

Description

Field of the invention

[0001] The present invention relates to a downhole tool for insertion into a casing having a lateral extending from a main casing. The present invention furthermore relates to a downhole system and a method for guiding a wireline of a downhole tool as described above.

Background art

[0002] From time to time, operations need to be performed in wells downhole. This type of operation, such as the opening or closing of a sliding sleeve, is often performed by means of a downhole wireline tool. In the event that the sliding sleeve is arranged in a lateral or side track, the wireline tool is diverted into the lateral and the wireline of the wireline tool is forced against the edge formed between the main part of the casing and the lateral. As the wireline tool moves forward in the lateral, the wireline slides against the edge and is torn and frayed. A wireline performing many jobs may thus eventually be damaged to such an extent that it cannot be reused for further operations.

Summary of the invention

[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 capable of preventing the wireline from being damaged as the tool moves forward in the 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 tool for insertion into a casing having a lateral extending from a main casing, the main casing having a first diameter and the lateral having a second diameter, the first diameter being larger than the second diameter, the downhole tool comprising:

- a tool body having a first tool end and a second tool end and a tool width,
- a wireline connected with the first end of the tool body, and
- a wireline guide device arranged at least partly around the wireline, wherein the wireline is movably arranged within the wireline guide device.

[0005] In an embodiment, the wireline guide device may have a transport position and a guide position, the wireline guide device having a width which is larger than the second diameter of the lateral at least in the guide position.

[0006] Also, the wireline guide device may have a first

width in the transport position and a second width in the guide position, the first width being smaller than the second width.

[0007] The first width may be equal to or smaller than the tool width.

[0008] Further, the wireline guide device may be arranged fully surrounding the wireline.

[0009] Moreover, the wireline guide device may comprise a first part and a second part, the first part extending in a first direction and the second part extending in a second direction, defining an angle α between the parts.

[0010] In an embodiment, the first part may be longer than the second part in the guide position.

[0011] The wireline guide device may comprise a first part and a second part, each part having a first part end and a second part end, and the first part ends may be joined or connected and define an angle between the parts.

[0012] The angle in the transport position may be smaller than the angle in the guide position.

[0013] Furthermore, the angle in the transport position may be smaller than 90°.

[0014] In addition, the first part may, in the transport position, be connected with the tool body.

[0015] The wireline guide device may have a through-going opening in which the wireline extends, the opening having a diameter which is larger than a diameter of the wireline.

[0016] Also, the wireline guide device may comprise a spring for ensuring that the angle is larger than 20°.

[0017] In an embodiment, a spring may be arranged in the connection between the first part and the second part.

[0018] Moreover, the first part may be extendable in a longitudinal direction thereof.

[0019] Additionally, the first part may comprise a spring for extending the first part in the longitudinal direction.

[0020] Further, the second end of the first and second parts may have a rounded shape.

[0021] The wireline guide device may be expandable from the first width to the second width, the second width being larger than the diameter of the lateral.

[0022] In addition, the wireline guide device may comprise an inflatable element.

[0023] In an embodiment, the wireline guide device may be configured as a disc or a cone.

[0024] Furthermore, the downhole tool may comprise a pump for inflating the wireline guide device.

[0025] Also, the wireline guide device may comprise a guide body part, and at least a first arm and a second arm, the first and second arms each comprising a first arm part and a second arm part, the first and second arm parts each having a first arm part end and a second arm part end, the first arm part ends of the arm parts being rotatably connected with the guide body part, and the second arm part ends of each arm part being rotatably connected with each other.

[0026] The guide body may comprise a first body part

and a second body part, the first body part being displaceably connected with the second body part.

[0027] Also, the first body part may be threadingly connected with the second body part.

[0028] Moreover, the first arm parts may be slidably connected with the guide body.

[0029] In an embodiment, the wireline guide device may have an outer face, and a magnet may form part of the outer face.

[0030] Further, the wireline guide device may be disconnectable from the tool body by means of a contact.

[0031] The contact may be an electronic contact or a mechanical contact.

[0032] Furthermore, the tool body may comprise an activation means for activating the contact in order to release the wireline guide device.

[0033] The downhole tool as described above may further comprise a lateral locator.

[0034] Also, the lateral locator may comprise an activation means for activating the contact and/or expanding the wireline guide device.

[0035] In an embodiment, a sensor may be arranged in the lateral locator.

[0036] The present invention also relates to a downhole system comprising:

- a casing having a lateral extending from a main casing, and
- a downhole tool according to any of the preceding claims.

[0037] The present invention further relates to a method for guiding a wireline of a downhole tool as described above, comprising the steps of:

- inserting the downhole tool into the casing,
- locating the lateral,
- positioning the wireline guide device in a transition area between the main casing and the lateral, and
- guiding the wireline through the wireline guide device at the transition area for ensuring a distance is provided between the wireline and the transition area when the downhole tool is present in the lateral.

[0038] The method as described above may further comprise the step of activating the wireline guide device from the first width to the second width when locating the lateral.

Brief description of the drawings

[0039] 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. 1a shows the downhole tool according to the

present invention in a casing and having a wireline guide device which is shown in its transport position,

Fig. 1b shows the downhole tool of Fig. 1a in its guide position,

Fig. 2a shows one embodiment of the tool having a cone-shaped wireline guide device,

Fig. 2b shows the tool of Fig. 2a in its guide position,

Fig. 3a shows another embodiment of the tool having an inflatable wireline guide device,

Fig. 3b shows the tool of Fig. 3a in its guide position,

Fig. 4a shows yet another embodiment of the tool in its transport position,

Fig. 4b shows the tool of Fig. 4a in its guide position,

Fig. 4c shows an enlarged view of the wireline guide device of Figs. 4a and 4b,

Fig. 5a shows yet another embodiment of the tool in its transport position and having a magnet in the wireline guide device,

Fig. 5b shows the tool of Fig. 5a in its guide position,

Fig. 6 shows an embodiment of the wireline guide device, and

Fig. 7 shows another embodiment of the wireline guide device having extendable arms.

[0040] 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. Especially, the angle between the main casing and the lateral is not as large as in most wells as illustrated in the drawings.

Detailed description of the invention

[0041] Fig. 1a shows a downhole tool 1 for insertion into a casing 2 in a borehole 30. The casing has a lateral 3 extending from a main casing 4 in an angle from the main casing for extending into the reservoir. The main casing has a first diameter D_1 which is larger than a second diameter D_2 of the lateral. The downhole tool comprises a tool body 5 having a first tool end 6 and a second tool end 7 and a tool width w_1 which in Fig. 1 is also the outer diameter of the tool body. A wireline 8 is connected with the first tool end and is thus arranged closest to the top of the well. The downhole tool 1 further comprises a wireline guide device 9 which is arranged around the wireline so that the wireline is slidably arranged within

the wireline guide device. The tool comprises a driving unit, such as a downhole tractor, having wheels rotatably arranged on wheel arms for driving the tool forward in the casing. As the tool moves into the lateral as shown in Fig. 1b, the wireline is pressed towards a transition area 31 between the main casing and the lateral. As the wireline guide device reaches the transition, the wireline guide device is seated in a guide position as shown in Fig. 1b in which the wireline guide device is separated from the tool body, and the wireline guide device guides the wireline so that the wireline does not scrape against the metal edge between the main casing and the lateral.

[0042] The wireline guide device has a width w_d which is larger than the second diameter of the lateral in the guide position, as shown in Fig. 1b, and the wireline guide device is therefore not capable of entering the lateral and is thus left behind in the transition area 31. The wireline guide device comprises a first part 10 and a second part 11. The first part extends in a first direction and the second part extends in a second direction, defining an angle between the first and the second parts. The first part is longer than the second part so that the wireline guide device is not forced into the lateral by the drag in the wireline as the tool moves into the lateral. The first part 10 and the second part 11 are joined or manufactured with a fixed angle, and the second part extends into the lateral but as the angle is fixed, the first part 10 is maintained outside the lateral. The wireline guide device is arranged fully surrounding the wireline, and as the tool moves into the lateral, the wireline slides in the wireline guide device and is thus kept at a distance from the sharp edge in the transition between the main casing and the lateral. When the downhole tool returns from the lateral, the wireline guide device is forced upwards by the first end of the tool body, and the wireline guide device is therefore not left behind when the tool is retracted from the well.

[0043] In Figs. 2a and 2b, the wireline guide device has the shape of a hollow cone, thus matching the shape of the first end of the tapering tool body as shown in Fig. 2a. The wireline guide device has a through-going opening 32 in which the wireline extends, and the opening has a diameter which is larger than a diameter of the wireline, so that the wireline can easily slide within the wireline guide device. When transported down through the main casing, the wireline guide device is in its transport position and kept in connection with the first end of the tool body. As the tool moves into the lateral, as shown in Fig. 2b, the wireline guide device is - due to its larger width - prevented from entering the lateral and is left behind, and the wireline slides through the through-going opening 32. As illustrated by the dotted lines, the wireline guide device may also be tilted. However, due to its shape, the wireline guide device cannot enter the lateral in the tilted position either.

[0044] The wireline guide device has a transport position, shown in Fig. 3a, and a guide position, shown in Fig. 3b, and the wireline guide device has a first width w_{d1} in

the transport position and a second width w_{d2} in the guide position and the expanded position. The first width is smaller than the second width so that the downhole tool is capable of passing restrictions down the main casing, while the wireline guide device is unable to enter the lateral since the width w_d of the wireline guide device in the expanded position is larger than the second diameter of the lateral. The wireline guide device is inflated by means of a pump 33 in the tool just before the tool enters the lateral. The opening in the wireline guide device may be conical so that the wireline can run through the wireline guide device without significantly bending, as illustrated with dotted lines. The lateral 3 is located by a lateral locator 24 having a sensor 34 for detecting the lateral. When the lateral is detected, the lateral locator 24 projects a locator arm 35 and, approximately simultaneously an activation means 25 activates the wireline guide device which is inflated to its second width w_{d2} . The locator arm in its projected position will force the tool to move into the lateral as the tool moves forward in the casing. As can be seen, the first width of the wireline guide device is equal to or smaller than the tool width, so that the wireline guide device does not prevent the downhole tool from moving forward in the main part of the casing until the tool locates the lateral into which the tool should enter. Thus, the wireline guide device comprises an inflatable element 36 arranged around a wireline guide device body in which the wireline slides when the wireline guide device is seated in the opening 37 of the lateral as shown in Fig. 3b. The opening 37 of the lateral is in most wells larger than illustrated in the drawings since the angle between the lateral and the main casing is smaller.

[0045] In Fig. 4a, the wireline guide device comprises a guide body part 14 and at least a first arm 15 and a second arm 16, the arms being projectable from the tool body towards the casing. The wireline guide device has a projected position/guide position as shown in Figs. 4a and 4b and a transport position in which the wireline guide device may vary in width. The first and second arms each comprises a first arm part 17 and a second arm part 18 and the first and second arm parts each has a first arm part end 19 and a second arm part end 20. The first arm part ends of the arm parts are rotatably connected with the guide body part, and the second arm part ends of each arm parts are rotatably connected with each other. The second arm parts are slidably connected with the guide body in a groove 38 in the body as illustrated with dotted lines in Fig. 4a.

[0046] In another embodiment, the guide body may comprise a first body part 39 and a second body part 40, the first body part being displaceably connected with the second body part, as shown in Fig. 4c. The first body part is threadingly connected with the second body part by means of a threaded shaft 41 which may be rotated by a motor in the tool.

[0047] In Figs. 5a and 5b, the wireline guide device has an outer face 21, and a magnet 22 forming part of

the outer face. The magnet is an electromagnet which is activated when the tool is near the lateral, and as the tool enters the lateral, the magnet comes closer to the casing and is thus able to attach to the metal casing as shown in Fig. 5b. The wireline guide device is disconnectable from the tool body by means of a contact 23, and the contact is either an electronic contact or a mechanical contact as shown in Fig. 5a. The tool body comprises an activation means 25 for activating the contact in order to release the wireline guide device. The activation means 25 may activate the contact when the locator arm 35 of the lateral locator 24 "hit" against the lateral, and thus a reaction force is created which can activate the contact. The wireline guide device is arranged around the wireline, and as the tool is retracted from the casing, the first end 6 of the tool body contacts the wireline guide device and deactivates the magnet which releases from the casing and thus is retracted with the tool.

[0048] In Fig. 6, the wireline guide device comprises a first part 10 and a second part 11, each part having a first part end 44 and a second part end 45 and the first part ends being connected and defining an angle α between the parts. The first and the second parts are movable away from each other so that the parts are projecting from the tool body 5. The wireline guide device is shown in its transport and retracted position in which the angle is smaller than the angle in the guide position and the angle in the transport position is smaller than 90° . The first part 10 is, in the transport position, connected with the tool body 5 and held in contact by an electromagnet 46. The wireline guide device comprises a spring 47 which is arranged in the connection between the first part and the second part for ensuring that the angle is larger than 30° when the electromagnet 46 no longer holds the first part in contact with the tool body. The first part 10 is thus forced away from the second part by means of the spring 47 when the first part is released.

[0049] As shown in Fig. 7, the first part 10 and the second part 11 are extendable in a longitudinal direction thereof. The first part and the second part comprise a spring 50 (illustrated with dotted lines) for extending the first part and the second part in the longitudinal direction 51. In another embodiment, only the first part is extendable. Contacts 52 (illustrated with dotted lines) hold the first and the second part in its retracted position as shown in Fig. 7, and upon release the spring forces an extendable part 53 away from a main part 54 of the first and second parts. The spring is arranged with the parts. The contact may be activated upon location of the lateral. As shown, the second end of the first and second parts has a rounded shape.

[0050] The invention further relates to a downhole system 100, as shown in Figs. 1a-4b, comprising the casing having the lateral extending from the main casing, and comprising the downhole tool. The tool is inserted in the main part of the casing - often through a well head - and then the lateral is located. When locating the lateral, the wireline guide device is positioned in a transition area 26

between the main casing and the lateral. The wireline is guided through the wireline guide device at the transition area for ensuring that there is a distance l (as shown in Fig. 4b) between the wireline and the transition area when the downhole tool is present in the lateral. In some embodiments, the wireline guide device is expandable or inflatable from a first width to a second width and in these embodiments, the wireline guide device is activated to expand from the first width to the second width when locating the lateral and shortly thereafter.

[0051] By a casing is meant any kind of pipe, tubing, tubular, liner, string etc. used downhole in relation to oil or natural gas production.

[0052] 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®.

[0053] Although the invention has been described in the above in connection with preferred embodiments of the invention, it will be evident for 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 tool (1) for insertion into a casing (2) having a lateral (3) extending from a main casing (4), the main casing having a first diameter (D_1) and the lateral having a second diameter (D_2), the first diameter being larger than the second diameter, the downhole tool comprising:
 - a tool body (5) having a first tool end (6) and a second tool end (7) and a tool width (w_t),
 - a wireline (8) connected with the first end of the tool body, and
 - a wireline guide device (9) arranged at least partly around the wireline, wherein the wireline is movably arranged within the wireline guide device.
2. A downhole tool according to claim 1, wherein the wireline guide device has a transport position and a guide position, the wireline guide device having a width (w_d) which is larger than the second diameter of the lateral at least in the guide position.
3. A downhole tool according to claim 1 or 2, wherein the wireline guide device has a first width (w_{d1}) in the transport position and a second width (w_{d2}) in the guide position, the first width being smaller than the second width.
4. A downhole tool according to any of the preceding

- claims, wherein the wireline guide device comprises a first part (10) and a second part (11), the first part extending in a first direction and the second part extending in a second direction, defining an angle (α) between the parts. 5
5. A downhole tool according to claim 4, wherein the first part is longer than the second part in the guide position. 10
6. A downhole tool according to claim 3, wherein the wireline guide device is expandable from the first width to the second width, the second width being larger than the diameter of the lateral. 15
7. A downhole tool according to claim 6, wherein the downhole tool comprises a pump (12) for inflating the wireline guide device.
8. A downhole tool according to any of the claims 1-3, wherein the wireline guide device comprises a guide body part (14), and at least a first arm (15) and a second arm (16), the first and second arms each comprising a first arm part (17) and a second arm part (18), the first and second arm parts each having a first arm part end (19) and a second arm part end (20), the first arm part ends of the arm parts being rotatably connected with the guide body part, and the second arm part ends of each arm part of each arm being rotatably connected with each other. 20 25 30
9. A downhole tool according to claim 1, wherein the wireline guide device has an outer face (21), and a magnet (22) forms part of the outer face. 35
10. A downhole tool according to any of the preceding claims, wherein the wireline guide device is disconnectable from the tool body by means of a contact (23). 40
11. A downhole tool according to any of the preceding claims, further comprising a lateral locator (24). 45
12. A downhole tool according to claim 11, wherein the lateral locator comprises an activation means (25) for activating the contact and/or expanding the wireline guide device. 50
13. A downhole system comprising: 55
- a casing having a lateral extending from a main casing, and
 - a downhole tool according to any of the preceding claims.
14. A method for guiding a wireline of a downhole tool according to any of the claims 1 to 12, comprising the steps of:
- inserting the downhole tool into the casing,
 - locating the lateral,
 - positioning the wireline guide device in a transition area (26) between the main casing and the lateral, and
 - guiding the wireline through the wireline guide device at the transition area for ensuring a distance (l) is provided between the wireline and the transition area when the downhole tool is present in the lateral.
15. A method according to claim 14, further comprising the step of activating the wireline guide device from the first width to the second width when locating the lateral.

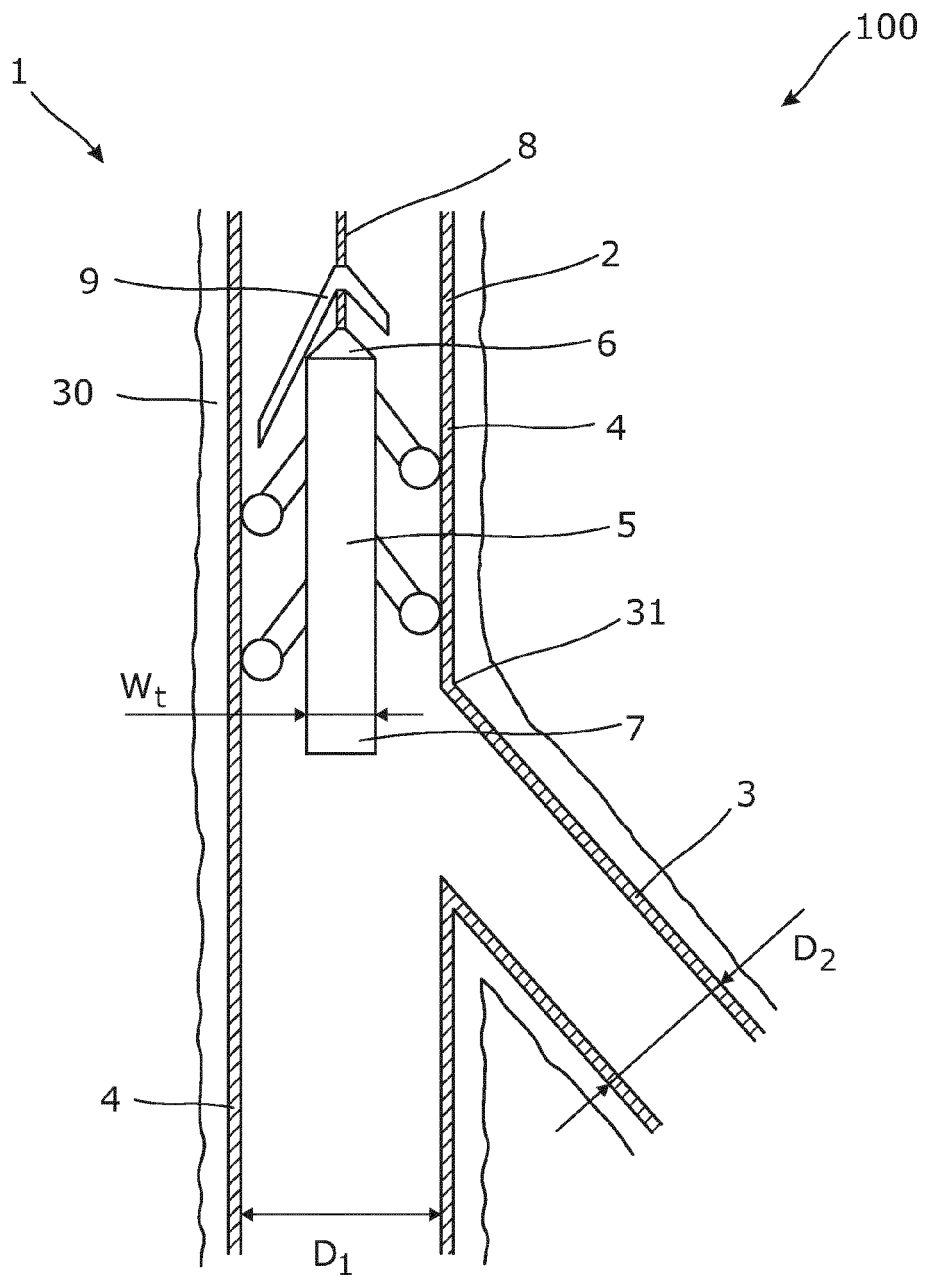


Fig. 1a

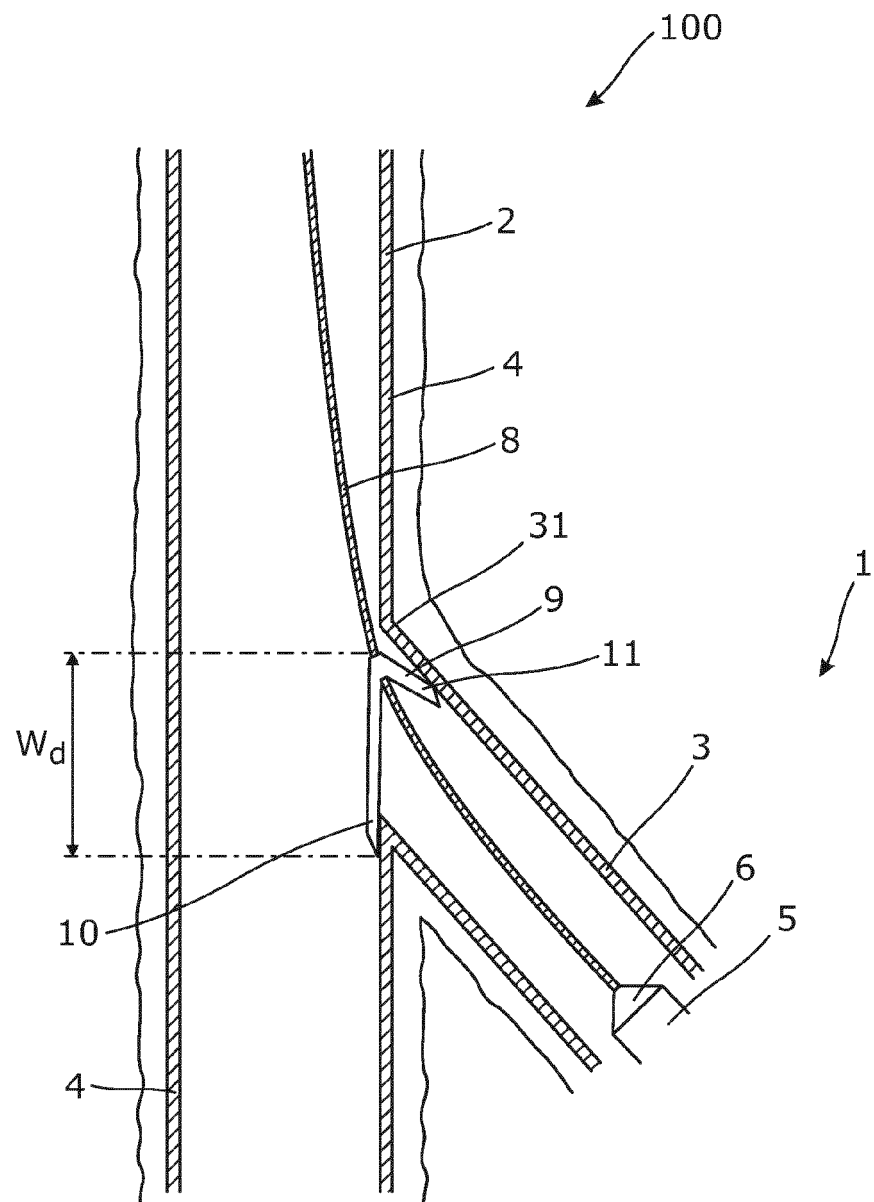


Fig. 1b

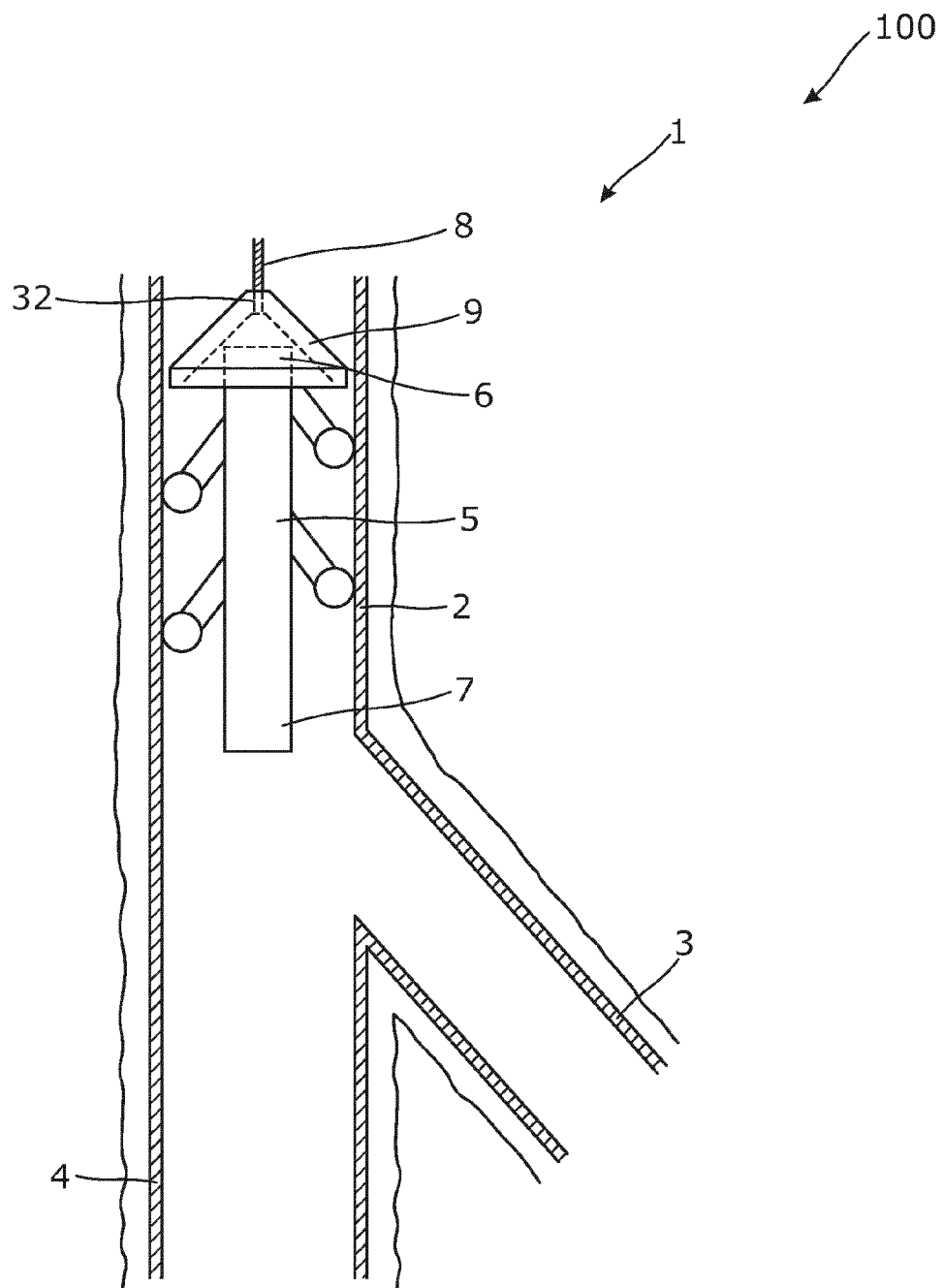


Fig. 2a

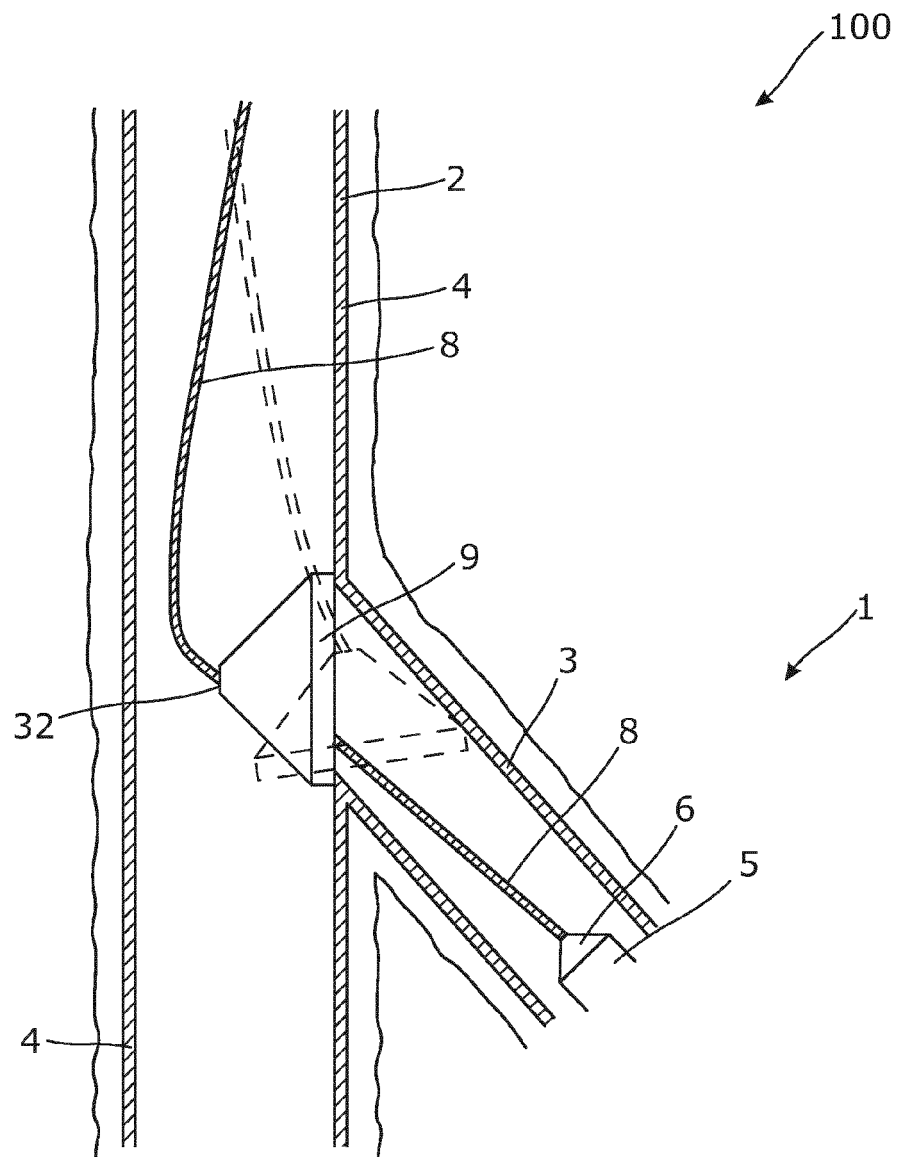
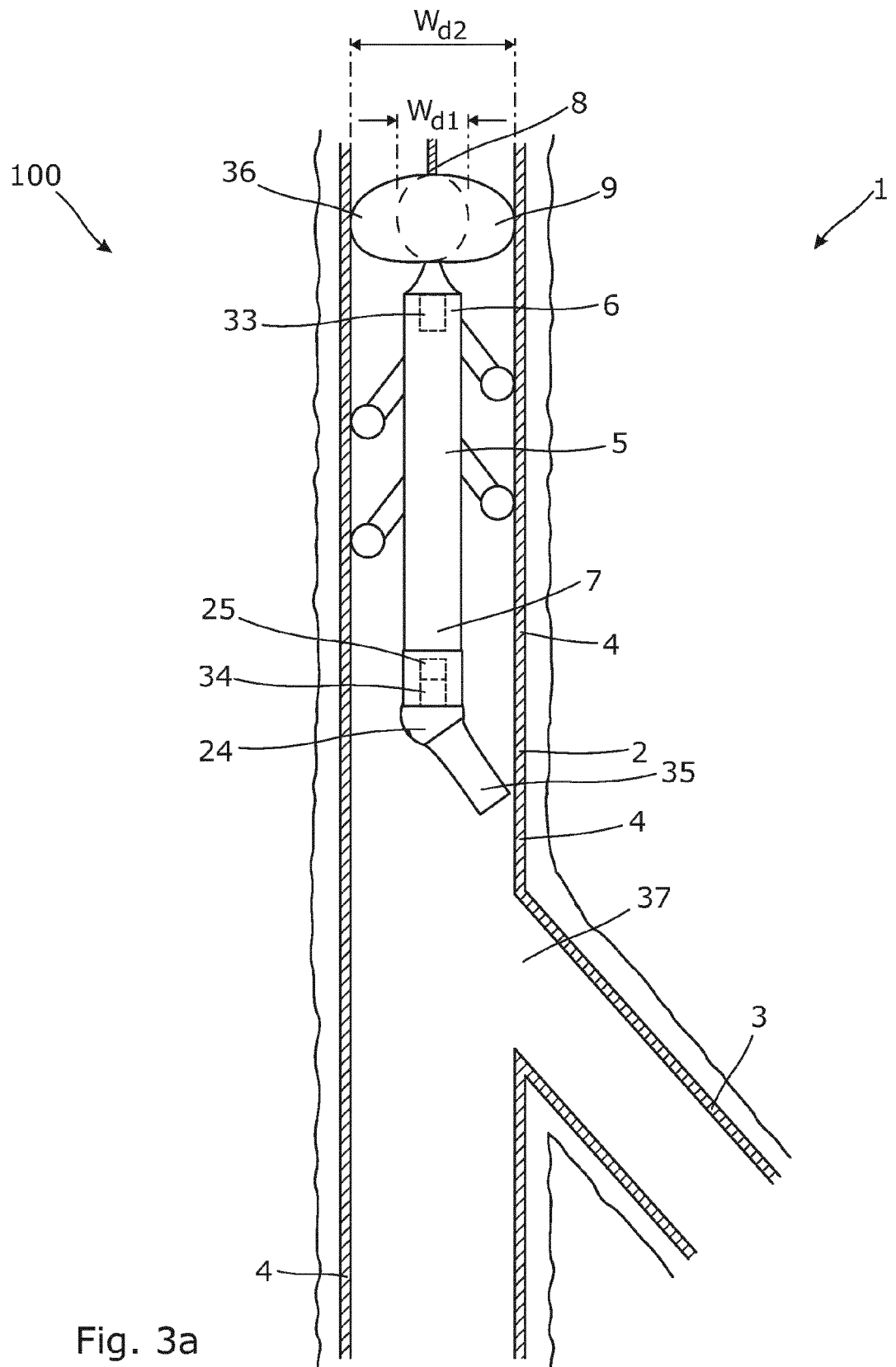


Fig. 2b



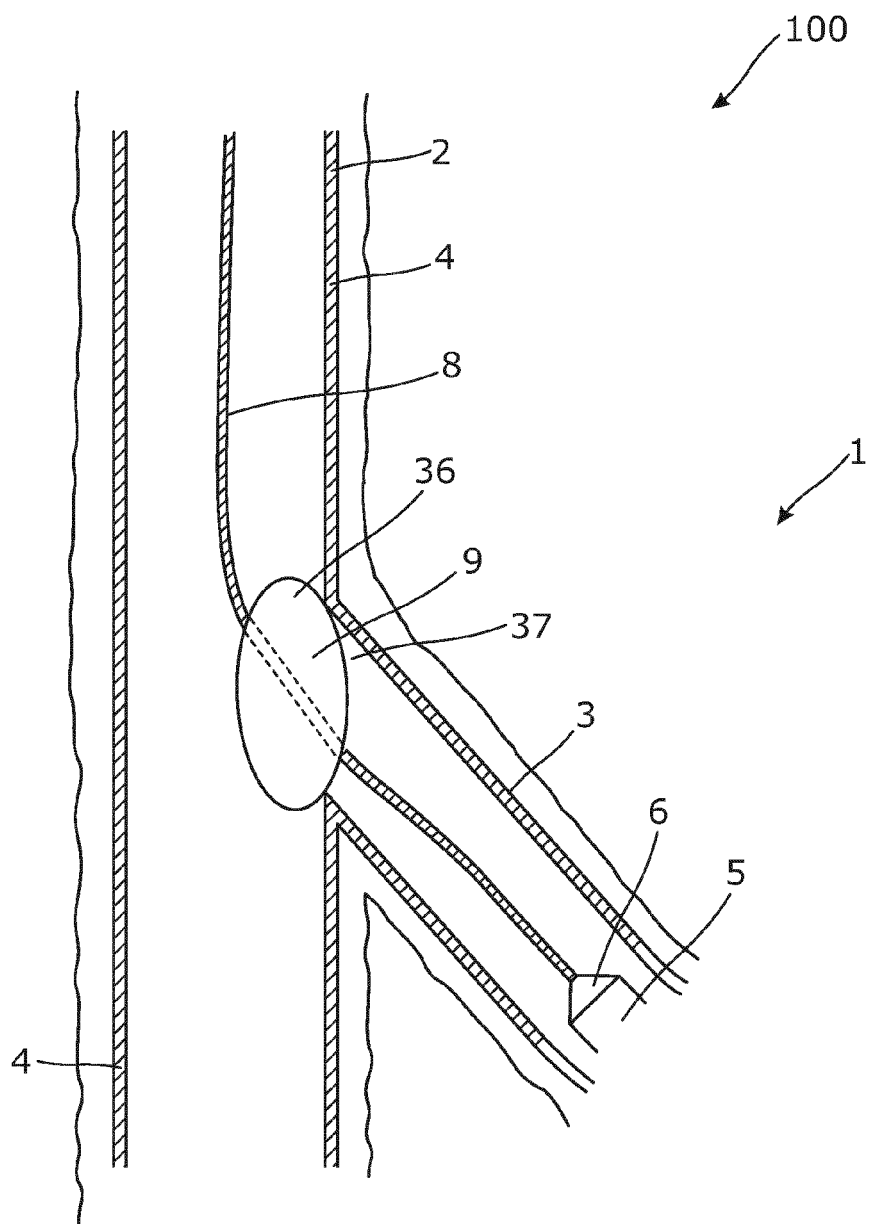


Fig. 3b

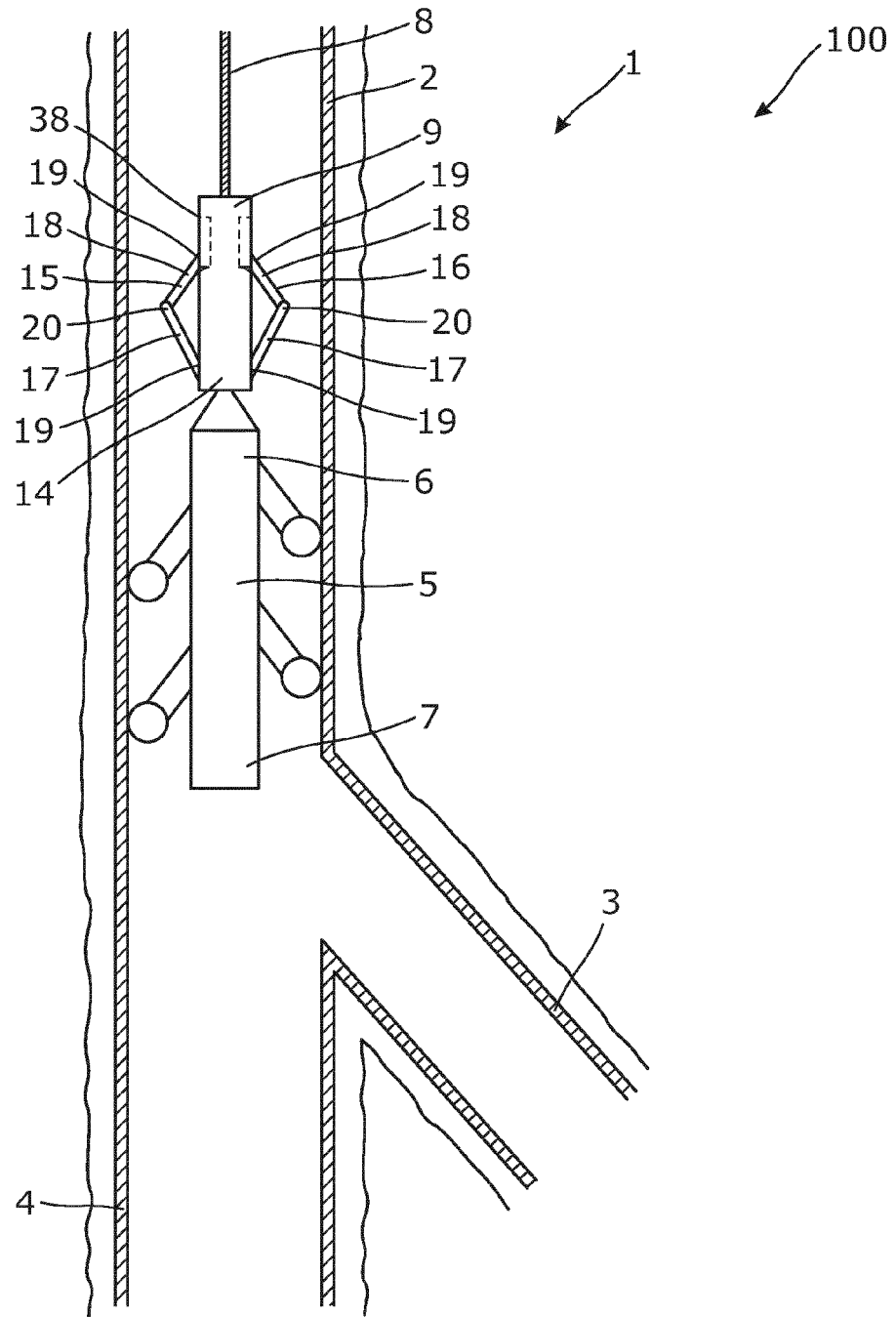


Fig. 4a

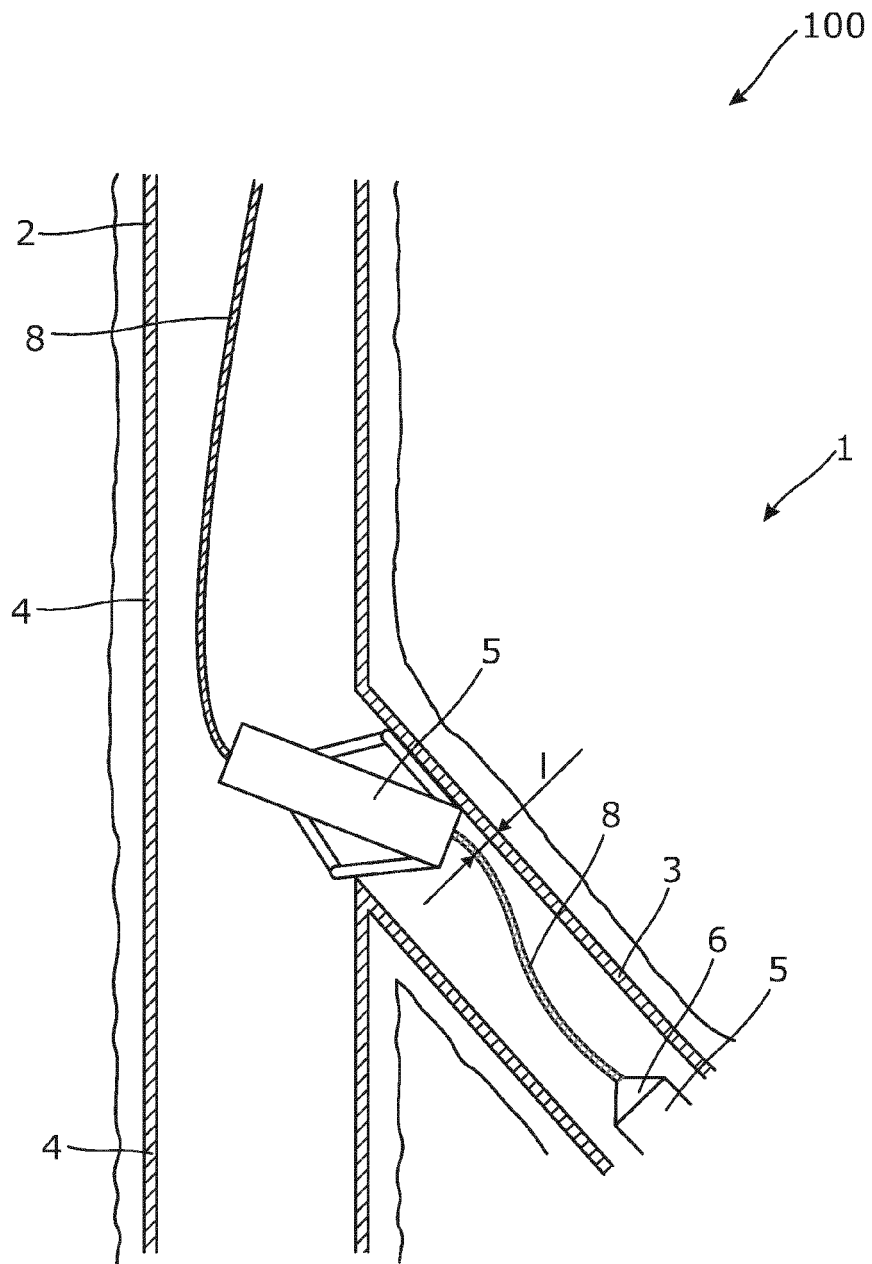


Fig. 4b

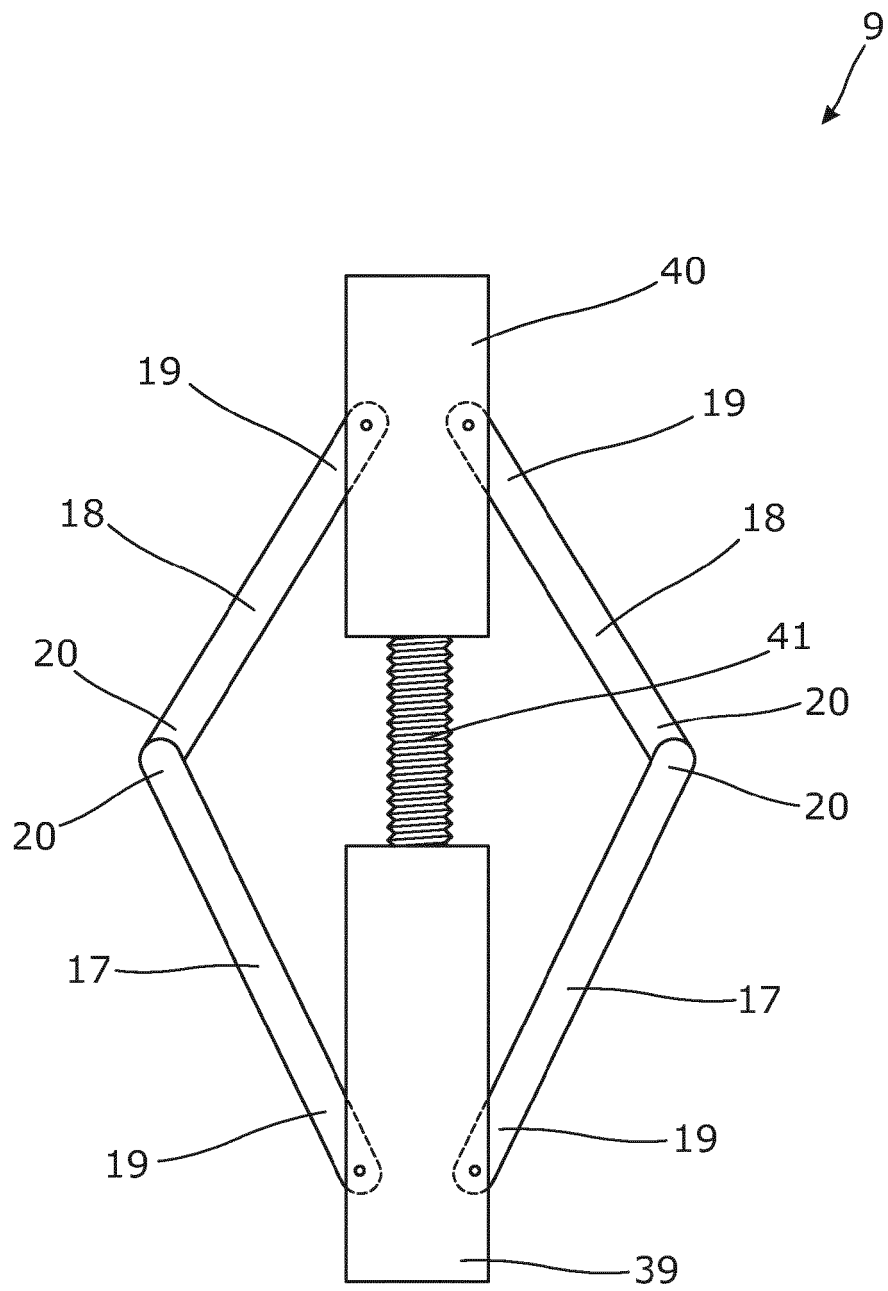


Fig. 4c

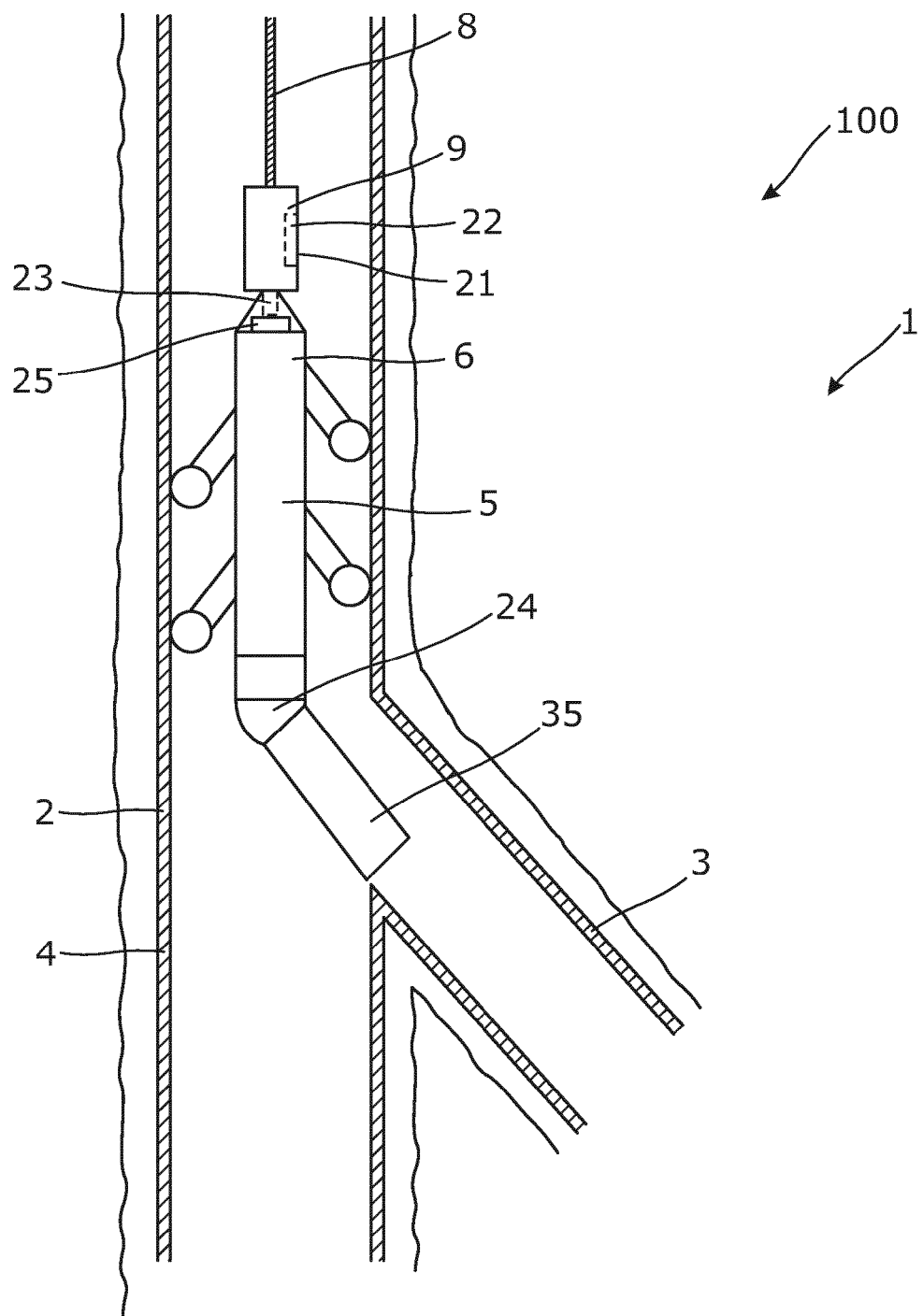


Fig. 5a

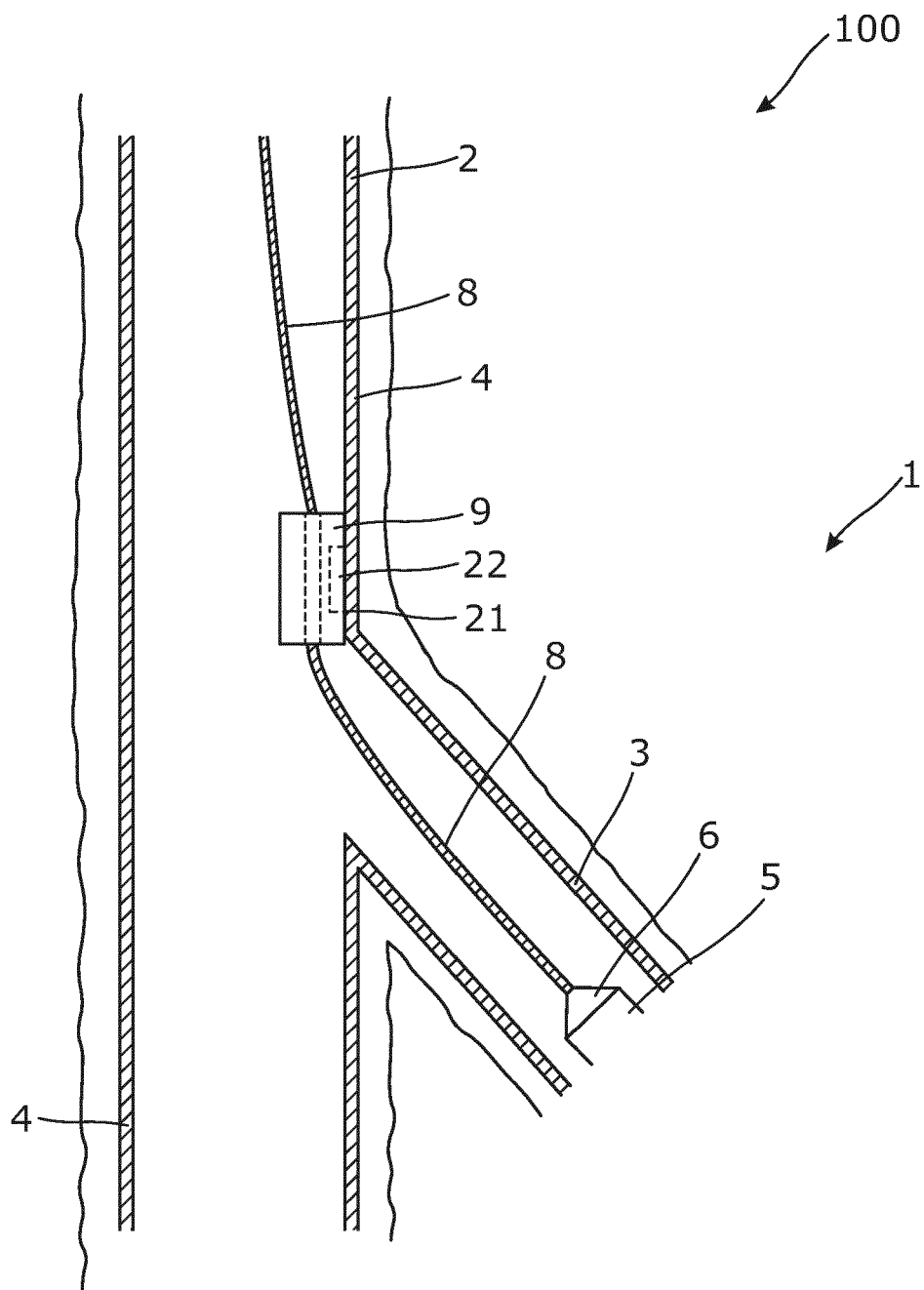


Fig. 5b

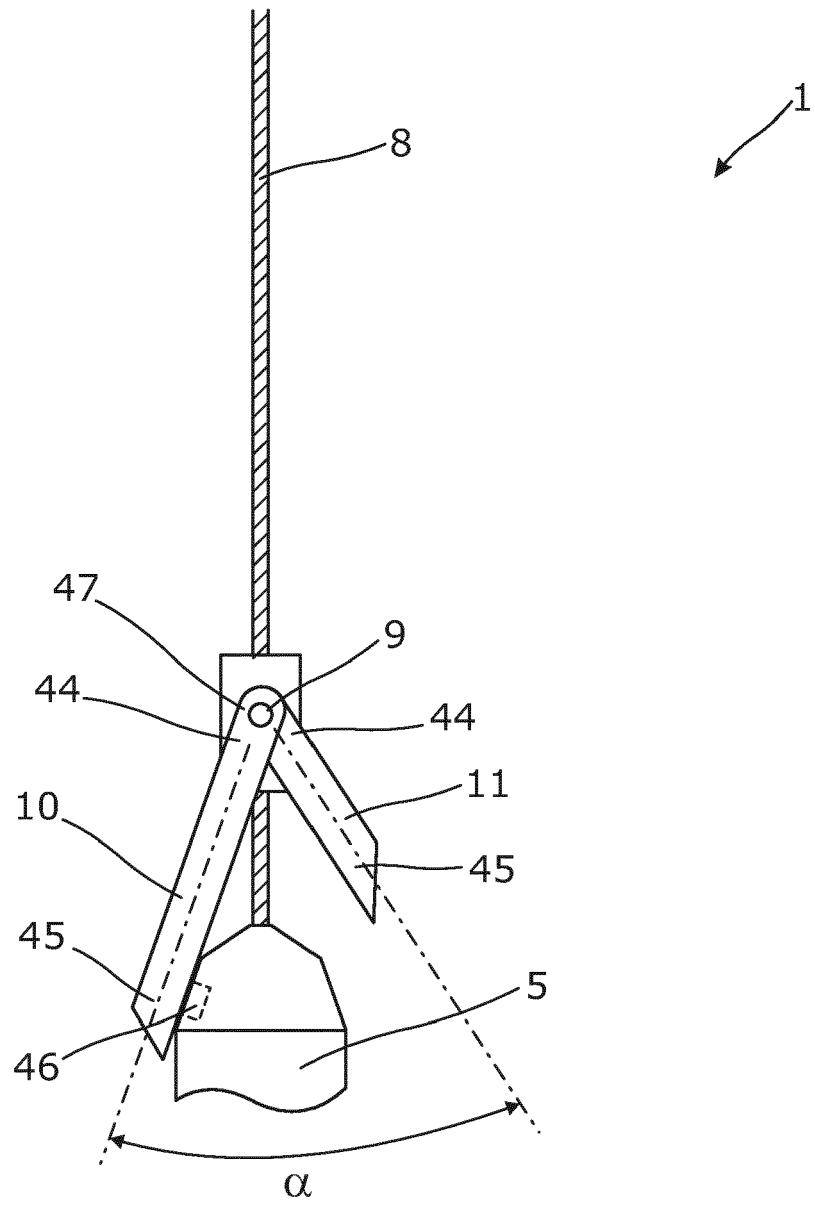


Fig. 6

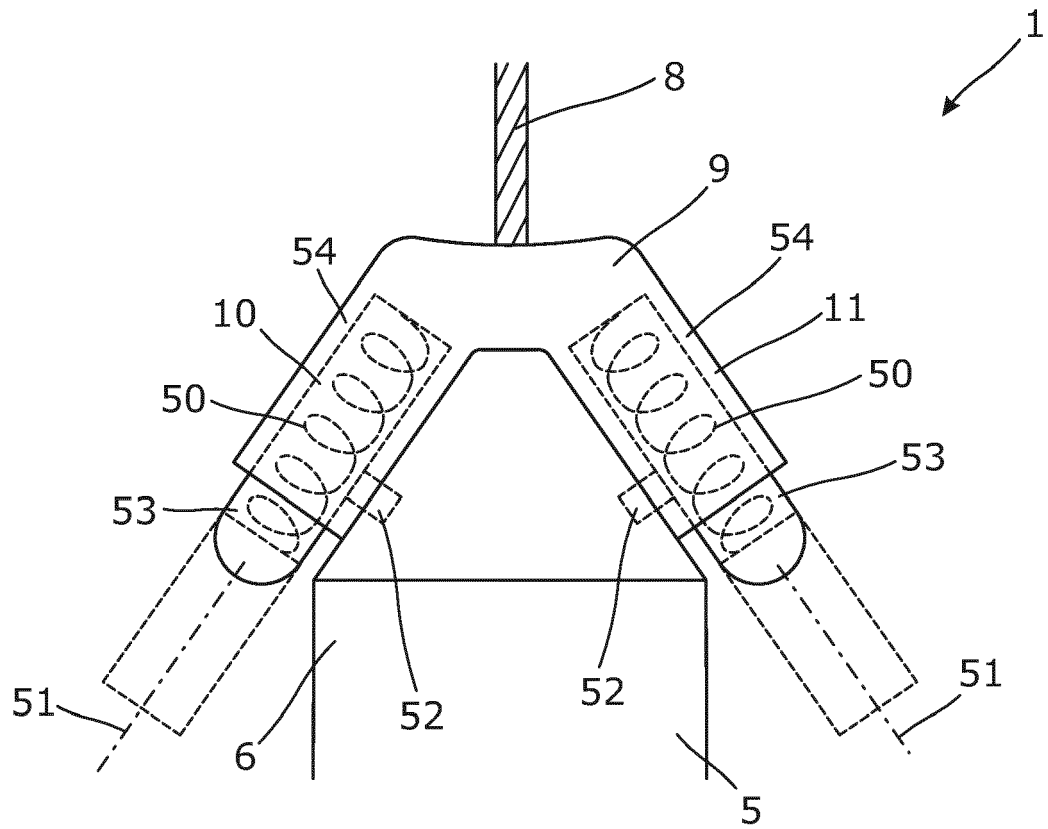


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 12 19 6097

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 2 May 2013	Examiner van Berlo, André
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 12 19 6097

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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