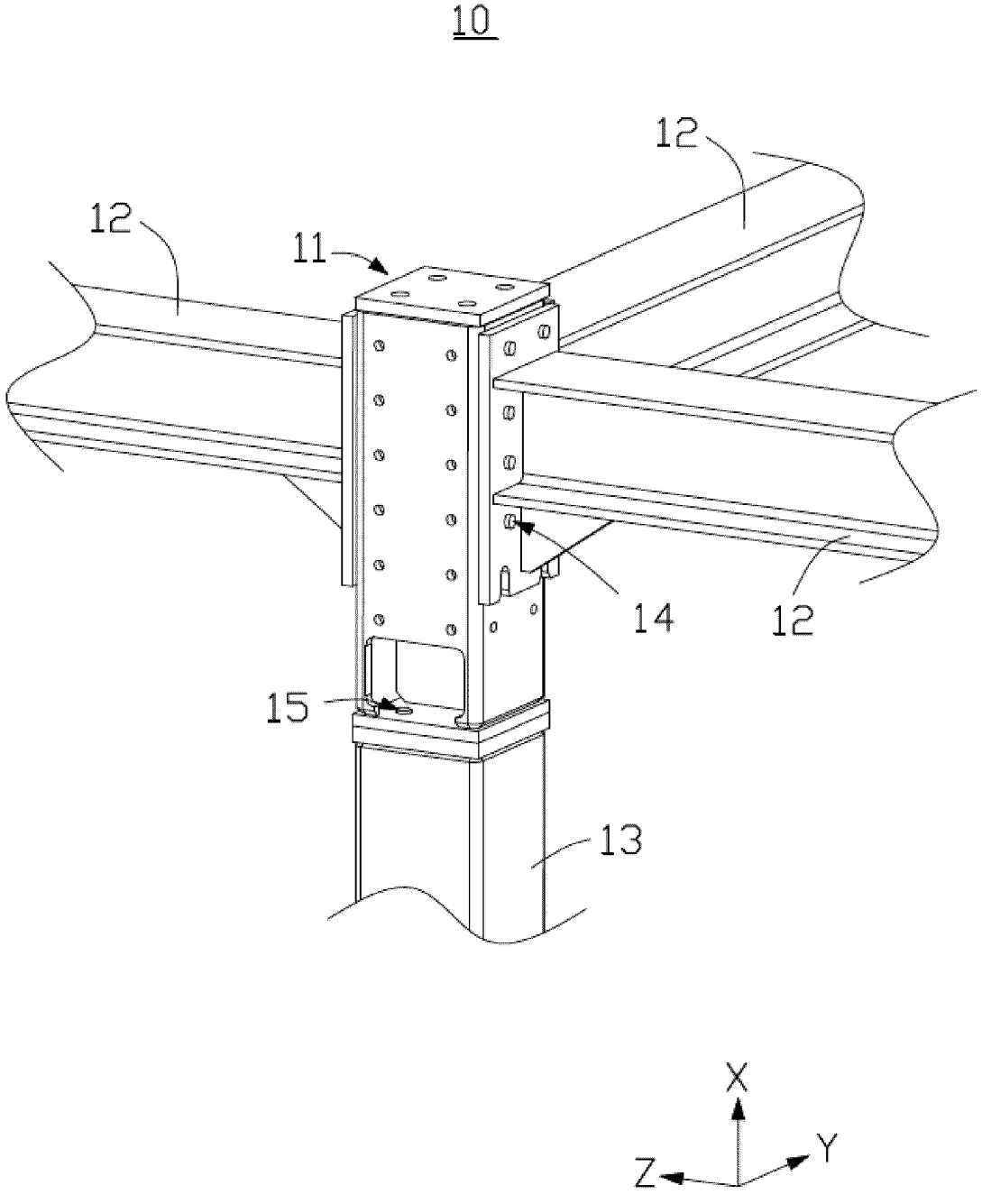


FIG. 7

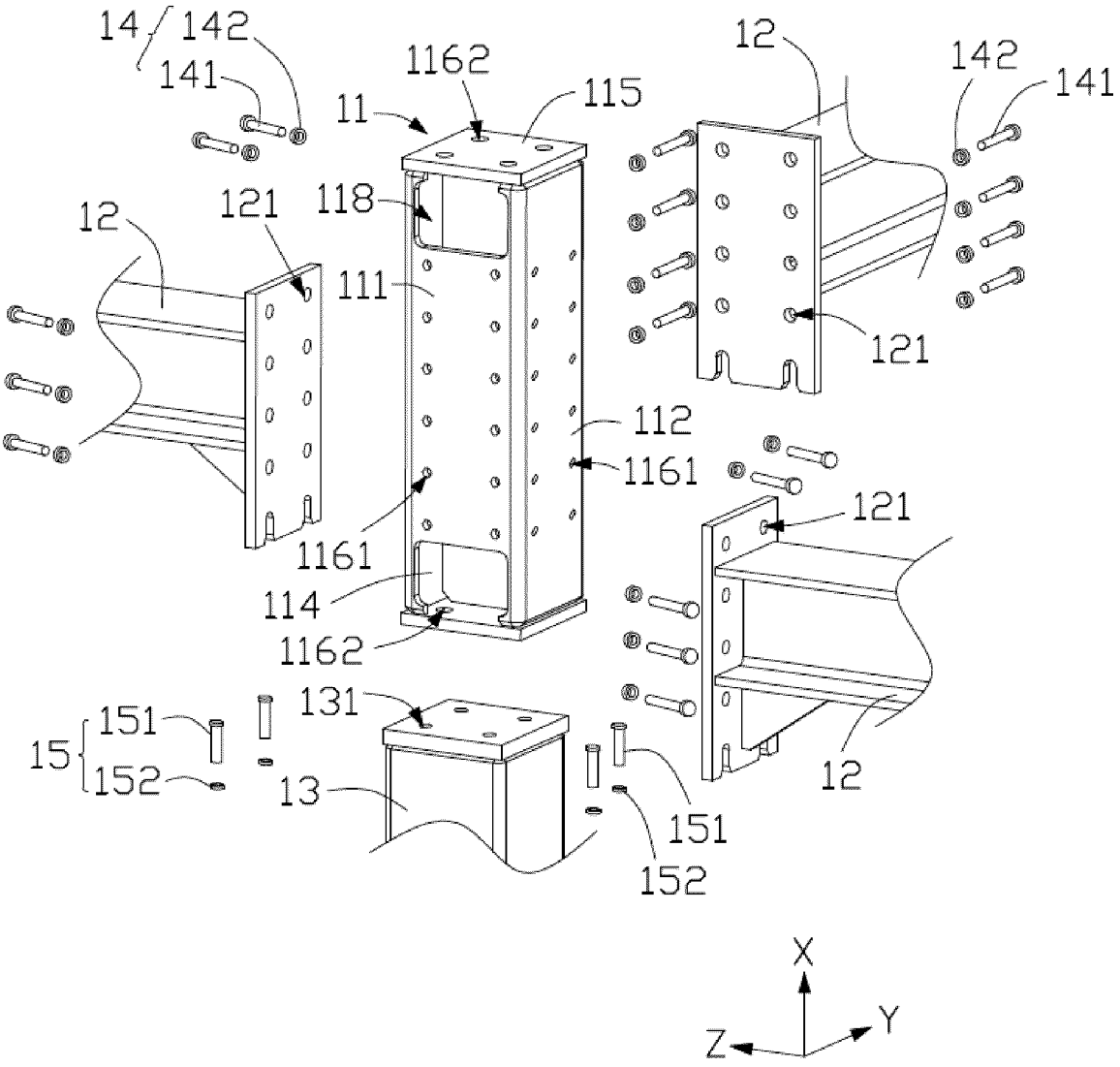

14
142
141
1162
11
115
12
142
141
121
118
12
111
121
112
1161
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131
15
151
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13
151
152
12
X
Y
Z

FIG. 8

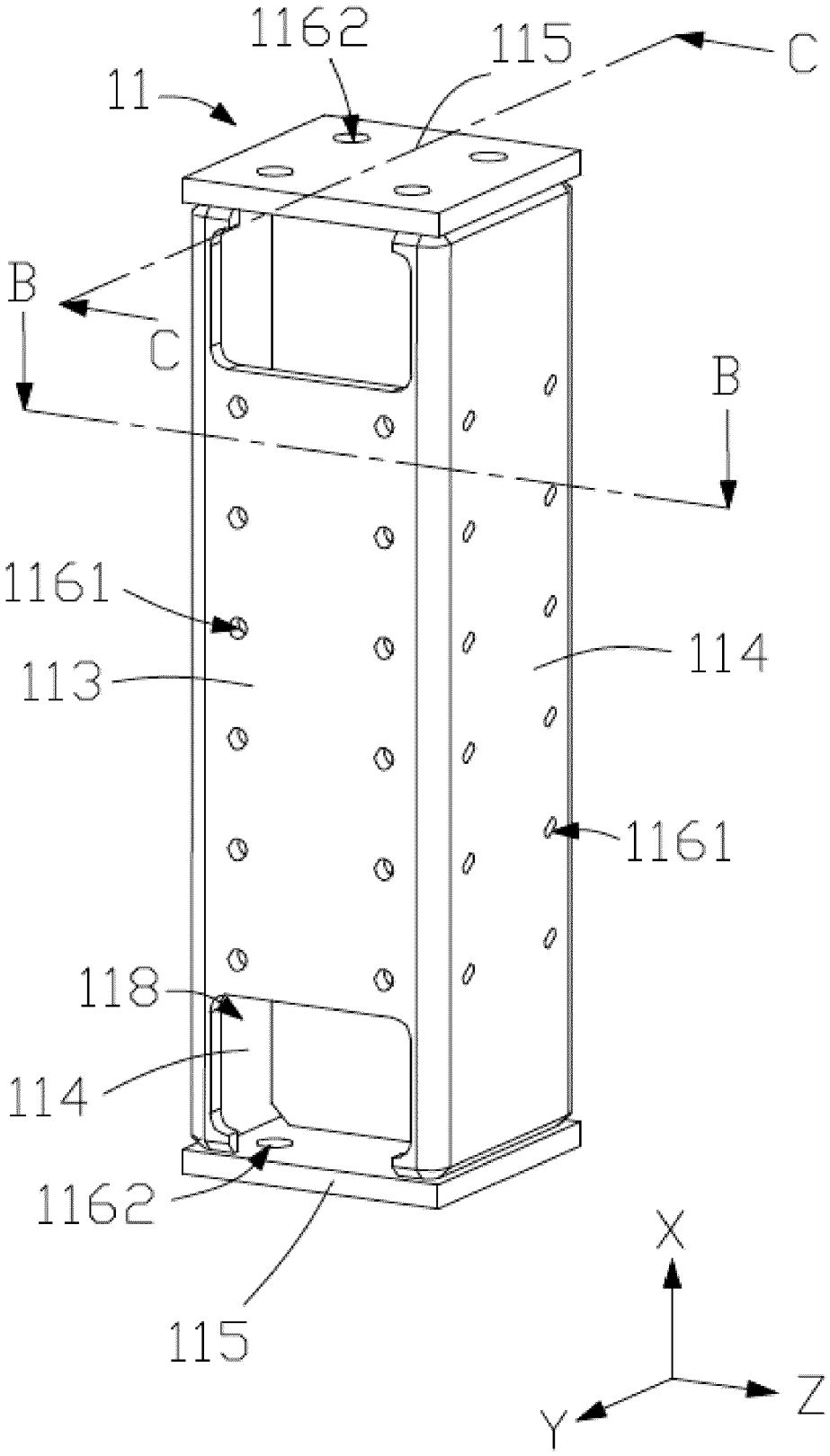


FIG. 9

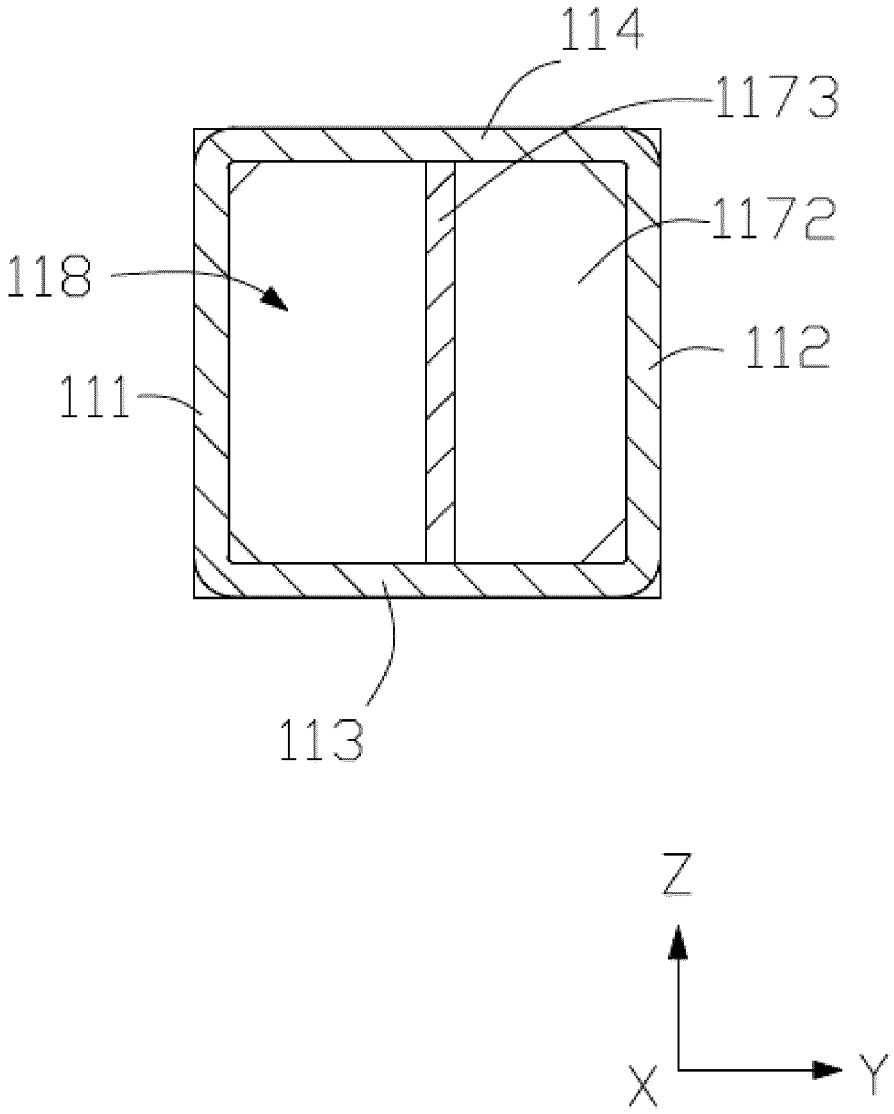


FIG. 10

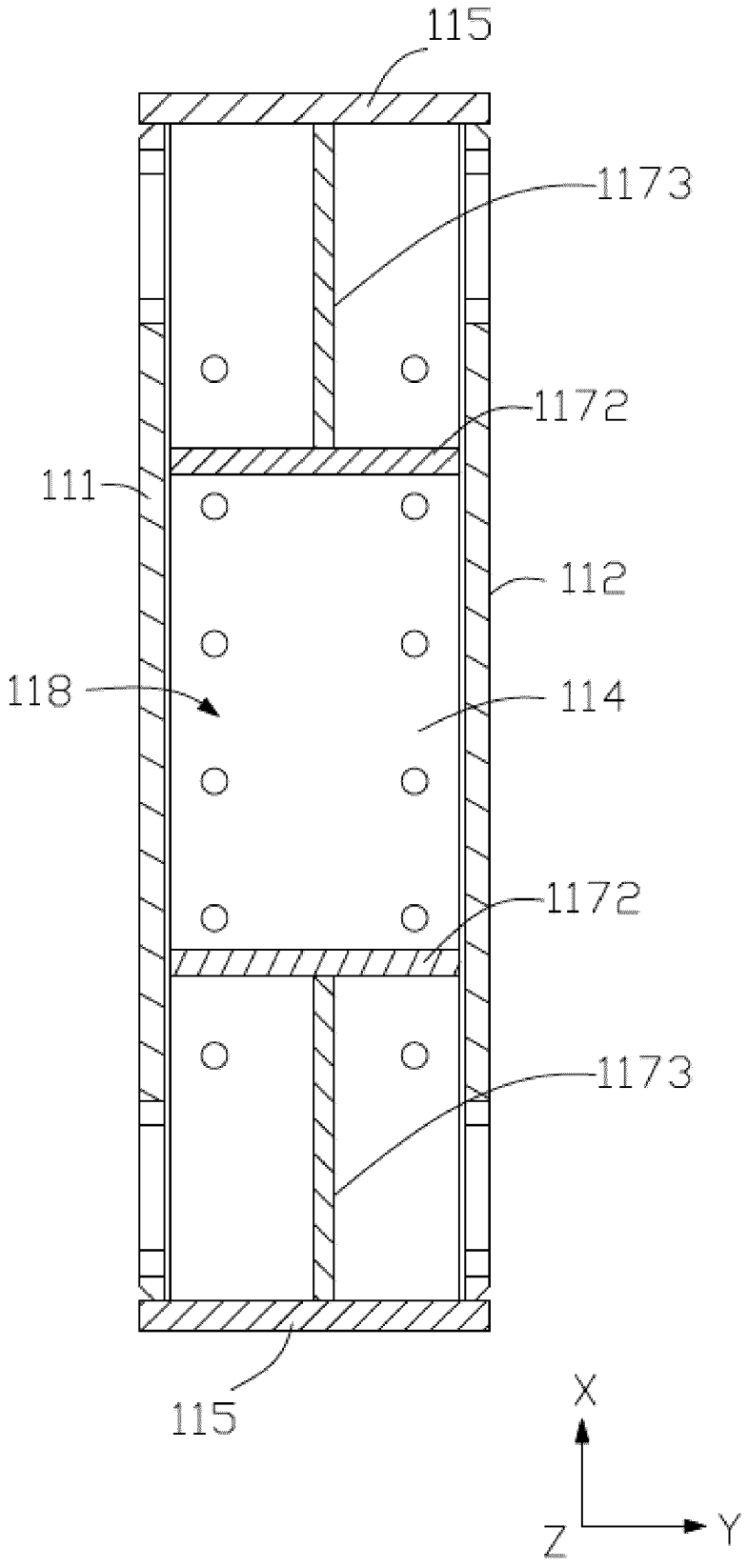


FIG. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 25 17 5078

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	CN 220 978 385 U (HANGXIAO STEEL STRUCTURE LUOYANG CO LTD) 17 May 2024 (2024-05-17) * abstract; figures 1-3 * -----	1-9, 13-15 10-12	INV. E04B1/24
X	DE 101 14 005 B4 (KIEFEL EXTRUSION GMBH [DE]) 30 June 2005 (2005-06-30) * abstract; figures 1-6 * -----	1-15	
X	CN 205 617 562 U (UNIV XIAN TECHNOLOGY) 5 October 2016 (2016-10-05) * abstract; figures 1,2,3,5,6 * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC) E04B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	29 October 2025	Couprie, Brice

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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P : intermediate document

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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
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& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 25 17 5078

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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29-10-2025

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 220978385 U	17-05-2024	NONE	
DE 10114005 B4	30-06-2005	NONE	
CN 205617562 U	05-10-2016	NONE	

EPO FORM P0459

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