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Pogonowski

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[54] **ASSEMBLY SYSTEM FOR A DETACHABLY CONNECTED OFFSHORE MARINE STRUCTURE**

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[52] **U.S. Cl.** **61/46.5**

[51] **Int. Cl.** **E02b 17/00**

[58] **Field of Search** 61/46.5, 46, 63, 50, 52

[56] **References Cited**

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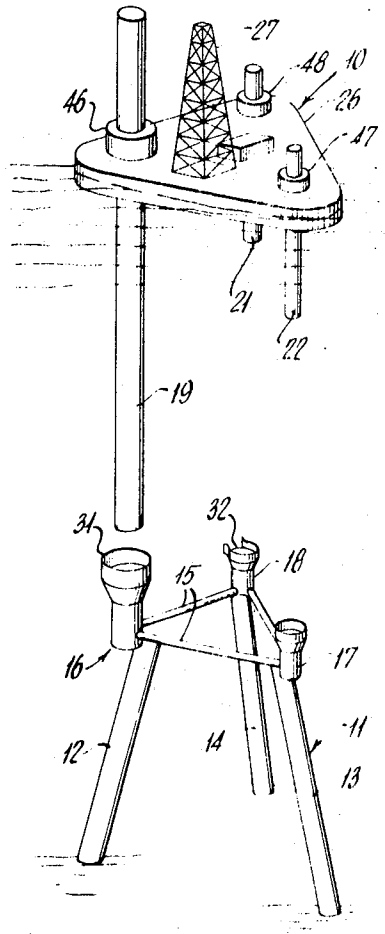
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[57] **ABSTRACT**

The invention relates to an offshore marine structure characteristic of the kind adapted to be positioned in a body of water. The structure includes a lower pedestal that is anchored, piled or otherwise firmly fixed to the floor of the body of water. A deck section normally elevated above the water's surface, is supported by a plurality of downwardly extending columns or legs that connect it to said lower pedestal. The respective members are brought into unitary engagement by supporting at least one of said legs from the buoyant deck while the latter is floating. The said one leg thereby engages its lower end in a docking receptacle carried on the anchored pedestal. Thereafter, by rotating the deck at the water's surface in such a manner as to pivot about the single connected leg, the remaining support legs are brought into correct alignment as to be lowered and similarly engage other docking receptacles at the pedestal.

6 Claims, 3 Drawing Figures



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SHEET 1 OF 2

Fig. 1.

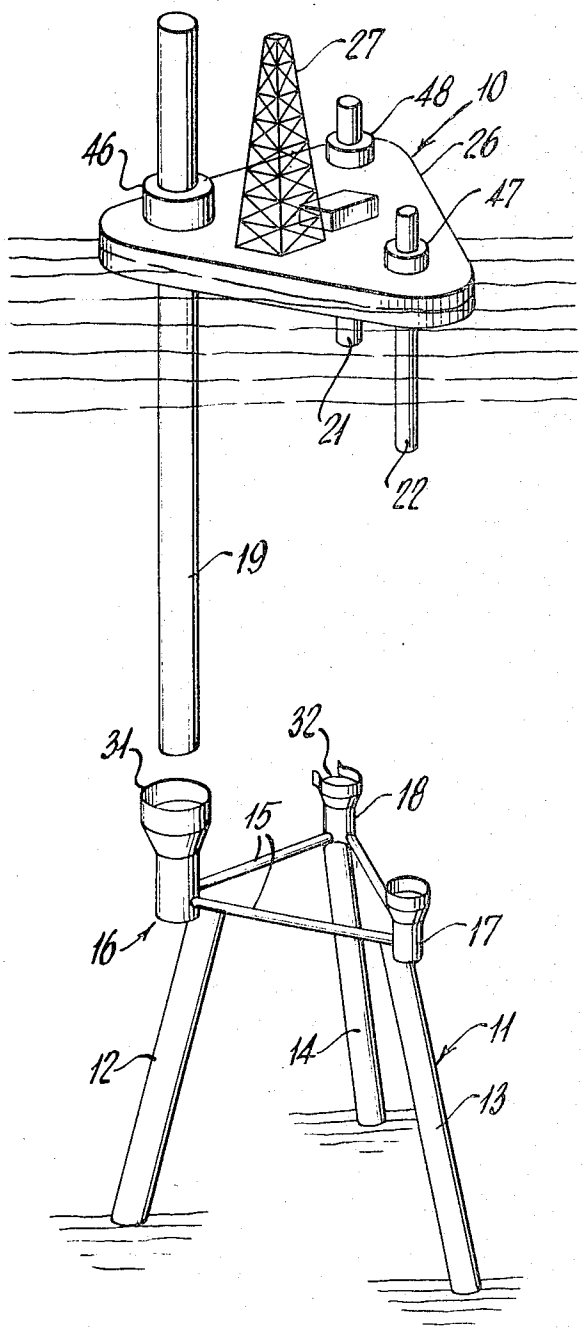
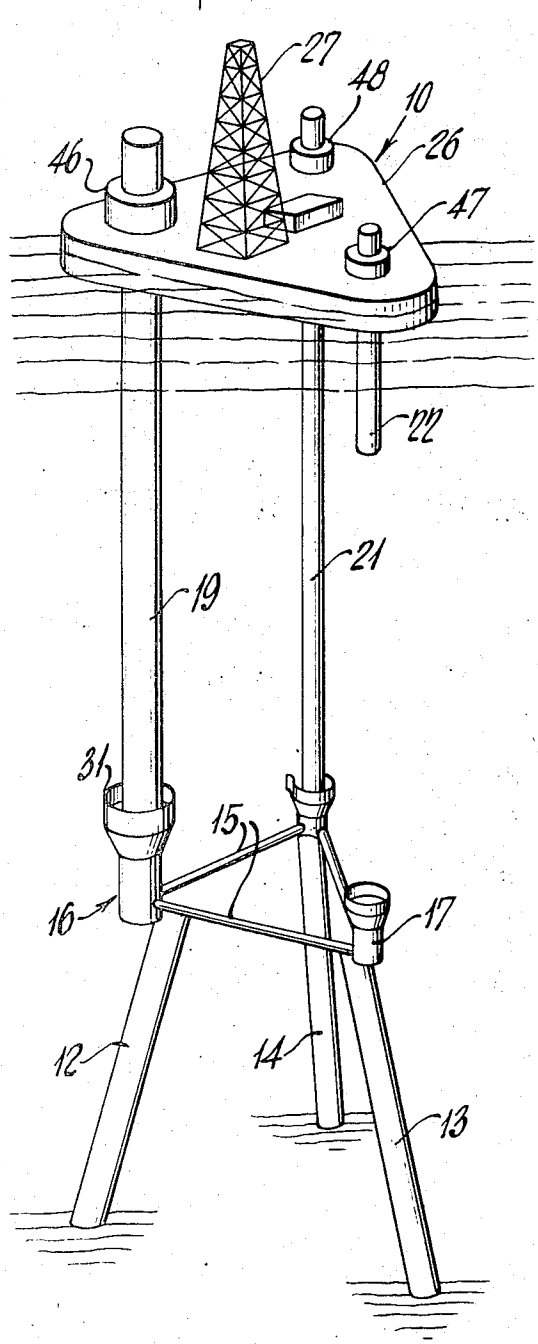


Fig. 2.



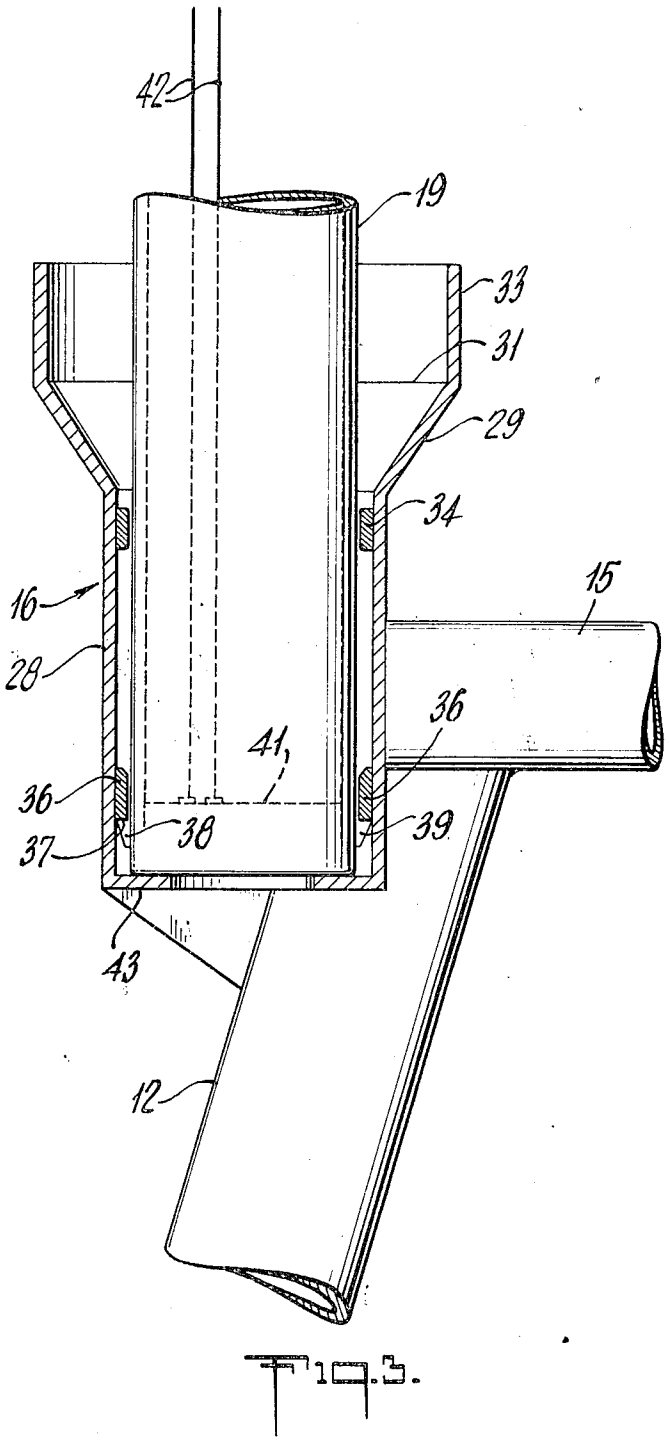


FIG. 5.

ASSEMBLY SYSTEM FOR A DETACHABLY CONNECTED OFFSHORE MARINE STRUCTURE

BACKGROUND OF THE INVENTION

In the offshore exploration for and production of various materials such as oil and the like, the most expeditious form of platform utilized to accomplish an efficient operation consists of a stationarily anchored structure. Normally such anchoring is achieved by the use of piles which extend into the substratum a sufficient distance to firmly anchor the platform.

In the instance of marine structures located in excessive water depths, it is understandable that for engineering stability, the lower section must be provided with a relatively broad base. Further, interconnecting sections between the base and the deck require a considerable amount of steel to provide the necessary strength and rigidity to the overall structure.

One means whereby the cost of such marine platforms is minimized is through the use of a disconnectable type platform that embodies at least three operably engaged members. These members include a pedestal, fixedly positioned to the ocean floor by piles, anchors or the like. A work deck, normally elevated beyond the water's surface carries the necessary drilling and/or producing equipment characteristic of such platforms or to the particular operation.

The spaced apart deck and pedestal members are mutually joined by at least one, and more commonly, by a plurality of downwardly extending legs or support columns which operably engage each of said respective members.

At the lower end, the legs are firmly connected to receptacle means in the pedestal. Simultaneously, the legs' upper ends are operably connected to a suitable jacking apparatus in the deck. Thus, the latter can be progressively elevated beyond the water's surface a sufficient distance out of the reach of storm waves, once the support columns are firmly fixed at the ocean floor.

This type of structure has the unique advantage of being detachable such that the major portions thereof can be moved from a particular drilling or producing location and utilized at an alternate site. Such an operation is achieved by uncoupling the lower end of the respective support columns from their connecting receptacles. Thereafter the columns are raised towards the water's surface, and the individual units are towed or otherwise floated away. The individual members can subsequently be reassembled and used at an alternate location merely by reassembling the columns to the deck, lowering the latter to engage a corresponding pedestal at the alternate site, and adjusting the deck to a proper operating height.

Aside from the economic practicality thereof, one of the problems inherent in the use of such structures is the difficulty encountered to properly align columns lowered from the floating deck. This must be achieved in such a manner as to engage corresponding docking receptacles at the ocean floor.

An ever changing, yet present detriment to such an operation is the weather conditions at the surface of the water. Thus, the floating deck section can be controllably moved about, and at times rigidly positioned only with great difficulty. Further, depending on the depth of the water in which the marine structure is located, water currents and other force inducing factors tend to urge or displace lowered columns as to make the coupling operation arduous.

In the arrangement presently disclosed, a floor positioned pedestal structure is provided at an under water well drilling site. Said member includes a plurality of upwardly facing docking receptacles which are adapted to receive the lower ends of support legs depending downwardly from a floating deck. At least one of said docking receptacles is adapted to pivotally receive the lower end of a support column, whereby to position the lower end of said column yet permit rotation of the deck about the upper end of the column. Thus, subsequent to the initial pivotal connection being made between deck and pedestal, the deck section is adjusted in the water by tugs or by self propulsion to be rotated about said pivotal column. Adjustment is made until a second downwardly extending leg engages a corresponding receptacle.

DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a vertical elevation view showing the pedestal and deck section disconnected.

FIG. **2** is similar to FIG. **1** illustrating the deck and pedestal section in partially connected condition.

FIG. **3** is a segmentary view on an enlarged scale and in cross section showing the portion of the pedestal receptacle.

Referring to FIG. **1**, a marine platform **10** of the type contemplated includes a plurality of removably connected discrete structural elements. A pedestal section **11** positioned at the floor of the body of water, includes at least three upstanding lateral members **12**, **13** and **14**. The latter are connected into a rigid open framework through a plurality of intermediate cross elements such as **15**. The pedestal is normally formed of steel, tubular units which are terminally welded one to another to form the necessary open framework structure.

Pedestal **11** is provided with a sufficiently expansive lower base to afford the subsequently assembled upstanding column an adequate degree of stability whereby to avoid being laterally displaced or upset by wind and wave forces. Similarly, the height of pedestal **11** is such as to afford the latter sufficient strength to support a deck or similar member. Toward this end, pedestal **11** serves the additional function of defining a protective network above well heads that have been drilled into the ocean floor within the periphery of the pedestal. Such well heads are normally provided with remotely operated Christmas tree arrangements to control the well's production rate.

Pedestal **11** is provided in addition with a plurality of corner positioned, elongated receptacles **16**, **17** and **18**, which are disposed in a generally axial orientation with respect to the pedestal legs **19**, **21** and **22**. Said receptacles as shown, normally comprise a minimum of at least two, and preferably several sections. There, three such sections adequately support the surface mounted deck section **26** as to prohibit movement of the latter regardless of the displacing wind and wave forces.

Deck section **26** is provided with a plurality of leg jacks **46**, **47** and **48**. Said members are well known in the art and can assume a number of configurations depending on the type of support leg which is utilized. In

the instant arrangement, the respective jacking mechanisms are located most advantageously about the edge of deck **26** and include a center opening which operably receives an elongated support column so as to engage the periphery of the latter. Thus, with the respective columns firmly positioned in pedestal **11** and extending upwardly through deck **26**, the latter can be elevated along the columns as to be a desired distance beyond the water's surface.

As noted above, the function and the operation of the respective leg or column jacks is well known in the art and the structure thereof will not be considered further. Said jacks however are individually operable and cooperate with lateral openings or other appurtenances formed on the leg external surface whereby to afford a satisfactory releasable grip between the jack and the leg surface for climbing purposes.

Deck **26** as herein noted is provided with the usual accouterments ancillary to a drilling and/or producing operation. Structurally, deck **26** comprises a buoyant, enclosed body whereby to floatably support equipment carried thereon. In the instance of a drilling platform, deck **26** is provided with an upstanding derrick structure **27** as well as with a rotary table positioned immediately therebelow. The latter is connected to a draw works which, through the table, rotates a drill string supported from derrick **27**.

Further, while not presently shown in detail, deck section **26** is at least partially enclosed as to form the buoyant, barge-like member embodying a sufficient degree of buoyancy to be self supporting as well as to carry the respective support columns **19**, **21** and **22** prior to the latter engaging corresponding receptacles at the pedestal.

In the majority of cases the floatable deck sections or platforms are towed by tug or other propulsion means between successive working spots. In some instances however, and toward making the platform more self sufficient deck section **26** is provided with one or more drive mechanisms. These can be in the form of power units together with suitable outboard propeller means. The propulsion units are suspended from the deck or so positioned as to be lowered from the deck into the water. Thus, when such a self contained power unit is utilized on a deck section, the latter can be readily rotated or maneuvered to adjust and properly align above pedestal **11**.

The respective support legs or columns **19**, **21** and **22**, which operably connect pedestal **11** with the deck **26**, comprise in their simplest form an elongated continuous element generally of cylindrical disposition. For convenience, the column is fabricated of a plurality of shorter lengths of steel pipe having a uniform diameter. The short lengths are sequentially end welded until the proper length of column is achieved for a particular water depth. The walls of the support column can be provided as noted, with suitable openings or appurtenances positioned to engage corresponding jaws or actuating mechanism on the deck positioned column jacks.

The column-like support legs preferably are fabricated of steel to provide maximum strength. In the instance of the present arrangement the columns are of uniform diameter to afford uniformity in structure. However, initially lowered column **19** can be of a substantially greater diameter than the remaining support columns. Added strength is required here since column **19** is subjected to additional stresses as a result of the procedure for pivoting deck **26** into proper alignment whereby remaining support columns can be accurately lowered to pedestal **11**.

Referring again to pedestal section **11** and to FIG. **3**, the respective column receptacles, **16** for example, comprise in essence an elongated body **28**. The latter is disposed about a lower locking section, which is adapted to slidably receive a predetermined length of support column **19**. The upper end of said locking section **28** is provided with a frusto conical neck **29** which opens at an enlarged inlet **31** of substantially greater diameter than the diameter of the pivotal column **19**. The function of said enlarged inlet **31** is to facilitate the initial engagement and proper alignment between the lower end of column **19** as the latter descends from the deck **26** toward pedestal **11**. The upper edge of said frusto conical neck **29** can be further provided with a rim **33** to further facilitate guiding of the column lower end into the column docking mechanism.

Under normal operating conditions, and as herein noted, pivotal column **19** is lowered from the deck **26** through the jacking mechanism **27**. The column is thus sequentially elongated by welding together of the respective column sections. As the lower end of the column arrives at the vicinity of the ocean floor, deck **26** is manipulated to bring the column lower end into alignment with the corresponding docking mechanism or receptacle **16**, such that the column can be grasped.

Positioning of the floating deck section **26** to achieve alignment of leg **19** with receptacle **16** can be accomplished through any of several known guidance systems. Such a guidance means can include use of sonar or other electronic oriented equipment whereby the deck section is accurately maneuvered at the water's surface to properly align the lowered leg.

One embodiment of the locking means in each pedestal receptacle, and as shown in FIG. **3**, each leg is provided with one or more longitudinally spaced clamping rings **34**. The latter are actuated between retracted and expanded or locking positions through control lines which extend to the water's surface. Such remote actuation can be by way of hydraulic, pneumatic, electrical or other suitable system.

A retaining ring **36** is carried at the inner wall of body **28** to permit rotation of column **19** while simultaneously restraining the latter from vertical movement. Said ring **36** includes a lower bearing surface **37** positioned to engage locking means extending outwardly from the column surface.

Said locking means can take the form of any of several such devices adapted to removably engage the locking or bearing surface **37**. In one embodiment the locking means includes a plurality of radially actuated lugs **38** and **39** disposed within actuating ring **41**. The latter operably positions the respective lugs whereby to permit radial reciprocal movement thereof as will be required. Said ring is communicated with a surface based source of power through lines **41**.

Normally the actuating ring will include internal mechanism urged to the expanded and contracted positions through a hydraulic system. Thus, the leg **19** is positioned as shown in FIG. **3**, that is with the lower

edge thereof engaging backing plate **43**. The radial locking lugs **38** and **39** can then be actuated into an expanded position such that the upper surface thereof engages the lower surface **37** of ring **36**. The leg will in such condition be restrained from vertical movement, while being permitted to rotate. Upstanding leg **19** will in such position function as a pivoting point for the deck section **26** as the latter floats at the water's surface.

A second docking mechanism **18** is provided at an alternate position on pedestal **11**, normally at one corner thereof. Said second docking mechanism **18** is disposed preferably with the upper end thereof at a lower elevation than the previously mentioned docking mechanism **16** to facilitate the positioning of second support column **22** as deck **26** is pivoted about the initially connected support column **19**.

Said second docking mechanism **21** comprises a similar, elongated jaw section and is adapted to removably connect with the lower end of support leg **21**. The upper end of said mechanism is likewise provided with an enlarged lateral opening **32** which provides an entranceway whereby the arcuately moving support column **21** will engage said entranceway **32**, and be positively aligned with the lower positioned column locking mechanism.

As floating deck section **26** is rotated through the water about pivotal column **19**, the lower end of column **22** will register with its docking receptacle. Thereafter, by actuation of column supporting jack **48**, the entire column **22** is controllably lowered until the column end is suitably seated and engaged within docking section **18**.

With deck **26** and pedestal **11** now fixedly positioned by the interconnecting columns **19** and **22**, the locking sections at the respective docking receptacles are actuated to firmly grip the column lower ends. Such column grasping mechanisms can assume a number of dispositions, the most simple of which is a set of jaws, here shown in FIG. **3** as ring **34**, which are radially movable with respect to each other as to be actuated radially inwardly to engage the column outer walls. In such a manner the respective support columns will be fixedly locked in a vertical disposition to steady the floating deck section **26**. Thereafter, remaining support columns such as **22** can be readily lowered through the deck positioned jacks to align with, and engage corresponding column receptacle at pedestal **11**.

Similarly as above noted, each of the support columns is firmly locked at the lower end. When so located, deck **26** is in a condition to be elevated from its floating position at the water's surface a sufficient distance beyond the latter to facilitate either a drilling or producing operation. By the simultaneous actuation of the respective jack mechanisms, deck **26** is raised 50 or 60 feet beyond the water's surface such that the deck and its contents are in effect protected from the action of water, waves and the like. Thereafter the derrick suspended drill string and bit can be lowered in the usual manner to a position intermediate the base of pedestal section **11** for the drilling of one or more wells.

At such time as no further activity is contemplated at the platform location, deck **26** as well as the respective support legs **19**, **21** and **22** can be disconnected from pedestal **11** and removed. Such a move is appropriate when it is determined that the field is either unproductive, or the wells are cemented for future use. In either event, the raised deck section **26** is floated to the water's surface. The lower ends of the support legs are remotely disconnected from the pedestal **11** to permit the legs to be sequentially withdrawn from their docking receptacles.

The legs are raised by actuation of the deck based jack mechanism to bring the legs or column upwardly a sufficient distance to clear pedestal **11**. Depending on the depth of the water, the legs or column can be retained within the jacking sections for transportation, or they can be disconnected into smaller more readily manipulated lengths. With the removal of all the legs from the pedestal, pivot column **19** is released from its receptacle and similarly elevated through its deck mounted jack **46** to completely disengage the deck from the pedestal.

With the deck **26** again in a floating condition, the latter can be moved through the water to another location at which a pedestal has been previously installed at the under water site. Engagement of deck **26** with the pedestal then follows the procedure described herein. Such an operation at a new location can be for the purpose of drilling new wells, or merely for the purpose of a workover on producing wells after a period of operation. In either instance deck **26** is again positioned such that pivot column **19** can be lowered through jacking mechanism **46** until the column lower end engages the corresponding docking receptacle. Thereafter, the remaining support legs are lowered in turn until each leg is aligned with and engaged with its receptacle as to be firmly positioned and permit the deck to be elevated.

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

I claim:

1. A marine platform comprised of selectively connectable members to permit assembly of said members into a unitary structure at an offshore body of water, which platform includes;

a. a pedestal, having a base including column locking receptacles, fixedly disposed at the floor of said offshore body of water,

b. a buoyant work deck having a plurality of support column jacks thereon adapted to individually receive and operably engage a support column,

c. a plurality of said support columns having opposed upper and lower ends respectively, each of said columns having an upper end registered in a support column jack on said work deck, and a column lower end releasably received at said pedestal, said respective support columns being aligned in a generally upright disposition, and clamping means in said column locking receptacles being actuatable to engage a support column whereby to affix the latter within said receptacle.

2. A marine platform as defined in claim **1**, wherein said respective column clamping means includes; control means extending downward thereto from the water's surface and actuatable from said surface to permit locking of said respective clamping means on a column lower end.

3. A marine platform as defined in claim 1, including; means for separably engaging at least one of said support columns connecting said pedestal and deck respectively, to permit pivotal floating movement of the deck about said at lease one support column, whereby to properly align remaining support columsn with said pedestal.

4. Method for assembling a marine platform at an offshore body of water, said marine platform comprising discrete and separably engaged elements including a pedestal adapted to be fixedly positioned to the floor of said body of water and having upwardly facing, remotely controllable column locking clamps, at least one of said locking clamps including a lateral opening to receive a support column into a side thereof, a floatable work deck disposed above said pedestal including a plurality of support column jacks arranged in vertical alignment with said column locking clamps on said pedestal, a plurality of elongated support columns, which method includes the steps of;

a. aligning said work deck when in a floating condition, at the water's surface with said pedestal at the floor of said body of water,

b. lowering a first support column from said deck to align with and engage a column locking clamp at said pedestal,

b'. lowering a second support column from said deck to a position corresponding to the height of said at least one locking clamp having said lateral openings therein,

c. pivotally rotating said work deck about said first support column to engage said second support column with said corresponding column locking clamp having said lateral opening therein,

d. thereafter lowering the remaining support columns to engage a locking clamp at the pedestal.

5. Method as defined in claim 4, including the steps of fixedly engaging one end of said first support column and slidably engaging the other end thereof to permit said rotative movement of said deck with respect to said pedestal.

6. Method as defined in claim 4, including the steps of fixedly locking the lower ends of said respective support columns into said pedestal subsequent to engagement of the second of said support columns with said at least one locking clamp.

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