

(51) International Patent Classification:
H01L 31/0525 (2014.01) *H02S 40/44* (2014.01)(21) International Application Number:
PCT/EP2015/066432(22) International Filing Date:
17 July 2015 (17.07.2015)

(25) Filing Language: English

(26) Publication Language: English

(72) Inventor; and

(71) Applicant : SCHWERTNER, Heiko [DE/CH]; Ottigen-
bühlstrasse 48, 6030 Ebikon (Luzern) (CH).(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,
MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM,PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC,
SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ,
TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU,
TJ, 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).

Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- of inventorship (Rule 4.17(iv))

Published:

- with international search report (Art. 21(3))

(54) Title: DEVICE FOR THE INTEGRATED COLLECTION OF KINETIC, PHOTONIC AND THERMAL ENERGY

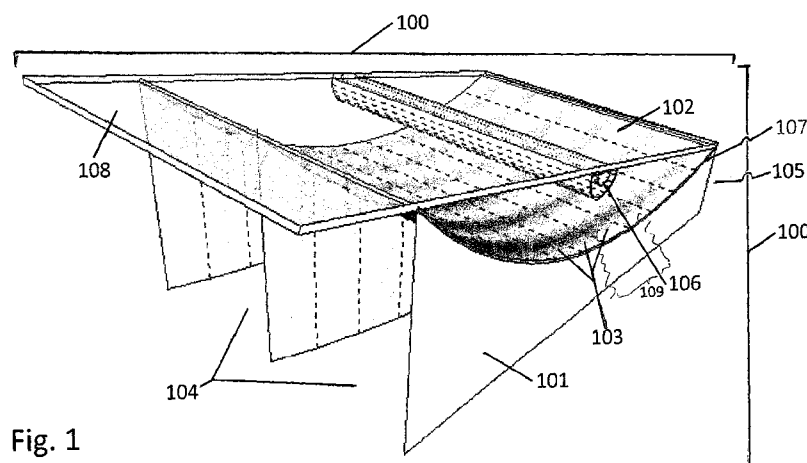


Fig. 1

(57) Abstract: The device (100, 100", 407, 802) of this invention integrates at minimum three energy collecting methods in one design. This device consists of a collector for kinetic, thermal and photovoltaic energy. The energy yield enhancing elements are based on a trumpet like form of a channel in which an electric generator (111, 403) is placed in the area of the smallest diameter. The aim of the design is to make use of low wind speed for the production of electricity. The resulting surface is formed equivalent to a concave mirror, where the surface is plated with photovoltaic cells (103, 104). The concave space is covered with a transparent material which includes a thermal energy harvester in form of a heat pipe or other thermal energy harvester (106, 401, 402). The photovoltaic cells are orientated in a way, that incoming light waves are reflected with the focus to the heat pipe. Such a module can be connected to a network to increase the total energy yield. Such network or single module can be placed on many different types of surfaces. Preferred places are perpendicular walls, bevel roofs or flat roofs. A network of modules can completely replace roofing tiles and includes isolation material for saving energy.



Description

Device for the integrated collection of kinetic, photonic and thermal energy

Technical Field

[0001] The present disclosure relates to the field of collection of renewable energy with a device, later also called module, which integrates energy harvesting of kinetic, thermal, and photovoltaic energy forms and a method to integrate multiple modules in house roofs and other surfaces. This device includes as well an isolation layer to prevent a loss of thermal energy and to support noise reduction. The main target of the invention is to provide an easy and efficient method for collecting renewable energy not only for industrial use but also for the private use.

[0002]

Background Art

[0003] Collecting energy from environment is one possibility to reduce the need of fossil energy carriers or nuclear energy. Until today, several methods have been developed to reach this target. The most often applied systems are windmills for the production of electric power from kinetic wind energy

G.M. JOSELIN HERBERT, et al. A review of wind energy technologies.

Renewable and Sustainable Energy Reviews. Aug.2007, vol.11, no.6, p.1117-1145. , heat exchanger to harvest thermal energy

MIRUNALINI

THIRUGNANASAMBANDAM, et al. A review of solar thermal technologies

. Renewable and Sustainable Energy Reviews. 2010, vol.14, no.1,

p.312-322. and photovoltaic cells to collect electric energy form the sun

light **MARKVART, TOMAS , et al.** Solar Electricity . 2nd edition. Edited by

MARKVART, TOMAS , et al. Wiley, 2000. ISBN 0471988537. p.0-256.

[0004] A main disadvantage of the current energy collecting devices or method is the limited usability **UNITED NATIONS, et al.** Global Trends in Sustainable Energy Investment 2007: Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency in OECD and Developing Countries. *United Nations Environment Programme*. 2007, p.0-End. For examples in a very reduced explanation:

- Windmills can only produce electric power if the wind blows
- Heat exchangers only work if the thermal energy differences are high

enough

- Photovoltaic cell do not produce electric energy during the night

[0005] These disadvantages oppose the fact that energy is needed around the clock. To mitigate this situation several methods for the storage of energy have been developed.

[0006] To increase harvesting energy from different sources several combinations are in use on house roofs for example. There are windmill generators on house roofs and in addition to those, photovoltaic cells or a combination of photovoltaic cells with thermal collectors or other combinations. The main point of such combinations is that the energy collectors are separate units, they are not integrated.

[0007] Disadvantages are now shown using the example of a windmill harvesting kinetic energy. For the efficient production of energy, windmills need a minimum of air velocity. Near the ground, the speed of air is low, mostly below 2 m/s. As a result of this fact, wind turbines are placed on masts or on the highest point of roof ridges DE 102009012520 A (RICHARD SEIDENBUSCH) 10.03.2009 DE 202008014689 U (TÖRBER JÜRGEN) 06.11.2008 . The efficiency of windmills is in addition to the air speed depending on the diameter of the rotor blades. In case of bladeless wind systems it is also depending on the diameter of the total surface of the system. These three factors are the reason that windmill generators have to be sufficiently large to produce enough energy for a single-family home. Therefore windmills have diameters more than 5 m. Due to legal restrictions of house construction, this kind of windmills is not in use in normal cases. Apart from that, this kind of construction is not accepted from an architectural point of view.

[0008] A second example is the combination of photovoltaic cells with a thermal collector WO 2009081439 A (BONOMI GIANFRANCO) 02.07.2009 . Both systems are widely used and the efficiency increased during the past decades. But the main disadvantage is the dependency from weather conditions. If the weather is cloudy or cold and cloudy, both systems suffer from a dramatic loss of efficiency. Another disadvantage is the need of considerable space for photovoltaic cells and thermal collectors. Both

systems are competing systems related to the area of installation.

- [0009] A system harvesting wind energy using connectable modules with small wind generators inside the modules is known. The modules are placed on roofs. These modules can be extended with solar cells, but they are not integrated and there is no possibility to combine these modules with a thermal collector. DE 102011105965 A (SPIEGELMACHER, JANA) 03.01.2013 DE 102004001875 A (THOMAS HAKE) 04.08.2005
- [0010] Systems integrating thermal energy collectors, kinetic energy collectors and photovoltaic energy in one module or functional unit are not known. According to the state of technology devices including wind speed enhancing systems or a cooling system for photovoltaic cells are not known so far.
- [0011] Systems which are state of technology are installed in separate units and not in completely integrated devices.

[0012]

Disclosure of Invention

- [0013] The present disclosure provides a device later also called module that integrates all three energy collecting methods described above to avoid the disadvantages of the present existing methods and devices. The module is able to harvest or collect kinetic, thermal and photovoltaic energy at the same time.
- [0014] The present disclosure is modular in two ways. First modular in the meaning that each part (collector for thermal, kinetic and photovoltaic energy) is exchangeable, for example in cases of damage. Second modular in the meaning that in a network of devices according to the invention one device can be replaced to newer one, for example in a case of malfunction.
- [0015] As an important advantage of the present disclosure the preferred design provides not only an integration of three energy collecting methods, it provides additionally enhancement of wind speed, cooling possibility, enhancement of collecting thermal energy and a safety system against environmental influence like hail.
- [0016] Due to the integration of three different energy collecting methods, in one

module - according to the present invention - the required space can be used more efficiently. The usable space for photovoltaic cells and for thermal energy elements is doubled.

[0017] The integration of kinetic energy collectors, later called wind generators, in the module – according to the present invention - allows the use during uncomfortable weather situations like stormy and cloudy weather. The present disclosure uses well-known technology like wind generators or wind mills so that the usability of the module is given under all weather conditions. Such weather conditions are cloudy skies, coldness, storms, blizzards and so on. These weather situations caused low efficiency of photovoltaic cells or thermal collectors. Wind generators work perfectly, according to their specifications, under bad weather conditions.

[0018] These features cannot be released with existing energy collecting methods and devices.

[0019]

Technical Problem

[0020] The technical problem is to use at the same time three different methods for collecting energy, like renewable energy from sun, wind or thermal energy.

[0021] Additional to the technical problem describe before is the technical problem to reduce the required area need for collecting kinetic, photovoltaic and thermal energy.

[0022] A further technical problem is the architecturally integration of an apparatus which full fill the both technical described problems before.

[0023] A further technical problem is to reduce the storage problem of collected energy.

Technical Solution

[0024] By the way of illustration, specific exemplary embodiments in which the invention may be practiced now are described.

[0025] In one embodiment, a device, later also called module, is providing including a channel with an internal electric generator, photovoltaic cells, a thermal collector and a bottom with isolation properties.

[0026] The channel has at minimum one inlet which becomes smaller to a

fractional internal diameter. After the smallest diameter is reached, the channel diameter increases once again to the outlet. This design is later called trumped shape. Other channel forms are possible, for instance tubes with no difference between inlet and outlet diameters or cross-sections which are not circular, like quadratic or rectangular or combinations of them.

[0027] The trumped shape is the preferred design, because an air stream speed will increase on the way through the trumped channel with the maximum speed at the smallest diameter of the channel. In principle, this effect follows the fluid dynamic properties and the law of Bernouilli.

[0028] In the area of the minimal diameter of the channel, an electric generator with rotor blades is placed in the manner that an airstream can initiate the rotation of the rotor blades. The result of the trumped design and the resulting Bernoulli Effect increases the rotating velocity of the rotor and as a result the energy efficiency increases too. The preferred combination is that one channel possesses one electric generator and a module, according to the invention, consists of two channels. One embodiment of the device according to the invention is as well that one channel may have two or more electric generators inside. A module can possess only one or multiple channels. The electric generators can be completely embedded in the channel or only be fixed at one point. All these variations are embodiments of the device according to this invention.

[0029] The channel of the device constitutes the main structural element of the housing of the module. The walls of this housing can be made out of plastic, glass, metals like steal or aluminum, ceramics, natural materials like cellulose or other material. The preferred material is plastic, because of the multifunctional material properties. Three properties of plastic are specially mentioned because they give additional features to the module: the anti-corrode property, the thermal and electric isolation and the noise reduction property.

[0030] As a result of the trumpet form the channel forms a concave surface. On the area of this concave surface photovoltaic cells are placed. Thermo-voltaic cells or mirror glass, plastics or foils can be placed also on

the surface. Thermo-voltaic cells can be placed in addition under the photovoltaic cells.

- [0031] The space between the planked concave surfaces is sealed with a transparent cover. This cover can be made out of glass or transparent plastic materials. To increase the efficiency, the cover can be layered with filter foils having different features.
- [0032] This cover can have additional elements like filter foils, lenses like Fresnel lenses or surface structures outside as inside or a combination of them. These different elements enhance the energy yield of the total device or give more structural features to the module. The cover itself is a construction element and has the property to protect the internal parts of the module. Additionally, the cover is a design element, because the cover is the biggest part visible from outside and architects can modify the cover for a proper optical integration in the local architecture.
- [0033] In the line of the focus of the concave surface, a heat pipe for the collection of thermal energy is placed in the space between the cover and the concave surface. To increase the efficiency of the heat exchanger element, for instance like a heat pipe, the photovoltaic cells which are built-in in a bending in such a way that the focus of each photovoltaic cell is located in the heat pipe. This variant of the module is the preferred design.
- [0034] The thermal energy collector shown in Fig. 1 is a design variant to show the technical concept. This element can have different sizes, forms and positions in the module. The final design depends on the surface and environmental situation where the module or modules are installed.
- [0035] The device itself is a completely integrated system but in total a modular system. That means that all parts of the module: channel, concave surface, photovoltaic cells, cover and heat pipe, electric generator, connector, sensor, control unit etc. are exchangeable. A single module may contain several parts of the same type, e.g. one or more electric generators, one or more heat pipes, one or more sensors.
- [0036] Modular means that each energy collecting system in the device can be replaced by others, for example the photovoltaic cells can be replaced by

more modern ones or a malfunctioning part with new one. Modular means also that one module can be connected to a network of several modules. In both cases, modular means also that a part in a module or a module in a network can be replaced by a module or another system, like watering system, fire preventive system or others.

- [0037] The modules itself can have different sizes. It is an advantage that the modules are connected together and are placed on elevated spots, like roofs, towers or elevated soil/rock formations. The modules can be used for a fully integration in a roof or replacement of single or all roof tiles. Connected networks of modules can have two or more modules, there are no limitations regarding the quantity.
- [0038] The trumpet design is the preferred version of a module according to the invention. A variant of this preferred design includes all three collector types: thermal energy collector, kinetic energy collector and photovoltaic energy. But the channel is only the linear tube with a windmill rotor in the channel. The outer surface is plated with photovoltaic cells and between these photovoltaic cells electro thermal cells are placed. These electro thermal cells can generate electric power und have the property to cool the photovoltaic cells. The channel can be made out of the thermal electric cell material itself to increase the electric output of the total system.
- [0039] To connect the modules, each module has electric connectors like cables or conductive paths, mechanical connectors, like snappers, screws etc. and additional fluid connectors like pipe connectors or pines, if needed. These connectors conglomerate the modules amongst themselves. And each module is fixed internally to the surface on which the modules are mounted. The connectors connect one module or a grid of modules to a central unit for storage of electric energy and with a unit for the storage of thermal energy. These connectors connect one module or a grid of modules to a control unit, which allows the control and the management of the modules.
- [0040] One module or a grid of modules can be additionally connected to one or several windmills on the top of a roof or be integrated in the roof itself.
- [0041] In case that both sides of a roof are covered with devices according to the

invention a windmill - or multi windmill generators on the roof top are coupled in that way that an air stream can flow from the windward side (LUV side) to the LEE side. This possibility of the device according to the invention increases the total yield of a network of modules. The connection of one module or a network of modules with a windmill - or multi windmill generators on the top of a roof can also be realized, if only one side of the roof or surface is plated.

- [0042] The module can be placed in every angle on surfaces from 0° to 180° on the ground, on roofs, walls etc. The most common and efficient way is to fix one or more modules on roofs or surfaces that have an angle between 20° and 75°. It is not necessary that the surface is inflexible, the surface can be flexible too. In cases that modules as described in this invention are placed on surfaces which are not ideal, the design has to be adapted, so that the total energy harvesting potential can be maximized. The modules can be connected with each other so that a network is created. This kind of network can replace completely traditional roof tiles or wall bricks or hard cover sails.
- [0043] The modules can be completely built out of isolation material or they can include an additional isolating layer. This isolation part avoids thermal energy losses and/or reduces noise emissions, coming from the rotating part of the module or from rain drops falling on the surface.
- [0044] The cover itself protects the thermal element and the solar cells against environmental and animal influences. Animals like birds, insects, mice, etc. are protected by the corpus of the device against contact with the rotating blades of the electric generator. A grid or mesh is a protection element too at the inlet and outlet of the device. It also protects the module against contamination with, like leaves, wood sticks and other things.
- [0045] It is understood that one or more of the afore mentioned embodiments of the subject matter may be combined as long as the combined embodiments are not mutually exclusive.
- [0046] The following non-limiting examples illustrate certain embodiments of the present subject matter.

Advantageous Effects

[0047] The chapter "Disclosure of invention" describes advantages of the device according to the invention. There are several additional advantages of the integrated energy harvesting module described in the present disclosure:

- Several modules can be connected to a network without a technical limitation regarding the size, only limited by the availability of the surface.
- Each module is a close system that protects the thermal collector and/or the photovoltaic collector in the same way as the electric generator.
- The modules have noise und thermal isolation properties
- No harm to birds, regarding rotating blades
- No flickering shadow emissions from free blades
- Possibilities of fully integration on a roof or replacement of single or all roof tiles
- A better design integration in actual roof shapes

[0048] These features integrated in one module cannot be released with existing energy collecting devices ort apparatuses.

Brief Description of Drawings

[0049] Other und further objects, features and advantages of the embodiments will appear more fully from the following description. The accompanying drawings, together with the general description given above and the detailed description given below, serve to explain the principles of the embodiments.

[0050] Fig. 1 - shows an exploded view of the components which make up an example of a device

[0051] Fig. 1A - shows perspective view of the front of an example of the device

[0052] Fig. 1B - shows perspective view of the backside of an example of the device

[0053] Fig. 2 - shows perspective view of the side of an example of the device and additional components, like a bottom panel

[0054] Fig. 3 - shows perspective view of an example of the device which includes examples of connector sets

[0055] Fig. 3A - shows from a bottom view examples of usable internal spaces for sensors, electronic controls and mechanical elements

- [0056] Fig. 4 - shows perspective view of a further example of a device which includes all elements of the preferred device
- [0057] Fig. 5 - shows perspective view of an example of the device whereby one device is connected to a network plated on a roof as an example of a surface
- [0058] Fig. 6 - shows perspective view of an example of the device connected to a network plated to a vertically wall as an example of a surface
- [0059] Fig. 7 - shows perspective view of an example of the device whereby the preferred device is connected to a network plated on a roof and additionally connected to an internal central generator
- [0060] Fig. 7A - shows perspective view of a variant of Fig. 7 whereby the central generator is on the top of the roof
- [0061] Fig. 8 - shows a perspective front view of a device according to the invention where the thermal collector and the concave surface are orientated in a longitudinal direction
- [0062] Fig. 8A - shows a front view of a device from Fig. 8 according to the invention where the parts are orientated in a longitudinal direction
- [0063]
- [0064] List of reference numerals
- [0065] Fig.1
- [0066] 100 module
- [0067] 101 outer wall of the trumpet form case
- [0068] 102 transparent cover
- [0069] 103 photovoltaic cell layer
- [0070] 104 inlet
- [0071] 105 outlet
- [0072] 106 thermal harvester element
- [0073] 107 concave surface with thermo-electric system
- [0074] 108 overhang
- [0075] 109 area of small diameter
- [0076] Fig.1A
- [0077] 104 inlet
- [0078] 111 generator with blades

- [0079] 112 inner side of 107
- [0080] 113 inner wall of the trumpet form case
- [0081] Fig. 1B
- [0082] 121 back side of the transparent cover
- [0083] 122 front side of the transparent cover
- [0084] Fig. 2
- [0085] 201 bottom plate
- [0086] 202 orientation arrows
- [0087] 203 grid or mesh
- [0088] Fig. 3
- [0089] 301 roof connector
- [0090] 302 module to module connector
- [0091] 303 inter module connector for electric connection
- [0092] 304 connector for mechanical fixing of modules
- [0093] 305 electric cable and lines
- [0094] 306 module control unit
- [0095] 307 sensors
- [0096] 308 fluid connector
- [0097] Fig. 3A
- [0098] 311 space and/or chamber for sensors, and/or mechanical control units
- [0099] Fig. 4
- [0100] 401 thermal energy collector as a design variant of 106 – inlet
- [0101] 402 thermal energy collector as a design variant of 106 – outlet
- [0102] 403 generators with blades as a variant of 111
- [0103] 404 photovoltaic cells in a variant of 103
- [0104] 405 wall of the module channel with a quadratic profile
- [0105] 406 inlet as a variant of 104
- [0106] 407 design variant of 100
- [0107] 408 inner wall of the trumpet form case as a variant of 113
- [0108] 409 outlet as a variant of 105
- [0109] Fig. 5
- [0110] 501 surface with an angle of 45° equivalent to a roof
- [0111] 502 network of modules plated on the surface

- [0112] 503 surface construction elements
- [0113] Fig. 6
- [0114] 601 network of modules plated on a surface in an angle of 90° equivalent to a house wall
- [0115] 602 wall
- [0116] 603 ground
- [0117] 604 roof
- [0118] 605 arrows for wind direction
- [0119] Fig. 7
- [0120] 701 internal electric generators in a roof ridge
- [0121] 702 channel system
- [0122] 703 cover element
- [0123] 704 air flow direction
- [0124] 705 Luv side - side of a roof in the direction of the wind flow
- [0125] 706 Lee side - side of a roof opposite to the wind direction
- [0126] Fig. 7A
- [0127] 711 electric generator external on a roof ridge as a variant of 701
- [0128] 712 protecting cover
- [0129] Fig. 8
- [0130] 801 front wall of the concave surface
- [0131] 802 design variant of 100 in longitudinal direction
- [0132] 803 cooling layer
- [0133] 804 concave surface as a variant of 107
- [0134] Fig. 8A
- [0135] 813 variant of the inner wall of the concave according to 113
- [0136] 814 variant of electric generators according to 111 and 403
- [0137] While the foregoing embodiments have been described in some detail for purposes of clarity and understanding, it will be clear to one skilled in the art from a reading of this disclosure that various changes in form and detail can be made without departing from the true scope of the invention. For example, all the techniques and apparatus described above can be used in various combinations. All publications, patents, patent applications, and/or other documents cited in this application are incorporated by

reference in their entirety for all purposes to the same extent as if each individual publication, patent application, and/or other document were individually indicated to be incorporated by reference for all purposes.

[0138]

Best Mode for Carrying Out the Invention

[0139] In the following, examples are provided in order to display certain embodiments and to exemplify the subject matter described herein. It is to be understood that also other embodiments are comprised by the scope of the subject matter, as known by the person skilled in the art.

[0140] The preferred design of the module 100 is given in Fig. 1. It is possible and target of this invention to design a wide range of variants beginning by the size of the preferred design. The form of the trumped can assume different shapes with reference to the cross section horizontal, vertically and longitudinal direction and in a combination of them. The cross-section of the inlet 104 has a wider diameter than the outlet 105. The trumpet itself has an area 109 where the diameter is smaller than the diameter of the outlet. The trumpet builds a concave surface 107 on which one or more photovoltaic cells 103 are placed. Under the surface of the photovoltaic cells 107 one or more thermo-electric cells are installed, they are able to use thermal energy to produce electric energy and at the same time they hold the property to cool the photovoltaic cells. This cooling effect enhances the yield of the photovoltaic cells.

[0141] The space built by the concave surface is covered with a transparent cover 102 which can be made out of glass or different plastics materials. This cover can be coated with chemical substances, foils or additional layers of glass or plastic sheets. These additional modifications are used to enhance the energy yield of the module.

[0142] Nearly in the middle of the cover nearby of the focus of the concave surface a thermal energy harvester 106 is integrated in the module. This thermal energy harvester 106 can be placed as shown in Fig.1 directly under the cover or separated from the cover.

[0143] The wall 101 of the module can be made out of several material incl. isolation materials. Several material means glass, metal like Aluminium or

Steel, ceramics, clay, plastics or biological polymers like Cellulose or Chitin or a combination of them.

- [0144] The overhang **108** can adapt to the needs resulting from the surface structure and place where the modules are placed. Fig. 1A shows the front view of a module **100** from the inlet side **104**. The embodiment illustrates the position of the electric generator **111** and the inner sides of the concave surface **112** and the inner side of the outer wall of a module **113**.
- [0145] Fig. 1B shows a perspective view of a module **100**. This illustrates the outlet and a position of electric generators **111**. The example described here has two electric generators **111** and each generator has its own trumpet channel. A module according to the invention can have one electric generator **111** or more and each generator **111** can have its own channel or in one channel can be more than one electric generator **111**.
- [0146] Fig. 2 shows the placement **202** of a bottom plate **201** for a module **100**. The inlet **104** can be protected with a grid or mesh **203** to protect against incoming waste or animals. The bottom plate can be made of isolation materials or other materials, which supports the structural integrity of a module **100**.
- [0147] Fig. 3 illustrates the connection sets and placement variants for sensor **307** and control units **306** of a module **100**. Photovoltaic cells, sensor and control unit/s are electrically connected with cables or conductive lines **305**. Necessary mechanically connectors are roof connectors **301** and module to module connectors **302**. Each module has to be electronically connected as shown in **303** and connected for the transportation of fluids **308**, namely from the thermal elements **106**.
- [0148] Embodiment Fig. 3A shows the rooms/chambers **311** for control unit and sensor cables necessary for a module **100**.
- [0149] A network of modules **502** is shown in Fig. 5 made out of the preferred module **100** of this invention. This network is placed on a roof **501** with an angle of 45° , as an example for usable surfaces. Construction elements of the roof are **503**. They guarantee the structural integrity of the roof itself. Such network can be on surfaces from an angle of 0° to 180° . An example of a module network **601** of the module **100** plated on a wall with an angle

of 90° is shown in Fig.6. Construction elements of the walls are anchored **602** on the ground **603** topped with a roof **604**. The kinetic energy given by wind flow **605** directs to the wall and will be distracted along the wall to the roof.

[0150] The target of all these possible variants of the modules of this invention is to optimize the yield of harvested energy. The variants of the connector sets presented in Fig. 3 are depending on the national requirements and standards according to local laws.

[0151] The module of the preferred design is plated on a ridge roof or on a slant surface on the ground or building Fig. 7, Fig. 7A. A network of modules can replace the complete roof tiles or a part of them Fig. 7, Fig. 7A. Together with a bottom plate **201**, **301** of the module the surface area is an isolation layer, preventing low thermal energy loss. The angles of the roof can be variants in a wide range from 0° to 90°.

[0152] In case both or several sides of the roof are plated with modules **100** a LUV- **705** and LEE side **706** is the result of this arrangement. A wind stream **705** flows from the LUV- to the LEE side and activates all electric generators combined in the network.

[0153] A single or a network of several modules can be combined with one or several top generators **701** in the inner side of the crest to enhance the yield collected wind energy. Construction elements of the roof are **503**. They are used to fix the generator and additional necessary parts. To navigate the wind stream and to direct it to an external generator, whereby external means that this generator is on the top of the roof, a channel system is used **702**. A cover is installed as an element for protection **703**. Fig. 7A shows a variant of one or several external generators **701** placed on the top of the roof **711**. This variant has also a protecting cover **712**.

[0154] An air stream, initiated by the wind hitting the surface, is coming out of the first module line and is streaming into the next line of modules and so on. This is the case in all networks of the modules of the invention. In Fig. 7A the last module in line of a network directs the air stream into the top generator on the crest. This configuration exploits a greater share of the kinetic energy of the air stream, flowing around a building.

- [0155] The connector set allows fixing the modules on the construction elements of the roof. In case the modules do not replace the tiles, the connector set allows fixing the modules directly on the tiles or other roof cover materials.
- [0156] The modules can be plated on a flat roof or a flat surface on grounds or buildings. Therefore, the overhang by the inlet built by the cover of a module is designed in a variation of the preferred design, in a way that an air stream is directed into the channel of a module. This variation allows increasing the yield of kinetic energy harvested from an air stream.
- [0157] A module or a network of modules can be also plated on an exterior wall of a building. The main different point is the angle of the surface. Module variants can be plated on surfaces in angles from 0° to 180°. Especially in different surface situations the modules have to be adapted to increase the yield of harvesting energy from light, thermal energy and kinetic energy.
- [0158] An unexpected area for placing a module or a network of modules is the plating of the inner wall and ceiling of a tunnel. Such tunnel can be a train tunnel, car tunnels or an open tunnel between buildings or natural structures or a combination of them. The kinetic harvester in a module can capture air stream energy from bypassing vehicles or from natural wind streams.
- [0159] A module or a network of modules can be placed on hard wing sails, wings or flexible sails or flexible undergrounds/surfaces. This opportunity enables a wide range of possibilities where the modules can be placed. Especially hardcover sails offer opportunities, because if the sails are completely plated with a module or a network of modules the wind passing the Luv side of the sail and transfers energy the movement of the ship. At the same moment, the passing air steam activates the electric generators in the modules according to the invention.
- [0160] At sea there is no shadow. Therefore the photovoltaic cells have ideal conditions for producing solar energy. This refers as well to the thermal energy harvester inside the module. Hardcover sails are preferred surfaces for mounting the modules according to the invention. That's possible because hard cover sails meet the requirements of the modules according to the invention.

[0161] Self-moving surfaces like the surfaces from ships, vans, cars etc. are also possible superficies which can be used for plating with modules or networks of modules. The kinetic energy is harvested mainly from the forward movement of the vehicle.

[0162]

Mode(s) for Carrying Out the Invention

[0163] Fig. 4 gives a variant of a module **407** according to this invention. In this example of a module the channel is nearly a tube with a quadratic cross section **405** with an integrated thermal harvester shown with an inlet **401** and outlet **402** and also integrated photovoltaic cells **404**. This example should show how the variances could be regarding the form of the housing which is building the channel. In those channels one or more electric generators **403** are placed. Like the preferred design of a module this variant has an inlet **406**, an inner wall **408** and an outlet **409** and so on, as described before. This module variant is used as a single module or in a network of modules.

[0164] Fig. 8 and Fig. 8A give a variant of a module **802** according to the invention. The main difference is the longitudinal direction of the concave surface **804** in opposite to the transversal orientation **107**. This surface is plated, as describe before, with photovoltaic cells **103**. These cells are orientated in that way, that they are reflected incoming light waves to the central thermal collector **106**. The housing of the module **802** has the trumped design of the module **100** too. In the area of the smallest diameter of the module variant **802** are also placed one or more electric generators **814**. **813** show the inner wall surface of the concave surface. In this surface can be integrated a cooling layer/system **803**, to reduce the temperature of the photovoltaic cells. Such system can be a fluid cannel system, e.g. for water or gases, or electro thermal elements.

[0165] Devices according to the invention can have in the inner channel surface a structure, which transform an incoming air stream into a vortex stream. These kind of rotating air stream flows directly to the kinetic generator, whereby the air stream can be additionally directed with one or more flaps or one or more valves or a combination of them, in or outside of the device

or a combination of them. This design enhances the total efficiency of the complete module system.

[0166] As describe before both sides of a roof can be covered with devices according to the invention a windmill - or multi windmill generators on the roof top are coupled in that way that an air stream can flow from the windward side (LUV side) to the LEE side. To manage the air stream flows can directed with one or more flaps or one or more valves or a combination of them, in or outside of the device or a combination of them (702).

[0167] Devices according to the invention have to minimum one channel with an inlet (406) and outlet (409) with an arbitrary lateral cross section (406, 409) and an arbitrary length cross section (407).

[0168]

Industrial Applicability

[0169] A device according to the invention which use at the same time three different methods for collecting energy, deliver energy 24 hours a day. Deliver energy 24 hours is independent form night or unfavourable weather conditions. This property can be used in industrial and private application.

[0170] Because of the modularity and the ubiquities applicability of a device according the invention the required area need for collecting kinetic, photovoltaic and thermal energy is reduce, so more spaces can be used for collecting energy. The architecturally integration increase the acceptance by customers and official authorities or none profit organisations.

[0171] Several institutions including government authorities monitor the overall situation regarding collection of renewable energies, for example the U.S. Department of Energy USA Wind Vision: A new era for Wind Power in the United States. Edited by JOSE, Zayas, et al. March 12: U.S. Department of Energy, 2015. p.0-348. NREL. Best Research-Cell Efficiencies (Graphic). *The National Center for Photovoltaics (NCPV) at NREL*. Jun 05, 2015, p.1.

[0172]

[0173]

References

[0174]

- DE 102009012520 A (RICHARD SEIDENBUSCH) 10.03.2009
- DE 202008014689 U (TÖRBER JÜRGEN) 06.11.2008
- WO 2009081439 A (BONOMI GIANFRANCO) 02.07.2009
- DE 102011105965 A (SPIEGELMACHER, JANA) 03.01.2013
- DE 102004001875 A (THOMAS HAKE) 04.08.2005
- G.M. JOSELIN HERBERT, et al. A review of wind energy technologies. *Renewable and Sustainable Energy Reviews*. Aug.2007, vol.11, no.6, p.1117-1145.
- MIRUNALINI THIRUGNANASAMBANDAM, et al. A review of solar thermal technologies. *Renewable and Sustainable Energy Reviews*. 2010, vol.14, no.1, p.312-322.
- MARKVART, TOMAS , et al. Solar Electricity . 2nd edition. Edited by MARKVART, TOMAS , et al. Wiley, 2000. ISBN 0471988537. p.0-256.
- UNITED NATIONS, et al. Global Trends in Sustainable Energy Investment 2007: Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency in OECD and Developing Countries. *United Nations Environment Programme*. 2007, p.0-End.
- Wind Vision: A new era for Wind Power in the United States. Edited by JOSE, Zayas, et al. March 12: U.S. Department of Energy, 2015. p.0-348.
- NREL. Best Research-Cell Efficiencies (Graphic). *The National Center for Photovoltaics (NCPV) at NREL*. Jun 05, 2015, p.1.

Claims

1. A device (100, 100", 407, 802) for collecting energy from kinetic, thermal and photo voltaic sources, comprising: a channel with the electric generator (111) which are activated by kinetic energy; photovoltaic cells (103, 404) which are activated by light sources and a thermal collector (106) which are activated by a thermal sources or thermal differences; wherein the collection portion comprises:
one housing (101) which includes at minimum one channel with at minimum one inlet (104) and one outlet (105);
whereby each channel has a great inlet (104) diameter a decreasing diameter to the middle area (109) of the channel and an increasing diameter to the outlet of the channel, whereby the outer surface built one concave surface (107); whereby inlet and/or the outlet can be covered with a grid or mesh;
at minimum one electric generator (111, 403) in at minimum one channel for collecting kinetic energy;
at minimum one photovoltaic cell (103, 404) for collecting energy for light sources places on the light side directed side of the concave surface or on the outer housing surface or a combination of them;
at minimum one collector for thermal energy (106, 401, 402) activatable by thermal sources or thermal differences inside or outside of the housing;
whereby the collector for thermal energy is placed inside (106, 401, 402) or outside of the housing;
at minimum one transparent cover sheet (102) which can be include an overhang (108);
at minimum one transparent bottom sheet (201).
2. The device of claim 1, wherein the outer concave channel surface is orientated longitudinal (804) or transverse (107) direction or an orientation between these absolute orientations.
3. The device of claim 1 and 2, wherein the kinetic electric generator which has rotor blades (111), is a bladeless generator, a tesla fluid generator or wave generator or a combination of them.
4. The device of claim 1 and 2, wherein the thermal collector (106, 401, 402) is a head pipe, a thermal voltaic element, a thermal storage element or a

combination of them.

5. The device of claim 1, 2 and 3, wherein between the photovoltaic cell and the out surface of the housing is an electro thermal layer.
6. The device of claim 1, 2 and 3, wherein one, partially or all photovoltaic cells (103, 103", 404) are replaced with mirrors, thermal cells, absorbers or a combination of them.
7. The device of claim 1 and 2, wherein a channel has an inlet (406) and outlet (409) with an arbitrary lateral cross section (406, 409) and an arbitrary length cross section (407).
8. The device of claim 1 and 2, wherein a concave surface of the channel (107, 804) channel is plated with at minimum one photovoltaic cell, according to claim 1 to 4, with an orientation to reflect incoming light to at minimum one thermal energy collector.
9. The device of claim 1, 2, 3, 4 and 5, wherein the inner channel surface is structured in that way, that an incoming air stream is transformed in a vortex stream, which flows directly to the kinetic generator according to claim 1 to 3; whereby the air stream can be additionally directed with one or more flaps or one or more valves or a combination of them (702), in or outside of the device or a combination of them.
10. The device of claim 1 and 2, where contains sensors (307) for kinetic movement, electricity and light expose, whereby the sensor s are managed by a control unit (306).
11. The device of claim 1 and 2, wherein the device is connectable with one or more of the devices of claim 1 and 2 in a multiple way (502, 601).
12. The device of claim 1 and 2, wherein the channel outlet (105) of one or more devices lead to one or more inlets (104) of devices, whereby the outlet does not covered the complete inlet surface of the next device (501, 601).
13. The device of claim 1 and 2, wherein the housing of the device itself or the bottom (201) or the cover sheet (102) or a combination of them have noise isolation or thermal isolation or a combination of them, properties.
14. The device of claim 1, 2, 4, and 5, wherein the room of the concave surface (107) is sealed with transparent or semi-transparent a glass plate or plastic plate, with an overhang or not.

15. The device of claim 1 and 2, with includes connectors for electric (303, 305), mechanical (304), thermal and fluid properties (308) internally or externally or a combination of them and connectors for fixation of devices internally (303) and to a surface where they installed e.g. on a roof (301).
16. The device of claim 1 and 2, wherein one or connected device of claim 1 can be placed on surface with an angle of 0° until 180° (501, 601) and independent of altitude.
17. The device of claim 1 and 2, wherein one or more connected device of claim 1 are coupled with an external roof top wind generator system whereby the wind generator are installed on the roof, in the roof or under the roof.
18. The device of claim 1, 2 to 4, wherein the wind generator (111, 406) can be used without a photovoltaic and thermal generator.
19. The device of claim 1, 2 to 4, wherein the device has no wind generator, but a combination of a photovoltaic and thermal generator in a concave module.
20. The device of claim 1 and 2, wherein one device or a network of them installed on roofs, walls, shafts, towers, soil surfaces or water or sails or surfaces which are flexible or moving surfaces.
21. The device of claim 1 and 2, wherein one or connected devices are connected with a LEE (706) and LUV (705) of a double-angled surface, as a house roof, uses one or more flaps or one or more valves or a combination of them.

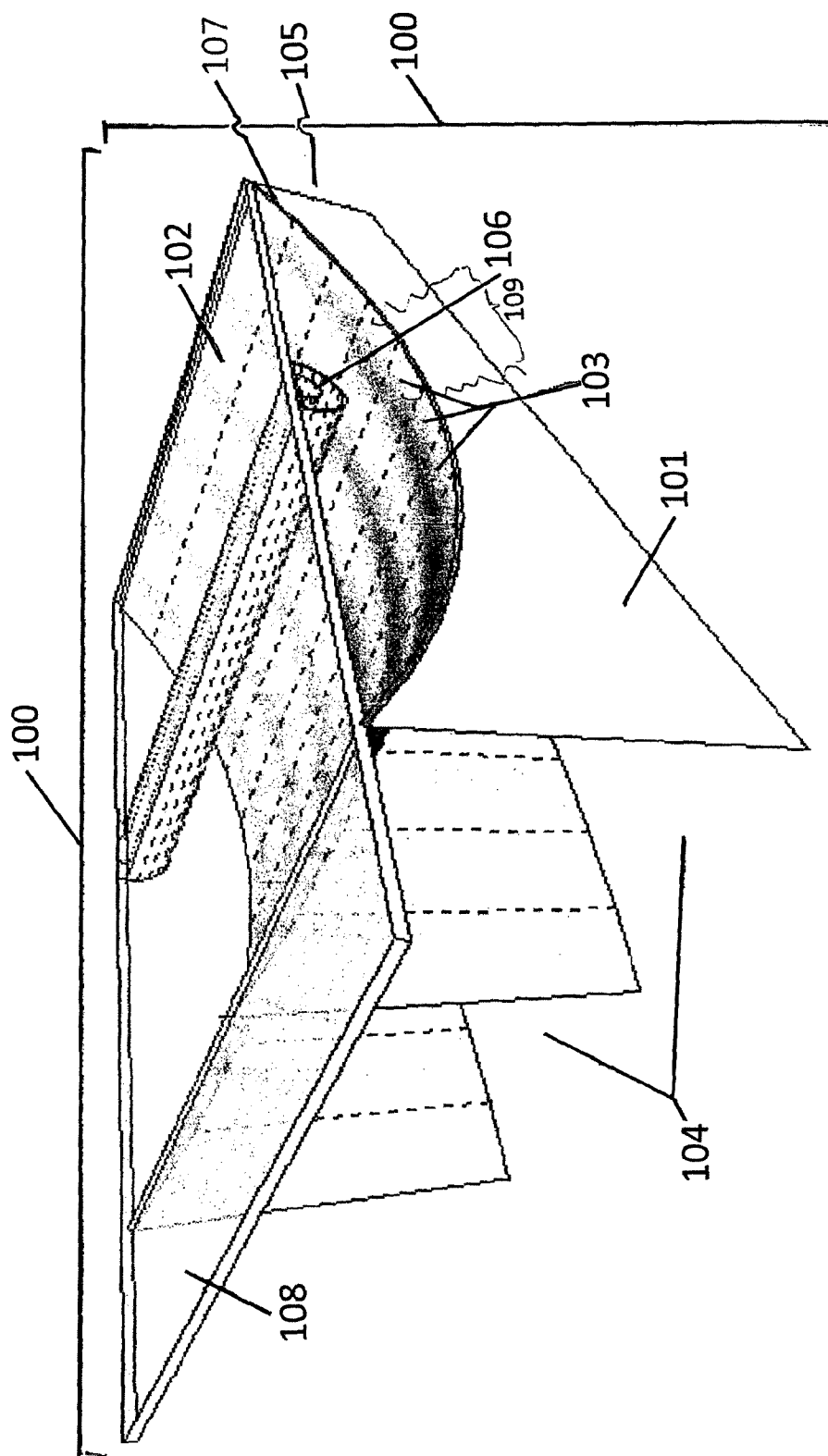


Fig. 1

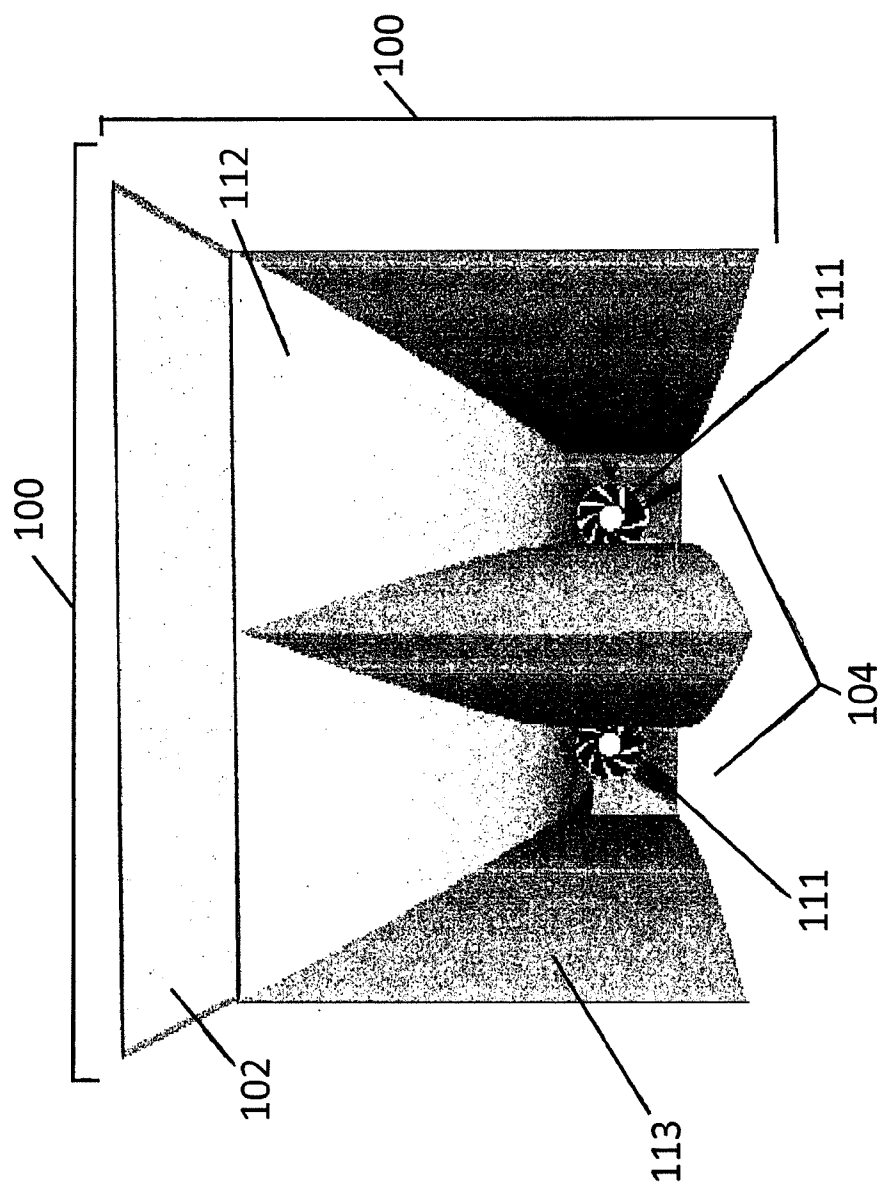


Fig. 1A

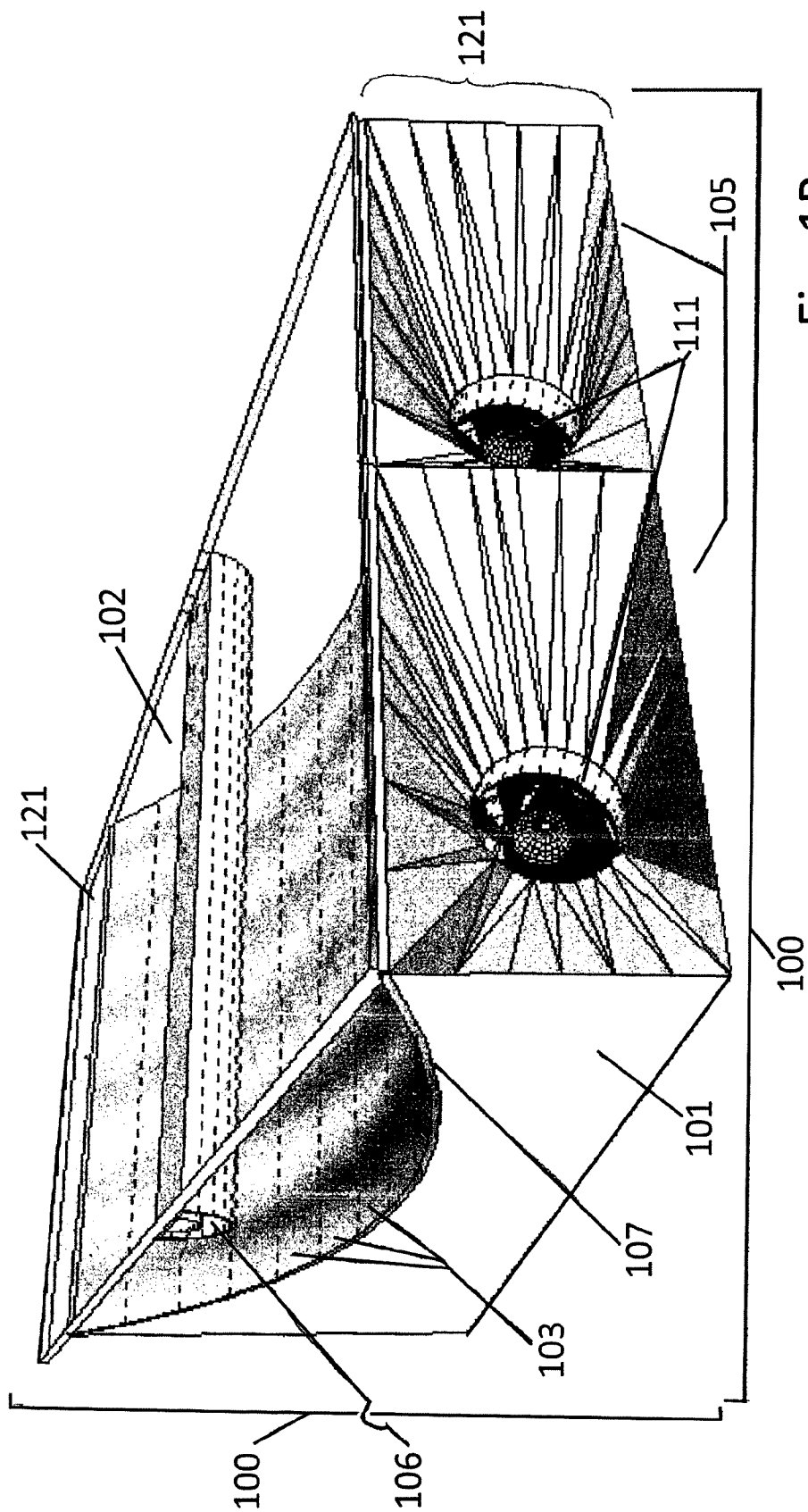


Fig. 1B

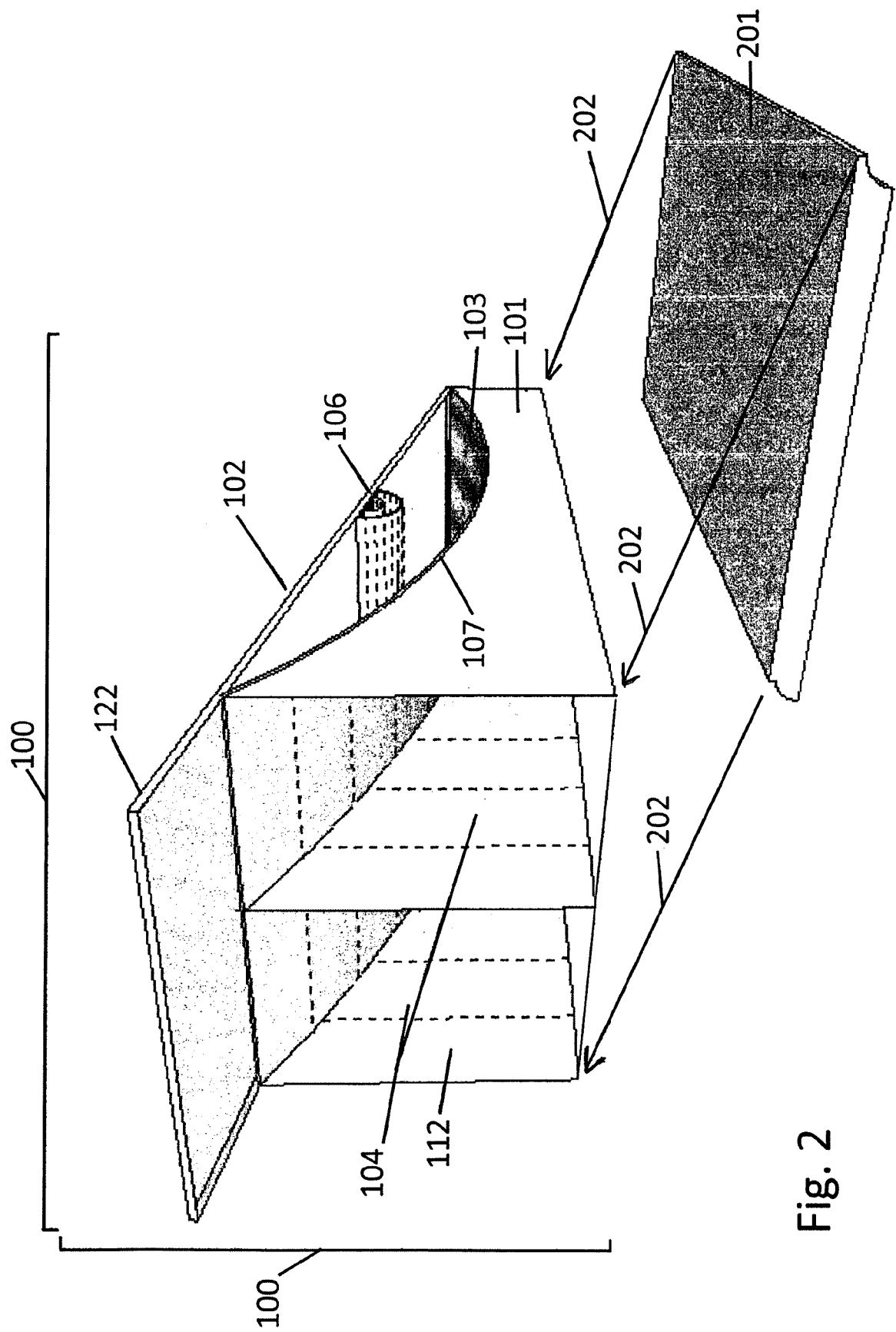


Fig. 2

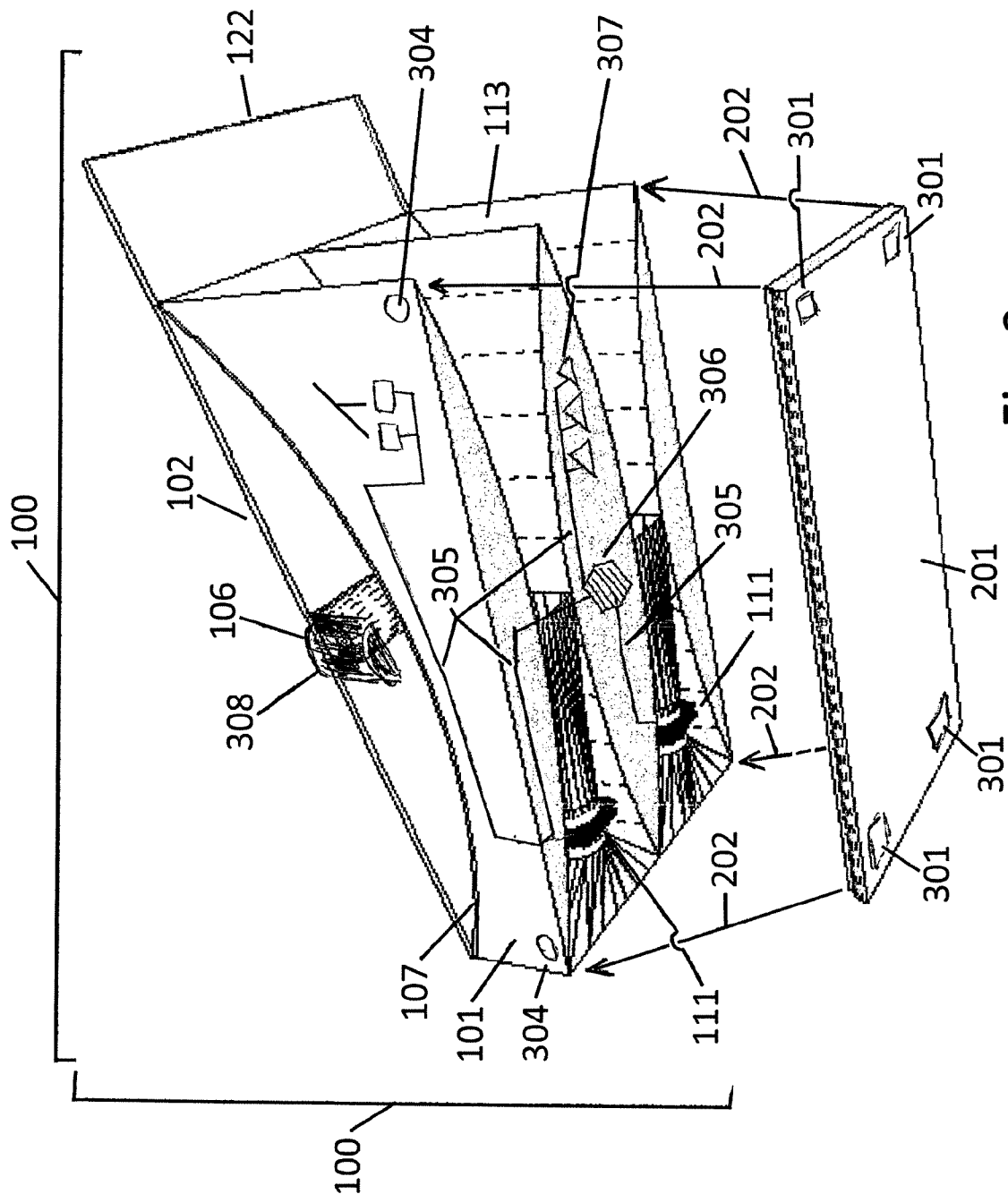


Fig. 3

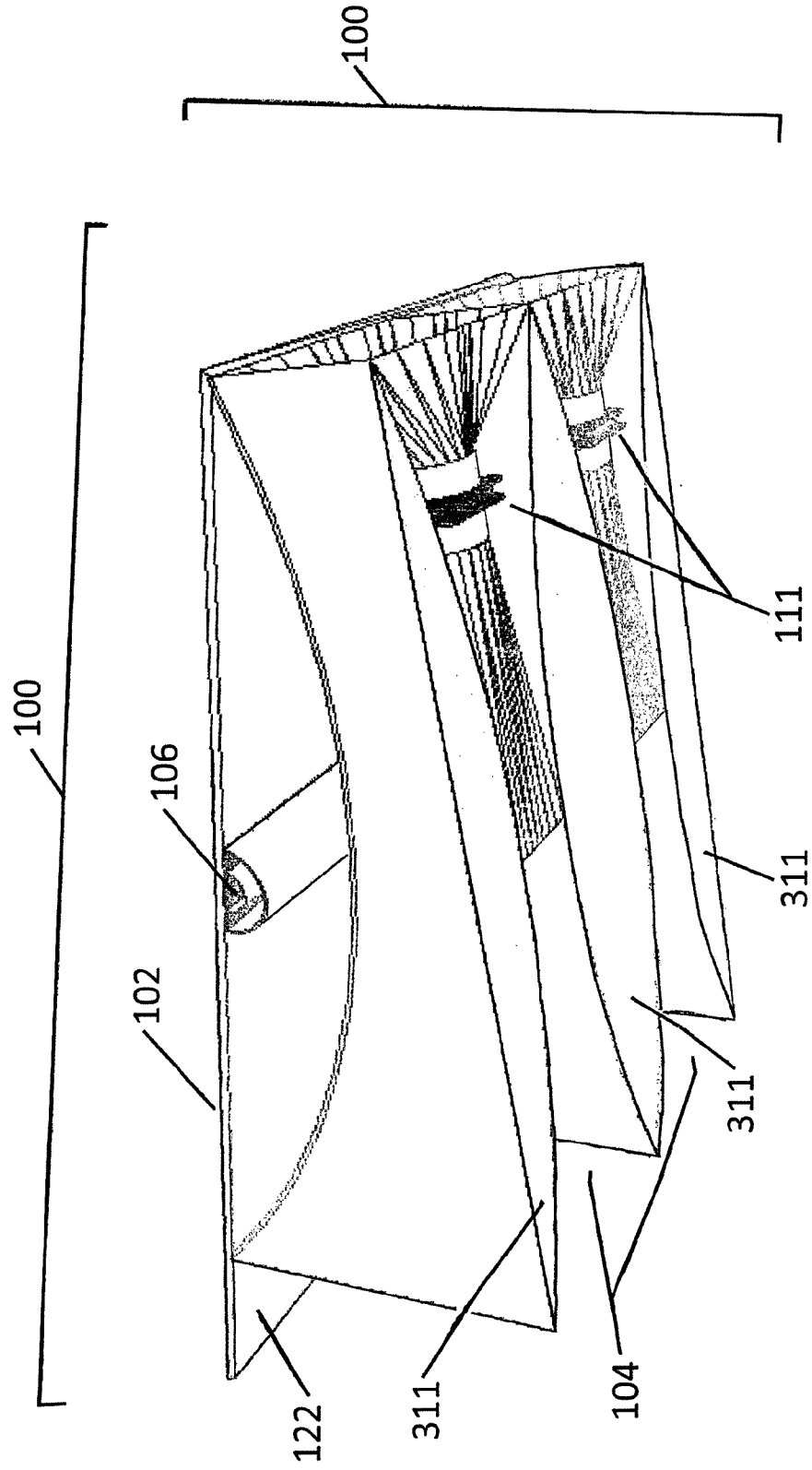


Fig. 3A

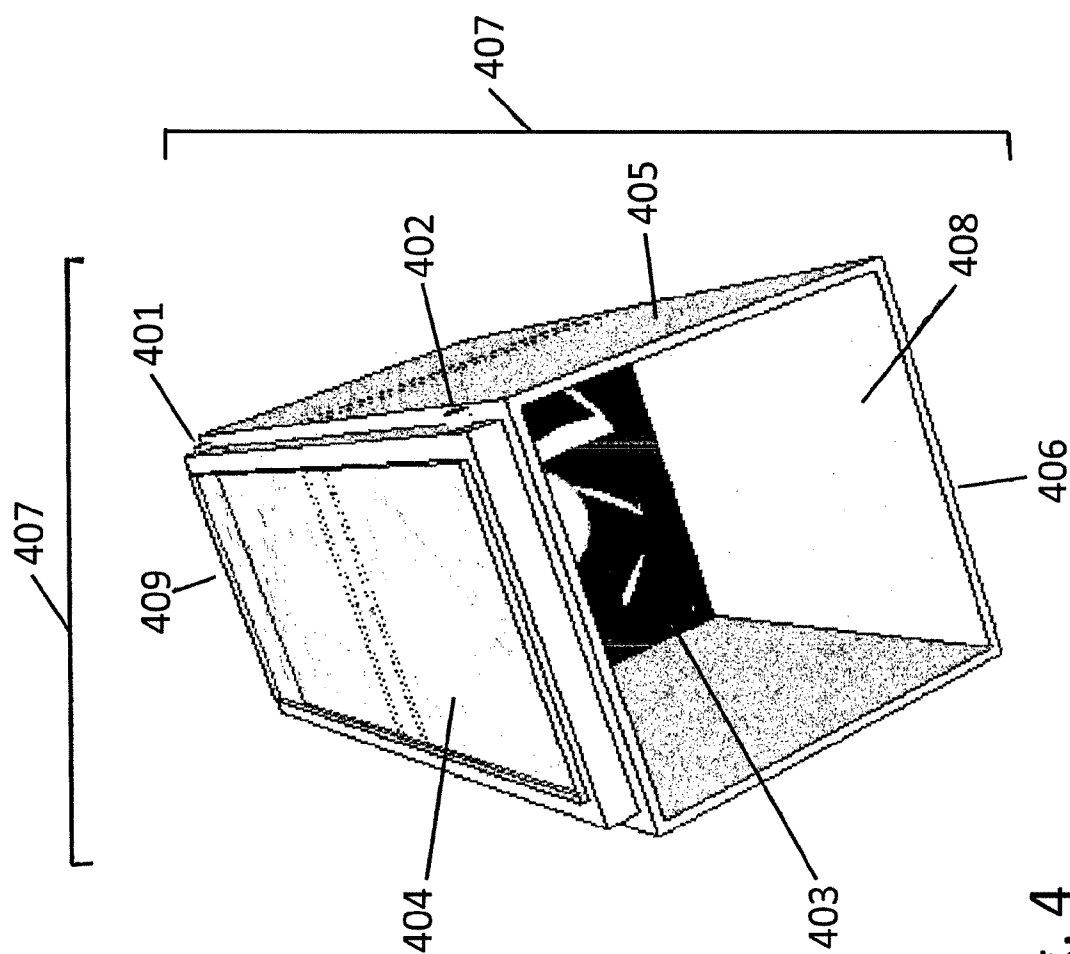


Fig. 4

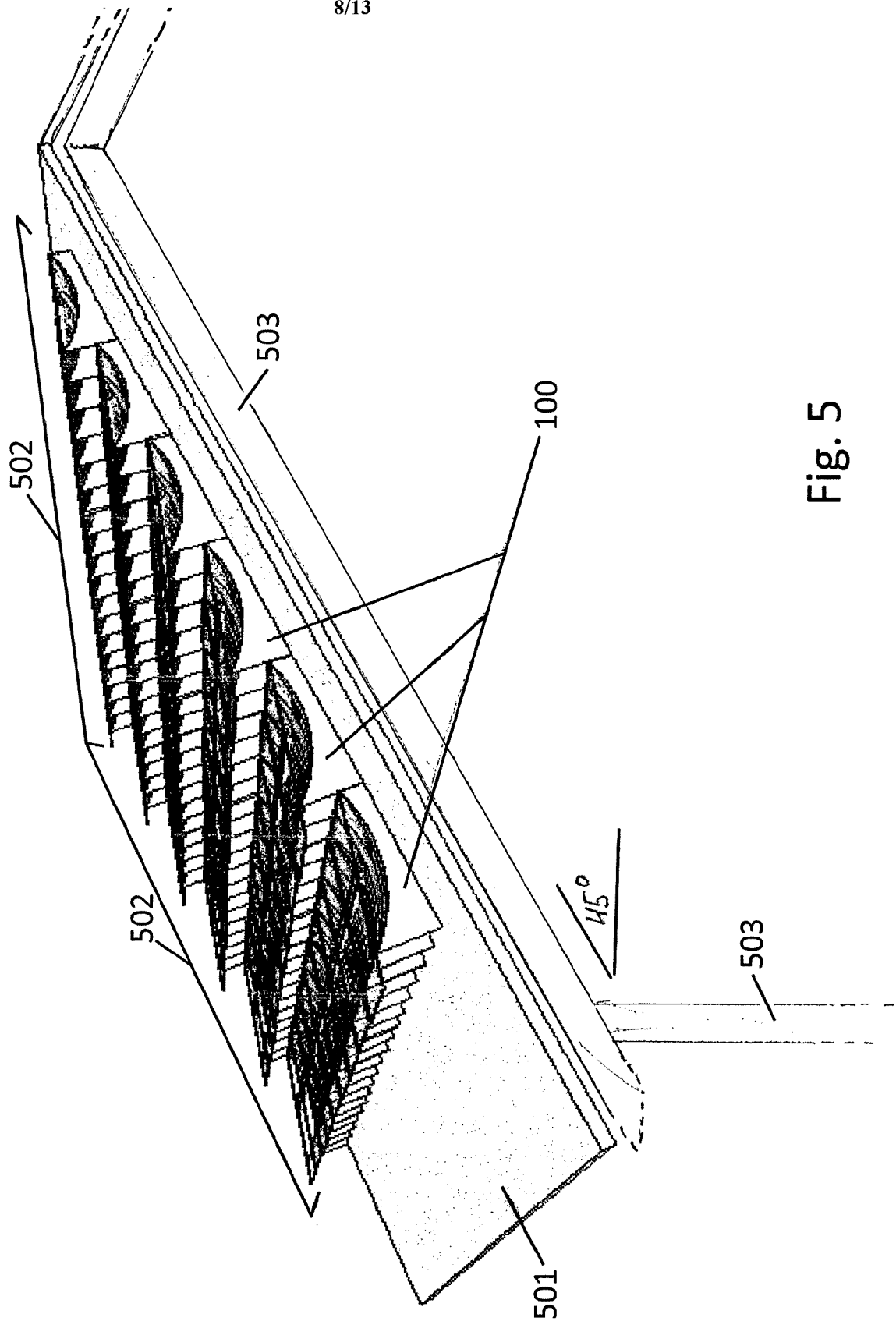


Fig. 5

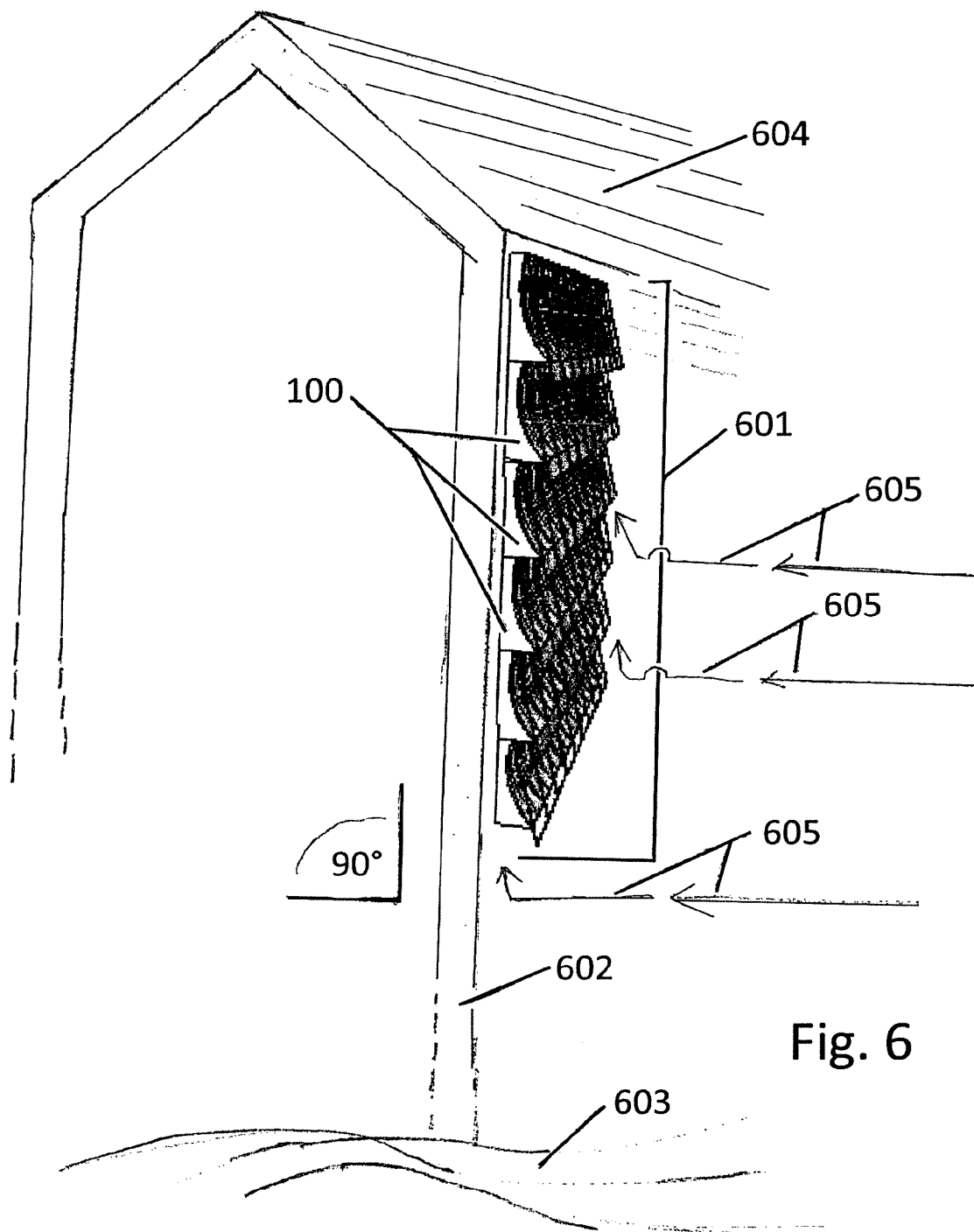


Fig. 6

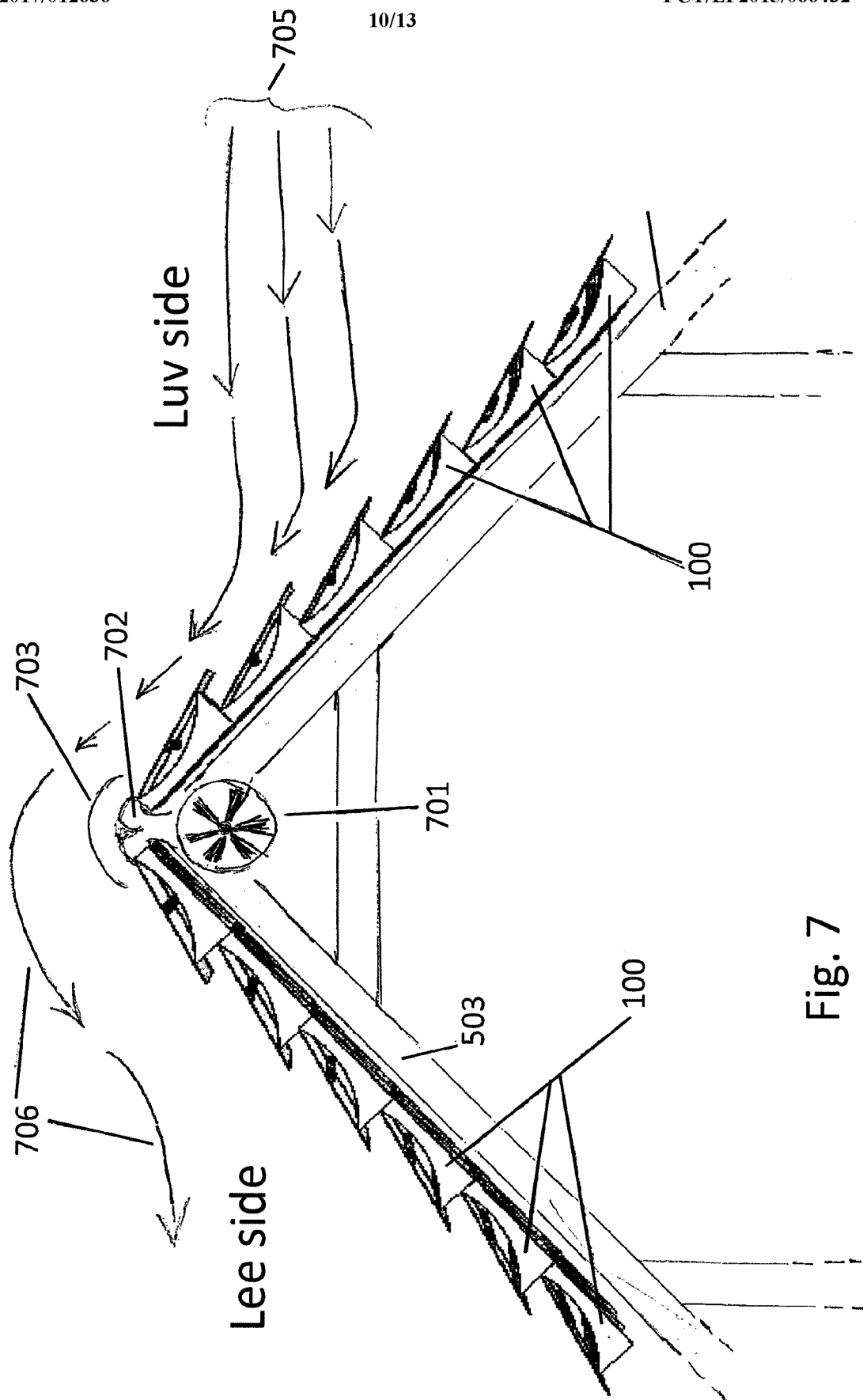


Fig. 7

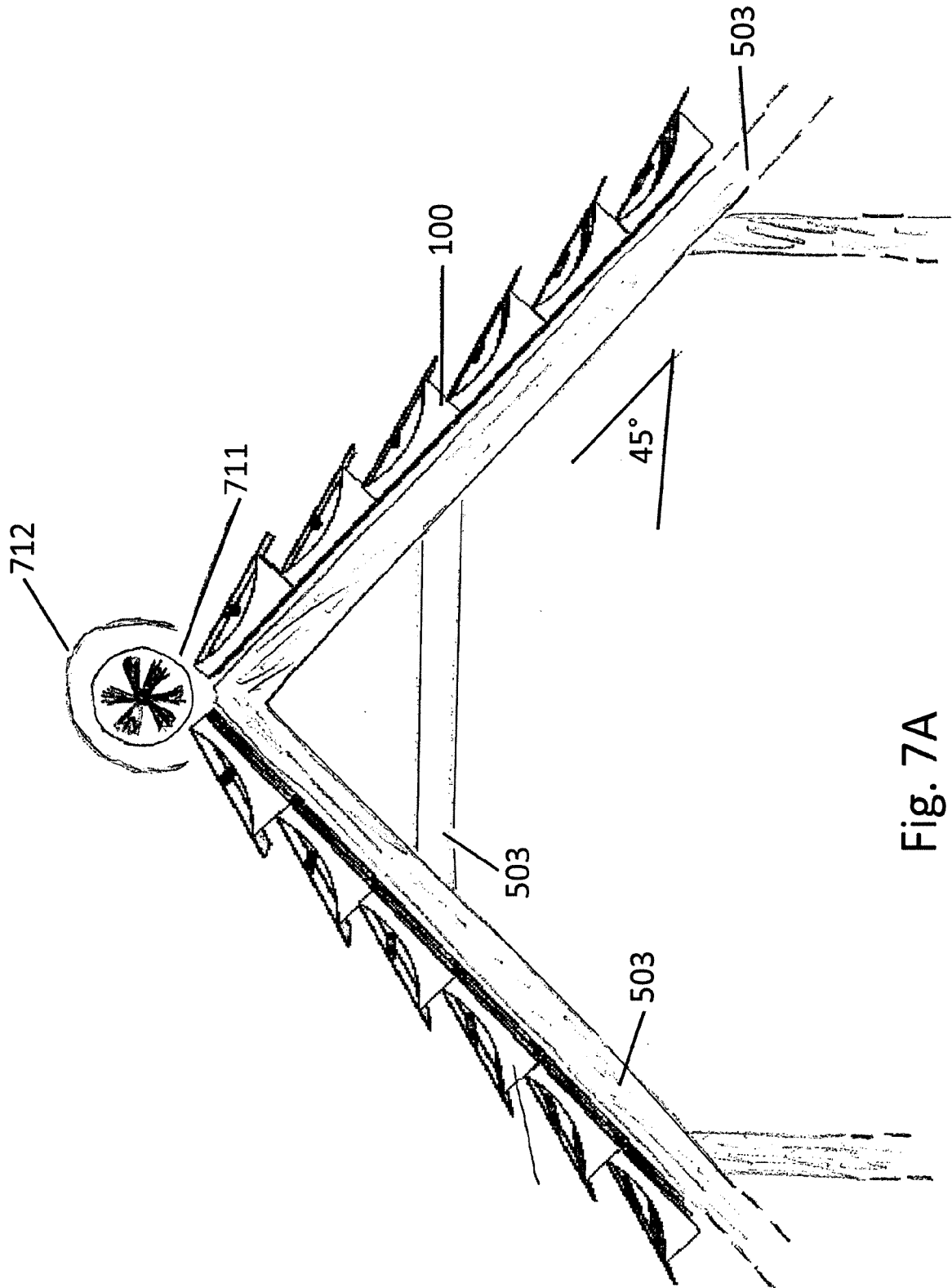
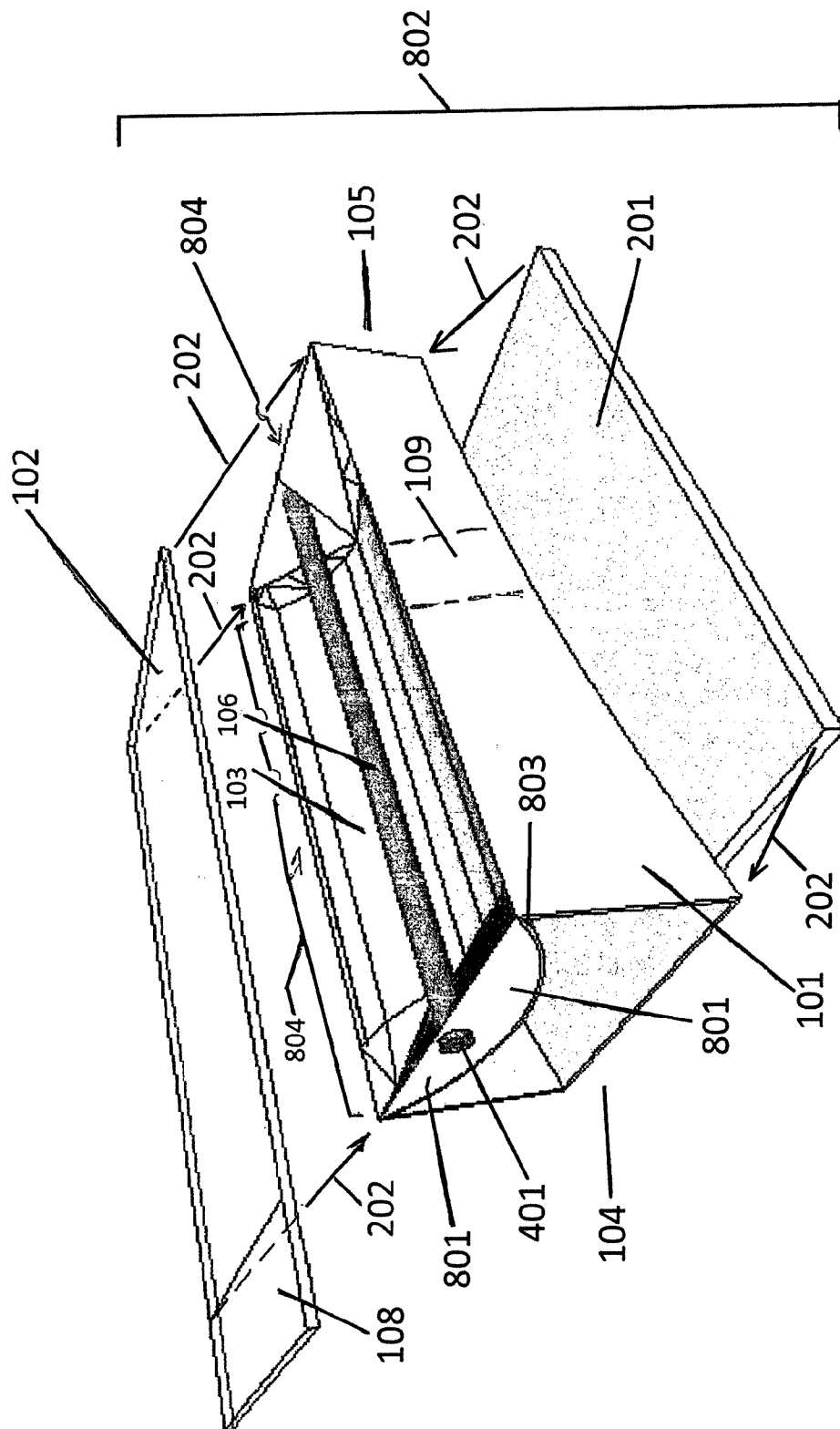


Fig. 7A



Fi. 8

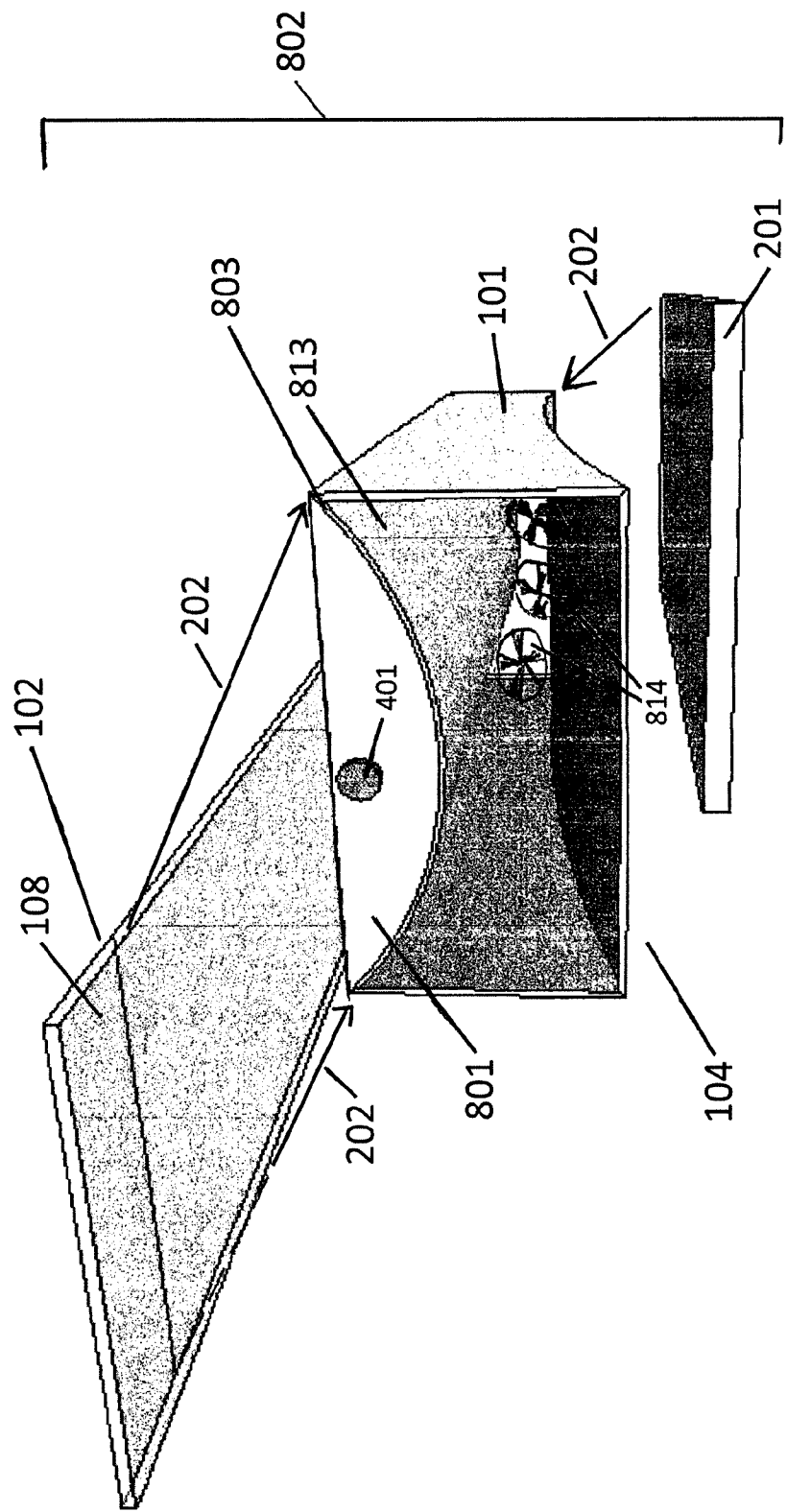


Fig. 8A

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2015/066432

A. CLASSIFICATION OF SUBJECT MATTER
 INV. H01L31/0525 H02S40/44
 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)

H01L H02S F03D F03G

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 2013/100865 A1 (YANGPICHIT PITAYA [TH]) 4 July 2013 (2013-07-04) figure 1 page 5, line 13 - line 15 page 6, line 16 - line 18 -----	1-21
A	US 2010/183443 A1 (THORNE STEVE [US]) 22 July 2010 (2010-07-22) the whole document -----	1-21
A	WO 2011/001375 A1 (BIUCCHI GABRIELE [IT]; MANTOVANI MARCO [CH]) 6 January 2011 (2011-01-06) the whole document -----	1-21



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

14 March 2016

Date of mailing of the international search report

24/03/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040,
 Fax: (+31-70) 340-3016

Authorized officer

Fernandez Ambres, A

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/066432

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2013100865 A1	04-07-2013	AU 2012363378 A1	10-07-2014
		CN 104169577 A	26-11-2014
		EP 2798208 A1	05-11-2014
		US 2014373537 A1	25-12-2014
		WO 2013100865 A1	04-07-2013

US 2010183443 A1	22-07-2010	NONE	

WO 2011001375 A1	06-01-2011	NONE	
