

United States Patent

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2,895,300	7/1959	Hayward	61/46.5
2,938,352	5/1960	Knapp et al.....	114/123 X

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[54] OFFSHORE DRILLING STRUCTURE
10 Claims, 7 Drawing Figs.

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[51] **Int. Cl.**.....**B63b 35/00,**
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[50] **Field of Search**..... 114/0.5, 0.5
D, 123; 61/46.5

[56] **References Cited**

UNITED STATES PATENTS

2,525,955	10/1950	Scott	61/46.5
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ABSTRACT: An offshore-drilling structure capable of being floated for movement to a drilling site and then being semisubmerged or submerged for drilling has a hull, a working platform, fixed vertically elongated stabilizing members extending between the hull and the working platform, and movable vertically elongated stabilizing members which are arranged to swing outboard in a horizontal plane to provide added stability to the structure, to be fixed in the outboard position by means of a hinge assembly and brace members, and to swing inboard to provide a structure with a reduced beam. To reduce the resistance of the floating structure during movement through the water, the hull has a pointed bow and the stabilizing members are located above the load water line of the hull.

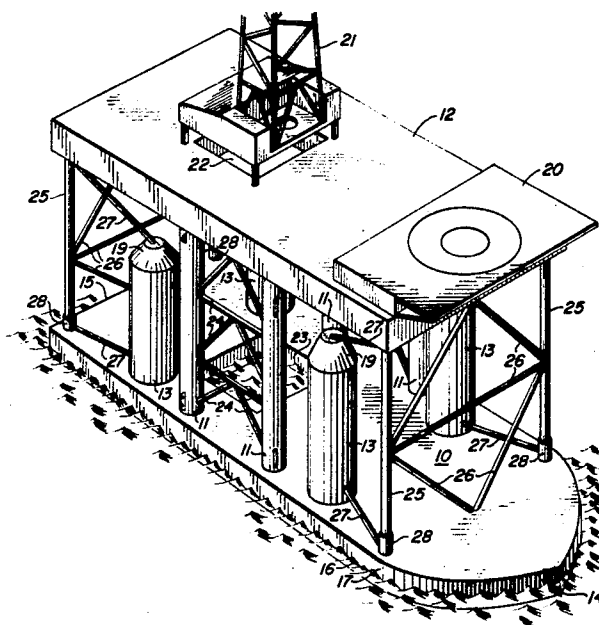


Fig. 1

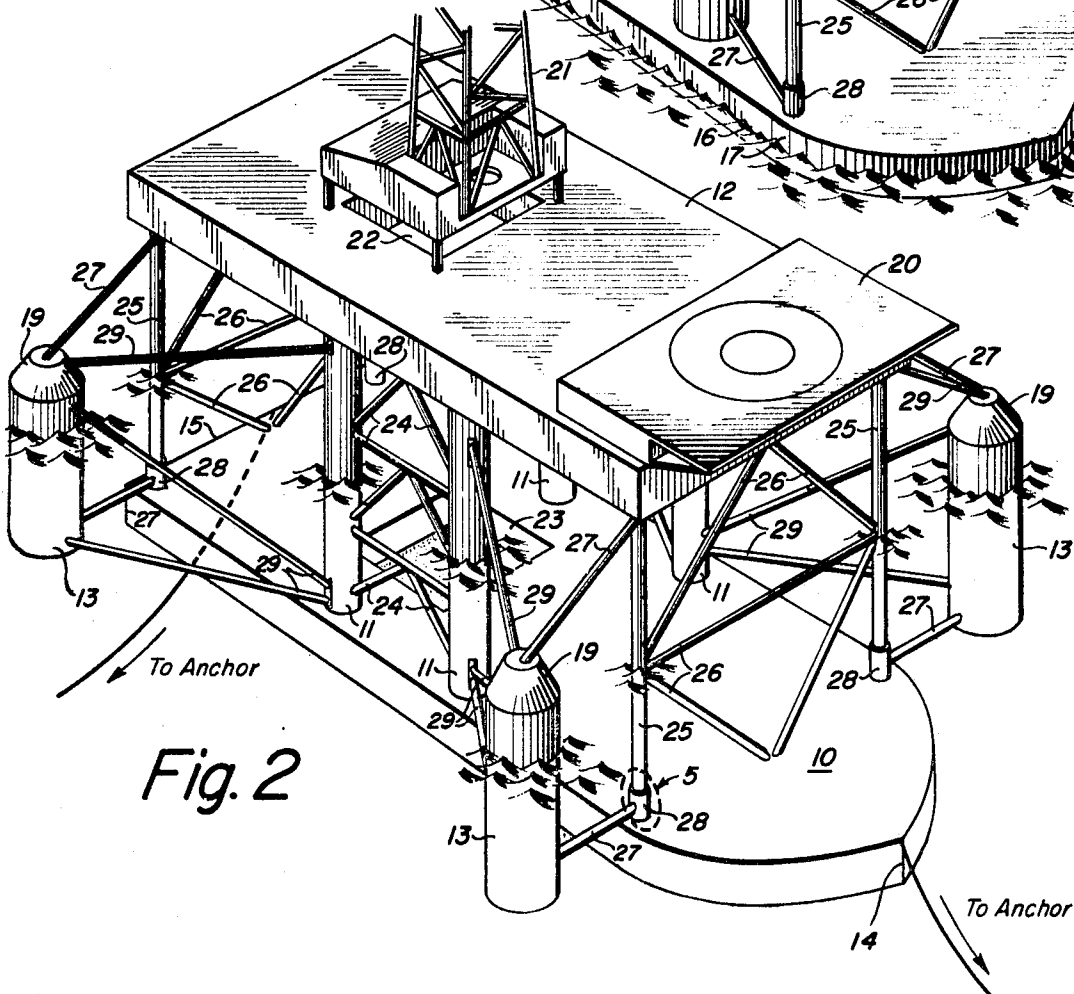
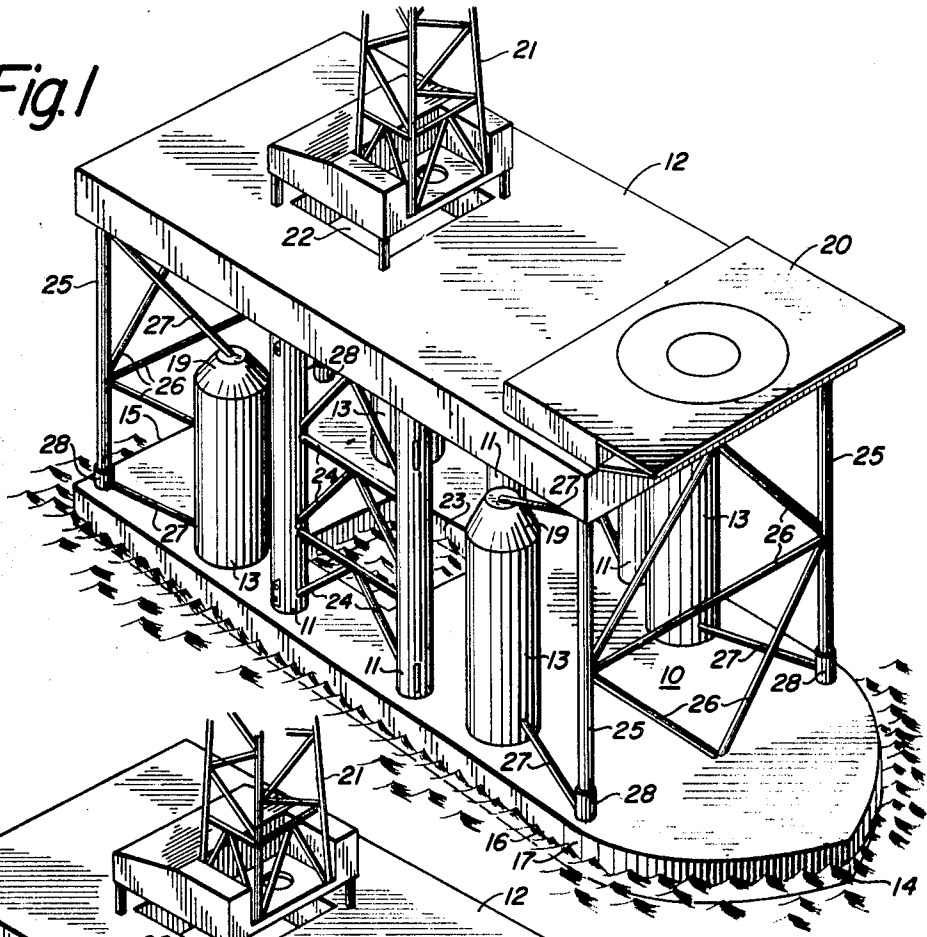


Fig. 3

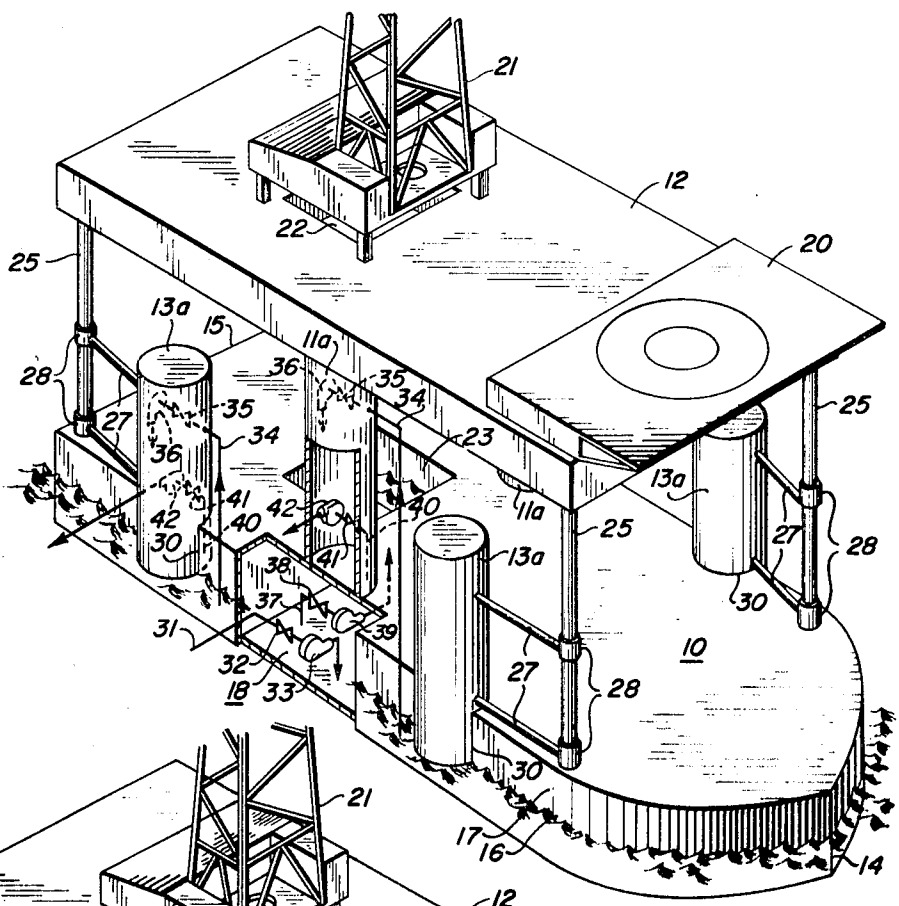


Fig. 4

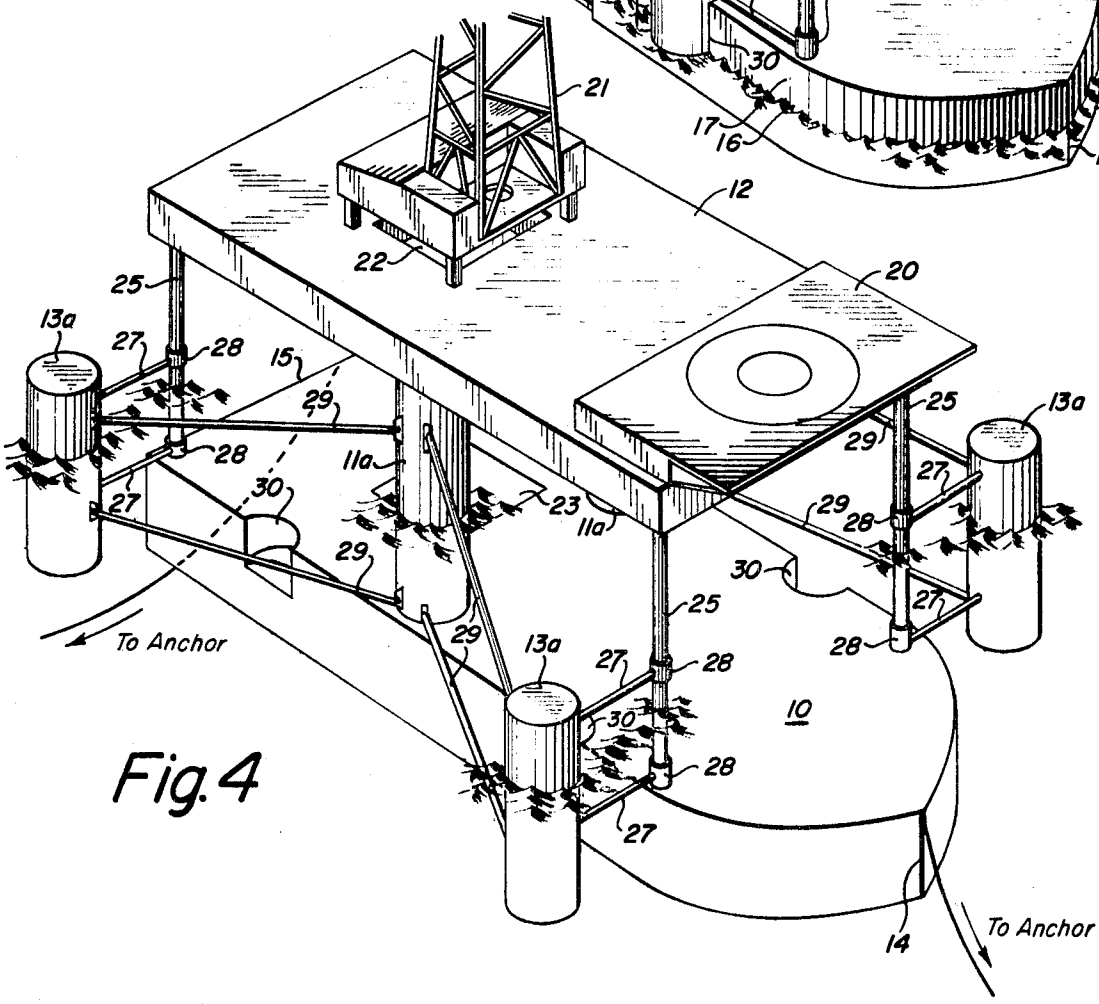


Fig. 7

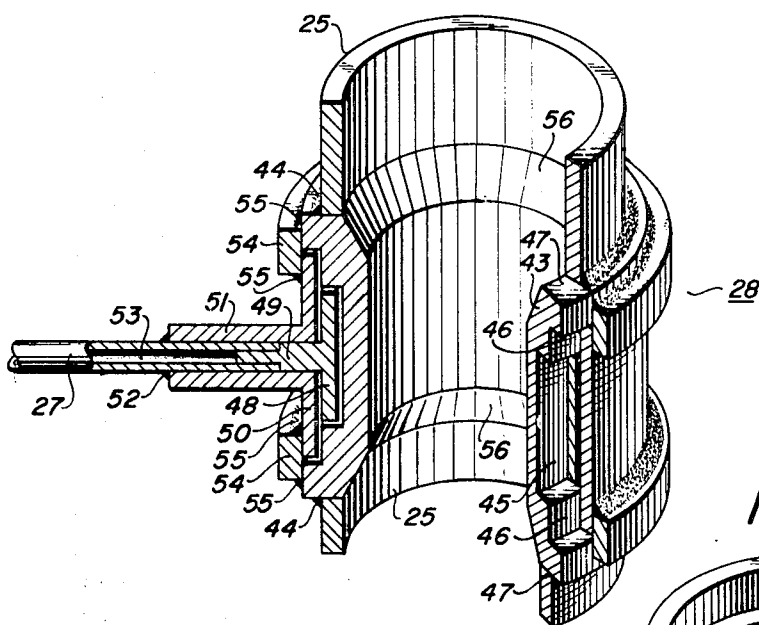


Fig. 6

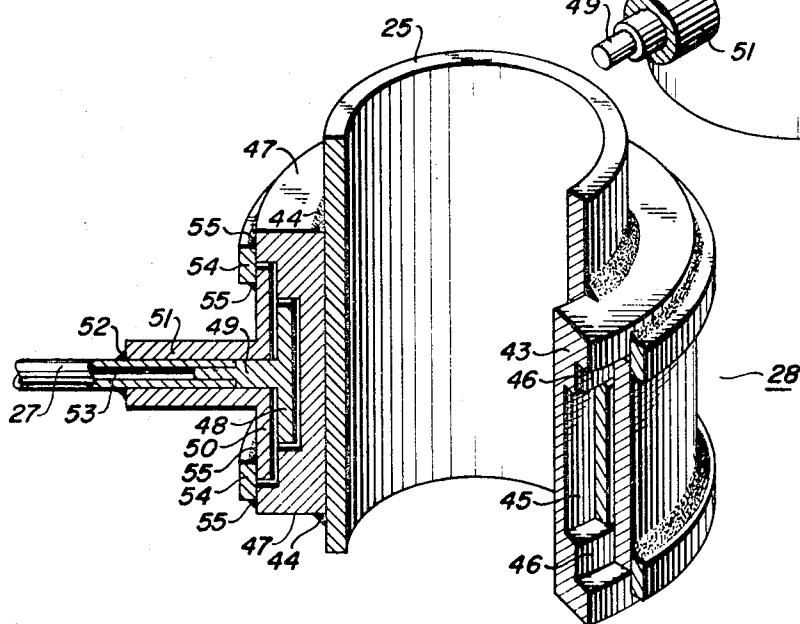
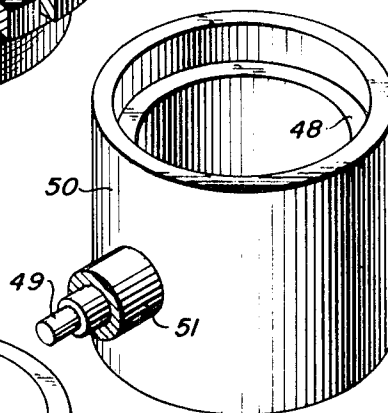


Fig. 5

OFFSHORE DRILLING STRUCTURE

BACKGROUND OF THE INVENTION

This invention relates generally to an offshore-drilling structure and specifically to an offshore-drilling structure having maximum stability while semisubmerged or submerged and minimum resistance to movement through water while afloat.

The trend in offshore drilling is to drill in deeper water and to move the drilling structure a considerable distance to a drilling site. To effectively drill in deeper water requires a drilling structure having maximum stability. To efficiently move a drilling structure a considerable distance requires a mobile-drilling structure which presents a minimum of resistance during movement through water. In addition, the beam of the structure should be such as to permit it to pass through narrow waterways, e.g., the Panama Canal.

Generally, the prior art offshore-drilling structures are not well adapted for stability and mobility. The structures which have good stability, are not mobile; while the structures which are mobile, do not possess good stability.

SUMMARY OF THE INVENTION

An object of this invention is to provide an offshore-drilling structure capable of being efficiently floated a considerable distance to a drilling site.

Another object of this invention is to provide a mobile offshore-drilling structure to effectively drill in deep water.

Still another object of this invention is to provide an offshore-drilling structure having maximum stability while semisubmerged or submerged and minimum resistance to movement through water while afloat.

The above objects can be attained by providing an offshore-drilling structure comprising a hull with a pointed bow, a working platform, fixed vertically extending stabilizing members between the hull and working platform, and movable vertically extending stabilizing members adapted to swing in a horizontal plane and to be rigidly fixed in an outboard position. The stabilizing members are located above the load water line of the hull when the structure is afloat.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a three-dimensional view of the structure while afloat.

FIG. 2 is a three-dimensional view of the structure of FIG. 1 semisubmerged.

FIG. 3 is a three dimensional view of another embodiment of the structure while afloat.

FIG. 4 is a three-dimensional view of the structure of FIG. 3 semisubmerged.

FIG. 5 is an enlarged fragmentary three-dimensional view taken within circle 5 of FIG. 2.

FIG. 6 is a three-dimensional view of certain parts of FIG. 5.

FIG. 7 is a view similar to FIG. 5 showing another embodiment.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to the drawings, an offshore-drilling structure comprises a hull 10, support means including fixed vertically elongated stabilizing members 11 for connecting a working platform 12 to and in spaced relation above the hull 10, and movable vertically elongated stabilizing members 13 adapted for movement in a horizontal plane between a position immediately adjacent the hull 10, as shown in FIGS. 1 and 3, and a position substantially outboard of the hull 10, as shown in FIGS. 2 and 4.

The hull 10 has a bow 14 and a stern 15. The bow 14 is pointed or wedge shaped to reduce the resistance of the hull 10 to movement of the structure through water. As shown in FIGS. 1 and 3, the hull 10 is shaped to provide sufficient displacement to buoyantly support the drilling structure while maintaining the hull 10 with a load water line 16 and freeboard 17. In addition, the shape of the hull 10 provides

stability to the drilling structure when the structure is semisubmerged and anchored as shown in FIGS. 2 and 4. The hull 10 includes a plurality of ballastable compartments 18.

The working platform 12 has mounted thereon the usual equipment and structures including a heliport 20 and derrick 21. The derrick 21 is positioned over an opening 22 in the working platform 12 which is in vertical alignment with an opening 23 in the hull 10.

With reference to FIGS. 1 and 2, the support means for the working platform 12 includes four fixed vertically elongated stabilizing members 11 which extend between and are connected to the hull 10 and the working platform 12. Two stabilizing members 11 are positioned on each side of the hull 10 and are rigidly joined together by cross braces 24. The cross-sectional shape and position of the stabilizing members 11 are such as to aid in providing the required stability during all positions of the drilling structure. In addition to the stabilizing members 11, vertical structural members 25 may extend between and be connected to the hull 10 and working platform 12. Suitable cross braces 26 may be connected to structural members 25 to provide the required rigidity.

With reference to FIGS. 3 and 4, the support means for the working platform 12 includes two fixed vertically elongated stabilizing members 11a, one positioned on each side of the hull, and four vertical structural members 25, two positioned on each side of the hull fore-and-aft of stabilizing members 11a. Stabilizing members 11a and structural members 25 extend between and are connected to hull 10 and platform 12.

Referring to FIGS. 1 and 2, four movable vertically elongated stabilizing members 13, two on each side of hull 10, are hingedly mounted to structural members 25 by means of arms 27 which are attached to hinge assemblies 28. Two arms 27 and hinge assemblies 28 support each stabilizing member 13. One arm 27 extends substantially horizontal and is attached to the lower end of movable stabilizing member 13, while the other arm 27 extends upwardly from the upper surface of movable stabilizing member 13 to structural member 25. Hinge assemblies 28 and arms 27 allow stabilizing members 13 to be moved in a horizontal plane between a position immediately adjacent the hull 10, as shown in FIG. 1 and a position substantially outboard of the hull 10, as shown in FIG. 2. Movable stabilizing members 13 are circular in cross section with a substantially uniform area throughout most of their height. The upper portions 19 of movable stabilizing members 13 are conical in shape to reduce the wave forces on movable stabilizing members 13.

After the movable stabilizing members are moved to an outboard position, brace members 29 are used to rigidly secure them in this outboard position. As shown in FIGS. 1 and 2, brace members 29 have one end attached to the movable stabilizing member 13 and the other end to the fixed stabilizing member 11. Two brace members 29 rigidly secure each movable stabilizing member 13, one brace member 29 extends substantially horizontal and is attached to the lower end of stabilizing member 13, while the other brace member 29 extends upwardly from the upper surface of movable stabilizing member 13 to fixed stabilizing member 11.

In the embodiment shown in FIGS. 3 and 4, movable stabilizing members 13a are cylindrical and are hingedly mounted to structural members 25 by means of parallel arms 27 which are attached to hinge assemblies 28. Two parallel arms 27 support each stabilizing member 13a. Thus, movable stabilizing members 13a can be moved in a horizontal plane between a position immediately adjacent the hull 10 and a position substantially outboard of the hull 10. After the stabilizing members 13a are moved to the outboard position, brace members 29 are rigidly secured to the stabilizing members 13a and 11a. Two brace members 29 extend between each stabilizing member 13a and the support means for platform 12.

With reference to FIGS. 5 and 6, hinge assembly 28 has a cylindrical base member 43 which encircles and is attached to structural member 25 by welds 44. The periphery of base

member 43 is shaped to form an annular groove 45, annular shoulders 46, and flanges 47. Slidably positioned within annular groove 45 is a cylindrical hinge plate 48 which has an integral boss 49 extending outwardly therefrom. Slidably positioned between flanges 47 and outwardly adjacent annular shoulders 46 is a cylindrical sleeve 50 which has an integral hollow cylindrical portion 51 extending outwardly therefrom and into which boss 49 extends. Thus, with respect to base member 43 which is attached to structural member 25, hinge plate 48 and cylindrical sleeve 50 rotate as a unit within annular groove 45 and between flanges 47, respectively.

Arm 27 has one end attached to a movable stabilizing column 13 or 13a and its other end positioned within cylindrical portion 51 of sleeve 50 and attached to sleeve 50 by weld 52. The outer end of boss 49 has a reduced diameter portion which extends within opening 53 in arm 27. Thus, arm 27 and movable stabilizing column 13 or 13a are rigidly attached to cylindrical sleeve 50 and hinge plate 48 for rotation therewith about structural member 25 between the inboard position shown in FIGS. 1 and 3 and the outboard position shown in FIGS. 2 and 4.

In order to secure the movable stabilizing column in the outboard position, a pair of brace members 29 are attached to and extend between the movable stabilizing columns 13 or 13a and the fixed stabilizing columns 11 or 11a as described above. These brace members are so attached after the stabilizing column is rotated to the outboard position by means of hinge assemblies 28 and prior to the submerging of hull 10. Also, prior to submerging the hull, ring 54 is positioned with its inner surface in contact with the outer surface of sleeve 50 and one of flanges 47 and secured in this position by welding one side of the ring 54 to sleeve 50 and the other side to flange 47 as indicated by numeral 55 in FIGS. 5 and 7. By so securing ring 54 to sleeve 50 and flange 47, the hinge assembly 28 is not capable of further rotation and ring 54 acts to transmit a load from the movable stabilizing column 13 or 13a and sleeve 50 to the base member 43 and structural member 25 without any substantial load passing through the hinge plate 48. Thus, hinge plate 48 need only be capable of transmitting a load during rotation of the movable stabilizing column 13 or 13a. If such rotation is carried out before submergence of the hull 10, wave loads which may be imposed on the movable stabilizing columns 13 or 13a are not transmitted to hinge plate 48.

If it is desired to rotate the movable stabilizing columns 13 or 13a inboard from the position shown in FIGS. 2 and 4, the hull 10 is refloated and, thereafter, the brace members 29 removed. The rings 54 are cut and removed so that the sleeve 50 and hinge plate 48 are free to rotate. Thereafter the movable stabilizing column 13 or 13a can be rotated inboard to the position shown in FIGS. 1 and 3.

Obviously, rings 54 are disposable and are installed and removed according to the desired positioning of the stabilizing column 13 or 13a as described above.

The hinge assembly shown in FIG. 7 has the same parts and operates the same as the hinge assembly shown in FIG. 5. However, in FIG. 7, the structural member 25 extends from and is welded to the top and bottom surface of base member 43. In addition, base member 43 includes chamfers 56 and an internal diameter smaller than structural member 25.

As shown in FIGS. 1 and 3, the bottoms of the movable stabilizing members 13 and 13a are located above the load water line 16 of hull 10. By so positioning the bottom, the movable stabilizing members 13 and 13a do not offer any resistance when the floating hull 10 is moving through the water. As shown in FIGS. 2 and 4, stabilizing members 13, 13a and the support means for platform 12 have a height greater than the maximum depth to which said hull 10 is submerged.

In the embodiment shown in FIGS. 3 and 4, the hull 10 includes a semicylindrical recess 30 complementary to the cylindrical shape of stabilizing members 13a. As shown in FIG. 3, the lower ends of stabilizing members 13a are received by recesses 30 when members 13a are positioned immediately adjacent hull 10.

Means are provided to add ballast to the hull ballast compartments 18 and stabilizing members 11, 11a, 13 and 13a. As shown diagrammatically in FIG. 3, the hull 10 may include a number of water ballast compartments 18, each having an inlet pipe 31, connected through a valve 32 to a pump 33 for introducing water to the compartment 18. Likewise, each stabilizing member 11a and 13a may have an inlet pipe 34 connected through a valve 35 to a pump 36 for introducing water to the stabilizing members 11a and 13a. Means are also provided to remove ballast from the hull compartments 18 and stabilizing members 11a and 13a. The hull compartments 18 may include an outlet pipe 37 connected through a valve 38 to a pump 39 for discharging water from the compartment. Likewise, each stabilizing member 11a and 13a may have an outlet pipe 40 connected through a valve 41 to a pump 42 for discharging water from the stabilizing members 11a and 13a. It should be understood that the embodiment of FIGS. 1 and 2 would be provided with a similar arrangement to add and remove ballast.

In operation and with the movable stabilizing members 13 positioned adjacent the hull 10, as shown in FIGS. 1 and 3, the drilling structure is floated with the hull 10 having freeboard 17 to a drilling site. The shape of the bow 14 of the hull 10, which approximates that of a conventional ship, offers a minimum amount of resistance to movement through the water. Furthermore, the beam of the structure is at a minimum with the movable stabilizing members located immediately adjacent the hull 10. In addition the stabilizing members having their lower ends above the load water line 16 of the hull 10 do not offer resistance to movement through the water. This arrangement provides for efficient transporting of the floating structure to the drilling site.

After arrival at the drilling site, the movable stabilizing members 13 or 13a are swung outboard in a horizontal plane to the position shown in FIGS. 2 and 4. Brace members 29 are attached to the movable stabilizing members 13 or 13a, and the support means for the platform 12 in order to rigidly secure the movable stabilizing members 13 or 13a in the outboard position. In addition, ring 54 is welded to sleeve 50 and flange 47 to prevent rotation of hinge assembly 28.

Next, the hull 10 is submerged by the controlled admission of ballast to the desired depth and anchored. Due to the positioning of the movable stabilizing members 13 or 13a a substantial distance outboard of the hull 10 the moments of inertia of the water plane areas of these stabilizing members are of such magnitude as to establish the metacenter of the vessel above the center of gravity and thereby provide a stable structure.

In moving the drilling structure to another drilling site, the structure can be refloated, the brace members 29 and rings 54 removed, and the movable stabilizing members 13 or 13a swung inboard to the position shown in FIGS. 1 and 3. In the alternative, when the new drilling site is not located an appreciable distance from the old site, the drilling structure could be transported with the movable stabilizing members located in the outboard position.

While the above description has been directed to a semisubmerged or floating type drilling structure, the structure of this invention could be used as a submerged or bottom supported type drilling structure.

We claim:

1. An offshore-drilling structure comprising:

- a. a hull,
- b. a working platform,
- c. support means for connecting said working platform to and in spaced relation above said hull,
- d. a movable stabilizing member extending substantially perpendicular to said platform and having a height greater than the maximum depth of water to which said hull is submerged,
- e. a hinge assembly attached to said structure and including an arm member rotatable about a vertical axis and fixedly attached to said movable stabilizing member for horizon-

5

tally moving said movable stabilizing member between a first portion immediately adjacent said hull and a second position substantially outboard of said hull,

- f. means for adding ballast to said structure to submerge said hull, and
- g. means for removing ballast from said structure to float said structure with said hull having freeboard.

2. A structure as described in claim 1 wherein the hull of subparagraph (a) has a pointed bow and the bottom of said movable stabilizing member is located above the load water line when said hull has freeboard.

3. An offshore-drilling structure comprising:

- a. a hull,
- b. a working platform,
- c. support means for connecting said working platform to and in spaced relation above said hull including first vertically elongated stabilizing members,
- d. second vertically elongated stabilizing members positioned on both sides of said hull,
- e. means adapted for horizontally moving said second vertically elongated stabilizing members between a first position immediately adjacent said hull and a second position substantially outboard of said hull, including a pair of hinge assemblies for each second vertically elongated stabilizing member, each hinge assembly comprising a base member fixedly attached to said support means, a hinge plate rotatably attached to said base member and a sleeve fixedly attached to said hinge plate and rotatable therewith, and an arm extending between and fixedly attached to said sleeve and said second vertically elongated stabilizing member,
- f. means for adding ballast to said structure to submerge said hull, and
- g. means for removing ballast from said structure to float said structure with said hull having freeboard.

4. A structure as described in claim 3 including means to rigidly secure each second vertically elongated stabilizing member in said second position comprising brace members extending between and fixedly attached to said second vertically elongated stabilizing member and said support means and a ring fixedly attached to said sleeve and said base member.

5. An offshore-drilling structure comprising:

- a. a hull,
- b. a working platform,

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c. support means for connecting said working platform to and in spaced relation above said hull including first vertically elongated stabilizing members,

d. second vertically elongated stabilizing members on both sides of said hull,

e. means adapted for horizontally moving said second vertically elongated stabilizing members between a first position immediately adjacent said hull and a second position substantially outboard of said hull,

f. means for adding ballast to said structure to submerge said hull,

g. means for removing ballast from said structure to float said structure with said hull having freeboard,

said hull includes recesses complementary to the configuration of the lower ends of said second vertically elongated stabilizing members and positioned to receive said lower ends when said second vertically elongated stabilizing members are in said first position.

6. A structure as defined in claim 1 wherein the hinge assembly of subparagraph (e) further includes a base member fixedly attached to said support means, a hinge plate rotatably attached to said base member and a sleeve fixedly attached to said hinge plate and said arm member and rotatable therewith.

7. A structure as defined in claim 6 including means to rigidly secure said movable stabilizing member in said second position comprising brace members extending between and fixedly attached to said movable stabilizing member and said support means and a ring fixedly attached to said sleeve and said base member.

8. A structure as described in claim 1 wherein said hull includes a recess complementary to the configuration of the lower end of said movable stabilizing member and positioned to receive said lower end when said movable stabilizing member is in said first position.

9. A structure as described in claim 1 wherein the support means of subparagraph (c) includes fixed vertically extending stabilizing members, a movable stabilizing member as described in subparagraph (d) is positioned on each side of said hull, and a hinge assembly as described in subparagraph (e) is provided for each movable stabilizing member.

10. A structure as described in claim 9 wherein each hinge assembly of subparagraph (e) further includes a base member fixedly attached to said support means, a hinge plate rotatably attached to said base member, and a sleeve fixedly attached to said hinge plate and said arm member and rotatable therewith.

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