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(54) ROCK DRILL INSERT WITH IDENTIFICATION TAG POSITIONED IN RECESS

(57) A cemented carbide insert for mining or rock cutting applications comprising a base portion at the bottom end of the insert; a working tip portion at the top of the insert; a cylindrical portion located between the base potion and the working tip portion and an axial central axis; a peripheral surface extending over the working tip portion and the cylindrical portion; wherein the insert further comprises at least one identification (ID) marker encoded with one-dimensional or two-dimensional optical machine-readable code; characterized in that: the peripheral surface comprises at least one recess extending radially inwardly towards the central axis and wherein the at least one identification marker is located in the recess.

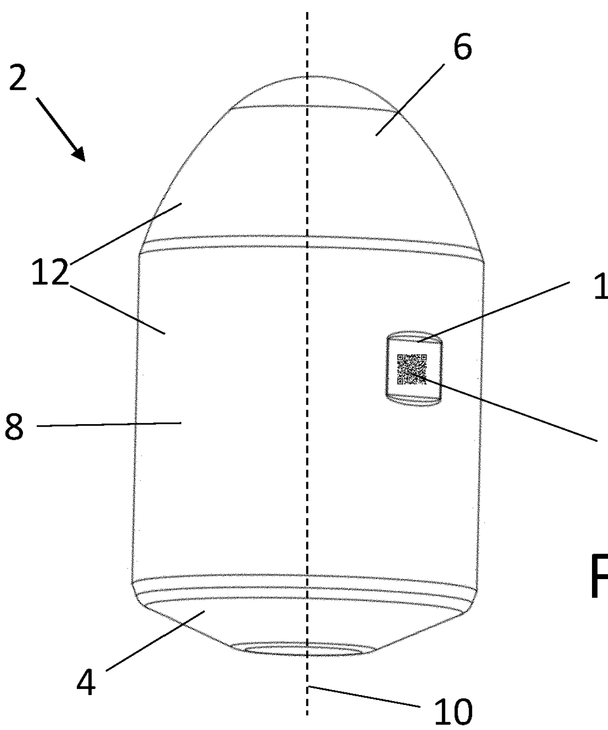

Fig 1

EP 4 484 698 A1

Description

FIELD OF INVENTION

[0001] The present invention relates to a cemented carbide insert or button for mining or rock cutting applications comprising an identification tag.

BACKGROUND

[0002] Cemented carbide comprises a hard metal phase and a binder phase and has a unique combination of high elastic modulus, high hardness, high compressive strength, high wear and abrasion resistance with a good level of toughness. Therefore, cemented carbide is commonly used in products such as mining inserts. The tungsten and cobalt in the cemented carbide bodies are both strategic rare metals and therefore there is significant value and an environmental benefit to being able recycle the inserts to provide an important secondary resource of cobalt and tungsten metals and to gain information about the origin of the cobalt and tungsten to ensure safe and responsible mining and material sourcing. In order for cemented carbide inserts to be able to be recycled into new cemented carbide material it is important to know what the composition of the cemented carbide insert is. However, the problem is that exposure to post sintering treatments and to the harsh environmental surroundings during the drilling or cutting operation of the inserts means that identification markings produced by known methods of marking mining inserts that could be used to sort the inserts into batches containing the same composition ready for recycling or for back tracing the origin of the product and its constituents do not survive.

[0003] Therefore, the problem to be solved to how to provide an identification marking on the drill bit insert that survives operating conditions.

[0004] Attempts to solve this problem have been made by providing cemented carbide inserts for mining or rock cutting application with unique identification markers in form of DataMatrix codes, which provide access to unique product information. For example, EP22160151 discloses that the identification marker is located on the base of the insert. It would be even more optimal that the identification marking is positioned on the peripheral surface of the insert to facilitate readability in production. The problem with placing the identification marker on the peripheral surface is that it easily worn away, either by the drilling operation if it is positioned towards the working tip portion of the insert or by friction if it is positioned towards the base portion (i.e. the part that is pressed into the drill bit). The problem to be solved is how to enable the identification marker to be located on the peripheral surface of the insert in order to aid easier readability without being worn away.

<u>Summary of the Invention</u>

[0005] According to a first aspect of the present invention it is an objective to provide a cemented carbide insert for mining or rock cutting applications comprising a base portion at the bottom end of the insert; a working tip portion at the top end of the insert; a cylindrical portion located between the base potion and the working tip portion and an axial central axis; a peripheral surface extending over the working tip portion and the cylindrical portion; wherein the insert further comprises at least one identification (ID) marker encoded with one-dimensional or two-dimensional optical machine-readable code; characterized in that: the peripheral surface comprises at least one recess extending radially inwardly towards the central axis and wherein the at least one identification marker is located in the recess.

[0006] Advantageously, by positioning the identification marker in a recess this enables the identification marker to be positioned on the peripheral surface of the insert whilst being protected from wear. Positioning the identification marker on the peripheral surface is beneficial as this facilitates the identification markers being able to be read when the inserts are laid down on their side, i.e. lying on their peripheral surface. This enables easier readability in production, for example after sintering or tumbling the inserts would already be in this position and so no additional work is required to reposition the inserts in order to read the identification marker. By positioning the identification marker in the recess it is protected from friction that arises between the peripheral surface of the insert and the pocket of the drill bit as the inserts are press fit into the drill bit and / or from wear from the drilling operation, therefore the risk that the identification marker is worn away and therefore consequently is not readable after use is reduced.

[0007] A further benefit of arranging the at least one identification marker in a recess is that the manufacturing of the mining insert is facilitated since post-sintering operations, such as grinding, can be performed on the mining insert with a reduced risk of damaging the identification marker.

[0008] According to another aspect of the present invention there is a method of producing the cemented carbide insert as described hereinbefore or hereinafter comprising the steps of:

a) pressing a powder composition comprising at least the one or more hard constituents, the metallic binder phase, and an organic binder system;
b) forming a recess on the green body;
c) sintering the green body to form a sintered insert comprising a recess;
d) adding an identification marker in the recess on the insert.

[0009] Advantageously, if the recess is added as part of the pressing operation, then this avoids needed to add additional processing steps.

[0010] According to another aspect of the present invention there is an alternative method of producing the cemented carbide insert as described hereinbefore or hereinafter comprising the steps of:

a) pressing a powder composition comprising at least the one or more hard constituents, the metallic binder phase, and an organic binder system forming a green body;
b) sintering the green body to form a sintered insert;
c) forming a recess on the insert;
d) adding an identification marker in the recess on the insert.

Brief description of drawings

[0011] A specific implementation of the present invention will now be described, by way of example only, and with reference to the accompanying drawings in which:

Figure 1 is a schematic drawing of a cemented carbide mining insert comprising an identification marker located in a recess positioned on the cylindrical portion.

Figure 2 is a schematic drawing of a cross sectional view of the recess.

Figure 3 is a schematic drawing of a cemented carbide mining insert comprising an identification marker located in a recess positioned on the working tip portion.

Figure 4 is a schematic drawing of a cemented carbide mining insert comprising an identification marker located in a recess positioned on the bottom end of the cylindrical portion adjacent to the base portion.

Detailed description

[0012] Figure 1 shows a cemented carbide insert 2 for mining or rock cutting applications comprising a base portion 4 at the bottom end of the insert 2; a working tip portion 6 at the top of the insert 2; a cylindrical portion 8 located between the base potion 4 and the working tip portion 6 and an axial central axis 10. A peripheral surface 12 extends over the working tip portion 6 and the cylindrical portion 8 of the insert 2. The peripheral surface 12 comprises at least one recess 16 extending radially inwardly towards the central axis 10 and at least one identification marker 14 (otherwise known as a tag) encoded with one-dimensional or two-dimensional optical machine-readable code is located in the recess 16 (otherwise known as a pocket or indent).

[0013] The term "one-dimensional or two-dimensional optical machine readable code" represents a passive identification marker that can be read by an optical reading device, e.g. a camera. The "one-dimensional or two-dimensional optical machine readable code" can be e.g. a Quick Response code, a High Capacity Colored Two Dimensional Code, a European Article Number code, a DataMatrix code, or a MaxiCode.

[0014] The at least one identification marker preferably comprises unique identification information, such as a unique identification number, of the insert.

[0015] In one embodiment the identification marker is etched, engraved, impressed, imprinted, pressed, or laser printed on. However it could also be added using any other suitable method.

[0016] In one embodiment the identification marker 14 is a Quick Response (QR) code, a High Capacity Coloured Two Dimensional Code, a European Article Number code, a DataMatrix code, or a MaxiCode. Preferably, the identification marker 14 is in the form of a data matrix code. A data matrix code is a two-dimensional bar code which may be in the form example a square or rectangular or circular symbol or any other suitable shape made up of individual modules of predetermined size in the form of dots or squares. The individual modules form an ordered grid of contrasting (e.g. dark or light) modules, bordered by a finder pattern used to specify the orientation and structure of the symbol. The identification marker can in this case be used to store information about a very large amount of individual sintered bodies, depending on the size of the data matrix code. The size may typically be 12x12 modules, or larger depending on needs. In an error correction algorithm, several damaged or blurred modules can be corrected for. Advantageously if a data matrix code is used more information can be stored in a smaller area. Further, only approximately 32-72% of the data matrix code needs to be intact in order for the information to be read, therefore even if the data matrix code is slightly damaged the information can still be read. It may be preferable that the identification marker used has an industry standard associated with it.

[0017] Figure 2 shows a cross sectional view of the recess 16 taken in any direction, longitudinal or axial or other. The recess 16 comprises a bottom surface 18 and side walls 20. A first transition section 22 connects the bottom surface 18 to the side walls 20. A second transition section 24 connects the side walls 20 of the recess 16 and the peripheral surface 12 of the insert 2.

[0018] In one embodiment the maximum depth (d) of the recess 16 is in the range of 10-200 μm, preferably 10-150 μm, and more preferably 10-125 μm. Advantageously, this depth provides the optimal balance between being deep enough that the identification marker 14 is protected from the grinding process and /or friction generated between the insert 2 and drill bit during press fitting and furthermore the identification marker 14 is protected from wear resulting from the drilling operation whilst not being too deep that it will impact the rigidity of the insert. It should be understood that depth (d) is measured from the bottom surface 18 of the recess 16 to the peripheral surface 12 of the insert 2 in its finished state, i.e. when the insert 2 is ready for insertion into the drill bit. For example, the finished state of the cylindrical portion 8 is typically post grinding and the finished state of the working tip portion 6 is typically post sintering (i.e. usually the working tip portion is not ground).

[0019] In one embodiment, the first transition section 22 is curved.

[0020] In one embodiment, the second transition section 24 is curved.

[0021] In other words, the recess is free of sharp edges or corners, all the edges and corners are rounded. Advantageously, the curved transitional sections remove any sharp corners which could be propagation points for chipping and cracking as the drill bit insert is subjected to impact from tumbling, drilling or forces from other operations.

[0022] The bottom surface 18 of the recess 16 could be flat, concave or convex or any other geometry that an identification marker 14 could be positioned on and read from.

[0023] The geometry of the recess 16 could be symmetrical or non-symmetrical.

[0024] The geometry of the recess 16 should enable the identification marker to be readable.

[0025] In one embodiment an angle (a) between the bottom surface 18 and side walls 20 of the recess 16 is ≥90° and <180°, preferably ≥90° and <170°, even more preferably ≥90° and <145°. Advantageously, this enables the identification marker to be read whilst maintaining the structural integrity of the insert and additionally provides a smooth transition between the different surfaces, thus avoiding the creation of crack initiation points. Optionally, angle (a) is >90°.

[0026] In one embodiment an angle (b) between the peripheral surface 12 of the insert 2 and the side walls 20 of the recess 16 is ≥90° and <180°, preferably ≥90° and <170°, more preferably ≥90° and <145°. Advantageously, this enables the identification marker to be read whilst maintaining the structural integrity of the insert and additionally provides a smooth transition between the different surfaces, thus avoiding the creation of crack initiation points. Optionally, angle (a) is >90°.

[0027] In one embodiment the first transition section 22 has a radius (r) and wherein r > d.

[0028] In one embodiment the area of the bottom surface 18 of the recess 16 is between 1-6 times, preferably between 1-2 times larger than the area of the identification marker 14. Advantageously, this size range enables the identification marker to fit in the recess 16 and be readable whilst maintaining the rigidity of the insert. Typically, the minimum dimensions of the identification marker 14 are 0.7 x 0.7 mm.

[0029] In one embodiment the at least one identification marker 14 comprises a plurality of first type modules and second type modules, wherein each first type module is in level with the bottom surface 18 and wherein each second type module comprises an indention with respect to the bottom surface 18. By having the first type modules being in level with the bottom surface and the second type modules comprising an indention with respect to the bottom surface, a good contrast between the first type modules and the second type modules is achieved, which improves the readability of the identification marker 12. By having only the second type modules comprising an indention with respect to the bottom surface, the amount of material removal in the cutting element is reduced compared to the case where both the first and second type modules comprise indentions relative the bottom surface. The identification marker's impact on the rigidity of the cutting element and on the stability in the mounting of the cutting element in the toolholder is thereby kept to a minimum.

[0030] In one embodiment the area of the bottom surface 18 of the recess 16 is ≤ 25%, preferably ≤20%, even more preferably ≤10% of the surface area of the cylindrical portion 8 of the insert 2. Advantageously, this size range provides sufficient space for the identification marker 12 to be located and protected therein without compromising the rigidity of the insert or adversely affecting how well the insert can be gripped for pressing into the drill bit. Furthermore the contact surface between the insert and the pocket of the drill bit is not reduced too much. This means there the insert is still sufficiently well gripped and held into the pocket of the drill bit such that there is not an increased risk that the insert is lost during the drilling operation from it not being gripped tightly enough in place.

[0031] In one embodiment, as shown in figure 1, the recess 16 with the identification marker 14 positioned therein is positioned on the cylindrical portion 8. Advantageously, positioning in this location means the identification tag is protected from wear during the drilling operation.

[0032] Figure 3 shows an alternative embodiment wherein the recess 16 with the identification marker 14 positioned therein is located on the working tip portion 6. Advantageously, if the recess with the identification tag is positioned on the working tip portion, then the identification marker 14 is still readable after it has been press fit into the drill bit.

[0033] Figure 4 shows another embodiment wherein the recess 16 with the identification marker 14 positioned therein is located at a bottom end of the cylindrical portion 8 adjacent to the base portion 4. Advantageously, positioning the recess in this location means that it can be formed using a uniaxial pressing method, which broadens the manufacturing options possible. Further, positioning in this location means the identification tag is protected from wear during the drilling operation.

[0034] Another aspect of the present application is a method of producing the cemented carbide insert 2 as described in hereinbefore or hereinafter comprising the steps of:

a) pressing a powder composition comprising at

least the one or more hard constituents, the metallic binder phase, and an organic binder system;
b) forming a recess on the green body;
c) sintering the green body to form a sintered insert 2 with a recess 16;
d) adding an identification marker 14 in the recess 16 on the insert 2.

[0035] Steps c) and d) could also be conducted the other way around.

[0036] The recess 16 could be added on the green body using pressing, milling, laser processing or any other suitable means. If the recess 16 is added as part of the pressing operation, then this avoids the need to add additional processing steps. It would be possible to use powder injection moulding, uniaxial pressing, multiaxial pressing or green machining for example.

[0037] Alternatively, the method could comprise the following steps:

a) pressing a powder composition comprising at least the one or more hard constituents, the metallic binder phase, and an organic binder system forming a green body;
b) sintering the green body to form a sintered insert 2;
c) forming a recess 16 on the insert 2;
d) adding an identification marker 14 in the recess 16 on the insert 2.

[0038] The recess 16 could be added to the sintered body via milling, laser processing or spark-erosion cutting. The recess 16 and / or the identification marker 14 could be added either before or after tumbling.

[0039] In one embodiment, a laser to selectively modify the surface of the green body is used to form the identification marker 14.

[0040] In one embodiment, data is stored on the identification marker relating to the raw materials, insert composition and / or manufacturing methods used.

[0041] In one embodiment, the data is stored in the database after the manufacturing is completed.

[0042] In one embodiment, the identification marker 14 is read prior to the insert being added to the drill bit. This facilities easier and more efficient recycling of the inserts after the bits have been used. Additionally, if the drill bit also comprises an identification marker a digital twin between the drill bit and the inserts can be created.

Claims

1. A cemented carbide insert (2) for mining or rock cutting applications comprising a base portion (4) at the bottom end of the insert (2); a working tip portion (6) at the top of the insert (2); a cylindrical portion (8) located between the base potion (4) and the working tip portion (6) and an axial central axis (10);
a peripheral surface (12) extending over the working tip portion (6) and the cylindrical portion (8);
wherein the insert (2) further comprises at least one identification (ID) marker (14) encoded with one-dimensional or two-dimensional optical machine-readable code;
characterized in that:
the peripheral surface (12) comprises at least one recess (16) extending radially inwardly towards the central axis (10) and wherein the at least one identification marker (14) is located in the recess (16).

2. The cemented carbide insert (2) according to claim 1 wherein the ID marker (14) is a Quick Response (QR) code, a High Capacity Coloured Two Dimensional Code, a European Article Number code, a DataMatrix code, or a MaxiCode.

3. The cemented carbide insert (2) according to any of the previous claims wherein the maximum depth (d) of the recess (16) is in the range of 10-200 μm.

4. The rock drill insert (2) according to any of the previous claims wherein the recess (16) comprises a bottom surface (18) and side walls (20) and a first transition section (22) that connects the bottom surface (18) to the side walls (20) and wherein the first transition section (22) is curved.

5. The rock drill insert (2) according to any of the previous claims wherein there is a second transition section (24) that connects the side walls (20) of the recess (16) and the peripheral surface (12) of the insert (2) and wherein the second transition section (24) is curved.

6. The rock drill insert (2) according to any of the previous claims wherein an angle (a) between the bottom surface (18) and side walls (20) of the recess (16) is ≥90° and <180°.

7. The rock drill insert (2) according to any of the previous claims wherein an angle (b) between the peripheral surface (12) of the insert (2) and the side walls (20) of the recess (16) is ≥90° and <180°.

8. The rock drill insert (2) according to any of the previous claims wherein the first transition section (22) has a radius (r) and wherein r > d.

9. The rock drill insert (2) according to any of the previous claims wherein the area of the bottom surface (18) of the recess (16) is between 1-6 times larger than the area of the identification marker (14).

10. The rock drill insert (2) according to any of the pre-

vious claims wherein the area of the bottom surface (18) of the recess (16) is ≤ 25% of the surface area of the cylindrical portion (8) of the insert (2).

11. The rock drill insert (2) according to any of previous claims wherein the recess (16) is positioned on the working tip portion (6).

12. The rock drill bit () according to any of claims 1-10 wherein the recess is positioned on the cylindrical portion (8).

13. The rock drill bit () according to any of claims 11 wherein the recess is positioned at a bottom end of the cylindrical portion (8) adjacent to the base portion (4).

14. A method of producing the cemented carbide insert (2) according to any one of claims 1-13, comprising the steps of:

a) pressing a powder composition comprising at least the one or more hard constituents, the metallic binder phase, and an organic binder system;
b) forming a recess on the green body;
c) sintering the green body to form a sintered insert (2) with a recess (16);
d) adding an identification marker (14) in the recess (16) on the insert (2).

15. A method of producing the cemented carbide insert (2) according to any one of claims 1-13, comprising the steps of:

a) pressing a powder composition comprising at least the one or more hard constituents, the metallic binder phase, and an organic binder system forming a green body;
b) sintering the green body to form a sintered insert (2);
c) forming a recess (16) on the insert (2)
d) adding an ID marking in the recess (16) on the insert (2).

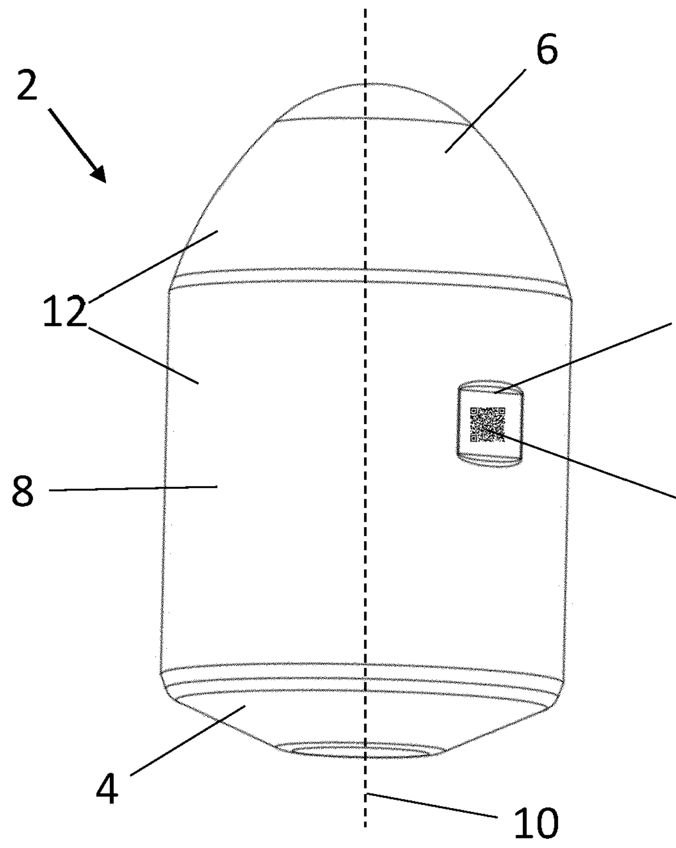

Fig 1

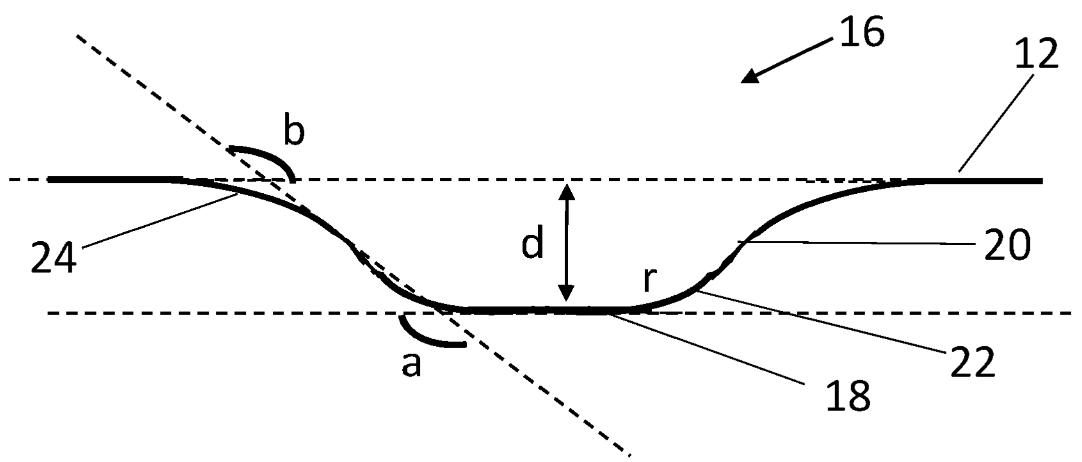

Fig 2

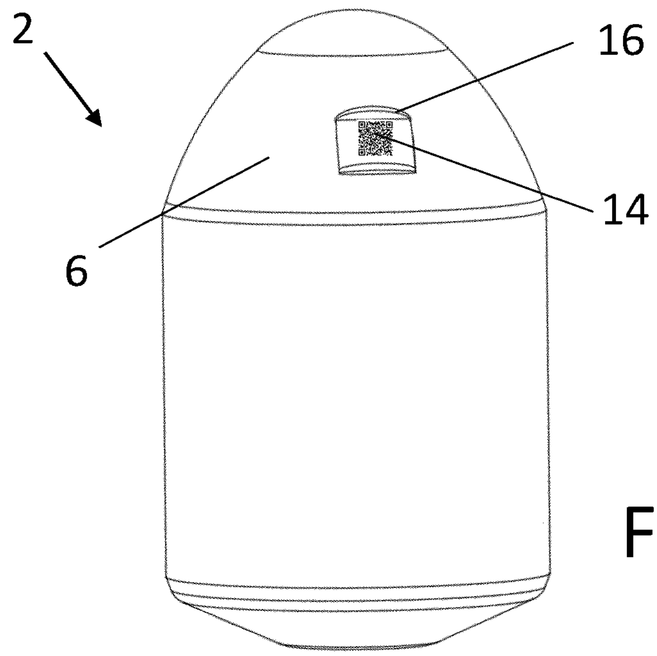

Fig 3

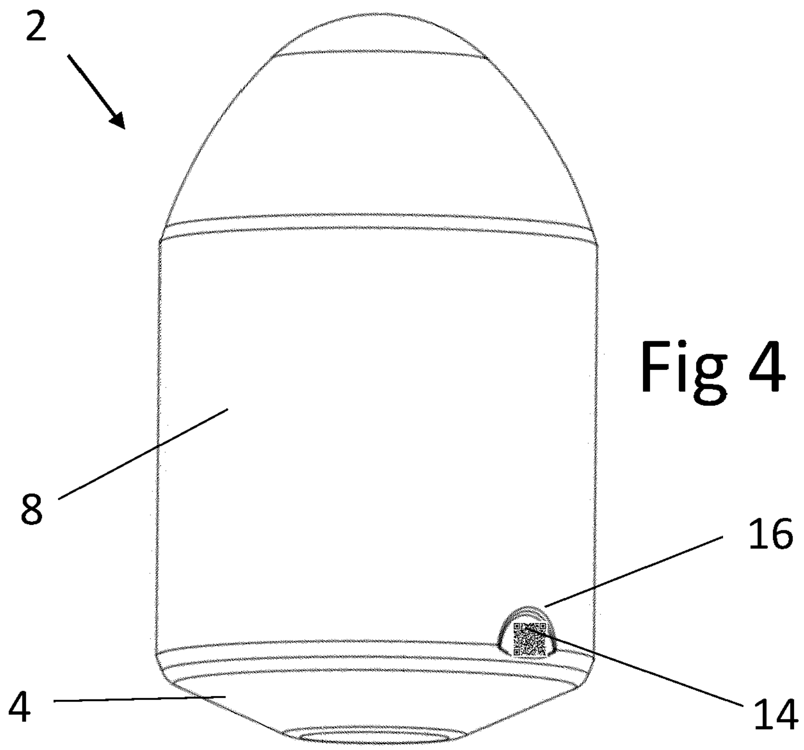

Fig 4

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EUROPEAN SEARCH REPORT

Application Number
EP 23 18 1447

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	JP 2021 151680 A (MITSUBISHI MATERIALS CORP) 30 September 2021 (2021-09-30) * paragraphs [0021], [0061], [0065]; figures 1, 2, * -----	1-15	INV. E21B10/573
A	US 2020/356077 A1 (SINGER-SCHNOELLER ALEXANDER [AT]) 12 November 2020 (2020-11-12) * figure 5c * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			E21B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	26 October 2023	Georgescu, Mihnea

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 23 18 1447

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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26-10-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2021151680 A	30-09-2021	NONE	
US 2020356077 A1	12-11-2020	AT 16360 U1	15-07-2019
		CN 111491755 A	04-08-2020
		EP 3710191 A1	23-09-2020
		JP 2021502907 A	04-02-2021
		KR 20200123405 A	29-10-2020
		US 2020356077 A1	12-11-2020
		WO 2019094997 A1	23-05-2019

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- EP 22160151 A **[0004]**