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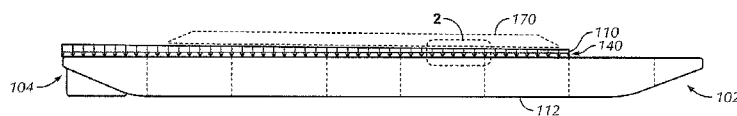


FIG. 1

(57) Abstract: A system comprising a floating vessel comprising a deck having a longitudinal axis and a lateral axis; a plurality of support structures in an array spaced along the longitudinal axis and the lateral axis; a plurality of lateral support members spanning a lateral distance between adjacent support structures; a plurality of longitudinal support members spanning a longitudinal distance between adjacent support structures; and a skid beam resting on the plurality of lateral support members and the plurality of longitudinal support members.



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SKID BEAM ASSEMBLY FOR LOADING AND TRANSPORTING LARGE STRUCTURES

Field of the Invention

5 The invention is directed to systems and methods for loading and transporting large structures over bodies of water.

Background of Invention

 U.S. Patent Number 4,864,957 discloses an apparatus for recovery and launch of secondary watercraft such as SALM bases, barges and the like onto and
10 from the deck of a host ship, comprising a pair of elongated inclined skid beam assemblies extending transversely across the host ship defining a pair of parallel skid paths spaced apart longitudinally of the ship, each skid beam assembly comprising a stationary skid beam section and a hinged skid beam section. The stationary skid beam section has a substantially rectilinear skid surface spanning a
15 major portion of the width of the ship's deck and extending in an inclined plane relative to the deck defining a wedge-like skid formation converging toward a side of the vessel for slidably supporting the secondary watercraft during launch and recovery thereof. A hinge block supports the hinged beam at an end of its associated stationary skid beam section adjacent a lateral margin of the deck for
20 swivel movement about a pivot axis lying in a vertical transverse plane and extending perpendicular to the inclined plane of the skid surfaces of the stationary and hinged beam sections. U.S. Patent Number 4,864,957 is herein incorporated by reference in its entirety.

 U.S. Patent Number 5,290,128 discloses a skidbase and a drilling structure
25 are adapted for transfer between a jack-up platform and a fixed platform. The jack-up platform is moved into position adjacent the fixed platform and raised to a height aligned with the fixed platform. The skidbase is then transferred onto the fixed platform to provide a base on which the drilling structure is next placed. The jack-up platform is raised to a vertical height aligned with the skidbase. To ensure
30 proper location of the top surface of the jack-up platform relative to the skidbase, a connection means automatically engages and aligns the jack-up platform with the skidbase so that skid rails located on the deck of the jack-up platform and on a top surface of the skidbase are positioned a precise distance apart and at the same

vertical height. The drilling structure is then skidded onto the skidbase so that drilling operations may be performed from the fixed platform. The connection means takes the form of a multi-dimension blade member affixed to the skidbase. The blade member progressively engages a series of guide members on the jack-up platform and, thereby, progressively and stagewise aligns the skidbase as the jack-up platform is moved to its desired vertical height. U.S. Patent Number 5,290,128 is herein incorporated by reference in its entirety.

U.S. Patent Number 5,388,930 discloses a method and apparatus for transporting and using a drilling apparatus or a construction crane apparatus from a single moveable vessel. Either a drilling apparatus or a construction crane apparatus is skidded onto the deck of a jack-up rig which is then floated to a remote location for use of the apparatus. The skidding of the construction crane apparatus is facilitated by a new and unique pony structure to raise the base of the construction crane apparatus above a skid on the jack-up rig. U.S. Patent Number 5,388,930 is herein incorporated by reference in its entirety.

U.S. Patent Number 7,350,475 discloses a method and apparatus for launching and recovering an object by a host vessel while the host vessel is in motion. The recovery system utilizes a tethered capture system for connecting with the object and then directing the object to the host vessel where it is secured. The tethered capture system includes one or more side planers that direct a capture cable away from the host vessel. The capture cable is preferably disposed below the waterline through the use of a diving rig or extended cable struts so that the cable does not foul the propeller of the object to be recovered. The side planer itself may include a ramped surface for loading the object prior to securing to the host vessel. After the capture, the object may be secured by way of a boom attached to the host vessel or by a lifting cradle that selectively extends aft of the host vessel. U.S. Patent Number 7,350,475 is herein incorporated by reference in its entirety.

Summary of Invention

One aspect of the invention provides a system comprising a floating vessel comprising a deck having a longitudinal axis and a lateral axis; a plurality of support structures in an array spaced along the longitudinal axis and the lateral axis; a plurality of lateral support members spanning a lateral distance between

adjacent support structures; a plurality of longitudinal support members spanning a longitudinal distance between adjacent support structures; and a skid beam resting on the plurality of lateral support members and the plurality of longitudinal support members.

5 Brief Description of Drawings

Figure 1 shows a perspective view of a transport vessel with a skid beam assembly in accordance with embodiments of the present disclosure.

Figure 2 shows a detail view of the skid beam assembly shown in Figure 1 in accordance with embodiments of the present disclosure.

10 Figure 3 shows a top view of the skid beam assembly shown in Figure 2 in accordance with embodiments of the present disclosure.

Figure 4 shows a top view of support structures shown in Figure 2 in accordance with embodiments of the present disclosure.

15 Figures 5-7 show cross-sectional views of the skid beam assembly and support structures shown in Figure 2 in accordance with embodiments of the present disclosure.

Detailed Description of the Drawings

20 In one aspect, embodiments disclosed herein relate generally to apparatuses and methods for loading and transporting large structures over bodies of water. Specifically, embodiments disclosed herein relate to a structure that may be disposed on a transport vessel, such as a barge, that enables larger structures to be transported on the transport vessel.

25 A large structure, such as an oil platform or an oil rig, may be used to house machinery and/or workers used within the oil and gas industry to drill and/or extract oil and gas (*i.e.*, hydrocarbons) through wells formed in the ocean bed. This platform or oil rig, depending on the environment and circumstances at the location of the hydrocarbons, may be attached to the ocean floor, may be formed as an artificial island, or may be floating at a desired location.

30 Offshore structures may be located on the continental shelf, though improvements in technology have enabled drilling and production of hydrocarbons in deeper waters and environments to be both feasible and profitable. A typical offshore structure may then include around thirty wellheads located about the platform, in which directional drilling enables reservoirs to be accessed at both

different depths and positions up to 10 kilometers away from the structure. Offshore structures may be of various types, including fixed platforms, semi-submersibles, jack-ups, floating production systems ("FPSO's"), tension leg platforms, SPAR platforms, and others known to those skilled in the art.

5 In an offshore oil platform, the "topsides" of the platform may generally refer to the surface hardware installed above the water. This may include an oil production plant, workers' housing quarters, a drilling rig and other drilling equipment, and any other equipment known to those skilled in the art. Topsides may be modular in design, in which the topsides may be rearranged to enable
10 expensive platforms to be readily updated with newer or different technology. Typical topsides may range in size, such as from about 6,000 short tons to about 10,000 short tons (5440 metric tons to 9070 metric tons), depending on the size and needs of the project. As such, large transport vessels, typically barges, may be used to transport the topsides from a construction yard on land to the desired
15 offshore site. These topsides may then be transported in a single unit, or the topsides may be divided into portions for transport.

As oil exploration and production moves to deeper waters, though, larger structures such as oil platforms and topsides may be required. Typically, a larger barge that provides more buoyancy for loadout and additional stability during
20 transportation is used to transport the larger topsides. In turn, this may limit the barges that may be used for transport, as there may only be a select few barges that are large enough to handle the larger topsides. Other alternatives to accommodate larger loads have included sponsons or other buoyancy devices attached to the transport vessel. Accordingly, there exists a need to outfit a
25 normal sized barge to handle larger topsides and/or other equipment for transport to offshore sites.

Figures 1 & 2:

Referring now to Figures 1 and 2, multiple side views of a transport vessel
100 having a skid beam assembly 110 disposed thereon in accordance with
30 embodiments of the present disclosure is shown. Figure 1 shows a perspective side view of the transport vessel 100 with the skid beam assembly 110, whereas Figure 2 shows a detail side view of a portion of the skid beam assembly 110.

The transport vessel 100 may include, for example, a barge or ship, on which the skid beam assembly 110 may then be placed and/or assembled to the deck of the transport vessel 100. As shown, in one embodiment, rather than having the skid beam assembly 110 placed directly upon the deck of the transport vessel 100, one or more support structures 140 may be placed on the deck of the transport vessel 100. The skid beam assembly 110 may then be placed on top of the support structures 140. Because the deck of the transport vessel 100 may not be substantially flat and/or level, each of the support structures 140 may be individually adjusted, such as shimming the support structures 140. The support structures 140 may be adjusted to form a substantially flat and/or level surface to dispose the skid beam assembly 110 thereon. Otherwise, any non-level surfaces of the transport vessel 100 may affect the orientation of the skid beam assembly 110.

Further, as shown, the skid beam assembly 110 is tapered, for example, longitudinally (from bow 102 to stern 104) along the length of the assembly 110. The taper of the skid beam assembly 110 may be such that the height of the skid beam assembly 110 at the stern 104 of the transport vessel 100 is higher than the height of the skid beam assembly 110 at the bow 102 of the transport vessel 100. By including a taper on the skid beam assembly 110, the transport vessel 100 may have a lowered vertical center-of-gravity. For example, the skid beam assembly 110 may still be high enough at the stern 104 for loading and unloading the transport vessel 100, but may then also be lower in height at other portions of the transport vessel 100 to lower the vertical center-of-gravity of the skid beam assembly 110 and the transport vessel 100. By lowering the center-of-gravity, the transport vessel 100 may be more stable at transport and, therefore, sustain larger loads.

The taper of the skid beam assembly 110 may range from about 0.5 degrees to about 1.5 degrees, depending on the size of the topside to be disposed upon the skid beam assembly. Specifically, the upper surface of the skid beam assembly 110 may be disposed at an angle between about 0.5 degrees and 1.5 degrees with respect to the lower surface of the skid beam assembly 110. More particularly, the upper surface of the skid beam assembly 110 may be disposed at an angle of about 0.6 degrees to about 1 degrees with respect to the lower surface

of the skid beam assembly 110. However, those having ordinary skill in the art will appreciate that the present disclosure is not so limited, and in other embodiments, the taper of the skid beam assembly may be disposed at an angle outside of the above described range. For example, in other embodiments, the taper of the skid beam assembly may be disposed at an angle between about 0.1 degrees and about 3.0 degrees.

Further, the skid beam assembly 110 may be formed as one large structure, or may instead be formed in multiple portions assembled together. As shown, particularly in Figure 2, the skid beam assembly 110 may be formed as multiple portions 110A, 110B, in which each of the portions 110A, 110B may then be disposed on top of the support structures 140. If preferred, though not required, the skid beam assembly 110 may then be fixed to the support structures 140, for example, by welding or using mechanical fasteners, and/or the skid beam assembly portions 110A, 110B may be fixed to each other.

Figures 3 & 4:

Referring now to Figures 3 and 4, multiple top perspective views of the skid beam assembly portion 110A and the support structures 140 in accordance with embodiments of the present disclosure are shown. Specifically, Figure 3 shows a top perspective view of the skid beam assembly portion 110A, and Figure 4 shows a top perspective view of the support structures 140 that support the skid beam assembly portion 110A.

As shown, the skid beam assembly portion 110A includes multiple beams 112 that run longitudinally when placed upon the transport vessel. These beams 112 of the skid beam assembly 110A may be intersected and supported by other support members 114 that run laterally (side-to-side across the transport vessel) when placed upon the transport vessel. The support members 114 are rigidly attached to the beams 112, such as by welding, adhering, or mechanically fastening the support members 114 to the beams 112, such that the support members 114 may then distribute weight and forces evenly across the skid beam assembly portion 110A.

Further, as discussed above, support structures 140 may be placed upon the deck of the transport vessel to support the skid beam assembly 110 and portions thereof. The support structures 140 may all be formed and/or configured

substantially the same, if desired. However, as shown in Figure 4, the shape and size of the support structures 140 may vary, such as depending on the location of the support structure 140 with respect to the skid beam assembly 110.

Each of the support structures 140 includes a frame 142, in which base members 144 are attached to the frame 142. The frames 142 may be formed in varying shapes and sizes, for example, a trapezoidal shape, a triangular shape, and a pyramidal shape. Example designs are described more below with reference to Figures 5-7. The base members 144 are attached to a bottom of each of the frames 142, in which the base members 144 provide support for the support members 140 in the longitudinal direction, and the frames 142 provide support for the support members 140 in the lateral direction. As such, for additional support, those having ordinary skill in the art will appreciate that each support structure 140 may include one or more frames 142 and/or one or more base members 144.

Further, as discussed above, depending on the location of the support structure 140 with respect to the skid beam assembly 110, the shape and size of the support structures 140 may vary. Because support structures 140A, 140F have larger frames 142, these support structures 140A, 140F may be placed underneath ends **A**, **F** of the skid beam assembly portion 110A to provide the most support to the skid beam assembly portion 110A. Support structures 140C, 140D, which have additional base members 144 attached thereto, may then be placed underneath central locations **C**, **D** of the skid beam assembly portion 110A to provide support to the skid beam assembly portion 110A in the longitudinal direction. Support structures 140B, 140E may be placed underneath locations **B**, **E** of the skid beam assembly portion 110A to provide any additional support necessary for the skid beam assembly. One having ordinary skill in the art will appreciate that various configurations of support structures may be used at various locations along the skid beam assembly based on the load to be supported by the skid beam assembly without departing from the scope of the present disclosure.

Figures 5-7:

Referring now to Figures 5-7, multiple cross-sectional views of the skid beam assembly portion 110A with the support assemblies 140 in accordance with embodiments of the present disclosure are shown. Specifically, Figure 5 shows a

cross-sectional view of the skid beam assembly portion 110A with support assembly 140 taken across the cross-section **A-A** in Figure 2, Figure 6 shows a cross-sectional view of the skid beam assembly portion 110A with support assembly 140 taken across the cross-section **B-B** in Figure 2, and Figure 7 shows a cross-sectional view of the skid beam assembly portion 110A taken across the cross-section **C-C** in Figure 2.

As shown in Figure 5-7, the skid beam assembly portion 110A includes multiple beams 112 that run longitudinally in length and support members 114 that intersect the beams 112 for support. As such, these support members 114 may intersect the tops of the beams 112, as shown, or at other locations upon the support members 114, when providing support. Further, the support members 114 may include a raised edge 116 formed at one or more of the ends thereof. This raised edge 116 may provide support to prevent any movement of the topside when loaded on top of the skid beam assembly.

Further, as shown, the support structures 140 each include a frame 142 and base members 144 attached thereto. Specifically, in Figure 5, the support structure 140 includes two base members 144 attached thereto, and in Figure 6, the support structure 140 includes three base members 144 attached thereto. As such, the support structures 140 may have one or more base members 144 attached thereto to help brace the support structures 140. Also, the frame 142 is shown having a trapezoidal shape to support the skid beam assembly 110A. However, as discussed above, those having ordinary skill in the art will appreciate that the present disclosure is not so limited, and other shapes, such as a rectangular shape or a triangular shape, may be used without departing from the scope of the present disclosure.

The skid beam assembly and the support structures may be fabricated in a shipyard and custom manufactured to transport particular topsides offshore. The skid beam assembly and the support structures may be constructed of metal mainly, such as steel, with fabrication techniques, such as welding or bolting, which are known in the art. The skid beam assembly and the support structures may also be coated with corrosion resistant coatings to withstand the offshore environment and/or to protect the integrity of the welds.

Furthermore, referring back to Figure 1, the skid beam assembly 140 may be used with a skid shoe 170 when loading and transporting large structures, such as topsides. For example, the skid shoe 170 may be attached to the top side, in which the skid shoe 170 would facilitate the loadout of the topside upon the transport vessel 100. An example of a skid shoe 170 is discussed in greater detail in co-pending application 61/153,332 (Attorney Docket No. TH3495), and is incorporated herein in its entirety.

Advantageously, embodiments of the present disclosure may provide for a transport vessel that is capable of transporting topsides that may otherwise have been too large for the capacity of the transport vessel. Due to the lowered vertical center-of-gravity and the increased buoyancy, the transport vessel may be able to sustain more weight while maintaining stability. Additionally, embodiments disclosed herein may allow some transport vessels to transport larger loads, thereby not requiring the need for other larger vessels.

Illustrative Embodiments:

In one embodiment, there is disclosed a system comprising a floating vessel comprising a deck having a longitudinal axis and a lateral axis; a plurality of support structures in an array spaced along the longitudinal axis and the lateral axis; a plurality of lateral support members spanning a lateral distance between adjacent support structures; a plurality of longitudinal support members spanning a longitudinal distance between adjacent support structures; and a skid beam resting on the plurality of lateral support members and the plurality of longitudinal support members. In some embodiments, the skid beam is inclined at an angle from 0.1 to 3 degrees relative to the floating vessel deck along the longitudinal axis. In some embodiments, the skid beam is inclined at an angle from 0.5 to 1.5 degrees relative to the floating vessel deck along the longitudinal axis. In some embodiments, the skid beam further comprises a raised edge along at least one of its sides. In some embodiments, the system also includes a connection between a lateral support member and a longitudinal support member, the connection selected from the group consisting of bolts and welds. In some embodiments, the support structures comprise from 2 to 3 base members. In some embodiments, the support structures comprise a trapezoidal frame shape. In some embodiments, the system also includes a skid shoe resting on the skid beam. In

some embodiments, the system also includes an offshore structure resting on the skid beam, the offshore structure comprising a topsides structure. In some embodiments, the array comprises from 3 to 10 support structures spaced along the longitudinal axis. In some embodiments, the array comprises from 4 to 8
5 support structures spaced along the longitudinal axis. In some embodiments, the array comprises from 2 to 6 support structures spaced along the lateral axis. In some embodiments, the array comprises from 3 to 5 support structures spaced along the lateral axis. In some embodiments, the skid beam comprises a plurality of sections connected to each other at a lateral beam. In some embodiments, the
10 skid beam comprises a plurality of sections connected to each other at a longitudinal beam.

While the present disclosure has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments may be devised which do not depart from
15 the scope of the disclosure as described herein. Accordingly, the scope of the disclosure should be limited only by the attached claims.

C L A I M S

1. A system comprising:
 - a floating vessel comprising a deck having a longitudinal axis and a lateral
 - 5 axis;
 - a plurality of support structures in an array spaced along the longitudinal axis and the lateral axis;
 - a plurality of lateral support members spanning a lateral distance between adjacent support structures;
 - 10 a plurality of longitudinal support members spanning a longitudinal distance between adjacent support structures; and
 - a skid beam resting on the plurality of lateral support members and the plurality of longitudinal support members.
- 15 2. The system of claim 1, wherein the skid beam is inclined at an angle from 0.1 to 3 degrees relative to the floating vessel deck along the longitudinal axis.
3. The system of one or more of claims 1-2, wherein the skid beam is inclined at an angle from 0.5 to 1.5 degrees relative to the floating vessel deck along the
- 20 longitudinal axis.
4. The system of one or more of claims 1-2, wherein the skid beam further comprises a raised edge along at least one of its sides.
- 25 5. The system of one or more of claims 1-4, further comprising a connection between a lateral support member and a longitudinal support member, the connection selected from the group consisting of bolts and welds.
6. The system of one or more of claims 1-5, wherein the support structures
- 30 comprise from 2 to 3 base members.
7. The system of one or more of claims 1-6, wherein the support structures comprise a trapezoidal frame shape.

8. The system of one or more of claims 1-7, further comprising a skid shoe resting on the skid beam.

5 9. The system of one or more of claims 1-8, further comprising an offshore structure resting on the skid beam, the offshore structure comprising a topsides structure.

10 10. The system of one or more of claims 1-9, wherein the array comprises from 3 to 10 support structures spaced along the longitudinal axis.

11. The system of one or more of claims 1-10, wherein the array comprises from 4 to 8 support structures spaced along the longitudinal axis.

15 12. The system of one or more of claims 1-11, wherein the array comprises from 2 to 6 support structures spaced along the lateral axis.

20 13. The system of one or more of claims 1-12, wherein the array comprises from 3 to 5 support structures spaced along the lateral axis.

14. The system of one or more of claims 1-13, wherein the skid beam comprises a plurality of sections connected to each other at a lateral beam.

25 15. The system of one or more of claims 1-14, wherein the skid beam comprises a plurality of sections connected to each other at a longitudinal beam.

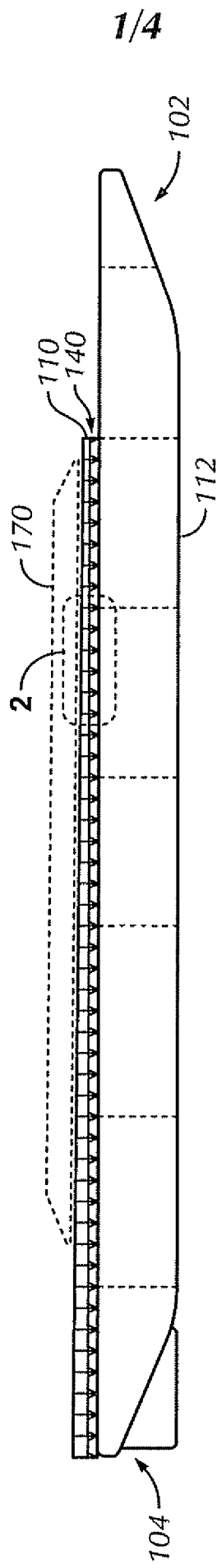


FIG. 1

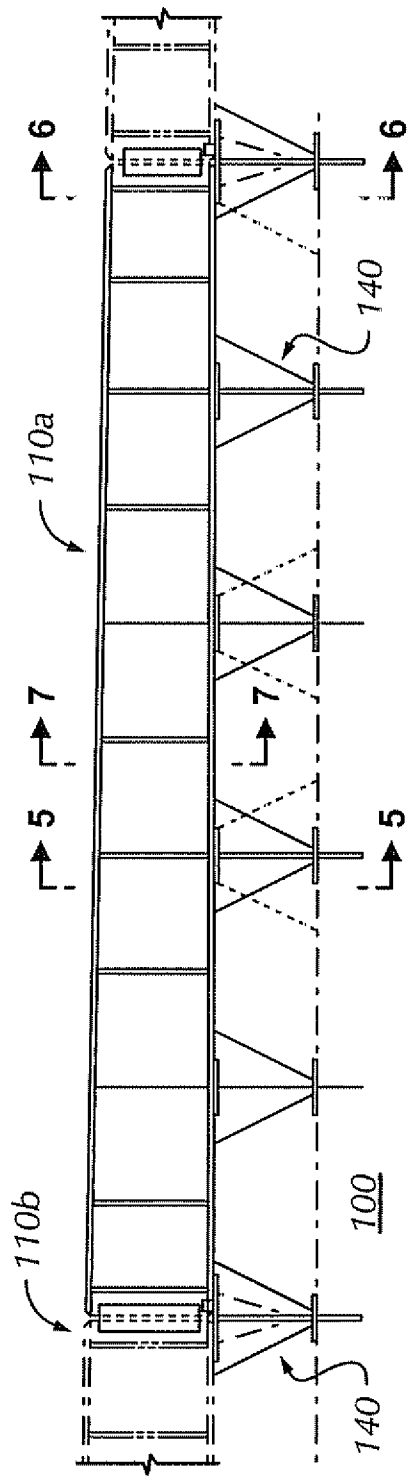


FIG. 2

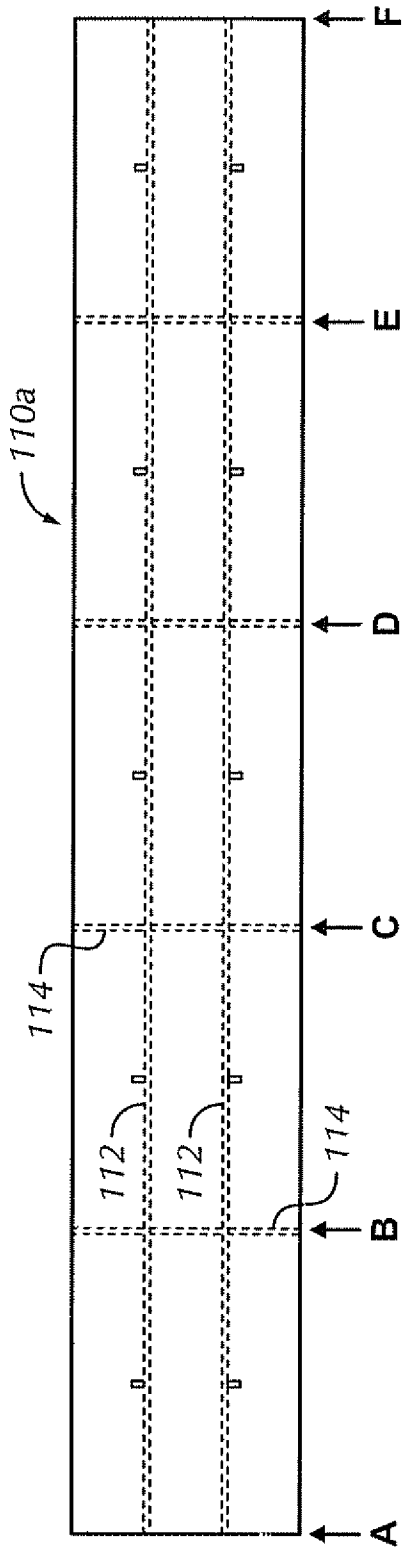


FIG. 3

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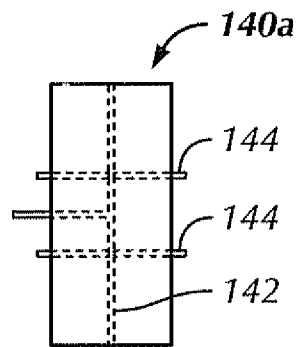


FIG. 4A

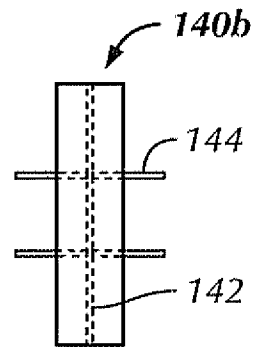


FIG. 4B

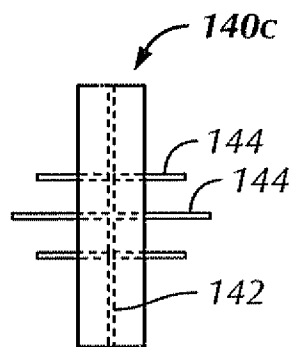


FIG. 4C

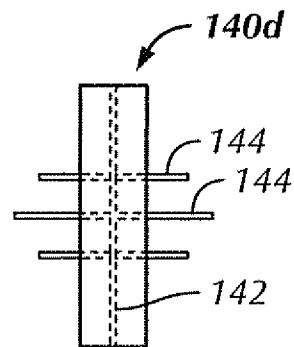


FIG. 4D

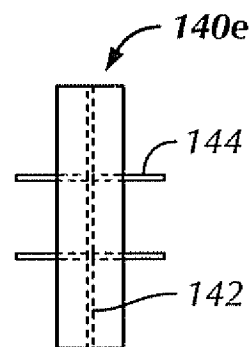


FIG. 4E

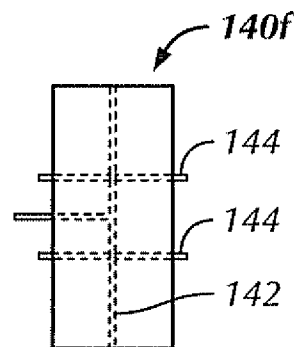
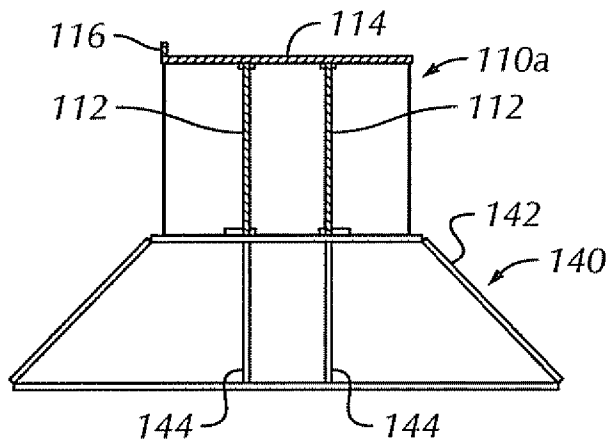
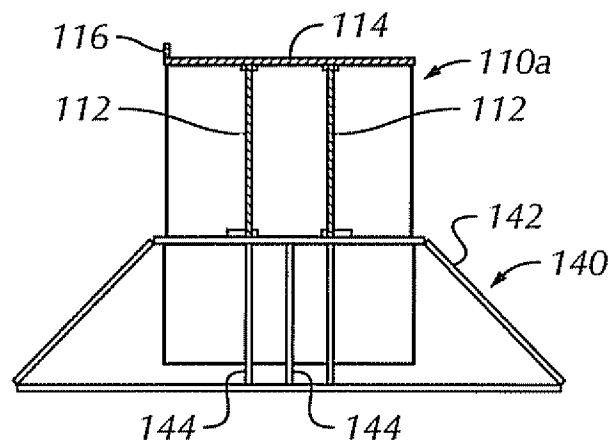
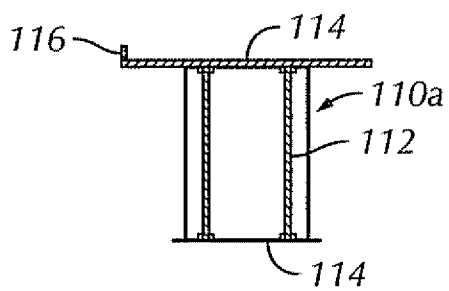


FIG. 4F

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**FIG. 5****FIG. 6****FIG. 7**