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(71) Applicant: SANDVIK INTELLECTUAL PROPERTY
AB [SE/SE]; SE-811 81 Sandviken (SE).

(72) Inventor; and

(71) Applicant (for BB only): RENTON, Tim [AU/AU]; c/o
SE-811 81 Sandviken (SE).

(72) Inventors: VAN DER LOOS, Jacob; c/o SE-811 81
Sandviken (SE). HOWARD, William; c/o SE-811 81
Sandviken (SE). FRITH, Robert; c/o SE-811 81 Sand-
viken (SE). MEEHAN, Patrick; c/o SE-811 81 Sandviken
(SE). LAIRD, Sean; c/o SE-811 81 Sandviken (SE).

(74) Agent: MADDERN; GPO Box 2752, Adelaide, South
Australia 5001 (AU).

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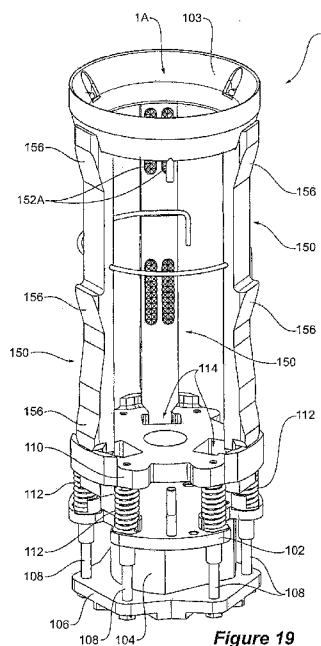


Figure 19

(57) Abstract: This invention relates to a handling means for drill rods, a drill rod support thereof, a method of operation for the handling means, and a drill rig employing the handling means and the drill rod support. The drill rod support comprises a socket configured to receive a portion of a length of a drill rod, and clamping means disposed within the socket and movable between clamping and release positions with respect to the drill rod.



ROD HANDLER IMPROVEMENTS

PRIORITY DOCUMENT

[0001] The present application claims priority from:

Australian Provisional Patent Application No 2012905435 titled "ROD HANDLER IMPROVEMENTS" filed on 11 December 2012. The content of this application is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates to a handling means for drill rods, a drill rod support thereof, a method of operation for the handling means, and a drill rig employing the handling means and the drill rod support.

BACKGROUND

[0003] Drill rigs for drilling bore holes generally comprise an upstanding mast supporting a drill head which is movable along the mast. The drill head is provided with means which can receive and engage the upper end of a drill rod forming part of a drill string to drive the drill string and drill bit mounted to the lower end of the drill string. In addition, the drill head may have means for applying a downward force to the drill string to facilitate penetration.

[0004] The drill string comprises a number of lengths of drill rod which are connected end to end, where the length of drill rod generally is at the most equal to the height of the mast. During a drilling operation when the drill head has reached the lower end of the mast, the drill string is retained to the mast and the drill head is disconnected from the drill string and raised to the upper end of the mast. A fresh length of drill rod is then raised and positioned in the chuck of the drill head and then the lower end becomes engaged with the upper end of the drill string. Once the fresh length of drill rod has been put in place, the drilling operation can recommence until the drill head again reaches the lower end of the mast. During drilling activities which may extend for hundreds of meters, it is necessary to locate fresh lengths of drill rod into a drill string at very regular intervals.

[0005] Throughout this specification the term "drill rod" should be construed as including all forms of elongate members used in the drilling, installation and maintenance of bore holes and wells in the ground, and will include rods, pipes, tubes and casings which are provided in lengths and are interconnected for use in the borehole.

[0006] In practice however, not all drill rods are the same, they differ significantly. For instance, rods for diamond core drilling (hereinafter diamond rods) are much lighter and more delicate than rods for reverse circulation drilling (hereinafter RC rods), particularly at the threads, so a means suitable for handling RC rods is generally unsuitable for handling diamond rods, and vice versa.

[0007] It is against this background and the problems and difficulties associated therewith that the present invention has been developed.

[0008] Certain objects and advantages of the present invention will become apparent from the following description, taken in connection with the accompanying drawings, wherein, by way of illustration and example, an embodiment of the present invention is disclosed.

SUMMARY

[0009] In a first aspect the present invention accordingly provides a drill rod support for a means for handling drill rods, the support defining a socket configured to receive a portion of a length of a drill rod, and clamping means disposed within the socket and movable between clamping and release positions with respect to the drill rod.

[0010] In one form, the clamping means comprises at least one movable portion, or jaw.

[0011] In one form, the clamping means comprises a plurality of jaws arranged radially about the socket.

[0012] In one form, the clamping means comprises three radially equi-spaced jaws.

[0013] In one form, the socket, and the or each jaw, is elongate, each having a substantially parallel direction of elongation to the other.

[0014] In one form, the clamping means is self-centering, and as such always clamps the rod centrally with respect to the socket.

[0015] In an alternative, the clamping means may comprise one or more bands for encircling the drill rod and tightening about this.

[0016] In one form, the support further comprises drive means for the clamping means. In one form, the drive means comprises one or more actuators. In one form, the or each actuator drives the clamping means via a transmission system. In one form, in an alternative, the or each actuator drives the clamping means directly.

[0017] In one form, the clamping means is biased towards its release position by biasing means, so the drive means need only drive the clamping means into its clamping position. In one form, the biasing means comprises a spring device or element.

[0018] In one form, the drive means comprises a linear actuator which drives a jacking plate against the bias of the biasing means, the drill rod support further comprising a floating plate which will follow the jacking plate by virtue of being linked to the jacking plate by at least one connecting rod, the or each movable jaw following the floating plate by virtue of being operatively associated with this, and wherein the or each movable jaw is moved into its clamping position as it is driven against the bias of the biasing means.

[0019] In one form, the or each movable jaw comprises a guide follower operatively associated with a jaw guide disposed in the socket to drive the jaw into its clamping position as it is driven against the bias of the biasing means.

[0020] In one form, each guide follower comprises an inclined plane which will slide smoothly against an oppositely directed but similarly inclined plane of the jaw guide with any longitudinal movement driven by the linear actuator.

[0021] In one form, the drill rod support further comprises an elongate cylindrical housing defining the socket internally, where one end of the housing is open, and an opposing end is substantially closed by an end plate from which there depends the linear actuator.

[0022] In one form, the biasing means comprises a compression spring disposed over each of the connecting rods and between the end plate and the floating plate so as to maintain a predetermined spacing between these

[0023] In a further aspect, the invention may be said to reside in a drill rod support for a means for handling drill rods, the support comprising at least a pair of elongate jaws, at least one of which is movable between clamping and release positions with respect to a drill rod so that a full length of each jaw clamps the rod along its longitudinal axis when in the clamping position.

[0024] In a further aspect, the invention may be said to reside in a handling means for drill rods comprising a base, a drill rod support as described above, wherein the drill rod support depends from the base so as to be movable with respect to the base as to effect transfer of a length of drill rod from a drill rod storage position, to a position in line with a drill string, and vice versa.

[0025] In one form, the drill rod support depends from the base so as to rotatable about an axis transverse to a longitudinal axis of the drill rod support whereby the support can be moved between an upright position and a substantially horizontal position, as well as movable between a first position located adjacent the drill rod storage position and one or more positions clear of the first position, including the position in line with the drill string.

[0026] In one form, the socket is defined by a housing having an open end through which the drill rod is receivable and a closed end in opposed relation to the open end, said closed end being lowermost when the drill rod support is in its substantially upright position.

[0027] In one form, the direction of elongation of the socket extends between the open and closed ends of the housing.

[0028] In one form, the drill rod support depends from an arm which is rotatably supported from the base for rotation about a substantially upright axis.

[0029] In a further aspect, the invention may be said to reside in a drill rig comprising a handling means as described above.

[0030] A detailed description of one or more embodiments of the invention is provided below along with accompanying figures that illustrate by way of example the principles of the invention. While the invention is described in connection with such embodiments, it should be understood that the invention is not limited to any embodiment. On the contrary, the scope of the invention is limited only by the appended claims and the invention encompasses numerous alternatives, modifications and equivalents. For the purpose of example, numerous specific details are set forth in the following description in order to provide a thorough understanding of the present invention.

[0031] In order to further understand the invention, preferred embodiments, will now be described. However, it will be realised that the scope of the invention is not be confined or restricted to the details of the embodiments described below. Variations and alterations that would be readily apparent to a person skilled in the art are deemed as being incorporated within the scope of the invention.

BRIEF DESCRIPTION OF DRAWINGS

[0032] Embodiments of the present invention will be discussed with reference to the accompanying drawings wherein:

- [0033] Figure 1 is an isometric view of a drill mast for a drilling rig;
- [0034] Figure 2 is a detail view of a lower end of the drill mast of Figure 1;
- [0035] Figure 3 is a side view of a rod support from the drill mast of Figure 1;
- [0036] Figure 4 is a cross-sectional view through the rod support of Figure 3;
- [0037] Figure 5 is an isometric view of the rod support of Figure 1, minus a guard cage for the jack and jacking plate;
- [0038] Figure 6 is a side view of the rod support of Figure 5;
- [0039] Figure 7 is a cross-sectional view through the rod support of Figure 5;
- [0040] Figure 8 is an end view of the rod support of Figure 5;
- [0041] Figure 9 is a cross-sectional view through the connecting rods of the rod support of Figure 5;
- [0042] Figure 10 is a plan view of an end plate from the rod support of Figure 5;
- [0043] Figure 11 is a plan view of a jacking plate from the rod support of Figure 5;
- [0044] Figure 12 is a plan view of a floating plate from the rod support of Figure 5;
- [0045] Figure 13 is a side view of a housing from the rod support of Figure 5;
- [0046] Figure 14 is a cross-sectional view through the housing of Figure 12;
- [0047] Figure 15 is a view of a gripping face of a jaw from the rod support of Figure 5;
- [0048] Figure 16 is a side view of the jaw of Figure 15;
- [0049] Figure 17 is view of a guide following face (opposite to the gripping face) of the jaw of Figure 15;
- [0050] Figure 18 is cross-sectional view through the jaw of Figure 15;

[0051] Figure 19 is an isometric view of the rod support of Figure 1, minus the housing and guard cage, which are removed for improved visibility of the internal assembly;

[0052] Figure 20 is a drive end view of the rod support internals of Figure 19, illustrating all of the moving components in a rod release position; and

[0053] Figure 21 is a drive end view of the rod support internals of Figure 19, illustrating all of the moving components in a rod gripping position.

[0054] In the following description, like reference characters designate like or corresponding parts throughout the figures.

DESCRIPTION OF EMBODIMENTS

[0055] Referring now to Figure 1, where there is illustrated a drill rig 10 for support by a vehicle (not shown) and comprising a mast 12 which can be pivoted between an upright operative position as shown in the drawings, and a horizontal position (not shown), in which it lies along a substantially central axis of the vehicle to facilitate transportation.

[0056] Optionally the drill rig 10 can be configured so that it can be transported by a vehicle and then left in a stationary position when de-coupled from the vehicle.

[0057] The drill mast 12 supports a drill head 14 which, in use, drives the drill string (not illustrated) rotationally via a drive motor accommodated in the drill head 14, as well as driving the drill string into and out of a bore hole via a feed system.

[0058] The drill rig 10 comprises a drill rod handling means which is intended to simplify the transfer of a drill rod from a storage bin to a position in line with the drill string, in which the drill rod can be engaged with the drill head 14 at its upper end and engage with the drill string at its lower end, and to also simplify the removal of a length of drill rod from a drill string.

[0059] The drill rod handling means can be incorporated into a drill rig 10 either as an attachment or as an integral part of the drill rig.

[0060] Referring now to Figure 2, wherein, in the illustrated embodiment the drill rod handling means comprises a linear actuator 15 which is supported to one side of the drill mast 12 clear a front face of the drill mast 12. The linear actuator 15 comprises an upstanding shaft 17 which is substantially parallel to the main axis of the drill mast, one end 18 of which is fixed to a base of the mast. The other end of the

shaft 17 is received within a closed cylinder 19 and is provided with a seal whereby the space defined between the seal and each end of the cylinder 19 comprises a separate enclosed space. The cylinder 19 is slideably received within a support block 20 mounted to the side of the drill mast which facilitates longitudinal displacement of the cylinder 19 through the support block 20. The enclosed spaces within the cylinder 19 are connected to a source of fluid pressure whereby the displacement of the cylinder along the shaft 17 can be controlled to cause the cylinder 19 to move upwardly or downwardly with respect to the drill mast 12 through the support block 20.

[0061] The upper end of the cylinder 19 has a first rotary actuator 21 mounted to it whereby the drive shaft of the first rotary actuator 21 is mounted to the cylinder 19 while the body of the first rotary actuator 21 is supported in such a way as to prevent relative rotation between the body thereof and the mast 12, but which will permit longitudinal displacement there between. As a result, the cylinder 19 is capable of being turned about its central axis through the action of the first rotary actuator 21 and is capable of being displaced upwardly and downwardly with respect to the drill mast by the linear actuator 15.

[0062] The lower end of the cylinder 19 is provided with a radial arm 23 which is provided at its outer end with an upstanding support plate 24 which is generally tangential to the radial axis of the cylinder 19. The support plate 24 rotatably supports a drill support 1 which is rotatable about an axis which is transverse to the central axis of the cylinder 19. The rotation of the drill rod support 1 is controlled by means of a second rotary actuator 26 which takes the form of a hydraulic motor and which controls the rotation of the drill rod support 1 on the support plate 24 about its axis of rotation.

[0063] Referring now to Figures 3 through 20, where it can be seen that the drill rod support 1 comprises an elongate cylindrical housing 100 defining a generally tubular socket 1A internally. One end of the housing 100 is open, and an opposing end is closed by an end plate 102 bolted to the housing 100. Extending around an opening to the socket 1A is a tapered guide ring 103 shaped to guide the end of a drill rod into the socket 1A.

[0064] Secured to an outer-side of the end plate 102 is an hydraulically powered jack 104 (drive means) having a piston rod 105 which bears against, and thereby drives, a jacking plate 106. The jack 104 and the jacking plate 106 are enclosed by a guard cage 107.

[0065] From the jacking plate 106 there extends a plurality of connecting rods 108, which extend through apertures 103 (see Figure 9) in the end plate 102 to a floating plate 110 disposed within the socket.

[0066] Disposed over each of the connecting rods 108 and between the end plate 102 and the floating plate 110 is a compression spring 112 biased to maintain a predetermined spacing between these.

[0067] A jaw 150 locates in each one of a set of three radially equi-spaced jaw slots 140 (clamping means) formed into an inner wall of the housing 100, and each of the jaws 150 is keyed to the jacking plate 106 and so follows the movement of this. These jaws 150 can be replaced once worn, and are interchangeable for instances where specially adapted jaws are required for certain types or sizes of drill rod.

[0068] Referring now to Figure 12, where it can be seen that the floating plate 110 comprises a set of three radially equi-spaced guide slots 112, and a set of three radially equi-spaced, T-shaped retaining slots 114, the purpose of all of which will be discussed in greater detail below.

[0069] Referring now Figure 14, where it can be seen that the socket 1A defined by the housing 100 is generally circular in cross-section, with the exception that this comprises the set of three radially equi-spaced jaw slots 140, and a set of three radially equi-spaced guide splines 142.

[0070] The guide splines 142 are elongate splines extending lengthwise along the inner wall of the housing 100. The guide splines 142 extend from the closed end of the housing 100 and end where the jaw slots 150 begin. In use, for each guide spline 142 there is a guide slot 112 in the floating plate 110 which will run along the guide spline 142 with a sliding fit.

[0071] The jaw slots 140 are elongate slots extending lengthwise along the inner wall of the housing 100. One of the jaws 150 will locate in each of these jaw slots 140.

[0072] Each of the jaw slots 140 comprise a pair of side walls separated by a floor. Each floor comprises a lengthwise extending jaw guide 144, where this jaw guide 144 is characterised by a pair of substantially identical but longitudinally spaced apart inclined planes 146. The purpose of these jaw guides 144 and the inclined planes 146 will be described in greater detail below.

[0073] Referring now to Figures 15 through 18, where it can be seen that each of the jaws 150 comprises a T-shaped head portion 151 which is engaged with one of the T-shaped retaining slots 114 in the floating plate 110, so that in use, each of the jaws 150 follows the movement of the floating plate 110.

[0074] Each of the jaws 150 further comprises a gripping face 152 (with carbide inserts 152A), and an oppositely directed guide follower 154 characterised by a pair of substantially identical but longitudinally spaced apart inclined planes 156. Once assembled, the inclined planes 156 of the guide follower 154 will

bear against the oppositely directed but similarly inclined planes 146 of the jaw guides 144 in the housing 100, and slide smoothly against these with any longitudinal movement driven by the floating plate 110.

[0075] This smooth sliding action will be assisted by grease supplied via journals extending through the jaws 150.

[0076] Referring now to Figures 20 and 21, where it can be seen how in use, the piston rod 105 of the jack 104 will drive the jacking plate 106 outwardly (with respect to the housing 100) against the bias of the springs 112, and the floating plate 110 will follow by virtue of being tied to the jacking plate 106 by the connecting rods 108.

[0077] The jaws 150 will similarly follow the floating plate 110 by virtue of being tied to this.

[0078] As the jaws 150 are drawn downwardly within the housing 100 they are simultaneously driven inwardly (by the sliding of the inclined planes 156 of the guide follower 154 over the inclined planes 146 of the jaw guides 144) to clamp upon any drill rod inserted therein.

[0079] Because there are there equi-spaced jaws 150, the clamping means is self-centring, so the drill rod (irrespective of diameter) will be centralised in the socket 100A. Moreover, because the jaws 150 are elongate, these clamp lengthwise along a portion of the drill rod, making for secure retention of the drill rod in the drill rod support 1.

[0080] When force provided by the jack 104 is removed, the springs 112 will bias the floating plate 110 upwardly, resulting in the return of the jaws 150 to their respective retracted, or home positions, and release of any drill rod in turn.

[0081] A vehicle supporting the drill rig 10 is generally configured so that drill rods are located in a bin lying alongside the drill mast 12.

[0082] When it becomes necessary to insert a new drill rod into position in a drill string, the drill rod support 1 can be positioned over an end of a drill rod lying in the bin. The clamping means is then activated (as described above) so that the end of the drill rod is secured in the drill rod support 1.

[0083] The second rotary actuator 26 is then actuated, causing the drill rod support 1 (and drill rod with it) to rotate into a substantially upright position with the innermost end of the tubular socket 1A lowermost and the drill rod extending upwardly from the socket 1A. With the drill rod so supported, the first rotary actuator 21 is then activated to cause the base plate 23 to move until the drill rod is

substantially in alignment with the centreline of the drill head 14 and therefore the drill string. The support 23 can then be raised by the linear actuator 15 to cause the drill rod to be raised until its uppermost end becomes engaged with an adapter sub 13 with a lowermost tapered end 13a (to aid alignment) depending from the drill head 14. Once the upper end of the drill rod is engaged with the adapter sub 13, the clamping means in the drill rod support 1 are released and the drill rod support 1 can be lowered away from the drill rod and returned to a home position. The lower end of the drill rod is then lowered to the drill string with the guidance of a lower guide 16 (to aid alignment), and then engaged with the drill string, whereupon drilling can recommence.

[0084] When it becomes necessary to remove a length of drill rod from the drill string, the lower end of the drill rod is disengaged from the drill string and the drill rod is then raised with the drill head 14. The drill rod support 1 is then positioned so that the lower most end of the drill rod can be received within the tubular socket 1A of the drill rod support 1. The clamping means is then activated (as described above) so that the end of the drill rod is secured in the drill rod support 1. Once the drill rod has been so secured by the drill rod support 1, the upper end of the drill rod is disengaged from the drill head 14. The drill rod can be then lowered by lowering the base plate 23 in order that the upper end of the drill rod clears the drill head 14. The drill rod is then carried by the drill rod support 1 to a position beside the drilling mast 12 and is lowered to a horizontal position at which the clamping means is released so that the drill rod can be deposited into the bin.

[0085] It will be apparent from all of the above, that the drill rod support 1 disclosed herein can accommodate drill rods of various sizes, and retain drill rods of various sizes securely. Moreover, it will be apparent that a handling means comprising the drill rod support can position drill rods of various sizes relative to a drill string (and drill head), with a high degree of positional accuracy and no (or at least minimal) misalignment relative to the drill string and drill head.

[0086] Throughout the specification and the claims that follow, unless the context requires otherwise, the words “comprise” and “include” and variations such as “comprising” and “including” will be understood to imply the inclusion of a stated integer or group of integers, but not the exclusion of any other integer or group of integers.

[0087] The reference to any prior art in this specification is not, and should not be taken as, an acknowledgement of any form of suggestion that such prior art forms part of the common general knowledge.

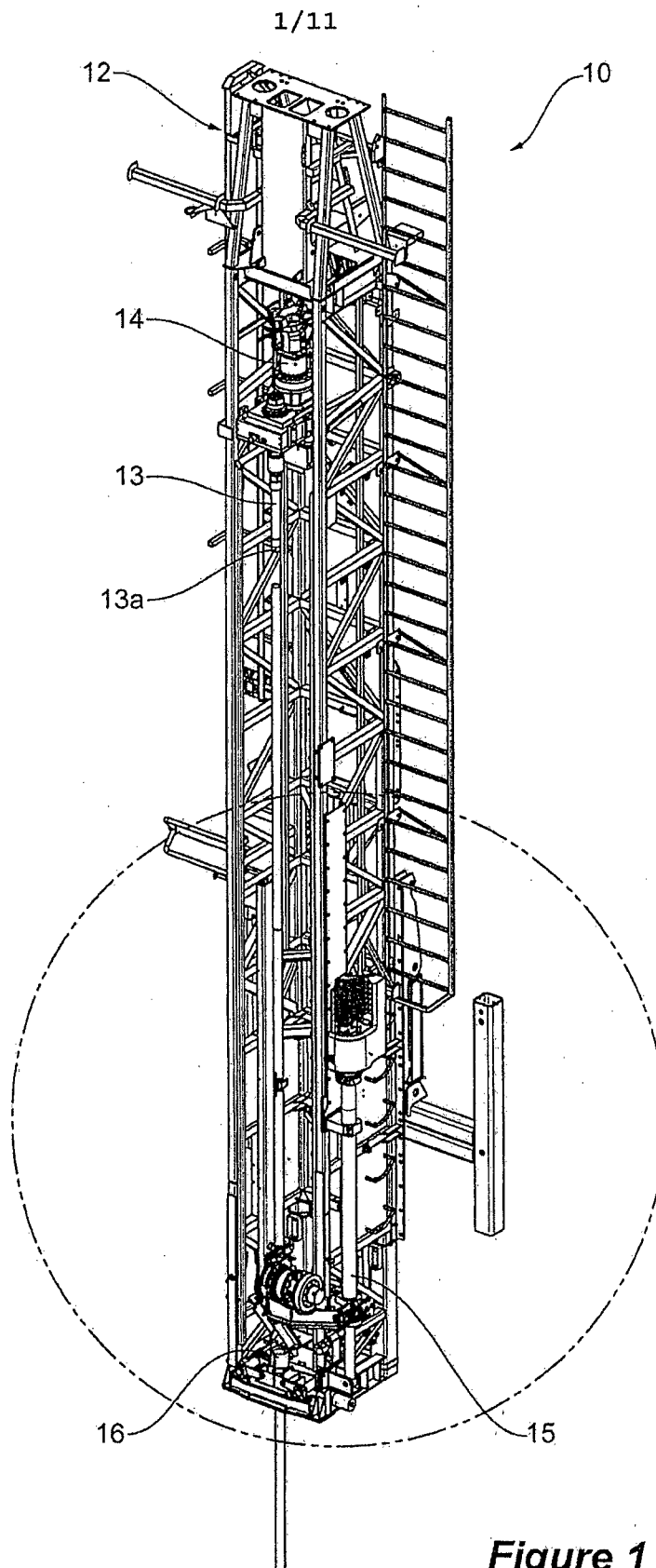
[0088] It will be appreciated by those skilled in the art that the invention is not restricted in its use to the particular application described. Neither is the present invention restricted in its preferred embodiment

with regard to the particular elements and/or features described or depicted herein. It will be appreciated that the invention is not limited to the embodiment or embodiments disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention as set forth and defined by the following claims.

CLAIMS

1. A drill rod support for a means for handling drill rods, the support comprising a socket configured to receive a portion of a length of a drill rod, and a clamping means disposed within the socket and movable between clamping and release positions with respect to the drill rod.
2. The drill rod support of claim 1, wherein the clamping means comprises at least one movable portion, or jaw.
3. The drill rod support as in either of the preceding claims, wherein the clamping means comprises a plurality of jaws arranged radially about the socket.
4. The drill rod support of claim 3, wherein the clamping means comprises three radially equi-spaced jaws.
5. The drill rod support as in any one of claims 2 through 4, wherein the socket and the or each jaw is elongate, each having a direction of elongation which is substantially parallel to the other.
6. The drill rod support as in either of claims 4 or 5, wherein the clamping means is self-centering, and as such always clamps the rod centrally with respect to the socket.
7. The drill rod support as in any one of the preceding claims, wherein the support further comprises drive means for the clamping means.
8. The drill rod support of claim 7, wherein the clamping means is biased towards its release position by biasing means, so the drive means need only drive the clamping means into its clamping position.
9. The drill rod support of claim 8, wherein the drive means comprises a linear actuator which drives a jacking plate against the bias of the biasing means, the drill rod support further comprising a floating plate which will follow the jacking plate by virtue of being linked to the jacking plate by at least one connecting rod, the or each movable jaw following the floating plate by virtue of being operatively associated with this, and wherein the or each movable jaw is moved into its clamping position as it is driven against the bias of the biasing means.
10. The drill rod support of claim 9, wherein the or each movable jaw comprises a guide follower operatively associated with a jaw guide disposed in the socket to drive the jaw into its clamping position as it is driven against the bias of the biasing means.

11. The drill rod support of claim 10, wherein each guide follower comprises an inclined plane which will slide smoothly against an oppositely directed but similarly inclined plane of the jaw guide with any longitudinal movement driven by the linear actuator.
12. The drill rod support as in any one of claims 9 through 11, wherein the drill rod support further comprises an elongate cylindrical housing defining the socket internally, where one end of the housing is open, and an opposing end is substantially closed by an end plate from which there depends the linear actuator.
13. The drill rod support as in any one of claims 9 through 12, wherein the biasing means comprises a compression spring disposed over each of the connecting rods and between the end plate and the floating plate so as to maintain a predetermined spacing between these.
14. A drill rod support for a means for handling drill rods, the support comprising at least a pair of elongate jaws, at least one of which is movable between clamping and release positions with respect to a drill rod so that a full length of each jaw clamps the rod along its longitudinal axis when in the clamping position.
15. A handling means for drill rods comprising a base, a drill rod support as described in any one of the preceding claims, wherein the drill rod support depends from the base so as to be so movable with respect to the base as to effect transfer of a length of drill rod from a drill rod storage position, to a position in line with a drill string, and vice versa.
16. The handling means of claim 15, wherein the drill rod support depends from the base so as to be rotatable about an axis transverse to a longitudinal axis of the drill rod support whereby the support can be moved between an upright position and a substantially horizontal position, as well as movable between a first position located adjacent the drill rod storage position and one or more positions clear of the first position, including the position in line with the drill string.
17. The handling means of claim 16 when depending from claim 12, wherein the closed end of the socket is lowermost when the drill rod support is in its substantially upright position.
18. The handling means as in any one of claims 15 through 17, wherein the drill rod support depends from an arm which is rotatably supported from the base for rotation about a substantially upright axis.
19. A drill rig comprising a handling means as described in any one of claims 15 through 19.



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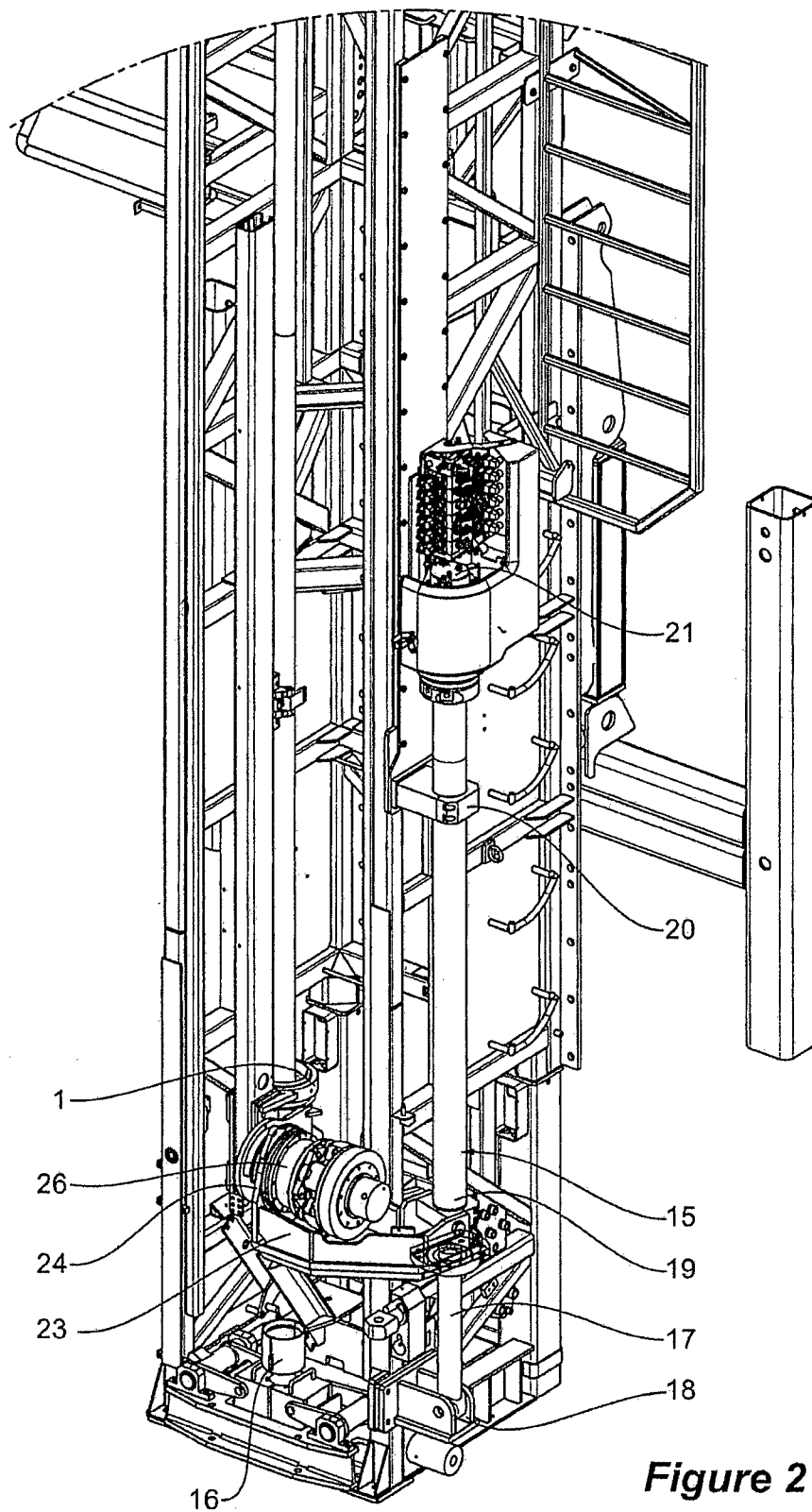


Figure 2

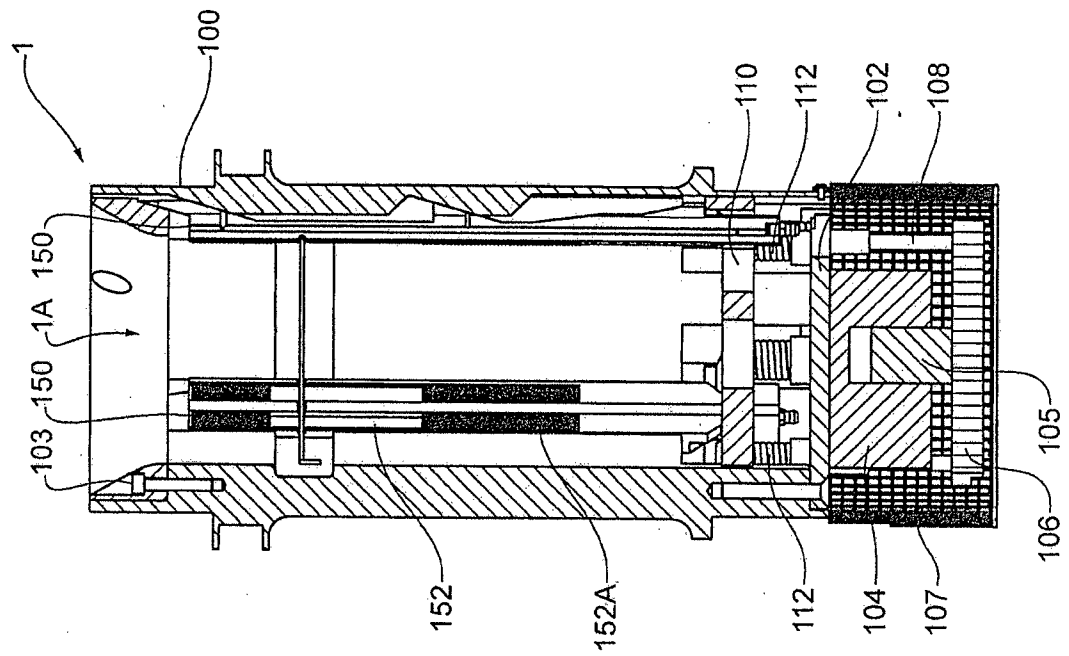


Figure 4

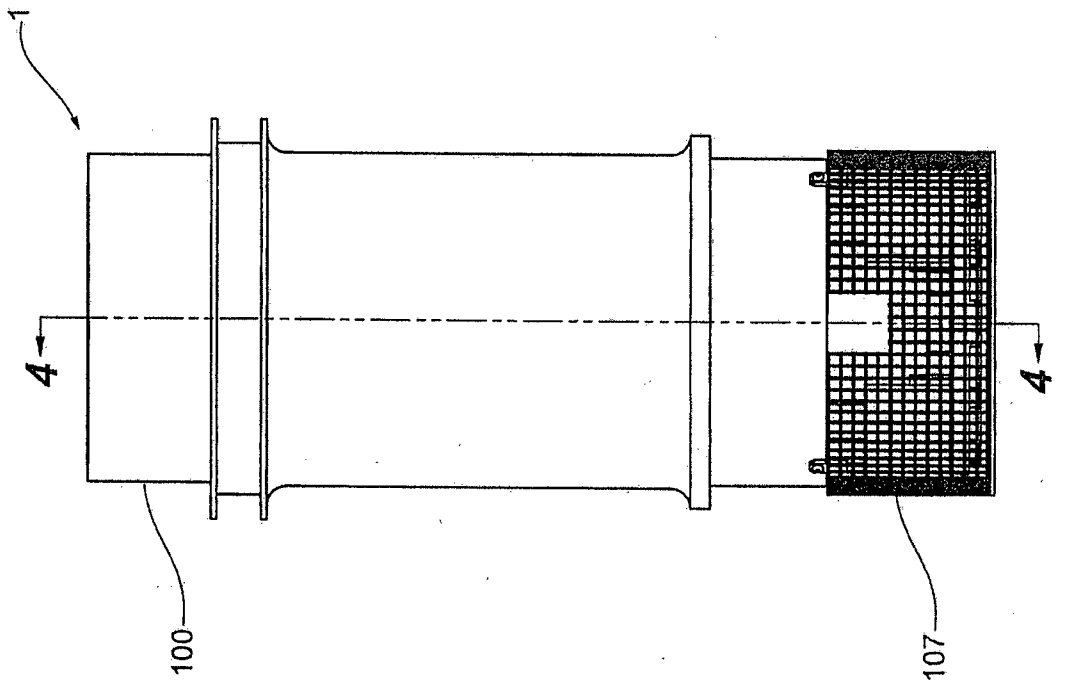


Figure 3

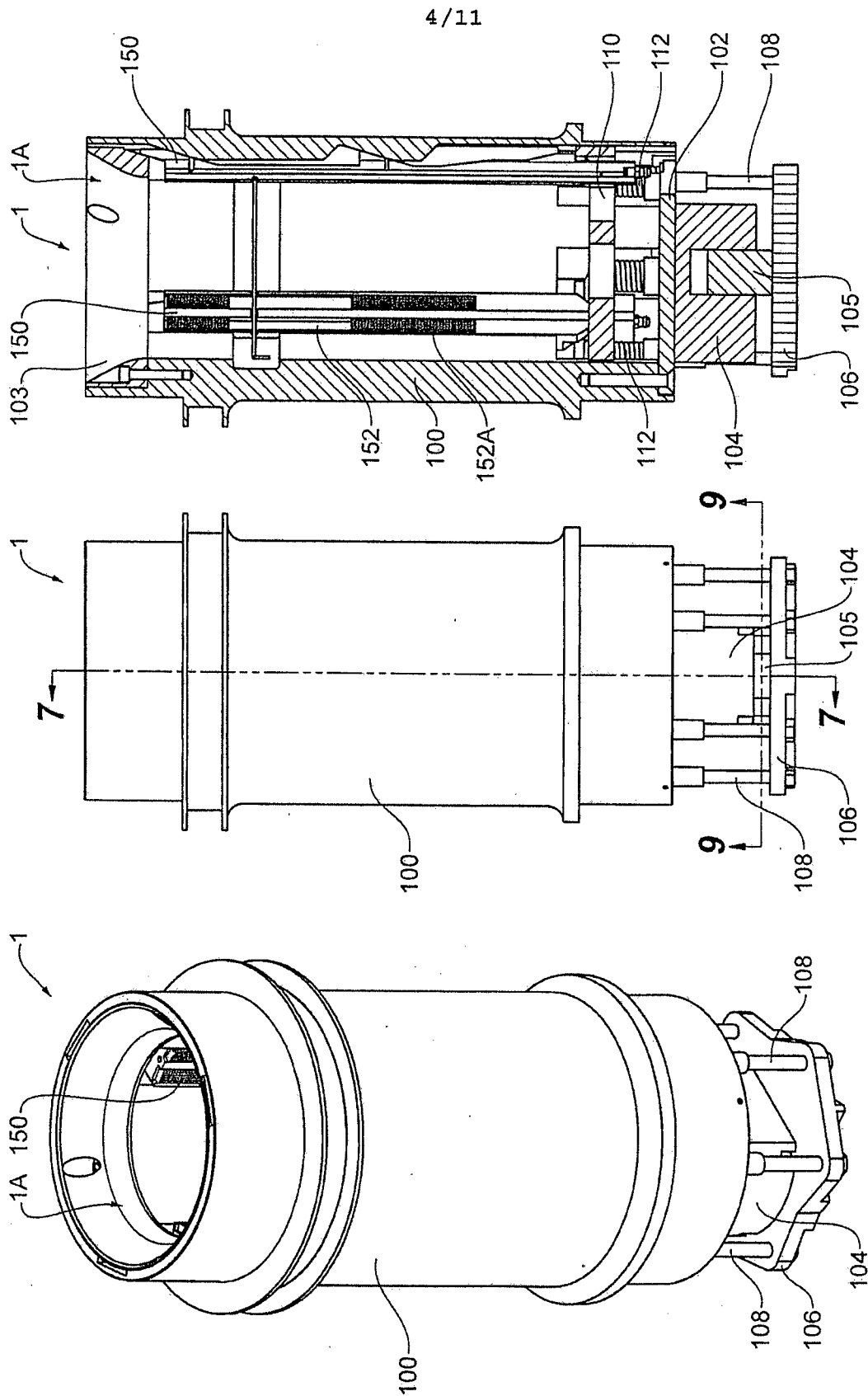


Figure 7

Figure 6

Figure 5

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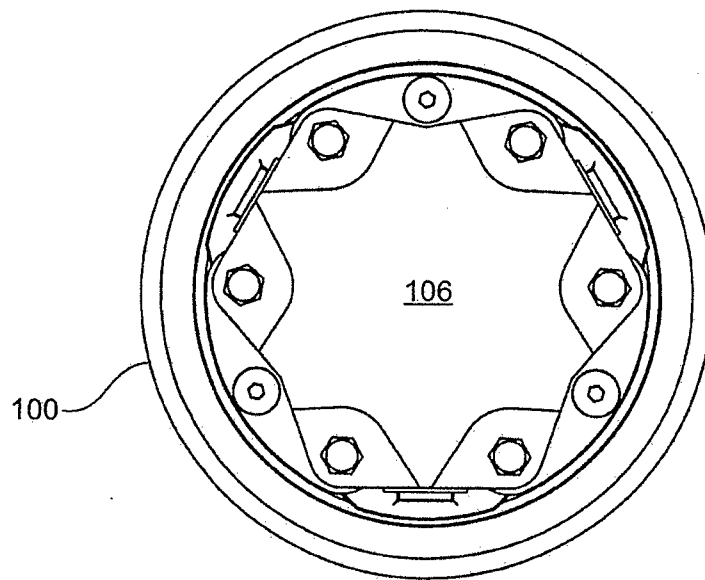


Figure 8

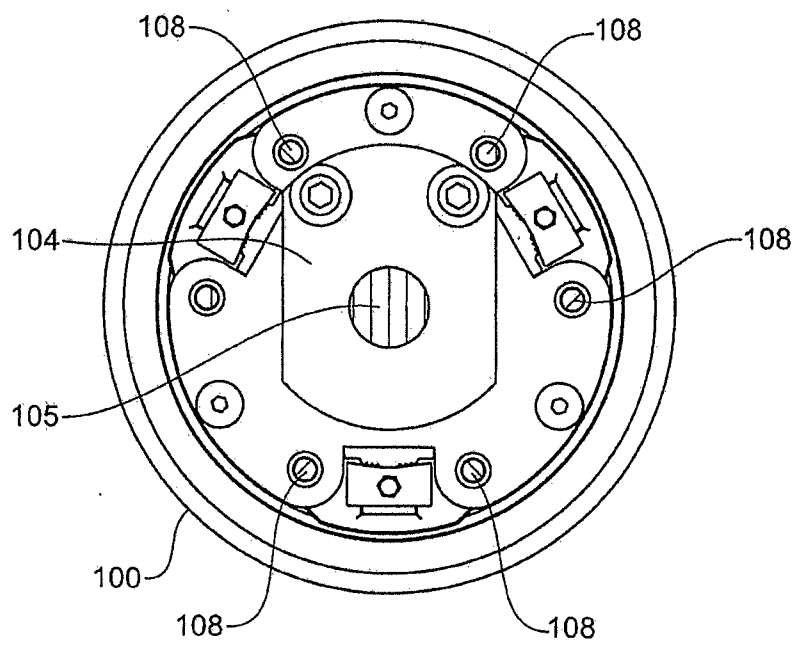


Figure 9

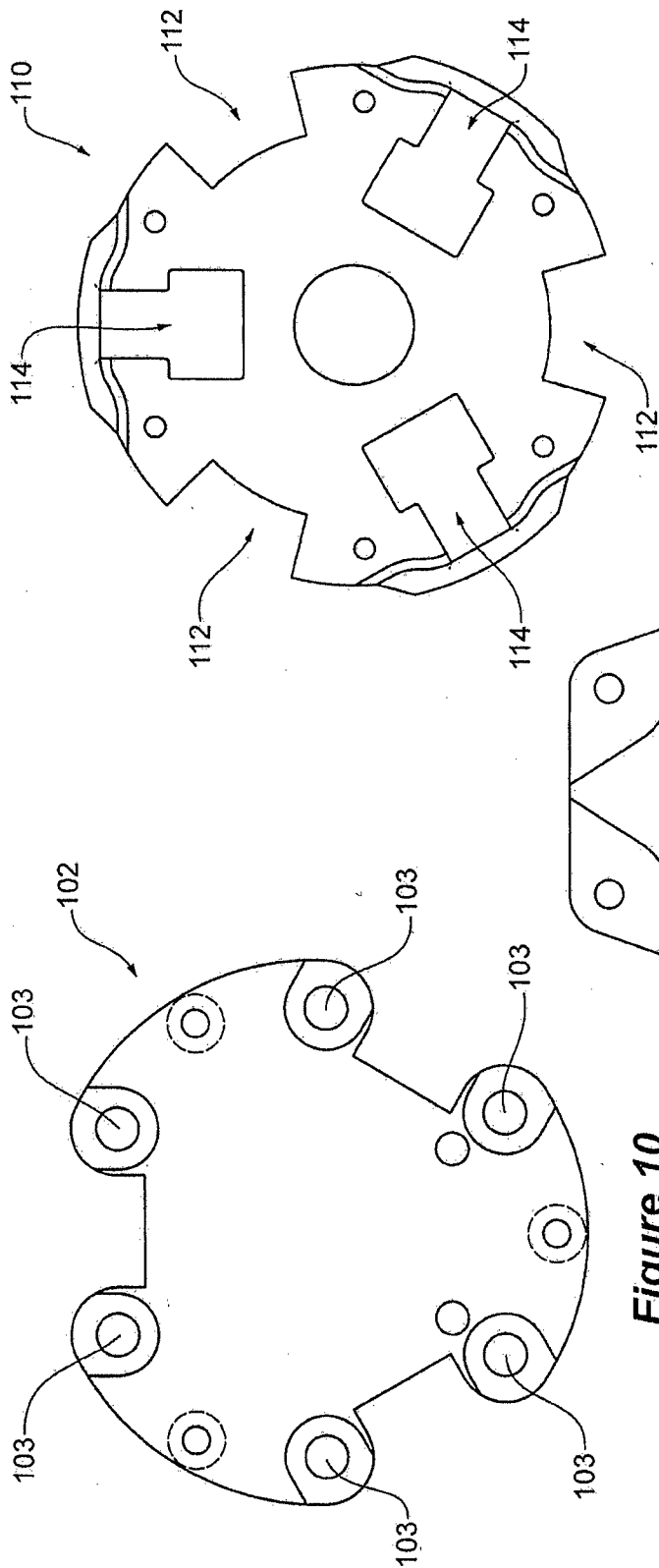


Figure 10

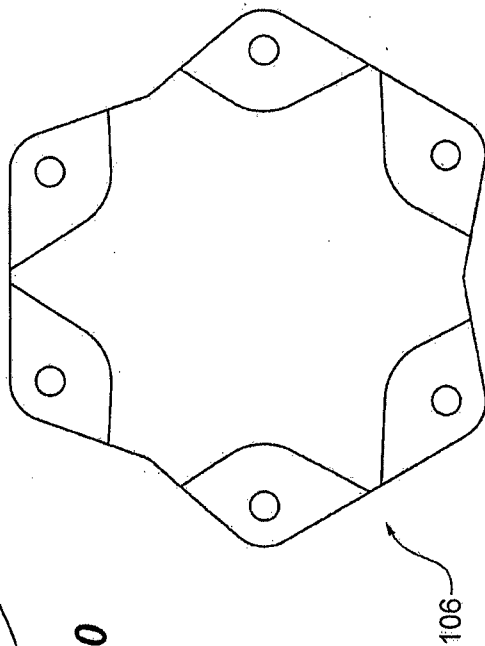


Figure 11

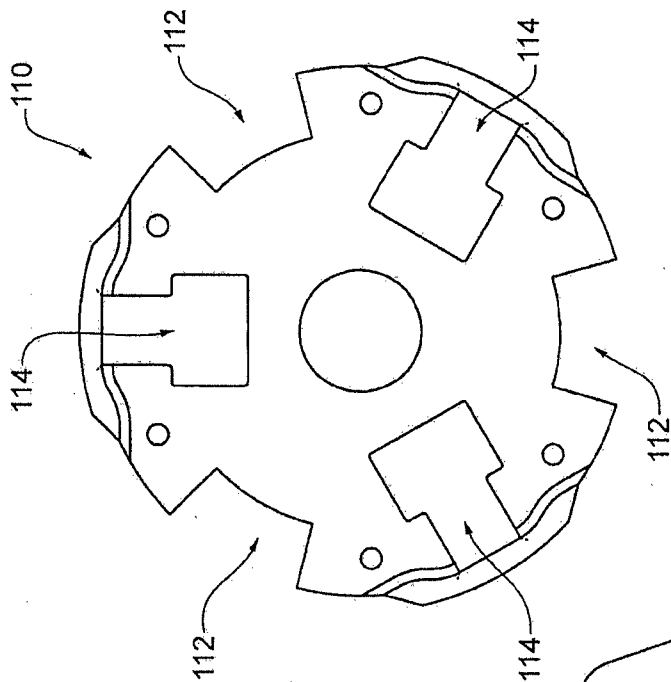


Figure 12

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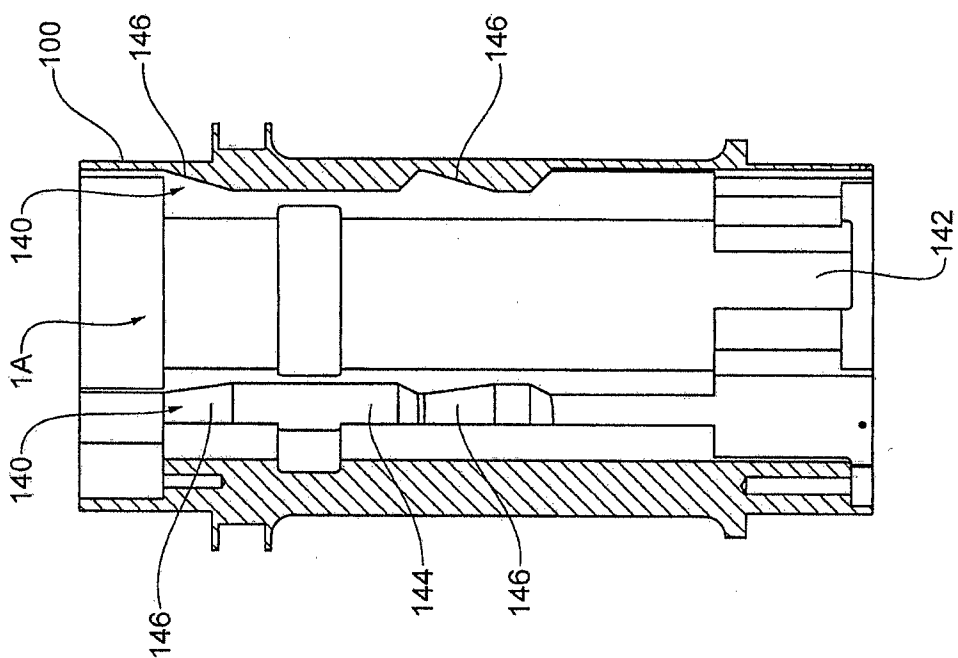


Figure 14

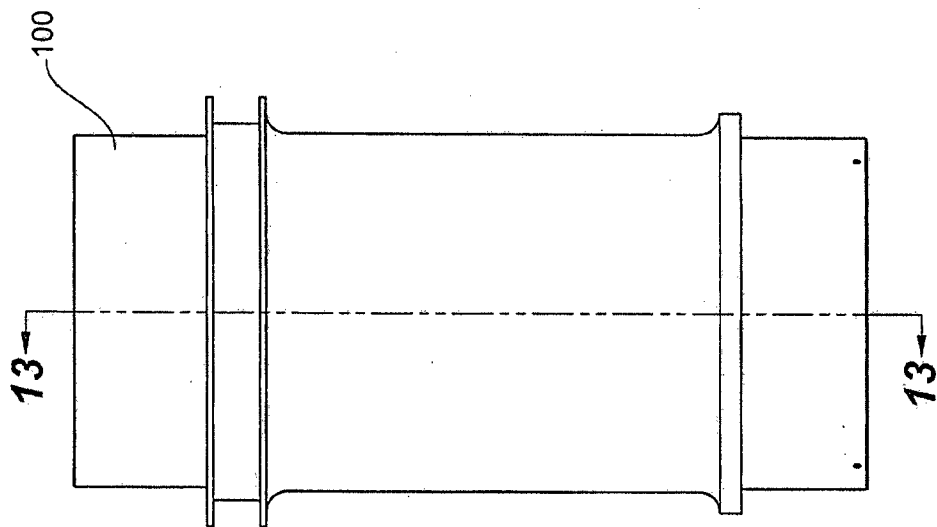


Figure 13

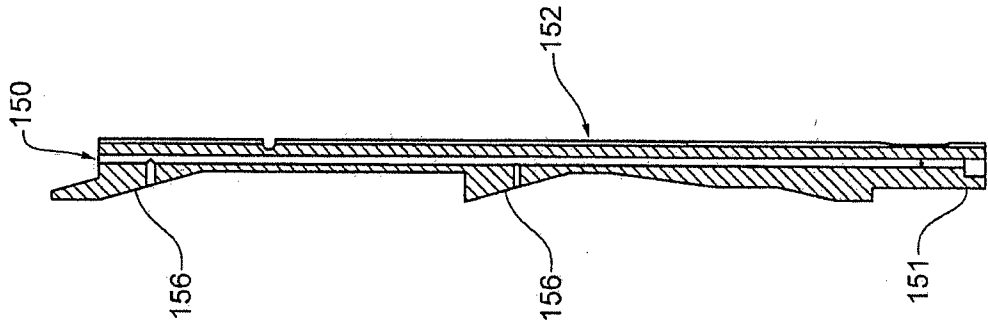


Figure 15

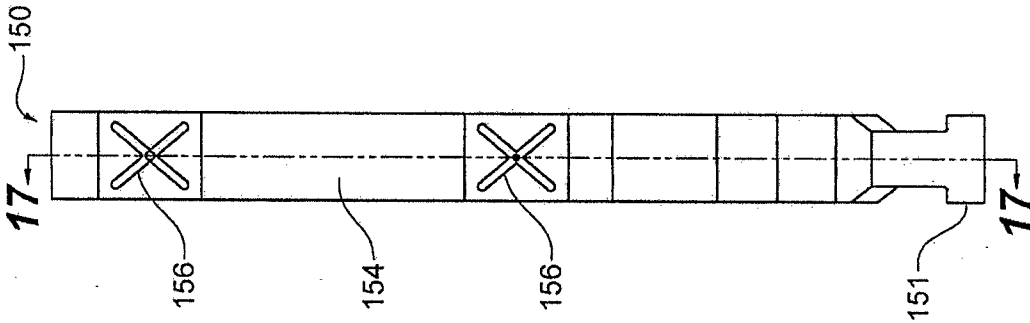


Figure 16

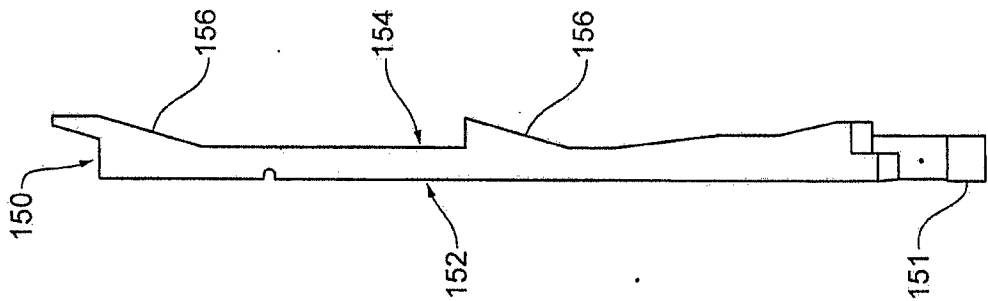


Figure 17

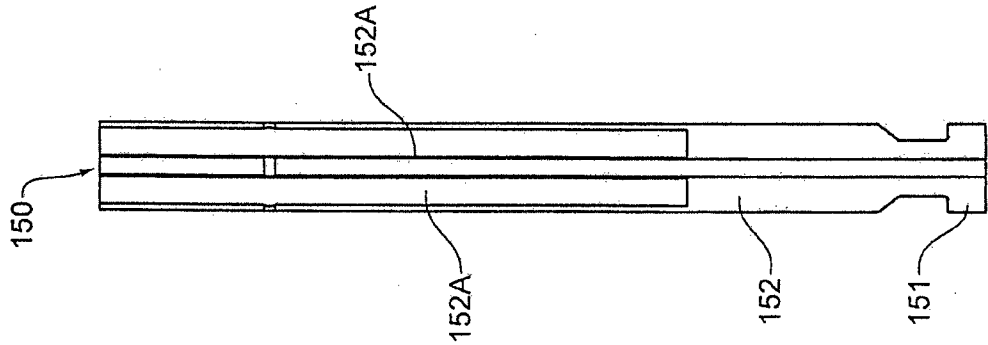


Figure 18

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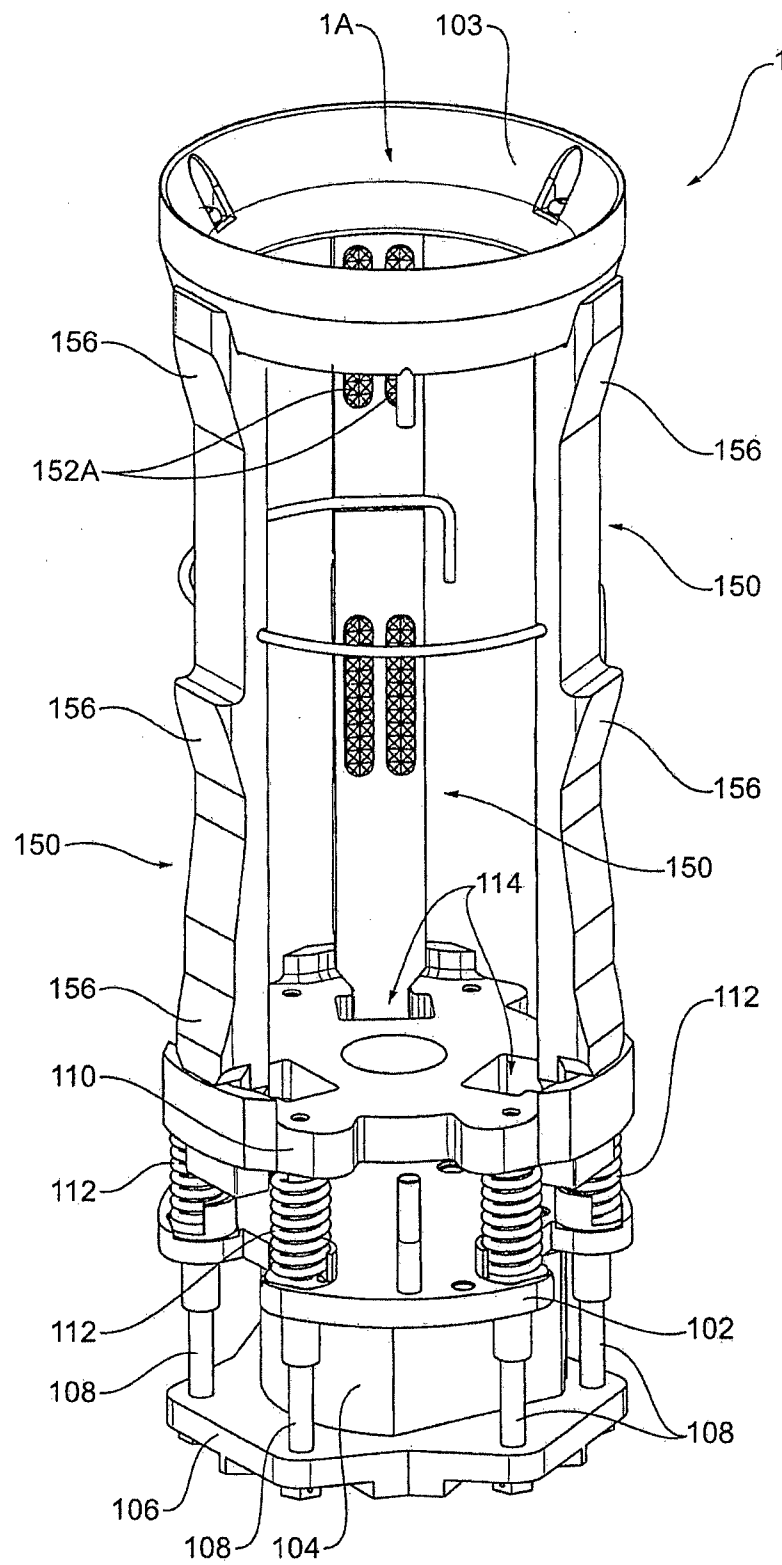


Figure 19

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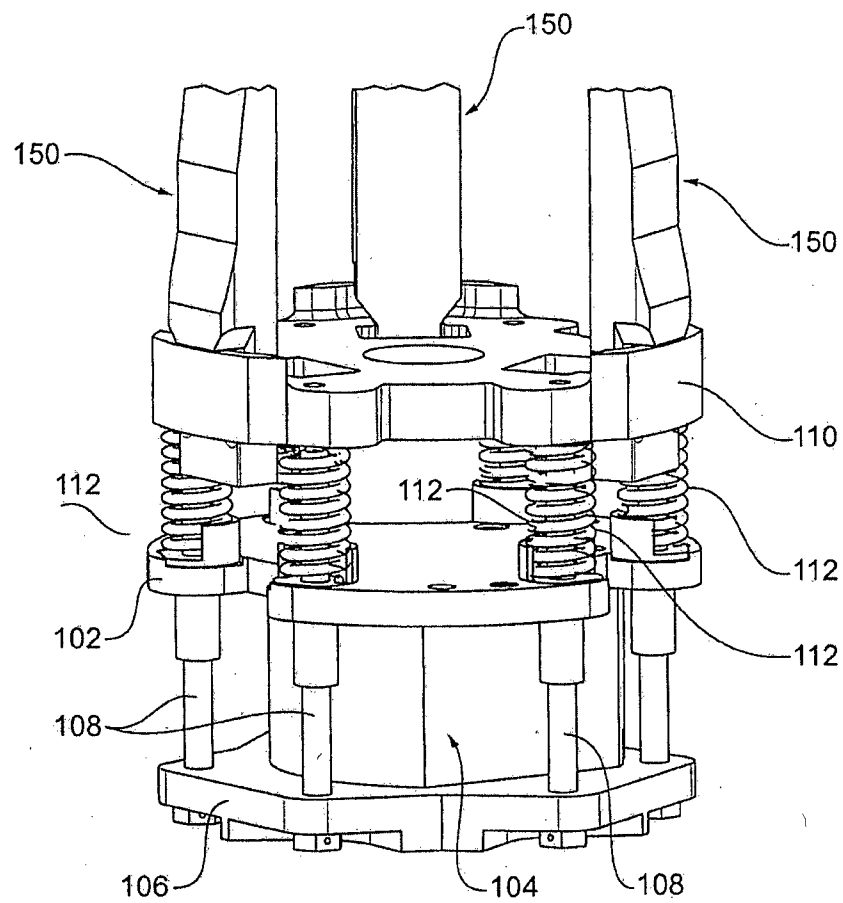


Figure 20

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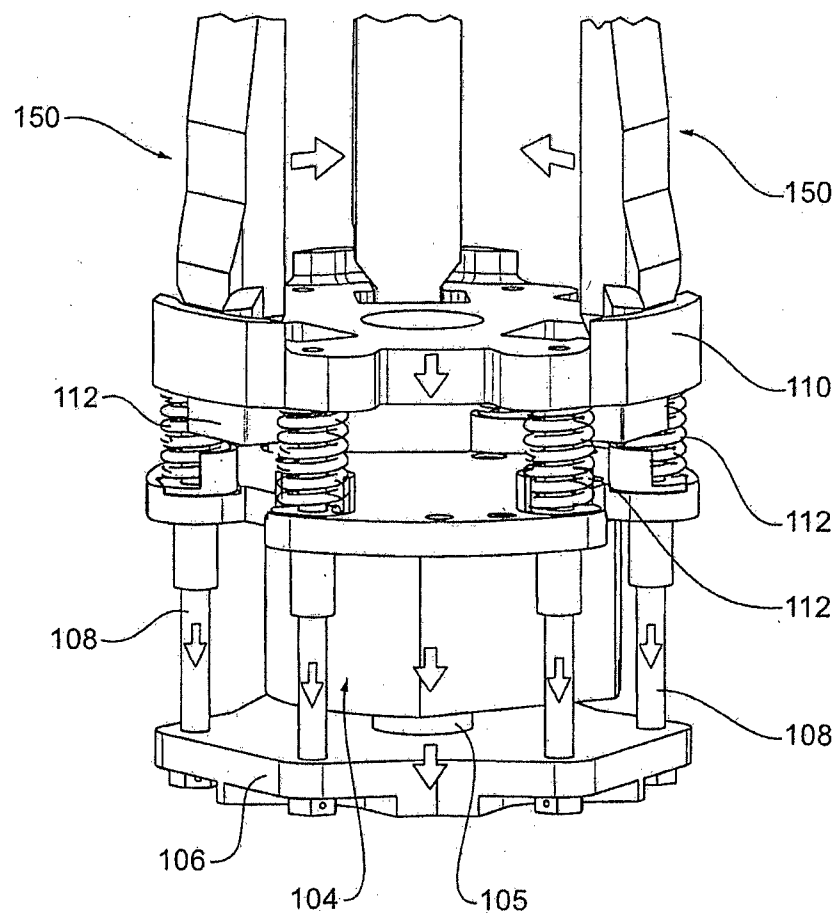


Figure 21

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2013/001440

A. CLASSIFICATION OF SUBJECT MATTER

E21B 19/02 (2006.01) E21B 19/087 (2006.01) E21B 19/20 (2006.01)

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)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC: CPC, IPC: E21B19 with keywords: rod, pipe, tube, casing, string, clamp, grip, tong, jaw, bias, resilient, spring, urge, ram, jack, piston, cylinder, actuator, housing, socket, sleeve and similar terms
Espacenet: "clamp bias" or "clamp spring plate" in the title or abstract AND E21B19 as the IPC classification; the applicant and inventor search in Espacenet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

☒ 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	"J" 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
"E" earlier application or patent but published on or after the international filing date	"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
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 4 March 2014	Date of mailing of the international search report 04 March 2014
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustralia.gov.au Facsimile No.: +61 2 6283 7999	Authorised officer Leopold Filipovic AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832105

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2013/001440
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CA 2306306 A1 (TESCO CORPORATION) 08 April 2001 page 5, line 23 - page 9, line 16 and Figures 1-5	1-14
X	US 5992801 A (TORRES) 30 November 1999 column 4, line 7 - column 5, line 56 and Figures 1-4	1-8 and 14
X	US 2009/0095489 A1 (ROODENBURG et al) 16 April 2009 paragraphs 37-65 and Figures 1-5E	1-8 and 14
X	GB 424557 A (THE NATIONAL SUPPLY CORPORATION et al) 22 February 1935 page 1, line 95 - page 2, line 77 and Figures 1-5	1-8 and 14

Form PCT/ISA/210 (fifth sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2013/001440

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-14

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT	International application No. PCT/AU2013/001440
Supplemental Box	
Continuation of: Box III <u>A) Unity is considered in the first instance, only in relation to the independent claims</u> This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups: □ Claims 1-13 are directed to a drill rod support, claims 15-18 (when construed as being appended to claims 1-13) are directed to a handling means and claim 19 (when construed as being appended to claims 1-13 through claims 15-18) is directed to a drill rig. The feature of the support provided with a socket having a clamping means movable between clamping and release positions is specific to this group of claims. □ Claim 14 is directed to a drill rod support, claims 15-18 (when construed as being appended to claim 14) are directed to a handling means and claim 19 (when construed as being appended to claim 14 through claims 15-18) is directed to a drill rig. The feature of the support having at least a pair of elongate jaws arranged in such a way so that a full length of each jaw clamps the rod along its longitudinal axis is specific to this group of claims. PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art. When there is no special technical feature common to all the claimed inventions there is no unity of invention. In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The only feature common to all the claimed inventions is the feature of the jaws/clamping means being movable between clamping and release positions. However, it is considered that this feature is generic in this particular art. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied <i>a priori</i>. <u>B) Lack of unity in dependent claims arising from a novelty objection</u> Based on the novelty and inventive step search conducted, it is considered that the inventions defined in at least claims 1 and 14 do not avoid prior art in light of many patent documents of which D1-D4 are a selection and therefore it is necessary to reassess the special technical feature(s). The disclosures of D1-D4 are discussed in Box No. V of the written opinion. The inventive link between the dependent claims has been considered and the examiner has concluded that there is a residual <i>a posteriori</i> lack of unity in dependent claims arising from the novelty objection discussed in the written opinion. Based on this, there are the following different significant embodiments in the dependent claims: 1) Claims 9-13 are directed to a drill rod support. The feature of the drive means having a linear actuator, jacking plate and floating plate arrangement as defined by the feature added by claim 9 is considered to be specific to this group of claims. 2) Claims 15-18 are directed to a handling means and claim 19, appended to claims 15-18, is directed to a drill rig. The feature of the drill rod support being movable with respect to the base as to effect transfer of a length of drill rod from a drill rod storage position to a position in line with a drill string and vice versa is considered to be specific to this group of claims. In the above groups of claims (1) and (2), the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The features common to all the claimed inventions are the features of the broadest appended claim 1 to which the above groups of claims (1) and (2) are appended to. However, because claim 1 is not novel there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied <i>a posteriori</i>.	
Form PCT/ISA/210 (Supplemental Box) (July 2009)	

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/AU2013/001440	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
CA 2306306 A1	08 Apr 2001	CA 2496102 A1	08 Apr 2001
		US 6311792 B1	06 Nov 2001
US 5992801 A	30 Nov 1999	None	
US 2009/0095489 A1	16 Apr 2009	EP 1931851 B1	14 Oct 2009
		US 2009095489 A1	16 Apr 2009
		WO 2007024128 A1	01 Mar 2007
GB 424557 A	22 Feb 1935	None	
End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2009)			