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(54) **Hole opener**

(57) The present invention relates to a hole opening tool to be used in oil well drilling. This tool is typically mounted on the lower end of a drill string and is rotated by adding rotating power to the drill string from the top end or by actuation of a down hole motor. A rotating drill bit produces a borehole at a diameter equal to that of the drill bit as the drilling proceeds downward.

In many cases, the earth formation may be relatively soft or subject to geometrical change. This change may take place due to absorbing moisture from the drilling mud. In such cases earth formation swells and narrows, choking the drill string movement and producing unwanted and potentially damaging negative torque. The present invention provides a hole opening tool that has:
- A steel body (1) having through axial bore for passing drilling fluid through (2).
- A straight stabilizing and reaming part (3)
- One tapered part above (4) and one tapered part below (5) the stabilizing part (3), both hold a number of cutters (6) to cut hole back to nominal size while drilling (5) downward or while pulling the drill string out of the hole (4).

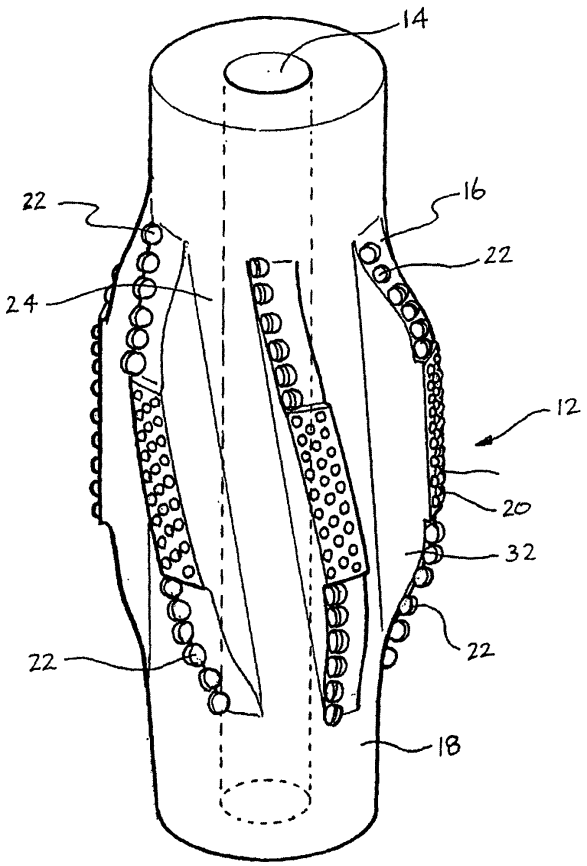

Fig 7

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a hole *opening tool* to be used in the stabilizing of a drilling tool during operation and in particular to a dual-opening tool.

BACKGROUND OF THE INVENTION

[0002] An earth-boring tool is typically mounted on the lower end of a drill string and is rotated by rotating the drill string at the surface or by actuation of downhole motors. The rotating drill bit engages the sidewalls of the formation and produces a borehole of equivalent diameter to the drill bit as the drill proceeds downwards.

[0003] As will be appreciated in many drilling situation a hole of substantial depth is created. In addition it will also be appreciated that in many cases the earth formation through which the drilling operation occurs can be relatively soft or subject to change. This may occur during the use of the drill. For example, in the case where the drilling operation is conducted through some clay earth formation, the earth formation at near the bore hole is exposed to moisture levels that would not otherwise prevail and the soil material may thus hydrate. Where the earth through which the drill moves contains significant levels of swellable clays, for example bentonites or montmorillonites a problem can arise. As the drill string gradually drills downwards through the soil the material closer to the surface is exposed for some time and can swell thereby reducing the drilled hole diameter.

[0004] Similarly, movement of the earth around the drill hole may cause material to slump and protrude into the hole, again, thereby reducing the diameter of the hole and causing difficulties in the removal of the drill bit at the end of the drill string.

[0005] In very long drill pipes the wall of the drilled hole may slump inwardly during the drilling operation thus choking the drill pipe in the hole and producing unwanted and potentially damaging torque. As a further consequence of the reduced hole diameter, retrieval of the drill bit can be complicated by the bit becoming lodged against the hole wall.

[0006] Another hole problem occurs when the hole is created inside the earth formation, this may disturb the forces balance around the hole, and may distort the circular hole into an elliptical hole.

[0007] The tool of the present invention is directed to an arrangement that works as a hole opening tool and which serves as safeguard to counteract the effects of formation tectonic movement, formation swelling and hole deconfiguration during the drilling operation.

SUMMARY OF THE INVENTION

[0008] Therefore according to a first aspect of the present invention there is provided a hole opening tool for use in association with a drill stem and a drill bit in drilling a hole in a rock formation, said a hole opening tool having:

- a body having through going bore for passage of drilling fluids there through, the body having a generally cylindrical lowermost part adapted for connection to a drill string; and
- said body including a tapered cutter part, the cutter part being axially tapered and including on an outer surface thereof a plurality cutting devices said cutter devices serving as back hole opening cutters and a stabilizer portion having low wear surfaces that bear against a drilled hole wall in use and;
- said body further including a plurality of spaced apart axially extending spiral flutes cut into said outer surface.

[0009] The hole opening tool of the invention may be embodied as a forward hole opening tool, a back hole opening tool or as a dual action hole opening tool. In the case of a forward opening tool the cutter part is located below the stabilizer and tapers downwardly. In the case of a back opening tool the cutter part is located above the stabilizer and tapers upwardly. By contrast a dual opening tool has a tapered cutter section both above and below the stabilizer.

[0010] The inwardly directed taper of the cutter part creates a cutting surface of reduced diameter relative to the body of the tool. Thus, in one form of the invention, as the tool is moved through the drilled hole the cutter part redrills any parts of the hole that have collapsed inwardly as a result of earth movements, or have swelled as a result of the composition of the earth surrounding the hole. The original hole diameter is thereby restored and the drill bit is retrieved as required.

[0011] Preferably, the cutting devices are polycrystalline diamond compacts (PDC) embedded in cutter pockets in the tapered upper part of the body.

[0012] In a convenient arrangement the tool of the invention incorporates a stabilizer portion having wear surfaces. Stabilizers are typically positioned above the drill bit to ensure that the drill bit and stabilizer assembly drill a straight hole of the desired diameter and thereby minimize unintentional hole-angle directional drilling. A stabilizer thereby extends the life of the drill by maintaining the diameter of the hole to the original specification.

[0013] In a particularly preferred arrangement of the invention a stabilizing portion of the tool forma a central band of the body and is surrounded by a lowermost an inwardly tapered cutter part the cutter part being inwardly tapered and including on an outer surface thereof a plurality cutting devices said cutter devices serving as back hole opening cutters as well as an uppermost cutter part having an inward taper and a cutter surface.

[0014] Preferably, the wear surfaces of the stabilizing parts are studded with a plurality of hardwearing studs, for example carbide surface studs.

[0015] Preferably, said spaced apart axially extending spiral flutes cut into the outer surface of the tool and are cut at a high angle relative to the tool hereby minimize the extent of helical movement in fluid moving in the flutes.

DESCRIPTION OF DRAWINGS

[0016] The above and other objects, features and advantages of the present invention will be apparent from the following detailed description of a preferred embodiment in conjunction with the accompanying drawings. In the drawings:

Figure 1 illustrates, in perspective view, a back-hole cutter constructed in accordance with a first embodiment of the present invention;
Figure 2 illustrates in side view back hole cutter of figure 1;
Figure 3 illustrates a cross-sectional view of the back-hole cutter of figure 4;
Figure 4 illustrates, in perspective view, a forward hole cutter constructed in accordance with a second embodiment of the present invention;
Figure 5 illustrates in side view forward hole cutter of figure 4;
Figure 6 illustrates a cross-sectional view of the forward hole cutter of figure 4;
Figure 7 illustrates, in perspective view, a dual hole cutter constructed in accordance with a third embodiment of the present invention;
Figure 8 illustrates in side view dual hole cutter of figure 7; and
Figure 9 illustrates a cross-sectional view of the dual-hole cutter of figure 7

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0017] Shown in figures 1-3 is a back-hole cutter 10 formed in accordance with the present invention. The back-hole cutter 10 is shown to advantage in perspective view in figure 1. The back-hole cutter 10 is used in association with a drill stem and a drill bit in drilling a hole in a rock formation. In the orientation shown a drill is located below the back-hole cutter 10. The geometry of the back-hole cutter 10 is such that a drill bit would be located below the tool 10 with the top of the drill hole beyond the top of the page. The back-hole cutter 10 includes a body 12 having a through going bore 14 for passage of drilling fluids there through. The bore 14 is of appropriate size to allow smooth passage of drilling fluids there through.

[0018] The body 12 includes an inwardly tapered cutter part 16 extending upwardly of the body 12. The cutter part 16 is connected at its upper end to a drill string (not shown).

[0019] Below the body 12 is a lowermost collar 18 of reduced diameter. The collar 18 serves as a connection point for the drill bottom hole assembly. The diameter of the collar 18 is selected to match that of the bottom hole assembly.

[0020] Located between the cutter part 16 and the collar 18 is a centrally located stabilizing section 20.

[0021] The cutter part 16 is inwardly tapered so as to be of reduced diameter relative to the central part of the body 12. The outer surface of the cutter part 16 is studded with cutter devices 22 in the form of PDC cutters embedded in pockets in the cutter part 16. The cutters 22 will cut and scour any rock surfaces encountered as the drill rotates. From an inspection of the drawings it can be seen that the cutter part 16 is narrowest at a position that, in use, would be the uppermost part of the tool 10, and is wider towards the centre of the body 12.

[0022] Six spiral or helical flutes 24 are cut into the outer surface tool 10. As seen in the drawings the spiral flutes 24 are evenly spaced around the circumference of the tool 10. The spiral flutes 24 serve to collect drilling fluid and entrained rock material collected from a hole during a drilling operation and to deliver the material to the surface. It can also be observed from figure 3 that the spiral flutes 24 have a slightly squared off cross-section. It has been found in practice that such an arrangement provides for the smoothest transition of fluid through the flutes 24. Careful inspection of the drawings also reveals that the flutes 24 are cut at a relatively close angle to the vertical. Again this has been found in practice to yield the smoothest delivery of material from the cutting face to the surface.

[0023] Thus, it can be observed that, as the tool 10 is moved down a hole in a drilling operation behind a drill string and associated drill bit, the cutter portion 16, and cutter devices 22 would not engage the wall of the drilled hole because the hole drilled by the bit is wider than the cutter portion 16. However, as the drill is gradually removed from the drilled hole the position is somewhat different. Should the hole diameter have reduced as a result of either swelling of the hole material, or as a result of movement of the formation, the cutter part 16 comes into contact with the rock surface. The cutter part 16 is as has been noted tapered. Accordingly, the part gradually engages the rock surface and reopens the drilled hole to the original dimensions.

[0024] An alternative embodiment of the invention is shown in figures 4-6 in the form of a forward hole opener 30. The hole opener 30 shares many features in common with the back hole opener 10 and like numerals have been used on the drawings to illustrate like parts. These parts will not be described in detail, other than to say that the outline shape and dimensions of the opener 30 are in general the same as the opener 10. In particular the opener 30 incorporates the generally annular form of the opener 10 and has a stabilizer section 20 towards the centre of the tool 30 between ends thereof. In addition the tool 30 incorporates the spiral flutes 24 shown in the tool 10.

[0025] However, the tool 30 does have a tapered cutter part located upwardly of the body 12. Rather a lowermost

cutter part 32 is situated below the stabilizer section 20 and towards the collar 18. The lowermost cutter portion 32 tapers from a widest diameter at the top thereof to a narrow lower section. The lowermost cutter portion 18 includes an array of PDC cutter devices 22 on its surface.

[0026] In use the forward hole opener would, as with the tool 10 be used on a drill pipe spaced some distance from the bottom hole assembly where the drilling takes place. In practice a drill pipe may be several thousand meters long and the inward collapse of the drill hole walls can occur even as the drill is still boring downwards. A forward hole opener therefore serves to reopen the drilled hole during the drilling operation to prevent the choking of the drill pipe and the torsional strain thereby introduced in the arrangement.

[0027] An further alternative embodiment of the invention is shown in figures 7-9 in the form of a dual hole opener 40. The dual hole opener 40 incorporates features of both the back hole opener 10 and the forward hole opener 30 in that it includes both an upper tapered cutter portion 16 and a lowermost tapered cutter portion 32. Thus, the dual hole opener 40 will remove blockages as required both as a drill is operated to produce the drill hole and again as the drill is retrieved from the drill hole.

[0028] Further advantages and improvements may very well be made to the present invention without deviating from its scope. Although the invention has been shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made there from within the scope and spirit of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices and apparatus.

[0029] In any claims that follow and in summary of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprising" is used in the sense of "including", i.e. the features specified may be associated with further features in various embodiments of the invention.

Claims

1. A hole opener stabilizer used in boreholes, including a body having through going bore for passage of drilling fluids there through. The body generally has a cylindrical lower most part adapted for connection to a drill string and another similar at the topmost. The said body also includes a tapered cutter part below the stabilizer part. The cutter part is axially tapered with a specific profile and carrying on its outer surface thereof a plurality of cutting devices. Similar curved surface above the stabilizer part carrying said cutter devices serve as back hole opening part. A straight cylindrical part parallel to tool axis and having low wear surfaces that bear against drilled hole wall acts as a stabilizer portion. Said tool body further includes a plurality of circumferentially spaced spiral flutes cut into said tool outer surface.

2. A Stabilizer part in claim 1 stabilizes the drill string, reduces vibrations and protects drill string from damage by confining its lateral movement.

3. A stabilizer as in claim 1 has a said surface including a plurality of hard tungsten carbide dome or flat inserts embedded into the surface to protect the surface from wear when they come in contact with the hole walls.

4. Said dome carbide inserts in claim 3 has the capacity of reaming the hole to gauge hole size while drilling.

5. Said two curved surfaces in claim 1 include a plurality of cutters arranged and integrated with the main body of the hole opener.

6. Down hole curve one of Said two curved surfaces go gradual in attacking and cutting the bore hole walls while drilling down earth starting from small size at the very bottom to full size at the bottom of stabilizer reamer straight part.

7. Up hole curve of Said two curved surfaces go gradual in attacking and cutting the bore hole walls while pulling out of hole starting from small size at the very top of the curved surface to full size at the top of stabilizer reamer straight part.

8. During well drilling, earth formation may absorb liquid from the drilling mud and swell or change shape due to formation stresses. Also, in some cases, the well walls drop and burry the drill string.

9. Said tool has the capacity to open drilled hole while going down hole or going upward out of the drilled hole. In case of tight hole due to any of claim 8, the tool is capable of cutting its way out of the trouble.

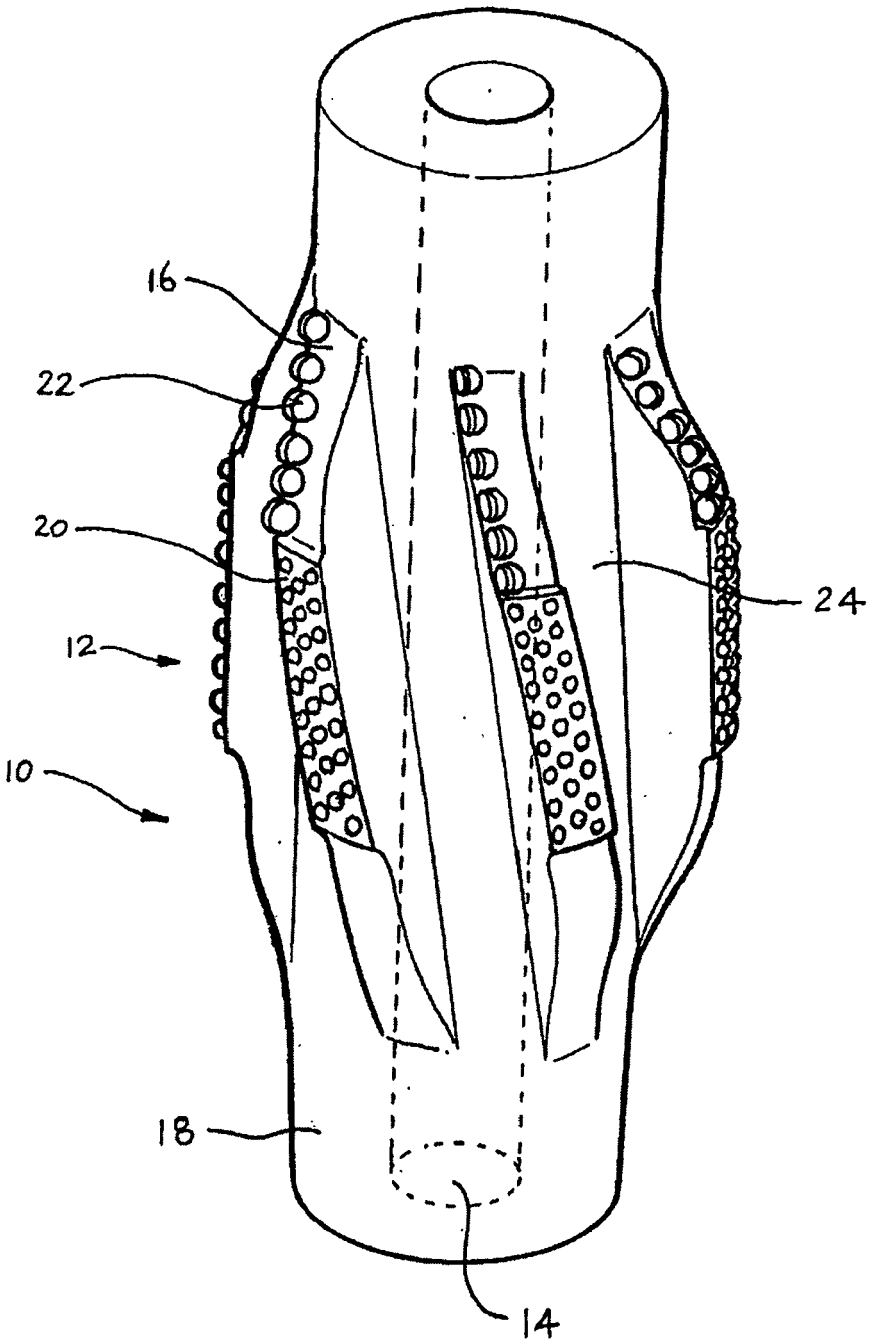

Fig 1

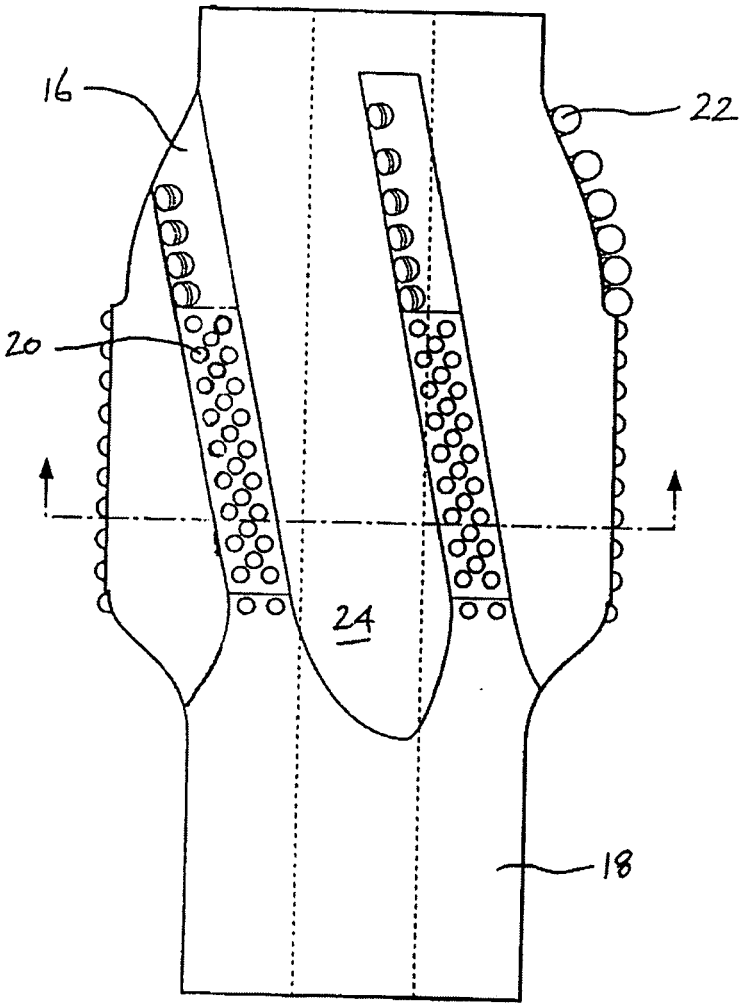

Fig 2

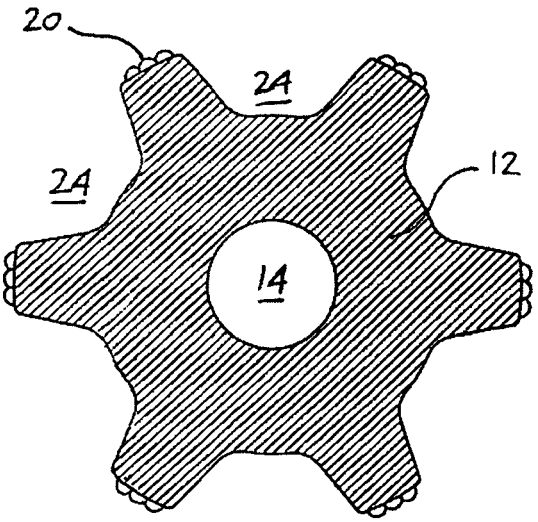

Fig 3

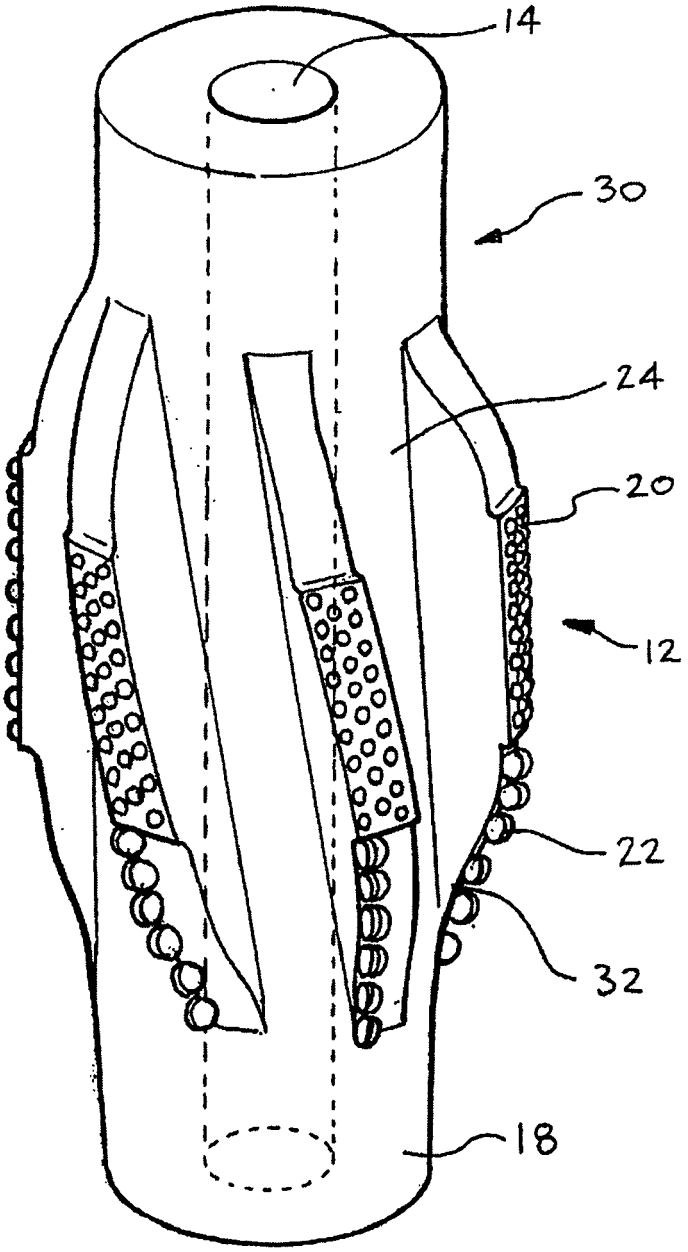

Fig 4

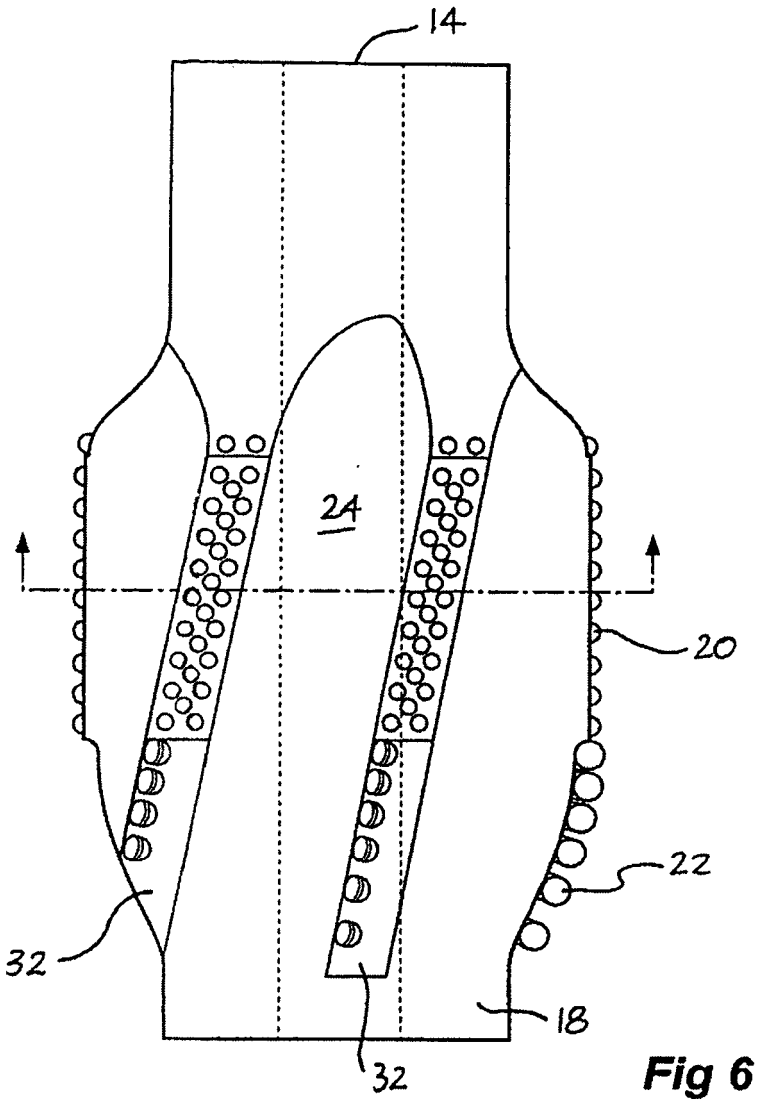

Fig 6

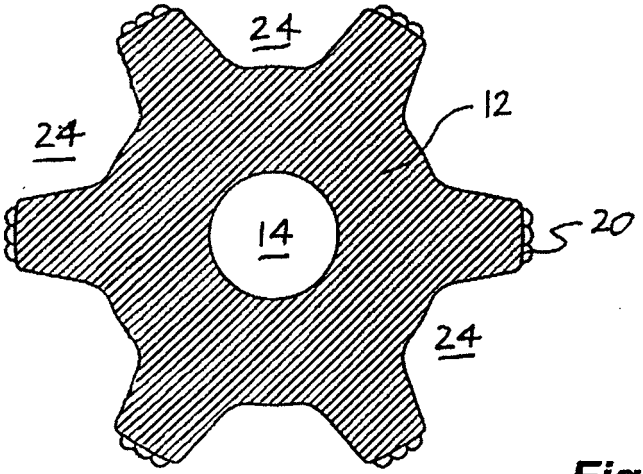

Fig 5

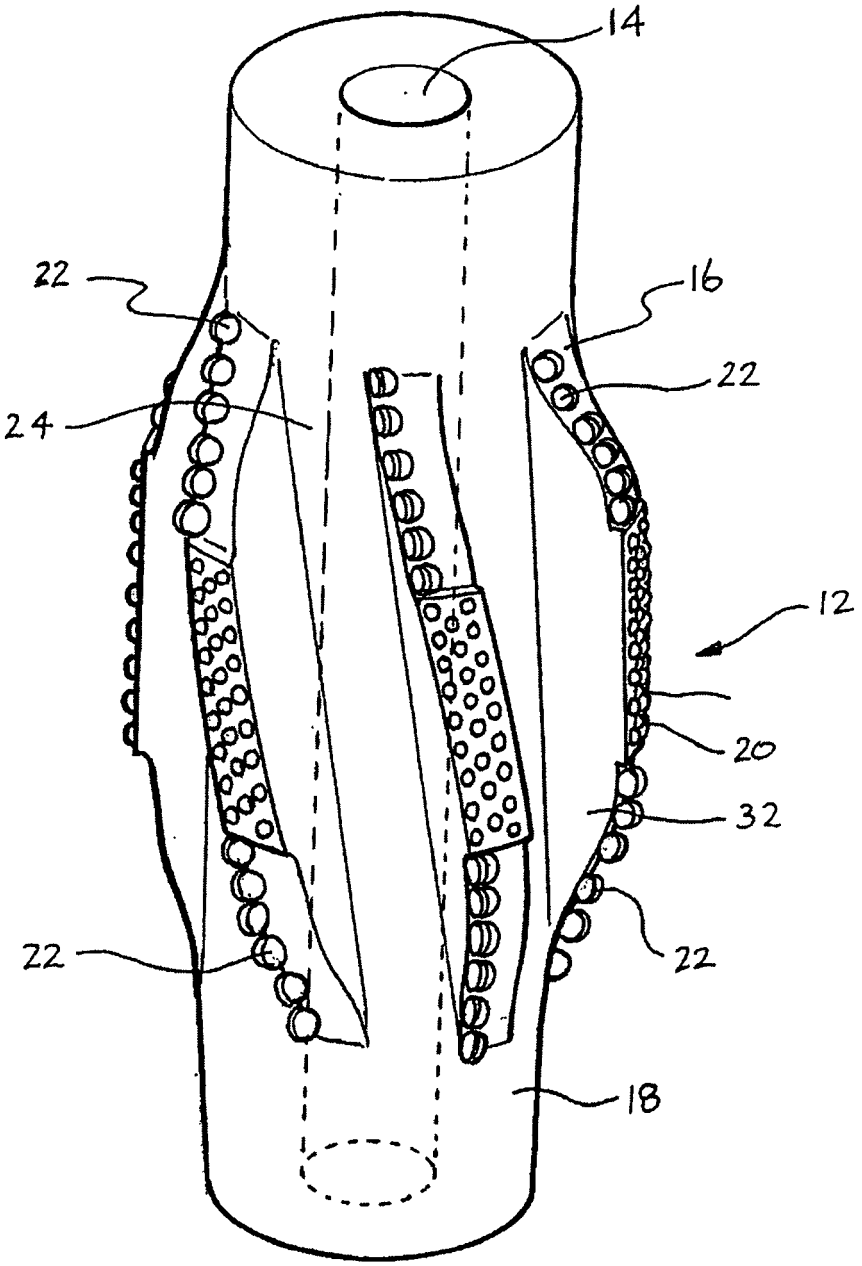

Fig 7

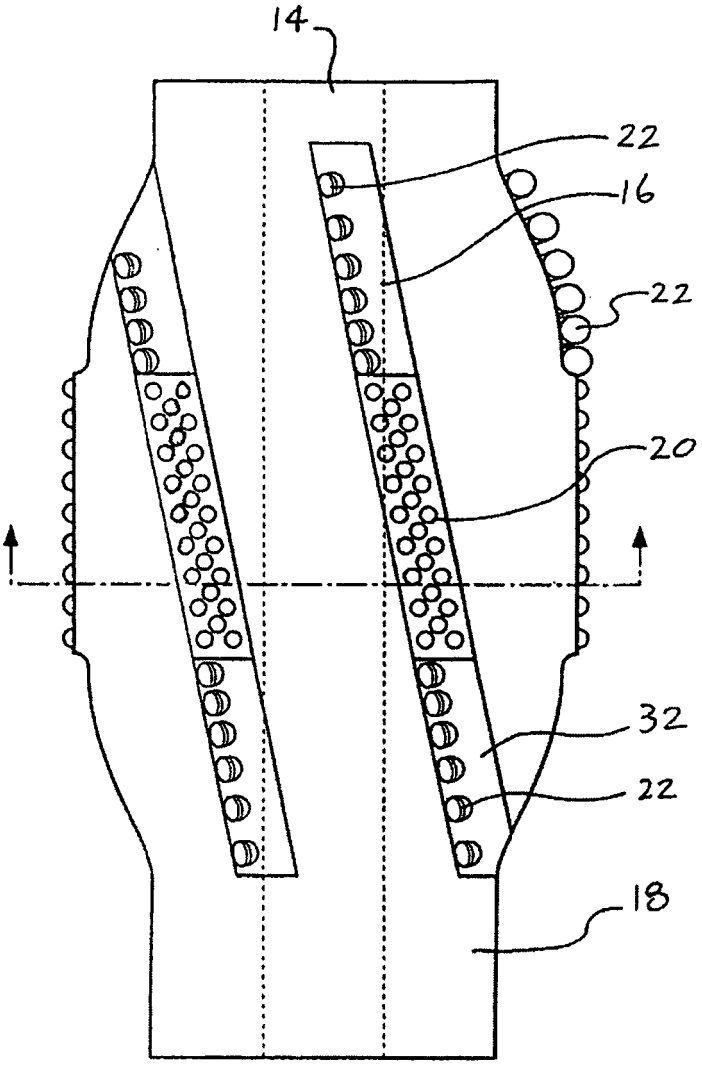

Fig 9

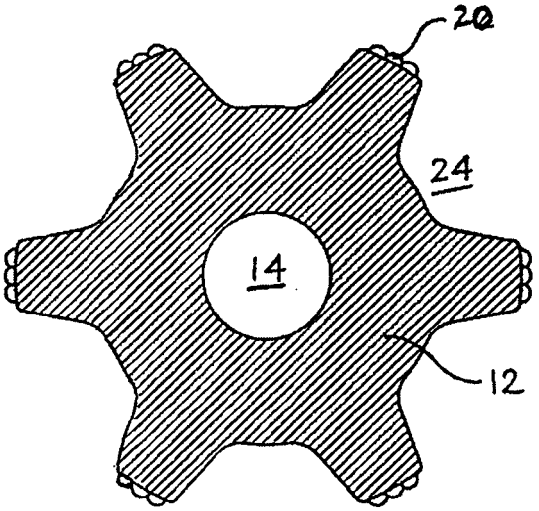

Fig 8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 00 1055

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	24 May 2006	Schouten, A

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X : particularly relevant if taken alone
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