

EP 2 305 948 A1

(51) Int Cl.:
E21B 37/02 (2006.01)

(22) Date of filing: **25.09.2009**

- **Gelardi, Torben**
2000 Frederiksberg (DK)
- **Nygård, Niels**
3400 Hillerød (DK)

(74) Representative: **Hoffmann, Claus**
Hoffmann Dragsted A/S
Rådhuspladsen 16
1550 Copenhagen V (DK)

(74) Representative: **Hoffmann, Claus**
Hoffmann Dragsted A/S
Rådhuspladsen 16
1550 Copenhagen V (DK)

longitudinal axis and comprising at least one brushing element (2). The brushing element comprises a centre part (18) and a plurality of arms (4) and the arms have a rectangular configuration when seen in cross-section.

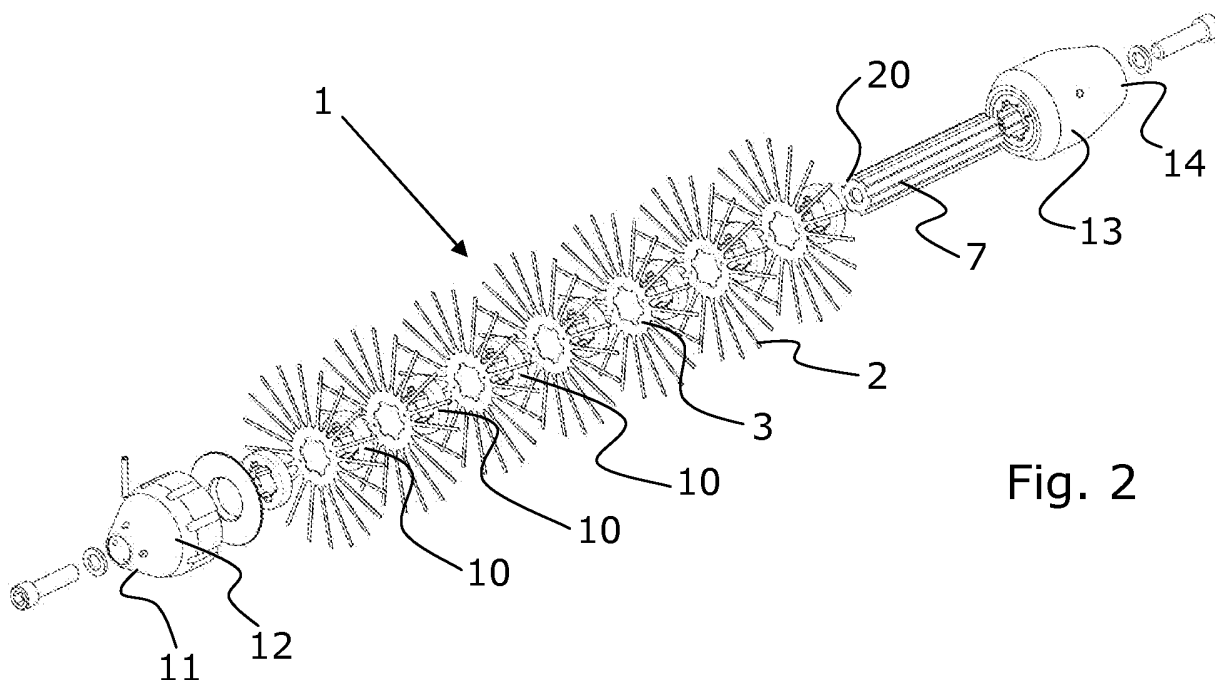


Fig. 2

Description

Technical Field

[0001] The present invention relates to a brush assembly for performing a cleaning and/or brushing operation in a casing downhole, the brush assembly having a longitudinal axis and comprising at least one brushing element. The brushing element comprises a centre part and a plurality of arms.

Background

[0002] In a casing downhole, scales may be formed in the well fluid and precipitate onto the sides of the casing wall or onto other elements comprised in a completion, such as a valve. Such scales are very rigid and stick easily to the casing wall or valve, and are thus very difficult to remove without damaging the valve or weakening the wall.

[0003] Prior art cleaning tools have individual wires fastened to the side of the tool or a rail in the tool. However, the wires are often too soft to be able to clean scales off a valve and/or of the sides of a casing wall.

[0004] Furthermore, the brushes often get worn fast. When the brushes get worn, they lose their brushing effect and need to be replaced or, in some cases, the entire cleaning tool needs to be substituted by a new tool. Furthermore, replacement of the brushes in the prior art solutions are very cumbersome.

[0005] Also, the prior art cleaning tools, and especially the brushing elements, are rather complex, and they are thus not easy to manufacture.

Description of the Invention

[0006] It is an object of the present invention to wholly or partly overcome the above disadvantages and drawbacks of the prior art and to provide an improved cleaning tool able to remove scales from the inside of a casing, a valve, a sleeve, etc. substantially without damaging this object.

[0007] 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 brush assembly for performing a cleaning and/or brushing operation in a casing downhole, the brush assembly having a longitudinal axis and comprising:

- at least one brushing element comprising:
 - a centre part, and
 - a plurality of arms,

wherein the arms have a rectangular configuration when seen in cross-section.

[0008] A cleaning tool is obtained in which the brushes

are strong enough to brush the interior of a casing downhole, cleaning it free off rigid debris and other precipitated materials, such as scales and the like.

[0009] Furthermore, the rectangular cross-sectional configuration of the arm may have two first opposing sides being longer than two second opposing sides.

[0010] By having two first opposing sides longer than two second opposing sides, the arm is able to bend easier in one direction than in another direction, thus making the arm more flexible in one direction and more rigid in the other direction.

[0011] The centre part may be a longitudinal element, a winded part, or a disc.

[0012] In addition, the arms may extend through the centre part, be securely connected to the centre part, or the arms and the centre part is formed as one element.

[0013] In one embodiment, the brushing element may be made from a sheet element.

[0014] Furthermore, a cleaning tool is obtained which is easy to manufacture and which facilitates maintenance and replacements of brushing elements.

[0015] The sheet element may be made of metal or a reinforced composite material. The metal may e.g. be spring steel.

[0016] Spring steel is extremely stress resistant and has an inherent flexibility, which allows the arms of the brushing element to return to their original shape despite significant bending or twisting.

[0017] In one embodiment, the spring steel may comprise 0.50%-2.50% silicon, 0.20%-2.50% manganese, and 0.02%-1.50% carbon.

[0018] The arms of the brushing element may extend radially from the centre part and they may be distributed around the centre part with an even distance and/or an uneven distance between them. The arms may have a length and a width.

[0019] In one embodiment, part of the arms may be twisted around their length in an angle θ . Hereby, the arm forms a tapered point end. The angle θ may be between 0-85°, preferable between 20-65°, more preferably between 30-60°.

[0020] By twisting the arms around the length, a second part of the arm is given an angle θ in relation to the other first part of the arm. In this way, the second part of the arm is made flexible in a direction angled by the angle θ in relation to the first part.

[0021] When the part of the arm is twisted in angle θ , the arm does not substantially damage the inside wall of the casing or the valve since the arm is able to bend away from the direction of rotation. If the arm is not twisted, it can only bend in the direction of rotation which will not happen or in a direction perpendicular thereto. By twisting the arm, it is easier for the arm to bend when operating the tool.

[0022] In another embodiment, a second part of the arm furthest away from the centre part is twisted.

[0023] In addition, the second part is 10-90% of the length of the arm, preferably 30-70% of the length of the

arm, and more preferably 40-60% of the length of the arm.

[0024] The thickness of the sheet element may be between 0.2 and 3.0 mm.

[0025] The brushing element may be arranged on a shaft and the centre part of the brushing element may comprise locking means adapted to engage with corresponding locking means of the shaft.

[0026] The purpose of equipping the brushing element with locking means is to hinder the brushing element from rotating around the shaft.

[0027] In one embodiment, a plurality of brushing elements may be arranged in succession along the longitudinal axis of the brush assembly, which makes it possible to clean and brush a greater area.

[0028] The brushing elements may be spaced apart by distance bushes.

[0029] Moreover, the lengths of the arms of the brushing elements may be substantially identical or the arms of the brushing elements may have different lengths.

[0030] In one embodiment, the length of the arms near a front end of the brush assembly is shorter than the length of the arms of the subsequent brushing elements. The object to be cleaned may thus be cleaned very gently, as the shorter arms near the front end rip up the surface of the elements to be removed before they are removed by the subsequent, longer arms.

[0031] The brush assembly may comprise a first end piece arranged at the front end of the assembly and a second end piece arranged at a back end of the assembly. In one embodiment, the second end piece may be adapted to engage with a rotatable element, allowing the brushing element to be rotated.

[0032] The invention also relates to a brushing element for use in a brush assembly as described above and to use of such a brush assembly for cleaning or brushing a variety of different objects downhole.

[0033] In addition, the invention relates to a downhole tool comprising one or more brush assemblies as described above. The downhole tool may also comprise an anchor section for anchoring the tool in a position downhole, e.g. against the inside wall of a casing.

[0034] Finally, the invention also relates to a downhole system comprising such a downhole tool and a driving unit, such as a downhole tractor.

Brief Description of the Drawings

[0035] 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 brushing element according to the present invention,

Fig. 2 shows an exploded view of the brush assembly in perspective,

Fig. 3 shows a cross-sectional view of the brush assembly along the longitudinal extension of the assembly,

Fig. 4 shows a brush assembly with a spindle providing rotation and a translating movement of the brush assembly,

Fig. 5 shows a downhole tool comprising a brush assembly,

Fig. 6 shows another embodiment of the brushing element according to the invention, and

Fig. 7 shows the arm when twisted in angle.

[0036] 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.

Detailed description of the invention

[0037] The invention relates to a brush assembly 1 for removing scales from e.g. a valve, a casing wall, or a sleeve and for cleaning the openings in a perforated section of the casing. The brush assembly 1 comprises at least one brushing element 2 as shown in Fig. 1. The brushing element 2 is here a plate-shaped element 18, where the brushes are created when the element is cut out from a metal plate or sheet. The brushing element 2 is cut into the shape of a flower or a sun, the flower petals or sunbeams constituting the arms 4 of the brush.

[0038] As shown in Fig. 2, the brush assembly 1 may comprise several brushing elements 2 spaced apart by a distance bush 10. The brushing elements 2 and the distance bushes 10 are arranged on a common shaft 7 and are held together by a first 12 and a second end piece 13. Each distance bush 10 is in the form of a ring. The thickness of the distance bushes 10 may vary along the longitudinal axis of the brush assembly 1.

[0039] When the arms and the centre part is formed as one element, such as the brushing element 2 being cut from a single metal sheet, the arms 4 of the brush assembly 1 have been made substantially more rigid than in prior art solutions. During a cleaning operation, the arms 4 may be worn out, or damaged. When the brushing element 2 is manufactured in one piece, the brush assembly may be easily repaired in that damaged arms 4 may be replaced quickly by simply replacing the brushing element. Furthermore, the brushing element 2 is easy to manufacture, avoiding additional mounting processes for fastening the arms in the centre part 3.

[0040] In Fig. 1, the arms 4 have both a tapering part and a straight part. In Fig. 6, the tapering part is much smaller so that the arm is substantially straight.

[0041] In the drawings, the brush assembly 1 is shown having seven brushing elements 2; however, in another

embodiment, it may comprise as few as one or even more than seven brushing elements.

[0042] Even though the centre part 3 is shown in the form of a disc 18, the centre part may have a variety of shapes, being a longitudinal element, a winded part, or the like shape. The arms may also extend through the centre part, or be securely connected to the centre part. By securely connected is meant any form of fastening, such as by means of welding, glue, screws, rivets or the like fastening means.

[0043] The brushing elements 2 are provided with locking means 8 for hindering the elements from rotating around the shaft 7. The locking means 8 may be indentations 19 matching projections 20 on the shaft 7, preventing the brushing element 2 from rotating. The indentations 19 and projections 20 may have any suitable form and, in another embodiment, the locking means may be provided with projections matching indentations in the shaft 7 instead.

[0044] The brush assembly 1 may comprise a rotatable element 15, such as a spindle 21 and a connecting element (not shown) as shown in Fig. 4. The spindle 21 may either slide in relation to the connecting element, so that the spindle rotates and the connecting element is fixed, or the connecting element may slide in relation to spindle, so that the connecting element rotates and the spindle is fixed. The shaft 7 or the second end piece 13 is connected with the rotating part, whether this is the connecting element or the spindle 21. Thus, the brushing elements 2 can be moved back and forth while rotating in order to remove scales from e.g. a valve. The spindle 21 may have any suitable pattern 22 in order to engage the connecting element and provide rotation. The spindle is shown as a spindle able to return without having to change the direction of rotation. In another embodiment, the rotatable element 15 may be a shaft rotated by means of hydraulics, pneumatics, an electronic motor, or the like.

[0045] When the brush assembly 1 is provided with several brushing elements 2, the length of the arms 4 may differ between the brushing elements. Accordingly, the arms 4 of the first brushing element 2 or the first couple of brushing elements situated in the front end of the brush assembly 1, i.e. the end of the assembly first encountering the object to be cleaned, may be shorter than the arms of the subsequent brushing element or elements. Similarly, the arms 4 of these brushing elements 2 may again be shorter than the arms of the subsequent brushing element or elements.

[0046] In Fig. 1, the brushing element 2 has 20 arms 4 extending radially outwards and the arms are spaced along the periphery of the centre part 3 at an equal distance. However, the arms 4 may also be spaced at an uneven distance. Each arm 4 is rectangular in shape and has a width w and a length L and a thickness which is less than the width, which again is less than the length. In this embodiment, the arms 4 of all the brushing elements 2 have substantially the same thickness; however, they may also have different thicknesses. The arms 4 of

the first brushing element 2 may e.g. be thinner than the arms of the subsequent brushing element or brushing elements. The arms 4 may have a thickness of 0.2-3.0 mm, preferably 0.3-2.0 mm, and more preferably 0.4-1.0 mm.

[0047] The sheet or plate-shaped element 18 from which the brushing element 2 is manufactured may be made of any substantially rigid material having the flexibility necessary for the brush to remove the scales without damaging the object to be cleaned.

[0048] The sheet or plate-shaped element 18 may thus be made of a metal sheet or plate or a reinforced composite material. If metal is used, spring steel is advantageous as it is both stress resistant and flexible enough to be able to return to its original shape despite significant bending and twisting. The spring steel may comprise 0.50%-2.50% silicon, 0.20%-2.50% manganese, and 0.02%-1.50% carbon. The metal sheet may also be made of austenitic stainless steel.

[0049] In Fig. 1, the brushing element 2 has twenty straight arms 4. Each arm 4 may be twisted in order to provide flexibility to the arm in two directions. The arms 4 may be twisted around their lengths L or have a bended or corrugated shape when seen from one side or in cross-section along the length.

[0050] In one embodiment, each arm 4 may be partly twisted so that a first part 23 of the arm closest to the centre part 3 is maintained in the same plane 25 as the original sheet element from which it was made, whereas a second part 24 of the arm is twisted. This is illustrated in Fig. 6. The upper plane 26 of the twisted second part 24 is twisted at an angle θ of approximately 45° to the plane 25 of the first part 23, forming a tapered point end 5. The angle θ may be between $0-85^\circ$, preferable between $20-65^\circ$, more preferably between $30-60^\circ$.

[0051] In another embodiment, a second part of the arm furthest away from the centre part is twisted. In addition, the second part is 10-90% of the length of the arm, preferably 30-70% of the length of the arm, and more preferably 40-60% of the length of the arm. In Fig. 6, the second part is approximately 50% of the length of the arm so that the twist is distributed along the middle 6 of the arm.

[0052] By twisting the arms around the length, the second part of the arm is made flexible in a direction angled by the angle θ in relation to the upper plane 25 of the first part. When the part of the arm is twisted, the arm does not substantially damage the inside wall of the casing or the valve since the arm is able to bend away from the direction of rotation. If the arm is not twisted, it can only bend in the direction of rotation which will not occur or in a direction perpendicular thereto. By twisting the arm, it is easier for the arm to bend when operating.

[0053] Fig. 5 shows a downhole tool 16 comprising a brush assembly 1. As shown, the tool 16 may also comprise an anchor section 17 which may be used to anchor the tool to the inside wall of the casing before the cleaning operation with the brush assembly 1 begins.

[0054] The tool 16 may also have so-called no-gos (not shown), i.e. hindering devices arranged outside the tool. The devices about a restriction (not shown) or a bottleneck (not shown) in the casing preventing the tool 16 from moving any further and the brush assembly 1 is subsequently moved further into the casing in order to clean the casing from within.

[0055] The brush assembly 1 can be used for cleaning a variety of different objects downhole. Due to the stiffness and high yield strength of the brushing elements 2, the brush assembly 1 is highly suitable for removing even very difficult elements from the object, such as scales from a valve, without doing any essential damage to the valve preventing it from functioning properly subsequently.

[0056] In the course of time, scales will inevitably be formed and precipitate, but the well fluid may also comprise other elements, such as shavings or formation pieces from a drilling process, which are very difficult to remove unless by means of a brush assembly 1 according to the present invention.

[0057] 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.

[0058] By a casing is meant all kinds of pipes, tubings, tubulars, liners, strings etc. used downhole in relation to oil or natural gas production.

[0059] In the event that the brush assembly 1 or the tool 16 is not submersible all the way into the casing, a downhole tractor can be used to push the tools all the way into position in the well. A downhole tractor is any kind of driving tool capable of pushing or pulling tools in a well downhole, such as a Well Tractor®.

Claims

1. A brush assembly (1) for performing a cleaning and/or brushing operation in a casing downhole, the brush assembly having a longitudinal axis and comprising:

- at least one brushing element (2) comprising:

- a centre part (3), and
- a plurality of arms (4) each having a length (L) and a width (w),

wherein the arms have a rectangular configuration when seen in cross-section.

2. A brush assembly according to claim 1, wherein the

centre part is a longitudinal element, a winded part, or a disc.

3. A brush assembly according to claim 1 or 2, wherein the arms extend through the centre part, are securely connected to the centre part, or the arms and the centre part is formed as one element.

4. A brush assembly according to any of claim 1 to 3, wherein the brushing element is made from a sheet element.

5. A brush assembly according to claim 4, wherein the sheet element is made of metal, such as spring steel.

6. A brush assembly according to any of the preceding claims, wherein the arms extend radially from the centre part.

7. A brush assembly according to any of the preceding claims, wherein part of the arms are twisted around their length in an angle (θ).

8. A brush assembly according to claim 7, wherein the angle θ is between $0-85^\circ$, preferable between $20-65^\circ$, more preferably between $30-60^\circ$

9. A brush assembly according to claim 7 or 8, wherein the a second part (24) of the arm furthest away from the centre part is twisted, and wherein the second part is 10-90% of the length of the arm, preferably 30-70% of the length of the arm, and more preferably 40-60% of the length of the arm.

10. A brush assembly according to any of the preceding claims, comprising a first end piece (12) arranged at the front end of the assembly and a second end piece (13) arranged at a back end (14) of the assembly, and wherein the second end piece is adapted to engage with a rotatable element (15) allowing the brushing element to be rotated.

11. A brushing element for use in a brush assembly according to any of the claims 1 to 10.

12. Use of a brush assembly according to any of the claims 1 to 10 for cleaning or brushing a variety of different objects downhole.

13. A downhole tool (16) comprising a brush assembly according to any of the claims 1 to 21.

14. A downhole tool according to claim 13, further comprising an anchor section (17) for anchoring the tool in a position downhole, e.g. against an inside wall of a casing.

15. A downhole system comprising a downhole tool ac-

according to any of claims 13 or 14 and a driving unit,
such as a downhole tractor.

5

10

15

20

25

30

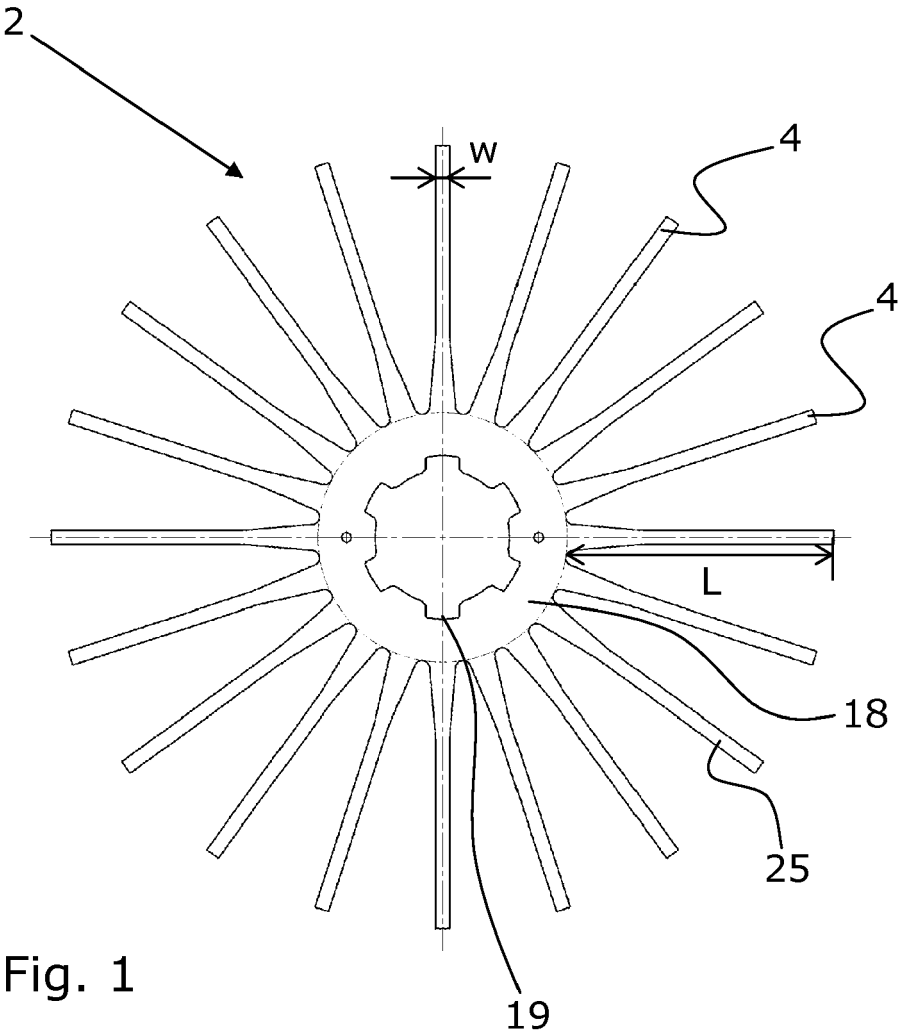
35

40

45

50

55



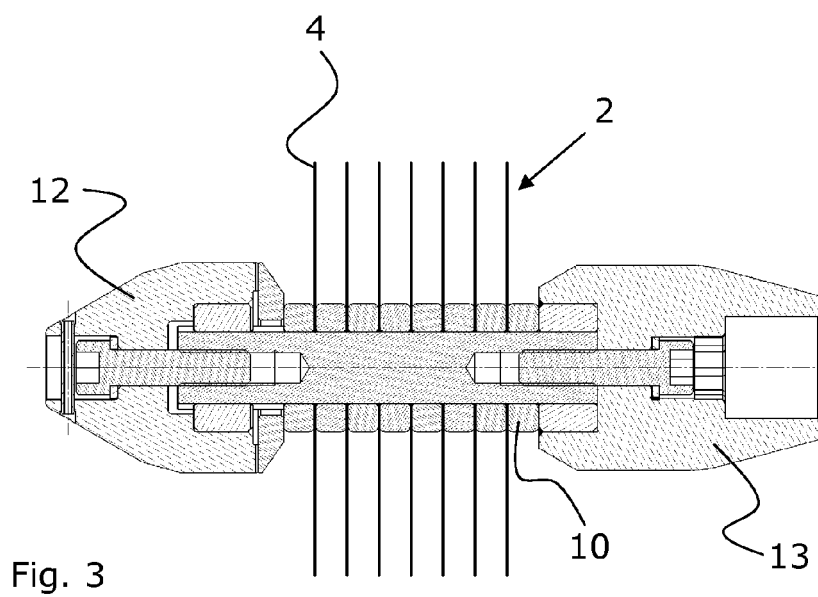
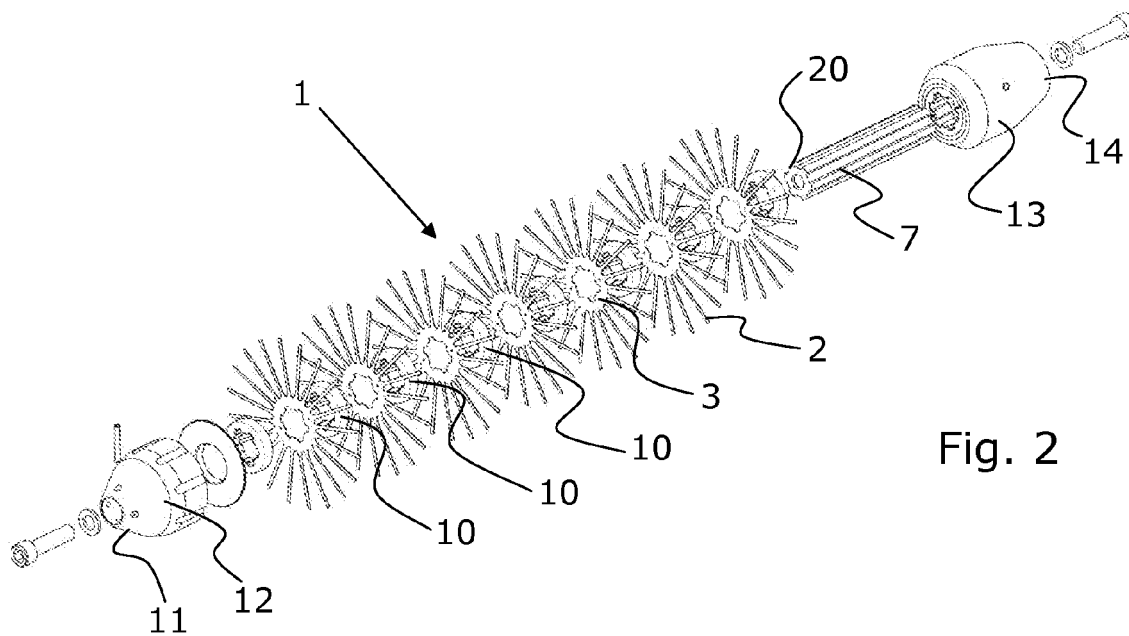


Fig. 4

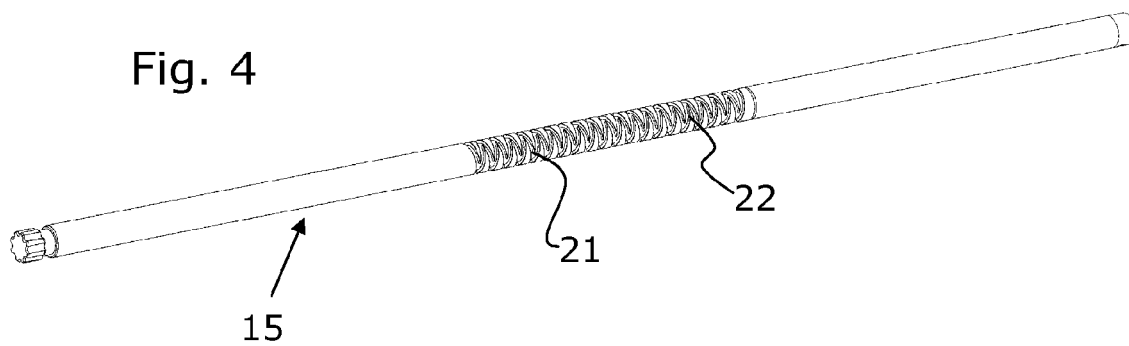
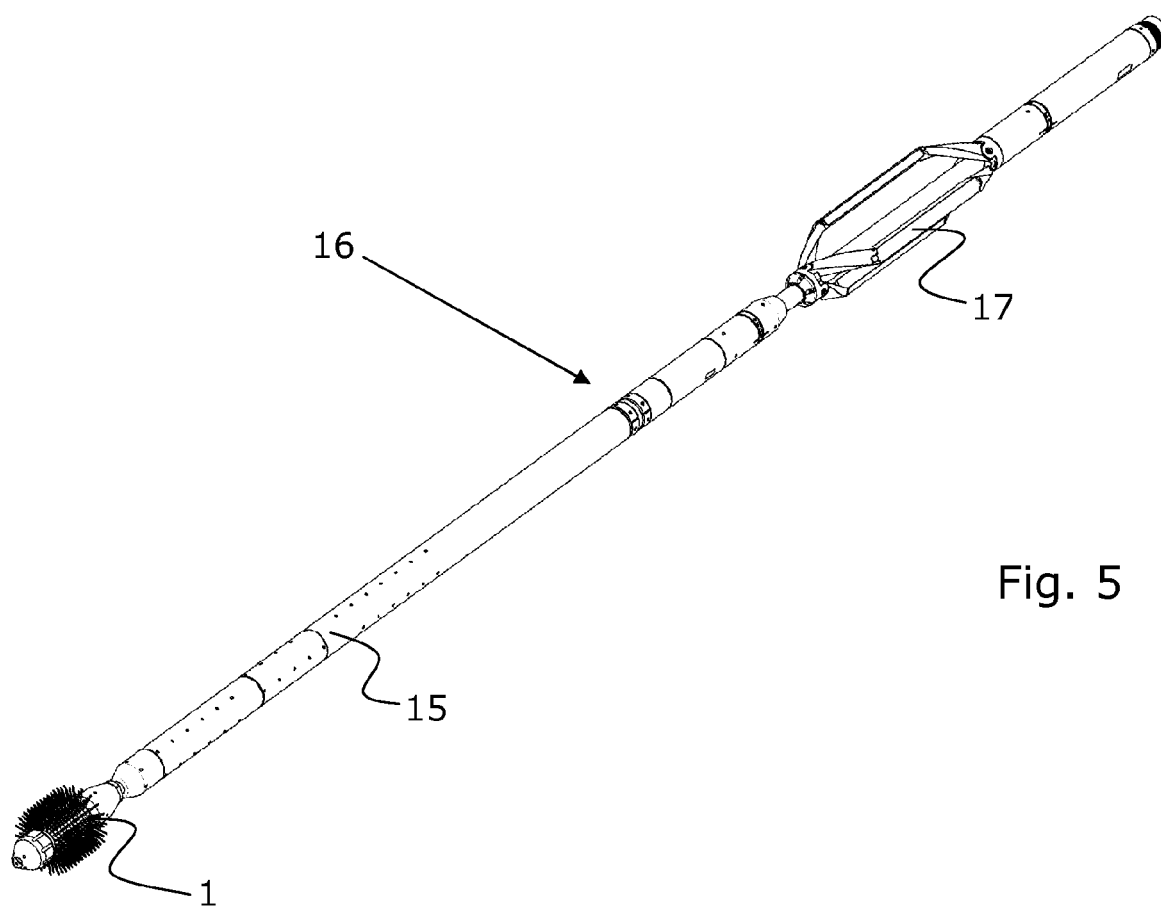


Fig. 5



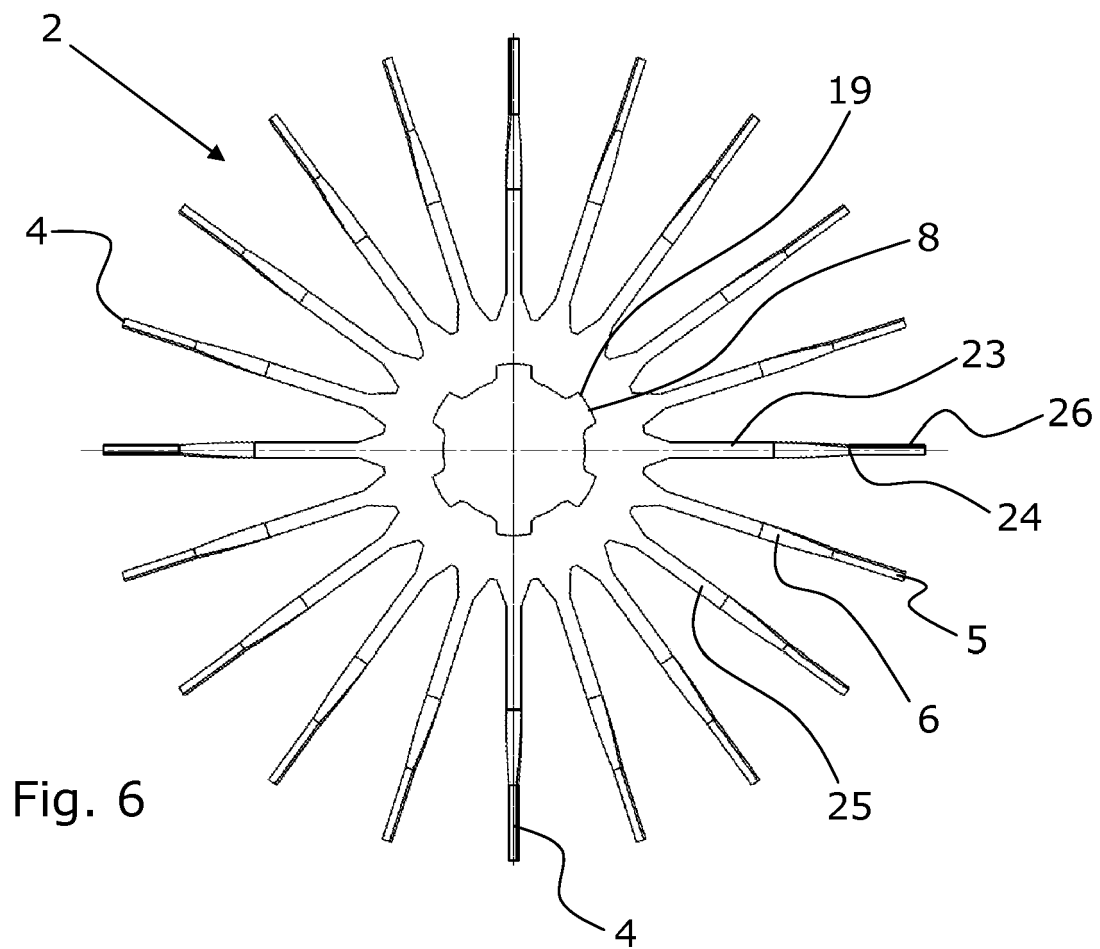


Fig. 6

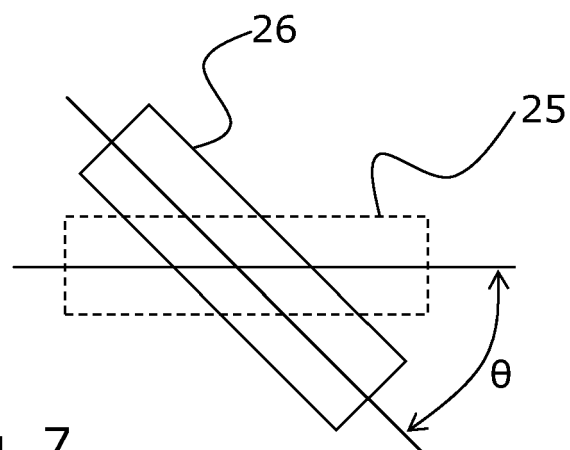


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 09 17 1406

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	US 2 517 017 A (CLIFFORD NESTLE ALFRED) 1 August 1950 (1950-08-01)	1-13	INV. E21B37/02
Y	* column 3, line 25 - line 29 *	14,15	
Y	WO 01/18351 A1 (WEATHERFORD LAMB [US]; SIMPSON NEIL ANDREW ABERCROMBI [GB]) 15 March 2001 (2001-03-15) * page 4, paragraph 2 * * page 5, paragraph 4 - page 6, paragraph 2 * -----	14,15	
			TECHNICAL FIELDS SEARCHED (IPC)
			E21B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 30 April 2010	Examiner Ott, Stéphane
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			

2
EPO FORM 1503 03/82 (P04C01)

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

EP 09 17 1406

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

30-04-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2517017	A	01-08-1950	NONE

WO 0118351	A1	15-03-2001	CA 2384056 A1 15-03-2001
		DE 60015774 D1 16-12-2004	
		EP 1210500 A1 05-06-2002	
		NO 20020842 A 24-04-2002	
		US 6745839 B1 08-06-2004	
