June 6, 1967 W. A. HUNSUCKER 3,323,478

FLOATING SUPPORT

Filed Sept. 20, 1965 2 Sheets-Sheet 1

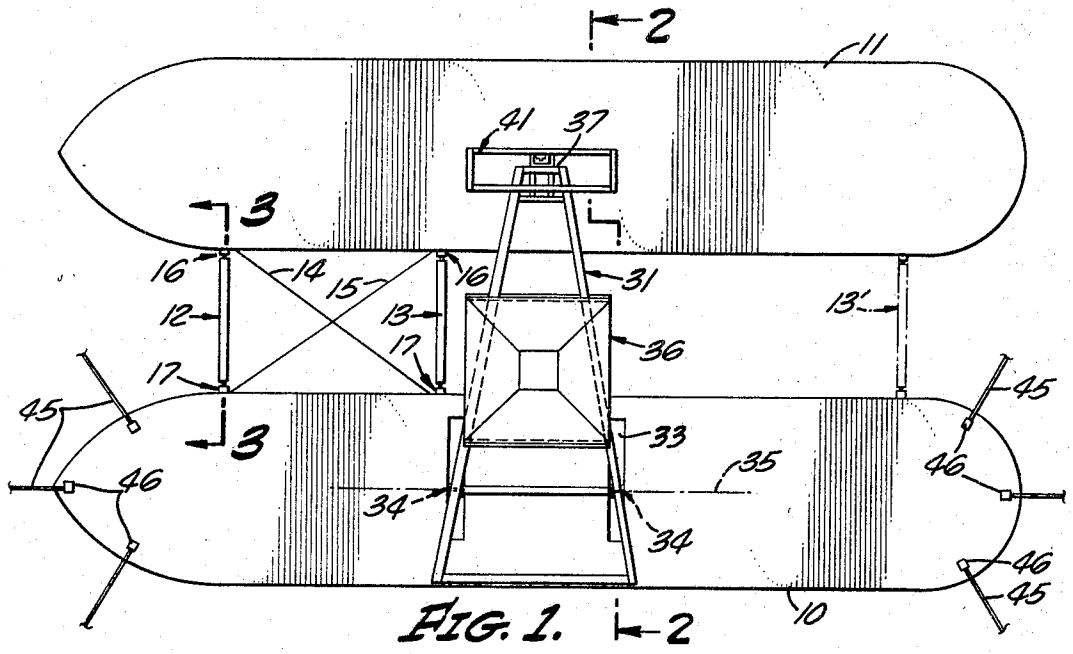


FIG. 1.

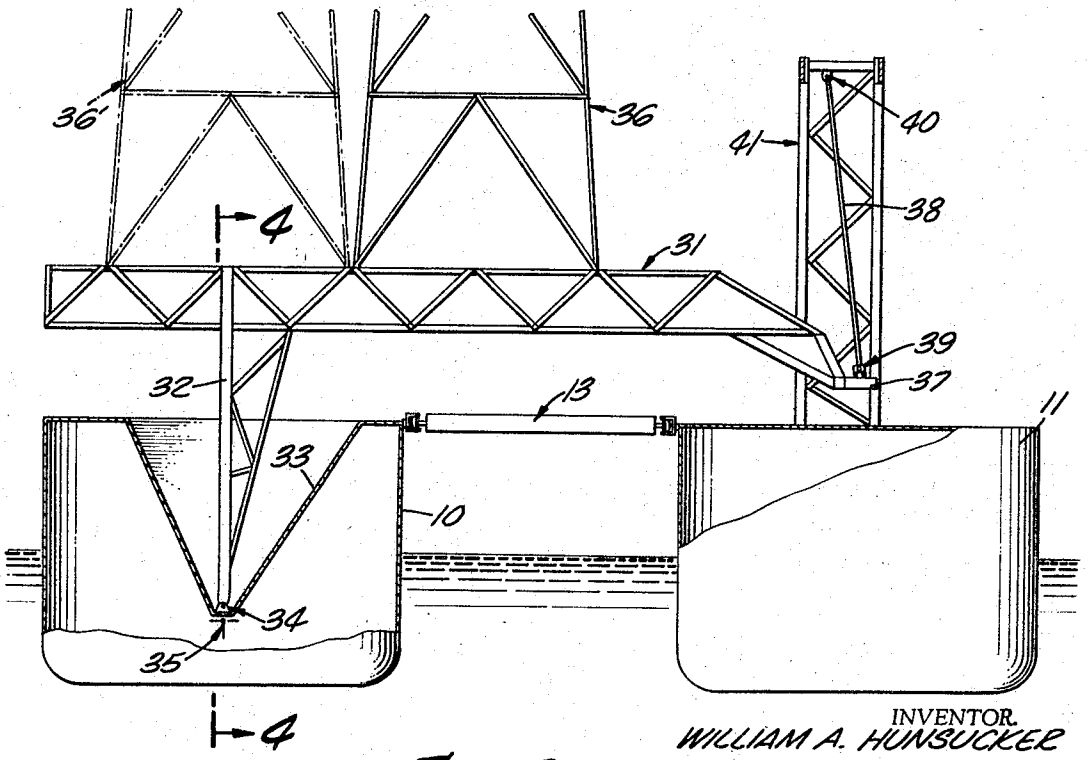


FIG. 2.

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Filed Sept. 20, 1965 2 Sheets-Sheet 2

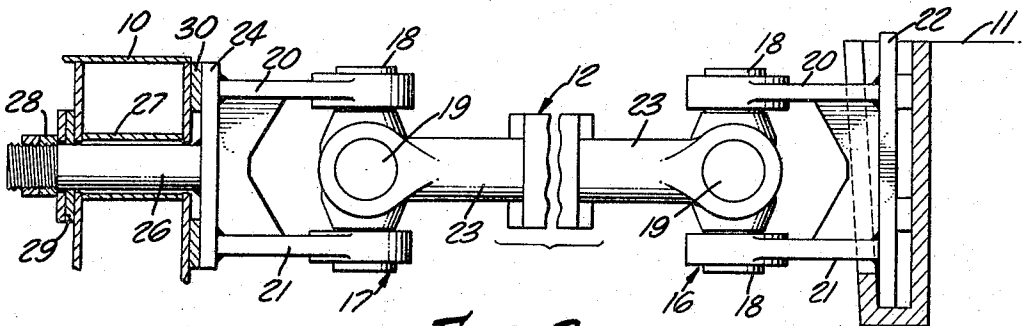


FIG. 3.

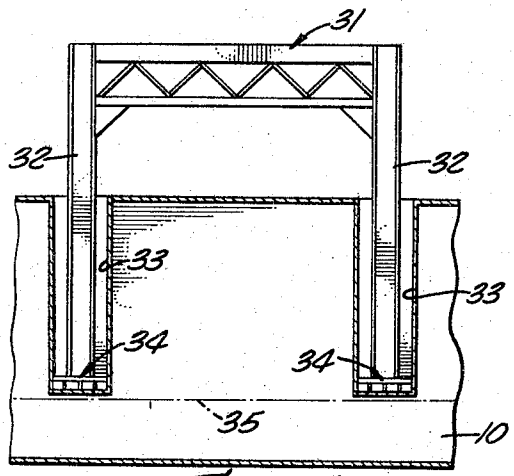


FIG. 4.

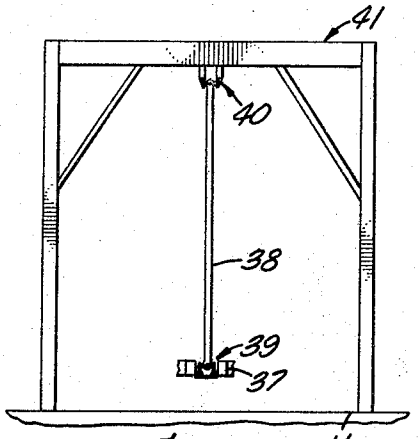


FIG. 5.

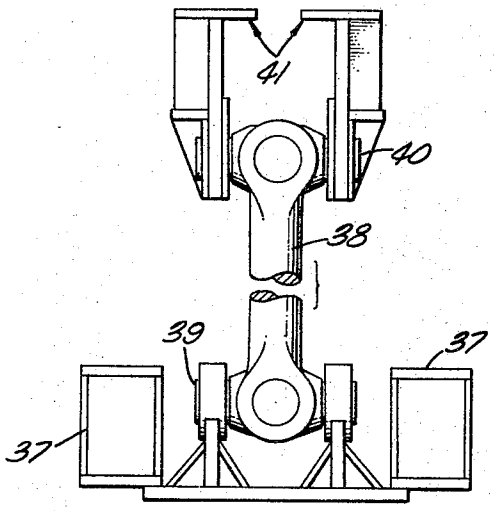


FIG. 6.

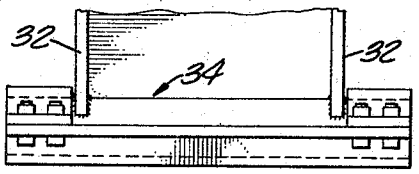


FIG. 7.

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FLOATING SUPPORT

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4 Claims. (Cl. 114—.5)

This invention relates to apparatus for supporting heavy loads in or over a body of water, and is particularly directed to improvements over apparatus of the type shown in my prior Patent No. 2,916,002, granted Dec. 8, 1959, for Marine Hoisting Apparatus. The present invention has particular usefulness as a support for marine drilling, salvage or construction operations. This invention will be described in connection with marine drilling apparatus although this is only by way of illustration.

Present-day marine drilling devices using a floating vessel require specialized construction of the vessel which is very expensive. Moreover, such specialized floating vessels for drilling operations are often so large and difficult to transport that they cannot pass through existing canals or waterways, and thus have limited usage.

Among the important objects of the present invention are to provide apparatus to overcome the foregoing difficulties by employing substantially conventional vessels to reduce the cost and to enable them to pass through existing waterways.

Conventional supporting apparatus for well drilling operations commonly employ a single floating vessel which tends to roll in response to wind or wave action. Rolling of the vessel seriously interferes with drilling operations, to the extent that drilling activities must be halted during bad weather. The present invention contemplates the use of two supporting vessels with the result that motion of the drilling platform brought about by rolling action of the vessels is largely eliminated. Another object is to provide a marine support employing conventional vessels with minimum modification so that the vessels can be used for conventional purposes when not required for drilling operations.

Another object is to provide a floating support at minimum cost.

Briefly stated, these and other objects of the invention are achieved by a pair of floating vessels, struts spacing the vessels so that each may roll and pitch independently of the other, a support extending laterally between the vessels, one portion of the support being pivotally carried at a low elevation at or near the center of one of the vessels, and another portion of the support being pendantly suspended from a tower on the other of the vessels, thereby minimizing movement of the support brought about by rolling motion of the vessel.

Referring to the drawings,

FIGURE 1 is a top plan view in diagrammatic form showing a preferred embodiment of the invention.

FIGURE 2 is a sectional end elevation taken substantially on the lines 2—2 as shown in FIGURE 1.

FIGURE 3 is a detail of one of the horizontal strut assemblies taken substantially on the lines 3—3 as shown in FIGURE 1.

FIGURE 4 is a side elevation of the compression legs of the support bridge or deck taken substantially on the lines 4—4 as shown in FIGURE 2.

FIGURE 5 is a side elevation showing the tower and tension member which carries one end of the support bridge or deck.

FIGURE 6 is a side elevation partly broken away showing the gimbal mounting structure at opposite ends of the tension member.

FIGURE 7 is an enlarged detail showing one of the pivot supports for the compression legs of the support bridge or deck.

Referring to the drawings, a pair of floating vessels or barges **10** and **11** are provided. These are of substantially conventional design. The vessels are held in spaced relationship by means of strut assemblies **12** and **13** acting in concert with diagonal members **14** and **15**. The diagonal members prevent longitudinal movement of one vessel with relation to the other. Strut assembly **13** may optionally be located at the phantom line position as shown at **13'**.

One end of each strut assembly is attached to vessel **11** by means of self-aligning connection **16**, and the other end of each strut assembly is connected to vessel **10** by means of a self-aligning and rotating connection **17**. These strut assemblies and connections are similar to those disclosed in my prior patent identified above. They serve to space the vessels **10** and **11** apart in predetermined relationship and at the same time permit each vessel to respond to wind and wave action independently of the other vessel. The strut assemblies **12** and **13** are duplicates. As shown in FIGURE 3, the strut assembly **12** has yoke parts **23** at opposite ends connected by ends **18** and **19** to parallel parts **20** and **21**. Plate **22** fixed to vessel **11** is fixed to one pair of the parts **20** and **21**, while plate **24** is fixed to the other pair of parts **20** and **21**. The plate **24** is attached to vessel **10** by means of a shank **26** fixed to plate **24** and free to rotate within tubular member **27**. A nut **28** threaded to the shank **26** has a flange which prevents disassembly. Bearing plates **29** and **30** distribute loads from the plates to the vessel **10**.

The support bridge or deck **31** spans the distance between the two vessels **10** and **11** and is supported in a novel manner upon them. Compression legs **32** on the support bridge **31** extend into wells **33** provided in vessel **10**, as shown in FIGURE 4. A pivot support **34** extending longitudinally of the vessel **10** is provided at the lower end of the compression legs **32**. The wells **33** in the vessel **10** provide clearance so that the compression legs **32** may turn about the pivotal supports **34** as the vessel **10** rolls about its axis of oscillation **35**. The derrick **36** used in drilling operations is carried on the support bridge **31**. The derrick **36** may optionally be located as shown at the phantom line position **36'**, in which latter case the drilling operations would be performed through an opening (not shown) extending entirely through the vessel **10**.

The support bridge **31** has one end **37** which terminates in a position above the central portion of the vessel **11**. A tension bar **38** is connected to the end portion **37** of the support bridge **31** by means of gimbal joint **39**. The upper end of the tension bar **38** is connected by a gimbal joint **40** to the tower **41** rigidly attached to vessel **11**.

In a conventional floating apparatus for drilling operations beneath a body of water, the derrick is rigidly attached to the floating vessel. As a result, rolling action of the vessel in response to wind and wave action produces exaggerated motion at the top of the derrick. Since the weight of the drill pipe and related drilling equipment is suspended from the top of the derrick, such motion may be sufficiently severe to require suspension of drilling operations until the weather becomes more calm. It is also evident that the operations within the remaining portions of the derrick as well as the derrick floor and the equipment supported thereby will be adversely affected by such rolling motion of the floating vessel.

When a floating vessel rolls in response to wind or wave action, the effect is that that entire vessel pivots through a small angle of rotation, for example one degree to fifteen degrees about an axis **35** commonly known as the axis of oscillation. It is apparent that any structural ele-

ments or items of equipment that are rigidly attached to the floating vessel will also be forced to turn about this same axis of oscillation. The further the item of equipment is located from the axis of oscillation, the greater its motion will be. Conversely, the closer it is to the axis of oscillation, the smaller its motion will be.

In the embodiment of this invention as shown and described herein, the two spaced floating vessels may independently roll with wind and wave action, but very little of this rolling motion is transmitted to the support bridge **31** on which the derrick **36** is mounted. The pivot support assemblies **34** are located at or near the axis of oscillation **35** so that rolling motion is at a minimum. The support bridge is rigidly attached to the compression members **32** and hence the support bridge is pivotally mounted near the axis of oscillation **35** of the vessel **10**. The end **37** of the supported ridge **31** is pendantly supported from the tower **41** on the other vessel **11** by means of the tension bar **38** and gimbal joints **39** and **40**.

It should be noted that it is not necessary that the pivotal supports **34** be located exactly on the axis of oscillation of the vessel **10**. Derricks commonly in use on floating vessels may be from 100 feet to 150 feet high. Motion at the top of the derrick is approximately equal to the height of the derrick multiplied by the angle of roll. If the pivotal assemblies **34** were placed approximately 10 or 15 feet above the axis of oscillation **35** of the vessel **10**, motion of the parts **34** would be equal to the respective distances from the axis of oscillation **35** multiplied by the angle of roll. Thus it is evident that the pivotal supports **34**, support bridge **31** and derrick **36** would move only one tenth as much at the top of the derrick as compared to the conventional mounting of the derrick by rigid attachment to one of the vessels. From the foregoing it is evident that a very significant reduction in the motion caused by rolling can be achieved by the apparatus of this invention.

The connection between the gimbal joint **39** and the end **37** of the support bridge **31** is preferably positioned above the central portion of the vessel **11**. The pendant support supplied by the tension member **38** tends to restore the system to the original position which the parts would occupy during calm weather. Thus there are forces of restitution which tend to minimize and damp out any motion of the support bridge **31** which might be caused by rolling of vessel **10**.

It is of particular importance to note that the pivotal supports **34**, mounted on or near the axis of oscillation of vessel **10**, in conjunction with gimbal joint **39** on vessel **11**, determine a plane which in turn establishes a plane of support for the derrick and related equipment which is relatively free of motion which might otherwise be induced because of rolling of vessel **10**. This result is achieved primarily because gimbal joint **39**, supported by vessel **11** and attached to one end of the framework **31**, enforces turning motion around pivotal supports **34** as vessel **10** rolls.

The vessel **10** may be maintained in the desired offshore position by means of the anchor cables **45** and winches **46**.

Having fully described my invention, it is to be understood that I am not to be limited to the details herein set forth but that my invention is of the full scope of the appended claims.

I claim:

1. Floating support apparatus having in combination: two buoyant members, means spacing the members apart so that they may each roll and pitch independently of the other, a bridge extending laterally to span the space between the two buoyant members, pivot means supporting one portion of said bridge on one of said buoyant members near its longitudinal axis of oscillation, a tower on the other buoyant member, and pendant means supporting another portion of said bridge from said tower.

2. Floating support apparatus having in combination: two buoyant members, means spacing the members apart so that they may each roll and pitch independently of the other, a bridge extending laterally to span the space between the two buoyant members, one of the buoyant members having a well in the upper portion thereof, pivot means in said well supporting one portion of said bridge on said buoyant member near its longitudinal axis of oscillation, a tower on the other buoyant member, and pendant means including a tension member supporting another portion of said bridge from said tower.

3. Floating support apparatus having in combination: two floating vessels, means spacing the vessels apart so that they may each roll and pitch independently of the other, a bridge extending laterally to span the space between said vessels, longitudinally spaced pivot means supporting one portion of said bridge on one of said vessels near its longitudinal axis of oscillation, a tower on the other of said vessels, and pendant means supporting another portion of said bridge from said tower.

4. Floating support apparatus having in combination: two floating vessels, means spacing the vessels apart so that they may each roll and pitch independently of the other, a bridge extending laterally to span the space between said vessels, said bridge having spaced compression members, longitudinally spaced pivot means supporting said compression members on one of said vessels near its longitudinal axis of oscillation, a tower on the other of said vessels, and pendant means supporting an extending end of said bridge from said tower.

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