(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 063 911**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **82302009.4**

(22) Date of filing: **20.04.82**

(51) Int. Cl.³: **B 63 B 35/44**, E 21 B 43/01

(30) Priority: **29.04.81 GB 8113224**

(43) Date of publication of application: **03.11.82 Bulletin 82/44**

(84) Designated Contracting States: **AT BE CH DE FR IT LI LU NL SE**

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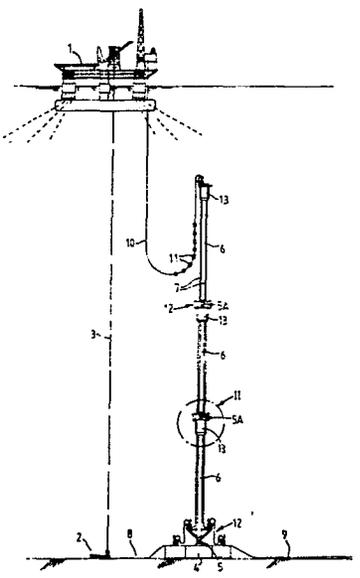
(54) Flow line for use in the transfer of fluid to or from under water sites.

(57) A flow line system for use in the transfer of fluid to or from an under water site comprises a first flow line arrangement (7) installed so as to extend from the water bed to near, but below, the surface, this arrangement (7) being carried by a buoyant support column that is connected to the water bed at an articulated connection (5) and that consists of rigid sections (6) that are connected in series at articulated connections (5A) so that the first flow line arrangement (7) is rigidly supported by each section (6) but can articulate at the base of the column and at the connections (5A) between the rigid sections (6); and a second, flexible, flow line arrangement (10) releasably connected to the first arrangement (7), where the first arrangement terminates near the surface, so as to extend the first arrangement. As the first flow line arrangement and the column can articulate they have good ability to absorb lateral loads and impacts, and to cope with extensive movement at the surface end of the second flow line arrangement. The system is therefore well-suited for use in considerable water depths, and as it can articulate the column can be made slim which facilitates its handling during installation and removal.



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FLOW LINE FOR USE IN THE TRANSFER OF FLUID TO OR FROM UNDER WATER SITES

This invention relates to a flow line system for use in the transfer of fluid to or from under water sites.

In the transfer of fluid to or from an under water site, for example in the extraction of oil or gas, it is necessary to provide a flow line or lines between the water bed and production facilities which may be on a fixed, tensioned or moored floating production platform. Advantageously such flow lines should be easily disconnectable from, and re-connectable to, the subwater well heads or manifold, particularly in potentially rough water areas. The problems in providing ease of connection and disconnection are greater at deep water sites, or where icebergs are a problem and/or if the production facilities are on a floating production platform. However, whilst disconnection and connection, when required, should be easy to accomplish, it is also important that the need to effect such manoeuvres should be minimised.

In United Kingdom published Patent Application No. 2 024 766 A there is disclosed a marine production riser system in which a rigid column that extends from a rigid connection at the water bed to near but below the surface supports a flow

line arrangement that is rigidly supported over the whole length of the column. From the top of the column the flow line arrangement is flexible as it passes to a vessel floating on the surface. As the column is rigidly connected to the water bed and is rigid throughout its length it is unable to absorb anything more than very minor lateral loads and impacts because such loads of any size would cause excessive stress at the rigid connection at the water bed. Furthermore, the depth to which such a system can be installed is limited as an unduly long rigid column is difficult to handle during installation (and subsequent removal), and if made slim to facilitate such handling would, in situ, be subjected to excessive deflections and stresses over its length.

According to the present invention there is provided a flow line system for use in the transfer of fluid to or from an under water site, the system comprising a first, flow line arrangement to be installed so as to extend from the water bed to near, but below, the surface, this arrangement being carried by a buoyant support column that is for articulated connection to the water bed and that consists of rigid sections that are connected in series at articulated connections so that the first flow line arrangement is rigidly supported by each section but can articulate at the base of the column and at the connections between the rigid sections; and a second, flexible, flow line arrangement releasably connectable to the first arrangement, where the first arrangement terminates near the surface, so as to extend the first arrangement. Such a system can be installed between a wall head, manifold or other convenient location at the water bed and production facilities at the surface with the advantage that the connection

between the first and second flow line arrangements is near the surface and hence readily accessible. The articulated connections at the water bed and between the rigid sections, with the otherwise rigidly supported first flow line arrangement able to articulate with the support column at these connections, enables the system as a whole to cope with extensive movement of floating facilities at the surface so that the system is suitable for use at considerable depths (extent of surface movement increases with water depth). The suitability for use at considerable depth is enhanced by the provision of articulation of the column and the first flow line arrangement as this gives to the column and the flow line arrangement it supports good ability to absorb lateral loads and impacts. Also as this is achieved by the provision of the articulated connections, the column can be made slim which facilitates its handling during installation and removal.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawing, in which there is illustrated, in Figure 1, a flow line system between a sea bed well head and production facilities provided on a semi-submersible production platform. Figure 2 shows on a larger scale the detail ringed at II in Figure 1.

Referring to the drawing, the semi-submersible production platform 1 is shown in position over the sea bed well head 2 with workover guidelines 3 extending between the platform and the well head. To one side of the platform and well head there is a sea bed anchorage structure 4 to which is anchored, by an articulated connection 5, a series of buoyed rigid column sections 6. The

column sections 6 are connected to one another in series at articulated connections 5A, and each section incorporates a buoy 13 at its upper end. The articulated connections can be of any suitable construction as known in the art giving freedom of movement about two mutually perpendicular axes. The column made-up by the sections 6 rigidly supports between the connections 5A a first flow line arrangement 7. One part of this first flow line arrangement 7 is connected to flow lines 8 from the well head 2. Another part is connected to export flow lines 9. At each connection 5A there is an articulated connection 12 in the flow line arrangement 7 and this arrangement can also articulate at the base of the column. Thus the flow line arrangement 7 is rigidly supported by the buoyed column sections 6 but can articulate at the base of the column and at the connections between the column sections. The articulated connections in the flow line arrangement 7 are effected by flexible flow line portions 12A interconnecting the otherwise rigid runs of the flow line.

The column terminates near, but below, the surface of the sea, and at this termination the first articulated flow line arrangement 7 is releasably connected to a second, flexible, flow line arrangement 10. This second flow line arrangement 10 extends to the production platform 1, to which it is releasably connected, and serves for supply to, and export from, the production facilities.

The semi-submersible platform 1 can be held on station by a conventional mooring system or by an automatic jack mooring system, the inclusion of the flexible flow line arrangement allowing movement of the platform to take place within a predetermined range. Conveniently the automatic

jack mooring system can utilise the top of the column as a reference point for locating the platform.

Should weather conditions become such that platform movement cannot be constrained within the allowable range, or should it be desired to move the platform off-station, disconnection from the well head and export facilities is facilitated by the provision of the releasable connections at the platform and at the top of the column. The latter connection is near the surface and can be of a form not requiring operation by a diver. It is to be noted here that not only is it advantageous to have this connection near the surface from the point of view of ease of actuation, but also by so positioning the connection the length of the flexible flow line arrangement is kept to a minimum. A flexible flow line arrangement is required to accommodate motion of the floating platform, but to have the flexible flow line arrangement extending, for example, all the way to the water bed could result in a flexible flow line arrangement of such considerable length and consequent weight as to introduce problems in, for example, recovery thereof after disconnection from the well head. On the other hand, by having an articulated but otherwise rigidly supported flow line arrangement terminating below surface level, adverse effects of wave action, lateral loads and impacts on this arrangement and its support (the column) are avoided or readily absorbed.

Preferably at least the connection 5 at the base of the column is releasable, along with flow line connections to the flow lines 8 and 9, but in the system shown all the connections 5A and 12 are releasable as well.

In the illustrated form, the flexible flow line arrangement 10 is provided with buoyancy 11 to cushion the movement of the flexible flow line, especially when it is disconnected in an emergency. The flexible flow line arrangement 10 also avoids a need for providing tensioning equipment on the floating platform, as is necessary in constructions where a tensioned riser flow line arrangement is provided between a well head and a floating production platform. Also loading on the production platform is reduced as compared with a tensioned flow line arrangement. The illustrated form also has the advantage that the flow line arrangements are disposed to one end of the floating platform, leaving the central moonpool of the platform free for working over the well head. Workover relative to the flow line arrangements is via a separate derrick mounted over the flow line arrangements.

It may not always be necessary to provide buoyancy for the flexible flow line arrangement 10. Also the flexible flow line arrangement 10 need not necessarily be connected to floating facilities, and the facilities to which it is connected could be other than production facilities.

The buoyancy for the column sections 6 can be built-in along the length of each section, rather than provided by the buoys 13.

CLAIMS

1. A flow line system for use in the transfer of fluid to or from an under water site, the system comprising a flow line arrangement (7,12) to be installed so as to extend from the water bed to near, but below, the surface, and in flexible manner from the termination of the column near the surface to the surface; characterised in that the column is for articulated connection to the water bed and consists of rigid sections (6) that are connected in series at articulated connections (5A) so that a first part (7) of the flow line arrangement is rigidly supported by each section (6) but can articulate at the base of the column and at the connections between the rigid sections (6); and in that a second part (12) of the flow line arrangement, which is flexible, is releasably connectable to the first part so as to extend the first part.

2. A flow line system as claimed in claim 1, wherein the first part (7) of the flow line arrangement consists of rigid runs supported by corresponding rigid column sections (6), and articulated connections (12) between these runs and corresponding to the articulated connections (5A) between the rigid column sections (6).

3. A flow line system as claimed in claim 1 or 2, wherein the articulated connection (5) of the column to the water bed is releasable, and wherein the first part (7) of the flow line arrangement is releasably connected, at the water bed, to fluid flow lines (8,9).

4. A flow line system as claimed in claim 2 or claims 2 and 3, wherein each articulated connection (5A), (12) between column sections (6) and the runs of the first part (7) of the arrangement is releasable.

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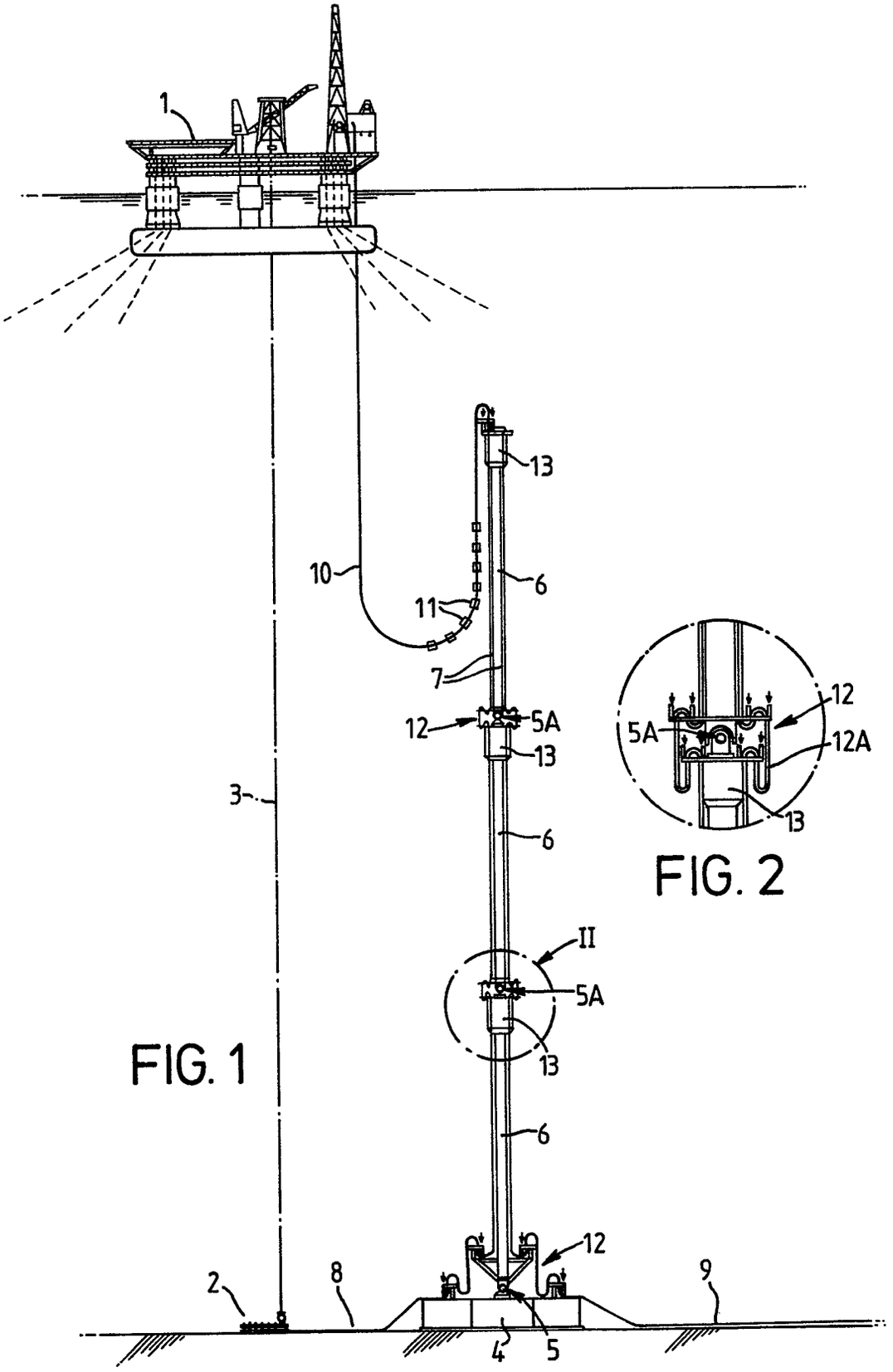

FIG. 1

FIG. 2