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(54) **DEEPWATER CONTAINMENT SYSTEM AND METHOD OF USING SAME BACKGROUND**

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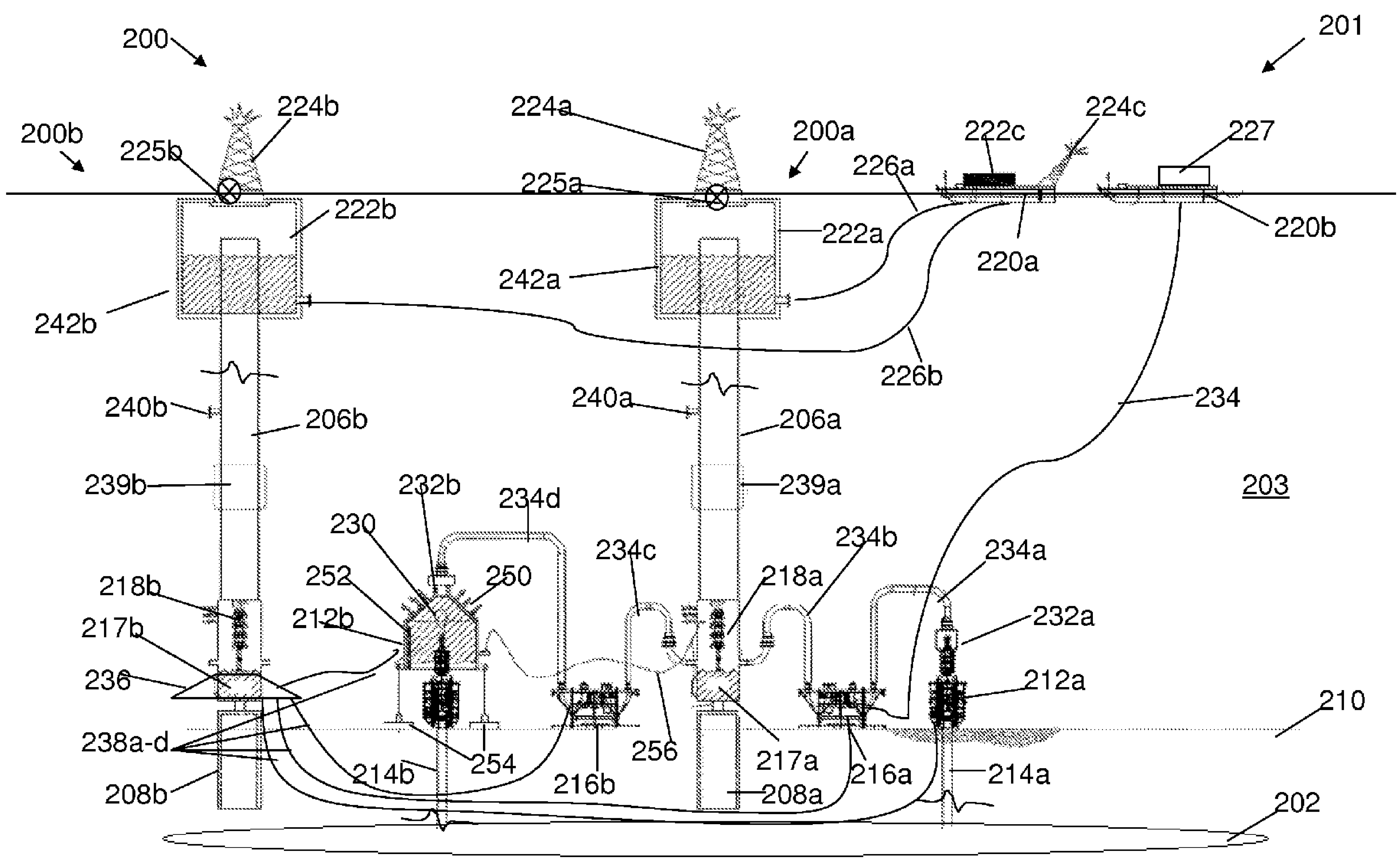
(57) **ABSTRACT**

An oil and gas collection system, comprising a source of oil and gas flowing into a body of water; a collector located adjacent the source of oil and gas; a riser to transport the oil and gas towards a surface of the body of water, a first end of the riser fluidly connected to the collector; and a separator fluidly connected to a second end of the riser, the separator adapted to separate the oil and gas into a first oil rich stream and a second gas rich stream, the separator comprising an oil rich stream outlet and a gas rich stream outlet. In some embodiments, the source of oil and gas comprises a blow out preventer.



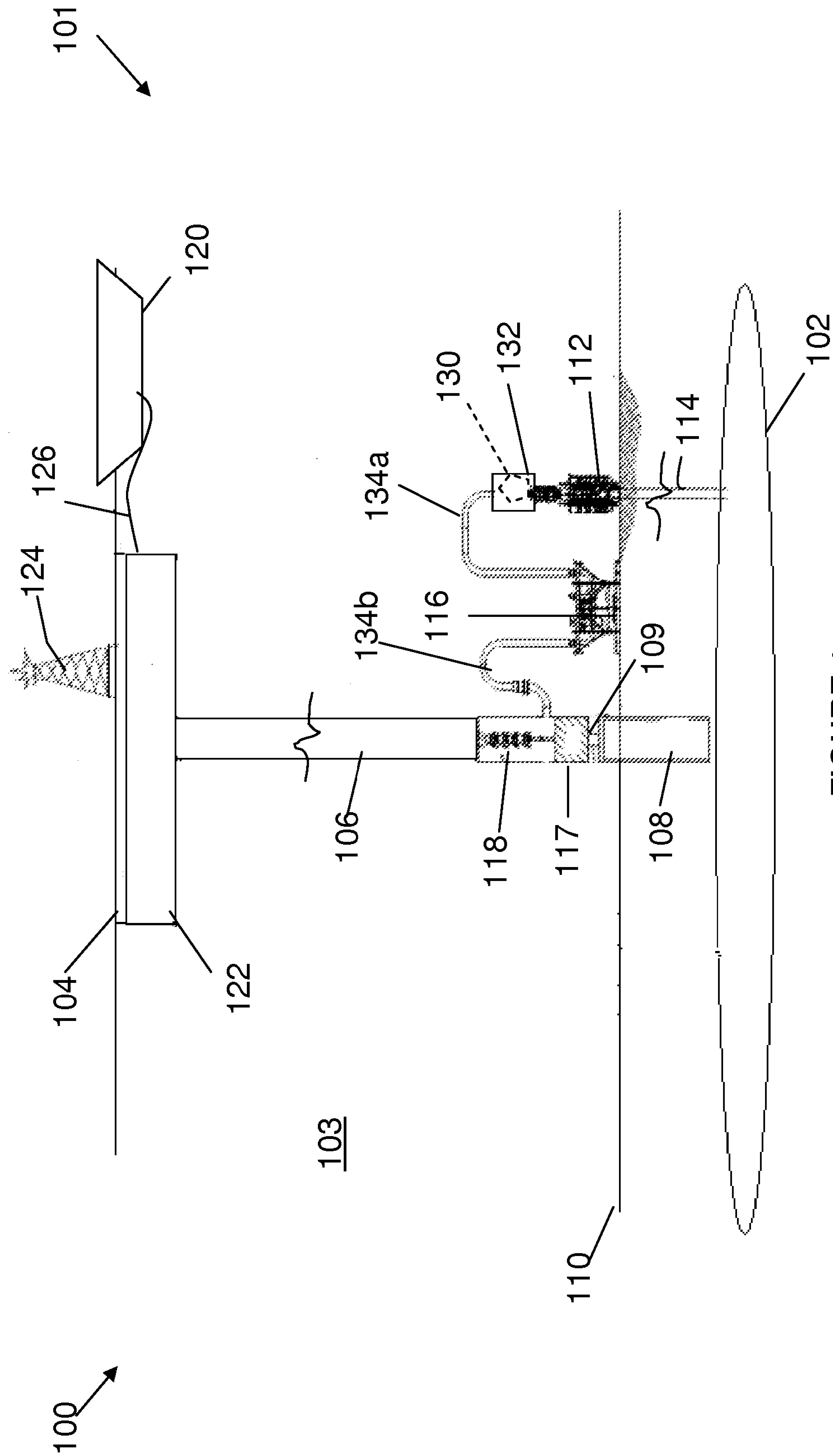

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FIGURE 1

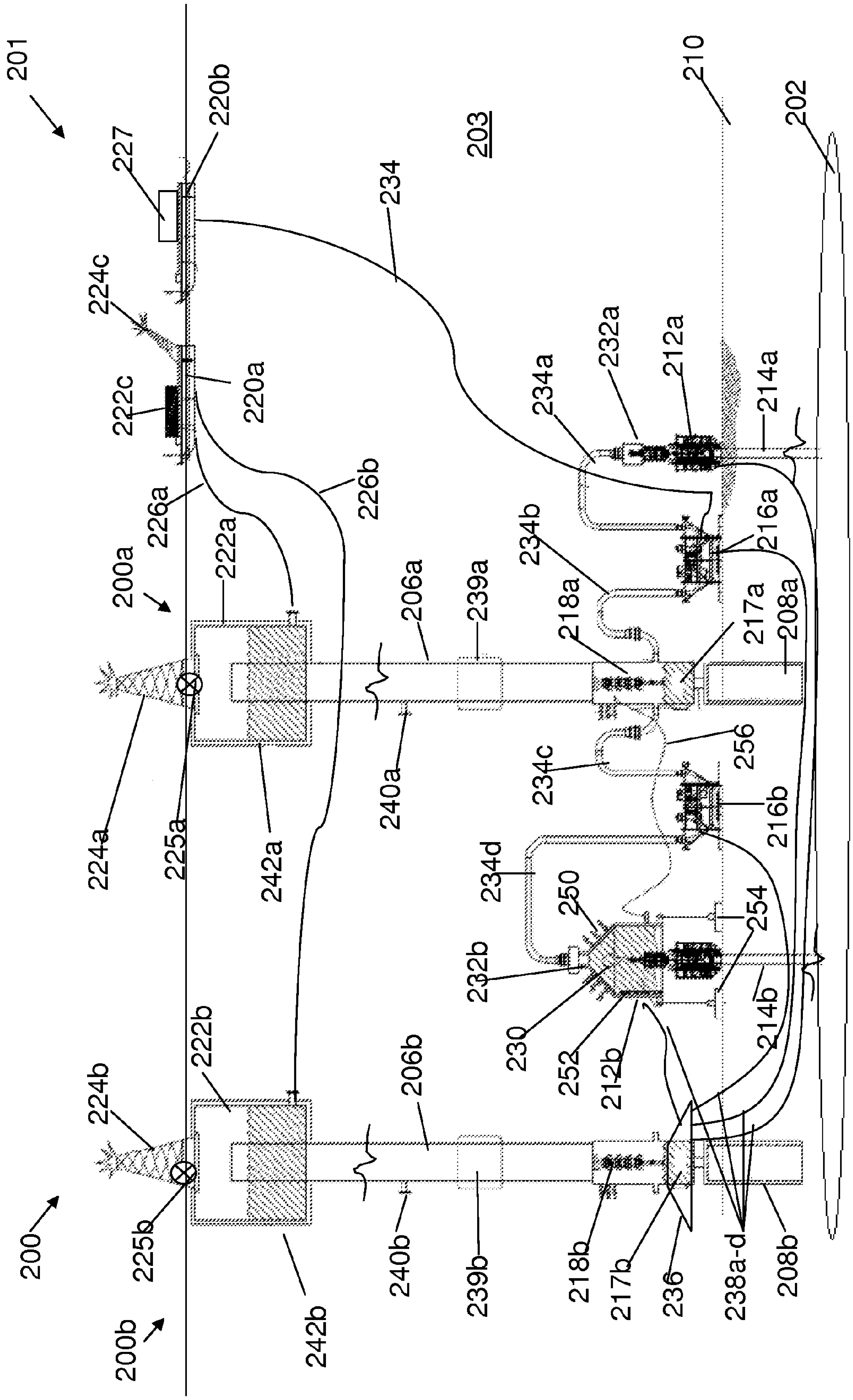
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FIGURE 2

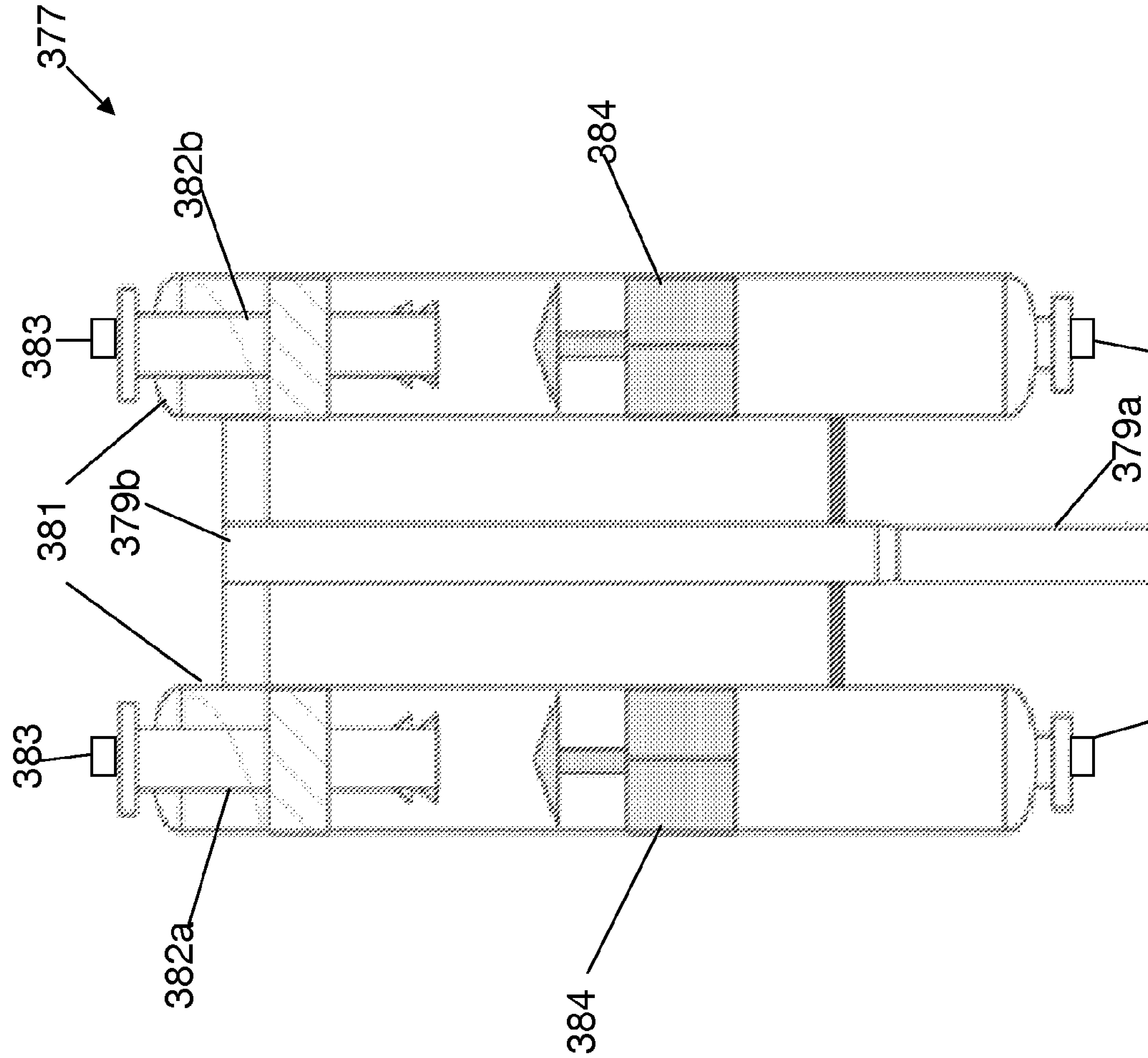


FIGURE 3B

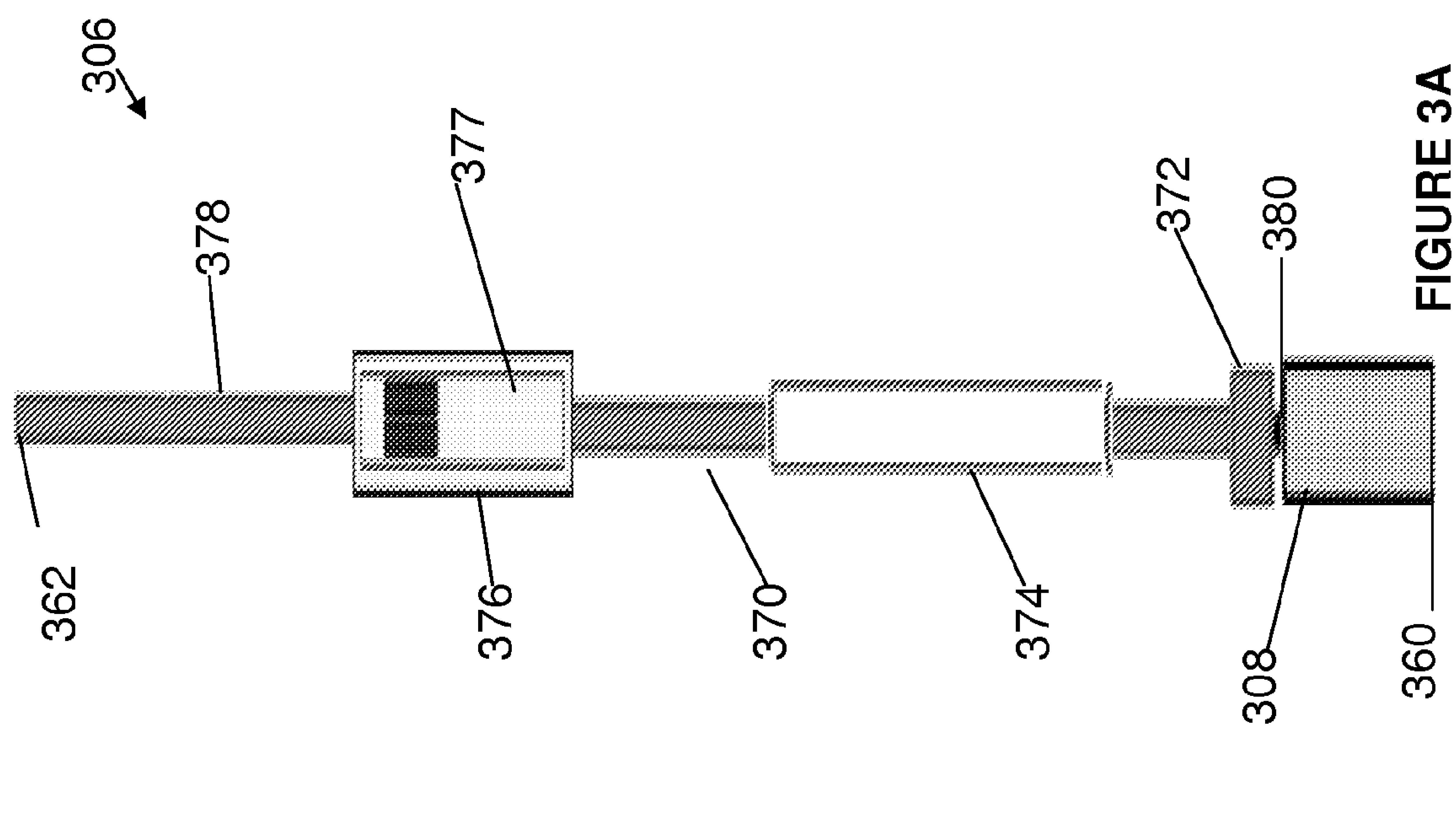
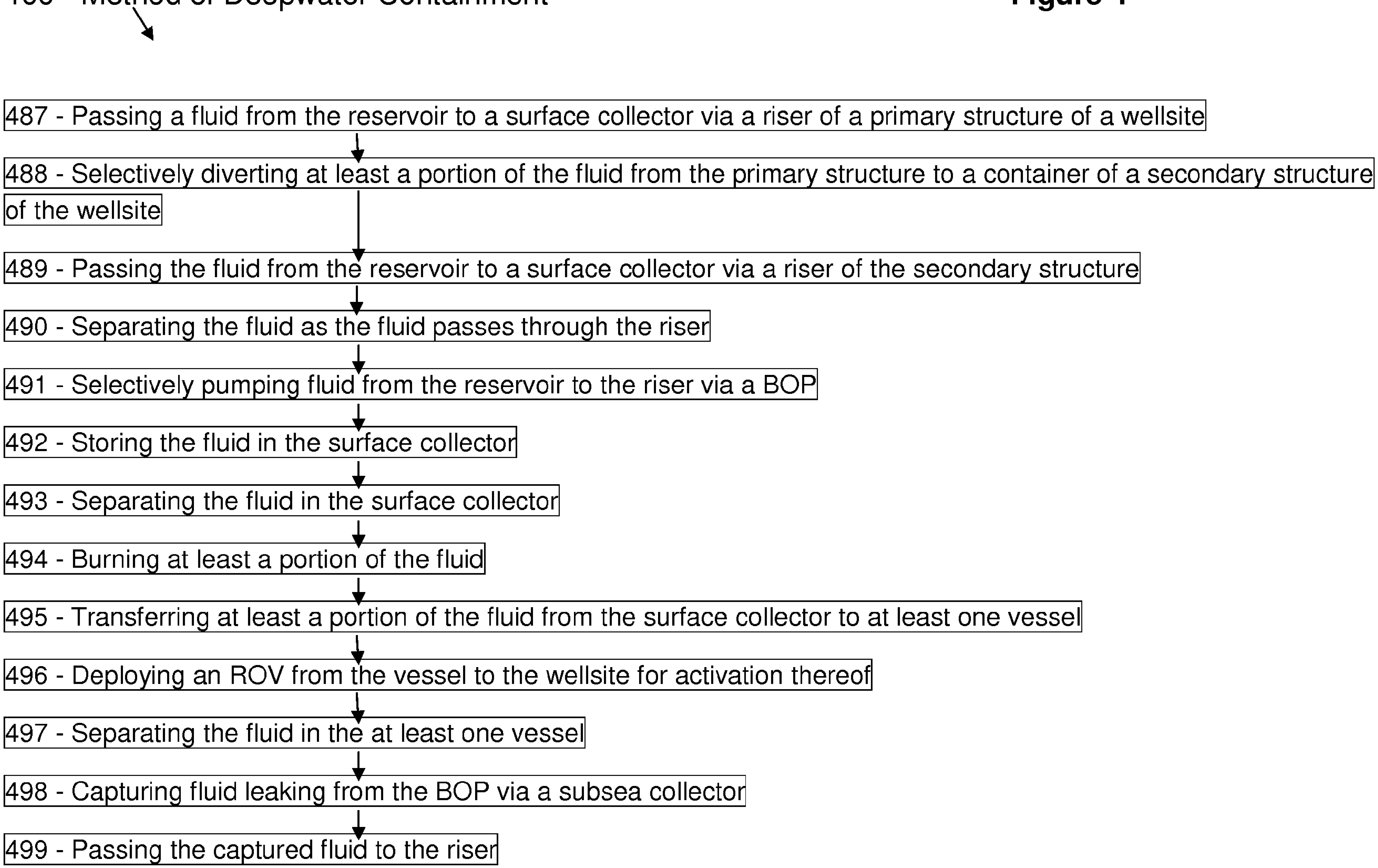


FIGURE 3A

Figure 4

400 - Method of Deepwater Containment



DEEPWATER CONTAINMENT SYSTEM AND METHOD OF USING SAME BACKGROUND

[0001] This application claims the benefit of U.S. Provisional Application No. 61/376,542 filed Aug. 24, 2010, the entire disclosure of which is hereby incorporated by reference.

BACKGROUND

[0002] When oil and gas is spilled into the sea, for example from a leaking tanker ship, a leaking pipeline, from oil seeping from an underground formation, or from oil flowing from a subsea wellhead or blowout preventer, there is a desire to collect the oil and gas and contain and transport or otherwise dispose of the oil and gas to prevent environmental damage to the sea and nearby coastlines. Various systems and methods of collecting spilled oil and gas are known in the art and set forth below:

[0003] U.S. Pat. No. 4,405,258 discloses a method for storing a lighter-than-water fluid, e.g., oil, produced from the blowout of an offshore subsea well. The method includes the steps of deploying a containment dome in shallow water near the location of the seabed where the containment dome is to be located. The containment dome as an upper expanded dome-like fluid impervious membrane, a fluid impervious hollow peripheral ring attached to the periphery of the membrane to provide a depending bag-like container, and discrete water drainage means within the bag-like container for connection to pump conduit means therefrom. Wet sand from the seabed is then pumped into the bag-like container, and water is then drained from the wet sand through the water drainage means so as to provide a body of drained sand disposed within the bag-like container and providing a hollow peripheral ring as a hollow peripheral torus acting as a self-supporting structure and as an anchor for the dome-like structural unit. The dome is then charged with a buoyant amount of air and the buoyed dome is floated out to the site where the dome is to be deployed. It is then submerged by controllably releasing the air while substantially simultaneously filling the dome with water, thereby sinking the dome until the lighter-than-water fluid is captured within the dome, while such fluid substantially simultaneously displaces water from within the dome. U.S. Pat. No. 4,405,258 is herein incorporated by reference in its entirety.

[0004] U.S. Pat. No. 4,643,612 discloses an oil storage barge having a concave bottom is adapted to be anchored over a subsea well or pipeline that is leaking oil. Flexible skirts extend to the ocean floor, and oil that is trapped under the barge may be stored in the barge or then transferred to another vessel. U.S. Pat. No. 4,643,612 is herein incorporated by reference in its entirety.

[0005] U.S. Pat. No. 5,114,273 discloses a protective device installed to or around an offshore drilling platform for oil or gas and the device when in operation to encircle or enclose the platform with a floating containment device and attached oil containment curtain hanging from the device to the ocean floor. The pollution containment device to be submerged normally and activated to the surface when needed. This device will entrap offshore platform pollutants in a short amount of time with a minimum amount of effort and will maintain a clean environment. Other methods of offshore platform pollution containment devices are shown, including permanent non-moving oil pollution containment barriers and activated barriers that operate internally and externally of the oil platform to form an all encompassing barrier from the ocean floor to above the water surface to hold an oil spill to the platform area. U.S. Pat. No. 5,114,273 is herein incorporated by reference in its entirety.

[0006] U.S. Pat. No. 5,213,444 discloses an oil/gas collector/separator for recovery of oil leaking, for example, from an offshore or underwater oil well. The separator is floated over the point of the leak and tethered in place so as to receive oil/gas floating, or forced under pressure, toward the water surface from either a broken or leaking oil well casing, line, or sunken ship. The separator is provided with a downwardly extending skirt to contain the oil/gas which floats or is forced upward into a dome wherein the gas is separated from the oil/water, with the gas being flared (burned) at the top of the dome, and the oil is separated from water and pumped to a point of use. Since the density of oil is less than that of water it can be easily separated from any water entering the dome. U.S. Pat. No. 5,213,444 is herein incorporated by reference in its entirety.

[0007] U.S. Pat. No. 6,592,299 discloses a method of detecting and locating fresh water springs at sea essentially by taking salinity measurements and by methods and installations for collecting the fresh water. The collection installations comprise an immersed bell-shaped reservoir containing and trapping the fresh water in its top portion, and a pumping system for taking fresh water and delivering the fresh water via a delivery pipe, characterized in that the circumference of the bottom end of the reservoir and/or the circumference of the bottom end of a chimney inside the reservoir and open at its top end and surrounding the fresh water resurgence in part and preferably in full, follow(s) closely the outline of the relief of the bottom of the sea so as to provide leakproofing between the circumference(s) and the bottom of the sea. U.S. Pat. No. 6,592,299 is herein incorporated by reference in its entirety. There is a need in the art for one or more of the following:

[0008] Improved systems and methods for collecting spilled oil and gas from a marine environment;

[0009] Improved systems and methods for collecting oil and gas spilling from a subsea well;

[0010] Improved systems and methods for collecting oil and gas spilling from a subsurface formation located beneath a body of water; and/or

[0011] Improved systems and methods for collecting oil and gas spilling from a subsurface formation located beneath a body of water, and then burning the gas and containing the oil in a surface vessel.

SUMMARY OF THE INVENTION

[0012] One aspect of the invention provides an oil and gas collection system, comprising a source of oil and gas flowing into a body of water; a collector located adjacent the source of oil and gas; a riser to transport the oil and gas towards a surface of the body of water, a first end of the riser fluidly connected to the collector; and a separator fluidly connected to a second end of the riser, the separator adapted to separate the oil and gas into a first oil rich stream and a second gas rich stream, the separator comprising an oil rich stream outlet and a gas rich stream outlet.

[0013] Another aspect of the invention provides a method comprising locating a source of oil and gas flowing into a body of water; collecting at least a portion of the oil and gas; flowing the collected oil and gas to a surface of the body of water; separating at least a portion of the oil from the gas; flowing the portion of oil to a floating vessel; and burning at least a portion of the gas.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] So that the features and advantages of the present invention can be understood in detail, a more particular description of the invention may be had by reference to the embodiments thereof that are illustrated in the appended drawings. These drawings are used to illustrate only typical embodiments of this invention, and are not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments. The figures are not necessarily to scale and certain features and certain views of the figures may be shown exaggerated in scale or in schematic in the interest of clarity and conciseness.

[0015] FIG. **1** is a schematic diagram depicting a wellsite positioned about a subsea reservoir, the wellsite having a containment system in accordance with an aspect of the present invention.

[0016] FIG. **2** is a schematic diagram depicting a wellsite positioned about a subsea reservoir, the wellsite having a redundant containment system in accordance with an aspect of the present invention.

[0017] FIG. **3**A is a schematic diagram depicting a riser usable with the containment systems of FIGS. **1** and/or **2**. FIG. **3**B is a schematic view of an integrated separator usable with the riser of FIG. **3**A.

[0018] FIG. **4** is a flow chart depicting a method of deepwater containment.

DETAILED DESCRIPTION

[0019] Presently preferred embodiments of the invention are shown in the above-identified figures and described in detail below. Embodiments are described with reference to certain features and techniques for containing fluids released into the sea.

[0020] FIG. **1**:

[0021] FIG. **1** is a schematic diagram depicting a wellsite **100** positioned about a subsea reservoir **102**. The wellsite **100** is provided with a containment **101** for capturing fluids released into the sea **103**. The wellsite **100** includes a surface platform **104** floating on the sea **103**, with a riser **106** extending therebelow for receiving fluids generated from the reservoir **102**. A subsea end of the riser **106** is secured to a suction pile **108** positioned in the sea floor (or mud line) **110**. Riser connector **109** is provided to secure the riser **106** in position.

[0022] The wellsite **100** is further provided with a blow-out preventer (BOP) **112** positioned at a top end of wellbore **114**. The wellbore **114** extends through the subsea floor **110** and into the reservoir **102**. The BOP **112** is in fluid communication with the wellbore **114** for receiving the fluids (e.g., gas, hydrocarbons, water, etc.) from the reservoir **102**. A manifold **116** may optionally be fluidly connected between the BOP **112** and the riser **106** to facilitate the flow of fluids therebetween. The riser **106** may be, for example, a tubular member for passing fluid received from the BOP **112** and/or manifold **116** to the surface. A trap **117** is provided at the subsea end of the riser to collect fluids and/or solids. A pump **118** may also be provided within riser **106** to selectively draw fluid from the BOP **112** through the riser **106**. The manifold **116** and/or pump **118** may be used to manipulate the flow of fluid about the wellsite **100**.

[0023] Fluid drawn from the reservoir **102** and to the surface via riser **106** may be stored in a surface collector **122**. The surface collector **122** may be, for example, a separator that separates components of the fluid, such as gas and liquid, as will be described more fully herein. The portions of the fluid stored in the collector may optionally be removed, for example, by burning the gas with a flare **124**. Preferably, the pressure of the fluid is reduced in the collector **122**. The remaining fluid may be passed to a vessel **120** via tubing (or off-take line) **126** for transport. The tubing **126** preferably fluidly connects the collector **122** to the vessel **120** for establishing fluid communication therebetween.

[0024] From time to time, fluid from the reservoir **102** may escape into the sea **103**. For example, a wellsite leak **130** may allow fluid to escape from the wellsite system **100** and into the sea **103** as fluid is produced from the reservoir **102**. In such cases, the containment system **101** may be employed to recapture fluid released by one or more wellsite leaks **130**. As shown in FIG. **1**, the subsea containment system **101** includes subsea collector **132** positionable about the leak(s). Additional subsea collectors **132** could also be connected to manifold **116**. The subsea collectors **132** may be fluidly connected to riser **106** and/or manifold **116** via flowlines **134***a-b* for passing fluid thereto. The subsea collectors **132** are configured to capture wellsite leaks **130** to prevent release of reservoir fluids into the sea **103** as will be described more fully herein.

[0025] In some embodiments, collector **132** may be a flange which is directly bolted and/or sealed to BOP **112**.

[0026] In some embodiments, collector **132** may be a dome which is cemented in place around BOP **112**.

[0027] In some embodiments, collector **132** may be a dome which is sealed around the BOP **112**, and anchored to and sealed to the sea floor **110** with annular suction piles.

[0028] In some embodiments, collector **132** may be a dome which is sealed around the BOP **112**, by forcing the edges of the dome down into the sea floor **110**.

[0029] In some embodiments, collector **132** may be a dome which is not sealed around the BOP **112**, and which provides one or more areas of access between the BOP **112** and the body of water **103**.

[0030] In some embodiments, riser **106** may be connected directly to and located directly above collector **132**.

[0031] In some embodiments, collector **122** includes from about 1 to about 6 separator vessels, for example from about 2 to about 4 vessels, for example Gasunie separators.

[0032] FIG. **2**:

[0033] FIG. **2** is a schematic diagram depicting a wellsite **200** positioned about a subsea reservoir **202**, the wellsite **200** having a redundant containment system **201**. The wellsite **200** of FIG. **2** includes a primary structure **200***a* and an optional secondary structure **200***b*. The primary and secondary structures **200***a,b* each may have a buoyant riser **206***a,b*, a suction pile **208***a,b*, a trap **217***a,b* and a pump **218***a,b* that may operate in the same manner as the riser **106**, the suction pile **108**, trap **117** and the pump **118**, respectively, of FIG. **1**.

[0034] A primary BOP **212***a* and a secondary BOP **212***b* are also provided about corresponding wellbores **214***a,b*. The wellbores **214***a,b* extend into a reservoir **202** for passing fluids therefrom. The primary and secondary BOPs **212***a,b* may operate in the same manner as the BOP **112** previously described herein. A primary manifold **216***a* and a secondary manifold **216***b* are also operatively connected to primary BOP **212***a* and secondary BOP **212***b*, respectively. The primary and secondary manifolds **216***a,b* may operate in the same manner as the manifold **116** previously described herein. As shown, the primary and secondary BOPS **212***a,b* and the primary and secondary manifolds **216***a,b* are operatively connected to the risers **206***a* and **206***b*.

[0035] The primary structure **200***a* is configured to produce fluids from subsea reservoir **202** through one or both wellbores **214***a,b*. Optionally, one or more wellbores **214***a,b* may be provided to produce fluids from subsea reservoir **202**. The BOPs **212***a,b* and/or manifolds **216***a,b* may be fluidly connected via primary flowlines **234***a-d* to buoyant riser **206***a* to pump fluid from reservoir **202** thereto. Pump **218***a* and manifolds **216***a,b* may be selectively activated to manipulate flow into riser **206***a*. Fluid received in riser **206***a* may be passed to collector **222***a*, and on to vessels **220***a,b* for transport.

[0036] Optionally, a secondary structure **200***b* may be provided to transport at least a portion of the fluid to the surface. This configuration provides an additional structure for transporting the fluid, thereby increasing flow volume and/or rate capabilities and/or flexibility regarding downtime and maintenance. This configuration also provides an alternative wellsite for transporting fluids to the surface, should the primary structure **200***a* be unavailable, for example, due to bad weather or malfunction.

[0037] The primary and/or secondary structure may be provided with a container **236** at a subsea end of the buoyant riser **206***b*. The container **236** is preferably positioned about the riser **206***b* above trap **217***b*. Container **236** may be a frustoconically shaped container configured to receive high pressure fluid. The container **236** may be fluidly connected to various conduits about secondary structure **200***b* for receiving fluid therefrom. As schematically depicted in FIG. **2**, secondary structure **200***b* is fluidly connected via secondary flowlines **238***a-d* to BOPs **212***a,b* and/or manifolds **216***a,b*. A pump **218***b* may be used to draw fluid into the riser **206***b* through the flowlines **238***a-d*. Valving (not shown) may optionally be provided in secondary flowlines **238***a-d* to control flow into the container **236**.

[0038] Pumps **218***a,b* may be used to draw fluid into the buoyant risers **206***a,b* for transport to the surface. The buoyant risers **206***a,b* may be conventional risers or tubing used to carry fluid to the surface. In some embodiments, buoyant risers **206***a,b* are provided with buoyancy modules **239***a,b*, respectively, for maintaining position and functionality of the buoyant risers **206***a,b* in the sea **203**, alternatively, or in addition, a platform (not shown) may be used to provide buoyancy.

[0039] As shown in FIG. **2**, the buoyant risers **206***a,b* are 'free standing,' or separate from the BOPs **212***a,b*. However, in some configurations, one or both of the buoyant risers **206***a,b* may be positioned about or connected to the BOPs **212***a,b*. The buoyant risers **206***a,b* may optionally be provided with devices, such as clean out ports **240***a,b*, for performing various functions. One or more chokes (not shown) may also be provided in the riser for controlling flow therethrough. While a conventional riser may be used, various other risers with advanced capabilities may be used as will be described further herein.

[0040] A surface end of the risers **206***a,b* may be connected to collectors **222***a,b* for passing fluid thereto. The collectors **222***a,b* may be conventional collectors capable of storing fluid at or near the surface. Part of all of the collectors **222***a,b* are preferably towable and/or submergeable as needed. For example, in bad weather, it may be desirable to transport the collectors **222***a,b* to another location, or submerge the collectors **222***a,b* a distance below sea level. Preferably, the collector may be submerged a distance (e.g., about 50-100 m below sea level) to avoid waves and/or to provide stability.

[0041] As shown in FIG. **2**, each collector **222***a,b* is preferably operatively connectable to the risers **206***a,b* for receiving high pressure fluids therefrom. The collectors **222***a,b* may be positioned in a floating platform (or boom) **242***a,b*. The collectors **222***a,b* are preferably capable of storing the fluids at a desired pressure at or below sea level. Preferably, the collectors **222***a,b* separate the fluids received into components, such as gases and liquids. One or more flares **224***a,b* may be positioned above the collectors **222***a,b* for burning separated gas and/or oil. A flare tube may extend from collectors **222***a,b* to the flare for passing the fluid to be burned thereto, as will be described more fully herein. The remaining fluids may be stored in the collector **222***a,b*, or released therefrom for transport.

[0042] Preferably, the pressure of the fluid received from the collectors **222***a,b* is reduced during separation and burning. The collector is preferable capable of operating from about 350 kPa to about 1750 KPa, or from about 700 KPa to about 1000 KPa. A choke **225***a,b* may be provided to control the pressure of the liquid in the collectors. Each collector **222***a,b* may be fluidly connected to the vessel **220***a* via tubing **226***a,b* for passing fluid thereto. The tubing **226** may be a low pressure hose capable of floating at the surface. One or more tubings **226** may be positioned between one or more of the collectors **222***a,b* and/or vessels **220***a,b*. Preferably, the tubing **226** obviates the need for a high pressure swivel or other pressure reduction devices.

[0043] As shown, multiple vessels **220***a,b* may be used in connection with the primary and/or secondary structure **200***a, b*. Preferably, vessel or vessels **220***a,b* have sufficient volume to enable transport at high rates. The vessels **220***a,b* may be selectively connected to one or more structures **200***a,b* via the tubing **226***a,b* for receiving fluid therefrom. The vessels may be, for example, a tanker, an FPSO, a shuttle tanker, a work boat such as a remote operated vehicle (ROV) (or communications) boat, or other transporter capable of performing operations for the wellsite. Vessel **220***a* may be provided with an additional collector **222***c* for further separating the fluids received therein, and a flare **224***c* for burning gas from these fluids. Vessel **220***a* may then be connected to a pipeline, or periodically offload liquids to another vessel or storage container.

[0044] Vessel **220***a* may be capable of storing and/or transporting fluids from the collectors **222***a,b*. The vessel **220***a* may be, for example, a conventional offloading shuttle tanker. Vessel **220***b* may be operatively connectable to the manifold **216***a* or other equipment via an umbilical **234** for passing communication and/or power signals therebetween, for example by controlling an ROV. The vessel **220***b* may be capable of deploying an ROV (not shown) for performing various functions about the structures **200***a,b* as will be understood by one of skill in the art. Preferably, vessel **220***b* is provided with electronics **227**, such as controllers, processors or other devices, for operating the ROV and/or one or more components at the wellsite. The electronics **227** may further include communication systems, such as transceivers, for communication with the components of the structures **200***a,b* and/or with offsite locations.

[0045] In the event that a leak **230** occurs through one or both BOPs **212***a,b*, a containing system or subsea collector, such as cap **232***a*, may be provided. The cap **232***a* may be connected to the BOP **212***a* for capturing fluid leaking therefrom. The cap **232***a* is positioned directly over the BOP **212***a* to create a seal thereon to prevent release of the fluid into the sea **203**. The cap **232***a* may be fluidly connected via flowline **234***a* to the manifold **216***a* for passing fluid thereto. Optionally, the cap **232***a* may be fluidly connected to other components about the structures **200***a,b*, such as riser **206***a*, collector **222***a* and/or vessels **220***a,b*.

[0046] In the event a cap **232***a* cannot be directly sealed to the BOP, then a funnel may be used. The funnel **232***b* is positioned above the BOP **212***b* for capturing fluid leaking therefrom. The funnel **232***b* may have a cylindrical body with an open bottom and a tapered top. In one embodiment, the funnel **232***b* may be positioned over the BOP **212***b* to create a seal thereon or forced into the mud or sea bottom to create a seal and to prevent release of the fluid into the sea **203**. In another embodiment, the funnel **232***b* may be a non-sealed, open water cap allowing free passage of sea water into and out of the funnel. The funnel **232***b* may be fluidly connected via flowline **234***d* to the manifold **216***b* for passing fluid thereto. Optionally, the funnel **232***b* may be fluidly connected to other components about the structures **200***a,b*, such as riser **206***a,b*, collector **222***a,b* and/or vessels **220***a,b*.

[0047] Various features may be provided in the funnel **232***b*, such as collector valves **250** to control flow, gauge (or fluid indicator) **252** to measure fluid parameters, and clump weights **254** or pilings with tethers to secure the funnel **232***b* in position on sea floor **210**. A pump indicator **256** may also be connected between the funnel **232***b* and the manifold **216***b* or pump **218***a* to gauge fluid parameters, such as pressure, flow rates and temperature. Similar features may also be provided in cap **232***a*.

[0048] FIGS. **3**A & **3**B:

[0049] FIGS. **3**A and **3**B are schematic diagrams depicting a riser **306** usable with the subsea containment systems of FIGS. **1** and/or **2**. The riser may be configured to provide high rate separation of fluids, for example to reduce gas handling and/or fluid pressure. The riser **306** is operatively connected to a suction pile **308** via riser connector **380** at a subsea end **360**. A surface end **362** of the riser **306** is positionable at the surface adjacent, for example, collector **122**,**222** of FIGS. **1** and/or **2**. As shown in FIG. **3**, the riser **306** is a straight, vertical tube for passing fluid therethrough, but may optionally be of another configuration or angle.

[0050] The riser **306** of FIG. **3** comprises a tubular portion **370**, an intake portion **372**, a buoyancy portion **374**, a separator portion **376** and a flare portion **378**. The intake portion **372** may be provided with, for example, a pump **118***a,b* as shown in FIG. **2** for drawing fluid into the riser **306**. The intake portion **372** receives fluid and passes it through the tubular portion **370**. The tubular portion extends from the intake portion **372** to the separator portion **376** for passing fluid therethrough. The buoyancy portion **374** preferably has a float or other member to provide buoyancy support to the riser **306**. The buoyancy portion **374** may be integral with the tubular portion **370**, or separate therefrom, for example, on an outer surface thereof.

[0051] Separator portion **376** is connected to the tubular portion **370** for separating fluid passing therethrough. The separator portion **376** is positionable in fluid communication with the tubular portion **370** for receiving fluid therefrom, and separating such fluid into components, such as gas and liquid. The separator portion **376** preferably passes a gas portion of the fluid to the flare portion **378** to be burned off. The flare portion **378** may comprise a flare pipe for transferring the gas to the flare (see, e.g., flares **124**, **224***a,b* of FIGS. **1** and **2**). The separator portion **376** also preferably passes a fluid portion out to a storage and/or transport facility, such as vessel **220***a,b* and/or collector **222***a,b* of FIG. **2**.

[0052] The separator portion **376** comprises an integrated separator **377** as shown in greater detail in FIG. **3**B. FIG. **3**B is a schematic view of an integrated separator **377** usable with the riser **306** of FIG. **3**A. The integrated separator **377** is preferably capable of separating components of the fluid into, for example, gas and liquid. The integrated separator **377** comprises upper and lower central tubes **379***a,b* fluidly connected to separator tanks **381**. The central tubes **379***a,b* are in fluid communication with tubular portion **370** for receiving fluid therefrom. The lower central tube **379***a* may have a smaller diameter than the upper central tube **379***b*. Fluid passing into the lower and upper central tubes **379***a,b* passes into the separator tanks **381**. Each of the separator tanks **381** has a separator valve **384** to facilitate separation of the components of the fluid. The separation valves **384** may be, for example, a perforated plate, a series of plates that allow fluid passage therethrough, or a centrifugal member that rotationally separates the fluid. Preferably, separation occurs at a high rate of speed as the fluid flows through the integrated separator **377**, and provides the desired separation and pressure of the fluid. Gas may be passed from gas outlets **383** to flare pipe **378** and/or liquid may be passed from liquid outlets **385** to the collectors **222***a,b* and/or vessels **220***a,b* as shown in FIG. **2**.

[0053] Once separated, the gas components may be passed from the integrated separator **377** to the flare portion **378** for burning, and the liquid components diverted out of the integrated separator **377** to a desired location for storage and/or transport. The fluid components may be diverted, for example, to collector **122**, collectors **222***a,b* and/or vessels **120**, **220***a,b* as shown in FIGS. **1** and **2**. Flowlines and other devices (not shown) may be provided for transferring the fluids from the integrated separator **377**.

[0054] Additional separation capabilities may be provided within the integrated separator **377** and/or riser **306** and/or separate therefrom. For example, an integrated separator **377** may also be incorporated in other portions of the riser **306**, such as the buoyancy portion **374**. The buoyancy portion **374** may be used to provide a first stage of separation to the fluid prior to passing through the separator portion **376** for further separation. Additional separation may be provided by other devices, such as the collectors **222***a,b* of FIG. **2**.

[0055] Suitable separators for use with the invention are disclosed in U.K. Patent Publication GB1397863, and U.S. Pat. No. 3,988,132; which are herein incorporated by reference in their entirety.

[0056] FIG. **4**:

[0057] FIG. **4** is a flow chart depicting a method **400** of deepwater containment. The method involves passing (**487**) a fluid from the reservoir (e.g., **102**, **202**) to a surface collector (e.g., **122**, **222***a,b*) via a riser (**106**, **206***a,b*, **306**) of a primary structure (e.g., **200***a*). The method **400** may optionally involve selectively (**488**) diverting at least a portion of the fluid from the primary structure (e.g., **200***a*) to a container (e.g., **236**) of a secondary structure (e.g., **200***b*). Like the primary structure, fluid may be passed (**489**) from the reservoir (e.g., **102**, **202**) to a surface collector (e.g., **122**, **222***a,b*) via a riser (e.g., **106**, **206***a,b*, **306**) of the secondary structure (e.g., **200**a). Fluid may be separated (**490**) as the fluid passes through the riser (e.g., **106**, **206**a,b, **306**).

[0058] The fluid may be selectively pumped (**491**) from the reservoir (e.g., **102**, **202**) to the riser (e.g., **106**, **206**a,b, **306**) via a BOP (e.g., **112**, **212**a,b). The fluid passed to the riser may be stored (**492**) in the surface collector (e.g., **122**, **222**a, b). The fluid may be separated (**493**) in the surface collector (e.g., **122**, **222**a,b). At least a portion of the fluid may be burned (**494**) using a flare (e.g., **124**, **224** a,b,c).

[0059] At least a portion of the fluid may be transferred (**495**) from the surface collector (e.g., **122**, **222**a,b) to at least one vessel (e.g., **120**, **220**a,b). The vessel may be provided with an ROV. In such cases, an ROV may be deployed (**496**) from the vessel (e.g., **220**b) to the structure (e.g., **200**a,b) for performing wellsite tasks. A collector (e.g., **222**c) may be provided on the vessel so that the fluid may be separated (**497**) in the at least one vessel (e.g., **220**a,b).

[0060] If a leak occurs from the BOP, fluid may be captured (**498**) from the BOP (e.g., **112**, **212**a,b) via a subsea collector (e.g., **232**a,b). The captured fluid may be passed (**499**) from the subsea collector (e.g., **232**a,b) to the riser (e.g., **106**, **206**a,b), and on to the surface. Additional steps may be performed, such as measuring fluid parameters, towing the surface collector (e.g., **122**, **222**a,b), or passing the fluid through a manifold (e.g., **116**, **216**a,b). The steps of the method may be performed in any order, and repeated as desired.

Illustrative Embodiments

[0061] In one embodiment, there is disclosed an oil and gas collection system, comprising a source of oil and gas flowing into a body of water; a collector located adjacent the source of oil and gas; a riser to transport the oil and gas towards a surface of the body of water, a first end of the riser fluidly connected to the collector; and a separator fluidly connected to a second end of the riser, the separator adapted to separate the oil and gas into a first oil rich stream and a second gas rich stream, the separator comprising an oil rich stream outlet and a gas rich stream outlet. In some embodiments, the source of oil and gas comprises a blow out preventer. In some embodiments, the collector is sealed to the source of oil and gas. In some embodiments, the collector is open to the source of oil and gas and the body of water. In some embodiments, the collector comprises a containment dome. In some embodiments, the riser is anchored to a sea floor beneath the body of water. In some embodiments, the riser is anchored to a sea floor with a suction pile driven into the sea floor. In some embodiments, the system also includes a manifold located between the collector and the riser. In some embodiments, the system also includes a plurality of hoses connected the manifold with the first end of the riser, where the manifold may include a valve connected to each of the hoses. In some embodiments, the system also includes a pump with an outlet feeding into the first end of the riser. In some embodiments, the separator provides buoyancy to the riser. In some embodiments, the separator is floating on a surface of the body of water. In some embodiments, the separator is submerged a distance beneath a surface of the body of water, for example from about 50 meters to about 250 meters. In some embodiments, the separator is operating at a pressure from about 50 to about 250 psi. In some embodiments, the system also includes a flare at a surface of the body of water, the flare fluidly connected the gas rich stream outlet. In some embodiments, the system also includes a trap at a first end of the riser, the trap comprising an access port for cleaning out the trap. In some embodiments, the system also includes a vessel floating on a surface of the body of water, the vessel fluidly connected the oil rich stream outlet. In some embodiments, the oil rich stream comprises a portion of gas, the vessel further comprising a separator to separate the portion of gas from the oil. In some embodiments, the separator on the vessel is a low pressure separator, for example operating a pressure less than about 50 psi. In some embodiments, the vessel further comprises a flare adapted to burn the portion of gas. In some embodiments, the system also includes a second riser to transport the oil and gas towards a surface of the body of water, a first end of the riser fluidly connected to the collector; and a second separator fluidly connected to a second end of the riser, the separator adapted to separate the oil and gas into a first oil rich stream and a second gas rich stream, the separator comprising an oil rich stream outlet and a gas rich stream outlet.

[0062] In one embodiment, there is disclosed a method comprising locating a source of oil and gas flowing into a body of water; collecting at least a portion of the oil and gas; flowing the collected oil and gas to a surface of the body of water; separating at least a portion of the oil from the gas; flowing the portion of oil to a floating vessel; and burning at least a portion of the gas.

[0063] It will be understood from the foregoing description that various modifications and changes may be made in the preferred and alternative embodiments of the present invention without departing from its true spirit. For example, one or more wellsites and/or components thereof (e.g., collectors, vessels, BOPS, risers, etc.) may be positioned about the reservoir for producing fluids and/or containing leaks.

[0064] This description is intended for purposes of illustration only and should not be construed in a limiting sense. The scope of this invention should be determined only by the language of the claims that follow. The term "comprising" within the claims is intended to mean "including at least" such that the recited listing of elements in a claim are an open group. "A," "an" and other singular terms are intended to include the plural forms thereof unless specifically excluded.

We claim:

1. An oil and gas collection system, comprising:

a source of oil and gas flowing into a body of water;

a collector located adjacent the source of oil and gas;

a riser to transport the oil and gas towards a surface of the body of water, a first end of the riser fluidly connected to the collector; and

a separator fluidly connected to a second end of the riser, the separator adapted to separate the oil and gas into a first oil rich stream and a second gas rich stream, the separator comprising an oil rich stream outlet and a gas rich stream outlet.

2. The system of claim **1**, wherein the source of oil and gas comprises a blow out preventer.

3. The system of claim **1**, wherein the collector is sealed to the source of oil and gas.

4. The system of claim **1**, wherein the collector is open to the source of oil and gas and the body of water.

5. The system of claim **1**, wherein the collector comprises a containment dome.

6. The system of claim **1**, wherein the riser is anchored to a sea floor beneath the body of water.

7. The system of claim **1**, wherein the riser is anchored to a sea floor with a suction pile driven into the sea floor.

8. The system of claim **1**, further comprising a manifold located between the collector and the riser.

9. The system of claim **1**, further comprising a pump with an outlet feeding into the first end of the riser.

10. The system of claim **1**, wherein the separator provides buoyancy to the riser.

11. The system of claim **1**, wherein the separator is floating on a surface of the body of water.

12. The system of claim **1**, wherein the separator is submerged a distance beneath a surface of the body of water, for example from about 50 meters to about 250 meters.

13. The system of claim **1**, wherein the separator is operating at a pressure from about 50 to about 250 psi.

14. The system of claim **1**, further comprising a flare at a surface of the body of water, the flare fluidly connected the gas rich stream outlet.

15. The system of claim **1**, further comprising a trap at a first end of the riser, the trap comprising an access port for cleaning out the trap.

16. The system of claim **1**, further comprising a vessel floating on a surface of the body of water, the vessel fluidly connected the oil rich stream outlet.

17. The system of claim **1**, wherein the oil rich stream comprises a portion of gas, the vessel further comprising a separator to separate the portion of gas from the oil.

18. The system of claim **17**, wherein the separator on the vessel is a low pressure separator, for example operating a pressure less than about 50 psi.

19. The system of claim **17**, wherein the vessel further comprises a flare adapted to burn the portion of gas.

20. The system of claim **1**, further comprising:

a second riser to transport the oil and gas towards a surface of the body of water, a first end of the riser fluidly connected to the collector; and

a second separator fluidly connected to a second end of the riser, the separator adapted to separate the oil and gas into a first oil rich stream and a second gas rich stream, the separator comprising an oil rich stream outlet and a gas rich stream outlet.

21. A method comprising:

locating a source of oil and gas flowing into a body of water;

collecting at least a portion of the oil and gas;

flowing the collected oil and gas to a surface of the body of water;

separating at least a portion of the oil from the gas;

flowing the portion of oil to a floating vessel; and

burning at least a portion of the gas.

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