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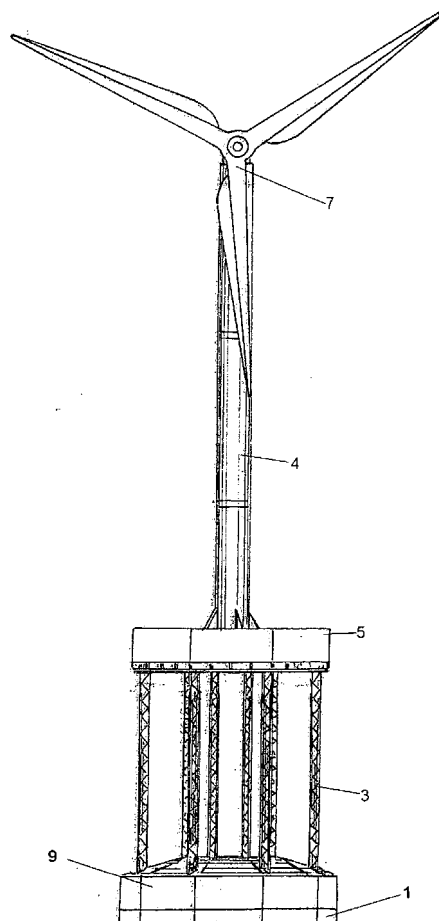
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(54) **MULTI-PURPOSE OCEAN PLATFORM, AND PRODUCTION AND INSTALLATION METHOD THEREOF**

(57) Multi-purpose offshore platform and method for manufacturing and installing thereof in the water for the installation of power generation, desalinated water and food production devices from sea's natural resources, or in order to serve as foundation for any structure to be installed in water. It includes a foundation formed by one or more reinforced concrete slabs (1) with lattice (3) pillars, piles for driving into the seabed, placed inside the pillars (3), a superfluous sealing and buoyancy system (8), an immersion controlling system that allows immersing the foundation at a controlled rate, once the platform is in its final location, a hydraulic system for lifting the platform to a height above the highest wave expected, as well as plants (5) for installing devices.



**FIGURE 5**

## Description

### Technical sector

[0001] The present invention belongs to the sector of constructions placed on water surfaces, in general, structures or platforms developed for installing power generation, desalinated water and food production devices from sea's natural resources, or in order to serve as foundation for any structure to be installed in water.

### Background of the invention

[0002] Almost all developed countries, International Organizations and scientists means unanimously agree when stating that the earth does not have capacity for producing water, energy and food necessities of the world's population, with the current production and consumption patterns.

[0003] The only possible solutions depend on changing the production and consumption patterns, and prudently and rationally exploiting renewable resources from seas, oceans and inland waters.

[0004] So far humanity has only performed, in oceans, activities for extracting foods (seaweeds and fishes) and energy (oil and natural gas).

[0005] None productive activity has been carried out so far, with the only exception of aquaculture in sheltered water and the incipient development of wind generated power.

[0006] The oil industry extracts in one day the resources produced and accumulated by the earth over thousands or millions of years, this fact along with the high market price of the extracted matter, allows them to have sufficient financial resources for paying off the platforms, as well as drilling and extracting devices.

[0007] However, sea production from its renewable resources does, obviously, not allow the revenue potential of extracting activities. Therefore, in order to take advantage of the renewable resources from the sea, and meeting the need's population for water, energy and foods is essential to develop solutions, methods and devices that make this possible, with economic viability and environmental friendliness.

[0008] As mentioned, the only existing devices are intended for executing works for extracting accumulated resources (basically, oil and natural gas); these are, therefore, specific and economically inappropriate for performing any other activity.

[0009] Methods and devices for the offshore oil industry have been used in some wind turbine installations in the sea, which have been founded on large-section piles (monopiles), driven into the seabed. This solution, in addition of being costly and environmentally inappropriate in many cases, is limited to those facilities in which there is a depth lower than 15 to 20 m and geotechnically optimal greater thick beds (greater than 32 m for a medium wind turbine and a moderate maritime climate), circum-

stances given in very few locations. The installation requires light weather conditions, therefore when these are not given, stopping days and costs for mobilizing the devices increase to unassumable levels, and it makes sense to understand that if a location has been selected to take advantage of the frequency and intensity of the winds, these make difficult or impossible carrying out the operations that have to be executed in calm or breeze times.

[0010] Dedicating the old offshore platforms, out of service, for installing wind power generation devices has also been proposed, but the scrapping net value, i.e. the selling price of scrap minus the moving and scrapping costs is economically unaffordable for production activities based on the use of renewable resources.

[0011] Therefore, the present invention intends to describe a light, multi-purpose and multi-use offshore platform that solves in an economically viable manner the following technical problems:

- Creating a way of installing in water devices capable of economically producing foods, desalinated water, and generating power.
- Installing in the sea a platform entirely built on land.
- Enabling mass production.
- Being valid for any type of construction and at any location, either in sea or inland water, regardless of how the location and the ground are.
- Able of being towed to the position without taking into account weather conditions.

### Description of the invention

[0012] The offshore platform object of the present invention has a structure entirely built on land completely installing all production devices, whether for producing power, desalinated water, foods....

[0013] The platform comprises a foundation formed by one or several reinforced concrete slabs stiffened by beams or edge beams wherein lattice pillars and/or tubular section towers are embedded. In the vertical elements, whether lattice pillars or tubes placed in the vertexes of the tubular section towers, piles for being driven into the seabed are introduced, once the platform is placed at the location.

[0014] The platform also includes a superfluous sealing and buoyancy system that makes it to be floating and unsinkable, so that it can be safely towed towards its final location, regardless of its size, shape or weight, and weather conditions.

[0015] It further comprises an immersion controlling system that allows immersing the foundation at a controlled rate, once the platform is in its final location.

[0016] It also has a hydraulic system for lifting the platform at a height above the highest wave expected.

[0017] The platform also includes plants for installing production devices and those for, operating and maintaining thereof.

**[0018]** The method for manufacturing the platform, taking into account the operations performed at each station, comprises the steps of: making the reinforced concrete slab that is part of the foundation, installing the superfluous sealing and buoyancy system as well as that for immersion controlling, installing the prefabricated pillars incorporating piles therein, and in case the platform is used as support for a wind turbine, the telescopic tower of said wind turbine will be installed; installing all devices needed for developing the intended activity on the platform, and in case the platform is used as support for a wind turbine, said wind turbine will also be installed with two of its blades on the telescopic tower next to a system for positioning the third blade.

**[0019]** After the platform manufacturing has ended, its launching and transferring towards the final location are performed. For this purpose, the platform is towed, since it meets the condition of *new ship in intact condition*, that is, it can navigate in the same way as any ship would do.

**[0020]** Once the location is reached, the immersion system of the platform for allowing the vertical downward motion of the foundation, guided by the tower and pillars that make the platform to reach the ground at a controlled rate and without oscillations until lying on the bed, is actuated.

**[0021]** The bed has been previously conditioned and leveled.

**[0022]** Once the slab rests on the bed, the piles are driven into therein by using a hydraulic pressure system, until the load thereof is that expected. In this way, there will be no need of oversizing the foundation, since the driving-into mechanism provides the exact value of load that it resists, and serves as load test.

**[0023]** In case the ground is of rocky type, the piles are replaced by drilled anchorages.

**[0024]** The part of the platform that is kept afloat (operation and maintenance plant) is lifted through a hydraulic system to a height above the maximum wave height expected.

**[0025]** This platform and method for manufacturing and placing thereof in the sea, has a number of advantages over those existing in the state of the art.

**[0026]** Facing the problems mentioned in the previous section, the solution that has been developed and which protection is requested has the following advantages:

- Its design allows manufacturing and installing production devices on land in an automated manufacturing and assembling, and in mass production chain. Therefore there are no stopping days due to the weather inclemency or contingency. Costs are significantly reduced and the quality is improved and ensured.

- Fully completed, the platform is set afloat, its sealing and stability systems allows it meeting the requirements of international standards, ranking the platform as a *new ship in intact condition*, which means it can thus be towed to any location and under

any weather conditions.

- Its special design allows it adapting to the conditions of any location, by simply modifying the geometry of the foundation slab and/or the number, diameter and length of the piles anchoring it to the bed.

- The vertical structures, for its special design, can be designed for installing any device.

- It can be provided with plants for installing devices, and operating and maintenance thereof which substantially reduces the O&M costs and allows the multiple-use of the facility.

- The foundation slab has been specifically designed for installing a set of devices and equipments, for the controlled immersion at the location, and protecting the foundation from erosion. Automatically and successively performing both methods significantly reduces the installation costs and allows this to be performed regardless of the state of the sea.

- Plants of device have been designed for allowing the installation of a set of devices that keep them afloat during the immersion process of the foundation, and these have devices and equipments that allow sliding the structures jointly connected to the foundation.

- Vertical structures and plant of devices have been specially designed for allowing the automatic lifting thereof until placing them at a level above the maximum wave height expected, within the recurrence period considered in each case.

- In designing immersed structures, the fact that these can be designed to avoid environmental impact, especially in sedimentary dynamics, has been particularly taken into account.

- The special design of the O&M plant allows installing light devices in order to allow the access from the sea, making unnecessary the use of helicopters which are now the method of access to wind turbines installed in the sea, which avoids the costs of building a platform on the wind turbine, and simplifies and significantly reduces the costs of access for repair or maintenance works.

- The design, manufacture, launching, towing, installation and security of the operation fulfill the internationally accepted technological standards.

## Description of the figures

**[0027]** In order to complete the description being now made and with the aim of helping to a better understanding of the features of the invention, a set of drawings is accompanied, wherein with an illustrative and not limitative manner the following has been represented:

Figure 1: Elevation of the platform with the foundation slab stiffened with beams

Figure 2: Plan view of the foundation slab stiffened with beams

Figure 3: Elevation of the platform with the founda-

tion slab stiffened with edge beams

Figure 4: Plan view of the foundation slab stiffened with edge beams

Figure 5: Platform assembly with wind turbine and liquefied natural gas tank.

Figure 6: Platform assembly with wind turbine before being driven into the bed

**[0028]** A list with the references used in the figures is now given:

- (1) Foundation slab
- (2) Stiffening beams
- (3) Lattice pillars
- (4) Tower or tubular structure
- (5) Operation and maintenance plant
- (6) Device for installing the third blade of the wind turbine
- (7) Wind turbine
- (8) Superfluous sealing and buoyancy system
- (9) Liquefied natural gas tank

#### Detailed description of the invention

**[0029]** In order to achieve a better understanding, the invention is going to be described below with the help of the figures, the platform structure as well as the method for manufacturing and installing thereof.

**[0030]** As shown in figure 1, the multi-purpose platform consists of a concrete slab (1) which may be stiffened using radial beams (2) or edge beams. This slab does not have to have a defined geometry, i.e. it may be of octagonal-, hexagonal-, square-...type.

**[0031]** The concrete used for its manufacturing has a high initial resistance in order to be capable of moving the slab (1) in a short period of time from its manufacturing and so as not to delay the production, and a low hydration heat for avoiding cracks and corrosion.

**[0032]** It further comprises a series of lattice pillars (3) joined to the foundation by anchoring plates. Inside the pillars (3) piles that complete the platform foundation are inserted.

**[0033]** With this clamping system comprising a concrete slab (1) driving into the seabed, splitting up the load and moments between the surface and deep ground horizons is achieved. Furthermore, it allows its installation in any location, regardless of the ground quality, so that if it is a low resistance ground, mud type, the piles will be those resisting more load, and if it is a higher resistance ground the slab (1) will be the one resisting more load.

**[0034]** In case the platform is used for supporting a wind turbine (7), the slab (1) will have installed at its center the wind turbine (7) tower (4) of telescopic type, which is joined through the anchoring plate to the foundation.

**[0035]** The wind turbine (7) will be installed with only two blades, since if the third blade were installed the height of the last telescopic section of the tower, wherein the wind turbine is placed, should be at least equal to the

length of the blade and the gravity center of the assembly would rise making the assembly unstable when floating and towing to the final location.

**[0036]** Moreover the device for placing the third blade (6) will be carried on the platform.

**[0037]** As for the manufacturing method, as mentioned above, this is a mass production performed on land. In order to carry it out, there is a facility that has a series of stations aligned so that the platform moves forward in an orderly fashion between said stations through a rolling mechanism, carrying out at each of them the corresponding operations, until reaching the last station wherein the floating and launching method will start as well as transferring the platform towards the final location starting once there, the immersion method and that for fixing it to the ground.

**[0038]** Prior to the first station there is a workshop of prefabricated concrete and a workshop of prefabricated steel, wherein the elements required to build the platform, such as concrete stiffening beams (2) and steel lattice pillars (3) will be manufactured.

**[0039]** The method for manufacturing the platform, taking into account the operations carried out at each station, comprises the following steps:

1. First station: manufacturing the reinforced concrete slab (1) that is part of the foundation, either stiffened by beams or edge beams.
2. Second Station: installing the superfluous sealing and buoyancy system. The prefabricated pillars (3) incorporating the piles therein for driving into the bed are also installed. Furthermore, in the case of using the platform as support for a wind turbine (7), the telescopic tower (4) will be placed in the center of the slab (1), at this time.
3. Third station: the installation of the superfluous sealing and buoyancy system (8) is completed.
4. Fourth Station: therein all the devices required in order to develop the intended activity on the platform are installed. In case the platform is used as support for a wind turbine (7), the installation of said wind turbine on the telescopic tower takes place at this station. The wind turbine (7) will include two of its blades arranged upwardly, while the third blade is placed *in situ* in the final location of the platform. The device (6) required for placing the third blade will be also installed at this station.

**[0040]** Once the platform manufacturing is completed, its launching and motion towards the final location are performed. For this purpose, the platform is towed, since it meets the condition of *new ship in intact condition*, i.e. it can navigate in the same way as any ship would do.

**[0041]** Once the location is reached, the immersion system of the platform for allowing the vertical downward motion of the foundation, guided by the tower and pillars that make the platform to reach the ground at a controlled rate and without oscillations until lying on the bed, is ac-

tuated.

[0042] The bed has been previously conditioned and leveled.

[0043] Once the slab (1) rests on the bed, the piles are driven into therein by using a hydraulic pressure system, until the load thereof is that expected. In case the ground is of rocky type, the piles are replaced by drilled anchorages.

[0044] The part of the platform that is kept afloat (operation and maintenance plant) is lifted through a hydraulic system at a height above the maximum wave height expected.

[0045] While the operation and maintenance plant is lifted, it is fixed to the pillars on some anchoring plates. The fixing will be performed at different points and at different heights, and can be accomplished by screws or any other equivalent fixing system that withstands outdoor conditions, corrosion and loads to which will be subjected.

[0046] Then, if the tower has been installed with the generator, this is lifted in a hydraulic manner up to a height that allows the installation of the third blade. With three blades installed, the telescopic tower is completely lifted up to the production height.

[0047] This system is specifically designed for use as support for wind turbines, but there are a number of alternative applications such as for example:

- Platform for installing wind motors that directly actuate a sea water desalination machine.
- Platform for installing desalination machines.
- Platform for installing combined cycle plant. Conventional or organic Rankine or Calima with tank for storing fuel (9) built on the foundation slab (1) (see figure 5).
- Platform for installing a laboratory for marine study and aquaculture.

[0048] However, its application in other industrial fields requiring similar characteristics is not excluded since, as mentioned above, this is a manufacturing and installing system wherewith any type of construction that has to be installed in the aquatic environment can be designed, manufactured and installed. It has an adaptability that allows it to be installed and transferred to any location, regardless of how the land is or what the weather conditions are.

[0049] Similarly, it may be installed in all type of waters, whether sea or inland water and, because of its multifunctionality, the platform may be used in the applications described above and equivalent or even, as pillars for a bridge, as foundation for marine pipelines, or any other work or structure required to be fixed in the water.

## Claims

1. Multi-purpose offshore platform for installing devices

for power generation, for producing desalinated water and food from natural sea resources, or in order to serve as foundation for any structure intended to be installed in the sea, comprising the following elements:

- A foundation formed by one or several reinforced concrete slabs (1) wherein lattice pillars (3) and/or tubular section towers are embedded.
- Piles for driving into the seabed, placed inside the lattice pillars (3) or in the tubular section towers,
- A superfluous sealing and buoyancy system (8)
- An immersion controlling system that allows immersing the foundation at a controlled rate, once the platform is in its final location
- A hydraulic system for lifting the platform at a height above the highest wave expected.
- The platform also includes plants (5) for installing production devices and devices for operating and maintaining thereof.

2. Offshore platform according to claim 1, **characterized in that** the slab (1) may have any geometry, whether be rectangular, hexagonal, octagonal...
3. Offshore platform according to claim 2, **characterized in that** the slab (1) is stiffened by beams (2).
4. Offshore platform according to claim 2, **characterized in that** the slab (1) is stiffened by edge beams.
5. Offshore platform according to claim 1, **characterized in that** the pillars (3) are made of a steel lattice.
6. Offshore platform according to claim 1, **characterized in that** in case the bed is rocky, the pillars (3) have a device for drilling anchorages therein.
7. Offshore platform according to claim 1, **characterized in that** it comprises a wind turbine (7) mounted in a telescopic tower or tubular structure (4) joined through it bottom to the foundation.
8. Method for manufacturing and installing the offshore platform described in the preceding claims, **characterized in that** the manufacturing is carried out in land and mass production, and comprises the following steps:

- Previous step for pre-manufacturing the pillars and manufacturing the concrete
- Manufacturing the platform passing through the following stations:

- First station: manufacturing the reinforced concrete slab (1) that is part of the founda-

tion, either stiffened by beams or edge beams.

- Second station: installing the superfluous sealing and buoyancy system; the prefabricated pillars (3) incorporating the piles therein for driving into the bed are also installed; furthermore, in case of using the platform as support for a wind turbine (7), the telescopic tower (4) will be placed in the center of the slab (1), at this time.

- Third station: the installation of the superfluous sealing and buoyancy system (8) is completed.

- Fourth Station: therein all the devices required in order to develop the intended activity on the platform are installed.

- Setting afloat and launching the platform and transferring it to the final location

- Conditioning and leveling the bed at the location

- Immersing the platform allowing the vertical downward motion of the foundation, guided by towers and pillars, reaching the ground without oscillations and being flat at the bed.

- Driving and inserting the piles and/or perforating the anchorages. Embedding the slab into the piles and/or anchorages. Fixing the structure to the ground.

- Lifting the operation and maintenance plant (5) to a height above the maximum wave height expected

- Screwing the pillars

9. Method for manufacturing and placing the offshore platform at its final location according to claim 8 **characterized in that** if the platform will be use as support for a wind turbine (7) a telescopic tower (4) will be placed at the center of the slab (1) in the second station of the manufacturing process.

10. Method for manufacturing and installing the offshore platform according to claim 9 **characterized in that** at the fourth station of the manufacturing process takes place the installation of the wind turbine (7) with only two of its blades, on the telescopic tower (4), the device (6) required for placing the third blade will also be installed at this station.

11. Method for manufacturing and installing the offshore platform at its final location according to claim 10 **characterized in that** after lifting the operation and maintenance plant (5) and screwing the pillars (3), the tower (4) with the wind turbine (7) is lifted up to a height that allows the installation of the third blade.

12. Method for manufacturing and installing the offshore platform at its final location according to claim 8 **char-**

**acterized in that** at the fourth station a laboratory for marine study and aquaculture is installed.

13. Method for manufacturing and installing the offshore platform at its final location according to claim 8 **characterized in that** at the fourth station wind motors that directly actuate a sea water desalination machine are installed.

14. Method for manufacturing and installing the offshore platform at its final location according to claim 8 **characterized in that** at the fourth station a combined cycle plant of organic Rankine or Calima with liquefied gas tank is installed.

15. Method for manufacturing and installing the offshore platform at its final location according to claim 8 **characterized in that** at the fourth station any device, structure o installation required to be fixed in water is installed.

#### Amended claims under Art. 19.1 PCT

1. Multi-purpose offshore platform for installing devices for power generation, for producing desalinated water and food from natural sea resources, or in order to serve as foundation for any structure intended to be installed in the sea, comprising the following elements:

- A foundation formed by one or several reinforced concrete slabs (1) stiffened by beams or edge beams (2) wherein constant section lattice pillars (3) and/or tubular section towers or structures are embedded (4)

- Piles for driving into the seabed, placed inside the lattice pillars (3) or in the tubular section towers (4)

- A superfluous sealing and buoyancy system (8)

- An immersion controlling system that allows immersing the foundation at a controlled rate, once the platform is in its final location

- A hydraulic system for lifting the platform at a height above the highest wave expected.

- The platform also includes plants (5) for installing production devices and devices for operating and maintaining thereof.

2. Offshore platform according to claim 1, **characterized in that** the slab (1) may have any geometry, whether be rectangular, hexagonal, octagonal...

3. Offshore platform according to claim 1, **characterized in that** the pillars (3) are made of a steel lattice.

4. Offshore platform according to claim 1, **character-**

**ized in that** in case the bed is rocky, the pillars (3) have a device for drilling anchorages therein.

5. Offshore platform according to claim 1, **characterized in that** it comprises a wind turbine (7) mounted in a telescopic tower or tubular structure (4) joined through it bottom to the foundation.

6. Method for manufacturing and installing the offshore platform described in the preceding claims, **characterized in that** the manufacturing is carried out in land and mass production, and comprises the following steps:

- Previous step for pre-manufacturing the pillars (3), stiffening beams (2) and manufacturing the concrete
- Manufacturing the platform passing through the following stations:

- First station: manufacturing the reinforced concrete slab (1) that is part of the foundation, either stiffened by beams (2) or edge beams.

- Second station: installing the superfluous sealing and buoyancy system; the prefabricated pillars (3) incorporating the piles therein for driving into the bed are also installed; furthermore, in case of using the platform as support for a wind turbine (7), the telescopic tower (4) will be placed in the center of the slab (1), at this time.

- Third station: the installation of the superfluous sealing and buoyancy system (8) is completed.

- Fourth Station: therein all the devices required in order to develop the intended activity on the platform are installed.

- Setting afloat and launching the platform and transferring it to the final location

- Conditioning and leveling the bed at the location

- Immersing the platform allowing the vertical downward motion of the foundation, guided by towers and pillars, reaching the ground without oscillations and being flat at the bed.

- Driving and inserting the piles and/or perforating the anchorages. Embedding the slab into the piles and/or anchorages. Fixing the structure to the ground.

- Lifting the operation and maintenance plant (5) through a hydraulic system to a height above the maximum wave height expected

- Fixing the operation and maintenance plant (5) to the pillars (3) on anchoring plates; the fixing will be performed at different points and at different heights, and can be accomplished by

screws or any other equivalent fixing system that withstands outdoor conditions, corrosion and loads to fixing will be performed at different points and at different heights, and can be accomplished by screws or any other equivalent fixing system that withstands outdoor conditions, corrosion and loads to which will be subjected.

7. Method for manufacturing and placing the offshore platform at its final location according to claim 8 **characterized in that** if the platform will be use as support for a wind turbine (7) a telescopic tower (4) will be placed at the center of the slab (1) in the second station of the manufacturing process.

8. Method for manufacturing and installing the offshore platform according to claim 7 **characterized in that** at the fourth station of the manufacturing process takes place the installation of the wind turbine (7) with only two of its blades, on the telescopic tower (4), the device (6) required for placing the third blade will also be installed at this station.

9. Method for manufacturing and installing the offshore platform at its final location according to claim 8 **characterized in that** after lifting the operation and maintenance plant (5) and screwing the pillars (3), the tower (4) with the wind turbine (7) is lifted up to a height that allows the installation of the third blade.

10. Method for manufacturing and installing the offshore platform at its final location according to claim 6 **characterized in that** at the fourth station a laboratory for marine study and aquaculture is installed.

11. Method for manufacturing and installing the offshore platform at its final location according to claim 6 **characterized in that** at the fourth station wind motors that directly actuate a sea water desalination machine are installed.

12. Method for manufacturing and installing the offshore platform at its final location according to claim 6 **characterized in that** at the fourth station a combined cycle plant of organic Rankine or Calima with liquefied gas tank is installed.

13. Method for manufacturing and installing the offshore platform at its final location according to claim 6 **characterized in that** at the fourth station any device, structure o installation required to be fixed in water is installed.

#### Statement under Art. 19.1 PCT

#### Amendments made

The new set of claims that has been filed includes the following amendments in respect of the original application:

Claims 1, 8 modified; claims 2, 5, 6 and 7 not modified; claims 3 and 4 cancelled; claims 9-15 modified.

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Basis for the amendment: Claim 1 has been amended in its characterizing part, as reference 4 corresponding to the tubular section tower or structure based on page 6 line 8 has been added; the wording *structure* in line 7 of the claim based on page 6 line 8 has been added; a characteristic defining the lattice pillars has been added in order to indicate that such they are *constant section* lattice pillars, based in the originally-filed figures 1, 3, 5 and 6; it has been indicated that the slab or slabs that form the foundation are *stiffened by beams or edge beams*, based on originally-filed claims 3 and 4.

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Basis for the amendment: Claim 8 has been amended to indicate that *the stiffening beams* (2) are manufactured in the previous step, based on pag. 7, line 22 of the originally-filed description; it has been indicated that the lifting of the operation and maintenance plant is performed *through a hydraulic system*, based on pag. 8, line 22 of the originally-filed description, the last step of the process has been detailed, based on pag. 8, lines 24-28 of the originally-filed description.

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In the original claims 9-15 only their dependence has been corrected as a result of the changes in the numeration of the claims.

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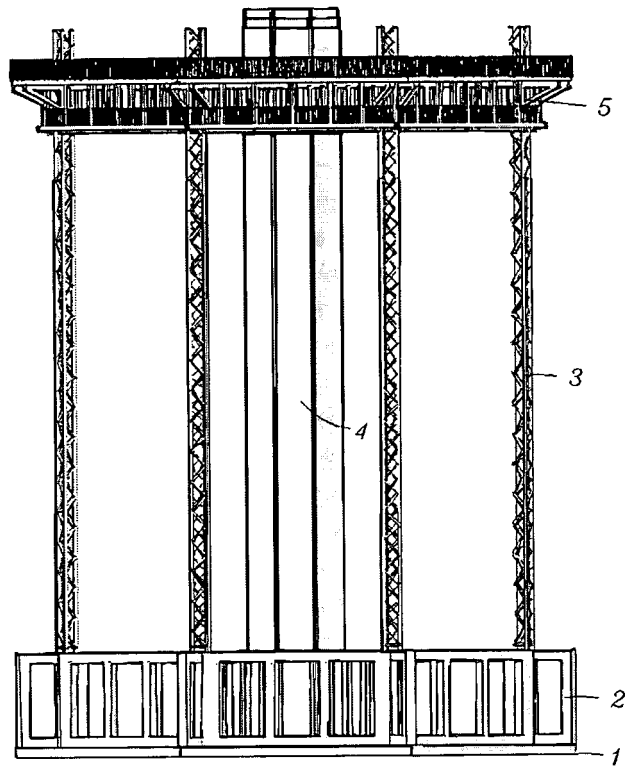


FIGURE 1

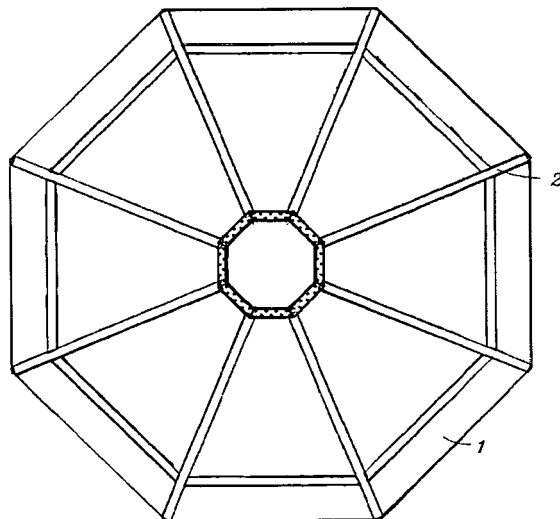


FIGURE 2

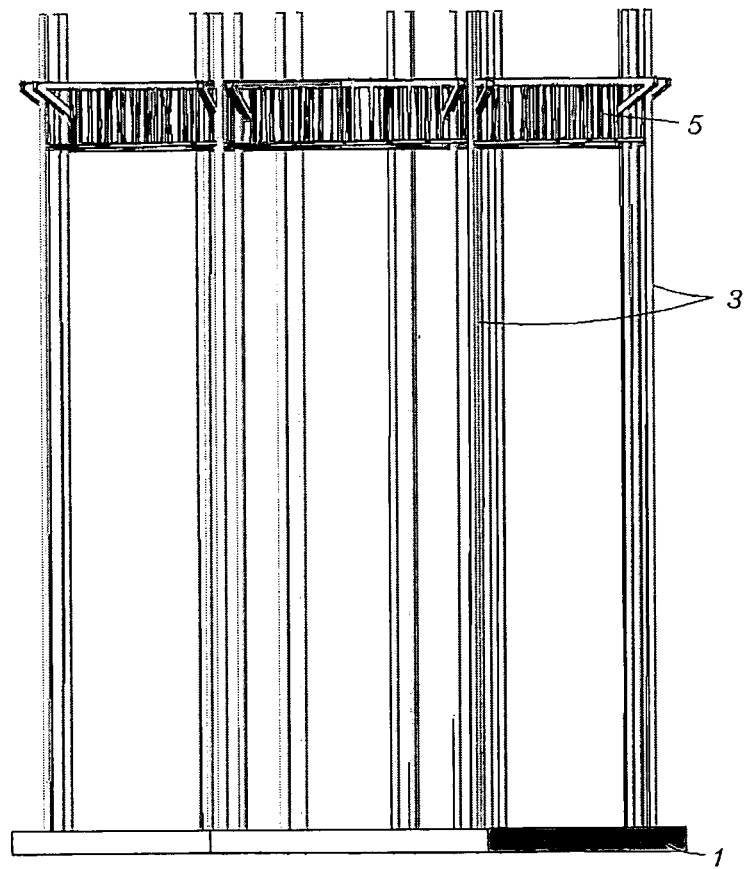


FIGURE 3

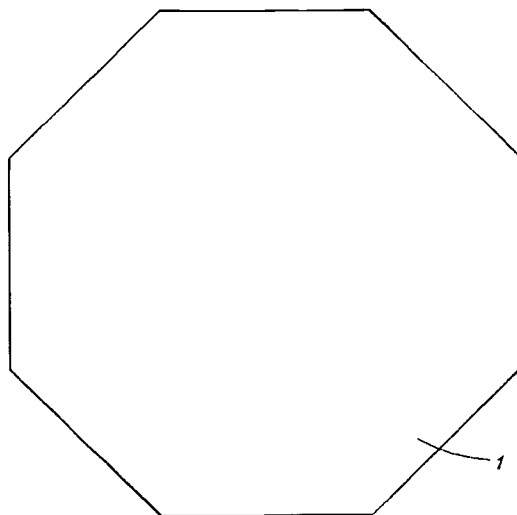


FIGURE 4

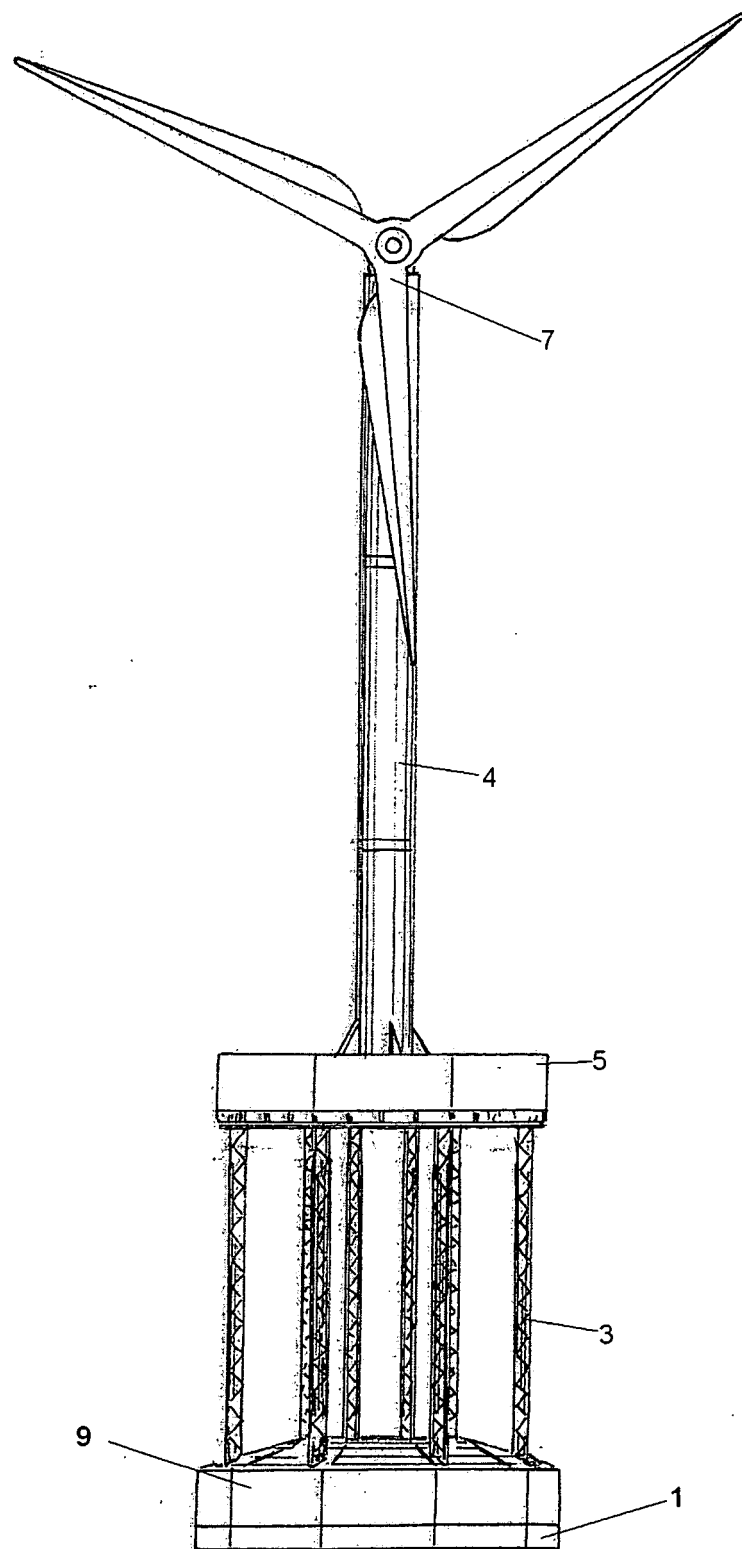


FIGURE 5

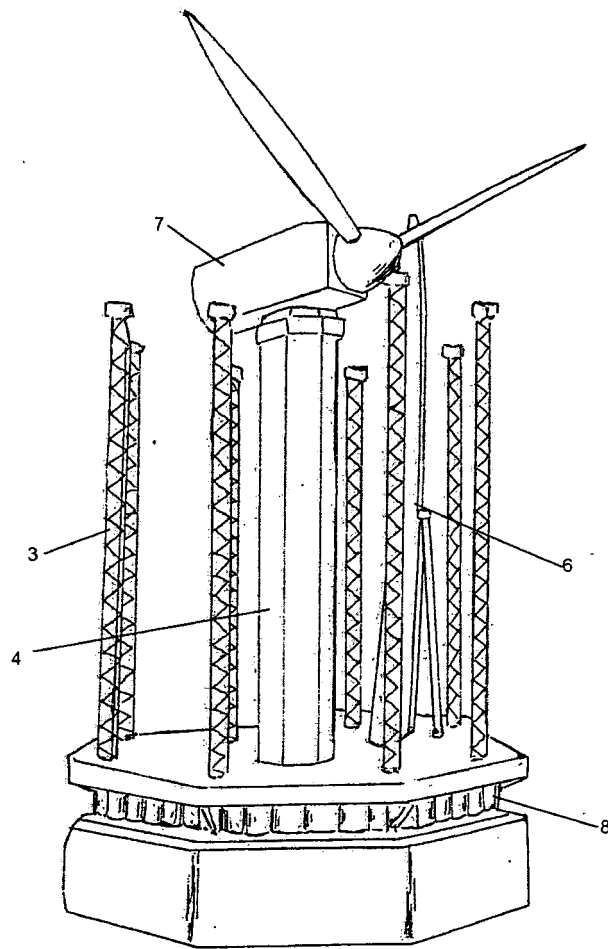


FIGURE 6

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/ES2010/000501

## A. CLASSIFICATION OF SUBJECT MATTER

E02B17/02 (2006.01)

F03D1/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E02B, F03D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, INVENES

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 4388024 A (DYSARZ EDWARD D ) 14/06/1983, column 4, line 10 - column 20, line 55; figures.	1-6 8,12-15
X Y	US 4266887 A (CORDER PAUL R ) 12/05/1981, column 5, line 25 - column 12, line 30; figures.	1-6,8,12-15 7,9
Y	US 2004169376 A1 (RUER JACQUES ET AL.) 02/09/2004, paragraphs [51 - 95]; figures.	7,9
X Y	US 5573355 A (THOMAS PIERRE-ARMAND ) 12/11/1996, column 1, line 63 - column 4, line 43; figures.	1-6,8,12-15 7,9
Y	GB 2365905 A (OCEAN TECHNOLOGIES LTD ) 27/02/2002, pages 2 - 3; figures.	7,9

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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"&amp;" document member of the same patent family

Date of the actual completion of the international search  
09/05/2011Date of mailing of the international search report  
(17/05/2011)

Name and mailing address of the ISA/

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## INTERNATIONAL SEARCH REPORT

International application No.  
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C (continuation).		DOCUMENTS CONSIDERED TO BE RELEVANT
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