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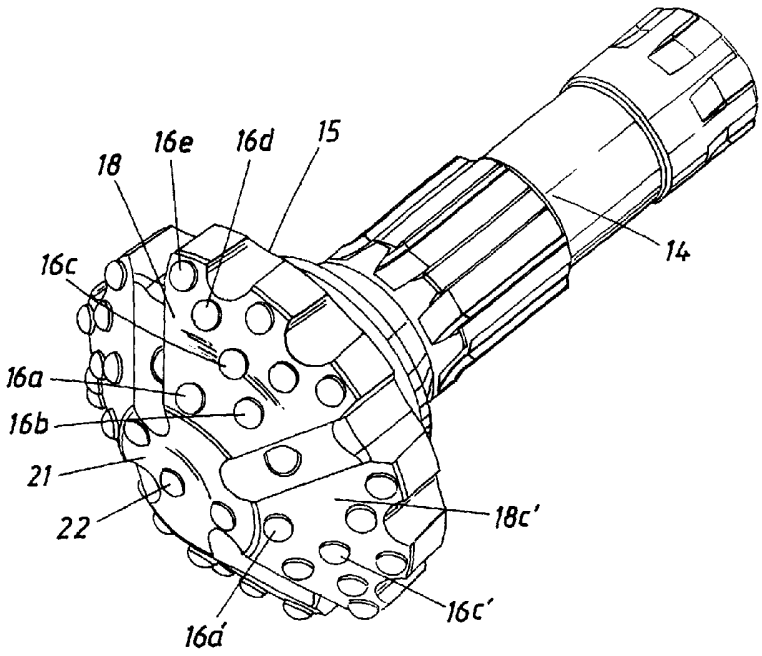
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(54) Title: A REAMER ASSEMBLY



(57) Abstract: The present invention relates to a reamer assembly for widening a drilled pilot hole or for widening a hole that has been widened in a first step in a down-the-hole drilling operation, wherein the reamer assembly includes a shank (14) for attachment of the reamer to the end of a down-the-hole hammer drill and a conical drill bit or crown (15). The conical bit (15) of the reamer is divided into at least three segments (18) which are terminated with a transverse end surface (21) that directly connects said conical segments and at least three of said segments (18) include drill buttons (16) that are disposed equidistantly from the centre axis of the drill bit (15).

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A REAMER ASSEMBLY

The present invention relates to a reamer drill assembly, i.e. a drill for widening a drilled pilot hole or for widening a hole that has been widened in a first step in a down-the-hole drilling operation.

Reamers, of this kind include a shank for attachment of the drill to the end of a down-the-hole hammer drill, a conical drill bit, and to a pilot body disposed on one end of the drill bit. The pilot body has a somewhat smaller outer diameter than that of the pre-drilled pilot hole, so as to enable the pilot body to slide down in the pre-drilled pilot hole and therewith guide the drill to follow the pilot hole.

One problem with such reamers is that if the drill bit, or crown, is slightly oblique and therewith causes the pilot body to contact the edge of the pilot hole, there is a risk that the shank will break or fracture, resulting in operational breakdowns and stoppages. Such breakages can also lead to other complications, for instance the need to fish up the drill bit lost down the drill hole.

Another problem is that larger drill cuttings may find it difficult to fall down in the pilot hole and therewith leave the drill location. Large cuttings that are able to fall down in the pilot hole despite their large size are liable to fasten in and block the hole, so as to present an obstacle to the pilot body, which lacks a cutter, and therewith halt drilling until the cuttings can be removed.

Another drawback with such reamers is that a reamer must be made available for each size of pilot hole, so that the pilot

body will be able to pass down through the hole and therewith guide the reamer during the reaming process.

Accordingly, one object of the present invention is to provide a novel reamer assembly which allows all of these problems and drawbacks to be avoided.

This object is achieved in that the conical configuration of the drill bit of the reamer is divided into at least three segments which are terminated with a transverse end surface which directly connects said conical segments, and in that a drill button is provided in at least three of said segments with said buttons disposed equidistantly from the centre axis of the drill bit.

The invention will now be described in more detail by way of example only, with reference to the accompanying drawings, in which **Figure 1** is a schematic illustration of a known reamer assembly used in rock drilling operations; **Figure 2** is a corresponding view of an inventive reamer assembly for use in rock drilling operations; **Figure 3** is a schematic illustration of a common plane projection of the drill buttons in one segment of the reamer; **Figure 4** illustrates schematically and in perspective a reamer constructed in accordance with the invention; and **Figure 5** is an end view of the reamer shown in Fig. 4, as seen from the side of the drill.

Fig. 1 thus shows a reamer assembly 1 used to drill in rock 2 in order to widen a predrilled pilot hole 3. The reamer 1 includes a shank 4 and a conical drill bit 5 attached to the shank 4. Attached to the conical surfaces of the drill bit are a number of drill buttons 6 which are adapted to carry out the actual rock drilling and rock removing operation.

Arranged on the end of the bit or crown 5 distal from the shank 4 is a generally cylindrical pilot body 7 which projects slightly outwards from the conical drill bit 5. The pilot body 7 has an outer diameter that is slightly smaller than the inner diameter of the pilot hole 3, therewith enabling the pilot body to guide the reamer 1 so that said drill will cut away or otherwise remove rock 2 symmetrically around the centre of the pilot hole and so that the widened hole will follow the earlier drilled pilot hole 3.

Figure 2 illustrates a reamer assembly 11 constructed in accordance with the present invention. The main difference between this drill and the earlier known drill 1 shown in Fig.1 is that the novel inventive reamer assembly 11 lacks a guide pilot body. Instead, the drill buttons 16 are relied upon to guide the reamer in the pilot hole. In the case of reamers designed in accordance with the present invention, the drill buttons 16 are given precise positions in the drill bit 15 of the reamer 11 so that combined action of said buttons will ensure that the reamer 11 is guided in the pilot hole 3 when drilling in rock 12. In other respects the reamer 11 has generally the same design as the reamer shown in Fig. 1, in other words includes a shank 14 and a generally conical drill bit 15.

According to the present invention, the conical surface of the drill bit 15 of the reamer 11 is divided into a plurality of segments 18 each containing a plurality of drill buttons 16. These buttons 16 have mutually the same positions in respective segments 18, in other words each segment contains buttons that are situated at mutually the same distance from the centre axis of the drill bit/reamer as the buttons in other segments. Thus, the button 16a in the segment 18 is the

same distance from the centre axis of the reamer as the button 16a´ in the segment 18´; see Figs 4 and 5. Similarly, the button 16c in the segment 18 is situated at the same distance from the centre axis of the reamer as the button 16c´ in the segment 18´.

By placing the buttons 16 in the drill bit 15 in this way, the buttons are themselves able to guide the reamer 11 when drilling in rock 12, so as to cause the drilled hole to follow the pilot hole 13.

The various buttons 16 of each segment 18 are positioned so as to lie at different radial distances from the axial centre of the drill bit, so that at least one button of each segment will be able to guide the reamer towards the edge of the pilot hole. As will be seen from the common plane projection shown in Fig. 3, the buttons 16 will lie adjacent one another or overlap each other to some extent. This will ensure that at least one button 16 of each segment 18 will always be able to support against the edge of a pilot hole and therewith guide the reamer along the hole.

With the aid of different vertical chain lines 19a, 19b and 19c, Fig. 3 shows how different buttons 16a, 16b and 16c will be those buttons that function as guides in a pilot hole whose wall follows the lines 19a, 19b or 19c. Thus, as a result of the close-by or overlapping relationship of respective buttons 16, there will always be one button in each segment 18 that is able to guide the reamer in the pilot hole. Also shown are those buttons 16d and 16e that lie further out towards the edge 20 of the drill bit 15. These latter buttons do not normally have a guiding effect, but are always those buttons that cut or remove rock irrespective of

whether the edge of the pilot hole follows the line 19a, the line 19b or the line 19c.

Those buttons that are furthest in towards the centre of the drill bit on its conical segments, i.e. the buttons 16a, are those which determine the smallest size of the pilot hole with which the reamer can be used. For example, it has been possible with the aid of the present invention to widen a pilot hole with a diameter of from about 150 mm to about 205 mm with one and the same reamer.

The buttons 16 are preferably placed in mutually the same pattern in each of the segments. Moreover, several buttons may be placed equidistantly from the centre of the drill bit in one and the same segment. See in particular Fig. 5.

The drill bit 15 must include at least three segments 18, in order to achieve correct guidance of the reamer 11. There are four segments in the case of the illustrated embodiment, although this number may be greater depending on the size of the drill 11.

The segments 18 are joined together at the end of the drill bit 15, by a planar or slightly concave transverse end surface 21. Drill buttons 22 are also provided in the transverse end surface 21 of the drill bit. The function of these latter buttons is not to cut away rock, but to grind down any cuttings that may have fallen down and fastened in the pilot hole. When drilling a blind hole, these buttons 22 will also support against the bottom of the hole so as to prevent material damage to the drill bit 15.

Thus, an inventive reamer assembly enables one and the same reamer to be used with pre-drilled pilot holes of mutually different sizes, although within certain limits of course, as distinct from the earlier case where it was necessary to use different reamers adapted to the size of respective pilot holes.

Because an inventive reamer lacks a pilot body, there is less risk of the drill being subjected to bending loads that result in breaking of the drill shank.

The design of the inventive reamer also lowers the risk of the drill being stopped by cuttings that remain in the pilot hole, by virtue of the fact that the buttons 22 situated on the end 21 of the drill bit 15 are able to grind away said cuttings. Drill cuttings can move past the drill bit and fall down through the pilot hole more easily than was previously the case, due to the absence of an obstructive pilot body.

The inventive reamer is also better than prior art reamers when reaming blind holes, since the risk of material damage to the drill bit is considerably less than in the case of prior art reamers that include a pilot body. Another advantage afforded by the invention is that a drill bit that does not include a pilot body is lighter than one that does.

As will be apparent from the above description, the inventive reamer may be divided into more than three segments, wherein buttons in at least three segments are placed at mutually the same distance from the axial centre of the drill bit, as defined in the accompanying claims, so as to obtain the necessary stability in guiding the drill bit. The buttons in

remaining segments may conveniently be positioned differently.

Claims

1. A reamer assembly (11) for widening a drilled pilot hole or for widening a hole that has been widened in a first step in a down-the-hole drilling operation, wherein the reamer assembly includes a shank (14) for attachment of the reamer to the end of a down-the-hole hammer drill and a conical drill bit or crown (15), c h a r a c t e r i s e d in that the conical bit (15) of the reamer is divided into at least three segments (18) which are terminated with a transverse end surface (21) which directly connects said conical segments; and in that at least three of said segments (18) include drill buttons (16) that are disposed equidistantly from the centre axis of the drill bit.

2. A reamer assembly according to Claim 1, c h a r a c t e r i s e d in that each segment (18) includes a plurality of drill buttons (16a - 16e).

3. A reamer assembly according to Claim 2, c h a r a c t e r i s e d in that the drill buttons (16a - 16e) are placed in mutually the same pattern in each of said segments (18).

4. A reamer assembly according to Claim 2 or 3, c h a r a c t e r i s e d in that a plurality of drill buttons (16) in one and the same segment are disposed equidistantly from the centre of the drill bit (15).

5. A reamer assembly according to any one of the preceding Claims, c h a r a c t e r i s e d in that the drill buttons (16a - 16e) of one segment are disposed so as to lie close to

or to slightly overlap each other in a common plane projection. (Fig. 3).

6. A reamer assembly according to any one of the preceding Claims, c h a r a c t e r i s e d in that drill buttons (22) are provided in the transverse end surface (21) of the drill bit (15).

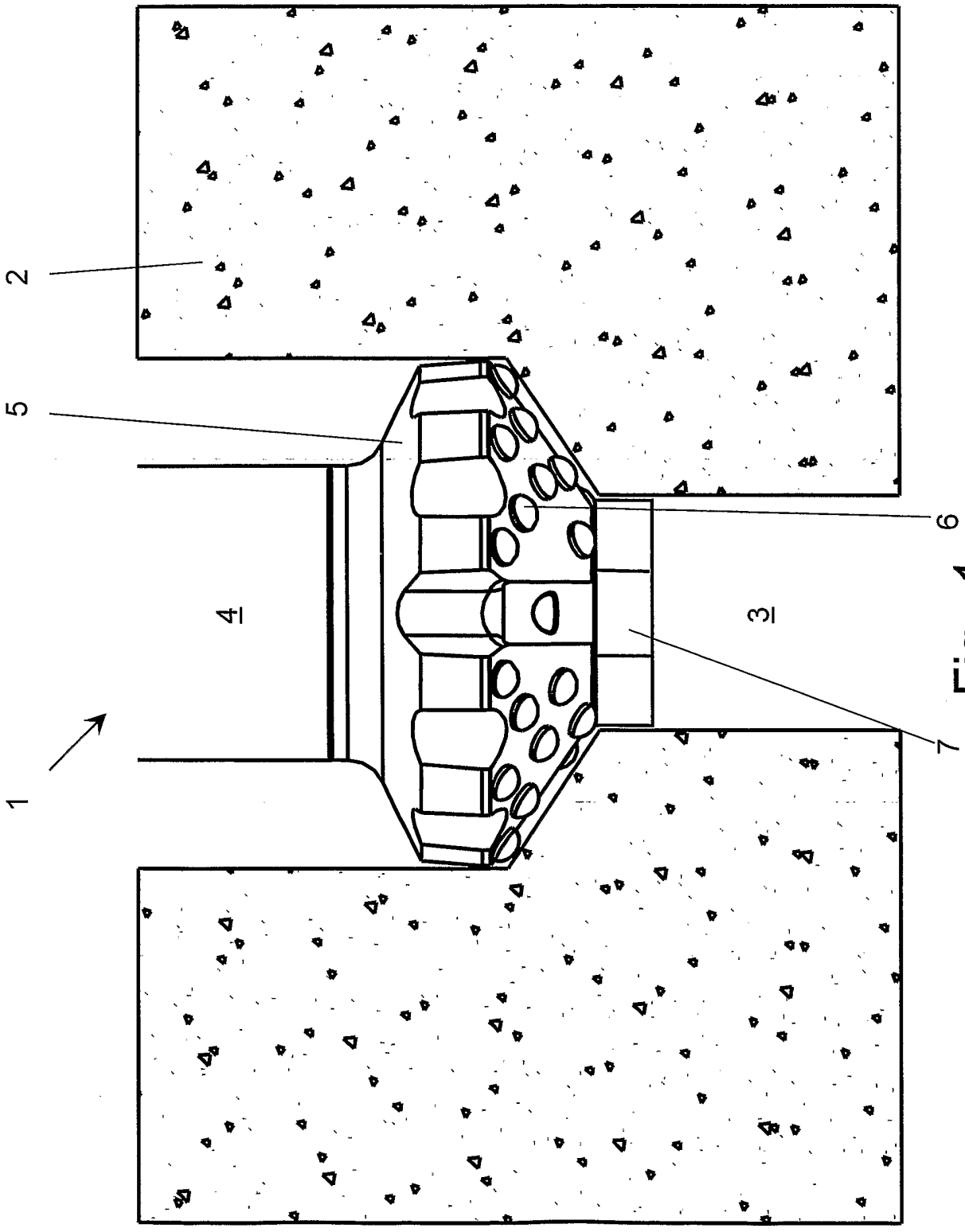


Fig. 1

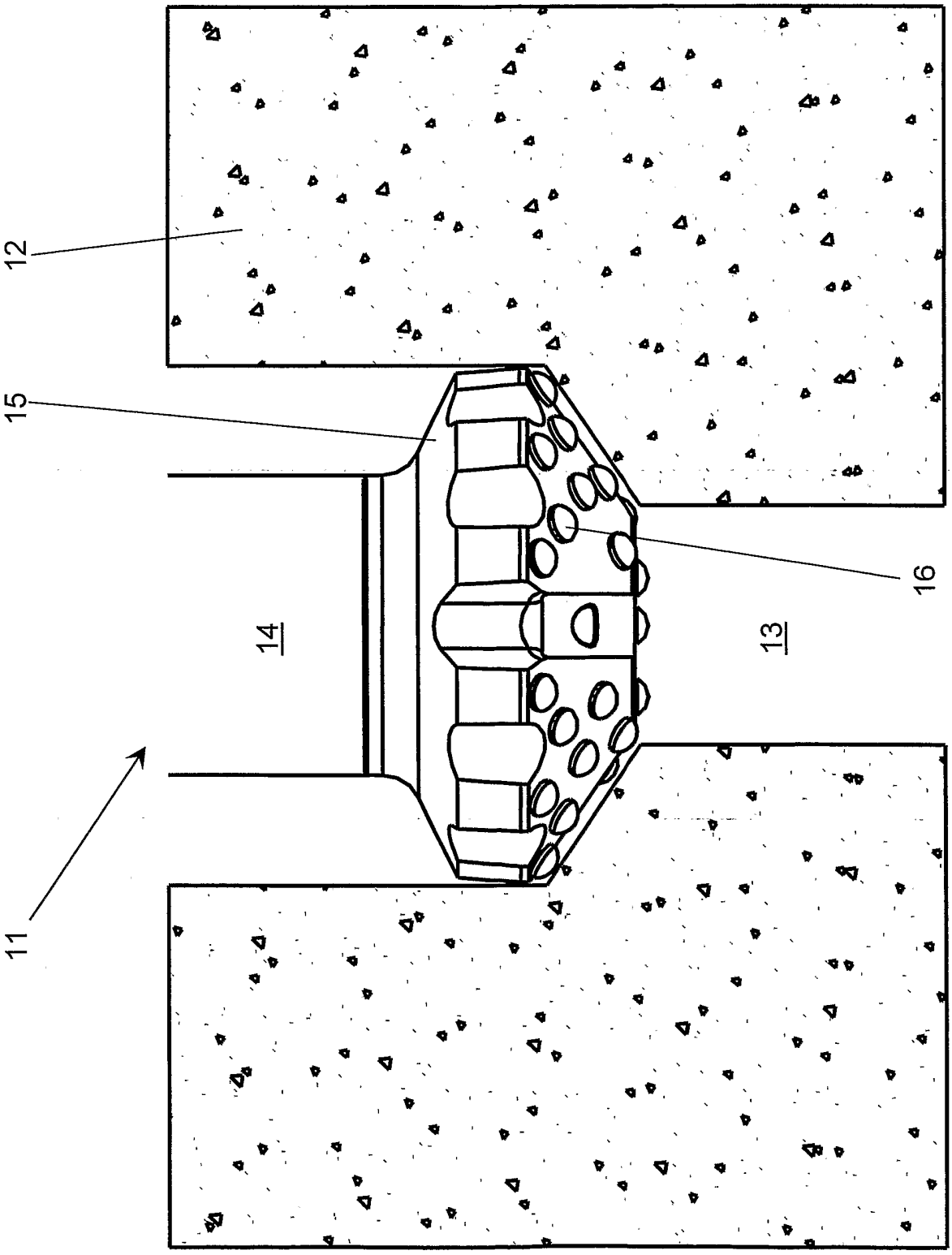


Fig. 2

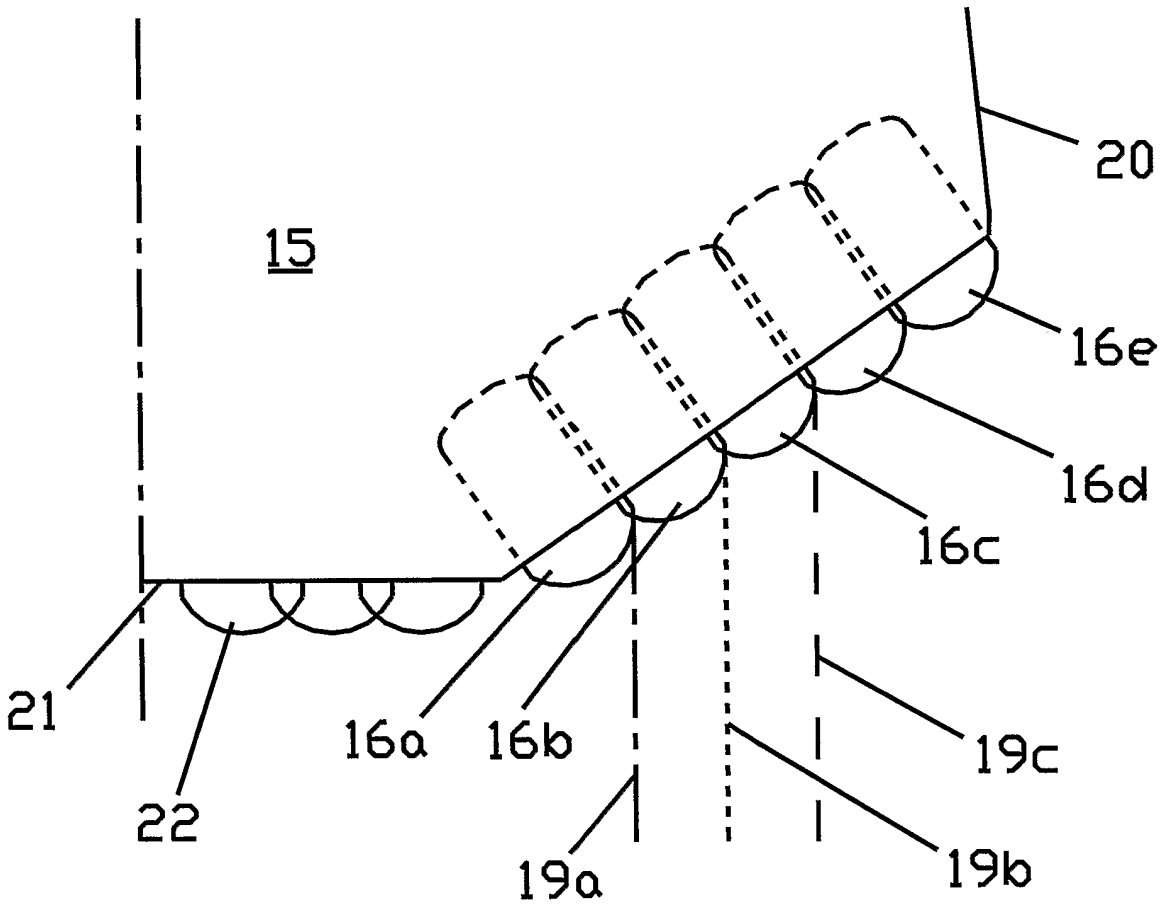


Fig. 3

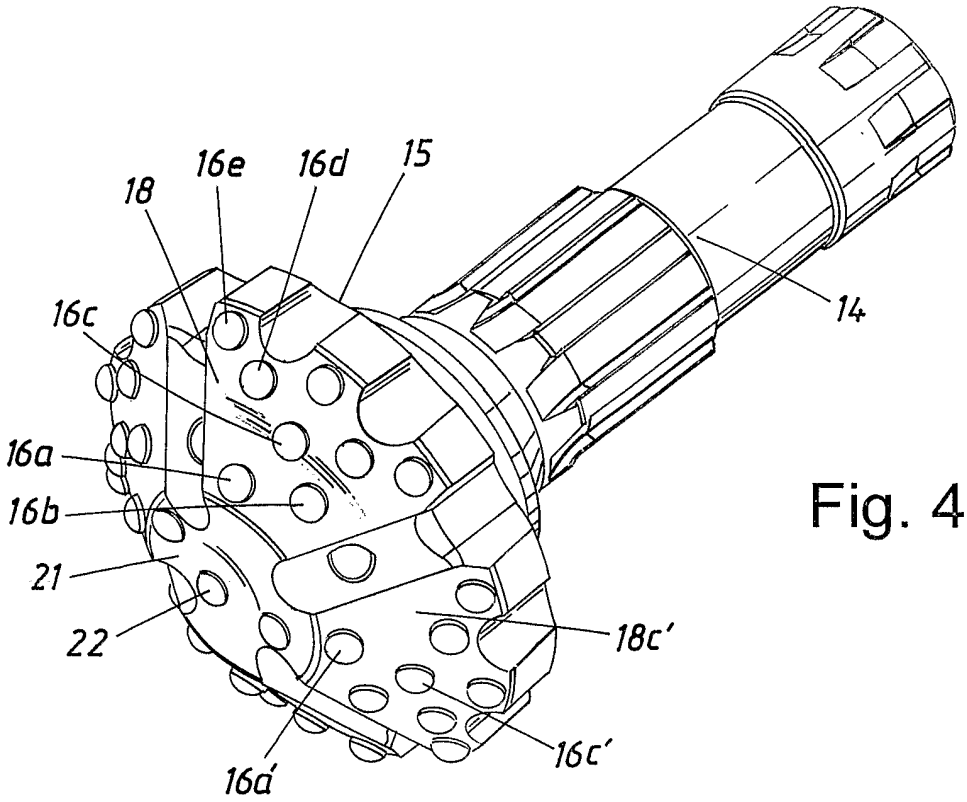
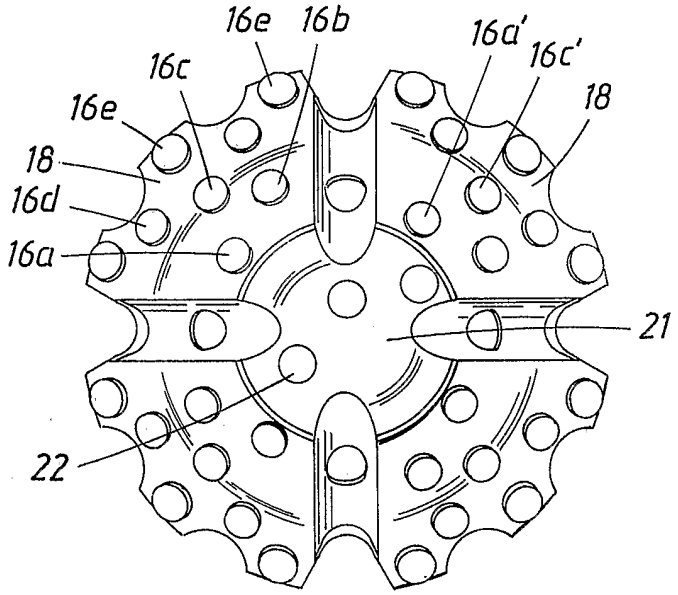

18
16e
16d
15
14
16c
16a
16b
21
22
18c'
16c'
16a'

Fig. 4

Fig. 5


16e
16b
16a'
16c'
16c
18
16e
18
16d
16a
21
22

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 03/01485

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: E21B 10/26, E21B 7/28
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2823900 A (C.W. KANDLE), 18 February 1958 (18.02.58) --	1-6
A	US 3885638 A (S.C. SKIDMORE), 27 May 1975 (27.05.75) --	1-6
A	US 4515227 A (J. CERKOVNIK), 7 May 1985 (07.05.85) --	1-6
A	US 4635738 A (H. SCHILLINGER ET AL), 13 January 1987 (13.01.87) -- --------	1-6

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
11 December 2003	17 -12- 2003
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Christer Bäcknert / MRo Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT
Information on patent family members

31/10/03

International application No.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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