

(19)



(11)

**EP 3 581 352 A1**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:

**18.12.2019 Bulletin 2019/51**

(51) Int Cl.:

**B28D 1/14** (2006.01)

**E21B 10/26** (2006.01)

**B28D 1/18** (2006.01)

(21) Application number: **18176922.5**

(22) Date of filing: **11.06.2018**

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB  
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO  
PL PT RO RS SE SI SK SM TR**

Designated Extension States:

**BA ME**

Designated Validation States:

**KH MA MD TN**

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**Corporate Intellectual Property**  
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(54) **REAMER AND METHOD FOR PRODUCING COUNTERSUNK BORES IN CONCRETE**

(57) The invention relates to a reamer for expanding the mouth of a bore in a concrete substrate. The reamer is equipped with a shaft, which is provided, at the rear end region of the shaft, with a shank, a guide pin protruding at the front end of the reamer, cutting wings connected to the shaft, wherein each of the cutting wings has a lateral surface that tapers towards the front end of the ream-

er, and cutting teeth provided on each cutting wing, wherein the cutting teeth protrude from the respective cutting wing on the lateral surface of the respective cutting wing. The invention also relates to a method for producing a countersunk bore in concrete, in which a bore is first produced and the bore is subsequently, following removal of the drill from the bore, reamed.

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## Description

**[0001]** The invention relates to a reamer for expanding the mouth of a bore in a concrete substrate according to claim 1 and to a method for producing countersunk bores in a concrete substrate according to claim 12.

**[0002]** EP3103756 A1 describes a method for lifting a hollow-core slab concrete body, in which self-tapping screws are screwed into the concrete body, which screws provide attachment points for hoisting cables. The hoisting cables are attached to lifting rings or lifting heads provided on the screws. According to one embodiment of EP3103756 A1, the lifting head is received in a recess in the upper surface of the concrete body.

**[0003]** DE10008342 A1 shows screws for lifting autoclaved lightweight concrete blocks, which screws are placed in stepped holes in the concrete blocks. The stepped holes are obtained according to DE10008342 A1 by first making a larger-diameter, cylindrical hole in the concrete and by subsequently drilling a smaller-diameter hole in the bottom surface of the larger-diameter, cylindrical hole.

**[0004]** US7384223 B2 discloses a two-stage drill bit, which includes a shaft, a first stage cutter on the shaft, a second stage cutter on the shaft spaced apart from the first stage cutter, and a depth gage on the shaft spaced apart from the second stage cutter in a direction opposite the first stage cutter. The first stage cutter has a first cutting diameter that is less than a second cutting diameter of the second stage cutter. The drill bit can be used to drill concrete slabs.

**[0005]** US4769960 A discloses a hoisting coupler that can grab the head of a bolt which is cast-into a concrete body. The coupler has a bifurcated section that can grab the head of the bolt in a swivel movement.

**[0006]** It is an object of the invention to provide a reamer for expanding the mouth of a bore in a concrete substrate and to provide a method for producing countersunk, in particular spherically countersunk, bores in a concrete substrate, which allow achieving particularly good re-suits in a particularly easy, reliable and reproducible manner and at particularly low expenditure and effort.

**[0007]** This object is achieved with a reamer according to claim 1 and with a method according to claim 12. Dependent claims refer to preferred embodiments of the invention.

**[0008]** An inventive reamer for expanding the mouth of a bore in a concrete substrate is provided with:

- a shaft, which is provided, at the rear end region of the shaft, with a shank,
- a guide pin protruding at the front end of the reamer,
- cutting wings connected to the shaft,
- wherein each of the cutting wings has a lateral surface that tapers towards the front end of the reamer, and
- cutting teeth provided on each cutting wing, wherein

the cutting teeth protrude from the respective cutting wing on the lateral surface of the respective cutting wing.

**[0009]** Such a reamer has separate cutting wings, which preferably form a cross in front view of the reamer. The individual cutting wings each have inserted cutting teeth, e.g. cutting pins, that are suitable for cutting the concrete substrate. It was found that a winged reamer geometry allows particularly efficient dust removal with little effort, and that it also allows operation with particularly little undesired force on the concrete substrate and the shaft of the reamer. Moreover, it allows producing symmetric geometries with relatively little manufacturing effort, wherein the symmetry efficiently counteracts undesired tumbling of the reamer during operation, further improving work quality.

**[0010]** The mouth of the bore is located at the open end of the bore, i.e. in the region where the drill used for producing the bore first entered the substrate. The bore is preferably a blind hole.

**[0011]** The shaft can be an elongate member, defining a longitudinal axis of the reamer. The terms axial, radial and circumferential preferably relate to the longitudinal axis of the reamer. Unless indicated otherwise, the expressions "front" and "rear" are used in a consistent manner throughout this text.

**[0012]** The shank is to be grasped by the chuck of a drilling machine. It can e.g. be a SDS shank.

**[0013]** The cutting wings are connected to the shaft to allow transfer of torque and axial force, at least forwardly directed axial force, from the shaft to the cutting wings.

**[0014]** Each lateral surface tapers towards the front end of the reamer, i.e. the distance of the lateral surface from the longitudinal axis decreases as the lateral surface approaches the front end of the reamer.

**[0015]** On each cutting wing, a plurality of cutting teeth is provided. Preferably, the number of cutting teeth is the same on each cutting wing, for particular symmetric reaming. The cutting teeth are part of reamer.

**[0016]** Preferably, the lateral surface of each cutting wing tapers towards the front end of the reamer in a convexly curved manner. According to this embodiment, the cutting wings are convex at their respective lateral surfaces, when viewed in longitudinal sections of the reamer. This allows to produce concave, preferably spherical, expansions of the mouth of the bore in a particularly easy manner. Concave expansions of the mouth of the bore can be particularly advantageous for hoisting applications, in particular when the head of a fastener, preferably a screw, inserted into the bore is grabbed by a hoisting coupler, since the concave, preferably spherical, shape provides space for a swivel-type operation of the hoisting coupler. The cutting wings can also be concave at their respective lateral surfaces when viewed in cross-sectional view.

**[0017]** It is particularly advantageous if on each cutting wing, the radial offset of the tips of the cutting teeth pro-

vided on that cutting wing decreases towards the front end of the reamer, preferably in a concave manner. In other words, on each cutting wing, the radial distance of the tips of neighbouring cutting teeth from the longitudinal axis of the reamer decreases towards the front end of the reamer, wherein preferentially, this decrease is in a convex manner. This can further improve load uptake and/or the shape of the expansion produced by the reamer. The radial offset is, in particular, to be understood as the distance from the longitudinal axis of the reamer.

**[0018]** According to another preferred embodiment, on each cutting wing, the tips of the cutting teeth provided on that cutting wing are positioned on a longitudinal plane. In other words, each of the cutting wings has an attributed plane, on which the tips of the cutting teeth provided on that cutting wing are positioned. The planes are longitudinal planes, i.e. planes that comprise the longitudinal axis of the reamer. This can further improve design and cutting efficiency.

**[0019]** In addition to the cutting teeth, the reamer can also have auxiliary cutting teeth, which are formed and/or arranged different from the cutting teeth.

**[0020]** Preferably, at least one of the cutting wings has a reaming-depth-limiting stop shoulder. This shoulder provides a discontinuity that abuts on the surface of the substrate once a predetermined reaming depth is achieved. This allows producing particularly well-defined bore expansions in a particularly easy manner. More preferably, each of the cutting wings has a reaming-depth-limiting stop shoulder, wherein the reaming-depth-limiting stop shoulders define a unitary maximum reaming depth, i.e. wherein the stop shoulders are located at the same axial height. This can further improve ease of use and counteract undesired tumbling of the reamer.

**[0021]** According to another preferred embodiment, the cutting wings are arranged equidistantly around the longitudinal axis of the reamer. In other words, the cutting wings are arranged equidistantly in the circumferential direction. This can further counteract undesired tumbling of the reamer.

**[0022]** It is particularly advantageous that the reamer has four cutting wings arranged equidistantly, in particular equidistantly around the longitudinal axis of the reamer. This provides, while being easy to manufacture, particular good symmetry, further reducing tendency to tumble. According to this embodiment, the cutting wings are arranged in an orthogonal relationship and/or can form a cross shape in front view of the reamer. In particular, the reamer has precisely four cutting wings.

**[0023]** Each cutting wing is in particular limited by two side surfaces. The side surfaces of a cutting wing are preferably in an angled relationship to the lateral surface of the respective cutting wing. Preferably, the side surfaces are parallel, i.e. each cutting wing is limited by two parallel side surfaces. This can e.g. facilitate manufacturing and can provide particularly good load uptake.

**[0024]** Preferably, each cutting wing is limited by two side surfaces, which side surfaces are also parallel to

the longitudinal axis of the reamer. In this case, the cutting wings extend parallel to the longitudinal axis. This can be advantageous in view of easy manufacturing of the reamer and material removal during reaming.

**[0025]** In a preferred method of use, the guide pin is used for guiding only and not for drilling. Preferably, the guide pin is rotationally symmetrical, particularly preferred it is circularly symmetrical, i.e. rotationally symmetrical with respect to any angle. This can, at low manufacturing costs, efficiently prevent unwanted interlocking with the substrate. The axis of symmetry is the longitudinal axis of the reamer. Preferably, at least a part of the guide pin is a circular cylinder.

**[0026]** The cutting wings preferably consist of a metal material, particularly preferred of steel. The shaft preferably consists of a metal material, particularly preferred of steel. The guide pin preferably consists of a metal material, particularly preferred of steel. The cutting teeth preferably consist of a metal material, more preferably of carbide metal. The cutting teeth can e.g. be welded to the respective cutting wing.

**[0027]** Preferably, the cutting wings and the shaft are integral. This provides a particularly good force and/or torque transfer from the shaft to the cutting wings. The guide pin and the shaft can be integral as well, e.g. to facilitate manufacturing. However, the guide pin and the shaft can also be two different pieces.

**[0028]** The invention also comprises a method for producing a countersunk bore in a concrete substrate, comprising

- a drilling step, in which a bore is produced in the concrete substrate by drilling a drill into the concrete substrate,
- a drill removal step, in which the drill is removed from the bore, wherein the drill removal step is performed after the drilling step, and
- an expansion step, in which the mouth of the bore is expanded using a reamer, wherein the expansion step is performed after the drill removal step.

**[0029]** This concept is based on the surprising finding that producing countersunk bores in concrete using stepped drills can be difficult, especially if deep bores with wide expansions at their mouths are to be produced. This is since the wide expansion requires a correspondingly wide and therefore heavy reaming region of the stepped drill. However, a high accumulation of mass in a region of the drill that is remote from the tip of the drill can make the drill prone to tumbling motion, especially if forces required to cut concrete are applied. This tumbling motion can lead to unsatisfactory drilling performance in certain situations.

**[0030]** To overcome this potential issue, a two-step approach is proposed. The bore is produced in a first step with a drill and the expansion of the bore is produced in a second step, using a separate tool, namely the reamer. Since the reamer is only used for expanding, but not for

making the original bore, the reamer can be significantly shorter when compared to a corresponding stepped drill, significantly reducing the proneness to tumbling motion. And even if tumbling motion of the reamer occurs, its effect is much less severe when compared to a tumbling stepped drill, since only the expanded region of the bore is affected by the tumbling motion.

**[0031]** The drill can be a spiral drill or a hollow drill. It is preferentially drilled into the concrete substrate in a rotary percussive manner. In the expansion step, the diameter of the bore is locally increased.

**[0032]** It is particularly preferred that an inventive reamer is used in the method.

**[0033]** After a countersunk bore is produced using the reamer and/or the method, a headed screw can be screwed into the countersunk bore, such that the head of the screw is located in the expanded part created by the reamer. The head of the screw can then be grabbed by a hoisting coupler for lifting the substrate. Since the head is located within the countersunk bore, it does not have to protrude from the flat surface of the substrate.

**[0034]** Features that are described here in connection with the inventive reamer can also be used in connection with the inventive method, and features that are described here in connection with the inventive method can also be used in connection with the inventive reamer.

**[0035]** The invention is explained in greater detail below with reference to preferred exemplary embodiments, which are depicted schematically in the accompanying drawings, wherein individual features of the exemplary embodiments presented below can be implemented either individually or in any combination within the scope of the present invention.

Figure 1: is a perspective view of an embodiment of a reamer for expanding the mouth of a bore in a concrete substrate;

Figure 2: is a side view of the reamer of figure 1;

Figure 3: is a longitudinally cut view, A-A in figure 2, of the reamer of figure 1;

Figure 4: is a front view of the reamer of figure 1;

Figures 5 to 9: show consecutive steps of a method for producing a countersunk bore in a concrete substrate, using a reamer as shown in figures 1 to 4; and

Figure 10: is a perspective view, similar to that of figure 1, of a second embodiment of a reamer for expanding the mouth of a bore in a concrete substrate.

**[0036]** Figures 1 to 4 show a first embodiment of a reamer. The reamer 1 has an elongate shaft 10, which

defines a longitudinal axis 99 of the reamer 1, the longitudinal axis 99 extending in the long direction of the shaft 10. At the rear end of the shaft 10, the shaft 10 is provided, in particular on its outer surface, with a shank 18, which is intended to be received by the chuck of a drilling machine. At its front end, the reamer 1 has a guide pin 11, which projects forwardly from the reamer 1, and which is for centring the reamer 1 in a bore. The longitudinal axis of the guide pin 11 is coaxial with the longitudinal axis 99 of the reamer 1. In the present example the guide pin 11 is mainly cylindrical.

**[0037]** The reamer 1 also has cutting wings 20, each cutting wing 20 radially projecting from the reamer 1. In particular, the cutting wings 20 protrude from the shaft 10. In the present embodiment, four cutting wings 20 are provided, spaced equidistantly around the longitudinal axis 99.

**[0038]** Each of the cutting wings 20 has two opposed side surfaces, namely side surface 23 and side surface 24, as well as a lateral surface 21. The lateral surfaces 21 of the cutting wings 20 all taper towards the front end of the reamer 1, i.e. their distance from the longitudinal axis 99 decreases towards the front end of the reamer 1. In particular, the lateral surfaces 21 of the cutting wings 20 all taper towards the front end of the reamer 1 in a convex manner, i.e. the cutting wings 20 bulge out in longitudinal section, wherein an exemplary longitudinal section is shown in figure 3. At their front ends, all cutting wings 20 merge and all their lateral surfaces 21 merge.

**[0039]** Each of the cutting wings 20 is provided with a reaming-depth-limiting stop shoulder 27, formed on the lateral surface 21 of the respective cutting wing 20. At the reaming-depth-limiting stop shoulder 27, the respective cutting wing 20 protrudes radially in a discontinuous manner, so that the reaming-depth-limiting stop shoulder 27 can abut on the surface of the substrate when the desired reaming depth is achieved.

**[0040]** Each of the cutting wings 20 further has a plurality of cutting teeth 30, five each in the present embodiment. The cutting teeth 30 project from the respective cutting tooth 30, in particular from the lateral surface 21 thereof. Each cutting tooth 30 has a tip 33, located at that end of the cutting tooth 30 that is remote from the respective cutting wing 20.

**[0041]** On each cutting wing 20, the locations of the tips 33 of the cutting teeth 30 converge to the longitudinal axis 99 towards the front end of the reamer 1, i.e. the closer a tip 33 is to the front end of the reamer 1, the smaller the distance of this tip 33 from the longitudinal axis 99. In the present embodiment, the tips 33 of all cutting teeth 30 of a cutting wing 20 lie on a common longitudinal plane 95. However, an offset of neighbouring tips 33 of a cutting wing 20 in the circumferential direction is also possible.

**[0042]** The cutting wings 20, the shaft 10 and the guide pin 11 consist of a metal material, preferably of steel. The cutting wings 20 and the shaft 10 are preferably integral. In the embodiment of figures 1 to 4, the guide pin 11 is

integral with the shaft 10 as well.

**[0043]** Figures 5 to 9 show consecutive steps of a method for producing a countersunk bore 85 in a concrete substrate using the reamer 1 described above. In a first step, namely in the drilling step, a cylindrical bore 80 is made in the concrete substrate 89 by drilling a drill 2 into the concrete substrate 89, preferably using a hammer drilling machine. In a subsequent drill removal step, the drill 2 is then pulled out of the bore 80. Afterwards, in an expansion step, the mouth 81 of the bore 80, i.e. the region of the bore 80 adjacent to the surface of the concrete substrate 89 into which the bore 80 has been drilled, is radially expanded using the reamer 1 described above. In particular, the reamer 1 is inserted - guide pin 11 first - into the bore 80, so that the cutting wings 20 abut against the concrete substrate 89, and the reamer 1 is actuated in a rotary percussive manner, preferably using a hammer drilling machine. This leads to loosening of concrete substrate 89 material around the bore 80. The loosened concrete substrate 89 material can be removed via the spacings that are formed between the cutting wings 20. The reamer 1 is sunken into the concrete substrate 89 until the reaming-depth-limiting stop shoulders 27 of the cutting wings 20 abut on the surface of the concrete substrate 89. Subsequently, the reamer 1 is removed. The result is a countersunk bore 85, that is cylindrical in its deeper part and which gradually widens at the mouth 81 of the bore 80, preferably in a concave manner, in particular in a spherically concave manner. The drill 2 can be a spiral drill or a hollow drill.

**[0044]** Figure 10 shows a second embodiment of a reamer. The reamer of figure 10 has many similarities to the reamer of figures 1 to 4, and in this respect, reference is made to the above description of the reamer of figures 1 to 4, which applies mutatis mutandis to the reamer of figure 10.

**[0045]** The reamer 1 of figure 10 primarily differs from the reamer 1 of figures 1 to 4 by the design of the guide pin 11. According to figure 10, the guide pin 11 is a spiral concrete drill, having a cutting tip and a spiral shaft. Thus, the reamer 1 of figure 10 allows producing a cylindrical bore and an expansion at the mouth of the bore in a single drilling step.

**[0046]** Moreover, in the embodiment of figure 10, the guide pin 11 and the shaft 10 are not integral, i.e. the guide pin 11 is a separate piece.

## Claims

1. Reamer (1) for expanding the mouth (81) of a bore (80) in a concrete substrate (89), having
  - a shaft (10), which is provided, at the rear end region of the shaft (10), with a shank (18),
  - a guide pin (11) protruding at the front end of the reamer (1),
  - cutting wings (20) connected to the shaft (10),

wherein each of the cutting wings (20) has a lateral surface (21) that tapers towards the front end of the reamer (1), and

- cutting teeth (30) provided on each cutting wing (20), wherein the cutting teeth (30) protrude from the respective cutting wing (20) on the lateral surface (21) of the respective cutting wing (20).

2. Reamer (1) according to claim 1, **characterized in that** the lateral surface (21) of each cutting wing (20) tapers towards the front end of the reamer (1) in a convexly curved manner.
3. Reamer (1) according to any one of the preceding claims, **characterized in that** on each cutting wing (20), the radial offset of the tips (33) of the cutting teeth (30) provided on that cutting wing (20) decreases towards the front end of the reamer (1).
4. Reamer (1) according to any one of the preceding claims, **characterized in that** on each cutting wing (20), the tips (33) of the cutting teeth (30) provided on that cutting wing (20) are positioned on a longitudinal plane (95).
5. Reamer (1) according to any one of the preceding claims, **characterized in that** at least one of the cutting wings (20) has a reaming-depth-limiting stop shoulder (27).
6. Reamer (1) according to any one of the preceding claims, **characterized in that** the cutting wings (20) are arranged equidistantly around the longitudinal axis (99) of the reamer (1).
7. Reamer (1) according to any one of the preceding claims, **characterized in that** the reamer (1) has four cutting wings (20) arranged equidistantly around the longitudinal axis (99) of the reamer (1).
8. Reamer (1) according to any one of the preceding claims, **characterized in that** each cutting wing (20) is limited by two parallel side surfaces (23, 24).
9. Reamer (1) according to claim 8, **characterized in that** each cutting wing (20) is limited by two parallel side surfaces (23, 24), which side surfaces (23, 24) are

parallel to the longitudinal axis (99) of the reamer.

10. Reamer (1) according to any one of the proceeding claims,  
**characterized in that** 5  
 the guide pin (11) is circularly symmetrical.
11. Reamer (1) according to any one of the proceeding claims,  
**characterized in that** 10  
 the cutting wings (20) and the shaft (10) are integral.
12. Method for producing a countersunk bore (85) in a concrete substrate (89), comprising 15  
 - a drilling step, in which a bore (80) is produced in the concrete substrate (89) by drilling a drill (2) into the concrete substrate (89),  
 - a drill removal step, in which the drill (2) is removed from the bore (80), wherein the drill removal step is performed after the drilling step, and 20  
 - an expansion step, in which the mouth (81) of the bore (80) is expanded using a reamer (1), wherein the expansion step is performed after the drill removal step. 25
13. Method according to claim 12,  
**characterized in that**  
 a reamer (1) according to one of the claims 1 to 11 30  
 is used in the expansion step.

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Fig. 1

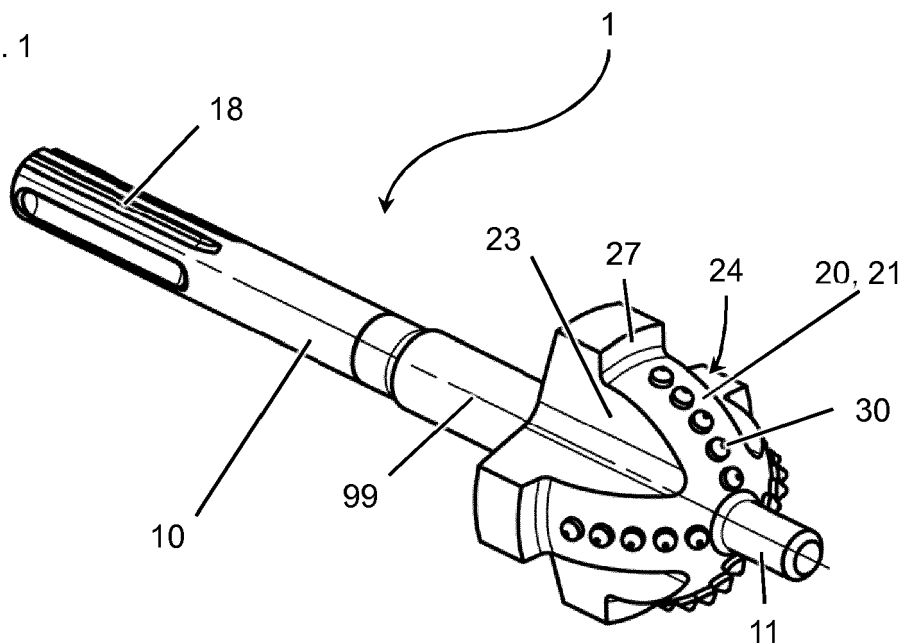


Fig. 2

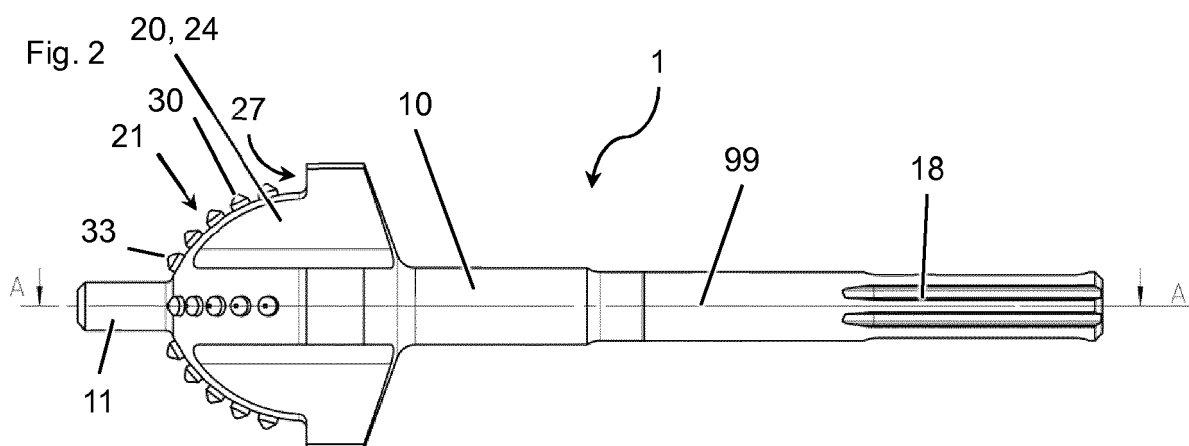


Fig. 3

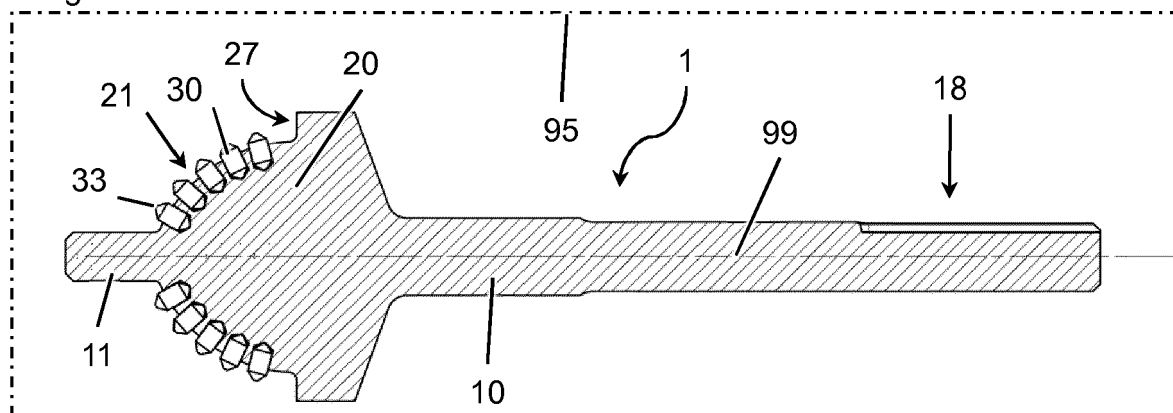


Fig. 4

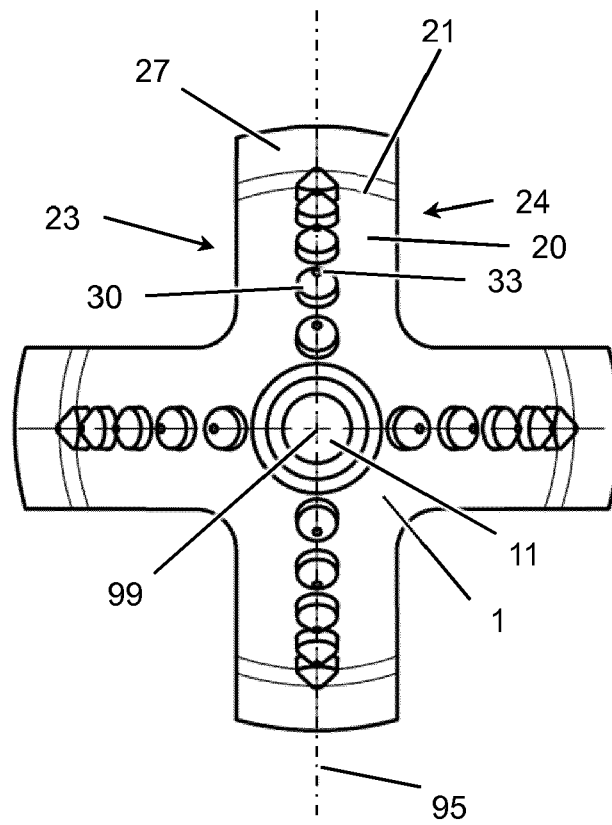


Fig. 10

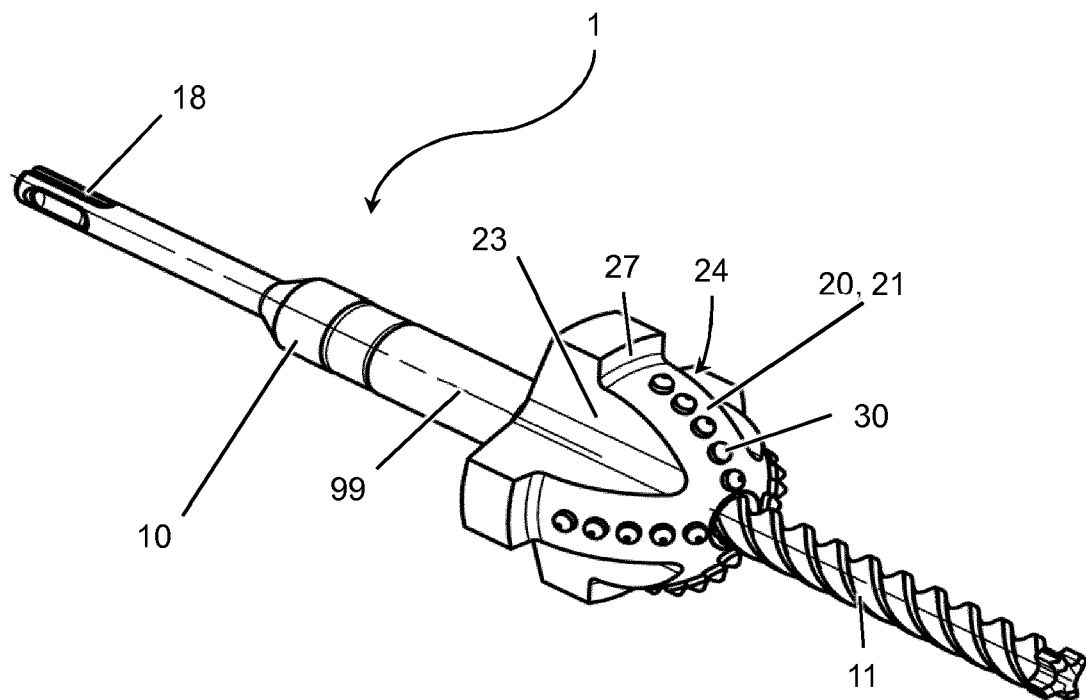


Fig. 5

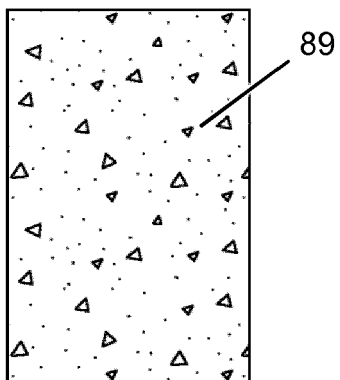


Fig. 6

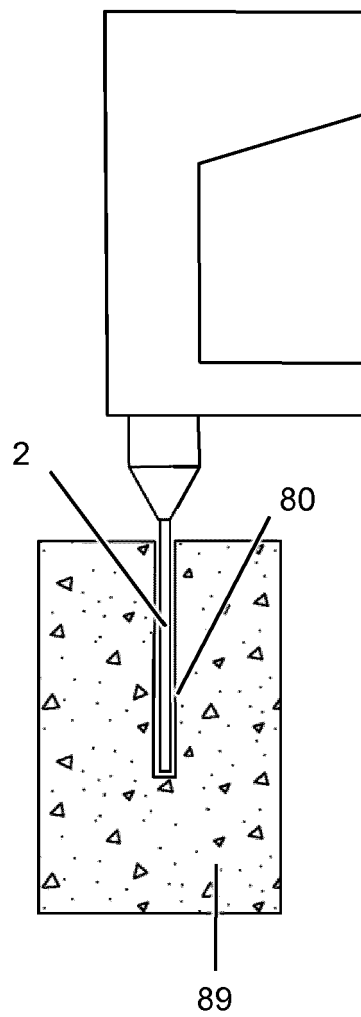


Fig. 7

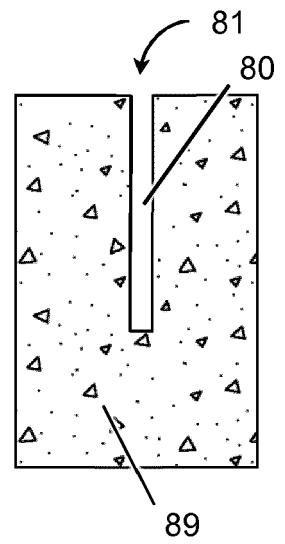


Fig. 8

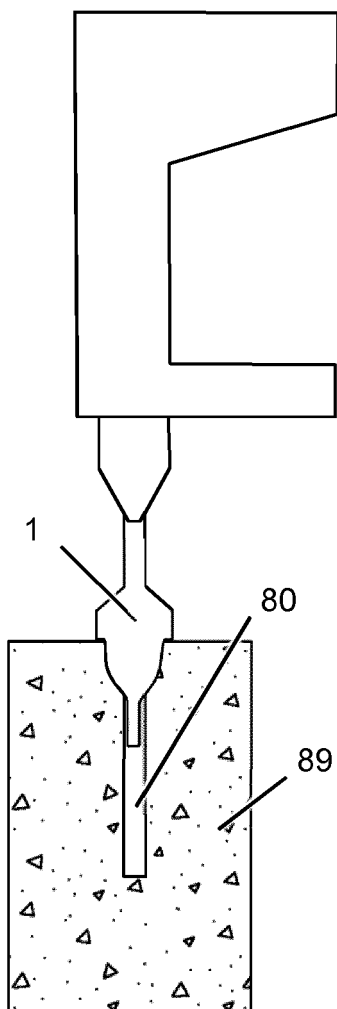
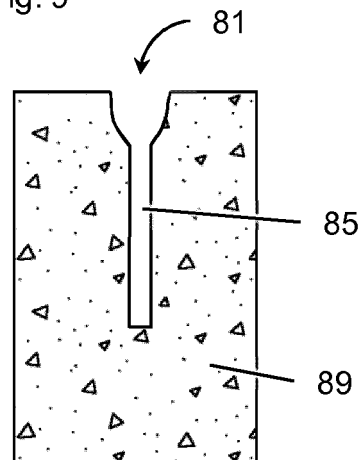


Fig. 9





## EUROPEAN SEARCH REPORT

Application Number  
EP 18 17 6922

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	FR 1 154 010 A (HELLEFORS BRUKS AKTIEBOLAG) 1 April 1958 (1958-04-01) * the whole document *	1-7, 10-13	INV. B28D1/14 B28D1/18 E21B10/26
X	GB 2 479 146 A (BENTLEY PAUL JAMES [GB]) 5 October 2011 (2011-10-05) * the whole document *	1,3-13	
X	FR 2 315 602 A1 (KRUPP GMBH [DE]) 21 January 1977 (1977-01-21) * pages 4,5; figures 1-4 *	1-11	
X	DE 41 02 794 A1 (HAWERA PROBST KG HARTMETALL [DE]) 6 August 1992 (1992-08-06) * columns 4-6; figures 1,4,6,7 *	1-9,11	
A	DE 10 2012 221114 B3 (HILTI AG [LI]) 10 April 2014 (2014-04-10) * paragraph [0028]; figure 1 *	5	
			TECHNICAL FIELDS SEARCHED (IPC)
			B28D E21B B23B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 26 November 2018	Examiner Garmendia Irizar, A
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	

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 1154010 A	01-04-1958	NONE	
GB 2479146 A	05-10-2011	NONE	
FR 2315602 A1	21-01-1977	DE 2528003 A1	20-01-1977
		DK 265876 A	25-12-1976
		FR 2315602 A1	21-01-1977
		SE 7602306 A	25-12-1976
DE 4102794 A1	06-08-1992	NONE	
DE 102012221114 B3	10-04-2014	CN 104797383 A	22-07-2015
		DE 102012221114 B3	10-04-2014
		EP 2919945 A1	23-09-2015
		ES 2606305 T3	23-03-2017
		JP 5960367 B2	02-08-2016
		JP 2015533664 A	26-11-2015
		PL 2919945 T3	31-03-2017
		US 2015290722 A1	15-10-2015
		WO 2014076125 A1	22-05-2014

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- EP 3103756 A1 [0002]
- DE 10008342 A1 [0003]
- US 7384223 B2 [0004]
- US 4769960 A [0005]