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(54) Title: PLANT FOR EXPLOITING RESERVOIRS OF NATURAL FLUIDS, SUCH AS FOR EXAMPLE OIL, NATURAL GAS OR OTHER HYDROCARBON-BASED EXTRACTED FLUIDS

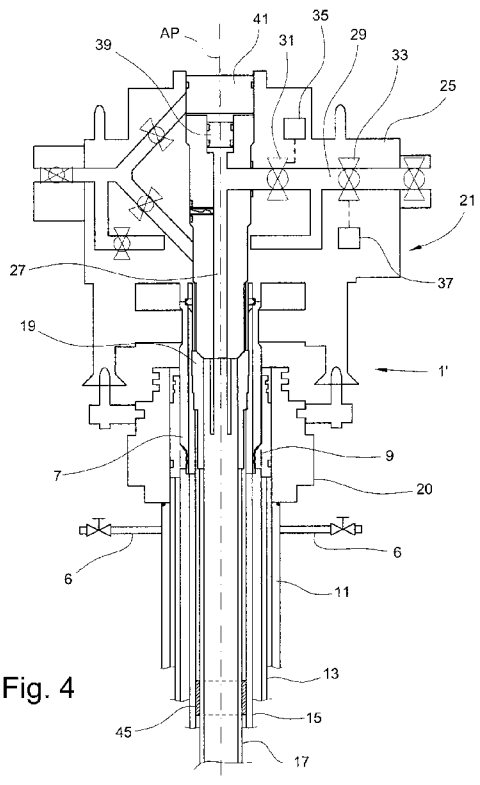

Fig. 4

(57) Abstract: The plant according to the invention for exploiting reservoirs of natural fluids, such as for example oil, natural gas or other hydrocarbon-based extracted fluids, through a well, wherein the plant comprises a production cross (21) suitable for being installed and operating on a submersed bed. The valves (31, 33) of the production cross suitable for allowing, preventing or regulating the flow of the extracted fluid through the production cross itself are activated by electric actuators. The control umbilical 5' is therefore less costly and can connect oil platforms (3) on the sea surface with production crosses (21) situated on the seabed at depths also reaching 150 meters and over, or situated horizontally at distances from the master oil platform (3), of even 6.5-20 km and over.

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PLANT FOR EXPLOITING RESERVOIRS OF NATURAL FLUIDS, SUCH AS FOR EXAMPLE OIL, NATURAL GAS OR OTHER HYDROCARBON-BASED EXTRACTED FLUIDS

Field of the invention

[1] The present invention relates to a plant for exploiting underwater reservoirs of natural fluids, such as for example, oil, natural gas or other hydrocarbon-based extracted fluids. More specifically, the invention relates to an extraction plant through a horizontal production cross.

State of the art

[2] In order to exploit already mature underwater hydrocarbon reservoirs to the maximum, it is almost always necessary to create new wells at distances, in a horizontal direction from the pre-existing production platform, which are such as to require well trajectories with excessively low gradients, and consequently too difficult or costly to be managed directly by the production platform itself. Therefore in these cases the peripheral wells could be managed by specific secondary production platforms, currently called “monotubes”, having smaller dimensions than the original platform. The construction of these secondary platforms, however, has various drawbacks: as they are smaller than the main platform, they are more vulnerable to terroristic attacks, and as they are less visible, they are more likely to be struck or in any case damaged by passing ships; at the same time, as they are partially above the surface, they spoil the

surrounding landscape.

[3] In order to avoid these drawbacks of secondary platforms, it is customary to manage secondary wells with production crosses 1 situated on the seabed, sending the hydrocarbons extracted to the master platform 3 with a duct 5, commonly called sealine. Current underwater production crosses 1 are each controlled by an extremely flexible multiple line 5 called control umbilical (Figure 1). In Figure 1, the reference P indicates a well for the extraction of hydrocarbons, the references G indicate hydrocarbon reservoirs already being exploited, the reference M indicates the sea and the reference SM indicates the ground beneath the sea.

[4] Present underwater production crosses are currently remotely activated by means of hydraulic actuations. The control umbilical is therefore substantially a bundle of tubes comprising the duct for the passage of the hydrocarbons extracted, two or more pipes for the supply and return of the oil of the hydraulic actuation circuits and a bundle of electric feeding and signalling wires for the electric instrumentation of the production cross. The hydraulic actuation circuit is fed by a unit comprising a pump, the relative actuation motor and the tank for the oil or other hydraulic fluid; this unit is normally situated on the master platform 3. For horizontal distances of over 6 km, however, the control of the production cross becomes complicated and the costs of the known control

umbilical become excessively high, making the development of the satellite well economically inconvenient.

[5] An objective of the present invention is therefore to overcome the drawbacks of the known systems described above for exploiting hydrocarbon reservoirs through a control umbilical and submersed production cross, in particular allowing a reduction in the costs of the control umbilical and increasing the maximum horizontal distance and/or maximum depth of the well for which the exploitation of the latter is economically convenient.

Summary of the invention

[6] According to a first aspect of the present invention, this and other objectives are achieved by providing a plant for exploiting reservoirs of natural fluids, such as for example oil, natural gas or other hydrocarbon-based extracted fluids, having the characteristics according to claim 1.

In a second aspect, the invention relates to a method according to claim 11.

Further characteristics of the device are object of the dependent claims.

[7] The advantages offered by the present invention will appear more evident, to experts in the field, from the following detailed description of a particular non-limiting embodiment, illustrated with reference to the following schematic figures.

List of Figures

Figure 1 shows, in a vertical section, a plant of the known type for exploiting an underwater hydrocarbon reservoir;

Figure 2 shows, in a vertical section, a plant for exploiting an underwater hydrocarbon reservoir, according to a preferred embodiment of the invention;

Figure 3 shows, in a side view, a functional electric and fluid scheme of the plant of Figure 2;

Figure 4 shows a section, according to a longitudinal plane, of the production cross of the plant of Figure 2;

Figure 5 shows a functional electric and fluid scheme of the production cross of Figure 4;

Figure 6 shows a protection structure that can be used for installing and protecting the production cross of Figure 4 on the installation seabed;

Figure 7 shows a step of a method for installing a production cross according to an aspect of the invention.

Detailed description

[8] Figures 2-6 relate to a plant for exploiting underwater reservoirs of oil, natural gas or other hydrocarbon-based extracted fluids, according to a preferred embodiment of the invention. Said plant, indicated with the overall reference number 10, can comprise a first surface part and a second underwater part. The first surface part can comprise an oil platform 3' on which the following are preferably positioned (Figure 3):

- an electrical distribution unit or EDU 101;
- a topside umbilical termination unit or TUTU of the surface system 102;
- a hydraulic power unit or HPU 103;
- a master control station or MCS 104.

The oil platform 3' can be sustained for example by pylons or anchored to fixed cables on the seabed.

The second underwater part comprises a well head unit 1' situated on a seabed (Figure 2). The first surface part and the second underwater part are connected by a control umbilical or another connection cord 5'.

The well head unit 1' can be like that shown in Figure 4, and comprise a production completion unit of the well, in turn comprising for example:

- cementation vent systems 6 (shallow water devices);
- a main connector of the production completion unit of the well (subsea well connector) 7;
- a casing hanger surface casing 9 also called seal ring or VX gasket;
- a surface casing 11;
- an intermediate casing 13;
- a production casing 15;
- a supply duct, also called tubing or casing design 17, which terminates above in a tubular connecting joint for the secondary production tube (production casing hanger) 19,
- a cross support 20, also called conductor pipe

housing 20.

[9] The elements 7, 9, 11, 13, 15, 17, 19, all have a substantially tubular form and are known *per se*, as is also the conductor pipe housing 20. The well head unit 1' also comprises a so-called production cross or Christmas tree indicated with the reference number 21. The production cross 21 rests on and is connected to the production completion unit of the well with the necessary hydraulic seal by means of the casing hanger surface casing 9.

The production cross 21 comprises:

a) a valve body 25, suitable for being fixed to the production completion unit of the well and in which there is a first 27 and second extraction duct 29, suitable for the outflow of the oil, natural gas or other fluid extracted from the reservoir G, outside the reservoir itself;

b) a first 31 and second extraction control valve 33, both housed in the valve body 25.

[10] The first extraction duct 27 extends coaxially, or in any case longitudinally, with respect to the axis AP of the well section closest to the surface of the sea bottom on which the production cross is situated. The second extraction duct 29 branches out from the first extraction duct 27 and extends transversally with respect to the latter, for example perpendicularly. The first 31 and second extraction control valve 33 are suitable for reversibly allowing, preventing or regulating the flow of oil, natural gas or other fluid

extracted through the second extraction duct 33 towards the outside of the production cross 21 itself.

[11] According to an aspect of the invention, the production cross 21 is a so-called horizontal production cross, i.e. at least one of the extraction control valves 31, 33 is positioned along the second extraction duct 29, and along the first extraction duct 27 there is no valve suitable for reversibly allowing, preventing or regulating the flow of oil, natural gas or other fluid extracted; this allows secondary interventions to be effected on the well for example with slick line, coiled tubing or wire line operations (rigless, i.e. without any plant) and always for example for connecting a BOP (Blow Out Preventer) on the well head without having to completely remove the production cross 21 - or at least its valve body 25 - from the production completion unit of the well, unlike a production cross of the vertical type. For this purpose, preferably the upper end of the first extraction duct 27 is substantially straight for a suitable length. In order to connect a BOP to the well head unit 1', for example, it is sufficient to remove the crown caps 39, 41 which, during the normal functioning of the well, close and seal the upper end of the cross 21 and the first extraction duct 27.

[12] Preferably at least one of the first 31 and second extraction control valve is an intercepting valve, i.e. only capable of completely opening and closing the duct along which they are positioned, or a regulation or

control valve, i.e. capable of varying the flow-rate passing through it with continuity or at different levels.

[13] According to an aspect of the invention, the two extraction control valves and possible other valves suitable for reversibly allowing, preventing or regulating the flow of oil, natural gas or other fluid extracted through the production cross itself 21, are activated by electric actuators 35, 37, which can be assembled for example inside or in any case on the valve body 25. The electric actuators 35, 37, can for example be rotating motors, linear motors or solenoids depending on the type of valve to be activated (Figure 4).

[14] The first 31 and second extraction control valve 33, and the other possible valves suitable for allowing, preventing or regulating the flow of extracted fluid through the production cross itself, are advantageously not activated by fluid actuators, such as for example, hydraulic or pneumatic actuators, but only by electric actuators preferably combined with manual activations according to the redundancy principle; the manual actuators can be in turn activated for example by scuba-divers, skin-divers or mechanical arms of robots or bathyscaphes.

In order to reduce the weight of the production cross and give it a compact volume, it is preferable to avoid or limit activation interfaces with underwater robots.

The absence of hydraulic or pneumatic actuators advantageously allows to feed the production cross 21 by means of a control umbilical 5' without any piping for the feeding and return of compressed air, oil or other actuation fluids, and only equipped for example with electric feeding and signaling cables, thus obtaining a simplicity and slenderness which is reflected in smaller encumbrance dimensions and consequently also in a greater installation facility.

The control umbilical 5' can be known *per se*, and for example can be of the type currently supplied by the companies Technip, Oceaneering or Saipem Energy System.

All the valves suitable for reversibly allowing, preventing or regulating the flow of oil, natural gas or other fluid extracted through the production cross itself 21 are advantageously activated by electric actuators,, which can be assembled for example inside or in any case on the valve body 25.

[15] This allows a reduction in the costs of the control umbilical 5' and enables it to be used for connecting oil platforms on the sea surface with production crosses 21 positioned on the seabed at depths also reaching 150 metres - currently the maximum admissible depth for jack ups - and over or situated horizontally at distances, from the master oil platform, also reaching 6.5-20 km and over.

This implies much lighter modifications on the oil platform 3', moreover, and in particular to its control

room, with respect to a submersed production cross activated by hydraulic or pneumatic actuators.

[16] Thanks to the absence of hydraulic or pneumatic actuators, the production cross 21 can be significantly lightened, allowing its installation on the well head by means of a fixed drill plant (jack up) with the derrick of the plant, for example. This allows to use plants at a lower cost - indicatively with a daily installment about a third of that of a floating plant - and with a greater diffusion.

The actuators of the production cross 21 advantageously guarantee the redundancy principle which is part of the safety system of the production cross. The redundancy system envisages the activation of the valve with a redundant electric system, if a breakage in the primary system is recorded. The two systems should be considered completely independent and are applied not only to 5 inch valves but also, for example, to 2 inch valves. The production cross 21 is advantageously equipped with a manual mechanical control system of the production cross valves in the case of contemporary damage of the two actuator systems.

In case of no electric power on the surface, a secondary electric power unit is advantageously automatically activated, which is capable of supplying electric current to the whole underwater system. The secondary electric power unit is situated on the oil platform 3' or in any case on the above first surface part of the exploitation plant and can comprise a

continuity group or a suitable UPS (Universal Power Supply) such as for example an electrogen group with a thermal combustion motor or accumulator battery.

Also the various subsystems on the oil platform 3' or in any case on the first surface part of the exploitation plant, such as for example EDU, TUTU, HPU or MCS are advantageously constructed applying the redundancy principle.

The production cross 21 preferably comprises a watertight casing (not shown) which encloses and seal separates from the outside water the extraction control valves 31, 33, the possible other valves suitable for allowing, preventing or regulating the flow of the extracted fluid through the production cross 21 itself and the relative electric actuators.

The production cross 21 is suitable for being installed and operating on a seabed, ocean, lake, or river.

[17] The well head unit 1' is preferably equipped with a well bottom safety valve, or a Surface Controlled Subsurface Safety Valve (SCSSV) 45, of the known type and is exclusively activated and controlled electrically - and possibly also manually - by the production cross 21 through appropriate electric penetrators or in any case electric cabling (Figures 4, 5). Said feeding and control cabling of the well bottom safety valve 45 is preferably interfaced with the underwater electrical control module 47 through one or more suitable connectors 49 which can be exposed to a

sea environment (wet-mate), of the known type, for example one or more DigiTRON wet-mate connectors commercialized by the company EXPRO/TRONIC. The well bottom safety valve 45 is currently hydraulically activated but the production cross according to a preferred embodiment of the invention only has electric penetrations. This standardization allows greater simplicity in the engineering phase of the components, production of the system, operations onboard the drilling plant. Furthermore, the insertion of the electric safety valve 45 allows to remove a valve, elsewhere important, on the body of the production cross. This favours the weight and compactness of the system itself.

The underwater electrical control module 47, also called SEM (subsea electrical module) comprises an appropriate logic unit and a plurality of signal or power input and/or output gates to control the various electric actuators of the production cross 21' and/or exchange data with these.

The underwater electrical control module 47 is preferably assembled on the production cross 21' itself, for example on its valve body 25, and separated from the water of the sea environment by a suitable watertight casing.

As shown in Figures 3, 4, the control umbilical 5' is preferably suitable for being reversibly coupled with the underwater electrical control module 47 by means of an umbilical termination unit 51, for the sake

of brevity also called UTA, which can comprise one or more electric connectors of the wet-mate type and possible rapid couplings 53 for connecting the feeding lines of particular auxiliary chemical substances, such as for example methanol, glycol or other water-based chemical inhibitors for preventing the formation of hydrates. In Figure 5, the reference 54 indicates a plurality of electric data or signal lines directed towards the inside of the production cross 21, the references 55 indicate the group of electric data or power lines which connect the underwater electrical control module 47 and the electric safety valve 45, whereas the references 57, 59 indicate the feeding lines through which the umbilical termination unit 51 supplies the production cross 21 with the above auxiliary substances.

There are preferably a total of at least four electric lines 54 and 55, for a better interfacing of the production cross 21 for example with intelligent completions and bottom pressure meters.

Figure 6 shows a side view of an example of a protection structure 61 that can be used for installing and protecting the production cross 21 on the seabed. The protection structure 61 comprises:

- a plurality of withdrawable legs 63, which, when the structure has been installed, rest on the seabed;
- a trunk 65 suitable for protecting the production cross for example from fishing nets, anchors,

waste products or pieces of wreckage coming from the surface;

- a cap 67, also called debris cap, suitable for protecting the production cross from any debris or other objects falling from above.

During the normal functioning of the cross 21, the protection structure 61 rests on the cross support 20 by means of the connection frame 69.

To allow the production cross 21 to be installed on the seabed by means of a jack-up, it preferably has a weight equal to or less than 35 tons; more preferably the combination of production cross 21 + protection structure 61 has a weight equal to or less than 35 tons.

[18] In a second aspect, the present invention relates to a method for installing, maintaining or running the plant 10 comprising the following steps:

-providing a jack up that is a platform 50 comprising a buoyant hull 52 and one or more extendable legs 54 fixed to the hull 52;

-carrying the production cross 1' on a predetermined installation place by means of the platform 50;

-extending the one or more extendable legs 54 so as to rest them on an underlying installation seabed SB;

-raising the buoyant hull 52 above the sea-surface or other water-surface so that the hull 52 is supported by the one or more extendable legs 54;

-lowering the production cross 1' from the buoyant hull 52 down to the installation seabed SB.

The extendable legs 54 can be for example retractable columns or pillars, for example having reticulated or

tubular structures. The extendable legs are kept preferably lifted and retracted while the platform 50 sails carrying the production cross 1' towards the destination place.

After the production cross 1' has been installed, for example onto a well head, the extendable legs 54 can be lifted and retracted again, and the platform can sail away and be used in other locations.

Advantageously the platform -i.e. jack up- is provided with a derrick 56 or other drilling tower or mobile tower, and the production cross is lowered from the buoyant hull 52 down to the installation seabed SB is made by hanging the production cross 1' to the derrick 56 or other drilling tower or mobile tower, and hauling the production cross 1' from the derrick 56 or other drilling tower or mobile tower down to the installation seabed SB. Preferably the production cross 1' is lowered from the platform down to a well head. This way the production cross 1' can be installed on a well head at particularly low costs. In particular the previously described platform 50, that is a jack up, is a relatively cheap apparatus for installing, running or maintaining electric production crosses 1' according to the invention.

[19] The characteristics of the device and of the method, object of the present invention, as also its advantages, are evident from the above description.

Finally, the device thus conceived can obviously undergo numerous modifications and variants, all included in the invention. The oil platform 3', for example, can be substituted by a support ship, a floating platform or other surface control unit. A

production cross according to the invention can be suitable for being installed and operating underwater not only on a seabed but also on the bed of an ocean, lake, river or other submersed beds. Furthermore, all the details can be substituted by technically equivalent elements. In practice, the materials used, as also the dimensions, can vary according to technical requirements. The examples and lists of possible variants of the present patent application should be considered as being non-exhaustive lists.

The present application claims priority of the italian patent application n° MI2011A001112 and incorporates by reference the content thereof.

CLAIMS

1) A plant for exploiting reservoirs of natural fluids, such as for example oil, natural gas or other hydrocarbon-based extracted fluids, through a well comprising a well head (1'), wherein the plant comprises a production cross (21) arranged for being installed and operating on a submersed bed, for example of a sea, lake, ocean or river, and comprises:

a) a valve body (25) arranged for being fixed onto the well head (1') and in which a first (27) and a second extraction duct (29) are provided, arranged for allowing the extracted fluid to flow out of the same reservoir;

b) at least one extraction control valve (31, 33), housed in the valve body (25);

wherein:

- the first extraction duct (27) extends coaxially, or in any case longitudinally, with respect to the axis (AP) of the section of the well closest to the surface of the ground or bed on which the production cross is located;

- the second extraction duct (29) branches out from the first extraction duct and extends transversally with respect to the latter;

- the at least one extraction control valve (31, 33) is positioned along the second extraction duct (29) and is arranged for allowing, preventing or regulating the flow of the extracted fluid through the second extraction duct (29) towards the outside of the production cross (21) itself;

- along the first extraction duct (27) there is no valve arranged for allowing, preventing or regulating the flow of the extracted fluid;

- the at least one extraction control valve (31, 33) and the possible other valves arranged for allowing, preventing or regulating the flow of the extracted fluid through the production cross (21) itself, are driven by electric actuators.

2) The plant according to claim 1, wherein the at least one extraction control valve (31, 33) and the possible other valves arranged for allowing, preventing or regulating the flow of the extracted fluid through the production cross (21) itself, are not activated by fluid actuators, such as for example hydraulic or pneumatic actuators.

3) The plant according to claim 1, wherein the at least one extraction control valve (31, 33) and the possible other valves arranged for allowing, preventing or regulating the flow of the extracted fluid through the production cross (21) itself and the relative electric actuators are assembled on and/or in the valve body (25).

4) The plant according to claim 1, wherein the production cross (21) comprises a watertight casing which encloses and seal separates from the outside water the at least one extraction control valve (31, 33), the possible other valves arranged for allowing, preventing or regulating the flow of the extracted fluid through the production cross (21) itself and the relative electric actuators.

5) The plant according to claim 1, comprising a connection cord (5') arranged for evacuating the extracted fluid from the production cross (21), supplying an electric feed to the latter and transmitting from and/or towards the latter information and/or control signals.

6) The plant according to claim 5, wherein the connection cord (5') does not supply the production cross (21) with pressurized fluids for feeding hydraulic and/or pneumatic actuators assembled on the same cross.

7) The plant according to claim 5, comprising a surface control unit (3) selected from the following:

- an oil platform;
- a support ship;
- a floating platform;

and the connection cord (5') fluidly and electrically connects the surface control unit (3) to the production cross (21).

8) The plant according to claim 1, wherein the production cross (21) is situated on a bed of the sea, ocean, lake or river.

9) The plant according to claim 8, wherein the production cross (21) is situated at a depth equal to or less than 150 metres below the water surface.

10) The plant according to claim 8, wherein the production cross (21) is situated at a horizontal distance equal to or greater than 6.5 km from the surface control unit (3).

11) Method for installing, maintaining or running a plant (10) according to one or more preceding claims, comprising the following steps:

-providing a platform (50) comprising a buoyant hull (52) and one or more extendable legs (54) fixed to the hull;

-carrying the production cross (1') on a predetermined installation place by means of the platform (50);

-extending the one or more extendable legs (54) so as to rest them on an underlying installation seabed (SB)

or other submersed bed;

-raising the buoyant hull (52) above the sea-surface or other water-surface so that the hull (52) is supported by the one or more extendable legs (54);

-lowering the production cross (1') from the buoyant hull (52) down to the installation seabed (SB) or other submersed bed.

12) Method according to claim 11, wherein:

-the platform (50) is provided with a derrick (56) or other drilling tower or mobile tower;

-the step of lowering the production cross from the buoyant hull (52) down to the installation seabed (SB) or other submersed bed comprises the steps of hanging the production cross (1') to the derrick (56) or other drilling tower or mobile tower and hauling the production cross (1') from the derrick or other drilling tower or mobile tower down to the installation seabed (SB) or other submersed bed.

13) Method according to claims 11 or 12, wherein the production cross (1') is lowered from the platform (50) down to a well head.

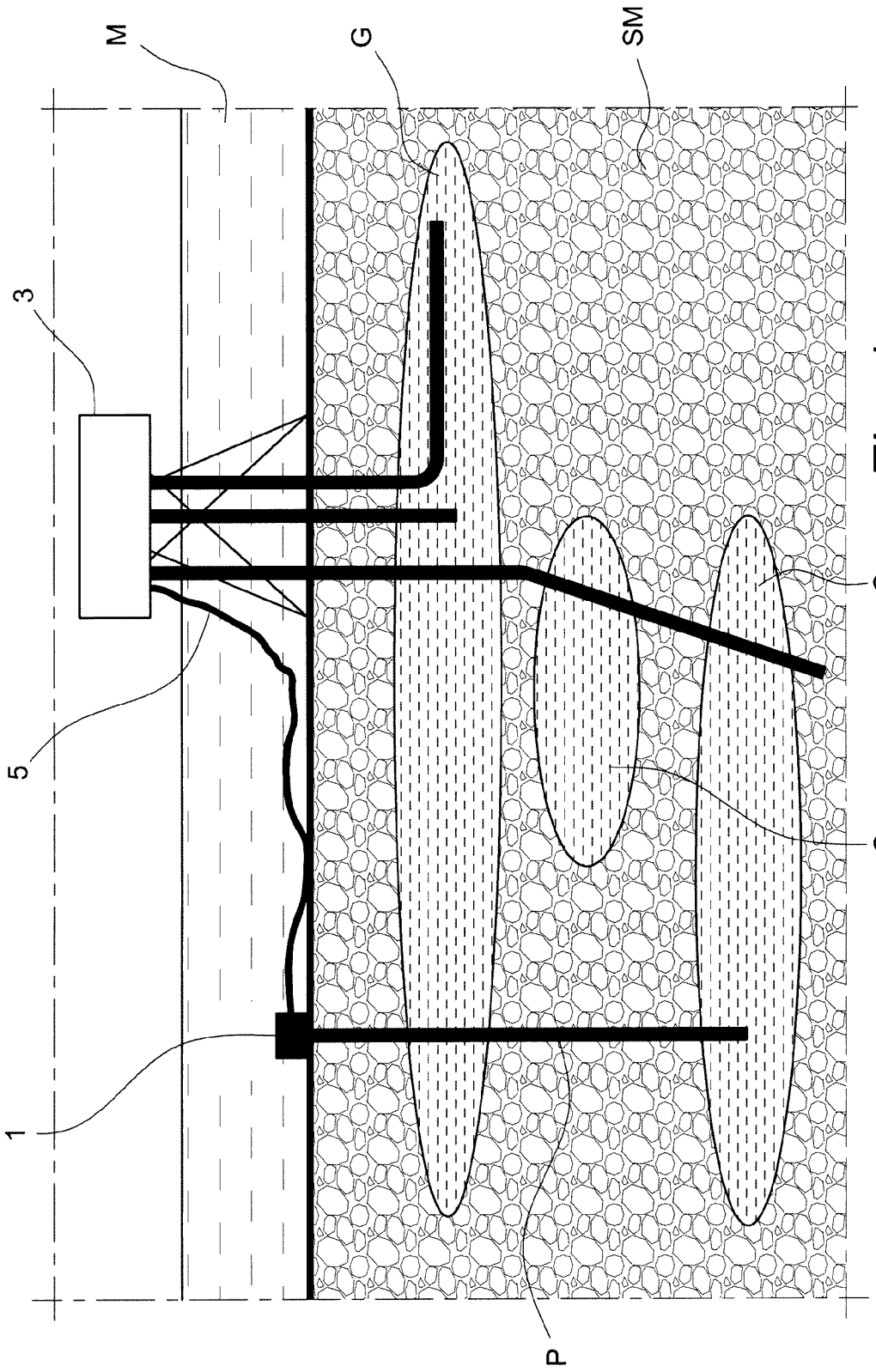


Fig. 1

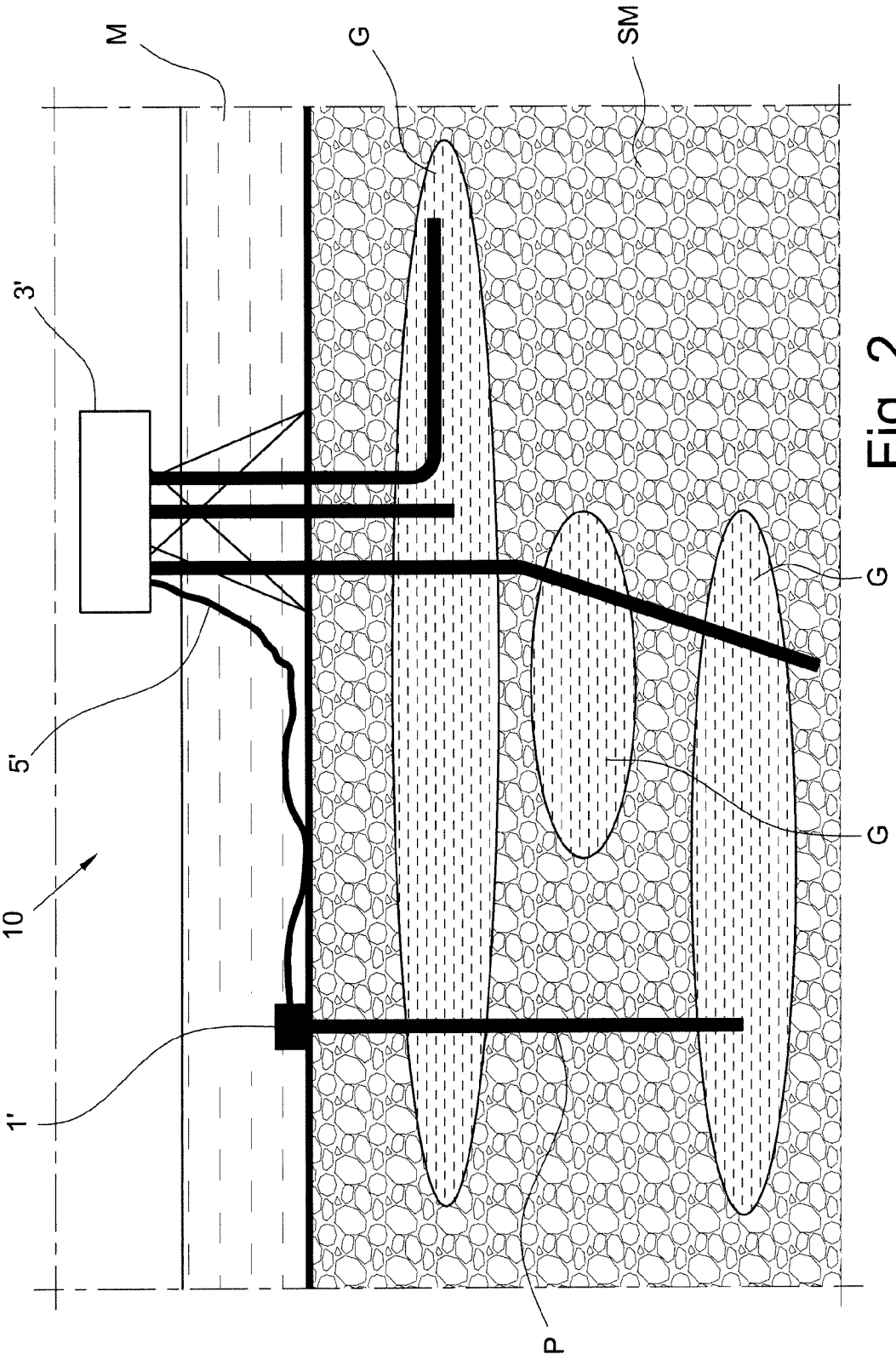
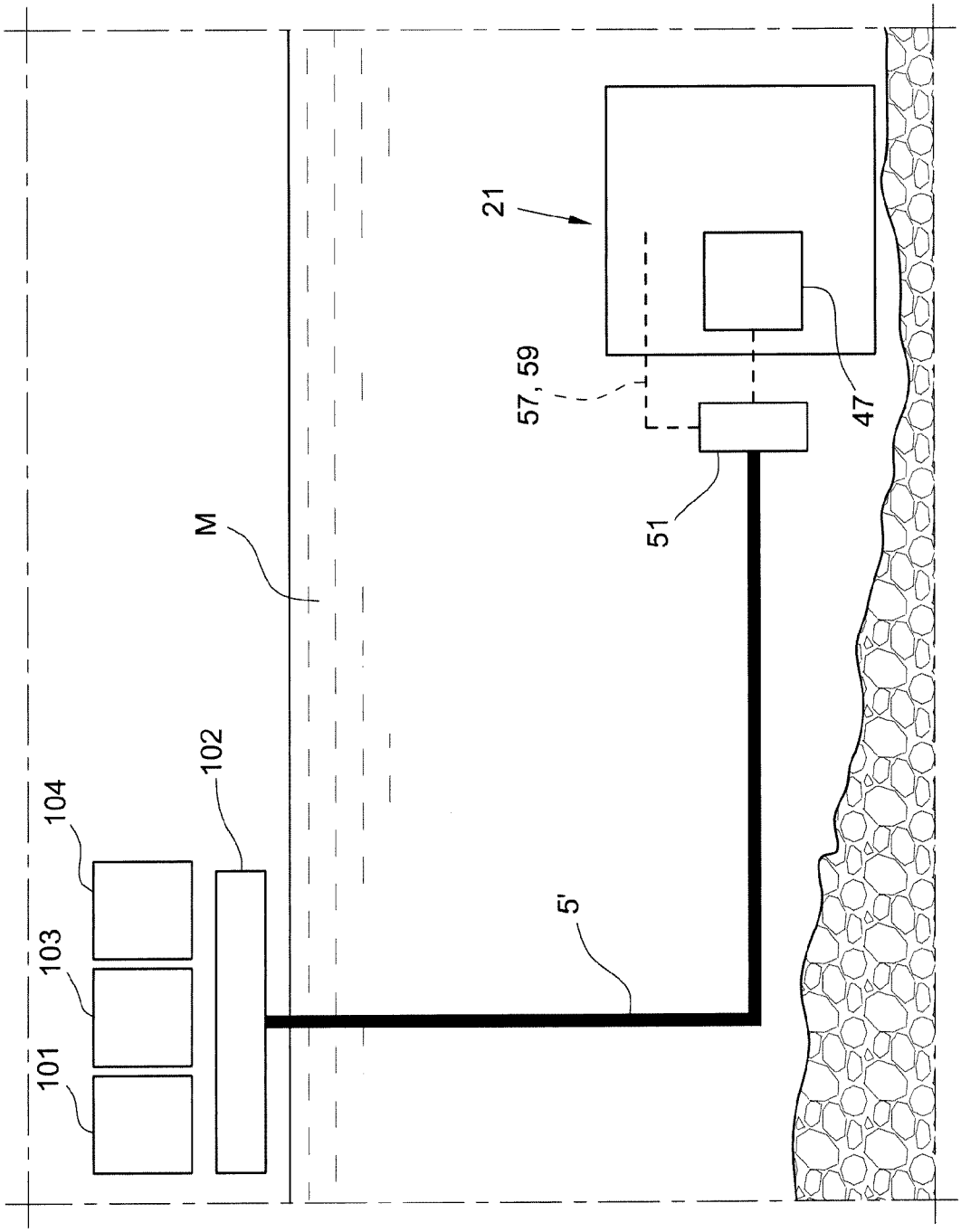


Fig. 2

Fig. 3



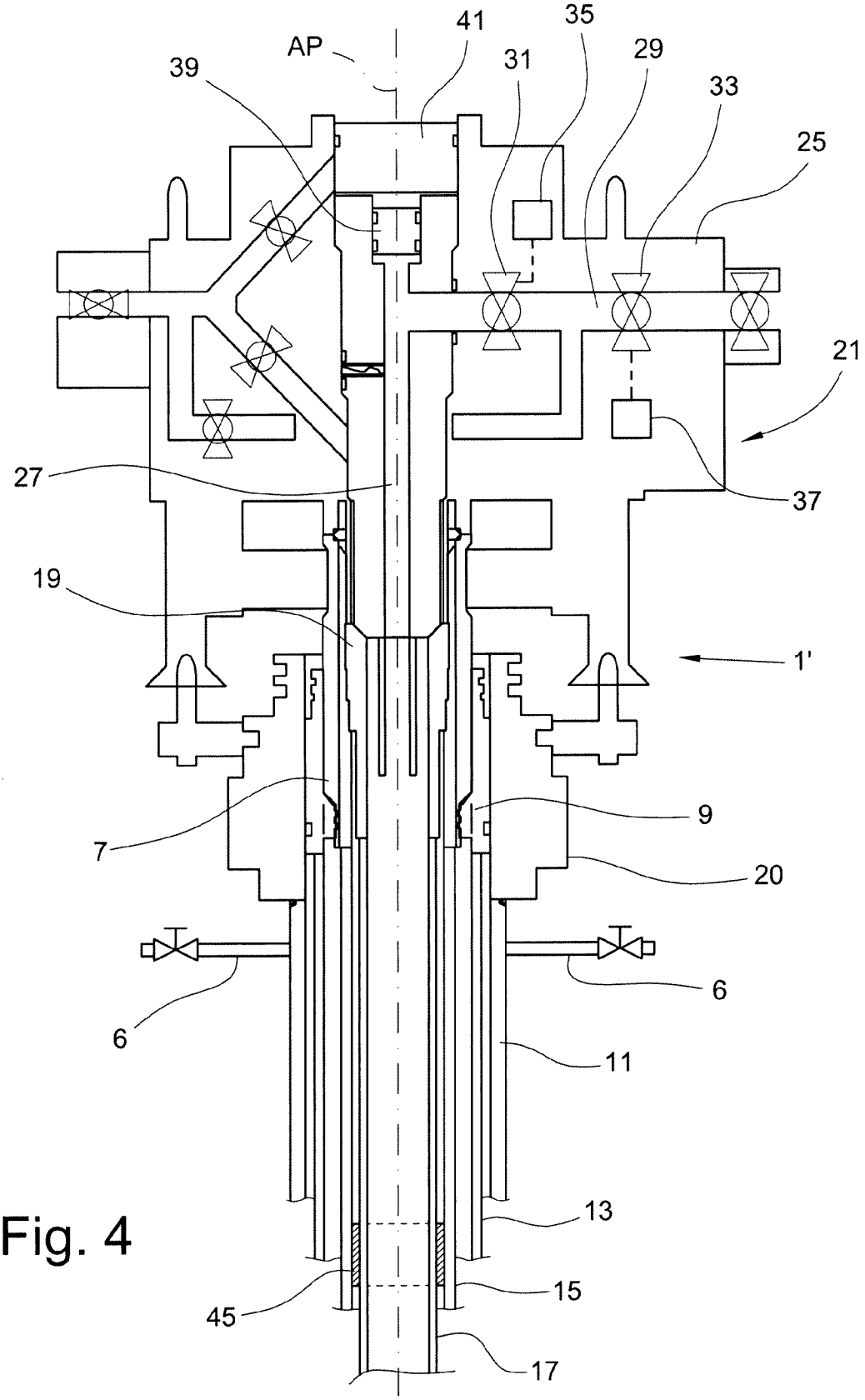


Fig. 4

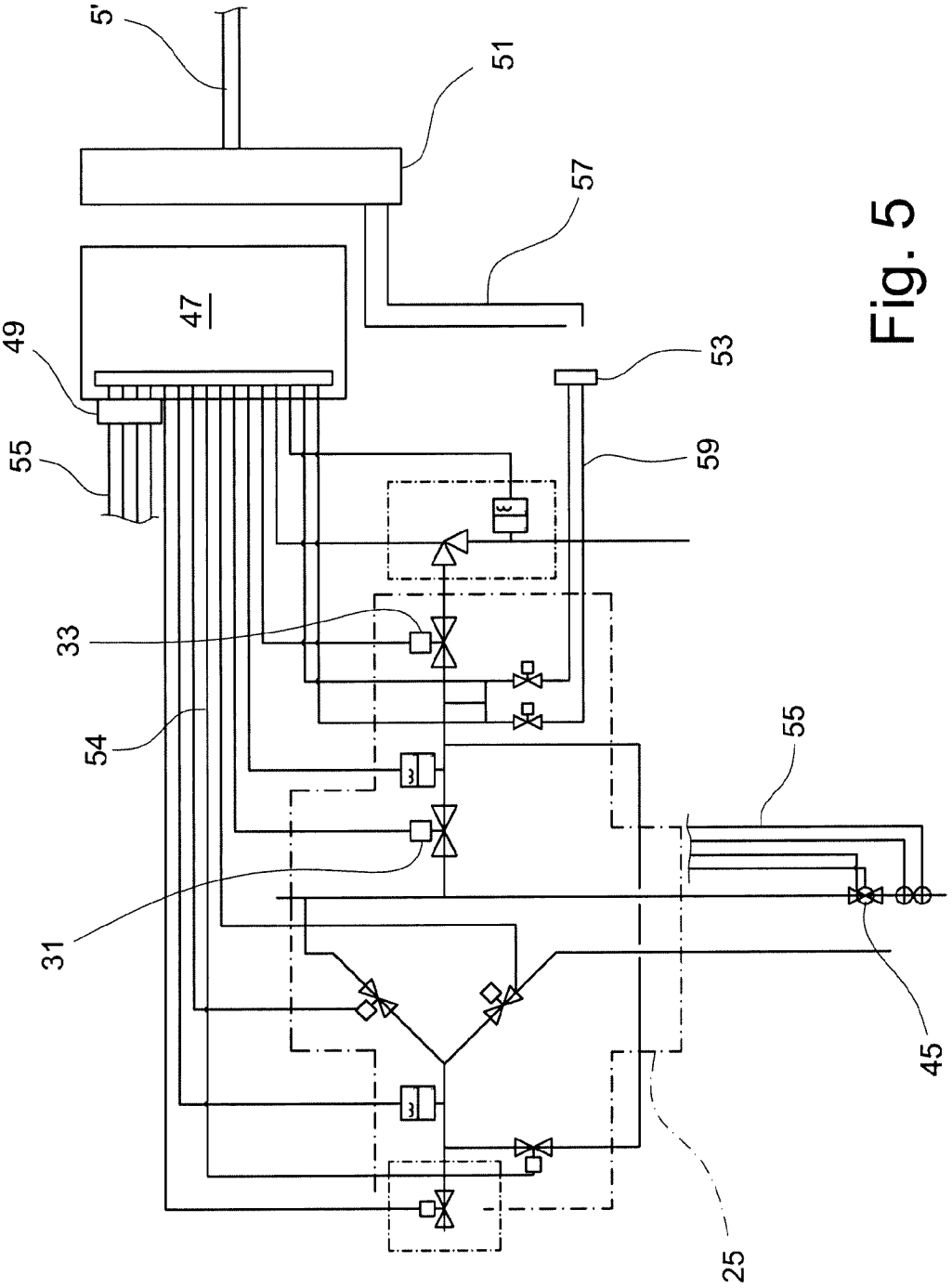


Fig. 5

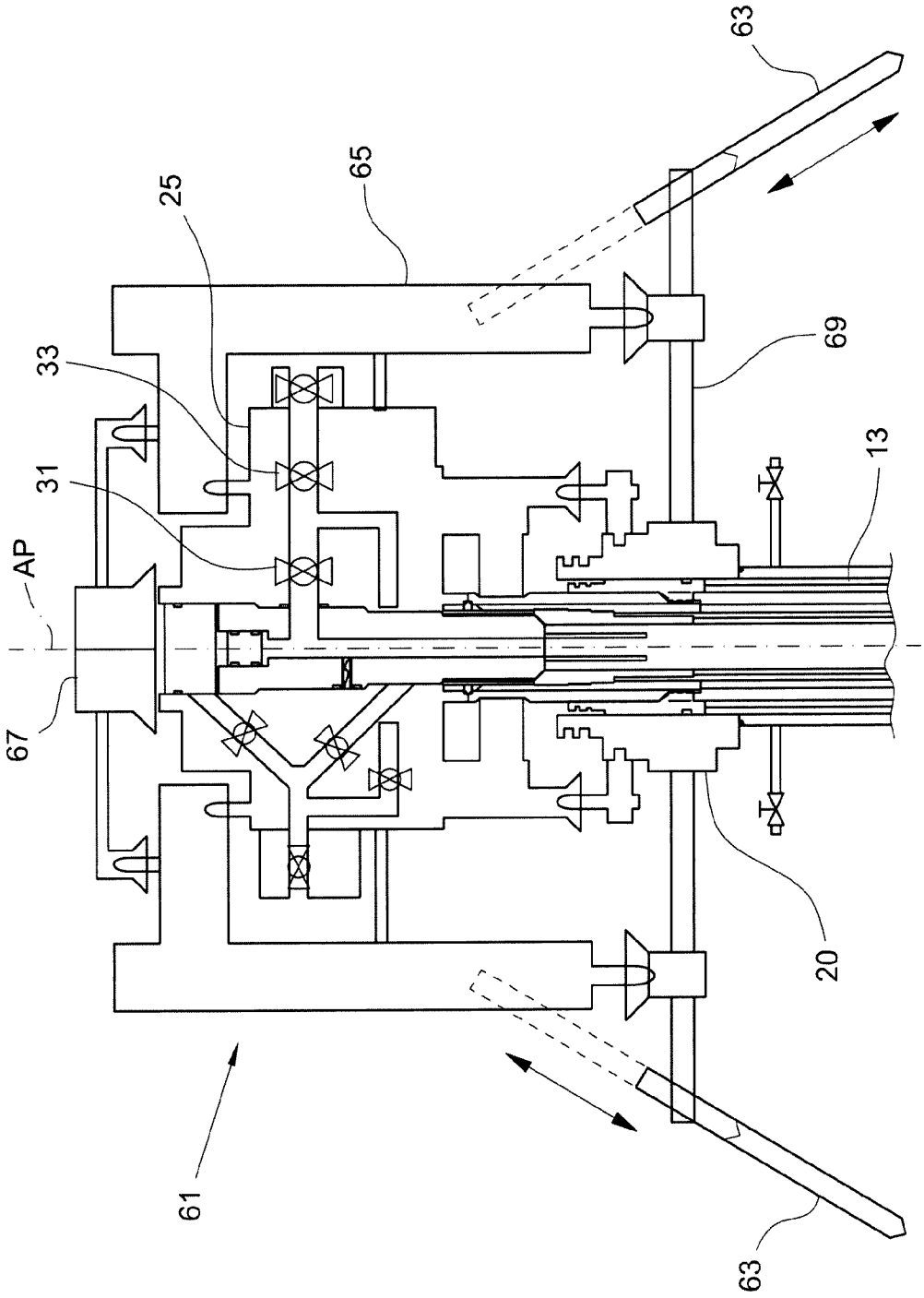


Fig. 6

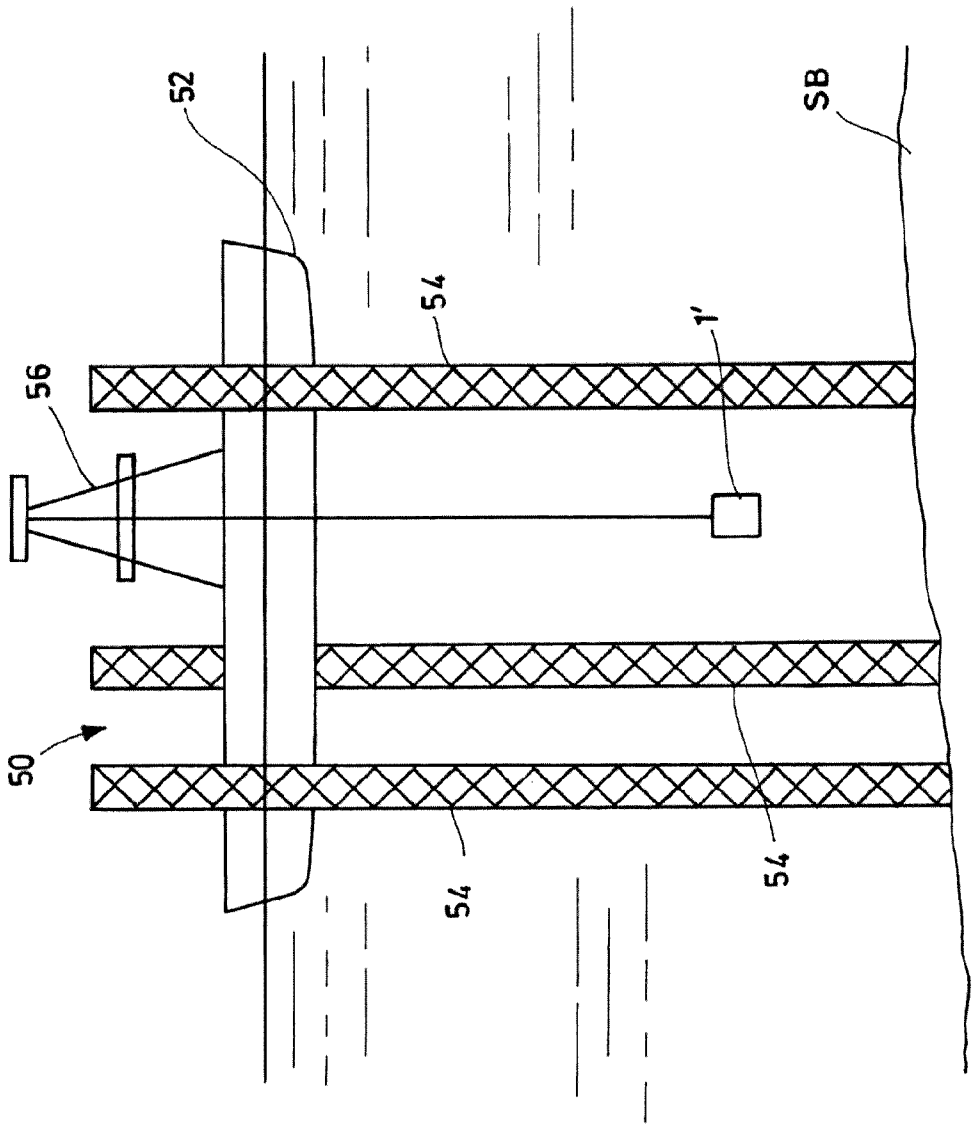


Fig.7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/061796

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21B33/035 E21B33/038 E02B17/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E21B E02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2005/111484 A2 (COOPER CAMERON CORP [US]; BIESTER KLAUS [DE]; KUNOW PETER [DE]; LENZ N) 24 November 2005 (2005-11-24)	1-10
Y	production master valve 1314; pages 64,65; figure 34 claims 39-44; figures 31-33 the whole document	11-13

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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Date of the actual completion of the international search	Date of mailing of the international search report
1 August 2012	21/08/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	van Berlo, André

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Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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X	Winther-Larssen, E.: "Design of an Electric X-mas Tree Gate Valve Actuator", , 16 June 2007 (2007-06-16), XP007920078, Trondheim Retrieved from the Internet: URL:http://daim.idi.ntnu.no/masteroppgaver/IME/ITK/2007/3359/masteroppgave.pdf [retrieved on 2012-01-16] pages 11,12; figures 2.3, 2.7 pages 80,81	1-10
Y	GERARDIN P ET AL: "The First All Electric Subsea System on Stream: Development, Operational Feedback and Benefits for Future Applications", SPE OFFSHORE EUROPE OIL AND GAS CONFERENCE AND EXHIBITION,, 8 September 2009 (2009-09-08), pages 1-10, XP007920890, page 6 X-trees installed from Jack-up rig	11-13
A	CHRIS WILSON: "Running Subsea Trees from a Jack-up MODU", 20080901, 1 September 2008 (2008-09-01), pages 1-34, XP007920891, the whole document	11-13
A	APPLEFORD D: "ALL-ELECTRIC MODULAR SOLUTION TO SEABED PROCESSING AND FIELD CONTROL", OFFSHORE, PENNWELL, TULSA, OK, US, vol. 61, no. 3, 1 March 2001 (2001-03-01), page 81/82,84, XP001112240, ISSN: 0030-0608 the whole document	1
A	LEESON T ET AL: "DISTRIBUTED ELECTRONICS ARCHITECTURE FOR SUBSEA CONTROLS IN DEEPWATER LOGIC FOR EMERGENCIES, SEQUENCING, DATA", OFFSHORE, PENNWELL, TULSA, OK, US, vol. 60, no. 8, 1 August 2000 (2000-08-01) , XP001017605, ISSN: 0030-0608 the whole document	1
A	GB 2 358 204 A (FMC CORP [US] FMC CORP [US]; FMC TECHNOLOGIES [US]) 18 July 2001 (2001-07-18) claims 8-10; figures 1,2 the whole document	1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2012/061796

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