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(54) PRODUCTION SYSTEM FOR PRODUCING HYDROCARBONS FROM A WELL

PRODUKTIONSSYSTEM ZUR HERSTELLUNG VON KOHLENWASSERSTOFFEN AUS EINEM BOHRLOCH

SYSTÈME DE PRODUCTION POUR PRODUIRE DES HYDROCARBURES À PARTIR D'UN PUITS

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Description

Field of the invention

[0001] The present invention relates to a production system for producing hydrocarbons from a well. Furthermore, the present invention relates to a well completion comprising the production system according to the invention as well as to a production method for the production of hydrocarbons from a well.

Background art

[0002] During oil and gas production, it is sometimes necessary to assist the production in a well due to a high hydro-static pressure. If the well itself is not capable of generating the adequate pressure to drive oil or gas to the surface, or the well has been deliberately killed, artificial lift may be used to lift the well fluid at the upper part of the well.

[0003] By submerging a pump into a well, the pump may be used to boost the pressure or perhaps restart a dead well. The pump sets a plug or seal in the well and pumps well fluid from one side of the plug to the other to overcome the static pressure of the well fluid above the pump.

[0004] Other methods of artificial lifting use chemicals or gasses to provide the lift required to ensure an acceptable production outcome from the well. However, the known solutions overcoming the static pressure of the well fluid use external energy sources. One example can be found in the document US 2004/149435 A1 which is considered the closest prior art.

Summary of the invention

[0005] 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 production system for producing hydrocarbons from a well without using an artificial lift system, such as a pump, gas or chemicals.

[0006] 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 production system for producing hydrocarbons from a well, comprising:

- a production casing,
- a monitoring unit adapted to measure a production outcome of the well,
- a first reservoir zone comprising at least a first fluid, extending along and outside part of the production casing,
- a second reservoir zone comprising at least a second fluid, extending along and outside another part of the production casing,
- a first inflow device arranged in the first reservoir zone, having a first inflow area and being adapted to let the first fluid into the production casing at a first volume rate, and
- a second inflow device arranged in the second reservoir zone, having a second inflow area and being adapted to let the second fluid into the production casing at a second volume rate,

wherein the first and second inflow areas of the inflow devices are adjustable, whereby the first and second inflow devices can be adjusted so that the first volume rate is equal to or higher than the second volume rate.

[0007] Hereby, a production system is obtained wherein the energy in the reservoir and well is used for lifting the well fluid out of the well, substantially without using external energy sources.

[0008] In an embodiment, the inflow device comprises a first outer sleeve and a second inner sleeve movable in relation to each other, the first outer sleeve having outer inflow openings arranged in rows with a different number of openings in each row, and the second inner sleeve having inner openings, whereby the inflow area of the inflow device is adjustable in that the inner openings of the second inner sleeve can be moved and aligned in relation to the outer openings of the first sleeve.

[0009] Said inflow openings may be arranged in rows along the inflow device.

[0010] Furthermore, the inner openings may be arranged with a distance between them in relation to the outer openings, whereby the inflow area of the inflow device is adjustable in that the inner openings of the second inner sleeve can be moved and aligned in relation to the outer openings of the first sleeve.

[0011] Moreover, the inner openings of the inner sleeve may be arranged with predetermined circumferenctial distances between them so that each row of outer inflow openings can optionally be opened or closed by moving the inner sleeve.

[0012] In one embodiment, the second inner sleeve may be rotatably movable in relation to the first outer sleeve.

[0013] In another embodiment, the inflow device may have an axial extension, and the inner sleeve may be slidable in relation to the outer sleeve along the axial extension.

[0014] Furthermore, the outer sleeve may have a recess in which the inner sleeve slides along the axial extension.

[0015] In yet another embodiment, the second sleeve may comprise recesses for engaging with a key tool for adjusting the inflow device.

[0016] In yet another embodiment, the inner sleeve may be slidably movable in relation to the outer sleeve.

[0017] In addition, the production system as described above may further comprise a monitoring unit adapted to measure a production outcome of the well.

[0018] Moreover, the monitoring unit may be adapted to measure a water content of the production outcome so that the inflow devices may be adjusted to obtain an optimum between production outcome and water content.

[0019] Also, the monitoring unit may be adapted to measure a volume rate of the production outcome and/or a pressure at the top of the well so that the inflow devices may be adjusted based on the volume rate and/or pressure measured at the top of the well.

[0020] In one embodiment, the inflow devices may be manually adjustable.

[0021] In another embodiment, the inflow devices may be remotely adjustable.

[0022] Furthermore, the inflow device may be operated by a magnetic source.

[0023] Moreover, the reservoir zones may be separated by annular barriers.

[0024] In an embodiment, the system may comprise a plurality of reservoir zones.

[0025] Further, a plurality of inflow devices may be arranged in the system and/or in each reservoir zone.

[0026] Said plurality of inflow devices may be arranged in the system and/or in each reservoir zone.

[0027] Also, the first fluid may be oil and the second fluid may be water or gas.

[0028] In addition, a valve may be arranged in one or more of the openings.

[0029] Furthermore, a screen may be arranged outside the openings.

[0030] In one embodiment, the inflow device may comprise a first packer, the second sleeve may be arranged in a recess of the first sleeve, and the first packer may be arranged between the first sleeve and the second sleeve.

[0031] Furthermore, the packer may extend around the inner circumferential recess and have an inner diameter which is substantially the same as that of the second sleeve.

[0032] Moreover, the packer may have a number of through-going packer channels for being aligned with first axial channels in the first sleeve.

[0033] In addition, the packer may be made of ceramics.

[0034] In an embodiment, the production casing may comprise annular barriers, each annular barrier being adapted for being expanded in an annulus between the production casing and an inside wall of a borehole downhole, and each annular barrier comprising:

- a tubular part for mounting as part of the production casing,
- an expandable sleeve surrounding the tubular part, each end of the expandable sleeve being fastened to the tubular part by means of a connection part,
- an annular barrier space between the tubular part and the expandable sleeve, and
- an aperture in the tubular part for letting fluid into the annular barrier space to expand the sleeve,

wherein annular barriers are arranged, separating the first reservoir zone and the second reservoir zone.

[0035] Furthermore, the expandable sleeve may be made of metal.

[0036] The present invention also relates to a well completion comprising the production system as described above and a well head.

[0037] The well completion may further comprise a control unit arranged in the well head for adjusting the inflow devices.

[0038] In addition, the well completion may further comprise a key tool connected with a downhole tractor for adjusting the inflow devices.

[0039] Further, the present invention relates to a production method for production of hydrocarbons from a well, comprising the steps of:

- determining a first reservoir zone comprising at least a first fluid,
- determining a second reservoir zone comprising at least a second fluid,
- opening a first inflow device in the first zone to let the at least first fluid into a production casing at a first volume rate,
- opening a second inflow device in the second zone to let the at least second fluid into the production casing at a second volume rate,
- monitoring a production outcome of the well, and
- adjusting the first and second inflow devices based on the production outcome so that the first volume rate is equal to or higher than the second volume rate or so that the second volume rate is higher than the first volume rate.

[0040] In said method, the monitoring step may comprise one or more of the steps of:

- measuring a pressure at the top of the well,
- measuring a volume rate of the production outcome at the top of the well, and/or
- measuring a water content of the production outcome at the top of the well.

[0041] Also, the step of adjusting the first and second inflow devices may further comprise adjustment of at least one of the inflow devices based on the measured pressure, volume rate and/or water content at the top of the well.

[0042] Moreover, the step of step of adjusting the first and second inflow devices may be performed manually, e.g. by a key tool connected with a downhole tractor.

[0043] Additionally, the step of adjusting the first and second inflow devices further may be performed remotely from the top of the well.

[0044] Finally, the step of adjusting the first and second inflow devices further may be performed wirelessly.

Brief description of the drawings

[0045] 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 production system according to one embodiment of the invention,

Fig. 2 shows another embodiment of the production system having a plurality of reservoir zones,

Fig. 3 shows a diagram of volume rate in relation to pressure,

Fig. 4 shows a cross-sectional view of an embodiment of an inflow device,

Fig. 5 shows a cross-sectional view of another embodiment of an inflow device,

Fig. 6 shows a cross-sectional view of an additional embodiment of an inflow device,

Fig. 7 shows, in a partly cross-sectional view and partly in perspective, the inflow device of Fig. 4,

Figs. 8a-8o show cross-sectional views of different positions of the inflow device of Figs. 4 and 7 in relation to the volume rate,

Fig. 9 shows a cross-sectional view of the inflow device of Fig. 6,

Fig. 10 shows, in a partly cross-sectional view and partly in perspective, another embodiment of the inflow device having an axially sliding inner sleeve, and

Fig. 11 shows a cross-sectional view of the inflow device of Fig. 10 along the axial extension.

[0046] 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

[0047] Fig. 1 shows a production system 1 for producing hydrocarbons from a well 2. The production system 1 comprises a production casing 3 extending along the well 2. The production system 1 furthermore comprises a monitoring unit 4 adapted to measure a production outcome of the well 2. In this embodiment, the monitoring unit is positioned at the top of the well 2, i.e. at the well head 5. The monitoring unit may comprise a flow measuring device, a pressure sensor, a water cut measuring device or a combination thereof.

[0048] The production system 1 also comprises a first reservoir zone 6 comprising at least a first fluid 10, extending along and outside the production casing 3, and a second reservoir zone 7 comprising at least a second fluid 11, extending along and outside the production casing. Furthermore, a first inflow device 8 is arranged in the first reservoir zone 6, having a first inflow area and being adapted to let the first fluid 10 into the production casing 3 at a first volume rate V1, and a second inflow device 9 is arranged in the second reservoir zone 7, having a second inflow area and being adapted to let the second fluid 11 into the production casing 3 at a second volume rate V2. The first and second inflow areas of the inflow devices 8, 9 are adjustable, whereby the first and second inflow devices 8, 9 can be adjusted based on the production outcome so that the first volume rate V1 is equal to or higher than the second volume rate V2. Hereby, it is obtained that the production of hydrocarbons from the well 2 may be optimised by adjusting the inflow volume rates of the inflow devices 8, 9 to the instantaneous requirement based on either the volume rate of the production outcome, the pressure at the top of the well 2, the water content of the production outcome, or a combination thereof. Thus, by means of the present system, it is possible to create lift of the fluids in the well by adjusting the inflow volume rates of the fluids and thereby avoid using artificial lift or at least substantially reduce the use of artificial lift.

[0049] In the event that the first fluid 10 comprises more water or gas, it may be used for driving the second and heavier fluid 11, and thus, artificial lift higher up the well may be avoided. Similarly, the second fluid may have a higher content of water which is normally shut off by hindering its inflow into the casing, however, the second fluid may be useful for mixing with the first fluid to ease the flow of the well of the first fluid.

[0050] In the production system 1 shown in Fig. 1, the first and second reservoir zones 6, 7 are adjacent zones, and they are separated from each other by expandable annular barriers 12. In Fig. 1, the first fluid 10 in the first reservoir zone 6 is essentially oil and the second fluid 11 in the second reservoir zone 7 is essentially water. The first and second reservoir zones 6, 7 each has a reservoir pressure of 300 bar. The first inflow device 8 of the first reservoir zone 6 is adjusted to let in the first fluid 10, i.e. oil, so that there is a pressure of 200 bar in the production casing 3. Thereby, there is a pressure difference of 100 bar between the reservoir and the casing. The second inflow device 9 of the second reservoir zone 7 is adjusted to let in the second fluid 11, i.e. water, so that there is a pressure of 250 bar in the production casing 3, i.e. the 200 bar from the first zone and 50 bar from the second zone. Thereby, there is a pressure difference of 50 bar between the reservoir at the second zone and the production casing. By letting in the second fluid 11, i.e. water, a higher water content is obtained in the production outcome. However, at the same time, a higher volume rate of the production outcome and enhanced lift to the well are achieved. In fact, the energy in the reservoir is utilised for lifting the well instead of using secondary means, such as artificial lift, by means of gas, or adding chemicals, for providing lift.

[0051] In Fig. 2, the production system has five reservoir zones 6, 7, 13, 14, 15 mutually separated by expandable annular barriers 12. In Fig. 2, the first and second reservoir zones 6, 7 are separated by another reservoir zone 14 having a third fluid 10b with a lower oil content than the first fluid 10. Below the first zone 6 furthest away from the well head 5, there is another reservoir zone 13 having a fourth fluid 10a which also has a lower oil content than the first fluid 10. Furthermore, above the second zone 7, there is a fifth zone 15 having a fourth fluid 11a with a lower water content than the second fluid 11. Furthermore, one or more of the additional inflow devices 16, 17, 18 arranged in the other reservoir zones 13, 14, 15, respectively, may also be adjusted to let fluid at certain volume rates into the production casing to enhance the lift in the well and provide an optimum production outcome. Thus, the production system 1 may function in the same manner as described in relation to Fig. 1.

[0052] Fig. 3 shows a diagram disclosing different relationships between volume rate of the production outcome and pressure. As an example, the diagram has three different curves 19, 20, 21 each representing varying volume rates at a certain pressure. In the example above disclosed in Fig. 1, the first inflow device is positioned at a high volume rate at a pressure lower than that of the second inflow device, and the fluid there-through would therefore follow curve 20. The second device is positioned at a lower volume rate but at a higher pressure, and the fluid there-through will therefore be positioned on curve 21 but not at a volume rate as high as that of the fluid through the first inflow device. From the diagram, it is deducible that a high pressure and a high volume rate, cf. curve 21, provide a high production outcome.

[0053] Fig. 4 shows a cross-sectional view of the inflow device 8 along an axial extension of the inflow device 8 being concentric with the axial extension of the casing. In this embodiment, the inflow device 8 comprises an outer sleeve 22 and an inner sleeve 23, and the inner sleeve 23 may be movable in relation to the outer sleeve 22. The cross-sectional view is taken along a row of inflow openings 24 arranged in the extension of the inflow device 8. In this row, there are seven inflow openings 24. The inflow area of the inflow device is *inter alia* constituted by these inflow openings 24 each having an opening area. If the inflow device 8 has several rows of inflow openings, the total opening area of all these rows provides the total available inflow area of the inflow device. The inflow openings 24 are in fluid connection with the inner opening 25 of the second inner sleeve 23 so that fluid from the reservoir may flow in through the inflow device 8. In this embodiment, the inner opening 25 is shown as a through-going groove extending in the axial extension of the inflow device 8. The inner opening 25 has a larger extension than the inflow openings 24 to ensure that the inner opening 25, when being aligned with the inflow openings, does not prevent the fluid from flowing. A screen 26 or filter is arranged on the outside of the inflow openings.

[0054] Another embodiment of the inflow device 8 is shown in Fig. 5 in a cross-sectional view along an axial extension of the inflow device 8. The inflow device 8 also comprises the outer sleeve 22 and the inner sleeve 23 which are movable in relation to each other. The inflow openings 24 are in fluid connection with the inner openings 25 of the second inner sleeve 23 to allow fluid from the reservoir to flow in through the inflow device 8. In this embodiment, the inner openings 25 are shown as seven through-going holes being aligned with the inflow openings 24 of the outer sleeve. The inner openings 25 have a larger extension than each of the inflow openings 24 so they do not prevent the fluid from flowing. Again, a screen 26 or filter is arranged on the outside of the inflow openings 24.

[0055] An additional embodiment of the inflow device 8 is shown in Fig. 6 in a cross-sectional view along a row of inflow openings 24 arranged in the extension of the inflow device 8. The inflow openings 24 terminate in an axially extending channel 27 arranged in the wall of the outer sleeve 22. The axial channel 27 abuts an axial channel 55 arranged in the inner sleeve 23, whereby the inflow openings 24 are in fluid communication with the inner opening 25 via the two axial channels 27, 55, respectively. Also, in this embodiment, a screen 26 or filter is arranged on the outside of the inflow openings 24. The embodiment of the inflow device 8 shown in Fig. 6 will be described further in connection with Fig. 9 below.

[0056] The inflow device 8 of Fig. 4 is shown in perspective in Fig. 7. The inflow device 8 comprises the outer sleeve 22 and the inner sleeve 23, wherein the inner sleeve 23 is movable in relation to the outer sleeve 22 by rotation. Four rows of inflow openings 24, 28, 29, 30 are arranged adjacent to each other and along the axial extension of the inflow device 8. The first row has seven inflow openings 24, as shown in the cross-sectional view in Fig. 4. The second row has six inflow openings 28. The third row has four inflow openings 29, and the fourth row has two inflow openings 30. The inflow openings 24, 28, 29, 30 of the four rows constitute the inflow area of the inflow device 8.

[0057] In other embodiments, the inflow device may have a different number of rows and a different number of inflow openings in each row. Thus, the embodiment shown in Fig. 7 is one configuration of the inflow device 8.

[0058] The inner sleeve 23 is shown in Fig. 7 with four inner openings 25 visible in cross-section, and the openings 25 are each aligned with an inflow opening in the row of inflow openings 24 arranged in the outer sleeve 22. Also, the inflow device 8 may have a different number of inner openings and different positions along the periphery of the inner sleeve.

[0059] Figs. 8a to 8o show a sequence of different adjustments to different positions of the inflow device in relation to the desired inflow volume rate of the inflow device 8.

[0060] In the same manner as described above, the inflow device 8 comprises an inner sleeve 23 or tubular which is rotatable within the outer sleeve 22 or tubular. The inflow device 8 is shown in a cross-sectional view of a radial extension of the inflow device 8. The outer sleeve 22 has four rows of inflow openings 24, 28, 29, 30. In the first row 24, there are seven inflow openings, as shown in Fig. 7, in the second row 28, there are six openings, in the third row 29, there are four openings, and in the fourth row, there are two openings. In Fig. 8a, the inner sleeve 23 has ten inner openings 25, 31, 32, 33, 34, 35, 36, 37, 38, 39 in the form of grooves, the grooves being shown in Fig. 4, and the openings are arranged along the periphery of the inner sleeve 23. The inner openings 25, 31, 32, 33, 34, 35, 36, 37, 38, 39 are arranged with predetermined distances between them so that each row of outer inflow openings 24 can optionally be opened or closed by rotating the inner sleeve 23, which will be further described below.

[0061] In Fig. 8a, the rows of inflow openings 24, 28, 29, 30 are all aligned with the inner openings 31, 32, 33, 34 of the inner sleeve 23. Thus, in Fig. 8a, all inflow openings 24, 28, 29, 30 of the inflow device 8 are open, whereby fluid may flow through all nineteen openings. This is the maximum flow capacity of the inflow device 8.

[0062] In Fig. 8b, the inner sleeve 23 is rotated slightly to the right, whereby the inner opening 25 is aligned with the first row of inflow openings 24, the inner opening 31 is aligned with the row of inflow openings 29, and the inner opening 32 is aligned with the row of inflow openings 30. Thus, by this adjustment of the inflow device 8, the rows of inflow openings 24, 29, 30 are open and the row of inflow openings 28 is closed, resulting in thirteen openings being open. By rotating the inner sleeve even further so that the inner opening 25 is aligned with the third row of inflow openings 29, four openings are open, and by rotating the inner sleeve even further so that the inner opening 25 is aligned with the fourth row of inflow openings 30, two openings are open.

[0063] In Fig. 8c, the inner sleeve 23 is rotated slightly to the left, whereby the inner opening 31 is aligned with the row of inflow openings 28, the inner opening 32 is aligned with the row of inflow openings 29, and the inner opening 33 is aligned with the row of inflow openings 30. Thus, by this adjustment of the inflow device 8, the rows of inflow openings 28, 29, 30 are open and the row of inflow openings 24 is closed, resulting in twelve openings being open.

[0064] In Fig. 8d, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8c, whereby the inner opening 32 is aligned with the row of inflow openings 24, the inner opening 33 is aligned with the row of inflow openings 28, and the inner opening 34 is aligned with the row of inflow openings 29. Thus, by this adjustment of the inflow device 8, the rows of inflow openings 24, 28, 29 are open and the row of inflow openings 30 is closed, resulting in seventeen openings being open.

[0065] In Fig. 8e, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8d, whereby the inner opening 33 is aligned with the row of inflow openings 24, the inner opening 34 is aligned with the row of inflow openings 28, and the inner opening 35 is aligned with the row of inflow openings 30. Thus, by this adjustment of the inflow device 8, the rows of inflow openings 24, 28, 30 are open and the row of inflow openings 29 is closed, resulting in fifteen openings being open.

[0066] In Fig. 8f, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8e, whereby the inner opening 34 is aligned with the row of inflow openings 24 and the inner opening 35 is aligned with the row of inflow openings 29. Thus, by this adjustment of the inflow device 8, the rows of inflow openings 24, 29 are open and the rows of inflow openings 28, 30 are closed, resulting in eleven openings being open.

[0067] In Fig. 8g, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8f, whereby the inner opening 35 is aligned with the row of inflow openings 28. Thus, by this adjustment of the inflow device 8, the row of inflow openings 28 are open and the rows of inflow openings 24, 29, 30 are closed, resulting in six openings being open.

[0068] In Fig. 8h, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8g, whereby the inner opening 35 is aligned with the row of inflow openings 24 and the inner opening 36 is aligned with the row of inflow openings 30. Thus, by this adjustment of the inflow device 8, the rows of inflow openings 24, 30 are open and the rows of inflow openings 28, 29 are closed, resulting in nine openings being open.

[0069] In Fig. 8i, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8h, whereby the inner opening 36 is aligned with the row of inflow openings 28 and the inner opening 37 is aligned with the row of inflow openings 30. Thus, by this adjustment of the inflow device 8, the rows of inflow openings 28, 30 are open and the rows of inflow openings 24, 29 are closed, resulting in eight openings being open.

[0070] In Fig. 8j, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8i, whereby the inner opening 36 is aligned with the row of inflow openings 24 and the inner opening 37 is aligned with the row of inflow openings 29. Thus, by this adjustment of the inflow device 8, the rows of inflow openings 24, 29 are open and the rows of inflow openings 28, 30 are closed, and this adjustment thus results in the same position as in Fig. 8f.

[0071] In Fig. 8k, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8j, whereby the inner opening 38 is aligned with the row of inflow openings 29 and the inner opening 39 is aligned with the row of inflow openings 30. Thus, by this adjustment of the inflow device 8, the rows of inflow openings 29, 30 are open and the rows of inflow openings 24, 28 are closed, resulting in six openings being open.

[0072] In Fig. 8l, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8k, whereby the inner opening 38 is aligned with the row of inflow openings 28 and the inner opening 39 is aligned with the row of inflow openings 29. Thus, by this adjustment of the inflow device 8, the rows of inflow openings 28, 29 are open and the rows of inflow openings 24, 30 are closed, resulting in ten openings being open.

[0073] In Fig. 8m, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8l, whereby the inner opening 38 is aligned with the row of inflow openings 24 and the inner opening 39 is aligned with the row of inflow openings 28. Thus, in this adjustment of the inflow device 8, the rows of inflow openings 24, 28 are open and the rows of inflow openings 29, 30 are closed, resulting in thirteen openings being open.

[0074] In Fig. 8n, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8m, whereby the inner opening 39 is aligned with the row of inflow openings 24. Thus, by this adjustment of the inflow device 8, the rows of inflow openings 24 are open and the rows of inflow openings 28, 29, 30 are closed, resulting in seven openings being open.

[0075] In Fig. 8o, the inner sleeve 23 is rotated slightly to the left in relation to the adjustment of Fig. 8n, whereby all rows of inflow openings 24, 28, 29, 30 are closed. Thus, by this adjustment, the inflow device 8 is closed.

[0076] The sequence of adjustments shown in Figs. 8a-8o shows different flow capacities of the inflow device 8, resulting in fourteen different volume rates. Even though some possible adjustments of the inflow device 8 are not shown in Figs. 8a-8o, it is evident for the skilled person that the configuration of the inflow device 8 makes it possible to open and close all rows of inflow openings independently of each other by rotating the inner sleeve into the intended position.

[0077] Fig. 9 shows a longitudinal cross-sectional view of another embodiment of an inflow device 8. The inflow device 8 comprises a first sleeve or tubular 40 having twelve inflow openings 24 in a first wall 41 and twelve first axial channels 27 extending in the first wall 41 from the inflow openings 24 to an outlet 53. By axial channels is meant that the channels extend in an axial direction in relation to the inflow device 8.

[0078] The inflow device also comprises a second sleeve 42 or tubular having a first end 43 near the outlet 53 and a second end 44 and, in this view, six inner openings 25. Even though the second sleeve 42 or tubular only shows six inner openings 25, the number of inner openings is actually the same as in the first sleeve 40 or tubular, i.e. 12 inner openings.

[0079] Furthermore, the second sleeve 42 or tubular is rotatable within the first sleeve 40 or tubular, and the second sleeve 42 has a second wall 45 having twelve second axial channels (not shown) extending in the second wall 45 from the first end 43 to the inner opening 25. Thus, each inner opening 25 has its own second axial channel.

[0080] The second sleeve 42 or tubular is arranged in an inner circumferential recess 46 in the first wall 41 of the first sleeve 40 or tubular, meaning that when the second sleeve 42 or tubular is arranged in the recess, the second sleeve 42 or tubular will not decrease the overall inner diameter of the inflow device and thereby of the production casing.

[0081] The second sleeve 42 or tubular is rotatable in relation to the first sleeve 40 or tubular at least between a first position, in which the first channel 27 and second channel (not shown) are aligned to allow fluid to flow from the reservoir into the production casing via the first end 43 of the second sleeve 42 or tubular, and a second position (the position shown in Fig. 9), in which the first channel 27 and second channel (not shown) are not aligned, meaning that fluid is prevented from flowing into the production casing.

[0082] The inflow device 8 also comprises a first packer 47 which is arranged between the first sleeve 40 or tubular and the first end 43 of the second sleeve 42 or tubular. The packer 47 extends around the inner circumferential recess 46 and has an inner diameter which is substantially the same as that of the second sleeve or tubular. The packer 47 has a number of through-going packer channels 48 corresponding to the number of first axial channels, i.e. in this embodiment twelve, the packer channels 48 being aligned with the first axial channels 27. The packer is fixedly connected with the first sleeve or tubular so that the packer channels 48 are fluidly connected with first axial channels. The packer is ring-shaped, and the through-going packer channels 48 extend through the packer along the axial extension of the first sleeve or tubular.

[0083] The packer 47 is preferably made of ceramics, whereby it is possible to make the contact surfaces of the packer 47 smooth, which enhances the sealing properties of the packer 47, since the smooth contact surface may be pressed closer to the opposite surface which is the first end 43 of the second sleeve 42 or tubular. However, in other embodiments, the packer may be made of metal, composites, polymers or the like.

[0084] Furthermore, a second packer 49 is arranged between the first sleeve 40 or tubular and the second end 44 of the second sleeve 42 or tubular. However, in another embodiment, the second packer is omitted, whereby the second end 44 of the second sleeve 42 or tubular faces the first wall of the first sleeve 40 or tubular.

[0085] In Fig. 9, a first spring element 50 is arranged between the first packer 47 and the first sleeve 40 or tubular. The spring element 50 thus forces the first packer against the second sleeve 42 to provide a seal therebetween.

[0086] Furthermore, the second sleeve 42 or tubular may comprise at least one recess 51 accessible from within, the recess 51 being adapted to receive a key tool (not shown) for rotating the second sleeve 42 or tubular in relation to the first sleeve 40 or tubular.

[0087] The adjustment of the inflow devices 8, 9 may be performed manually, e.g. by inserting a downhole tool having a key tool into the production casing and moving the downhole tool to the inflow device which needs to be adjusted. The inflow devices 8, 9 may also be operated by a magnetic source.

[0088] The inflow device 8 of Fig. 7 has an inner sleeve 23 rotating in relation to an outer sleeve 22, and in Fig. 10, the inner sleeve 23 slides axially in relation to the outer sleeve 22. The inner sleeve 23 slides in a recess in the outer sleeve 22, as shown in Fig. 11 where the inner sleeve covers three of the four rows shown in

[0089] Fig. 10, and thus, all the inflow openings 24 except two are covered. The first row comprises eight inflow openings 24, the second row comprises six inflow openings 24, the third row comprises four inflow openings 24, and the fourth row comprises two inflow openings 24. By sliding the sleeve back and forth in the recess along the inner surface of the outer sleeve, the number of inflow openings 24 which the fluid may flow through may be varied in the same manner as in the embodiment of the inflow device 8 shown in Fig. 7. In other embodiments of an inflow device having an axially slidable inner sleeve, the inflow device may have a different number of rows and a different number of inflow openings in each row. Thus, the embodiment shown in Figs. 9 and 10 is only one configuration of the inflow device 8.

[0090] Fig. 1 shows the production casing comprising annular barriers, each annular barrier being adapted for expansion in an annulus 52 between a production casing and an inside wall 54 of a borehole 55 downhole. Each annular barrier comprises a tubular part 57 for mounting as part of the production casing and an expandable sleeve 58 surrounding the tubular part. Each end 59, 60 of the expandable sleeve is fastened to the tubular part by means of a connection part 72. At least one end is slidably connected with the tubular part. The expandable sleeve surrounds the tubular part and defines an annular barrier space 73 between the tubular part and the expandable sleeve. The annular barrier further comprises an aperture 71 in the tubular part for letting fluid into the annular barrier space to expand the sleeve. The annular barriers are arranged separating the first reservoir zone 6 and the second reservoir zone 7 so that three annular barriers provide two reservoir zones. The expandable sleeve, the tubular part and the connection parts are made of metal.

[0091] In other embodiments, the inflow devices may be remotely adjustable, e.g. by wireline or wireless control.

[0092] The inflow device 8 is adapted to be inserted and form part of the production casing 3, thus forming a cased completion (not shown). Accordingly, the ends of the inflow device 8 are adapted to be connected with another casing element by conventional connection means, for instance by means of a threaded connection.

[0093] In the embodiments described above, the outer openings are shown as openings per se. However, the outer openings may comprise flow restrictors, throttles or valves, such as inflow control valves (not shown).

[0094] Even though the above-mentioned embodiments have been described primarily in relation to rotatable movement of the inner sleeve in relation to the outer sleeve, the inner sleeve may be slidably movable in relation to the outer sleeve.

[0095] 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.

[0096] By a casing is meant any kind of pipe, tubing, tubular, liner, string etc. used downhole in relation to oil or natural gas production.

[0097] In the event that the tools are not submergible all the way into the casing, a downhole tractor can be used to push the tools all the way into position in the well. A downhole tractor is any kind of driving tool capable of pushing or pulling tools in a well downhole, such as a Well Tractor®.

[0098] 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 production system (1) for producing hydrocarbons from a well (2), comprising:

   - a production casing (3),
   - a first reservoir zone (6) comprising at least a first fluid (10), extending along and outside a part of the production casing (3),
   - a second reservoir zone (7) comprising at least a second fluid (11), extending along and outside another part of the production casing (3),
   - a first inflow device (8) arranged in the first reservoir zone (6), having a first inflow area and being adapted to let the first fluid (10) into the production casing (3) at a first volume rate (V1), and
   - a second inflow device (9) arranged in the second reservoir zone (7), having a second inflow area and being adapted to let the second fluid (11) into the production casing (3) at a second volume rate (V2),

   wherein the first and second inflow areas of the inflow devices (8, 9) are adjustable, whereby the first and second inflow devices (8, 9) can be adjusted so that the first volume rate (V1) is equal to or higher than the second volume rate (V2), and wherein the inflow device (8, 9) comprises a first outer sleeve (22) and a second inner sleeve (23) movable in relation to each other, **characterised in that** the first outer sleeve (22) has outer inflow openings (24, 28, 29, 30) arranged in rows with a different number of openings in each row, and **in that** the second inner sleeve (23) has inner openings (25, 31, 32, 33, 34, 35, 36, 37, 38, 39), whereby the inflow area of the inflow device (8, 9) is adjustable **in that** the inner openings (25, 31, 32, 33, 34, 35, 36, 37, 38, 39) of the second inner sleeve (23) can be moved and aligned in relation to the outer openings (24, 28, 29, 30) of the first sleeve (22).

2. A production system (1) according to claim 1, wherein the inner openings are arranged with a distance between them which is different from a distance between the outer openings (24, 28, 29, 30), whereby the inflow area of the inflow device (8, 9) is adjustable in that the inner openings (25, 31, 32, 33, 34, 35, 36, 37, 38, 39) of the second inner sleeve (23) can be moved and aligned in relation to the outer openings (24, 28, 29, 30) of the first sleeve (22).

3. A production system (1) according to claim 1 or 2, wherein the inner openings of the inner sleeve may be arranged with predetermined circumferenctial distances between them so that each row of outer inflow openings can optionally be opened or closed by moving the inner sleeve.

4. A production system (1) according to any of the preceding claims, further comprising a monitoring unit (4) adapted to measure a production outcome of the well (2).

5. A production system (1) according to claim 4, wherein the monitoring unit (4) is adapted to measure a water content of the production outcome so that the inflow devices (8, 9) may be adjusted to obtain an optimum between production outcome and water content.

6. A production system (1) according to claim 4 or 5, wherein the monitoring unit (4) is adapted to measure a volume rate of the production outcome and/or a pressure at the top of the well (2) so that the inflow devices (8, 9) may be adjusted based on of the volume rate and/or pressure measured at the top of the well (2).

7. A production system (1) according to any of the preceding claims, wherein the reservoir zones (6, 7) are separated by annular barriers (12).

8. A production system (1) according to any of the preceding claims, wherein the first fluid (10) is oil and the second fluid (11) is water or gas.

9. A production system (1) according to any of the preceding claims, wherein the inflow device comprises a first packer (47), the second sleeve is arranged in a recess (46) of the first sleeve, and the first packer is arranged between the first sleeve and the second sleeve.

10. A production system (1) according to claim 9, wherein the packer extends around the inner circumferential recess (46) and has an inner diameter which is substantially the same as that of the second sleeve.

11. A production system (1) according to any of the preceding claims, wherein the production casing comprises annular barriers, each annular barrier being adapted for being expanded in an annulus (52) between the production casing and an inside wall (54) of a borehole (55) downhole, and each annular barrier comprising:

- a tubular part (57) for mounting as part of the production casing,
- an expandable sleeve (58) surrounding the tubular part, each end (59, 60) of the expandable sleeve being fastened to the tubular part by means of a connection part (72),
- an annular barrier space (73) between the tubular part and the expandable sleeve, and
- an aperture (71) in the tubular part for letting fluid into the annular barrier space to expand the sleeve,

wherein annular barriers are arranged, separating the first reservoir zone (6) and the second reservoir zone (7).

12. A well completion comprising the production system (1) according to any of claims 1 to 11 and a well head (5).

13. A production method for production of hydrocarbons from a well (2) by means of the production system according to any of claims 1-11, comprising the steps of:

- identifying a first reservoir zone (6) comprising at least a first fluid (10),
- identifying a second reservoir zone (7) comprising at least a second fluid (11),
- opening a first inflow device (8) in the first zone (6) to let the at least first fluid (10) into a production casing (3) at a first volume rate (V1),
- opening a second inflow device (9) in the second zone (7) to let the at least second fluid (11)

into the production casing (3) at a second volume rate (V2),

- monitoring a production outcome of the well (2), and
- adjusting the first and second inflow devices (8, 9) based on the production outcome so that the first volume rate (V1) is equal to or higher than the second volume rate (V2) or so that the second volume rate is higher than the first volume rate.

14. A method according to claim 13, wherein the monitoring step comprises one or more of the steps of:

- measuring a pressure at the top of the well,
- measuring a volume rate of the production outcome at the top of the well, and/or
- measuring a water content of the production outcome at the top of the well.

15. A method according to claim 13 or 14, wherein the step of adjusting the first and second inflow devices further comprises adjustment of at least one of the inflow devices (8, 9) based on the measured pressure, volume rate and/or water content at the top of the well.

Patentansprüche

1. Produktionssystem (1) zur Förderung von Kohlenwasserstoffen aus einem Förderbohrloch (2), Folgendes umfassend:

- eine Produktionsverrohrung (3),
- eine erste Vorratszone (6), die wenigstens ein erstes Fluid (10) umfasst, das sich entlang und auf der Außenseite eines Abschnitts der Produktionsverrohrung (3) erstreckt,
- eine zweite Vorratszone (7), die wenigstens ein zweites Fluid (11) umfasst, das sich entlang und auf der Außenseite eines weiteren Abschnitts der Produktionsverrohrung (3) erstreckt,
- eine erste Einströmungsvorrichtung (8), die in der ersten Vorratszone (6) angeordnet ist und die einen ersten Einströmungsbereich hat und dafür eingerichtet ist, das erste Fluid (10) mit einer ersten Volumenrate (V1) in die Produktionsverrohrung (3) hineinzulassen, und
- eine zweite Einströmungsvorrichtung (9), die in der zweiten Vorratszone (7) angeordnet ist und die einen zweiten Einströmungsbereich hat und dafür eingerichtet ist, das zweite Fluid (11) mit einer zweiten Volumenrate (V2) in die Produktionsverrohrung (3) hineinzulassen,

wobei der erste und zweite Einströmungsbereich der Einströmungsvorrichtungen (8, 9) einstellbar sind, wobei die erste und zweite Einströmungsvorrichtung (8, 9) derart eingestellt werden können, dass die erste Volumenrate (V1) gleich der oder größer als die zweite Volumenrate (V2) ist, und wobei die Einströmungsvorrichtung (8, 9) eine erste äußere Buchse (22) und eine zweite innere Buchse (23) umfasst, die gegeneinander beweglich sind, **dadurch gekennzeichnet, dass** die erste äußere Buchse (22) äußere Einströmöffnungen (24, 28, 29, 30) hat, die in Reihen angeordnet sind, mit einer verschiedenen Zahl von Öffnungen in jeder Reihe, und dadurch, dass die zweite innere Buchse (23) innere Öffnungen (25, 31, 32, 33, 34, 35, 36, 37, 38, 39) hat, wobei der Einströmungsbereich der Einströmungsvorrichtung (8, 9) dadurch einstellbar ist, dass die inneren Öffnungen (25, 31, 32, 33, 34, 35, 36, 37, 38, 39) der zweiten inneren Buchse (23) relativ zu den äußeren Öffnungen (24, 28, 29, 30) der ersten Buchse (22) bewegt und ausgerichtet werden können.

2. Produktionssystem (1) nach Anspruch 1, wobei die inneren Öffnungen mit einem Abstand zwischen ihnen angeordnet sind, der verschieden ist von einem Abstand zwischen den äußeren Öffnungen (24, 28, 29, 30), wobei der Einströmungsbereich der Einströmungsvorrichtung (8, 9) dadurch einstellbar ist, dass die inneren Öffnungen (25, 31, 32, 33, 34, 35, 36, 37, 38, 39) der zweiten inneren Buchse (23) relativ zu den äußeren Öffnungen (24, 28, 29, 30) der ersten Buchse (22) bewegt und ausgerichtet werden können.

3. Produktionssystem (1) nach Anspruch 1 oder 2, wobei die inneren Öffnungen der inneren Buchse mit vorgegebenen über den Umfang verteilten Abständen zwischen ihnen angeordnet sein können, derart, dass jede Reihe von äußeren Einströmöffnungen optional geöffnet oder geschlossen werden kann, indem die innere Buchse bewegt wird.

4. Produktionssystem (1) nach einem der vorhergehenden Ansprüche, das außerdem eine Überwachungseinheit (4) umfasst, die dafür eingerichtet ist, ein Fördererergebnis des Förderbohrlochs (2) zu messen.

5. Produktionssystem (1) nach Anspruch 4, wobei die Überwachungseinheit (4) dafür eingerichtet ist, einen Wassergehalt des Fördererergebnisses zu messen, derart, dass die Einströmungsvorrichtungen (8, 9) eingestellt werden können, um ein Optimum zwischen dem Fördererergebnis und dem Wassergehalt zu erreichen.

6. Produktionssystem (1) nach Anspruch 4 oder 5, wobei die Überwachungseinheit (4) dafür eingerichtet ist, eine Volumenrate des Fördererergebnisses und/oder einen Druck am oberen Ende des Förderbohrlochs (2) zu messen, derart, dass die Einströmungsvorrichtungen (8, 9) basierend auf der Volumenrate und/oder dem am oberen Ende des Förderbohrlochs (2) gemessenen Druck eingestellt werden können.

7. Produktionssystem (1) nach einem der vorhergehenden Ansprüche, wobei die Vorratszonen (6, 7) durch ringförmige Sperren (12) getrennt sind.

8. Produktionssystem (1) nach einem der vorhergehenden Ansprüche, wobei das erste Fluid (10) Öl ist und das zweite Fluid (11) Wasser oder Gas ist.

9. Produktionssystem (1) nach einem der vorhergehenden Ansprüche, wobei die Einströmungsvorrichtung einen ersten Packer (47) umfasst und die zweite Buchse in einer Vertiefung (46) der ersten Buchse angeordnet ist und der erste Packer zwischen der ersten Buchse und der zweiten Buchse angeordnet ist.

10. Produktionssystem (1) nach Anspruch 9, wobei der Packer sich um die innere in Umfangsrichtung verlaufende Vertiefung (46) herum erstreckt und einen Innendurchmesser hat, der im Wesentlichen gleich demjenigen der zweiten Buchse ist.

11. Produktionssystem (1) nach einem der vorhergehenden Ansprüche, wobei die Produktionsverrohrung ringförmige Sperren umfasst und jede ringförmige Sperre dafür eingerichtet ist, in einem Ring (52) zwischen der Produktionsverrohrung und einer Innenwand (54) eines Bohrlochs (55) unten im Bohrloch expandiert zu werden, und wobei jede ringförmige Sperre Folgendes umfasst:

- ein röhrenförmiges Teil (57), das dafür vorgesehen ist, als Teil der Produktionsverrohrung montiert zu werden,
- eine expandierbare Hülse (58), die das röhrenförmige Teil umgibt, wobei jedes Ende (59, 60) der expandierbaren Hülse mittels eines Verbindungsteils (72) am röhrenförmigen Teil befestigt ist,
- einen ringförmigen Sperrenraum (73) zwischen dem röhrenförmigen Teil und der expandierbaren Hülse, und
- eine Öffnung (71) im röhrenförmigen Teil, um Fluid in den ringförmigen Sperrenraum hineinzulassen, um die Hülse zu expandieren,

wobei die ringförmigen Sperren derart angeordnet sind, dass sie die erste Vorratszone (6) und die zweite Vorratszone (7) trennen.

12. Bohrlochausstattung, die das Produktionssystem (1) nach einem der Ansprüche 1 bis 11 und eine Bohrlochmündung (5) umfasst.

13. Produktionsverfahren zur Förderung von Kohlenwasserstoffen aus einem Förderbohrloch (2) mittels des Produktionssystems nach einem der Ansprüche 1 bis 11, die folgenden Schritte umfassend:

- Identifizieren einer ersten Vorratszone (6), die wenigstens ein erstes Fluid (10) umfasst,
- Identifizieren einer zweiten Vorratszone (7), die wenigstens ein zweites Fluid (11) umfasst,
- Öffnen einer ersten Einströmungsvorrichtung (8) in der ersten Zone (6), um das wenigstens erste Fluid (10) in eine Produktionsverrohrung (3) mit einer ersten Volumenrate (V1) hineinzulassen,
- Öffnen einer zweiten Einströmungsvorrichtung (9) in der zweiten Zone (7), um das wenigstens zweite Fluid (11) in eine Produktionsverrohrung (3) mit einer zweiten Volumenrate (V2) hineinzulassen,
- Überwachen eines Fördererergebnisses des Förderbohrlochs (2), und
- Einstellen der ersten und zweiten Einströmungsvorrichtung (8, 9) basierend auf dem Fördererergebnis, derart, dass die erste Volumenrate (V1) gleich der oder größer als die zweite Volumenrate (V2) ist, oder derart, dass die zweite Volumenrate größer ist als die erste Volumenrate.

14. Verfahren nach Anspruch 13, wobei der Überwachungsschritt einen oder mehrere der folgenden Schritte umfasst:

- Messen eines Drucks am oberen Ende des Förderbohrlochs,
- Messen einer Volumenrate des Fördererergebnisses am oberen Ende des Förderbohrlochs, und/oder
- Messen eines Wassergehalts des Fördererergebnisses am oberen Ende des Förderbohrlochs.

15. Verfahren nach einem der Ansprüche 13 oder 14, wobei der Schritt zum Einstellen der ersten und zweiten Einströmungsvorrichtung außerdem das Einstellen einer der Einströmungsvorrichtungen (8, 9) basierend auf dem gemessenen Druck, der gemessenen Volumenrate und/oder dem gemessenen Wassergehalt am oberen Ende des Förderbohrlochs umfasst.

Revendications

1. Système de production (1) pour produire des hydrocarbures à partir d'un puits (2), comprenant :

- un tubage de production (3),
- une première zone de réservoir (6) comprenant au moins un premier fluide (10) s'étendant le long et à l'extérieur d'une partie du tubage de production (3),
- une seconde zone de réservoir (7) comprenant au moins un second fluide (11), s'étendant le long et à l'extérieur d'une autre partie du tubage de production (3),
- un premier dispositif d'entrée (8) agencé dans la première zone de réservoir (6) ayant une première zone d'entrée et étant adapté pour laisser le premier fluide (10) dans le tubage de production (3) à une première vitesse en volume (V1), et
- un second dispositif d'entrée (9) agencé dans la seconde zone de réservoir (7), ayant une seconde zone d'entrée et étant adapté pour laisser le second fluide (11) dans le tubage de production (3) à une seconde vitesse en volume (V2),

dans lequel les première et seconde zones d'entrée des dispositifs d'entrée (8, 9) sont ajustables, moyennant quoi les premier et second dispositifs d'entrée (8, 9) peuvent être ajustés de sorte que la première vitesse en volume (V1) est égale ou supérieure à la seconde vitesse en volume (V2), et dans lequel le dispositif d'entrée (8, 9) comprend un premier manchon externe (22) et un second manchon interne (23) mobiles l'un par rapport à l'autre, **caractérisé en ce que** le premier manchon externe (22) a des ouvertures d'entrée externes (24, 28, 29, 30) agencées en rangées avec un nombre différent d'ouvertures dans chaque rangée, et **en ce que** le second manchon interne (23) a des ouvertures internes (25, 31, 32, 33, 34, 35, 36, 37, 38, 39), moyennant quoi la zone d'entrée du dispositif d'entrée (8, 9) est ajustable **en ce que** les ouvertures internes (25, 31, 32, 33, 34, 35, 36, 37, 38, 39) du second manchon interne (23) peuvent être déplacées et alignées par rapport aux ouvertures externes (24, 28, 29, 30) du premier manchon (22).

2. Système de production (1) selon la revendication 1, dans lequel les ouvertures internes sont agencées avec une distance entre elles qui est différente d'une distance entre les ouvertures externes (24, 28, 29, 30), moyennant quoi la zone d'entrée du dispositif d'entrée (8, 9) est ajustable en ce que les ouvertures internes (25, 31, 32, 33, 34, 35, 36, 37, 38, 39) du second manchon interne (23) peuvent être déplacées et alignées par rapport aux ouvertures externes (24, 28, 29, 30) du premier manchon (22).

3. Système de production (1) selon la revendication 1 ou 2, dans lequel les ouvertures internes du manchon interne peuvent être agencées avec des distances circonférentielles prédéterminées entre elles de sorte que chaque rangée d'ouvertures d'entrée externes peut facultativement être ouverte ou fermée en déplaçant le manchon interne.

4. Système de production (1) selon l'une quelconque des revendications précédentes, comprenant en outre une unité de surveillance (4) adaptée pour mesurer un résultat de production du puits (2).

5. Système de production (1) selon la revendication 4, dans lequel l'unité de surveillance (4) est adaptée pour mesurer une teneur en eau du résultat de production de sorte que les dispositifs d'entrée (8, 9) peuvent être ajustés pour obtenir un optimum entre le résultat de production et la teneur en eau.

6. Système de production (1) selon la revendication 4 ou 5, dans lequel l'unité de surveillance (4) est adaptée pour mesurer une vitesse en volume du résultat de production et/ou une pression au sommet du puits (2) de sorte que les dispositifs d'entrée (8, 9) peuvent être ajustés en fonction de la vitesse en volume et/ou de la pression mesurée au sommet du puits (2).

7. Système de production (1) selon l'une quelconque des revendications précédentes, dans lequel les zones de réservoirs (6, 7) sont séparées par des barrières annulaires (12).

8. Système de production (1) selon l'une quelconque des revendications précédentes, dans lequel le premier fluide (10) est du pétrole et le second fluide (11) est de l'eau ou du gaz.

9. Système de production (1) selon l'une quelconque des revendications précédentes, dans lequel le dispositif d'entrée comprend une première garniture d'étanchéité (47), le second manchon est agencé dans un évidement (46) du premier manchon, et la première garniture d'étanchéité est agencée entre le premier manchon et le second manchon.

10. Système de production (1) selon la revendication 9, dans lequel la garniture d'étanchéité s'étend autour de l'évidement circonférentiel interne (46) et a un diamètre interne qui est sensiblement identique à celui du second manchon.

11. Système de production (1) selon l'une quelconque des revendications précédentes, dans lequel le tubage de production comprend des barrières annulaires, chaque barrière annulaire étant adaptée pour être expansée dans un espace annulaire (52) entre le tubage de production et une paroi interne (54) d'un sondage (55) de fond de trou, et chaque barrière annulaire comprenant :

- une partie tubulaire (57) destinée à être montée comme faisant partie du tubage de production,
- un manchon expansible (58) entourant la partie tubulaire, chaque extrémité (59, 60) du manchon expansible étant fixée à la partie tubulaire au moyen d'une partie de raccordement (72),
- un espace de barrière annulaire (73) entre la partie tubulaire et le manchon expansible, et
- une ouverture (71) dans la partie tubulaire pour laisser le fluide dans l'espace de barrière annulaire pour expanser le manchon,

dans lequel les barrières annulaires sont agencées, séparant la première zone de réservoir (6) et la seconde zone de réservoir (7).

12. Complétion de puits comprenant le système de production (1) selon l'une quelconque des revendications 1 à 11 et une tête de puits (5).

13. Procédé de production pour produire des hydrocarbures à partir d'un puits (2) au moyen du système de production selon l'une quelconque des revendications 1 à 11, comprenant les étapes consistant à :

- identifier une première zone de réservoir (6) comprenant au moins un premier fluide (10),
- identifier une seconde zone de réservoir (7) comprenant au moins un second fluide (11),
- ouvrir un premier dispositif d'entrée (8) dans la première zone (6) pour laisser le au moins un premier fluide (10) dans un tubage de production (3) à une première vitesse en volume (V1),
- ouvrir un second dispositif d'entrée (9) dans la seconde zone (7) pour laisser le au moins un second fluide (11) dans le tubage de production (3) à une seconde vitesse en volume (V2),
- surveiller un résultat de production du puits (2), et
- ajuster les premier et second dispositifs d'entrée (8, 9) basés sur le résultat de production de sorte que la première vitesse en volume (V1) est égale ou supérieure à la seconde vitesse en volume (V2) ou de sorte que la seconde vitesse en volume est supérieure à la première vitesse en volume.

14. Procédé selon la revendication 13, dans lequel l'étape de surveillance comprend une ou plusieurs étapes consistant à :

- mesurer une pression au sommet du puits,
- mesurer une vitesse en volume du résultat de production au sommet du puits, et/ou
- mesurer une teneur en eau du résultat de production au sommet du puits.

15. Procédé selon la revendication 13 ou 14, dans lequel l'étape consistant à ajuster les premier et second dispositifs d'entrée comprend en outre l'étape consistant à ajuster au moins l'un des dispositifs d'entrée (8, 9) en fonction de la pression mesurée, de la vitesse en volume et/ou de la teneur en eau au sommet du puits.

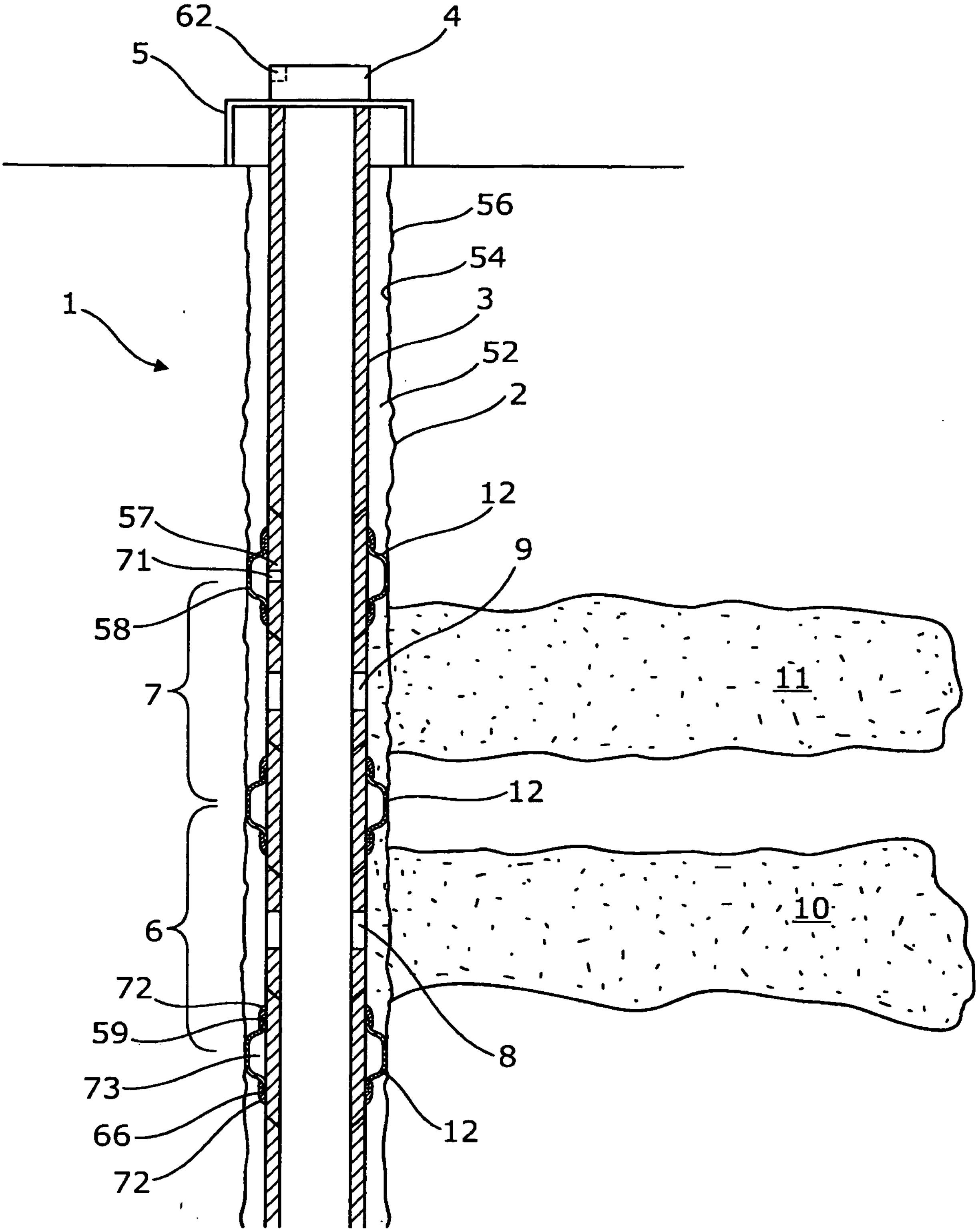


Fig. 1

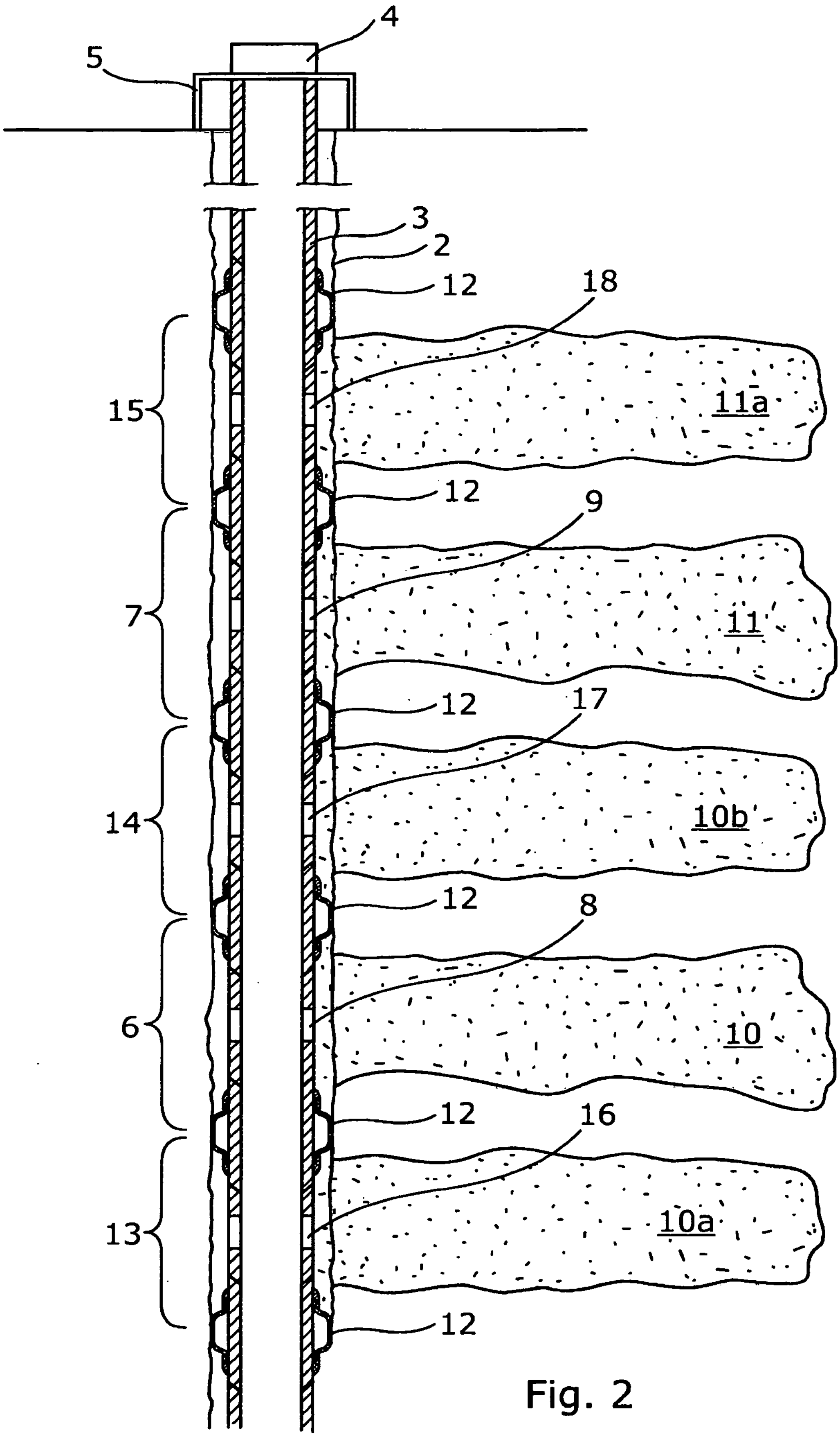
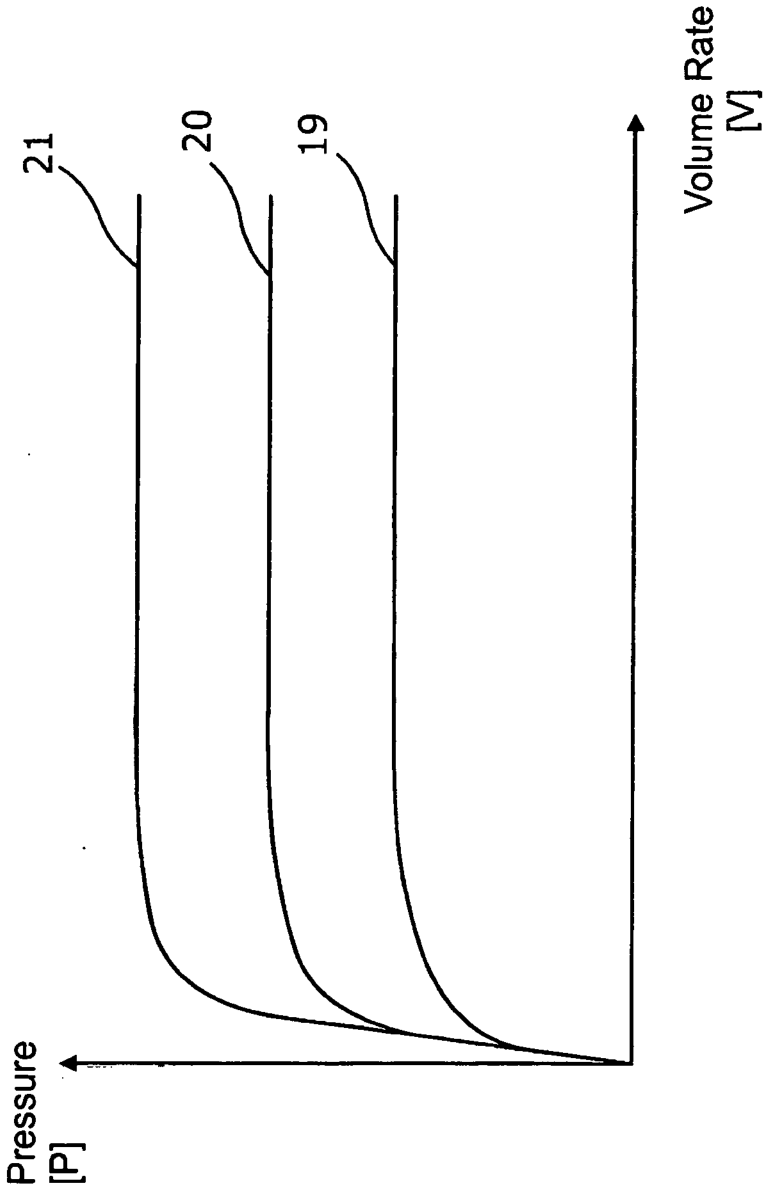


Fig. 2



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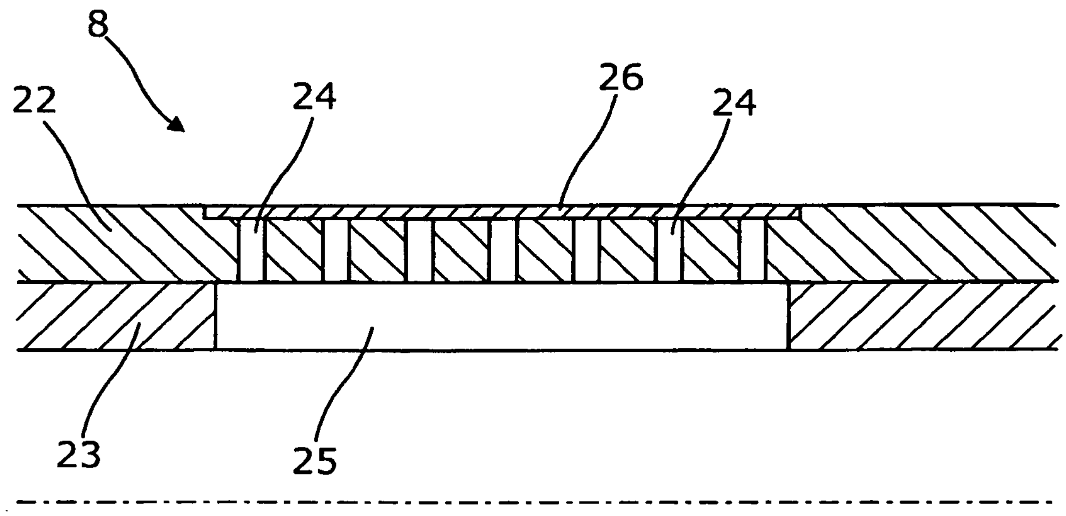
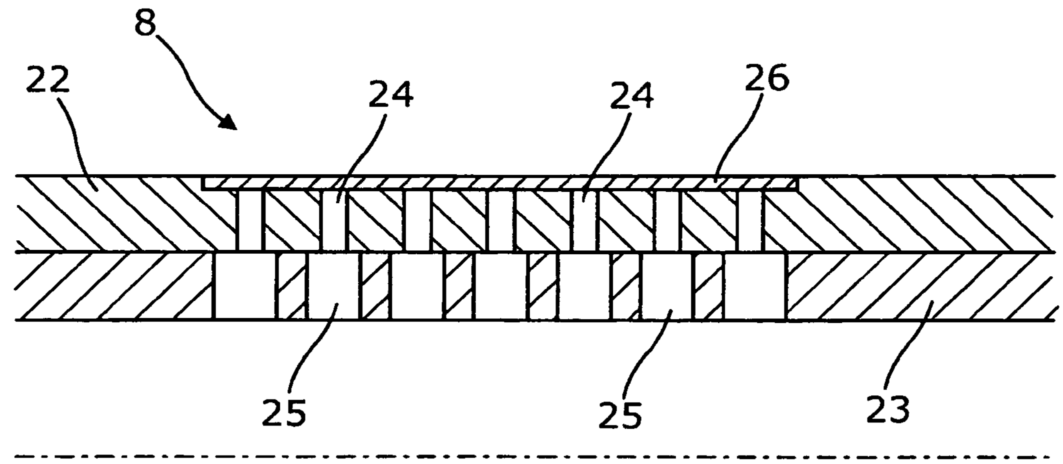


Fig. 4



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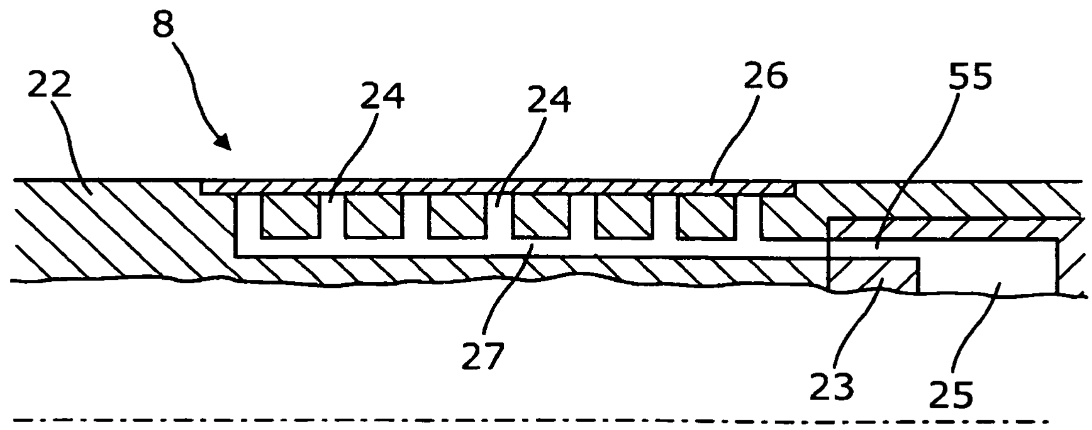

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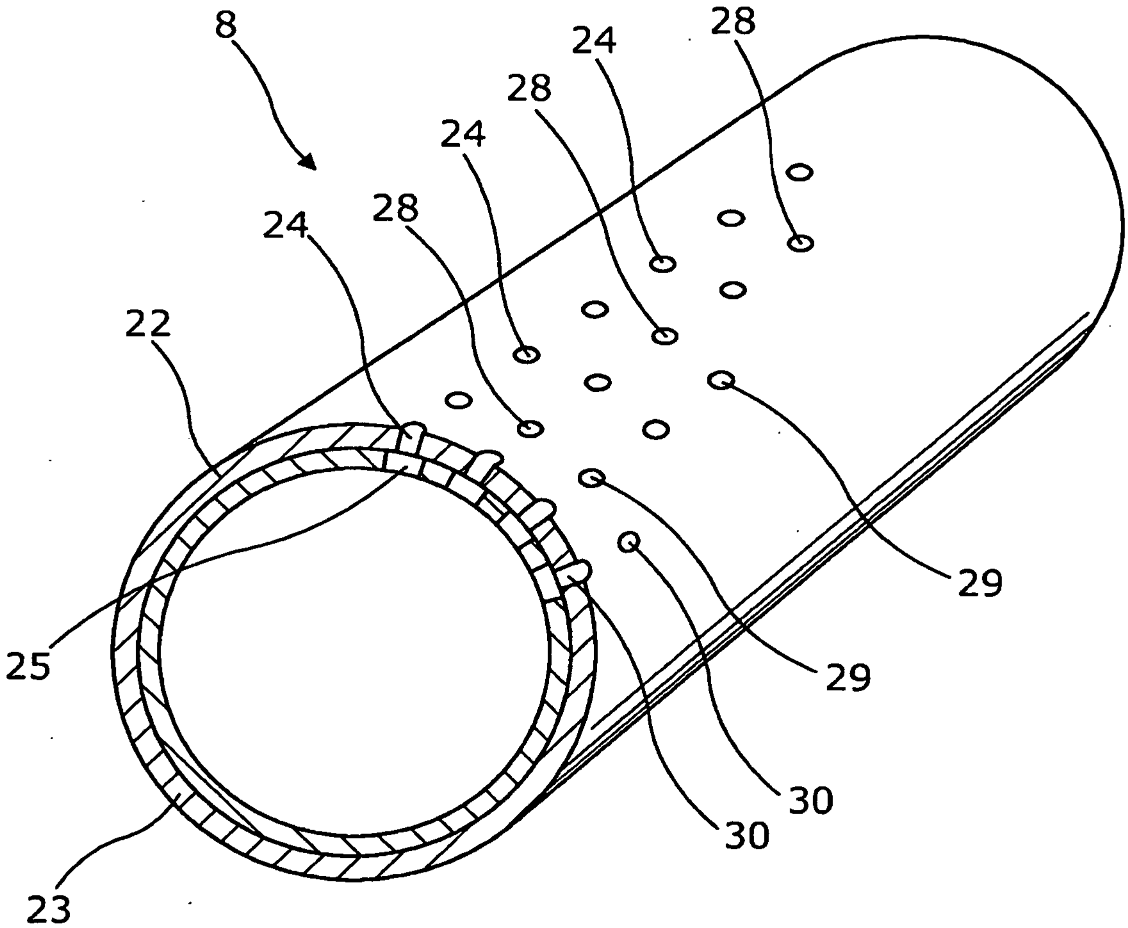


Fig. 7

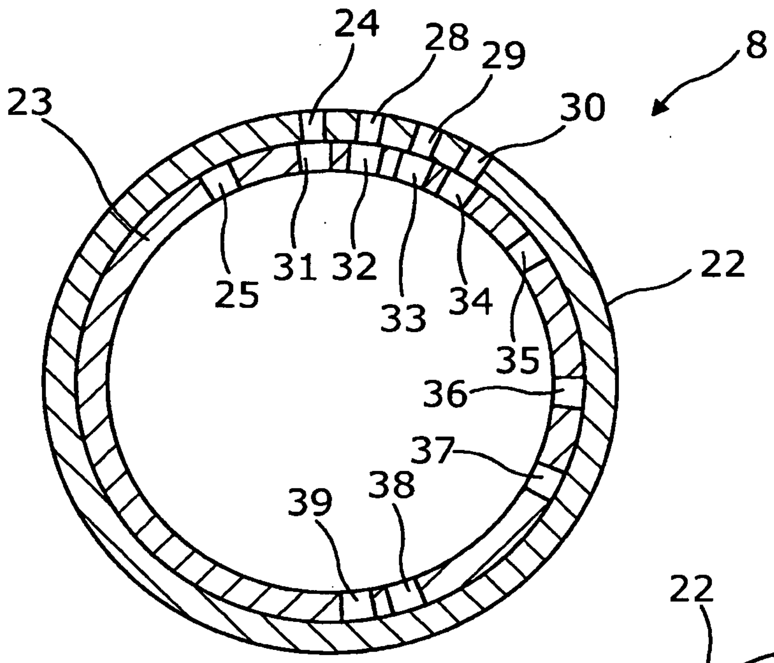
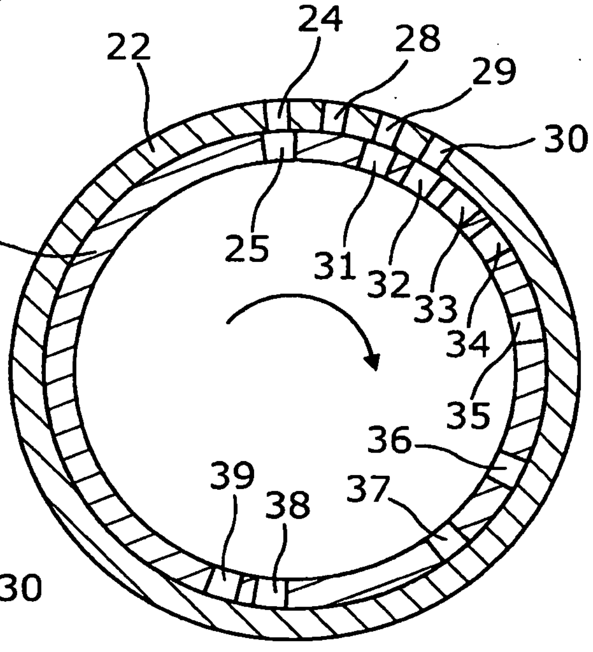


Fig. 8a



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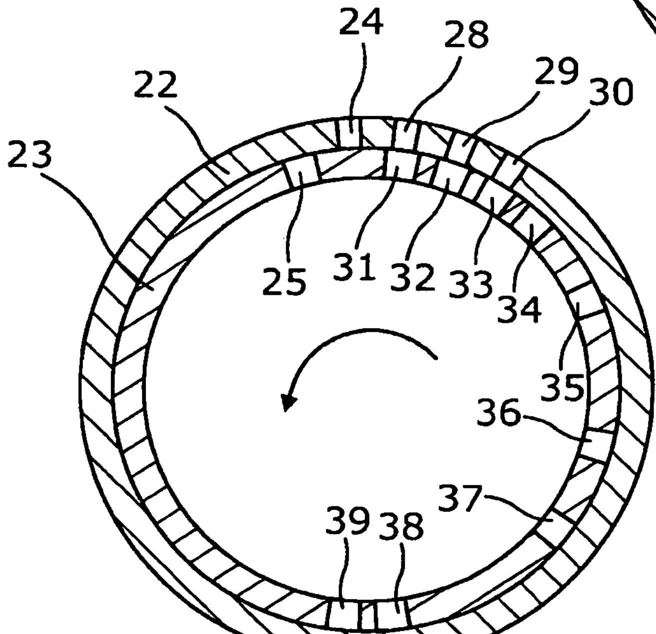

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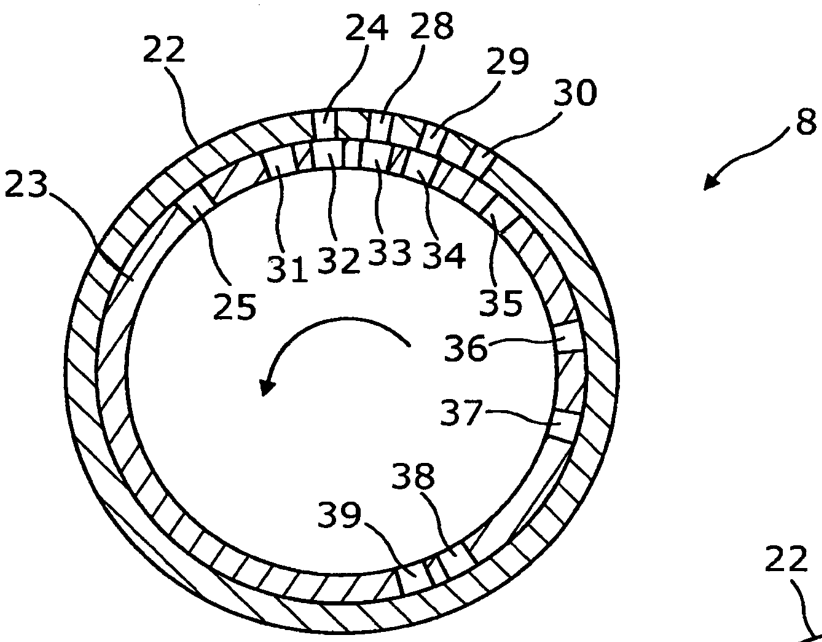
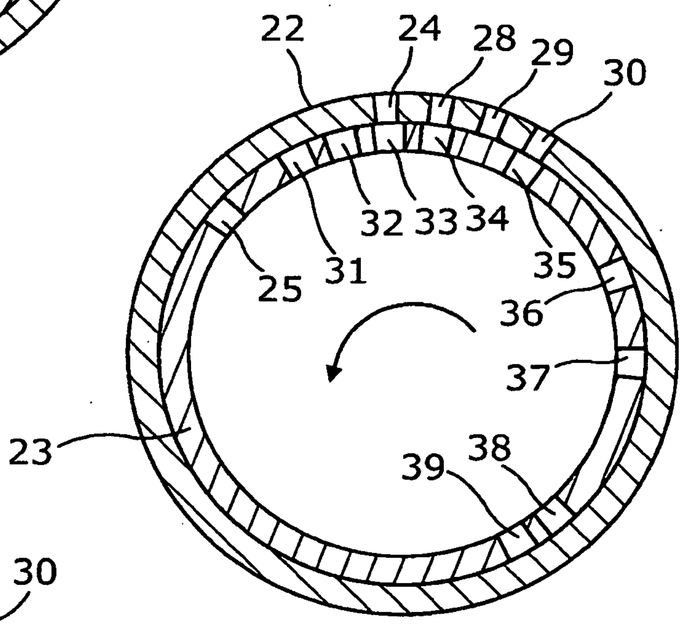


Fig. 8d



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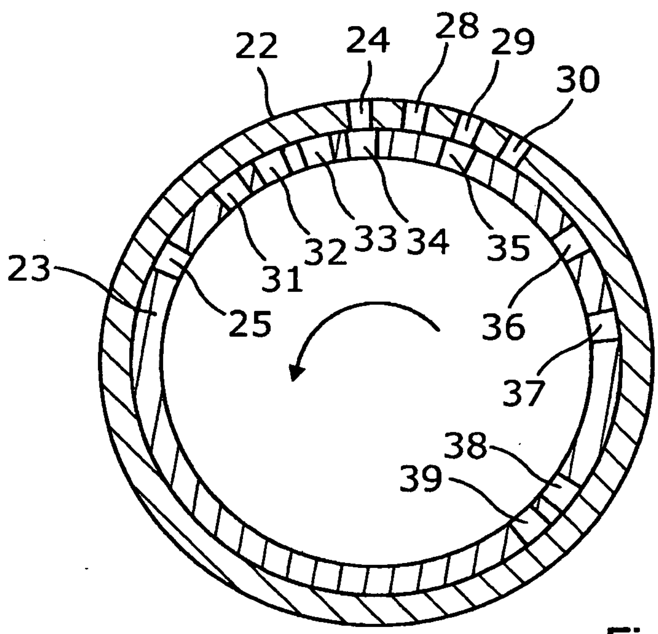

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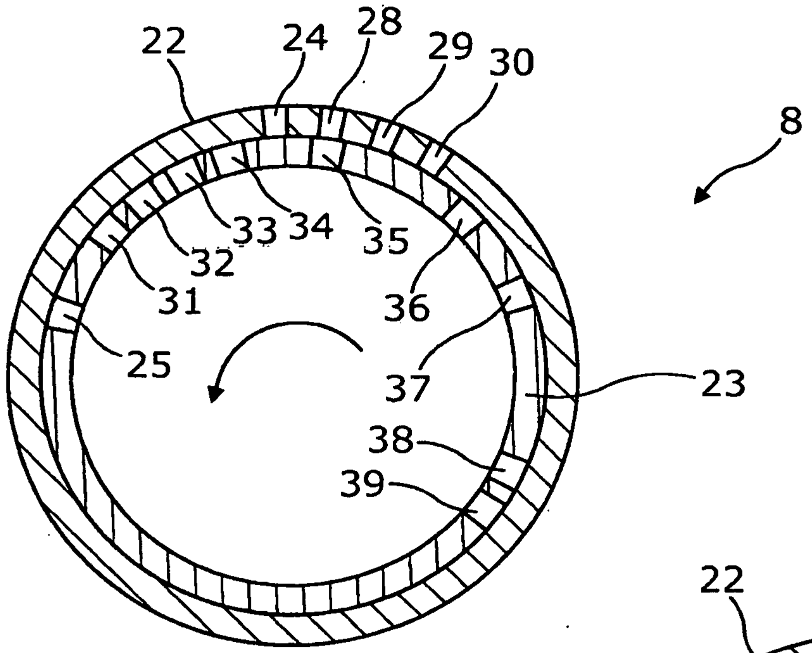
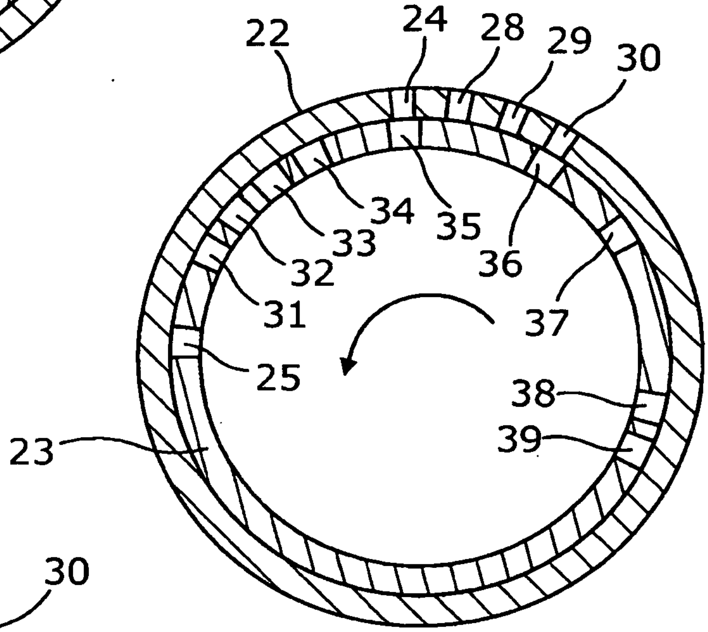


Fig. 8g



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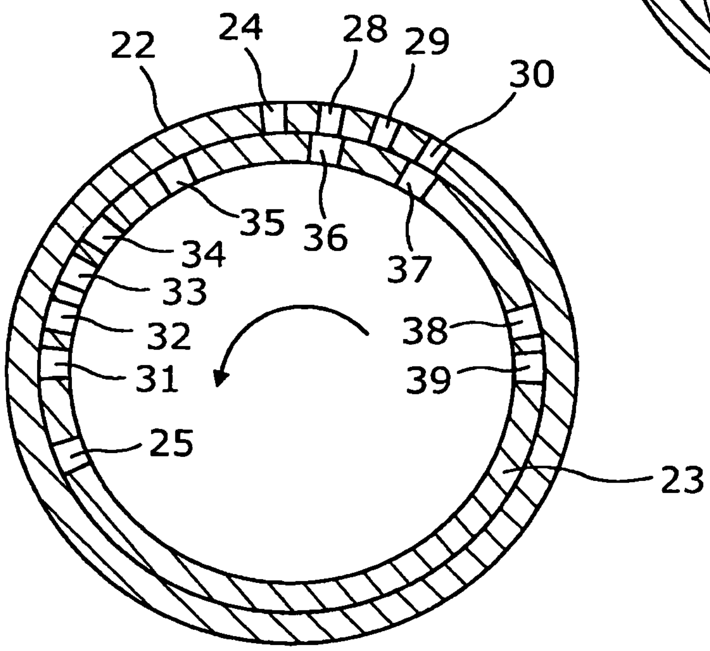

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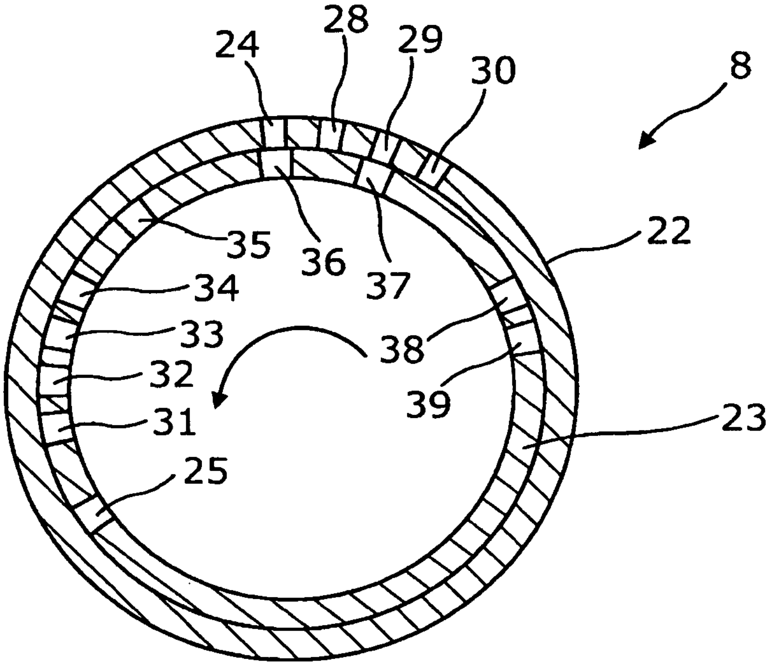

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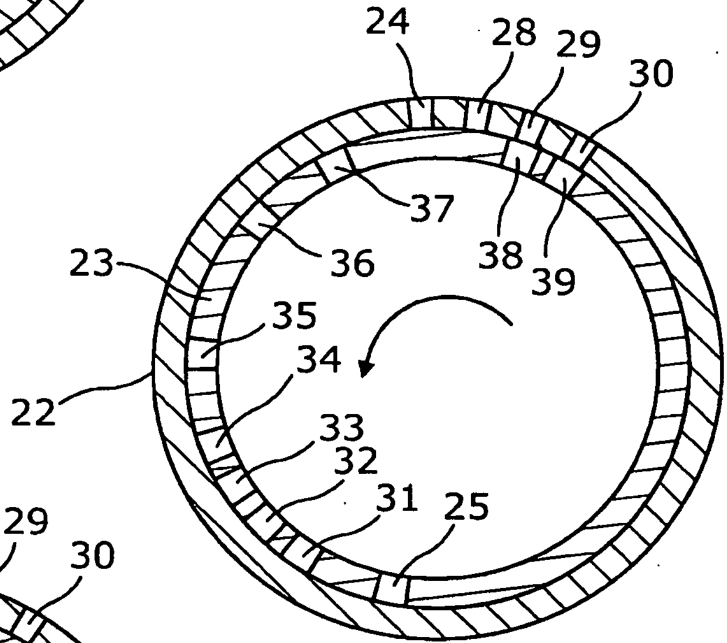

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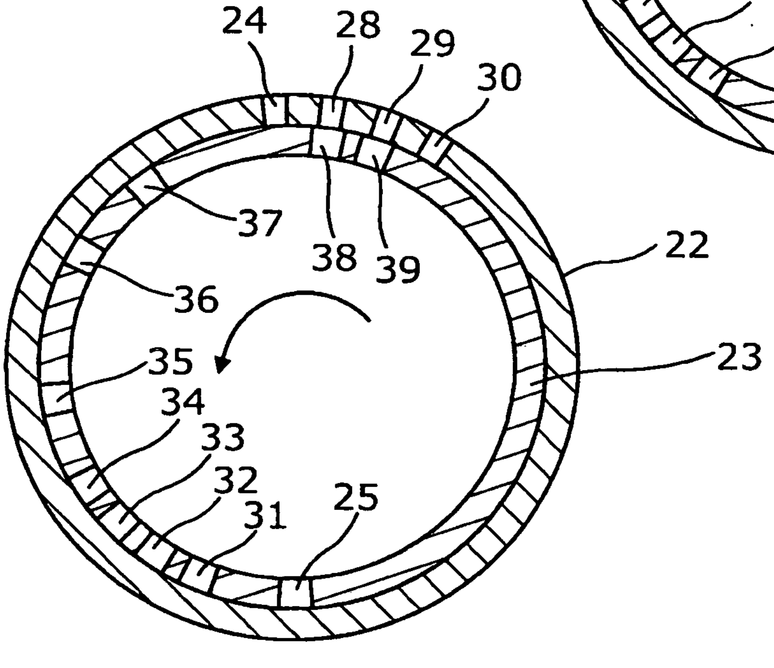

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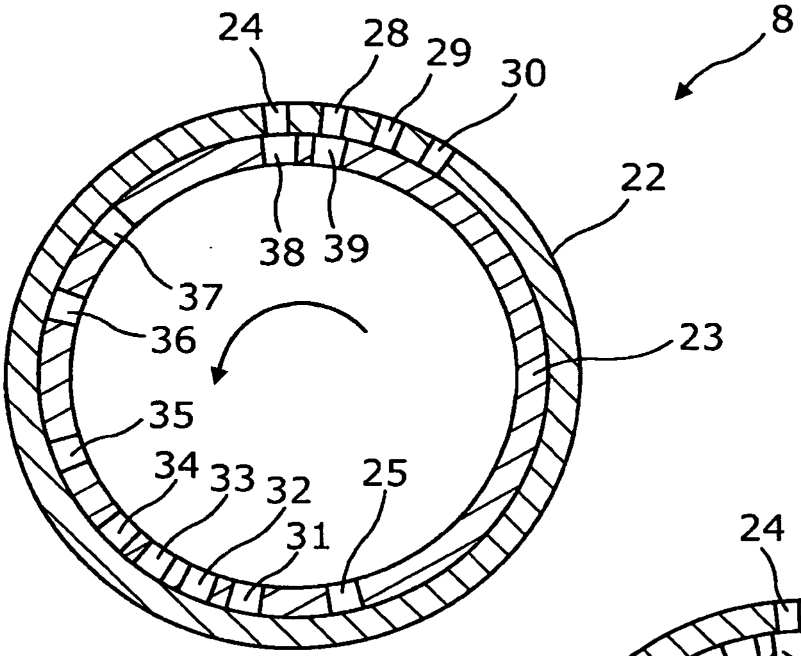

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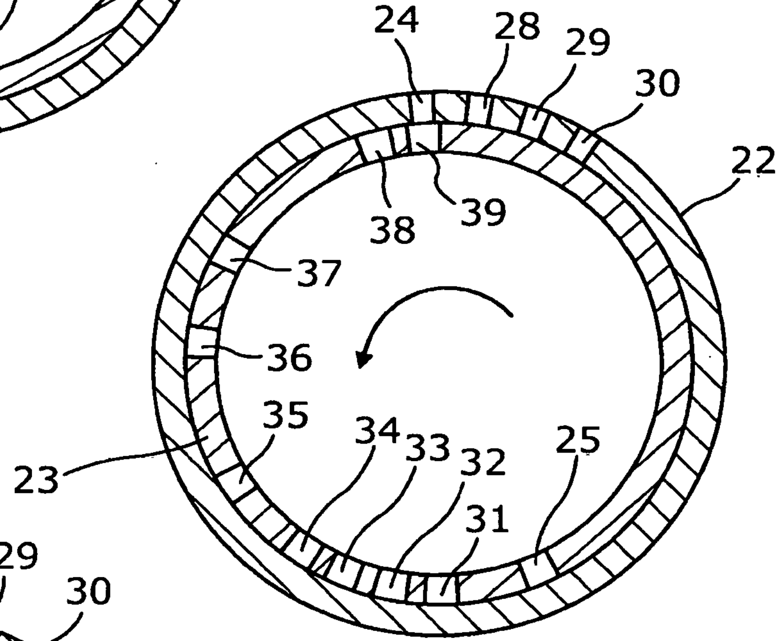
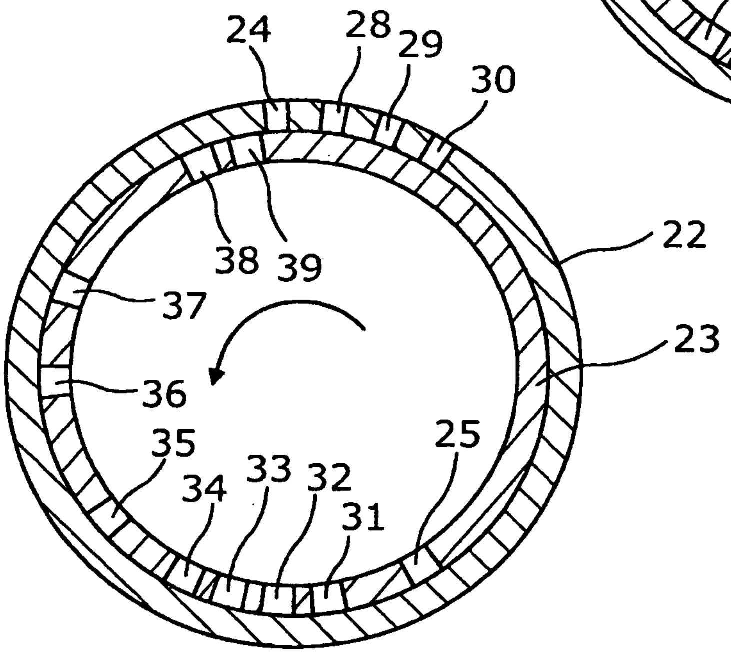


Fig. 8n



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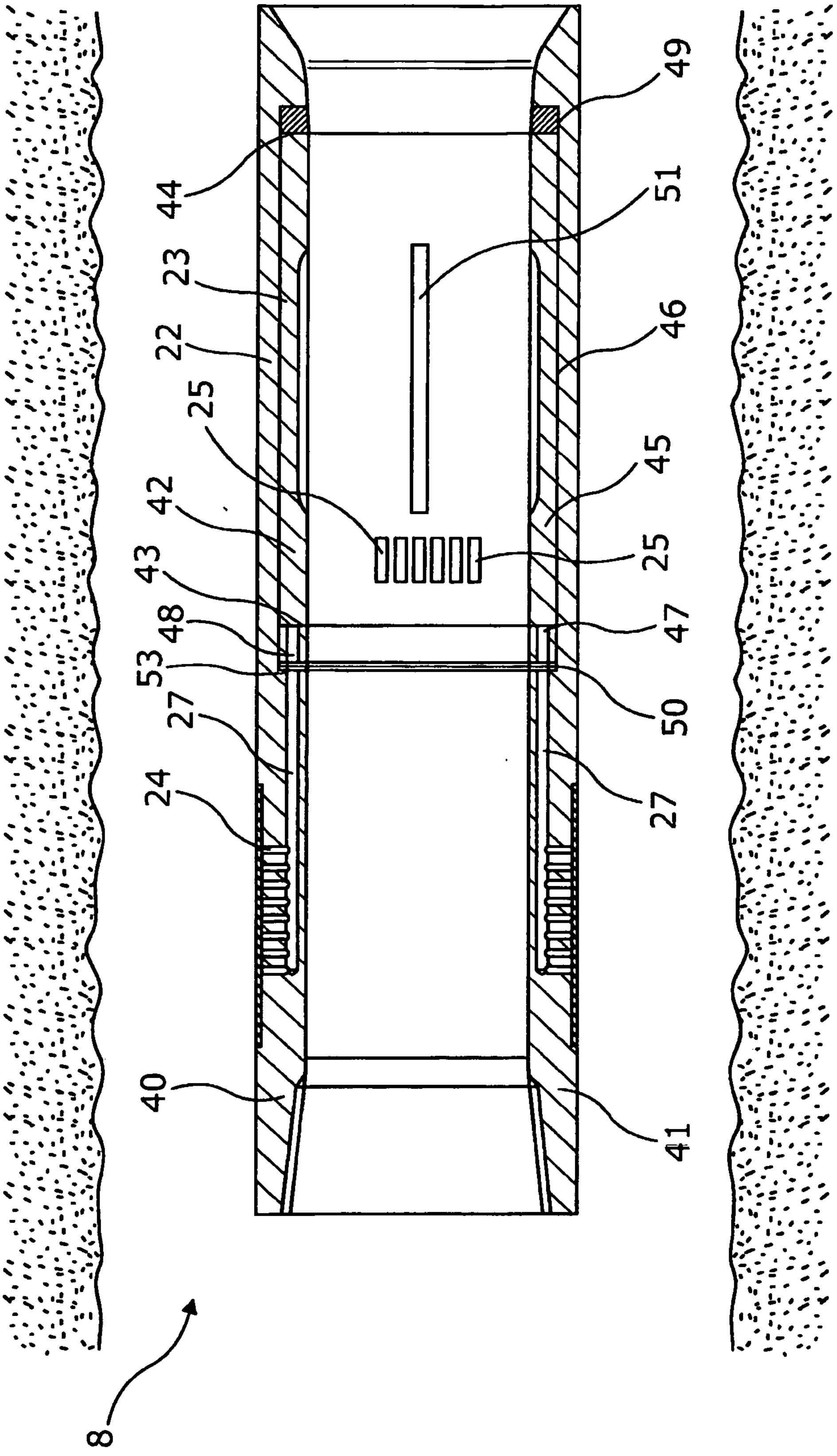

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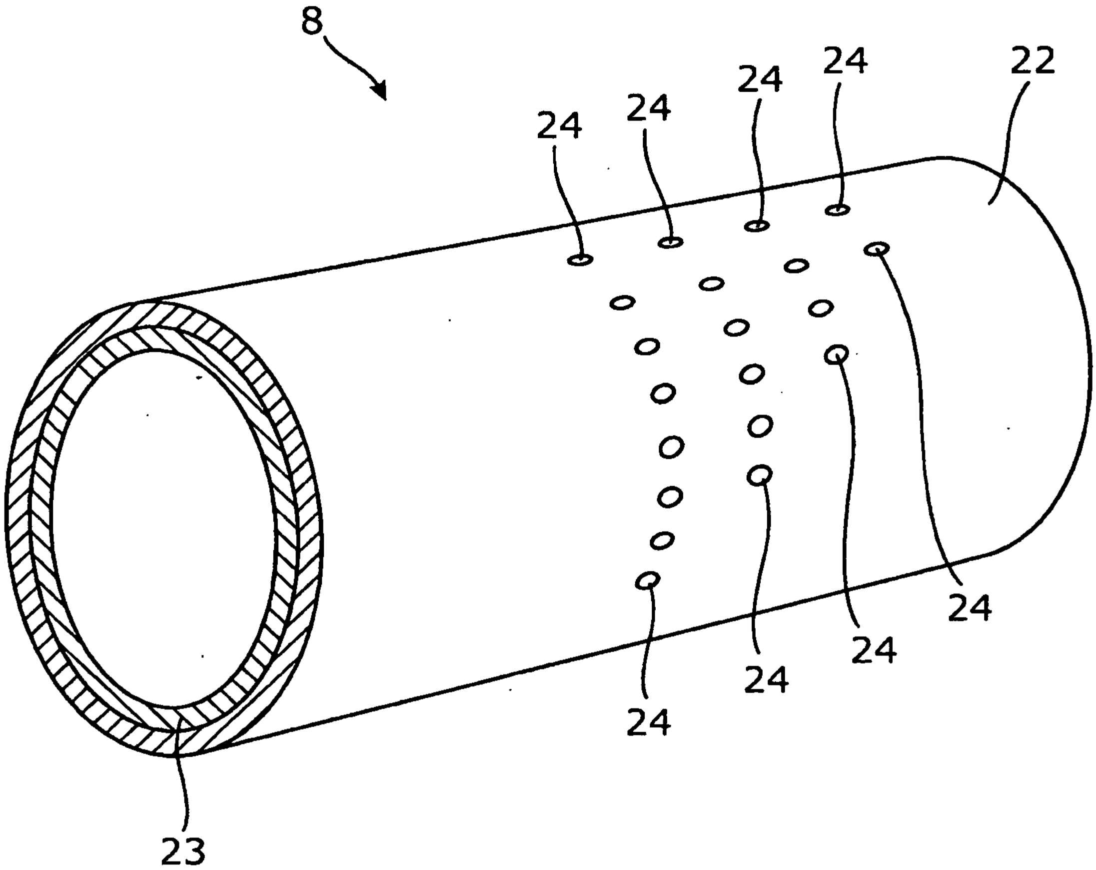

Fig. 10

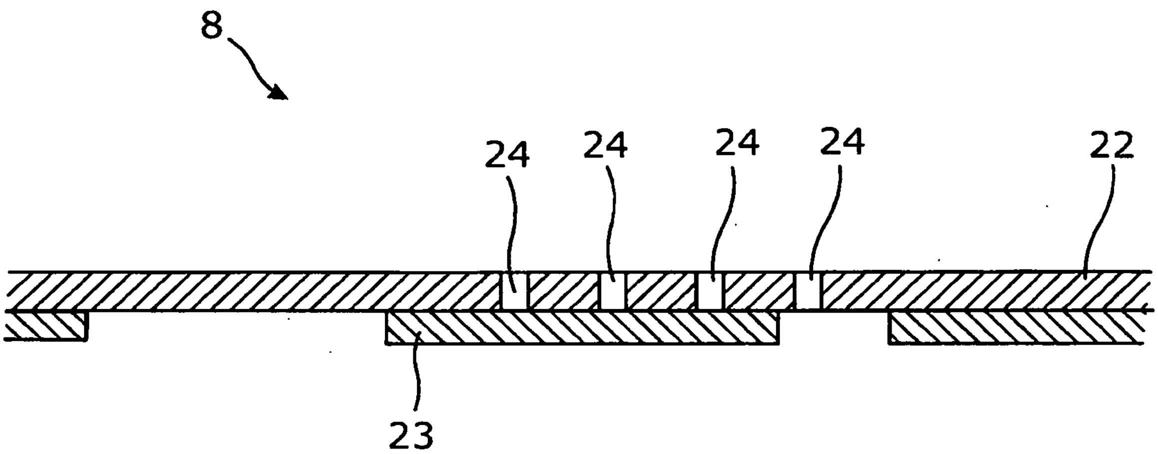

Fig. 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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