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2,970,447

MARINE APPARATUS AND METHOD FOR RAISING AND LOWERING SAME

Filed April 1, 1957

2 Sheets-Sheet 1

FIG. 1.

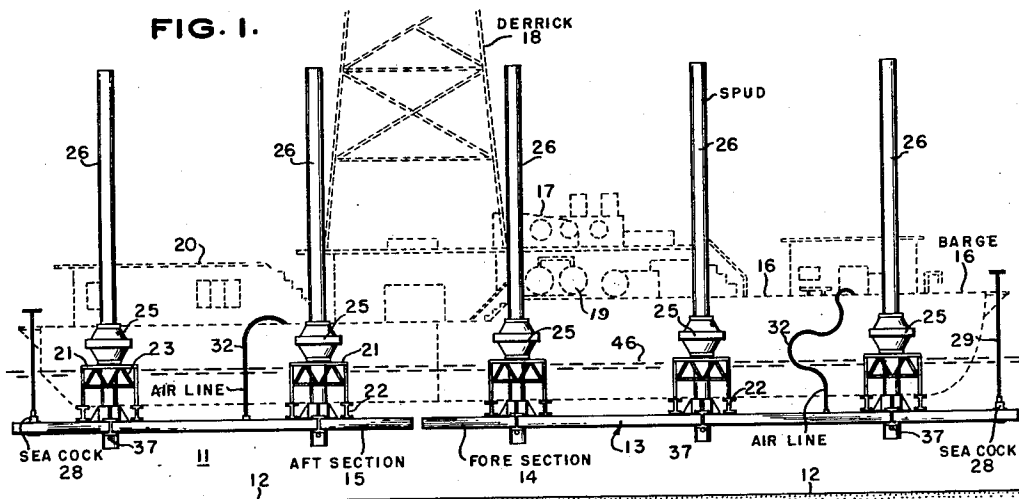
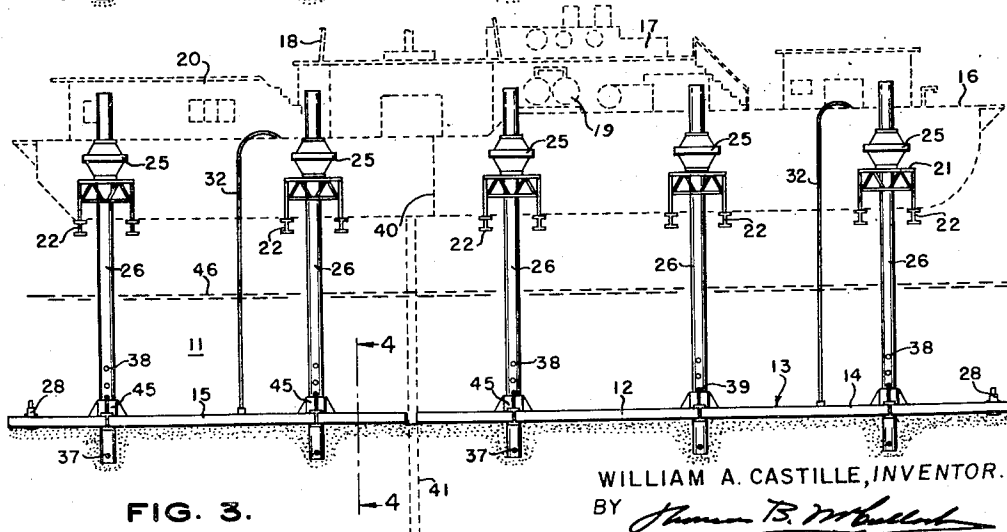
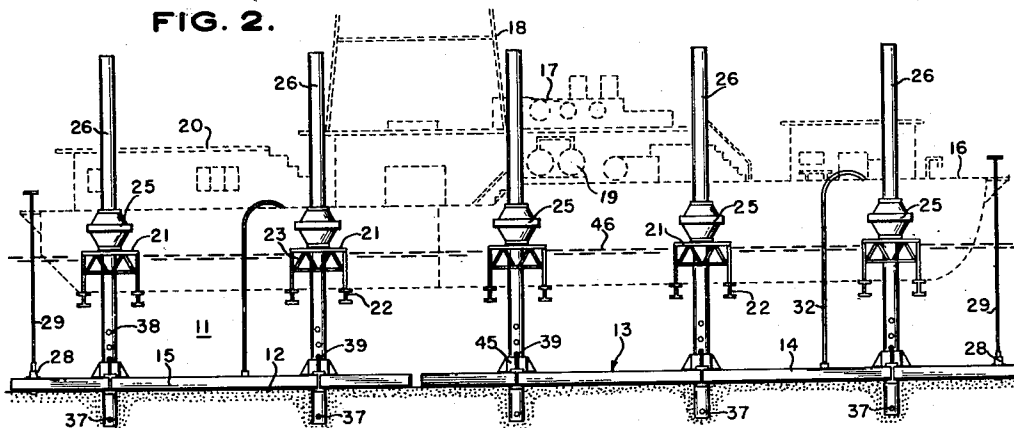


FIG. 2.



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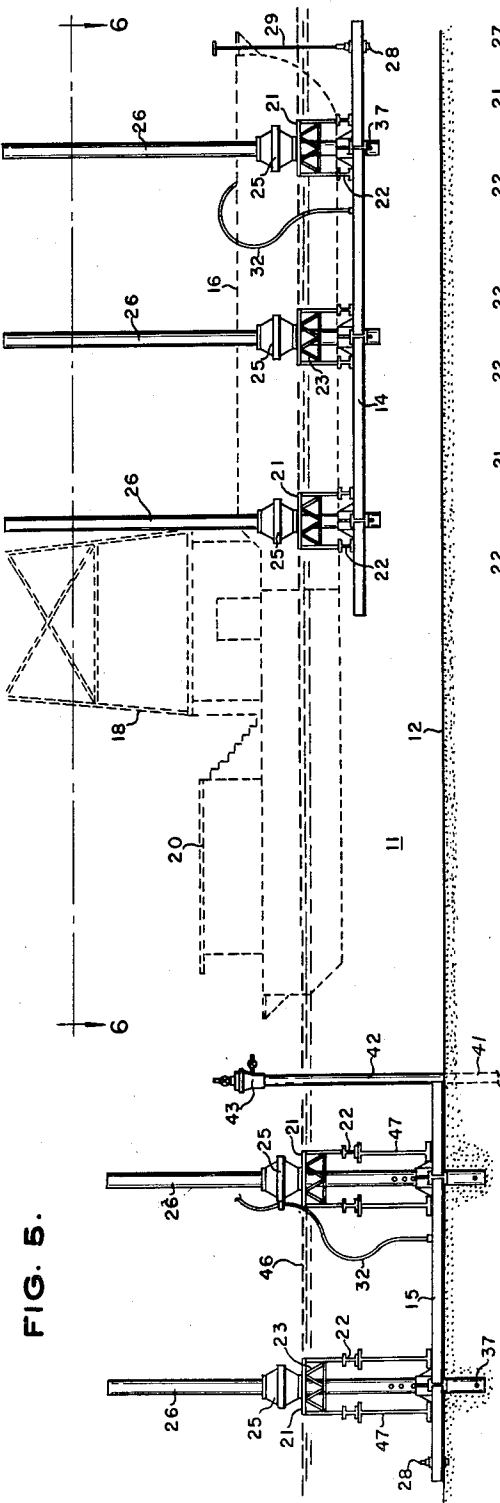


FIG. 5.

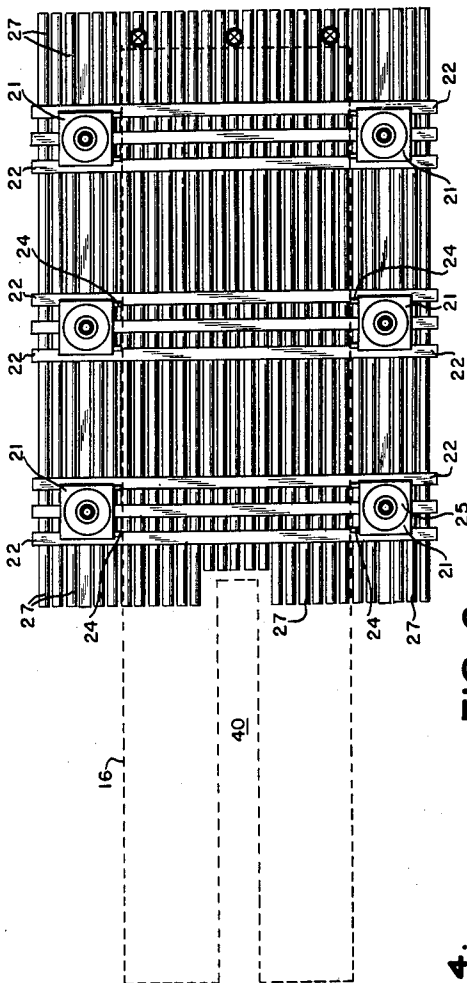


FIG. 6.

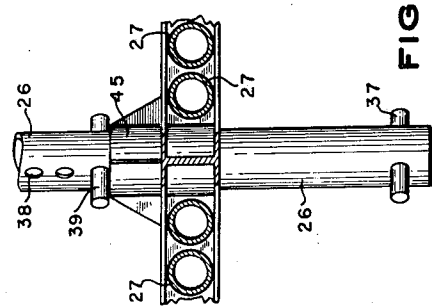


FIG. 4.

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MARINE APPARATUS AND METHOD FOR RAISING AND LOWERING SAME

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8 Claims. (Cl. 61—46.5)

The present invention is directed to marine well drilling apparatus. More particularly the invention is concerned with apparatus which may be used in deep water for drilling oil and gas wells and the like. In its more specific aspects the invention is concerned with apparatus for use in raising vessels above the surface of water.

The present invention may be briefly described as apparatus for use in a body of water which comprises a buoyant mat having a fore section and an aft section separable from the fore section, the aft section being symmetrical fore and aft. Vertically arranged spuds are provided on the mat and are attached to the mat for limited vertical movement relative to the mat. The spuds are spaced apart on the mat. A cradle is arranged on each of the spuds for vertical movement on the spuds, the spuds being provided with means for transferring the weight on the cradles from the spuds to the mat. A vessel such as a drilling barge provided with drilling facilities is arranged in and releasably attached to the cradles for vertical movement therewith.

The mat is suitably constructed of hollow members to provide buoyancy thereto and is provided with means for varying the buoyancy thereof. Each of the cradles is provided with means for imparting vertical movement to the cradles such as a hydraulic jacking mechanism. The hydraulic jacking mechanism also serves to force the spuds into penetration with the bottom of a body of water in which the apparatus is employed. The vessel or barge is releasably attached in the cradles by suitable attaching or clamping means which will allow the vessel or barge to be released from the cradle as may be desired.

The spuds are provided with means for transferring the weight on the cradles from the spuds to the mat. A suitable weight transferring means may include a pin transversely arranged in each of the spuds below the mat and a second pin transversely arranged and vertically adjustable in the spuds above the mat.

The present invention will be more fully described by reference to the drawing, in which:

Fig. 1 is a side elevational view of the apparatus in a transporting position;

Fig. 2 is a side elevational view of the apparatus landed on a water bottom;

Fig. 3 is a side elevational view of the apparatus with the barge in a raised or drilling position;

Fig. 4 is a partial sectional view taken along the line 4—4 of Fig. 3;

Fig. 5 is a showing of the removing of the apparatus from a well drilled in the water bottom; and

Fig. 6 is a view taken along the line 6—6 of Fig. 5.

Referring now to the drawing in which identical numerals will be employed to designate identical parts, numeral 11 designates a body of water having an earth bottom 12. The apparatus of the present invention including a buoyant mat 13 comprised of a first section 14 and a second section 15 is buoyantly arranged in the

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water 11. A drilling barge 16 provided with a drilling rig 17 including a derrick 18 and other associated equipment 19 and provided with living quarters 20 is supported when in a raised position on cradles 21 made up of transversely supporting beams 22 and attaching cross members 23. The drilling barge 16 is suitably attached to the supporting members 23 by releasable clamping means 24 shown schematically in Fig. 6. The supporting means 23 are attached to hydraulic or pneumatic spud jacks 25 which are arranged on cylindrical spud members 26. The spud members 26 may be cylindrical or of other cross section and may be open or closed to provide auxiliary buoyancy as desired. Spud members may be of open lattice construction using square, triangular, or other geometric cross section. Each of the sections 14 and 15 is made up of a plurality of attached tubular members 27, as shown in Figs. 4 and 6, and the tubular members 27 of section 14 are provided with sea cocks 28 operated by removable reach rods 29 from the drilling barge 16. It will be understood that although only a few sea cocks have been illustrated, more may be used if desired. The pipes 27 are fluidly interconnected so that they may all be flooded or air pressurized when necessary. Similarly, tubular members 27 of the section 15 are provided with sea cocks 28 operated by removable reach rod 29 from the drilling barge 16. The tubular members 27 of sections 14 and 15 each is provided with flexible conduit 32 having valves not shown which connect to air compressors not shown and which are employed to vary the buoyancy of the mat 13. Mat 13 shown may be similar in construction to the tubular marine mat titled the "Sea Raft" and developed by the Sea Raft Corp. This unit is described in The Oil and Gas Journal for June 11, 1956, page 92. The tubular mat is used for purposes of illustration only. The buoyant mat may be conventional barge section with compartmented bulkheads or other water-tight structure.

As shown more clearly in Fig. 4, the spuds 26 are each provided with pin members 37 arranged through the spuds 26 transversely below the mat 13. Also, the spuds 26 are provided with a plurality of transverse holes 38 above the mat 13 in which a pin 39 may be arranged transversely and which is vertically adjustable in the holes 38. The pins 37 and 39 provide a means for transferring the weight of the cradles 21 from the spuds 26 to the mat 13.

The drilling barge 16 is suitably provided with a slot or well 40, as shown in Fig. 6, for conducting drilling operations to allow drilling of a well 41 by means of the derrick 18 from the barge 16. The well 41, as shown in Fig. 5, may suitably be provided with a surface conductor pipe 42 and closed in by a suitable Christmas tree arrangement 43.

Referring again to the drawing and particularly to Figs. 1 and 2, the apparatus with the barge 16 releasably clamped by clamps 24 in the cradles 21 is floated into position where it is desired to drill a well or conduct other marine operations. For example, oil, gas or sulfur wells may be drilled with the apparatus of the present invention. After the apparatus of Figs. 1 and 2 has reached the desired location, sections 14 and 15 of the mat 13 are flooded with water by opening the sea cocks 28 by manipulation of reach rod 29. The descent of the apparatus to the bottom 12 may be controlled by the action of jacks 25 and the spuds 26, the jacks 25 being employed to exert pressure downwardly on the spuds 26 forcing the spuds 26 into the bottom 12 as shown more clearly in Figs. 2 and 3. The amount of penetration of the spuds 26 may be predetermined by setting the pin 39 in a selected one of the holes 38 above the mat 13. When the pin 39 in the spuds 26 reaches

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the collar 45 in which the spud 26 is arranged as it passes through the mat 13, the downward pressure of the spuds 26 is transferred thereby to the mat 13. As shown in Figs. 2 and 3, the spuds 26 have penetrated the sea bottom 12 the desired depth.

Downward pressure exerted by jacks 25 on the spuds 26 is then continued until all of the spuds 26 have penetrated the selected distance, determined by the pins 39, into the sea bottom 12. This penetration of the spuds 26 fixes the mat 13 to the water bottom and also prevents the mat 13 from moving horizontally due to water action caused by a wave or tidal forces. Furthermore, the pins 37 also securely fix the spuds 26 in the bottom 12.

Referring now to Fig. 3, as the jacks 25 continue to exert downward pressure on the spuds 26 the pins 39 transfer the vertical loads to the collars 45 and then to the mat 13. The mat 13 distributes the weight of the total assembly over a wide area without appreciable settlement and thereafter continued downward pressure by the jacks 25 on the spuds 26 results in the barge 16 being raised clear of water level 46. As shown more clearly in Fig. 3, the barge 16 is raised by the jacks 25 on the spuds 26 until it reaches a height above the expected wave crest of the particular marine area of operation. The apparatus is now in a drilling position for drilling the well 41 as shown in Fig. 3.

Referring now to Fig. 5, the apparatus may be moved off of a drilling site after the well 41 has encountered production or a dry hole has been obtained. Movement of the apparatus off a producing well such as 41 may be accomplished by dividing the mat 13 into its component sections 14 and 15, section 14 being the fore section and section 15 being the aft section. The drilling barge 16 is lowered on the spuds 26 by means of the jacks 25 until the barge 16 is again afloat, as shown in Fig. 5. The releasable clamping means 24 on the aft section 15 are released to disconnect the barge 16 therefrom. The jacks 25 on the fore section 14 of the mat 13 continue to exert upward pressure which causes the spuds 26 of the fore section 14 to be pulled free of the bottom 12. Pin 37 below the section 14 lifts the section 14 from the bottom. Additional lift may be obtained by expelling water from the section 14 by starting the air compressors connected by flexible conduit 32 again to provide buoyancy to the section 14. The air hose 32 connected to the aft section 15 may be disconnected from its valve and clamped to a convenient place such as the jack 25 so that the barge 16 may be moved. With this buoyancy pull plus the upward force of the jacks 25 of the section 14, the section 14 is again raised into a transport position as shown in Fig. 5. The fore section of the assembly may then be moved away from well 41 leaving the aft section in position as shown in Figs. 3 and 5. As stated, the barge 16 and section 14 are pulled away and clear of the well 41. The aft section with its spuds 26 acts as a guide to the movement of the barge 16 off the well 41 and also serves to protect the well 41 and its conductor pipe 42 and Christmas tree 43 during the operation.

Once the barge 16 and the section 14 are clear of the well 41, the section 15 may be removed from the well by any one of several ways. For example, protective cribbing may be built around the well 41 or the section 15 may jack itself clear of the bottom 12 by inserting columns 47 between section 15 and the cradles 21, the jacks 25 pulling the spuds 26 clear of the bottom. Thereafter by expelling water from the tubular members 27 of the section 15 buoyancy is obtained which assist in lifting section 15 to the surface.

A third and preferred method of lifting the section 15 is to bring the barge 16 with the section 15 around to the opposite side of the well, that is 180° from its original position and float the barge 16 back into position over the aft section 15, reattaching the barge 16 by the

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releasable clamping means 24 to the aft section 15 and raising the aft section 15 to the transporting position as has been described with respect to section 14. It is to this end that the aft section is made symmetrical both fore and aft.

The present invention is quite advantageous and useful in that drilling barges which have been designed for use in shallow water may be used in deeper waters for employing the apparatus of the present invention. Furthermore, by employing the present apparatus it is no longer necessary to provide earthen mounds beneath the water surface or other fixed supporting means for supporting the sunken barge when deep water is encountered. Furthermore, the present invention is advantageous and useful in that a drilling barge is employed which is firmly and fixedly attached to the sea or water bottom such that it is raised above wave height and lateral movement is prevented.

The jacks employed in the present invention are those available commercially such as have been described in World Oil, April 1956, page 256, and in The Oil and Gas Journal, June 22, 1953, page 176. Other similar jacks may be used and these references are given only for purposes of illustration.

The nature and objects of the present invention having been completely described and illustrated, what I wish to claim as new and useful and to secure by Letters Patent is:

1. Apparatus for use in a body of water which comprises a buoyant mat having a fore section and an aft section separable from the fore section, said aft section being symmetrical fore and aft, means for varying the buoyancy of the mat, vertically arranged horizontally spaced apart pairs of cylindrical spuds on said mat attached to the mat for limited vertical movement relative to the mat, a cradle on each pair of said spuds, a jack movably arranged on each of said spuds, each of said jacks being connected to one of said cradles for imparting vertical movement to said cradles, a first pin transversely arranged in each of said spuds below said mat, said first pins being adapted to securely fix said spuds to the bottom of said body of water, and a second pin transversely arranged and adjustable vertically in each of said spuds above said mat for transferring the weight on the cradles from the spuds to the mat, a drilling barge provided with well drilling facilities arranged in said cradles for vertical movement therewith from a floating position in said body of water to a raised position above said body of water and vice versa, and means for releasably attaching said barge in said cradles.

2. A method for raising a vessel above a body of water which comprises floating said vessel to a selected position in said body of water, said vessel being arranged on a buoyant mat and being carried releasably thereon on vertically movable pairs of cradles mounted on vertically arranged horizontally spaced-apart pairs of spuds on said mat, said spuds having limited vertical movement relative to said mat, sinking said mat while maintaining said vessel afloat, embedding said spuds in the bottom of said body of water, transferring the weight of said vessel from said spuds to said mat, and raising said cradles and said vessel on said spuds from the floating position in said body of water to a position above said body of water, whereby a stable structure is provided for conducting offshore operations.

3. A method for raising a vessel above a body of water and for lowering said vessel back into said body of water which comprises floating said vessel to a selected position in said body of water, said vessel being arranged on a buoyant mat and being carried releasably thereon on vertically movable pairs of cradles mounted on vertically arranged horizontally spaced-apart pairs of spuds on said mat, having limited vertical movement relative to said mat, said buoyant mat having separable fore and aft sections, sinking said mat while maintaining said vessel afloat, embedding said spuds in the bottom of said body

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of water, transferring the weight of said vessel from said spuds to said mat, raising said cradles in said vessel on said spuds from the floating position in said body of water to a position above said body of water, whereby a stable structure is provided for conducting offshore operations, separating said fore and aft sections of said mat, lowering said cradles and vessel from the raised position above said body of water to the floating position in said body of water, pulling said spuds free of the bottom of said body of water, floating said fore section of said mat to the surface of said body of water under said vessel, floating said vessel and said fore section of said mat away from said selected position, and then floating said aft section and rejoining it to said fore section.

4. A method for raising a vessel above a body of water and lowering said vessel back into said body of water which comprises floating said vessel to a selected position in said body of water, said vessel being arranged on a buoyant mat and being carried releasably thereon on vertically movable pairs of cradles mounted on vertically arranged horizontally spaced-apart pairs of spuds on said mat, said spuds having limited vertical movement relative to said mat, sinking said mat while maintaining said vessel afloat, embedding said spuds in the bottom of said body of water, transferring the weight of said vessel from said spuds to said mat, raising said cradles and vessel on said spuds from the floating position in said body of water to a position above said body of water, whereby a stable structure is provided for conducting offshore operations, lowering said cradles and vessel from the raised position to the floating position in said body of water, pulling said spuds free of the bottom of said body of water, floating said mat to the surface of said body of water under said vessel, and then floating said vessel and said mat away from said selected position.

5. Apparatus for use in a body of water which comprises a buoyant mat, vertically arranged horizontally spaced-apart pairs of spuds on said mat attached to the mat for limited vertical movement relative to the mat, a cradle on each pair of said spuds, moving means movably arranged on each of said spuds, each of said moving means being connected to one of said cradles for imparting vertical movement to said cradles, first transverse means arranged in each of said spuds below said mat, said first transverse means being adapted to securely fix said spuds to the bottom of said body of water, second transverse means arranged and adjustable vertically in each of said spuds above said mat for transferring the weight on the cradles from the spuds to the mat, releasable attaching means on each of said cradles, and a vessel arranged in and releasably attached to the cradles

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by said attaching means for vertical movement therewith from a floating position in said body of water to a raised position above said body of water and vice versa.

6. Apparatus for use in a body of water which comprises a buoyant mat having a fore section and an aft section separable from the fore section, vertically arranged horizontally spaced-apart pairs of spuds on said mat attached to the mat for limited vertical movement relative to the mat, a cradle on each pair of said spuds, moving means movably arranged on each of said spuds, each of said moving means being connected to one of said cradles for imparting vertical movement to said cradles, first transverse means arranged in each of said spuds below said mat, said first transverse means being adapted to securely fix said spuds to the bottom of said body of water, second transverse means arranged and adjustable vertically in each of said spuds above said mat for transferring the weight on the cradles from the spuds to the mat, a vessel arranged in said cradles for vertical movement therewith from a floating position in said body of water to a raised position above said body of water and vice versa, and means for releasably attaching said vessel in said cradles.

7. Apparatus in accordance with claim 6 in which the aft section is symmetrical fore and aft.

8. Apparatus in accordance with claim 5 in which the mat is provided with means for varying the buoyancy thereof.

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