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- (71) Applicant: **SINGLE BUOY MOORINGS INC.**
[CH/CH]; Route de Fribourg 5, CH-1723 Marly (CH).
- (72) Inventor: **GUILLOIR, Emmanuel**; 24 Avenue de
Fontvieille, 98000 Bât. Aigue Marine (MC).
- (74) Agent: **NEDERLANDSCH OCTROOIBUREAU**; P.O.
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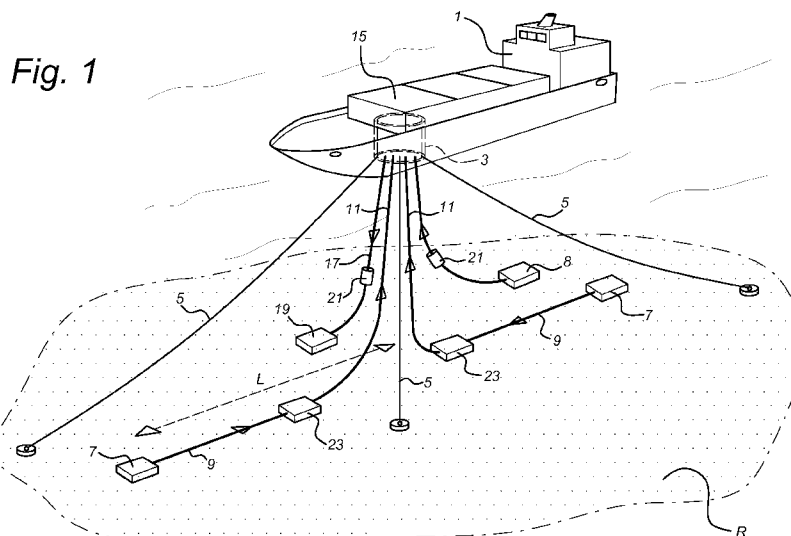
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(54) Title: ARRANGEMENT FOR RELOCATABLE OFFSHORE HYDROCARBONS PRODUCTION STORAGE AND OFF-LOADING FROM A SERIES OF DISTINCT RESERVOIRS



(57) Abstract: Arrangement of an offshore vessel for hydrocarbons production and storage at a location at sea, includes the offshore vessel (1), at least one flow line (9) and at least one riser line (11). Each flow line on one end is connected in fluid communication with a well (7) in the seabed and on another end in fluid communication with one riser line. Each riser line is in fluid communication with process equipment (15) on the offshore vessel. The flow lines and riser lines consist of recoverable flexibles.



Arrangement for relocatable offshore hydrocarbons production storage and offloading from a series of distinct reservoirs

Field of the invention

- 5 The present invention relates to an arrangement for offshore hydrocarbons production storage and offloading. Also, the invention relates to a method for offshore hydrocarbons production storage and offloading.

Background art

- 10 In the late 90's of the twentieth century, oil companies made discoveries of relatively large oil reservoirs in deep water offshore and developed those reservoirs on the basis of a stationary floating production unit developing one large reservoir with fluids flowing from the wells to the floating production unit through a fixed network of flow lines and riser lines. The floating production unit could be a floating production
15 storage and offloading unit (FPSO) or a combination of a semisubmersible vessel or a tension-leg platform (TLP) with a floating storage and offloading unit (FSO).

- The so-called "hub" or "cluster" architecture was also used for larger projects with several segregated reservoirs located in the same geographical area, with fluids flowing from the wells of each reservoir to the FPSO through a dedicated fixed
20 network of flow lines and riser lines. The hub/cluster development architecture proved very successful at times of high and increasing oil prices with several gigantic projects achieved such as the Pazflor development which covers about 600 square kilometers.

 The hub development architecture though creates a number of constraints:

- Fluids accruing from the various reservoirs forming part of the hub, may have
25 very different characteristics and properties. As they are collected and processed by the same surface unit, this causes a multiplication of equipment and greater complexity of the topsides process on the floating production unit to treat that variety of fluids, driving up the complexity and costs for topside process equipment.

- All or most reservoirs forming part of the hub generally start their production in
30 the same timeframe (typically within 6 to 12 months from first to last driven by the completion planning of the subsea infrastructures installed by the main pipe lay vessel), summing up to a level of production for which the floating production unit has to be designed in terms of process, storage and offloading capacity. Once past the plateau of

production, the floating production unit often continue to operate for years with low to very low utilization rates compared to design capacity, affecting the project economic return.

The connection of several reservoirs to a single floating production unit, often located close to the barycenter of the reservoirs, causes hub development projects to have a much larger geographical footprint than the earlier single large reservoir developments. This also has a number of consequences:

It results in a significant increase in the mileage of flow lines and umbilicals involved. Some projects involve hundreds of kilometers of flow lines.

On top of the pure quantitative effect mechanically driving costs up, this also added significant flow assurance impacts. As the fluids travel through longer distances, they cool down, thus requiring higher thermal insulation of the flow lines and riser lines. In the prior art, pipe in pipe flow lines and insulated riser lines (such as pipe in pipe single hybrid riser lines or riser towers) are used which are much costlier to design, procure, transport and manufacture than single wall pipelines. The installation of those insulated flow lines and riser lines requires the use of dedicated and expensive pipe lay vessels. In some cases, only a limited number of pipe lay vessels worldwide is technically capable of safely installing those pipelines with adverse effects on costs and maintenance.

Moreover, each reservoir forming part of the hub, has to be independently maintained so as to keep the reservoirs producing over a long period of time in a cost-effective manner. This causes each of the reservoirs to be served by its dedicated network of injection flow lines and riser lines for either water or gas or both, further adding to the initial CAPEX cost of the hub architecture.

It is an object of the present invention to overcome or mitigate one or more of the disadvantages from the prior art.

Summary of the invention

The object is achieved by an arrangement of an offshore vessel for hydrocarbons production and storage at a location at sea, in accordance with claim 1. Such an arrangement allows a more flexible mode of operation for hydrocarbons production than the prior art hub developments as described above.

According to an aspect, the invention provides the arrangement as described above, wherein subsea processing equipment is included in the flow and the riser lines.

According to an aspect of the invention, the arrangement further comprises a subsea system, comprising at least two well xmas trees (i.e., a branched structure), and
5 associated flow lines and riser lines; each flow line on one end connected in fluid communication with a well in the seabed through the associated xmas tree and on another end in fluid communication with one riser line.

According to an aspect, the invention provides that the subsea system further comprises one or more selected from manifolding equipment, jumper; the selected item
10 being included in the flow and riser lines.

According to an aspect, the storage reel facility is arranged on the offshore vessel or on an installation vessel.

According to an aspect, the invention provides the arrangement as described above, wherein the offshore vessel is spread moored or turret moored.

According to an aspect, the invention provides the arrangement as described
15 above, wherein a horizontal distance between the location of the vessel and the location of the well is about 4 kilometers or less.

According to an aspect, the invention provides the arrangement as described above, wherein the subsea processing equipment provides multiphase or monophas
20 e pumping of fluids through the flow lines and riser lines.

According to an aspect, the invention provides the arrangement as described above, wherein the subsea processing equipment is configured for either fluid-gas separation or hydrocarbons-water separation.

According to an aspect, the invention provides the arrangement as described
25 above, further comprising a gas re-injection line consisting of recoverable flexibles running from the offshore vessel to a re-injection location in the seabed.

According to an aspect, the invention provides the arrangement as described above, wherein an inner diameter of the flow lines, an inner diameter of the riser line and an inner diameter of an inlet or outlet of the subsea processing equipment are
30 identical.

According to an aspect, the invention provides the arrangement as described above, wherein the inner diameter of the flow line and the riser line and the inlet or outlet is 10 inch or less.

According to an aspect, the invention provides the arrangement as described above, wherein the offshore vessel comprises hydrocarbon production equipment for processing a feed received from the well through the riser lines, wherein the equipment is tuned for processing the feed according to a predetermined composition range of the feed.

According to an aspect, the invention provides the arrangement as described above, wherein the flow lines and the riser lines are arranged as redundant duplicate or triplicate parallel lines for maintaining a flow path of constant and identical diameter while meeting a required flowrate.

According to an aspect, the invention provides the arrangement as described above, wherein the subsea processing equipment is configured to be recoverable.

According to an aspect, the invention provides the arrangement as described above, wherein the hydrocarbon production equipment on the offshore vessel is configured for a production of about 80.000 barrels per day or less.

According to an aspect, the invention provides the arrangement as described above, wherein the hydrocarbon production equipment on the offshore vessel is in fluid communication with at most ten wells simultaneously at said location at sea.

According to an aspect, the invention provides a method of operation for the arrangement as described above, wherein the offshore vessel is a first FPSO and the method comprises: within a predetermined reservoir area determining locations of a number of additional reservoir spots based on corresponding fluid characteristics of the feed from the additional reservoir spots; locating within the reservoir area the first FPSO at the location of one of the determined additional reservoir spots of the reservoir area; arranging the first FPSO with recoverable flow lines and recoverable risers connected to a number of wells within each additional reservoir spot and arranging the first FPSO to produce at the respective additional reservoir spot for a relatively short duration in comparison to a working time of the reservoir area, before relocating the first FPSO to a next one of the number of additional reservoir spots.

According to an aspect, the invention comprises: locating within a reservoir area a main FPSO at a main reservoir spot, the main FPSO provided with flow lines and riser lines connected to a second number of wells at the main reservoir spot, the main FPSO being arranged for production at the main reservoir spot for a long duration comparable the working time of the reservoir area.

According to an aspect, the invention provides that the first number of wells at the additional reservoir spot is less than the second number of wells at the main reservoir spot.

In an embodiment, the first number is about 5 and the second number is between
5 10 and about 20.

Advantageous embodiments are further defined by the dependent claims.

Brief description of drawings

The invention will be explained in more detail below with reference to drawings
10 in which illustrative embodiments thereof are shown. The drawings are intended exclusively as an illustration and not as a restriction of the inventive concept. The scope of the invention is only limited by the definitions presented in the appended claims. Furthermore, identical reference signs in the drawings relate to corresponding or similar elements.

15 Figure 1 schematically shows an arrangement of a floating production vessel at a location of an offshore reservoir, in accordance with an embodiment of the invention; Figure 2 schematically shows details of an arrangement in accordance with an embodiment of the invention;
Figure 3 shows a processing scheme for FPSO processing equipment in accordance
20 with an embodiment of the present invention;
Figure 4 shows schematically a relocation scheme for a floating production vessel in accordance with an embodiment of the invention, and
Figure 5 shows schematically a relocation scheme for a floating production vessel in accordance with an embodiment of the invention.

25

Detailed description of embodiments

Figure 1 schematically shows an arrangement of an floating production vessel at a location of an offshore reservoir R, in accordance with an embodiment of the invention.

30 A floating production unit 1 such as an FPSO vessel, or in general an offshore vessel, is moored at a location at sea near a reservoir in the seabed.

The floating production unit 1 is either spread moored or turret moored. Optionally, the floating production unit 1 is positioned using dynamic positioning. In

figure 1, according to an embodiment, the floating production unit is shown as turret moored, by means of a turret mooring system.

Turret mooring systems provide a turret mooring structure comprising a turret structure 3 and a support structure mounted on either the outside or the inside of the floating production unit 1. The turret structure 3 is anchored to the seabed with anchoring lines 5. The support structure, provided on the floating production unit 1, has a receptacle for receiving the turret structure 3, such that rotation of the floating production unit 1 about the turret structure 3 is still possible. In this manner, the floating production unit 1 can weathervane under influence of wind, waves, currents and/or drifting ice and adopt the position of least resistance with regards to the environment.

Instead of targeting a large scale hub/cluster development, the floating production unit 1 is utilized in an individual separate reservoir R (or a number of neighboring reservoirs), with a limited number of wells, preferably at most ten. From each well 7, 8 on the seabed at least one flow line 9 is in fluid communication with an associated riser line 11. Each riser line 11 extends to the turret structure 3. Through a suitable swivel interface (not shown) the riser line 11 is in fluid communication with process equipment 15 on the floating production unit 1.

According to an embodiment, a re-injection line 17 comprising a riser line in fluid communication with a flow line is provided between the floating production unit 1 and a re-injection point 19 on the seabed. The re-injection line 17 is arranged for re-injection of water or gas. A second re-injection line (not shown) may be provided if both water re-injection and gas re-injection are required.

According to the invention, the flow lines 9 and the riser lines 11 each are recoverable flexible lines.

The flexible lines 9, 11 are recoverable to allow relocation of the lines to another location in the reservoir or to another reservoir. In this manner, relatively small reservoirs can be operated for a short period without full depreciation of the arrangement in that period.

In a preferred embodiment the flexible lines i.e., flow lines and riser lines have a same relatively small diameter which in comparison to large diameter lines allow relatively easy handling that can be met by comparatively simple lay vessels ("availability of capable vessels"). Also, the use of small diameter flexible lines will

facilitate interventions whether maintenance, installation or decommissioning by such a relatively large group of pipe lay vessels.

By choosing a same diameter for flow lines and riser lines interconnection is simplified.

- 5 The floating production unit 1 is located in a central position in proximity of the production drill center without recourse to long tie backs as caused in a hub development. As a result the subsea infrastructure can be compact: the length of the at least one flow line can be relatively short.

- 10 A typical length L is about 4 kilometers or less whereas in hub development the flow line is usually much longer from about 15 to about 20 km.

- The flow line and riser line may be coupled directly by connector elements 21 at their respective ends to form an assembled conduit line (i.e., a flow path) between the well 7 and the swivel interface at the floating production unit vessel 1 (or the swivel interface and the re-injection point). In an embodiment, subsea processing equipment
15 23 is provided in the assembled conduit line which subsea processing equipment 23 is configured to resolve flow assurance issues in the assembled conduit line of the flow path.

- The subsea processing equipment 23 may be configured for actions such as subsea pumping monophasic feed or multiphase feed and/or subsea separation of
20 liquid/gas or oil/water. These processing actions enhance the flow of feed through the assembly of the flow lines 9 and riser lines 11.

- Moreover, using subsea processing equipment 23 may reduce the need for high thermal insulation of the flow lines 9 and riser lines 11, so as to enable use of flow lines and riser lines with a thermal insulation (thermal transmittance or U value) always
25 greater than $2,5 \text{ (m}^2 \cdot \text{K} \cdot \text{W}^{-1})$ enabling the use of flexible line products.

 Subsea processing by subsea equipment 23 may also contribute to reduced required flowrates in risers 11 facilitating the use of small diameter flow lines 9 and riser lines 11 as described above.

- In an embodiment, the inlets and outlets of the subsea processing equipment 23
30 have a same diameter as the flow lines 9 and riser lines 11, which simplifies not only reduction of throughput flow rates but also installation, maintenance and decommissioning of the subsea infrastructure.

 The subsea processing equipment 23 is designed to be recoverable.

According to an embodiment, the inner diameter of the flow lines and riser lines is about 10 inch or less. If subsea processing equipment is used, the inlets and outlets of the subsea processing equipment have a same inner diameter.

It is noted that additional auxiliary equipment and/or umbilicals may be present,
5 but for reasons of clarity are not shown.

Figure 2 schematically shows details of a layout of an arrangement according to an embodiment of the invention.

According to an embodiment of the invention, between a plurality of (subsea) wellheads, each mounted on a respective well 7, and the subsea processing equipment
10 23 the flow path is implemented as duplicate riser lines 11 which can be controlled to forming loops through by-pass 11a. A plurality of flow lines 9 provides a connection between a respective outlet of the wellhead on the well 7 and an inlet of the subsea processing equipment 23 to establish a flow of feed from the respective well 7. By increasing the number of parallel flow lines 9 and riser lines 11, flow rates are
15 improved without enlarging the diameter of the respective lines 9, 11. The alternative of installing a single flow and/or riser line with larger diameter may be complicated as the line must designed and manufactured to withstand high external pressure in subsea conditions.

The duplicate flow lines and/or riser lines may follow a same path on the seabed
20 between the well head and the subsea processing equipment 23. Alternatively, the lines may follow different paths. In a further embodiment, triplicate flow and/or riser lines may be installed.

According to an embodiment, one or more water injection points 22 are provided on the seabed in the area of the reservoir R.

25 The water injection points 22 are coupled to a water pump facility (not shown) on the floating production unit 1 by a water injection line 18 which couples to each of the water injection points 22 through in-line tees 20 for water injection. The water pump facility on the floating production unit 1 is described in more detail with reference to Figure 3.

30 In addition, umbilicals 25 are provided between the floating production unit 1 and the subsea processing equipment 23. On the seabed the umbilicals 25 may be daisy chained to other subsea equipment such as the well head(s), gas re-injection point 19 or water injection point(s) 22.

According to an embodiment, the water injection line(s) 18 and/or gas-re-injection line(s) 17 are recoverable flexible lines.

Figure 3 shows a layout of an FPSO processing facility.

The FPSO processing facility 15 is configured to accommodate the fluid characteristics of the reservoir R. In comparison to prior art hub development projects, the operation on the reservoir will be relatively small-scale. Therefore the FPSO is configured to relatively small production capacity. The processing equipment on the FPSO vessel is designed to a production of about 80×10^3 barrels per day or less.

According to the arrangement all wells relate to the same reservoir or some neighboring reservoirs, and the range of fluid characteristics of the feed will typically be narrow. This allows to “tune” the topside processes of the FPSO processing facility 15 to these characteristics and omit any process stages for feed outside the range of fluid characteristics.

The top side processes may be limited to a two-stage hydrocarbon production process facility. Through a suitable swivel device 50 the riser line(s) is connected to the FPSO. In a first stage 51, hydrocarbons in the incoming feed 40 are separated from water and gases. The separated water is output 54 to a water treatment facility 53. The separated gases are output 55 to a gas flare device 56. Further, hydrate compounds are output 57 to a dehydration unit 58 for processing them into fuel gas 59.

The hydrocarbon fluid 60 from the first stage 51 are output through a heating stage 61 to a second stage 62. In the second stage a further separation of water takes place. The water output 63 is coupled to the water treatment facility 53. The hydrocarbon fluid 64 after processing in the second stage 62, is output to an electro coalescer 65, in which water and gases are separated from the hydrocarbon fluid. The water is output 66 to the water treatment facility 53, the gases are output 67 to the gas flare device 56. The hydrocarbon fluid stream 68 is output from the electro coalescer 65 to a cooling unit 69 and after cooling output to a storage unit 70 on the FPSO and subsequently offloaded to a tanker vessel.

The FPSO further comprises an injection facility for water. Sea water 80 is taken in 81, subsequently pre-treated 82 and then pumped 83 to the injection point 22 on the seabed. Additionally, the FPSO may comprise a gas re-injection facility that is connectable to a gas re-injection point 19 by a gas re-injection line 17.

In addition, the arrangement comprises an installation vessel that is equipped with storage reels for storing flexible lines, such as flow lines 9 and riser lines 11.

Optionally, the FPSO is arranged with storage reels for storing flexible lines, such as flow lines 9 and riser lines 11.

5 Figure 4 shows schematically a mode of operation for the arrangement according to the invention. The invention aims at rendering possible, even in a relatively low oil price environment, economic development of marginal fields due to the use of relocatable assets; i.e., recoverable flexibles and recoverable subsea processing equipment. The arrangement comprising an FPSO will produce a selected group of
10 reservoirs Field1, Field2, Field3, Field4, one reservoir at a time, staying on a respective reservoir's site for a relatively short duration (e.g. 3 to 7 years), before moving to the next reservoir as indicated by the arrows. The reservoirs Field1 ... Field4 have similar fluid characteristics.

 The skilled in the art will appreciate that composite pipes, which have bending
15 mechanical properties similar to flexibles thus enabling reeling and re-use, may be used in lieu of flexibles.

 Figure 5 shows schematically a mode of operation for the arrangement according to the invention.

 A reservoir area 50 consists of a main reservoir spot 55 and additional reservoir
20 spots 51, 52, 53, 54.

 From a survey the locations of the main and additional reservoir spots are determined as locations for hydrocarbon extraction. Of each reservoir spot capacity as well as the characteristics of the feed are determined. In this exemplary case it has been found that the main reservoir spot 55 has a high capacity and may remain operational
25 for a relatively long period, for example for 20 years. The additional reservoir spots 51 – 54 have typically a lower capacity for a relatively shorter period of for example 3 to 7 years.

 In the mode of operation a main FPSO 100 is located at the main reservoir spot 55 and arranged with flow lines 71 and riser lines 72 connected to a number of wells 73
30 in the main spot. Typically, 10 to about 20 wells are used for feed to the main FPSO 100. The main FPSO will have a high processing capacity of about 150×10^3 (or more) barrels per day. The main FPSO typically will stay at the main reservoir spot as long as the main reservoir spot remains operational. A second dedicated FPSO 1 is used for

hydrocarbon extraction of the additional reservoir spots, one reservoir at a time, staying on a respective site for a relatively short duration (e.g. 3 to 7 years), before moving to the next additional reservoir spot. Typically, the dedicated FPSO 1 has a processing capacity of the hydrocarbon production equipment between about 60×10^3 and about
5 100×10^3 barrels per day.

According to the invention the dedicated FPSO 1 is connected to wells in the respective additional reservoir spot by flow lines 9 and riser lines 11 that are recoverable flexibles. The number of wells 74 per additional reservoir spot is less than for the main reservoir spot, for example 3 to 5 wells in the additional reservoir spot,
10 each well connected to the FPSO 1 at the same time. The length of the recoverable flow lines and riser lines between the dedicated FPSO and each of the wells in the additional reservoir spot is about 5 km or less.

After ending operation at one additional reservoir spot, the dedicated FPSO is relocated to another additional reservoir spot. The recoverable flow lines 9 and riser
15 lines 11 are now disconnected from the wells at the one reservoir spot and recovered. The recoverable flow lines and riser lines 9, 11 are stored at a storage reel facility on either the dedicated FPSO 1 or an installation vessel (not shown). Next the dedicated FPSO 1 is relocated to the other reservoir spot. Connections for hydrocarbon feed are made between the wells 74 of the respective additional reservoir spot and the dedicated
20 FPSO by re-using recoverable flow lines 9 and riser lines 11 that were kept in the storage reel facility. This operation is repeated until the dedicated FPSO 1 has been located at each of the predetermined additional reservoir spots 51 – 54 and has produced the wells 74 of these additional reservoir spots 51 – 54.

The inventive concept enables the following benefits:

- 25
- **Cost effective Installation:** Smaller diameter flowlines and risers are, for a considered water depth, installable by a wider range of vessels, than larger diameter flexibles (lighter weight causing lower flexlay vessel VLS capacity requirement). Thus the use of small diameter flexibles will enable cost reductions (inherent lower vessel day rates and higher competition) and facilitate
30 interventions, whether maintenance, installation or decommissioning, thanks to a larger panel of vessels being capable of performing the works, offering greater availability opportunities;

- **Production availability:** loops of duplicate or triplicate flow and /or riser lines will ensure a high degree of redundancy in the system enabling high production availability;
- 5 • **Seamless System operations:** The loops will be used for pigging purpose and flushing/inerting during shutdowns;
- **System simplification:** the loops nullify the requirement for a service line to loop the production line.

10 The invention has been described with reference to some embodiments. Obvious modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims.

Claims

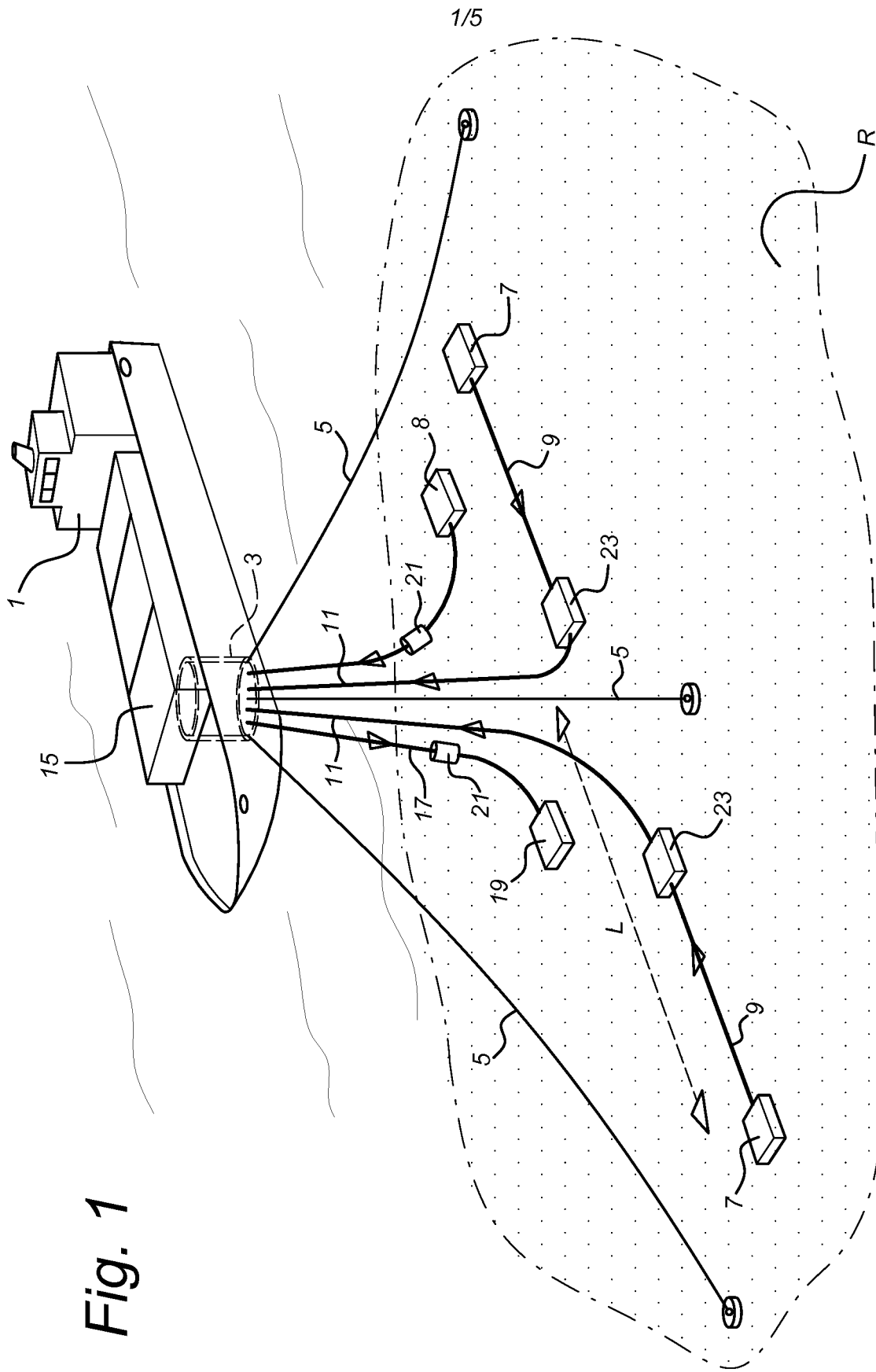
1. Arrangement of an offshore vessel for hydrocarbons production and storage at a location at sea, comprising the offshore vessel, at least one flow line and at least one riser line;
5 each flow line on one end connected in fluid communication with a well in the seabed and on another end in fluid communication with one riser line;
each riser line in fluid communication with process equipment on the offshore vessel, wherein the flow lines and riser lines consist of recoverable flexibles, the arrangement comprises a storage reel facility for storing and re-use of the
10 recoverable flow lines and/or riser lines.
2. Arrangement according to claim 1, wherein subsea processing equipment is included either in the recoverable flow line or recoverable riser line between the well and the process equipment on the vessel, or inbetween the recoverable flow
15 line and the recoverable riser line.
3. Arrangement according to claim 1 or claim 2, wherein the arrangement further comprises as storage reel facility an installation vessel provided with one or more reels for storing the recoverable flexibles.
20
4. Arrangement according to claim 1 or 2, wherein the offshore vessel is provided with the storage reel facility for storing the recoverable flexibles.
5. The arrangement according to claim 1, wherein the offshore vessel is spread
25 moored or turret moored.
6. The arrangement according to any one of claims 1 - 5, wherein a horizontal distance between the location of the vessel and the location of the well is about 4 kilometer or less.
30
7. The arrangement according to claim 2, wherein the subsea processing equipment provides multiphase or monophasic pumping of fluids through the flow lines and

riser lines.

8. The arrangement according to any one of claims 2 – 7, wherein the subsea processing equipment is configured for either fluid-gas separation or hydrocarbons-water separation.
9. The arrangement according to any one of the preceding claims, further comprising a gas re-injection line consisting of recoverable flexibles running from the offshore vessel to a re-injection location in the seabed.
10. The arrangement according to any one of the preceding claims, wherein an inner diameter of the recoverable flow line, an inner diameter of the recoverable riser line and an inner diameter of an inlet or outlet of the subsea processing equipment are identical.
11. The arrangement according to claim 10, wherein an inner diameter of the recoverable flow line and the recoverable riser line and the inlet or outlet is 10 inch or less.
12. The arrangement according to any one of claims 1 – 11, wherein the offshore vessel comprises hydrocarbon production equipment for processing a feed received from the well through the recoverable flow and riser lines, wherein the hydrocarbon production equipment is tuned for processing the feed according to a predetermined composition range of the feed.
13. The arrangement according to any one of the preceding claims, wherein the recoverable flow lines and riser lines are arranged as redundant duplicate or triplicate parallel lines.
14. The arrangement according to any one of the preceding claims, wherein the subsea processing equipment is configured to be recoverable.

15. The arrangement according to any one of the preceding claims, wherein the hydrocarbon process equipment on the offshore vessel is configured for a production of about 80×10^3 barrels per day or less.
- 5 16. The arrangement according to any one of the preceding claims, wherein the hydrocarbon process equipment on the offshore vessel is in fluid communication with at most ten wells simultaneously at said location at sea.
- 10 17. Method of operation for the arrangement according to any one of the preceding claims 1 – 16, wherein the offshore vessel is a first FPSO and the method comprises:
 - within a predetermined reservoir area determining locations of a number of additional reservoir spots based on corresponding fluid characteristics of the feed from the additional reservoir spots;
 - 15 locating within the reservoir area the first FPSO at the location of one of the determined additional reservoir spots of the reservoir area;
 - arranging the first FPSO with recoverable flow lines and recoverable risers connected to a first number of wells within each additional reservoir spot and
 - arranging the first FPSO to produce at the respective additional reservoir spot for
 - 20 a relatively short duration in comparison to a working time of the reservoir area, before relocating the first FPSO to a next one of the number of additional reservoir spots.
- 25 18. Method according to claim 17, additionally comprising:
 - locating within a reservoir area a second FPSO as a main FPSO at a main reservoir spot, the main FPSO provided with flow lines and riser lines connected to a second number of wells at the main reservoir spot, the main FPSO being
 - arranged for production at the main reservoir spot for a long duration comparable to the working time of the reservoir area.
- 30 19. Method according to claim 17 or 18, wherein the first number of wells at the additional reservoir spot is less than the second number of wells at the main reservoir spot.

20. Method according to claim 19 wherein the first number is about 5 and the second number is between 10 and about 20.
21. Method according to any one of claims 17 - 20, wherein the length of the flow lines and riser lines between the main FPSO and the main reservoir spot is about 20 km.
22. Method according to any one of claims 17 - 21, wherein the length of the recoverable flow lines and riser lines between the first FPSO and the additional reservoir spot is about 5 km or less.
23. Method according to any one of claims 18 - 22, wherein the main FPSO has a hydrocarbon production capacity of about 150×10^3 barrels per day.
24. Method according to any one of claims 17 - 23, wherein the first FPSO has a hydrocarbon production capacity between about 60×10^3 and about 100×10^3 barrels per day.
25. Method according to any one of the claims 18 – 24, comprising: leaving the main FPSO located at the main reservoir spot, while relocating the first FPSO from the location of one of the determined additional reservoir spots to the location of another of the determined additional reservoir spots.
26. Method according to any one of claims 17 – 25, wherein the relocation of the first FPSO comprises:
recovering the recoverable flow lines and riser lines at said one of the determined additional reservoir spots;
subsequently storing the recovered flow lines and riser lines at a storage reel facility,
and using the recovered flow lines and riser lines from the storage reel facility at said other one of the determined additional reservoir spots.



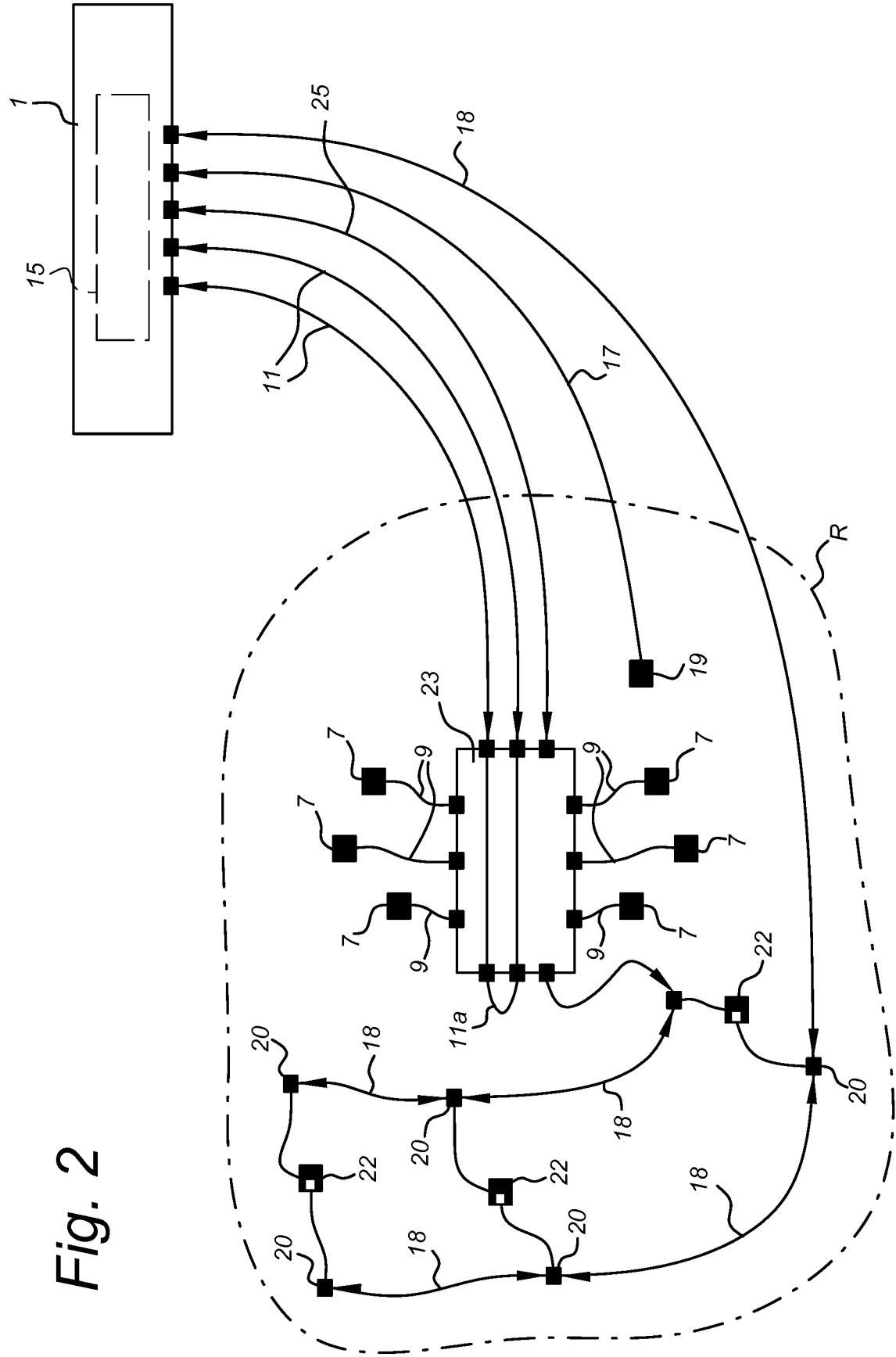


Fig. 3

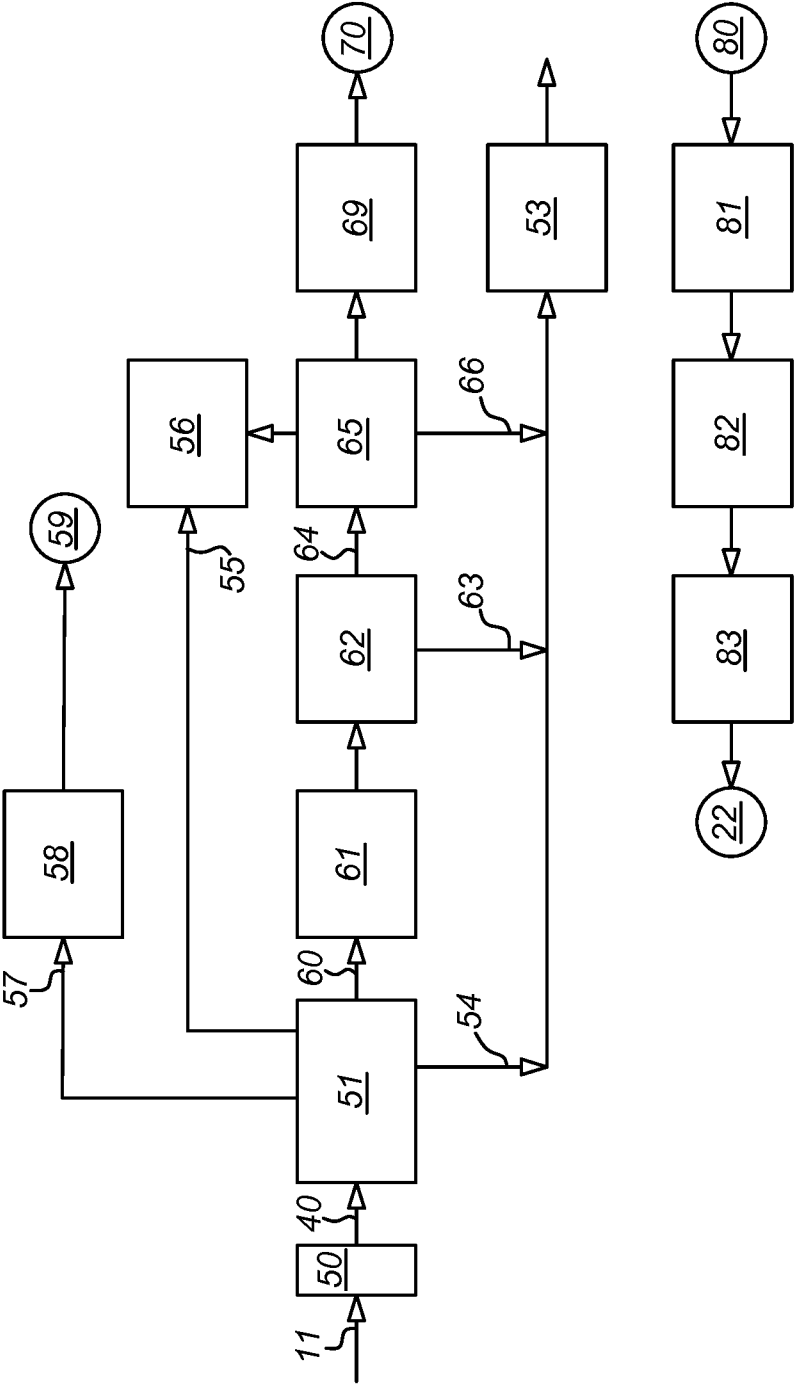


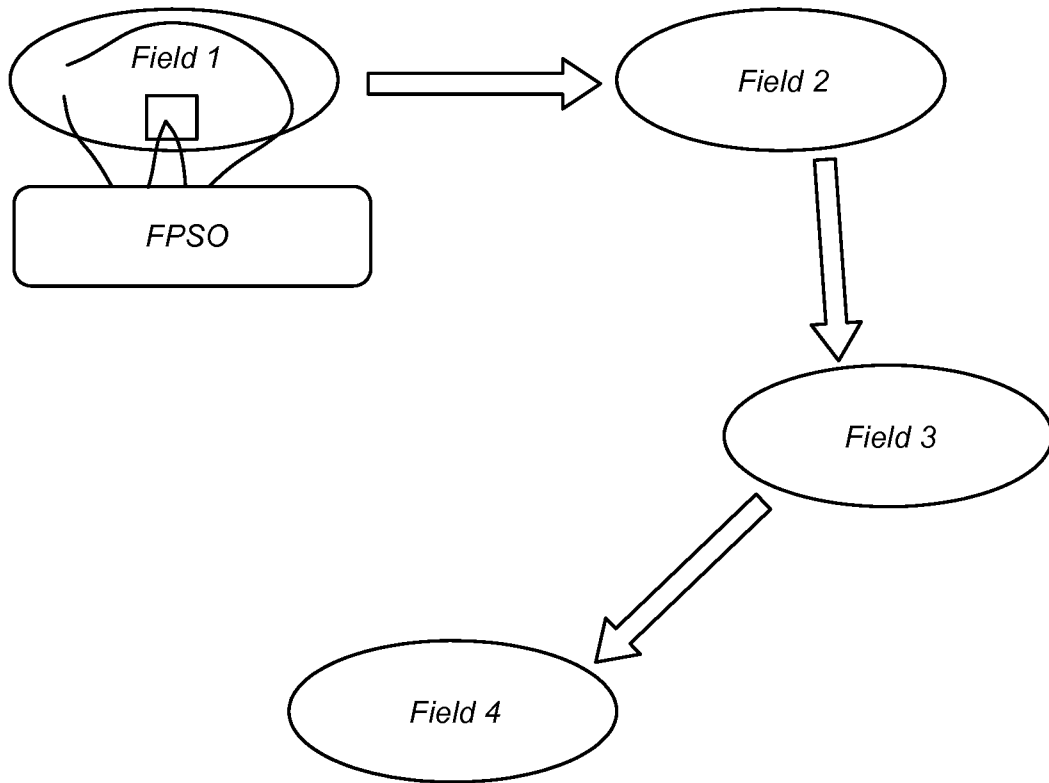
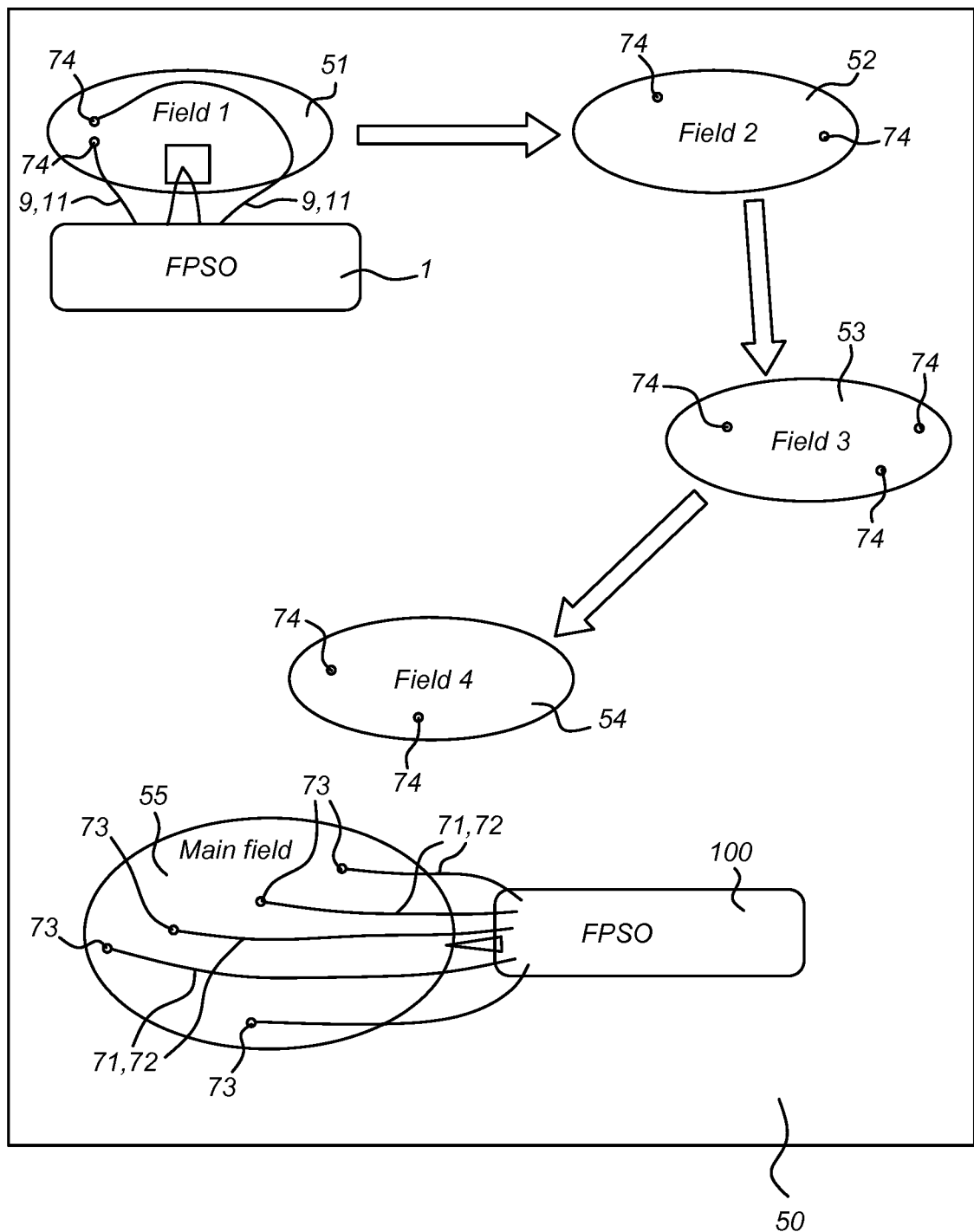
Fig. 4

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/058830

A. CLASSIFICATION OF SUBJECT MATTER
INV. E21B43/017
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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015/107845 A1 (MACMILLAN ADRIAN ARMSTRONG [AU] ET AL) 23 April 2015 (2015-04-23) paragraphs [0036], [0038], [0041], [0042] -----	1-26
A	WO 01/12948 A1 (COFLEXIP STENA OFFSHORE LTD [GB]; COFLEXIP [FR]; CRICHTON TORQUIL MACL) 22 February 2001 (2001-02-22) page 2, line 1 - line 7 -----	1,17
A	US 4 371 037 A (ARNAUDEAU MARCEL [FR]) 1 February 1983 (1983-02-01) column 3, line 1 - line 3 -----	1,17



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

12 September 2017

Date of mailing of the international search report

21/09/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Rampelmann, Klaus

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/058830

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