(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 696 026 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.02.2014 Bulletin 2014/07

(51) Int Cl.:
E21B 23/14 *(2006.01)*

(21) Application number: **12180078.3**

(22) Date of filing: **10.08.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicant: **Welltec A/S**
3450 Allerød (DK)

(72) Inventors:
- **Hallundbæk, Jørgen**
  3230 Græsted (DK)
- **Mangal, Lars**
  2900 Hellerup (DK)
- **Vasques, Ricardo Reves**
  2840 Holte (DK)

(74) Representative: **Hoffmann Dragsted A/S**
Rådhuspladsen 16
1550 Copenhagen V (DK)

(54) **Downhole turbine-driven system**

(57) The present invention relates to a downhole system for performing an operation in a well downhole. The system comprises an elongated tubing string for conducting fluid in the well; a turbine driven by the fluid for driving a shaft; a generator driven by the turbine, and an electrically driven driving section comprising an electrical motor powered by the generator for propelling the driving section and the tubing string forward in the well.

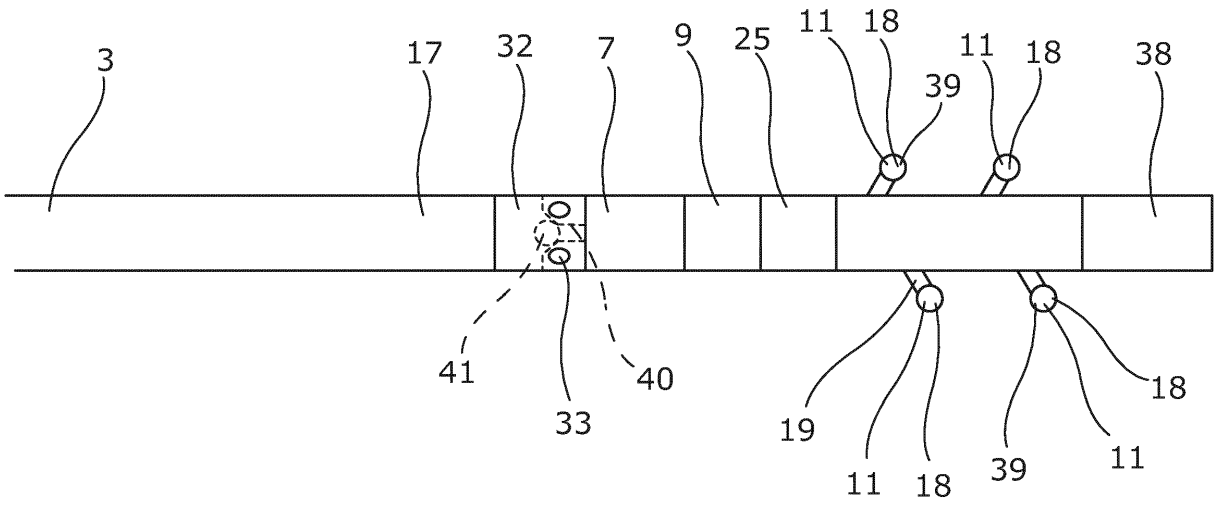


Fig. 2

EP 2 696 026 A1

Description

Field of the invention

[0001] The present invention relates to a downhole system for performing an operation in a well downhole, comprising an elongated tubing string for conducting fluid in the well and an elongated tubing string for conducting fluid in the well.

Background art

[0002] Hydrocarbon wells often have more than one branch or lateral radiating from the main borehole. The laterals may again have laterals and be of varies length. When a borehole having long lateral have been completed, the borehole is treated with acid to make the hydrocarbon containing fluid flow and the production is initiated. In order to perform an acid treatment in a lateral, the coiled tubing is pushed down through the borehole or cased hole into the lateral. However, when the coiled tubing is pushed down from surface it tends to curl as its moves into the lateral which is more horizontal than the main borehole and at some point the coiled tubing gets stuck in the lateral. The laterals are therefore not made as long as it is possible to drill them as the later acid and service equipment is not able to enter the last part of such long laterals as they have too small a diameter for the known equipment to enter.

Summary of the invention

[0003] It is an object of the present invention to wholly or partly overcome the above disadvantages and drawbacks of the prior art. More specifically, it is an object to provide an improved downhole system being able to service a long lateral with a tubing string.

[0004] The above objects, together with numerous other objects, advantages, and features, which will become evident from the below description, are accomplished by a solution in accordance with the present invention by a downhole system for performing an operation in a well downhole, comprising:

- an elongated tubing string for conducting fluid in the well,
- a turbine driven by the fluid for driving a shaft,
- a generator driven by the turbine, and
- an electrically driven driving section comprising an electrical motor powered by the generator for propelling the driving section and the tubing string forward in the well.

[0005] The downhole system may further comprise a fluid-driven driving section comprising a pump driven by the fluid for propelling the driving section and the tubing string forward in the well, the fluid-driven driving section being arranged between the generator and the electrically driven driving section.

[0006] In an embodiment, the pump may be driven by the shaft of the turbine.

[0007] Furthermore, the elongated tubing string may be coiled tubing.

[0008] Furthermore, the driving sections may have outer diameters being less than 7 inches, preferably less than 6 inches, and more preferably less than 5 inches.

[0009] Moreover, the tubing string may have a length of at least 5 km, preferably a length of at least 7 km, more preferably a length of at least 9 km, and even more preferably a length of at least 10 km.

[0010] Additionally, the generator and the electrical motor may be electrically connected through an electrical connection extending through the fluid-driven driving section.

[0011] Also, the fluid from the tubing string may be supplied to the pump of the fluid-driven driving section through a fluid channel extending through the turbine and the generator.

[0012] In addition, a pressure control valve may be arranged in the fluid channel for reducing the passage of fluid to the pump of the fluid-driven driving section.

[0013] Further, a flow diverter valve may be arranged in the fluid channel for diverting the fluid supplied to the channel to the turbine.

[0014] Moreover, the driving section may comprise propelling units contacting an inner surface of the well for propelling the driving sections forward in the well.

[0015] Also, the propelling units may be non-hydraulically driven units and driven by the electrical motor.

[0016] Furthermore, the propelling units may be wheels contacting an inner surface of the well.

[0017] In an embodiment, each wheel may be arranged on a projectable wheel arm.

[0018] In addition, the wheel arms of the fluid-driven driving section may project in a first direction from a section housing, and the wheel arms of the electrically driven driving section may project in a second direction substantially perpendicular to the first direction.

[0019] Furthermore, the electrical motor may drive the wheels of the electrically driven driving section.

[0020] Moreover, each propelling unit of the electrically driven driving section may comprise an electrical motor powered by the generator.

[0021] Additionally, the electrically driven driving section may comprise a pump driven by the electrical motor for driving the electrically driven driving section forward in the well.

[0022] The downhole system may further comprise a second electrically driven driving section driven by the generator through an electrical connection in the other electrically driven driving section arranged closest to the tubing string.

[0023] In one embodiment, the electrically driven driving section arranged closest to the tubing string may comprise a pump for driving hydraulically driven propelling units.

[0024] Moreover, the second electrically driven driving section may comprise propelling units which are non-hydraulically driven units.

[0025] In another embodiment, each propelling unit of the second electrically driven driving section may comprise an electrical motor powered by the generator.

[0026] Furthermore, the electrically driven driving section may comprise a rechargeable battery.

[0027] The downhole system may further comprise a flow diverter for diverting at least part of the fluid from the tubing string into the well.

[0028] It is hereby possible to perform acid treatment of the well after the tubing string has been pulled all the way into the very long lateral by starting to pump an acid composition into the tubing string from surface.

[0029] In an embodiment, the flow diverter may be arranged in a dispersion unit for dispersion of fluids, such as chemical reactants in the well.

[0030] The chemical reactants may be acid or base containing fluid.

[0031] The downhole system may further comprise an inflation unit for shielding the driving section while a stimulation operation is performed or the well is treated with an acid or base containing fluid.

[0032] Furthermore, the downhole system may comprise a detachment unit for detaching the driving section from the tubing string.

[0033] In an embodiment, the detachment unit may be comprised in the dispersion unit.

[0034] Furthermore, the downhole system may comprise several electrically driven driving sections, all powered by the generator.

[0035] Moreover, the downhole system may comprise several generators driven by the shaft.

[0036] Finally, the present invention relates to a stimulation method for performing acid treatment of a long lateral by the downhole system described above, comprising the steps of:

- connecting the turbine with the tubing string,
- connecting the generator with the turbine,
- connecting the fluid-driven driving section with the turbine,
- connecting the electrically driven driving section with the fluid-driven driving section so that electricity is conducted from the generator to the electrically driven driving section,
- supplying pressurised fluid into the tubing string,
- pulling the tubing string into the lateral by means of the driving sections, and
- supplying fluid having an acid concentration down the tubing string to an outlet in the downhole system for treating the lateral with acid.

Brief description of the drawings

[0037] 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 downhole system according to the present invention,

Fig. 2 shows a side view of a downhole system according to the invention,

Fig. 3 shows a side view of another downhole system according to the invention,

Fig. 4 shows a side view of the downhole system according to Fig. 1,

Fig. 5 shows a side view of another embodiment of the downhole system,

Fig. 6 shows a cross-sectional view of the fluid-driven driving section shown in Fig. 4,

Fig. 7 shows a side view of another downhole system,

Fig. 8 shows a side view of yet another downhole system,

Fig. 9 shows a side view of yet another downhole system in its deflated position, and

Fig. 10 shows the downhole system in its inflated and detached position.

[0038] 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

[0039] Fig. 1 shows a hydrocarbon well 2 having laterals radiating from a main borehole 12. In one of the long laterals 13, a tubing string 3, also called coiled tubing, is being pulled into the more horizontal part of the lateral 13 by two driving sections 5, 10, being a fluid-driven driving section 5 and an electrically driven driving section 10. The driving sections 5, 10 propel themselves and the tubing string within a casing 15 in the lateral. The driving sections 5, 10 are connected with the end 14 of the tubing string which is the furthest away from a well head 30 at the top of the well at the surface or seabed. When entering long laterals by forcing a tubing string down the well, the tubing string will curl at some point - also called the "coiled tubing hang-up point" - which causes the string to get stuck. By arranging the driving sections in front of the tubing string, the end of the tubing string is forced forward, preventing the string from curling

and getting stuck, and the tubing string is thereby pulled further into the lateral beyond the hang-up point.

[0040] Today, laterals are made as long as operation and service equipment are able to operate and service along the entire length of the lateral. Once the operation equipment is able to enter further into the ground, the borehole and the laterals can be made longer. Laterals are made with a substantially smaller diameter than the main borehole, which limits the diameter of the equipment and service tools and thus the types of equipment and tools able to enter even the final and smallest part of a long lateral. Before a well is able to produce, it is subjected to acid treatment. In order to treat even the final part of the lateral, i.e. the part which is the furthest away from the main borehole, with acid, the tubing string supplying the acid needs to be pulled almost all the way to the end of the lateral. If this is not done, the tubing string will curl, which will render acid treatment of the entire lateral impossible and thereby prevent it from producing hydrocarbons. Pulling tools which are able to pull the tubing in the narrow and long laterals therefore need to be self-powered as they cannot be powered sufficiently through wireline from surface.

[0041] Therefore, between the driving sections 5, 10 and the tubing string 3, a turbine 7 is connected with the tubing string and is driven by high pressurised fluid supplied through the tubing string from the top of the well. The turbine 7 drives a generator 9 supplying power through the fluid-driven driving section 5 to the electrically driven driving section 10. When the driving sections enter the end or final part of the lateral, the lateral diameter is highly reduced, meaning that the diameter of the driving sections needs to be equally smaller. Therefore, there is no room in the first fluid-driven driving section for supplying fluid to a second driving section, and the second driving section therefore needs to be electrically driven, as electricity can be conducted through the fluid-driven driving section to the next electrically driven driving section 10.

[0042] The tubing string 3 may also be pulled into the lateral by only one electrically driven driving section comprising an electric motor 11, as shown in Fig. 2. The electrically driven driving section comprises propelling units 18 in the form of wheels, and each wheel comprises an electrical motor for rotating the wheel and propelling the driving unit and the tubing string forward in the well. Thus, the electrically driven driving section comprises non-hydraulically driven propelling units which are directly driven by the generator 9 through a control package 25. The downhole system may comprise several electrically driven driving sections arranged successively and all driven by the generator, as shown in Figs. 9 and 10.

[0043] The propelling units 18 of the electrically driven driving section may also be rotating units 36 around which a track 37 is arranged. One rotating unit 18 per track comprises an electrical motor 11 driving the track 37 or belt and thus propelling the driving section forward in the well.

[0044] As shown in Fig. 4, the fluid-driven driving section 5 comprises a pump 6. The pump 6 is either driven by the rotational shaft of the turbine or by the fluid 4 which is supplied to the pump through a fluid channel 16 penetrating the turbine 7 and the generator 9. The electrically driven driving section 10 comprises the electrical motor 11 powered by the generator for providing a propelling motion of the electrically driven driving section 10.

[0045] In Fig. 4, part of the high pressurised fluid drives the turbine 7 and thus the generator 9, and the motor of the electrically driven driving section 10 and part of the fluid drive the pump 6 of the fluid-driven driving section 5. In Figs. 2 and 3, all the fluid is used for driving the turbine and thus the generator powering the electrically driven driving section 10 or even further operational tools 38. The fluid in the tubing string 3 thus powers the driving section or sections as the tubing string is pulled into the long lateral 13 by the self-propelling driving sections. Hereby, the fluid from the tubing string is used to drive the tubing string forward in the lateral, and the fluid in the tubing string is simultaneously and/or subsequently used to perform an operation. The tubing string is thus able to enter even long and narrow laterals, such as laterals longer than 2 km and having an inner diameter of the casing or borehole smaller than 7 inches.

[0046] In order to propel the driving sections and the tubing string forward or backward in the well, the driving sections comprise propelling units 18, such as wheels 39, for contacting an inner surface of the casing or borehole in the well, as shown in Figs. 2, 4-5, and 7-10. The wheels 39 are arranged on projectable wheel arms 19 projecting from a housing 20 of the driving sections 5, 10.

[0047] In Fig. 5, the wheel arms of the fluid-driven driving section project in a first direction 21 from a section housing, and the wheel arms of the electrically driven driving section project in a second direction 22 substantially perpendicular to the first direction. The wheels are pressed into contact with the inner face of the casing or borehole by the projectable wheel arms for propelling the driving sections forward in the well.

[0048] The wheels of the fluid-driven driving section are rotated as each wheel comprises a hydraulic motor 23. All the hydraulic motors 23 of the fluid-driven driving section 5 are driven by the pump 6.

[0049] The wheels of the electrically driven driving section shown in Fig. 5 are also driven by a pump 24 comprised in the electrically driven driving section, which pump is driven by the electrical motor and drives the hydraulic motors 23 in each wheel 39.

[0050] In Figs. 2 and 7, the wheels 39 of the electrically driven driving section 10 each comprises an electrical motor 11 powered by the generator 9. As shown in Fig. 7, the electrically driven driving section 10 may comprise a control package 25 and a rechargeable battery 26. The rechargeable battery 26 may be charged as the tubing string is pushed down into the first part of the well where there is no risk of curling and getting stuck, and when the tubing string enters the last part of the well, the electrically

driven driving section 10 is activated to pull the end of the tubing string into the lateral.

[0051] The generator 9 generates electricity for powering the electrical motor arranged in the electrically driven driving section. The generator and the electrical motor are electrically connected through an electrical connection 17 extending through the fluid-driven driving section 5, as shown in Fig. 6.

[0052] In Fig. 4, a pressure control valve 28 is arranged in the fluid channel 16 for reducing the passage of fluid to the pump of the fluid-driven driving section. In this way, the pressure of the pressurised fluid does not need to be controlled as accurately from surface to avoid harming the components of the pump. If the pressure of the fluid is too high and to hinder damage of the components of the turbine and the generator, a flow diverter 29 is arranged in connection with the turbine for diverting at least part of the fluid supplied to the turbine out through an outlet 33 and into the well surrounding the downhole system, as shown in Fig. 5.

[0053] As shown in Fig. 7, a flow diverter valve 31 is arranged in the fluid channel for diverting the fluid supplied to the channel to the turbine, and thus, if the pressure of the fluid in the channel is too high, more fluid is allowed to pass through the turbine.

[0054] When the tubing string 3 has been pulled all the way into the long lateral and the acid operation is to be performed, the fluid having a high acid concentration is supplied down through the tubing string. When performing this type of operation, the downhole system may comprise a flow diverter 29, as shown in Fig. 8, for diverting at least part of the fluid from the tubing string into the well to eliminate the need for detaching the driving sections to let the fluid out of the tubing to perform the acid treatment or acid stimulation of the well. The flow diverter 29 is arranged in a dispersion unit 32 for dispersion of a chemical reactant, such as acid, in the well which is supplied to the chemical dispersion unit through the tubing string 3.

[0055] In Fig. 2, the dispersion unit 32 comprises a ball seat 40 which is activated by dropping a ball 41 down the tubing string to move the seat and enable passage of the fluid to the outlets 33. The ball in the ball seat closes the passage of fluid to the turbine.

[0056] A downhole system comprising both a fluid-driven driving section and an electrically driven driving section is shown in Fig. 7. This downhole system further comprises an operational tool arranged in front of the driving section and the furthest away from the tubing string. When the tubing string has been pulled to a certain position in the well, the enormous amount of power in the pressurised fluid in the tubing string can be used to generate power through the turbine and the generator to drive the operational tool.

[0057] The operational tool 38 shown in Figs. 2 and 7 may be any kind of tool, such as a setting tool, a release tool, a stroker tool, a key tool, a logging tool, etc. Due to the enormous amount of power in the pressurised fluid in the tubing string, the logging tool may operate when the tubing string is pulled down into the well without diminishing the propelling speed of the driving sections.

[0058] The downhole system shown in Fig. 9 comprises an inflation unit 35. The inflation unit 35 is inflated to shield the driving section while performing a stimulation operation, such as treating the well with acid or base containing fluid. The inflation unit 35 can be any kind of packer inflatable by high pressurised fluid. The inflation unit 35 is inflated e.g. by dropping one size ball into the fluid for moving the ball seat from a position where the fluid is allowed to pass into the turbine to a second position where the fluid is let into the inflation unit. After inflation of the inflation unit, a second and larger ball is dropped, moving the ball seat to a third position where the fluid is let into the well.

[0059] The downhole system may further comprise a detachment unit 43 arranged inside the dispersion unit 32 for detaching the driving sections from the tubing string, as shown in Fig. 9. Each driving section comprises a battery 26 and a control package 25 so that when the driving sections are detached from the tubing string and when e.g. the acid treatment has been performed, the driving sections are able to propel themselves out of the well.

[0060] The detachment of the tubing string may take place when the second ball is dropped and the ball seat is moved into a second position where the tubing string is detached from the driving section, thus allowing the fluid to enter into the well.

[0061] When the inflation unit has been inflated and the driving sections have been detached from the tubing string, as shown in Fig. 10, the tubing string may be pulled backwards, and the stimulation operation, such as the acid treatment, may be initiated.

[0062] Instead of having an inflation unit 35, the detached tubing string may be pulled further backwards to prevent damage of the driving sections while e.g. the acid treatment is performed.

[0063] Timers may be used for deflating the inflation unit and activating the driving section to propel themselves out of the well.

[0064] The electrical motor of the electrically driven driving section may also drive a gearing system driving the propelling units 18 or belts, and one electrical motor is thus able to drive several propelling units or even all propelling units.

[0065] When the downhole system comprises a second electrically driven driving section, this electrically driven driving section is driven by the generator through an electrical connection 17 in the other electrically driven driving section arranged closest to the tubing string. Hereby, a large number of electrically driven driving sections can be mounted onto the tubing string for pulling the tubing string forward in the well.

[0066] In another embodiment, the electrically driven driving section arranged closest to the tubing string may comprise a pump for driving the hydraulically driven pro-

pelling units each comprising a hydraulic motor 23.

[0067] In the event that two driving sections, such as one fluid-driven driving section and one electrically driven driving section, are not able to pull the tubing string all the way into the lateral, the downhole system may comprise several electrically driven driving sections all powered by the generator, as shown in Fig. 8. The downhole system may also comprise several generators driven by the output shaft 8 of the turbine in order to gain more power for pulling the tubing string.

[0068] In order to perform acid treatment or other fluid stimulations, such as scale removing operations, of the lateral of the well, the downhole system is mounted by connecting the turbine with the tubing string and connecting the generator with the turbine so that the generator is driven by the output shaft 8. Then, the fluid-driven driving section is connected with the turbine so that the fluid channel 16 is connected with the pump 6 of the fluid-driven driving section, and the electrically driven driving section is then connected with the fluid-driven driving section so that electricity is conducted from the generator through the fluid-driven driving section to the electrically driven driving section. The pressurised fluid is supplied down the tubing string to the turbine and the fluid channel. In this way, the tubing string is pulled directly into the lateral by the fluid-driven driving section by means of the pressurised fluid and by the electrically driven driving section by means of the turbine, the generator and the electrical motor. When the tubing string is in place for performing the acid treatment or another stimulation operation, fluid having a particular composition, e.g. an acid or base concentration or comprising enzymes, is supplied down through the tubing string to an outlet 33 in the downhole system for treating the lateral with acid.

[0069] The downhole system may comprise a dispersion unit 32 for dispersion of the fluid, such as acid or base, into the lateral. The dispersion unit may also comprise valves angled so that the unit is rotated as the pressurised acid containing fluid enters through the valves.

[0070] Driving sections able to contain long laterals may have an outer diameter being less than 5 inches and more preferably less than 4 inches. By long laterals is meant laterals, branches or side tracks having a length of at least 4 km, more preferably a length of at least 5 km, and more preferably a length of at least 7 km.

[0071] 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, or a chemical composition, such as an acid composition. 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.

[0072] By a casing is meant any kind of pipe, tubing, tubular, liner, string etc. used downhole in relation to oil or natural gas production.

[0073] The driving sections may be a downhole tractor or any kind of driving tool capable of pushing or pulling tools in a well downhole, such as a Well Tractor®.

[0074] Although the invention has been described in the above in connection with preferred embodiments of the invention, it will be evident for a person skilled in the art that several modifications are conceivable without departing from the invention as defined by the following claims.

Claims

1. A downhole system (1) for performing an operation in a well downhole (2), comprising:

   - an elongated tubing string (3) for conducting fluid (4) in the well,
   - a turbine (7) driven by the fluid for driving a shaft (8),
   - a generator (9) driven by the turbine, and
   - an electrically driven driving section (10) comprising an electrical motor (11) powered by the generator for propelling the driving section and the tubing string forward in the well.

2. A downhole system according to claim 1, further comprising a fluid-driven driving section (5) comprising a pump (6) driven by the fluid for propelling the driving section and the tubing string forward in the well, the fluid-driven driving section being arranged between the generator and the electrically driven driving section.

3. A downhole system according to claim 2, wherein the generator and the electrical motor are electrically connected through an electrical connection (17) extending through the fluid-driven driving section.

4. A downhole system according to claim 2 or 3, wherein the fluid from the tubing string is supplied to the pump of the fluid-driven driving section through a fluid channel (16) extending through the turbine and the generator.

5. A downhole system according to any of the preceding claims, wherein the driving section comprises propelling units (18) contacting an inner surface (27) of the well for propelling the driving sections forward in the well.

6. A downhole system according to claim 5, wherein the propelling units are non-hydraulically driven units and driven by the electrical motor.

7. A downhole system according to claims 5 or 6, wherein the propelling units are wheels (39) contacting an inner surface (27) of the well.

8. A downhole system according to claim 7, wherein each wheel is arranged on a projectable wheel arm (19).

9. A downhole system according to any of claims 5-8, wherein each propelling unit of the electrically driven driving section comprises an electrical motor (11) powered by the generator.

10. A downhole system according to any of the preceding claims, wherein the electrically driven driving section comprises a pump (24) driven by the electrical motor for driving the electrically driven driving section forward in the well.

11. A downhole system according to any of the preceding claims, wherein the electrically driven driving section comprises a rechargeable battery (26).

12. A downhole system according to any of the preceding claims, further comprising a flow diverter (29) for diverting at least part of the fluid from the tubing string into the well.

13. A downhole system according to claim 12, wherein the flow diverter is arranged in a dispersion unit for dispersion of fluids, such as chemical reactants in the well.

14. A downhole system according to any of the preceding claims, further comprising an inflation unit (35) for shielding the driving section while a stimulation operation is performed or the well is treated with an acid or base containing fluid.

15. A downhole system according to any of the preceding claims, further comprising a detachment unit for detaching the driving section from the tubing string.

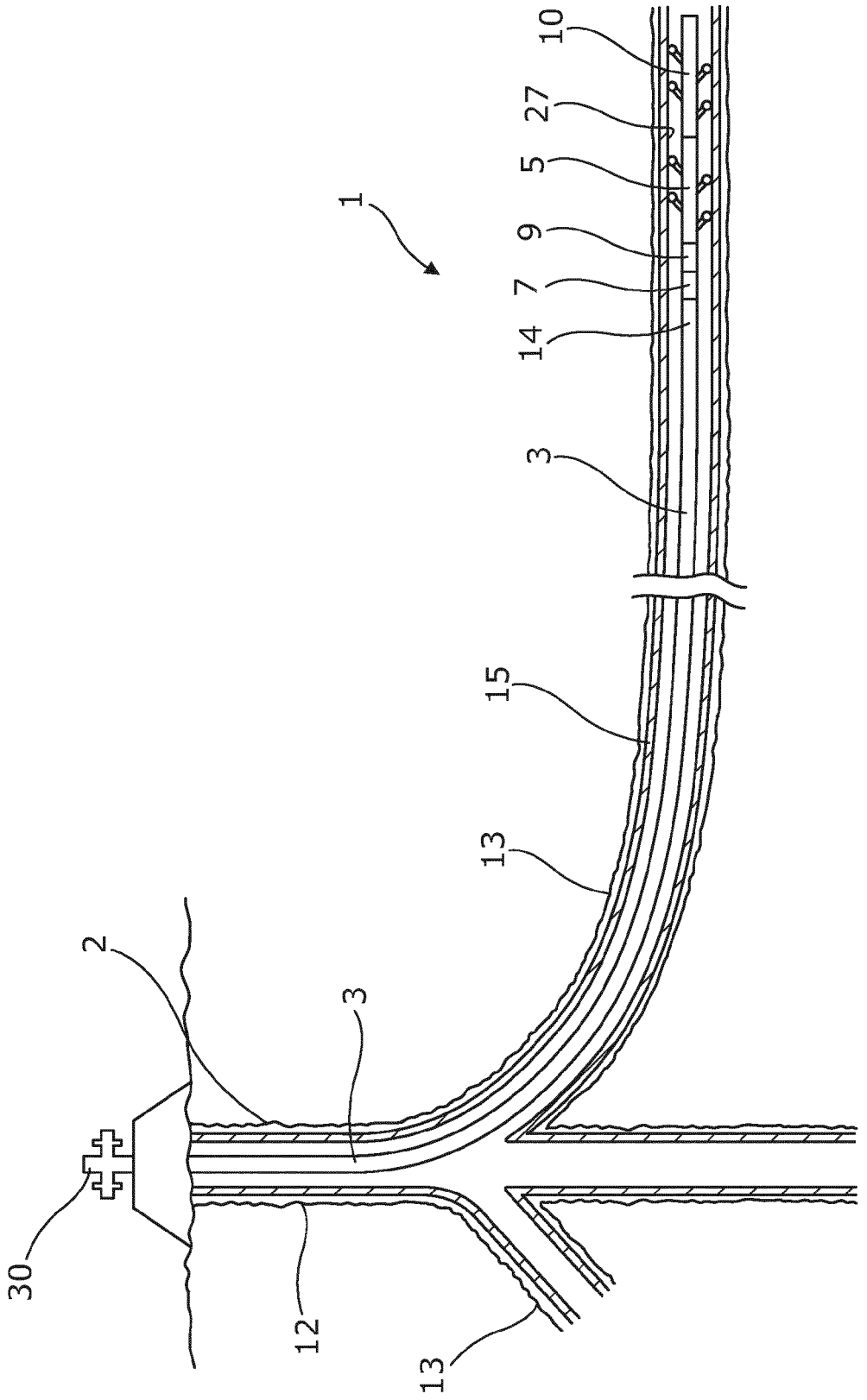


Fig. 1

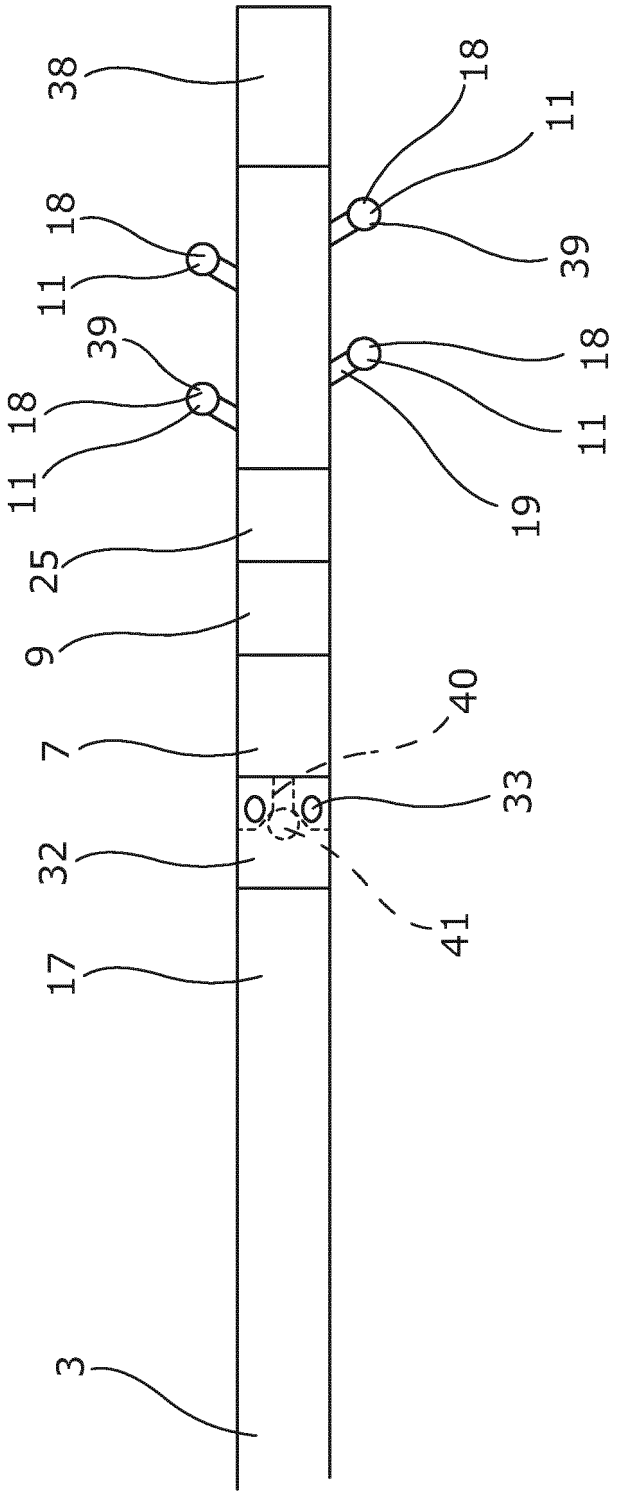


Fig. 2

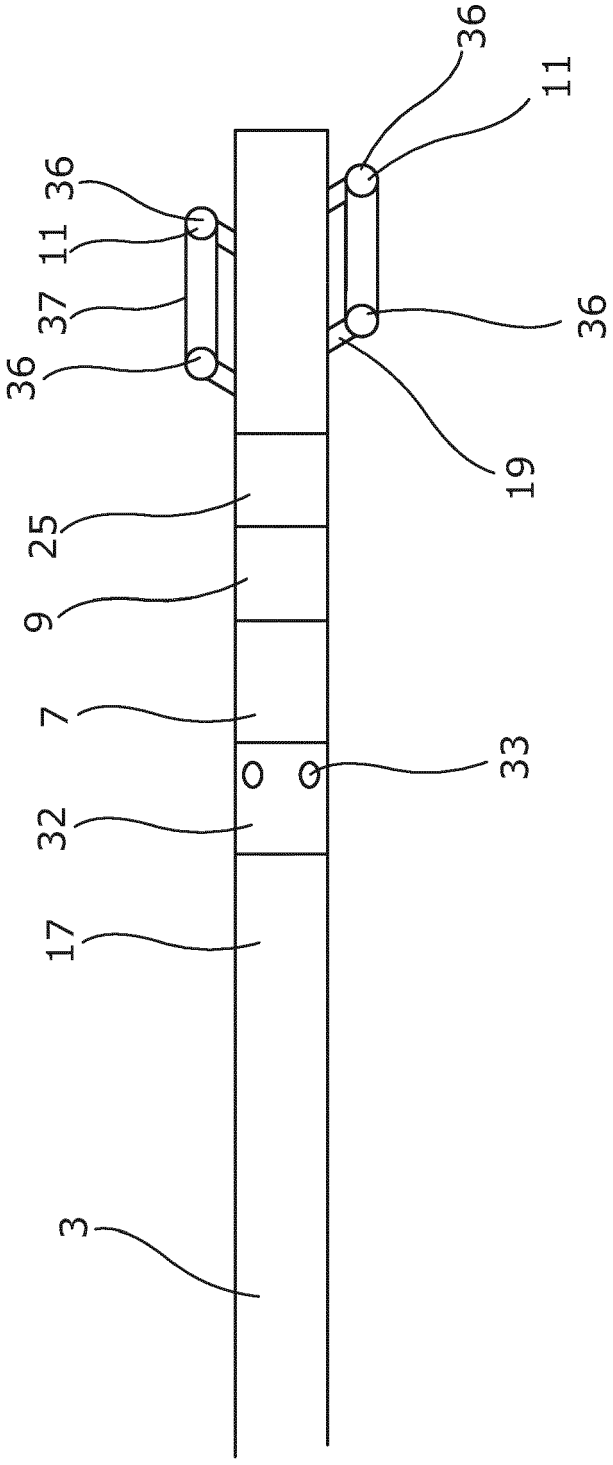


Fig. 3

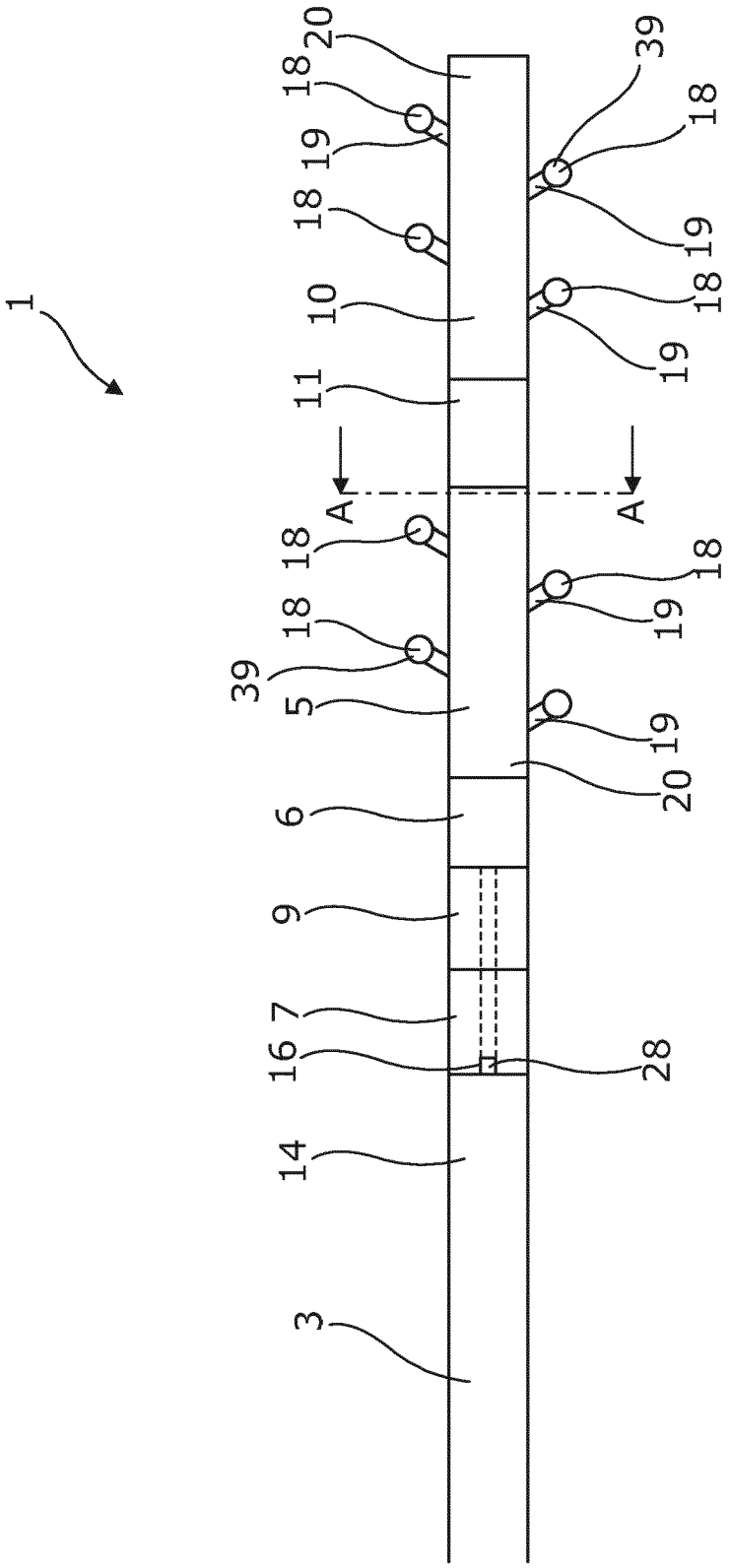


Fig. 4

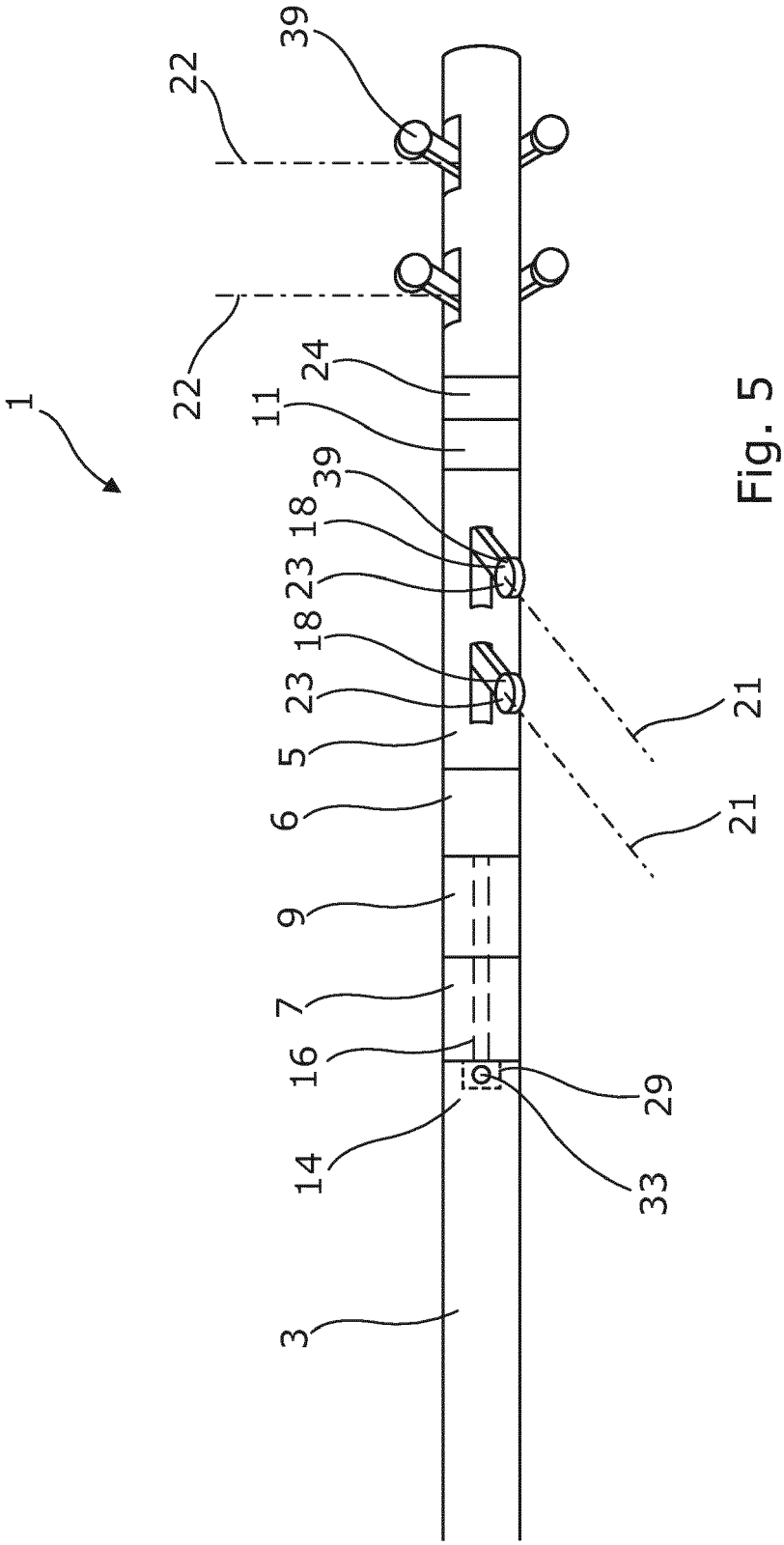
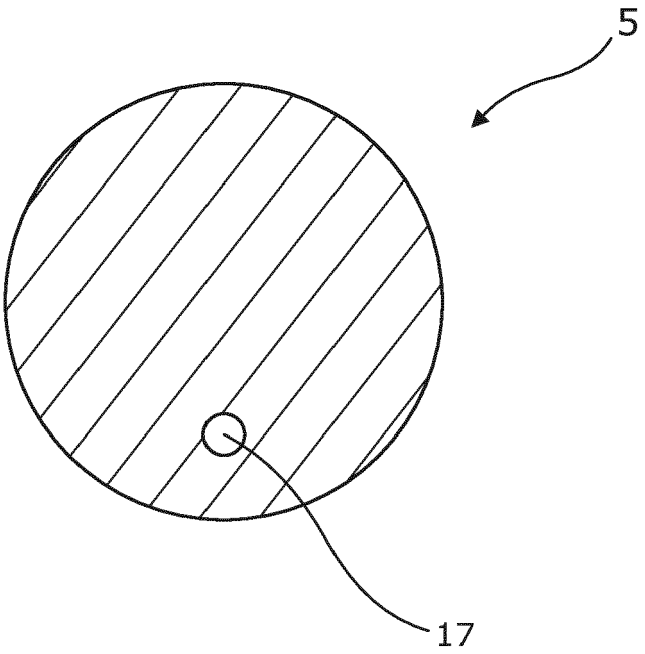


Fig. 5



A-A

Fig. 6

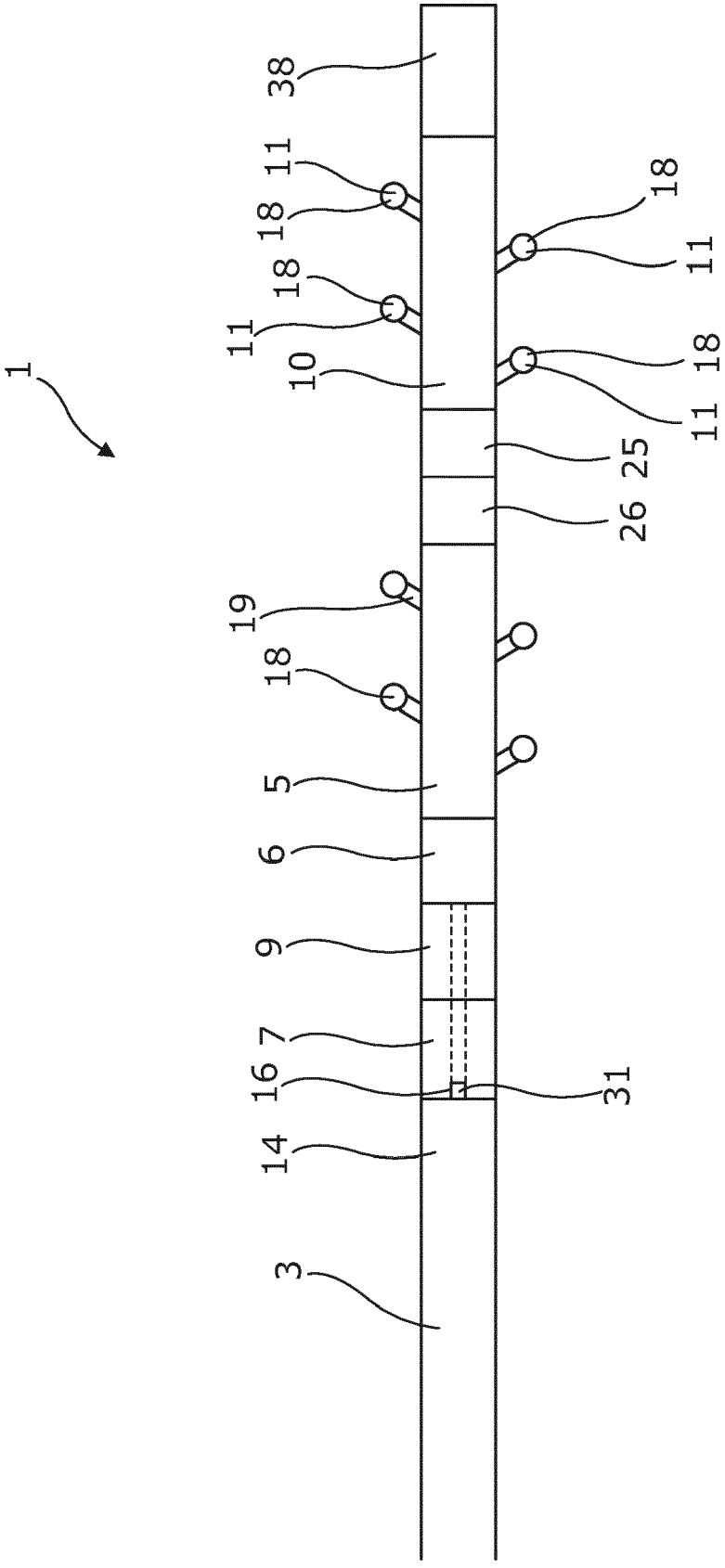


Fig. 7

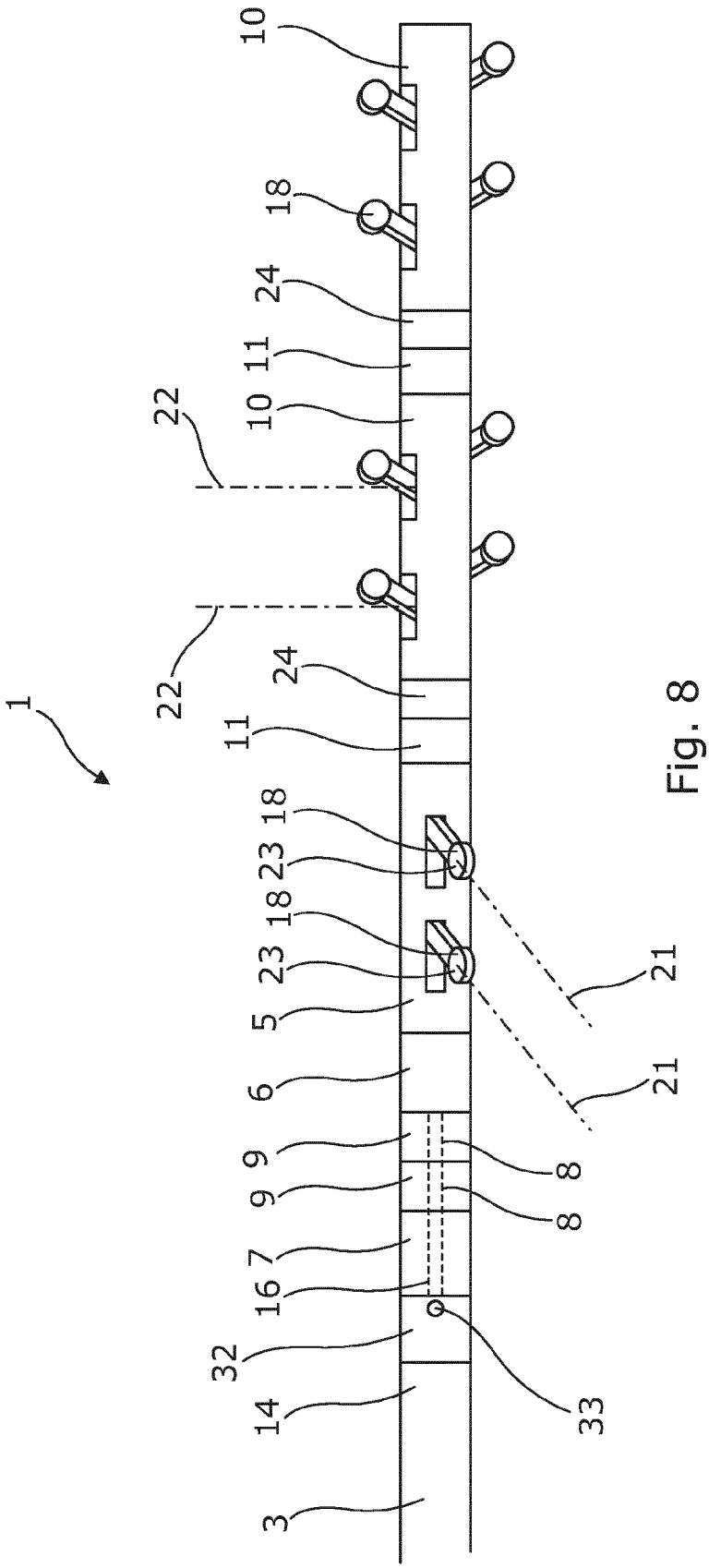


Fig. 8

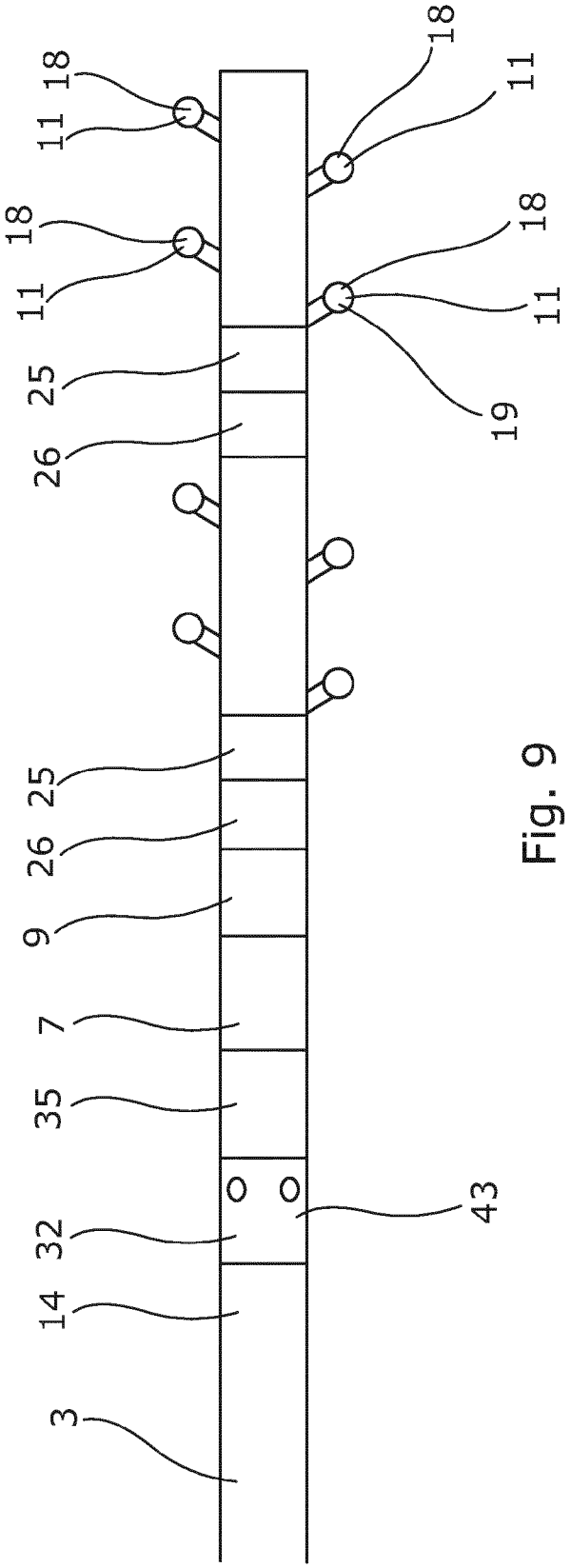


Fig. 9

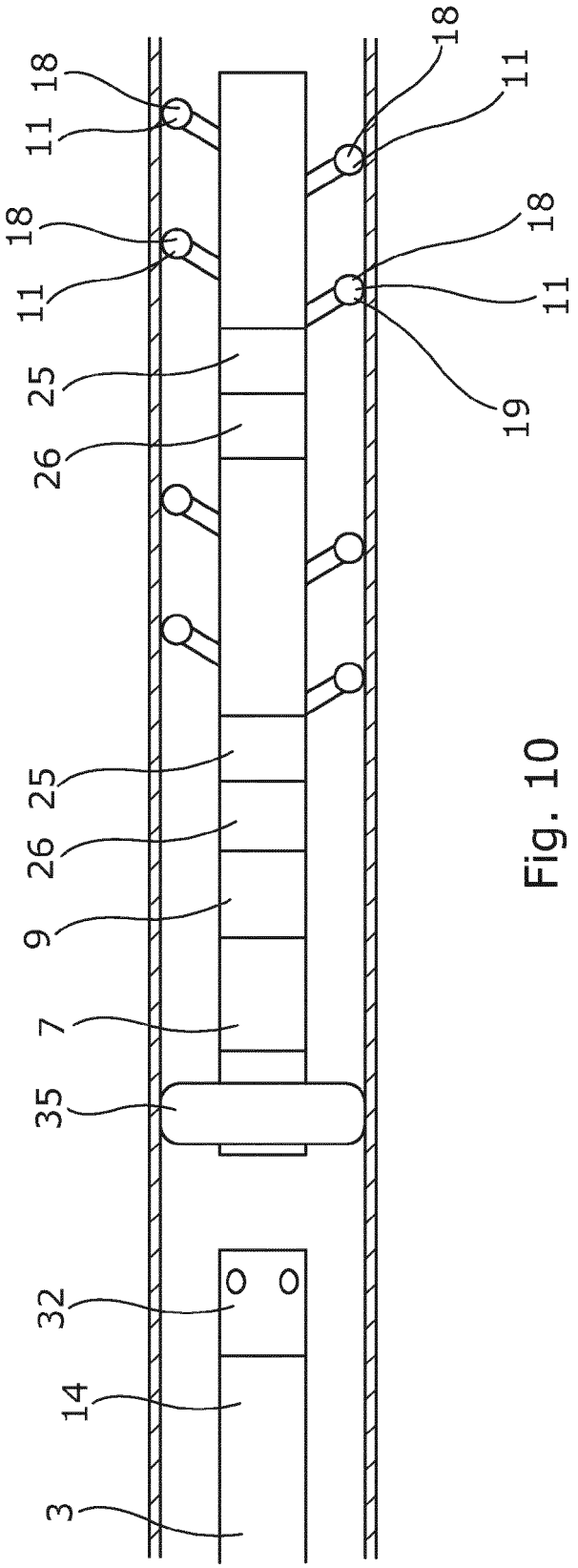


Fig. 10

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 12 18 0078

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 2008/217024 A1 (MOORE NORMAN [US]) 11 September 2008 (2008-09-11) * paragraph [0026] *	1,5,10, 11 2-4,6-9	INV. E21B23/14
Y	US 2001/045300 A1 (FINCHER ROGER [US] ET AL) 29 November 2001 (2001-11-29) * paragraph [0047] *	2-4	
A	US 2009/084540 A1 (SCHILTE PAUL DIRK [NL]) 2 April 2009 (2009-04-02) * paragraph [0025] *	2-4	
Y	US 6 273 189 B1 (GISSLER ROBERT W [US] ET AL) 14 August 2001 (2001-08-14) * claim 1; figures 1,7 *	6-9	
			TECHNICAL FIELDS SEARCHED (IPC) E21B

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
Munich	12 November 2012	Bellingacci, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

Application Number
EP 12 18 0078

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-11

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

Europäisches Patentamt
European Patent Office
Office européen des brevets

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 12 18 0078

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-11

   Downhole system comprising a turbine, an electrical generator, an electric driving section comprising an electric motor and a hydraulic driving section

   ---

2. claims: 12-15

   Downhole system comprising a turbine, an electrical generator, an electric driving section comprising an electric motor and a diverter.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 18 0078

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-11-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008217024 A1	11-09-2008	US 2008217024 A1	11-09-2008
		WO 2008024881 A1	28-02-2008
US 2001045300 A1	29-11-2001	CA 2266198 A1	20-09-1999
		GB 2335450 A	22-09-1999
		US 2001045300 A1	29-11-2001
US 2009084540 A1	02-04-2009	BR PI0621041 A2	10-07-2012
		CA 2636496 A1	26-07-2007
		CN 101360883 A	04-02-2009
		GB 2447389 A	10-09-2008
		US 2009084540 A1	02-04-2009
		WO 2007082590 A1	26-07-2007
US 6273189 B1	14-08-2001	AU 2307400 A	25-08-2000
		EP 1151177 A1	07-11-2001
		NO 20013814 A	03-08-2001
		US 6273189 B1	14-08-2001
		WO 0046481 A2	10-08-2000

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82