

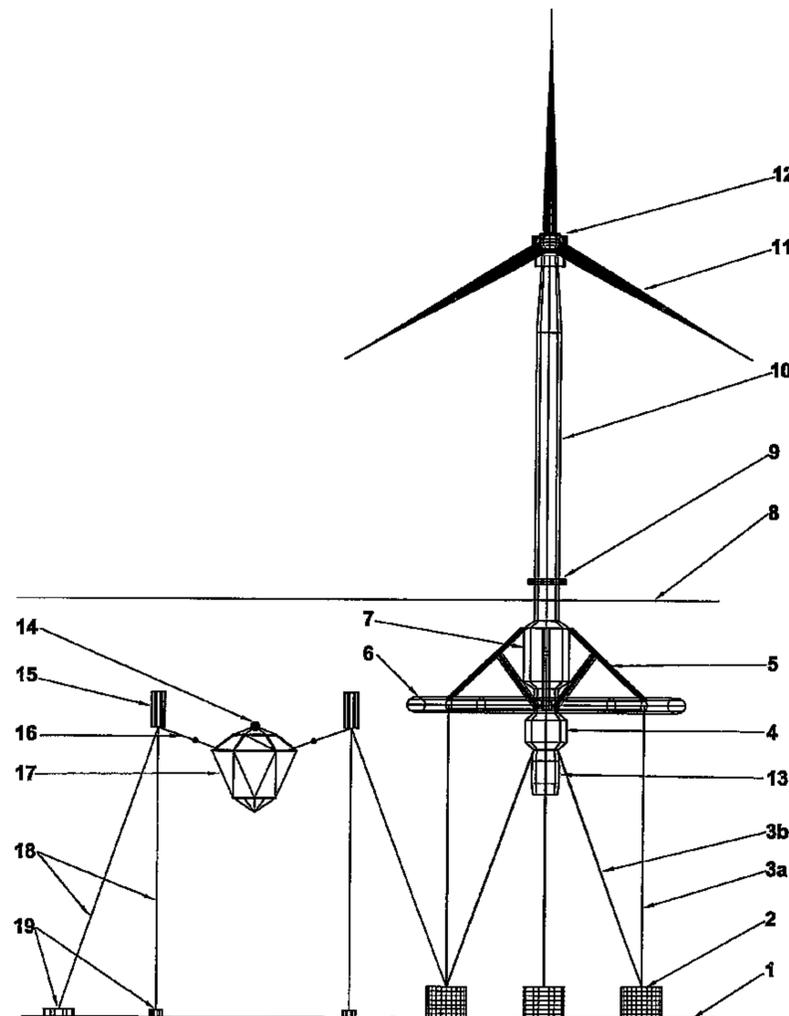


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(54) Titre : PROCÉDE DE CONSTRUCTION D'UNE FONDATION MARINE IMMERGÉE AVEC POUSSÉE VERTICALE BLOQUÉE, UTILISÉE EN TANT QUE BASE DE SUPPORT POUR L'INSTALLATION D'UNE ÉOLIENNE, D'UN ÉLECTROLYSEUR POUR L'ÉLECTROLYSE D'EAU ET D'AUTRES ÉQUIPEMENTS COMBINÉS AVEC LA PISCICULTURE

(54) Title: CONSTRUCTION OF A SUBMERGED FLOATING FOUNDATION



(57) **Abrégé/Abstract:**

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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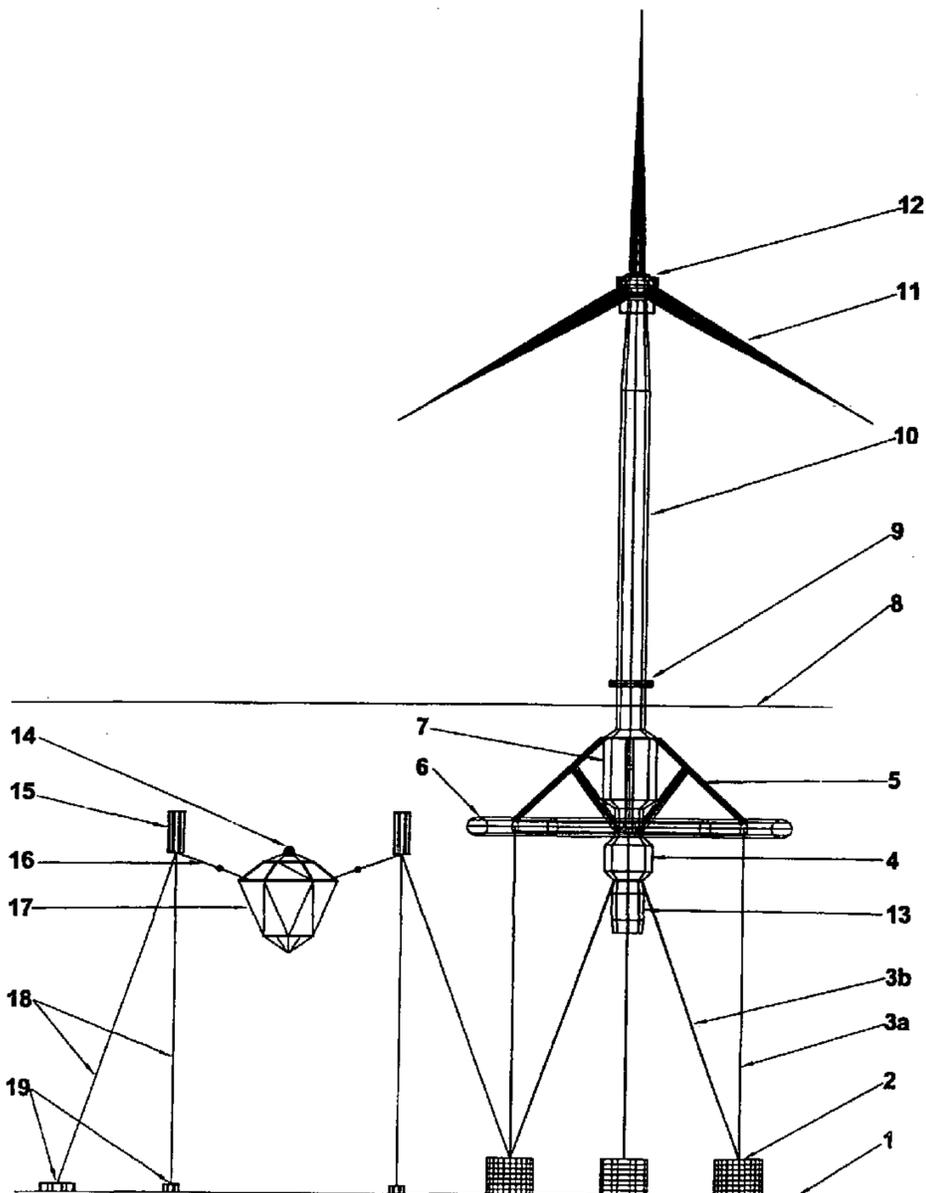
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Description of an industrial utility model named:

(METHOD OF) CONSTRUCTION OF A SUBMERGED FLOATING FOUNDATION WITH BLOCKED VERTICAL THRUST AS A SUPPORT BASE FOR THE  
5 INSTALLATION OF A WIND TURBINE, OF AN ELECTROLYSER FOR THE ELECTROLYSIS OF WATER AND OF OTHER EQUIPMENT, COMBINED WITH FISH FARMING, on behalf of:  
ENERTEC AG, headquartered in Industriestrasse 105A, FL-9491 RUGGEL (Liechtenstein), represented by Mr. Markus Hasler and on behalf of:  
10 Mr. Martin JAKUBOWSKI, born in Itzehoe (D) on 22/02/1951, resident in Bachstrasse 44, D-63452 Hanau, the sole inventor.

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15 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  
20 with fish farming facilities, placed in the immediate vicinity of the foundation and attached permanently to the foundation with various cables or ropes.  
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  
25 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  
30 fish farming facility.

#### DESCRIPTION OF THE INVENTION

35 The invention comprises the following elements, described and evidenced in the attached drawings.  
The foundation consists of a horizontal hexagonal body built in concrete, or preferably in steel.  
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  
40 floor (Nr. 1).  
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  
45 attached, which allows access to the inside of the tower.

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.

50 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  
55 by the electrolyser.

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  
60 structures, such as ships or other storage and transport facilities.

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  
65 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.

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  
70 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  
75 foundation and also to the hydrogen reservoirs (Nr. 13).

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  
80 (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.

Further innovation is represented by the new positioning system for the fish farming  
85 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  
90 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

95 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  
100 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

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

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).

110 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  
115 electricity.

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

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

120 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.

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

125 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.

130 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.

135 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.

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140 Claims of the industrial invention named:

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

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150 CLAIMS

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  
 155 blocked vertical thrust.
2. Method 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.
- 160 3. Method of placing a counter-weight 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.
- 165 4. Method of installing and positioning of a cylinder or floating tank, above the submerged foundation and fastened to the foundation.
5. Method of using the above named floating tank as a container for the electrolyser.
- 170 6. Method of installing and positioning of a reservoir below the foundation, fastened to the counterweight described in claim 3 above, and used for storage of the hydrogen produced by the electrolyser.
7. Method 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.
- 175 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. Method of attaching the submerged cages to floats using pullable ropes or chains.
- 180 10. Method of anchoring the floats with ropes to bottom-weights on the sea floor.
11. Method 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.

- 185 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  
190 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.

