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(71) Applicant: **Drillmec S.p.A.**
29027 Gariga di Podenzano (PC) (IT)

(72) Inventor: **Ferrari, Stefano**
43035 Barbiano (PR) (IT)

(74) Representative: **Di Gennaro, Sergio**
Barzanò & Zanardo Milano S.p.A.
Corso Vittorio Emanuele II, 61
10128 Torino (IT)

(54) Drilling rig

(57) A drilling rig 2 comprises:
• a substructure 21,
• a drill floor 22, connected to said substructure 21 through a folding frame 212;
• a mast 23, connected to said drill floor 22;
• at least one actuating device 3, adapted to allow switching from a first lowered operating configuration to a second upright operating configuration, and/or vice versa, of said drilling rig 2.

The handling required for switching between the two operating configurations is carried out by using one actuating device 3, while keeping said actuating device 3 always connected to a fixed connection point.

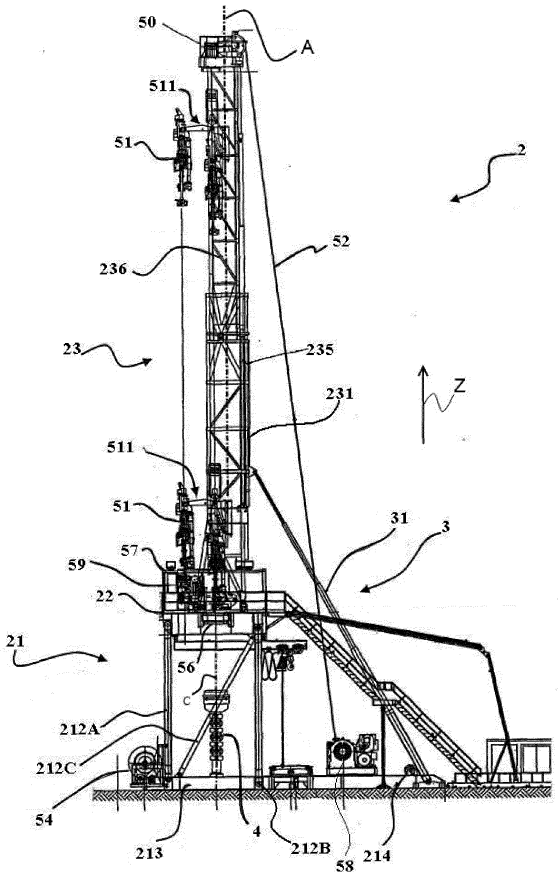

Fig. 4

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Description

[0001] The present invention relates to a drilling rig made up of modules that can be easily transported and assembled into a drilling unit which is highly automated as regards both drilling operations and pipe handling.

[0002] In the gas and oil extraction industry, drilling systems are required wherein assembly times, in particular the drilling rig's rig-up and rig-down times, are as short as possible.

[0003] It is also desirable that the cost incurred for transporting the various parts of the drilling rig is as low as possible; therefore, capability in compacting parts and transport organization are needed.

[0004] Drilling systems are known wherein the drilling rig must be separated into a plurality of parts in order that the system can be moved to the area where drilling will take place, typically searching for fuel gas or oil.

[0005] The separation of the drilling rig is necessary because of the huge dimensions thereof which prevent moving the whole structure as one piece, also due to the fact that drilling places are very distant from one another, and in some cases highly populated areas must be crossed and transportation must take place by truck, resulting in the known problems of compliance with the road code in terms of weight and width of every single part being transported.

[0006] The drilling rig is typically transported in many pieces, which comprise the three main sections, in particular the substructure, the drill floor, and the mast.

[0007] Depending on the drilling rig concerned, the same constituent parts may be further disassembled into elements having characteristics compatible with the limits specified for transportation by truck, such as weight and dimensions.

[0008] Since it is very big and heavy, the mast can be manufactured by using different technologies; for example, it may be disassembleable, subdivided into a plurality of parts, e.g. a lower section, an intermediate section and a top section complete with crown block, or said mast may be a telescopic one.

[0009] Typically, disassembleable masts are preferred for high- capacity drilling rigs, e.g. masts divided into three sections, whereas for smaller drilling rigs the mast can be transported as one piece, and in particular it may be of the telescopic type, thus reducing its length for transportation and facilitating the step of rigging it up from horizontal to vertical.

[0010] In addition, in order to save time when raising the drilling rig during the rig-up step, the top section also includes the top drive.

[0011] The drilling line is wound between the crown block and the travelling block, which in turn supports the top drive.

[0012] A first end of the line, normally called fast line, is constrained to the top section of the mast. The second end of the line, called dead line, is wound around a powered drill line spooler, which during transportation is secured to the top section of the mast by means of pins.

[0013] For medium-capacity drilling rigs, the top drive is transported inside the mast, while the line is wound around the powered drill line spooler as in the previous case.

[0014] Typically, the top drive slides on a guide secured at the top to the upper portion of the crown block by means of lines and at the bottom, near the drill floor, to the lower portion of the mast by means of an anti- torsion bar. Therefore, the drilling torque generated by the top drive is not discharged onto the mast structure, but onto the base of the drill floor.

[0015] If the mast is a telescopic one or a three-section one, the guide of the top drive must be dismounted and transported separately.

[0016] The drill floor comprises several segments which, when assembled together, create a floor for the drilling devices and for the mast, which will be used during the drilling operations.

[0017] In drilling operations for oil or fuel gas extraction, drilling rigs are commonly used wherein the drill floor is lifted from ground to protect both the personnel and the drilling equipment against gas or oil blow-out.

[0018] If a lifted drill floor is used, the drill floor is connected to a folding structure or frame for lowering or lifting the drill floor.

[0019] The folding structure or frame, comprised in the substructure, is normally connected to the base side boxes, thus forming a base from which the drilling rig extends upwards, and is connected to the drill floor side boxes, which are integral with the drill floor itself.

[0020] Once all the parts that constitute the drilling rig have reached the site where drilling will take place, they must be reassembled before the drilling operations can be started.

[0021] Much time is required for assembling the drilling rig at the drilling site; also, assembling prior-art drilling rigs proves to be a very complex task.

[0022] According to one prior-art solution, the substructure, the drill floor and the mast must be assembled and connected together essentially by means of successive steps, one piece at a time; this process is commonly referred to as piece-by-piece operation.

[0023] Moreover, according to such a solution the big and heavy drill floor and substructure, after having been assembled, must still be moved and aligned for connection.

[0024] This problem particularly concerns the connection of the drill floor to the substructure, wherein the two parts must be joined by means of suitable pins. Because of the large dimensions and heavy weights involved, the alignment of the holes for insertion of said pins is a very complex and time-consuming task. In many cases, these operations

require the use of cranes. The prior-art solution described so far is particularly difficult to implement if the area surrounding the place where the substructure has been positioned is not adequately prepared by levelling out the ground and removing any bumps. As a matter of fact, it is necessary that the ground is sufficiently flat and even in the area where the drilling rig is to be assembled.

[0025] The prior art essentially uses two types of substructure. The first type employs two distinct frames mounted on sub-bases, which in turn are laid on the ground and interconnected. A first part of the frame carries the drawworks. The second part of the frame carries the base hinges of the mast, the rotary drill floor and the set back drill floor. Typically, the mast is laid onto said second frame and pins are inserted into two hinges; the mast is then erected by means of the drawworks or through other means, and is definitively constrained to four hinges.

[0026] Finally, the frame is lifted through telescopic legs or through other means up to the height required for allowing installation of the blow- out preventer, also known as BOP. The height at which the drill floor is lifted is normally called clearance for BOP.

[0027] The first frame, whereon the drawworks are located, can remain in the lowered position, or it may be lifted up to the same height as the drill floor by the drawworks themselves and then secured by means of pins.

[0028] The second type of substructure is connected, through a parallelogram kinematic system, to the mast legs, which are directly hinged to the sub-bases. The mast is raised by means of the drawworks and a stand equipped with idle pulleys. At the same time the substructure is also lifted, which consists of the rotary drill floor and the set back drill floor.

[0029] One example of this latter configuration is described in United States patent US4221088 to Patterson.

[0030] In many known drilling rigs, the mast is erected by said drawworks. However, using the drawworks for raising the mast requires that the drawworks be already operational. The operations for putting the drawworks in operation are complex and time-consuming, resulting in delayed assembly of the drilling rig.

[0031] In fact, for the drawworks to be operational and usable, the drawworks must be connected to the electric line and the control unit must be set up for appropriately controlling it. It follows that in uninhabited areas, where no power distribution line is available, it is necessary to prearrange an autonomous generator.

[0032] The methods of assembling the drilling rig, and the drilling rig itself, are very complex and time-consuming, thus requiring much time to complete the assembly operations.

[0033] In addition to transporting and assembling the drilling rig, another very important aspect is reducing the time required for lowering the mast. Measures are also being taken which are aimed at making the drilling rig as automated as possible, so as to reduce the number of people involved and to improve the safety of the well, in an attempt to maximize operations efficiency.

[0034] A desire is increasingly felt for a drilling rig that can be transported from one drilling site to another and can be assembled at the drilling site in a simpler and quicker manner than in the solutions known in the art.

[0035] It is also desirable to reduce as much as possible the use of large cranes and of the drawworks for raising the mast.

[0036] In this regard, United States patent US7306055 called Barnes has disclosed an automatic method for installing the drilling rig. This solution comprises a plurality of hydraulic cylinders which are conveniently connected first to the mast, in order to raise the mast alone, and then to the substructure, in order to lift the drill floor up to the desired height. This solution therefore provides for moving the connection point of said cylinders, which are initially connected to the mast and then to the drill floor, so that they can both raise the mast and lift the drill floor. Moving the thrust application point slows down rig-up operations, and requires personnel entrusted with such a task. Likewise, during rig-down operations it is necessary to move the connection point in order to lower the drill floor first and subsequently the mast.

[0037] A further solution is also known from patent US7765749 and patent applications CN201778611 and CN201448062, wherein two pairs of cylinders are employed. In particular, a first pair is adapted to raise the mast, while a second pair is adapted to lift the drill floor. This implies higher costs and makes the whole drilling rig more complex.

[0038] The present invention aims at overcoming the above-mentioned problems by providing a drilling rig that allows switching from a lowered operating configuration to an upright operating configuration and/or vice versa in a quick and simplified manner.

[0039] One aspect of the present invention relates to a drilling rig having the features set out in the appended claim 1.

[0040] Another aspect of the present invention relates to a method for rigging up a drilling rig, having the features set out in the appended independent claim 9.

[0041] A further aspect of the present invention relates to a method for rigging down a drilling rig, having the features set out in the appended independent claim 11.

[0042] Auxiliary features are set out in the appended dependent claims.

[0043] The features and advantages of the device, and of the associated method, according to the present invention will become apparent from the following description of a few embodiments thereof and from the annexed drawings, wherein:

- Figures 1A, 1B 1C and 1D show the sequence of steps necessary for rigging up a drilling rig with a telescopic mast; more in detail, Fig. 1A shows the step of connecting the mast to the substructure and to the actuating device;

Fig. 1B shows the mast raised by means of said actuating device; Fig. 1C shows an instant of the lifting of the drill floor, still by means of said actuating device; Fig. 1D shows the drilling rig fully rigged up;

- Figures 2A, 2B 2C and 2D show the sequence of steps necessary for rigging up a drilling rig with a mast disassembleable into a plurality of portions; more in detail, Fig. 2A shows the step of connecting the mast to the substructure and to the actuating device; Fig. 2B shows the mast raised by means of said actuating device; Fig. 2C shows an instant of the lifting of the substructure, still by means of said actuating device; Fig. 2D shows the drilling rig fully rigged up;
- Figures 3A, 3B are side views of one embodiment of the actuating device according to the present invention; more in particular, Fig. 3A shows the position of the actuating device when the drilling rig is in a first lowered operating configuration, and Fig. 3B shows the position of the actuating device when the drilling rig is in a second upright operating configuration;
- Figure 4 is a side view of a second embodiment of the drilling rig of Fig. 2D, which comprises the actuating device according to the present invention, when the same drilling rig is in the upright operating configuration;
- Figures 5A and 5B are plan views of the drilling rig in the upright configuration; in particular, Fig. 5A shows the drilling rig of the first embodiment of Figs. 1A-1D, and Fig. 5B shows the second embodiment of Figs. 2A-2D.

[0044] With reference to the above-listed drawings, the drilling rig 2 comprises: a substructure 21, a drill floor 22, connected to said substructure 21 through a folding frame 212; a mast 23, connected to said drill floor 22, and at least one actuating device 3, adapted to allow switching from a first lowered operating configuration to a second upright operating configuration and/or vice versa of said drilling rig 2.

[0045] The handling required for switching between the two operating configurations is carried out by using one actuating device 3, while keeping said actuating device 3 always connected to a fixed connection point.

[0046] The switching from the first operating configuration to the second operating configuration is called rig-up, and comprises the following consecutive steps:

a) assembling the parts comprised in said drilling rig 2 and connecting it to an actuating device 3;
b) raising mast 23 by means of said actuating device 3;
c) lifting drill floor 22 by means of said actuating device 3;
d) securing and stiffening substructure 21.

[0047] During the rig-up sequence, said rig-up steps b) and c) are carried out by using a single actuating device 3, which stays always connected to a fixed connection point.

[0048] The switching from the second operating configuration to the first operating configuration is called rig-down, and comprises the following consecutive steps:

a) releasing substructure 21;
b) lowering drill floor 22 by means of said actuating device 3;
c) lowering mast 23 by means of said actuating device 3;
d) disassembling the parts comprised in said drilling rig 2.

[0049] During the rig-down sequence, said rig-down steps b) and c) are carried out by using one actuating device 3, said actuating device 3 being kept always connected to a fixed connection point.

[0050] In a preferred embodiment, the rig-up sequence is always followed by the rig-down sequence when drilling is over.

[0051] Preferably, drilling rig 2 may also be equipped with a pipe manipulator 24 and a vertical pipe container 25, as shown by way of example in Figs. 1A- 1D. Preferably, said vertical pipe container 25 and manipulator 24 are adapted to handle double range 2 pipes, i.e. a pipe assembly reaching a length of 18.3 metres.

[0052] Likewise, mast 23 is sized for manipulating double range 2 pipes as well, i.e. a pipe assembly reaching a length of 18.3 metres, and is transported as a separate unit.

[0053] In a first embodiment, shown in Figs. 1A-1D, mast 23 is a telescopic one and comprises a top section adapted to slide telescopically into a lower section 231 in order to increase or decrease the height of mast 23.

[0054] In a second embodiment, shown in Figs. 2A-2D, the mast can be disassembled preferably into two sections, in particular into a lower section 231 and a top section.

[0055] In both embodiments, lower section 231 of the mast is constrained, preferably hinged, to drill floor 22 at suitable mast shoes 234. In both configurations, entire mast 23 is kept totally separate; in fact, drill floor 22 comprises no portion of mast 23, which is directly constrained to drill floor 22. In the prior art, the drill floor normally comprises a mast starting section to which mast 23 is constrained. Said suitable mast shoes 234 are comprises in the plane described by drill floor 22.

[0056] The drill floor further comprises a rotary drill floor 56, a dog house 57, a dead line anchor and a pair of power

tongs 59, all of which are known to those skilled in the art.

[0057] In order to promote the automation of the whole drilling rig in accordance with the present invention, said drill floor 22 comprises, in addition to a hole centre "P", where drilling takes place along a first axis "C" parallel to a vertical axis "Z", a secondary hole or mouse hole 221 describing a second axis "D" parallel to said first axis "C", where the drill pipes are temporarily positioned, and a mouse hole clamp 222 adapted to hold the drill pipes in mouse hole 221. Drill floor 22 is illustrated in Figs. 5A and 5B.

[0058] Mast 23 comprises a back-side 235 and two opposite side faces 236 that create a U-shaped structure, which are connected together by four chord members, two at the front and two at the rear, arranged parallel to one another along the longitudinal axis "A" of mast 23. Said rear chord members delimit back-side 235 of mast 23.

[0059] Substructure 21 comprises at least two sub-bases 213 and a folding frame 212, which is adapted to connect said substructure 21 to said drill floor 22.

[0060] The substructure also includes footboards and stairs, the dog house and the grass hopper, which will not be described in detail herein because they are known to the man skilled in the art.

[0061] Folding frame 212 comprises elevating legs (212A, 212B) and braces 212C, thus forming a parallelogram or pantograph structure.

[0062] During the transportation stage, said substructure 21 and drill floor 22 are connected together and can be transported as one piece.

[0063] Within mast 23, a top drive 51 is preferably installed which, by means of a parallelogram or pantograph kinematic system 511, can be moved from hole centre "P" to a pick-up point, identified in mouse hole 221, by displacing it from said first axis C of hole centre P to a second axis D of mouse hole 221. Top drive 51 is placed in the inner part of the U-shaped structure of mast 23 and can slide along longitudinal axis "A" of mast 23 by means of suitable guides. In the prior art, said guides are located on said back-side 235 of mast 23. In the present invention, the guides are located on the front chord members of mast 23, so that top drive 51 can move vertically without any significant offset from a straight line nor any rotation in the horizontal plane. The efficiency of the guides allows automated pipe transfer maneuvers, as shown by way of example in Fig. 4.

[0064] Said parallelogram or pantograph kinematic system 511, in cooperation with said manipulator 24, allows bringing the pipes from the vertical pipe container 25 towards hole centre "P", and vice versa, thus considerably increasing the automation of the handling of the pipes in drilling rig 2. As shown in Figs. 5A and 5B, the pipes vertically arranged in vertical pipe containers 25 can be picked up by manipulator 24 and deposited into mouse hole 221. Once it has been positioned in the mouse hole, the pipe is clamped and held in position by mouse hole clamp 222, and then a step of greasing the threads between the drill pipes can take place, if necessary. Finally, by extending kinematic system 511, top drive 51 is moved to the second axis "D" of mouse hole 221 in order to pick up the pipe and move it to hole centre "P", while said kinematic system 511 folds back, in order to continue the drilling operation. These steps are fully automated and require only a small number of operators, unlike prior-art drilling rigs.

[0065] Preferably, according to the present invention, the rig- up sequence of raising mast 23 and lifting drill floor 22 up to the safety height specified by the BOP is independent of the sequence for lifting vertical pipe containers 25 and manipulator 24, because the two rig- up sequences take place on opposite sides relative to the hole centre. For the same reason, the rig- down sequence of lowering the mast and drill floor 22 is independent of the sequence for lowering vertical pipe containers 25 and manipulator 24.

[0066] Actuating device 3, as aforementioned, is adapted to carry out a rig-up sequence and/or a rig-down sequence on drilling rig 2.

[0067] Said actuating device 3 preferably consists of a pair of hydraulic cylinders 31 called raising cylinders, e.g. telescopic ones, which are permanently secured to a single point of drilling rig 2 during all steps included in the rig-up sequence and/or in the rig-down sequence of said drilling rig 2.

[0068] In particular, each cylinder of said pair 31 in hinged to substructure 21 at one end, and to a fixed point of drilling rig 2 at the opposite end.

[0069] Preferably, each cylinder of said pair 31 is a three- section telescopic cylinder.

[0070] The rig-up sequence begins at step a) of assembling the various parts, wherein it is required that substructure 21, still folded as it was during transportation, be placed at the hole centre. Mast 23 is then brought near in a substantially horizontal position. Subsequently, mast 23 is hinged to two first mast shoes 234, comprised in drill floor 22. Also, during this step actuating device 3 is connected to a predetermined point of drilling rig 2.

[0071] Preferably, said pair of cylinders 31 are directly connected to mast 23. In a preferred embodiment, actuating device 3 is connected to back- side 235 of mast 23. Preferably, said actuating device 3 is secured to the outer portion of the U- shaped structure of mast 23 because in said step a) mast 23 is arranged horizontally, with the U- shaped structure facing upwards, relative to the ground. In the prior art, on the contrary, the fastening point of the rig- up system is located in the inner portion of the U- shaped structure, because the U- shaped structure of the mast faces downwards.

[0072] Step b) of raising mast 23 is then carried out, wherein said mast 23 is made to rotate, by means of said actuating device 3, about the axis of the hinge of said first mast shoes 234 to which the mast itself is hinged. In said step b) mast

23 switches from a substantially horizontal position, in which longitudinal axis "A" is parallel to the ground, to a substantially vertical position, in which longitudinal axis "A" is perpendicular to the ground.

[0073] During the execution of step b), drill floor 22 stays rigidly connected to substructure 21, e.g. by means of at least one locking element 214.

[0074] Between the rig-up steps b) and c), there is an additional step b1) of definitively securing mast 23 to drill floor 22 through said mast shoes 234. There is also a second additional step c0) of releasing said folding structure or frame 212, which will allow actuating device 3 to carry out the next rig-up step d), which would otherwise be prevented by said at least one locking element 214, e.g. a pin. Said locking element 214 is preferably positioned on sub-bases 213 and comprises a retractable pin.

[0075] Preferably, steps b0) and c0) take place substantially at the same time, thereby further reducing the time necessary for completing the rig- up sequence.

[0076] At the rig-up step c), drill floor 22 is lifted by means of the same actuating device 3 previously used for raising the mast, without changing the connection point of cylinders 31, thus reducing the manual intervention required during the rig-up sequence.

[0077] The rig-up step c) is followed by a step d) of securing and stiffening substructure 21.

[0078] During this step, in particular, when the legs, in particular front legs 212A and rear legs 212B, have become substantially perpendicular to the ground, at least one brace 212C is positioned between said front legs 212A and said rear legs 212B for the purpose of securing folding frame 212 and preventing it from taking other configurations, thereby also stiffening the entire structure and stabilizing drill floor 22.

[0079] During all steps a) - d), drill floor 22 is always kept horizontal, parallel to the ground. In fact, the configuration of said folding frame 212 is such that it keeps drill floor 22 always horizontal and parallel to the ground while switching from said first lowered operating configuration to said second upright operating configuration and/or vice versa.

[0080] After the securing step d) there is a further step e) of installing and putting in operation drawworks 58, as known to the man skilled in the art.

[0081] In the second embodiment shown in Figs. 2A-2D, step e) is followed by a further step of extending the mast 23 into its final position, which is also shown in Fig. 4.

[0082] In the first embodiment, shown in Figs. 1A-1D, said mast 23 is telescopic and is extended by using telescopic cylinders comprised therein. Said telescopic cylinders (not shown) comprise a main hydraulic cylinder that lifts the telescopic part, thus doubling, by means of lines and pulleys, the stroke of top drive 51, which slides on guides arranged on the extensible telescopic part.

[0083] In this first embodiment, the drawworks are replaced by a hydraulic hoist cylinder and the drilling lines are replaced by hoisting lines, as known to the man skilled in the art.

[0084] Furthermore, in the second embodiment drilling rig 2 is completed by the drilling line reeving, wherein the first end of the line is brought onto the drawworks, and then the line is released from spooler 54 and the second end of the line, or dead line, is wound around the dead line anchor.

[0085] Switching from the second operating configuration to the first operating configuration, called rig-down sequence, requires the execution of the same steps as the rig-up sequence, but in the reverse order and for opposite purposes. For this reason, the various steps will not be described in detail below, because they can be easily understood by those skilled in the art.

[0086] By way of example, the steps of the rig-down sequence will be the following:

a) releasing substructure 21;
b) lowering drill floor 22 by means of said actuating device 3;
b1) releasing mast 23 from drill floor 22;
b2) securing said folding frame 212;
c) lowering mast 23 by means of said actuating device 3;
d) disassembling the parts comprised in said drilling rig 2.

[0087] As aforementioned, said pair of hydraulic cylinders 31 are, for example, three-section telescopic units. In particular, a first section 31A of each cylinder is used for raising/lowering mast 23 from a substantially horizontal position to a vertical position, and/or vice versa, whereas the second and third sections (31B, 31C) are used for lifting and/or lowering drill floor 22 from a height substantially equal to zero from the ground to a predefined height called clearance for BOP, and vice versa.

[0088] The configuration of actuating device 3 allows the rig-up sequence to be carried out by means of a single pair of cylinders 31, without requiring the installation of any further devices for starting the upward movement of drill floor 22.

[0089] Substructure 21 of drilling rig 2 according to the present invention allows sufficient room under drill floor 22 for blow-out preventer (BOP) 4, which in large wells may be very tall, and which is normally handled by the BOP handling equipment "B". Preferably, said blow-out preventer is arranged on a carriage 41 adapted to slide on rails 42 for being

positioned as considered appropriate, as shown in Figs. 5A and 5B.

[0090] The solution proposed by the present invention, therefore, allows to abandon the solution wherein the drill floor and the dog house are connected to a transportation semitrailer adapted to transport the mast, the semitrailer and the mast itself are then raised by means of stabilizer cylinders, and finally the mast is raised from horizontal to vertical by means of a specific cylinder pair.

[0091] The present invention allows to provide a single drilling rig 2, wherein the operations required for assembling and/or disassembling the drilling rig itself are faster, resulting in less time required for moving the drilling rig from one drilling site to the next.

[0092] In addition, by associating the above-mentioned manipulator 24 and pipe container 25 with drilling rig 2 in a manner independent of drilling rig 2 itself, it is possible to create a drilling rig 2 equipped with traditional drawworks 58 while eliminating the traditional racking board and the associated automatic racking mechanisms. The result is a lighter and less bulky mast which can be transported more easily.

[0093] Said manipulator 24 and said pipe container 25 are described in the granted patent EP1158136B1 and in patent application PCT/IB 2011/001999, and for this reason they will not be described in detail herein.

[0094] Said automatic pipe handling system is nevertheless illustrated in the annexed drawings.

[0095] Preferably, the maximum pipe length is approx. 13 metres, called Range 3 in the technical jargon, and the pipes are handled individually, i.e. one at a time.

[0096] The use of the automatic pipe handling system in a drilling rig 2 allows handling at least "double" Range 2 pipes, i.e. two Range 2 pipes, the individual length of which is approx. 9.15 metres. Said Range 2 pipes are joined together to form an extended pipe called "drill stand", which is approx. 18.3 metres long.

[0097] Furthermore, by using top drive 51 with pantograph kinematic system 511 it is possible to pick up the pipes from the mouse hole, thereby facilitating the handling of the pipes without requiring the use of elevators associated with the traditional top drives normally included in prior- art systems.

[0098] Preferably, mast 23 is brought near the drill floor in order to be constrained by means of two hinges and then raised through automated stands that allow raising the entire mast along a vertical axis "Z" when the latter is still in a horizontal position, and then moving it along an axis parallel to longitudinal axis "A" of the mast itself in order to bring it near the drill floor.

[0099] The embodiment illustrated and described herein by way of example may be subject to structural modifications, which must be considered to fall within the protection scope of the present invention.

[0100] The drilling rig having the features described in the present description allows not only to speed up the installation of a drilling rig thanks to the actuating device according to the present invention, but also to considerably enhance the automation of the drilling steps; in fact, by means of the vertical pipe container, the manipulator, the top drive equipped with a pantograph kinematic system and guides on the front chord members, the mouse hole and the mouse hole clamp, it allows to automatize many operations which are carried out manually in traditional drilling rigs.

REFERENCES

[0101]

Drilling rig	2
Substructure	21
Folding structure or frame	212
Front elevating legs	212A
Rear elevating legs	212B
Braces	212C
Locking element	214
Sub-base	213
Drill floor	22
Mouse hole	221
Mouse hole clamp	222
Mast	23
Lower section	231
Mast shoes	234
Back-side	235
Side faces	236
Manipulator	24

(continued)

Vertical pipe container	25
Actuating device	3
Raising cylinders	31
Blow-Out Preventer (BOP)	4
Crown block	50
Top drive	51
Parallelogram or pantograph kinematic system	511
Drilling/fast line	52
Powered drill line spooler	54
Rotary drill floor	56
Dog-house	57
Drawworks	58
Power-tongs	59
Longitudinal axis	A
BOP handling equipment	B
First axis	C
Second axis	D
Hole centre	P
Vertical axis	Z

Claims

1. Drilling rig (2) comprising:

- a substructure (21),
- a drill floor (22), connected to said substructure (21) through a folding frame (212);
- a mast (23), connected to said drill floor (22);
- at least one actuating device (3), adapted to allow switching from a first lowered operating configuration to a second upright operating configuration, and/or vice versa, of said drilling rig (2);

characterized in that the handling required for switching between the two operating configurations is carried out by using a single actuating device (3), while keeping said actuating device (3) always connected to a fixed connection point.

2. Rig according to claim 1, wherein said actuating device comprises a pair of hydraulic cylinders (31), each of which is permanently secured to the drilling rig (2) at one point.

3. Rig according to claim 2, wherein said pair of cylinders (31) are connected to the mast (23).

4. Rig according to claim 3, wherein said pair of cylinders (31) are connected to the back-side (235) of the mast (23).

5. Rig according to claim 2, wherein each cylinder of said pair of cylinders (31) is telescopic.

6. Rig according to claim 5, wherein said pair of cylinders (31) are three-section telescopic cylinders.

7. Rig according to claim 6, wherein a first section (31A) of each cylinder is used for raising the mast (23) from a substantially horizontal position to a vertical position, and/or vice versa, whereas the second and third sections (31B, 31C) of each cylinders are user for lifting and/or lowering the drill floor (22).

8. Rig according to claim 1, wherein said folding frame (212), while switching from a first lowered operating configuration to a second upright operating configuration, and/or vice versa, is adapted to keep the drill floor (22) always horizontal and parallel to the ground.

9. Rig according to claim 1, wherein: the drill floor (22) comprises: a rotary drill floor (56), a pair of power-tongs (59),

a hole centre (P), where drilling takes place along a first axis (C), a mouse hole (221), where the drill pipes are temporarily positioned, describing a second axis (D) parallel to said first axis (C), and a mouse hole clamp (222), adapted to hold the pipes in the mouse hole (221).

10. Rig according to claim 1 or 9, wherein the mast (23) is of the lattice type, and within the same mast (23) a top drive (51) is installed which, by means of a parallelogram or pantograph kinematic system (511), can be moved from a first axis (C) of the hole centre (P) to a second axis (D) of a mouse hole (221).

11. Method for rigging up a drilling rig (2) according to claim 1, comprising the following consecutive steps:

a) assembling the parts comprised in said drilling rig (2) and connecting it to an actuating device (3);
b) raising the mast (23) by means of said actuating device (3);
c) lifting the drill floor (22) by means of said actuating device (3);
d) securing and stiffening the substructure (21); wherein said rig-up steps b) and c) are carried out by a single actuating device (3) which is always kept connected to a fixed connection point.

12. Method according to claim 11, wherein between the rig-up steps b) and c) there is a first additional step b1) of definitively securing the mast (23) onto the drill floor (22), and a second additional step c0) of releasing said folding frame (212) to allow the actuating device (3) to carry out the next rig-up step d).

13. Method for rigging down a drilling rig (2) according to claim 1, comprising the following consecutive steps:

a) releasing the substructure (21);
b) lowering the drill floor (22) by means of said actuating device (3);
c) lowering the mast (23) by means of said actuating device (3);
d) disassembling the part comprised in said drilling rig (2);
wherein the rig-down steps b) and c) are carried out by one actuating device (3) which is always kept connected to a fixed connection point.

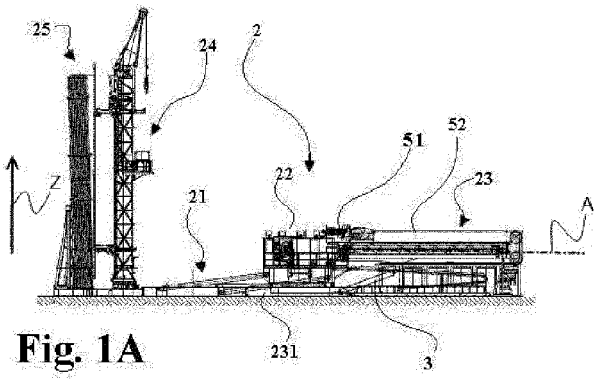


Fig. 1A

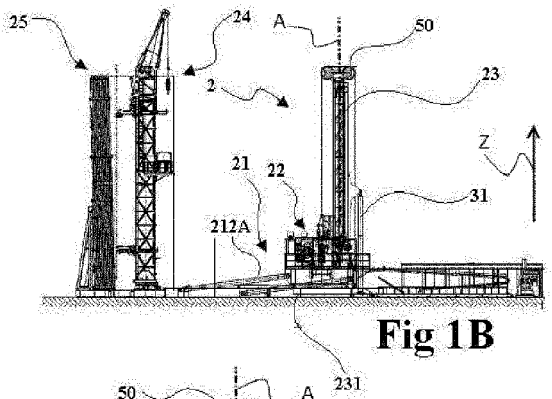


Fig 1B

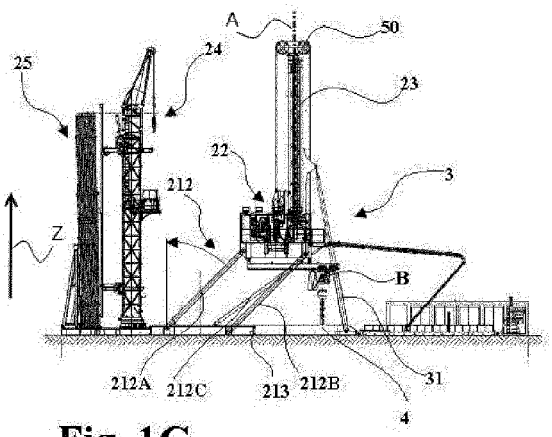


Fig. 1C

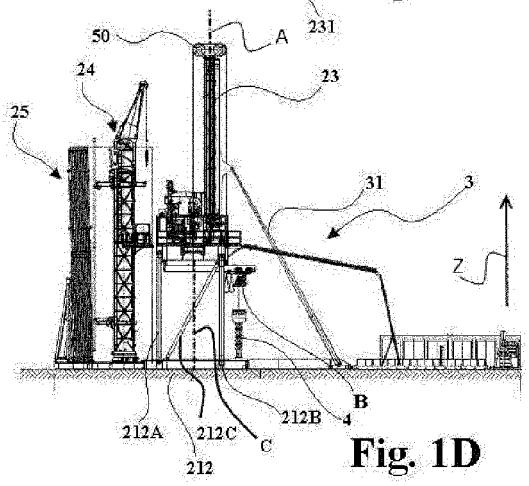


Fig. 1D

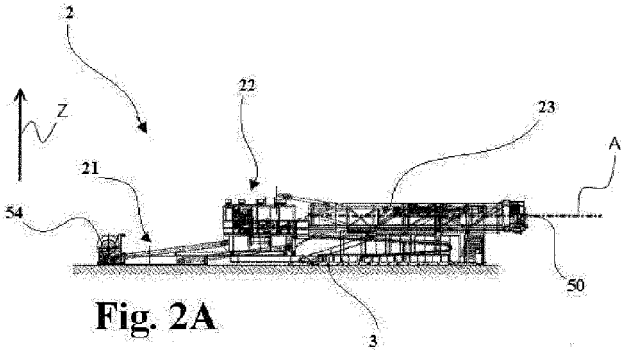


Fig. 2A

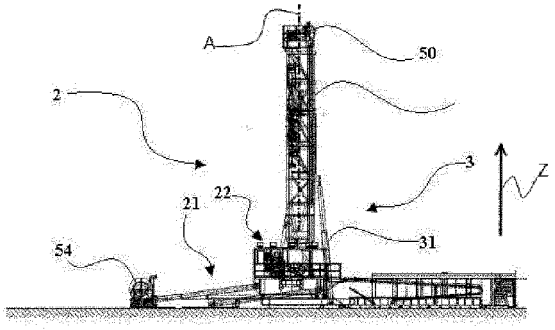


Fig. 2B

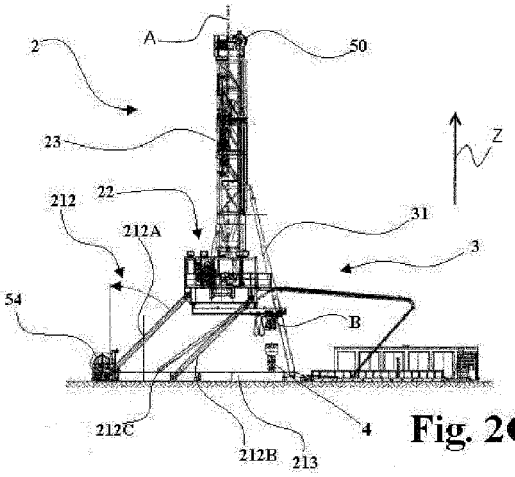


Fig. 2C

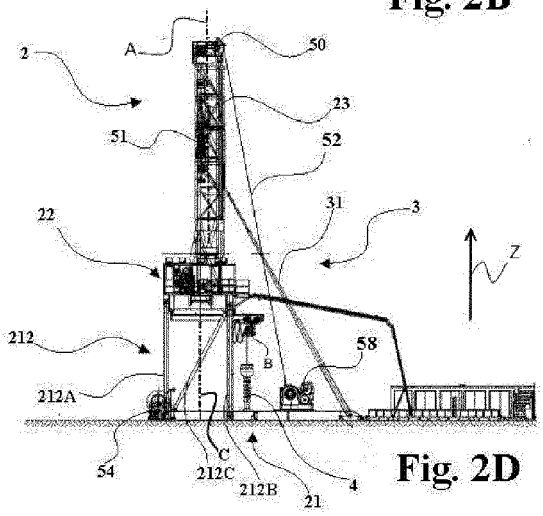


Fig. 2D

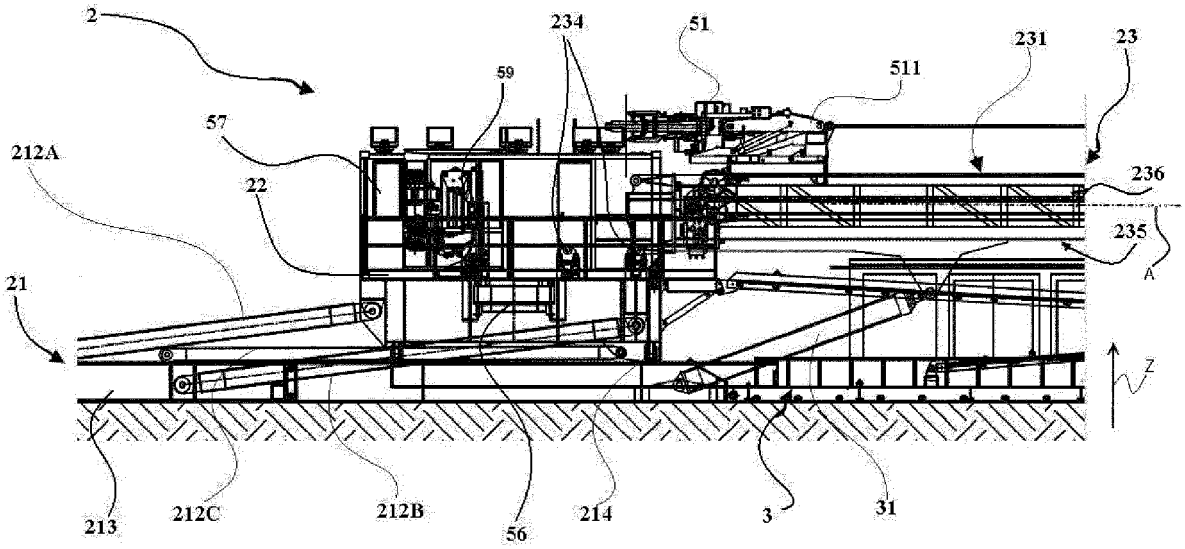
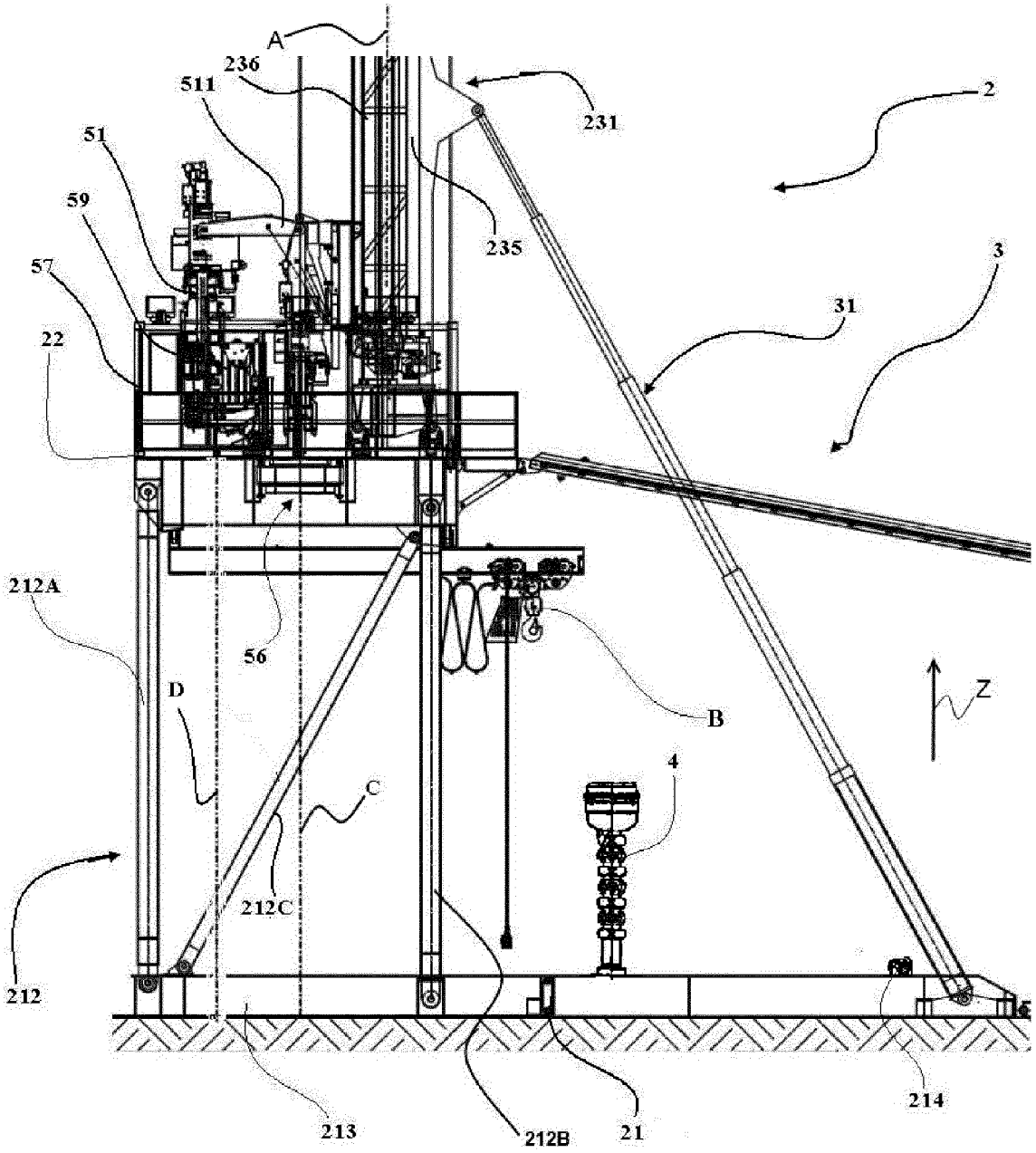

2
234
51
231
23
59
511
57
212A
22
236
235
A
21
Z
213
212C
212B
56
214
3
31

Fig. 3A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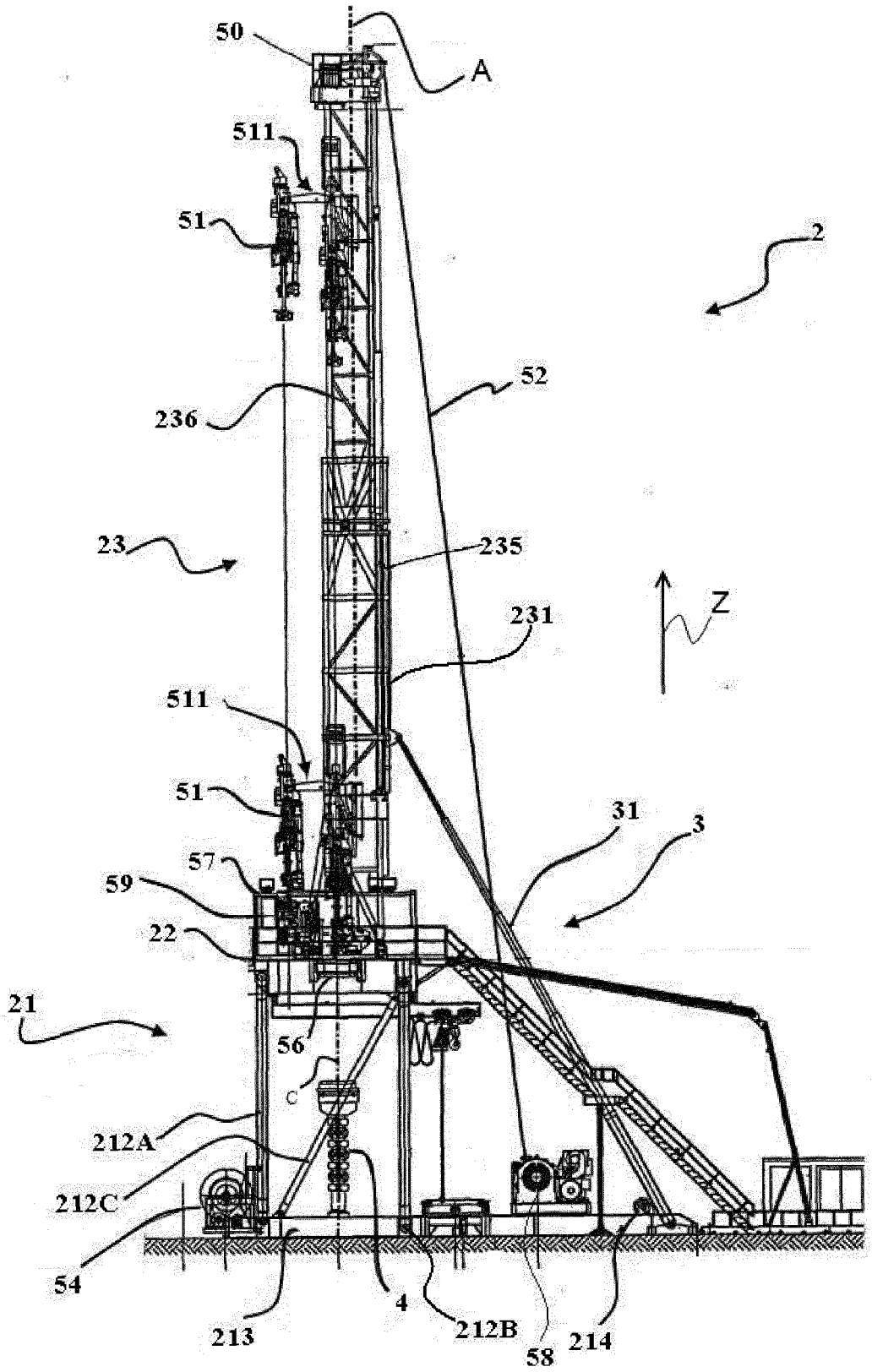
4
C
212C
212
213
212B
21
214

Fig. 3B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231
Z
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56
C
212A
212C
54
213
4
212B
58
214

Fig. 4

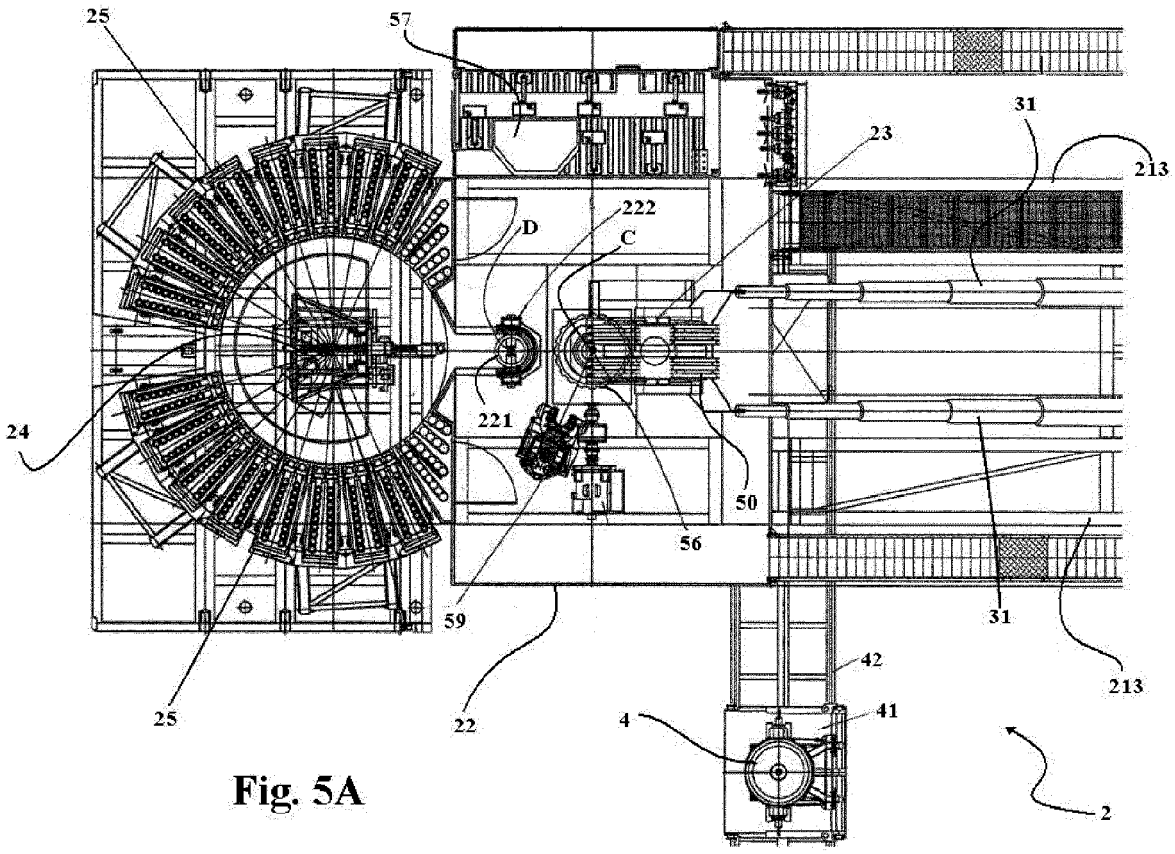

Fig. 5A

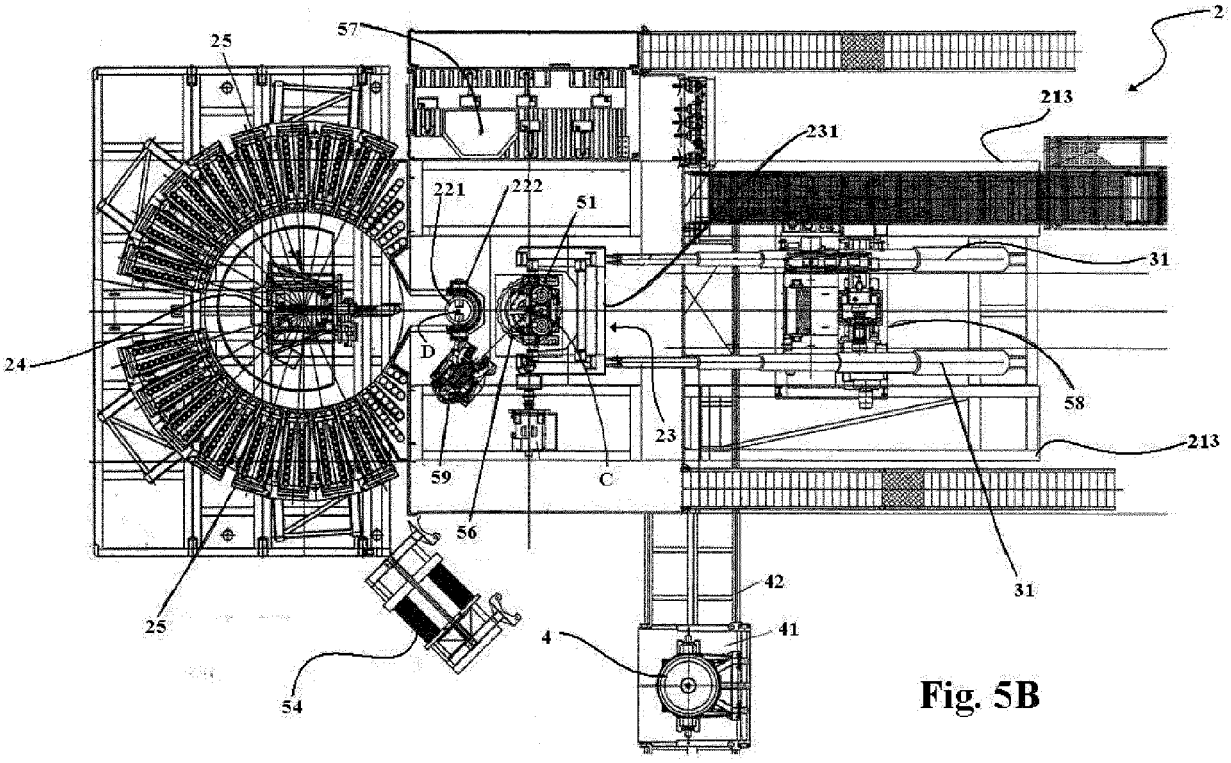

Fig. 5B

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EUROPEAN SEARCH REPORT

Application Number
EP 12 16 1040

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	US 7 306 055 B2 (BARNES R M [US] BARNES R MICHAEL [US]) 11 December 2007 (2007-12-11) * column 7, line 45 - line 62; figures 5-7,9 * -----	1-9, 11-13	INV. E21B15/00
A,D	CN 201 448 062 U (YUFU ZHANG) 5 May 2010 (2010-05-05) * abstract; figures 1-3 * -----	1-13	
			TECHNICAL FIELDS SEARCHED (IPC) E21B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 August 2012	Dantinne, Patrick

CATEGORY OF CITED DOCUMENTS

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1

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 16 1040

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23-08-2012

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US 7306055 B2	11-12-2007	NONE	
CN 201448062 U	05-05-2010	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- EP IB2011001999 W **[0093]**