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(54) **A completion component with position detection**

(57) The present invention relates to a completion component having a circumference for insertion into a well tubular structure, comprising a tubular base part having an axial extension and a thickness and being adapted to be mounted as part of the well tubular structure, and a displaceable part having a thickness and being displaceable in relation to the tubular base part from a first position to a second position, wherein the tubular base part comprises a first marker and the displaceable part

comprises a second marker for determining a position of the displaceable part in relation to the tubular base part, the first and second markers being arranged with a marker distance. The present invention also relates to a down-hole system and to a method for determining a position of a displaceable part of a completion component according to the present invention in relation to a tubular base part.

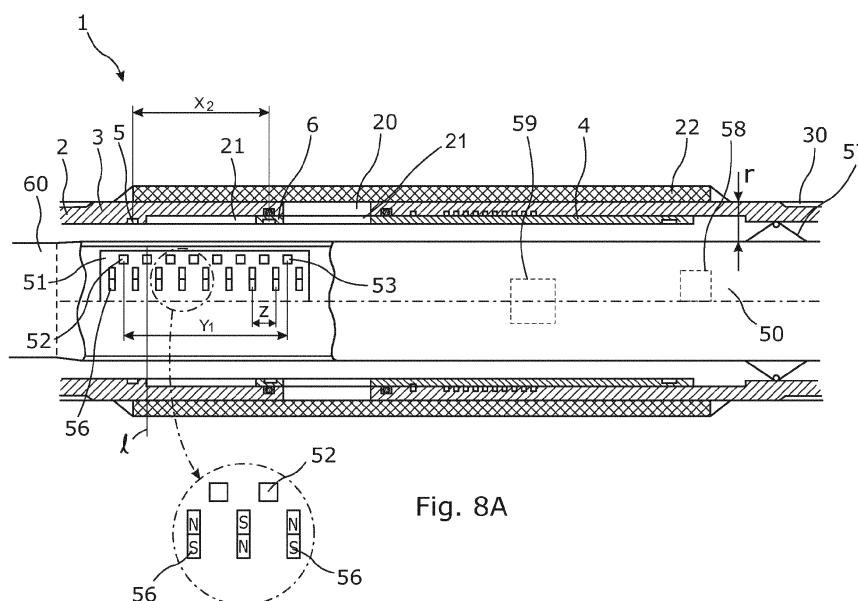


Fig. 8A

Description

Field of the invention

[0001] The present invention relates to a completion component, a downhole system and a method for determining a position of a displaceable part of a completion component.

Background art

[0002] Many of the completion components in a well or completion downhole comprise movable parts, which is why it is relevant to identify the position of the movable parts. The completion component may for instance be an inflow control device, which can be open and closed for inflow of fluid into the well. Accordingly, it may be desirable to determine whether a specific inflow control device is open or closed and to verify this.

[0003] Equipment for performing identification of components downhole is known and may for instance be tools which are arranged to make contact with the components for identifying the position of the movable part of the component. However, in this operation there is a risk that the tool may accidentally displace the movable part and thereby open or close the component, contrary to what was intended. Furthermore, when the tool makes contact with the component and the surrounding area, there is a risk that it wears the components and damages them.

[0004] In other known tools, the identification may be performed by logging or scanning tools. However, such tools often provide inaccurate determinations, which means that the operators of the well will not know for certain the position of the movable parts.

[0005] Hence, there is a need for a more reliable way of determining the position of the movable parts of a completion component downhole.

Summary 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. More specifically, it is an object to provide an improved completion component in which the position of a displaceable part may easily be determined.

[0007] Furthermore, it is an object of the present invention to provide a downhole system having a detection tool in which determination of the position of the displaceable part of the completion component is facilitated independently of a velocity of the detection tool and with the determination having a high degree of reliability.

[0008] 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 completion component having a circumference for insertion into a well tubular structure, comprising:

- a tubular base part having an axial extension and a thickness and being adapted to be mounted as part of the well tubular structure, and
- a displaceable part having a thickness and being displaceable in relation to the tubular base part from a first position to a second position,

wherein the tubular base part comprises a first marker and the displaceable part comprises a second marker for determining a position of the displaceable part in relation to the tubular base part, the first and second markers being arranged with a marker distance.

[0009] In an embodiment, the displaceable part may be displaceable in an axial direction in relation to the tubular base part.

[0010] Further, the displaceable part may be displaceable by rotation in relation to the tubular base part.

[0011] In one embodiment, the displaceable part may be arranged within the tubular base part.

[0012] In another embodiment, the displaceable part may be arranged outside the tubular base part.

[0013] Also, the displaceable part may be arranged in a groove of the tubular base part.

[0014] Moreover, the marker distance may be larger than zero, so that the first and second markers do not overlap in the axial extension.

[0015] Furthermore, the marker may be made of a magnetic material.

[0016] The magnet may be a magnet or an emitter.

[0017] Additionally, the marker may be a Radio Frequency Identification (RFID) tag.

[0018] Further, the marker may be a geometrical pattern provided by varying the thickness of the tubular base part and the displaceable part, respectively.

[0019] In an embodiment, the marker may be ring-shaped.

[0020] Also, the first marker may be arranged at a first position along the circumference of the completion component and the second marker may be arranged at an angle (α) along the circumference from the first marker.

[0021] This angle may be at least 45°.

[0022] Alternatively, the angle may be 90°, preferably 180°.

[0023] Moreover, the first marker may be different from the second marker.

[0024] The completion component as described above may comprise a projecting element which is connected with either the tubular base part or the displaceable part and which may be adapted to engage grooves in the other part.

[0025] In addition, the projecting element may be connected by means of a spring device.

[0026] Also, the completion component may comprise a plurality of first and second markers spaced around the circumference.

[0027] Hereby is obtained that the position of a specific marker may be determined independently of the orientation of the completion component in relation to the de-

tection tool.

[0028] Furthermore, the emitter may be a gamma ray source or an x-ray source.

[0029] Additionally, the marker may be elongated and extend along the axial extension.

[0030] Elongated markers are especially expedient in circumstances where the displaceable part rotates in relation to the tubular part.

[0031] In an embodiment, the displaceable part may be displaceable in intermediate positions arranged between the first and second positions.

[0032] Moreover, the tubular base part may have a first opening and the displaceable part may have a second opening, the first and second openings not overlapping in a first position of the displaceable part, and the first and second openings overlapping in a second position of the displaceable part.

[0033] The first and second openings may have substantially the same size.

[0034] Also, in the intermediate positions of the displaceable part, the first and second openings may be partly overlapping.

[0035] Hereby it is possible to control a fluid flow rate through the completion component by displacing the second opening in the displaceable part in relation to the first opening in the tubular base part, and the present invention facilitates the determination and establishment of how high the fluid rate is by determining the marker distance between the markers.

[0036] Furthermore, the tubular base part may have a thread engaging a thread in the displaceable part.

[0037] In addition, the completion component may comprise a screen arranged on the outside of the openings.

[0038] Further, the completion component may be any kind of completion component having a stationary part being the tubular base part and the displaceable part, such as a sleeve, a sliding or rotational sleeve, an annular barrier, an inflow control device, a valve, or a packer.

[0039] The present invention also relates to a downhole system comprising:

- a well tubular structure,
- a completion component according to any of the preceding claims, and
- a detection tool having a detection unit for detecting a marker distance between the first marker of the tubular base part and the second marker of the displaceable part.

[0040] In an embodiment, the distance between the first and second markers may be detected independently of a velocity of the detection tool.

[0041] Also, the detection unit may comprise a first detector having a first detection range in the axial extension and a second detector having a second detection range in the axial extension, the first and second detection ranges defining a common detection range in the axial direc-

tion, the common detection range being greater than the marker distance between the first and second markers.

[0042] Moreover, the first detection range and the second detection range may each be half the common detection range.

[0043] Furthermore, the detection unit may comprise intermediate detectors arranged between the first and second detectors.

[0044] The marker distance may be determined by simultaneous detection of the first and second markers by two separate detectors.

[0045] The detectors of the downhole system as described above may be magnetometers.

[0046] Also, the detectors may be readers or Geiger counters.

[0047] Further, the detector unit may comprise a plurality of magnets.

[0048] Moreover, the magnets may have a north pole and a south pole, and two adjacent magnets may be arranged so that repelling poles are arranged in opposite directions.

[0049] In an embodiment, the detectors may be arranged along a line arranged between two adjacent magnets.

[0050] In addition, the detectors may be arranged with a predetermined distance between them, so that when two detectors detect the markers, the position of the displaceable part may be determined.

[0051] Furthermore, the first detector may be different from the second detector.

[0052] The present invention further relates to a completion comprising any of the aforementioned completion components.

[0053] The detection tool may comprise a centraliser for maintaining the detection tool in a predetermined radial distance from the completion component.

[0054] Also, the detection tool may comprise a measurement device adapted to continuously measure a radial distance from the detection tool to the completion component.

[0055] In an embodiment, the detection unit may comprise a processor device adapted to process observations provided by the detectors for calculating the marker distance on the basis of the detectors detecting the respective markers.

[0056] Moreover, the detection tool may comprise a communication unit adapted for communicating the determined marker distance to an external source.

[0057] In the downhole system according to the present invention, the communication may be performed via a wireline.

[0058] The present invention furthermore relates to a method for determining a position of a displaceable part of a completion component as described above in relation to a tubular base part, comprising the steps of:

- arranging a first marker in connection with the tubular base part,

- arranging a second marker in connection with the displaceable part, and
- moving a detection tool having a detection unit past the first and second markers for detecting the first and second markers and hence for detecting a marker distance between the markers, independently of a velocity of the detection tool.

[0059] The method as described above may comprise the step of arranging a first detector having a first detection range in the axial extension and a second detector having a second detection range in the axial extension for providing a common detection range in the axial extension, wherein the common detection range is greater than the marker distance between the first and second markers.

[0060] Further, said method may comprise the step of arranging a plurality of intermediate detectors between the first and second detectors with predetermined distances between them.

[0061] Additionally, the method according to the present invention may comprise the step of determining the marker distance by simultaneous detection of the first and second markers by two separate, different detectors.

[0062] Finally, this method may comprise the step of processing observations provided by the detectors for calculating the marker distance on the basis of the detectors detecting the respective markers.

Brief description of the drawings

[0063] 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 cross-sectional view of a completion component according to the invention,

Figs. 2a-2c show the displaceable part in different positions in relation to the tubular part,

Fig. 3 shows a cross-sectional view of another embodiment of the completion component,

Fig. 4 shows a view of Fig. 3 along the line A-A,

Fig. 5 shows a cross-sectional view of another embodiment of a rotatable completion component,

Fig. 6 shows a tubular base part in perspective,

Fig. 7 shows a displaceable part in perspective,

Fig. 8A shows a cross-sectional view of a downhole system comprising a completion component and a detection tool within the component,

Fig. 8B shows a cross-sectional view of another detection unit,

Fig. 9 shows a cross-sectional view of another embodiment of the downhole system,

Figs. 10a and 10b show cross-sectional views of a completion component where the displaceable part is shown in its closed and open position,

Figs. 11a and 11b show cross-sectional views of a completion component being an annular barrier where the displaceable part is shown in its unexpanded and expanded positions,

Fig. 12 shows a cross-sectional view of another embodiment of the downhole system,

Fig. 13 shows a cross-sectional view of yet another embodiment of the completion component having an identification code,

Fig. 14 shows a partial cross-sectional view of another embodiment of the downhole system,

Fig. 15 shows a cross-sectional view of another embodiment of the completion component,

Figs. 16A-C show cross-sectional views of the completion component of Fig. 15, the displaceable part being shown in its different, axial positions, and

Fig. 17 shows the enlarged partial view of Fig. 15.

[0064] 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

[0065] Fig. 1 shows a completion component 1 having a circumference for insertion into a well tubular structure 2 as illustrated in Fig. 12. The completion component 1 comprises a tubular base part 3 which is to be mounted as part of the well tubular structure 2 via a thread 30. The tubular base part 3 has an axial extension along the axial extension of the well tubular structure and a thickness t_1 . The completion component 1 comprises a displaceable part 4 arranged within a groove 33 in the tubular base part 3 and displaceable in relation to the tubular base part 3 from a first position to a second position in order to align or unalign a first opening 20 in the tubular base part 3 with a second opening 21 in the displaceable part 4 to let fluid flow between a formation surrounding the completion component 1 and an inside of the tubular base part 3. A screen 22 is arranged on the outside of the tubular base part 3 opposite the opening 20 in the tubular

base part 3 for filtering the well fluid before it is let into the tubular base part 3. The base part 3 comprises a first marker 5, and the displaceable part 4 comprises a second marker 6 for determining a position of the displaceable part in relation to the tubular base part 3. As can be seen, the first and second markers 5, 6 are arranged with a first marker distance in which the openings 20, 21 are unaligned, so that the first and second openings do not overlap and no fluid is allowed to flow from the formation into the tubular base part 3. Sealing means 32, such as O-rings or Chevron seals, arranged in grooves in the tubular base part 3, provides a sealing connection between the tubular base part 3 and the displaceable part 4.

[0066] The displaceable part 4 is displaceable in the axial direction in relation to the base part by means of a key tool operating with a stroking tool (shown in Fig. 14) engaging a groove 31 in the displaceable part 4. The completion component comprises a projecting element 34 arranged in a groove 35 in the displaceable part 4. The projecting element projects 34 from the displaceable part 4 and is adapted to engage grooves 36 in the tubular base part 3. When the key tool or stroking tool moves the displaceable part 4 axially in relation to the tubular base part 3, the projecting element 34 is forced to revert into the groove in the displaceable part 4, and the displaceable part 4 is moved axially until the projecting element 34 faces an internal groove 36 in the tubular base part 3 closest to groove 35. When the projecting element 34 is opposite the groove 36, the projecting element engages the groove and the displaceable part 4 is again locked for movement in the axial direction. The displaceable part 4 is now in its slightly open position in which the first opening 20 and the second opening 21 are overlapping. The completion component 1 can be further adjusted so that the openings overlap even more by moving the displaceable part 4 further in the axial direction in relation to the tubular base part 3, and the projecting element 34 is forced to retract, and the displaceable part 4 can move to position the projecting element 34 opposite another of the internal grooves 36 in the tubular base part 3. In this way, the displaceable part 4 is moved axially in relation to the tubular base part 3 from a first and closed position, in which the first and second openings do not overlap, to a fully open position, in which the first and second openings overlap completely. In Fig. 1, the completion component 1 can be arranged in the closed position and in ten other positions in which the openings 20, 21 are more or less aligned. The projecting element may be a spring element, such as a circlip or circlip ring, or be connected by means of a spring device, so that the projecting element is able to retract into the groove in the displaceable part 4.

[0067] In Figs. 2a-c, the first marker 5 and the second marker 6 of the completion component 1 are ring-shaped so that the markers can be easily detected, irrespectively of the orientation of the completion component 1. The completion component 1 has a plurality of first openings 20 and a plurality of second openings 21. When complet-

ing a well and inserting the completion component 1, the well tubular structure is often rotating as the structure is submerged down through the well. Therefore, the orientation of the completion component 1 is often not known until a tool has been down the well to investigate and detect the orientation. However, such investigation and detection do most often not occur. Fig. 2a shows a partial view of the completion component 1 being arranged in the first position P_1 which is also the closed position of the completion component 1. In the first position, the first and second openings 20, 21 do not overlap in the axial extension of the completion component, and the markers 5, 6 are arranged having a first marker distance X , X_1 between them. Fig. 2b shows a partial view of the completion component 1 being arranged in the second and fully open position in which the first and second openings 20, 21 fully overlap in the axial extension of the completion component. The markers 5, 6 are arranged having a second marker distance X , X_2 between them. Thus, the marker distance X between the markers varies between the first and the second marker distances X_1 , X_2 .

[0068] In Fig. 2c, the completion component 1 is arranged in an intermediate position X_1 which is a position in which the completion component 1 is partially open and the first and second openings partially overlap.

[0069] Fig. 3 shows a cross-sectional view of the completion component 1, in which the first marker 5 is arranged in the tubular base part 3 in the top half of the completion component 1 and the second marker 6 is arranged in the displaceable part 4 in the bottom half of the completion component 1. Fig. 4 shows a cross-sectional view along line A-A in Fig. 3 to illustrate that the first marker 5 is arranged at a first position along the circumference of the completion component and the second marker 6 is arranged at an angle α of approximately 180° along the circumference from the first marker while markers 5 and 6 are not aligned in the axial extension. In other embodiments, the angle is at least 45° or preferably at least 90° . As can be seen in Fig. 3, the first and second openings 20, 21 have substantially the same size in the axial extension. In other embodiments, the first opening 20 may be larger in the axial extension than the second opening.

[0070] The displaceable part 4 of completion component 1 may be moved axially or rotated in relation to the tubular base part 3 in order to activate or deactivate the completion component 1. In Fig. 5, the displaceable part is displaceable by rotation in relation to the base part. The tubular base part 3 has a thread 30A engaging a thread 30B in the displaceable part, so that when the displaceable part 4 is rotated, the displaceable part 4 also moves axially in relation to the tubular base part 3 aligning or unaligning the openings 20, 21. The second openings are arranged at a substantially small mutual distance so that the openings always partly overlap the first openings when the displaceable part 4 is rotated. Hereby, the volume flow of fluid passing the openings is kept substantially linearly increasing while rotating the

displaceable part 4. The displaceable part 4 is rotated by means of an operational tool (shown in Fig. 14) engaging the grooves 31. The first and second markers are elongated and have a substantially small circumferential extension as shown in Figs. 6 and 7. When the displaceable part 4 of Fig. 5 is rotated, the displaceable part 4 is moved axially so that the first marker overlaps the second marker. By having elongated markers, the second marker is still detectable.

[0071] Fig. 6 shows the tubular base part 3 having a plurality of markers 5. As can be seen, the circumferential distance between two markers vary. Fig. 7 shows the displaceable part 4 which fits into the tubular base part 3 in Fig. 6, and the displaceable part 4 has only one marker 6.

[0072] Fig. 8A discloses a downhole system comprising a well tubular structure 2, the completion component 1 and a detection tool 50 having a detection unit 51 for detecting a marker distance between the first marker of the base part and the second marker of the displaceable part. As the displaceable part 4 is moved in relation to the tubular base part 3, the marker distance changes. When the detection tool 50 passes the completion component 1, the detection unit detects the position of the markers simultaneously so that the detection does not rely on the time from one measurement to the next. The marker distance between the first and second markers is thus detected independently of a velocity of the detection tool. The detection unit 51 in this embodiment comprises eight detectors.

[0073] In Fig. 8B, the detection unit 51 comprises a first detector 52 having a first detection range d_1 in the axial extension and a second detector 53 having a second detection range d_2 in the axial extension. The first and second detection ranges define a common detection range d_c in the axial direction, and the common detection range is greater than the first distance between the first and second markers, so that the detection unit is capable of detecting both markers at the same time independently of the position of the displaceable part 4 in relation to the tubular base part 3.

[0074] As can be seen from Fig. 8A, the detection unit comprises intermediate detectors arranged between the first and second detectors 52, 53. The common detector range d_c is the common detection range for all eight detectors. The detectors are magnetometers and the detection unit further comprises a plurality of magnets 56. Each magnet has a north pole and a south pole as shown in the enlarged view of Fig. 8A, and two adjacent magnets are arranged so that repelling poles are arranged in opposite directions. The detectors are arranged along a line I arranged between two adjacent magnets, so that the magnetic field lines are substantially linear through the magnetometers. The detectors are arranged with a predetermined distance z so that when two detectors detect the markers, the position of the displaceable part is determined. Along this line I, the magnetic field lines are substantially parallel to the axial extension of the tool 50,

and when the magnets pass the markers, the markers are magnetised and divert the magnetic field. The detectors detect this diversion, and based on the detected diversion, the position of the markers can be determined in that the distance between the detectors is known. Thus, the marker distance is determined by simultaneous detection of the first and second markers by two separate detectors, and since the distance between the two detectors having detected the first or the second marker is known, the marker distance can be determined. When knowing the marker distance, the position of the displaceable part 4 in relation to the tubular base part 3 is known. By knowing the position of the displaceable part 4 in relation to the tubular base part 3, information of how much the openings 20, 21 are overlapping is also known. In another embodiment, the magnetometers measure the change in direction or magnitude of the magnetic field.

[0075] In Fig. 8A, the markers are made of a magnetisable material, and the displaceable part 4 and the tubular base part 3 are made of a non-magnetisable material. In Figs. 9, 10A-10B, the markers are magnets and the detectors are magnetometers. In Fig. 9, the detector unit comprises three magnetometers for detection of the magnet markers 5, 6. The completion component is in its open position, and the detection range is equal to the distance between the first detector 52 and the second detector 53. The detector range is larger than the marker distance X_2 in the fully open position of the completion component. In Fig. 10A, the completion component 1 is fully closed and the displaceable part 4 is in its first position P_1 , and the markers are arranged with the first marker distance X_1 between them. In Fig. 10B, the completion component 1 is fully open and the displaceable part 4 is in its second position P_2 , and the markers are arranged with the second marker distance X_2 between them. The common detection range d_c is greater than the second marker distance X_2 , and thus the markers can be detected simultaneously by the detection unit and the determination of the marker distance X is thus independent of the velocity of the tool.

[0076] The marker may be a magnet or any kind of emitter, such as an RFID tag, an ionizing radiation source, such as a gamma ray source or an x-ray source. The marker may also be a geometrical pattern provided by varying the thickness of the base part and the displaceable part, respectively. The detectors may be readers, such as RFID readers, Geiger-counters or magnetometers. As can be seen in Fig. 3, the first marker is different from the second marker and the first detector may also be different from the second detector.

[0077] The completion component 1 may be a sleeve as shown in Fig. 1, an inflow control device, a valve, a packer, or an annular barrier as shown in Figs. 11A and 11B. In Figs. 11A and 11B, the displaceable part is the connection part of the annular barrier and is arranged outside the tubular base part 3, and the second marker is arranged outside the tubular base part 3. While an annular barrier is expanded, the sliding connection part

being the tubular base part 3 slides towards the fixed connection part. In order to determine whether the annular barrier has been successfully expanded, the detection tool can pass the annular barrier and determine the marker distance which is equal to the distance that the sliding end has travelled during expansion. The annular barrier 1 comprises an expandable sleeve 70 which shrinks in the axial extension as the fluid passes through the opening 71 in the tubular base part 3 and the annular barrier is expanded. The travelling distance of the sliding end is a result of how far the expandable sleeve 70 has expanded in the radial direction of the completion component 1.

[0078] In Fig. 8A, the detection tool 50 comprises a centraliser 57 for maintaining the detection tool at a pre-determined radial distance r from the completion component. The detection tool further comprises a measurement device 59 adapted to continuously measure the radial distance from the detection tool to the completion component. The detection tool further comprises a processor device 58 adapted to process observations provided by the detectors for calculating the first distance on the basis of the detectors detecting the respective markers. The processor device may also be arranged in the detection unit. The detection tool comprises a communication unit 60 adapted for communicating the determined first distance to an external source. The communication may be performed via a wireline connecting the detection tool with surface.

[0079] The completion component may comprise a plurality of first and second markers spaced around the circumference. Hereby it is obtained that the position of a specific marker may be determined independently of the orientation of the completion component in relation to the detection tool.

[0080] In Fig. 12, the downhole system 100 according to the invention is shown, wherein three completion components 1 are arranged in succession of each other in the well tubular structure 2. The three completion components 1 are shown with their displaceable parts 4 in different positions in relation to the base parts 3.

[0081] In the upper completion component 1a, the displaceable part 4 is displaced into a first position in relation to the base part 3, in which the first opening 20 in the base part is open so that fluid may flow into the well tubular structure 2.

[0082] In the middle completion component 1b, the displaceable part 4 is displaced into a second position in relation to the base part 3, in which the first opening 20 in the base part is partly open, so that less fluid than in the upper completion component 1a may flow into the well tubular structure 2.

[0083] In the lower completion component 1c, the displaceable part 4 is displaced into a third position in relation to the base part 3, in which the first opening 20 in the base part is closed, so that no fluid may flow into the well tubular structure 2.

[0084] The detection tool 50 having the detection unit

51 is rapidly lowered into well tubular structure 2 past the completion components 1a-1c and determines the position of the displaceable parts 4 of each completion component as described above. When the detection tool 50 has determined and verified the position of the displaceable parts 4 and thereby, in this embodiment, determined which completion components 1a-1c are open, partly open and closed, this may be communicated to the operator of the completion. By means of the downhole system according to the present invention it is obtained that the position of the displaceable parts of the completion components may be determined independently of the velocity of the detection tool 50 when it moves through the well tubular structure 2.

[0085] Fig. 13 shows a partial, cross-sectional view of an embodiment of the completion component in which the first marker 5 of the tubular base part 3 is a weld seam 80 of a magnetisable material. The second marker 6 in the displaceable parts 4 is also a weld seam 80 of a magnetisable material. By the markers being weld seams 80 of a magnetisable material, the markers are easily made and the markers can thus be made as a pattern. Each completion component 1 can thus be made having a unique identification pattern, barcode or signature, so that the detection tool can also detect in which completion component 1 in the well structure 2, the detection tool has measured a marker distance. In another embodiment, the markers may be a circumferential groove or adjacent grooves, such as a thread. The signature or identification code in each completion component 1 may also be an RFID tag or the like.

[0086] As shown in Fig. 14, the detection tool 50 in the downhole system 100 may further comprise a downhole driving unit 73, an anchoring tool section 74 having radial extension anchors 75 and a key tool 76 having keys 77 engaging grooves in the completion component 1. The key tool 76 is operated by a stroking tool 79. The detection tool 50 is powered through a wireline 78. The key tool 76 is able to both open and close a completion component in one run, that is without the tool having to be retracted from the well. By the detection tool 50 and the key tool being in the same tool string, the key tool can change the position of the completion component and the detection tool can verify that the performed operation of the key tool has resulted in the planned position change of the completion component.

[0087] The completion component 1 may either be a rotational sleeve or an axially slidable sleeve. In Fig. 15, another completion component 1 is shown in which the displaceable part 4 rotates in relation to the tubular base part 3 in order to expose the first openings 20 in the tubular base part 3 to the formation so that well fluid is allowed to flow into the interior of the completion component 1. The first openings vary in size to regulate volume flow as the displaceable part 4 is exposing more or fewer openings 20. The displaceable part 4 is rotated by means of a key tool or the like engaging the grooves 31 in the displaceable part 4. The displaceable part 4 has a thread

30B engaging a guiding pin 43 arranged in the tubular base part 3. The completion component 1 further comprises a second displaceable part 4B having a thread engaging a second guiding pin 43B in the tubular base part 3. A set of sealing means are arranged between the displaceable parts 4, 4B and the tubular base part 3 to prevent well fluid from entering the potential gap between one of the displaceable parts and the tubular base part 3. The completion component 1 further comprises a scraping ring 41. Two locking rings 40 are arranged at the ends of the completion component 1 in order to prevent the displaceable parts 4, 4B from falling out of the tubular base part 3 during mounting of the completion component 1 in the well tubular structure.

[0088] Figs. 16A-C show different positions of the completion component 1 of Fig. 15. In Fig. 16A, the displaceable part 4 is in its first and initial position in which the displaceable part 4 covers the first openings. In the first position, a first projecting part 46 of the displaceable part 4 and a second projecting part of the second displaceable part 4B are in the same transversal plane of the completion component 1. The first and second projecting parts 46, 47 are opposite each other, and as the displaceable part 4 is rotated, the first projecting part 46 engages the second projecting part 47, forcing the second displaceable part 4B to rotate along with the displaceable part 4. In Fig. 16B, the completion component 1 is partly open and the displaceable part 4 only partly covers the first openings 20. The displaceable part 4 has a thread having thread pitch which is larger than the thread pitch of the thread of the second displaceable part 4B. As the displaceable part 4 is rotated, the displaceable part 4 moves a greater distance in the axial extension than the second displaceable part 4B. In this way, the displaceable part 4 moves axially away from the second displaceable part 4B, and the first projecting part 46 and the second projecting part 47 no longer engage. Thus, the second displaceable part 4B moves in the axial extension along with the displaceable part 4 until the second displaceable part 4B has passed the sealing means 32, and thus the second displaceable part 4B provides a seal before the first openings are exposed and the well fluid is let into the completion component 1. In Fig. 16C, the completion component 1 is more open than in Fig. 16B, and the displaceable part 4 uncovers more first openings 20 and thus more fluid is allowed to flow in through the openings of the completion component 1.

[0089] The guiding pin 43 is shown in Fig. 17 having a round end 48 engaging a thread and a piston end 49. The piston end is provided with a sealing ring so that well fluid applying pressure from the outside of the tubular base part 3 does not flow past the guiding pin or in between the displaceable part 4 and the tubular base part 3. The piston end thus moves in a bore 45 in the tubular base part 3.

[0090] The invention further relates to a method for determining a position of the displaceable part of the completion component in relation to the tubular base part, so

that a function of the completion component can be detected, e.g. whether a sliding sleeve is closed, partly open or fully open, or whether an annular barrier is expanded. The method comprises the steps of arranging a first marker in connection with the tubular base part and arranging a second marker in connection with the displaceable part. After displacement of the displaceable part in relation to the tubular base part as a result of the expansion of an annular barrier or in order to open or close the sleeve, a detection tool having a detection unit is moved past the first and second markers for detecting the first and second markers and hence a marker distance being the distance between the markers. The first detector may be arranged having a first detection range in the axial extension of the tool and the completion component, and a second detector may be arranged having a second detection range in the axial extension for providing a common detection range in the axial extension so that the common detection range is greater than the marker distance between the first and second markers. Since the detection is able to detect both first and second markers at the same time, the determination of the position of the completion component is performed independently of a velocity of the detection tool. Furthermore, the detection is performed without the detection tool having any physical contact with the completion component.

[0091] A plurality of intermediate detectors may be arranged between the first and second detectors with predetermined distances between them. Thus, the marker distance may be determined by simultaneous detection of the first and second markers by two separate different detectors.

[0092] A stroking tool is a tool providing an axial force. The stroking tool comprises an electrical 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 stroker shaft. The pump may pump fluid into the piston housing on one side and simultaneously suck fluid out on the other side of the piston.

[0093] 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.

[0094] By a casing is meant any kind of pipe, tubing, tubular, liner, string etc. used downhole in relation to oil or natural gas production.

[0095] In the event that the tool is not submergible all the way into the casing, 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®.

[0096] 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 completion component (1) having a circumference for insertion into a well tubular structure (2), comprising:

- a tubular base part (3) having an axial extension and a thickness and being adapted to be mounted as part of the well tubular structure, and
- a displaceable part (4) having a thickness and being displaceable in relation to the tubular base part from a first position to a second position,

wherein the tubular base part (3) comprises a first marker (5) and the displaceable part (4) comprises a second marker (6) for determining a position of the displaceable part in relation to the tubular base part, the first and second markers (5, 6) being arranged with a marker distance.

2. A completion component according to claim 1, wherein the marker is made of a magnetic material.
3. A completion component according to claim 1, wherein the marker is a magnet or an emitter.
4. A completion component according to any of the preceding claims, wherein the marker is ring-shaped.
5. A completion component according to any of the preceding claims, wherein the first marker is arranged at a first position along the circumference of the completion component and the second marker is arranged at an angle (α) along the circumference from the first marker.
6. A completion component according to any of the preceding claims, wherein the completion component comprises a projecting element (34) which is connected with either the tubular base part or the displaceable part and is adapted to engage grooves in the other part.
7. A completion component according to any of the preceding claims, wherein the displaceable part is displaceable in intermediate positions arranged between the first and second positions.

8. A completion component according to any of the preceding claims, wherein the tubular base part has a first opening (20) and the displaceable part has a second opening (21), the first and second openings not overlapping in a first position (P_1) of the displaceable part, and the first and second openings overlapping in a second position (P_2) of the displaceable part.

9. A downhole system (100) comprising:

- a well tubular structure,
- a completion component (1) according to any of the preceding claims, and
- a detection tool (50) having a detection unit (51) for detecting a marker distance between the first marker of the tubular base part and the second marker of the displaceable part.

10. A downhole system (100) according to claim 9, wherein the distance between the first and second markers is detected independently of a velocity of the detection tool.

11. A downhole system (100) according to claim 9 or 10, wherein the detection unit (51) comprises a first detector (52) having a first detection range (d_1) in the axial extension and a second detector (53) having a second detection range (d_2) in the axial extension, the first and second detection ranges defining a common detection range (d_c) in the axial direction, the common detection range being greater than the marker distance between the first and second markers.

12. A downhole system (100) according to claim 11, wherein the detection unit comprises intermediate detectors arranged between the first and second detectors (52, 53).

13. A downhole system (100) according to claim 11 or 12, wherein the detectors are magnetometers.

14. A downhole system (100) according to any of the claims 11 to 13, wherein the detector unit comprises a plurality of magnets.

15. A method for determining a position of a displaceable part of a completion component according to any of the claims 1 to 8 in relation to a tubular base part, comprising the steps of:

- arranging a first marker in connection with the tubular base part,
- arranging a second marker in connection with the displaceable part, and
- moving a detection tool (50) having a detection unit (51) past the first and second markers for

detecting the first and second markers and hence for detecting a marker distance between the markers independently of a velocity of the detection tool.

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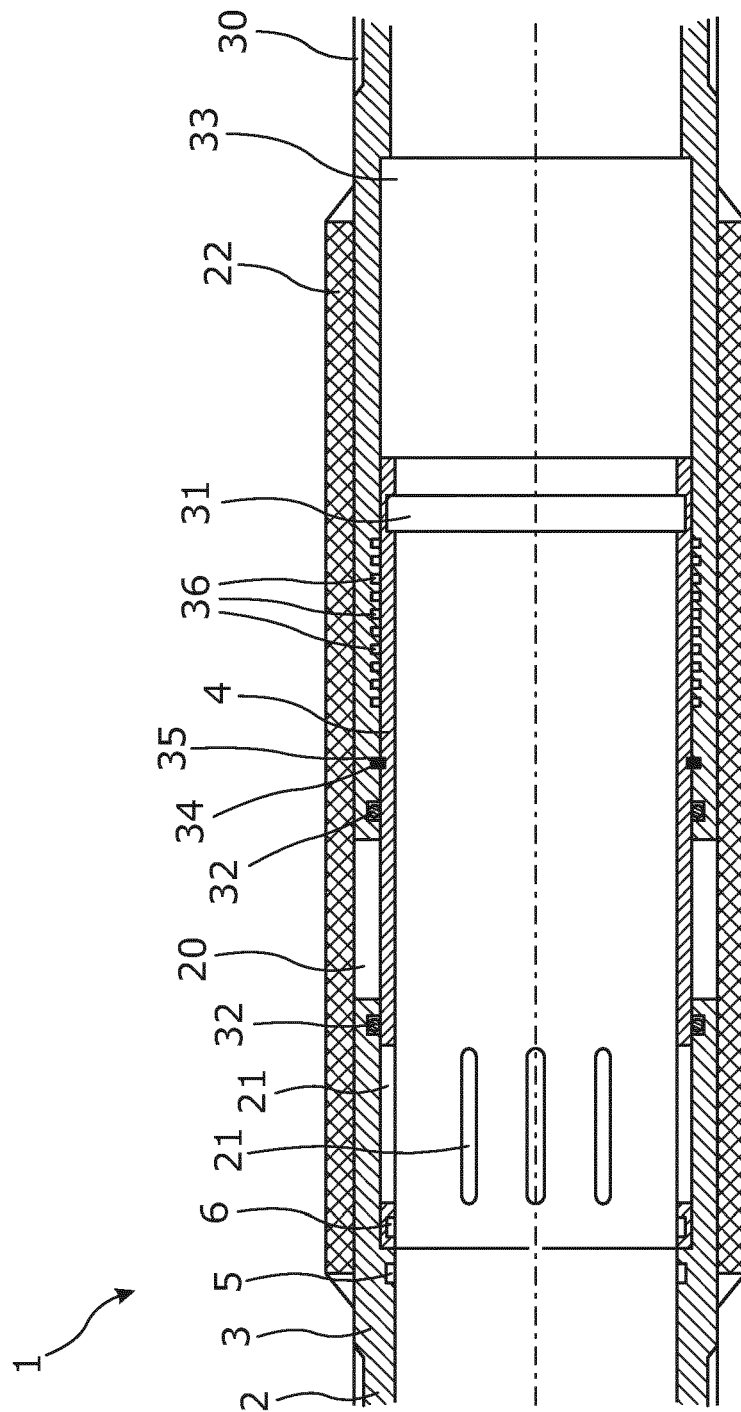


Fig. 1

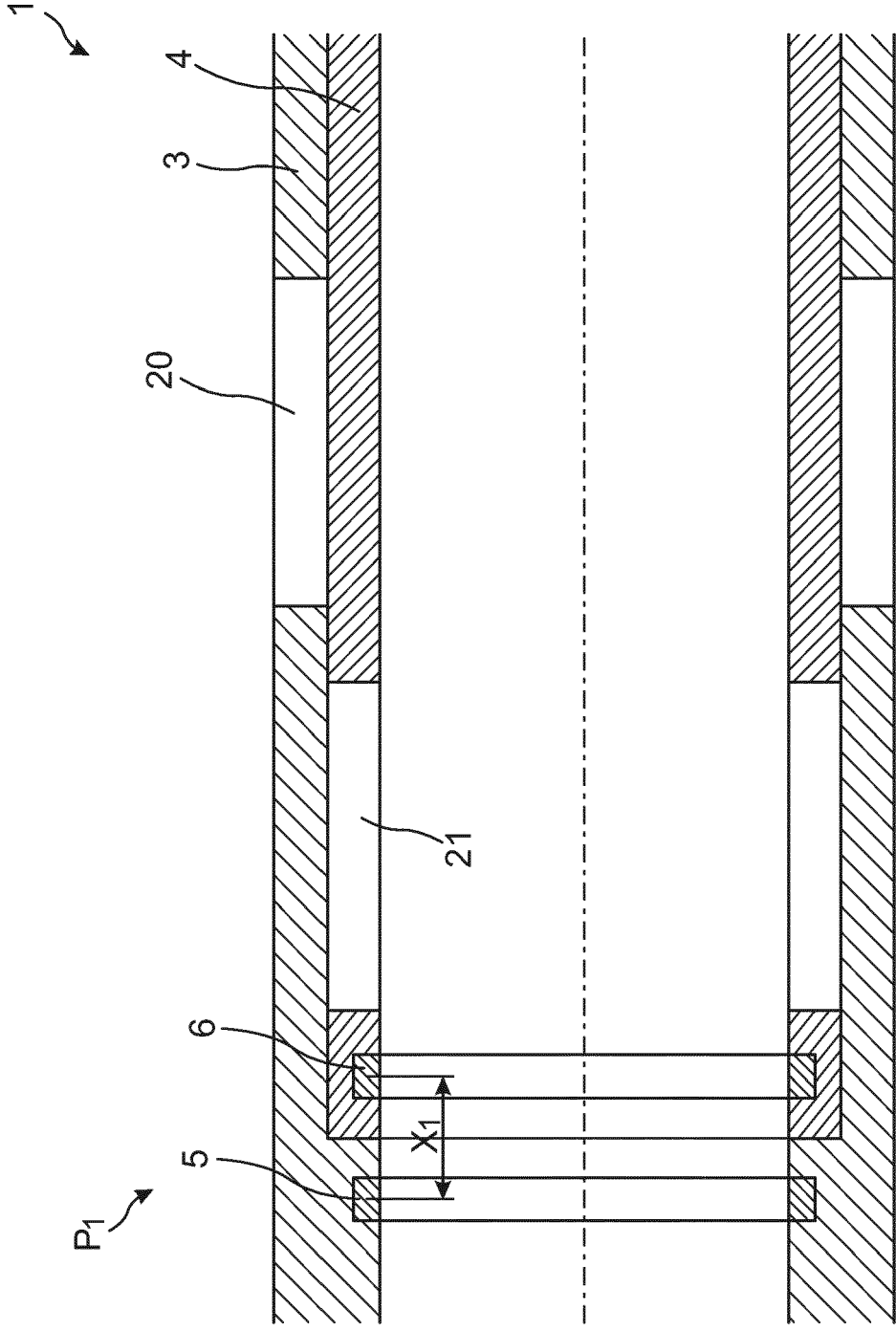


Fig. 2a

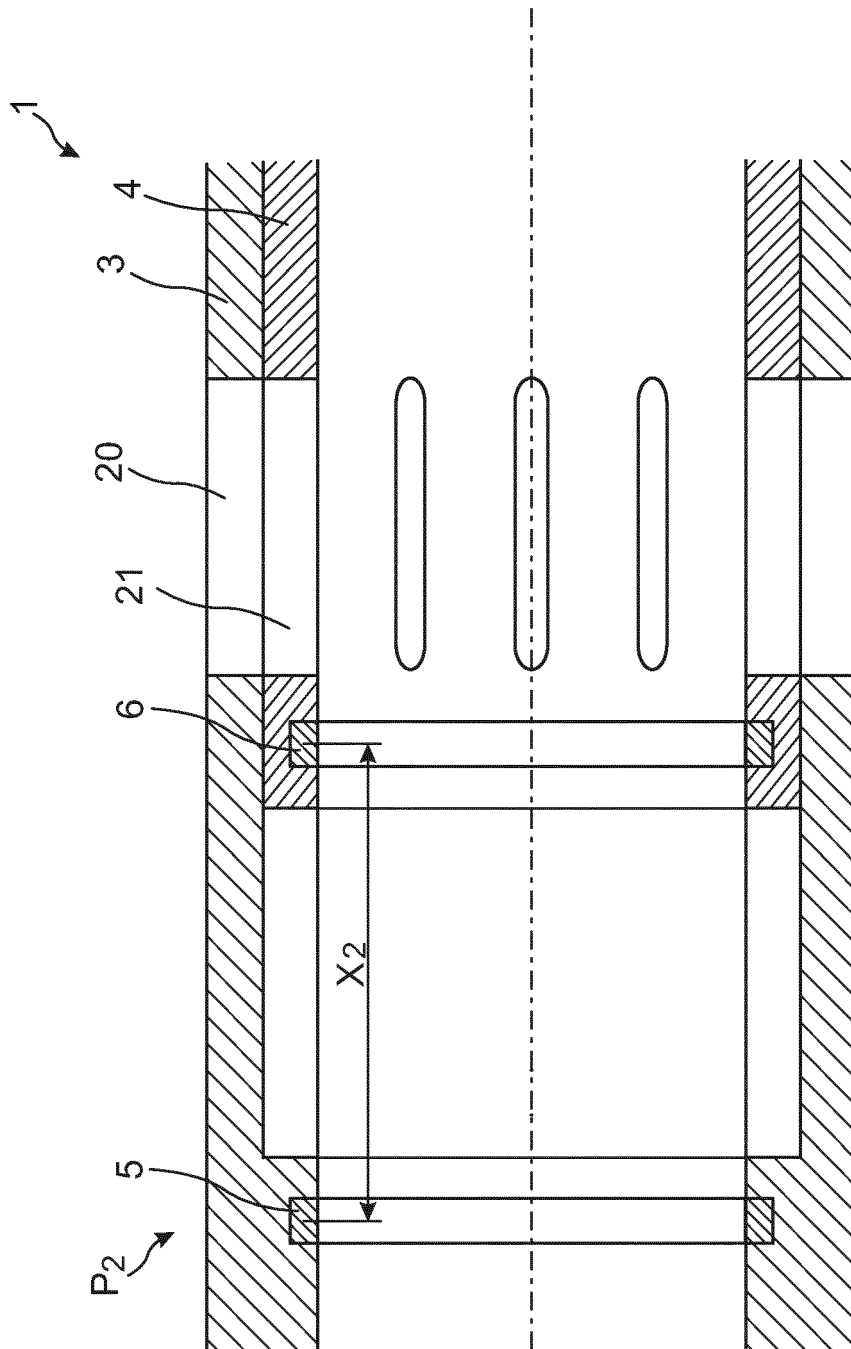


Fig. 2b

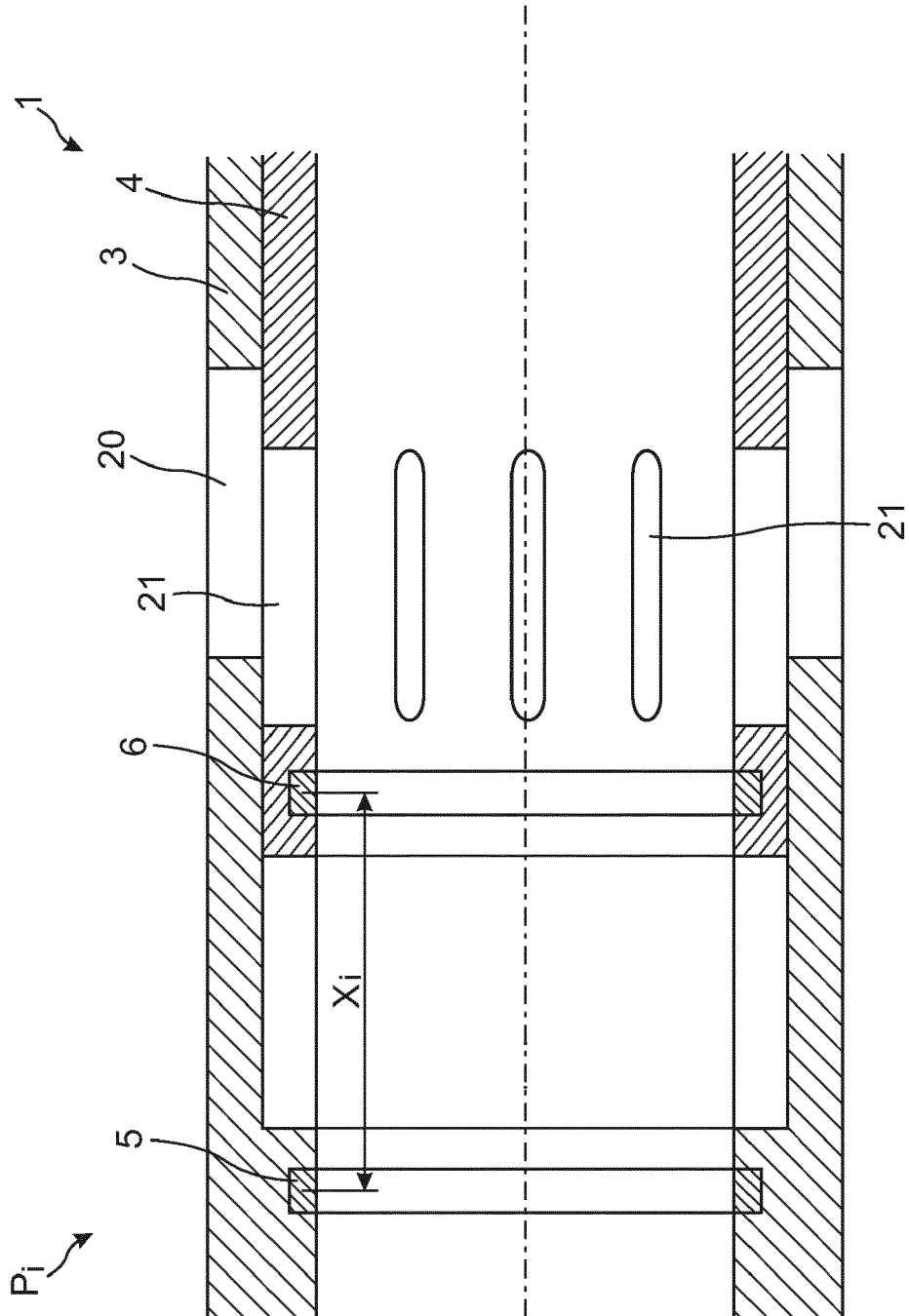


Fig. 2c

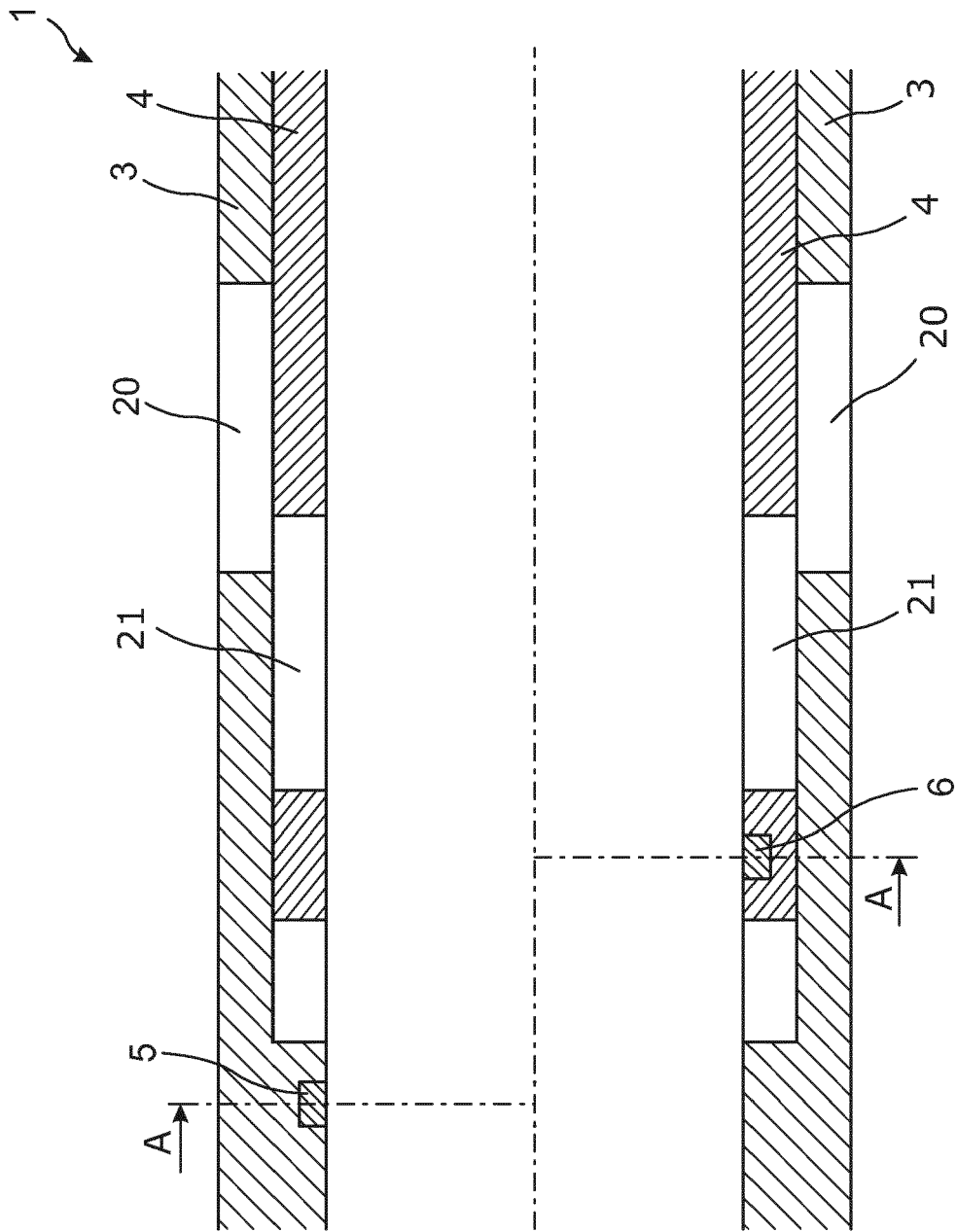


Fig. 3

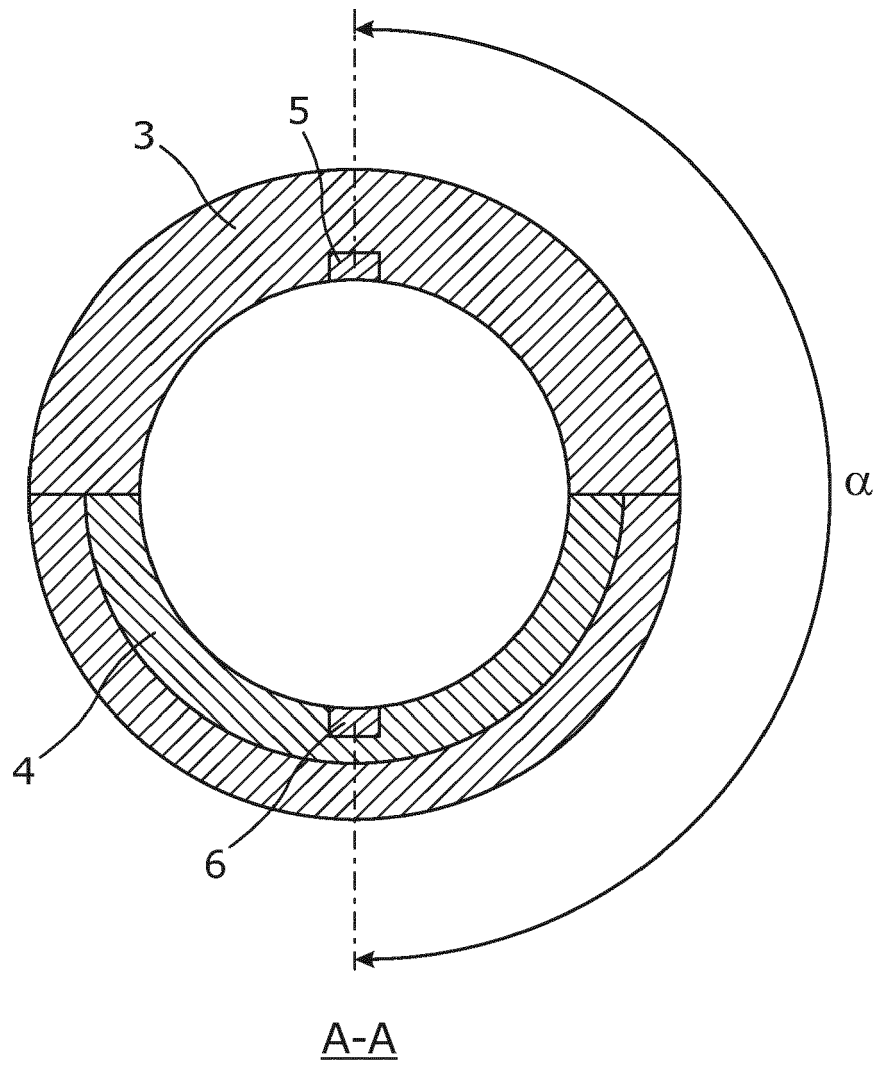


Fig. 4

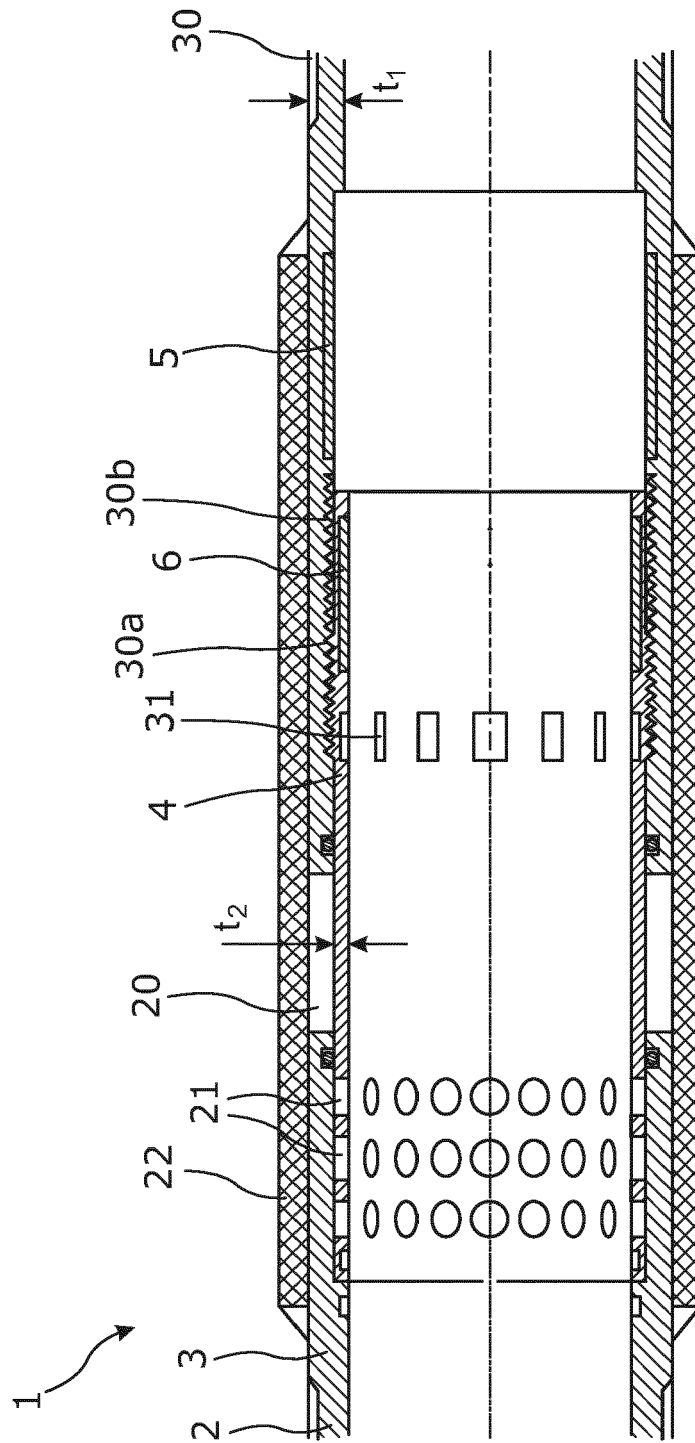


Fig. 5

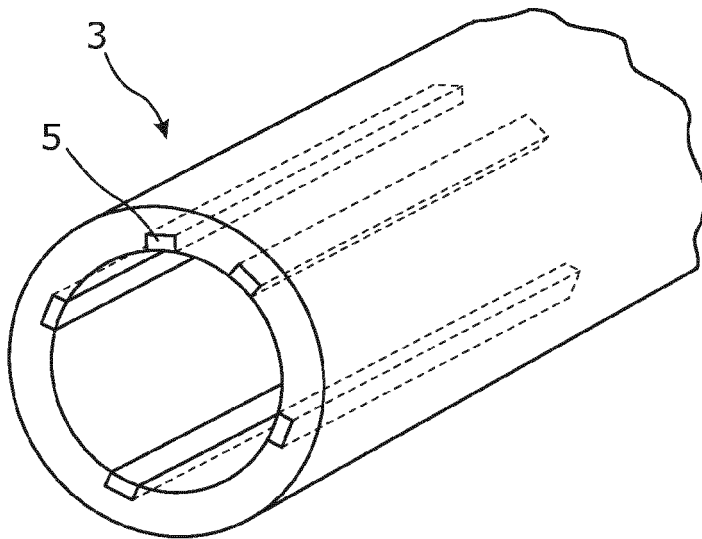


Fig. 6

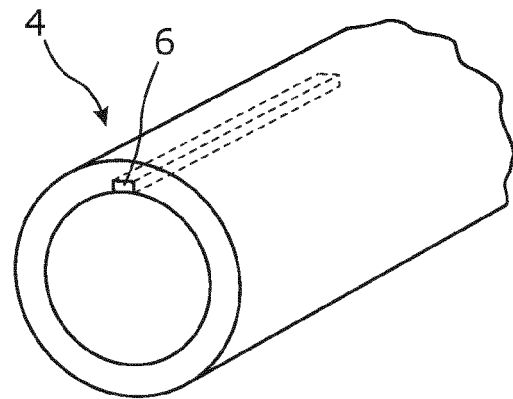
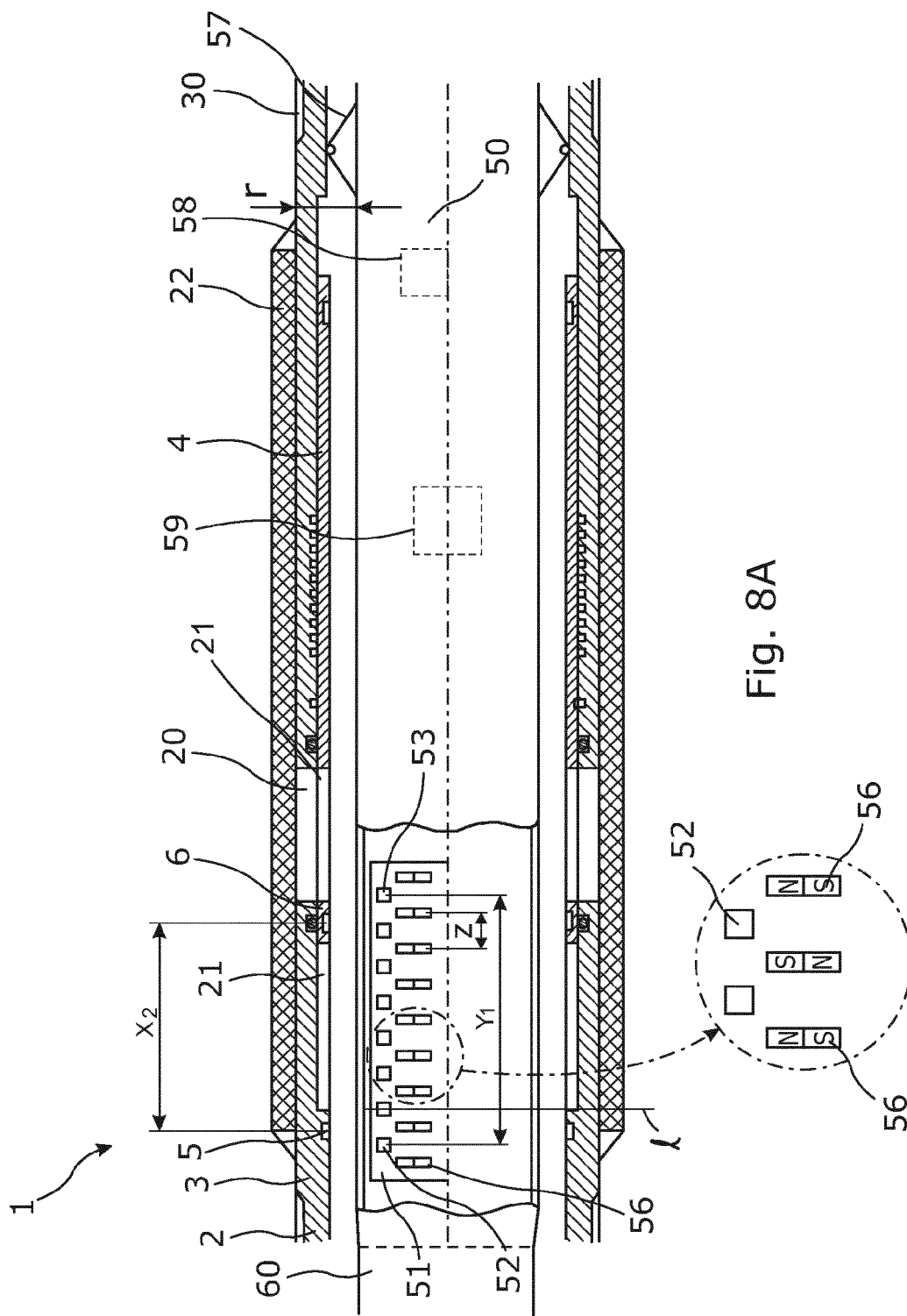


Fig. 7



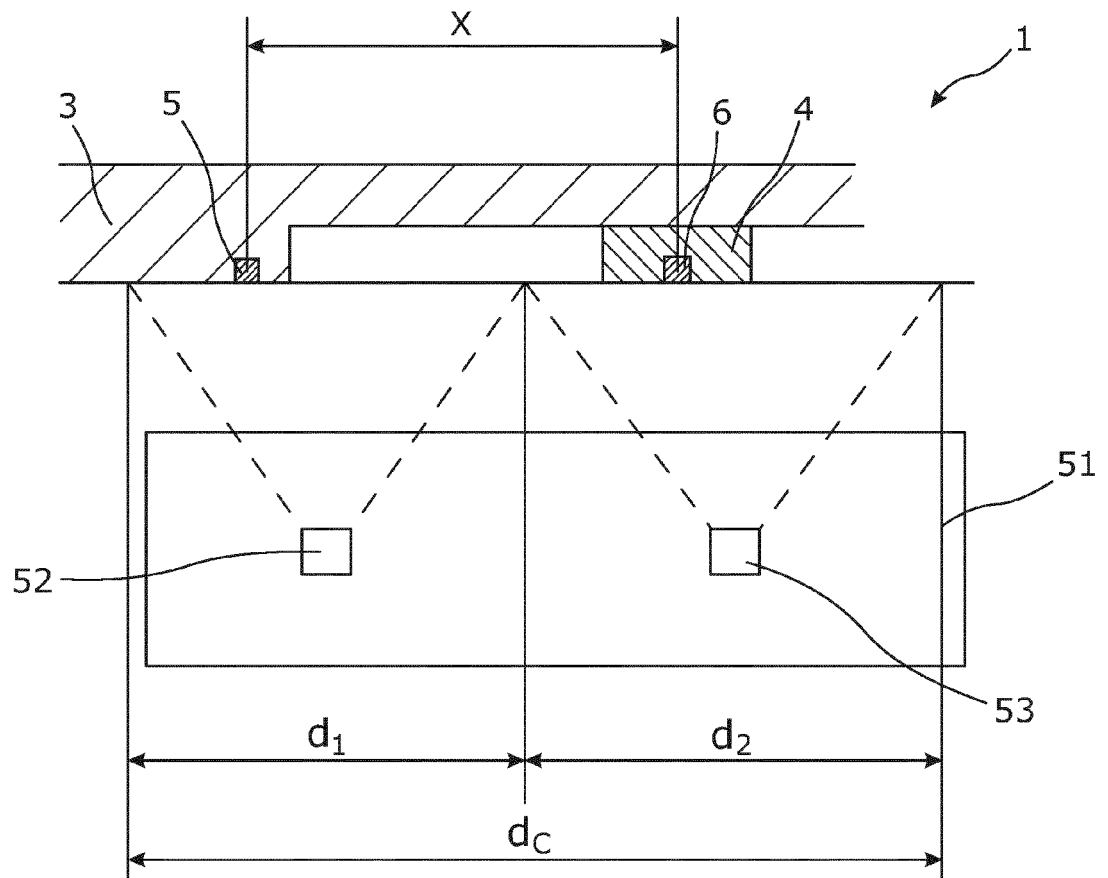


Fig. 8B

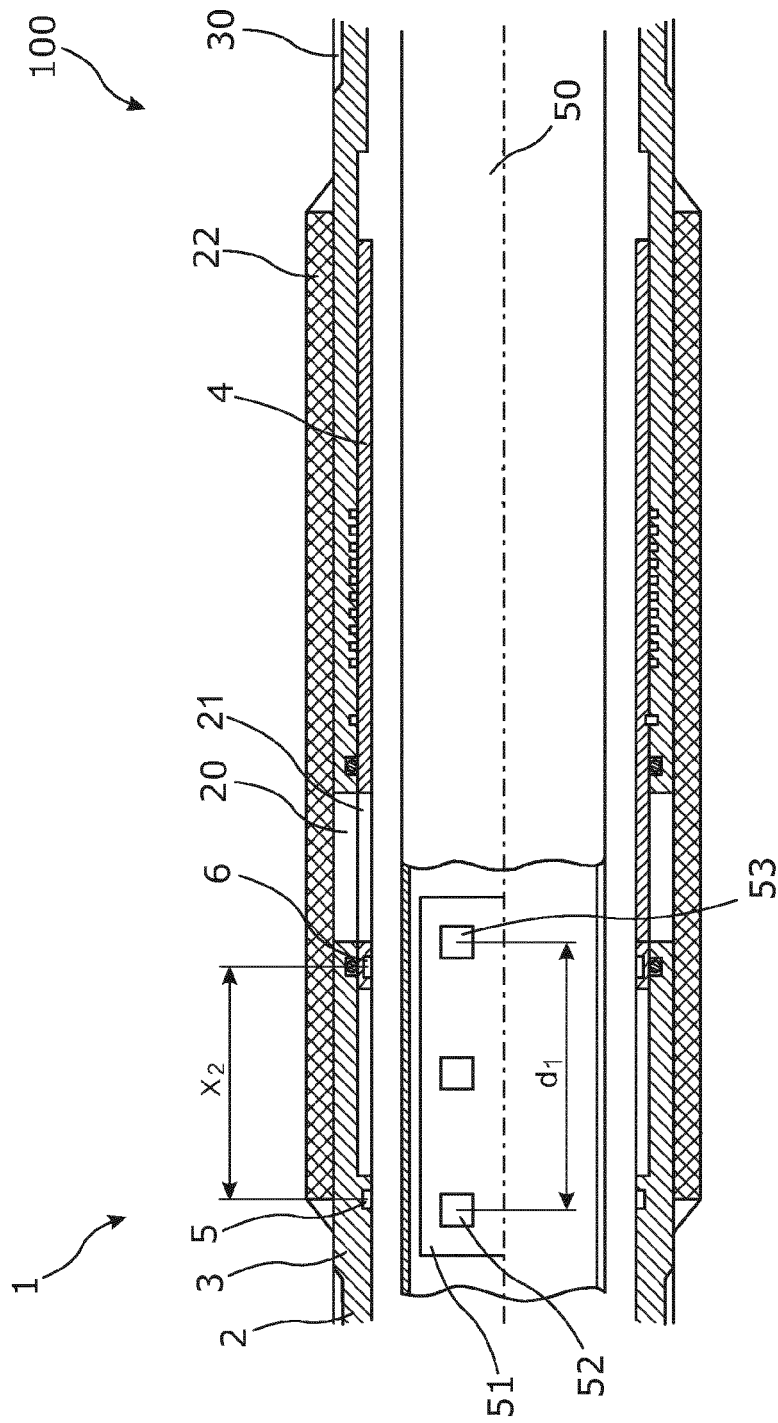


Fig. 9

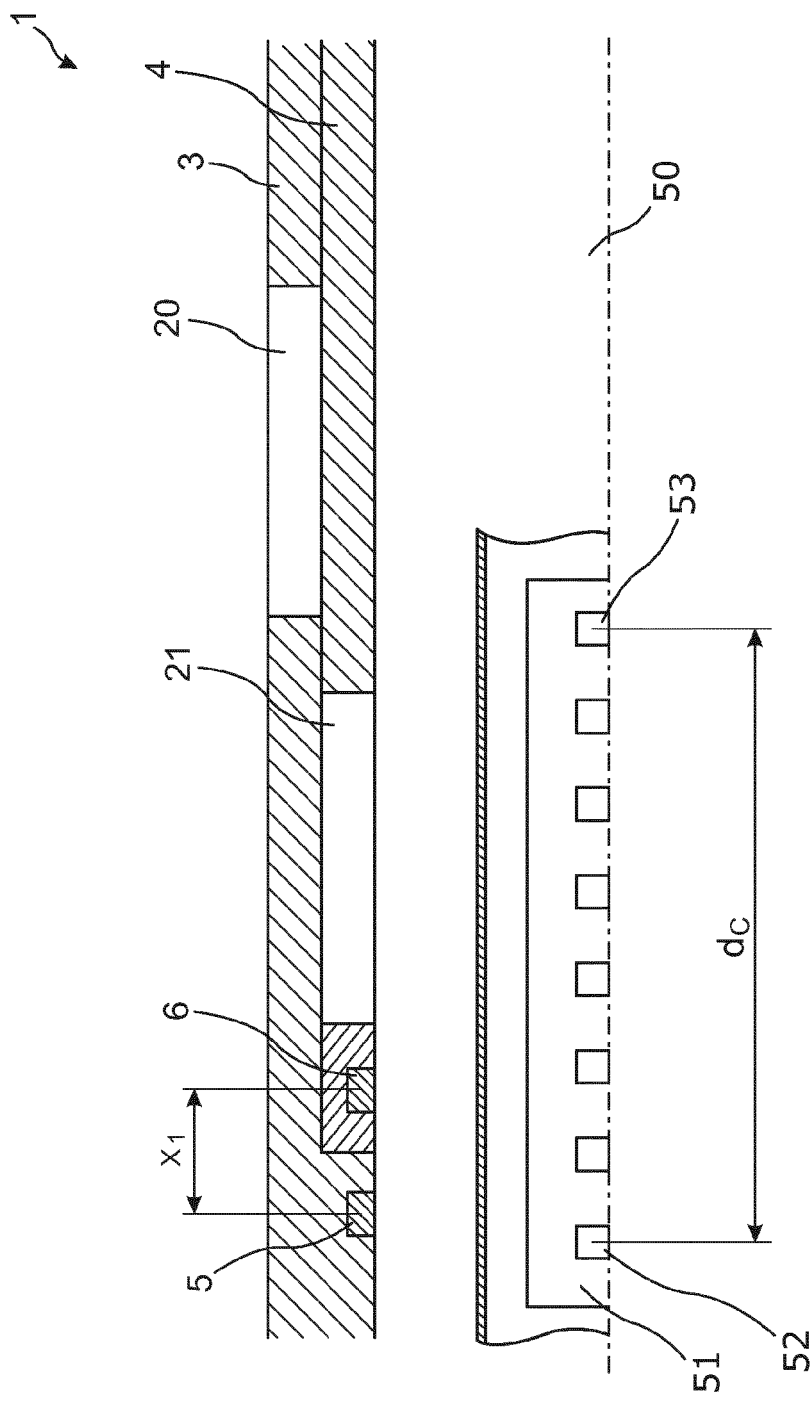


Fig. 10a

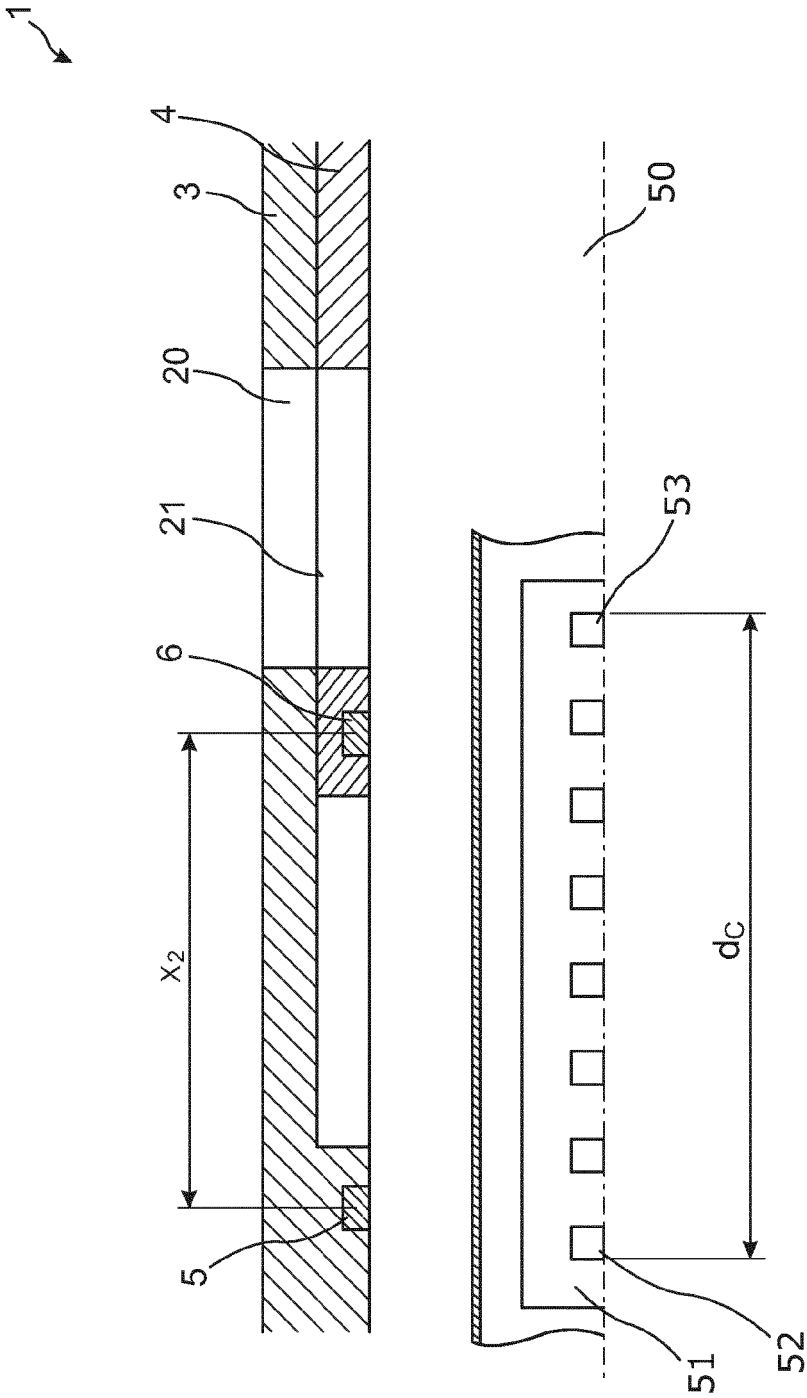
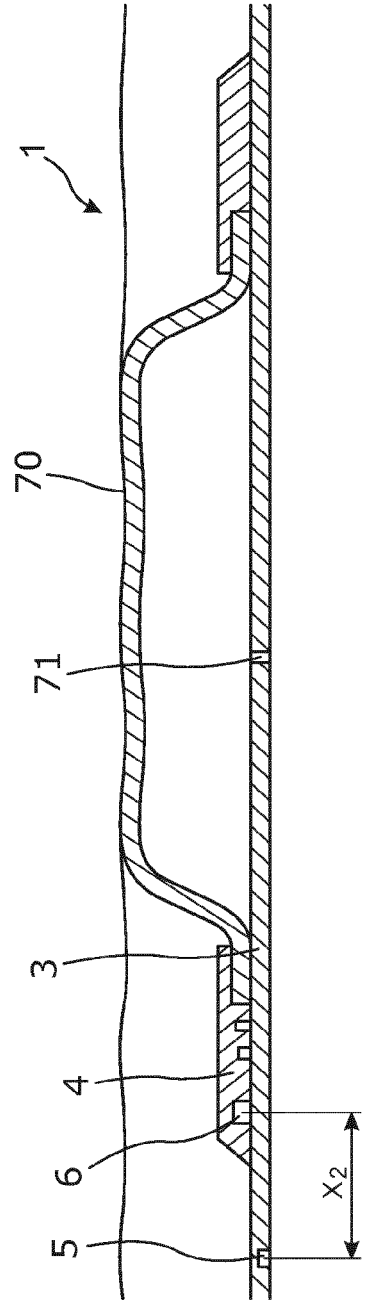
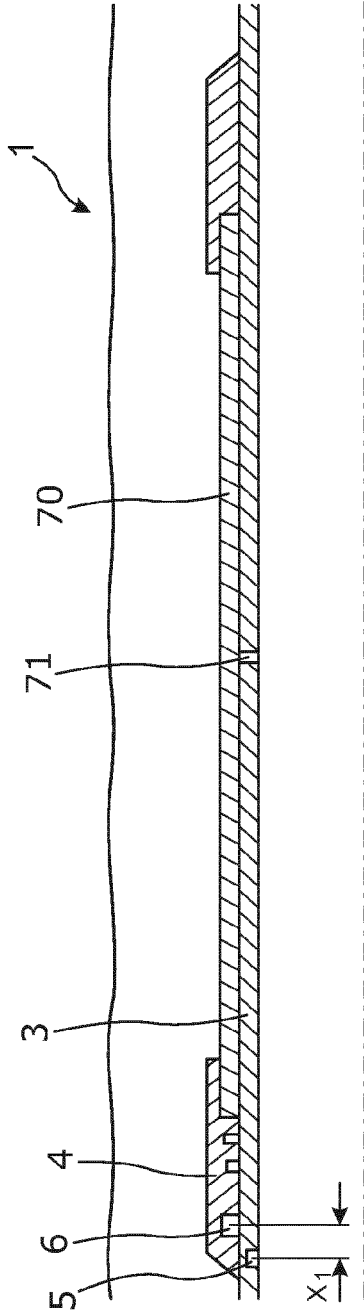


Fig. 10b



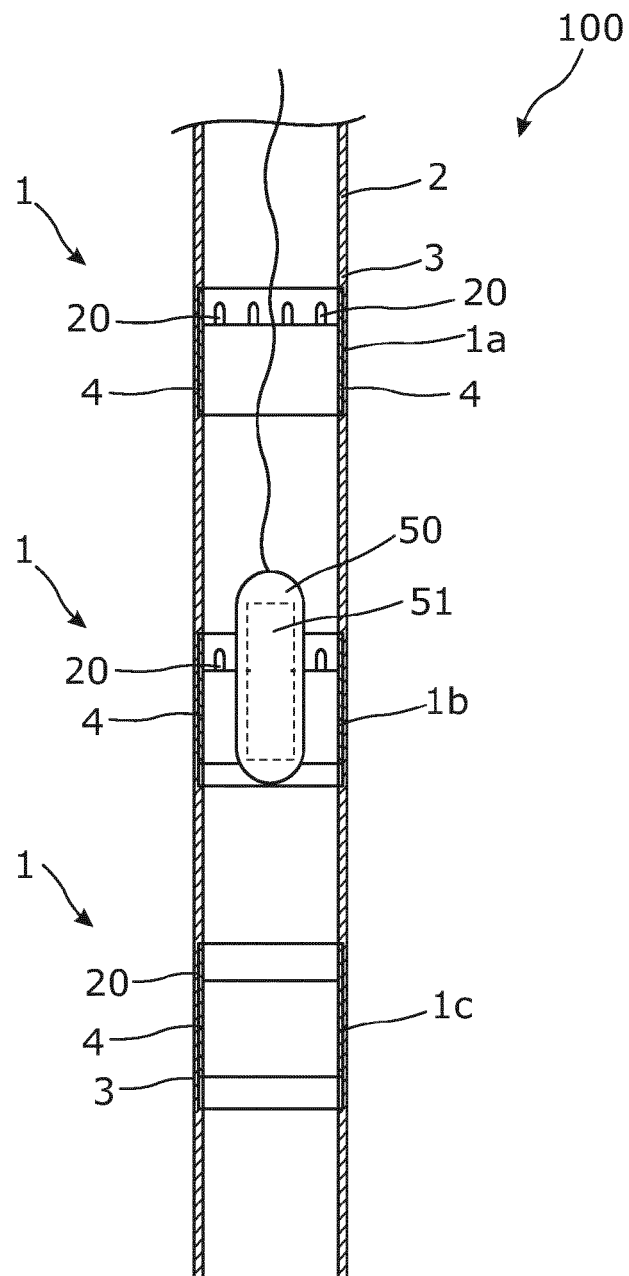


Fig. 12

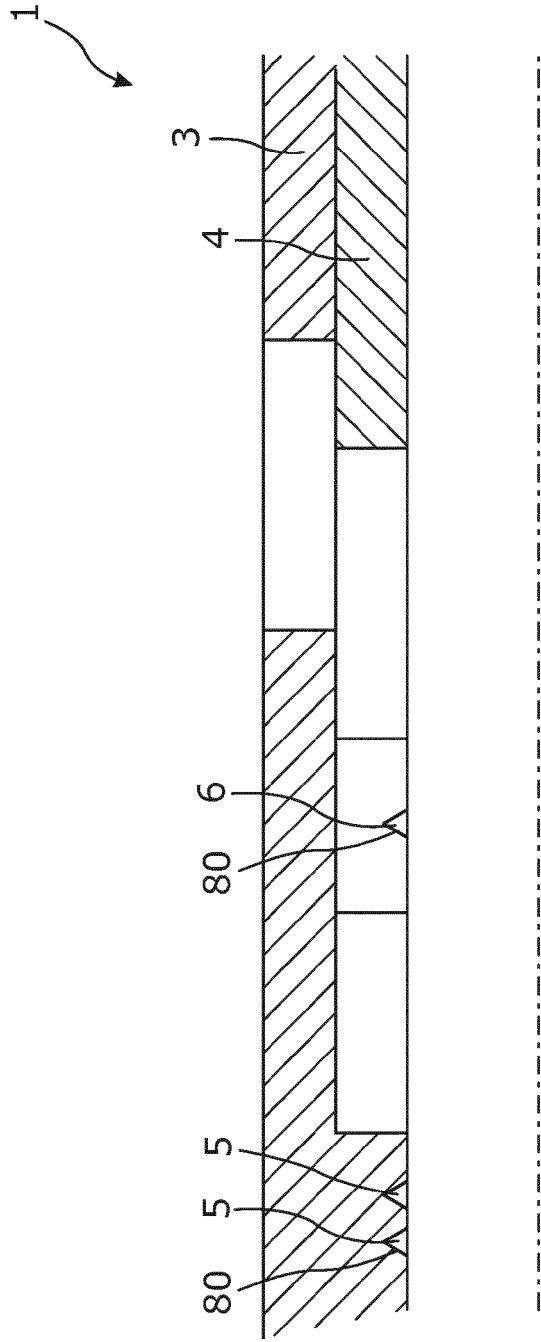


Fig. 13

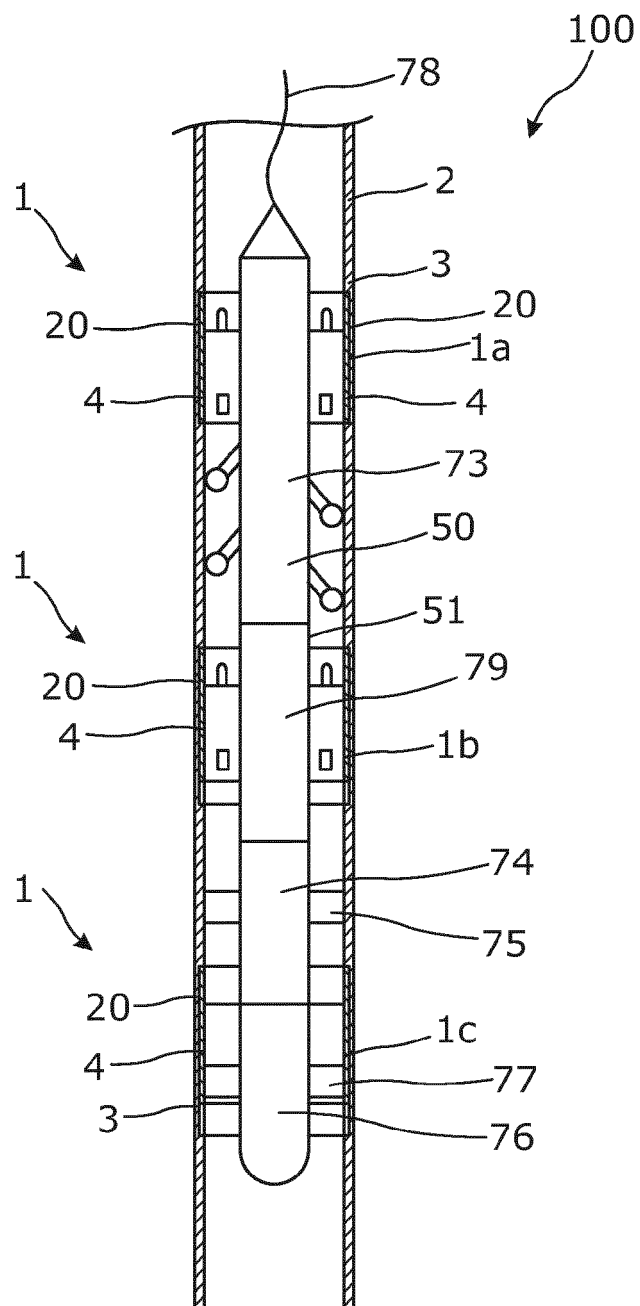


Fig. 14

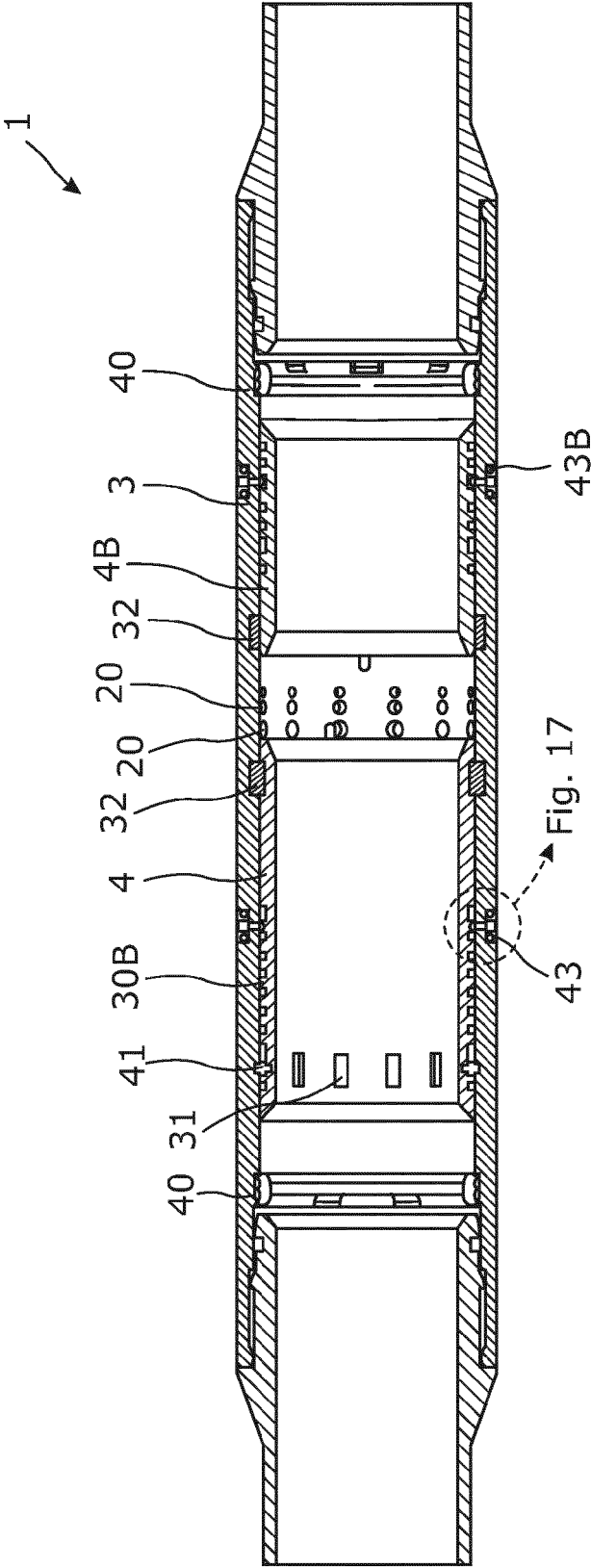


Fig. 15

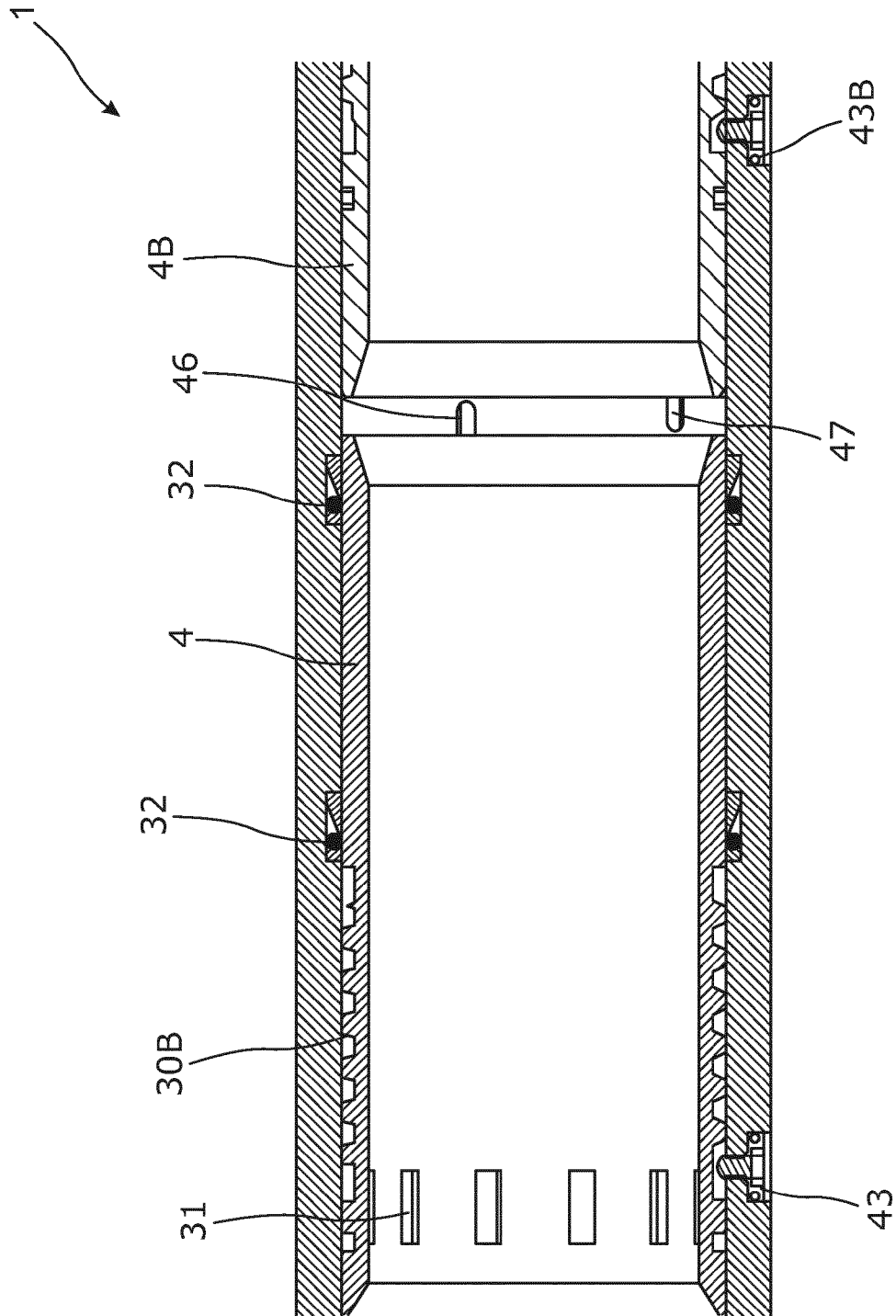


Fig. 16A

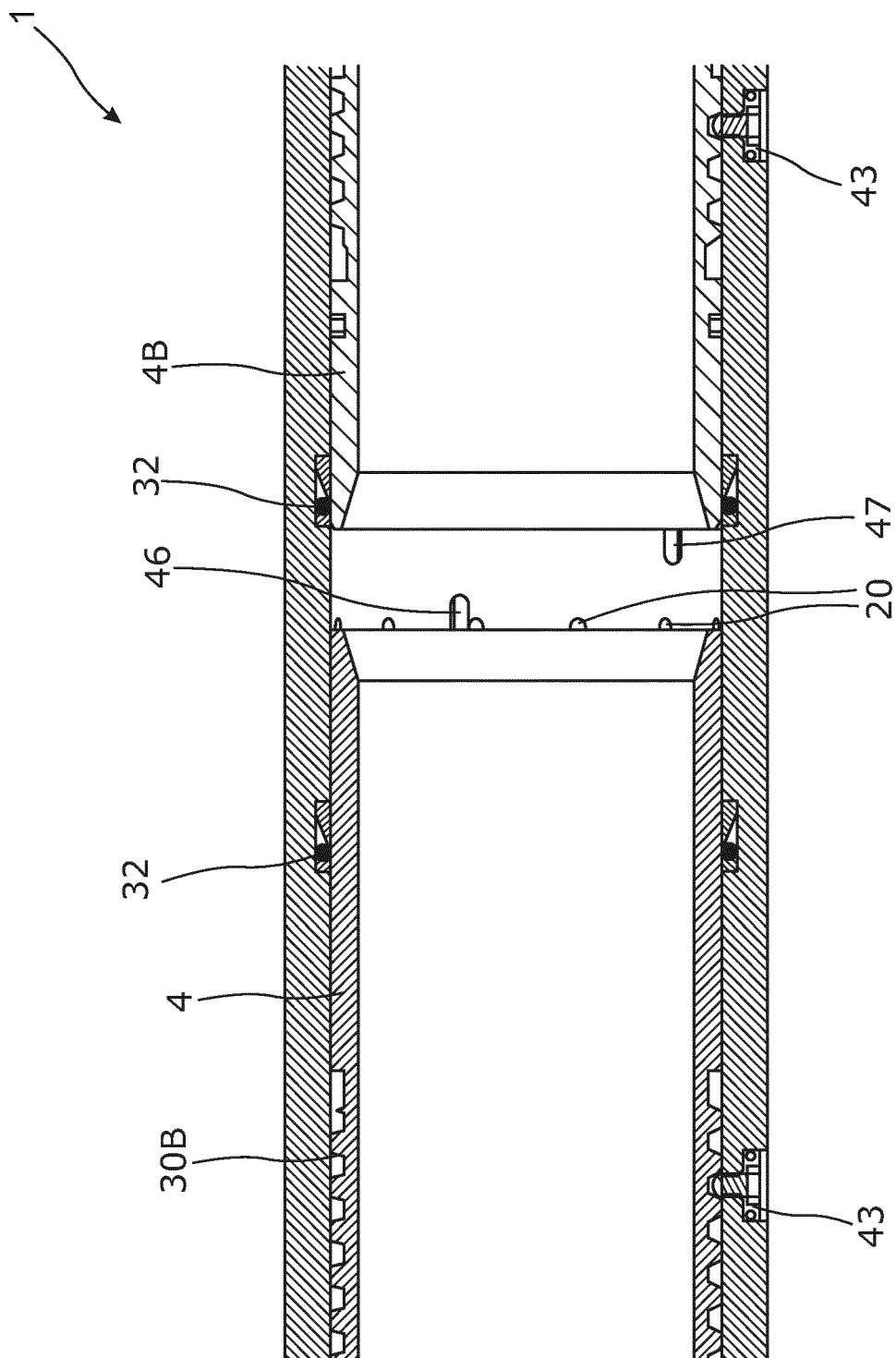


Fig. 16B

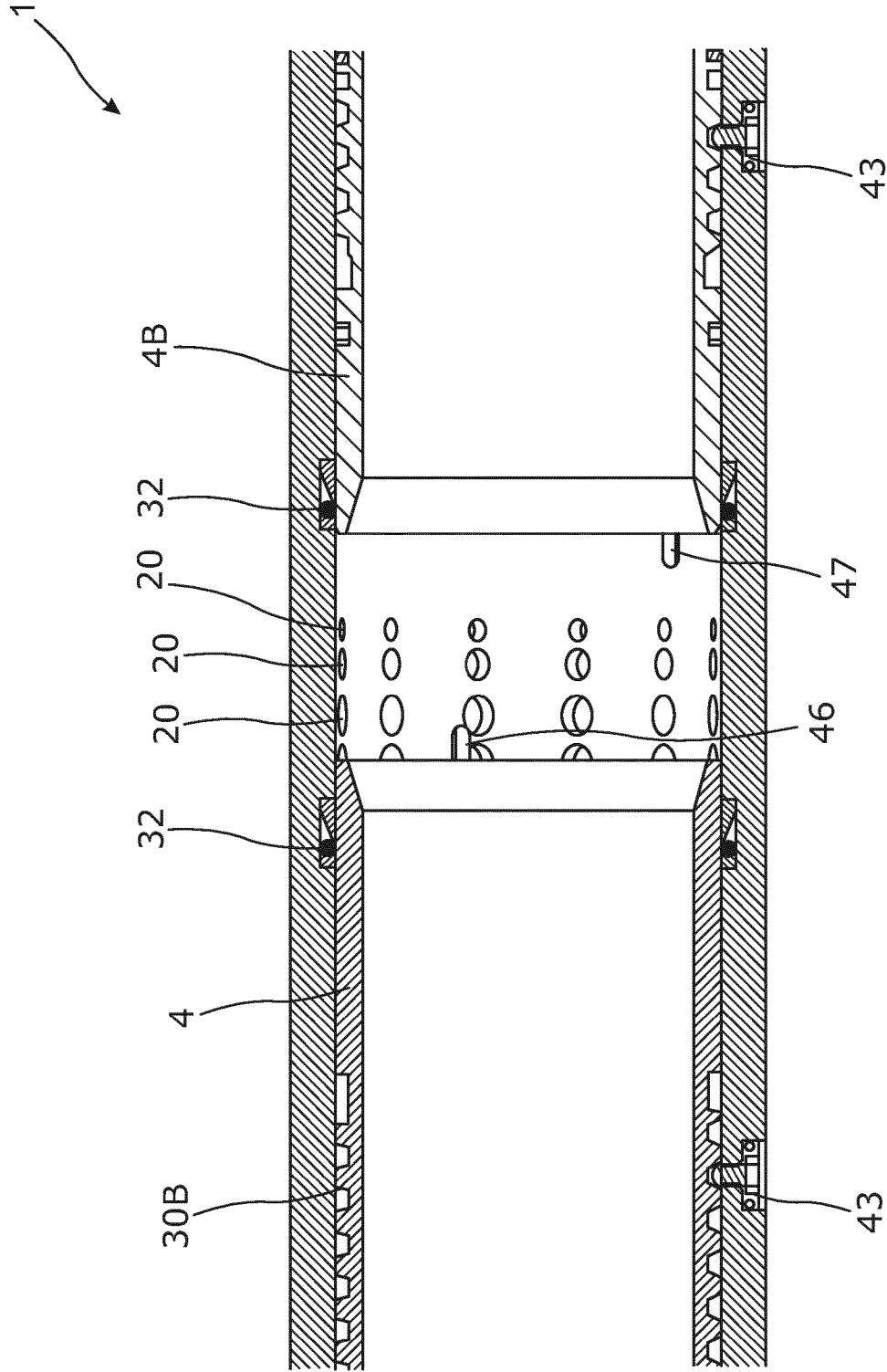


Fig. 16C

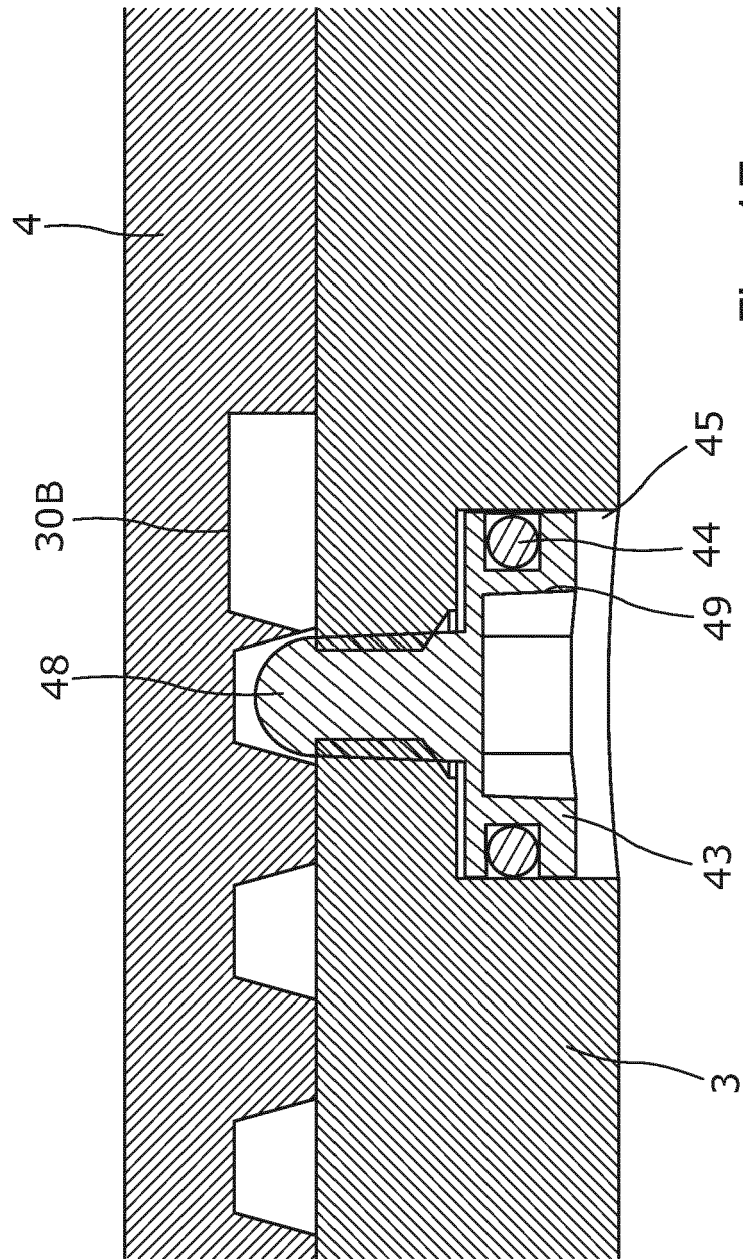


Fig. 17



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 Application Number
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Place of search		Date of completion of the search	Examiner
Munich		25 June 2013	Strømmen, Henrik
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