

[54] **OFFSHORE MARINE STRUCTURE
EMBODYING ANCHOR PILE MEANS**

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[51] Int. Cl. **E02b 17/00, E02d 11/00**

[58] Field of Search..... **61/46.5, 46, 50,
61/52, 53.5; 173/43**

[56] **References Cited**

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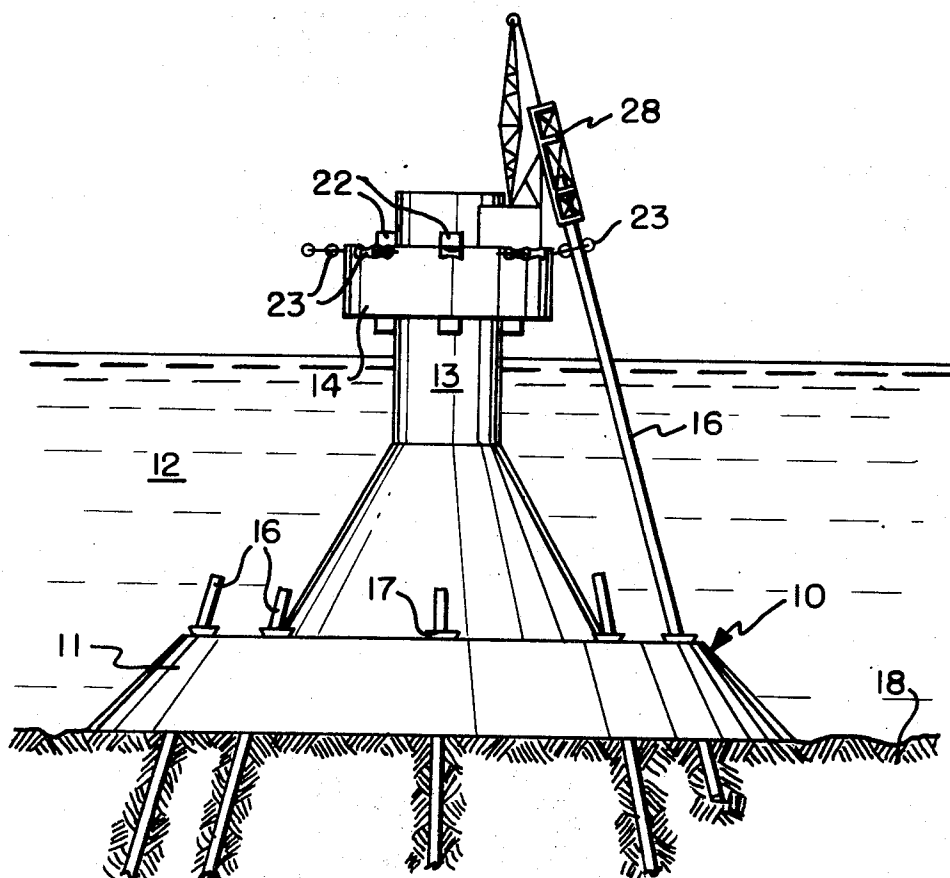
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[57] **ABSTRACT**

The invention relates to a buoyant marine structure as would be found, or is usable in a body of water which lies above a penetrable substratum. The structure is comprised of several operably connected components and is controllably buoyant as to be floated or propelled to a proposed working site. Thereafter, the buoyancy is regulated to sink the hull portion of the structure to a resting place on the ocean floor. A series of anchoring piles are carried on the structure in such manner that they can be readily released from a fixed position to enter the penetrable substratum, and thereafter be driven to a desired depth.

8 Claims, 8 Drawing Figures



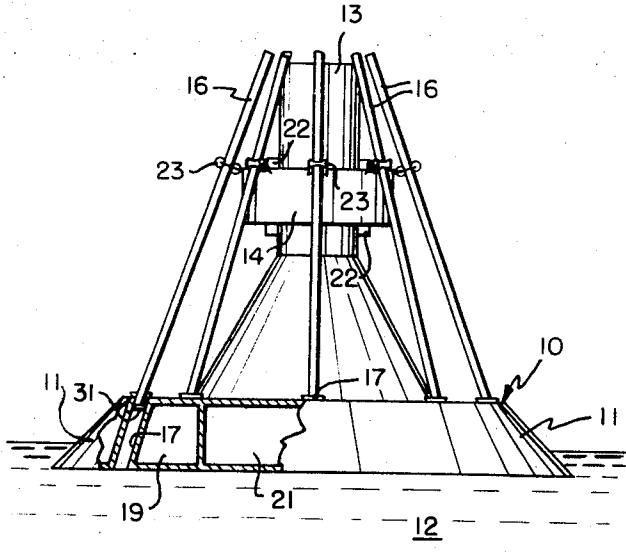


FIG. 1

FIG. 2

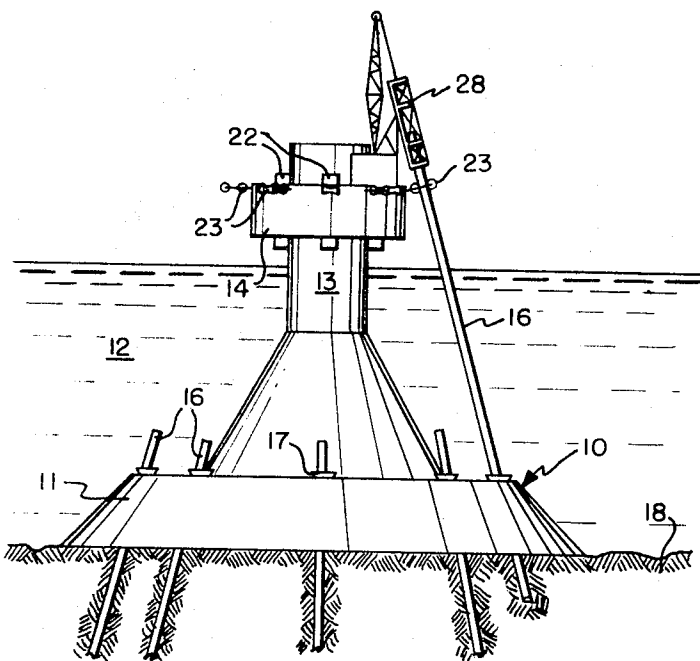
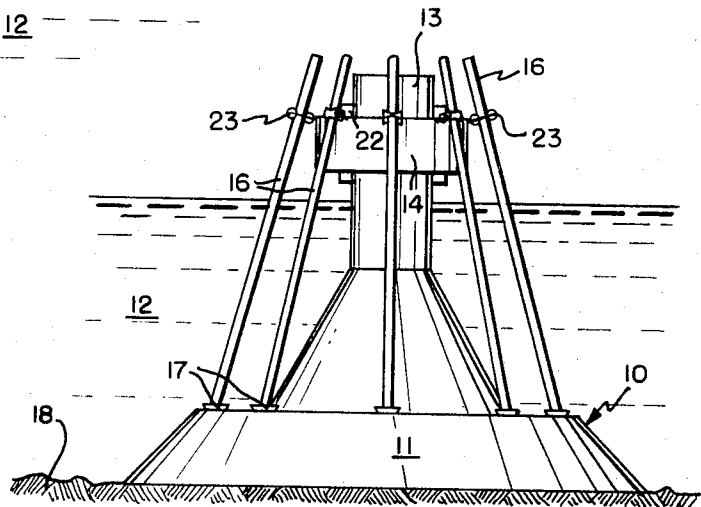


FIG. 3

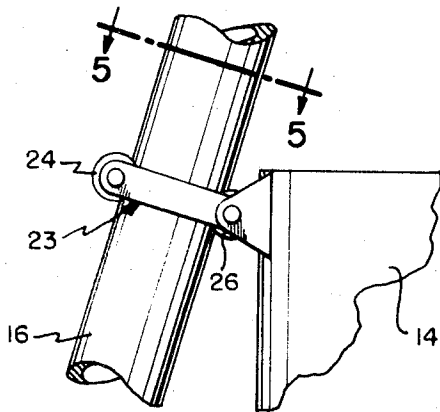


FIG. 4

FIG. 5

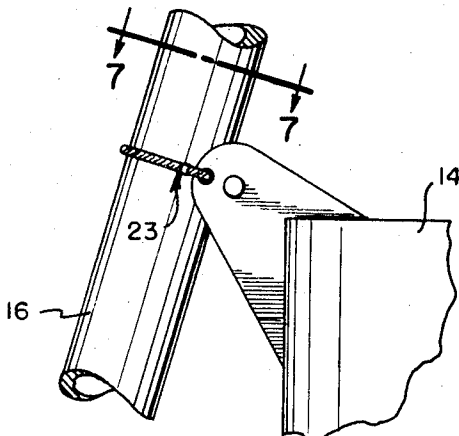
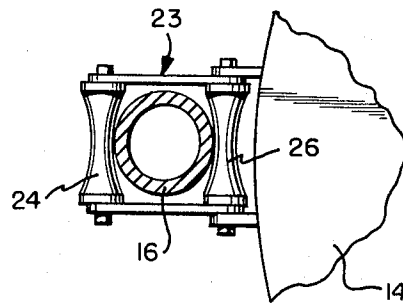


FIG. 6

FIG. 7

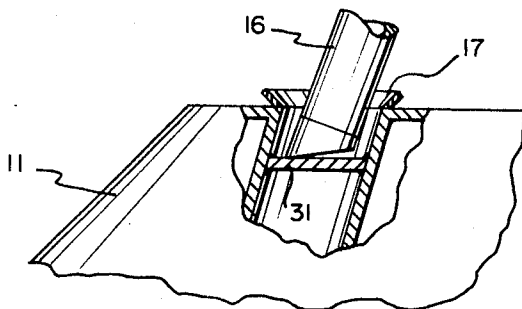
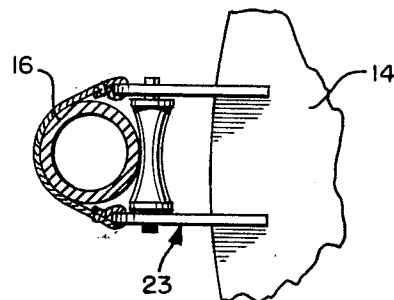


FIG. 8

OFFSHORE MARINE STRUCTURE EMBODYING ANCHOR PILE MEANS

BACKGROUND OF THE INVENTION

In the drilling for and production of oil from offshore locations, it is feasible and quite normal in most instances to fasten a rigid platform or similar structure to the ocean floor and thereafter to form the necessary number of wells from the structure. Such platforms in many instances are so constructed as to be floatably propelled to a proposed offshore site or in the alternative, are barged to the site after being fabricated on-shore.

Normally, once the platform has reached a desired location and is anchored to the floor of the offshore spot, a working deck is positioned beyond the water's surface. The deck accommodates the various forms of equipment usually associated with a drilling or producing operation.

In most instances, such equipment will include a derrick, rotary table, draw works and the like, all of which are ancillary to the usual drilling procedure. As a matter of practicality, such offshore work platforms are built sufficiently strong to withstand the forecasted environmental conditions at a particular site. Thus, the structures tend to be relatively expensive and as a consequence good economic practice recommends that the platform be salvaged to the greatest extent possible at the termination of its use.

Normally offshore marine structures are of such a nature that they are fixed in place by being piled to the ocean floor. This can be achieved by extending piles through the structure's downwardly extending legs or by means of anchors depending from the structure by chains, cables or the like. The type of structure in issue is normally not designed for a high degree of seaworthiness. It is thus desirable to transport the structure between working sites in the most expeditious manner and preferably by avoidance of bad weather which would tend to damage the unit.

Still another factor pertinent to the use of such fixed marine structures, is the time required to provide the necessary amount of piling which must extend from above the water's surface to a point in the substratum whereby sufficient load carrying capacity is provided. This fixing operation normally embodies driving the anchoring piles to a desired depth by sequentially welding one length of pile to the next as the pile is progressively urged into the substratum. In essence, the platform anchoring operation is normally time consuming and relatively expensive due to the character of known techniques, and to the inability to drive more than one or two piles simultaneously.

It is therefore one object of the invention to provide a novel offshore structure which is adapted to be readily fastened to the floor of an offshore working site and to be readily removed therefrom.

Another object is to provide a marine structure of the type contemplated wherein anchoring piles are prepositioned and carried on the marine structure in such a manner that they can be readily released as to penetrate the substratum at an offshore working site as soon as the platform reaches such site.

Still another object is to provide a means of driving or drilling and securing piles at large angles of inclination or batter in order that substantial amounts of lat-

eral ice loads can be resolved into axial pile loads instead of having to be resisted in bending.

In achieving the above delineated objectives, there is presently provided a marine structure of the type contemplated wherein the structure itself is floatable either by self propulsion, or by being towed through the water. The structure is at least partially buoyant whereby it can be controllably regulated to assume a desired depth and attitude in a body of water. At its ultimate positioning or working point, the structure's base or hull is lowered from its normal position above the water's surface to a resting place at the ocean floor. When so positioned, one or more anchoring piles are released to penetrate the substratum and provide interim protection against lateral movement.

DESCRIPTION OF THE DRAWINGS

In the drawings,

FIG. 1 illustrates the instant marine platform disposed in a floating condition at the surface of a body of water.

FIG. 2 is similar to FIG. 1, showing the structure after being submerged to the floor of said body of water.

FIG. 3 shows the structure partially anchored to said ocean floor.

FIG. 4 is an enlarged segmentary view of a portion of the structure shown in FIG. 1.

FIG. 5 is a cross sectional view taken along line 5—5 of FIG. 4.

FIG. 6 illustrates an alternate embodiment of the device shown in FIG. 4.

FIG. 7 is a cross sectional view taken along line 7—7 of FIG. 6.

FIG. 8 is a segmentary view on an enlarged scale and in partial cross section showing a portion of the platform illustrated in FIG. 1.

Referring to FIG. 1, a marine structure 10 of the type contemplated is shown floatably positioned on the surface of a body of water. The structure comprises a multi-component unit, the members of which are operably connected to provide the structure with a degree of versatility. A hull 11 carried at the lower end, embodies buoyant means therein which permits the entire platform 10 to be controllably submerged within the body of water 12. A support means 13 depending from the upper deck of said hull 11, extends upward a sufficient distance to be at least partially beyond the water's surface when the hull is submerged.

A stage or deck 14 is operably carried on the support means 13 to assume a desired disposition thereon. At least one, and preferably a plurality of elongated anchor piles 16 are supported in part at the deck 14 in such manner that when the latter is lowered to the position of FIG. 1, the pile will rotate about its lower end within pile guide 17, and thus be restrained from penetrating through said guide by a restraining mechanism. However, as stage 14 is elevated to its upper position, inclination of the piles 16 will be decreased to the angle of the pile guide 17. The piles are thereby released to penetrate the guide and substratum, at such time as the pile restraining mechanism is released. Thereafter, the pile or piles 16 can be further driven or drilled into the substratum 18 to a suitable depth whereby to provide the required bearing capacity.

The hull 11 member as shown, comprises a unitary barge-like arrangement formed with a plurality of discrete internal compartments 19 and 21. The latter are

so divided and mutually connected to a buoyancy system which, although not presently shown in detail, normally embodies remotely actuated pumps, valve means, and suitable manifolding to permit the desired movement of fluid whereby to achieve a desired attitude of buoyancy. In the instant arrangement, the respective tanks 19 and 21 within hull 11 can be so connected to the buoyancy system as to receive salt water, drilling mud, or other fluid whereby to afford the hull the desired controlled buoyancy versatility.

Hull 11 is further provided with means to operably engage the stage or working deck 14 which in turn is actuatable to rise, preferably beyond the water's surface during the normal period of operation. The deck 14, as it will be hereinafter referred to, is of a lesser horizontal cross sectional area than the corresponding area covered by the lower hull. Said deck is further provided with means at its periphery to engage the respective anchoring piles 16 as will be herein noted.

Support means 13 is shown as comprising a generally cylindrical column-like member having a sufficiently large wall thickness to function as a foundation element as deck 14 is raised to its desired working level. While the column 13 is presently shown as a heavy walled cylindrical member it could as well be formed of an alternate embodiment such as an open work, structural member or the like. It is appreciated that column 13 can be adjusted for lengthening or reducing its height depending on the depth of water at a particular site at which platform 10 is to operate.

Column 13 as shown, is fastened substantially centrally of hull 11 whereby to afford the latter stability and balance particularly during the transportation periods when it is buoyed at the water's surface. In the instance where hull 11 comprises a plurality of members characterized as a trimaran or a similar vessel, support column 13 can be laterally reinforced by ancillary members, or can be provided with a relatively extensive base whereby to assure its stability.

Deck 14 as previously noted, is operably carried on support means 13 which in the instant description is afforded by the single upstanding column. The vertically operable stage or working deck 14, includes at least one central opening through which column 13 is registered. Said deck is further provided with clamping means 22 such as a plurality of jacks, gears, cables, or the like disposed about column 13 in a manner to be actuatable whereby to engage the column and thereby adjust the elevation of deck 14 with respect to hull 11.

The periphery of the said deck 14 is provided with a plurality of anchor pile clamping members 23. The latter are so arranged and spaced to permit the respective piles to be singly grasped, and sequentially, or simultaneously released from the deck whereby to pass downwardly and into the substratum 18.

Referring to FIGS. 1 and 4, the pile locking member 23 as shown, can assume a number of embodiments within the ambit of the instant invention. One embodiment of said locking means includes a roller-like arrangement comprising oppositely disposed rollers 24 and 26. Said rollers are positioned to encircle a portion of pile 16, whereby to provide a sufficient degree of restraint to prevent the piles from moving horizontally and yet permit vertical inclination and axial movement thereof. When the lower end of pile 16 is therefore positioned within a pile guide 17 but not extending through the hull 10, the lateral urging of the pile 16 in-

ward toward the deck 14 when the latter is in the lower position, causes the pile to engage the displaceable or frangible restraining mechanism 31 and prevents the pile from moving downward.

As shown in FIG. 1, with deck 14 in its lowered position spaced adjacent to the hull 11 upper surface, the respective anchoring piles 16 are drawn inwardly toward the deck center. However, as deck 14 is elevated above hull 11, the peripherally disposed pile clamping apparatus 23 will maintain rolling contact with the pile outer surface, while simultaneously aligning the pile with pile guide 17. With continued raising, deck 14 will then be at such a height that the respective piles will be in a position whereby they fall into alignment with the lower pile guide 17. When so aligned, releasing of the respective restraining devices will permit the pile to slide freely of its own weight, downwardly through the pile guide 17 and into substratum 18.

The degree to which the pile will freely embed itself is of course dependent on the consistency of the substratum. However, this factor is normally determined prior to the drilling of any offshore site by means of coring or similar known procedures. Thus, pile 16 will only be permitted to enter substratum 18 to a sufficient depth that it prohibits hull 11 from moving laterally. The pile will be restrained however such that it will not pass entirely through the hull and guide 17 and become lost.

After pile 16 has initially penetrated substratum 18, it can be further driven into the latter or as such driving progresses, be provided if necessary with additional pile lengths at the upper end. Eventually, the pile or piles will be driven to a predetermined point where it will constitute a firm anchor for platform or structure 10.

Normally the pile driving operation can be accomplished with driving mechanism mounted on deck 14, or on an adjacently positioned vessel. As shown in FIG. 3, such equipment 28 can be transferred to deck 14 when the latter is at the water's surface.

As noted, the marine structure 10 can carry any number of piles deemed to be necessary to achieve the desired degree of anchoring at a particular location. In any instance, piles 16 can be simultaneously released from the upwardly positioned deck 14, or sequentially positioned as the deck is elevated whereby the piles can be progressively driven.

As the respective piles achieve their desired degree of embedment, they will of course be fastened into the hull 10 by the usual method. This generally consists of cementing the pile length confined within the pile guide 17, as to rigidly interlock the two. Thereafter, with the respective piles properly set, the stage or deck 14 can be provided with necessary equipment to proceed with the drilling of one or more wells into the substratum either through the piles or independently thereof.

At such time as it is determined that the usefulness of structure 10 at a particular site is not further warranted, the structure will be released from its floor resting place and transported to an alternate working site. Said repositioning is achieved initially by disconnecting the structure from its respective anchoring piles 16. The industry has developed several means to readily achieve such detachment. These include either cutting the piles beneath the mud line with an appropriate tool, or by explosively severing the pile.

The buoyancy of hull 11 is then adjusted such that the latter will rise and assume the disposition of a seaworthy vessel for transportation to the alternate site. This is achieved by first breaking the under suction between hull 11 with the substratum 18. This step permits the hull to be freed of the soil-structure bond which normally results from its being anchored over an extended period of time.

By controllably regulating its buoyancy, hull 11 can thereafter be raised from its resting place to a floating position at the water's surface. Simultaneously, the operably carried deck, if still in place, is lowered along support column 13 to be as close as possible to hull 11. This relationship assures the seaworthiness of the entire structure particularly should it encounter inclement weather or rough seas.

Prior to being further used at an operating site hull 11 is provided with a new set of pile guides 17. Thus, the original set can be reamed out and new units fastened within the original pile guides. The new set of anchoring piles 16 is positioned on platform 10 by being lowered partially through the center opening of the pile guide 17 until coming to rest on the restraining device 31. They are further guided through pile clamps 23 carried at the periphery of the deck 14.

With the piles so positioned stage 14 is then depressed to its lowermost position. During the downward passage of the stage, it will of course operably retain contact with the upwardly depending piles 16. In such a position, the structure 10 will be fully loaded with its complement of anchoring piles and will again be a seaworthy unit which can be safely towed to an offshore site.

Other modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore, only such limitations should be imposed as are indicated in the appended claims.

We claim:

1. A buoyant marine structure for an offshore body of water adapted to be releasably fixed to the floor beneath said body of water and comprising;
 - a. a submergible hull having a deck support means extending upwardly therefrom, said hull including controllable buoyancy means therein adapted to regulate the disposition of said hull within said body of water,
 - b. pile guide means positioned transversely of said hull, being canted inwardly toward said support means, said pile guide means including an inlet at

the hull upper side and an outlet opening at the lower side thereof,

- c. a deck operably carried on said deck support means, and being movable along the latter between upper and lower positions with respect to said hull, at least one elongated cylindrical pile having the lower end thereof received in said pile guide means and having the upper end operably engaged at said deck, said at least one pile upper end being urged toward the deck whereby to bend the pile and cause the lower end thereof to be fixed within said pile guide means and to preclude downward movement of the pile when said deck is in the lowered position, and as said deck is elevated to its upper position, said pile being permitted to adjust into alignment with the pile guide means and to slide therethrough whereby to enter the substratum beneath said hull.

2. In an apparatus as defined in claim 1, including pile positioning means disposed in said pile guide means to engage the lower end of a pile and at least partially support the pile.

3. In an apparatus as defined in claim 2, wherein said pile positioning means includes a displaceable member engaging the pile lower end.

4. In an apparatus as defined in claim 2, wherein said pile positioning means includes a frangible member engaging the pile lower end.

5. In an apparatus as defined in claim 1, wherein said deck includes; an outer edge, clamping means carried on said deck edge being actuatable to releasably grasp a pile prior to the latter being lowered to the substratum.

6. In an apparatus as defined in claim 1, wherein said deck is formed with a substantially circular peripheral configuration, said pile guides being circularly arranged in said hull whereby said plurality of piles will be brought into alignment with said respective pile guides substantially simultaneously as said deck is raised toward the upper position.

7. In an apparatus as defined in claim 1, including; pile locking means carried on said deck to operably grasp the pile, and being actuatable to releasably grasp a pile to regulate movement of the latter during upward movement of said deck.

8. In an apparatus as defined in claim 7, wherein said pile locking means includes; cooperatively arranged rollers disposed about said pile and being operable to regulate movement of the pile.

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