

DESCRIPTION

TITLE OF INVENTION: [METHOD AND SYSTEM FOR INSTALLING A DFMA MODULE]

REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to the following Chinese patent applications, the contents of which are incorporated herein by reference: Chinese patent application No. 2025212826675, titled "A Bracket Assembly", filed on 20 June 2025; Chinese patent application No. 2025107279536, titled "Installation Method and System for a MiMEP Module", filed on 3 June 2025; Chinese patent application No. 2025107272857, titled "Installation Method and System for a MiMEP Module", filed on 3 June 2025; Chinese patent application No. 2025203457648, titled "A Lifting Connecting Member", filed on 28 February 2025; Chinese patent application No. 202410843251.X, titled "A Bracket Assembly", filed on 27 June 2024; and Chinese patent application No. 2024214885495, titled "A Connecting Member Convenient for Installation", filed on 27 June 2024.

TECHNICAL FIELD

[0002] The present invention relates to the technical field of building MEP (mechanical, electrical, and plumbing) pipeline support assembly, and specifically concerns a method and system for installing a DFMA (Design for Manufacturing and Assembly) module.

BACKGROUND

[0003] The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

[0004] The finished bracket is a support system in which prefabricated channel steels and various connecting members are directly produced by a factory and then assembled on-site by construction personnel. This support system can be used to support various types of pipelines and conduits and plays a significant role in indoor installations within buildings.

[0005] Typically, to arrange various pipelines or conduits in the upper section of a building (e.g., near the ceiling), the bracket must be installed by means of lifting. However, due to the generally large size and weight of the bracket, conventional lifting methods are often challenging to execute. For instance, if the bracket is misaligned with the target installation position, repositioning the bracket can be extremely difficult, thereby imposing high demands on workers' operational skill and precision.

[0006] For example, Chinese patent application CN202421127272.3 "A BRACKET FOR FIXING ELECTROMECHANICAL PIPELINES DURING TRANSPORTATION OF STEEL STRUCTURE MODULES" discloses a bracket used for fixing MEP pipelines during the transportation of steel structure modules. This type of pipeline-fixing bracket typically features a multi-layer structure, and even with the use of mechanical lifting equipment, the lifting operation remains highly challenging.

SUMMARY

[0007] Specifically, to address the above-mentioned technical problems, the present invention specifically uses the following technical solutions:

[0008] Accordingly, an aspect of the invention refers to an installation method for a DFMA module, comprising the steps of:

[0009] S101, providing a DFMA module, the DFMA module comprising at least two sets of two-dimensional brackets (1), the at least two sets of two-dimensional brackets (1) being connected by a connecting bracket (2); wherein each two-dimensional bracket comprises at least two oppositely arranged first brackets (11), and the at least two first brackets (11) are connected by a second bracket (12), a through-passage being formed inside each first bracket (11);

[0010] S102, passing a first pulling wire (3) through the through-passage, a first end of the first pulling wire (3) protruding outward from the top of the through-passage and being connected to a first end of a second pulling wire (4), a second end of the second pulling wire (4) being fixed to a mounting surface; wherein the first pulling wire and the second pulling wire are connected via a connecting portion (7);

[0011] S103, driving the DFMA module to move upward along the first pulling wire;

[0012] S104, when the DFMA module reaches the second pulling wire, unloading the connecting portion (7) to disconnect the second pulling wire from the first pulling wire;

[0013] S105, sealing the bottom of the through-passage, and locking an end of the second pulling wire that passes through the top of the through-passage using a locking member, so as to fix the DFMA module to the mounting surface via the second pulling wire.

[0014] In some embodiments, the second pulling wire comprises a first section (41) and a second section (42) connected via a swing module (5), the swing module (5) comprising: a first connection end (51) provided with a fixing hole for fixing the first section (41); a second connection end (52) connected to the first connection end (51), the second connection end being provided with a swing slot (521), an end of the second section (42) passing through the swing slot (521) and being fixed to an inner side of the swing slot (521) via a third limiting member (522); and wherein step S103 further comprises adjusting a movement direction of the DFMA module using the swing module (5), such that when the second section (42) reciprocates within the swing slot (521), the DFMA module is enabled to shift in a corresponding movement direction.

[0015] Another aspect of the invention refers to an A DFMA module system, comprising: a DFMA module, the DFMA module comprising at least two sets of two-dimensional brackets (1), the at least two sets of two-dimensional brackets (1) being connected by a connecting bracket (2); wherein each two-dimensional bracket comprises at least two oppositely arranged first brackets (11), and the at least two first brackets (11) are connected by a second bracket (12), a through-passage being formed inside each first bracket (11); a first pulling wire (3), configured to pass through the through-passage and connect to a first end of a second pulling wire (4), a second end of the second pulling wire (4) being configured to be fixed to a mounting surface; wherein the second pulling wire comprises a first section (41) and a second section (42) connected via a swing module (5), the swing module (5) comprising: a first connection end (51) provided with a fixing hole for fixing the first section (41); a second connection end (52) connected to the first connection end (51), the second connection end being provided with a swing slot (521), an end of the second section (42) passing through the swing slot (521) and being fixed to an inner side of the swing slot (521) via a third limiting member (522); wherein when the second section (42) reciprocates within the swing slot (521), the DFMA module is enabled to shift in a corresponding movement direction, so that the first pulling wire and/or the second pulling wire has a degree of freedom of movement in the horizontal direction.

[0016] In some embodiments, the first section (41) is fixedly connected to the first connection end (52).

[0017] In some embodiments, the DFMA module system further comprises at least one first limiting member and at least one second limiting member disposed on the first section, wherein when the first section (41) passes through the fixing hole, the first limiting member and the second limiting member are respectively positioned on two sides of the fixing hole to fix the first section.

[0018] In some embodiments, the third limiting member (522) comprises: a first nut (5221), sleeved on the second section; a second nut (5222), sleeved on the second section and located between the first nut and the swing slot (521).

[0019] In some embodiments, at least one swing module provides a rotational degree of freedom for the second pulling wire.

[0020] In some embodiments, the first section (41) is rotatable relative to the fixing hole.

[0021] In some embodiments, the first limiting member comprises: a third nut sleeved on one side of the first section passing through the fixing hole; a fourth nut sleeved on the first section and positioned between the third nut and the fixing hole; wherein the first section is capable of rotating relative to the fixing hole under an external force.

[0022] In some embodiments, the DFMA module system further comprises: a gasket (6), sleeved on the second pulling wire (4); and/or a lifting member disposed on a second bracket (12)

at a top of the two-dimensional bracket (1); and/or a sealing member configured to seal a bottom of the through-passage.

[0023] Other aspects and features of the present invention will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

[0024] Technical Advantages of the Present Invention:

[0025] To address the challenges in regions with high labor costs, the present invention provides a construction method capable of significantly reducing labor-related expenses. Specifically, the invention discloses a wire-guided lifting solution for DFMA modules, in which a large DFMA module is guided into alignment and installation by means of multiple segments of pulling wires. This segmented wire-guided solution enables the DFMA module to gradually align upward along the wires for precise positioning. In particular, the cooperation between the swing module and the segmented wires allows for fine lateral or longitudinal adjustments during the upward movement of the module, thereby avoiding installation failure due to misalignment between the module and the target installation position.

[0026] Preferably, the invention provides a multi-segment wire-guided lifting scheme based on micro swing adjustment. On one hand, the multiple wire segments cooperate to guide the module in the vertical direction, ensuring rough alignment with the installation point in the horizontal plane. On the other hand, the swing module enables micro swing adjustment, allowing the module to achieve precise alignment with the installation point (or with an adjacent module) through slight movements of the wire.

[0027] It is worth noting that on large construction sites, such as tunnels, airports, or subways, construction efficiency can be improved by preassembling large DFMA modules formed from multiple two-dimensional brackets. However, larger DFMA modules (hereinafter referred to as "modules") also face greater installation challenges. For example, in a tunnel project, the module needs to be installed at the tunnel ceiling and fixed to predetermined points. In such scenarios, the tunnel environment may be complex, with limited lighting and constrained space for equipment operation, making it highly demanding for workers to install the module precisely at the designated position. Furthermore, multiple modules need to be installed along the tunnel, and seamless interfacing between adjacent modules must be ensured.

[0028] To cope with such complex construction conditions, workers may adopt a stepwise alignment strategy. For instance, in the first step, mechanical equipment (e.g., a stacker) may be used to achieve preliminary alignment between the module and the installation point, followed by lifting the module toward the top of the tunnel. In the second step, when there is a deviation in height or horizontal position between adjacent modules, the swing module can be used to adjust the vertical or horizontal position of at least one module, promoting alignment between the two.

[0029] In other words, the micro swing-adjustable multi-segment wire-guided lifting solution provided by the present invention facilitates stepwise alignment by construction personnel and reduces the difficulty of manipulating mechanical equipment. As a result, even less-experienced workers can quickly learn and apply the installation method. Accordingly, this micro swing-adjustable lifting solution substantially reduces the labor deployment cost associated with module installation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] To more clearly illustrate the technical solutions in the embodiments of the present invention or the prior art, a brief introduction to the drawings required for describing the embodiments or the prior art is provided below. In all the drawings, similar elements or components are generally denoted by similar reference numerals. The drawings are not necessarily drawn to scale. It should be understood that the accompanying drawings described below illustrate certain embodiments of the present invention, and that other drawings may be derived from these by those of ordinary skill in the art without requiring inventive effort.

[0031] [FIG. 1] illustrates a first schematic view of the lifting process in an exemplary embodiment of the present invention;

[0032] [FIG. 2] illustrates a second schematic view of the lifting process;

[0033] [FIG. 3] illustrates a third schematic view of the lifting process;

[0034] FIG. 4] illustrates a fourth schematic view of the lifting process;

[0035] FIG. 5] illustrates a structural schematic view of the MiMEP module;

[0036] FIG. 6] illustrates a structural schematic view of the connection between the MiMEP module and the pulling wire;

[0037] FIG. 7] illustrates a structural schematic view of the two-dimensional bracket;

[0038] FIG. 8] illustrates a structural schematic view of the connection between the first bracket and the pulling wire;

[0039] FIG. 9] illustrates a first structural schematic view of the swing module;

[0040] FIG. 10] illustrates a second structural schematic view of the swing module;

[0041] FIG. 11] illustrates a third structural schematic view of the swing module;

[0042] FIG. 12] illustrates a fourth structural schematic view of the swing module;

[0043] FIG. 13] illustrates a structural schematic view of the locking member;

[0044] FIG. 14] illustrates a first structural schematic view of the locking member in another exemplary embodiment;

[0045] FIG. 15] illustrates a second structural schematic view of the locking member;

[0046] FIG. 16] illustrates a third structural schematic view of the locking member;

[0047] FIG. 17] illustrates a structural schematic view of the connecting portion;

[0048] FIG. 18] illustrates a side view schematic of the connecting portion;

[0049] FIG. 19] illustrates a first schematic view of the module lifting process;

[0050] FIG. 20] illustrates a second schematic view of the module lifting process;

[0051] FIG. 21] illustrates a structural schematic view of Embodiment 2 of the present application;

[0052] FIG. 22] illustrates an assembly schematic view of the present application;

[0053] FIG. 23] illustrates a schematic view of the initial installation state of the connecting fastener in Embodiment 2;

[0054] FIG. 24] illustrates a schematic view of the locked state of the connecting fastener in Embodiment 2;

[0055] FIG. 25] illustrates a structural schematic view of the limiting bracket in Embodiment 2;

[0056] FIG. 26] illustrates a sectional view of the connecting fastener in Embodiment 2;

[0057] FIG. 27] illustrates a structural schematic view of the fixing block in Embodiment 2;

[0058] FIG. 28] illustrates a structural schematic view of the overall system;

[0059] FIG. 29] illustrates an assembly schematic view showing the connection between the first bracket and the connecting bracket using an anti-drop saddle;

[0060] FIG. 30] illustrates a schematic view showing the cooperation between the connecting fastener and the connecting bracket;

[0061] FIG. 31] illustrates a schematic view of the lifting process;

[0062] FIG. 32] illustrates a structural schematic view of the base;

[0063] FIG. 33] illustrates a structural schematic view of the base from another angle;

[0064] FIG. 34] illustrates an assembly schematic view of the base with the first and second brackets;

[0065] FIG. 35] illustrates a perspective view of the overall structure of the connecting member;

[0066] FIG. 36] illustrates a perspective view of the connecting member from another angle;

[0067] FIG. 37] illustrates a schematic view of the initial installation state of the connecting fastener;

[0068] FIG. 38] illustrates a schematic view of the locked state of the connecting fastener;

[0069] FIG. 39] illustrates another view of the connecting fastener in its locked state;

[0070] FIG. 40] illustrates a structural schematic view of the fixing block;

[0071] FIG. 41] illustrates a structural schematic view of the limiting bracket;

[0072] FIG. 42] illustrates a sectional view of the connecting fastener;

[0073] FIG. 43] illustrates a perspective view of the mating structure between the guide rail and the connecting member;

[0074] [FIG. 44] illustrates a side view of the mating state between the guide rail and the connecting member;

[0075] [FIG. 45A] illustrates a perspective view of the lifting connecting member;

[0076] [FIG. 45B] illustrates another perspective view of the lifting connecting member;

[0077] [FIG. 45C] illustrates an exploded view of the lifting connecting member;

[0078] [FIG. 45D] illustrates a front view of the lifting connecting member;

[0079] [FIG. 45E] illustrates a side view of the lifting connecting member;

[0080] [FIG. 45F] illustrates a schematic view before the lifting connecting member is connected to the bracket assembly;

[0081] [FIG. 45G] illustrates a schematic view during the connection process between the lifting connecting member and the bracket assembly;

[0082] [FIG. 45H] illustrates a schematic view after the lifting connecting member is connected to the bracket assembly; and,

[0083] [FIG. 45I] illustrates a schematic view showing multiple lifting connecting members supporting the bracket assembly.

DETAILED DESCRIPTION

[0084] To make the objectives, technical solutions, and advantages of the embodiments of the present invention more apparent, the technical solutions in the embodiments of the present invention will be clearly and fully described below with reference to the accompanying drawings. It should be understood that the described embodiments are merely part of the embodiments of the present invention, and not all embodiments. Based on the embodiments of the present invention, all other embodiments obtained by those of ordinary skill in the art without creative efforts shall fall within the scope of protection of the present invention.

[0085] Throughout this document, unless otherwise indicated to the contrary, the terms “comprising”, “consisting of”, “having” and the like, are to be construed as non-exhaustive, or in other words, as meaning “including, but not limited to”.

[0086] Furthermore, throughout the document, unless the context requires otherwise, the word “include” or variations such as “includes” or “including” will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0087] In this document, suffixes such as “component”, “module”, “part”, or “unit” used to denote elements are intended solely to facilitate the description of the present invention and do not carry any specific meaning by themselves. Therefore, the terms “component”, “module”, “part”, and “unit” may be used interchangeably.

[0088] In this document, terms such as “upper”, “lower”, “inner”, “outer”, “front”, “rear”, “one end”, and “the other end” indicate directions or positional relationships based on those shown in the accompanying drawings. They are used merely to simplify the description of the invention and are not intended to indicate or imply that the referenced components or structures must have a particular orientation or be constructed and operated in a particular orientation. Thus, they should not be construed as limiting the invention.

[0089] In addition, terms such as “first”, “second” and “third” are used solely for descriptive purposes and should not be interpreted as indicating or implying relative importance.

[0090] Unless otherwise clearly specified or limited, terms such as “mounted”, “provided with”, and “connected” should be interpreted broadly. For example, “connected” may refer to a fixed connection, a detachable connection, or an integral connection; it may also refer to mechanical coupling, direct connection, indirect connection via an intermediate medium, or internal communication between components. For those of ordinary skill in the art, the specific meanings of these terms in the context of the present invention can be understood according to specific circumstances.

[0091] The phrase “and/or” in this document includes any and all combinations of one or more of the listed associated items.

[0092] The term “plurality” means two or more, including two, three, four, five, and so on.

[0093] As used in this specification, the term “about” typically refers to $\pm 5\%$ of the stated value, more typically $\pm 4\%$, more typically $\pm 3\%$, more typically $\pm 2\%$, even more typically $\pm 1\%$, and even more typically $\pm 0.5\%$.

[0094] In this specification, certain embodiments may be disclosed in terms of a range. It should be understood that such range disclosures are provided for convenience and brevity, and should not be construed as a rigid limitation on the scope of the disclosed range. Accordingly, the disclosure of a range should be interpreted as specifically disclosing all possible sub-ranges and individual numerical values contained within that range. For example, a disclosure of the range from 1 to 6 should be regarded as specifically disclosing sub-ranges such as from 1 to 3, from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6, and individual values such as 1, 2, 3, 4, 5, and 6. This interpretation applies regardless of the breadth of the disclosed range.

[0095] The term “horizontal direction” typically refers to a direction that is parallel or substantially parallel to the mounting surface. A pulling wire having a degree of freedom of movement in the horizontal direction may be understood to mean that the pulling wire is capable of reciprocating along a straight line within a horizontal plane defined by or approximately parallel to its cross-sectional orientation. A pulling wire having a degree of rotational freedom in the horizontal direction may be understood to mean that the wire can rotate within the same horizontal plane.

[0096] MiMEP Module (also referred to as DFMA module, 3D module, or simply “module”): As used herein, a MiMEP module refers to a bracket assembly (or frame) formed by assembling multiple brackets (such as uprights, cross arms, U-shaped steels, C-channel steels, etc.), which is configured to carry or secure pipeline-type objects. For example, the bracket assembly may be used to support and fix pipelines, air ducts, cables, and other equipment. Such brackets are widely applied in fields such as building plumbing systems and building electrical systems, particularly for the fixation and load-bearing of pipelines in basements, utility corridors, and similar environments.

[0097] Pulling Wire: as used herein, the pulling wire may be a multi-segment pulling wire. A “multi-segment pulling wire” refers to a linear connection component for connecting the MiMEP module to the mounting surface. One end of the wire may be mounted or fixed to the mounting surface, while the other end may be connected directly to the MiMEP module or indirectly through similar linear connectors or other connection components. The wire adopts a multi-segment structure, for example, a two-segment or three-segment configuration. In a three-segment configuration, in addition to the aforementioned first and second segments, a third segment is included, which may also be referred to as the first pulling wire. One end of this third segment is connected to the second segment, and the other end is connected to the bracket module.

[0098] The applicant has observed that, to improve on-site construction efficiency, MiMEP modules are often pre-assembled in a factory and directly lifted into place on-site. However, in large-scale construction scenarios, the required MiMEP modules are typically very large in size and weight, resulting in significant difficulty during installation. Even with the use of modern mechanical lifting equipment, reliable installation can still be challenging. Specifically, the pulling wire may be implemented as a lead screw.

[0099] Anti-Drop Saddle: As used herein, an anti-drop saddle refers to a saddle-shaped component, or a component having a “ $\square$ ”-shaped cross-section, that is adapted to the shape of column members in a building structure, such as the first bracket 11 (e.g., C-channel steel or upright) in the bracket module.

[0100] Column Member: as used herein, a column member refers to an upright structural element in a building that supports the structure, such as a channel steel upright in an anti-drop bracket, or a supporting upright embedded in a wall.

[0101] Connecting Member: as used herein, a connecting member refers to a component configured to connect brackets to other brackets or to connect brackets to the mounting surface (e.g., a wall). Such connecting members may include lifting connecting members, L-shaped connecting members, anti-drop saddles, bases, swing modules, and the like. For example, a lifting connecting member refers to a connecting component configured to cooperate with a pulling wire to achieve connection between the bracket and the mounting surface.

[0102] Unless defined otherwise, all other technical and scientific terms used herein have the same meaning as is commonly understood by a skilled person to which the subject matter herein belongs.

[0103] **EMBODIMENT 1**

[0104] Referring to [FIGs. 1 to 20], the present application provides a swing-type installation solution based on multi-segment wire guidance, which aims to simplify the lifting and installation of the MiMEP module.

[0105] First, the present invention provides an installation method for a MiMEP module (also referred to as a DFMA module), comprising the following steps:

[0106] Step S101: Providing a MiMEP module. As illustrated in [FIG. 1], the MiMEP module comprises at least two sets of two-dimensional brackets 1, with the at least two sets of two-dimensional brackets 1 being connected via a connecting bracket 2. Each two-dimensional bracket comprises at least two first brackets 11 arranged oppositely, and the at least two first brackets 11 are connected via a second bracket 12. A through-passage is formed inside each first bracket 11.

[0107] It should be understood that the types and quantities of components forming the MiMEP module (e.g., the brackets) can be adaptively selected and combined based on on-site construction requirements.

[0108] For example, in some embodiments, the MiMEP module may include only one set of two-dimensional brackets 1. In other embodiments, the connecting bracket 2 may be a cross-arm bracket. In yet other embodiments, the first bracket may be a vertical post.

[0109] Step S102: Passing a first pulling wire 3 through the through-passage, wherein a first end of the first pulling wire 3 protrudes outward from the top of the through-passage and is connected to a first end of a second pulling wire 4. A second end of the second pulling wire 4 is fixed to a mounting surface (e.g., a ceiling or other building wall).

[0110] Additionally, the second end of the first pulling wire 3 may exit from the bottom of the through-passage.

[0111] In some embodiments, the first and second pulling wires are connected via a connecting portion 7.

[0112] Preferably, and as illustrated in [FIG. 9], the second pulling wire comprises a first section 41 and a second section 42 connected via a swing module 5. The swing module 5 comprises: a first connection end 51 provided with a fixing hole for fixing the first section 41; and a second connection end 52 connected to the first connection end 51, wherein the second connection end is provided with a swing slot 521. One end of the second section 42 passes through the swing slot 521 and is fixed to the inner side of the swing slot 521 via a limiting member 522.

[0113] Step S103: Driving the MiMEP module to move upward along the first pulling wire.

[0114] For example, in some embodiments, for large-scale MiMEP modules, automated equipment may be used to lift the module upward. Such automated equipment may include a stacker; specifically, a stacker may be placed at each end of the module, or beneath the central portion, to raise the MiMEP module.

[0115] Alternatively, in other embodiments, a crane may be used to lift the MiMEP module upward.

[0116] Preferably, in some embodiments, the swing module 5 may be used to adjust the movement direction of the MiMEP module. When the second section 42 reciprocates within the swing slot 521, the MiMEP module can shift in the corresponding direction of movement.

[0117] Step S104: When the MiMEP module reaches the second pulling wire, the connection between the second and first pulling wires is disengaged (e.g., by removing the connecting portion 7).

[0118] Step S105: Sealing the bottom of the through-passage and locking the end of the second pulling wire that passes through the top of the through-passage using a locking member, thereby fixing the MiMEP module to the mounting surface via the second pulling wire.

[0119] For example, as illustrated in [FIG. 13], in some embodiments, the locking member may be a bolt 9, and a gasket 6 may be provided between the bolt 9 and the module.

[0120] It is worth noting that the multi-segment wire-guided lifting scheme adopted in the present invention for the MiMEP module can effectively reduce on-site construction costs in economically developed regions.

[0121] Typically, in countries or regions with high labor costs, various modular installation schemes have been proposed to reduce on-site labor expenses. For example, brackets can be pre-assembled during the factory stage, and the pre-assembled modules are then transported to the site for integral installation, thereby reducing on-site labor effort and cost.

[0122] However, the applicant has observed that for large-scale construction projects, such as tunnels, airports, subways, and large parking facilities, the required bracket modules are themselves large in size and weight. Consequently, even with conventional lifting solutions and the assistance of modern equipment such as stackers, it remains extremely difficult to complete the lifting operation reliably. In other words, applying traditional bracket systems to large-scale construction scenarios still involves significant challenges.

[0123] Accordingly, the present invention preferably provides a multi-segment wire-guided lifting solution with micro swing adjustment. In this solution, the cooperation of multiple wire segments enables vertical guidance of the module, ensuring approximate alignment with the installation position in the horizontal plane. Additionally, the micro swing enabled by the swing module allows the module to achieve precise alignment with the installation position (or with adjacent modules) through fine movements of the wire.

[0124] In other words, the multi-segment wire-guided lifting scheme with micro swing adjustment proposed in this embodiment enables rapid upward lifting using a stacker. The micro swing adjustment feature realized through the wire system reduces the dependency on the operator's construction experience. For example, even if slight misalignment occurs during the lifting process by the stacker, the swing module can be used to make fine directional corrections.

[0125] Of course, in construction sites where the installation difficulty is relatively low, the module may be directly lifted using the multi-segment wire system alone, without requiring a swing module.

[0126] Further, as illustrated in [FIGs. 1 to 10], the present invention also provides a MiMEP module system (also referred to as a module assembly) adapted for segmented wire-guided lifting, comprising:

[0127] (i) A MiMEP module, which comprises at least one set of two-dimensional brackets 1. In some embodiments, as shown in [FIG. 7], the MiMEP module may include only one set. Alternatively, the MiMEP module comprises at least two sets of two-dimensional brackets 1, with at least two of the two-dimensional brackets 1 connected by a connecting bracket 2. Each two-dimensional bracket includes at least two oppositely arranged first brackets 11, and the first brackets 11 are connected by a second bracket 12. A through-passage is formed within each first bracket 11.

[0128] (ii) A first pulling wire 3, which is configured to pass through the through-passage and connect to a first end of a second pulling wire 4, while the second end of the second pulling wire 4 is configured to be fixed to the mounting surface.

[0129] Preferably, as illustrated in [FIGs. 9 to 12], the MiMEP module system further comprises a swing module 5. Correspondingly, the second pulling wire comprises a first section 41 and a second section 42 connected via the swing module 5. The swing module 5 includes: A first connection end 51, which is provided with a fixing hole for fixing the first section 41; and A second connection end 52 connected to the first connection end 51, the second connection end 52 being provided with a swing slot 521, wherein one end of the second section 42 passes through the swing slot 521 and is fixed to the inner side of the swing slot 521 via a third limiting member 522. When the second section 42 reciprocates within the swing slot 521, the MiMEP module is enabled to shift in the corresponding movement direction.

[0130] It should be noted that traditional module installation requires a high level of operator expertise. Typically, only personnel with certified construction qualifications are allowed to perform such operations, which significantly increases installation costs. However, the wire-guided lifting system provided by the present invention can greatly reduce the complexity of on-

site construction, thus lowering the technical threshold required of operators and achieving substantial labor cost savings.

[0131] Furthermore, the wire-guided lifting system of the present invention is particularly well-suited for use in construction environments such as airports, subway stations, and other large-scale infrastructure projects.

[0132] In some embodiments, the first section 41 is fixedly connected to the first connection end 52.

[0133] Further, in some embodiments, the system further comprises: at least one first limiting member 511 and at least one second limiting member 512 disposed on the first section 41. When the first section 41 passes through the fixing hole, the first and second limiting members are respectively positioned on opposite sides of the fixing hole, thereby securing the first section in place.

[0134] Here, "fixed connection" refers to a state in which the first and second limiting members are in tight contact with both ends of the fixing hole, such that the first section cannot rotate relative to the fixing hole.

[0135] Alternatively, in some embodiments, the first section may be configured to rotate relative to the fixing hole. For example, when two adjacent modules need to be aligned and their axial orientations differ slightly, the wire may be rotated appropriately to bring the modules into alignment.

[0136] It should be noted that in large-scale construction environments, such as tunnels, airports, or subways, multiple two-dimensional brackets may be preassembled into large-size MiMEP modules to improve construction efficiency. However, these larger MiMEP modules (hereinafter referred to as modules) also present greater installation challenges. For example, in tunnel applications, such modules must be installed at the tunnel ceiling and fixed to predetermined positions.

[0137] In such scenarios, the tunnel environment may be relatively complex, e.g., with poor lighting conditions; furthermore, the available space for equipment operation may be constrained. Accurately installing a large module at a designated position requires a high level of operator expertise. Additionally, since tunnels can be long, multiple modules must be installed in sequence along the route, and precise interfacing between adjacent modules must be ensured.

[0138] To address such complex construction conditions, a stepwise alignment approach can be adopted. For example, in the first step, mechanical equipment (such as a stacker) may be used to achieve preliminary alignment between the module and the target position. The equipment then lifts the module toward the tunnel ceiling. In the second step, when vertical or horizontal deviation exists between adjacent modules, the swing module can be used to adjust the vertical or horizontal position of at least one module to achieve alignment.

[0139] In other words, the multi-segment wire-guided lifting scheme with micro swing adjustment provided by the present invention facilitates stepwise alignment by construction personnel, thereby reducing the difficulty of operating lifting equipment. As a result, even less experienced workers can quickly learn and apply the installation method. Thus, this solution significantly reduces labor deployment costs.

[0140] Preferably, in some embodiments, to further improve the lifting efficiency of large modules, the present embodiment provides a configuration scheme based on differentiated degrees of freedom. For example, swing modules with different degrees of freedom can be arranged at the edge and central areas of the module. Specifically: (i) when the wire reciprocates relative to the swing slot, it is considered to have a degree of translational freedom in the horizontal direction; (ii) when the wire rotates relative to the fixing hole, it is considered to have a degree of rotational freedom in the horizontal direction; (iii) when the length of the wire is adjusted, e.g., by adjusting the length through which the wire passes through the fixing hole or swing slot, it is considered to have a degree of translational freedom in the vertical direction.

[0141] To distinguish between swing modules that allow or disallow rotational motion of the wire, the following definitions are used: A first swing module is disposed on at least one second pulling wire corresponding to a non-edge two-dimensional bracket (e.g., one located at the center of the module); the first swing module provides one degree of translational freedom in the horizontal direction and preferably does not allow rotational freedom; and, A second swing module

is disposed on at least one second pulling wire corresponding to an edge two-dimensional bracket (e.g., at either end of the module); the second swing module provides one degree of translational freedom and one degree of rotational freedom in the horizontal direction.

[0142] In other words, the difference between the first and second swing modules lies in the degrees of freedom of the second pulling wire (such as its first or second section). In the first swing module, the second pulling wire can be linearly adjusted in the horizontal direction. In the second swing module, the second pulling wire can be both linearly and rotationally adjusted in the horizontal direction.

[0143] Here, linear adjustment refers to reciprocating motion of the second pulling wire (e.g., the second section) along the axial direction of the swing slot 521; rotational adjustment refers to rotation of the pulling wire relative to the swing module, such as rotation of the first section relative to the fixing hole.

[0144] In some embodiments, referring to [FIG. 10], the first limiting member 511 comprises: a third nut 5111, sleeved on one side of the first section 41 where it passes through the fixing hole; and a fourth nut 5112, sleeved on the first section 41 and positioned between the third nut and the fixing hole.

[0145] Preferably, the second pulling wire is externally threaded, and the nuts are internally threaded so that they can be sleeved onto the second pulling wire via threaded engagement.

[0146] Taking the first swing module as an example, the first and second limiting members on the swing module are tightly abutted against the upper and lower surfaces of the first connection end during the lifting process. In this case, when the second pulling wire (e.g., the first section) attempts to rotate relative to the fixing hole, it must overcome a first resistance. In contrast, in the second swing module, the first and second limiting members are not tightly abutted against the upper and lower surfaces of the first connection end (e.g., they are merely in contact or spaced slightly apart). In this configuration, rotation of the second pulling wire relative to the fixing hole only requires overcoming a second resistance, which is smaller than the first resistance.

[0147] It should be understood that the specific values of the first and second resistance may be selected based on the module's specifications, such as weight. For example, when the module sways due to inertia or impact during lifting, it may tend to rotate relative to the fixing hole. The second resistance, implemented by ensuring tight contact between the limiting members and the connection end, provides friction that limits or mitigates this rotational tendency. Conversely, if there is no tight abutment between the limiting members and the connection end, the second pulling wire may rotate under moderate external force (e.g., when adjusted manually or by mechanical equipment), allowing horizontal alignment between the module and the installation point or an adjacent module via rotational freedom.

[0148] In this embodiment, multiple second pulling wires of the module are provided with swing modules having differentiated functions. For example, only swing modules at the module edges may be configured to allow rotational adjustment freedom. This arrangement ensures that the module has a certain degree of freedom during lifting for precise alignment with the installation point or adjacent module, while avoiding excessive degrees of freedom that could otherwise increase the complexity of lifting large modules.

[0149] Further, in some embodiments, when the swing module is configured with rotational freedom, the third nut 5111 and fourth nut 5112 are preferably spaced apart along the second pulling wire, with a gap of at least two thread pitches. Such spacing helps mitigate nut loosening during rotation.

[0150] In some embodiments, the third limiting member comprises: a first nut 5221, sleeved on the second section, for example, near the top end; and a second nut 5222, positioned between the first nut and the swing slot 521.

[0151] Preferably, for swing modules with both translational and rotational degrees of freedom, the translational and rotational freedom mechanisms are respectively arranged at the bottom and top of the module. This ensures that each degree of freedom can be independently adjusted, thereby reducing complexity and improving the stability of the connection between the swing module and the first section during adjustment.

[0152] In some embodiments, the system further comprises a gasket 6, which is sleeved on the second pulling wire 4.

[0153] In some embodiments, the gasket is disposed between the swing module 5 and the MiMEP module. For example, in some embodiments, a nut may also be arranged above the gasket. After the first and second pulling wires are disconnected, the nut can be tightened to secure the second pulling wire to the MiMEP module.

[0154] In some embodiments, once the first and second pulling wires are disconnected, the top and bottom openings of the through-passage in the MiMEP module may be sealed and tightened using nuts, thereby fixing the module onto the second pulling wire.

[0155] It should be noted that, after the module is lifted to the desired height via the pulling wire, the second pulling wire must be fixed to the module, specifically, locked at both ends where it enters and exits the through-passage. For example, at the bottom of the through-passage, a bolt may be used to pass through the second pulling wire, and by tightening the bolt, the wire is locked in place. Additionally, a gasket may be placed between the bolt and the bottom of the through-passage to enhance the locking effect.

[0156] Alternatively, in other embodiments, a locking member 8 may be used to quickly secure the second pulling wire to the module.

[0157] As illustrated in [FIG. 16], the locking member 8 comprises: a first locking part 81 and a second locking part 82, wherein the first locking part 81 is provided with a first groove 811, and the second locking part 82 is provided with a second groove 821. When the first and second locking parts are fitted together, the first and second grooves are aligned to form a locking groove through which the second pulling wire passes. Specifically, the first locking part is provided with at least one first through hole (e.g., one on each side of the groove), and the second locking part is provided with at least one second through hole. When the first and second locking parts are fitted together and the second pulling wire passes through the locking groove, fasteners (e.g., bolts or screws) are inserted through the through holes and tightened to achieve locking.

[0158] The locking parts (e.g., either the first or second) include a first mating plate, which is provided with the groove and through holes, and a second mating plate extending laterally from the side of the first plate (e.g., perpendicular or substantially perpendicular). The second mating plate is configured to abut the surface of the first bracket. Additionally, a bolt hole may be provided on the second mating plate to allow the locking member to be further secured to the module using bolts.

[0159] Preferably, the diameter of the locking groove is smaller than that of the second pulling wire, thereby enabling effective locking.

[0160] It should be noted that the locking member 8 can be tightened laterally to lock the pulling wire. This form of indirect lateral tightening results in higher locking efficiency. In other words, the use of such locking members can improve lifting efficiency and reduce the difficulty of installing large modules.

[0161] In some embodiments, the system comprises a lifting member disposed on the second bracket 12 positioned at the top of the two-dimensional bracket 1. The lifting member is configured to mate with a connector on the installation surface (e.g., a hook or similar fitting), thereby assisting in fixing or installing the MiMEP module onto the installation surface (such as the top wall of a building).

[0162] In some embodiments, the system comprises a sealing member configured to seal the bottom of the through-passage. For example, in some embodiments, a sealing operation may be facilitated directly by bolts or other similar components.

[0163] In some embodiments, the length of the second pulling wire is greater than that of the through-passage.

[0164] In some embodiments, the diameter of the second pulling wire is greater than that of the first pulling wire.

[0165] In some embodiments, the first pulling wire and the second pulling wire are fixedly connected via a connecting part. For instance, the connection point between the first and second pulling wires may include an external thread structure. A cylindrical connecting part may be sleeved over both wires, and the inner surface of the connecting part may include an internal thread structure. This arrangement enables threaded engagement to achieve secure connection. Furthermore, when disconnection is required, the connecting part can be loosened by unscrewing.

[0166] As shown in [FIG. 17] and [FIG. 18], the connecting part 7 comprises: a first connecting portion 71; and at least one second connecting portion 72 disposed at one or both ends of the first connecting portion 71.

[0167] The inner surface of the second connecting portion 72 (or of both the second and first connecting portions) is provided with internal threads, configured to mate with the external threads of the pulling wires.

[0168] Further, the width of the second connecting portion 72 gradually decreases in the direction away from the first connecting portion 71-i.e., the end of the connecting part is tapered. This tapered configuration provides a guiding effect during lifting.

[0169] It should be noted that the first bracket 11 is designed to be assembled with multiple other brackets. Therefore, multiple fasteners (e.g., screws, bolts) may be arranged axially through the first bracket. In this embodiment, the tapered end of the connecting part 7 serves a guiding function. For example, when the pulling wire moves within the through-passage, the tapered tip more easily passes through the spatial gaps between the interleaved screws or bolts, reducing the risk of the pulling wire becoming jammed.

[0170] Preferably, in this embodiment, longitudinal and lateral movement guidance is jointly achieved via the swing module 5 and the connecting part 7. This dual-axis guidance facilitates the rapid hoisting of the module. On one hand, it enables the module to be smoothly lifted with the assistance of a stacker; on the other hand, it enhances the precision alignment of large modules during the installation process.

EMBODIMENT 2

[0171] As shown in FIGs. 21 to 26, the present invention provides a bracket assembly comprising a MiMEP module and an L-shaped connector 12a. The MiMEP module comprises at least two sets of two-dimensional brackets, and at least two sets of the two-dimensional brackets are connected by a connecting bracket. Each two-dimensional bracket comprises two first brackets arranged in parallel, and a second bracket connected between the two first brackets; see FIG. 2.

[0172] The L-shaped connector 12a comprises a first vertical contact plate 121 and a second horizontal contact plate 122. Through holes are respectively formed in the first vertical contact plate 121 and the second horizontal contact plate 122; see FIG. 21.

[0173] As shown in FIGs. 23 to 27, the L-shaped connector 12a further comprises multiple connecting fasteners 105 configured to secure the first bracket and the second bracket.

[0174] Referring to FIGs. 23 and 24, the connecting fasteners 105 comprise a fastener 1051, an elastic member 1052, a fixing block 1054, and a limiting bracket 1053. The fixing block 1054 is provided with a threaded hole matching the fastener 1051. The upper surface of the fixing block 1054 is provided, in parallel, with two sets of teeth 10541 for engaging with the teeth on the inner folded edge of the first bracket, the two sets of teeth 10541 being respectively located on both sides of the threaded hole. The limiting bracket 1053 comprises a bracket body fixed to the first vertical contact plate 121 or the second horizontal contact plate 122. The bracket body is provided with a mounting hole 10533 allowing the fastener 1051 to move up and down. On both sides of the bracket body in the lengthwise direction, protrusions 10534 extend along the height direction at both ends to form limiting protrusions. A limiting groove 10536 is formed between the two limiting protrusions 10534 on the same side. Among the four limiting protrusions 10534 located on diagonals, two protrusions extend along the width direction of the bracket body to form deformable bent portions 10535. A gap is reserved between each bent portion 10535 and the adjacent limiting protrusion 10534 on the opposite side. The bracket body, the limiting protrusions 10534, and the bent portions 10535 cooperate to form a clamping structure for holding the fixing block.

[0175] When the fixing block 1054 is inserted into the clamping structure, the bracket body, the limiting protrusions 10534, and the bent portions 10535 cooperate to clamp the fixing block 1054.

[0176] Preferably, referring to the assembly schematic of the L-shaped connector 12a with the first bracket and the second bracket shown in FIG. 22:

[0177] When the elastic member 1052 is sleeved on the fastener 1051 and the fastener 1051

is inserted through the through hole of the first vertical contact plate 121 or the second horizontal contact plate 122 and the mounting hole 10533 to be threaded into the fixing block 1054, the two ends of the elastic member 1052 abut against the head of the fastener 1051 and the limiting bracket 1053, respectively, so that the L-shaped connector 12a is in a pre-assembled state.

[0178] When the pre-assembled L-shaped connector 12a is mounted at the junction of the first bracket and the second bracket, the two fixing blocks 1054 clamped within the clamping structures on the L-shaped connector 12a are respectively located between two inner folded edges of the second bracket or the first bracket.

[0179] When the fastener 1051 is pressed along its height direction, the fastener 1051 drives the fixing block 1054 to move along the same direction, causing the bent portion 10535 to deform under the pressure of the fixing block 1054. The fixing block 1054 is thereby driven to disengage from the clamping structure through the gap and rotate into the limiting groove 10536, so that the two sets of teeth 10541 on the upper surface of the fixing block 1054 engage with the teeth on the two inner folded edges of the second bracket or the first bracket, respectively.

[0180] After the components of the L-shaped connector 12a are assembled, the elastic pre-tightening force of the elastic member 1052 holds them together to form a pre-assembled L-shaped connector 12a. This integrated connector is then aligned to the vertical junction between the first and second brackets. By simply pressing the fastener 1051 in its height direction, the fastener 1051, under the elastic force of the bent portion 10535, rotates automatically and enters the limiting groove 10536 for fixation. At the same time, the two sets of teeth 10541 on the fixing block 1054 engage with the teeth on the inner folded edges of the first or second bracket, thus completing the fixation between the first and second brackets. The operation is simple, convenient, and efficient.

[0181] In some embodiments, the fixing block 1054 is in the shape of a parallelogram, and the angle between the alignment direction of each set of teeth 10541 and the corresponding side edge (i.e., the slanted edge) of the fixing block 1054 is 5° – 25° .

[0182] Further, in order to facilitate easier rotation of the fixing block 1054, the fixing block 1054 is formed as a parallelogram such that, in the pre-assembled state, the two obtuse angles of the parallelogram correspond to the gaps between the bent portion 10535 and the limiting protrusion 10534. The angle between the sets of teeth 10541 and the slanted edges on the two sides of the parallelogram facilitates improved engagement after rotation with the teeth on the inner folded edges of the first or second bracket.

[0183] In some embodiments, the limiting bracket 1053 has an overall shape of a hollow cuboid.

[0184] In some embodiments, the upper surface of the fixing block 1054 is provided with two parallel grooves. Each set of teeth 10541 is arranged in one of the grooves and comprises two interlaced rows of teeth; see FIG. 27.

[0185] In some embodiments, the bracket body comprises a first body 10531 fixed against the first bracket or the second bracket, and two second bodies 10532 extending from both sides of the first body 10531 in the length direction of the limiting bracket 1053 along the height direction. Each second body 10532 has limiting protrusions 10534 extending from both ends in its extension direction. Among them, two diagonally opposite limiting protrusions 10534 extend in the direction toward the opposite-side limiting protrusions 10534 to form two deformable bent portions 10535 in parallel.

[0186] In some embodiments, each bent portion 10535 has a rectangular shape. The width of each bent portion 10535 is the same as that of the limiting protrusion 10534. A gap is reserved between the free end of each bent portion 10535 and the facing limiting protrusion 10534 to allow the fixing block 1054 to pass through.

[0187] In some embodiments, the width of the fixing block 1054 is equal to the distance between the two limiting protrusions 10534 disposed on the same side along the length direction of the limiting bracket 1053; and/or, the height and width of the fixing block 1054 match the internal height and width of the limiting bracket 1053.

[0188] In some embodiments, gaskets 1055 are provided at the through holes of the first vertical contact plate 121 and the second horizontal contact plate 122.

[0189] In some embodiments, the bent portion 10535 is an elastic metal spring piece.

[0190] In some embodiments, the first vertical contact plate 121 and the second horizontal contact plate 122 are integrally formed to produce the L-shaped connector 12a; and/or, the entire L-shaped connector 12a is made of rigid material; and/or, the surface of the L-shaped connector 12a is provided with an anti-oxidation coating.

EMBODIMENT 3

[0191] As shown in FIGs. 28 to 30, the present invention provides a bracket assembly comprising a MiMEP module and a fall-prevention saddle. The MiMEP module comprises at least two sets of two-dimensional brackets, and at least two sets of the two-dimensional brackets are connected by a connecting bracket. Each two-dimensional bracket comprises two first brackets arranged in parallel and a second bracket connected between the two first brackets.

[0192] As shown in FIGs. 30 and 28, the fall-prevention saddle 10 comprises, in order from left to right, a second horizontal connecting plate 102, a first vertical connecting plate 103, a first horizontal connecting plate 101, a second vertical connecting plate 106, and a third horizontal connecting plate 104. The first vertical connecting plate 103, the second vertical connecting plate 106, and the first horizontal connecting plate 101 together enclose a mounting space adapted for installing the connecting bracket in a building structure. Through holes are formed in the first horizontal connecting plate 101, or the second horizontal connecting plate 102, or the third horizontal connecting plate 104. The bracket assembly further comprises multiple connecting fasteners 105 configured to fix the connecting bracket to the first bracket or the second bracket.

[0193] As shown in FIGs. 23, 24, and 26, in some embodiments, each connecting fastener 105 comprises a fastener 1051, an elastic member 1052, a fixing block 1054, and a limiting bracket 1053. The fixing block 1054 is provided with a threaded hole matching the fastener 1051. The upper surface of the fixing block 1054 is provided, in parallel, with two sets of teeth 10541 for engaging with the teeth on the inner folded edge of the first bracket, and the two sets of teeth 10541 are respectively located on both sides of the threaded hole. The limiting bracket 1053 comprises a bracket body fixed to the first horizontal connecting plate 101, the second horizontal connecting plate 102, or the third horizontal connecting plate 104. The bracket body is provided with a mounting hole 10533 allowing the fastener 1051 to move vertically. On both sides of the bracket body in the length direction, two ends extend upward to form limiting protrusions 10534. A limiting groove 10536 is formed between two limiting protrusions 10534 on the same side. Among the limiting protrusions 10534 on the diagonal lines, two extend in the width direction of the bracket body to form deformable bent portions 10535. A gap is reserved between each bent portion 10535 and the adjacent limiting protrusion 10534 on the opposite side. The bracket body, the limiting protrusions 10534, and the bent portions 10535 together form a clamping structure configured to clamp the fixing block 1054.

[0194] When the fixing block 1054 is inserted into the clamping structure, the bracket body, the limiting protrusions 10534, and the bent portions 10535 cooperate to clamp the fixing block 1054.

[0195] When the elastic member 1052 is sleeved on the fastener 1051, and the fastener 1051 is passed through the through holes of the first horizontal connecting plate 101, the second horizontal connecting plate 102, and the third horizontal connecting plate 104, and then threaded into the fixing block 1054, the two ends of the elastic member 1052 respectively abut against the head of the fastener 1051 and the limiting bracket 1053, thereby putting the fall-prevention saddle 10 and the connecting fastener 105 into a pre-assembled state.

[0196] As shown in the assembly diagram in FIG. 30, when the pre-assembled fall-prevention saddle 10 and the connecting fastener 105 are mounted on the first horizontal connecting plate 101, the second horizontal connecting plate 102, or the third horizontal connecting plate 104, the fixing block 1054 clamped inside the clamping structure is positioned between the two inner folded edges of the connecting bracket or the first bracket or the second bracket.

[0197] When the fastener 1051 is pressed along its height direction, the fastener 1051 drives the fixing block 1054 to move in the same direction. The bent portion 10535 deforms under the pressure of the fixing block 1054 and causes the fixing block 1054 to disengage from the clamping structure through the gap and rotate into the limiting groove 10536, thereby allowing the two sets of teeth on the upper surface of the fixing block 1054 to engage with the teeth on the two inner

folded edges of the connecting bracket or the first bracket or the second bracket; see FIG. 29.

[0198] In the fall-prevention saddle proposed in the present invention, the fixing block is first secured within the limiting bracket to complete pre-assembly. During use, the pre-assembled fall-prevention saddle is installed on other components. By pressing the fastener radially, the fastener drives the fixing block downward. The bent portion deforms under the pressure of the fixing block, increasing the gap between the bent portion and the limiting protrusion, allowing the fixing block to disengage from the two opposing gaps of the limiting bracket. Meanwhile, under the combined action of the fastener and the limiting bracket, the fixing block rotates automatically during descent under the elastic force of the bent portion and enters the limiting groove for fixation. At the same time, the two sets of teeth on the fixing block engage with the teeth on the two inner folded edges of the connecting bracket or the first bracket or the second bracket, thereby achieving fixation between the connecting bracket and the first bracket or between the connecting bracket and the second bracket. The invention allows the connecting fastener to be inserted in the height direction of the fall-prevention saddle, and by pressing the fastener, the fixing block rotates automatically and the teeth on the fixing block engage with the folded edges, enabling quick installation and facilitating convenient and rapid on-site assembly.

[0199] In some embodiments, the fixing block 1054 is shaped as a parallelogram, and the angle between the alignment direction of each set of teeth 10541 and the corresponding side edge (i.e., the slanted edge) of the fixing block 1054 is 5° – 25° . In this embodiment, configuring the fixing block 1054 as a parallelogram is more conducive to rotation and prevents jamming that might occur with a rectangular shape. Moreover, the two obtuse angles of the parallelogram respectively correspond to the gaps between the two bent portions 10535 and their associated limiting protrusions 10534; see FIG. 23, which facilitates easier rotation. Furthermore, the obtuse corners are rounded to provide a guiding function.

[0200] As shown in FIG. 27, specifically, the upper surface of the fixing block 1054 is provided with two parallel grooves. Each set of teeth 10541 is arranged in one of the grooves and comprises two interlaced rows of teeth. The spacing between the two sets of teeth corresponds to the spacing between teeth on the two inner folded edges of the connecting bracket or the first bracket.

[0201] As shown in FIG. 25, in some embodiments, the limiting bracket 1053 has an overall shape of a hollow cuboid.

[0202] In some embodiments, the bracket body comprises a first body 10531 fixed in close contact with the bracket, and two second bodies 10532 respectively extending from both sides of the first body 10531 in the length direction of the limiting bracket 1053 along its height direction. The two ends of each second body 10532 extend along its length direction to form the limiting protrusions 10534. Among them, two diagonally opposite limiting protrusions 10534 extend in the direction of the opposite-side protrusions to form two parallel and deformable bent portions 10535.

[0203] In some embodiments, each bent portion 10535 has a rectangular shape, and the width of the bent portion 10535 is the same as that of the limiting protrusion 10534. A gap is left between the free end of the bent portion 10535 and the opposing limiting protrusion 10534 to allow the fixing block 1054 to pass through.

[0204] In some embodiments, the fixing block 1054 is cuboid-shaped, with the threaded hole located at its center, and two edges in the height direction are smoothly rounded.

[0205] In some embodiments, the width of the fixing block 1054 matches the spacing between the two limiting protrusions 10534 disposed on the same side along the length direction of the limiting bracket 1053.

[0206] In some embodiments, the height and width of the fixing block 1054 respectively match the internal height and width of the limiting bracket 1053.

[0207] In some embodiments, the first horizontal connecting plate 101, the second horizontal connecting plate 102, and the third horizontal connecting plate 104 are provided with through holes for the connecting fasteners 105 to pass through, and gaskets are arranged on the through holes.

[0208] In some embodiments, the bent portion 10535 is an elastic metal spring piece.

[0209] In some embodiments, the first horizontal connecting plate 101, the first vertical connecting plate, the second horizontal connecting plate 102, the second vertical connecting plate

106, and the third horizontal connecting plate 104 are integrally formed to constitute the fall-prevention saddle 10; and/or, the fall-prevention saddle 10 is made of rigid material.

[0210] In some embodiments, the surface of the fall-prevention saddle 10 is provided with an anti-oxidation coating.

[0211] In some embodiments, the fastener mentioned above is a bolt with external threads.

EMBODIMENT 4

[0212] Referring to FIGs. 9 to 12 and FIG. 31, the present invention provides a swing module 5 for connecting a segmented guy wire. The swing module 5 comprises a first connecting end 51 and a second connecting end 52 connected to the first connecting end 51. Preferably, the end-face distance between the first connecting end 51 and the second connecting end 52 is sufficient to accommodate at least four fasteners (e.g., nuts) arranged perpendicularly in the direction in which the guy wire extends.

[0213] Referring to FIG. 23, the first connecting end 51 is provided with a fixing hole penetrating through it, while the second connecting end 52 is provided with a swing slot 521 that also penetrates through it. The size of the swing slot 521 is smaller than that of the fixing hole. Here, "size" mainly refers to the respective lengths of the swing slot 521 and the fixing hole along the length direction of the second and first connecting ends.

[0214] More specifically, the segmented guy wire used for lifting the bracket module comprises a first segment 41 and a second segment 42. The connecting end of the first segment 41 is fixed/mounted to the surface to be installed (such as the ceiling wall of a building), while the connecting end of the second segment 42 is connected to the bracket module via the swing module 5. By employing a segmented guy wire and using the swing module 5 to connect the free ends of the two segments, the second segment 42 is enabled to swing back and forth within the swing slot 521 on the second connecting end 52 of the module, thereby enabling fine horizontal adjustment of the module.

[0215] Specifically, when connecting the first segment 41 and the second segment 42 of the segmented guy wire, the free end of the first segment 41 (not connected to the installation surface) passes through the fixing hole and is fixed to the first connecting end 51 by a first limiting member 511 and a second limiting member 512. The free end of the second segment 42 (not connected to the bracket module) passes through the swing slot 521 and is connected to the second connecting end 52 by a third limiting member 522 and a fourth limiting member, allowing the second segment 42 of the guy wire 4 to reciprocate relative to the second connecting end 52. The term "fixed connection" means that the first limiting member 511 and the second limiting member 512 are tightly fitted to the two ends of the fixing hole to prevent relative rotation between the first segment 41 and the fixing hole.

[0216] In some embodiments, when it is necessary to adjust the angle of the module, the swing module may be configured to rotate relative to the first segment 41. For example, when two adjacent modules need to be joined but their axial directions differ slightly, it is possible to rotate the swing module with respect to the guy wire 4 to align the modules. Specifically, the spacing between the first limiting member 511 and the second limiting member 512 may be adjusted to be greater than the thickness of the first connecting end 51, thereby allowing the swing module and the second segment 42 to rotate relative to the first segment 41 for alignment. Alternatively, the second segment 42 may be configured to rotate relative to the second connecting end 52 of the swing module 5. In other embodiments, the second limiting member 512 may be omitted, thereby maintaining the swing module's rotational freedom relative to the first segment 41.

[0217] In other embodiments, to adjust the height of the bracket module, one may fine-tune the position of the first and second limiting members along the first segment, and/or the third and fourth limiting members along the second segment. For example, when two adjacent modules have a slight height difference, fine adjustments of the limiting members can facilitate alignment.

[0218] To accommodate various installation needs, such as differing degrees of freedom at the edge or center regions of the bracket module, the guy wire 4 may be configured for different degrees of freedom relative to the swing slot. For instance, movement of the guy wire 4 within the swing slot constitutes one translational degree of freedom in the horizontal direction; rotation of the guy wire 4 relative to the fixing hole constitutes one rotational degree of freedom; and

adjustment of the length of the guy wire through the fixing hole or swing slot constitutes one translational degree of freedom in the vertical direction.

[0219] For example, on the second guy wire corresponding to a two-dimensional bracket located at a non-edge area (e.g., at the center of the module), the swing module may be configured to allow only horizontal movement (one translational degree of freedom), preferably without rotational freedom.

[0220] Alternatively, on the second guy wire corresponding to a two-dimensional bracket located at the edge of the module (e.g., at both ends), the swing module may be configured to allow both horizontal movement and rotation (i.e., one translational and one rotational degree of freedom).

[0221] In other words, the difference between the two configuration needs is that the segmented guy wire (such as its first or second segment) may be adjustable in a horizontal linear manner, or both in horizontal linear and rotational manners. Here, linear adjustment refers to the second segment moving back and forth along the axis of the swing slot 521; rotational adjustment refers to rotation of the second segment relative to the swing module, such as when the swing module rotates via the fixing hole relative to the first segment.

[0222] Preferably, two third connecting ends 53 are symmetrically arranged on both ends of the first connecting end 51 or the second connecting end 52, and the first connecting end 51, the second connecting end 52, and the third connecting ends 53 together define an isosceles trapezoid.

[0223] Further, in some embodiments, the system also comprises at least one first limiting member 511 and at least one second limiting member 512 disposed on the first segment 41. When the first segment 41 passes through the fixing hole, the first limiting member 511 and the second limiting member 512 are respectively located at both ends of the fixing hole to fix the first segment 41.

[0224] In some embodiments, the first limiting member 511 comprises: a third nut 5111 sleeved on one side of the first segment 41 after it passes through the fixing hole; and, a fourth nut 5112 sleeved on the first segment 41 and disposed between the third nut 5111 and the fixing hole.

[0225] Preferably, the guy wire 4 is provided with external threads, and the nuts are provided with internal threads, so that the nuts can be sleeved onto the guy wire 4 via threaded engagement.

[0226] In some embodiments, when the swing module is configured with rotational freedom, the third nut 5111 and the fourth nut 5112 are preferably arranged on the guy wire 4 with a spacing of at least two thread widths. This spacing helps reduce the risk of nut loosening during rotation.

[0227] In some embodiments, the third limiting member 522 comprises: a first nut 5221 sleeved on the second segment 42, such as at its top end; and, a second nut 5222 disposed between the first nut 5221 and the swing slot 521.

[0228] Preferably, for swing modules with translational and rotational degrees of freedom, the base and top ends of the swing module are respectively configured for the translational and rotational freedoms, ensuring relatively independent adjustment of each degree of freedom. This enhances adjustment efficiency and improves the stability of the connection between the swing module and the first segment during adjustment.

[0229] In some embodiments, the second limiting member 512 comprises at least one sixth nut, which is disposed on the other side of the first segment 41 after it passes through the fixing hole.

[0230] In some embodiments, the fourth limiting member 523 comprises at least one fifth nut, which is disposed on the other side of the second segment 42 after it passes through the swing slot 521.

[0231] When a vertical or horizontal deviation exists between two lifting modules during the hoisting process, the present invention enables fine adjustment of at least one module's height or horizontal position to achieve alignment. The micro swing adjustment of the guy wire proposed in the present invention helps construction workers to align components step by step, reducing the difficulty of operating lifting equipment. Thus, even inexperienced personnel can quickly learn and master the installation process.

[0232] Based on the swing module described above, the present invention also provides a swing assembly, comprising the segmented guy wire which includes a first segment and a second segment. The connecting end of the first segment can be fixed/mounted to the installation surface (e.g., the ceiling of a building), and the connecting end of the second segment is connected to the bracket module. The free ends of the two segments respectively pass through the fixing hole and swing slot in the swing module and are limited by corresponding limiting members. For example, the other or free end of the first segment passes through the fixing hole in the first connecting end of the swing module and is fixedly or rotatably connected to the first connecting end via the first and second limiting members. The other or free end of the second segment passes through the swing slot in the second connecting end and is slidably and/or rotatably connected to the second connecting end via the third and fourth limiting members. The specific working principle and assembly method may refer to the embodiment described above and are not repeated here.

EMBODIMENT 5

[0233] As shown in FIGs. 32 to 34, the present invention provides a bracket assembly and a base, comprising a MiMEP module and a base 13.

[0234] The MiMEP module comprises at least two sets of two-dimensional brackets, and at least two sets of the two-dimensional brackets are connected by a connecting bracket. Each two-dimensional bracket comprises two first brackets arranged in parallel and a second bracket connected across the tops of the two first brackets.

[0235] The base 13 comprises a first mounting plate 131, a second mounting plate 132, a third mounting plate 133, and a fourth mounting plate 134, wherein the second, third, and fourth mounting plates are fixedly connected to the bottom of the first mounting plate 131. The second mounting plate 132, the third mounting plate 133, and the fourth mounting plate 134 enclose a receiving space for accommodating the connection between the first bracket and the second bracket; see FIG. 32.

[0236] The second mounting plate 132 and the third mounting plate 133 are symmetrically arranged and may be perpendicular to the first mounting plate 131. Both the second and third mounting plates are provided with a first mounting hole 135 and a second mounting hole 136. The top of the first mounting plate 131 is provided with a third mounting hole 137 and a wire hole 138 for the guy wire to pass through.

[0237] The base 13 is connected to the first and second brackets by self-tapping fasteners (e.g., self-tapping screws). These include first self-tapping fasteners 139 matched with the first mounting holes 135 on the second and third mounting plates, and second self-tapping fasteners 140 matched with the second mounting holes 136 on the second and third mounting plates. By setting self-tapping fasteners respectively on the second and third mounting plates, the use of a long bolt to penetrate both mounting holes is avoided, which can otherwise lead to misalignment due to unpredictable internal structure, thus complicating assembly. Preferably, a gap is left between the two first self-tapping fasteners in the symmetric first mounting holes, and likewise between the second self-tapping fasteners in the symmetric second mounting holes, to prevent mutual interference and ensure structural stability.

[0238] The base 13 proposed in the present invention provides a receiving space enclosed by multiple mounting plates to accommodate the right-angle joint formed by the connection of the first and second brackets. Multiple mounting holes are provided, corresponding to through-holes on the first and second brackets. When the self-tapping fasteners pass through these mounting holes and tap into the through-holes of the brackets, the base 13 is securely connected to the bracket assembly.

[0239] A lifting ring is detachably mounted on the first mounting plate for lifting the MiMEP module. The lifting ring comprises a ring body 142 and a third fastener 141 fixedly connected to the ring body, with the third fastener 141 being matched with the third mounting hole 137.

[0240] On the side of the wire hole 138, a lifting ring (also referred to as a hoisting member) is provided. In addition to using the guy wire to lift the MiMEP module, separate lifting equipment can be attached to the lifting ring to hoist the module via the ring.

[0241] In some embodiments, the second mounting plate 132 and the third mounting plate

133 each comprise a first body 1321 and a second body 1331. The first mounting hole 135 penetrates the first body 1321 and is a slot extending in the length direction of the first body 1321. The second mounting hole 136 penetrates the second body 1331 and is a slot extending in the height direction of the second body 1331. This configuration allows for fine adjustment in the horizontal and/or vertical direction.

[0242] In some embodiments, the wire hole 138 communicates with a through-channel inside the first bracket.

[0243] In some embodiments, the first body 1321 is fixed to the second bracket via the first self-tapping fastener, and the second body 1331 is fixed to the first bracket via the second self-tapping fastener.

[0244] In some embodiments, the first mounting plate 131, second mounting plate 132, third mounting plate 133, and fourth mounting plate 134 are integrally formed.

[0245] In some embodiments, the lifting ring body 142 comprises a U-shaped section 1421 and a crossbar 1422 fixed to both free ends of the U-shaped section. An annular part 1423 is fixed to the center of the crossbar and is connected to the top of the third fastener 141. This configuration allows the lifting ring body 142 to be fixed to the first mounting plate 131 via the third fastener 141 (e.g., a bolt and nut assembly).

[0246] The lifting ring, fixed via the third fastener 141 to the first mounting plate 131, ensures that force is simultaneously applied to both the first and second brackets, thereby facilitating lifting of the MiMEP module.

[0247] In some embodiments, the plane of the lifting ring body 142 is perpendicular to the plane of the first mounting plate 131.

[0248] In some embodiments, the lifting ring body 142 and the third fastener 141 are integrally formed.

[0249] In some embodiments, both the lifting ring body 141 and the base 13 are made of rigid material; and/or, the surface of the base 13 is provided with an anti-oxidation coating.

[0250] In other embodiments, the present invention further provides another base structure, which comprises all components of the base described above, except that the lifting ring is not provided.

[0251] This embodiment proposes a semi-open structure for the base. A semi-open base refers to one with an opening at the bottom and on one side, while the top and other sides are provided with mounting plates, forming an internal cavity that serves as an installation space for the connection between the first and second brackets. The receiving space enclosed by multiple mounting plates of the base can accommodate the right-angle structure formed by the vertical connection of the first bracket and the second bracket. The multiple mounting holes provided on the base correspond to through-holes on the first and second brackets and enable secure connection via self-tapping fasteners such as self-tapping screws.

[0252] The following section describes a second set of reference numerals for a connector that facilitates installation, as well as the corresponding bracket assembly.

EMBODIMENT 6

[0253] This embodiment is generally shown in FIGs. 35 to 42:

[0254] As illustrated in FIGs. 35 and 36, the present solution provides a connector facilitating installation, comprising a mounting seat 1B and at least two connecting fasteners 2B. The mounting seat 1B comprises a first mounting plate and a second mounting plate connected vertically. Each of the first and second mounting plates is provided with at least one mounting hole 11B.

[0255] In some embodiments, auxiliary mounting plates are provided on the same side of both the first and second mounting plates, respectively. Each auxiliary mounting plate is perpendicular to its corresponding main plate, forming a mounting space between the auxiliary plate and the first mounting plate to accommodate a first guide rail, and likewise, between the other auxiliary plate and the second mounting plate to accommodate a second guide rail. To increase the structural strength, a reinforcement plate is arranged between the two auxiliary mounting plates.

[0256] By cooperating the vertically structured mounting seat and multiple connecting fasteners, two perpendicular guide rails (e.g., a first guide rail and a second guide rail) can be securely fixed, forming a bracket assembly.

[0257] As shown in FIGs. 37 to 39, each connecting fastener comprises a fastener 21B, an elastic member 22B, a fixing block 23B, and a limiting bracket 24B. The fixing block 23B is provided with a threaded hole matching the fastener 21B. The fastener 21B passes through the mounting hole 11B and the threaded hole to be screwed into the fixing block 23B. The elastic member 22B is sleeved on the fastener 21B, with both ends abutting the fastener head and the limiting bracket 24B.

[0258] In some embodiments, the fastener 21B is a bolt and the elastic member 22B is a spring.

[0259] In some embodiments, the mounting hole 11B is a round clearance hole with an inner diameter slightly greater than the maximum diameter of the fastener's threaded shaft, allowing the fastener and spring to pass through freely while still serving as a guide and restraint to prevent large shifts.

[0260] As shown in FIG. 41, the limiting bracket 24B comprises a bracket body fixed to the mounting seat. The bracket body has a through hole 243B for the vertical movement of the fastener. At both ends of the bracket body in the lengthwise direction, limiting protrusions 244B extend upward along the height direction. Between two protrusions on the same side, a limiting groove 246B is formed. Two diagonally arranged limiting protrusions extend along the width direction to form deformable bent portions 245B. The cross-section of the interconnected bent portion and limiting protrusion is L-shaped, and the bracket body, limiting protrusions 244B, and bent portions 245B cooperate to form a clamping structure for the fixing block.

[0261] In some embodiments, the inner diameter of the through hole 243B is smaller than the outer diameter of the elastic member, so the spring is supported on the upper surface of the bracket body.

[0262] In some embodiments, the bent portion is an elastic metal spring tab, enabling it to reset after deformation when the fixing block disengages, allowing reuse.

[0263] To facilitate disengagement, a gap is left between the free end of the bent portion and the adjacent limiting protrusion, allowing the fixing block to pass through. During deformation, the gap widens.

[0264] The bracket body may comprise a first body 241B fixed to the mounting seat and two second bodies 242B extending from both sides of the first body in the height direction. Each second body 242B is shorter than the fixing block in height and comprises two sub-bodies positioned on either side of the first body. Each sub-body has two limiting protrusions extending from its ends, forming one limiting groove per sub-body. Together, the two grooves 246B provide stop control after the fixing block rotates.

[0265] Referring to FIG. 41, taking the center of the limiting bracket 24B as the origin, the X-axis is the length direction (axial), the Y-axis is the width direction, and the Z-axis is the height direction (radial).

[0266] In some embodiments, the upper surface of the first body 241B is spot welded to the mounting seat.

[0267] As shown in FIG. 40, the fixing block 23B is a cuboid with a centrally located threaded hole 231B. To ease removal, the two longitudinal edges of the fixing block are rounded to align with the gap in the limiting bracket, enabling smoother passage during rotation.

[0268] In some embodiments, the spacing between the two sub-bodies and the width of the limiting groove are equal to the width of the fixing block, allowing stable fixation in both pre-assembled and locked states.

[0269] In some embodiments, the limiting bracket is an internally hollow cuboid frame. Its two sides in the width direction are open, allowing insertion of the fixing block. The limiting grooves are located on the sidewalls along the length direction, such that in the pre-assembled state, the fixing block is held inside the cavity, and after rotating 90°, it is held in the limiting groove.

[0270] When the fastener is pressed downward, the bent portion is deformed under pressure from the fixing block, generating a force decomposed into radial and axial components. The radial

force is counteracted by the pressing force, and the axial force drives rotation as the fixing block descends. Upon release, the elastic force of the bent portion pushes the fixing block upward, guiding it into the groove for locking.

[0271] Based on the above-described connector, the present solution also provides a bracket assembly, as shown in FIGs. 43 and 44. This assembly comprises the connector and vertically arranged first guide rail 3B (also referred to as a second bracket) and second guide rail (or first bracket). Both guide rails have two sidewalls 32B that are bent inward twice (first horizontally, then vertically) to form two inwardly folded edges 33B, with openings facing the guide rail's bottom wall 31B.

[0272] When the connector is mounted at the junction of the first and second guide rails, the bent portion is parallel to the plane where the edge 331B of the inward fold lies, and the distance between the bent portion and the inner wall (bottom wall) is smaller than the distance between the inward fold plane and the inner wall, so that the gap is within that region.

[0273] In some embodiments, the end of the inwardly folded edge is flush with the groove bottom of the limiting groove (i.e., the bottom edge of the second body), allowing the upper surface of the fixing block to contact both the groove bottom and the inwardly folded edge for better fixation.

[0274] Installation process for the bracket assembly (with two connecting fasteners, two guide rails, and mounting plates):

[0275] First, the connector is pre-assembled (as in FIG. 37). This includes inserting the fixing block into the limiting bracket, placing the elastic member over the mounting hole, and inserting the fastener through the elastic member, mounting hole, and threaded hole to screw into the fixing block. The elastic member provides preload to stabilize the connector.

[0276] Next, the first guide rail is aligned with the first mounting plate. The fixing block is located between the two inwardly folded edges. After confirming alignment, the fastener is pressed downward, compressing the elastic member and driving the fixing block. The bent portion deforms, the gap expands, and the fixing block rotates 90° into the groove and locks. The fastener is then rotated to tighten the assembly, making the fixing block's top surface closely engage the inwardly folded edge for secure holding (as in FIG. 38).

[0277] The same process is repeated for the second guide rail and second mounting plate, forming the final bracket assembly.

[0278] Compared with prior art (e.g., CN208123872U), which requires pressing, rotating, and tightening bolts manually, and uses tooth-matching for fixation (increasing complexity and cost), the present solution offers a self-rotating, auto-locking connector that works with non-serrated vertical guide rails, creating a stable bracket assembly. The connector is pre-assembled, positioned, and fixed by simply pressing the fastener. The elastic bent portion drives automatic rotation and locking, engaging the folded edges for firm holding, which is fast, simple, and efficient.

[0279] Moreover, unlike prior art relying solely on friction between serrated structures, this invention securely locks the fixing block via the limiting bracket, achieving strong fixation without any serration pre-treatment, thus ensuring simple structure, low cost, and high reliability.

[0280] Overall, the present solution introduces a one-press, auto-rotating bracket assembly that is structurally simple and easy to install.

[0281] It should be understood that the L-shaped connector, fall-prevention saddle, base, and other connecting parts provided in the previous embodiments may be selectively used independently or in combination in a 3D module according to specific construction needs. Correspondingly, the 3D module system provided by the invention comprises one or more combinations of these connecting parts.

[0282] Next, a third set of reference numerals will be used to illustrate the connector provided by the present invention and the corresponding bracket assembly.

EMBODIMENT 7

[0283] As generally shown in FIGs. 45A-45I, the present invention provides a hoisting connector comprising a baffle and a hoisting body 1A in a Chinese Character "Door" ("门")-shaped frame (i.e., resembling the Chinese character for "door"). The first and second ends of the hoisting body 1A are respectively provided with a first mounting region 3A and a second mounting region

4A, which are arranged opposite each other. The second mounting region 4A extends obliquely away from the centerline of the hoisting body to form an inclined structure, such that the spacing between the first and second mounting regions increases from top to bottom. A second end of the baffle 2A is rotatably mounted to the second end of the second mounting region 4A. A limiting hole 5A is formed in the first mounting region 3A.

[0284] In the absence of external force, a portion of the baffle 2A is located within the limiting hole 5A. The baffle 2A and the hoisting body 1A together define an installation space for receiving a bracket assembly.

[0285] Specifically, the hoisting body 1A comprises a first portion 101A, a second portion 102A, and a third portion 103A connected in sequence. The first and third portions are parallel or approximately parallel, while the second portion is perpendicular or nearly perpendicular to the first or third portion. The first and second mounting regions 3A and 4A are located on the first and third portions respectively. The first portion may be slightly longer than the third portion, so that when the baffle is in the open state, the hoisting body forms a slightly asymmetrical "door"-shaped frame, with the baffle parallel to the second portion. When in the initial (closed) state, the baffle and the hoisting body enclose a substantially rectangular installation space.

[0286] From another perspective, when the baffle is open, the hoisting body 1A has a U-shaped structure: the first ends of the first and third portions connect to both ends of the second portion (e.g., the second portion as the top, with through holes formed thereon), while the second ends form an open bottom (see FIG. 45A). Thus, the installation space has an open bottom to facilitate bracket insertion.

[0287] As shown in FIGs. 45F-45H, when the bracket assembly 6A is inserted upward into the installation space, the baffle rotates in a first direction under the force of the bracket to expose an opening at the bottom. Once the bracket assembly is fully received and moves above the baffle, the baffle returns in a second (opposite) direction under gravity and supports the bracket by bearing its weight. The bracket assembly 6A is thus retained inside the installation space.

[0288] In some embodiments (see FIG. 45C), the limiting hole comprises a limiting section 502A and a movement section 501A arranged in a bottom-up sequence. The width of the limiting section 502A is smaller than that of the movement section 501A. The two sections are interconnected. A limiting block 201A is formed by extending the first end of the baffle outward. The width of the limiting block is greater than that of the limiting section 502A but smaller than that of the movement section 501A.

[0289] In some embodiments, the portion of the baffle between the first and second mounting regions is wider than the portion positioned inside the limiting hole. That is, card slots 202A are formed on both sides of the baffle at the limiting-hole-matching region. When at rest, part of the baffle sits within the limiting section 502A, while the extended ends with increased width prevent displacement or deformation due to gravity acting on the bracket or the first mounting region, thereby avoiding accidental disengagement of the baffle from the limiting section.

[0290] A smooth arc-shaped transition structure 503A is provided between the limiting and movement sections. The arc surface faces inward toward the limiting hole, enabling the baffle to smoothly fall into place when returning, even if slightly misaligned, thus preventing jamming.

[0291] In some embodiments, the second end of the second mounting region is provided with a rotation groove 401A. The second end of the baffle is rotatably mounted within the groove via a rotation shaft 402A. The sidewalls of the groove limit axial displacement of the baffle.

[0292] In specific embodiments, first mounting holes 403A are provided on both sides of the groove, and the baffle has corresponding second mounting holes 404A. When the rotation shaft 402A passes through both sets of holes, it links the baffle and hoisting body, allowing the baffle to rotate around the shaft.

[0293] Alternatively, the baffle may be connected to the second mounting region via a hinge seat or another rotational mechanism. The above configuration does not limit how the rotation is achieved.

[0294] In some embodiments (see FIG. 45D), the acute angle α formed between the extension of the inclined structure 9A and the vertical extension of the hoisting body 1A is 10° - 30° , preferably 30° . This angled design allows both easy insertion of the bracket assembly from a wider opening that narrows upward, limiting side-to-side sway inside the space; and, sufficient

rotation space for the baffle to open up to 90°, aligning the baffle plane parallel to the height direction, thereby saving interior space.

[0295] In some embodiments (see FIG. 45B), the hoisting body 1A has at least one fixing hole 7A. When the first end of a fixing member (e.g., bolt) is inserted into the fixing hole 7A, it presses against the bracket inside, and the second end remains outside. This creates clamping with the opposite wall of the hoisting body to prevent movement.

[0296] Preferably, two fixing holes are provided symmetrically on either side of the hoisting body. Two opposing fixing members then clamp the bracket from both sides for added stability.

[0297] In some embodiments (see FIGs. 45B and 45F), the top of the hoisting body is provided with a through hole 8A. During use, a threaded rod 10A is first driven into the ceiling, with its other end passing through the through hole 8A to secure the hoisting connector 11A. By rotating the threaded rod 10A, the position (i.e., height) of the hoisting connector 11A can be adjusted.

[0298] When being used (see FIGs. 45F-45I), the hoisting connector 11A is pre-mounted on the threaded rod 10A and adjusted to the designated height. The bracket assembly is then lifted by hoisting equipment until the top of the bracket enters the installation space. The baffle is pushed open by the bracket and rotates about the shaft. Once the bracket is fully inserted above the baffle, it no longer applies force to the baffle, which then returns by gravity to close the bottom opening and support the bracket. The bracket is then manually fixed to the wall 14A. Multiple bracket assemblies and corresponding hoisting connectors 11A can then be aligned for connection (e.g., pipelines 13A mounted on the bracket assemblies).

[0299] During lifting, the bracket assembly automatically pushes the baffle open, and once inserted, the baffle automatically returns to secure the bracket without manual intervention. After insertion, the hoisting connector supports the bracket assembly, eliminating the need for hoisting equipment to maintain support. Multiple hoisting connectors can be pre-installed at the designated height, enabling brackets to align automatically upon insertion-no manual adjustment of heavy parts is required. Once fixed to the wall, the hoisting connector continues to bear the load, reducing stress on the bracket-to-wall connection and improving stability.

[0300] In contrast with prior solutions, which require manual handling and offer poor stability in constrained indoor environments (where large hoisting equipment is impractical and small ones are unstable), the present invention provides an auto-locking, pre-positioning connector that improves both stability and convenience.

[0301] Additionally, the bracket assembly may be a two-dimensional bracket (e.g., the first or second bracket) or a connecting bracket in a 3D module; or it may correspond to a first or second guide rail.

[0302] In summary, this embodiment presents an auto-opening, auto-closing pre-fixed hoisting connector designed for indoor use, enabling efficient, stable installation of bracket assemblies without manual interference or constant lifting support.

[0303] It should be understood that the present invention provides several different hoisting methods for the bracket or bracket assembly. For example, Embodiment 1 provides a method for hoisting the bracket using a guy wire in cooperation with a locking member 8 (as shown in FIG. 14). In addition, the present embodiment provides a method for hoisting the bracket by means of a hoisting connector (as illustrated in FIGs. 45A to 45I).

[0304] It should be understood that, in some embodiments, the above hoisting methods may be used independently or in combination. Correspondingly, the module system may comprise one or more of the above-mentioned hoisting components, such as the locking member, hoisting connector, and so on.

[0305] It should be further appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments falling within the intended scope of the invention. As would be understood by a person skilled in the art, each embodiment, may be used in combination with other embodiment or several embodiments.

[0306] **FIRST GROUP OF REFERENCE NUMERALS**

1 – Two-dimensional bracket

2 – Connecting bracket
 3 – First pulling wire
 4 – Second pulling wire
 5 – Swing module
 6 – Gasket
 11 – First bracket
 12 – Second bracket
 12a – L-shaped connecting member
 121 – First vertical contact plate
 122 – Second horizontal contact plate
 41 – First section
 42 – Second section
 4a – Multi-segment pulling wire
 51 – First connection end
 52 – Second connection end
 53 – Third connection end
 521 – Swing slot
 511 – First limiting member
 512 – Second limiting member
 522 – Third limiting member
 523 – Fourth limiting member
 5111 – Third nut
 5112 – Fourth nut
 5221 – First nut
 5222 – Second nut
 105 – Connecting fastener
 1051 – Fastener
 1052 – Elastic member
 1053 – Limiting bracket
 1054 – Fixing block
 1055 – Gasket I
 10531 – First body
 10532 – Second body
 10533 – Mounting hole
 10534 – Limiting protrusion
 10535 – Bent portion
 10536 – Limiting slot
 10541 – Tooth
 10 – Anti-drop saddle
 101 – First horizontal connecting plate
 102 – Second horizontal connecting plate
 103 – First vertical connecting plate
 104 – Third horizontal connecting plate
 106 – Second vertical connecting plate
 13 – Base
 131 – First mounting plate
 132 – Second mounting plate
 133 – Third mounting plate
 134 – Fourth mounting plate
 135 – First mounting hole
 136 – Second mounting hole
 137 – Third mounting hole
 138 – Pulling wire hole
 139 – First self-tapping fastener
 140 – Second self-tapping fastener
 141 – Third fastener

142 – Lifting ring body
1321 – First body
1331 – Second body
1421 – U-shaped portion
1422 – Cross bar
1423 – Annular member

[0307] SECOND GROUP OF REFERENCE NUMERALS

1B – Mounting base
11B – Mounting hole
2B – Connecting fastener
21B – Fastener
22B – Elastic member
23B – Fixing block
231B – Threaded hole
24B – Limiting bracket
241B – First body
242B – Second body
243B – Through hole
244B – Limiting protrusion
245B – Bent portion
246B – Limiting slot
3B – First guide rail
31B – Guide rail bottom surface
32B – Side wall
33B – Inwardly folded edge
331B – End of inwardly folded edge

[0308] THIRD GROUP OF REFERENCE NUMERALS

1A – Lifting body
2A – Baffle
201A – Limiting block
202A – Card slot
3A – First mounting area
4A – Second mounting area
401A – Rotation slot
402A – Rotating shaft
403A – First mounting hole
404A – Second mounting hole
5A – Limiting hole
502A – Limiting portion
501A – Movable portion
503A – Transition structure
6A – Bracket assembly
7A – Fixing hole
8A – Through hole
9A – Inclined structure
10A – Lead screw
11A – Lifting connecting member
14A – Wall
13A – Pipeline
101A – First part
102A – Second part
103A – Third part

CLAIMS

1. An installation method for a DFMA module, comprising the steps of:

S101, providing a DFMA module, the DFMA module comprising at least two sets of two-dimensional brackets (1), the at least two sets of two-dimensional brackets (1) being connected by a connecting bracket (2); wherein each two-dimensional bracket comprises at least two oppositely arranged first brackets (11), and the at least two first brackets (11) are connected by a second bracket (12), a through-passage being formed inside each first bracket (11);

S102, passing a first pulling wire (3) through the through-passage, a first end of the first pulling wire (3) protruding outward from the top of the through-passage and being connected to a first end of a second pulling wire (4), a second end of the second pulling wire (4) being fixed to a mounting surface; wherein the first pulling wire and the second pulling wire are connected via a connecting portion (7);

S103, driving the DFMA module to move upward along the first pulling wire;

S104, when the DFMA module reaches the second pulling wire, unloading the connecting portion (7) to disconnect the second pulling wire from the first pulling wire;

S105, sealing the bottom of the through-passage, and locking an end of the second pulling wire that passes through the top of the through-passage using a locking member, so as to fix the DFMA module to the mounting surface via the second pulling wire.

2. The installation method for a DFMA module according to claim 1, wherein the second pulling wire comprises a first section (41) and a second section (42) connected via a swing module (5), the swing module (5) comprising:

a first connection end (51) provided with a fixing hole for fixing the first section (41);

a second connection end (52) connected to the first connection end (51), the second connection end being provided with a swing slot (521), an end of the second section (42) passing through the swing slot (521) and being fixed to an inner side of the swing slot (521) via a third limiting member (522);

and wherein step S103 further comprises adjusting a movement direction of the DFMA module using the swing module (5), such that when the second section (42) reciprocates within the swing slot (521), the DFMA module is enabled to shift in a corresponding movement direction.

3. A DFMA module system, comprising:

a DFMA module, the DFMA module comprising at least two sets of two-dimensional brackets (1), the at least two sets of two-dimensional brackets (1) being connected by a connecting bracket (2); wherein each two-dimensional bracket comprises at least two oppositely arranged first brackets (11), and the at least two first brackets (11) are connected by a second bracket (12), a through-passage being formed inside each first bracket (11);

a first pulling wire (3), configured to pass through the through-passage and connect to a first end of a second pulling wire (4), a second end of the second pulling wire (4) being configured to be fixed to a mounting surface;

wherein the second pulling wire comprises a first section (41) and a second section (42) connected via a swing module (5), the swing module (5) comprising:

a first connection end (51) provided with a fixing hole for fixing the first section (41);

a second connection end (52) connected to the first connection end (51), the second connection end being provided with a swing slot (521), an end of the second section (42) passing through the swing slot (521) and being fixed to an inner side of the swing slot (521) via a third limiting member (522);

wherein when the second section (42) reciprocates within the swing slot (521), the DFMA module is enabled to shift in a corresponding movement direction, so that the first pulling wire and/or the second pulling wire has a degree of freedom of movement in the horizontal direction.

4. The DFMA module system according to claim 3, wherein the first section (41) is fixedly connected to the first connection end (52).

5. The DFMA module system according to claim 3, further comprising at least one first limiting

member and at least one second limiting member disposed on the first section, wherein when the first section (41) passes through the fixing hole, the first limiting member and the second limiting member are respectively positioned on two sides of the fixing hole to fix the first section.

6. The DFMA module system according to claim 3, wherein the third limiting member (522) comprises:

a first nut (5221), sleeved on the second section;

a second nut (5222), sleeved on the second section and located between the first nut and the swing slot (521).

7. The DFMA module system according to claim 5, wherein at least one swing module provides a rotational degree of freedom for the second pulling wire.

8. The DFMA module system according to claim 7, wherein the first section (41) is rotatable relative to the fixing hole.

9. The DFMA module system according to claim 8, wherein the first limiting member comprises:

a third nut sleeved on one side of the first section passing through the fixing hole;

a fourth nut sleeved on the first section and positioned between the third nut and the fixing hole; wherein the first section is capable of rotating relative to the fixing hole under an external force.

10. The DFMA module system according to claim 9, further comprising:

a gasket (6), sleeved on the second pulling wire (4);

and/or a lifting member disposed on a second bracket (12) at a top of the two-dimensional bracket (1);

and/or a sealing member configured to seal a bottom of the through-passage.