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(54) Title: ROCK DRILL

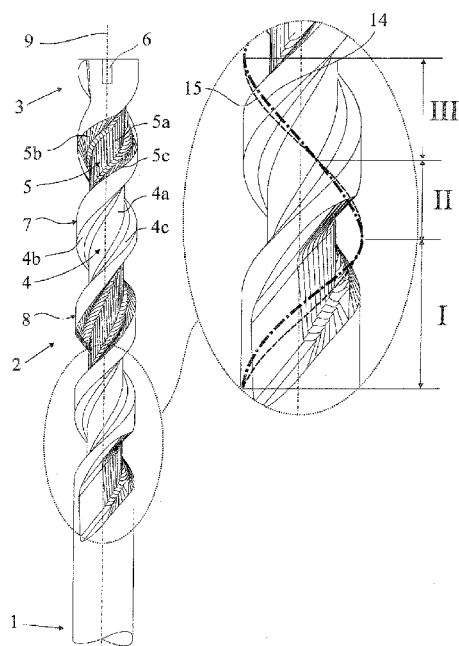


Fig. 1

(57) Abstract: The invention relates to a rock drill comprising an insertion portion, a flute adjoined to the insertion portion, and a head portion adjoined to the flute, wherein the flute is of at least double-spiral configuration and correspondingly has at least two substantially spiral discharge grooves, to which respectively two substantially spiral flute webs forming the lateral groove walls are assigned. It is proposed that a constant spiral pitch is assigned to the first discharge groove, inclusive of the lateral groove walls thereof, along the drill longitudinal axis, and that at least one of the two flute webs assigned to the first discharge groove has or have along the drill longitudinal axis, at least in sections, a web spine width which changes, in particular, alternately.



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- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

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Rock drill

The invention relates to a rock drill, in particular for use in connection with a hammer drilling device,
5 having the features of the preamble to claim 1, and to a method for producing a rock drill, having the features of the preamble to claim 11.

The rock drill in question is suitable for drilling in
10 concrete or reinforced concrete, but also in other masonry, rock or the like. The rock drill in question is usually equipped with an insertion portion, a flute adjoined to the insertion portion and a head portion adjoined to the flute.

15 Particular importance is in the present case attached to the flute, which serves to evacuate the removed cuttings from the head portion in the direction of the insertion portion. The flute is usually of spiral
20 configuration, so that appropriate conveying edges and conveying surfaces for the cuttings are obtained.

The conveyance of cuttings when drilling in concrete or the like places quite particular demands on the flute,
25 since the consistency here ranges from powdery to lumpy. In the light of this, measures must be taken to ensure the frictionless evacuation of cuttings and, in particular, avoid blockage of the flute.

30 At the same time, care must be taken to ensure that the formation of natural vibrations of the drilling system is as far as possible suppressed overall.

The known rock drill (DE 201 08 179 U1) from which the
35 invention derives shows a flute whose geometry changes along the drill longitudinal axis. More specifically, for the improvement of the cuttings transport, it is provided that the pitches of discharge grooves and flute webs change along the drill longitudinal axis.

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Due to the symmetrical geometry of its flute along the drill axis, the known rock drill is advantageous with regard to the suppression of natural vibrations.

5 Potential exists to optimize the cuttings transport.

The invention is based on the problem of designing and refining the known rock drill in such a way that the cuttings transport is optimized, at the same time as
10 natural vibrations are effectively suppressed.

The above problem is solved in a rock drill according to the preamble to claim 1 by virtue of the features of the characterizing part of claim 1.

15

Of fundamental importance is the basic notion of constructing the flute from a symmetrical geometry and a non-symmetrical geometry in such a way that, on the one hand, natural vibrations are suppressed and, on the
20 other hand, cuttings transport is optimized.

More specifically, it is firstly proposed that a constant spiral pitch is assigned to a first discharge groove, inclusive of the lateral groove walls thereof,
25 along the drill longitudinal axis. It is thereby ensured that a discharge groove is in any event configured symmetrically along the drill longitudinal axis. In trials, that has proved to be optimal with regard to the cuttings transport.

30

It is additionally proposed that the two flute webs assigned to the first discharge groove have along the drill longitudinal axis, at least in sections, a web spine width which changes, in particular, alternately.
35 That means that the second discharge groove adjacent to the first discharge groove is specifically not configured symmetrically along the drill longitudinal

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axis. This leads to an effective suppression of the abovementioned natural vibrations.

5 All in all, the proposed rock drill has demonstrated optimal results with regard to the cuttings transport, on the one hand, and the natural vibration characteristics, on the other hand.

10 In the particularly preferred embodiment as claimed in claim 5, the second discharge groove has a spiral pitch which lies in one flute portion substantially above and in another flute portion substantially below the spiral pitch of the first discharge groove. An abovementioned, alternately changing web spine width is thus able to be
15 produced in a particularly simple manner.

According to a further teaching as claimed in claim 11, to which independent importance is likewise attached, a method for producing a rock drill of the generic type
20 is claimed, wherein at least one discharge groove of the rock drill has different spiral pitches in different axial flute portions.

25 The proposed method is aimed at the introduction of discharge grooves into a substantially cylindrical drill blank. For this purpose, a standard grinding or milling cutter disk having a peripheral face and two side faces is provided, wherein the grinding or milling cutter is set at a setting angle in relation to the
30 longitudinal axis of the rock drill. For the introduction of the at least one discharge groove, the grinding or milling cutter disk is displaced with a longitudinal feed in the direction of the drill longitudinal axis and the drill blank is rotated with
35 an angular feed about the drill longitudinal axis.

Now it is of fundamental importance that, for the introduction of the at least one discharge groove, the

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setting angle of the grinding or milling cutter disk is kept constant and the ratio of longitudinal feed to angular feed is varied, in particular alternately, for the adjustment of the different spiral pitches.

5

According to the proposal, it has been recognized that the spiral pitch of the discharge groove, which changes along the drill longitudinal axis, can be easily realized by varying the ratio of longitudinal feed to angular feed, while the setting angle of the grinding or milling cutter disk remains constant.

The embodiment as claimed in claim 12 relates to a method for producing a rock drill according to the first-named teaching, wherein, for the introduction of the first discharge groove, the ratio of longitudinal feed to angular feed is kept constant and, for the introduction of the second discharge groove, the ratio of longitudinal feed to angular feed, as illustrated above, is varied, in particular alternately.

Although the proposed method leads to increased lateral load upon the grinding or milling cutter disk, since in this method the grinding or milling cutter disk regularly "slips" via one of its side faces, the advantage of short set-up times through elimination of the change of adjustment angle of the grinding or milling cutter disk far outweighs this aspect.

The invention is explained in greater detail below with reference to a drawing representing merely illustrative embodiments, in which drawing:

fig. 1 shows a proposed rock drill as a semifinished part in side view,

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fig. 2 shows the rock drill according to fig. 1 during the introduction of the first discharge groove,

5 fig. 3 shows the rock drill according to fig. 1 during the introduction of the second discharge groove.

The proposed rock drill is represented in the drawing
10 as a semifinished part. It has an insertion portion 1, which is usually provided with a coupling configuration (not represented). Adjoined to the insertion portion 1 is a flute 2, which is here and preferably of double-spiral configuration. The flute 2 is in turn adjoined
15 by a head portion 3, which, in the product-ready state, is equipped with a cutting edge arrangement. The cutting edge arrangement is here preferably inserted in a slot 6 in the head portion 3. In the case of the represented semifinished part, the slot 6 is merely
20 indicated and the cutting edge arrangement is not shown.

The represented rock drill is designed for a two-lipped cutter, which has two cutting edges extending in
25 opposite directions. On both sides of such a cutting edge arrangement, designed preferably as an insert element, extend the discharge grooves 4, 5, which together form the flute 2.

30 In the represented illustrative embodiment, two spiral discharge grooves 4, 5 are provided. It is also conceivable, however, for more than two discharge grooves 4, 5 to be provided, for instance if the cutting edge arrangement is in the form of a three-
35 lipped cutter or a four-lipped cutter.

The discharge grooves 4, 5 can have quite different cross-sectional forms. It is in any event the case that

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respectively one groove floor 4a, 5a and respectively two groove walls 4b, 5b and 4c, 5c are provided.

From the representation in fig. 1, it can be seen that
5 the lateral groove walls 4b, 4c, 5b, 5c are formed by substantially spiral flute webs 7, 8.

With a view to a clear representation, the first discharge groove 4 is represented in the drawing
10 without polygonal surface marking, and the second discharge groove 5 with polygonal surface marking.

Now it is of fundamental importance that a constant spiral pitch is assigned to the first discharge groove
15 4, inclusive of its lateral groove walls 4b, 4c, along the drill longitudinal axis 9. In this respect, this first discharge groove 4 provides a symmetrical component part of the proposed rock drill.

20 It is also of fundamental importance that at least one of the two flute webs 7, 8 assigned to the first discharge groove 4 has or have along the drill longitudinal axis 9, at least in sections, a changing web spine width. Here and preferably, both flute webs
25 7, 8 are equipped with changing web spine widths. In this context, it can in principle be provided that the web spine widths, at least in sections, are constant. As a result, an asymmetrical component of the proposed rock drill is obtained.

30 A further increase in the symmetry of the rock drill can preferably be achieved by virtue of the fact that the first discharge groove 4, related to the cross section perpendicular to the drill longitudinal axis 9,
35 has an identical cross sectional contour substantially over the entire flute 2.

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In a particularly preferred embodiment, it is the case that the entire flute 2, viewed in cross section perpendicular to the drill longitudinal axis 9, in any event with respect to the configuration of the flute webs 7, 8, is asymmetrically configured at least in one axial flute portion, in this case over the entire flute 2. Given a suitable design, the asymmetrical cross section can have an extremely vibration-reducing effect.

10

In the illustrative embodiment represented in fig. 1, it is the case that the web spine widths of both flute webs 7, 8 change over the entire drill longitudinal axis 9. In principle, it can also however be advantageous for at least one of the two flute webs 7, 8 assigned to the first discharge groove 4 to have web spine widths which are constant, at least in sections, along the drill longitudinal axis 9.

15

20 An alternately changing web spine width can be realized in a simple manner by at least a second discharge groove 5 having a spiral pitch which lies in one axial flute portion substantially above, and in another axial flute portion substantially below the spiral pitch of the first discharge groove 4. For this effect of changing web spine widths, the adjacent arrangement of the second discharge groove 5 relative to the first discharge groove 4 is necessary.

25

30 The spiral pitch of the second discharge groove 5 can be seen in first approximation from the representation in fig. 1, there on the basis of the web spine widths of the flute webs 7, 8. In regions in which the web spine width of the respective flute web 7, 8 decreases in the direction of the head portion 3, the spiral pitch of the second discharge groove 5 is in first approximation greater than the spiral pitch of the first discharge groove 4. If, on the other hand, the

35

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corresponding web spine width increases in the direction of the head portion 3, then the spiral pitch of the second discharge groove 5 lies in first approximation below the spiral pitch of the first discharge groove 4. Insofar as the web spine width of a flute web 7, 8 remains constant in the direction of the head portion, the spiral pitches of the first discharge groove 4 and of the second discharge groove 5 are in first approximation identical.

10

An interesting variant consists in the second discharge groove 5 having, at least in sections, a substantially constant spiral pitch. The symmetry of the second discharge groove 5 can thus be enhanced, which can be advantageous, in particular, with respect to the cuttings transport.

15

Alternatively or additionally, it can be provided that the second discharge groove 5, at least in sections, has a changing spiral pitch. Above all, the combination of an, in sections, substantially constant spiral pitch with an, in sections, changing spiral pitch of the second discharge groove 5 has led in trials to quite especially good results.

25

Also of interest is an embodiment in which the second discharge groove 5 shows between two flute portions an uneven spiral pitch pattern. Additional conveying edges can thereby be produced, which, once again, can be advantageous with regard to the cuttings transport.

30

With a view to a visually appealing configuration, it can also however be provided that the second discharge groove 5 shows between two flute portions of different spiral pitch a substantially even spiral pitch pattern.

35

In the present case, particular importance is attached to the method of producing the proposed rock drill. In principle, different production methods such as

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grinding, milling or rolling are applicable here.
According to a further teaching, to which independent
importance is attached, a specific grinding or milling
method is claimed.

5

The method relates quite generally to the production of
a rock drill comprising an insertion portion 1, a flute
2 adjoined to the insertion portion 1, and a head
portion 3 adjoined to the flute 2, wherein the flute 2
10 has at least one spiral discharge groove 4, 5, at least
one discharge groove 5 having in different axial flute
portions different spiral pitches. One example of this
at least one discharge groove is the abovementioned
second discharge groove 5.

15

For the implementation of the method, a grinding or
milling cutter disk 10 having a peripheral face 11 and
two side faces 12, 13 is provided, wherein the grinding
or milling cutter disk 10 is set in a known manner at a
20 setting angle ϕ in relation to the drill longitudinal
axis. For the introduction of the at least one
discharge groove 4, 5, the grinding or milling cutter
disk 10 is displaced with a longitudinal feed v_x in the
direction of the drill longitudinal axis 9, and the
25 drill blank is rotated with an angular feed ω about the
drill longitudinal axis 9. In this respect, the
production method still corresponds to the method known
from the prior art.

30 Now it is of fundamental importance that, for the
introduction of the second discharge groove 5, the
setting angle ϕ of the grinding or milling cutter disk
10 is kept constant and the feed ratio R of
longitudinal feed v_x to angular feed ω is varied, in
35 particular alternately, for the adjustment of the
different spiral pitches.

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It has been recognized that a spiral pitch which is variable along the drill longitudinal axis 9 can be easily realized by the feed ratio R of longitudinal feed v_x to angular feed ω being varied, in particular
5 alternately, for the adjustment of the different spiral pitches.

More specifically, for the production of the drill represented in fig. 1, it is preferably provided that,
10 for the introduction of all discharge grooves 4, 5, the setting angle ϕ of the grinding or milling cutter disk 10 is kept constant, and that, for the introduction of the first discharge groove 4, the feed ratio R is kept constant and, for the introduction of the second
15 discharge groove 5, the feed ratio R is varied, in particular alternately, for the adjustment of the different spiral pitches. It is thus possible, with one and the same setting angle ϕ of the grinding or milling cutter disk 10, to produce both the first discharge
20 groove 4 with constant spiral pitch and the second discharge groove 5 with changing spiral pitch.

Insofar as the feed ratio R is set such that the material removal is effected substantially via the
25 peripheral face 11, and not via the side faces 12, 13 of the grinding or milling cutter disk 10, the grinding or milling cutter disk 10 works in synchronous operation. In a particularly preferred embodiment, it is the case that, for the introduction of at least one
30 discharge groove 4, in particular of the first discharge groove 4, the constant synchronous feed ratio R_0 is adjusted.

In a particularly preferred embodiment, it is provided
35 that, for the introduction of at least one discharge groove 5, here the second discharge groove 5, the feed ratio R is varied, in particular alternately, for the adjustment of different spiral pitches, such that the

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feed ratio R lies, in some sections, above the synchronous feed ratio R_0 and, in some sections, below the synchronous feed ratio R_0 .

5 Insofar as an above, at least in sections constant spiral pitch pattern is desired, it is preferably provided that the feed ratio R , for the introduction of at least one discharge groove 4, 5, is at least in sections constant.

10

Fig. 2 shows in quite schematic representation the position of the grinding or milling cutter disk 10 relative to the drill blank, wherein, with a view to a clear representation, the ready-ground or ready-milled 15 flute 2 is represented, even though this, at the represented production point, is not yet fully ground or milled.

From the feed ratio-time graph in fig. 2, it becomes 20 clear that, when the first discharge groove 4 is introduced, the feed ratio R is constant throughout the production time. The feed ratio R is here constituted by the abovementioned synchronous feed ratio R_0 . The grinding or milling cutter disk 10 is here operated at 25 the rotation speed n .

It looks different in that introduction of the second discharge groove 5 which is represented in fig. 3. From the feed ratio-time graph in fig. 3, it can be seen 30 that the feed ratio R changes over the production time, namely in a first segment I lies above the synchronous feed ratio R_0 , in a second segment II lies below the synchronous feed ratio R_0 , and in a third segment III again lies above the synchronous feed ratio R_0 . The time 35 segments I, II, III represented in fig. 3 correspond to the axial portions I, II, III represented in fig. 1.

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The detailed view in fig. 1 shows in a dash-dot line the real trajectory 14 of the tool reference point of the grinding or milling cutter disk 10 during the grinding or milling of the second discharge groove 5.

5 The tool reference point of the grinding or milling cutter disk 10 is constituted by a point which has a fixed relative position to the mounting of the grinding or milling cutter disk 10.

10 By means of the tool reference point, the trajectory of the grinding or milling cutter disk 10 relative to the workpiece can be defined in the usual manner.

By comparison, an imaginary trajectory 15 of the tool
15 reference point of the grinding or milling cutter disk 10 during the grinding or milling of an imaginary discharge groove 5 having a spiral pitch which is identical to the spiral pitch of the first discharge groove 4 is shown in fig. 1 in a dashed line. This
20 imaginary trajectory 15 is hereinafter referred to as the reference trajectory 15.

The fact that the real trajectory 14 of the tool reference point intersects the reference trajectory 15
25 several times, namely respectively at the transition from one portion to the next portion of portions I, II, III, is of interest here.

It can be clearly seen from the detailed representation
30 in fig. 1 that the spiral pitch of the trajectory 14 of the tool reference point moves around the spiral pitch of the reference trajectory 15. Related to the spiral pitch of the reference trajectory 15, the spiral pitch of the trajectory 14 lies in a range between about 70%
35 and 140%, in particular between 75% and 135%.

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Patent claims

1. A rock drill comprising an insertion portion (1),
a flute (2) adjoined to the insertion portion (1), and
5 a head portion (3) adjoined to the flute (2), wherein
the flute (2) is of at least double-spiral
configuration and correspondingly has at least two
substantially spiral discharge grooves (4, 5), to which
respectively two substantially spiral flute webs (7, 8)
10 forming the lateral groove walls (4b, 4c, 5b, 5c) are
assigned,

characterized in that

a constant spiral pitch is assigned to the first
discharge groove (4), inclusive of the lateral groove
15 walls (4b, 4c) thereof, along the drill longitudinal
axis (9), and in that at least one of the two flute
webs (7, 8) assigned to the first discharge groove (4)
has or have along the drill longitudinal axis (9), at
least in sections, a web spine width which changes, in
20 particular alternately.

2. The rock drill as claimed in claim 1,
characterized in that the first discharge groove (4),
related to the cross section perpendicular to the drill
25 longitudinal axis (9), has an identical cross sectional
contour substantially over the entire flute (2).

3. The rock drill as claimed in claim 1 or 2,
characterized in that the entire flute (2), viewed in
30 cross section perpendicular to the drill longitudinal
axis (9), in any event with respect to the
configuration of the flute webs (7, 8), is
asymmetrically configured at least in one axial flute
portion.

35

4. The rock drill as claimed in one of the preceding
claims, characterized in that at least one of the two
flute webs (7, 8) assigned to the first discharge

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groove (4) has or have along the drill longitudinal axis (9), at least in sections, a constant web spine width.

5 5. The rock drill as claimed in one of the preceding claims, characterized in that at least a second discharge groove (5) has a spiral pitch which lies in one axial flute portion substantially above, and in another axial flute portion substantially below the
10 spiral pitch of the first discharge groove (4).

6. The rock drill as claimed in claim 5, characterized in that the second discharge groove (5) has a spiral pitch which from one axial flute portion
15 to the next axial flute portion lies alternately substantially above or substantially below the spiral pitch of the first discharge groove (4).

7. The rock drill as claimed in one of the preceding
20 claims, characterized in that the second discharge groove (5) has, at least in sections, a substantially constant spiral pitch.

8. The rock drill as claimed in one of the preceding
25 claims, characterized in that the second discharge groove (5) has, at least in sections, a changing spiral pitch.

9. The rock drill as claimed in one of the preceding
30 claims, characterized in that the second discharge groove (5) shows between two portions of different spiral pitch an uneven spiral pitch pattern.

10. The rock drill as claimed in one of the preceding
35 claims, characterized in that the second discharge groove (5) shows between two portions of different spiral pitch a substantially even spiral pitch pattern.

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11. A method for producing a rock drill, in particular as claimed in one of the preceding claims, comprising an insertion portion (1), a flute (2) adjoined to the insertion portion (1), and a head portion (3) adjoined to the flute (2), wherein the flute (2) has at least one spiral discharge groove (4, 5), wherein at least one discharge groove (5) has different spiral pitches, wherein a grinding or milling cutter disk (10) having a peripheral face (11) and two side faces (12, 13) is provided, wherein the grinding or milling cutter disk (10) is set at a setting angle (ϕ) in relation to the drill longitudinal axis (9), wherein, for the introduction of the at least one discharge groove (4, 5), the grinding or milling cutter disk (10) is displaced with a longitudinal feed (v_x) in the direction of the drill longitudinal axis (9) and the drill blank is rotated with an angular feed (ω) about the drill longitudinal axis (9),

characterized in that,

for the introduction of the at least one discharge groove (5) with different spiral pitches, the setting angle (ϕ) of the grinding or milling cutter disk (10) is kept constant and the feed ratio (R) of longitudinal feed (v_x) to angular feed (ω) is varied, in particular alternately, for the adjustment of the different spiral pitches.

12. The method as claimed in claim 11, characterized in that, for the introduction of all discharge grooves (4, 5), the setting angle (ϕ) of the grinding or milling cutter disk (10) is kept constant, and in that, for the introduction of a first discharge groove (4), the feed ratio is kept constant and, for the introduction of a second discharge groove (5), the feed ratio (R) is varied, in particular alternately, for the adjustment of the different spiral pitches.

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13. The method as claimed in claim 11 or 12, characterized in that, given a certain synchronous feed ratio (R_0), the material removal is effected substantially via the peripheral face (11), and not via
5 the side faces (12, 13) of the grinding or milling cutter disk (10), and in that, for the introduction of at least one discharge groove (4), the constant synchronous feed ratio (R_0) is adjusted.

10 14. The method as claimed in one of claims 11 to 13, characterized in that, for the introduction of at least one discharge groove (5), the feed ratio (R) is varied, in particular alternately, for the adjustment of different spiral pitches, such that the feed ratio (R)
15 lies, in some sections, above the synchronous feed ratio (R_0) and, in some sections, below the synchronous feed ratio (R_0).

15. The method as claimed in one of claims 11 to 14,
20 characterized in that, for the introduction of at least one discharge groove (4, 5), the feed ratio (R), at least in sections, is constant.

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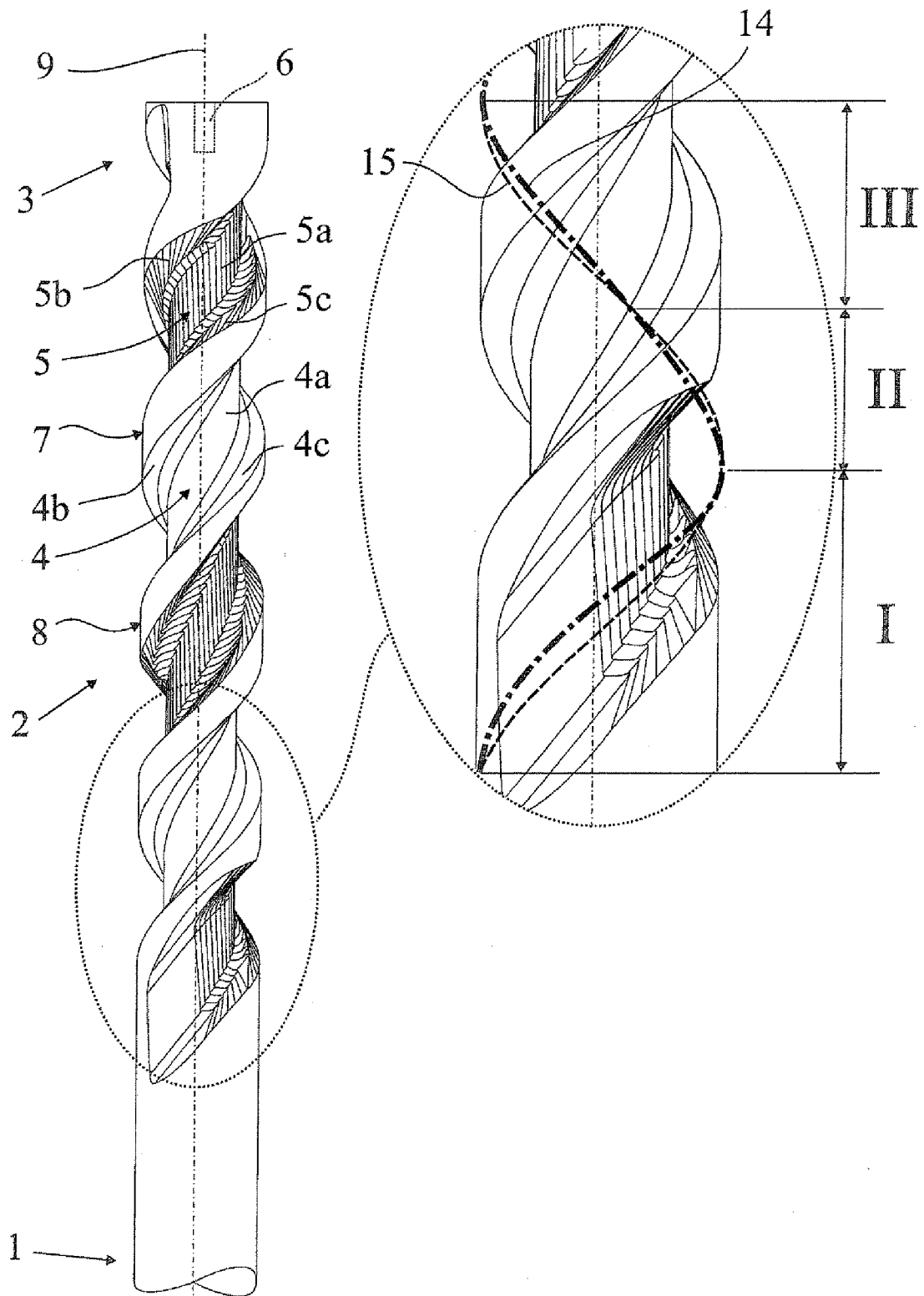


Fig. 1

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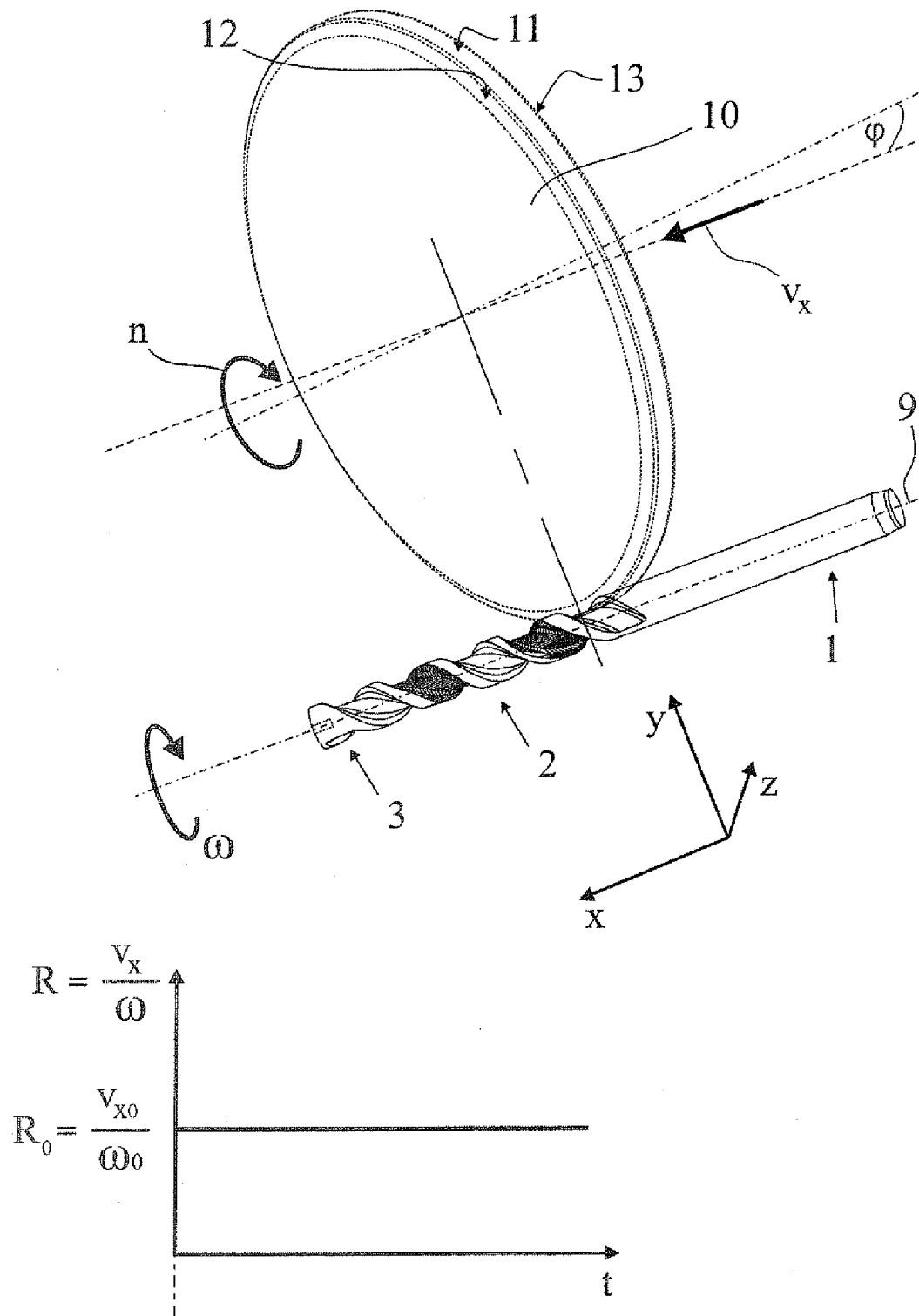


Fig. 2

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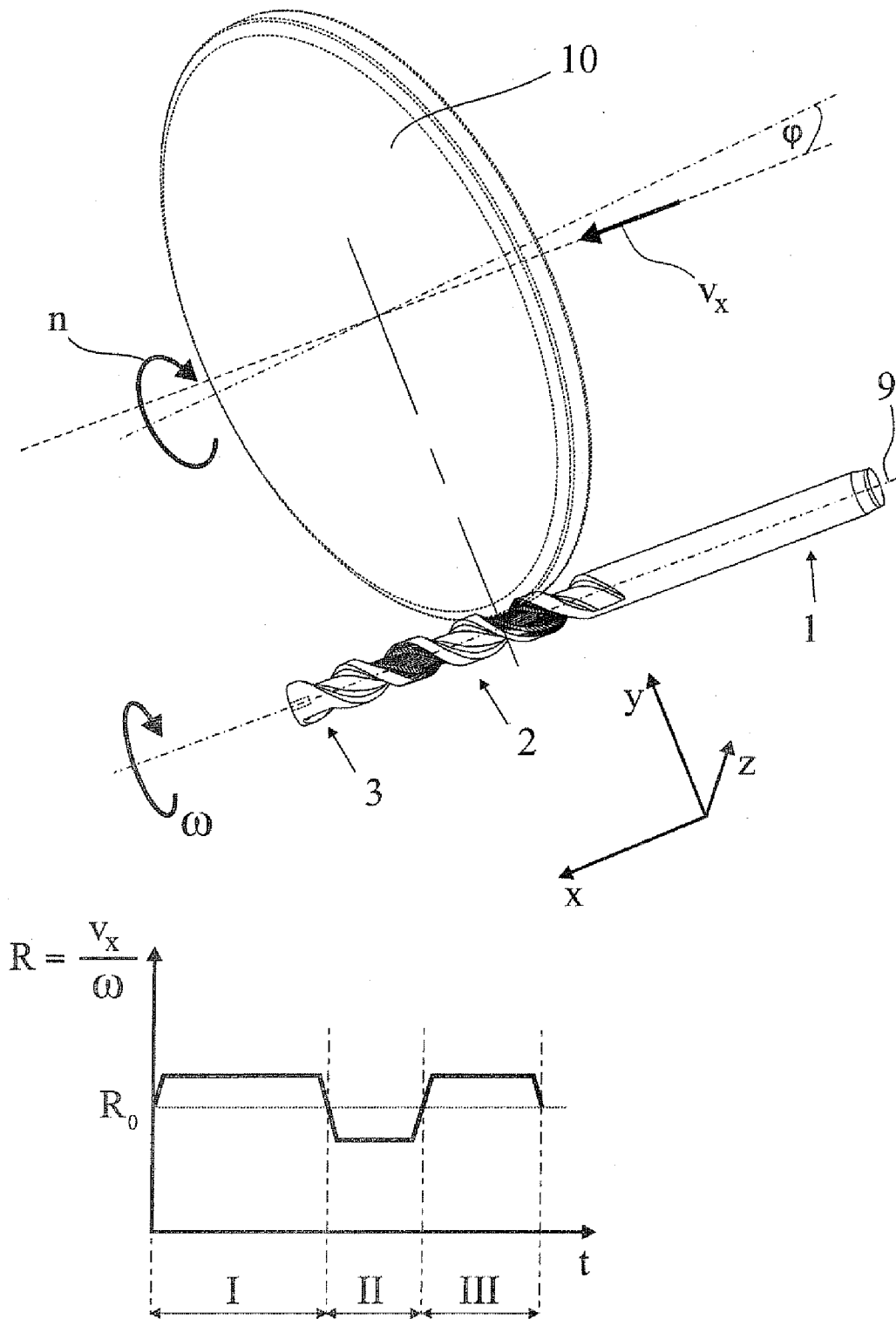


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/051750

A. CLASSIFICATION OF SUBJECT MATTER

INV. B23B51/02 B23C3/32 B24B19/04 B28D1/14 E21B10/44
ADD.

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)

B23B B28D E21B B24B B23C

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 250 857 B1 (KERSTEN HEINRICH [DE]) 26 June 2001 (2001-06-26)	1-10
A	column 1, lines 4-6; figures 1-5 column 1, lines 55-62	11-15
X	US 2003/019667 A1 (PEETZ WOLFGANG [DE]) 30 January 2003 (2003-01-30)	1
A	paragraphs [0001], [0011]; figures 1,2	2-15
X	EP 1 396 303 A2 (MITSUBISHI MATERIALS CORP [JP]) 10 March 2004 (2004-03-10)	11-15
A	paragraphs [0001], [0028], [0058]; figures 1-11	1-10
X	DE 102 43 403 A1 (HAWERA PROBST GMBH [DE]) 1 April 2004 (2004-04-01)	11
A	paragraphs [0001], [0012]; figures 1-10	1-10, 12-15
	----- -/-	



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

26 July 2012

Date of mailing of the international search report

07/08/2012

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2012/051750

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 967 855 A (MOSER BERNHARD [DE]) 6 November 1990 (1990-11-06) paragraph [0001]; figures 1-5 -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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