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

(11) **EP 4 541 988 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
23.04.2025 Bulletin 2025/17

(21) Application number: **24822296.0**

(22) Date of filing: **05.03.2024**

(51) International Patent Classification (IPC):
E04H 5/04 *(2006.01)* ***E04B 1/348*** *(2006.01)*
H05K 5/00 *(2025.01)* ***H01R 13/506*** *(2006.01)*
H05K 7/14 *(2006.01)* ***H01M 50/20*** *(2021.01)*

(52) Cooperative Patent Classification (CPC):
E04B 1/348; E04H 5/04; H01M 50/20; H01R 13/506; H05K 5/00; H05K 7/14

(86) International application number:
PCT/CN2024/080126

(87) International publication number:
WO 2024/255338 (19.12.2024 Gazette 2024/51)

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

(30) Priority: **16.06.2023 CN 202310713816**

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(54) DEVICE INSTALLATION MODULAR UNIT

(57) The present disclosure provides with a modular unit for apparatus installation, comprising a plurality of vertical struts and multiple layers of apparatus installation frame connecting the plurality of vertical struts for installing apparatuses. The modular unit for apparatus installation is transported in its entirety to a desired installation site to perform installation in a state where various apparatuses are mounted to respective layers of the apparatus installation frame. In the multiple layers of apparatus installation frame, at least the apparatus installation frame at a bottom layer is a crossbeam frame composed of a plurality of crossbeams, and the crossbeam frame is detachably connected not only to a plurality of vertical struts, but also to the various apparatuses mounted to the crossbeam frame. With the modular unit for apparatus installation according to the present disclosure, at least a portion of the crossbeam frame at the bottom layer on which various apparatuses are mounted may be disassembled after the modular unit arrives at the installation site, such that the potential danger caused by the crossbeam frame obstructing the diffusion of gases stranded at the bottom layer can be prevented.

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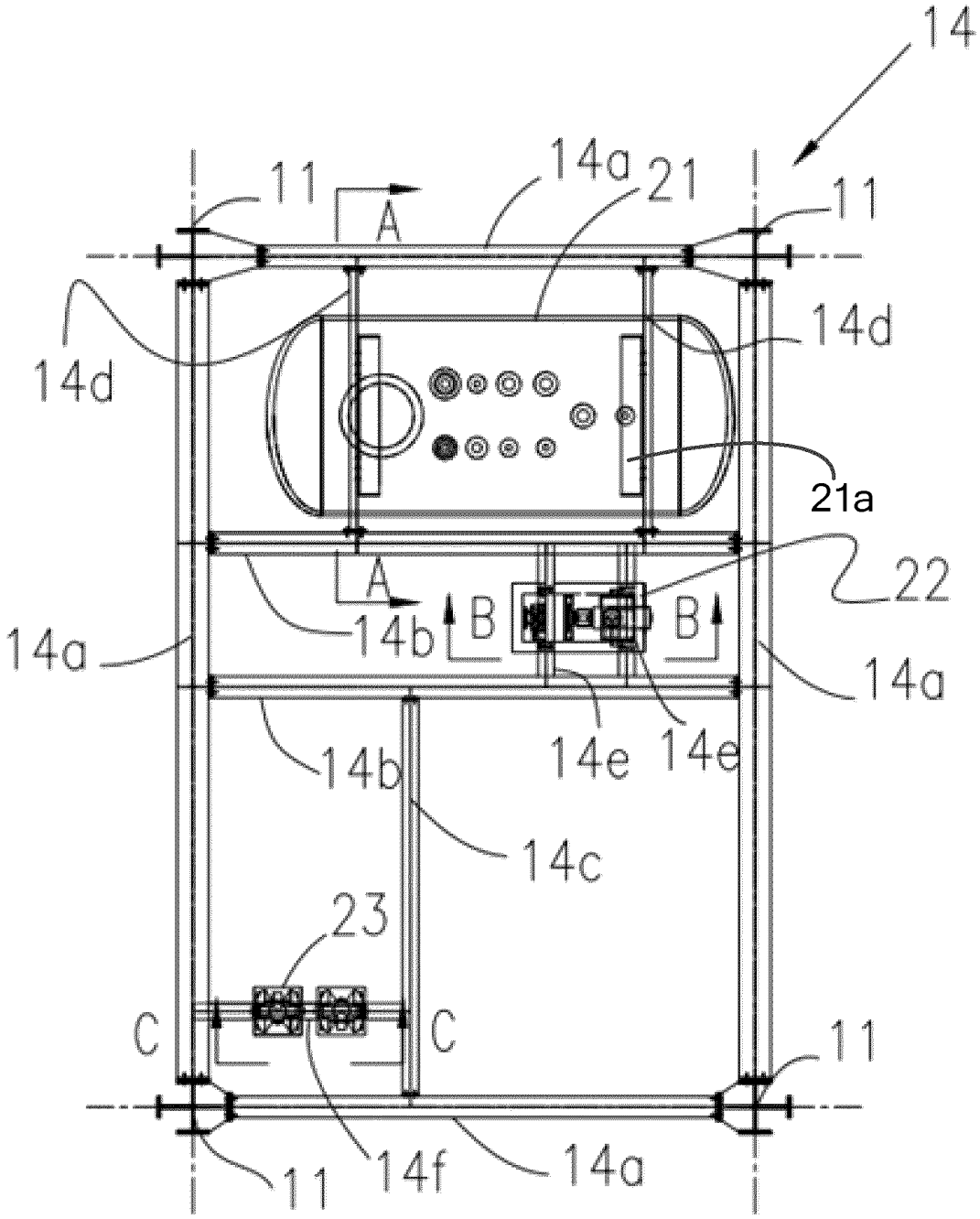
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FIG. 2

Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims the benefit of a priority of a previous invention application, which was filed in China on June 16, 2023, with the application number of 202310713816.8 and titled "Modular Unit For Apparatus Installation", the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to a modular unit for apparatus installation, in particular to an installation and support structure for apparatuses at a bottom layer in a modular unit for apparatus installation.

BACKGROUND

[0003] Currently, in order to enable easy and rapid installation of plant facilities, a common solution (such as that disclosed in patent document CN112166233A) is applied in which the related facilities are modularized and the prefabricated modular units are transported to the construction site for installation. According to the design of the conventional modularization solution, for a modular unit for apparatus installation with multiple layers of apparatus installation frames, all layers of the apparatus installation frames, including the bottom layer, apply the same standardized design. Moreover, considering the process requirements and floor space saving, the bottom layer, like other layers, also needs to have relevant apparatuses mounted thereon. In addition, in order to ensure that the apparatuses and pipelines at the bottom layer are hoisted and transported together with the modular unit, to achieve the maximum trial assembly and inspection in the modular structure manufacturing plant, as well as to ensure the hoisting strength, a layer of steel structure is usually added at the bottom layer of the modular unit, and a grating plate or diamond plate is laid. However, for industries such as the chemical industry or the pharmaceuticals industry, inert harmful gases will be generated in the production process, and these gases are often deposited between the structures (such as the laid grating plates or diamond plate) of the apparatuses at the bottom layer. That is to say, such existing apparatus installation structures at the bottom layer in the prior art will block the diffusion of inert gases (or harmful gases) and leave these gases stranded in the vicinity of the bottom layer, leaving potential dangers. Therefore, for this kind of modular unit for apparatus installation used in related industries such as the chemical industry or the pharmaceuticals industry, which will produce inert gases (or harmful gases), it is necessary to consider using a module with a bottom layer structure which facilitates the diffusion of gases.

SUMMARY

[0004] The present disclosure provides with a modular unit for apparatus installation, in particular a modular unit for apparatus installation with a bottom layer structure which facilitates the diffusion of gases.

[0005] A modular unit for apparatus installation provided by the present disclosure comprises a plurality of vertical struts and multiple layers of apparatus installation frames for installing apparatuses, the multiple layers of apparatus installation frames connects the plurality of vertical struts for installing an apparatus and are located between the plurality of vertical struts. In case where various apparatuses are mounted to respective layers of the apparatus installation frames, the modular unit for apparatus installation in its entirety is transported to a desired installation site for installation. In the multiple layers of apparatus installation frame, at least a crossbeam frame at the bottom layer is consisted of a plurality of crossbeams, and the crossbeam frame is not only detachably connected to the plurality of vertical struts, but also detachably connected to the various apparatuses mounted to the crossbeam frame.

[0006] In at least one embodiment, the plurality of crossbeams of the crossbeam frame comprise frame beams and apparatus foundation beams connected to the apparatuses, and the apparatus foundation beams are detachably connected to the frame beams.

[0007] In at least one embodiment, the connections between the crossbeam frame and the plurality of vertical struts, the connections between the crossbeam frame and the various apparatuses, and the connections between the apparatus foundation beams and the frame beams apply bolt connection structure.

[0008] In at least one embodiment, at least one of the various apparatuses has anchor bolt(s) which is/are fixed to a concrete foundation at the installation site.

[0009] In at least one embodiment, at least one of the apparatus foundation beams is welded and fixed to a pre-embedded plate in a slot of the concrete foundation at the installation site, or is connected and fixed to the concrete foundation at the installation site by means of chemical anchor bolt(s).

[0010] In at least one embodiment, the apparatus installation frames comprise an apparatus installation plane frame at an intermediate layer, an apparatus installation plane frame at a top layer, and the crossbeam frame at the bottom layer. The modular unit for apparatus installation in its entirety is hoisted and transported to a desired installation site for installation.

[0011] In at least one embodiment, the crossbeam frame comprises a plurality of outer frame crossbeams, a plurality of inner frame crossbeams, and a plurality of apparatus installation beams. After at least part of the apparatuses are mounted to the concrete foundation at the desired installation site, the outer frame crossbeams are removed, and one or more of the plurality of inner frame crossbeams and the plurality of apparatus installa-

tion beams is/are removed.

[0012] In at least one embodiment, a height of the apparatus from the ground plane of the foundation is 200 mm to 400 mm in case where at least one of the apparatus foundation beams is welded and fixed to a pre-embedded plate in a slot of the concrete foundation at the installation site, and a height of the apparatus from the ground plane of the foundation is more than 400 mm in case where chemical anchor bolt(s) is/are used.

[0013] In at least one embodiment, the height of the apparatus foundation beam is determined based on the height of the apparatus from the ground plane of the foundation as specified by industrial requirements.

[0014] In at least one embodiment, the frame beams comprise: a plurality of outer frame crossbeams which form an outer frame of the crossbeam frame and which are detachably connected to the plurality of vertical struts; at least one first inner frame crossbeam which connects the outer frame crossbeams facing each other within the outer frame; and at least one second inner frame crossbeam which connects the outer frame crossbeam and the first inner frame crossbeam facing each other within the outer frame, wherein at least one apparatus foundation beam is provided in the outer frame, and the at least one apparatus foundation beam is detachably connected to at least one of the outer frame crossbeam, the first inner frame crossbeam and the second inner frame crossbeam, and the apparatus is detachably mounted to the at least one apparatus foundation beam.

[0015] In at least one embodiment, in the multiple layers of apparatus installation frames, diagonal bracing beam(s) is/are provided between the apparatus installation frames adjacent to each other. The diagonal bracing beam(s) is/are connected to the apparatus installation frames adjacent to each other and is/are inclined with respect to the apparatus installation frames adjacent to each other.

[0016] In at least one embodiment, in the multiple layers of apparatus installation frames, at least one layer of the apparatus installation frame, other than the crossbeam frame, is detachably connected not only to the plurality of vertical struts, but also to the various apparatuses mounted to the at least one layer of the apparatus installation frame.

[0017] With the modular unit for apparatus installation provided by the present disclosure, after the modular unit for apparatus installation arrives at the installation site, at least part of the structure of the crossbeam frame at the bottom layer where various apparatuses are mounted can be disassembled, such that the potential danger caused by the crossbeam frame obstructing the diffusion of gases stranded at the bottom layer can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a schematic side view showing a modular unit for apparatus installation according to one embodiment of the present disclosure.

FIG. 2 is a schematic top view showing a state of a crossbeam frame at a bottom layer in a modular unit for apparatus installation, in which various apparatuses are mounted to the crossbeam frame, according to one embodiment of the present disclosure.

FIG. 3 is a schematic longitudinal sectional view showing a state of a first apparatus when being installed in an installation site according to one embodiment of the present disclosure.

FIG. 4 is a schematic longitudinal sectional view showing a state of a second apparatus when being installed in an installation site according to one embodiment of the present disclosure.

FIG. 5 is a schematic longitudinal sectional view showing a state of a third apparatus when being installed in an installation site according to one embodiment of the present disclosure.

FIG. 6 is a partial perspective view showing a state where various apparatuses at a bottom layer in a modular unit for apparatus installation are connected to a crossbeam frame according to one embodiment of the present disclosure.

FIG. 7 is a partial perspective view showing a state where various apparatuses at a bottom layer in a modular unit for apparatus installation are detached from a crossbeam frame and then fixed to a concrete foundation according to one embodiment of the present disclosure.

DETAILED DESCRIPTION

[0019] The technical solution of the present disclosure and its effects will be described in detail through specific embodiments. The following embodiments are only intended to illustrate the present disclosure, and the present disclosure is not limited to the following embodiments. Variations made to the present disclosure by applying the concept of the present disclosure are all within the protection scope of the present disclosure.

[0020] A modular unit 10 for apparatus installation provided by an embodiment of the present disclosure is a modular unit for apparatus installation that can be applied to industries such as the chemical industry or the pharmaceuticals industry. As shown in FIG. 1, the modular unit 10 for apparatus installation has a cuboid frame structure, which comprises a plurality of (four in this embodiment) vertical struts 11, a plurality of apparatus installation plane frames 12 at the intermediate layers, an apparatus installation plane frame 13 at the top layer, a crossbeam frame 14 at the bottom layer for installing apparatuses, diagonal bracing beams 15 connected to the vertical struts 11, the apparatus installation plane frames 12, 13 and the crossbeam frame 14, and a plurality of lifting lugs 16 provided to the frame structure.

[0021] The length of the plurality of vertical struts 11 may be used to define the height of the modular unit 10 for

apparatus installation. The apparatus installation plane frames 12, 13 and the crossbeam frame 14 may be used to form multiple layers of apparatus installation frames of the modular unit 10 for apparatus installation between the plurality of vertical struts 11.

[0022] The apparatus installation plane frames 12, 13 each may, for example, be provided in the following configuration: a polygonal frame (a rectangular frame in this embodiment) surrounded by a plurality of (four in this embodiment) outer frame crossbeams, with a plate provided within the frame. The plate in the frame may be fixed to the respective outer frame crossbeams or may be detachably mounted to the respective outer frame crossbeams. In case of such configuration, the respective outer frame crossbeams forming the polygonal frames of the respective apparatus installation plane frames are fixed by being engaged with the plurality of vertical struts 11, and the plates provided in the frames of the respective apparatus installation plane frames may be provided to be parallel to each other.

[0023] Further, as shown in FIGS. 1, 2, and 6, the crossbeam frame 14 for apparatus installation at the bottom layer may, for example, be provided in the following configuration: a polygonal frame (a rectangular frame in this embodiment) surrounded by a plurality of outer frame crossbeams (four outer frame crossbeams 14a in this embodiment), with inner frame crossbeams, apparatus installation beams or the like, which are engaged with the respective outer frame crossbeams, provided within the frame. In case of such configuration, the respective outer frame crossbeams of the crossbeam frame 14 are fixed by being engaged with the plurality of vertical struts 11, and a plane in which the frame enclosed by the outer frame crossbeams of the crossbeam frame 14 is located may be provided to be parallel to the plates of the apparatus installation plane frames 12, 13.

[0024] Further, as shown in FIG. 1, connecting a plurality of diagonal bracing beams 15 to the respective vertical struts 11, the apparatus installation plane frames 12, 13, and the crossbeam frame 14, respectively, can prevent the modular unit 10 for apparatus installation from being deformed by an external force, and can improve the structural stability of the modular unit 10 for apparatus installation.

[0025] As shown in FIG. 1, in the frame structure of the modular unit 10 for apparatus installation, at a portion where at least one layer apparatus installation frame of the apparatus installation frames (the apparatus installation plane frames 12, 13, and the crossbeam frame 14) at respective layers is engaged with at least one of the vertical struts 11, there are provided lifting lugs 16 for lifting the modular unit 10 for apparatus installation in scenarios such as moving, transporting, installing, and disassembling the modular unit 10. Thus, it is possible to move, transport, install and disassemble the modular unit 10 for apparatus installation by directly hooking the lifting lugs 16 with a crane or the like, which is easy to operate.

[0026] The modular unit 10 for apparatus installation may be manufactured and assembled in advance in a modular device manufacturing plant; and after required relevant apparatuses are mounted to the respective layers of the apparatus installation frames (the apparatus installation plane frames 12, 13 and the crossbeam frame 14), the modular unit 10 for apparatus installation in its entirety is hoisted and transported to a construction and installation site of a plant such as a chemical plant or a pharmaceutical plant for installation and fixation. The transportation mode of the modular unit 10 for apparatus installation according to the present disclosure is certainly not limited to hoisting transportation, that is, the modular unit 10 for apparatus installation according to the present disclosure may be transported by any suitable vehicle or tool. In the respective layers of the apparatus installation frames (the apparatus installation plane frames 12, 13 and the crossbeam frame 14) in this embodiment, the connections between the plurality of crossbeams of the crossbeam frame 14 at the bottom layer and the vertical struts 11 and the connections between the plurality of crossbeams of the crossbeam frame 14 at the bottom layer and the apparatuses mounted to the bottom layer may both be detachable connections.

[0027] FIG. 2 is a schematic top view showing a state of the crossbeam frame 14 at the bottom layer of the modular unit 10 for apparatus installation, in which various apparatuses are mounted to the crossbeam frame 14, according to one embodiment of the present disclosure. As shown in FIG. 2, the plurality of crossbeams of the crossbeam frame 14 comprise four outer frame crossbeams 14a connected to the vertical struts 11; two first inner frame crossbeams 14b connecting two outer frame crossbeams 14a facing each other; a second inner frame crossbeam 14c connecting one outer frame crossbeam 14a of the two outer frame crossbeams 14a which are not connected to the first inner frame crossbeams 14b, and the first inner frame crossbeam 14b facing the said one outer frame crossbeam 14a; two first apparatus installation beams 14d connecting the other outer frame crossbeam 14a of the two outer frame crossbeams 14a which are not connected to the first inner frame crossbeams 14b, and the first inner frame crossbeam 14b facing the said other outer frame crossbeam 14a; two second apparatus installation beams 14e connecting the two first inner frame crossbeams 14b; and a third apparatus installation beam 14f connecting the outer frame crossbeam 14a and the second inner frame crossbeam 14c.

[0028] The outer frame crossbeams 14a, the first inner frame crossbeams 14b, and the second inner frame crossbeam 14c serve as frame beams of the crossbeam frame 14, and the first apparatus installation beams 14d, the second apparatus installation beams 14e, and the third apparatus installation beam 14f serve as apparatus foundation beams of the crossbeam frame 14 for installing apparatuses. In this embodiment shown in FIG. 2, the two first apparatus installation beams 14d are configured

to install a first apparatus 21, the two second apparatus installation beams 14e are configured to install a second apparatus 22, and the third apparatus installation beam 14f is configured to install a third apparatus 23.

[0029] The number and layout of the outer frame crossbeams 14a, the first inner frame crossbeams 14b, the second inner frame crossbeam 14c, the first apparatus installation beams 14d, the second apparatus installation beams 14e, and the third apparatus installation beam 14f of the crossbeam frame 14 are not limited to those shown in FIG. 2, that is, they may be modified based on the specific apparatuses to be installed. In this way, the crossbeam frame 14 at the bottom layer of the modular unit 10 for apparatus installation according to the present disclosure has excellent generality.

[0030] The first apparatus 21 may be a horizontal apparatus with saddles 21a, which has anchor bolts that may be fixed to the concrete foundation at the installation site. During the assembly and transportation of the modular unit 10 for apparatus installation, the two first apparatus installation beams 14d are connected to side faces of the saddles 21a by fasteners (such as bolt connection fasteners), respectively. In other words, the saddles 21a are connected and fixed to the two first apparatus installation beams 14d by fasteners (such as bolt connection fasteners), i.e., allowing the first apparatus 21 to be mounted and fixed to the crossbeam frame 14.

[0031] Specifically, the first apparatus 21 is, for example, substantially cylindrical in shape and is mounted and fixed to the two first apparatus installation beams 14d in a horizontally placed manner with the aid of the two saddles 21a under the first apparatus 21. The saddles 21a are made of, for example, channel steel, i.e. C-shaped steel. In this embodiment, as shown in FIG. 3, the saddle 21a has a substantially trapezoidal shape that is wide at the top and narrow at the bottom when viewed from the side along the horizontal direction. In addition, the two first apparatus installation beams 14d are also made of, for example, channel steel. At the installation site, as shown in FIG. 2, the channel steel serving as the saddles 21a and the channel steel serving as the first apparatus installation beams 14d are connected back to back at two places spaced apart from each other by a certain distance in the longitudinal direction of the first apparatus 21, that is, the openings of the channel steel are connected in such a way that they face opposite sides.

[0032] The second apparatus 22 may be a mounting base without any saddle or the like, a predetermined apparatus can be mounted to the second apparatus, and the predetermined apparatus, for example, needs to be at a certain height (for example, 200 mm to 400 mm) from the ground plane G of the foundation based on industrial requirements. It needs to provide apparatus foundation beams on the second apparatus 22. Specifically, as shown in FIG. 2, the second apparatus installation beams 14e serving as the apparatus foundation beams are fixed under the second apparatus 22. Therefore, before the modular unit 10 for apparatus installation is hoisted and transported, the two second apparatus installation beams 14e should be respectively fixedly connected to the second apparatus 22 by means of fasteners (such as bolt connection fasteners), welding, or the like. In other words, the second apparatus 22 is fixedly connected to the two second apparatus installation beams 14e by means of fasteners (such as bolt connection fasteners), welding, or the like. Then, the two second apparatus installation beams 14e are respectively connected to the two first inner frame crossbeams 14b by fasteners (such as bolt connection fasteners), such that the second apparatus 22 with the apparatus foundation beams is mounted and fixed to the crossbeam frame 14.

[0033] However, the present disclosure is not limited thereto. It is also possible to connect the two second apparatus installation beams 14e to the two first inner frame crossbeams 14b by fasteners (such as bolt connection fasteners), and then fixedly connect the second apparatus 22 to the two second apparatus installation beams 14e by means of fasteners (such as bolt connection fasteners), welding, or the like.

[0034] In addition, the predetermined apparatus mounted to the second apparatus 22 may be appropriately modified based on the actual needs.

[0035] The third apparatus 23 may be a mounting base without any saddle or the like, a predetermined apparatus can be mounted to the third apparatus 23, and the predetermined apparatus, for example, needs to be at a greater height (such as higher than 400 mm) from the ground plane G of the foundation based on industrial requirements. Similarly, as shown in FIG. 2, the third apparatus installation beam 14f serving as the apparatus foundation beam is fixed under the third apparatus 23. Therefore, before the modular unit 10 for apparatus installation is hoisted and transported, the third apparatus installation beam 14f should be fixedly connected to the third apparatus 23 by means of fasteners (such as bolt connection fasteners), welding, or the like. In other words, the third apparatus 23 is fixedly connected to the third apparatus installation beam 14f by means of fasteners (such as bolt connection fasteners), welding, or the like. Then, the third apparatus installation beam 14f is connected to the outer frame crossbeam 14a and the second inner frame crossbeam 14c respectively by fasteners (such as bolt connection fasteners), such that the third apparatus 23 with the apparatus foundation beam is mounted and fixed to the crossbeam frame 14.

[0036] However, the present disclosure is not limited thereto. It is also possible to connect the third apparatus installation beam 14f to the outer frame crossbeam 14a and the second inner frame crossbeam 14c respectively by fasteners (such as bolt connection fasteners), and then fixedly connect the third apparatus 23 to the third apparatus installation beam 14f by means of fasteners (such as bolt connection fasteners), welding, or the like.

[0037] In addition, the predetermined apparatus mounted to the third apparatus 23 may be appropriately

modified based on the actual needs.

[0038] The outer frame crossbeams 14a, the first inner frame crossbeams 14b, the second inner frame crossbeam 14c, the second apparatus installation beams 14e, and the third apparatus installation beam 14f may all be made of H-shaped steel, with end plates provided at both ends and bolt connection holes provided in the end plates. And the first apparatus installation beams 14d are made of channel steel, with end plates provided at both ends and bolt connection holes provided in the end plates. However, the present disclosure is not limited thereto, that is, the outer frame crossbeams 14a, the first inner frame crossbeams 14b, the second inner frame crossbeam 14c, the first apparatus installation beams 14d, the second apparatus installation beams 14e, and the third apparatus installation beam 14f may also be made of any other steel known in the art based on the actual needs.

[0039] After the first apparatus 21, the second apparatus 22, the third apparatus 23, and their pipelines are mounted and fixed to the crossbeam frame 14, and the predetermined apparatuses and pipelines are mounted to other respective layers of the apparatus installation frames, the assembly and production of the modular unit 10 for apparatus installation are completed. The modular unit 10 for apparatus installation can then be transported to the installation site for on-site installation.

[0040] Hereinafter, the installation methods of the above various apparatuses at the bottom layer will be described, which could be performed after the modular unit 10 for apparatus installation is transported to the installation site.

[0041] FIG. 3 is a schematic longitudinal sectional view showing a state of the first apparatus 21 when being installed in the installation site according to one embodiment of the present disclosure, that is, FIG. 3 is a sectional view taken along the line A-A in FIG. 2. Before installation, while the anchor bolts B of the first apparatus 21 are being inserted into anchor bolt insertion holes reserved on site, the saddles 21a directly fall on the pre-poured concrete foundation C on site. Then, the connections of the two first apparatus installation beams 14d to the outer frame crossbeam 14a and the first inner frame crossbeam 14b is removed, thereinafter the connections and fixations of the two first apparatus installation beams 14d to the saddles 21a are removed, then the outer frame crossbeams 14a, the first apparatus installation beams 14d, and the first inner frame crossbeams 14b are gradually removed, and finally the first apparatus 21 is fixed to the concrete foundation C by grouting the gaps between the anchor bolts B and the anchor bolt insertion holes. Thus, in case where the first apparatus 21 is a horizontal apparatus which is in large scale, by applying the anchor bolts B and grouting the gaps between the anchor bolts B and the anchor bolt insertion holes, the installation strength of the first apparatus 21 can be ensured and the first apparatus 21 can thus be stably secured to the concrete foundation C.

[0042] FIG. 4 is a schematic longitudinal sectional view showing a state of the second apparatus 22 when being installed in the installation site according to one embodiment of the present disclosure, that is, FIG. 4 is a sectional view taken along the line B-B in FIG. 2. Before installation, first, the connections between the second apparatus installation beams 14e and the two first inner frame crossbeams 14b are removed. And then the second apparatus installation beams 14e are provided into pre-prepared slots W of the on-site concrete foundation and fixed to pre-embedded plates P in the slots by welding. In this way, the second apparatus 22 is fixed to the concrete foundation C by means of the second apparatus installation beams 14e having a certain height. Thus, it is possible to ensure that the installation height of the second apparatus 22 meets the industrial requirements by utilizing the second apparatus installation beams 14e arranged between the concrete foundation C and the second apparatus 22. It is also possible to appropriately modify the structure of the second apparatus installation beams 14e arranged between the concrete foundation C and the second apparatus based on the apparatuses to be actually installed, that is, it is also possible to determine the height of the second apparatus installation beams 14e based on the height of the second apparatus 22 from the ground plane of the foundation as specified by the industrial requirements. Therefore, the crossbeam frame 14 at the bottom layer of the modular unit 10 for apparatus installation according to the present disclosure has excellent generality.

[0043] FIG. 5 is a schematic longitudinal sectional view showing a state of the third apparatus 23 when being installed in the installation site according to one embodiment of the present disclosure, that is, FIG. 5 is a sectional view taken along the line C-C in FIG. 2. Before installation, first, the connections of the third apparatus installation beam 14f to the outer frame crossbeam 14a and the second inner frame crossbeam 14c are removed. And then the third apparatus installation beam 14f is provided onto the on-site concrete foundation C, and finally is grouted after being fixed to the concrete foundation C by means of chemical anchor bolts H. In this way, the third apparatus 23 is fixed to the concrete foundation by means of the third apparatus installation beam 14f having a certain height. Thus, it is possible to ensure that the installation height of the third apparatus 23 meets the industrial requirements by utilizing the third apparatus installation beam 14f arranged between the concrete foundation C and the third apparatus 23. It is also possible to appropriately modify the structure of the third apparatus installation beam 14f arranged between the concrete foundation C and the third apparatus based on the apparatuses to be actually installed, that is, it is also possible to determine the height of the third apparatus installation beam 14f based on the height of the third apparatus 23 from the ground plane of the foundation as specified by the industrial requirements. Therefore, the crossbeam frame 14 at the bottom layer of the modular

unit 10 for apparatus installation according to the present disclosure has excellent generality. In addition, the chemical anchor bolt H is simpler to operate than the anchor bolt B, and can improve operability and reduce costs while meeting the strength requirements of the third apparatus 23.

[0044] FIG. 6 is a partial perspective view showing a state where various apparatuses at the bottom layer of the modular unit 10 for apparatus installation are connected to the crossbeam frame 14 according to one embodiment of the present disclosure.

[0045] FIG. 7 is a partial perspective view showing a state where various apparatuses at the bottom layer of the modular unit 10 for apparatus installation are detached from the crossbeam frame 14 and then fixed to the concrete foundation according to one embodiment of the present disclosure.

[0046] The state in which the crossbeam frame at the bottom layer has not been disassembled and the state in which the crossbeam frame at the bottom layer has been disassembled can be seen in FIGS. 6 and 7. Specifically, in the embodiment shown in FIG. 7, at least the outer frame crossbeams 14a, the first inner frame crossbeams 14b, the second inner frame crossbeam 14c, and the first apparatus installation beams 14d of the crossbeam frame 14 are disassembled at the time of on-site installation, whereby sufficient space is created between the various apparatuses mounted to the crossbeam frame 14.

[0047] By applying the modular unit for apparatus installation according to the present disclosure, the supporting installation method of the apparatuses at the bottom layer is reserved, such that the apparatuses at the bottom layer, the pipelines, and the like may be hoisted and transported together with the modular unit, thus meeting the requirements of maximum trial installation, acceptance check and inspection of a module factory. Moreover, the present disclosure applies the technical solution that the crossbeam frame supporting the apparatuses at the bottom layer may be disassembled from the apparatuses at the bottom layer or from the apparatus foundation beams of the apparatuses at the bottom layer, such that the regions where the apparatuses at the bottom layer are located can be provided with space where gases, such as inert gases or hazardous gases, can sufficiently diffuse, and the problem that the inert gases are apt to be deposited on the bottom layer of the frame to cause potential dangers in the prior art can be solved.

[0048] The following modifications may be made in other embodiments of the present disclosure.

[0049] The detachable connections between the crossbeams constituting the crossbeam frame, between the crossbeams and the vertical struts, and between the crossbeams and the apparatuses at the bottom layer or the apparatus foundation beams of the apparatuses at the bottom layer may also be effected by other detachable connection methods such as buckling and snap-fit, besides the connection method using fasteners (such as bolt connection fasteners).

[0050] In addition to the bottom layer, other layers of the apparatus installation frames may also apply the same connection structure as the bottom layer.

[0051] It is also to be noted that the individual specific technical features described in the above specific embodiments may be combined in any suitable manner without causing contradiction.

List of Reference Signs

[0052]

10 modular unit for apparatus installation
11 vertical strut
12 apparatus installation plane frame at the intermediate layer
13 apparatus installation plane frame at the top layer
14 crossbeam frame
14a outer frame crossbeam
14b first inner frame crossbeam
14c second inner frame crossbeam
14d first apparatus installation beam
14e second apparatus installation beam
14f third apparatus installation beam
15 diagonal bracing beam
16 lifting lug
21 first apparatus
21a saddle
22 second apparatus
23 third apparatus
B anchor bolt
H chemical anchor bolt
G ground plane

Claims

1. A modular unit for apparatus installation, **characterized in that** the modular comprising a plurality of vertical struts (11) and multiple layers of apparatus installation frames for installing apparatuses, the multiple layers of apparatus installation frames connecting the plurality of vertical struts (11) and located between the plurality of vertical struts (11), the modular unit (10) for apparatus installation being transported in its entirety to a desired installation site to perform installation in a state where various apparatuses are mounted to respective layers of the apparatus installation frames, and
in the multiple layers of apparatus installation frames, at least a crossbeam frame (14) for apparatus installation at a bottom layer being composed of a plurality of crossbeams, and the crossbeam frame (14) being detachably connected not only to the plurality of vertical struts (11), but also to the various apparatuses mounted to the crossbeam frame.

2. The modular unit for apparatus installation according to claim 1, **characterized in that**
the plurality of crossbeams of the crossbeam frame (14) comprise frame beams and apparatus foundation beams connected to the apparatuses, the apparatus foundation beams being detachably connected to the frame beams.

3. The modular unit for apparatus installation according to claim 2, **characterized in that**
connections between the crossbeam frame and the plurality of vertical struts (11), connections between the crossbeam frame and the various apparatuses, and connections between the apparatus foundation beams and the frame beams apply bolt connection structure.

4. The modular unit for apparatus installation according to claim 1, **characterized in that**
at least one of the various apparatuses has anchor bolt(s) that is/are fixed to a concrete foundation at the installation site.

5. The modular unit for apparatus installation according to claim 2, **characterized in that**
at least one of the apparatus foundation beams is welded and fixed to a pre-embedded plate in a slot of a concrete foundation at the installation site, or is connected and fixed to the concrete foundation at the installation site by means of chemical anchor bolt(s).

6. The modular unit for apparatus installation according to claim 1, **characterized in that**

the apparatus installation frames comprise an apparatus installation plane frame (12) at an intermediate layer, an apparatus installation plane frame (13) at a top layer, and the crossbeam frame (14) at the bottom layer,
the modular unit (10) for apparatus installation in its entirety is hoisted and transported to the desired installation site for installation.

7. The modular unit for apparatus installation according to claim 1, **characterized in that** the crossbeam frame (14) comprises a plurality of outer frame crossbeams (14a), a plurality of inner frame crossbeams, and a plurality of apparatus installation beams, and after at least part of the apparatuses are mounted to a concrete foundation (C) at the desired installation site, the outer frame crossbeams (14a) are removed, and one or more of the plurality of inner frame crossbeams and the plurality of apparatus installation beams is/are removed.

8. The modular unit for apparatus installation according to claim 5, **characterized in that**
a height of the apparatus from a ground plane of the foundation is 200 mm to 400 mm in case where at least one of the apparatus foundation beams is welded and fixed to the pre-embedded plate in the slot of the concrete foundation at the installation site, and
a height of the apparatus from the ground plane of the foundation is more than 400 mm in case where chemical anchor bolt(s) is/are used.

9. The modular unit for apparatus installation according to claim 5, **characterized in that**
a height of the apparatus foundation beam is determined based on a height of the apparatus from a ground plane of the foundation as specified by industrial requirements.

10. The modular unit for apparatus installation according to claim 2, **characterized in that**
the frame beams comprise:

a plurality of outer frame crossbeams (14a) which form an outer frame of the crossbeam frame and which are detachably connected to the plurality of vertical struts;
at least one first inner frame crossbeam (14b) which connects the outer frame crossbeams facing each other within the outer frame; and
at least one second inner frame crossbeam (14c) which connects the outer frame crossbeam and the first inner frame crossbeam facing each other within the outer frame,
wherein at least one apparatus foundation beam (14d, 14e, 14f) is provided in the outer frame,
the at least one apparatus foundation beam is detachably connected to at least one of the outer frame crossbeam, the first inner frame crossbeam, and the second inner frame crossbeam, and
the apparatus is detachably mounted to the at least one apparatus foundation beam.

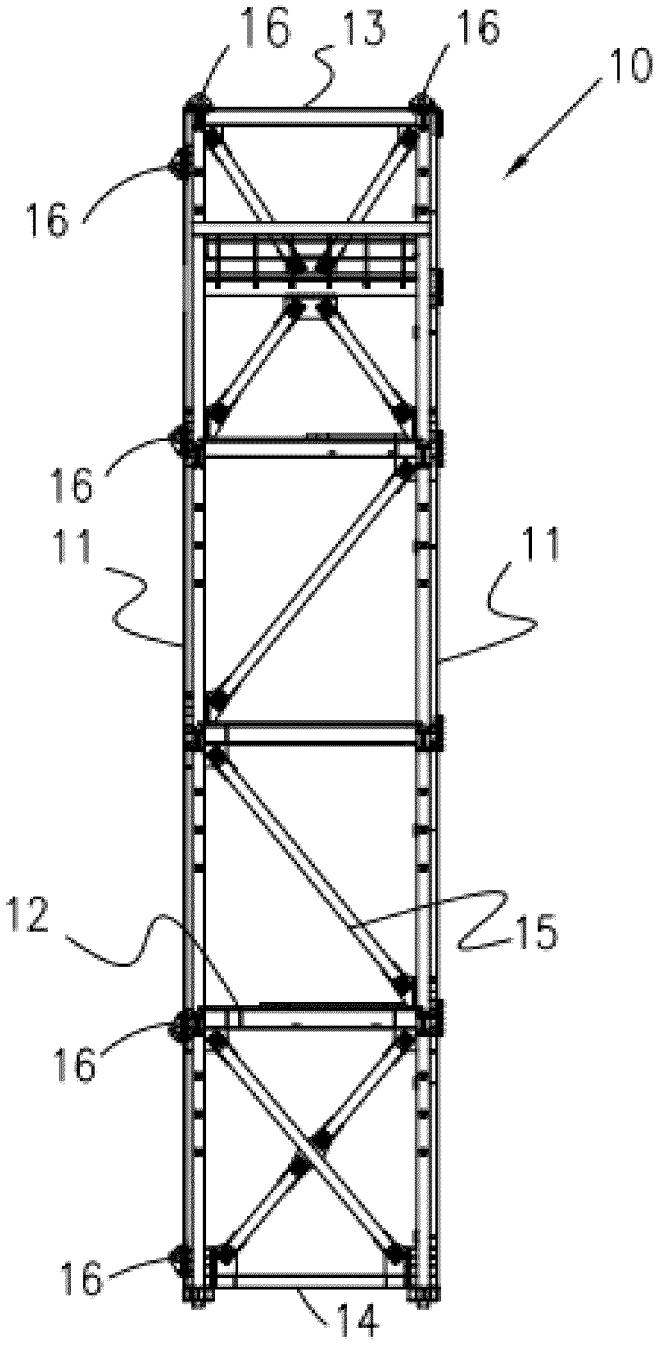

FIG. 1

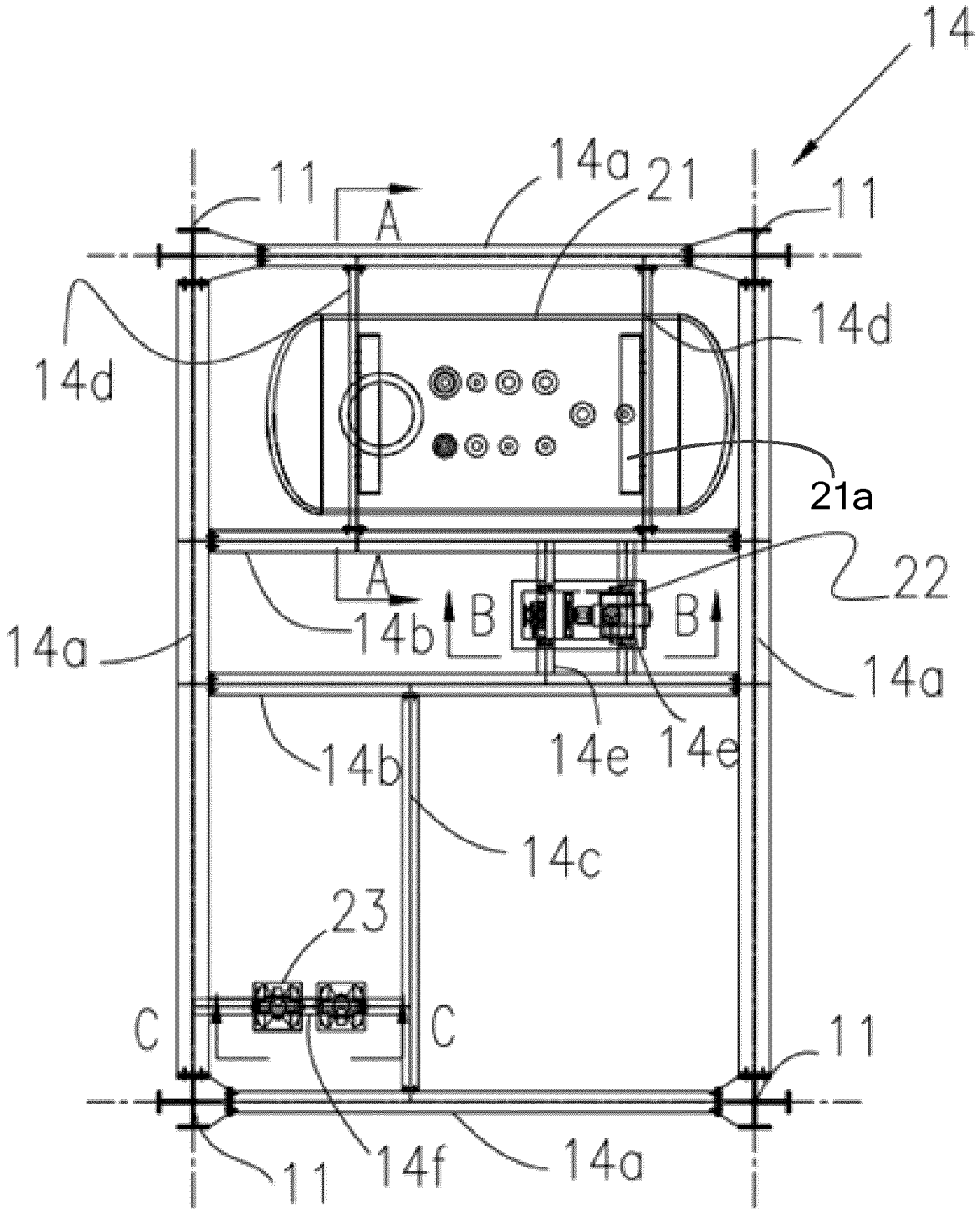
14
11
A
14a
21
11
14d
14d
21a
22
A
14b
B
B
14a
14a
14b
14e
14e
14c
23
C
C
11
11
14f
14a

FIG. 2

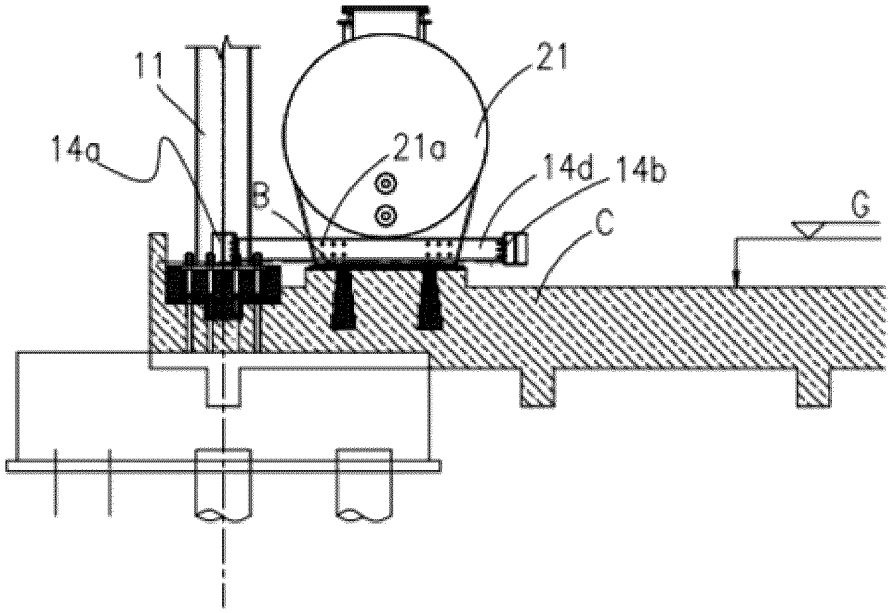

FIG. 3

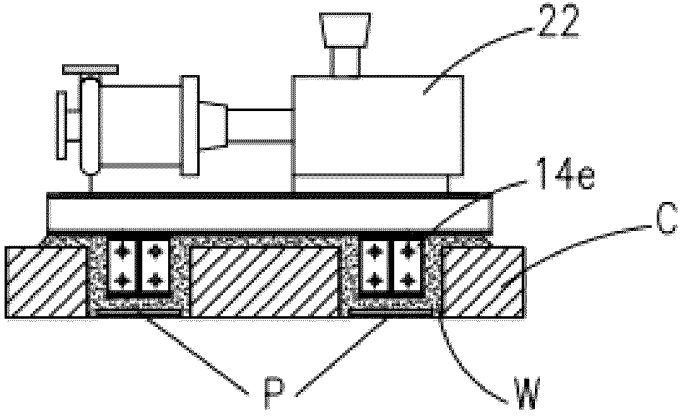

FIG. 4

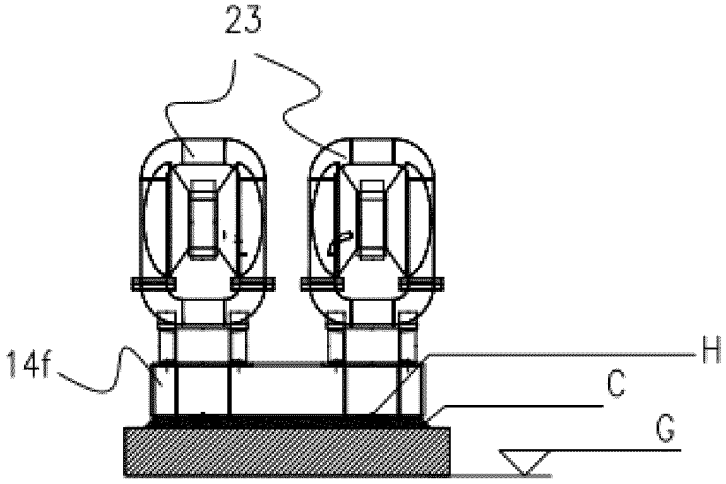

FIG. 5

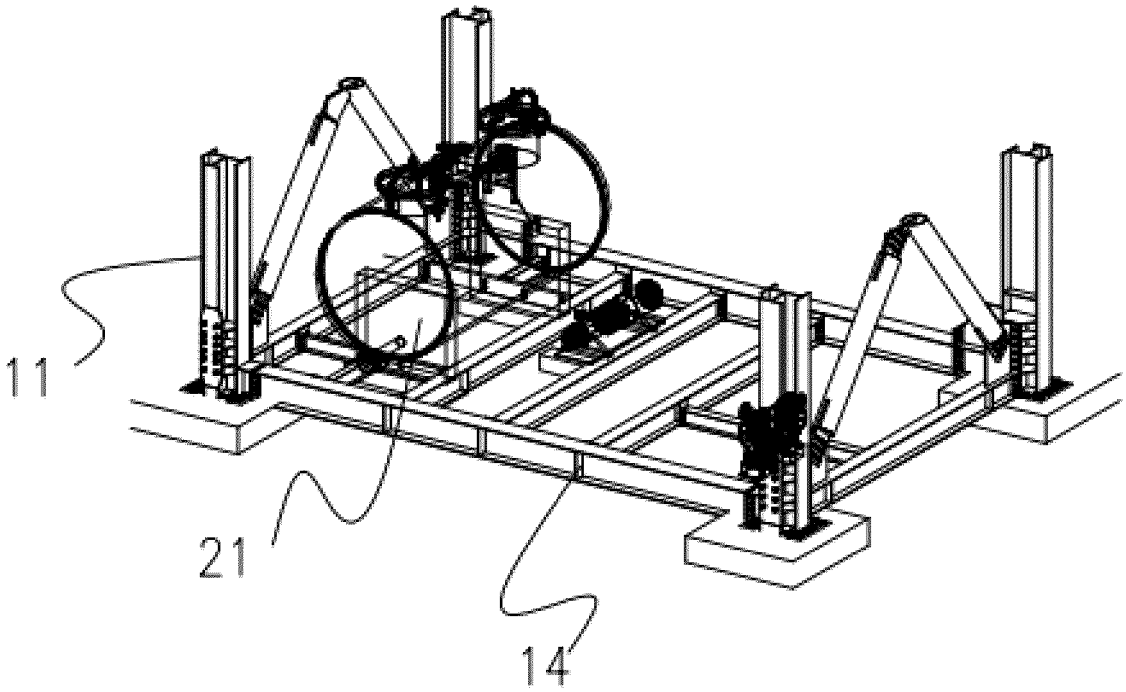

FIG. 6

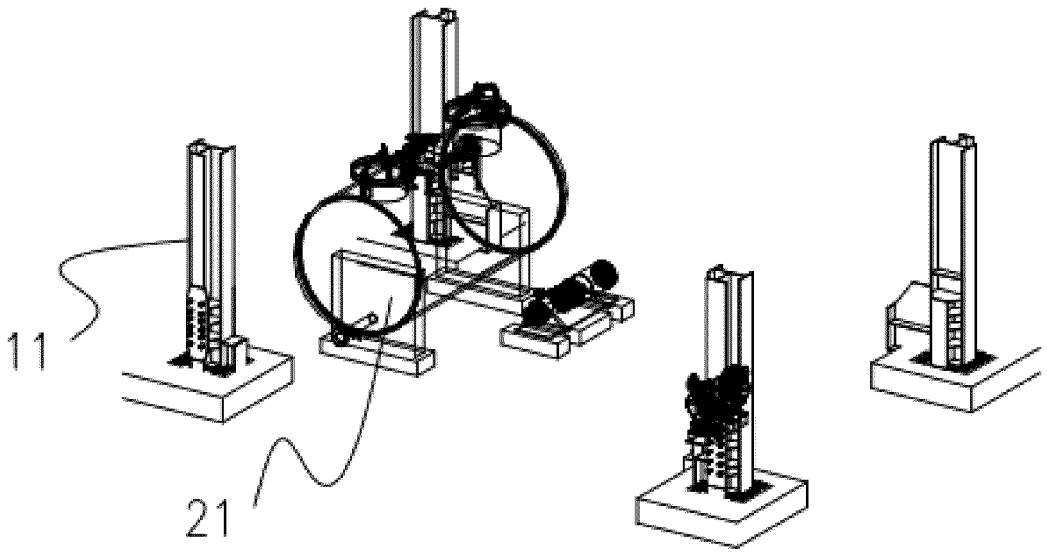

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/080126

A. CLASSIFICATION OF SUBJECT MATTER

E04H5/04(2006.01)i; E04B1/348(2006.01)i; H05K5/00(2006.01)i; H01R13/506(2006.01)i; H05K7/14(2006.01)i; H01M50/20(2021.01)i; H01R13/506(2006.01)i

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)

IPC: E04H5/04, E04B1/348, E04B1/343, H05K 5, H01R 13,H05K 7, H01M 50, H01R 13

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)

CNTXT, ENTXT, CNKI, VEN: 设备, 机电, 模块, 安装, 单元, 模块, 框架, 支架, 吊, 柱, 装配, 组装, module, modular, model, unit, component, device, equip, column, frame, support, mount, hoisting, prefabricate, assemble

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 114139997 A (SHANXI INDUSTRIAL EQUIPMENT INSTALLATION GROUP CO., LTD.) 04 March 2022 (2022-03-04) entire document	1-10
A	CN 110005051 A (CHANGSHA BROAD HOMES INDUSTRIAL GROUP CO., LTD.) 12 July 2019 (2019-07-12) entire document	1-10
A	CN 113722788 A (GUANGDONG CHINA MCC20 GROUP CORP., LTD. et al.) 30 November 2021 (2021-11-30) entire document	1-10
A	CN 212301771 U (WUHAN JINGHONG ELECTRONIC TECHNOLOGY CO., LTD. et al.) 05 January 2021 (2021-01-05) entire document	1-10
A	CN 102469877 A (MODUL SYSTEM HH AB) 23 May 2012 (2012-05-23) entire document	1-10

☑ 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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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 May 2024	**18 May 2024**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/080126

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 105545059 A (MORIMATSU (JIANGSU) HEAVY INDUSTRY CO., LTD.) 04 May 2016 (2016-05-04) entire document	1-10
A	CN 111801991 A (FRAMATOME SA) 20 October 2020 (2020-10-20) entire document	1-10
A	CN 115506599 A (QINGDAO TGOOD ELECTRIC CO., LTD.) 23 December 2022 (2022-12-23) entire document	1-10
A	CN 208094956 U (NANJING CANATAL DATA-CENTRE ENVIRONMENTAL TECH CO., LTD.) 13 November 2018 (2018-11-13) entire document	1-10
A	CN 215760751 U (SHANGHAI BILIBILI TECHNOLOGY CO., LTD.) 08 February 2022 (2022-02-08) entire document	1-10
A	CN 218072121 U (WUHAN HENGRUNZE TECHNOLOGY CO., LTD.) 16 December 2022 (2022-12-16) entire document	1-10
A	CN 218183779 U (SHENZHEN ITEAQNETWORK POWER TECHNOLOGY CO., LTD.) 30 December 2022 (2022-12-30) entire document	1-10
A	US 10271449 B1 (YOUSIF GORGIUS L) 23 April 2019 (2019-04-23) entire document	1-10
A	US 2023123420 A1 (SAMSUNG SDI CO., LTD.) 20 April 2023 (2023-04-20) entire document	1-10

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2024/080126

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 114139997 A	04 March 2022	None	
CN 110005051 A	12 July 2019	WO 2020228000 A1	19 November 2020
CN 113722788 A	30 November 2021	None	
CN 212301771 U	05 January 2021	None	
CN 102469877 A	23 May 2012	WO 2011000431 A1	06 January 2011
		EP 2448448 A1	09 May 2012
		EP 2448448 B1	28 February 2018
CN 105545059 A	04 May 2016	None	
CN 111801991 A	20 October 2020	None	
CN 115506599 A	23 December 2022	None	
CN 208094956 U	13 November 2018	None	
CN 215760751 U	08 February 2022	None	
CN 218072121 U	16 December 2022	None	
CN 218183779 U	30 December 2022	None	
US 10271449 B1	23 April 2019	None	
US 2023123420 A1	20 April 2023	None	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202310713816 **[0001]**
- CN 112166233 A **[0003]**