Sept. 27, 1949. J. MOON 2,482,788

PORTABLE MARINE DRILLING STRUCTURE

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Fig. 1.

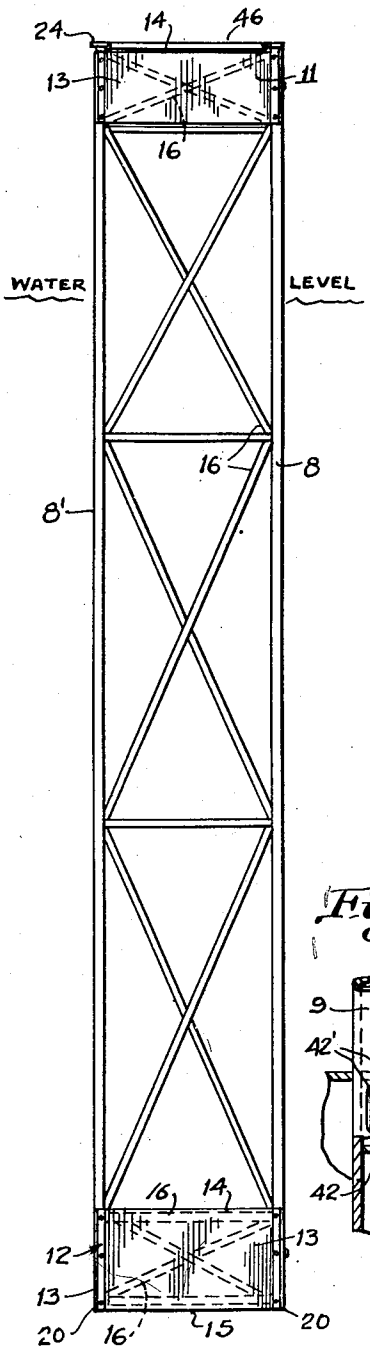


Fig. 3.

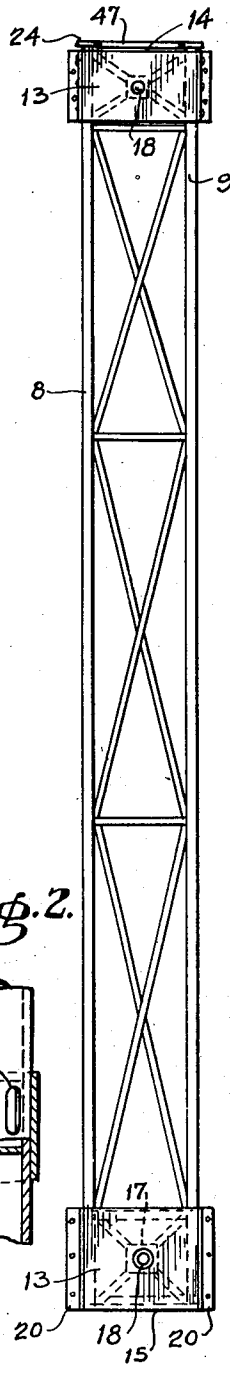


Fig. 2.

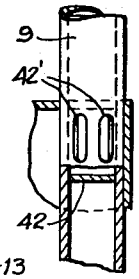


Fig. 4.

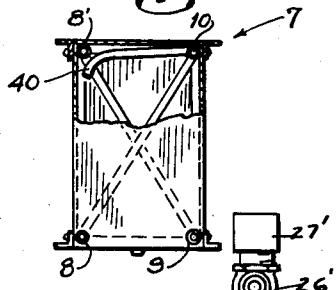


Fig. 4a.

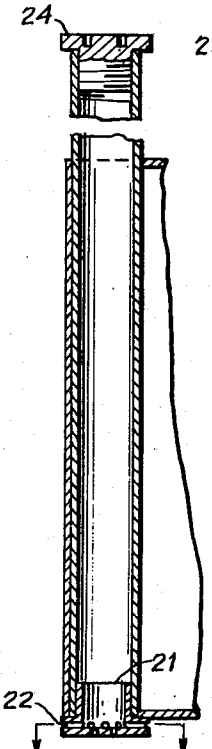


Fig. 4c.

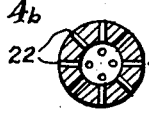


Fig. 4b.

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Fig. 5.

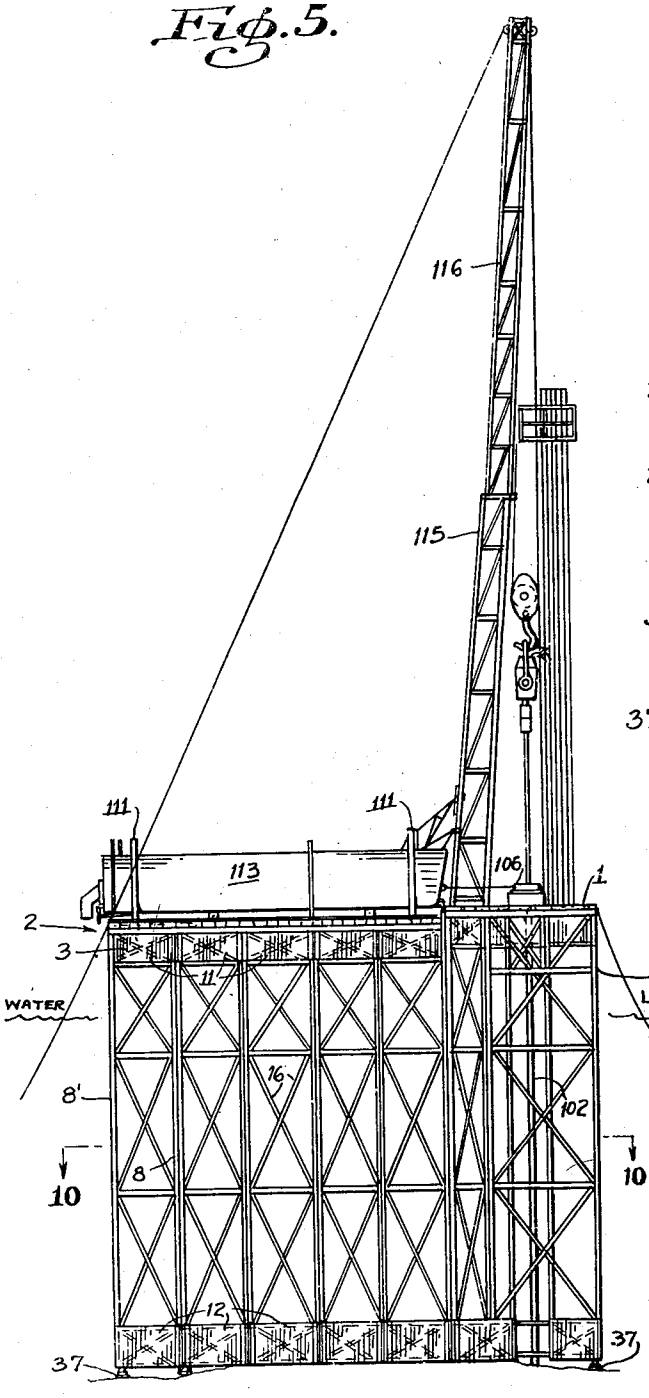
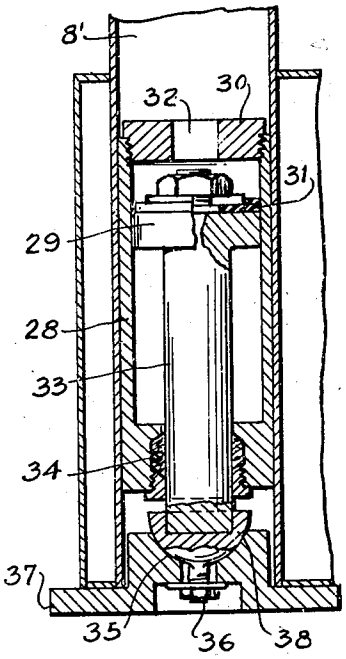


Fig. 4d.



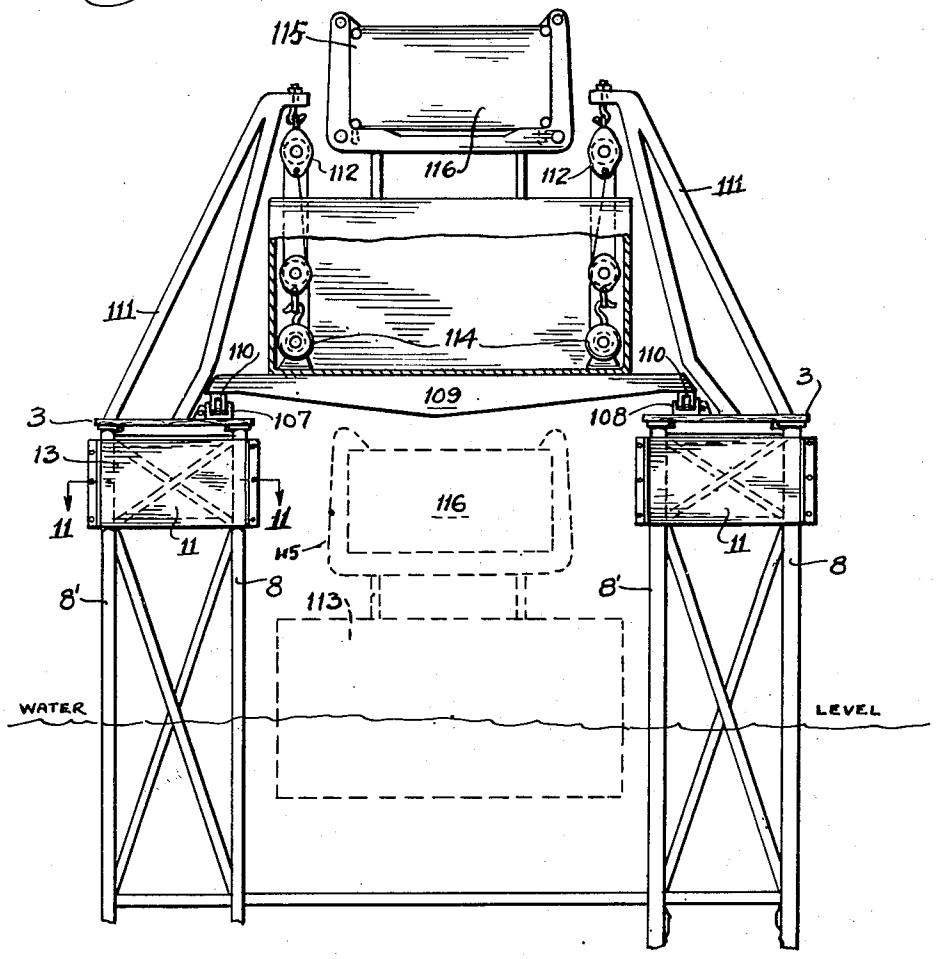
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PORTABLE MARINE DRILLING STRUCTURE

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Fig. 6.



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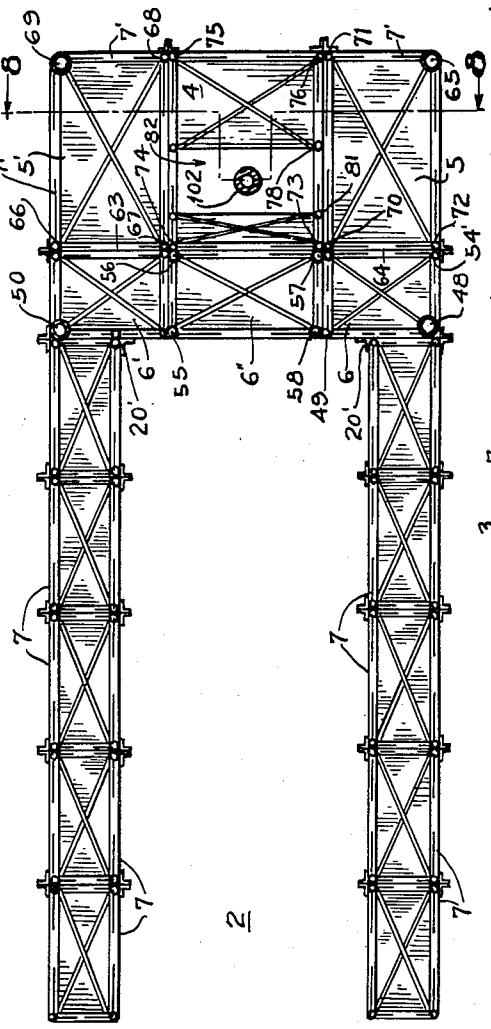


Fig. 10.

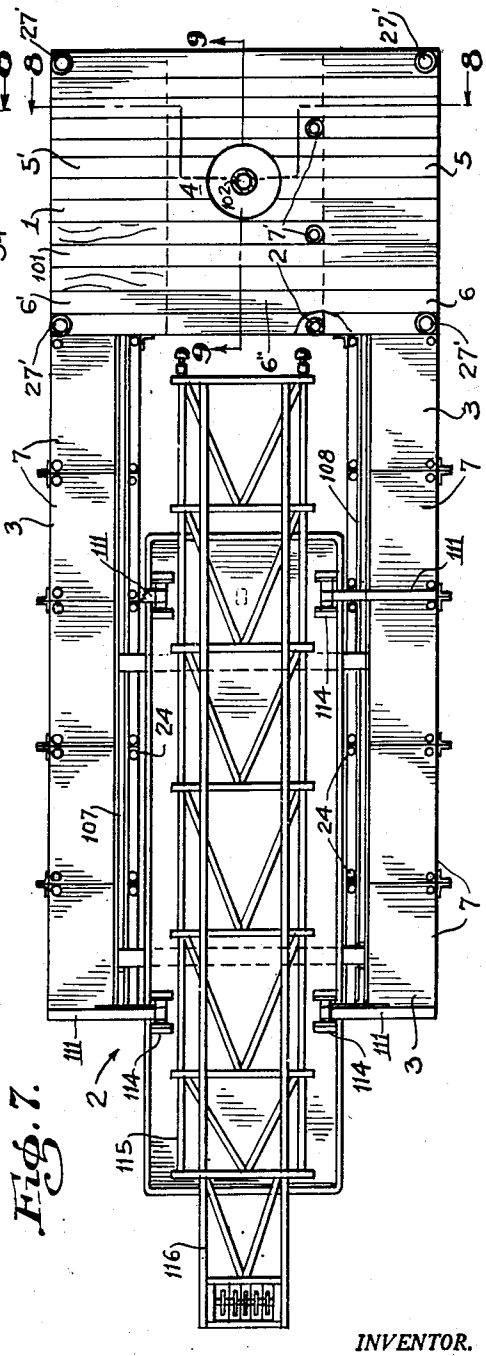


Fig. 7.

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Fig. 8.

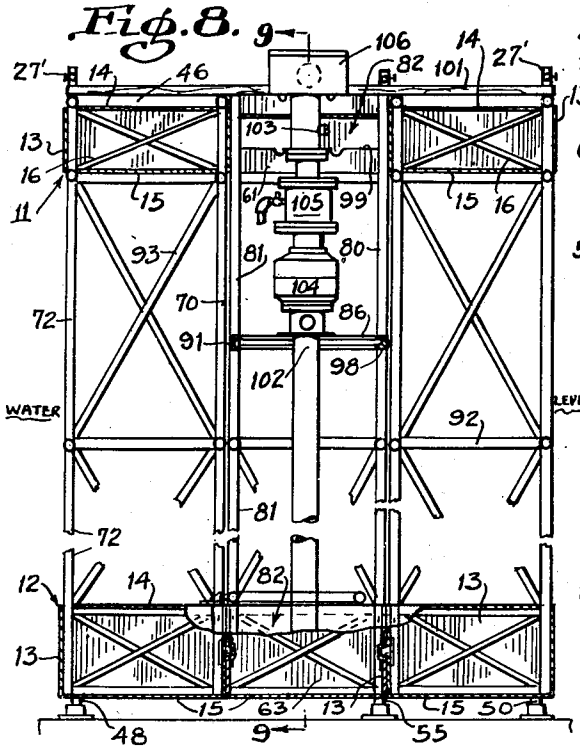


Fig. 9.

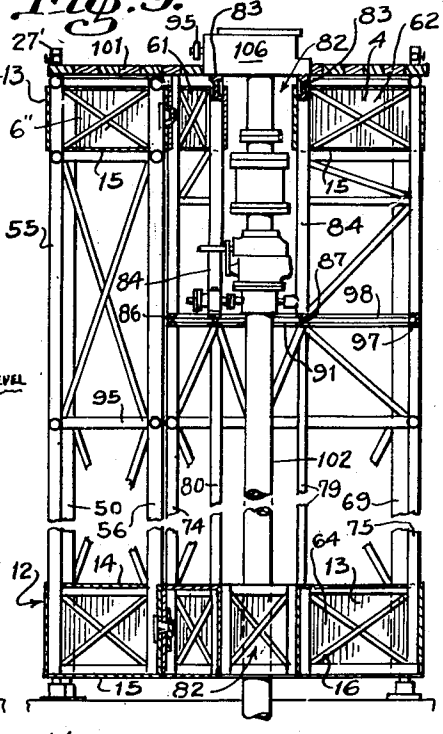


Fig. 11.

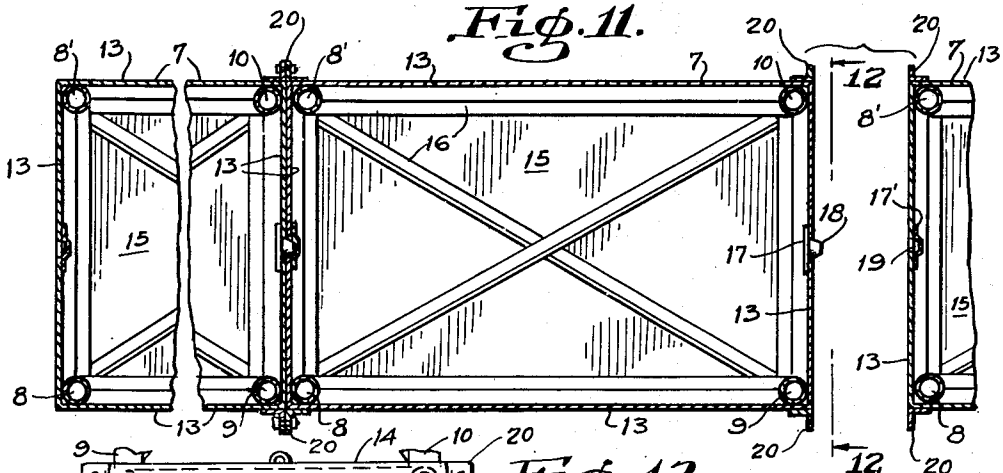
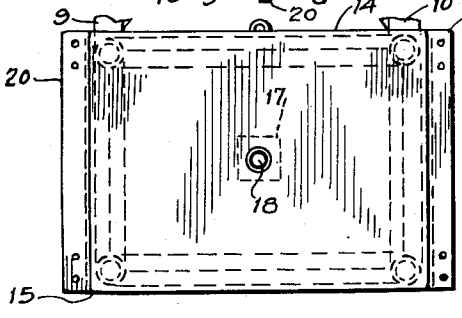


Fig. 12.



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PORTABLE MARINE DRILLING STRUCTURE

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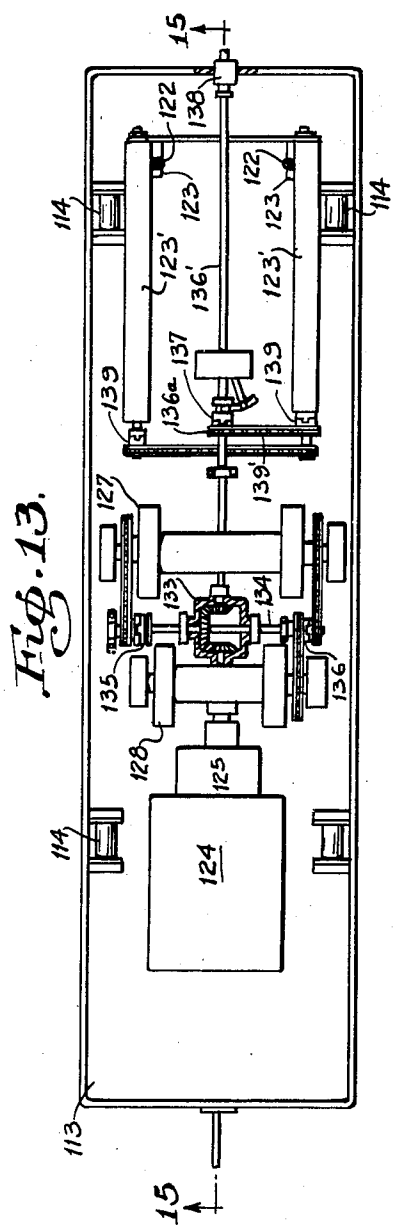


Fig. 13.

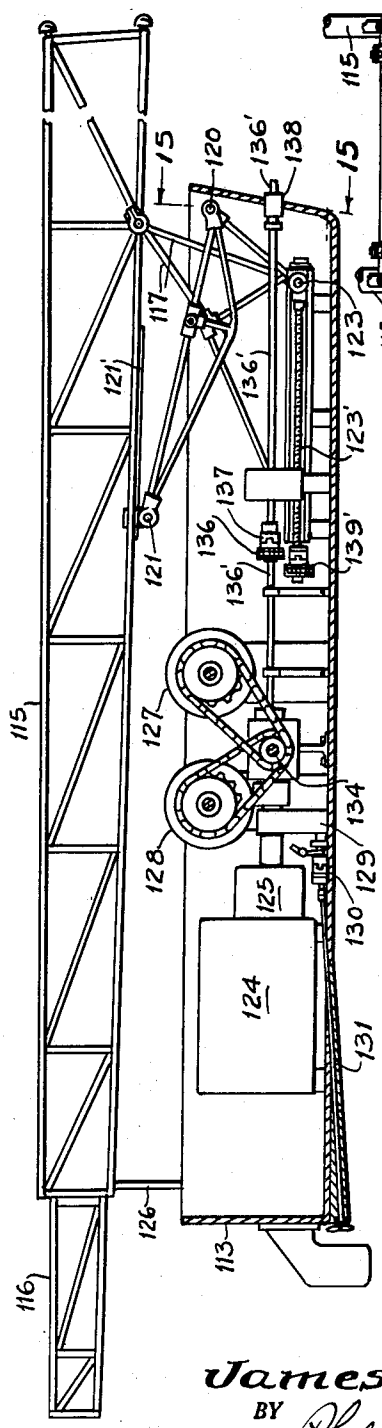


Fig. 14.

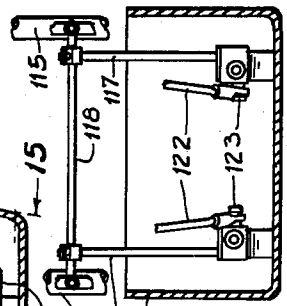


Fig. 15.

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Patented Sept. 27, 1949

2,482,788

UNITED STATES PATENT OFFICE

2,482,788

PORTABLE MARINE DRILLING STRUCTURE

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Application September 29, 1947, Serial No. 776,632

14 Claims. (Cl. 61—46)

1

The problem of erecting a safe platform in deep water disconnected from the land has involved the attention of marine and civil engineers because of its utility for many purposes. The most important practical utility to date is, however, in drilling for oil in ocean bottoms. The earliest solution of this problem was the steel island disclosed in the Roberts Patent No. 1,867,031 which was erected off the coast of California. This was a steel structure formed of steel piles driven into the submarine bottom and cross-braced under water by tension members tied by clamps to the main columns. This structure, although it gave many years of useful service, finally collapsed into the ocean. The structure was not transportable and disassemblable and had to be erected at the site from its individual members.

Recently a variation of the Roberts structure has been constructed in the Lake Maracaibo region, employing concrete piles or concrete filled steel tubular piles.

Other solutions of the problem involve the use of submersible barges such as are shown in the Giliasso Patent No. 1,681,533. Many such barges have been employed, but they are of a nature suitable for shallow water only and have been used in the Gulf of Mexico, in the shallow waters off the coast of Texas and Louisiana.

These represent the main type of structures unconnected to the land which have been employed for drilling operations. Others have been suggested but not employed.

One of the major problems is security during storm conditions. The problem of maintaining derricks of more than 100 feet in height and other drilling equipment in deep water at a great distance from shore, as well as personnel, is one of the serious problems not solved prior to my invention.

I have solved this problem by a unique design of a drilling platform and by the provision of a demountable and transportable drilling barge which may be moved into position and erected on the drilling platform.

In a preferred embodiment of my invention I construct my drilling platform with wing piers between which is provided a slip.

In a preferred modification of such structure, I also provide a drilling barge which may be moved into position in said slip. This drilling barge may carry the power plant for the drilling or servicing operation and a retractible and collapsible derrick for drilling or servicing of the well.

I also desirably provide means for elevating the barge from the water and position the barge on the wing piers in operative relation to the drill pipe for drilling or to the well for servicing. When so positioned the derrick may be erected in operating position by means mounted on the barge. It may then be lowered and at any stage in the procedure, as when storm connections make it desirable so to do. The drilling or servicing operations may be suspended, the derrick lowered, and, if desired, the barge lowered into the water for movement to a safe harbor.

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While the drilling platform, wing piers, and slip may be constructed at the well site by any suitable means for the erection of a drilling platform and piers in deep water, I prefer to employ prefabricated cell sections.

My structure is composed of prefabricated cell sections which may be launched individually or in groups from the shore and floated and towed to position and erected seriatum and joined together on the marine bottom to give the type of structure desired.

The connections between the several sections and their form of structure will give a stable foundation for any desired superstructure, such as the equipment necessary to marine oil well drilling operations, and may also be, and preferably is, disassemblable when the drilling operation is of a prospecting nature.

I construct my structure of cell units, each unit having a flotation tank which can be flooded to cause the cell to sink onto the ocean bottom in an erect position. The tank can be filled with a weighting fluid, such as water or heavy mud, which can be withdrawn when the cell is to be refloated, or may be filled with cement when a permanent foundation is to be provided.

I preferably employ two such tanks, one at each end, and flood one of the tanks under controlled conditions to cause the unit to pivot into an erect position. I preferably employ hollow tubular members for the column supports of my cell and obtain as a result an advantage in that these columns can form the conduits for introduction and discharge of the weighting fluid or form the conduits for introduction of cement. The columns can also form conduits for introduction of water for jetting action by a jet positioned on one of said columns, to clear the foundation to insure a stable foundation for the cell. One or more of said columns can also be employed as a means for levelling the cell, as will be more fully set forth below.

In order to facilitate the assembly of the cells into an island or wharf structure, I may and preferably do provide alignment joints on the cells whereby the cells may be accurately assembled into a multiple cell structure.

For purposes of prospect drilling or oil well production, I assemble these units into a drilling island and preferably one in which wing piers and a slip are provided by adding onto the drilling platform two spaced wing piers formed of the assembly cell sections.

This invention will be further described by reference to the accompanying drawings, in which

Fig. 1 is a vertical view of a cell employed in erecting the structure of my invention:

Fig. 2 is a detail of one of the columns of my invention with parts in section and parts broken away;

Fig. 3 is a side view of Fig. 1;

Fig. 4 is a bottom view of Fig. 1 with parts broken away;

Fig. 4*a* is a sectional view of another of the columns of Fig. 1;

Fig. 4*b* is a section taken on line 4*b*—4*b* of Fig. 4*a*;

Fig. 4*c* is a detail section of an attachment to Fig. 4*a*;

Fig. 4*d* is a sectional detail of the end of another of the columns of Fig. 1;

Fig. 5 is a side view of the structure of my invention;

Fig. 6 is an end view of Fig. 5 showing the derrick retracted on the barge and the barge broken away;

Fig. 7 is a plan view of Fig. 5, showing the derrick retracted and drilling equipment removed;

Fig. 8 is a section taken on line 8—8 of Fig. 7 with parts broken away, showing the rotary table and the casing attachments in position;

Fig. 9 is a section taken on line 9—9 of Fig. 8;

Fig. 10 is a section taken on line 10—10 of Fig. 5;

Fig. 11 is an exploded fragmentary section taken on line 11—11 of Fig. 6;

Fig. 12 is a side view taken on line 12—12 of Fig. 13;

Fig. 13 is a schematic plan view of the barge with the derrick and derrick elevating mechanism removed;

Fig. 14 is a section taken on line 14—14 of Fig. 13, showing the derrick mounted in its retracted position;

Fig. 15 is a fragmentary section taken on line 15—15 of Fig. 14.

The portable marine structure of my invention is composed of a drilling platform 1, a slip 2 formed of two wing piers 3 (see Figs. 5, 6, and 7). The platform is of cellular construction composed of a center cell 4, side cells 5 and 5', and end cells 6, 6', and 6''. Each of the wing piers is composed of a plurality of cells 7 composed of four tubular columns 8, 8', 9 and 10 (see particularly Figs. 4 and 11) positioned at the corners of the cells and connected by suitable bracing between adjacent columns. In like manner, the cells of the drilling platform are formed of cells similarly constructed but of greater width, length, and height, and with other variations more fully set forth below.

Mounted at the top of the cell is a top tank 11 and mounted at the bottom of each cell is a bottom tank 12 to be further described. The top and bottom tanks are similarly constructed and formed of side walls 13, top 14, and bottom 15 suitably braced by interior cross members 16 between adjacent columns. The columns pass through the tanks and through the bottom and top thereof (see Figs. 1, 3, 8, 9, and 11). The tops and bottoms are suitably sealed at the legs as they pass through the top or bottom of the tank to make an air-tight and water-tight joint by welding, brazing, or other methods of attachment.

The tanks are oblong in cross section, and upon one oblong side of the tank is positioned a plate 17 carrying a central boss 18 (see Figs. 1, 10, and 11). On the opposite side of the tank is positioned a plate 17' and a detent 19 axially positioned with the boss 18 (see Figs. 1, 10, and 11). Tanks 11 and 12 are similarly provided with such bosses and detents. Flanges 20 are attached to the corners of the top and bottom tanks.

A jetting nozzle 21 carrying side jet orifices 22 and end jet orifices 23 are positioned in the bottom of the hollow tubular column 8. A plug 24 is screwed into the top of the column 8 (see Figs. 4*a*, 4*b*, and 4*c*). This plug may be withdrawn by unscrewing and a tubular fitting 25 may take the place of the plug 24. A pipe 26 may be connected to this fitting by means of a union 27, as will be further described.

A cylindrical barrel 28 is fixed in the column 8' near the bottom of the tubular column (see Fig. 4*d*), and a cylinder head 30 carrying an orifice 32 is connected to the barrel 28. Slidably positioned in the barrel is a piston 29 suitably provided with wall packing 31. Piston rod 33 passes through a packing gland 34 and is connected to a levelling foot 37 by a ball and socket joint composed of socket 35 and a ball adjustably mounted in the socket by a nut and stud 36 mounted to give sufficient play to permit of adjustment of the ball and socket joint. The upper end of the column 8 is closed by the plug 24.

The tubular column 10 is closed at its upper end by a removable screw plug 24 and sealed at its lower end inside the lower tank 12 to a pipe 40 which is positioned inside the tank 12, and discharges into the bottom of the tank at a point near the opposite wall of the tank adjacent column 8'.

The tubular column 9 is closed at its upper and lower ends in a similar manner to column 10. Column 9 also carries a diaphragm 42 (see Fig. 2) at a point in the column inside the bottom tank 12 and somewhat spaced from the top of the tank 12. The column 9 is also slotted at 42' at a point in the column somewhat near the top of the tank. This provides an outlet orifice near the top of the tank.

With the piston 29 of the levelling foot 37 fully retracted inside the barrel 28, the ends of the four legs may all be flush with the bottom of the tank 12 or may protrude beyond the bottom of the tank 12 an equal distance and, being closed by plates, provide four columns capable of being set on a level foundation to give a vertical compound column.

Each of the columns 8, 8', 9, and 10 is formed to receive a plug, such as 24, which may be replaced by screwing fitting 25 which may be connected to conduit 26 by the union fitting 27. When the plug 24 is in position, the top surfaces of the plug 24 are in one plane and coplanar with the top girders 47 of the cell positioned above tank 11. The columns 9, 10, and 8, 8' are connected by I-beam 46 at the top of the cell, and columns 9, 8, and 8' and 10 are also connected by similar I-beams 47 so placed as to present coplanar top flanges. Tubular members may be used in place thereof.

The cells 6, 6', and 6'' are similarly constructed to the pier cells with the following difference. In cell 6 one of the corner columns 48 (see Fig. 10) is of larger diameter than the tubular columns of the pier cells, for reasons to be described later. This column carries the levelling foot 37 and is otherwise constructed in a manner similar to that of column 8'. In the case of cell 6', the corner column 50 is of the same diameter as column 48 and of the same construction as column 8'; col-

umns 52 and 53 are of the same construction as 10 and 9, respectively. In like manner, in cell 6 the columns 49, 54, and 54' correspond in construction to 8, 9, and 10, respectively. Cell 6'' is constructed similarly to the cells 6 and 6' with the following differences: The columns 55, 56, 57, and 58 are of a diameter intermediate the diameter of the columns 50 or 48 and the columns 8, 8', 9, and 10 for reasons to be further explained. Thus, column 55 is constructed similarly to column 8'; column 58 is constructed similarly to column 8; and column 56 is constructed similarly to column 10; and column 57 is constructed similarly to column 9.

The two cells 5 and 5' are similarly constructed and are of a width substantially equal to the length of cell 6'', 6', or 6, but are of length several times the length of each of said cells as indicated in the drawing. They are otherwise similarly constructed with the following differences: The corner columns 66, 67, 68, 70, 71, and 72 are of a diameter similar to the columns of the wing piers. The corner columns 65 and 69 are of a diameter similar to that shown for columns 48 and 50. Columns 67 and 70 are constructed in a similar manner to column 9, and columns 66 and 72 are constructed similar to column 8; and columns 68 and 71 are constructed in a manner similar to that of column 10.

The cell 4 is framed in the same manner as the cells 5 and 5' and constructed similarly thereto except in the following respects. Instead of employing a single top and bottom tank, the top and the bottom are divided into two separate tanks, shown as 61, 62, 63, and 64, employing four additional columns 78, 79, 80, and 81 in addition to the corner columns 73, 74, 75, and 76. Columns 73 and 78 are constructed similarly to column 8', and columns 74 and 79 are constructed similarly to column 8. Columns 81 and 76 are constructed similarly to column 10, and columns 80 and 79 are constructed similarly to column 9.

Instead of using two separate top and bottom tanks, one top and one bottom tank with an opening through the tank for passage of the conductor pipe may be provided as by a circular conduit sealed to the top and bottom walls of the top and bottom tanks.

Positioned on one of the walls of the top and bottom tanks of cell 6 between the columns 48 and 49 and in the wall of the upper and lower tanks of cell 6' between the columns 50 and 51 is the aligning joint formed in a manner similar to the joint for the pier cells (see Figs. 8, 9, 10 and 11). The detent 19 or the boss 18, whichever is used in the wall of the cells 6 and 6', is so positioned as to mate with the opposite members of the joint formed in the wall of the adjacent cell of the wing piers which is centrally positioned in the walls of the pier cells. Centrally positioned on the walls of the upper and lower tanks of cells 5 and 5' and of the upper and lower tanks of the cells 6 and 6' are the mating halves of such aligning joints.

Centrally positioned on the walls of the upper tanks 61 and 62 and lower tanks 63 and 64 between the columns 74 and 80 and 79 and 75, respectively, is one element of an aligning joint. The mating portions of the joint are positioned in the walls of the top and bottom tanks 95' between columns 67 and 68 to mate with the joint elements on the walls of tanks 61 and 62. Centrally of said upper and lower tanks and in the walls thereof between the columns 73 and 81 and between 78 and 76 are similar elements of the alignment joint which mate with suitably positioned elements in the walls of the upper and lower tanks of cell 5 between the columns 70 and 71. A similar joint exists between cell 6' and 4 by means of a joint whose elements are centrally positioned on the abutting walls of the upper and lower tanks of cell 6'' and the tanks 61 and 63 of cell 4.

It will be observed that the abutting walls of the cell 6'' and the adjoining cells 6 and 6' do not carry any aligning joints and are smooth so that, as will be explained later, cell 6'' can be slid into position between cells 6 and 6'.

The tops of the columns of the cells 6, 6', 6'', 4, 5 and 5' are all closed by a plug such as 24 which, as in the case of the columns of the cells of the wing piers, may be replaced by the fittings 25, 27, and pipe 26. With the plugs in place the top surfaces are coplanar with the top flanges of the upper girders of the cells 6, 6', 6'', 4, 5, and 5'.

Mating flanges 20 are provided on all of the walls of the tanks at an external joint between the cells. Thus, a flange is provided at columns 50, 52, 48 and 54 to mate with the cooperating flange of adjacent tanks of the wing pier cells and with those of cells 5 and 5' positioned adjacent columns 66 and 72, respectively. Likewise flanges 20 are provided in the walls and at the diagonally opposite corner of the upper and lower tanks of cells 5 and 5' at columns 68 and 71, respectively, to mate with cooperating flanges on the upper tank 62 and lower tank 64 adjacent columns 75 and 76. Cooperative flanges are provided on the upper and lower tanks of cell 6'' adjacent the columns 55 and 58, respectively, to mate with cooperating flanges on the upper and lower tanks of cells 6 and 6' adjacent columns 51 and 49. An angle strap 20' is fastened in the corner between the tanks of the wing piers and the tanks of 6 and 6'.

It will be observed that a space 82 is provided between the tanks 61 and 62 and between tanks 63 and 64 in the tank sections, the purpose of which will be further described. The framing of cell 4 includes, at the elevation of the deck or platform floor, girders 83 which act as supports for the rotary table 106, as will be later described. Vertical girders 84 are provided as are connecting girders 83, 87, and 88. At the elevation of the girders 84 are provided transverse and longitudinal girders for the cells 4, 5, 5', 6, 6' and 6'', and cross bracing shown at 92, 93, 94, and 95, similar to the bracing in the pier cells.

Transverse girders 83 cooperating with the horizontal girders 86, 87, 88, 91, 97, and 98 provide a support for the rotary table and for the conduit and Christmas tree connections for the well, as will be further described. A surface conductor 102 is centrally positioned within the space 82 and is connected to blowout preventers 104 and 105 of conventional design. A mud outlet is provided at 103 in the surface pipe. The rotary table 106 is mounted upon the girders 83. A drain pan 99 extends across the whole of the space 82 and makes a tight joint with the casing and a tight joint at the walls of the upper tanks 61 and 62 and at the walls of the upper tanks of cells 5 and 5'. A drain 99' is connected to the drain pan 99.

Floor 101 is positioned upon the top girders of all the cells and over the plugs 24 to form a continuous surface over the wing piers and over the top surface of cells 6, 6', 6'', 5, 5', and 4 with the latter surface raised above the eleva-

tion of the deck of the wing piers in amount and in a manner to be further described.

Extending the full length of the wing piers 3 and adjacent the inner edge thereof next to slip 2 are two tracks 107 and 108 on which tracks are mounted beams 109 which ride on wheels 110 which ride on the tracks. Two or more such beams are provided. Four symmetrically placed davits 111 may be provided, two upon each wing pier. The davits carry blocks 112 which cooperate with winches 114 positioned in the derrick barge 113 in order to position the derrick barge on the beams 109. The drive connections for the winches are not shown, but any suitable drive may be used as will be understood by those skilled in the art.

The derrick barge carries an extendible derrick composed of a bottom section 115 and an extendible mast 116 which may be telescoped within the bottom section and carried on the barge in a down position, one end resting upon a derrick support 126. The forward end of the lower mast section 115 is hinged at 118 upon a frame 117 mounted on the starboard and port side of the bow section of the barge. The elevating truss 119 is pivotally hinged at 121 to a slide operating on a track 121' mounted upon a leg of 115 and also pivotally mounted at 119' to the frame 117. Link 122 is pivotally connected at 120 to one end of frame 119 and at the other end to a travelling nut 123 mounted upon screw 123'. It will be observed that the hinge point 118 is outside the barge and is so positioned that the derrick may be moved to an upright position shown in Fig. 5. The hinge points 119' and 120 and the screws at all positions of the derrick are inside the barge.

A suitable power plant 124, such as a Diesel engine or Diesel-generator motor unit may be provided. A suitable drum 127 is employed for elevating the travelling block of the swivel, as is conventional for drilling operations. A suitable drum 128 may be provided as is employed for sand line operations.

The power plant drives through a torque converter and a transfer gear box 129 and through a clutch 130 to the propeller shaft 131 and through a forward and reverse gear box 132 and right angle gear box 133 to the sprocket shaft 134 carrying clutches 135 and 136. From shaft 134 the drums 127 and 128 may be driven by suitable sprocket and chain drives as illustrated. The main drive shaft 136' extends axially of the barge toward the bow and suitably supported in bearings and carries a sprocket 136a, a clutch 137 and extends through the bow end through a suitable bearing such as a marine type propeller shaft bearing 138 made of lignum vitae or hard rubber. The sprocket 136a drives the screws 123' through suitable sprockets and sprocket chains 139' and clutches 139.

Suitable containers for mud, cement, and suitable high pressure pumps may also be mounted on the barge, if room is available, or may be mounted on additional barges, as will be described below.

The method of erecting submarine foundations according to my invention will next be described. When a suitable location has been found and the depth of water determined, as also the conditions of wave action in the region, cells are constructed in a manner previously described. The height of the cells is such that the distance between the submarine bottom and the bottom of the upper tank 11 of the cells, when the cells are erected, will be such that, on the extreme wave action anticipated, the waves will break and pass underneath the bottom of the upper tank. The purpose is to avoid any uplifting force or to minimize the uplifting force which may be attained from wave action.

The pressure and magnitude of wave action which may be anticipated are set forth in the Garth L. Young Patent No. 2,382,763 to which reference may be made for such discussion. It will be useful, however, to make observations in the area in which the structure is to be erected to determine the height of the waves during storm action in order that the best conditions may be obtained. Considerable information is available at most locations which may come under consideration, particularly for the drilling of oil, and if such information is not available, observations may be made in such area. Having established the desirable free board, that is, the height of the bottom of the upper tank 11 from the mean high tide line, and the depth of the water, one can determine the length of the cells which should be employed.

The cells may be constructed on land, launched with the upper tank 11 and lower tank 12 full of air and floated in the water with the columns 8' and 8 submerged and columns 10 and 9 above water. In the case of cells 4, 5, 5', 6, 6', and 6'', they are floated in a similar position with the columns equivalent to 10 and 9 out of water. The cells, being a balanced system, will float on an even keel.

The following description illustrates a method of assembly of the cells of the wing piers where they are erected either as a first step in the construction of the structure illustrated or as a pier or foundation of a form other than illustrated herein. The cell is towed to the desired position by a tug. The tug tows the cell by means of tow lines connected to the submerged corners of the submerged section of the upper tank 11 and with snubbing lines connected to the lower corners of the submerged section of the lower tank 12. When the proper position has been reached by the tug, the tug is anchored by a sea anchor. The plug 24 is removed from columns 9 and 10, and column 10 is connected to pipe 26 by fittings 25 and 26. Pipe 26 carries a valve 26' and a union fitting 27' (see Figs. 4 and 4c). Fitting 27' is connected to a mud or water pump on the tug and water or mud is pumped down through column 10 through line 40 to the bottom of the tank 12 and thus weights that section of the column which then sinks at its weighted end. The upper tank 11, being buoyant, is connected by the tow line to the tug. The snubbing line 142 is kept taut by a winch on the tug. The amount of water or mud introduced into the lower tank 12 is sufficient to overcome the buoyancy of the cell to a degree sufficient to permit it to sink at a controlled rate under the control of tow and snubbing lines. The cell thus pendulums around the barge controlled by the tow line, the snubbing line being pulled in to assist the cell to become upright as it descends. During this operation the admission of mud through pipe 26 is controlled to maintain the necessary negative buoyancy to cause the cell to descend under controlled conditions. If desired, at this point and while the lines to the tow barge are still attached, the plug 24 on column 8' may be removed and a line, such as 26, connected by fittings 27, 26', and 27' to the column 8 by means of the fitting 25 and mud jetted, by means of the mud pump on the

tug, through the jets 23 and 22 to scour out any loose mud or sand and permit the cells to settle to a firm foundation. When the cells settle in an upright position, the lower tank 12 is filled with water or mud until the mud overflows the top of the column 9.

At this point the hose connections are removed from columns 8, 9, and 10 and the plugs replaced. Sea anchors are set to each of the four corners of the cell and the snubbing lines are cast off.

A second cell may be erected in a similar manner adjacent the first cell. When the second cell is erect a connection may then be made as previously described for the jetting column 8, and by jetting the column in position it may be manipulated by the snubbing lines and tow lines and also, if desired, with the aid of divers, to align the second cell against the first cell, the alignment joints aiding in this operation. The controlled buoyancy occasioned by the control of waater in the lower tank permits of sufficient buoyancy to manipulate the column into position. The aligning joints accurately align the top and bottom tanks against the adjacent top and bottom tanks of the previously erected cells so that the bolt holes in the flanges 20 are in alignment and divers may then bolt the lower tanks together and the upper tanks may also be bolted together. The lower tanks are filled with water or mud before casting off. The conduits 26 are cast off, plugs 24 replaced, the snubbing and tow lines are cast off, and the anchors set to the four corners of the assembled cells. In this way all of the cells may be assembled to produce the structure previously described.

In erecting the structure shown in the figures, the cell 4 is first spotted into position and centered, with the space 82 centered over the well location which has been previously determined. Cells 5 and 5' are then erected with the aligning joints on the walls of the tanks 61, 62, 63, and 64 cooperating with the corresponding elements of the aligning joints on the tanks of the cells 5 and 5' to accurately align the end cells in the manner described employing the method described above.

Cells 6 and 6' are then erected with the aligning joints on the walls of the cells 5 and 5' cooperating with those of cells 6 and 6' to accurately align 6 and 6'.

Cell 6'' is now set into position in the space between the cells 6 and 6' and the cell 4, and, thus being centered, the aligning joints on the walls between 61 and 63 and on the tanks of 6'' are brought into alignment. The cells are bolted together. The drilling platform is thus erected in the manner previously described, the cells having been bolted in the manner previously described.

If desired now the drilling platform can be levelled. For this purpose the plugs on the columns 48, 50, 58, 65, 69, 73, 78, that is, all of the columns of the drilling platform which contain the levelling foot, are connected to a mud or water line for the operation of the levelling foot of each of the columns by connecting these columns by the fitting shown in Fig. 4c. The columns 51, 49, 55, 74, 79, 66, and 72, that is, all of the jet columns, are also connected to a water or mud line by a similar fitting. These cells are thus levelled by applying pressure to the pistons of the levelling foot and jetting selectively by the independent hydraulic line connected to each of the levelling foot columns and each of the jet columns. By providing a valve 26' on pipe 26 close to the fitting 25 and providing an additional fitting 27' for suitably disconnecting the hydraulic line from such fitting, the valves may then be closed with pressure on the line and the hydraulic system in the levelling foot maintained under pressure at the aligned condition. These fittings are thus left on the levelling foot when the system is erected and project through suitable holes in the deck. All other columns are closed by removing the fitting 27 and replacing it with plug 24.

The wing piers may now be erected by moving into position cells adjacent the cells 6 and 6', centering with the aligning joints on the upper and lower tanks of 6 and 6' and bottom and top tanks of the cells of the wing piers. They are manipulated into position by tow lines in a manner similar to that described above with suitable adjustment of the tow lines to compensate for the progressive dimensions of the structure, as will be understood by those skilled in this art. The subsequent cells are now moved into position and joined seriatim to establish the wing piers, as will be clear from what has been said before. The wing piers may then be aligned by the jet and levelling foot of each cell which, it will be observed, are on the side of the cells adjacent the slip 2 and between the rails. The wing piers are thus levelled in the manner previously described for the drilling platform. Sea bottom anchors of suitable character may be joined to the piers and drilling platform at various points to gain stability.

It will be observed that in the erected platform with all the bottom tanks full of mud or with water, the cells are weighted at their lower end and the center of mass of the whole structure is below the horizontal median plane of the structure. The low center of gravity together with the anchoring means previously described and the number of additional ones which may be set at various points in the structure establish a firm and stable foundation. As erected it may be considered temporary, in that the structure may be disassembled in a manner which will be clear from what has been said before by a reverse operation, since it is a structure which is tied together by disassemblable joints such as bolts.

After levelling, in order to increase the stability of the foundation, gravel or other fill may be introduced underneath the bottom tanks. The fittings 26, 27, etc., may, if desired, then be removed from the levelling columns 8' and the cap 24 set on the columns.

Instead of moving each of the unit cells in separately, they may be preassembled in sections and moved in. Thus, all or a portion of the drilling platform may be assembled on the shore, floated to position, and erected in a manner similar to that described for the unit cells. After erection it is settled and levelled as previously described. The wing piers may be floated in sections or each in its entirety to a position and erected in a similar manner and joined to the drilling platform as previously described.

With the structure in position and levelled, the top surface may be suitably decked and the machinery moved in, erected, and the conductor pipe 102 passed between the columns 84 in the space 82 between the tanks 61, 62, 63, and 64, and jetted into position as is usual with such a pipe. The conductor pipe may be cemented in position and the blowout preventers and Christmas tree units 104, 105 mounted, and mud outlet tubing 103 set in the pan 99 in the manner previously

described. The rotary table is positioned so that its drive shaft is axially aligned with the cell 4 for the purpose to be further described hereinbelow.

The barge 113 is then moved into the slip 2 until the winches 114 come underneath the davits 111. The winches 114 then elevate the barge out of the water into a position above the wing piers, as shown in Fig. 6. The beams 109 are rolled into position underneath the barge 113 by moving them along the tracks 107 and 108. The barge is then lowered onto the beams 109. The beams 109 are then advanced until the barge reaches the proper position on the platform to accurately locate the barge in position at a predetermined point in relationship to the drilling platform. A suitable stop may be provided for this purpose on the wing piers. The barge and the beams 109 are then locked into position to prevent the movement of the barge from its predetermined position. The locking means, not illustrated, may be any locking means for this purpose, as will be understood by those skilled in the art.

The screws 123' are then driven by means of the power plant 124, the gear train and shaft, and chain and sprocket assembly previously described to advance the nuts 123 from extreme position at the bow end toward the stern. This withdraws the links 122, rotates the truss 119 on its pivot 119', and with the slide travelling down the track 121', the derrick is moved into erect position with the four legs of the lower section 116 resting on columns 55, 56, 57, and 58, being the four columns of cell 6''. The elevation of the drilling platform is in relationship with the platform of the wing pier and the elevation of the pivot points 119' and 118 is such that upon elevation the derrick legs rest upon the floor of the drilling platform, with the legs on the girders connecting the columns of cell 6''. By omitting the levelling foot connection to column 58 and by fitting the plug therein, and by suitable spacing of the derrick legs and the columns, the legs of the derrick may be placed immediately above the columns of cell 6''. After erection suitable guy wires. only one being shown in Fig. 5, may be connected to sea bottom anchors, or to the structure itself, not illustrated, in order to increase the stability of the derrick.

The derrick construction may be conventional and its method of elevation may also be conventional or be such as is shown in my co-pending application Serial No. 691.717. The erection thereof and the extension of the derrick and its latching may be conventional or may be according to the device shown in my co-pending application Serial No. 677.584. Such derricks are employed on land operation of transportable units such as trucks.

When the barge is in position. the shaft 138 is axially aligned with the shaft 95' of the rotary table 106 and a connection may be made in between. The block, the swivel, and the drilling equipment may then be erected in conventional manner.

A separate mud barge and a separate tubing barge may be anchored along side the drilling platform. The mud barge may contain mud pumps and the usual mud equipment and connections for connecting them to the swivel and to receive the mud flow from the casing outlet 103. The tubing barge may be used to store the drill tubing.

If during the drilling operation storms are encountered which make it unsafe to leave the derrick erect, the drill pipe may be suspended in position in the rotary table by slips, in a manner which will be well understood by those skilled in the art, and the travelling block removed from the swivel or the swivel removed from the kelly, as may be desired. The guy wires are disconnected from the derrick and secured to the platform. The telescoped derrick is lowered into its lower section and the derrick retracted into the position shown in Figs. 6 and 14. This lowers the extended section and reduces the hazards of operation in open waters. In the event, however, that the storm appears to be one which may be protracted and unduly severe, the derrick may be retracted onto the barge 113 and the barge lowered into the water by unlocking the barge and moving it backward into position under the davits 111. The barge is lifted off the beams 109 and lowered into the water and driven to safety and it may tow the mud and pipe barges with it to a safe location.

Should the drilling operation prove to be a failure, as a wildcat operation well may be, the barge is removed as previously described and all the drilling equipment may be removed and the system disassembled by unbolting the sections in a manner previously described.

A tow line having been connected to the unbolted section at the corners of tank 11 adjacent the columns 8 and 8' and a tow line being also connected to the lower corners of tank 12 adjacent columns 8 and 8' and each tow line connected to an oppositely directed tug, air pressure is imposed on the top of the lower tank 12 through the slots 42' and the water is blown out through line 40 and column 10. By connecting an air line to the column 9 and permitting the water to be discharged through column 10, the air forces the water in column 9 down through the slot 42' into the top of the tank 12, the mud and water discharging through line 40 and up column 10 until all water is discharged from tank 12. Any mud or water contained in column 10 remaining after such discharge as may be obtained by the pressure method and the air lift which is obtained in column 10 will return, of course, to the tank 12, but in so doing when the tank is de-watered the buoyancy of the cell is re-established. The tow lines are then taken in so that the bottom tank is moved to the surface and the cell floated with the columns 9 and 10 out of the water.

After flotation, the conduits are disconnected from the columns 9 and 10 and plugs reinserted. The cells may thus be re-floated singly or in multiple sectional assembly.

If it be desired to convert this temporary location into a permanent location, such as, for example, if oil is struck, divers are sent down to build forms underneath and around the bottom tanks encompassing the lower tanks of the various cells of the structure and the forms are filled with concrete cement. Cementing under water may be carried out by standard and conventional procedure well known to those skilled in this art. The decking is removed over the tops of the columns 9 and 10 of the wing piers and the equivalent columns of the drilling platform, and the plugs are removed. Connections are made to the column 10 and the equivalent columns of the cells of the drilling platform for introduction of cement down column 10 and the other equivalent columns of the drilling platform. Cement is pumped down these columns, displacing the water or mud in the tank due to its higher gravity, the water being

discharged through orifice 42' and up column 9 and the equivalent columns of the cells of the drilling platform until the lower tank and columns are filled with cement. The tanks are thus filled with cement and form a reinforced, continuous, solid concrete cement platform reinforced by the concrete poured into the forms set around it, as previously described.

While I have described a particular embodiment of my invention for the purpose of illustration, it should be understood that various modifications and adaptations thereof may be made within the spirit of the invention as set forth in the appended claims.

I claim:

1. A drilling platform erected on a marine bottom, a pair of wing piers connected to said drilling platform forming a slip between said wing piers and said drilling platform, track ways mounted on said wing piers extending the length of said wing piers, travelling beams movably mounted on said track ways, a drilling barge movable into said slip, said drilling barge carrying a collapsible and extendible drilling mast, means on said barge to erect said mast onto said drilling platform and to collapse and disconnect said mast from said drilling platform and position said mast on said barge, means to elevate said barge from said slip onto said travelling beams and to place said barge in drilling relation to said drilling platform.

2. A drilling platform erected on a marine bottom, a pair of wing piers connected to said drilling platform forming a slip between said wing piers and said drilling platform, track ways mounted on said wing piers extending the length of said wing piers, travelling beams movably mounted on said track ways, a drilling barge movable into said slip, said drilling barge carrying a collapsible and extendible drilling mast, means on said barge to erect said mast onto said drilling platform and to collapse and disconnect said mast from said drilling platform and position said mast on said barge, means positioned on said wing piers to elevate said barge from said slip onto said travelling beams and to place said barge in drilling relation to said drilling platform.

3. A drilling platform according to claim 1, said means to elevate said barge comprising davits mounted on said wing piers, and power means on said barge in operative relation to said davits.

4. In the drilling platform according to claim 1, said drilling platform and said wing piers being formed of a plurality of cells, said cells comprising a plurality of elongated column members forming the longitudinal members of said unit cell, bottom and top closed flotation tanks mounted on said columns, one on each end of said columns between said columns, cross bracing between said columns, conduits connected to said bottom tank and extending the longitudinal length of said cells for introduction and for removal of fluid from said bottom tank, said cells being arranged one adjacent another, alignment joints between said cells, means for connecting said aligned cells together into a unitary structure, and weighting fluid positioned in the lower tanks of said cells.

5. In the drilling platform according to claim 1, said drilling platform and said wing piers being formed of a plurality of cells, said cells comprising a plurality of elongated column members forming the longitudinal members of said cells, bottom and top closed flotation tanks mounted on said columns, one on each of said columns mounted between said columns, cross bracing between said columns, conduits connected to said bottom tank and extending the longitudinal length of said cells for introduction and for removal of fluid from said bottom tank, a jet line extending the longitudinal length of said cells and terminating near the bottom of said bottom tank, a levelling foot connected near the bottom of said bottom tank, and means operable from the other end of said cells for actuating said levelling foot, said cells being arranged one adjacent another, alignment joints between said cells, means for connecting said aligned cells together into a unitary structure, and weighting fluid positioned in the lower tanks of said cells.

6. In the drilling platform according to claim 1, said drilling platform and said wing piers being formed of a plurality of cells, said cells comprising a plurality of elongated column members forming the longitudinal members of said cells, bottom and top closed flotation tanks mounted on said columns, one on each end of said columns mounted between said columns, cross bracing between said columns, conduits connected to said bottom tank and extending the longitudinal length of said cells for introduction and for removal of fluid from said bottom tank and at least one of said unit cells comprising a drilling conduit passageway between said top and bottom tanks, also said cells being arranged one adjacent another, alignment joints between said cells, means for connecting said aligned cells together into a unitary structure, and weighting fluid positioned in the lower tanks of said cells.

7. In the drilling platform according to claim 1, said drilling platform and said wing piers being formed of a plurality of cells, said cells comprising a plurality of elongated column members forming the longitudinal members of said cells, bottom and top closed flotation tanks mounted on said columns, one on each end of said columns, mounted between said columns, cross bracing between said columns, conduits connected to said bottom tank and extending the longitudinal length of said cells for introduction and for removal of fluid from said bottom tank, a jet line extending the longitudinal length of said cells and terminating near the bottom of said bottom tank, a levelling foot connected near the bottom of said bottom tank, means operable from the other end of said cells for actuating said levelling foot, at least one of said unit cells comprising a drilling conduit passageway between said top and bottom tanks, also said cells being arranged one adjacent another, alignment joints between said cells, means for connecting said aligned cells together into a unitary structure, and weighting fluid positioned in the lower tank of said cells.

8. In the drilling platform according to claim 1, said drilling platform and said wing piers being formed of a plurality of cells, said cells comprising a plurality of elongated column members forming the longitudinal members of said cells, bottom and top closed flotation tanks mounted on said columns, one on each of said columns, mounted between said columns, cross bracing between said columns, conduits connected to said bottom tank and extending the longitudinal length of said cells for introduction and for removal of fluid from said bottom tank, a jet line extending the longitudinal length of said cells and terminating near the bottom of said bottom tank, a levelling foot connected near the bottom of said bottom tank, means operable from the other end of said cells for actuating said levelling

foot, one of said cells including a drilling conduit passageway between said top and bottom tanks, said cells being arranged one adjacent another, alignment joints between said cells, means for connecting said aligned cells together into a unitary structure, and weighting fluid positioned in the lower tanks of said cells.

9. In the drilling platform according to claim 1, said drilling platform and said wing piers being formed of a plurality of cells, said unit cells comprising elongated tubular columns forming the longitudinal members of said cells, cross braces for said columns, at least one of said cells including a plurality of top tanks mounted between one of the said columns, said last-named tanks being spaced to provide an opening therebetween, cross beams at the top of said tanks adjacent the ends of said tubular columns, said last-named cells including also a plurality of bottom tanks mounted between the other of the ends of said columns, said last-named bottom tanks being spaced to provide an opening between said bottom tanks, said last-named opening being in registry with said first-named opening, certain of said columns forming a communication with the interior of each of said bottom tanks and forming fluid inlet conduits into said bottom tank, others of said columns communicating with the interior of each of said bottom tanks and forming fluid outlets for said tanks, means positioned adjacent said top tanks for closing the tops of said columns, said cells being arranged one adjacent another, alignment joints between said cells, means for connecting said aligned cells together into a unitary structure, and weighting fluid positioned in the lower tanks of said cells.

10. In the drilling platform according to claim 1, said drilling platform and said wing piers being formed of a plurality of cells, said cells comprising elongated tubular columns forming the longitudinal members of said cells, cross braces for said columns, top and bottom tanks mounted between one of the ends of said columns at least one of said cells including a plurality of top tanks, said last-named tanks being spaced to provide an opening therebetween, cross beams at the top of said top tanks adjacent the ends of said tubular columns, said last-named cells including also a plurality of bottom tanks mounted between the other of the ends of said columns, said last-named bottom tanks being spaced to provide an opening between said bottom tanks, said last-named opening being in registry with said first-named opening, certain of said columns forming a communication with the interior of each of said bottom tanks and forming fluid inlet conduits into said bottom tank, others of said columns communicating with the interior of each of said bottom tanks and forming fluid outlets for said tanks, others of said columns being open at one end adjacent the bottom of said bottom tanks, a jet fitting attached to said open end, means positioned adjacent said top tanks for closing the tops of said columns, additional columns forming levelling means for said cells, said levelling means comprising a piston mounted in said columns near the end thereof adjacent the bottom tank, a piston rod connected to said piston, a levelling foot connected to the piston rod and positioned near the bottom of said bottom tank, said cells being arranged one adjacent another, alignment joints between said cells, means for connecting said aligned cells together into a unitary structure, and weighting fluid positioned in the lower tanks of said cells.

11. In the drilling platform according to claim 1, said drilling platform and said wing piers being formed of a plurality of unit cells, said unit cells comprising elongated tubular columns forming the longitudinal members of said cells, bottom and top closed flotation tanks mounted on said columns, one on each end of said columns and mounted between said columns, cross bracing between said columns, one of said cells including a plurality of bottom tanks mounted between the other of the ends of said columns, said bottom tanks being spaced to provide an opening between said bottom tanks, said last-named opening being in registry with said first-named opening, certain of said columns forming a communication with the interior of each of said bottom tanks and forming fluid inlet conduits into said bottom tank, others of said columns communicating with the interior of each of said bottom tanks and forming fluid outlets for said tanks, others of said columns being open at one end adjacent the bottom of said bottom tanks, a jet fitting attached to said open end, additional columns forming levelling means for said cell, said levelling means comprising a piston mounted in said columns near the end thereof adjacent the bottom tank, a piston rod connected to said piston, a levelling foot connected to the piston rod and positioned near the bottom of said bottom tank, means operable from the other end of said cells for actuating said levelling foot, said cells being arranged one adjacent another, alignment joints between said cells, means for connecting said aligned cells together into a unitary structure, and weighting fluid positioned in the lower tanks of said cells.

12. A drilling base erected on a marine bottom, a barge movable to said base, means to lift said barge from the water and means to support said barge on a stable basis in operative relation to said base, a collapsible and extensible drilling mast positioned in collapsed and retracted position on said barge, a supporting structure on said barge for said mast, means for hinging said mast on said supporting structure, means to rotate said mast about said hinge to erect said mast on said base, and means to extend said mast after erection on said base, said erection and extension means also acting to collapse said mast and rotate said mast on the hinge.

13. A drilling base erected on a marine bottom, a drilling barge movable to said base, said drilling barge carrying a collapsible and extensible drilling mast, means to elevate said drilling barge from the water onto said base and means to erect said mast from said barge onto said base and to collapse and disconnect said mast from the base and position said mast on said barge.

14. A drilling base erected on a marine bottom, wing piers connected to said base, forming a slip between said wing piers and said base, a drilling barge movable on the water into said slip, said drilling barge carrying a collapsible and extensible drilling mast, means to lift said barge from the water to drilling position above said slip and means to support said barge on said piers, and means to erect said mast onto said base in drilling position and to retract and collapse said mast from drilling position onto said barge.

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No references cited.