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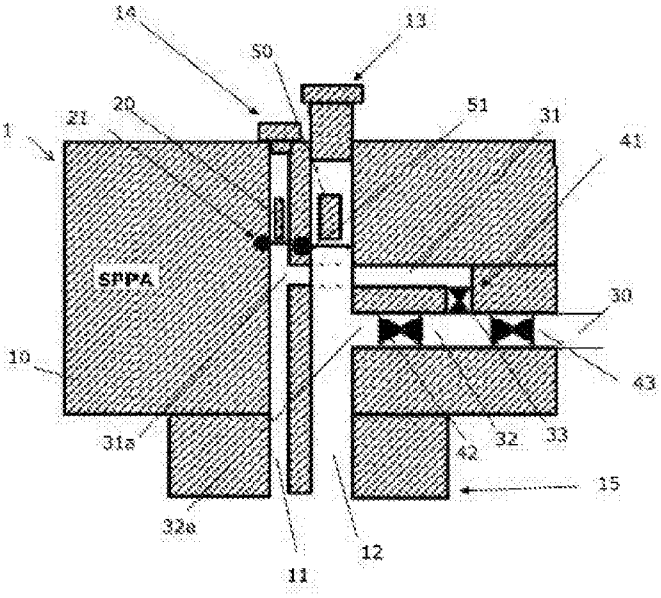
(54)	Title	**Method and device for enabling removal of a Christmas tree from a wellhead and method and device installation of a Christmas tree on a wellhead**
(56)	References Cited:	US 20140048278 A1, US 20150275608 A1, WO 9849422 A1
(57)	Abstract	

The present invention relates to a device (1) for enabling removal of a Christmas tree (XT) from a wellhead (WH) or for installation of a Christmas tree (XT) on a wellhead. The device (1) comprises a housing device (10) having a first bore (11) provided axially through the housing (10) and a lower connector (15) for connection to an upper re-entry mandrel of the Christmas tree (XT). A first tool (20; 50) is provided in the first bore (11). A first tool holding device (21, 51) is also provided, for holding the first tool (20; 50) in an initial position in the first bore (11) and for releasing the first tool (20; 50) from the initial position upon actuation of the first tool holding device (21; 51). A fluid communication port (30) is provided in fluid communication with the first bore (11) via a fluid line (31), where a first fluid line (31) entry point (31a) into the first bore (11) is provided below the first tool holding device (21; 51). A first valve (41) provided in the fluid line (31) between the fluid communication port (30) and the first bore (11).



FIELD OF THE INVENTION

The present invention relates to a device for enabling removal of a Christmas tree from a wellhead, or for enabling installation of a Christmas tree on a wellhead.

The present invention also relates to a method for performing a well operation in a hydrocarbon well with either a vertical dual bore Christmas tree and/or a vertical monobore Christmas tree and/or a horizontal Christmas tree.

In particular, the present inventions are related to the possible use of a monohull vessel instead of a drilling rig, a drill ship or a jack-up rig during subsea well operation.

BACKGROUND OF THE INVENTION

There is an increasing demand to simplify well operations on subsea oil and/or gas wells in order to reduce time and costs for the well operations. Such operations may be to install, remove or replace a vertical dual bore Christmas tree or a vertical monobore Christmas tree (often referred to as a VXT).

During completion of a well, one of the last steps is to install or hang off the top completion string and the tubing hanger (TH) in the wellhead (WH) of the well. Thereafter, the blowout preventer (BOP) is retrieved to surface prior to installing the specified Christmas tree. Except for the Christmas tree installations the above operations are today only performed using drilling rigs or drill ships. Installation of the specified Christmas tree may be performed from a drilling rig, a drill ship, a jack-up rig, a riserless light well intervention (RLWI) vessel or another monohull vessel suitable for such operations.

When e.g. a VXT has been installed, a shallow tubing hanger plug may have to be retrieved to surface and sometimes it is also required to retrieve a deep production tubing plug to surface. These operations are today performed by a drilling rig, a drill ship, a jack-up rig or a RLWI vessel.

During the above operations, there is a need to circulate fluid into the well via the VXT in order to e.g. pressure test barriers, change the type of fluid in the well, actuate pressure and/or fluid actuated well plugs and other types of completion equipment.

Removal of the VXT from the wellhead is an operation performed during a temporary or permanent plug and abandonment operation of the well, or when the VXT is experiencing malfunction(s) and must be replaced.

As above, prior art technology for removing the VXT involves the use of a drilling rig, a drill ship or a RLWI vessel with subsea pressure control equipment, such as a subsea blowout preventer (BOP) or a RLWI pressure control stack respectively.

There are two different methods to control the well during abandonment operations, either the operations are performed in a pressurized well or the well is bullheaded/killed prior to establishing the needed barrier(s). In both cases a deep barrier plug must be installed in the production tubing, alternatively the production tubing may comprise flow control valves (FCV) and/or gas lift valves (GLV) that could be closed and used as deep barrier elements. These valves can be controlled from the platform or from the rig/vessel via the respective control systems.

Initially, a short description of the vertical dual bore Christmas tree (VXT) will be given with reference to fig. 1a.

The vertical dual bore Christmas tree (VXT) is arranged on the seabed, on top of a subsea wellhead on a well extending into the seabed. Prior to installing a vertical dual bore Christmas tree VXT on the wellhead a tubing hanger (TH)/tubing is run and hung off in the wellhead.

After installing the completion string (TH and the tubing), the completion string/wellhead is temporarily isolated with lower and upper barrier elements until the XT is landed and connected. This indicates that the production bore and the annulus bore of the TH are normally isolated by installation of a plug in the upper parts of the respective bores.

The VXT controls the flow of fluids, in particular produced hydrocarbons flowing out from the well and constitutes a barrier between the well and the environment.

A vertical dual bore VXT as referred to, have two bores, one bore is the main bore, known as a production or injection bore, and the other bore is referred to as the annulus bore which communicates with the tubing annulus. The tubing annulus is the annular space between the production tubing and the well casing.

The annulus bore in the VXT communicates through a bore extending vertically from the tubing annulus through the TH and through the VXT main body. A dual bore VXT has, due to this, access from topside to the TH main production/injection bore and the TH annulus bore through the respective dual bores. A wireline tool and/or other remedies can be used to install and/or retrieve barrier elements or other remedies in the VXT bores and/or in the well through e.g. a workover riser.

Both vertical bores are equipped with bore valves that could be used during installation and/or retrieval phase to shut off/barrier off the access to the well. These valves are qualified as barrier valves and permit the removal of the temporary

plugs in the main bore and the annulus bore of the tubing/TH after installation of the VXT.

Another type of prior art Christmas tree is the vertical monobore VXT, shown in fig. 1b. This tree is similar to the vertical dual bore VXT, however there is no vertical access from topside to the tubing annulus bore for any mechanical intervention operations, only fluid communication to/from the tubing annulus bore is possible.

For the vertical monobore VXT the tubing annulus access is barricaded off by mechanical devices or valves prior to any retrieval of the VXT. If the tubing hanger is installed in the Wellhead (WH) the tubing hanger (TH) annulus bore is closed by use of an annulus bore barrier device installed in the tubing hanger. If the tubing hanger (TH) is landed in a tubing head, the tubing annulus bore is closed off by closing the valves on the annulus inlet line. These arrangements leave no need for an annulus bore plug to be installed in the tubing hanger (TH) annulus bore.

The vertical monobore VXT design allows for bigger internal diameter tubing hanger (TH) production bore than the dual bore version does, as well as the bore is centric as is the production bore in a horizontal Christmas tree (HXT) system, thereby provides the possibility to use common tools with the horizontal Christmas tree system.

Yet another prior art Christmas tree is the horizontal Christmas tree (often referred to as a HXT), shown in fig. 1c.

The HXT is arranged on the seabed, on top of a subsea wellhead on a well extending into the seabed. After installing the HXT on the wellhead a Tubing hanger (TH)/tubing is run, landed and locked in the HXT. As of today all operations, involving running or retrieving of production tubing/upper completion include utilization of drilling rigs or drill ships and installation of BOPs on top of the HXTs prior to handling completion strings.

After installing the completion string (TH and the tubing), the completion string/HXT is isolated with two individual barrier plugs of which the lower one is installed in the TH bore and the upper one is installed in the HXT bore in an internal tree cap (ITC). These plugs shut off/barrier off any eventually leakage originating from the tubing production bore and permits the removal of the BOP after installation of the upper completion. During the installation and/or retrieval phase of the upper completions, the BOP rams will be used to shut off/barrier off the access to the well if necessary.

A HXT as referred to, only have one bore, which allows the upper completion/tubing to be run into the well/casing, the TH to be landed on a landing

shoulder in the HXT bore, aligned with the horizontal production outlet from the HXT and then locked in the HXT. Hence, produced fluid is guided from the production bore and out into the manifold and then the pipeline.

A HXT has, due to this, access from topside to the TH main production/injection bore and allows for wireline (WL) tools and/or drill pipe to be used to install and/or retrieve barrier elements and other remedies in the TH/production tubing in the well through e.g. a workover riser, a marine riser or similar.

There is only fluid communication with the tubing annulus, which is the annular space between the production tubing and the well casing. The HXT controls the flow of fluids, in particular produced hydrocarbons flowing out from the well and constitutes a barrier between the well and the environment.

In all cases when running or retrieving Christmas trees, there is need for a separate tree running tool or the functionality of such a tool implemented in the present invention for operation of the Christmas tree well head WH-connector and eventually other vital functions on the Christmas tree as well as being the dedicated lifting tool. In this context, the wording "tree running tool," indicates either a dedicated tool or implemented functionalities in another tool as described above. If represented by a special tool the design and fabrication must, as is for the present invention, be according to relevant rules and regulations governing well control equipment deliveries.

US 2014/0048278 describes a subsea well assembly having a Christmas tree and wellhead. A part of a production flow passage extends vertically from the tubing hanger in a vertical bore of the Christmas tree.

US 2015/0275608 describes a subsea hydrocarbon production system comprising a tubing hanger which is positioned at an upper end of a well bore, a tubing string which extends from the tubing hanger into the well bore and is fluidly connected to the tubing hanger production bore, and a christmas tree which is positioned above the tubing hanger. The christmas tree comprises a production bore which is fluidly connected to the tubing hanger production bore, a production outlet which is connected to the production bore, a first barrier element which is positioned in the production outlet, and a first closure device which is positioned in the production bore above the production outlet, and a outlet.

WO 1998/49422 describes a method and apparatus for utilizing a tree running tool for guiding a conventional or horizontal tree for the purpose of connection to a subsea wellhead without the use of guidelines or guide funnels.

The object of the present invention is to reduce the potential safety issue of handling heavy equipment onboard floating work platforms as well as reduce the

complexity, time, cost, equipment/tools and personnel involved with such operations through the possibility to run and retrieve Christmas trees from other monohull vessels than drill ships and RLWI-vessels.

SUMMARY OF THE INVENTION

The present invention relates to a device for enabling removal of a Christmas tree from a wellhead or for installation of a Christmas tree on a wellhead. The features of the device are defined in claim 1. Aspects of the device are defined in the dependent claims 2 – 14.

The present invention also relates to a method for removal of a Christmas tree from a wellhead as defined in claim 15.

The present invention also relates to a method for installing a Christmas tree on a wellhead as defined in claim 18.

DETAILED DESCRIPTION

Embodiments of the invention will be described herein in detail with reference to the enclosed drawings, where:

Fig. 1a illustrates a vertical dual bore VXT landed on a wellhead schematically, where the different main valves in the tree are indicated by their respective names;

Fig. 1b illustrates a vertical monobore VXT landed on a wellhead, where the different main valves in the tree are indicated by their respective names;

Fig. 1c illustrates a HXT landed on a wellhead, where the different main valves in the tree are indicated by their respective names;

Fig. 2a illustrates a first embodiment of the device according to the present invention schematically;

Fig. 2b illustrates a second embodiment of the device according to the present invention schematically;

Fig. 2c illustrates a third embodiment of the device according to the present invention schematically;

Fig. 2d illustrates a fourth embodiment of the device according to the present invention schematically;

Fig. 2e illustrates a fifth embodiment of the device according to the present invention schematically;

Fig. 3 illustrates schematically the submerging of the device from a vessel and down to a Christmas tree;

Fig. 4 illustrates a cross sectional view of a first embodiment of the invention installed on the VXT via a tree running tool;

Fig. 5 – 32 illustrates different steps of how the embodiments of the invention may be used.

There are three main embodiments of the present invention, where these three embodiments can be equipped with several add-ons. These three embodiments and add-ons will be described in detail below, but first, the common features of the three embodiments will be explained. The three main embodiments are shown in fig. 2a, 2b and 2e.

As mentioned in the introduction, the present invention can be used to enable removal of a Christmas tree from a wellhead WH or for installation of a Christmas tree on a wellhead. Moreover, the present invention can be used with several types of Christmas trees, such as a vertical monobore Christmas tree (VXT), a vertical dual bore Christmas tree (VXT) and a horizontal Christmas tree (HXT).

In the following description, the term XT is used as an abbreviation for Christmas tree, where such a tree can be both a vertical Christmas tree abbreviated VXT and a horizontal Christmas tree abbreviated HXT. A list of other abbreviations used in the drawings are provided in the end of the description below.

The invention is related to a device generally referred to with reference number 1. In some of the drawings, the term SPPA is also used for the device 1, which is an abbreviation for "Subsea Pump and Plug Adapter".

The device 1 comprises a housing device 10 having a bore 11 provided axially through the housing 10. Moreover, the device comprises a lower connector 15 for connection to an upper re-entry mandrel of the Christmas tree. The lower connector 15 may be connected directly to the Christmas tree. In this case, the device 1 must comprise the functionality of a tree running tool, an EQDP or similar. Such functionalities could be to e.g. hydraulically operate soft landing cylinders or jacks, include a connection point for umbilical and/or relevant hydraulic supplies to the XT, include ROV-panel for operating of device 1 e.g. shear rams, have the capabilities to lift the complete Christmas tree stack, in this case the device 1 and the Christmas tree, have attached a bumper structure for any under- and/or over-hull guiding structure interface etc.

However, a more practical solution will be to connect the lower connector 15 to the upper re-entry mandrel of a tree running tool TRT, where the tree running tool TRT is comprising a lower connector to interface with the Christmas tree re-entry mandrel. In the drawings, this is referred to as a TRT/XT connector. In this case, the above functionality of the device 1 is provided as part of the TRT/XT connector.

A first tool is provided in the first bore. It is provided a first tool holding device for holding the first tool in an initial position in the first bore 11. The first tool holding device is also configured to release the first tool from the initial position upon actuation of the first tool holding device.

The device further comprises a fluid communication port 30 provided in fluid communication with the first bore 11 via a fluid line 31. The first fluid line 31 entry point 31a into the first bore 11 is provided below the first tool holding device. A first valve 41 is provided in the fluid line 31 between the fluid communication port 30 and the first bore 11.

The device 1 is equipped with gauges for pressure reading.

It is now referred to fig. 3. Here, a vessel 100 is disclosed at sealevel SL above the seabed SB. A subsea well is provided on the seabed, illustrated as a wellhead WH with a Christmas tree XT. The vessel 100 comprises a lifting device 101 that is used to lower the device 1 down towards the Christmas tree via a wire 102.

The vessel 100 is preferably a monohull vessel. Alternatively, other vessels, such as a drilling rig may be used. However, monohull vessels are often a less expensive solution.

The lifting device 101 may be a crane, an A-frame, a module handling system MHS or drillpipe DP with its drill pipe derrick and draw-works.

The wire 102 may be a wire or a drillpipe.

In addition, a remotely operated vehicle ROV 120 is controlled from the vessel 100 via a control and power cable 122. The first valve 41 and the first tool holding device of the device 1 are preferably configured to be operated by a remotely operated vehicle 120. As is known, ROV 120 is commonly used to open/close valves of XTs and to perform other types of subsea operations with use of hydraulic supplies from a ROV hydraulic test skid. Alternatively, the device 1 could be configured so that the different hydraulic functions to be performed on device 1 and if applicable the tree running tool as well as the Christmas tree, are controlled and supplied from the vessel 100 via a separate umbilical attached to the device 1 from the vessel 100.

The fluid communication port 30 is provided for connection to a fluid circulation device 110. The fluid circulation device 110 may be provided topside on the vessel, and may for example be a pumping device. The fluid circulation device 110 may be connected to a fluid reservoir containing fluids with desired properties e.g. mud, brine, seawater etc.

As shown in fig. 3, the fluid circulation device 110 is connected to the fluid communication port 30 of the device 1 via a hose 111. Preferably, the hose is a high pressure hose, and the fluid circulation device 110 is a high pressure pump for applying a high fluid pressure into the port 30 of the device 1. The fluid circulation device 110 comprises pressure and flow meters to measure the pressure of the fluid in port 30 and/or the fluid rate through port 30. The fluid circulation device 110 and hose 111 are used to pressure test the tree and well barriers during the well operation.

All of the embodiments of the devices 1 can be deployed and operated from any work platform, e.g. mono-hull vessels, drilling rigs, platforms etc.

The conveyance method for running and retrieving activities from a monohull vessel will be by wire. If the SPPA is run/retrieved from a drilling rig, a drill ship and a jack-up without the possibility to run equipment on wire, a drill-pipe solution will have to be used.

The most effective and less complicated method using drill pipe (DP) would then be to use a forerunner between a DP lifting sub made up to the lower end of the DP and the lifting arrangement on the device 1. Such a solution will either require a standard lifting sub to be made up to the DP and use of the aforementioned high pressure pumping hose run down from the rig to the device 1, or it would require a special lifting adapter with a side outlet for pumping purposes. The idea behind such a purpose-made side outlet adapter is twofold; lifting of the XT stack, similar function as the standard lifting sub, and in addition make pumping activities possible without the need for a surface hose reel and the corresponding high pressure pumping hose. If using a purpose-made side outlet adapter the required fluid could be pumped down the DP through the adapter outlet and a high-pressure hose and into the well through the port 30 on the device 1, thus enabling bullheading/killing of well, pressure testing, pumping of prong/plug, etc. - “as normal”.

The above-mentioned DP conveyance methods will enable the forerunner to be disconnected from the device 1 by use of a ROV, hence there is no “locked to bottom”-situation requiring weak-link, device 1 bore valves, drive-off/drift-off calculations/evaluations, control system etc. The high pressure pumping hose will still be connected to both the device 1 port 30 and the special lifting adapter side outlet, thus demanding the hose connector to either be equipped with a disconnect

device/design enabling both disconnect and re-connect or a guillotine to cut the hose in an emergency. A non-return/shut-in valve taking care of the integrity of the device 1 in a drive-off/drift-off situation would also be part of the overall design.

Example 1: First main embodiment

The first main embodiment of the invention is shown in fig. 2a. This embodiment may be used together with the vertical monobore VXT shown in fig. 1b and the HXT shown in fig. 1c.

In fig. 2a, the first bore 11 is a bore for alignment with a production bore PB of the Christmas tree XT. Therefore, the first bore of the device 1 is here referred to as a production bore. If a dedicated tree running tool TRT is used, a production bore is also provided through the tree running tool TRT.

In addition, a second valve 42 is provided in the fluid line 31 between the fluid communication port 30 and the first bore 11.

The first tool provided in the first bore 11 is a production tube tool 50. The production tube tool 50 may be a dart tool, a jarring tool, a plug release and retrieval tool, a plug, a prong or other type of tool and/or equipment that represent a fluid restriction or barrier in the bore. The first tool holding device 51 is holding the production tube tool 50 in the initial position shown in fig. 2a. By actuating the first tool holding device 51 to open position the production tube tool 50 falls down to a position below the entry point 31a of the fluid line 31 into the first bore 11. Here, fluid pumped into the fluid line 31 via port 30 and hose 111 by means of the fluid circulation device 110 will then transport the production tube tool 50 further down and into the XT and possibly also further into the wellhead WH and/or the well. This requires that the valves 41, 42 provided in the fluid line 31 are open.

The first tool holding device 51 is operated by the ROV, alternatively, the first tool holding device 51 is operated from the vessel via an umbilical.

As shown in fig. 1a, the device also comprises an end cap 13 for closing the upper end of the first bore 11. The end cap 13 may be removed during later operations, as will be apparent from the description below. The end cap 13 may be removed by means of the ROV 120.

In fig. 26 it is shown that the device 1 further comprises a first plug retrieval unit 16, comprising a production bore lubricator 16a, a production bore stuffing box 16b, a wireline sheave 16c having a wire or slickline 16d connected to a ROV D-handle 16e. The lubricator 16a and stuffing box 16b are aligned the first bore 11. The retrieval unit 16 may be connected, either by the ROV 120 or installed prior to

deployment, to the device 1 after the end cap 13 has been removed. Disconnection of the unit 16 and installation of the end cap 13 could also be achieved using ROV or carried out on surface on the vessel or rig.

The lubricator 16a, stuffing box 16b and wireline sheave 16c are considered to be prior art technology and will not be described in detail here. A plug retrieval tool 16f may be connected to the end of the slickline and hence, the ROV 120 can be used to retrieve plugs from the production bore.

In fig. 2c, it is shown that the device 1 further comprises a bore insert device 60 provided in the first bore 11 below the entry point 31a. The bore insert device 60 may be a bore selector or annulus or production bore adapter. The functionality of the bore selector/annulus or production bore adapter is to guide the production tube tool 50 into the respective XT bores and/or TRT bores to allow for mechanical and/or pumping operations in the respective bore.

In fig. 29 it is shown that the device 1 further comprises a vessel-operated plug running and/or retrieval unit 18. It should be noted that plug running and/or retrieval unit 18 is an alternative, and not an addition to, the plug retrieval unit 16 described above. The plug running and/or retrieval unit 18 comprises a production bore lubricator 18a, a production bore stuffing box 18b, where a wireline unit located on the vessel 100 has a wire 18d pre-installed into the plug running and/or retrieval unit 18. Here, the tool 50 is a plug unit 18f comprising a barrier plug with a setting and/or retrieval tool connected to the wire 18d.

In fig. 2d, it is shown that the device 1 comprises an upper shear ram device 62 and a lower shear ram device 63 provided in the first bore 11 below the tool holding device 51 but above the entry point 31a. The shear ram devices 62 and 63 may be operated by the ROV 120 to cut any wires present in the bore 11, for example the wire 18d, 16d described above. Alternatively, the shear ram devices 62 and 63 may be operated via an umbilical from the vessel.

Example 2: Second main embodiment

The second main embodiment of the invention is shown in fig. 2b. This embodiment may be used together with the vertical dual bore VXT shown in fig. 1a in situations where there is no need to insert tools into the production bore of the VXT.

Here, the first bore is a bore for alignment with an annulus bore AB of the VXT. Therefore, the first bore of the device 1 is here referred to as an annulus bore. If a TRT/XT connector is used, an annulus bore is also provided through the TRT.

Also here, a second valve 42 is provided in the fluid line 31 between the fluid communication port 30 and the first bore 11.

The first tool provided in the annulus bore 11 is an annulus tool 20. The annulus tool 20 may for example be a prong, which is used to actuate a plug function when moved into a plug located in the annulus of the wellhead WH. The annulus tool 20 may also be a jarring tool, a plug release and retrieval tool, an annulus plug etc.

The first tool holding device 21 is holding the annulus tool 20 in the initial position shown in fig. 2b. By actuating the first tool holding device 21 to open position the tool 20 falls down to a position below the entry point 31a of the fluid line 31 into the first bore 11. Here, fluid pumped into the fluid line 31 via port 30 and hose 111 by means of the fluid circulation device 110 will then transport the tool 20 further down and into the annulus bore AB of the XT and further into the wellhead WH. This requires that the valves 41 and 42 provided in the fluid line 31 are open.

As shown in fig. 2b, the device also comprises an end cap 14 for closing the upper end of the first bore 11. The end cap 14 may be removed during later operations, as will be apparent from the description below. The end cap 14 may be removed by means of the ROV 120.

The second main embodiment of the invention shown in fig. 2b may be utilized in situations where the deep barrier element(s) in the production bore is verified prior to operations commence. The only remaining work to be performed before retrieval of the VXT is to establish an upper barrier/second barrier in the annulus bore of the TH. The upper annulus barrier is achieved by installing a prong or plug in the annulus TH bore either by pumping and/or by simple WL-operations through the annulus bore 11 of the device 1.

The device 1 may comprise a plug running and/or retrieval unit 17 for the annulus bore. The plug running and/or retrieval unit 17 is described in detail in the third example below with reference to fig. 8.

Example 3: Third main embodiment

The third main embodiment of the invention is shown in fig. 2e. This embodiment may be used together with prior art XT shown in fig. 1a

It should be noted that the third main embodiment is essentially a combination of the first and second main embodiments. Here, the first bore 11 is the annulus bore as in the second main embodiment above. The first tool is the annulus tool 20 held in its initial position by means of the first tool holding device 21. The fluid communication port 30 is provided in fluid communication with the first bore 11 via the fluid line 31. The first valve 41 is provided in the first fluid line 31.

The second bore is here the production bore 12 as in the first main embodiment above. The second tool is the tool 50 held in its initial position by means of a

second tool holding device 51. The fluid communication port 30 is provided in fluid communication with the second bore 12 via a second fluid line 32, where a second fluid line 32 entry point 32a into the second bore 12 is provided below the second tool holding device 51.

As described in example 2 above, the annulus tool 20 may also be a prong, a jarring tool, a plug release and retrieval tool, an annulus plug etc.

The second tool 50 is referred to as a production tube tool, which can be a restrictor tool, a dart, a prong, a plug, a plug release and retrieval tool etc. In some embodiments the tool 50 is moved into the well by means of gravity, in other embodiments, fluid flow may be used to move the tool into the well from below the entry point 32a.

A second valve 42 is provided in the second fluid line 32 between the fluid communication port 30 and the second bore 12.

As shown in fig. 2e, a third fluid line 33 is provided as a common subsection of both the first fluid line 31 and the second fluid line 32. A third valve 43 is provided in the third fluid line 33. It should be noted that it could be possible to provide the device 1 with two ports, one for each of the first and second fluid lines 31, 32. However, this would increase the complexity by having two hoses from the fluid circulation device 110 to the device 1.

The device 1 may comprise a running and/or retrieval unit 16 as described above with reference to the first main embodiment, for running and/or retrieving plugs, tools etc in the production bore 12. This is for example shown in fig. 22.

In fig. 8, it is shown a second plug running and/or retrieval unit 17, comprising a annulus bore lubricator 17a, a annulus bore stuffing box 17b, a wireline sheave 17c having a wire or slickline 17d connected to a ROV D-handle 17e. The lubricator 17a and stuffing box 17b are aligned the first bore 11, i.e. the annulus bore. The running and/or retrieval unit 17 may be connected to the device 1 after the end cap 13 has been removed. The annulus tool 20 is here a plug release and retrieval tool 17f which is provided in the initial position and which may be lowered into the well to run and set and/or release and retrieve an annulus prong or plug.

In fig. 22, it is shown that the device 1 could comprise a first plug running and/or retrieval unit 16 for the production bore and a second plug running and/or retrieval unit 17 for the annulus bore.

Below, examples of the use of the above main embodiments of the device 1 will be described with reference to the drawings. These examples are meant only as examples, and does not prevent the above three main embodiments and their alternatives to be used in other types of operations.

Initially, it should be mentioned that, depending on the type of operation and the type of XT, a rig may be needed in order to prepare the well, the wellhead and/or the XT before the device 1 can be used. These prerequisite operations will be described very short in the examples, as such rig operations are considered to be known for the skilled person. As monohull vessels have advantages over rigs with respect to costs etc. as discussed above, it may still be advantageous to use the present invention for only parts of the well operation.

Moreover, in the examples below, some details will be omitted as they are considered know for the skilled person. For example the ROV technology and general communication technology (sending and receiving communication signals from sensors for sensing fluid flow, fluid pressure, fluid temperature, valve status etc) between the ROV 120, the vessel 110 and the device 1 will not be described. Moreover, the connection between the device 1 and the XT with or without the tree running tool TRT is considered prior art. Systems to position a monohull vessel, a rig or a jack-up rig above the well such as anchoring, dynamic positioning or resting on legs penetrated into the seabed are considered prior art knowledge for a skilled person and will not be further described. Further the operational aspects of functioning a gas lift valve or a flow control valve is also considered prior art and will not be described. Preparations prior to entering the well with the device 1 will not be described as these also are considered prior art. The different type of plugs that could be opened by pumping - plugs with shear open device and electronic activated plugs - are considered prior art technology and will not be further explained.

Example 4: Installation of a vertical dual bore Christmas tree on a wellhead WH

An example of an operation of installing a vertical dual bore Christmas tree XT on a wellhead WH by using the device 1 will now be described in detail.

Initially, the device 1 according to example 3 and shown in fig. 2e are connected to the Christmas tree topside on the vessel. A tree running tool TRT could be used for connecting the device 1 to the Christmas tree.

As described above, the first bore 11 is aligned with the annulus bore AB of the Christmas tree and the second bore 12 is aligned with the production bore PB of the Christmas tree.

First, the device 1 together with the Christmas tree XT is lowered into the sea. Then, the Christmas tree XT and the device 1 is connected to the wellhead WH.

As is known for a skilled person, several tests must be performed during such operations, such as tests of the connection between the Christmas tree and the WH as well as tests of the valves of the Christmas tree after the connection.

This situation is shown in fig. 5, were fluid is pumped into port 30 of the device 1 for pressure testing of the bores 11, 12, AB, PB and valves.

In fig. 6 fluid is pumped into the annulus bore 11 to pump open the annulus plug and for testing of the production packer.

In fig. 7, different operations of the completion process are performed to make the well ready for production. For example opening of the well barrier production tubing hanger TH plug by pumping up the pump-open sub in the plug or removing the plug as indicated in fig. 22, where it is shown that the device 1 could comprise a first plug running and/or retrieval unit 16 for the production bore PB, pressurizing the production bore PB to fire side mounted guns SMG to perforate predetermined zones of the well, placing or replacing different fluids in the well (i.e. MEG, brine or other fluids could be circulated out from or into the well) as well as testing the integrity of the lower barrier elements e.g. gas lift valve GLV and flow control valves FCV's.

The device 1 with the tree running tool may then be disconnected from the Christmas tree and elevated to the vessel. A cap may be mounted on top of the Christmas tree XT.

All valves of the Christmas tree and down hole devices may then be tested through commissioning activities initiated from the production unit and supported from the vessel 100 through utilization of the ROV 120. Thereafter the production may start.

In the above operation, if everything works as expected, no tools 20, 50 are needed. However, if the annulus plug cannot be pumped open, it will be necessary to pull and retrieve the plug. In such a situation shown in fig. 8, the device 1 could be disconnected from the tree and elevated to the vessel, where the above described plug running and/or retrieval unit 17 will be connected to the device 1 and then lowered and re-connected to the tree again. Another method could be to remove the end cap 14 of the device 1 subsea with use of the ROV and then lower a plug running and/or retrieval unit 17 from the vessel 100 down to the device 1 and use the ROV for connecting the unit 17 to the device 1.

The ROV may then lower e.g. the plug release and retrieval tool 17f via wire 17d and retrieve the annulus plug before the above operations are performed to make the well ready for production. Of course, the above method may also be used to retrieve a prong in the annulus bore.

In fig. 9, it is shown that the annulus plug is retrieved up into the top of the annulus bore 11 of the device 1. During installation of the Christmas tree, it may also be needed to install plugs, remove plugs or to release locks in the production bore. In such cases, the above described plug running and/or retrieval unit may be connected

to the device 1 above the production bore in a similar way as the unit 17 was for the annulus bore.

Example 5: Removal of a dual bore vertical Christmas tree from a wellhead

An example of an operation of removing a vertical dual bore Christmas tree XT from a wellhead WH will now be described. Initially, the device 1 according to example 3 and shown in fig. 2e are submerged from the vessel as shown in fig. 3 and is connected to the wellhead WH as shown in fig. 4. Here, it is shown that a tree running tool TRT is used for connecting the device 1 to the Christmas tree.

As shown, the first bore 11 is aligned with the annulus bore AB of the Christmas tree and the second bore 12 is aligned with the production bore PB of the Christmas tree.

In a first step, a pressure testing of the connection between the tree running tool and the Christmas tree will be performed. Also, pressure testing of the different valves in the tree will be performed. Such pressure testing operations will be considered known for the skilled person and will not be described here in detail.

Then, in fig. 10, a bullheading and well killing operation is started by pumping bullhead/killing fluid into the well. As shown in fig. 10 a first tool 20 in the form of an annulus prong is provided in the annulus tool holding device 21. Then, in fig. 11 the tool 20 is released and the tool is falling down to the annulus plug AP. Then, fluid is pumped into the annulus bore from port 30 to pump the annulus prong into the pump-open plug/shear sub to actuate the plug to its closed state as shown in fig. 12. A barrier is now established in the annulus bore.

If everything works as expected, the first and second barriers of the well can be closed. In many wells, the first barrier is formed by GLV and FCVs as mentioned above, and the second barrier is provided by the downhole safety valve DHSV and the debris catcher which could be a dedicated catcher device, a production tubing hanger TH plug without sealing elements or a production tubing hanger TH plug with proper seals.

After testing of the barriers by pumping fluid into the bores through port 30, the tree can be disconnected from the wellhead and retrieved up to the vessel together with the device 1.

A production tubing hanger TH plug could then be installed by ROV 120 if the DHSV together with a debris catcher without proper sealing functionalities is not accepted as the upper barrier for a longer period. After installation of the production tubing hanger TH plug pressure testing of the plug has to be conducted for the plug to be accepted as a barrier element. This could be achieved by e.g. installing a

wellhead high pressure cap on top of the WH or re-land the device 1 and pressure test the plug through the hose 111.

An alternative to the barrier presented above could be achieved by installing the abovementioned high pressure wellhead cap on the wellhead after retrieval of the tree, without installing a production tubing hanger TH plug. Verification of such a barrier could be performed by connecting the hose 111 to the cap, pressurizing the hose and testing the cap.

If the pumping operation of the annulus prong is not sufficient to close the annulus plug, then a jarring tool may be connected to the unit 17 as shown in fig. 13. As is known for a skilled person, a jarring tool is used to apply an additional upwards or downwards force on top of well tools.

If a production bore plug, for example the debris catcher, must be removed, then the unit 16 may be connected to the device above the production bore and the plug may be retrieved, as shown in fig. 14, 15 and 16. As described above, this operation may be performed by the ROV actuating the ROV D-handle.

In case that there is no deep barrier in the well, for example no FCVs and GLV, then the second tool 50 in the form of a dart or restrictor may be provided in the second tool holding device 51 as shown in fig. 17.

In fig. 18, the second tool holding device 51 is actuated and is releasing the tool 50. In fig. 19 the tool 50 has fallen down to a position above a tubing restriction or nipple in the production tubing. In fig. 20, fluid is pumped into the production bore via port 30 for transporting the tool 50 down to the tubing restriction or nipple. In fig. 21, a barrier fluid, for example resin, is pumped on top of the tool 50, and is forming a deep barrier in the well. A pressure test of this barrier may be performed.

In fig. 22, an alternative embodiment is disclosed, here a jarring tool is provided in unit 17 above the annulus bore and a plug retrieval tool is provided in the unit 16 above the production bore.

Alternatively, as shown in fig. 29, the vessel-operated plug running and/or retrieval unit 18 may be connected to the device 1 for establishing a deep barrier. Here, it is assumed that the barrier must be set so deep that the ROV-operated unit 16 cannot be used. Instead, a complete vessel-operated wireline lubricator system in the form of the unit 18 is used, having a production bore lubricator 18a, a production bore stuffing box 18b, and a wireline 18d for lowering and setting the plug (plug with setting tool indicated as 18f) as a deep barrier in the well. Here, it is also shown that the device 1 is equipped with shear rams as shown in fig. 2d. Such a configuration with shear rams could also be part of the device 1, shown in fig. 2e, for use together with a dual bore vertical Christmas tree.

Example 6: Installation and removal of a vertical monobore Christmas tree

The operations performed in the production bore of the dual bore vertical Christmas tree in example 4 and 5 above may also be performed during installation and removal of the vertical monobore Christmas tree, and those operations will not be repeated here in detail.

In fig. 23, it is shown that the device 1 of the type shown in fig. 2a is connected to a vertical monobore Christmas tree, here of the type shown in fig. 1b. Here, initial pressure and function testing of valves and bores of device 1, tree running tool and tree are tested.

In fig. 24, fluid is pumped into the Christmas tree annulus bore via the device 1 production bore and port 30 for testing the production packer.

In fig. 25, operations corresponding to fig. 7 above are performed.

In fig. 26, a unit 16 is mounted above the production bore to pull a tubing hanger plug, such as a debris catcher.

In fig. 27, it is shown that if no deep barrier is present, this barrier can be established by using a tool in the form of a restrictor/dart in the first tool holding device and then pump a barrier fluid such as resin on top of this tool when the tool is supported in the tubing restriction or nipple as shown in fig. 28.

Alternatively, as shown in fig. 29, a plug running and/or retrieval unit 16 may be connected to the device 1 for establishing a deep barrier. Here, it is assumed that the barrier must be set so deep that the ROV-operated unit 16 can not be used. Hence, wireline 18d is used to lower and set the plug (plug with setting tool indicated as 18f) as a deep barrier in the well. Here, it is also shown that the device 1 is equipped with shear rams as shown in fig. 2d above.

In fig. 30 the tool holding device is opened and the plug with its setting tool is lowered to a desired location in the well. In fig. 31 the barrier plug has been set and the setting tool has been elevated up to the tool holding device of the device 1 again.

Example 7: Installation and removal of a horizontal Christmas tree

The operations performed in the production bore of the dual bore vertical Christmas tree in example 4, 5 and 6 above may also be performed during installation and removal of the horizontal Christmas tree, and those operations will not be repeated here in detail.

In fig. 32 it is shown that the device 1 of the type shown in fig. 2a is connected to a horizontal Christmas tree HXT of the type shown in fig. 1c. Fig. 32 also shows the

testing of the different valves, bores, connections as well as the upper and lower crown plug, during installation of the horizontal Christmas tree HXT, by pumping fluid into the production bore 11 via port 30.

Alternative embodiments

It should be noted that there are alternative embodiments to the above. For example, a bore adapter may be provided between the device 1 and the Christmas tree, between the device 1 and the tree running tool and/or between the tree running tool and the Christmas tree XT in situations where device 1 is a device such as in fig. 2a and/or 2d, and the Christmas tree XT is a vertical dual bore Christmas tree VXT as shown in figure 1a. The purpose of the bore adapter is to allow for guiding of tool 50 from a wider diameter, centric bore 11, ref. fig. 2a and into a lower diameter, acentric bore in the Christmas tree, ref. fig. 1a or tree running tool, ref. fig. 5. The referred Christmas tree bore and/or tree running tool bore could either be the annulus bore or the production bore.

As described above, the ROVs 120 is used to perform operations on the device 1, the Christmas tree XT, such as to release tools 20, 50 via tool holding devices 21, 51, to open/close valves of XTs etc. In an alternative embodiments, it would be possible to connect the device 1 to the vessel 100 by means of an umbilical, where some of, or most of, the above operations are performed via the umbilical.

List of abbreviations used in description and drawings:

Abbreviations	
AB	Annulus Bore
ABEC	Annulus Bore End Cap
ABP	Annulus Bore Plug
ABPPOS	Annulus Bore Plug Pump Open Sub
ABRC	Annulus Bore Riser Connection
ACV	Annulus Circulation Valve
AIP	Annulus Insert Plug
AIV	Annulus Isolation Valve
AL	Annulus Lubricator
AMV	Annulus Master Valve
AP	Annulus Prong
APS	ASL pump-in sub (APS)
ASL	Annulus Subsea Lubricator
ASLC	ASL Cylinder
ASLCC	ASLC Clamp
ASV	Annulus Swab Valve
AWV	Annulus Wing Valve
BG	Bore Guide

BMV	Bleed Monitoring Valve
BOP	Blow Out Preventor
BSR	Blind Shear Rams
DC	Debris Cap
DCA	Debris Catcher
DHSV	Down Hole Safety Valve
DP	Drill Pipe
DPB	Drill Pipe Box
EQDP	Emergency Quick Disconnect Package
EQDPC	Emergency Quick Disconnect Package Connector
EL	Electric Wireline
FCV	Flow Control Valve
GF	Guide Funnel
GFC	Guide Funnel Cone
GLV	Gas Lift Valve
HCL	Hydraulic Control Line
HXT	Horizontal X-mas Tree
IFS	Interface Spool
IFSC	Interface Spool Connector
ITC	Internal Tree Cap
JD	Jarring Device
KV	Kill Valve
LA	Lifting Appliances
LC	Lifting Cap
LMB	Lower Mechanical Barrier
LPB	Lower Pumpable Barrier
LRP	Lower Riser Package
LRPC	Lower Riser Package Connector
LW	Lifting Wire
MEG	Glycol (Monoetylenglykol)
MHHC	Mechanical /Hydraulic Hose Connector
MPSP	Multi Purpose Subsea Package
MPSPC	Multi Purpose Subsea Package Connector
NG	No Go
P&A	Plug and Abandonment
PB	Production Bore
PBEC	Production Bore End Cap
PBP	Production Bore Plug
PBSB	Production Bore Stuffing Box
PIV	Production Isolation Valve
PL	Production Lubricator
PRT	Plug Running & Retrieval Tool
PMV	Production Master Valve
PP	Production Packer
PR	Pipe Ram

PSV	Production Swab Valve
PWV	Production Wing Valve
PWLS	Production Wire Line Sheave
RC	Riser Connector
RES	Restrictor
RJC	Riser Joint Connector
ROV	Remote Operated Vehicle
ROVH	ROV Handle
RS	Rope Socket
R&RT	Running and Retrieval Tool
SB	Sea Bed
SJ	Stress Joint
SL	Sea Level
SWL	Slick(wire)line
SMG	Side Mounted Gun
SP	Support Plate
SPPA	Subsea Pump & Plug Adapter
SPPAC	Subsea Pump & Plug Adapter Connector
SPPAIV	Subsea Pump & Plug Adapter Isolation Valve
SPPAKV	Subsea Pump & Plug Adapter Kill Valve
SPPANRV	Subsea Pump & Plug Adapter Non-Return Valve
SPPAXOV	Subsea Pump & Plug Adapter X-Over Valve
SRS	Subsea Rope Socket
SSBOPL	Subsea BOP Lubricator
SSBOPRT	Subsea BOP Running and Retrieval Tool
SSR-L	Subsea Shear Ram Lower
SSR-U	Subsea Shear Ram Upper
STB	Stuffing Box
SW	Sea Water
TH	Tubing Hanger
TNP	Tubing Nipple Profile
TRT	Tree Running Tool
TRTC	Tree Running Tool Connector
UMB	Upper Mechanical Barrier
UPB	Upper Pumpable Barrier
VXT	Vertical X-mas Tree
VXTB	VXT Body
VXTC	VXT Connector
VXTREM	VXT Re-entry Mandrel
WH	Wellhead
WHC	Wellhead Connector
WL	Wire Line
XORS	X-Over Riser Sub
XOV	X-Over Valve

CLAIMS

1. Device (1) for enabling removal of a Christmas tree (XT) from a wellhead (WH) or for installation of a Christmas tree (XT) on a wellhead, comprising:

- a housing device (10) having a first bore (11) provided axially through the housing (10);

- a lower connector (15) for connection to an upper re-entry mandrel of the Christmas tree (XT);

- a first tool (20; 50) provided in the first bore (11);

- a first tool holding device (21, 51);

- a fluid communication port (30) provided in fluid communication with the first bore (11) via a fluid line (31);

- a first valve (41) provided in the fluid line (31) between the fluid communication port (30) and the first bore (11);

characterized in that
- a first fluid line (31) entry point (31a) into the first bore (11) is provided below the first tool holding device (21; 51) for holding the first tool (20; 50) in an initial position in the first bore (11) and for releasing the first tool (20; 50) from the initial position upon actuation of the first tool holding device (21; 51).

2. Device (1) according to claim 1, where the first valve (41) and the first tool holding device (21; 51) are configured to be operated by a remotely operated vehicle (120).

3. Device (1) according to claim 1 or 2, where the fluid communication port (30) is provided for connection to a fluid circulation device (110) via a hose (111).

4. Device (1) according to any one of the above claims, where the lower connector (15) is connected to the upper re-entry mandrel of the vertical Christmas tree via a tree running tool (TRT).

5. Device according to any one of claims 1 - 4, where the first bore (11) is a production bore for alignment with a production bore (PB) of the Christmas tree (XT) and where the first tool is a production tube tool (50).

6. Device according to claim 5, where a tool running and/or retrieval unit (16) comprising a production bore lubricator (16a), a production bore stuffing box (16b), and a wireline sheave (16c) is provided above the production bore, where the

lubricator, the stuffing box and wireline sheave are configured to be operated by the remotely operated vehicle (120).

7. Device according to claim 5, where a bore insert device (60) in the first bore (11) or a bore adapter is provided.

8. Device according to claim 5, where a shear ram device (62) is provided in the first bore (11).

9. Device according to any one of the above claims, where the Christmas tree is a vertical monobore Christmas tree (VXT) or a horizontal Christmas tree (HXT).

10. Device according to claim 1, where the first bore (11) is an annulus bore for alignment with an annulus bore (AB) of the Christmas tree (XT) and where the first tool is an annulus tool (20).

11. Device (1) according to claim 10, where the device (1) further comprises:

- a second bore (12) provided axially through the housing (10), where the second bore (12) is provided for alignment with a production bore (PB) of the Christmas tree (XT);

- a second tool (50) provided in the second bore (12), where the second tool is a production tube tool;

- a second tool holding device (51) for holding the second tool (50) in an initial position in the second bore (12) and for releasing the second tool (50) from the initial position upon actuation of the second tool holding device (51);

where the fluid communication port (30) is provided in fluid communication with the second bore (12) via a second fluid line (32), where a second fluid line (32) entry point (32a) into the second bore (12) is provided below the second tool holding device (51);

where a second valve (42) is provided in the second fluid line (32) between the fluid communication port (30) and the second bore (12).

12. Device (1) according to claim 11, where a third fluid line (33) is provided as a common subsection of both the first fluid line (31) and the second fluid line (32), and where a third valve (43) is provided in the third fluid line (33).

13. Device (1) according to claims 1 – 4 or claims 10 – 12, where the Christmas tree is a dual bore vertical Christmas tree (VXT).

14. Device (1) according to any one of claims 1 - 10, where a second valve (42) is provided in the fluid line (31) between the fluid communication port (30) and the first bore (11).

15. Method for removal of a Christmas tree (XT) from a wellhead (WH), **characterized in** that the method is comprising the steps of:

a) submerging a device (1) according to any one of claim 1 - 14 from a vessel (100) down to the Christmas tree (XT);

b) connecting the device (1) to the Christmas tree (XT) by aligning a first bore (11) of the device (1) with a bore (AB; PB) of the Christmas tree (XT);

c) establishing a first and a second barrier below the Christmas tree (XT);

d) disconnecting the Christmas tree (XT) from the wellhead (WH);

e) elevating the Christmas tree (XT) and the device (1) to the vessel (100).

16. Method according to claim 15, further comprising the step of:
- testing the connection between the device (1) and the Christmas tree (XT) by - pumping a fluid under pressure from the vessel (100) into the device (1) by means of a fluid circulation device (110) via a hose (111).

17. Method according to claim 15, further comprising the step of:
- releasing the first tool (21; 51) from a first tool holding device (20, 50) provided in the device (1)
- pumping a tool (21; 51) into the first bore (11) by means of the fluid circulation device (110) via the hose (111).

18. Method for installing a Christmas tree (XT) on a wellhead (WH) , **characterized in** that the method is comprising the steps of:

a) connecting a device (1) according to any one of claims 1 - 14 to the Christmas tree (XT) by aligning a first bore (11) of the device (1) with a bore (AB; PB) of the Christmas tree (XT);

b) submerging the device (1) from a vessel (100) down to the Christmas tree (XT);

c) connecting the Christmas tree (XT) and the device (1) to the wellhead (WH);

d) opening of a first and a second barrier provided in or below the wellhead (WH);

e) disconnecting the device (1) from the Christmas tree (XT);

f) elevating the device (1) to the vessel (100).

PATENTKRAV

1. Anordning (1) for å muliggjøre fjerning av et ventiltre (XT) fra et brønnhode (WH) eller for installasjon av et ventiltre (XT) på et brønnhode, omfattende:

- en husanordning (10) som har en første boring (11) som er tilveiebrakt aksialt gjennom huset (10);

- en nedre konnektor (15) for tilkobling til en øvre gjentilkoblingsmandrell hos ventiltreet (XT);

- et første verktøy (20; 50) tilveiebrakt i den første boringen (11);

- en første verktøyholdeanordning (21, 51);

- en fluidkommunikasjonsport (30) tilveiebrakt i fluidkommunikasjon med den første boringen (11) via en fluidledning (31);

- en første ventil (41) tilveiebrakt i fluidledningen (31) mellom fluidkommunikasjonsporten (30) og den første boringen (11);

karakterisert ved at

- et første inngangspunkt (31a) for fluidlinjen (31) inn i den første boringen (11) er tilveiebrakt under den første verktøyholdeanordningen (21; 51) for holding av det første verktøyet (20; 50) i en utgangsstilling i den første boringen (11) og for frigjøring av det første verktøyet (20; 50) fra utgangsstillingen ved aktivering av den første verktøyholdeanordningen (21; 51).

2. Anordning (1) ifølge krav 1, hvor den første ventilen (41) og den første verktøyholdeanordningen (21; 51) er konfigurert til å bli operert av en fjernstyrt farkost (120).

3. Anordning (1) i henhold til krav 1 eller 2, hvor fluidkommunikasjonsporten (30) er tilveiebrakt for forbindelse med en fluidsirkulasjonsanordning (110) via en slange (111).

4. Anordning (1) ifølge et hvilket som helst av de ovennevnte krav, hvor den nedre konnektoren (15) er forbundet til den øvre gjentilkoblingsmandrellen hos det vertikale ventiltreet gjennom et ventiltre-kjøreverktøy (TRT).

5. Anordning i samsvar med et av kravene 1 - 4, hvor den første boringen (11) er en produksjonsboring for innretting med en produksjonsboring (PB) hos ventiltreet (XT), og hvor det første verktøyet er et produksjonsrørverktøy (50).

6. Anordning ifølge krav 5, hvor en verktøykjørings- og / eller opphentingsenhet (16) omfattende en produksjonsboringslubrikator (16a), en produksjonsboringspakkboks (16b), og en vaiertrinse (16c) er tilveiebrakt over

produksjonsboringen, hvor lubrikatoren, pakkboksen og vaierstrinsen er konfigurert til å bli operert av en fjernstyrt farkost (120).

7. Anordning ifølge krav 5, hvor en boringsinnsatsanordning (60) eller en boringsadapter er tilveiebrakt i den første boringen (11).

8. Anordning ifølge krav 5, hvor en kutteventilanordning (62) er tilveiebrakt i den første boringen (11).

9. Anordning i samsvar med et hvilket som helst av de ovennevnte krav, hvor ventiltreet er et vertikalt enløps ventiltre (VXT) eller et horisontalt ventiltre (HXT).

10. Anordning ifølge krav 1, hvor den første boringen (11) er en ringromsboring for innretting med en ringromsboring (AB) hos ventiltreet (XT), og hvor det første verktøyet er et ringromsverktøy (20).

11. Anordning (1) ifølge krav 10, hvor anordningen (1) videre omfatter:

- en andre boring (12) som er tilveiebrakt aksialt gjennom huset (10), hvor den andre boringen (12) er tilveiebrakt for innretting med en produksjonsboring (PB) hos ventiltreet (XT);

- et andre verktøy (50) tilveiebrakt i den andre boringen (12), hvor det andre verktøyet er et produksjonsrørverktøy;

- en andre verktøyholdeanordning (51) for å holde det andre verktøyet (50) i en utgangsstilling i den andre boringen (12) og for frigjøring av det andre verktøyet (50) fra utgangsstillingen ved aktivering av den andre verktøyholdeanordningen (51);

hvor en fluidkommunikasjonsport (30) er tilveiebrakt i fluidkommunikasjon med den andre boringen (12) via en andre fluidlinje (32), hvor den andre fluidlinjens (32) inngangspunkt (32a) i den andre boringen (12) er tilveiebrakt under den andre verktøyholdeanordningen (51);

hvor en andre ventil (42) er tilveiebrakt i den andre fluidledningen (32) mellom fluidkommunikasjonsporten (30) og den andre boringen (12).

12. Anordning (1) ifølge krav 11, hvor en tredje fluidledning (33) er tilveiebrakt som en felles subseksjon av både den første fluidledningen (31) og den andre fluidledningen (32), og hvor en tredje ventil (43) er tilveiebrakt i den tredje fluidledningen (33).

13. Anordning (1) i henhold til krav 1 - 4 eller krav 10 - 12, hvor ventiltreet er et toløps vertikalt ventiltre (VXT).

14. Anordning (1) ifølge hvilket som helst av kravene 1 - 10, hvor en andre ventil (42) er tilveiebrakt i fluidledningen (31) mellom fluidkommunikasjonsporten (30) og den første boringen (11).

15. Fremgangsmåte for fjerning av et ventiltre (XT) fra et brønnhode (WH), **karakterisert ved** at fremgangsmåten omfatter følgende trinn:

a) senking av en anordning (1) ifølge hvilket som helst av kravene 1 - 14 fra et fartøy (100) ned til ventiltreet (XT);

b) kobling av anordningen (1) til ventiltreet (XT) ved å innrette en første boring (11) hos anordningen (1) med en boring (AB, PB) hos ventiltreet (XT);

c) etablering av en første og en andre barriere under ventiltreet (XT);

d) frakobling av ventiltreet (XT) fra brønnhodet (WH);

e) løfting av ventiltreet (XT) og anordningen (1) til fartøyet (100).

16. Fremgangsmåte ifølge krav 15, videre omfattende trinnet:

- testing av forbindelsen mellom anordningen (1) og ventiltreet (XT) ved å pumpe et fluid under trykk fra fartøyet (100) inn i apparatet (1) ved hjelp av en fluidsirkulasjonsanordning (110) via en slange (111).

17 Fremgangsmåte ifølge krav 15, videre omfattende trinnet:

- frigjøring av det første verktøyet (21; 51) fra den første verktøyholdeanordningen (20, 50) tilveiebrakt i anordningen (1)

- pumping av et verktøy (21; 51) inn i den første boringen (11) ved hjelp av fluidsirkulasjonsanordningen (110) via slangen (111).

18 Fremgangsmåte for installasjon av et ventiltre (XT) på et brønnhode (WH), **karakterisert ved** at fremgangsmåten omfatter følgende trinn:

a) kobling av en anordning (1) ifølge et hvilket som helst av kravene 1 - 14 til ventiltreet (XT) ved å innrette en første boring (11) hos anordningen (1) med en boring (AB, PB) hos ventiltreet (XT);

b) senking av anordningen (1) fra et fartøy (100) ned til ventiltreet (XT);

c) kobling av ventiltreet (XT) og anordningen (1) til brønnhodet (WH);

d) åpning av en første og en andre barriere tilveiebrakt i eller under brønnhodet (WH);

e) frakobling av enheten (1) fra ventiltreet (XT);

f) heving av anordningen (1) til fartøyet (100).

Fig. 1a: Prior art vertical dual bore VXT landed on wellhead

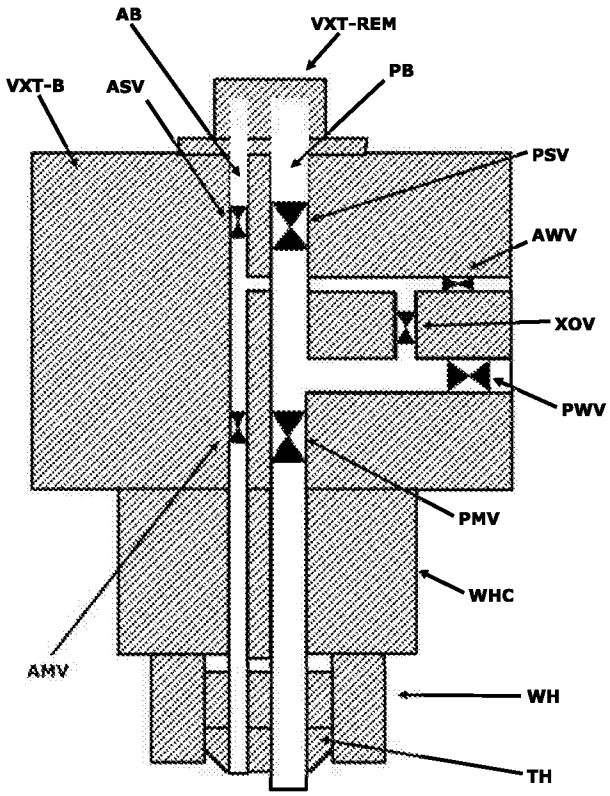


Fig. 1b: Prior art vertical monobore VXT landed on wellhead

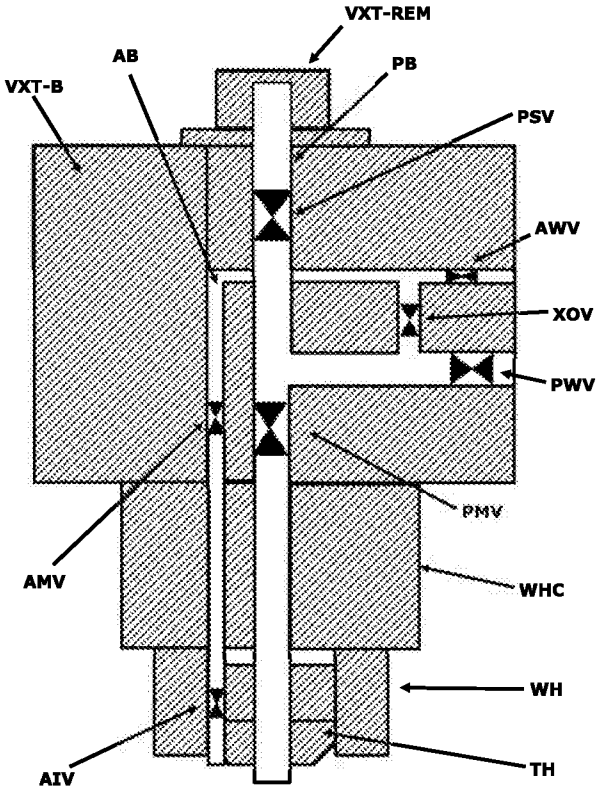


Fig. 1c: Prior art HXT landed on wellhead

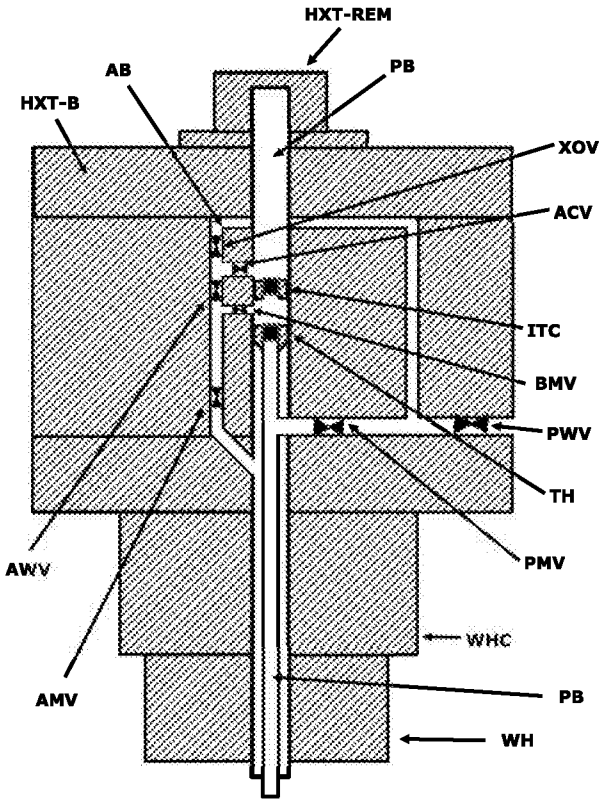


Fig. 2a: Monobore HXT/VXT SPPA

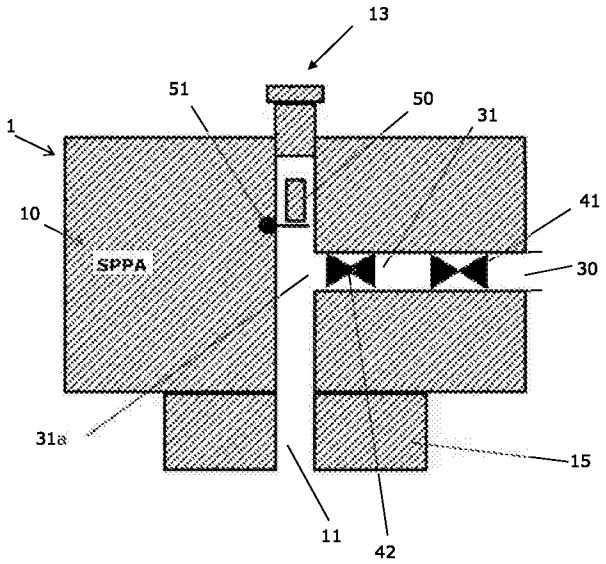


Fig. 2b: Annulus bore SPPA

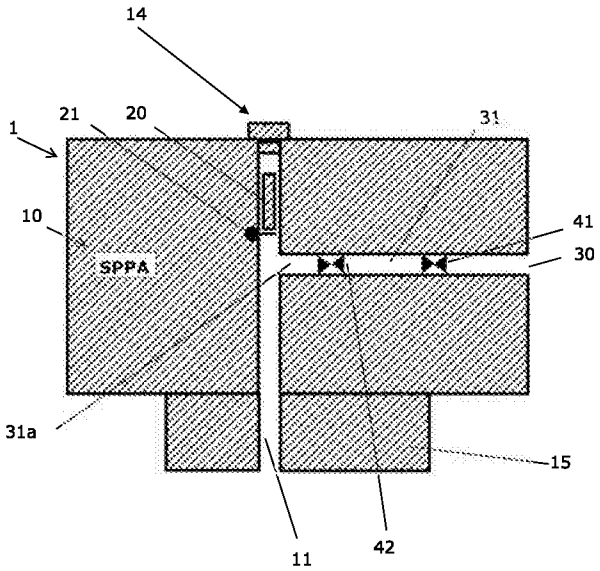


Fig. 2c: Monobore HXT/VXT SPPA w/bore selector/adapter-solution

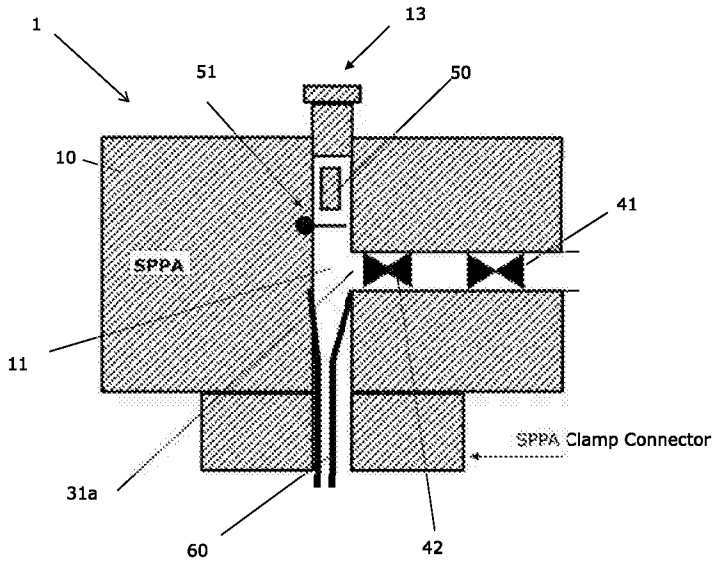


Fig. 2d: Monobore VXT/HXT SPPA with shear capacity

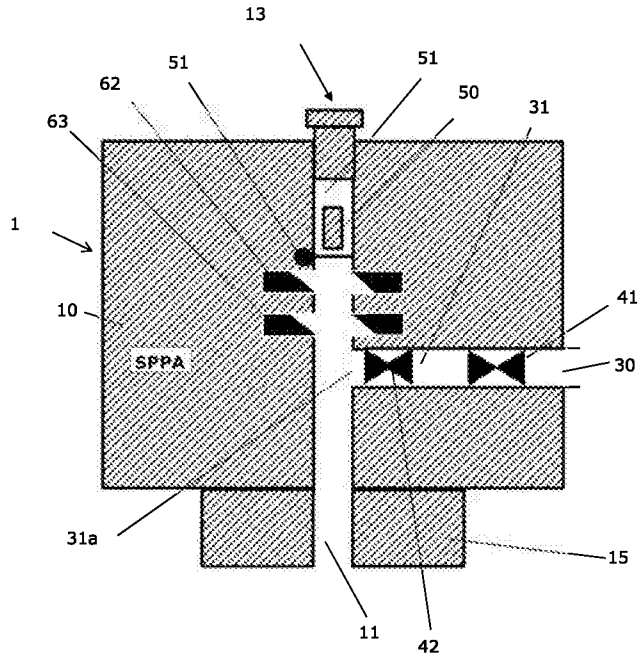


Fig. 2e: Vertical Dual Bore VXT SPPA

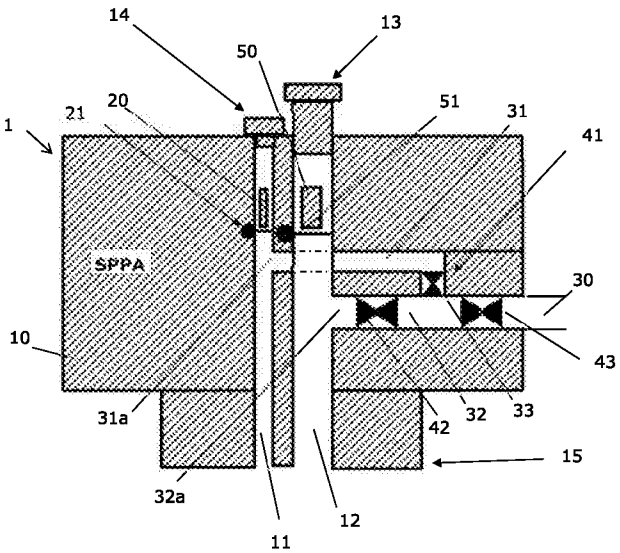


Fig. 3

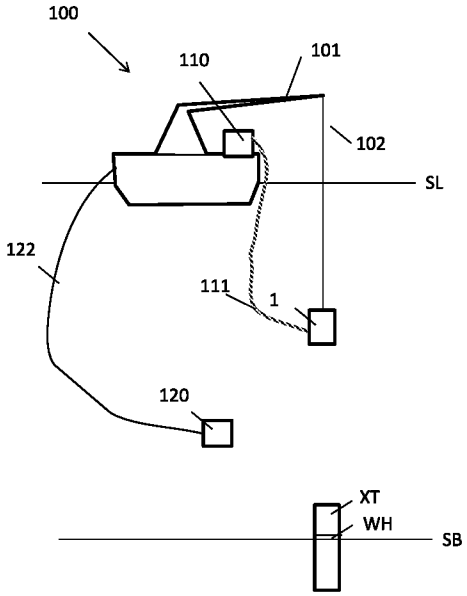
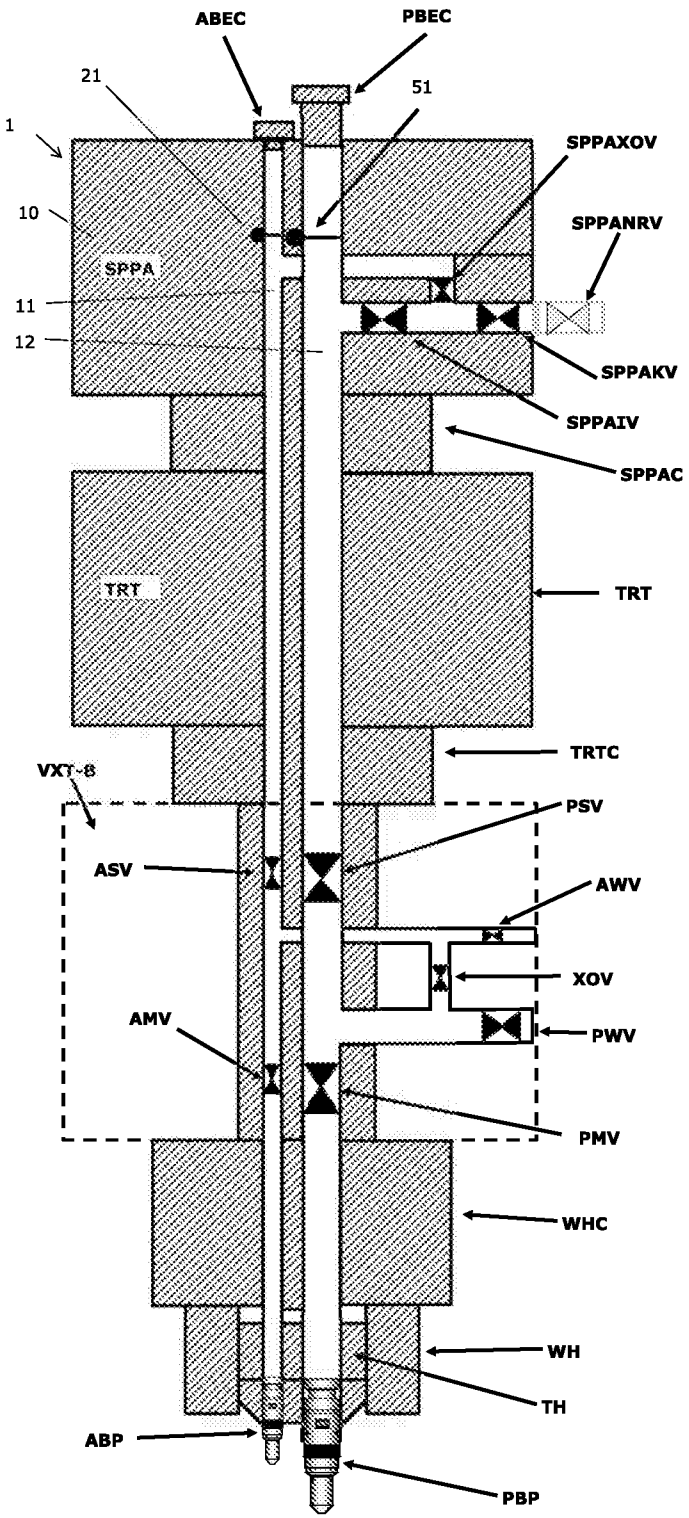


Fig. 4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PBEC
21
51
1
SPPAXOV
10
SPPANRV
SPPA
11
12
SPPAKV
SPPAIV
SPPAC
TRT
TRT
TRTC
VXT-8
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
TH
ABP
PBP

Fig. 5

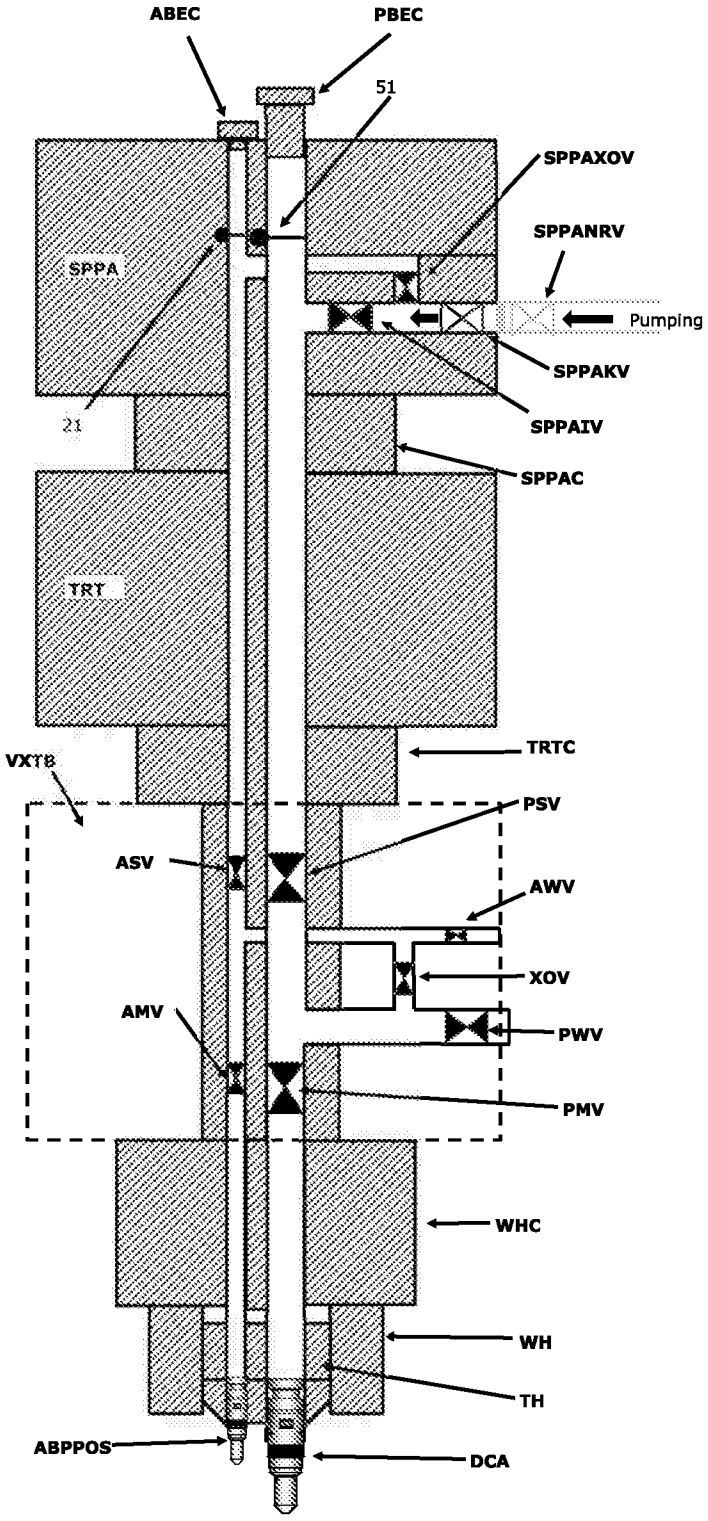

ABEC
PBEC
51
SPPAXOV
SPPANRV
SPPA
Pumping
SPPAKV
21
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
TH
ABPPOS
DCA

Fig. 6

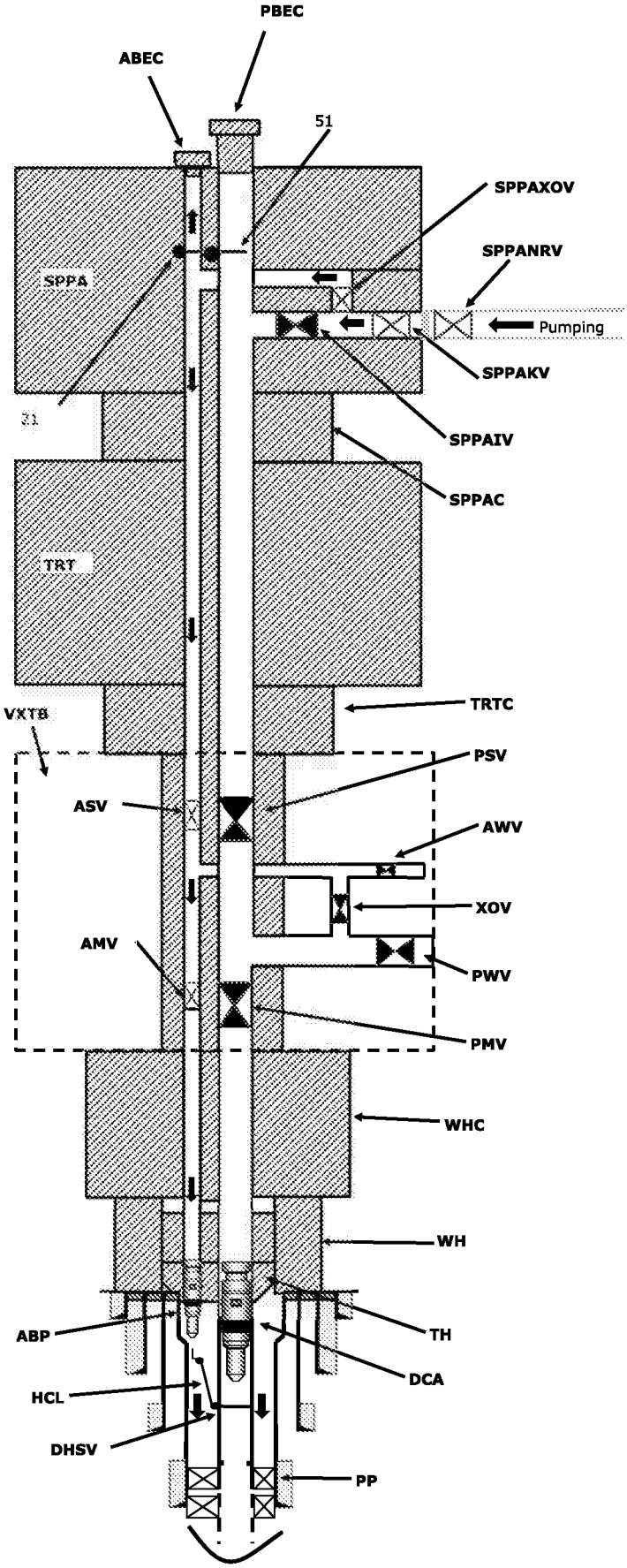
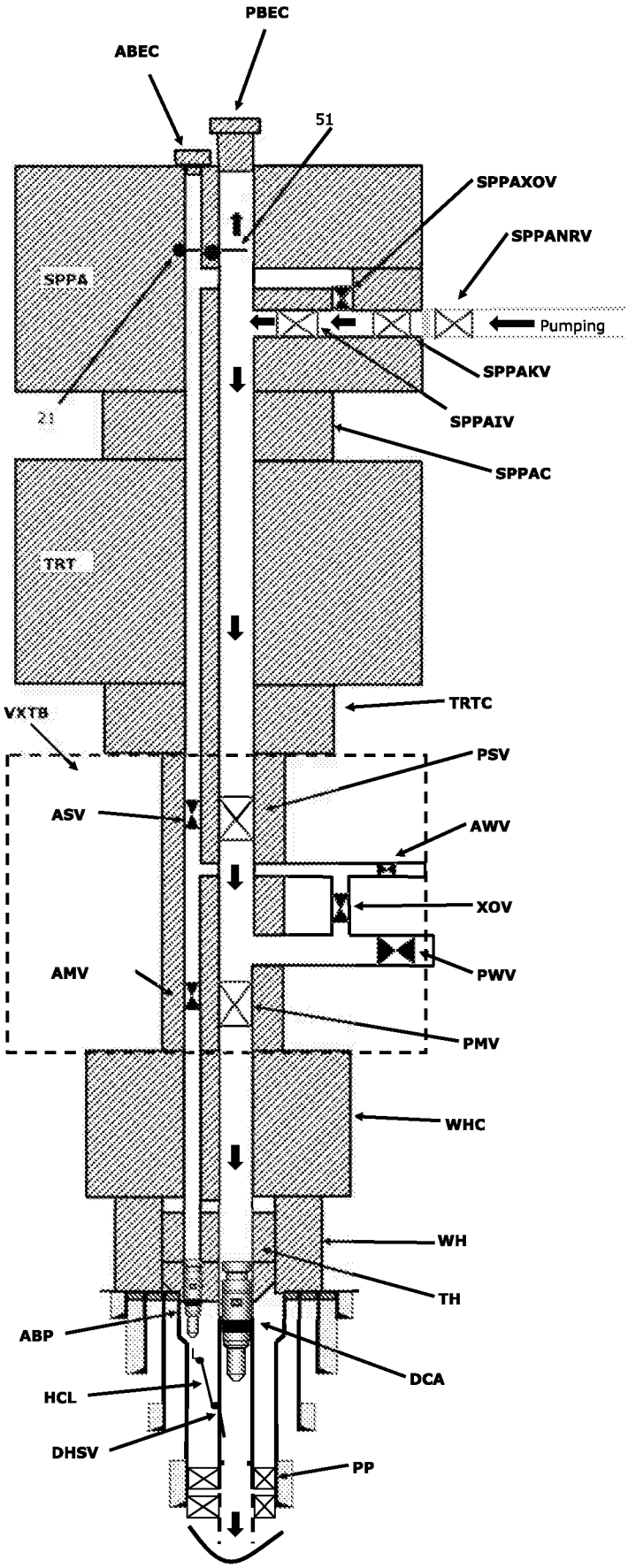

PBEC
ABEC
51
SPPAXOV
SPPANRV
SPPA
Pumping
SPPAKV
31
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
ABP
TH
DCA
HCL
DHSV
PP

Fig. 7


PBEC
ABEC
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SPPAXOV
SPPANRV
SPPA
Pumping
SPPAKV
21
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
TH
ABP
DCA
HCL
DHSV
PP

Fig. 8

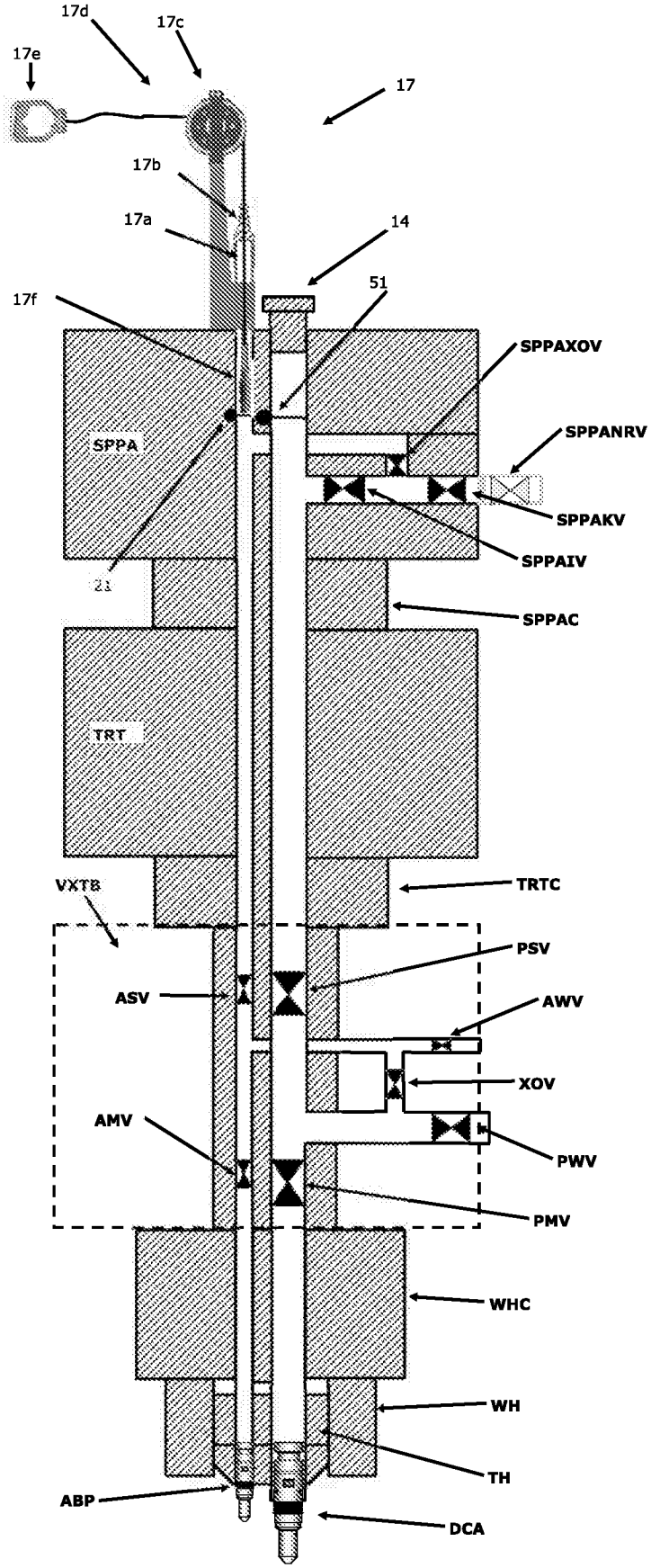
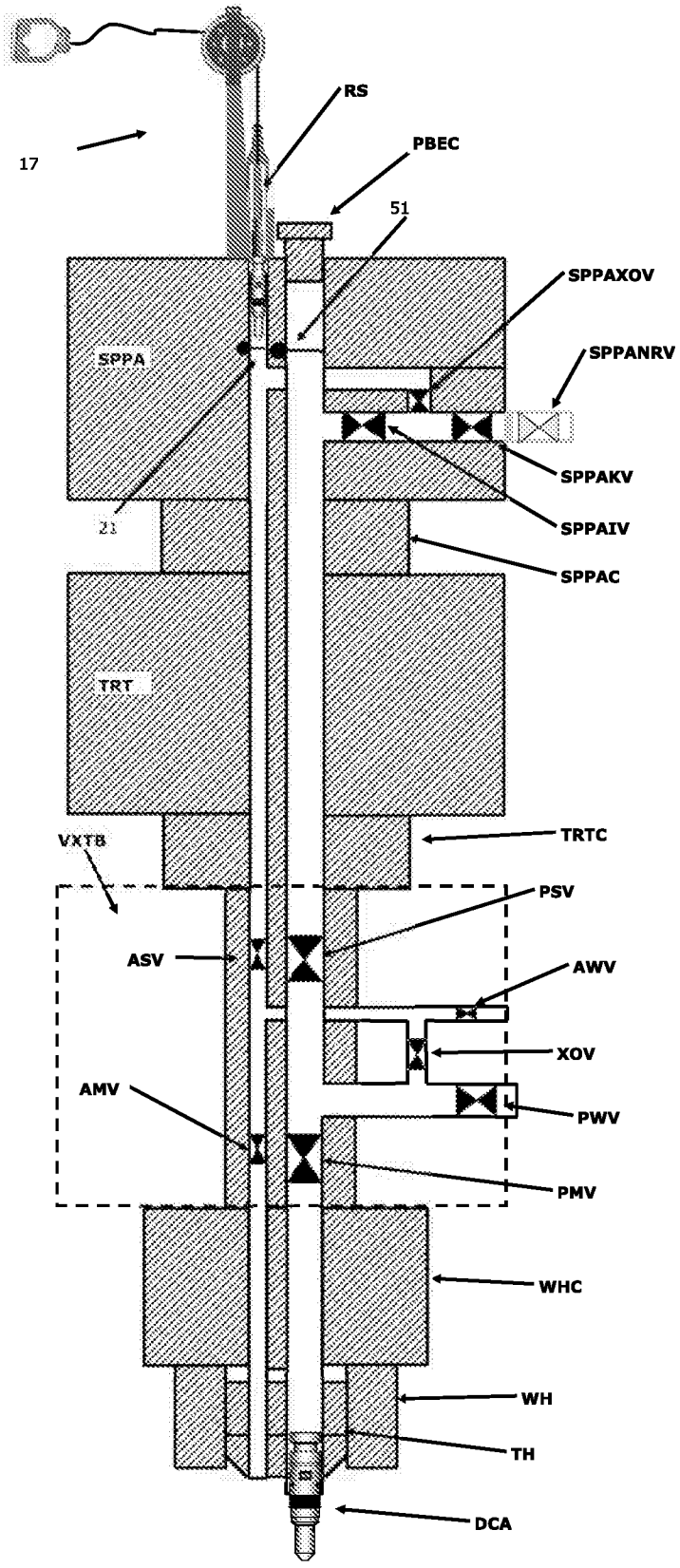

17d
17c
17e
17
17b
17a
14
51
17f
SPPAXOV
SPPANRV
SPPA
SPPAKV
SPPAIV
21
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
TH
ABP
DCA

Fig. 9


RS
17
PBEC
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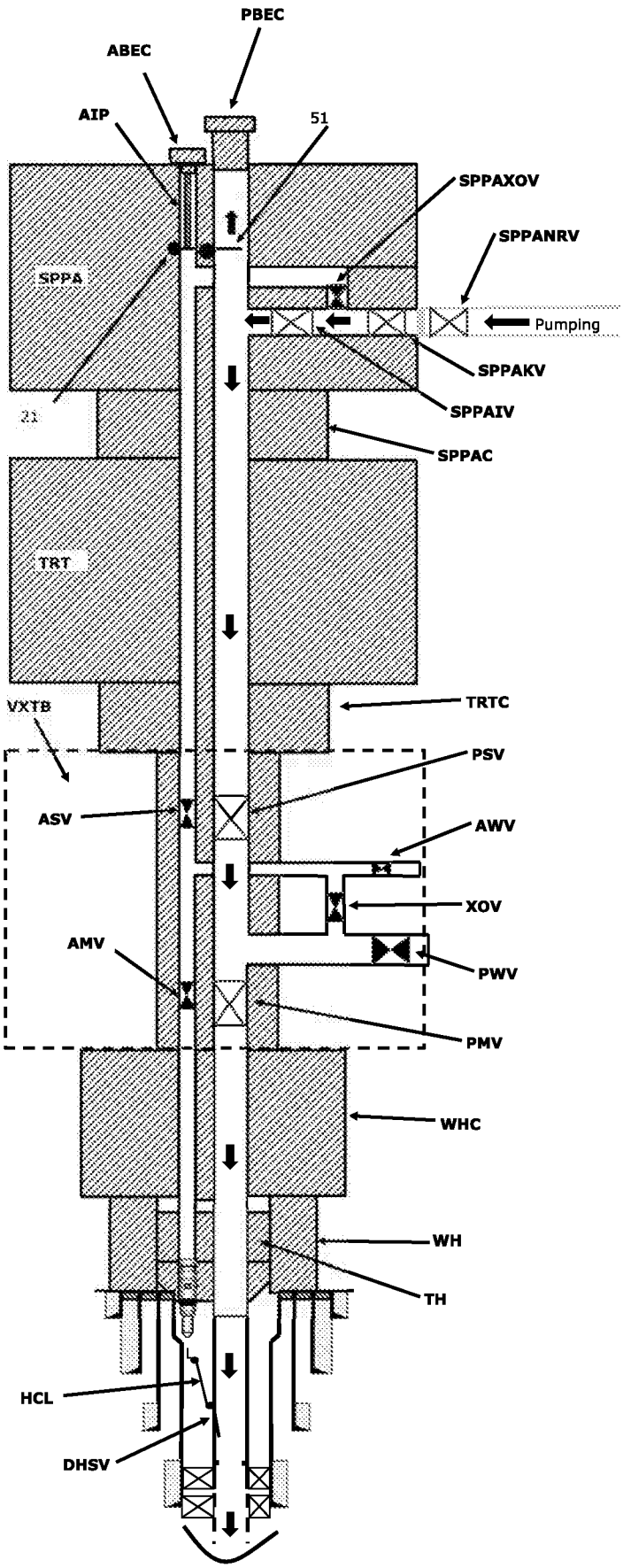
SPPAXOV
SPPA
SPPANRV
SPPAKV
21
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
TH
DCA

Fig. 10


PBEC
ABEC
AIP
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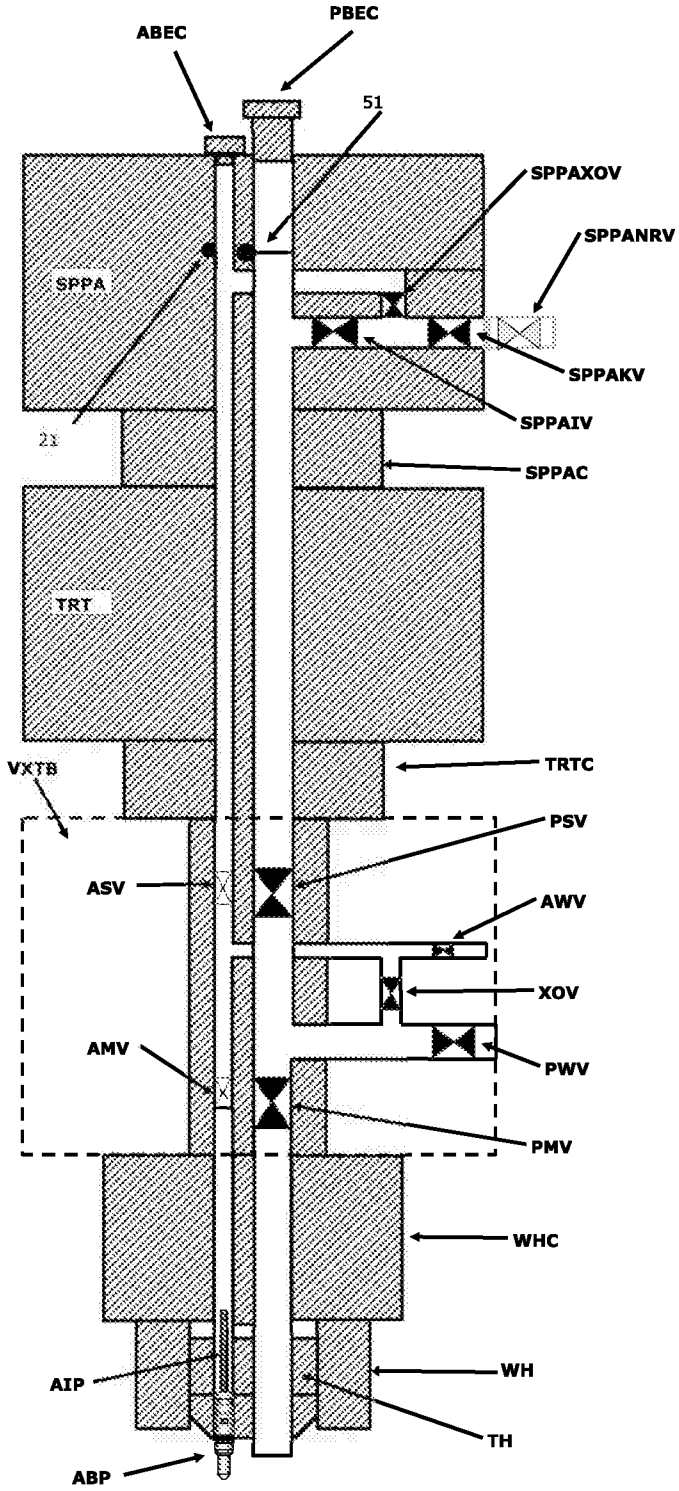
SPPANRV
SPPA
Pumping
SPPAKV
SPPAIV
21
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
TH
HCL
DHSV

Fig. 11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PBEC
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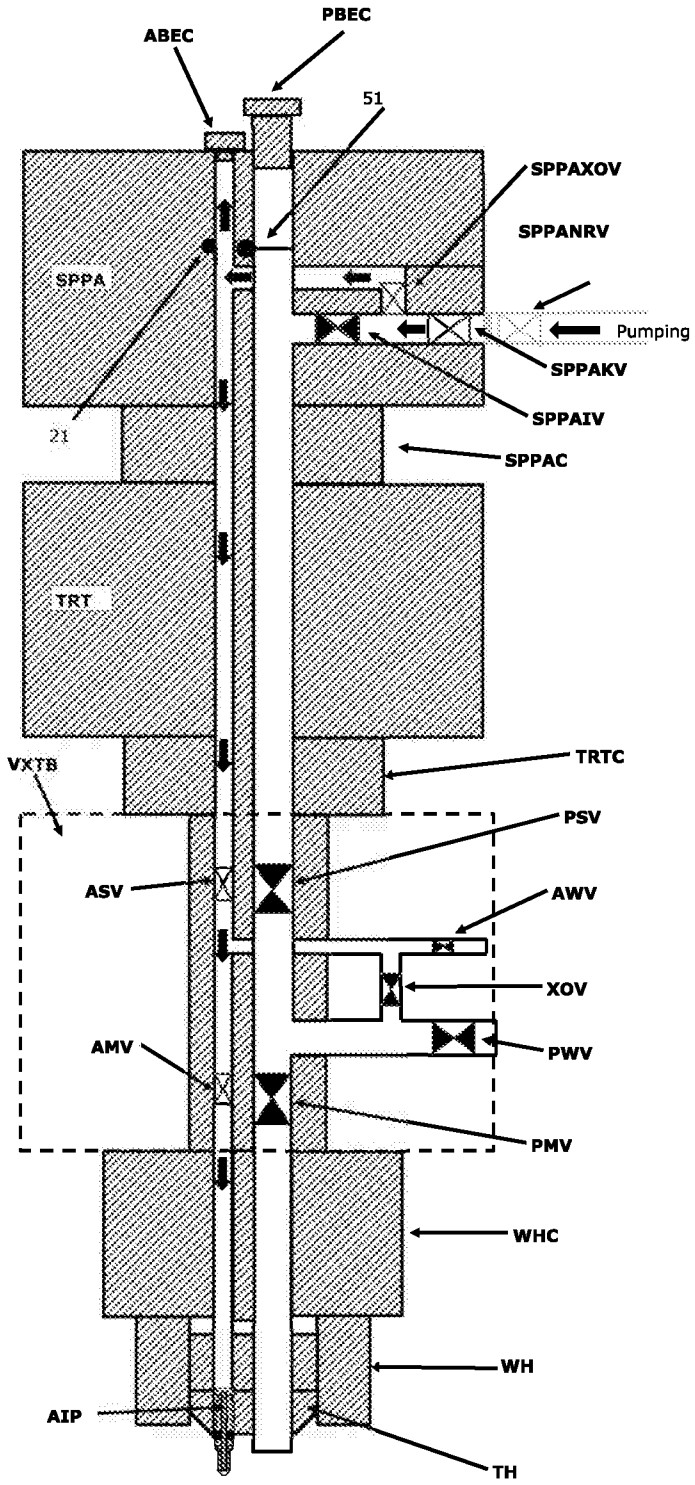
SPPAXOV
SPPANRV
SPPA
SPPAKV
SPPAIV
21
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
AIP
WH
TH
ABP

Fig. 12


PBEC
ABEC
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SPPAXOV
SPPANRV
SPPA
Pumping
SPPAKV
SPPAIV
21
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
PWV
AMV
PMV
WHC
WH
AIP
TH

Fig. 13

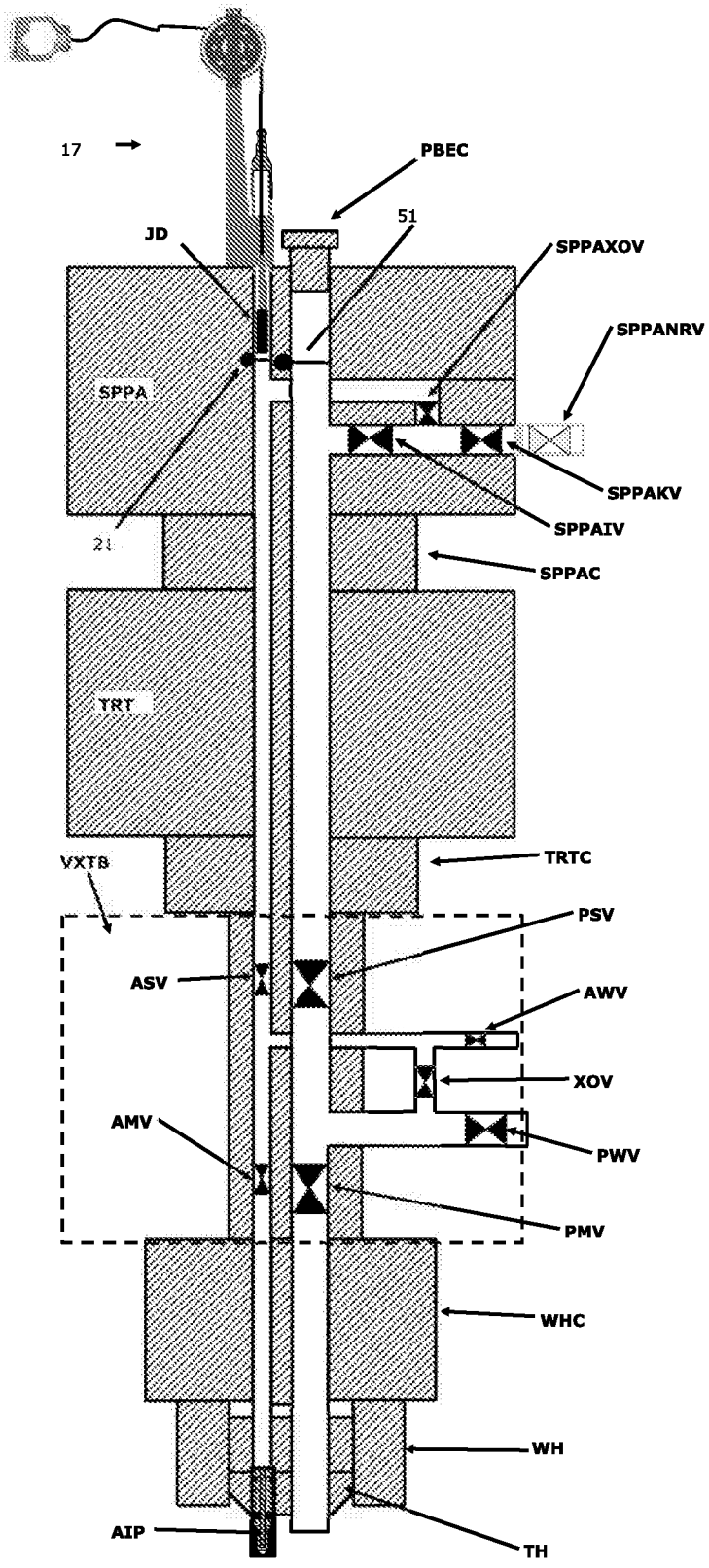

17
PBEC
51
JD
SPPAXOV
SPPANRV
SPPA
SPPAKV
SPPAIV
21
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
AIP
TH

Fig. 14

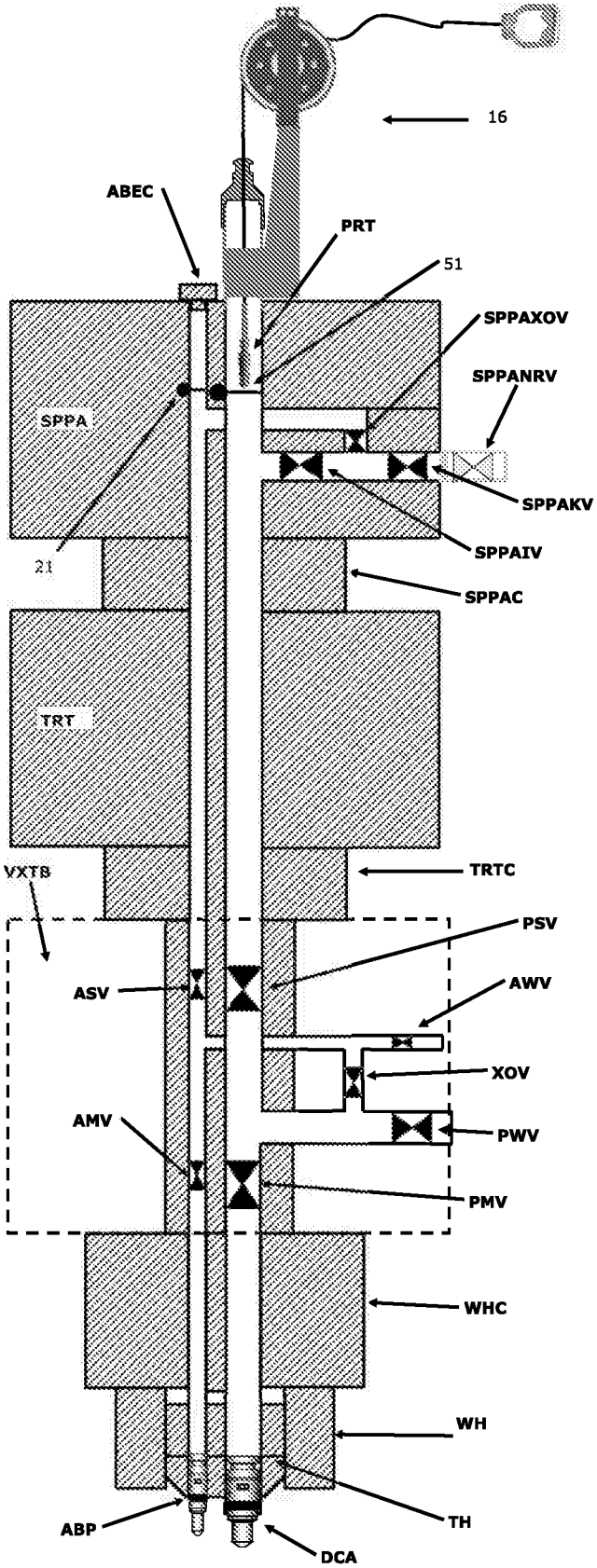

16
ABEC
PRT
51
SPPAXOV
SPPANRV
SPPA
SPPAKV
SPPAIV
21
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
TH
ABP
DCA

Fig. 15

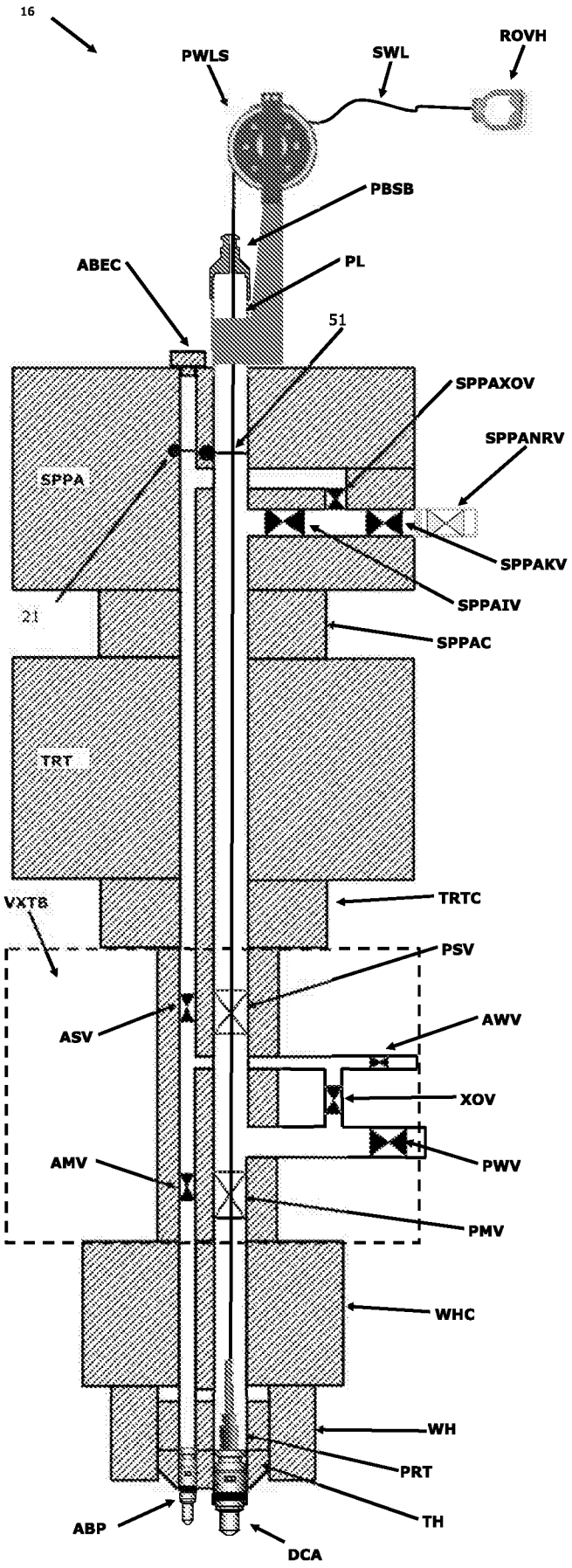

16
PWLS
SWL
ROVH
PBSB
ABEC
PL
51
SPPAXOV
SPPANRV
SPPA
SPPAKV
SPPAIV
21
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
PWV
AMV
PMV
WHC
WH
PRT
TH
ABP
DCA

Fig. 16

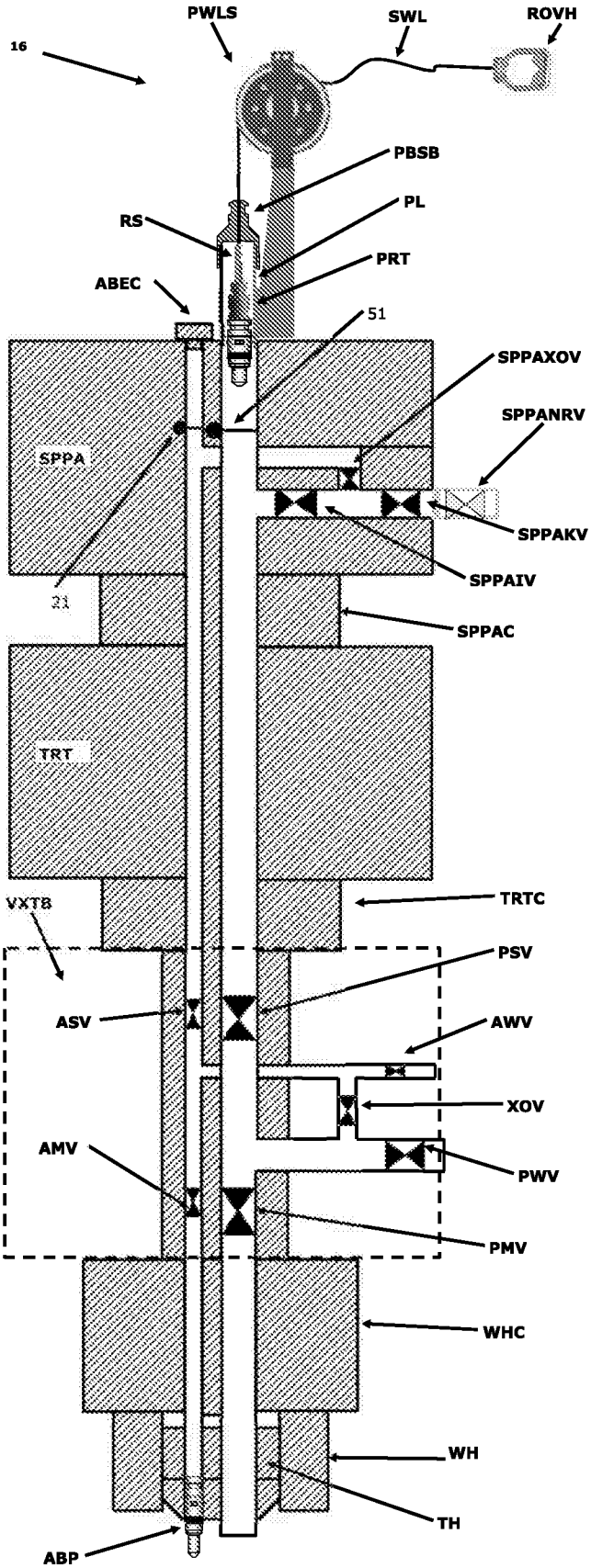
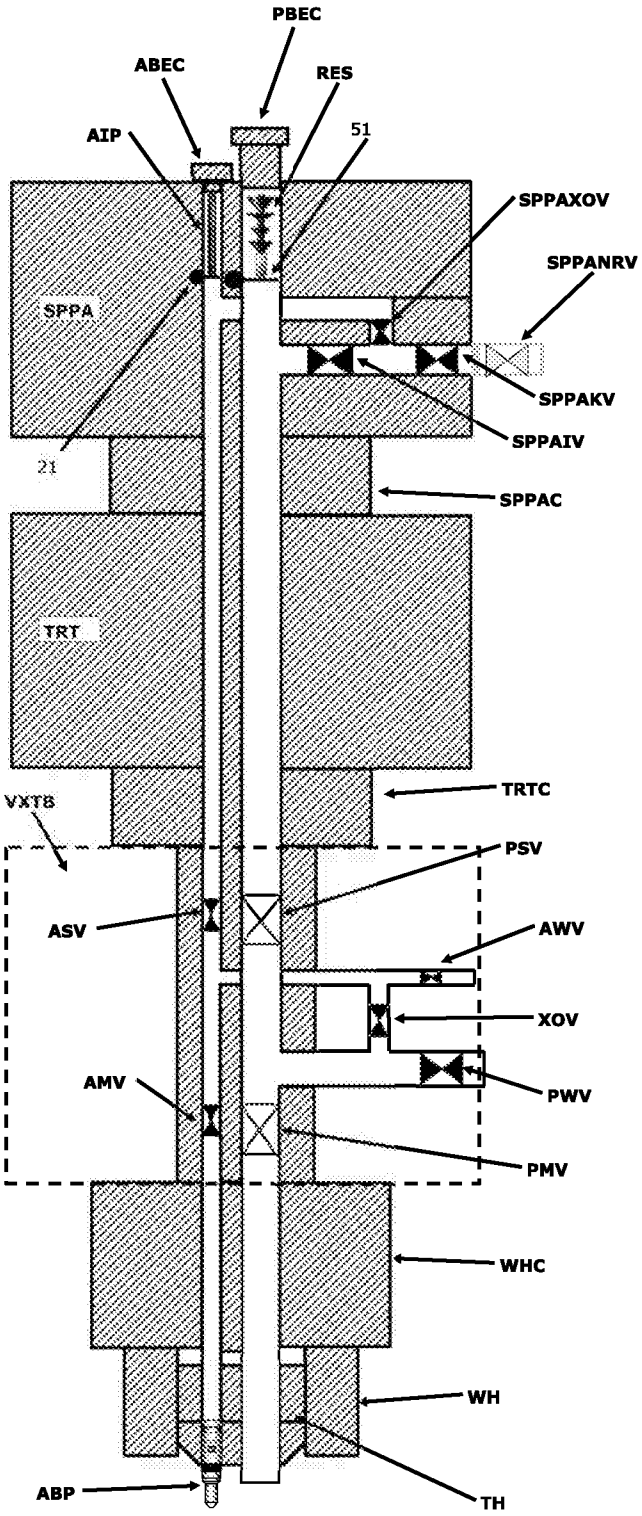

PWLS
SWL
ROVH
16
PBSB
PL
RS
PRT
ABEC
51
SPPAXOV
SPPANRV
SPPA
SPPAKV
SPPAIV
21
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
TH
ABP

Fig. 17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ABEC
RES
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SPPANRV
SPPA
SPPAKV
SPPAIV
21
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
ABP
TH

Fig. 18

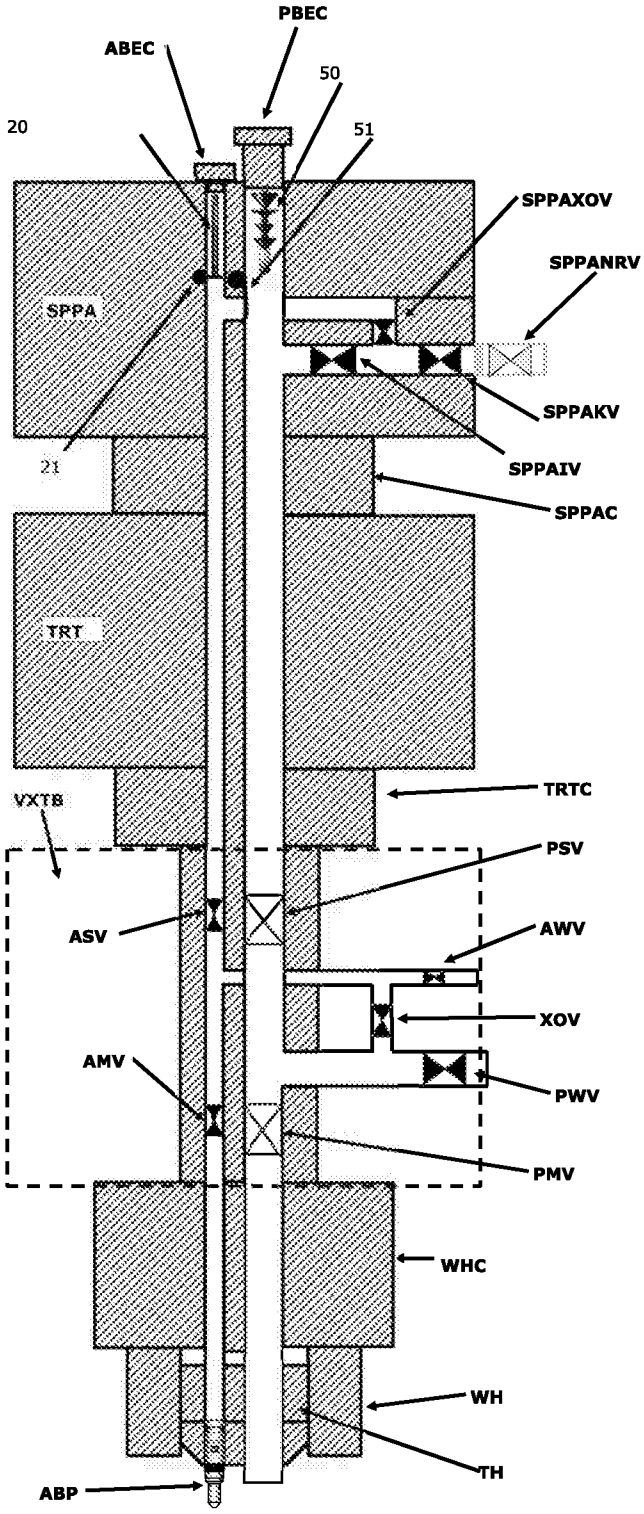

PBEC
ABEC
50
20
51
SPPAXOV
SPPANRV
SPPA
SPPAKV
21
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
TH
ABP

Fig. 19

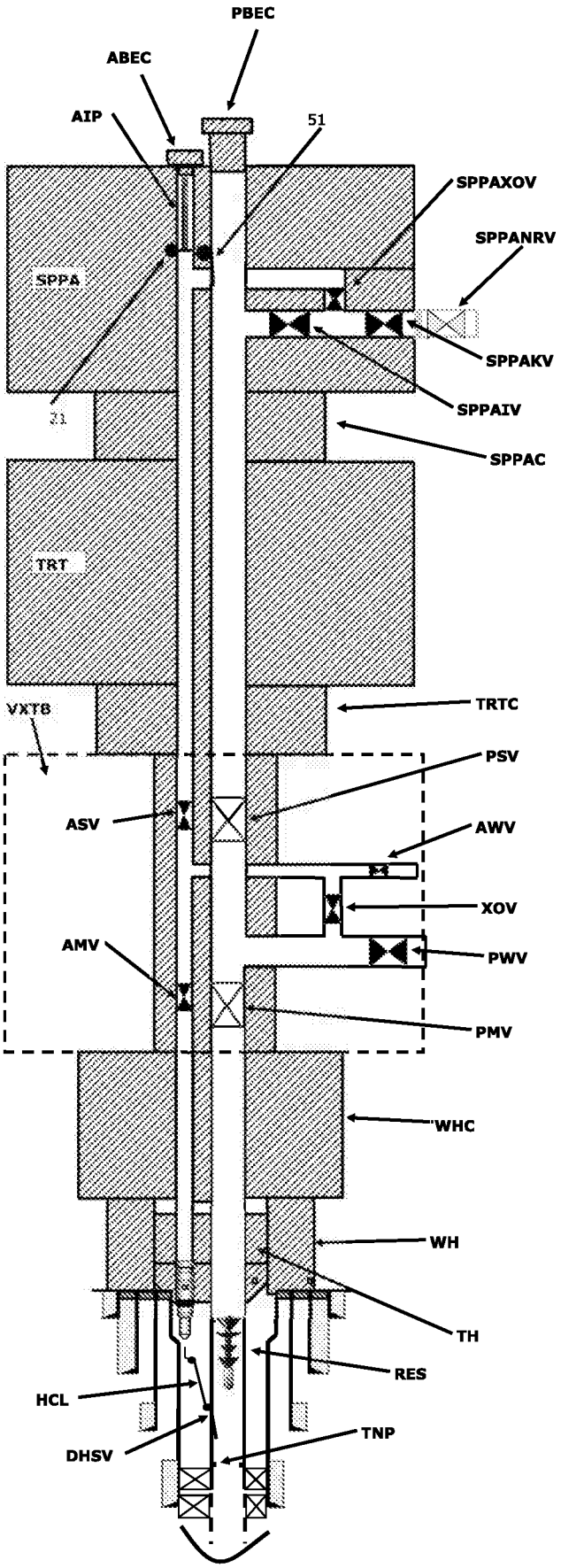

PBEC
ABEC
AIP
51
SPPAXOV
SPPANRV
SPPA
SPPAKV
SPPAIV
31
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
TH
RES
HCL
TNP
DHSV

Fig. 20

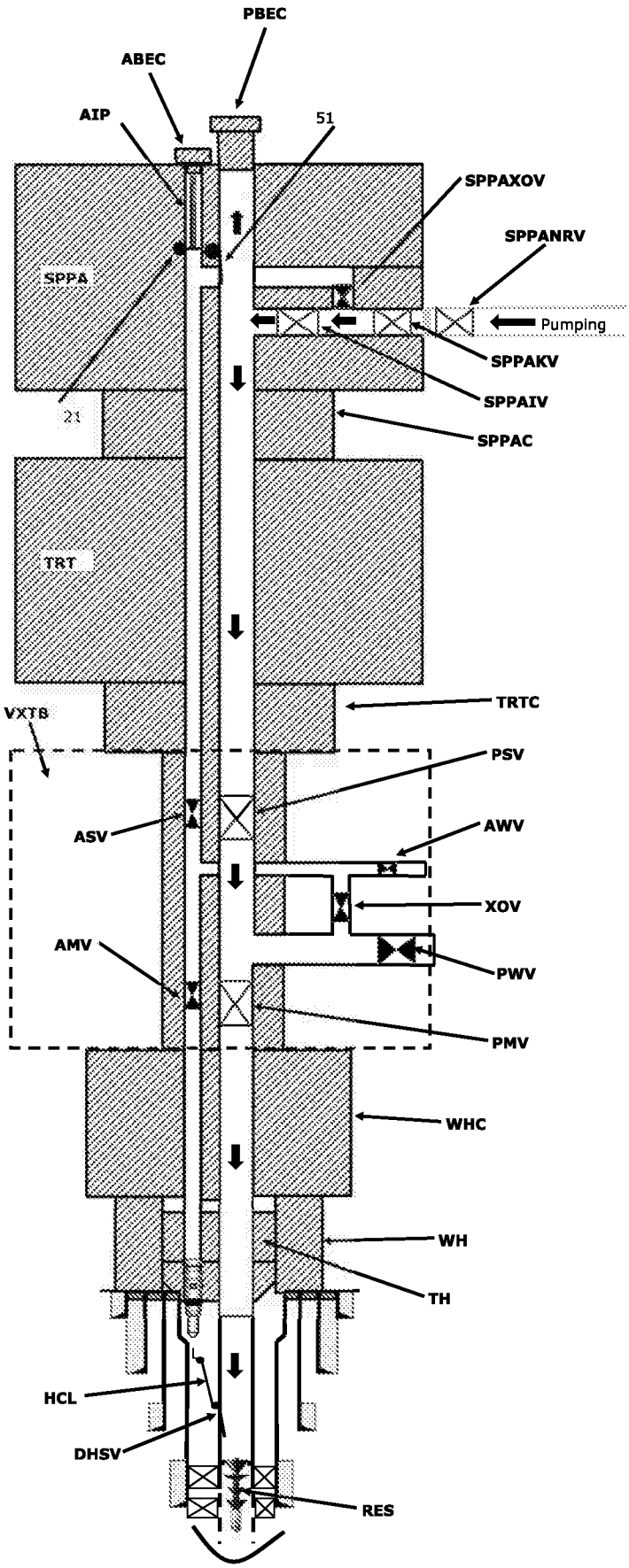

PBEC
ABEC
AIP
51
SPPAXOV
SPPANRV
SPPA
Pumping
SPPAKV
SPPAIV
21
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
AMV
PWV
PMV
WHC
WH
TH
HCL
DHSV
RES

Fig. 21

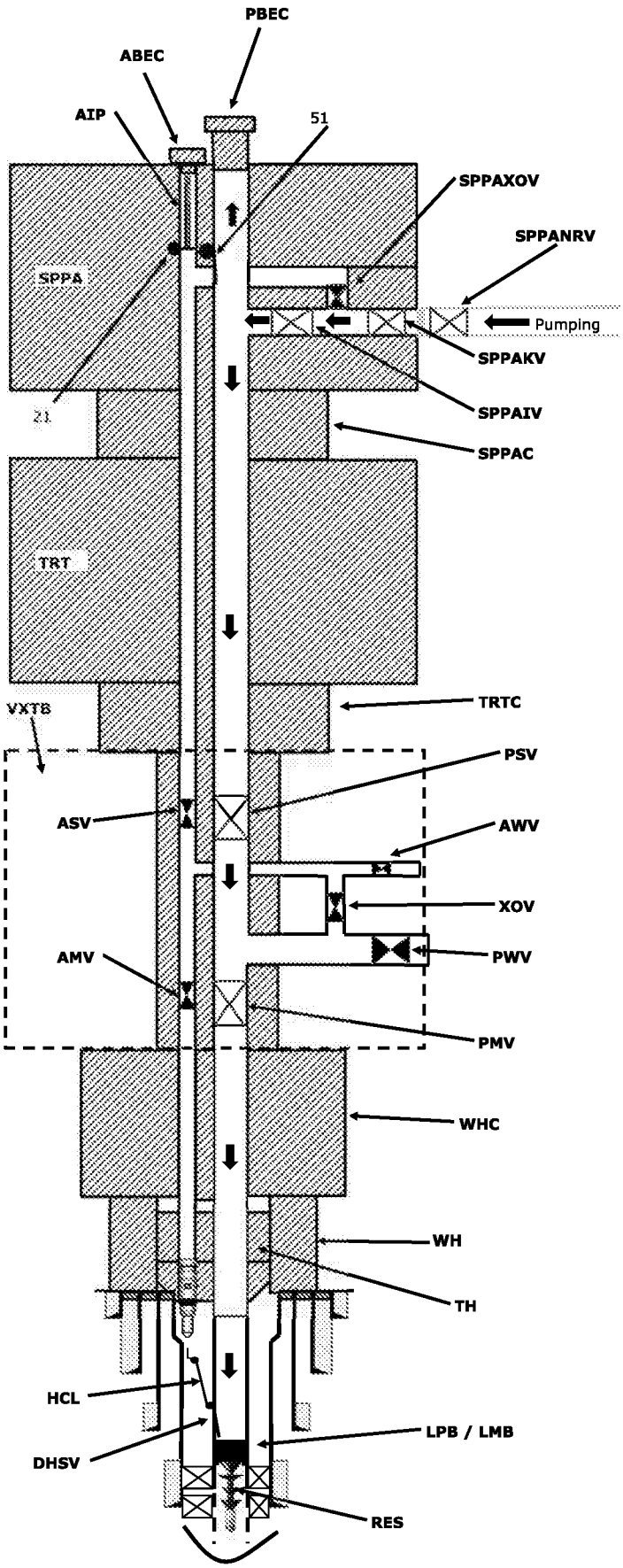

PBEC
ABEC
AIP
51
SPPAXOV
SPPANRV
SPPA
Pumping
SPPAKV
21
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
PWV
AMV
PMV
WHC
WH
TH
HCL
LPB / LMB
DHSV
RES

Fig. 22

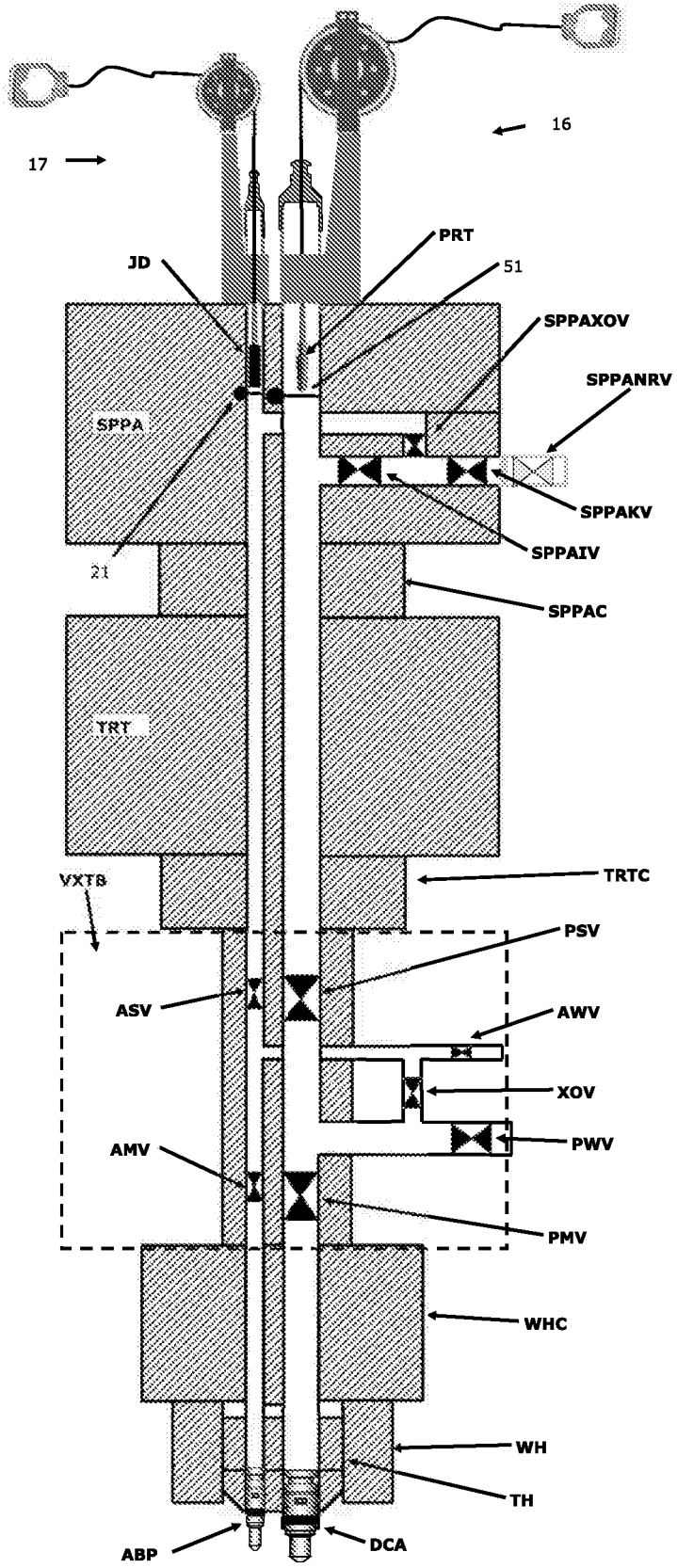

16
17
PRT
JD
51
SPPAXOV
SPPANRV
SPPA
SPPAKV
SPPAIV
21
SPPAC
TRT
TRTC
VXTB
PSV
ASV
AWV
XOV
PWV
AMV
PMV
WHC
WH
TH
ABP
DCA

Fig. 23

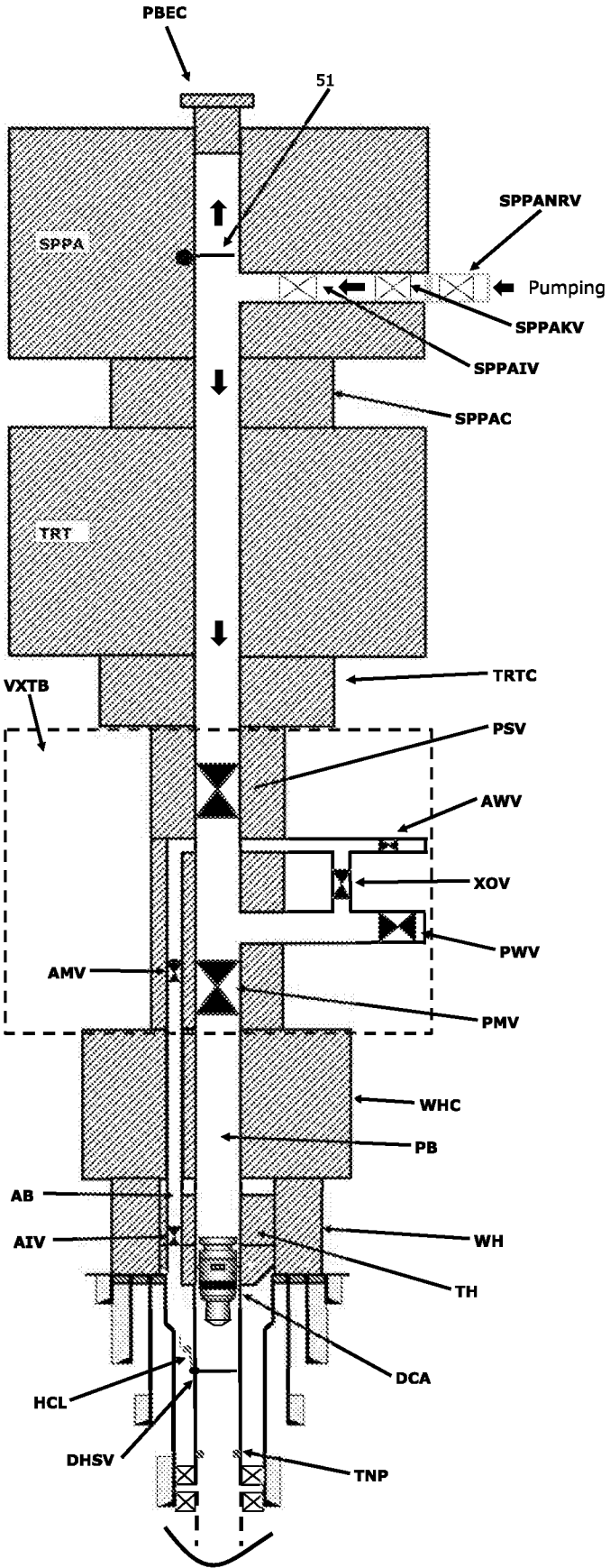

PBEC
51
SPPANRV
SPPA
Pumping
SPPAKV
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
AWV
XOV
PWV
AMV
PMV
WHC
PB
AB
AIV
WH
TH
DCA
HCL
DHSV
TNP

Fig. 24

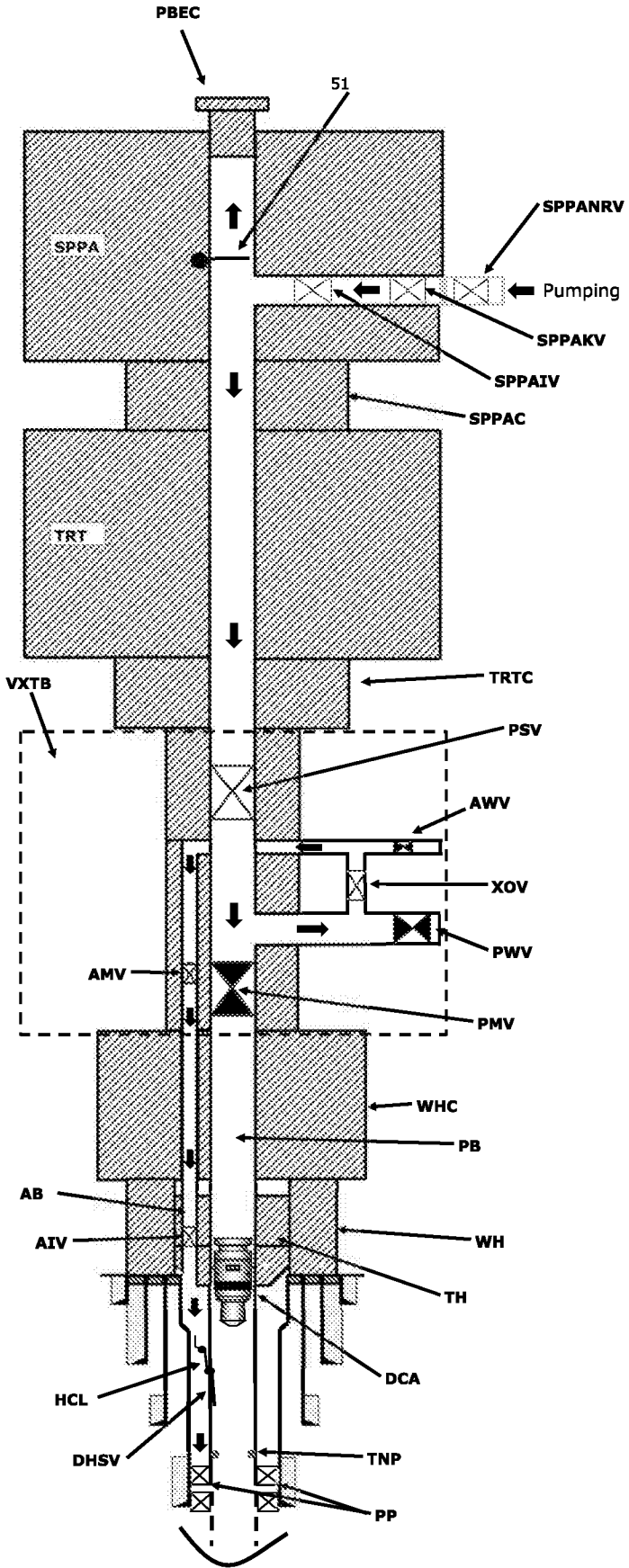

PBEC
51
SPPA
SPPANRV
Pumping
SPPAKV
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
AWV
XOV
PWV
AMV
PMV
WHC
PB
AB
AIV
WH
TH
DCA
HCL
DHSV
TNP
PP

Fig. 25

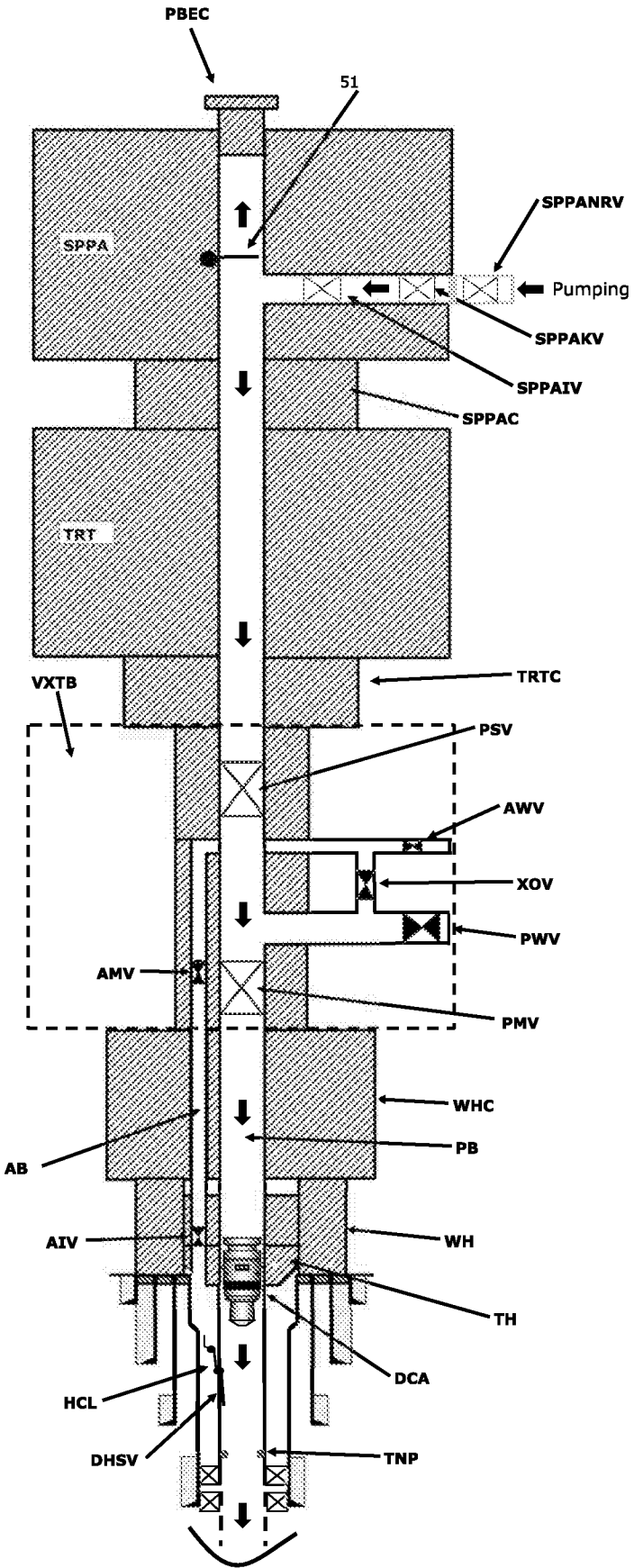

PBEC
51
SPPA
SPPANRV
Pumping
SPPAKV
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
AWV
XOV
PWV
AMV
PMV
WHC
AB
PB
AIV
WH
TH
DCA
HCL
DHSV
TNP

Fig. 26

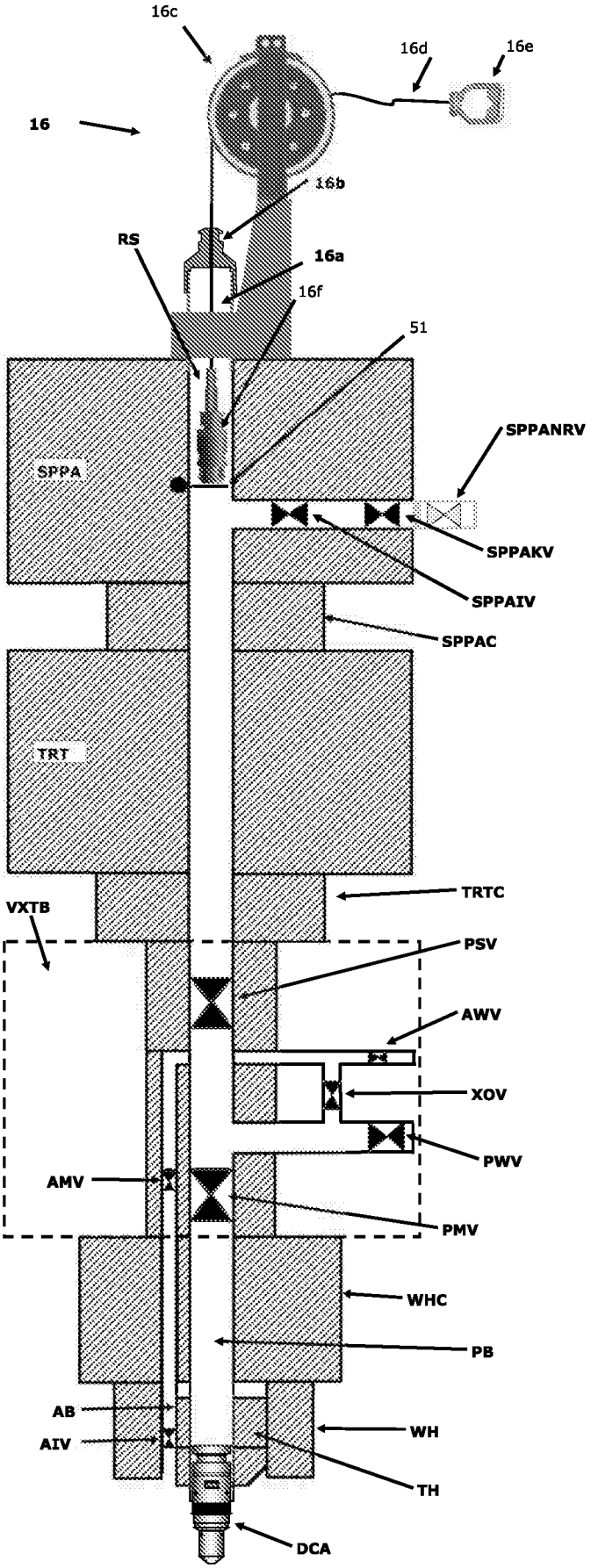

16c
16d
16e
16
16b
RS
16a
16f
51
SPPANRV
SPPA
SPPAKV
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
AWV
XOV
PWV
AMV
PMV
WHC
PB
AB
AIV
WH
TH
DCA

Fig. 27

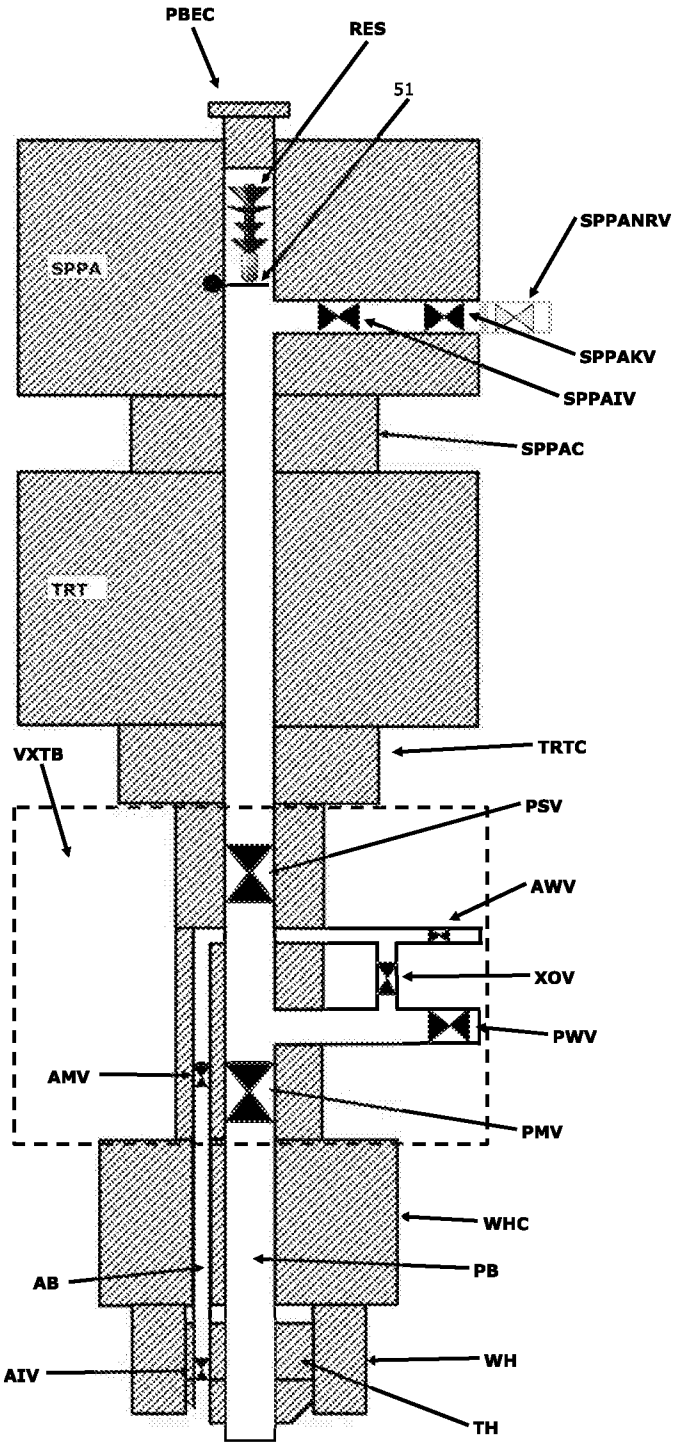

PBEC
RES
51
SPPANRV
SPPA
SPPAKV
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
AWV
XOV
PWV
AMV
PMV
WHC
AB
PB
WH
AIV
TH

Fig. 28

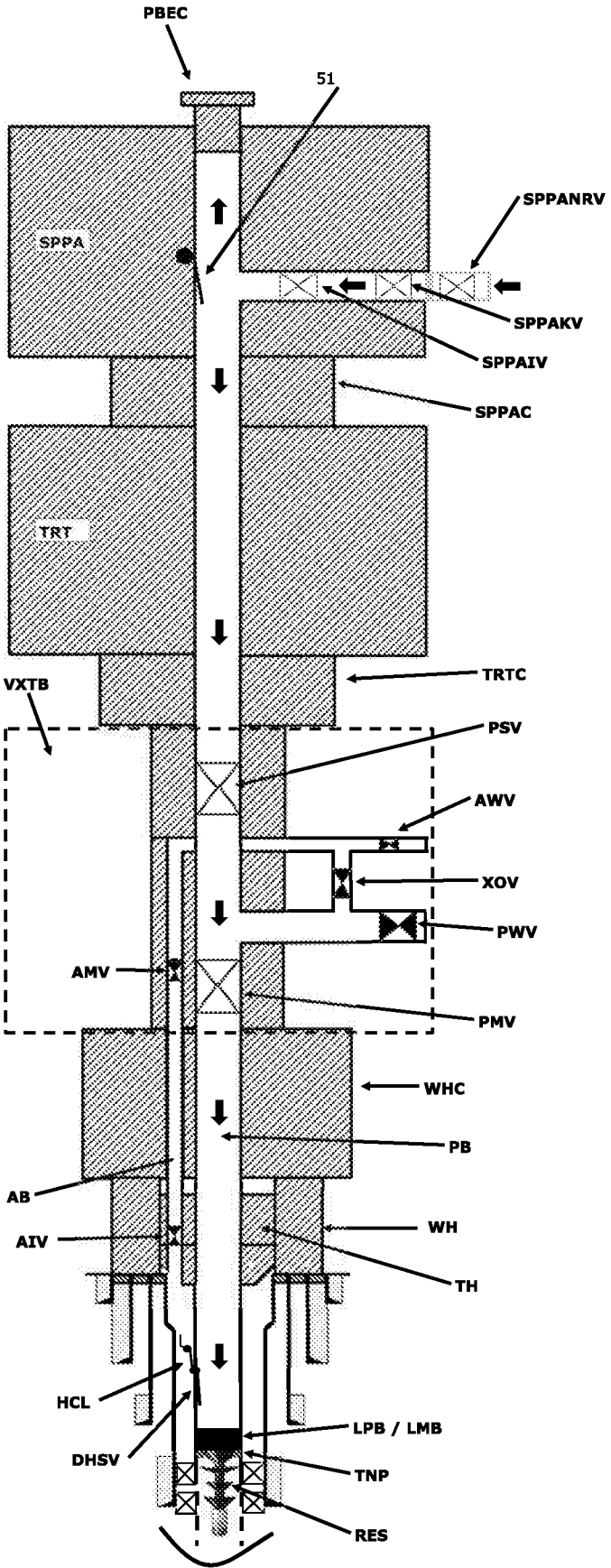

PBEC
51
SPPA
SPPANRV
SPPAKV
SPPAIV
SPPAC
TRT
TRTC
VXTB
PSV
AWV
XOV
PWV
AMV
PMV
WHC
PB
AB
WH
AIV
TH
HCL
LPB / LMB
DHSV
TNP
RES

Fig. 29

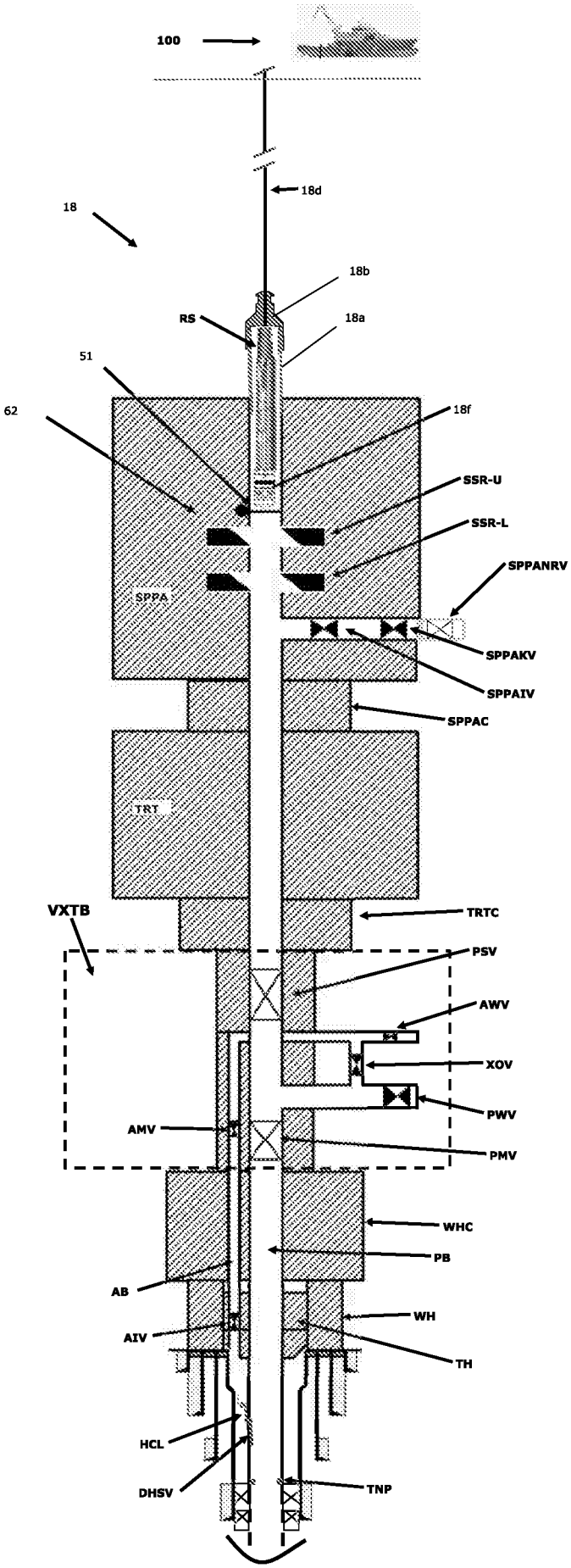

100
18d
18
18b
RS
18a
51
62
18f
SSR-U
SSR-L
SPPANRV
SPPA
SPPAKV
SPPAIV
SPPAC
TRT
VXTB
TRTC
PSV
AWV
XOV
PWV
AMV
PMV
WHC
PB
AB
WH
AIV
TH
HCL
DHSV
TNP

Fig. 30

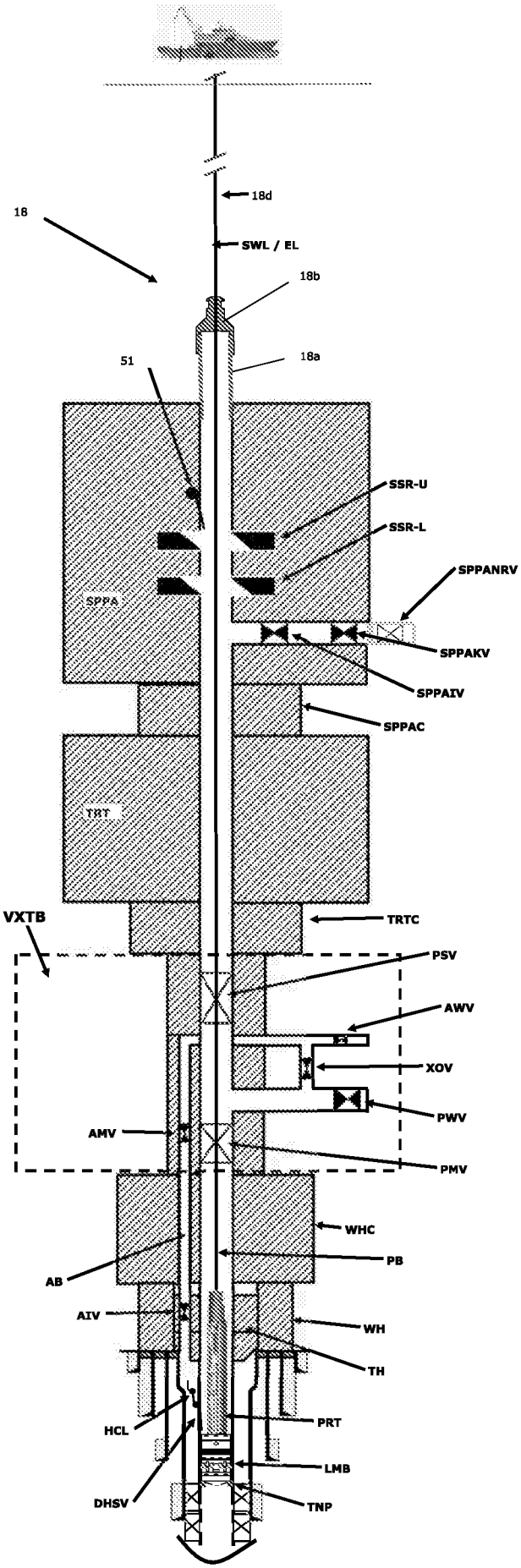

18
18d
SWL / EL
18b
18a
51
SSR-U
SSR-L
SPPANRV
SPPA
SPPAKV
SPPAIV
SPPAC
TRT
VXTB
TRTC
PSV
AWV
XOV
PWV
AMV
PMV
WHC
PB
AB
AIV
WH
TH
HCL
PRT
LMB
DHSV
TNP

Fig. 31

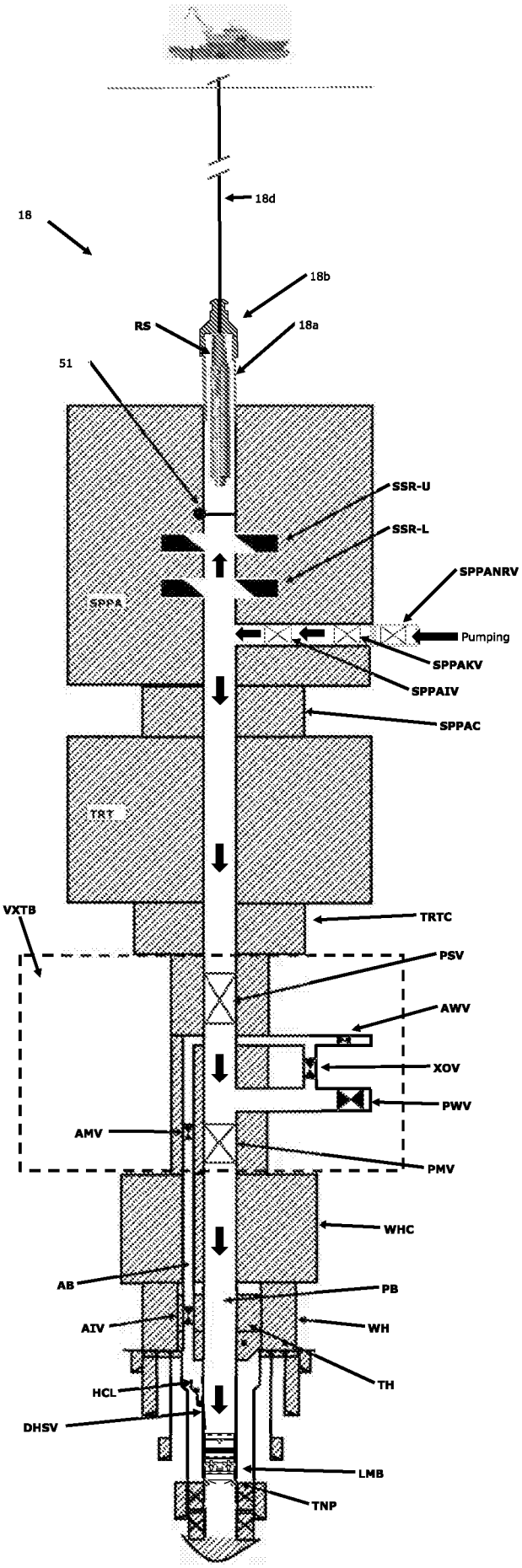
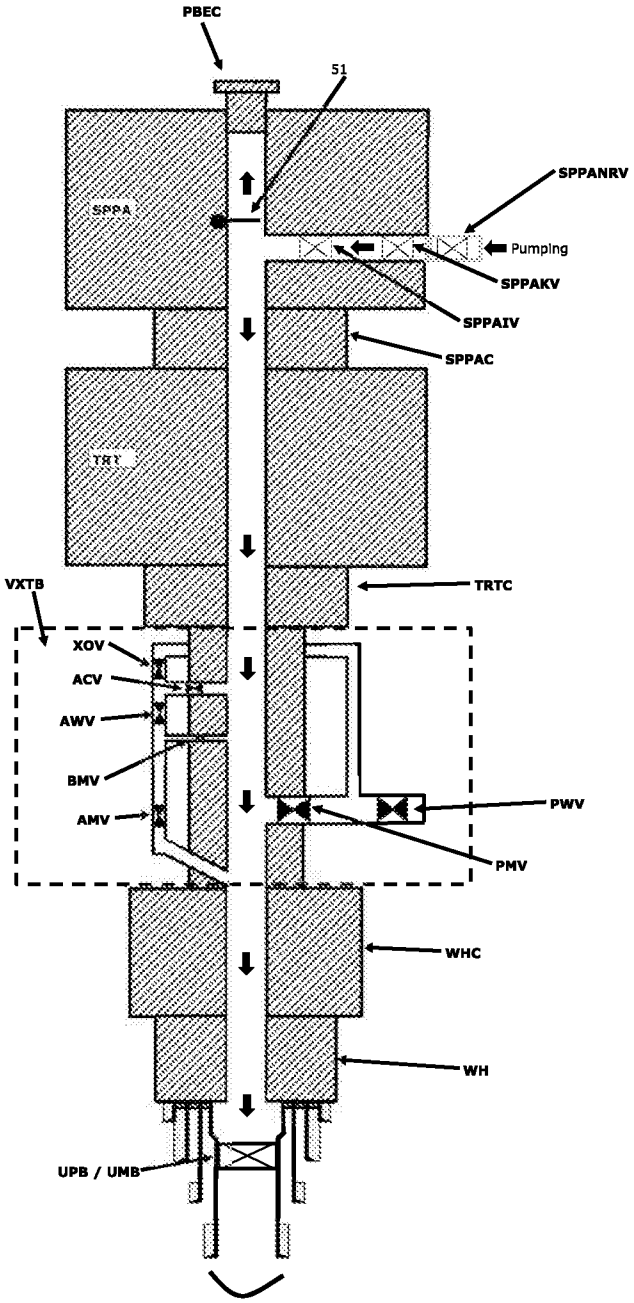

18
18d
18b
18a
RS
51
SSR-U
SSR-L
SPPANRV
SPPA
Pumping
SPPAKV
SPPAIV
SPPAC
TRT
VXTB
TRTC
PSV
AWV
XOV
PWV
AMV
PMV
WHC
AB
PB
AIV
WH
TH
HCL
DHSV
LMB
TNP

Fig. 32


PBEC
51
SPPA
SPPANRV
Pumping
SPPAKV
SPPAIV
SPPAC
TRT
VXTB
TRTC
XOV
ACV
AWV
BMV
AMV
PWV
PMV
WHC
WH
UPB / UMB