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(54) **COMPENSATING SYSTEM AND METHOD**

(57) A hoisting system for a floating drilling platform or vessel is described. The hoisting system includes a smart block system that can be configured for either high speed or high load modes by moving the smart block between the crown block and traveling block. The smart block is also configurable for providing passive compensation.

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Description

Reference To Related Application

[0001] This application claims the benefit of and incorporates by reference U.S. Provisional Patent Application Serial Number 62/820,211 filed on March 18, 2019.

Technical Field

[0002] The present disclosure relates to systems and methods for compensating for motion of a drilling platform or vessel. More specifically, this disclosure relates to passive compensation of a drill string suspended from a drilling platform or vessel.

Background

[0003] This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the present disclosure, which are described and/or claimed below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present invention. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

[0004] Natural resources, such as oil and gas, are used as fuel to power vehicles, heat homes, and generate electricity, in addition to various other uses. Once a desired resource is discovered below the surface of the earth, drilling and production systems are often employed to access and extract the resource. These systems may be located onshore or offshore depending on the location of the desired resource. Further, such systems may include a wide variety of components, such as various casings, fluid conduits, tools, and the like, that facilitate extraction of the resource from a well during drilling or extraction operations.

[0005] Whether onshore or offshore, a drilling rig can be provided to drill a well to access the desired resource. A drill string can be suspended from the drilling rig and rotated to drill the well. While the drill string can be suspended from a kelly and driven by a rotary table on the drill floor of the drilling rig, in most instances the drill string is instead suspended from and driven by a top drive of the drilling rig. Such a top drive generally includes a drive stem (also referred to as a main shaft) that can be connected to the drill string. One or more motor(s) in the top drive is/are connected to the drive stem to drive rotation of the drill string via the drive stem. The top drive can be raised and lowered via a derrick or a mast and a hoisting system to raise and lower the drill string within the well.

[0006] The drilling rig also includes a hoisting system configured to raise and to lower drilling equipment relative to the drill floor. The hoisting system typically includes a crown block, a traveling block, a draw-works system, and a cable assembly (e.g., wire) that extends from the

draw-works system and couples the crown block to the traveling block.

[0007] When conducting a drilling operation in an off-shore setting a floating rig such as on a platform or drilling vessel or drillship is often employed. In many offshore drilling operations, for example while drilling or in "lock-to-bottom operations," it is desirable to compensate for vessel motions, such as might be caused by wave motion, tidal variation and the like. During drilling, the payload, often a drill string having a drill bit at its bottom end, is suspended from the travelling block. In such cases it is desirable to compensate for motion of the vessel and crown block, thereby maintaining the position of the travelling block with respect to a fixed reference point such as the seabed and/or the well being drilled. Two main types of heave compensation systems are traditionally employed: active draw-works heave compensation systems, and passive top mounted or crown mounted compensation system, sometimes with some active heave assistance. Active draw-works heave compensation systems rely on the draw-works system to actively adjust the hoisting system to account for vessel motion. Some active heave compensation systems actively control the draw-works of the hoisting system to draw in and pay out the cable in accordance with vessel motion in order to maintain a desired position of the travelling block. Although active draw-works compensating systems can be very accurate and precise, they may have problems in cases where one or more systems on which it relies (e.g. control system, mechanical draw-works system, or power systems) experiences failure or malfunction.

[0008] In some cases, it is desirable to include an additional compensation system. Top mounted or crown mounted compensation systems can be designed or retrofitted onto the top or crown block of the derrick. Such systems can be active or passive in nature and typically function to dampen or compensate for movement in the crown block relative to the travelling block. Passive top or crown mounted compensator system may incorporate hydraulic cylinders, gas accumulators and the like. Due to their nature, top or crown mounted compensator systems tend to add quite a bit of mass to the top of the derrick and can be quite costly to retrofit.

Summary

[0009] This summary is provided to introduce a selection of concepts that are further described below in the detailed description. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining or limiting the scope of the claimed subject matter as set forth in the claims.

[0010] According to some embodiments, a hoisting system for suspending a drilling string from a floating drilling platform or vessel is described. The hoisting system includes a crown block mounted atop a derrick. The crown block includes a plurality of crown block sheaves

and being in fixed relation to the derrick. The hoisting system also includes: a traveling block including a number of traveling block sheaves; and an intermediate sheave assembly moveable between and alternatively connectable to the crown and traveling blocks. The intermediate sheave assembly is further connectable to a compensation system that is configured to provide movement between the intermediate sheave assembly and the crown block to compensate for motion of the floating drilling platform or vessel.

[0011] According to some embodiments, the compensation system comprises one or more compensating cylinders. According to some embodiments, the hoisting system is configured for a first load capacity when the intermediate sheave assembly is connected to the crown block, and the hoisting system is configured for a second higher load capacity when the intermediate sheave assembly is connected to the traveling block. The hoisting system can be configured for a first travel speed when the intermediate sheave assembly is connected to the crown block and configured for a second lower travel speed when the intermediate sheave assembly is connected to the traveling block.

[0012] According to some embodiments, the traveling block sheaves are arranged to include a gap sized to accommodate the one or more sheaves of intermediate assembly, and the motion of the floating drilling platform or vessel includes heave motion.

[0013] According to some embodiments, a method is described to compensate for motion of a floating drilling platform or vessel being transferred to a drill string. The drill string is suspended by a hoisting system that is mounted on the floating drilling platform or vessel. The hoisting system also includes a crown block and a travelling block. The method includes: connecting an intermediate sheave assembly to a crown block structure in fixed relationship with the crown block via a compensation system; and compensating for motion of the floating drilling platform or vessel being transferred to the drill string that is suspended by the travelling block at least in part with the compensation system by allowing vertical motion between the crown block structure and the intermediate sheave assembly.

Brief Description of the Drawings

[0014] The subject disclosure is further described in the following detailed description, and the accompanying drawing and schematic of non-limiting embodiment of the subject disclosure. The features depicted in the figure are not necessarily shown to scale. Certain features of the embodiments may be shown exaggerated in scale or in somewhat schematic form, and some details of elements may not be shown in the interest of clarity and conciseness.

FIG. 1 is a schematic diagram of a portion of a drilling and production system with a smart block configura-

ble for passive compensation, accordance to some embodiments;

FIGs. 2A and 2B are schematic diagrams of a hoisting system having a smart block configurable for passive compensation, according to some embodiments;

FIGs. 3A-3C are partial perspective views illustrating a hoisting system with a smart block configured for passive compensation, according to some embodiments;

FIGs. 4A-4B are partial perspective views illustrating further aspects a hoisting system with a smart block configured for passive compensation, according to some embodiments; and

FIG. 5. is a partial perspective view illustrating further aspects a hoisting system with a smart block configured for passive compensation, according to some embodiments.

Detailed Description

[0015] One or more specific embodiments of the present disclosure will be described below. These described embodiments are only exemplary of the present disclosure. Additionally, in an effort to provide a concise description of these exemplary embodiments, all features of an actual implementation may not be described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure. Like reference numerals are used herein to represent identical or similar parts or elements throughout several diagrams and views of the drawings.

[0016] The present embodiments are generally directed to drilling and production system comprising a hoisting system that may be utilized to support and lift a load (e.g., pipe section, drill pipe collar, casing section, or the like) within a drilling and production system.

[0017] To facilitate discussion, certain embodiments disclosed herein refer to pipe sections and drill strings; however, it should be understood that the disclosed embodiments may be adapted for use with any of a variety of tubular structures, including drill pipe collars, casing sections, or the like. Additionally, certain embodiments relate to a subsea (e.g., offshore) drilling and production system; however, it should be understood that the disclosed embodiments may be adapted for use within an onshore (e.g., land-based) drilling and production system.

[0018] FIG. 1 is a schematic diagram of a portion of a drilling and production system with a smart block configurable for passive compensation, accordance to some embodiments. As shown, the system 110 includes a derrick 112 supported by a floating platform 114 (e.g., floating platform or vessel). The system 110 includes a hoisting system 116 configured to raise and to lower drilling equipment relative to the drill floor 114. In the illustrated embodiments, the hoisting system 116 includes a crown block 118, a traveling block 120, a draw-works system 122, and a cable assembly 124 (e.g., wire) that extends from the draw-works system 122 and couples the crown block 118 to the traveling block 120. Note that the crown block 118 is mounted to a crown block structure 130 that forms an integral part of the derrick 112. In the illustrated embodiment, a top drive 126 is coupled to the traveling block 120, and a drill string 128 supporting a drill bit (not shown) is suspended from the top drive 126 and extends through the platform 114 into the wellbore through which drill string 128 is disposed. The top drive 126 may be configured to rotate the drill string 128, and the hoisting system 116 may be configured to raise and to lower the top drive 126 and the drill string 128 relative to the platform 114 to facilitate drilling of the wellbore.

[0019] Additionally, the hoisting system 116 in this case includes a smart block 140 that can be moved and "parked" and be fixed in relation to either the crown block 118 or the travelling block 120. For further details associated with the use of smart block 140, see copending Patent Application Publication WO2018/187253 filed on April 3, 2018, which is incorporated herein by reference and hereinafter referred to as the "'253 application." The '253 application describes a travelling block system where the operator may park a part of the travelling block to achieve a different reeving of drill lines, and thereby a different gearing of the hoisting system when running with lower loads. This will help the operator to achieve fast and effective operations with low loads in combination with safe operation of high loads without losing time. According to some embodiments, the hoisting system 116 is further equipped with a compensation system configured to provide passive compensation by allowing movement between smart block 140 and crown block 118 so as to isolate the travelling block 120 from the motion of the platform 114, derrick 112, crown block structure 130 and crown block 118. The passive compensation is configured by engaging passive compensating cylinders 150 and 152 between the crown block structure 130 and smart block 140. The motion of the crown block structure 130 and smart block 140 during passive compensation is illustrated by the dashed arrows. Note that the relative motion of the crown block structure 130 and smart block 140 during passive compensation will be opposite to each other in order to reduce or eliminate motion imparted on traveling block 120, top drive 126 and drill string 128.

[0020] FIGs. 2A and 2B are schematic diagrams of a hoisting system having a smart block configurable for

passive compensation, according to some embodiments. The smart block in FIGs. 2A and 2B is shown configured to provide passive compensation. For further details of the operation of a smart block for "Low Load / High Speed" mode and connected to the traveling block in "High Load / Low Speed" mode, see the '253 application. The draw works 122 is shown with the fast line 218 leading to fast line sheave 220 which is fixed to the crown block structure 130 (shown in FIG. 1) and crown block 118. Similarly, the deadline sheave 250, deadline 252, deadline anchor 254 and drill line drum 256, are also in fixed positions relative to the fixed to the crown block structure 130 (shown in FIG. 1) and crown block 118. FIGs. 2A and 2B are shown configured to provide passive compensation. In particular, the smart block 140 is allowed to travel relative to the crown block 118 through the action of passive compensating cylinders 150 and 152. The dashed arrows indicate the likely movement direction of the crown block 118 and smart block 140. FIG. 2A, shows the hoisting system configured for passive compensation and when the rig (i.e. the platform, derrick and crown block) is in a relatively high position or "rig high" position. FIG. 2B shows the hoisting system configured for passive compensation and when the rig (i.e. the platform, derrick and crown block) is in a relatively low position or "rig low" position. As can be seen, the position of the smart block 140, relative to the crown block 118, changes in order to compensate for position of the crown block 118 relative to the travelling block 120. Note that distance between the crown block 118 and travelling block 120 changes between the rig high (FIG. 2A) and rig low (FIG. 2B) positions such that $h > h'$. In this way, a simple passive compensator function can be provided for operations in lock-to-bottom operations, according to some embodiments.

[0021] FIGs. 3A-3C are partial perspective views illustrating a hoisting system with a smart block configured for passive compensation, according to some embodiments. FIG. 3A shows the hoisting system 116 configured for maximum load hoisting capability. In the example shown, the smart block 140 is parked within the travelling block 120. In this case, there are 16 lines when combining the travelling block 120 and smart block 140. FIG. 3B shows the hoisting system 116 configured for maximum speed (i.e. lowest load). In the example shown, the smart block 140 is parked up next two crown block 118. The smart block 140 is parked within dolly 340 which is also used in compensation mode (shown in FIG. 3C). In FIG. 3C, the dolly 340 is parked close to a cylinder mid position below the crown block support structure 130. In this fast mode, 8 lines run between the crown block 118 and travelling block 120. Note that other numbers of line and sheaves can be provided on the crown block, travelling block and smart block, according to the application and other factors. FIG. 3C shows hoisting system 116 configured for passive compensation. In this case, the smart block 140 is parked within dolly 340, and dolly 340 is allowed to move with respect to crown block 118 (and

crown block structure 130) using two cylinders 150 and 152. The cylinders 150 and 152 can be fluid and/or gas filled and often connected to gas bottles 351 and 352 via an accumulator 353, thereby providing a gas spring. Gas bottles 350 and 352 and other components such as accumulators 353, dampening mechanism, coil springs, and the like may also be used for providing damped compensating movement between crown block structure 130 and dolly 240.

[0022] FIGs. 4A-4B are partial perspective views illustrating further aspects of a hoisting system with a smart block configurable for passive compensation, according to some embodiments. FIGs. 4A and 4B are show the hoisting system 116 configured for passive compensation. The dashed arrows indicate the likely movement direction of the crown block 118 and crown block structure 130 (which move together) and of smart block 140. FIG. 4A shows the system 116 in a "rig high" position, analogous to FIG. 2A, and FIG. 4B shows the system 116 in a "rig low" position, analogous to FIG. 2B.

[0023] FIG. 5. is a partial perspective view illustrating further aspects of a hoisting system with a smart block configured for passive compensation, according to some embodiments. FIG. 5 shows more clearly some of the components that may be included to add or retrofit an existing hoisting system with a smart block 140 for flexibility in hoisting capability, and including cylinders 150 and 152, dolly 340 and dolly guide rails 510 and 512 for passive compensation capability.

[0024] The techniques presented and claimed herein are referenced and applied to material objects and concrete examples of a practical nature that demonstrably improve the present technical field and, as such, are not abstract, intangible or purely theoretical. Further, if any claims appended to the end of this specification contain one or more elements designated as "means for" performing a function or a "step for" performing a function, it is intended that such elements are to be interpreted under 35 U.S.C. 112(f). However, for any claims containing elements designated in any other manner, it is intended that such elements are not to be interpreted under 35 U.S.C. 112(f).

[0025] While the disclosure may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. However, it should be understood that the disclosure is not intended to be limited to the particular forms disclosed. Rather, the disclosure is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure as defined by the following appended claims.

[0026] The techniques presented and claimed herein are referenced and applied to material objects and concrete examples of a practical nature that demonstrably improve the present technical field and, as such, are not abstract, intangible or purely theoretical. Further, if any claims appended to the end of this specification contain one or more elements designated as "means for" or "step

for" performing a function, it is intended that such elements are to be interpreted under 35 U.S.C. 112(f). However, for any claims containing elements designated in any other manner, it is intended that such elements are not to be interpreted under 35 U.S.C. 112(f).

Claims

1. A hoisting system for suspending a drilling string from a floating drilling platform or vessel, the hoisting system comprising:
 - a crown block mounted atop a derrick or mast, the crown block including a plurality of crown block sheaves and being in fixed relation to the derrick or mast;
 - a traveling block including a number of traveling block sheaves; and
 - an intermediate sheave assembly moveable between and alternatively connectable to the crown and traveling blocks, the intermediate sheave assembly further connectable to a compensation system configured to provide movement between the intermediate sheave assembly and the crown block to compensate for motion of the floating drilling platform or vessel.
2. A system according to claim 1 wherein the compensation system comprises one or more compensating cylinders.
3. A system according to claim 2 wherein the compensation system further comprises one or more accumulators and gas bottles.
4. A system according to any one of the preceding claims wherein the hoisting system is configured for a first load capacity when the intermediate sheave assembly is connected to the crown block, and the hoisting system is configured for a second higher load capacity when the intermediate sheave assembly is connected to the traveling block.
5. A system according to any one of the preceding claims wherein the hoisting system is configured for a first travel speed when the intermediate sheave assembly is connected to the crown block, and configured for a second lower travel speed when the intermediate sheave assembly is connected to the traveling block.
6. A system according to any one of the preceding claims wherein the traveling block sheaves are arranged to include a gap sized to accommodate the one or more sheaves of intermediate assembly.
7. A system according to any one of the preceding

claims wherein the motion of the floating drilling platform or vessel includes heave motion.

8. A method to compensate for motion of a floating drilling platform or vessel being transferred to a drill string that is suspended by a hoisting system mounted on the floating drilling platform or vessel and including a crown block and a travelling block, the method comprising:
 - connecting an intermediate sheave assembly to a crown block structure in fixed relationship with the crown block via a compensation system;
compensating for motion of the floating drilling platform or vessel being transferred to the drill string that is suspended by the travelling block at least in part with the compensation system by allowing vertical motion between the crown block structure and the intermediate sheave assembly.
9. A method according to claim 8 further comprising:
 - providing a first load capacity by connecting the intermediate sheave assembly to the crown block structure; and
providing a second higher load capacity by connecting the intermediate sheave assembly to the traveling block.
10. A method according to claim 9 wherein said first load capacity is associated with a first travel speed that is higher than a second travel speed associated with the second higher load capacity.
11. A method according to any one of the claims 8-10 wherein the motion of the floating drilling platform or vessel includes heave motion.
12. A method according to any one of the claims 8-11 wherein the compensation system comprises one or more compensating cylinders
13. A method according to claim 12 wherein the compensation system further comprises one or more accumulators and gas bottles.

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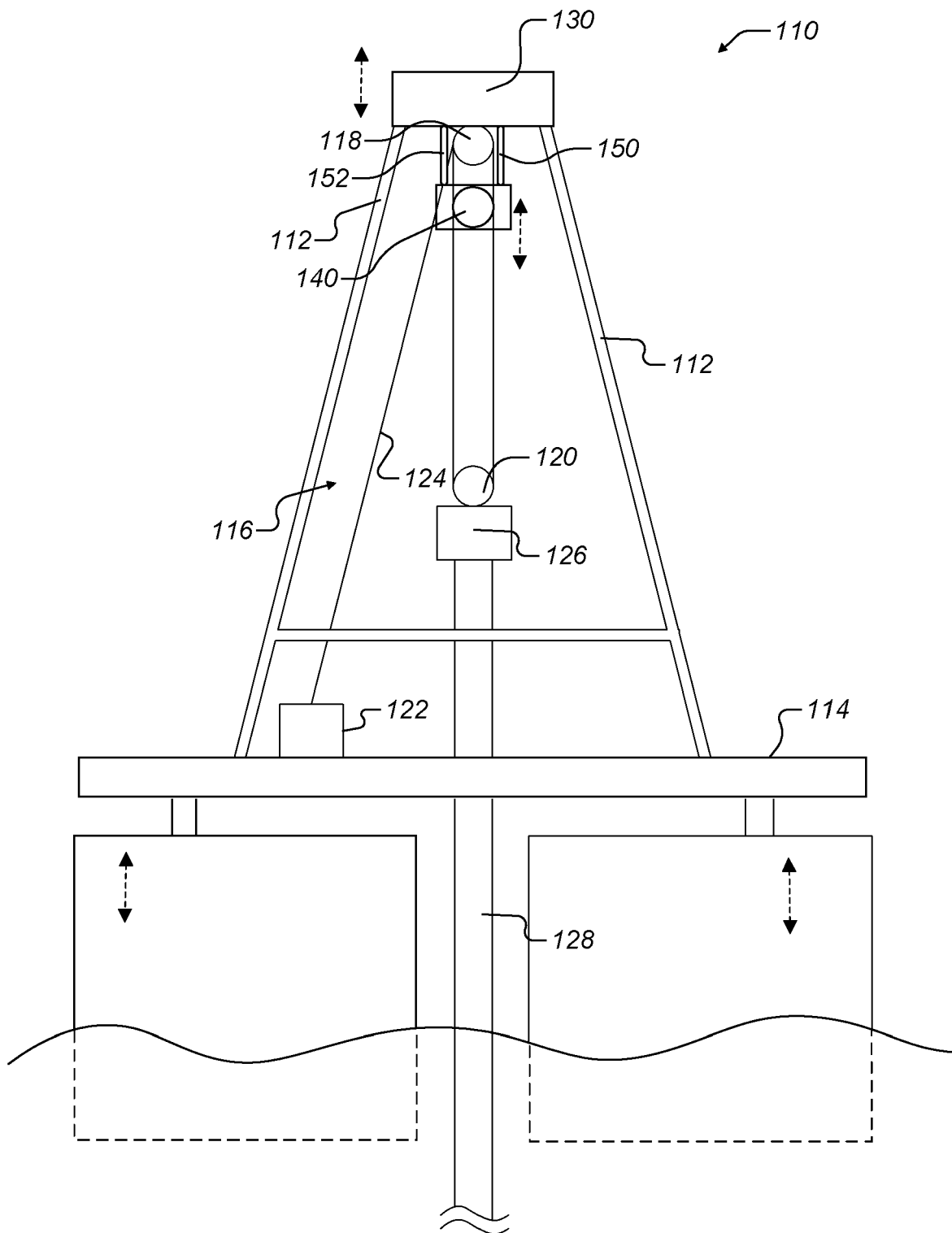


FIG. 1

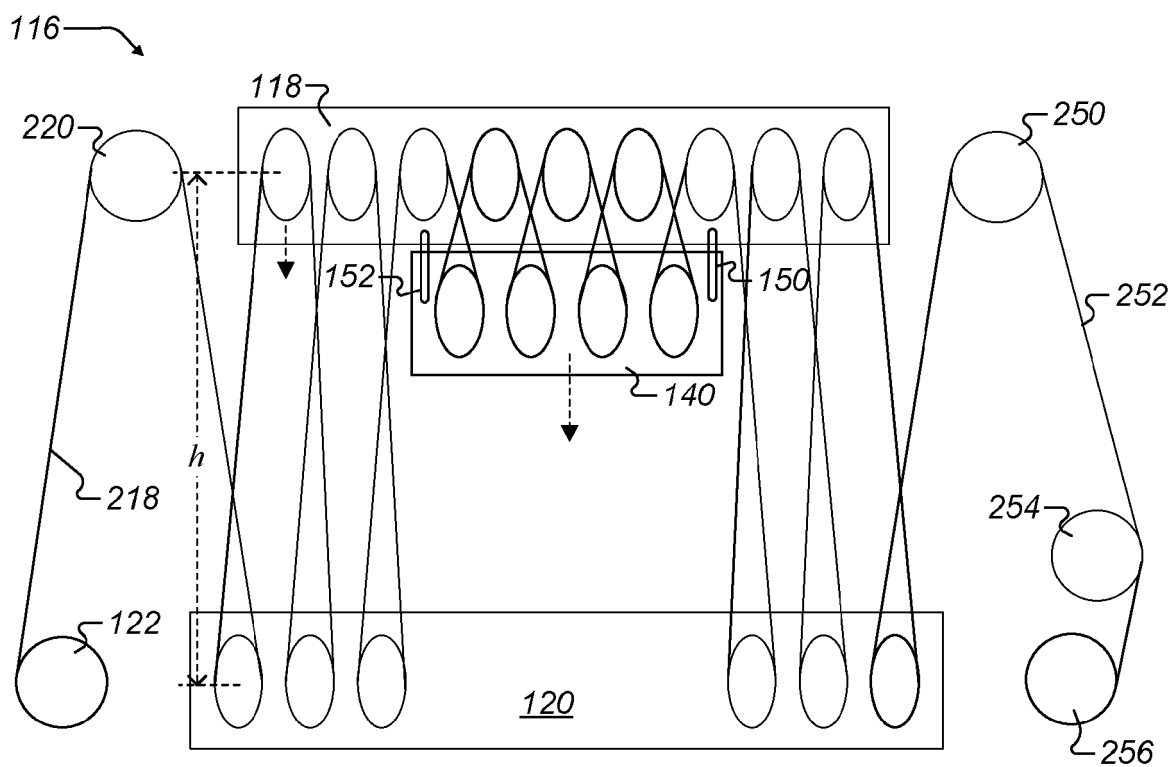


FIG. 2A

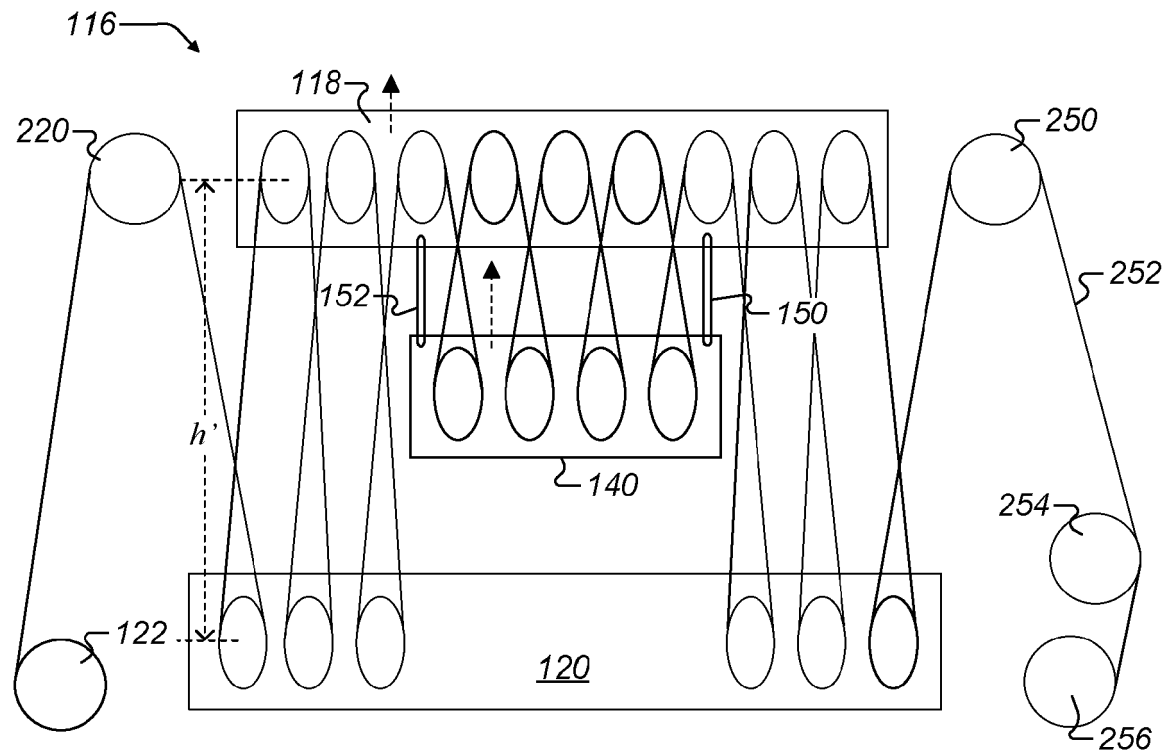


FIG. 2B

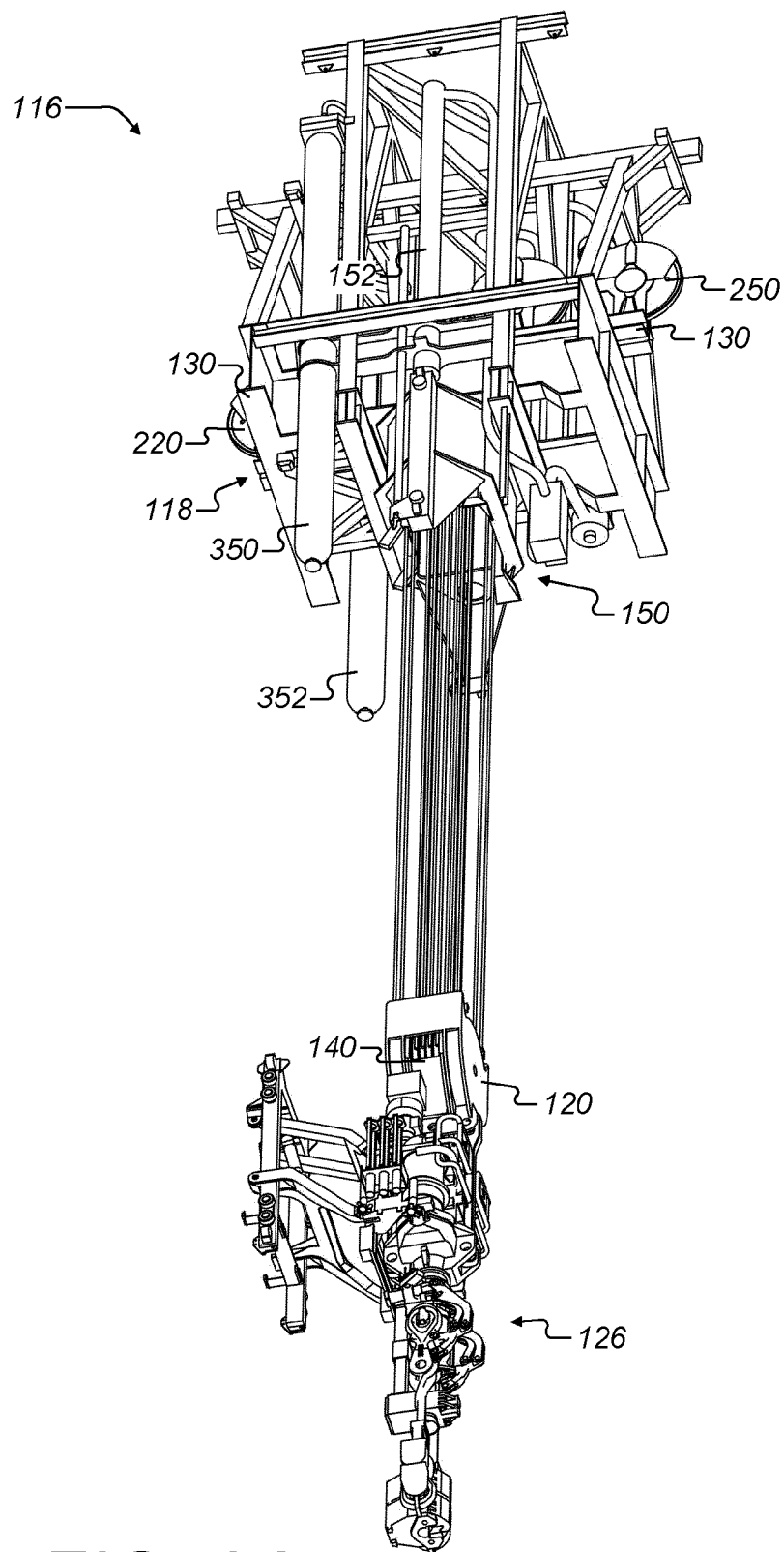
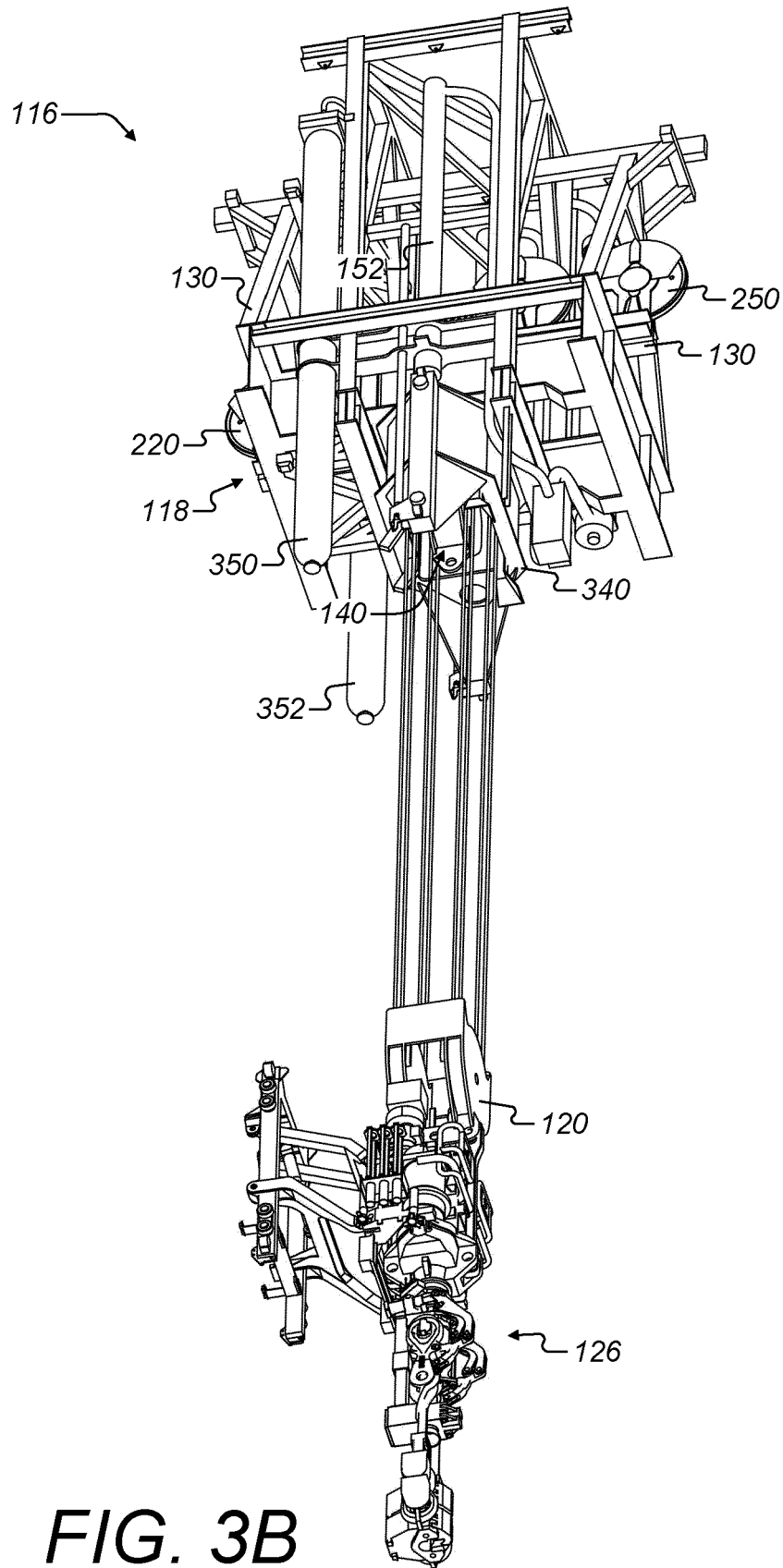


FIG. 3A



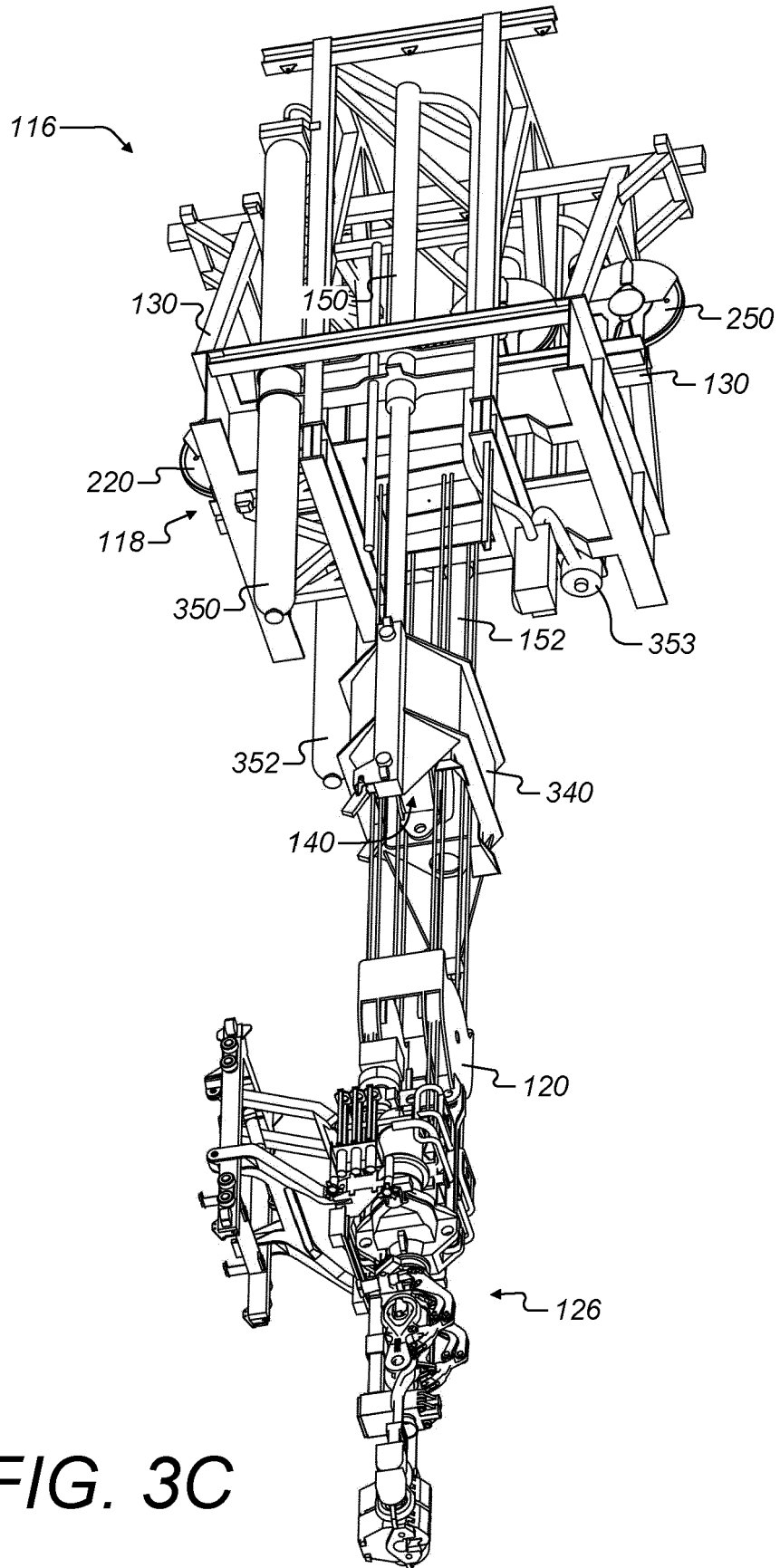


FIG. 3C

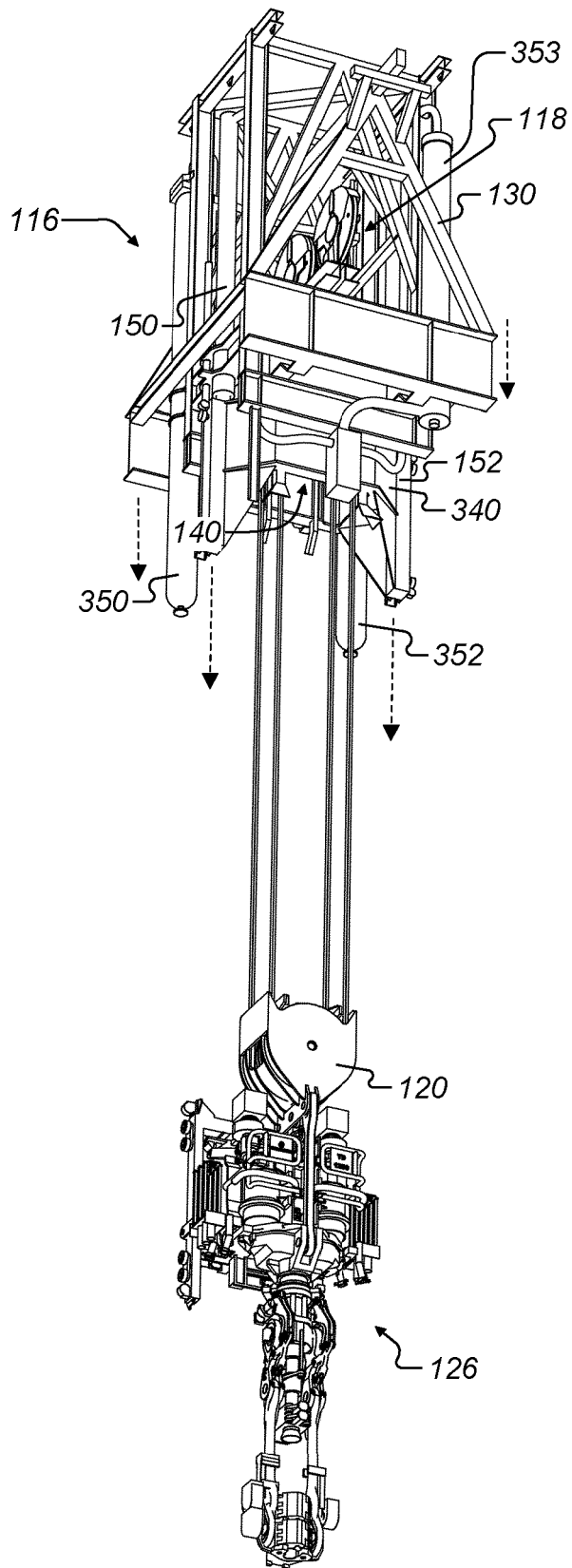


FIG. 4A

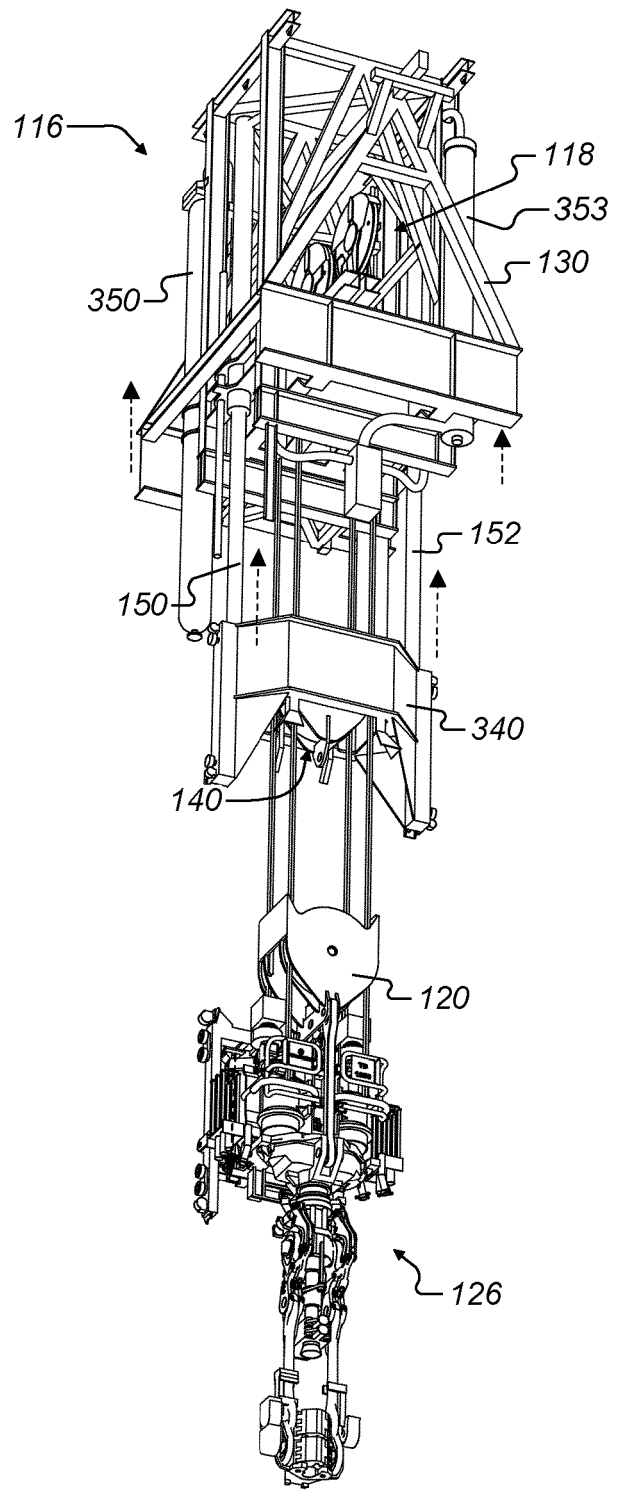


FIG. 4B

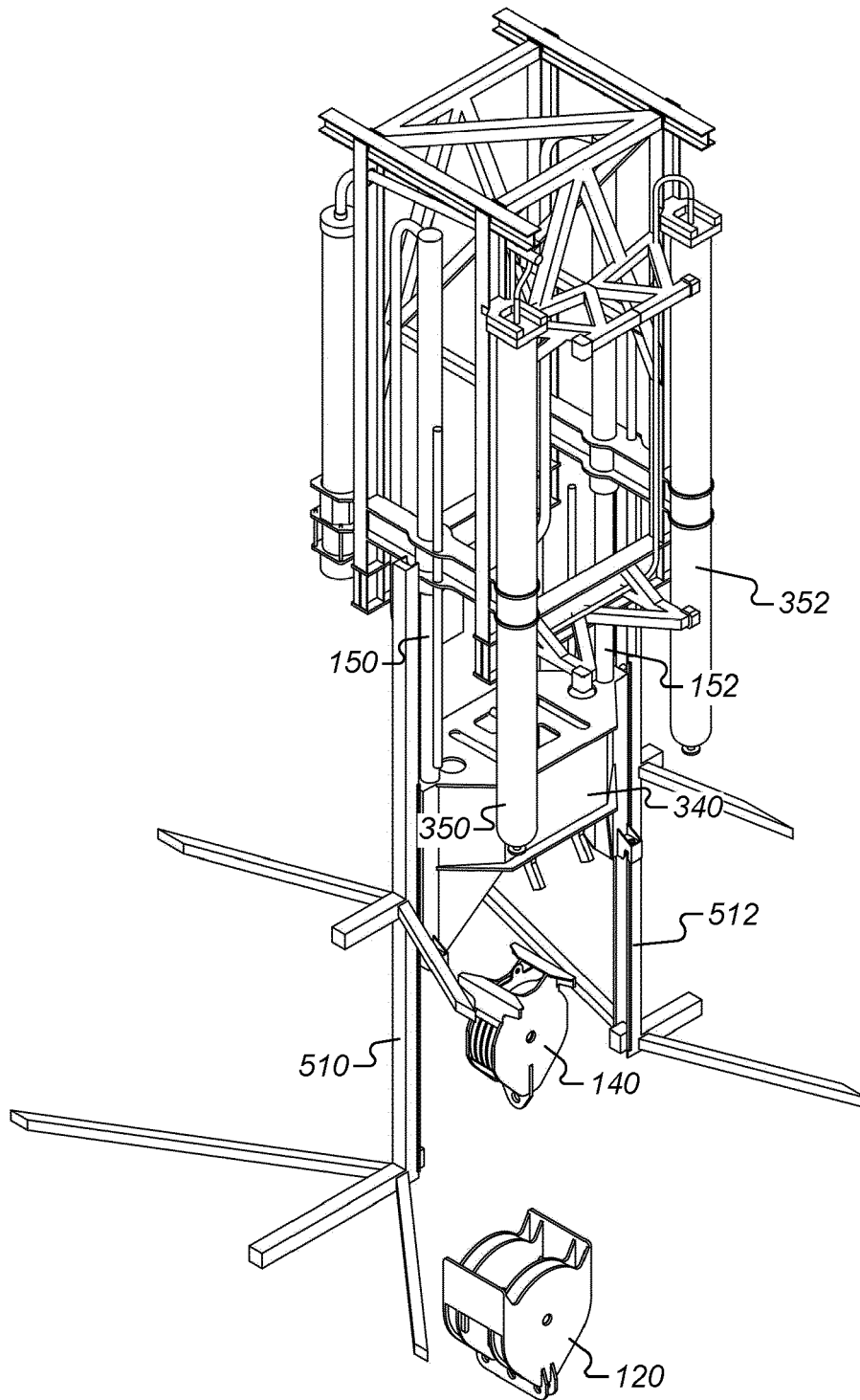


FIG. 5



EUROPEAN SEARCH REPORT

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Place of search Munich		Date of completion of the search 20 August 2020	Examiner Ing, James
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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