[54] JACK-UP TYPE OFFSHORE OIL PRODUCTION PLATFORM APPARATUS AND METHOD

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[57] ABSTRACT

Jack-up type offshore platform apparatus particularly adapted for assembly and partial erecting, then towing to an offshore site in fully outfitted and loaded condition, and subsequent installation and use as a substantially permanent oil well drilling and production platform in water depths of 500 feet or more. Apparatus has one or more lower support platform structures, each having attached upwardly projecting support legs for supporting the platform structure thereof. Downwardly projecting lower legs have "pads" which rest on, but are not pinned to the sea bottom. In a preferred embodiment a bottom platform structure provides a "mat" which rests on sea bottom. Method involves assembly and partial erecting of apparatus with lower legs and lower platform structures fully extended below, and submerged beneath the then floating upper platform before and during towing to oil field site. At the site the apparatus is self-erecting.

22 Claims, 9 Drawing Figures
JACK-UP TYPE OFFSHORE OIL PRODUCTION
PLATFORM APPARATUS AND METHOD

This application is a continuation-in-part of my co-
pending application Ser. No. 287,256, filed Sept. 8,
1972, now U.S. Pat. No. 3,797,256, the disclosures and
specification of which are hereby incorporated by ref-

erence.

This invention relates to jack-up type offshore plat-
tforms used for the drilling and production of oil from
sea beds and similar places, and more particularly to
so-called "production" platforms, which are relatively
permanent installations as distinguished from mobile-
type platforms from which initial exploration drilling
operations are conducted over a period of only several
months after which the mobile rig is relocated. A pro-
duction platform may be expected to remain on the site
for twenty years or more. The invention further relates
to techniques for installing such platforms.

Jack-up type production platforms are not new, but
heretofore the use of such platforms has been limited to
comparatively shallow water depths. Permanent ma-
rine platform structures which are not of the jack-up
type, such as that shown in U.S. Pat. No. 3,209,544
(Borrman), are very costly to erect in place, and must
be completely torn down to be removed. Thus, there
exists a need for oil production platforms that can be
erected quickly in deep water that do not require pin-
ing to the ocean floor and further can be erected with
all production equipment mounted in place on the
platform prior to erection on the site. A jack-up type
platform sails as a ship to the site and is therefore ide-
ally suited to achieve these ends. Moreover, when such
may become necessary after the 20 year life of the
platform has expired, by reversing the jack-up proce-
dure the structure can be removed comparatively eas-
ily.

In its presently preferred embodiment to be de-
scribed, the invention contemplates a two-stage self-
erecting gravity type jack-up production platform for
installation in the North Sea in water 500 feet deep or
more, and to withstand the meteorological conditions
prevailing in that area. However, using the principles of
the invention the apparatus might have a different
number of stages, and might be modified for use under
different environmental conditions.

As in the apparatus described in my aforesaid co-
pending application, a production platform apparatus
in accordance with the present invention includes a
lower support platform located about midway between
the sea bottom and the sea surface, the function of
which is to provide fixity to the legs thereafter and
therebelow, and by so doing reduce the bending mo-
ments in the legs to practical values. Although this
lower platform structure has wave-transparent con-
struction as in the apparatus described in the earlier
application, in the preferred embodiment of the pres-
ent invention the upper legs above this lower support
platform have hollow cylindrical rather than trussed
construction, and the vertical offset relation of these
upper legs with respect to the lower legs below this
lower support platform has been eliminated. That is,
the support legs above the lower or intermediate plat-
form are vertically aligned with those below the plat-
form, and both the upper and lower legs have cylindri-
cal construction to minimize high local stresses as
occur in the joints of a trussed structure. In one erected
configuration the bottom of the upper legs may be
arranged in partially telescoped relation within the tops
of the lower legs, the overlap being equal to the height
or depth of the lower support platform. However, in a
presently preferred erected configuration the upper
and lower legs do not telescope into each other but,
rather, a conical transition section connects the lower
ends of the upper legs to the upper ends of the lower
legs. The lower legs extend to, and support the appar-
atus on the sea bottom. However, in the preferred em-
bodyment a bottom platform structure or mat is rigidly
attached to and between all of the lower legs at their
bottom ends, the mat resting upon the sea bottom and
supporting the entire structure. Rigid connection is
made between all of the legs and the upper working
platform and both the lower and bottom support plat-
tforms, and the lower legs can extend through and
slightly below the mat to "bite" into the sea bottom. In
another modification, the bottom or lowermost support
platform is omitted, and each lower leg has an adjust-
able telescoping portion for leveling of the rig.

Of course, an advantage of the construction and
arrangement lies in the fact that, not only can the rig
components be fabricated easily at an established ship-
yard location, but also the rig is erected in the manner
of a mobile jack-up rig. Thus, the final erecting and
ssetting procedure is quicker and therefore less hazardous in the open sea, and less complicated and therefore more economical. Moreover, the entire rig is floated to the site in partially erected condition as will be seen and, as previously noted, the rig is floated to the site with all drilling and production machinery, equipment, and supplies on board.

The in-line arrangement of the large-diameter tubu-
lar upper and lower legs permits drilling and oil-well
production activity to be carried on conveniently within the hollow cylindrical legs, thus to protect drill stems, gas and oil lift lines and the like from wave forces, and to provide containment for any oil leakage in the event of breakage.

In the preferred embodiment a square-shaped float-
able working or upper platform, which is ultimately hoisted on four upper legs some 60 to 70 feet above the water surface, is equipped with corner tanks and adjacent deep tanks which can be ballasted with salt water for pre-loading of the rig after it is erected.

The lower or intermediate support platform structure
is formed by initially buoyant box-like corners, tied
together by open trusswork of hollow rectangular
chords and cylindrical bracing, and is therefore float-
able to facilitate assembly of the rig. A cylindrical
sleeve passes vertically through each of these box-like corners to receive one of the large diameter lower legs.

The bottom platform structure or mat included in the
preferred embodiment is formed by four, large-dia-
meter cylindrical footings or pads respectively secured to
and surrounding the lower ends of the four lower legs
and joined together using open truss work construction.
In the preferred form of the invention each of these pads has a grid mat construction formed by radially extend-
ing, vertical plates which punch into the bottom sedi-
ment at the site, this grid footing arrangement itself
being the design of Vattanbyngnadsbyran (VBB), Con-
sulting Engineers of Stockholm, Sweden. By temporary
closing-in of these vertical plates, the mat can be made buoyant for rig-assembly purposes. Alternatively, the
cylindrical pads may be of more conventional, initially
buoyant cylindrical construction, or an entirely en-
3,927,535

3 closed and initially buoyant square-shaped pad structure might be provided, such also serving as a storage place for several days' oil production.

Prior production platforms require extensive fabrication sites which, because of the immense size of the structure, are more often located in remote places adjacent to deep water and which have rural populations.

Such sites are vulnerable to transportation system failures and, generally speaking, most of the required skilled construction personnel are not available locally. An advantage of the platform described herein is that its fabrication phase, which consumes a large portion of the total manhours required to finally erect the structure, can be distributed among a number of competent and established fabricators, so that it is only in the assembly and installation phases that a work crew might have to be sent to a relatively remote site.

The several components of the rig are easily fabricated and are each capable of being floated, or lifted on to a barge for hauling to the assembly site. For example, the large cylindrical legs might be temporarily sealed and floated to the site, or may be sectionalized so that barges may carry the sections to the point of assembly. After assembly and loading with equipment and supplies, the entire rig is towed to the offshore oilfield site and installed by controlled sinking and setting of its lower and bottom platform structures, and jacking up of its working platform, as will be described.

Several methods of initial assembling of the components are permitted by their construction and arrangement, these assembly methods making use of the buoyancy chambers of the prefabricated rig components, or of auxiliary buoyancy tanks and auxiliary jacking legs by which the rig is assembled in water about 150 feet deep, as will be described. This last phase of the assembly, prior to towing the rig to the oilfield site, is conducted in such sheltered, deep water locations as are found in the fjords of Norway and in Scotland. Upon completion of this phase of assembly the rig is partially erected with its lower legs and bottom mat extending below the still floating upper and lower platforms, and its upper legs extending upwardly above the working platform. When the rig arrives over the oilfield site, the mat, lower platform structure and leg assembly is jacked down until the mat rests on the sea bottom and the rig is initially leveled. Sand and gravel are then pumped down into the cells of the mat or footing, and the working platform is jacked upwardly on the upper legs and welded to them at the desired elevation. Further leveling and stabilizing by pressing of the footings to refusal is accomplished by preloading the corner and deep tanks of the hoisted upper platform using salt water ballast.

These and other objects, features and advantages of the invention will become more fully apparent from the following detailed description of the invention, in which reference is made to the accompanying drawings. In the drawings:

FIG. 1 is a side elevation of an offshore oil production platform apparatus in accordance with the invention as it would appear when installed ready for oil well drilling and production at an offshore oilfield site;

FIG. 2 is a top plan view of the platform apparatus of FIG. 1;

FIG. 3 is a plan view of the lower or intermediate support platform structure of the platform apparatus as seen from lines 3-3 in FIG. 1;

FIG. 4 is a plan view of the mat or bottom support platform structure of the platform apparatus as seen from lines 4-4 in FIG. 1;

FIG. 5 is an enlarged sectional side elevational showing of the connections between the upper and lower legs, and between the lower legs and lower support platform structure of the platform apparatus of FIG. 1;

FIG. 6 is a fragmentary side elevational view, similarly enlarged and partly in section, of a modified form of platform apparatus in accordance with the invention;

FIG. 7 is a side elevational showing of the platform apparatus of FIG. 1 in assembled and partly erected condition as it appears when being towed to the offshore oilfield site;

FIG. 8 is a side elevational showing of a method by which the platform apparatus of FIG. 1 is assembled prior to towing to the oilfield site; and

FIG. 9 is a fragmentary side elevation, partly in section, illustrating another modified form of platform apparatus in accordance with the invention.

Referring first to FIGS. 1 and 2, a two-stage jack-up type offshore oil production platform apparatus in accordance with a preferred embodiment of the invention is generally indicated by reference numeral 10. The apparatus is shown in its fully erected condition over an offshore oilfield drill site at a depth of about 500 feet in open sea. In general arrangement, the apparatus 10 includes an initially floatable working or upper platform 11 which is hoisted and positioned some 60 to 70 feet above sea level S on four laterally spaced apart, hollow cylindrical upper support legs 12, a horizontal lower support platform structure generally indicated by reference numeral 14, and four laterally spaced apart lower support legs 15 which are respectively aligned beneath each of the upper support legs 12. The lower support legs have larger diameter than the upper support legs 12 and therefore a conical transition portion 12a at the lower end of each upper support leg 12 connects each upper leg to the lower leg 15 therebelow. In addition, the apparatus 10 includes a lowermost or bottom platform structure generally indicated by reference numeral 16 and to which the lower ends of the lower legs 15 are rigidly attached. Although the apparatus 10 is shown as having four upper and lower support legs 12, 15 and only one lower support platform structure 14, it will be understood that the apparatus might have been provided with only three, or more than four aligned upper and lower support legs, and might include more than one lower support structure 14.

As illustrated in FIG. 5, each joined upper and lower support leg 12, 15 of the preferred embodiment is rigidly attached, as by several annularly disposed rows of shear connectors 41, to the lower support platform structure 14. The shear connectors 41 are welded in place across the interface between the upper end 15a of each lower support leg 15 and the vertical cylindrical sleeve 17, formed in the enclosed box-like structure 18 at one of the corners of the lower platform structure 14, through which the lower leg extends.

In the preferred embodiment shown in FIGS. 1-4, the upper platform 11 is square-shaped, measuring some 200 × 200 × 35 feet high. Its upper and lower support legs 12, 15, are laterally spaced about 150 feet from each other; the upper legs 12 including their 30-foot long conical sections 12a are each 355 feet long; and the lower legs 15 are each 275 feet long, including
about 20 feet at the lower end thereof which is buried in the silt of the sea bottom B. Each cylindrical upper leg 12 is 18 feet in diameter, and each lower support leg 15 has a diameter of 26 feet. The box-like corner structures 18 of the lower platform structure 14 each measure 50 × 50 feet, and are each 50 feet high. They are joined together as illustrated in FIG. 3 by open trusswork formed by hollow rectangular chords 19 and tubular bracing 20 to form a 200 × 200 foot floatable structure. However, and because of its open-truss construction 19, 20, the lower support platform structure 14 is substantially “wave-transparent” when submerged.

Referring now to the construction of the lowermost or bottom platform 16, as illustrated in FIGS. 1 and 4, it is formed by four vertically disposed cylindrical footings or pads 22 through which the lower end portions 15b of the lower support legs 15 respectively extend. Each pad 22 is rigidly attached to its associated lower support leg 15 as by forming the lower end portion 15b of the leg integrally with the pad 22 as a vertical sleeve passing through the latter. Each of the pads 22 measures 75 feet in diameter and is 65 feet high and, as in the case of the support platform 14, are connected together by hollow rectangular chords 24 and tubular bracing 25 to form a “mat”, which is a substantially wave-transparent structure. In the illustrated preferred embodiment each pad 22 is formed by a plurality of vertically disposed plates 26 which extend radially between the lower leg portion 15b and an outer cylinder 27, to which they are attached. As shown in FIG. 1, the pads 22 “bite” into the sea bottom B a distance of about 10 feet when the apparatus 10 is erected. In addition, sand and gravel (not shown) are poured into and fill the spaces between the vertical plates 26, thereby to “weight” the structure and anchor it by gravity and frictional forces. Without the use of conventional piling as would “pin” the structure to the sea bottom. Preferably, as illustrated in FIG. 1, the open lower ends of the legs 15 project downwardly a distance of about 10 feet below the undersides of the pads 22, thus to also “bite” into the sea bottom B a distance of about 20 feet when the rig is erected as shown. During assembly of the apparatus 10 as will subsequently be described, the bottom platform structure 16 may be rendered floatable by temporarily sealing the bottoms of the pads 22 by temporary plating or the like (not shown).

Thus, in the overall arrangement as erected, it may be said that the lower legs 15 are attached to, and project upwardly from the lowermost platform structure 16, and that the upper legs 12 are substantially attached to, and project upwardly from the intermediate or lower platform structure 14.

As generally indicated in FIG. 2, each of three of the four hollow cylindrical support legs 12, 15 of the apparatus as erected contains as many as seven separate strings of oil well casing, each extending downwardly from the upper platform 11 to and into the sea bottom B, for a total of 15 production wells and six water-injection wells. Of course, the produced oil may be stored within these legs around such casing. As presently proposed, the fourth leg houses a 20-inch diameter production line, a 12-inch diameter water-injection line, an 8-inch diameter gas lift line, a 12-inch diameter oil storage line, and electrical and telephone cables.

Further with reference to FIGS. 1 and 2, a 50-person, 2-story house and helipad unit 30 is located on the weather deck 11a at one of the corners of the upper platform 11, and an oil well drilling derrick 31 can be skidded between the remaining corner positions of the structure to conduct drilling operations downwardly through each of the support legs 12, 15. The central area of the platform, generally indicated by reference numeral 32 provides space for mud pumps, bins, sack storage and the like accessible to both of the swivel-type outboard cranes 33 and 34 at opposite sides of the platform. A 150-foot long pipe truss catilever flare boom 35 projects outwardly from a third side of the platform 11, as shown. A retractable float 36 and stairway 37 facilitate boarding of the structure from the sea. As indicated by dotted lines in FIG. 1, in addition to its weather deck 11a the upper platform structure 11 has a lower or second deck 11b and a hold or bottom 11c for housing switchgear, transformers, workshops, blowers, laboratory, water and diesel oil tanks, compressors, pumps and the like. As previously noted, all of this machinery and equipment and supplies can be installed and placed on board before the apparatus 10 is towed to the site, as will be described. Corner and deep tanks, generally indicated by numeral 38 are provided for ballasting with salt water to pre-load the structure as it is set in place.

As will be further described, the upper platform 11 is jacked upwardly on the upper legs 12 from its floating condition to the elevated position shown in FIG. 1 by respective hydraulic jacks at each leg which are removed after the platform has been rigidly attached, as by welding in a ring girder construction at each of the legs when the platform is at that elevation. As illustrated in FIG. 7, this ring or box girder construction 39, two of which may be installed in each leg, fills the annular space between each 18-foot diameter upper leg 12 and each corresponding 26-foot diameter cylindrical sleeve 40 of the platform 11 through which the leg 12 extends.

FIG. 7 shows the floating apparatus 10 as it appears after it has been completely assembled and partly erected, and while being hauled to the oilfield with its lower support legs 15 fully extended downwardly from the still buoyant lower platform structure 14, to which they are now rigidly attached. The towline is indicated by reference letter T, and extends to two 7,000 H.P. tugs (not shown). The bottom platform structure 16 is rigidly attached to the legs 15 as previously described and, as desired, may or may not be partially buoyant during towing. The floating upper platform is temporarily attached to the legs 12 to add buoyancy to the entire structure. Thus, the rig is upright before it is towed to the oilfield site, so that all machinery, equipment, and supplies, including well-casing and the like, remain undisturbed during towing and final erecting and setting of the structure.

The manner of assembling and partly erecting the apparatus 10 prior to loading and towing is illustrated in FIG. 8. As there shown, an appropriate number of auxiliary legs 50, say eight on each of two opposite sides, are used during the assembly of the prefabricated and initially floating upper, lower and bottom platform structures 11, 14 and 16, respectively. These auxiliary legs are conventional 6-foot diameter piping. As necessary for jacking any of these platform structures upwardly or downwardly along the auxiliary legs 50, conventional pneumatic jacks 51 are temporarily mounted on any of the platform structures to thus connect it to the auxiliary legs.
It is intended that the apparatus 10 will be so assembled and partially erected at a naturally sheltered fjord location where the waters are adequately deep for the purpose, yet still. In these locations great depths are encountered close to the shoreline, thus facilitating these operations. In FIG. 8, such sea bottom within a fjord is indicated by reference letter F, and it will be understood that such is at a depth of 150-feet or more and, at a later stage as will be seen, up to 300 feet. A barge mounted crane C may be used during the assembly.

Although many alternative sequences and steps in the assembly operation are available, the auxiliary legs 50 may first be passed downwardly through the temporary jacks 51 mounted on the floating lower platform structure 14, whereupon the structure 14 is jacked up on the legs 50. The bottom platform structure or mat 16 is then floated under the elevated lower platform structure 14, the pads 22 being either temporarily sealed for buoyancy as previously mentioned, or auxiliary buoyancy tanks (not shown) being temporarily attached. The lower platform structure 14 is then jacked downwardly on the auxiliary legs 50 until its sleeves 17 are aligned atop the lower legs portions 15b which are formed integrally with the said, and the combined structures 14 and 16 are floating in stacked condition. The auxiliary legs 50 are then lifted out of the temporary jacks 51 on the structure 14 and moved, perhaps using the crane C, to the separately floating upper platform structure 11 where they are passed downwardly to the sea bottom F through the temporary jacks 51 mounted thereon and the upper platform structure 11 is jacked up on the auxiliary legs 50, sufficiently high to permit the combined lower and bottom platform structures 14 and 16 to be floated thereunder. Additional lengths of the lower support legs 15b are welded in place through and above the aligned corner sleeves 17 and 40 of the lower and upper platform structures 14 and 11, respectively. The lengths of the lower legs 15 may be added using the crane C as illustrated. As the lengths of the lower legs 15 are completed, the lowermost platform structure 16 is commensurately jacked downwardly below the now floating intermediate or lower platform structure 14 and upper platform structure 11. Although not illustrated, it was understood that the structure 14 is then rigidly attached to the upper ends of the legs 15, and that the conical portions 12a and upper legs 12 are set and welded in place, the upper platform 11 then being in slidable relation to the upper legs 12. As desired, the lower structures 14 and 16 are lowered, and the upper platform 11 is temporarily attached to the upper legs 12. The legs 50 and supports 51 are removed, and apparatus 10 is now assembled and in partly erected condition as illustrated in FIG. 7, ready for outfitting, loading, and towing to the site.

Among available assembly alternatives is the possibility that the structures 16, 14 and 11 may be build and launched in stacked relation, and then towed to the assembly site where the lower and upper legs are installed. In any event, the finally assembled and partly erected apparatus is upright, as shown in FIG. 7, at the time when it is towed to the oilfield site.

When the floating apparatus 10 arrives over the wellsite, temporary jacks 55 are installed surrounding each leg 12 at the weather deck 11c of the upper platform (FIG. 7), the upper platform 11 is detached from its temporary connection to the legs 12, and the legs 12 and thus the lower legs 15 and platform structures 14 and 16, are jacked downwardly until the bottoms of the legs 15 and the pads 22 are pressed to refusal, at a predetermined pressure, into the sea bottom B. The platform 11 is then jacked upwardly on the legs 12 using the jacks 55, and welded on the legs 12 at the elevation shown in FIG. 1. The corner and deep tanks 38 of the platform 11 are then ballasted with sea water, selectively or contemporaneously, until the apparatus is adequately set and leveled.

Referring now to FIG. 6, an alternative construction is indicated in an offshore oil production platform 60 in accordance with the invention. In addition to an upper or working platform (not shown), this apparatus includes a lower support platform structure 14 and lower support legs 15 as in the previously described preferred embodiment. Also as in the previous embodiment, the upper end of each lower leg 15 extends through to the top of its associated cylindrical sleeve 17 in the structure 14. However, the lower end of each upper support leg 12 telescopes into the open top end of its associated lower support leg 15, the length of telescoping overlap in the finally erected condition of the rig being equal to the height or depth of the box-like corners 18 of the lower platform structure 14 as illustrated in FIG. 6. The upper and lower support legs are ultimately rigidly attached together and to the platform structure 14 by structural ring girders 61 and shear connectors 62 welded in place, as shown. Depending upon the manner of assembling the apparatus, this telescoping relation of the upper legs to the lower legs may be advantageous.

The apparatus 60 illustrated in FIG. 6 has as a bottom platform structure an enclosed tank-like platform 65 which is 50 feet high and 250 feet square, and to which all four lower support legs 15 of the apparatus 60 are rigidly attached. As illustrated, the bottom platform 65 may sink several feet into the sea bottom B when the apparatus is set on the well-site. This type of mat will hold 440,000 barrels of oil, and would weigh about 6,000 tons, so that the erected apparatus would be very stable without the need for pinning.

FIG. 9 illustrates a further modified form of apparatus, generally indicated by reference numeral 70, in which each lower leg 15 thereof has a downwardly and outwardly flaring bottom pad 71. In addition, the pad 71 is formed on a telescoping lower end portion 15c of each lower support leg 15. Using temporarily installed hydraulic or pneumatic jacks 72 mounted in the interior of each leg 15, the telescoping lower end portion 15c of any leg 15 may be jacked downwardly as much as ten feet as necessary, and independently of any other leg 15, to level the apparatus 70 as it is finally set in place at the well-site. The telescoping section 15c is then rigidly attached to, or otherwise permanently set with respect to the remainder of the leg 15 as by pouring concrete into the leg between the annular jack locations. Alternatively, each lower leg 15 need not be adjustable as illustrated but, rather, the pad 71 may be formed integrally at the lower end of the continuously extending lower support leg 15. The remainder of the apparatus 70 has features as previously described, including a lower support platform 14, and a telescoping arrangement of its upper support legs 12 within its lower support legs 15 as described in connection with FIG. 6.

Of course, and as indicated by FIGS. 1 and 4, the pads attached to the lower ends of the lower support legs 15 might also take the form of very large, enclosed
cylindrical containers, as might also serve to store oil or water or the like.

Thus has been described a jack-up type offshore oil production platform apparatus, in several embodiments, and a method of assembling, outfitting, loading, towing and erecting the same, which achieves all of the objects of the invention.

What is claimed is:

1. Jack-up type offshore platform apparatus comprising a floatable upper platform structure, at least one horizontal lower support platform structure below and substantially aligned with said upper platform structure for disposition in vertically spaced tandem relation thereto when said apparatus is in erected condition, means defining corresponding pluralities of laterally spaced apart vertical support leg openings through each of said upper and lower support platform structures, the respective of said vertical openings through any one platform structure being vertically aligned with the respective of said openings through the other of said platform structures, a corresponding plurality of elongated lower support legs respectively extending through said vertical openings through the lowermost of said lower support platform structures and projecting downwardly therefrom, said lower support legs being rigidly attached at their upper ends to, and secured in vertically non-slidable and fixed relation to said lowermost lower support platform structure, whereby said lowermost lower support platform structure provides lateral structural support for said support legs, and a corresponding plurality of elongated upper support legs respectively aligned with, and attached substantially to said upper ends of said lower support legs, said upper support legs respectively extending upwardly through said aligned vertical openings of any of said platform structures thereabove, and at least said upper platform structure being vertically slidable with respect to said upper support legs at least prior to the erection of said platform apparatus.

2. Jack-up type offshore platform apparatus according to claim 1 wherein at least said lower support legs have substantially hollow cylindrical construction.

3. Jack-up type offshore platform apparatus according to claim 2 wherein all of said upper and lower support legs have substantially hollow cylindrical construction.

4. Jack-up type offshore platform apparatus according to claim 3 wherein each of said lower support legs has diameter which is larger than that of said upper support leg therewith and with which it is aligned, and each of said upper support legs has a downwardly and outwardly flaring conical transition section on its lower end which is attached to the upper end of said lower support leg with which it is aligned.

5. Jack-up type offshore platform apparatus according to claim 3 wherein each of said lower support legs has diameter which is larger than that of said upper support leg therewith and with which it is aligned, and each of said upper support legs has a lower end portion extending into, and rigidly attached in telescopic relation within the upper end of that lower support leg therewithin with which it is aligned.

6. Jack-up type offshore platform apparatus according to claim 2 wherein the lower end of each of said lower support legs carries a pad having diameter larger than that of the lower support leg itself.

7. Jack-up type offshore platform apparatus according to claim 6 wherein the lower end of each of said lower support legs carries a telescoping cylindrical section and means providing for limited telescoping movement of said section with respect to the lower end of the support leg, said pad being carried by said cylindrical section at its lower end.

8. Jack-up type offshore platform apparatus according to claim 1 wherein said platform apparatus comprises a bottom platform structure attached to and between all of said lower support legs adjacent to the respective lower ends thereof, said bottom support structure being rigidly secured in vertically non-slidable relation to said respective lower ends.

9. Jack-up type offshore platform apparatus according to claim 8 wherein said bottom platform structure comprises an enclosed tank structure.

10. Jack-up type offshore platform apparatus according to claim 8 wherein said bottom platform structure has substantially wave-transparent construction.

11. Jack-up type offshore platform apparatus according to claim 10 wherein said bottom platform structure comprises a cylindrical pad attached to and surrounding substantially the lower end of each of said lower support legs, and open latticework construction attached to, and extending between said cylindrical pads.

12. Jack-up type offshore platform apparatus according to claim 11 wherein the lower end of each of said lower support legs projects through, and extends below its said associated cylindrical pad, each of said lower support legs being open at its said lower end.

13. Jack-up type offshore platform apparatus according to claim 2 wherein each of said upper and lower support legs is at least 200 feet long.

14. Jack-up type offshore platform apparatus according to claim 13 wherein each of said upper support legs is at least 250 feet long.

15. Jack-up type offshore platform apparatus according to claim 1, wherein said means defining said vertical support leg openings comprise respective substantially cylindrical sleeve means forming said openings through each of said upper and lower support platform structures and secured to the respective structures, all of said upper and lower support legs having correspondingly cylindrical construction of smaller diameter than the respective of said cylindrical sleeve means which form said openings through which said legs extend, said upper ends of said lower support legs being respectively rigidly attached and secured in vertically non-slidable and fixed relation to their associated cylindrical sleeve means of said lowermost platform structure.

16. Jack-up type offshore platform apparatus according to claim 15, wherein each of said lower support legs has a diameter which is larger than that of said upper support leg therewith and with which it is aligned, and said cylindrical sleeve means attached within said upper and lower support platform structures and which are in vertical alignment with each other initially have substantially the same diameter, and which further comprises ring girders means within and rigidly secured to each of said vertically aligned cylindrical sleeve means and adapting its said associated sleeve means for attachment thereto of said upper support leg which extends therethrough.

17. Jack-up type offshore platform apparatus according to claim 12 wherein each of said cylindrical pads comprises a cylindrical sleeve having diameter substantially greater than that of said lower support leg with which it is associated, said cylindrical sleeve concentrically surrounding its said associated lower support leg
adjacent to its lower end, and a plurality of annularly spaced apart vertical plates attached to and extending radially between the interior of said cylindrical sleeve and the exterior of its said associated lower support leg.

18. Jack-up type offshore platform apparatus according to claim 1, wherein each of said lower support platform structures has substantially wave-transparent construction.

19. The method of assembling and erecting an offshore oil production platform apparatus having a floatable upper platform structure, at least one lower support platform structure for disposition in vertically spaced tandem relation below said upper platform structure when said apparatus is in erected condition, respective corresponding and aligned pluralities of upper support legs extending between the respective of said platform structures and upwardly from the uppermost of said lower support platform structures, and a corresponding plurality of lower support legs respectively aligned with said upper support legs and attached to and extending downwardly from the lowermost of said lower support platform structures, comprising the steps of prefabricating and floating each of said upper and lower support platform structures, prefabricating all of said support legs at least in sectional leg components, assembling and attaching together in said relations at least said lowermost support platform structure and its said attached upper and lower support legs with said lowermost support platform and said attached lower support legs being below said floating upper support platform structure and the uppermost of said upper support legs projecting upwardly above sea level and having said floating upper platform structure mounted for vertical movement thereon, then towing said apparatus to an offshore site, lowering all of said platform apparatus with respect to its said floating upper platform structure until its said lower support legs engage the sea bottom, then jacking said upper platform structure upwardly on said upper support legs to a predetermined elevation above sea level, and rigidly attaching said upper platform structure to said upper support legs at said elevation.

20. The method according to claim 19 wherein, before said towing step, said apparatus is outfitted and loaded with required machinery, equipment, supplies and the like for operation of said platform and for oil recovery.

21. The method according to claim 19 wherein said apparatus when in erected condition further has a bottom mat structure attached to and extending between substantially the lower ends of said lower support legs, said prefabricating and floating steps comprising fabrication and floating said bottom mat structure and attaching the lowermost sectional leg component of each of said lower support legs thereto to project upwardly therefrom, and said assembling and attaching steps comprise attaching a plurality of peripherally spaced apart temporary jacks to said floating lowermost support platform structure, lowering a corresponding plurality of temporary support legs through the respective of said jacks and into supporting engagement with the sea bottom, jacking said lowermost support platform structure upwardly on said temporary support legs to an elevation at its underside above sea level which is higher than the tops of said lower support legs components attached to said floating bottom mat structure, floating said bottom mat structure under said elevated lowermost support platform structure, jacking said lowermost support platform structure downwardly on said temporary support legs and into engagement with said bottom mat structure, said lowermost support platform and bottom mat structure then being combined in floating condition and said lowermost support platform structure having attached vertical cylindrical sleeves extending therethrough to respectively receive and surround said tops of said lower support leg components attached to said bottom mat structure, removing said temporary support legs and said temporary jacks from said lowermost support platform structure, attaching a plurality of peripherally spaced apart temporary jacks to said floating upper platform structure, lowering a corresponding plurality of temporary support legs through the respective of said jacks and into supporting engagement with the sea bottom, jacking said upper platform structure upwardly on said temporary support legs to an elevation at its underside above sea level which is higher than said combined and floating lowermost support platform and bottom mat structures, floating said combined lowermost support platform and bottom mat structures under said elevated upper platform structure, jacking said upper platform structure downwardly on said temporary support legs and into engagement with said lowermost support platform structure, said upper and lowermost support platform structures and said bottom mat structure then being combined in floating condition and said upper platform structure having attached vertical cylindrical sleeves extending therethrough and respectively in vertical alignment with said cylindrical sleeves of said lowermost support platform structure, all of said cylindrical sleeves having substantially equal diameters, lowering additional lower support leg sectional components through said lowermost support platform sleeves and attaching them to said lower support leg components therebelow, jacking said bottom mat structure downwardly below said lowermost support platform structure as additional of said lower support leg sectional components are attached together respectively to form the full lengths of said lower support legs, attaching said lowermost support platform structure to the upper ends of said lower support legs, lowering one of said upper support leg sectional components through each of said cylindrical sleeves on said upper platform structure and attaching it to said upper end of said lower support leg therebelow, attaching additional of said upper support leg sectional components together respectively to form at least substantial lengths of said upper support legs projecting upwardly above said upper support platform structure, and removing said temporary support legs and said temporary jacks from said upper support platform structure.

22. Jack-up type offshore platform apparatus comprising a floatable upper platform structure, at least one horizontal lower support platform structure below and substantially aligned with said upper platform structure for disposition in vertically spaced tandem relation thereto when said apparatus is in erected condition, means defining corresponding pluralities of laterally spaced apart vertical support leg openings through each of said upper and lower support platform structures, the respective of said vertical openings through any one platform structure being vertically aligned with the respective of said openings through the other of said platform structures, a corresponding plurality of elongated lower support legs respectively extending through, and attached at their upper ends
within said vertical openings through the lowermost of said lower support platform structures and projecting downwardly therefrom, and a corresponding plurality of elongated upper support legs respectively aligned with, and attached substantially to said upper ends of said lower support legs, said upper support legs respectively extending upwardly through said aligned vertical openings of said platform structures thereabove, each of said lower support platform structures being formed by a plurality of substantially box-like, floatable structures interconnected by open-latticework construction, one of said vertical openings of the lower support platform structures being formed through each of said box-like structures.