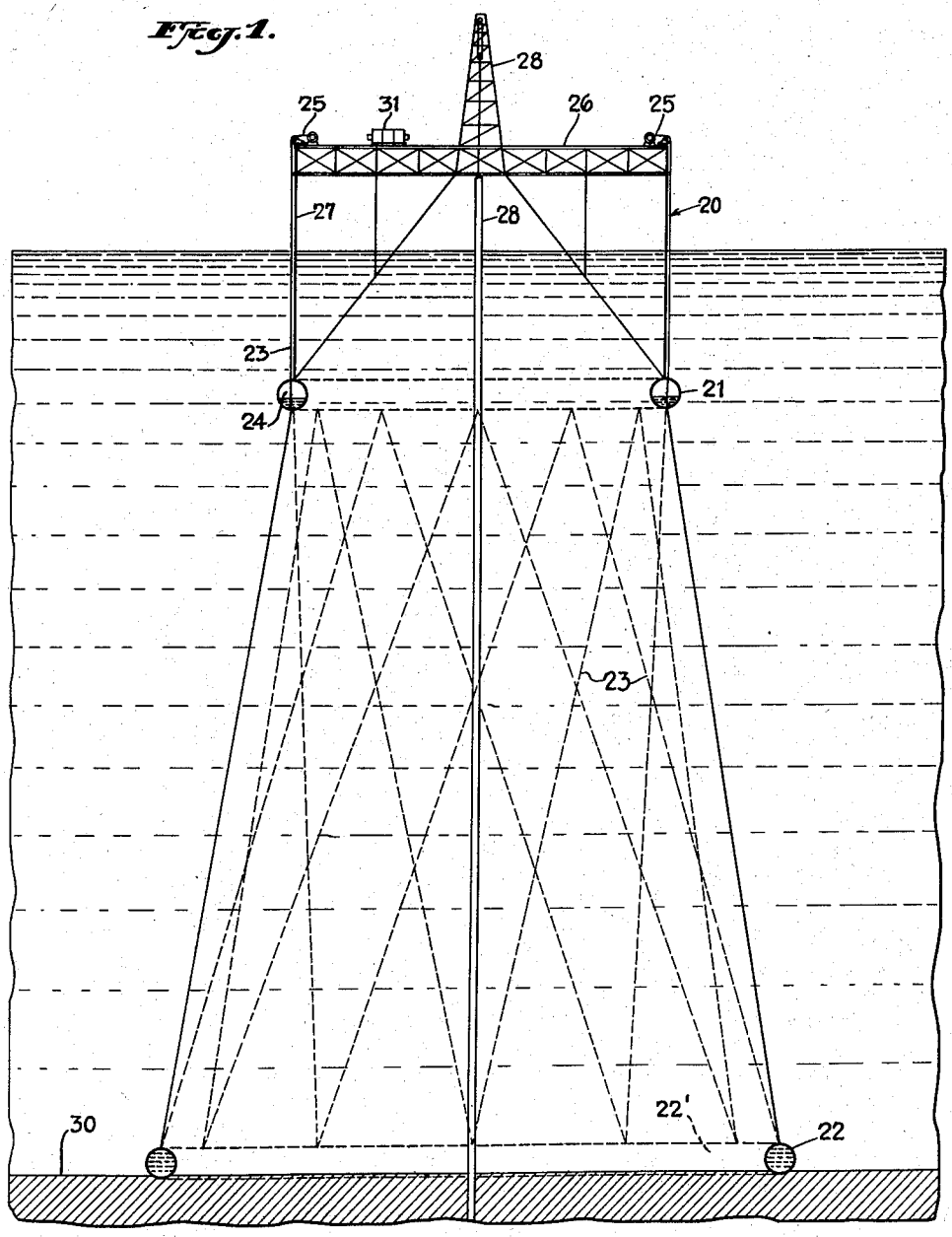
Oct. 13, 1959 R. O. MARSH, JR 2,908,141

MARINE PLATFORMS

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Fig. 1.



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MARINE PLATFORMS

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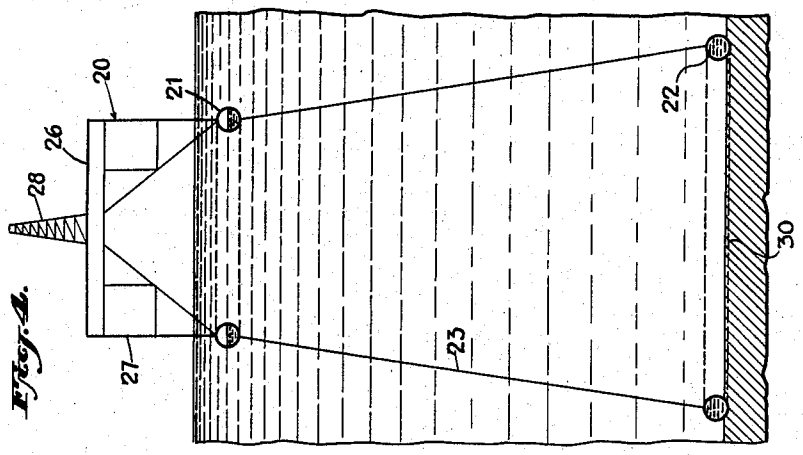


Fig. 4.

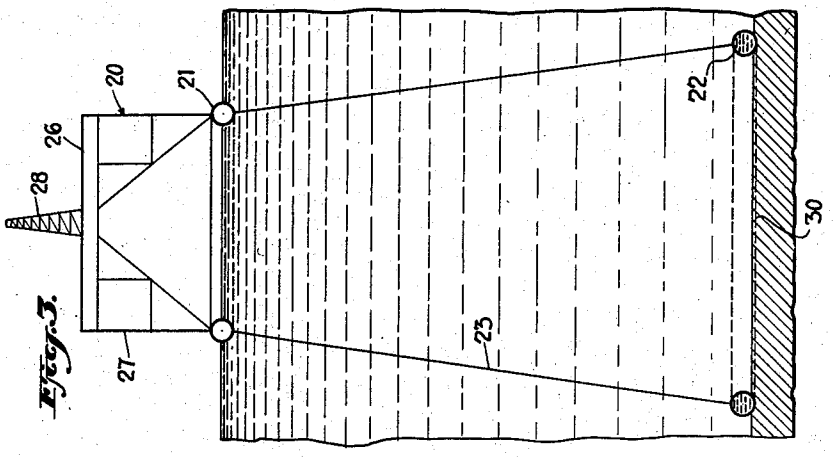


Fig. 3.

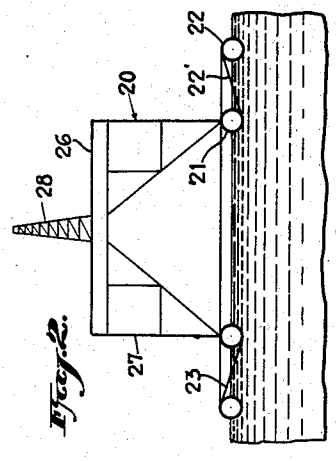


Fig. 2.

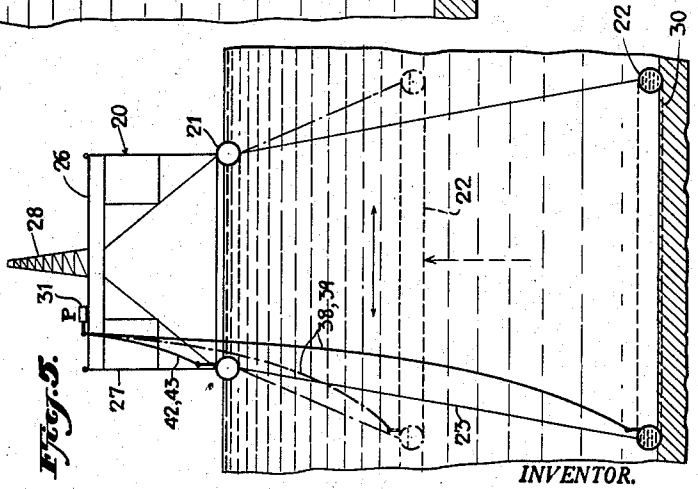


Fig. 5.

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Fig. 7.

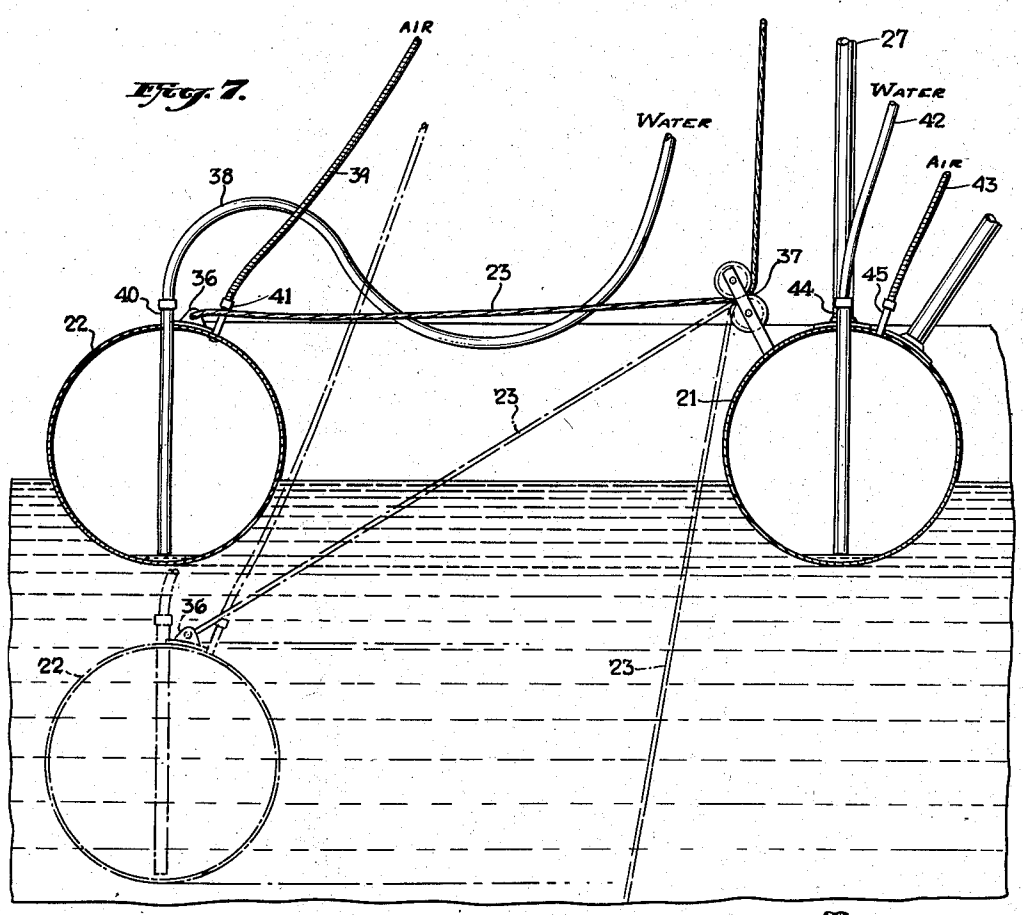
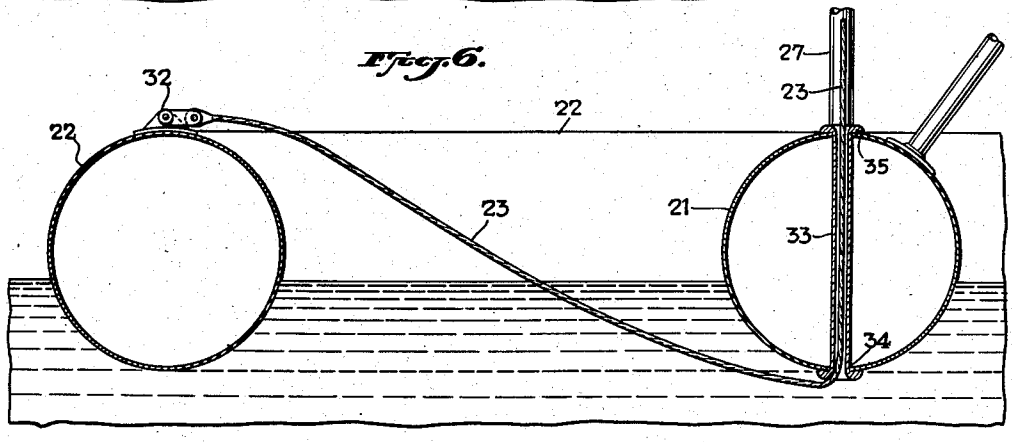


Fig. 6.



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2,908,141

MARINE PLATFORMS

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Application July 23, 1954, Serial No. 445,303

2 Claims. (Cl. 61—46.5)

This invention relates to mobile marine platforms of types which can be anchored in any desired off-shore location, and more particularly it relates to such platforms which are designed for use in ocean depths of considerable magnitude.

Mobile marine platforms of various constructions are well known but certain disadvantages however have been manifested in their actual operation. These types of platforms find utility in many fields but are most advantageous in off-shore oil well drilling operations. In order to meet the requirements of a successful off-shore oil well drilling operation it is a primary requisite that the platform used be stable regardless of the condition of the sea in which it is anchored. In an effort to provide this necessary stability the platforms heretofore known have in many instances employed rigid supporting studs or columnar structures which extend downwardly from the platform to the anchor means positioned on the sea bottom. While such constructions are quite satisfactory for shallow water operations, it is obvious that, when the ocean depths at the desired location range into the hundreds of feet, such rigid members must necessarily be of such magnitude as to be cumbersome, unwieldy and too costly. Since the platform, to be useful, must be self-contained as well as mobile, the problem of transporting such huge rigid supporting structure becomes a practical impossibility when substantial ocean depths are involved. In order to successfully operate such platforms in depths beyond 100 feet for example, experience has indicated that cables or similar flexible anchor lines, that can be conveniently stored on deck when the platform is being towed, should be used to interconnect the working platform with its anchorage base. Although various platform constructions have been proposed which do employ such flexible anchor lines they have failed to satisfy the requirements of providing a stable working platform while maintaining a construction which is simple enough to avoid continual operational difficulties or breakdowns. It is of course obvious that the problem of maintaining stability assumes greatly increased proportions when flexible cable or chain means, rather than rigid supports and the like, are used to interconnect the platform with its anchor. Any such flexible anchor lines must be maintained uniformly under tension if the platform is to resist pitching and tossing under the normal wave action and since the tendency of any floating body is alternately to rise on the crest and then fall in the trough of such waves, thereby alternately causing strain and slack in cables, the problem of maintaining uniform tension is a difficult one. Moreover when flexible anchor lines are utilized the problem of avoiding tangling or snarling thereof with resultant operational breakdowns is of course of distinct importance. Heretofore proposed constructions using such flexible anchor lines have involved a plurality of individual anchors with the natural result being a shifting of one anchor relative to the other as a consequence of any severe strain being applied to the cable or cables running to that particular anchor. This

involves the danger of tangled anchor lines. Moreover in order to provide a suitably broad and stable anchorage base, it would be desirable to have such anchor lines extend downwardly and outwardly at an angle from the platform rather than merely vertically downwardly. With a plurality of individual anchors such an anchorage base is difficult to maintain since the natural tendency of those anchors will be to shift or creep inwardly to a position beneath the platform. Any such movement of course not only destroys the broad anchorage base but also causes the anchor lines to become slack thereby destroying the stability of the platform. When it is realized that sometimes the ocean depths involved may range up to hundreds of feet, the dimensions of such problems take on more serious proportions.

These and other disadvantages of the constructions heretofore known are overcome by the present invention which provides a mobile marine platform relatively simple in construction and in its principles of operation, and designed moreover to provide a working deck space which is stable under all the usual conditions of the surrounding sea, and furthermore capable of operation in ocean depths of the order of 100 to 600 feet. The platform of the invention comprises a unitary float member carrying an elevated deck structure and a unitary anchor member connected to said float member by flexible anchor cables or chains. Both members are buoyant and have hollow chambers which are provided with suitable conduit connections designed to permit the entry and removal of water as desired in order that their bnoyancy can be adjustably controlled. The horizontal dimensions of the anchor body are considerably greater than those of the float body so as to provide a broad based anchorage means and said anchor body is preferably provided with an open central portion of a size sufficient to encompass the float body. Thus in the mobile condition of the platform both members may float on the surface of the water with the float member positioned within the central opening of the anchor member. Furthermore it is preferable according to the invention that the float and anchor members be so proportioned relative to one another that the net buoyancy of the float member be great enough to support the weight of the anchor body when the latter is completely flooded with water.

Preferably the anchor member is in the form of a large hollow sheet metal ring which may be of circular cross-section. However, the ring may be rectangular, square or polygonal cross-section. Also, the float member may preferably be in the form of a hollow sheet metal ring either circular or other shape preferably corresponding to the shape of the anchor member.

In operation the platform is towed to the desired off-shore location and the anchor member is then flooded with water thereby causing the same to submerge until it finally comes to a position of rest on the sea bottom. During this descent of the anchor body, the anchor cables, which run from winches provided on the elevated deck through suitable guide means on the float member to the anchor member, are of course slacked off. With the anchor member in this position, the float member and its elevated deck are in effect tied to the ocean floor, but, since such float member is still free to rise and fall in the trough of surface waves, stability is lacking. To provide this essential stability the float member is partially flooded with water so as to decrease its buoyancy to an amount which is insufficient to support the weight of the anchor member. Tension is then applied to the cables by taking up on the winches and the float member is thereby pulled down until it is totally submerged below the water surface at a level which is below the trough of the largest contemplated waves. Due to the continuous upward buoyant force upon the float member in this position,

the anchor cables will be continuously held under tension and therefore the working deck space will be maintained stable. And if this working deck space is originally constructed at a sufficient height above the float member, it can be maintained at a level which is above the crest of the highest contemplated waves even when the float member is thus submerged. When it is desired to move the platform to a new sea location the water is pumped out of the interior of the float member thereby increasing the buoyant force exerted by said member to its original amount which by initial design is greater than the weight of the anchor body. Once this has been accomplished the float member will lift the anchor member from the sea bottom and will itself return to the water surface. Then by taking up on the winches, the anchor body can be raised further, and when it nears the surface of the water by pumping out its hollow interior, it can be floated the remaining distance to the surface. The platform is then in position for movement to the next off-shore drilling location.

Other and more specific objects, features and advantages of the invention will appear from the detailed description given below, taken in connection with the accompanying drawings which form a part of this specification and illustrate by way of example the present preferred embodiment of the invention.

In the drawings:

Fig. 1 is an elevational view showing the mobile platform of the invention anchored in operating position.

Fig. 2 is a schematic elevational view showing the platform in mobile condition with both float and anchor members at the water surface.

Fig. 3 is a somewhat schematic elevational view, showing the platform with the parts thereof in the positions assumed after the anchor member has been submerged.

Fig. 4 is a similar elevational view showing the float member partially flooded and on its way down to a level beneath the trough of the largest contemplated waves.

Fig. 5 is a schematic elevational view of the platform showing the anchor member being raised to the surface.

Fig. 6 is an enlarged fragmentary view showing one means of rigging the anchor cables between the float and anchor members, and

Fig. 7 is a view similar to Fig. 6 but showing an alternative embodiment.

Referring now in further detail to the drawings and particularly to Fig. 1 there is shown a mobile marine platform **20** which comprises a ring-shaped, water tight float member **21** and a similarly ring-shaped water tight anchor member **22**. Both of these members are preferably fabricated from steel or other suitable sturdy structural material such as is capable of withstanding the enormous stresses to which a device of this type must be subjected. It should be understood that while these members are preferably ring-shaped as shown, they may also assume various other shapes such as a rectangular frame-like structure. It is preferred however that the anchor member be substantially larger than the float member and be provided with an open central portion **22'** which is large enough to receive said float member. When ring-shaped, the anchor member preferably has a diameter approximately twice that of the diameter of the float member. Thus when this type of platform is to be used in ocean depths ranging from 100 to 600 feet the float member can for example have a diameter of approximately 200 feet and the anchor member a diameter of approximately 400 feet. Interconnecting these two members are a plurality of anchor cables or chains **23** which are secured at one end to the anchor member and extend therefrom to or through suitable guide means **24** provided on the float member and thence upward to winch and pulley means **25** positioned on a working deck **26**. The cables are preferably, although not necessarily, arranged in crisscrossed relation as shown. The word "cables" as used herein is intended to include chains or

the like linkages as well as wire or other forms of rope or cables. This working deck is supported from the float member **21** by rigid tubular or fabricated supporting columns **27** which rise from said float member and maintain the deck **26** at a fixed elevation thereabove. In constructing the platform the dimensions of these supports **27** and the consequent elevation of the deck **26** are calculated, having in mind the size of the waves which are to be encountered by the platform at its off-shore drilling location. As will be more fully described hereinafter it is necessary that the deck **26** be constructed at a sufficient elevation above float member **21** so that when said member is submerged to a level beneath the trough of the largest wave, the deck is at the same time positioned at a level above the crest of the highest wave. An oil well derrick **28** of common construction is mounted on deck **26** and is of course designed to sink the customary type oil well casing **29** down through the open central portion of the float and the anchor members into the sea bottom **30**. Similarly mounted on the working deck **26** are conventional pumps **31** which are designed to be connected via suitable hose means **38, 39** and **42, 43** (Fig. 7) and fluid port means **40, 41** and **44, 45**, with the interiors of the anchor and float members respectively when it is desired to introduce or remove water from either of these members.

Referring now to Fig. 6 one means of rigging the anchor cables **23** is there shown. Each cable **23** is secured at its lower end to an eye **32** provided on the outer surface of the anchor member. The other end of the cable is led through a hollow conduit **33** which is welded in position in the interior of the float member **21** extending from the bottom to the top thereof with said float member being suitably bored at **34** and **35** in alignment with said conduit so as to permit passage of the cable. Tubular supports **27** are welded or otherwise secured to the exterior of the float member in alignment with conduits **33**. These tubular supports are similarly hollow and the cables **23** pass therethrough and are led to the deck winches **25**. In the alternate embodiment shown in Fig. 7 each cable **23** is secured to an eye **36** provided on the exterior of the anchor member and extends therefrom to a pulley guide **37** mounted on the external surface of the float member **21**, and through the pulley guide to the deck winches.

Referring now to Figs. 2 to 5 the operation of the device will be described:

Fig. 2 portrays the platform **20** in the mobile condition ready to be towed to the desired off-shore drilling location. As shown both the anchor and float members **21, 22** are floating at the surface of the water with the float member **21** positioned within the open central portion **22'** of the anchor member. When the platform has been towed to the desired drilling location, water is introduced into the interior of the anchor member so as to flood the same and thereby cause it to submerge to the position shown in Fig. 3, resting on the bottom of the sea. Various means for flooding this anchor member may be used, but for purposes of illustration a water hose **38** and an air hose **39** may be connected as shown in Fig. 7 and water pumped into the interior of the anchor member **22** through hose **38** by the pump **31** while air is permitted to evacuate through hose **39**. Suitable means may if desired be provided for permitting disconnection of these hoses prior to the complete submerging and downward descent of the anchor member. As the anchor member descends to its position of rest on the sea bottom **30** as shown in Fig. 3, the winches **25** are released so as to slack off anchor cables **23** thereby permitting the float member **21** to remain on the surface. In this position the float member and its elevated deck structure will of course be in effect tied to the desired off-shore drilling location. However due to the flexibility of cables **23** the float **21** and its deck **26** will of course rise and fall

with any surface waves which may be present in the particular area.

To eliminate this undesirable motion and to render the platform substantially stable, the interior of the float member **21** is partially flooded with water, as shown in Fig. 4, so as to decrease its buoyancy to an extent whereby the net buoyant force acting upon said float ring is less than the weight of the anchor member **22**. Then if tension is applied to the cables **23** by taking up on the deck winches **25**, because of the above relationship of the magnitude of the buoyant force acting on the float member to the weight of the anchor member, the anchor member will at all times remain firmly lodged on the sea bottom, while the float member will be pulled down until it is totally submerged beneath the surface of the water. By continuing this downward movement of the float member to a position where the same is held at a level which is below the trough of the largest waves contemplated in the particular area, it is possible to create a relationship of the parts of the platform structure wherein the cables **23** are continuously held under tension due to the continuous upward thrust caused by the buoyant force acting on the float member **21**. In this position the float member will remain substantially stationary and the elevated deck structure **26** will of course present a most stable working area. As mentioned above in the initial design of this deck **26** it is of course important to build the same at sufficient elevation above the float member **21** so that, when the latter is held in his submerged position, the deck itself will still be maintained at a level which is sufficiently raised above the crest of the largest contemplated waves.

It will be observed that since the anchor member has a diameter which is substantially larger than the diameter of the float member, the anchor cables descend downwardly and outwardly from the float member thereby providing a broad and stable anchorage base.

In a typical case, for example, where the anchor ring has a diameter of 400 feet and a cross-sectional diameter of 20 feet, if it is made of 1 inch steel plate, its weight will be in the neighborhood of 1500 tons, which if desired might be increased say to 2000 to 2500 tons by adding concrete to the interior thereof. In such a case the float ring member 21 may have a diameter of about 200 feet and a cross-sectional diameter of 20 feet giving a normal buoyancy when empty of approximately 6000 tons. The weight of such a float ring plus the weight of the deck, deck supports and drilling equipment would amount to about 800 tons and the necessary cables another 80 tons thereby leaving a net buoyancy of about 5120 tons. When the anchor member has been submerged, this net buoyancy of the float member can be reduced to 1000 tons by partially flooding the same with 4120 tons of water or other ballast. Then by taking up on the winches the float member can be submerged, and when submerged the buoyant force acting thereon will create a total tension in the cables of about 1000 tons, ample to retain the platform structure in substantially stable condition in the presence of quite heavy seas but insufficient to raise or dislodge the anchor ring which has a weight of 1500 tons. A platform of this description is particularly suitable for off-shore oil drilling.

Similar but smaller arrangements may be used for other purposes, such as soil test boring rigs, etc. and then the overall diameter of the anchor ring may, for example, be 50 feet with a cross-sectional diameter of 10 feet. Such an anchor member if made, for example, of ¾ inch steel plate would weight about 75 tons, which could be increased to 100 tons by adding concrete or the like. In this case the float ring **21** might have an overall diameter of 25 feet and a cross-sectional diameter of 10 feet to provide a buoyancy of about 180 tons. Assuming that this float ring were constructed of ⅜ inch steel plate, it would weigh approximately 18 tons, which together with about 10 tons of deck structure, 2 tons of cables and 7 tons of boring equipment would bring the total weight to about 37 tons leaving a net buoyancy of 143 tons for the float member. By partially flooding the same with 93 tons of water ballast, this buoyancy can be reduced to 50 tons, thereby permitting the float unit to be submerged and create a 50 ton tension in the anchor cables, which would be adequate to hold the platform stable but would be insufficient to lift the 75 ton anchor ring.

In view of the above factors the advantages of the present invention may now be better appreciated as compared to prior proposals involving pluralities of anchoring cables each connected to individual anchors. If such individual anchors are placed directly below the platform, then, depending upon wind and wave conditions, the platform will tend to move to one side or another while the cables assume angular positions. But any such sideways movements of the platform will of course necessitate suspension of the drilling operation. On the other hand, if, to prevent such sideways movement of the platform, the individual anchors are dropped in positions laterally outward of the platform so that the cables therefrom are inclined inwardly in various directions and upwardly to the platform, the following difficulty will occur. If the water conditions are such as tend to cause the platform to travel in one direction, then the holding tension will be largely confined to the cables which extend down to the anchors positioned in the opposite direction, and the remaining cables will become slack or have very little tension. Thus the holding action will be confined to a few individual anchors and those will tend to be dragged along the ocean bottom inwardly of the assembly, thereby allowing the platform to shift its position and eventually perhaps allowing all the cables to become loosened and entangled and allowing the submerged float means to rise up toward the surface of the sea.

With the present invention however using a unitary heavy, single anchorage, particularly if in the form of a ring larger than the float member, there will be no possibility of one part of the anchorage creeping along the ocean surface with respect to other parts and accordingly all of the cables will retain their uniform tension and thus hold the platform submerged to the desired degree and at the desired location.

When it is desired to return the platform to its mobile condition for movement to another off-shore drilling location the winches **25** will be freed so as to release the tension on cables **23** thereby permitting the float member **21** to rise to the surface of the water under the action of the buoyant force thereupon. When this member reaches the surface, as shown in Fig. 5, water hose **42** and air hose **43** are connected and the water pumped out of the interior of the float member by means of pumps **31**. This action of course restores to that float member its original buoyancy which by design, is in excess of the weight of the anchor member **22**. Therefore by then taking up on the winches **25** and thus applying tension to the cables **23**, the anchor member may be raised from the bottom of the sea to an intermediate position such as is shown in dotted lines in Fig. 5 or at a position nearer the water surface. When this position of the anchor member is reached water hose **38** and air hose **39** are then connected to that member and the water pumped out from the interior thereof, thereby restoring its buoyancy and permitting the anchor member to rise to the surface of the water and return to its initial position as shown in Fig. 2.

Various means may be provided by which these hoses **38** and **39** are attached to the anchor member when the latter is in an intermediate position preferably near the water surface. This can be accomplished by divers or other expedients if necessary. Depending upon the depths of the water in which the platform is to be anchored the precise mechanism for elevating the anchor member may of course vary. Thus as described above in con-

nection with Fig. 6, a simple rig has been shown which may be used with success in relatively shallow depths. However when the depths involved range towards the 500 foot mark, the rig shown in Fig. 7 may be preferred, since the pulley guide **37** on the exterior of the float member provides a better angle of lift which permits the anchor member to be pulled up a greater distance from the sea bottom thereby decreasing the depth to which a diver or other means must descend in order to attach water hose **38** and air hose **39**.

The invention, in addition to being useful for offshort oil drilling purposes, may be used for providing either mobile or permanent bridge piers, docks and airplane runways over deep waters.

Although certain particular embodiments of the invention are herein disclosed for purposes of explanation, various further modifications thereof, after study of this specification, will be apparent to those skilled in the art to which the invention pertains. Reference should accordingly be had to the appended claims in determining the scope of the invention.

What is claimed and desired to be secured by Letters Patent, is:

1. A mobile marine platform comprising a buoyant, generally ring-shaped float member carrying a working deck structure supported at a level thereabove, a unitary, generally ring-shaped, normally buoyant anchor member having an open central portion of a size sufficient to encompass the float member, said float and anchor members resting on the water surface with the float member nesting within the open central portion of the anchor member when the platform is in the mobile condition, a plurality of anchor cables interconnecting said ring-shaped members, means for controlling the buoyancy of said anchor member by flooding and deflooding the same whereby the same may be submerged to a position of rest on the sea bottom, said anchor member having an overall diameter substantially greater than the overall diameter of the float member whereby when the anchor member is submerged said anchor cables extend downwardly and outwardly from the float member to the anchor member, said float member having an original buoyancy greater than the weight of said anchor member when the latter is flooded, means for controlling the buoyancy of the float member by flooding or deflooding same whereby its buoyancy may be decreased by partially flooding the same until the net buoyant force of the float member is less than the weight of the anchor member, and means for taking up on said cables whereby said float member can be pulled down to a level beneath the trough of the waves with the deck remaining above the wave crests and the cables thereby held under uniform tension sufficient to maintain the deck substantially stable.

2. A mobile platform comprising a buoyant float member having an elevated deck supported thereabove, a unitary anchor member that is normally buoyant and has a periphery greater than that of said float member and an open central portion of a size sufficient to receive the float member, said float and anchor members floating on the water surface with the float member positioned within the open central portion of the anchor member when the platform is in the mobile condition, said anchor member being adapted to be flooded with water and to sink to the sea bottom when the platform is in the operative position, a plurality of anchor cables extending from said float member downwardly and outwardly to said anchor member, means provided on the deck and connected with said cables for taking up or slacking off on the cables, and means for flooding and deflooding the float member operable to decrease its buoyant force to a value less than the weight of the flooded anchor member whereby said float member can be submerged to a level below the troughs of the waves with the deck above the wave crests and with the anchor cables held under uniform tension sufficient to maintain the elevated deck substantially stable, said float member having a maximum effective buoyancy when deflooded great enough to support the weight of the flooded anchor member whereby the latter may be raised from the sea bottom by means of the cables so that the platform may be moved to a new location.

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