July 22, 1969 J. S. BREWER 3,456,720

APPARATUS AND METHOD FOR DRILLING WELLS

Filed Jan. 11, 1967 3 Sheets-Sheet 1

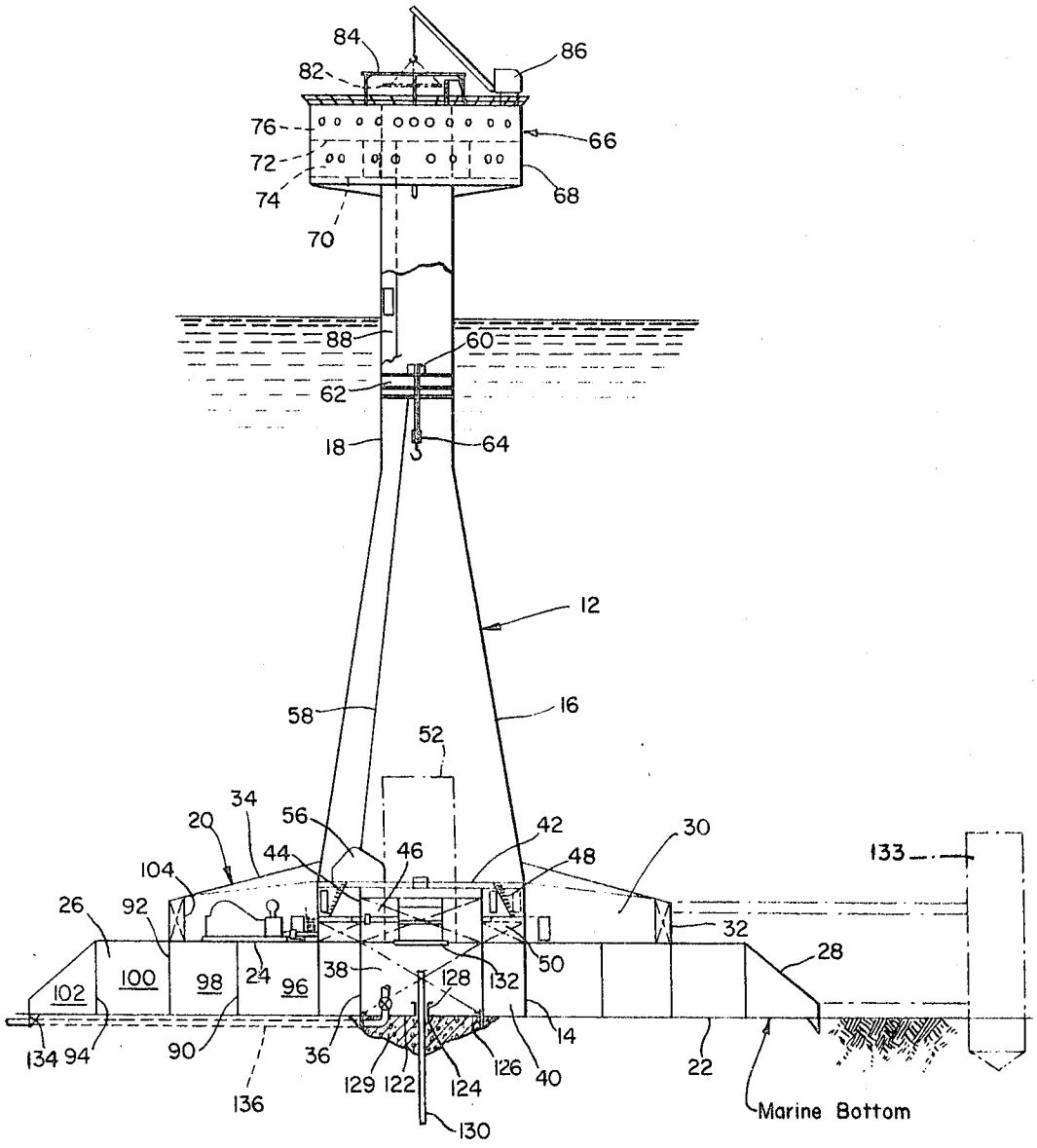


Fig. 1

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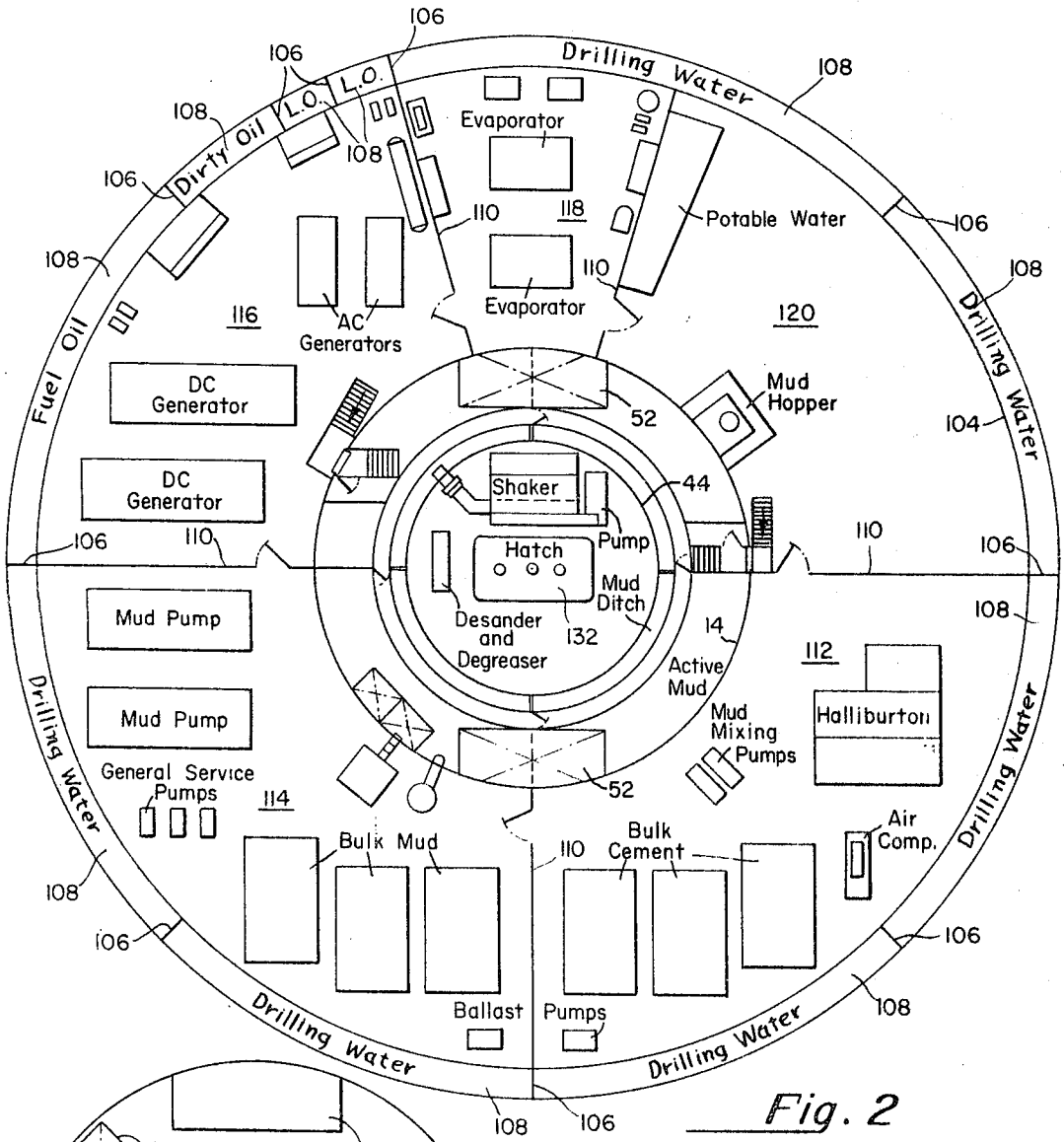


Fig. 2

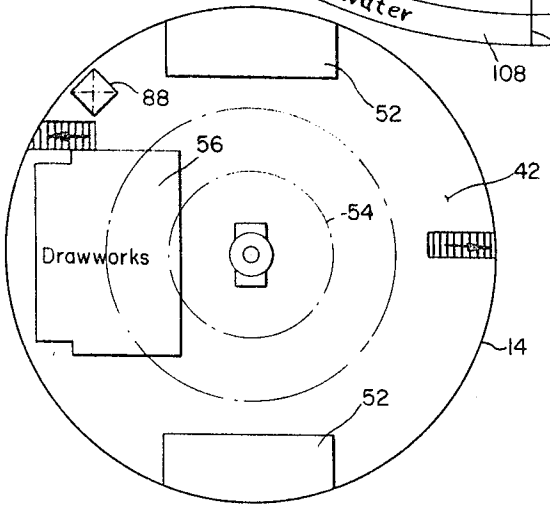


Fig. 3

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APPARATUS AND METHOD FOR DRILLING WELLS

Filed Jan. 11, 1967 3 Sheets-Sheet 3

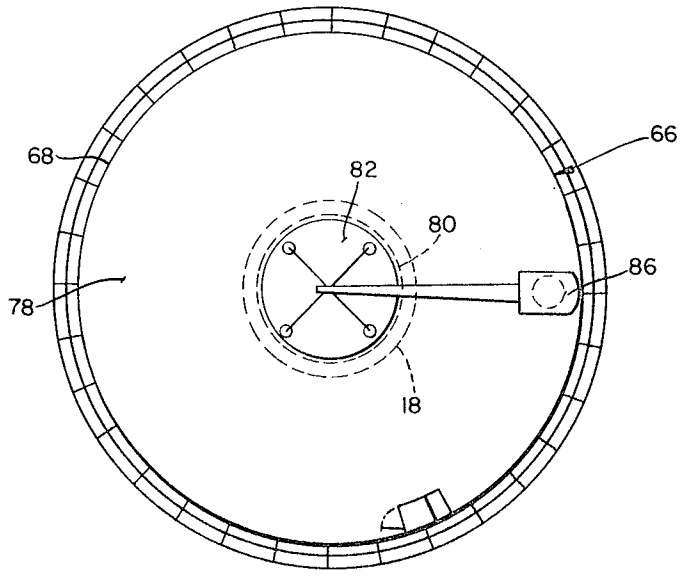


Fig. 4

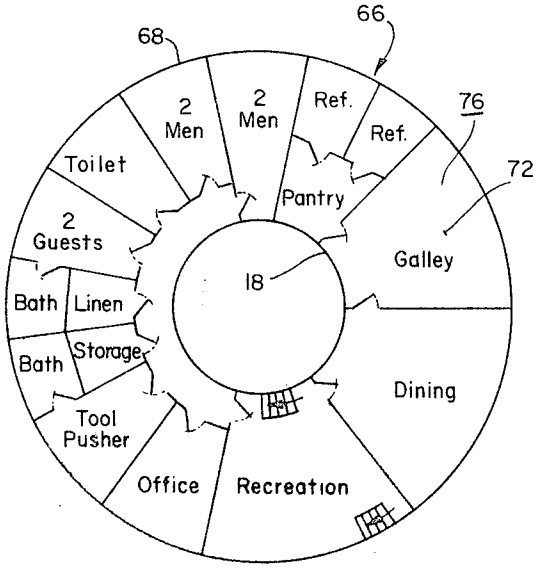


Fig. 5

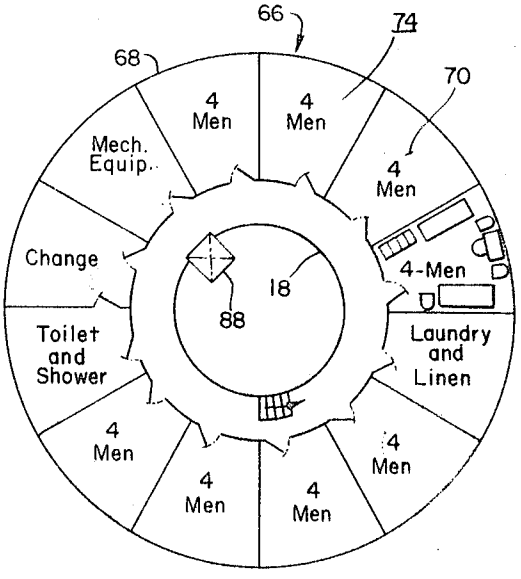


Fig. 6

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APPARATUS AND METHOD FOR DRILLING WELLS

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Int. Cl. E21b 33/035, 43/01, 7/12
U.S. Cl. 166—.5 7 Claims

ABSTRACT OF THE DISCLOSURE

A watertight floatable hull is disclosed for marine drilling comprising a caisson section extending from above the water line to the marine bottom, an annular base section extending about the lower portion of the caisson, a lower chamber at the bottom of the caisson, a lower floor extending across the bottom of the caisson and annular base section and resting directly on the marine bottom and having a skirt penetrating into the marine bottom, a covered opening in the floor of the lower chamber for pumping cement therethrough to lay a bed of cement, and a production line through the floor. The skirt and floor are detachable, together with the production line, from the balance of the hull so that after the well is sunk the hull may be removed, leaving the chamber floor and production line on the cement bed on the marine bottom.

This invention relates generally to apparatus and a method of drilling wells under a body of water, and particularly to a rig or vessel for and method of drilling and completing a well from a position adjacent the marine bottom.

For drilling wells under a body of wtaer, apparatus has been proposed comprising a derrick in the form of a caisson which may be sunk to the marine bottom and a submersible barge detachably connected to the bottom of the caisson. The barge serves as a source of power for the rotary table and draw works, and of materials necessary for drilling and completing the well. When the well is completed, the barge is disconnected from the caisson, refloated and moved to a new site, but the caisson which serves as the derrick remains in position at the site of the completed well, in consequence of which the apparatus suffers the disadvantage that a new caisson must be provided for use at the new site. Accordingly, an important object of this invention is to provide a self-contained rig or vessel with all necessary equipment for drilling and completing the well, which vessel may be sunk to the marine bottom and, after the well is drilled, completed and placed in production, refloated substantially intact for removal to and use at another site.

Another object is to provide such a vessel which makes it possible to carry on the drilling operation from start to finish from a drilling position adjacent the marine bottom in much the same manner as on dry land.

It will be understood, of course, that the invention consists not only in the combination, construction, location and relative arrangement of parts as shown in the accompanying drawings, but also in the novel method of drilling a well under a body of water made possible by the apparatus of the present invention, all as will appear more fully hereinafter and as finally pointed out in the appended claims.

In the accompanying drawings, which are illustrative of a preferred form of apparatus constructed in accordance with and embodying the principles of the present invention:

FIGURE 1 is an elevation of a rig or vessel constructed in accordance with the invention, part being shown in section;

FIGURE 2 is a plan view of the machinery deck;
FIGURE 3 is a plan view of the derrick floor;
FIGURE 4 is a plan view of a helicopter deck;
FIGURE 5 is a plan view of the upper-quarters deck; and
FIGURE 6 is a plan view of the lower-quarters deck.

The following description is directed to the specific form of the apparatus shown in the drawings and to a specific method of using the apparatus illustrated. It is not directed to the scope of the invention, which may be practiced in a variety of forms.

Apparatus constructed in accordance with the invention includes a hull having a caisson section **12** with a cylindrical lower end portion **14**, a frustum-shaped intermediate portion **16** and a cylindrical upper end portion **18**. Extending about the lower end portion **14** of the caisson is a base section **20** having a lower floor or bottom **22** and an upper floor or machinery deck **24** dividing the base section **20** into a lower part **26** bounded by a sloping peripheral wall **28** and an upper part **30** bounded by an upright peripheral wall **32**. Topping the upper part **30** is a soping wall **34**.

Between the bottom **22** and the machinery deck **24** and within the lower end portion **14** of the caisson is a cylindrical wall **36** defining a lower chamber or cellar **38** about which there extends an annular chamber for ballast, designated **40**. Above the machinery deck **24** is a derrick floor **42**, and between the machinery deck **24** and the derrick floor **42** is a cylindrical wall **44** defining an upper chamber or shale shaker compartment **46** about which there extends an annular chamber **48** containing a mud pit compartment **50**. On opposite sides of the caisson, extending upwardly from the machinery deck and through the derrick floor, are pipe racks **52**. Centered in the derrick floor **42** is a rotary table **54**, and supported on the derrick floor **42** is a hoist **56** from which there extends upwardly a line **58** to a crown block **60** carried by a support **62** in the cylindrical upper section **18** of the caisson. The support **62** is adjustable vertically. Depending from the crown block **60** is a traveling block **64**.

Extending about the head of the caisson is a housing **66** comprising a cylindrical outer wall **68**, a lower-quarters deck **70** and an upper-quarters deck **72** dividing the interior of the housing **66** into a lower part **74** and an upper part **76**. The roof of the housing, designated **78**, is flat and serves as a heliport. In the center of the roof is an opening **80** for access to the interior of the caisson, the opening being provided with a cover **82**. A portable canopy **84** is provided over the opening **80**, and a crane **86** is located to one side of the roof **78** for use in handling the cover **82**. Access from the heliport to the derrick floor **42** is had by means of an elevator, designated **88**. The interior of the housing **66** is suitably arranged to quarter the crew of the vessel.

The lower part **26** of the base section **20** is provided with a series of upright concentric cylindrical partitions **90**, **92** and **94**, which divide the lower part **26** into four annular ballast compartments **96**, **98**, **100** and **102**. The upper part **30** of the base section **20** is provided with an upright cylindrical partition **104** and circumferentially spaced radially extending partitions **106**, which divide the annular space between the partition **104** and the peripheral outer wall **32** into an outer ring of arcuate compartments **108** for fluid storage. The annular space between the partition **104** and the lower end portion **14** of the caisson is provided with radially extending partitions **110**, which divide the annular space into an inner ring of arcuate compartments **112**, **114**, **116**, **118** and **120** for accommodating machinery and materials necessary for the drilling operation.

The bottom **22** is provided centrally thereof with a sec-

tion 122 which serves as the floor of the cellar 38. The floor 122 is provided with a covered opening in the center thereof, designated 124. The cover is not shown in the illustration. Extending about the floor 122 and depending therefrom is a skirt 126. The floor 122 and the skirt 126 are detachable from the balance of the apparatus. Underlying the floor 122 is a bed of cement 129. Extending about the bottom 22 and depending therefrom is a skirt 134, and extending through a notch in the skirt 134 is a production line 136 which runs along the bottom 22 and upwardly through the bed of cement 129, being valved off within the cellar 38. Extending downwardly through a collar 128 and through the bed of cement 129 is a pipe section 130. It will be noted that the hatch over the opening in the floor of the shale shaker compartment 46, designated 132, and the rotary table 54 in the derrick floor 42, are vertically aligned with the opening in the floor 122.

If desired, the stability of the vessel may be increased by attaching lines to the upper end portion of the caisson and extending them downwardly and outwardly to anchors (not shown) resting on the marine bottom. Alternatively, the base section 20 may be fitted with suitable outriggers 133, shown in phantom, extending outwardly therefrom and embedded in the marine bottom. The bottom 22 is provided with a jetting system for a purpose to appear.

When the vessel arrives at the well site, it is loaded with the necessary drill pipe, casing, sack and liquid mud, cement, fuel and lube oil, fresh water, etc. The cellar 38 may be full of water, which is pumped out after the vessel is firmly on the marine bottom.

After all personnel are evacuated from the lower portion of the vessel, sea cocks are opened to distribute water in controlled manner to the ballast compartments. The operation is executed by remote control console (not shown) located in the above surface portion of the vessel. The vessel is now stabilized by dropping the anchors.

The opening 124 is uncovered and cement is pumped therethrough to lay the bed of cement 129. After the cement sets, a surface hole is drilled through the cement and the well is completed in the usual manner. Upon completion of the well, the preventer stack is removed from the cellar through the hatch 132 and placed in the shale shaker room. With the production head in place upon the well, the production line is connected to the well tree and the well is placed in production.

Now, preparatory to refloating the vessel, the floor 122 of the cellar 38 is disconnected from the balance of the apparatus. Then the hatch 132 is closed. Now the jetting system on the bottom 22 is continuously operated until the vessel is refloated, whereupon the vessel is deballastized by expelling ballast in proper sequence and under proper control, the operation being accomplished by remote control console.

It will be understood that when upward movement of the vessel begins, the vessel separates from the floor 122 of the cellar 38. The floor 38, firmly seated upon its cement bed 129, the skirt 126 extending thereabout, the producing well and the production line 136 extending out to the buoy remain in place. Thereafter the end of the production line at the buoy end is connected to a storage facility.

Before submerging the vessel at the next well site, the vessel is fitted with a new floor 122 and a new skirt 126 for the cellar 38 and a new production line 136.

What is claimed is:

1. In apparatus for drilling a well under a body of water, a water-tight floatable hull comprising a caisson section adapted to extend from the marine bottom to a height above the water, a base section extending about the lower portion of said caisson section, means within said caisson section providing a lower chamber at the bottom thereof, a lower floor extending across the bottoms of said caisson and base sections including a floor for said chamber, said lower floor being adapted to rest directly upon the marine bottom, and the floor of said chamber being detachable from the balance of said hull, a covered opening in the floor of said chamber adapted for use in installing surface casing, a production line extending through the floors of said chamber and placing the interior thereof in communication with the exterior of said hull, and a skirt extending about the floor of the chamber and depending therefrom for penetration into the marine bottom, said skirt being detachable with the floor of said chamber and the production line from the balance of the hull.

2. In apparatus for drilling a well under a body of water, a water-tight floatable hull comprising a caisson section adapted to extend from the marine bottom to a height above the water, a base section extending about the lower portion of said caisson section, means within said caisson section providing a lower chamber at the bottom thereof, a lower floor extending across the bottoms of said caisson and base sections including a floor for said chamber, said lower floor being adapted to rest directly upon the marine bottom, and the floor of said chamber being detachable from the balance of said hull, a covered opening in the floor of said chamber adapted for use in installing surface casing, a production line extending through the floor of said chamber and placing the interior thereof in communication with the exterior of said hull, an upper chamber in the lower portion of the caisson section directly over the lower chamber, an upper floor, including a floor for said upper chamber, dividing the base section and the lower portion of said caisson section into a lower part adapted for accommodating ballast and an upper part adapted for accommodating machinery, a covered access opening in the floor of said upper chamber directly over the covered opening in the floor of said lower chamber, the lower portion of the caisson section being cylindrical, the lower and upper chambers being cylindrical and smaller in diameter than the lower portion of said caisson section, whereby to provide annular chambers respectively extending about said lower and upper chambers.

3. In apparatus for drilling a well under a body of water, a water-tight floatable hull comprising a caisson section adapted to extend from the marine bottom to a height above the water, a base section extending about the lower portion of said caisson section, means within said caisson section providing a lower chamber at the bottom thereof, a lower floor extending across the bottoms of said caisson and base sections, including a floor for said chamber, said lower floor being adapted to rest directly upon the marine bottom, and the floor of said chamber being detachable from the balance of said hull, a covered opening in the floor of said chamber adapted for use in installing surface casing, a production line extending through the floor of said chamber and placing the interior thereof in communication with the exterior of said hull, an upper chamber in the lower portion of the caisson section directly over the lower chamber, an upper floor including a floor for said upper chamber dividing the base section and the lower section of said caisson into a lower part and an upper part, means in said lower part for partitioning the same into a series of concentric fluid-tight compartments extending about the lower chamber and adapted for accommodating ballast, and means in said upper part for partitioning the same into an outer ring of fluid-tight arcuate compartments for storage of fluids and an inner ring of arcuate compartments extending about said upper chamber and adapted for accommodating machinery.

4. In apparatus for drilling a well under a body of water, a water-tight floatable hull comprising a caisson section adapted to extend from the marine bottom to a height above the water, a base section extending about the lower portion of said caisson section, means within said caisson section providing a lower chamber at the bottom thereof, a lower floor extending across the bottoms of said caisson and base sections including a floor for said chamber, said lower floor being adapted to rest directly upon the marine bottom, and the floor of said

chamber being detachable from the balance of said hull, a covered opening in the floor of said chamber adapted for use in installing surface casing, a production line extending through the floor of said chamber and placing the interior thereof in communication with the exterior of said hull, the caisson section having a cylindrical lower end portion, a frustrum-shaped intermediate portion and a relatively small diameter cylindrical upper end portion; an upper chamber in the lower end portion of said caisson section directly over the lower chamber, a derrick floor extending across the lower end portion of the caisson section providing a ceiling for said upper chamber, the space above the derrick floor being freely in communication with the upper end portion of said caisson, and the top of said base section connected into said caisson section at approximately the same level as said derrick floor.

5. The hull according to claim 4 wherein a housing extends about the upper end of the caisson section well above the water, and the housing is arranged internally to provide living quarters for a crew of men.

6. The hull according to claim 5 wherein the upper end portion of the caisson section extends through the

housing to the roof thereof, and access to the interior of the caisson section is had through an opening in the roof closed by a removable cover.

7. The hull according to claim 6 wherein the roof of the housing is flat for service as a helicopter deck.

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U.S. Cl. X.R.

175—8