Sept. 23, 1969 R. D. HAWKINS 3,468,279

FLOTATION APPARATUS

Original Filed Dec. 29, 1965 4 Sheets-Sheet 1

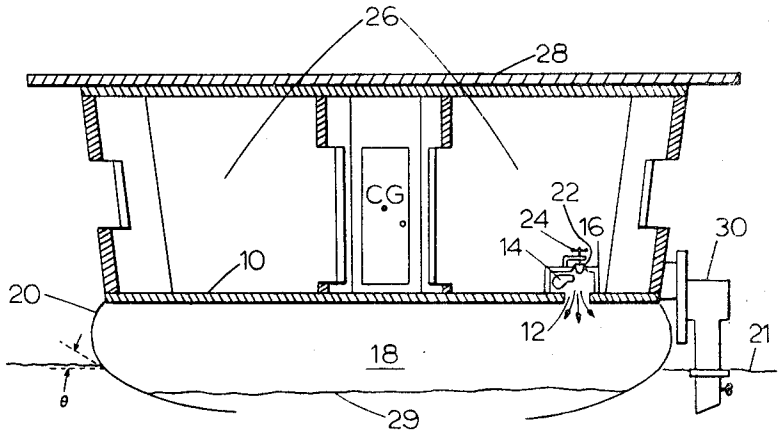


FIG. 1

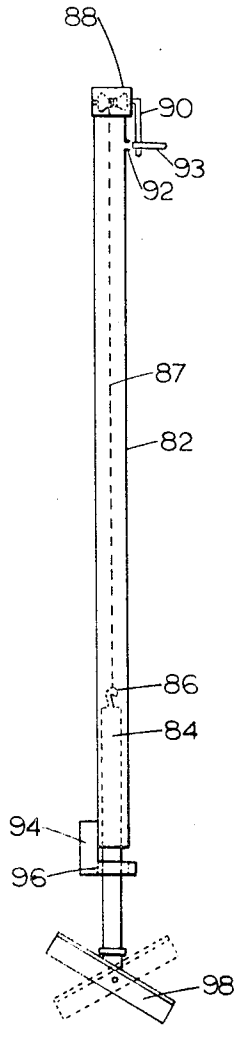


FIG. 11

FIG. 2A

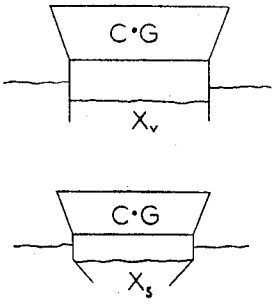


FIG. 2C

FIG. 2B

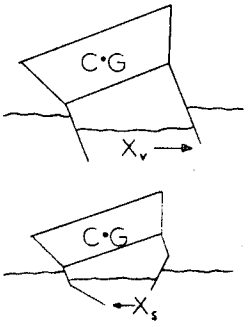


FIG. 2D

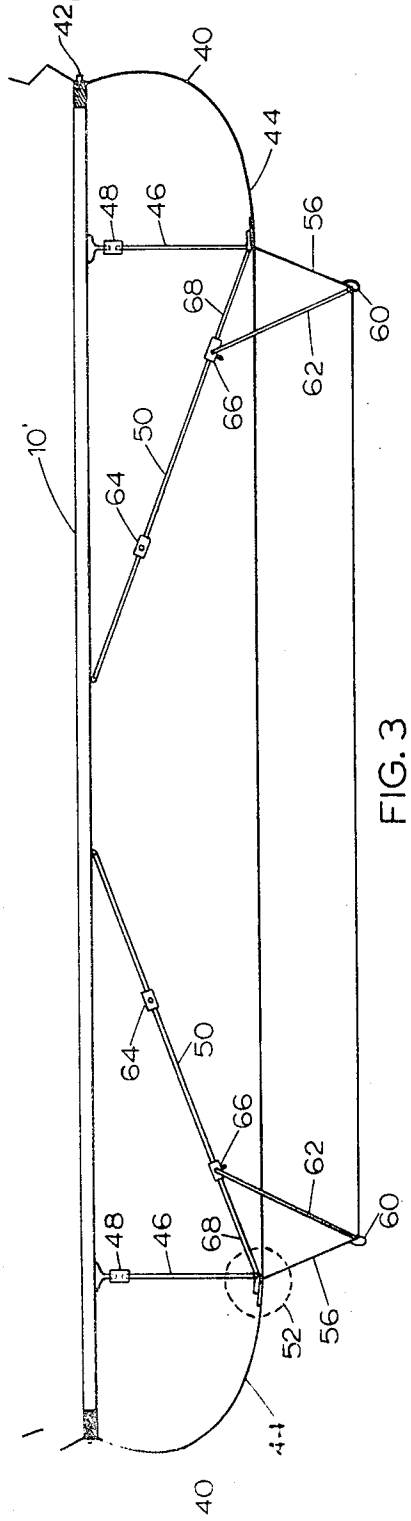


FIG. 3

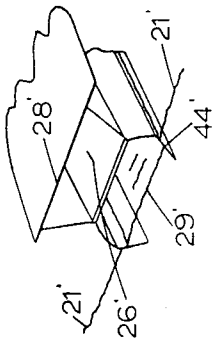


FIG. 12

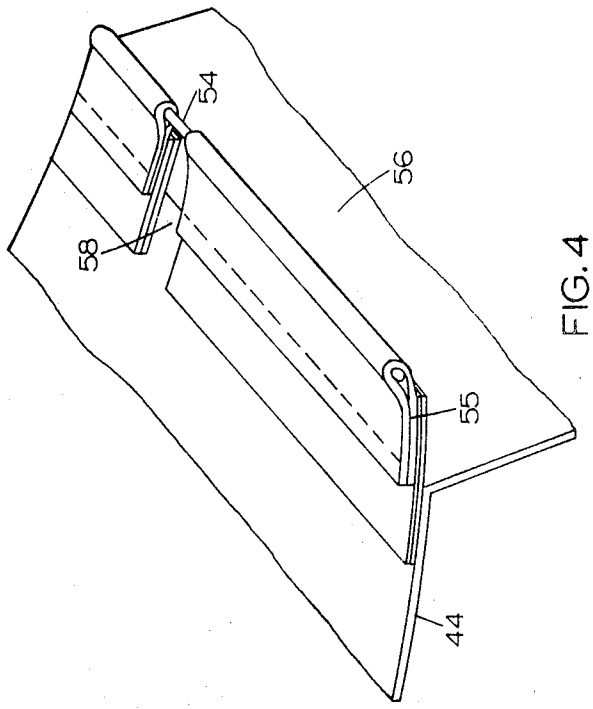


FIG. 4

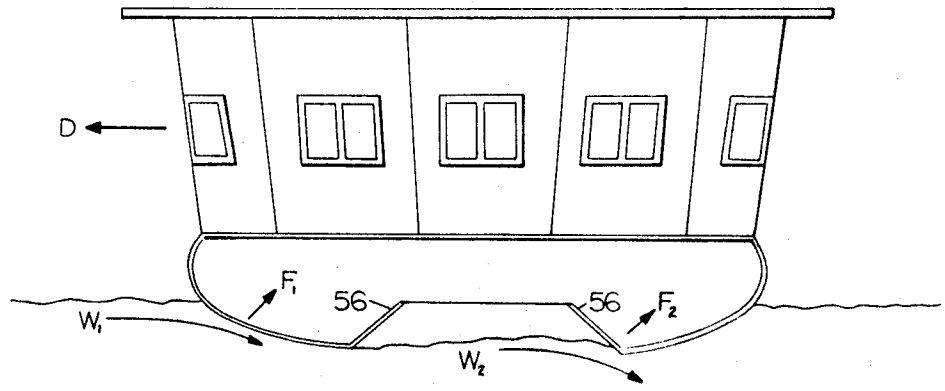


FIG. 6

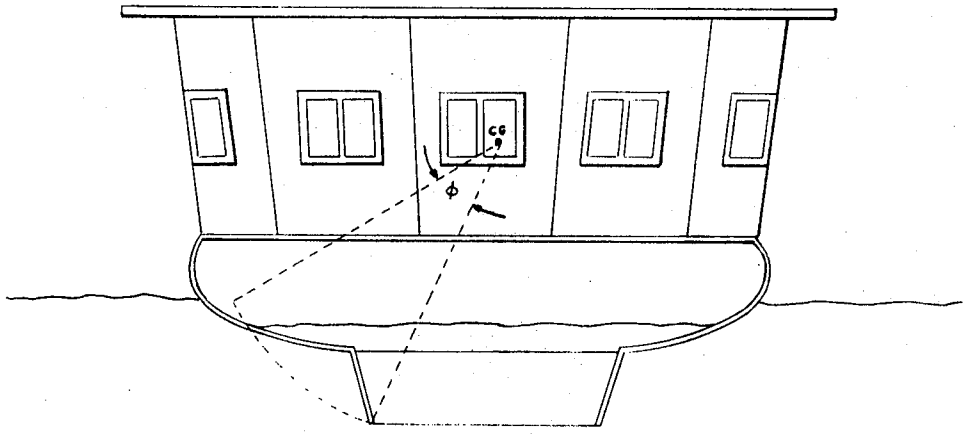


FIG. 5

Sept. 23, 1969 R. D. HAWKINS 3,468,279

FLOTATION APPARATUS

Original Filed Dec. 29, 1965 4 Sheets-Sheet 4

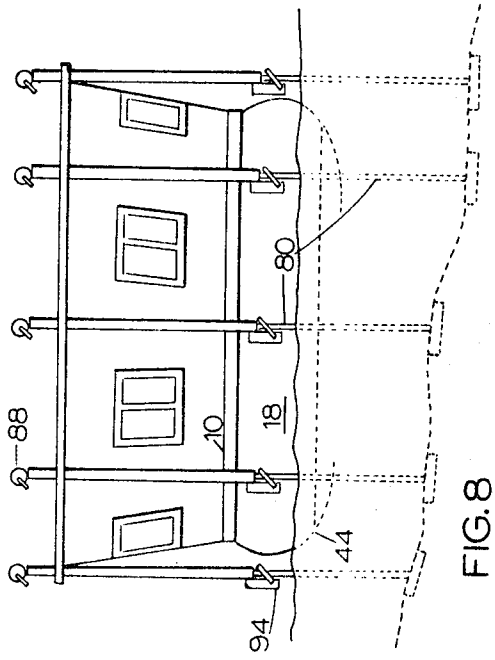


FIG. 8

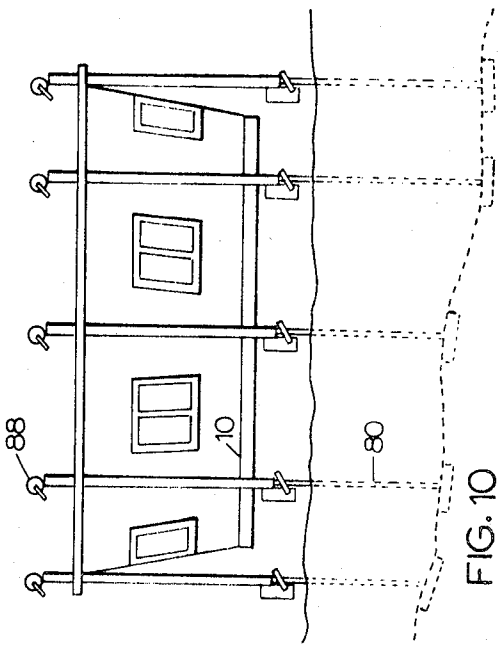


FIG. 10

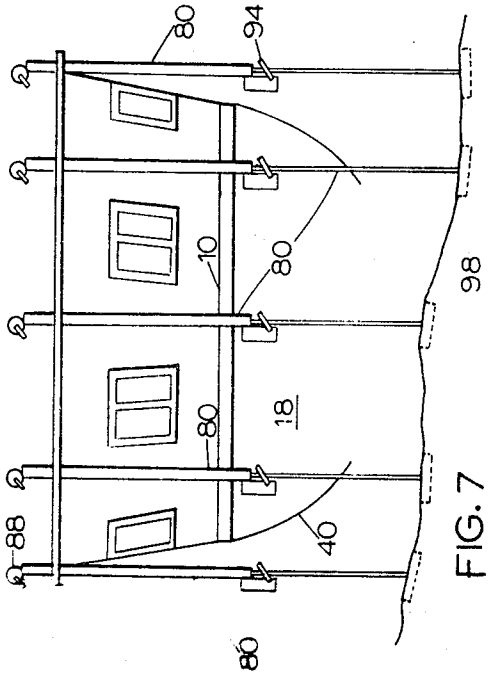


FIG. 7

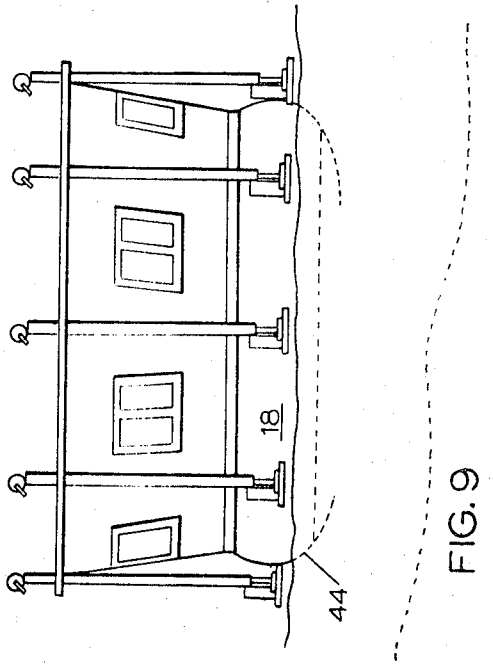


FIG. 9

United States Patent Office 3,468,279 Patented Sept. 23, 1969

3,468,279

FLOTATION APPARATUS

Robert D. Hawkins, 115 Stony Hollow Road, Greenlawn, N.Y. 11740

Original application Dec. 29, 1965, Ser. No. 517,349, now Patent No. 3,370,562, dated Feb. 27, 1968. Divided and this application Jan. 2, 1968, Ser. No. 694,612
Int. Cl. B63b *1/38;* B60v *1/04*
U.S. Cl. 114—67 12 Claims

ABSTRACT OF THE DISCLOSURE

An air supported vessel for use in water is described as having an open bottomed hull from which there is extended a movable partition or skirt member secured about the opening in the hull. This partition when extended upward gives the vessel desirable properties for mobility and when extended downward gives the vessel desirable properties for station keeping.

Cross reference to related application

Copending application Ser. No. 517,349, filed Dec. 29, 1965 of which the present application is a divisional application.

Background summary of the invention

This invention relates in general to floatable structures, and in particular provides an improved form of hull therefore which works to stabilize itself in response to and as a result of the very forces tending to unstabilize the hull.

Basically the invention provides an open inverted hull that so captures a large volume of air (under relatively slight pressure, e.g., 0.6 p.s.i. above atmospheric) between the water line and a deck supported by the hull that the center of gravity of the overall structure is substantially well above the water line. While admittedly such a configuration is ordinarily considered unstable and will readily flip over and sink in response to even very slight forces acting thereupon, nevertheless by suitably designing the sides of the hull, the craft center of buoyancy can be constantly shifted with such forces—not in a way that encourages "flipping" and ultimate "sinking"—but in a way that counteracts the tendency of the craft to invert. This aspect of the invention will be described in detail later.

A second aspect of the invention relates to a form thereof which readily lends itself to such uses as sea platforms and the like, e.g. as is often employed in off-shore drilling for oil. Typical of present practice here is to float a large platform structure to the anchoring location, and then at a time when the sea state is reasonably calm, jacking up the whole platform by means of expensively designed and complicated support legs, using the ocean floor as a base for the legs. Rather than adopt this conventional form of sea platform, the present invention proposes the use of a platform or deck supported by a hull as briefly described above, but in which the hull may take the form of a removable skirt, preferably of an elastic material for wave isolation purposes. To the platform or deck, vertically positionable anchoring stilts are secured, whereby once the platform has been floated to its anchoring location by means of the hull, and the stilts have been lowered for anchoring and support purposes, the hull skirt may be evacuated or even removed to effect a sea platform, and this without jacking equipment.

A third aspect of the invention relates to a presently preferred form of hull skirt, i.e. one which is adjustable to accommodate different conditions of floatation, e.g. when the hull respectively is and is not being driven across the surface of the sea. As to this third aspect of the invention, the hull skirt is provided with an extendable portion which when extended into the water increases the vertical dimensions of the hull and prevents leakage of the captured volume of air. For hull mobility however the extendable hull position may be raised to a shallow depth to prevent drag, and to encourage planing.

A principal object of the invention is to provide an improved form of hull design.

Another object of the invention is to provide a floatable structure that is supported by a captured volume of air.

Another object of the invention is to provide a floatable structure having a center of gravity above the water line and an inverted open hull having sides so disposed that the center of buoyancy of the structure always positions to counter any tendency of the hull to invert.

Another object of the invention is to provide a floatable structure having an inverted open hull and a deck supported by the hull, such hull being removably secured to the deck.

Another object of the invention is to provide an improved hull configuration that not only is exceedingly stable, but which also isolates members supported by said hull from wave disturbances and the like.

Another object of the invention is to provide an inverted open hull structure, the vertical dimensions of which are adjustable for different conditions of flotation.

The invention will be described with reference to the figures wherein:

FIG. 1 is a schematic presentation of one embodiment of the invention,

FIGS. 2A through 2D are diagrams useful in describing the concepts of this invention,

FIG. 3 is a view showing a presently preferred hull design according to the invention,

FIG. 4 is a view showing a feature of interest that is employed in the presently preferred hull design of FIG. 3,

FIGS. 5 and 6 depict the presently preferred hull respectively stationary and moving,

FIGS. 7 through 10 show how a hull according to the invention may be employed to effect a sea platform,

FIG. 11 is a view showing a boat-supporting stilt as may be employed with the invention, and

FIG. 12 is a sectional view showing another embodiment of the invention.

Referring to FIG. 1, the presently preferred embodiment of the invention is shown having a deck **10** with an opening **12** therein. The deck **10** is preferably of a material that is impervious to air. An air pump **14** (which preferably is automatically controlled with respect to a pressure reference as is well known in the art) within a walled compartment **16** is adapted to blow air into a chamber **18**, the sides of which constitute an open inverted hull **20**. The hull **20** is secured to the deck **10** in as close to an airtight manner as possible, and as required for the principal feature of the invention, the sides of the hull **20** make an acute angle with the normal water line **21**, being of such form that the sides preferably gradually become more and more acute with respect to the water surface. This latter aspect is desirable since gradually sloping sides compromise between those which are strictly vertical (for virtually complete isolation against the vertical force of waves) and those which are strictly horizontal (ideally the most preferable for stability purposes). The compartment **16** in which the blower **14** contains is provided with a valve **22** that may be adjusted by means of a stem member **24** to exhaust air from the interior of the hull chamber **18**. The deck **10** so supports a network of cabins **26**, having a topside deck **28**, that the craft center of gravity, C.G., is substantially well above the normal water line **21**. The water line **29** within the open hull **20** is well below the line **21** because of air pressure within the hull chamber **18**. The motor

30 for propelling the craft secures to and is rigidly supported by the deck 10.

Reference should now be had to the series of illustrations that constitute FIG. 2, whereby an explanation is given as to why a craft employing the instant techniques has been found to be extremely stable. First off, illustrations A and B, while depicting an open inverted hull that is "not" in conformity with the invention, are nevertheless useful in emphasizing the concepts of the invention. In FIG. 2A a craft with vertically sloping hull sides 20_V is shown in level attitude, its center of buoyancy being on the same vertical as its center of gravity. With a slight unsettling force applied to the craft (FIG. 2B), it starts to rotate about its center of gravity, whereby the captured volume of water X_V is pushed rightward (looking at FIG. 2B) by the sides of the hull 20_V. Hence, it is seen that the craft center of buoyancy (i.e. the center of gravity of the displace volume of water) is shifted rightward as the craft rotates about its own center of gravity, with attendantly the craft flipping over and sinking like an inverted water glass in a tub of water.

Consider now a hull according to the invention (FIG. 2 illustrations C and D), viz one with hull sides that slope acutely into the water. Here, when the craft is forced from a level attitude (FIG. 2C) to that shown in FIG. 2D, the captured volume of water X_S and the craft center of buoyancy are moved—not rightward—but leftward. This can be appreciated from the FIG. 2D which shows the left side of the "sloped" hull 20_S entering and "scooping" (not pushing) the captured water X_S, whereby the center of buoyancy shifts leftward. As far as the right-hand side of the hull 20_S is concerned, this (because of its slope) cuts through the water like a knife edge, and therefore never pushes on the water. In other words, the water adjacent to the right hand side of the hull spills off such side and, in bootstrap fashion, flows onto the left-hand side of the hull. Since the craft center of buoyancy moves leftward as the lefthand side of the craft tends to sink deeper into the water, a stabilizing counterforce is created by the craft itself, whereby the craft attitude is kept level, a principal object of the invention being thus obtained.

Reference should now be had to FIGS. 3 and 4 which together show the details of a presently preferred form of hull design. A resilient (hull) skirt 40, as might for example be formed from rubberized nylon, secures to the deck 10' by means of bolts 42 in sufficiently airtight manner. When inflated, the hull balloons outward so that its part 44 acutely cuts the water, such ballooning being made possible by means of plural hull support poles 46 which are stationed generally circumferentially within the interior of the hull. Each pole 46 at one end secures to the underside of the deck 10' by means of a flexible coupling 48, and the couplings 48 in combination with the flexible hull itself substantially eliminate any tendency of the craft to respond to high frequency wave disturbances. Each pole 46, at its other end, secures to the hull skirt 40; in addition, respective cables 50 secure those support pole ends to the deck 10'. The walls of the hull 40 are thus prevented from substantial lateral motion as the hull is inflated, whereby the hull part 44 is forced to assume an acute relationship with the line of the water.

As shown in FIG. 4, the hull part depicted within the dashed line 52 of FIG. 3 has a cable 54 that secures within a substantially airtight juncture 55 of the hull part 44 and a hull part 56. In the hull regions 58, the support poles 46 are adapted to be pivotally secured. A weighted ring 60 so secures to the base of the hull part 56 that that part ordinarily extends into the water. If desired, the part 56 may be raised by means of cables 62 that are spatially aligned with the poles 46 and the cables 50. That is, the extendable hull part 56 may be raised into the interior of the hull 40, and against the weight of the ring 60, by hooking the cables 62 to respective hasps 64 fixedly located on the cables 50. Hasps 66 are provided to secure the cables 62 to prevent them from damaging the hull when the part 56 is extended; and similarly the cables 50 may be covered at 68 by suitable material to prevent them from wearing the hull part 56 when that part is secured within the hull interior.

FIGS. 5 and 6 diagrammatically show (without unnecessary detail) the modes of flotation when respectively the craft of the instant invention is adapted for use as a sea platform, and for substantial mobility with minimal drag.

In FIG. 5, the vertical dimension of the hull has been extended as for example when the internal hull cables 62 secure to the hasps 66. As noted above, this is the sea platform mode and has the advantages of being least susceptible to the loss of air from within the hull chamber 18. That is, for air to escape from within the hull of FIG. 5 as a result of rolling (or pitching), would require the roll angle to be in excess of the angle ϕ, an essentially remote possibility as discussed above re FIG. 2. (Were the angle of roll to be greater than the angle ϕ, however, the air pump 14 would quickly replace the quantity of lost air.) In addition, when the sea state is such that the hull sits atop the crests of, for example, a pair of waves, the extended hull portion 56 assures that there is minimal loss of air, i.e. the opening in the hull bottom is always immersed.

In FIG. 6, the vertical dimension of the hull 20 is shown shortened, as for example by securing the internal hull cables 62 to their respective hasps 64; in addition, the hull is here presumed propelled in a direction D. By raising the hull part 56 substantially out of the water, drag obviously is kept minimal, a first effect necessary to good mobility. Secondly, because of such relatively high mobility, the craft has an improved tendency to plane (further decreasing drag), and to assist such planing the raised part 56 itself contours to augment the lift forces on the craft. See FIG. 6 which shows the lift force F_1 acting on the craft bow, and created as the craft cuts through the water W_1. A small aft lift force F_2 results from water W_2 within the raised part 56 continually washing against that part. When moving, the craft of FIG. 6 rides well out of the water drawing less than 10 inches of water though weighing 60,000 pounds.

With reference to FIGS. 7 to 10, the sea platform feature of the invention will now be described. FIG. 7 shows the instant boat prior to launching, standing (on circumferentially located stilts 80 to be described presently) near the shore line, at low tide, and with the resilient hull 40 completely deflated. The stilts 80 (see FIG. 11) each comprise a hollow casing 82 having a weighted telescoping leg member 84. The member 84 secures by means of a hook 86 to a nylon cable 87 that winds on a winch 88. The winch 88 is provided with a crank 90 having a cooperating handle 98 that may be slidably locked in a casing hole 92 to hold the weighted leg member 84 in place against its downward force. Secured to the casing 82 is a leg clamp 94 having a hole 96 that is slightly larger than the outer diameter of the leg member 84, and which leg member is slidably contained in the hole 96. Locking the leg member 84 against upward movement is attained by the natural wedging of the leg member 84 against the sides of the hole 96 in response to an off-axis upward force. Universally pivotally secured to the end of the leg member 84 is a foot piece 98 which is adapted to orient in accordance with the footing.

As the tide moves in, the hull 40 of the unlaunched boat submerges partially, thereby trapping some air within the chamber portion 18 and readying the hull 40 for flotation, which fact is achieved by turning on the pump 15 (FIG. 1) and causing the hull 40 to balloon as shown in FIG. 8. With the hull sides ballooned, the stilt legs 84 are raised by means of the winches 88 and their cooperating cranks 90 (FIG. 9), whereby the boat becomes mobilely floated on the captured volume of air within its chamber 18. See FIG. 6. At the anchoring location, the stilt legs 84 are

lowered, by releasing the winches **88** from their respective locked positions, whereby the boat becomes fixedly supported by means of its stilts **80**, the feet pieces **98** of the stilts **80** assuming the contours of the ocean floor. Now the hull skirt **40** may be deflated, by opening the exhaust valve **22**, after which time the hull may be removed from its deck **10** (see FIG. 10), thereby effecting a sea platform that is clear of tides, waves, etc., without need for jacking equipment, a principal object of the invention being thus achieved.

While the invention has been described in its presently preferred forms, it is to be realized that the words which have been used are words of description rather than of limitation, and that many changes to the instant embodiments may be made without departing from the true scope and concept of the invention. For example, it would be well within the purview of the invention to employ a doughnut-shaped hull, cross section of which is shown in FIG. 12. The parts depicted on FIG. 12, which relate to respective parts of FIGS. 1, 3, etc., have the same reference characters as indicated on those figures but to distinguish the FIG. 12 characters, primed notations have been employed.

What is claimed is:

1. Floatable apparatus for use on bodies of water comprising an open bottomed hull and a deck supported thereby, both of which are substantially impervious to air, means for pumping air between said deck and said hull, a partition extended from the lower edge of said hull and inclined upwardly to form a barrier between the inside of said hull and the water, and a substantially rigid member, said rigid member being adapted to limit the motion of said lower edge of said hull with respect to said deck.

2. The apparatus of claim **1** including means for use in adjusting the angle of inclination of said partition.

3. The apparatus of claim **1** wherein said rigid member is coupled to and pivotally supported with respect to said deck.

4. The apparatus of claim **2** wherein said partition is nonrigid.

5. The apparatus of claim **3** wherein said hull is nonrigid.

6. The apparatus of claim **1** wherein both said partition and said hull are nonrigid.

7. Floatable apparatus for use on bodies of water comprising an open bottomed hull and a deck supported thereby, both of which are substantially impervious to air, means for pumping air between said deck and said hull, said apparatus including an extendable partition secured about the opening in said open bottomed hull, and means for raising said partition into said hull and for lowering same therefrom as desired.

8. The apparatus of claim **7** wherein said partition is nonrigid.

9. The apparatus of claim **7** wherein said hull is nonrigid.

10. The apparatus of claim **7** wherein both said partition and said hull are nonrigid.

11. The apparatus of claim **10** wherein said hull is supported by means comprising a compression member (**46**), means (**48**) for pivotally supporting said compression member (**46**) to said deck (**10'**) and to said hull (**40**), and a tension member (**50**) secured between said hull (**40**) and said deck (**10'**) the points at which said compression and tension members (**46**, **50**) secure to said hull being substantially the same, and the points at which said compression and tension members (**46**, **50**) secure to said deck (**10'**) being in spaced apart relationship.

12. The apparatus of claim **11** including a tension member (**62**) one end of which secures to said skirt (**56**) the other end thereof being adapted for coupling to a part of said floatable apparatus within the confines of said hull (**40**).

References Cited

UNITED STATES PATENTS

3,258,080	6/1966	Williams et al.	180—127
3,387,685	6/1968	Fresh et al.	180—127

ANDREW H. FARRELL, Primary Examiner

U.S. Cl. X.R.

180—126, 127