SUBMERSIBLE PLATFORM WITH BLOCKED THRUST FOR OFFSHORE WIND PLANTS IN OPEN SEA IN CONCRETE-STEEL HYBRID SOLUTION

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ABSTRACT

A tension-legged offshore submerged platform, in hybrid concrete-steel solution, having a pre-stressed concrete central body; a steel peripheral structure, which is connected to the central body through steel stiffeners, and further to a basement for such a platform.
SUBMERSIBLE PLATFORM WITH BLOCKED THRUST FOR OFFSHORE WIND PLANTS IN OPEN SEA IN CONCRETE-STEEL HYBRID SOLUTION

BACKGROUND

[0001] In US 2008/0014025 A1 a mounting system for mounting structures and equipment such as wind-electric generators on water comprising a carrier is disclosed which is attached to a foundation through connecting elements. The carrier has an inherent buoyancy and the connecting elements are used to maintain a stable position of the carrier in the water.

[0002] WO 02/10589 A1 shows a wind powered generator for locating offshore comprises a semi-submersible structure made of concrete or steel for carrying a wind turbine. The semi-submersible structure comprising a buoyancy chamber and is secured to the sea bed by a primary anchor cable (mooring line) and auxiliary anchor cables. The primary anchor cable is secured in the buoyancy chamber by a connecting bracket. Additionally, a winching mechanism is provided for winching the semi-submersible structure downwardly on the primary anchor cable in the water against the upward buoyancy force acting on the semi-submersible structure.

[0003] FR 1 327 924 A shows a platform comprising a first caisson and a second caisson which can be made from pre-stressed concrete. The second caisson is held in position by cables. Winches are mounted on the corners for level adjustment. In use the winches are exposed to the sea water.

SUMMARY OF THE INVENTION

[0004] The object of the present invention is a submersible offshore wind platform with blocked thrust, constituted by a concrete-steel mixed structure, according to some features specified in the Italian patent Nr. 0001331996. Said Italian patent Nr. 0001331996 relates to a submersed floating platform with the double function of support base for wind plant in combination with a mariculture plant. The whole is implemented by using a partially submerged platform with blocked thrust, ballastable and transportable as far as the site wherein it is anchored to a basement placed onto the seafloor; the anchoring being implemented with connection tie rods apt to support even combined weights, pressures and efforts, due to the floating force and to the outer forces deriving from the sea and from the wind.

[0005] The object of the present invention is to overcome some critical aspects linked to the use of a platform according to the features of the patent Nr. 0001331996, in the specific case relating to the configuration, the materials used in the implementation, the system for anchoring the platform to the basement, as well as the use of the latter as semi-submersible pontoon whereupon the platform in the construction plant is to be constructed and assembled. At the construction plant, the wind turbine is mounted on the structure after which the entire unit is to be transported from the construction plant to the offshore site.

[0006] The platform object of the present invention is a submersible platform, with blocked thrust, equipped with an axial-symmetric central body made of pre-stressed concrete and a peripheral structure made of steel connected thereto by means of a plurality of stiffening members. A solution of this kind allows obtaining several advantages: to contain the whole weight of the structure, to guarantee high features of mechanical resistance, to simplify and economize the construction, to allow implementing the platform itself by avoiding or however limiting to resort to qualified building crafts for special processes (welding, etc.).

BRIEF DESCRIPTION OF THE DRAWING

[0007] The detailed description of the invention will refer specifically to the figures wherein a preferred embodiment example of the present invention is represented, absolutely not for limptive purposes.

[0008] In particular:

[0009] FIG. 1 represents a scheme of the general configuration of the system;

[0010] FIG. 2 represents a plan and a section view of the basement;

[0011] FIG. 3 represents a plan view of the submerged platform.

DETAILED DESCRIPTION

[0012] As it can be seen from the above-mentioned figures, the platform comprises a central body 1 made of pre-stressed concrete, a peripheral structure made of steel 2 connected to the central body 1 by means of specific inserts made of steel 9 buried in the concrete, tie rods made of steel 10 and a stiffening ring 5. The central body is dominated by a tower made of steel 12 supporting the wind turbine.

[0013] Fundamental feature of the present invention is the system for anchoring the platform to the basement 15, comprising a plurality of textile ropes 6 which, anchored downwards the basement 15, extend upwards to penetrate inside the central body 1. At the top of the central body 1, tensioning systems 11 are placed, planned to allow modifying the length of the ropes 6, having effect onto the preload of the same, by even a great number of meters. This feature also allows compensating the possible vertical settling of the basement 15, even by several metres, consequent to the action of the various marine currents, above all in sites with a huge layer of sand, by acting simply from the inside of the platform. The solution further comprises devices 7 and 8 apt to protect the ropes 6 extending outwardly the platform and to minimize/annul the frictions along the route of the same. The platform already object of the patent Nr. 0001331996, on the contrary, was characterized by the use of tie rods (for example chains) which at the periphery tied up vertically the platform to the counterweight or anchor weight (basement). Such chains were anchored to the legs of the platform with hydraulic jacks equipped with mechanical safe devices and therefore adjustable in a limited way.

[0014] In such case, the length of the chains had to be defined based upon the depth and condition of the seabed, so that the wished preload onto the tie rods was implemented. This requested to perform precise surveys of the seabed. Furthermore, during installation, and then for maintenance purposes, the reference solution requested the use of scuba divers.

[0015] These problems are overcome in the present invention thanks to the use of said textile ropes 6 with related tensioning system 11 incorporated at the top of the central body 1.

[0016] Furthermore, as far as the use of the materials is concerned, a platform only made of pre-stressed concrete comprising a central body tied up, in the lower portion, to a
Peripheral crown, made of concrete too, would have a weight constituted by 80% by the peripheral portion and by 20% by the central body. On the other hand, the structure wholly made of steel would be relatively light in the peripheral portion, but would require long periods of time, qualified building crafts and high costs for the implementation thereof.

The structure made of pre-stressed concrete and steel object of the present invention adds up the advantages of the solutions wholly made of concrete and wholly made of steel, by eliminating the disadvantages thereof. The solution of the patent No. 0001331996 provided to transport the platform to the site and, subsequently, to anchor it by means of the tie rods to the basement previously arranged onto the seabed. On the contrary, the solution of the present invention comprises a basement made of pre-stressed concrete with free volumes which can be pressurized with air and which can be flooded, which, after the construction thereof, can be used as semi-submersible pontoon for constructing the platform thereupon and the joined transportation basement plus the construction plant to the site.

Furthermore, during the unit installation, the basement during the submersion thereof, remains anchored to the platform standing above, through said ropes, which is kept in tension, with positive effect on the system stability.

1. A tension legged offshore submerged platform for offshore wind plants in an open sea, in hybrid concrete-steel solution, comprising:
a pre-stressed concrete central body, and
a steel peripheral structure, surrounding the central body and which is connected to the central body through steel stiffeners.

2. The platform according to claim 1, further comprising:
an anchorage system of the platform, which is anchored to a basement and includes a plurality of textile ropes, which are anchored downwards to the basement and extend upwards until they penetrate inside the central body, and
at least one tensioning system operating to modify a rope length and preloading the ropes themselves, said tensioning system being located at the top of cylindrical the central body.

3. - 4. (canceled)

5. The platform according to claim 2, wherein the at least one tensioning system is provided above sea level.

6. The platform according to claim 2, further comprising protection devices for protecting the textile ropes.

7. The platform according to claim 2, wherein the basement is formed from pre-stressed concrete, including free volumes, which are pressurizable with air and floodable, such that the basement operates as a semi-submerged pontoon for constructing the platform and for transporting the basement and platform from a building yard to an offshore site.

8. The platform according to claim 7, wherein during installation of the platform at an offshore site, the platform remains anchored to the basement such that the platform is partially submerged by means of said textile ropes in tension.

9. The platform according to claim 2, further comprising free volumes, which are pressurizable with air and floodable such that the platform operates as a semi-submerged pontoon for constructing the platform and for transporting the basement and platform from a building yard to an offshore site.

10. Platform according to claim 9, wherein during installation of the platform at an offshore site, the platform remains anchored to the basement such that the platform is partially submerged by means of said textile ropes in tension.

11. The platform according to claim 2, wherein the at least one tensioning system is provided inside of the central body.

12. The platform according to claim 11, wherein the at least one tensioning system is provided above sea level.

13. The platform according to claim 12, further comprising protection devices for protecting the textile ropes.

14. The platform according to claim 13, wherein the basement is formed from pre-stressed concrete, including free volumes, which are pressurizable with air and floodable, such that the basement operates as a semi-submerged pontoon for constructing the platform and for transporting the basement and platform from a building yard to an offshore site.

15. The platform according to claim 14, wherein during installation of the platform at an offshore site, the platform remains anchored to the basement such that the platform is partially submerged by means of said textile ropes in tension.

16. The platform according to claim 13 further comprising free volumes, which are pressurizable with air and floodable such that the platform operates as a semi-submerged pontoon for constructing the platform and for transporting the basement and platform from a building yard to an offshore site.

17. Platform according to claim 16, wherein during installation of the platform at an offshore site, the platform remains anchored to the basement such that the platform is partially submerged by means of said textile ropes in tension.

18. The platform according to claim 12, wherein the basement is formed from pre-stressed concrete, including free volumes, which are pressurizable with air and floodable, such that the basement operates as a semi-submerged pontoon for constructing the platform and for transporting the basement and platform from a building yard to an offshore site.

19. The platform according to claim 18, wherein during installation of the platform at an offshore site, the platform remains anchored to the basement such that the platform is partially submerged by means of said textile ropes in tension.

20. The platform according to claim 12, further comprising free volumes, which are pressurizable with air and floodable such that the platform operates as a semi-submerged pontoon for constructing the platform and for transporting the basement and platform from a building yard to an offshore site.

21. Platform according to claim 20, wherein during installation of the platform at an offshore site, the platform remains anchored to the basement such that the platform is partially submerged by means of said textile ropes in tension.

22. The platform according to claim 11, further comprising protection devices for protecting the textile ropes.

23. The platform according to claim 11, wherein the basement is formed from pre-stressed concrete, including free volumes, which are pressurizable with air and floodable, such that the basement operates as a semi-submerged pontoon for constructing the platform and for transporting the basement and platform from a building yard to an offshore site.

24. The platform according to claim 23, wherein during installation of the platform at an offshore site, the platform remains anchored to the basement such that the platform is partially submerged by means of said textile ropes in tension.

25. The platform according to claim 11, further comprising free volumes, which are pressurizable with air and floodable such that the platform operates as a semi-submerged pontoon for constructing the platform and for transporting the basement and platform from a building yard to an offshore site.
26. Platform according to claim 25, wherein during installation of the platform at an offshore site, the platform remains anchored to the basement such that the platform is partially submerged by means of said textile ropes in tension.

27. The platform according to claim 1, further comprising free volumes, which are pressurizable with air and floodable such that the platform operates as a semi-submerged pontoon for constructing the platform and for transporting the basement and platform from a building yard to an offshore site.

28. Platform according to claim 27, wherein during installation of the platform at an offshore site, the platform remains anchored to the basement such that the platform is partially submerged by means of said textile ropes in tension.

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