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(54) **GUIDE ADAPTER WITH WEAR INSERTS**

(57) A guide adapter (1) for connection between a drill bit and a drill string or rod, said guide adapter (1) comprising an elongate shaft (2) extending along a longitudinal axis (3) of the guide adapter (1), wherein a front portion of the shaft (2) is provided with first connection means (4), and wherein a rear portion of the shaft (2) is provided with second connection means (5). The shaft (2) is provided with a plurality of radially extending wear inserts (6) distributed around the circumference of the shaft (2).

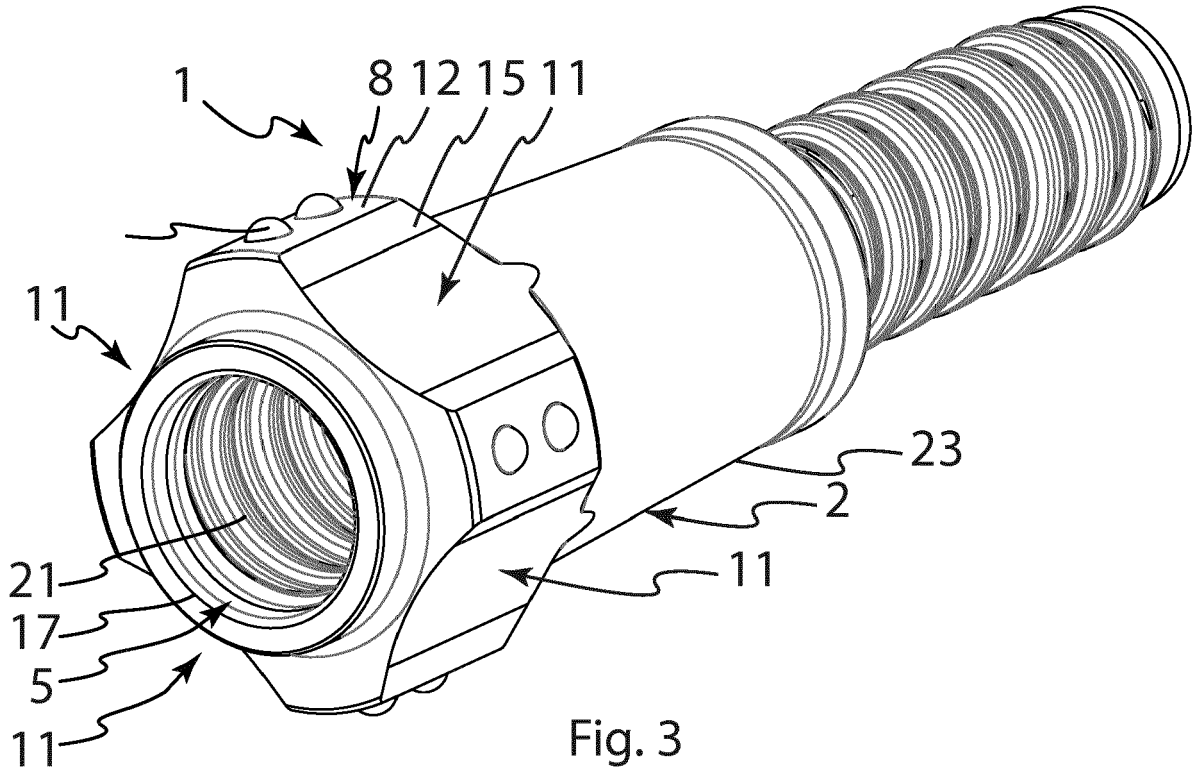

Fig. 3

EP 3 690 181 A1

Description

Technical field

[0001] The present invention relates to rock drill bits and in particular to related technology used for drilling straight.

Background

[0002] Percussion drill bits are widely used both for drilling relatively shallow bores in hard rock and for creating deep boreholes. For the latter application, drill strings are typically used in which one or more rods are added to the string via male/female threads or coupling sleeves as the depth of the bore increases. A terrestrial machine is operative to transfer a combined impact and rotary drive motion to an upper end of the drill string whilst a drill bit positioned at the lower end is operative to crush the rock and form the boreholes. Fluid, such as air, is typically flushed through the drill string and exits at the base of the borehole via apertures in the drill head to flush the drill cuttings from the boring region to be conveyed backward and up through the bore around the outside of the drill string.

[0003] The drill bit typically comprises a drill head that mounts a plurality of hard drilling inserts, commonly referred to as cutting inserts or buttons. Such buttons comprise a carbide-based material to enhance the lifetime of the drill bit. The gauge buttons are configured to engage material to be crushed and to determine the diameter of the bore. The head may also mount a plurality of front buttons provided at a recessed front face of the drill head for engaging material to be crushed at the axial region immediately in front the drill head.

[0004] Typically, a plurality of flushing channels or grooves are recessed into the head to allow the flushing of fractured material rearwardly from the drill bit via the flushing fluid. However, some rocks are very fractured and that leads to large size cuttings which are too heavy to be flushed to the surface. Further, some conventional drill heads are disadvantageous in that large pieces of material cut from the seam cannot pass through the flushing grooves without being further crushed by the bit head. This reduces the effectiveness of the cutting bit to fracture and further penetrate the rock or seam face.

[0005] Also, equipment may suffer from not being able to drill straight enough and quick enough.

[0006] What is therefore required is improved drilling equipment promoting increased penetration rate and improved straightness.

Summary

[0007] Accordingly, an object of the present disclosure is to provide technology allowing for increased cutting action at rock drilling. A further object is to provide technology for drilling straight.

[0008] These and other objects achieved by a guide adapter as defined in the appended independent claim with alternative embodiments set forth in the appended dependent claims. Specifically, these objects are achieved by a guide adapter for connection between a drill bit and a drill string or rod. The guide adapter comprises an elongate shaft extending along a longitudinal axis of the guide adapter. A front portion of the shaft is provided with first connection means, and a rear portion of the shaft is provided with second connection means. The shaft is provided with a plurality of radially extending wear inserts distributed around the circumference of the shaft. In use, the guide adapter is attached between a drill bit and a drill string or rod. At drilling, the wear inserts of the guide adapter face the walls of the bore drilled, thereby preventing excessive radial displacement of the shaft of the guide adapter away from the center of the bore, which in turn keeps the drill bit straight in the bore. Such guide adapters may be provided in different sizes with different diameters selected slightly smaller than the diameter of the drill bit/bore, typically 93-97% of the diameter of the bore. The space around the wear inserts prevents continuous contact between bore and wear inserts such that wear on the guide adapter and its wear inserts is reduced. Also, the space around the wear inserts is suitable for crushing drill cuttings between the wear bits and the surrounding bore, which leads to improved transport of drill cuttings away from the drill bit. Further, the use of wear inserts enables increase of the size of space between the wear inserts for the drill cuttings to move through, since the wear inserts are made of a hard material which provides the required resistance to wear in a small footprint. This leads to reduced risk of drill cutting getting stuck or moving slowly and thereby increases the rate at which drill cuttings are transported away from the drill bit, which in turn enables increased penetration rate. The wear inserts prevent the surrounding material of the guide adapter from getting worn. Furthermore, if bending of the drill string happens, the wear insert will touch the wall of the bore thereby improving the straightness of the bore.

[0009] The wear inserts may protrude equally far from the longitudinal axis of the guide adapter. In other words, the radial distance between the longitudinal axis of the guide adapter and the radially outermost point of each respective wear insert is the same for all wear inserts. Since all wear inserts provide radial support at the same distance from the longitudinal axis, the guide adapter is less prone to vibrate radially upon rotation within a bore.

[0010] The wear inserts may be attached to the shaft by means of attachment protrusions extending radially from the shaft, wherein each attachment protrusion comprises an attachment recess receiving a respective base portion of a

respective one of said wear inserts. The attachment protrusions are distributed around the circumference of the shaft and are separated by flushing recesses for flushing of drill cuttings past the attachment protrusions. The recess of each attachment protrusion provides an increased gripping area for holding each wear insert by virtue of each gripping area being permitted to extend further radially outwards rather than along the length or along the circumference of the shaft. Decreasing the footprint along the length of the shaft and/or along the circumference of the shaft enables increased size of the flushing recesses and thereby of the flow of flushing fluid. Also, the design featuring an attachment protrusion enables reduction of the main diameter/size of the shaft, i.e. of the shaft portion connecting the rear portion of the shaft with the head of the shaft, since the attachment protrusion provides the required gripping area for securely holding the wear insert.

[0011] The shaft may comprise a conical portion extending between the first connection means and the attachment protrusions, with the larger end of the conical portion by the attachment protrusions and the smaller end of the conical portion by the first connection means.

[0012] The conical portion of the shaft provides a reduced cross-sectional area adapted to the smaller diameter of the rear end of the drill bit, and a larger cross-sectional area by the attachment protrusions. The larger cross-sectional area provides greater strength closer the attachment protrusions where extra strength is needed. The conical shape provides a smooth transition between the smaller end by the drill bit and the larger end by the attachment protrusions and thereby provides for improved flow of drill cuttings and flushing fluid, such as air, from the drill bit and along the guide adapter.

[0013] Each attachment protrusion may comprise a plurality of said wear inserts longitudinally distributed with respect to the guide adapter. By longitudinally distributing a plurality of wear inserts along each attachment protrusion rather than using only one wear insert per attachment protrusion, the wear inserts provide radial support at multiple depths of the bore such that the attachment protrusion can still radially support the guide adapter despite recesses or cracks in the formation leaving some of the wear inserts without radial support/pressure from the bore formation. When longitudinally distributed but not circumferentially distributed, the wear inserts are effectively arranged in a straight line parallel to the longitudinal axis of the guide adapter or on a straight line diagonally on the attachment protrusion from one corner to another opposite corner.

[0014] Each attachment recesses may also be circumferentially distributed with respect to the guide adapter. By circumferentially distributing the wear inserts, they act over a widespread circumferential area or circle sector of the shaft to thereby enable support in several radial directions about the longitudinal axis of the guide adapter, which in turn enables use of fewer attachment protrusions. When being both longitudinally and circumferentially distributed, the wear inserts are effectively diagonally arranged with respect to the longitudinal axis of the guide adapter.

[0015] Each attachment protrusion may comprise a top surface in which the attachment recess is formed, and a curved or slanted front surface extending in front of each attachment protrusion from the top surface to surrounding surfaces of the shaft. The front surfaces provide a smooth transition in front of each attachment protrusion, between the top surface of each attachment protrusion and surrounding surfaces of the shaft. The smooth transition mitigates excessive turbulence of flushing fluid, typically air, passing the attachment protrusion, and thereby mitigates low-flow regions in which drill cuttings could deposit.

[0016] Each attachment protrusion may comprises a/said top surface in which the attachment recess is formed, and first and second curved or slanted side-surfaces. Each respective side surface extends from a respective opposite side of the top surface in opposite directions along the circumference of the shaft, to surrounding surfaces of the shaft. The side-surfaces provide a smooth side-ways transition along the circumference of each attachment protrusion, between the top surface of each attachment protrusion and surrounding surfaces of the shaft. The smooth transition mitigates excessive turbulence of flushing fluid passing the attachment protrusion, and thereby mitigates low-flow regions in which drill cuttings could deposit.

[0017] The wear inserts may be provided at a rear portion of the shaft. A specific amount of radial movement permitted for the wear inserts within the bore gives rise to a lower angular displacement of the interconnected drill bit and guide adapter when the wear inserts are provided at a rear portion of the shaft than what would have been the case if the same amount of radial movement would occur closer to the front of the guide adapter, thereby increasing the directional stability of the interconnected drill bit and guide adapter within the bore.

[0018] The guide adapter may comprise at least three of said wear inserts distributed around the circumference of the shaft. The provision of three wear inserts enables support by the wear inserts in all directions about the longitudinal axis of the guide adapter.

[0019] The wear inserts may be evenly distributed around the circumference of the shaft. Such positioning of the wear insert provides for an even flow of flushing fluid. Also, such positioning mitigates vibrations since the same amount of support is provided in all directions.

[0020] The wear inserts comprise tungsten carbide. Tungsten carbide is a material suitable for the intended use since it is very hard and resists wear better than steel.

[0021] Each wear insert may comprise a respective rounded or semi-spherical outer tip. The rounded or semi-spherical shape of the outer tip makes the wear insert robust by avoiding sharp edges prone to chipping. Also, the rounded shape

provides a slanted surface for oncoming drill cuttings to glide along for being crushed between the wear insert and the surrounding bore formation. Further, the rounded or semi-spherical shape provides an increase in the height of the insert, and only a small area will be in contact with the rock, thereby increasing local stress achieved on the oncoming drill cuttings by each wear insert such that the wear inserts easier breaks drill cuttings. Also, the reduced contact surface results in less heat being produced.

[0022] Each wear insert may comprise a cylindrical base portion. The cylindrical attachment portion is advantageous since it enables firm grip of the wear insert by enabling distribution of forces applied to the wear insert in any radial direction of the cylindrical attachment portion, which in turn enables use of smaller wear inserts, which in turn enables improved flushing past the wear inserts.

Brief description of drawings

[0023]

Figs. 1-6 all relate to a guide adapter according to a first embodiment of the invention.
Fig. 1 shows a side view of the guide adapter.
Fig. 2 shows an elevated front perspective view of the guide adapter also shown in Fig. 1.
Fig. 3 shows an elevated back perspective view of the guide adapter also shown in Figs. 1-2.
Fig. 4 shows a side view of a wear insert used in the guide adapter shown in Figs. 1-3.
Fig. 5 shows an elevated front perspective view of the wear insert also shown in Fig. 4.
Fig. 6 shows a top view of the guide adapter also shown in Figs. 1-3.

1	guide adapter	13	front surface
2	shaft	14	first side surface
3	longitudinal axis	15	second side surface
4	first connection means	16	rear portion of shaft
5	second connection means	17	inlet opening
6	wear inserts	18	outlet opening(s)
7	first radial distance	19	outer tip of wear insert
8	attachment protrusion	20	central flushing channel
9	attachment recess	21	thread
10	base portion of wear insert	22	externally threaded portion
11	flushing recesses	23	conical portion/main portion
12	top surface		

Detailed description

[0024] A guide adapter 1 according to a first embodiment of the invention will hereinafter be described with reference to Figs. 1-6.

[0025] The guide adapter 1 comprises a shaft 2 extending rearwards along a longitudinal axis 3 of the guide adapter 1. An alternative word for the shaft 2 is 'shank' and the wording 'shaft' is not to be construed as limited to cylindrical or axisymmetric shapes. The longitudinal axis 3 corresponds to the rotational axis of the guide adapter 1. The shaft 3 is provided with a plurality of radially extending wear inserts 6 distributed around the circumference of the shaft 3. The wear inserts 6 are typically made from any suitable drilling insert material, such as tungsten carbide. The wear inserts 6 are press-fitted within respective recesses 9. The shaft 3 is made of steel. Also, the shaft 3 may be made in one piece except for the wear inserts 6 but could in other embodiments alternatively be made of multiple pieces joined temporarily or permanently to form the shaft 2.

[0026] The shaft 2 has a main portion from which the attachment protrusions extend. The main portion of the shaft 2 is conical but could in other embodiments alternatively have any other suitable shape, diameter or cross-sectional area, such as cylindrical. The conical portion 23 of the shaft 2 extends between the first connection means 4 and the attachment protrusions 8 with the larger end of the conical portion 23 by the attachment protrusions 8 and the smaller end of the

conical portion 23 by the first connection means 4. This results in a thicker and more robust wall thickness towards the attachment protrusions 8.

[0027] The wear inserts 6 protrude equally far from the longitudinal axis 3 of the guide adapter 1. Thereby, the wear inserts 6 jointly provide radial support at a second first radial distance 7 from the longitudinal axis 3.

[0028] The wear inserts 6 are attached to the shaft 2 by means of attachment protrusions 8 extending radially from the shaft 2. Each attachment protrusion 8 comprises two attachment recesses 9 receiving a respective base portion 10 of a respective one of said wear inserts 6. The attachment protrusions 8 are distributed around the circumference of the shaft 2 to carry the wear inserts 6 and are separated by flushing recesses 11 for flushing of drill cuttings past the attachment protrusions 8.

[0029] The attachment recesses 9 of each attachment protrusion 8 are longitudinally distributed with respect to the guide adapter 1 such that they are arranged in a straight line parallel to the longitudinal axis 3 of the guide adapter. In other embodiments, each attachment protrusion 8 may alternatively comprise more or fewer than two wear inserts 6. In further other embodiments, the straight line of wear inserts 6 on the attachment protrusion 8 could also be diagonally arranged on the attachment protrusion such that the line is not parallel to the longitudinal axis 3.

[0030] Each attachment recess 9 may in other embodiments be circumferentially distributed with respect to the guide adapter 1 such that the wear inserts 6 act over a widespread circumferential area or circle sector of the shaft 2 to thereby enable support from each attachment protrusion 8 in several radial directions about the longitudinal axis 3 of the guide adapter 1.

[0031] Each attachment protrusion 8 comprises a top surface 12 in which the attachment recesses 9 are formed, and a slanted front surface 13 extending in front of each attachment protrusion 8 from the top surface 12 to surrounding surfaces of the shaft 2. The front surface 13 provides a smooth transition in front of each attachment protrusion 8, between the top surface and surrounding surfaces of the shaft 2.

[0032] Each attachment protrusion 8 also comprises first 14 and second 15 slanted side-surfaces. Each side surface 14, 15 respectively extends from a respective opposite side of the top surface 12 in opposite directions along the circumference of the shaft 2, to surrounding surfaces of the shaft 2.

[0033] The wear inserts 6 and attachment protrusions 8 are provided at a rear portion 16 of the shaft 2, as far back as possible. The rear portion 16 is defined as the rearmost 50% of the length of the guide adapter as measured from behind the front connection means to the rear end of the guide adapter. In other embodiments, the wear inserts 6 may alternatively be positioned further forward on the guide adapter 1.

[0034] The guide adapter 1 comprises four attachment protrusions 8 evenly distributed around the circumference of the shaft 2. In other embodiments, the number and shape of the attachment protrusions 8 may vary. However, at least three evenly spaced attachment protrusions 8 are advantageous since they provide support in all directions about the longitudinal axis 3 of the guide adapter 1 and gives no unbalance when being evenly distributed. The number of the attachment protrusions 8 could also be six or eight, depending on the size of the guide adapter.

[0035] The wear inserts 6 comprise tungsten carbide which it is very hard and resists wear better than steel. In other embodiments any other suitable material may be used.

[0036] Each wear insert 6 comprises a respective semi-spherical outer tip 19 and a cylindrical base portion 10. In other embodiments, the shape of the wear inserts 6 may be different provided they protrude radially and protect adjacent portions of the guide adapter 1 from surrounding material of the bore.

[0037] The first connection means 4 is a male connection means and the second connection means 5 if a female connection means, but in other embodiments it could be the other way around. The first 4 and second 5 connection means are provided with threads 21, 22 and the threads 21, 22 are matching. Thus, when a guide adapter 1 is used to extend a drill string or rod, the thread of the drill string or rod fits with the guide adapter 1, which in turn provides the same thread geometry as the drill string/rod at the front of the guide adapter 1 for connection to the drill bit. The drill string can thus still be connected to the same type of drill bit when using the guide adapter 1 as without the guide adapter 1. In other embodiments, other types of connection means may be provided, as long as they are suitable for their intended use.

[0038] A central flushing channel 20 extends internally throughout the guide adapted such that flushing fluid, typically air, can move through the guide adapter 1 and further into the drill bit connected thereto. In other embodiments, the flushing channel 20 may alternatively be otherwise routed through the guide adapter 1.

Claims

1. A guide adapter (1) for connection between a drill bit and a drill string or rod, said guide adapter (1) comprising an elongate shaft (2) extending along a longitudinal axis (3) of the guide adapter (1),
wherein a front portion of the shaft (2) is provided with first connection means (4), and
wherein a rear portion of the shaft (2) is provided with second connection means (5),

characterized in that the shaft (2) is provided with a plurality of radially extending wear inserts (6) distributed around the circumference of the shaft (2).

2. A guide adapter (1) according to claim 1, wherein the wear inserts (6) protrude equally far in radial direction from the longitudinal axis (3) of the guide adapter (1).

3. A guide adapter (1) according to any one of claims 1 or 2, wherein the wear inserts (6) are attached to the shaft (2) by means of attachment protrusions (8) extending radially from the shaft (2),
wherein each attachment protrusion (8) comprises an attachment recess (9) receiving a respective base portion (10) of a respective one of said wear inserts (6),
wherein the attachment protrusions (8) are distributed around the circumference of the shaft (2), and
wherein the attachment protrusions (8) are separated by flushing recesses (11) for flushing of drill cuttings past the attachment protrusions (8).

4. A guide adapter (1) according to claim 3, wherein the shaft comprises a conical portion extending between the first connection means and the attachment protrusions with the larger end of the conical portion by the attachment protrusions and the smaller end of the conical portion by the first connection means.

5. A guide adapter (1) according to any one of claims 3 or 4,
wherein each attachment protrusion (9) comprises a plurality of attachment recesses (10),
wherein each attachment recess (10) is provided with a respective wear insert (6), and
wherein the plurality of attachment recesses (10) of each attachment protrusion are longitudinally distributed with respect to the drill bit (1).

6. A guide adapter (1) according to claim 5 wherein the plurality of attachment recesses (9) of each attachment protrusion (8) are also circumferentially distributed with respect to the drill bit (1).

7. A guide adapter (1) according to any one of claims 3 to 6, wherein each attachment protrusion (8) comprises a top surface (12) in which the attachment recess (9) is formed, and a curved or slanted front surface (13) extending in front of each attachment protrusion (8) from the top surface (12) to surrounding surfaces of the shaft (2).

8. A guide adapter (1) according to any one of the preceding claims,
wherein each attachment protrusion (8) comprises a top surface (12) in which the attachment recess (9) is formed, and first (14) and second (15) curved or slanted side-surface, each side surface (14, 15) respectively extending from a respective opposite side of the top surface (12) in opposite directions along the circumference of the shaft (2), to surrounding surfaces of the shaft (2).

9. A guide adapter (1) according to any one of the preceding claims,
wherein the wear inserts (6) are provided at a rear portion (16) of the shaft (2).

10. A guide adapter (1) according to any one of the preceding claims,
wherein the guide adapter (1) comprises at least three of said wear inserts (6) distributed around the circumference of the shaft (2).

11. A guide adapter (1) according to any one of the preceding claims,
wherein the wear inserts (6) are evenly distributed around the circumference of the shaft (2).

12. A guide adapter (1) according to any one of the preceding claims,
wherein the wear inserts (6) comprise tungsten carbide.

13. A guide adapter (1) according to any one of the preceding claims,
wherein each wear insert (6) comprises a respective rounded or semi-spherical outer tip (19).

14. A guide adapter (1) according to claim 13, wherein each wear insert (6) comprises a cylindrical base portion (10).

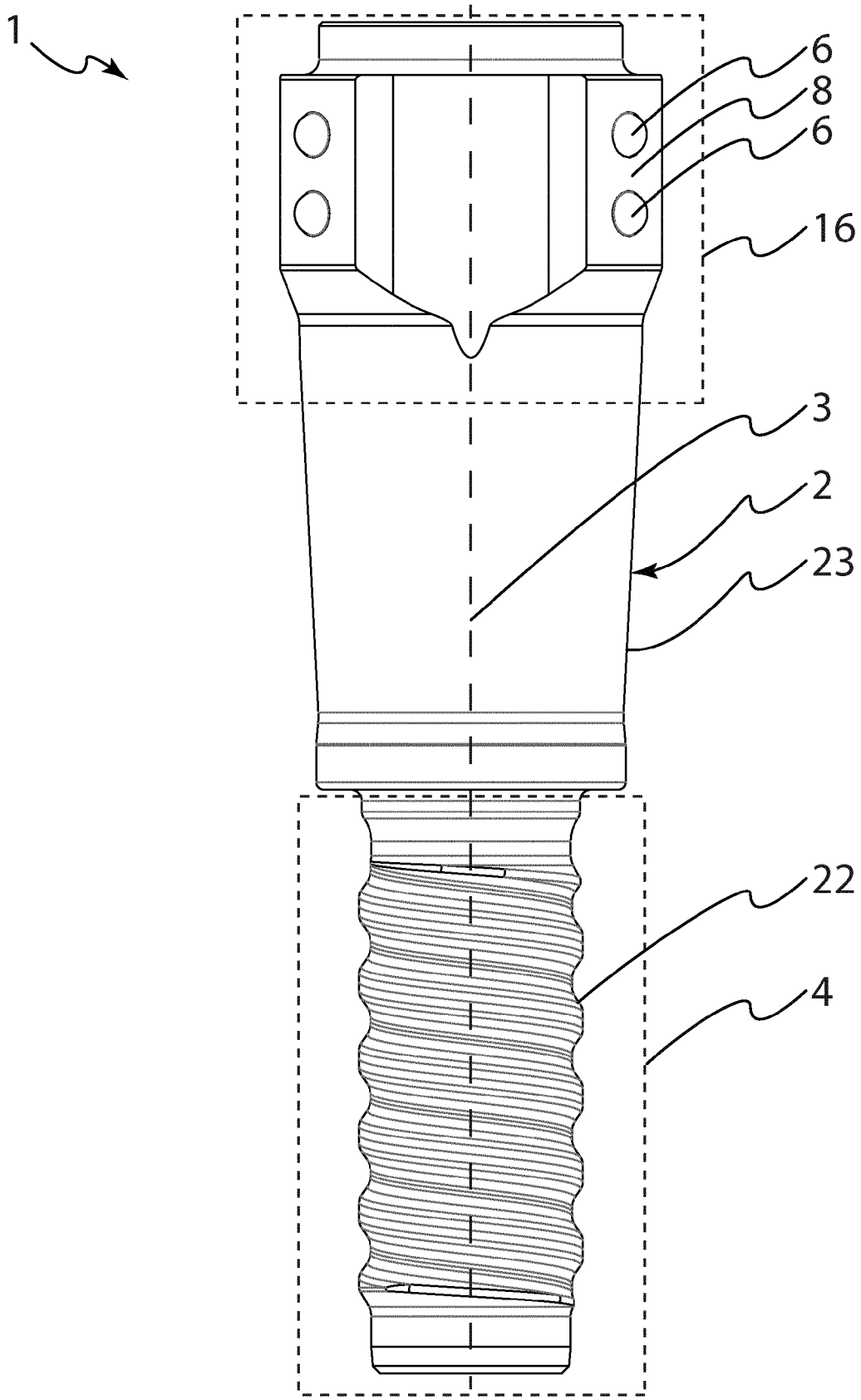

Fig. 1

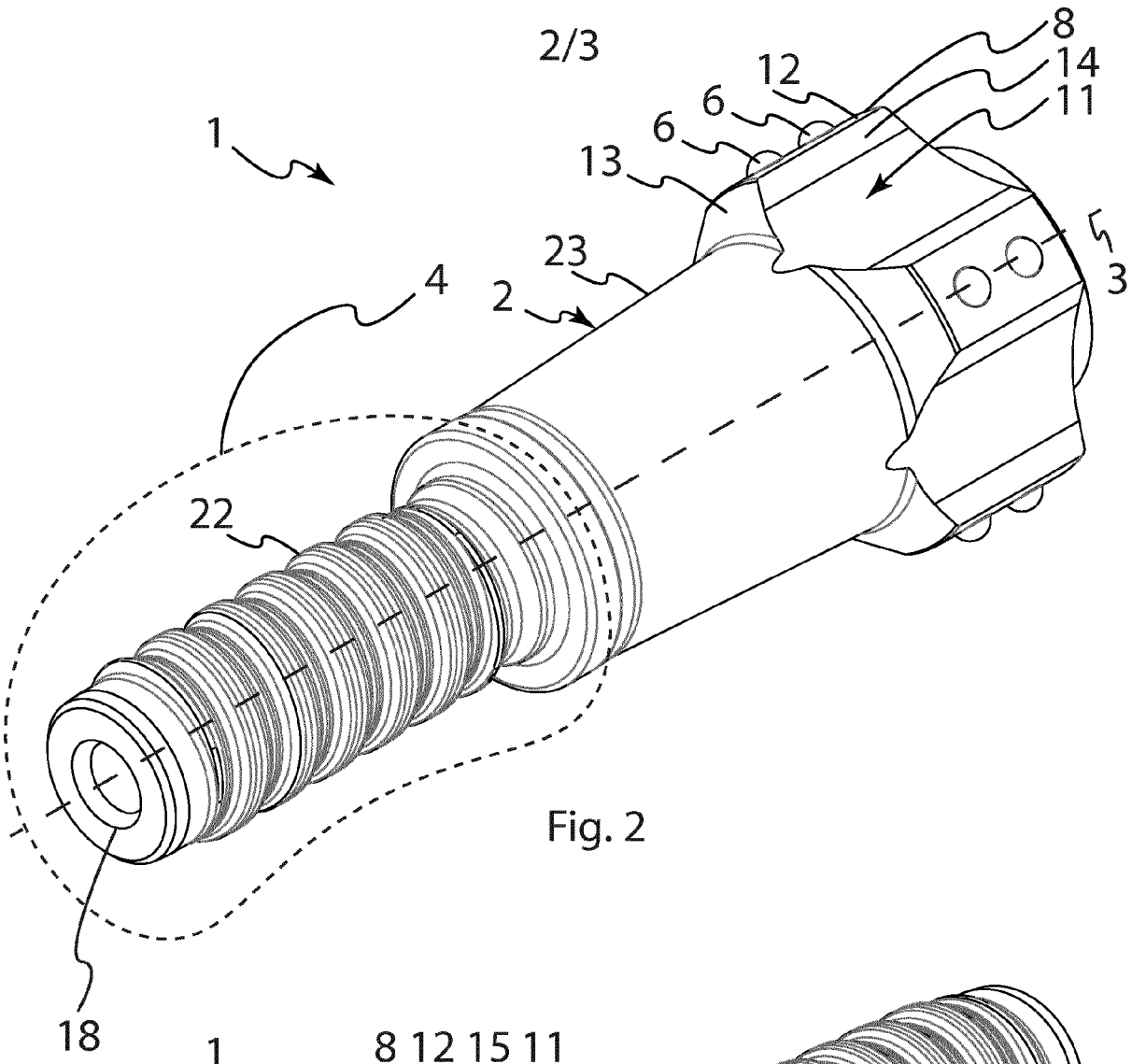

Fig. 2

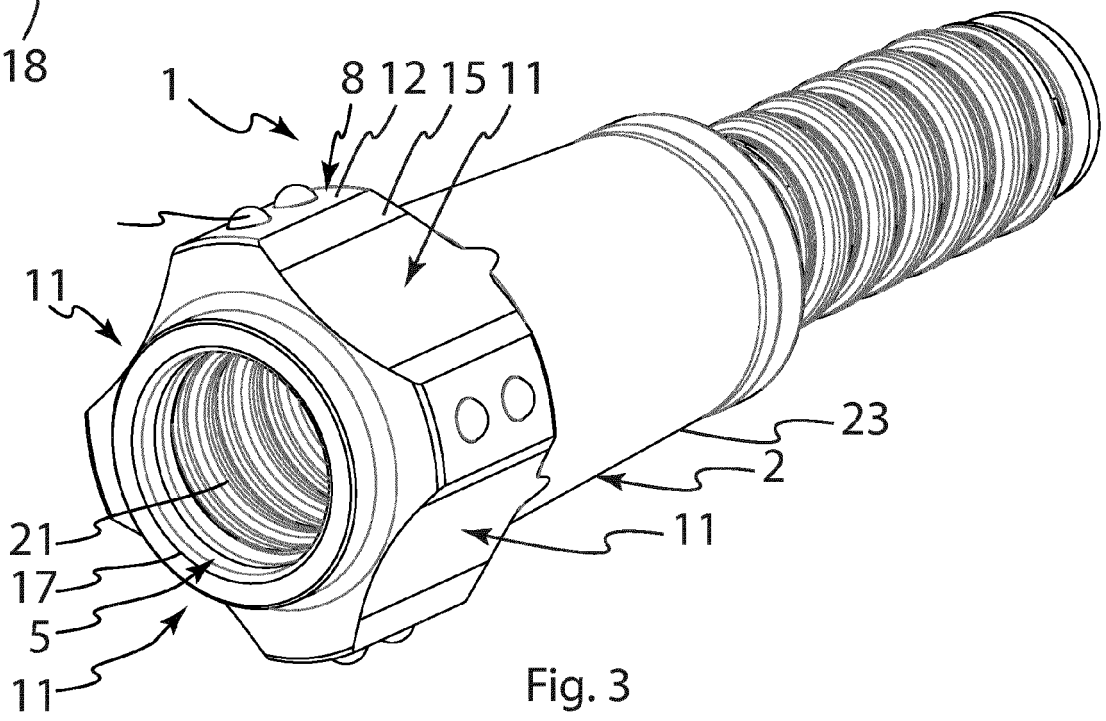

Fig. 3

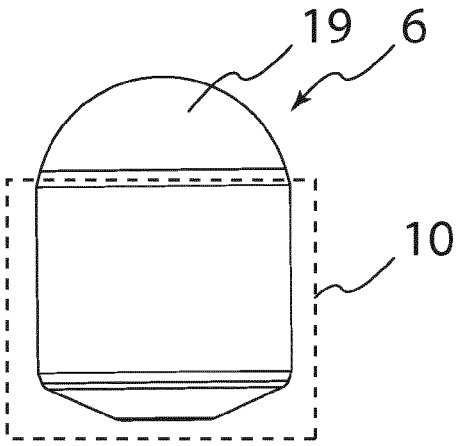

Fig. 4

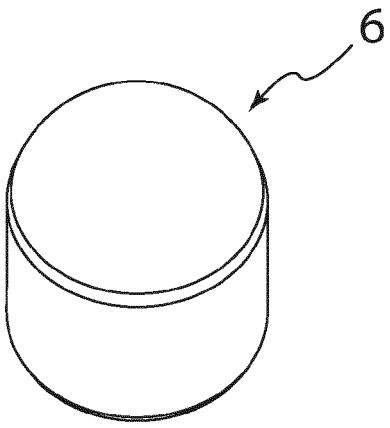

Fig. 5

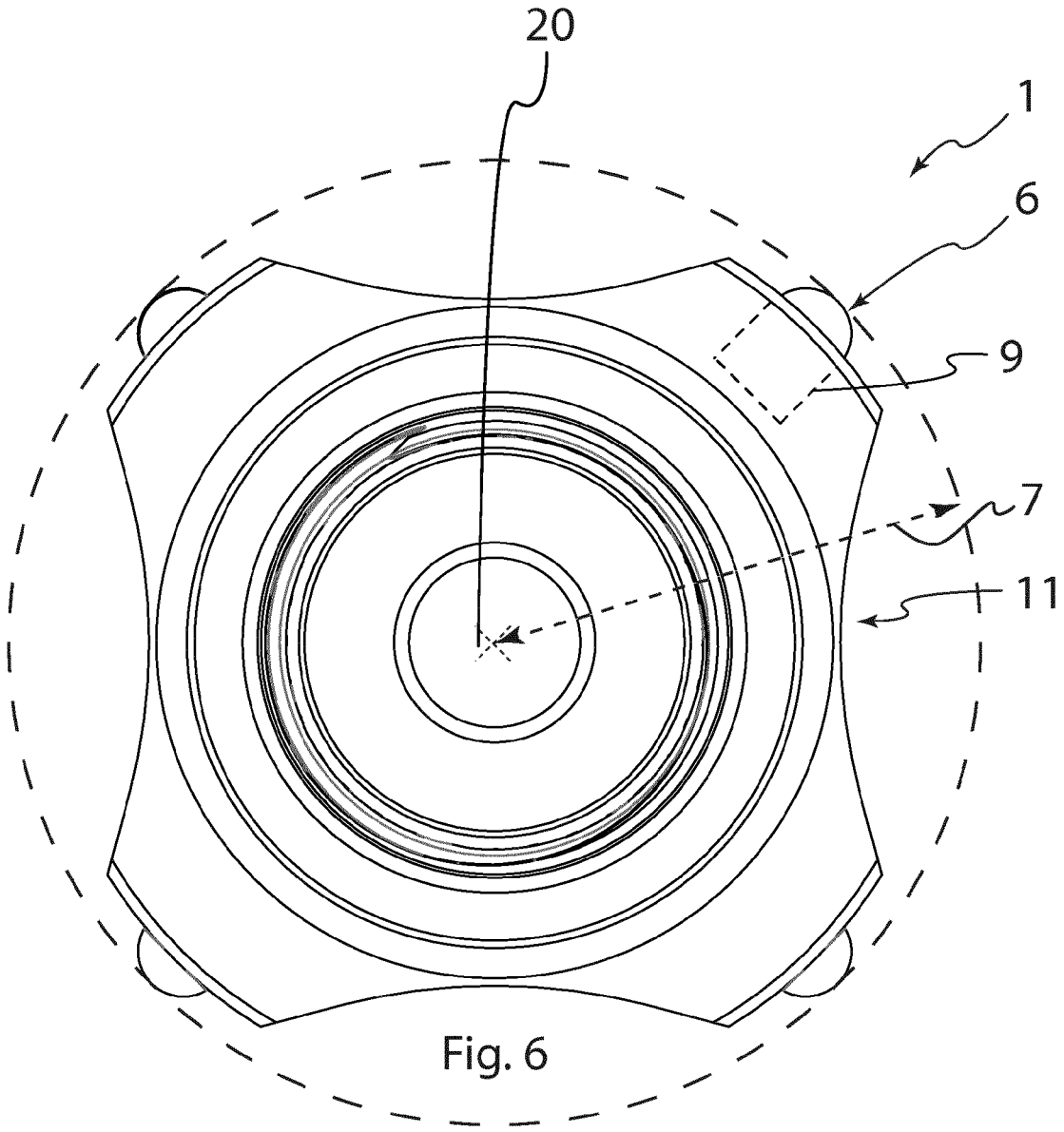

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 19 15 4472

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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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	15 July 2019	Manolache, Iustin

CATEGORY OF CITED DOCUMENTS

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