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(54) **(METHOD OF) CONSTRUCTION OF A SUBMERGED FLOATING FOUNDATION WITH A BLOCKED VERTICAL THRUST AS A SUPPORT BASE FOR THE INSTALLATION OF A WIND TURBINE, OF AN ELECTROLYSER FOR THE ELECTROLYSIS OF WATER AND OF OTHER EQUIPMENT, COMBINED WITH FISH FARMING**

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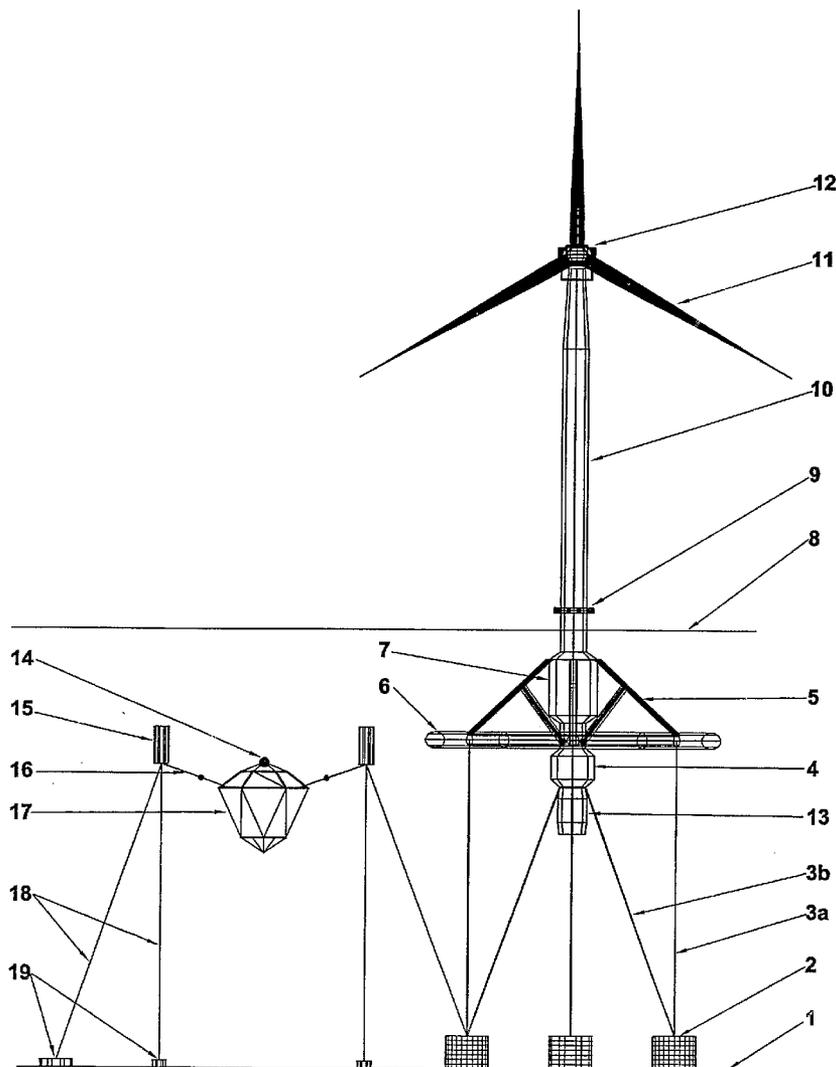
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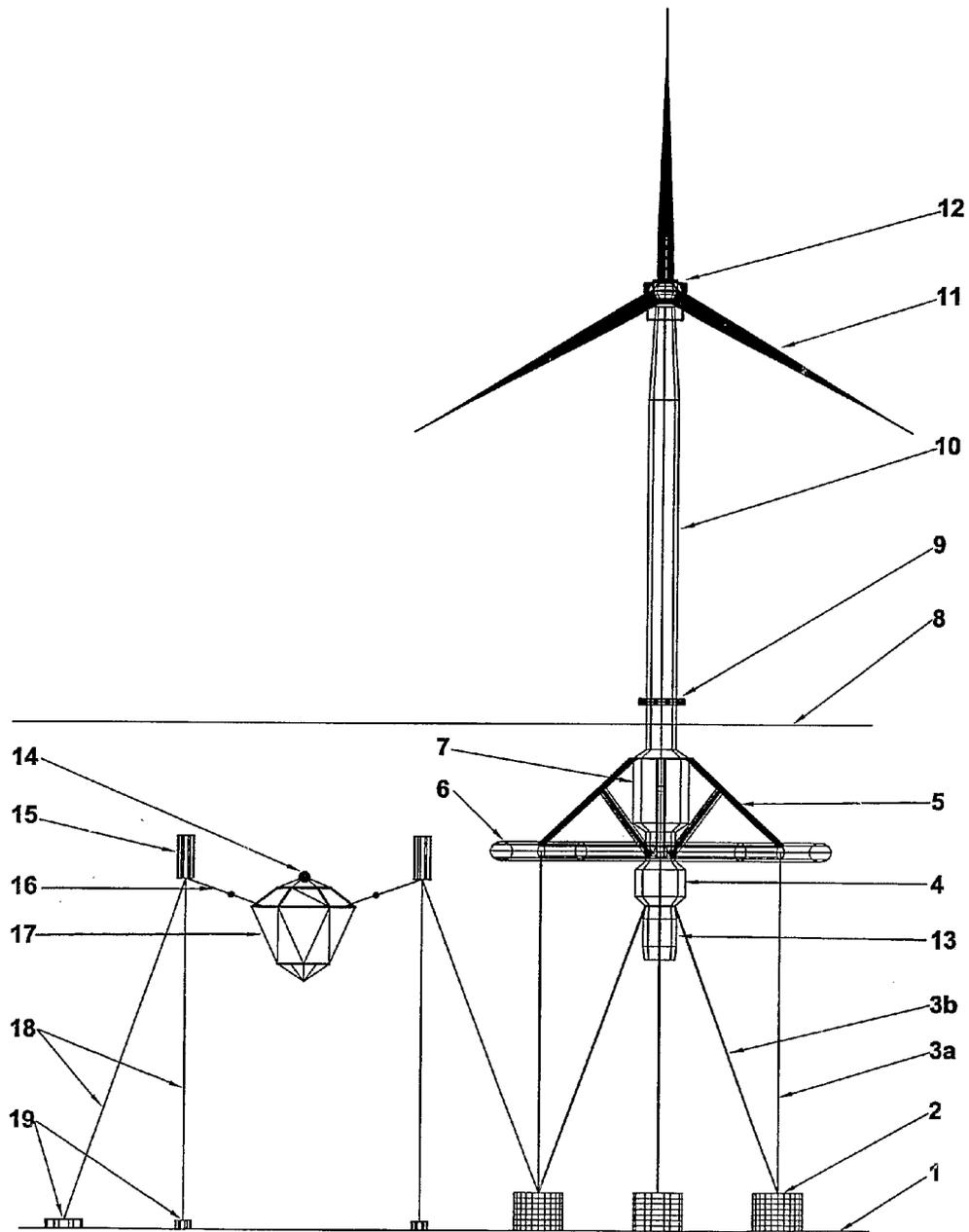
(57) **ABSTRACT**

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The invention is related to a method of positioning chains or pipes on the upper part of a floating foundation in order to make the foundation more rigid and stable.

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**(METHOD OF) CONSTRUCTION OF A
SUBMERGED FLOATING FOUNDATION
WITH A BLOCKED VERTICAL THRUST AS
A SUPPORT BASE FOR THE INSTALLATION
OF A WIND TURBINE, OF AN
ELECTROLYSER FOR THE ELECTROLYSIS
OF WATER AND OF OTHER EQUIPMENT,
COMBINED WITH FISH FARMING**

[0001] The present invention relates to the combination of innovative techniques for the construction of a submerged floating foundation, to be used as a submerged support base for a wind turbine and for an electrolyser, and with the possibility of utilising the entire submerged facility to house additional equipment; the entire structure to be combined with fish farming facilities, placed in the immediate vicinity of the foundation and attached permanently to the foundation with various cables or ropes.

[0002] The innovative content does not only relate to the creation, at a depth below the area affected by wave movements, in fresh or sea waters, of a submerged floating foundation, by itself a technical innovation in view of the method used for executing the work, but also to the use of the structure to house an electrolyser for the electrolysis of water and the production and storage of hydrogen, together with all the equipment required to carry out these activities. A second innovation relates to the particular method used to make the structure rigid through the use of chains and pipes, and to the particular method used to stabilize the foundation by using bottom-weights. Furthermore, the particular method of anchoring the structure to the sea floor permits the positioning and the realization of a fish farming facility.

DESCRIPTION OF THE INVENTION

[0003] The invention comprises the following elements, described and evidenced in the attached drawings.

[0004] The foundation consists of a horizontal hexagonal body built in concrete, or preferably in steel.

[0005] At the centre of the foundation are attached two bodies, one on the upper side, pointing towards the sea surface (Nr. 8) and one on the lower side, pointing towards the ocean floor (Nr. 1).

[0006] The upper body is a hollow, buoyant body containing an electrolyser for the production of oxygen and hydrogen (Nr. 7). In the same hollow body are placed one or more tanks for the storage of the oxygen produced by electrolysis. This hollow body is also the support base a tower (Nr. 10), to which a working platform above the sea level is attached, which allows access to the inside of the tower.

[0007] On top of the tower a nacelle is positioned containing the turbine and its accessories (Nr. 12); the nacelle contains the rotor, the revolutions multiplier and the generator (Nr. 11). All these items rest, without interruption, on the foundation (Nr. 6), whose main purpose is therefore to provide a support base for the turbine and the electrolyser.

[0008] The lower body consists first of a hollow body, cylindrical or polygonal (Nr. 4), full or filled with ballast; this body acts as a counterweight to stabilize foundation movements. To this first body is permanently attached a second hollow body (Nr. 13), preferably of spherical shape (or polygonal or cylindrical), to be used—also, if needed,

with the hollow body of the foundation (Nr. 6)—as a reservoir for the storage of the hydrogen produced by the electrolyser.

[0009] Inside the structure run the cables for the transmission of electricity from the nacelle and the pipes for the transport of hydrogen from the electrolyser to the storage containers; from the main body go off the cables and the pipes for the transmission of the electricity, hydrogen and oxygen produced either directly to shore or towards intermediate structures, such as ships or other storage and transport facilities.

[0010] The entire structure is designed to stand against external natural forces (wind, waves, currents, tides) through the joint and combined action of two forces: the force, based on Archimedes principle, which pushes the structure upwards vertically, and the reaction produced by the anchoring chains (Nr. 3a), which pulls the structure downwards; these two forces, however, are not sufficient to ensure the absolute stability of the foundation, necessary for the correct working of the turbine.

[0011] In order to make the structure more rigid and better able to resist horizontal external forces (and to prevent capsizing), in addition to positioning the central ballast below the foundation (Nr. 4), further precautions have been added. These are shown in the drawing as rigid metal pipes (Nr. 5) (although reinforced cement is also possible), placed above the foundation and fastened to the top of the upper buoyant hollow body (Nr. 7). It is possible that these pipes will be replaced by chains attached on the upper part in the same manner as the pipes, or also attached to the lower hollow body (Nr. 4) below the foundation and also to the hydrogen reservoirs (Nr. 13).

[0012] The entire structure is attached with cables or preferably by chains to bottom-weights (Nr. 2), placed on the sea floor (Nr. 1). To the outside rim of the foundation (Nr. 6) are attached the main vertical chains (Nr. 3a) that tie the foundation to the bottom-weights (Nr. 2) at the bottom of the sea. From the central ballast (Nr. 4) go off additional chains placed diagonally (Nr. 3b), also attached to the bottom-weights (Nr. 2), whose function is to off-set and prevent any horizontal shifting of the structure.

[0013] Further innovation is represented by the new positioning system for the fish farming installation. The installation is no longer positioned above the foundation but on its side. More precisely, from each main bottom-weight (Nr. 2) placed on the sea floor (Nr. 1) go off some anchoring ropes, which connect the bottom-weight to floats (Nr. 15) which are themselves connected through additional anchoring ropes (Nr. 18) to other bottom-weights (Nr. 19) on the sea floor. From the floats go off ropes (Nr. 16) which connect the floats to the fish farming installation, which consists of a cage (Nr. 17) on top of which is placed the dispenser used to provide fish-food inside the cage.

APPLICATION SCOPE

[0014] The scope for the use of this technology is almost unlimited. In fact, in addition to its application to the production of electricity, of hydrogen and of oxygen, it includes aquaculture. Furthermore, thanks to the characteristics of the foundation and of the structure resting on it, it can be used as a meteorological station, as a substation, or

as a facility for the storage of energy, hydrogen and oxygen and more generally for other activities in the open sea.

ADVANTAGES AND INNOVATIVE CONTENT OF THE INVENTION

[0015] Existing technologies do not foresee such combination of inventions, which are anyway innovative in their own right.

[0016] As a matter of fact, the method of construction of the submerged foundation is totally innovative, as it creates a stable structure able to withstand and compensate automatically the impact of all natural forces acting at the site where the foundation is located (winds, waves, marine currents, tides of any foreseeable intensity).

[0017] In addition, using the structure to house a facility to produce and stock hydrogen and oxygen is very innovative. Furthermore it is possible to use the produced and stored oxygen to oxygenize the water in the fish farming facility and to produce electrical energy using fuel cells placed inside the hollow body above the foundation (Nr. 7), which recombining oxygen and hydrogen previously created by electrolysis can produce electricity.

[0018] The innovative content of the fish farming facility comprises various elements.

[0019] Firstly, the method of construction is greatly changed by the current invention.

[0020] Secondly, the fact that the facility uses the submerged floating foundation as its primary anchoring support provides greater stability and allows the breeding of any fish species in open and deep waters.

[0021] Thirdly, the described facility is completely automatic with regard to the feeding of the fish and the oxygenation of the water.

[0022] The main technical aspects of this innovative construction, although combined to create a single structure, each reflect innovative and autonomous methodologies in their own right, which, if used in combination among them result in the creation of a single facility, with economic advantages and lower costs.

[0023] Such a combined facility allows the use of a single structure to generate at least three revenue streams from: the turbine (electricity), the electrolyser (hydrogen) and the aquaculture plant (sea food). Also innovative is the fact that a limited amount of space is used to generate substantial financial benefits, while totally respecting the environment.

[0024] Various phases in the implementation of the project may be carried out at different times and be subject to changes and modifications, to take account of the geography of the site.

1. Method of positioning chains or pipes, preferably on the upper part of the foundation, but possibly both on the

upper and lower parts of the foundation, in order to make more rigid and stable a submerged floating foundation with blocked vertical thrust.

2. A method according to claim 1 of attaching the submerged floating foundation with blocked vertical thrust, to bottom-weights placed on the sea floor using steel chains placed diagonally so as to stop and neutralize possible horizontal shifts and therefore provides additional stability.

3. A method according to claim 1 of placing a counterweight below the submerged floating foundation with blocked vertical thrust, thus moving the centre of gravity of the whole structure below its centre of rotation, thus avoiding and neutralizing possible external forces which may otherwise cause rotation and tipping over of the structure.

4. A method according to claim 1 of installing and positioning of a cylinder or floating tank, above the submerged foundation and fastened to the foundation.

5. A method according to claim 1 of using the floating tank as a container for the electrolyser.

6. A method according to claim 1 of installing and positioning of a reservoir below the foundation, fastened to a counterweight and used for storage of the hydrogen produced by the electrolyser.

7. A method according to claim 1 of anchoring the foundation, using suitable steel cables or chains connecting vertically and diagonally the foundation to submerged hollow bodies buried in the sand below the sea floor, and filled with rubble and sand.

8. Method of creating a submerged floating facility for fish farming, made of cages for the breeding of various types of fish, fixed with ropes or chains to floats on the sea surface.

9. A method according to claim 8 of attaching the submerged cages to floats using pullable ropes or chains.

10. A method according to claim 8 of anchoring the floats with ropes to bottom-weights on the sea floor.

11. A method according to claim 8 of connecting the floats to the bottom-weights holding the submerged floating foundation in place, so as to create a single multi-purpose installation, entirely or partially submerged.

12. Method of combining, using innovative techniques, design and construction methods, a submerged floating foundation with blocked vertical thrust used as a support base for a tower holding a wind turbine, with a facility for the production of hydrogen, placed above the foundation, and with a facility for storage of hydrogen placed below the foundation, and furthermore combining the use of the bottom-weights to anchor the foundation and the entire structure to the sea floor and to attach floats which hold by means of ropes or chains cages used for fish farming.

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