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[Continued on next page]

(54) **Title**: METHOD OF ERECTING A FLOATING OFF-SHORE WIND TURBINE AND A FLOATING OFF-SHORE WIND TURBINE

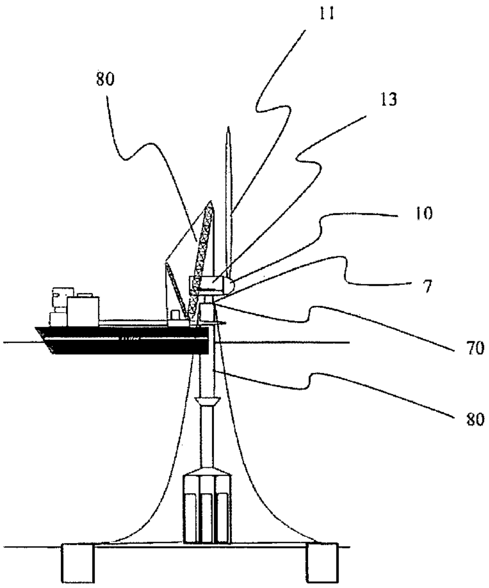

Fig 2c

(57) **Abstract**: This invention relates to a method of erecting a floating off-shore wind turbine (1), said wind turbine being modularized in modules (7, 8, 9) comprising a floatation element (20), one or more tower modules forming a tower (2), a nacelle (13) and blades (11), the method comprising the steps of: providing at least one anchorage (40) to the seabed and first and second connecting means (30, 30a, 30b) connected thereto; submerging a Sower part of said wind turbine, the latter being in a non, partly or fully assembled condition, said Sower part comprising at least the floatation element; connecting the first connecting means to a lower end of said Sower part of the wind turbine; connecting the second connecting means to one of the modules to be arranged above sea level when the wind turbine is in a fully assembled condition; and elevating said wind turbine to an operational level. The invention also relate to a floating off-shore wind turbine erected by said method.

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METHOD OF ERECTING A FLOATING OFF-SHORE WIND TURBINE AND A FLOATING OFF-SHORE WIND TURBINE

Technical field

The present invention generally relates to method of erecting a floating off-shore wind turbine and the floating off-shore wind turbine as such.

Background of the invention

Off-shore wind turbines often comprise a pile, such as a mono-pile, which is anchored to the seabed, e.g. by being driven down into the seabed or by being held in place by a structure standing on the seabed. This mono-pile, possibly together with other structures affiliated with it, forms a foundation for a wind turbine tower to be erected thereon.

This method is involved with a complicated work since the seabed varies in topography and structural stability. Further, there is also a great risk of small angular difference in the axial direction between the tower modules and the mono-pile. There are also restrictions of how far off from the coast line or at what depths such off-shore wind turbines can be erected due to the total tower/mono-pile length required to reach seabed.

Another type of off-shore wind turbine is known as a floating wind turbine. In short this means that a conventional wind turbine is mounted on a floatation element, also known as a spar buoy, the latter being provided with ballast at the bottom in order to ensure the balance.

The general problem with these solutions is the overall weight of the turbine since a considerable amount of material is needed to not only secure the turbine, but also for the latter to withstand wave forces. Also, mounting and erecting at sea can be complicated. All parts, i.e. floatation elements, tower, nacelle and blades must be transported to the off shore site and then mounted, piece by piece. This requires specially built seaborne cranes, which are expensive and not easily available. Also, it can be a complicated work providing the anchoring of the wind turbine. Alternatively, the fully assembled wind turbine with nacelle and blades mounted to the tower can be towed to the site and then fixed to the seabed. Again, this is a complicated work.

Summary of the invention

In view of the above, an object is to provide a method of erecting a floating off-shore wind turbine.

The method should allow conventional onboard ship cranes to be used.

Also, the method should be applicable no matter to what extent the wind turbine is modularized and assembled.

Further, the method should be applicable to present tower technology.

According to one aspect, the invention refers to a method of erecting a floating off-shore wind turbine, said wind turbine being modularized in modules comprising a floatation element, one or more tower modules forming a tower, a nacelle and blades, the method comprising the steps of:

providing at least one anchorage to the seabed and first and second connecting means connected thereto;

submerging a lower part of said wind turbine, the latter being in a non, partly or fully assembled condition, said lower part comprising at least the floatation element;

connecting the first connecting means to a lower end of said lower part of the wind turbine;

connecting the second connecting means to one of the modules to be arranged above sea level when the wind turbine is in a fully assembled condition; and

elevating said wind turbine to an operational level.

This method offers a number of advantages. By a modularized wind turbine in a non or partly assembled condition, the individual modules can be pre-installed with necessary installations on land, and then easily transported by boat to the site. The transportation can be made onboard a boat or by towing. The wind turbine can also, still by being modularized as such, be fully assembled on-shore and later transported to the site by boat, either on-board or by towing.

It is to be understood that the tower can be arranged as a single module as well as arranged as a number of modules to be assembled to form the tower.

The floatation element can be used as a buoyant which during transport to the site is taken in tow. This allows longer tower modules to be used or even a full sized tower or fully assembled wind turbine to be taken in tow, provided the floatation element is pre-mounted on-shore.

By the lower part of the wind turbine being formed as a floatation element that is gradually submerged during erection, i.e. as the wind turbine increases its height as more and more modules are mounted, the working surface being the upper most surface to which additional modules are to be mounted, can always be arranged more or less in level with the working platform used, such as the boat. Thereby no specially built cranes are needed, but instead conventional onboard cranes can be used. Such onboard cranes allow convenient access to all parts of the wind turbine as it is assembled. It goes without saying that the boat used for transport of the modules to the site can be used as said working platform, while at the same time storing the modules yet to be assembled. Also, additional boats can be used in order to allow use of several cranes.

In the case the wind turbine is transported to the site fully assembled, the submersion allows easy connection of the second connecting means by using said conventional onboard cranes.

By the connecting means being connected to a lower end of the lower part of the modularized tower and one of the modules to be arranged above sea level when the wind turbine is in a fully assembled condition, while the floatation element is submerged, the connecting means can be tensioned to a more or less pre-determined extent while elevating the wind turbine to its operational level. This greatly facilitates and reduces the work required for mounting and tensioning the connecting means since the lifting force of the floatation element during elevation lifts and tensions the connecting means. Any fine-tuning can though still remain.

Further, the connecting means facilitate supporting the tower against horizontal forces to which it is subjected, and vertically aligning the tower, holding the wind turbine in an upright vertical position.

Further, due to the floating design there are no restrictions as to how far off from land the wind turbine can be arranged. Rather, there is a restriction of how close to land it can be arranged, since the depth must allow submersion of at least parts of the wind turbine during assembly.

By said method, no special re-design of the tower or the wind turbine as such is necessary but rather existing tower technology can be used.

In case the wind turbine is provided in a non or partly assembled condition, the method can further comprise the step of mounting a subsequent module on top of a working surface before elevating said wind turbine to the operational level, said working surface being formed by an upper end arranged above sea level of the submerged wind turbine.

In case additional modules remain, such as additional tower modules, the nacelle or the blades, these can be assembled step by step. In case these add to the height and are not reachable or not easily reachable by the cranes used, the wind turbine can be submerged additionally to thereby always have easy access.

In case the wind turbine is provided in a non or partly assembled condition, the step of connecting the second connection means can be preceded by further submerging the partly assembled wind turbine to provide a new working surface arranged above sea level on an upper end thereof; and mounting an additional subsequent module thereto, and repeating this until the wind turbine has been fully assembled. Every time an additional subsequent module is mounted, the latter forms a new working surface. By repeatedly submerging the partly assembled wind turbine after each additional, subsequent module has been mounted, the working surface can always be kept more or less in level with the working platform used.

The tower modules can be telescopically arranged. In this case, the method can further comprise the steps of telescoping one or more telescopically arranged tower modules to extend the height of the tower, the upper most module of said telescoped tower modules forming a working surface; and further submerging the partly assembled wind turbine as the height of the tower increases to provide a new working surface arranged above sea level on an upper end thereof.

A telescopically arranged tower means that at least some of the modules forming the tower are arranged one within the other in some stage during handling, e.g during transport. The telescoping is also favourable in case of maintenance if the tower must be disassembled. In case of disassembling, it is understood that the reverse order applies.

In case the tower modules are telescopically arranged, the method can further comprise the steps of further submerging the partly assembled wind turbine to provide a new working surface arranged above sea level on an upper end thereof; and mounting an additional subsequent module thereto, and repeating this until the wind turbine has been fully assembled.

No matter if the wind turbine is non, partly or fully assembled the working surface is arranged at a height above sea level adapted to the operational range of an onboard crane. By using the crane onboard a boat no special built cranes are needed. Also, the boat can be used as working platform.

In case the wind turbine is provided in a fully assembled condition, the method can comprise the step of transporting the fully assembled wind turbine to the erection site in a horizontal or vertical position. The transportation can e.g. be made a boat transporting the wind turbine completely onboard. The wind turbine can also be towed, partly supported by the boat. Further, the wind turbine can by fully towed supported by the floatation element.

The submersion and elevation can be made by regulating the density of the floatation element. Said density can be regulated by adapting the ratio between water and gas in the floatation element. This means that the floatation element is provided with a regulation system comprising inlets, outlets, valves and pumps, regulating the volume of water and gas respectively and thereby the lifting force required. By elevating the wind turbine to an operational level by regulating the density, the laws of physics are used rather than complicated and expensive equipment especially provided for that specific purpose.

The anchorages can comprise anchoring points being evenly distributed in the circumferential direction of the tower. The number of anchoring points is preferably at least three in order to give an even balancing and force distribution. The anchorages are secured to the seabed in a manner determined by the prevailing soil conditions. The anchorages can be arranged on the same radial distance from the tower or on different radial distances.

The connecting means can be pre-tensioned during elevation of said wind turbine to the operational level. This means that the length of the connecting means can be dimensioned in advance to such length that once the fully assembled wind turbine is erected to its operational level, the initial slack of the connecting means is eliminated to such extent that only fine tuning of the tensioning remains. Such fine tuning can easily be made by e.g rigging screws etc.

The first connecting means can be connected to the floatation element. This provides for a low connecting point to the wind turbine, enhancing the balancing thereof.

The second connecting means can be connected to an upper portion of the tower. This provides for a high connection point to the wind turbine, enhancing the balancing thereof.

The first and/or second connecting means can be arranged in at least two sets each, said sets being connected to the tower/and or the floatation element at different heights thereof. The plurality of connecting points along the longitudinal extent of the wind turbine increase the stability and the balancing of the wind turbine during use since the wind turbine can be seen as a balancing standing pendulum.

The floatation element can comprise at least one compartment formed in a tower module in the lower end of the tower or be formed as at least one separate compartment attached to the lower most tower module or the lower end of the tower. Thus, the floatation element can be integrated with the tower or its modules or be provided as a separate unit formed by one or several compartments. In case of separate units, these are to be regarded as modules within the meaning of the term “modularized” as use herein.

The density can be regulated by using a regulation system comprising at least one inlet and at least one outlet, valves connected thereto, a control system and a gas supply system.

According to another aspect, the invention relates to a floating off-shore wind turbine erected by the above disclosed method.

Other objectives, features and advantages of the present invention will appear from the following detailed disclosure, from the attached claims as well as from the drawings.

Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, step, etc]" are to be interpreted openly as referring to at least one instance of said element, device, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

Brief description of the drawings

The above, as well as additional objects, features and advantages of the present invention, will be better understood through the following illustrative and non-limiting detailed description of preferred embodiments of the present invention, with reference to the appended drawing, where the same reference numerals will be used for similar elements.

Fig 1 is a schematic side view of a floating off-shore wind turbine of the present invention.

Figs 2a-2f disclose the steps of mounting and erecting a floating off-shore wind turbine.

Detailed description of preferred embodiments

Fig 1 is a schematic side view of a floating off-shore wind turbine 1 of the present invention.

As used herein the term modules is to be understood as the different main parts making up a wind turbine, no matter if these parts are assembled onshore or offshore.

The modularized disclosed wind turbine 1 comprises a tower 2 made up of one or several modules 7, 8 and 9 mounted one on top of the other. In the disclosed embodiment the tower is divided into three modules, an upper module 7, a middle module 8 and a lower module 9. It is to be understood that the number of modules should not be a limiting factor and that the tower also can be provided as a single unit. The modules forming the tower can be telescopically arranged. This applies to all tower modules or only some of them.

On top of the upper tower module 7, a nacelle 13 is mounted. To a vertical side of the nacelle 13, a rotor comprising a hub 10 and rotor blades 11 are rotatable mounted. In the sense of the invention, the nacelle, the hub and the blades all form modules.

In order to facilitate access to the tower and the interior thereof, the tower 2 can be provided with a platform 12 forming yet another module. The platform can also be used to carry personnel and wind turbine components during e.g. construction and maintenance of the wind turbine. At the level of said platform a door (not disclosed) can be arranged.

The tower can have a locally reduced cross section at sea level. By the floating element being submerged to a depth where it stays clear of the higher wave forces, the horizontal forces due to water impact are reduced. As is known, the wave forces are very high at surface level and decrease with diminishing depth. Depending on factors such as the overall strength of the tower and the prevailing sea depth, the longitudinal extent of the tower below sea level, i.e. the position of the floating element can be adapted to the specific conditions prevailing. Also, it is as will be understood, a matter of the total height of the tower above sea level since the wind turbine can be seen as a balancing standing pendulum.

A floatation element 20, forming a module, is connected to the lower end of the tower 2.

In the disclosed embodiment the floatation element 20 is arranged as a plurality of interconnected compartments 21, 22, 23 arranged to the lower end of the tower 2. The disclosed compartments 21, 22, 23 are arranged to the outer periphery of the tower 2 surrounding the same. Also, the lower end of the tower or the lower-most module forming part of the tower can as a whole or as a part form a compartment. In that case, the interior of that module of the tower is acting as said floatation element. Alternatively, the floatation element can be formed by a combination of compartments formed by the tower and by compartments attached thereto.

The floatation element 20 is axially aligned with the longitudinal extent of the tower 2.

The floatation element 20 is filled and emptied with water and gas respectively in order to control the degree of submersion or elevation of the tower 2 and the floatation element 20. More precisely, the submersion and elevation is made by regulating the density of the floatation element 20. The density is regulated by changing the ratio between water and gas in the floatation element 20. Accordingly, the floatation element 20 can be seen as a ballast tank. It is to be understood that some of the compartments 21, 22, 23 can be arranged to be filled with gas only. In its simplest form, the gas used is air.

For this purpose the floatation element 20 is provided with a highly schematically disclosed regulation system 25. It is to be understood that each compartment 21, 22, 23 making up the floatation element 20 can be provided with its own regulation system 25, or the floatation element as a whole can be provided with one regulation system serving all compartments. In the latter case the individual compartments 21, 22, 23 can be communicating with each other.

The regulation system 25 comprises at least (not disclosed) one inlet and at least one outlet, valves connected thereto, a control system and a gas supply system.

By altering the ratio between water and gas in the floatation element 20, the floatation element can either function as a floating element elevating the wind turbine 1 or as a weight submerging the same. Accordingly, the tower 2 together with the floatation element 20 can be seen as a standing pendulum balancing in the vertical direction in the sea.

The floatation element can in addition comprise additional modules or compartments of a material having a density lower than water. Such additional floatation elements can be connected upon need or be permanently connected .The material can be a low density material such as foam or gas. Thus, as used herein, the term “material” is used in a broad sense to refer to any type of matter associated with a structure. In case of gas, the additional floatation elements can be inflatable compartments.

Connecting means 30 connect the wind turbine 1 to the seabed. In the disclosed embodiment two sets of connecting means are used. A first set 30a extends from the floatation element 20 to anchorages 40 in the seabed. A second set 30b of connecting means 30 extend from the tower 2 to the anchorages.

The connecting means 30b extending from the tower 2 preferably connect to the tower above sea level. In case of two or more sets of connecting means extending from the tower to the anchorage, they preferably engage the tower at different heights. It is to be understood that the number of sets of connecting means can be varied. Further, the number of connecting means in each set can be varied depending on types and dimensions, but the number of connecting means in each set is preferably at least three and even more preferred at least six.

In the disclosed embodiment the two sets of connecting means 30a, 30b extend to the same anchorages 40 but it is to be understood that they can connect to different anchorages.

The connecting means 30 and anchorages 40 are distributed evenly spaced.

The connecting means 30 may extend from any part of the tower 2. If the tower is divided into a plurality of modules 7, 8, 9 the connecting means 30 may extend from any one of the modules or from a plurality of the modules, depending on the design and requirements of the wind turbine.

The connecting means 30 can be from the group consisting of rods, wires, chains and ropes or any combination thereof. In case of a combination, it can be a combination of two or more of the listed types. All the connecting means supporting the tower may be similar in type, or combination of types, or they may be different such that e.g. some connecting means are of one type or combination of types and others are of a different type or combination of types. Regardless of whether a connecting means is a combination of different types or not, it may be convenient to allow the connecting mean to comprise a plurality of exchangeable segments connected to each other. An advantage of such a connecting mean is that segments of the element may be individually replaced, without having to replace other segments of the connecting mean. This may facilitate maintenance caused by e.g. corrosion.

The connecting means may comprise rigging screws, or any other means for facilitating tightening and adjusting.

The anchorages 40 can be of any type depending on the prevailing seabed and it is well known to the skilled person to choose a suitable type. Also, although the disclosed anchorages 40 are arranged at the same radial distance from the tower, it is to be understood that they can be arranged at different radial distances.

Now turning to figures 2a-2f, method of erecting a wind turbine of the invention will be described. It is to be understood that the order of performance of the different steps can be changed and that this is only one embodiment out of many falling within the scope of the invention.

The method will be illustrated referring to a wind turbine having a pre-assembled tower comprising two tower modules 8 and 9 in its lower end and a third tower module 7 in the upper end. The third module is telescopically arranged within the tower module 8 forming the middle tower module.

Starting with Fig. 2a, anchorages 40 are arranged as an initial step to the seabed. The type, size, number and distribution depends, as is given above, on the prevailing type of seabed and on the expected loads to the wind turbine during operation.

Connecting means 30 are connected to the anchorages 40. The connecting means 30 can be provided with floating bodies 50 in order to at least partly elevate them from the seabed to enhance accessibility during the work to follow.

As disclosed, during transport, the tower 2 or the lower most module together with the floatation element 20 mounted is towed by a boat 60, with the boat supporting the tower. In the disclosed view the boat supports the tower module 8, which in the fully erected wind turbine will form the middle tower module. The upper most tower module 7 is telescopically arranged within the middle module and thereby not visible. Any such pre-assembling is preferably made onshore where the floatation element is also pre-filled with gas.

As a next step, see Fig. 2b, the density of the floatation element 20 is increased by changing the ratio between water and gas in the floatation element 20, whereby at least a part of the floatation element is submerged below water level. In this submerged position, the previously mounted connecting means 30 are connected to at least the floatation element 20. Depending on the initial longitudinal extent of the tower module mounted thereto, the second connecting means can also be connected to the tower at this stage of erection. Due to the submersion of the floatation element 20, the connecting means 30 have an initial slack.

In this position, the floatation element 20 and any tower module 2 mounted thereto is standing in an upright position in the water with the floatation element 20 facing the seabed and the upper end of the tower module arranged above sea level. Provided no tower module was mounted to the floatation element before submersion, an upper end of the floatation element to which a tower module is to be assembled is now arranged above sea level. The upper end arranged above sea level, no matter which module it is formed by, forms a working surface 70.

The change of ratio between water and gas in the floatation element 20 is made by means of the regulation system 25. Depending on the design of the compartments 21, 22, 23 of the floatation element 20, each compartment can have its own regulation system, or all compartments can be served by one and the same regulation system.

The degree of submersion is adapted so that the working surface 70 is at a level above sea level which is easily accessible by a conventional onboard crane 80 on the boat 60. In this position a subsequent module is assembled to the working surface 70, see Fig 2c disclosing mounting of the nacelle 13 and a first blade 11. In the disclosed embodiment, the nacelle is in fact mounted to what is to form the upper most tower module 7, which is kept within what is to form the middle tower module 8. The upper tower module 7 is in this stage kept telescopically inside the middle tower module 8.

The assembling is made by using the onboard crane 80 which can pick the module to be mounted from a position on or below deck and lift it to the working surface 70 for it to be mounted thereto by using e.g. bolting or welding. If necessary an additional crane from an additional boat can be used. The upper end of this subsequent assembled module forms a new working surface.

In case the wind turbine increases in height when mounting subsequent modules thereto, the working surface can fall outside the operational range of the crane. To gain access to this new working surface, the now partly assembled wind turbine can be further submerged to so that the new working surface again is in level with the boat and the operating range of the onboard crane. This process is repeated until all modules of the wind turbine have been assembled, e.g. all tower modules, the nacelle and the blades.

During submersion, when the intended connection point along the wind turbine for the connection of the connection means 30 are in level with the crane 80, the second connecting means already connected to the anchorages, are lifted up and connected to the intended connection point along the longitudinal extent of the wind turbine, still with a slack.

Once all modules of the wind turbine have been assembled, it is time to elevate the wind turbine to its operational level, see Fig 2d and 2e. This is made by decreasing the density of the floatation element 20, i.e. by changing the ratio between water and gas.

During this elevation, the previously mounted connecting means 30 between the anchorages 40 and the tower 2 and the floatation element 20, respectively will automatically be tensioned. Any slack still remaining can be fine tuned by using e.g. rigging screws or the like.

It is to be understood that if the possible density increase/decrease allowable by the floatation element and the available volume that can be filled with water or gas should not be sufficient to provide the necessary degree of submersion or elevation, additional weights or floating elements can be mounted upon need. Additional floating elements can e.g. be formed as inflatable elements.

With reference to Fig. 2f, in this position, the tower module 7 to form the upper most tower section, is telescoped, whereby the nacelle 13 and the blades 11 are raised to the intended operational level, and also so that the blades are allowed to rotate freely without engaging the second connecting means 30. If maintenance is needed later on the upper most tower module 7 can be lowered by telescoping in the reversed direction. This can off course be combined with submersion.

If the tower is designed without telescoping, maintenance can easily be performed by using the regulation system to submerge the wind turbine to gain access and then again elevate the same to its operational level.

The method has above been described by referring to a non or partly assembled wind turbine. In case the wind turbine is fully assembled in advance, the wind turbine is towed to the erection site supported by the floatation element. At the site it is submerged in order to be able to connect the connecting means thereto and then elevated to the operational level. Thus the erecting is made by using the same methodology as described with reference to Figs. 2a-2f.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

CLAIMS

1. Method of erecting a floating off-shore wind turbine (1), said wind turbine being modularized in modules comprising a floatation element (20), one or more tower modules (7, 8, 9) forming a tower (2), a nacelle (13) and blades (11), the method comprising the steps of:

providing at least one anchorage (40) to the seabed and first and second connecting means (30, 30a, 30b) connected thereto;

submerging a lower part of said wind turbine, the latter being in a non, partly or fully assembled condition, said lower part comprising at least the floatation element (20);

connecting the first connecting means (30a) to a lower end of said lower part of the wind turbine;

connecting the second connecting means (30b) to one of the modules (7, 8, 9) to be arranged above sea level when the wind turbine is in a fully assembled condition; and

elevating said wind turbine (1) to an operational level.

2. The method according to claim 1, the wind turbine (1) being in a non or partly assembled condition, further comprising the step of

mounting a subsequent module on top of a working surface (70) before elevating said wind turbine (1) to the operational level, said working surface being formed by an upper end arranged above sea level of the submerged wind turbine.

3. The method of erecting a floating off-shore wind turbine (1) according to claim 2, wherein the step of connecting the second connection means (30b) is preceded by

further submerging the partly assembled wind turbine to provide a new working surface arranged above sea level on an upper end thereof; and

mounting an additional subsequent module thereto, and repeating this until the wind turbine has been fully assembled.

4. The method of erecting a floating off-shore wind turbine (1) according to claim 1, the wind turbine being in a non or partly assembled condition, further comprising the steps of:

telescoping one or more telescopically arranged tower modules to extend the height of the tower, the upper most module of said telescoped tower modules forming a working surface (70);

further submerging the partly assembled wind turbine as the height of the tower increases to provide a new working surface arranged above sea level on an upper end thereof.

5. The method of erecting a floating off-shore wind turbine (1) according to claim 4, further comprising the steps of

further submerging the partly assembled wind turbine to provide a new working surface (70) arranged above sea level on an upper end thereof; and

mounting an additional subsequent module thereto, and repeating this until the wind turbine has been fully assembled.

6. The method of erecting a floating off-shore wind turbine (1) according to any of claims 2-5, wherein the working surface (70) is arranged at a height above sea level adapted to the operational range of an onboard crane (80).

7. The method according to claim 1, the wind turbine (1) being in a fully assembled condition, comprising the step of transporting the fully assembled wind turbine to the erection site in a horizontal or vertical position.

8. The method of erecting a floating off-shore wind turbine (1) according to any of the preceding claims, wherein the submersion and elevation is made by regulating the density of the floatation element (20).

9. The method of erecting a floating off-shore wind turbine (1) according to claim 8, wherein the regulation of density is made by changing the ratio between water and gas in the floatation element (20).

10. The method of erecting a floating off-shore wind turbine (1) according to any of the preceding claims, wherein the anchorages (40)

comprise anchoring points being evenly distributed in the circumferential direction of the tower (2).

11. The method of erecting a floating off-shore wind turbine (1) according to any of the preceding claims, wherein the connecting means (30, 30a, 30b) are pre-tensioned during elevation of said wind turbine (1) to the operational level.

12. The method of erecting a floating off-shore wind turbine according to any of the preceding claims, wherein the first connecting means (30a) are connected to the floatation element (20).

13. The method of erecting a floating off-shore wind turbine (1) according to any of the preceding claims, wherein the second connecting means (30b) are connected to an upper portion of the tower (2).

14. The method of erecting a floating off-shore wind turbine (1) according to any of the preceding claims, wherein the first and/or second connecting means (30a, 30b) are arranged in at least two sets each, said sets being connected to the tower (2)/and or the floatation element (20) at different heights thereof.

15. The method of erecting a floating off-shore wind turbine according to any of the preceding claims, wherein the floatation element (20) comprises at least one compartment (21, 22, 23) formed in a tower module in the lower end of the tower or is formed as at least one separate compartment attached to the lower most tower module or the lower end of the tower.

16. The method of erecting a floating off-shore wind turbine according to claim 8, wherein the density is regulated by using a regulation system (25) comprising at least one inlet and at least one outlet, valves connected thereto, a control system and a gas supply system.

17. A floating off-shore wind turbine erected by the method of any of claims 1-16.

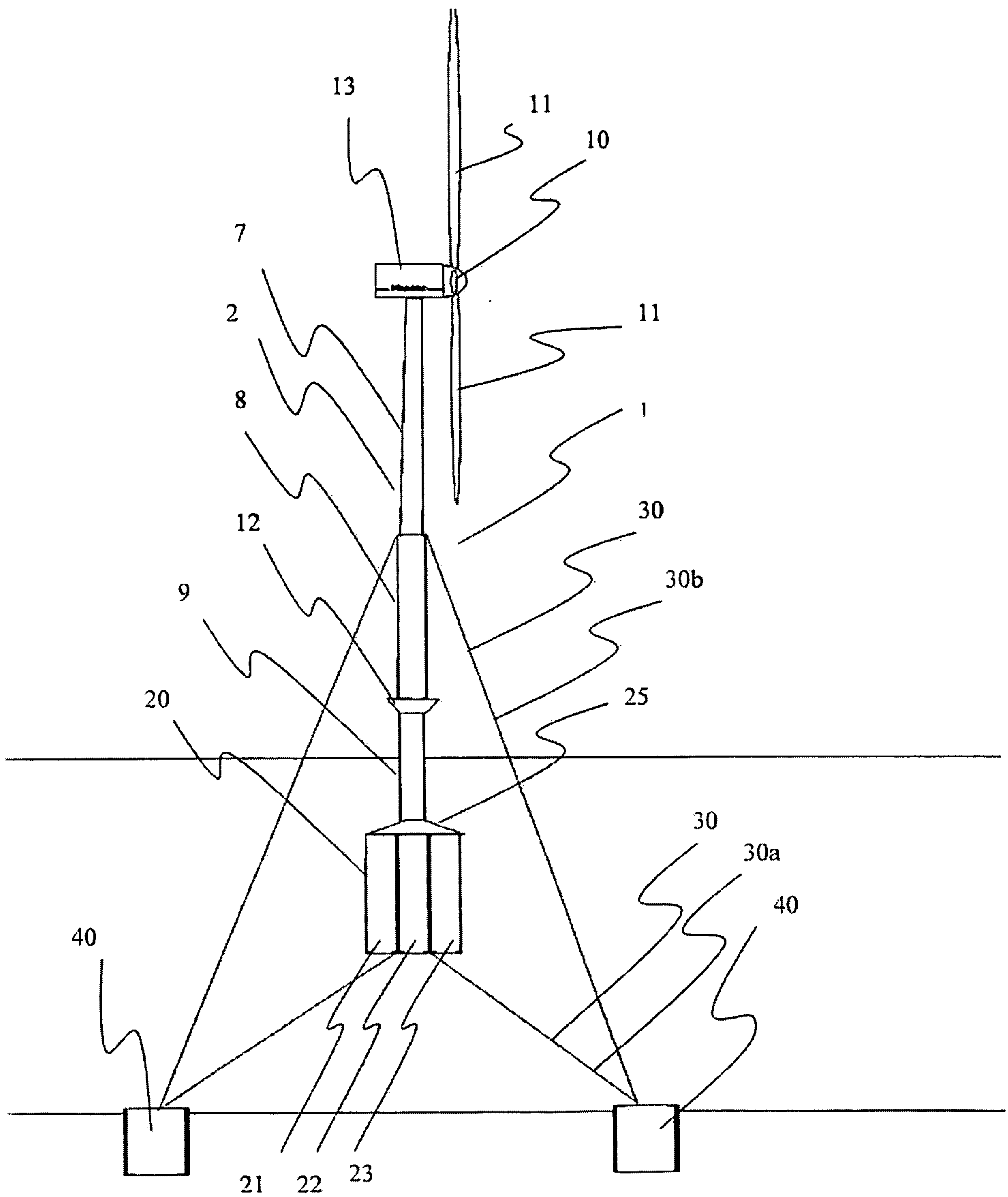

Fig 1

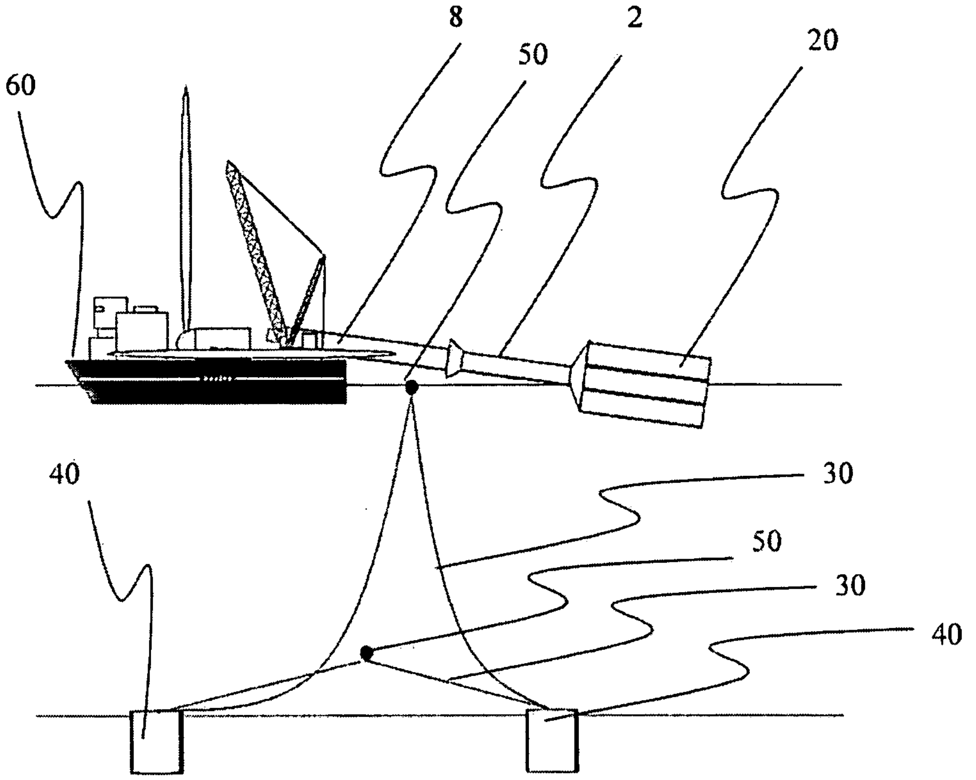

Fig 2a

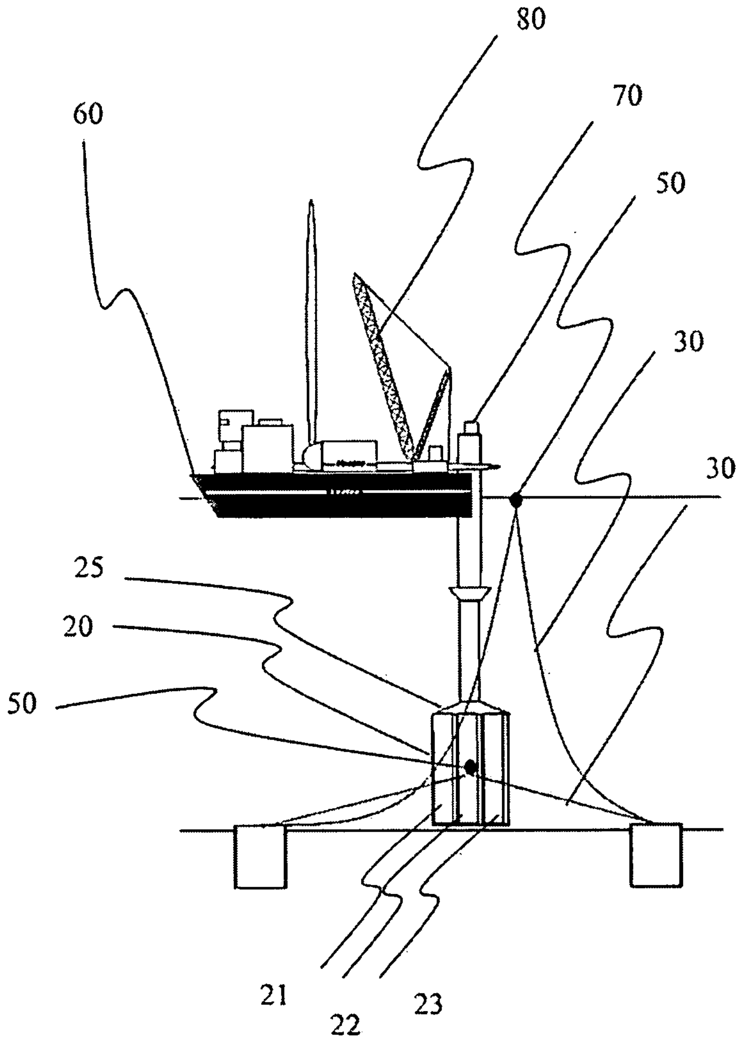

Fig 2b

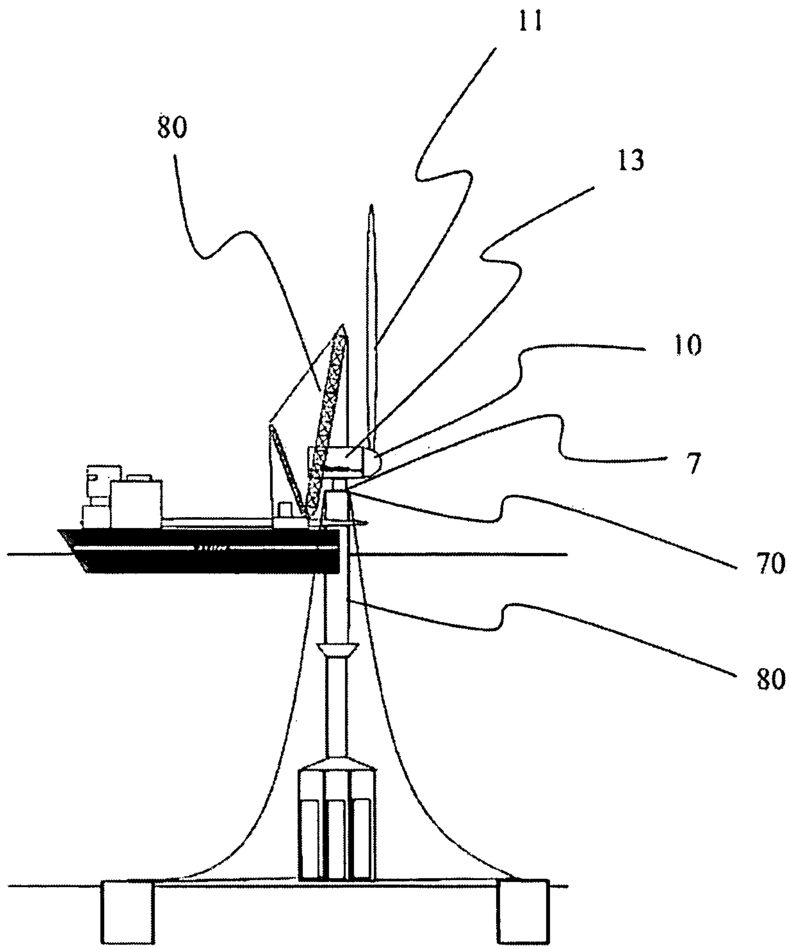

Fig 2c

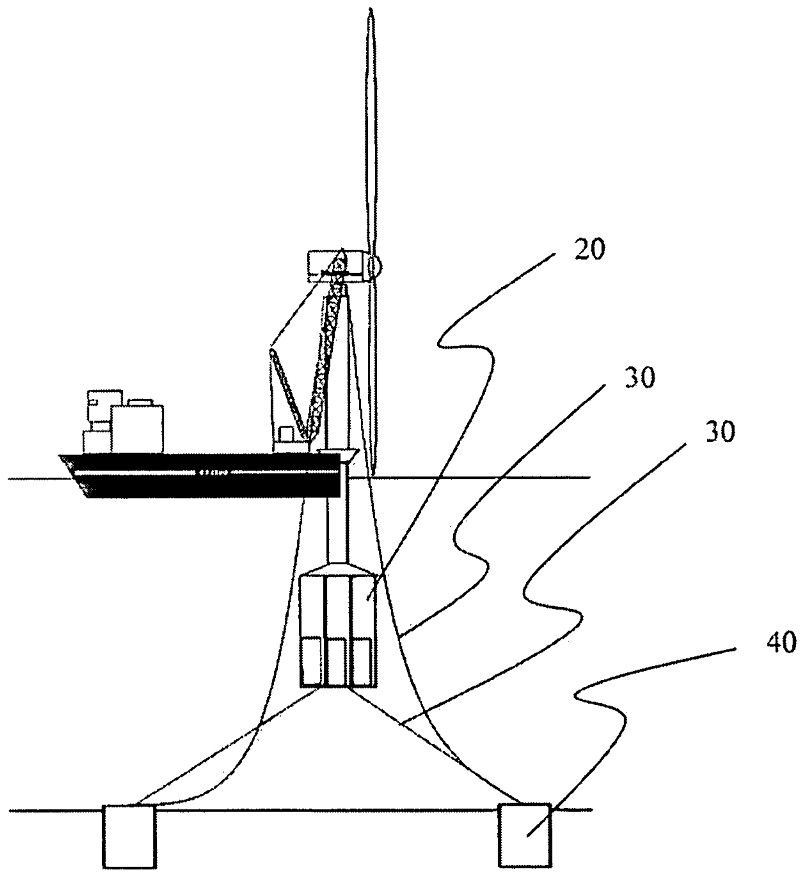

Fig 2d

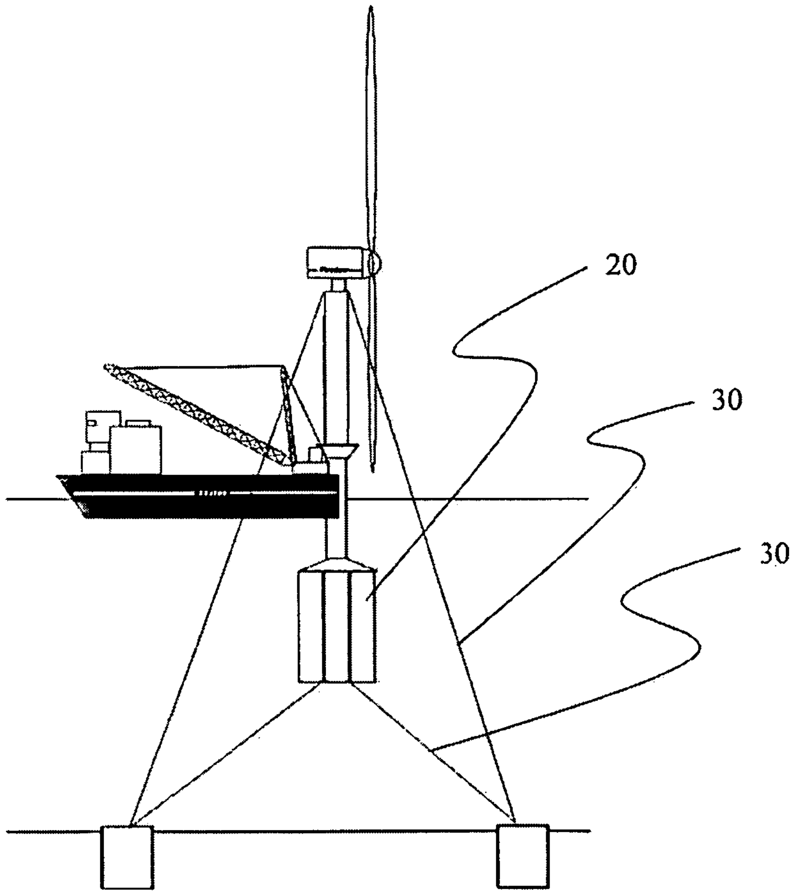

Fig 2e

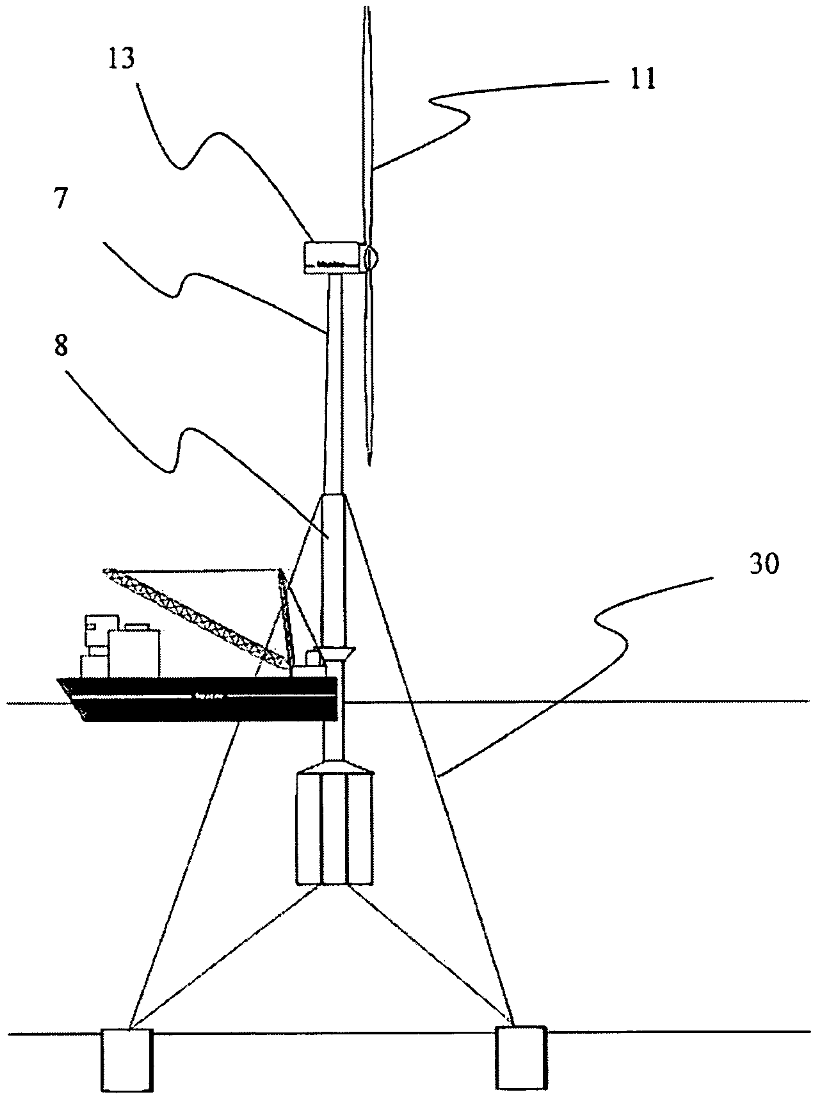

Fig 2f