

[54] **ARTICULATED MARINE PLATFORM**

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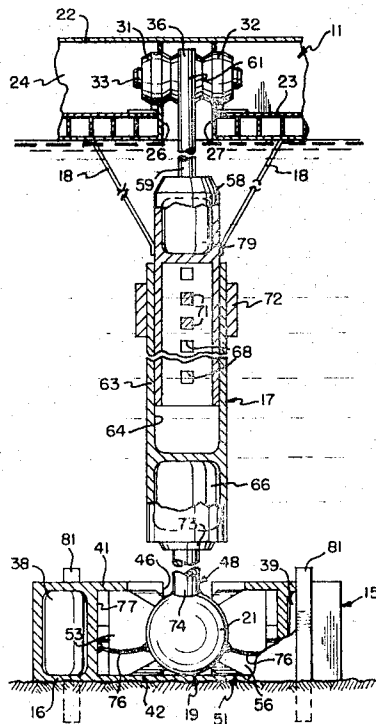
Primary Examiner—Jacob Shapiro

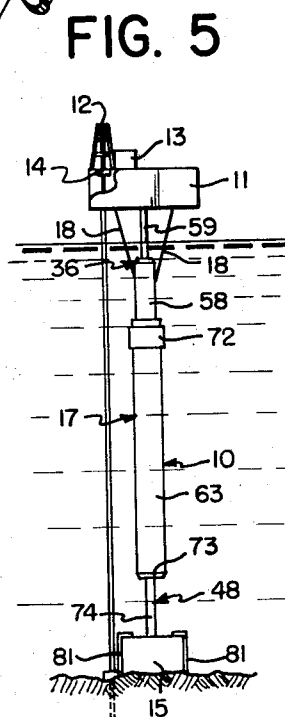
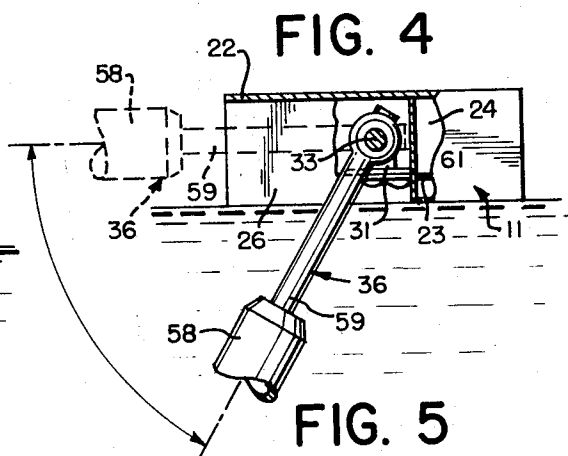
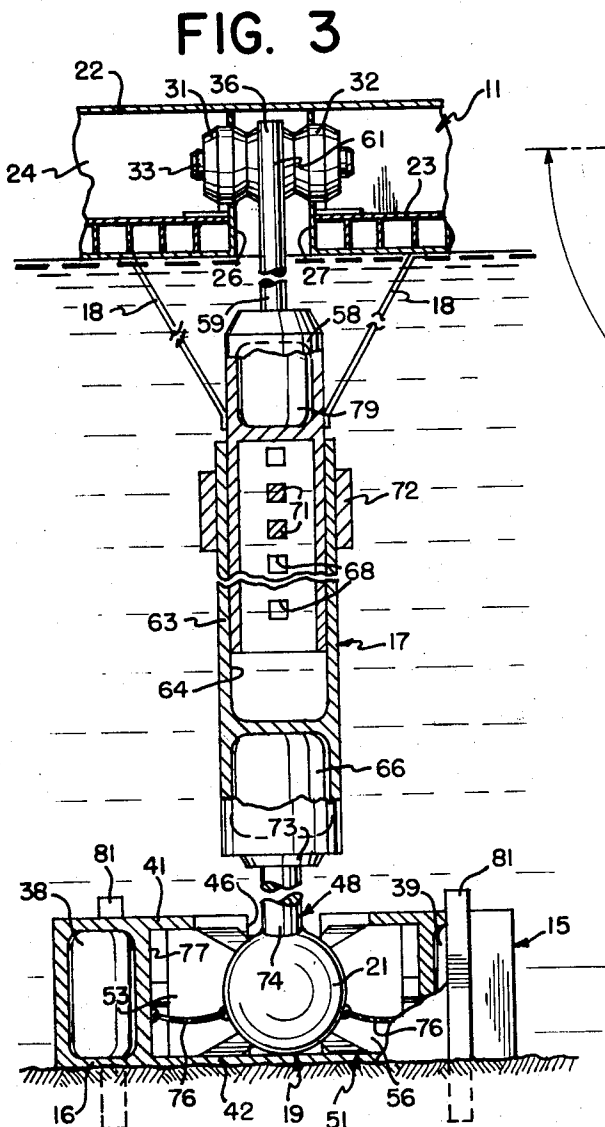
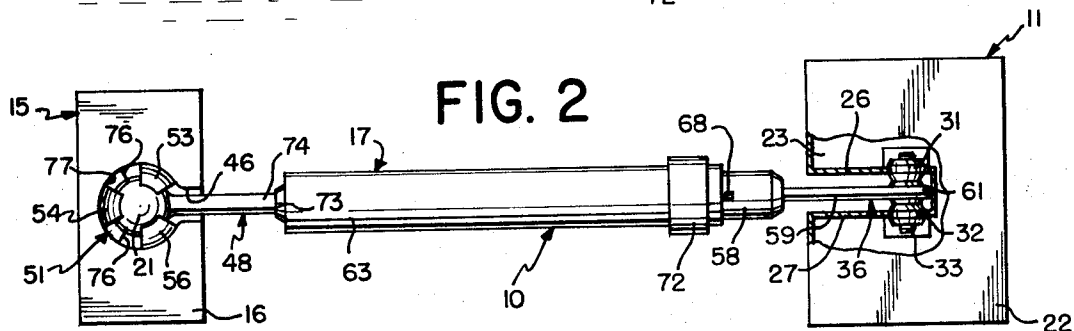
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[57] **ABSTRACT**

The invention relates to a monopad articulated marine structure for offshore waters, which unit comprises an anchoring base, a work platform which is normally positioned above the water's surface, and an intermediate support column. The latter is operably connected at opposed ends to the respective base and deck or platform whereby the entire unit can be readily floated to and from working sites.

1 Claim, 5 Drawing Figures





ARTICULATED MARINE PLATFORM

BACKGROUND OF THE INVENTION

In the exploration for and production of offshore petroleum sources, use of more versatile marine platforms has been the object of much consideration and innovative engineering. To permit such platforms to function in the deeper waters to which such exploration and development activities are gravitating, the platform must be adapted to satisfactorily withstand excessive stresses and strains due to the environment.

One form of such a platform which embodies many of the virtues of a stationary, as well as floating type unit, comprises a buoyant column that is free to move within limitations while being firmly anchored to the ocean floor. The column normally supports a work deck at the upper end, which deck is disposed beyond the ocean's surface.

One disadvantage of such units for deep water use is the difficulty in transporting or moving the platform between a shore based construction site and a distant offshore operating site, or between working sites. Preferably, the entire unit is controllably buoyant, which feature permits its being floated into place as well as being relocated at an alternate drilling location.

Toward achieving an improved platform of the type contemplated, the presently disclosed articulated unit embodies essentially three sections. Each of the sections is at least partially buoyant to permit being floated into place and yet facilitate the proper positioning of the platform for drilling and producing purposes.

The platform includes a work deck which is constructed as to be self-buoyant. The deck accommodates the normal complement of equipment peculiar to such offshore drilling and producing structures. The deck is normally supported in place in a substantially horizontal disposition to maintain said equipment above the water's surface. The lower end of the marine structure is provided with a controllably buoyant anchoring base which embodies anchoring means such as piles or other facility for rigidly maintaining the base in place at a particular working site.

The deck and base respectively are pivotally connected by a rigid, telescoping, column-like structure which operably engages each of said units. When in the working position, the column is buoyed into a substantially upright disposition; when being transported between sites it is horizontal.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation view showing the marine platform in a horizontally, floating position.

FIG. 2 is a top view of FIG. 1.

FIG. 3 is a sectional view of the marine platform on an enlarged scale.

FIG. 4 is a segmentary view in partial cross section showing the deck section.

FIG. 5 is an elevation view showing the platform in a vertical, floating position.

A preferred embodiment of the disclosed marine platform 10 as shown in the figures, includes a work deck unit 11 which comprises in effect a barge-like vessel incorporating internal, controlled buoyancy tanks not presently shown. When in operating position, the upper surface of deck 11 carries the normal complement of drilling equipment such as a derrick 12, draw

works 13, rotary table 14, as well as crew's quarters, storage facilities and the like.

Anchoring member 15 of platform 10 comprises a pad-like foundation base 16 which as shown, is held at the ocean floor forming a generally planer foundation. Base 16 also embodies internal, controllably buoyant tanks, operable from the water's surface to permit said anchoring member to be controllably submerged to the ocean floor, or raised from the latter as required.

An elongated column-like structure 17 is disposed generally uprightly in the water, being operably connected at its upper end to the deck 11, and at its lower end to anchoring member 15. When column 17 is so disposed, deck 11 is supported as to be rigidly fixed to the column by a bracing means such as removable brace arms 18 extending therebetween. However, the latter are positioned subsequent to column 17 being raised to its vertical disposition from its horizontal attitude at a drilling site.

Deck section 11 is formed of upper and lower spaced apart deck plates 22 and 23 connected peripherally by an intermediate wall whereby to form the unit into a substantially water tight hull. The deck interspace 24 is as mentioned, provided with the equipment and facilities peculiar to an offshore platform of the type contemplated. Referring to FIG. 2, deck unit 11 is provided on one side with a slotted portion defined by parallel walls 26 and 27 that extend from the deck center, outwardly to one side. Said slotted portion is of sufficient width to accommodate the upper end of column 17 when the latter is raised to a horizontal disposition.

Referring to FIGS. 3 and 4, deck interspace 24 is further provided with a bearing means including spaced apart journals 31 and 32 having aligned center openings which accommodate a shaft 33 extending therethrough. Shaft 33 is adapted to slidably engage in turn the upper end 36 of column 17 whereby to permit relative movement between the shaft and column respectively during the transition period as the column adjusts from horizontal to vertical disposition.

Anchor member 15 disposed at the opposed or lower end of column 17 is formed with a plurality of compartments or tanks 38 and 39. Said tanks are adapted to be remotely and controllably flooded to regulate both the disposition and the attitude of the anchor member either in the water or at the ocean floor. As shown in FIG. 3, said anchor member includes upper and lower, spaced apart panels 41 and 42 which, together with a surrounding wall, form the controllably buoyant compartments 38 and 39.

Anchor member 15, as in the instance of the above mentioned deck 11, is provided with a similar slotted section 46 extending from a point substantially centrally of the anchor, outwardly to the edge. Thus, said slot 46 is sufficiently wide to register the lower end 48 of column 17 as the latter is buoyed to a horizontal disposition.

Anchor member 15 is further provided with clamping means 51 for engaging the lower positioned pivotal ball 21 on column 17. As shown in FIGS. 3 and 4, said clamping mechanism includes a plurality of radially positioned jaws 53, 54 and 56, each having an inner face that slidably engages a substantial portion of the pivotal ball 21 surface. Said sliding engagement permits

restrained oscillatory movement of column 17 about hinged joint 19 while maintaining the column at the desired location. The ball clamping mechanism 51 can be sufficiently versatile whereby the respective jaws 53, 54 and 56 are adjustable to engage ball 21. However, a similar retaining grip can be achieved with a relatively stationary set of jaws having sufficient lateral space, between adjacently positioned jaws to permit the column lower end 48 to register therebetween when the column is in the longitudinal position.

Column 17 comprises as mentioned, upper and lower sections 36 and 48 respectively, which are preferably axially aligned to permit telescoping movement therebetween. Column 17 upper end 36 includes a body section 58 which can be formed of an elongated cylindrical member, or can be formed of a lattice work of structural beams. The column upper end 36 further includes a constricted neck 59 which comprises the base for an elongated bearing head 61. The latter is provided with a transverse opening extending therethrough in a direction normal to the column longitudinal axis. As shown in FIG. 3, when properly assembled, the column bearing head 61 slidably registers shaft 33, which in turn is received in the respective journal bearings 31 and 32 supported within deck 11. As so arranged, the column 17 is free to move restrictively within an arc of approximately 90° whereby the column can assume a parallel relationship to the water's surface, while remaining in operable engagement with deck 11.

The column 17 lower end 48 includes base portion 63 having an elongated cavity 64 extending longitudinally thereof and adapted to receive the upper column body section 58. Said longitudinal cavity 64 extends substantially the length of the column end 48, terminating above buoyancy tank 66. Cavity 64 is of sufficient length to permit the upper body section 58 to be slidably positioned therein for substantially the entire length of the latter whereby to minimize the length of the column during periods when it is being floated between operating sites.

The respective column end segments 36 and 48 are maintained in longitudinal alignment by a guide means which prohibits relative rotational movement between said two members. Each of said column segment members is further provided with a series of longitudinally spaced apart lug openings 68. Said openings are alignable with corresponding openings in the mating lower column segment to receive one or more positioning pins 71 carried in lug ring 72 disposed at the upper end of lower column section. Said pins 71 are remotely actuatable to lock or release the column segments as required.

Column 17 lower end as previously noted is provided at its lower end with a pivotal ball 21 which slidably engages the socket formed within the clamping mechanism 51 of anchor member 15. Said ball 21 is connected to the column lower end at a constricted collar 73 which terminates in an elongated shank 74. The latter as mentioned is of sufficient width to fit intermediate adjacently positioned jaws 53 and 56 when the latter are in the sliding engagement with said ball 21. As shown in FIG. 3, column 17 is maintained within the anchoring member 15 as a safety feature by one or more cables 76 extending from the ball lower end to the adjacent walls of the anchor cavity 77.

Operationally, the articulated structure is normally transported or floated between drilling sites while in the disposition shown in FIG. 1. Thus, the respective deck 11 and anchor sections 15 are buoyantly adjusted to float at the water's surface and to simultaneously support elongated column 17 disposed therebetween. The column ends will be so registered with respect to said anchor 15 and deck 11 as to be operably connected to each. Thus, in the event of severe water disturbances such as a storm or the like, which would normally effect the deck and anchor differently, there will be a degree of relative articulated movement permitted by virtue of the two terminal connections. Therefore, in spite of rough seas and other adverse conditions, there will be a minimum of strain imposed on the telescoped column during floating movement when the column is in a horizontal position.

To facilitate said movement between operating sites, the column segments are normally disposed in a fully contracted position whereby the respective portions are received one within the other. At the drilling site, to properly position the column in an upright alignment, the buoyant tank or compartments 38 and 39 within the anchor 15 are controllably flooded. As flooding continues, the buoyancy of the anchor unit 15 will be effected to the point where the latter will submerge, thereby aligning the column into an upright disposition.

By controlled buoyancy of both the column tanks 66 and 79 as well as the anchor unit 15, the entire structure will be floatably supported by the deck member 11. Release of the intercolumn locking means at ring 72 will then permit the lower end of the column to slidably detach from the column upper end, after which anchor 15 will descent to the ocean floor and engage the latter.

In the desired operating position, and as shown in FIG. 5, deck 11 is preferably raised beyond the water's surface to maintain the deck as well as the equipment carried thereon out of contact with the water. Thus, the column 17 upper end 36 will be extended either by mechanical and hydraulic means or it can be floated to bring the deck beyond the water's surface by controlled regulation of upper buoyancy tank 79 within the column end.

In either instance, and as shown in FIG. 3, with the deck raised to the upper position, or immediately prior to this adjustment, braces 18 are fastened into position firmly connecting deck 11 with the column upper end whereby to rigidize the relationship therebetween. Thus, sufficient weight will be exerted on the anchor to maintain the latter at its desired spot while still permitting oscillatory movement of the column as well as the deck in response to wind and wave movement. However, the anchor 15 can be provided with ancillary positioning means such as a plurality of piles 81 or anchors disposed thereabout which can be driven into the substratum to assure a firm positioning of the anchor in spite of lateral displacing forces.

With the platform in place, in the instance of a drilling operation, the necessary derrick 12 and draw works 13 will be hoisted into place at the desired location on the deck. The drilling operation can then be carried out through the deck and downward whereby to form one or more well bores into the ocean floor either through the anchor 15 or adjacent thereto.

When it becomes necessary to discontinue an operation at a particular site, the entire structure is released from its fixed location by disconnecting from the wells drilled, and by separating from the respective anchoring piles 81 in the normal manner. By controlled contraction, column 17 is telescopically brought together to permit the deck to be buoyantly supported at the water's surface. Thereafter, controlled blowing of the ballast tanks or compartments 38 and 39 in the anchor, will adjust the buoyancy of the latter until it is freed from the ocean floor and will gradually ascend to the water's surface.

Other modifications and variations of the invention, as hereinafter 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. An articulated, controllably submergible marine platform adapted to be floatably transported to, and at least partially submerged at an offshore site, said platform including;
an elongated column having opposed upper and

lower ends,

an anchor pivotally connected to said column lower end to permit relative movement between said anchor and said column, a buoyant deck operably engaging said column upper end and including;

means for controllably regulating the deck buoyancy to at least partially support said platform within a body of water as well as at the water's surface, a unitary bearing means carried on said deck,

a slotted portion formed in said deck and extending between said bearing and the deck outer edge, said slotted portion being of sufficient width to register said column upper end therein when said column is adjusted to a horizontal position in the water's surface,

said column upper end engaging said unitary bearing means whereby to permit pivotal movement therebetween when said deck is in horizontal disposition in the water's surface, and to permit the subsequent pivoting of the column to an upright disposition, to be floatably supported by said buoyant deck at said offshore site.

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