

Oct. 12, 1954

R. TOWNSEND ET AL

2,691,272

SUBMERSIBLE OIL WELL DRILLING RIG

Filed Sept. 23, 1950

6 Sheets-Sheet 1

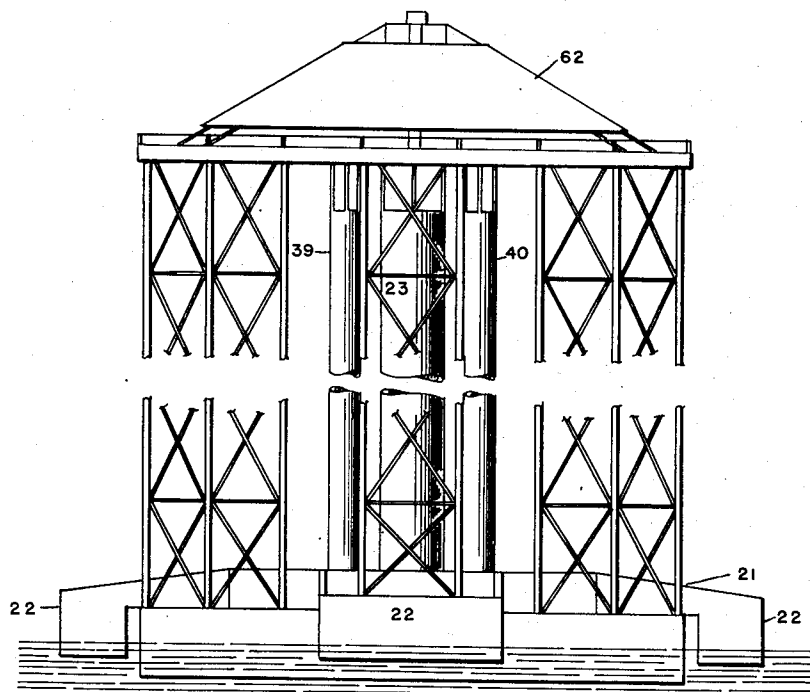


FIG. 1

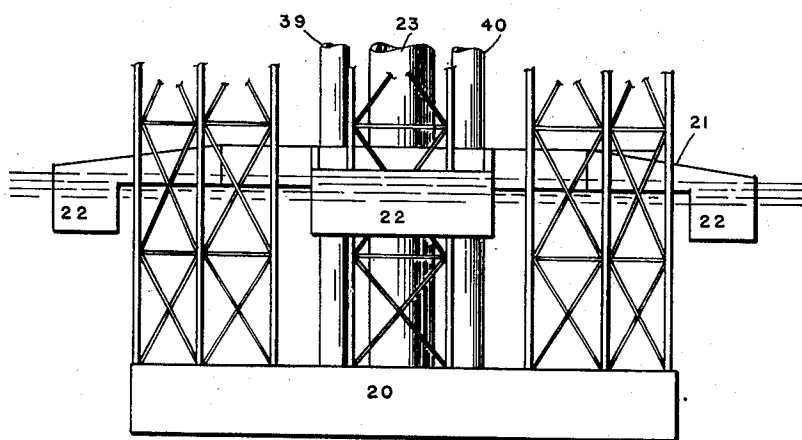


FIG. 2

REX TOWNSEND &
FRANK L. DAVIS

INVENTORS

BY

Philip S. McLean

ATTORNEY

Oct. 12, 1954

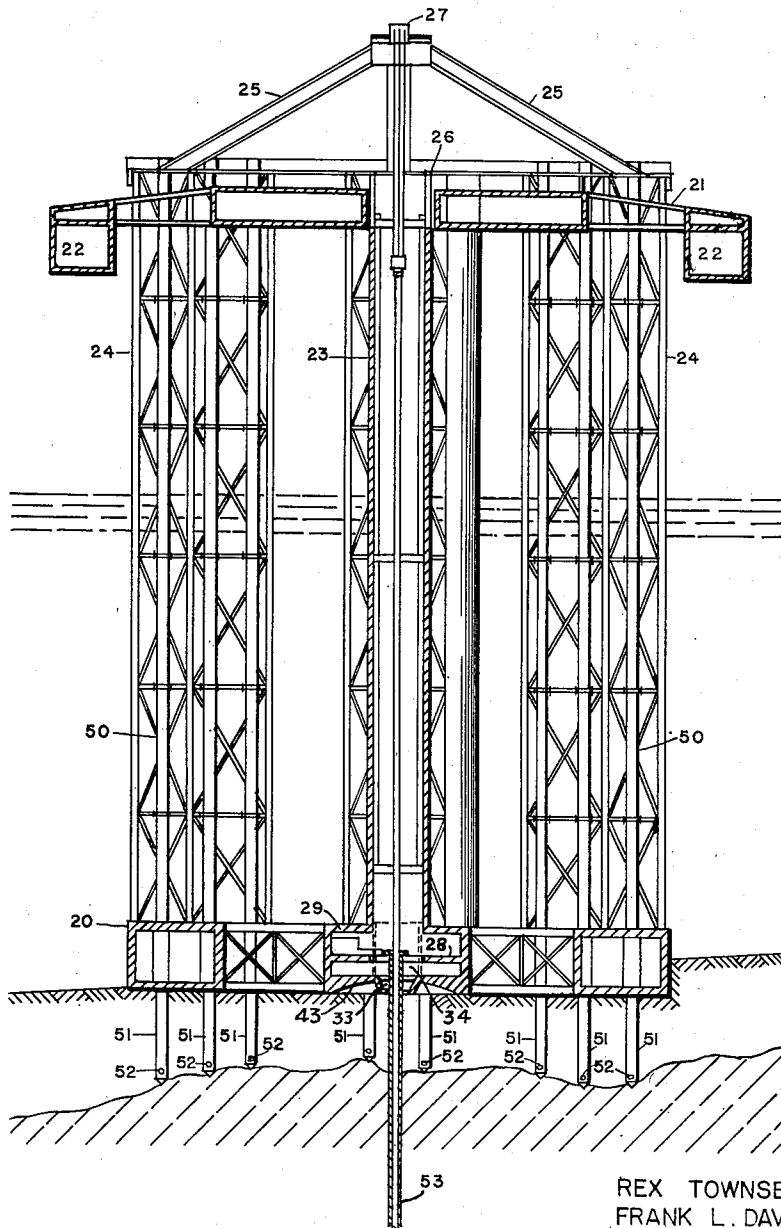
R. TOWNSEND ET AL

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6 Sheets-Sheet 2



REX TOWNSEND &
FRANK L. DAVIS
INVENTORS

FIG. 3

BY

Philip S. Mean
ATTORNEY

Oct. 12, 1954

R. TOWNSEND ET AL

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SUBMERSIBLE OIL WELL DRILLING RIG

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6 Sheets-Sheet 3

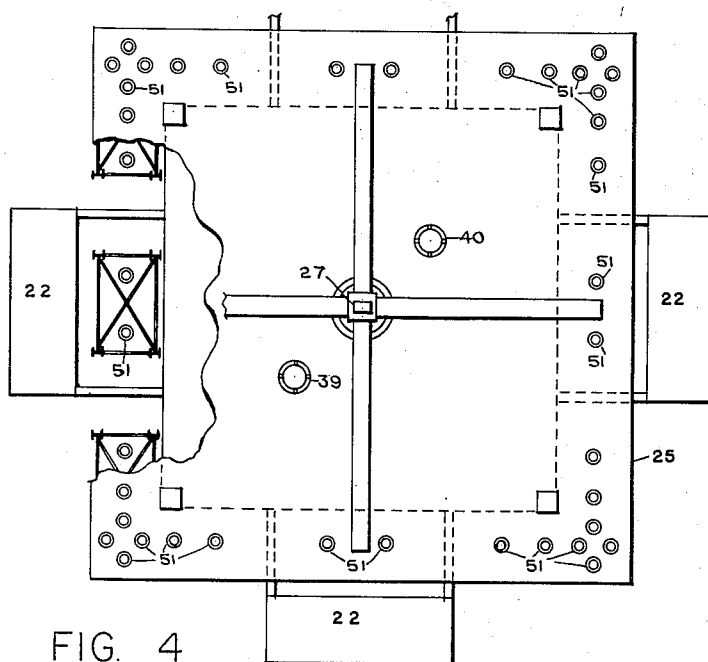


FIG. 4

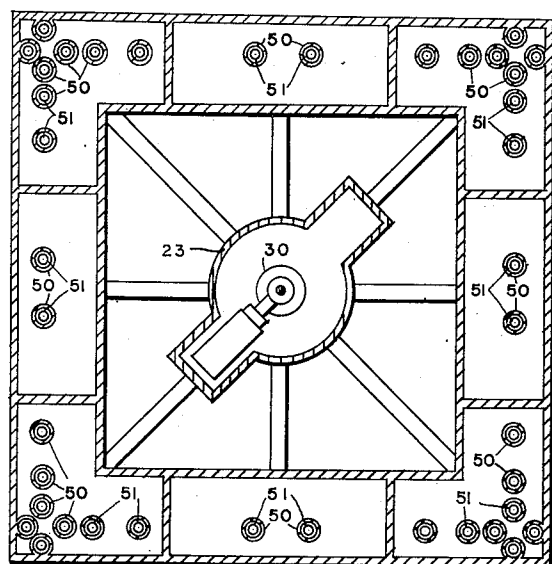


FIG. 5

REX TOWNSEND &
FRANK L. DAVIS
INVENTORS

BY

Philip J. McLean

ATTORNEY

Oct. 12, 1954

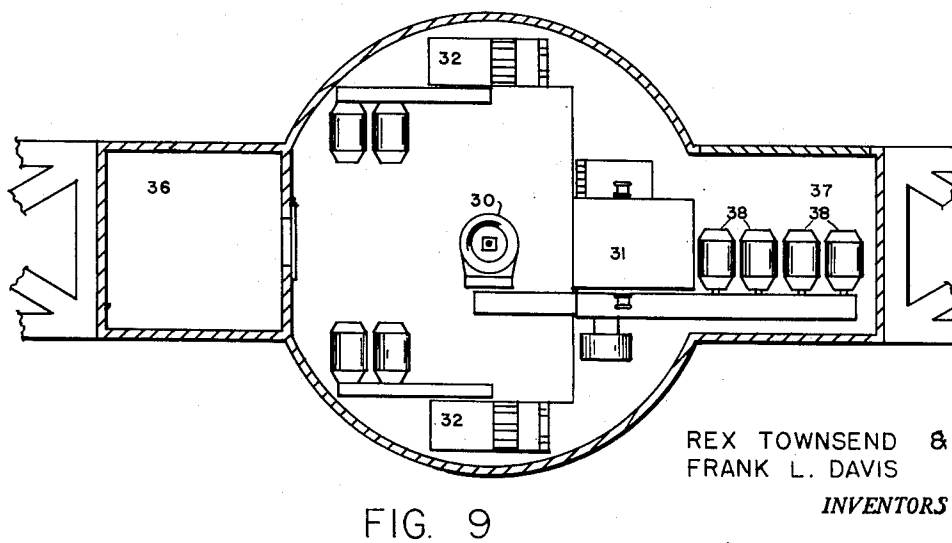
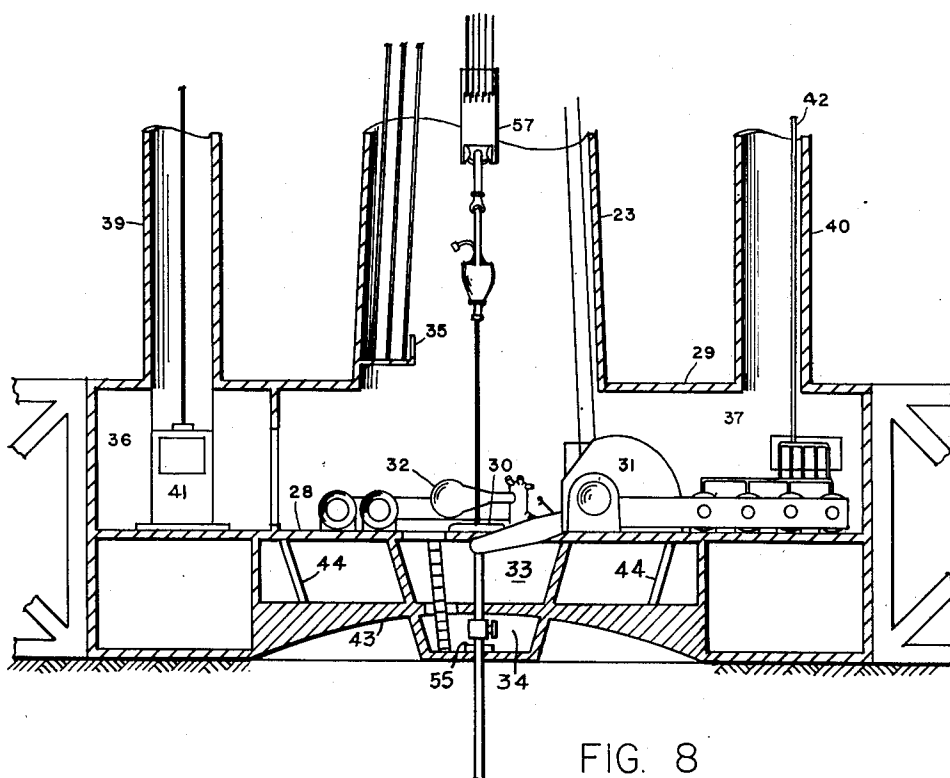
R. TOWNSEND ET AL

2,691,272

SUBMERSIBLE OIL WELL DRILLING RIG

Filed Sept. 23, 1950

6 Sheets-Sheet 5



REX TOWNSEND &
FRANK L. DAVIS
INVENTORS

EV

Philip S. M. Dean

ATTORNEY

Oct. 12, 1954

R. TOWNSEND ET AL

2,691,272

SUBMERSIBLE OIL WELL DRILLING RIG

Filed Sept. 23, 1950

6 Sheets-Sheet 6

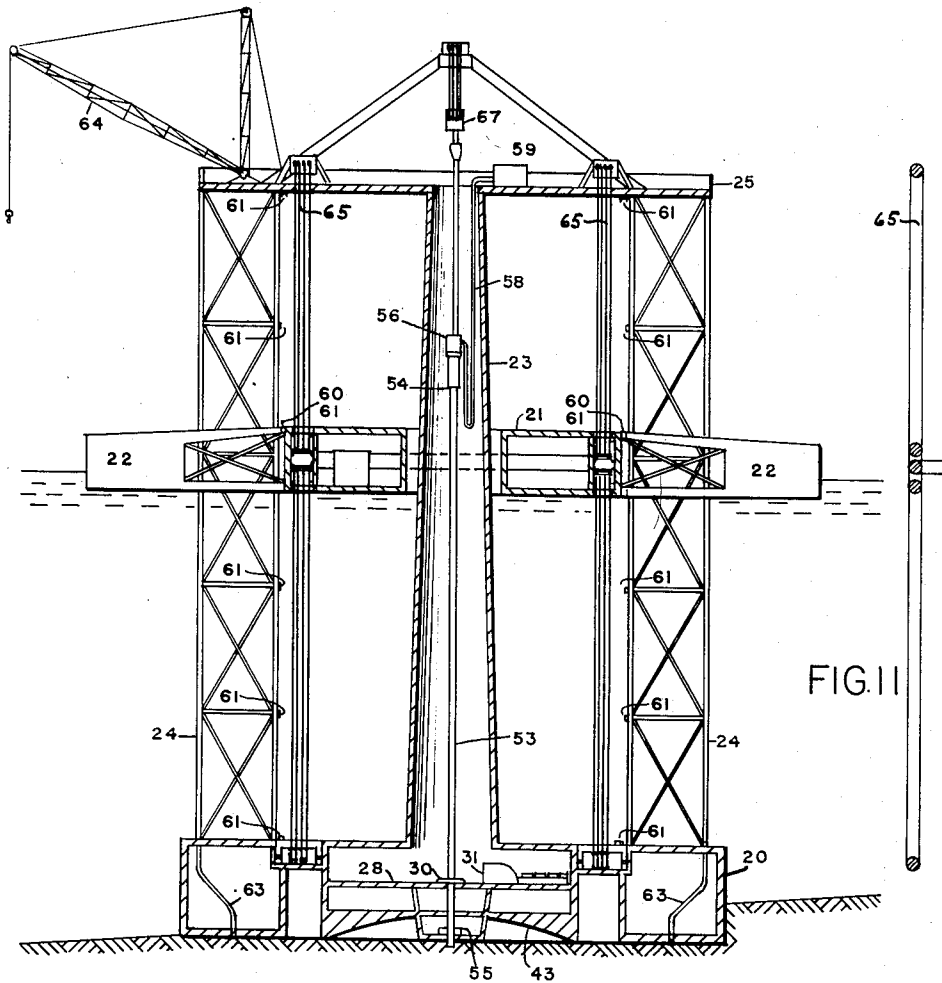


FIG. 11

FIG. 10

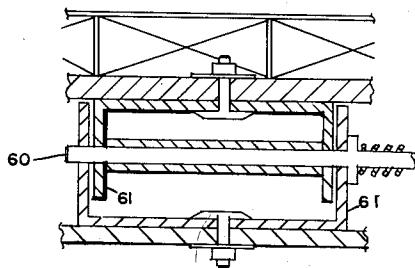


FIG. 12

REX TOWNSEND &
FRANK L. DAVIS

INVENTORS

BY

Philip S. Mean

ATTORNEY

UNITED STATES PATENT OFFICE

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SUBMERSIBLE OIL WELL DRILLING RIG

Rex Townsend, Greenwich, Conn., and Frank L.
Davis, College Point, N. Y.

Application September 23, 1950, Serial No. 186,394

4 Claims. (Cl. 255—2.5)

1

The invention here disclosed relates to the drilling of oil wells under water, particularly in off-shore, deep water locations.

General objects of the invention are to provide a drilling rig which can be floated into position, set down on bottom to establish a drilling floor at the bottom level, operate at this level in accord with established practice and then after the well is completed, be floated away, leaving only a wellhead connection and with the bottom left clear for fishing and other operations.

This floatable and submersible rig is designed to fully withstand tidal, wave and wind action and, in fact, in its settled condition on bottom, to withstand severe, hurricane weather such as is seasonal in the Gulf and other known underwater producing fields.

All this is accomplished in the present invention by constructing the derrick in a watertight, submersible form, equipped to seat on bottom and having at the base a derrick floor working chamber for the drilling equipment, sealed to the bottom but open to the surface up through a tubular derrick tower-forming column.

Special features of the invention include a pontoon form of derrick base which can be floated and submerged, as required, a supplemental pontoon structure which can be raised and lowered with respect to the main pontoon to add weight or buoyance to the base, the driving of supporting piles in selected pattern to meet conditions on the bottom, the leveling of the base by jetting operations and the finishing off of the wellhead with suitable accessible flow connections and without leaving obstructions on the bottom.

Other important features of the invention and other desirable objects attained are set forth and will appear in the course of the following specification.

The drawings accompanying and forming part of the specification illustrate certain present practical embodiments of the invention but structure may be further modified and changed as regards this illustration, all within the true intent and broad scope of the invention as hereinafter defined and claimed.

Fig. 1 in the drawings is a side elevation, broken in height, showing one of the drilling rigs in floating condition;

Fig. 2 is a similar view showing the main, base float submerged and the supplemental float in buoyant condition;

Fig. 3 is a broken vertical sectional view showing the unit set on bottom and the supplemental float raised to load the foundation structure;

2

Fig. 4 is an enlarged broken top plan view of the unit;

Fig. 5 is a cross sectional view on a plane above the derrick floor level;

Fig. 6 is a broken vertical sectional view of the derrick floor chamber with the tubular derrick and air shafts rising therefrom and the cellar chamber below the same;

Fig. 7 is a broken sectional view of a completed wellhead illustrating a buoyed form of flow connection;

Fig. 8 is a further enlarged, broken vertical sectional view of the working chamber at the foot of the derrick column with portions of the drilling equipment indicated in operating relation;

Fig. 9 is a broken horizontal sectional view of the same;

Fig. 10 is a broken part sectional side elevation showing the rig as seated on bottom and operating to drive a length of surface casing for sealing the working chamber to the bottom;

Fig. 11 is a broken sectional view on a plane at right angles to that of Fig. 10, showing a power cable system for effecting vertical adjustments of the supplemental float with respect to the main float;

Fig. 12 is a broken sectional view of a spring loaded shear pin for locking the float to the derrick structure.

Fig. 1 shows the rig in fully buoyant condition, ready for floating to a selected location. The superstructure may be in excess of the height of a full size oil well derrick to enable drilling at depths up to two hundred feet and over.

The floatable and submersible base structure therefore is extended to provide stable flotation and to render the unit as an entirety seaworthy and non-capsizing.

The derrick structure as a whole is mounted on and carried by the main float and this, as shown at 20, is a substantially square, barge-like pontoon braced to carry the weight of the derrick when floating and to sustain the full drilling load of the derrick, when on bottom.

This main float is subdivided into chambers and tanks and equipped with valves, pumps and remote as well as immediate controls by which its buoyancy can be governed and it be leveled in floating or sunken condition.

The supplemental float is shown as a hollow, compartmented structure 21 bridging over the main float and having pontoon compartments 22 extended beyond the sides of the main float for stabilizing purposes.

In the full floating condition illustrated in Fig. 1, the two floats are locked together as by bolts, shear pins or the like, to act as a unitary, wide base, floating platform.

When the derrick is lowered on bottom the supplemental float 21 is released and controlled to float independently or to partially support the main float, as is indicated in Fig. 2, or may be raised and supported clear of the water, as in Fig. 3, to add weight to the base structure.

This second float, like the first, is suitably compartmented and equipped with valves, pipe lines, pumps, controls and the like by which its buoyancy can be regulated, and means are provided such as shown at 65 in Figs. 10 and 11, for hoisting and lowering it with respect to the main float and for locking it, as by shear pins or the like, in raised, lowered, and possibly intermediate positions.

The derrick structure consists, in the illustration, of a central column 23 of the approximate diameter of a standard openwork derrick so as to pass the traveling block, permit stacking of pipe and casing and other operations ordinarily effected in and on the derrick, and openwork towers 24 at the four corners of the main float capped by a bridge or head structure 25 to which the upper end of the tubular column is joined at 26, Fig. 3.

This forms a strong, well braced structure having a wide supporting base, capable of carrying all drilling loads, offering relatively small resistance to sea and wind but having the necessary working portions of the derrick closed against the sea and weather.

The crown block indicated at 27 may be carried by the bridge or head structure 25 or be mounted directly on the upper end of the tubular derrick column 23.

The simulation of the standard form of derrick is further carried out in this invention by the provision of a full size derrick floor working chamber at the base of the tubular derrick column and an extended working chamber 29, all designed for conventional operations of rotary 30, draw-works 31, mud pumps 32 and such other equipment as ordinarily employed in established or approved drilling operations.

Further than this, a cellar chamber 33 is provided below the derrick floor working chamber and, if desired, as shown in Fig. 8, a sub-cellar 34 for Christmas tree and well-head control valve installation and the like.

As also shown in Fig. 8, the lower end, or in fact the entire derrick column, may be of upwardly tapering formation, in the nature of a conventional derrick, providing space and clearance for cables, tools and other objects.

Further, as indicated in this view, the interior of the column may be provided with stands 35 and galleries at different levels and the like, for racking and handling the pipe, etc.

The working chamber at the foot of the derrick column is shown extended laterally in bays or rooms 36, 37, which are utilized in the present instance as an elevator chamber and as a power room for the electric motors 38 used for the draw-works and rotary.

These side extensions are shown connected with the surface by air shafts 39, 40, the first further utilized as a shaft for the elevator 41, Fig. 8, and the second as a shaft for the power supply connections 42.

The bottom of the main float about the cellar forming extension 33, 34, is shown in Figs. 6 and

8 as domed at 43, and pipes 44 are indicated as extended down through this concaved ceiling to clear this space and project the concrete required to form a rounded wellhead base such as shown at 45 in Fig. 7.

This wellhead base may be left on the ocean floor, substantially flush where it will not interfere with fishing, dragging or other operations, and with the well casing capped at 46 and possibly provided with a valve, or in some instances equipped with flexible armored hose 47 floated to the surface by an identifying buoy 48 stabilized by guys 49 anchored to the concrete dome.

The open towers 24 supporting the four corners of the derrick head 25, are shown in Figs. 3, 4 and 5 as including tubular columns 50, for strength and for providing guides for driving piles 51 for anchoring, leveling and supporting the base structure.

As shown particularly in Fig. 5, these pile guides 50 may be located or grouped to provide a pattern which may be varied to best level and carry the load.

Fig. 3 shows how such piles may be driven to different extents to meet rock formation underlying a sand or silt floor. By proper controls the load on individual piles may be varied to equalize the support or to apply force for leveling and maintaining the structure in leveled condition.

Additionally, the piles may be used for leveling or clearing the bottom by making them with nozzle openings 52 at their lower ends and connecting them with pressure hose by which water may be jetted under the base in different directions.

Jet nozzles also may be extended through the bottom of the main float, as indicated at 63, Fig. 10, regulatable to clear away and level off the bottom surface. These may be so disposed and controlled as to jet control the whole bottom surface of the main float.

The concave dome wall 43 about the cellar projection through and by which the concrete for the wellhead is placed and formed may effect watertight sealing connection with the bottom under ordinary or usual circumstances, but special sealing means such as illustrated in Fig. 10 may be provided in the form of a casing 53 which may be capped at 54 and driven down through a gland or stuffing box 55 as far as may be necessary into the bottom. This sealing connection between the bottom and float structure may be cut off at any level so as not to interfere with drilling operations.

This means of sealing the working chamber to the bottom may be a length of surface casing. It is shown as driven by means of a pile hammer 56 suspended from the travelling block 57 and actuated through connections 58 from the power unit 59 on the upper deck or elevated working platform 25.

The supplemental float is of such size as to support all the power equipment such as Diesel engines, steam engines or the like, and various supplies of fuel and other requirements. This float, which may readily be compartmented for the purpose, may also carry living quarters for the crew.

Figs. 10 and 12 show a form of locking means for securing the two floats together in either the combined floating relation shown in Fig. 1 or in the fully raised condition shown in Fig. 3, involving shear pins 60 which can be passed through registering openings in shear plates 61 carried by the respective float structures. These

or other means may be provided also for locking the floats together in various intermediate positions.

As a protection against the sun and weather the working platform may be covered by a canopy, either permanent or removable, such as indicated at 62 in Fig. 1.

To subdue noise in the working chamber suitable "deafening" means may be utilized. Illuminating means are provided where required and to the extent necessary for full normal operations; also, ventilating means, where necessary, though ventilation maintained by the air shafts 39 and 40 may suffice to a main extent.

The tubular derrick tower 23, while shown as cylindrical or upwardly tapering in form, may be square or other shape in cross section. Constituting as it does a complete enclosure for the full depth of the water in which the rig is operating, it is possible that in some circumstances it might be desirable to employ an ordinary openwork derrick tower, which can be done by mounting the same on the derrick floor 28, wholly enclosed within the column.

Safety hatches and doors may be provided in the various chambers of the main and supplemental floats.

The four corner towers 24 rising from the main float, instead of being constructed of tubular columns, may be fabricated of I or H beams, to lighten weight and reduce over-all costs without reducing strength.

A suitable unloading crane or cranes may be mounted on the elevated working platform, as indicated at 64, Fig. 10, for taking pipe, casing and other materials from supply barges and lowering same through the open top of the tubular derrick column.

In the fully buoyant condition such as shown in Fig. 1, the two floats are locked together and thereby constitute for all practical purposes, a single unitary float. Both in this condition and in the fully submerged, seated on bottom relation, the rig is a stable, unitary structure capable of withstanding all weather and water conditions liable to be encountered.

Fig. 12 shows the locking means unit, comprising a spring loaded shear pin 60 which locks in the shear plate 61 on the structural power unit, at various stations.

What is claimed is:

1. A buoyant, deep-water drilling rig for floating to location, settling on bottom, drilling on bottom and refloating away from a drilled well, comprising a submersible and refloatable barge having buoyancy to float the rig in a stable, upright condition and submersible to seat on underwater bottom ground and of sufficient mass and lateral extent to form a solid, on-bottom drilling foundation, said barge having an enclosed working chamber including a full size derrick floor and having access to the sea bottom on which the barge may be seated, well drilling machinery on said derrick floor and within said working chamber for drilling from said working chamber through the bottom of the barge into underwater ground on which the barge is seated, said working chamber having communicating lateral side extensions, drilling equipment within said communicating side extensions of the working chamber, a tubular derrick column at the central portion of the barge coextensive with and rising from the working chamber to a height above the level of the water in which the barge is to be submerged

and open to atmosphere at the top to enable on-bottom drilling operations to be conducted under open-air conditions, open work towers on the barge, said towers being located about the tubular derrick column and rising to approximately the height of the derrick column, a stationary elevated working platform supported by said towers above water level and open at the center to the open, upper end of the tubular derrick column, a crown block supported on the barge above said working platform and over the open end of the tubular derrick column, and open-air communication shafting at the side of the tubular derrick column extending from the lateral side extensions of the working chamber up to said stationary working platform and of a size for full ventilation and free communication and transport of men and materials between the elevated, above-water working platform and the underwater on-bottom derrick floor working chamber, independently of and apart from the central tubular derrick column to leave the derrick column clear for all usual well drilling operations.

2. Apparatus according to claim 1, further comprising a pontoon float guided for vertical rising and lowering movement over said towers and tubular derrick column for adding buoyancy and stability to the rig or for adding weight to settle the barge on bottom, hoisting means including connections extending from the pontoon float downwardly to the barge to apply lifting effort to the barge and extending upwardly to the working platform for suspending the float from the working platform to impose the weight of the float on the barge and locking means for securing the pontoon float in adjusted relation to the towers.

3. Apparatus according to claim 1, wherein said towers are of openwork construction made up at least in part of open-ended tubular pile guides extending all the way from the elevated working platform at the top, down through the barge and whereby piles for anchoring or leveling the rig may be driven from said elevated working platform down through the barge into the underwater ground.

4. Apparatus according to claim 1, wherein said enclosed working chamber has a downwardly extending communicating cellar formation and downwardly concave dome-forming bottom structure for molding concrete in the bottom ground below the working chamber to leave a concrete cellar and well head dome on the sea bottom when the barge is refloatated away from the location.

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