May 6, 1969 L. B. CHRISTENSON 3,442,340

MOBILE FIXED DRILLING AND PRODUCTION STRUCTURE

Filed June 9, 1967 Sheet 1 of 3

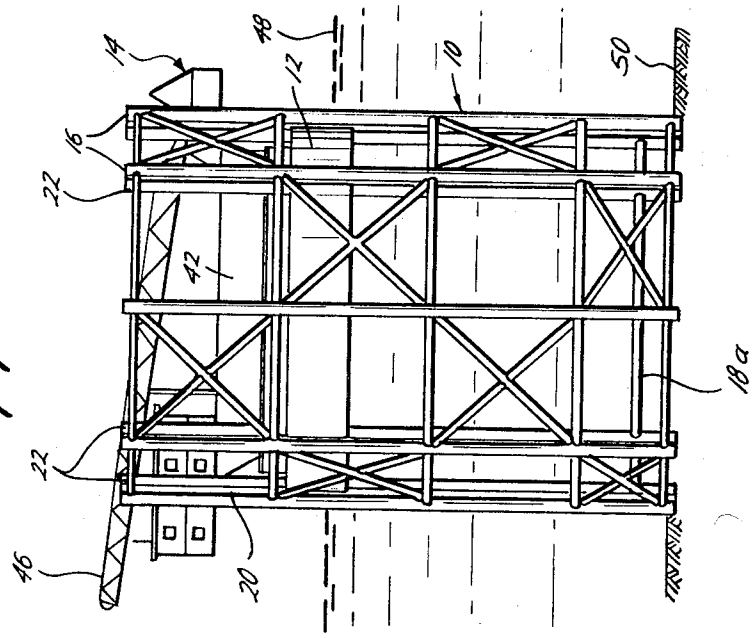


Fig. 2

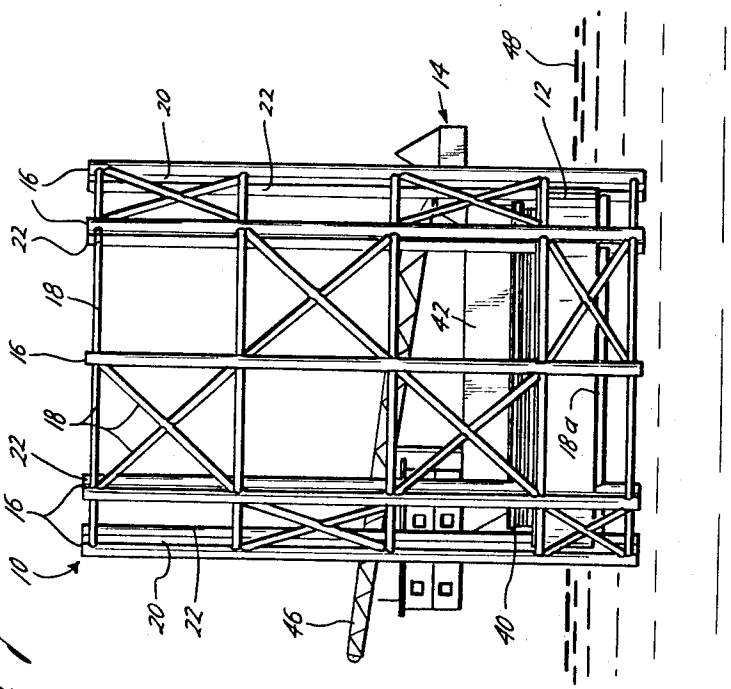


Fig. 1

Lowell B. Christenson
INVENTOR

BY James F. Weiler
Jefferson D. Gilley
William A. Stout
Dudley R. Dobie, Jr.
ATTORNEYS

May 6, 1969 L. B. CHRISTENSON 3,442,340

MOBILE FIXED DRILLING AND PRODUCTION STRUCTURE

Filed June 9, 1967 Sheet 2 of 3

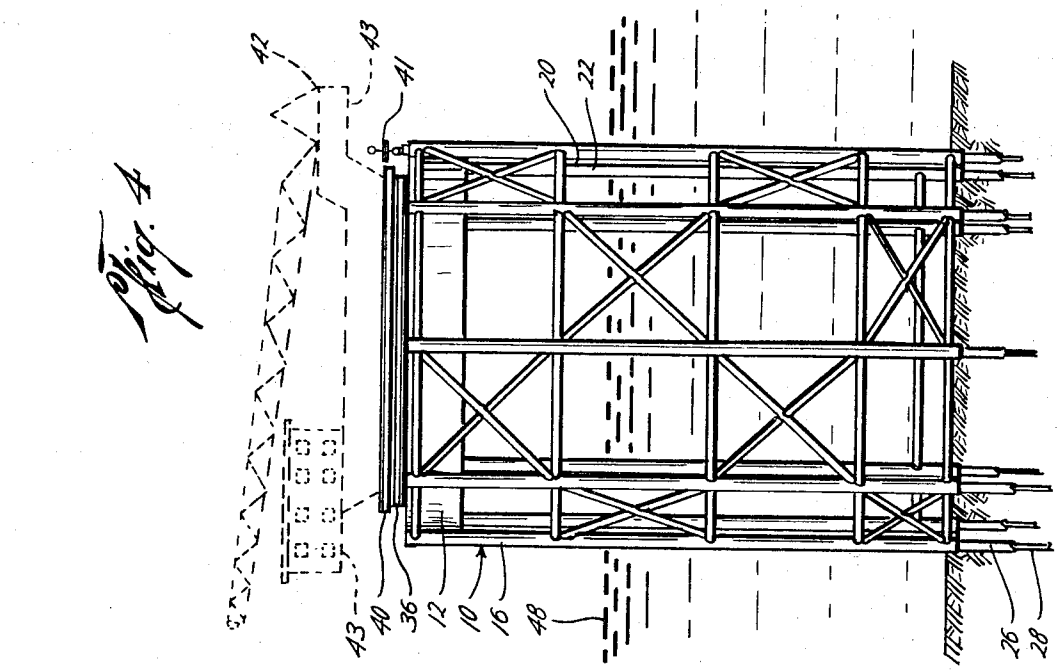


Fig. 4

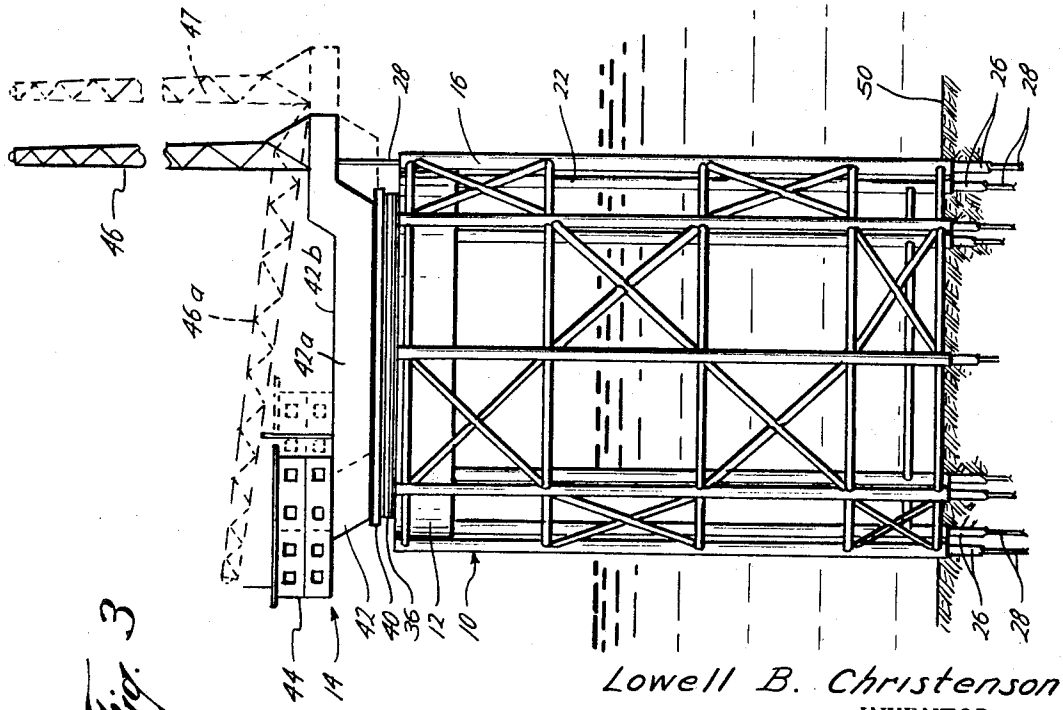


Fig. 3

Lowell B. Christenson
INVENTOR

BY James F. Weiler
Jefferson D. Gilley
William A. Strout
Dudley R. Dobie, Jr.
ATTORNEYS

May 6, 1969 L. B. CHRISTENSON 3,442,340

MOBILE FIXED DRILLING AND PRODUCTION STRUCTURE

Filed June 9, 1967 Sheet 3 of 3

Fig. 5

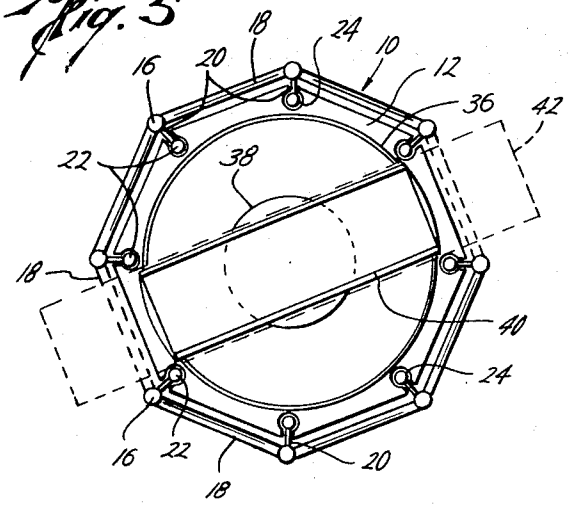


Fig. 6

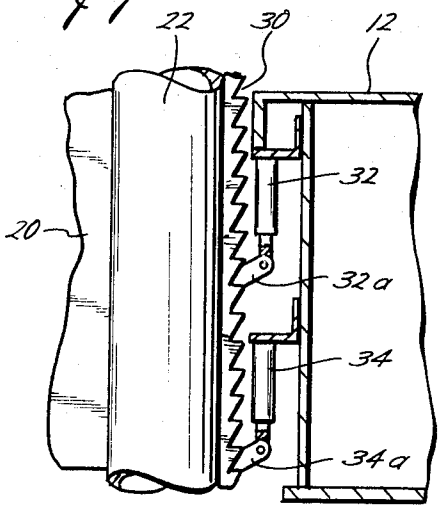


Fig. 7

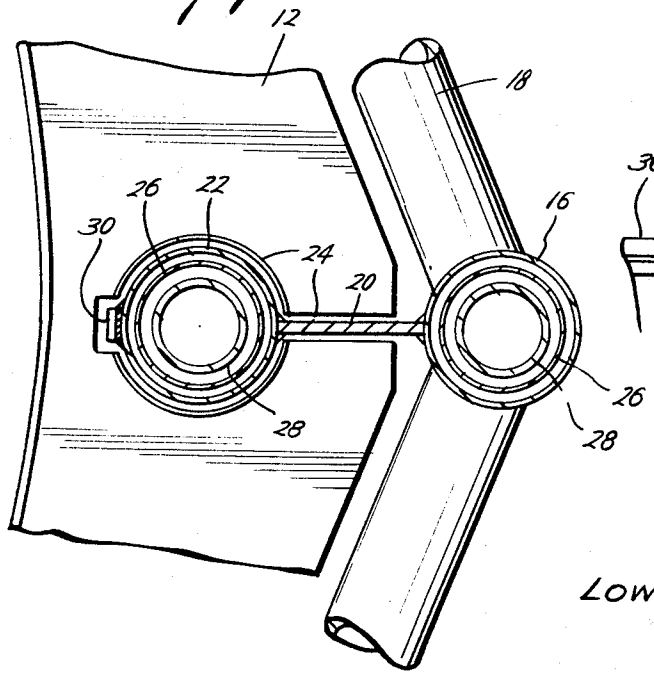
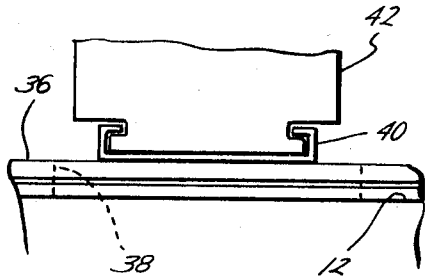


Fig. 8



Lowell B. Christenson
INVENTOR
James F. Weiler
Jefferson D. Gilley
BY William A. Stout
Dudley R. Dobie, Jr.
ATTORNEYS

United States Patent Office 3,442,340
Patented May 6, 1969

3,442,340

MOBILE/FIXED DRILLING AND PRODUCTION STRUCTURE

Lowell B. Christenson, 7410 Thurow,
Houston, Tex. 77017

Filed June 9, 1967, Ser. No. 644,883
Int. Cl. E21b 15/02; E02b 17/00
U.S. Cl. 175—8 13 Claims

ABSTRACT OF THE DISCLOSURE

An offshore drilling and production structure having a plurality of vertical columnar support members secured in polygon spaced relation about a buoyant platform which is releasably maintained therewithin for vertical adjustment. The columnar support members are adapted to receive anchor or spud members as well as drill bit means such that the entire structure may function both as a drilling rig and a production platform. Also included is a method for drilling a sub-surface well by lowering the support members to the underwater ground and drilling through the spuds and support members.

Background of the invention

The design, fabrication and operation of mobile offshore drilling rigs have developed to such a high degree at the present time that currently accepted offshore drilling practice is quite expensive. Current acceleration of drilling activity in deeper waters has necessitated use of extremely stable platform structures not only because of greater stability required for greater water depths but also because of adverse conditions naturally existing on the high seas. Thus the trend has been toward development of large and complex rigs which are more difficult to transport to offshore sites and which are laborious to remove from the drilling site once production is obtained.

Aside from the complexity of modern mobile offshore drilling structures, platforms must be constructed in place of such structures at the offshore site once productive wells are obtained. Again, the deeper the water the greater is the effort and expense involved in constructing a production platform at the well site not to mention the expense and difficulties involved in first removing the drilling apparatus.

It is, of course, well understood that the greater number of wells that may be completed at a single offshore drilling site the more economical it is to conduct offshore operations at such site. However, the advent of multiple completions at a single offshore site has in fact necessitated the fabrication of relatively larger mobile drilling structures in order to compensate for increased stability and working area requirements. Thus the larger and more complex structures in the offshore drilling industry leave much to be desired especially from the economic viewpoint.

Summary of the invention

The present invention is directed to an offshore drilling structure with unique mobile features uniquely suited for the drilling and completion of multiple wells and is further directed to a method of drilling multiple wells. The structure is highly stable both in transit as well as while in place at the offshore location and is readily adaptable as a fixed production platform. Simplicity of construction effectively contributes to economical fabrication and operation which

is in marked contrast with current trends in the offshore drilling industry.

It is, therefore, an object of the present invention to provide a method and apparatus for the drilling of a plurality of offshore oil or gas wells, such apparatus being adaptable as a fixed production platform or in the alternative capable of being transported to other sites for drilling should completion attempts be unsuccessful.

A further object of the present invention is the provision of an offshore drilling structure capable of fabrication and operation at greatly reduced costs due to simplicity of construction.

Still another object of the present invention is the provision of an offshore drilling structure of a polygon configuration wherein versatility in drilling and production as well as overall stability of the structure increases proportionately with the number of sides added to the polygon.

Yet a further object of the present invention is the provision of an offshore drilling structure of the mobile type having a buoyant platform which supports the entire superstructure while mobile and at the same time having minimum draft to permit dockside berth of the entire unit for purposes of loading, unloading, or otherwise servicing the unit.

Another object of the present invention is the provision of such an offshore drilling structure having a working deck capable of horizontal sliding and/or pivoting movement and supporting a drilling apparatus for use both in anchoring the structure at an offshore site as well as drilling a plurality of wells. Such working deck is uniquely adaptable to be removed from the structure should production be obtained at the offshore site so that the remaining structure may serve as a production platform.

Still another object of the present invention is the provision of a mobile offshore drilling structure economically fabricated and having remarkable stability due to integration of well structure with support pilings, yet permitting adequate spacing of wells, the completion of which further increases platform stability.

Yet another object of the present invention is the provision of a method of conducting offshore marine drilling operations by anchoring a superstructure on the underwater ground and drilling through vertical supports of the superstructure.

Other and further objects, features and advantages will be apparent from the following description of presently preferred embodiments of the present invention, given for the purpose of disclosure, and taken in conjunction with the accompanying drawings.

Brief description of the drawings

In the drawings forming a part of the disclosure herein, like character references designate like parts throughout the several views wherein,

FIGURE 1 is an elevational view of the structure of the present invention in a mobile position capable of being transported to an offshore drilling site,

FIGURE 2 is an elevational view of the drilling structure of the present invention wherein the vertical, trussed support members have been engaged with the ocean floor at the drilling site,

FIGURE 3 is an elevational view of the structure of the present invention wherein the buoyant platform and working deck have been raised to operational position,

FIGURE 4 is an elevational view illustrating use of

the structure of the present invention as a production platform,

FIGURE 5 is a plan view of the platform as shown in FIGURE 4,

FIGURE 6 is a partial elevational view of jacking means for vertically adjusting the buoyant platform,

FIGURE 7 is a partial, sectional view showing the integrated well structure and vertical columnar support members, and

FIGURE 8 is a partial elevational view of the slidable working deck pivotally engaging the buoyant platform.

Description of the preferred embodiment

The present invention generally comprises an offshore drilling apparatus uniquely stable in transit as well as in operation at an offshore site and adapted to permit drilling and production of a multiplicity of wells. The structure is comprised of a plurality of vertical columnar supports trussed to form a polygon within which a buoyant platform having a working deck may be vertically adjusted for mobility or for drilling operations.

Referring now to the drawings and particularly FIGURES 1 and 2, reference numeral **10** generally designates the trussed superstructure within which is positioned a buoyant platform **12** and a working deck generally represented by the reference numeral **14**. The superstructure **10** is generally comprised of a plurality of vertical columnar support members **16** secured in spaced relation by a plurality of trusses **18**. Arrangement of the columnar support members **16** is more clearly illustrated in FIGURE 5 wherein the trusses **18** maintain such support members in a polygon configuration shown in the present embodiment as an octagon. As shown in FIGURES 1, 5 and 7, web means comprising a plate **20** rigidly secured along substantially the length of each columnar support member **16** projects inwardly of the polygon support formation **10**. Tubular studs **22** are then secured along substantially the length of the inward projection of each plate **20** for coaction with the buoyant platform **12** as will be described hereafter.

As shown in FIGURES 1 and 2, suitable additional trusses **18***a* interconnect the columnar support members at their lower extremities for further rigidity of the superstructure **10**. It should be noted that such additional truss members **18***a* are preferably located at the lowermost portion of each columnar support member or tubular stud so that they may extend across the interior of the polygon configuration without interfering with vertical movement of the buoyant platform **12**.

Referring now to FIGURE 5 and to FIGURE 7 for detail, the buoyant platform **12** is provided with a plurality of sleeves **24** of a "keyhole" configuration spaced peripherally and vertically therethrough for sliding engagement with the web means and more particularly with tubular stud **22** and each plate **20**. Thus the buoyant platform **12** is maintained interiorly of the polygon support formation of superstructure **10** yet is capable of sliding engagement with the web means so that it may be adjusted vertically.

As shown in FIGURE 7, each columnar support member **16** as well as each tubular stud **22** is adapted to receive concentrically a spud or piling member **26** capable of being driven into the ocean floor (as shown in FIGURES 3 and 4) for anchorage of the entire rig structure as will be explained hereafter. Such spuds or piling members **26** slidably engage each columnar support member and/or each tubular stud and are of a diameter great enough to receive a drill bit (not shown) and drill pipe **28** therethrough.

It will be recognized, of course, that the buoyant platform **12** for floating the entire structure as well as for supporting decks, etc. must be constructed of sufficient size and buoyancy to provide adequate balance while mobile as will be apparent to those skilled in the art. It will be recognized also that the columnar support members **16** as well as the trusses **18** may be made watertight by means known to those skilled in the art to provide further buoyancy while the entire structure is mobile.

Referring now to FIGURE 6, one form of jacking means is shown for adjusting and releasably maintaining the platform **12** vertically relative to the web means of the columnar support members **16**. Thus a rack bar **30** may be carried by each of the tubular studs **22** and positioned so as to coact with jacks **32** and **34** secured to the buoyant platform **12**. As shown in the drawing, the jacks have pawls **32***a* and **34***a* respectively for engagement with the teeth of the rack bar **30**. The jacks **32** and **34** with their respective pawls may be used both to force the superstructure **10** downwardly for engagement with the ocean floor as well as to elevate the buoyant platform **12** to operational level as will be described hereafter. In addition, the jacks may serve to maintain the buoyant platform at any desired vertical position. By use of a pair of jacks as shown, the buoyant platform **12** may be adjusted vertically by alternate reciprocation of the jacks as is well known. Of course, other types of jacking means may be used such as portable jacks currently used on offshore rigs.

Referring once again to FIGURE 5, secured to the top of the buoyant platform **12** is a circular track **36** as well as suitable turntable means **38** known to those skilled in the art. The turntable means **38** pivotally support a horizontal frame **40**, the ends of which may slide or otherwise be rotatably supported on the circular track **36**. As shown in FIGURE 8, the horizontal support **40** rotatably secured to the turntable means **38** and slidable on the circular track **36** may be of a "box" configuration so as to slidably engage a deck member **42**. Such deck **42** is shown in dotted outline in FIGURE 5 as being of a suitable width such that it may be adjusted vertically along with the buoyant support member **12** to clear opposed pairs of columnar support members **16** as well as tubular studs **22** of the superstructure **10**. Coaction of the horizontal support **40** with the turntable means **38** as well as the circular track **36** will be apparent to those skilled in the art both as to conestruction and operation and no further explanation is necessary.

Turning now to FIGURE 3 which best illustrates the entire invention in operational relation, the deck **42** is arranged and designed such that its center section **42***a* is suitable for bay storage with a pipe rack **42***b* provided topside. The necessary crew quarters **44** may be constructed at one end with derrick means **46** at the other end of the working deck **42**. It will be noted that the derrick **46** may be lowered into a retracted position **46***a* indicated by dotted outline. The deck **42** as just described is preferably of an integrated structure so that it may be slidably removed from the horizontal support **40** should production be obtained at the offshore site and the superstructure **10** used as a production platform as will be explained hereafter.

In operation and with reference to FIGURE 1, the mobile drilling and production structure of the present invention including the superstructure **10** and buoyant platform **12** with the working deck **14** secured thereon is shown arranged for towing to an offshore site. The superstructure **10**, of course, comprises the trussed columnar support members **16** maintained in vertical relation above the buoyant platform **12** which floats in the water (designated by the reference numeral **48**). In the position as shown in FIGURE 1, the draft of the superstructure **10** is relatively shallow whereby the entire rig may be placed dockside for loading of supplies onto the working deck **42**. In this position, the working deck **42** itself may be slidably placed onto the horizontal support **40**. Of course, the derrick means **46** are in a retracted position for proper balance. As previously described in relation to FIGURE 5, the working deck **42** is of such a width that it may clear the columnar support members **16** as well as the tubular studs **22** so that it may be adjusted vertically. As becomes

apparent at this point, truss members **18** are not permanently placed between the columnar supports or tubular studs between which the working deck **42** must pass.

Once the mobile rig of the present invention has been towed to the designated offshore site, the superstructure **10** is jacked down or otherwise lowered so as to contact the ocean floor **50** as shown in FIGURE 2. Appropriate leveling means such as hydraulic or pneumatic jets well known to those in the art may be provided at the bottom of the superstructure **10** so as to properly level and seat the superstructure on the ocean floor. The superstructure **10** may be allowed to drop gravitationally to the ocean floor or may be forced downwardly by the jacks as explained in relation to FIGURE 6. Downward jacking of the superstructure **10** may be necessary, for example, if the columnar support members **16**, tubular studs **22** and truss members **18** are initially sealed for buoyancy.

After the superstructure **10** is firmly leveled on the ocean floor **50**, the buoyant platform **12** and deck **42** are raised to operational level as shown in FIGURE 3. Once again the jack means of FIGURE 6 are actuated to elevate the platform and deck and to maintain them in such elevated position. At this point, additional trusses **18** may be added to secure the particular columnar support members **16** between which the working deck **42** is vertically adjusted. Such additional truss members may be welded or bolted at suitable intervals along the length of the columnar support members.

When the buoyant platform **12** and deck **42** are in the operational position as shown in FIGURE 3, the derrick **46** may be raised as shown in the drawing. Then the deck **42** may be pivoted on the turntable **38** (FIGURE 5) and along the circular track **36** so that the derrick is positioned above a selected columnar support member **16**. The deck **42** may also be slidably moved along the horizontal support **40** to the extent necessary for proper positioning of the derrick **46**. The derrick apparatus **46** may then be used for driving the piling or spud members **26** into the ocean floor **50**, such operation being performed with each columnar support member **16** and each tubular stud **22** as is necessary to insure proper anchoring of the superstructure **10** against lateral movement. Ability of the deck **42** to pivot circularly as well as slide horizontally as described greatly facilitates driving of the spuds into the ocean floor through each columnar support member or each tubular stud, so as to place the rig structure in a condition whereby drilling of oil or gas wells may proceed.

Again referring to FIGURE 3 as well as to FIGURE 7, the columnar support members **16** and tubular studs **22** with their respective concentric spuds **26** are of great enough diameter such that drill pipe **28** may pass therethrough with drill bit means and other necessary drilling apparatus attached. Drilling of a multiplicity of wells may thus be accomplished, the number being dependent upon the number of columnar support members **16** and tubular studs **22** provided in the superstructure **10**. Upon completion of drilling operations in one well, the working deck **42** is easily rotated and/or slidably moved for positioning with other columnar support members **16** or other tubular studs **22**. As mentioned at the outset, the total number of wells possible depends upon the number of sides employed in the polygon configuration of the superstructure **10**. In the embodiment shown in the drawings, there are eight sides in the polygon with eight columnar support members **16** and eight tubular studs **22** resulting in 16 possible wells being drilled.

As shown in dotted outline in FIGURE 3, the deck **42** may slide along the horizontal support **40** so that the drilling rig may assume a position designated by numeral **47**. In such position, the drilling rig extends beyond the edge of the superstructure **10** whereby exploratory wells may be drilled if desired.

Once a well is drilled and proved to be productive, the usual cementing and completion operations are carried out. Since the columnar support members and tubular studs each serve both as drill casing and as structural supports, the addition of cement therein increases their rigidity as structural supports thereby adding to overall stability of the rig.

Also, it will be noted that as wells are completed, the usual "Christmas tree" apparatus **41** may be installed on each wellhead. In order that the deck **42** may clear each wellhead while pivoting, it is constructed so as to overhang at each end **43** for the desired clearance. Alternatively, the deck **42** may be constructed of a shorter length than shown in any of the drawings which would permit placement of permanent trusses **18** in place of the non-permanent trusses **18** shown in dotted outline in FIGURE 5.

Assuming that a sufficient number of productive wells are completed, the structure of the present invention is readily adaptable to function as a production platform as shown in FIGURE 4. To accomplish such adaptation, the non-permanent truss members **18** (shown in dotted outline in FIGURE 5) are removed and the buoyant platform **12** is lowered by the jack means to water level as shown in FIGURE 2. A tender may be brought alongside the rig whereby the entire working deck **14** may be slidably moved as a unit along the horizontal support **40** for removal onto the tender. The working deck is thus available for further use with other superstructure and buoyant support member combinations, leaving the present superstructure **10** and buoyant support member **12** anchored in place on the offshore site as shown in FIGURE 4.

After the deck **42** has been removed, the buoyant platform **12** is again raised to operational level as shown in FIGURE 4. The buoyant platform may then serve as a working area and storage facility for production purposes. Of course, a portion of the platform may be converted for use as a helicopter landing pad if desired. The resulting production platform through adaptation of the superstructure **10** as just described provides a highly stable structure which will withstand heavy seas and which, of course, obviates replacement by a separate production structure as would be required otherwise with the usual conventional drilling rigs. Costly rig removal and production operations are thus greatly reduced.

In the event that only minimal production is obtained upon completion of drilling operations at the offshore site, and as an alternative to adapting the superstructure **10** as a production platform as explained above, the entire superstructure **10** and working deck assembly **14** may be removed for towing to another drilling site if desired. Thus, the spuds or pilings **26** may be pulled from the sea floor or sheared to weigh anchor so to speak. The buoyant platform **12** is then lowered into the water as shown in FIGURE 2 and the superstructure **10** elevated as shown in FIGURE 1 to again make the entire structure mobile.

Additional embodiments of the present invention will now suggest themselves such as elimination of the tubular studs **22** as shown in FIGURE 7 and substitution of other suitable vertical beams therefor if the additional support and drilling facility provided by the tubular studs are deemed unnecessary for the particular offshore application. In other words, the rack bar **30** as shown in FIGURES 6 and 7 may be secured directly to the plate **20** or beams attached thereto thereby forming other web means configurations with appropriate alteration of configuration of the sleeves **24** as might be preferred for particular operations contemplated. In any event, the web means formed of the plate **20** rigidly secured to each columnar support member **16** with the attendant tubular studs **22** or other beam configurations must provide adequate support for vertical adjustment of the buoyant platform **12**.

Thus provided is an extremely versatile, mobile offshore drilling and production structure which is of sufficient strength to meet all anticipated stresses and strains during towing, anchoring on site and operation in heavy

seas. Drilling equipment is easily removed as a unit for conversion of the structure to a production platform wherein each well completed through the columnar support members or tubular studs enhances stability of the structure as a whole. Not only is the structure economical to construct, but operation costs are greatly reduced since anchoring and drilling operations are so greatly facilitated through ability of the working deck to pivot and slide on the buoyant platform.

The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned as well as those inherent therein. While presently preferred embodiments of the invention are given for the purpose of disclosure, numerous changes in the details of construction and arrangement of parts can be made which will readily suggest themselves to those skilled in the art and which are encompassed within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. An offshore drilling and production structure comprising:
- a plurality of vertical columnar support members each adapted to receive a spud member and drill bit means, said columnar support member being maintained in polygonal spaced relation by trusses,
- web means rigidly secured along substantially the length of each columnar support member and projecting inwardly of the polygonal support formation,
- a buoyant platform positioned interiorly of the polygonal support formation, said platform having sleeves for slidably receiving each web means,
- means for releasably maintaining the platform in a vertically adjusted position relative to said polygonal support formation, and
- mean for anchoring the polygonal support formation to the ocean floor.

2. The invention of claim 1 including,
- a working deck movably secured to the top of the buoyant platform,
- means for sliding the working deck horizontally relative to the buoyant platform, and
- means for horizontally pivoting the working deck on the buoyant platform.

3. The invention of claim 2, including rotary drilling means mounted on one end of the working deck whereby said drilling means may be vertically aligned with any of the vertical columnar support members for conducting drilling operations through said columnar support members.

4. The invention of claim 1 wherein the anchor means include tubular spuds extending axially through and slidably engaging the columnar support members, each said spud adapted to receive a drill bit means.

5. A mobile apparatus for the drilling and production of offshore wells comprising,
- a buoyant platform adapted to be towed to and from a marine well site and to be elevated above wave action,
- a plurality of vertical columnar support members each adapted to receive a spud member and drill bit means therethrough, said columnar support members being securably positioned about the buoyant platform in polygonal spaced relation by trusses,
- web means rigidly secured along substantially the length of each columnar support member and projecting inwardly toward and slideably engaging the buoyant platform,
- sleeve means spaced peripherally of the buoyant platform for sliding engagement with the web means whereby said platform is maintained within the columnar support members,
- means for adjusting and releasably maintaining the platform vertically relative to the columnar support members,
- tubular spuds extending axially through and slidably engaging the columnar support members, each said spud arranged to be forced into the underwater ground and to receive a drill bit means therethrough,
- a working deck movably secured to the top of the buoyant platform,
- means for sliding the working deck horizontally relative to the buoyant platform,
- means for horizontally pivoting the working deck on the buoyant platform, and
- rotary drilling means mounted on one end of the working deck whereby said drilling means may be vertically aligned with any of the vertical columnar support members for conducting drilling operations through said columnar support members.

6. The invention of claim 5 wherein the web means rigidly secured along substantially the length of each columnar support member comprises a beam projecting inwardly toward the buoyant platform.

7. The invention of claim 5 wherein the web means comprises,
- a plate rigidly secured along substantially the length of the columnar support member and projecting inwardly toward the buoyant platform, and
- a tubular stud rigidly secured along substantially the length of the inward projection of the plate.

8. The invention of claim 7 wherein the tubular stud is adapted to receive a spud member therethrough.

9. The invention of claim 7 wherein the tubular stud is adapted to receive a spud member and drill bit means and wherein the drilling means may also be vertically aligned with the tubular stud for conducting drilling operations through said stud.

10. A method for drilling a sub-surface well in the underwater ground with an offshore marine drilling structure provided with a plurality of vertically disposed columnar supports trussed in polygonal relation as a superstructure and having drilling means mounted therewithin for vertical as well as horizontal adjustment of said drilling means, such method comprising the steps of,
- lowering said superstructure until said supports rest on the underwater ground,
- anchoring said superstructure against lateral movement by driving open spuds through the columnar supports and into the underwater ground,
- aligning the drilling means over one of the columnar supports and drilling into the underwater ground through said columnar support and the spud therewithin, and
- horizontally adjusting the drilling means to align said means over at least another columnar support and drilling into the underwater ground through said columnar support and the spud therewithin.

11. A method of conducting offshore marine drilling operations by means of a mobile structure provided with a plurality of vertically disposed columnar supports trussed in polygonal relation as a superstructure and having horizontally moveable drilling means mounted on a floatable buoyant platform which may be vertically adjusted relative to and within the superstructure, such method comprising the steps of,
- raising the superstructure to an elevated position relative to the buoyant platform,
- transporting the structure to an offshort drilling site,
- lowering the superstructure until it rests on the underwater ground,
- elevating the buoyant platform to a position adjacent the top of the superstructure,
- anchoring the superstructure against lateral movement by driving open spuds through the columnar supports and into the underwater ground,
- aligning the drilling means over one of the columnar supports and drilling into the underwater ground through said columnar support and the spud therewithin, and

moving the drilling means over at least another of the columnar supports and drilling into the underwater ground through said columnar support and the spud therewithin.

12. A method in accordance with claim 11 including additionally,

lowering the buoyant platform to a floating position, and

raising the superstructure to an elevated position relative to the buoyant platform for mobility of the structure.

13. A method in accordance with claim 11 in which the drilling means is mounted on a working deck which is horizontally and movably secured to the buoyant platform, with the additional steps of,

completing producing wells through the columnar supports,

lowering the buoyant platform to a floating position,

removing the drilling means and working deck from the buoyant platform, and

elevating the buoyant platform to a position adjacent the top of the superstructure.

References Cited

UNITED STATES PATENTS

2,430,014	11/1947	Hansen	61—46.5
2,877,629	3/1959	De Long	61—46.5
3,001,595	9/1961	Lucas	175—9
3,004,612	10/1961	Kofahl	175—10 X
3,244,242	4/1966	Wolff	175—9

CHARLES E. O'CONNELL, *Primary Examiner.*

RICHARD E. FAVREAU, *Assistant Examiner.*

U.S. Cl. X.R.

61—46.5