(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 361 039 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
15.08.2018 Bulletin 2018/33

(51) Int Cl.:
E21B 7/04 *(2006.01)* ***E21B 19/16*** *(2006.01)*

(21) Application number: **17155841.4**

(22) Date of filing: **13.02.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(71) Applicant: **Epiroc Rock Drills Aktiebolag**
701 91 Örebro (SE)

(72) Inventors:
- **KÄMPE, Ulf**
  692 33 KUMLA (SE)
- **EDETUN, Tommy**
  702 28 Örebro (SE)
- **HARTWIG, Sverker**
  187 33 TÄBY (SE)

(74) Representative: **Ehrner & Delmar Patentbyrå AB**
Drottninggatan 33, plan 4
111 51 Stockholm (SE)

(54) DRILL STRING GUIDING DEVICE AND METHOD OF JOINING DRILL STRING COMPONENTS WITH SUCH A DEVICE

(57) A drill string guiding device (2) for holding elongate drill string components (3, 3', 3") during assembling or disassembling of a drill string (4) in a drilling operation, the drill string guiding device (2) comprising a frame (6) with an opening (7) through which the drill string (4) is arranged to protrude during operation, the drill string (4) extending in an axial direction (A_1). A holding device (8) is arranged, and a positioning device (13) is arranged on the frame (6) for positioning the holding device (8) between an inactive position and an active gripping positon in which it is arranged to hold the drill string component (3') as an adjacent drill string component (3) is being connected thereto or removed therefrom. The holding device (8) comprises a guiding support (11) comprising upper, lower and side portions arranged to partially enclose and fix a section of said first drill string component (3') and a guiding support (11) with at least one guide surface (12a,12b) for aligning said drill string component (3').

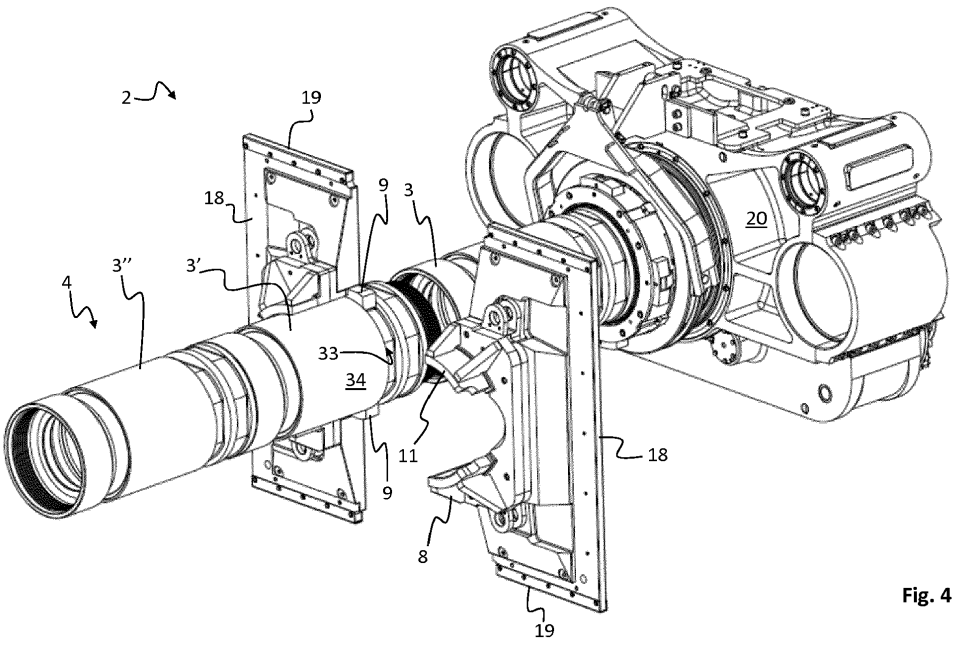

Fig. 4

EP 3 361 039 A1

Description

TECHNICAL FIELD

[0001] The invention relates to a drill string guiding device for assistance in the joining of drill string components, where a plurality of joined drill string components form a continuous drill string being connected to a cutter head at its outer end.

BACKGROUND

[0002] In most rock drilling applications with a drill string of a considerable length several drill string components in the form of rods or pipes are joined so as to form a continuous drill string. In operation the drilling is performed stepwise, wherein the drill string is advanced by length of one drill string component at the time, followed by a stop during which another drill string component is fastened to the drill string component of the drill string that is closest to the drive arrangement. The drilling may be performed downwards, sideways, upwards or any angle there between.

[0003] In WO 2005/068772 A1 a holding wrench is disclosed. The holding wrench is arranged to hold drill string components during assembling and disassembling of a drill string. The holding wrench is arranged to fix the drill string from rotational movement during such assembling and disassembling of the drill string.

[0004] A problem that arises especially when the drilling is not performed straight downwards or upwards is that bending forces act on the drill string. These bending forces are particularly troublesome to handle in the joints between the drill string components, especially if the components are hollow, e.g. tubular. Typically, such drill string components may be utilised in drilling applications where the crushed rock residues are transported within the drill string comprised of a plurality of interconnected drill string components.

[0005] In some cases, the cutting head, which is arranged at the outer end of the drill string, has a wider diameter than the drill string itself. As a consequence, the drill string may be hanging within the bore hole between the two fixed points constituted by the cutting head at one end, and the drill rig at the opposite end. These problems are particularly troublesome in drilling operations that are performed horizontally, or close to horizontally. Namely, when drilling horizontally, the load of the whole drill string, and during operation the crushed rock residues passing inside it, needs to be supported by the drill string itself.

[0006] It is a problem that pipe sections have a relatively short service life and particularly that the connective portions thereof, which typically include threads, are prematurely worn out, such that one or more drill sections need to be machined or even replaced after just a few drilling operations.

[0007] In a prior art solution, these problems are addressed by the addition of spacer rings that are to be arranged at regular locations around the drill string so as to support the drill string with respect to surrounding drill hole. This solution reduces the problems but does not completely eliminate them. Further, the step of adding and removing the spacer rings each time the drill string is set-up or dismounted contributes to an unwanted prolongation of the duration of a drilling operation.

[0008] Hence, there is a need of an arrangement that prolongs the service life of the drill string components in general and their connective portions in particular, preferably without adding additional steps to the drilling procedure.

SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to provide an arrangement in connection to a drilling machine that contributes to prolonging the service life of drill string components such as drill pipes or rods. This is achieved by means of a drill string guiding device and a method of joining drill string components by means of such a drill string guiding device.

[0010] According to a first aspect the invention relates to a drill string guiding device for holding elongate drill string components during assembling or disassembling of a drill string in a drilling operation, each drill string component having a connective portion at each end for interconnection with an adjacent drill string component, the drill string guiding device comprising a frame with an opening through which the drill string is arranged to protrude during operation, the drill string extending in an axial direction; a holding device arranged to hold a drill string component of the drill string as an adjacent drill string component is being connected thereto or removed therefrom; and a positioning device arranged on the frame for positioning the holding device between an inactive position in which it allows free passage of the drill string through the opening of the frame, and an active gripping positon in which it is arranged to hold the drill string component as an adjacent drill string component is to be connected thereto or removed therefrom. The holding device comprises a guiding support comprising upper, lower and side portions arranged to at least partially enclose and fix a portion of said first drill string component when in the active position and at least one guide surface, extending in the axial direction of the drill string from the guiding support to support said first drill string component and thereby align the drill string along its axial direction when in the active position.

[0011] With the inventive holding device is achieved that the drill string component, to or from which another drill string component is to be connected or removed, is rectified. Thereby, the connective portions of the respective drill string components to be connected or disconnected are aligned such that harmful effects are avoided. Typically, the connective portions are formed of threads, but they may also be formed of interacting cam surfaces

or a bayonet coupling.

[0012] In a specific embodiment of the drill string guiding device the holding device comprises two sections that are arranged to be positioned from opposite sides of the drill string component, each section comprising separate parts of the guiding support and of the at least one guide surface.

[0013] In a specific embodiment of the drill string guiding device substantially horizontal tracks are arranged on the frame, and wherein the two sections of the holding device comprise tracks arranged to be slided sideways along said tracks between the active position and the inactive position.

[0014] In a specific embodiment the holding device comprises two sections that are arranged to be positioned from opposite sides of the drill string component, each section comprising separate upper and lower guide surfaces.

[0015] Specifically, the positioning device may comprise hydraulic cylinders arranged to move the two sections of the holding device.

[0016] In a specific embodiment the sections of the holding device include mating elements so as to align said sections with each other.

[0017] In one specific embodiment the holding device comprises a lower guide surface extending in the axial direction of the drill string to support said first drill string component from below, and in one specific embodiment, the same or another, the holding device comprises an upper guide surface extending in the axial direction of the drill string to support said first drill string component from above.

[0018] Specifically, the upper and lower guide surfaces may be part circular having a radius corresponding to the radius of a cylindrical portion of the drill string components.

[0019] In a specific embodiment both separate sections of the holding device comprises a part circular portion, which part circular portions are arranged opposite each other on said separate sections of the holding device.

[0020] In one specific embodiment the holding device comprise a wrench portion with non-circular surfaces for interaction with a corresponding non-circular surface of said first drill string component.

[0021] In another specific embodiment both separate sections of the holding device comprise a separate wrench portion with non-circular surfaces for interaction with a corresponding non-circular surface of said first drill string component.

[0022] Specifically, the wrench portion may constitute the guiding support, comprising upper, lower and side portions arranged to partially enclose and fix a section of said first drill string component, when the holding device is in the active position.

[0023] According to a second aspect the invention relates to a rock drilling machine for drilling a hole in a rock by means of a cutting head arranged on the drilling machine via drill string components, wherein the drilling machine comprises a drill string guiding device as described above.

[0024] According to a third aspect the invention relates to a method of joining drill string components to drill string by means of a drill string guiding device as described above, the method comprising the steps of positioning the holding device in the active gripping position, and by means of a guiding support of the holding device, axially aligning said first drill string component of the drill string, the guiding support having an a guiding support comprising upper, lower and side portions arranged to partially enclose a section of said first drill string component and at least one guide surface, extending in the axial direction of the drill string to support said first drill string component, and connecting or disconnecting a drill string component to or from said first drill string component of the drill string, while said first drill string component is held by said guiding support of the holding device.

[0025] The method may further comprise the step of, by means of a wrench portion of the holding device, holding said first drill string component of the drill string, the wrench portion comprising a non-circular surface for interaction with a mating non-circular surface of the drill string component.

[0026] Other embodiments and advantages will be apparent from the detailed description and the appended drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0027] An exemplary embodiment related to the invention will now be described with reference to the appended drawings, in which;

Fig. 1 is a schematic view of a rock drilling machine in operation on which a drill string guiding device in accordance with the invention may be arranged;

Fig. 2 is a perspective view the rock drilling machine of fig. 1;

Fig. 3 is a side view of a drill string extending from a rotation unit and part of a drill string guiding device in accordance with the invention;

Fig. 4 is a perspective view of a drill string extending from a rotation unit and part of the inventive drill string guiding device in a part open mode;

Figs. 5-6 are perspective views of an embodiment of a drill string guiding device in accordance with the invention, in an open and closed mode, respectively;

Fig. 7 is a perspective view of a drill string compo-

nent and part of the inventive drill string guiding device in an open mode; and

Fig. 8 is a detailed view of the inventive drill string guiding device in a part open mode.

DETAILED DESCRIPTION OF EMBODIMENTS

[0028] In the following the invention will be described with reference to a shown embodiment of the invention in the form of a slotboring machine arranged to drill holes by means of a cutting head and a pilot bit, drilling away from the drilling machine. The invention is however useful in any type of drilling where the drill string will be exposed to forces acting at least partially orthogonally with respect to the drill string, including but not limited to slotboring, raise boring, and the boring of box holes, easer holes, air holes or the like where a relatively wide cutting head, with respect to the diameter of the drill string, is used.

[0029] Fig. 1 shows a rock drilling machine 1 in excavating operation at an underground location. In the shown embodiment the rock drilling machine comprises a derrick 5, which is secured in a rock drilling position at the underground location. A drill string 4 comprised of several hollow drill string components 3, 3', 3" extends from the derrick 5. At the outer end of the drill string 4, extending into the rock which is being excavated, a cutting head 16 and pilot bit 17 are arranged. The cutting head is arranged to crush the rock into muck, which is transported through the drill string 4 to an unloading station for subsequent extraction of metals or the like. The rock drilling machine may also be used to simply provide a through hole, e.g. to produce a tunnel or to connect different mining galleries for pressure equalizing purposes. In such cases extraction of metals or the like from the muck is optional.

[0030] Fig. 2 is a perspective view of the rock drilling machine 1 showing a compartment 22 on which several drill string components 3 may be stored. A handling device (not shown) is arranged to lift one drill string component at a time between the compartment 22 and an operating position 23 where it is arranged to form part of the drill string 4 with the cutting head 16 extending out through an opening 7 of a frame 6 arranged on the derrick 5. The frame 6 forms part of a drill string guiding device 2, which constitutes a first aspect of the invention, as further described below.

[0031] The frame 6 may be any part that is firmly attached to the derrick 5. An object of the frame is to fix a holding device, which is further described below, with respect to the rotation unit 20, and hence with respect to the derrick 5. The rotation device 20 is arranged to provide the rotational movement so as to thread or unthread a drill string component to or from the drill string 4. Further, the rotation device is movably arranged so as to be translated in the axial direction A_1 of the drill string 4 for a little bit more than a full length of a drill string component 3.

[0032] Fig. 3 is a side view of a drill string 4 extending from a rotation unit 20 and part of a drill string guiding device 2 in accordance with the invention. The drill string guiding device 2 is arranged to hold one drill string component 3' as another drill string component 3 is being connected thereto, or during dismounting of the drill string, as another drill string component 3 is being removed therefrom.

[0033] As is apparent in fig. 3 the drill string component is provided with a connective portion 31,32 at each end for interconnection to an adjacent drill string component. In the shown embodiment these connective portions 31,32 are comprised of interconnectable threads, but they may also be formed of interacting cam surfaces or a bayonet coupling. In the shown embodiment a male thread 31 is provided at a first end and a female thread 32 is provided at the opposite end. In between these threaded portions the drill string component 3 comprises a non-circular surface 33, typically a polygonal surface, and a cylindrical portion 34. For the context of the application the term cylindrical portion denotes an elongate portion that has substantially the same cross section along its whole axial extension. It may have, but does not have to be, a circular cross section throughout its whole axial extension. The cylindrical portion does however have substantially the same width for its whole extension.

[0034] The drill string guiding device 2 in the sown embodiment comprises a holding device 8 adapted to interact with said non-circular surface 33 and cylindrical portion 34 so as to hold the innermost drill string component 3' as another drill string component 3 is being connected, e.g. threaded, thereto or, during dismounting, to hold the second innermost drill string component 3' as the innermost drill string component 3 is being disconnected, e. g. unthreaded, therefrom.

[0035] Fig. 4 is a perspective view of the drill string 4 extending from the rotation unit 20. The holding device 8 of the inventive drill string guiding device 2 is shown in a part open mode for illustrative purposes. Specifically, in the shown embodiment, the holding device 8 comprises two sections, whereof one (the left in the figure) is positioned in an active gripping positon holding the drill string component 3', and the other section (the right section in the figure) is in an open mode with no contact.

[0036] In the shown embodiment, the holding device 8 comprises a wrench portion 9 with a non-circular surface 10 (see figure 8) for interaction with a corresponding non-circular surface 33 of the drill string component 3' so as to fix the drill string component 3' from rotation, a guiding support 11 for partly enclosing and fixing the drill string component 3', and at least one guide surface 12a,12b (see figure 8) for aligning the same. In the shown embodiment, the guide surface 12a,12b is arranged at a distance in the axial direction A_1 of the drill string from the guiding support 11 and the non-circular surface of the wrench portion 9.

[0037] The guiding support 11 comprises upper, lower and side portions arranged to partially enclose and fix a

portion of the drill string component 3' when in the active position. In the shown embodiment the guiding support 11 is comprised of two semi-circular supports which together enclose the whole circumferential of a portion of the drill string component 3'. It is however sufficient that the guide support 11 comprise three support surfaces preferably arranged 120° apart. The aim of the guide support is to fix a portion of the drill string component 3' from moving upwards, downwards or sideways. Exactly how this fixing may effectively be achieved is readily understandable to a person skilled in the art. In a way, the guiding support 11 creates a pivot point around which the drill string component 3' may pivot to a certain degree. The guide surface 12a,12b is hence arranged to limit the possibility to pivot and to align the drill string component 3' in the axial direction A_1 of the drill string 4. In a specific embodiment the wrench portion 9 may alone constitute the guiding support 11, such that the wrench portion 9 comprises contact surfaces 10 that fix a portion of the drill string component 3' from moving upwards, downwards or sideways. In the shown embodiment the holding device 8 comprises both a guiding support 11 and a wrench portion 9 that both contribute to fixing the drill string component 3'. The wrench portion 9 may however just as well be arranged separate from the holding device 8, being positionable between an active, gripping position and a positon allowing unhindered passage of the drill string 4 by means of a separate positioning device (not shown).

[0038] As is indicated in fig. 3 the extension of the contact surface between joint extension of the guide surface 12a,12b and the guide support 11 of the holding device 8 and the cylindrical portion 34 of the drill string component equals a length L_2, corresponding to a part of the full length L_1 of a drill string component. Preferably, said length L_2 corresponds to at least a fifth of said full length L_1, or more preferably at least a quarter of said full length L_1, or even a third of said full length L_1. The axial extension of the wrench portion 9 of the holding device 8 is to be counted as included in said length L_2 if it is tight enough to contribute to the alignment of the drill string 4. This is preferably the case. Namely. in view of that space for the rock drilling machine is very limited both at the operation location and during transport in connecting between different operation locations the axial length L_2 of the holding device 8 may not be too long.

[0039] In the embodiment shown in figure 4 each section of the holding device 8 is arranged on a sliding element 18 provided with rails 19 for sliding interaction at its upper and lower end. The holding device may of course be directly provided with means for sliding interaction with the frame 6. However, as the size of the opening 7 in the frame 6 is relatively big with respect to the drill string elements to be held by the holding device 8, an intermediate arrangement such as the two sliding elements 18 is useful.

[0040] In the assembly of a drill string the following steps are performed:

- positioning the holding device 8 in the active gripping position,
- holding a drill string component 3' of the drill string 4 by means of a guiding support 11 of the holding device 8 and at least one interconnected guide surface 12a,12b,
- connecting or disconnecting of a drill string component 3 to or from said drill string component 3' of the drill string 4, while said drill string component 3' is held by the guiding support 11 and said guide surface 12a,12b.

Optionally, the drill string component 3' is also held by a wrench portion, which may or may not be a part of the holding device.

[0041] Preferably, the rotation device 20 is arranged to provide the rotation of the drill string component 3 that is being connected or disconnected to or from the drill string 4.

[0042] After a successful adding of a drill string component 3 the drilling machine is operated such that the cutting head 16 is advanced a full length L_1 of one drill string component, whereby the operation of adding another drill string component is repeated until the excavation operation has been concluded, whereupon the operation is reversed and the drill string components are removed one by one.

[0043] Figs. 5 and 6 are perspective views of an embodiment of a drill string guiding device 2 in accordance with the invention, in an open and closed mode, respectively. As is apparent from these figures the sliding element 18 carrying the holding device 8 is arranged on a frame 6 with an opening 7 through which the drill string 4 is arranged to protrude in the axial direction A_1 during operation. The frame 6 carries tracks 15 for a track-rail sliding interaction with the sliding elements 18. Alternatively, the sliding elements 18 could be provided with tracks and the frame 6 with interacting rails. Either way, the tracks are preferably arranged substantially horizontally.

[0044] Further, a positioning device 13 is arranged on the frame 6 for positioning the holding device 8, and hence the sliding element 18, between an inactive position in which it allows free passage of the drill string 4 through the opening 7 of the frame 6, and an active gripping positon in which it is arranged to hold a drill string component of the drill string 4 as an adjacent drill string component is to be connected thereto or removed therefrom.

[0045] In the shown embodiment, the wrench portion 9 and the guiding support 11 of the holding device 8 are interconnected to each other. Further, an upper and a lower guide surface 12a,12b are arranged and extend away from the guiding support 11 and the non-circular surface 10 of the wrench portion 9. In the shown embodiment a positioning device 13 is arranged to position both

the wrench portion 9 and the guiding support 11 between the inactive position and the active gripping position. The positioning device 13 comprises hydraulic cylinders 14 arranged to move the two sections of the holding device 8 and the sliding elements 18 on which they are arranged between the inactive position (fig. 5) and the active gripping position (fig. 6).

[0046] In a possible not shown embodiment of the invention it suffices that the length L_2 as defined above only concern the lower guide surface 12b of the guiding support 11. Specifically, an outer portion of the lower guide surface 12b may be arranged at an outward distance in the axial direction A_1 of the drill string 4 with respect to an inner portion of the opposed upper guide surface 12a for aligning said first drill string component 3' along its axial direction A_1. Namely, typically the drill string 4 will be hanging between the cutting head at its outer end and the drilling machine at its inner end, such that merely the outer portion of the lower guide surface 12b and the inner portion of the upper guide surface 12a will be in contact with the surface of the drill string component 3' to be held. In order to align the drill string in such a case it will hence be sufficient that an outer portion of the lower guide surface 12b is arranged at an outward distance in the axial direction A_1 of the drill string 4 with respect to an inner portion of the opposed upper guide surface 12a.

[0047] However, in order to achieve an arrangement adapted to align the drill string more firmly and/or with respect to other forces an inner portion of the lower guide surface 12b is preferably arranged at an inward distance in the axial direction A_1 of the drill string 4 with respect to the outer portion of the lower guide surface 12b. Hence, the lower guide surface 12b comprises an inner and an outer portion that are spaced apart from each other in the axial direction of the drill string 4.

[0048] As is apparent from the figures of the specific embodiment the holding device 8 is primarily adapted to align the torques acting upwards or downwards on the drill string. This is because these are generally the most important forces acting on the drill string 4. However, the shape of both the upper and lower guide surfaces 12 and 12b, respectively, is also adapted to align the drill string 4 sideways, the guide surfaces 12 and 12b extending circularly so as to support the drill string component 3' that is being held. Typically, the upper and lower guide surfaces 12 and 12b may be part cylindrical. For best mechanical stability, the upper and lower guide surfaces 12 and 12b are half cylindrical, and interconnected to each other so as to form a cylinder arranged to enclose the drill string component 3' to be held and support it in all directions.

[0049] Fig. 7 is a perspective view of a part of the inventive drill string guiding device 2 in an open mode encircling a drill string component 3 and fig. 8 is a detailed view of the holding device 8 of the drill string guiding device 2 in a part open mode. In the shown embodiment the non-circular surface 33 of the drill string component 3 is octagonal and the wrench portion 9 comprises four mating non-circular surfaces 10, including an upper, a lower, and two opposed non-circular surfaces 10 that are provided on separate sections of the holding device 8. As is apparent from figure 8, each non-circular surface 10 is in fact divided into two flat surfaces 10a and 10b, respectively, which are arranged at an angle of about 6° with respect to each other. Four of these surfaces 10a are arranged to support a drill string component 3' when another drill string component 3 is being threaded thereto, and the other four surfaces 10b are arranged to support a drill string component 3' when another drill string component 3 is being unthreaded therefrom. After closing of the holding device around a drill string component the drill string component is allowed to rotate about 3° in the appropriate direction before abutting contact is made with the non-circular surfaces 10a or 10b.

[0050] In the shown embodiment the upper and lower non-circular surfaces 10a and 10b, which are opposing each other, are arranged on the same section of the holding device 8 (the left in the figures). This is advantageous as it eliminates the risk of having these surfaces displaced with respect to each other. The wrench portion comprising the upper and the lower non-circular surfaces also comprises chamfered portions 21 arranged to facilitate assembly/closing of the holding device 8. Further, the wrench portion comprises an outer chamfered portion 25 to facilitate closing of the holding device 8 and to help align the sections of the holding device to each other. The protruding parts of the wrench portion 9 carrying the chamfered portions 21 and 25 fit tightly in the opposed section of the holding device 8 so as to align the two sections to each other (not shown).

[0051] As described above the holding device is provided with at least one guide surface 12a,12b. In the shown embodiment, the holding device 8 comprises two sections that are arranged to be positioned from opposite sides of the drill string component, each section comprising a part of the guiding support 11. Further, of each section of the holding device 8 includes opposed upper and lower guide surfaces 12a,12b arranged to support the drill string component 3 from above and below, respectively. The upper and lower guide surfaces 12a,12b have a part circular cross section of a radius corresponding to the radius of a cylindrical portion 34 of the drill string components, so as to connect closely thereto.

[0052] In the shown embodiment, the axial extension of the contact surface between the guide surfaces 12a, 12b of the holding device 8 is continuous, wherein the guide surfaces 12a,12b extends away from the guiding support 11 and the non-circular surface 10 of the wrench portion 9. The guide surfaces 12a, 12b do however not need to be continuous. The object of the axial extension thereof is to axially align the drill string 4 and especially the drill string component 3' that is being held by the holding device 8. This may be achieved by means of spaced apart support points. Hence, the guide surfaces 12a,12b may be comprised of two spaced apart support

sections positioned at an axial distance corresponding to the length L_2 from each other.

[0053] In the shown embodiment a plurality of strengthening elements 24 are arranged to support the guide surfaces 12a ,12b of the guiding support 11. The forces acting on the guiding support 11 may be important such that a rigid construction is called for. The strengthening elements 24 may be comprised of transverse ridges or plates.

[0054] Throughout this application the term comprising is used in a non-exclusive manner, hence meaning that a comprised part is to be understood as an included part, among other included parts.

[0055] Above, the invention has been described with reference to specific embodiments. The invention is however not limited to these embodiments. It is obvious to a person skilled in the art that other embodiments are possible within the scope of the following claims.

Claims

1. A drill string guiding device (2) for guiding elongate drill string components (3, 3', 3") during assembling or disassembling of a drill string (4) in a drilling operation, each drill string component (3, 3', 3") having a connective portion (31,32) at each end for interconnection with an adjacent drill string component, the drill string guiding device (2) comprising:

   - a frame (6) with an opening (7) through which the drill string (4) is arranged to protrude during operation, the drill string (4) in operation extending in an axial direction (A_1) from an inner end thereof, which is to be connected to a drilling machine (1) outwards to a cutting head (16) at an outer end of the drill string (4);
   - a holding device (8) arranged to hold a first drill string component (3') of the drill string (4) as an adjacent drill string component (3) is being connected thereto or removed therefrom, and
   - a positioning device (13) arranged on the frame (6) for positioning the holding device (8) between an inactive position in which it allows free passage of the drill string (4) through the opening (7) of the frame (6), and an active gripping positon in which it is arranged to hold said first drill string component (3'), **characterised in that** the holding device (8) comprises a guiding support (11) comprising upper, lower and side portions arranged to at least partially enclose and fix a portion of said first drill string component (3') when in the active position and at least one guide surface (12a,12b), extending in the axial direction (A_1) of the drill string (4) from the guiding support (11) to support said first drill string component (3') and thereby align the drill string (4) along its axial direction (A_1) when in the active position.

2. The drill string guiding device (2) according to claim 1, wherein the holding device (8) comprises two sections that are arranged to be positioned from opposite sides of the drill string component (3'), each section comprising separate parts of the guiding support (11) and of the at least one guide surface (12a,12b).

3. The drill string guiding device according to claim 2, wherein substantially horizontal tracks (15) are arranged on the frame (6), and wherein the two sections of the holding device (8) comprise tracks (19) arranged to be slided sideways along said tracks (15) between the active position and the inactive position.

4. The drill string guiding device according to anyone of the preceding claims 2 or 3, wherein the sections of the holding device (8) includes mating elements so as to align said sections with respect to each other.

5. The drill string guiding device according to anyone of the preceding claims, wherein the holding device (8) comprises a lower guide surface (12b) extending in the axial direction (A_1) of the drill string (4) to support said first drill string component (3') from below.

6. The drill string guiding device according to claim 5, wherein the holding device (8) further comprises an upper guide surface (12a) extending in the axial direction (A_1) of the drill string (4) to support said first drill string component (3') from above.

7. The drill string guiding device according to claim 6, wherein the upper and lower guide surfaces (12a,12b) extend outwards from the guiding support (11) in the axial direction (A_1) of the drill string (4).

8. The drill string guiding device according to claim 6 or 7, wherein the upper and lower guide surfaces (12a,12b) are part circular having a radius corresponding to a radius of a cylindrical portion of the drill string components (3).

9. The drill string guiding device according to anyone of claims 2-8, wherein both separate sections of the guiding support (11) comprises a part circular portion, which part circular portions are arranged opposite each other on said separate sections of the holding device (8).

10. The drill string guiding device according to anyone of claims 2-8, wherein both separate sections of the holding device (8) comprises a wrench portion (9) with non-circular surfaces (10) for interaction with a corresponding non-circular surface (33) of said first drill string component (3').

11. The drill string guiding device according to claim 10, wherein the wrench portion (9) constitutes the guiding support (11) comprising upper, lower and side portions arranged to partially enclose and fix a section of said first drill string component (3'), when the holding device is in the active position.

12. The drill string guiding device according to anyone of claims 2-8, wherein both separate sections of the holding device (8) comprises a part circular portion, which are arranged opposite each other on said separate sections of the holding device (8), and a wrench portion (9) with non-circular surfaces (10) for interaction with a corresponding non-circular surface (33) of said first drill string component (3').

13. The drill string guiding device (2) according to claim 12, wherein the positioning device (13) is arranged to position both the wrench portion (9) and the guiding support (11) between the inactive position and the active gripping positon.

14. Rock drilling machine (1) for drilling a hole in rock by means of a cutting head (16) arranged on the rock drilling machine via drill string components (3), **characterised in that** the rock drilling machine comprises a drill string guiding device (2) according to anyone of the preceding claims.

15. Method of joining drill string components (3, 3', 3") to form a drill string (4) by means of a drill string guiding device (2) comprising:

- a frame (6) with an opening (7) through which the drill string (4) is arranged to protrude in an axial direction (A_1) during operation;
- a holding device (8) arranged to hold a first drill string component (3') as another drill string component (3) is being connected thereto or removed therefrom, and
- a positioning device (13) arranged on the frame (6) for positioning the holding device (8) between an inactive position in which it allows free passage of the drill string (4) through the frame, and an active gripping positon in which it is arranged to hold said first drill string component (3'), the method being **characterised by**
- positioning the holding device (8) in the active gripping position,
- by means of a guiding support (11) of the holding device (8), axially aligning said first drill string component (3') of the drill string (4), the guiding support (11) having an a guiding support (11) comprising upper, lower and side portions arranged to partially enclose a section of said first drill string component (3') and at least one guide surface (12a,12b), extending in the axial direction (A_1) of the drill string (4) to support said first drill string component (3'), and
- connecting or disconnecting a drill string component to or from said first drill string component (3') of the drill string (4), while said first drill string component (3') is held by said guiding support (11) of the holding device (8).

16. The method of claim 15, further comprising the step of, by means of a wrench portion (9) of the holding device (8), fixing said first drill string component (3') of the drill string (4), the wrench portion comprising a non-circular surface for interaction with a mating non-circular surface (33) of the drill string component (3').

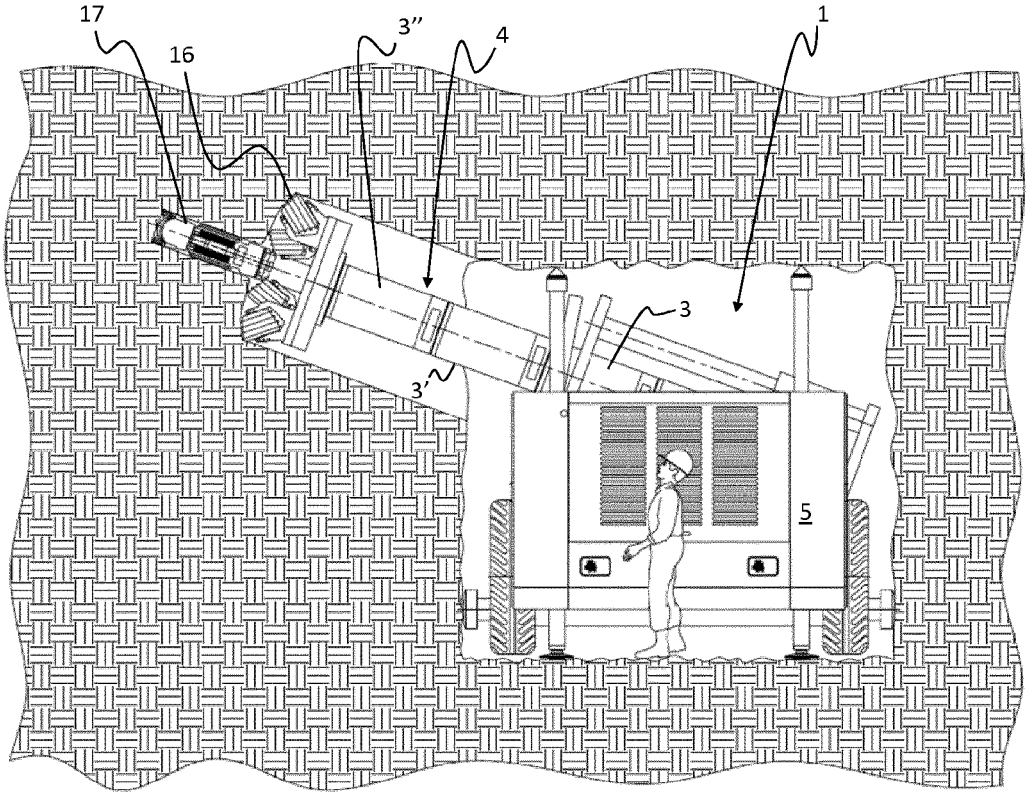

Fig. 1

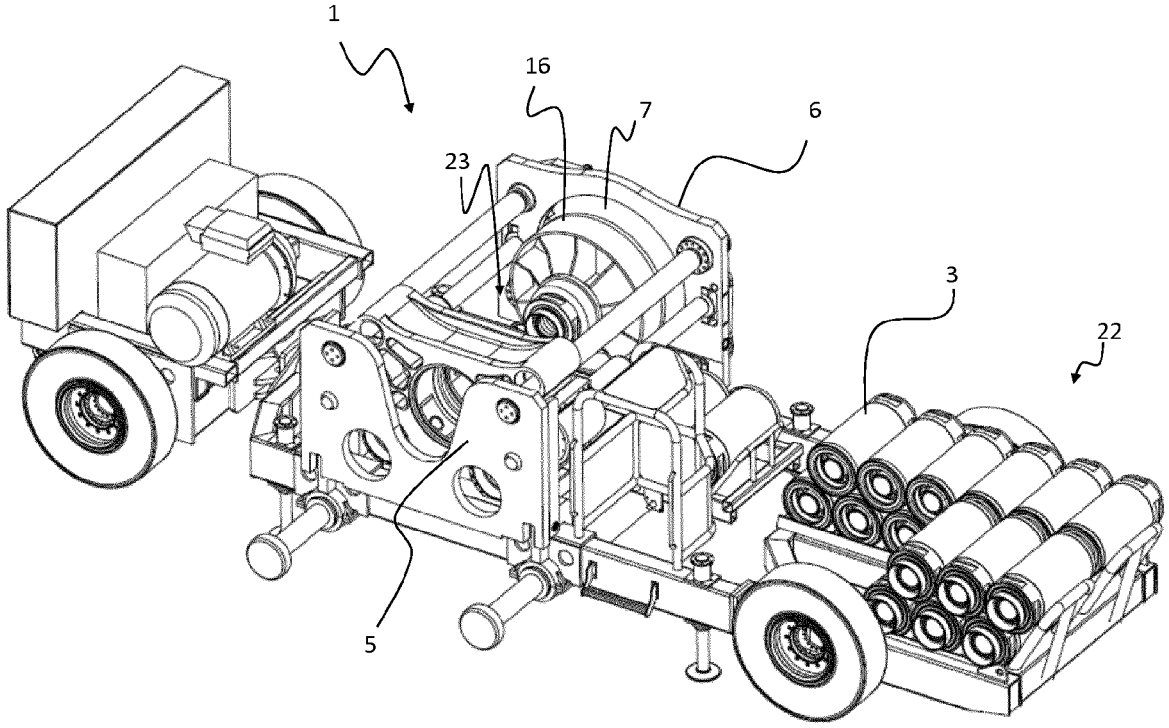

Fig. 2

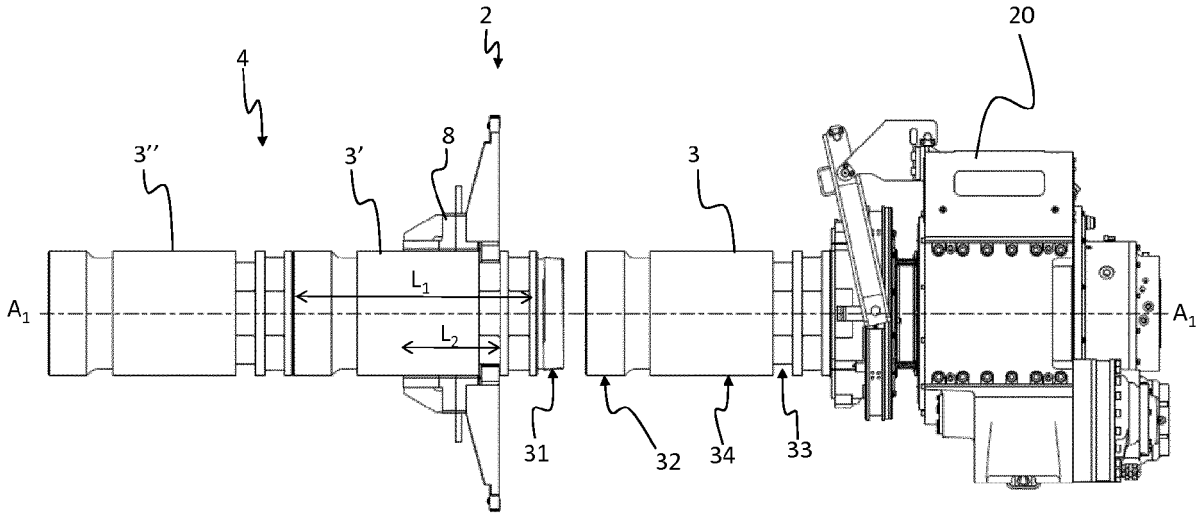

Fig. 3

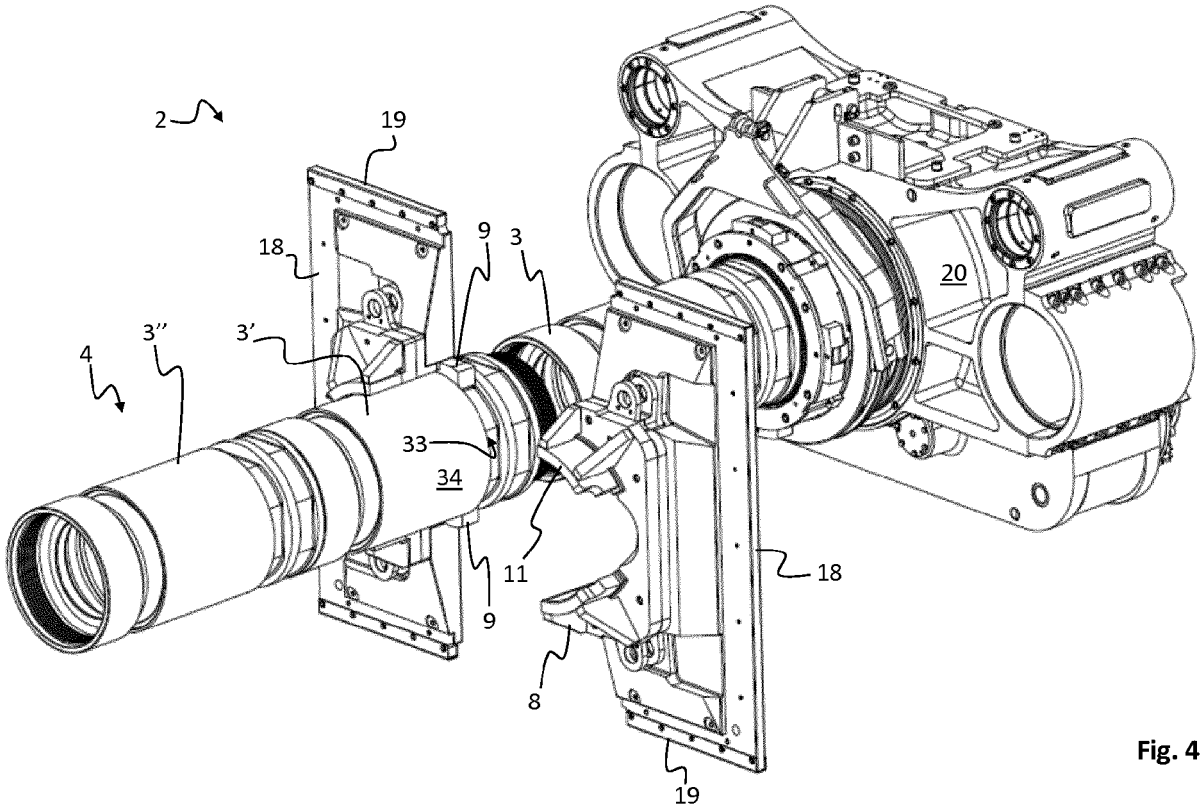

Fig. 4

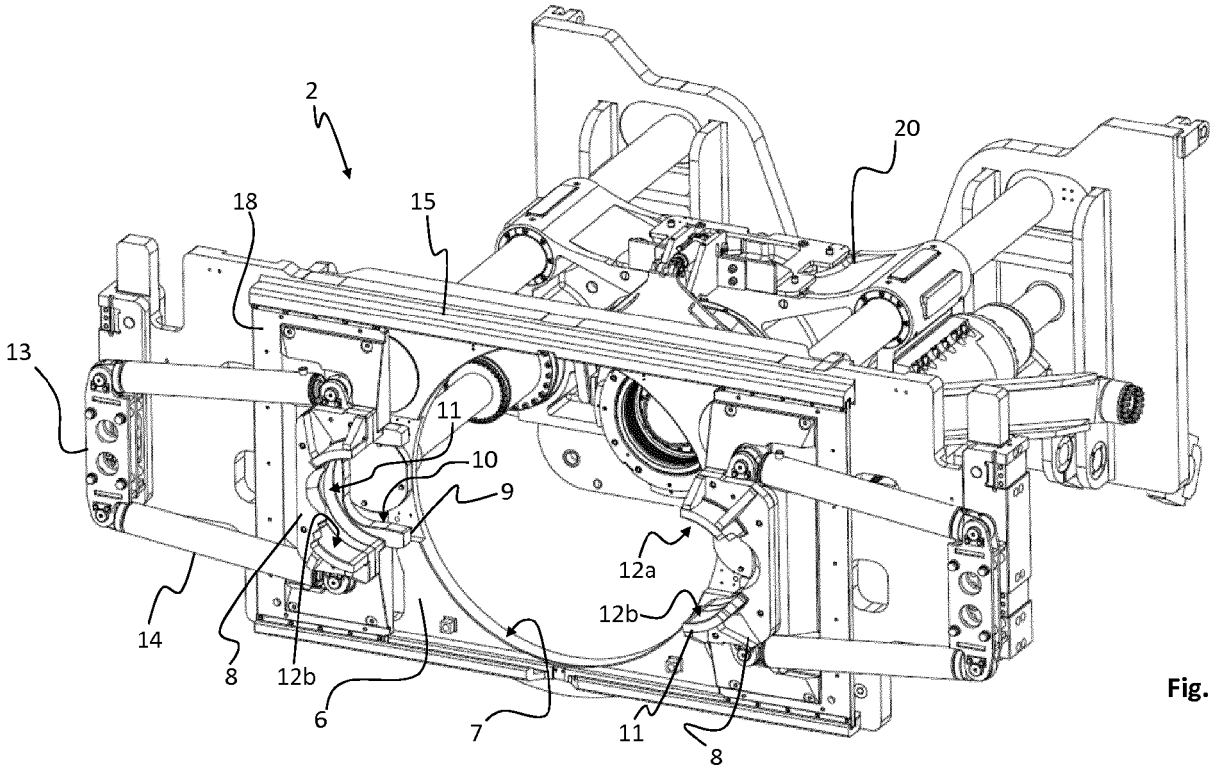

Fig. 5

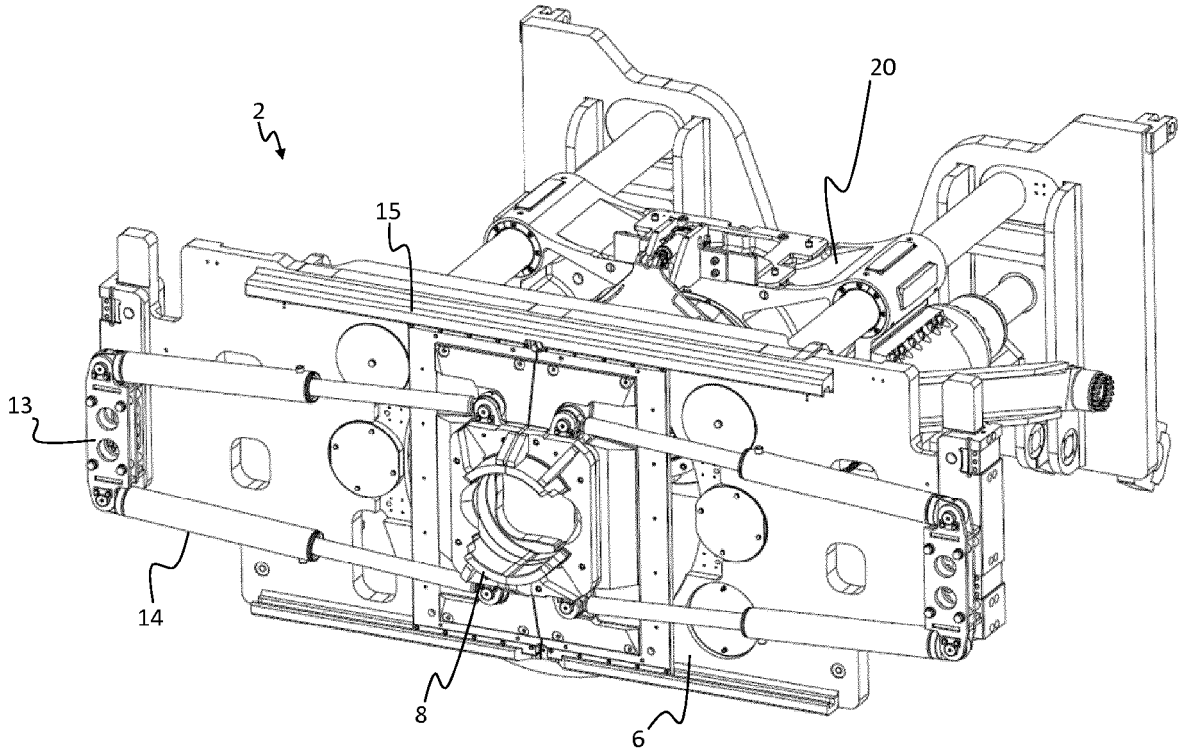

Fig. 6

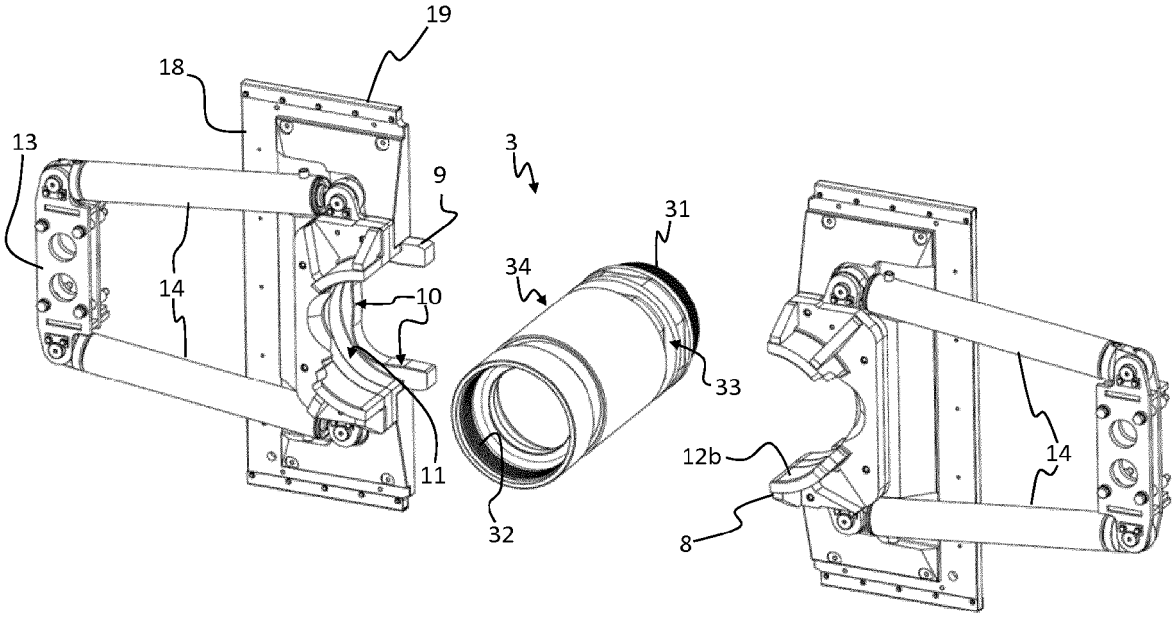
19
18
13
3
9
31
34
14
10
33
11
32
12b
14
8

Fig. 7

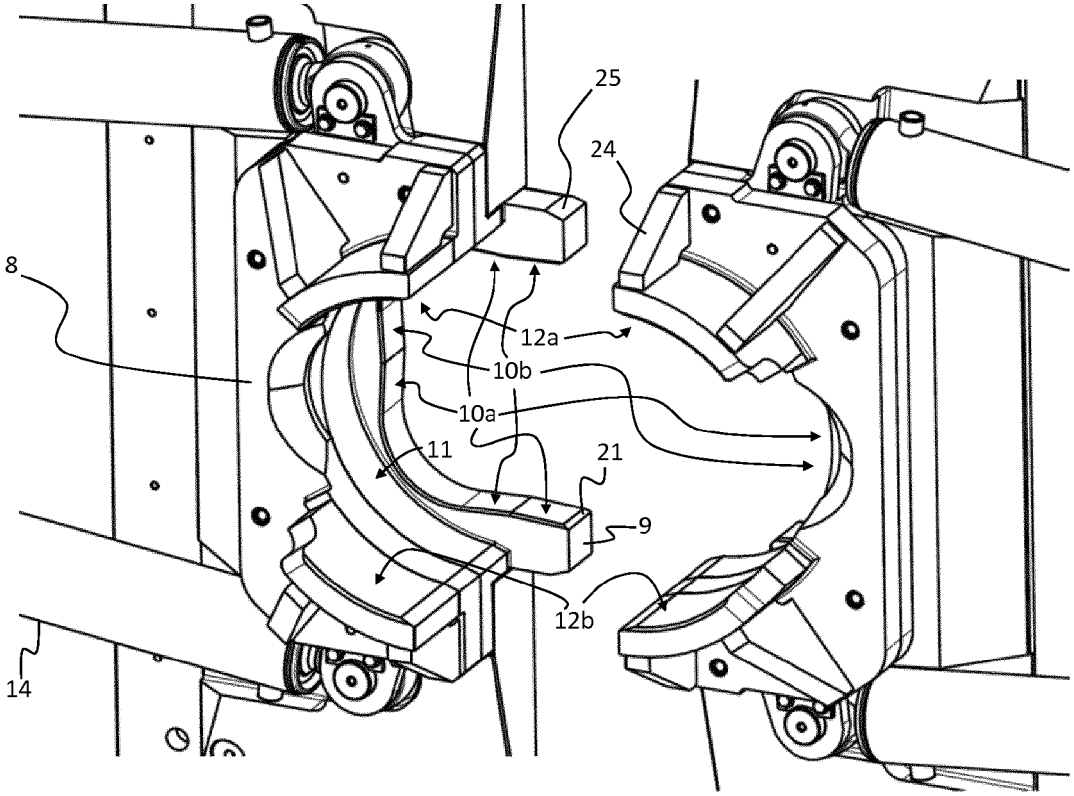
25
24
8
12a
10b
10a
11
21
9
12b
14

Fig. 8

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 15 5841

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 351 903 A2 (TERRA AG TIEFBAUTECHNIK [CH]) 3 August 2011 (2011-08-03) * paragraphs [0045] - [0053]; figures 8-20 * * paragraphs [0030] - [0044]; figures 1-7 * * the whole document *	1,2,4-16	INV. E21B7/04 E21B19/16
X	WO 2016/005701 A2 (SOLETANCHE FREYSSINET [FR]) 14 January 2016 (2016-01-14) * page 15, lines 8-27; figures 9-11 * * figures 1-8 * * the whole document *	1,2,4,9, 14,15	
X	US 2015/315858 A1 (GASKIN KEITH [GB] ET AL) 5 November 2015 (2015-11-05) * paragraph [0071]; figure 1; example 6 * * paragraph [0029]; figures 2-7 * * the whole document *	1,2,15	
X	WO 2014/066368 A2 (PILGRIM RICK [US]) 1 May 2014 (2014-05-01)	1	TECHNICAL FIELDS SEARCHED (IPC)
A	* paragraph [0018]; figures 1-12 * * the whole document * * sliding automated pipe tripping apparatus 101 horizontally along drilling floor 10; as a whole *	3	E21B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	9 August 2017	van Berlo, André

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 15 5841

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-08-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2351903 A2	03-08-2011	DE 102010004287 A1	14-07-2011
		EP 2351903 A2	03-08-2011
WO 2016005701 A2	14-01-2016	EP 3167141 A2	17-05-2017
		FR 3023577 A1	15-01-2016
		JP 2017519922 A	20-07-2017
		US 2017159361 A1	08-06-2017
		WO 2016005701 A2	14-01-2016
US 2015315858 A1	05-11-2015	GB 2505610 A	05-03-2014
		GB 2527423 A	23-12-2015
		US 2015315858 A1	05-11-2015
		WO 2014091246 A2	19-06-2014
WO 2014066368 A2	01-05-2014	AU 2013334830 A1	26-03-2015
		CA 2883713 A1	01-05-2014
		CN 104936745 A	23-09-2015
		KR 20150074014 A	01-07-2015
		SG 11201503105T A	28-05-2015
		US 2014124218 A1	08-05-2014
		US 2016376857 A1	29-12-2016
		WO 2014066368 A2	01-05-2014

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2005068772 A1 **[0003]**