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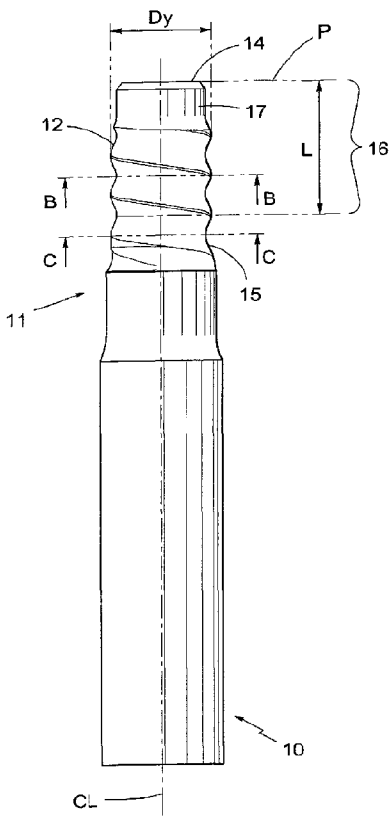
(54) Title: MALE PORTION, DRILL BIT AND THREADED JOINT FOR PERCUSSIVE ROCK DRILLING



(57) Abstract: According to the present invention a male portion (10) for percussive rock drilling is provided comprising sections of reduced cross-sectional areas, at least one thread (12) for percussive rock drilling provided at a portion (16) at an end of the male portion. The end of the male portion comprises an abutment surface (14) for transfer of impact waves. The length (L) of the portion (16) is defined as the length of a cylinder (C), from a plane (P) of the impact surface, that touches the external diameter (Dy) of the thread, wherein said length (L) divided by the external diameter of the cylinder lies within the interval of 1-2. The intervention further relates to a drill bit and a threaded joint.

WO 2004/003334 A1

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MALE PORTION, DRILL BIT AND THREADED JOINT FOR PERCUSSIVE ROCK DRILLING

Background of the invention

The present invention relates to a male portion, a drill bit and a threaded joint for percussive rock drilling in accordance with the preambles of the subsequent independent claims.

Prior art

In percussive top hammer drilling in rock, a drill string is intended to be fastened in a shank adapter in a drilling machine via one end surface of a rod or a tube. The other end of the rod or the tube is threaded either to another rod or to another tube or to a drill bit for percussive drilling. The rod or the tube can also be fastened to the shank adapter or another detail by means of threaded sleeves. A flush channel runs through the entire drill string in order to lead flush medium to the drill bit to coil away drill cuttings.

During drilling, the drill string, i.e. crowns, rods, tube, sleeves and shank adapters, is subjected to mechanical and corrosive attack. This particularly applies in during drilling underground where water is used as flush medium and where the environment is humid. Corrosion and other attacks are especially serious at the most stressed parts, that is in thread bottoms and other reductions, that is parts with small cross-sectional area. The drilling tool is often subjected for bending moments in connection with the drill bit reaching a skew wall in a cavity in the rock. In combination with pulsating strain, caused by impact waves and bending stresses, fatigue or breakage arises.

Objects of the invention

An object of the present invention is to improve the resistance against fatigue in a drill elements for percussive rock drilling.

It is desirable to improve the resistance against fatigue in sections of reduced cross-sectional areas in a drill element for percussive rock drilling.

It is desirable to improve the resistance against fatigue in thread bottoms in a threaded portion in a drill element for percussive rock drilling.

Summary of the Invention

The present invention provides a male portion for percussive rock drilling comprising sections of reduced cross-sectional areas, at least one thread for percussive rock drilling provided at a portion at an end of the male portion, said end of the male portion comprising an abutment surface for transfer of impact waves, said male portion having a first cross-sectional area at an area where the thread has full profile, said at least one thread having an exit, wherein the length of the portion is defined as the length of a cylinder, from a plane of the abutment surface, where the diameter of the cylinder coincides with the external diameter of the thread, wherein said length divided by the external diameter of the thread has a ratio in the range between 1 and 2, said male portion having a second cross-sectional area just beyond said thread exit, said second cross-sectional area being greater than the first cross-sectional area.

The present invention also provides a threaded joint between a male portion and a drill bit for percussive rock drilling, said male portion comprising sections of reduced cross-sectional areas, at least one thread for percussive rock drilling provided at a first portion at an end of the male portion, said end of the male portion comprising an abutment surface for transfer of impact waves, said male portion having a first cross-sectional area in an area where the thread has full profile, said drill bit comprising sections of reduced cross-sectional areas, said drill bit being provided with a central recess comprising an internal female thread for percussive rock drilling provided at an other portion of the recess, said recess comprising an abutment surface,

wherein the length of the first portion is defined as the length of a cylinder, from a plane of the abutment surface, where the cylinder touches the external diameter of the thread, wherein said length divided by the external diameter of the thread has a ratio in the range between 1 and 2 and in that the length of the second portion is defined as the length from a plane of the abutment surface of a straight circular cylinder where this touches the internal diameter of the thread, and in that the length divided by the internal diameter of the thread has a ratio in the range between 1 and 2.

Brief description of the drawings

These and other objects have been achieved by means of a male portion, a drill bit and a threaded joint for percussive rock drilling, which have obtained features according to characterizing portions of the subsequent independent claims with reference to the drawings, wherein:

Fig. 1 shows a male portion of a conventional rod in a side view.

Fig. 2 shows another male portion of a conventional rod in a side view.

Fig. 3A shows a male portion according to the present invention of a rod in a side view.

Fig. 3B shows a cross-section according to the line B-B in Fig. 3A. Fig. 3C shows a cross-section according to line C-C in Fig. 3A. Fig. 3D shows the male portion in a perspective.

Fig. 4 shows an axial cross-section of a drill bit according to the present invention.

Fig. 5 shows a threaded joint according to the present invention partially in cross-section.

Detailed description of the invention

Each of the rods 1 and 2 for percussive drilling shown in Figs. 1 and 2 is provided with a threaded male portion 3 at its one end and an identical male portion or a female portion in the shape of an internally threaded, sleeve-shaped portion at its other end, not shown. The male portion 3 is connected in this case to a round rod

4, preferably by friction welding. The weakest cross-section of the male portion is where the smallest cross-sectional area is found, shown as the thread clearance 5 and the last thread turn 6.

At simulated bending test with the aid of the finite element method (FEM) we have found that it is possible to considerably lower the load at the weakest cross-section of the male portion and thereby obtain longer life spans for the male portions.

The end of the drill rod 10 for percussive drilling shown in Figs. 3A-3D is formed with a spigot or male portion 11 according to the present invention provided with a male thread or external thread 12. The drill rod further has a through-going flush channel 13, through which a flush medium, generally air or water, is led. The end surface of the male portion 11 forms a ring-shaped abutment surface 14, which at connection to a drill bit is intended to abut against a corresponding annular abutment surface at a bottom of a central recess in the drill bit. The area of the full profile of the thread on the male portion 11 has a smallest first cross-sectional area X, as illustrated by the dashed area in Fig. 3B. The male portion 11 comprises a last thread turn 15 or a thread exit with an increased second cross-sectional area relative to the field of the full profile of the thread, as illustrated by the dashed area Y in Fig. 3C. The smallest cross-sectional area of the male portion is provided in the area where the thread has full profile and the second cross-sectional area is measured within the range of 1 to 5 mm from the first cross-sectional area. The thread 12 is provided at a first portion 16 at the end of the male portion. The length L of the portion 16 is the length from a plane P of the impact surface 14 of an imaginary, straight circular cylinder C that touches the external periphery or external diameter Dy of the thread, see Fig. 3D. The external diameter Dy of the cylinder C is preferably smaller than 37 mm. The plane P is perpendicular to the centerline CL. The length L divided by the diameter Dy of the cylinder has a ratio in the range between 1 and 2. The ratio is preferably between 1,2 to 1,9 and most preferably 1,3 to 1,6. As an example can be mentioned that male portions with the length L=57 mm and Dy=32,85 mm give the approximate quota 1,7 and male portions with length L=44,3 mm and Dy=32,85 mm give the approximate quota 1,3. The abutment surface 14 connects via a chamfer to a spigot 17 that is cylindrical or conical. The

spigot 17 lacks thread and is in certain cases intended to steer on a recess in the drill bit when the connection has been mounted. The spigot 17 connects to the thread 12.

The drill bit 20 for percussive drilling shown in Fig. 4 comprises a drill head 21 and a shank or a skirt 22. The drill head 21 and the skirt 22 are performed in one piece. A common longitudinal center line CL for the drill bit 20 and the male portion 10 is drawn in the figures. The drill bit 20 is provided with a recess 23 provided with an internal female thread 24, which will receive the external male thread 12 of the male portion 10. The drill head 21 of the drill bit according to the present invention is in usual manner provided with rock cutting means, in the shown embodiment having the shape of cemented carbide inserts, of which a number of circularly positioned peripheral inserts 25 and two front buttons 26 are shown. A number of flushing channels 27 extends axially between the recess 23 of the drill bit and the front of the drill head 21. An abutment surface 30, a so-called bottom abutment, is provided at the bottom of said recess for the abutment surface 14 of the male portion 10.

The thread 24 connects to a thread clearance 28 of reduced cross-sectional area. The thread 24 is provided at a second portion 29 in the recess 23. The length L' of the portion 29 is the length from a plane P' of the impact surface 30, that an imaginary, straight circular cylinder C' touches the internal periphery Di of the thread. The internal diameter Di of the cylinder C' is preferably smaller than 37 mm, preferably less than 36 mm. The plane P' is perpendicular to the centerline CL. The length L' divided by the diameter Di of the cylinder has a ratio in the range between 1 and 2. The ratio is preferably between 1,2 to 1,9 and most preferably 1,3 to 1,6. The abutment surface 30 connects via a shoulder to the thread clearance 28. As an example can be mentioned that drill bits with the length L'=39,7 mm and Di=29,5 mm give the approximate quota 1,4 and drill bits with the length L'=52,5 mm and Di=29,5 mm give the approximate quota 1.8.

The length L, L' is calculated from the plane P, P' as long as the thread has a full profile. Stated alternatively, a straight circular cylinder should be able to enter over the male portion 10 or to be moved into the recess 23 with a slide fit a distance or a length L, L' from the plane P, P' until the cylinder either clears from the thread or abuts against a thickened thread end.

In Fig. 5 a threaded joint 40 according to the present invention is shown comprising the male portion 10 and the drill bit 20. The male portion 10 has been screwn into the drill bit 20 until the impact surfaces 14 and 30 impacted against each other. Since the part of reduced cross-sectional area on the male portion 10 is provided at a relatively short distance from the free end of the joint 40 the bending stress will be lower there than at conventional joints where the lever is considerably longer. The male portion and the drill bit comprise cylindrical surfaces provided axially beyond and radially outside of the threads for slide fit against each other during mounting.

The invention is based on that a shorter thread gives lower bending stress. The tension in the last thread turn or the thread clearance is lowered at least 30 % as compared with known joints. Generally just a few thread turns, for example two thread turns on each part, are in engagement with the other part as can be concluded from Figs. 3A, 4 and 5. With a conventional threaded joint normal tool life is about 850 m while the new male portion reached about 2050 m before the joint was considered worn-out.

The disclosures in Swedish patent application No. 0201989-1, from which this application claims priority are incorporated herein by reference.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A male portion for percussive rock drilling comprising sections of reduced cross-sectional areas, at least one thread for percussive rock drilling provided at a portion at an end of the male portion, said end of the male portion comprising an abutment surface for transfer of impact waves, said male portion having a first cross-sectional area at an area where the thread has full profile, said at least one thread having an exit,
wherein the length of the portion is defined as the length of a cylinder, from a plane of the abutment surface, where the diameter of the cylinder coincides with the external diameter of the thread, wherein said length divided by the external diameter of the thread has a ratio in the range between 1 and 2, said male portion having a second cross-sectional area just beyond said thread exit, said second cross-sectional area being greater than the first cross-sectional area.

2. The male portion according to claim 1, wherein the smallest cross-sectional area of the male portion is provided at an area where the thread has full profile and in that the second the cross-sectional area is measured within the range of 1 to 5 mm from the first cross-sectional area.

3. The male portion according to claim 1 or 2, wherein the ratio is 1.2 to 1.9, most preferably 1.3 to 1.6 and in that the external diameter of the cylinder is preferably smaller than 37 mm.

4. The male portion according to claim 1, wherein it is firmly connected to an end of a rod or a tube of steel and forms a drill rod and in that the drill rod comprises a through-going flush channel.

5. A drill bit for percussive rock drilling comprising sections of reduced cross-sectional areas, said drill bit being provided with a central recess comprising an

internal female thread for percussive rock drilling provided at a portion in the recess, said recess comprising an abutment surface,
wherein the length of the portion is defined as the length of a straight circular cylinder from a plane of the abutment surface where the diameter of the cylinder coincides with the internal diameter of the thread, and in that the length divided by the internal diameter of the thread has a ratio in the range between 1 and 2.

6. The drill bit according to claim 5, wherein the range is 1.2 – 1.9, most preferably 1.3 – 1.6 and in that the internal diameter of the cylinder is preferably smaller than 36 mm.

7. The drill bit according to claim 5 or 6, wherein it is firmly connected to an end of an rod or a tube of steel and forms a drill rod and in that the drill rod comprises a through-going flush channel.

8. A threaded joint between a male portion and a drill bit for percussive rock drilling, said male portion comprising sections of reduced cross-sectional areas, at least one thread for percussive rock drilling provided at a first portion at an end of the male portion, said end of the male portion comprising an abutment surface for transfer of impact waves, said male portion having a first cross-sectional area in an area where the thread has full profile, said drill bit comprising sections of reduced cross-sectional areas, said drill bit being provided with a central recess comprising an internal female thread for percussive rock drilling provided at an other portion of the recess, said recess comprising an abutment surface,
wherein the length of the first portion is defined as the length of a cylinder, from a plane of the abutment surface, where the cylinder touches the external diameter of the thread, wherein said length divided by the external diameter of the thread has a ratio in the range between 1 and 2 and in that the length of the second portion is defined as the length from a plane of the abutment surface of a straight circular cylinder where this touches the internal diameter of the

thread, and in that the length divided by the internal diameter of the thread has a ratio in the range between 1 and 2.

9. The threaded connection according to claim 8, wherein the ratio is 1.2 to 1.9, most preferably 1.3 to 1.6 and in that the diameter of the cylinder is preferably smaller than 37 mm.

10. A male portion for percussive rock drilling substantially as herein described with reference to Figures 3A to 5.

11. A drill bit for percussive rock drilling substantially as herein described with reference to Figures 3A to 5.

12. A threaded joint between a male portion and a drill bit for percussive rock drilling substantially as herein described with reference to Figures 3A to 5.

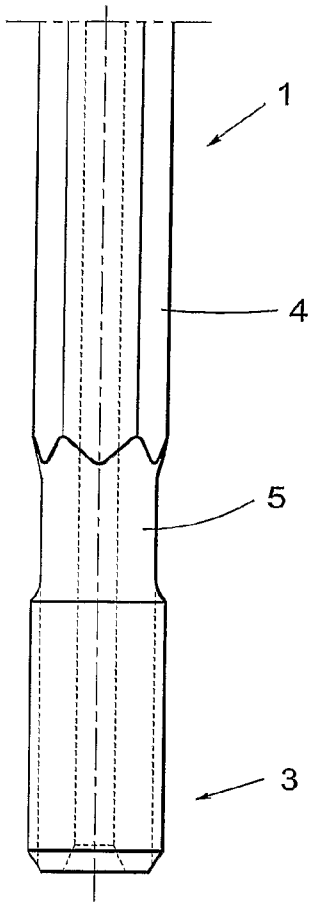

Fig. 1

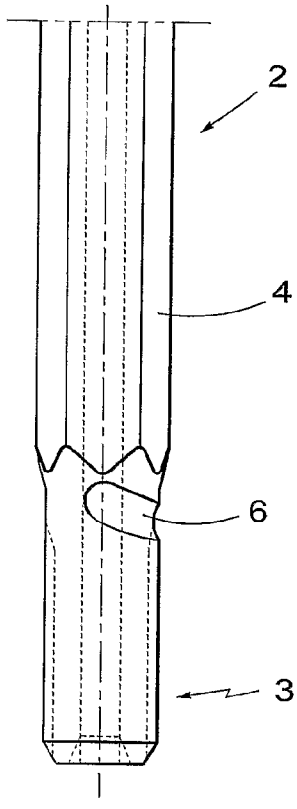

Fig. 2

Fig. 3A

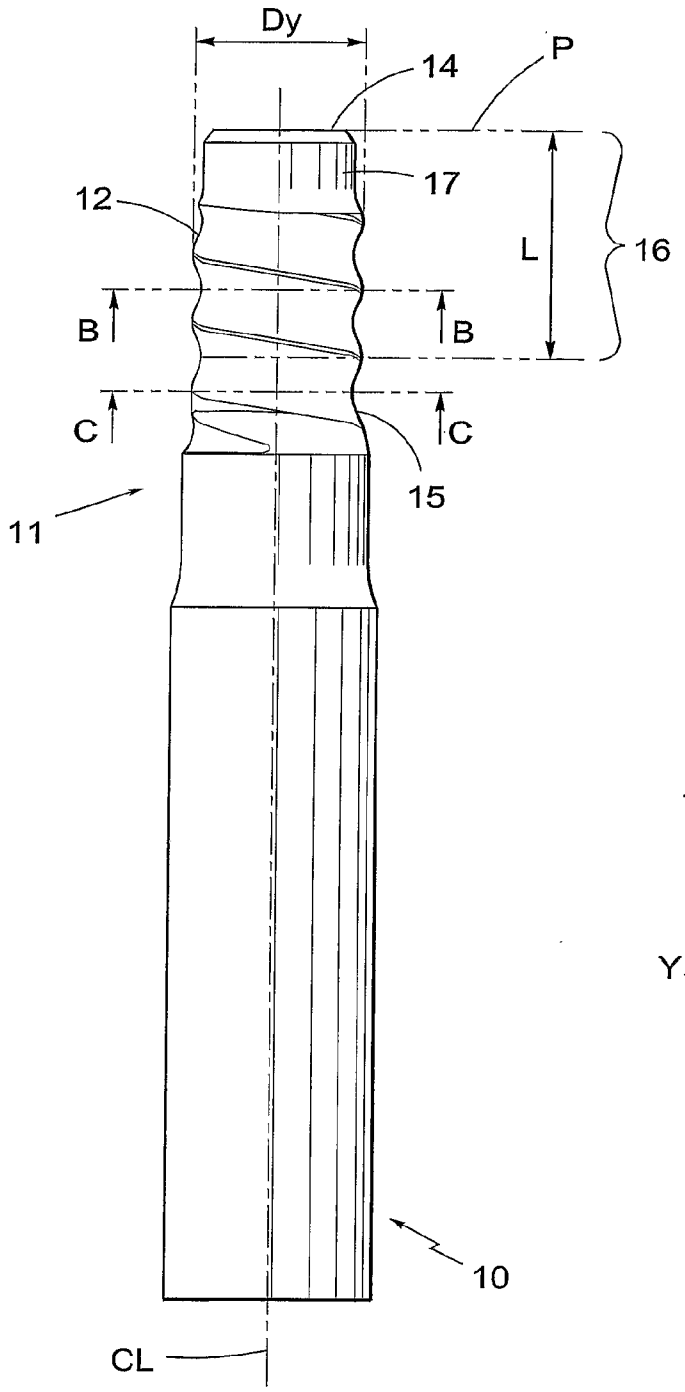

Fig. 3B

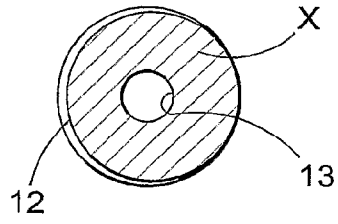

Fig. 3C

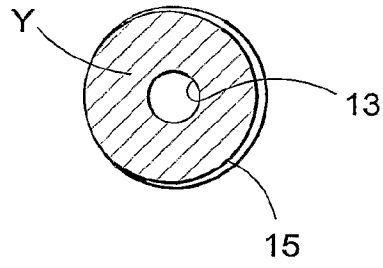

Fig. 3D

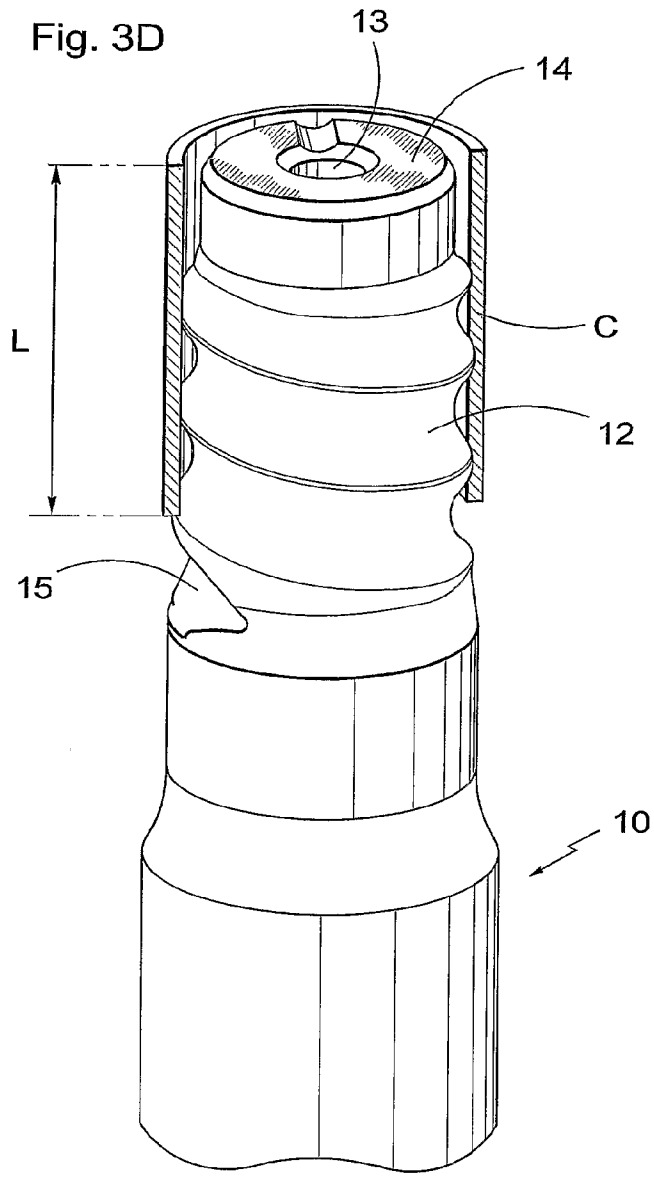

Fig. 4

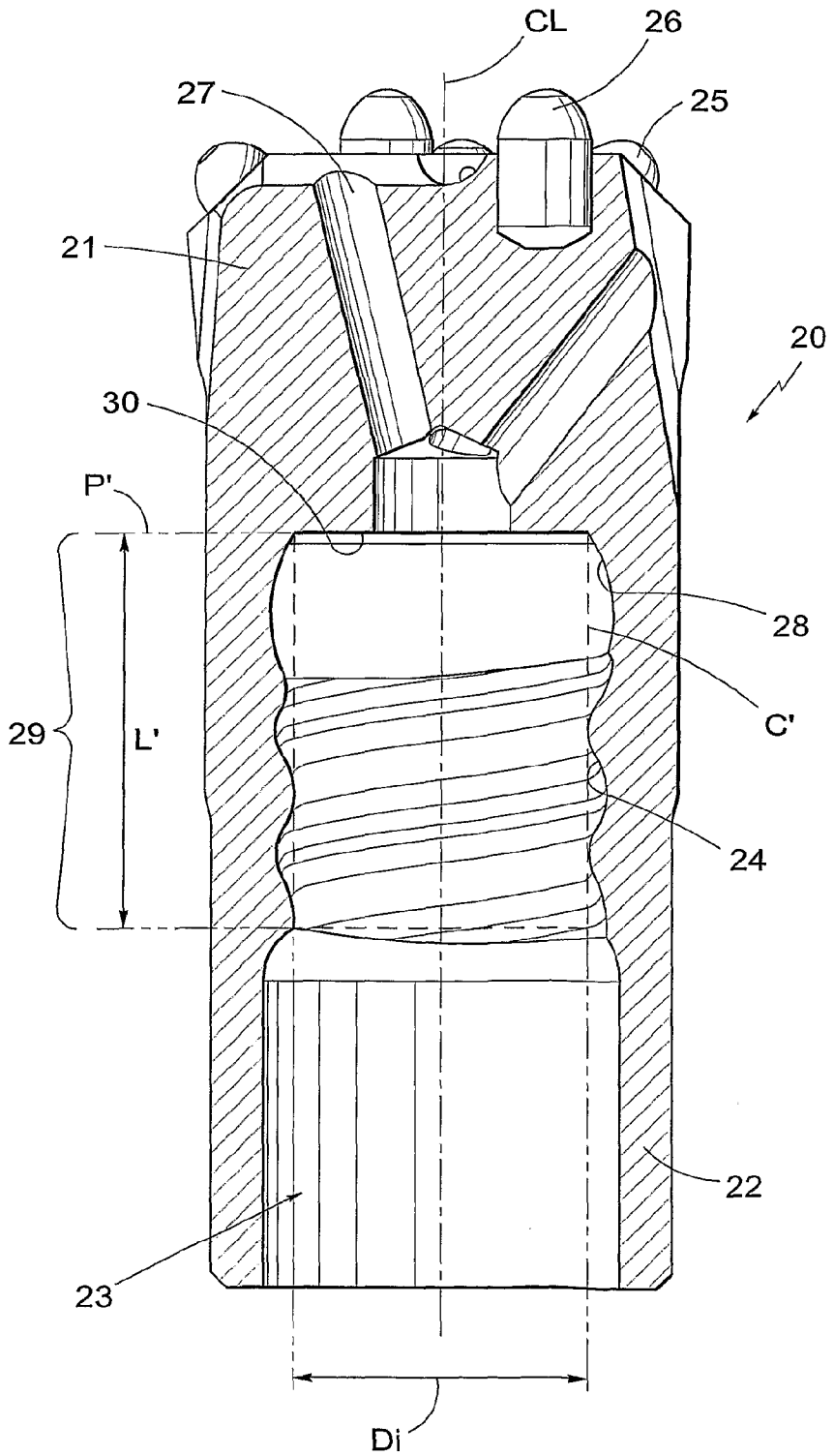

Fig. 5