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VASQUES

(54) **A GAS LIFT SYSTEM AND A GAS LIFT METHOD**

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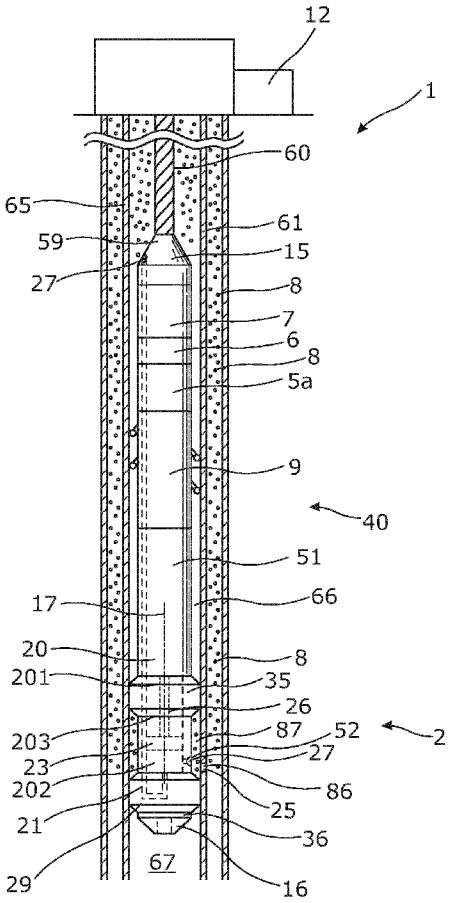
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(57) **ABSTRACT**

The present invention relates to a gas lift system (**1**) arranged in a well (**65**) having a top (**10**) and comprising a well fluid (**11**), the gas lift system comprising a casing (**61**) arranged in the borehole defining a surrounding annulus (**62**), an opening (**86**) in the casing, and a pumping unit (**12**) for pumping gas (**8**) into the annulus, wherein the gas lift system further comprises a downhole tool (**14**) having a first end (**15**) nearest the top of the well and a second end (**16**), the down-hole tool comprising a pump section (**2**) comprising a housing (**20**) comprising a chamber (**201**) having an axial extension (**17**), a plunger (**23**) sliding in the chamber and dividing the chamber into a first compartment (**203**) and a second compartment (**202**), a plunger rod (**26**) connected with the plunger, a chamber inlet channel (**27**) and a chamber outlet channel (**21**), the inlet channel and the outlet channel being in fluid communication with the second compartment, a sealing element (**29**) for isolating a first part (**66**) of the casing from a second part (**67**) of the casing, the first part and the inlet channel being in fluid communication with the opening, a one-way valve (**24**) arranged in the inlet channel to allow fluid to flow into the chamber, and a one-way valve (**22**) arranged in the outlet channel to allow fluid to flow out of the chamber. The invention also relates to a gas lift method.



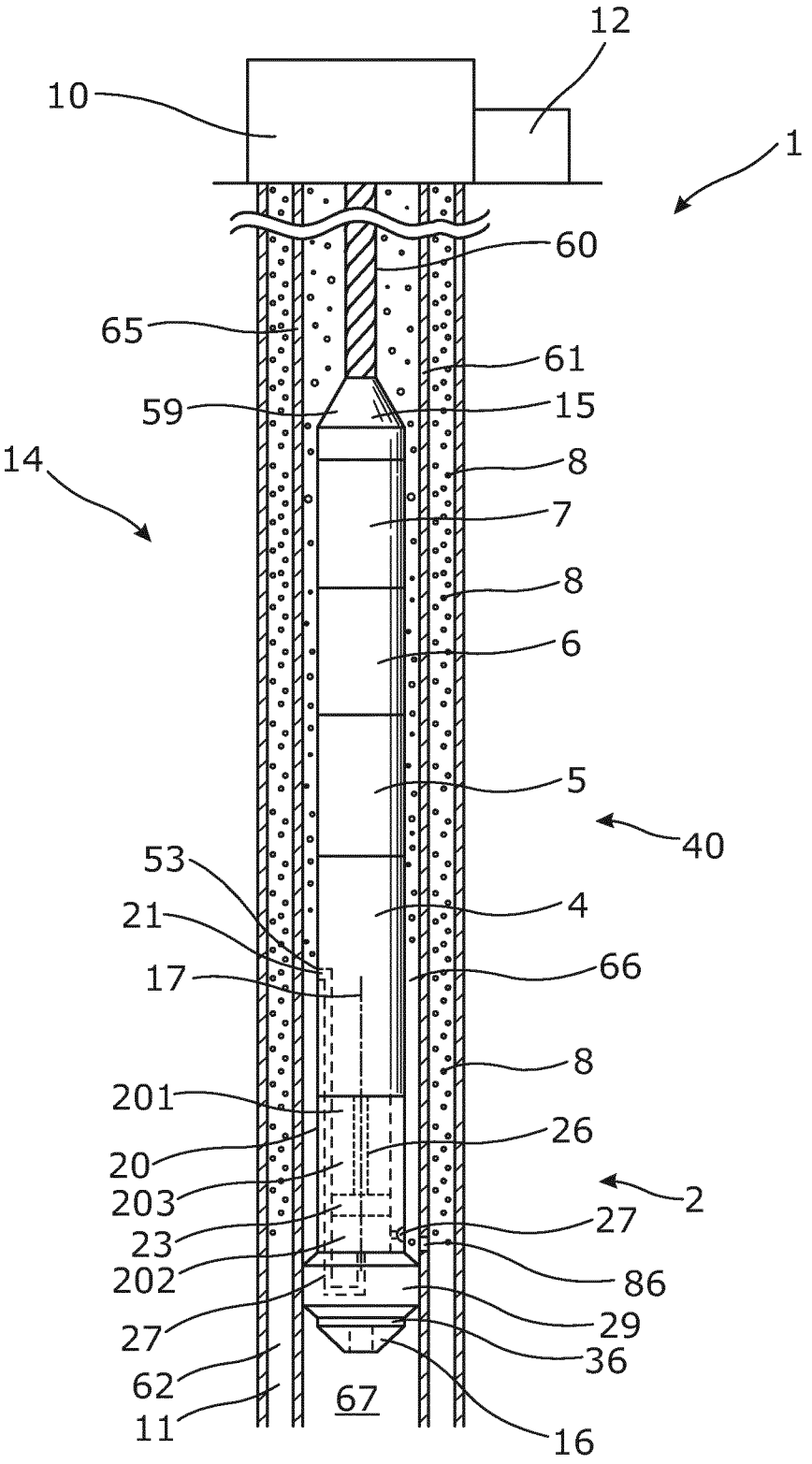

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Fig. 1

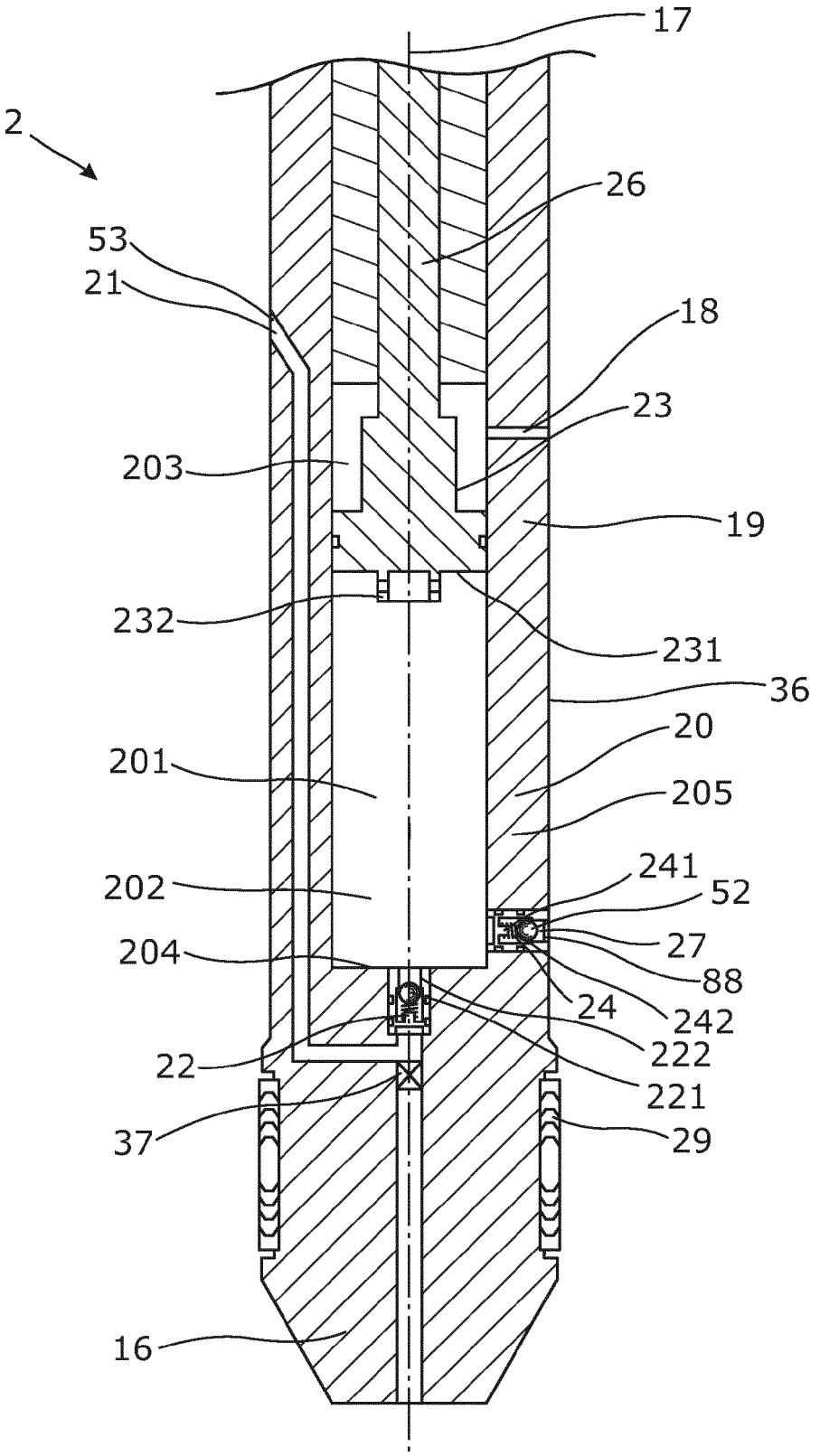

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Fig. 2

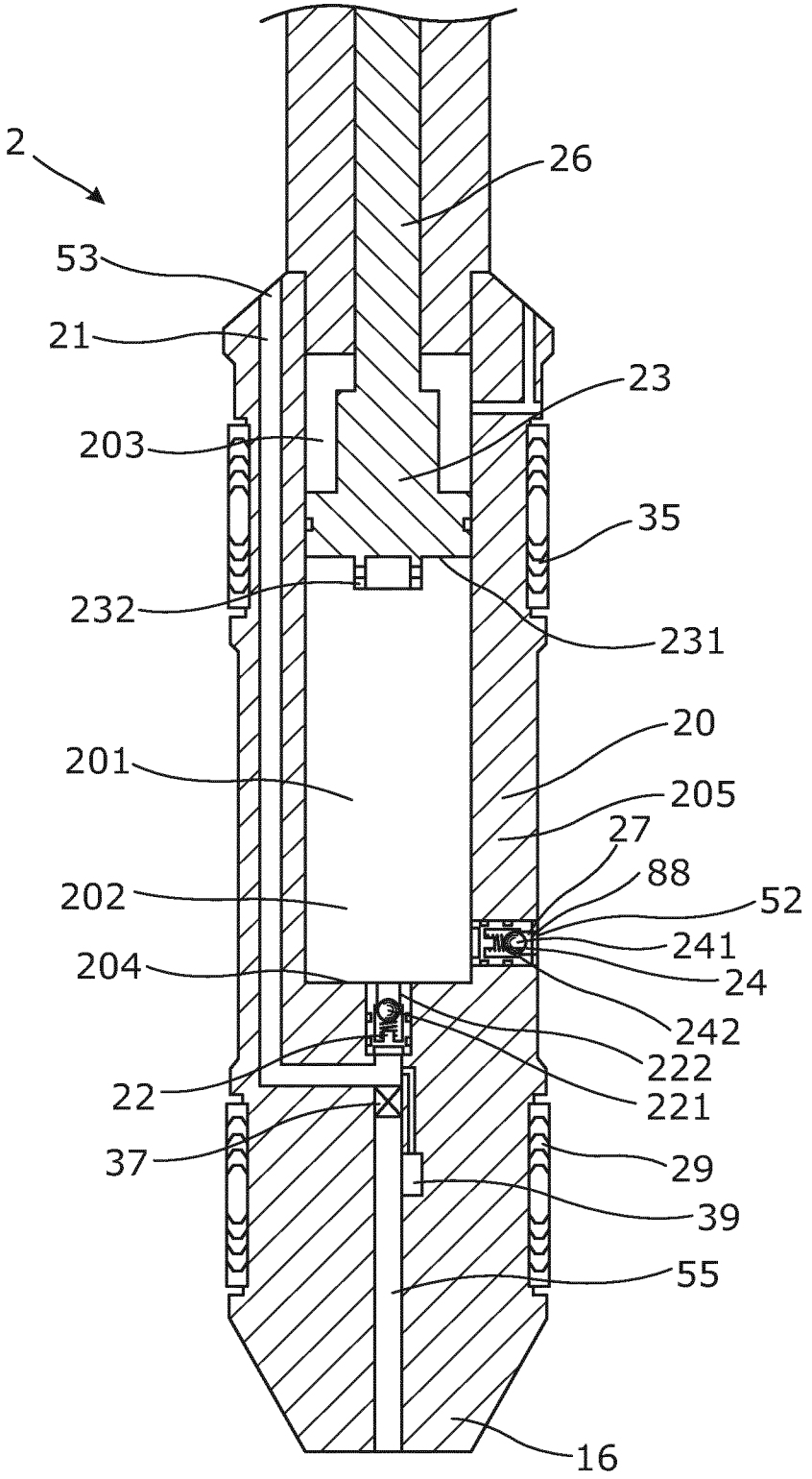

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Fig. 3

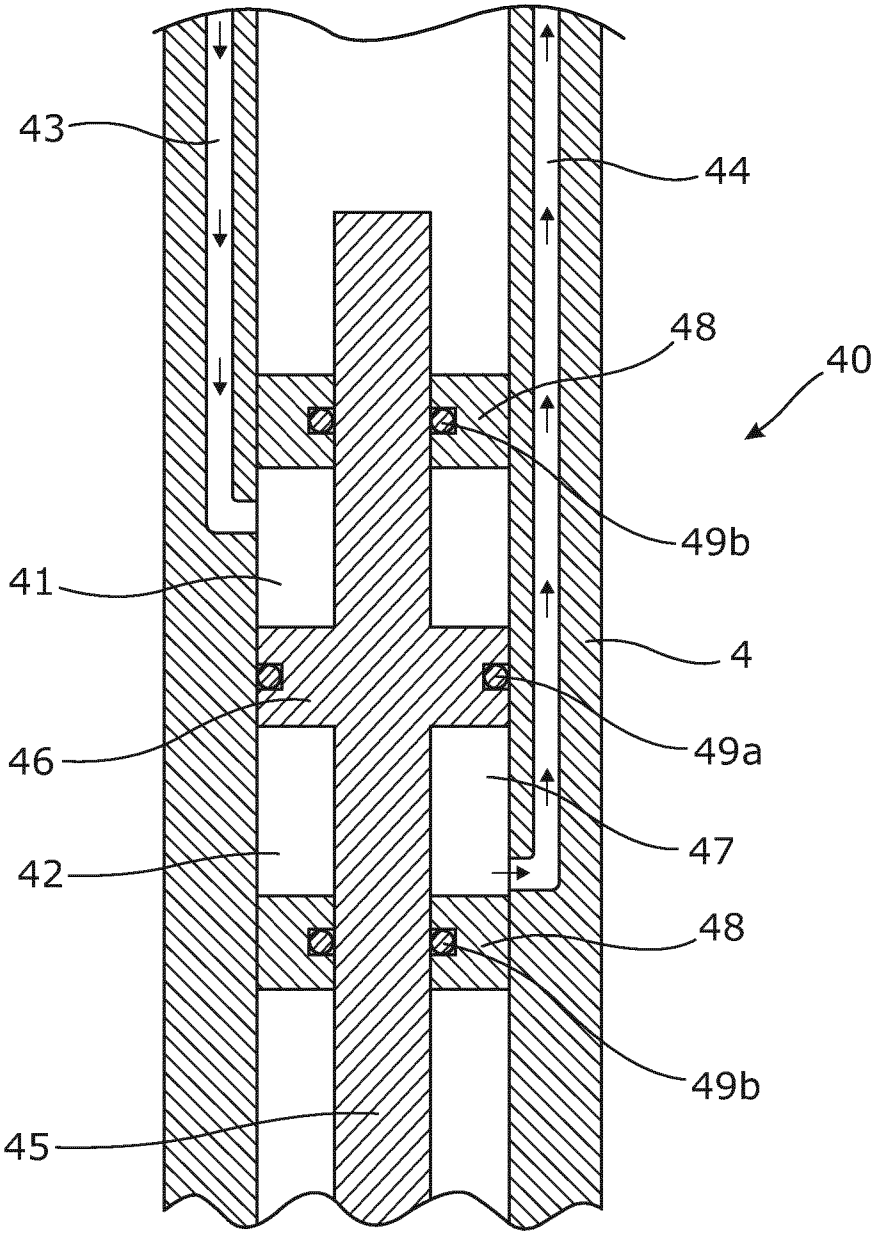


Fig. 4

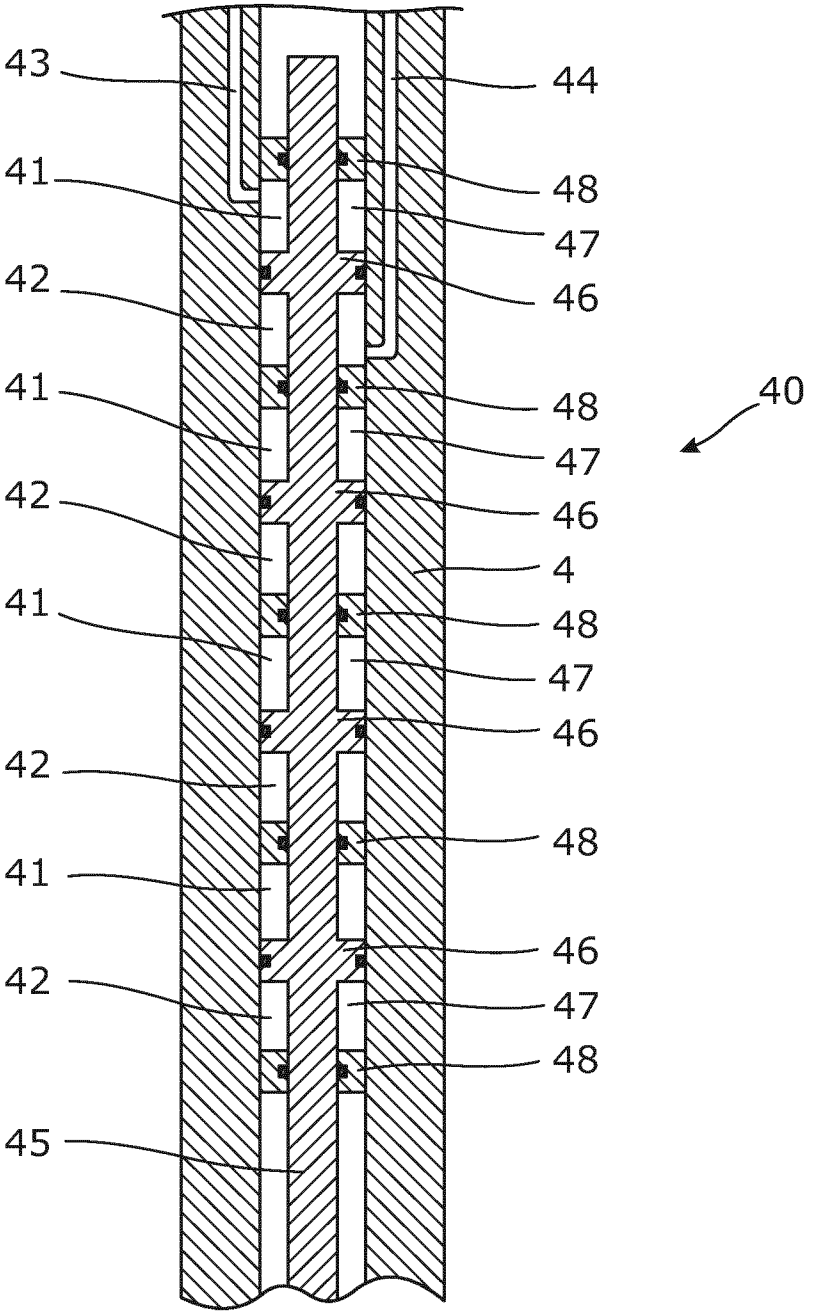

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Fig. 5

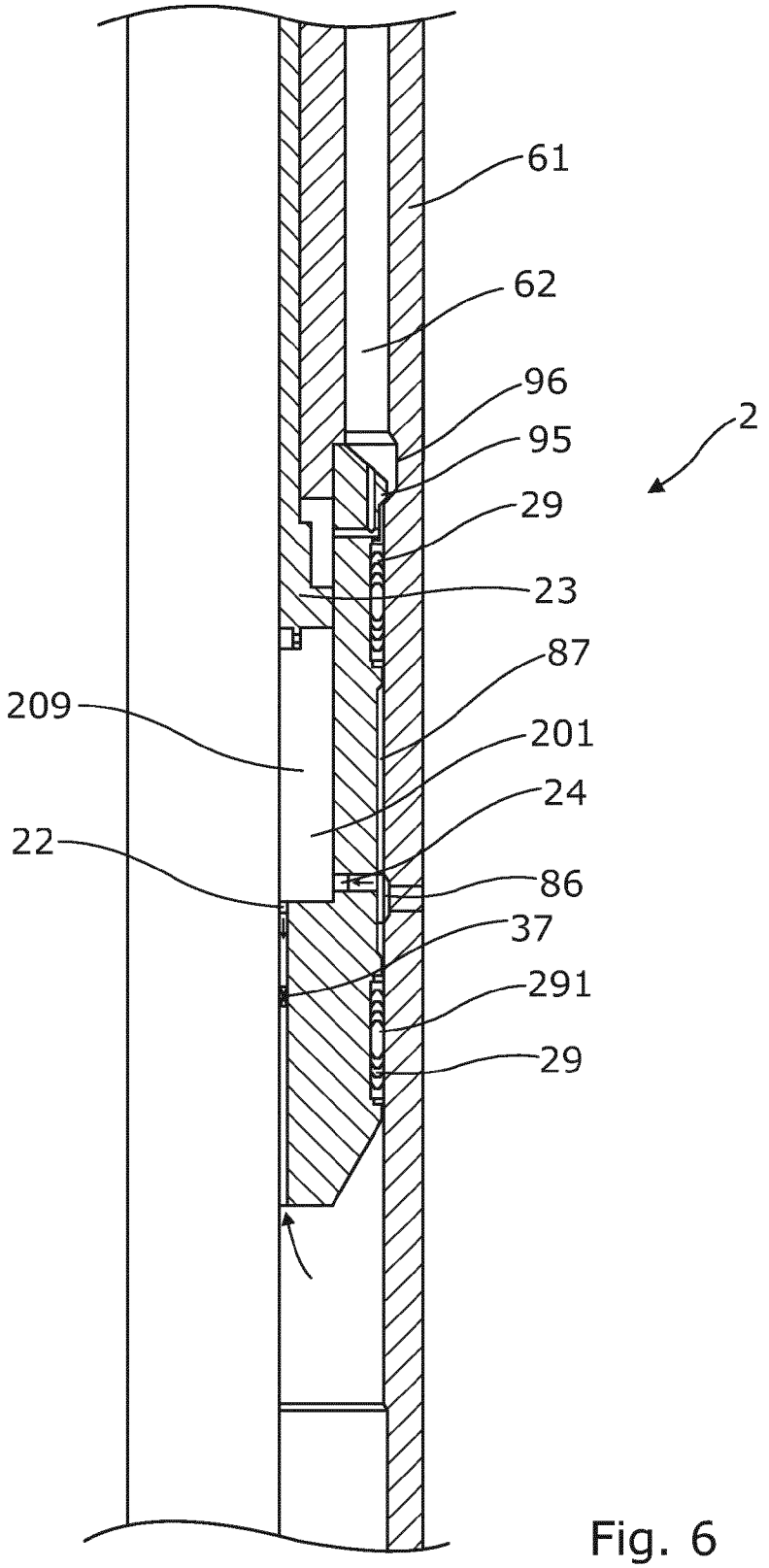


Fig. 6

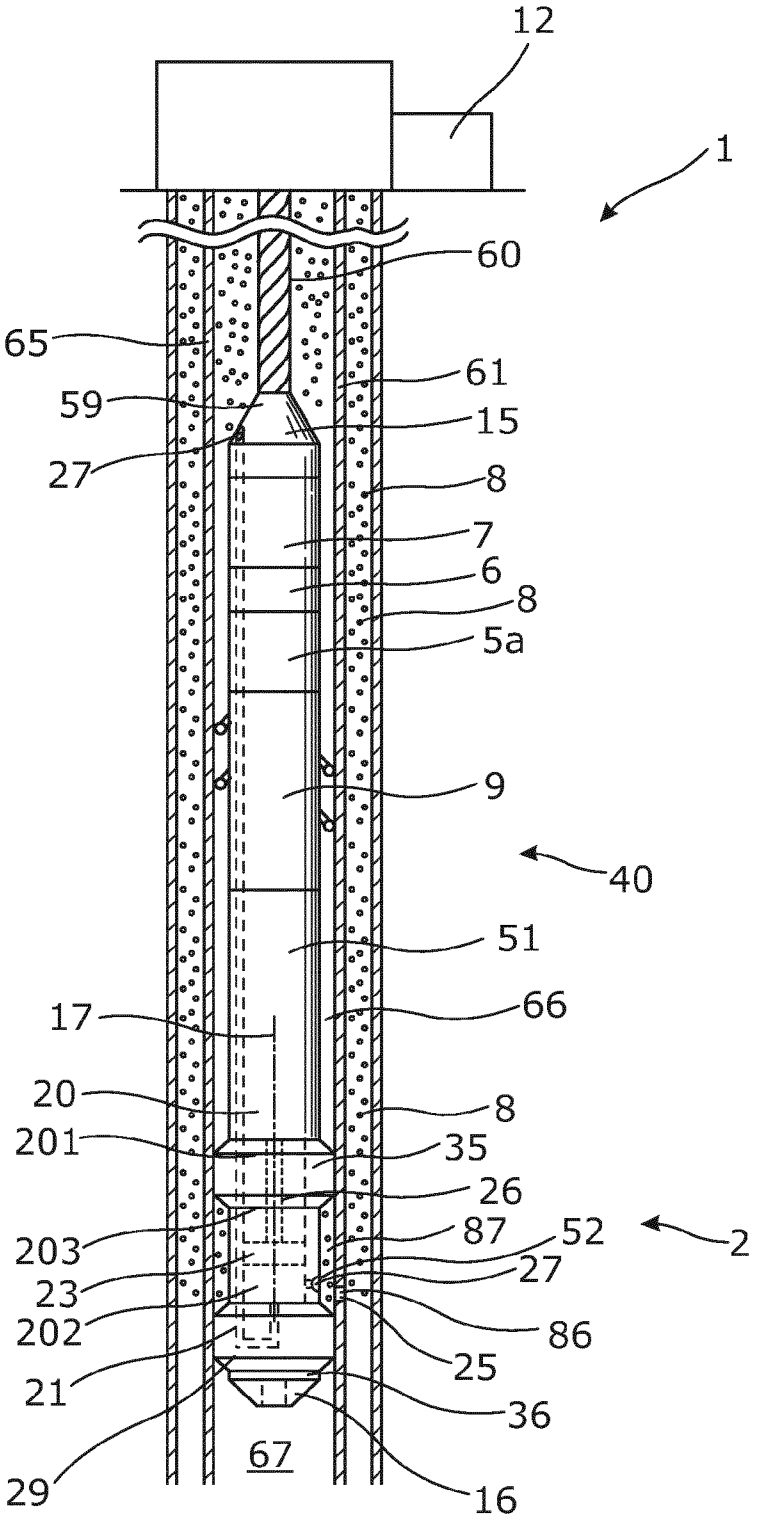

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Fig. 7

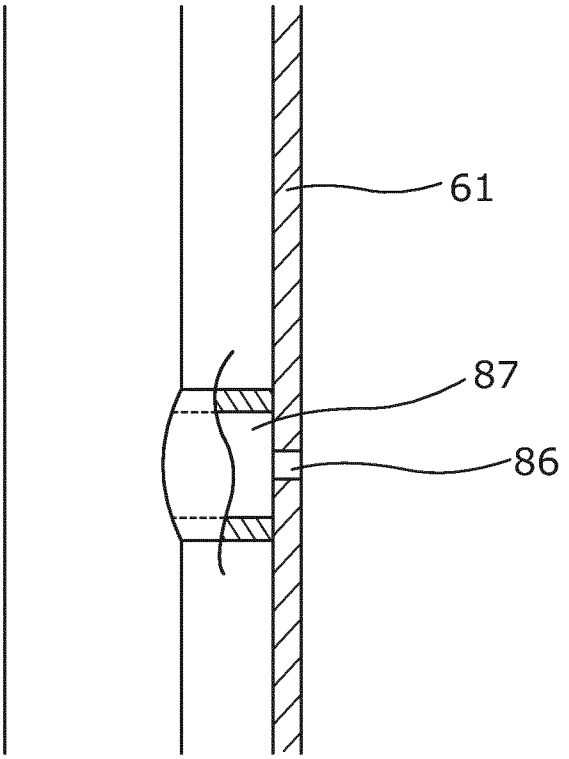


Fig. 8

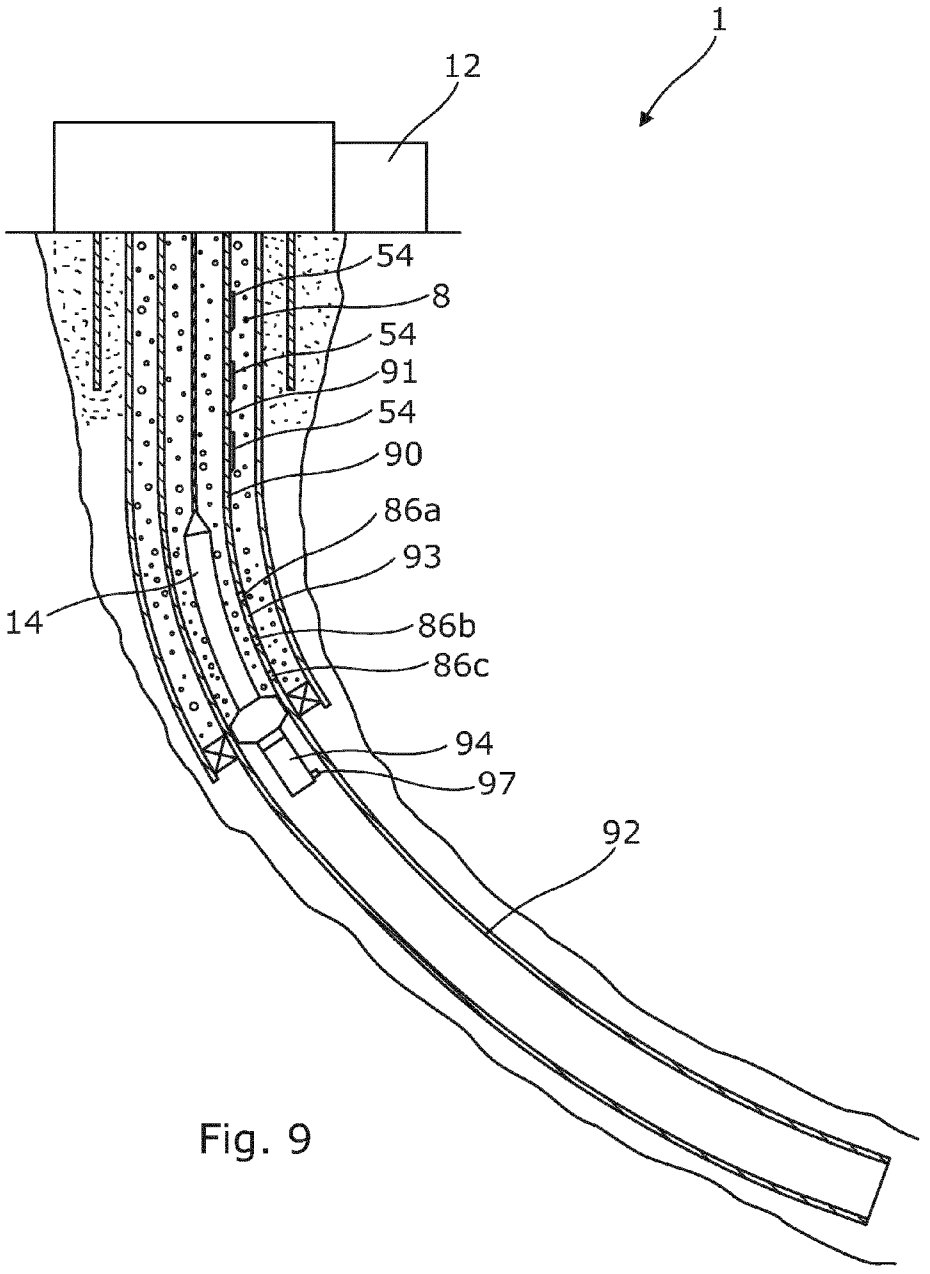


Fig. 9

A GAS LIFT SYSTEM AND A GAS LIFT METHOD

FIELD OF THE INVENTION

[0001] The present invention relates to a gas lift system arranged in a well having a top and comprising a well fluid, the gas lift system comprising a casing arranged in the borehole defining a surrounding annulus, an opening in the casing, and a pumping unit for pumping gas into the annulus. The invention also relates to a gas lift method.

BACKGROUND ART

[0002] Gas lifting of the fluid column in a well to overcome a hydro-static pressure and drive hydrocarbons to surface is typically performed by means of side pockets arranged as part of the production casing. The annulus created between the production casing and the intermediate casing is pressurised with gas which, at certain pressures, is allowed to flow in through a certain side pocket gas lift valve. Pressurised gas is able to flow down the annulus until a certain point, at which point the last side pocket is normally arranged. At present, it is impossible to pressurise the gas to flow past this point.

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 gas lift system which is able to provide gas lift further down the well beyond the point which can be reached by known systems having side pocket gas lift valves.

[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 gas lift system arranged in a well having a top and comprising a well fluid, the gas lift system comprising:

[0005] a casing arranged in the borehole defining a surrounding annulus,

[0006] an opening in the casing, and

[0007] a pumping unit for pumping gas into the annulus, wherein the gas lift system further comprises a downhole tool having a first end nearest the top of the well and a second end, the downhole tool comprising a pump section comprising:

[0008] a housing comprising a chamber having an axial extension,

[0009] a plunger sliding in the chamber and dividing the chamber into a first compartment and a second compartment,

[0010] a plunger rod connected with the plunger,

[0011] a chamber inlet channel and a chamber outlet channel, the inlet channel and the outlet channel being in fluid communication with the second compartment,

[0012] a sealing element for isolating a first part of the casing from a second part of the casing, the first part and the inlet channel being in fluid communication with the opening,

[0013] a one-way valve arranged in the inlet channel to allow fluid to flow into the chamber, and

[0014] a one-way valve arranged in the outlet channel to allow fluid to flow out of the chamber.

[0015] By having a suction tool within the casing, the gas can enter further down the well, and the system is thus capable of providing gas lift on more fluid than in the known systems. The present system is thus capable of providing gas lift of wells which cannot be gas lifted by the known systems.

[0016] Furthermore, the downhole system may also be submerged into deep water wells to decrease the pressure in these wells so that hydrate does not form in the well head or blow-out preventer. Hydrate is formed when having low temperature and high pressure and a certain amount of water in the well fluid.

[0017] Also, at least part of the inlet channel may extend radially from an outer surface of the housing towards the chamber.

[0018] Moreover, the plunger may comprise a protrusion protruding from a first plunger face of the plunger facing the inlet channel and/or the outlet channel.

[0019] The protrusion may be arranged, extending from an end face of the chamber nearest the second end of the tool.

[0020] In addition, the sealing element may be an annular seal for sealing around the opening.

[0021] Furthermore, a one-way valve may be arranged in the opening to allow fluid to flow into the casing.

[0022] The sealing element may also circumferent the housing and may be adapted for sealing against the casing.

[0023] The gas lift system according to the invention may further comprise a second sealing element circumferenting the housing and adapted for sealing against the casing, thereby isolating a part of the first part of the casing opposite the opening.

[0024] Moreover, an inlet of the inlet channel may be arranged substantially opposite the opening along the axial extension.

[0025] Additionally, the inlet of the inlet channel may be arranged substantially opposite the opening along a circumference of the housing.

[0026] Further, an outlet of the outlet channel may be arranged closer to the first end of the tool than the inlet channel.

[0027] In addition, an outlet of the outlet channel may be arranged closer to the first end of the tool than the inlet.

[0028] The gas lift system according to any of the invention may further comprise a linear actuator for providing a reciprocating movement of the plunger.

[0029] The linear actuator described above may comprise:

[0030] a tubular stroker cylinder comprising one or more piston housings,

[0031] one or more piston elements slidably disposed in the piston housing to divide the piston housing into a first chamber and a second chamber,

[0032] a stroker shaft operably connected to the piston element for connecting with a plunger rod to provide reciprocation of the plunger,

[0033] a pump for alternately supplying hydraulic fluid under pressure to the first chamber and the second chamber of the piston housing to reciprocate the piston element in the piston housing, and

[0034] an electrical motor for driving the pump.

[0035] Furthermore, the sealing element may be a chevron seal.

[0036] Also, the first end of the tool may be connected with a wireline.

[0037] Moreover, the opening may comprise two successive one-way valves.

[0038] The casing may also comprise a plurality of openings spaced apart along the casing.

[0039] Additionally, the sealing element may be inflatable or expandable.

[0040] The tool may comprise a driving unit for propelling the tool forward in the well.

[0041] In addition, the tool may comprise a tool section comprising a drilling bit for drilling or milling an opening in the casing.

[0042] Further, the casing may comprise at least one side pocket, and the side pocket may be arranged closer to the top than the opening.

[0043] The casing may have a substantially vertical part and a substantially horizontal part and a toe part connecting the vertical part and the horizontal part, and the opening may be arranged in the toe part or the horizontal part.

[0044] A bore may extend from the second end of the tool to an equalising valve arranged in the outlet channel to connect the bore and part of the outlet channel.

[0045] The present invention also relates to a gas lift method comprising the following steps:

[0046] inserting the gas lift system according to any of the preceding claims into the borehole,

[0047] arranging the inlet channel opposite the opening,

[0048] isolating the first part of the casing from the second part of the casing by means of a sealing element, so that the first part is in fluid communication with the opening and the inlet channel is in fluid communication with the opening,

[0049] activating the pump unit to pump gas into the annulus,

[0050] moving the plunger rod in a reciprocating movement, and

[0051] sucking fluid from the first part of the casing, so that the gas in the fluid in the annulus is sucked towards the opening and into the first part and further into the first compartment and out through the outlet channel.

[0052] The gas lift method described above may further comprise the step of isolating a part of the first part of the casing opposite the opening to create a suction area between the casing and the tool opposite the opening.

[0053] The method may further comprise the step of making the opening in the casing.

[0054] Further, the gas lift method may further comprise the step of drilling an opening in the casing.

[0055] Also, the method may comprise the step of releasing the tool from the casing.

[0056] Moreover, the method may comprise the step of making a second opening in the casing.

[0057] Additionally, the method may comprise the step of moving the tool further away from the top of the well to be opposite a second opening and engaging the casing by means of the sealing element.

[0058] Finally, the method may comprise the step of sucking fluid in through the second opening.

BRIEF DESCRIPTION OF THE DRAWINGS

[0059] 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

[0060] FIG. **1** shows a perspective view of a gas lift system in a well,

[0061] FIG. **2** shows a cross-sectional view of part of a tool,

[0062] FIG. **3** shows a cross-sectional view of part of another tool,

[0063] FIG. **4** shows a cross-sectional view of part of a linear actuator,

[0064] FIG. **5** shows a cross-sectional view of part of another linear actuator,

[0065] FIG. **6** shows a partly cross-sectional view of another tool,

[0066] FIG. **7** shows a perspective view of another gas lift system in a well,

[0067] FIG. **8** shows a partly cross-sectional view of part of the gas lift system, and

[0068] FIG. **9** shows another gas lift system arranged in a well.

[0069] 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

[0070] FIG. **1** shows a gas lift system **1** arranged in a well **65** for providing gas lift of well fluid to overcome a hydro-static pressure and drive hydrocarbon-containing fluid, such as oil, to surface at a top **10** of the well. The gas lift system comprises a casing **61** arranged in the well defining a surrounding annulus **62** and further comprises a pumping unit **12** arranged at the top, e.g. near the well head or blowout preventer, for pumping gas **8** into the annulus. The gas lift system further comprises a downhole tool **14** having a first end **15** nearest the top of the well and a second end **16** arranged near an opening **86** in the casing **61**. The downhole tool comprises a housing **20** in which a pump section **2** is arranged. The pump section comprises a chamber **201** having an axial extension **17**. The tool further comprises a plunger **23** sliding in the chamber and dividing the chamber into a first compartment **203** and a second compartment **202**. The plunger is connected with a plunger rod **26** and is moved in a reciprocating motion for suction of fluid in through the opening **86**. The chamber has a chamber inlet channel **27** and a chamber outlet channel **21**, the inlet channel and the outlet channel both being in fluid communication with the second compartment. A sealing element **29** is arranged to isolate a first part **66** of the casing from a second part **67** of the casing, the first part and the inlet channel being in fluid communication with the opening **86** in the casing for letting gas from the annulus into the fluid in the casing.

[0071] When using the gas lift system shown in FIG. **1**, in which a suction tool **14** in the form of the downhole tool having the pump section is arranged within the casing, the gas can enter further down the well than in known systems, simply by using gas lift through side pockets, and the system is thus capable of providing gas lift further down the well than in the known systems, and more fluid may thus be lifted so that the well can be self-producing again. The present system is thus able to gas lift wells which cannot be gas lifted by the known systems in order to produce again.

[0072] Furthermore, the downhole system can also be submerged into deep water wells to decrease the pressure in these wells so that hydrate does not form in the well head or blowout preventer. Hydrate is formed when having low temperature and high pressure and a certain amount of water in the well fluid.

[0073] As shown in FIG. **2**, a one-way valve **24** is arranged in the inlet channel **27** to allow fluid to flow into the chamber, and a one-way valve **22** is arranged in the outlet channel to allow fluid to flow out of the chamber. Thus, by moving the

plunger in a reciprocating movement, fluid is sucked in through the inlet channel and ejected through the outlet channel. In this way, gas-containing fluid in the annulus is sucked into the first part of the casing and provides gas lift of the well fluid in the casing to overcome the hydro-static pressure and drive the hydrocarbons to surface.

[0074] Due to the fact that in known pumping systems, gas can only be pumped to a certain point down the annulus, gas lift can only be provided down to this point, which in some wells results in the well not being capable of producing again. By inserting a tool opposite the opening arranged further down the well than the certain point, the tool aids the gas-containing fluid in the annulus further down beyond the certain point by sucking fluid into the chamber just opposite the opening. It is thus possible to provide gas lift further beyond the certain point, which is needed when the known gas lift systems are not able to overcome the hydro-static pressure and drive the hydrocarbons to surface through side pocket gas lift mandrels. Furthermore, by inserting the tool into the casing opposite the opening, side pocket gas lift mandrels are no longer needed in order to provide gas lift. When having side pockets installed in the casing, the platform at the sea bed or surface has to be made sufficiently larger, because the cross-sectional diameter of the casing at the side pockets is substantially increased. The making of such platforms with side pockets is substantially more costly than casings without the side pockets. Therefore, the present gas lift system also results in wells no longer having to be made with side pockets initially, and thus the costs involved in completing a well are substantially reduced.

[0075] As shown in FIG. **2**, the inlet channel extends radially from an outer surface **36** of the housing towards the chamber. The inlet channel may have a radial extending part and an axial extending part, so that fluid enters radially and is then let axially into an outlet of the inlet channel arranged in an end face of the chamber. The plunger comprises a ring-shaped protrusion **232** protruding from a first plunger face **231** of the plunger facing the inlet channel and/or the outlet channel. The protrusion may have any kind of cross-sectional shape and may also be arranged extending from an end face **204** of the chamber nearest the second end of the tool. The protrusion ensures a certain minimum distance between the plunger face and the end face of the pump chamber, thereby preventing the plunger from blocking the outlet provided in the wall of the pump housing. Furthermore, a strainer element **88** may be provided for filtrating well fluid before such well fluid enters the chamber or the inlet. For illustrative purposes, the strainer element **88** is shown to be arranged at an inlet **52** of the inlet channel **27**.

[0076] The pump section shown in FIGS. **3** and **7** further comprises a second sealing element **35** circumferenting the housing and adapted for sealing against the casing, thereby isolating a part of the first part of the casing opposite the opening. Thus, the sealing elements **29**, **35** are disposed around the housing on opposite sides of the inlet **52**. The sealing elements are configured to provide a seal between the tool and the casing, thereby sealing off a section **87** of the casing as shown in FIGS. **6** and **7**. Thus, the gas-containing fluid from the annulus is drawn in through the chamber in the tool and out through the outlet **53** closer to the first end **15** of the tool as shown in FIG. **1**.

[0077] The tool **14** further comprises a linear actuator **40** arranged in association with the housing **20**, as shown in FIG. **1**. As shown in FIG. **4**, the linear actuator **40** comprises a tubular stroker cylinder **4** defining a piston housing **47** and a piston element **46** slidably disposed in the piston housing to divide the piston housing into a first chamber **41** and a second chamber **42**. A stroker shaft **45** extending from the piston element is operably connected with the plunger rod of the pump section to provide reciprocation of the plunger in the chamber. The linear actuator further comprises a pump **5** (shown in FIG. **1**) for alternately supplying hydraulic fluid under pressure to the first chamber **41** and the second chamber **42** of the tubular stroker cylinder, and an electrical motor **6** (shown in FIG. **1**) is provided for driving the pump. When fluid is alternately supplied to the first chamber **41** and a second chamber **42**, the piston element is reciprocated in the tubular stroker cylinder, thereby creating a linear motion. The linear motion is transferred via the stroker shaft to the plunger rod **26** (shown in FIGS. **2** and **3**), thereby reciprocating the plunger in the chamber, causing a pumping or sucking effect to be created.

[0078] Referring to the embodiment of a pump section **2** shown in FIG. **2**, when the plunger is reciprocated, well fluid with gas is drawn into the pump chamber **201** through the inlet channel **27** in the lower part of the chamber, forced through the one-way valve **24**, and expelled through the outlet channel **21**, also in the lower part of the chamber. More specifically, during an upstroke motion, the plunger moves away from the inlet channel **27** and the one-way valve **24**, resulting in well fluid opposite the opening being sucked in through the inlet channel **27**, past the open one-way valve **24** and into the second compartment **202** of the chamber. The one-way valve in the inlet channel **27** is a check-valve only allowing fluid to flow into the chamber, and the one-way valve in the outlet channel is closed, since fluid is only allowed to flow out of the one-way valve in the outlet channel **21**. Thus, as the plunger **23** reaches an upper extreme position, the second compartment **202** of the chamber has been flooded and the first compartment almost emptied. Fluid in the first compartment **203** is forced out through an aperture **18** in a chamber wall **19** and let out into the casing. A subsequent down-stroke motion of the plunger, wherein the plunger moves towards the inlet channel **27** and the one-way valve **24**, forces the fluid through the outlet one-way valve **24** and thus out into the casing as the inlet one-way valve is closed. In the shown embodiment, the first valve and the second valve are embodied as check-valves of the ball-type and comprise a displaceable valve ball **221**, **241** cooperating with a valve seat **222**, **242** to control the flow direction. However, the skilled person would know that many other types of valves may be envisaged providing similar functionality. Further, the design of the pump section is based on the principles of widely used rod pumps, and other designs of the pump section may thus be envisaged by the skilled person without departing from the invention.

[0079] Details about the design of the linear actuator are shown in FIGS. **4** and **5** showing different embodiments of a linear actuator. In both embodiments, the stroker shaft **45** extends through the tubular stroker cylinder **4** sectioned into one or more piston housings **47** by partitions **48**. The partitions comprise a sealing means **49***b*, such as an O-ring, in order to provide a sealing connection between the partitions and the stroker shaft **45**. In each of the piston housings **47**, a piston element **46** is provided around the stroker shaft **45**, so that the stroker shaft **45** may run back and forth within the tubular stroker cylinder **4** to provide the linear motion. Each of the piston elements **46** divides each of the one or more

piston housings into a first chamber **41** and a second chamber **42**, and the piston elements are provided with sealing means **49**a in order to provide a sealing connection between the inside of the piston housing **47** and the outside of the piston element **46**. As shown in FIG. **4**, fluid is alternately supplied to the first chamber **41** and the second chamber **42** via the respective fluid channels **43**, **44**. In the embodiment shown in FIG. **5**, only the fluid channels in fluid communication with the first piston housing are shown. However, the other piston housings are provided with a similar arrangement of fluid channels. To provide the linear motion of the linear actuator, the pump of the linear actuator pumps fluid into the first chamber by sucking a corresponding amount of fluid from the second chamber **42**, and vice versa. When the first chamber **41** is substantially filled, the pump shifts its pumping direction and pumps fluid from the first chamber **41** into the second chamber **42**. Consequently, the piston element **46** is forced in the opposite direction. And hence the stroker shaft **45** is forced back and forth, thereby providing the linear motion. As can be seen in FIG. **4**, the first chamber **41** is provided with a fluid channel **43** at one end of the piston housing **47**, and the second chamber **42** is provided with a fluid channel **44** at the opposite end of the piston housing **47**. In this way, fluid can be sucked or pumped into each chamber until the piston element **46** almost abuts the partitions **48**. The linear actuator is thus a closed system, meaning that the same fluid is recirculated by being pumped back and forth in the piston housing **47** in order to move the one or more piston elements **46** back and forth.

[0080] In another embodiment, the linear actuator may comprise an electric linear motor **51** driving the stroker shaft as shown in FIG. **7**. Furthermore, a one-way valve **25** is arranged in the opening to allow fluid to flow into the casing but prevent the fluid from flowing from the casing into the annulus. The opening **86** may also be provided with two successive one-way valves to provide a safer solution.

[0081] In order to increase the amount of gas sucked into the casing, the inlet **52** of the inlet channel is arranged substantially opposite the opening along the axial extension as shown in FIG. **7**. Thus, the inlet of the inlet channel is arranged substantially opposite the opening, also along a circumference of the housing. The tool may comprise a plurality of inlets in order to ensure that the orientation of the tool is not important.

[0082] As shown in FIG. **1**, the outlet channel has an outlet **53**, which is arranged closer to the first end **15** of the tool than the inlet channel **27**. In FIG. **1**, the outlet **53** is arranged substantially above the chamber in the wall of the hydraulic cylinder, and in FIG. **7**, the outlet is arranged in a connector **59** in the first end **15** of the tool.

[0083] In FIG. **8**, the sealing element is an annular seal for sealing around the opening, and the sealing element has the shape of a cup seal surrounding the opening **86**.

[0084] The sealing elements in FIGS. **2** and **3** are chevron seals, and the sealing elements in FIGS. **1** and **7** are inflatable or expandable seals which are typically made of elastomers or metal.

[0085] As can be seen in FIGS. **1** and **7**, the tool of the gas lift system is a wireline tool where the first end of the tool is connected with a wireline **60**.

[0086] The casing comprises a plurality of openings **86***a*, **86***b*, **86***c* spaced apart along the casing as shown in FIG. **9**. First the tool is arranged opposite the first opening **86***a* so that the sealing element is inflated just below the opening. After some time, when the gas-containing fluid has entered through the first opening for some time, the tool and the sealing element are deflated, and the tool is lowered further down the well to be opposite the second opening **86***b* at which the sealing element is inflated just below the second opening, and gas-containing fluid is sucked in through the second opening. After some time, the tool is lowered further down the well and inflates the sealing element, so that the inlet of the tool is arranged opposite the third opening **86***c* as shown in FIG. **9**. The tool may comprise a bit for making the openings.

[0087] As can be seen in FIG. **7**, the tool comprises a driving unit **9** for propelling the tool forward in the well. The driving unit is driven by a pump **5***a* which is driven by the motor **6**.

[0088] In FIG. **9**, the casing of the gas lift system comprises three side pockets **54**, and the side pockets are arranged closer to the top than the opening. The point **90** at which the gas can be introduced by means of the side pockets are at the bottom side pocket. The casing has a substantially vertical part **91** and a substantially horizontal part **92** and a toe part **93** connecting the vertical part and the horizontal part, and the opening is arranged in the toe part or the horizontal part.

[0089] In FIG. **3**, a bore extends from the second end **16** of the tool to an equalising valve **37** arranged in the outlet channel **21** to connect the bore and part of the outlet channel. The equalisation valve is adapted to equalise a differential pressure created across the sealing element **29** when the sealing element **29** is set in the well, and gas-containing well fluid is pumped into the first part of the casing above the sealing element **29**. To monitor and measure the differential pressure across the sealing element **29**, the sealing element **29** or other parts of the tool may comprise a system for measuring the differential pressure, such as one or more sensors **39** for measuring the pressure in the lower and the upper sections of the well. The differential pressure may, however, also be determined based on other principles known to the skilled person, inter alia based on the force required to drive the plunger in the pump section. When the gas lift system has lifted the fluid for some time, the well may to some extent be self-producing, so that the pressure in the second casing part is higher than in the first casing part, and the fluid from the second part is thus let through the equalisation valve and out through the outlet, which helps overcome a hydro-static pressure of the fluid above the opening.

[0090] In FIG. **6**, the no-go shoulder **95** provided in the tool interacts with a recess **96** in the casing **61** to fixate the position of the tool and ensure that the pump section **2** is positioned in the correct position. The part of the casing comprising the recess **96** may be a landing nipple known to the skilled person. As shown in FIG. **6**, the sealing elements **29** are positioned on opposite sides of an opening **86**. Each sealing element **29** hereby provides a seal in the annulus between the pumping assembly and the casing in order to seal off a section **87** of the casing.

[0091] Further, as described above, the design of the pump section allows well fluid to flow from the inlet **52** towards the outlet **53** regardless of the position of the plunger **23**. The tool **14** may thus be arranged in the well downhole permanently or for longer periods of time, operating based on the actual demand for boosting the flow in the well. If, for some reason, the flow in the well suddenly drops, the tool may be activated to boost the flow until the well is once again able to run by itself. The tool may be activated either automatically based on a measured pressure in the well or by a signal received from an operator through the wireline. The measured differential

pressure across the set sealing element may thus be used to control the operation of the pumping action of the tool by continuously activating and deactivating the pumping action to boost the flow in the well by providing gas lift.

[0092] The tool **14** of the gas lift system **1** is thus lowered into the casing and arranged so that the inlet channel **27** is opposite the opening, then the first part **66** of the casing is isolated from the second part **67** of the casing by means of a sealing element **29**, so that the first part and the inlet channel are in fluid communication with the opening. Subsequently, the pump unit is activated to pump gas into the annulus, and the plunger rod is moved in a reciprocating movement in order to suck fluid from the first part of the casing, so that the gas in the fluid in the annulus is sucked towards the opening and into the first part and further into the first compartment and out through the outlet channel.

[0093] When having two sealing elements **29**, **35**, a part of the first part of the casing opposite the opening can be isolated to create a suction area between the casing and the tool opposite the opening. The tool may further comprise means for making the opening in the casing downhole.

[0094] In the event that the gas lift provided through the first opening is not sufficient for well fluid to start flowing by the pressure present in the reservoir, the tool releases itself from the casing by deflating or unexpanding the sealing elements and subsequently moves further down the well and makes a second opening in the casing and initiates a sucking action opposite the second opening and provides gas lift further down the well from the first opening. Should the gas lift provided through the second opening not be sufficient, the process of deactivating the sealing elements and making an opening further down the well is repeated. Thus, the tool may comprise a tool section **94** comprising a drilling bit **97** for providing such opening in the casing as shown in FIG. **9**.

[0095] The linear actuator may be a stroking tool or stroker 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.

[0096] 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.

[0097] By a casing is meant any kind of pipe, tubing, tubular, liner, string etc. used downhole in relation to oil or natural gas production.

[0098] 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®.

[0099] 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.

1. A gas lift system arranged in a well having a top and comprising a well fluid, the gas lift system comprising:
- a casing arranged in the borehole defining a surrounding annulus,
- an opening in the casing, and
- a pumping unit for pumping gas into the annulus,

wherein the gas lift system further comprises a downhole tool having a first end nearest the top of the well and a second end, the downhole tool comprising a pump section comprising:
- a housing comprising a chamber having an axial extension,
- a plunger sliding in the chamber and dividing the chamber into a first compartment and a second compartment,
- a plunger rod connected with the plunger,
- a chamber inlet channel and a chamber outlet channel, the inlet channel and the outlet channel being in fluid communication with the second compartment,
- a sealing element for isolating a first part of the casing from a second part of the casing, the first part and the inlet channel being in fluid communication with the opening,
- a one-way valve arranged in the inlet channel to allow fluid to flow into the chamber, and
- a one-way valve arranged in the outlet channel to allow fluid to flow out of the chamber.

2. A gas lift system according to claim **1**, wherein at least part of the inlet channel extends radially from an outer surface of the housing towards the chamber.

3. A gas lift system according to claim **1**, wherein the plunger comprises a protrusion protruding from a first plunger face of the plunger facing the inlet channel and/or the outlet channel.

4. A gas lift system according to claim **1**, wherein the sealing element is an annular seal for sealing around the opening.

5. A gas lift system according to claim **1**, wherein a one-way valve is arranged in the opening to allow fluid to flow into the casing.

6. A gas lift system according to claim **1**, wherein the sealing element circumferents the housing and is adapted for sealing against the casing.

7. A gas lift system according to claim **1**, further comprising a second sealing element circumferenting the housing and adapted for sealing against the casing, thereby isolating a part of the first part of the casing opposite the opening.

8. A gas lift system according to any claim **1**, wherein an inlet of the inlet channel is arranged substantially opposite the opening along the axial extension.

9. A gas lift system according to claim **1**, wherein an outlet of the outlet channel is arranged closer to the first end of the tool than the inlet channel.

10. A gas lift system according to claim **1**, further comprising a linear actuator for providing a reciprocating movement of the plunger.

11. A gas lift system according to claim **1**, wherein the tool comprises a driving unit for propelling the tool forward in the well.

12. A gas lift system according to claim **1**, wherein the tool comprises a tool section comprising a drilling bit for drilling or milling an opening in the casing.

13. A gas lift system according to claim **1**, wherein the casing comprises at least one side pocket, and the side pocket is arranged closer to the top than the opening.

14. A gas lift method comprising the following steps:
inserting the gas lift system according to claim **1** into the borehole,
arranging the inlet channel opposite the opening,
isolating the first part of the casing from the second part of the casing by means of the sealing element, so that the first part is in fluid communication with the opening and the inlet channel is in fluid communication with the opening,
activating the pump unit to pump gas into the annulus,
moving the plunger rod in a reciprocating movement, and
sucking fluid from the first part of the casing, so that the gas in the fluid in the annulus is sucked towards the opening and into the first part and further into the first compartment and out through the outlet channel.

15. A gas lift method according to claim **14**, further comprising the step of isolating a part of the first part of the casing opposite the opening to create a suction area between the casing and the tool opposite the opening.

16. A gas lift method according to claim **14**, further comprising the step of drilling an opening in the casing.

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