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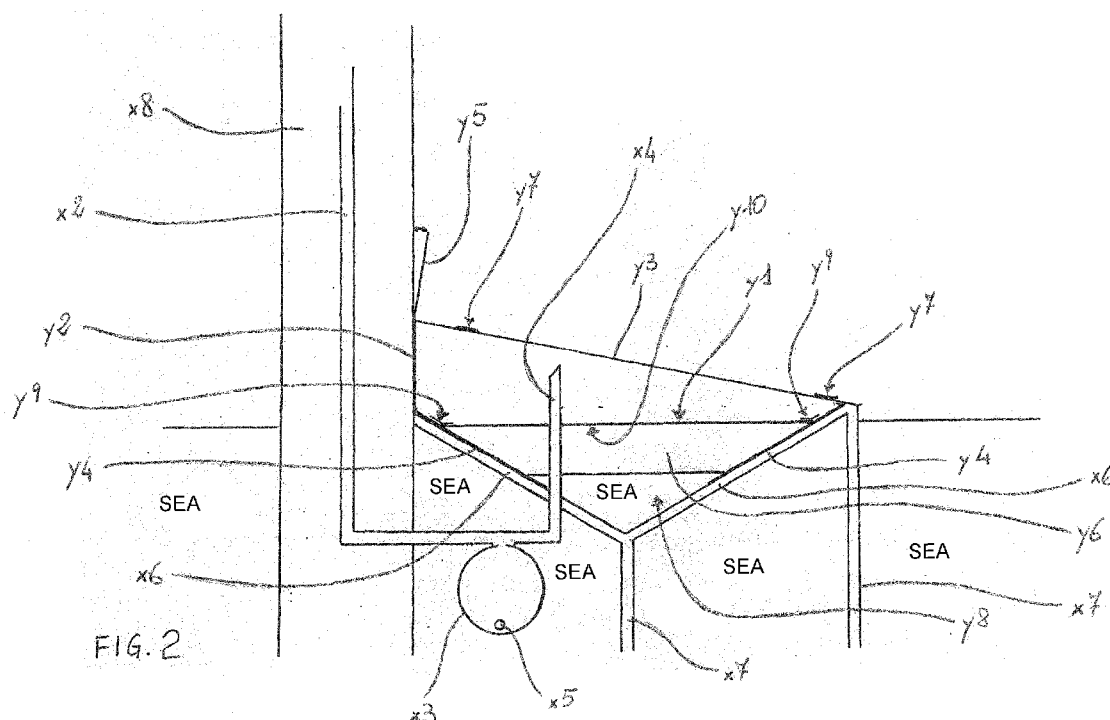
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(54) Title: SOLAR AND WIND ENERGY WATER PURIFIER



(57) Abstract: The artifact is a prism in which a plane is formed by the surface layer of water - usually seawater - and the plane of said prism is therefore a portion of sea/water. A second plane, smaller than the aforementioned one, is orthogonal to the water plane and is, for example, made of a material such as black-colored fiberglass. A third plane joins the above planes with an inclination preferably of about 25% starting from the free edges, strictly of transparent material, for example glass. The two triangular planes of the sides are also hermetically sealed by trapezoidal panels, as they penetrate the water, and are also made of transparent material. The water plane has, at its two free ends, a plane for each part that with an angle preferably of about 30 degrees heads into the water towards the center of the prism. All the above is better shown in the description and in the annexed drawings. The high plane of the prism is oriented southwards so as to form a solar furnace inside. The plane on the water is equipped with a grid of electric resistors - like those

TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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for domestic water heaters - over its entire surface. The necessary electrical energy can be produced by wind turbines, photovoltaic panels, fossil fuel-based or hydrogen based energy production systems, or other types of power generation systems. The purpose of the system is to produce pure drinking water from the water vapor that is generated in the solar furnace of the prism.

“SOLAR AND WIND ENERGY WATER PURIFIER”

Field of the Invention

The present invention relates to the technical field of water purifiers.

State of the Art

- 5 The aim of this project is to patent a new apparatus capable of producing pure drinking water by using a method that differs from the traditional ones. Generally, the production process uses chemical and bacteriological methods, using almost exclusively rainwater. The present invention is innovative in that it can produce pure drinking water also and directly from seawater, eliminating the need to dispose of the resulting salt.

10 *Summary of the Invention*

The present invention is devised for making a system for water purification. In a first aspect, the present invention relates to a system for water purification according to claim 1.

- The present invention stems from the general consideration that the technical problem described above can be effectively and reliably solved by means of a water purification system comprising a three-dimensional structure (prism) consisting of a plurality of plates (made of transparent plastic material, glass, photovoltaic panels or other material apt to promote an increase in the temperature within the structure) interconnected in a tight sealing manner so as to leave an open space at its lower portion, wherein said structure is apt to be placed on the surface of the water of a sea, a lake or an artificial water reservoir, so that the water surface on which said structure is placed contributes to the hermetic sealing of the structure itself. The present invention integrates the boiling and vaporization principles for the intended purpose. Moreover, the invention uses both energy collected from amplified solar irradiation and energy collected from an additional external source.
- 15
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- The water purification system of the present invention is characterized in that it further comprises:
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- at least one heat source, associated with said three-dimensional structure (prism), said at least one heat source being positioned at the surface and under the water level of said reservoir (water reservoir here meaning both an artificial water reservoir and a body of water belonging to the surface of a lake or sea), wherein said heat source is capable of heating the portion of water surrounding said at least one heat source and of generating a corresponding amount of water vapor by bringing water to its boiling point;
- 30

- at least one conduit - a pipe, for instance - preferably provided with at least one valve, wherein said conduit is capable of connecting said water vapor with a cold air source in order to transform said water vapor into purified water;

- at least one tank to store the purified water produced;

5 - at least one arrangement of lenses arranged on the side exposed to the sun;

- no pumping system for feeding the water to be treated;

- the possibility of lowering the level of liquid within the prism with respect to the outer level of the same liquid by increasing the pressure of the air volume within said prism.

This is achieved by joining several plates – glass, transparent plastic elements, photovoltaic panels or other material - as in the following exemplifying description, and supporting said artifact on the liquid surface in such a way as to hermetically seal the entire artifact, thus essentially forming a solar furnace.

According to a preferred embodiment, said three-dimensional structure further comprises additional plates placed below the water surface and representing a kind of underwater continuation of the three-dimensional structure itself.

In this embodiment, immediately below the surface of the water, there are electric resistors capable of rapidly bringing the water to its boiling point, the vapor of which is conveyed through a pipe to a cold air source so as to be re-transformed into distilled water, which in turn is stored in an ad-hoc tank for use and distribution.

20 The present invention further relates to a method for water purification comprising the steps of:

- providing a three-dimensional structure consisting of a plurality of plates interconnected in a tight sealing manner so as to form walls so that said structure is provided with at least one open space at its lower portion;

25 - positioning the three-dimensional structure on the surface of the water to be purified contained in a body of seawater or water reservoir, so that the water surface on which said structure is positioned contributes to making the structure hermetically sealed;

- bringing the water to be purified into the three-dimensional structure by means of said step of positioning said structure on the surface of the water to be purified, only by means of said open space of said structure;

30 - providing at least one heat source arranged under the level of the water to be

purified;

- heating the surrounding portion of water at least by means of said one heat source and generating a corresponding amount of water vapor;

- connecting said water vapor with a cold air source in order to transform said water vapor into purified water;

- storing said purified water.

Brief Description of the Drawings

Further objects, features and advantages of the present invention will be more evident from the following detailed description, given merely by way of example and without limitation, and illustrated in the attached figures, in which:

Fig. 1 shows a perspective view of a preferred embodiment of the present invention on a 1:40 scale;

Fig. 2 shows a first lateral sectional view of a preferred embodiment of the present invention on a 1:50 scale.

LIST OF REFERENCE SIGNS:

y1 = rectangular plane of the water (longer cathetus in the sectional view);

y2 = rectangular plane orthogonal to the water and hermetically joined to y1 (shorter cathetus in the sectional view);

y3 = rectangular plane of top closing of the prism (hypotenuse in the sectional view);

y4 = oblique plane immersed in water at the beginning and at the end of the prism;

y5 = mirror;

y6 = trapezoid-like right and left closing planes of the prism, said planes being almost entirely immersed in water;

y7 = lenses;

y8 = rectangular plane open in water;

y9 = V-shaped profile arranged at the beginning and at the end of the electric resistors, said profile being irradiated by the focal point of the lens;

y10 = grid of resistors arranged at the water level;

x2 = air pipe rising together with the supporting pole x8 of the wind turbine;

x3 = tank for collecting purified water waiting to be transferred;

x4 = venting tube with valve (not shown in the figures) within the solar furnace;

x5 = pipe leaving the tank x3 for collecting purified water;
x6 = supporting structure made of steel (girders and pillars);
x7 = load bearing structure (beams and pillars);
x8 = structure made as a supporting pole for the wind turbine.

5 *Detailed Description of the Invention*

In a preferred embodiment, the artifact of the present invention is built on a planar area of a strip of water having a width of 5 meters and a length of about 5 meters. Merely by way of example and without limitation, the water reservoir is a portion of seawater surface. The supporting structure x6 is made of steel and consists of girders and pillars. Fiberglass materials; glass/transparent plastic material; transparent photovoltaic panels; electrical, electronic and hydraulic components complete its realization. The artifact concerned consists of a prism assembled at the water level, in which a rectangular plane – Fig. 1, y1 - is the surface of the seawater; a second plane – Fig. 1, y2 - also rectangular, is orthogonal to the first one, and a third rectangular plane – Fig. 1, y3 - joins the ends of the above-mentioned planes so as to form a prism; the two lateral planes are also closed in a trapezoid-like shape. Planes are provided that are oblique relative to the surface of the liquid and continue into said liquid – Figs 1 and 2 – so as to narrow the water inlet by forming a smaller rectangular plane – Figs. 1 and 2, y8 – under the surface of the liquid from where the water (for example, seawater) enters the volume of the prism autonomously, i.e. without requiring any pumping systems, in order to be treated.

Analyzing Fig. 2, we will note that said three-dimensional structure, when viewed in cross section, has a shape consisting of a trapezoid (in its portion almost entirely immersed in water) and a right-angled triangle, at its top portion, where the catheti are 5 meters in length and about 1.65 meters in height. The longer cathetus – Fig. 2, y1 – almost coincides with the water surface while the shorter one – Fig. 2, y2 - is orthogonal to the surface of the sea and rises skywards to the north. The hypotenuse – Fig. 2, y3 - is directed towards the sun and joins the two catheti with a gradient of about 25%. This hypotenuse rests on a rigid structure formed by pillars and beams x7 made of steel and anchored to the seabed. The hypotenuse y3 is strictly made of transparent material, glass/transparent plastic material or latest-generation transparent photovoltaic panels. The irradiation of the sun on the above-mentioned transparent surface creates a greenhouse effect between the plate in question and

the surface of the sea.

The shorter cathetus - rectangular plane - that is, the one that pointing upwards creates a side of 1.65 meters - Figs 1 and 2, y2 - continues for about twice its length also under the water, forming a 30-degree angle with the water - which could even drop to a 20-degree angle - reaching under the longer cathetus and it is made of the same material - black fiberglass, thus forming a rectangular plane under the sea – Figs. 1 and 2, y4. The same panel - rectangular plane – also continues upwards rising above the cathetus by 1.65 meters above the sea surface – Fig. 2, y2 - by an equal measure but with different material and with a different orientation, thus reaching a total of 3.30 meters above the water surface. The latter portion, of a further length of 1.65 meters – Figs. 2 and 3, y5 - is a refractive mirror – Figs. 1 and 2, y5 - and can be adjusted by slightly rotating the base. This refractive mirror extends over the entire length of the prism. The opposite end of the hypotenuse, i.e. the one that is in contact with the water to the south, is also supported by the rigid structure x6 made of steel – girders, but it closes the surface of the sea with a black fiberglass panel – Figs. 1 and 2, y4 - that goes underwater to a depth of about 3 meters, and that is rotated, in its position orthogonal to the water - by 60/80 degrees towards the inside of the hypotenuse, thus forming another rectangular plane - Fig. 1, y4.

The aim of this artifact is to build, with the aid of electric resistors y10 - like those used for domestic water heaters - placed at the surface and at the water level, a furnace capable of reaching a temperature of over 100 degrees centigrade at its inside. In the upper part of the north-facing hypotenuse, the supporting structure x6 of the artifact consists of pillars x7 anchored firmly to the seabed. One of these steel pillars points skywards for allowing laying of a wind turbine to produce energy for water needs. A tank – Fig. 2, x3 – is fixed to the base of this pillar x8 in order to collect water. Said tank is tubular. It has three pipes: the first one lets the air out from the top of the tank – Fig. 2, x2. This pipe rises above the tank, immersed in the sea, up to the end of the pillar x8 supporting the wind power system. The second pipe – Fig. 2, x4 – also rises from the top of the tank and goes into the volume of the right-angled triangular prism serving as a water-evaporating furnace. This pipe has the purpose of conveying the vapor into the tank to turn it back into distilled water. The third pipe – Fig. 2, x5 - is placed at the beginning and the end of the tank, i.e. at its both ends, and draws the water produced in the lower part of the tank for transferring the same. On the

plane of the prism in contact with the sea, which, viewed in section, is the longer cathetus about 5 meters long at the water level in the project – Fig. 2, y1 - a grid is placed, formed by resistors - like those used for domestic water heaters - placed transversely, parallel to each other and joined at the two ends by two longitudinal rods which are joined to the rigid supporting structure x6 so as to hold the water resistors y10 at the water level, said resistors being apt to be heated to high temperatures by an arrangement of lenses. Said resistors y10 heat up to over 1000 degrees centigrade and are spaced apart at a distance of 0.20/0.30 meters and are painted black. Obviously, the two ends of the artifact are closed by trapezoidal transparent panels – Fig. 2, y6 – said panels dropping down orthogonally from said hypotenuse by about 2 meters below the surface of the water in order to contain the air pressure inside the prism. The mentioned panels – Fig. 2, y6 - are trapezoid-shaped since the natural triangular shape to close the prism has been extended with a view to immersing a further part thereof in the water. This volume between the hypotenuse and the surface of the water - prism - serving as an assisted solar furnace, must be isolated and sealed in order to have the features of a large pressure cooker with pipes as the only outlet – Fig. 2, x4 – wherein said pipes from below the water surface connect the cylindrical tank to collect the water vapor - that becomes pure water inside said tank - and the aforementioned prism formed at the water level by the hypotenuse in question - inclined plane - and the catheti - water surface and plane orthogonal to the water, the orthogonal and oblique planes being immersed in water. Said connecting pipes may be provided with valves. As already mentioned, this three-dimensional structure, which works as a pressure cooker, has no bottom, because said bottom is the surface of the mentioned body of water. Said surface, of the body of water, can also be lowered from its natural level by virtue of the principle of the upturned glass immersed in a liquid which does not allow water to enter inside due to the presence of a volume of air and the level of said water/air is adjusted by the allowed pressure. Said three-dimensional structure has no pumping systems for carrying the water to be treated, because the liquid autonomously enters the open space in its lower portion. The project in question is based on the principles of solar furnaces that have always been used to produce thermal energy mostly for the preparation of food. With the present invention, the aim is to combine wind energy or other sources of energy with the heat produced by solar furnaces, so as to obtain the heat necessary to produce purified water.

In the present project this phenomenon is exploited by integrating the aforesaid energies also directly at sea. However, the requirements of the project call for a short timeline for the production of pure water in large quantities. For this reason, it is necessary to raise the water temperature of the first layer in the furnace - regarding minimum depths from the volume of air inside the prism (about 3 centimeters) - to about 100 degrees centigrade by means of electric resistors y10 like those used in domestic water heaters. These resistors y10 are placed at the water level along the plane of the prism, that is, the surface of the sea/water, and they follow the direction of the 25% inclined plane closing on top the furnace/prism. The resistors y10 are placed parallel to each other at intervals of about 0.20 /0.30 meters and joined at the ends with an orthogonal rod emerging from water and adapted to be heated to high temperatures by means of lenses – Fig. 2, y7. For the resistors y10, an iron float is provided at the center of each resistor, which float keeps the resistors immersed in water a couple of centimeters below the surface. These resistors y10 maintain the first centimeter of water below the surface at a temperature between 90 and 100 degrees centigrade. The task of the resistors y10 is to increase the temperature of the seawater from about 20 degrees centigrade to the above-mentioned temperature. At this point, it is easy for the solar furnace, at a temperature of only about 150 degrees centigrade, to allow the vaporization process in a very short time, thanks mainly to the arrangement of lenses that help to significantly increase the working temperature of the resistors y10, limiting the demand for electricity. The water vapor produced in such a short time will seek an escape route towards the cold air and it will then be channeled into the pipes x4 that from a tank well below the sea level lead into the solar furnace prism to collect the water at the gaseous state by means of intake vents. In turn, the tank has another pipe x2 that rises from the top portion orthogonally out of the sea up to a hundred meters in height to seek cooler air that will help to create intake currents for the gaseous water coming from the intake vents placed in the solar furnace. Once the water vapor or water at the gaseous state enters the tank, the temperature of the same drops suddenly from about 110 degrees to about 25 degrees centigrade. This sudden change between these two temperatures transforms the water vapor inside the said tank into purified liquid water once again.

With reference to this patent, a quantitative evaluation was carried out in order to verify the quantity of distilled water produced over a period of time equal to one day (24 hours). This

evaluation calculates the energy required to bring one m³ of water at a temperature of 20 °C to a state of water vapor at a temperature of 100 °C. As can be seen from the calculation below, the value is 2.57 GJ. This value refers to an isolated system that therefore does not exchange energy and matter with the outer environment. As far as energy is concerned, this situation can be considered substantially verified. In fact, the greenhouse effect produced by the structure forming the solar furnace makes it possible to maintain the temperature of the water vapor at least at 100 °C. The estimate in the patent foresees a much higher temperature (about 150-200 °C), thus making the calculation a conservative calculation. As far as the exchange of matter is concerned, the structure can be considered almost closed and allows a limited entry of water at room temperature through the lower part of the structure itself. This water, being colder, will tend to remain at the bottom of the structure, thus not triggering convective motions. The water heated to 100 °C on the surface is therefore affected in a very limited way by this exchange and in the first approximation it is legitimate to assume, for the sole purpose of the calculations, the system as being almost closed. In conclusion, the assumption of considering the system as almost isolated is therefore reasonable. As far as the necessary power is concerned, this clearly depends on the number of hours per day during which the greenhouse effect can be exploited. Taking as a reference a duration of 6 hours of average sunshine on the southern coast of Sardinia, the power required is 120 kW. Therefore, using a wind turbine with a capacity of 8 MW would produce over 100 m³ of distilled water per day. For the remaining 18 hours the wind power system can then deliver the energy produced for other processes. The energy assessment of water evaporation is given here.

$\lambda_{ev} = 2230 \text{ J/g}$ (latent heat of water evaporation)

$C_v = 4.186 \text{ J/gK}$ (specific heat of water)

$E \text{ (per 1 g of H}_2\text{O)} = (4.186 \text{ J/K} \times 80 \text{ K}) + 2230 \text{ J} = 2.57 \text{ kJ}$

$E \text{ (per 1 m}^3 \text{ of H}_2\text{O)} = 2.57 \times 10^6 \text{ kJ} = 2.57 \text{ GJ}$

As a result of the solar furnace mentioned above, the energy consumption has decreased by about 20%. If further reduction in the energy consumption of the above-mentioned calculation is desired, the resistors y10, arranged at the water level (immediately below the surface of the liquid) are joined together, both north and south, by a profile – Fig. 2, y9 – of the same color and material, said profile being formed in the approximate shape of a very

open V defining therein and angle between 90 and 120 degrees. Said profile has a leg positioned in such a way as to join the resistors y10 to one another by running transversely through the structure and remaining at the same level as the liquid, but a couple of centimeters higher. The other leg rests on the black panel closing the solar furnace. This profile is apt to be heated up to high temperatures, 2000 degrees centigrade, by means of small, but very powerful, lenses – Fig. 2, y7 – which with their focal point concentrate the sun rays onto the mentioned V-shaped profile.

CLAIMS

1. A water purification system comprising a three-dimensional structure comprising a plurality of plates interconnected so as to form walls (y2, y3, y4, y6) so that said structure has at least an open space (y8) at its lower portion, wherein said structure is apt to be placed
5 on the surface of the water of a portion of a sea, a lake or an artificial water reservoir, so that the water surface on which said structure is placed contributes to the hermetic sealing of the structure itself,

characterized in that it comprises:

- at least one heat source (y10) apt to be placed, in use, under the water level within
10 said three-dimensional structure, and capable of heating the portion of water surrounding said at least one heat source (y10) and of generating a corresponding amount of water vapor;
- at least one conduit (x2) capable of connecting said water vapor with a cold air source in order to transform said water vapor into purified water;
- at least one tank (x3) to store said purified water;
- 15 - at least one arrangement of lenses (y7) arranged on the side exposed to the sun and apt to heat up said at least one heat source (y10);
- means for carrying the water to be purified into said three-dimensional structure consisting exclusively of said open space (y8) in the lower portion of said three-dimensional structure.

20 2. The water purification system according to claim 1, characterized in that said heat source (y10) is associated with suitable energy supply means.

3. The water purification system according to one or more of the preceding claims, characterized in that said plates include a first rectangular plane of top closing (y3), a second rectangular plane (y2) that is substantially orthogonal, in use, to the water surface, a third
25 and a fourth plane (y4) that are substantially oblique, in use, relative to the water surface and are configured to be immersed into the water, and a fifth and a sixth plane of lateral closing (y6) that are substantially orthogonal, in use, to the water surface.

4. The water purification system according to claim 3, wherein said first plane (y3) and said fifth and sixth planes (y6) are made of a material selected from the group comprising
30 transparent plastic material, glass, photovoltaic panels.

5. The water purification system according to one or more of the preceding claims,

characterized in that said heat source (y10) comprises at least one electric resistor.

6. The water purification system according to one or more of the preceding claims, characterized in that it comprises at least one supporting element (x6, x7, x8) for said three-dimensional structure, wherein said supporting element (x6, x7, x8) is anchored to the bottom of said portion of sea, lake or water reservoir, or it is anchored to a suitable base surface positioned at a certain depth of said portion of sea, lake or water reservoir.

7. The water purification system according to one or more of the preceding claims, characterized in that said at least one conduit (x2) comprises an intake tube connected to said tank and said cold air source.

8. The water purification system according to claim 7, characterized in that said intake tube comprises at least one valve.

9. The water purification system according to one or more of the preceding claims, characterized in that the atmospheric pressure within said three-dimensional structure can be changed at will.

10. The water purification system according to one or more of the preceding claims, characterized in that said three-dimensional structure comprises further plates (y4, y6) apt to stay immersed under the water surface when the system is operating, said further plates (y4, y6) representing a continuation of said structure under the water level and leaving, at its lower portion, an open plane (y8) that allows the water to enter and hermetically seal said three-dimensional structure.

11. A method for water purification by means of a system of water purification as claimed in claim 1, said method comprising the steps of:

- providing a three-dimensional structure consisting of a plurality of plates (y2, y3, y4 and y6) interconnected in a tight sealing manner so as to form walls so that said structure is provided with at least one open space (y8) at its lower portion;

- positioning the three-dimensional structure on the surface of the water to be purified contained in a body of seawater or in a water reservoir, so that the water surface on which said structure is positioned contributes to making the structure hermetically sealed;

- bringing the water to be purified into the three-dimensional structure by means of said step of positioning said structure on the surface of the water to be purified, only by means of said open space (y8) of said structure;

- providing at least one heat source (y10) arranged under the level of the water to be purified;

- heating the surrounding portion of water at least by means of said one heat source (y10) and generating a corresponding amount of water vapor;

5 - connecting said water vapor with a cold air source in order to transform said water vapor into purified water;

- storing said purified water.

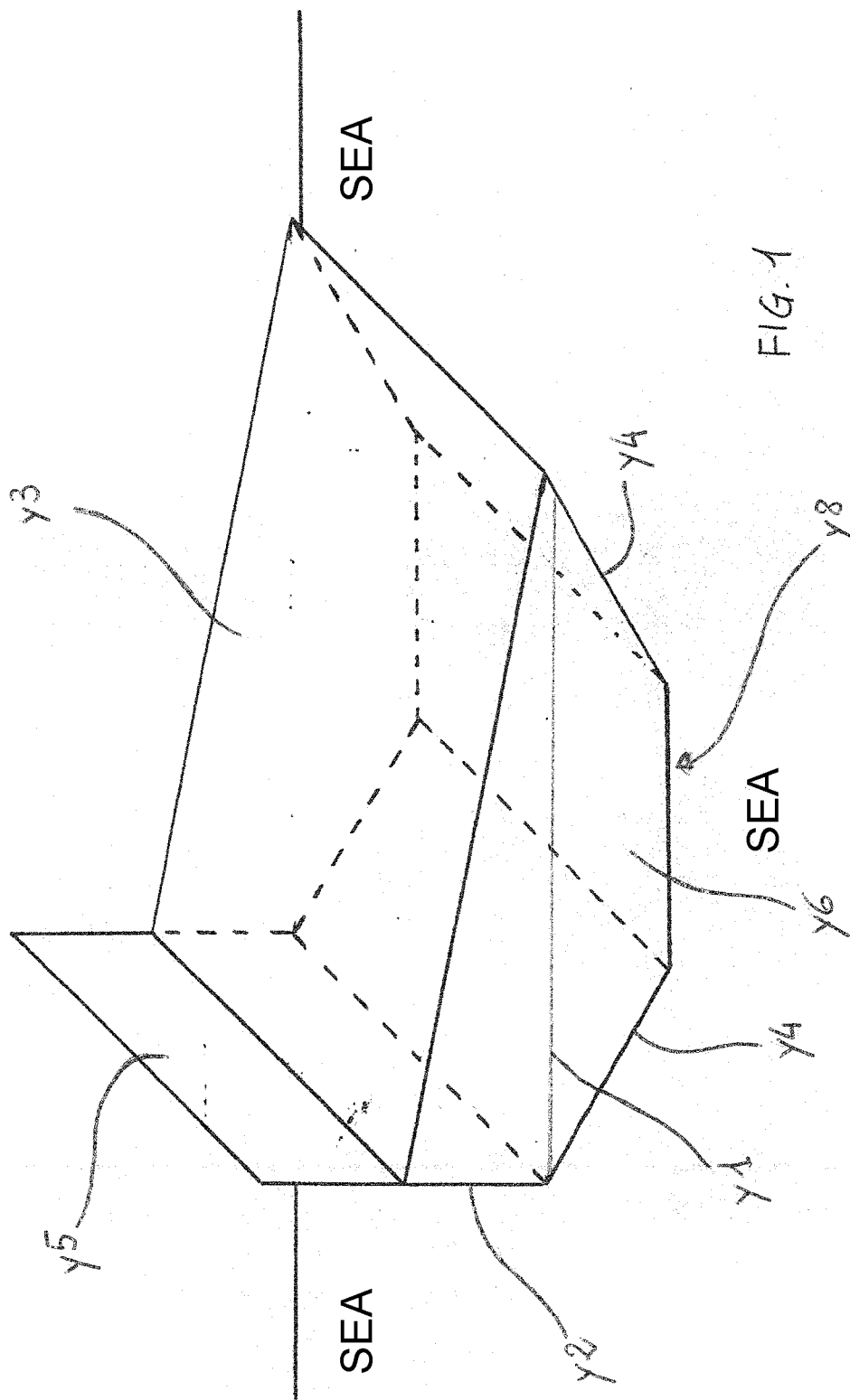
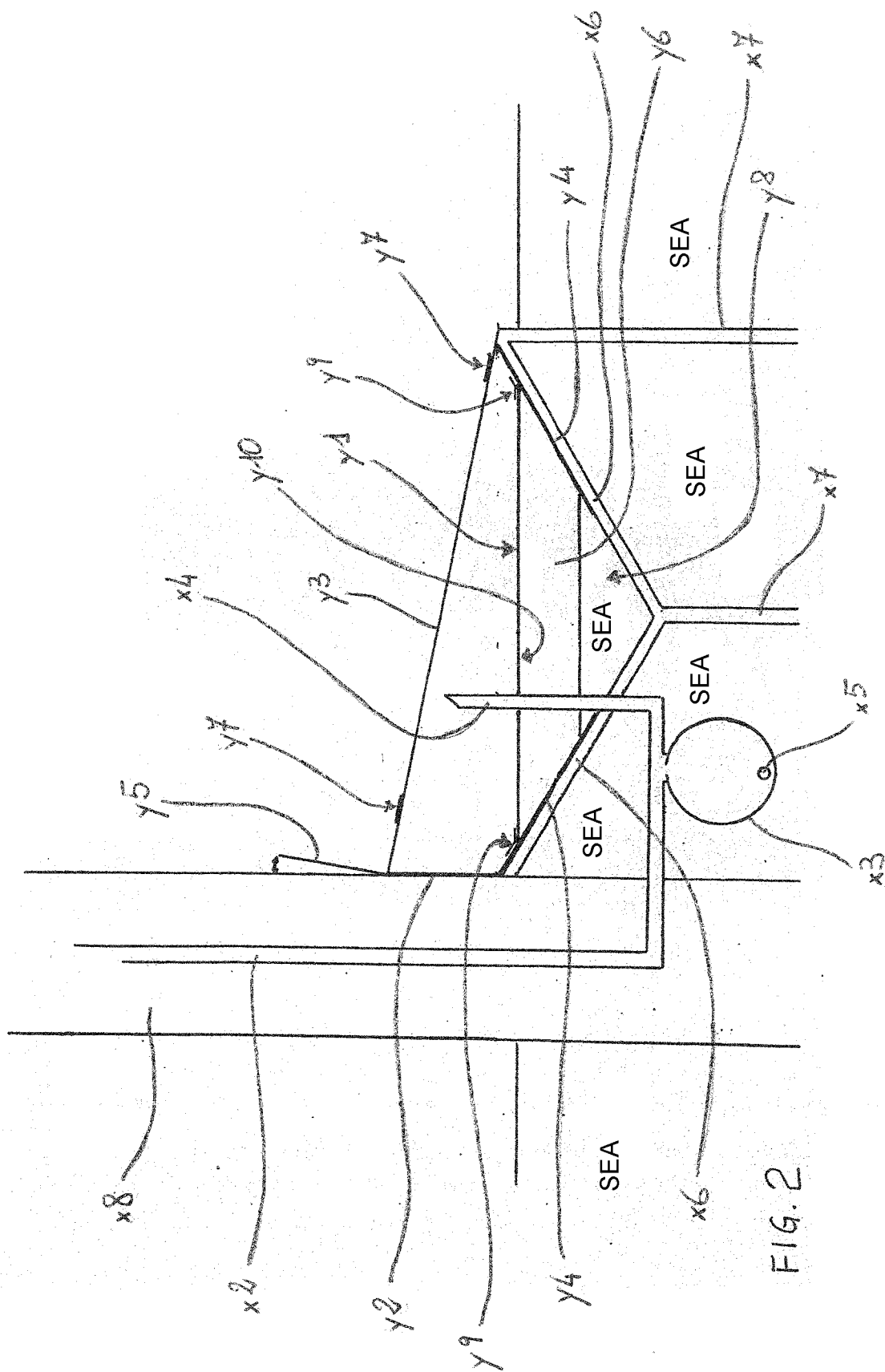


FIG. 1



INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER

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ADD.

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)

B01D C02F

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 957 071 A1 (GACHET LUDOVIC [FR]) 9 September 2011 (2011-09-09) fig.A, page 1-4 -----	1,2,4-11
X	US 3 960 668 A (RUSH MARTIN A) 1 June 1976 (1976-06-01) fig.1,2, column 2 line - 3 column 4 line 50 -----	1,2,4-11
X	WO 2017/175104 A1 (OPPO STEFANO [IT]) 12 October 2017 (2017-10-12) figures 1,2 -----	1-11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

3 February 2020

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
FR 2957071	A1	09-09-2011	NONE	

US 3960668	A	01-06-1976	NONE	

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