

(12) **Patent Application Publication**
Rawles, II et al.

(43) **Pub. Date:** **Aug. 25, 2011**

Publication Classification

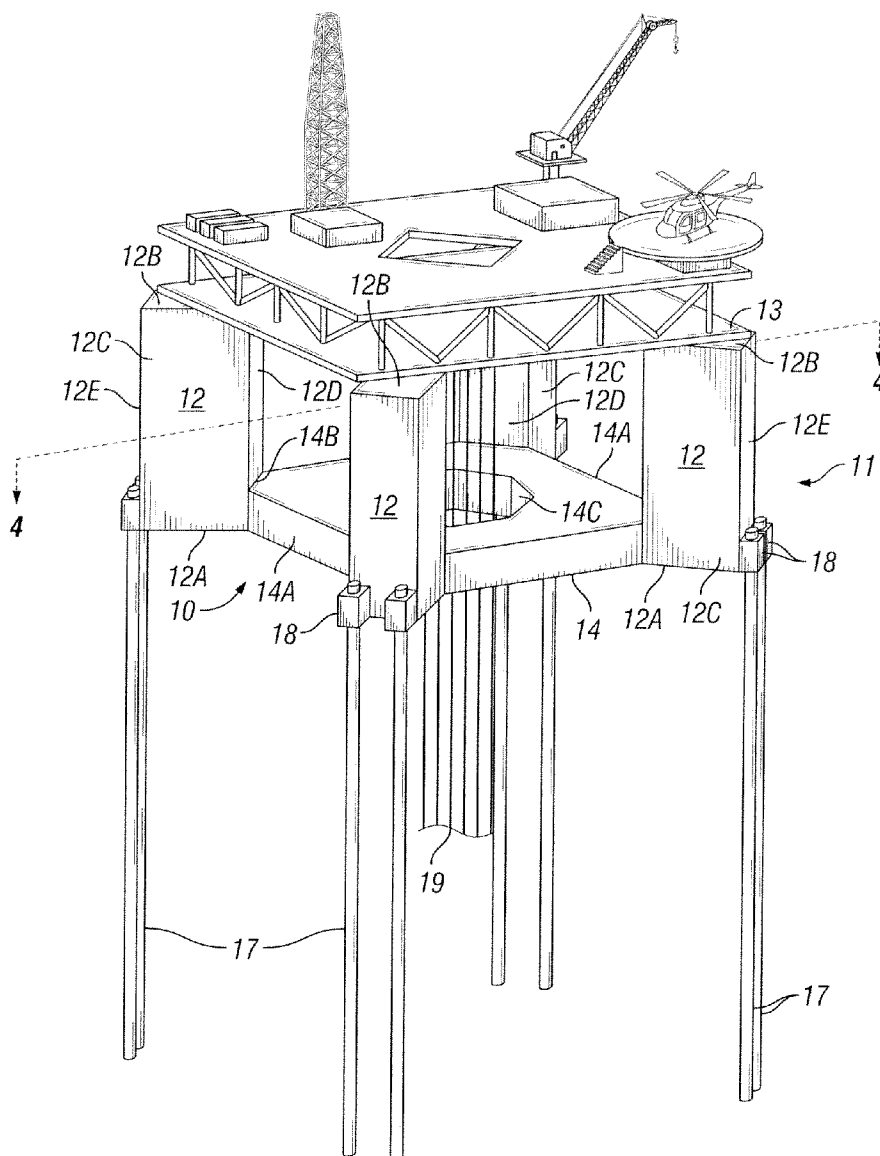
(2006.01)

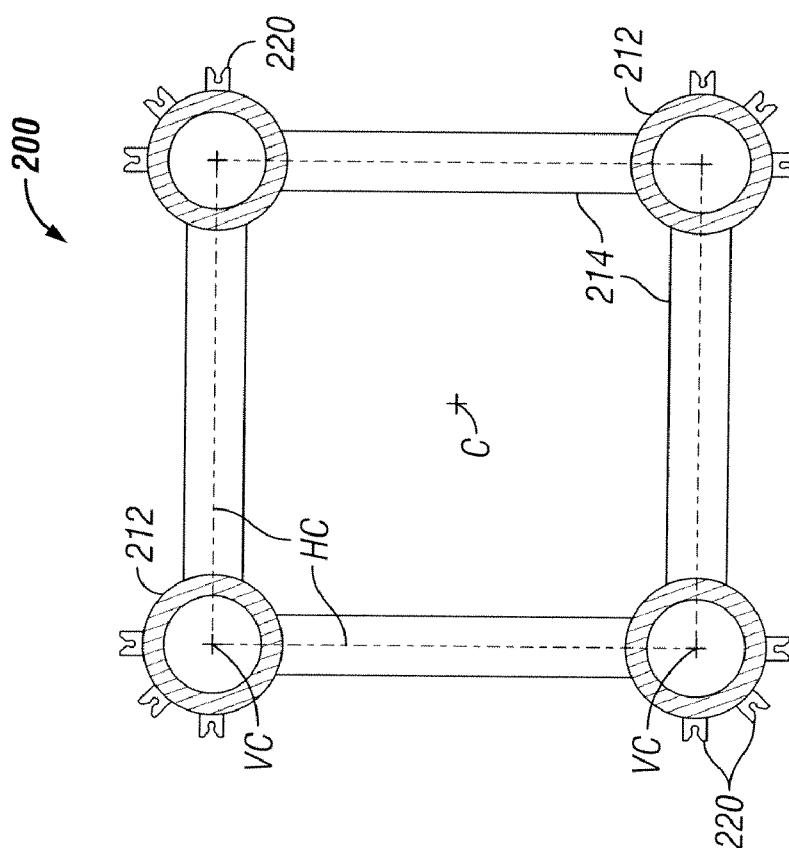
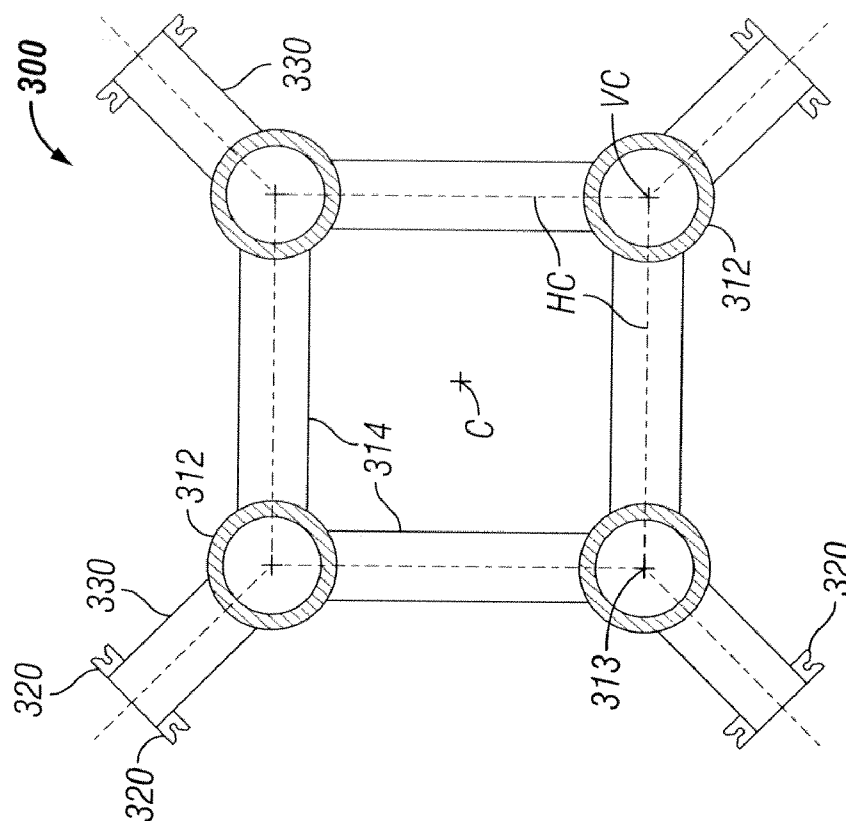
(52) **U.S. Cl.** 405/223.1

(57) **ABSTRACT**

(22) Filed: **Feb. 25, 2010**

A tension leg platform that is stable with a quayside-integrated deck without the use of temporary stability modules or specialized installation techniques. The hull preferably consists of four radially-oriented vertical corner columns connected with four central ring pontoon segments. The vertical columns are fixed to the outer periphery of the central pontoon. The columns are characterized by a major radial axis and a minor transverse axis. The mooring system includes tendons supported at tendon porches directly at the four column outboard lower corners, without additional radially-extending tendon support structures.





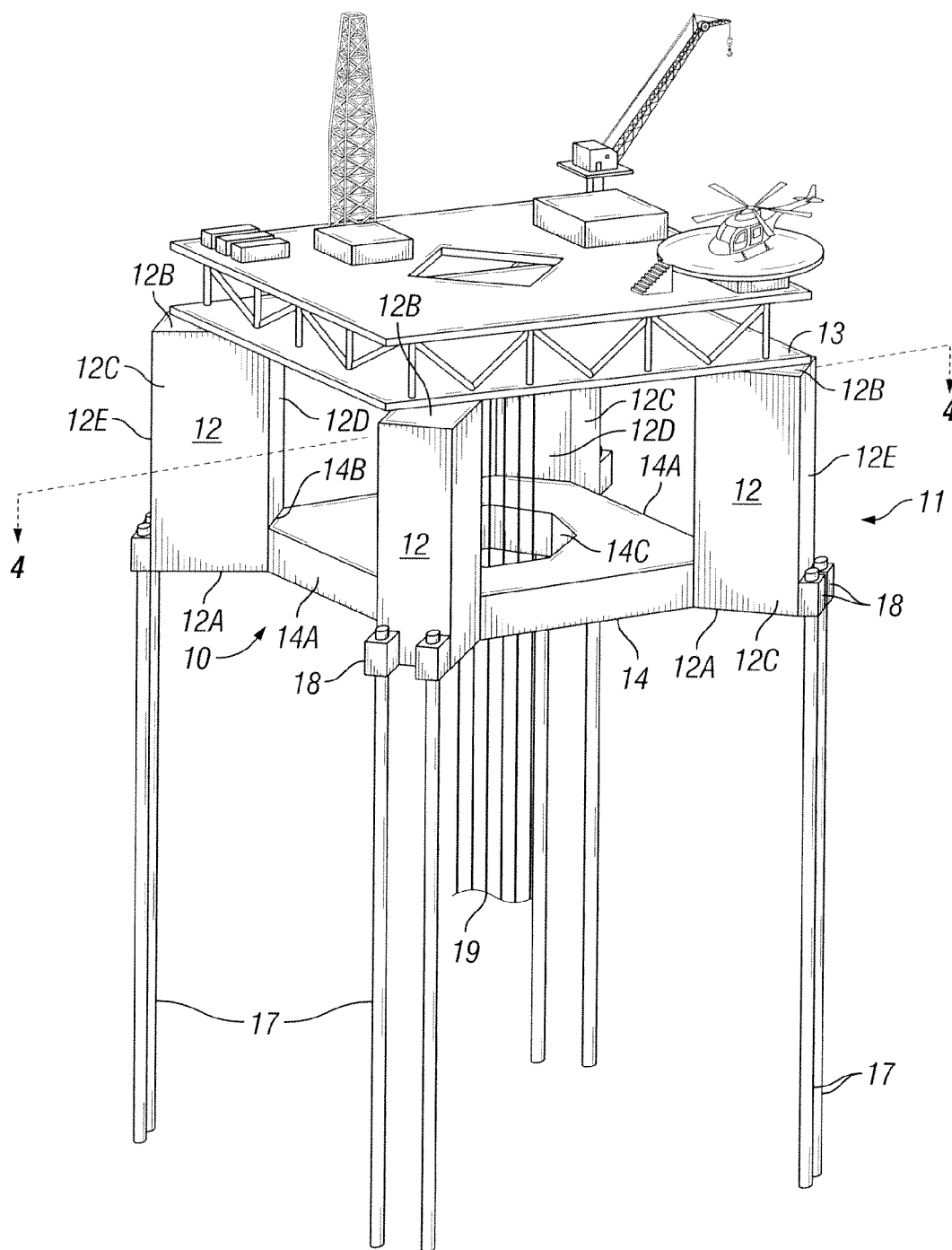


FIG. 3

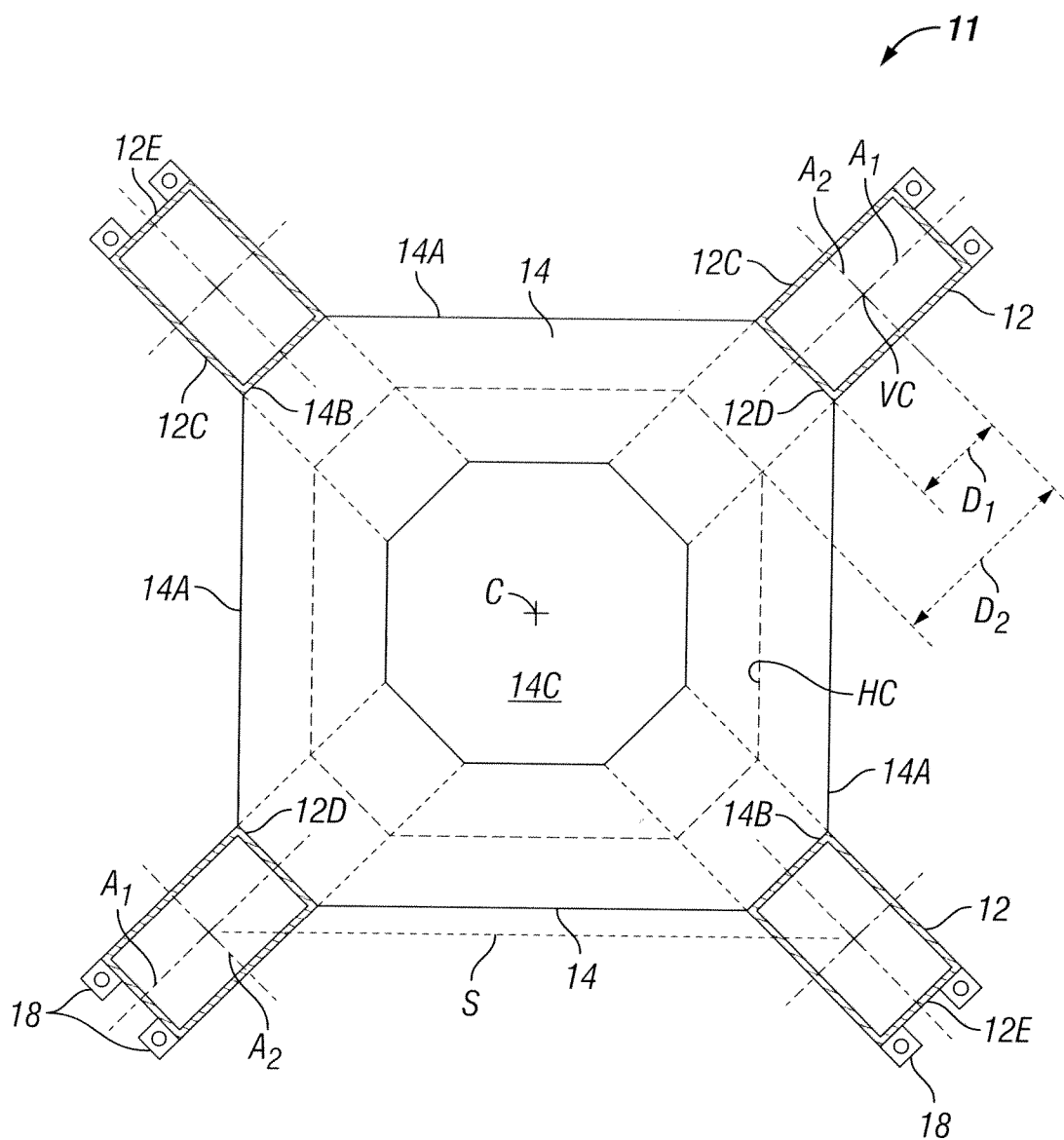


FIG. 4

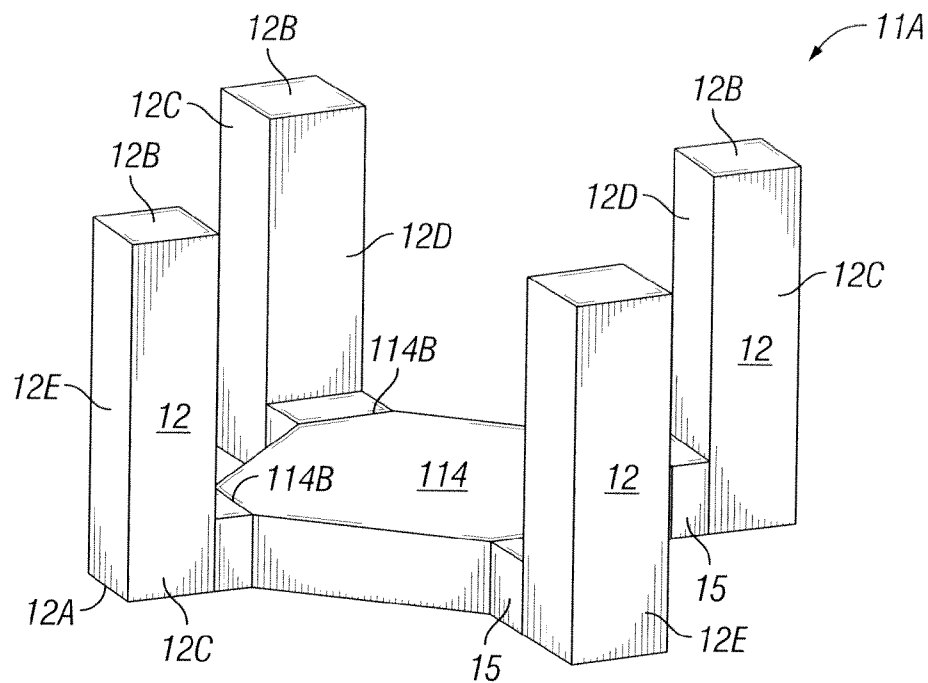


FIG. 5

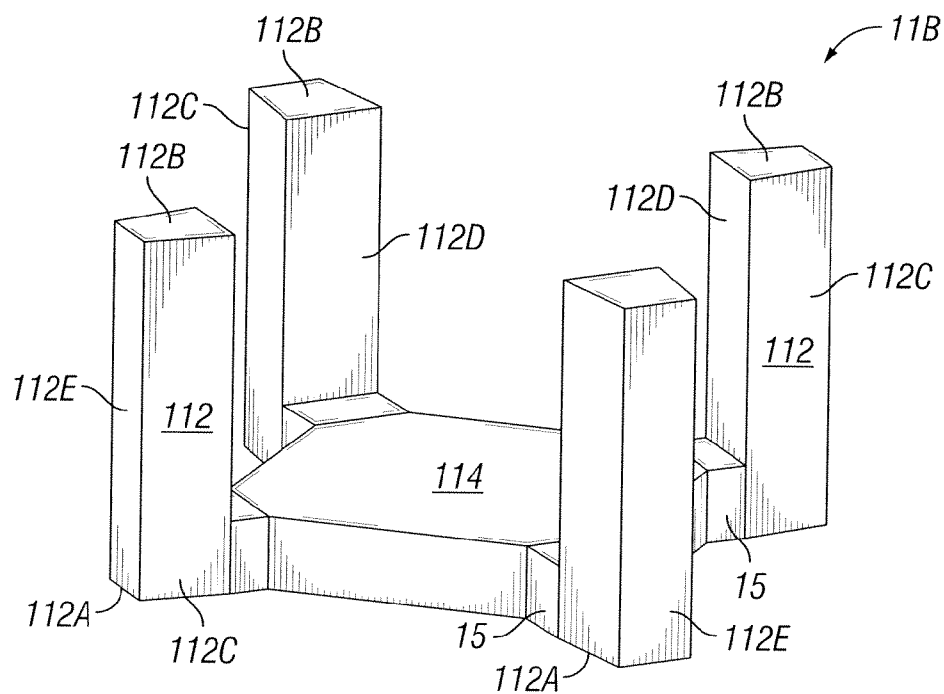


FIG. 6

TENSION LEG PLATFORM WITH IMPROVED HYDRODYNAMIC PERFORMANCE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates generally to tension leg platforms, such as for offshore oil and gas drilling and production, and more particularly to a tension leg platform that has ample inherent stability so as to allow for quayside integration of the superstructure, towing of the integrated hull and topsides to the installation site, and installation, all without the use of temporary stability modules or other specialized equipment.

[0003] 2. Background Art

[0004] In the offshore oil and gas industry, floating vessels such as tension leg platforms (TLPs) for drilling and/or production are common. A TLP is a type of floating platform that is used for drilling and production in relatively deep water. A typical TLP hull configuration consists of one, three, or four vertical columns, and three or four pontoons, which connect the columns below the water surface. The columns and pontoons are typically rectangular or cylindrical in cross section. Carried on top of the columns is the superstructure, which includes one or more decks that support the topsides production facilities, drilling system, production risers, and living quarters, etc. At its installed draft, the TLP's pontoons are submerged and the columns extend from below to above the water's surface.

[0005] The mooring system of a TLP includes tubular steel members called tendons (also referred to as tethers) which are highly tensioned because they are connected to a buoyant, submerged or partially submerged platform hull. High tendon stiffness reduces the system's vertical natural periods to a level well below that of the dominant wave energy. As a result, dynamic amplification of vertical motion is nearly non-existent and the platform has limited heave, roll and pitch motions. The highly tensioned tendon system also limits horizontal offsets to a very small percent of water depth.

[0006] FIG. 1 is a top view (in a horizontal cross-section taken through the columns) of the hull of a conventional TLP 200 of prior art. Four columns 212 are arranged to form a square pattern, with the axial centerline VC of each column 212 forming one corner of the square. Four individual pontoons 214 form each side of the square. Pontoons 214 are typically positioned so that their axial centerlines HC are aligned between column centerlines VC. Tendon porches 220 are mounted directly to the outboard corners of columns 212 for connecting the mooring tendons.

[0007] FIG. 2 is a top view (in a horizontal cross-section taken through the columns) of a newer generation TLP 300 of prior art, known as an extended tension leg platform (ETLP). Like the prior art TLP 200 of FIG. 1, in the ETLP 300 of FIG. 2, the corner columns 312 are located such that the vertical centerlines VC of the columns 312 intersect the axial centerlines HC of the pontoons 314 connected thereto. As compared to a conventional TLP 200 of FIG. 1, which has a mooring footprint of similar dimensions, the ETLP of FIG. 2 differs by positioning the columns 312 and pontoons 314 more inboard to form a smaller square. Four tendon support structures 330 are mounted to the outboard corners of columns 312 at keel level. Tendon porches 320 are mounted to the distal ends of tendon support structures 330 for connecting the mooring tendons.

[0008] Because the columns 312 are located closer to the platform center C, a simplified deck structure may be used resulting in greater structural weight efficiency than the TLP 200 of FIG. 1. The smaller ring-shaped pontoon structure 314 also contributes to a greater structural weight efficiency and simplifies construction, reduces support spans and cantilevers, and provides improved hydrodynamic performance of the platform. In other words, a greater payload can be supported for a given combined weight of the hull and superstructure. Furthermore, the ETLP 300 of FIG. 2, with its simplified superstructure, may allow for more economical topsides integration at quayside, or eliminate the need for heavy lift vessels or float-over deck installation.

[0009] For both the TLPs 200 and ETLPs 300, the interior of both the columns and the pontoons are typically compartmentalized by structural bulkheads for damage control, to strengthen the structure, to provide enclosed spaces for locating and storing various equipment (e.g., anchors, chains, propulsion mechanisms, etc.), for storage of liquids such as fuel water, and hydrocarbon products, and for ballasting.

[0010] Depending on its configuration, the stability of a TLP (conventional or extended) may be inadequate during installation. When a TLP is ballasted between the initial free floating draft (e.g. the wet-tow draft or float-off draft) and the lock-off draft (the draft at which securing the TLP to the tendons is initiated), there is a range of drafts at which the TLP stability is critical—the TLP may be unstable or only marginally stable prior to being locked-off to the tendons and de-ballasted.

[0011] There are a number of ways to address this stability problem when transiting the installation drafts before lock-off and de-ballasting. Most prior art installation techniques rely on using costly specialized installation equipment. For example, one option is to install the topsides deck offshore, after the hull is connected to the tendons. Offshore installation of the deck is an expensive and high risk operation, because it typically requires the use of heavy-lift vessels or float-over deck installation techniques. Moreover, it requires a relatively long window of good weather. Accordingly, it is generally preferable to integrate the superstructure quayside and tow the completed platform to the installation site, if possible.

[0012] Another method employs the use of an upward hook load to the integrated TLP by a larger installation-support vessel. A hook load has the advantage of being able to quickly tension the tendons after lock-off without waiting for the slow de-ballasting process. However, only a very limited number of vessels exist worldwide which are capable of providing the required hook load for a TLP of ordinary size.

[0013] Yet another method to increase stability during platform installation is to use temporary buoyancy modules to keep the hull from capsizing before it can be secured to its mooring tendons and subsequently de-ballasted. For example, U.S. Pat. No. 6,503,023, issued to Huang, et al. on Jan. 7, 2003, discloses an ETLP that employs temporary stability modules located outboard of columns above the tendon support structures. The Huang et al. method permits the TLP structure, including platform, deck and equipment to be constructed in an upright position, towed to an installation site, and installed by ballasting the structure or temporary stability modules. Because the Huang et al. arrangement increases the structure surface area at the waterline, which subjects the ETLP to greater wave action in the wave zone at

the sea surface, after the ETLP is locked off and de-ballasted, the temporary stability modules are preferably removed.

[0014] U.S. Pat. No. 5,551,802, issued to Wybro on Sep. 3, 1996, and U.S. Pat. No. 7,044,685, issued to Wybro et al. on May 16, 2006, disclose methods for installing a TLP in which hold-down or pull-down lines (or chains) are used at each corner of the TLP to prevent the TLP from capsizing prior to tendon lock-off. The hold-down or pull-down lines are fastened at their lower ends to the upper tips of the installed tendons. The lines pass through the tendon porches and then through ratcheting gripper members or winches located above the tendon porches. As the TLP draft increases for receiving the tendons into the tendon porches, the grippers or winches maintain tension in the lines, thus preventing the TLP from toppling to any one side.

[0015] As an alternative to these specialized installation techniques, TLPs can be designed to have inherent stability necessary for tow and installation. A combination of wider column spacing and/or larger columns or a design change that raises the metacentric height of the platform, such as lowering the center of mass, may be used to increase stability. For example, the conventional TLP configuration of FIG. 1 inherently has greater stability than the ETLP configuration of FIG. 2, all else being equal. As the design of any complex system requires trade-offs between competing requirements, the conventional TLP design of FIG. 1 gains greater stability than the ETLP design of FIG. 2 at the expense of sacrificing structural weight efficiency and hydrodynamic performance.

[0016] U.S. Patent Publication No. 2002/0090270 in the name of Malcolm et al. discloses a column-stabilized semi-submersible offshore platform. The Malcolm et al. platform employs a triangular ring-shaped pontoon structure that is located inboard of the three corner columns. Specifically, the longitudinal centerlines of the three pontoon members lie to the inside of the side of the triangle defined by locating the corners at the column vertical centerlines. However, as the pontoons are only located slightly inboard of the columns, the geometric triangle sides still pass through the pontoons but just to the outside of the pontoon centerlines.

[0017] U.S. Pat. No. 7,140,317, issued to Wybro et al., also discloses a semi-submersible platform with improved stability. The Wybro '317 platform employs four columns and a rectangular ring-shaped pontoon structure that is located inboard of the columns. That is, the sides of the square, defined by locating the four corners of the square at the vertical centerlines of the four columns, are located completely outside and outboard of the pontoons. Because the Wybro '317 pontoons are located inboard of the columns, the platform is characterized by simplified construction with reduced support spans and cantilevers and by improved hydrodynamic performance than if each pontoon was centered between its two end columns.

[0018] Each of the semi-submersible platforms described by Malcolm '270 and Wybro '317 is moored with a plurality of catenary mooring lines that extend radially about the outer periphery of the platform. For this reason, these platforms are not heave restrained, as is a TLP. It is desirable, therefore, to have a heave-restrained tension leg platform that employs a broader column spacing for enhanced stability, yet having a smaller pontoon structure that is located inboard of the columns for improved structural efficiency and hydrodynamic performance.

[0019] 3. Identification of Objects of the Invention

[0020] A primary object of the invention is to provide a tension leg platform for use in offshore applications, such as for offshore oil and gas drilling and production, having a hull with a plurality of columns and a central pontoon structure that is disposed inboard of the columns, which simplifies construction, reduces support spans and cantilevers, and provides improved hydrodynamic performance of the platform.

[0021] It is another object of the invention to provide a tension leg platform having a hull with radially oriented rectangular columns and a central pontoon structure disposed inboard of the columns which are formed substantially of flat plate construction, thus simplifying the construction of the structure.

[0022] Another object of the invention is to provide a tension leg platform having vertical columns of rectangular cross section that have major axis oriented radially outward from the center of the hull, which provide support for the deck and reduces the support spans and cantilevers of the deck structure required for deck support in conventional TLPs.

[0023] Another object of the invention is to provide a tension leg platform having a unitized central pontoon structure located inboard of the vertical columns that may have a central moonpool opening or may be completely enclosed, which improves the hydrodynamic performance of the platform as compared to conventional ring pontoon, is simpler construction, lighter in weight, and facilitates the support of steel catenary and flexible risers.

[0024] Another object of the invention is to provide a tension leg platform having a hull with radially oriented rectangular columns and a central pontoon structure with a moon pool, with the pontoon structure being disposed inboard of the columns, which allows the support of flexible risers on the inboard or the outboard side of the central pontoon structure.

SUMMARY OF THE INVENTION

[0025] The objects described above and other advantages and features of the invention are incorporated in a tension leg platform for use in offshore applications, such as for offshore oil and gas drilling and production, which has a hull configuration including vertical support columns, a central pontoon structure disposed inboard of the columns at a lower end thereof, and a deck structure supported at an upper end of the columns. The structure is anchored by vertical tension legs, connected at keel level to the outboard faces of the columns and extending vertically downward to the seabed. The vertical mooring tendons are connected by tendon porches, which are located directly on the columns without the use of extended tendon support structures.

[0026] The vertical columns and pontoon structure are preferably constructed substantially of flat plate. The vertical columns are adjoined to the outer periphery of the central pontoon and have a transverse cross sectional shape with a major axis oriented radially outward from a center point of the hull, and a central vertical axis disposed a distance outward from the pontoon outer periphery.

[0027] Risers can be supported on the inboard or outboard side of the pontoon and extended to the deck. The central pontoon and outboard column structure simplifies construc-

tion, reduces support spans and cantilevers, and provides improved hydrodynamic performance of the platform.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The invention is described in detail hereinafter on the basis of the embodiments represented in the accompanying figures, in which:

[0029] FIG. 1 is a plan view in cross section of a conventional TLP hull of prior art, showing pontoons disposed between and connecting vertical columns;

[0030] FIG. 2 is a plan view in cross section of an extended TLP (ETLP) hull of prior art, showing vertical columns having a closer lateral spacing therebetween (as compared to a conventional TLP hull of FIG. 1 having the same mooring footprint), pontoons disposed between and connecting the vertical columns, and tendon support structures extending radially outward from the columns;

[0031] FIG. 3 is a perspective view of the tension leg platform according to a preferred embodiment of the invention, showing vertical columns that are connected together by a ring-shaped pontoon, which is located inboard of the columns;

[0032] FIG. 4 is a plan view in cross section taken along lines 4-4 of FIG. 3 of the hull (columns and pontoons) of the tension leg platform of FIG. 3;

[0033] FIG. 5 is a perspective view of the hull (columns and pontoons) of a tension leg platform according to an alternative embodiment of the invention, wherein the central pontoon structure does not have a central opening and is located a greater distance inboard of the columns and adjoined to the columns by rectangular extensions; and

[0034] FIG. 6 is a perspective view of the hull (columns and pontoons) of a tension leg platform according to another alternative embodiment of the invention, which is similar to the embodiment of FIG. 5 except that the vertical columns have a generally trapezoidal transverse cross section with a wider inboard side wall and a narrower outboard side wall.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

[0035] U.S. Pat. No. 7,140,317, issued to Wybro et al. on Nov. 28, 2006 and entitled "Central Pontoon Semisubmersible Floating Platform," is incorporated herein by reference in its entirety.

[0036] FIGS. 3 and 4 show a tension leg platform 10 according to a preferred embodiment of the invention for use in offshore applications, such as for offshore oil and gas drilling and production. The platform 10 has a hull 11 including vertical support columns 12 and a central pontoon structure 14 disposed inboard of the columns at a lower end thereof. TLP 10 includes a deck structure 13 supported by the upper ends of the columns 12.

[0037] The interior of both the columns 12 and the pontoon structure 14 is preferably subdivided by structural bulkheads (not illustrated) to strengthen the structure, to provide enclosed spaces for locating and storing various equipment (e.g., anchors, chains, propulsion mechanisms, etc.), and to provide a plurality of separate tanks for purposes of ballasting the vessel and storing various fluids and other materials which may be required or desired during drilling or production by the well.

[0038] TLP 10 is anchored by a plurality of vertical or near vertical mooring tendons 17 that are connected to tendon

porches 18 on the lower end of the outboard face of the columns 12. Each column 12 is designed to mate with at least one, but usually two or more tendons 17. The tendon porches are positioned near the keel elevation and contain connection sleeves (not illustrated) to receive the upper tips of the tendons 17 and clamp thereto. The connection sleeves may be ring-shaped, requiring vertical entry of the tendons 17, or they may be slotted to allow side entry of the tendons 17.

[0039] Various types of risers 19 can be supported by the hull 11, including near-vertical top tensioned risers (TTR), flexible risers, or steel catenary risers (SCR). The flexible risers or steel catenary risers (SCRs) can be supported on the inboard or the outboard side of the central pontoon structure 14, and extended to the deck 13 by either a single span spool piece or by piping supported on the hull. The top tensioned risers (TTRs) can be supported on the deck 13, and can also be supported laterally at the pontoon elevation by riser keel joints (not illustrated).

[0040] Although any suitable shape may be used, the central pontoon structure 14 is preferably octagonal-shaped, having four orthogonally-oriented side segments 14a intervalled with four diagonally-oriented corner segments 14b that are connected to the pontoon structure 14 to form a unitized structure centered about the platform central vertical axis C. In the embodiment shown in FIGS. 3 and 4, the central pontoon structure 14 includes a central moonpool opening 14c, which is illustrated as an octagonal opening but may have any other suitable shape. Side and corner segments 14a, 14b are each preferably characterized by generally rectangular transverse cross section surrounding a central horizontal axis or horizontal centerline HC.

[0041] Each of the vertical columns 12 has a lower end 12a and an upper end 12b. The columns 12 preferably have a quadrilateral transverse (horizontal) cross-section, which may be a generally rectangular or trapezoidal-shaped configuration. FIGS. 3 and 4 show columns 12 as rectangular, having a transverse cross-sectional shape with a major axis A_1 oriented radially outward from a center point C of the hull 11. Specifically, columns 12 define a rectangular transverse cross section formed of two parallel spaced wider lateral side walls 12d connected to narrower inner and outer side walls, 12d, 12e, respectively. Thus, each vertical support column 12 defines a major axis A_1 extending between the inboard and outboard side walls, 12d, 12e, and a minor axis A_2 extending between the two lateral side walls 12c. Each vertical support column 12 defines a vertical longitudinal axis or vertical centerline VC at the intersection of major axis A_1 and minor axis A_2 . The major axis A_1 of each of the vertical support columns 12 is preferably oriented radially outward from the center C of the platform. A lower portion of inboard side wall 12d of each vertical support column 12 abuts and is joined to a respective diagonal corner segment 14b of the pontoon structure 14.

[0042] Vertical support columns 12 are disposed substantially outboard of the central pontoon structure 14. The vertical axis VC of each column 12 is disposed a distance D_1 outwardly from the outer periphery of corner segment 14b of the pontoon structure 14 and a distance D_2 outwardly from the central horizontal axis or horizontal centerline HC extending through the pontoon corner segment 14b. Thus, with the hull configuration of the present invention, the central pontoon structure 14 is positioned inboard of the vertical support columns 12, such that a line S defined between the vertical centerlines VC of two adjacent columns 12 lies outside the

horizontal centerline HC of the pontoon side segments and, more preferably, outside the outer periphery of the pontoon structure 14. This design feature differs from the prior art tension leg platform designs (such as illustrated in FIGS. 1 and 2), which typically have individual pontoons centered between the columns, with the vertical centerlines of the support columns intersecting the horizontal centerlines of the adjacent pontoons.

[0043] FIG. 5 illustrates the hull 11a of a TLP according to an alternative embodiment of the invention. As with TLP hull 11 of the embodiment of FIGS. 3 and 4, hull 11a has a central pontoon structure 114 located inboard of the columns 12, but unlike TLP 10 of FIGS. 3 and 4, the pontoon structure 114 of FIG. 5 excludes a central moonpool opening. Additionally, the outer periphery of the pontoon structure is spaced a greater distance radially inward from the vertical support columns 12, (i.e., the pontoon 114 outer periphery is closer to the platform centerline C). In this embodiment, the lower portion of the inboard side wall 12d of each vertical support column 12 is mounted and fixed to the diagonal corner portions 114b of the pontoon structure 114 by a rectangular extension 15 secured between the pontoon corner portions and inboard side wall 12d of the column 12 to form a unitized structure.

[0044] FIG. 6 illustrates a hull 11b of a TLP according to a third embodiment of the invention. In this alternative embodiment, each of the vertical support columns 112 has a lower end 112a and an upper end 112b and defines a generally trapezoidal transverse cross section with a wider inboard side wall 112d and a narrower outboard side wall 112e interconnected in parallel spaced relation by two nonparallel laterally spaced side walls 112c.

[0045] According to the various embodiments of the invention, including those of FIGS. 3-6 and variations thereof widening the column spacing increases stability, and placing the central pontoon structure 14, 114 radially inboard of the vertical support columns 12, 112 improves the hydrodynamic performance of the platform and reduces support spans and cantilevers. And because the columns 12, 112 and pontoon 14, 114 are preferably not cylindrical, they may be substantially constructed of flat metal plate (with the possible exception of corners, which may be provided with either simple radius curves or sharp corners). This feature simplifies the hull construction.

[0046] The Abstract of the disclosure is written solely for providing the United States Patent and Trademark Office and the public at large with a way by which to determine quickly from a cursory reading the nature and gist of the technical disclosure, and it represents solely a preferred embodiment and is not indicative of the nature of the invention as a whole.

[0047] While some embodiments of the invention have been illustrated in detail, the invention is not limited to the embodiments shown; modifications and adaptations of the above embodiment may occur to those skilled in the art. Such modifications and adaptations are in the spirit and scope of the invention as set forth herein:

What is claimed is:

1. A tension leg platform (10) comprising:

a hull (11, 11a, 11b) including a plurality of vertical columns (12, 112), a pontoon structure (14, 114) disposed inboard of said columns and adjoined to said columns at lower ends (12a, 112a) thereof, each of said columns having a horizontal cross-sectional shape that defines a

major axis A_1) that is oriented radially outward from a center point (C) of said hull;

a deck (13) supported at upper ends (12b, 112b) of said columns; and

a plurality of tendons (17) connected under tension between said columns and the seabed for maintaining said tension leg platform above a desired subsea location and substantially restraining said tension leg platform from vertical heave motions.

2. The tension leg platform (10) according to claim 1 wherein:

said columns (12, 112) and said pontoon structure (14, 114) are constructed substantially of flat plate.

3. The tension leg platform (10) according to claim 1 wherein:

each of said plurality of columns (12, 112) has a polygonal transverse cross-section.

4. The tension leg platform (10) according to claim 1 wherein:

each of said plurality of columns (12, 112) has a quadrilateral transverse cross-section.

5. The tension leg platform according to claim 4 wherein: each of said plurality of columns (112) has a generally trapezoidal transverse cross-section defined by an inboard side wall (112d) and an outboard side wall (112e) interconnected in parallel spaced relation by two nonparallel laterally spaced side walls (112c), said outboard side wall (112e) being wider than said inboard side wall (112d), whereby said major axis (A_1) extends between said inboard and outboard side walls.

6. The tension leg platform (10) according to claim 4 wherein:

each of said plurality of columns (12) has a generally rectangular horizontal cross-section defined by an inboard side wall (12d) and an outboard side wall (12e) of substantially equal width interconnected in parallel spaced relation by two parallel laterally spaced side walls (12c) of greater width than said inboard and outboard side walls (12d, 12e), whereby said major axis (A_1) extends between said inboard and outboard side walls.

7. The tension leg platform (10) according to claim 1 wherein:

said pontoon structure (14, 114) is octagonal-shaped.

8. The tension leg platform (10) according to claim 7 wherein:

each of said columns (12, 112) is adjoined to a corner portion (14b, 114b) of said pontoon structure (14, 114) by an extension member (15).

9. The tension leg platform (10) according to claim 1 wherein:

said pontoon structure (14) includes a central moonpool opening (14c) formed vertically therethrough.

10. The tension leg platform (10) according to claim 9 wherein:

said pontoon structure (14) includes four orthogonally-oriented side segments (14a) interconnected with four diagonally-oriented corner segments (14b); and

each of said side segments and corner segments (14a, 14b) are generally rectangular in transverse cross section and define horizontal axes (HC).

11. The tension leg platform (10) according to claim 9 wherein:

each of said columns (12, 112) is adjoined to one of said corner segments (14b) of said pontoon structure (14) by an extension member (15).

12. A tension leg platform (10) comprising:

a hull (11, 11a, 11b) including a pontoon structure (14, 114) having an outer periphery surrounding a central vertical axis (C), vertical columns (12, 112) each adjoined at a lower end (12a, 112a) to said pontoon structure outer periphery, said pontoon structure disposed inboard of said columns, each of said columns defining a vertical column axis (VC) located radially outward from said central vertical axis (C) a first non-zero distance (D₁) from said outer periphery of said pontoon structure;

a deck (13) supported by upper ends (12b, 112b) of said columns; and

tendons (17) under tension connected at upper ends to said columns by tendon porches (18) mounted directly to said columns (12, 112) and at lower ends to the seabed for maintaining said tension leg platform above a desired subsea location and substantially restraining said tension leg platform from vertical heave motions.

13. The tension leg platform (10) according to claim 12 wherein:

each of said columns (12, 112) has a transverse cross-sectional shape with a horizontal major axis (A₁) oriented radially outward from said central vertical axis (C).

14. The tension leg platform (10) according to claim 13 wherein:

said pontoon structure (14) includes a vertical central opening (14c) formed therethrough;

said pontoon structure (14) includes four orthogonally-oriented side segments (14a) intervalled with four diagonally-oriented corner segments (14b);

each of said side segments and corner segments (14a, 14b) have a polygonal vertical cross-section and define horizontal longitudinal axes (HC) therethrough; and

each vertical column axis (VC) of each column (12, 112) is located a second non-zero distance (D₂) radially outward from the horizontal longitudinal axis (HC) of an adjacent corner segment (14b) of said pontoon structure (14).

15. The tension leg platform (10) according to claim 13 wherein:

each of said columns (12, 112) has a polygonal transverse cross section.

16. The tension leg platform (10) according to claim 15 wherein:

each of said columns (112) has a generally trapezoidal transverse cross section formed of D an inboard side wall (112d) and an outboard side wall (112c) that is narrower than said inboard side wall, which are interconnected in parallel spaced relation by two nonparallel laterally spaced side walls (112e).

17. The tension leg platform (10) according to claim 15 wherein:

each of said columns (12) has a generally rectangular transverse cross section formed of an inboard side wall (12d) and an outboard side wall (12e) of substantially equal width interconnected in parallel spaced relation by two parallel laterally spaced side walls (12c) of greater width than said inboard and outboard side walls.

18. The tension leg platform (10) according to claim 12 wherein:

an imaginary line (S) extending between the vertical column axes (VC) of two adjacent columns (12, 112) lies outboard of said pontoon structure outer periphery.

19. The tension leg platform (10) according to claim 14 wherein:

an imaginary line (S) extending between the vertical column axes (VC) of two adjacent columns (12, 112) lies outboard of the horizontal longitudinal axis (HC) of the side segment (14a) located generally between said two adjacent columns.

20. A tension leg platform (10) comprising:

a ring pontoon structure (14) surrounding a central opening (14c) and formed by a plurality of segments (14a, 14b) which in transverse cross section define a horizontal center line (HC);

vertical columns (12, 112) each adjoined at a lower end (12a, 112a) to an outboard side of said pontoon structure (14) so that said pontoon structure is disposed inboard of said columns, each of said columns defining a central vertical longitudinal axis (VC) disposed radially outward from a platform center (C) a distance (D₂) from said horizontal axial center line (HC) so as not to intersect therewith; and

vertical mooring tendons (17) connected between said columns and the seabed.

* * * * *