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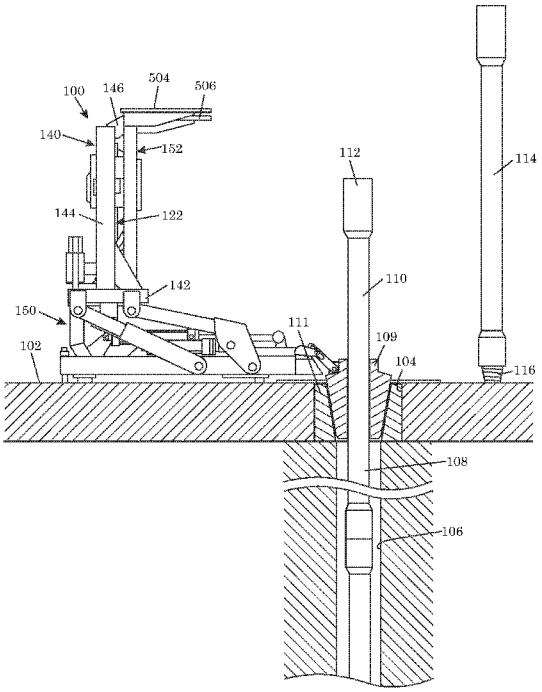

(57) Abstract: A pipe joint apparatus includes a stabbing guide configured to protect a rim of a box of a first pipe end while guiding a second pipe end into the first pipe end. At least one actuator is configured to move the stabbing guide between a non-working position where the stabbing guide does not guide the second pipe end into the first pipe end and a working position where the stabbing guide guides the second pipe end into the first pipe end.

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PIPE JOINT APPARATUS AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a non-provisional application claiming priority to U.S. Provisional Patent Application Serial Number 61/680,896, filed on August 8, 2012, entitled "Pipe Joint Apparatus and Method," which is incorporated by reference herein in its entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

BACKGROUND

Field of the Disclosure

[0003] The present disclosure relates generally to apparatus and methods for making connections between pipes. More specifically, the present disclosure relates to an apparatus and method for guiding one pipe end into another.

Background of the Technology

[0004] Operations in an oil or gas well are normally carried out using tool strings made of "pipes" and other tools. The term "pipe" encompasses any tubular good that can be included in a tool string for the purpose of carrying out an operation in a well. A drill string is an example of a tool string used for drilling a well and is made up of drill pipes and other drilling-related tools. For a drilling operation, a rotary table or power drive, arranged above the well, engages the top of the drill string and rotates the drill string to drill the borehole. Periodically, drill pipes are added to the drill string, e.g., in order to make the drill string of sufficient length to reach the desired depth of the well. Periodically, drill pipes are also removed from the drill string, e.g., in order to change the configuration of a tool, such as a drill bit, in the drill string. Drill pipes are typically added to or removed from the drill string in the form of "pipe stands." A pipe stand is made up of multiple connected pipes.

[0005] To add a new pipe stand to a pipe in a well, the new pipe stand is suspended over the pipe in the well by an elevator and then moved vertically towards the pipe in the well by draw-works. The lowermost end of the pipe stand includes a pin, and the uppermost end of the pipe in the well includes a box. To make a connection between the pipe stand and the pipe in the well, the pin has to be stabbed into the box. After the pin has been stabbed into the box, the pipe stand can be

rotated to make up the connection. However, the threads on the pin or box or the sealing areas of the pin or box can be damaged if the pin is not properly aligned with the box prior to the stabbing. To prevent this damage, a manual stabbing guide can be used to guide the pin into the box. This manual operation often requires personnel to be in close proximity to the well center during the stabbing process, which may be dangerous.

[0006] U.S. Patent No. 7,114,235 (Jansch et al.) discloses an automated pipe joining system. In this system, a wrenching assembly is positioned above and centered with a first tubular body, and a stabbing guide is mounted on and centered with the wrenching assembly. While the stabbing guide is in the open position, a second tubular body is positioned above the first tubular body and near the center of the stabbing guide. The stabbing guide has two movable semi-circular segments. In the closed position, these semi-circular segments create a substantially circular inside diameter for at least partially encircling the second tubular body. The smallest inner diameter formed by the closed stabbing guide is slightly larger than the outside diameter of the second tubular body, which permits vertical movement of the second tubular body while substantially inhibiting horizontal movement. The pin of the second tubular body is guided into the box of the first tubular body when the stabbing guide is closed.

SUMMARY

[0007] In one aspect of the present disclosure, a pipe joint apparatus includes a stabbing guide configured to protect a rim of a box end of a first pipe end while guiding a second pipe end into the first pipe end. At least one actuator is configured to move the stabbing guide between a non-working position where the stabbing guide does not guide the second pipe end into the first pipe end and a working position where the stabbing guide guides the second pipe end into the first pipe end.

[0008] In one aspect of the present disclosure, a pipe joint apparatus includes a stabbing guide having a pipe guard that is movable between a non-working position and a working position. In the working position, the pipe guard defines a first hole, a seat above the first hole, and a second hole above the seat that is axially aligned with the first hole. At least one actuator is coupled to the pipe guard for moving the pipe guard between the non-working position and the working position.

[0009] In one embodiment, the at least one actuator is remotely operable.

[0010] In one embodiment, the pipe guard comprises a pair of jaws. Each of the jaws has a first inner surface, a second inner surface, and a third inner surface. The jaws are movable between an open position corresponding to the non-working position and a closed position corresponding to the working position. In the closed position, the first inner surfaces define the first hole, the second inner surfaces define the seat, and the third inner surfaces define the second hole.

[0011] In one embodiment, the jaws are made of a material softer than steel.

[0012] In one embodiment, the stabbing guide further comprises a retainer removably coupled to the pipe guard. The retainer is made of a harder material than that of the pipe guard and provides support to the pipe guard.

[0013] In one embodiment, the pipe guard comprises a pair of jaws as described above and the retainer comprises a pair of retainer ring halves. Each of the jaws is coupled to one of the retainer ring halves via a removable joint, making the jaws disposable.

[0014] In one embodiment, the at least one actuator is coupled to the pair of retainer ring halves and rotation of the pair of ring halves by the at least one actuator moves the jaws between the open and closed positions.

[0015] In one embodiment, the pipe joint apparatus further includes a positioning mechanism coupled to the stabbing guide and operable to selectively translate and rotate the stabbing guide along and about a select axis.

[0016] In one embodiment, the pipe joint apparatus further includes a lubricator configured to sit on a pipe end and deliver a lubricant to the pipe end. The positioning mechanism is coupled to the lubricator and operable to selectively translate and rotate the lubricator along and about the select axis.

[0017] In one embodiment, the lubricator is spatially separated from the stabbing guide to allow selective positioning of the stabbing guide and lubricator at a select location by the positioning mechanism.

[0018] In one embodiment, the pipe joint apparatus further includes a translation mechanism for moving the stabbing guide, the lubricator, and the positioning mechanism between a parked position where the stabbing guide and lubricator cannot be selectively positioned at the select location and a use position where the stabbing guide and lubricator can be selectively positioned at the select location.

[0019] In another aspect of the present disclosure, a method of guiding pipes on a drill floor includes suspending a first pipe within a hole in the drill floor such that a pipe end of the first pipe protrudes above the hole. The method includes suspending a second pipe such that a pipe end of the second pipe is above the pipe end of the first pipe. The method includes positioning a stabbing guide on the pipe end of the first pipe and actuating a pipe guard of the stabbing guide to a working position where the pipe guard defines a first hole in which the pipe end of the first pipe is received, a seat above the first hole that sits on a rim of the pipe end of the first pipe, and a second hole above the seat and axially aligned with the first hole. The method includes lowering the pipe end of the second pipe through the second hole into the pipe end of the first pipe while the pipe guard protects the rim of the pipe end of the first pipe from substantial contact with the pipe end of the second pipe.

[0020] In one embodiment, the method includes centering the second pipe with the first pipe prior to lowering the pipe end of the second pipe into the pipe end of the first pipe.

[0021] In one embodiment, the method includes delivering a lubricant to the pipe end of the first pipe prior to positioning the stabbing guide on the pipe end of the first pipe.

[0022] It is to be understood that both the foregoing general description and the following detailed description are exemplary of the disclosure and are intended to provide an overview or framework for understanding the nature and character of the disclosure as it is claimed. The accompanying drawings are included to provide a further understanding of the disclosure and are incorporated in and constitute a part of this specification. The drawings illustrate various embodiments of the disclosure and together with the description serve to explain the principles and operation of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The following is a description of the figures in the accompanying drawings. The figures are not necessarily to scale, and certain features and certain views of the figures may be shown exaggerated in scale or in schematic in the interest of clarity and conciseness.

[0024] FIG. 1 shows a schematic of a pipe joint apparatus and related mechanisms on a drill floor in a parked position.

[0025] FIG. 2 shows a side view of the pipe joint apparatus, with some related mechanisms removed or shown partially.

[0026] FIG. 3 shows a top view of the pipe joint apparatus, with some related mechanisms removed.

[0027] FIG. 4 shows the lubricator of the pipe joint apparatus in the working position.

[0028] FIG. 5 shows the stabbing guide of the pipe joint apparatus in the working position.

[0029] FIG. 6 shows a cross-section of the stabbing guide.

[0030] FIG. 7A shows the stabbing guide in the working position relative to a box and a pin.

[0031] FIG. 7B is an enlargement of area 7B of FIG. 7A.

[0032] FIG. 8 shows a top view of the pipe joint apparatus, with some related mechanism removed and the stabbing guide and lubricator coupled to a positioning mechanism.

[0033] FIG. 9 shows a cross-section of the lubricator in a working position.

[0034] FIG. 10 shows a translation mechanism for moving the pipe joint apparatus between parked and use positions.

[0035] FIG. 11 shows a centralizer mechanism for centering a pipe.

[0036] FIG. 12 shows a top view of the pipe joint apparatus with centralizer arms of the centralizer mechanism in a non-constraining position.

[0037] FIG. 13 shows a top view of the pipe joint apparatus with centralizer arms of the centralizer mechanism in a constraining position.

[0038] FIG. 14A-14L illustrates a process of making a pipe connection.

[0039] FIG. 15 is a control system for the pipe joint apparatus.

DETAILED DESCRIPTION

[0040] In the following detailed description, numerous specific details may be set forth in order to provide a thorough understanding of embodiments of the disclosure. However, it will be clear to one skilled in the art when embodiments of the disclosure may be practiced without some or all of these specific details. In other instances, well-known features or processes may not be described in detail so as not to unnecessarily obscure the disclosure. In addition, like or identical reference numerals may be used to identify common or similar elements.

[0041] FIG. 1 shows a pipe joint apparatus 100 mounted on a drill floor 102. The pipe joint apparatus 100 is movable between a parked position remote from a hole 104 in the drill floor 102 and a use position proximate the hole 104. The pipe joint apparatus 100 is shown in the parked position in FIG. 1. Below the hole 104 is a well 106. A tool string 108, such as a drill string, is

suspended in the well 106 by means such as slips 109 in a rotary table 111. Protruding above the hole 104 is a pipe 110, which is part of the tool string 108 and may be one of many pipes in the tool string 108. The pipe 110 has a box 112. A "box" in pipe terminology is "an internal (female) threaded end." Off to the side of the hole 104 is a pipe 114 to be joined to the pipe 110. The pipe 114 may be a standalone pipe or may be part of a pipe stand. Several of such pipes, or pipe stands, may be arranged on a rack (not shown) in preparation for joining them to the tool string 108 suspended in the well 106. The pipe 114 has a pin 116. A "pin" in pipe terminology is "an external (male) threaded end" of the pipe. The box 112 has an inner receptor shaped like the pin 116. A connection can be made between the pipes 110, 114 by stabbing the pin 116 into the box 112 and tightening the threads between the box 112 and pin 116.

[0042] FIG. 2 shows that the pipe joint apparatus 100 includes a stabbing guide 118 and a lubricator 120. The pipe joint apparatus 100 can be operated to vertically align the stabbing guide 118 or the lubricator 120 with the box 112 (in FIG. 1) in order to perform a pipe joint apparatus function. The stabbing guide 118 provides the pipe joint apparatus function of guiding the pin 116 (in FIG. 1) into the box 112. The guiding may be a precursor to the actual stabbing of the pin 116 into the box 112. The lubricator 120 provides the pipe joint apparatus function of delivering lubricant or "dope" to the box 112 before the pin 116 is stabbed into the box 112. The box 112 will share the lubricant with the pin 116 while the threads between the box 112 and pin 116 are tightened. The pipe joint apparatus 100 includes a positioning or translation mechanism, generally indicated at 122, for placing the stabbing guide 118 and lubricator 120 in their working positions relative to the box 112. The positioning mechanism 122 provides a combination of rotary and linear motions to position the stabbing guide 118 and lubricator 120 at their working or non-working positions.

[0043] In one embodiment, the positioning mechanism 122 includes a linear actuator 124 that provides linear motion along a vertical axis Y. Two arms 126, 128 are coupled to the linear actuator 124 (also see FIG. 8). The first arm 126 is attached to the stabbing guide 118, and the second arm 128 is attached to the lubricator 120. Coupling of the two arms 126, 128 to the linear actuator 124, in one embodiment, involves attaching the first arm 126 to the linear actuator 124 and attaching the second arm 128 to the first arm 126. Thus the two arms 126, 128 form a compound arm that is coupled to the linear actuator 124. In an alternate embodiment, each of the arms 126, 128 may be separately attached to the actuator 124. In general, any manner of

coupling the stabbing guide 118 and lubricator 120 may be used. Typically, the coupling of the stabbing guide 118 and the lubricator 120 to the linear actuator 124 would be such that any motion provided by or acting on the linear actuator 124 can be simultaneously applied to the stabbing guide 118 and lubricator 120. This may simplify control of the positioning mechanism 122.

[0044] The shapes of the arms 126, 128 may be such that the stabbing guide 118 and lubricator 120 are generally diametrically opposed about the vertical axis Y (also see FIG. 8). The shapes of the arms 126, 128 may also be such that a common horizontal plane H can intersect both the stabbing guide 118 and lubricator 120, i.e., the stabbing guide 118 and lubricator 120 are generally at about the same level relative to the vertical axis Y. These factors may lend symmetry to the system that can be exploited when designing the control for the positioning mechanism 122. However, diametric opposition and common horizontal plane are not to be taken as restrictions on coupling of the stabbing guide 118 and lubricator 120 to the linear actuator 124. It is possible for the angle between the stabbing guide 118 and lubricator 120 to be less than 180 degrees in a selected horizontal plane and/or for the stabbing guide 118 and lubricator 120 to not be at positions where they can both be intersected by a common horizontal plane.

[0045] The linear actuator 124 can be operated to move the arms 126, 128 linearly along the vertical axis Y, where the stabbing guide 118 and lubricator 120 will move with the arms 126, 128. The linear actuator 124 can have any suitable configuration to provide the linear motion to the arms 126, 128. In one example, the linear actuator 124 includes a conveyor 130, such as a belt conveyor, that moves along the vertical axis Y and a fixture 132 that is coupled to the conveyor 130. The arms 126, 128 are coupled to the fixture 132. In another example, the linear actuator 124 includes a track that is oriented along the vertical axis Y and a carriage that travels along the track. In this second example that is not shown, the arms 126, 128 would be coupled to the traveling carriage. There are other types of linear actuators besides those mentioned above, e.g., a fluid-powered piston cylinder or screw-type linear actuator. The linear actuator 124 may respond to external control signals, which would allow for remote or automated control of the position of the arms 126, 128, and hence the position of the stabbing guide 118 and lubricator 120, along the vertical axis Y. The external control signals may take on any suitable form, e.g., mechanical, electrical, or radio. The stabbing guide 118 and lubricator 120 may have proximity

sensors (not shown) to assist in determining when to stop moving the arms 126, 128. Alternatively, appropriately positioned mechanical stops can assist in determining when to stop moving the arms 126, 128.

[0046] The positioning mechanism 122 further includes a rotary actuator 134, whose output shaft or pin is coupled to the linear actuator 124. The rotary actuator 134 may be mounted below the linear actuator 124, as shown, or above the linear actuator 124. The rotary actuator 134 can have any suitable configuration to provide rotary motion. For example, the rotary actuator 134 may be an electric motor. The rotary actuator 134 can be operated to impart rotary motion on the linear actuator 124 such that the linear actuator 124 is rotated about the vertical axis Y by a predetermined rotational angle. As the linear actuator 124 is rotated, the arms 126, 128 to which the stabbing guide 118 and lubricator 120 are attached, respectively, will also be rotated. The angle of rotation can be selected such that either of the stabbing guide 126 and lubricator 128 is vertically aligned with the box (112 in FIG. 1). The rotary actuator 134 may respond to external control signals, which would allow for remote or automated control of the placement of the stabbing guide 118 or lubricator 120 above the box 112. The external control signals may take on any suitable form, e.g., mechanical, electrical, or radio.

[0047] FIG. 3 shows the stabbing guide 118 and lubricator 120 in a non-working position. Here, neither of the stabbing guide 118 and lubricator 120 is aligned with the box 112. The rotary actuator 134 (see FIG. 2) can be operated to rotate the lubricator 120 from the non-working position to an intermediate position where the lubricator 120 is above and centered with the box 112 (see FIG. 4). In FIG. 4, the box 112 is covered by the lubricator 120. Afterwards, the linear actuator 124 (see FIG. 2) can be operated to move the lubricator 120 towards the box 112 and into the working position on the box 112, where the lubricator 120 will be able to deliver lubricant to the box 112. This sequence will be reversed to move the lubricator 120 back to the non-working position. Similarly, the rotary actuator 134 can be used to the rotate the stabbing guide 118 to an intermediate position where the stabbing guide is above and centered with the box 112 (see FIG. 5). Then, the linear actuator 124 can be used to move the stabbing guide 118 to the working position on the box 112. Proximity sensors or mechanical stops may assist in placing the stabbing guide 118 and lubricator 120 in their working positions.

[0048] FIG. 6 shows that the stabbing guide 118 has a pipe guard 200 made of two jaws 200a, 200b that may be operated to encircle a box. The jaw 200a has an inner wall 202a that is made of

an upper tapered section 202a1, an upper vertical section 202a2, and a lower vertical section 202a3. The lower vertical section 202a3 is recessed relative to the upper vertical section 202a2, resulting in a horizontal shoulder 202a4 between them. Similarly, the jaw 200b has an inner wall 202b that is made of an upper tapered section 202b1, an upper vertical section 202b2, and a lower vertical section 202b3, with a horizontal shoulder 202b4 between the upper vertical section 202b2 and the lower vertical section 202b3.

[0049] In the working position of the stabbing guide 118, the jaws 200a, 200b are brought together, i.e., moved to the closed position, such that the inner walls 202a, 202b are opposing and form an encircling wall 211. In this position, the surfaces of the lower vertical sections 202a3, 202a4 define a hole 203 in which a box can be received. The surfaces of the upper tapered sections 202a1, 202b1 and the upper vertical sections 202a2, 202b2 define a hole 204 in which a pin can be received. The hole 204 is axially aligned with the hole 203. The hole 204 is shaped to encourage a pin to fall into alignment with a box that is received in the hole 203. For example, the hole 204 may have a funnel shape. Also in the working position of the stabbing guide 118, the horizontal shoulders 202a4, 202b4 form a seat 205 that is designed to sit on the rim of a box received in the hole 203. The seat 205 is between the holes 203, 204. The seat 205 is generally annular in shape and will substantially cover the rim such that when the pin is being inserted into the box, the pipe guard will prevent substantial contact between the pin and the rim of the box.

[0050] The stabbing guide 118 also has a retainer 214 in which the pipe guard 200 is held. The retainer 214 is made of two retainer ring halves 214a, 214b. The jaws 200a, 200b are mounted on the inner surfaces of the retainer ring halves 214a, 214b, respectively, via removable joints, such as tongue-and-groove joints 216a, 216b. This arrangement allows the jaws 200a, 200b to be replaceable. The jaws 200a, 200b are made of a relatively soft material whereas the ring halves 214a, 214b are made of a relatively hard material 214a, 214b. Thus the retainer ring halves 214a, 214b provide support to the jaws 200a, 200b. The material of the jaws 200a, 200b will also be selected to be softer than the material of the pipes or the box and pin. This is so that if the pin hits the jaws 200a, 200b as it is being lowered into the box, any damage will be taken by the jaws 200a, 200b rather than by the pin. Typically, the pipes or the box and pin and the stabbing guide 118 will be made of a hard material such as steel. The jaws 200a, 200b can be made of a softer material such as plastic or soft metal, e.g., aluminum. In general, the material of the jaws 200a, 200b will be softer than steel.

[0051] Ears 206a, 206b, which are best seen in FIG. 8, are attached to the retainer ring halves 214a, 214b, respectively. The ears 206a, 206b are also coupled to a support plate 208 via pivot joints 210a, 210b. An actuator 212 is coupled to both of the ears 206a, 206b to rotate the ears about the pivot joints 210a, 210b, respectively. In alternate embodiments, it is possible for each ear 206a, 206b to have its own actuator. The actuator 212 may be a linear actuator, such as a trunnion cylinder, whose linear motion will cause the ears 206a, 206b to be rotated about the pivot joints 210a, 210b. In one embodiment, the actuator 212 can respond to external control signals, which would allow remote or automated control of rotation of the ears 206a, 206b. The external control signals may take on any suitable form, e.g., mechanical, electrical, or radio.

[0052] Because the retainer ring halves 214a, 214b carry the jaws 200a, 200b, rotation of the ears 206a, 206b about the pivot joints 210a, 210b will result in rotation of the jaws 200a, 200b about the same pivot joints. By this arrangement, the jaws 200a, 200b can be moved between their open and closed positions. In the open position, the jaws 200a, 200b are separated from each other, as shown, for example, in FIG. 4. In the closed position, the jaws 200a, 200b are brought together, as shown, for example, in FIG. 8. In the closed position, the jaws 200a, 200b form the holes 203, 204 (in FIG. 6) and seat 205 (in FIG. 6) mentioned above. The normal position of the jaws 200a, 200b is the open position. The jaws 200a, 200b are actuated to the closed position when the stabbing guide 118 is mounted on a box to provide a protective guiding function.

[0053] FIG. 7A shows the stabbing guide 118 in the working position relative to the box 112 and pin 116. Here, the stabbing guide 118 has been positioned on the box 112 via a combination of linear and rotational motions provided by the positioning mechanism 122 (in FIG. 2), and the actuator 212 has been operated to move the jaws 200a, 200b into the closed position. The box 112 is received in the lower hole 203 formed by the closed jaws 200a, 200b. The jaws 200a, 200b may or may not grip the box 112 in this position. The jaws 200a, 200b sit on the rim 112a of the box 112 via the annular seat 205 formed by the closed jaws 200a, 200b while the pin 116 is being inserted into the box 112 via the upper hole 204 formed by the closed jaws 200a, 200b. In one embodiment, the jaws 200a, 200b cover the rim 112a of the box 112 as the pin 116 is being guided into the box 112 by the upper hole 204. In a preferred embodiment, the inner diameter of the annular seat 205 formed by the closed jaws 200a, 200b is at least equal to the inner diameter of the rim 112a of the box 112 such that the jaws 200a, 200b completely cover the

rim 112a of the box 112 as the pin 116 is being guided into the box 112. As shown in FIG. 7B, if x is the radial difference between the inner diameter of the annular seat 205 and the inner diameter of the rim 112a, then x is equal to or greater than zero.

[0054] FIG. 9 shows that the lubricator 120 has a drum 300, which is arranged inside a generally cylindrical housing 302. The drum 300 is of a smaller diameter than the housing 302 such that an annulus 304 is defined between them. This annulus 304 is large enough to receive the wall of the box 112. At the top of the housing 302 is a cap 306, which has a conduit 308 that runs into the inside of the drum 300. A shaft 310 is inserted into the drum 300 through the conduit 308. The upper end 312 of the shaft 310 is coupled to a rotary actuator 314 above the cap 306. The rotary actuator 314 may be an electrical motor or any other actuator capable of rotating the shaft 310. In one embodiment, the rotary actuator 314 can respond to external control signals, which would allow remote or automated control of the rotation of the shaft 310. The external control signals may take on any suitable form, e.g., mechanical, electrical, or radio. The lower end 316 of the shaft 310 is coupled to the lower end of the drum 300 in a manner that allows the shaft 310 to be rotated within the drum 300.

[0055] The cap 306 has a port 317 that is in communication with the inside of the drum 300 and through which lubricant or "dope" can be delivered to the inside of the drum 300. A tubing 318 couples the port 317 to a lubricant source (not shown), which may be located remotely from the lubricator 120. The drum 300 is perforated or has pores 320. Lubricant 322 received inside the drum 300 is distributed about the drum 200 and squeezed out of the pores 320 of the drum 300 via centrifugal force, which is provided by rotation of the shaft 310. In use, the lubricator 120 is vertically aligned with the box 112 using the rotary actuator 134 (in FIG. 2). The lubricator 120 is then lowered onto the box 112 using the linear actuator 124 (in FIG. 2) such that the wall of the box 112 fits into the annulus 304 and the housing 302 sits on the rim of the box 112. The thread of the box 112 will be in opposing relation to the drum 300 and will be lubricated via centrifugal force as mentioned above. Alternatively, other lubricators besides lubricator 120 may be used with apparatus 100. For instance, lubricators described in U.S. Patent Application Serial No. 61/807,676 may be used, which is herein fully incorporated in its entirety by reference for all that the patent application discloses. For instance, lubricator 142 shown in Figure 3D of that application may be used in lieu of lubricator 120. Further, coupler apparatus 200 shown in Figure 7 of that application may also be used in lieu of lubricator 120.

[0056] FIG. 2 shows that the positioning mechanism 122, stabbing guide 118, and lubricator 120 are supported on a frame structure 140 including a base frame 142 and a vertical frame 144. A bracket 146 is attached to the top of the vertical frame 144, and the top end of the linear actuator 124 is coupled to the bracket 146 via a rotary joint 148. The bottom end of the linear actuator 124 is coupled to the rotary actuator 134, which is coupled to or mounted on the base frame 142. The frame structure 140 is movable between the parked position and the use position via another translation mechanism 150 coupled to the base frame 142. The translation mechanism 150 can be any suitable mechanism capable of moving an object between two positions, typically along a linear direction. In one embodiment, for safety and efficiency reasons, the translation mechanism 150 can be operated remotely or automatically. One embodiment of the translation mechanism 150 is shown in FIGS. 1 and 10. Alternatively, the base 190 shown in Figures 6A and 6B of the incorporated U.S. Patent Application Serial No. 61/807,676 may be used in lieu of frame structure 140.

[0057] FIG. 10 shows a platform 400 secured to the drill floor 102 in parallel to the base frame 142. The translation mechanism 150 is arranged between and coupled to the base frame 142 and the platform 400. In one embodiment, the translation mechanism 150 is configured as a linkage mechanism having a rear linkage 401 arranged at the rear of the base frame 142 and a front linkage 402 arranged at the front of the base frame 142. The translation mechanism 150 may have a pair of rear linkages and a pair of front linkages for a stable system. The rear linkage 401 has a link 404 that is coupled to the base frame 142 by a pivot joint 408 and a link 406 that is coupled to the platform 400 by a pivot joint 410. The two links 406, 408 may be coupled together by a slider or fixed joint. The front linkage 402 has a link 412 that is coupled to the base frame 142 by a pivot joint 416 and a link 414 that is coupled to the platform 400 by a pivot joint 418. The two links 412, 414 may be coupled together by a slider or fixed joint.

[0058] In one embodiment, a linear actuator 420 is coupled to the link 414 of the front linkage 402 by a pivot joint 422. The linear actuator 420 can be operated to apply a push or pull force to the link 414 depending on the direction in which the base frame 142 is to be moved. The push or pull force will cause the front linkage 402 to rotate about the pivot joint 418. As the front linkage 402 rotates clockwise, the base frame 142, which is coupled to the front linkage 402, will move to the right, i.e., in a direction towards the hole 104 (in FIG. 1) or towards the use position. Similarly, as the front linkage 402 rotates counterclockwise, the base frame 142 will move to

left, i.e., in a direction away from the hole 104 or towards the parked position. The moving base frame 142 will cause the rear linkage 401 to rotate about the pivot joint 410 in the same direction that the front linkage 402 is rotating. Any suitable linear actuator 420 may be used to apply a push or pull force to the link 414. The linear actuator 420 may be a fluid-powered piston cylinder, for example, where the piston may be coupled to the link 414 and the cylinder may be fixed to the platform 400.

[0059] FIG. 1 shows that a centralizer mechanism 152 may be used with the pipe joint apparatus 100. The centralizer mechanism 152 will assist in generally centering the pipe 114 with the pipe 110 above the box 112 prior to using the stabbing guide 118 to guide the pin 116 into the box 112. In one embodiment, as shown in FIG. 11, the centralizer mechanism 152 has two support arms 500, 502, which in use are arranged on opposite sides of the vertical frame 144 (in FIGS. 1 and 2). The support arms 500, 502 are coupled to the base frame 142 via pivot joints 514, 516. The support arms 510, 502 are also coupled to a plate 518 mounted on the base frame 142 via actuators 520, 522. The actuators 520, 522 can be operated to rotate the support arms 500, 502 towards or away from each other. The actuators 520, 522 may be linear actuators, whose extensions will rotate the support arms 500, 502 about the pivot joints 514, 516. In general, rotation of the support arms 500, 502 will be in opposing directions. In one embodiment, the actuators 520, 522 can respond to external control signals, which would allow remote or automated control of the rotation of the support arms 500, 502. The external control signals may take on any suitable form, e.g., mechanical, electrical, or radio.

[0060] Each support arm 500, 502 carries a centralizer arm 504, 506, respectively. As shown in FIG. 11, the centralizer arms 504, 506 have inner surfaces 508, 510, respectively, which are in opposing relation. The centralizer arms 504, 506 have a non-constraining position and a constraining position. In the non-constraining position (shown in FIG. 12), the centralizer arms 504, 506 do not overlap and there is a wide space between the inner surfaces 508, 510. In the constraining position (shown in FIG. 13), the centralizer arms 504, 506 overlap such that an opening 524 (in FIG. 3) is defined between the inner surfaces 508, 510 for receiving and constraining the pipe 114. The opening for receiving and constraining the pipe 114 will be vertically aligned with the pipe 110 suspended in the drill floor so that the pipe 114 can be generally centered with the pipe 110 prior to guiding the pin 116 of the pipe 114 into the box 112 of the pipe 110. The centralizer arms 504, 506 constrain the pipe 114 by limiting the extent to

which the pipe 114 can travel horizontally or laterally. The centralizer arms 504, 506 are moved between the non-constraining and constraining positions by rotation of the support arms 500, 502.

[0061] FIGS. 14A-14L show a process of forming a connection between two pipes with the aid of the pipe joint apparatus 100. In FIG. 14A, the pipe joint apparatus 100 is in the parked position. In FIG. 14B, the pipe joint apparatus 100 has been moved to the use position. The centralizer arms 504, 506 are extended over the box 112 of the pipe 110 in this position. In FIG. 14C, the lubricator 120 has been rotated so that it is positioned above and vertically aligned with the box 112. In FIG. 14D, the lubricator 120 has been lowered onto the box 112 and is delivering lubricant to the box 112. In FIG. 14E, the lubricator 120 has been lifted off the box 112. In FIG. 14F, the stabbing guide 118 has been rotated so that it is positioned above and centered with the box 112. In FIG. 14G, the stabbing guide 118 has been lowered onto the box 112. In FIG. 14H, the pipe 114 has been picked up from its rest position and is about to be placed in between the centralizer arms 504, 506. In FIG. 14I, the pipe 114 has been constrained between the centralizer arms 504, 506 and is now generally centered with the pipe 110.

[0062] FIG. 14J shows the pin 116 of the pipe 114 guided into the box 112 of the pipe 110 through the stabbing guide 118. FIG. 7A shows the relationship between the pin 116, box 112, and the stabbing guide 118 during this process. Here, the stabbing guide 118 sits on top of the box 112 via the seat 205 formed by the closed jaws 200a, 200b. The box 112 is received in the hole 204 formed by the closed jaws 200a, 200b, and the pin 112 is guided in the box 112 by the hole 203, also formed by the closed jaws 200a, 200b. In FIG. 14K, the stabbing guide 118 has been removed from the box 112 and returned to the non-working position so that stabbing of the pin 116 into the box 112 can be completed. In FIG. 14L, the threaded connection between the pin 116 and box 112 has been made and the pipe joint apparatus 100 has been returned to the non-working position. The threaded connection may be made by an iron roughneck or other apparatus that can provide the torque needed to tighten the threads between the pin 116 and box 112.

[0063] FIG. 15 shows a control system 600 that can be used for automatic operation of the pipe joint apparatus 100 (in FIG. 1). The control system 600 may include a controller 602 that sends signals to the actuators 124, 134, 212, 314, 420 associated with operation of the pipe joint apparatus 100. The controller 602 may also receive signals from the actuators, e.g., so that the

controller 602 knows that a certain action has been completed before the controller 602 issues the next command. In one embodiment, the controller 602 is implemented as a computer system. In one configuration, the computer system may include a processor 604, memory 606, display 608, communications interface (or device(s)) 610, and input interface (or device(s)) 612. The controller 602 can receive input from a user via the input interface 612 and communicate with the actuators and sensors associated with the pipe joint apparatus 100 via the communications interface 610. The controller 602 may include a program that is stored in memory 606 or another computer-readable media 614 and executed by the processor 604. The program may include instructions for executing the process described above with reference to FIGS. 14A-14L. The controller 602 may be a separate system or part of a larger system used on the drill floor to control various operations.

[0064] It is envisioned that the pipe joint apparatus 100 can be controlled remotely or automatically so that it is not necessary for personnel to be near the well center, or hole in the drill floor, while potentially dangerous operations such as stabbing are being performed. The stabbing guide of the pipe joint apparatus 100 is configured to sit on the rim of a box so that it protects the rim of the box while a pin is being inserted into the box. By protecting the rim of the box, the stabbing guide also protects the pin.

CLAIMS

1. A pipe joint apparatus, comprising:

a stabbing guide configured to protect a rim of a box of a first pipe end while guiding a second pipe end into the first pipe end; and

at least one guide actuator configured to move the stabbing guide between a non-working position where the stabbing guide is not vertically aligned with the box of the first pipe end and a working position where the stabbing guide is vertically aligned with the box of the first pipe end.

2. The pipe joint apparatus of claim 1, further comprising:

a lubricator configured to provide lubricant to the box of the first pipe; and

at least one lubricator actuator configured to move the lubricator between a non-working position where the lubricator is not vertically aligned with the box of the first pipe end and a working position where the lubricator is vertically aligned with the box of the first pipe end.

3. The pipe joint apparatus of claim 2, further comprising:

a positioning mechanism coupled to the stabbing guide and the lubricator and is configured to position the stabbing guide and the lubricator in their non-working and working positions.

4. The pipe joint apparatus of claim 3, wherein the positioning mechanism further comprises:

a conveyor configured to vertically move the stabbing guide and the lubricator; and

a fixture coupled to the stabbing guide and the lubricator, wherein the fixture is coupled to the conveyor and is configured to move vertically along the conveyor.

5. A pipe joint apparatus, comprising:

a stabbing guide comprising a pipe guard having an inner wall including an upper tapered section, an upper vertical section and a lower vertical section, wherein a horizontal shoulder is formed between the upper vertical section and the lower vertical section; and

at least one guide actuator configured to move the stabbing guide between a non-working and a working position

wherein the horizontal shoulder of the inner surface of the pipe guard at least partially covers a rim of a box end of a first pipe.

6. The pipe joint apparatus of claim 5, wherein the pipe guard comprises two jaws that are configured to encircle the box of the first pipe, wherein the jaws include an open position and a closed position.

7. The pipe joint apparatus of claim 6, further comprising an actuator configured to transition the pipe guard between the open position and the closed position.

8. A method for guiding one pipe into another, comprising:

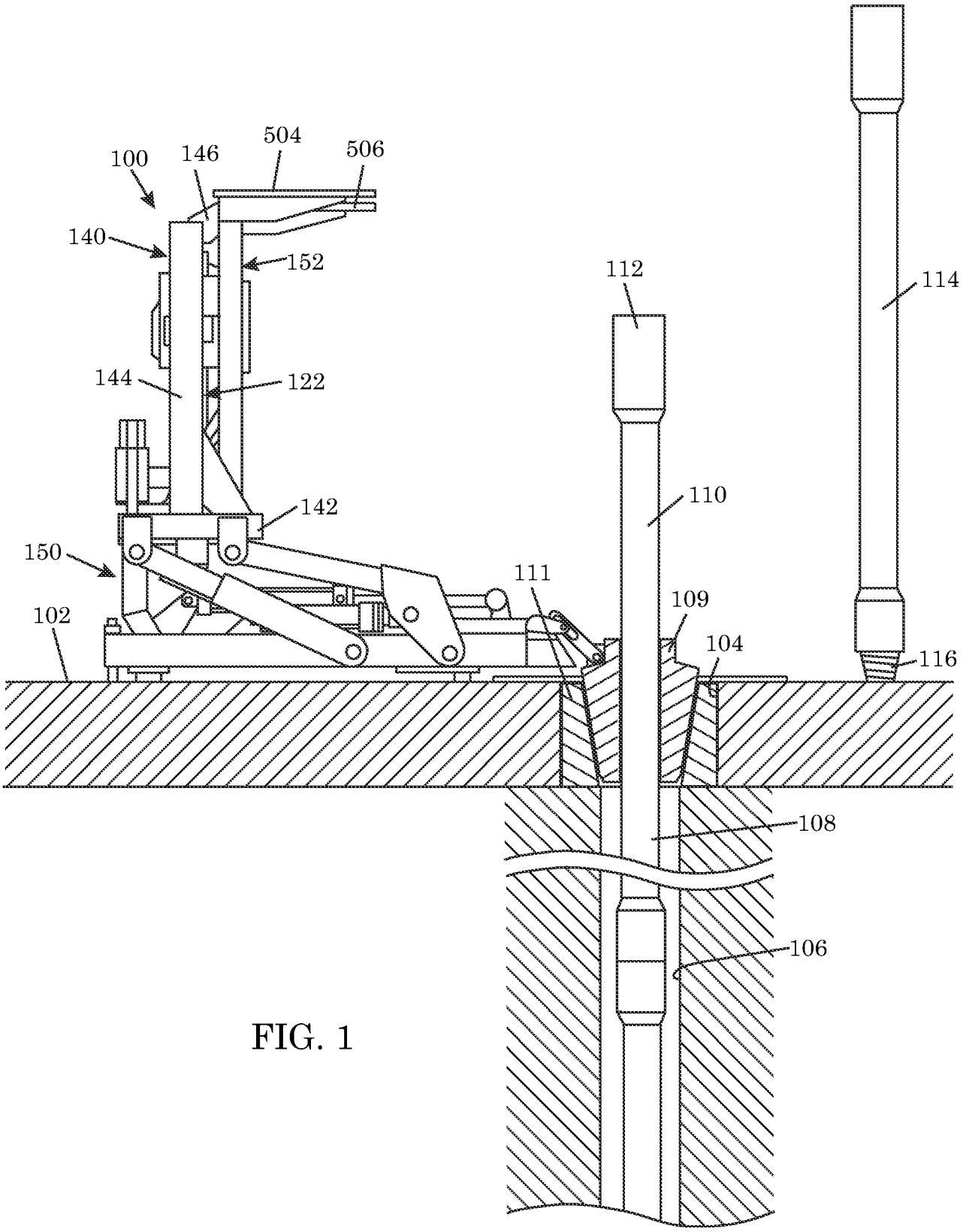
vertically aligning a stabbing guide of a pipe joint apparatus vertically over a box of a first pipe;

covering a rim of the box of the first pipe with a pipe guard of the stabbing guide; and

inserting a pin of a second pipe into the box of the first pipe.

9. The method of claim 8, further comprising vertically aligning a lubricator of the pipe joint apparatus vertically over the box of the first pipe.

10. The method of claim 9, further comprising lubricating the box of the first pipe using the lubricator of the pipe joint apparatus.


100
146
504
506
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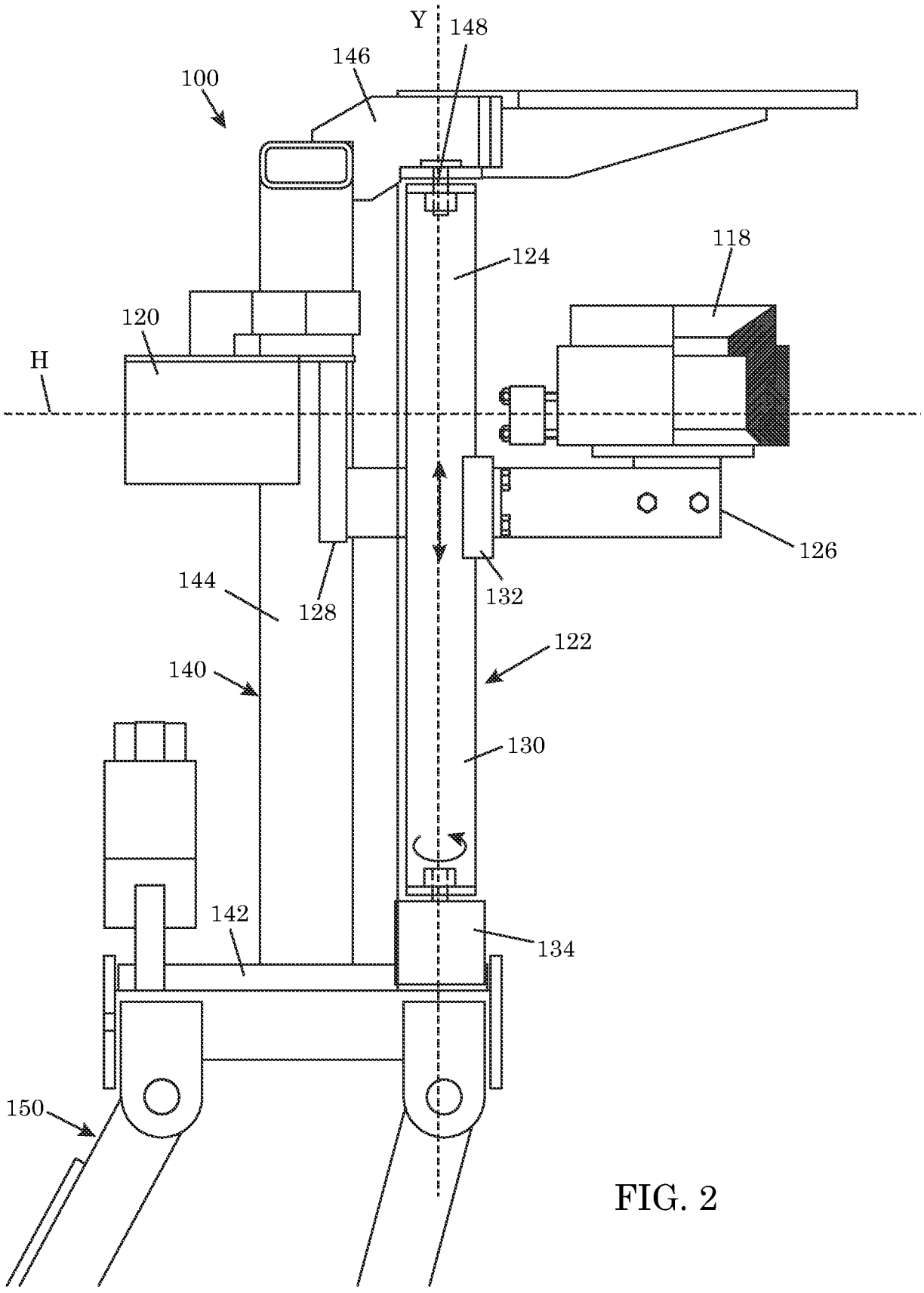
152
112
114
144
122
110
142
150
111
109
102
104
116
108
106

FIG. 1


Y
148
146
100
118
124
120
H
126
144
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132
122
140
130
142
134
150

FIG. 2

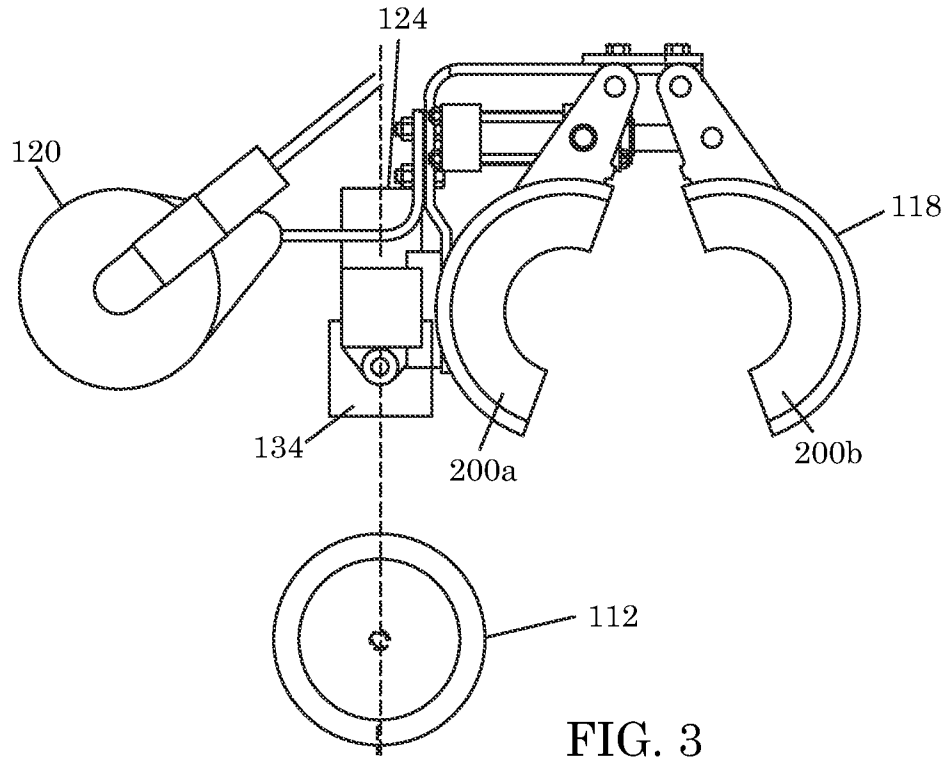


FIG. 3

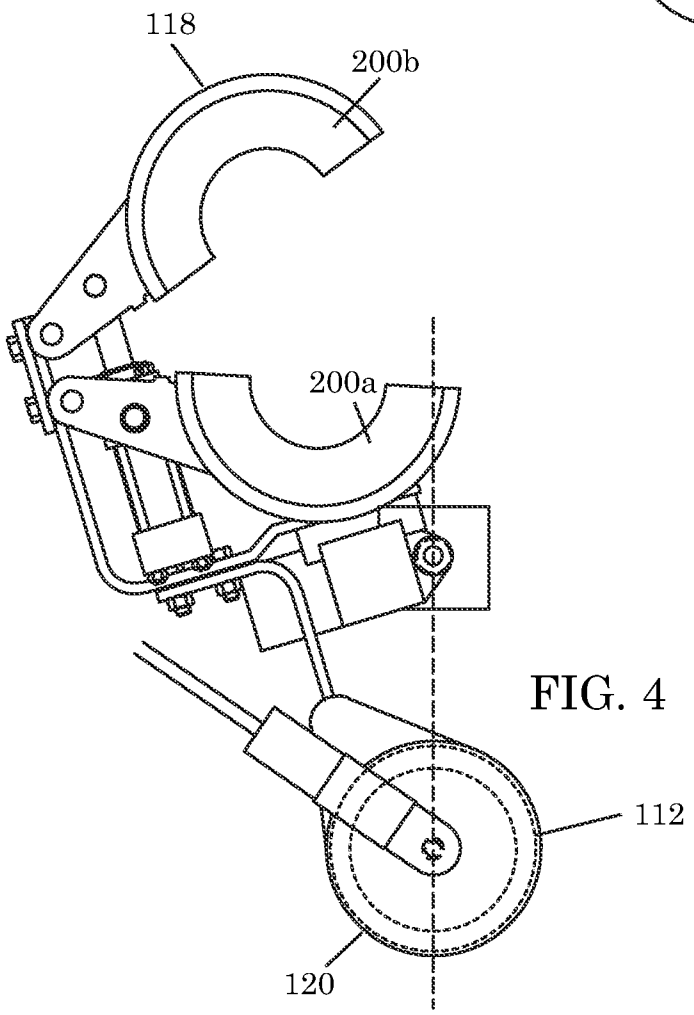
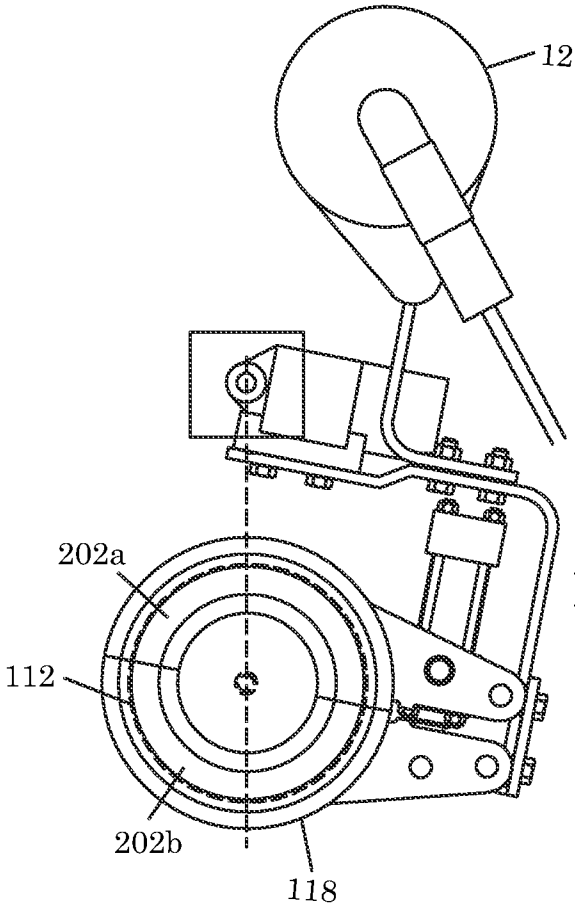


FIG. 4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202a
112
202b
118

FIG. 5

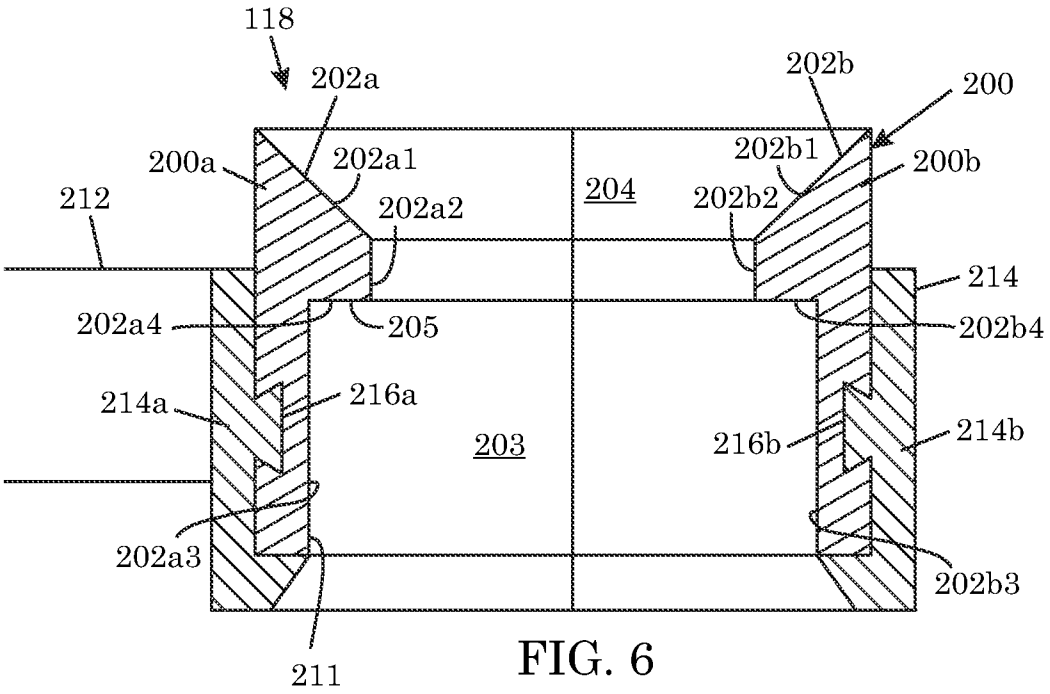
118
202a
202b
200
200a
202a1
202b1
200b
212
202a2
204
202b2
214
202a4
205
202b4
214a
216a
203
216b
214b
202a3
202b3
211

FIG. 6

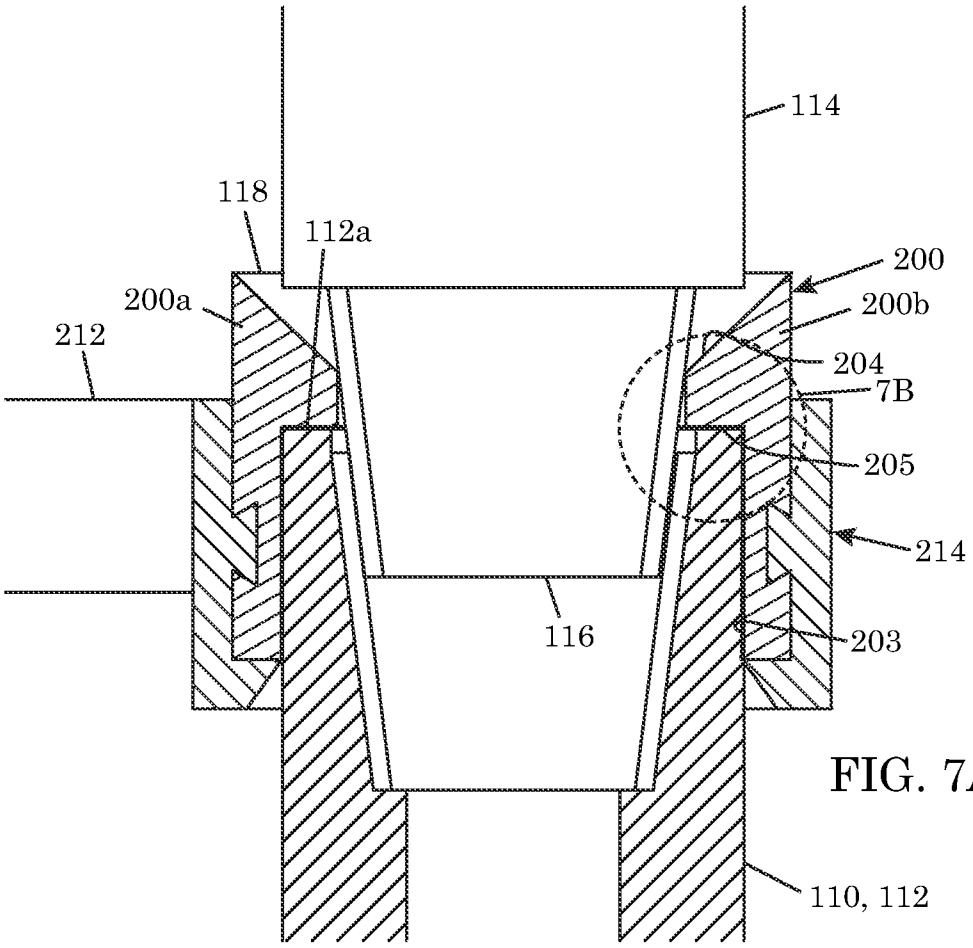
114
118
112a
200
200a
200b
212
204
7B
205
214
116
203
110, 112

FIG. 7A

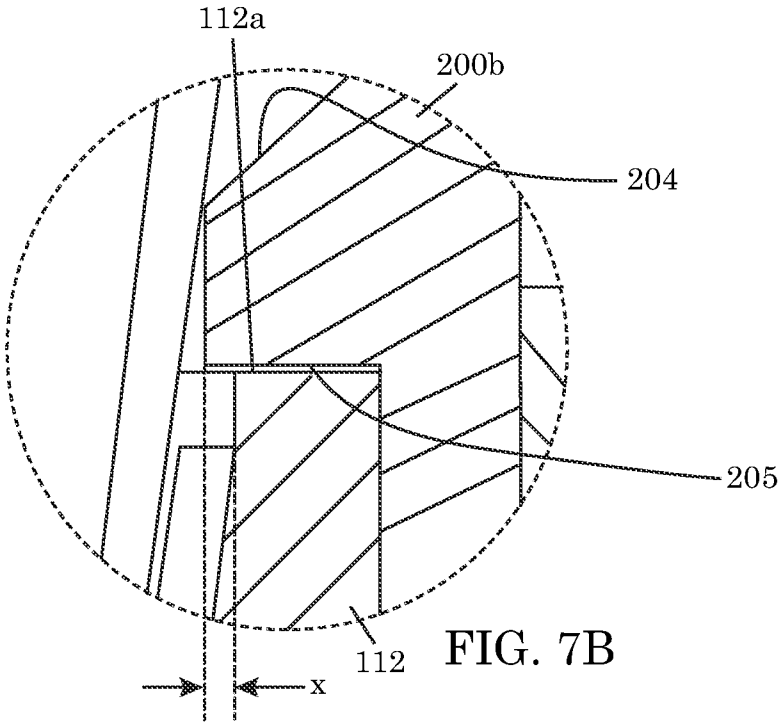
112a
200b
204
205
112
x

FIG. 7B

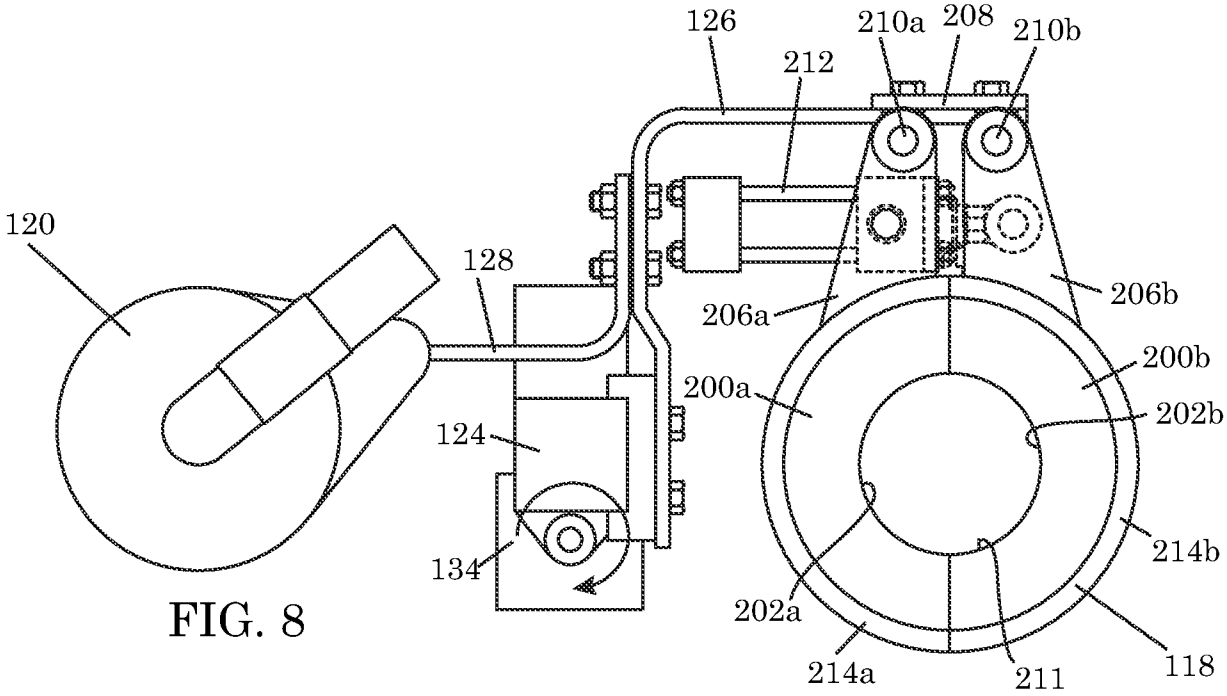
126
210a
208
210b
212
120
128
206b
206a
200b
200a
202b
124
214b
134
202a
214a
211
118

FIG. 8

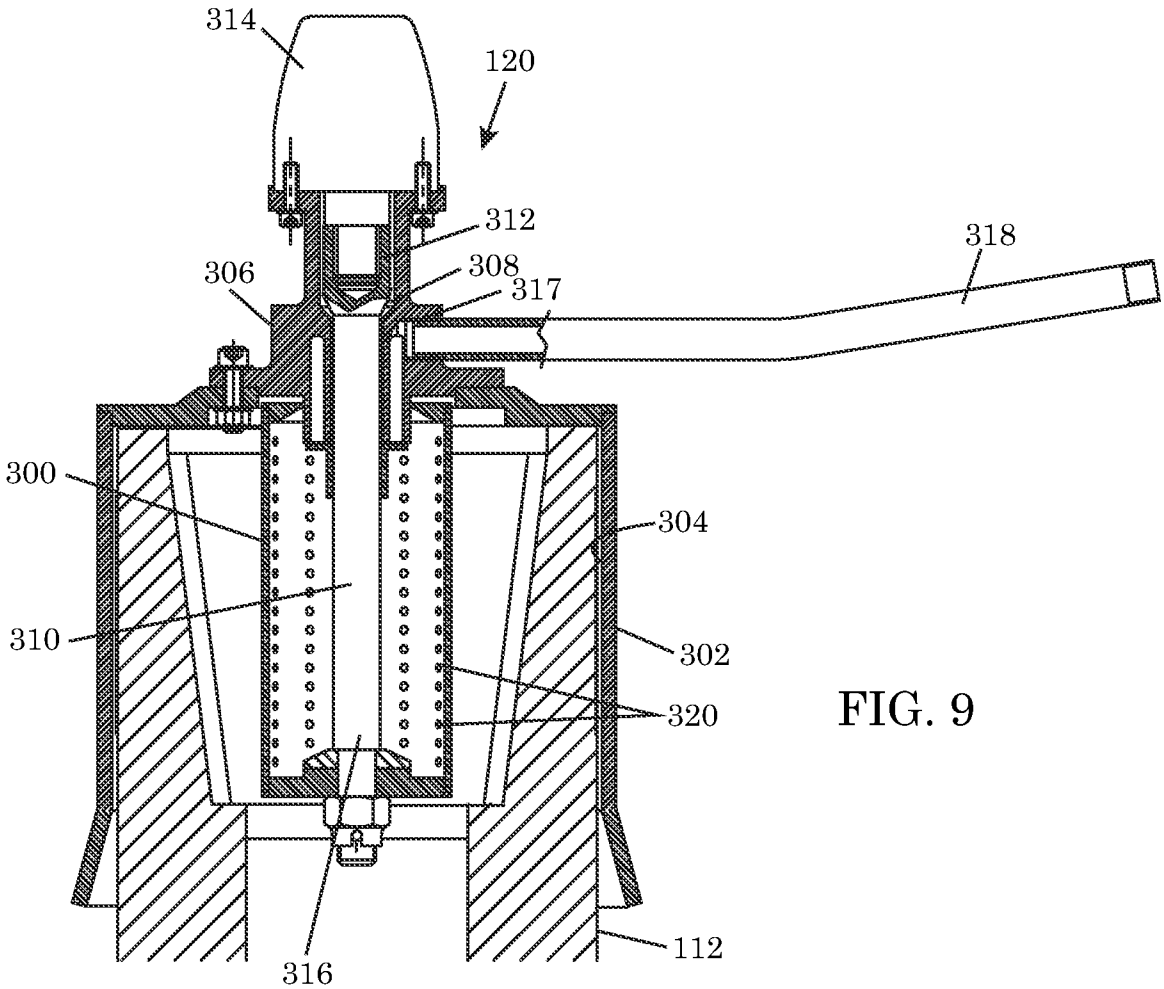
314
120
312
318
306
308
317
300
304
310
302
320
316
112

FIG. 9

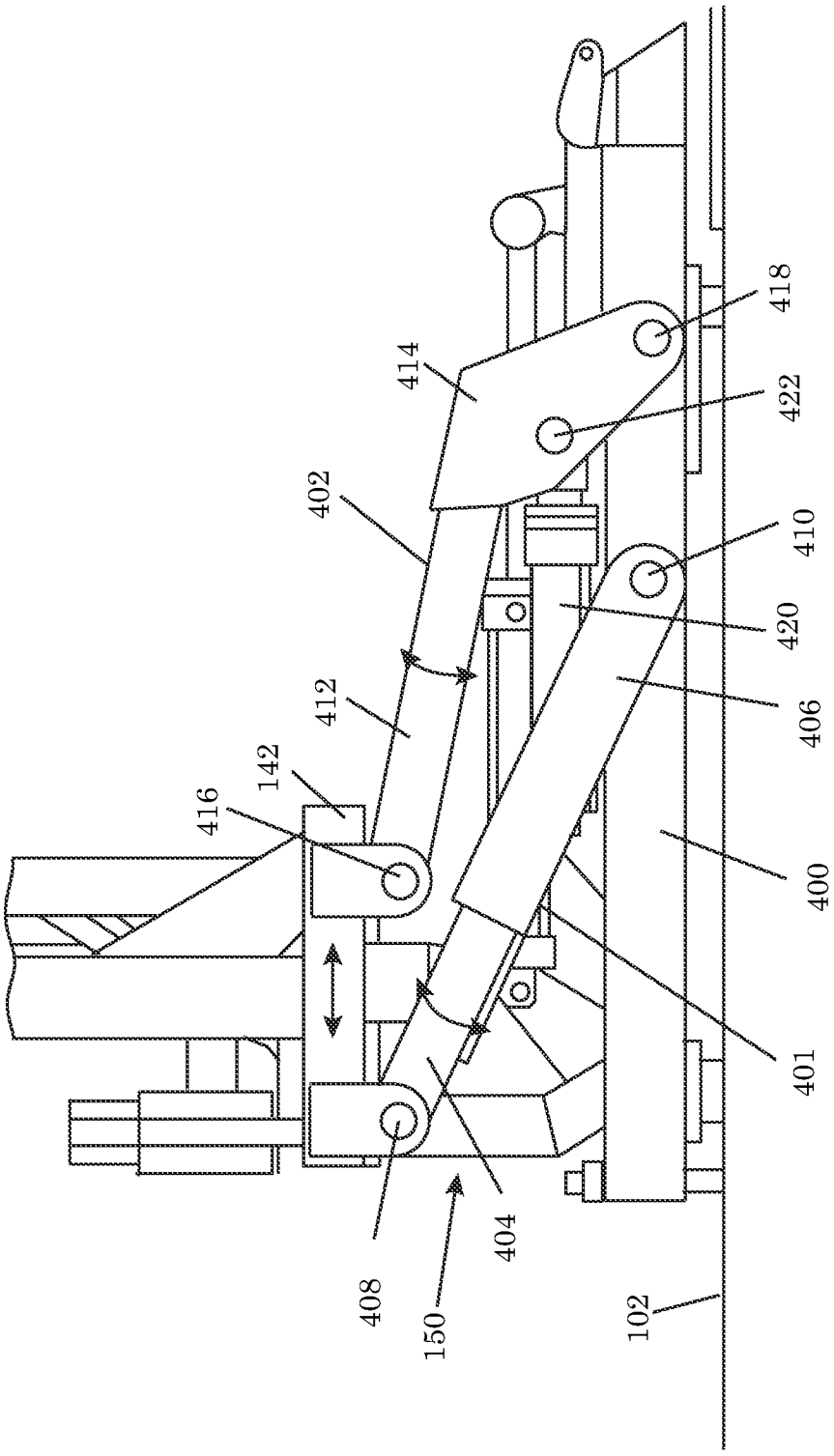

FIG. 10

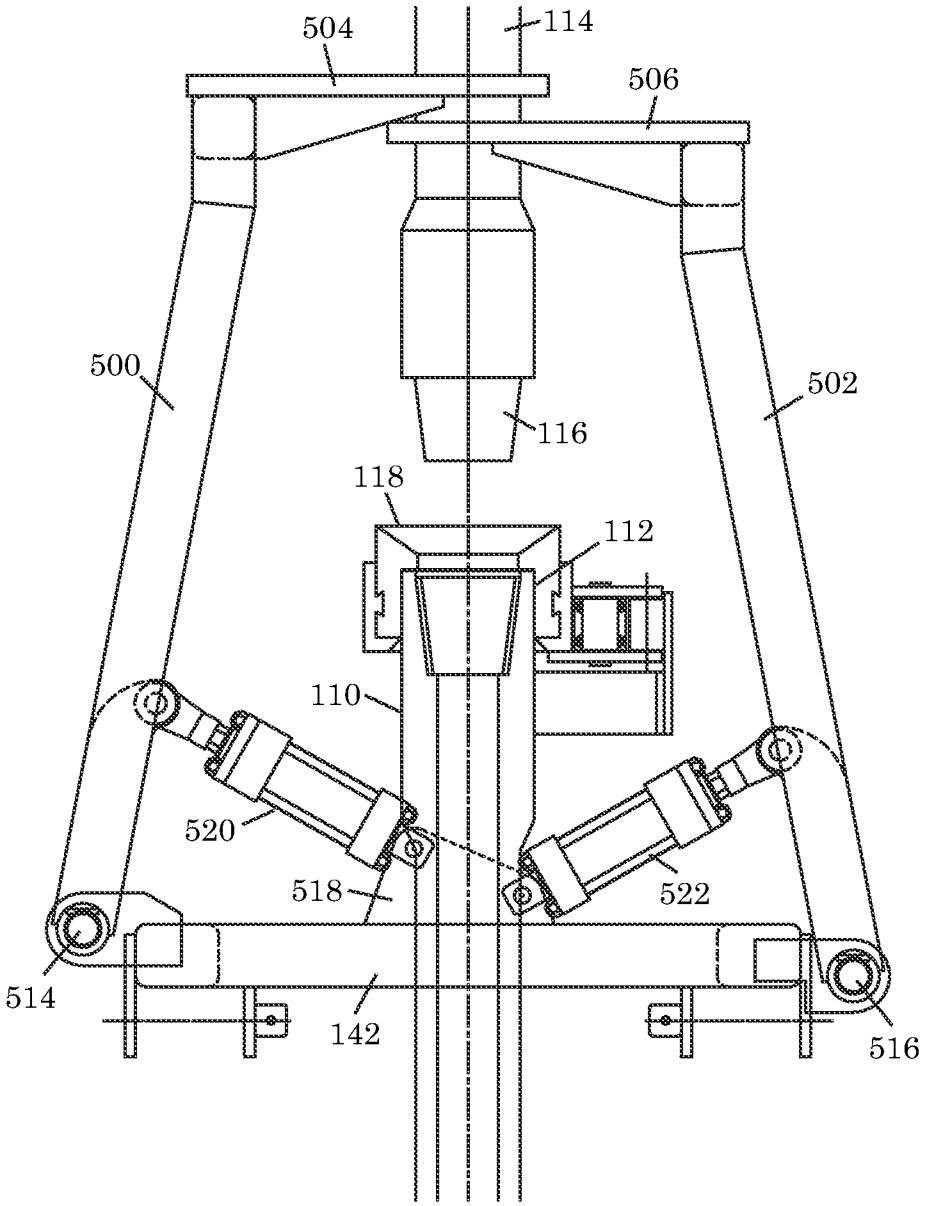

FIG. 11

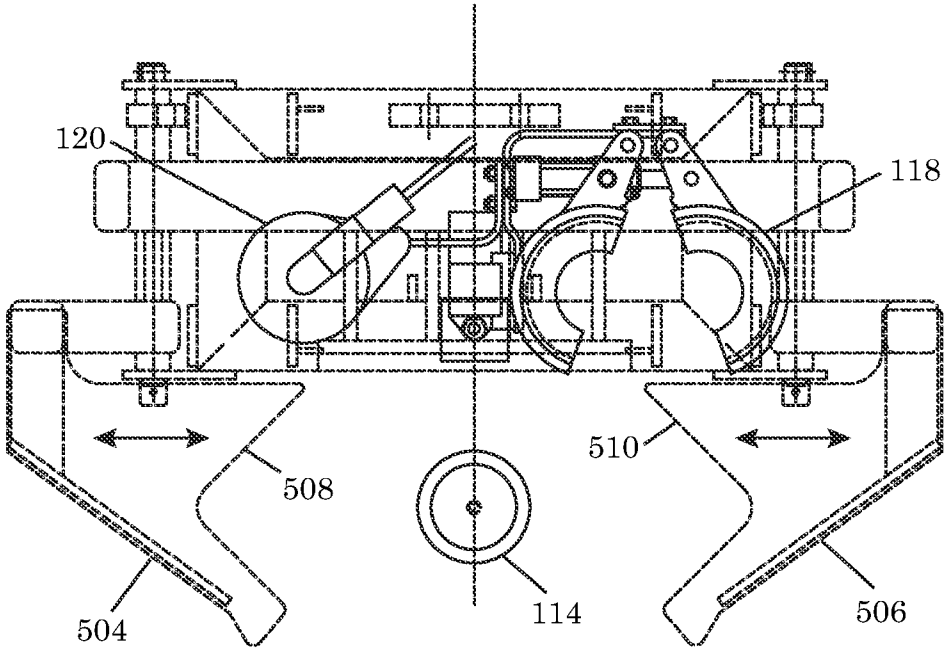

FIG. 12

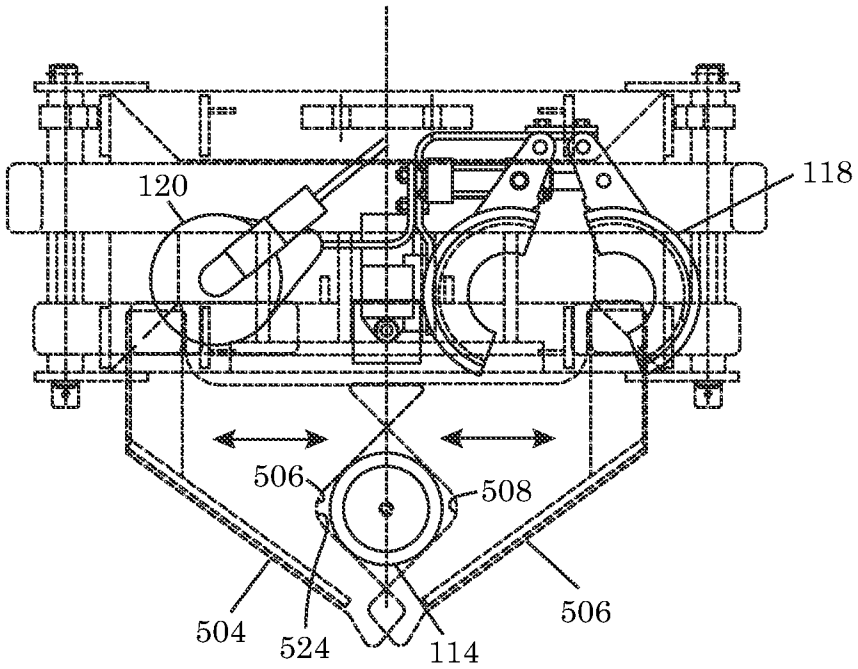

FIG. 13

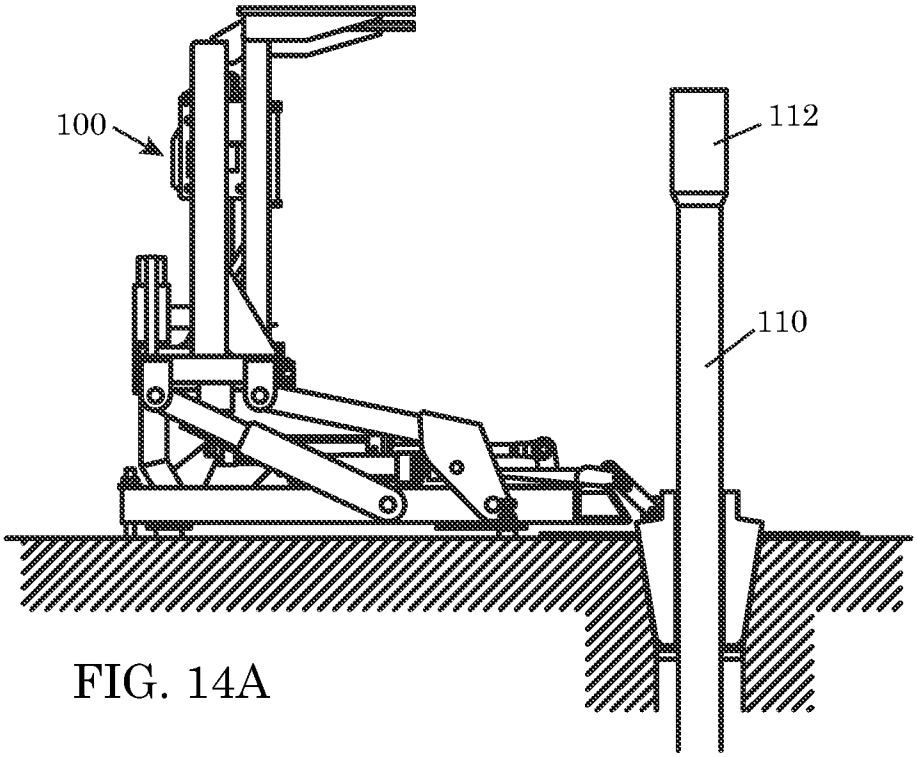

FIG. 14A

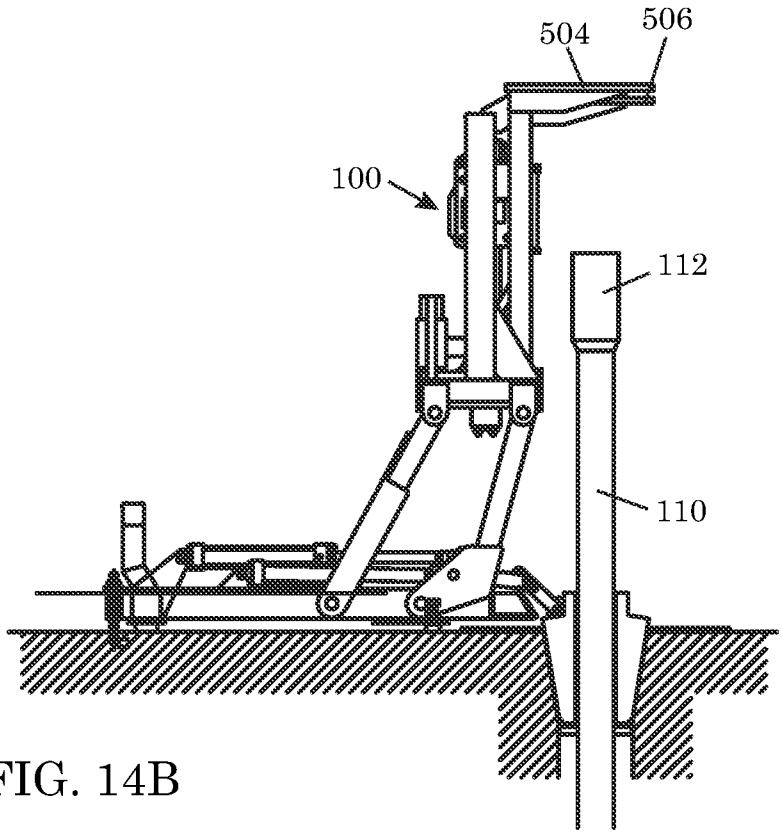

FIG. 14B

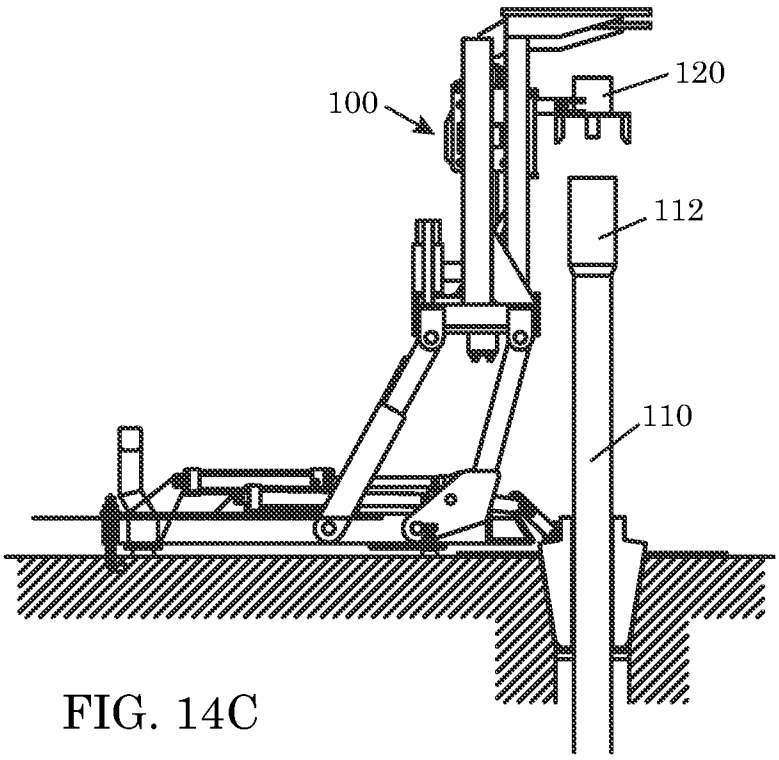

FIG. 14C

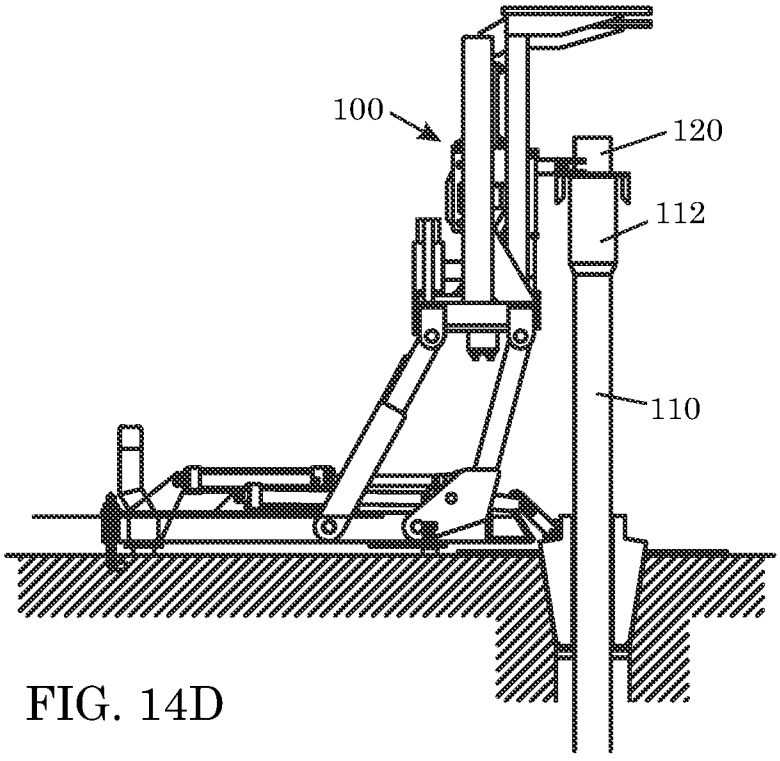

FIG. 14D

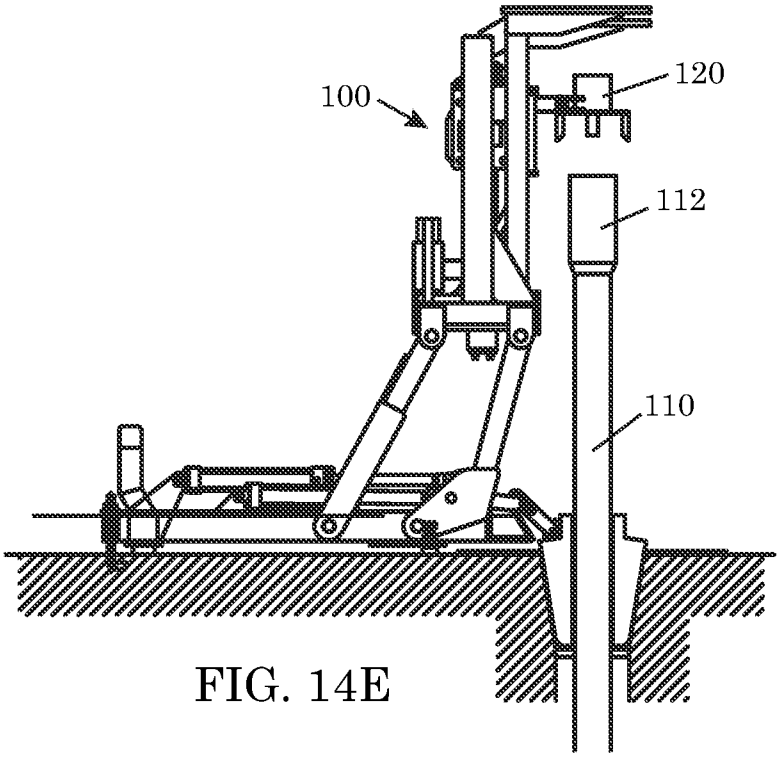

FIG. 14E

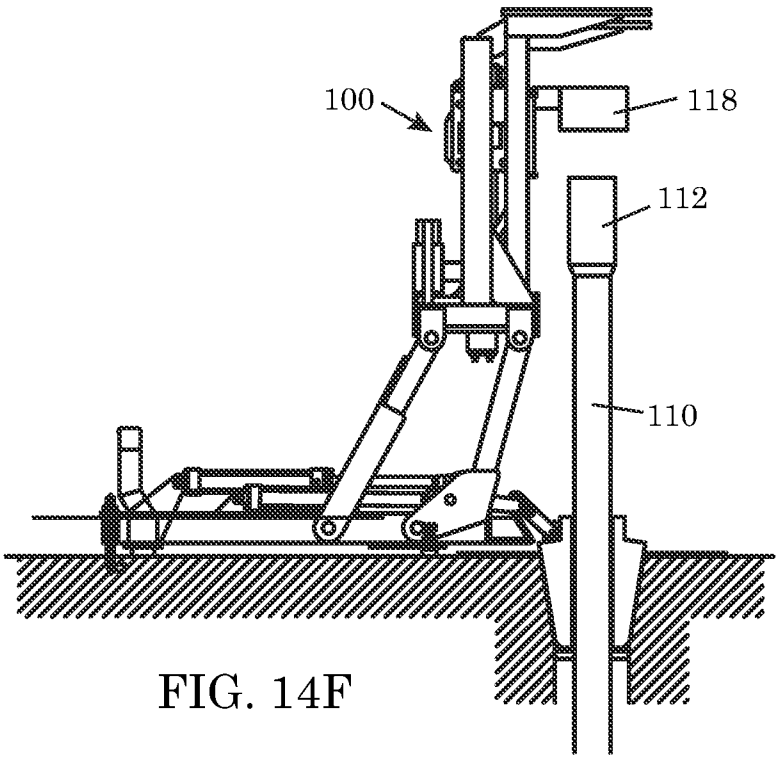

FIG. 14F

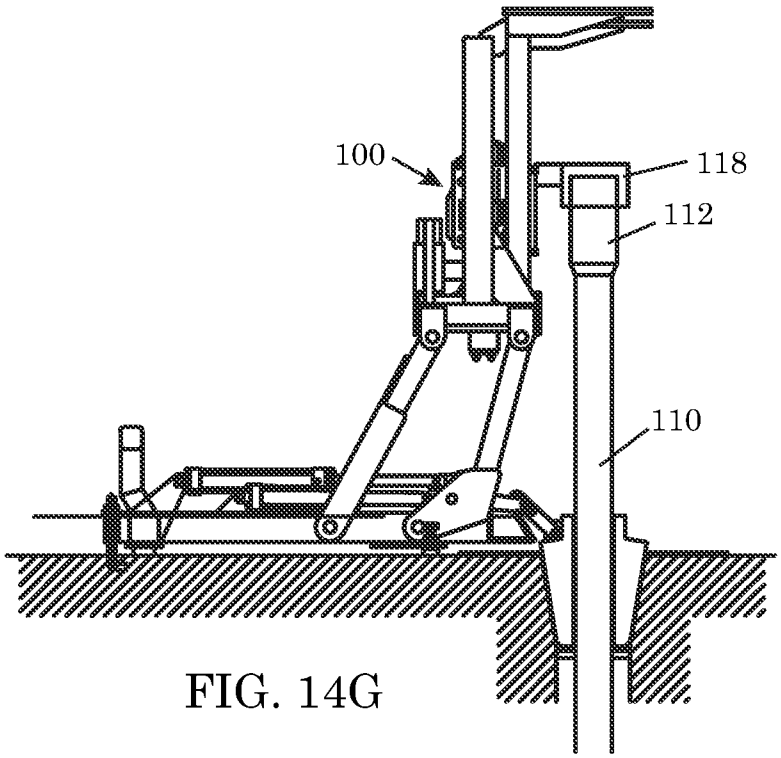

FIG. 14G

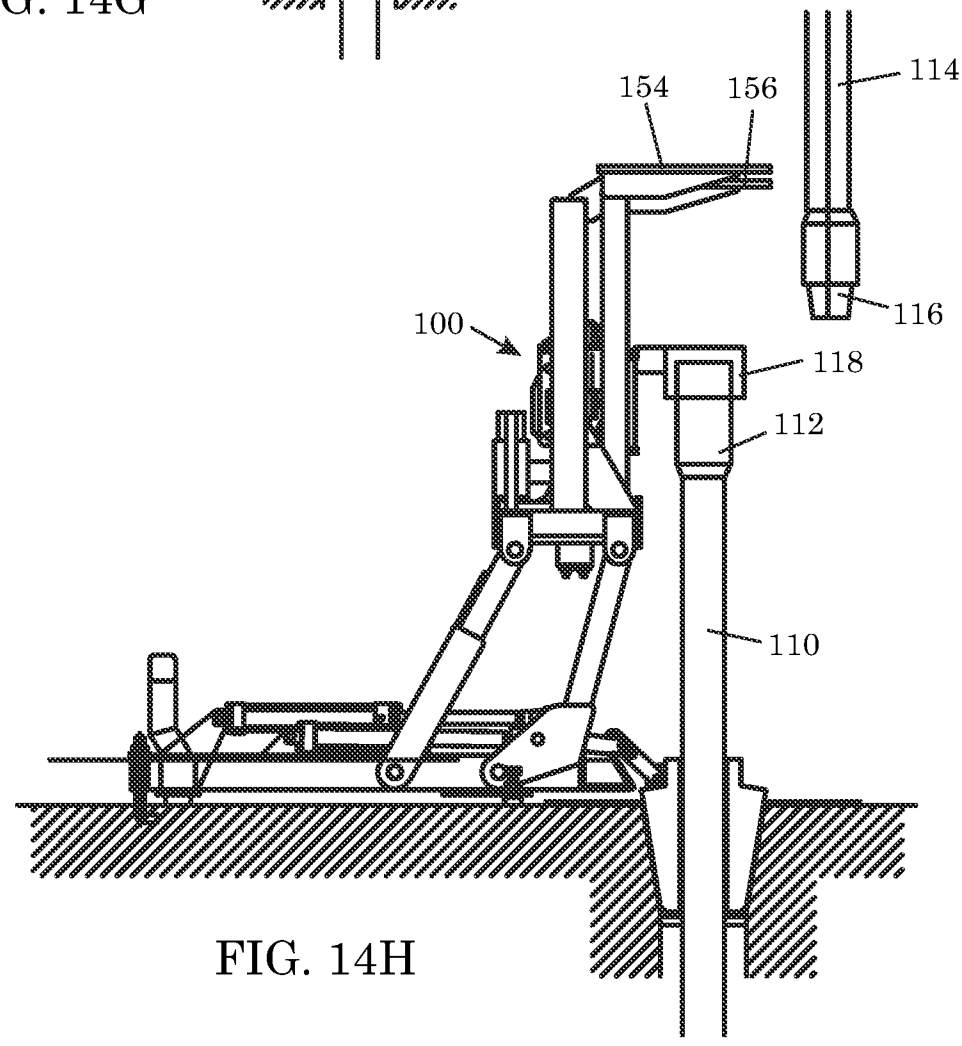

FIG. 14H

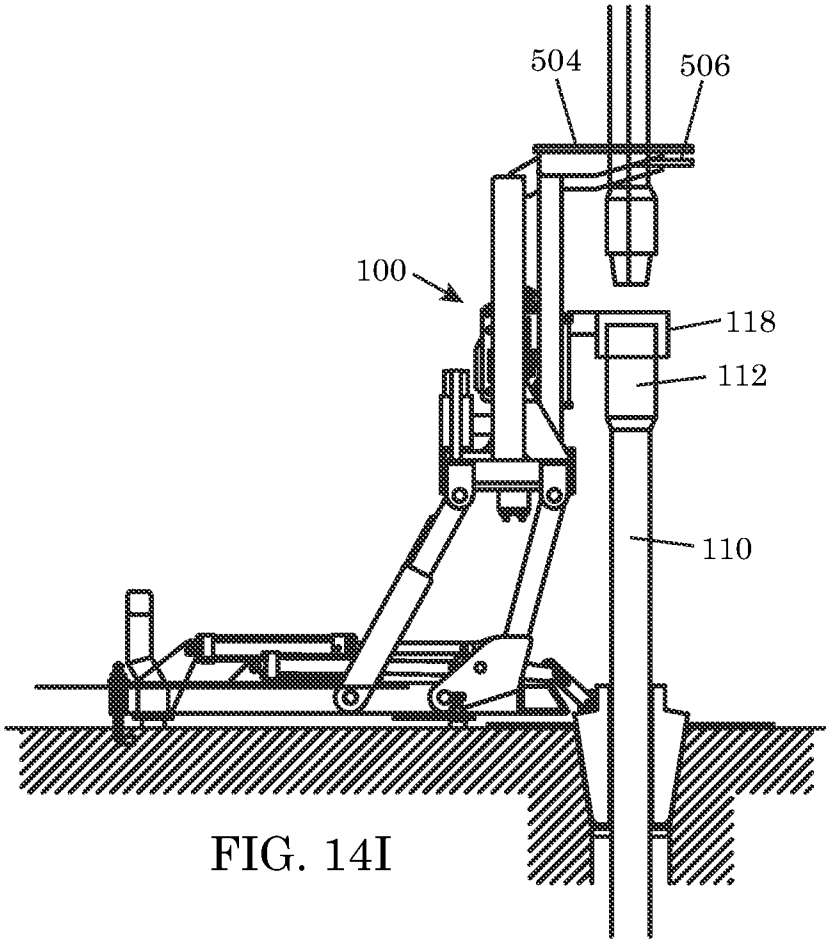

FIG. 14I

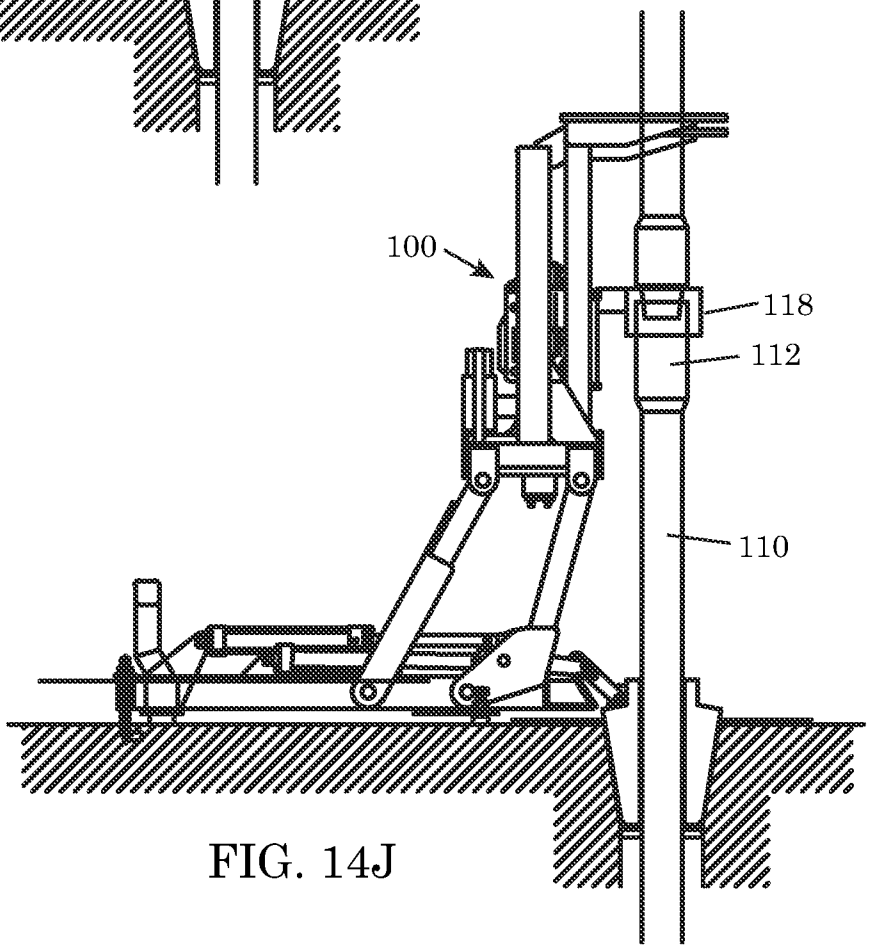

FIG. 14J

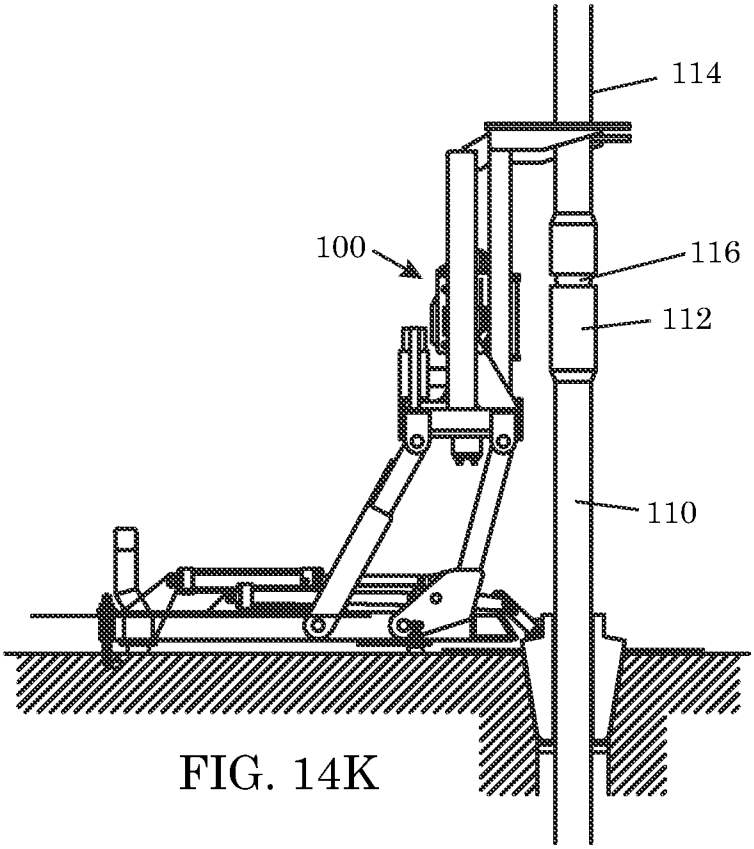

FIG. 14K

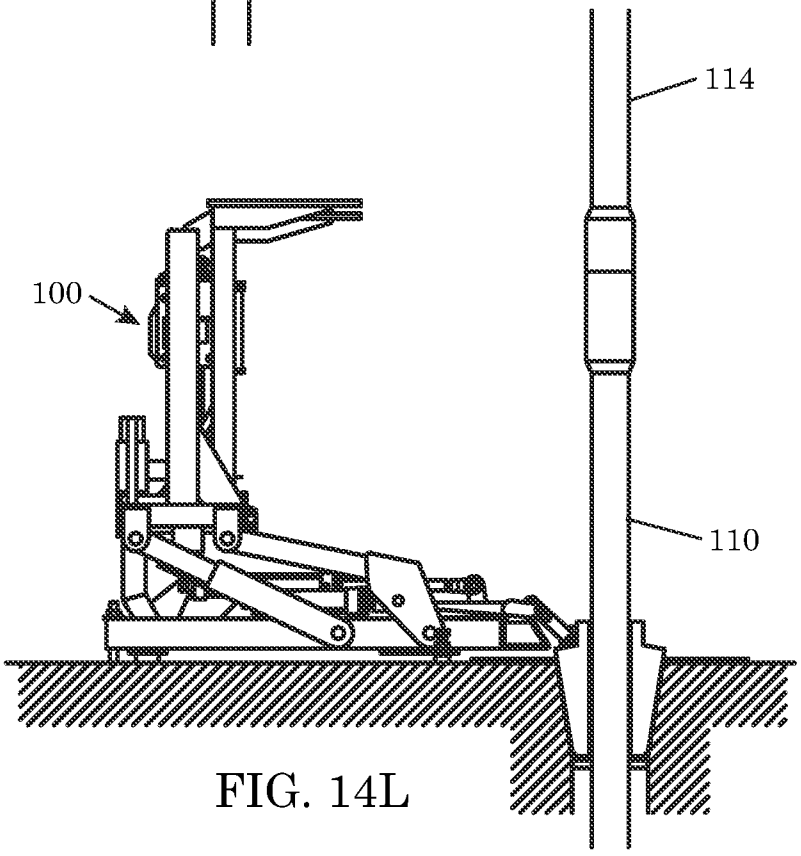

FIG. 14L

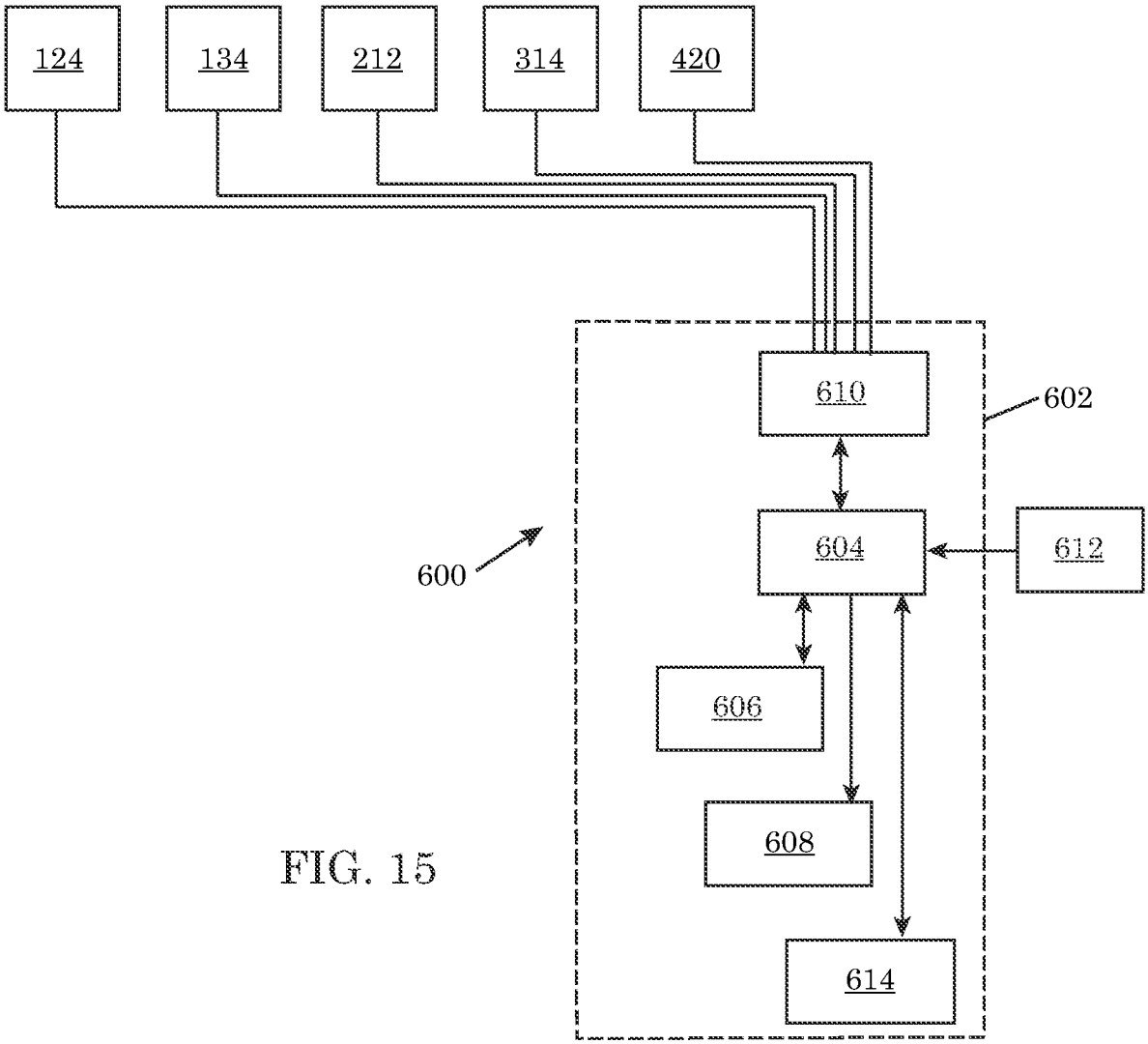

FIG. 15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/054197

A. CLASSIFICATION OF SUBJECT MATTER

E21B 19/16(2006.01)i, E21B 17/02(2006.01)i, E21B 19/20(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E21B 19/16; B23Q 3/00; E21B 19/06; B25B 13/50; B21D 39/03; B25B 17/00; E21B 17/02; E21B 19/20

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: pipe, joint, connect, couple, actuator, lubricator, and stabbing guide

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4667752 A (BERRY et al.) 26 May 1987 See abstract, column 2, lines 31-57, claim 1, and figures 1-4.	1,8
Y		2,9-10
A		3-7
Y	US 2010-0230115 A1 (BELIK, JAROSLAV) 16 September 2010 See abstract, paragraphs [0005],[0060],[0070], claims 31,56, and figure 5A.	2,9-10
A	US 7114235 B2 (JANSCH et al.) 03 October 2006 See abstract, claim 1, and figures 1-2.	1-10
A	US 4979356 A (VATNE, PER A.) 25 December 1990 See abstract, claim 1, and figure 5.	1-10
A	US 4023449 A (BOYADIJIEFF, GEORGE I.) 17 May 1977 See abstract, column 3, lines 38-54, and figures 1-3.	1-10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 October 2013 (22.10.2013)	**01 November 2013 (01.11.2013)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
CHOI, Hyun Goo
Telephone No. +82-42-481-8288

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2013/054197

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