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(54) **DOWNHOLE WIRELINE TOOL**

(57) The present invention relates to a downhole wireline tool (1) for performing a machining operation in a well having a top, such as milling, the downhole wireline tool having a longitudinal axis, a first end configured to be connected to a wireline and a second end forming a front of the tool facing away from the wireline along the longitudinal axis, the downhole wireline tool comprising a tool housing (12), a holding section (7) having projectable parts configured to prevent a part of the downhole wireline tool from moving in a direction towards the top,

a machining tool (9) arranged in the front of the tool, and a rotation unit (10) for rotating the machining tool, wherein the downhole wireline tool further comprises an oscillation device (11) having a rotational stationary part (14) being connected with the rotation unit and a rotational part (15) being connected to the machining tool, the oscillation device being configured to provide an oscillating movement of the machining tool by oscillating the rotational part in relation to the rotational stationary part.

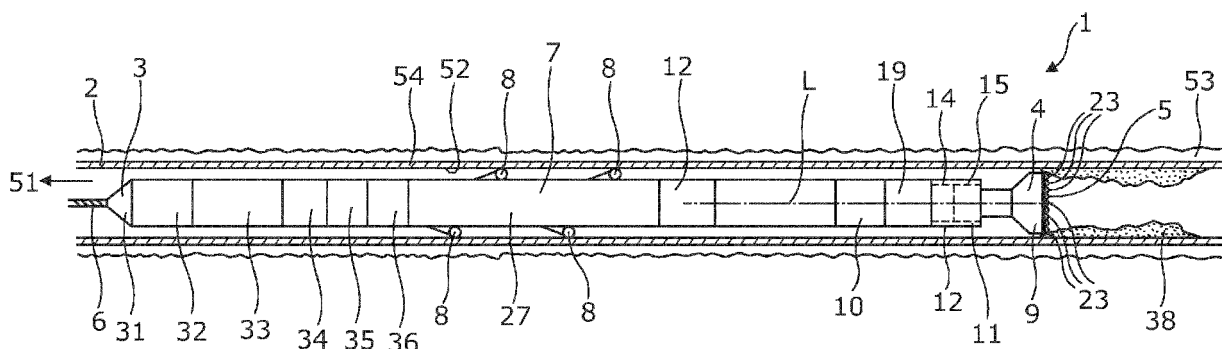


Fig. 1

## Description

**[0001]** The present invention relates to a downhole wireline tool for performing a machining operation in a well having a top, such as milling, the downhole wireline tool having a longitudinal axis, a first end configured to be connected to a wireline and a second end forming a front of the tool facing away from the wireline along the longitudinal axis.

**[0002]** When performing wireline operations, power for performing the operation is very limited compared to coiled tubing and drill pipe operations; however, the total time spent on the operation is at least reduced by half compared to coiled tubing and drill pipe operations. Wireline tools are therefore not able to drill through formations for drilling boreholes, but some less power-demanding operations may, after completing the well, be performed by intervening the well on wireline. However, some interventions may take too much time as higher operation speed is too power-demanding to be performed on wireline. One of such operations may be removing a cement plug or very hard scale inside the well tubular metal structure.

**[0003]** It is an object of the present invention to wholly or partly overcome the above disadvantages and drawbacks of the prior art. More specifically, it is an object to provide an improved downhole wireline tool which is able to also perform removal of cement or hard scale blocking the well tubular metal structure in a well.

**[0004]** The above objects, together with numerous other objects, advantages and features, which will become evident from the below description, are accomplished by a solution in accordance with the present invention by a downhole wireline tool for performing a machining operation in a well having a top, such as milling, the downhole wireline tool having a longitudinal axis, a first end configured to be connected to a wireline and a second end forming a front of the tool facing away from the wireline along the longitudinal axis, the downhole wireline tool comprising:

- a tool housing,
- a holding section having projectable parts configured to prevent a part of the downhole wireline tool from moving in a direction towards the top,
- a machining tool arranged in the front of the tool, and
- a rotation unit for rotating the machining tool,

wherein the downhole wireline tool further comprises an oscillation device having a rotational stationary part being connected with the rotation unit and a rotational part being connected to the machining tool, the oscillation device being configured to provide an oscillating movement of the machining tool by oscillating the rotational part in relation to the rotational stationary part.

**[0005]** Moreover, the oscillation device may be a mechanical oscillation device.

**[0006]** In addition, the rotational stationary part and/or

the rotational part of the oscillation device may have serrations providing the oscillating movement.

**[0007]** Furthermore, the rotational stationary part has a first end face abutting a second end face of the rotational part of the oscillation device, the first end face and/or the second end face having serrations.

**[0008]** Also, the first end face or the second end face may have serrations, the other of the first end face and the second end face having a cooperating part.

**[0009]** Additionally, the cooperating part(s) may be spike(s), projection(s), or similar.

**[0010]** Further, the serrations may have a serration height (h) of less than 5mm along the longitudinal axis, preferably less than 2.5mm.

**[0011]** Moreover, the serration height may extend along a longitudinal axis.

**[0012]** In addition, the serrations may have a triangular shape with an inclining face and a right face extending along the longitudinal axis.

**[0013]** Further, the oscillation device may be arranged in the tool housing.

**[0014]** Also, the machining tool may comprise bits for cutting or milling through scale or cement at least partly blocking the well.

**[0015]** Additionally, the present invention may further comprise a rotational member or shaft driven by the rotation unit, the rotational member extending at least through the stationary rotational part of the oscillation device.

**[0016]** Moreover, the present invention may further comprise a rotational member or shaft driven by the rotation unit, the rotational member extending at least through the rotational part and/or the stationary rotational part of the oscillation device.

**[0017]** Furthermore, the rotational member may comprise cooperating shafts transferring rotation from the rotation unit to rotation of the machining part.

**[0018]** The present invention may also further comprise the gearing unit arranged between the rotation unit and the machining tool.

**[0019]** In addition, the holding section may be configured to provide an axial force along the longitudinal axis away from the top.

**[0020]** Additionally, the downhole wireline tool may further comprise the holding section is a rolling anchor.

**[0021]** Also, the downhole wireline tool may further comprise a stroking tool providing an axial force along the longitudinal axis in relation to the holding section.

**[0022]** Finally, the holding section may be a stationary anchor configured to anchor the downhole wireline tool along the longitudinal axis when the projectable parts are in a projected state engaging a wall of a borehole or a well tubular metal structure.

**[0023]** The invention and its many advantages will be described in more detail below with reference to the accompanying schematic drawings, which for the purpose of illustration show some non-limiting embodiments and in which:

Fig. 1 shows a side view of a downhole wireline tool having a machining tool and an oscillation device for removing scale partly blocking the inside of the well tubular metal structure,

Fig. 2 shows a side view of another downhole wireline tool having a machining tool and an oscillation device for removing cement fully blocking the inside of the well tubular metal structure,

Fig. 3 shows a perspective of part of a downhole wireline tool having a machining tool and an oscillation device,

Fig. 4 shows an illustration of part of an oscillation device having a rotational part in relation to a rotational stationary part of the oscillation device, and

Fig. 5 shows an illustration of part of another oscillation device having a rotational part in relation to a rotational stationary part of the oscillation device.

**[0024]** All the figures are highly schematic and not necessarily to scale, and they show only those parts which are necessary in order to elucidate the invention, other parts being omitted or merely suggested.

**[0025]** Fig. 1 shows a downhole wireline tool 1 for performing a machining operation in a well 2 having a top 51. The machining operation is milling or similar low power machining operation for milling or cutting into scale 38 or cement 39 (shown in Fig. 2) fastened in a well tubular metal structure 54 in the well. The downhole wireline tool 1 has a longitudinal axis L, a first end 3 configured to be connected to a wireline 6 and a second end 4 forming a front 5 of the tool facing away from the wireline 6 along the longitudinal axis. The downhole wireline tool 1 comprises a tool housing 12 and a holding section 7 having projectable parts 8 configured to prevent a part of the downhole wireline tool from moving in a direction towards the top 51. The downhole wireline tool 1 comprises a machining tool 9 arranged in the front of the tool, and a rotation unit 10 for rotating the machining tool. The downhole wireline tool 1 further comprises an oscillation device 11 having a rotational stationary part 14 being connected with the rotation unit 10 and a rotational part 15 being connected to the machining tool, and the oscillation device 11 is configured to provide an oscillating movement of the machining tool 9 by oscillating the rotational part 15 in relation to the rotational stationary part 14.

**[0026]** By having a downhole wireline tool 1 with a holding section for preventing the downhole wireline tool from moving upwards while the machining tool performs the operation, the oscillating movement generated in the oscillation device 11 is transferred fully to the machining tool. Hereby, the oscillating movement is not scattered to the entire downhole wireline tool and thereby partly wasted but instead focussed on the machining process only. Known tools use vibration for releasing a tool string

in the well where the purpose is for the vibration to be distributed to the whole tool string which is the opposite purpose of the present invention, where the oscillating movement is to be fully transferred to the machining tool.

**[0027]** The downhole wireline tool 1 comprises a cable head 31 for connection to the wireline 6, an electric control unit 32, a compensator 33 for maintaining a predetermined over-pressure inside the tool 1, an electric motor 34 driving a pump 35 and a hydraulic section 36 for distribution of the pressurised fluid from the pump. In Fig. 1, the holding section 7 comprises a rolling anchor 27 in the form of a downhole self-propelling unit having the projectable parts 8 being wheels on projectable wheel arms. The downhole self-propelling unit may be a hydraulic-driven downhole self-propelling unit. The holding section 7 comprising the rolling anchor 27 is configured to provide an axial force, also called weight on bit 23 of the machining tool 9, along the longitudinal axis away from the top 51 while preventing the downhole wireline tool 1 from moving towards the top during the oscillating movement and thus preventing the oscillating movement from being scattered to the other parts of the downhole wireline tool 1. The hydraulic pump 35 generates fluid for projecting the arms and a separate fluid for rotating the wheels. The wheels may also be rotated by an electric motor in each wheel. The downhole wireline tool further comprises a gearing unit 19 arranged between the rotation unit 10 and the machining tool 9 and being pressure-compensated by a second compensator 33b.

**[0028]** The oscillation device 11 is a mechanical oscillation device arranged inside the tool housing 12 so that it is protected from the well fluid. The oscillation device 11 may be operated close to a natural frequency of the tool 1, so that when the oscillating force is applied at a resonant frequency of the tool, the tool will oscillate at a higher amplitude than when the same force is applied at other, non-resonant frequencies. The machining tool 9 comprises bits 23 for cutting or milling through non-metallic material, such as scale 38 or cement 39 at least partly blocking the well. The machining tool 9 comprises a rotational member 18, such as one or more shaft(s), driven by the rotation unit 10, and the rotational member 18 extends at least through the stationary rotational part 14 of the oscillation device 11. The rotational member 18 comprises cooperating shafts transferring rotation from the rotation unit 10 to rotation of the machining part 9 via the gearing unit 19. By having a rotational member 18 extending through the stationary rotational part 14 of the oscillation device 11, the oscillation device can easily be arranged inside the tool housing 12 and be protected from the "dirty" well fluid. Furthermore, the oscillation device 11 can be made in a very simple design which is easily integrated into the tool.

**[0029]** In Fig. 2, the downhole wireline tool 1 further comprises a stroking tool 28 providing an axial force along the longitudinal axis in relation to the holding section 7 and is thus configured to provide an axial force, also called weight on bit 23 of the machining tool 9, along

the longitudinal axis L away from the top 51. The holding section 7 is a stationary anchor 29 configured to anchor the main part of the downhole wireline tool 1 along the longitudinal axis L when the projectable parts 8 are in a projected state engaging a wall 52 of a borehole 53 or a well tubular metal structure 54. The machining tool 9 is still free to oscillate along the longitudinal axis L in relation to the holding section 7. In Fig. 2, the machining tool 9 is oscillated during cutting into a cement plug 39 fully blocking the well tubular metal structure 54.

**[0030]** In Fig. 3, part of the downhole wireline tool 1 is shown disclosing the rotational stationary part 14, the rotational part 15 of the oscillation device 11 having serrations 16 providing the oscillating movement when the rotational part 15 is rotated with the rotation of the machining tool 9. The rotational stationary part 14 is held stationary by the holding section 7. As indicated by dotted lines, the rotational member 18 driven by the rotation unit 10 extends through the stationary rotational part 14 of the oscillation device 11 and is connected with the rotational part 15 for rotating itself and the machining tool 9. The rotational stationary part 14 has a first end face 21 abutting a second end face 22 of the rotational part 15 of the oscillation device 11, and the first end face and the second end face have the serrations 16. The serrations have a serration height h of less than 5mm along the longitudinal axis, preferably less than 2.5mm, and the serration height extends along longitudinal axis L. The oscillating movement will thus correspond to the serration height and thus preferably be less than 5mm. As shown in Fig. 4, the serrations 16 have a triangular shape 24 with an inclining face 25 and a right face 26 extending along the longitudinal axis L. The oscillation device 11 is fully comprised inside the tool housing 12, indicated by a dotted line and the tool housing is sealing around a shaft 37 of the machining tool 9. Thus, the oscillation device 11 can also be pressure-compensated by means of the compensator 33b. Even though not shown, the machining tool 9 may have a centre bore extending from the front face at least partly into the machining tool and inside the bore, a fastening element may be arranged for fastening the cut-out part of the cement plug and bring it to surface.

**[0031]** In Fig. 5, the first end face 21 has serrations 16 and the second end face 22 or second end of the rotational part 15 having cooperating parts 17 in the form of radially extending spike(s), projection(s), or similar extensions. By having radially extending cooperating parts 17, the cooperating parts 17 can be used to control the oscillating movement by engaging a groove in the tool housing 12.

**[0032]** A stroking tool is a tool providing an axial force. The stroking tool comprises an electric motor for driving a pump. The pump pumps fluid into a piston housing to move a piston acting therein. The piston is arranged on the stoker shaft. The pump may pump fluid out of the piston housing on one side and simultaneously suck fluid in on the other side of the piston.

**[0033]** By "fluid" or "well fluid" is meant any kind of fluid that may be present in oil or gas wells downhole, such as natural gas, oil, oil mud, crude oil, water, etc. By "gas" is meant any kind of gas composition present in a well, completion or open hole, and by "oil" is meant any kind of oil composition, such as crude oil, an oil-containing fluid, etc. Gas, oil and water fluids may thus all comprise other elements or substances than gas, oil and/or water, respectively.

**[0034]** By "casing" or "well tubular metal structure" is meant any kind of pipe, tubing, tubular, liner, string, etc., used downhole in relation to oil or natural gas production.

**[0035]** In the event that the tool is not submergible all the way into the casing, a downhole self-propelling unit, such as a downhole tractor, can be used to push the tool all the way into position in the well. The downhole tractor may have projectable arms having wheels, wherein the wheels contact the inner surface of the casing for propelling the tractor and the tool forward in the casing. A downhole tractor is any kind of driving tool capable of pushing or pulling tools in a well downhole, such as a Well Tractor®.

**[0036]** Although the invention has been described above in connection with preferred embodiments of the invention, it will be evident to a person skilled in the art that several modifications are conceivable without departing from the invention as defined by the following claims.

## Claims

1. A downhole wireline tool (1) for performing a machining operation in a well (2) having a top (51), such as milling, the downhole wireline tool having a longitudinal axis (L), a first end (3) configured to be connected to a wireline (6) and a second end (4) forming a front (5) of the tool facing away from the wireline along the longitudinal axis, the downhole wireline tool comprising:

- a tool housing (12),
- a holding section (7) having projectable parts (8) configured to prevent a part of the downhole wireline tool from moving in a direction towards the top,
- a machining tool (9) arranged in the front of the tool, and
- a rotation unit (10) for rotating the machining tool,

wherein the downhole wireline tool further comprises an oscillation device (11) having a rotational stationary part (14) being connected with the rotation unit and a rotational part (15) being connected to the machining tool, the oscillation device being configured to provide an oscillating movement of the machining tool by oscillating the rotational part in relation to the

rotational stationary part.

2. A downhole wireline tool according to claim 1, wherein the oscillation device is a mechanical oscillation device. 5
3. A downhole wireline tool according to claim 1 or 2, wherein the rotational stationary part and/or the rotational part of the oscillation device have serrations (16) providing the oscillating movement. 10
4. A downhole wireline tool according to claim 3, wherein the rotational stationary part has a first end face (21) abutting a second end face (22) of the rotational part of the oscillation device, the first end face and/or the second end face having serrations. 15
5. A downhole wireline tool according to claim 4, wherein the first end face or the second end face has serrations, and the other of the first end face and the second end face has a cooperating part (17). 20
6. A downhole wireline tool according to any of claims 3-5, wherein the serrations have a serration height (h) of less than 5mm along the longitudinal axis, preferably less than 2.5mm. 25
7. A downhole wireline tool according to any of claims 3-6, wherein the serrations have a triangular shape (24) with an inclining face (25) and a right face (26) extending along the longitudinal axis. 30
8. A downhole wireline tool according to any of the preceding claims, wherein the oscillation device is arranged in the tool housing. 35
9. A downhole wireline tool according to any of the preceding claims, wherein the machining tool comprises bits (23) for cutting or milling through scale or cement at least partly blocking the well. 40
10. A downhole wireline tool according to any of the preceding claims, further comprising a rotational member (18) (shaft) driven by the rotation unit, the rotational member extending at least through the stationary rotational part of the oscillation device. 45
11. A downhole wireline tool according to any of the preceding claims, further comprising the gearing unit (19) arranged between the rotation unit and the machining tool. 50
12. A downhole wireline tool according to any of the preceding claims, the holding section being configured to provide an axial force along the longitudinal axis away from the top. 55
13. A downhole wireline tool according to any of the pre-

ceding claims, further comprising the holding section is a rolling anchor (27).

14. A downhole wireline tool according to any of the preceding claims, further comprising a stroking tool (28) providing an axial force along the longitudinal axis in relation to the holding section.
15. A downhole wireline tool according to any of the preceding claims, wherein the holding section is a stationary anchor (29) configured to anchor the downhole wireline tool along the longitudinal axis when the projectable parts are in a projected state engaging a wall (52) of a borehole (53) or a well tubular metal structure (54).

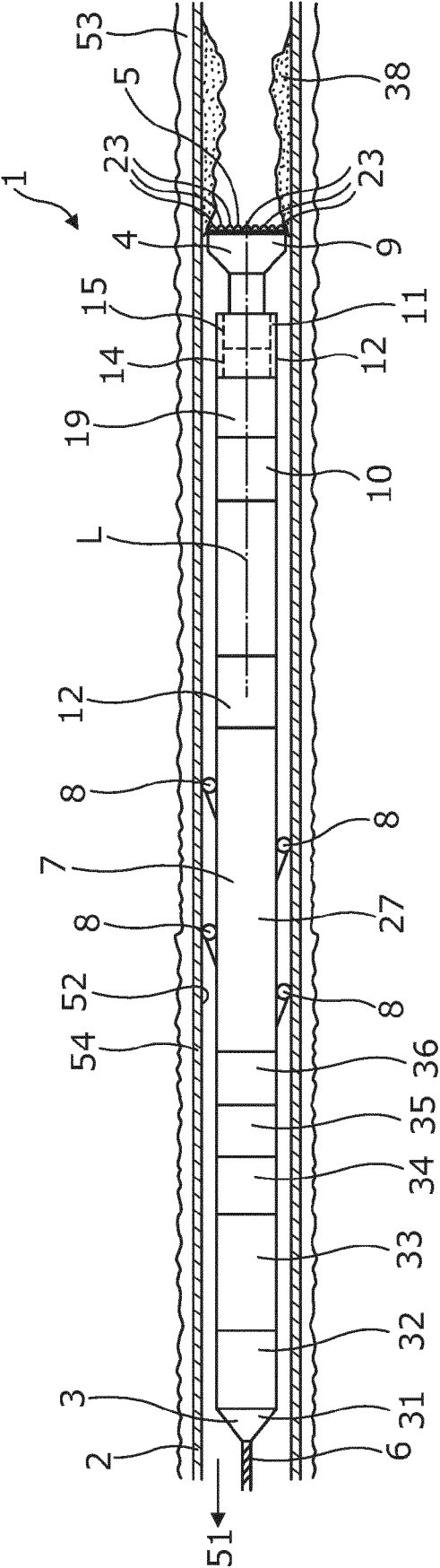


Fig. 1

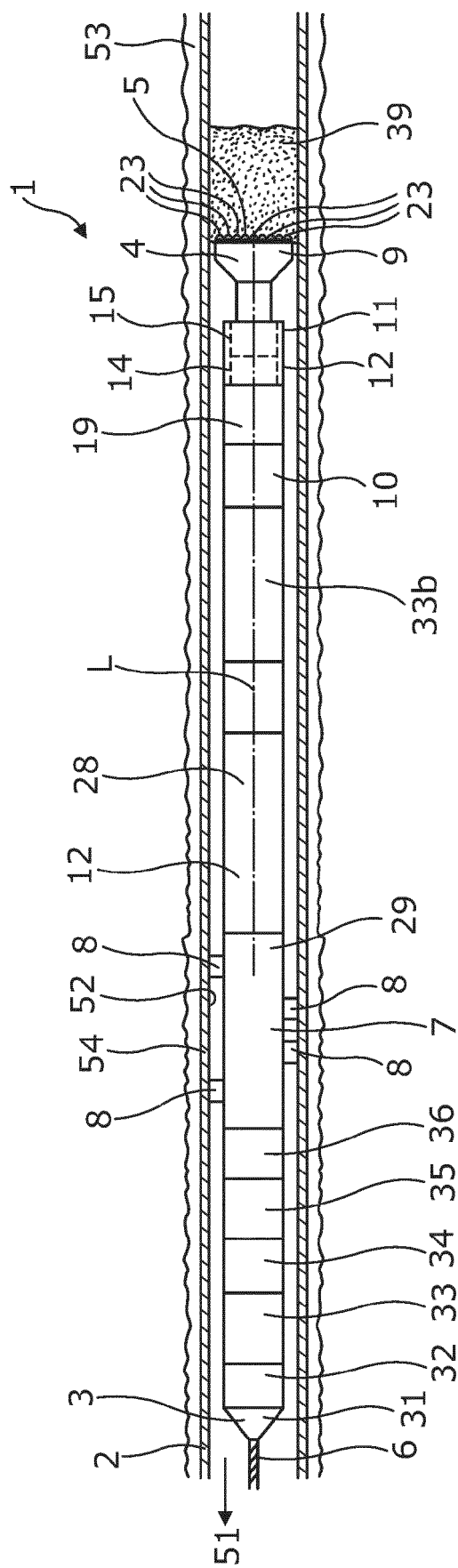
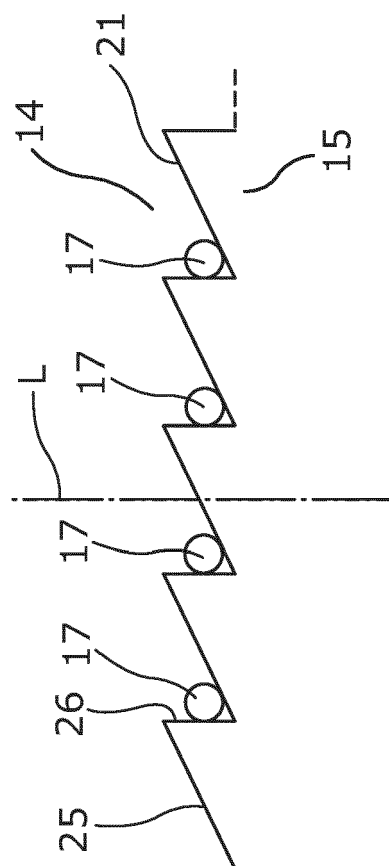
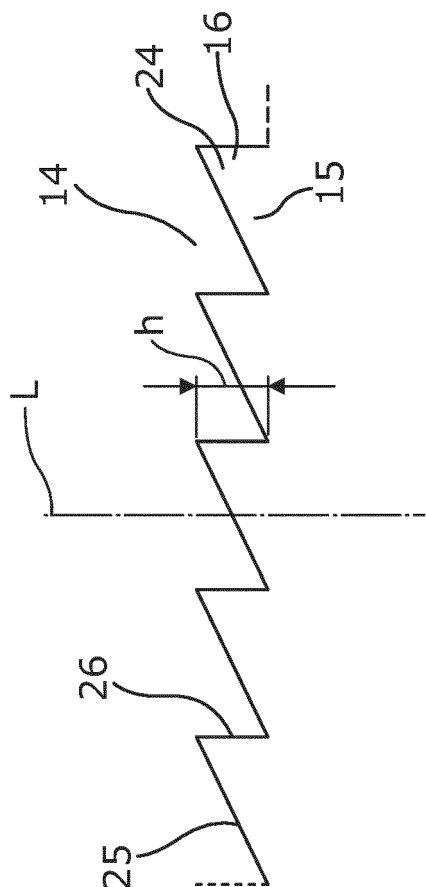
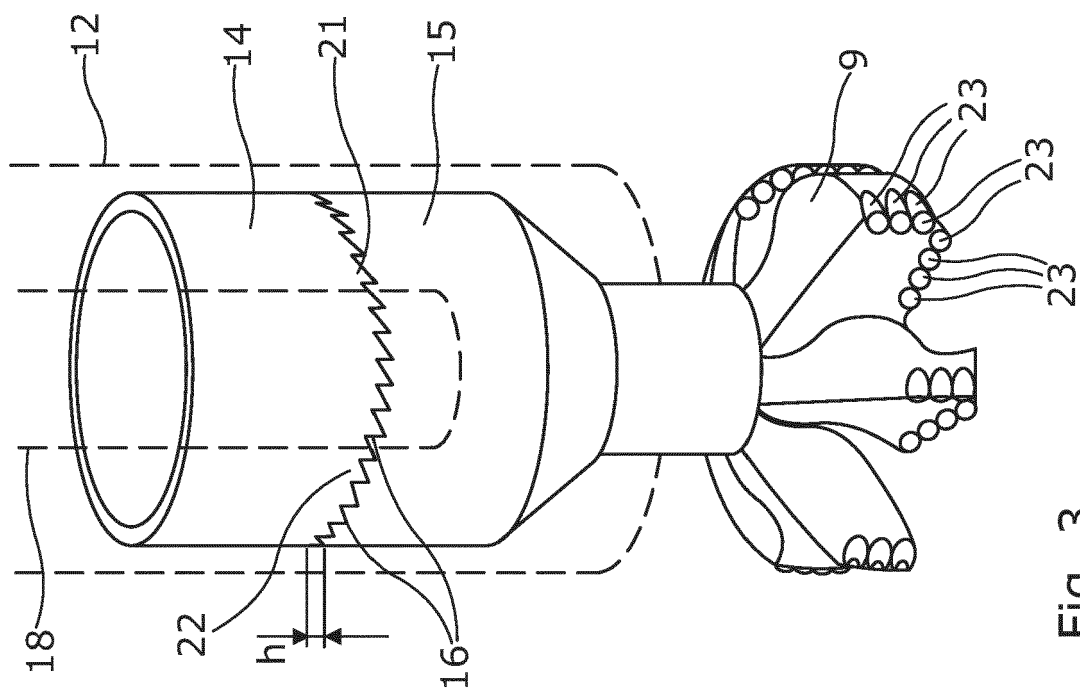


Fig. 2







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Application Number

EP 21 21 2876

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                    |                                                                                                                                     |                                                                                                                                                                                                                                                                                       |                                                                                                |
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| Category                                                                                                                                                                                                                                               | Citation of document with indication, where appropriate, of relevant passages                                                       | Relevant to claim                                                                                                                                                                                                                                                                     | CLASSIFICATION OF THE APPLICATION (IPC)                                                        |
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|                                                                                                                                                                                                                                                        |                                                                                                                                     |                                                                                                                                                                                                                                                                                       | TECHNICAL FIELDS SEARCHED (IPC)                                                                |
|                                                                                                                                                                                                                                                        |                                                                                                                                     |                                                                                                                                                                                                                                                                                       | E21B                                                                                           |
| The present search report has been drawn up for all claims                                                                                                                                                                                             |                                                                                                                                     |                                                                                                                                                                                                                                                                                       |                                                                                                |
| Place of search<br><b>Munich</b>                                                                                                                                                                                                                       |                                                                                                                                     | Date of completion of the search<br><b>31 March 2022</b>                                                                                                                                                                                                                              | Examiner<br><b>Ott, Stéphane</b>                                                               |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                                     | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>.....<br>& : member of the same patent family, corresponding document |                                                                                                |

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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