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(54) Offshore platform

(57) A tension leg subsea platform (TLSP) (1) comprises a buoyant, submersible hull anchored to the seabed by tendons (3). A jack-up platform (6), either for drilling operations, production operations or any combination of these, is located such that its legs (8), when lowered, rest on the TLSP. In an alternative arrangement (Fig 3), legs or columns are pre-installed on the TLSP, and the working platform lifted or floated onto them. In either case, the two components can be fabricated and travel separately to the field location. The effective depth of the TLSP may be 30m to 100m, while the sea itself is substantially deeper than 100m. The working platform may be re-used at other locations. A drilling platform may be exchanged for a production platform while the TLSP remains moored on location, and the production platform may in turn be exchanged for a decommissioning platform.

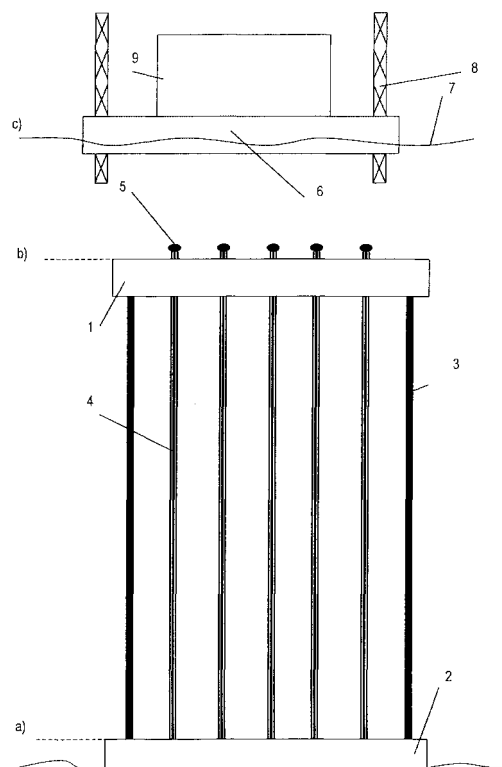


FIG 1.

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Description

[0001] The present invention relates to an offshore platform, such as may be used for drilling, production and/or maintenance operations, and to methods of constructing, deploying and using such platforms.

[0002] Offshore drilling for oil or gas requires a platform to act as a working stage for conducting offshore operations. There are several types of platform used in such operations, choice of which depends on a number of factors, such as the role of the platform, likely weather conditions, permanence of the platform and the depth of the water.

[0003] Conventional offshore platforms are permanently installed on a steel structure referred to as a "jack-et", which is erected on the seabed, and has a deck and topsides attached for the necessary equipment and accommodation. For other situations, especially in deep water, and for temporary operations, floating or "semi-submersible" vessels and drillships are also used.

[0004] A different type of platform is the jack-up platform which has been used for offshore drilling for some time now. A jack-up platform is a mobile drilling platform wherein the platforms legs can be raised while under tow, projecting only a few metres below the water surface, and therefore can be easily moved to a drilling/production location. This has the advantage that the deck and topsides can be assembled on land or at least in shallow waters, and then towed as a unit to their desired location. When at the desired location, the legs can be lowered to the seabed and therefore, in use, the platform has greater stability than many other types of mobile platforms. Jack-up platforms, however, are only suitable for use in shallow water applications, generally less than 110 metres deep. One example is described in US 4 907 912, which also has a submersible production storage barge.

[0005] Another type of known platform is the tension leg platform or TLP. The TLP is a light, buoyant platform moored to the seabed by some means, such as wires, cables, pipes or chains, such that these moorings are under tension due to the buoyancy of the platform. The advantages of this type of platform are that it can be used at virtually unlimited depths, is easily constructed, and is mobile and therefore can be towed to a drilling/production location.

[0006] When on-location, vertical wave motions should preferably be reduced as much as possible ensuring that the moorings are not under undue tension and therefore reducing the necessary strength and cost of the moorings. This is best achieved by having the buoyancy well below the surface of the water. However, this would result in a tall structure and therefore when being towed, such a tall structure would be very unstable, although stability is key when floating to location.

[0007] Another type of platform which may address this drawback is proposed in US 4 913 591 (Steele). Here, a submersible, buoyant pontoon is secured by

tendons to the seabed in the manner of a tension leg platform. The pontoon is provided with a column or columns extending upwardly from it, and passing through the upper, operating deck. The upper deck can thus be raised and lowered above the surface of the sea in the manner of a jack-up rig. US 4604001 (Wetmore) describes a "jack-down" platform, in which four legs are anchored to the seabed via tendons. The legs pass through the extremities of a buoyant hull, and the hull is jacked down the legs, to submerge it and apply the tension which creates a tension leg arrangement.

[0008] It is an object of the invention in a first aspect to allow use of existing, economical, field-proven technology for the top structure of drilling and/or production facilities, independently from water depth.

[0009] The inventors have realised that it is possible effectively to raise the deep water level to that of the shallow water level, by using one form of working platform, such as a jack-up, on top of another type. In particular, the invention defined in appended claim 1 provides a tension leg subsea platform (TLSP), on which there can be planted the legs of a working platform.

[0010] The TLSP may be moored to the seabed by some means, such that the working platform itself is operated at a water depth conventionally suitable for a fixed platform (typically 30m-100m), while the buoyancy of the TLSP is well below the water surface. The effective depth of the TLSP may be 30m to 100m, while the sea itself is substantially deeper than 100m.

[0011] The working platform may in particular be a jack-up platform, although this is not essential. A jack-up platform, either for drilling operations, production operations or any combination of these, is located such that its legs, when lowered, rest on the TLSP. In an alternative arrangement, legs or columns are pre-installed on the TLSP, and the working platform lifted or floated onto them. In either case, the two components can be fabricated and travel separately to the field location.

[0012] The invention in suitable embodiments enables fabrication of a platform for deep water use in yards with relatively shallow depth of water to work in, such as 5-10 metres. In particular, the invention provides a method in which the TLSP and working platform are separately fabricated, the TLSP submerged and moored at a desired location, and the working platform then mounted so as to be supported above the surface by the TLSP.

[0013] Since the height of the individual components travelling to the location can be made much smaller than their depth when on location, the invention in suitable embodiments permits an increase in the proportion of work that can be conducted in yards local to the offshore site.

[0014] The invention in a further aspect allows use of the same substructure (TLSP) for the total lifecycle of the project, and to change out as necessary, the floating/jacked up/ minimal topside structures with necessary equipment for, for example, drilling purpose, work area purpose or production purpose.

[0015] The inventors have further realised it is possible to use the same TLSP substructure for the total life-cycle of a project.

[0016] This method of performing offshore operations is achieved by exchanging, as necessary, the floating/jacked-up/minimal topside structures with the necessary equipment for the operation being undertaken. The TLSP can remain in place throughout.

[0017] The working platform can be of the same traditional design as for shallower water operation, and may even be one previously used on the seabed, and/or on another TLSP.

[0018] A preferred embodiment of the invention has a well-head located at the TLSP level such that the TLSP effectively acts as a seabed for the jack-up platform. However, other embodiments of the invention may have the well-head located either at the seabed or the jack-up platform level.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Embodiments of the invention will now be described, by way of example only, by reference to the accompanying drawings, in which:

[0020] Fig 1. shows a jack-up platform afloat on the water surface and a TLSP below the water surface, in the course of deploying a platform in one embodiment of the present invention.

[0021] Fig 2. shows the same jack-up platform located on the TLSP after deployment.

[0022] Fig 3. Shows a further embodiment of the invention wherein the legs are pre-installed on the TLP.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0023] Figs 1 & 2 show one embodiment of the present invention. Fig 1 shows a tension leg platform TLSP 1 comprising a submersible, buoyant hull moored to a base 2 by tendons 3. The base 2, located in the vicinity of at the seabed (level (a)), may be positioned and maintained in position by any suitable technology, such as weight or suction anchors or other means, depending on the soil condition and the loads induced by the environment. A unitary base is not essential. Flexible or rigid conduits, pre-installed to the TLSP 4, transport oil, gas, any well production or any other fluids required for the process in hand, from the seabed to a well-head 5 on the TLSP. In the vicinity of the water surface (level c) there floats a jack-up platform 6 with raised legs 8. The jack-up can be of known type, for example having production, drilling and accommodation modules 9, the nature and design of which depends on what application the platform 6 is to be used for.

[0024] The TLSP 1 is either manufactured from a buoyant material or has floats attached to it, which ensures that the tendons 3 are kept under tension. The tendons 3 are of such a length that the TLSP 1 is held at a water depth of 30m-100m (level b)), the buoyancy

of the TLSP is therefore significantly below the water surface c). It should be noted that the strain is being taken entirely by the tendons 3, the conduits 4 are not themselves under any tension, other than their own weight and any transmitted weight by friction

[0025] The self-elevated jack-up platform 6 floats upon the water surface c) while being towed to the drilling site. The jack-up platform has tubular or lattice legs 8 which can be raised or lowered by electric or hydraulic jacks, winches or other means (not shown). When in transit the legs 8 are raised so as not to drag in the water. By this means, the jack-up platform can be fabricated inshore, at any depth, with complete deck and topsides (modules 9).

[0026] Fig 2 shows the invention when the jack-up platform 6 is in place with transfer lines 10 and control and command function lines 11 attached. Once the platform 6 is floating directly above the TLSP 1 the legs 8 of the jack-up platform are lowered to rest on the TLSP 1 and then further jacked such that the platform 6 is raised clear of the water surface 7. Transfer lines 10 (which may also be rigid or flexible) are then lowered from the platform 6 or installed by external means and equipment and are attached to the well-head 5, so as to act as conduits for the oil, gas or any other fluid either being produced or required for the process from well-head 5 to surface platform 6. The well-head 5 is now at level b), a shallow water level, and therefore the coupling of the transfer lines 10 to the platform 6 is a simpler operation. The control and command function lines 11 are for the control of any equipment located subsea, at either level b) or a), such as the well-head 5, manifold or ballasting of the TLSP 2.

[0027] Depending on the actual conditions, other embodiments may have cables, pipes, chains, tethers as the tension members of the TLSP 1 instead of the tendons 3. Another embodiment may have conduits 4 that are installed by jack-up as opposed to being pre-installed, and other embodiments of the invention may have the well-head located at levels a) or c).

[0028] Fig 3. shows an embodiment of the invention wherein the legs 12 of the top platform 13 are now pre-installed on the TLSP 1 such that the tops of the legs 12 are at a level usually just above the surface of the water. (The ends of said legs can alternatively be located below the water level.) The transfer lines 7 are pre-installed on guides 14 for simpler coupling to the top platform 13. The TLSP is unchanged below level b) but, in this example, the top platform is lifted by some means onto the pre-installed legs 12. Instead of the guides 14 the transfer lines 7 may be linked to the pre-installed legs 12.

[0029] In these two embodiments, it is seen how a conventional jacket or jack-up platform design can be used in a variety of applications, the depth of water below the design depth of the legs being spanned by the TLSP.

[0030] The skilled reader will appreciate that many variations are possible within the spirit and scope of the

invention defined in the appended claims, and the embodiments disclosed herein should be regarded as examples only.

The TLSP may be formed by anchoring the submersible hull 5

[0031] It will be understood that terms such as "marine" and "seabed" as used in the description and claims are not intended to exclude application in bodies of water other than open seas. "Legs" is used broadly to refer to any form of support column, which may be a steel lattice, concrete or other suitable construction. Depending on what load is to be supported, a single column may in principle be sufficient, as shown in the first embodiment of US 4 913 591, mentioned above. 10 15

Claims 20

1. A tension leg subsea platform (TLSP) comprising a buoyant, submersible hull for subsea installation (TLSP), and tendons for anchoring the hull to the seabed at a desired depth and location, the submersible hull being adapted to provide a foundation for a working platform standing above the surface of the sea. 25

2. A subsea platform as claimed in Claim 1, in combination with a working platform suitable for mounting thereon. 30

3. A platform combination as claimed in Claim 2, wherein said working platform is a jack-up platform comprising one or more supporting columns and a working deck mounted on said column(s) for vertical travel thereon. 35

4. A platform combination as claimed in Claim 2 or 3, wherein said working platform has been fabricated separate from and mountable to the hull of the TLSP in its moored and submerged condition. 40

5. A platform combination as claimed in Claim 2, 3 or 4, wherein said working platform is a drilling platform. 45

6. A platform combination as claimed in Claim 2, 3 or 4, wherein said working platform is a production platform. 50

7. A platform combination as claimed in Claim 2, 3 or 4, wherein said working platform is a decommissioning platform. 55

8. A platform combination as claimed in any of Claims 2 to 7, wherein said working platform has been fabricated separate from and mountable to the

hull of the TLSP in its moored and submerged condition.

9. A platform combination as claimed in any of Claims 2 to 8, wherein said working platform is one which has operated at another location prior to installation on said TLSP at its present location.

10. A method of installing a working platform in a depth of water, the method comprising:

- providing a buoyant, submersible hull for subsea installation, the submersible hull being adapted to provide a foundation for a working platform standing above the surface of the sea
- anchoring the hull to the seabed at a desired depth and location by means of tendons, thereby to form a tension leg subsea platform (TLSP), and
- mounting a working platform on the TLSP.

11. A method as claimed in Claim 10, wherein said working platform is mounted subsequently to anchoring and submerging the hull to form said TLSP.

12. A method as claimed in Claim 10 or 11, wherein said working platform is a jack-up platform comprising one or more supporting columns and a working deck mounted on said column(s) for vertical travel thereon, said mounting being performed subsequently to anchoring of the TLSP by lowering the columns from the working platform until they are planted on the TLSP.

13. A method as claimed in Claim 10, 11 or 12, wherein said working platform is operated as a drilling platform.

14. A method as claimed in Claim 10, 11 or 12, wherein said working platform is operated as a production platform.

15. A method as claimed in Claim 10, 11 or 12, wherein said working platform is operated as a decommissioning platform.

16. A method as claimed in any of Claims 10 to 15, wherein said working platform is exchanged for another working platform while the TLSP remains moored.

17. A method as claimed in any of Claims 10 to 16, wherein said working platform is one which has operated at another location prior to installation on said TLSP at its present location.

17. A method as claimed in any of Claims 10 to 16, wherein the effective depth of the TLSP is in the

range 30m to 100m, while the sea at said location is substantially deeper than 100m.

18. A method as claimed in any of Claims 10 to 17, wherein the TLSP carries wellheads for connecting the working platform to seabed wells. 5

19. A platform or platform as claimed in any of Claims 1 to 9, wherein the TLSP carries wellheads for connecting the working platform to seabed wells. 10

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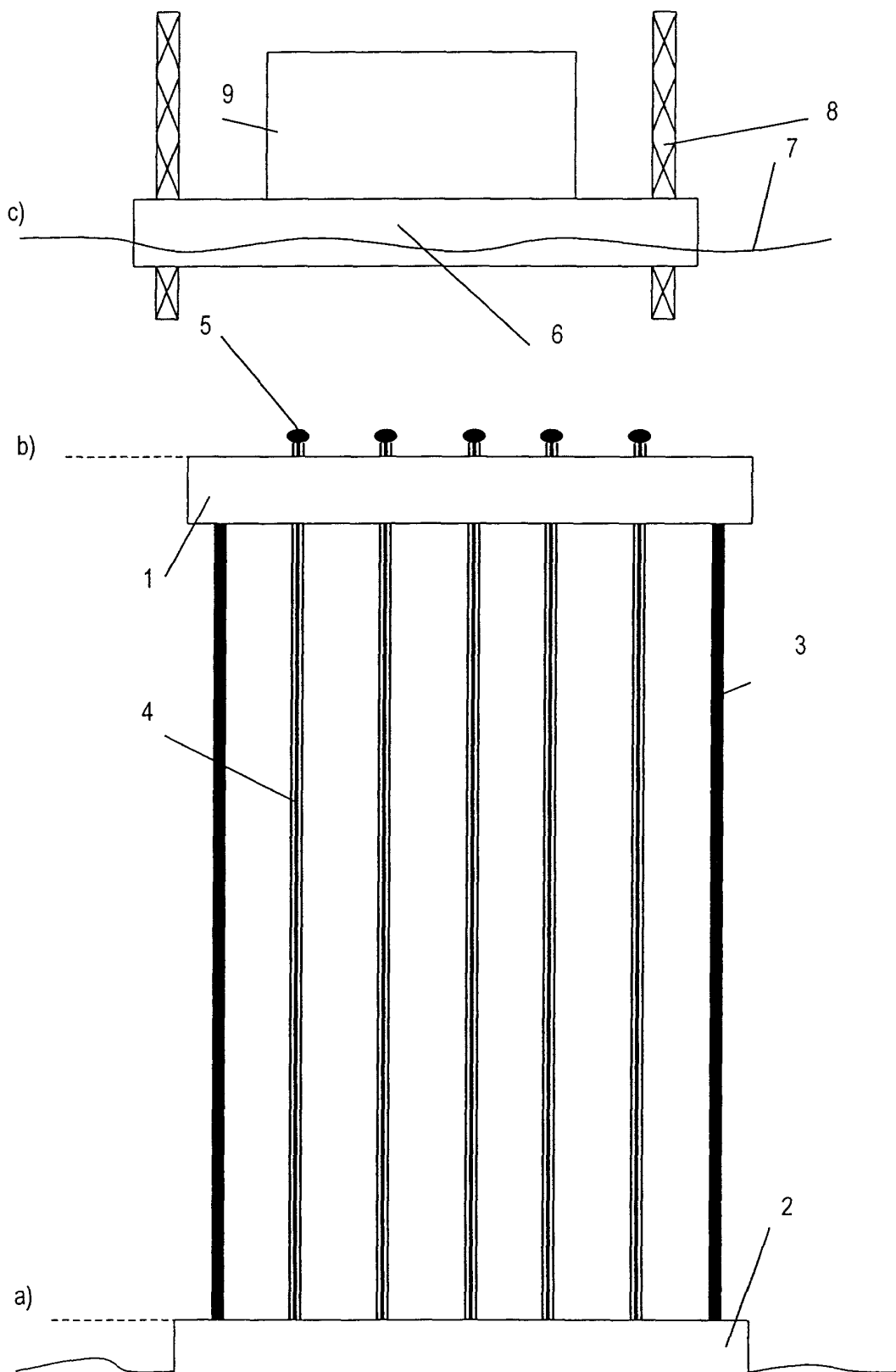


FIG 1.

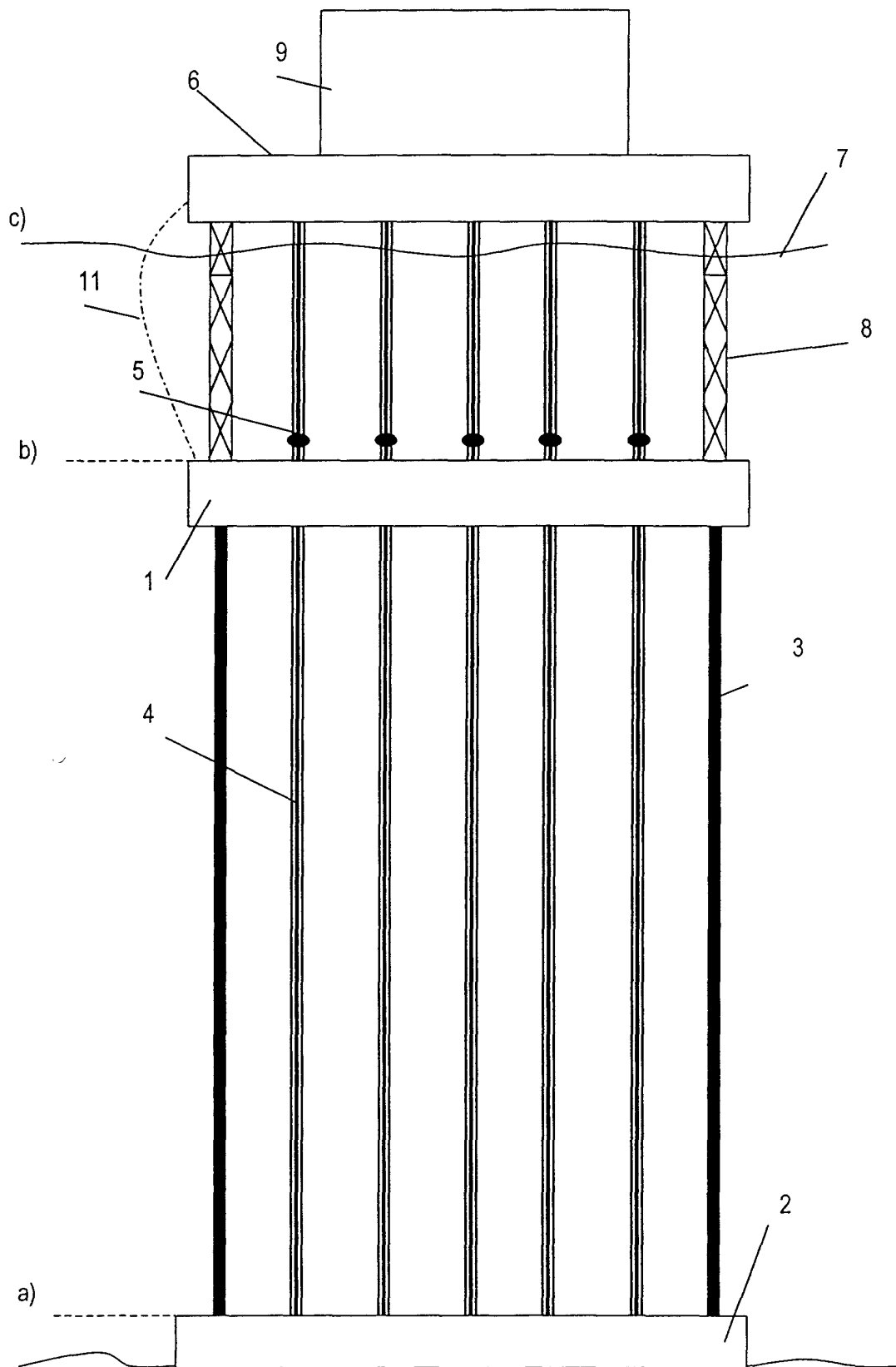


FIG 2.

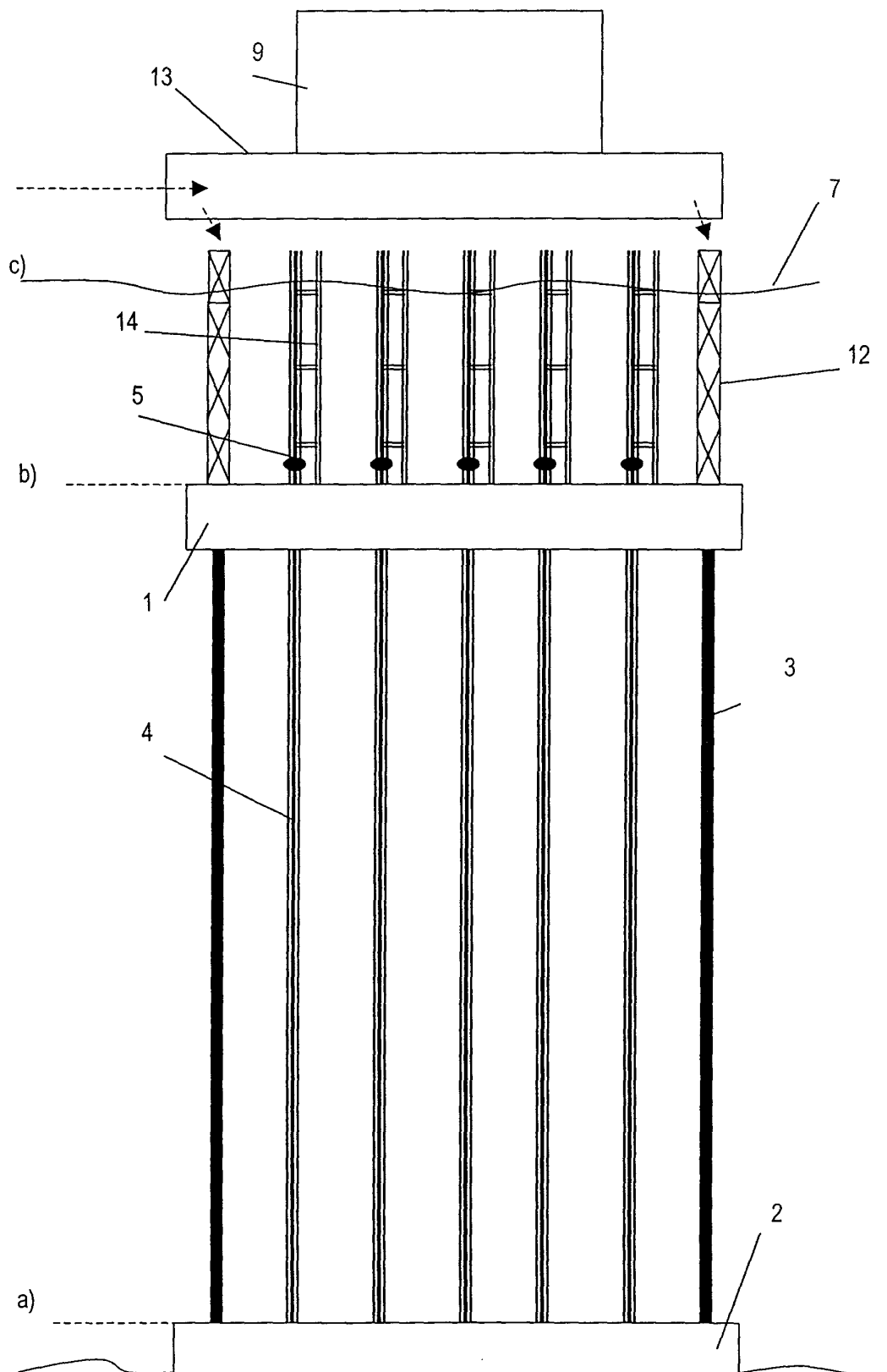


FIG 3.



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EUROPEAN SEARCH REPORT

Application Number
EP 00 40 1887

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Y	* column 3, line 25 - column 4, line 40; figures 1, 10 *	6, 7, 14, 15	
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A	US 5 575 592 A (POLLACK JACK) 19 November 1996 (1996-11-19) * column 6, line 5 - line 8 *	18	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 15 November 2000	Examiner DE SENA HERNAND.., A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/92 (P04001)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 00 40 1887

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