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(54) Title: TOOL DEPLOYMENT SYSTEM

(57) Abstract: A tool deployment system is disclosed. The tool deployment system is installable underwater for facilitating deployment of tools thereon. The tool deployment system includes a foldable base, a platform and a tool holding structure. The foldable base has a plurality of openings configured thereon. The openings reduce buoyant force to which the foldable base is subjected to. The platform is disposed operatively above the foldable base and spaced apart from the foldable base by means of at least one support element. The tool holding structure is disposed on the platform for facilitating deployment of at least one tool thereon.



TOOL DEPLOYMENT SYSTEM

FIELD OF THE DISCLOSURE

The present disclosure generally relates to systems and methods used for facilitating operation in a fluidic environment. Particularly, the present disclosure relates to a tool deployment system installable within a fluidic environment, such as an underwater environment, for facilitating deployment of tools required for underwater intervention and operation.

BACKGROUND

In general, any operation that is to be performed in a fluidic environment which is out of reach for manual intervention, requires one or more tools installed therewithin that work in an automatic mode. A suitable example of such an environment is underwater environment, and more particularly, subsea environment.

Subsea generally refers to equipment, technology and methods used for underwater operations such as scientific study of organisms in the sea/ocean, geological oceanography, offshore oil and gas production and underwater mining. Generally, retrieval tools are used for subsea intervention, wherein permanently installed subsea equipment is retrieved for repair/ refurbishment using the retrieval tools. Generally, tool deployment system is used to deploy and handle the installed subsea equipment.

The installed retrieval subsea equipment, such as Mono Ethylene Glycol (MEG) filters or Injection valves, are provided to do specific functions. Such equipment may exist in subsea either with 100% redundancy or without redundancy. During the retrieval of such equipment for repair/ refurbishment purpose, the subsea system is either left without any redundancy or without the operation thereof during the period of intervention. A continuous operation of subsea system is required during interventions, especially in deep water operations. Therefore, there is a need to reduce/

minimize intervention duration. Generally, the time period for interventions varies from 12 to 24 hours based on several factors including visibility, bottom current and the like.

During retrieval or deployment of subsea equipment with retrieval tools by using conventional tool deployment systems, the subsea equipment may get damaged and/or lost at subsea.

Conventional retrieval tools include remotely operated vehicles (ROV) and cranes for retrieval of subsea equipment. Retrieval of subsea equipment using conventional retrieval tools is difficult due to absence of lifting arrangements in conventional retrieval tools. Further, such retrieval tools do not include any buoyancy module for reducing the handling weight and hence such tools experience a heavy weight during retrieval of subsea equipment. Therefore, there is a risk of malfunctioning of such tools which can lead to production loss. Further, there is also a risk that subsea items may get damaged due to handling by the conventional retrieval tools.

The US patent application US20100050921 relates to a system and method for use on subsea structures from a surface vessel. System includes a vessel floating on water, a winch provided on the vessel to lower/raise a tool, connected to a line, in water and a weight connected to the line and provided on bottom of the ocean floor. The line typically includes either a rope, or a cable, or an umbilical, or a wire and is supported by the winch. The tool is releasably connected to the line at a fixed location. The winch is a constant tension winch, which acts to keep tool stationary by keeping tension on the line while the vessel heaves. The tool is used to work on or provide materials for subsea structure. The subsea structure may be a pipeline, a crude oil flow line, a mooring line, a riser, a tubular, or any other structural element installed in a body of water. In other embodiments, the tool may be a transport tool to carry devices subsea, which may be used in conjunction with an installation tool, such as an ROV, to attach the devices to the subsea structure. In some other embodiments, devices/components may be attached to the tool on the vessel by hand and the

tool may then be launched from the vessel and lowered to a depth where the devices are to be removed from the tool and installed on the subsea structure. Additionally a stationary apparatus, such as a buoyancy apparatus or a clamp, may be used to keep the tool stationary.

Further, the US patent application US20100025043 relates to a system for operation and service of hydrocarbon-producing wells and structures located underwater, a vessel for use in operation and maintenance of hydrocarbon-producing wells and structures located underwater and a method for intervention on subsea equipment which is used in connection with production and further transport of a well stream. The vessel is provided with a system for anchoring, e.g. a mooring system, a dynamic positioning system or a combination of the two. The vessel includes means for carrying out an intervention on equipment disposed below the water surface. These means include tool systems which can be lowered through an opening in the vessel or from a lifting arrangement which is normally located at the back end of the vessel. The anchor point and location of the equipment for lowering and raising the tool systems are stated to be located in different parts of the vessel so that the vessel covers a greater area when it rotates or pivots round the anchor. The tool system used in a given situation is stated to be dependent on what kind of equipment is to be worked on and which operations have to be performed on the equipment. The vessel may be positioned in such a manner that by pivoting the vessel to given positions it can be employed as an intervention platform for subsea-mounted equipment. Alternatively, the vessel may be disconnected from its anchoring and riser system and positioned freely over the intervention object. When the vessel is in position, relevant tool systems are lowered in the conventional manner to subsea equipment from the vessel through either an opening in the vessel or from a lifting arrangement which is stated to be normally positioned in the after end of the vessel.

However, each of the above-mentioned prior art patent documents are prone to damage and/ or loss of the installed subsea equipment during transportation to an installation site.

There is thus felt a need for eliminating the problems associated with the prior art tool deployment systems. Further, there is a need to provide a tool deployment system that prevents damage to an equipment to be installed in a fluidic environment, such as subsea environment. Furthermore, there is a need to provide a tool deployment system that prevents wastage of time in tracing subsea equipment dropped on the sea bed. Again, there is a need to provide a tool deployment system that reduces operational time for retrieval of subsea equipment.

OBJECTS

Some of the objects of the present disclosure which at least one embodiment is adapted to provide, are described herein below:

An object of the present disclosure is to provide a tool deployment system that prevents damaging of at least one tool/equipment to be deployed.

Another object of the present disclosure is to provide a tool deployment system that prevents wastage of time in tracing at least one tool dropped within a fluidic environment.

Yet another object of the present disclosure is to provide a tool deployment system that prevents loss/damage of tools.

Still another object of the present disclosure is to provide a tool deployment system that reduces operational time for retrieval of at least one tool.

Further, an object of the present disclosure is to provide a tool deployment system that is cost effective.

Other objects and advantages of the present disclosure will be apparent from the following description when read in conjunction with the accompanying figures, which are not intended to limit the scope of the present disclosure.

SUMMARY

In accordance with an embodiment of the present disclosure, there is provided a tool deployment system installable in a fluidic environment for facilitating deployment of tools thereon. The tool deployment system includes a foldable base, a platform and a tool holding structure. The foldable base has a plurality of openings configured thereon. The plurality of openings is adapted to reduce buoyant force subjected to the foldable base. The platform is disposed operatively above and spaced apart from the foldable base by means of at least one support element. The tool holding structure is disposed on the platform for facilitating deployment of at least one tool thereon.

In accordance with an embodiment of the present disclosure, the foldable base includes a base plate and a plurality of pivotable peripheral plates pivotably connected to the base plate.

The foldable base includes a plurality of openings configured thereon, the plurality of openings adapted to reduce buoyant forces to which said foldable base is subjected to.

In accordance with an embodiment of the present disclosure, the plurality of pivotable peripheral plates of the foldable base is adapted to be folded to define a space between the foldable base and the platform.

The platform may include a plurality of walls disposed along the edges of the platform. In accordance with an embodiment of the present disclosure, the tool holding structure is a central tower having at least one slot for facilitating deployment of the at least one tool thereon.

In accordance with an embodiment of the present disclosure, the at least one support element is at least one support pillar.

The portion of the foldable base may be detachably connected to the at least one support element.

Typically, the tool holding structure includes a lifting lug having at least one slot adapted to facilitate anchoring and lifting of the tool deployment system.

In one embodiment, the tool holding structure includes at least one handle.

Preferably, the tool holding structure is made of a material that is easily available and cost effective, such as carbon steel.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

The tool deployment system of the present disclosure will now be described with the help of the accompanying drawings, in which:

FIGURE 1 illustrates a perspective view of a tool deployment system including a foldable base, a platform and a tool holding structure, in accordance with an embodiment of the present disclosure;

FIGURE 2 illustrates a perspective view of the tool holding structure of the tool deployment system of FIGURE 1;

FIGURE 3 illustrates a side view of the tool deployment system of FIGURE 1;

FIGURE 4 illustrates a perspective view of the foldable base of the tool deployment system of FIGURE 1;

FIGURE 5 illustrates a perspective view of the platform of the tool deployment system of FIGURE 1; and

FIGURE 6 illustrates a perspective view of the platform of the tool deployment system of FIGURE 1 along with a plurality of walls and support elements.

DETAILED DESCRIPTION

The tool deployment system of the present disclosure will now be described with reference to the embodiments which do not limit the scope and ambit of the disclosure. The description relates purely to the exemplary preferred embodiments of the disclosed system and its suggested applications.

The system herein and the various features and advantageous details thereof are explained with reference to the non-limiting embodiments in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

The tool deployment system of the present disclosure will now be explained with reference to Figure 1 through Figure 6 with the key components being referenced generally by numerals as indicated in the accompanying drawings.

Referring to Figures 1 to 6, a tool deployment system **100** installable in a fluidic environment is disclosed, in accordance with an embodiment of the present disclosure. The tool deployment system **100** includes a foldable base **102**, a platform **104**, and a tool holding structure **112**.

The foldable base 102 includes a base plate 102a and a plurality of pivotable peripheral plates 116. Each of the plurality of pivotable peripheral plates 116 is pivotably connected to the edges of the base plate 102a to define a space between the foldable base 102 and the platform 104. The foldable base 102 has a plurality of openings 106 configured thereon. The platform 104 is disposed operatively above and spaced apart from the foldable base 102. The tool holding structure 112 includes a plurality of plates 132, 134, 136, 138, 140, 142 and 144, as illustrated in FIGURE 2. The plates 132, 134, 136, 138, 140, 142 and 144 provide strength to the tool holding structure 112. The tool holding structure 112 is adapted to bear vertical loading on the tool deployment system 100. The platform 104 includes at least one plate 128 and a plurality of channel 130 for supporting the plate 128. The platform 104 and the foldable base 102 are connected by means of at least one support element 108 to define the space between the platform 104 and the foldable base 102. In one embodiment, the support elements 108 are support pillars. In accordance with an embodiment of the present disclosure, the plurality of pivotable peripheral plates 116 connected to edges of the base plate 102a is folded to define a space between the foldable base 102 and the platform 104. The pivotable peripheral plates 116 of the foldable base 102 are configured to be removably connected to the support elements 108 by means of various fasteners, such as nuts and bolts, screws, a latch and the like. Further, a plurality of walls 110 is provided along the edges of the platform 104 to form a basket or an enclosure. Further, the tool holding structure 112 is disposed on the platform 104. In one embodiment, the tool holding structure 112 is integral with the platform 104. In an alternative embodiment, the tool holding structure 112 is detachably attached to the platform 104. The tool holding structure 112 facilitates deployment of at least one tool 122 thereon. In accordance with an embodiment, the tool holding structure 112 is a central tower made up of steel, typically carbon steel, and positioned on the central portion of the platform 104. The tool holding structure 112 has at least one slot 114 to hold at least one tool 122. Suitable examples of the tool 122 include but are not limited to mono ethylene glycol (MEG) filters and injection valves. Various mechanisms, such as underwater scooters, underwater cranes, remotely operated underwater vehicles (ROVs) and the like, may be used for

carrying, resting, holding or deploying the tool **122**. The ROVs may also be used to withdraw the tool **122** installed on the tool holding structure **112** and then implement/position the tool **122** at a required position. Further, holding of the tool **122** at the top by means of the slots **114** configured on the tool holding structure **112**, the platform **104** and the foldable base **102** facilitate the system **100** of the present disclosure to stay stabilized and not to topple over.

In an alternate embodiment, the tool holding structure **112** may be positioned in proximity to one or more walls **110** of the platform **104**.

In accordance with the present disclosure, the tool holding structure **112** has a lifting lug **118** including at least one slot **120** for facilitating anchoring and lifting of the tool deployment system **100**. The tool deployment system **100** further includes at least one handle **126** fixed on the tool holding structure **112**. The handle **126** is provided for supporting the ROV(s) in order to stabilize the tool deployment system **100** while hydraulically unlocking the tool **122** by mechanisms including but not limited to hydraulic means.

In accordance with the present disclosure, the tool deployment system **100** is used for transportation of tools **122** underwater. Generally, transportation of tools **122** is required during change-out intervention. The tool deployment system **100** in accordance with the present disclosure facilitates change out of the tools **122** in a single operation.

In one embodiment, at least one tool **122** is locked to the tool deployment system **100** by loading the tools **122** into the slots **114**. The pivotable peripheral plates **116** of the foldable base **102** are folded and locked to the support structures **108** by means of locking elements **124**, in order to form a space between the foldable base **102** and the platform **104**. The tool deployment system **100** is then deployed to subsea at a desired location by anchoring the tool deployment system **100** using a crane present on the deck from which the tool deployment system **100** is deployed into the sea. The crane is attached to the slot **120** of the lifting lug **118**, typically through a hook. The

openings 106 pass the water therethrough, thereby reducing the buoyant force which could have act on the foldable base 102 in absence of the openings 106. The space between the foldable base 102 and the platform 104 protects the platform 104 from the force exerted by water, thereby preventing it from any damage. The space between the foldable base 102 and the platform 104 also encloses an amount of water therein, thereby keeping the tool holding structure 112 in an operative vertical position with respect to the foldable base 102 during transportation of the tools 122 using the tool deployment system 100. The tool deployment system 100 is supported on the sea bed by using the foldable base 102 upon reaching the sea bed in the operation of transportation of the tools 122. Typically, the foldable base 102 may be bolted on the sea bed in order to stabilize the tool deployment system 100 on the sea bed. Once the tool deployment system 100 is stabilized on the sea bed, the tools 122 are unloaded from the tool holding structure 112 either for installation of the tools 122 or the replacement of the faulty tools by the tools 122. After installation or replacement of the tool 122, the hook of the crane may be attached to the slot 120 of the lifting lug 118 for lifting the tool deployment system 100 to the deck.

For example, retrieval of a faulty Mono Ethylene Glycol (MEG) filter and an injection valve is carried out by the tool deployment system 100 of the present disclosure as described herein below. The tool deployment system 100 is fitted with a pre-supplied Mono Ethylene Glycol (MEG) Filter inboard receptacle and an injection valve receptacle, on which the replacement MEG filter and the injection valve is respectively locked. Then the tool deployment system 100 is deployed to subsea using a crane at a target location for retrieval of the faulty MEG filter and the injection valve. The faulty MEG filter and injection valves are unlocked from the host structure and then locked to the tool deployment system 100. The replacement MEG filter and the injection valve are then unlocked from the the tool deployment system 100 and locked to the host structure, thereby completing the replacement on the host structure. After retrieval of the faulty MEG filter and the injection valve, the crane hook is connected to the tool deployment system 100 and the tool deployment system 100 is retrieved back to the deck.

In accordance with the present disclosure, the basket formed by the walls **110** and the platform **104** collects the tools **122** in case of inadvertently dropping of the tools **122** from the tool holding structure **112** during transportation of the tools **122**. Thus, the basket prevents damage and loss of the tools **122**, thereby preventing the wastage of time in tracing the tools **122** as in case in the absence of the basket. Further, the basket is provided to aid operation of ROV and allowing 360 degrees access with tooling at an acceptable depth within the basket. The basket is constructed by taking into consideration various factors such as stability, payload, dynamic amplification factors and loads exerted by a working class ROV with a large base. The basket is heavy and strong to bear loads during the operation and to bear shear loads during stationary position at sea bed.

The foldable base **102**, the platform **104**, the tool holding structure **112** and respective components thereof have pre-determined shape, size and material for manufacturing thereof depending upon the method of operation and application.

The above description is made with reference to subsea type of a fluidic environment. However, without departing from the scope of the present disclosure, the tool deployment system **100** may be employed in any other type of fluidic environment.

TECHNICAL ADVANCEMENTS AND ECONOMIC SIGNIFICANCE

The technical advantages of the system envisaged by the present disclosure include the realization of:

- a tool deployment system that prevents damage to a tool to be deployed;
- a tool deployment system that prevents loss of tools;
- a tool deployment systems that prevents wastage of time in tracing a tool dropped within a fluidic environment (such as on the sea bed);

- a tool deployment system that reduces operational time for retrieval of a tool;
and
- a tool deployment system that is cost effective.

Throughout this specification the word “comprise”, or variations such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

The use of the expression “at least” or “at least one” suggests the use of one or more elements or ingredients or quantities, as the use may be in the embodiment of the disclosure to achieve one or more of the desired objects or results.

The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the embodiments as described herein.

CLAIMS:

1. A tool deployment system installable within a fluidic environment for facilitating deployment of at least one tool, said tool deployment system comprising:
 - a foldable base;
 - a platform disposed operatively above and spaced apart from said foldable base by means of at least one support element; and
 - a tool holding structure disposed on said platform for facilitating deployment of the at least one tool thereon.
2. The tool deployment system as claimed in claim 1, wherein said foldable base comprises a base plate and a plurality of pivotable peripheral plates pivotably connected to the base plate.
3. The tool deployment system as claimed in claim 1, wherein said foldable base comprises a plurality of openings configured thereon, said plurality of openings adapted to reduce buoyant forces to which said foldable base is subjected to.
4. The tool deployment system as claimed in claim 2, wherein said plurality of pivotable peripheral plates of said foldable base is adapted to be folded to define a space between said foldable base and said platform.
5. The tool deployment system as claimed in claim 1, wherein said platform comprises a plurality of walls disposed along edges of said platform.
6. The tool deployment system as claimed in claim 1, wherein said tool holding structure is a central tower having at least one slot for facilitating deployment of said at least one tool thereon.
7. The tool deployment system as claimed in claim 1, wherein said at least one support element is at least one support pillar.

8. The tool deployment system as claimed in claim 1 and claim 2, wherein said plurality of pivotable peripheral plates of said foldable base are removably connected to said at least one support element.
9. The tool deployment system as claimed in claim 1, wherein said tool holding structure comprises a lifting lug having at least one slot adapted to facilitate anchoring and lifting of said tool deployment system.
10. The tool deployment system as claimed in claim 1, wherein said tool holding structure comprises at least one handle.
11. The tool deployment system as claimed in claim 1, wherein said tool holding structure is of carbon steel.

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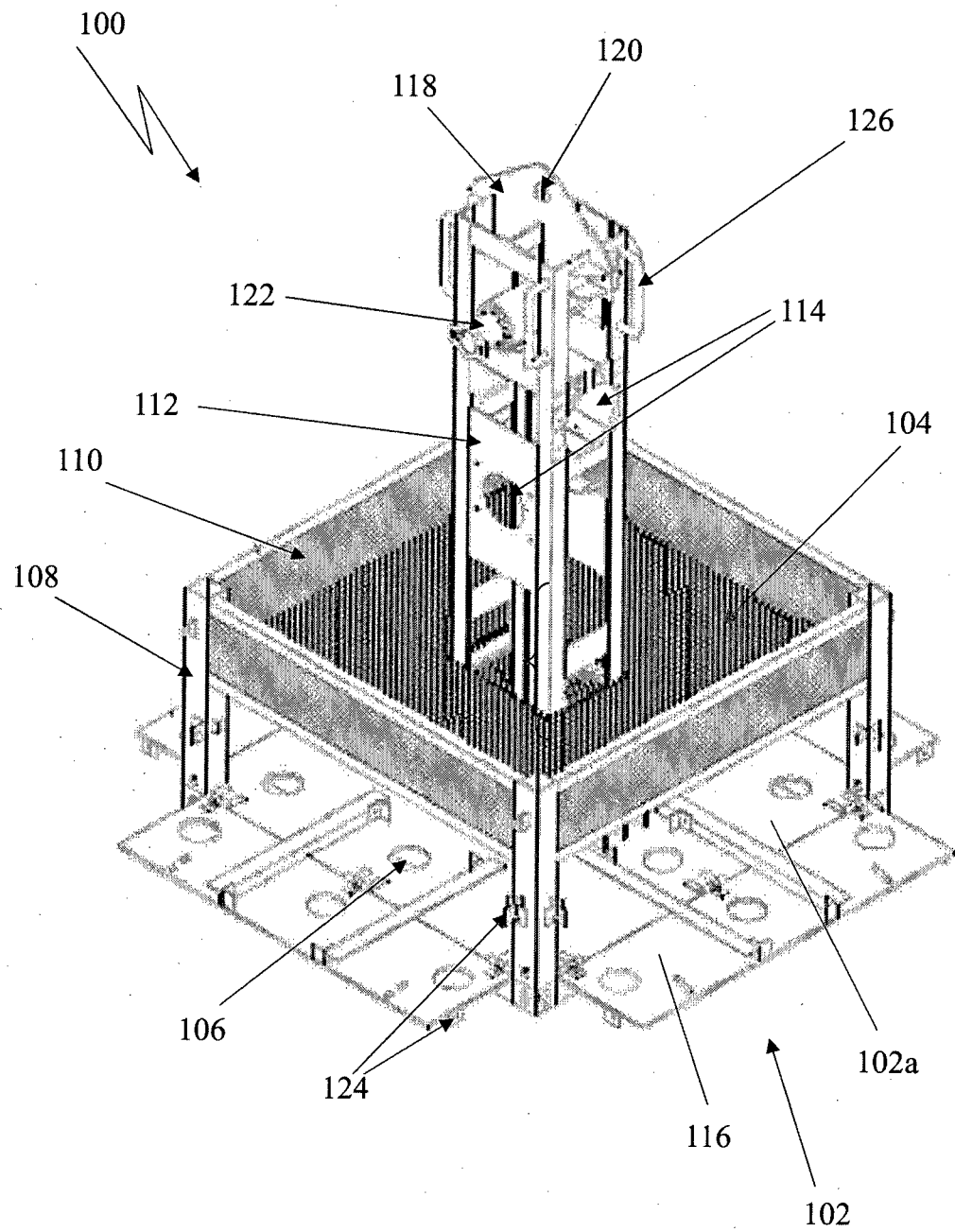


FIGURE 1

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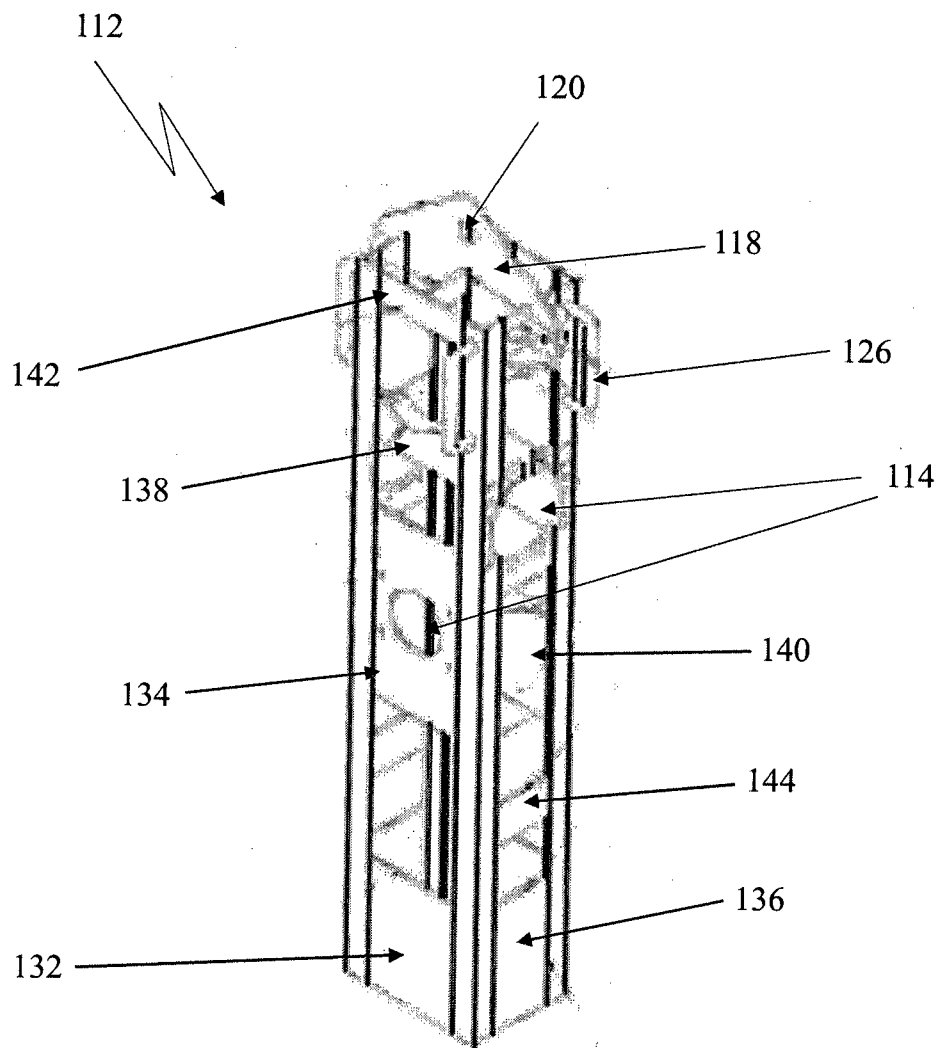


FIGURE 2

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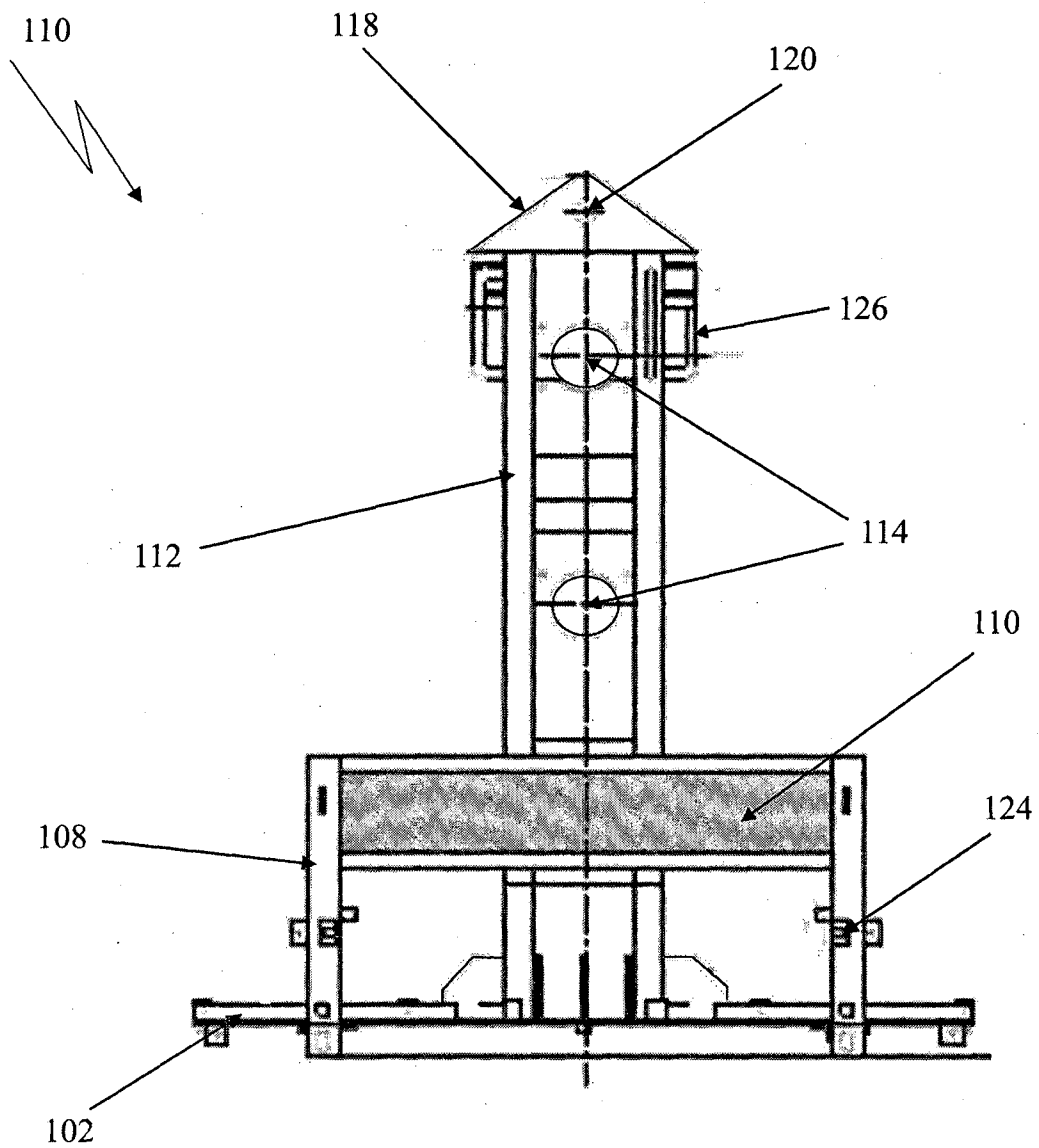


FIGURE 3

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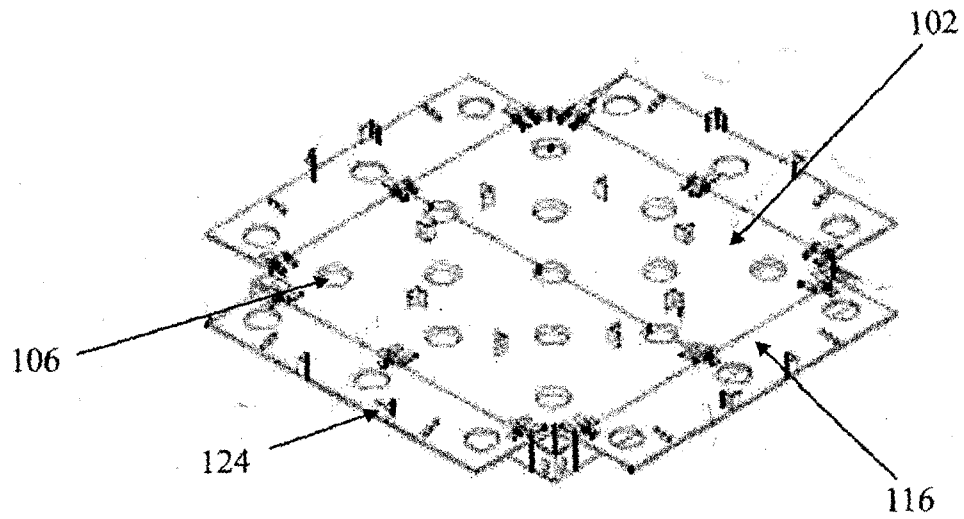


FIGURE 4

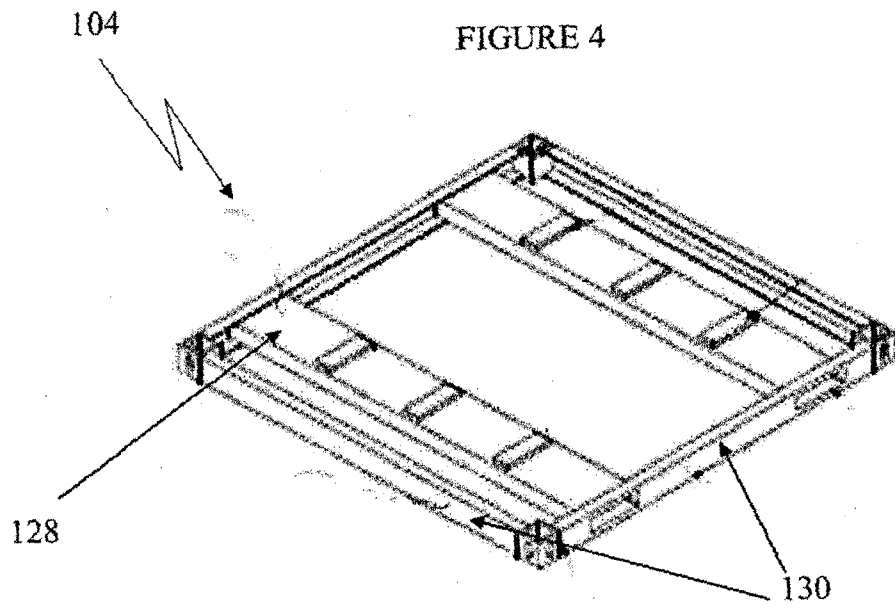


FIGURE 5

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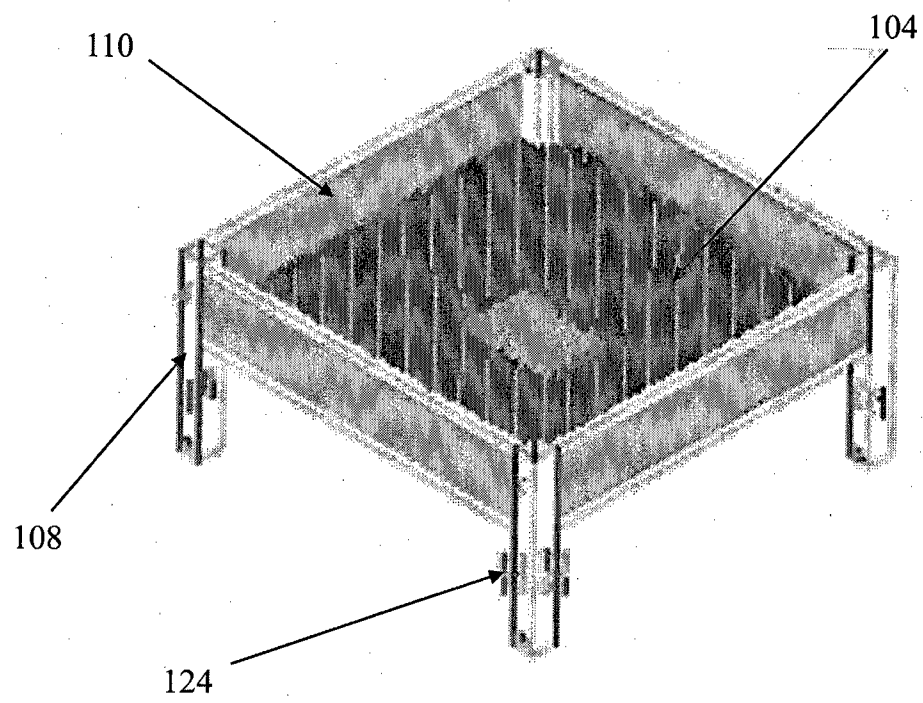


FIGURE 6