

DESCRIPTION**"Drillship"**Field of application

[0001] The present invention relates to a drillship, in particular for localising, exploring and exploiting deposits of hydrocarbons or other energy and mineral resources.

[0002] For such reasons the drillship according to the present invention is intended, in particular, for operating in deep (over 450m) and ultra-deep (over 1,500m) waters.

State of the art

[0003] Drillships are a class of offshore units specialised in drilling underwater oil wells at over 3000m deep in the sea bed. These units typically operate to locate and prepare oil wells for future use by other offshore units specialised in the production of natural gas and crude oil.

[0004] The drillships comprise an operating area for the drilling rigs, generally positioned at midship.

[0005] As known, in current drillships, the drilling rigs comprise at least one drilling tower constituted by a structural lattice (known in the jargon as a derrick) characterised by a structure of crossed rods, bolted to each other. Almost all the drill equipment, including the

hook for lifting the drill strings, is enclosed within the lattice structure.

[0006] From a structural point of view, the the lattice structure A rests on the so-called drill floor B. In turn, the drill floor B is supported by a scaffold C, in jargon "substructure" which in turn rests on the main deck of the ship D. The entire structure described above extends above a central drilling well E (in the jargon "moon pool") which extends from the main deck as far as the bottom and through which there is direct access to the water.

[0007] This solution has been widely experimented in over twenty years of use on various offshore floating vessels.

[0008] One limitation of this constructive solution is linked to the fact that the lattice derrick limits the extension of the drill floor surface to within its base perimeter since the main suspension and drilling machinery is contained inside the lattice-like casing. As a result, a possible increase in the operational areas of the deck effectively conflicts with the physical and structural limits of the derrick.

[0009] For the reason stated above it is impossible to create new operating spaces on the drill floor while remaining constrained by the traditional derrick.

Presentation of the invention

[0010] Consequently, the purpose of the present invention is to eliminate or at least attenuate the drawbacks of the prior art mentioned above, by making available a drill ship which has a more extended drill floor without requiring an increase in the floor dimensions of the drilling towers.

[0011] A further purpose of the present invention is to make available a drillship, which has a more extended drill floor and which at the same time ensure full operation of the drilling rigs.

Brief description of the drawings

[0012] The technical characteristics of the invention, according to the aforesaid purposes, can be seen clearly from the contents of the following claims and the advantages of the same will be more clearly comprehensible from the detailed description below, made with reference to the attached drawings, showing one or more embodiments by way of non-limiting examples, wherein:

[0013] - Figure 1 shows a schematic isometric view of a lattice tower of the traditional type and of the relative support structure of the drill floor on the main deck;

[0014] - Figure 2 shows a perspective view of a drillship according to a preferred embodiment of the present invention;

[0015] - Figures 3 and 4 show two isometric side views respectively of the right side and the left side of the ship illustrated in Figure 2;

[0016] - Figure 5 is a plan view of the drill floor of the ship shown in Figure 2;

[0017] - Figure 6 shows a plan view of the main deck of the ship shown in Figure 2, positioned under the drill floor; and

[0018] - Figure 7 is a view of the hull of the ship shown in Figure 2.

Detailed description

[0019] With reference to the appended drawings reference numeral 1 globally denotes a drillship according to the invention.

[0020] Here and henceforth in the description and the claims, reference will be made in addition to the ship 1 in conditions of use. References to an upper or lower position or horizontal or vertical direction should therefore be understood in this sense.

[0021] According to a general embodiment of the invention, the drillship 1 comprises a hull 2 which extends along a longitudinal axis X between a bow 3 and a stern 4.

[0022] The ship 1 comprises a main deck 5, above which a drill floor 6 is positioned, and one or more drilling towers 7', 7'', each of which extends above the drill

floor 6 in proximity of least one moonpool 8', 8" which vertically crosses the hull 2 at the drill floor 6 to the bottom 9 of the hull itself.

[0023] The "drill floor" is understood to mean the space on the ship where the drill rigs are arranged and where the technicians operating the aforesaid rigs are called to operate directly. In particular this is the space where the drill strings are sunk and operated in the moonpool.

[0024] According to the invention each of said one or more drilling towers 7, 7' has a box-like structure and supports the lifting devices 70 externally to itself.

[0025] In particular, each of the aforesaid one or more towers 7', 7" has a column shape and base of any shape (generally circular). The lifting devices comprise in particular a lifting hook 70 of the drill strings arranged externally to the tower and cantilevered with respect to the vertical extension axis Y of said tower.

[0026] This type of drilling tower supports a compression load only, the external, overhanging load suspended from the lifting hook and the pull coming from the lifting winch cables 71 on the opposite side to the drilling tower being perfectly aligned, vertical and symmetrical. As shown for example in Figures 2, 3 and 4, the lifting cables of the hook go to a pair of pulleys 72 and 73 positioned on the top of the tower 7', 7" and directly

running to the winch 71 symmetrically to the lifting hook 70. Such geometry guarantees a perfect vertical and symmetrical alignment of the lifting cables and thus a static load on the drilling tower solely of compression.

[0027] According to the invention, as shown in particular in figure 2, the drill floor 6 extends completely outside the floor dimensions of the aforesaid one or more drilling towers 7', 7" so as to exploit the available space on the ship.

[0028] Thanks to the invention, the ship 1 can thus have a more extended drill floor without requiring an increase in the floor dimensions of the drilling towers. The limit in the extension of the drill floor is essentially dictated only by the size of the hull of the ship.

[0029] This is made possible by the use of drilling towers with the box structure and with external lifting devices instead of lattice structure towers with internal lifting devices.

[0030] The box-structure tower is a constructive solution that provides a number of advantages compared to the traditional lattice solution.

[0031] In particular, a significant advantage derives from the previously mentioned external positioning of the line of suspension of the drill strings. In fact, given that the suspension line is generally cantilevered from the

tower, it is basically exposed and free of obstructions on a large part of the horizon. This makes the entire area of the deck surrounding the tower available, the suspension line allowing the easy distribution of heavy and bulky equipment through the lifting means on board. This operation would not be possible if the closed cage structure of the traditional lattice drilling tower were present. In the conventional lattice solution the drill floor is divided into two distinct operating zones. A first operating zone is confined inside (covered) the perimeter of the base of the derrick and is thus blocked by the structure above. In this first zone the handling of any equipment by means of external lifting means such as the crane on board is prevented. A second operating zone is external (uncovered) to the perimeter of the derrick. In this second operating zone the equipment supporting the various operations can be moved, including with the support of the lifting means on board. Diversely, by using towers with a box structure, the entire surface extension of the drill floor is uncovered and available for lifting and manoeuvring operations, including but not only with the aid of the lifting means on board. This increases the safety and operativity of the entire zone.

[0032] Another advantage is linked to the lowering of the

level of the drill floor of some of the activities which in the traditional lattice configuration take place higher up with a consequent increase in operational and safety difficulties. In particular large size winches are arranged at the drill floor level. This brings important advantages in terms of efficiency and safety of operations on board.

[0033] Preferably, the ship 1 comprises at least two drilling towers 7', 7" with a box-like structure and external lifting devices.

[0034] Advantageously, each of said at least two towers 7', 7" is dedicated to a single drilling line. In other words, such towers 7', 7" operate independently of each other. As a result, in the case in which the vessel 1 is equipped with a double drilling line for double drilling activities to perform in parallel, using independent towers 7', 7" with a single drilling line, the physical constraint imposed by the traditional derrick towers of having the two drilling lines adjacent (inasmuch as supported by the same tower) is eliminated. The total structural and functional independence of the two or more towers 7' and 7" makes it possible to locate them in the most convenient reciprocal position, reducing the risk of mutual interference and thus improving the movement of objects and people on the drill floor. A configuration

with an extended drill floor is thus obtained which gives all the benefits related to an extended and unobstructed workspace.

[0035] Even in the case not illustrated in the attached drawings in which the ship 1 is equipped with a single drilling tower, such single tower may be structured to serve a single drilling line.

[0036] According to the preferred embodiment illustrated in the appended drawings, the ship 1 comprises the aforesaid drilling towers 7', 7" with a box-like structure and external lifting devices. The drill floor 6 extends continuously between said two drilling towers 7', 7" forming a single extended drill floor.

[0037] Advantageously, the two towers 7' and 7" may be arranged at the greatest distance possible from each other, compatibly with the available dimensions of the ship platform.

[0038] This way it is possible to maximise the surface of the drill floor 6.

[0039] As shown in Figure 2, the ship 1 comprises an operating zone 20 dedicated to the drilling activities. Advantageously, the two drilling towers 7', 7" are placed in distal positions within said operating drilling area 20 in a direction parallel to the longitudinal axis X of the ship so as to maximise the available surface area of

said extended single drill floor 6.

[0040] The expression "arranged in distal positions" is used to mean that the two towers 7' and 7" are spaced as far apart as possible within the operating drilling zone, in opposite positions in a direction parallel to the longitudinal axis X of the ship.

[0041] Preferably, as shown in Figures 2, 5 and 6, the aforesaid operating area 20 dedicated to drilling activities is positioned at midship between a first operating zone 10 of ship management, preferably located at the bow, and a third operating zone 30 of power generation for the propulsion of the ship, preferably located at the stern.

[0042] The distribution of the three operating zones as provided for in the embodiment illustrated in the appended drawings is typical of the existing vessels for drilling and provides in particular for:

[0043] - a housing tower 10 at the bow end;

[0044] - a main exposed deck 5, extending from the housing tower to the stern end;

[0045] - a lower deck (under the main deck) containing most of the operational support areas of the ship platform and of the drilling machinery and which at the stern end houses the engine room and power generation machinery;

[0046] - a high drill floor 6 on which manoeuvres are

performed with the drill strings and the hooks for lifting the strings and rotating them.

[0047] The invention may however also be applied to ships with different configurations of the operating zones.

[0048] Preferably, the aforesaid single extended drill floor 6 extends substantially throughout the longitudinal extension of the second operating zone 20 from the first operating zone 10 as far as the third operating zone 30.

[0049] According to the embodiment illustrated in the appended drawings, the ship 1 comprises in the second operating zone 20 a hold for the riser 23 and a cementer 24, one arranged one at the stern and the other at the bow of the two drilling towers 7', 7". The maximum longitudinal distance between the two drilling towers 7', 7" is limited by the distance between the hold 23 and the cementer 24.

[0050] Preferably, the drill floor 6 extends with a main portion 6' into the area where the drilling towers 7', 7" are positioned, and extends at the bow with a first appendix portion 6" above the aforementioned hold 23 and at the stern with a second appendix portion 6"' above the cementer 24.

[0051] Preferably, as shown in the appended drawings, the aforesaid single extended drill floor 6 extends from bow to stern integrating in its extended area both the area

of the cementer 24 at the stern and the hold 23 for the storage of the risers at the bow, extending above them same. Such extended single floor 6 rests at the bow on the housing tower 10.

[0052] Advantageously, the use of a single extended drill floor 6 makes it easier to implement a solution with two or more separate and independent moon pools in the ship. The extended drill floor 6 in fact offers greater operational flexibility for drilling activities. This makes it possible to increase the distance between the drilling towers and thus technically possible to devote an independent moon pool to each drilling tower.

[0053] Preferably, the ship comprises two or more moon pools 8', 8", separate and independent of each other, each dedicated to a single drilling tower 7', 7". This technical solution is constructively feasible in particular in the case in which the drilling towers are independent of each other and can thus be spaced apart without any constraint of an operational type related to the drilling activities.

[0054] The presence of several smaller moon pools rather than a single moonpool of a large size brings a number of advantages, listed below:

[0055] - an increase in the hydrostatic thrust volume of the submerged part of the hull;

[0056] - an increase in the interior space of the ship to be used as compartments for consumable liquids (greater autonomy) and technical spaces (warehouses, workshops, ancillary, etc.);

[0057] - a probable reduction of wave motion inside the small moonpools;

[0058] - a probable reduction of the resistance to motion due to the reduced open surface on the bottom of the ship;

[0059] - an improvement of structural continuity and therefore reduced localised stresses;

[0060] - a greater free surface area available on the main deck; and

[0061] - a probable simplification of the possible complete and/ or partial closure systems of the moon pools.

[0062] The presence of a single large moon pool, which all the drilling towers work in, may be provided for as an alternative. However, this solution is not preferred because it imposes restrictions on the maximum distance between the towers. To avoid hydrodynamic problems there is in fact a tendency not to make moon-pools over a certain size.

[0063] In particular, the aforesaid two or more independent moon pools 8', 8" are made along the longitudinal axis of the centre line X of the ship.

[0064] Unlike the lattice towers, the towers with a box structure and with external lifting devices cannot be centred on the axis of the moon pool, but must be positioned in a decentralised manner with respect to this axis so as to have the lifting hook of the tower vertical to the moon pool.

[0065] Preferably, as shown in particular in Figures 5, 6 and 7, the aforesaid two or more towers 7', 7'' are arranged asymmetrically with respect to the longitudinal axis of the centreline X, shifted towards a first side 2' of the ship (in particular towards the left side). In particular, the two towers are both shifted towards the same side.

[0066] According to an alternative embodiment not shown in the appended drawings, the aforesaid two or more towers may be positioned symmetrically with respect to the longitudinal axis X of the centreline of the ship, i.e. aligned on said longitudinal centreline axis X.

[0067] The arrangement off-axis or on the axis of the centreline can also be adopted in the case in which the ship has a single drilling tower.

[0068] According to the embodiment illustrated in the appended drawings, inside the drilling operational area 20 the ship 1 comprises a storage and assembly area 40 of the drill strings made in proximity of the aforesaid two

or more drilling towers 7', 7". In particular, such storage area 40 is shifted to a second side 2" of the ship in relation to the longitudinal centreline axis X, opposite the side, which the two towers are shifted towards. As shown in particular in Figure 2, on the side facing outwards the storage area 40 is bounded by a vertical wall 60 which extends from the main deck 5 beyond the drill floor 6. This wall serves as a vertical support element for the drill strings.

[0069] The storage and assembly area of the drill strings is called the "set back" in the jargon. This area, integrated or in any case next to the drill floor is used to store the drill strings previously prepared in groups of three strings screwed one to the other to form a single string of normally approximately 41 m long. This makes it possible to reduce the times for lowering and raising the total string, often several kilometres long and to have the right diameter and type of string for the specific drilling operation planned. Operatively, the drill strings thus pre-assembled using the main lifting hooks are vertically stored - one drilling campaign and another - in the set back in special racks called fingerboards which block the strings vertically in two points, one at the bottom and one at the top. In particular, such fingerboards may be made in the

aforesaid wall 30, used as a vertical support element of the drill floor. In this step the strings are always handled in a vertical position to prevent them from bending under their own weight and being damaged, by special machines called smart rackers which claw the prepared string under the main hook and previously screwed by a machine known as a rough neck, shifting it into place in the fingerboard of the set back. From this moment the strings are ready to begin their cycle of introduction and extraction from the oil well, moved by means of the smart racker from the fingerboard to the lifting hook at the centre of the drill floor and vice versa. At the end of the drilling operations, in a reverse operation to the one described above, the strings are unscrewed from each other with the rough neck and singly replaced in the storage stacks using a special dedicated horizontal chute called catwalk. According to the embodiment illustrated in the appended drawings, the drill strings are stored on one side of the ship, laid against the aforesaid vertical wall, to then be inclined towards midship, one by one, until the upper end is at the centre of the moon pool vertically beneath the lifting hook; the string is then raised and inserted in the central hole on the drill floor and lowered into the hole of the oil well below on the sea bed.

[0070] Preferably, said drill floor 6 also extends to such storage area 40. As shown in particular in figure 5, on the drill floor 6 at the storage area 40 one or more openings are made for moving the strings between the towers and the set back.

[0071] The positioning of the set back in the body of the ship make it possible to attach the pre-assembled strings to the lifting hook (Topdrive) of the tower, just above the drill floor and no longer at over 40 metres high, as is the case in traditional lattice towers, which normally also require the presence at such height of a person who visually checks the correct gripping of the string to avoid the risk of falling and damage caused by incorrect manoeuvring.

[0072] Preferably, each drilling tower 7', 7" is directly supported by a support structure 50 structurally integrated with the hull 2 of the ship. Said support structure 50 and/or the tower 7', 7" crosses the drill floor 6. The latter is structurally supported by the support structure 50 and/or by the drilling tower itself.

[0073] In particular, as shown in Figure 4, the support structure 50 of the tower 7', 7" extends vertically inside the hull 2.

[0074] Preferably the support structure is structurally integrated with the main deck 5 resting on it or with a

secondary deck below the main deck resting on it or with the bottom 9 of the hull 2 resting to it.

[0075] Advantageously, as shown in the appended drawings, the drill floor 6 is structurally integral with the ship, resulting in a fixed structure of the ship.

[0076] As explained above, given the considerable weight and structural dimensions dictated by the enormous loads that they are called upon to support and manoeuvre, the drilling towers 7' and 7" are integral with the hull structure of the ship. Consequently, the ship must be equipped with one or more moon pools made in the hull to permit the launching of the instruments needed for diving operations.

[0077] The dimensions and weights of the structures of the towers and of the relative lifting equipment are such that it is not technically possible to assemble them on mobile drill floors suitable to move the towers off board. This solution (outside the present invention) would avoid the complication of perforating the bottom of the ship for the passage of the instruments needed for diving operations, but could only be used for lighter equipment. In this case, contrary to the provisions of the present invention, the drilling towers would be supported by the mobile drill floor and could not be integrated with the ship hull.

[0078] The use of a fixed and not movable drill floor in the sense specified above is advantageous in terms of increasing the free area available on the deck under the drill floor. In the case of a mobile drill floor the area of the deck below needed for the movements of the mobile deck must be kept free, making it unusable for other purposes. Instead, with a fixed drill floor, the area under the drill floor is a free area advantageously utilisable for diving operations.

[0079] Advantageously, the drill floor 6 - as well as by the tower 7', 7" and/or by support structure of the tower - may also be conveniently supported by dedicated pillars or other vertical structures present in the perimeter of its extension. In particular, the drill floor 6 is supported by at least one structural support element 60, which extends vertically from the main deck 5 in proximity of the second side 2" of the ship, in a position opposite the aforesaid one or more drilling towers 7', 7" in relation to the longitudinal centreline axis X of the ship 1. Advantageously, said structural support element 60 is constituted by the wall which delimits the storage and assembly area 40 of the drill strings.

[0080] The invention permits numerous advantages to be achieved, in part already described.

[0081] The drillship according to the invention has a more extended drill floor compared to the traditional solutions, without requiring an increase in the floor dimensions of the drilling towers.

[0082] The drillship according to the invention has a more extended drill floor and at the same time ensures full operation of the drill rigs.

[0083] Thanks to the invention, and in particular thanks to the use of drilling towers independent of each other it is constructively sensible and feasible to equip the ship with several independent moon pools, of small dimensions, with advantages in terms of the ship's hydrodynamic performance and the distribution of space on board.

[0084] The invention thus conceived thereby achieves the intended objectives.

[0085] Obviously, its practical embodiments may assume forms and configurations different from those described while remaining within the sphere of protection of the invention.

[0086] Furthermore, all the parts may be replaced with technically equivalent parts and the dimensions, shapes and materials used may be varied as required.

Amended claims

1. Drillship, comprising a hull (2) which extends along a longitudinal axis (X) between a bow (3) and a stern (4), said ship (1) comprising a main deck (5), above
5 which a drill floor (6) is positioned, and one or more drilling towers (7', 7''), each of which extends above the drill floor (6) in proximity of least one moon pool (8', 8'') which vertically crosses the hull (2) at the drill floor (6) to the bottom (9) of the hull itself (2),
10 wherein each of said one or more drilling towers (7', 7'') has a box-like structure and supports the lifting devices (70) externally to itself and in that the drill floor (6) extends completely outside the floor dimensions of said one or more drilling towers (7', 7'') so as to exploit the
15 available space on the ship,
characterized by the fact that it comprises at least two of said drilling towers (7', 7''), each drilling tower being dedicated to a single drilling line,
said drill floor (6) extending continuously between said
20 two drilling towers (7', 7'') forming a single extended drill floor,
said drillship comprising an operating area (20) dedicated to drilling activities, wherein said two drilling towers (7', 7'') are placed in distal positions
25 within said operating drilling area (20) in a direction

parallel to the longitudinal axis (X) of the ship so as to maximise the available surface area of said extended single drill floor (6)

and by the fact that said drillship comprises two or more
5 moon pools (8', 8"), separate and independent of each other, each dedicated to a single drilling tower (7', 7").

2. Ship according to claim 1, wherein said two or more moon pools (8', 8") are made along the longitudinal
10 centreline axis (X) of the ship, said two or more drilling towers (7', 7") being asymmetrically positioned in relation to the longitudinal centreline axis (X), said towers being shifted towards a first side (2') of the ship.

15 3. Ship according to claim 2, comprising a storage and assembly area of the drill strings made in proximity of said two or more drilling towers (7', 7") and shifted towards a second side (2") of the ship in relation to the longitudinal centreline axis (X), preferably said drill
20 floor (6) extending to said storage area (40).

4. Ship according to one or more of the previous claims, wherein said at least one drilling tower or each of said two or more drilling towers (7', 7") is directly supported by a support structure (50) structurally
25 integrated with the hull (2) of the ship and wherein the

support structure (50) of the drilling tower (7', 7") and/or the drilling tower itself (7', 7") crosses the drill floor (6), the drill floor (6) being structurally supported by the support structure (50) of the drilling tower and/or by the drilling tower itself.

5. Ship according to claims 2 and 4, wherein the drill floor (6) is supported by at least one structural support element (60) which extends vertically from the main deck (5) in proximity of a second side (2") of the ship, in a position opposite to said one or more drilling towers (7', 7") in relation to the longitudinal centreline axis (X) of the ship (1).

6. Ship according to claims 3 and 5, wherein said structural support element (60) is constituted by a wall that delimits the storage and assembly area (40) of the drill strings.

7. Ship according to claim 1, wherein said operating area (20) dedicated to drilling activities is positioned at midship between a first operating zone (10) of ship management, preferably located at the bow, and a third operating zone (30) of power generation for the propulsion of the ship, preferably located at the stern.

8. Ship according to claim 7, wherein said single drill floor (6) extends substantially throughout the longitudinal extension of the second operating zone (20)

from the first operating zone (10) as far as the third operating zone (30).

9. Ship according to claim 7 or 8, comprising in the second operating zone (20) a hold (23) and a cementer
5 (24), positioned one at the stern and the other at the bow of said two drilling towers (7', 7''), the maximum longitudinal distance between said two drilling towers (7', 7'') being limited by the distance between the hold (23) and the cementer (24).