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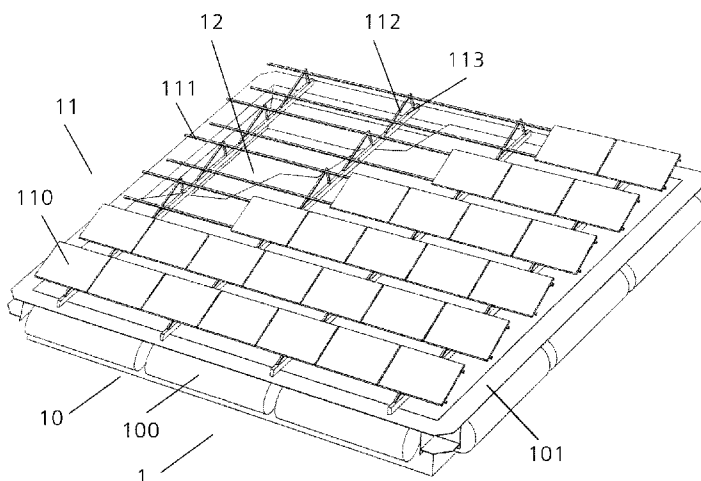


Fig. 1a

(57) **Abstract:** Disclosed is a solar harvesting system, including: a) at least one solar harvesting pontoon (1), the solar harvesting pontoon (1) including: a peripheral frame structure (10); a platform (12), the platform spanning a pontoon area; wherein a bottom side of the platform (12) and a liquid surface (S) of the liquid reservoir serve as delimiting top surface and delimiting bottom surface of a gastight containment when the at least one solar harvesting pontoon (1) floats on the liquid reservoir, the gastight containment enclosing an enclosed volume (V); a solar harvesting arrangement (11), the solar harvesting arrangement (11) being arranged on or above a top side of the platform (12); b) a gas supply unit (2); c) a gas feeding system with at least one gas supply aperture (30)) for feeding gas into the enclosed volume (V), thus generating an overpressure inside the enclosed volume (V), the overpressure suspending the at least one solar harvesting pontoon (1). Disclosed is further a method for operating a solar harvesting system.

SOLAR ENERGY HARVESTING SYSTEM

TECHNICAL FIELD

The present invention lies in the field of solar energy harvesting. Particularly, it is
5 related to solar harvesting systems and methods for operating solar harvesting systems.

BACKGROUND

Harvesting of solar energy has become a technical area of considerable importance over the last years. Harvesting of solar energy is of particular interest for
10 local energy supply in areas of little or generally insufficient power generation and power distribution infrastructure, as well as in the general context of an increasing necessity for renewably energy generation with as little environmental impact as possible.

A variety of concepts, systems and devices for solar harvesting have accordingly
15 been developed, from highly miniaturized systems to huge solar power plants.

WO 2009/001225 A2 of the applicant discloses a man-made island with solar energy collection facilities. The man-made island includes a platform and an outer ring that allows the platform to float on a liquid, in particular water, that is arranged in a ring-shaped tank. Under the platform, an airtight volume is defined in
20 which overpressure is maintained by means of a compressor, thus suspending the

floating man-made island. The man-made island has a circular footprint, thus allowing alignment relative to the sun by rotating the floating island.

SUMMARY OF DISCLOSURE

It is an overall objective of the present invention to improve the state of solar harvesting systems for renewable energy generation. It is a particular object to provide systems that are suited for small-scale and large-scale applications in sunny areas. This overall objective is achieved by the subject matter as defined by the features of the independent claims. Particular and exemplary embodiments are defined by the dependent claims as well as by the overall disclosure of the present document.

According to one aspect, the objective is achieved by providing a solar harvesting system. A solar harvesting system in accordance with the present invention includes at least one solar harvesting pontoon that is designed to float on a liquid reservoir. The at least one solar harvesting pontoon includes a peripheral frame structure and a platform. The platform is arranged on or above a top side of the peripheral frame structure and spans the pontoon area that is laterally delimited by the peripheral frame structure.

In this document, directional terms, in particular "top", "bottom", "up", "down", "above", "below" are generally used with reference to their ordinary meaning during operation. The gravity vector accordingly points downwards from top to bottom.

When the solar harvesting pontoon floats on the liquid reservoir, a bottom side of the platform and a liquid surface of the liquid reservoir, in particular a liquid surface under the platform, serve as delimiting top surface and delimiting bottom surface of a gastight containment. The gastight containment encloses an enclosed
5 volume as its inner volume.

Any gas that is present inside the enclosed volume as described further below is accordingly sandwiched between the underside of the platform and the liquid surface under the platform. The underside of the platform and the liquid surface accordingly define the vertical extension of the enclosed volume. Horizontally or
10 laterally, the enclosed volume is delimited and its lateral extension is defined by a peripheral delimitation that extends between the underside of the platform and the liquid surface. The peripheral delimitation may be formed by the peripheral frame structure. In this case, the peripheral frame structure and the platform are peripherally connected in a gastight or sealing way. Alternatively or additionally,
15 the enclosed volume may be laterally delimited by a skirt that projects downwards from the platform or the peripheral frame structure. In this case, the skirt serves as peripheral delimitation. In a more general way, the peripheral delimitation may be formed by any peripheral structure that is gastight connected to the platform and defines, together with the platform and the liquid surface below the platform, a
20 gastight containment.

The enclosed volume being sealed means that it is gastight and any gas, e.g. air, inside the enclosed volume is trapped and cannot exit the trapped volume unless intentionally relieved. That is, some leakage rate is acceptable as long as the gas

supply unit as discussed below is capable of replacing the escaping gas. Tightness is especially given with respect to a gas that is, in operation, present within the enclosed volume.

The surface of the liquid reservoir on which the solar harvesting pontoon floats is
5 favourably continuous or substantially continuous and may especially have dimensions and a footprint that is at least as large as or may be substantially larger than the footprint of the solar harvesting pontoon. The surface of the liquid reservoir accordingly extends at least over the whole footprint area of the at least one solar harvesting pontoon. Within this document, the term "footprint" is used in its
10 ordinary technical meaning of a top view geometry.

Solar harvesting pontoons in accordance with the present invention may have substantially any desired size. To be of practical economic and/or ecologic interest, the size of a single pontoon may typically be in a range between 10 m x 10 m to 50 m x 50 m, but smaller or larger dimensions are physically possible. As will be
15 discussed in more detail further below, individual pontoons may be coupled to and arranged in clusters. Clusters may be coupled to each other and arranged in solar harvesting plants or cluster groups of substantially any required dimension.

The at least one solar harvesting pontoon further includes a solar harvesting arrangement. This solar harvesting arrangement is arranged on or above a top side
20 of the platform.

The solar harvesting system further includes a gas supply unit. This gas supply unit may in particular be an air supply unit as will be described in more detail further below.

The solar harvesting system further includes a gas feeding system. The gas feeding system includes at least one gas supply aperture. The gas feeding system is designed to feed gas that is provided by the gas supply unit into the enclosed volume of the at least one solar harvesting pontoon, thus generating an overpressure inside the enclosed volume. In operation, this overpressure suspends the at least one solar harvesting pontoon.

10 The peripheral frame structure favourably provides horizontal stability to the solar harvesting pontoon. The peripheral frame structure can be realized in one piece or by any number of adjacently connected elements.

The peripheral frame structure favourably further provides rigidity to the whole solar harvesting pontoon. For this purpose, the peripheral frame structure may include a dedicated stiffening structure, especially a peripheral stiffening structure of high rigidity. Such stiffening structure may, e.g., include one or more peripheral elements that may be made from plastic, metal, e.g., aluminium or steel and/or reinforced materials, e.g. glass fibre reinforced plastics, and/or from concrete.

20 Additionally or alternatively, the overpressure of the gas inside the enclosed volume may be employed for stiffening purposes and improving rigidity of the solar harvesting pontoon. In particular, the overpressure of the gas in the enclosed vol-

ume does not only exert a force in vertical direction that suspends the solar harvesting pontoon, but also exerts a force in lateral direction which may be used to tension the peripheral frame structure, thereby stiffening the solar harvesting pontoon.

- 5 The footprint of the solar harvesting pontoon is essentially defined by the top view geometry of the peripheral frame structure. In an embodiment, the peripheral frame structure has the shape of a square, ring or toroid, resulting in a square, circular or elliptical footprint of the solar harvesting pontoon. In further favourable embodiments, however, other footprints are used as will be discussed further below in more detail.
- 10

The peripheral frame structure may further carry and serve as mechanical support for the solar harvesting arrangement.

- As will be discussed further below in more detail, the peripheral frame structure may, in some embodiments, generate floatation in addition to the floatation that results from the overpressure inside the enclosed volume.
- 15

- In operation, vertical forces that result from the overpressure in the enclosed volume and optionally from additional floatation that may be generated by the peripheral frame structure allow the solar harvesting pontoon to float on top of the liquid reservoir. Such vertical forces exactly compensate the total weight of the solar harvesting pontoon. The weight of the solar harvesting pontoon is substantially uniformly distributed over its surface.
- 20

Elongated stiffening elements are provided in some embodiments that span the pontoon area and are attached to the peripheral frame structure. Examples for such elements are bars or beams that may be used for attaching the solar harvesting arrangement to the peripheral frame structure as will be discussed further below. Such stiffening elements may in some embodiments be tensioned by a radial or lateral force that is exerted by the enclosed gas, thereby stiffening the solar harvesting pontoon.

The gas that is supplied by the gas supply unit is typically air. However, other stable gases, such as CO₂, or a stable gas mixture could be used as well. For supplying gas with the required overpressure, the gas supply unit may be realised as or include a gas pump, a blower, a compressor, pressurised gas tanks, or any combination thereof. In some embodiments, two or more gas supply units may be present that operate in parallel. In such configurations, the two or more gas supply units may be configured to maintain a sufficient gas supply in case of a given maximum number of e.g. one or two gas supply units failing. In further embodiments, at least two gas supply units are present with at least one gas supply unit being a backup gas supply unit that is not used during regular operation.

In some embodiments, a gas supply conduit of the gas feeding system crosses, in an operational state, below the peripheral frame structure. It is accordingly at least partly arranged within the liquid, below the liquid surface and crosses the peripheral frame structure in the liquid and below the solar harvesting pontoon. This allows to provide the pressurized gas to the solar harvesting pontoon and to

feed it into the enclosed volume from the bottom side of the solar harvesting pontoon without requiring supply connectors on the solar harvesting pontoon.

In dependence of the additional floatation that may additionally be generated by the peripheral frame structure, the overpressure in the enclosed volume that is required for suspending the solar harvesting pontoon to float on the liquid can be
5 comparatively low. Typically, the overpressure does not exceed a few percent of the atmospheric pressure and may be about 1% of the atmospheric pressure or below 1% of the atmospheric pressure (1% of the atmospheric pressure equals about 100 kg/m²) .

10 The liquid reservoir may be any suited natural or man-made liquid reservoir, in particular water reservoir, such as a lake, a pond, an ocean, a man-made tank, a drinking water reservoir or any other water area. The liquid may, e.g. be plain and clean sweet water, but may also be salt water or seawater or polluted water or even chemicals. The water reservoir may accordingly also be, e.g. a sedimentation
15 tank or the like. The water reservoir may also be any otherwise unused liquid reservoir and in particular water reservoir. This is particularly favourable since in many countries, land is reserved for housing and crops and cannot be used for solar energy harvesting, resulting in rooftops remaining as essentially only areas for installing solar harvesting equipment on land.

20 For a solar harvesting system in accordance with the present invention, the platform is, in operation, above the liquid surface level, while the peripheral frame structure contacts and dips into the liquid. The enclosed gas volume accordingly

forms an air cushion or air buffer. This air buffer acts as gas pressure spring and absorbs waves between the liquid surface and the platform. In typical embodiments, the lateral extension or width of the peripheral frame structure is further small as compared to the overall lateral dimension of the solar harvesting pontoon and forms a rim at the periphery of the pontoon. The liquid under the platform is accordingly in direct contact with the gas in the enclosed volume. This is particularly favourable in typical embodiments where the gas is air and aquatic life is present in the liquid reservoir. Fish etc. can accordingly still attain the surface under the platform. As will be explained further below, the gas supply can additionally be used to oxygenate the liquid, in particular water, of the liquid reservoir.

The solar harvesting arrangement may operate according to any or a combination of generally known solar harvesting technologies, such as photovoltaics (PV); concentrated photovoltaics with linear concentrating parabolas, dishes or Fresnel lenses/mirrors; solar thermal; concentrated solar-thermal with linear concentrating parabolas, dishes or Fresnel lenses/mirrors.

In some embodiments, the platform includes and preferably consists of a gastight foil or membrane, in particular an airtight foil or membrane. The foil or membrane covers the solar harvesting pontoon area.

In accordance with the present invention, the platform is suspended over its total surface area by the pressurized gas in the enclosed volume. Therefore, the platform itself does not need to be very strong or sturdy, such that a gastight foil or membrane, e.g. an industrial-grade foil in a range of typically 0.1mm to 5mm,

more particularly 0.5mm to 3mm thickness, is generally sufficient. The foil or membrane may optionally be reinforced by cables which may be connected to and supported by the peripheral frame structure. In alternative embodiments, the platform is made of any other solid and gastight material, for example, but not
5 limited to, metal, plastic, epoxy or processed wood. In comparison to alternative floatable structures, such as boats or conventional floats, a pontoon according to the present invention has a particularly low weight.

A further advantage over alternative structures is a reduced growth of algae. This advantages results from the comparatively small liquid-contacting surface of the
10 pontoon, which is limited to a liquid-contacting portion of the peripheral frame structure and an optional skirt.

The platform may either be transparent or opaque. Furthermore, the solar harvesting arrangement, e.g. solar thermal collectors or PV panels, may not cover the whole platform area. By using a transparent platform, e.g. a platform that is made
15 of a transparent foil, sunlight may accordingly be provided to the liquid surface below the platform. This is especially favourable if aquatic life is present in the liquid reservoir, typically water reservoir. On the other side, the platform may be designed to be largely or partly light-absorbing. In further favourable embodiments, the platform is of a reflective material, e.g. a white foil. For this type of
20 embodiment, rays of sunlight are reflected from the platform towards the solar harvesting arrangement, thus increasing the energy harvesting efficiency.

In some embodiments, the peripheral frame structure is designed to generate a floatation that is sufficient for the solar harvesting pontoon to float on the liquid reservoir without overpressure inside the enclosed volume.

While the solar harvesting pontoon is, in operation, gas suspended as discussed
5 before, it is favourable if the peripheral frame structure provides sufficient floatation for the solar harvesting platform to float on its own. While not being essential, such design is particularly favourable for safety reasons if the overpressure in the enclosed volume is lost. It is further favourable, e.g. in view of maintenance of the gas supply unit and/or the gas feeding system as well as during installation. The
10 generated floatation may be just at the limit of floatation in order to use as little material as possible, thus reducing costs. In such embodiments, the peripheral frame structure may include or consist of at least one float element. Suited float elements may be realized by hoses, tubes or the like that are filled with air or another gas or fully or partly filled with floating material, such as polystyrene foam.
15 In further embodiments, float elements are fully made of such floating material. In further embodiments, float elements are realized by a flexible inflatable hull which may, e.g. be made from rubber.

In alternative embodiments, the peripheral frame structure generates less floatation than is required for the solar harvesting pontoon to float or generates substantially no floatation. For such embodiments, the required floatation is fully
20 generated by the pressure of the gas inside the enclosed volume.

In some embodiments, the at least one solar harvesting pontoon includes a peripheral skirt, the peripheral skirt extending in a downwards direction in or into the liquid of the liquid reservoir. The peripheral skirt is gastight connected to the platform directly or via the peripheral frame structure. In some embodiments including a peripheral skirt, the peripheral skirt is attached to the peripheral frame structure and projects downwards beyond a liquid-contacting area or bottom side of the peripheral frame structure. This type of embodiment is favourable if the peripheral frame structure is gastight connected to the platform and the peripheral frame structure serves as peripheral delimitation for the enclosed volume. The peripheral skirt is gastight attached to the peripheral frame structure. The peripheral skirt dips deeper into the liquid than the body of the peripheral frame structure. Thereby, gas is prevented from escaping out of the enclosed volume when there are waves or the like on the liquid surface. The peripheral skirt can be a separate element that may be made of any rigid, semi-rigid or soft material such as plastic or metal, or it can be part of a peripheral stiffening structure. Optionally, additional weight may be provided at the bottom side of the skirt to keep the peripheral skirt tight. On calm liquid reservoirs, such as smaller lakes or some man-made tanks, a skirt may not be needed and accordingly be omitted.

In some further embodiments that include a peripheral skirt, the peripheral skirt is attached to the platform in a gastight way or is formed integrally with the platform, such that the platform and the peripheral skirt form, together with the liquid surface, a gastight containment. The skirt projects downwards from the bottom side of the platform and dips into the liquid. It accordingly extends over the whole vertical dimension of the enclosed volume. In such embodiments, the pe-

ripheral skirt accordingly serves as peripheral delimitation of the enclosed volume. In such embodiments, gastightness is not required for the peripheral frame structure.

In some embodiments, the at least one solar harvesting pontoon includes a pressure relief valve, the pressure relief valve being designed to fluidic connect the enclosed volume with the environment if the gas pressure inside the enclosed volume exceeds a threshold pressure.

The threshold pressure may be set to a value that is somewhat higher than the minimum that is required for suspending the platform. In this case, the platform, in particular a platform that is made from a flexible material such as a foil or membrane, will somewhat bulge which is favourable to evacuate water in case of rain.

The pressure relief valve may be a mechanical valve of generally known design with a design-given or adjustable threshold pressure. Alternatively, it may be a controllable valve, such as an electrically or pneumatically actuated valve in operative coupling with a pressure sensor and corresponding control circuitry. The pressure relief valve may further allow adjustment of the threshold pressure remotely, e.g. via a remote control unit in dependence of the specific environmental conditions.

As will be discussed later on in more detail, a plurality of solar harvesting pontoons may be arranged as a cluster and a plurality of clusters may be arranged as

cluster groups. In such configurations, different solar energy harvesting technologies and different types solar of harvesting arrangements may be used on different pontoons and/or in different clusters. Since different types of solar harvesting arrangements have different weights, pressure relief valves with different threshold pressures may be required for different pontoons and/or clusters.

In some embodiments, the gas feeding system includes a network of gas supply conduits, the network of gas supply conduits having a number of branches and having gas supply apertures in at least some of the branches.

Such a network of gas supply conduits may be used to supply gas to a number of solar harvesting pontoons from a common gas supply unit, as discussed further below in more detail. In such embodiments, the gas feeding system serves as gas feeding and distribution system that distributes gas to a number of solar harvesting pontoons. It may further be used to equally distribute the pressure between the individual enclosed volumes in a cluster of solar harvesting pontoons and/or the clusters of a cluster group.

In some embodiments, the gas supply aperture or plurality of gas supply apertures is, in an operational state, below the liquid surface level, favourably in an area below the platform of the at least one solar harvesting pontoon. For this type of embodiment, the gas exits the at least one gas supply aperture as a stream of gas bubbles, e.g. air bubbles, under the platform of the at least one solar harvesting pontoon, i.e. within the area that is delimited by the peripheral delimitation.

For this type of embodiment, the travel path of the gas bubble will depend on the depth of the at least one gas supply aperture under the liquid surface. With increasing depth as well as with increasing potential flow speed of the liquid within the liquid reservoir, the stream of gas bubbles will widen. In case of the gas being
5 air, the air bubbles may accordingly, in addition to suspending the solar harvesting pontoon, oxygenate the water. This is favourable in case of aquatic life within the water reservoir which needs oxygen. Furthermore, anaerobes bacteria grow in non-oxygenated waters. Their growth is accordingly prevented or at least reduced by oxygenated water.

10 Alternatively, or additionally, other types of gas than air may be used, e.g. a sterilizing and/or antibacterial gas. Such type of embodiment may be favourable e.g. in case of the liquid reservoir being a man-made drinking water reservoir.

If no oxygenation or other treatment of the liquid is required or desired, the at least one gas supply aperture may be arranged closely under the liquid surface e.g.
15 slightly below the most bottom parts of the at least one solar harvesting pontoons. In a further variant, the gas supply conduits cut the liquid surface under the platform and the at least one gas supply aperture directly opens into the enclosed volume above the liquid surface.

In further favourable embodiments, at least one gas supply conduit of the gas
20 feeding system is arranged on the ground of the liquid reservoir. Anchors and/or weights may be attached to the at least one gas supply conduit to keep it in place.

In some embodiments, the at least one solar harvesting pontoon includes pontoon couplers. The pontoon couplers are preferably arranged at the periphery of the at least one solar harvesting pontoon. The pontoon couplers are designed for mechanically and preferably rigidly coupling the at least one solar harvesting pontoon with further neighbouring solar harvesting pontoons. Pontoon couplers may be designed to operatively interact with pontoon link elements such as rods, bars, chains or ropes. The pontoon link elements bridge the gap between pontoon couplers of neighbouring pontoons to be coupled and may be provided separately from the solar harvesting pontoons. Alternatively, pontoon link elements may be provided integrally with the solar harvesting pontoons. In further embodiments, the pontoon couplers are designed to directly couple neighbouring solar harvesting pontoons, without intermediate link elements.

In some embodiments, the gas supply unit is arranged remote from the at least one solar harvesting pontoon. The gas supply unit, which may be of any of the before-discussed types, may be arranged outside of the liquid reservoir. Alternatively, it may be arranged on a separate floating pontoon, a ground-fixed platform, an island or the like within the liquid reservoir. A liquid-tight gas supply unit may in principle also be arranged within the liquid reservoir, e.g. on its ground. In further embodiments, the gas supply unit is arranged on the solar harvesting pontoon, e. g. mounted to the peripheral frame structure. In such an embodiment, a gas supply conduit may run downwards around the peripheral frame and crosses under the peripheral frame and an optionally present skirt. One or more gas supply apertures may either be arranged below the liquid surface or the gas supply conduit may cut the liquid surface such that one or more gas supply apertures are

located above the liquid surface within the enclosed volume. In embodiments that include a cluster of solar harvesting pontoons as discussed further below, the gas supply unit may further be arranged on one of those pontoons and supply further solar harvesting pontoons via the gas feeding system.

- 5 In some embodiments, the solar harvesting system includes a cluster of solar harvesting pontoons. The individual solar harvesting pontoons of the cluster are generally designed in the same way. In operation, the individual solar harvesting pontoons of the cluster float on a common surface of a common liquid reservoir in a side-by-side arrangement. The gas feeding system is designed to feed gas into the
- 10 enclosed volumes of at least two solar harvesting pontoons from a common gas supply unit. The gas feeding system is accordingly a common gas feeding system for at least two solar harvesting pontoons and the gas supply unit may be a common gas supply unit for at least two solar harvesting pontoons.

Some or all solar harvesting pontoons of the cluster may be connected via pontoon couplers and optional pontoon link elements, as discussed before.

15

For a cluster of solar harvesting pontoons, the gas feeding system is favourably designed as net, grid, or tree of gas supply conduits and has a plurality of gas supply apertures for supplying gas to the individual solar harvesting pontoons of the cluster. Favorably, gas supply conduits run under the liquid surface to supply

20 gas under or into the individual enclosed volumes of the individual solar harvesting pontoons.

As will be discussed below in the context of exemplary embodiments, the solar harvesting system may include a pressure and/or flow control system with one or more control valves, sensors, and a control unit. Such pressure and/or flow control system is designed for controlling the gas pressure in the individual enclosed
5 volumes and or the gas supply to the individual enclosed volumes to be substantially uniform.

In some embodiments with a cluster of solar harvesting pontoons, the individual solar harvesting pontoons of the cluster of solar harvesting pontoons have a footprint such that the solar harvesting pontoons plaster a surface area of the cluster
10 substantially without spacing remaining between the individual solar harvesting pontoons.

Such "plastering pontoons" have the advantage of making efficient use of the liquid reservoir surface. The limited footprint of each single solar harvesting pontoon, however, is favourable under aspects such as mechanical stability, transportation
15 and on-site installation.

Additionally - and in some cases even more important - the liquid that is covered by the solar harvesting pontoons is prevented from evaporation. In operation, the gas (typically air) in the enclosed volume of each solar harvesting pontoon is saturated with liquid (typically water steam). Since the enclosed volume is tightly
20 sealed, no or very little evaporation will occur. By providing clusters of large combined footprint area, a substantially infinite liquid surface area can be prevented

from evaporation. This is a particular advantage in warmer countries where water evaporation is a major issue and in some cases an urging and life-critical problem.

According to a further aspect, the present invention is directed towards the use of a solar harvesting pontoon, a solar harvesting cluster or a cluster group or solar
5 harvesting plant for preventing evaporation from a liquid reservoir. In such an embodiment, the at least one solar harvesting pontoon serves a double goal of harvesting solar energy as well as preventing evaporation.

It will be understood that the effect of preventing liquid (typically water) from evaporation is additional and independent from the aspect of solar energy har-
10 vesting. In applications where only evaporation prevention is required, evaporation prevention pontoons and clusters of evaporation prevention pontoons may accordingly be designed in accordance with the present invention in essentially the same way as solar harvesting platoons. The solar harvesting arrangement, however, may be omitted in this case.

15 As will be discussed further below in more detail, individual solar harvesting pontoons may be arranged in and coupled to clusters and clusters may be arranged in and coupled to cluster groups or solar harvesting plants. In an analogue way, evaporation prevention pontoons may be arranged in and coupled to evaporation prevention clusters and evaporation prevention cluster groups, respectively.

20 For the solar harvesting pontoons, different footprint geometries may be used. Each geometry has its own advantages and disadvantages. Suited footprint ge-

ometries are, e.g., triangular, rectangular, square, or hexagonal. For a given layout, the hexagonal shape for example enables six possible angular orientations of the solar harvesting arrangement towards the sun.

If desired, a number of solar harvesting clusters may be combined to a larger solar harvesting plant or cluster group. The single solar harvesting clusters of such a
5 larger solar harvesting plant or cluster group may be coupled in essentially the same way as the single solar harvesting pontoons within the clusters. Therefore, cluster couplers may be provided at all pontoons of the cluster or at least at pontoons at the periphery of each cluster. The cluster couplers may generally be designed in the same way as the pontoon couplers. Furthermore, a single type of
10 couplers may serve as both pontoon couplers and cluster couplers. The cluster couplers may directly engage each other. Alternatively, additional cluster link elements may be provided that bridge the distance between the cluster couplers. Cluster link elements may generally be designed in the same way as pontoon link
15 elements. The clusters may be coupled in a loose or flexible way, e.g., via steel ropes, chains, or the like as cluster link elements.

Single solar harvesting pontoons, clusters of solar harvesting pontoons as well as cluster groups or solar harvesting plants may further be anchored or bound to the ground of the liquid reservoir, via submerged weights, anchors, steel ropes and
20 concrete bases, or the like. Similarly, they may be anchored to the shore or generally the (lateral) borders of the liquid reservoir.

In some embodiments with a cluster of solar harvesting pontoons, the gas feeding system includes pressure equalization conduits, the pressure equalization conduits fluidic coupling the enclosed volumes of different solar harvesting pontoons. The pressure equalization conduits include pressure equalization apertures that
5 are, in operation, arranged within the enclosed volumes and above the liquid surface.

Such pressure equalization conduits are particularly favourably used in large clusters to ensure substantially identical pressure for the individual solar harvesting pontoons. Pressure equalization conduits further enable embodiments where at
10 least some of the solar harvesting pontoons do not receive the gas for supporting the pontoon directly from the gas supply unit. Instead, they may receive the gas from the enclosed volume(s) of one or more other solar harvesting pontoon(s). Pressure equalization circuits may be arranged above and/or below the liquid surface level.

15 According to another aspect, the overall objective of the present invention is achieved by providing a method for operating a solar harvesting system. Such method includes:

- a) providing a solar harvesting system as disclosed before and/ further below;
- b) arranging the at least one solar harvesting pontoon floating on a liquid reservoir;
20
- c) operating the gas supply unit to maintain an overpressure in the enclosed volume of the at least one solar harvesting pontoon.

In some embodiments, the method further includes controlling the gas supply unit to operate intermittently. Alternatively, it may also include controlling the gas supply unit to operate intermittently or continuously if needed to better oxygenate the liquid, preferably water, and renew the gas, preferably air, in the enclosed
5 volume. The time between consecutive operations may be 1 hour or more, favourably more than 6 hours, or more than 12 hours. The gas supply may also be continuous with a small or large flow.

Since the gas inside the enclosed volume is trapped and accordingly stays inside the enclosed volume, providing additional gas and accordingly operating the gas
10 supply unit is generally not required, once the required overpressure is established. According to a typical mode of operation, small quantities of gas, e.g. air, are supplied once or twice a day, for example in the evening or at night and/or in the morning when the air contracts with the lower temperatures. Simple visual inspection may be used optionally in the morning to check the height of the solar
15 harvesting pontoons, e.g., from an observation tower. In this way, any malfunction, potentially requiring maintenance or repair, can be identified. More sophisticated electronic arrangements, such as tele-monitoring systems may be present and connected to pressure sensors measuring overpressure within the enclosed volume(s). Via corresponding control circuitry, the gas supply unit may be actu-
20 ated automatically to compensate for any pressure loss as required. Alternatively to pressure sensors, further sensors may be used for this purpose. If the platform is realized as foil or membrane, displacement sensors may be provided that measure the position of some measuring points of the foil or membrane. In further variants, strain gage sensors are attached to the foil or membrane.

Optionally, the gas supply unit may be operated as required in case of temperature or atmospheric pressure changes that result in the gas in the enclosed volume(s) to contract or expand. For this purpose, temperature sensors and corresponding control devices and/or control algorithms may be present. The gas supply unit may further be operated manually or automatically in case of leakages and until the source of leakage is identified and fixed.

In some embodiments, the method further includes maintaining an overpressure in the enclosed volume of the at least one solar harvesting pontoon that does not exceed 10% of the environmental pressure and does preferably not exceed 1% of the environmental pressure.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1a, 1b show exemplary solar harvesting pontoons in a schematic perspective view;

Figure 2a, 2b show sections of exemplary solar harvesting pontoons in a schematic cross sectional view;

Figure 3a shows an exemplary solar harvesting system in a schematic side view;

Figure 3b shows an installation setup in a schematic side view;

- Figure 4 shows a part of an exemplary solar harvesting plant or cluster group in a schematic top view;
- Figure 5 shows an exemplary arrangement for coupling of solar harvesting pontoons in a schematic side view;
- 5 Figure 6 shows a further exemplary solar harvesting pontoon in a schematic perspective view;
- Figure 7 schematically shows cluster arrangements with different pontoon footprints.
- Figure 8 shows a further exemplary cluster of solar harvesting pontoons in
10 a schematic top view;
- Figure 9 shows a further exemplary cluster of solar harvesting pontoons in a schematic top view.

EXEMPLARY EMBODIMENTS

- 15 Reference is made to Figure 1a. Figure 1a shows solar harvesting pontoon 1 in accordance with the present invention in a schematic perspective view. Like in the following figures, elements that are present multiple times are generally refer-

enced only once. Furthermore, elements that are identically present in a number of drawings may be referenced only once.

The exemplary solar harvesting pontoon 1 includes a peripheral frame structure 10, a solar harvesting arrangement 11, and a platform 12.

5 The peripheral frame structure 10 includes a number of exemplary float elements 100 that form the delimiting boundaries of the solar harvesting pontoon 1 together with the peripheral frame structure. In the exemplary embodiment of Figure 1, the footprint is square. The peripheral frame structure 10 further includes the peripheral stiffening structure 101 that is exemplarily realized by metal beams
10 of L-shaped cross section. For the peripheral frame structure 10, an L-shaped cross section is not essential. Other cross sectional geometries may be used as well, provided the rigidity and stiffness requirements are met.

The solar harvesting arrangement 11 includes a number of solar collectors 110 that are exemplarily arranged as an array of rows and columns. The solar collectors 110 are carried and supported by a solar collectors carrying structure 111,
15 112, 113. The solar collector carrying structure 111, 112, 113 includes an arrangement of solar collector carrying beams or solar collector carrying rods 111. The back sides of the solar collectors 110 are attached to the solar collector carrying beams or solar collector carrying rods 111. The solar collector carrying rods
20 111 are carried and supported by angled alignment beams or alignment rods 112. The arrangement is such that the solar collectors 110 are directed towards the main irradiation direction of the sun. If desired, the angle of the solar collectors

110 may be adjustable, for example by a pivoting mechanism (not shown) for pivoting the solar collectors 110 about an axis defined by the solar collector carrying rods 111. The alignment rods 112 are carried and supported by an arrangement of base beams or base rods 113. The base rods 113 are attached to the stiffening structure 101 as part of the peripheral frame structure 10. While this
5 design of a solar collector carrying structure 111, 112, 113 is both stiff and of low weight and therefore well suited, it is to be understood that other arrangements may be used as well.

The platform 12 is realized by a foil that spans and thereby covers the pontoon
10 area that is defined by the peripheral frame structure 10. The foil is fixed to the float elements 100 and/or the stiffening structure 101 all along its periphery in a gastight way.

Since the base rods 113 are attached to the peripheral frame structure 10, they are, in operation, tensioned by a lateral force that is exerted onto the peripheral
15 frame structure 10 and in particular to the float elements 100. Thereby, they favorably further act as elongated stiffening elements. For symmetry reasons, elongated stiffening elements (not shown) may additionally be provided on the bottom side of the solar harvesting pontoon 1.

Optionally, the base rods 113 may be attached to and thereby support and/or
20 reinforce the platform 12. Such attachment may be achieved via suitable bonding means, such as gluing or hot air welding. In further variants, the foil of which the

platform 12 is made is releasable fastened to the base rods 13 by releasably fastening means, such as Velcro straps.

In operation, the foil of the platform 12 is pressed against the base rods 113 by the gas pressure inside the enclosed volume. To avoid unintended foil deformation such as creeping, one or more pressure distribution pads may be arranged
5 between the platform 12 and the base rods 113.

In the following, reference is additionally made to Figure 1b. Figure 1b shows a further exemplary solar harvesting pontoon 1'' in accordance with the present invention in a schematic perspective view. The solar harvesting pontoon 1'' is designed in the same way as the solar harvesting pontoon 1 of Figure 1a. The solar
10 harvesting pontoon 1'', however, has a gas supply unit 2 in form of a compressor that is arranged at the periphery of the solar harvesting pontoon 1'' and attached to the peripheral frame structure 10. In this embodiment, a gas supply conduit (not shown) runs downwards and around the peripheral frame structure 10 and
15 crosses under the peripheral frame structure 10 such that a gas supply aperture of the gas supply conduit is under the platform 12 and under the liquid surface (S) or above the liquid surface level within the enclosed volume (V). In addition, a pressure relief valve 14 is arranged at the periphery of the solar harvesting pontoon 1'' and attached to the peripheral frame structure 10.

20 In the following, reference is additionally made to Figure 2a. Figure 2a shows a section of solar harvesting pontoon 1 in a schematic cross sectional view; the cutting plane is transversal to the longitudinal axis of a float element 100.

The float elements 100 are hollow and closed tube elements of circular cross section that are closed at their end walls, thus trapping and enclosing a cylindrical volume of air or another gas for floatation generation. The cross sectional geometry, however, is not essential as long as floating is given. If desired, the inner volume of the float elements 100 may be filled, e.g., with light weight foam, such as Styrofoam, or another light weight filling material. Alternatively, the float elements 100 may be completely made from such a material. In a further variant, the float elements 100 are made from other floatable materials, such as a floatable volume made of concrete. Furthermore, the circular cross section of the float elements 100 is not essential. In a further variant, the float elements 100 are inflatable elements and have a flexible hull that may be made from a gastight foil or membrane, such as rubber. In such embodiments, the float elements 100 may be sealed hoses or balloons. In operation, such float elements 100 are inflated.

In operation, the peripheral frame 10 structure forms wall below the platform 12 that contacts and dips into the liquid, while the platform 12 is above and spaced apart from the liquid surface level. A pressure equalization valve (not shown) is favorably additionally present.

The stiffening structure 101 extend continuously along the length and width of the solar harvesting pontoon 1, with the longitudinal axis of the stiffening structure 101 being aligned with the longitudinal axis of the float elements 100. The beams 101 are attached to and thereby connected with the float elements 100 by any suited technology such as screwing, riveting, welding, or gluing.

The L-shaped beams of the stiffening structure 101 have a horizontal leg 101a that is, in operation, parallel to the liquid surface (S) and carries the solar harvesting arrangement 11 as explained above.

A vertical leg 101b of the stiffening structure 101 cuts, in operation, the liquid surface S and dips into the liquid L. The vertical leg 101b serves as peripheral delimiting surface for the enclosed volume. The vertical leg 101b is vertically extended by an optional peripheral skirt 102 that is attached to the vertical leg 101b. Alternatively, the peripheral skirt 102 may be formed with the vertical leg 101b in an integral way by simply extending the height of the vertical leg 101b. As explained before, the peripheral skirt 102 ensures that the pressurized gas remains trapped in the enclosed volume in case of waves or the like. In the shown embodiment, the peripheral skirt 102 is made from a flexible material. Therefore, weights 103 are provided at the bottom side of the skirt 102 to keep the skirt 102 straight.

The platform 12 is exemplarily attached to the horizontal leg 101a by a platform attachment element 114. The platform attachment element 114 is realized as a ring that clamps a peripheral area of the platform 12 to the horizontal leg 101a in a substantially gastight way. The fixing may additionally or alternatively be achieved by any bonding suited technology such as gluing or hot air welding. Alternatively or additionally to the horizontal leg 101a, the platform 12 may be attached to the vertical leg 101b.

In the following, reference is additionally made to Figure 2b. Figure 2b shows a section of another exemplary solar harvesting pontoon 1 in a schematic cross sectional view. In the embodiment of Figure 2b, the peripheral delimitation for the enclosed volume is not defined by the vertical leg 101b. Instead, a peripheral skirt 102' is gastight attached to the platform 12. The peripheral skirt 102' may be of a different or the same material as the platform 12 and serves as peripheral delimitation for the enclosed volume V. The peripheral skirt 102' extends downwards from the platform 12 on the inside of the peripheral frame structure 10 and dips into the liquid L (not shown).

Along its edge, the peripheral skirt 102' is attached to the platform 12 in a gastight way by platform seam 115, which may be, e.g. a gluing seam, a thermowelded seam, or the like. Alternatively, the peripheral skirt 102' is formed integrally with the platform 12. In these embodiments, no gastight attachment of the platform 12 to the peripheral frame structure 10 is required. Therefore, screws, rivets, bolts or the like may serve as platform attachment members 114'.

In the following, reference is additionally made to Figure 3a. Figure 3a schematically shows a solar harvesting system with a solar harvesting pontoon 1 as discussed before, a gas supply unit 2 and a gas feeding system 3 in an operational state.

In the embodiment of Figure 3a, the solar harvesting system only includes a single solar harvesting pontoon 1. The gas supply unit 2 is exemplarily realized as air

pump and the gas feeding system 3 is realized as a hose with gas supply apertures 30.

The hose 3, and in particular its section that carries the gas supply apertures 30, is arranged inside the liquid L of the liquid reservoir. It is particularly arranged under the liquid surface S and under the solar harvesting pontoon 1. The hose 3 may be arranged in any desired depth, for example on the ground of the liquid reservoir where it may be kept in place by additional weights. Gas exits the hose 3 via the gas supply apertures 30 and rises to the liquid surface S where it is trapped in the enclosed volume V. The resulting vertical force that is exerted onto the foil 12 and the resulting lateral or horizontal forces that is exerted onto the float elements 100 are indicated by horizontal and vertical arrows, respectively.

In the following, reference is additionally made to Figure 3b. As explained before, only little gas supply is required in a steady operational state as exemplarily shown in Figure 3a. For initially establishing the overpressure within the enclosed volume V, however, a considerable amount of gas may be temporarily required. Therefore, a powerful installation gas supply unit 2', e.g. in form of a portable compressor may be used initially during installation.

During installation, an installation gas feeding system 3' may temporarily be used to feed gas into the enclosed volume V and to establish the overpressure. Such installation gas feeding system 3' may be realized by a length of hose or tube which serves as gas supply conduit and is connected to the installation gas supply

unit 2'. The installation gas feeding system 3' feeds gas into the enclosed volume V.

For a cluster of solar harvesting pontoons as will be described further below in more detail, an installation arrangement as shown in Figure 3b may be used for
5 establishing the required overpressure in the enclosed volumes V of multiple harvesting pontoons one after another. Once all harvesting pontoons are installed and the overpressure is properly established, a permanent gas supply unit 2 and a permanent gas feeding system 2 may be used for maintaining the overpressure with an arrangement as shown in Figure 3a.

10 In the following, reference is additionally made to Figure 4. Figure 4 shows a section of a solar harvesting plant or cluster group in a schematic view. The solar harvesting plant comprises a number of clusters 4 that are exemplarily arranged in a grid of rows and columns. Each cluster 4 includes a number of exemplarily nine
15 solar harvesting pontoons 1 as described before. The individual solar harvesting pontoons 1 of a cluster 4 are connected by pontoon couplers (not referenced) and pontoon link elements as described before. The clusters 4 are connected via cluster link elements 41 such as rods, bars, ropes or chains. In combination all clusters 4 form a solar harvesting plant or cluster group.

The solar harvesting plant or cluster group further includes a gas supply unit (not
20 shown). This gas supply unit may be common to all pontoons and clusters 4.

The solar harvesting plant further includes a gas feeding and distribution system (not shown). In general, the gas feeding and distribution system corresponds to the arrangement as shown in Figure 3. However, instead of a single hose 3, a net, grid, or tree of interconnected hoses and tubes is provided for supplying gas to all
5 clusters 4 and solar harvesting pontoons 1.

In dependence of the overall dimension of the solar harvesting plant, substantive pressure loss may occur within the gas supply system. This may result in some of the solar harvesting pontoons 1 and/or some of the clusters 4 not receiving a sufficient amount of gas. To compensate for this effect, a number of measures may
10 be provided alone or in combination. Instead of a single and common gas supply unit, a number of gas supply units may be provided, with each gas supply unit supplying gas to some pontoons 1 and/or clusters 4. Here, each of the gas supply units may feed gas into an associated gas feeding system. Alternatively or additionally, a number of gas supply units may also be provided that feed gas into a
15 common gas feeding system at different locations. Alternatively or additionally, a pressure and/or flow control system may be provided. Such pressure and/or flow regulation system may include a number of pressure sensors and/or flow sensors and control valves that are integrated into the gas feeding system. The pressure and/or flow sensors provide input signals to a control unit which in turn controls
20 the control valves to provide a sufficiently uniform gas supply. Alternatively or additionally to pressure and/or flow sensors that are integrated into the gas supply system, an input signal to the control unit may be pressure sensors that measure the gas pressure inside the enclosed volume of the solar harvesting pontoons.

From Figure 4 it can be seen that the clusters 4 cover substantially the complete liquid surface area, with only minor spacing or gaps remaining between the single clusters 4. The solar harvesting plant accordingly prevents evaporation from the liquid surface in an efficient way.

- 5 In the following, reference is additionally made to Figure 5. Figure 5 schematically shows the coupling of two solar harvesting pontoons 1 within a cluster 4, e.g. in a solar harvesting plant as shown in Figure 4.

The solar harvesting pontoons 1 are coupled by pontoon link elements 40 that are exemplary assumed as rods. The pontoon link elements 40 engage corresponding
10 pontoon couplers 13 of the pontoons 1.

The gas feeding system 3 includes additional optional pressure equalization conduits 32 which may be realized as hoses, tubes or pipes and fluidic couple the enclosed volumes V of the solar harvesting pontoon 1, resulting in equal or substantially equal pressures. In Figure 5, the pressure equalization conduit 32 is shown
15 as running below the liquid surface level S. Alternatively or additionally, pressure equalization conduits may run above the liquid surface level S. They may, e.g. be attached to or integrated into pontoon link elements 40.

Both the hose 3 and the pressure equalization conduit 32 run below the liquid surface S and cross below the solar harvesting pontoons 1 and in particular their
20 peripheral frame structures 10. While the conduits 3, 32 are shown unattached to the solar harvesting pontoons 1, either or both of them may optionally be at-

tached, e.g. loosely attached or fastened to the solar harvesting pontoons 1. In the exemplary embodiment of Figure 5, the end sections of the pressure equalization conduit 32 that are above the liquid surface level S are attached to float elements (not referenced) that keep the end sections above the liquid surface S.

- 5 Figure 6 shows a further exemplary solar harvesting pontoon 1' in a schematic perspective view. The design of the solar harvesting pontoon 1' is generally similar to the design of the solar harvesting pontoon 1 as shown in Figure 1 and discussed above. The pontoon area and the footprint, of the solar harvesting pontoon 1' however, are hexagonal. Further in deviation to the embodiment shown in
- 10 Figure 1, the peripheral frame structure 10 includes a single float element 100' that extends over substantially the whole length of each hexagon edge.

In the following, reference is additionally made to Figure 7. Figure 7 schematically shows cluster arrangements with different pontoon footprints. In the example of Figure 7d, the footprint of the single pontoons is circular. The footprint is square

15 in Figure 7a and rectangular in Figure 7b. Figure 7c and Figure 7a show cluster with hexagonal pontoon footprints. All of the shown footprint geometries are generally suited for to be arranged in a large number as cluster groups or solar harvesting plants. With exception to the circular footprint, they are further suited for plastering a liquid surface with little or even substantially no gaps between the

20 individual pontoons. In addition to solar harvesting, they are therefore well suited for preventing evaporation from the liquid reservoir.

In the following, reference is additionally made to Figures 8 and 9, each showing an embodiment of a cluster of solar harvesting pontoons in a schematic top view.

In both the embodiments of Figure 8 and Figure 9, two types of solar harvesting pontoons are present. The solar harvesting pontoons 1a comprise a gas supply unit 2, e.g. a blower or compressor and a pressure relief valve 14. The other solar harvesting pontoons 1b do not comprise a gas supply unit and a pressure relief valve.

In the embodiment of Figure 8, the solar harvesting pontoons are fluidic arranged as a chain with the outmost solar harvesting pontoons of the chain being solar harvesting pontoons 1a and the inner solar harvesting pontoons being solar harvesting pontoons 1b. The enclosed volumes V of all solar harvesting pontoons 1a, 1b are coupled by the gas feeding system 3 which is also designed as linear chain. The enclosed volume V of each of the inner solar harvesting pontoons 1b is accordingly fluidic linked to the enclosed volume V of its neighbors 1a, 1b. The gas feeding conduits may run above and/or or under the liquid surface S.

In operation, gas is fed into the enclosed volumes V either by both of the gas supply units 2 simultaneously, or only one of the gas supply units 2 is generally in operation, while the other one serves as backup and is only activated in case of failure. If the gas supply chain is interrupted for any reason, e.g. because of a leakage of any of the solar harvesting pontoons 1a, 1b or a conduit of the gas feeding system 3, the cluster is split into two sub-clusters. While the enclosed volumes V

are fluidic connected within a sub-clusters, the two sub-clusters are fluidic isolated from each other.

The embodiment of Figure 9 is similar to the embodiment of Figure 9. In Figure 9, however, only one gas supply unit 2 is present on a single solar harvesting pontoon 1a. This solar harvesting pontoon 1a is the center of a star, with the enclosed volumes V of the outer solar harvesting pontoons 1b each being fluidic coupled to the enclosed volume V of the central solar harvesting pontoon 1a. In this configuration, it is ensured that a failure of a single outer solar harvesting pontoon 1b or a gas supply conduit will only affect this particular solar harvesting pontoon 1b.

10 In both the embodiments of Figure 8 and Figure 9, shut-off valves may be present in the feeding system for closing a leakage.

REFERENCE SIGNS

S	liquid surface
V	enclosed volume
L	Liquid
t	top direction
b	bottom direction
1, 1', 1'', 1a, 1b	solar harvesting pontoon
2, 2'	gas supply unit
3, 3'	gas feeding system / hose
4	Cluster
10	peripheral frame structure
11	solar harvesting arrangement
12	platform / foil
13	pontoon coupler
14	pressure relief valve
30	gas supply aperture
32	pressure equalization conduit
40	pontoon link element
41	cluster link element
101	stiffening structure
101a	horizontal leg

101b	vertical leg
102	skirt
103	weight
110	solar collector
111	solar collector carrying rods
112	alignment rods
113	base rods
114	platform attachment element
115	platform seam
100, 100'	float element

Claims

1. Solar harvesting system, including:

a) at least one solar harvesting pontoon (1), the at least one solar harvesting pontoon (1) being designed to float on a liquid reservoir, the solar harvesting pontoon (1) including:

- a peripheral frame structure (10);
- a platform (12), the platform (12) being arranged on a top side of the peripheral frame structure (10) and spanning a pontoon area that is laterally delimited by the peripheral frame structure (10);

wherein a bottom side of the platform (12) and a liquid surface (S) of the liquid reservoir serve as delimiting top surface and delimiting bottom surface of a gastight containment when the at least one solar harvesting pontoon (1) floats on the liquid reservoir, the gastight containment enclosing an enclosed volume (V);

- a solar harvesting arrangement (11), the solar harvesting arrangement (11) being arranged on or above a top side of the platform (12);

b) a gas supply unit (2), in particular an air supply unit;

c) a gas feeding system with at least one gas supply aperture (30), the gas feeding system (3) being designed to feed gas that is provided by the gas supply unit (2) into the enclosed volume (V), thus generating an overpressure inside the enclosed volume (V), the overpressure suspending the at least one solar harvesting pontoon (1).

2. Solar harvesting system according to claim 1, wherein a gas supply conduit (3) of the gas feeding system (3) crosses below the peripheral frame structure (10).
3. Solar harvesting system according to either of the preceding claims, wherein
5 the platform (12) includes and preferably consists of a gastight foil or membrane, in particular an airtight foil or membrane, the foil or membrane covering the pontoon area.
4. Solar harvesting system according to either of the preceding claims, wherein
10 the peripheral frame structure (10) is designed to generate a floatation that is sufficient for the solar harvesting pontoon (1) to float on the liquid reservoir without overpressure inside the enclosed volume (V).
5. Solar harvesting system according to either of the preceding claims, wherein
15 the at least one solar harvesting pontoon (1) includes a peripheral skirt (102, 102'), the peripheral skirt (102, 102') extending in a downwards direction in or into the liquid of the liquid reservoir..
6. Solar harvesting system according to claim 5, wherein the peripheral skirt (102') is attached to the peripheral frame structure (10) and projects downwards beyond a liquid-contacting area of the peripheral frame structure (10).
- 20 7. Solar harvesting system according to claim 5, wherein the peripheral skirt is attached to the platform (12) in a gastight way or is formed integrally with the platform (12), such that the platform (12) and the peripheral skirt form, together with the liquid surface (S), the gastight containment.

8. Solar harvesting system according to either of the preceding claims, wherein the at least one solar harvesting pontoon (1) includes a pressure relief valve (14), the pressure relief valve (14) being designed to fluidic connect the enclosed volume with the environment if the gas pressure inside the enclosed volume exceeds a threshold pressure.
9. Solar harvesting system according to either of the preceding claims, wherein the gas feeding system (3) includes a network of gas supply conduits, the network of gas supply conduits having a number of branches and having gas supply apertures (30) in at least some of the branches.
10. 10. Solar harvesting system according to claim 9, wherein the gas supply aperture (30) or plurality of gas supply apertures (30) is, in an operational state, below the liquid surface level (5), favourably in an area below the platform (12) of the at least one solar harvesting pontoon (1).
11. Solar harvesting system according to either of the preceding claims, wherein the gas supply unit (2) is arranged remote from the at least one solar harvesting pontoon (1).
12. Solar harvesting system according to either of the preceding claims, the solar harvesting system including a cluster (4) of solar harvesting pontoons (1, 1'), wherein the gas feeding system (3) is designed to feed gas into the enclosed volumes (V) of at least two solar harvesting pontoons (1, 1') from a common gas supply unit (2).
13. Solar harvesting system according to claim 12, wherein the individual solar harvesting pontoons (1, 11') of the cluster of solar harvesting pontoons (1,

1') have a footprint such that the solar harvesting pontoons (1, 1') plaster a surface area of the cluster substantially without spacing remaining between the individual solar harvesting pontoons (1, 1').

5 **14.** Solar harvesting system according to either of claim 12 or claim 13, further including at least one pressure equalization conduit (32), the at least one pressure equalization conduit (32) fluidic coupling the enclosed volumes (V) of different solar harvesting pontoons (1, 1').

15. Method of operating a solar harvesting system, the method including:

- 10 a) providing a solar harvesting system according to either of the preceding claims;
- b) arranging the at least one solar harvesting pontoon (1, 1') floating on a liquid reservoir;
- c) operating the gas supply unit (2) to maintain an overpressure in the enclosed volume (V) of the at least one solar harvesting pontoon (1,
- 15 1').

16. Method according to claim 15, wherein the method further includes controlling the gas supply unit (2) to operate intermittently, with the time between consecutive operations being 1 hour or more, preferably 6 hours or more, preferably 12 hours or more.

20 **17.** Method according to either of claim 15 or claim 16, wherein the method further includes maintaining an overpressure in the enclosed volume (V) of the at least one solar harvesting pontoon that does not exceed 10% of the environmental pressure and does preferably not exceed 1% of the environmental pressure.

18. Method according to either of claim 15 to claim 17, wherein the gas is air and the method further includes oxygenizing the liquid (L) inside the liquid reservoir with air exiting the at least one gas supply aperture (30).

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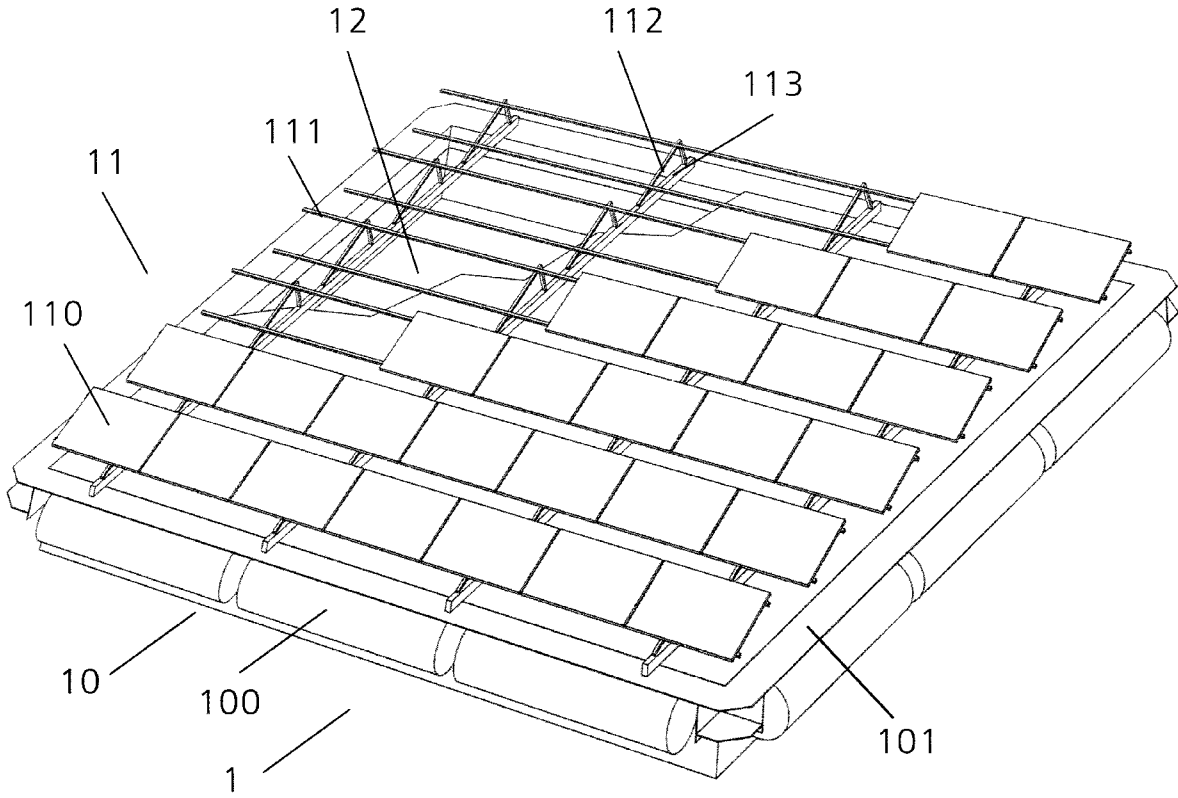


Fig. 1a

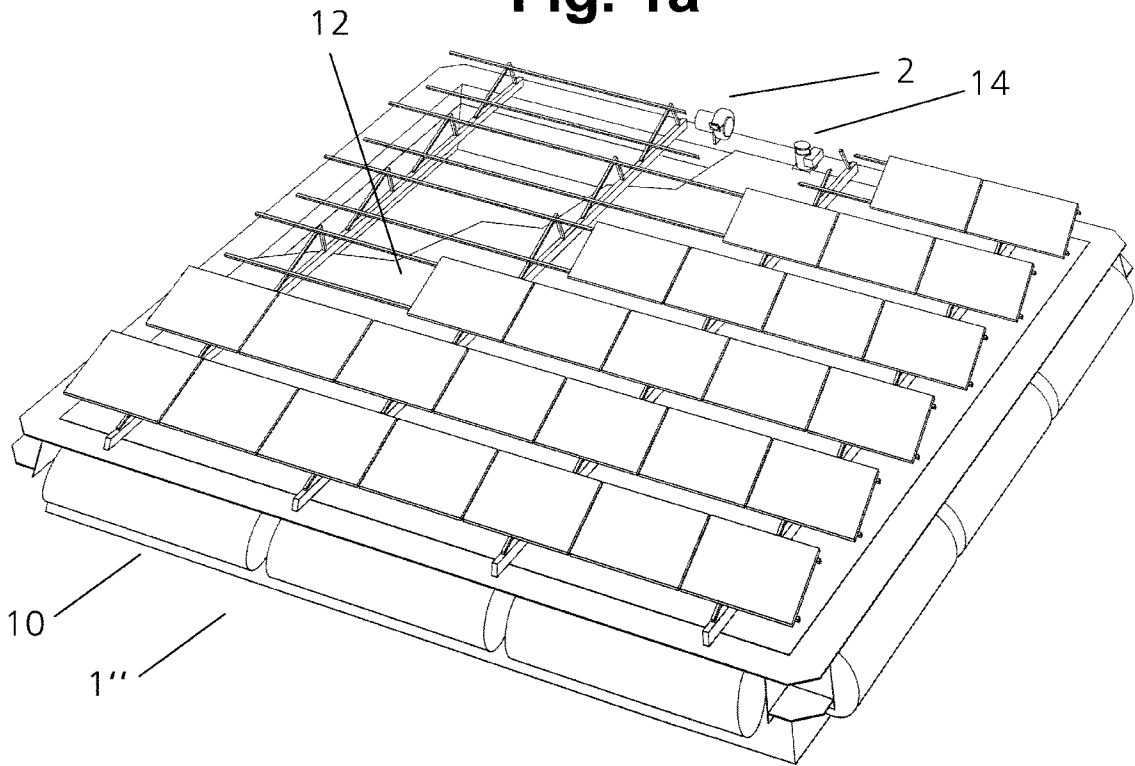


Fig. 1b

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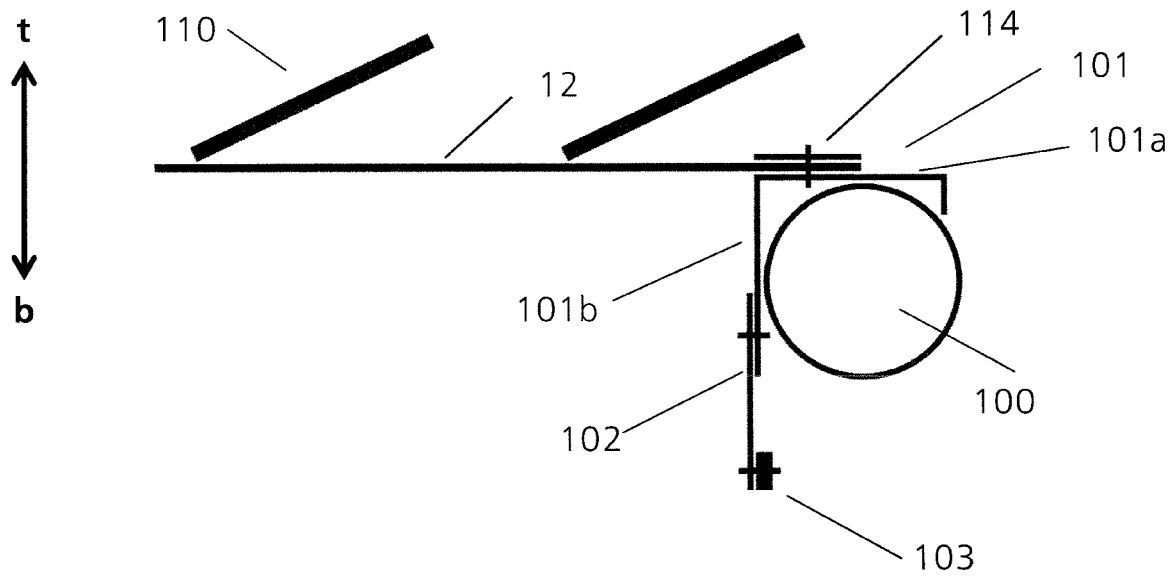


Fig. 2a

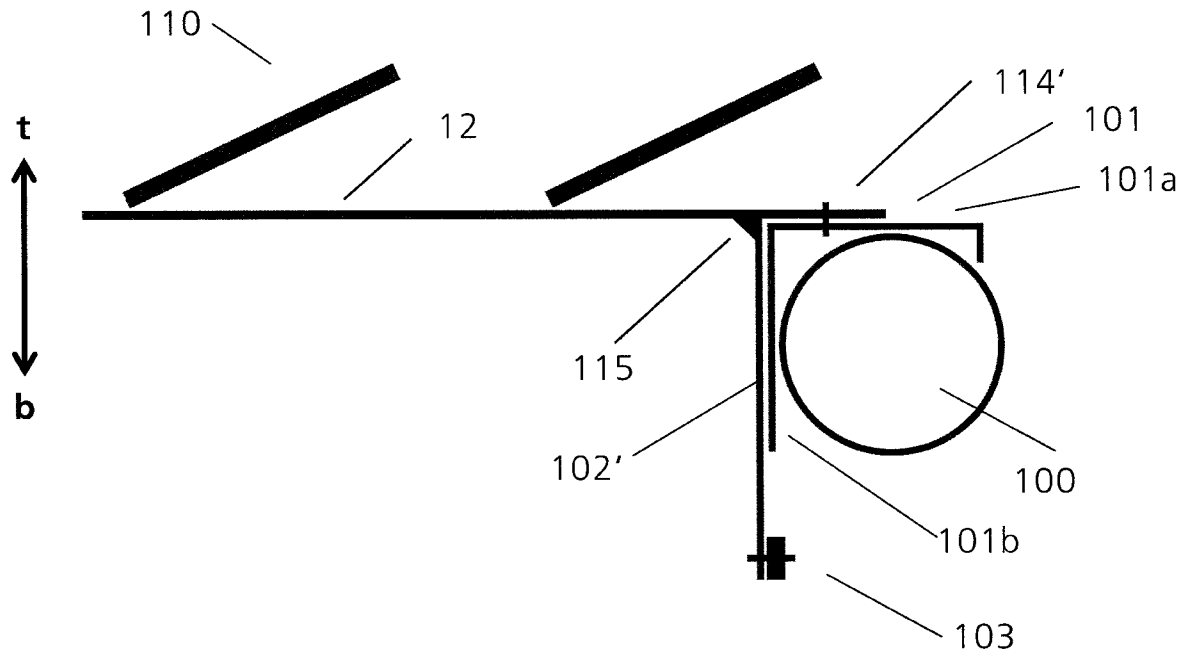


Fig. 2b

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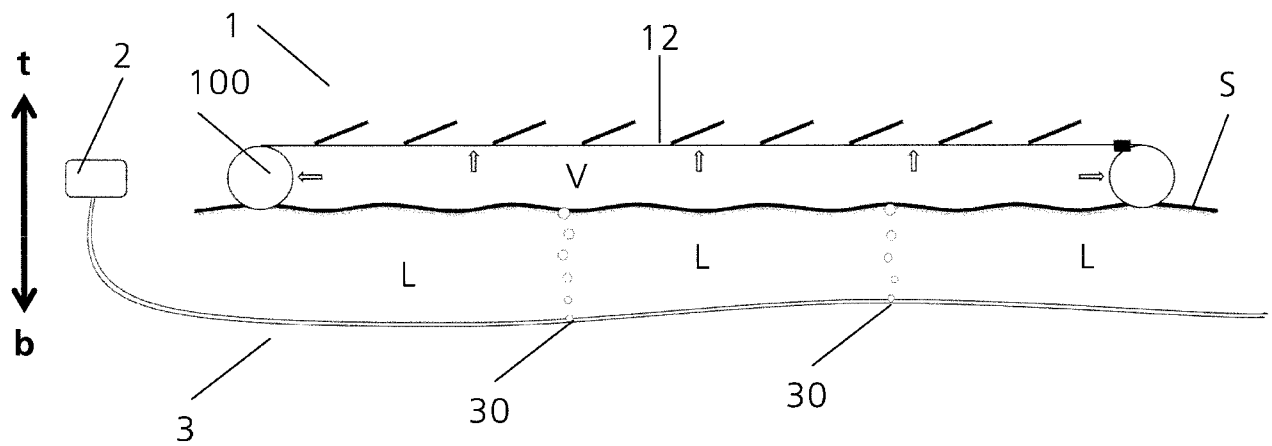


Fig. 3a

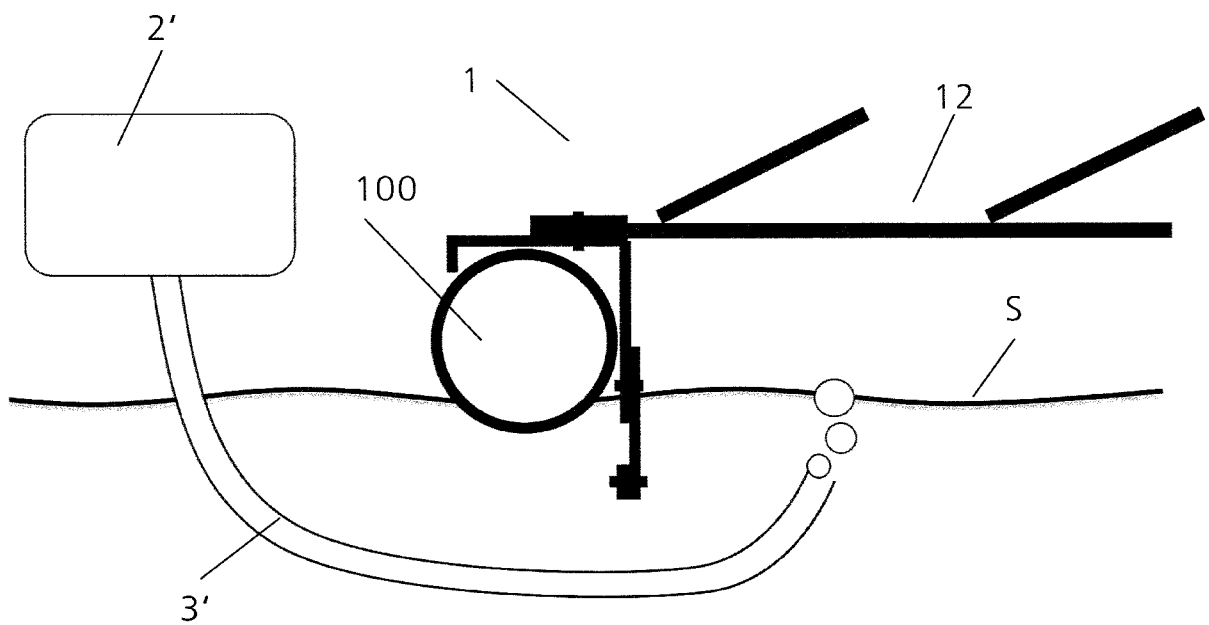


Fig. 3b

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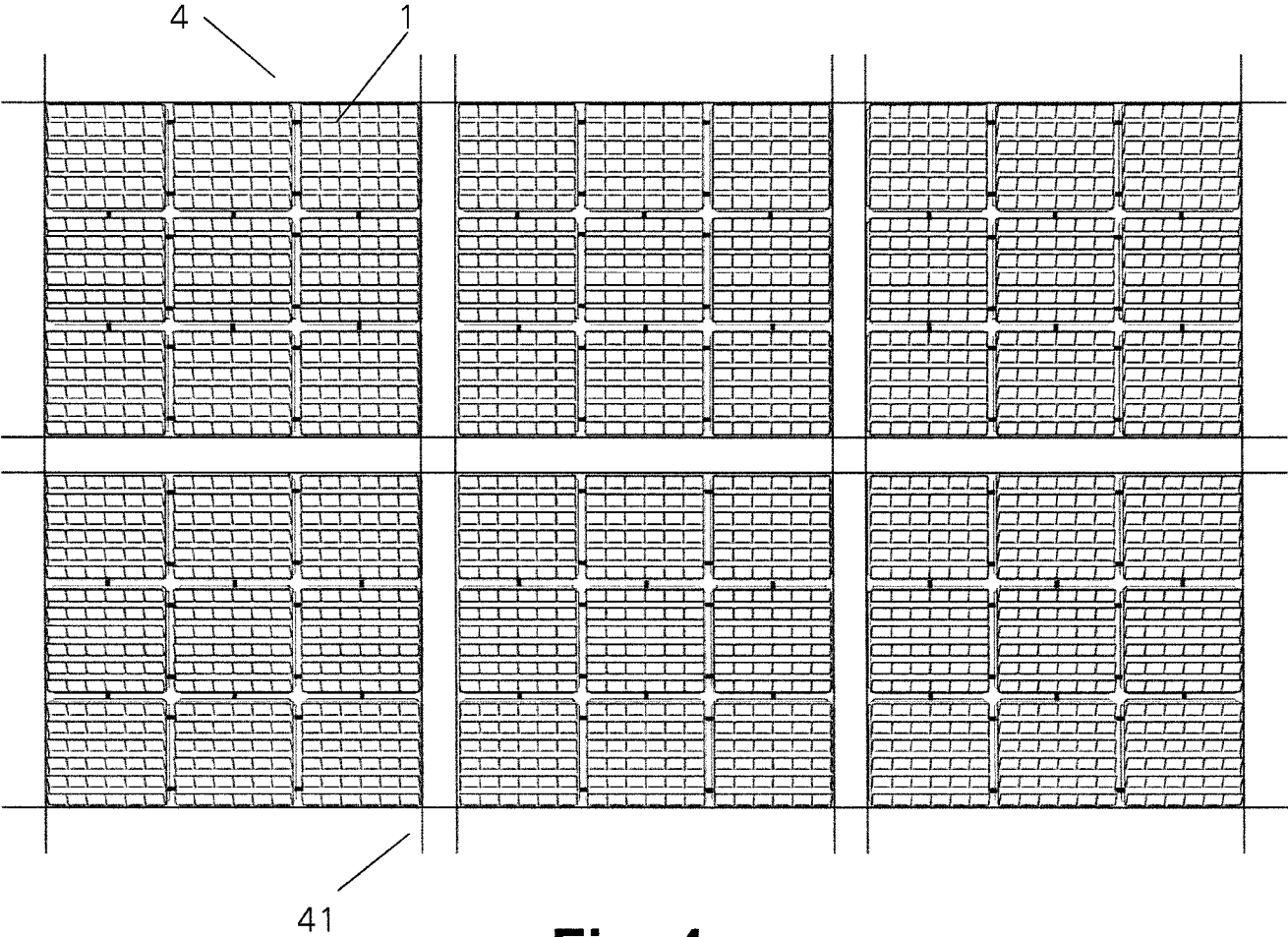


Fig. 4

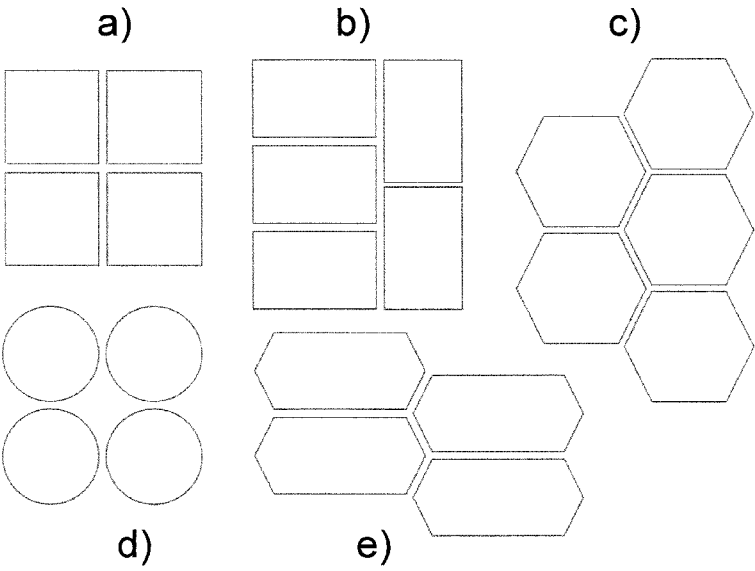


Fig. 7

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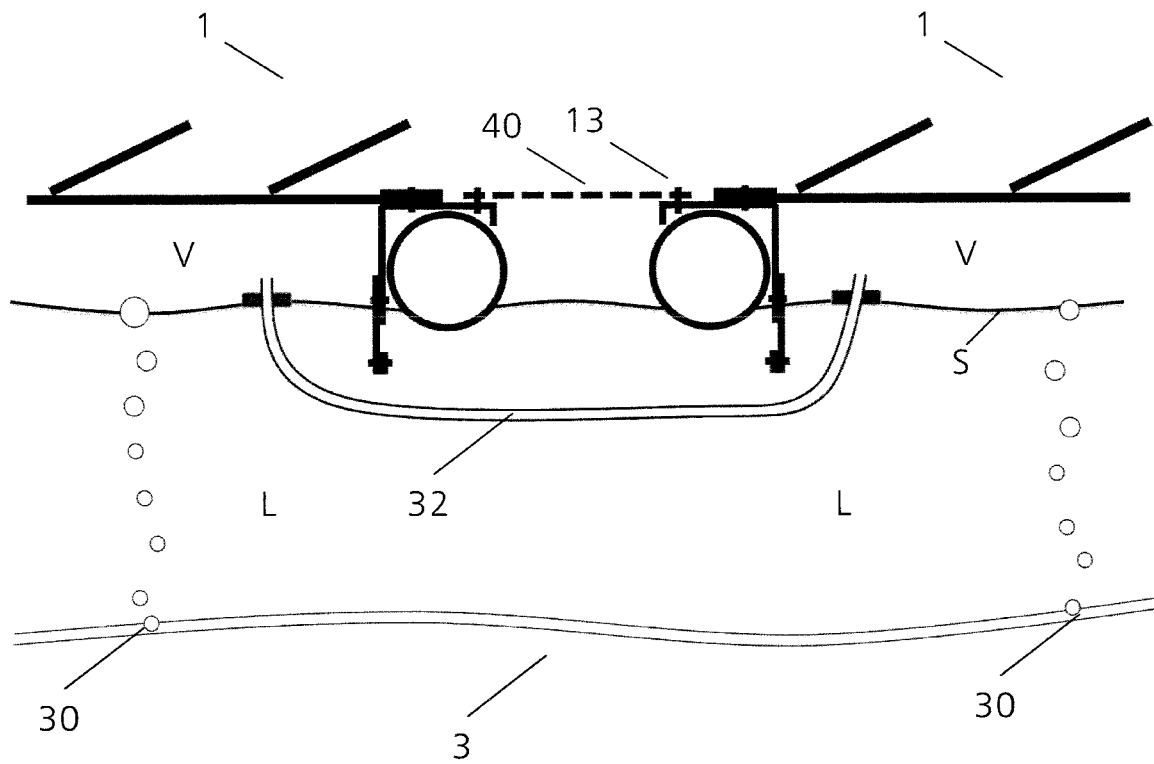


Fig. 5

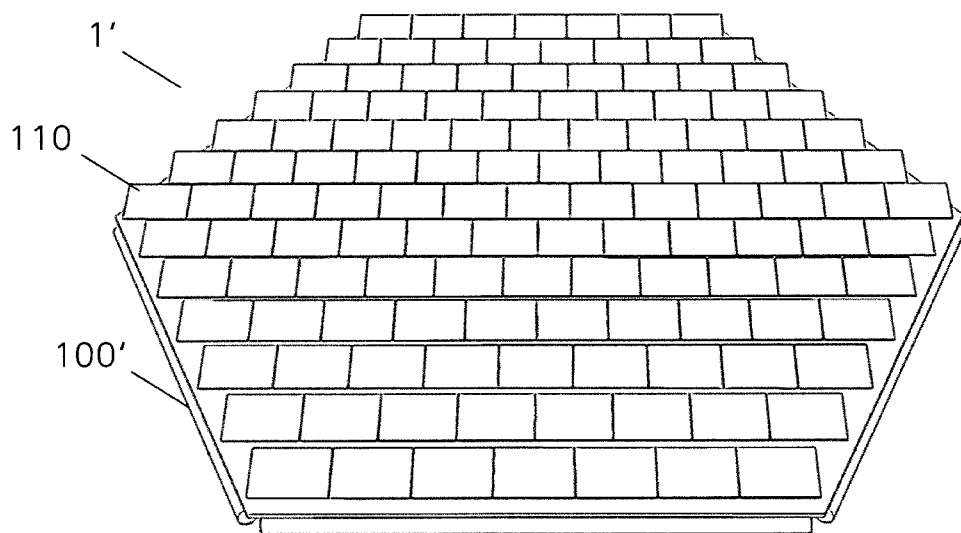


Fig. 6

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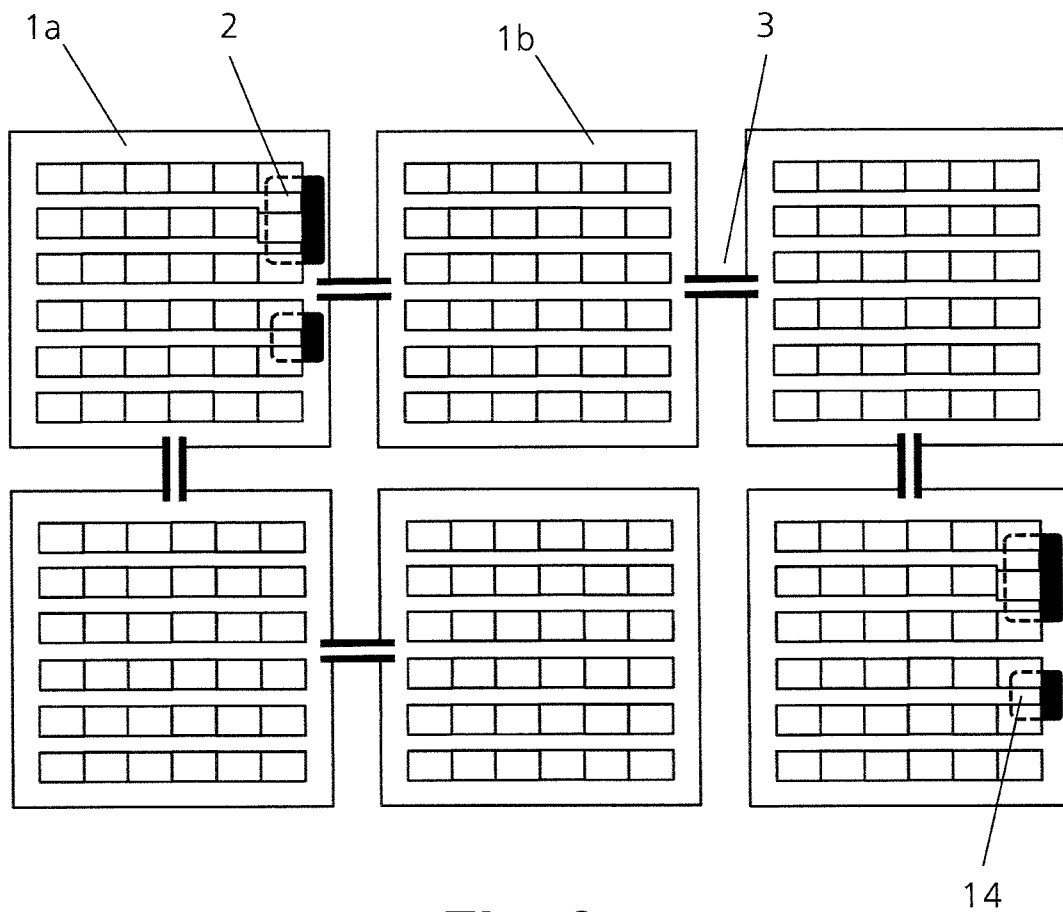


Fig. 8

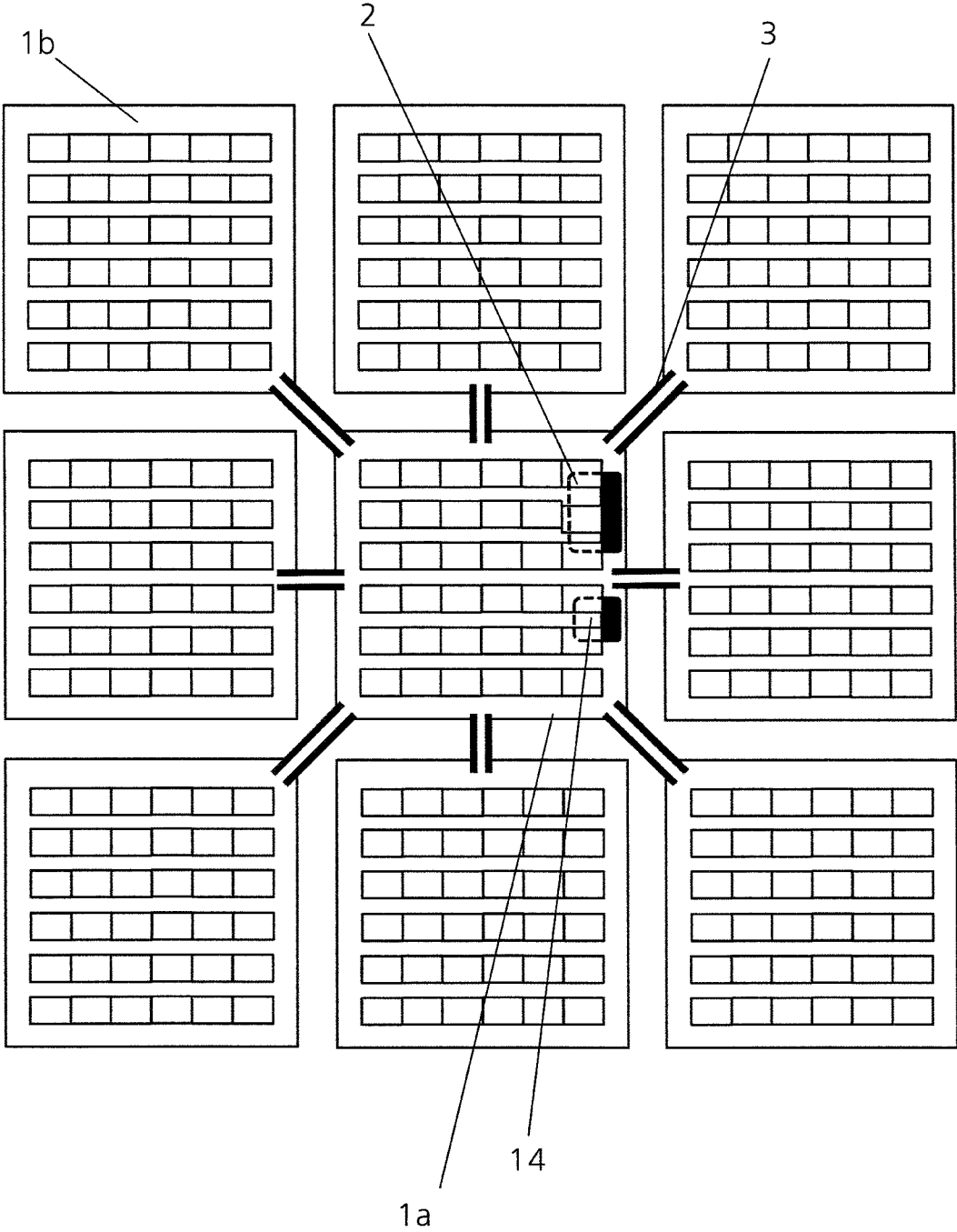


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/063849

A. CLASSIFICATION OF SUBJECT MATTER
INV. F24J2/52 B63B35/44
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)
F24J B63B

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	WO 99/46543 A1 (YEOMANS ALLAN JAMES [AU]) 16 September 1999 (1999-09-16) page 1, line 3 - line 5 page 6, line 28 - line 30; figures 1,2,4 page 6, line 21 - line 24; figures 1,2,4 page 8, line 3 - line 11; figures 1,2,4 page 6, line 17 - page 8, line 11; figures 1,2,4 ----- -/--	1,2, 5-10, 12-16,18



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

31 August 2015

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No
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