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(54) **INSERT FOR A JOURNAL LEG OF A ROTARY DRILL TOOL**

(57) An insert 10, 20 adapted to be mounted in a journal leg 5 of a rotary drill tool for cutting rock, the insert being adapted to reinforce the neck 2 of the journal leg 5. The insert 10, 20 has a mushroom shape comprising

a hat 16, 26 and a foot 13, 23, the hat 16, 26 having a diameter D1 and the foot 13, 23 having a diameter D2 being smaller than the diameter D1 of the hat 16, 26. And a journal leg 5 of a rotary drill tool for cutting rock.

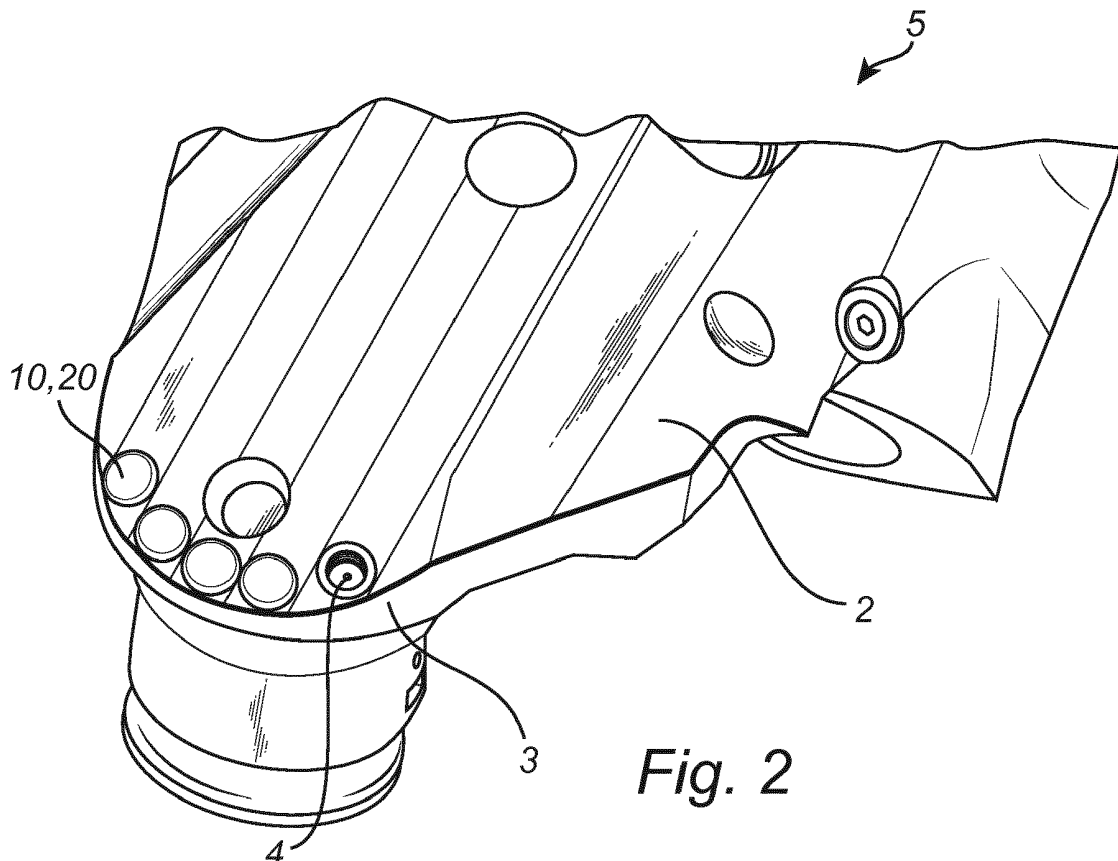


Fig. 2

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Description

Technology field

[0001] The present invention relates to an insert for a rotary drill tool and a rotary drill tool comprising an insert.

Background

[0002] Rotary drills have emerged as an effective tool for specific drilling operations such as the creation of blast holes and geothermal wells. The drill typically comprises a rotary drill bit having three journal legs that mount respective cone-shaped rolling cutters via bearing assemblies that include rollers and balls.

[0003] Typically, the drill bit is attached to one end of a drill string that is driven into the borehole via a rig. The cutting action is achieved by generating axial feed and rotational drive forces that are transmitted to the drill bit via the drill rods coupled end-to-end. Each of the cone-shaped cutters comprise externally mounted hardened cutting buttons positioned at different axial regions for optimised cutting as the drill bit rotates.

[0004] During the drilling operations the journal legs come into contact with the wall. Therefore, this area is subject to excessive wear.

[0005] In order to protect the legs their area closest to the wall is normally covered with some kind of hard facing. Covering the leg with a welded seam is a known solution to protect the shirt tail. An example rotary cone drill bit is described in US 8,522,899.

[0006] However, the known designs are not sufficiently durable. They also involve manual work to a large extent. When welding is used the layout of the welded pattern varies, which results in an irregular wear protection both in thickness and hardness. Another drawback with a welded hard facing is that the surface adherence not always is satisfactory.

[0007] Accordingly, what is required is a drill tool that addresses the above problems and drawbacks.

Summary

[0008] It is an objective of the present invention to provide a rotary drill tool with a journal leg configured for maximum wear protection of the neck of the journal leg. It is a further specific objective to provide a journal leg wear protection that requires a minimum amount of manual work in manufacturing and that the journal leg wear protection is not worn out faster than the cutting buttons that are used for drilling. It is yet a further specific objective to provide a journal leg with an efficient wear protection that also gives the same protection wherever applied and not gives variation in thickness or hardness or any other kind of variation in hardness, layout and design.

[0009] According to a first aspect of the present invention there is provided an insert adapted to be mounted in a journal leg of a rotary drill tool for cutting rock, the

insert being adapted to reinforce the neck of the journal leg. The insert has a mushroom shape comprising a hat and a foot, the hat having a diameter and the foot having a diameter being smaller than the diameter of the hat.

This shape of the insert going beyond the diameter of the hole where the insert is located and above the surface of the neck of the journal leg gives good wear protection.

[0010] Preferably, the insert with the foot has a certain length from its outer end to the joint of the hat. The foot has a tapered outer end. This results in the insert smoothly fitting into the hole.

[0011] Preferably, the insert with the hat has a specific height from upper to lower side ranging from 1 mm to 4 mm. More specifically the height might be 2 mm or 3 mm, or it might even be larger than 4 mm, such as 5 mm or 6 mm. The height gives optimal protection of the journal leg.

[0012] Optionally, the insert has a hat with a flat top surface. This surface is mainly parallel with the surface of the journal leg. This gives good wear protection in certain types of drilling machines such as HDD when drilling is performed in horizontal directions.

[0013] Optionally, the insert has a hat with a rounded top surface. Any type of round can be used such as conical, spherical, ballistic or pointed. A rounded shape has the advantage of smooth wear protection, that is good in certain types of drilling such as rotary drilling.

[0014] Optionally, the insert with the hat has a chamfered lower side. This ensures a good fit in the hole.

[0015] Preferably, the insert with the diameter of the hat having a relation to the diameter of the foot that is 1,5. This gives good protection around the hole on the shirt of the journal leg.

[0016] Preferably, the insert having a height of the hat in relation to the length of the foot being 30% to 65%. This relation can also be 35%, 40%, 45%, 50%, 55% or 60%. A certain thickness of the hat is needed in order to not brake and last for wear protection. The relation of the height of the hat versus the diameter of the foot is in the range of 20% to 40%, such that it can also be 25%, 30% or 35%. The relation of the height of the hat versus the diameter of the hat is in the range of 10% to 25%, it could also be 15% or 20%.

[0017] Preferably, the insert has a circumference or perimeter of the foot with lengthwise extending ridges and grooves. This gives a good grip. It also results in less manual work while manufacturing.

[0018] According to a second aspect of the present invention there is provided a journal leg of a rotary drill tool for cutting rock comprising at least one insert.

[0019] Optionally, the journal leg of a rotary drill tool comprises a plurality of inserts being arranged at the neck of the journal leg. This is an area that is subject to a lot of wear, so the inserts give good protection.

[0020] Optionally, the journal leg comprises at least four inserts being arranged at the shirt of the journal leg. This area is specifically in need of wear protection, so it is advantageous to arrange inserts in this area.

[0021] Preferably, the journal leg comprises a plurality

of inserts being arranged at the shirt of the journal leg such that the outer circumference of the hat is in line with the outer edge of the shirt. The inserts are placed as close to the edge as possible to in the best possible way protect the area specifically in need of wear protection.

[0022] Preferably, the journal leg comprises a plurality of inserts being arranged at the shirt of the journal leg such that the outer circumference of the hat of each insert is arranged adjacent to or on a short distance to the neighbouring insert. This ensures a reliable wear protection.

Brief description of drawings

[0023] A specific implementation of the present invention will now be described, by way of example only, and with reference to the accompanying drawings in which:

Figure 1 is an external perspective view of a rotary cutting tool for mounting at one end of a drill string;

Figure 2 is a perspective view of one of the three journal legs of the tool of figure 1 according to a specific implementation of the present invention;

Figure 3 is a side view of one embodiment of an insert of a journal leg;

Figure 4 is a side view of a further embodiment of an insert of a journal leg.

Detailed description

[0024] Referring to figure 1, a rotary cutting tool 100 is formed as a cutting bit and comprises a cutting end 101 at an axially forward position and an axially rearward attachment end 102 configured for mounting at one end of a drill string (not shown) forming part of a drill assembly operated via a drilling rig (not shown) configured to provide axial and rotational drive of tool 100. Tool 100 comprises three journal legs 105 projecting axially forward from attachment end 102 and being aligned slightly radially outward such that cutting end 101 comprises a generally larger cross section than attachment end 102. A generally conical shaped cutter 103 is mounted at an end of each journal leg 105 so as to be capable of rotation relative to leg 105 and independent rotation about a separate axis relative to a general rotation of tool 100 and the drill string (not shown).

[0025] Each cone cutter 103 comprises a generally cone or dome shaped configuration. A plurality of sets of cutting buttons that are used for drilling indicated generally by reference 104 (not shown) are provided at each respective axial direction of the cone cutter 103. Each cutting button 104 is formed from a wear resistant cemented carbide based material and may comprise any known configuration including semi-spherical, conical, ballistic, semi-ballistic or chisel shaped.

[0026] While drilling large number of cuttings pass in

touching relation to the neck of the legs 105. This results in excessive wear of the surface of the leg. The leg 105 may be protected from erosion and abrasion of the cuttings by respective protectors 110 mounted there along. Each leg protector 110 may be an insert mounted in a respective socket formed in the respective leg portion by an interference fit. The leg protectors normally have the same diameter as the hole along the entire length. The diameter of the outer end is normally flush with the outer surface of the neck.

[0027] Referring to figure 2 disclosing a journal leg 5 of the present invention. A neck 2 is the area of the leg being farthest away from the attachment end to the drill string (seen as 102 in figure 1). At a shirt 3 of the neck is a cone cutter attached. On the neck surface, close to the shirt 3 wear protection is important since wear is heavy in this area. The neck surface is provided with a number of holes 4 for receiving inserts 10, 20 to act as protectors. The hole 4 has the same diameter along its length with a tapering close to the neck surface, as can be seen in figure 2. In this figure five holes 4, whereof four of them are illustrated to have inserts 10, 20 received therein. The fifth hole is also intended to receive an insert 10, 20.

[0028] The number of holes 4 with protective inserts can be spread throughout a larger area of the neck surface, e.g. as shown in figure 1 having a large number or protectors 110.

[0029] Figure 3 discloses a first embodiment of an insert 10 having a general shape of a mushroom. The insert has a foot 13 with a specific length (similar as can be seen in figure 4), on top of which foot a hat 16 is connected. The outer diameter of the hat is larger than the outer diameter of the foot (similar as can be seen in figure 4). The lower part of the hat 18 connecting to the foot having a chamfered shape to smoothly fit into the tapered hole 4. The outer diameter of the foot 13 has a wave shaped layout with ridges 14 and grooves 15 regularly spread around the perimeter throughout the length of the foot, except for the lower part. The lower part of the foot 17 has a tapered section, where the tapering in radial direction is somewhat larger or going deeper into the core of the foot than the grooves 15. This results in the lower part of foot 17 having no ridges. The length L of the foot is defined as from the outer end defining the extremity of the lower part 17 to where the foot 13 intersects with the hat 16. So the length L of the foot includes the lower tapered section.

[0030] In an alternative version of the insert of the first embodiment the foot may be designed without grooves and ridges, such that the diameter is uniform along its length except for the tapered lower part.

[0031] The first embodiment shown in figure 3 has an upper outer part of the insert being a flat top surface 11 of the hat. As seen from the side the hat contour from the foot and upwards can be described as the chamfered lower part 18 followed by an outer edge of the hat 12, which represents the perimeter of the outer diameter of

the hat 16. The outer edge of the hat 12 seen from the side is perpendicular to the top surface 11 or the outer edge of the hat 12 can be said to be parallel with the longitudinal axis of the foot. The contour of the hat also includes a tapered section between the outer edge of the hat 12 and the top surface 11. The height H of the hat 16 is defined as from a point of the horizontal plane that is arranged in the intersection of the chamfered lower part 18 and the outer edge of the hat 12 to the horizontal plane representing the top surface 11. The chamfering 18 fits into the tapered hole 4 (seen in figure 2).

[0032] Figure 4 discloses a second embodiment of an insert 20 having a general shape of a mushroom. The insert has a foot 23 with a specific length L, on top of which foot a hat 26 is connected. The outer diameter of the hat D1 is larger than the outer diameter of the foot D2. The lower part of the hat 28 connecting to the foot having a chamfered shape to smoothly fit into the tapered hole 4. The outer diameter of the foot 23 has a wave shaped layout with ridges and grooves (similar as the design of the foot in figure 3) regularly spread around the perimeter throughout the length of the foot, except for the lower part. The lower part of the foot has a tapered section, where the tapering in radial direction is somewhat larger or going deeper into the core of the foot than the grooves. This results in the lower part of foot having no ridges. As in the first embodiment the length L of the foot is defined as from the outer end to where the foot 23 intersects with the hat 26.

[0033] There might also be an alternative design of the second embodiment having a foot without ridges and grooves. This results in a foot with a uniform diameter throughout the length. The diameter however diminishes at the lower part, which is tapered.

[0034] The second embodiment shown in figure 4 has an upper outer part of the insert being a rounded top surface 21 of the hat. The top surface 21 can have any rounded shape such as conical, spherical or similar. As seen from the side the hat contour from the foot and upwards can be described as the chamfered lower part 28 followed by an outer edge of the hat 22, which represents the perimeter of the outer diameter of the hat 26. The outer edge of the hat 22 seen from the side is parallel with the longitudinal axis of the foot. The contour of the hat then follows with the round top surface 21, so the round shape is intersecting with the outer edge 22. The height H of the hat 26 is defined as from a point of the horizontal plane that is arranged in the intersection of the chamfered lower part 28 and the outer edge of the hat 22 to a horizontal plane along the tangent of the uppermost point of the rounded top surface 21.

[0035] The outer edge of the hat 12, 22 corresponding to the circumference of the hat 16, 26 being defined by the outer diameter (corresponding to D1, as seen in figure 4). This outer edge 12, 22 of the top of the insert could be arranged close to a neighbouring insert on the journal leg. The outer edge 12, 22 of one insert could even be arranged adjacent to the following insert, such that there

is only a very small distance in between. So, nearly in touching relationship with a neighbouring insert. The distance between two inserts following upon each other could also be somewhat larger, i.e. where the edge 3 of the shirrtail 2 of the journal leg is more rounded the inserts will be somewhat more distanced due to the curvature of the edge 3.

10 Claims

1. An insert (10, 20) adapted to be mounted in a journal leg (5) of a rotary drill tool for cutting rock, the insert being adapted to reinforce the neck (2) of the journal leg (5);
wherein the insert (10, 20) has a mushroom shape comprising a hat (16, 26) and a foot (13, 23), the hat (16, 26) having a diameter (D1) and the foot (13, 23) having a diameter (D2) being smaller than the diameter (D1) of the hat (16, 26).
2. The insert (10, 20) as claimed in claim 1 wherein the foot (13, 23) has a certain length (L) from its outer end to the joint of the hat (16, 26);
and wherein the foot (13, 23) has a tapered outer end (17).
3. The insert (10, 20) as claimed in any preceding claim wherein the hat (16, 26) has a specific height (H) from upper to lower side ranging from 1 mm to 4 mm.
4. The insert (10) as claimed in any preceding claim wherein the hat (16) has a flat top surface (11).
5. The insert (20) as claimed in any of claims 1 to 3 wherein the hat (26) has a rounded top surface (21).
6. The insert (10, 20) as claimed in any preceding claim wherein the hat (16, 26) has a chamfered lower side (18, 28).
7. The insert (10, 20) as claimed in any preceding claim wherein the diameter (D1) of the hat (16, 26) has a relation to the diameter (D2) of the foot (13, 23) that is 1,5.
8. The insert (10, 20) as claimed in any preceding claim wherein the height (H) of the hat (16, 26) in relation to the length (L) of the foot (13, 23) is 30% to 65%.
9. The insert (10, 20) as claimed in any preceding claim wherein the circumference/perimeter of the foot (13, 23) has lengthwise extending ridges (14) and grooves (15).
10. A journal leg (5) of a rotary drill tool for cutting rock comprising at least one insert (10, 20) according to any preceding claim.

11. The journal leg (5) of a rotary drill tool according to claim 10 comprising a plurality of inserts (10, 20) being arranged at the neck (2) of the journal leg (5).
12. The journal leg (5) of a rotary drill tool according to any of claims 10 or 11 comprising at least four inserts (10, 20) being arranged at the shirt (3) of the journal leg (5). 5
13. The journal leg (5) of a rotary drill tool according to any of claims 10 to 12 comprising a plurality of inserts (10, 20) being arranged at the shirt (3) of the journal leg (5) such that the outer circumference of the hat (16, 26) is in line with the outer edge of the shirt (3). 10
14. The journal leg (5) of a rotary drill tool according to any of claims 10 to 13 comprising a plurality of inserts (10, 20) being arranged at the shirt (3) of the journal leg (5) such that the outer circumference of the hat (16, 26) of each insert (10, 20) is arranged adjacent to or on a short distance to the neighbouring insert (10, 20). 15 20

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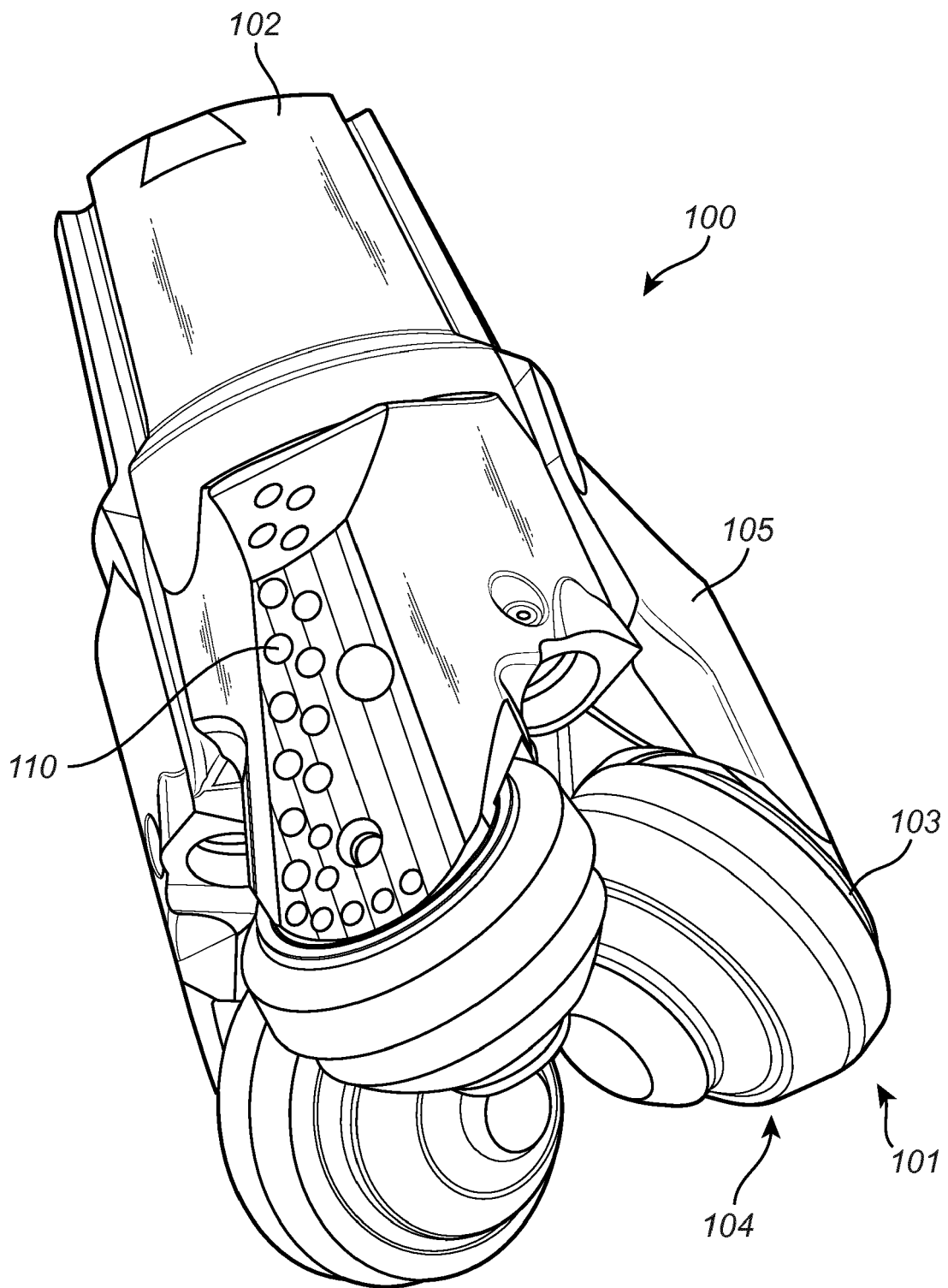
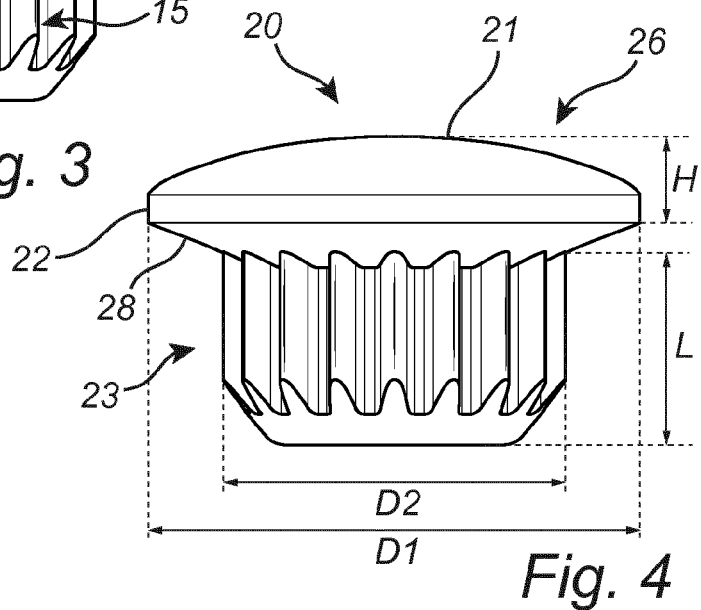
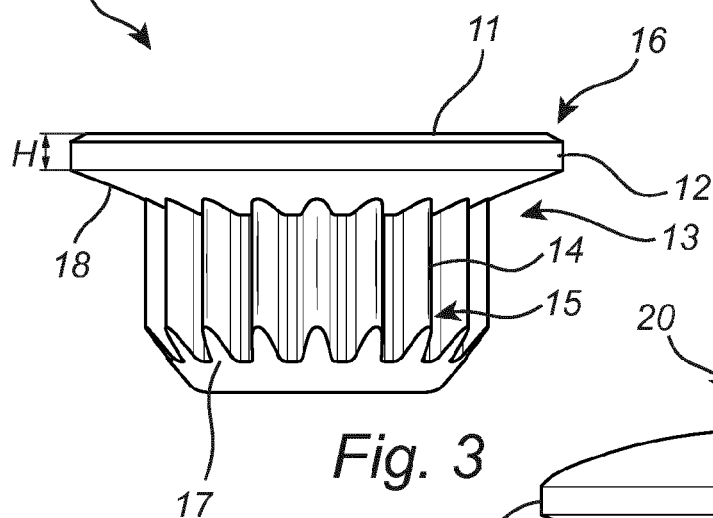
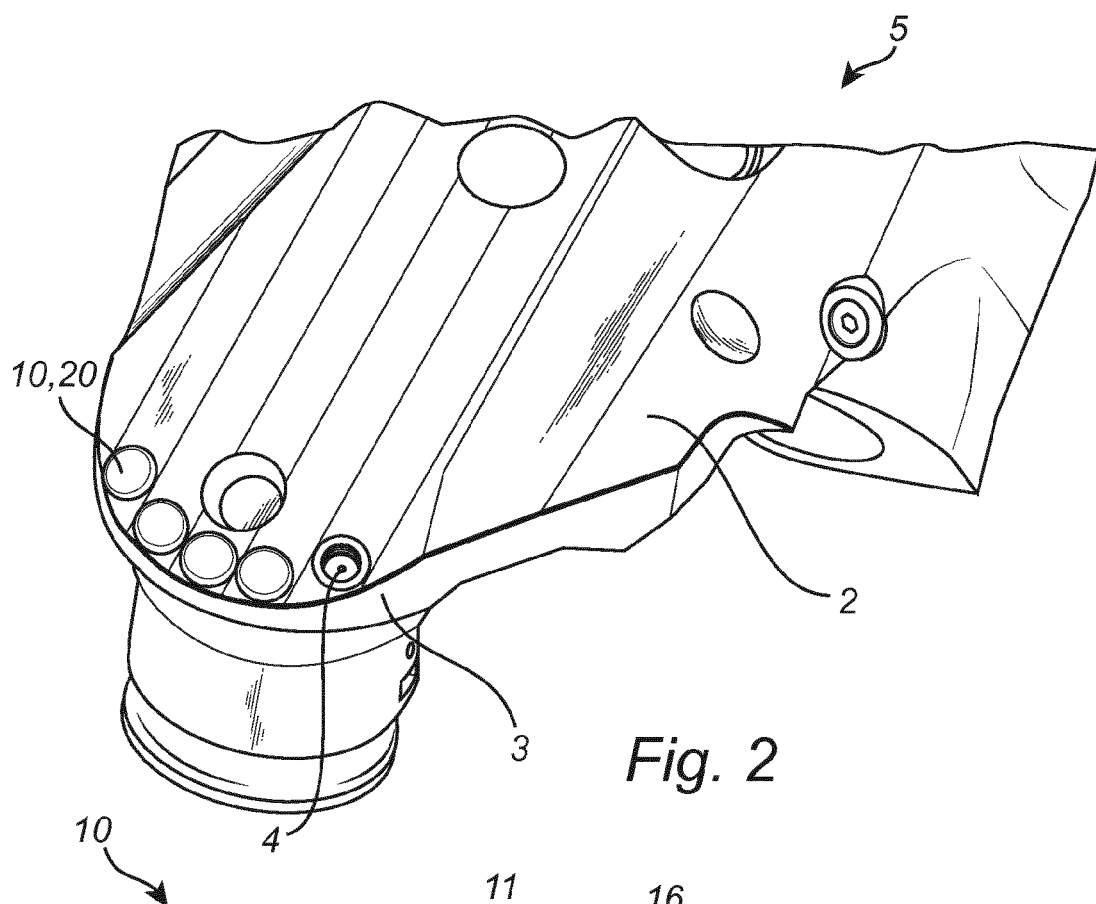


Fig. 1





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Application Number
EP 19 15 7436

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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 July 2019	Examiner Georgescu, Mihnea
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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