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

(11) **EP 4 328 412 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.02.2024 Bulletin 2024/09

(21) Application number: **22192053.1**

(22) Date of filing: **25.08.2022**

(51) International Patent Classification (IPC):
E21B 17/04 *(2006.01)* ***E21B 17/042*** *(2006.01)*
E21B 17/16 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E21B 17/04; E21B 17/042; E21B 17/16

(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:
KH MA MD TN

(71) Applicant: **Sandvik Mining and Construction Tools AB**
81181 Sandviken (SE)

(72) Inventors:
- **Chavan, Vitthal**
  81181 Sandviken (SE)
- **Azizoglu, Yagiz**
  81181 Sandviken (SE)

(74) Representative: **Sandvik**
Sandvik Mining and Construction Oy
Patent Department
PL 100
33311 Tampere (FI)

(54) **END PIECE OF DRILL PIPE, DRILL PIPE ASSEMBLY AND METHOD**

(57) An end piece, a drill pipe assembly and method. The drill pipe assembly (13) is for rotary drilling and DTH drilling and comprises a drill pipe (14) provided with end pieces (15, 16) at its opposite ends. For the mounting of the end pieces shrink fit and welding is implemented. For improving the shrink fit contact surfaces (22, 24) between the components are tapered.

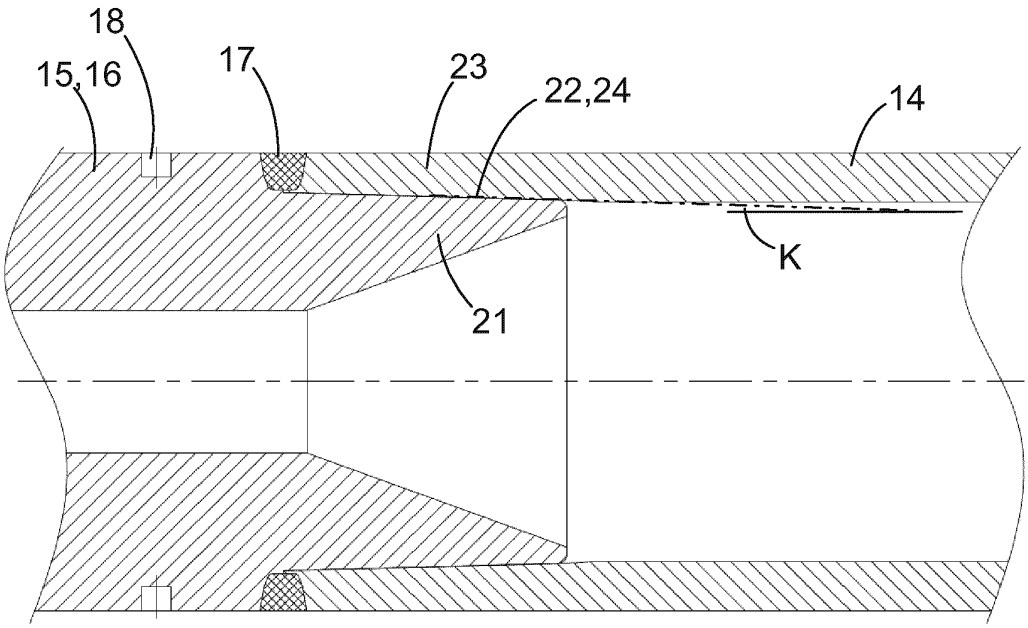

FIG. 6

EP 4 328 412 A1

Description

Background of the invention

[0001] The invention relates to an end piece of a drill pipe for a rotary or DTH drilling rig.

[0002] The invention further relates to a drill pipe assembly and to a method of forming a drill pipe assembly to be used in a rock drilling rig.

[0003] The field of the invention is defined more specifically in the preambles of the independent claims.

[0004] In mines and at other work sites different type of rock drilling rigs are used for drilling drill holes to rock surfaces. In rotary drilling and DTH drilling drill pipes are connected to a rock drilling machine or unit and are rotated by a rotation device. The drill pipe is an elongated hollow tubular and thin-walled element trough which drilling fluid is pumped down the hole to a drill bit. The drill pipe transfers rotation and torque from the rotation device to the drill bit and it also transmits axial feed forces. Typically, the drill pipe is provided with separate end pieces at its opposite ends. Joints between the end pieces and the drill pipe comprise shrink fits. However, the known solutions have shown some disadvantages, and especially relating to crack formation and overall durability of the joints between the components.

Brief description of the invention

[0005] An object of the invention is to provide a novel and improved end piece and drill pipe assembly for rotary or DTH drilling, and a method for forming a drill pipe assembly to be used in a rock drilling rig.

[0006] The end piece according to the invention is characterized by the characterizing features of the first independent apparatus claim.

[0007] The drill pipe assembly according to the invention is characterized by the characterizing features of the second independent apparatus claim.

[0008] The method according to the invention is characterized by the characterizing features of the independent method claim.

[0009] An idea of the disclosed solution is that a drilling tool intended for a rotary or DTH drilling rig comprises one or more drill pipes. The drill pipe is provided with end pieces. The end piece is an elongated tubular piece and comprises a first end provided with first coupling means comprising thread surfaces for thread mounting with other drill components. An opposite second end is provided with second coupling means for coupling the end piece to the drill pipe by means of a shrink fit. The second coupling means comprise radial outwardly facing first contact surface extending a first axial distance from the second end towards the first end. Further, the first contact surface for providing the shrink fit has tapered configuration.

[0010] In other words, the tapering second coupling means are formed on a male configuration which is configured to be received by a female configuration formed at an end of the drill pipe. The female part can also be considered as a socket part with the receiving feature and is provided with mating tapering surfaces.

[0011] An advantage of the disclosed solution is that the shrink fit with the tapering shapes provides improved stress distribution between the assembled components and decreases the risks for cracks in the joint. This way high load carrying capacity is possible. Further, less interference is required to transfer the forces and the lower degree of interference means less stresses for the joint.

[0012] The tapering surfaces provide also proper alignment for the end joints and drill pipe and thereby facilitate assembly of the components of the solution.

[0013] Further, due to the tapering outer surfaces the drill pipe ends may have greater wall thickness which is also beneficial for the load carrying capacity and durability of the solution.

[0014] A further advantage is that the disclosed structure is relatively simple and inexpensive to manufacture. The tapering contact surfaces are relatively easy and quick to manufacture accurately by means of modern lathes.

[0015] According to an embodiment, the first contact surface forms a truncated cone which can be inserted inside the socket part formed at the end of the drill pipe. An interference fit between the truncated cone and the socket part is formed when the contact surfaces of the truncated cone and the socket part overlap because of the insertion. In the interference fit, or shrink fit, there is a slightly oversized truncated cone (shaft part) assembled into a slightly undersized socket part (hole part). Thus, the two parts being connected are of slightly different sizes, and this discrepancy holds the parts together. Prior to assembly, the truncated cone i.e., an inside component, is larger than the socket part i.e., the outside component, to form the desired interference fit.

[0016] The end piece and the drill pipe wherein the end piece is mounted are intended to be connected between a rotating head and a drill bit of the rock drilling rig. The end piece is part of a drill string and is configured to transmit torque and axial forces between components of the drill string during the drilling.

[0017] Outer diameter of the first contact surface has minimum value at the second end and increases towards the second end. In other words, the tapering of the truncated cone is arranged so that diameter of the truncated cone increases from the second end towards the first end.

[0018] According to an embodiment, angle of the tapering first contact surface is 0,2 - 12°. Magnitude of the angle of the tapering contact surface is dependent on dimensions of the end piece, and especially on diameter of the end piece.

[0019] According to an embodiment, angle of the tapering first contact surface is 1 - 6°. In practical test it has been fount that this range is suitable especially for drilling tools with commonly implemented diameters.

[0020] According to an embodiment, length of the first axial distance is 75 - 160 mm. In other words, axial di-

mension of the tapered male portion at the second end of the end piece is in accordance with the mentioned range 75 - 160 mm.

[0021] According to an embodiment, axial length of the tapering first contact surface is defined by a stop surface being orientated perpendicularly in relation to longitudinal axis of the end piece. In other words, the truncated cone ends to the stop surface which is orientated perpendicularly in relation to longitudinal axis of the end piece. Then the stop surface is configured to set in the assembly against the front end of the drill pipe. The stop surface defines axial length of the tapering first contact surface and axial length where the contact surfaces of the truncated cone and the socket part intermesh.

[0022] According to an embodiment, the second end of the end piece is provided with a radial inner surface extending an axial distance from the second end towards the first end. The inner surface has tapered configuration. In other words, the end piece comprises two tapering surfaces at its second end portion. Magnitude of angle of the tapering of the inner surface is significantly greater as compared to the tapering of the outer surface.

[0023] According to an embodiment, an outer surface of the end piece is provided with at least one discard indicator comprising a recess having a predetermined depth. An advantage of the discard indicator is that a simple, robust, and reliable visual indicator is provided for providing information on degree of wear of the drill pipe assembly. An outer surface of the drill pipe assembly is subjected to wear during the use and material is loosened on the outer surface causing decrease in depth of the discard indicator. Thus, the operation of the discard indicator is based on phenomena wherein loosening of the material surrounding the recess leads to decrease in depth and information on degree of wearing is provided for an operator in an intuitive manner. The discard indicator is inexpensive to manufacture.

[0024] According to an embodiment, the depth of the discard indicator is defined in relation to wall thickness of the drill pipe.

[0025] According to an embodiment, the depth of the discard indicator is dimensioned to be half of dimension of a wall thickness of the drill pipe.

[0026] According to an embodiment, the depth of the discard indicator is dimensioned to be 5 - 70 % of dimension of a wall thickness of the drill pipe.

[0027] According to an embodiment, the depth of the discard indicator is dimensioned to be 10 - 60 % of dimension of a wall thickness of the drill pipe.

[0028] According to an embodiment, the depth of the discard indicator is dimensioned to be 30 - 50 % of dimension of a wall thickness of the drill pipe.

[0029] According to an embodiment, the discard indicator is located at a maximum axial distance 150 mm from the weld joint between the end piece and the drill tube. Then the discard indicator is intended to provide wearing data of the weld joint and to indicate when the wearing degree has reached a level wherein there is a risk that the weld joint is no longer capable of transmitting axial loads and torque.

[0030] According to an embodiment, the discard indicator comprises at least one notch, groove, blind drilling, or any other type of recess.

[0031] According to an embodiment, there may be several discard indicators in the end piece. Alternatively, or in addition to one or more discard indicators may be provided on drill pipes.

[0032] According to an embodiment, there may be several discard indicators with different depths indicating wearing of the drill pipe or drilling component. The discard indicators may form a group of blind holes, grooves, or recesses with different depths. The depths of the recesses may grow by predetermined steps and they may clearly indicate wearing degree of the examined component.

[0033] According to an embodiment, the disclosed solution relates also to a drill pipe assembly for rotary or DTH drilling. The drill pipe assembly comprises a drill pipe and two end pieces mounted fixedly to opposite ends of the drill pipe. The end pieces comprise male portions with second coupling means provided with outwardly facing first contact surfaces and being inserted inside socket portions at ends of the drill pipe whereby the end pieces are connected to the ends of the dill pipe by means of shrink fits based on differences in the diameters existing between the male and socket portions. The mentioned end pieces are in accordance with the features disclosed in this document. Thereby mating radial contact surfaces between the male portions and the socket portions have tapered configuration.

[0034] According to an embodiment, magnitude of the mentioned shrink fit is 0,1 - 0,8 mm. Amount of interference (tightness of fit, or degree of tightness) is controlled by amount of interference.

[0035] The magnitude of the shrink fit indicates how much greater is a diameter of a shaft part in relation to a diameter of a hole part before being mounted. Since mating contact surfaces of the shaft part and the hole part are tapered, the examination needs to be done at cross-sections which have the same axial location and will match in the final shrink fit joint.

[0036] According to an embodiment, magnitude of the mentioned shrink fit is 0,2 - 0,6 mm. It has been found in practical tests that this range for the shrink fit is particularly suitable for drilling pipes and end pieces with commonly used diameters.

[0037] According to an embodiment, joints between the end pieces and the drill tube are provided with weld joints for providing additional fastening and ensuring the interference fit.

[0038] According to an embodiment, the disclosed solution is utilized in rotary drilling wherein no impact devices are utilized in rock breaking.

[0039] According to an embodiment, the rock drilling rig is utilized in down-the-hole drilling (DTH). In the DTH drilling a drill bit end of a rotated drilling tool is provided with an impact device, i.e., the impact device is located

at a bottom of the drill hole during the drilling.

[0040] According to an embodiment, the disclosed solution relates to a method of forming a drill pipe assembly to be used in a rock drilling rig. The method comprises: mounting end pieces to opposite ends of a tubular drill pipe; providing first ends of the end pieces with first coupling means comprising thread surfaces for thread mounting; providing opposite second ends of the end pieces with truncated cones wherein radial outer surfaces of the truncated cones form first contact surfaces; forming socket parts to both ends of the drill pipe for receiving the truncated cones and being provided with second contact surfaces; heating the ends of the drill pipe at the socket parts to expand diameters of the second contact surfaces by means of the thermal expansion; pushing the truncated cones inside the thermally expanded socket parts; allowing the heated socket parts to cool and shrink whereby shrink fits are formed between the first and second contact surfaces; and securing the mountings between the drill pipe and the end pieces by welding. The method further comprises providing the mating first and second connecting surfaces with tapered shapes.

[0041] The above disclosed embodiments may be combined to form suitable solutions having those of the above features that are needed.

Brief description of the figures

[0042] Some embodiments are described in more detail in the accompanying drawings, in which

Figure 1 is a schematic side view of a surface rock drilling rig intended for rotary drilling,

Figure 2 is a schematic view of a rock drilling unit suitable for down-the-hole drilling,

Figure 3 is a schematic side view of a drill pipe assembly,

Figure 4 is a schematic and cross-sectional view of a detail of a joint between a first end piece and a drill pipe in the drill pipe assembly of Figure 3;

Figure 5 is a schematic and cross-sectional view of a detail of a joint between a second end piece and a drill pipe in the drill pipe assembly of Figure 3;

Figure 6 is a schematic cross-sectional side view showing a joint between an end piece and a drill pipe, and

Figure 7 is a schematic cross-sectional side view of a connecting end portion of an end piece, and

Figure 8 is a schematic cross-sectional side view of a connecting end portion of a drill pipe.

[0043] For the sake of clarity, the figures show some embodiments of the disclosed solution in a simplified manner. In the figures, like reference numerals identify like elements.

Detailed description of some embodiments

[0044] Figure 1 shows a rock drilling rig 1 intended for surface drilling. The rock drilling rig 1 comprises a movable carrier 2 and at least one drilling mast 3 connected to the carrier 2. The mast 3 is provided with a drilling unit 4 provided with a rotating head 5 supported on the mast 3 and being movable in a drilling direction A and return direction B by means of a feed device 6. The rotating head 5 is connected to a drilling tool 7 by means of a subassembly 8. The drilling tool 7 is shown in a simplified manner for clarity reasons. The drilling tool 7 comprises one or more tubular elongated drill tube assemblies and a drill bit 9 at its distal end. The rotating head 5 rotates R the drilling tool 7 around its longitudinal axis and the drilling tool 7 is simultaneously fed towards a rock surface being drilled. This is known as rotary drilling method. Drilling cuttings are flushed by feeding flushing fluid from a flushing system Fs via the drilling tool 7 to a drill hole 10 being drilled so that the drilling cuttings are flushed away from the drill hole 10. The drilling unit 4 may be hydraulic whereby it may be connected to a hydraulic system Hs.

[0045] Figure 2 discloses another solution which differs from the one shown in Figure 1 in that there is an impact device 11 mounted between a drill bit 9 and a drilling tool 7. The disclosed solution is intended for a down-the-hole drilling method, known also as DTH-drilling. A drilling unit 4 can be mounted movably on a feed beam 12, or in a similar manner as is shown in Figure 1. The drilling tool 7 may comprise a drill pipe assembly which is in accordance with the solution disclosed in this document.

[0046] Figure 3 discloses a drill pipe assembly 13 comprising a drill pipe 14 and two end pieces 15, 16 mounted fixedly to opposite ends of the drill pipe 14. Figure 3 discloses the drill tube 14 in a shortened view for clarity reasons. On the upper end i.e., on the drilling unit end, of the drill pipe 14 there is a first end piece 15 and on the lower end i.e., on the drill bit end, of the drill pipe 14 there is a second end piece 16. The end pieces 15, 16 are mounted to the ends of the drill tube 14 by arranging their joint ends one inside another and utilizing shrink fit between their substantially radial contact surfaces. The mounting is typically ensured by weld joints 17. The end pieces 14, 15 may be provided with one or more discard indicators 18 which may be blind drillings, for example. Figure 3 further shows boxes 19 and 20 at the joint areas and detailed structures of the joints are shown in Figures 4 and 5.

[0047] Figures 4 and 5 disclose that the end pieces 15, 16 comprise male portions 21 provided with outwardly facing first contact surfaces 22 and being inserted inside socket portions 23 at ends of the drill pipe 14. The socket portions 23 are provided with mating contact surfaces 24. As can be seen, the substantially radial mating contact surfaces between the male portions 21 and the socket portions 22 have tapered configurations. The end pieces 15, 16 are connected to the ends of the dill pipe 14

by means of shrink fits based on differences in the diameters existing between the male portions 21 and the socket portions 23.

[0048] Figures 4 and 5 further discloses that the ends facing towards the drill pipe 14 are provided with radial inner surfaces 25 extending an axial distance from the second end towards the first end and having tapered configurations. Then the end pieces 15, 16 comprises two tapering surfaces at their end portions. Magnitude of angle of the tapering of the inner surfaces 25 is significantly greater as compared to the tapering of the outer surfaces.

[0049] The end pieces 15, 16 are elongated tubular pieces and comprise outer surfaces 26 and inner surfaces 27.

[0050] Figure 3 further discloses that the end pieces 15, 16 comprise first ends 28 provided with first coupling means 29 comprising thread surfaces 29 for thread mounting with other drill components. Opposite second ends are provided with the tapering second coupling means for the shrink fit with the drill pipe ends.

[0051] Figure 6 discloses a joint between a second end portion 30 of an end piece 15,16 and a drill pipe 16. A male portion 21 with an angled contact surface 22 is mounted inside a socket portion 23 of the drill pipe 14 provided with a mating angled contact surface 24. Magnitude of angle K of the tapering contact surfaces 22, 24 may be 0,2 - 12°.

[0052] Figure 7 discloses an end of an end piece 15, 16 provided with a male portion 21. The male portion 21 forms an axially protruding truncated cone at the end of the end piece 15, 16. There is a substantially radial outwardly facing contact surface 22 extending a first axial distance L from the distal end towards the opposite end. Length of the axial distance L may be 75 - 160 mm. The axial length L of the tapering first contact surface 22 may be defined by a stop surface 31 being orientated perpendicularly in relation to longitudinal axis of the end piece 15, 16. There may also be a shaped surface 32 for forming together with a correspondingly shaped end surface of a drill pipe a groove for a weld joint.

[0053] Figure 8 discloses an end of a drill pipe 14 provided with a socket portion 23 for receiving a male portion of an end piece. Length L2 of the socket portion 23 is at least equal or greater compared to length of the male portion and the socket portion 23 comprises a tapered contact surface 24. A distal end of the drill pipe 14 may comprise a shaped surface 33 forming part of a welding groove.

[0054] The drawings and the related description are only intended to illustrate the idea of the invention. In its details, the invention may vary within the scope of the claims.

Disclosure of an additional invention

[0055] Further, an additional solution, which is not in accordance with the independent claims of this document, is disclosed below:

A drilling tool component for a rotary or DTH drilling wherein an outer surface of the component is provided with at least one discard indicator comprising a recess having an initial depth and wherein decrease of the initial depth is configured to indicate wear of the component.

[0056] The drilling tool component may be a drill pipe, an end piece of a drill pipe, or any other component connectable between a rotating unit and a drill bit.

[0057] Thus, the disclosed drilling tool component may or may not comprise tapered contact surfaces.

Claims

1. An end piece (15, 16) of a drill pipe (14) for a rotary or DTH drilling rig;
   wherein the end piece (15, 16) is an elongated tubular piece comprising:

   an outer surface (26) and an inner surface (27);
   a first end (28) provided with first coupling means (29) comprising thread surfaces for thread mounting with other drill components;
   an opposite second end (30) provided with second coupling means for coupling the end piece (15, 16) to the drill pipe (14) by means of a shrink fit;
   and wherein the second coupling means comprise radial outwardly facing first contact surface (22) extending a first axial distance (L) from the second end (30) towards the first end (28);
   characterized in that
   the first contact surface (22) has tapered configuration.

2. The end piece as claimed in claim 1, **characterized in that**
   angle (K) of the tapering first contact surface (22) is 0,2 - 12°.

3. The end piece as claimed in claim 1 or 2, **characterized in that**
   angle (K) of the tapering first contact surface (22) is 1 - 6°.

4. The end piece as claimed in any one of the preceding claims 1 - 3, **characterized in that**
   length of the first axial distance (L) is 75 - 160 mm.

5. The end piece as claimed in any one of the preceding claims 1 - 4, **characterized in that**
   axial length (L) of the tapering first contact surface (22) is defined by a stop surface (31) being orientated perpendicularly in relation to longitudinal axis of the end piece (15, 16).

6. The end piece as claimed in any one of the claims 1 - 5, **characterized in that**

at the second end (30) of the end piece (15, 16) there is also a radial inner surface (25) extending an axial distance from the second end (30) towards the first end (28) and having tapered configuration.

7. The end piece as claimed in any one of the preceding claims 1 - 6, **characterized in that**
an outer surface (26) of the end piece (15, 16) is provided with at least one discard indicator (18) comprising a recess having a predetermined depth.

8. A drill pipe assembly (13) for rotary or DTH drilling;

and wherein the drill pipe assembly (13) comprises a drill pipe (14) and two end pieces (15, 16) mounted fixedly to opposite ends of the drill pipe (14);
the end pieces (15, 16) comprise male portions (21) with second coupling means provided with outwardly facing first contact surfaces (22) and being inserted inside socket portions (23) at ends of the drill pipe (14) whereby the end pieces (15, 16) are connected to the ends of the dill pipe (14) by means of shrink fits based on differences in the diameters existing between the male and socket portions (21, 23);
characterized in that
the mentioned end pieces (15, 16) are in accordance with any one of the previous claims 1 - 7;
and wherein mating radial contact surfaces (22, 24) between the male portions (21) and the socket portions (23) have tapered configuration.

9. The drill pipe assembly as claimed in claim 8, **characterized in that**
magnitude of the mentioned shrink fit is 0,1 - 0,8 mm.

10. The drill pipe assembly as claimed in claim 8 or 9, **characterized in that**
magnitude of the mentioned shrink fit is 0,2 - 0,6 mm.

11. The drill pipe assembly as claimed in any one of the previous claims 8 - 10, **characterized in that**
there are weld joints (17) between the end pieces (15, 16) and the drill tube (14) for providing additional fastening.

12. A method of forming a drill pipe assembly (13) to be used in a rock drilling rig (1),
wherein the method comprises:

mounting end pieces (15, 16) to opposite ends of a tubular drill pipe (14);
providing first ends (28) of the end pieces with first coupling means (29) comprising thread surfaces for thread mounting;
providing opposite second ends (30) of the end pieces with truncated cones wherein radial outer surfaces of the truncated cones form first contact surfaces (22);
forming socket parts (23) to both ends of the drill pipe (14) for receiving the truncated cones and being provided with second contact surfaces (24);
heating the ends of the drill pipe (14) at the socket parts (23) to expand diameters of the second contact surfaces (24) by means of the thermal expansion;
pushing the truncated cones inside the thermally expanded socket parts (23);
allowing the heated socket parts (23) to cool and shrink whereby shrink fits are formed between the first and second contact surfaces (22, 24); and
securing the mountings between the drill pipe (14) and the end pieces (15, 16) by welding (17);
characterized by
providing the mating first and second connecting surfaces (22, 24) with tapered shapes.

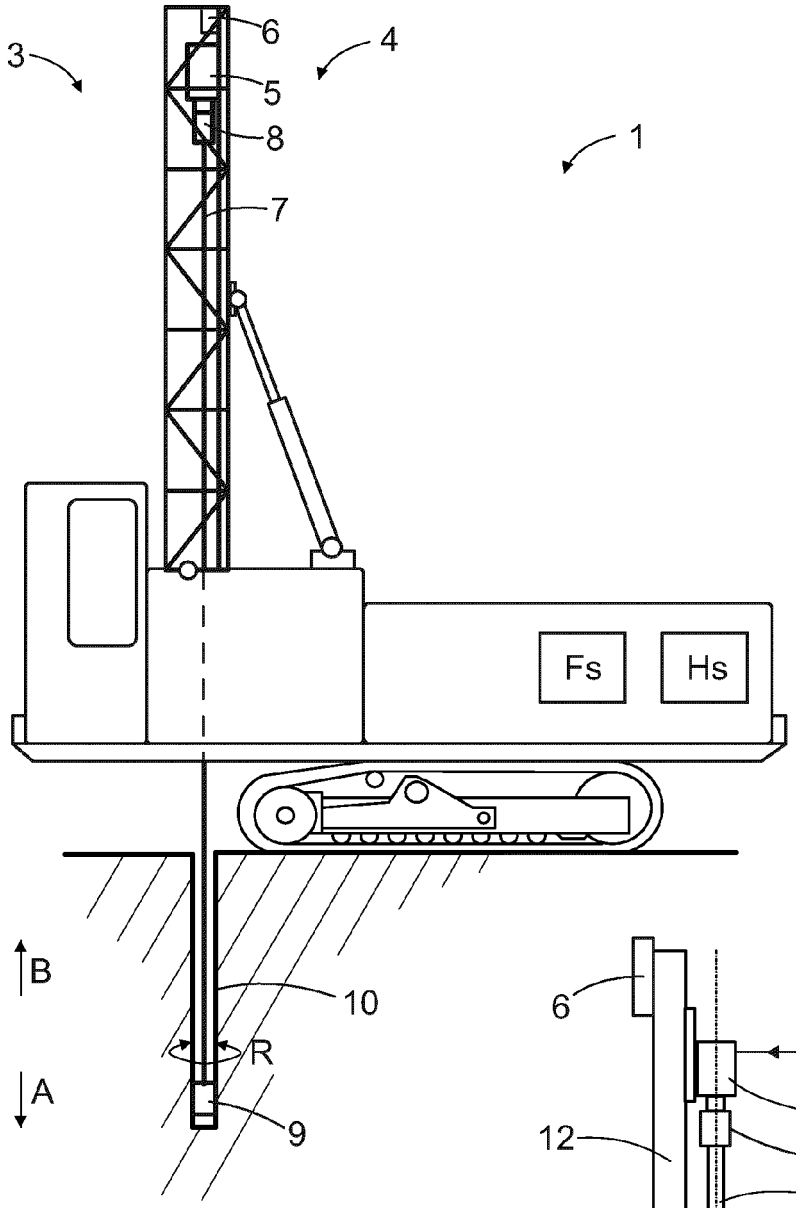

FIG. 1

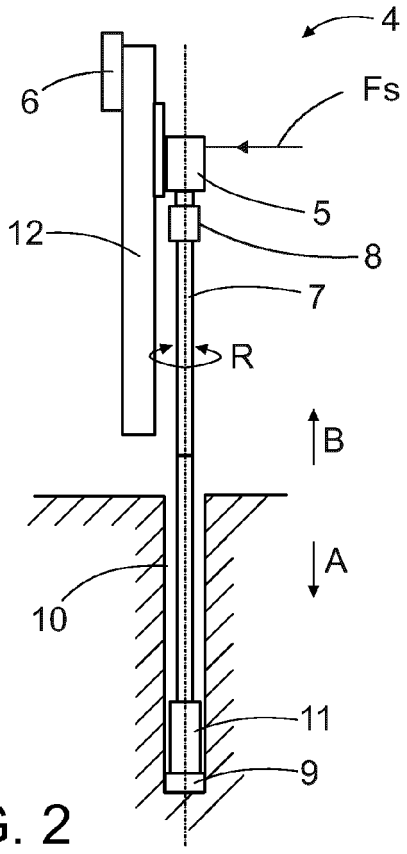

FIG. 2

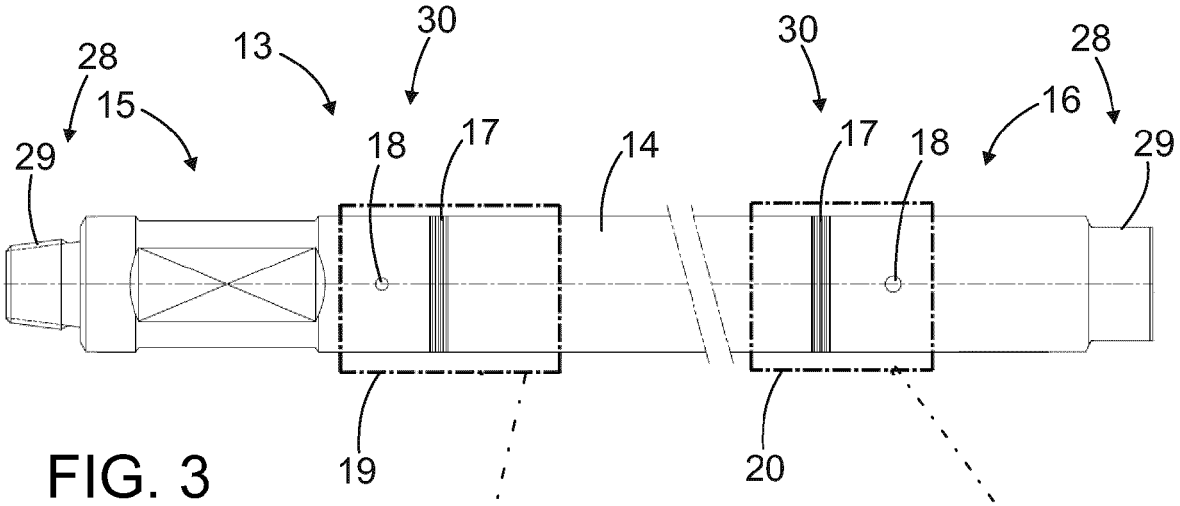

FIG. 3

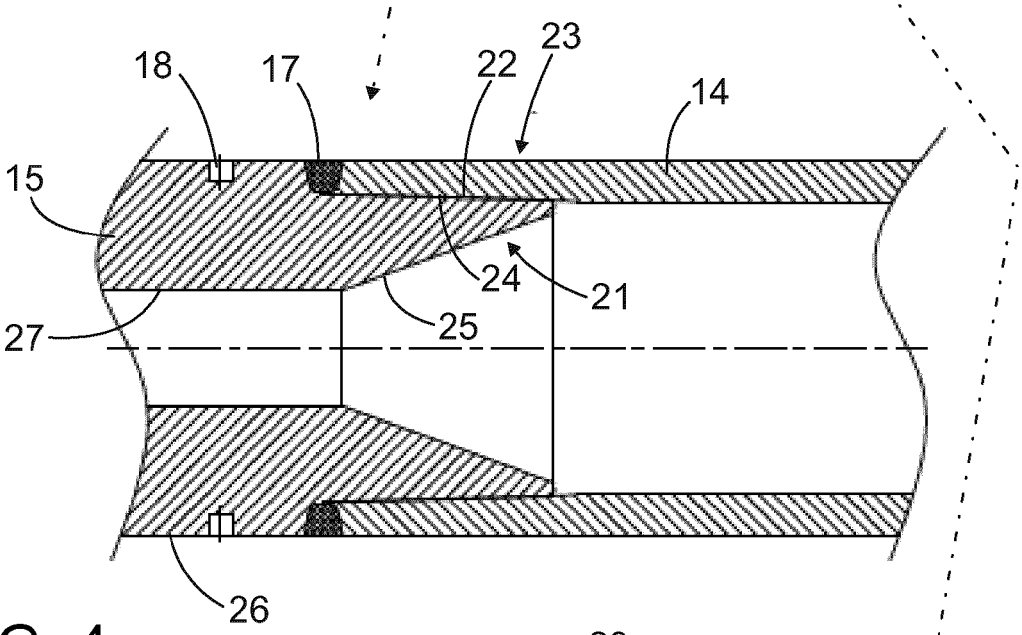

FIG. 4

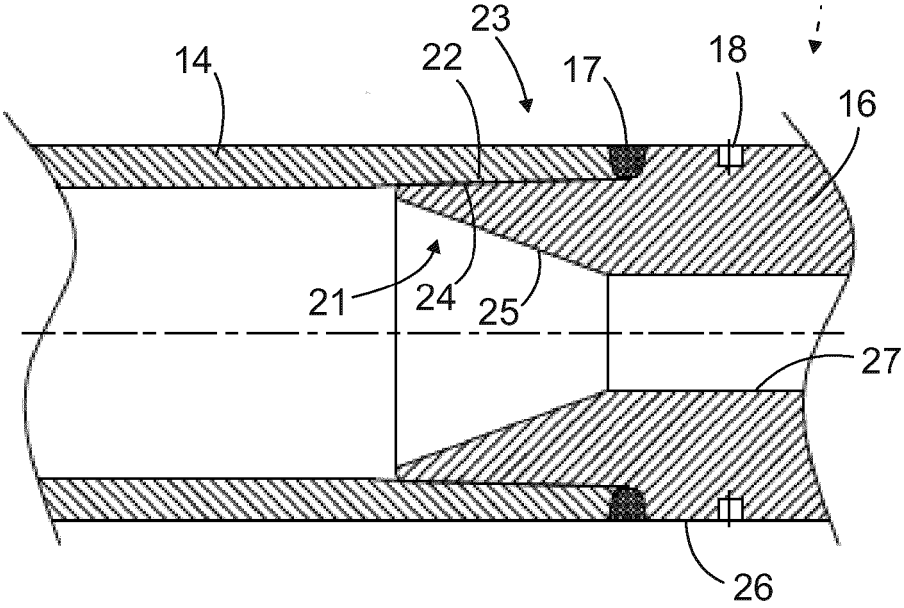

FIG. 5

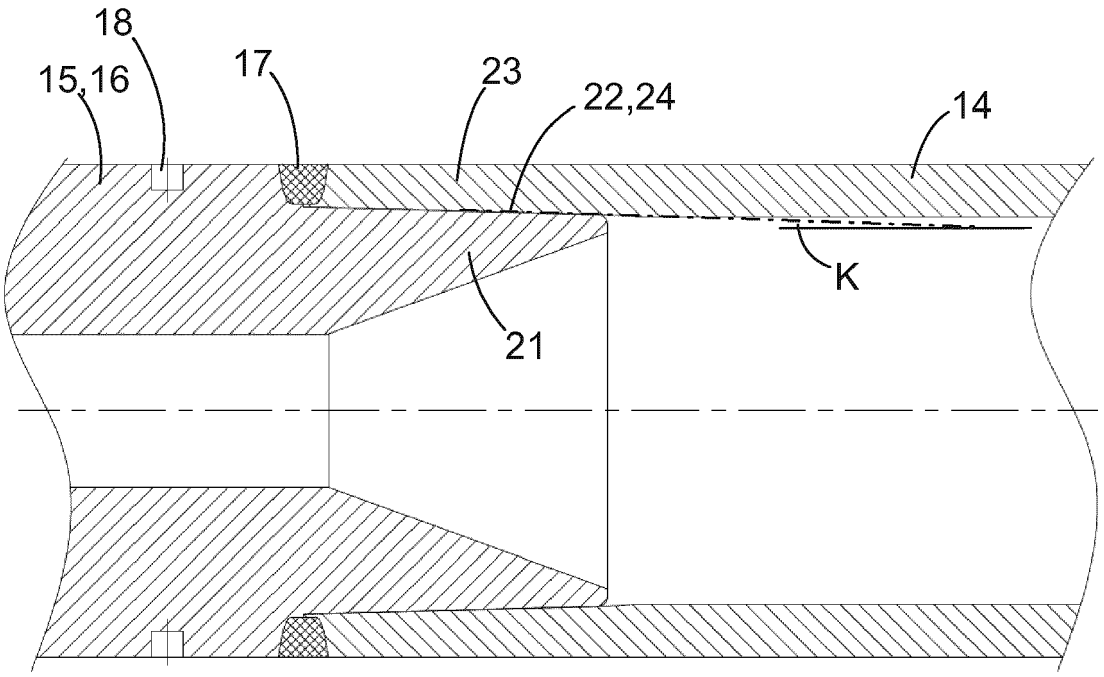

FIG. 6

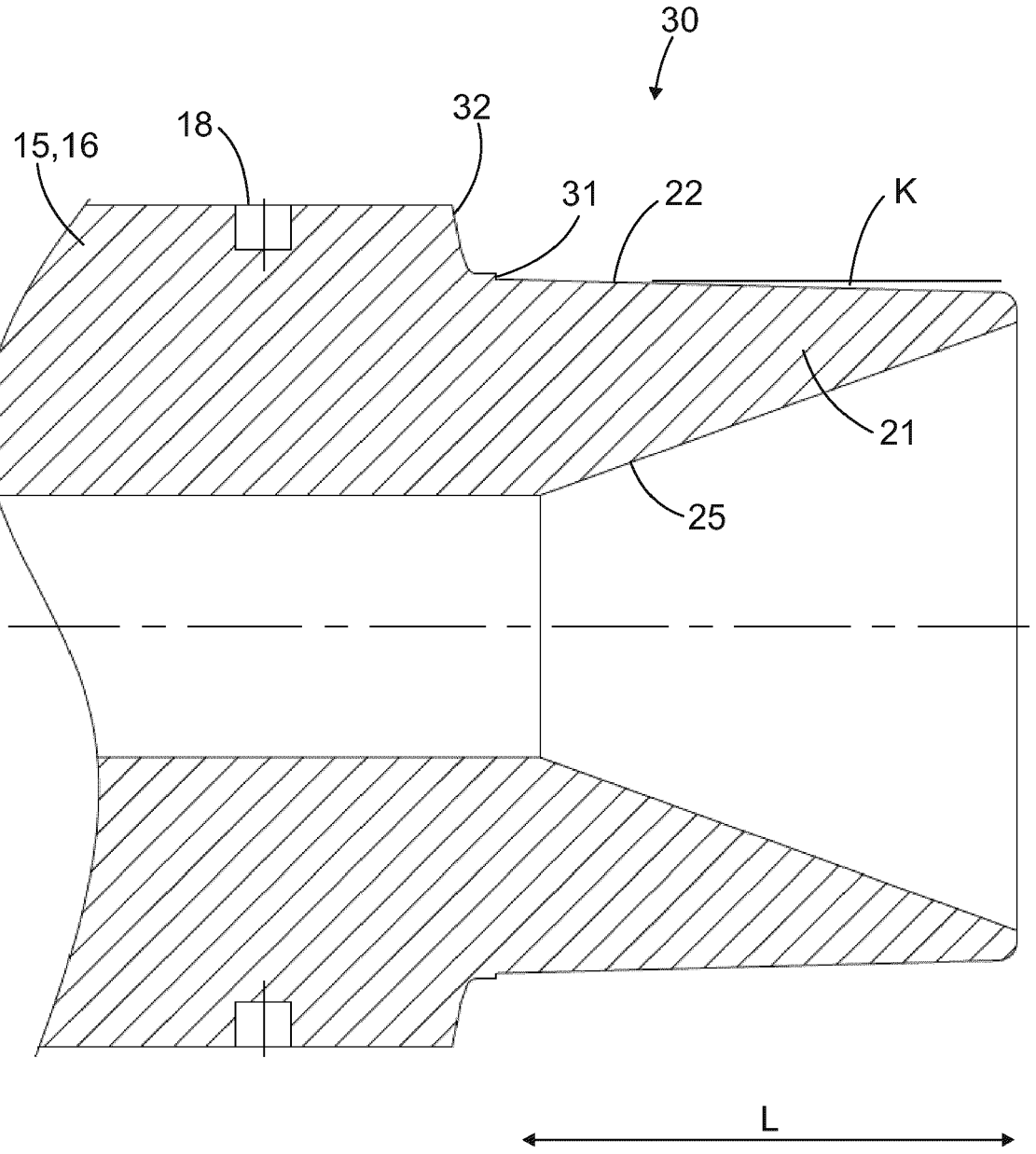

FIG. 7

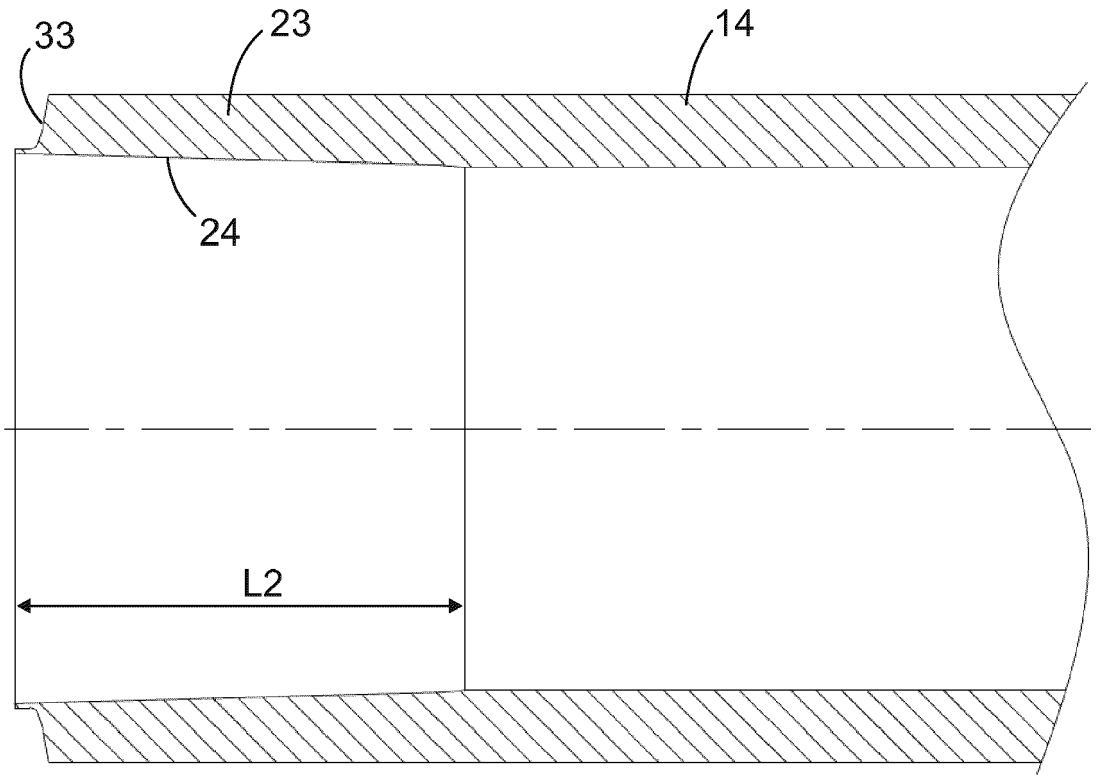

FIG. 8

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 19 2053

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 Y A	US 3 923 324 A (CRUICKSHANK JAMES R ET AL) 2 December 1975 (1975-12-02) * column 2 - column 4; figures 1a,1b,2 *	1-4 8-11 5-7,12	INV. E21B17/04 E21B17/042 E21B17/16
Y	US 3 114 566 A (COBERLY CLARENCE J ET AL) 17 December 1963 (1963-12-17) * column 9, line 25 - line 69; figure 1a * * column 8, line 65 - column 9, line 22 *	8-11	
A	US 3 542 404 A (ROLLINS HENRY MOAK ET AL) 24 November 1970 (1970-11-24) * the whole document *	1-12	
A	US 2005/087983 A1 (VERGER ERIC [FR] ET AL) 28 April 2005 (2005-04-28) * the whole document *	1-12	

TECHNICAL FIELDS SEARCHED (IPC)

E21B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 January 2023	Morrish, Susan

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 22 19 2053

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.

10-01-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3923324 A	02-12-1975	AU 6546374 A	14-08-1975
		CA 983471 A	10-02-1976
		DE 2313664 A1	03-10-1974
		FR 2222526 A1	18-10-1974
		GB 1430494 A	31-03-1976
		JP S549963 B2	28-04-1979
		JP S49122801 A	25-11-1974
		US 3923324 A	02-12-1975
US 3114566 A	17-12-1963	FR 1392533 A	19-03-1965
		US 3114566 A	17-12-1963
US 3542404 A	24-11-1970	NONE	
US 2005087983 A1	28-04-2005	AR 040307 A1	23-03-2005
		AT 360778 T	15-05-2007
		AU 2003255659 A1	19-01-2004
		BR 0312117 A	29-03-2005
		CA 2489516 A1	08-01-2004
		CN 1666056 A	07-09-2005
		DE 60313460 T2	03-01-2008
		EA 200500102 A1	30-06-2005
		EG 23594 A	21-09-2006
		EP 1518068 A1	30-03-2005
		FR 2841626 A1	02-01-2004
		JP 4234100 B2	04-03-2009
		JP 2005536691 A	02-12-2005
		MX PA05000026 A	08-04-2005
		MY 137063 A	31-12-2008
		OA 12828 A	11-07-2006
		PL 207609 B1	31-01-2011
		UA 79618 C2	10-07-2007
		US 2005087983 A1	28-04-2005
		WO 2004003416 A1	08-01-2004

EPO FORM P0459

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