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(54) **CROSSOVER FOR A FLOW PATH FOR A FLUID TO A SUBSEA DEVICE**

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(57) **ABSTRACT**

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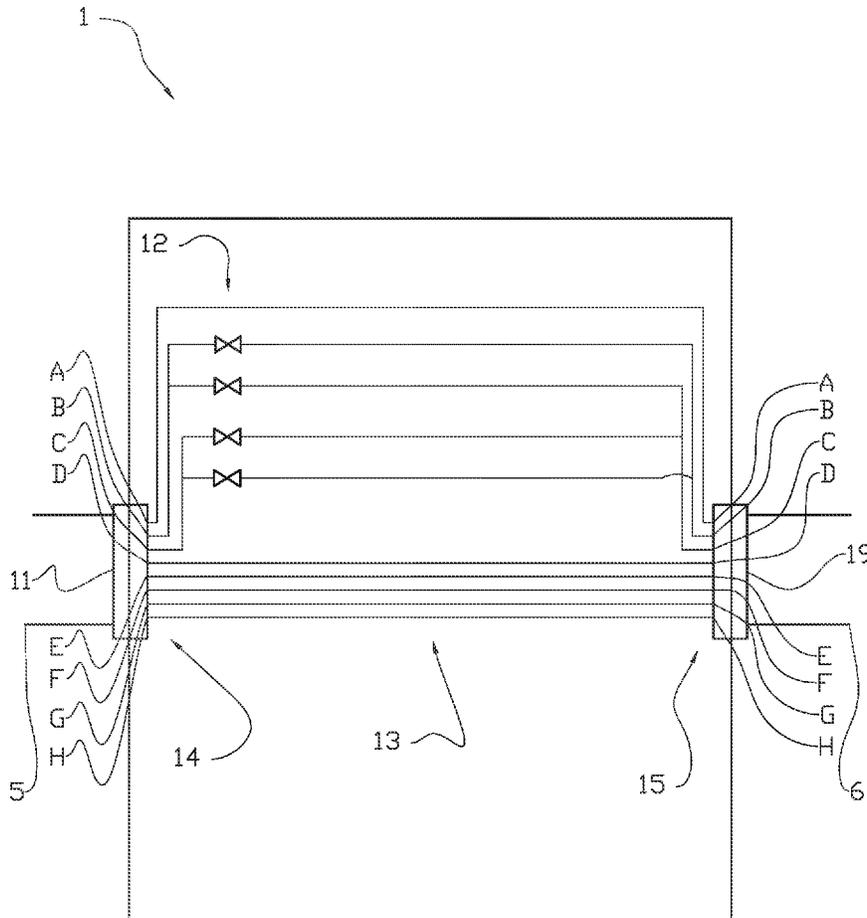
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An apparatus method and system are enable sending fluid to a receiver when a main line for the fluid in an umbilical is faulty. The apparatus has: first and second inlet lines and a first outlet line; A first inlet connector connects the main line for the fluid in the umbilical to the first inlet line and a second inlet connector connects a second line to the second inlet line; An outlet connects a receiver to the apparatus and has a first outlet connector connecting the receiver for the fluid; A switch mechanism for switches from a default setting wherein the first inlet line leads to the first outlet connector through the first outlet line to a secondary setting wherein the second inlet line leads to the first outlet connector through the first outlet line for enabling transferring the fluid through the second inlet line to the first outlet connector.



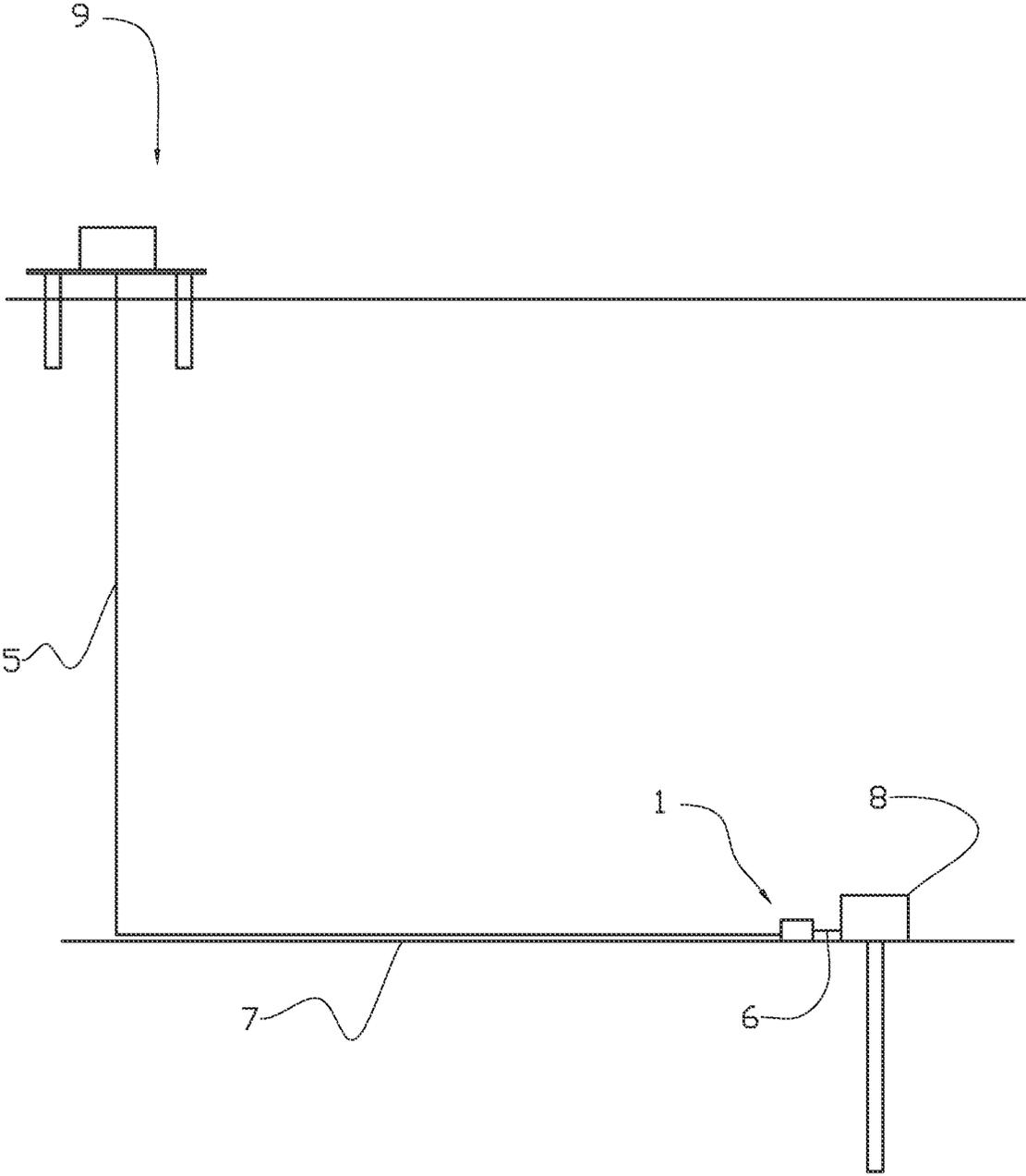


Fig. 1

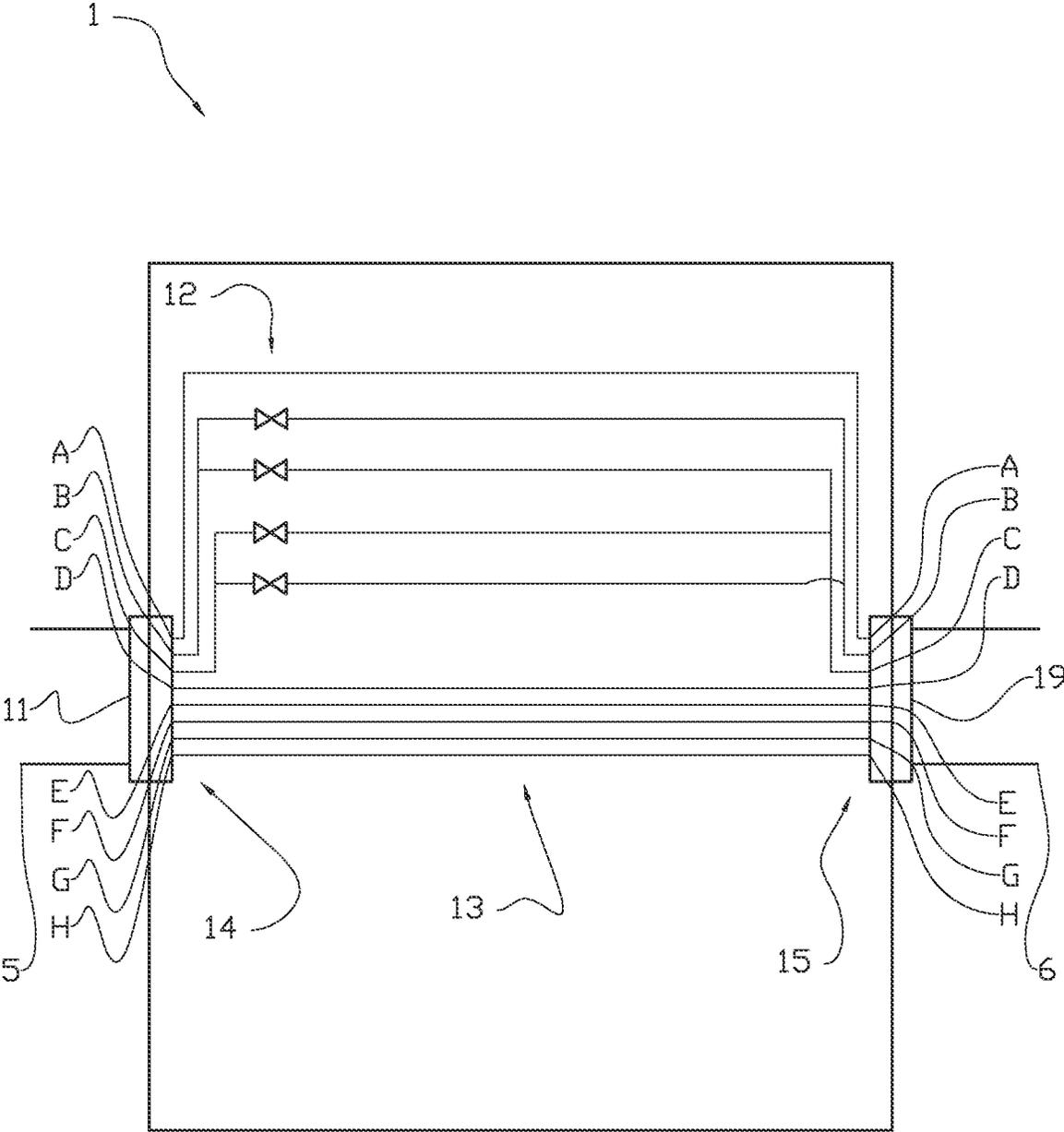


Fig. 2

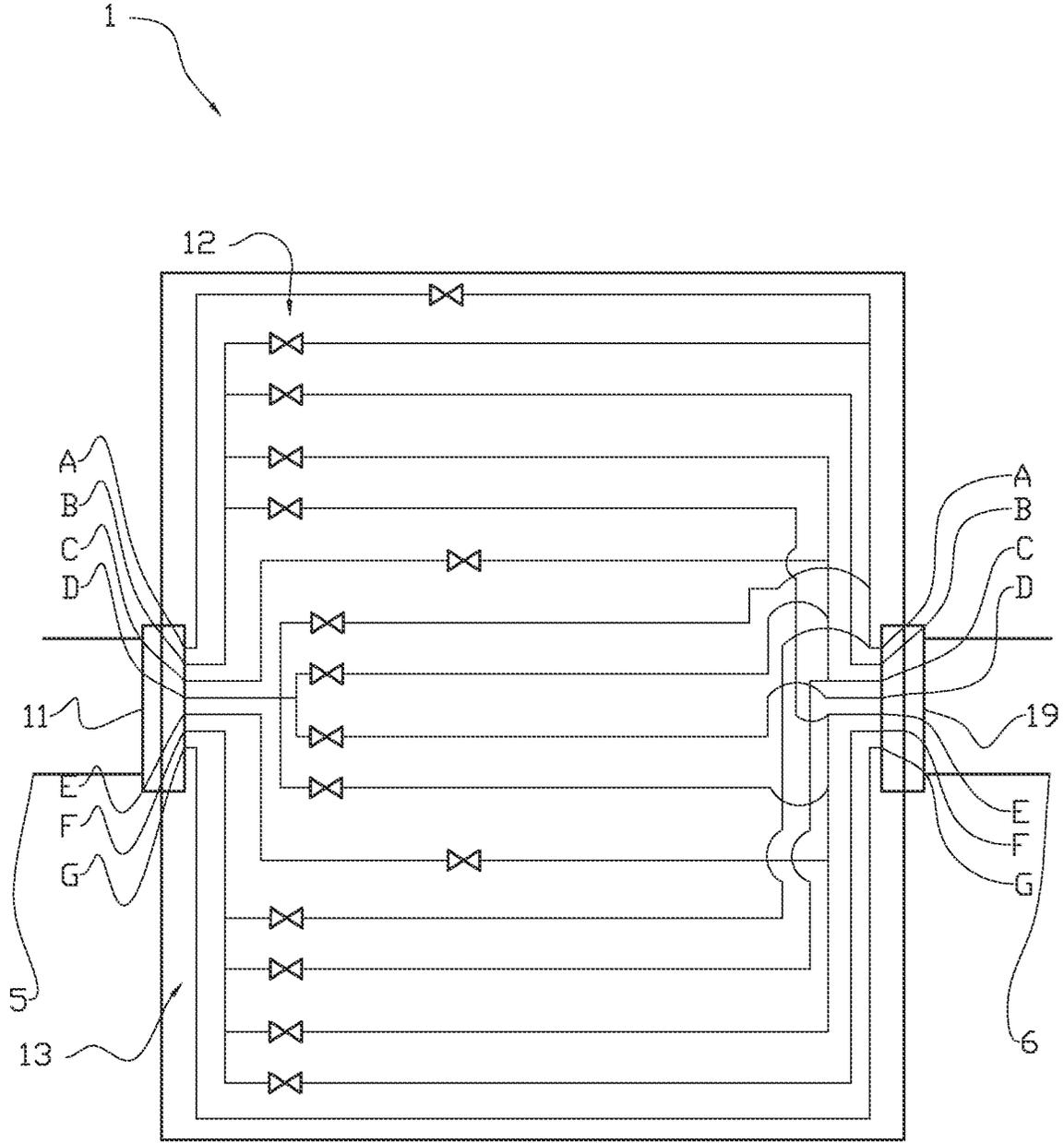


Fig. 3

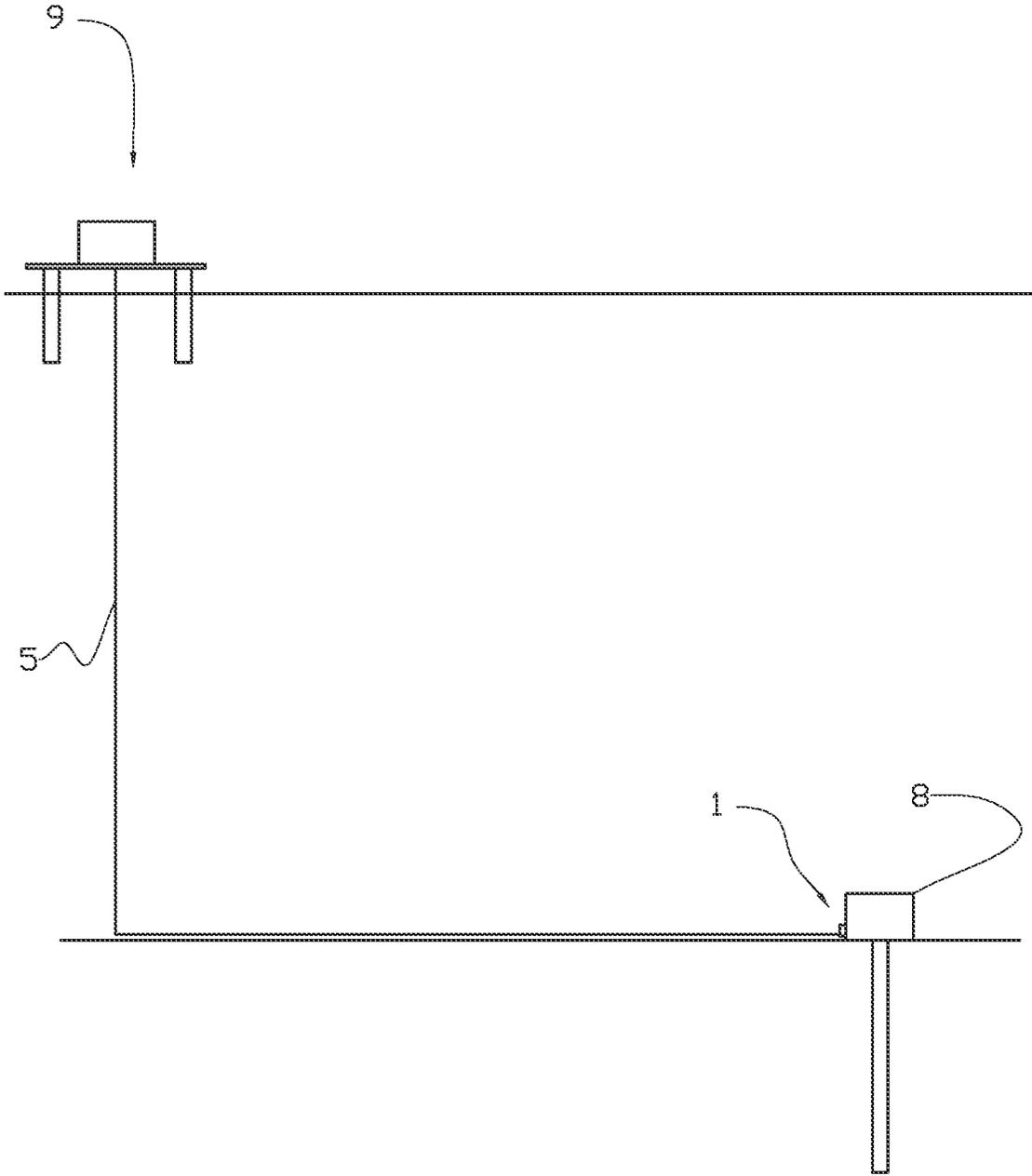


Fig. 4

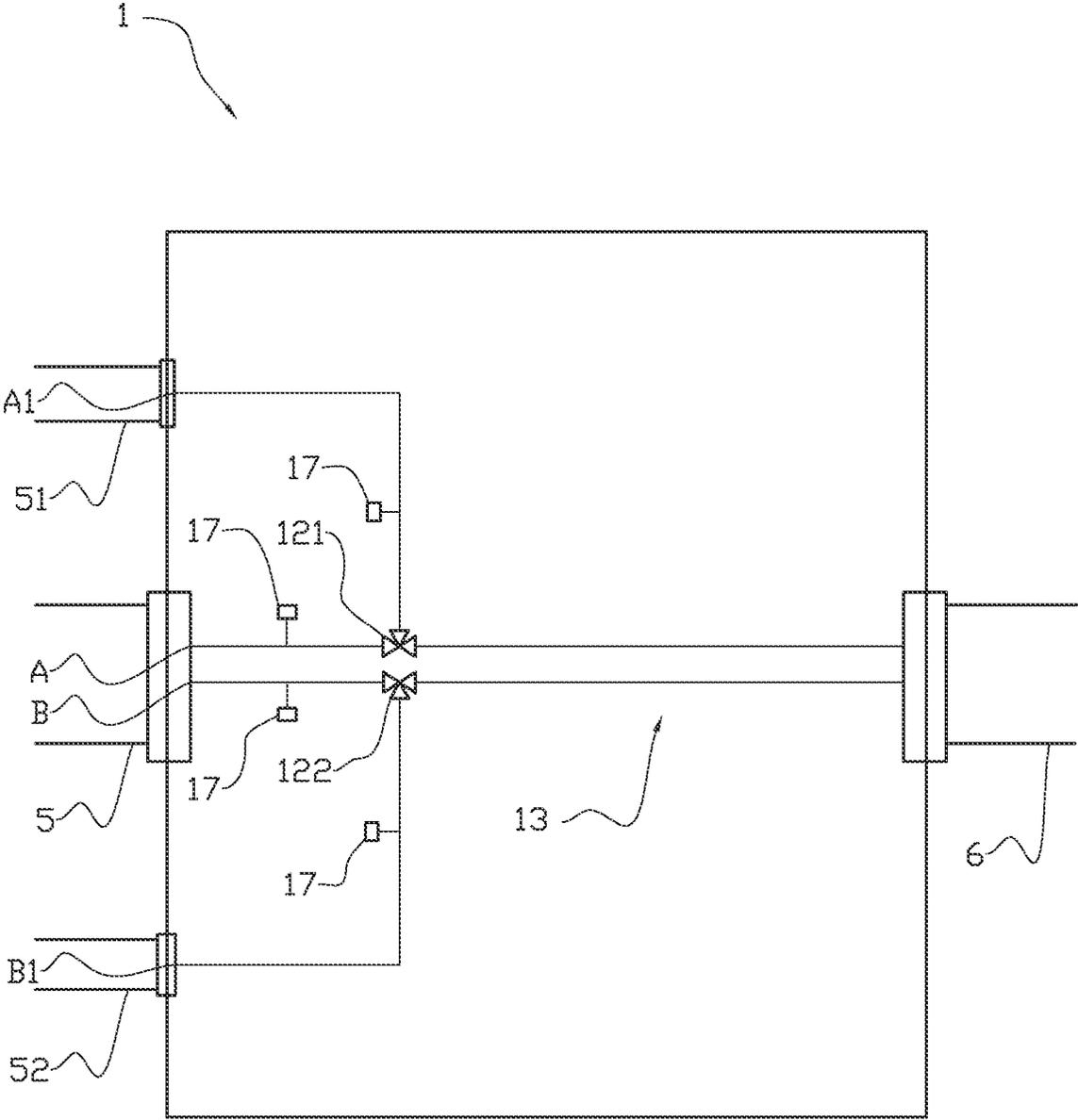


Fig. 5

## CROSSOVER FOR A FLOW PATH FOR A FLUID TO A SUBSEA DEVICE

### FIELD OF INVENTION

[0001] The present invention relates to the field of petroleum technology, and in particular to the field of subsea infrastructure for supply of fluids for subsea wells. The invention more particularly relates to an apparatus for providing a crossover for a flow path for a fluid to a subsea device and a method of repairing a broken flow path for a fluid to a subsea device.

### BACKGROUND

[0002] Subsea petroleum system for oil extraction often requires fluids to be delivered from a topsides facility through an umbilical. These fluids may include e.g. a high-pressure hydraulic fluid, a low-pressure hydraulic fluid, methanol, chemicals, and more.

[0003] An umbilical may typically have two lines for each fluid to be delivered, so that there is a backup line should a line become damaged in any way that would make the line become unsuitable for transfer of a fluid.

[0004] Two lines are reserved for each one of a plurality of fluids to be delivered to a subsea device, such as a subsea wellhead, through the umbilical. The subsea device receiving the fluids has an inlet comprising inlet connectors, wherein each inlet connector of the inlet is arranged for leading a fluid to the system in the device that requires said fluid. When a primary line and a backup line for a fluid are both broken, a backup line for another fluid could, in theory be used, but then the fluid would typically be delivered to the wrong system in the subsea device for that fluid.

[0005] Thus, should both lines for a given fluid be damaged, the umbilical may typically need to be replaced altogether. Such a replacement is a considerable task, being both costly and time-consuming.

[0006] Other alternatives to amend a situation wherein there are no intact lines for a fluid is to repair the umbilical, or to place a subsea tank on a seabed near the subsea device to deliver the fluid from said tank. Repairing the umbilical is a complicated and time-consuming affair. Placing a tank on the seabed may also be time-consuming, and additionally it is not a practical solution for some fluids as the amount of a fluid needed may be such that a tank would have to be impractically huge.

[0007] All the alternatives have significant drawbacks.

### SUMMARY OF THE INVENTION

[0008] In a first aspect of the invention, there is provided an apparatus for enabling sending a fluid to a receiver for the fluid in a situation where a main line for the fluid in an umbilical is faulty, wherein the apparatus comprises:

[0009] a first and a second inlet line and a first outlet line in the apparatus;

[0010] a first inlet connector for connecting the main line for the fluid in the umbilical to the first inlet line in the apparatus and a second inlet connector for connecting a second line to the second inlet line in the apparatus;

[0011] an outlet for connecting one or more receivers to the apparatus, the outlet comprising a first outlet connector for connecting the receiver for the fluid to the apparatus;

[0012] a switch mechanism for selectively switching from a default to a secondary setting, wherein in the default setting the first inlet line leads to the first outlet connector through the first outlet line, and wherein in the secondary setting the second inlet line leads to the first outlet connector through the first outlet line for enabling transferring the fluid through the second inlet line to the first outlet connector.

[0013] A “faulty” main line may be a line that is damaged in any way such that the line may be deemed unsuitable for reliably transferring of a fluid through the line.

[0014] The fluid may be a first fluid of a plurality of fluids being transferred through the umbilical and/or through other means to a receiver through the apparatus. The second inlet line may be an inlet line for a backup line in the umbilical. The second inlet line may be an inlet line for a main line for another fluid in the umbilical. The backup line may be a backup line for the fluid in the umbilical, or it may be a backup line for another one of the plurality of fluids. The apparatus may enable sending a fluid to a receiver for the fluid in a situation where both a main line and a backup line for the fluid in an umbilical is faulty, e.g. in an embodiment of the apparatus wherein the second inlet connector is for connecting to a line that is originally intended as a main line or backup line for another fluid of the plurality of fluids, or for connecting to e.g. a secondary backup line for the fluid, or for connecting to e.g. another umbilical connected to the apparatus. Note that the umbilical, as referred to in this document, may be any type of hose or cable or umbilical or something substantially similar that may comprise a plurality of lines for providing flow paths for a fluid over a distance. The umbilical may connect the apparatus e.g. to an offshore platform or a surface vessel, or to a subsea hydraulic power unit. Note further that the receiver may be an inlet for a subsea device, and that the apparatus thus may e.g. be configured to be directly connected to the subsea device, or the receiver may e.g. be a cable, hose, an umbilical or something substantially similar to indirectly connect the apparatus to the subsea device. Note further that when, in this document, references are made to the apparatus, it may be any one of or both of apparatus according to the first aspect of the invention, or the belowmentioned described apparatus.

[0015] The apparatus may comprise an inlet that comprises the inlet connectors. Both the main line and the second line may be lines in one and the same umbilical, or they may be lines in different umbilicals. The apparatus may comprise a plurality of inlets.

[0016] There is described a further apparatus for providing a crossover for a flow path for a fluid to a subsea device, wherein the apparatus comprises: a plurality of lines for providing fluid paths through the apparatus;

[0017] an inlet for connecting an umbilical to the apparatus, the inlet comprising a plurality of inlet connectors, each one of the inlet connectors being arranged for connecting one of a plurality of lines of the umbilical to one of the plurality of lines of the apparatus, for receiving in the line of the apparatus a fluid from the line of the umbilical;

[0018] an outlet for connecting a receiver to the apparatus, the outlet comprising a plurality of outlet connectors for connecting one of a plurality of lines of the apparatus to one of a plurality of lines of the receiver, for providing an outlet for the fluid in the line from the apparatus; and

**[0019]** at least one switch mechanism for altering to which one of the plurality of lines in the receiver one of the plurality of lines of the umbilical leads.

**[0020]** The apparatus according to the first aspect of the invention may be highly advantageous in that it allows for, instead of replacing a faulty umbilical, which may be very expensive, simply operating the switch mechanism to enable sending the fluid to the receiver for the fluid through an alternative line in the umbilical.

**[0021]** The apparatus may be arranged for switching a number of inlet connectors to any one of at least a selection of a plurality of outlet connectors, wherein each of said plurality of outlet connectors each leads to a receiver for a different fluid. The apparatus may thus enable sending a second fluid to a receiver for the second fluid, a third fluid to a receiver for the third fluid, and/or fourth fluid to a receiver for the fourth fluid, in a situation where a main line for the second, third, and/or fourth fluid is faulty, and/or in a situation where both a main line for the second, third, and/or fourth fluid is faulty. In embodiments it may enable the same for a fifth fluid, a sixth fluid, and possibly even for one or more further fluids. Note that each of the first, the second, the third, and the fourth fluid, and so on, may be different fluids. “Different fluids” in this context includes fluids within the same category but delivered at e.g. different pressures, rates and/or temperatures, such as e.g. a high-pressure hydraulic fluid and a low-pressure hydraulic fluid. To achieve this, the apparatus may have a plurality of switch mechanism, or the switch mechanism may comprise of a plurality of switches. A “switch” in this context may e.g. be a valve.

**[0022]** The apparatus may have one or more lines that go straight from the inlet connector to the outlet connector without going via a switch mechanism. For other lines, that go via a switch mechanism, the inlet line may be the line leading up to the switch mechanism from the inlet connector, and the outlet line may be the line leading from the switch mechanism to the outlet connector.

**[0023]** The apparatus may have more inlet connectors than outlet connectors in some embodiments. In other embodiments, the apparatus may have an equal number of inlet connectors and outlet connectors. In yet other embodiments, the apparatus may have a higher number of outlet connectors than inlet connectors. The apparatus may have more than one inlet for receiving more than one umbilical and more than one outlet for connecting to one or more receivers.

**[0024]** The apparatus may be said to be an apparatus for providing a crossover for a flow path for a fluid to a subsea device, as it enables switching to which outlet connector an inlet connector leads, and thus to which outlet connector a line in an umbilical leads, and thus crossover a flow path from one outlet connector to another.

**[0025]** In embodiments of the apparatus, the apparatus may be arranged to receive an umbilical for a subsea petroleum device, such as e.g. an umbilical for a subsea wellhead. The apparatus may be arranged to receive an umbilical that may comprise one or more of a main high-pressure hydraulic line, a main low-pressure hydraulic line, a main chemical line, a main electrical power line, a main signal communications line, a main gas line for gas-lift gas and a main methanol line, and a backup-line for some, most or all of its main lines.

**[0026]** A line in an umbilical “originally intended for” a fluid may be a main line or a backup line or both of a main

and a backup line for said fluid in the umbilical—e.g. “originally intended” by the manufacturer or designer of the umbilical, or e.g. by an operator using the umbilical.

**[0027]** An umbilical may typically be designed such that all fluid lines or a number of fluid lines for different fluids are designed to withstand similar loads and/or are dimensioned equally.

**[0028]** Thus, that sending a first fluid, such as e.g. a high-pressure hydraulic fluid or a methanol, in a line originally intended for another fluid, such as a low-pressure hydraulic fluid or a chemical fluid, may be unproblematic.

**[0029]** An umbilical may typically be designed with a backup line for each of the main lines of the umbilical, wherein each main line is for transferring a type of fluid to a receiver for said type of fluid. Such a design offers a level of redundancy, in that if the main line becomes faulty, there will be one backup line available to transfer the fluid that was to be transferred in said main line. However, with embodiments of the apparatus according to the invention, any backup line could be used to transfer the fluid that was to be transferred in said main line. In addition to offering greater redundancy, the apparatus also enables the option to use an umbilical with a lower amount of backup lines yet still offer greater redundancy than just one backup line per main line. E.g. an umbilical could have six main lines, and three backup lines, whereby going through the apparatus each of the three backup lines could function as a backup line for any one of the main lines. The apparatus could further enable using a main line for a second fluid as a backup line for a first fluid, e.g. in a situation where there is no longer a need for transferring the second fluid to a subsea device through the umbilical.

**[0030]** In some situations, it may be beneficial or even required to flush a line before using it for another fluid. The apparatus may comprise means for facilitating flushing of a line. The means may e.g. comprise a switch mechanism to direct a line in the umbilical to e.g. a dump tank or to a return line. The apparatus may comprise the dump tank. The dump tank may e.g. be a subsea dump tank for being placed subsea. The dump tank may comprise one or more sensors or transmitters for obtaining information about a content of the dump tank, such as e.g. a temperature, a volume of fluid or a pressure in the tank.

**[0031]** The apparatus may have plurality of different settings, wherein each setting offers a different combination of connections between inlet lines and outlet lines, e.g. wherein the default setting and the second setting are two. There may be a small number of further settings, such as one, two or three further settings, or a large number of further settings such as 20, 30, 40 or more than 40 settings.

**[0032]** The fluid or any of the different fluids, e.g. the second fluid, the third fluid or the fourth fluid, may e.g. be a high-pressure hydraulic fluid, a low-pressure hydraulic fluid, a methanol, a chemical fluid, a gas for gas injection, or another type of fluid.

**[0033]** The apparatus may further comprise a means for changing the pressure of a fluid, e.g. for increasing the pressure of a fluid. The means for changing the pressure of a fluid may be used e.g. to increase the pressure of a low-pressure hydraulic fluid, so as to increase the pressure of the hydraulic fluid to a high-pressure level.

**[0034]** In some embodiments of the apparatus, each of one or more inlet connectors of the apparatus, although not all of the inlet connectors, may lead directly to one outlet connec-

tors of the apparatus through a line of the apparatus. Each of one or more inlet connectors may be connected through a line of the apparatus to one or more valves. Each of said lines may lead, through the one or more valves, to two or more different outlet connectors.

**[0035]** The apparatus may be configured for receiving an umbilical and connecting a line from the umbilical to a line in the apparatus, the line of the apparatus leading from the inlet to the outlet of the apparatus. The switch mechanism may be configured to change which outlet connector an inlet connector leads to.

**[0036]** The apparatus may provide a crossover for a line from an umbilical, to facilitate leading a line in an umbilical to a line in the inlet of the subsea device that would not be connected to said line in the umbilical without said crossover. It may be used to provide a fluid or several fluids from an umbilical to more than one receiver, to isolate or reroute one or more lines and/or to test a line.

**[0037]** As an example, an umbilical having six lines, wherein lines 1 and 2 are main and backup line for a high-pressure hydraulic fluid respectively, lines 3 and 4 are main and backup line for a low-pressure hydraulic fluid respectively, and lines 5 and 6 are main and backup line for methanol respectively. If lines 5 and 6 are broken, but all other lines are intact, the invention offers an alternative to the prior art solutions of replacement of the umbilical, repair of the umbilical, or the use of a tank placed on the seabed.

**[0038]** If the umbilical of the example is connected to the inlet of the apparatus according to the invention and the outlet of the apparatus is connected to the inlet of the subsea device, the lines 1, 2, 3, 4, 5 and 6 of the umbilical will lead to inlet connectors 1, 2, 3, 4, 5 and 6 of the apparatus respectively, inlet connectors 1, 2, 3, 4, 5 and 6 of the apparatus will normally lead to outlet connectors 1, 2, 3, 4, 5 and 6 of the apparatus respectively, and the outlet connectors 1, 2, 3, 4, 5 and 6 of the apparatus will lead to inlet lines 1, 2, 3, 4, 5 and 6 of the subsea device. However, when lines 5 and 6 are damaged, the apparatus may provide a crossover, such that e.g. the backup line for the high-pressure hydraulic fluid can be used to deliver methanol to the correct inlet line of the subsea device. This can be done by rerouting the inlet connector 2 of the apparatus to outlet connector 5 of the apparatus instead of outlet connector 2. Outlet connector 5 of the apparatus will still lead to inlet line 5 of the subsea device. Thus, the umbilical line 2 will lead to inlet connector 2 of the apparatus, to outlet connector 5 of the apparatus and to inlet line 5 of the subsea device, and thus deliver methanol from umbilical line 2 correctly to inlet line 5 of the subsea device.

**[0039]** The invention may thus offer an elegant, time-efficient way to fix a problem where an umbilical can not provide a fluid path for a fluid to a correct inlet in a subsea device. The apparatus may be installed precautionary, prior to damage to the umbilical, to be ready for providing crossover should one or more lines become damaged, or it may be installed when damage has already occurred.

**[0040]** The inlet may be arranged to receive an umbilical comprising a multitude of lines, or it may be arranged to receive one or more lines from an umbilical through the use of an external connector. The outlet may be an outlet for one line or a plurality of lines.

**[0041]** The apparatus may comprise one or more further inlets, wherein the one or more further inlets may be inlets for e.g. a line from a subsea hydraulic power unit, from a

subsea reservoir for a chemical, etc. and/or for a further umbilical, etc. The apparatus may be arranged to connect a line from one of the further inlets to an outlet connector.

**[0042]** The apparatus may comprise more than one outlet. Each of the more than one outlets may be an outlet for one line, for a plurality of lines, and/or for one or more lines for each line received in the inlet.

**[0043]** The subsea device may be any subsea device that may receive a fluid to be delivered to it by use of an umbilical, such as a control system, a tool, a fluid reservoir, a Christmas tree, etc. The apparatus may be connected to a plurality of subsea devices.

**[0044]** The apparatus may be part of or be a subsea manifold. The apparatus may be a simple apparatus merely for performing a crossover between two lines of an umbilical, or an apparatus capable of performing a crossover from any one or more of the inlet connectors to any one or more of the outlet connectors.

**[0045]** With respect to the previously mentioned example, the apparatus may be configured only to crossover from e.g. inlet connector 2 to outlet connector 3, which may be done by having an apparatus comprising only a single valve suitable for the purpose. Alternatively, the apparatus may be configured to crossover from e.g. inlet connector 2 or 6 to outlet connector 3, or to crossover from e.g. inlet connector 1, 2, 4, 5 or 6 to outlet connector 3, or from e.g. inlet connector 1, 2, 3, 4 or 5 to inlet connector 6, etc.

**[0046]** The apparatus may comprise a single valve, two valves, three valves, or any number of valves and/or other means for closing or opening for flow of fluid through a line or a number of lines. The one or more valves and/or other means for closing or opening for flow of fluid through a line or a number of lines may be the at least one switch mechanism. One or more of the any number of valves and/or other means for closing or opening for flow of fluid may be operable by use of one or more actuators. One or more valves may be electrically operable, one or more valves may be hydraulically operable, and/or one or more valves may be manually and/or mechanically operable. One or more valves may be solenoid valves.

**[0047]** One or more valves may be three-way valves. A three-way valve may be used to shut one flow line and open another for flow through the three-way valve.

**[0048]** The apparatus may comprise a hydraulics inlet for a hydraulic fluid for operating a hydraulically operable valve or other means for closing or opening for flow of fluid through a line in the apparatus.

**[0049]** The apparatus may comprise an inlet for a cable for providing an electric signal for operating an electrically operable valve or other means for closing or opening for flow of fluid through a line in the apparatus. The apparatus may comprise an inlet for a cable for providing electrical power to the apparatus. The apparatus may comprise a battery for providing electrical power to the apparatus.

**[0050]** The apparatus may comprise a control unit for controlling the at least one switch mechanism of the apparatus. The apparatus may comprise means for communicating, which may be used to communicate wirelessly or through a wire, for receiving control signals and/or information from a sender and/or for sending control signals and/or information to a remote communications unit.

**[0051]** The above features may advantageously facilitate for remote control of the apparatus, e.g. by facilitating for control over the switching mechanism of the apparatus.

[0052] A manual valve of the apparatus may be operated e.g. by use of an ROV.

[0053] The apparatus may be a separate unit, e.g. to be placed at a seabed near a subsea device, or it may be a unit configured to be attached directly to a subsea device or an apparatus configured to form part of a subsea device, a unit configured to be attached directly to another type of subsea device or to form part of another type of subsea device.

[0054] The apparatus may comprise one or more sensors e.g. for detecting a pressure of a fluid in a line, a temperature in the apparatus or of a fluid in a line, a pH of a fluid in a line, and more. The information obtained from the sensor may be used e.g. to detect whether there is a leak in a line at any given point in time. The information obtained from the sensor or sensors may be transmitted by use of the means for communicating, which means may transmit the information to a remote communications unit. Gathering and sending such information may be highly beneficial to enable urgent detection and action if there a line is damaged, e.g. if a leak occurs.

[0055] The apparatus may be configured to be able to provide a crossover from any one inlet connector to any one outlet connector, it may be configured to provide a crossover from multiple inlet connectors each to any one outlet connector, and/or it may be configured to provide a crossover from any one of a number of backup/spare lines of an umbilical to any one of a number of main inlet lines in the subsea device. Other configurations are possible. A main line in this respect may be a line that is intended to be used to provide a flow path for a fluid when an umbilical is in an undamaged state, whereas a backup line may be a line that is intended to be used to provide a flow path for a fluid when the umbilical is in an damaged state, e.g. when a main line is damaged such that there is a leak in said main line.

[0056] The apparatus may further be configured to facilitate/allow for flushing of one or more of the lines of the apparatus. The apparatus may be configured so as to provide a loop for a fluid, such that a fluid received from a line of the umbilical through one inlet connector of the apparatus may be returned to another line of the umbilical through another inlet connector of the apparatus. The loop may comprise one or more valves for closing a flow path to an outlet connector and one or more valves for opening a flow path between two inlet connectors of the apparatus.

[0057] According to a second aspect of the invention, there is provided a method of sending a fluid to a receiver for the fluid in a situation where a main line for the fluid in an umbilical is faulty, wherein the method comprises the steps of:

[0058] connecting the umbilical to the apparatus according to the first aspect of the invention such that the main line for the fluid in the umbilical is connected to the first inlet connector in the apparatus, and connecting a second line to the apparatus such that the second line is connected to the second inlet connector;

[0059] using the switch mechanism in the apparatus to alter the setting of the apparatus from the default setting to the second setting;

[0060] sending the fluid through the second line, through the apparatus, to the receiver for the first fluid.

[0061] There is described a further method of providing a crossover for a flow path for a fluid to a subsea device, the method comprising the steps of:

[0062] providing an apparatus according to the first aspect of the invention; and

[0063] using the switch mechanism of the apparatus to alter to which one of the plurality of lines in the receiver one of the plurality of lines of the umbilical leads.

[0064] The apparatus mentioned in either one or both of the above methods may be the apparatus according to the first aspect of the invention or the further apparatus.

[0065] The method may further comprise the step of:

[0066] using a means for communication to communicate from and/or to the apparatus.

[0067] The communication may be performed by use of e.g. electrical signals, optic signals, acoustic signals, radio waves.

[0068] The method may further comprise the step of:

[0069] using a sensor of the apparatus to obtain a fluid characteristic, such as a fluid pressure, a fluid temperature, a pH of a fluid, a chemical component of a fluid, etc, e.g. to detect whether there is a problem related to a line in the apparatus, such as a lack of fluid pressure due to a leak.

[0070] The method may further comprise the step of:

[0071] using one or more switch mechanisms to alter to which outlet connector each one of a multiple of inlet connectors lead.

[0072] The method may further comprise the step of:

[0073] communicating to the means for communication of the apparatus from a sender, to open and/or close one or more valves to open and/or close one or more flow paths within the apparatus.

[0074] The method may further comprise the step of:

[0075] using an ROV to operate a manual valve to open or close a flow path in the apparatus.

[0076] The method may further comprise the step of:

[0077] closing a flow path within the apparatus to close a flow path from an umbilical to a subsea device and opening a flow path within the apparatus to connect a subsea reservoir or subsea hydraulic power unit to the subsea device instead.

[0078] According to a third aspect of the invention, there is provided a system for providing a crossover for a flow path for a fluid to a subsea device, the system comprising an umbilical, the apparatus according to the first aspect of the invention, and a receiver, wherein a first end of the umbilical is connected to a topsides or onshore facility and a second end of the umbilical is connected to an inlet of the apparatus, and the receiver is connected to an outlet of the apparatus.

[0079] The system may further comprise a cable being connected to the outlet of the apparatus for providing a flow path for a fluid from the apparatus to the subsea device. The cable may be a hose or something substantially similar. The cable may be an umbilical. The cable may have one line for a fluid or a plurality of lines for a fluid or for a plurality of fluids.

[0080] The system may comprise a plurality of apparatuses according to the first aspect of the invention, wherein the apparatuses may be placed at a distance from each other, and be connected by use of one or more cables, hoses, umbilicals or similar.

[0081] The system may further comprise an apparatus for performing a flushing of one or more lines of the umbilical, for preparing for a change of fluid to be transferred through said one or more lines.

[0082] In a situation where fluid is to be transported a very long distance from a topsides or onshore facility to a subsea device, it may be necessary or at least beneficial to use a plurality of umbilicals. Between each of the plurality of umbilicals, an apparatus according to the first aspect of the invention may be placed, such as to enable a switch of to which outlet connector an inlet connector leads in any one of the apparatuses. This may be highly advantageous to avoid having to replace a damaged umbilical.

[0083] In the following is described examples of preferred embodiments illustrated in the accompanying drawings, wherein:

[0084] FIG. 1 shows the apparatus installed on a seabed, and a platform being connected to a subsea wellhead through an umbilical extending to the wellhead via the apparatus;

[0085] FIG. 2 shows a schematic of a simple embodiment of the apparatus;

[0086] FIG. 3 shows a schematic of a more complex embodiment of the apparatus;

[0087] FIG. 4 shows a schematic representation of the apparatus being attached directly to a wellhead; and

[0088] FIG. 5 shows a schematic representation of an embodiment of the apparatus wherein the apparatus has a plurality of inlets and three-way valves.

[0089] Note that the Figures show examples of the apparatus and configurations of the apparatus in use, and that the Figures are not necessarily drawn to scale.

[0090] FIG. 1 shows the apparatus 1 placed on a seabed 7 near a subsea device 8 in the form of a subsea wellhead 8. The apparatus 1 is connected to the subsea wellhead 8 by a receiver 6 in the form of a cable 6, and to a topsides or onshore facility 9 in the form of a platform 9 by an umbilical 5. The umbilical 5 and the cable 6 both have a number of lines (not shown) for providing flow paths for fluids to be transferred from the platform 9 to the subsea wellhead 8.

[0091] Each line in the umbilical 5 initially, upon installation, leads to a corresponding line in the cable 6, through the apparatus 1. However, the apparatus 1 comprises a switch mechanism in the form of valves (not shown in FIG. 1) that can be opened or closed to facilitate switching to which line in the cable 6 a line in the umbilical 5 leads.

[0092] FIG. 2 shows a schematic representation of an embodiment of such an apparatus 1. The apparatus 1 has an inlet 11 and an outlet 19. An umbilical 5 from a platform 9 (not shown in FIG. 2) is connected to the inlet 11 through inlet connectors 14, and a cable 6 leading to a wellhead 8 (not shown in FIG. 2) is connected to the outlet 19 through outlet connectors 15.

[0093] The apparatus 1, in the embodiment shown in FIG. 2 has eight inlet connectors 14A-H, each connecting a line in the umbilical 5 to a line 13 in the apparatus 1. The apparatus 1 further has eight outlet connectors 15A-H, each connecting a line 13 in the apparatus 1 to a line in the cable 6. The cable 6 and the umbilical 5 both have eight lines (not shown). The lines 13 in the apparatus 1 are all connected to their corresponding lines A-H in the umbilical 5, each through an inlet connector 14 of the apparatus 1. Six of the lines 13A and D-H lead directly through the apparatus 1, whereas the remaining two, lines 13B and C in the apparatus 1 are branched. Both lines 13B and C have a branched inlet line, each branch of the inlet lines leading to a valve 12. From each valve, an outlet line leads to an outlet connector. Each of the two lines 13B and C pass have two possible

paths through the apparatus 1, one leading to its corresponding line in the cable 6, and the other leading to the other line in the cable 6. Thus, line B from the umbilical 5 can, through the apparatus 1, lead to either line B or line C of the cable 6, and line C from the umbilical 5 can, through the apparatus 1, lead to either line B or line C of the cable 6. Each of the branches of lines 13B and C has a switch mechanism 12 in the form of a valve 12 that can be selectively opened or closed to open or close a flow path through the apparatus 1. By opening or closing one or more of the valves 12, a switch can be performed in the apparatus 1. Line B in the cable 6 can be connected to a receiver for a second fluid, and Line C in the cable 6 can be connected to a receiver for the first fluid. Line B in the umbilical may be a backup line for the second fluid, and line C may be the main line for a first fluid. Line B can be used to send a second fluid through to outlet connector 19B and to the receiver for receiving the second fluid, or, by use of the switch mechanism (the valves), line B can be used to send a first fluid through to outlet connector 19C and the receiver for the first fluid. The apparatus can have a first/default setting where the valves are set such that outlet connector 19B is connected to inlet connector 11B and outlet connector 19C is connected to inlet connector 11 and a second setting where the valves are set such that outlet connector 19C is connected to inlet connector 11B, and a third setting where the valves are set such that outlet connector 19B is connected to inlet connector 11C, and a fourth setting where outlet connector 19B is connected to inlet connector 11C and outlet connector 19C is connected to inlet connector 11B.

[0094] FIG. 3 shows a more advanced embodiment of the apparatus 1. The apparatus 1 has a cable 6 connected to its outlet 19 and an umbilical 5 connected to its inlet 11. The apparatus 1 has seven lines 13, lines A-G, as does the umbilical 5 and the cable 6. Only line 13G goes straight through the apparatus 1 without going through a valve. Lines 13A, C and E pass through one valve each, that may open or close said lines 13. Lines 13B, D and F has four branches each, each branch going through a valve 12 to open or close the branch. One branch of each of lines 13B, D and F:

[0095] leads to line A in the outlet 19;

[0096] leads to line C in the outlet 19;

[0097] leads to line E in the outlet 19;

[0098] leads to its corresponding line in the outlet 19 (line B in the outlet 19 for line B, line D in the outlet 19 for line D, line F in the outlet 19 for line F).

[0099] The embodiment of the apparatus 1 shown in FIG. 3 can lead any one of lines A-G in the inlet 11 to its corresponding line in the outlet 19 and it can lead any one of lines B, D or F in the inlet 11 to any one of lines A, C or E in the outlet 19, thus offering a plurality of options for crossovers to facilitate for delivery of fluid through a faulty umbilical 5.

[0100] FIG. 4 shows an alternative embodiment of the apparatus 1. In this embodiment, the apparatus 1 is configured for being attached directly to an inlet (not shown) for an umbilical 5 on a subsea wellhead 8. The apparatus 1, being connected to the inlet (not shown) on the wellhead 8, receives an umbilical 5 from a platform 9.

[0101] FIG. 5 shows an alternative embodiment of the apparatus 1, in which the apparatus 1 has a plurality of inlets. In addition to the main inlet 11, for an umbilical 5, the apparatus 1 has two further inlets 111, 112, the further inlets 111, 112 in this embodiment being inlets 111, 112 for

one-line pipes **51**, **52**. The embodiment of the apparatus shown in FIG. **5**, is a simplified example with a low number of lines **13**. The umbilical **5** shown in FIG. **5** only has two lines. Each of the two lines of the umbilical **5** are connected to one of two three-way valves **121**, **122** through a line A, B in the apparatus **1**. Each of the pipes **51**, **52** only have one line leading into the apparatus **1**, each of the lines leading to one of the aforementioned three-way valves **121**, **122** through lines A1 and B1 of the apparatus **1**. Each line **13** in the apparatus, leading to the three-way valves **13**, is connected to a pressure transmitter **17** for monitoring the pressure in the lines **13** to detect if a line **13** in the apparatus **1**, a line in one of the pipes **51**, **52** or umbilical **5** leading to the apparatus **1** is faulty. Each of the two three-way valves **121**, **122** leads to an outlet connector **19** and to a line in a cable **6**.

[0102] It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims.

[0103] Examples of further possible embodiments of the apparatus according to the first aspect of the invention, that are not illustrated, includes:

[0104] an apparatus comprising multiple outlets, wherein one line from an umbilical leading to the apparatus may be branched so as to lead to each one of the multiple outlets;

[0105] an apparatus wherein each one of a plurality of lines leading to the apparatus through an umbilical may be connected to any one of a number of lines leading from the apparatus;

[0106] an apparatus where any one of a plurality of lines leading to the apparatus may be crossovered to any one or more of a plurality of lines leading from the apparatus;

[0107] an apparatus having a pressure transmitter, and a pH sensor and a temperature transmitter in fluid communication with a plurality of lines in the apparatus; and

[0108] an apparatus having a combination of the features of the above mentioned embodiments.

[0109] Note that the figures show simplified versions of the apparatuses. They do not illustrate or mention parts of the apparatus that may be present in embodiments of the apparatus, such as e.g. a battery for providing electrical power to the apparatus, a power cable connected to an inlet of the apparatus for providing electrical power to the apparatus, a control unit, a communications unit, a cable for providing hydraulics for operating one or more valves of the apparatus connected to a hydraulics inlet of the apparatus, and more.

[0110] In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb “comprise” and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The article “a” or “an” preceding an element does not exclude the presence of a plurality of such elements.

[0111] The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

1. An apparatus for enabling sending a fluid to a receiver for the fluid in a situation where a main line for the fluid in an umbilical is faulty, wherein the apparatus comprises:

a first and a second inlet line and a first outlet line in the apparatus;

a first inlet connector for connecting the main line for the fluid in the umbilical to the first inlet line in the apparatus and a second inlet connector for connecting a second line to the second inlet line in the apparatus;

an outlet for connecting one or more receivers to the apparatus, the outlet comprising a first outlet connector for connecting the receiver for the fluid to the apparatus;

a switch mechanism for selectively switching from a default to a secondary setting, wherein in the default setting the first inlet line leads to the first outlet connector through the first outlet line, and wherein in the secondary setting the second inlet line leads to the first outlet connector through the first outlet line for enabling transferring the fluid through the second inlet line to the first outlet connector.

2. An apparatus for providing a crossover for a flow path for a fluid to a subsea device, wherein the apparatus comprises:

a plurality of lines for providing flow paths through the apparatus;

an inlet for connecting an umbilical to the apparatus, the inlet comprising a plurality of inlet connectors, each one of the inlet connectors being arranged for connecting one of a plurality of lines of the umbilical to one of the plurality of lines of the apparatus, for receiving in the line of the apparatus a fluid from the line of the umbilical;

an outlet for connecting a receiver to the apparatus, the outlet comprising a plurality of outlet connectors for connecting one of a plurality of lines of the apparatus to one of a plurality of lines of the receiver, for providing an outlet for the fluid in the line from the apparatus; and

at least one switch mechanism for altering to which one of the plurality of lines in the receiver one of the plurality of lines of the umbilical leads.

3. The apparatus according to claim 1, wherein the switch mechanism comprises at least one valve.

4. The apparatus according to claim 1, wherein the switch mechanism comprises a plurality of valves.

5. The apparatus according to claim 1, wherein at least one valve of the apparatus is hydraulically operated, and the apparatus comprises an inlet for a hydraulic fluid for operating the switch mechanism.

6. The apparatus according to claim 1, wherein at least one valve of the apparatus is electrically operated, and the apparatus comprises an inlet for providing electricity to the apparatus and/or a battery for providing electricity to the apparatus.

7. The apparatus according to claim 1, comprising a control unit and a means for communicating wirelessly or through a wire, for receiving a control signal and/or information and/or for sending a control signal and/or information to a remote communications unit.

8. The apparatus according to claim 1, wherein the apparatus comprises at least one sensor for detecting a fluid characteristic of a fluid in a line for detecting a problem with a line of the apparatus and/or a line leading to the apparatus.

9. A method of sending a fluid to a receiver for the fluid in a situation where a main line for the fluid in an umbilical is faulty, wherein the method comprises the steps of:

connecting the umbilical to the apparatus according to the first aspect of the invention such that the main line for the fluid in the umbilical is connected to the first inlet connector in the apparatus, and connecting a second line to the apparatus such that the second line is connected to the second inlet connector;

using the switch mechanism in the apparatus to alter the setting of the apparatus from the default setting to the second setting;

sending the fluid through the second line, through the apparatus, to the receiver for the first fluid.

**10.** The method of providing a crossover for a flow path for a fluid to a subsea device, the method comprising the steps of:

providing an apparatus, wherein the apparatus comprises: a first and a second inlet line and a first outlet line in the apparatus;

a first inlet connector for connecting the main line for the fluid in the umbilical to the first inlet line in the apparatus and a second inlet connector for connecting a second line to the second inlet line in the apparatus;

an outlet for connecting one or more receivers to the apparatus, the outlet comprising a first outlet connector for connecting the receiver for the fluid to the apparatus;

a switch mechanism for selectively switching from a default to a secondary setting, wherein in the default setting the first inlet line leads to the first outlet connector through the first outlet line, and wherein in the secondary setting the second inlet line leads to the first outlet connector through the first outlet line for enabling transferring the fluid through the second inlet line to the first outlet connector;

a plurality of lines for providing flow paths through the apparatus;

an inlet for connecting an umbilical to the apparatus, the inlet comprising a plurality of inlet connectors, each one of the inlet connectors being arranged for connecting one of a plurality of lines of the umbilical to one of the plurality of lines of the apparatus, for receiving in the line of the apparatus a fluid from the line of the umbilical;

an outlet for connecting a receiver to the apparatus, the outlet comprising a plurality of outlet connectors for connecting one of a plurality of lines of the apparatus to one of a plurality of lines of the receiver, for providing an outlet for the fluid in the line from the apparatus; and

at least one switch mechanism for altering to which one of the plurality of lines in the receiver one of the plurality of lines of the umbilical leads; and

using the switch mechanism of the apparatus to alter to which one of the plurality of lines in the receiver one of the plurality of lines of the umbilical leads.

**11.** The method according to claim 9, further comprising the step of:

using a means for communication to communicate from and/or to the apparatus.

**12.** The method according to claim 9, the method further comprising the step of:

using a sensor of the apparatus to obtain a fluid characteristic to detect whether there is a problem related to a line in the apparatus and/or a line leading to and/or from the apparatus.

**13.** The method according to claim 9, the method further comprising the step of:

altering to which outlet connector each one of a multiple of inlet connectors lead by use of one or more switching mechanisms.

**14.** The method according to claim 9, the method further comprising the step of:

communicating to the means for communication of the apparatus from a sender at a topsides or onshore facility, to open and/or close one or more valves to open and/or close one or more flow paths within the apparatus.

**15.** The method according to claim 9, the method further comprising the step of:

closing a flow path within the apparatus to close a flow path from an umbilical to a subsea device and opening a flow path within the apparatus to connect a subsea reservoir or subsea hydraulic power unit to the subsea device instead.

**16.** A system for providing a crossover for a flow path for a fluid to a subsea device, the system comprising an umbilical, an apparatus, and a receiver, wherein the apparatus comprises:

a first and a second inlet line and a first outlet line in the apparatus;

a first inlet connector for connecting the main line for the fluid in the umbilical to the first inlet line in the apparatus and a second inlet connector for connecting a second line to the second inlet line in the apparatus;

an outlet for connecting one or more receivers to the apparatus, the outlet comprising a first outlet connector for connecting the receiver for the fluid to the apparatus;

a switch mechanism for selectively switching from a default to a secondary setting, wherein in the default setting the first inlet line leads to the first outlet connector through the first outlet line, and wherein in the secondary setting the second inlet line leads to the first outlet connector through the first outlet line for enabling transferring the fluid through the second inlet line to the first outlet connector;

a plurality of lines for providing flow paths through the apparatus;

an inlet for connecting an umbilical to the apparatus, the inlet comprising a plurality of inlet connectors, each one of the inlet connectors being arranged for connecting one of a plurality of lines of the umbilical to one of the plurality of lines of the apparatus, for receiving in the line of the apparatus a fluid from the line of the umbilical;

an outlet for connecting a receiver to the apparatus, the outlet comprising a plurality of outlet connectors for connecting one of a plurality of lines of the apparatus to one of a plurality of lines of the receiver, for providing an outlet for the fluid in the line from the apparatus; and

at least one switch mechanism for altering to which one of the plurality of lines in the receiver one of the plurality of lines of the umbilical leads; and

wherein a first end of the umbilical is connected to a topsides or onshore facility and a second end of the umbilical is connected to an inlet of the apparatus, and wherein the receiver is connected to an outlet of the apparatus.

**17.** The system according to claim **16**, wherein the system comprises a plurality of apparatuses, placed at a distance from each other, the apparatuses being connected by use of one or more cables, hoses, umbilicals or similar.

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