

Dec. 5, 1967

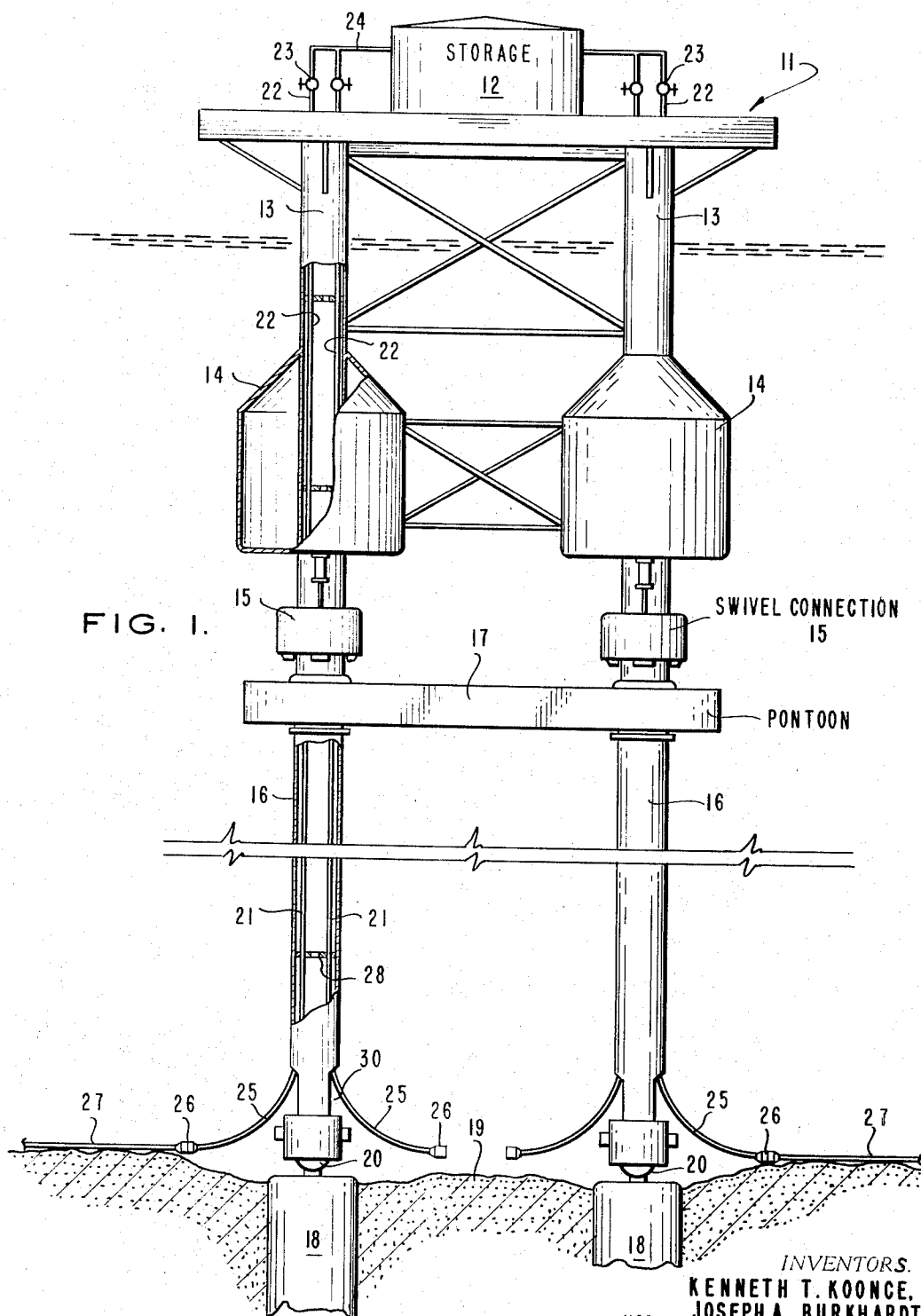
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3,355,899

OFFSHORE OPERATIONS

Filed May 31, 1966

4 Sheets-Sheet 1



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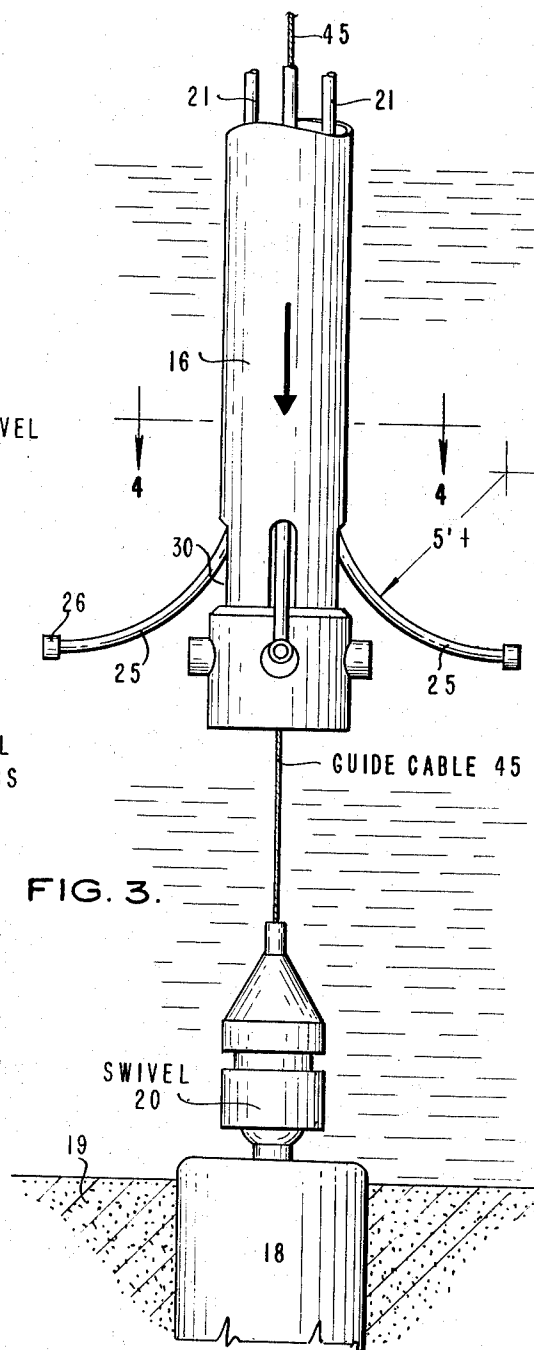
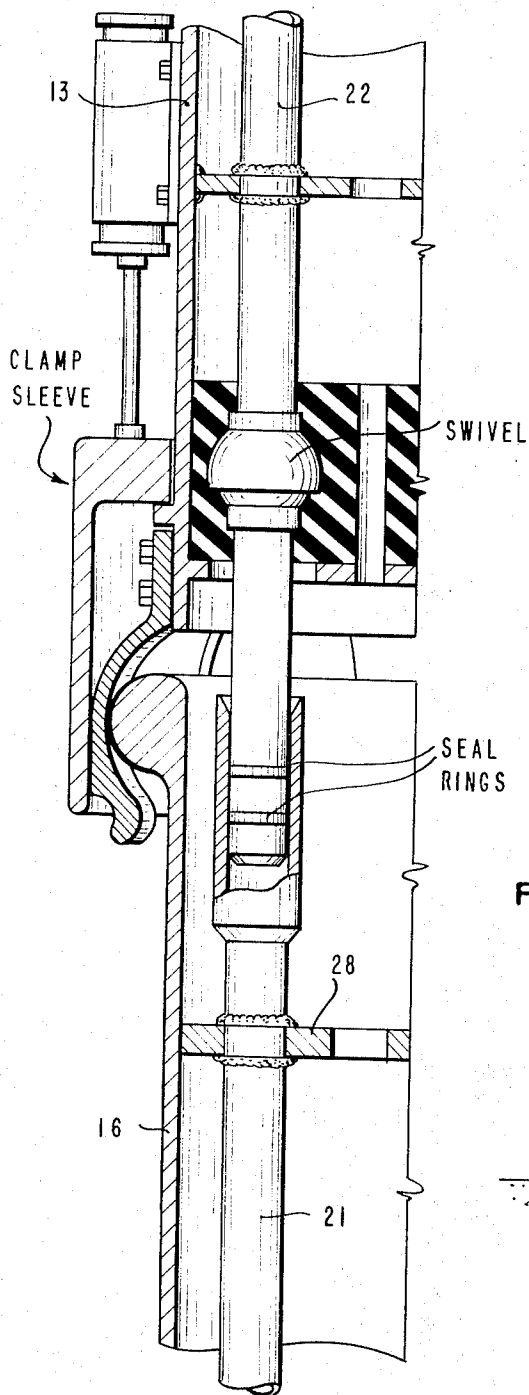
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

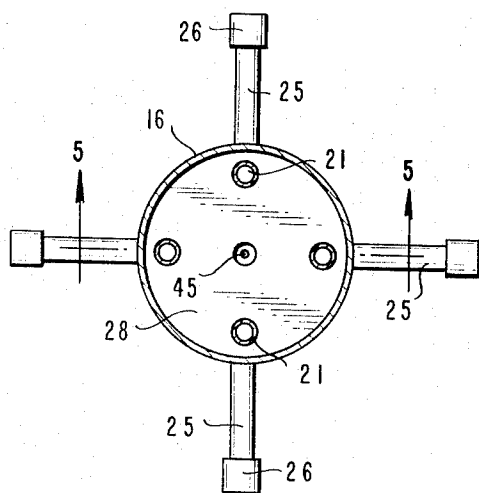


FIG. 4.

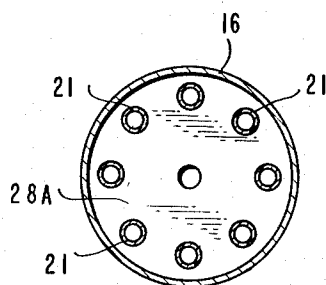


FIG. 6.

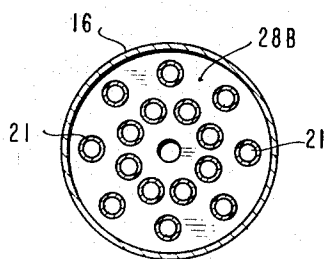


FIG. 6A.

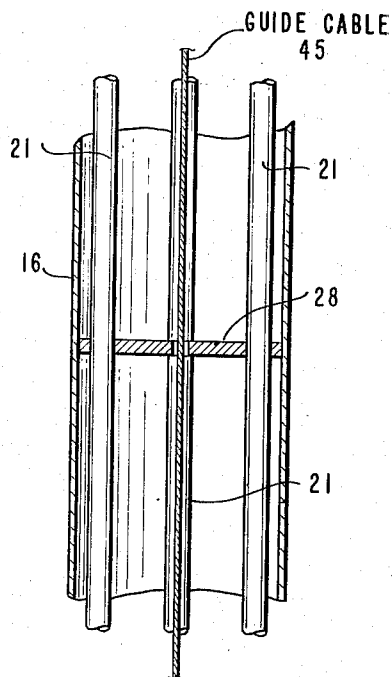


FIG. 5.

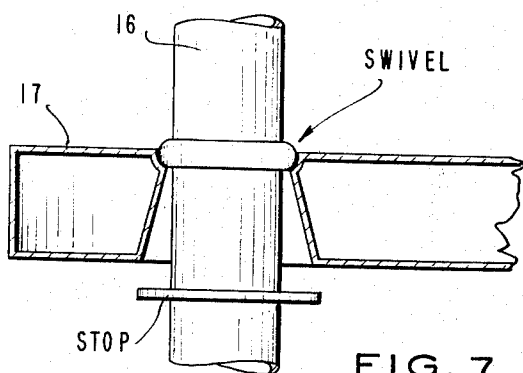


FIG. 7.

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4 Sheets-Sheet 4

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3,355,899

OFFSHORE OPERATIONS

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11 Claims. (Cl. 61—46.5)

The present invention is directed to a method for connecting an underwater conduit to a floating vessel. More particularly, the invention is concerned with connecting an underwater conduit such as a pipeline or a well flowline to a floating vessel for conducting operations therefrom. In its more specific aspects, the invention is concerned with the employment of a conduit which serves as a passageway for tubular members and as a means for anchoring a floating vessel to water bottom.

The present invention may be briefly described as a method for connecting an underwater conduit, such as one connected to a pipeline or a well flowline, to a floating vessel. The method involves lowering at least a conduit member from water surface to water bottom. The conduit member is provided with at least one tubular member having a first end and a second end. The tubular member or plurality of tubular members may extend through the conduit. The conduit is pivotally anchored to water bottom such that the upper end of the conduit member is at a point substantially below water surface. A buoyantly supported vessel is connected to the upper end of the conduit member about 20 to 100 feet below the water line and thereafter the tubular member is connected at its first end to a conduit through which fluid such as oil or gas or other fluids may be flowed and at its second end to the vessel. The conduit for fluids may be a pipeline on water bottom or a well flowline.

The buoyantly supported vessel is releasably connected to the conduit member and the conduit member may be guidingly lowered from a floating position at the water surface. After the conduit member has been anchored, it is maintained under tension which may be accomplished by providing a buoyantly supported member adjacent the upper end of the conduit.

The buoyantly supported vessel is suitably a platform which is supported buoyantly by vertically spaced apart buoyancy members and the conduit member is suitably a plurality of conduit members. The buoyancy members are each releasably attached to one of the conduit members. Other buoyancy members may be used which may be releasably attached to the vessel or to a platform.

The present invention also involves apparatus for conducting offshore operations such as drilling, producing and servicing and all operations which are suitably conducted from a stable area above water level. Such operations may encompass signalling devices, radar installations and other navigational aids. The apparatus involves a plurality of conduit members each provided with one tubular member extending therethrough with the conduit members each being pivotally attached at their lower ends to water bottom. Means are provided on the upper end of the conduit member for maintaining tension on the anchored conduit member. These means may suitably be buoyancy means such as releasable pontoons or pontoons slidably arranged on the upper end of the conduit member.

A platform member buoyantly supported by a plurality of vertically spaced apart buoyancy members is releasably attached by the buoyancy members to the upper end of the conduit members. First means are provided for connecting the tubular member to the platform member and second means are provided for connecting the tubular member to a fluid flowline on water bottom.

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The platform member is suitably attached to the upper ends of the conduit member by a pivotal attachment to the buoyancy members.

The means for maintaining tension on the anchored conduit member is suitably an auxiliary buoyancy means arranged on the conduit member adjacent its upper end.

The present invention is quite advantageous and useful in that not only does it provide a working surface for operations as has been enumerated hereinbefore, but it also provides means for allowing well connections and connections to underwater pipelines and the like to be made. Thus, in making well connections and in making connections to underwater pipelines, it is necessary to provide some sort of riser for making the connection.

In the present invention the risers are provided through the conduit members and the platform, which conduit members are arranged in a predetermined and ordered manner. Risers for development of an underwater hydrocarbon reservoir may be installed initially so that wells may be put on production as they are completed by connecting only a flowline at the platform. Likewise, the present invention provides protection from action of waves and submarine currents. In this respect, forces due to submarine currents may be accurately predicted and compensated for by the protection afforded by the large conduits rather than run the danger of severing a number of small lines. The present invention also provides for disconnection and reconnection after severe storms without the necessity of connecting a large number of individual flowlines.

The present invention will be more fully illustrated by reference to the drawings in which:

FIGURE 1 is a diagrammatic view of the present invention showing a platform with facilities for treating and storage and connected to a pipeline;

FIGURE 2 is an enlarged view in section showing the swivel connection between the upper and lower units of the assembly;

FIGURE 3 is a view in elevation showing the swivel connection of the lower section to the anchor means;

FIGURE 4 is a sectional view taken along the line 4—4 of FIGURE 3;

FIGURE 5 is a view taken along the line 5—5 of FIGURE 4;

FIGURES 6 and 6-A are sectional views similar to FIGURE 4 showing additional arrangements of flow pipes through the assembly;

FIGURE 7 is a sectional view showing the arrangement of the lower buoyancy means of the apparatus;

FIGURES 8-A through 8-D are stepwise views illustrating the installation of the apparatus at a marine location.

Referring now to the drawing in which identical numerals designate identical parts, and particularly to FIGURES 1-3, numeral 11 designates a platform member provided with storage means 12 which may be a plurality of tank means, or storage means may be formed within the platform itself. The platform 11 is suitably supported by tubular members 13 which have on their lower ends releasably attached buoyancy means such as pontoons 14 which are provided with means not shown for admitting and exhausting ballast such as water. The tubular members 13 may suitably be cross-braced as required. Connected to the pontoon members 14 by quick connection and disconnection swivel means 15 are conduit members 16. Arranged slidably on the conduit members 16 is an auxiliary buoyancy means such as a float member 17 which is also provided with means not shown for exhausting and admitting ballast such as water. Although not shown, the pontoon means 14 and the float means 17 may be suitably compartmented and are provided with lines leading to the platform 11 for control of buoyancy. The

conduit members 16 are attached to anchor members 18, which may be driven into sea bottom 19, by a pivot connection 20, such as a universal joint.

Extending through the conduit member 16 is a plurality of tubular members 21 which through connection means 15 (see FIGURE 2) mate with the tubular members 22 of tubular members 13 and form a continuous passageway therethrough. The tubular members 22 terminate on platform 11 and may suitably be closed by valves 23 and may connect by suitable pipe connection means such as 24 to storage or other pipe connections.

Referring now specifically to FIGURES 1 and 3, it will be seen that the lower ends of the tubular members 21 terminate in a curved section 25 which may have a radius bend of about 5 feet. Although this figure is given, it may have other radius bends ranging from about 5 feet upward to allow passage of well tools therethrough. The curved section 25 terminates in a connecting means 26 which is suitably connected to a pipeline or well flowline 27.

Referring to FIGURES 2 and 5, it will be seen that plate members 28 are provided with a plurality of passageways through which the tubular members 21 extend. As shown in FIGURE 2, it will be seen that some of the plate members 28 serve as supports for the tubular members. Conduits 13 are likewise provided with plates such as 28.

The lower ends of the tubular members 16 are provided with windows 30 through which the curved sections 25 extend. It will be noted that the plate members 28 provide passageways for the tubular members 21 which may be of any convenient number. A central passageway in plate 28 is provided for the passage of a guide cable used in installation of the assembly.

Referring now to FIGURES 6 and 6A, other configurations of plate members such as 28A and 28B are given. Plate members 28A and 28B show a larger plurality of tubular members than that of plate 28. Thus, the tubular members 16 provide a conduit for a plurality of tubular members which serve to protect pipeline risers which are suitably connected to underwater pipelines and underwater well flowlines.

FIGURE 7 shows the swivel connection between the conduit 16 and the lower pontoon member 17 whereby deviation from the vertical of conduit 16 can be accommodated.

Referring now to FIGURES 8A-8D inclusive, an installation barge or vessel such as 40 is shown floating in a body of water 41. Arranged on the barge 40 on a support member 42 and a pivot means 43 is a plurality of tubular members 16 having a float member 17 on one end. The tubular member 16 may be suitably cross-braced for installation with cross-bracing members 44 which are removable. When the barge 40 reaches the location where the tubular members 16 are to be installed, guide lines 45 connecting to anchor means 18 are led through the tubular members 16 and the tubular members 16 are then guidingly lowered from the barge 40 over the guide means 45 to the anchor 18 as shown more clearly in FIGURES 8B and 8C. In FIGURE 8C, the tubular members 16 are shown on water bottom connected to the anchors 18, the pivotal connections having been made as shown in FIGURE 1. The cross-braces 44 are removed and tension is provided on the tubular members 16 by discharging sea water ballast from the float 17. The platform member 11 is then brought in to the location as shown in the left hand side of FIGURE 8C and connected to the tubular member 16 by connection means 15 as shown in FIGURES 1 and 8D.

The platform member 11 is suitably a platform member such as described in the Knapp Patent 3,154,039. In this particular instance, a tubular conduit 16 serves not only as anchoring means, but also as conduits for well flowlines and pipeline risers and the like. The releasable connection means 15 also embodies a universal joint per-

mitting relative movement between the platform 11 and the conduit 16 such that the platform 11 even in high seas and winds will maintain its attitude in a horizontal position regardless of the turbulence caused by wind and water. Likewise, in accordance with the present invention, such turbulence due to wind, waves, and currents does not affect the pipeline risers or well flowline risers since they are protected by the conduits 16 and 13.

In accordance with the present invention, referring again to FIGURES 8A to 8D and FIGURE 1, after the installation has been made as shown in FIGURES 8A-8D and FIGURE 1, the float 17 will be ballasted and tension will be asserted on the conduit 16 by discharging ballast from the pontoon members 14. Thus, in accordance with the present invention the tubular members 16 are maintained under tension at all times. Prior to connection with platform 11 through the pontoon 14, tension is provided by exhausting ballast from the float 17. When connection is made to the platform 11, tension is provided by exhausting ballast from the pontoon members 14 with float 17 being ballasted to neutralize the buoyancy.

While the present invention has been described and illustrated with reference to the Knapp Patent 3,154,039, other platform members may be employed in lieu of that described. Likewise, other float members besides those described with respect to the several figures of the drawing may be employed. Also, while the tubular members 16 and float 17 are shown in FIGURE 8A as being brought in on a barge, it is possible and sometimes desirable to float the tubular members 16 to the desirable water location by providing sufficient auxiliary buoyancy thereto or by employing the tubular members as buoyancy means themselves.

In the several figures of the drawing, an anchoring means 18 has been described. This anchoring means is shown driven into water bottom 19. In accordance with the present invention, it is considered within the purview of the invention to use anchoring means such as described in the aforesaid Knapp Patent 3,154,039.

The nature and objects of the present invention having been completely described and illustrated and the best mode and embodiment contemplated set forth, what we wish to claim as new and useful and secure by Letters Patent is:

1. A method for connecting an underwater conduit to a floating vessel which comprises:
 - lowering at least one conduit member from water surface to water bottom;
 - said conduit member having upper and lower ends and being provided with at least one tubular member having a first end adjacent to the bottom end of said conduit and a second end adjacent to the top end of said conduit;
 - pivotaly anchoring said conduit member to water bottom such that the upper end of said conduit member is below water surface;
 - connecting a buoyantly supported vessel to the upper end of said conduit member; and
 - connecting said tubular member at its first end to the conduit for fluid on water bottom and at its second end to said vessel.
2. A method in accordance with claim 1 in which the buoyantly supported vessel is releasably connected to the conduit member.
3. A method in accordance with claim 1 in which the conduit member is guidingly lowered.
4. A method in accordance with claim 1 in which the conduit member is maintained under tension after anchoring same.
5. A method in accordance with claim 4 in which the conduit member is maintained under tension by buoyantly supporting it at least adjacent its upper end.
6. A method in accordance with claim 1 in which the buoyantly supported vessel is a platform supported

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buoyantly by vertically spaced buoyancy members and in which a plurality of conduit members is provided, each of said buoyancy members being releasably attached to one of said conduit members.

7. A method in accordance with claim 1 in which the buoyantly supported vessel is pivotally connected to said conduit member. 5

8. A method in accordance with claim 1 in which the conduit member is lowered from a floating position at water surface. 10

9. Apparatus for conducting offshore operations which comprises: 15

a plurality of conduit members each provided with at least one tubular member extending there-through and each pivotally anchored at its lower end to water bottom;

means connected to the upper end of said conduit members for maintaining tension on said anchored conduit members;

a platform member buoyantly supported by a plurality of vertically spaced apart buoyancy mem- 20

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bers, each of said buoyancy members being releasably attached to the upper end of one of said conduit members;

first means connecting said tubular member to said platform member; and

second means connecting said tubular member to a fluid flowline on water bottom.

10. Apparatus in accordance with claim 9 in which the platform member buoyancy members are pivotally attached to the upper ends of said conduit members.

11. Apparatus in accordance with claim 9 in which the tension means is an auxiliary buoyancy means arranged on said conduit member adjacent its upper end.

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