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(54) **Earth drilling tool and method**

Erdbohrwerkzeug und -verfahren

Outil et procédé de forage du sol

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a drilling tool for down-the-hole drilling, which drilling tool is intended to drill a hole ahead of a following casing tube, the drilling tool comprising a drill assembly which comprises a central pilot drill bit portion, a peripheral ring shaped drill bit portion and a coupling device, said assembly being coupled to a drill string.

BACKGROUND INFORMATION

[0002] Drilling tools for down the hole drilling are previously known that comprise an assembly of parts forming a central drill bit portion, i.e. a central reusable drill bit portion with a pilot drill, a peripheral ring shaped drill bit portion and a ring shaped coupling device. When a hole is done the peripheral ring shaped drill bit portion and the ring shaped coupling device are left in the drill hole whereas the central pilot drill bit portion is retracted from the hole together with the drill string and can be reused. Known types of drilling tools are seen in EP1402146, US4773489, US5803192 and WO9534740.

[0003] Depending on the type of ground to be drilled (e.g. soft, medium or hard formation rock) different drill bit portions of various types are used. The size of the pilot drill bit portion is also varied depending on the desired diameter of the hole to be drilled. For each new circumstance the drill bit portion is switched into one that meets the new requirements, which may often be a time consuming process. If the drill bit portion is worn out it is disposed of and replaced by a new central drill bit portion. This leads to considerable waste of material which is undesirable both from an economical and environmental point of view.

[0004] Another problem related to presently known drilling tools is that production of the large and heavy drill bit portions is associated with a laborious and uneconomical production process. Often an initial large piece of steel material is cut in a metalworking lathe into a desired shape, which often leads to loss of material. During production of drill bit portions it is not uncommon that an initial steel block is reduced from a thickness of 800 mm to a final diameter of 100 mm, meaning a substantial amount of cut away steel is merely thrown as waste.

OBJECTS OF THE INVENTION

[0005] It is an object of the present invention to overcome or at least minimize at least one of the drawbacks and disadvantages of the above described known drilling tools.

[0006] A first object of the present invention is to be able to easily exchange the central drill bit portion so that the same drive shaft may be provided with a new pilot drill bit portion whereas the drive shaft itself is reused. This will lead to a number of advantages, such as

- reduced material consumption (i.e. only the actual pilot drill portion of the drilling tool which is subject to wear and tear is exchanged while the drive shaft is reused),
- the possibility of easily switching between differently dimensioned pilot drill portions enabling for quick adjustments of the equipment for drilling different types of holes and different types of ground (e.g. soft, medium or hard formation rock),
- easier manufacturing of the drilling tool due to that the smaller units of the invented tool can be produced with less material consumption compared to production of one large central drill bit portion as is known prior art,
- easier maintenance due to smaller and less heavy parts.

[0007] This and other objects, which are obvious to the expert, have been able to be realized in a surprising manner by designing the drilling tool in accordance with the characterizing part of claim 1. Preferred embodiments of the invented drilling tool are defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The invention will be described in more detail with reference to the enclosed figures, in which:

Fig. 1A	is an elevational view of the lower portion of a drilling tool according to one embodiment of the invention,
Fig. 1B	is a vertical cross sectional view of the lower portion of the drilling tool shown in Fig. 1A,
Fig. 2	is an exploded view showing a drilling tool according to one embodiment of the invention,
Fig. 3	is a perspective view showing the central pilot drill bit portion according to one embodiment of the invention,
Figs. 4A-C	show different views of the central pilot drill bit portion shown in Fig. 3,
Fig. 5	is a perspective view showing the blast protection ring according to one embodiment of the invention,
Fig. 6	is a perspective view showing the drill shaft according the one embodiment of the invention,
Figs. 7A-B	show different views of the casing shoe according to one embodiment of the invention,
Fig. 8A	is a perspective view showing the drill shaft according the another embodiment of the invention,

Fig. 8B shows an end view of the drill shaft shown in Fig. 8A,

Fig. 9A is a perspective view showing a central pilot drill bit portion according to another embodiment of the invention, and

Fig. 9B is a cross sectional view of the central pilot drill bit portion in Fig. 9A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings. Further, the description, and the examples contained therein, are provided for the purpose of describing and illustrating certain embodiments of the invention only and are not intended to limit the scope of the invention in any way.

[0010] In Figs. 1 and 2 is shown the drilling tool according to one embodiment of the invention. The shown drilling tool is intended for down-the-hole drilling, wherein a hole is drilled ahead of a following casing tube 13. As is known per se a chuck 12 is coupled to a continuous drill string (not shown), via a hammer unit (not shown) in a casing tube 13, by means of which a drill assembly 10 rotates clockwise in the embodiment illustrated and receives percussion energy from the hammer unit. The drill assembly 10 can be assigned percussion energy via a down-the-hole hammer (not shown) or a left-rotating top-hammer coupled in a torsionally rigid manner (not shown). The drill string, hammer unit and their parts are of a conventional type and are not shown in the figures.

[0011] The drilling tool 1 comprises a drill assembly 10 which has a central, reusable pilot drill bit portion 2, a peripheral ring shaped disposable ring drill bit portion 4 and a disposable coupling device 3 in the form of a casing shoe. The casing shoe 3 is fixed to the casing tube 13 by means of welding 5 (as in known per se). The ring drill bit portion 4 has external threads 45 at the top sides which are used to thread it into the casing shoe 3, past the threads on the casing shoe 3, to allow the ring drill bit portion 4 some axial play between the threads 35 and an intermediate edge 36. According to the invention the said assembly 10 is coupled to the drill string, via the chuck 12 , which in turn via internal splines 121 transfer torque to a drive shaft device 9 (via mating splines 98), which releasably interfits with the pilot drill bit portion 2 for transmitting torque from the drill string to the drill assembly 10. (Also the top flange 97 of the drive shaft device has splines to allow the chuck 12 to be moved onto it from above.)

[0012] The drive shaft device 9 interfits with the pilot drill bit portion 2 via a central hole 22 within the pilot drill bit portion 2, as will be explained more in detail below. Around the upper part 91 of said drive shaft 9 there is mounted the chuck 12, which in its turn is resting on a ring shaped blast protection unit 15. The blast protection ring 15 is interposed between the chuck 12 and the central pilot drill bit portion 2. As is known per se the chuck 12 is arranged with outer threads and an edge 121 for interfit with the casing of the hammer (not shown). The blows from the hammer hit on the top 99 of the drive shaft device 9 . The chuck 12 is arranged to axially slide along the splines 98 and also as a concequence along the cylindrical surface of the drive shaft below the splines 98. As known per se coupling halves (not shown), blocked by the upper edge 97 keep the chuck 12 safely in place together with the drive shaft device 9.

[0013] As is common knowledge, upon drilling a flushing medium (such as pressurized air) is supplied through the central through hole 94 of the shaft 9 and further via flushing channels 26, 26' within the pilot drill bit portion 2. Any by drilling loosened matter/gravel is activated by the onset of flushing medium and is removed from the drill hole through longitudinal flushing grooves 21 (see Fig. 3-4) on the outer side of the pilot drill bit portion 2. This results in a blasting stream of drilled loose matter which exits flushing grooves 21 in an upward direction. According to the invention said blast protecting ring 15 is positioned adjacent to the opening of the flushing grooves 21 so that the blasted matter will hit the surface of said ring 15 instead of hitting the guide body 12 thus protecting it from wear which is advantageous since the guide body 12 is made of a more expensive material compared to the ring 15 unit. Preferably the blast protecting ring 15 is made of a hardened steel material which will resist the heavy onset of blasting matter/gravel. When worn out the ring 15 is very easily exchanged into a new one. As is seen in Fig. 1B the ring 15 preferably has a tapered cross section with a narrow base abutting the top part of the pilot drill bit portion 2 and the wider portion abutting the guide body 12. The tapered shape leads to that the flushed matter/gravel is guided outwards and upwards and is transported along the inner walls of the casing tube 13.

[0014] The releasable connection between the drive shaft 9 and the pilot drill bit portion 2 is preferably achieved in two ways cooperating with each other. First in that a number of connecting bits 16 torsionally interconnect the two units 2, 9, and second in that at least one locking ball 250 is positioned within circumferential recesses 25, 95 preventing the drive shaft 9 from being retracted out of the central hole 22 (see Fig. 3) of the pilot drill bit portion 2. The connection between the drive shaft 9 and the pilot drill bit portion 2 will be described in more detail in connection to Fig. 2, Fig. 4B and Fig. 8 - 9. The second axial coupling may be achieved in other ways than by means of a locking ball, for instance by means of a locking pin or the like preventing axial retraction.

[0015] The present design of a drilling tool 1 leads to that only the pilot drill bit portion 2 may be exchanged by reusing the same drive shaft device 9, which provides many advantages, e.g. cost advantages (smaller part leads to less material and easier production) and easier

maintenance. Thanks to the invention it is possible to use modular design and subdivide the components of a drilling tool into modular units which may be combined in a highly flexible way into a desired drilling tool 1. This also leads to less heavy exchange part and easier accessible releasable connection.

[0016] Fig. 2 shows an exploded view of one embodiment according to the invention. The drive shaft 9 has an upper 91 and a lower 92 portion, where the lower portion is intended to be introduced into the central hole 22 (see Fig. 3) of the pilot drill bit portion 2. At the lower portion 92 the drive shaft is provided with a number of longitudinal recesses 93, preferably three outer recesses 93, which are symmetrically arranged around the outer surface of the drive shaft 9. Each recess matches a removable connecting bit 16. As is shown in Fig. 3 the central hole 22 of the pilot drill bit portion 2 comprises a number of inner recesses 23, preferably the same number of inner recesses 23 as there are outer recesses 93 within the drive shaft 9, that is, in the embodiment of Fig. 2 and 3 a number of three. The skilled person understands that the number of connecting bits 16 and inner recesses 23 respectively can be more than three, depending on the required torque momentum transmission of a particular drilling assembly 1. For larger drilling assemblies as many as twelve connecting bits 16 may be necessary in order to achieve a strong enough torque transmitting coupling, whereas for medium type assemblies six or eight may be enough.

[0017] The coupling of a drive shaft 9 and a pilot drill bit portion 2 is now to be described.

A connecting bit 16 is positioned within each of said recesses 93 so that each bit 16 is partly projecting radially out from the drive shaft 9. Preferably the arrangement according to the invention 1 comprises retaining means or a retaining mechanism for at least temporarily retaining the connecting bits 16 within the matching recesses 93 of the drive shaft 9. Thus when disconnecting the drive shaft 9 from a pilot drill bit portion 2 the connecting bits 16 will remain positioned within the recessed until being removed, which may for instance be done manually. Retaining of the connecting bits 16 may be achieved in many different ways, for example with of one or more O-rings being introduced around the plurality of connecting bits 16 keeping them in place. It is also possible to provide some sort of mechanical formfitting between the connecting bits 16 and the recesses 93, for instance matching protrusions and grooves, having an engaging effect. The drive shaft 9 is introduced into the central hole 22 of the pilot drill bit portion 2. Upon introduction of the drive shaft 9 the protruding connecting bits 16 are positioned to slide into the inner recesses 23 resulting in a torsional connection/coupling between the drive shaft 9 and the pilot drill bit portion 2. According to a preferred aspect of the invention the outer surface of each of the connecting bits 16 is arranged with an outer radius, and in a corresponding manner each of said inner recesses 23 has an inner radius mating the outer radius of said connecting bit 16. The radial mating surfaces of the connecting bits 16 and the inner recesses 23 respectively leads to a firm connection between the drive shaft 9 and the drill bit portion 2 where torque is transmitted from the drive shaft 9 to the drill bit 2 over the entire radius of the connecting bit 16, leading to a very effective transfer of forces and also to a significantly improved mechanical sustainability compared to known drilling tools.

[0018] A benefit of the releasable connecting bits 16 is that they are easily replaceable when worn out, leading to that by means of just shifting minor components of the connection its lifetime may be extended thus postponing the need for replacing the whole drive shaft 9, which obviously is expensive and leads to undesired waste of materials.

[0019] The drive shaft 9 further comprises an outer circumferential recess 95. Upon introduction of the drive shaft 9 into the central hole 22 of the pilot drill bit portion 2 the outer recess 95 is arranged to be positioned to face an inner circumferential recess 25 within the central hole 22 of the pilot drill bit portion 2 (see Fig. 4B) thus jointly creating a kind of inner annular groove 25, 95. In order to lock the drive shaft 9 and the pilot drill bit portion 2 in an axial direction one or more locking balls 250 are put through a radial bore inlet 251 within the drill bit portion 2, leading to the circumferential groove 25, 95, which allows the balls 250 to interconnect the drive shaft 9 and the pilot drill bit portion 2 in the axial direction, but with some play to not cause damage to the balls 250 upon blows from the hammer. After supply of the balls 250 the inlet 251 is arranged with a releasable plug (not shown) that extends into the periphery of the recess 25 to safety position the balls 250 within the groove 25, 95.

[0020] A particular advantage provided by the present invention relates to that threaded connections between the releasable components 2, 4; 2, 9 of the drilling tool 1 are essentially avoided. Threaded connections are often very hard to release after a drilling operation, whereas the couplings according to the invention on the contrary are quite easy to loosen.

[0021] Fig. 3 shows a perspective view of a pilot drill bit portion 2 according to one embodiment of the invention with said central hole 22 and inner recesses 23 dimensioned to match the connecting bits 16. The pilot drill bit portion 2 is further provided with a number (here three) of outer flushing grooves 21 which function as transporting channels for drilled matter and gravel out of the drilled hole. The lower part of the pilot drill bit portion 2 comprises protrusions 24 intended for connecting the pilot drill bit portion 2 to the ring drill bit portion 4 (see Figs. 7A-B).

[0022] According to a preferred embodiment the upper portion of the pilot drill bit portion 2 comprises a first 27 and a second 28 flange which function will be more described later.

[0023] Referring now to Figs. 4A-B which show the underside, a cross section and the upper side of a pilot drill bit portion 2 respectively. The lower drill surface 29 has openings of said flushing channels 26, the diameter of

which is adapted to the desired flushing medium and/or flow quantity. As is clear from Fig. 4B a first 27 and a second flange 28 are arranged at the upper part of the pilot drill bit portion 2 resulting in a first 270 and a second meeting edge 280. These edges assist in transferring the percussion energy that via the top 99 is transferred to the bottom 97 of the drive shaft device 9 and there from partly transferred to the ring drill bit portion 4 . The task of the first meeting edge 270 is to abut the top edge 30 of casing shoe 3. Likewise, the second meeting edge 280 is intended to meet and abut a inner top edge 443 of the ring drill bit portion 4 (as is also seen in Fig. 1B). During drilling operation the described design with double flanges 27, 28 on the pilot drill bit portion 2 leads to the advantage of substantially reduced wear on the equipment compared to a design with one flange, since percussion energy is absorbed by two pairs of meeting edges instead of one. Hence, the percussion energy will first be transferred to the central drill bit portion 2, some of which will directly act at its drill face 29, and some that via first edge 270, further via its intermediate edge 36 to an outer top edge 42 of the ring drill bit portion 4, and further some that via the second edge 280 will be transferred to the inner top edge 43 of the ring drill bit portion 4.

[0024] Hence, percussion energy is transferred from the drill bit portion 2 to the ring drill bit portion 4 at two radially off-set positions/edges 42, 43. Accordingly in total a large transfer area is obtained, which is even increased by having tapered mating surfaces 43/280; 42/36.

[0025] Another beneficial aspect of the invention is that the design of the assembly 10 (i.e. the meeting surfaces) results in that the backward recoil energy created during drilling operation will be effectively absorbed by the components of the drill assembly 10. Upon kickback, recoil energy will be transferred from the pilot drill bit portion 2 via the connecting protrusions 24 to the casing shoe 4, and there from to the lower end surface 36 of the ring bit portion 3. Also this design will lead to substantially reduced wear and tear on the drilling tools.

[0026] As is seen in the cross sectional view in Fig. 4B there is a radial bore 251 for the locking balls 250, adapted to the diameter of the radial recess 25.

[0027] For clarifying reasons are provided Figs. 5 and 6 showing perspective views of the blast protecting ring 15 and the drive shaft device 9 respectively. The blast protecting ring 15 is tapered with a lower narrow end 150 and a wider upper end 151, where the diameter of the wider end preferably corresponds to the outer diameter of the lower end of the chuck 12.

[0028] The perspective view of the drive shaft device 9 further shows the central flushing channel 94 intended for flushing of medium.

[0029] In Figs. 7A-B are seen the ring drill bit portion 4 according to a preferred embodiment. When shown from above, as in Fig. 7A, it is seen that the ring drill bit portion 4 comprises a number of connecting grooves 40 which matches the connection protrusions 24 of the pilot drill bit portion 2. The protrusions 24 are introduced into the grooves 40, until edges 280 and 43 meet, and the parts 2,4 are then turned so that relative to each other the protrusions 24 are fit into a recess 44 arranged at the bottom of each groove 40. Here the recesses 44 are positioned for right-hand rotation (seen from above) intended for the protrusions 24. In case of a drilling tool with a left-hand rotation the recesses 44 shall be positioned in a mirror-image position compared to Fig. 7A. When the drilling operation is completed the drill string is turned the opposite direction, so that the protrusions 24 of the pilot drill bit portion 2 are released/moved out from the recesses 44, whereby the drill string with shaft device 9 and pilot drill bit portion 2 is free to lift upwards from the ring drill bit portion 4 which is left in the drilled hole together with said casing shoe 3.

[0030] In Fig. 8A - B is shown a drive shaft device 9 according to another embodiment of the invention. In Fig. 8A, showing a perspective view of a drive shaft 9, there is seen that the component has a first upper end 91 and a second lower end 92, whereat in said upper end 91 there is arranged a top flange 97 arranged to keep the chuck 12 safely in place together with the drive shaft device 9. A protruding flange 920 ensures that the drill shaft 9 when connected to a drill bit portion 2 is introduced into the drill bit portion 2 to the right extent and is positioned correctly in order for the outer recess 95 and the inner circumferential recess 25 within the central hole 22 of the pilot drill bit portion to meet and jointly creating a kind of inner annular groove 25, 95.

The embodiment seen in Fig. 8A comprises in its lower end 92 a plurality of elongated connecting members 96 fixedly arranged onto and forming an integrated part of the drive shaft device 9. The connecting members 96 may be fixedly attached onto the drive shaft 9 or they may be cut out during the production of the drive shaft 9. Each of the connecting members 96 is formed with an outer radius, similar to the releasable connecting bits 16 previously described, and are arranged to match with inner recesses 23 of a mating drill bit portion 2 (see Fig. 9A - B).

[0031] In Fig. 8B there is shown an end view of the drill shaft 9 of Fig. 8A, exposing the central through hole 94. Herein is seen the plurality of connecting members 96 circumferentially distributed around the lower end 92 of a drill shaft 9. Preferably the connecting members 96 are evenly positioned around the circumference of the shaft 9 in order to achieve a balanced torque transmission upon operation. In this example the shaft 9 comprises eight connecting members 96, whereat two neighbouring connecting members 96 are arranged with an angle α in between as is illustrated in Fig. 8B. Preferably α is the same for all connecting members 96, meaning in this example (i.e. eight members 96) α equals 45°. However other numbers of connecting members 96 are also possible meaning that also angle α will vary. For larger drilling equipment (i.e. larger pilot drill bits 2) as many as twelve connecting members 96 might be necessary for attaining

enough strength in the torque coupling, whereas a lesser number may suffice for smaller drilling assemblies 10.

[0032] The drilling assembly 10 according to the invention may be used for a variety of sizes of drilling equipment. Fig. 8B shows the diameter D of the lower end 92 of the drill shaft 9. The diameter D may be between 50 - 250 mm depending on the size of the pilot drill bit portion 2 to be coupled to the drill shaft 9. The size of the pilot drill bit portion 2 will determine the size of the hole to be drilled, and the drill bit portion 2 in its turn must be adapted to the size of the casing tube 13. An advantageous aspect of the present invention is that one type of drill shaft 9 can be used for connecting many different types (e.g. sizes) of pilot drill bit portions 2, meaning that the drilling equipment is easily and quickly adapted to different types of drilling operations (e.g. in order to handle different typed of holes and different types of grounds respectively). By also being able to exchange the pilot drill bit 9 the assembly 10 according to the invention can cover a wide variety of different sizes of drilling tools 1, meaning for instance when a certain type of drill shaft 9 is too small to handle a given drill bit portion 2 changing of the shaft 9 into a larger one enables further operation with said drill bit portion 2 (providing that the casing tube 13 is also compatible, as is obvious to the skilled person).

[0033] In Fig. 9A there is seen a perspective view of a pilot drill bit portion 2 according to another embodiment of the invention, arranged to mate with and be connected to a drill shaft 9 as the one shown in Fig. 9A-B. In Fig. 9B there is seen a cross sectional view along line IXB in Fig. 9A. In a corresponding manner to what's previously been described the lower end 92 portion of a drill shaft 9 is arranged to be introduced into the central opening 22 of the drill bit portion 2 to achieve a torque coupling. Axial coupling is achieved by means of for instance a ball lock arrangement. The inner recesses 23 of the drill bit portion 2 are arranged with an inner radius mating the outer radius of said connecting members 96 so that a firm connection between the connecting members 96 and the inner recesses 23 is achieved resulting in an excellent torque momentum transmission over the entire radius surface.

[0034] As is well understood by the skilled person the size of the drill bit portion 2 will determine the size of the hole to be drilled. Various dimensions of drill bits 2 can be used in a drilling tool 1 according to the invention, and the diameter d of the drill bits 2 may vary between 90 - 610 mm for different types of drill bits 2. Thanks to the invention it is possible to rather easily adapt the equipment to handling different types of drilling, by providing a plurality of central pilot drill bit portions 2 (including at least two different drill bit portions 2) and exchange of one central drill bit portion 2 to a different kind.

[0035] It is understood that the objects of the present invention set forth above, among those made apparent by the detailed description, shall be interpreted as illustrative and not in a limiting sense. Within the scope of the following claims the set-up of various alterations of the present invention may be possible. For instance, for the skilled person it is evident that there exist a big variety of different solutions to achieve the couplings used between the drive shaft device 9 and the pilot drill bit portion 2, e.g. to achieve the axial coupling, by means of bores and pins (as known *per se*), or plate formed segments fitting into corresponding recesses, etc. Likewise the releasable torque coupling can be achieved in many different ways, e.g. by the use of splines, etc. Further it is also feasible to achieve the coupling by having a threaded connection between the drive shaft device 9 and the pilot drill bit portion 2. Further it is foreseen that a check valve device 6 (see fig 1) may be used to hinder dirt (pressurized) to enter into the hammer device during stand still.

Claims

1. Drilling tool for down-the-hole drilling, which drilling tool is arranged to drill a hole ahead of a following casing tube (13), the drilling tool comprising a drill assembly (10) which comprises a central pilot drill bit (2, 9), a casing shoe (3) and an outer peripheral ring shaped drill bit portion (3, 4) releasably attached to said central pilot drill bit (2, 9), said assembly (10) being coupled to a drill string, **characterized in that** the central pilot drill bit (2), comprises a central pilot drill bit portion (2) and a drive shaft device (9) which are arranged to releasably interfit to transmit torque from the drill string to the drill assembly (10), wherein the drive shaft device (9) has a lower, shaft formed portion (92), which releasably interfits within a central hole (22) of the pilot drill bit portion (2) by means of a first coupling arrangement (16, 96, 23, 93), wherein said shaft formed portion (92) is arranged with connecting members (16, 96) each comprising an outer radius arranged to mate with inner recesses (23) within the central hole (22), each recess (23) comprising an inner radius mating with the outer radius of said connecting members (16, 96), whereby a torque transmitting coupling is achieved.

2. Drilling tool according to claim 1, wherein said first coupling (16, 23, 93) is arranged by means of releasable, connecting bits (16) arranged to match recesses (93) around the periphery of said second end (92), and also to match inner recesses (23) in said central hole (22), so that upon coupling the rotational movement from the drive shaft (9) is transmitted to said assembly (10).

3. Drilling tool according to any preceding claim, wherein the drive shaft device (9) is axially coupled to the central pilot drill bit (2) by means of a second releasable axial coupling arrangement (25, 95, 250).

4. Drilling tool according to claim 3, wherein said second releasable coupling arrangement (25, 95, 250)

comprises at least one locking ball (250), preferably a number of locking balls (250), arranged within a circumferential recess (25) within said central hole (22) of the central pilot drill bit (2) and also a circumferential recess (95) around the periphery of the drive shaft device (9).

5. Drilling tool according to claim 4, wherein there is arranged a radial bore (251) in the body of said central pilot drill bit (2) arranged to facilitate supply and removal of said locking ball/s (250).

6. Drilling tool according to claim 5, wherein the central pilot drill bit portion (2) comprises a first (27) flange and a second flange (28), wherein said first (27) flange (27) is arranged to transmit percussion energy to said drill bit portion (2) indirectly via said casing shoe (3) and said second flange (28) is arranged to transmit percussion energy directly to said drill bit ring (4).

7. Drilling tool according to any preceding claim, wherein the drilling tool (1) comprises a chuck (12) arranged to transmit torque from said drill string to said drill assembly (10).

8. Drilling tool according to claim 7, wherein there is a blast protecting ring (15) positioned in between the central pilot drill bit portion (2) and the chuck (12).

9. Drilling tool according to claim 8, wherein the blast protecting ring (15) has a tapered cross section.

10. Drilling tool according to any preceding claim, wherein the central pilot drill bit portion (2) comprises axially extending flushing grooves (21).

11. Drilling tool assembly comprising a plurality of central pilot drill bit portions (2) according to any preceding claim, wherein said plurality of central pilot drill bit portions (2) include at least two different drill bit portions (2) arranged to handle different types of drilling.

12. Method for assembling a drilling tool comprising the steps of

a. providing a drill assembly (10) with a central pilot drill bit portion (2), a peripheral ring shaped drill bit portion (4) and a casing shoe (3),
b. providing a casing tube (13) which and a drill string,
c. **characterized in**
d. further providing a drive shaft device (9) and
e. connecting the drive shaft device (9) to transfer torque from a drill string, and
f. releasably connecting the drive shaft device (9) by means of a torque coupling (16, 23, 93) to the central drill bit portion (20).

13. Method according to claim 12, further also releasably connecting the drive shaft device (9) by means of a axial coupling (25, 95, 250) to the central drill bit portion (20).

14. Method according to claim 13, further providing a plurality of central pilot drill bit portions (2) including at least two different drill bit portions (2) and exchange of one central drill bit portion (2) to a different kind of drill bit portion (2) to handle different types of drilling.

15. Method according to claim 14, wherein said exchange is related to handle different types of holes.

16. Method according to claim 14, wherein said exchange is related to handle different kind of grounds.

Patentansprüche

1. Bohrwerkzeug zum Im-Loch-Bohren, wobei das Bohrwerkzeug eingerichtet ist, ein Loch vor einem nachfolgenden Gehäuserohr (13) zu bohren, wobei das Bohrwerkzeug eine Bohranordnung (10), welche einen zentralen Pilotbohrmeißel (2, 9) umfasst, einen Gehäuseschuh (3) und einen äußeren am Rand gelegenen ringförmigen Bohrmeißelabschnitt (3, 4), welcher lösbar an dem zentralen Pilotbohrmeißel (2, 9) angebracht ist, umfasst, wobei die Anordnung (10) an einen Bohrstrang gekoppelt ist, **dadurch gekennzeichnet, dass** der zentrale Pilotbohrmeißel (2) einen zentralen Pilotbohrmeißelabschnitt (2) und eine Antriebswellenvorrichtung (9) umfasst, welche eingerichtet sind, lösbar zu passen, um Drehmoment von dem Bohrstrang zu der Bohranordnung (10) zu übertragen, wobei die Antriebswellenvorrichtung (9) einen unteren, Wellen-förmigen Abschnitt (92) aufweist, welcher mittels einer ersten Kopplungseinrichtung (16, 96, 23, 93) lösbar in ein zentrales Loch (22) des Pilotbohrmeißelabschnitts (2) passt, wobei der Wellen-förmige Abschnitt (92) mit Verbindungelementen (16, 96) eingerichtet ist, wobei jedes einen äußeren Radius umfasst, der eingerichtet ist, mit inneren Vertiefungen (23) in dem zentralen Loch (22) zusammenzupassen, wobei jede Vertiefung (23) einen inneren Radius umfasst, der mit dem äußeren Radius der Verbindungselemente (16, 96) zusammenpasst, wodurch eine Drehmomentübertragungskopplung erreicht wird.

2. Bohrwerkzeug gemäß Anspruch 1, wobei die erste Kopplung (16, 23, 93) mittels lösbarer Verbindungseinsätze (16) eingerichtet ist, die eingerichtet sind, Vertiefungen (93) um den Rand des zweiten Endes (92) zu entsprechen und auch inneren Vertiefungen (23) in dem zentralen Loch (22) zu entsprechen, so

dass nach Koppeln die Drehbewegung von der Antriebswelle (9) zu der Anordnung (10) übertragen wird.

3. Bohrwerkzeug gemäß einem der vorstehenden Ansprüche, wobei die Antriebswellenvorrichtung (9) mittels einer zweiten lösbaren axialen Kopplungsanordnung (25, 95, 250) mit dem zentralen Pilotbohrmeißel (2) axial gekoppelt ist.

4. Bohrwerkzeug gemäß Anspruch 3, wobei die zweite lösbare Kopplungsanordnung (25, 95, 250) mindestens eine Verriegelungskugel (250), bevorzugt eine Anzahl von Verriegelungskugeln (250), die in einer umlaufenden Vertiefung (25) in dem zentralen Loch (22) des zentralen Pilotbohrmeißels (2) eingerichtet sind, und auch eine umlaufende Vertiefung (95) um den Rand der Antriebswellenvorrichtung (9) umfasst.

5. Bohrwerkzeug gemäß Anspruch 4, wobei eine radiale Bohrung (251) in dem Körper des zentralen Pilotbohrmeißels (2) eingerichtet ist, die eingerichtet ist, Zufuhr und Entnahme der Verriegelungskugel/n (250) zu erleichtern.

6. Bohrwerkzeug gemäß Anspruch 5, wobei der zentrale Pilotbohrmeißelabschnitt (2) einen ersten (27) Flansch und einen zweiten Flansch (28) umfasst, wobei der erste (27) Flansch (27) eingerichtet ist, Schlagenergie zu dem Bohrmeißelabschnitt (2) indirekt über den Gehäuseschuh (3) zu übertragen, und wobei der zweite Flansch (28) eingerichtet ist, Schlagenergie direkt zu dem Bohrmeißelring (4) zu übertragen.

7. Bohrwerkzeug gemäß einem der vorstehenden Ansprüche, wobei das Bohrwerkzeug (1) ein Spannfutter (12) umfasst, das eingerichtet ist, Drehmoment von dem Bohrstrang an die Bohranordnung (10) zu übertragen.

8. Bohrwerkzeug gemäß Anspruch 7, wobei ein Druckwellenschutzring (15) zwischen dem zentralen Pilotbohrmeißelabschnitt (2) und dem Spannfutter (12) angeordnet ist.

9. Bohrwerkzeug gemäß Anspruch 8, wobei der Druckwellenschutzring (15) einen sich verjüngenden Querschnitt aufweist.

10. Bohrwerkzeug gemäß einem der vorstehenden Ansprüche, wobei der zentrale Pilotbohrmeißelabschnitt (2) sich axial erstreckende Spülrillen (21) umfasst.

11. Bohrwerkzeuganordnung umfassend eine Vielzahl von zentralen Pilotbohrmeißelabschnitten (2) gemäß einem der vorstehenden Ansprüche, wobei die Vielzahl von zentralen Pilotbohrmeißelabschnitten (2) mindestens zwei unterschiedliche Bohrmeißelabschnitte (2) einschließt, die eingerichtet sind, unterschiedliche Arten von Bohren zu bewältigen.

12. Verfahren zum Zusammenbau eines Bohrwerkzeugs umfassend die Schritte von

a. Bereitstellen einer Bohranordnung (10) mit einem zentralen Pilotbohrmeißelabschnitt (2), einem am Rand liegenden ringförmigen Bohrmeißelabschnitt (4) und einem Gehäuseschuh (3),
b. Bereitstellen eines Gehäuserohrs (13) und eines Bohrstrangs,
c. **gekennzeichnet durch**
d. weiterhin Bereitstellen einer Antriebswellenvorrichtung (9) und
e. Verbinden der Antriebswellenvorrichtung (9), um Drehmoment von einem Bohrstrang zu übertragen, und
f. lösbar Verbinden der Antriebswellenvorrichtung (9) mittels einer Drehmomentkopplung (16, 23, 93) mit dem zentralen Bohrmeißelabschnitt (20).

13. Verfahren gemäß Anspruch 12, weiterhin auch lösbar Verbinden der Antriebswellenvorrichtung (9) mittels einer axialen Kopplung (25, 95, 250) mit dem zentralen Bohrmeißelabschnitt (20).

14. Verfahren gemäß Anspruch 13, weiterhin Bereitstellen einer Vielzahl von zentralen Pilotbohrmeißelabschnitten (2), einschließlich mindestens zweier unterschiedlicher Bohrmeißelabschnitte (2), und Austauschen eines zentralen Bohrmeißelabschnitts (2) mit einem Bohrmeißelabschnitt (2) eines unterschiedlichen Typs, um unterschiedliche Arten von Bohren zu bewältigen.

15. Verfahren gemäß Anspruch 14, wobei der Austausch sich darauf bezieht, unterschiedliche Arten von Löchern zu bewältigen.

16. Verfahren gemäß Anspruch 14, wobei der Austausch sich darauf bezieht, unterschiedliche Arten von Böden zu bewältigen.

Revendications

1. Outil de forage pour le forage en fond de trou, lequel outil de forage est agencé pour percer un trou à l'avant d'un tube d'enveloppe (13) qui suit, l'outil de forage comprenant un ensemble de forage (10) comprenant un trépan pilote central (2, 9), un sabot d'enveloppe (3) et une partie formant trépan (3, 4) en forme d'anneau périphérique externe fixé de façon

libérable audit trépan pilote central (2, 9), ledit ensemble (10) étant relié à un train de tiges de forage, **caractérisé en ce que** le trépan pilote central (2) comprend une partie de trépan pilote central (2) et un dispositif (9) formant arbre d'entraînement qui sont agencés pour s'inter-emboîter de façon libérable afin de transmettre à l'ensemble de forage (10) du couple provenant du train de tiges de forage, le dispositif (9) formant arbre d'entraînement présentant une partie inférieure (92) en forme d'arbre, qui s'emboîte de façon amovible dans un trou central (22) de la partie formant trépan pilote (2) au moyen d'un premier agencement de liaison (16, 96, 23, 93), ladite partie (92) en forme d'arbre étant agencée avec des organes de liaison (16, 96) comprenant chacun un rayon extérieur agencé pour venir correspondance avec des évidements intérieurs (23) aménagés dans le trou central (22), chaque évidement (23) comprenant un rayon intérieur correspondant au rayon extérieur desdits organes de liaison (16, 96), de sorte qu'une liaison de transmission de couple est obtenue.

2. Outil de forage selon la revendication 1, dans lequel ledit premier agencement de liaison (16, 23, 93) est agencé au moyen de pièces de liaison (16) amovibles agencées pour correspondre à des évidements (93) aménagés autour de la périphérie de ladite deuxième extrémité (92), et également pour correspondre à des évidements intérieurs (23) aménagés dans ledit trou central (22), de sorte que lors de la liaison, le mouvement de rotation de l'arbre d'entraînement (9) est transmis audit ensemble (10).

3. Outil de forage selon l'une quelconque des revendications précédentes, dans lequel le dispositif (9) formant arbre d'entraînement est relié axialement au trépan pilote central (2) au moyen d'un deuxième agencement de liaison axial (25, 95, 250) libérable.

4. Outil de forage selon la revendication 3, dans lequel ledit deuxième agencement de liaison (25, 95, 250) libérable comprend au moins une bille de verrouillage (250), de préférence un certain nombre de billes de verrouillage (250), disposées dans un évidement circonférentiel (25) aménagé à l'intérieur dudit trou central (22) du trépan pilote central (2) et également dans un évidement circonférentiel (95) aménagé autour de la périphérie du dispositif (9) formant arbre d'entraînement.

5. Outil de forage selon la revendication 4, dans lequel un alésage radial (251) est aménagé dans le corps dudit trépan pilote central (2), étant agencé pour faciliter la mise en place et le retrait desdites billes de verrouillage (250).

6. Outil de forage selon la revendication 5, dans lequel la partie (2) formant trépan pilote central comprend une première bride (27) et une deuxième bride (28), ladite première bride (27) étant agencée pour transmettre de l'énergie de percussion à ladite partie formant trépan (2) indirectement via ledit sabot d'enveloppe (3), et ladite deuxième bride (28) étant agencée pour transmettre de l'énergie de percussion directement audit anneau de trépan (4).

7. Outil de forage selon l'une quelconque des revendications précédentes, dans lequel l'outil de forage (1) comprend un mandrin (12) agencé pour transmettre audit ensemble de forage (10) le couple généré par ledit train de tiges de forage.

8. Outil de forage selon la revendication 7, dans lequel il y a un anneau de protection anti-explosion (15) positionné entre la partie de trépan pilote central (2) et le mandrin (12).

9. Outil de forage selon la revendication 8, dans lequel l'anneau de protection contre les explosions (15) a une section transversale allant en s'effilant.

10. Outil de forage selon l'une quelconque des revendications précédentes, dans lequel la partie (2) formant trépan pilote central comprend des rainures (21) d'écoulement de flux s'étendant axialement.

11. Ensemble formant outil de forage comprenant une pluralité de parties de trépan pilote central (2) selon l'une quelconque des revendications précédentes, dans lequel ladite pluralité de parties de trépan pilote central (2) comprend au moins deux parties de trépan (2) différentes agencées pour mettre en oeuvre différents types de forage.

12. Procédé d'assemblage d'un outil de forage comprenant les étapes consistant à

a. utiliser un ensemble de forage (10) ayant une partie (2) formant trépan pilote central, une partie (4) formant trépan en forme d'anneau périphérique et un sabot d'enveloppe (3),
b. utiliser un tube d'enveloppe (13) et un train de tiges de forage,
c. **caractérisé par** le fait
d. d'utiliser en outre un dispositif (9) formant arbre d'entraînement et
e. de connecter le dispositif (9) formant arbre d'entraînement pour transférer du couple provenant d'un train de tiges de forage, et
f. de relier à la partie (20) formant trépan central, de manière libérable, le dispositif (9) formant arbre d'entraînement au moyen d'un agencement de liaison de couple (16, 23, 93).

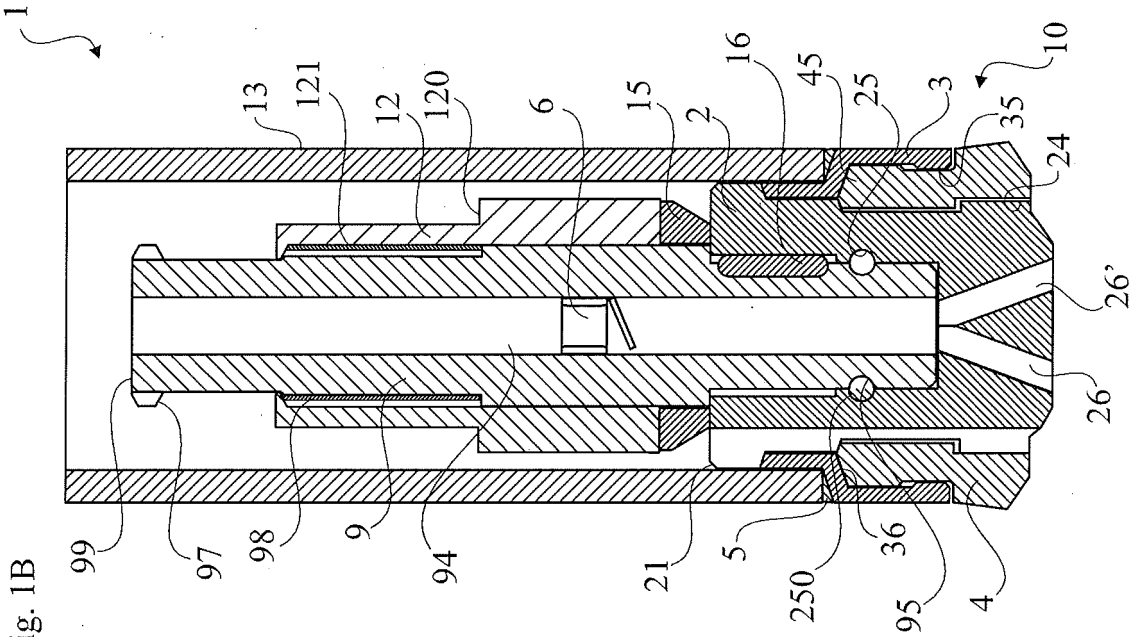
13. Procédé selon la revendication 12, reliant en outre

également à la partie (20) formant trépan central, de manière libérable, le dispositif (9) formant arbre d'entraînement au moyen d'un agencement de liaison axial (25, 95, 250).

14. Procédé selon la revendication 13, comprenant en outre le fait de prévoir une pluralité de parties (2) de trépan pilote central comprenant au moins deux parties de trépan (2) différentes et le fait d'échanger une partie (2) formant trépan central pour un type différent de partie de trépan (2) afin de mettre en oeuvre différents types de forage.

15. Procédé selon la revendication 14, dans lequel ledit fait d'échanger est lié à la réalisation de différents types de trous.

16. Procédé selon la revendication 14, dans lequel ledit fait d'échanger est lié à la prise en compte de différents types de sols.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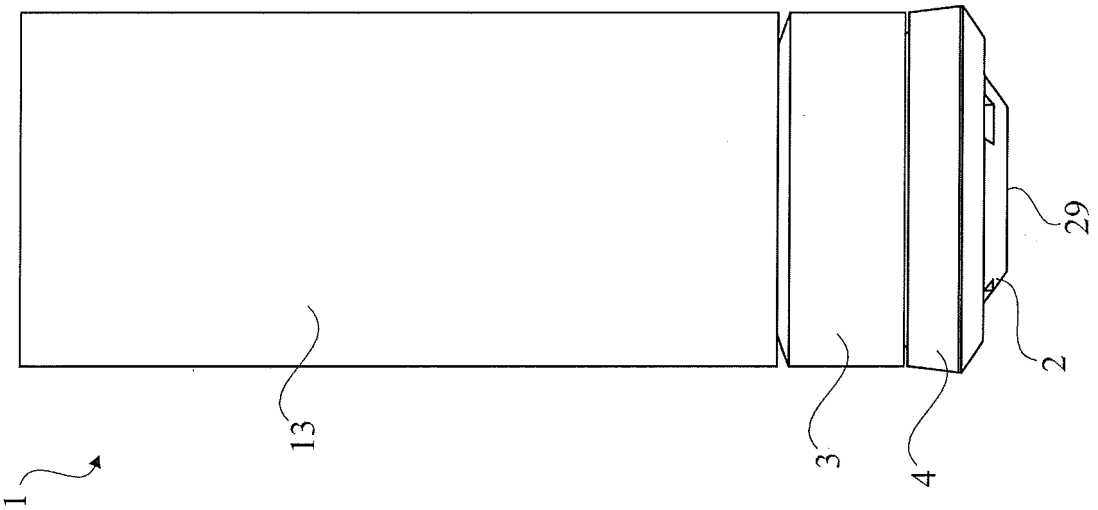
13
121
12
120
6
15
2
16
45
25
3
35
10
24
26'
26
99
97
98
9
94
21
5
250
36
95
4

Fig. 1B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13
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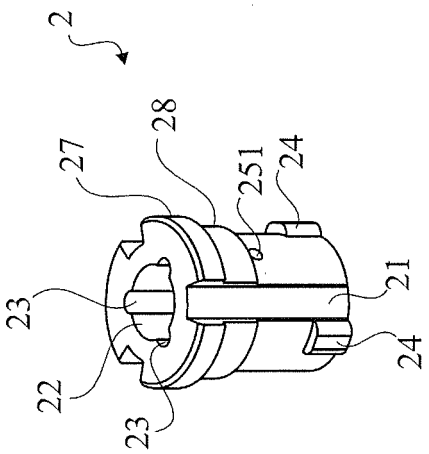
4
2
29

Fig. 1A

Fig. 3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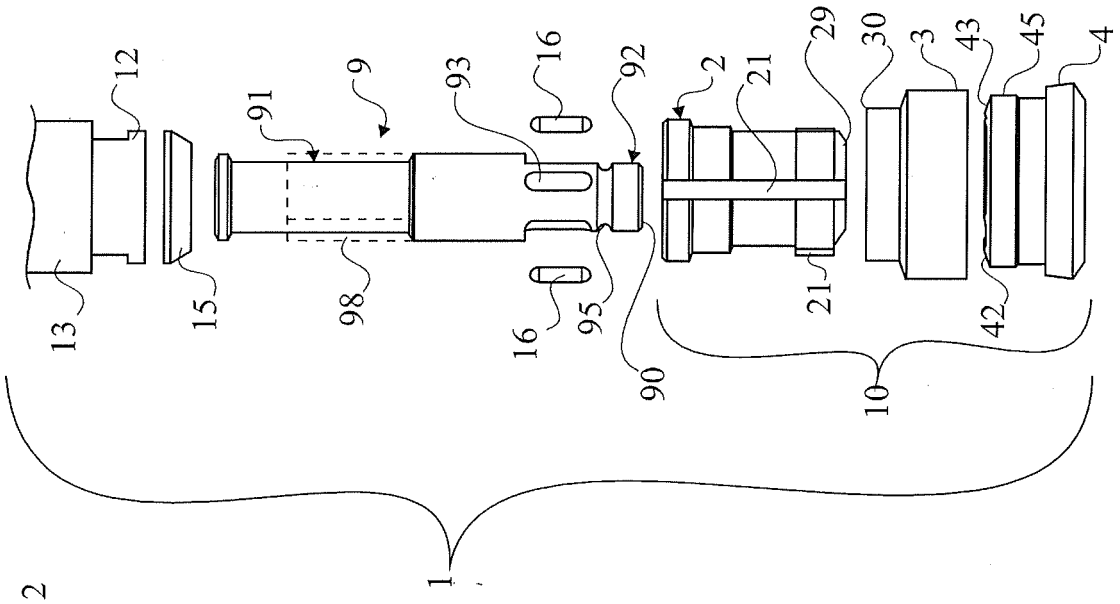
251
24
23
21
22
24
23

Fig. 2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92
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21
42
10
1

Fig. 4A

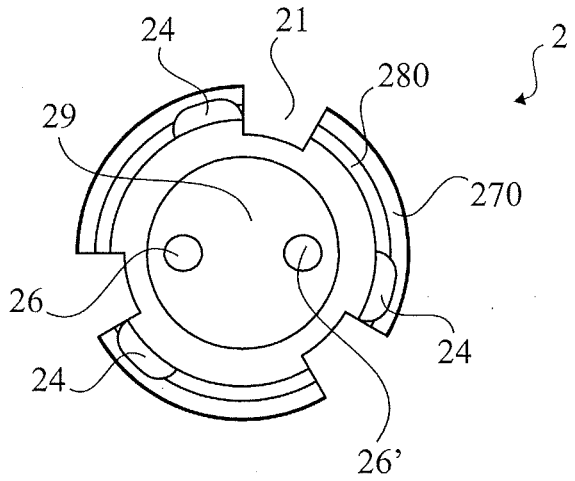


Fig. 4B

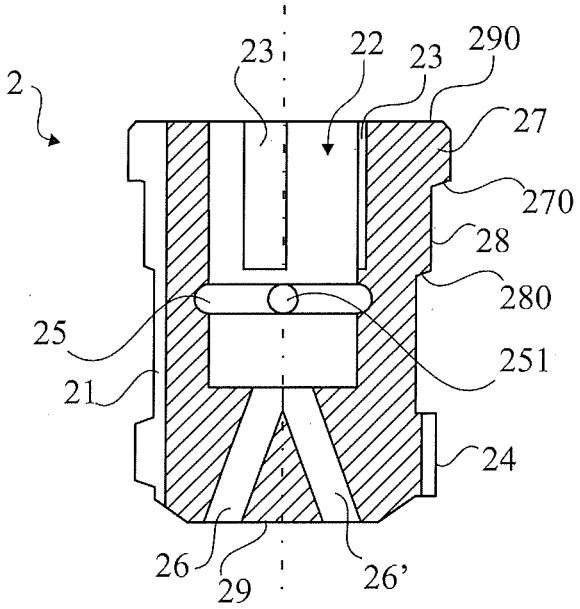
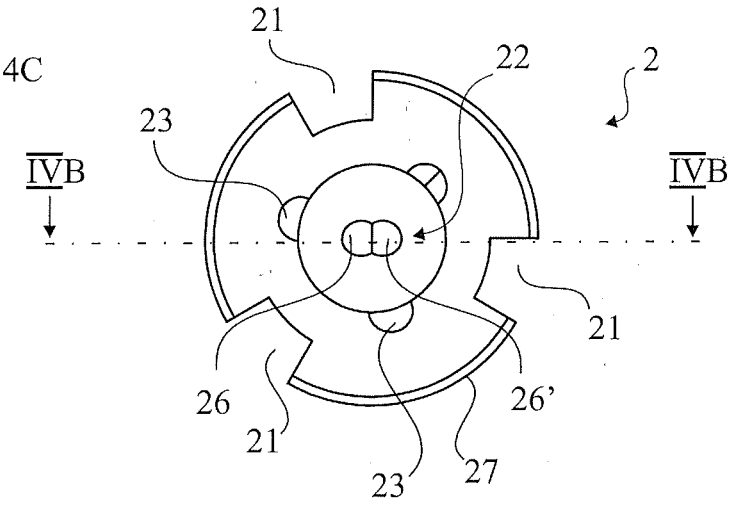


Fig. 4C



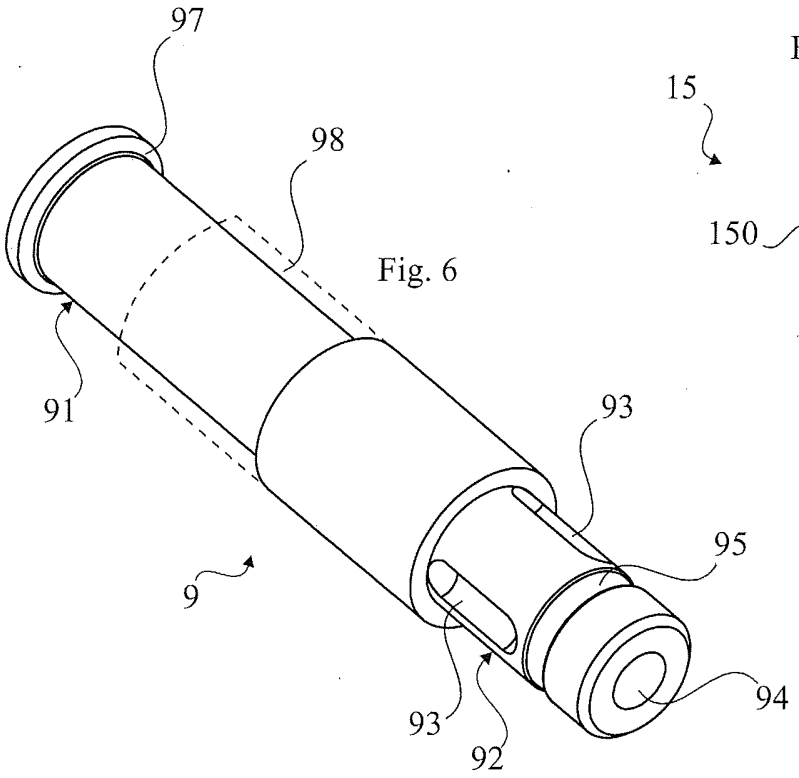


Fig. 6

Fig. 5

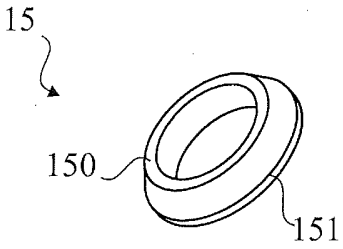


Fig. 7A

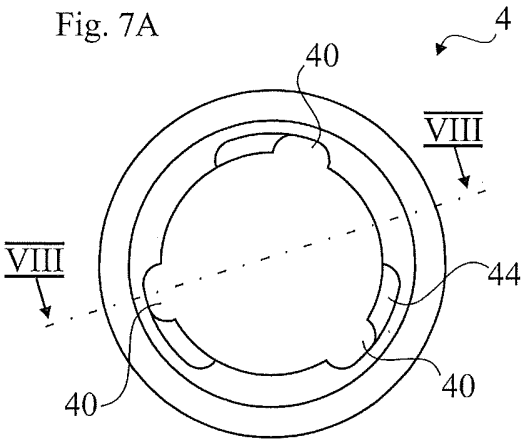
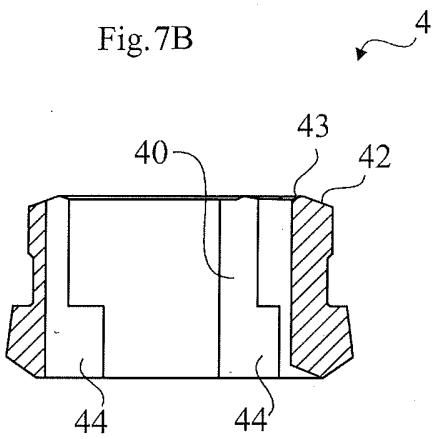


Fig. 7B



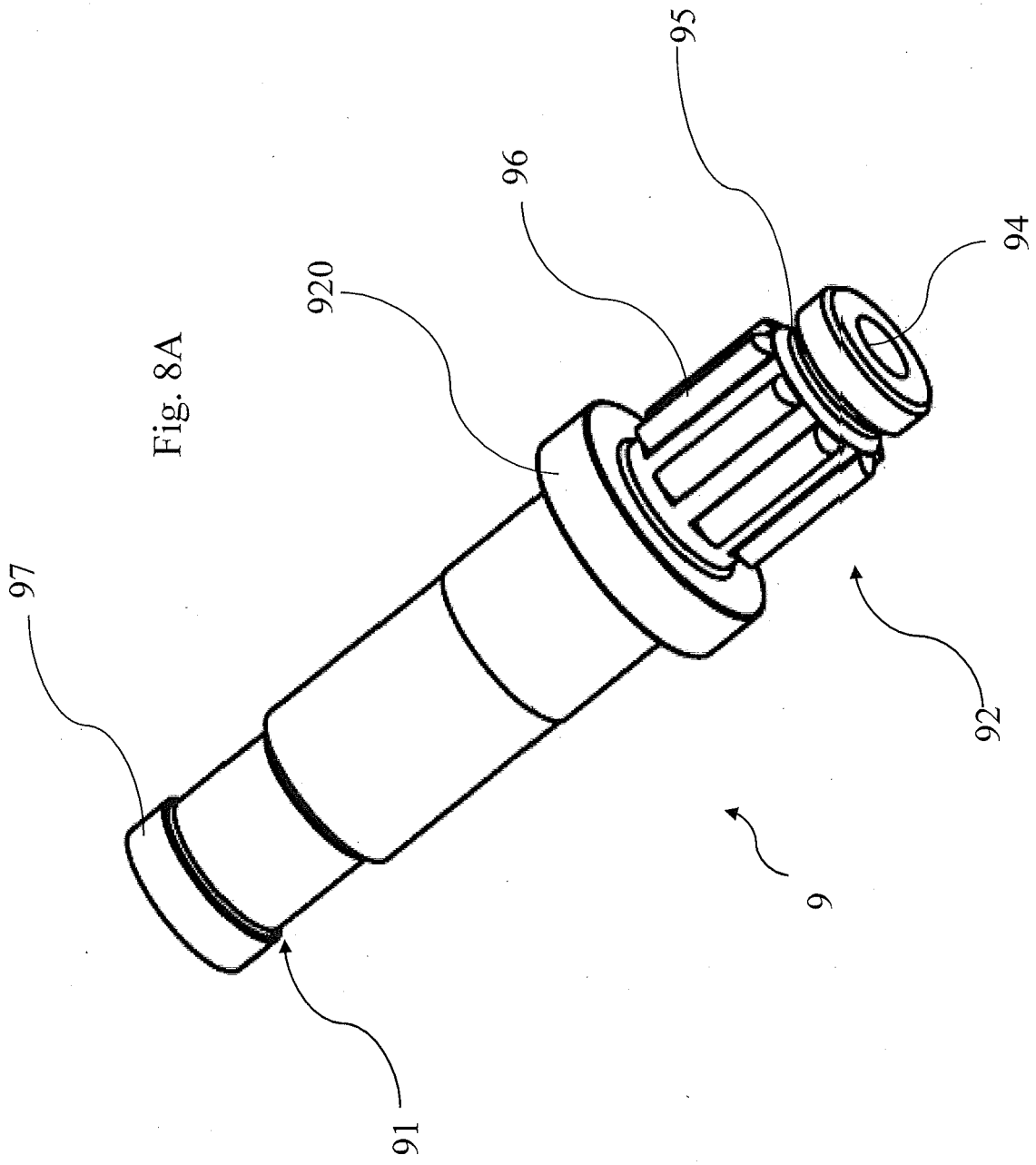
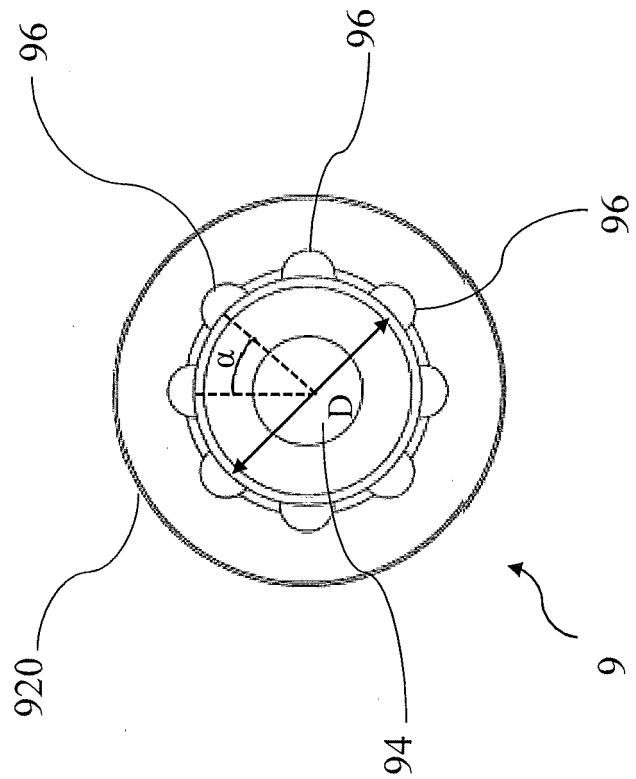


Fig. 8A

Fig. 8B



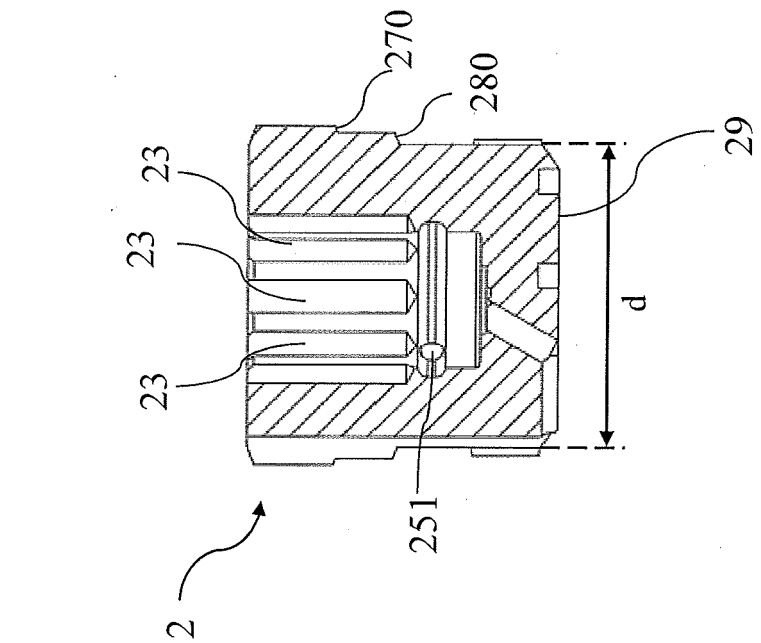


Fig. 9B

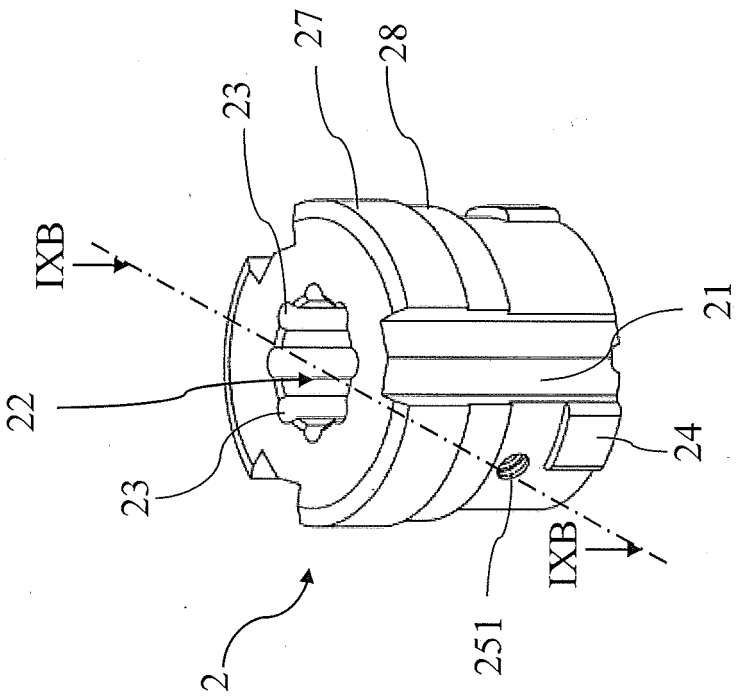


Fig. 9A

REFERENCES CITED IN THE DESCRIPTION

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