



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.04.2023 Bulletin 2023/15

(51) International Patent Classification (IPC):
E21B 23/00^(2006.01) E21B 23/14^(2006.01)

(21) Application number: **21202035.8**

(52) Cooperative Patent Classification (CPC):
E21B 23/001; E21B 23/14

(22) Date of filing: **11.10.2021**

(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
Designated Validation States:
KH MA MD TN

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

(72) Inventor: **ANDERSEN, Tomas Sune**
3450 Allerød (DK)

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

(54) **DOWNHOLE SELF-PROPELLING WIRELINE TOOL**

(57) A downhole driving unit for propelling a tool (1) forward in a well and/or for providing weight on a bit while performing an operation, comprising a tool body (3), an electric motor (4) operating at a rotational speed and powered by a wireline, a plurality of projectable arm assemblies (6) connected in a first arm end with the tool body, a plurality of wheels (8) for contacting a wall of the well, each wheel comprising a hydraulic motor (10) for rotation

of the wheel, each arm assembly being at a second arm end connected with one of the plurality of wheels, and a first hydraulic pump (12) driven by the electric motor for generation of a first fluid pressure for projection of the plurality of projectable arm assemblies, wherein the downhole driving unit further comprises a hydraulic section (15) comprising a first controllable valve controlling the first fluid pressure.

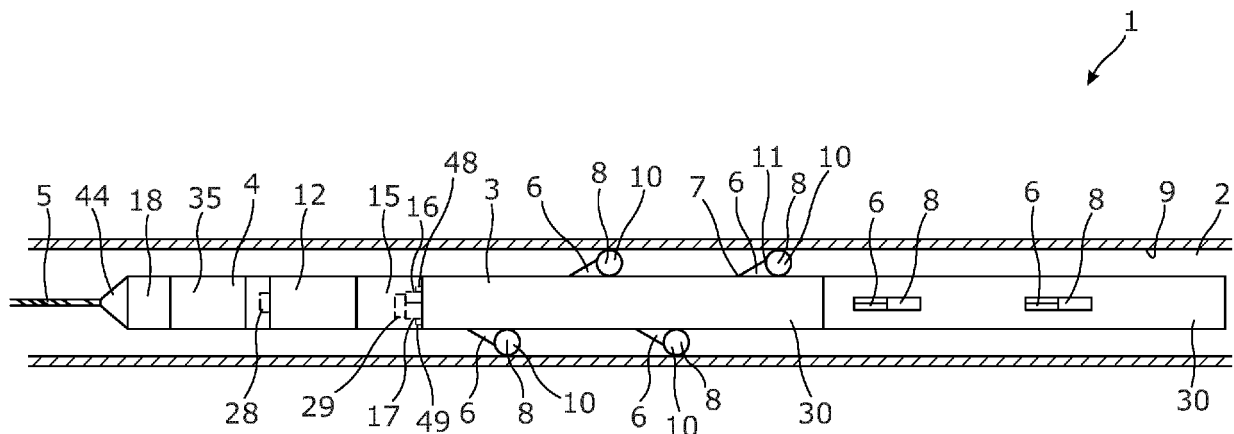


Fig. 1

Description

[0001] The present invention relates to a downhole self-propelling wireline tool for propelling a tool forward in a well and/or for providing weight on a bit while performing an operation. The present invention also relates to a downhole system.

[0002] Downhole intervention operations such as cleaning, milling, logging or sliding sleeves are often performed by means of a self-propelling driving unit propelling the operational tool forward in the well. When logging, the speed of the driving unit needs to be very constant over several kilometres, and in other operations the weight on bit (WOB) during a milling operation several kilometres down the well needs to be constant. While propelling the tool forward in the well, the driving unit also needs to pull the wireline with it, and as the tool is driven further and further down the well, the power for pulling the wireline increases. Thus, in existing driving units the speed in the last part of the well is calculated based on the power available in the last part of the well for pulling the wireline and for keeping a certain speed, and the driving unit is adjusted at surface to drive the calculated speed, even though more power is available in the first part of the well where less power is needed for pulling the wireline as the wireline is shorter. The driving unit, therefore, does not use all power available in the first part of the well since the driving unit can only be adjusted at surface to drive one predetermined speed. In some more developed driving units, the driving unit has a first driving section and a second driving section, and when driving in the first part of the well the second driving section is turned off so that all power is distributed to the first driving section, and in this way the driving unit is capable of driving at a higher speed than when both driving sections are activated. Such driving units are to drive at two different speeds.

[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 self-propelling wireline tool being able to drive at more varying speed than in the known solutions.

[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 self-propelling wireline tool for propelling a tool forward in a well and/or for providing weight on a bit while performing an operation, comprising:

- a tool body,
- an electric motor operating at a rotational speed and powered by a wireline,
- a plurality of projectable arm assemblies movably connected at a first arm end with the tool body and projectable from the tool body by means of a first fluid having a first fluid pressure,

- a plurality of wheels for contacting a wall of the well, each wheel comprising a hydraulic motor for rotation of the wheel and to provide a self-propelling movement, each wheel being connected with a second arm end of one of the arm assemblies,
- a first hydraulic pump driven by the electric motor for generation of a second fluid pressure for driving the hydraulic motor(s) rotating the wheel(s), and
- a first pressure sensor measuring the second fluid pressure, such as continuously measuring the second fluid pressure,

wherein the downhole self-propelling wireline tool further comprises a hydraulic section comprising a first controllable valve controlling the first fluid pressure based on the second fluid pressure.

[0005] By having a first controllable valve controlling the first fluid pressure based on the second pressure, the wheels are not pressed more outwards than needed. The higher the second pressure is, the higher the first pressure needs to be. When having a low second pressure, the first pressure is then adjusted to match the low second pressure so that power is not wasted on providing a first fluid pressure higher than needed. Furthermore, if the first fluid pressure is higher than the optimal first fluid pressure matching the present second fluid pressure, then too much friction to the wall of the well is provided compromising the maximum available velocity of the downhole driving unit.

[0006] The downhole self-propelling wireline tool may be a hydraulically driven downhole self-propelling wireline tool such as a downhole wireline tractor.

[0007] Furthermore, the first hydraulic pump may generate the first fluid pressure for projection of the plurality of projectable arm assemblies.

[0008] In addition, the downhole self-propelling wireline tool may further comprise a second hydraulic pump for generation of the first fluid pressure for projection of the plurality of projectable arm assemblies.

[0009] Also, the hydraulic section may further comprise a second controllable valve controlling the second fluid pressure.

[0010] Additionally, the downhole self-propelling wireline may further comprise a compensator for providing a predetermined overpressure in the tool.

[0011] Moreover, the downhole self-propelling wireline tool may further comprise a surface readout module for sending measured tool parameters, such as the first fluid pressure, the second fluid pressure, the operational rotational speed of the electric motor to surface, or the motor output torque.

[0012] In addition, the downhole self-propelling wireline tool may further comprise an electric control unit for controlling the rotational speed of the electric motor.

[0013] Further, the electric motor may be a first electric motor.

[0014] Also, the electric control unit may comprise a master and/or a motor driver or voltage inverter.

[0015] Furthermore, the electric motor may comprise a motor driver measuring an operational rotational speed of the electric motor.

[0016] Additionally, the electric control unit may be configured to determine a motor output torque of the electric motor.

[0017] Moreover, the electric control unit may be configured to measure the three phases in the motor and determine the output torque of the motor by measuring current in the three phases in the electric motor.

[0018] In addition, the electric control unit may comprise the motor driver.

[0019] Also, the electric control unit may be configured to determine a maximum allowable motor rotational speed based on the motor output torque.

[0020] Furthermore, the electric control unit may be configured to compare the operational rotational speed with the maximum allowable motor rotational speed.

[0021] Additionally, the electric control unit may be configured to adjust the operational rotational speed of the electric motor based on the comparison in order to adjust the first speed to a second speed if the operational rotational speed is higher than the maximum allowable motor rotational speed.

[0022] Moreover, the electric control unit may comprise a capacitor functioning as an energy storage or accumulator.

[0023] Also, the hydraulic section may further comprise a second pressure sensor.

[0024] In addition, the hydraulic section may be configured to measure the first and second fluid pressures by means of the first pressure sensor and the second pressure sensor and to control the valves based on the measured fluid pressures.

[0025] Further, the hydraulic section may measure a fluid pressure for rotating the wheels being the second fluid pressure, a first fluid pressure for projecting the arm assemblies, and/or a third fluid pressure in the compensator.

[0026] Also, the downhole self-propelling wireline tool may further comprise a second electric motor driving a second hydraulic pump, the first electric motor driving the first hydraulic pump.

[0027] Additionally, the second hydraulic pump may generate a third fluid pressure for projection of a second plurality of projectable arm assemblies.

[0028] Furthermore, the second hydraulic pump may generate a fourth fluid pressure for driving the hydraulic motor(s) rotating a second plurality of wheels.

[0029] Moreover, the second hydraulic pump may generate a third fluid pressure for projection of a second plurality of projectable arm assemblies, the second hydraulic pump generating a fourth fluid pressure for driving the hydraulic motor(s) rotating a second plurality of wheels.

[0030] In addition, the hydraulic section may be a first hydraulic section.

[0031] Also, the downhole self-propelling wireline tool may further comprise a second hydraulic section com-

prising a third controllable valve controlling the third fluid pressure and a fourth controllable valve controlling the fourth fluid pressure.

[0032] Additionally, the controllable valve(s) may be electronically adjustable/controllable.

[0033] Furthermore, the controllable valve(s) may be electronically controllable by means of the electric control unit.

[0034] Moreover, the first controllable valve and the second controllable valve may be electronically controllable by means of the electric control unit.

[0035] Further, the third controllable valve and the fourth controllable valve may be electronically controllable by means of the electric control unit.

[0036] In addition, the electric control unit may be arranged in the tool body.

[0037] Also, the hydraulic section may be arranged in the tool body.

[0038] Moreover, the electric motor(s) may be a synchron motor(s).

[0039] Additionally, the electric control unit may further comprise a voltage control unit.

[0040] Furthermore, the electric control unit may further comprise an electric current measuring unit.

[0041] In addition, the electric control unit may further comprise an electric voltage measuring unit.

[0042] Further, the electric control unit may control the controllable valve(s) based on the measured electric current and/or the measured electric voltage by the electric control unit.

[0043] Also, the controllable valve(s) may be a controllable pressure relief valve(s).

[0044] Moreover, the downhole self-propelling tool may further comprise a machining tool for performing a machining operation and a compression sub comprising a load cell adjacent the machining tool.

[0045] The invention further relates to a tool string comprising two the downhole self-propelling wireline tools mounted as one wireline tool string, where each downhole self-propelling wireline tool has a separate electric control unit, a separate electric motor, one or two hydraulic pumps, a hydraulic section, and one or more drive sections.

[0046] Furthermore, the tool string may comprise a first downhole self-propelling wireline tool according to any of the preceding claims, and a second downhole self-propelling wireline tool comprising

- a tool body,
- a second electric motor operating at a rotational speed and powered by a wireline,
- a plurality of projectable arm assemblies movably connected at a first arm end with the tool body and projectable from tool body by means of a first fluid having a third fluid pressure,
- a plurality of wheels for contacting a wall of the well, each wheel comprising a hydraulic motor for rotation of the wheel and provide a self-propelling movement,

- each wheel being connected with a second arm end of one of the arm assemblies,
- a at least one second hydraulic pump driven by the second electric motor for generation of a fourth fluid pressure for driving the hydraulic motor(s) rotating the wheel(s), and
 - a pressure sensor measuring the fourth fluid pressure, such as continuously measuring the fourth fluid pressure,

wherein the second downhole self-propelling wireline tool further comprises a second hydraulic section comprising a third controllable valve controlling the third fluid pressure based on the fourth fluid pressure, the first downhole self-propelling wireline tool being in one end connected with the wireline and in another end with the second downhole self-propelling wireline tool.

[0047] Finally, the present invention also relates to a downhole system comprising the downhole self-propelling wireline tool, the wireline, and a user interface at surface for controlling at least part of the downhole self-propelling wireline tool.

[0048] 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 self-propelling wireline tool according to the invention having two wheel sections driven by one electric motor and one hydraulic pump,

Fig. 2 shows another downhole self-propelling wireline tool according to the invention having two wheel sections driven by one electric motor and two hydraulic pumps,

Fig. 3 shows yet another downhole self-propelling wireline tool according to the invention having two wheel sections, each wheel section being driven by one electric motor and one hydraulic pump,

Fig. 4 shows yet another downhole self-propelling wireline tool comprising a compression sub and an operational tool for performing an operation in the well, such as milling with a bit,

Fig. 5 shows a downhole self-propelling wireline tool control method with some optional steps, and

Fig. 6 shows a graph of the power curve in relation to the pull force and the speed of the tool.

[0049] 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.

[0050] Fig. 1 shows a downhole self-propelling wireline

tool 1 for propelling a tool forward in a well 2 and may be also for providing weight on a bit 39 while performing an operation, as shown in the tool 1 of Fig. 4. The downhole self-propelling wireline tool comprises a tool body 3, and an electric motor 4 operating at a rotational speed and powered by a wireline 5. The downhole self-propelling wireline tool further comprises a plurality of projectable arm assemblies 6 movably connected at a first arm end 7 with the tool body and projectable from the tool body by means of a first fluid having a first fluid pressure, and a plurality of wheels 8 for contacting a wall 9 of the well, each wheel comprising a hydraulic motor 10 for rotation of the wheel and to provide a self-propelling movement, each wheel being connected with a second arm end 11 of one of the arm assemblies. The electric motor is configured to drive a first hydraulic pump 12 for generation of a second fluid pressure for driving the hydraulic motor(s) rotating the wheel(s). The downhole self-propelling wireline tool 1 is connected to a second end 47 of the wireline 5, a first end of the wireline being connected to a power supply (not shown) at the surface or seabed. The downhole self-propelling wireline tool further comprises a pressure sensor 49 continuously measuring the second fluid pressure, and a hydraulic section 15 comprising a first controllable valve 16 controlling the first fluid pressure based on the second pressure.

[0051] By having a first controllable valve controlling the first fluid pressure based on the second pressure, the wheels are not pressed more outwards than needed. The higher the second pressure is, the higher the first pressure needs to be in order to propel the downhole self-propelling wireline tool 1 forward in the well in the most optimal manner. When having a low second pressure, the first pressure is then adjusted to match the low second pressure so that power is not wasted on providing a first fluid pressure higher than needed. Furthermore, if the first fluid pressure is higher than the optimal first fluid pressure matching the present second fluid pressure, then too much friction to the wall of the well is provided compromising the maximum available velocity of the downhole driving unit.

[0052] In Fig. 1, the first hydraulic pump generates the first fluid pressure for projection of the plurality of projectable arm assemblies and in Fig. 2, the downhole self-propelling wireline tool further comprises a second hydraulic pump 14 for generation of the first fluid pressure for projection of the plurality of projectable arm assemblies. The downhole self-propelling wireline tool 1 further comprises an electric control unit 18 and a cable head 44 for connecting the tool to the wireline 5.

[0053] As shown in Fig. 1, the hydraulic section 15 further comprises a second controllable valve 17 controlling the second fluid pressure. The controllable valve(s) is/are electronically adjustable. The downhole self-propelling wireline tool 1 has two wheel sections 30 where one is rotated 90 degrees in relation to the other in order to centralise the tool in the well. In another operations where centralisation is not important, the downhole self-propel-

ling wireline tool only has one drive section 30, as shown in Fig. 2. Such operation could be a milling or grinding operation, in which the downhole self-propelling wireline tool comprises an operational tool as shown in Fig. 2.

[0054] The downhole self-propelling wireline tool 1 further comprises a compensator 35 for providing a predetermined overpressure in the tool so that the well fluid does not enter into the tool and jeopardise the function of the tool, and so that the dirtier well fluid is not mixed with the hydraulic fluid in the tool.

[0055] In Fig. 1, the electric control unit 18 controls the rotational speed of the electric motor and thus also the rotational speed of the pump and the tool speed of the downhole self-propelling wireline tool 1 along the longitudinal extension of the well as the pump generates a fluid flow into the wheels. In the beginning of the well, closest to the top of the well, the downhole self-propelling wireline tool 1 requires very little force for pulling the wireline 5 along with the tool, but as the downhole self-propelling wireline tool 1 proceeds down the well, the tool 1 requires an increasing amount of force for pulling the wireline. As the force increases, the wheels need a higher pressure to rotate and the pump thus need more rotational force, i.e. motor output torque, from the motor. The wirelines used for intervention operations where such downhole self-propelling wireline tool 1 is used are rated to a maximum current limit depending on the length and other wireline parameters. Thus, it is important that such current limit is not exceeded. Knowing of the voltage either by way of assumption, calculation or measurement, the power limit P of the operation is known, and this power limit is shown in Fig. 6. When the motor output torque increases, the current demand increases correspondingly, and when the current limit is reached, the downhole self-propelling wireline tool 1 needs to decrease its speed, i.e. move along the power limit curve in Fig. 6. This is performed in several ways where one very simple way is illustrated in Fig. 5.

[0056] In Fig. 5, a method 100 for controlling the downhole self-propelling tool 1 is illustrated. The method comprises running 110 a downhole self-propelling wireline tool 1 into a wellbore, supplying 120 electric power to the downhole self-propelling wireline tool to operate the downhole self-propelling wireline tool at a first speed to urge the downhole self-propelling wireline tool through the wellbore at a first force, then determining 130 a motor output torque of the motor, and determining 140 a maximum allowable motor rotational speed based on the motor output torque, for comparing 150 the operational rotational speed with the maximum allowable motor rotational speed. The control method further comprises adjusting 160 the operational rotational speed of the electric motor based on the comparison in order to adjust the first speed to a second speed if the operational rotational speed is higher than the maximum allowable motor rotational speed.

[0057] Hereby, a very simple way of adjusting the speed of the hydraulically driven downhole self-propel-

ling wireline tool is provided, as only the motor is adjusted to limit the speed, and the more complex hydraulic section merely adjusts the first controllable valve 16 for controlling the first fluid pressure based on the second pressure, thus optimising that enough power is submitted to project the wheel arms, but not more than needed. The speed of the hydraulically driven downhole self-propelling wireline tool is thus adjusted continuously using all available power i.e. below the current limit either for driving at a maximum speed or at the required force and the corresponding maximum allowable speed, and the hydraulically driven downhole self-propelling wireline tool is able to drive at maximum speed until the force to pull the wireline increases to a first force at the power limit curve above which first force the speed of the rotational speed of the electric motor needs to be reduced so that the current limit is not exceeded. The hydraulically driven downhole self-propelling wireline tool is thus controlled to continuously adjust its speed to a maximum without exceeding the current limit for the wireline. By having a first controllable valve controlling the first fluid pressure based on the second pressure, the continuous control of the hydraulically driven downhole self-propelling wireline tool is optimised even further so no power is wasted on projected the arm assemblies out towards the wall of the well other than what is needed for an optimal friction between the wheels and the wall to drive the hydraulically driven downhole self-propelling wireline tool forward.

[0058] In Fig. 6, the maximum speed of the hydraulically driven downhole self-propelling wireline tool is based on the maximum allowed rotational speed of the electric motor, and the maximum force is based on the minimum allowed rotational speed of the electric motor.

[0059] The electric control unit 18 comprises a motor driver 28, a master and/or or voltage inverter. The electric control unit 18 determines 145 the motor driver 28 measures 145a an operational rotational speed of the electric motor, and the motor driver 28 is configured to measure 125 current over the three phases in the motor for the electric control unit to determine 130 a motor output torque of the electric motor. The electric control unit is configured to determine 140 a maximum allowable motor rotational speed based on the motor output torque and to compare 150 the operational rotational speed with the maximum allowable motor rotational speed and then adjust 160 the operational rotational speed of the electric motor based on the comparison in order to adjust the first speed to a second speed if the operational rotational speed is higher than the maximum allowable motor rotational speed. Optionally, determining 140 a maximum allowable motor rotational speed based on the motor output torque is also based on pre-set values 142 for a maximum power or a maximum current. Furthermore, the electric control unit 18 may measure 135 a current demand/input of the motor and measure 135b a voltage input at the electric motor; and determining 140 a maximum allowable motor speed based on the motor output torque may thus also be also based on a measured cur-

rent and a measured voltage at the electric motor.

[0060] By measuring the actual current demand and the voltage at the electric motor, the maximum allowable motor speed can be determined more precisely as the efficiency of the electric motor varies depending on the operational rotational speed of the electric motor. Thus, at a high rotational speed, the current demand is lower than when rotating at a low rotational speed, and the maximum power may therefore vary to be somewhat larger at high rotational speed than when assuming that the maximum power is constant.

[0061] The method as shown in Fig. 5 may further comprise controlling 170 the first fluid pressure based on the second pressure by means of a first controllable valve 16 in the hydraulic section 15 of the downhole self-propelling wireline tool. The method may optionally further comprise determining 180 the load of the motor based on the torque output.

[0062] The downhole self-propelling wireline tool further comprises a surface readout module 29 for sending measured tool parameters, such as the first fluid pressure, the second fluid pressure, the operational rotational speed of the electric motor, and/or the motor output torque to surface.

[0063] In Fig. 2, the downhole self-propelling wireline tool comprises an operational tool 38 such as a logging tool 38b (shown in Fig. 4) or a machining tool 32 having a bit 39 for performing a machining operation and a compression sub 33 comprising a load cell 34 adjacent the machining tool in order to measure the actual weight on the bit. The operational tool 38 further comprises an electric control unit 40, a compensator 41, an electric motor 42 and a gear section 43 for rotating the bit at another speed than the rotational speed of the motor 42, often at a lower speed. The compression sub 33 comprising the load cell 34 is arranged between the electric control unit 40 and the drive section comprising the wheels 8 on arm assemblies 6.

[0064] In Fig. 3, the electric motor is a first electric motor, and the downhole self-propelling wireline tool comprises a second electric motor 22 driving a second hydraulic pump 14 and the first electric motor driving the first hydraulic pump. The first electric motor 4 thus drives a first hydraulic pump 12 for generating fluid to project the arm assemblies 6 and fluid for rotating the wheels 8 of one drive section 30a, and the second electric motor 22 thus drives a second hydraulic pump 14 for generating fluid to project the arm assemblies 23 and fluid for rotating the wheels 24 of a second drive section 30b. The plurality of projectable arm assemblies 23 are movably connected at a first arm end 7b with the tool body 3, and each wheel comprises a hydraulic motor 10b for rotation of the wheel and provides a self-propelling movement, each wheel being connected with a second arm end 11b of one of the arm assemblies 23. The second hydraulic pump generates a third fluid pressure for projection of a second plurality of projectable arm assemblies 23. The second hydraulic pump 14 generates a fourth fluid pressure for

driving the hydraulic motor(s) rotating a second plurality of wheel(s) 24. The hydraulic section 15 for the first drive section 30a is a first hydraulic section, and the downhole self-propelling wireline tool further comprises a second hydraulic section 25 comprising a third controllable valve 26 controlling the third fluid pressure and a fourth controllable valve 27 controlling the fourth fluid pressure. Both the first controllable valve and the second controllable valve are electronically controllable by means of the electric control unit, and the third controllable valve and the fourth controllable valve are electronically controllable by means of a second electric control unit 18b. The first electric motor and/or second electric motor is/are a synchronic motor(s).

[0065] The tool string of Fig. 3 is thus two downhole self-propelling wireline tools mounted as one wireline tool where each has a separate electric control unit, a separate electric motor, one or two hydraulic pumps, a hydraulic section, and one or more drive sections 30. As shown in Fig. 3, the downhole self-propelling wireline tool 1 further comprises a surface readout module 29 communicating instructions from surface to each tool and sending measured tool parameters, such as the first fluid pressure, the second fluid pressure, the third fluid pressure, the fourth fluid pressure, the operational rotational speed of the electric motors, and/or the motor output torque to surface.

[0066] The first downhole self-propelling wireline tool 1a comprises the electric control unit 18, the electric motor 4, one or two hydraulic pumps 12, 14, the hydraulic section 15, and the drive section 30, 30a with wheels 8 on arm assemblies 6. The second downhole self-propelling wireline tool 1b comprises the electric control unit 18, the electric motor 22, one or two hydraulic pumps 12, 14, the hydraulic section 15, and the drive section 30, 30b with wheels 24 on arm assemblies 23. The first downhole self-propelling wireline tool 1a is connected to the cable head 44 and the wireline 5. The hydraulic section 15 is configured to measure the first and second fluid pressures by means of the first pressure sensor 49 and the second pressure sensor 48 and to control the valves based on the measured first and second fluid pressures. The second hydraulic section 26 is configured to measure the third and fourth fluid pressures by means of the third pressure sensor 48b and the fourth pressure sensor 49b and to control the valves based on the measured third and fourth fluid pressures. The controllable valve(s) 16, 17, 26, 27 is/are a controllable pressure relief valve(s). The power to the tool string is thus divided equally between the first and second electric motors so that each motor is limited to half of the current limit so that the tool string does not exceed the allowed current limit on the wireline.

[0067] The step of running 110 comprises running both the first and second downhole self-propelling wireline tools 1, 1a, 1b into a wellbore 2, and the step of supplying 120 electric power comprises supplying electric power to both the first and second downhole self-propelling

wireline tools to operate the first and second downhole self-propelling wireline tools at a first speed to urge the tool string through the wellbore at a first force, and the step of determining 130 comprises determining a motor output torque of both the first and second electric motors, and the step of determining 140 comprises determining a maximum allowable motor rotational speed based on the motor output torque of both the first and second electric motors, and the step of comparing 150 comprises comparing the operational rotational speed of both the first and second electric motors with the maximum allowable motor rotational speed, and wherein the step of adjusting 160 comprises adjusting the operational rotational speed of both the first and second electric motors based on the comparison in order to adjust the first speed to a second speed if the operational rotational speed is higher than the maximum allowable motor rotational speed.

[0068] The electric control unit(s) further comprises a voltage control unit 19 having an overvoltage protection unit, so that voltage fed to the tool is kept more constant, and an electric current measuring unit 20. In Fig. 4, the electric control unit comprises a capacitor 50 functioning as an energy storage or accumulator. The downhole self-propelling tool further comprises a machining tool 32 for performing a machining operation and a compression sub 33 comprising a load cell 35 adjacent the machining tool. In another embodiment, the electric control unit(s) controls the controllable valve(s) based on the measured electric current and/or the measured electric voltage by the electric control unit.

[0069] In Fig. 4, the downhole self-propelling wireline tool is a user interface 36 at surface 37 for controlling at least part of the downhole self-propelling wireline tool. Thus, the field engineer may be informed of the current limit of the wireline/cable and through the user interface set the current limit for each motor of the tool, and the power-limiting units 31 or the current distribution unit 21 distributes the current equally between the first downhole self-propelling wireline tool 1a and the second downhole self-propelling wireline tool 1b forming the tool 1, so that both are able to drive at the same speed and therefore drive the tool string at the same speed. The first electric motor 4 may require more power than the second electric motor 22 in order to drive the tool string at the same speed, but this is possible as the first and second downhole self-propelling wireline tools are electrically connected in parallel. The downhole self-propelling wireline tool string may further comprise a stroking tool, even though not shown.

[0070] A stroking tool is a tool providing an axial force. The stroking tool comprises an electric motor for driving a pump. The pump pumps fluid into a piston housing to move a piston acting therein. The piston is arranged on the stoker shaft. The pump may pump fluid out of the piston housing on one side and simultaneously suck fluid in on the other side of the piston.

[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, 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.

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

[0073] Although the invention has been described above in connection with preferred embodiments of the invention, it will be evident to 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 self-propelling wireline tool (1) for propelling a tool forward in a well (2) and/or for providing weight on a bit while performing an operation, comprising:

- a tool body (3),
- an electric motor (4) operating at a rotational speed and powered by a wireline (5),
- a plurality of projectable arm assemblies (6) movably connected at a first arm end (7) with the tool body and projectable from the tool body by means of a first fluid having a first fluid pressure,
- a plurality of wheels (8) for contacting a wall (9) of the well, each wheel comprising a hydraulic motor (10) for rotation of the wheel and to provide a self-propelling movement, each wheel being connected with a second arm end (11) of one of the arm assemblies,
- a first hydraulic pump (12) driven by the electric motor for generation of a second fluid pressure for driving the hydraulic motor(s) rotating the wheel(s), and
- a first pressure sensor (49) measuring the second fluid pressure,

wherein the downhole self-propelling wireline tool further comprises a hydraulic section (15) comprising a first controllable valve (16) controlling the first fluid pressure based on the second fluid pressure.

2. A downhole self-propelling wireline tool according to claim 1, wherein the first hydraulic pump generates the first fluid pressure for projection of the plurality of projectable arm assemblies.

3. A downhole self-propelling wireline tool according to claim 1, further comprising a second hydraulic pump

- (14) for generation of the first fluid pressure for projection of the plurality of projectable arm assemblies.
4. A downhole self-propelling wireline tool according to any of the preceding claims, wherein the hydraulic section further comprises a second controllable valve (17) controlling the second fluid pressure.
 5. A downhole self-propelling wireline tool according to any of the preceding claims, further comprising an electric control unit (18) for controlling the rotational speed of the electric motor.
 6. A downhole self-propelling wireline tool according to any of the preceding claims, further comprising a second electric motor (22) driving a second hydraulic pump (14) and the first electric motor driving the first hydraulic pump.
 7. A downhole self-propelling wireline tool according to any of the preceding claims, wherein the second hydraulic pump generates a third fluid pressure for projection of a second plurality of projectable arm assemblies (23), the second hydraulic pump generating a fourth fluid pressure for driving the hydraulic motor(s) rotating a second plurality of wheels (24).
 8. A downhole self-propelling wireline tool according to claim 7, further comprising a second hydraulic section (25) comprising a third controllable valve (26) controlling the third fluid pressure and a fourth controllable valve (27) controlling the fourth fluid pressure.
 9. A downhole self-propelling wireline tool according to any of claims 1, 4 or 8, wherein the controllable valve(s) is/are electronically controllable by means of an electric control unit (18).
 10. A downhole self-propelling wireline tool according to claim 5 wherein the electric control unit further comprises a voltage control unit (19).
 11. A downhole self-propelling wireline tool according to any of claims 5 or 10, wherein the electric control unit further comprises an electric current measuring unit (20).
 12. A downhole self-propelling wireline tool according to any of claims 5, 10 or 11, wherein the electric control unit further comprises a voltage control unit (19) comprising an electric voltage measuring unit.
 13. A downhole self-propelling wireline tool according to any of claims 1, 4 or 8, wherein an electric control unit (18) controls the controllable valve(s) based on the electric current and/or the electric voltage measured by the electric control unit.
 14. A downhole self-propelling wireline tool according to any of claims 1, 4, 8 or 13, wherein the controllable valve(s) is/are a controllable pressure relief valve(s).
 15. A downhole system comprising the downhole self-propelling wireline tool according to any of the preceding claims, the wireline, and a user interface at surface for controlling at least part of the downhole self-propelling wireline tool.

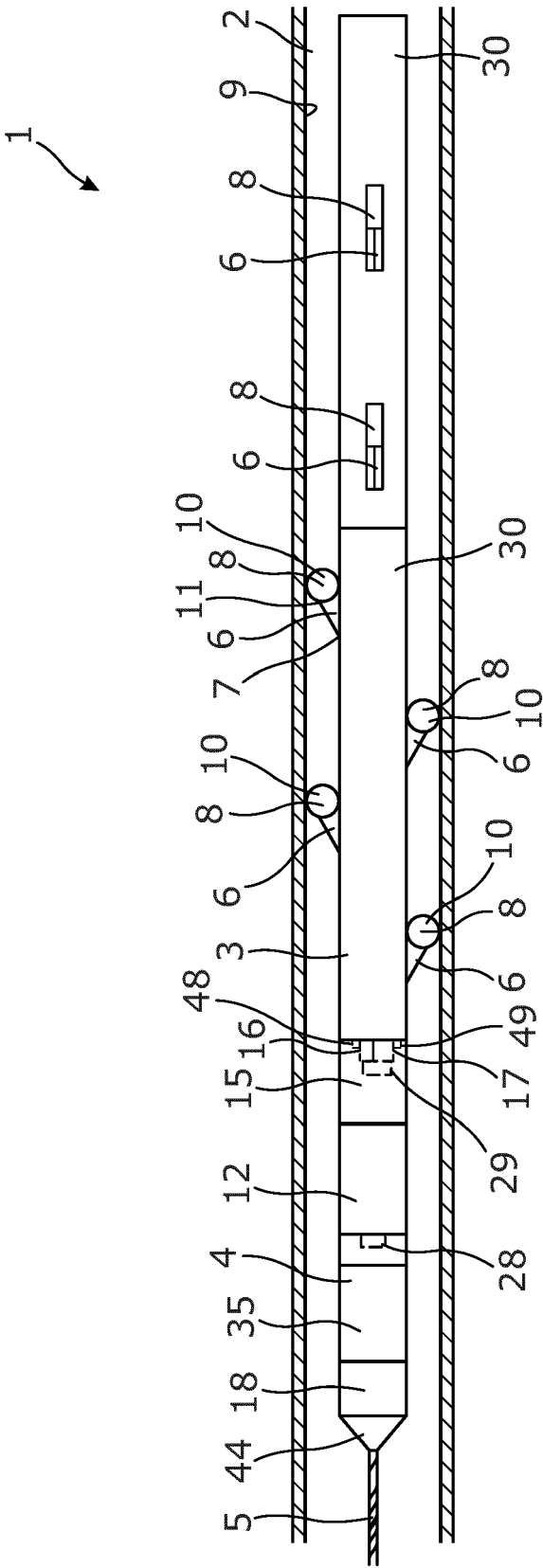


Fig. 1

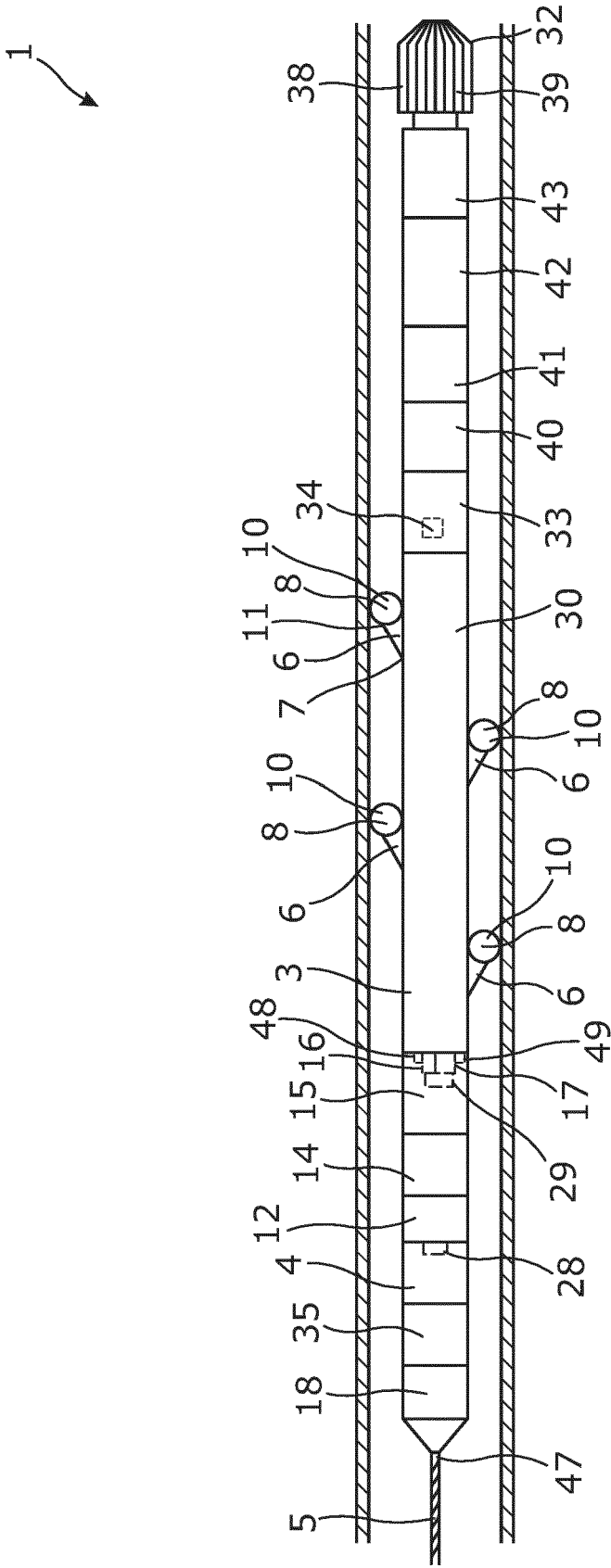
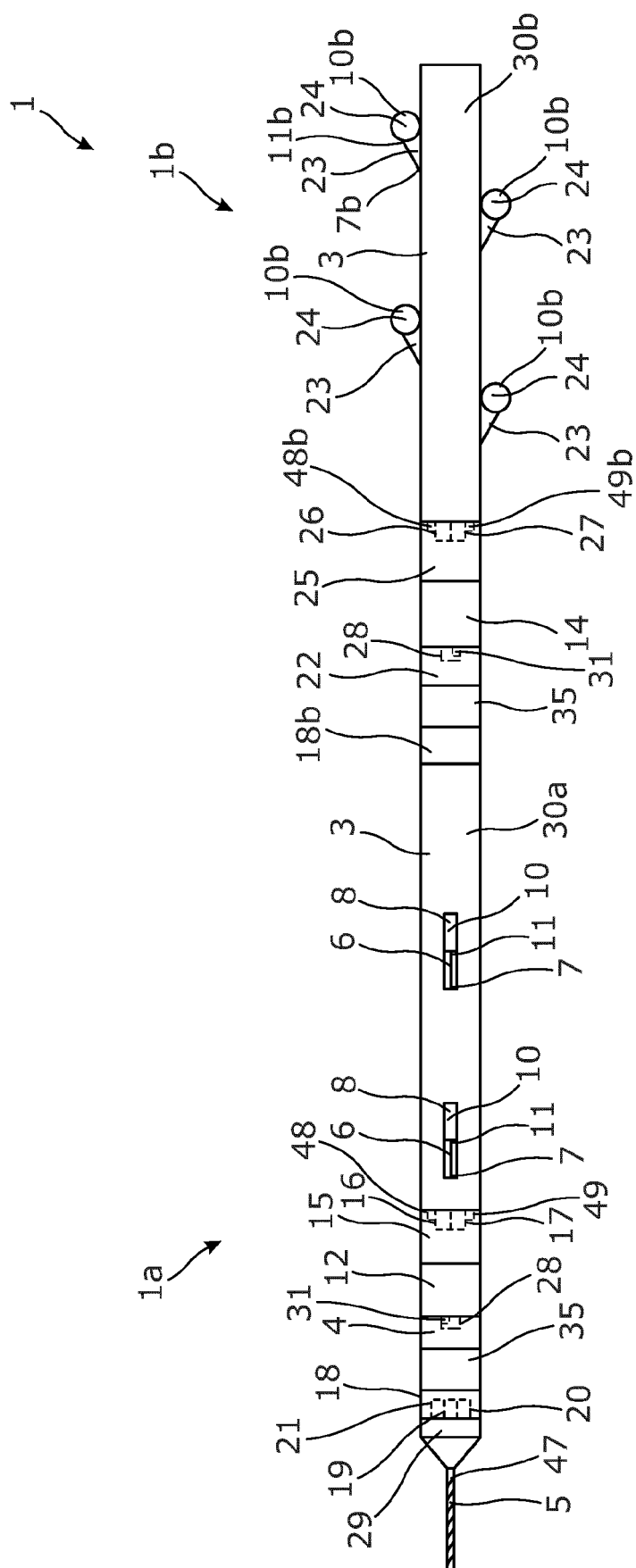


Fig. 2



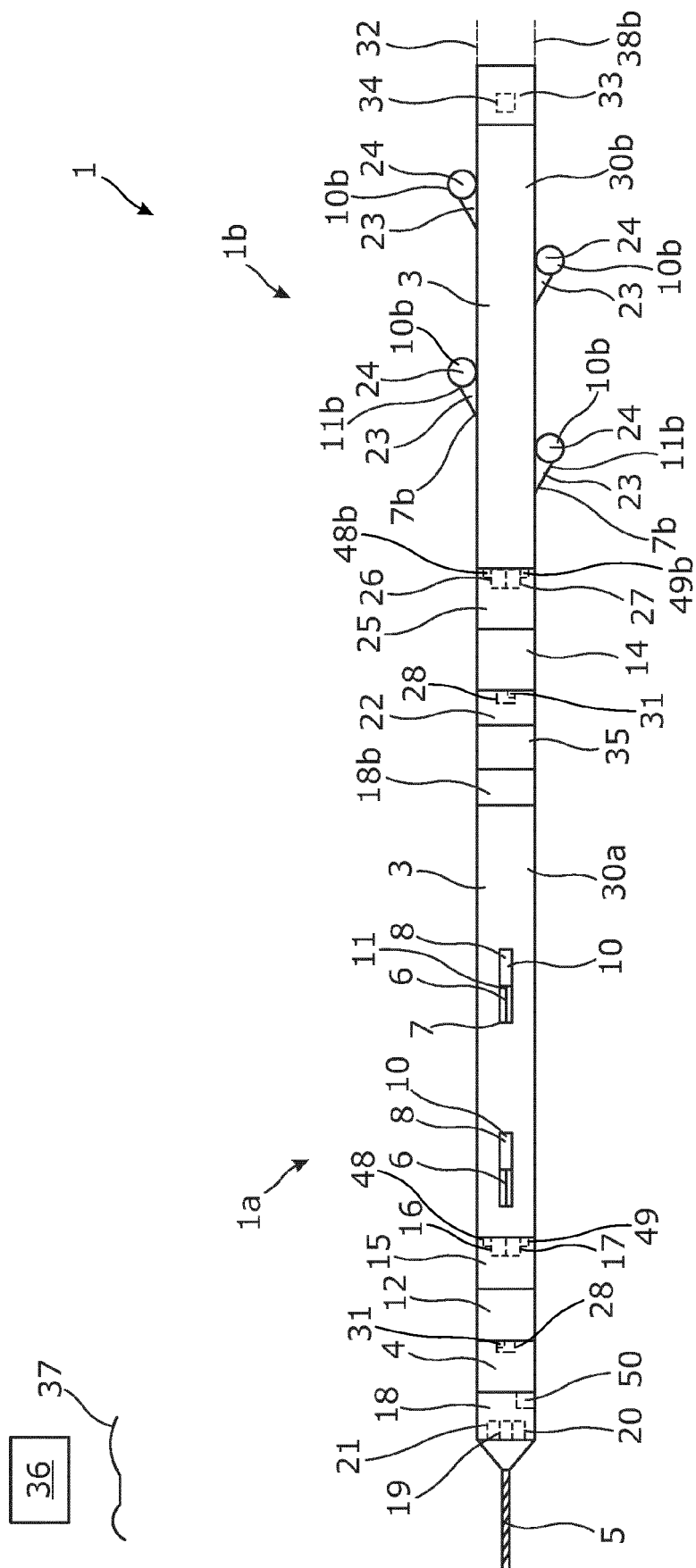


Fig. 4

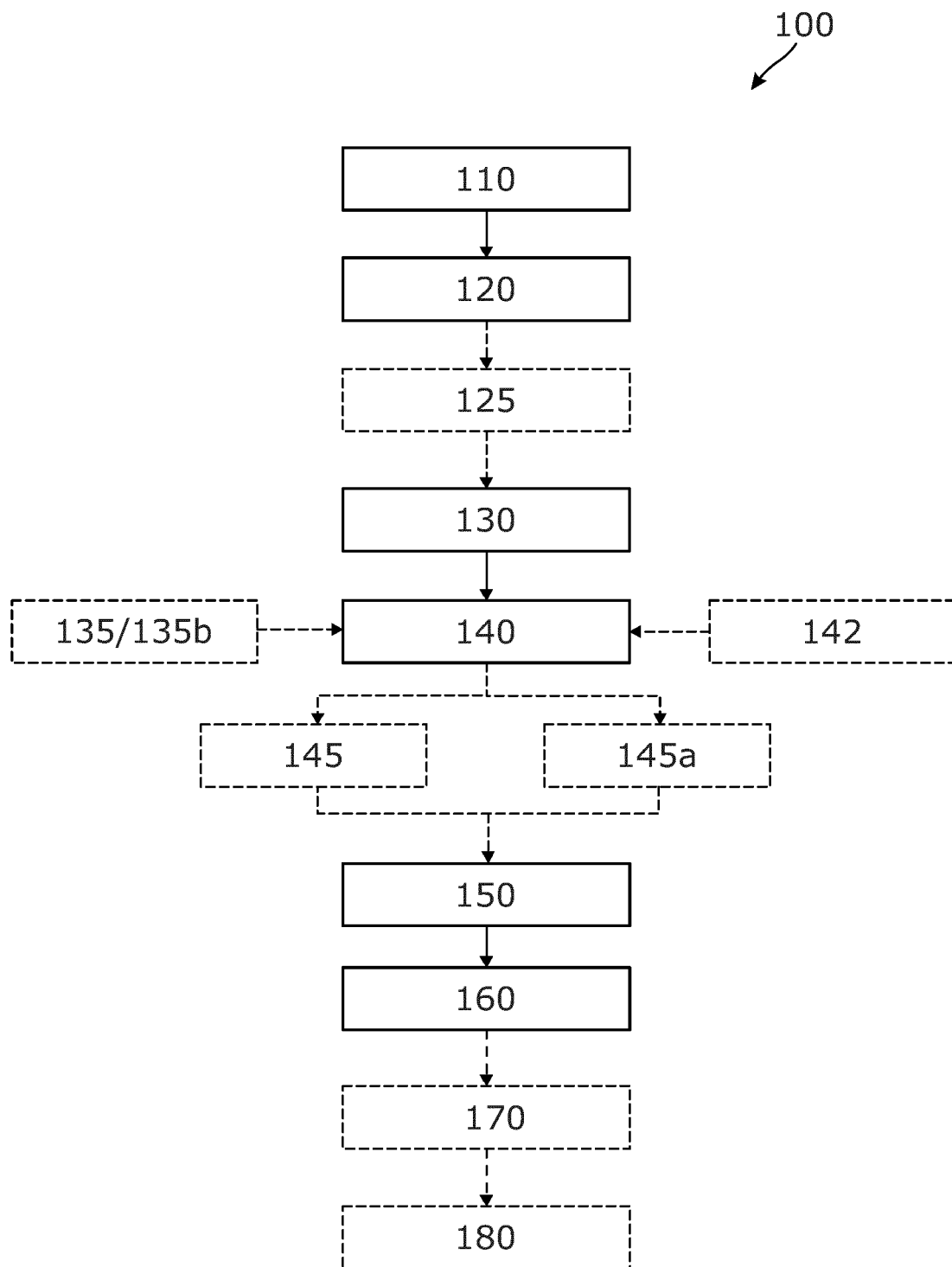


Fig. 5

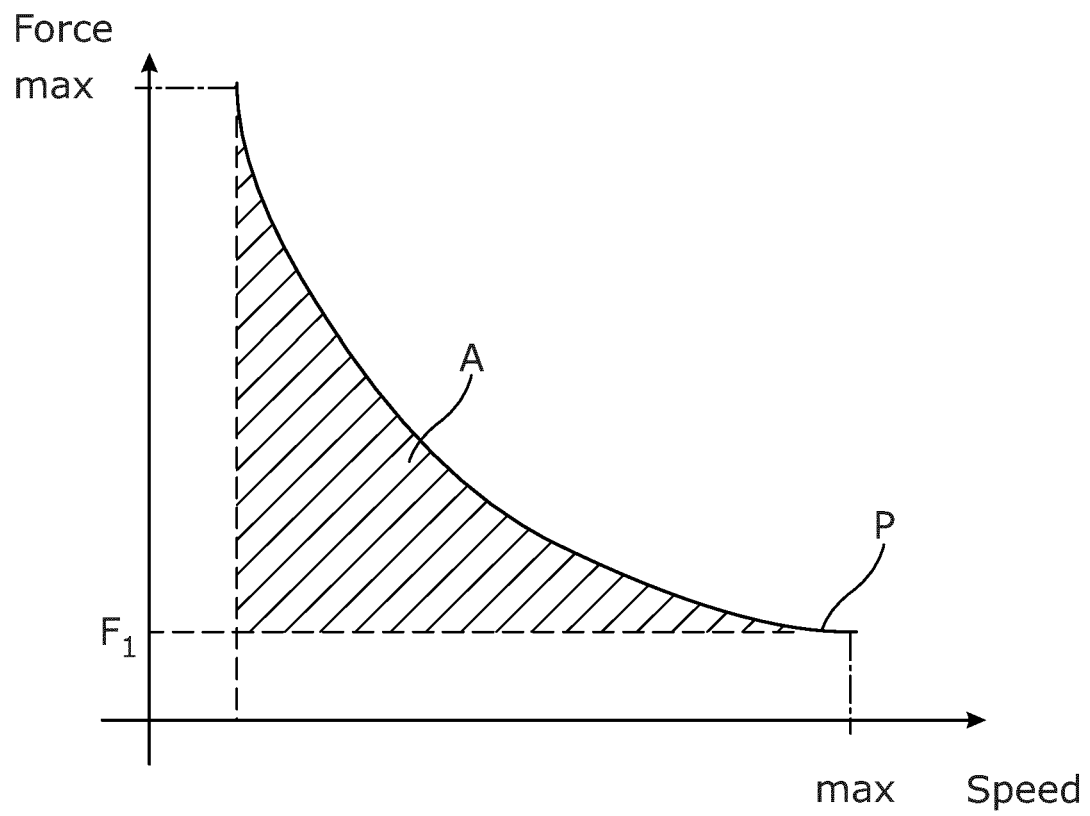


Fig. 6



EUROPEAN SEARCH REPORT

Application Number

EP 21 20 2035

5

10

15

20

25

30

35

40

45

50

55

1

EPO FORM 1503 03.82 (P04C01)

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	WO 2019/004834 A1 (QINTERRA TECH AS [NO]) 3 January 2019 (2019-01-03) * page 14, lines 23-26; claim 1; figures 1-4 *	1, 2, 4, 9, 14, 15	INV. E21B23/00 E21B23/14
A	EP 2 505 772 A1 (WELLTEC AS [DK]) 3 October 2012 (2012-10-03) * the whole document *	1-15	
A	WO 2017/142415 A1 (QINTERRA TECH AS [NO]) 24 August 2017 (2017-08-24) * the whole document *	1-15	
A	EP 2 696 026 A1 (WELLTEC AS [DK]) 12 February 2014 (2014-02-12) * the whole document *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			E21B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 22 February 2022	Examiner Manolache, Iustin
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			

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 21 20 2035

5

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.

22-02-2022

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
WO 2019004834	A1	03-01-2019	CA	3065212	A1	03-01-2019
			DK	202070038	A1	10-02-2020
			GB	2578552	A	13-05-2020
			NO	343461	B1	18-03-2019
			US	2020200194	A1	25-06-2020
			WO	2019004834	A1	03-01-2019

EP 2505772	A1	03-10-2012	AU	2012234262	A1	02-05-2013
			BR 112013025038	A2	27-12-2016	
			CA	2831662	A1	04-10-2012
			CN	103459762	A	18-12-2013
			DK	2505772	T3	05-08-2013
			EP	2505772	A1	03-10-2012
			MX	340132	B	28-06-2016
			MY	168347	A	31-10-2018
			RU	2013147498	A	10-05-2015
			US	2014014363	A1	16-01-2014
WO	2012130944	A1	04-10-2012			

WO 2017142415	A1	24-08-2017	CA	3012738	A1	24-08-2017
			DK	201800413	A1	12-09-2018
			GB	2562658	A	21-11-2018
			NO	343801	B1	11-06-2019
			US	2019040700	A1	07-02-2019
			WO	2017142415	A1	24-08-2017

EP 2696026	A1	12-02-2014	AU	2013301466	A1	26-03-2015
			BR 112015002298	A2	04-07-2017	
			CA	2881336	A1	13-02-2014
			CN	104541018	A	22-04-2015
			EP	2696026	A1	12-02-2014
			EP	2882927	A1	17-06-2015
			RU	2015107658	A	27-09-2016
			US	2015218900	A1	06-08-2015
			WO	2014023829	A1	13-02-2014
