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(54) Downhole cleaning system

(57) The present invention relates to a downhole cleaning system for cleaning an element inside a casing in a wellbore comprising well fluid having a wellbore pressure , comprising the casing, a wireline cleaning tool having a longitudinal direction and comprising a rotatable nozzle head having a plurality of nozzles, a tool housing having an inlet being in fluid communication with the nozzles for jetting well fluid into the tool, a flow hindering element arranged on an outside of the housing dividing the tool in a first and a second tool part and dividing the casing in a first and a second casing part and a rotatable shaft connecting the nozzle head with the housing, wherein the system further comprises a pumping device for pressurising the well fluid in the first part of casing to a pressure substantially above the wellbore pressure and above a pressure in the second part of the casing so that well fluid is pumped in through the inlet and out through the nozzles. Furthermore, the invention relates to a wireline cleaning tool and to a cleaning method.

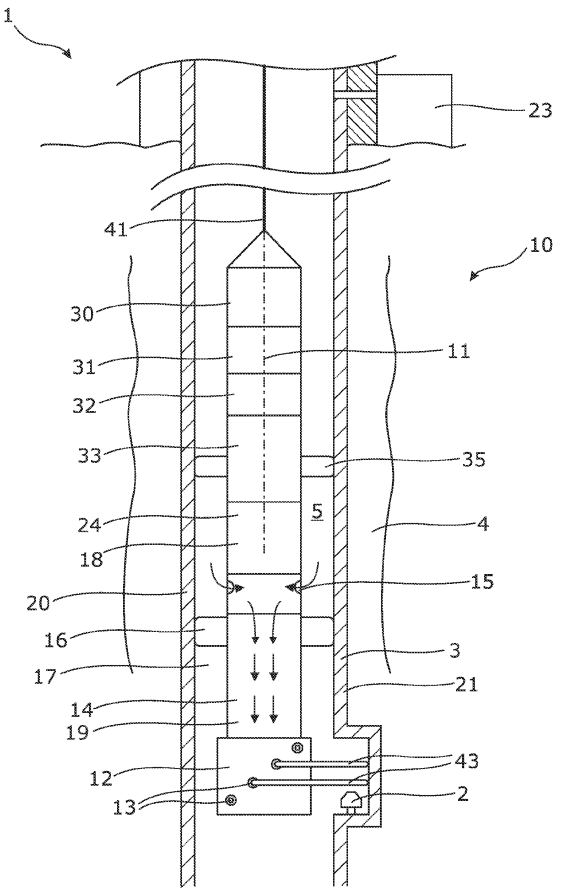

Fig. 1

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Description

Field of the invention

[0001] The present invention relates to a a downhole cleaning system for cleaning an element inside a casing in a wellbore comprising well fluid having a wellbore pressure, comprising the casing, a wireline cleaning tool having a longitudinal direction and comprising a rotatable nozzle head having a plurality of nozzles, a tool housing having an inlet being in fluid communication with the nozzles for letting well fluid into the tool, a flow hindering element arranged on an outside of the housing dividing the tool in a first and a second tool part and dividing the casing in a first and a second casing part and a rotatable shaft connecting the nozzle head with the housing, wherein the system further comprises a pumping device for pressurising the well fluid in the first part of casing to a pressure substantially above the wellbore pressure and above a pressure in the second part of the casing so that well fluid is pumped in through the inlet and out through the nozzles. Furthermore, the invention relates to a wireline cleaning tool and to a cleaning method.

Background art

[0002] During oil production, the completion needs to be optimised in order to produce as much oil as possible. Therefore, it is necessary that some valves are open and others closed. However, such valves may get stuck due precipitation scale and other particles accumulated on the valve so that the valve is stucked. Thus, it is sometimes necessary for the valves to be cleaned before being able to operate them.

[0003] Known cleaning tools require the presence of coiled tubing on the rig or vessel in order to clean a valve in a casing within a wellbore. However, such coiled tubing is not always situated on the rig or vessel and therefore needs to be transported to the rig or vessel.

Summary of the invention

[0004] 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 a downhole cleaning system which is more simple and easier to submerge into a wellbore without using drill pipes or coiled tubing.

[0005] 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 down hole cleaning system for cleaning an element inside a casing in a wellbore comprising well fluid having a wellbore pressure, comprising:

- the casing,
- a wireline cleaning tool having a longitudinal direction and comprising:
  - a rotatable nozzle head having a plurality of nozzles,
  - a tool housing having an inlet being in fluid communication with the nozzles for letting well fluid into the tool,
  - a flow hindering element arranged on an outside of the housing dividing the tool in a first and a second tool part and dividing the casing in a first and a second casing part,
  - a rotatable shaft connecting the nozzle head with the housing,

wherein the system further comprises a pumping device for pressurising the well fluid in the first part of casing to a pressure substantially above the wellbore pressure and above a pressure in the second part of the casing so that well fluid is pumped in through the inlet and out through the nozzles.

[0006] Also the downhole cleaning system according to the invention may comprise a control device to control the rotation of the shaft and the nozzle head.

[0007] In one embodiment the control device may be an electrical motor for rotating the shaft.

[0008] In another embodiment, the control means may comprise a gear, a motor brake or a centrifugal brake.

[0009] Furthermore, the nozzle head may comprise a hydraulic control unit for controlling which nozzles are open and which nozzles are closed.

[0010] In addition, the nozzle head may comprise a hydraulic control unit for controlling a supply of fluid to each nozzle.

[0011] In one embodiment, the shaft is hollow for supplying the well fluid to the nozzle head.

[0012] In another embodiment, the flow hindering element is a packer, an inflatable unit, a rubber element or an elastomeric element

[0013] The downhole cleaning system according to the invention may further comprise a stroker being a device providing a stroking reprocicating movement of the nozzle head in relation to the longitudinal direction of the tool, or a piston interacting with a piston housing in which a spring device is arranged for providing a reprocicating movement of the nozzle head in relation to the longitudinal direction of the tool.

[0014] In one embodiment, the tool may comprise anchoring units.

[0015] In another embodiment a filter may be arranged upstream of the inlet or inside the inlet.

[0016] Furthermore, the downhole cleaning system may comprise a downhole driving unit driving the tool and itself in the casing.

[0017] Also, the downhole cleaning system may comprise a measuring device measuring a rotational speed of the nozzle head.

[0018] Additionally, the downhole cleaning system may comprise a control unit to control the measuring de-

vice from surface.

[0019] In one embodiment, the nozzle head may comprise a check valve.

[0020] The present invention also relates to a wireline cleaning tool arranged in a casing downhole and having a longitudinal direction, comprising:

- a rotatable nozzle head having a plurality of nozzles,
- a tool housing having an inlet being in fluid communication with the nozzles for letting well fluid into the tool and out through the nozzles,
- a flow hindering element arranged on an outside of the housing dividing the tool in a first and a second tool part and dividing the casing in a first and a second casing part,
- a rotatable shaft connecting the nozzle head with the housing,

wherein the shaft may be a hollow shaft for supplying the nozzles with well fluid.

[0021] Finally, the invention relates to a cleaning method comprising the steps of entering a wireline cleaning tool of the system according to the invention into a casing, activating the pumping device and pressurising the first casing part, turning the nozzle head and cleaning a casing element by letting well fluid in through the inlet in the pressurised first casing part and out through nozzles in the second casing part.

Brief description of the drawings

[0022] The invention and its many advantages will be described in further 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 downhole cleaning system in a casing,

Fig. 2 shows a partly cross-sectional view along the longitudinal direction of the downhole cleaning system seen from the side,

Fig. 3 shows a partly cross-sectional view of another embodiment of the system,

and

Fig. 4 shows another embodiment of the downhole cleaning system in a casing.

[0023] 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

[0024] Fig. 1 shows a downhole cleaning system 1 for cleaning an element 2, such as a gas lift valve, a sleeve or a side pocket mandrel, in a casing 3 in a wellbore 4 comprising well fluid 5 having a well fluid pressure Pw. The downhole cleaning system 1 comprises the casing 3 and a wireline cleaning tool 10. The wireline cleaning tool 10 has a longitudinal direction 11, and comprises in the end furthest away from the surface a rotatable nozzle head 12 having a plurality of nozzles 13 for cleaning the gas lift valve by jetting high pressurised well fluid towards the valve.

[0025] By having a wireline cleaning tool 10, the cleaning operation can be performed anywhere in the well, also in the more horizontal parts of the well. No landing nipple is required in order to perform a cleaning operation. The system is easy to use, and the cleaning tool easily retrieved from the well by pulling in the wireline.

[0026] The wireline cleaning tool 10 has a tool housing 14 having an inlet 15 for letting well fluid into the tool 10 and the inlet 15 is inside the tool in fluid communication with the nozzles 13. The well fluid travels in through the inlet and out through the nozzle head, illustrated with arrows. The wireline cleaning tool 10 is submerged into the casing 3 in the well and a flow hindering element 16 arranged on an outside 17 of the housing 14 is set or inflated so that it divides the casing 3 in a first 20 and a second casing part 21. This enables that the well fluid in the first casing part 21 can be pressurised from the top of the well by a pumping device 23 and the fluid is forced into the inlets 15 and out through the nozzles in order to clean the casing or elements therein. Thus, the second part of the casing 21 has a substantially lower well fluid pressure so that the high pressurised well fluid in the first part 20 can be ejected as jets in the well fluid in the second part of the casing. In this way, the casing is used as the coiled tubing or drill pipe in order to provide the nozzles with high pressurised fluid; however, the fluid jetted from the nozzles is not a special cleaning fluid but merely the well fluid surrounding the tool. Thus, the environment surrounding the gas lift valve to be cleaned is not interfered.

[0027] As shown in Fig. 1, the wireline cleaning tool 10 is connected with a wireline 41. The tool comprises an electronic section 30, a motor 31, a pump 32 and an anchoring device 33 in a first tool part 18 above the flow hindering element 16. In a second tool part 19 below the flow hindering element 16, the nozzle head 12 is arranged.

[0028] In Fig. 2, the tool 10 is shown having a rotatable shaft 22 connecting the nozzle head 12 with the housing 14. The rotation of the shaft is controlled by a control device 24 in the form of an electrical motor having a gear, a motor brake or a centrifugal brake 25. The shaft 22 is hollow and in fluid communication with the inlet 15 for supplying well fluid to the nozzles 13 of the nozzle head 12. The shaft 22 is connected with the motor control device 24 which controls the rotation of the nozzle head 12

while fluid is jetted out through the nozzles 13. If the nozzle head was not controlled, the well fluid jet stream 43 ejected from the nozzles would loose its effect as fluid ejected through the nozzles would then force the nozzle head to rotate too fast resulting in that the jet stream would be spread along an inner circumference of the casing and not ejected as a straight line in the radially direction of the casing.

[0029] The flow hindering element 16 is shown as a rubber element being squeezed in the longitudinal direction 11 of the tool between two rings 42 forcing the rubber element radially outwards to seal against the casing at a pressure of 3000-5000 PSI. The flow hindering element could also be a packer, an inflatable unit or an elastomeric element. The flow hindering element does not necessarily have to seal against the inner wall of the casing in order to be able to create a pressure difference between the first and upper part of the casing and the second and lower part of the casing.

[0030] The tool 10 is anchored up inside the casing 3 by means of anchoring units 35 so that the nozzle head 12 is arranged outside a target area to be cleaned. The flow hindering element 16 is then inflated or set, and the pumping device 23 pressurising the well fluid in the first and top part of the casing 20 is activated. High pressurised fluid is subsequently jetted as a jet stream out through the nozzles 13 of the nozzle head 12 as the nozzle head turns in a controlled manner so that the jet streams do not loose too much jetting power.

[0031] The nozzle head comprises a hydraulic control unit for controlling which of the nozzles that jet fluid to clean a valve or the like element. The hydraulic control unit controls the openings and closings of the nozzles and/or the supply of fluid to each nozzle. As can be seen in Fig. 1, only two of the nozzles jet fluid into the casing in order to clean an element, such as a valve. In Fig. 2, only one nozzle jets fluid. If a high fluid velocity is needed in order to clean an object, the hydraulic control unit only lets one nozzle jet at a time. However if a high volume of fluid is needed, the hydraulic control unit lets several nozzles jet. Furthermore, the hydraulic control unit has means to control in which angles along the circumference of the nozzle head the nozzles are to jet so that their jet hit against the element to be cleaned.

[0032] In order to reach a larger target area, the tool may have means for moving the nozzle head in a reprocicating movement. In Fig. 2, a piston 26 interacting with a piston housing 27 in which a spring device 28 is arranged provides a reprocicating movement of the nozzle head 12 in relation to the longitudinal direction 11 of the tool 10. In Fig. 3, the tool 10 comprises a stroker 29 being a device providing a stroking reprocicating movement of the nozzle head 12 in relation to the longitudinal direction 11 of the tool 10. The reprocicating movement of the nozzle head 12 is illustrated by a double arrow in Fig. 3.

[0033] The wireline cleaning tool comprises a filter 36 arranged upstream of the inlet 15 or in the inlet. In Fig. 2, the filter 36 or screen surrounds the part of the tool 10 having the inlet 15. The tool 10 comprises several inlets all in fluid communication with the hollow shaft. The hollow shaft may be internally sectionised having an internal frame structure to strengthen the shaft.

[0034] As shown in Fig. 4, the downhole cleaning system 1 may further comprise a downhole driving unit 37 driving the tool 10 and itself forward in the casing 3. The driving unit 37 has wheels on arms and can be used as the anchoring device in order to set the packer. The downhole cleaning system 1 may also comprise a measuring device 38 measuring a rotational speed of the nozzle head 12. As shown in Fig. 4, the measuring device 38 may be arranged in the motor control device 24 around the shaft 22 so that the nozzle head is controlled to rotate at a speed lower than 30 RPM, preferably lower than 25 RPM and more preferably lower than 20 RPM. The control device 24 may be controlled from above surface by means of a control unit 39 shown in Fig. 4.

[0035] Before and after the cleaning operation, a logging unit of the cleaning tool can investigate the casing to see which part or element of the casing needs to be cleaned and if the element to be cleaned is properly cleaned.

[0036] The nozzle head 12 may further comprise a check valve 40 in an end opposite the end connected with the shaft 22.

[0037] The tool 10 may comprise a chamber with a cleaning fluid which is mixed with the well fluid before being jetted out through the nozzles 13.

[0038] By fluid or well fluid is meant any kind of fluid which 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.

[0039] By high pressurised fluid is meant fluid flowing at a volume flow rate of at least 250 L/min, preferably at least 300 L/min and even more preferably 350 L/min.

[0040] By a casing is meant any kind of pipe, tubing, tubular, liner, string etc. used downhole in relation to oil or natural gas production.

[0041] In the event that the system is not submerged all the way into the casing, a downhole tractor can be used to push the system 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®.

[0042] 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 cleaning system (1) for cleaning an element (2) inside a casing (3) in a wellbore (4) comprising well fluid (5) having a wellbore pressure (Pw), comprising:

    - the casing,
    - a wireline cleaning tool (10) having a longitudinal direction (11) and comprising:
    - a rotatable nozzle head (12) having a plurality of nozzles (13),
    - a tool housing (14) having an inlet (15) being in fluid communication with the nozzles for letting well fluid into the tool,
    - a flow hindering element (16) arranged on an outside (17) of the housing dividing the tool in a first (18) and a second tool part (19) and dividing the casing in a first (20) and a second casing part (21),
    - a rotatable shaft (22) connecting the nozzle head with the housing,

    wherein the system further comprises a pumping device (23) for pressurising the well fluid in the first part of casing to a pressure substantially above the wellbore pressure and above a pressure in the second part of the casing so that well fluid is pumped in through the inlet and out through the nozzles.

2. A downhole cleaning system according to claim 1, further comprising a control device (24) to control the rotation of the shaft and the nozzle head.

3. A downhole cleaning system according to claim 1 or 2, wherein the control device is an electrical motor for rotating the shaft.

4. A downhole cleaning system according to claim 2 or 3, wherein the control means comprises a gear, a motor brake or a centrifugal brake (25).

5. A downhole cleaning system according to any of the preceding claims, wherein the shaft is hollow for supplying the well fluid to the nozzle head.

6. A downhole cleaning system according to claim 5, wherein the flow hindering element is a packer, an inflatable unit, a rubber element or an elastomeric element

7. A downhole cleaning system according to any of the preceding claims, further comprising a stroker (29) being a device providing a stroking reprocicating movement of the nozzle head in relation to the longitudinal direction of the tool, or a piston (26) interacting with a piston housing (27) in which a spring device (28) is arranged for providing a reprocicating movement of the nozzle head in relation to the longitudinal direction of the tool.

8. A downhole cleaning system according to any of the preceding claims, wherein the tool comprises anchoring units (35).

9. A downhole cleaning system according to any of the preceding claims, wherein a filter (36) is arranged upstream of the inlet or inside the inlet.

10. A downhole cleaning system according to any of the preceding claims, further comprising a downhole driving unit (37) driving the tool and itself in the casing.

11. A downhole cleaning system according to any of the preceding claims, further comprising a measuring device (38) measuring a rotational speed of the nozzle head.

12. A downhole cleaning system according to claim 11, further comprising a control unit (39) to control the measuring device from surface.

13. A downhole cleaning system according to claim 12, wherein the nozzle head comprises a check valve (40).

14. A wireline cleaning tool arranged in a casing downhole and having a longitudinal direction, comprising:

    - a rotatable nozzle head having a plurality of nozzles,
    - a tool housing having an inlet being in fluid communication with the nozzles for letting well fluid into the tool and out through the nozzles,
    - a flow hindering element arranged on an outside of the housing dividing the tool in a first and a second tool part and dividing the casing in a first and a second casing part,
    - a rotatable shaft connecting the nozzle head with the housing,

    wherein the shaft is a hollow shaft for supplying the nozzles with well fluid.

15. A cleaning method comprising the steps of:

    - entering a wireline cleaning tool of the system according to any of claims 1-13 into a casing,
    - activating the pumping device and pressurising the first casing part,
    - turning the nozzle head,
    - cleaning a casing element by letting well fluid in through the inlet in the pressurised first casing part and out through nozzles in the second casing part.

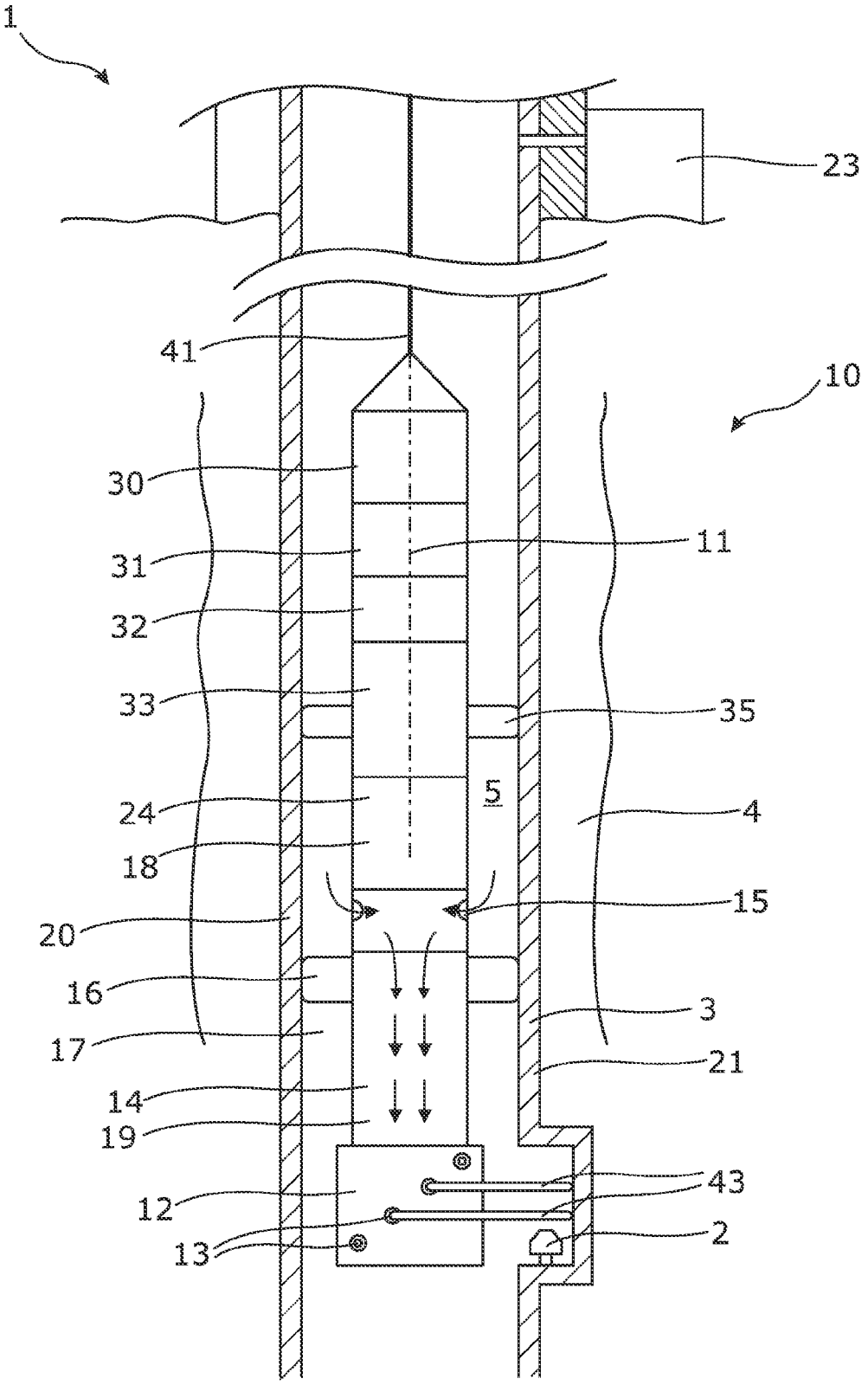

Fig. 1

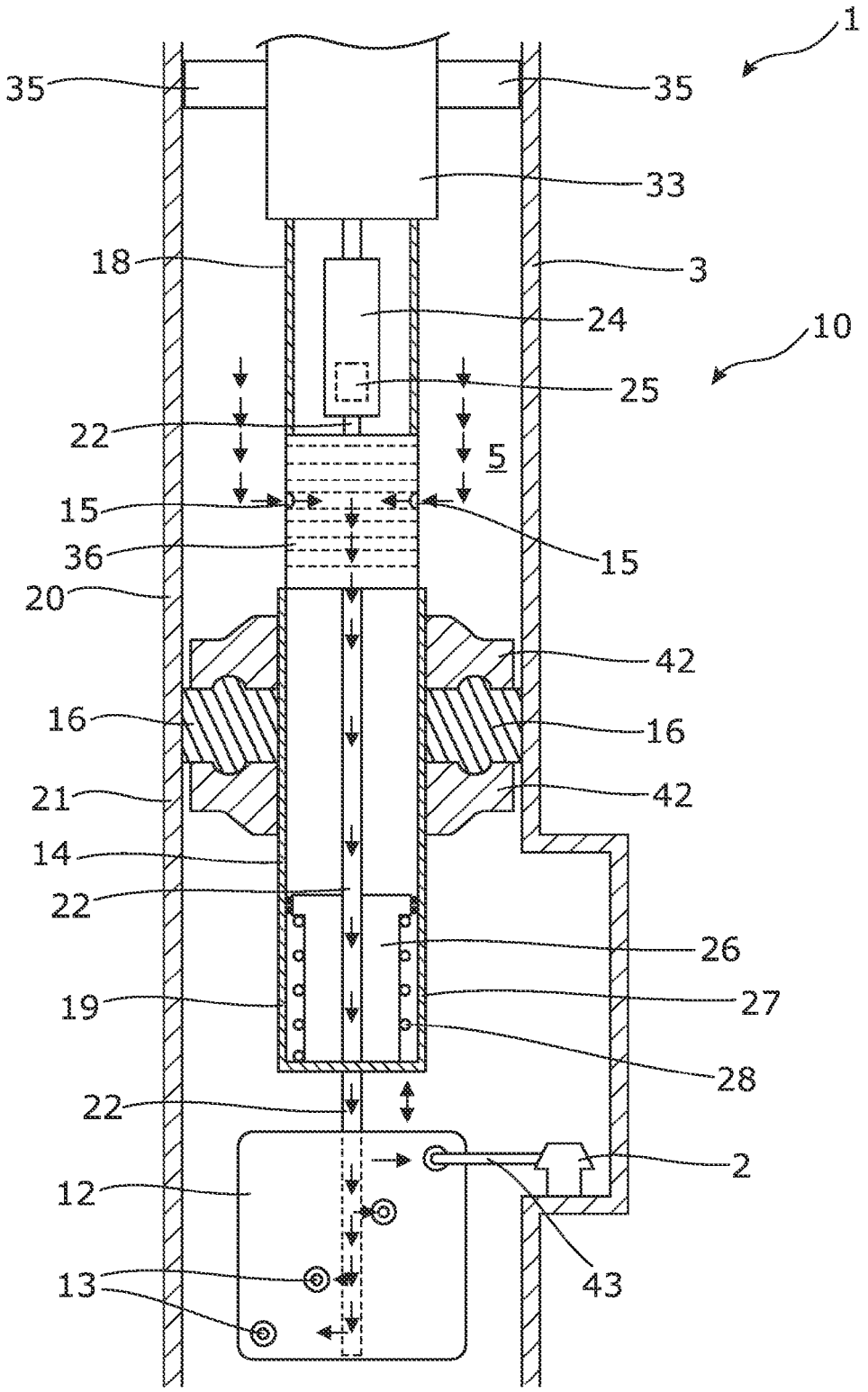
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Fig. 2

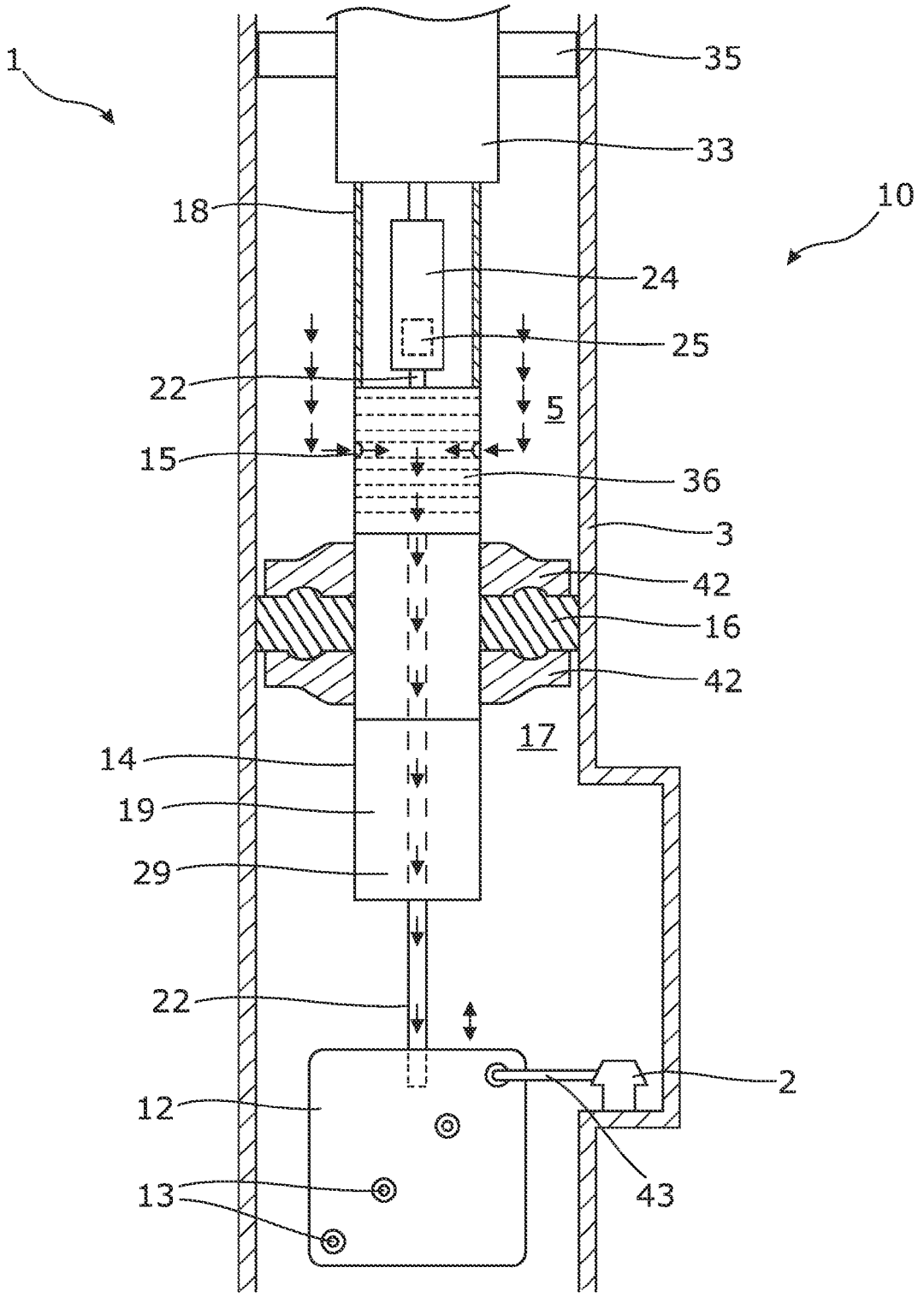

Fig. 3

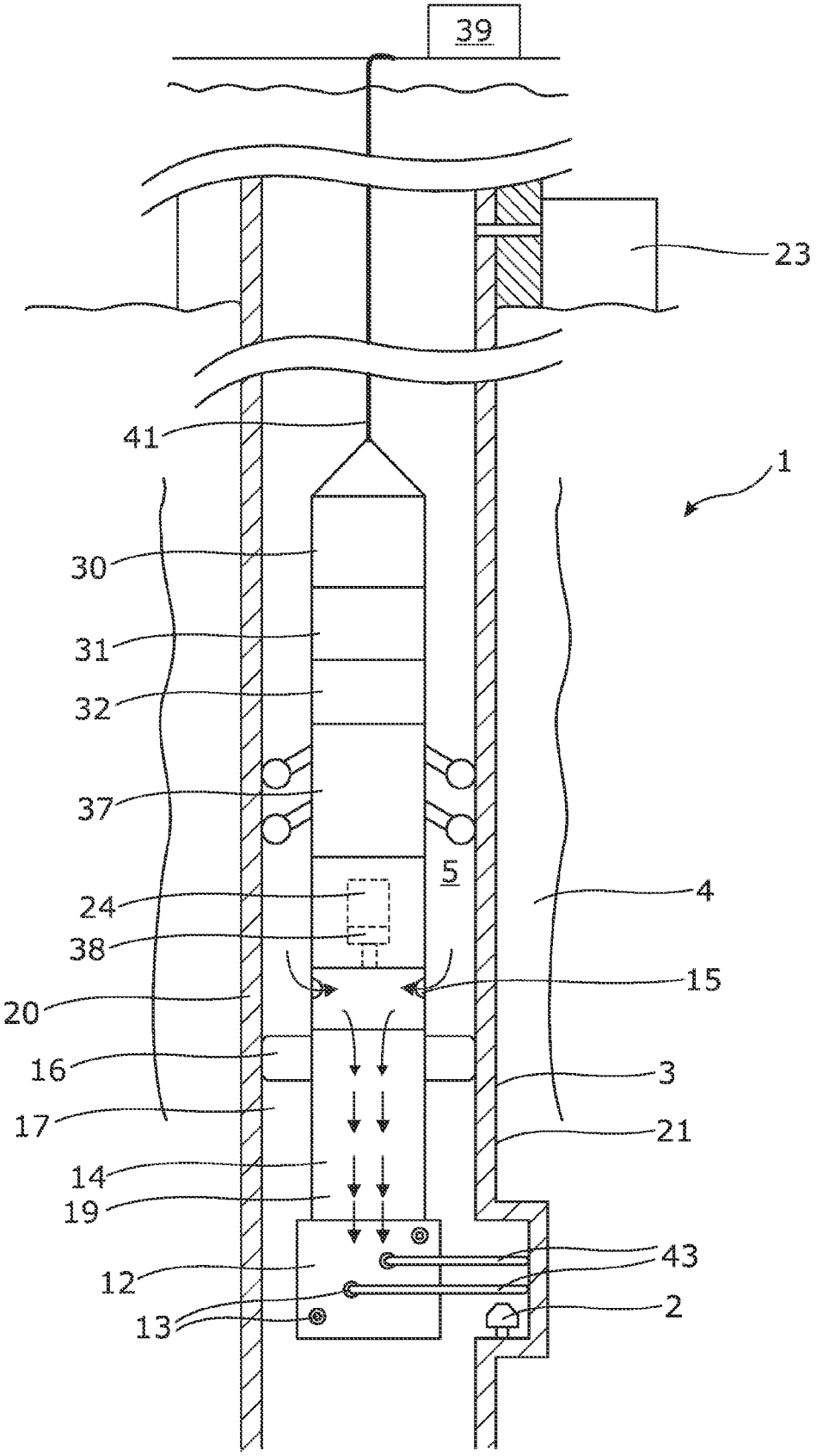

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 4021

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 Y	US 2010/032154 A1 (GILLAN PETER [GB]) 11 February 2010 (2010-02-11) * paragraphs [0019] - [0024], [0033] - [0035], [0041]; claims 12,13; figures 1,2,3a-3c,5 * * the whole document *	1-6,8-15 7	INV. E21B37/00 E21B41/00
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 October 2011	van Berlo, André

CATEGORY OF CITED DOCUMENTS

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