Oct. 18, 1966 J. J. STENGER 3,279,407

SURFACE VESSEL

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Fig - 1

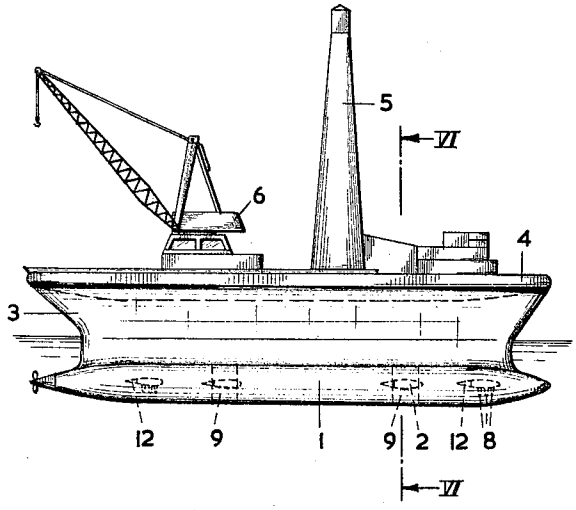


Fig - 2

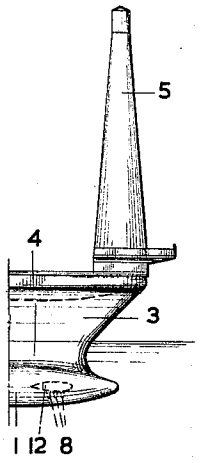
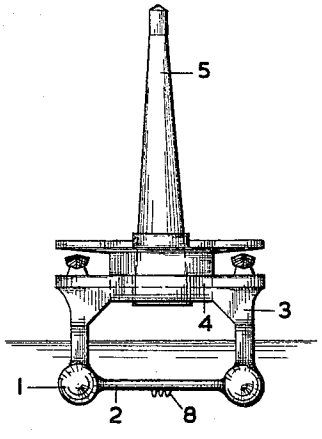


Fig - 3



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Fig. 4

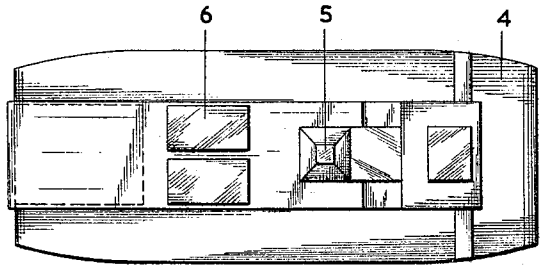


Fig. 5

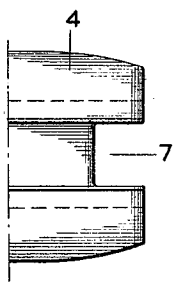
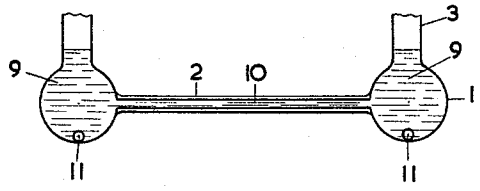


Fig. 6



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Fig - 7

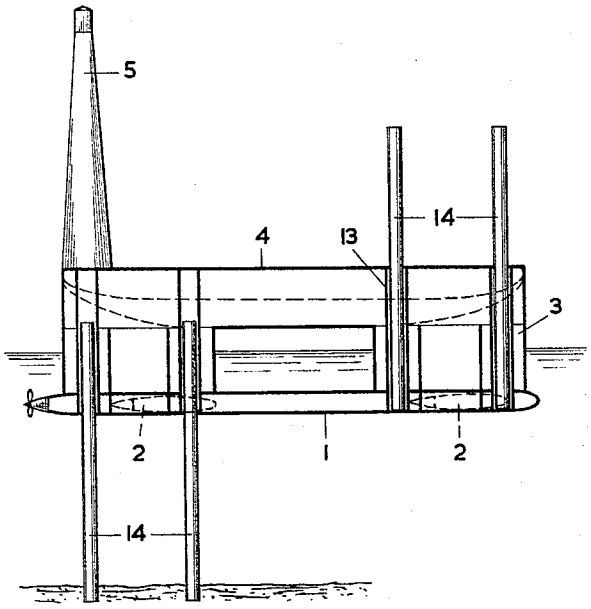


Fig - 9

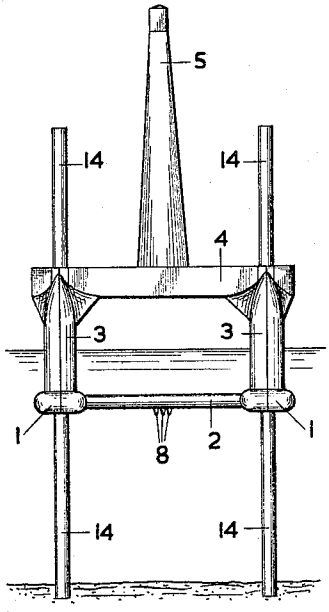
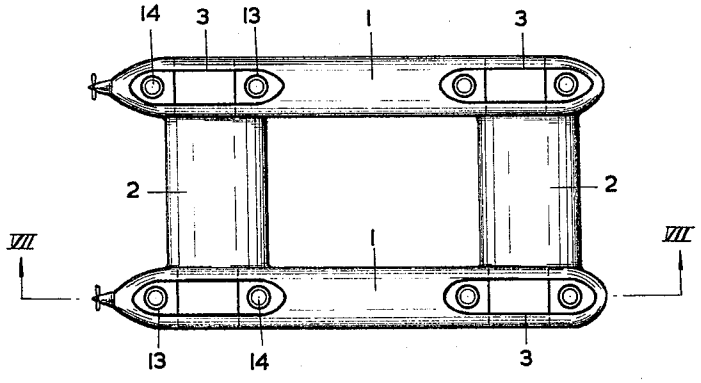


Fig - 8



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United States Patent Office 3,279,407
Patented Oct. 18, 1966

3,279,407

SURFACE VESSEL

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Filed May 27, 1964, Ser. No. 370,509
Claims priority, application Netherlands, May 28, 1963, 293302; Feb. 26, 1964, 6401842
9 Claims. (Cl. 114—66.5)

The invention relates to a surface-borne vessel of the type which has almost the same draught when lying on station and when sailing.

In the designs of surface-borne vessels two main trends are to be distinguished, viz. a tendency to raise the vessel from the water when sailing and a tendency to maintain substantially the same draught of the vessel both when lying on station and when sailing, the conventional type of vessel. The invention belongs to the latter group.

In this latter group proposals are known for propelling the vessel, so as to ensure its riding smoothly, with the larger part of its volume below water level, at a depth such that this volume is not affected by the action of the waves. To achieve this object, the vessel has been designed to be tubular, while mounted on this tubular body is a hollow plate-shaped body, which projects above the surface of the water.

It is also known for surface-borne vessels, for the sake of greater stability, to have one deck mounted on two, or several, separate vessels or floats, a principle known by the name of catamaran, trimaran, etc. These latter constructions, however, in practice showed many weak points, while it was difficult to eliminate the influence of the seaway. A special form of catamaran has also been proposed, consisting of a portal structure above water level, the vertical legs of which rest on submerged tubular members. On considerations of strength of material, however, vessels of this type are impracticable, since the known weak points of the catamaran are now loaded even more heavily.

It is the object of the invention to furnish a basic form for a surface-borne vessel which can be used as a platform for deep drilling on the high seas, a working platform, an aircraft platform, and the like, but which is equally suitable for the carriage of goods and passengers and for special forms of transport. It is a particular object of the invention to provide for a vessel riding smoothly in seaway, satisfying very high demands of stability both when lying on station in seaway and when sailing.

It is a particular object of the invention to provide for a surface-borne vessel of the said type in which use is made of the smooth riding of a body propelled below water level, with which is combined a dry working deck mounted above water level.

The invention provides for a surface-borne vessel of the type which has substantially the same draught both when lying on station and when sailing, the maximum width of the part of the vessel that is below water level being a multiple of that of the part lying at the level of the construction water-line, characterized in that the part below water level comprises spaced tubular members which are interconnected by means of transverse elements fitted between said tubular members, said elements having hydrofoil section for low under-water resistance, and that resting on the tubular members are vertical struts of supporting a deck structure, lying well above the surface of the water, while at least one controllable member is present with the aid of which an upward or downward pressure, as desired, can be exerted on the vessel, so as to enable the correction of any departure of the attitude of the vessel from the desired position, said combination of features making it possible to sail the vessel at various speeds and imparting great stability and smooth riding to the vessel both when lying and/or working on station in a seaway and when sailing.

In this way the favourable properties as to the smooth riding of a body propelled at a considerable depth below the surface of the water are combined with a dry working deck. All the parts propelled under water are completely streamlined, so that the resistance in the sailing direction becomes relatively small. The dimensions of the parts of the surface-borne vessel may be such that in any case an optimum value of the metacentric height (distance from metacentre to centre of gravity) is obtained. The hydrofoil transverse connections between the tubular members constitute essential elements for ensuring the vessel riding smoothly in a seaway, which is added to the effect of the greater depth at which these members are propelled. Moreover, the transverse elements can be used for fitting connecting pipes, tubes, and the like between the tubular members. Further, the maximum stresses in the material in the centre of the vessel are kept within reasonable limits by the transverse connections between the tubular members.

To keep the under-water part of the vessel, when sailing, at a constant level, measures are required, which according to the invention may consist in that at least one transverse element having a hydrofoil section is provided at the trailing edge with at least one tail flap. If only one transverse element is provided with such a tail flap, it is preferably fitted to the foremost transverse element.

When the vessel is sailing, this tail flap may also help to reduce any vertical movements.

If the vessel comprises at least one transverse element, near the tubular members, provided with tail flaps, according to the invention the tail flaps attached to one transverse element may be movable in opposite directions. This ensures a stabilization against rolling of the vessel.

It is also possible, according to the invention, for the average of the positions of the tail flaps attached to one transverse element to be movable in the opposite direction to the average of the positions of the tail flaps attached to the other transverse element. In this way, with the aid of four tail flaps, a stabilization against both rolling and pitching can be automatically effected by control systems well known in the art, which form no part of this invention, a high degree of stability thus being ensured when the ship is sailing.

The open portal constructions formed by deck-structure and vertical struts makes this vessel particularly suitable, for instance, for use as a drilling platform, so that a kind of port for lighters is formed, for starting the drilling platform at sea. The lighters can then sail underneath the portal structure and be unloaded there.

In order to improve the smooth riding of other vessels underneath the portal structure, according to the invention at least the outermost transverse elements can be provided in athwartship direction with pneumatic breakwaters. For a description of pneumatic breakwaters see Proceedings of the A.S.C.E., May 1961, Journal of Waterways and Harbours Division; J. L. Green: "Pneumatic Breakwaters to Protect Dredges." In addition, "the Dock and Harbour Authority," 19 Harcourt St. London, W. 1, has published several articles on this subject, as for instance in vol. XLIV, No. 511, May 1963; by: J. Gordon Bryan: "Non-solid Breakwaters, Performance of full Scale Installations." If the drilling platform has to be stored at sea, it can remain with its head in the waves, while in the space within the vessel a relatively quiet area is formed. The provision of pneumatic breakwaters may also be useful during work in rough weather, the material used thus being protected from the waves. The formation of an air screen when the vessel is sailing may also be of importance, since with high seas on either side of the vertical struts supporting the deck structure differ-

ences of level may arise between the waves, which cause considerable pressures on the struts. These differences of level may be eliminated, at least in part, by the pneumatic breakwaters.

Furthermore, according to the invention train oil may be added to the compressed air. The oil can be ejected with each compressed air bubble released by needle valves. The effect of the breakwaters is enhanced by this.

In particular when the vessel is used as a drilling platform or a working platform, a dynamic positioning device with Voith-Schneider propellers may be provided. Positioning devices of this type have been described in "The Oil and Gas Journal," May 6, 1963, with reference to the Mohole project. By this means it is possible to keep the vessel in position within the tolerances permitted during drilling, and the vessel is then very suitable to be used with dynamic positioning when anchoring has to be considered impossible or very inconvenient, e.g. owing to great depth or unsuitable anchoring ground. By means of this dynamic positioning device the vessel can be put with its head in the wind and the waves, e.g. in rough weather, as a result of which favourable conditions for continued work are created. The Voith-Schneider propellers can also be used for the actual control and propulsion of the vessel, while mooring or unmooring and sailing through canals, locks, and ports is greatly facilitated by it.

Preferably, and in particular when the vessel is used as a drilling platform, according to the invention its design may be such that the tubular buoyancy bodies are maintained completely submerged in the working position. Since the tubular members provide for the greater part of the buoyancy, this measure ensures very smooth riding when the vessel is sailing and during work, e.g. when it is used as a working platform.

The vessel according to the invention is also eminently suited for the fitting of stabilizing devices. According to the invention the vessel may be so constructed that in each of the tubular buoyancy members are accommodated at least two anti-roll tanks, which are interconnected in such a way that the connections between the fore and aft tanks in each member lie at a different vertical level from the connections extending through the transverse struts between tanks in the different members (see FIGURE 6). By means of the same anti-roll tanks it is thus possible to cause at the same time a counter-action to rolling, as well as pitching. This measure is particularly suitable, since according to the invention vessels can be built with such length: width proportions that the rolling and pitching periods will be of the same order.

It is a further object of the invention to provide for a vessel that can be used as a general-purpose drilling platform, which permits of working almost under any circumstances on the high seas, irrespective of the depth of the sea.

With the vessel as described it is at once possible to drill while sitting on bottom, while anchored, and with dynamic positioning. Dependent on the size of the vessel used, drilling while sitting on the bottom can be effected down to a depth of about 18 m. At depths from over 18 m. to about 100 m., anchored drilling is envisaged. At greater depths drilling may take place without any difficulty with dynamic positioning. In a region such as the North Sea, however, high and steep seas and ground swell are to be feared, which are expected to affect any dynamically positioned drilling vessel—especially in the shallower parts, where drilling while sitting on the bottom is no longer possible, say from 18 m. to 40 m.—so greatly that positioning with the aid of anchors will have insufficient effect on the movements of the vessels. Since in shelf regions this range of depth occurs over relatively large areas, a solution of this problem is of great importance.

In order to bridge over this comparatively critical range of depths between about 18 m. and about 40 m., according to the invention substantially vertically movable supporting legs adapted to be clamped to the vessel are fitted in the box-shaped legs of the portal. These supporting legs may be accommodated in tubes having a length corresponding to the total height of the vessel from the working deck downwards. The resultants of moments and forces transmitted by the action of the waves via the vessel to the supporting legs are comparatively small.

When the supporting legs are raised, they project a relatively short distance above the working deck, in consequence of which it is not very difficult to secure them and the construction of the vessel is not very seriously affected.

The supporting legs may also be of fairly light construction, since the magnitude of the vertical pressure to be exerted by the vessel on the supporting legs can be kept small by adjustment of the ballast condition. The pressure to be exerted on the supporting legs during the can, therefore, be chosen in conformity with the safe soil load to be permitted on the spot.

According to the invention the supporting legs may be entirely closed, with the exception of a water inlet and outlet in the bottom and an opening in the top for the discharge of air or the introduction of compressed air. The supporting legs can thus be raised and lowered by releasing the clamping device (not shown) on the supporting leg in question and admitting a larger or smaller amount of water into the supporting leg, as the supporting leg is lowered or raised.

According to the invention the construction of the vessel may also be such that the vertical struts of the box-shaped deck structure are provided with openings for the waves at right angles to the longitudinal direction, the longitudinal streamlining being maintained. This measure is of particular importance because the vessel, when standing on its supporting legs, cannot be shifted and storms may cause high pressure of waves and wind on the vertical struts. The pressure area is reduced by the openings. The legs of the portal structure are thus constructed in two parts, but the area of the cross-section at the level of the water-line remains at least equal and streamlining is maintained as much as possible.

The invention will be explained more fully by reference to the annexed drawing.

FIG. 1 shows a longitudinal elevation of the vessel.

FIG. 2 shows a longitudinal elevation of the foremost part of the vessel, with a derrick fore.

FIG. 3 shows a front elevation of the vessel.

FIG. 4 shows a plan of the vessel according to FIG. 1.

FIG. 5 shows a plan of the part of the vessel according to FIG. 2.

FIG. 6 shows a cross-section on a larger scale along the line VI—VI in FIG. 1.

FIG. 7 shows a cross-sectional elevation of a vessel constructed as a general-purpose drilling platform according to the invention along the line VII—VII in FIG. 8.

FIG. 8 shows a cross-section substantially at the level of the water-line.

FIG. 9 shows a front elevation of the vessel according to FIG. 7.

The vessel illustrated in FIGS. 1 to 6 comprises two substantially elliptic bodies, which are interconnected approximately halfway by means of transverse elements **2**. Mounted on this frame is a box-shaped portal structure consisting of a box-shaped vertical strut **3** fitted on each tubular body **1** and a horizontal box-shaped member **4**. Mounted on the horizontal box-shaped member (work deck) is a derrick **5**, while, furthermore, on this working deck is placed a crane **6** adapted to travel on this deck, and a part of the work deck, in this case aft, is arranged as a helicopter deck.

The derrick may be mounted, as desired, somewhere in the middle of the deck, or over a slot 7 fore, or similarly over a slot aft, according as the drilling holes are completed under water or above water. Drilling over the side is also possible.

In the embodiment four transverse elements 2 are present, which interconnect the tubular bodies 1 substantially halfway. Fitted at the lower side of the outermost transverse elements are Voith-Schneider propellers 8, which do no extend beneath the lower side of the tubular bodies.

In each of the tubular bodies are fitted anti-roll tanks 9, two tanks in different tubular bodies being interconnected by a tube 10 passing through the transverse element 2, while in the same tubular body 1 the tanks are interconnected by means of a tube 11.

The tanks are filled with water to a given level. When the vessel is rolling, the water e.g. from a tank in one tubular member will flow to a tank in another tubular body, but since the tubular connection 10 lies at a higher level than the bottom, none of the tanks can ever become entirely empty. When the vessel is pitching, the remaining water can flow via the low-level tube 11 to a tank in a similar tubular member 1.

The tubular elements 2 have a hydrofoil section, and tail flaps 12 are fitted on the sides of the tubular members at the trailing edge of the two outermost transverse elements.

FIGS. 7, 8 and 9 show a general-purpose drilling platform the vertical legs of which are constructed in two parts.

Passing through the deck 4, each part of the leg 3, and the corresponding tubular member 1 are two tubes 13, each serving to guide a supporting leg 14. In the embodiment shown, eight supporting legs have been provided for. Each of the supporting legs is adapted to be clamped in its corresponding guide tube.

Since in its working position the vessel can be kept partly buoyant, the vertical forces in the supporting legs can be kept within low limits. The supporting legs may be smooth tubes of very simple construction, having a sea inlet at the bottom and at the top a connection for the discharge of air or the introduction of compressed air.

Since during the operation on supporting legs some pressure will have to be exerted on the supporting legs if the vessel is to be kept in place with certainty, with the aid of the vessel a pressure may be exerted on, for instance, two diametrically opposed supporting legs until the supporting legs have been driven sufficiently into the soil.

The vessel described above constitutes a general-purpose drilling platform which is adapted for drilling while sitting on bottom, on supporting legs, anchored, and dynamically positioned.

What I claim is:

1. A water borne vessel having a submerged hull portion designed for substantial and substantially constant draught which includes at least two elongated tubular buoyant bodies extending in parallel horizontal relationship and connected with each other by at least two transverse strut means, the cross-section of at least one of the transverse strut means being of hydrofoil configuration and said one strut means being provided with movable trailing flap means, a work deck supported above the surface of the water by vertical streamlined strut means extending between the buoyant bodies and the work deck, and means for maintaining the stability of the vessel.

2. The invention as defined in claim 1, wherein said one strut means is provided with at least two horizontally aligned indpendently movable trailing flap means.

3. The invention as defined in claim 1, wherein each of said transverse strut means is provided with movable trailing flap means.

4. The invention is defined in claim 1, wherein each of said transverse strut means includes Voith-Schneider propeller means.

5. The invention as defined in claim 1, wherein said buoyont bodies and transverse strut means are submerged under all operating conditions of the vessel.

6. The invention as defined in claim 1, wherein each of said buoyant bodies is provided with a pair of internally disposed longitudinally spaced ballast tanks, first conduit means for communication between at least one of the tanks in one pair and at least one of the tanks in the other pair, and second conduit means in each of the buoyant bodies for communication between both tanks in each pair of tanks, said first and second conduit means being disposed in different vertical planes.

7. The invention as defined in claim 1, wherein vertical legs for supporting the vessel on the ground below water are positioned for vertical movement within said vertical struts, and means are provided for clamping the legs in place.

8. The invention as defined in claim 7, wherein said legs are hollow and are provided with an opening in the bottom for communication with the surrounding water, and means for supplying air under pressure to the interior of the legs at the top thereof.

9. The invention as defined in claim 1, wherein said vertical streamlined struts are provided with at least one transverse opening therethrough to reduce the surface area exposed to transverse forces caused by wind and waves.

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